



# Mountain Warfare 2040

The future of fighting in mountainous environment

Mountain Warfare Congress 2024



# NATO Mountain Warfare Centre of Excellence

**Population:**  
2.108 million (2021)

**Capital:**  
Ljubljana

**Highest Mountain:**  
Triglav (2864m)

**Area:**  
20,271 km<sup>2</sup>

**Adriatic coastline:**  
47km

**Independence:**  
25 June 1991

**European Union:**  
1 May 2004

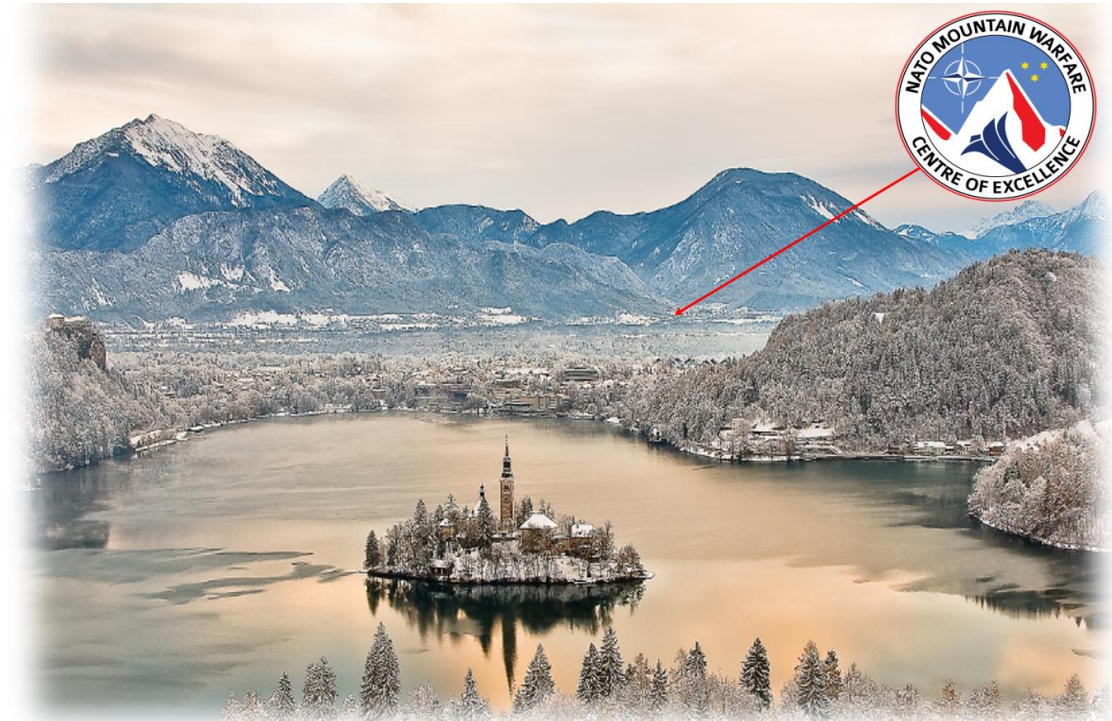


## VISION

to be the **central hub for mountain warfare expertise**, fostering collaboration among NATO members and partners, **setting global standards** for excellence in training, research, doctrine development and serving as a knowledge base for organizations **operating in mountainous environment**.

## MISSION

To assist NATO member countries, partners, other countries and international organizations, in order to **enhance mountain warfare capabilities**.



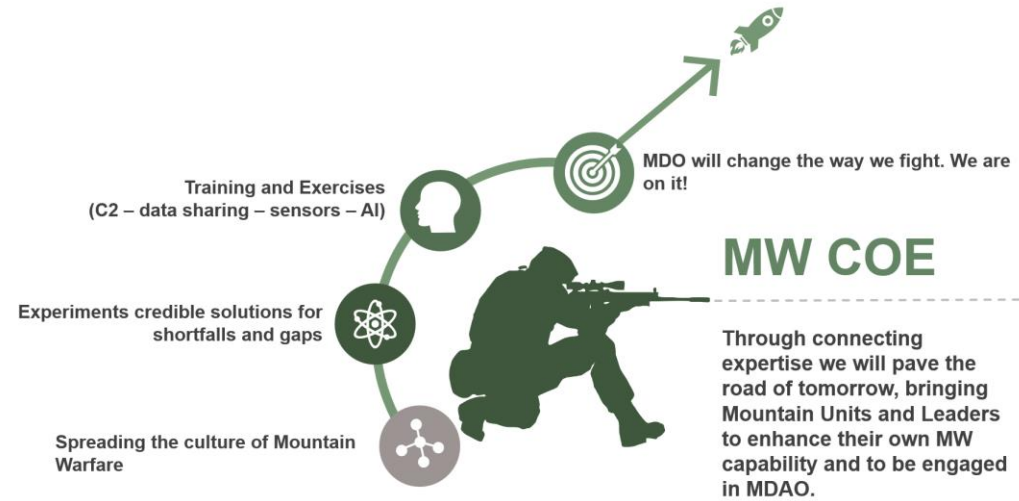


# NATO Mountain Warfare Centre of Excellence

## NATO MW COE History and Milestones



## We are focused on



ATP and ATrainP-6 custodian, Congress, Brochures

Doctrine and Standardization

MW Concept, MDAO and experiments, workshops

Concept Development and Experimentation

SULC, MW OPS Planning Courses, EX, seminars, METT, on-line courses

Education and Training

LL Portal, Staff Ride, Workshop

Lesson Learned



# Key Questions

## 1. What does Mountain Warfare mean?

2. Will Mountain Warfare still play a decisive role in the future?

3. What might Mountain Warfare look like in the future?



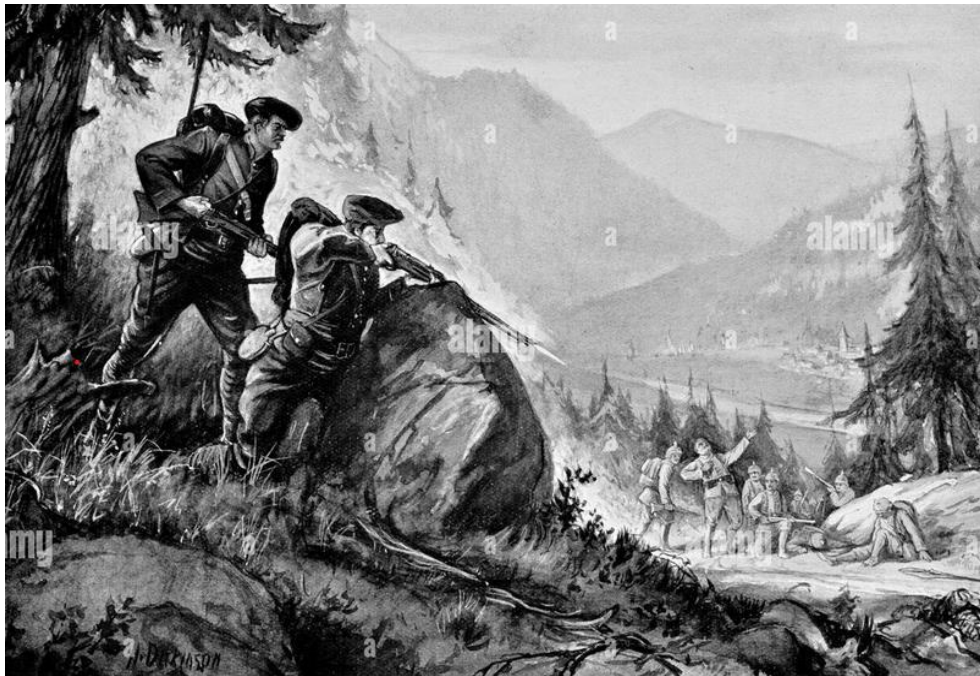
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# Mountain Warfare

## Definition

Mountain Warfare (MW) is the **employment of forces** in terrain with **major differences in elevation**, particular **meteorological effects**, and poor or **non-existent infrastructure**\*.



\*according to ATrainP-6 and ATP-3.2.1.3 (Not an authorized NATO term )



# Mountain Warfare

## Key factors

- **Terrain** (steep slopes and cliffs, limited mobility, natural obstacles, objective hazards)
- **Climate and Weather** (extreme cold, variable weather, altitude effects)
- **Tactical Considerations** (logistic, time, availability of forces)
- **Training and Equipment** (specialized troops, adapted equipment)



# Mountainous Terrain

## Definition

**Mountain Warfare = Warfare in Mountainous Environment / Terrain**



Mountainous terrain is a stretch of land, which has outstanding characteristics such as **slope inclination of more than 15 degrees**, wide variations in ground, climate and vegetation.



# Mountain Warfare

## Classification of Mountains

Classification	Description
<b>LOW MOUNTAINS</b>	0m - ~2400m AMSL
<b>HIGH MOUNTAINS</b>	~2400m – ~5500m AMSL
<b>EXTREMELY HIGH MOUNTAINS</b>	above ~5500m AMSL



Most likely and most expected

**Main focus**



Likely and expected



Unlikely but not impossible





# Mountainous Terrain

Mountainous terrain **covers about 25% of the world's land surface** and they differ in shape, extension, altitude, vegetation cover, and climate regime.



About **12% of the world's population** lives in mountainous areas / terrain.



Mountainous terrain can be found **all over the world** in various forms and appearances.



Mountainous terrain can be **extremely uneven, with high, steep ridges and deep valleys.**



It can be **vegetated, bare rocky, snowy, or glaciated.**

# Key Questions

**1. What does Mountain Warfare mean?**

**2. Will Mountain Warfare still play a decisive role in the future?**

**3. What might Mountain Warfare look like in the future?**





# Future Mountain Warfare

Will Mountain Warfare still play a decisive role in the future?

Three key points why mountain warfare will continue to play a crucial role in the future.

- **Area covered by mountains**

About 12% of the world's population live in mountainous areas.



- **Natural resources**

**Nearly 40%** the world's population depends on rivers originating in high mountains for their water supply.

- **Critical infrastructure**

Water plants, Power lines, Radio towers, tunnel, bridges, railways

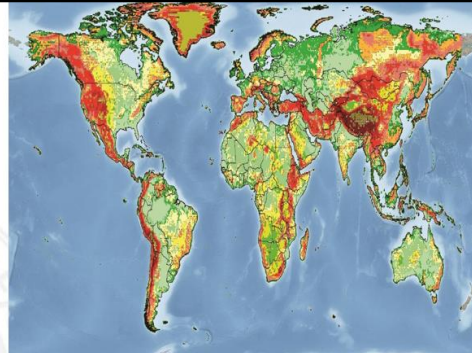




# Future Mountain Warfare

## Area covered by mountainous terrain

# Mountains are still a key terrain

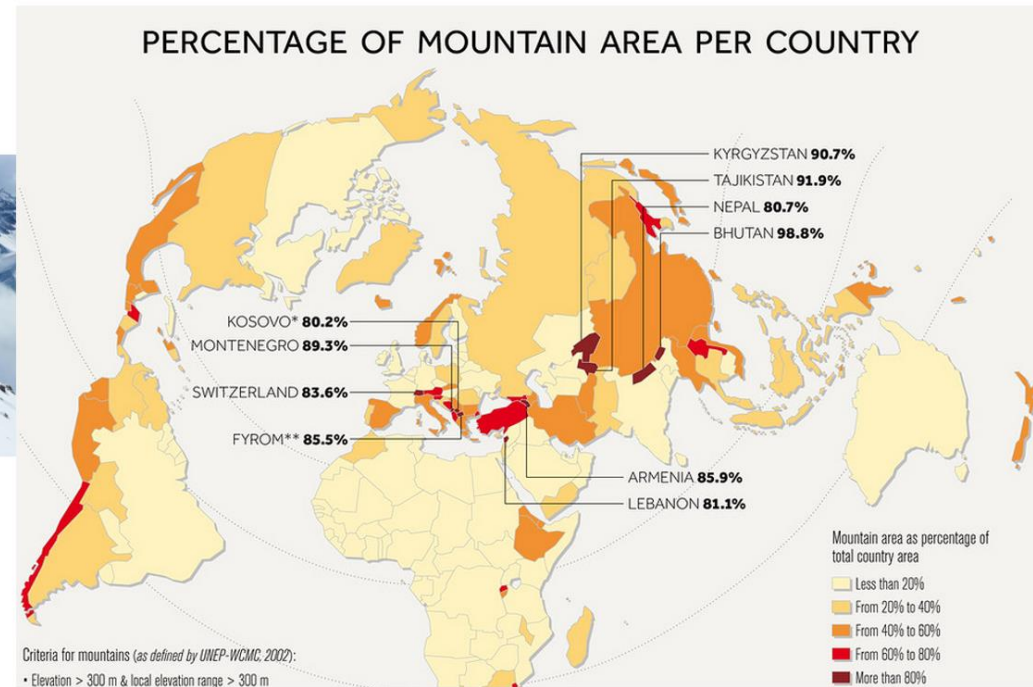


**About 12% of the world's population live in mountainous areas.**

### Global distribution of mountains

Over 25% of the land mass and 85% of the land borders of the world are categorized as mountainous environment in different climatic regions.  
About 12% of the world's population live in mountainous areas.

**35% of the land area of Europe is covered by mountains.**





# Future Mountain Warfare

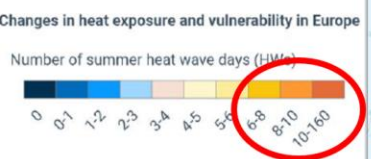
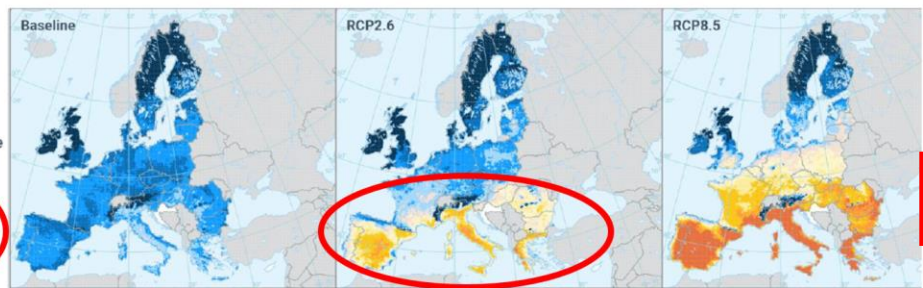
## Natural resources / Climate change

### • Europe:

Increased severity of droughts  
Heat waves

Reduced options for agriculture production  
Water scarcity (industry, cooling, hydropower)

Destabilization of frozen areas at high elevations



Some of the goods and services provided by mountain environments, such as timber, **hydropower** and **minerals**, have a measurable economic value.

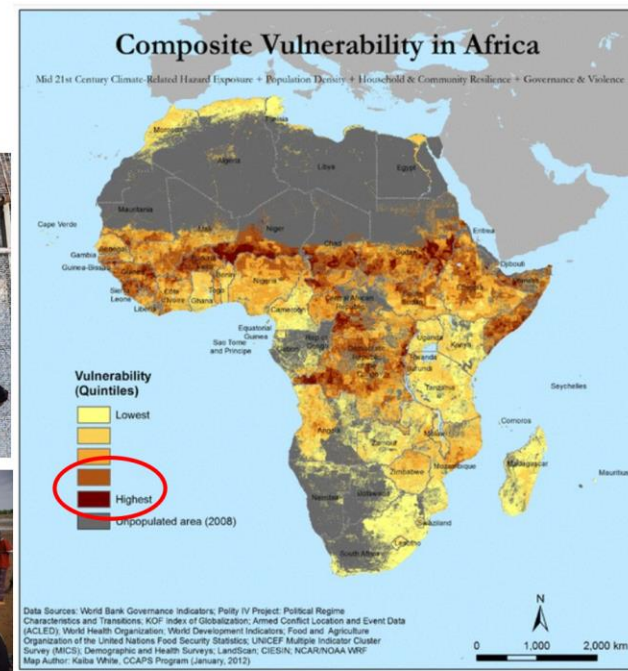
**Nearly 40%** the world's population depends on rivers originating in high mountains for their water supply.

### • Africa:

Increased severity of droughts  
Heat waves

Agricultural production failures  
Movement to cities and refugee camps  
Political and social conflicts  
Mass migration

Conflicts over fossil, nuclear and renewable energy



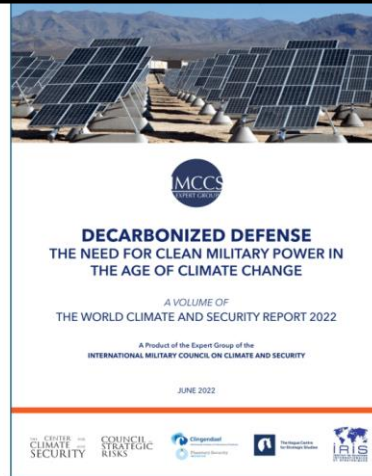


# Future Mountain Warfare

## Critical infrastructure

What does this transition mean for NATO armed forces?

- Significantly reducing GHG emissions over the next decades
- **Massively de-carbonize (i.e. de-fossilize) the energy used**
- Adopting new energy using technologies (infrastructure & mobility)
- **Increasing the use of energy from renewable sources**
- Diversifying energy types used



The **potential of hydropower** to help move the world away from its present high level of consumption of **fossil fuels**, which is an important factor in global warming, adds a **new dimension to the hydropower debate.**



A sufficient quantity of falling water must be available, means that **hilly or mountainous areas** are best.

**NATO declared to become carbon neutral by 2050 (“net zero goal”).**



# Key Questions

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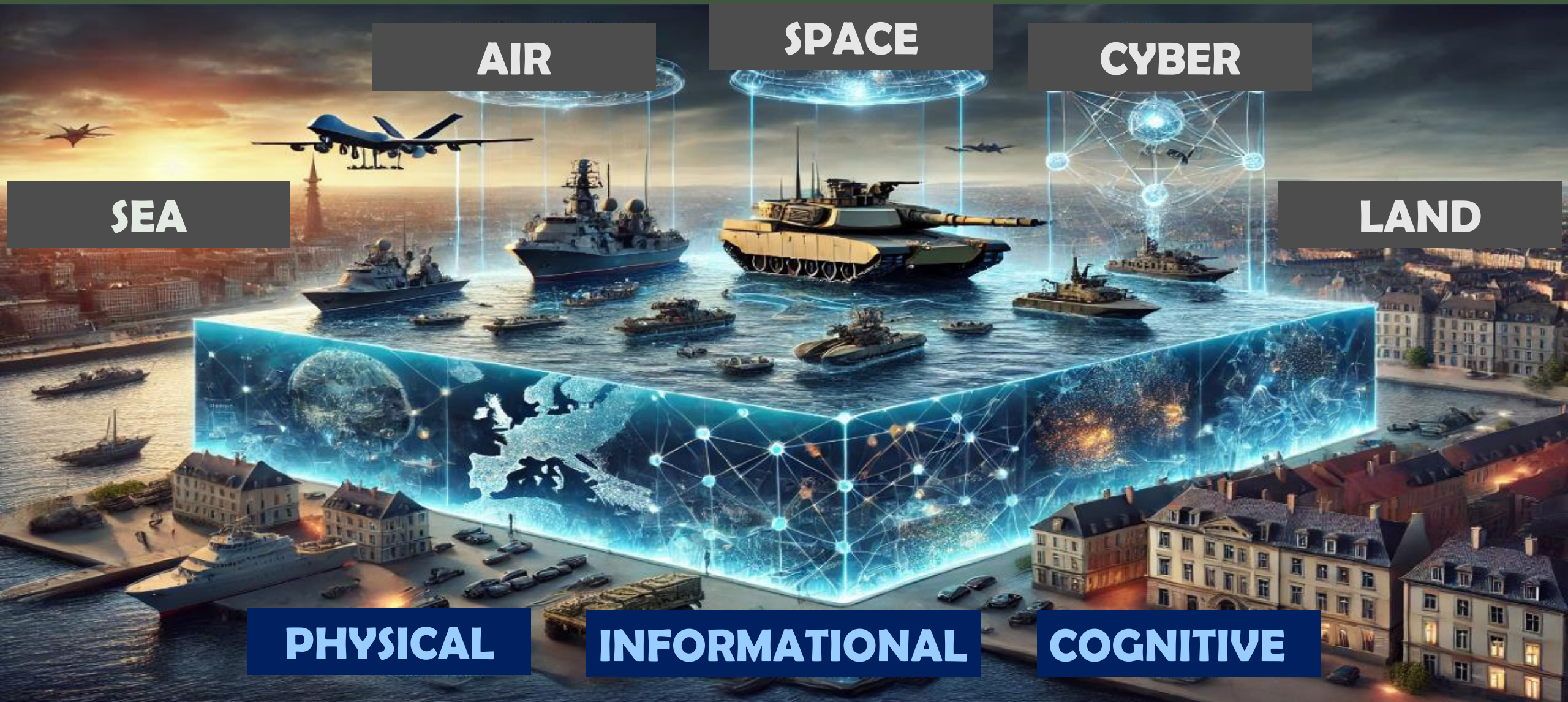
# Future MW Operating Environment







# Future MW Operating Environment





# Future MW Operating Environment

What might Mountain Warfare look like in the future?

## Opportunities

New technologies

Multi-Domain Operations

Artificial intelligence

UAV / UAS / UV

Domains Cyber / Space



## Threats

Climate change

Competition for raw earth materials

Extreme weather events

Food and water scarcity

Cognitive Warfare

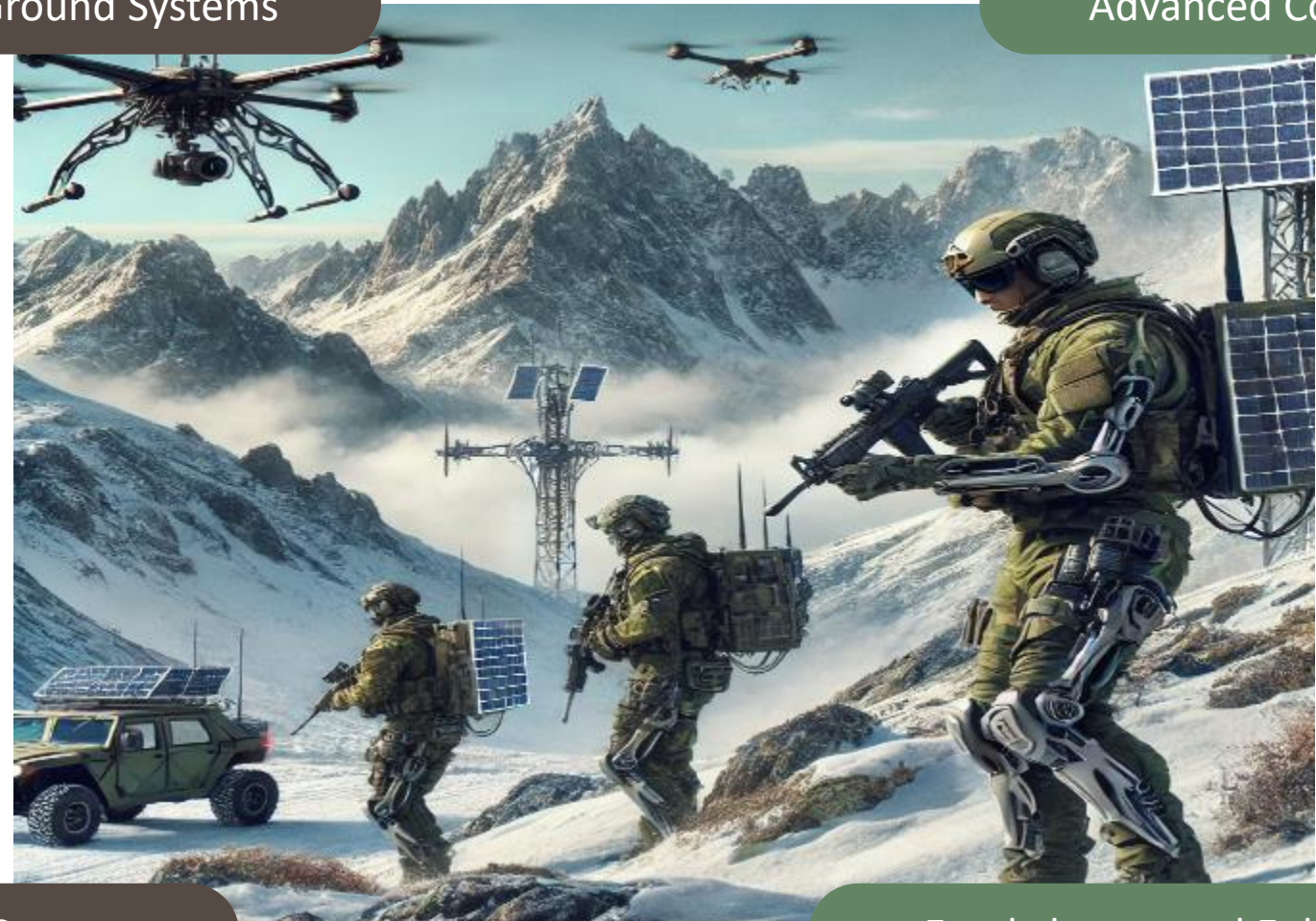


# Future MW Operating Environment

## Technological Integration and Modernization

Unmanned Air and Ground Systems

Advanced Communication Systems



**I2D2**

Intelligent  
Interconnected  
Decentralized  
Digital

AI and Autonomous Systems

Exoskeletons and Enhanced Soldier Systems



# New technologies

## Implications for future Mountain Warfare

I. WW	II. WW	IFOR/ KFOR	ISAF	UKR
				
				

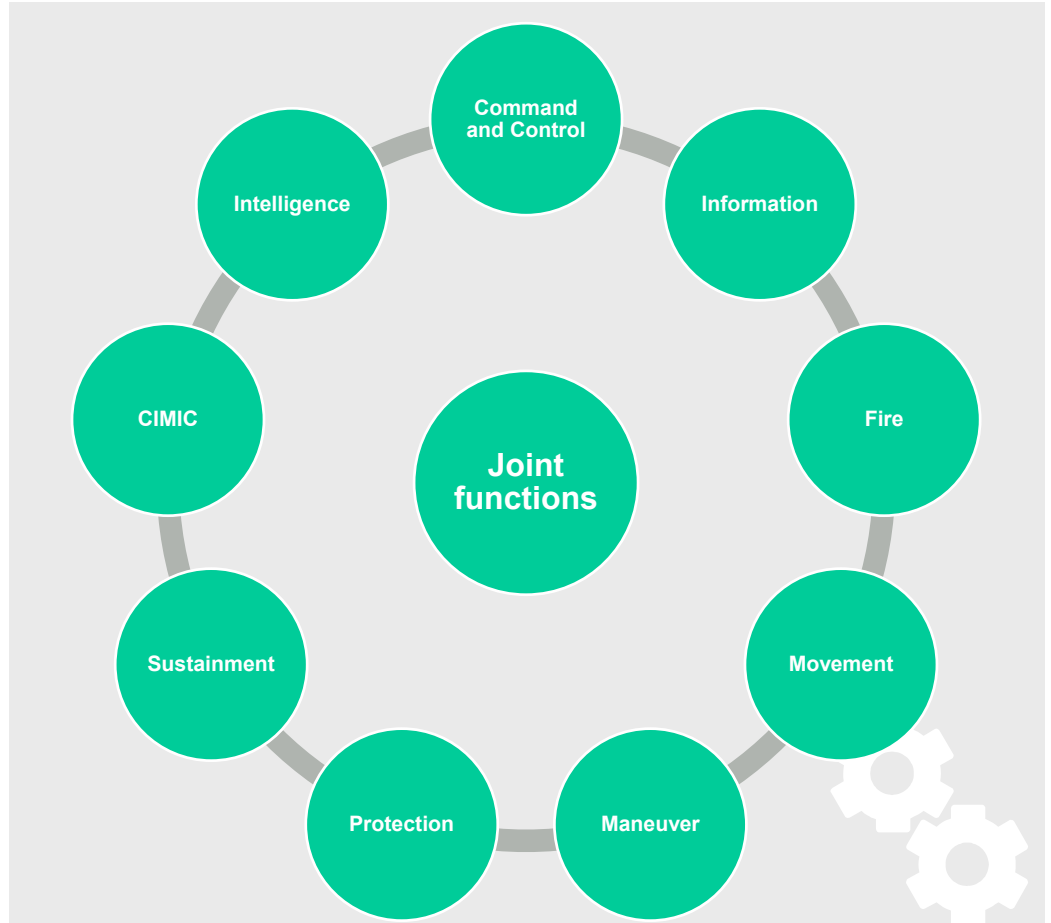


# Future MW Operating Environment

## Implications for future Mountain Warfare

### Effect on

- Complexity
- Climate change
- Technology
- Artificial Intelligence
- Cognitiv Warfare

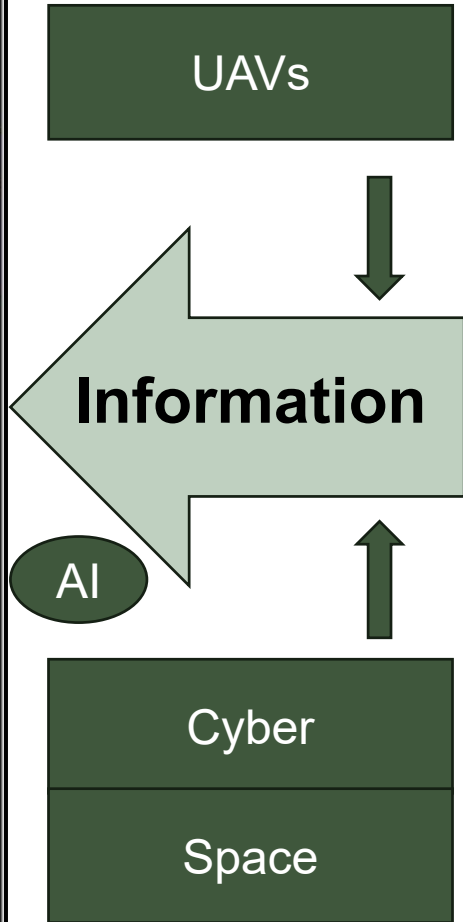
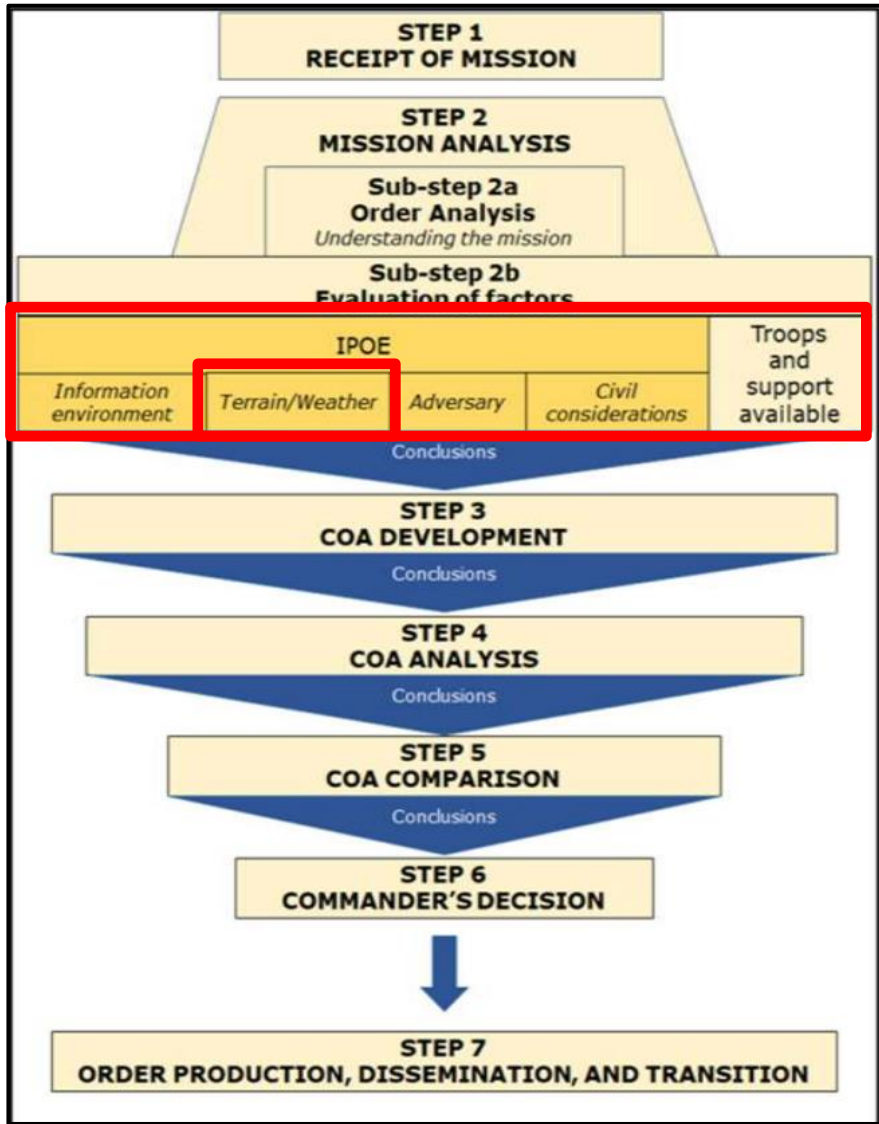


- Commercialization
- Big Data Usage
- Space / Cyber Domain
- New actors



# New technologies

## Implications for future Mountain Warfare



### Terrain analysis





# UAVs

## General Observation (Workshop)

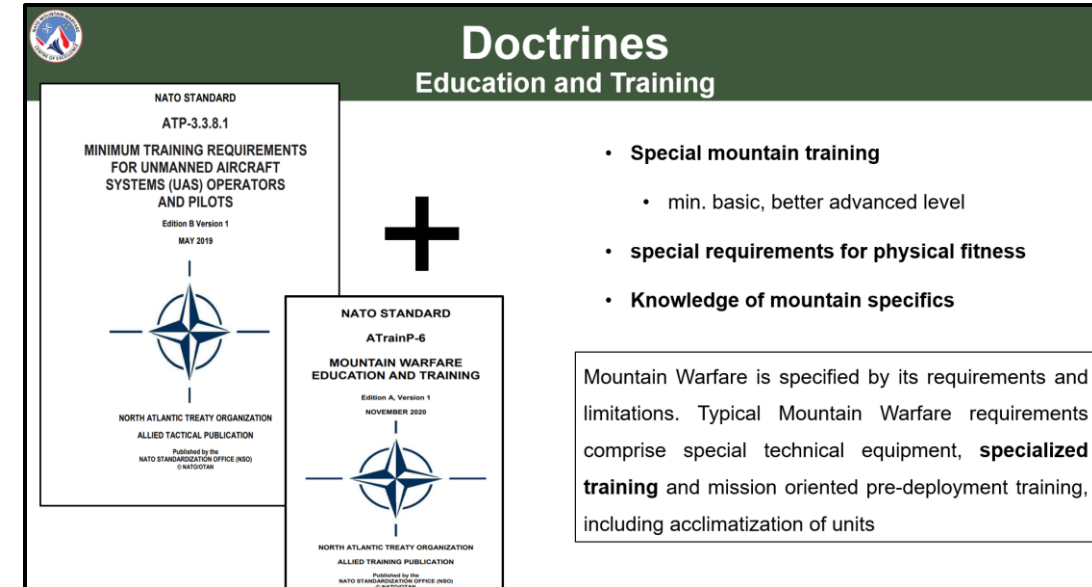
- NATO nations and partners have to apply the exciting regulations (STANAG), interoperability
  - **Review of the existing Task Organization** (UAV teams?)
  - Close cooperation with the companies (constantly monitor the market)
  - **Information Management**
  - Air Space Management
  - Train the trainer, continually train the operator
  - **considering UAS in training and exercises (CAX)**, planning process (consideration of UAS in the planning process [comparison of combat power, logistics...ROC drill])
- (BMS [SitaWare])



# Special requirements

## Use of UAS in mountainous environments

- Light (backpack), foldable
- Robust
- **Long battery life**
- resistant to extreme cold, high altitude, wind
- Easy to operate (buddy system up to platoon level)
- Operational even without Line of Sight
- **Operable under extreme weather conditions (gloves)**
- Display vs. FPV (e.g. strong sunlight in combination with snow)
- **Cheap (amount of UAVs)**
- GPS hardened

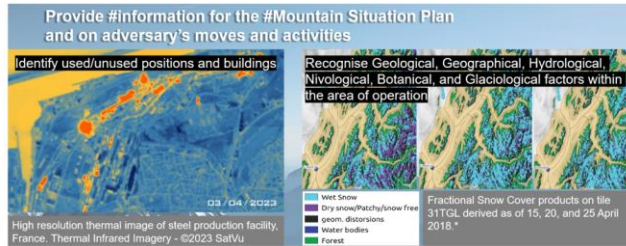
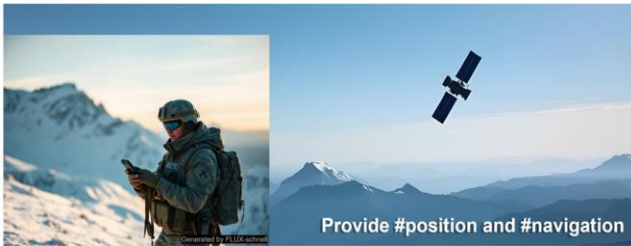






# Future MW Operating Environment

## MDO / Domain Space



- **Space support is essential to mountain operations** (even more than you might expect!).
- Today, more nations recognize space as an operational domain and understand the criticality of space support for NATO operations; consequently, **space support can no longer be guaranteed.**
- You might lack space support when you need it the most; **be prepared to react.**
- Mountain operations can also play a fundamental role in ensuring the continuity of space support!



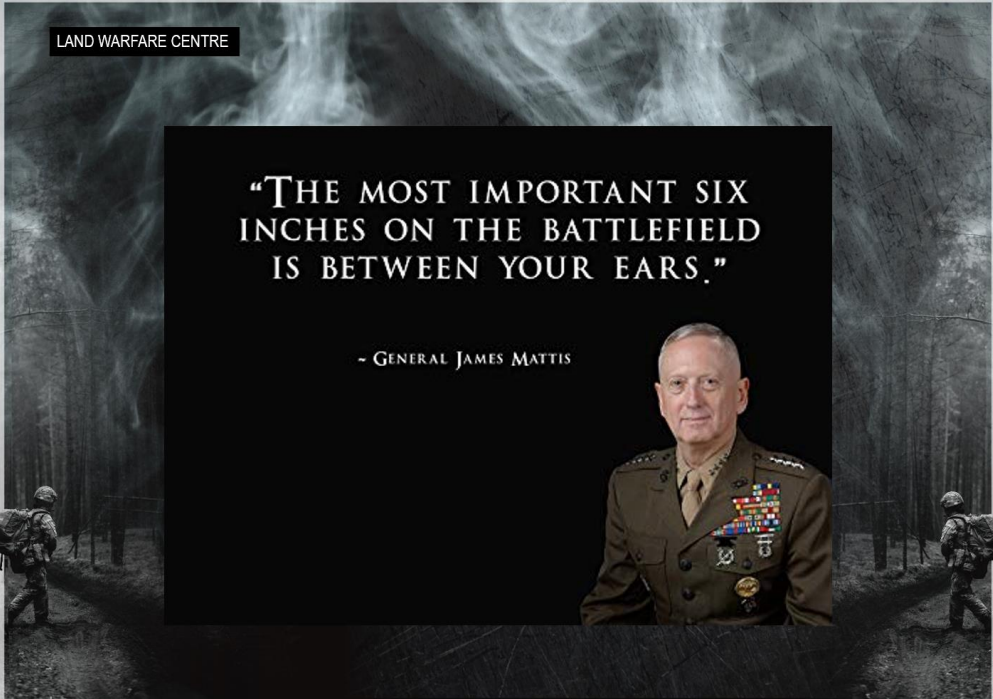
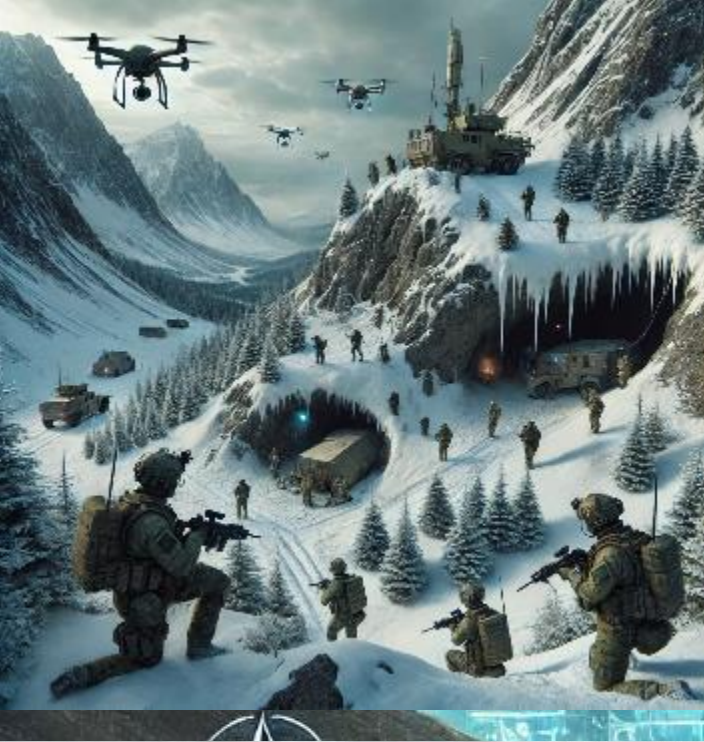


# Conclusion

Future operating environment for NATO mountain warfare troops will be:

- **characterized by the need for technological superiority,**
- **adaptable to climate and terrain challenges,**
- **able to counter hybrid threats in a complex geopolitical landscape.**

These troops will need to be **highly trained, technologically equipped, and integrated into wider NATO defence strategies** to effectively operate in rugged mountain environments.





# Activities 2024/25



17  
MAR

## Mountain Risk Management Workshop Winter, Integrating...

🕒 17 March 2025 - 21 March 2025

📍 Poljče 27, 4275 Begunje na Gorenjskem

Doctrine & Standardization



09  
JUN

## NATO Mountain Warfare Operations Planning Course

🕒 09 June 2025 - 13 June 2025

📍 Poljče 27, 4275 Begunje na Gorenjskem, SLOVENIA

Education & Training



22  
SEP

## Mountain Risk Management Workshop Sommer, Integrati...

🕒 22 September 2025 - 25 September 2025

📍 Poljče 27, 4275 Begunje na Gorenjskem

Doctrine & Standardization



20  
OCT

## Battlefield Tour KOTOR-LOVCEN, Montenegro

🕒 20 October 2025 - 24 October 2025

📍 KOTOR/ MONTENEGRO

Doctrine & Standardization



10  
NOV

## Mountain Warfare Small Units Leader Course in Poland

🕒 10 November 2025 - 21 November 2025

📍 AWL Mountain Training Centre - Szklarska Poreba, Poland

Education & Training



24  
NOV

## Mountaineering equipment & materials Workshop

🕒 24 November 2025 - 27 November 2025

📍 Poljče 27, 4275 Begunje na Gorenjskem

Doctrine & Standardization

<https://www.mwcoe.org>



03  
DEC

## Current and Future Security Threats: "Know Your Enemy" ...

🕒 03 December 2024 @ 08:30 - 05  
December 2024 @ 11:00

📍 Prešernova cesta 44, 4260 Bled, Slovenia

Lessons Learned



# NATO Mountain Warfare Centre of Excellence