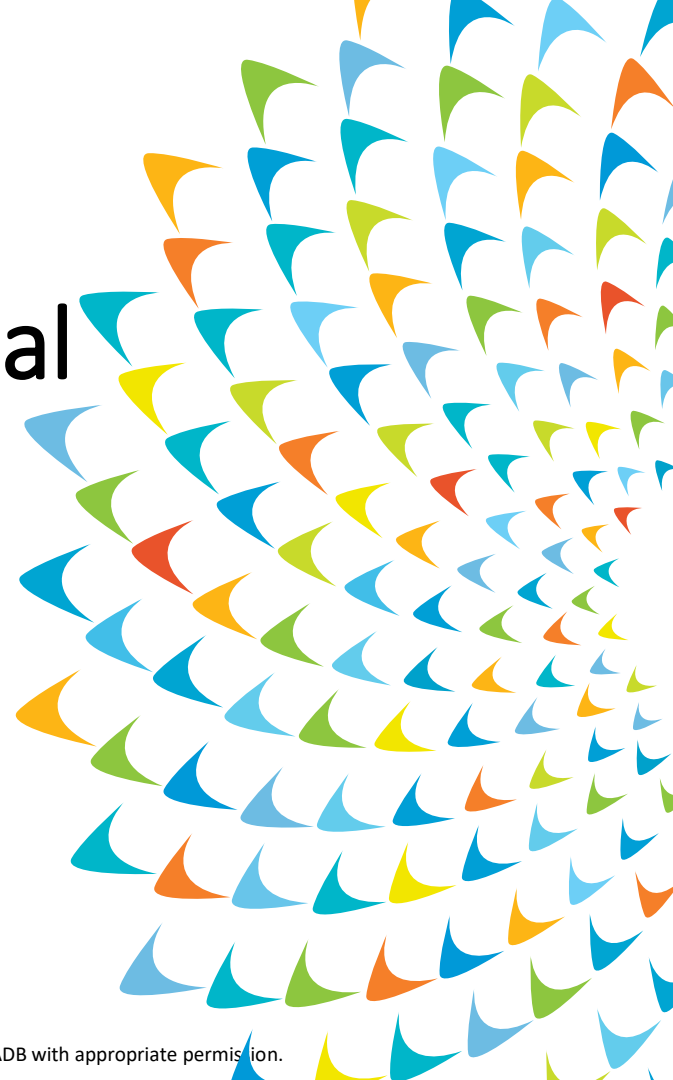# AI/ML Applications in Regional GeoDigitalTwin

Paolo Manunta Senior Digital Technology Specialit (Earth Observation)

AI/ML applications in GeoDigitalTwin

Overview: A 4D Digital Twin of Sumatra integrating existing and new geospatial data to support sustainable urban and regional planning and environmental management.

AI/ML Role:

- Automating the creation of regional-scale geospatial layers using big data;

- Filling data gaps in existing EO/Satellite data products;

- Generating new data layers leveraging heterogeneous proxy datasets.

Key Benefits: Providing accurate, dynamic, and actionable insights for decision-making.
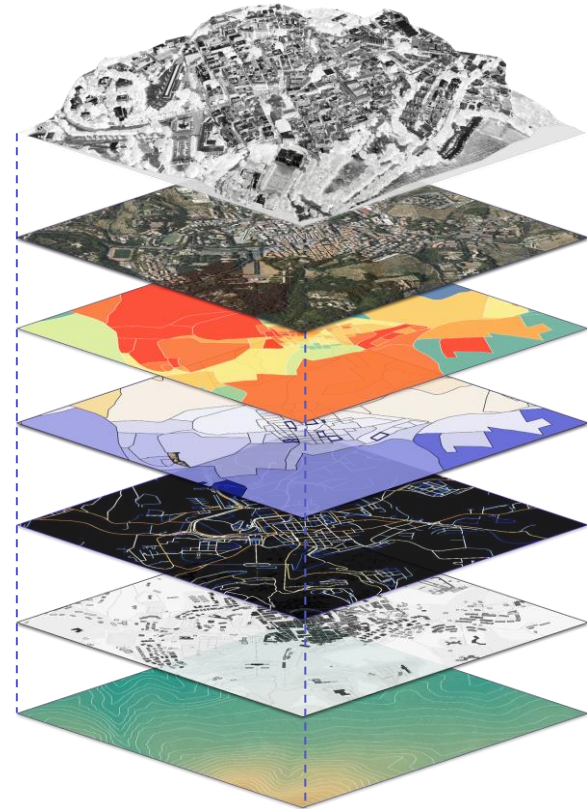
Base terrain model

Shuttle Radar Topography Mission digital elevation model - SRTM30 DEM

⪼ Spatial resolution of 30 meters.

⪼ Near-global coverage

Widely used across a variety of applications from environmental analysis to urban planning.

⪼ Employed to model 3D topography

⪼ Optimal balance between visual clarity and performance efficiency.

ADB

Environmental Hazard

Flood Risk (CIMA-GIRI)

Global Infrastructure Risk Model and Resilience Index (GIRI) based on the state-of-the-art flood risk model developed by CIMA Research Foundation, Ingeniar, NGI, and the University of Geneva, and provided in-kind by CIMA Research Foundation.
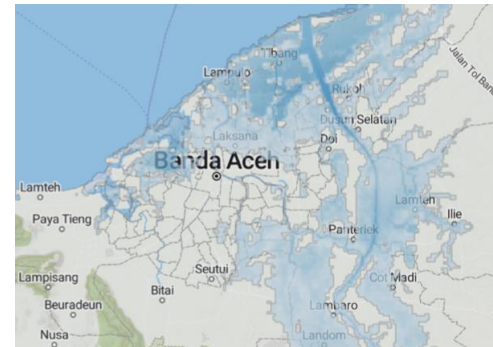
Flood risk, historical data 50-year return period

Flood risk, SSP126 scenario, 50-year return period
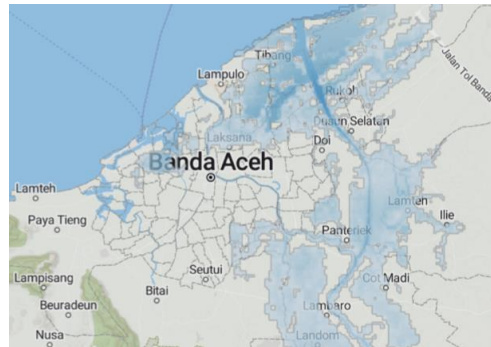
Flood risk, SSP585 scenario, 50-year return period
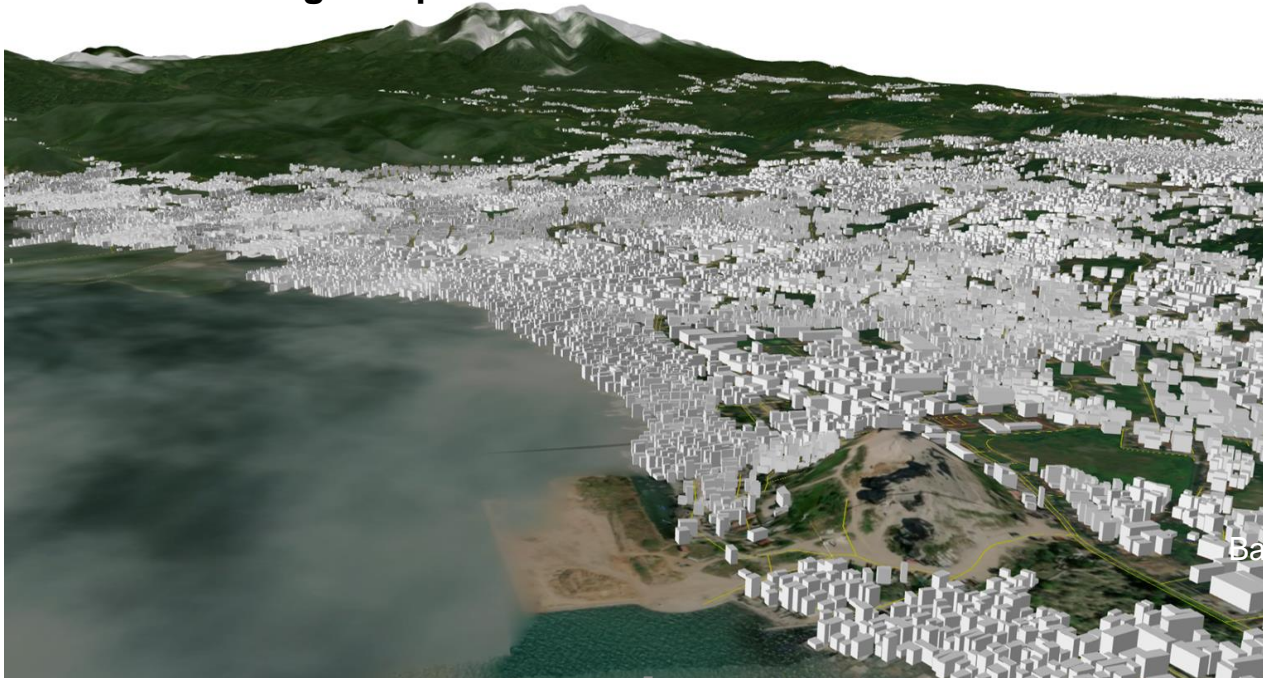

Hazard [adim]

1.0
250.8
500.5
750.2
1000.0

3D buildings

Building footprint

Building height

⸭ **Google's Open Building:** geometries

Microsoft's Global Building Footprints:

World Settlement Footprint 3D WSF3D):.
Provided in-kind by DLR

ADB

Building-level population

Residential Population

- Density of inhabitants at night for residential buildings

- Total population figures per unit are redistributed using dasymetric mapping by jointly exploiting Building Area and Height as weights.

- Computed using population figures for 2022 available at provincial level (2023 Statistical Yearbook of Indonesia) + Indonesia's estimated 2022-2023 population growth factor (UN's 2022 World Population Prospects).

less than 5

People

more than 150

Deutsches Zentrum
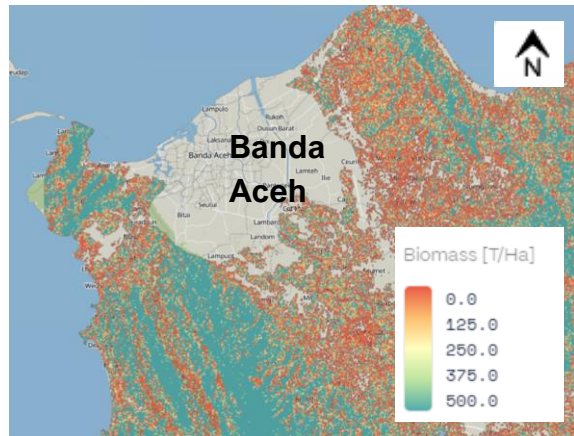DLR für Luft- und Raumfahrt
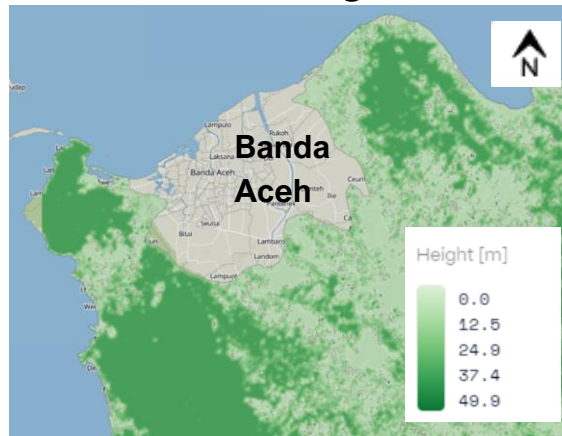
6

ADB

Environmental Indicators

Vegetation Carbon Profile
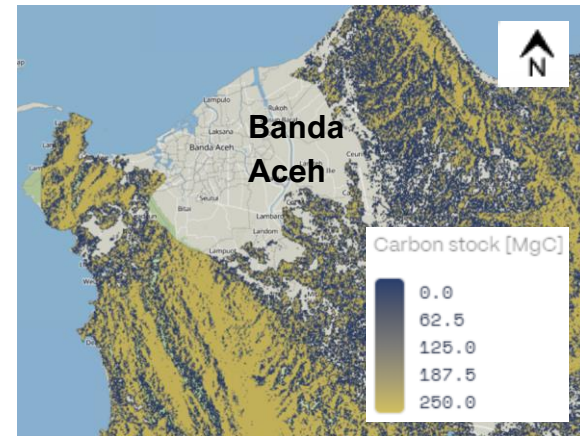
Above Ground Biomass

Measures forest biomass from ALOS-2 SAR imagery.

Tree height

Estimated from ALOS-2 ScanSAR and validated with GEDI and other datasets.
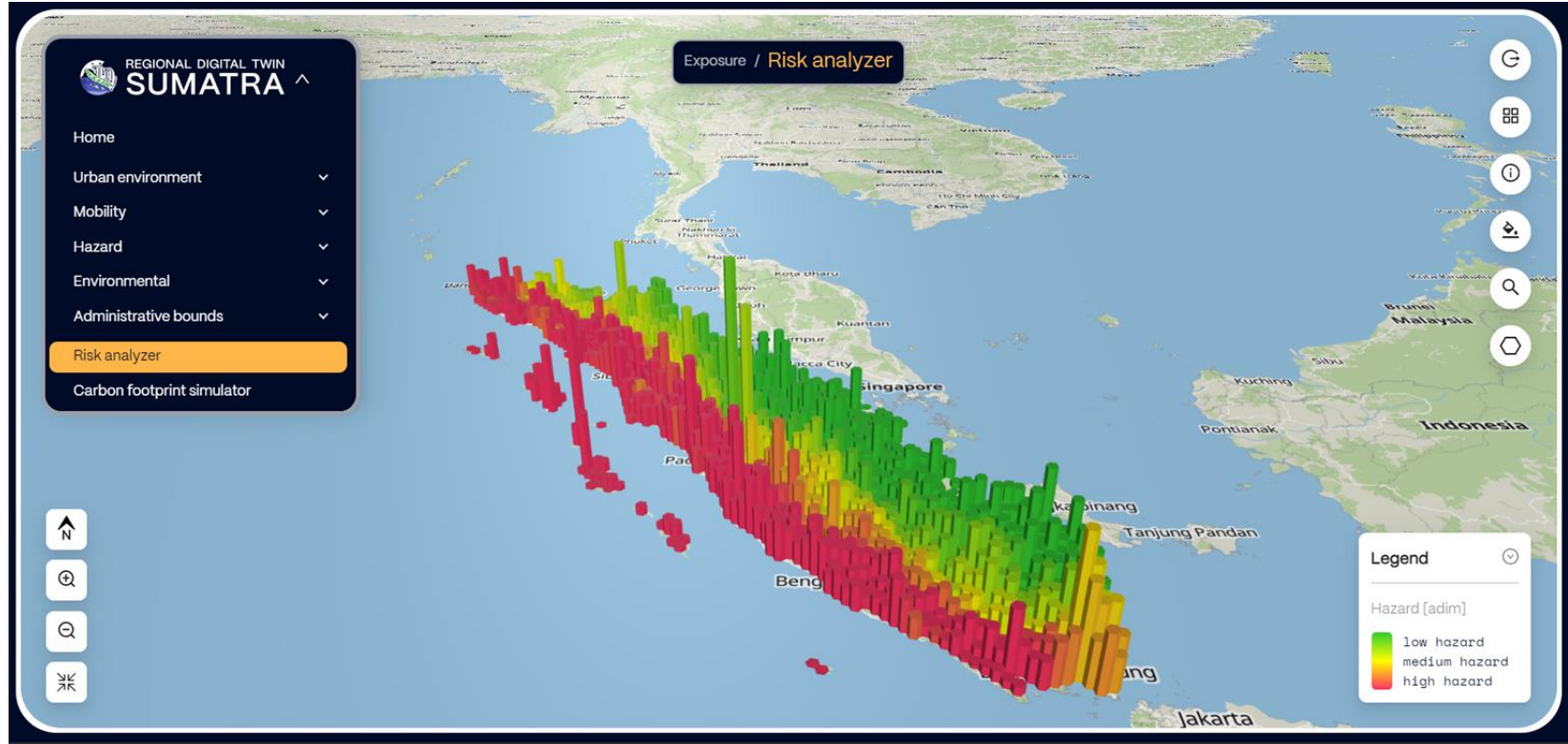
Carbon Stock

Estimated as 50% of AGB, based on biomass-to-carbon conversion.

Risk Analyzer

Pre-defined Policy Scenarios

We created three predefined policy scenarios focusing on and obtain numerical values for carbon budget :

- Green Urban Growth

- Slow-Growth Lifestyle

- Efficient and Green Mobility

These are based on an overview on existing policies and ambitions by the Indonesian Government in the building, transportation and ecosystem conservation sectors

Solomon: Geoportal for Natural Capital

PNG: Support to Transport
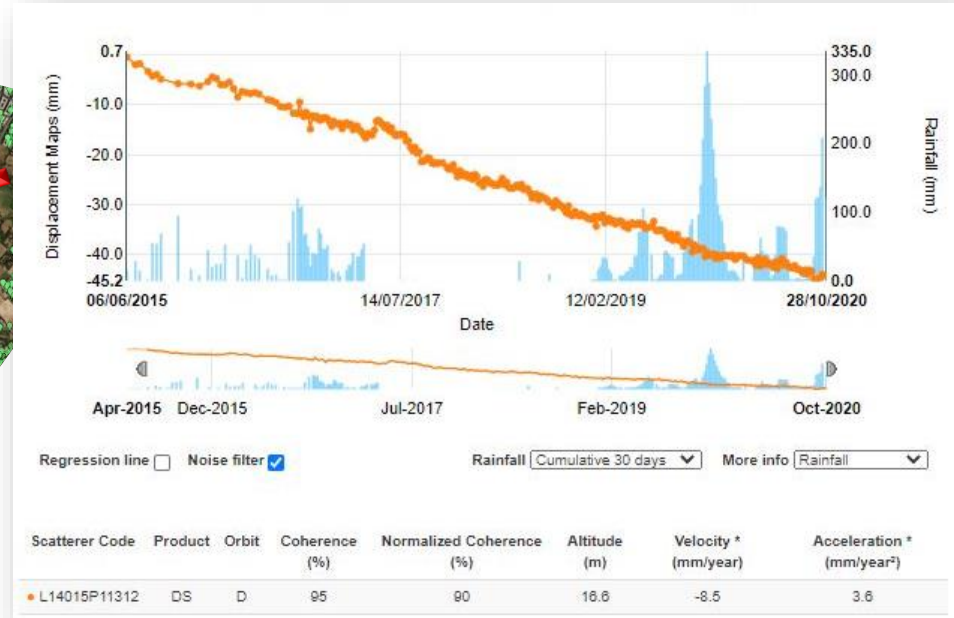

Subsidence

Inteferogram   phy   Movement

$$\Delta\phi = \frac{4\pi}{\lambda}\left(\frac{B_\perp \cdot h}{r_0 \sin\theta} + v \cdot \Delta t \right)$$

InSAR Processor
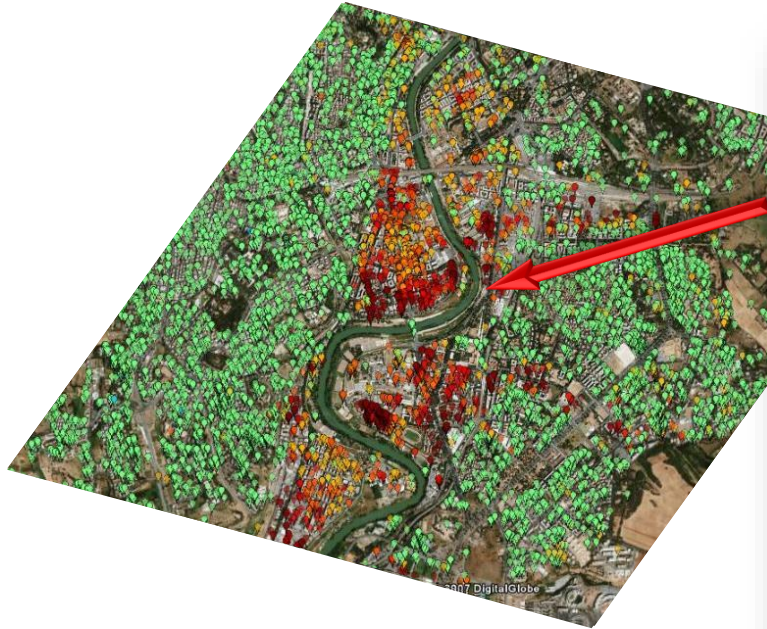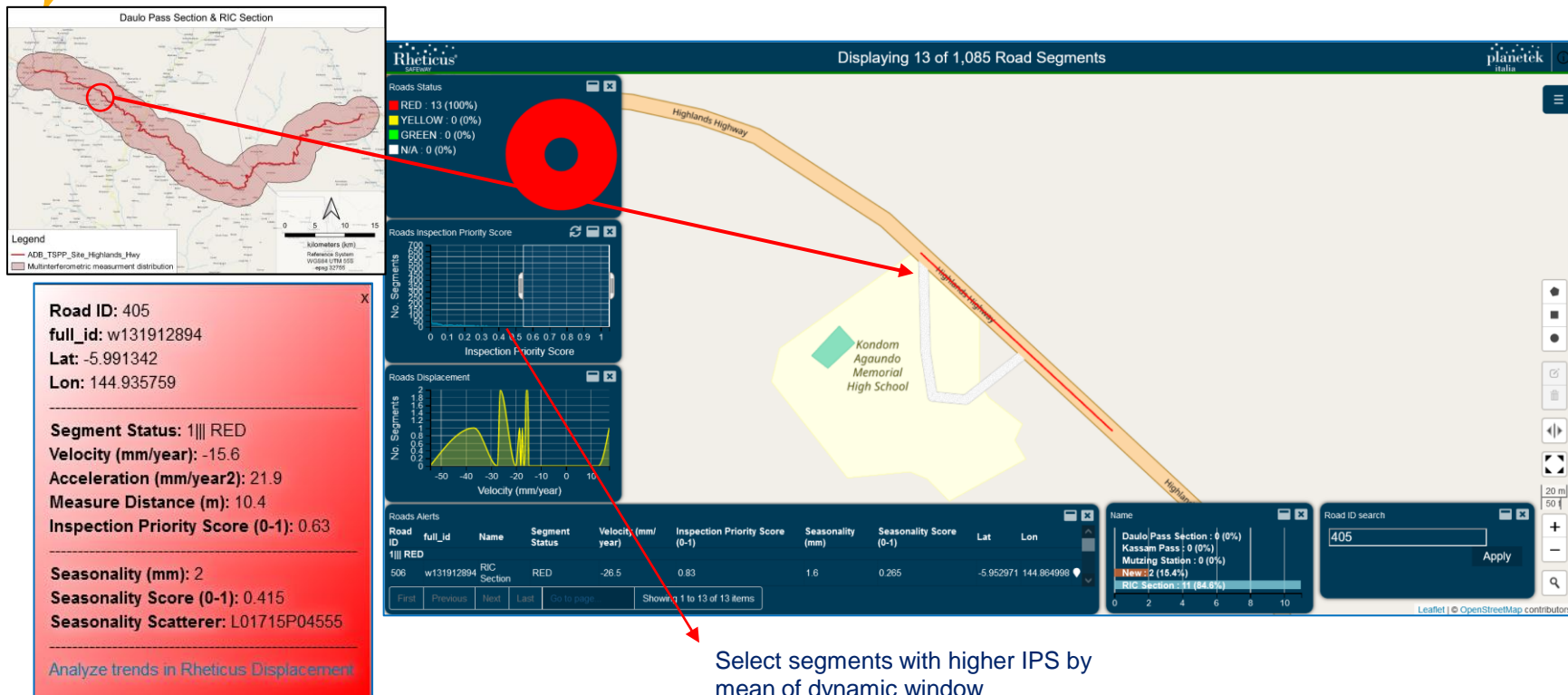
ADB

PNG Rheticus® Displacement service - PSI Methodology

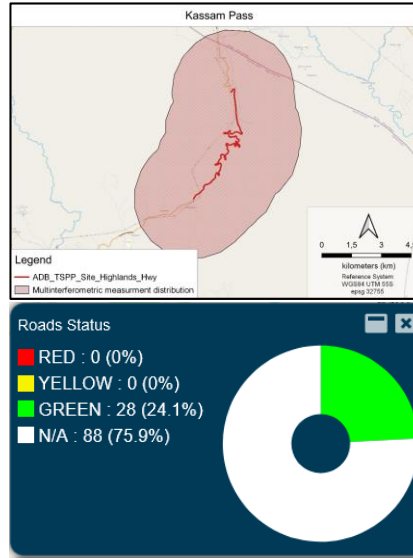Rheticus® Safeway Daulo Pass and RIC sections Sentinel-1 Asc/Desc (01/19 – 12/23)

Select segments with higher IPS by mean of dynamic window

Summary

Daulo Pass Section & RIC Section

Roads Status
- RED : 54 (6.2%)
- YELLOW : 52 (6%)
- GREEN : 496 (57%)
- N/A : 268 (30.8%)
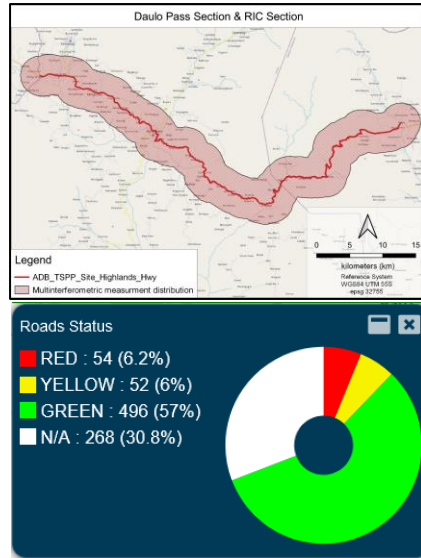
- **RED Segments** – IPS >0.3 [10 mm/yr <**Vel**< -10 mm/yr]
- **YELLOW Segments** – 0.2 < IPS < 0.3 [-10 mm/yr< **Vel** < -5mm/yr & 5 mm/yr < **Vel** < 10mm/yr]
- **GREEN Segments** – IPS <0.2 [-5 mm/yr <**Vel**< 5 mm/yr]

Kassam Pass

Roads Status
- RED : 0 (0%)
- YELLOW : 0 (0%)
- GREEN : 28 (24.1%)
- N/A : 88 (75.9%)

RED Segments – Inspection Priority Score >0.3
YELLOW Segments – 0.2 < Inspection Priority Score < 0.3
GREEN Segments – Inspection Priority Score <0.2 [-4 mm/yr < **Vel** < 0 mm/yr]
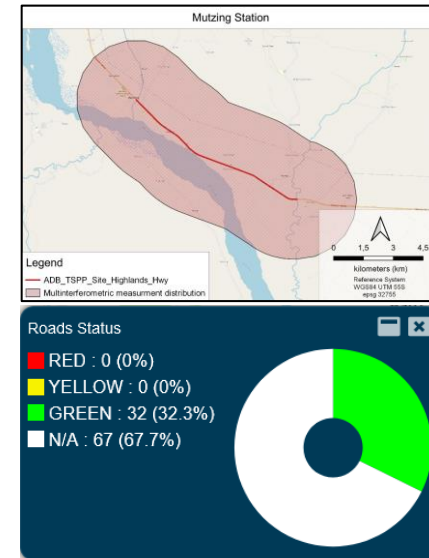
Mutzing Station

Roads Status
- RED : 0 (0%)
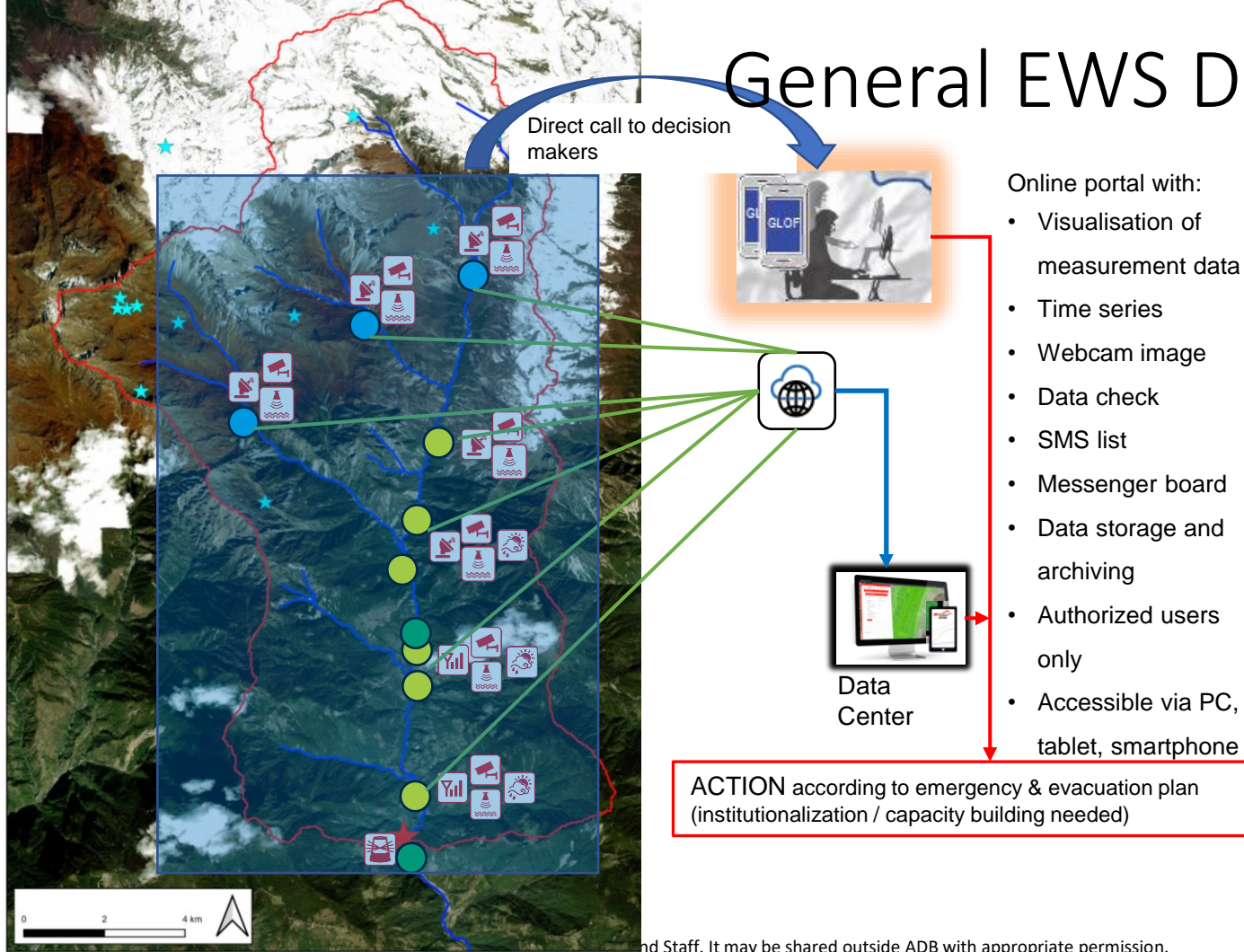- YELLOW : 0 (0%)
- GREEN : 32 (32.3%)
- N/A : 67 (67.7%)

RED Segments – Inspection Priority Score >0.3
YELLOW Segments – 0.2 < Inspection Priority Score < 0.3
GREEN Segments – Inspection Priority Score <0.2 -6 mm/yr < **Vel** < 0 mm/yr

General EWS Design

Direct call to decision makers

Online portal with:

- Visualisation of measurement data
- Time series
- Webcam image
- Data check
- SMS list
- Messenger board
- Data storage and archiving
- Authorized users only
- Accessible via PC, tablet, smartphone

Data Center

ACTION according to emergency & evacuation plan (institutionalization / capacity building needed)

Thank You