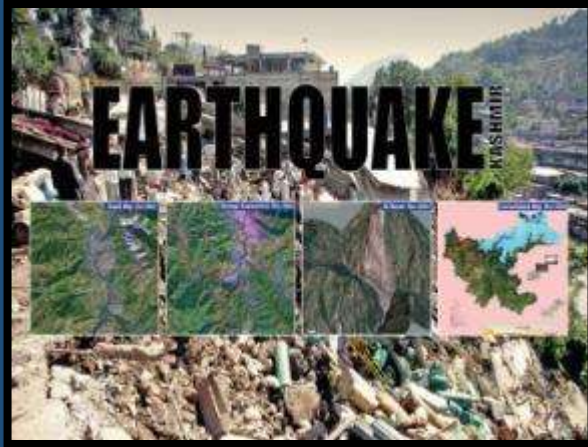

Damage Assessment using Optical Data

Dr Muhammad Farooq
PAKISTAN SPACE AND UPPER ATMOSPHERE RESEARCH COMMISSION

SUPARCO Role in Disaster Monitoring

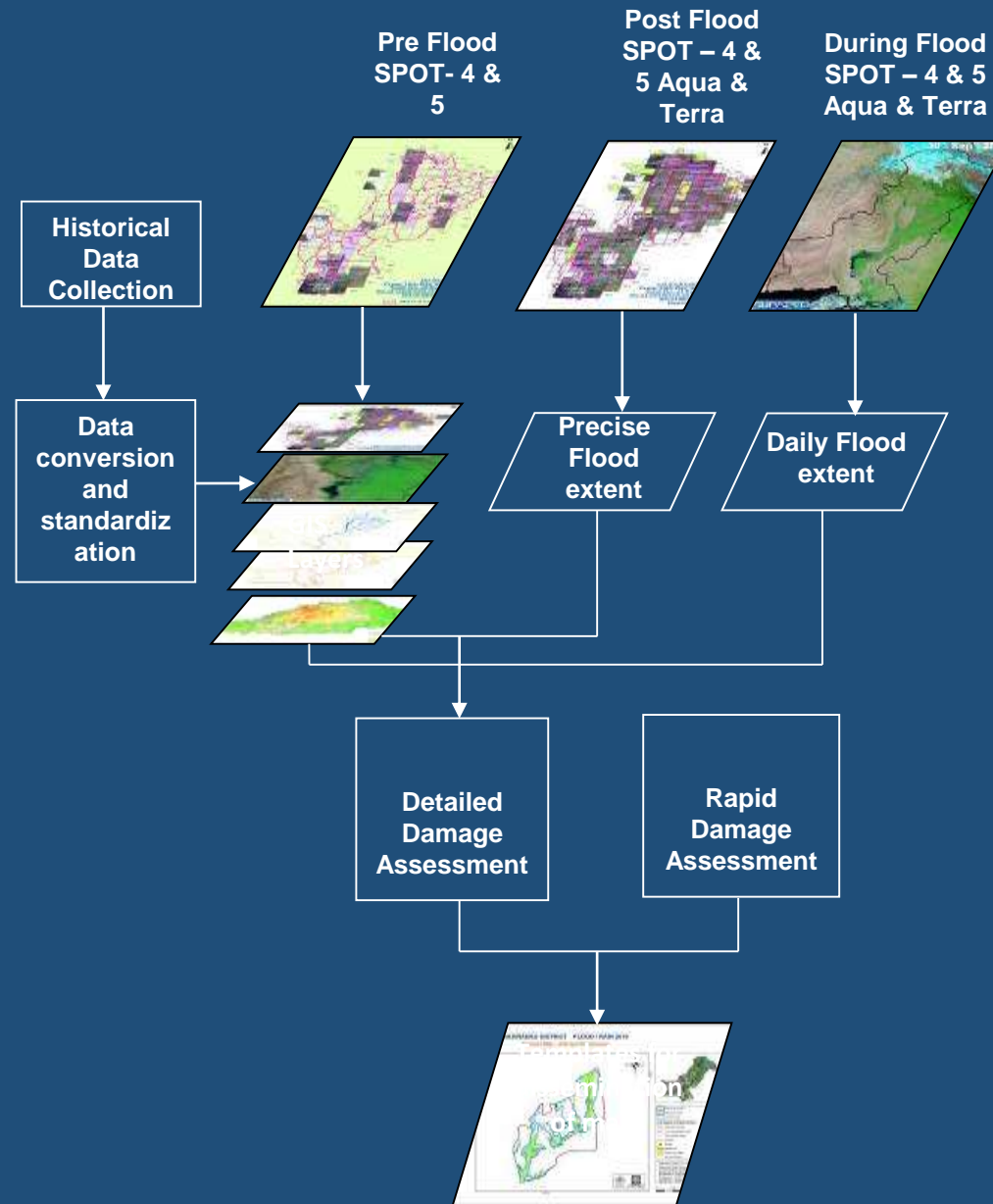


During Natural Disasters, SUPARCO provided technical support to various national Organizations NDMA, PDMAs and International Agencies ICIMOD, UN-FAO etc

Contents

- **Damage Assessment Overall Approach**
- **Flood Damage Assessment**
 - Crop Damages
 - Buildings/Settlements
 - Irrigation Network
 - Road/Rail Network
- **Earthquake**
 - Buildings/Settlements
- **Landslide**
 - Landcover
 - Buildings
 - Roads
- **Forest Fire**
 - Forest Types
 - Landcover

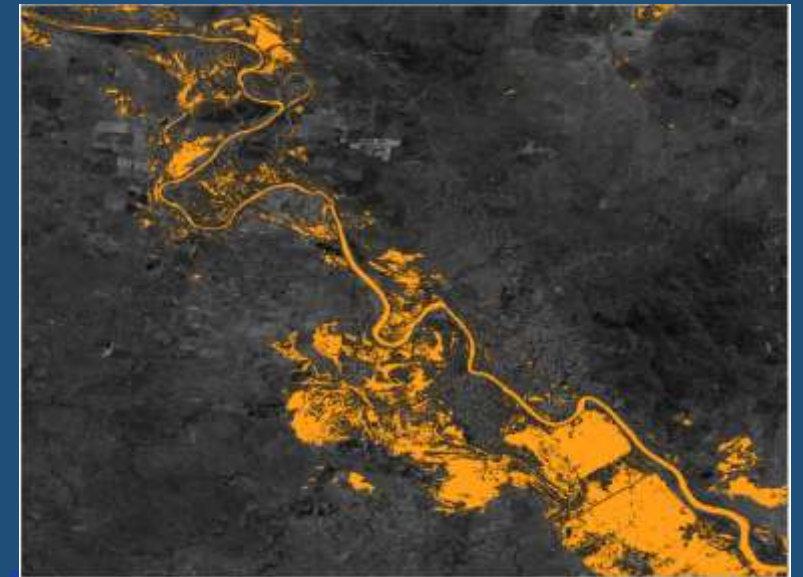
Rapid Damage Assessment Overall Approach



FLOOD

Flood Damage Assessment

- Flood Extent Extraction - Normalized Difference Water Index (NDWI)
- Elements at Risk – Crops , Houses/Built up , Roads and Water Infrastructure
- Change Detection
- Spatial Analysis Attributes/Statistical Calculation
- Rapid Damage Maps



Recommended Practices for UN-SPIDER Flood Mapping and Damage Assessment

UNITED NATIONS Office for Outer Space Affairs
UN-SPIDER KNOWLEDGE PORTAL
 Space-based information for Disaster Management and Emergency Response

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Flowchart

Flood Mapping and Damage Assessment using S2 Data



[Step by Step](#)

[In Detail](#)

Objective:
 The objective of this practice is to identify the extent of a flood as well as the affected infrastructure such as roads and settlements and impaired areas of interest for example agricultural regions. This information can be used by disaster management agencies and other stakeholders to undertake the rescue and relief activities in affected areas.

Disaster Cycle Phase:
 Recovery & Reconstruction · Relief & Response

Main Hazards:
 Flood

Test Site:
 Fitzroy River at Rockhampton, Queensland, Australia.

Context:
 The practice developed by the "Space Application Centre for Response in Emergency and Disaster" of SUPARCO (Pakistan) was initially applied to the flood event in Punjab (Pakistan) in July 2015. Thereafter, it was used annually for river monitoring during monsoon season. The extraction of the flood extent was applied to the river Jhelum upstream of Trimmu Barrage, while the map generation covered the River Indus and its tributaries in Punjab, Pakistan.

For this Recommended Practice the methodology was applied to the Fitzroy River around the city of Rockhampton in Queensland, Australia. In April 2017, the central city of Queensland was inundated by flood waters. The water rose over several days until its peak that was captured by the processed satellite imagery from 8 April 2017.

Applicability:
 Part A of this Recommended Practice can be applied to most flood events around the globe. The flood inundation is extracted from Sentinel-2 visible bands at 10 meters spatial resolution. The method can therefore only be applied for satellite scenes with little to no cloud cover. Part B then maps and quantifies the flood affected and damaged areas and can be applied to all shapfiles that are being included in the analysis.

Add new comment
 Submitted by Patriciu Zundirich on Mon, 27/06/2018 - 15:09

Recommended by:



Related Practices

Recommended Practice:
 Flood Hazard Mapping
 Recommended Practice:
 Radar-based Flood Mapping

Related data

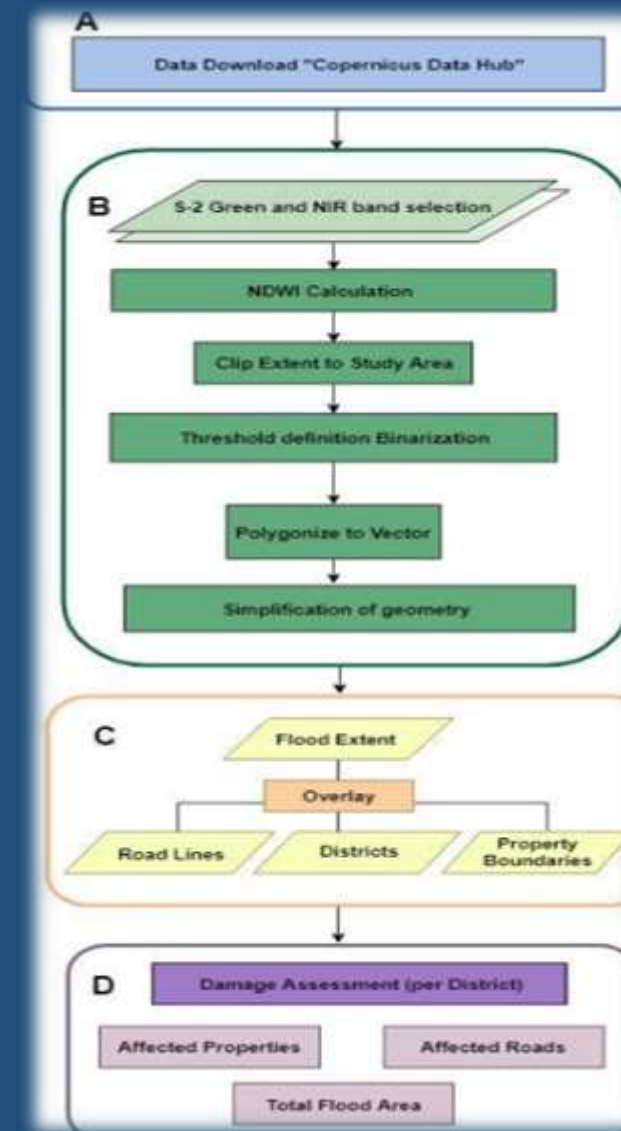
Sentinel 2 - Imagery
[view all](#)

Related Software

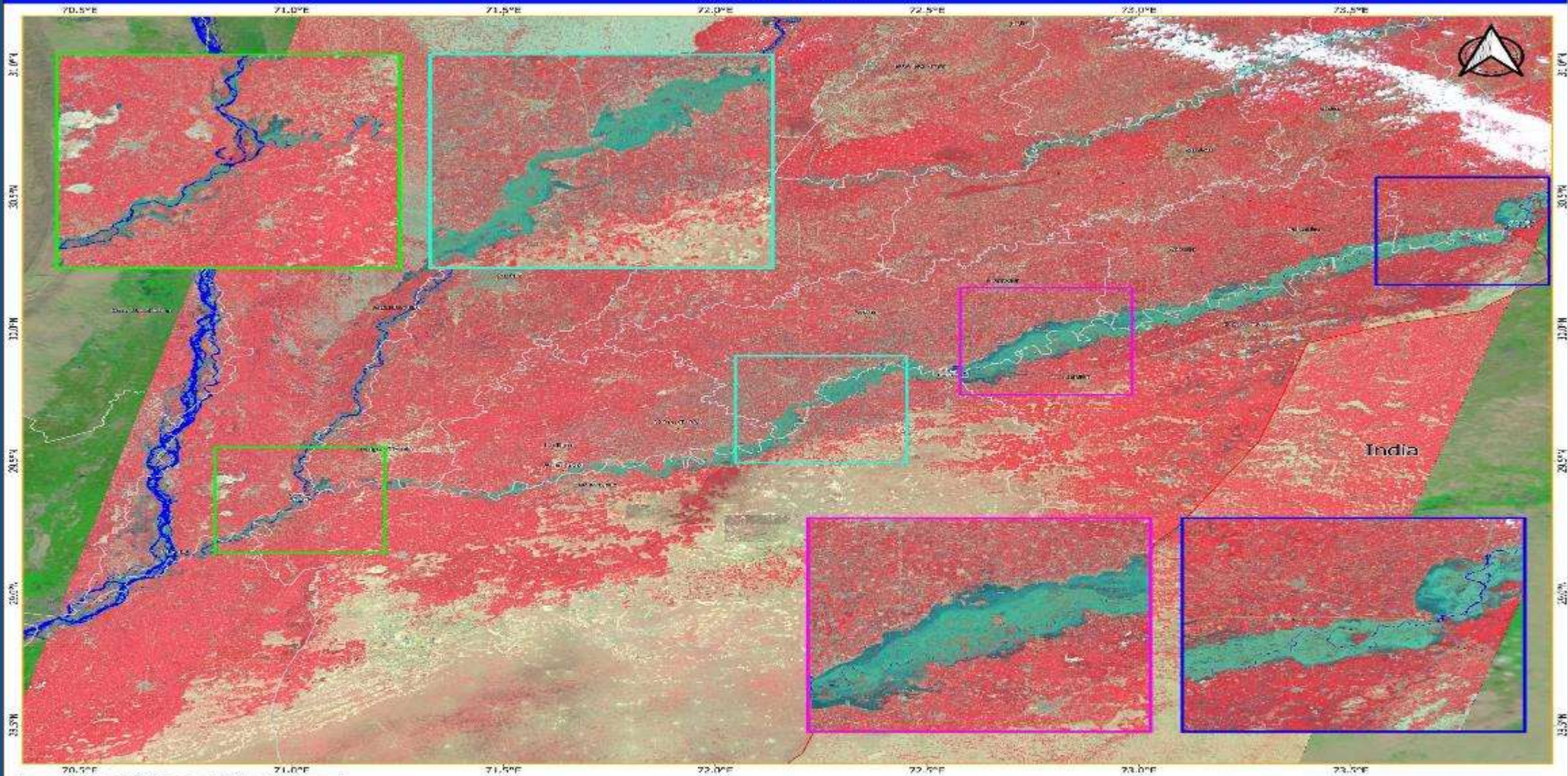
Quantum GIS
[view all](#)

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[Pin it](#)



Monsoon Situation Analysis - River Sutlej 28 August 2023



This map shows updated situation in River Sutlej. It shows an increase in river flows downstream Sulamanki and Islam Headworks. The analysis also shows normal river flow at Panjnad Barrage. Analysis was carried out using Sentinel-2 (10m) Satellite Imagery acquired on 28 August 2023.

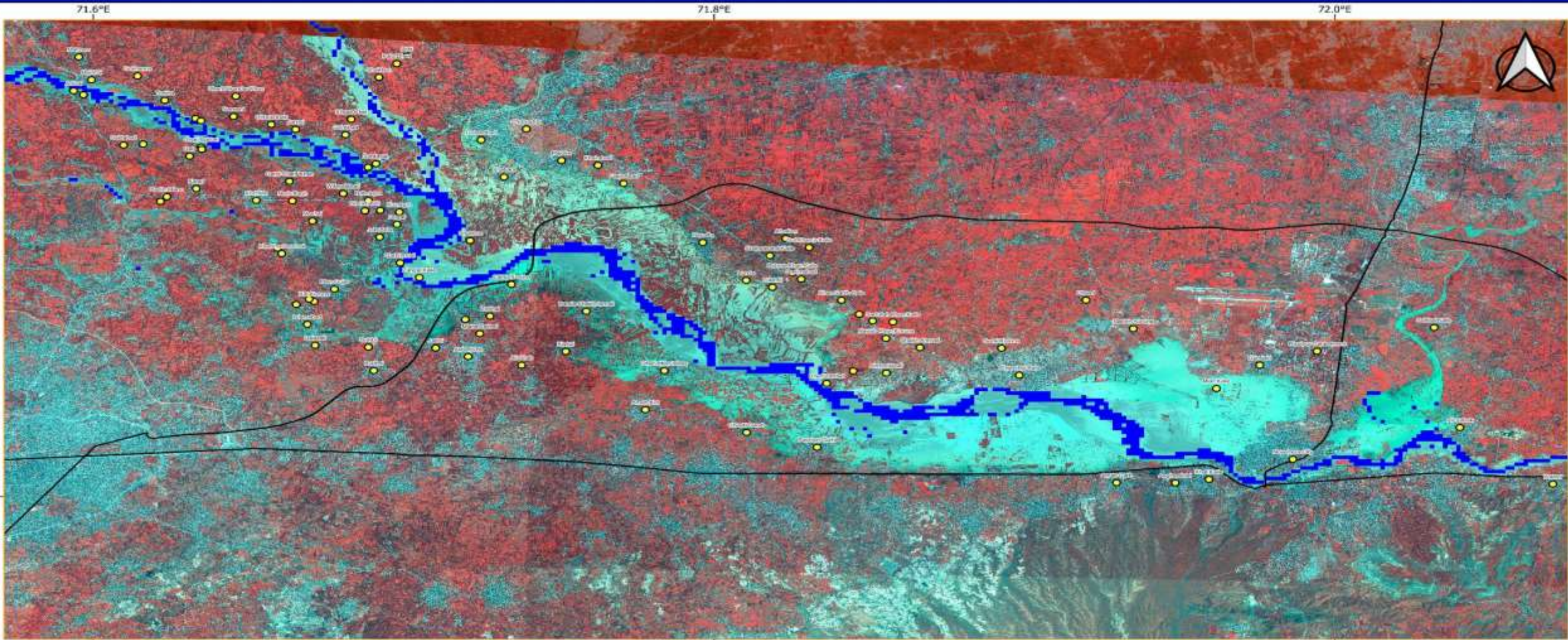
This analysis is yet to be validated in field.

This map is generated at Space Application Center for Response in Emergency and Disasters (SACRED) – SUPARCO on 28 August 2023.

- Cities/Towns
- Premonsoon 2023
- District Boundary
- International Boundary



Monsoon Situation Analysis - Kabul River 28 August 2022

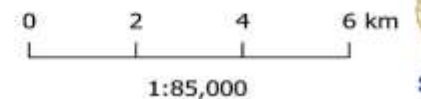


This map shows the current situation of Kabul River. The analysis indicates increase in river flows in the river course which have affected settlements in Districts Charsadda and Nowshera, Khyber Pakhtunkwa. The analysis is performed using Satellite imagery of SPOT6 (1.5 m) acquired on 28 August 2022.

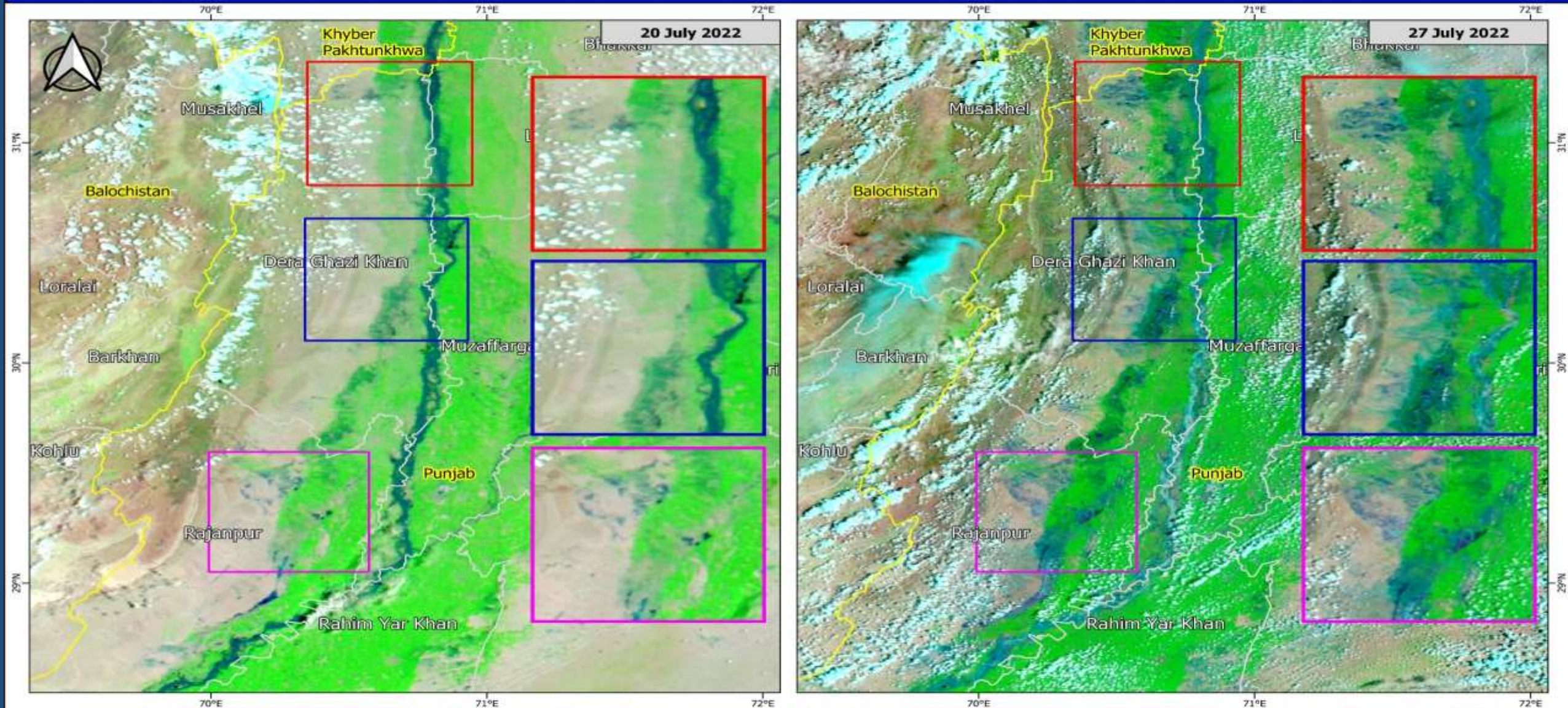
This analysis is yet to be validated in the field.

This map is generated at Space Applications Centre for Response in Emergency and Disasters (SACRED) on 28 August 2022

- Towns/ Villages
- Main Roads
- Pre-Monsoon Water Surface 2022
- District Boundary



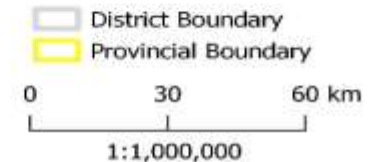
Monsoon Flooding - Situation Analysis 27 July 2022



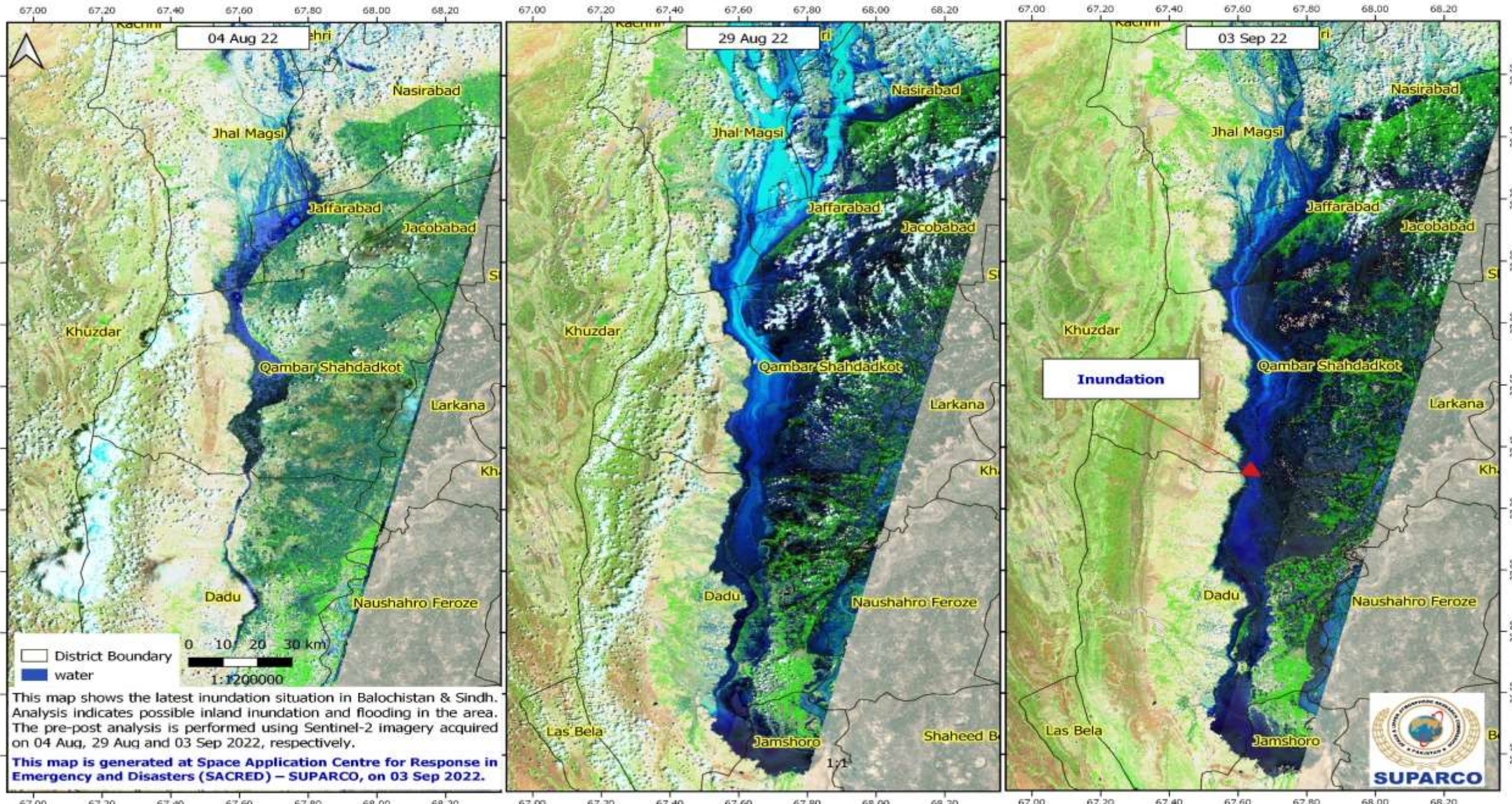
This map shows the updated flooding situation in Districts D.G Khan and Rajanpur, Punjab. The pre-post analysis shows inundation due to heavy rainfall. The pre-post analysis is performed using MODIS (250m) imagery acquired on 20 & 27 July 2022 respectively.

This analysis is yet to be validated in the field.

This map is generated at Space Applications Centre for Response in Emergency and Disasters (SACRED) on 27-July-2022



Monsoon Flooding Situation Analysis 03 Sep 22



This map shows the latest inundation situation in Balochistan & Sindh. Analysis indicates possible inland inundation and flooding in the area. The pre-post analysis is performed using Sentinel-2 imagery acquired on 04 Aug, 29 Aug and 03 Sep 2022, respectively.

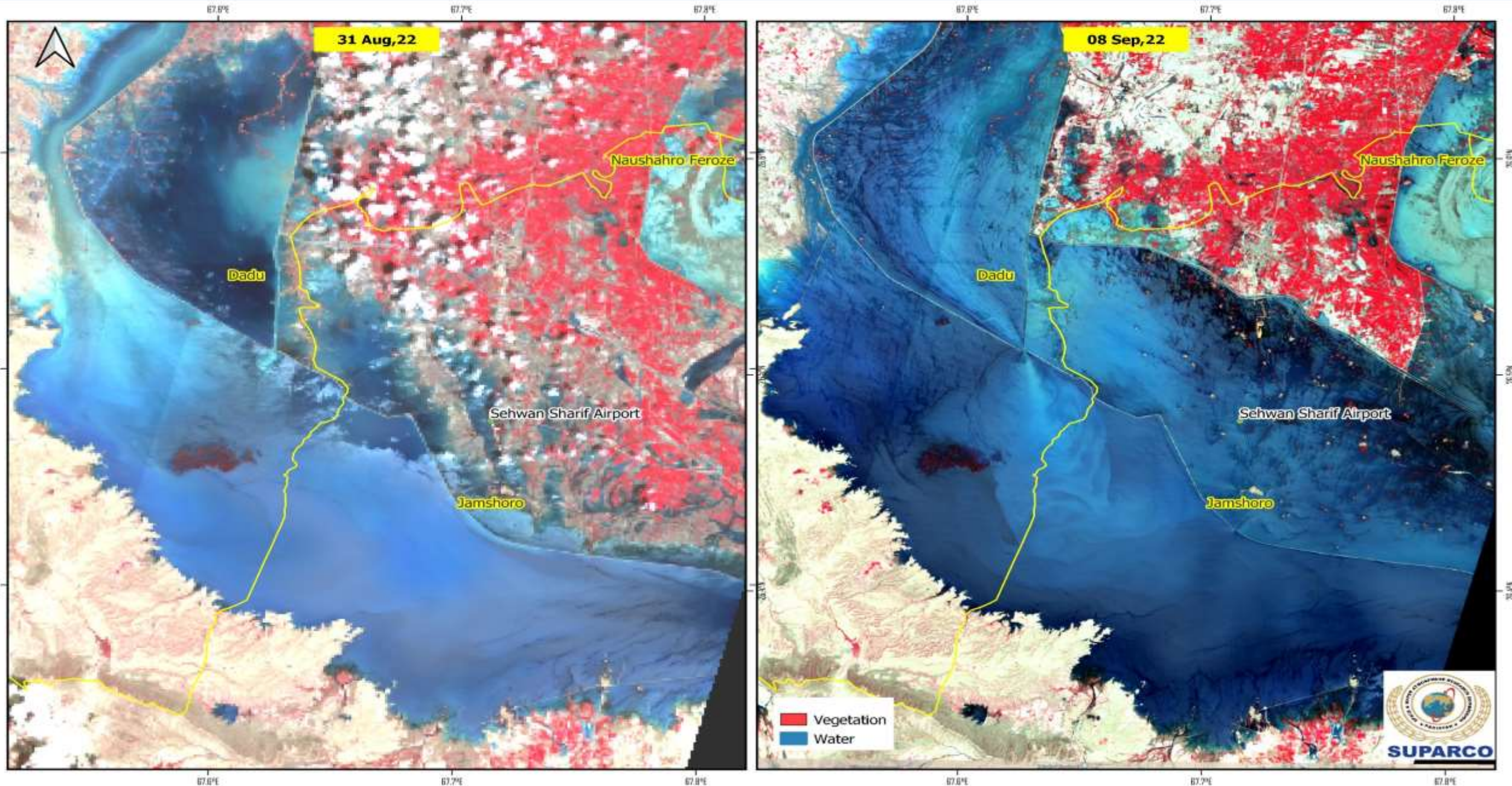
This map is generated at Space Application Centre for Response in Emergency and Disasters (SACRED) – SUPARCO, on 03 Sep 2022.



Monsoon Situation Analysis - 09 September 2022



Rapid Damage Assessment - 08 Sep,22 Manchar Lake



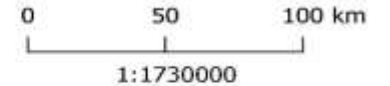
Flash Flooding in Balochistan 13 January 2022



- District Boundary
- Provincial Boundary
- International Boundary

This map shows the updated situation of flash flooding in Balochistan Province, as seen on latest satellite imagery of Modis (250 m) satellite acquired on 13 Jan 2022. Pondage water has been reduced as compared to previous imagery

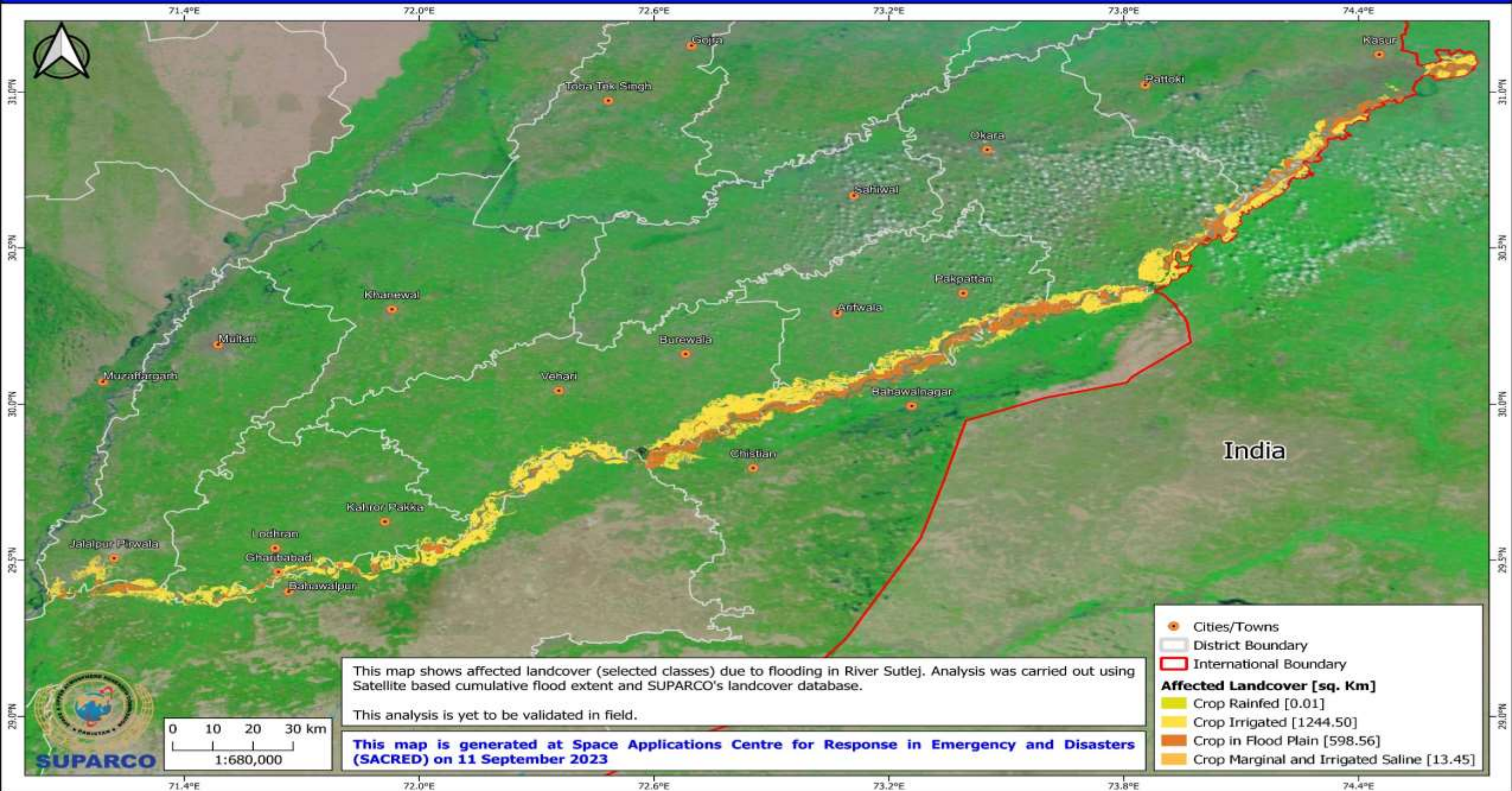
This analysis is yet to be validated in the field.



This map is generated at Space Applications Centre for Response in Emergency and Disasters (SACRED) on 14 January 2022.



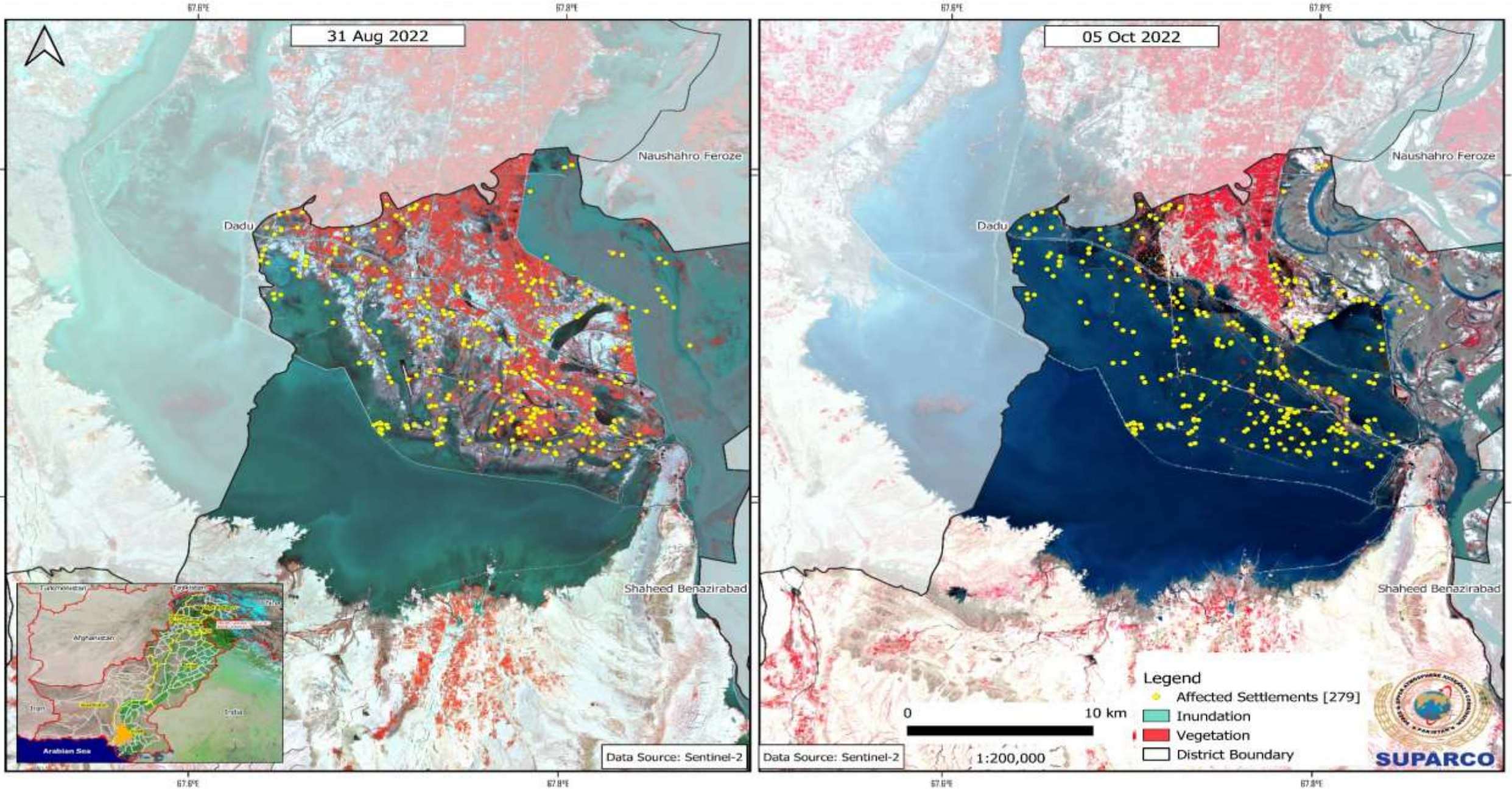
Monsoon Situation Analysis - River Sutlej Affected Landcover



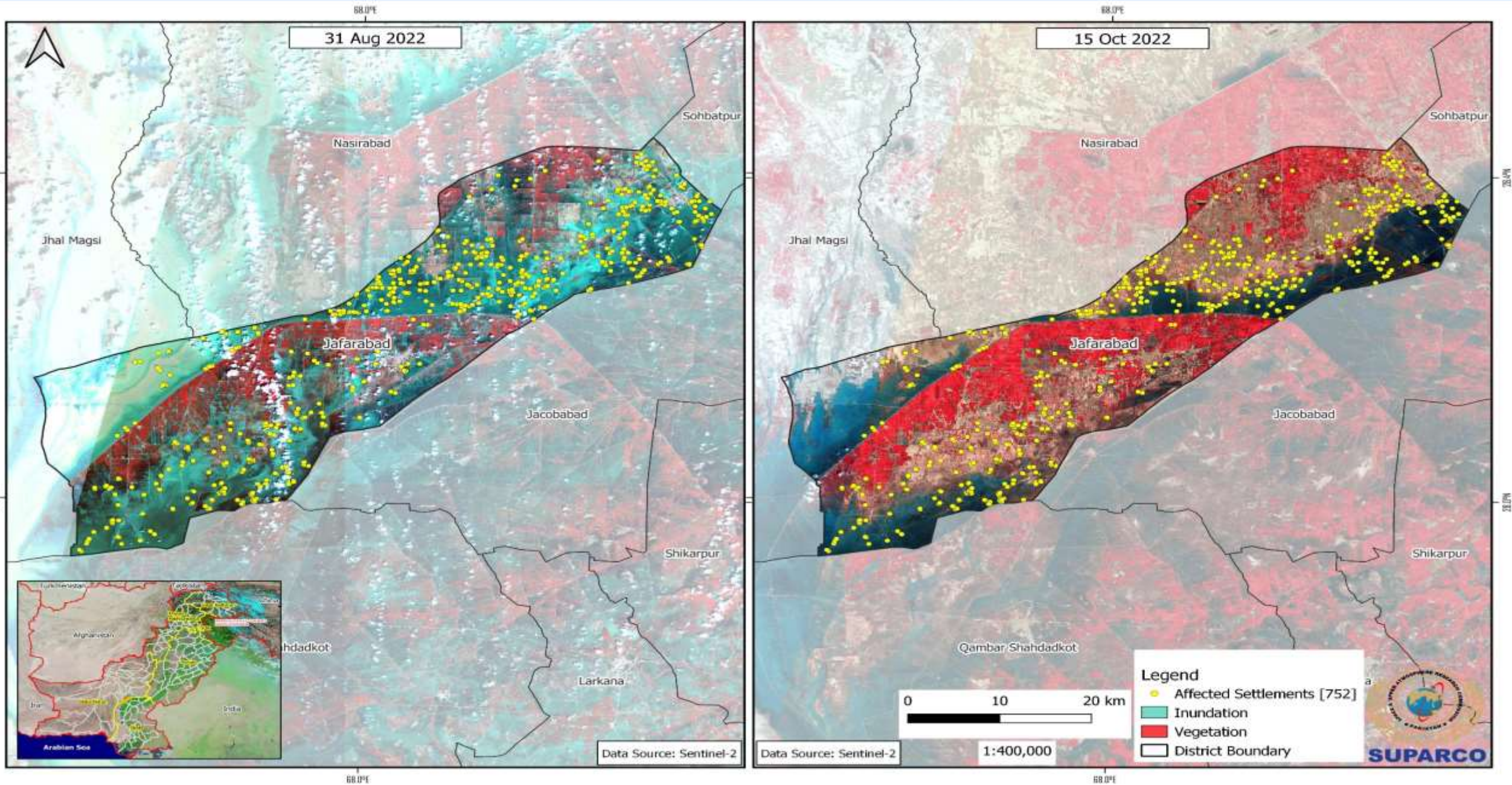
Monitoring of Erosion along River Indus, Layyah, Punjab



Rapid Damage Assessment - Settlements District Jamshoro, Sindh



Rapid Damage Assessment - Settlements District Jafarabad, Balochistan



Damages caused by Floods/Rains 2022 - Buildings



Pre - 01 Jun 2022

Post - 28 Aug 2022



Pre - 01 Jun 2022

Post - 28 Aug 2022

Flooding in River Swat – Bridge Damages



Collapsed Bridge on N-35



Hub River Bridge on N-25 Lasbella

Damages caused by Floods/Rains 2022 – Road/Bridges



Pre - 01 Jun 2022

Post - 28 Aug 2022



Pre - 01 Jun 2022

Post - 28 Aug 2022

Small Dam Breaches in Balochistan



Sherjan Khada Dam, Loralai, Balochistan

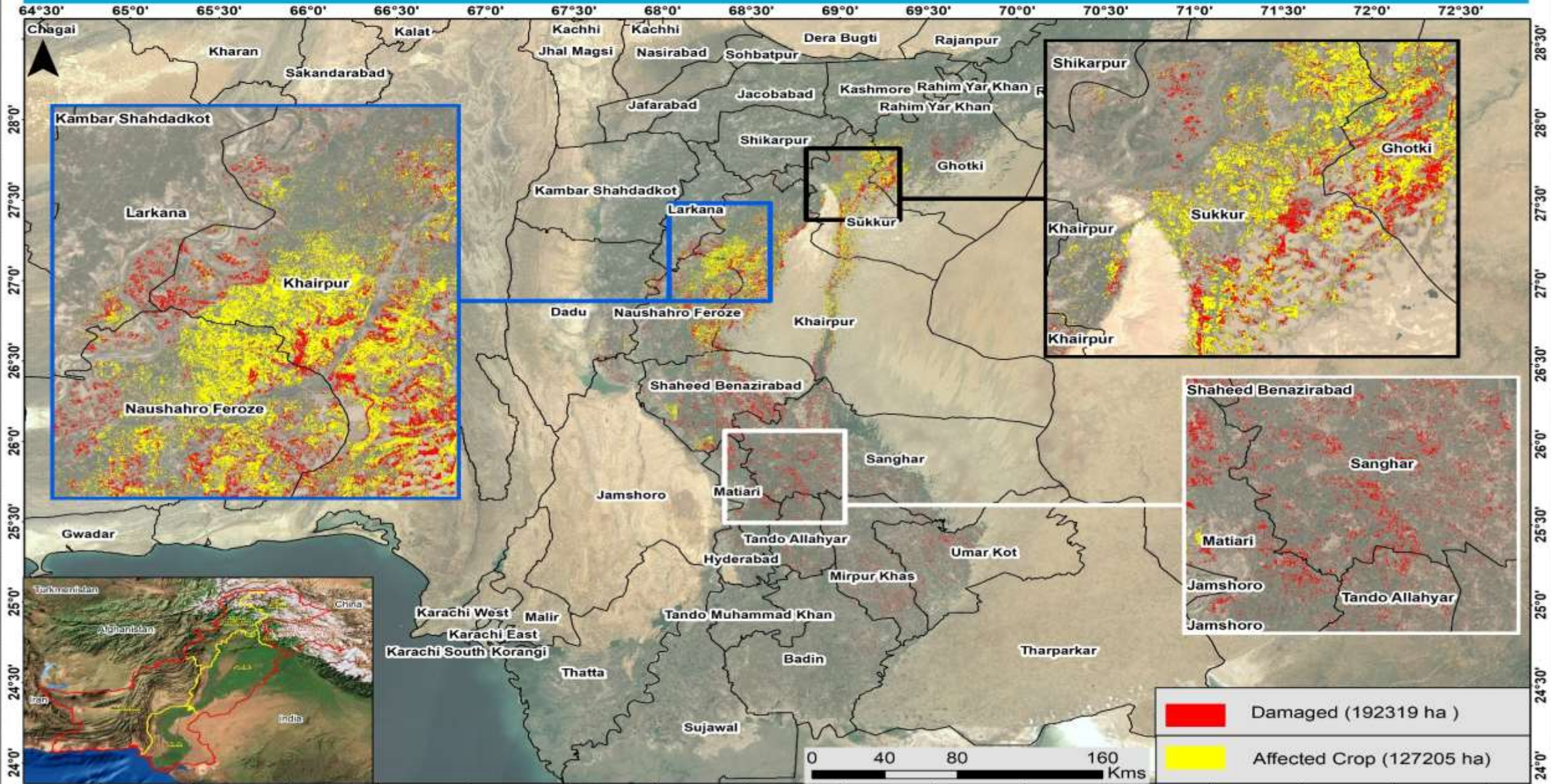


Dam Breach - Qilla Abdullah , Balochistan

Flooding in Swat River at Munda Headwork



Sindh Province - Cotton Crop Rapid Damage Assessment - Monsoon Flood 2022



Recommended Practices for UN-SPIDER Knowledge Portal

The screenshot shows the UN-SPIDER Knowledge Portal interface for the 'Recommended Practice: Flood Hazard Assessment'. The page features a search bar, navigation tabs (Home, Space Application, Risks & Disasters, Links & Resources, Advisory Support, Network, Projects, News & Events, About Us), and a sidebar with a 'Flowchart' section. The main content area includes a title, a satellite image of a flooded area, and a detailed description of the practice. It lists the objective, disaster cycle phase (Recovery & Reconstruction, Hazard & Response), main hazards (Floods), test sites (Plover River at Peshawar, Queensland, Australia), and content details. The practice was developed by SUPARCO, and the related software is HEC-RAS Hydrologic Engineering Center River Analysis System (HEC-RAS) (v6.0.16). The page also includes social media sharing options for Twitter and LinkedIn.

FLOOD HAZARD ASSESSMENT

The screenshot shows the UN-SPIDER Knowledge Portal interface for the 'Recommended Practice: Flood Mapping and Damage Assessment using S2 Data'. The page features a search bar, navigation tabs, and a sidebar with a 'Flowchart' section. The main content area includes a title, a satellite image of a flooded area, and a detailed description of the practice. It lists the objective, disaster cycle phase (Recovery & Reconstruction, Hazard & Response), main hazards (Floods), test sites (Plover River at Peshawar, Queensland, Australia), and content details. The practice was developed by SUPARCO, and the related software is QGIS. The page also includes social media sharing options for Facebook, Twitter, and LinkedIn.

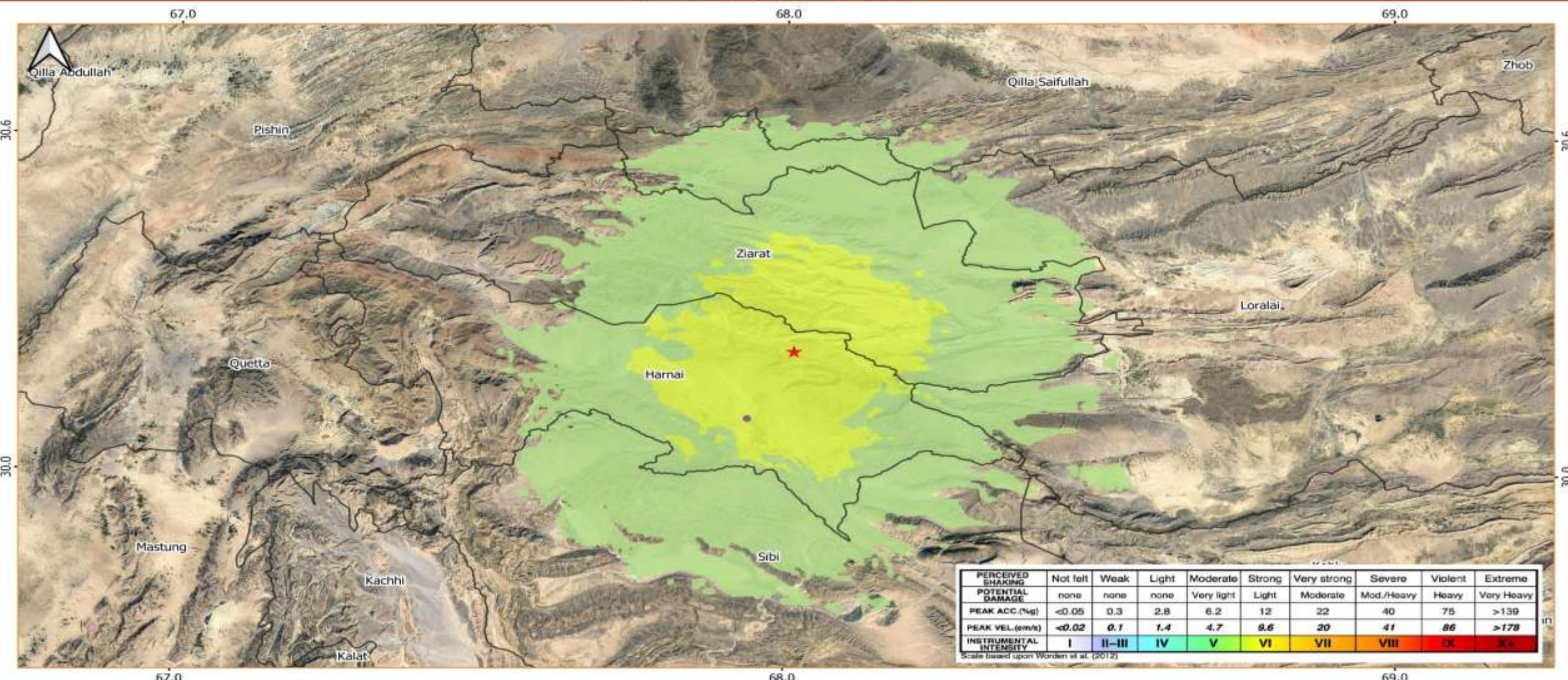
FLOOD MAPPING AND DAMAGE ASSESSMENT

The screenshot shows the UN-SPIDER Knowledge Portal interface for the 'Recommended Practice: Agriculture Drought Monitoring and Hazard Assessment using Google Earth Engine'. The page features a search bar, navigation tabs, and a sidebar with a 'Flowchart' section. The main content area includes a title, a map of Pakistan showing drought hazard, and a detailed description of the practice. It lists the objective, disaster cycle phase (Recovery & Reconstruction, Hazard & Response), main hazards (Droughts), test sites (Plover River at Peshawar, Queensland, Australia), and content details. The practice was developed by SUPARCO, and the related software is Google Earth Engine. The page also includes social media sharing options for Facebook, Twitter, and LinkedIn.

DROUGHT HAZARD ASSESSMENT

EARTHQUAKE

Harnai Earthquake - 07 Oct 2021 Instrumental Intensity Map



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC. (%g)	<0.05	0.3	2.8	6.2	12	22	40	75	>139
PEAK VEL. (cm/s)	<0.02	0.1	1.4	4.7	8.6	20	41	86	>178
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

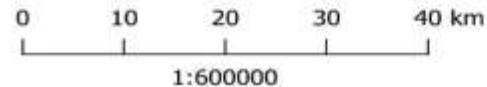
Scale based upon Worden et al. (2012)



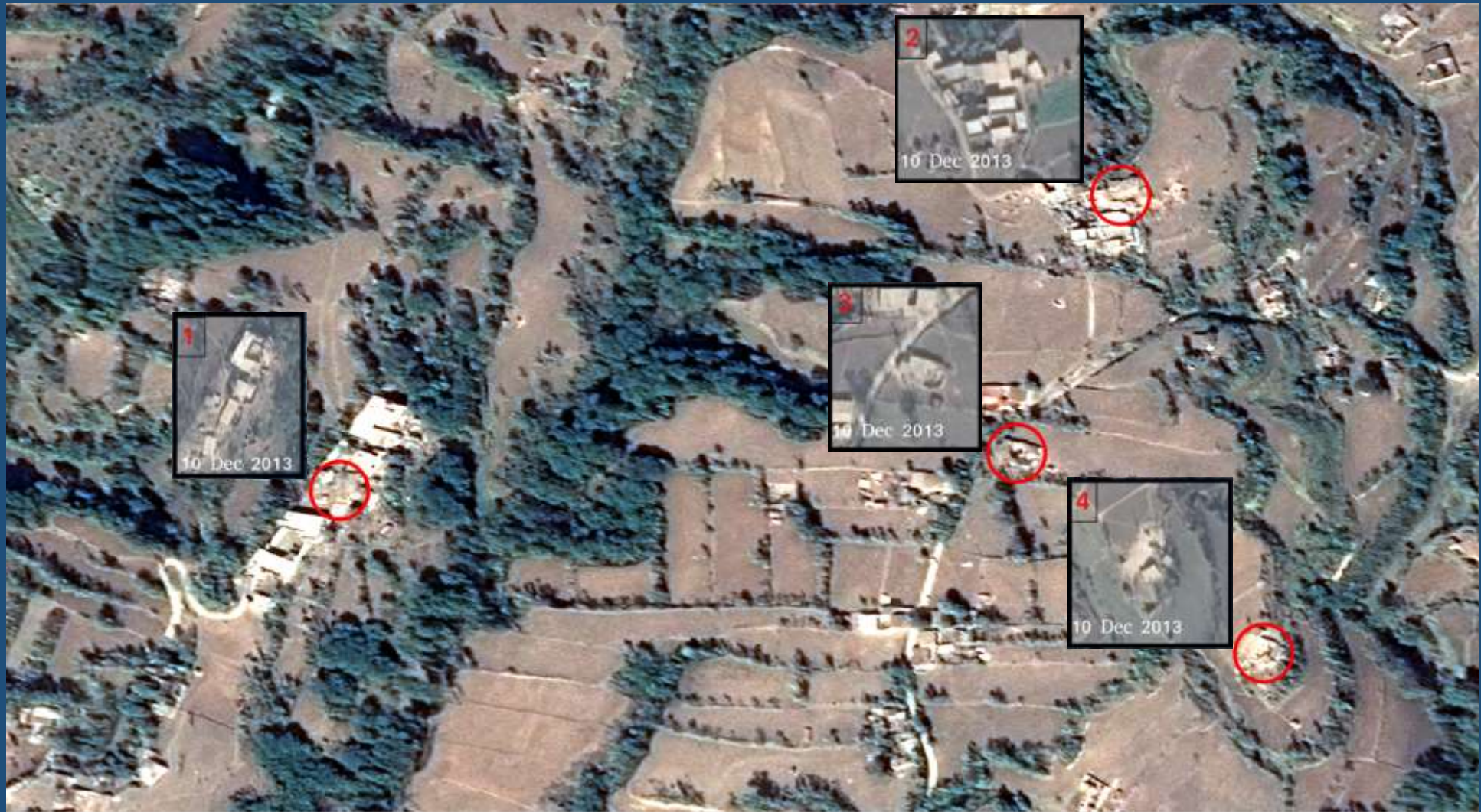
An earthquake of 5.9 magnitude with 09 km depth struck Harnai District and adjoining areas of Balochistan, on 07 Oct 2021 at 0301hrs local time (USGS). The epicenter was located at approx. 15 km NE of Harnai City. This map shows the epicenter and instrumental intensity of the earthquake. The intensity of earthquake was strong to moderate.

This map is generated at Space Applications Centre for Response in Emergency and Disasters (SACRED)-SUPARCO on 07-10-2021.

- Legend**
- ★ Epicentre
 - Harnai City
 - International Boundary
 - District Boundary
 - Provincial Boundary



Earthquake 2015 Damage Assessment, Buner, KP



Harnai Earthquake - 07 Oct 2021



Rapid Damage Assessment Map



An earthquake of 5.9 magnitude with 15 km depth struck Harnai District and adjoining areas of Balochistan, on 07 Oct 2021 at 0301hrs local time (PMD). The epicenter was located at approx. 15 km NE of Harnai City. Analysis indicates multiple partially/completely damaged structures in the affected area. This analysis was performed using very high resolution Pleiades (50 cm) satellite imagery acquired on 08 Oct 2021. This analysis is yet to be validated in the field

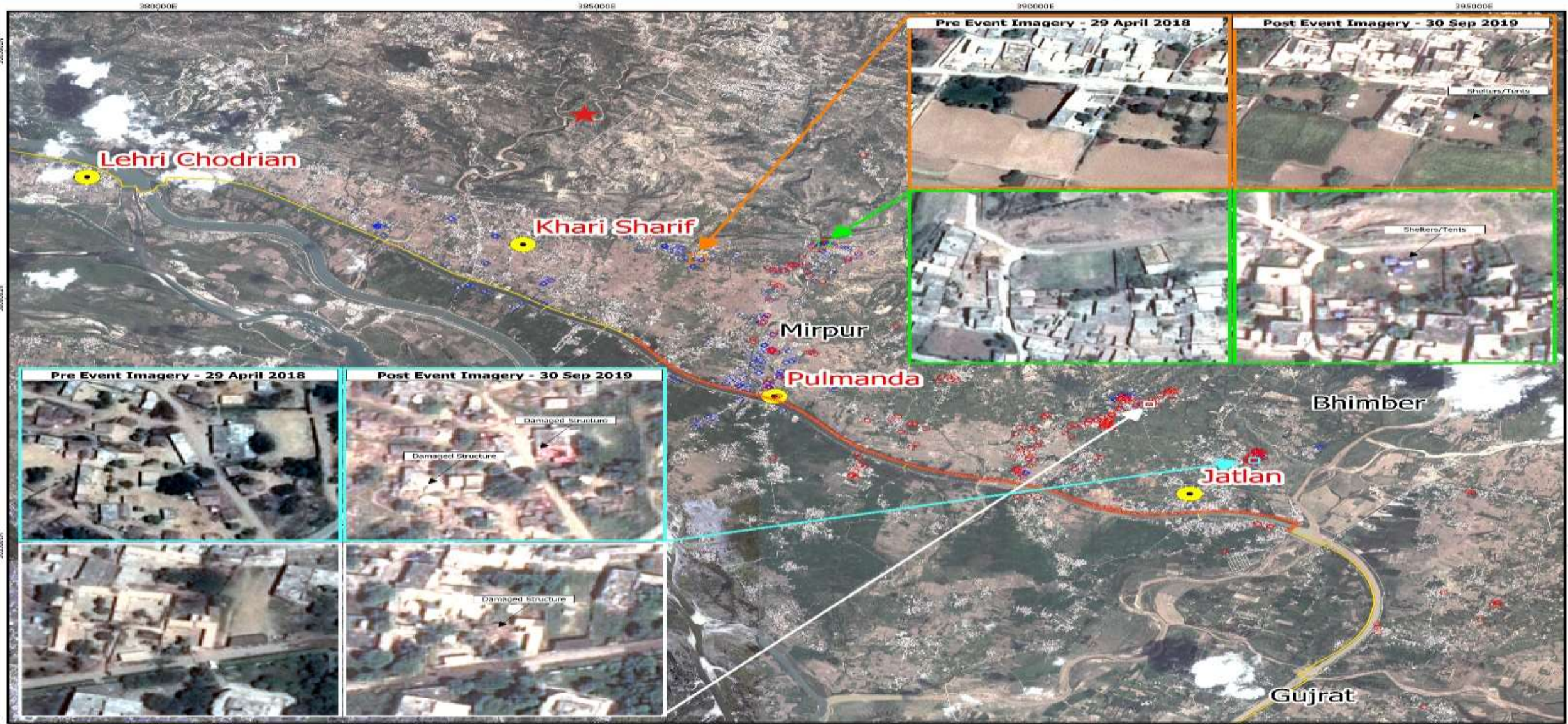
This map is generated at Space Applications Centre for Response in Emergency and Disasters (SACRED)- SUPARCO on 08-10-2021.

Legend

-  EQ Damages (67)
 -  District Boundary
- 0 250 500 750 m
- 1:20000



Mirpur Earthquake Detailed Damage Assessment Map - 30 Sep 2019



An earthquake of 5.6 magnitude with 10 km depth struck Mirpur and Northern areas of Pakistan on 24 Sep 2019 at 1602 hrs. The epicenter was located at Khari Sharif, District Mirpur. Analysis indicates, there are 334 partially/completely damaged structures in District Mirpur and Bhimber. Analysis also shows distribution of 451 tents in the affected area. This analysis was performed using pre and post imagery of Pleiades (50 cm) satellites acquired on 29 April 2018 and 30 Sep 2019, respectively. Post disaster image was provided by International Charter Space & Major Disasters. The analysis is yet to be validated in the field. This map is generated at Space Applications Centre for Response in Emergency & Disasters (SACRED)-SUPARCO on 04 Oct 2019.

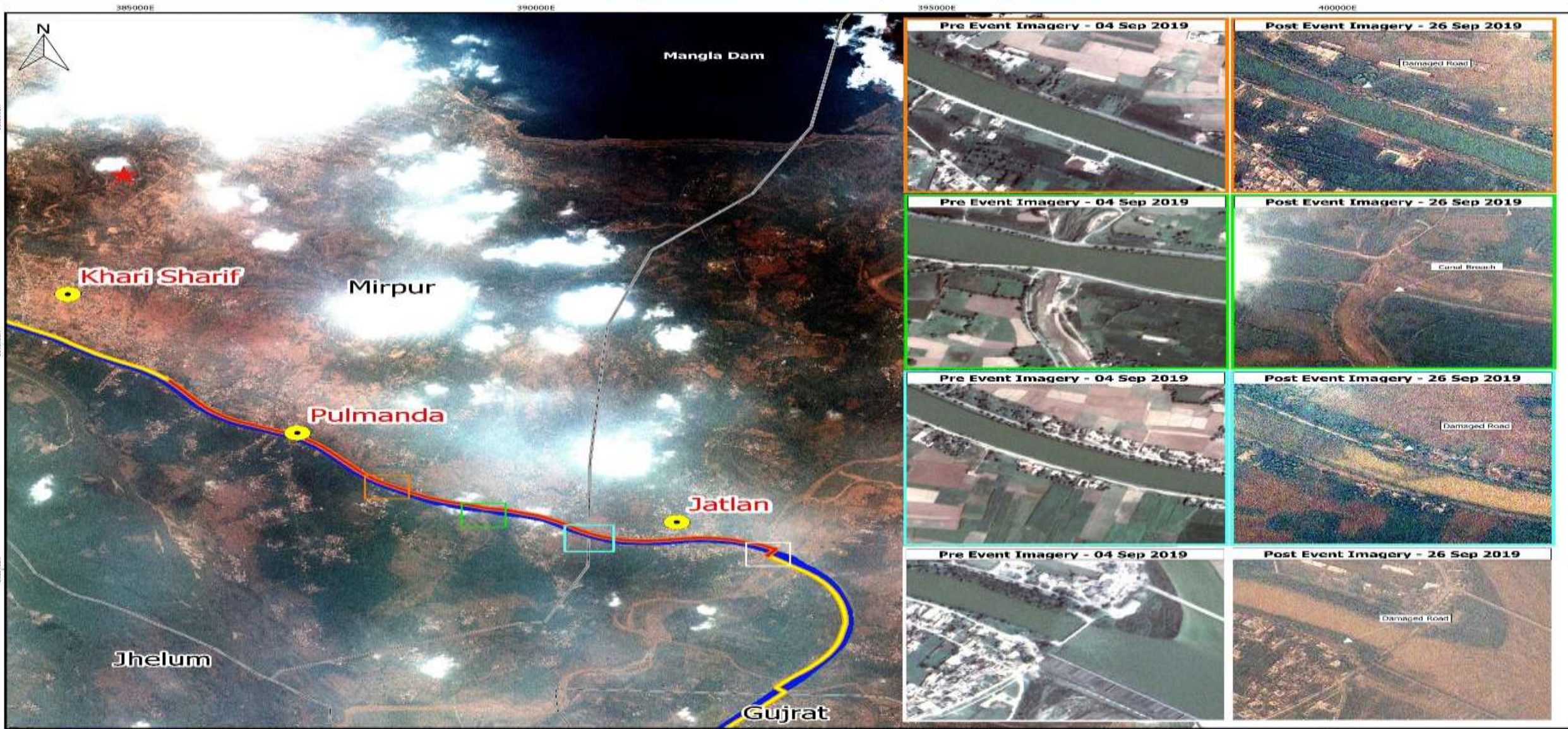
Datum: WGS 84; Projection: UTM 43N
1:20000

- ★ Epicenter
- ◇ Tents (451)
- Damaged Structures (334)
- Damaged Road
- Road
- City/Town
- Instrumental Intensity**
- 5 - Moderate
- 6 - Strong
- 7 - Very Strong



Mirpur Earthquake 2019

Rapid Damage Assessment Map - 26 Sep 2019



An earthquake of 5.6 magnitude with 10 km depth struck Mirpur and Northern areas of Pakistan on 24 Sep 2019 at 1602 hrs. The epicenter was located at Khari Sharif, District Mirpur. This map shows the possible damaged road sections along the Mirpur-Jatlan road, next to the upper Jhelum canal. As per the analysis/reports approx. 14 km section of the road has been damaged. Heavy cloud cover/haze was also observed across the scene. This analysis was performed using pre and post imagery of PRSS-1 (90 cm) and Pleiades (50 cm) satellites acquired on 04 Sep and 26 Sep 2019, respectively. The analysis is yet to be validated in the field.

This map is generated at Space Applications Centre for Response in Emergency & Disasters (SACRED)-SUPARCO on 26 Sep 2019.

- ★ Epicenter
- City/Town
- Road
- Damaged Road
- Canal
- District Boundary


Instrumental Intensity

- 5 - Moderate
- 6 - Strong
- 7 - Very Strong

Datum: WGS 84; Projection: UTM 43N

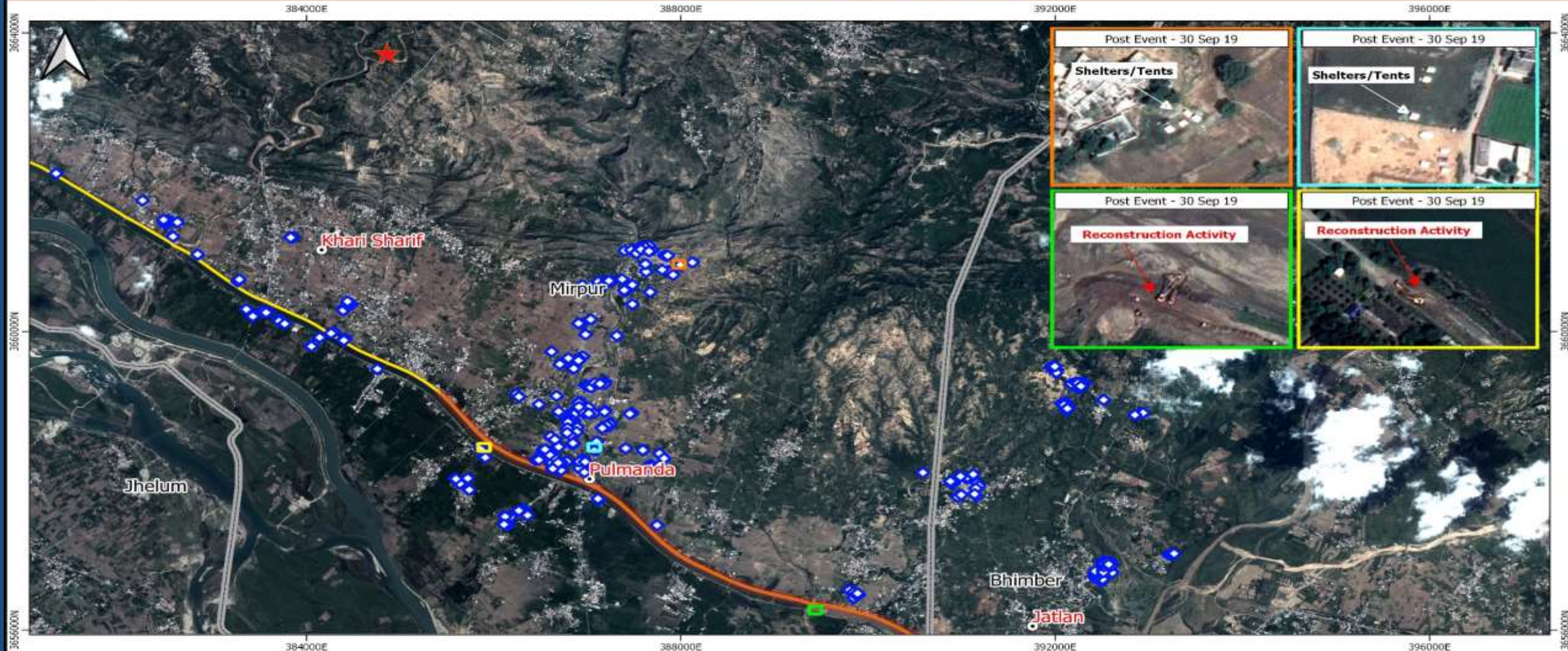
0 2 4 km

1:22000



Mirpur Earthquake 2019

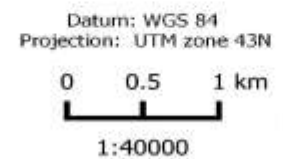
Early Recovery Activities - 30 Sep 2019



An earthquake of 5.6 magnitude with 10 km depth struck Mirpur and Northern areas of Pakistan on 24 Sep 2019 at 1602 hrs. The epicenter was located at Khari Sharif, District Mirpur. This map shows the locations of shelters/tents spread across the area. The reconstruction on the Mirpur-Jatlan road has also been started.

This analysis was performed using post event imagery of Pleiades (50 cm) satellite acquired on 30 Sep 2019. Post disaster image was provided by International Charter Space & Major Disasters in collaboration with UNOSAT/UNITAR. The analysis is yet to be validated in the field.

This map is generated at Space Applications Centre for Response in Emergency & Disasters (SACRED)-SUPARCO on 30 Sep 2019.

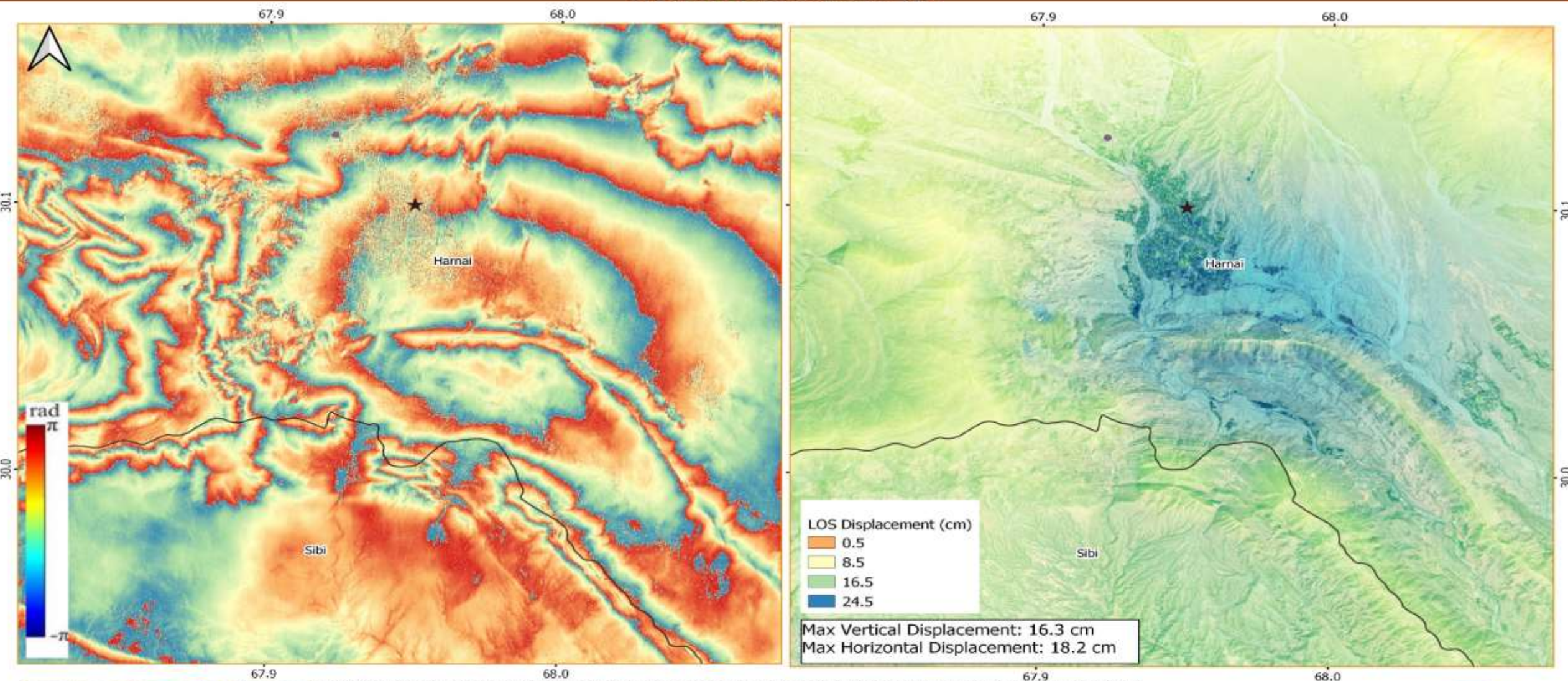


- ★ Epicenter
- ◆ Tents
- City/Town
- Damaged Road
- Road Network
- District Boundary



Harnai Earthquake - 07 Oct 2021

Ground Displacement Map



LOS Displacement (cm)

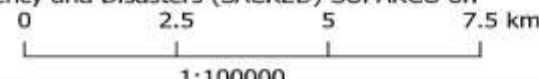
- 0.5
- 8.5
- 16.5
- 24.5

Max Vertical Displacement: 16.3 cm
Max Horizontal Displacement: 18.2 cm



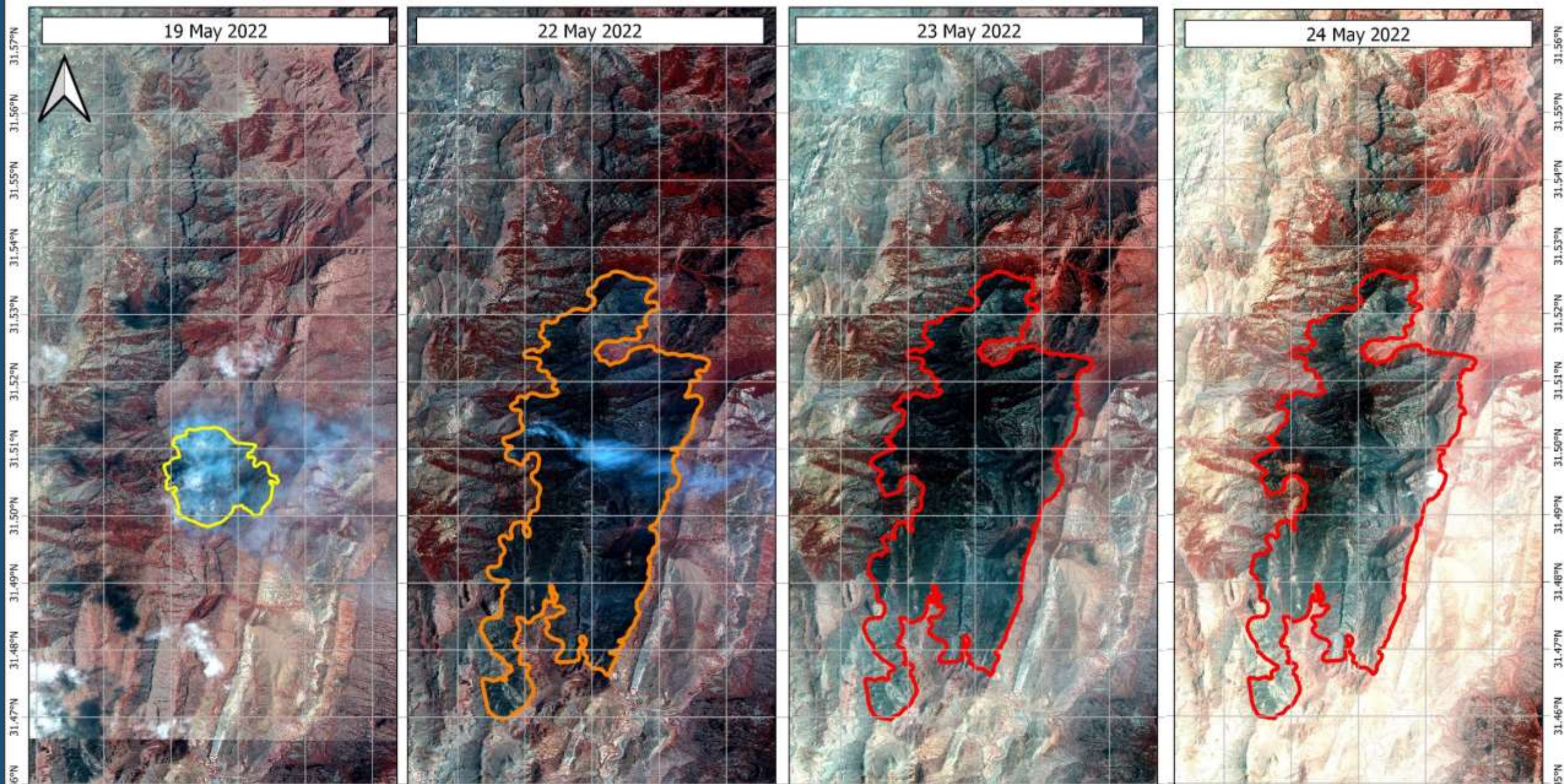
An earthquake of 5.9 magnitude with 09 km depth struck Harnai District and adjoining areas of Balochistan, on 07 Oct 2021 at 0301hrs local time. An earthquake of 5.9 magnitude with 15 km depth struck Harnai District and adjoining areas of Balochistan, on 07 Oct 2021 at 0301hrs local time (PMD). This map shows the ground deformation using Interferometric SAR technique. Analysis indicates 24.5 cm Line of Sight displacement (uplift) near the epicenter. This analysis is performed using pre-post Sentinel-1 C band SAR satellite acquired on 28 Sep 2021 and 10 Oct 2021, respectively. This analysis is yet to be validated in the field. This map is generated at Space Applications Centre for Response in Emergency and Disasters (SACRED)-SUPARCO on 12-10-2021.

- Legend**
- ★ Epicentre (PMD)
 - Harnai City
 - International Boundary
 - District Boundary
 - Provincial Boundary

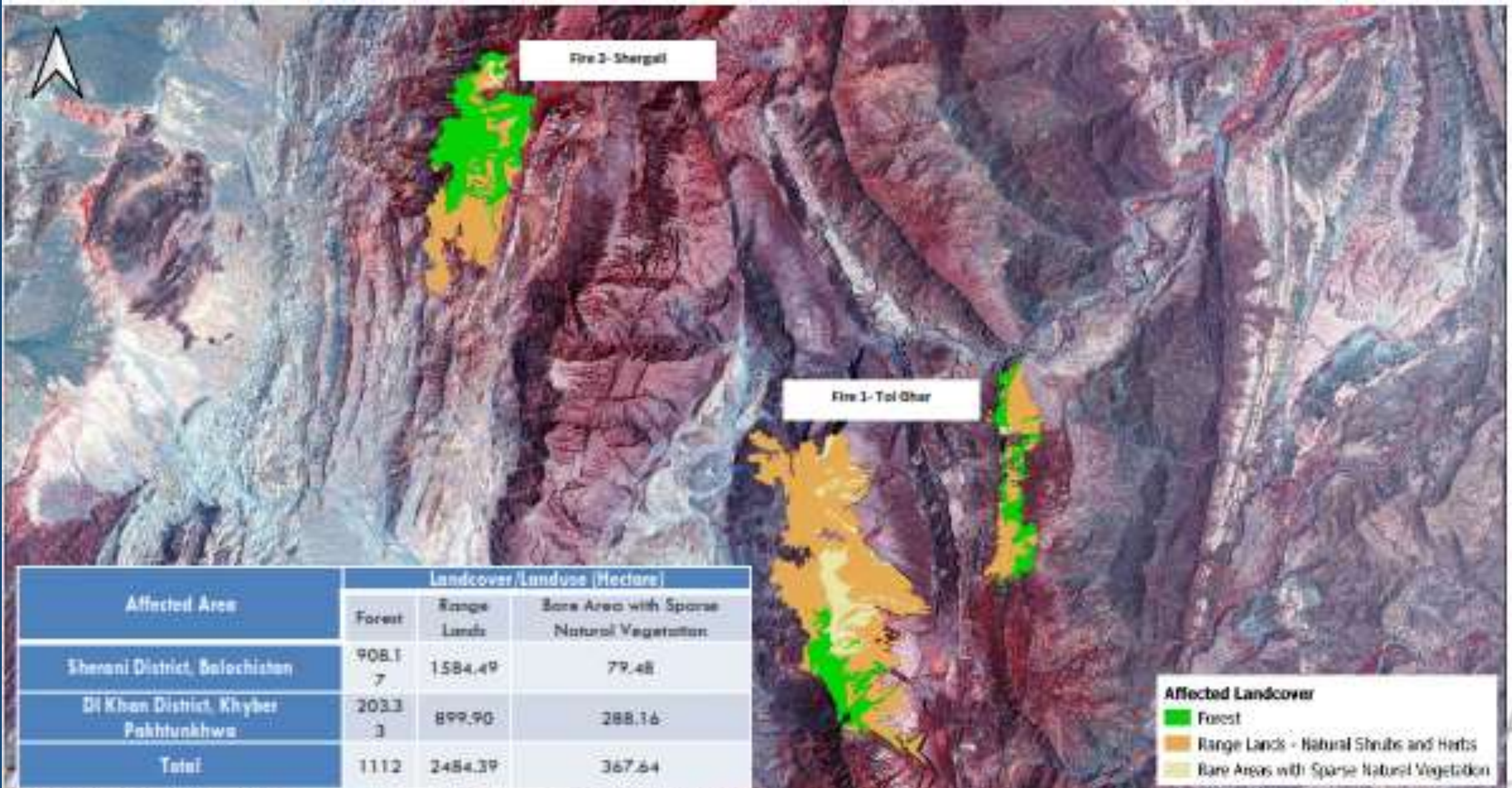


FOREST FIRE

TEMPORAL ANALYSIS OF FOREST FIRE - Sherghali



Balochistan Fire 2022 – Affected LandCover

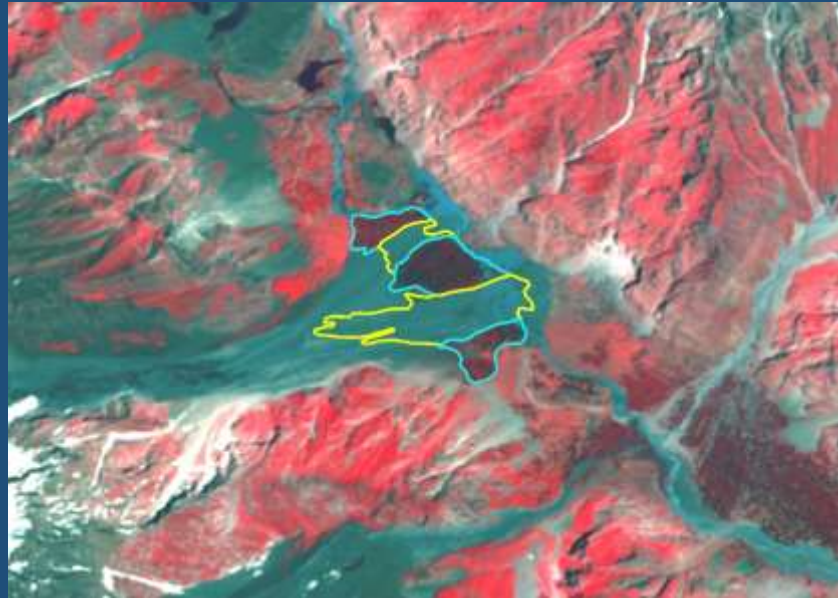


Landslide

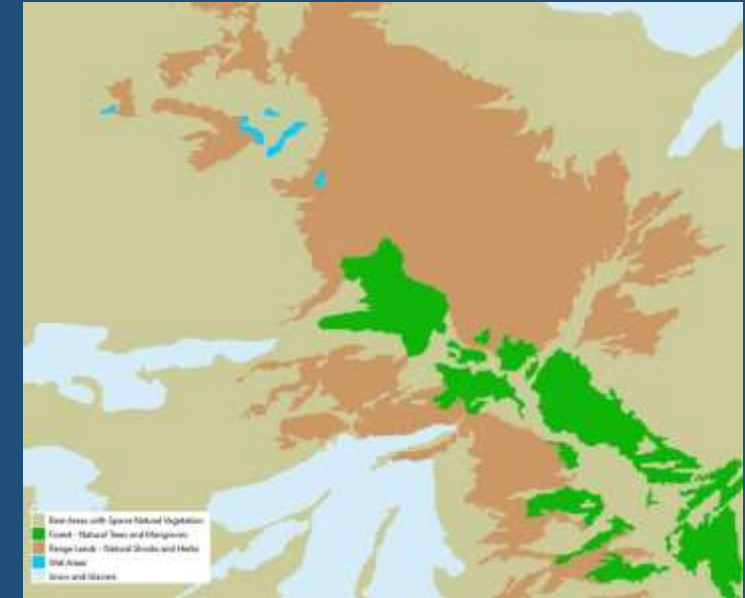
Landslide, Karora, Shangla, Khyber Pakhtunkhwa



Naltar 24-06-2021

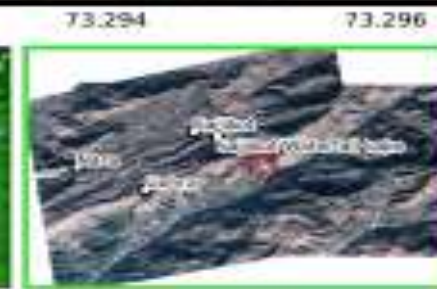


Naltar 09-07-2021

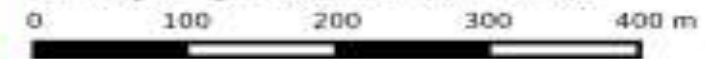


Naltar Landcover

Landslide Havelian, District Abbottabad



This map shows the landslide that occurred near Satara, Tehsil Havelian, District Abbottabad on 21-Nov-2015. This analysis indicates that the landslide mass covers approx. 7.92 ha area and about 203 m road has been completely damaged. The analysis is performed on 0.6m Pleiades Satellite Data acquired on 27-Nov-2015. This map is generated at SUPARCO on 02-12-2015. This analysis is yet to be validated in the field.



Legend

- Landslide
- River Blockade
- Destroyed Road
- Road
- District Boundary

Map Scale: 1:3800



Map Id: 02-12-2015_LS_01