



EUROPEAN UNION
SATELLITE CENTRE

Analysis for decision making

ESA Network of Resources Final Report

InSAR for underground water extraction impact on subsidence in vulnerable regions

Request ID: 2624a6

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Project Organization: EU Satellite Centre

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GEO SPACE-SECURITY

“Supporting the achievement of the wellbeing and security of countries and citizens by exploiting suitable space assets and collateral data”

Since 2015, SPACE-SECURITY works towards raising awareness and adoption of geospatial open data, citizen science, in-situ data and advanced technologies within the Space and Security stakeholders.

SPACE-SECURITY responds to stakeholders' needs by:

- Providing a forum for discussion and capacity building
- Contributing to R&I initiatives
- Collecting technological needs
- Identifying capability gaps to be filled by space technologies
- Developing and assessing innovative applications
- Building synergies with relevant GEO activities



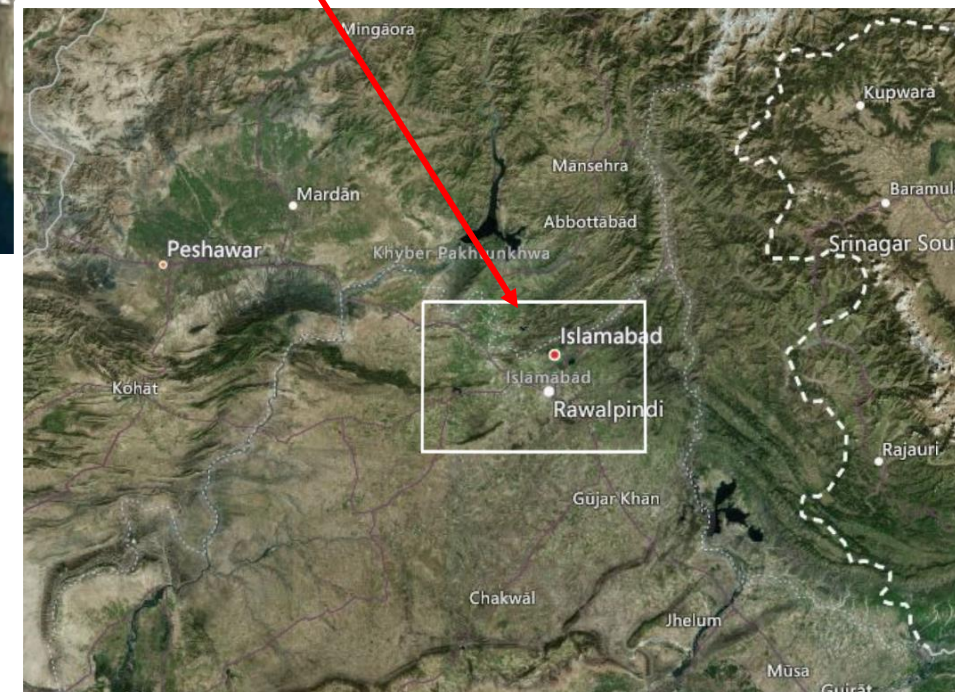
SPACE-SECURITY Pilot Project in a nutshell

The present pilot is part of the GEO SPACE-SECURITY activities undertaken during the period 2020-2022

It consisted in the development of an EO application to assess the impact underground water extraction on civil security and critical infrastructures in vulnerable regions

The area of interest identified is the Pakistani region of Islamabad-Rawalpindi

InSAR processing, specifically SBAS techniques, were identified as suitable tools to analyze the scenario



SPACE-SECURITY pilot definition



The scenario: Monitoring basic resources in regions vulnerable to geohazards – Water Security

Pakistan is currently facing a massive water scarcity challenge due to over-exploitation of groundwater resources for drinking and agricultural purposes. The effective monitoring of the water table is necessary for groundwater resource management, but also in support to guaranteeing safety and security of citizens in front of associated undesired events.



The approach: Joint cooperation within SPACE-SECURITY

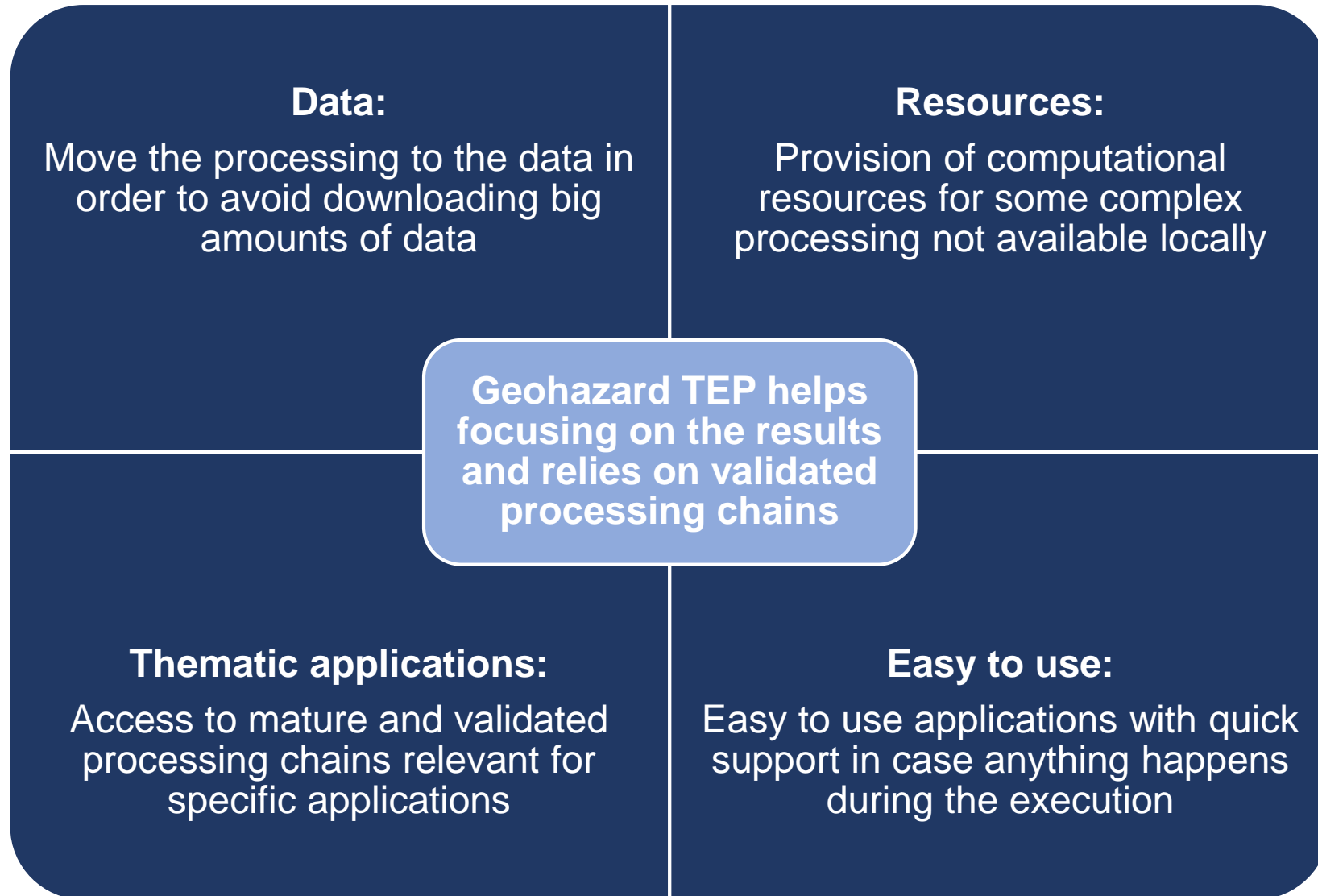
- SatCen, as leader of SPACE-SECURITY, coordinated and implemented the pilot project
- WFP, in particular its field office in Pakistan, is involved in food/water security activities in the AoI, and recognized the need of monitoring the underground water extraction activities
- IGME/EGS applied its experience and methodology to exploit Sentinel-1 data with interferometric techniques
- ESA supported the development by facilitating the access to the processing resources (sponsoring)
- BKG and IHE provided feedback about the pilot activities for future phases



The implementation: Building on available resources

- InSAR methodology consolidated within the Horizon 2020 e-shape project
- Sentinel-1 Small Baseline Subset (SBAS) processing in TEP Geohazards Platform resources
- Joint analysis of results and definition of the way-forward

Why Geohazards TEP for the processing?



Service exploited and processing parameters

SBAS Ground Motion Services:

Tools developed by CNR-IREA SBAS to generate surface displacement time series using Sentinel-1 data.

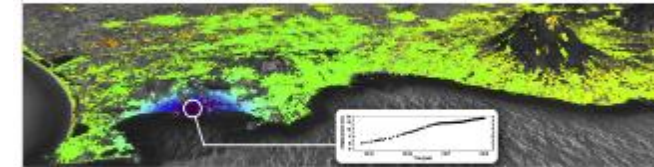
Pilot processing information:

- Acquisition period: October 2016 – Sep 2022 (~180 images)
- Temporal Coherence threshold: 0.75
- S1 descending orbit
- S1 relative orbit: 107
- Control point 1:
 - Lat: 33.7704972222
 - Lon: 73.13528055556
- Control point 2:
 - Lat: 33.747277778
 - Lon: 73.10838055556



P-SBAS InSAR Sentinel-1 TOPS (GEP)

SBAS Ground Motion Services



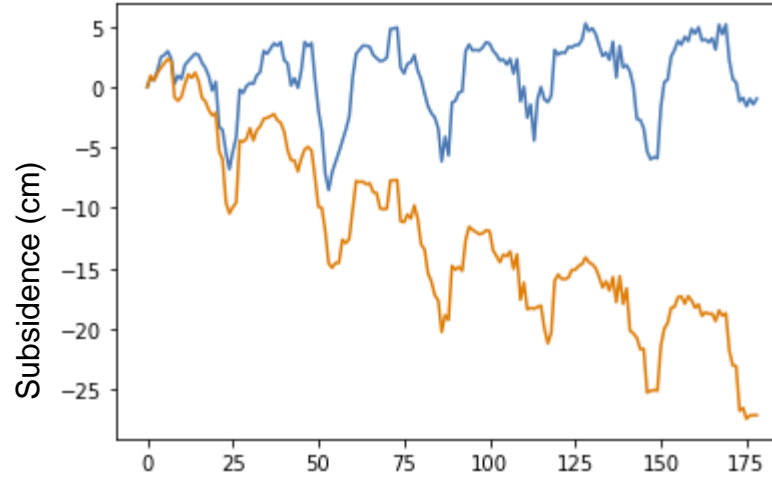
by **CNR IREA**



Results obtained

Control point 1:

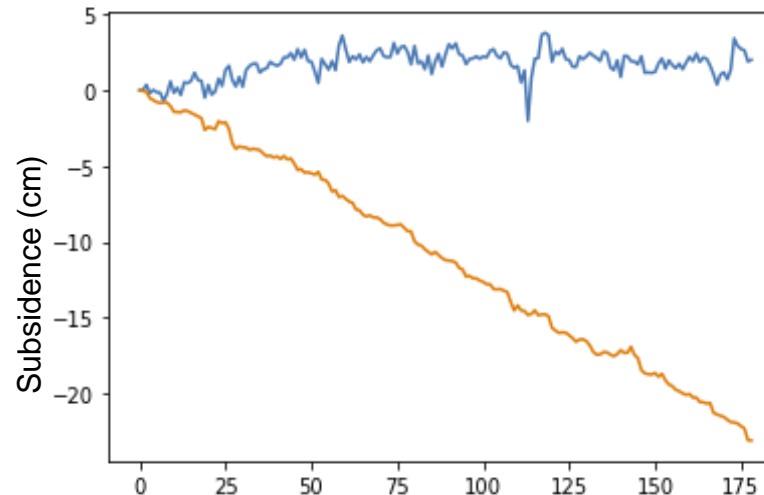
- Seasonal behavior



- Point close to control point
- Point from the most affected area

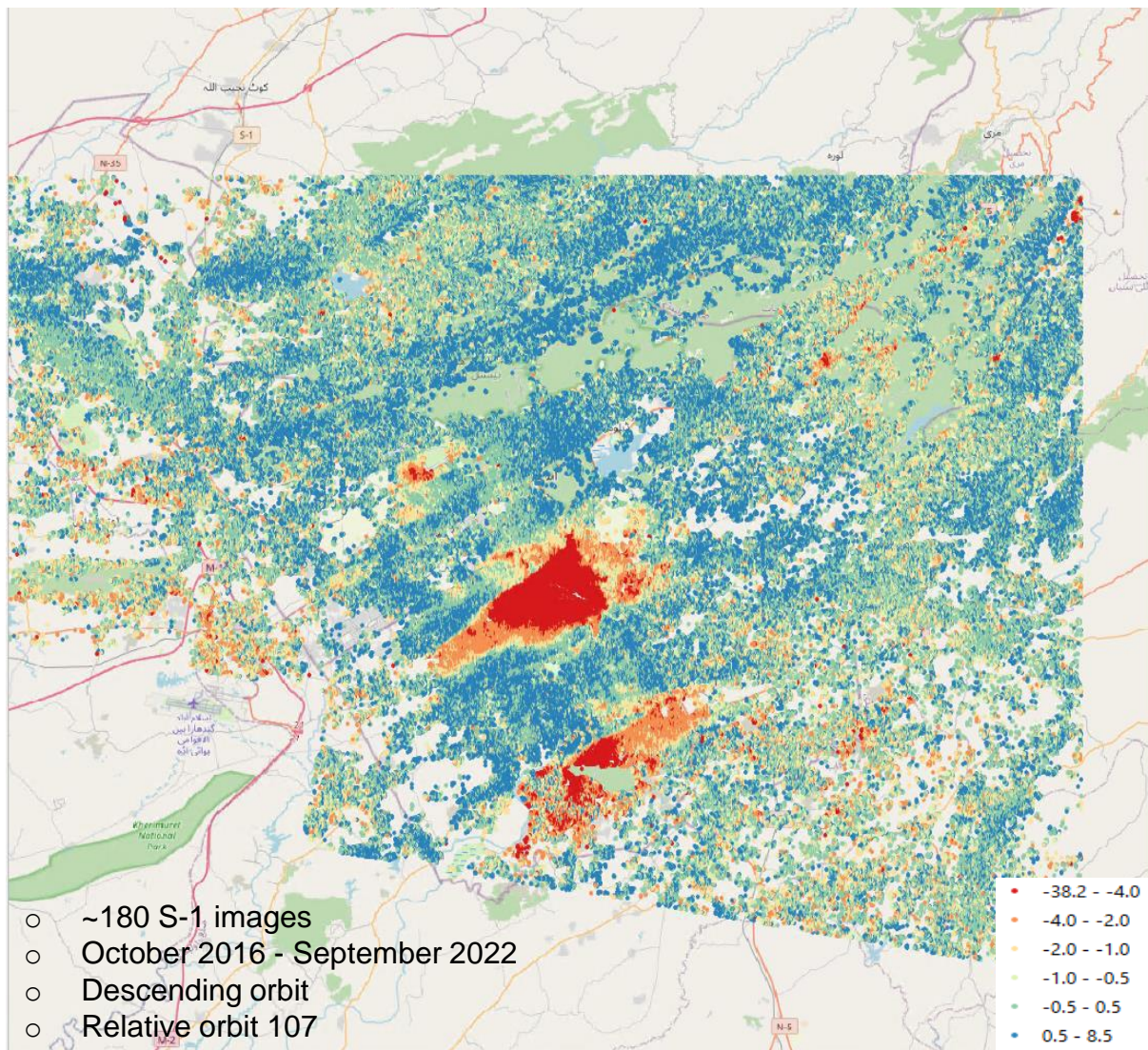
Control point 2:

- No seasonal behavior



Scene number (one image every 12 days)

Conclusions



DInSAR products provide relevant results for:

- Identifying active GeoHazard areas
- Identifying and assessing damages to infrastructures
- Identifying the potential origin of the displacements (together with ancillary data), e.g.:
 - Mining
 - Excessive water extraction



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