



EUROPEAN BORDER AND COAST GUARD AGENCY

# Copernicus Working Group on Geospatial Data

Annual meeting: 6-7 March 2025

Data and Geospatial Analytics Sector  
Fusion Unit, European Integrated Border Management Intelligence Division

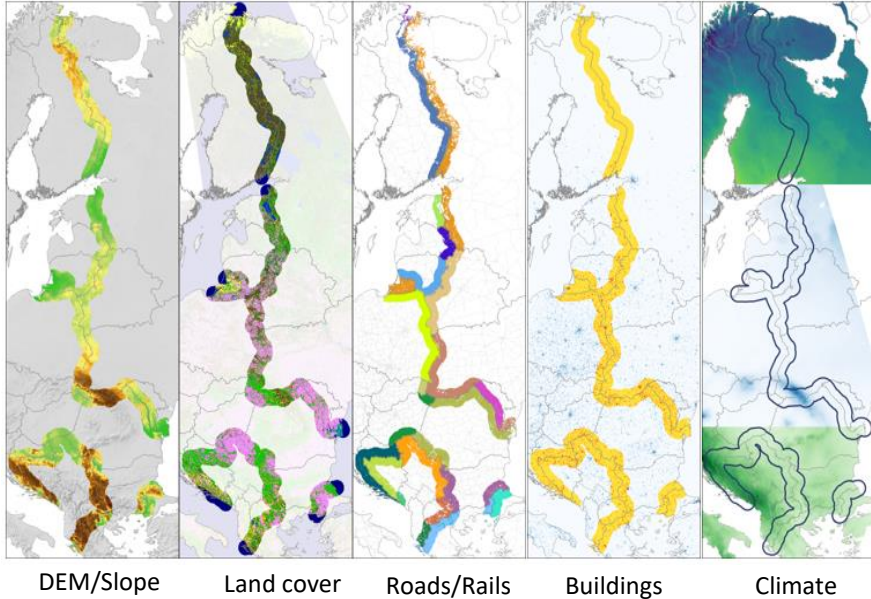
Katalin Bódis

# Frontex in the Copernicus Security Service

- Frontex is responsible for the **Border Surveillance Component** of the CSS.
- 17 products delivered in the framework of the Copernicus Programme.
- Sub-services are using **in-situ geodata** as reference or auxiliary data.
- Frontex is involved into the work of the WG on geospatial data since 2016.
- Frontex is rather a '*user*' of in-situ geodata than a public provider.
- Data requirements (geographic coverage, reference data, specific objects, real-time, model).

# Border Permeability Map - Environmental Module

The **Border Permeability Map** is a product provided by the Copernicus Border Surveillance service.



The **Border Permeability Map** provides information on the external land borders and their geographical permeability, considering several **environmental factors**, such as **terrain**, **land cover**, **hydrographic** and **climatic conditions** etc., and supports risk and vulnerability assessment models.

The map is based on a complex indexation methodology and multivariate geospatial analyses **developed in Frontex**.

## Components of the environmental module:

- Digital Elevation Model - high resolution global dataset, derived product: slope degree.
- Land Cover Database - characteristic land cover based on EO and statistics.
- Transport networks - all roads and railways.
- Human presence - inbuilt areas, settlements, buildings.
- Climatic conditions - number of ice days, heavy precipitation days, and cumulated snow depth (time series).



Land



Emergency



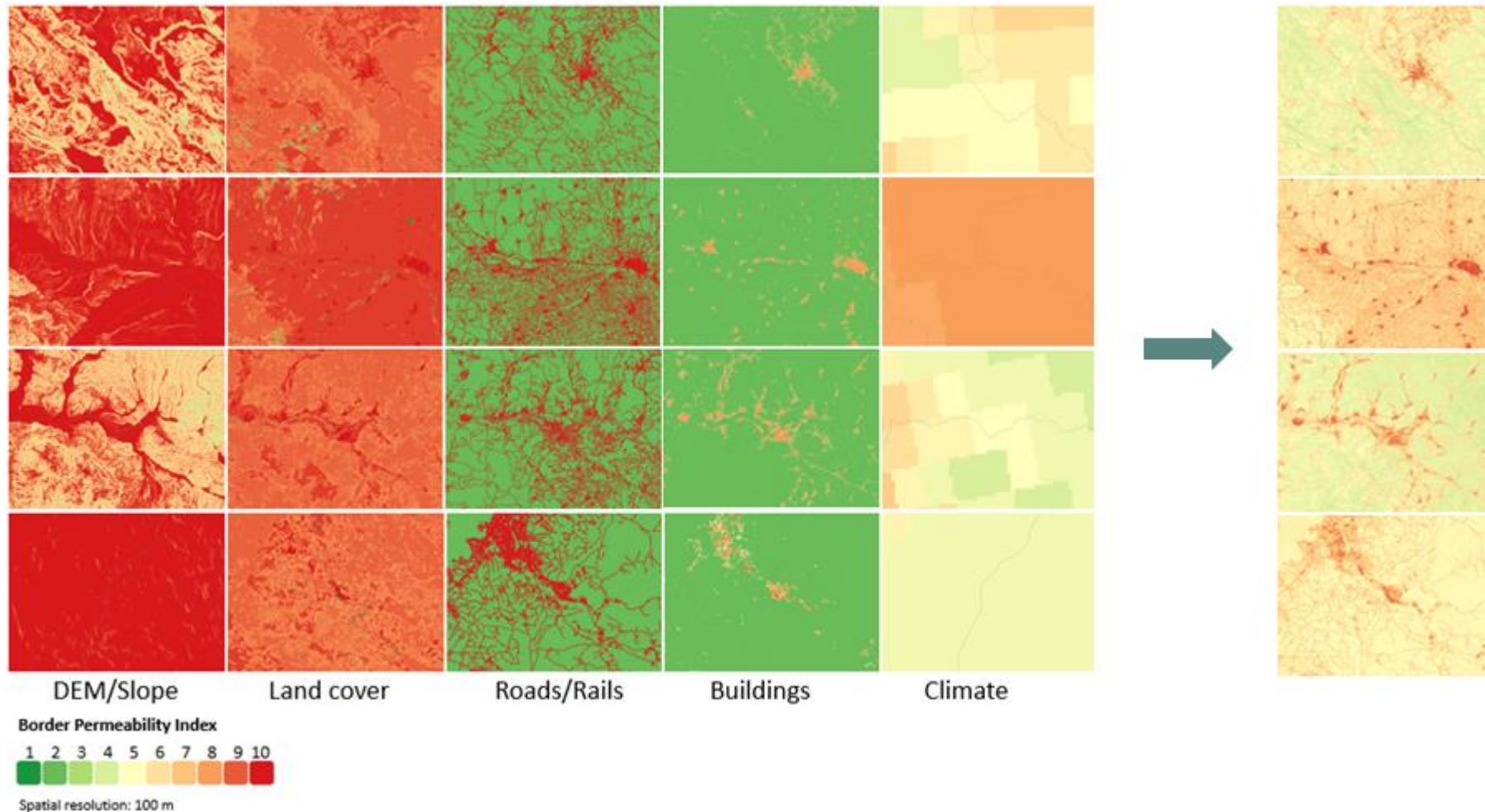
Atmosphere



Climate

# Border Permeability Map - Environmental Module

The map presents the **Border Permeability Index** with numerical values between 1 and 10, where 1 means low permeability (difficult to pass) and 10 means high permeability (easy to pass). The index can be attributed to any border area, minimum scale is 1 hectare,



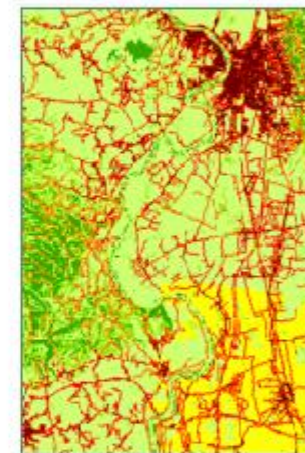
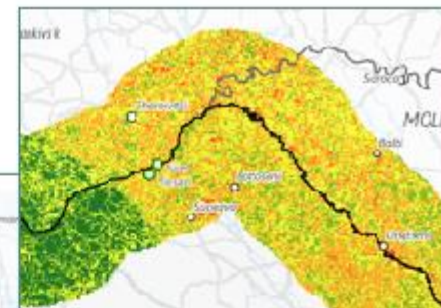
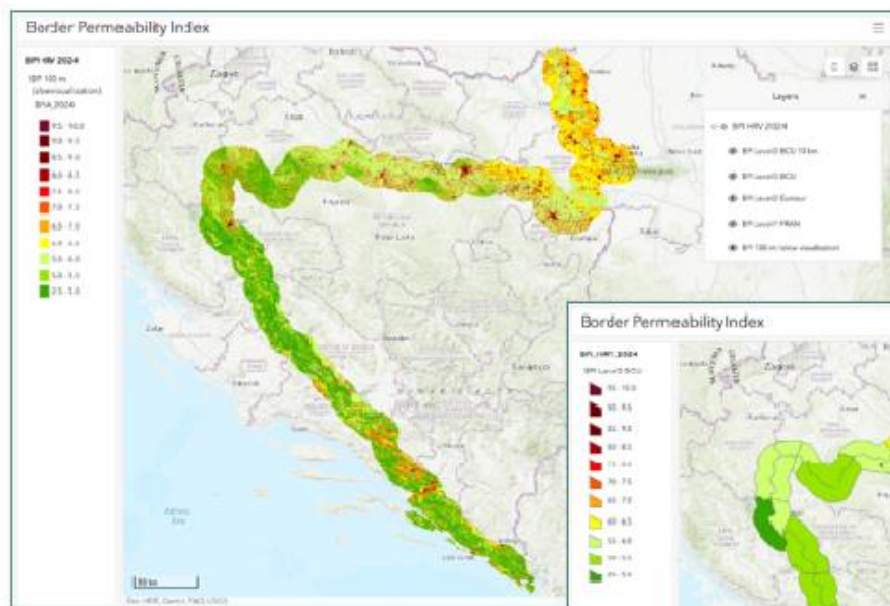


# Border Permeability Index - Border Permeability Map



Availability for risk and vulnerability assessment models, border quantification, mapping

The Permeability Map is available in various aggregation levels and several formats (printed, static digital or web map application) upon request from the EU MS/SAC.



# Border Permeability Map - Ongoing development

## Additional In-Situ Datasets

### Digital Elevation Model

- Spatial resolution 5-10 m, Morphology, 3D models (Lidar survey, drone based geometrically calibrated camera).

### Land Cover

- Seasonality, modelled changes.

### Transport networks

- All types of roads (e.g., tracks, game and hiking trails, railways), road surfaces, connected infrastructure.

**Mapping vulnerability ➡ Optimised resource allocation ➡ Efficient Border Surveillance**

# Border Permeability Map - Dynamic Border Permeability

## Extended components

### Hydrogeography

- Detailed geometry, morphology and landforms of water bodies and river network;
- Characteristics of the riverbeds (fine silt, clay, boulders);
- Hydro-meteorological hazards (e.g., usual flooding period, length of ice cover);
- Infrastructure connected to local water management (e.g., dikes, embankments, power plants, bridges etc.).

### Hydro-meteorological conditions / actual weather and weather forecast

- Real-time or near real-time data;
- Meteorological parameters (temperature, dew point, wind, fog etc.);
- Hydrological parameters (river discharge, water level, flow velocity);
- Extreme events, e.g.:
  - thermal extremes, drought, forest fires, heavy rain/snow, storms, floods, flash floods, landslides, ice cover.

**Mapping vulnerability ➡ Optimised resource allocation ➡ Efficient Border Surveillance**

# In-situ data collected by border surveillance \*

## **Border Infrastructure Monitoring**

- Checking integrity of barriers / fences (sensors detecting fence breaches);
- Road and path conditions (for patrol accessibility and tracking erosion);
- Bridge and river crossings monitoring (detecting illegal water crossings).

## **Maritime and River Surveillance**

- Water temperature and flow data (detection of unauthorized crossings);
- Sonar and underwater sensor data (detection of divers or submersibles);
- AIS (Automatic Identification System) data (vessel monitoring and tracking).

## **Movements in the Border Zone**

- Footprints and tire tracks (indicating recent crossings);
- Illegal crossings detection (patrols, infrared sensors, pressure-sensitive ground sensors);
- Acoustic data (unusual artificial noises, sound of vehicles, footsteps, human voices);
- Seismic activity sensors (detecting underground tunnels or activities, motion detection);
- Heat signals (thermal cameras identifying people hiding in vegetation).

## **Human and Vehicle Identification**

- Signals of communication networks (human trafficking, smuggling networks);
- Radio-frequency identification (RFID) or Bluetooth signals (from vehicles, mobile devices);
- License plate recognition (LPR) data (tracking vehicles).

\* Data access is limited to authorized users only.





# Copernicus Service Evolution - Prize Award Contest

Aim: Building a **Digital Twin**  
for border surveillance

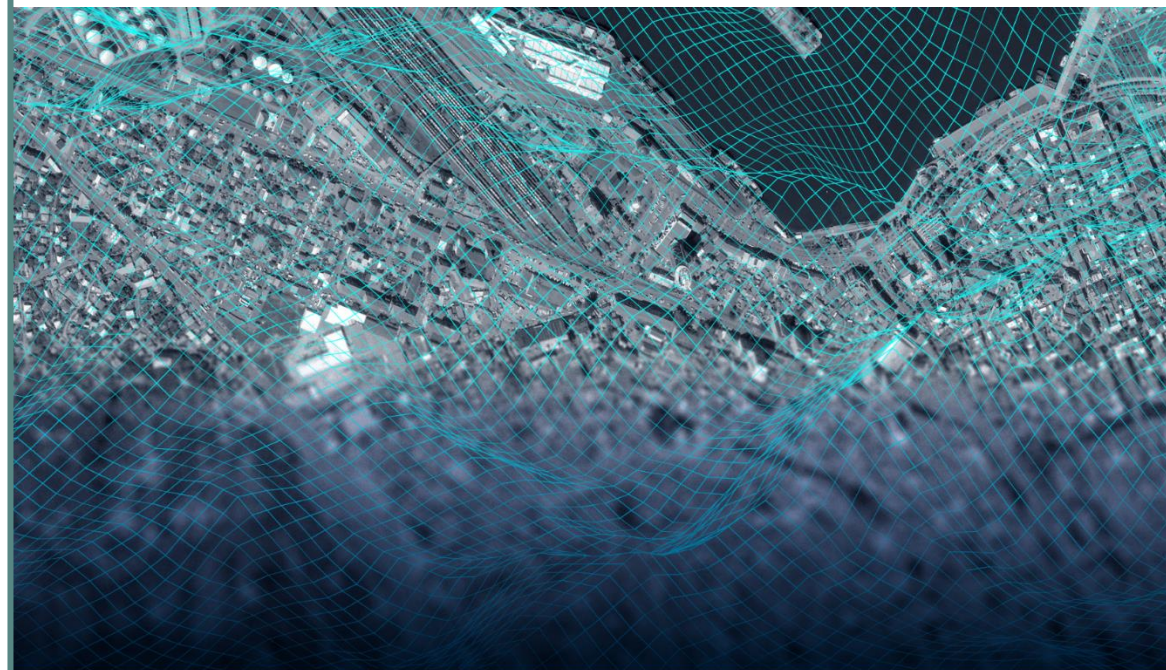
**March 7th, 2025, at 17:00 CET**

## Benefits:

- *Data collection and integration;*
- *Monitor and optimize performance;*
- *Simulate, test and experiment;*
- *Plan for and respond to emergencies;*
- *Prepare and improve trainings;*
- *Knowledge transfer.*

<https://www.frontex.europa.eu/innovation/research-and-innovation/prize-contests/prize-award-contest-on-copernicus-border-surveillance-service-evolution-CczoJ8>

# DIGITAL TWIN



# Frontex - In-situ geodata required - Summary

## General requirements

- Geographic coverage: European Union / Schengen Associated Countries (EU/SAC) - external border zones both sides of the land borders, focusing on the territories in the Third Countries, and the maritime borders of Europe.
- High temporal and spatial accuracy, and reliability of the content.
- Precision: High resolution raster and large-scale mapping data for vector data sets.

# Frontex - In-situ geodata required

## Reference data (focus on 25 km zone of both sides of the EU/SAC external borders)

- Administrative boundaries: detailed border geometry of the EU/SAC external borders.
- Official sea borders (Territorial Waters, Exclusive Economic Zone, Search and Rescue Regions).
- Harmonized water database, physical characteristics of water courses and water bodies (type of riverbanks, hydro-meteorological hazards, i.e., usual flooding period, length of ice cover).
- Infrastructure connected to local water management (e.g., dikes, embankments, power plants, bridges etc.).
- Coastlines, attributes: morphology and landforms, suitability for landing/launching.
- Transport infrastructures: infrastructures and facilities related to transport networks (e.g., roads, tracks, game and hiking trails, railways, bridges, train stations, harbours, airfields, heliports).
- Building dataset (building footprints), vector-based data indicating social- and critical infrastructures (e.g., hospitals and schools with capacity, power plants, water resources) and status of inhabited/abandoned edifices.
- Large scale and/or high-resolution information on geology and geomorphology.
- 3D models (Lidar survey, drone-based geometrically calibrated camera).
- Land cover data extended by agricultural activities: seasonal crops on arable lands.
- Harmonized gazetteer database (geographic names of locations and their coordinates).

# Frontex - In-situ geodata required

## Mapping characteristic land objects in the border zone

- Detailed border geometry: preferably containing every single geodetic basepoint as a vertex in the border line.
- Exact location of boundary markers / border stones / pillars along the EU/SAC external borders.
- Watch towers or observation towers (all purposes, e.g., military, surveillance, hunting, fire lookout, touristic, bird observation).
- Location of lighthouses along the sea borders.
- Telecommunication and radio towers, radar masts.
- Meteorological towers, wind measuring masts.
- Military facilities, i.e., camps, garrisons, fortresses, other fortifications and stations, military air bases, naval bases.
- Exact location of restricted access territories, e.g., suspected minefields in former Yugoslavia.

# Frontex - In-situ geodata required

## Real-time or near real time data (occasional, EU/SAC and neighbouring countries)

- Detailed traffic information, movements towards and within the border areas, congestions.
- Location of armed conflicts, transport, industrial, and energy infrastructures of related regions.
- Descriptive environmental and socio-demographics data related to crisis zones.
- Localization of extreme natural events (e.g., thermal extremes, storms, forest fires, heavy rain/snow, floods, flash floods, landslides).
- Location and magnitude of industrial hazards (e.g., pollution, fire, explosion, toxic release).

## Modelled data

- Country-based traffic estimates; estimated waiting time to cross the border (lorries, public transport, private cars).
- Meteorological forecast.
- Wind and wave forecast: Maritime areas, preferences: Mediterranean Sea, Atlantic Ocean (Canary Islands).
- Flood (flash flood) forecast.



