Dear Readers,

It is a great pleasure to present you the Eighth annual book of the Crisis Management and Disaster Response Centre of Excellence.

Our effort is to provide useful information for all subject-matter experts in the area of CMDR. We stress the importance of every subject and I do hope that the present edition will enhance the common understanding and expertise on international level.

The CMDR COE Proceedings 2022 provides a venue for publishing some articles related to topicsglobally discussed recently and thus we hope this will stimulate further researches.Based on our activities in the year of 2022, wefocus attention to factors and implications that insist interactions in response of disasters and crises.

I am convinced the present edition is contributing to the knowledge of CMDR and will be a useful tool for all SME in this area.

Presenting this edition, I would like to express my gratitude to the Defence Ministries of Bulgaria, Greece, Hungary and Poland and the Interior Ministry of Romania for the persistent support and sustain.

On behalf of the entire editorial board, I express appreciations to all authors and reviewers of the CMDR COE Proceedings 2022.

Orlin NIKOLOV,

CMDR COE Director

CIVILIAN AND MILITARY SYNERGIES IN DISASTER RELIEF

Bozhidara Kiryakova, Nina Tatarska, Siyana Pavlova

Abstract: This article investigates the main characteristics of disaster relief in the broader context of disaster management. Furthermore, with the objective to underline the importance of civil-military cooperation and humanitarian assistance, the article sheds light on the distribution of responsibilities among key stakeholders and explores in more detail the European Union's (EU) integrated approach to disaster management by means of providing specific examples related to the EU's Common Security and Defence Policy.

Key words: disaster management, disaster relief, civil-military cooperation, humanitarian assistance, integrated approach, European Union, Common Security and Defence Policy

In a context of a climate-disturbed environment and a related increase in the intensity and magnitude of disaster events, the urgent need for enhancing and transforming disaster management comes to the fore as a critical task at different levels and across various organisations. The present article investigates the importance of disaster relief while focusing on collaboration and exchange between civilian and military stakeholders. Effective civil-military cooperation requires not only a comprehensive understanding of the phases that make up disaster management but also the distribution of responsibilities among various stakeholders. In order to ensure complementarity of resources and to avoid duplication of efforts, this article highlights the EU's integrated approach as conducive to stimulating and fostering civil-military synergiesfor disaster relief activities.

Recovery and reconstruction

The latest Report of the International Panel on Climate Change (IPCC) notes that the frequency of natural disasters is constantly increasing due to the impacts of climate change.[1]To tackle this growing threat, the international community has developed cooperative disaster relief strategies. [2] Disaster relief is a short-term activity

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[1]International Panel on Climate Change,https://www.ipcc.ch/
[2] EU Concept on Effective CIVMIL Coordination in Support of HumanitarianAssistance and Disaster Relief (2019),https://data.consilium.europa.eu/doc/document/ST-5536-2019-INIT/en/pdf

thatinvolves providing an immediate support in the form of humanitarian aid[3]in the aftermath of a disaster event.[4]

Humanitarian assistance, based on the principles of independence, neutrality, impartiality and humanity,is aimed to save human lives and prevent sufferings.[5]The effectiveness of humanitarian assistance depends on sound coordination between different stakeholders at local, national, regional and international levels. Developing an effective mechanism for requesting and providing that type of assistance needs to have various features.[6] For example, type of support need, and the coordination, surveillance and correspondence procedures should be determined and observed by the stricken country whereas the assistance-providing countries should avoid delays, ineffective contributions and duplications.

A critical factor for the success of disaster relief operations is timely resource mobilization,logistical readiness,and effective inter-sectoral and inter-agency collaboration atdifferent levels – from the local to the international. Importantly, disaster relief depends on the level of preparedness of civil organizations and the role of the military[7]is complementary to civil defence assets.

The Oslo Guidelines on the *Use of Military and Civil Defence Assets in Disaster Relief*establish a framework to "improve the effectiveness and efficiency of foreignmilitary, civil defence teams and expertise in international disaster relief operations"[8] contributing to better civil-military collaboration in case of disaster relief operations.

The EU approach to disaster management

The EU has developed policies that emphasise prevention and disaster risk reduction and see to increase "the resilience of infrastructure, ecosystems, society,

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[3]Humanitarian aid responds to basic human needs such as security, food, water, shelter, sanitation, clothes, and health. For a more detailed account, see Girigiri, B. W., *ORGANIZATIONAL EFFECTIVENESS IN DISASTER MANAGEMENT: A CRITICAL REVIEW OF DISASTER MANAGEMENT CYCLE*. International Journal of Social Science and Humanities Research, 2019
[4]Disasters & Emergencies, Definitons - training package, *Who/EHA Panafrican Emergency Training Centre*
[5] (Global Humanitarian Assistance A development initiative 2017)
[6] (Pan American Health Organization 1999)
[7] Disaster Preparedness for Effective Response Guidance and Indicator Package for Implementing Priority Five of the Hyogo Framework, Chapter 2 - Key Components in Preparedness Planning, 2.2 Capacity Analysis and Capacity-Building, 2008, p.23
[8]Disaster Preparedness for Effective Response Guidance and Indicator Package for Implementing Priority Five of the Hyogo Framework, Chapter 1 - Holistic Approaches, Strategies, and Institutional Frameworks, 1.2 National Institutional and Legislative Frameworks, 2008, p.12

and the economy of the EU".[9] In that regard, the Global Strategy for the European Union's foreign and security policy published in 2016 expands further the notion of a "comprehensive approach" and introduces the *integrated approach* with the aim of improving means for peace and securityin the long-term.[10] The integrated approach to conflicts and crises is listed among the main priorities of the European External Action, as it is considered of great importance for the overall success of the EU's efforts to foster the security of the populations and to actively engage in peacebuilding activities. The 2016 Global Strategy further describes the integrated approach as "multi-dimensional", "multi-phased", "multi-level", and "multi-lateral".[11] The concept of an integrated approach reaffirms the importance of implementing the whole range of available resources and instruments during all stages of a conflict or crisis and places additional emphasis on the different levels of governance. Moreover, it highlights the ambition of the EU to expand its network of collaboration and international partnerships further as these represent another key aspect of the basis for achieving sustainable peace.In this regard, it is important to highlight the importance of the Civil-Military Coordination (CMCoord), which aims to establish and foster a symbiotic and productive relationship between civilian and military actors in humanitarian emergencies and disaster situations.[12]This is another example, which demonstrates that the multidimensional contemporary challenges call for enhanced collaboration and well-coordinated efforts.

The strong commitment of the EU to engageactively in disaster management was already clearly stated in 2001 with the establishment of the EU Civil Protection Mechanism. The main objective of the Mechanism is to enhance cooperation on civil protection between the 33 countries.[13]Joint efforts under the Mechanism include continuous global monitoring of events by the Emergency Response Coordination Centre (ERCC). The Centre also acts as a "coordination hub between all EU Member States, the 6 additional Participating States, the affected country, and civil

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[9] (European Commission, 2021)
[10] It aims to make the EU external action "more consistent, more effective and more strategic (…) by drawing on the full range of its instruments and resources". This approach "covers all stages of the cycle of conflict or other external crises" and depends on the "shared responsibility of EU-level actors and Member States". (European Commission, High Representative of the Union, 2013)
[11] (European External Action Service, 2017)
[12](European Commission, n.d.)
[13] This includes the 27 EU Member States and 6 Participating States (Iceland, Norway, Serbia, North Macedonia, Montenegro, and Turkey) (European Commission, 2022)

protection and humanitarian experts".[14] The ERCC provides up-to-date disaster-related information, ensures the effective coordination of the disaster relief efforts, as well as the quick and timely exchange of information related to civil protection and humanitarian aid. This places it at the core of the Mechanism.

Furthermore, the EU's Copernicus programme collects a vast amount of data, obtained from satellites and non-space monitoring networks that could serve policymakers and public authorities as a trustworthy basis during the decision-making process in times of crises and disasters, as well as in support of different preparedness and disaster prevention activities.[15] What is more, theEarly Warning and Monitoring component of the Copernicus Emergency Management Service (EMS) provides accurate and highly valuable information on floods, droughts and forest fires, which could be directly implemented in disaster management, as it facilitates the processes of conducting thorough risk assessments and forecasting possible future disasters, resulting both from natural and human-induced hazards.[16]

The European Commission Disaster Risk Management Knowledge Centre (DRMKC), focused on the concepts of partnership, innovation and knowledge, is a hub of expertise and a venue for close collaboration and information exchange, as well as for the development of "innovative methods, tools and technological solutions" for disaster mitigation.[17] The collection and thorough analysis of data and the active coordination of efforts serve as prerequisites for the effectiveness and success of disaster management and disaster relief activities.

Additionally, four EU macro-regional strategies "act as a bridge between EU and local policymaking" in support of tackling shared challenges.[18] This demonstrates the EU's dedicated efforts to take account for regional and local specifics and needs, while also providing opportunities for joint intergovernmental and inter-organisational responses to diverse, but shared, challenges.

What the EU's integrated approach serves to highlight is the need for a continuous adaptation to the new requirements of the security environment, for proactive

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[14] (European Commission, 2022)
[15] (European Commission, 2022)
[16] (European Union, 2020)
[17] (European Union, 2019)
[18] (European Union, 2017)

approach to disaster preparedness and prevention, for readiness to respond effectively and efficiently to emergencies, and to recover sustainably while drawing valuable lessons from previous experience. As disaster management, and in particular - disaster relief encompasses multiple stakeholders and activities, it is of critical importance for the roles, responsibilities and specific tasks to be clearly distributed as this would predicate the success of collective efforts.

Civil protection and humanitarian assistance – EU's CSDP and NATO's EADRCC

The term 'civil protection' is synonymous with 'civil defence'[19]as it refers to efforts at preserving the civilian population in case of a crisis or disaster. In 2001, the European Union established the Civil Protection Mechanism [20] with the aim to enhance the cooperation between EU member states in case of emergencies but also to foster collaboration with third parties.

The Common Security and Defence Policy (CSDP) [21] is part of the Common Foreign and Security Policy (CFSP)within the EU. Under the CSDP, both civilian and military experts mobilise efforts to contribute to security, peacekeeping and conflict prevention. An essential aspect of the EU CSDP is the Permanent Structured Cooperation (PESCO)[22] that allows for defence cooperation among EU member states. The CSDP structure[23] includesthe main EU institutions. For example, the European Commission and the European Council are closely cooperating with support bodies and standing executive committees. The whole structure is headed by the High Representative for Foreign Affairs[24].

To date, more than 5 000 military and civilian staffhave beendeployed to EU CSDP missions.[25]In fact, the deployed missions could be military, civilian or collaboration by both on abroad operations[26].The first military mission – Concordia -was deployed in 2003 in North Macedonia. [27] Subsequently, missions were deployed in Somalia,

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[19] (CMDR COE Crisis Management and Disaster response Course,2022)
[20] (European Commission)
[21] (EUR-LEX)
[22]PESCO
[23](European External Action Service 2021)
[24]European External Action Service.(2021, 08)
[25] (European Commission 2020)
[26] B2EU Consulting. (2020, 12)
[27] (European Union External action)

Ukraine, Moldova, Afghanistan, to name a few.[28] Each mission's operational and strategic features are debated by within the EC. An operational command corresponds with a military commander in the country where the mission is located, and the political and security committee debates the mission's status on a regular basis. In fact, those missions can have a great importance in disaster relief. In order to provide humanitarian assistance the EU can arrange the deployment of a CSDP mission.

NATO's main civil emergency response system isthe Euro-Atlantic Disaster Response Coordination Centre (EADRCC).[29] It is functioning during the whole year and includes all NATO Allies and Partner Countries. The Centre serves as a *clearinghouse* for (humanitarian)assistance in environmental and human-induced disasters as well as incatastrophes and Article 5 collective defence emergencies. The EADRCC requires the collaboration of proposals for assistance and calls for cooperation within NATO member states and partner countries.

The EADRCC[30] work is performed in close partnership with the United Nations Office for the Coordination of Humanitarian Affairs (UN OCHA)[31], which keeps playing the main role in the global disaster relief management. In humanitarian catastrophes, the United Nations Civil-Military Coordination (UN-CMCoord) is key for effective communication and collaboration among civilians and military as it enables mutual understanding and facilitates coordination. It contributes to the expansion of specific directions on internationally accepted principles, the development of humanitarian civil-military collaboration frameworks, and the certification of UN-CMCoord Officers to guarantee that the collaboration works.The EADRCC operations performed in collaboration with the UN OCHA has a great importance in disaster relief in order to ensure and provide the most effective communication among all the units participating in the operations. The civil-military humanitarian framework expands the UN's ability to manage the disaster relief operations in the most essential way.

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[28] (Finland's Presidency of the Council of the EU)
[29] (NATO 2021)
[30] (OCHA)
[31](OCHA)

Conclusion

After taking into consideration the different phases which constitute the disaster management cycle, it could be considered as highly productive to reach an agreement within the international community on the considerable importance of resilience and preparedness, and on the necessary joint actions, which could ensure these two concepts. Furthermore, the application of an integrated approach, such as in the case of the EU, should not be limited to a specific organization, but could be further investigated in the general context of international stakeholders, engaged with achieving sustainable peace. Additionally, the complexity of CSDP units like the Defence Industry Directorate-General of the European Commission, the EEAS and the MPCC demonstrates the readiness to address the challenges related to international security.

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OPEN DATA AND REMOTE SENSING IN FLOOD MONITORING IN THE MUNICIPALITY OF KARLOVO, BULGARIA

Temenuzhka Spasova, Andrey Stoyanov

Abstract: Interoperability of data from different sources is the aim of this research. It represents the results of a survey on the extent of the affected areas in the municipality of Karlovo and part of g the flood of the Stryama River, which occurred on the third of September 2022. The use of different satellite and in situ information in models allows us to obtain much more information from one point or area of interest. Different satellite data were used, which were compared with registers, Open and Spatial Data[1,2], Executive Forests Agency [3], the Basin Directorate and other. Much of the ground information is extremely rich in detailed information about the chemical, ecological and climatic condition of the particular point. The assessment was made on the basis of the orthogonal transformation components of the bands from different multispectral Sentinel 2 imagery: Tasseled Cap Transformation (TCT-brightness, TCT-wetness, TCT – greenness). Indicators of quantitative changes in areas affected by the floods have been obtained.

These interoperable data will be useful for the protection and security of the population before and after a flood, for environmental monitoring and adequate decision-making in the administration, for the needs of business and various other groups of data users. The methodology aims to support the Digital Twins of the Earth. Information from so many sources at one point will lead to much more efficient and effective management of territories in environmental disasters, various military conflicts and their consequences, as well as annual monitoring.

The results are in the form of thematic maps and graphics from satellite databases. It could be used by a wide range of scientists in the fields of river management, crisis and emergency services, polar research, various types of administration, the Ministry of Environment and Water (MoEW), as well as in the field of education.

Keyword: Remote Sensing, flood, SAR, Sentinel, Tasseled Cap Transformation, Digital Twins

During the disaster in the municipalities of Karlovo and Maritsa, when it rained 250 l/sq. m, the level of the Stryama River reaches 3 meters in just 8 hours[4].There was no indication of such extreme phenomena in the area of one of the most affected villages by the Bogdan and Karavelovo floods.During the floods on 02/09/2022, the level of the Stryama River near Banya reached 3 meters in 12 hours, the situation near Trilistnik was even more extreme, where the water reached 3 meters again, but in 8 hours.

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[1]https://data.egov.bg/organisation/datasets/resourceView/04baf3a1-9cec-4c37-8fc4-c3650874bf0f
[2]https://inspireportal.egov.bg/geonetwork/srv/bul/catalog.search#/metadata/bac47c6c-4d36-45b4-82a1-1ab021110eab
[3]https://www.iag.bg/cgi-bin/index.cgi
[4]https://bntnews.bg

Such type of floods are repeated once every 100 years according to the theoretical security curve, which is determined by the Maximum Likelihood Method[5]

Analyzes show that during the floods on September 3, heavy rains of over 200 liters per square meter were also near other cities such as Dobrich and Ruse, but such serious economic consequences were not observed. As a result of these rainfalls, the municipalities of Karlovo, Kaloyanovo and Maritsa were the most affected.

River levels in Bulgaria are constantly monitored. Information is published daily by the National Institute of Meteorology and Hydrology (NIMH).However, in areas where heavy rains were observed, the predicted amounts were much lower than the measured amounts. This is also due to the used hydrological models HEC-HMS and MIKE Basin. The disadvantage is that it is not always possible to simulate in a completely appropriate way the whole set of factors that influence the formation of the river runoff (meteorological factors, underlying surface factors, river bed factors, etc.)[6]

This is exactly what happened in the area of the flood, as the situation changed even after the dyke of the Stryama River near the village of Kalekovets, where the canals of the "Irrigation Systems" overflowed, followed by the tidal wave in the village of Trilistnik. In other places, serious changes are observed as a result of forest cutting, which according to the Forestry Agency is legal and each of the routes and tickets can be tracked on the administration's page[7].

Last but not least is the combination of intense rainfall in a small area in a short time and the orographic features of the area, as the Stryama River changes its typology from R13 to R5 in individual sections, making it a mountain-type place in a small and medium-sized Aegean river[1].

A review of satellite imagery preceding the disaster clearly shows two features:

1. *presence of a nascent vortex, which subsequently transformed[8] Citizens have been warned that intense rainfall is ahead for the period of the disaster.*
2. *caused by this defeat and rapid evolution (t ~ 12 hours) of a secondary cyclone.*

[5] Иванов, И.,М. Мандаджиев, Стр. Георгиев, (1979). „Хидрологичен наръчник – I, част II изд. Техника София
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[7] http://new.iag.bg/cgi-bin/map_ps.cgi .
[8] https://modis.gsfc.nasa.gov/

The damage caused is due to the aforementioned self-sustaining fallout of the cloud system, which is stimulated by the eroded steep gullies surrounding the affected area, its basin-like, low-drain structure[9].Often, global and sometimes unpredictably changing natural conditions modulate the activity of action centers and parameters hitherto neglected in the models become significant. This necessitates a continuous rethinking of local parameters and interdisciplinary research.

Study Area

Stryama is a river in southern Bulgaria - Plovdiv district, municipalities of Karlovo, Kaloyanovo, Rakovski and Maritsa, a left tributary of the Maritsa river. Its length is 110.1 km, a drainage basin of 1,490 km2, which is the 6th longest river in the watershed of the Maritsa River.

The Stryama has its source in the Balkan Mountains under Vezhen Peak, named Kameniditsa in this section, turning east at Stryama Station to pass close to Klisura and turn southeast at Rozino entering the Karlovo Plain[10] (fig.1)[11].
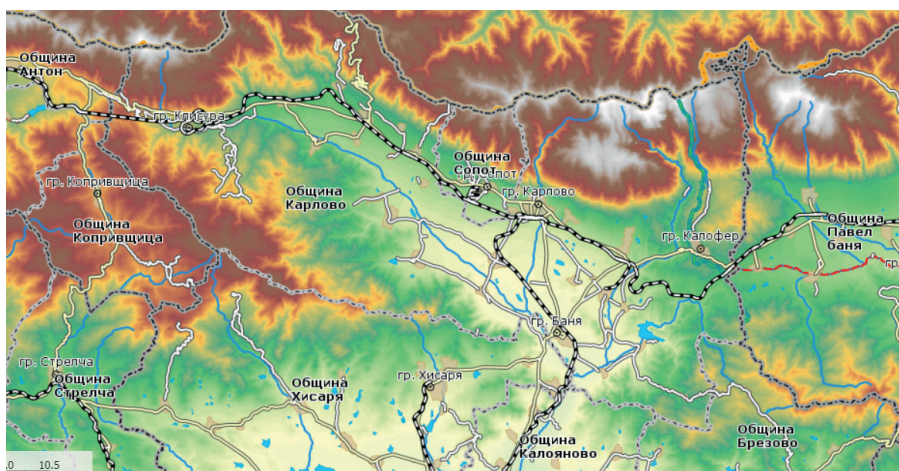
Figure 1 General physical geographic map of area of interest [11]

[9]Недков Р., Д. Гочев, Т. Спасова, М. Захаринова; (2016) Анализ на наводнението на територията на град Скопие от месец август 2016 година на базата на спътникови данни , Екологично инженерство и опазване на околна среда № 3, с.52-55, ISSN 1311-8668
[10]https://mapcarta.com/13799052
[11]https://earbd.bg/
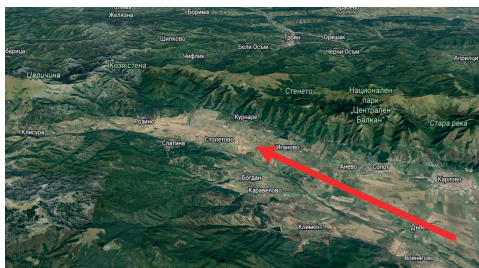
Area of interest[12]; 3D
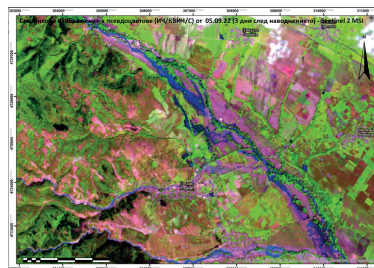
Sentinel 2 MSI, Bands: 11, 8, 4; 05/09/2022

Figure 2. The study area where the flood had been occurred

Methodology

The applied methodology includes combining different processed optical and radar satellite images of different temporal points: 1) from the previous month when there were no flood registered in the region; 2) after the flood was registered;

Formed in that way, the chosen temporal period allows tracking the dynamics of river waters and the changes had been occurred in the environment that surrounds river-bed. The temporal point dating from 28.08.2022 has been taken to serve as a independent referent showcase of non-flooded period.

Model of the methodology for monitoring

Figure 3. Model of the methodology for monitoring[13]

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[12]https://earth.google.com/web
[13]TEMENUZHKA SPASOVA (2022) "ASSESSMENT OF MONITORING AND SECURITY ON THE BLACK SEA COAST BY REMOTE SENSING AND OPEN DATA" SPIE Paper Number: 12263-13, SPIE Sensors + Imaging 2022 , 5 - 7 September 2022 Berlin, Germany

Data use

Data from the European Space Agency (ESA) satellites "Sentinel1-A", "Sentinel-2-A" are used. "Sentinel-1-A" has a Synthetic Aperture Radar (SAR) and "Sentinel-2-A" Multi-Spectral Instrument (MSI) register data in the optical bands with different resolutions. For the MSI the 13 spectral bands span from the visible (VIS) and the near infra-red (NIR) spectrum regions to the short wave infra-red (SWIR).

All available open data were also used, including data from the Forestry Executive Agency [14](fig.4).

Table 1 Satellite data[15, 16].

DATE	SATELLITE	SPECTRAL BAND	GSD (m)
28.08.2022	SENTINEL 2 MSI	All spectral channels	10x10 20x20 60x60
05.09.2022	SENTINEL 2 MSI		
06.09.2022	SENTINEL 1 SAR	λ=5,6 cm, Polarization: VH,VV	10x10

Ground Sample Distance (GSD)

[14] https://www.dw.com/bg/nepredvidimi-posledstvia-do-kakvo-vodi-izsicaneto-na-gorite-v-blgaria/a-63100393
[15] https://scihub.copernicus.eu/dhus/#/home
[16] https://sentinel.esa.int/web/sentinel/user-guides/sentinel-2-msi
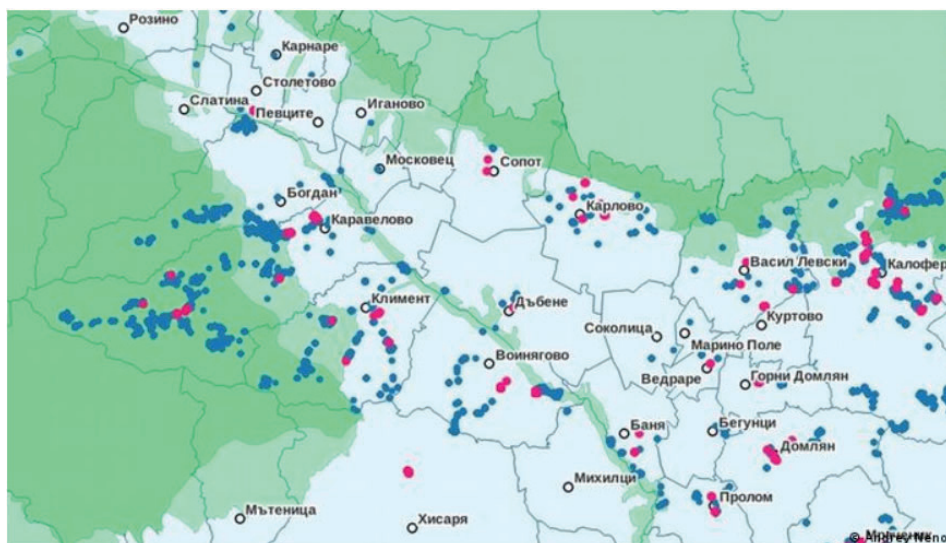
Figure 4 Transportation tickets for wood transportation Author of the map: Asen Nenov[14]

In green - the territories from the Natura 2000 network. In blue - the felling permits (over the village of Karavelovo and the village of Bogdan they are the largest number in the entire State Forestry (DGS) Karlovo). In pink - the transport tickets for wood. Author of the map: Asen Nenov, according to IAG data, Natura 2000, ECATTE [14].

Image processing methods

The multispectral instrument (MSI) Sentinel -2 sensor data is used for the spectral characteristics. The same data was also used for Tasseled Cap Transformation (TCT) and this is the most commonly used flood recognition method. This approach was chosen because it is possible to interpret, classify and analyze phenomena and processes related to the dynamics and change of the basic components of the earth's surface - moisture, soil and vegetation[17]. For better visualization of the floods, a combination of radar and optical images from Sentinel -1 SAR and Sentinel - 2 MSI were used (tabl.1).

The methodology contains a model with Open Data, which are pre-processed and published on the Open Data Portal of the Ministry of e-Government in Bulgaria, satellite data from Sentinel-1, Sentune-2 and Planet Application Program Interface: In Space for Life on Earth. Planet Team (2017). San Francisco, CA[18], MODIS and terrestrial data from many different monitoring devices. Different data formats are integrated, which requires transdisciplinary knowledge and a comprehensive approach. Images from optical and SAR (Synthetic Apertture Radar) data and terrestrial data from environmental assessments and data from basin directorates in Bulgaria are combined. The model is additionally checked by the spectral characteristics of the objects, various polarization and statistical data[19, 20].

Results

The false colors and different combinations of channels in the optical images are extremely useful and prove the presence of moisture and water. Very often, using

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[17]Spasova T, R. Nedkov; (2019) On The Use Of Sar And Optical Data In Assessment Of Flooded Areas. Seventh International Conference on Remote Sensing and Geoinformation of Environment Conference Program March 18-21, 2019 http://www.cyprusremotesensing.com/rscy2019/
[18]https://api.planet.com
[19]Spasova T., R. Nedkov;(2017) MONITORING OF SHORT-LIVED SNOW COVERAGE BY RADAR AND OPTICAL DATA FROM SENTINEL-1 AND SENTINEL-2 SATELLITES, Ecological engineering and environment protection Vol.2,pp. 13-19, ISSN 1311-8668
[20] Spasova T., (2018) Monitoring of short-lived snow coverage by SAR data around Livingston Island, South Shetland Islands in Antarctica, Adaptation Futures 2018 – „5th INTERNATIONAL CLIMATE CHANGE ADAPTATION CONFERENCE": Cape Town – South Africa 18-21 June 2018.)

only channels in the visible spectrum is not enough, but in combination with infrared channels and short wave infrared, the places under cloud cover are visualized much more clearly (fig.5).
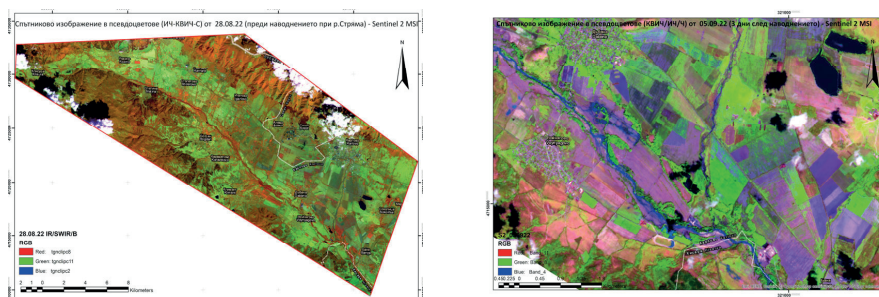
Figure 5 Composite images from Sentinel- 2 MSI with the test area, 28/08/2022 and 05/09/2022

The data from figure (fig. 6) show that the presence of moisture six days before bending is present, but not in a large amount. By pseudo-coloring the post-event image, quantities and areas are highlighted and highly magnified, which may be due to pre-event contents and runoff following intense rainfall.

It should not be considered that the cause is solely from logging, although there is a large concentration of logging in the area, which is a factor in the lack of health of the root system (Fig. 6). Before the event, the reflectance of the vegetation is high, which means it has a high chlorophyll value.
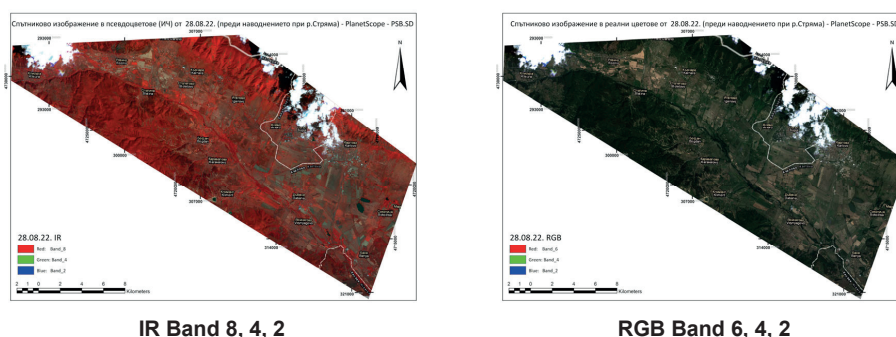
IR Band 8, 4, 2   **RGB Band 6, 4, 2**

Figure 6 Planet Team (2017). Planet Application Program Interface: In Space for Life on Earth. San Francisco, CA[21]

A processed Sentinel-2-TCT image (Wetness) from 28/08/2022 and 05/09/2022 (fig. 5) and its 3D diagram of Wetness distribution[22] are shown (fig. 7). The period before

[21]https://api.planet.com
[22] Andrey Stoyanov*, Denitsa Borisova; Application of SAR and optical data from Sentinel satellites for spatial-temporal analysis of the flood in the region of Bregovo - Bulgaria, 11/03/2018; Publication: Proceedings of the SPIE, Volume 10783, id. 107831K 7 pp. (2018). Pub Date: October 2018 DOI:10.1117/12.2325773

and after the flood is clearly distinguished. The correlation data of the two Wetness images is R^2= 0.68.
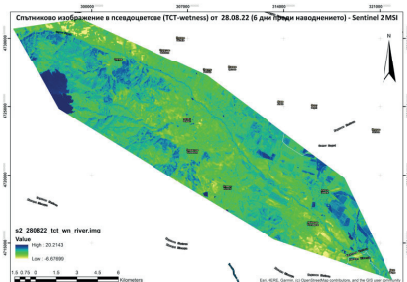
Sentinel-2-TCT image (Wetness), 28/08/2022
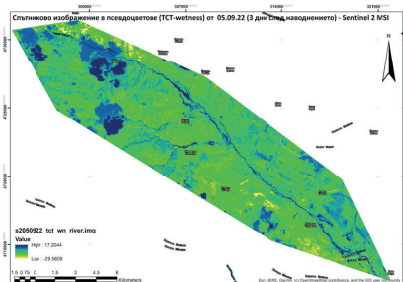
Sentinel-2-TCT image (Wetness), 05/09/2022
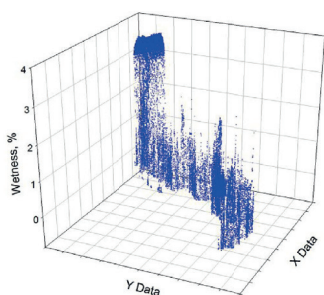
3D diagram of TCT image (Wetness), 28/08/2022
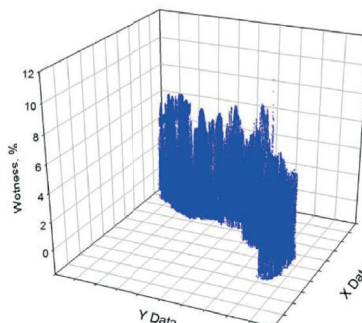
3D diagram of TCT image (Wetness), 05/09/2022

Figure 7. TCT-Wetness image and its diagram- 28/08/2022 and 05/09/2022

The reflection of water in radar images (fig.8) is very easy to analyze because it is depicted in black or dark gray. It is much easier to analyze water in the vv - polarization. The image is saturated with dark gray and black, which is a clear sign of high amounts of water, which also matches the optical data.

vh- polarization 06/09/2022   vv – polarization 06/09/2022
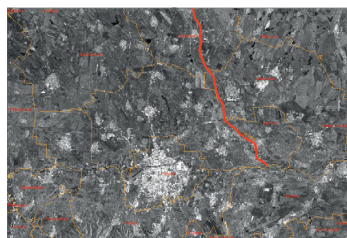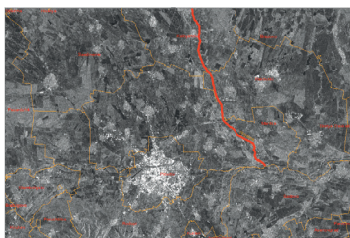
Figure 8 SAR image 06/09/2022

Composite SAR images from 06/09/2022 with different polarizations are generated in the following combination: R-vh, G-vv, B- vh/vv (fig.9) The aim of this post-processing is better determination the scale of the flood's extent[23,24]

Radar images are giving essential information and are playing of important role when satellite optic cloudless images for the studied area and considered period are missing. The overflown areas of Stryama river waters are clearly visible on the radar image and they matches with the overflown territories visible on the MSI-optical image from 05/09/2022.

Figure 9 Composite SAR image –Sentinel-1A, R – vh, G –vv, B –vh/vv; 06/09/2022

Conclusions

Based on the results obtained from the combined approach and post-processing of Sentinel-1 SAR radio images and Sentinel-2 MSI-optical images, calculated TCT -

[23]Nedkov, R., Spasova, T. and Gotchev, D., "A discriminative approach based on aerospace multispectral bands data in monitoring of snow cover and water," Ecological engineering and environment protection, 2, 55-61 (2016).
[24] Nedkov, R., Gotchev, D., Spasova, T. and Zaharinova, M., "The Skopje floods on August 2016 – a satellite data based analysis," Ecological engineering and environment protection, 3, 52-55 (2016).

Greenness indices, several different conclusions can be drawn that occurred during and after the flood and its consequences from this.

The applied complex method for post-processing of satellite images from SAR and MSI enables a reliable quantitative assessment of the negative impact on environmental components, especially on vegetation and soil. These indicators are quite sufficient to monitor the post-recovery process.

From SAR images, vv polarization is preferred when monitoring water bodies and flooded surfaces.

In the specific example, there is no need to make a long retrospective of the situation before the event, since it is a random event, with a small potential probability, which is most likely due to anthropogenic activity in a complex of prolonged orographic precipitation.

Nowhere in the preliminary plans of the Basin Directorate does this area appear to be marked with a potential risk of flooding.

For the restoration of this territory, checking from its previous biological, physicochemical and ecological condition, which until now has been moderate (Basin Directorate) and based on the evapotranspiration[25] and water indicators, it will take more than two months to restore in a warm autumn and not too cold winter.

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[25] EU Science Hub, https://ec.europa.eu/jrc/en

THE SIGNIFICANCE OF RISK COMMUNICATION FOR ACHIEVING SOCIETAL RESILIENCE THROUGH CIVIL PREPAREDNESS

Bozhidara Kiryakova

Abstract:This paper investigates the relationship in peacetime between civil society and the organisations, entrusted with crisis management, resilience and civil preparedness by placing emphasis on the significance of risk communication in the process of handling crisis. Taking into account the multiplicity of factors, which determine risk perception, information assessment and decision-making, the paper underlines the impact of disinformation and outlines the organisational efforts, aiming to counter this negative phenomenon. Furthermore, it analyses the tasks and objectives of risk communication in the context of the main phases of a crisis and places additional emphasis on the linkage between risk communication and the levels of public trust in institutions. Regarding the correlation between civil preparedness and resilience, this paper provides an overview of how different organisations understand the notion of resilience, what efforts have been already made in order to build resilience through the enhancement of civil preparedness, and how important risk communication turns out to be in this entire process.

Key words: risk, communication strategies, communication stages, disinformation, trust, resilience, civil preparedness.

As crises generally affect civil society as a whole, it is crucial to always have in mind that such situations, marked by high levels of stress and uncertainty, often have serious and adverse consequences for a significant group of people from different sociocultural backgrounds. What is more, individuals share their own perception of risk, which differs from one societal group to another. Nevertheless, women, men, boys and girls generally tend to apply certain mental strategies in order to understand risk, withstand crises and successfully recover from them. Due to the considerable complexity of the current security environment, contemporary crises have multidimensional effects and long-lasting impact. This illustrates the considerable significance of risk communication in peacetime, as it aims to address the concerns of the public and build resilience through the enhancement of civil preparedness. As key participants,organisations and the public play a key role in the risk communication process. The organisations represent the sending-end, as per

the research objectives of this research, whereas, for the purposes of this paper, the public is perceived as the receiving-end within the communication process. The overall success of risk communication is directly related to the ability of the organisations, responsible for crisis management and civil preparedness, to understand the specifics of the public and meet their expectations. The present research provides an analysis of several viewpoints regarding risk perception and acceptance, and outlines different mental strategies, which are often applied in the process of information assessment and decision-making. Furthermore, the role of disinformation and the efforts made by organisations to counter this phenomenon are subject to analysis, as they exert significant influence over the final success of risk communication. Additionally, the paper provides a comparative analysis of the effective techniques for reaching the respective target audience[1] during the main phases of a crisis situation. What is more, it includes a case study on the levels of public trust in societal institutions. Lastly, the paper outlines the correlation between risk communication, civil preparedness and resilience. A thorough analysis of risk itself goes beyond the scope of this paper and it does not claim to be exhaustive of the subject. Nevertheless, it strives to emphasize the importance of effective risk communication in peacetime, draw the attention of experts and practitioners in the field, and act as a catalyst for further research on this important topic.

Risk perception

Contemporary crises have demonstrated that a wider perspective needs to be applied when assessing the risk perception of civil society. This requires taking into account the factors, which predispose the level of risk acceptance on behalf of civil society, and the mechanisms, which are generally applied by the public in the process of information assessment and decision-making. Risk perception has been studied by many experts, since it is of major importance regarding the process of generating communication messages, which aim to inform about the likelihood and impact of risks. For instance, Chauncey Starr focuses on "the relationship between potential technical performance and the required investment of societal resources", as well as on "the relationship between social benefit and justified social cost".[2] Additionally, Starr's research draws attention to the fact that "society willingly

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[1] "Target audience" can be defined as "the group of people to whom a media text is specifically addressed because of a set of shared characteristics, such as age, gender, profession, class, etc." (UNESCO, 2013)
[2] (Starr, 1969)

tolerates higher risks for higher benefits and distinguishes in its behaviour between voluntary and involuntary hazards".[3] These findings could serve as a starting point for the analysis of people's risk perception in general. However, economic benefits do not conclude the list of characteristics which determine the way risk is being perceived by society. Risk perception also derives from the sociocultural background of individuals (women, men, boys and girls), which determines the mechanisms they apply in order to understand risks and adequately prepare and respond to them. This linkage has been studied by James F. Short, who notes that the analysis of risk is closely related to "the social and cultural context of hazards and attendant risks",[4] whereas Paul Slovic places emphasis on another method, called the "Psychometric Paradigm",[5] which focuses on understanding and predicting the risk perception and attitude of different societal groups. Slovic shows that "characteristics such as familiarity, control, catastrophic potential, equity, and level of knowledge also seem to influence the relation between perceived risk, perceived benefit, and risk acceptance".[6] These findings demonstrate the complex nature of risk and touch upon the need for interdisciplinary approach regarding risk assessment and risk analysis. However, a clear understanding of how risk is perceived is not the only prerequisite for successful risk communication.

Additional emphasis needs to be placed on the methods and strategies, which could result highly effective when applied by the public in order to assess newly-received information or reach a decision in times of crisis, marked by high level of uncertainty and time-pressure. On the one hand, it is important to point out that, in general, people can adopt different approaches regarding the assessment of information. This phenomenon has been studied by Seymour Epstein, who introduces the cognitive-experiential self-theory (CEST). This theory focuses on two mental systems, cognitive and experiential, which operate side by side and have a significant influence on human behaviour. The cognitive system works by rationally analysing facts on a conscience level, while the experiential system is automatic, requires less effort and is dominatedby emotions and previous personal

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[3](Hohenemser, C. et al., 1986)
[4](Short, 1984)
[5](Slovic, 1987)
[6]Ibid.

experiences.[7] Another research provides information about the double process theory of Kahneman and Tversky, by noting that "people, when expressing an opinion or a decision, use two different cognitive systems: intuitive processes (system 1) and analytical processes (system 2)".[8] This example interprets system 1 as "primitive, fast and associative", while system 2 "is slow, serial and deductive".[9] Additionally, an emphasis needs to be placed on the notion of sense-making,[10] as it represents another method, which could be applied in the complicated process of information assessment. Experts introduce three core elements of sense-making - "exploring the wider system", "creating a map of the current situation", and "acting to change the system to learn more about it".[11] Additionally, they suggest that sense-making could be considered as one of the core capabilities of successful leadership.[12]

Having in mind these conclusions,it is clear that risk communication should equally address the aforementioned systems and viewpoints through the application of a tailored approach. Moreover, this type of communication should also strive to provide trustworthy information and factual explanation of the particular issue.Furthermore, risk judgments and personal decisions could be based on individual mental strategies, more known as heuristics.[13] By drawing on heuristics, individuals manage to successfully examine closely a specific number of choices and, as a result, to speed up the entire decision-making process. This mental strategy is time-efficient and highly intuitive, as it is based on the personal experience of the individual. As Payne, Bettman and Johnson point out, heuristics and adaptive decision making strategies play an important role when the available information cannot be easily processed and the decisional task is complex.[14] However, when assessing the overall success of heuristic strategies, the possibility of risk misjudgements, risk denial and less confidence in judgments of fact needs to be taken into consideration

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[7](Epstein, The self-concept revisited: Or a theory of a theory, 1973)(Epstein, Integration of the cognitive and the psychodynamic unconscious, 1994)
[8](Maldonato & Dell'Orco, 2011, Vol.2, No.8)
[9]Ibid.
[10] The term is introduced by Karl Weick, who explores seven different properties of organisational sense-making in his book "Sensemaking in Organizations" (Weick, 1995)
[11](Ancona , 2011)
[12]Ibid.
[13](Tversky & Kahneman, 1974)
[14](Payne, Bettman, & Johnson, 1993)

because heuristic strategies may also result in persistent biases,[15] as outlined by Paul Slovic in his article on the risk perception.[16] Nevertheless, this strategy is of great importance for the human mental well-being, as it alleviates the stress, which could be produced from the constant necessity of making decisions and solving problems exclusively from an analytical perspective. Additionally, the possible difference between non-experts and experts regarding their perception of risk is another key factor, which needs to be taken into account, as it could determine the outcomes of risk communication. As Slovic points out, non-experts oftentimes relate risk to "lack of control, dread, catastrophic potential, fatal consequences, and the inequitable distribution of risks and benefits", whereas experts "appear to see riskiness as synonymous with expected annual mortality".[17] As risk communication generally addresses a wider target audience, the above-mentioned findings show the importance of understanding the level of prior knowledge as part of the specifics of the recipients.

In general, it is clear that the sending-end within the risk communication process needs to be well aware of how the target audience perceives risk in order to approach the recipients in the most adequate manner. In addition, the particular strategies applied by different societal groups in order to better cope with risk situations and the particular ways of perceiving risk itself ought to be seriously taken into account as they often represent the main cause for polarization of the public opinion regarding a particular topic. For instance, the COVID-19 pandemic exerted significant influence over the conventional schooling, as educational facilities remained closed for weeks during the lockdowns in response to the aforementioned life-threatening situation. The swift introduction of distance learning facilitated an uninterrupted learning process both in schools and universities and reduced to a great extent the risk of spreading the coronavirus in the conventional education environment. However, it was consequently noted by many psychologists that, although several platforms and resources were successfully used in support of the remote learning process, the lack of face-to-face social interaction led to higher levels of stress and distraction among pupils and students. Additionally, the technical

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[15]"Bias, in fact, is commonly defined as the difference between human judgement and a rational "norm", often considered as a logical or statistical law of propability" (Maldonato & Dell'Orco, 2011, Vol.2, No.8)
[16](Slovic, 1987)
[17]Ibid.

requirements for conducting online classes exposed many inequities in the education systems in numerous countries, thus leading to heated debates among parents regarding the overall effectiveness of online education and the need for school closing.

Nevertheless, what should also be taken into account with regard to the communication in times of crisis, is the existence of a phenomenon, called disinformation, which has already drawn the attention of organisations and institutions, entrusted with crisis management and civil preparedness. Additional emphasis should be placed on disinformation because it is widely spread across countries and communication platforms, and represents a serious challenge to the practitioners and experts in the field of risk communication.

Disinformation

Disinformation[18] poses a significant threat to the effectiveness of risk communication and multiple measures have already been taken by multinational organisations in order to minimise the negative impact of this phenomenon. These measures and efforts are mainly focused on raising the awareness of the public concerning this major issue, and on increasing the level of media literacy[19] of civil society. Among the main reasons for the constantly spreading disinformation is the fact that mass communication nowadays is determined by media pluralism, which "refers to the coexistence of different and diverse types of media" and "covers the distinctive roles of three sectors of media institutions: private media, community media and public media".[20] This provides an opportunity for rapid and active exchange not only of professional expertise, but also of personal opinion expressed by a wide range of actors and stakeholders. Furthermore, the multiplicity of communication platforms turns the efforts regarding fact-checking and verification of information into a laborious process, which requires a significant amount of time and efforts on behalf of the recipients. With regard to social media, experts in communications place emphasis on the significance it has as a "crucial outrage management tool" for risk

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[18] Disinformation represents "the deliberate creation and dissemination of false and/or manipulated information with the intent to deceive and/or mislead" (NATO, 2020)
[19] Media and information literacy refers to "the essential competencies (knowledge, skills and attitudes) that allow citizens to engage with content providers effectively and develop critical thinking and life-long learning skills for socializing and becoming active citizens" (UNESCO, 2021)
[20] Ibid.

communication. [21] However, social media platforms are at the same time well "adapted to expressing and exacerbating outrage", [22] which calls for continuous monitoring and rapid response on behalf of dedicated content management teams.

The criticality of verified and trustworthy sources of information grows dramatically, especially in times of crisis, when the overload of information could even lead to further confusion among the target audience. The results of a Eurobarometer survey, carried out among more than 26,000 respondents from 28 EU Member States in 2018, provide important data and demonstrate the strong correlation between risk communication, societal resilience and democracy. This survey shows that "83% of respondents said that fake news [23] represents a danger to democracy", [24] 39% thought that national authorities should take actions in order to mitigate the spread of fake news, and 36% considered that the "press and broadcasting management have this responsibility". [25] The COVID-19 pandemic has demonstrated that "national and international responses to the crisis" were hampered by an information crisis "generated by the worldwide circulation of false and misleading claims about the origins of the virus, possible treatments, protective measures, and (…) vaccine distribution". [26] In that regard, this particular case could serve to illustrate how situations, marked by high levels of risk and limited time for reaction, provide ample space for disinformation activities to be carried out, thus affecting multiple societal groups, regardless of the age, gender or level of education of the individuals. For instance, the public reaction to the multiple claims regarding the existence of a correlation between 5G signals and the spreading of COVID-19 exposed the high vulnerability of individuals to such misleading messages in times of significant levels of stress and uncertainty. Although the aforementioned claims were later on proven to be of misleading and non-reliable nature, they circulated the social media channels in a rapid and uncontrollable manner. As a result, many individuals were exposed to these messages, without having the necessary tools nor skills to debunk them on time. Additionally, the lack of sufficient knowledge about the fundamental features of the fifth generation of mobile network technology, as well as of the

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[21] (Sandman, P. M., 2015)
[22] Ibid.
[23] "Fake news and online disinformation are not per se illegal and thus are not covered by existing legislation or self-regulation although some Members States are looking into legislative actions" (European Commission, 2018)
[24] (European Commission, 2018)
[25] (European Commission, 2018)
[26] (Sanchez, 2021)

coronavirus itself, incremented the levels of uncertainty among the society and led to an increased separation between societal groups based on their personal beliefs and understanding of the aforementioned suggested correlation. Moreover, the public was left divided in opposing groups with regard to the adoption of vaccines, aimed to counter the COVID-19 pandemic. The multiplicity of information channels, disseminating continuously diverse messages concerning the efficacy of vaccines, their short-term and long-term effects on the human body, as well as the need for a mandatory vaccination against COVID-19, led to a further polarization of the public opinion on this matter and to increased tensions between society members. Individuals were left exposed to communication messages from a wide variety of sources, not all of which were trustworthy and verified. Combined with the information overflow and the insufficient time and capabilities for fact-checking and debunking, this situation led to increased tensions between society members and to intense debates on social media and through the traditional communication channels.

In response to the spread of disinformation, organisations have already made significant efforts in order to counter this threat. For instance, the European Statistical System Task Force on Strategic Communication released in February 2022 "Rules of Engagement for handling disinformation",[27] whereas UNESCO has several publications related to Media and Information Literacy (MIL).[28] Additionally, the World Health Organization (WHO) established in September 2021 a new competency framework related to "Building a response workforce to manage infodemics".[29] Furthermore, NATO focuses on "understanding the information environment" and counters disinformation "through a wide range of media engagements", by "working with partners" and providing tips in order to "help citizens better spot and counter disinformation".[30] As mass communication and social media play a key role in the contemporary communication process, the aforementioned findings could serve as a catalyst for an enhanced cooperation between media platforms, content managers and users. As a result of their combined efforts, information could be fact-checked and verified in a quick and effective manner. What

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[27](Publications Office of the European Union, 2022)
[28](UNESCO, n.d.)
[29](WHO, 2021). WHO defines "Infodemic" as "an overflow of information of varying quality, including of mis/disinformation, that surges across digital and physical environments during an acute public health event" (WHO, 2021)
[30](NATO, 2020)

is more, there are multiple approaches and strategies regarding risk communication, which could prove highly effective, as they take into account the particular specifics of the information environment and the target audience during the main stages of a crisis.

Risk communication tasks and strategies during the main phases of a crisis

Research in the field of communications distinguishes between different strategies and sheds more light on the specific tasks and objectives, which experts and practitioners in risk communications need to accomplish during the three main phases of a crisis: pre-crisis, crisis, and post-crisis. Some experts outline the main stages of communicating risk as corresponding to the above-mentioned three phases. For instance, the Arthur W. Page Center for Integrity in Public Communication provides the following analysis of the main tasks of risk communication during each stage: the first stage is related to monitoring the environment and training of the individuals "involved in the crisis management process"; the second one deals with the generation and dissemination of risk communication messages, whereas the final stage is dedicated to the evaluation of crisis management efforts.[31] A similar classification of risk communication methods and objectives is provided by Jonathan Bernstein, who emphasises the importance of the pre-crisis phase. What is more, he outlines several steps of the communication process, which should be undertaken during this first phase: creation of a "Crisis Response Plan" by the crisis communications team, training of the right spokespersons, efficient monitoring of stakeholders and media platforms, and preparation of "holding statements" which could be used immediately after the outbreak of a crisis.[32] This example proves that good initial preparation is essential in the face of high-stress situations. However, other experts state that the post-crisis phase requires maximum efforts and attention, as its main task could be defined as "assessing the damage" and "creating a strategy to preserve" the "organization's long-term reputation".[33] Although the aforementioned findings differ to some extent regarding the particular communication stage on which emphasis is placed, they all demonstrate the close connection between the particular tasks of risk

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[31](The Arthur W. Page Center for Integrity in Public Communication)
[32](Bernstein, 2015)
[33](Singer, 2019)

communication and the main phases of a crisis. However, there is also another approach to defining the strategies which could be applied within the risk communication process.

As Peter Sandman suggests, the categorisation of risk communication methods could be based on two key components of risk – "hazard" and "outrage".[34] Basing his analysis on the level of hazard and outrage, Sandman introduces four risk communication strategies, three of which will be included in this section as per the objectives of the paper, and outlines the required skills and main tasks related to each one of them.[35] The first communication strategy, defined in Sandman's work as "precaution advocacy" or "public relations", aims to raise awareness of the risk and to promote action among civil society. One of the fundamentals of this strategy is the dissemination of short messages, which are of interest to the recipients and appeal to the public's pre-existing needs and emotions, while also giving the audience the possibility to choose among several recommended precautions.[36] The main objective of the second strategy, called "crisis communication", is to "help people bear their feelings (their outrage) and cope effectively with serious hazards", as Sandman suggests.[37] In this case, he underlines the importance of avoiding "over-reassuring messages", as these could reduce the level of public trust in "leaders who over-reassured" their audience, and could even lead the civil population to ignoring the adequate precautions and abandoning the measures, which have been previously adopted.[38] The third communication strategy, defined as "outrage management", consists in reducing the "audience outrage by listening, acknowledging, sharing control and credit"[39] and occurs when the public believes that there are "substantive reasons to oppose" an organisation or an idea.[40] As Sandman explains, the above-mentioned communication strategies could be directly linked to the three-phase model of crises.[41] His analysis provides an additional perspective regarding the main objectives of risk communication and the specific approaches, which organisations could adopt before, during and after a crisis event.

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[34] "hazard, the technical or scientific measure of a risk, and outrage, the emotions that the risk evokes" (U.S. Department of Health and Human Services. Centers for Disease Control and Prevention, 2019)
[35] (Sandman P. M., Four Kinds of Risk Communication, 2003)
[36] (Sandman P. M., "Watch Out!" Precaution Advocacy Fundamentals, 2007)
[37] (Sandman P. M., Crisis Communication: A Very Quick Introduction, 2004)
[38] (Sandman & Lanard, COVID-19: The CIDRAP Viewpoint, Report 2, 2020)
[39] (Sandman P. M., Four Kinds of Risk Communication, 2003)
[40] (Sandman P. M., Managing Justified Outrage: Outrage Management When Your Opponents Are Substantively Right, 2008)
[41] Ibid.

In any case, the aforementioned findings have one common feature, regardless of the perspective adopted by experts in the analysis of communication strategies. They all demonstrate the complex nature of risk communication and underline its key role in the crisis management process. Not only does effective risk communication promote action and raise awareness of topics of great societal importance, but it also serves to strengthen the relationship between civil society and the organisations, entrusted with civil preparedness and resilience. This relationship highly depends on the levels of public trust in institutions. However, alarming tendencies related to this prerequisite pose significant challenges for practitioners in the area and call for rapid changes in the way organisations communicate with their target audience.

The role of trust

Crises are often related to high levels of uncertainty, fear and confusion among the public, which leads to major difficulties when it comes to effectively communicating risk and to ensuring the public trust in institutions and organisations, responsible for crisis management and civil preparedness. Trust is of critical importance to the effectiveness of communication and represents a topic of great interest for experts in the field. For instance, one research, based on 509,097 direct reports on the effectiveness of 97,872 leaders, reveals the conclusion that leaders who were highly trusted had "employees that were more satisfied with the organization than those leaders who scored high in communication skill". [42] These findings could be interpreted in the wider context of risk communications, as the proposed key factors for building trust can be analysed within the communication process between organisations, entrusted with crisis management and civil preparedness, and the public. Additionally, the evolution of trust in such organisations has been studied in depth by experts in strategic communications. The 2017 Edelman Trust Barometer survey, conducted online among more than 33,000 individuals in 28 countries, shows that 53% of total respondents "believe the system is failing them" which could be interpreted as related to the sense of injustice, lack of hope and/or competence, and the desire for change.[43] What is more, the 2020 Edelman Trust Barometer survey, which investigates the responses of over 34,000 participants from 28 countries, concludes that "less than 1 in 5 respondents agree that the system is

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[42](Folkman, 2020)
[43](Edelman Inc., 2017)

working for them".[44] These findings show an evident tendency towards further decline of the levels of public trust in institutions. Furthermore, attention needs to be drawn to the fact that none of the four societal institutions measured by the above-mentioned study, i.e. media, government, business and NGOs, "is seen as both competent and ethical".[45] In this case, public trust is analysed through the perspective of two basic attributes: competence is understood as "delivering on promises", while the ethical behaviour consists of "doing the right thing and working to improve society".[46] The results are illustrated in the figure below (Fig.1)

Dimensions of trust
(Competence score, net ethical score)

ETHICAL
35

No institution seen as both competent and ethical

NGOs
(-4, 12)

LESS COMPETENT ◄ -50 ————————————— 50 ► COMPETENT

Business
(14, -2)

Media
(-17, -7)

Government
(-40, -19)

-35
UNETHICAL
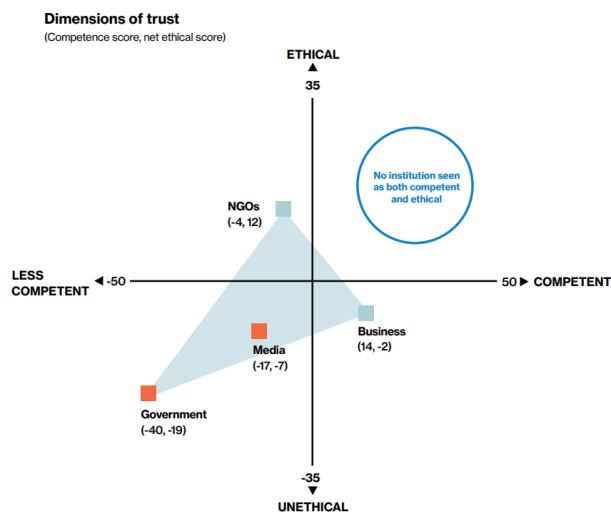
Figure 1:Dimensions of trust (Competence score, net ethical score). (Edelman, Inc., 2020)

These results place emphasis on the decline of trust in institutions, which could undermine the credibility of spokespersons and officials, and risk communication could fail to reach its objectives. This should draw attention to the proper selection and training of spokespersons, as they represent the entire organisation and need to communicate the organisational efforts in the most adequate manner. On the one hand, it is a common feature of the human psychology to perceive as more credible such spokespersons who possess similar personal traits as the majority of people

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[44](Edelman Inc., 2020)
[45] Ibid.
[46] Ibid.

from the target audience.[47] On the other hand, there are several principles of crisis and emergency risk communication which could be applied by spokespersons when they aim to build trust and credibility in the organisation, while also helping the affected individuals and gaining their support.[48] Following these principles, spokespersons need to provide accurate and reliable information in a quick manner, while demonstrating transparency and openness. Additionally, they should regularly inform the public about the efforts, which the organisation makes to tackle the crisis situation, and about the overall progress of crisis management. Expressing empathy in risk communication is another key point, as it demonstrates an understanding of the public concerns and could help spokespersons restore the levels of trust in their organisation by improving the relationship with their target audience.[49] The existence of stable and positive relationships between organisations and public increases the effectiveness of risk communication and the overall credibility of organisations. As a result, they have higher chances in succeeding in their main objective, which consists in building resilience and enhancing civil preparedness.

Resilience through civil preparedness

For over a decade the term "resilience" has been a subject of thorough analysis on behalf of major organisations such as the EU, NATO, the UN, the Organisation for Economic Co-operation and Development (OECD), to name but a few. Given the fact that each organisation has its own perspective and approach to understanding and building resilience, there are several definitions which are shown in the table below (Tab. 1).

Table 1: Definition of "resilience" given by different organisations

By:	Resilience is understood as:
EU	"the ability of an individual, a household, a community, a country or a region to withstand, to adapt, and to quickly recover from stresses and shocks"[50]
NATO	"a society's ability to resist and recover from such shocks" such as "a natural disaster, failure of critical infrastructure, or a hybrid or armed attack"[51]
UN	"the ability of individuals, households, communities, cities, institutions, systems

[47](Edelman Inc., 2017)
[48](U.S. Department of Health and Human Services. Centers for Disease Control and Prevention)
[49]Ibid.
[50](European Commission, 2012)
[51](NATO, 2021)

	and societies to prevent, resist, absorb, adapt, respond and recover positively, efficiently and effectively when faced with a wide range of risks, while maintaining an acceptable level of functioning and without compromising long-term prospects for sustainable development, peace and security, human rights and well-being for all"[52]
OECD	"the ability of households, communities and nations to absorb and recover from shocks, whilst positively adapting and transforming their structures and means for living in the face of long-term stresses, change and uncertainty"[53]

The commonality in these definitions is the ability of societies to recover from shocks and risks. However, the COVID-19 emergency has demonstrated clearly that governments and organisations are facing a global crisis which calls for "a combination of adaptation and transformation measures", including "the engagement of people, in discussions, and in actions".[54] Nevertheless, the COVID-19 pandemic does not conclude the list of examples of the interdependence between civil society and the organisations entrusted with crisis management and building resilience. As the 2016 EU Global Strategy notes, "societal resilience will be strengthened by deepening relations with civil society, notably in its efforts to hold governments accountable".[55] Another report, adopted by the Committee on democracy and security (CDS), notes that "by developing more inclusive communication strategies and by involving the education system, authorities must constantly reaffirm and strengthen ties between citizens and their democratic values and institutions".[56] These findings illustrate the key role of effective communication in the process of engaging the civil society in risk and crisis management. Other researchers in the field correlate resilience with the culture of preparedness, "whereby individuals and communities are expected to be continuously prepared to absorb and address very unlikely – but not impossible – stresses".[57] What is more, experts suggest that the culture of resilience "turns crisis response into a strategy of permanent, open-ended responsiveness, integrating emergency preparedness into the infrastructures of

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[52](United Nations, 2020)
[53](Mitchell, 2013)
[54](Giovannini, Benczur, Campolongo, Cariboni, & Manca, 2020)
[55](European External Action Service, 2017)
[56](Garriaud-Maylam, 2021)
[57](Anholt, et al., 2021)

everyday life and the psychology of citizens".[58] These findings provide another perspective regarding the notion of preparedness and resilience.

The strong correlation between civil preparedness and resilience could be interpreted in the context of continuous and coordinated efforts on behalf of several organisations. For instance, NATO considers that civil preparedness is "primarily concerned with aspects of national planning that affect the ability to contribute to Allied efforts in continuity of government, continuity of essential services to the population and civil support to military operations".[59] What is more, NATO makes unceasing efforts to build resilience through the enhancement of civil preparedness, and this can be illustrated by a special course, co-organised by the Crisis Management and Disaster Response Centre of Excellence (CMDR COE) and the Civil-Military Cooperation Centre of Excellence (CCOE).[60] The importance of community engagement is considered by WHO as one of the four "key areas of focus for urban preparedness for an effective response to COVID-19,[61] while the EU Civil Protection Mechanism, established in 2001, aims to "improve prevention, preparedness and response to disasters" by fostering the cooperation between EU Member and Participating States.[62]The European Commission Civil Protection and Humanitarian Aid Operations department notes that one of the co-funded prevention and preparedness projects aims to "inform citizens of the main pillars of disaster preparedness and the role they can play to protect themselves and others; to improve the link between relevant stakeholders at community level; and to share, translate and adapt awareness raising tools".[63] These findings serve to illustrate that organisations are actively engaged in the process of enhancing civil preparedness and building resilience.

However, the COVID-19 pandemic has shown that additional efforts have to be made. The 2021 Global Health Security Index conducted a research among 195 countries and concluded that "all countries remain dangerously unprepared for meeting future epidemic and pandemic threats".[64] Experts also point out that there is a need "for greater commitment to prioritizing risk communication to the public and

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[58](Walker, 2020)
[59](NATO, 2021)
[60](CMDR COE)
[61](Health Security Preparedness, WHO Health Emergencies Programme, 2020)
[62](European Commission)
[63](European Commission, 2018)
[64](Global Health Security Index, 2021)

trusted partners" and state that "countries and international health authorities should more fully incorporate community engagement and social science in preparedness".[65] These conclusions cast light on one important issue. Although dedicated efforts on behalf of organisations in response to the complex and constantly changing environment are already taking place, there is still a need for further development and research regarding the proper implementation of risk communication in the process of building resilience through enhanced civil preparedness.

Conclusion

In recent years, the intricate security environment, defined by high levels of uncertainty, insecurity and stress, has posed numerous challenges to the organisations entrusted with civil preparedness and resilience. Additionally, the key role of civil society in the process of building resilience, risk management and successful recovery from crises has captured the attention of experts and practitioners in the field of crisis management and disaster response. The process of communicating risk can be linked to a wide variety of actions, methods and strategies. Among its main objectives is to provide clarity and to address the concerns of the public in high-stress situations, such as crises. This task, however, results quite challenging, as it depends on the complex nature of civil society, the intricate global security and information environment, as well as on the established relationship between the public and the organisations entrusted with crisis management, resilience and civil preparedness. The general purpose of this paper is to highlight that effective risk communication is not limited to the generation and dissemination of important information in times of crisis, but it also represents a thriving opportunity to promote action, introduce lasting behavioural changes and, as a result, facilitate the process of building resilience. In order to adequately respond to emerging risks and crises, the models and approaches, applied by experts in risk communication, need to evolve without further ado. The active participation of the relevant stakeholders and their readiness to cooperate actively in the process of handling crisis should be considered as one of the key prerequisites for the successful management of a crisis situation. However, disinformation, insufficient preparedness and the lack of trust illustrate some of the numerous challenges, which

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[65](Johns Hopkins Center for Health Security, 2019)

individuals and organisations face and need to overcome. This paper could serve as a catalyst for further research in this area, as it aims to contribute to the deepening of the public understanding of risk communication. By incorporating various perspectives and analysing the efforts of experts in different fields of study, the present research sheds more light on the significance of risk communication, which could be considered as a key tool in the crisis management process, and outlines possible directions for further development in this area.

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EFFECTS OF MISINFORMATION ON COGNITION AND INHIBITION OF NATIONAL SECURITY: RESILIENT SOCIETIES IN THE WAKE OF SARS-COV-2

ElisavetKatmada

Abstract: SARS-CoV-2 has spread rapidly worldwide alongside a tsunami of misinformation that has proliferated across conventional social media platforms. The impact of misinformation is discussed throughout the paper from the perspective of disrupted cognitive patterns, which manifest in conspiracy beliefs. In effect, the internalization of conspiracy beliefs undermines the public's resilience to misinformation and threatens national security. More specifically, the paper explores the inhibition of a nation's security by examining two predictors: the public's low governmental trust and its distrust in health experts. In essence, the research is focused on the concepts of resilience and misinformation, linking the two terms, and providing an overview of factors amplifying misinformation, such as age, digital and media literacy, anxiety, motivational drives, and cognitive reflection.

Keywords: SARS-CoV-2; Conspiracy Theories; Disrupted Cognition; Misinformation; National Security; Resilience.

Effects of misinformation on Cognition and Inhibition of National Security: Resilient Societies in the Wake of SARS-CoV-2. Explaining two Perspectives on SARS-CoV-2.

WHO's Public Health Perspective

SARS-CoV-2 was initially identified in December 2019 in Wuhan, China, and was classified as a respiratory disease. The virus invades the immune system, causing mild, moderate, and severe symptoms. These include fever, sore throat, and shortness of breath. Additionally, SARS-CoV-2 is transmitted through the fecal-oral routes, specifically from nasal discharge and saliva secretion. Therefore, SARS-CoV-2's prevention plans consist of physical distancing and practicing respiratory etiquette (World Health Organization [WHO], 2020).

A Strategic - Civil Preparedness Perspective

Disasters can be classified as either natural, human-induced, or hybrid. The first one refers to natural and geologic processes like earthquakes or floods (Classification | EM-DAT, 2021). The second one entails a catastrophic event triggered by direct or

indirect human activities and affects the population on a social, physical, and psychological level (Types of Disasters, 2021). The third category refers to threats consisting of terrorist and cyber-attacks that aim to inhibit a specific civilian population or infrastructure (Roepke and Thankey, 2019).

As far as the novel coronavirus is concerned, the disease itself falls under a "grey area." However, one of its after-effects, the spread of misinformation, has been associated with the ramifications of hybrid warfare (Roepke and Thankey, 2019). During the 56th Munich Security Conference, the World Health Organization's director-general TedrosAdhanomGhebreyesus stated that 'we are not just fighting an epidemic; we are fighting an infodemic' (Zarocostas, 2020, p.676). It is evident that SARS-CoV-2 poses a threat not only in the immediate physical sense but also in disseminating false information (Brennen, Simon, Howard and Nielsen, 2020; Gupta et al., 2020).

How Does Misinformation Relate to Resilience?

Defining Resilience
Resilience is a multifaceted concept and can be viewed from an array of perspectives. For instance, psychological resilience would be defined as coping, adapting, and overcoming adversities utilizing mental and emotional capacities. (American Psychological Association [APA], 2020). Meanwhile, a different perspective is taking into consideration NATO's seven Baseline Requirements; it views resilience as the ability to withstand and overcome adversities relating to infrastructure, military preparedness, and civil support (Roepke and Thankey, 2019). As agreed upon by NATO Allies, the first Baseline Requirement for national resilience is 'Assured continuity of government and critical government services' (Heads of State and Government, 2016).

Although the concept of resilience from a psychological perspective seems quite different from NATO's definition of civil preparedness, the two views share common ground. Research on psychological resilience revolves around interventions used to prevent individuals from experiencing consequences of severe traumatic experiences such as post-traumatic stress disorder (PTSD), as well as other manifestations of stress-induced disorders (Liu, Zhang, Ji and Yang, 2018). On the other hand, Article 3 of the Washington Treaty states that resilience is essential in

the cases of military or hybrid threat in order to preserve the Alliance's continuity, communication, and defense line (Heads of State and Government, 2016). However, both approaches are accompanied by a high level of stress and anxiety because supporting a community at a societal and military level and providing the necessary services to deal with crises is a complex and multifaceted process (North Atlantic Treaty Organization [NATO], 2008).

Defining Misinformation

There are two types of false information: disinformation and misinformation. Disinformation refers to inaccurate information deliberately spread to harm a person, social group, or organization. Similarly, misinformation refers to false information, not intending to cause harm (Karlova and Fisher, 2013). That being said, this paper will elaborate on the concept of misinformation, and more specifically, health misinformation. For this reason, we can define health misinformation as the spread of health-related information without scientific merit (Pamment and Kimber-Lindwall, 2021).

When deliberately disseminating information relating to science, the goal is to polarize two types of populations: those with science literacy and those without science literacy (Kahan, 2017). Science literacy can be defined as the essential attainment of scientific knowledge and practical applications (Feinstein, 2010). Henceforth, science literacy can be a predictor for misconceptions regarding SARS-CoV-2 and, in effect, the spread of misinformation.

The Relation Between Resilience, Misinformation, and National Security

It has been previously mentioned that the NATO Warsaw Summit that took place during 2016 identified 'Assured continuity of government and critical government services' as one of the seven strategic sectors supporting the Alliance's resilience (Heads of State and Government, 2016). This Baseline Requirement refers to the smooth operation of government services, which in times of crisis (i.e., pandemics), ensure good communication among institutional/governmental entities, secure the public's safety, and enhance the public's support towards governmental resolutions (Civil-Military Cooperation Centre of Excellence [CCOE], 2021).

Considering the framework provided for resilience and misinformation, it is suggested that misinformation regarding the novel coronavirus has pronounced consequences for a society's internal vulnerability. To clarify, several studies suggest

that SARS-CoV-2-related misinformation leads countries to internalize false information and reduces their misinformation resilience (Enders, Uscinski, Klofstad, and Stolerm, 2020; Roozenbeek et al., 2020). This paves the way for conspiracy theories to "flourish," obstructs the public from maintaining trust in their government, and hinders their attempt to overcome the pandemic (Brennen, Simon, Howard and Nielsen, 2020). Therefore, posing a threat to the Alliance's resilience and security.

Factors Contributing to Misinformation

In the new and thriving era of information and communication technology, misinformation can take many forms and be spread via multiple mediums. Some of them include online platforms such as Facebook, Twitter, YouTube, and What's up. A question of interest is whether specific populations are more vulnerable to misinformation. If so, how does misinformation affect human cognition, and why does it pose a threat to internal security?

Studies and theories on how misinformation distorts and "contaminates" cognition have been conducted over the years, indicating some of the factors that increase susceptibility to false information, namely demographics (i.e., age), soft skills (i.e., digital and media literacy), personal traits (i.e., anxiety), motivational drives (i.e., education) and cognition (i.e., reasoning skills) (Lee, 2004; Roozenbeek et al., 2020; Vijaykumar et al., 2021).

Demographic Factors

Age and Misinformation

Misinformation has been rapidly disseminated by social media users (Vijaykumar et al., 2021). In terms of demographics, it is suggested that older users are more susceptible to false information than younger users (Roozenbeek et al., 2020). The reasoning behind this theory is based on how the corresponding age groups process information.

The first argument on how aging impacts misinformation susceptibility concerns younger and older adults' mnemonics[1]. Studies have shown that older adults tend to form more mnemonic errors that result from lower functions in the frontal and medial

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[1] Mnemonics refer to general patterns and strategies of encoding and organizing new pieces of information (i.e., by creating acronyms, synonyms, poems, etc.) (McCabe, 2015).

temporal lobe areas, responsible for higher cognitive functioning and memory (David and Loftus, 2004; Lee, 2004).

The second argument explaining the association between age and misinformation acceptance is 'source confusion.' Research supports that source confusion, one of the perceptual errors the older population tends to engage in, can lead to misinformation acceptance (Vijaykumar et al., 2021). Source confusion manifests in the form of 'source misattribution,' or 'source monitoring – error,' which refers to the cognitive inability to recall the original source of information accurately. Lastly, studies support that source misattribution is more prevalent in older adults than in younger adults. (Lee, 2004; Vijaykumar et al., 2021).

It is no precedent that aging is accompanied by cognitive decline and impediments in recalling and retrieving information. Thus, older adults with attenuated abilities to track and monitor the source of contextual information are more susceptible to misinformation acceptance because the credibility of the false source of information is enhanced (David and Loftus, 2004; Vijaykumar et al., 2021).

Soft Skills

Digital and Media Literacy

Digital and media literacy is nowadays considered necessary to comprehend the underlying functions of digital platforms and evaluate the disseminated information. Aging is linked to brain maturity and wisdom (David and Loftus, 2004); therefore, older adults can debunk false information by evaluating its content and segregating it from accurate facts. (Vijaykumar et al., 2021). However, one crucial propensity involved with this competency is associated with the distribution of information. It is suggested that due to their unfamiliarity with online forums, older adults are more resilient when it comes to information disseminated offline rather than online (Brashier and Schacter, 2020).

Personal Traits

Anxiety and Misinformation

Another compelling factor increasing a person's susceptibility to misinformation is psychological distress, specifically anxiety. Previous studies support that social-evaluative anxiety, in particular, is positively associated with false memory retrieval (Zhu et al., 2010). In light of the SARS-CoV-2 lockdowns, individuals' self-reported

symptoms of anxiety peaked. More precisely, the prevalence of anxiety-induced symptoms among U.S citizens increased from 32.6% to 37.2% during the second lockdown period[2] (Elflein, 2021).

Similar longitudinal studies have reported the prevalence of anxiety disorders during the two lockdown periods in 2020 and 2021 and have concluded that young and older adults have been disproportionately affected. For example, a recent Chinese study found that among the 1,074 participants of their survey, 12.9% reported symptoms of severe anxiety. In contrast, the overall cases concerning anxiety disorders constituted almost three-quarters of the total sample (Ahmed et al., 2020, p.3). Another 1-year long cohort study by the University of Pittsburgh concerning college students and their perceived anxiety symptoms indicated that almost 60% of the students had a chance of developing anxiety or depression-related symptoms. These findings were very insightful, since only a year ago, during 2019, the prevalence of anxiety and depression disorders was estimated at 11% compared to 25% in 2020 (Giuntella, Hyde, Saccardo, and Sadoff, 2021, p.1).

A recent study by Georgiou, Delfabbro, and Balzan (2020) concluded that external stressors caused by significant events such as natural, manufactured, or hybrid disasters induce memory distortion and vulnerability to misleading information. More specifically, the researchers support that stress and anxiety motivate individuals to create meaning from ambiguous circumstances leading to self-fulfilling and wrongful interpretations. The researchers explain that the novel coronavirus created a stressful situation where uncertainty was thriving; thus, individuals had to make sense of the unprecedented events leading them to form conspiracy theories, which led to a distrust of the people towards governmental institutions. Ultimately, they concluded that the relation of perceived stress during the SARS-CoV-2 pandemic and the susceptibility to conspiratorial beliefs was statistically significant (Georgiou, Delfabbro, and Balzan, 2020).

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[2] The indicators represent the anxiety symptoms of U.S adults considering the period from 16 September 2020 until 23 November 2020.

Motivational Drives

Education

Previous studies have suggested that there is a link between education and false information. Although the association is not always statistically significant, research supports that even individuals with scientific backgrounds have blind spots (Georgiou, Delfabbro, and Balzan, 2019; van Prooijen, 2017)

For instance, a recent study investigating conspiracy beliefs and educational attainment concluded that the participants owning a high school degree were more inclined to endorse either general, specific, and SARS-CoV-2 related conspiracy beliefs. Conversely, those who attended college and pursued an academic degree were more dubious due to their ability to identify and filter fake news from accurate information. The researchers designed an online study[3] examining the relationship between conspiracy beliefs and level of education. The results indicated that the level of general conspiracy beliefs (GCBS) among those who reported only high school education was 37.3% and 35.5% among those owning a higher degree. Likewise, a similar increase was found in the SARS-CoV-2 conspiracy scale. Specifically, the SARS-CoV-2 conspiracy belief indicator was 29.0% regarding participants with a high school degree and 26.3% for participants with a higher degree (Georgiou, Delfabbro, and Balzan, 2020, p.4). Therefore, it is supported that the educational level, alongside scientific knowledge, and critical thinking, acts as a buffer when filtering and debunking information (Georgiou, Delfabbro, and Balzan, 2019, 2020; van Prooijen, 2017).

Cognition

Reasoning Skills

The habitual acceptance of misinformation has also been closely interrelated with reasoning competencies, such as analytical, critical, and reflective thinking. The dual-processing theory supports two divergent cognitive styles: the intuitive style, also known as 'system 1', and the analytic thinking style or 'system 2'. The first one is described as a more fast and automatic type of thinking, whereas the second requires more deliberation and thorough analysis (Evans and Stanovich, 2013).

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[3] The study included online questionnaires and consisted of 640 participants spread across Europe, U.K, and the U.S.

Prior research suggests that most people tend to deflect from tasks requiring higher or more demanding mental and cognitive processing. Moreover, individuals who do not engage in cognitive and reflective thinking are at high risk of believing fake news and conspiracy theories (Stanley, Barr, Peters, and Seli, 2020). Additionally, other researchers have also proposed that the depth and extent of cognitive deliberation can benefit individuals to unveil valid from invalid facts. In effect, high deliberation has been positively linked with true discernment, while low deliberation is positively associated with susceptibility to false information (Bago, Rand, and Pennycook, 2020).

Stanley, Barr, Peters, and Seli (2020)[4] have demonstrated the effects of analytical thinking in reducing conspiracy beliefs. The researchers conducted a study[5] whereby participants had to undergo a cognitive-reasoning test (CRT). The research hypothesis stated that participants with lower CRT scores would demonstrate a higher disposition to conspiracy beliefs and low compliance with SARS-CoV-2 restrictions. This was based on the fact that individuals usually avoid tasks of higher-cognitive demand and cave to conspiracy theories. Ultimately, it was confirmed that 19% of the participants perceived the pandemic as being a hoax. Additionally, a relationship was established between hoax beliefs and lower CRT performance, which was rendered statistically significant, indicating a 63% correlation (Stanley, Barr, Peters, and Seli, 2020).

The implication of Misinformation for Cognition

Many authors have recognized the role of identity-protective cognition when faced with false information (Kahan et al., 2007; Kahan, 2017). To be more precise, identity-protective cognition refers to the cognitive process of selectively accepting or dismissing information that is in line with the beliefs of individuals' culturally affiliated groups. The underlying premise of this theory is that the interaction of cognitive capacities and cultural ideologies can either promote or inhibit the uptake of misinformation (Kahan, 2017). In the case of scientific consensus, individuals applying identity-protective reasoning often invoke knowledge aligned with their affinity groups' beliefs and not based on expert opinion or the veracity of the scientific

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[4] The study took place on 21 March 2020 and included 278 participants.

information (Kahan et al., 2007). Their desire to affirm their groups' beliefs and protect the subsequent group identity outweighs accurate information screening.

Additionally, erroneous reporting has profound adverse effects on cognition; particularly, it can alter, disrupt, and impair our everyday cognitive processes, beliefs, and subsequent information (Vijaykumar et al., 2021). With this in mind, it is essential to reiterate that one of the pioneer researchers conducting studies on misinformation, cognition, and malleable memory effects was Elizabeth Loftus. Her research provided valuable insights on the so-called 'misinformation effect,' which describes the process of incorporating post-encoded misleading information in pre-existing memories. This dynamic interaction results in tampering the memory of current events with new supplemental knowledge (Loftus & Hoffman, 1989).

Research suggests that two of the leading factors increasing misinformation, educational level, and cognitive skills (as discussed above), also contribute to increasing the misinformation effect causing cognitive distortions (Zhu et al., 2010). When It comes to SARS-CoV-2, the cognitive implication of the misinformation effect unfolds as conspiracy theories and, in extent, hoax beliefs and dubious ideas; some of them will be presented in the following sections.

SARS-CoV-2 Misinformation Claims on Social Media (Study 1)

Social media platforms have rapidly shifted the way information is shared and, thus, the way that misinformation is dispensed (Gupta et al., 2020). That being said, Brennen et al. (2020, pp.1-2) conducted a study to identify the types of SARS-CoV-2 misinformation spread across different social media platforms[6] , which accounted for 88% of the sources where false information was disseminated. The majority of them originated from Twitter (59%), while Facebook (24%) and YouTube (27%) had a lower impact. Fact-checking websites processed the information[7].

It is worth mentioning that although fact-checker websites and applications provide insightful results, they are not untainted. Fact-checking technology cannot collect and analyze every piece of information published; instead, it focuses on a specific portion of this information, representing a broader scope of engagement and influence. In addition, fact-checking that requires human supervision can also be

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[6] Conducted in the period January – March 2020.
[7] The data collection was undertaken by First Draft News, while their evaluation was conducted by International Fact-Checking Network (IFCN) and Google Fact-Checking Tools. A total of 225 pieces were examined.

susceptible to bias and subjectivity. Lastly, automated fact-checking cannot comprehend natural language fully; thus, this provides an obstacle when evaluating information containing words and phrases more abstract and ambiguous (Graves, 2020).

The researchers' analysis divided misinformation into reconfigured, fabricated, and satire or parody. The first category represented 59% of the total sample and was classified as reconfigured content (i.e., the content was partly genuine; however, the context was misleading or distorted). The next category represented 38% of the total sample and was classified as plain fabricated content, referring exclusively to false and inaccurate information. The last category, which accounted for 3% of the misinformation pieces, included reconfigured and fabricated information (Brennen et al., 2020, p.4).

In Brennen et al. 's (2020, p. 6) study, conspiracy beliefs accounted for 17% of the total misinformation claims, while false information regarding the vaccine development was at the time only 5%. However, their study was a precursor to the profound effects of misinformation, magnified to the extent that they threaten national security by dividing people into vaccine supporters and anti-vaccine groups and feeding paranormal beliefs (Roozenbeek et al., 2020). The following study will depict the development of different types of conspiracy theories.

Internalization of SARS-CoV-2 Conspiracy Theories (Study 2)
Another compelling study[8] conducted by Enders, Uscinski, Klofstad, and Stolerm (2020), examines the variety of dubious beliefs and false claims about SARS-CoV-2. The study identifies eleven controversial statements either endorsed or rejected by a sample of 1,040 U.S adults.

The results showed that the participants' views on SARS-CoV-2 information were disproportionately dispensed. This is evident, for instance, if we examine the endorsement of the statement, "The number of deaths related to the coronavirus has been exaggerated." Endorsement for the latter was estimated at almost 30%, whereas "Hydroxychloroquine can prevent or cure SARS-CoV-2" was estimated at 18% (p.5). The misinformation under examination escalated to conspiracy theories

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[8] Conducted in the period 7 – 14 June 2020.

regarding health-related information and political motivations. The following table illustrates the two types of claims and their endorsement by the participants.

Table 1SARS-CoV 2 Types of Misinformation and Claims (Enders, Uscinski, Klofstad, and Stolerm, 2020, p. 5).

Misinformation Statement	Endorsement (%)
The number of deaths relating to coronavirus has been exaggerated (health).	29%
The threat of coronavirus has been exaggerated by political groups who want to damage President Trump (politics).	28%
Coronavirus was purposely created and released by powerful people as part of a conspiracy (politics).	27%
The coronavirus is being used to force a dangerous and unnecessary vaccine on Americans (health).	25%
Ultra-violet (U.V.) light can prevent or cure COVID-19 (health).	19%
The coronavirus is being used to install tracking devices inside our bodies (politics).	18%
Hydroxychloroquine can prevent or cure COVID-19 (health).	18%
COVID-19 can't be transmitted in areas with hot and humid climates (health).	18%
Bill Gates is behind the coronavirus pandemic (politics).	13%
Putting disinfectant into your body can prevent or cure COVID-19 (heath).	12%

The dangers of 5G cell phone technology are being covered up (health).	11%

It is evident that SARS-CoV-2 misinformation has given rise to various conspiracy beliefs (as depicted above in *Table 1*). In retrospect, it seems that some of them have been gaining gradual support as time passes. For example, in the previous research by Brennen et al. (2020), false information regarding vaccination was only prevalent at 5% of the study's sample. In contrast, in the current research by Enders, Uscinski, Klofstad, and Stolerm (2020), the vaccination misinformation increased to 25%.

Of course, it is difficult to adequately compare the two studies as they vary significantly in the sample size, variables, methods, implications, etc. However, both provide a fascinating glance at the development of conspiracy theories and how they influence public opinion (for instance, when it comes to vaccination efforts). In effect, we can conclude that misinformation does not only influence individuals when it comes to the endorsement of specific beliefs, but it undermines the collective ability of a community or country to overcome the consequences of the SARS-CoV-2 pandemic. It achieves that by shaping public attitudes and mainly by building mistrust toward government services and towards health experts' guidelines, both of which are discussed in the following section.

Prevalence of Conspiracy Theories During SARS-CoV-2

Distrust in the Government

Anastasiou and Duquenne (2021) reported[9] significant feelings of distrust from the Greek population towards their government. The respondents reported a 4.3% trust in the government and the media, while the perceived preparedness of the Greek government to handle the pandemic was 3.18 (in a 5-point Likert scale where 1 = disagree and 5 = agree). Hence, it is evident that the Greek population reported significant feelings of insecurity and distrust towards the government and its response to the SARS-CoV-2 outbreak (Anastasiou and Duquenne, 2021, p.9).

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[9] The study was conducted online and utilized questionnaires disseminated between 20 – 23 March 2020. The total number of the survey's respondents was 4,305.

Similarly, Georgiou, Delfabbro, and Balzan (2020, p. 4) discovered that misleading information was associated with specific cognitive perceptions. Misinformation was accelerating and spreading among individuals who reported the government's response to the SARS-CoV-2 pandemic as illogical (10%) and in the interest of the leaders (12%), while the third conspiracy belief related to information hidden from the public (28%).

Likewise, another study by Pummerer et al. (2021) shed light[10] on the relationship between conspiracy theories and distrust in the government. The results were captivating as 416 respondents reported beliefs of an underlying political SARS-CoV-2 conspiracy while the average institutional trust was marked as 5.98 on a 7-point Likert scale (1 = disagree to 7 = agree). The same group of researchers performed[11] a second experiment which revealed that the rates of institutional trust, support of the governmental regulations, and adoption of physical distancing were lower among the political SARS-CoV-2 conspiracy group. They established a relationship between conspiracy beliefs and distrust in government, as well as institutional responses and regulations concerning SARS-CoV-2 (Pummerer et al., 2021, p.3).

Distrust in Health Experts

Another crucial impact of the SARS-CoV-2 outbreak is reflected through individuals' distrust towards health experts and professionals. Dealing with the pandemic's disruptive social and economic changes has been proven difficult to handle, and the danger of health misinformation has been obstructing this endeavor. A relevant study[12] by Enders, Uscinski, Klofstad, and Stolerm (2020, p.5) was designed to identify health-related misinformation about SARS-CoV-2 and the public's support of such beliefs. It was concluded that 12% of the respondents agreed with the statement that "Putting disinfectant into your body can prevent or cure SARS-CoV-2." In comparison, another 19% supported that "Ultra-violet (U.V.) light can prevent or cure SARS-CoV-2." It can be seen that the endorsement of the second latter is higher. Although the deviation seems small, this ought to raise concerns about the transmission of medical misinformation and its amplification and poor hygiene

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[10] The study was conducted during March 2020. The sample size was 5,000 random Danish participants.
[11] The experiment took place on 29 March 2020 and consisted of 200 third-level German students divided in two groups: control group and political Covid-19 conspiracy (PCC) group.
[12] Conducted in the period 7 – 14 June 2020. The total number of the respondents was 1,040 U.S. adults.

practices. The transmission of false information eventually hinders individuals' ability to overcome the pandemic by following appropriate prevention measures.

Conclusion

In conclusion, SARS-CoV-2 has altered the balance of the natural world and individuals' perceptions. It was already mentioned that the novel coronavirus causes respiratory complications; thus, preventive measures have been applied alongside the two quarantines. Due to the unprecedented crisis brought by SARS-CoV-2, the virus was classified as an 'invisible threat,' one that falls under a grey area regarding the classification of disasters. Nevertheless, the unexpected pandemic has cultivated the field for ongoing misinformation and its subsequent manifestations. The effects of SARS-CoV-2 have been profoundly evident when it comes to issues regarding resilience and security. One of the novel coronavirus's after-effects, the spread of misinformation, has impacted individuals' resilience. Susceptibility to misinformation varies according to demographic factors, the presence of soft skills, certain personality traits, underlying motivational drives, and cognitive skills. As a result, when resilience to misinformation is low, cognitive distortions come into play. Specifically, the cognitive implications fueled by false information are reflected in the spread of viral conspiracy theories. These can develop as either lower trust towards the government or distrust in health experts' guidelines.

When these theories are internalized, then there is an increase in a country's internal vulnerability. Specifically, the most critical consequence of conspiracy theories was distrust in public officials and government, which eroded national resilience regarding the government's values and preparedness during the pandemic. This is evident from the public's attitudes and stance when it comes to tackling the pandemic and overcoming its consequences.

As a result, national security is threatened, as the effort to implement corrective techniques to mitigate the effects of misinformation is obstructed. For this reason, the paper explored the different areas that contribute to these less-than-ideal circumstances so that policymakers or government officials can implement methods to minimize the spread of misinformation.

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RESILOC TRIALS – FEASIBILITY STUDY OF THE FULL-FLEDGED TRIAL IN TETOVO, BULGARIA

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Abstract:Project RESILOC (Resilient Europe and Societies by Innovating Local Communities) aims at studying and implementing a holistic framework of studies, methods and software instruments (tools) that combines the physical with the less tangible aspects associated with human behavior with the purpose of identifying new strategies for improving on the processes of preparedness of local communities against any kind of hazards, either planned or unplanned. Within RESILOC's framework, local communities of various types and with varying identities - one of which is the village of Tetovo, Bulgaria - participate in an attempt to better understand their own level of resilience against natural hazards.

This article presents an assessment of the trial taking place in Tetovo as part of the RESILOC project activities. The assessment is conducted through a feasibility study focusing on the added value of the RESILOC tools for Tetovo to increase the resilience of this local community, especially in view of wildfires and snowstorms as the natural hazards typical for the community. The results from the assessment can be used to estimate the potential the RESILOC tools have in supporting communities like Tetovo with little (strategic) decision making and control capacities when it comes to risk reduction and disaster management. The feasibility study is also used to support the practical trial in the community of Tetovo.

Keywords: Resilience, Tetovo, Natural hazards, Trial, RESILOC.

Resilient Europe and Societies by Innovating Local Communities (RESILOC) is a project funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No 833671. As the project name suggests, the overall goal of RESILOC is to identify new strategies for improving on the processes of preparedness of local communities against any kind of hazards, either planned or unplanned.

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The concept of a local community is defined in the RESILOC Glossary of Terms [1] as "the people living in, serving or responsible for a particular small area, especially of a country". Local communities are further characterized with the possibility to "share common values, interests, and needs" besides sharing common geographical aspects. The RESILOC glossary of terms further reads that community resilience "refers to the capacities of local communities as complex systems involving the actions and interactions of [actors and structures] to mitigate, withstand, and recover from the impacts of a disaster or emergency, as well as to adapt or transform themselves to be less vulnerable to future disasters or emergencies". The two definitions serve as the basis for applying the RESILOC scientific framework, including studies, methods and software instruments (hereafter "tools") to communities of varying sizes, autonomy statuses and identities. This setup is to be validated during the RESILOC trials that are taking place in the project lifetime. One of the RESILOC trial communities is the village of Tetovo, which is part of Ruse Municipality located in northeast Bulgaria (hereafter "Tetovo community" and "community of Tetovo").

The present article is divided in the following chapters. Section 1.1 sets the stage by introducing the community profile of Tetovo and the natural hazards that are most relevant for it. It also briefly describes the RESILOC scientific framework, emphasizing the RESILOC software instruments as they enable the community resilience assessment during the trials. It describes the trial phases. Chapter 2 consists of a feasibility assessment of the Tetovo trial among three dimensions, namely conceptual feasibility, technological feasibility and strategic feasibility. Each of these dimensions is examined via community feedback, RESILOC researchers' observations and publicly available administrative data. The data is after further analyzed with qualitative SWOT analysis [2, 3]. The article concludes in Chapter 3 with main takeaways and lessons identified.

Tetovo and the RESILOC framework

Tetovo is a village that is part of Ruse Municipality in the Region of Ruse situated in the northeastern part of Bulgaria. Tetovo is the only village from among the four RESILOC trial communities. The other three are Gorizia (Italy), Catania (Italy) and West Achaia (Greece).

Tetovo is one of several villages with similar dimensions in Ruse Municipality. These are Smirnenski, Hotantsa, and Glodjevo. The total area of Tetovo is around 74 km^2, its landscape consists mostly of planes. In 2022, the population of Tetovo was 1736 people [4], which makes it the second largest village in Ruse Municipality. In terms of economic development, Tetovo is a typical rural community, with the largest employer in agriculture being the local agricultural cooperative. The cooperative is also the one actor who heavily depends on the natural ecosystem of Tetovo. The territory of Tetovo presents several critical assets, such as the irrigation dam in immediate proximity to Tetovo and Municipal Route II-23 connecting Tetovo to the larger communities of Ruse to the west and Kubrat to the east. The dam guarantees a significant reserve of fresh water available for agriculture. The volume of the dam is 44,000 m^3. The high-voltage electricity routes providing electricity to Tetovo and the protected natural area of "Ludogorie", part of which is in the territory of Tetovo, are other critical assets.

To assess and work on the community's resilience, the RESILOC project employs a scenario-based approach to exploring several hazards [5]. Since it is a predominantly rural community, there are two particularly relevant natural hazards identified by Tetovo community members at the beginning of the RESILOC project, namely snowstorms and wildfires. Earthquake hazards are also relevant for the region, but the community emphasized snowstorms and wildfires at the time. Based on a hazard scenarios analysis performed in 2020 using the Australian Institute for Disaster Resilience likelihood and impact typology [6], both snowstorms and wildfires are classified as an almost certain to happen hazard with moderate impact on the community of Tetovo.

The outcome of the RESILOC approach towards assessing resilience is the conceptual Dimensions, Indicators and Proxies framework (hereafter "DIP framework") [7]. The framework operationalizes resilience allowing its measurement over space and/or time, so as to support comparison against a baseline state of the community [8].

To model the concept of resilience, the DIP framework consists of six dimensions: disaster risk reduction (DRR), economic, environmental, governance, infrastructure and social. The number of dimensions follows common practice in resilience

research, where modelling usually includes between three [e.g. 9] and seven [e.g. 10] dimensions. In each dimension of the DIP framework, there are between 7 and 17 indicators derived from literature. For example, the governance dimension includes indicators such as "citizens' participation" or "accountability, transparency and ethical conduct"; the social dimension includes indicators like "community engagement" or "social connectedness"; the infrastructure dimension includes indicators such as "transport routes redundancy", "water access" or "energy grid access for individuals". For each indicator there are example measurable proxies. To name a few, the framework allows for the indicator "transport routes redundancy" to be measured by the proxies "percentage of people with access to alternative transport routes", "number of land transport routes to enter/exit the community", "number of water transport routes to enter/exit the community" and/or "number of air transport routes to enter/exit the community". The proposed list of indicators and example proxies in the DIP framework can be found in D3.1 – RESILOC Resilience Indicators [7].

In terms of measurement, the DIP framework offers a hybrid methodology, i.e., it allows for using both quantitative and qualitative approaches embodied in the indicators and proxies. The advantage of this approach lies in the ability to combine/replace objective data with expert estimations for the preset indicators and proxies and for indicators and proxies that the community may wish to additionally include in its resilience assessment. In this sense, the RESILOC platform and other tools, with the underlying DIP framework, can be regarded as open systems that allow for expansion/adaptation depending on the community's current needs. The framework is viewed in more details in the following chapter.

The final element framing the trials is the procedure they are to follow. The RESILOC trials are constructed under an adapted version of the Trial Guidance Methodology [11], originally developed by the DRIVER+ project[5]. The trials consist of two phases – capacity building phase and full-fledged trial phase. Each phase includes stages that are further broken down in specific steps to be completed in each trial site. The steps are divided into trial and validation steps, the latter being internal assessment points marking a trial milestone. The work presented here builds on data derived from the capacity building

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phase and serves as a stepping stone for the full-fledged trial that will take place in Tetovo, the result of which will be a Local Resilience Strategy.

A specific feature of the RESILOC trials is that they are enabled by voluntary Local Resilience Teams (LRTs). The role of the LRT is double in that they (1) communicate the local community needs and requirements and conduct the resilience assessment with the RESILOC tools on behalf of the community during the trials and (2) bring the culture of "resilience" closer to the community employing the resources available as part of RESILOC. The LRTs consist of local community actors with varying roles and expertise, for example local authority representatives, emergency and DRR experts, civil society organization representatives, citizens). The LRT in each of the trial communities is unique in their composition, which is determined by available capacity, decision making structure and community needs. In Tetovo, the LRT is two-layered consisting of a core team (up to 6 members) and an extended team (20-25 members). The feasibility assessment presented here is based on feedback collected from the core LRT during the first two stages of the capacity building phase, in which the LRT's was upskilled to work with the DIP framework and the data for the full-fledged trial was collected. The feedback from the core LRT is combined with RESILOC researchers' observation on site and publicly available administrative data.

Feasibility assessment of the Tetovo full-fledged trial

The background information presented above is further detailed in each of the following three sections of the chapter. The first section discusses the conceptual feasibility of the trial, the second its technological feasibility and the third – the strategic feasibility, which is aligned with the overall goal of the RESILOC project. Conclusions are then used to create the SWOT analysis in the final section of the chapter.

Conceptual feasibility

The conceptual feasibility of the full-fledged trial is viewed in terms of the DIP framework's (perceived) appropriateness for the community of Tetovo.

As mentioned above, there are six dimensions in the DIP framework, namely DRR, economic, environmental, governance, infrastructure and social. The framework provides a list of ready-made indicators and proxies that are derived from existing

literature, but it also allows for introducing new indicators as well as new proxies depending on community specificities. In this sense, the DIP framework is structure, but also agent dependent.

Below is a summary of the number of indicators and proxies derived from literature per dimension:

Disaster risk reduction (DRR) – 13 indicators, 55 proxies.

Economic – 9 indicators, 32 proxies.

Environmental – 17 indicators, 58 proxies.

Governance – 8 indicators, 30 proxies.

Infrastructure – 16 indicators, 60 proxies.

Social – 7 indicators, 25 proxies.

During the first trial stage in the capacity building phase, the LRT members were introduced to the RESILOC DIP framework in a workshop format. Table 1 below gives a summary of the results on the framework's conceptual feasibility assessment operationalized through three anonymous survey questions touching on the following three topics: the framework's ability to describe the resilience of a community, its appropriateness for assessing the resilience of Tetovo and its complementarity to existing resilience evaluation approaches in the community/used by authorities. The scale that is used is a five-point one (from +2 to -2, in line with the RESILOC validation approach) and the total number of respondents are 6 members of the Tetovo LRT.

Table 1. DIP framework - conceptual feasibility evidence from Tetovo.

	+2	+1	0	-1	-2
Ability to describe resilience	1	4	1	0	0
Appropriateness for Tetovo	0	6	0	0	0

Complementa rity	2	4	0	0	0

Results from the assessment show LRT members have a balanced positive perception of the DIP framework. They note that from the point of view of the hazard scenarios for Tetovo (snowstorms and wildfires) the framework covers the specific needs of Tetovo. Moreover, they think that working with the hazard scenarios makes the understanding of the framework easier.

On the other hand, LRT members recognize that not all indicators and proxies are applicable to the community of Tetovo and that they need to be discarded altogether or adapted accordingly in order to meet the community's needs. In terms of complementarity with other approaches, participants were the most optimistic, with one of them noting that the RESILOC framework and broader approach reminds them of the instruments that the military use for planning (during the discussions they mentioned the mathematical optimization method used for strategic operations research [12]).

The observation conducted during the workshops confirms the results reported by the LRT members in the discussions. The first interaction with the theoretical DIP framework is the slowest one, that is, users need time to get acquainted with the terms used and the framework's hierarchical structure.

Technological feasibility

The RESILOC approach resembles that of using scorecards [13] to assess community resilience. However, RESILOC's main advantage to the scorecards is that it is more dynamic and flexible. This dynamism is enabled by the RESILOC inventory and its interface – the RESILOC platform[6]– which provide communities with the opportunity to take "snapshots" of their resilience at different times. The RESILOC platform is a cornerstone of the project trial activities in all trial locations.

The RESILOC platform is accompanied by two more information technology tools: (1) the RESILOC application[7] enabling the use of surveys and remote sensing for collecting proxy data in the communities and (2) a sentiment analysis interface operating with aggregated publicly available Twitter data. Since Twitter is not among

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[6] Accessible here: https://resiloc1.di.uoa.gr/auth/login
[7] Available for download here: https://play.google.com/store/apps/details?id=si.ijs.e6.resilocApp

the popular social networks in Bulgaria and there is one more Tetovo community located in North Macedonia, the use of the sentiment analysis interface is not feasible for the full-fledged trial in Tetovo, Ruse Municipality. On the other hand, the RESILOC app is a mobile and desktop application, which is used in Tetovo to collect information on proxies, the information for which cannot be obtained from administrative sources or expert estimation.

The use of the RESILOC platform by a community consists of users selecting already existing indicators and proxies or creating new ones. After this is done, the indicators and proxies are tied to a specific hazard scenario. In the scenarios, a proxy configuration process is required in order for the resilience assessment to be complete. This entails (1) determining a proxy's relevance (from 0 to 100), (2) its direction (positive or negative), (3) its target minimum and maximum values and (4) its current value. An example assessment[8] visualized through the RESILOC platform is shown in Fig. 2 below.
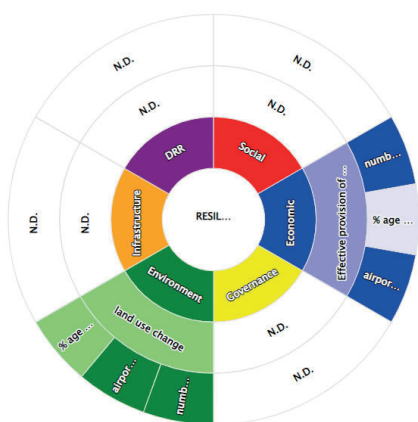
Fig. 2. Example assessment of local community resilience with the RESILOC platform

Employing the RESILOC tools at full capacity is both agent and structure dependent. While language is not an obstacle as the platform supports multiple languages, it is essential for users to have basic information technology skills. In order to use it as a sensing software, the RESILOC app also requires a smartphone on which to be installed.

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[8] This figure is not a real assessment for the community of Tetovo and has only illustrative purposes.

The minimum skills for RESILOC platform use is screens navigation and work with pop-up windows. Additionally, regardless of information technology skills, training for the platform (and app) users is needed before they start operating with it. On the other hand, a large part of the work with the platform consists of configuring the proxies with both current and target data.

Proxy target data can be derived both from available estimations found in literature and from expert estimations depending on local context. The same applies for current data that feeds in the assessment. The RESILOC platform allows for indicators to be quantitative or qualitative, while the proxies can be expressed in absolute or relative terms, or be binary [14]. The relative ones are preferred as relative expression makes their assessment insensitive to community size and allows for temporal and spatial comparisons.

A validation of the data collection requirements for the assessment and platform use was also conducted in a workshop format during the first stage of the capacity building phase before the full-fledged trial in Tetovo. The results are presented in Table 2 below.

Table 2. Data collection - technological feasibility evidence from Tetovo.

	+2	+1	0	-1	-2
Data collection process appropriateness	4	0	0	0	0
Data format appropriateness	0	4	0	0	0
Easiness to collect data	2	2	0	0	0

As one of the workshop participants[9] put it, "it is absolutely essential [to have the data] in order to work with the system". Participants perceived that collecting administrative data would be easier compared to collecting data in the field. They also straightforwardly noted that part of the data may not be available, nor are at all collectable. In that sense, even if one indicator or proxy is appropriate for resilience assessment, it will need to be discarded from it due to lack of data.

The observation during the workshops confirms the results reported by the LRT members within the discussions. The participants had no issues with understanding the format required for the data to be entered in the RESILOC platform. However, they were very skeptical with respect to collecting some data at the community level. By the Eurostat nomenclature, Tetovo is a community below NUTS 3 level and specific publicly available statistical data is quite scarce. For example, in the 2011 census in Bulgaria there is aggregated data on the total number of houses, blocks of flats, villas, etc. in the villages of Ruse Municipality, but there is no such data at the individual village level that is publicly available [15].

Strategic feasibility
The third feasibility dimension to be explored is the strategic one. The purpose of RESILOC is to enable the identification of new strategies for improving the processes of preparedness of local communities against any kind of hazards. This is why the intended outcome of the full-fledged trials is a Local Resilience Strategy co-created between the LRT and the broader community. The strategy should be based on the outcome of the resilience assessment in the RESILOC platform, which shows the identified gaps in community resilience.

The strategy in each of the trial communities will consist of a plan for maximum improvement of community resilience. However, in the case of Tetovo, this strategic planning may be hindered at the community level, because the village does not have full administrative capacity, i.e., the Tetovo Town Hall(as any other town hall in Bulgaria) acts almost exclusively under the auspices of the Municipality of Ruse (as any other municipality in Bulgaria) [16]. The LRT in Tetovo is aware of this limitation, as is evidenced by their responses to two validation questions touching upon the strategic dimension (see Table **3** below).

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[9] There were five participants in the workshop, four of whom completed their anonymized questionnaire.

Table 3. DIP framework - strategic feasibility evidence from Tetovo.

	+2	+1	0	-1	-2
Usability of the DIP framework by the community of Tetovo	1	3	0	0	0
Usability of the DIP framework by Ruse Municipality and its services	2	2	0	0	0

With respect to the usability of the DIP framework by Ruse Municipality and its services, the participants[10] mention that assessment outcomes can be used for future strategic planning. This is due to a large extent to the fact that in Ruse Municipality not only do local authorities have more power compared to the Town Hall in Tetovo, but also because all emergency services are located in Ruse. This finding, however, does not impede the Local Resilience Strategy building in Tetovo that will take place during the full-fledged trial phase, as it can be substantiated by developing soft measures and/or improving lobbying efforts in the greater municipality among others. Moreover, efforts contributing to the strategic dimension

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[10] There were five participants in the workshop, four of whom completed their anonymized questionnaire.

are already present in the Tetovo capacity building phase, as it includes practitioners from the Municipality of Ruse.

SWOT analysis

The final section in this chapter is dedicated to indicating what the strengths, weaknesses, opportunities and threats are that lie in the intersection between the general RESILOC approach and the full-fledged trial to be carried out in the Tetovo local community in Bulgaria. The available evidence suggests that conceptually, technologically and strategically, the RESILOC approach to assess local community resilience as applied in the Tetovo trial has a balanced array of strengths and weaknesses, but the opportunities it offers outweigh the threats it may bring.

Strengths.

The RESILOC approach is more dynamic and flexible compared to some existing approaches (e.g. scorecards) because it can be used by communities of different scales at different points in time.

With its composition of a local authority representative, DRR experts and civil society organization representatives among others, the Tetovo (core) LRT is capable of completing the trial process according to the trial script.

Objective data can be combined with expert estimations, which makes data sources diverse and at times interchangeable.

The RESILOC approach stimulates dialogue among experts with different backgrounds that do not always exchange information with each other in day-to-day operations.

Weaknesses.

Basic level of information technology skills is a prerequisite to operate with the RESILOC tools.

Local language availability should be ensured in order not to impede participation based on foreign-language knowledge.

(Stable) Internet connection must be present to operate the RESILOC tools.

Proxy data may not be available, nor at all collectible.

Data collection may be resource consuming (especially in terms of time).

Strategic decision making in Tetovo is with little efficiency.

Opportunities.

- Proxies and indicators should be adapted whenever necessary to meet the local context.
- Proxy data can be collected from stakeholders through the RESILOC app without the need for face-to-face interactions, which can lead to a significant reduction in data collection efforts.
- Local Resilience Teams should include an appropriate mix of stakeholders, so that access to administrative data that is not otherwise available is collected.
- Local communities that otherwise do not have access to resilience assessment tools, nor usually think and act in strategic terms have the opportunity to shift their mindset with the RESILOC framework and tools.

Threats.

- The lack of data may skew the resilience visualization and, thus, diverge strategic efforts.
- If local language translations of all items in the platform (incl. dimensions, indicators and proxies) are not available, this may dissuade local community representatives from using the RESILOC tools.

The lack of local capacity to analyze existing gaps may compromise strategic efforts.

Conclusion

This article provides preliminary evidence from the capacity building phase of the RESILOC trial in Tetovo, on one hand, to assess the feasibility of the full-fledged trial planned for the second phase of the trial activities in Bulgaria and, on the other, to assess the feasibility of the RESILOC approach to communities that have characteristics similar to Tetovo. Feasibility is examined by taking a look into the conceptual, technological and strategic dimensions. The conclusions of the LRT members in Tetovo are balanced, but more optimistic than not – the Tetovo full-fledged trial and the use of the RESILOC framework and tools in similar settings can bring significant added value to the community. However, in order for this to be achieved, some adaptation efforts by the LRT and mindfulness of the weaknesses and threats need to be present.

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COMMUNICATING STRATEGICALLY TO ENHANCE RESILIENCE AGAINST DISINFORMATION

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Abstract: Building resilience has proven to be a challenging endeavour due to the multitude of different aspects that constitute the notion of resilience. What is more, the evident dynamics of the contemporary security and information environment, which exerts significant influence over the societal state of resilience, poses multiple threats to the quality of the communication messages that are being disseminated to the public. One of these difficulties is represented by disinformation, which continues to trouble strategic communicators, because it remains far from completely eradicated, no matter how many efforts international organisations make in this direction. In that regard, the present paper looks into the nature of disinformation and the way in which different key stakeholders in resilience-building try to tackle this negative phenomenon. In addition, it analyses the potential of strategic communications to build resilient societies and takes into account the possible challenges which could be derived from the complexity of the current information environment. In the end, it provides a list of particular basic requirements for having resilient societies and closely examines each of them, as it could provide organisations, aiming to build societal resilience, with valuable insights concerning the public needs and expectations, which need to be satisfied in order to enhance the resilience of these individuals and of the society in general.

Key words: Strategic communications, narratives, resilience, disinformation, information environment

Introduction

The high complexity of the contemporary security and information environment poses numerous challenges to governments as well as to national and international organisations with regard to their short, medium and long-term objectives. Achieving and fostering societal resilience is considered to be quite a laborious task which is highly dependent on the diverse events and trends that take place in the aforementioned environment. The generation and dissemination of lasting and compelling strategic narratives is to be understood as a key communication tool,

which not only represents the vision and the mission of the message originator, but also plays a major role regarding the overall positioning of the respective stakeholder on the strategic landscape. However, the very nature of the information environment represents a source for numerous opportunities and challenges at the same time. Among these challenges is a phenomenon called disinformation, which requires special attention, as it could lead to major reputational damage and decrease of public trust in governments and key stakeholders dealing with resilience building. Therefore, the present paper begins with observations on this phenomenon, thus providing a comparative analysis between the concrete understanding of it on behalf of different international organisations. Additionally, the characteristics of the information environment are taken into account as well as the efforts made by key international stakeholders in order to better comprehend its dynamics and function in it in a more effective manner. Furthermore, the basic requirements for achieving societal resilience are taken into consideration and additional emphasis is placed on the significance of a people-oriented and multilateral approach, especially in the contemporary context, marked by globalisation and a wide variety of strategic actors. Lastly, the potential of strategic communications to establish and foster the connection between organisations and their target audiences is analysed. In that regard, the power of narratives in creating a compelling picture of the main organisational objectives and outlining its mission should be adequately applied, as it would assist organisations and governments to earn the public trust and to reach their target audience. Having established a close and stable relationship between organisations entrusted with building resilience and the population, the task of fostering a resilient society would be significantly easier to achieve. Nevertheless, strategic communicators should always be alert to the events, which occur in the information environment because they will most probably outline the particular future communication activities that will lead to the desired end-state, in this case – a resilient society.

Disinformation in the contemporary information environment

Disinformation has been at the core of recent research on communication process due to its relevance to the entire communication process as well as to the creation, dissemination and reception of messages within the contemporary information

environment.[1] Several international organisations have invested a significant amount of time, effort and expertise in the assessment and analysis of the disinformation phenomenon. As per the research objectives of this paper, a clear differentiation between the notion of "misinformation" and "disinformation" is to be introduced. Misinformation can be defined as "false or misleading information spread without the intention to deceive".[2] In this regard, misinformation remains out of the scope of the present paper, because the false or misleading nature of the shared information remains unknown to the originator of the particular message. However, the other phenomenon, called "disinformation", is defined as "the deliberate creation and dissemination of false and/or manipulated information with the intent to deceive and/or mislead".[3] As such, it should be effectively countered by the international community, because it could pose significant challenges to the establishment and preservation of a stable relationship between the organisations and institutions entrusted with building resilience, and the mass population. In that regard, the understanding of several international organisations is presented in this section. Although there are some differences in their viewpoints, all these key stakeholders take into account the significance of disinformation with regard not only to information, but also to the security environment, and make concerted efforts to minimise the negative impact and the distribution of this negative phenomenon. An overview of the respective understanding of key international organisations with regard to disinformation is provided in the table below (Tab. 1):

Table 4: Definition of "disinformation", provided by different sources

Definition of "disinformation", provided by different sources	
NATO	"the deliberate creation and dissemination of false and/or manipulated information with the intent to deceive and/or mislead"[4]
European Commission	"all forms of false, inaccurate, or misleading information designed, presented and promoted to intentionally cause public harm or for profit"[5]

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[1] The Information environment as a term has been defined in the NATO Military Policy for Information Operations, (MC 0422/5) 11 February 2015, as comprised of the information itself, the individuals, organisations, and systems that receive, process, and convey information, and the cognitive, virtual, and physical space, in which this occurs.
[2] (Colley, Granelli, & Althuis, 2020, p. 93)
[3] (NATO, 2020)
[4] (NATO, 2020)
[5] (European Commission, Directorate-General for Communications Networks, Content and Technology, 2018)

UNESCO	"deliberate (often orchestrated) attempts to confuse or manipulate people through delivering dishonest information to them" [6]
TF STRATCOM subgroup on handling disinformation	"Non-factual or demonstrably untrue or wrong information that is spread in public debate. This information has the intent to mislead or is being presented as a "truth untold by mainstream media" [7]

What these definitions have in common is the intent to manipulate – whether concerning the information itself, or the desired outcomes of the information process. As previously mentioned, the interest in the phenomenon of disinformation has grown exponentially in recent years due to the rapid and dramatic changes in the information environment, which are being continuously monitored and assessed by experts and working groups in the field of security and defence. Analysis of the contemporary information environment, offered by the NATO Strategic Communications Centre of Excellence, suggests that the main characteristics of this domain consist of five particular aspects, which all exert notable influence over the information flow and the relationships between the key stakeholders.[8]

The first characteristic is directly related to the multiple opportunities for access to and exchange of information, which modern technologies offer to the multiplicity and variety of users. The Statistical office of the European Union (EU – Eurostat, has conducted several surveys on the use of Information and Communication Technologies (ICT) among a broad spectrum of respondents. [9] One survey demonstrates that there is a continuous increase in the level of Internet access in households and these have at least one member being between 16 and 74 years of age – starting from 70% in 2010, the percentage of households which have Internet access at home grows to 90% in 2019[10]. Furthermore, the percentage of regular use of Internet among individuals between 16 and 74 years of age also continues to grow

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[6](UNESCO, 2018)
[7](Publications Office of the European Union, 2022)
[8](NATO StratCom COE, May 2016) pp. 5-6;
[9] For instance, households or individuals between 16 and 74 years of age from EU-member states, Iceland, Switzerland and Norway, candidate countries and potential candidate countries.
[10](Eurostat, 2022) – the results are related to the following Geopolitical entities: European Union 27 countries (2007-2013), and European Union – 28 countries (2013-2020);

– starting from 65% in 2010, and reaching 85% in 2019[11]. However, it is crucial to bear in mind that additional efforts are still required in order to equip the population in many countries with mobile devices and to ensure a sufficiently good and stable Internet connectivity on a global scale. Although this aspect of modern technologies and their availability to the global population remains out of the scope of this paper, it represents a topic for further research as it predetermines the choice of communication channels and methods when disseminating strategic messages. Nevertheless, the existence of numerous useful and user-friendly applications and programmes, available on smartphones and portable electronic devices, has shown many experts in the field of communications that the creation, dissemination and exchange of information no longer represent processes, limited to a specific group of people, but are rather actions, undertaken on a daily basis by the mass population.

Additionally, the contemporary information environment could be determined as positively dynamic and rapidly changing. In that regard, the speed of information generation and transfer represents a key aspect of social media platforms. They succeed in establishing connections between people with diverse sociocultural backgrounds and the multilateral interactions among users, registered on these platforms, are based on their personal interests and viewpoints. However, special attention needs to be placed on the so-called "echo chambers",[12] which tend to form quite easily on social media platforms. The reason for this trend is called "confirmation bias"[13] and this phenomenon resides in the necessity of people to have their personal opinion and/or viewpoint confirmed through the communication with other like-minded individuals. Nonetheless, the aforementioned tendency could also pose numerous challenges to the quality and reliability of information in the contemporary information environment, especially on social media platforms. Experts suggest that "echo chambers can help spread false stories",[14] because the information, which is being disseminated in such groups, results highly appealing to the group participants, thus spreading faster and without being consciously fact-checked. Additionally, social media provide an opportunity for those users, who are

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[11](Eurostat, 2022) – the results are related to the following Geopolitical entities: European Union 27 countries (2007-2013), and European Union – 28 countries (2013-2020)
[12](Oxford Advanced Learner's Dictionary) "an environment in which somebody encounters only opinions and beliefs similar to their own, and does not have to consider alternatives"
[13](Casad, 2016) "the tendency to process information by looking for, or interpreting, information that is consistent with one's existing beliefs"
[14](BBC)

officially registered in them, to exchange messages and to interact with each other by creating and sharing content in diverse multimedia formats and in an unprecedentedly swift and far-reaching manner.

Another key characteristic of the current information environment is the possibility for many users of different digital platforms to remain anonymous or even to distribute fabricated media content online. Experts suggest that this anonymity enables the dissemination of "extreme views" and "deliberate misinformation" alongside the creation of "hoaxes without revealing the person or organisation behind" it.[15] This could be considered as a major challenge, particularly to security, as it provides ill-intended actors with multiple opportunities for manipulating the public opinion in favour or against an idea, an individual or a group of people. However, the awareness of this negative tendency should not be understood as sufficient, as it does not guarantee by default that the issue with the regulatory mechanisms of the virtual environment will successfully be resolved.

Therefore, several organisations have embarked on addressing challenges in the contemporary information environment by applying a multi-dimensional approach. A high-level group of experts has been set up by the European Commission with the aim to adopt adequate policy initiatives that would effectively counter the online spreading of disinformation. The Group recommended that the disinformation issue be effectively tackled by "adequate and privacy-compliant sharing of data about the systems that enable their circulation online".[16] This objective could adequately be reached through promotion of media and information literacy, which would "help users navigate the digital media environment".[17] Another appropriate measure would be to empower "users and journalists to tackle disinformation" and foster a "positive engagement with fast-evolving information technologies" in a diverse and sustainable "European news media ecosystem", while conducting "continuous research on the impact of disinformation in Europe".[18] Such a broad approach calls for active engagement on behalf of multiple stakeholders and goes beyond the scope of a particular country or domain. Furthermore, a clear distribution of roles, shared understanding of the respective responsibilities among the relevant

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[15](NATO StratCom COE, May 2016, p. 8)
[16](European Commission, Directorate-General for Communications Networks, Content and Technology, 2018)
[17] Ibid.
[18] Ibid.

stakeholders, and their ongoing commitment to the provision of online content through transparent and trustworthy digital information channels would set out a stable basis, on which particular activities related to building resilience could successfully take place.

The European Commission has further differentiated between two types of disinformation, namely "simple disinformation incidents" and "sophisticated disinformation incidents", and suggested concrete approaches to counter their effects.[19] Adopting and consistently implementing the afore-mentioned approaches within a democratic and predominantly stable information environment would not only limit disinformation, but could also greatly contribute to the enhancement of resilience on a societal level.

However, in order to achieve the aforementioned challenging objectives, a clearer conceptual understanding of resilient societies is required, as it would serve as a solid basis for the common efforts directed towards building societal resilience and preserving the democratic values of societies.

The societal aspect of resilience

The conceptual complexity of resilience makes it difficult to arrive at a unified and commonly agreed definition.[20] However, the latter would be highly applicable during the planning phase regarding those activities, which are to be carried out in order to build resilience in societies. More precisely, after having agreed upon a common understanding of the notion of resilience, governments and society members would be able to outline and define clearly the basic necessary steps in order to succeed in building societal resilience. Nevertheless, the pure definition of the aforementioned concept should not be the only basic criterion regarding the entire resilience-building process. The concrete characteristics of a resilient society are to be taken into account, as these define the requirements, which need to be addressed during the process of building resilience. Therefore, it is highly recommendedthat organisations and governments conduct a vigorous initial research as a preparatory step, because it would provide experts with a thorough understanding of the society-related needs, capacities, vulnerabilities as well as of the past, current and future processes which

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[19](Publications Office of the European Union, 2022). Simple disinformation incidents can be countered by "stating the correct figure and providing referrals to the correct official data and documents", whereas the sophisticated disinformation incidents require a proactive and tailored approach which takes into account the specifics of the situation and the actors involved.
[20](Kiryakova, 2022)

occur among the public. Upon collection of sufficient sex, age and gender disaggregated data, researchers and experts in the field of resilience would be provided with a clear picture of the past, current and future political and economic trends that derive from the specifics of the particular society as well as the concrete security and information environment. Taking into consideration the considerable relevance of the aforesaid initial steps within the resilience-building process, it is to be highlighted that the application of a one-size-fits-all approach often results completely inappropriate. This is due to the fact that such action could lead to increasing tensions within society, dubious end results and higher instability of the national institutions, dedicated to risk management and resilience building.

The criticality of continuous efforts in the context of building resilience has been a topic of thorough analysis by key international actors such as the Organisation for Economic Co-operation and Development (OECD), the United Nations Sustainable Development Group (UNSDG), the United Nations Environment Programme (UNEP), the European Commission (EC), the European Union Institute for Security Studies (EUISS), the North Atlantic Treaty Organization (NATO) and the European Union (EU). The research available on this topic emphasises the high complexity of the risk landscape, as it is dependent on multiple systems such as "social, governance, economic, ecological and physical"[21], which coexist side by side and could exert notable influence over each other. Furthermore, as the people-oriented approach is proven to guarantee "the active participation of a broad range of individuals, communities, groups and institutions, blending community, public and private sector perspectives",[22] it should be considered as highly appropriate, due to the indisputable significance of the human factor with regard to resilience and resilient societies. In that regard, the expectations and the requirements of each societal group should be analysed in detail during the preparatory phase of the resilience-building process and should be adequately addressed by governments, making sure that no individual is being left behind.

Since the concept of societal resilience has been defined as "the capacity of communities to flexibly contain major disruptions and to rapidly bounce back and

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[21](United Nations, 2020, p. 34)
[22] Ibid.

forward following the unavoidable decline of their core functionalities",[23] the active engagement of societies and the private sector is of critical importance to the overall success of the long-lasting process, aiming to ensure the aforementioned state. In this regard, Joel Thomas suggests that the "private industry owns a large share of infrastructure that governments depend on for stability and continuity, and residents are most often the very first responders to incidents".[24] This statement draws the attention to one important trend that is being actively monitored by many experts in the field of security and resilience, because it concerns a key element within the resilience-building process, namely the stakeholders engaged in it. Governments appear no longer to be the sole and most important stakeholder when it comes to building resilience. The complex security environment at present poses numerous challenges to societies and the requirements for building resilient societies are continuously increasing.

With regard to the fundamental aspects of resilient societies and the concrete efforts that need to be made in order for effective civil preparedness to be ensured, NATO leaders have declared at the Warsaw Summit in 2016 their commitment to achieve a concrete list of seven baseline requirements.[25] The high quality and continuity of the services, provided by governments to society members, could be considered essential regarding the increasing of the levels of public trust in institutions and, consequently ensuring the sense of satisfaction on behalf of society members with the governments' efforts to provide them with stability and secure life conditions. Therefore, the continuity of government and key government services could be perceived by the public as a guarantee for political stability and a solid base for institutions to deliver on their initial promises. Additionally, as energy supplies result crucial for many economic and technological sectors, including the everyday individual needs of society members, they should also be secured as a source of multiple opportunities for further societal development. With regard to "the ability to deal effectively with uncontrolled movement of people",[26] recent major migratory flows of refugees have proven that major challenges are being posed to border

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[23] Elran, M. (2017). Societal Resilience: From Theory to Policy and Practice. In: Linkov, I., Palma-Oliveira, J. (eds) Resilience and Risk. NATO Science for Peace and Security Series C: Environmental Security. Springer, Dordrecht. https://doi.org/10.1007/978-94-024-1123-2_10
[24] (Thomas, 2021, p. 87)
[25] (Roepke & Thankey, 2019)
[26] Ibid.

control entities and humanitarian assistance organisations. These challenges originate from the lack of preparedness and capacity of such entities to receive and satisfy the basic needs of large groups of people that leave their country of origin and seek shelter in other countries. As for the aforementioned basic individual needs of society members, the resilience of food and water resources needs to be observed not only in the context of the public having access to basic supplies of the aforesaid kind, but also with regard to the sustainable utilization of these resources, especially in light of the continuously increasing negative effects of climate change and humanitarian crises. As the above-mentioned global trends may be related to both natural and human-induced disasters that could have notable repercussions over the life and well-being of individuals, proper risk and crisis management appears to be an integral part of the overall efforts for resilience to be built at a societal level. Analysed in the context of globalisation and interconnectedness, resilient civil communication and transportation systems are to be considered critical for the provision of a seamless flow of information, alongside the transfer of goods and the mobility of individuals. In addition, these two systems could be perceived as highly dependent on special infrastructure that needs to be safeguarded and constantly monitored, as it could be, in some cases, targeted by adversaries with the main objective to cause disruption.

Apart from enhancing the level of civil preparedness of societies, building resilience could "free up critical resources for sustainable development and create a conducive environment for public and private sector investments that are risk-informed".[27] Considering the trend towards increasing scarcity of some natural resources, such type of possibility for their relocation could be highly beneficial, especially because it could lessen the competence between countries. In that regard, such an approach would additionally assist societies adapt gradually to the novel requirements and conditions of the contemporary security, information and climate environment, hence to become more resilient.

On the one hand, it has become clear that the responsibility and the potential for resilience building does not lie solely with governments, but rather includes and necessitates active participation on behalf of the private sector and the public. On

[27](United Nations, 2020, p. 25)

the other hand, many individuals continue to perceive their role in the decision-making process as highly limited.[28] Nevertheless, the latter could adequately be addressed through effective planning and conducting of communication activities, thus not only raising the awareness about the importance of joint efforts with regard to resilience building, but also encouraging peopleto take an active part in this overarching process.

Strategic communications as a key element of resilience enhancement

Being an essential part of the interaction between organisations, entrusted with building resilience, and the public, strategic communications could rather be considered as a specific way of thinking, as a particular perspective that enables organisations and institutions to fulfil their long-term mission. Furthermore, strategic communications cover a wide range of activities, which some experts combine into six disciplines such as "management, marketing, public relations, technical communication, political communication, and information/ social marketing campaigns".[29] Each of the aforementioned aspects of strategic communications addresses a specific part of the interaction between an organisation and its target audience. However, such definition could hardly explain the very essence of the particular communication activities, which each organisation should choose to carry out, based on its specific mission, vision and main objectives. By preparing organisations for plausible future scenarios "(…) strategic communication shapes meaning, builds trust, creates reputation, and manages symbolic organizational growth".[30] Therefore, strategic communications surpass the everyday communication activities, which are carried out by organisations. Instead, they address the long-term organisational development goals by taking into account not only the objectives of these organisations, but also the requirements and expectations of their target audience. The term "strategic" could be directly related to the long-term organisational vision, which this type of communications aims to effectively transmit to the audience in order to gain public trust. Some researchers suggest that strategic communications are "aligned with the company's overall strategy" and that they "enhance its strategic positioning".[31] These statements place additional emphasis on

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[28](Dević, 2020)
[29](Hallahan, Holtzhausen, van Ruler, Verčič, & Sriramesh, 2007)
[30](Zerfass & Huck, 2007)
[31](Argenti, Howell, & Beck, 2005)

the significance of the development of sound and adequate strategic communications, due to their high applicability and importance in the context of the general organisational strategy. Such communications possess the potential to transmit key organisational values and objectives by incorporating these into long-lasting strategic messages, called "narratives". As the name suggests, narratives have the power to present unique and memorable stories to the audience. Having in mind this potential, such messages could exert strong influence over the recipients, as they "articulate a clear and compelling vision and strategy for the future".[32] As previously mentioned, the aim of strategic communications is to predict and prepare organisations to deal with future challenges, by ensuring an optimal positioning within the particular environment at hand and meeting the expectations of society members towards these organisations.

Furthermore, having in mind the above-mentioned characteristics of strategic narratives,it is important to introduce another application, which these narratives have in the context of the contemporary information environment. As already mentioned in this paper, the information environment opensspace for a wide range of communication activities and initiatives, although it is also constantly changing in a highly unpredictable manner. Therefore, the creation and dissemination of persistent and stable narratives could be used as a tool for portraying particular organisations as credible and reliable actors in the context of an environment, marked by high levels of uncertainty and insecurity. Moreover, forging sustainable narratives could be considered as one of the key tasks and responsibilities of high-level diplomacy, through which a "direct diplomatic engagement" in fragile contexts could be ensured and effectively established.[33] Narratives ought to be perceived as directly related to the strategic leadership, as they possess the power to present the main direction and the level of ambition for further development by incorporating these in easily understandable concepts and clear messages. Furthermore, narratives and strategic communications in general have the potential to counter the dissemination of disinformation as well as to raise awareness among the public about the importance of building resilient societies. Therefore, it is essential for strategic narratives to demonstrate a sense of "shared purpose" by outlining a clear path for reaching the

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[32](Cancialosi, 2015)
[33](Forsberg & Marley, 2020)

desired end state and placing emphasis on "a human, not an institutional relationship".[34] The people-oriented approach should once again be taken into account when forging narratives, as it would assist organisations in the process of establishing a close relationship with their audiences by effectively addressing their needs and expectations. Nevertheless, many organisations continue to formulate their leading narratives by placing emphasis on their own vision of the desired end state, and not the one that is commonly agreed among the rest of the society. However, the target-oriented or the task-oriented approach should not be considered as a panacea for the majority of contemporary challenges due to its limited capacity to address these on its own. A possible solution to the high complexity of the modern security and information environment would be to opt for a combination of different approaches when addressing multifaceted issues and building resilience. Furthermore, the adequate combination of such approaches would ensure optimal results, especially in case of limited time and capacities as well as high levels of uncertainty.

With regard to countering disinformation and raising awareness, the role of communication in transmitting knowledge and critical information needs to be taken into account and perceived as a key tool in building societal resilience. A key characteristic of societal resilience through adaptation "is social learning or the generation, preservation, and transfer of knowledge about (past) experience which then enables future planning, essentially expanding the scope of (potential) responses".[35] The number of crisis situations and disasters of diverse types is gradually increasing, whereas the time available for adaptation to the new aspects of the security environment is insufficient for individuals to process the entire information flow in a conscious and pragmatic manner. Therefore, the potential of communications to act as an enabler and intensifier of the aforementioned social learning needs to be effectively utilised by organisations and governments in their approach to the public. Additionally, the complexity of intergovernmental, interorganisational and interpersonal relationships calls for adequately planned communication activities as well as for collaborative interaction between key

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[34](Bonchek, 2016)
[35](Vaklinova, 2019, p. 16)

stakeholders, which would allow for "increased mutual understanding – of roles, mandates, objectives, and thus – trust".[36]

The clear distribution of responsibilities and roles has proven to be another key element of resilient societies, because it minimises possible duplication of efforts between the respective stakeholders and facilitates the creation of a sound situational awareness, thus devising an effective elaboration of plan for action in the face of a crisis or disaster situation. Additionally, experts consider innovation in the adaptation to emerging challenges as essential to the overall resilience of pluralistic societies and consider "the free flow of ideas and information, as well as the open and public discussion and examination of options, policies, and plans" as a foundational mechanism in this process.[37] As previously mentioned, strategic communications are directly related to long-term objectives and strategic narratives that represent the general vision of an organisation or government with regard to their own role and responsibilities in a particular area. Therefore, they ought to be considered as a tool with significant potential for the establishment and fostering of a strong and stable relationship between organisations, governments and the general public.

Conclusion

The concept of resilience proves to be an overarching topic, which touches upon multiple aspects of human societies as well as the different processes, which take place in the everyday life of society members. The strategic long-term aspect of resilience is to be taken into account and this paper places additional emphasis on the role, which communications play within the resilience-building process. In that regard, the power of strategic communications to forge lasting and compelling narratives should effectively be utilised by organisations and governments. By doing so, they would have greater chances for establishing a close and stable relationship with their target audiences, based on trustworthiness and accountability. However, this relationship depends on multiple factors, which are determined by the complex and dynamic contemporary security and information environment. Therefore, communicators should always be ready to adapt their communication activities to the novel requirements of the environment, coupled with the growing expectations of the

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[36] Ibid., p. 21
[37] (Johns Hopkins University, Imperial College London & Georgia Institute of Technology, 2021)

public. Thus, the concept of change management could be further analised with regard to the topic of the present paper, as it is directly linked to the levels of innovation and adaptability of organisations and governments, and to their preparedness to respond effectively to the unexpected and novel challenges of the contemporary security and information environment.

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CLASSICAL MODELING AND AI TRAINING ARE BASED ON DATA.

Kostadin Lazarov

Abstract: The article is focused on the technical problems and solutions related with the AI data pre-processing and management. The described algorithm and approach are embedded in software consisting of Database engine, Graphic User Interface, and number of functionalities related with research management. The main idea is to define workflow, supporting especially AI researches. The support is both conceptual and technical.

Keywords: AI, Database, Data Pre-processing, Integrity Check

The outcome of the process depends largely on the input data: how relative it is, how accurate, range, resolution, dispersion, etc.

Modelling:

Data → Processing → Outcomes

The importance of the input data for the modeling as a process is widely and well analyzed and it is not the focus of the report.

AI modeling has specific advantages and disadvantages compared with differential modeling for example. Some of the advantages are the reduced human efforts and involvement in the process, the flexibility and opportunity for fast readjustments.

In order to achieve it, a specific dataset should be available for each training iteration. The dataset preparation - as a frame, and data preprocessing consume a lot of manpower and attention. The report sees an opportunity to develop a database with embedded functionality for formalization of the process, logged dataset dynamic generation, store of the research parameters - AI model summary, shape of the input data, date and time, computed coefficients and achieved accuracy. The database interface should be able to export the logged data in reports which will support the research and will reduce the subjective influence.

At the moment, there are some solutions (free or under license) providing specific functionalities related with data management in AI applications. There is not one

setting a standard or providing full spectrum of necessary functionalities for data storage, access, pre-processing, etc.

CMDR COE's OpsLab wants to find what are the critical requirements for such data management solution and how to tune it in order to make it valuable and time/effort saving application.

The ambition is provoked by a scientific research, part of NMSG-187 work.

This sub-part of the modelling and simulation group is focused to find indications for Space Weather – Earth Activities correlations/ dependencies with specific impact on military activities.

The objective is to investigate the influence of space weather parameters on different Earth activities of military interest through the development of an impact estimation tool that considers those space weather data.

From then on two cases :

- Straightforward activities for which clear space weather influence has been confirmed (satellite activities, communication signals, ...) from then on the approach would be to directly find a way to estimate those impacts from the space weather data.
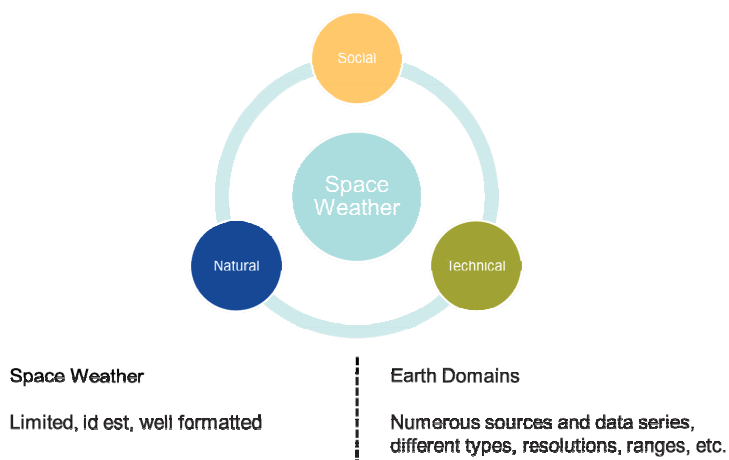
- Activities for which no clear link has been exhibited yet (global quality of the internet service, ...) then, consider existing model that predicts those impacts and see if the addition of space weather data as an input data do improve the quality of the prediction.

In the two cases, if the impact estimation is improved it exhibits a clear influence of space weather on the concerned activity and we could go on with further studies by looking for example at what happens during an extreme event or for a given scenario.

Satellite Parameters= k*Space Weather

$$EA = f_1(SW) + f_2(EI_1) + \ldots + f_N(EI_N)$$
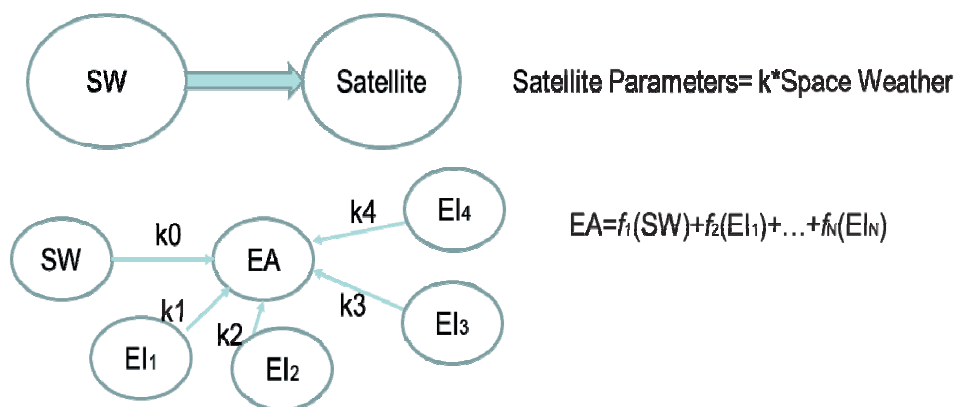
The NMSG-187 started development of database, graphic-user interface and software functionalities. All of the achieved results and conclusions will be used in order to generalize the problem of the data management in AI applications.

The OpsLab's roadmap contains AI usage and such tool will support significantly the production cycle. It will reduce the necessary time and manpower and could set a workflow for AI modelling.

Space Weather	Earth Domains
Limited, id est, well formatted	Numerous sources and data series, different types, resolutions, ranges, etc.

The data, used for AI modelling, comes from different sources. The preferred format is a dataset. A number of developed functions are available for specific operations with the datasets. The problem with the NMSG-187 research is that the collected

data is not organised in datasets. Also, it can't be done as one-time task. The reason could be explained with the following graph:
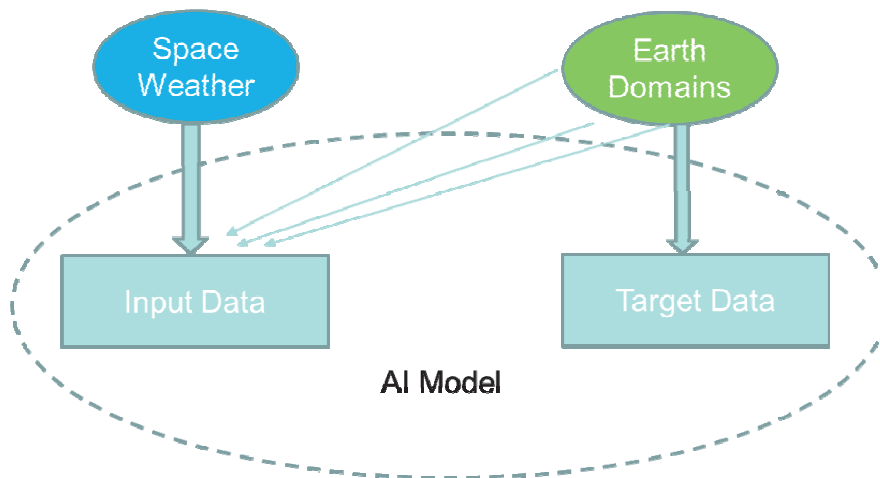
There are many possible combinations of the data as input data and target data.

One solution could be a function generating the dataset dynamically. The data is stored in database. The elaborated functionalities are embedded in GUI making easy and fast the data selection and pre-processing.

The data is collected from different sources and it means that it comes in different format. This fact sets some requirements to the database interfaces and flexibility.

The database with its interfaces should be capable of receiving data coming from a variety of sources - online and offline. The formats of the offline input data could be: xml, csv, json. The online interfaces should include direct connection with other databases or datasets stored online.

Preprocessing - after each specific data selection, the engine developed for the database should perform data preprocessing - normalization of the data in specific range (the range should be optional), setting the data in a dataframe with specific shape, dividing the data in train and validation sets, etc. The pre-processing could be done manually or using predefined scripts. The second option could save again time and efforts. Some specific accelerating modules could be used in order to speed up the data processing. For the current research the OpsLab staff plans to use both GPU and FPGA solutions.

Data Selection | AI Model Development | Outcomes

Pre-processing:
-data selection;
-data normalization;
-time shift;
-data check;

Storing:
-AI summary;
-Accuracy;
-Coefficients;

In order to keep the flexibility at certain level a lot of different options should be embedded in the GUI. They provide opportunity to change and choose a selection of the input raw data. The operator interface should display the available data series and the time matching opportunities. In case of difference in time discretization, the interface should allow the user to select a method for filtration or interpolation. The engine should alert when the data integrity is corrupted - the data series diverge each other. The interface should allow easy preconfiguration of the input and target data - target data could be transferred as input data and vice versa.

The interface should give opportunity for time shift of specific data series. The step will be chosen by an operator.

Finally, the application should support the AI modelling workflow. Metadata is stored additionally in the database with instructions about history records and saving of the model shape and coefficients. All the data should be stored in the database in a specific frame.

When an iteration is finished, using the database interface should easily add or remove a data series part of the dataset. In such a manner the operator will continue the research in the desired direction according to the achieved results. The results should be displayed in the interface with sorted accuracy or showing the inheritance.

The database is built and the mentioned functionalities are added sequentially. In short period of time the solution will have all planned functions and it will allow fast, objective and accurate AI modelling.

ENERGY TRANSITION IN THE MILITARY

Siyana Pavlova

Abstract: This research aims to investigate the impact of climate change on national and international security, taking into account the reasons for immediate actions regarding implementing energy transition strategies in the military. Although, the military sector was never transparent because if it was, the security of states could be exposed to threats on national or international level. Today's society has the right to know and it seems that the military sector is not obliged to report its greenhouse gas emissions and carbon footprint to the public. However "the idea that transparency is not an opponent but an inevitable component of national and international security has been gaining momentum in recent years".

Key words: energy security, climate change, energy transition, military operations

Global warming is a global phenomenon of climate transformation characterised by a general increase in average temperatures, and which permanently modifies meteorological balance and ecosystems[1].The international agreements and decrees concerning climate change should include every public or private sector. However, there is no legal obligation for the military sector to give specific information on its greenhouse gas emissions to the citizens, "countries do not have to include their carbon emissions in gas emission targets" regarding military operations[2]. Tackling the problem of climate change will not be easy, and we should do it together, without excluding any sector in particular, because the main threat to states' security became the impact of climate change on the population.

Therefore, the question stays why the military is not held accountable for its impact on the environment regarding greenhouse gas emissions and carbon footprint. Although, it is one of the most polluting sectors because of its multiple training activities, utilising military vehicles and aircraft, which emit a lot of greenhouse gases, while consuming a lot of fossil fuel.

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[1] Thiessen, Mark. "Climate Change." *National Geographic Society*, 19 May 2022, https://education.nationalgeographic.org/resource/climate-change.
[2] Ambrose, Tom. "World's militaries avoiding scrutiny over emissions, scientists say." *The Guardian*, 11 November 2021, https://www.theguardian.com/environment/2021/nov/11/worlds-militaries-avoiding-scrutiny-over-emissions.

The military operations are one of the reasons for hazardous events, on account of being one of the great polluters, whereas playing an active role in disaster relief operations of the European Union (EU), side by side with civil organisations[3]. However, since 1969, NATO's Science for Peace and Security Programme has had the objective to support cooperative activities to tackle environmental security issues[4]. For this very reason, the military should participate in energy transition every step of the way, while being transparent about their activities and held accountable for its emissions to the public.

For the last 50 years, NATO has been paying attention to environmental challenges and has tried to raise awareness of climate change as a threat to worldwide security[5]. Because we cannot continue denying the reason of the multiplication of extreme weather events such as "heatwaves, flooding, and droughts, which often require humanitarian assistance and can cause mass displacement[6]", we should be informed and better prepared in order to respond to these crises and disasters induced by human activities, including military, which is abandoned in the charts and statistics regarding the impact on the environment[7].

This research aims to investigate the impact of climate change on national and international security, taking into account the reasons for immediate actions regarding implementing energy transition strategies in the military. Although, the military sector was never transparent because if it was, the security of states could be exposed to threats on national or international level. Today's society has the right to know and it seems that the military sector is not obliged to report its greenhouse gas emissions and carbon footprint to the public. However "the idea that transparency is not an opponent but an inevitable component of national and international security has been gaining momentum in recent years"[8].

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[3]European Commission. "Civil-Military Cooperation in Emergencies." *Language selection | European Civil Protection and Humanitarian Aid Operations*, https://civil-protection-humanitarian-aid.ec.europa.eu/partnerships/relations/civil-military-cooperation-emergencies_en.

[4] NATO. "Topic: Environment, climate change and security." *NATO*, 8 June 2022, https://www.nato.int/cps/en/natohq/topics_91048.htm .

[5] Goodman, Sherri. "NATO Review." *NATO*, 1 February 2022, https://www.nato.int/docu/review/articles/2022/02/01/nato-an-unexpected-driver-of-climate-action/index.html.

[6] Nato and climate change: How big is the problem? 15 June 2021 https://www.bbc.com/news/world-57476349

[7] Crom, Pierre. "The EU military sector's carbon footprint - CEOBS." *The Conflict and Environment Observatory*, 23 February 2021, https://ceobs.org/the-eu-military-sectors-carbon-footprint/.

[8] Yordanova, Svetlana. "The Transparency - Security Dilemma in National and International Context (A Comparative Analysis of the UN' and NATO's Tran." *OHCHR*, 2015, p.1 https://www.ohchr.org/sites/default/files/Documents/Issues/Expression/IntOrganizations/SvetlanaYordonova.pdf.

Firstly, we will see how climate change impacts national and international security regarding greenhouse gas emissions and carbon footprint and why energy transition is so important for the state's security. We will look into the absence of the military in international agreements regarding collective climate change actions. concrete actions to reduce their greenhouse gas emissions and why the military was not held accountable to the public eye for their activities. In addition, we will try to give more information about the role and strategies of NATO and the EU in reaching this goal of carbon neutrality in the future.

Climate change and security in energy transition in the military

As it was said, the effects of climate change are already being felt: temperatures are rising, glaciers are melting, and extreme weather events are becoming more frequent and more intense each year[9]. Climate change is no longer a concern that will occur in the future, but is instead a problem that is currently influencing the security landscapes of all states. Due to the trajectory of the Earth's continuous warming, these dangers are now expected to dramatically increase [10]. Before continuing with this research, it is important to understand the definition of energy transition, in order not to mistake it for energy transformation. According to the International Renewable Energy Agency (IRENA) the energy transition is a pathway towards transforming the global energy sector from fossil-based to zero-carbon by the second part of this century. At its core is the need to minimise energy-related CO_2 emissions in order to limit the impact of climate change, induced by human activities. While a global energy transition is underway, additional action is required to cut carbon emissions and mitigate the effects of climate change. For now, renewable energy and energy efficiency initiatives have the ability to accomplish 90% of the required carbon reductions[11], which means that we have a long way before accomplishing climate neutrality.

Climate change could be the cause for water shortages in many parts of the world because of long-lasting drought[12]. Unfortunately, the amount of freshwater reserves

[9] Solana Madariaga, Javier. "CHANGEMENTS CLIMATIQUES ET SÉCURITÉ INTERNATIONALE." *consilium.europa.eu*, https://www.consilium.europa.eu/media/30861/fr_clim_change_low.pdf.
[10] Guy, Kate, and Leah Emmanuel. "2021 CLIMATE SECURITY RISK PERCEPTION SURVEY." *International Military Council on Climate and Security*, June 2021, p.11-17 https://imccs.org/wp-content/uploads/2021/06/World-Climate-and-Security-Report-2021.pdf.
[11] IRENA. "Energy Transition." *IRENA*, n.d., https://www.irena.org/energytransition.
[12] Lai, Olivia. "Water Shortage: Causes and Effects." *Earth.Org*, 26 June 2022, https://earth.org/causes-and-effects-of-water-shortage/.

will decrease due to climate change, resulting in a drop in agricultural production, leading to food insecurity in the least developed countries or aggravating its insecurity[13]. Water shortages are strictly related to a rise in food prices. In a more general way, climate change will nurture existing conflicts over limited resources, especially when access to these resources is a matter of political power[14].

Moreover, because of thermal expansion caused by warming of the ocean, melting glaciers, loss of Greenland and Antartica's ice sheets, sea level is rising[15], which endangers the security of coastal ports and military bases and its access for a prolonged period of time due to rising sea levels and storms[16]. In addition, almost a fifth of the world's population lives in coastal regions and the supporting infrastructure of some megacities, such as port facilities and refineries and oil mills, are often located by the sea or in the river deltas, which means they are also vulnerable to disasters and crises[17]. Those would be the reasons why the military needs to determine a method to adjust to these unforeseen challenges and restructure its activities in favour of a safer prospect that could be beneficial to the environment through energy transition strategies.

As the Allies are shifting to green cutting-edge technologies and alternative energy sources to address the impact of climate change on security, energy transition is now a priority, while developing capabilities[18], which means informing citizens about military greenhouse gas emissions and carbon footprint in a transparent way.

A great example of a country investing in developing sustainable practices in their military operations, is France. The first French Sustainable Defence Strategy was adopted in 2016, the French Armed forces had acknowledged the importance of taking into account the protection of the environment in military strategic planning[19]. This document aligns the actions of the armed forces with its sustainable

[13] FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS. "Climate change and food security: risks and responses." *Fao.org*, 2015, https://www.fao.org/3/i5188e/I5188E.pdf.
[14] Rüttinger,, Lukas, et al. "A New Climate for Peace." *Climate Diplomacy*, 2015, https://climate-diplomacy.org/sites/default/files/2020-11/NewClimateForPeace_FullReport_small_0.pdf
[15] Nunez, Christina. "Sea level rise, facts and information." *National Geographic*, 15 February 2022, https://www.nationalgeographic.com/environment/article/sea-level-rise-1.
[16] NATO. "The Secretary General's Report 2022 - Climate Change & Security Impact Assessment." p. 4 *NATO*, 2022, https://www.nato.int/nato_static_fl2014/assets/pdf/2022/6/pdf/280622-climate-impact-assessment.pdf.
[17] Lindsey, Rebecca. "Climate Change: Global Sea Level | NOAA Climate.gov." *Climate.gov*, 19 April 2022, https://www.climate.gov/news-features/understanding-climate/climate-change-global-sea-level.
[18] NATO. "The Secretary General's Report 2022 - Climate Change & Security Impact Assessment." p. 2 *NATO*, 2022, https://www.nato.int/nato_static_fl2014/assets/pdf/2022/6/pdf/280622-climate-impact-assessment.pdf.
[19] Ministry of French Armed Forces. "Stratégie Défense durable." *Ministère des Armées*, https://www.defense.gouv.fr/sga/au-service-nation-du-public/developpement-durable/strategie-defense-durable.

development strategy. Therefore, the EU's defence ministers discussed in 2019 how threats caused by climate change could be further incorporated into the Common Security and Defence Policy, concentrating on two issues: making sure that the military presence helps address climate change issues and taking climate change effects into consideration when planning military operations. In addition, relying on fuel creates further security risks for the missions.[20] On that account, the military should find another fuel or source of energy which will allow them to be independent and ecologically responsible.

The military must actively implement leading environment-related commercial technologies and explore all options. However, many of these renewable energy technologies are still in their development stage and are not destined for mass use. This encourages also the adaptation of the military to the current context of constant climate change crisis, and its transition to a new era through the use of clean and green energy, which is anticipated and facilitates a seamless transition to a logical and cutting-edge equipment system[21].

Responding to the consequences of climate change is emphasised in NATO 2030, "a transatlantic agenda for the future," which also mentions the potential use of "Emerging and Disruptive Technology (EDT)" as one potential remedy to global warming. The operational efficiency and mission longevity of a mission can both be improved by diversifying energy sources[22].

Lack of transparency in military reporting the greenhouse gas emissions and its carbon footprint

The impact of military forces on climate change and carbon emissions is immense and often neglected, having damaging effects among both the health of the civil population and the environment. The military has been allowed to rise their greenhouse gas emissions due to the presence of constant state of war-readiness,

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[20] Lazarou, Elena, and Linda Tothova. "Climate change considerations for EU security and defence policy." *European Parliament*, June 2022, https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/729467/EPRS_BRI(2022)729467_EN.pdf.
[21] The Sasakawa peace foundation. "Climate change as a security threat – strengthening the resilience of the military." *International Information Network Analysis*, 21 July 2021, https://www.spf.org/iina/en/articles/nagashima_07.html.
[22] De Maizière, Thomas, et al. "NATO 2030:." *NATO*, 25 November 2020, https://www.nato.int/nato_static_fl2014/assets/pdf/2020/12/pdf/201201-Reflection-Group-Final-Report-Uni.pdf.

ineffective international policy, which often does not include the military and the military industry[23].

In 1992, the United Nations Framework Convention on Climate Change (UNFCCC) secretariat was tasked with supporting the global response to the threat of climate change. The main aim of this secretariat has been to facilitate the intergovernmental climate change negotiations in order to implement the Convention through the Kyoto Protocol in 1997 and the Paris Agreement in 2015. The UNFCCC is the parent treaty of both of these documents, which aims to limit the effect of climate change through collective actions. All three UNFCCC accords have the same purpose which is to stabilise greenhouse gas emissions in the atmosphere at a level that would allow in a realistic timeframe for the ecosystems to naturally adapt to climate change caused by anthropogenic emissions of greenhouse gases, and that will enable sustainable development[24].

The United Nations Framework Convention on Climate Change requires members to submit yearly greenhouse gas emissions, however reporting of the military emissions is voluntary and frequently omitted by state's reports. Moreover when the information on the emissions is reported, it is typically insufficient and does not include emissions from equipment and supply networks, as well as those connected to the impact of military operations, along with infrastructure destruction, conflict-related environmental change, and post-conflict rebuilding[25].

The absence of appropriate reporting regarding military emissions is the reason for the appearance of the project of the Military Emissions Gap in collaboration between *Conflict and Environment Observatory*[26], a UK charity that works to contribute to developments in law and policy intended to reduce the environmental harm caused by conflicts and military activities and *Concrete Impacts*[27], a UK Research and Innovation-Economic Social Research Council funded collaboration between Lancaster and Durham University examining the socio-ecological effects of military supply chains and its wider environmental footprints. The objective of the project is to

[23] Johnson, Jack. "The impact of militaries on climate change." *University of Birmingham*, 2021, https://www.birmingham.ac.uk/research/climate/climate-publications/adaptation-and-resilience/the-impact-of-militaries-on-climate-change.aspx.
[24] United Nations. "About the Secretariat." *UNFCCC*, n.d., https://unfccc.int/about-us/about-the-secretariat.
[25] Conflict and Environment Observatory. "Governments: commit to meaningful military emissions cuts at COP26 - CEOBS." *The Conflict and Environment Observatory*, 24 May 2021, https://ceobs.org/governments-must-commit-to-military-emissions-cuts-at-cop26/.
[26] Conflict and Environment Observatory. *The Conflict and Environment Observatory*, https://ceobs.org/.
[27] Concrete Impacts. *Concrete Impacts*, https://www.concreteimpacts.org/.

track, analyse and close the military emissions gap by bringing together the data that governments report into one place.

The Paris Agreement does not mention such an exclusion, but these greenhouse gas emissions have remained unaccounted for. The Agreement gives the opportunity to governments to decide whether or not to set a reduction target for their armed forces. Because of this inaccurate posture, the military authorities and companies in the military industry will be tempted to dispense with any reduction effort in the carbon accounting of their activities[28]. The military's primary mission is to win wars, not to address and to combat the impact of global warming, yet the two crises are intertwined. The continuation and extension of military activities is one of the concerns raised by climate change, because militarization as a solution makes little sense since it harms the environment and the health of the entire civilian population[29].

However, NATO has recognised the importance of improving environmental security and environmental protection in recent years. For this reason, the organisation is looking for ways to establish high energy efficiency in the military through innovative technologies[30]. In June 2022, the secretary general of NATO, Jens Stoltenberg, pledged to reduce emissions by 45 percent by 2030 and with a net-zero emissions target in 2050 during his speech for this year's NATO Public Forum[31], which shows the gravity of climate change as a risk multiplier to international and national security. The implementation of international agreements, which aims to reduce greenhouse gas emissions, justifies the importance of energy transition in military activities in order to establish energy security and independence of limited resources such as fossil fuels.

The role of the military sector in energy transition is very important, because of the great impact caused by military activities such as operations and training, which often includes vehicles contributing to greenhouse gas emissions and carbon footprint. This is one of the reasons why the military should report their greenhouse

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[28] Cramer, Ben, and Bernard Dreano. "Le secteur militaire, toujours dispensé d'efforts pour le climat." *Reporterre*, 4 November 2021, https://reporterre.net/Le-secteur-militaire-toujours-dispense-d-efforts-pour-le-climat.
[29] Birnbaum, Michael, et al. "US Army unveils climate strategy as military prepares for climate change." *The Washington Post*, 10 February 2022, https://www.washingtonpost.com/climate-solutions/2022/02/10/army-military-green-climate-strategy/.
[30] NATO. "Environment, climate change and security." *NATO*, 8 June 2022, https://www.nato.int/cps/en/natohq/topics_91048.htm
[31] NATO. "Opening speech by NATO Secretary General Jens Stoltenberg at the High-Level Dialogue on Climate and Security." *NATO*, 28 June 2022, https://www.nato.int/cps/en/natohq/opinions_197168.htm.

emissions in order to find the best practices and methodologies to measure the impact of the military on the environment to combat climate change. If the military does not report their emissions, there is no other way to attain net zero by 2050. Jens Stoltenberg acknowledged that there is an energy revolution taking place out there in the civil society and he emphasised the fact that the military should be taking part in this transformation in order to keep up the pace with this tendency[32].

Lack of reporting the military's greenhouse gas emissions makes it difficult to understand and analyse the impact of all anthropogenic activities on the environment. Unfortunately, while planning the research, there was a dedicated part to the military footprint on the environment, which was excluded afterwards. The aim was to illustrate in numbers the great impact of the military activities and to show the importance of transparency, accountability and public reporting even in the military sector in order to reach carbon neutrality. However, the absence of reliable sources regarding the carbon emissions by the military proves this point, there is a crucial need for public reporting and transparency, because citizens have the right to know.

EU's and NATO's strategy to combat climate change and to participate in energy transition

Defence and crisis management rely on energy. It is critical to the efficiency of operations. Limitless access to energy sources are long gone, and moves forward improving efficiency and decreasing consumption provide numerous advantages. The resulting reduction in fossil fuel use lowers expenses, cuts pollutants and decreases our reliance based on non-European origins. The number of casualties can be greatly reduced as a result of there will be fewer gasoline convoys for enemies to attack, releasing resources that are now being used to safeguard the convoys. The overall skills are improved through increasing endurance, mobility, and autonomy.

Military Green is based on existing regulations and European Union (EU) guidelines. It expands on the new Environmental Protection Concept. The European Union Military Staff is developing the concept, which intends to outline the principles and duties for meeting regarding Environmental Protection for EU-led military operations. It focuses on improving energy efficiency and reducing energy consumption. It

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[32] John, Mark. "NATO chief: Armies must keep pace with global climate efforts." *Reuters*, 2 November 2021, https://www.reuters.com/business/environment/nato-chief-armies-must-keep-pace-with-global-climate-efforts-2021-11-02/.

promotes new technologies regarding water and waste management. Therefore, it encourages the development of more environmentally friendly materials and weapons. The objective is to understand the impact on the climate and ecosystem, raising awareness among stakeholders, and implementing dedicated green policies and strategies to combat climate change through energy transition for example[33].

However, the military sector was omitted from the European Green Deal, when it was presented on 11th of December 2019. The next year, the deal was approved by the European Commission with the overarching objective to make the EU neutral in 2050[34] and still the military is not included in European Green Deal policies, despite it generating considerable emissions and the existence of real advantages from becoming less dependent on fossil fuels. The low carbon energy transition can enhance strategic autonomy, reduce foreign import costs and improve operational effectiveness. It can help to modernise the army and stay ahead of the game in a time of geopolitical turmoil. For the EU, it can be an opportunity to innovate and strengthen its competitive edge in green military technology. Including the military in the European Green Deal would be a boost to the EU's international credibility on climate change[35]. If the military sector is included in the greenhouse gas emissions, it will help the EU holistically to meet the exigence of meeting carbon neutrality objectives by 2050.

Although the absence of the military regarding concrete actions and decisions establishing easy energy transition does not prove that the EU does not recognise climate change as a threat and an urgent matter which needs to provide a collective response to tackle the negative effects of climate change on the environment. Even so, the EU has an excellent track record in terms of climate action. The European Union hopes to become the first climate-neutral continent through the European Green Deal, even if it does not include one of the biggest emitters of greenhouse gas emissions. It lays forth a plan for increasing resource efficiency by transitioning to a clean, circular economy, halting climate change, reversing biodiversity loss, and reducing pollution. It covers the necessary investments and finance mechanisms, as

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[33] European Defence Agency. "MILITARY GREEN." *European Defence Agency*, 2012, p. 2-3
https://eda.europa.eu/docs/default-source/news/military-green-leaflet.pdf.
[34] Lambertz, Karl. "Europe's Green Deal plan unveiled – POLITICO." *POLITICO*, 11 December 2019,
https://www.politico.eu/article/the-commissions-green-deal-plan-unveiled/.
[35] Planetary Security Initiative, and Clingendael. "A European Green Deal Policy Brief for militaries to strengthen Europe's Defence." *Planetary Security Initiative*, April 2022, https://www.planetarysecurityinitiative.org/sites/default/files/2022-04/PB%20A%20European%20Green%20Deal_4e%20proef.pdf.

well as how to achieve an equitable and inclusive transition, upmost in the energy sector.

While NATO launched in 2011 an initiative to promote smart energy. The same year, it was held a conference "Innovative energy Solutions for Military Applications", which brought together representatives of the Organisation and national experts from the public and private sectors[36], recognizing the absolute need for secure and reliable sources of energy for operations, and knowing that the transport of energy exposes fuel convoys and armed forces to major risks[37]. In 2014, at the Wales Summit, NATO leaders agreed to continue working significantly to improve energy efficiency of the armed forces, taking into account the framework for green defence. The diversification of energy sources is one way among others to increase operational efficiency and autonomy in the context of military operations[38]. By using different energy sources and integrating innovative technologies into military platforms and systems, including smart grids based on renewable energy and energy storage technologies, it is possible to function without fuels while maintaining the level of efficiency of military operations for longer periods, while reducing their environmental footprint[39]. The objective is to find a solution, suitable for all without doing any more harm to the environment, even in conflict zones where the protection of the environment is not one of the leading purposes of military missions. However, the military is trying to "green" their efforts by "increasingly relying on renewable energy rather than oil or diesel[40]".

NATO and the European Union collaborate in crisis management, capability building, and political dialogues. The EU is a critical NATO ally. Both organisations share common values as well as state members, who are facing similar threats and challenges[41].

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[36]NATO. "Conference "Innovative Energy Solutions for Military Applications" - Vilnius, Lithuania." *NATO*, 10 November 2011, https://www.nato.int/cps/ru/natohq/photos_80795.htm?selectedLocale=fr.
[37] NATO. "Environment, climate change and security." *NATO*, 8 June 2022, https://www.nato.int/cps/en/natohq/topics_91048.htm?selectedLocale=fr.
[38] NATO ENSEC COE. "ENERGY HIGHLIGHTS." *ENERGY HIGHLIGHTS*, September 2021, p.17 https://enseccoe.org/data/public/uploads/2021/09/nato-ensec-coe-energy-efficiency-and-renewable-energy-solutions-in-nato-and-pfp-countries-military-operations-study-report-2021.pdf.
[39] NATO. "Topic: Environment, climate change and security." *NATO*, 8 June 2022, https://www.nato.int/cps/en/natohq/topics_91048.htm?selectedLocale=fr.
[40] INTERNATIONAL MILITARY COUNCIL ON CLIMATE AND SECURITY. "World Climate and Security Report 2021 | PRACTICES TO REDUCE CLIMATE SECURITY RISKS: A FIRST REFLECTION." *Clingendael Institute*, p.33, 7 June 2021, https://www.clingendael.org/publication/world-climate-and-security-report-2021.
[41] NATO. "Topic: Relations with the European Union." *NATO*, 24 June 2022, https://www.nato.int/cps/en/natohq/topics_49217.htm.

These last years, the Euro-Atlantic region has seen critical security challenges. Even as we address these important issues, we cannot disregard the inevitability of climate change and its security consequences. NATO, as entrusted with safeguarding its members' security, must assess the challenge, adapt to it, and contribute to reducing its impacts while preserving military effectiveness[42].

NATO's efforts to become more environmentally friendly are not incompatible with its ability to provide effective deterrence and defence. In fact, the reduction of emissions, combined with the use of green technologies, offers operational advantages: reduced dependence on fossil fuel supplies in areas with high insecurity, reduced logistical problems, and financial savings. The world of security must understand that sustainability and resilience could contribute to guaranteeing the effectiveness and the operational extension of the forces[43].

Climate change was incorporated into the 2010 Strategic Concept and has subsequently been incorporated into summit pronouncements. NATO developed a Green Defence Framework in 2014, and the current NATO headquarters, which was completed in 2018, incorporated energy efficiency and other environmental concerns. The foundations for a more ambitious and prominent involvement in climate security are already in place. One of NATO's most valuable assets is its global network of partners and structured relationships with other regional and international organisations such as the United Nations, the European Union, and the Organization for Security and Cooperation in Europe (OSCE). This network is critical for increasing capacity and resilience, as well as improving situational awareness.

Second, NATO provides a venue for Allies to exchange experience, best practices, and lessons learned on an almost daily basis. It is critical for armies to share lessons acquired in order to better comprehend the benefits of the green transition. Furthermore, the planned NATO-accredited Centre of Excellence on Climate and Security (which Canada has offered to host) and the current Centre on Energy

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[42] NATO. "NATO releases its Climate Change and Security Impact Assessment." *NATO*, 28 June 2022, https://www.nato.int/cps/en/natohq/news_197241.htm
[43] NATO. "Revue de l'OTAN - L'OTAN, un allié inattendu dans la lutte contre le changement climatique ?" *NATO*, 1 February 2022, https://www.nato.int/docu/review/fr/articles/2022/02/01/lotan-un-allie-inattendu-dans-la-lutte-contre-le-changement-climatique/index.html.

Security in Lithuania will very probably serve as information clearinghouses for both climate effects and the green transition[44].

Energy Transition is very important to NATO's strategy to combat climate change. For this reason, the secretary general mentioned a demand in his opening speech at the High-Level Dialogue on Climate and Security to all NATO civilian and military authorities to develop a new "Energy Transition By Design" initiative, and present it at the next High Level Dialogue Meeting next year in order to move forward with tackling the challenges caused by the climate change[45]. However, NATO does not have an objective to become a transparent and accountable organisation to the public regarding its energy transition and ways of reporting the impact of military activities on the environment. Moreover, a new system for assessing NATO's greenhouse gas emissions, both civilian and military, will aid in the organisation's efforts to reduce its emissions. It was stated that this reporting is critical 'since only what is measured can be reduced.' The goal is to guarantee that NATO maintains operational effectiveness and preparedness while being more ecologically responsible[46].

Importance for energy transition in military sector

Energy transition is inevitable for the military sector. Military force capabilities remain strongly reliant on energy sources and its supply channels. It is acknowledged that the effectiveness of Land, Air, and Naval operations necessitates the use of a large quantity of energy on a daily basis, mostly traditional fuels, with dramatically increased consumption during the war conflicts, which leads to the reason why NATO member states should look at energy security as part of their overall security, which lead us to the second problem of relying on traditional energy sources.

Unfortunately, the Alliance is dependent on states outside of the organisation to satisfy the amount of its energy need for its military operations and other activities such as training and actual operations. Along with rising consumption, the unpredictability of fuel costs can cause major problems for the military capabilities

[44] Goodman, Sherri. "NATO Review." *NATO*, 1 February 2022, https://www.nato.int/docu/review/articles/2022/02/01/nato-an-unexpected-driver-of-climate-action/index.html.
[45] NATO. "Opening speech by NATO Secretary General Jens Stoltenberg at the High-Level Dialogue on Climate and Security." *NATO*, 28 June 2022, https://www.nato.int/cps/en/natohq/opinions_197168.htm.
[46] NATO. "NATO releases its Climate Change and Security Impact Assessment." *NATO*, 28 June 2022, https://www.nato.int/cps/en/natohq/news_197241.htm.

during the operations[47]. The military forces' are over-reliant on petroleum based fuel, which causes operational, strategic, and financial risks, endangering the conduct of critical missions[48].

From this point of view, NATO is very vulnerable because of this dependance on imported sources of energy, without excluding its environmental impact. Fortunately, defence systems are increasingly incorporating more electric-based technology as a result of innovation, and the ability to deliver the energy required for such technologies will certainly become a critical element in the balance of future forces, but this will take time to be implemented. Therefore, energy transition strategies should be attentively developed without reducing military operational capabilities. For this purpose, each member state should take an active part in implementing best practices while taking into account other countries' experience-based innovative and sustainable energy solutions and develop new solutions to improve the energy efficiency and sustainability of military operations, which can enhance military capabilities and improve resilience, as well as security of military forces while managing risks[49].

Conclusion

Given that climate change and energy security are major threats to global and national security, unions and governments must include climate and energy risks into all of their planning processes, including the military, which entails addressing energy transition difficulties.

Because the military's greenhouse gas emissions are not reported, it is impossible to assess and analyse the impact of all human activities on the environment. However, the lack of reliable sources of information addressing the military's carbon emissions demonstrates that there is a critical need for public reporting and openness, because citizens have the right to know. We are all interconnected and we rely on each other's decisions in the combat of climate change.

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[47] Bazilian, Morgan, et al. "Energy and the military: Convergence of security, economic, and environmental decision-making." *Research gate*, 2019,
https://www.researchgate.net/publication/336962411_Energy_and_the_military_Convergence_of_security_economic_and_environmental_decision-making.
[48] NATO ENSEC COE. "ENERGY HIGHLIGHTS." *ENERGY HIGHLIGHTS*, September 2021, p.17
https://enseccoe.org/data/public/uploads/2021/09/nato-ensec-coe-energy-efficiency-and-renewable-energy-solutions-in-nato-and-pfp-countries-military-operations-study-report-2021.pdf. p. 14
[49] NATO ENSEC COE. "ENERGY HIGHLIGHTS." *ENERGY HIGHLIGHTS*, September 2021, p.17
https://enseccoe.org/data/public/uploads/2021/09/nato-ensec-coe-energy-efficiency-and-renewable-energy-solutions-in-nato-and-pfp-countries-military-operations-study-report-2021.pdf. p.5-8

The main objective of energy transition is to replace carbon-based energy sources with carbon-free alternatives without minimising the military capabilities, but reducing the impact on the environment. Given that the balance of existing and future armed forces is determined by technology and availability to energy sources, the military sector has always been technologically sophisticated. But relying on traditional sources of energy has an enormous influence on decision-making processes, which it is one of the main motives for creating alternative energy options, especially within the military sector.

Due to the fact that the defence sector needs a significant amount of fossil energy in both peacetime and conflict, the military forces understand the role of energy security and climate change challenges, as well as their influence on the armed forces' capabilities. Parallel to the changing nature of conflict, the need for energy sources has significantly increased, necessitating the transformation of its features.

Furthermore, sustainable energy-powered technologies reduced reliance on fossil fuels while reducing environmental impact. Overall, smart energy enhances military capabilities, unit autonomy, and operational resilience on the battlefield while decreasing defence costs as well as the negative impact on the environment. The development and broad use of such technologies require large expenditures, it may be a cheaper solution due to the ability to utilise free energy without incurring transit expenses. The energy transition will improve military resilience as well as its capabilities.

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DEPLETED URANIUM FOR MILITARY PURPOSES REVIEWED

Georgios Paschalidis

Abstract: The radiological wastes are a type of wastes which needs to be managed very carefully especially in the military environment. An analysis will be presented for Depleted Uranium for military purposes (use in military operations but also in the peace time period). The depleted uranium identified as an existed threat from the lessons learned during past military operations. Depleted Uranium is still used in military ammunitions and in the following paragraphs will be presented the measures and the actions that NATO military personnel have to follow. Additionally, will be presented the lack of data that exist of the remaining material in training areas and the gap of techniques and procedures of the use of Depleted Uranium ammunitions, during the peacetime period.

Keywords:Depleted Uranium, Radioactive

Depleted Uranium characteristics

Depleted Uranium (symbol: DU) is the uranium with isotope fissile content U-235 lower than natural uranium which has a content of 0,72% in U-235. At the past was referred as Q-metal or D-38. It has density 19,1 g/cm^3. The biggest quantity of Depleted Uranium is result of the produce of enriched uranium which will be used at nuclear reactors as fuel and at the construction of nuclear weapons. This sub-derivative is used for the protection of the radiation during medical treatment with radiation, to the construction of metal cubes for the transportation of radioactive material, at industrial equipment for x-rays but mainly for military use. The military industry uses depleted uranium for the armor of the tanks and at the piercing ammunitions. The Depleted Uranium is stored in special barrels under pressure like gas.

At the matrix 1 below is compared the concentration and the emitted radioenergy between Depleted Uranium and natural uranium in order to realize the possible level of threat.

Isotope	Natural Uranium		Depleted Uranium	
	% Concentration, w/w	% Emitted radioenergy	% Concentration, w/w	% Emitted radioenergy
U-238	99,28	48,8	99,8	83,7
U-235	0,72	2,4	0,2	1,1
U-234	0,0057	48,8	0,001	15,2

Matrix 1: Comparison between natural and depleted uranium

Use of Depleted Uranium and concerns

Air missiles with depleted uranium and anti-tank piercing missiles for armored tanks used in Kossovo – Serbia. An amount of 15 tons ammunitions with depleted uranium used from NATO forces for a period of eleven weeks. They used 1130 aircrafts which made 2300 sorties and used 420.000 missiles, rockets and bombes. In the Gulf War in 1991 the allied forces used 300.000 missiles. Similar ammunitions used in Afghanistan (US army), in Mali (French Army) [13] and in Syria (5.265 missiles). We must highlight that this is common ammunition for all modern armies. The last armed conflict that is ongoing in Ukraine we don't have data for the use of this ammunition. The Russian forces have engage armored vehicles (tanks T-72A and T-80BV) that can use depleted uranium ammunitions. It is assessed that the use of depleted uranium is mandatory but as already mentioned that doesn't exist data that confirm the use of them.

The map (picture 1) presents the targeted areas in which used ammunitions containing depleted uranium at Kosovo operations in 1999. As we can observe exists a concentration at the South part of the country and the number of them isn't small.
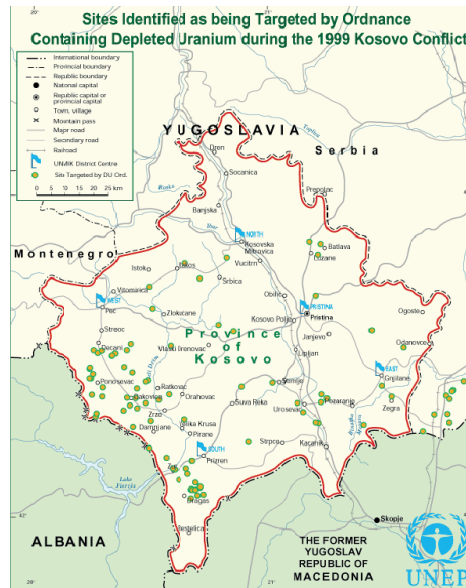
Picture 1: Targeted areas by depleted uranium ammunitions in Kosovo province in 1999 [9]

In Greece the use of depleted uranium ammunitions in the sea training area of Managro from Hellenic navy during exercises for the readiness of naval personnel, worried the local peoples for the environmental risks of this ammunition in the area. Moreover, in general in 2003 Hellenic armed forces used 20.000 depleted uranium missiles (picture 2) in maritime and land military exercises in Aegean Sea. Also, in the armors of the tanks is used depleted uranium because depleted uranium has 2,5 times bigger density, it is heavier and harder than steal in order to face the threat of piercing missiles.
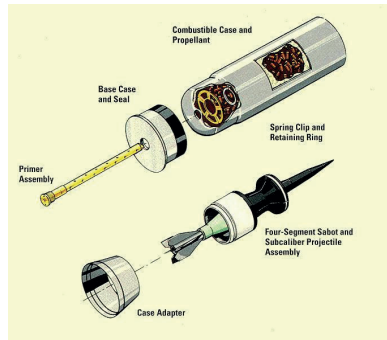
Picture 2: Schematic diagram/photos of ordinary piercing ammunitions

Typical depleted uranium ammunition is M829A4. The ammunition M829A4 (Picture 2) can penetrate 880mm of Rolled Homogeneous Armor at 4000 meters which is only slightly better than the 840mm of the M829A3, this is because its mainly meant to counter Explosive Reactive Armor and Hard Kill Active Protection Systems than composite armor. A serious disadvantage exists when you have a direct shoot at the tower of the tank and you may have depleted uranium particles inside the tank which can be breathed by the crew (picture 3).

Picture 3: Results on Targets of depleted uranium ammunitions [10]

One additional particularity that has Hellenic Forces is that in the whole mainland and in many big islands around the country exist different types of formations and unit. Especially at Crete exists a NATO military base. In order to retain all these formations/units their combat effectiveness they need a periodical and demanding training. The firing training for armored units is the main priority and often they use depleted uranium ammunitions. In picture 4 are depicted the numbers of the last

supply of depleted uranium ammunitions for Leopard2 tanks by Hellenic Army. So, initially were bought 42.000 depleted uranium ammunitions and then other 42.000 for the needs of Hellenic Forces.


Picture 4: The supply of depleted uranium ammunitions for Leopard2 tanks by Greek Army [11]

The worries of the scientists focus on the danger of the use of this ammunition, when it strikes an armored target or in an embankment in a training area and the military personnel breathe this powder/dust. The spread, the concentration and the chemical analysis of the small particles (like aerosols), can enter at the lungs and is assessed that can reach at 96%. The situation is more effective especially for the personnel who are close to the target during the explosion or the personnel that examines the result of the explosion or the target (like old armored tanks).

A crucial factor for the spread of flying powder during the exercises is the meteorological conditions. In the case of a light wind exists during exercises will increase the velocity and range of the spread. In the training areas (usually at the mountain slope) exist an ordinary use of depleted uranium missiles and have been identified big concentrations of depleted uranium and as a result when we have a rainfall a quantity of them will transferred to underwater and may affect the quality of the water. Due to the environmental conditions the metallic parts of the ammunition of the depleted uranium are vulnerable to oxidation, the oxides spread at the ground and as heavy metals emit ionizing alpha, beta and gamma radiation. Additionally, this spread at the neighborhood agriculture areas (during armed conflicts or training) or from some UXOs (Unexploded Ordnances) expose the farmers in danger with the radiation of the ammunition and moreover pollutes the ground and the cultivation because of the oxidation. Under these environmental conditions the chemicals are

soluble and can diffuse at the surface and underground waters and through this route to insert at the food chain and at the end to be consumed form the humans.

In the following picture (Picture 5) is a thematic map which shows the depleted uranium use around the world, during armed conflicts, accidents, past tests and training.
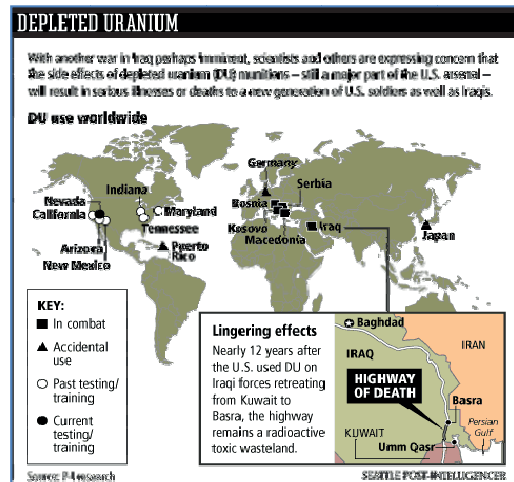
Picture 5: Thematic map for the usage of depleted uranium globally [12]

NATO doctrine

NATO identifies that Depleted Uranium has special and toxic chemical properties, and care must be taken to incorporate it safely. NATO has developed as doctrine different documentations concerning depleted uranium. Starting with the storage facilities for DU ammunition will usually be located in military controlled sites, at distances from the nearest point of public access beyond which the predictable explosive, inhalation and surface contamination effects would be acceptable. Quantity distances will, in general, be those appropriate to the HAZARD Classification of the particular ammunition storage. It is estimated that the adverse radiological/toxic effects of an atmospheric dispersion of DU could give rise to a possibility of injury to a member of the public comparable to that caused by the explosive components of the ammunition. In such a case the more restricted of the two distances, the radiological safety distance or the explosives quantity distance, shall be the one applied. [5]

A second area of interest is the radiation protection of military vehicles. Guidelines to improve the radiation protection and an assess decision process has been developed in order to certify at least the minimum standards for the military personnel. [6]

The requirements for potable water during field operations and in emergency situations is an area that maybe will be affected from the use of depleted uranium. So NATO developed a risk assessment process concerning long term standards for the quality water. For uranium in general they collect samples and make tests once per year. Following the limits that the World Health Organization (WHO) has defined as maximum concentration NATO has also accept the 0,03 mg/l. [7]

The last area that NATO developed a doctrine is clearance decontamination. This documentation provides guidance on cleanliness levels that may be acceptable in order the threat to be eliminated. In more details analyzes the risk levels, the equipment that must be used and the minimum requirements that the process demands. [8]

Summary

Despite the fact that military forces developed a doctrine for Depleted Uranium and processes for very basic issues, the real threat remains active because the concerns that coordinated does not face the real problem. The use of depleted uranium is really important and effective but must be developed Tactics Techniques and Procedures (TTPs) that certify the safety of the personnel and the natural environment during operations and peace time period. The biggest concern remains the use of depleted uranium during the peace time period that armed forces use them in their routine for training and does not exist data and measures to face the threat.

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RADIATION BACKGROUND ANALYSES OF THE LAND AROUND VAYA LAKE, KARAAGACH RIVER, BURGAS BAY - A TERRESTRIAL SURVEY

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Abstract. The radiation background analysis is very important for the assessment of the radiological risk, for every living creature as a source of external ionizing radiation. It is one of the components of the environment, as present everywhere and at the same time of great importance, because its level has a significant influence over the quality and length of life of living organisms. The radiation background may have natural origin, when it is formed mainly by radionuclides from the Th and U series, naturally present at soil, clay and some kind of rocks, K-40 and cosmic radiation, but it may be formed by an artificial sources such as nuclear reactions, accidents, waste or other industrial or medical use of radioactive sources. The radiation background analysis at the present research is an analyses of data, gathered as a terrestrial survey on gamma radiation dose rates over the land, alongside three types of large water objects in the south-east part of the Bulgarian Black Sea coast (salt and fresh water ones)-a lake, a river and Burgas bay –Port of Burgas and beach shore. The survey is done, with three different dosimeters, which measure gamma radiation and ambient dose equivalent rate, using Geiger-Muller counters, in radiation dose readout µSv per hour, placed 10 cm. above the ground at specifically selected monitoring points. The data is gathered for a period of ten months - June 2021-March-2022.

Keywords: Radiation background, Terrestrial survey, Bulgarian black sea coast.

[1] [0000-0002-4101-579X]
[2] [0000-0003-1714-1494]
[3] [0000-0003-0312-8280]
[4] [0000-0002-9777-7224]
5[0000-0002-2683-2222]
6 [0000-0003-0184-8743]
[7] [0000-0002-5619-3214]
[8] [0000-0002-2315-9685]
[9] [0000-0002-9617-9839]

[10][0000-0002-8800]-

The presence of natural and man-made radionuclides in the atmosphere serves as an indicator for determination of the atmospheric radioactivity, which is determined by the indicator "gamma background - γ-background" or the indicator that describes the impact of the environment on living organisms, namely: "power of the equivalent dose of gamma radiation from the air ".

The natural γ-background is a physical characteristic of the environment specific to an area. Above the earth's surface (air γ-background) it is created mainly by radionuclides, which are contained in the upper soil layer with a thickness of about 30 cm. For this reason, natural radionuclides of terrestrial origin from the natural radioactive series play a significant role in the formation of the terrestrial γ-background: Th and U series, naturally present at soil, clay but also some kind of rocks, which include 47 various radionuclides and are widespread in the earth's crust, K-40 and cosmic radiation [1].

Experiment

According to the Bulgarian legislation – "Ordinance on basic norms for radiation protection", adopted by the Council of Ministers №229 / 25.09.2012 on the territory of the Republic of Bulgaria the natural radiation gamma background is in the range of 0.06 to 0.40 μSv/h. These values are considered as safe. In the Republic of Bulgaria there is a continuous monitoring of the gamma background by 5 departments.

On the territory of Burgas District, which includes the areas of the surveyed Eco systems, systematic observations of the radiological state of the environment are carried out as an approved network for radiological monitoring, including points, monitored indicators and periodicity, mostly by the Regional Laboratory in Burgas and Regional Health Inspectorate. The departments, which are related with the measurement of the Radiation gamma background at Burgas district are gathering data on: Average monthly values for the ambient equivalent dose rate from the Local Monitoring Stations of Cape Emine and Ahtopol, which are part of the National Automated System for Continuous Monitoring of the Radiation Background, within the Executive Environment Agency of the MoEW, (BULRaMo system); Gamma radiation background monitoring of uncultivated soils in Burgas district and determination of natural gamma background, above water once a year in 2 sample points for surface waters: (lake "Vaya", "Atanasovsko" lake) and in 4 sample points for sea water: (Black Sea, Vromos Bay, Black Sea near Nessebar, Black Sea near

Sinemorets and Black Sea near Chernomorets). One of the main ideas of the present project is to collect data on gamma radiation background for further assessment and analysis on monthly basic, because the available information about it is based on data, gathered much rarer (as seen from above).

The present research data on gamma radiation background is gathered as a part of analysis of environmental indicators within a project, funded upon INTERREG-IPA CBC Bulgaria-Turkey 2014-2020, named "Cross-border Regions Collaborate for Blue Growth (BLUE GROWTH COLLABs)".The project aims to establish joint centers for applied research in the field of "Blue Growth", bringing together in a common research infrastructure existing university, scientific and institutional competencies in the cross-border region, to upgrade regional capacity to address key areas of environmental protection of river and marine ecosystems. One of the project's main ideas is the implementation of a pilot aquatic ecosystem studies in Burgas and Edirne, based on data collection on monitoring of aquatic system parameters (in the field work), within which is organized collection of data of specific environmental parameters and the gamma radiation background analysis at the present research is part of these analyses. The data, presented in this article is gathered as a terrestrial survey on gamma radiation dose rates over land and sand, alongside three types of large water objects in the south-east part of the Bulgarian Black Sea coast (salt and fresh water ones)-a lake, a river and Burgas bay –Port of Burgas and beach shore. The survey is done, with three different dosimeters, which measure gamma radiation and ambient dose equivalent rate, using Geiger-Muller counters, in radiation dose readout µSv per hour, placed 10 cm. above the ground at specifically selected monitoring points. The data is gathered for a period of ten months - June 2021-March-2022. The devices used for terrestrial gamma background radiation determination are three portable hand-held electronic instruments, for radiation detection – dosimeters - Dosimeter-radiometer Terra MKS-05 IP 20 - Ecotest trademark; SoeksEcovisor F4 – Soeks trademark; and VOLTCRAFT gamma-check-a geiger counter; in radiation dose readout µSv per hour (See Pic. 1). The detector for gamma radiation determination is type Geiger Mueller counter (GM).

The algorithm used for determination of the terrestrial gamma background had been developed for the purpose of the project in a methodology for gamma radiation

determination [2]. It includes the following steps – 1)The area is determined as a rough circle with radius of 1 meter and center-the sampling point. 2)The dosimeters are switched on and prepared for operation. 3)Within the surveyed area around the sampling point, the radiological examination includes three points to stop, to measure the background. The three locations (points) are placed approximately at the vertices of an equilateral triangle, with the center - the sampling point. 4) The area thus formed is traversed at a speed of about 0.5 m/s (approximately half a step per second). The movement of the hand of the operator with the dosimeter in it is in the form of the Latin letter "Z". 5)The dosimeter is held about 10 cm above the ground, for registration of terrestrial gamma background. 6)The data obtained is recorded in a protocol.(Pic. 1).

Pic.1 Terra MKS-05 IP 20, SoeksEcovisorF4 , VOLTCRAFT

Burgas Bay-Port of Burgas

The Bay of Burgas is the largest bay on the Bulgarian Black Sea coast and one of the largest in the Black Sea. [2].Alongside its coastal line, had been selected five monitoring and sampling points, on which are measured different parameters of the environment, including gamma radiation background. The location of the monitoring points was chosen in accordance with the anthropogenic pressure and their accessibility in land and are located in Port of Burgas zone and Burgas sand coast (see Figure 1)
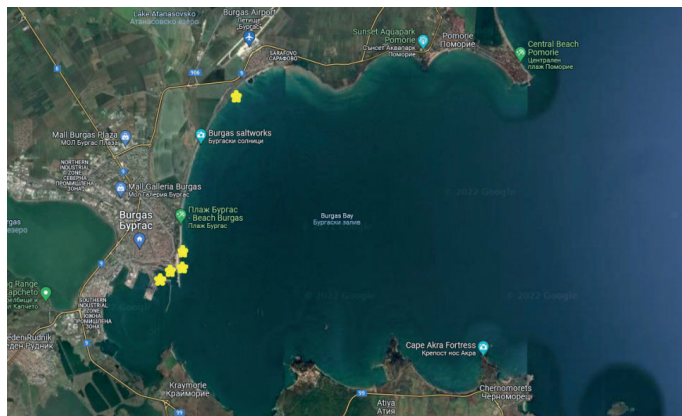
Fig. 3. Burgas Bay-Port of Burgas, sampling points (approximate location on Google Maps view)

Below is seen the collected and analyzed data, divided by sampling points, samplemonths and dosimetry devices and presented with charts in Figure 2.

It is seen that the detected gamma radiation, does not exceed the normal boundaries of 0.06-0.40 µSv/h, except in march 2022 in sample points 4 and 5. The highest values of the gamma background above the cement breakwater in the shallow water of the central part of Burgas beach (sample point 4) and over the sand at the area of Salinas Burgas (sample point 5) is detected by VOLTCRAFT gamma-check-a geiger counter. At sampling point 4 on the 8th of March it detected a value of 0.42 µSv/h and on the same date at point 5, a value of 0.48 µSv/h which is just a little bit over the normal value of 0.40 µSv/h.
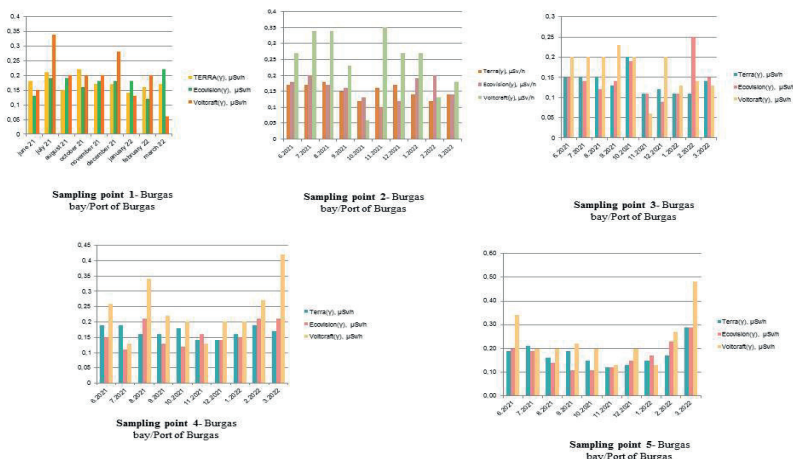
Fig. 2. Burgas Bay/Port of Burgas sample points 1-5 data on gamma radiation background, determined at the period June 21- March 22, by three dosimeters

Vaya Lake

Lake Vaya or Burgas Lake is the largest natural lake in Bulgaria - a shallow brackish coastal lake - an open estuary, slightly connected to the sea. It is located west of Burgas, and its entire eastern part borders the industrial and residential districts of the city. It is connected to the sea through a canal with a sluice, which provides vital fresh water from the sea, as well as nutrients and marine flora and fauna in the otherwise mostly freshwater lake. Three rivers flow into it - Aytoska, Sunderdere and Chukarska, which import fresh water. This makes Vaya lake extremely interesting ecosystem, which combines the salt and fresh water as well as the industrial and domestic influence of the city and thus cerates unique environment [3]. The sampling points are presented at Figure 3. They were chosen to be accessible by foot, to reflect the anthropogenic impact on the ecosystem and not to match on the sampling points for environmental monitoring incl. gamma radiation, analyzed by the Regional Laboratory, within MoEW in Burgas.

Fig. 3. Lake Vaya/Burgas Lake sample points 1-6

The data from dosimeters is presented at Figure 4. It is seen that following the data, gathered at the first surveyed ecosystem- Burgas Bay/Port of Burgas, the highest values of the gamma background above the land, alongside the boundaries of Vayalake is detected by VOLTCRAFT gamma-check-a geiger counter. At sampling point 1 on the 21st of February it detected gamma radiation background at the value – 0.48 μSv/h, which slightly over the normal value of 0.40 μSv/h.

Karaagach River

Karaagach or Kitenskariver is a river in southeastern Bulgaria, flowing into the Karaagach Bay on the Black Sea. Its length is 30.5 km. The valley of the Karaagach River is one of the typical drowned valleys of the southern Black Sea coast. Kitenskariver is extremely rich in fish and rare plant and animal species. It flows through a karst area, which is the reason for the loss of water in its riverbed. River Karaagsh and its area is protected area BG 0000143 under Directive 92/43 / EEC on natural habitats, approved by Decision of the Council of Ministers № 122 / 02.03.2007 (SG No. 21/2007) with a total area of 64.16 ha and protected area under Directive 92/43 / EEC on the conservation of natural habitats and of wild fauna and flora [3].

The sample points (not marked at the map, because of the scope of the picture) are alongside the river shores, they are five and are chosen to be accessible by foot, to present the anthropogenic influence over the river and not to match the sampling points for monitoring of the environmental indicators, done by some of the responsible institutions. See figure 5

The data of the dosimeters, is presented at Figure 6. It is seen that, here, also the highest values of the gamma background above the land, alongside Karaagach river is detected by VOLTCRAFT gamma-check-a geiger counter. At sampling point 2 on the 22nd of November and on the 8th of December had been detected gamma radiation background at the value – 0.48 µSv/h, which is just a little bit over the normal value of 0.40 µSv/h.
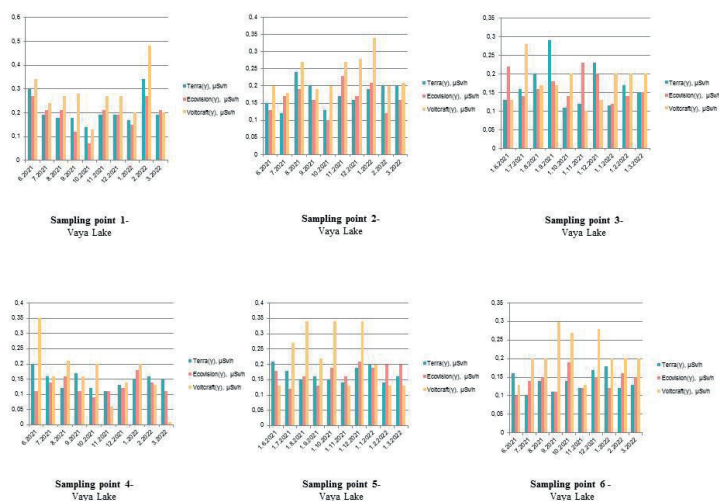

Fig. 4. Vaya Lake sample points 1-6 data on gamma radiation background, determined at the period June 21- March 22, by three dosimeters
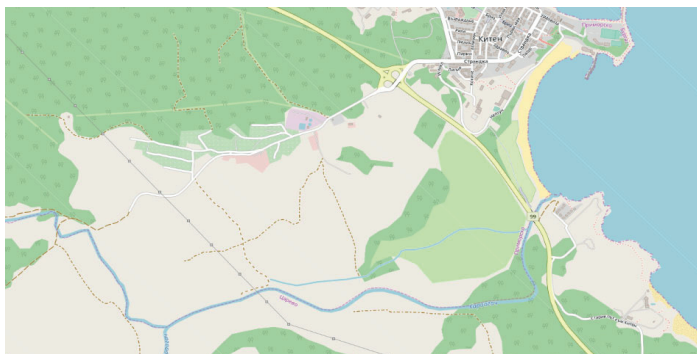
Fig. 5. Karaagach/Kitenska river sample points 1-5
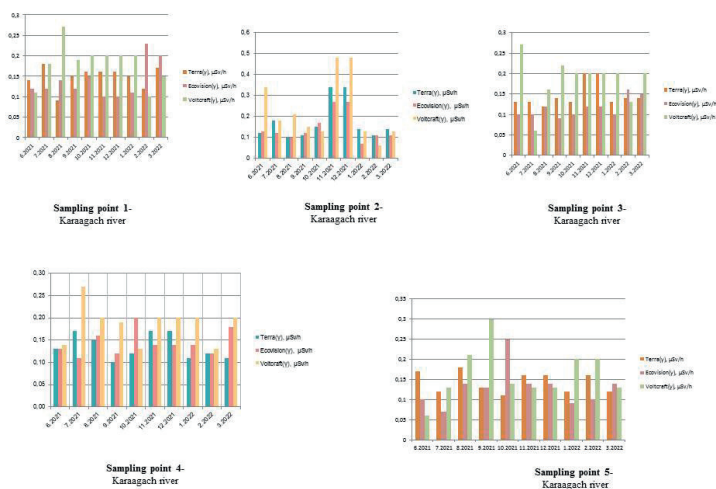
Fig. 6. Karaagach river sample points data on gamma radiation background, determined at the period June 21- March, by three dosimeters

Conclusion

Within the project we had gathered monthly data on the environmental indicators, which describe three types of large water objects in the south-east part of the Bulgarian Black Sea coast (salt and fresh water ones)-a lake, a river and Burgas bay –Port of Burgas and beach shore. The data on the terrestrial survey on gamma radiation dose rates over land and sand, alongside the surveyed eco systems had been regularly taken every month on the same sampling points and would form a

broad experimental data for further studies on the effect of gamma radiation on people and living organisms alongside and as a part of the common environmental status of the area (for example determining of annual effective dose and excess life time cancer risks, etc.)

The data shows values of gamma radiation, which are at the limits of the safe/normal numbers of 0,06-0.40 µSv/h. (with few exception which are quite near the safe values)

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