

COMBINED REMOTE SENSING AND MODELLING APPROACH FOR FLOOD RESPONSE AND MANAGEMENT IN PAKISTAN

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UNESCO, Islamabad



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ABOUT ME

- ▶ UNESCO Islamabad

- ▶ Spatial Hydrology Officer – Since Sep 2016

SUPARCO Islamabad

Sec.Head Disaster Monitoring Division – 2014 – 2016

Spatial Hydrologist UNESCO Project – 2013 – 2014

- ▶ Charles Sturt University, Australia

- ▶ Ph.D Student – 2009 – 2012
- ▶ M.Phil Student – 2007 - 2008

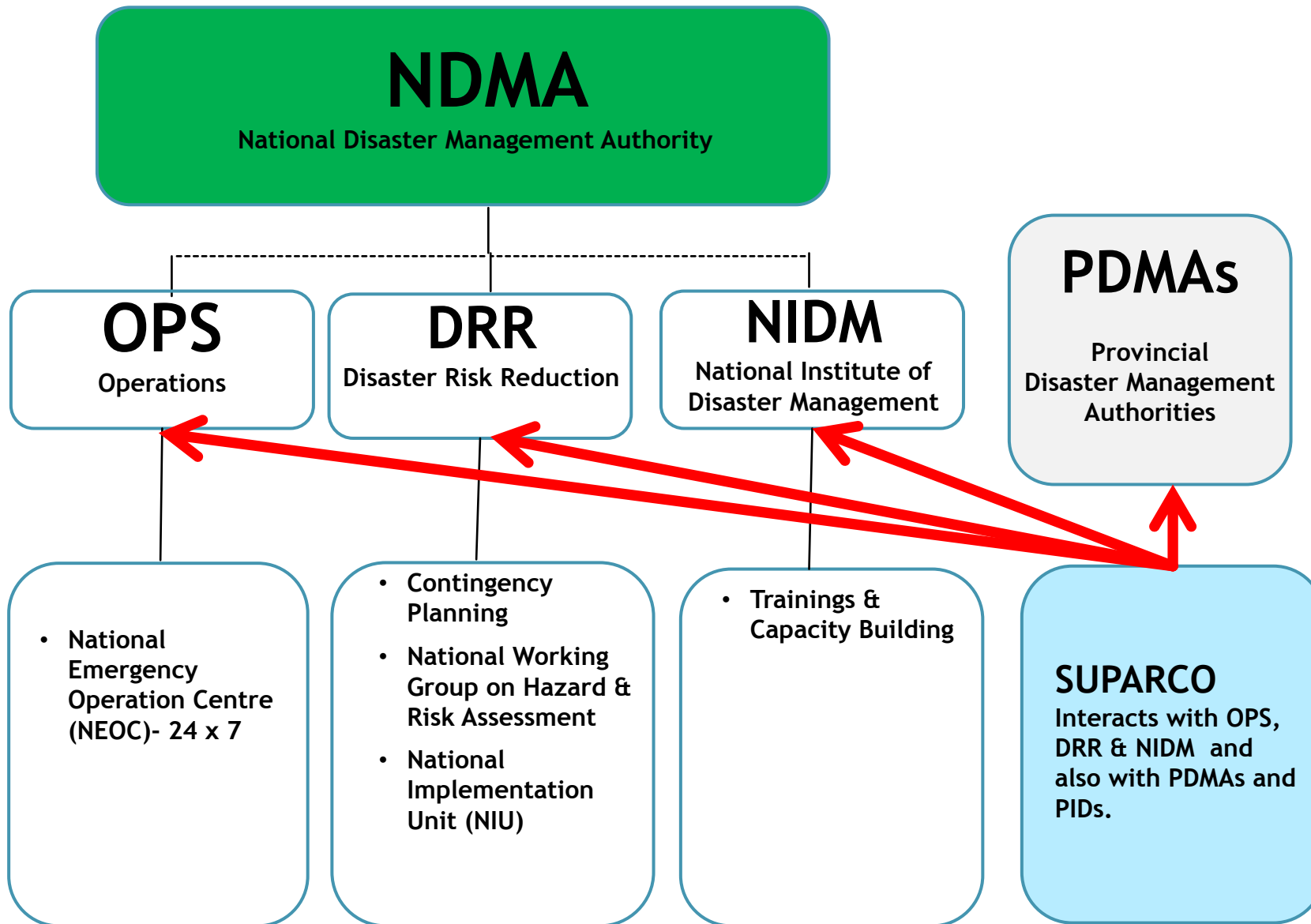


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DISASTER MANAGEMENT IN PAKISTAN

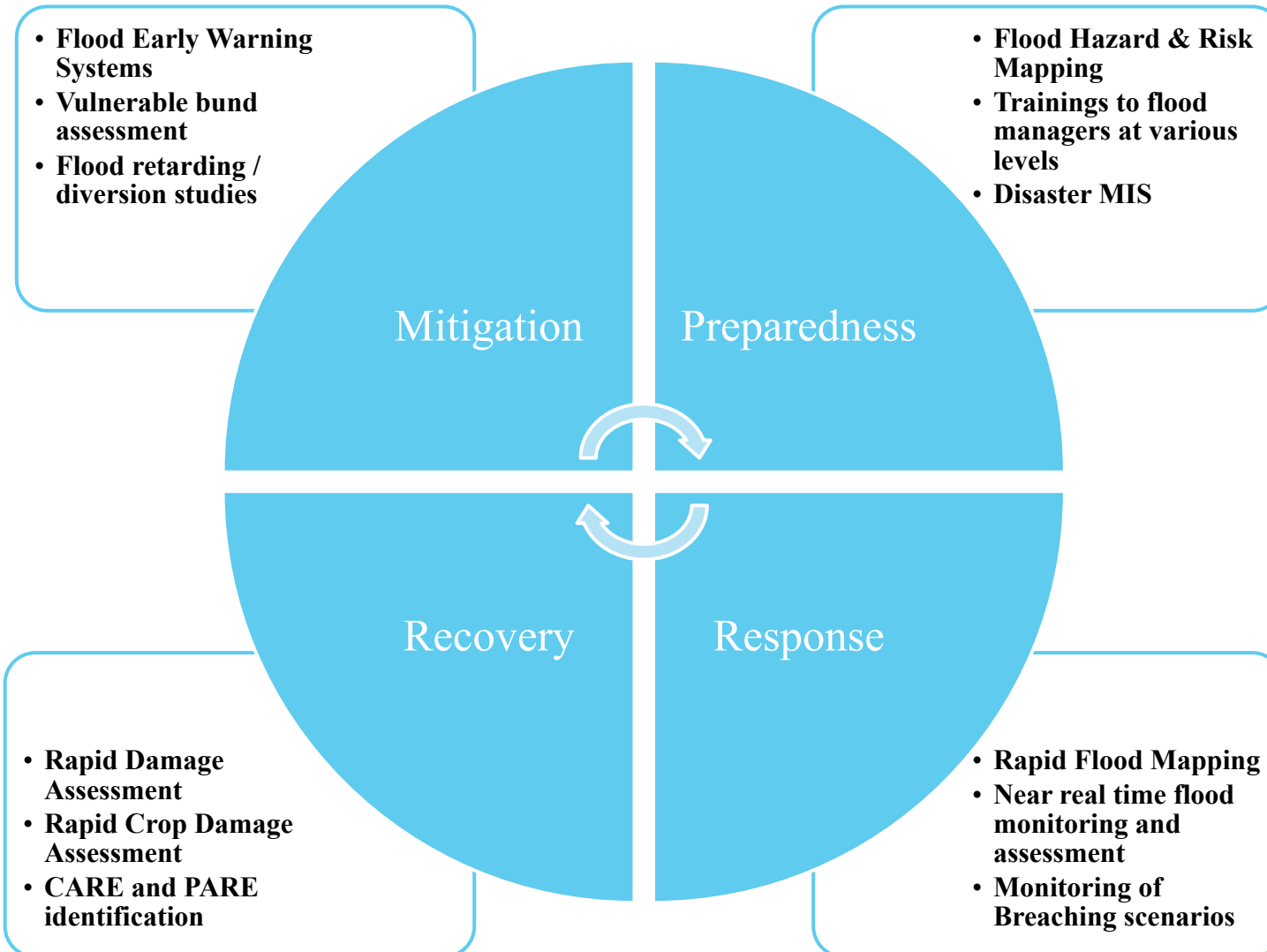


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FLOOD MANAGEMENT SUPPORT

SPATIAL TECHNOLOGY AND DISASTER MANAGEMENT CYCLE



ACCESS TO INTERNATIONAL CHARTERS



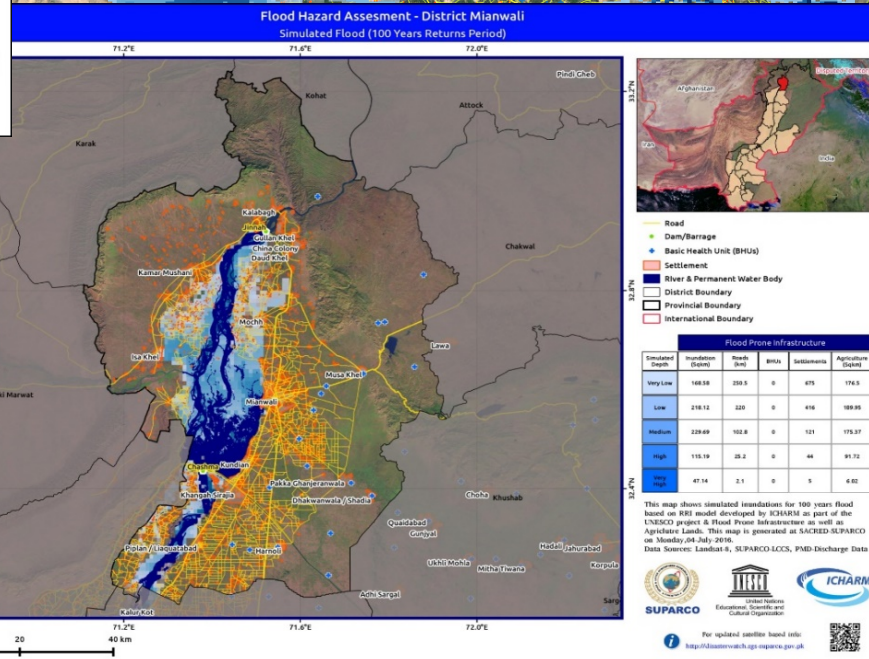
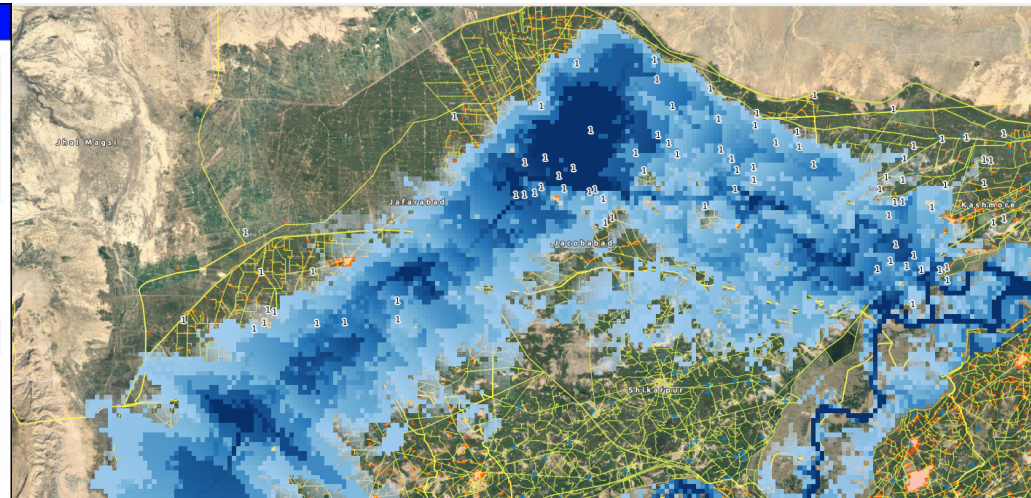
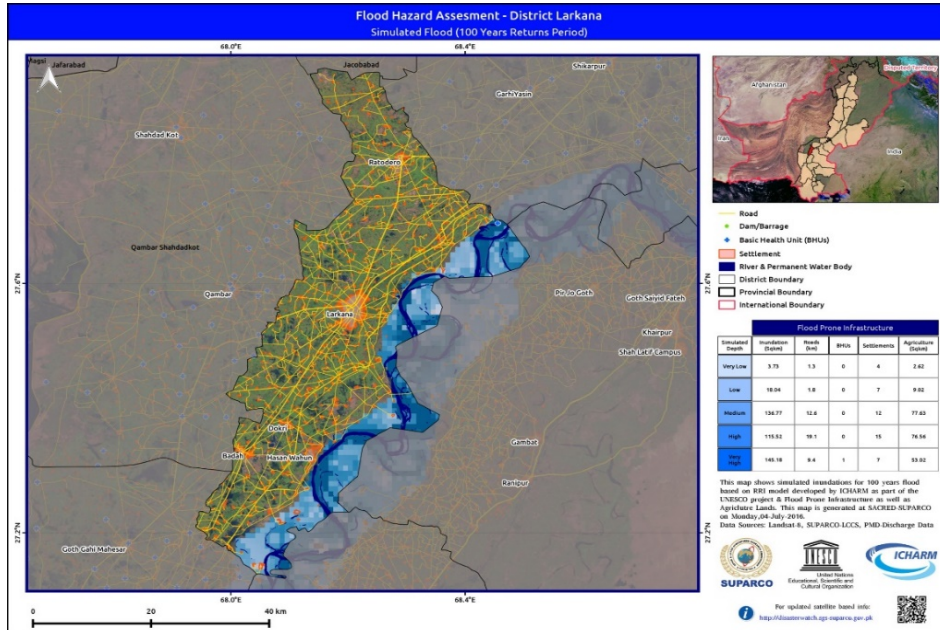
FLOOD HAZARD MAPPING – UNESCO PROJECT PHASE-

1

SIMULATING 10, 25, 50, 100 YEAR FLOODS WITH MULTIPLE (LIKELY / UNLIKELY) BREACHING SCENARIOS



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Hydrological Modeling:-

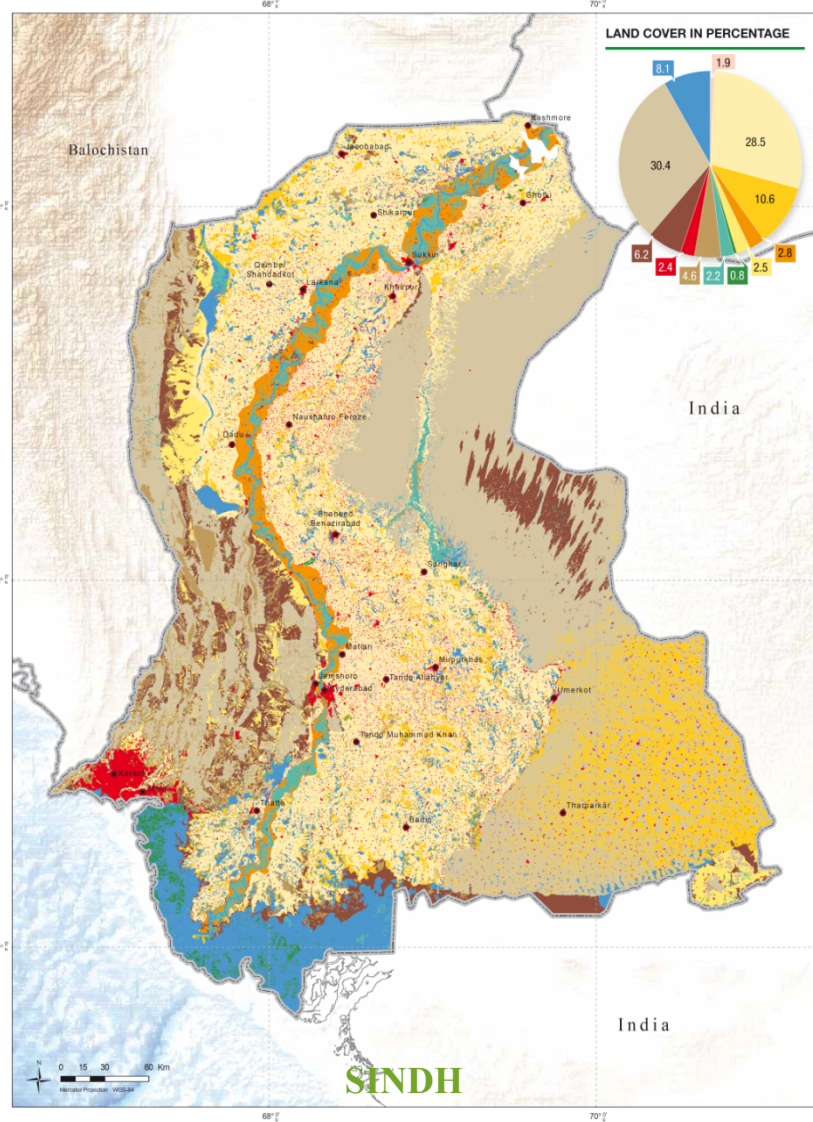
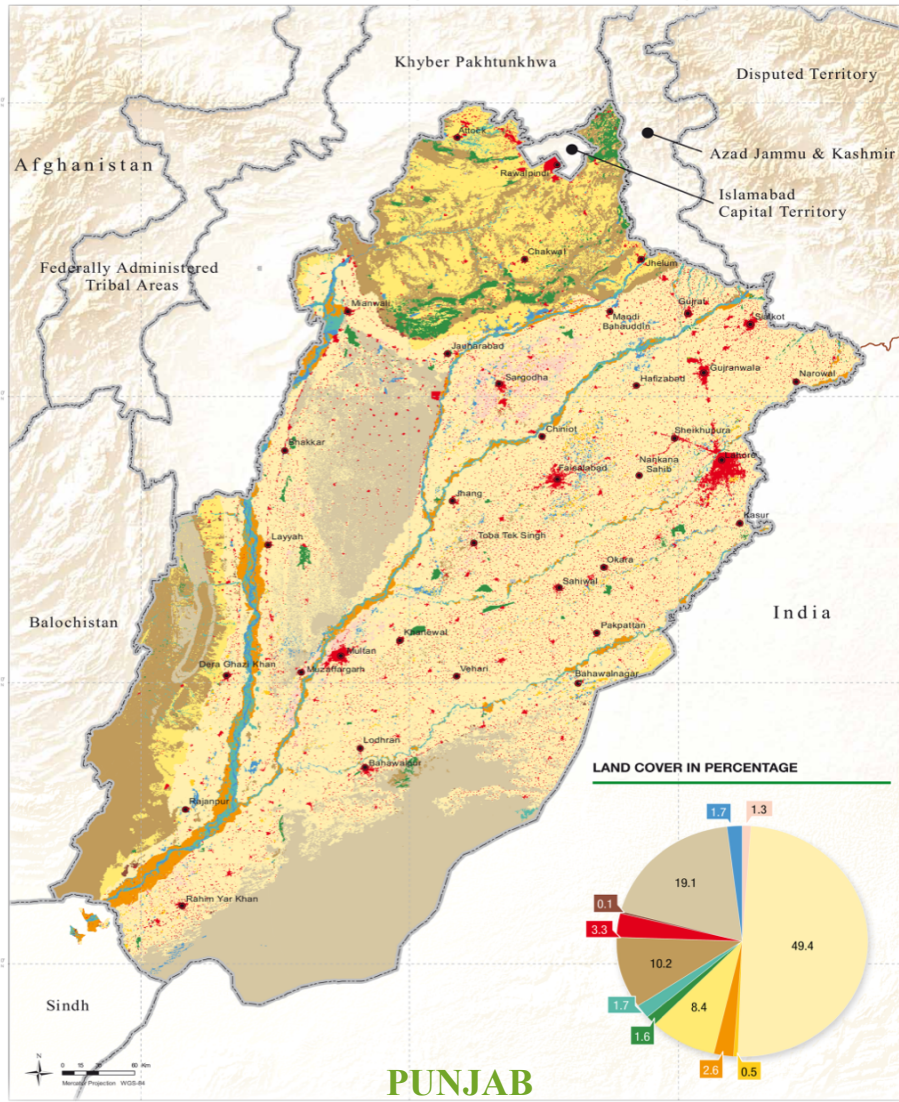
- ICHARM
- PMD
- SUPARCO

LAND COVER MAP

SUPARCO-FAO - LCCS



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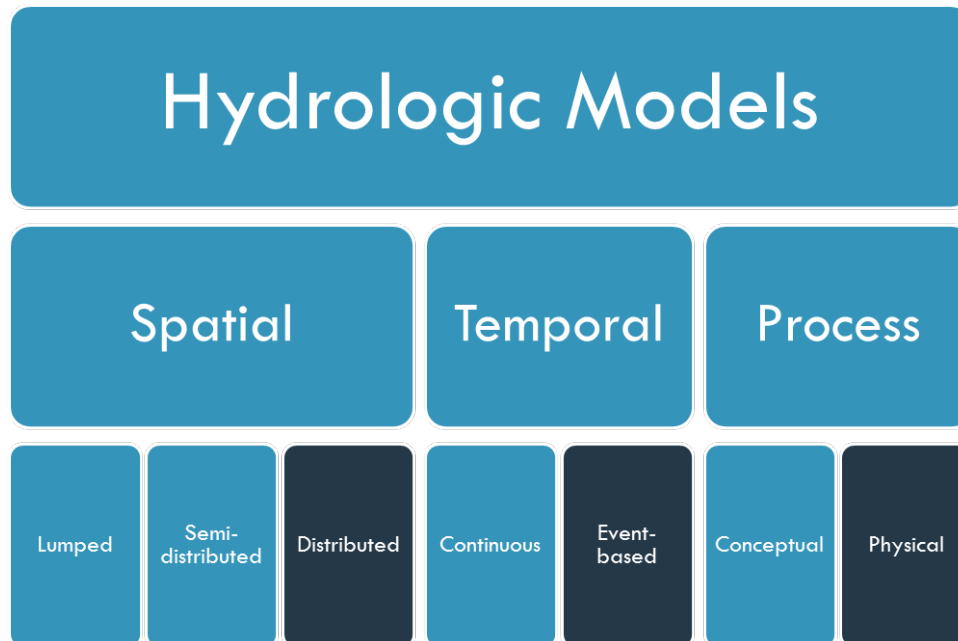


HYDROLOGICAL MODELING APPLICATIONS

RAINFALL-RUNOFF-INUNDATION (RRI) MODEL

RRI model is a 2-Dimensional Inundation Model based on diffusion wave approximations – can simulate rainfall-runoff and flood inundation simultaneously.

- ✓ Rainfall-Runoff
 - ✓ Flood Routing
 - ✓ Inundation
- } Integrated
} Simple
} Physically Sound



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COMBINED MAPPING AND MODELLING

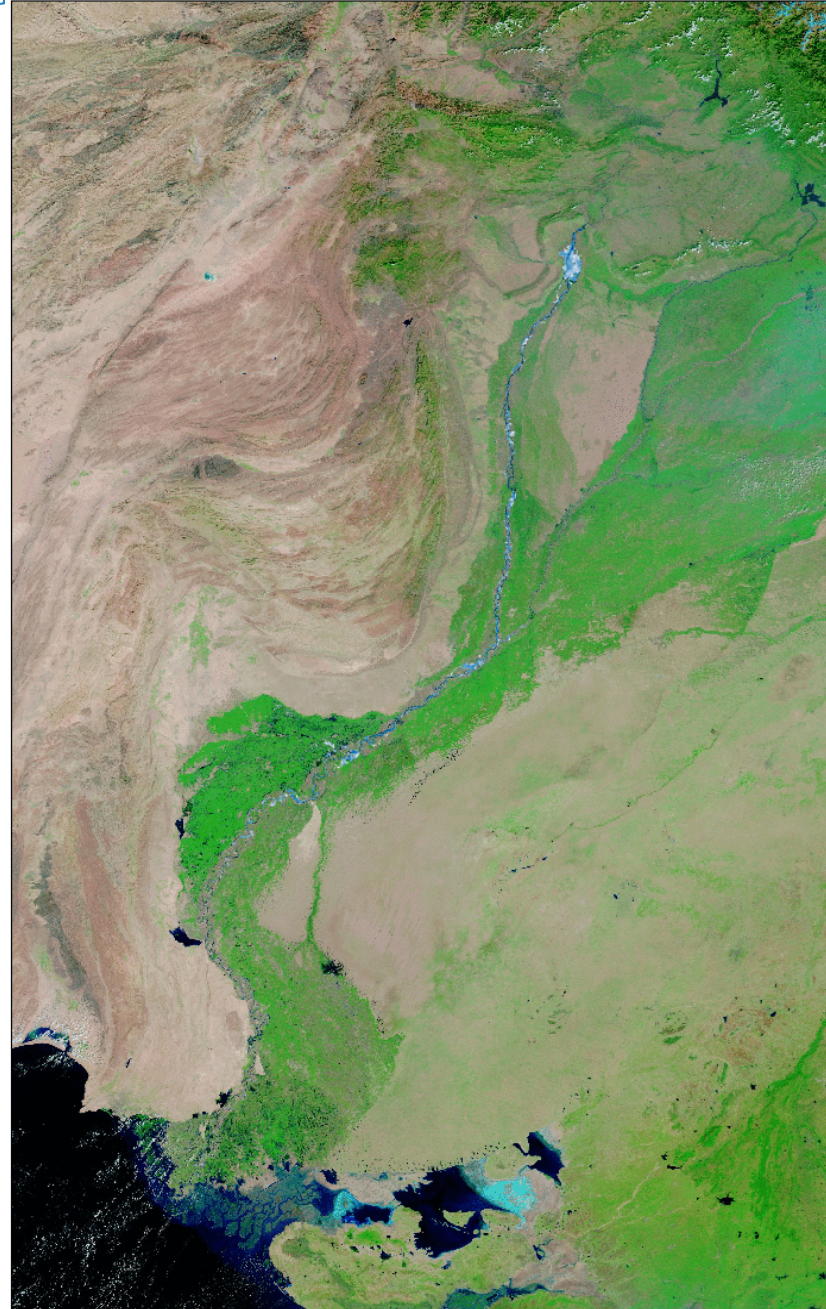
Indus Flood 2010 with Breaching at Tori site

FLOOD MODELING AS INUNDATION FORECASTING

- ▶ Indus River – Tarbela downstream
 - ▶ 2010 and historical floods with breaching scenarios (UNESCO Phase-1)
 - ▶ Implement RRI for NRT flood simulation: daily flood simulations for max inundation.
 - ▶ Data:- NDMA and PMD, also PID for river surveys and structures.
 - ▶ Develop RRI model for other rivers in Punjab mainly Chenab and Jhelum.

DAMAGE ASSESSMENTS

- ▶ Rapid and detailed mapping using satellite data.
 - ▶ Terra/Aqua MODIS
 - ▶ Landsat and Sentinel-2
 - ▶ Sentinel-1, TerraSAR-X, ALOS-PALSAR2



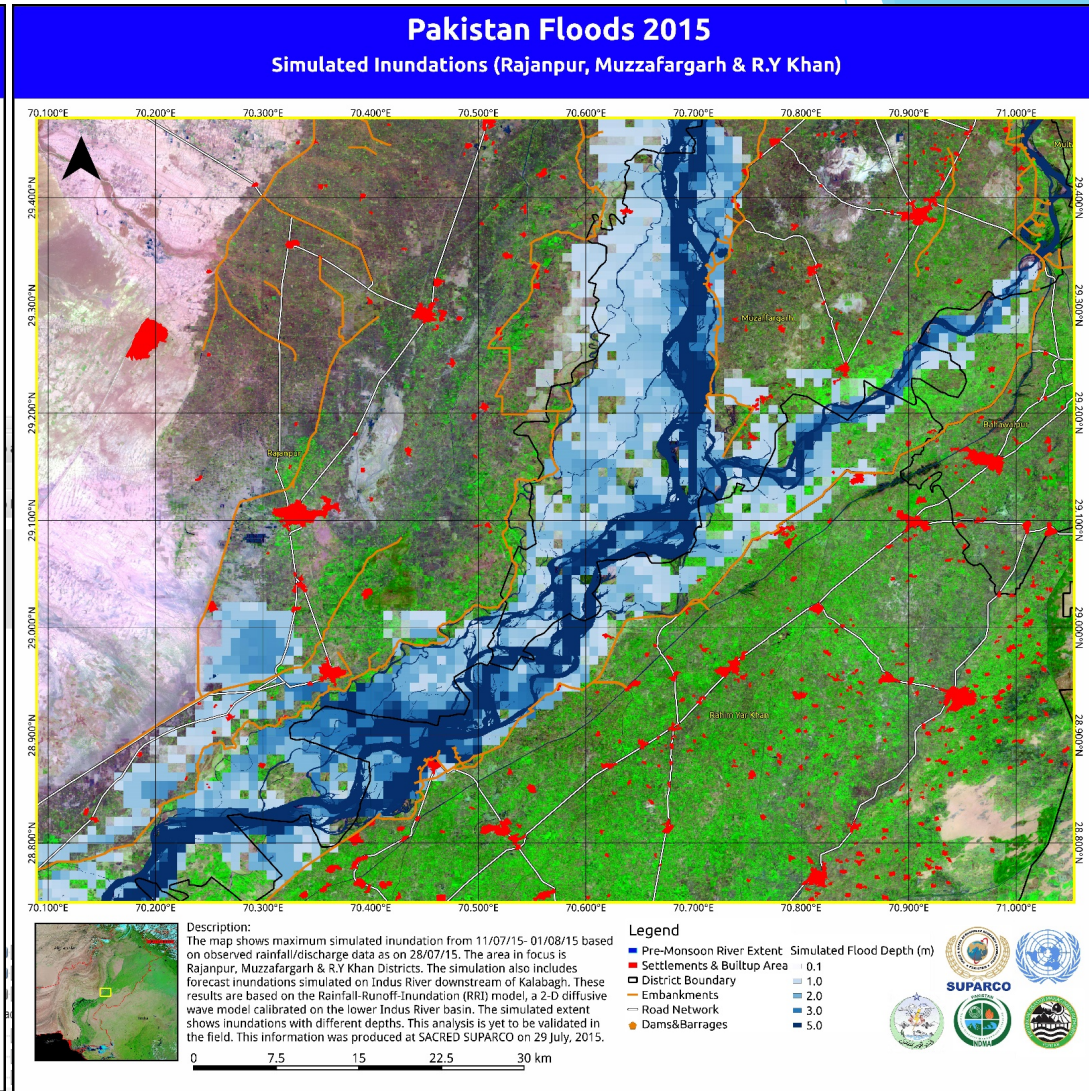
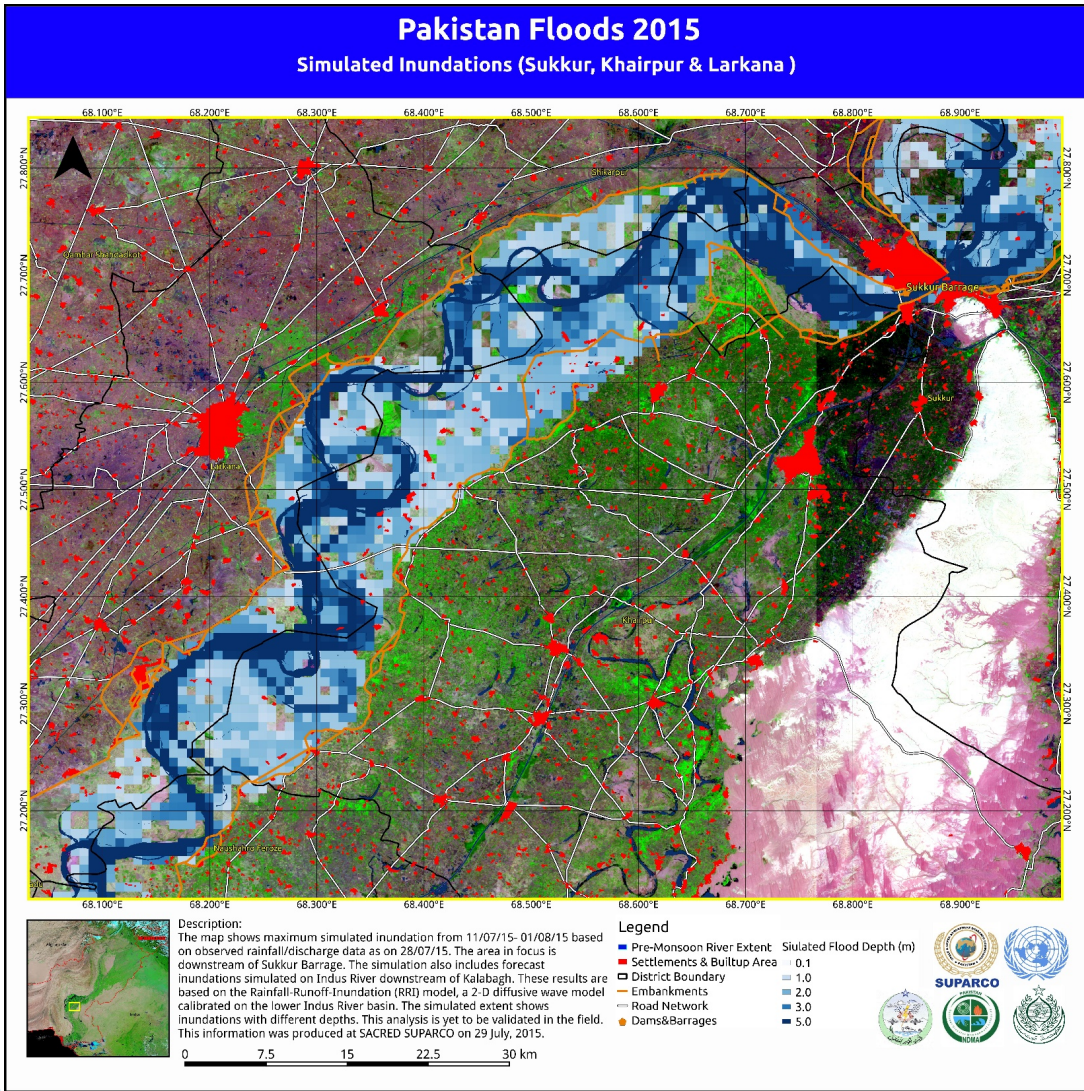
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HYDROLOGICAL MODELING APPLICATIONS

FLOOD MODELING AND INUNDATION FORECASTING



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COMBINED MAPPING AND MODELLING

Indus Flood 2010 with Breaching at Tori site



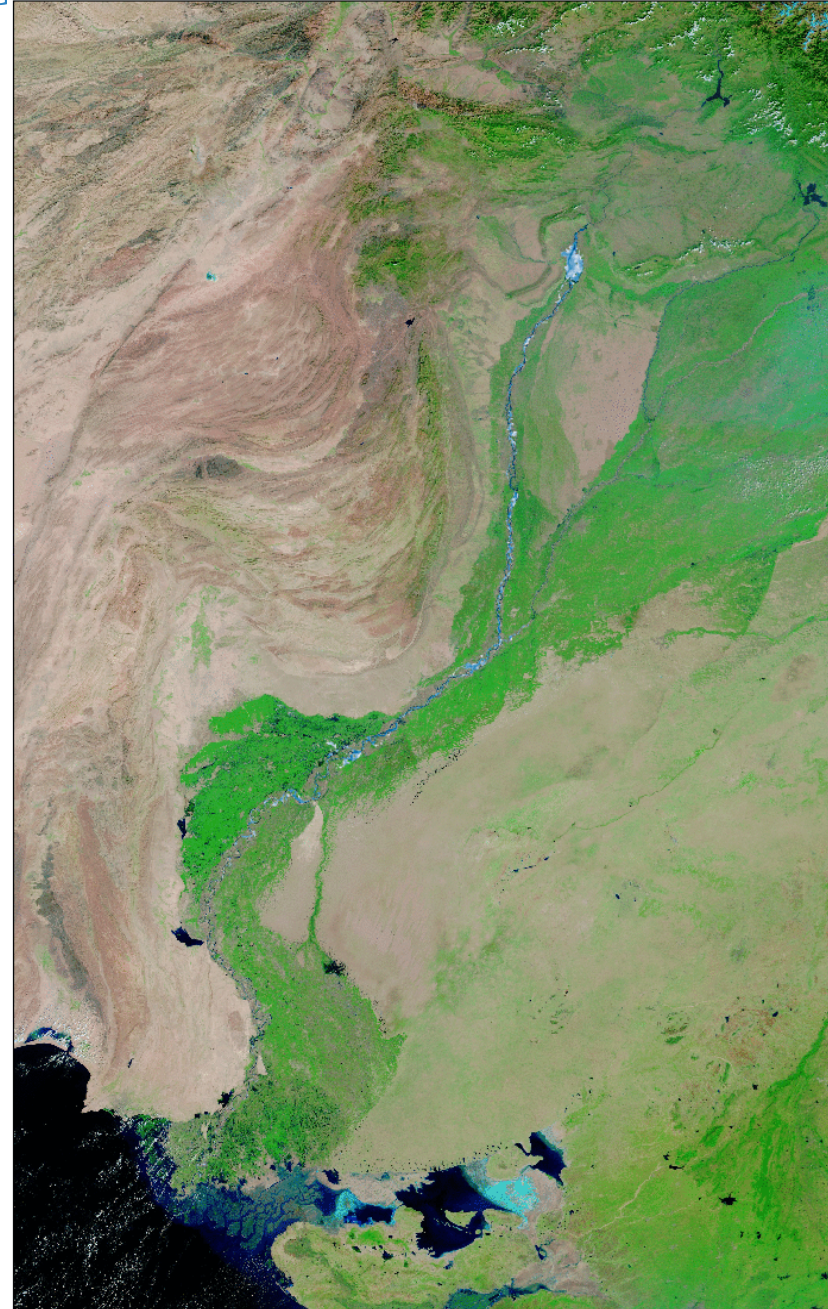
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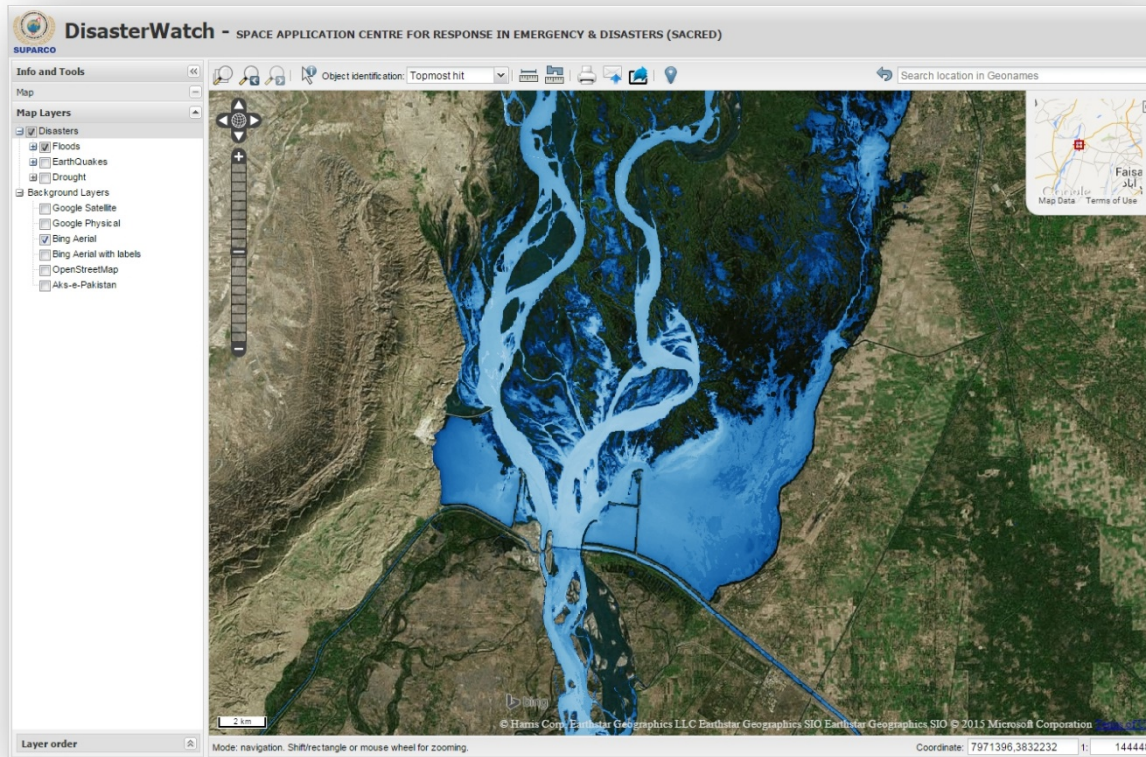


OPERATIONAL SUPPORT BASED ON NRT MONITORING OF FLOODS

PRE-MONSOON SURFACE WATER EXTENTS

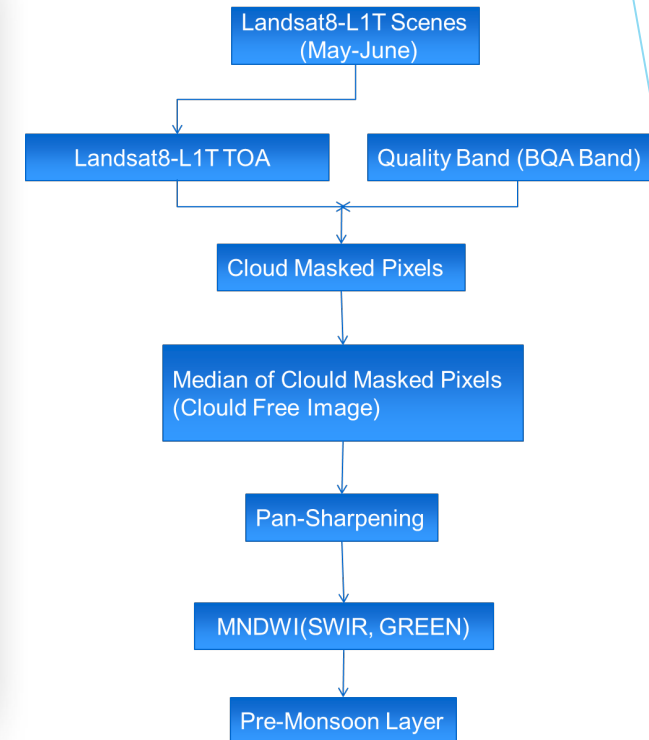


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Above: A view of Chashma Barrage showing pre-monsoon surface water extent using LSt 8 composite.

Right: Flow chart for to create country-wide pre-monsoon surface water extraction using LS 8 (May-June)



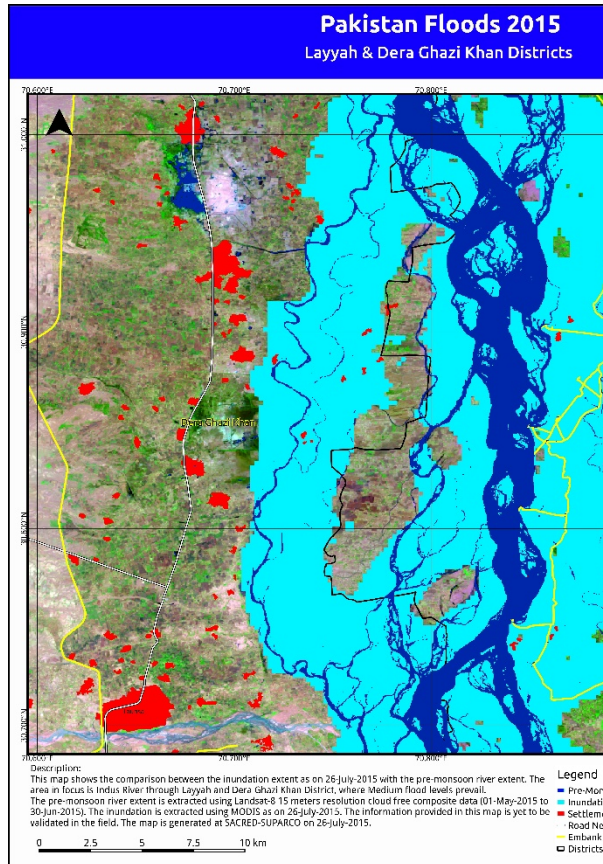
- Pre-monsoon surface water extent is useful to provide a yearly/seasonal baseline for satellite based flood monitoring.
- Separate permanent water bodies such and lakes from ponding due to flood.

OPERATIONAL SUPPORT BASED ON NRT MONITORING OF FLOODS

RAPID FLOOD ASSESSMENT & NEAR REAL-TIME SUPPORT



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DisasterWatch @disasterwatchPK · 1 Sep 2015
Processing Terabytes of Satellite Imagery in Google Earth Engine: Crisis Response for 2015 Flo... wp.me/p41nBw-65 via @wordpressdotcom

Processing Terabytes of Satellite Imagery in Googl...
Since the launch of Landsat-1 in the early '70s, a continuous observation of the globe from satellites has generated unprecedented volumes of remote sensing... earthenable.wordpress.com

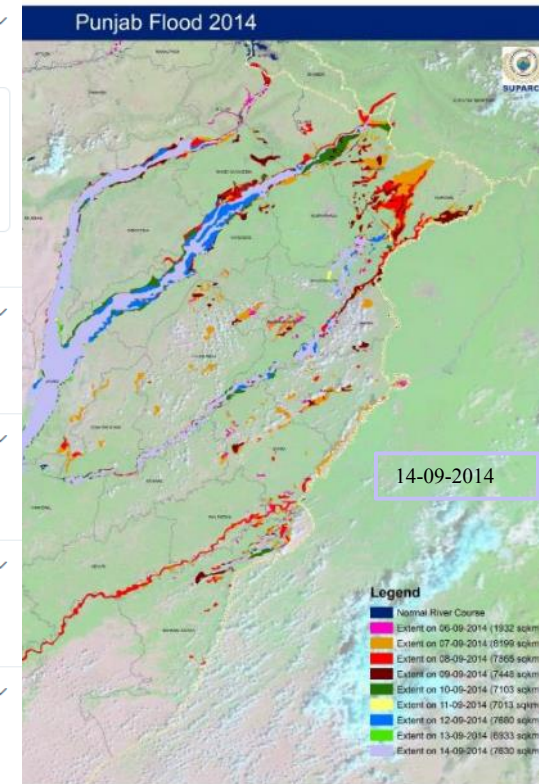
DisasterWatch @disasterwatchPK · 19 Aug 2015
Cumulative inundation extent from 16-07-2015 to 18-08-2015 has been updated on #DisasterWatch portal! @reliefweb @fasiehmehta @pdmapunjab

DisasterWatch @disasterwatchPK · 14 Aug 2015
Detailed inundation extents are now available on #DisasterWatch,using #Sentinel-1Synthetic Aperture Radar(SAR)data of 13-08-2015 @pdmapunjab

DisasterWatch @disasterwatchPK · 14 Aug 2015
Detailed inundation extents are now available on #DisasterWatch,using #Sentinel-1Synthetic Aperture Radar(SAR)data of 14-08-2015 @pdmapunjab

DisasterWatch @disasterwatchPK · 12 Aug 2015
Simulated flood extents have been updated on #DisasterWatch showing inundations from 25 July - 15 Aug 2015.disasterwatch.sgs-suparco.gov.pk

DisasterWatch @disasterwatchPK · 11 Aug 2015
Simulated flood extents have been updated on #DisasterWatch showing inundations from 23 July - 13 Aug 2015.disasterwatch.sgs-suparco.gov.pk



Maps were generated on a daily basis to provide a tent of floods

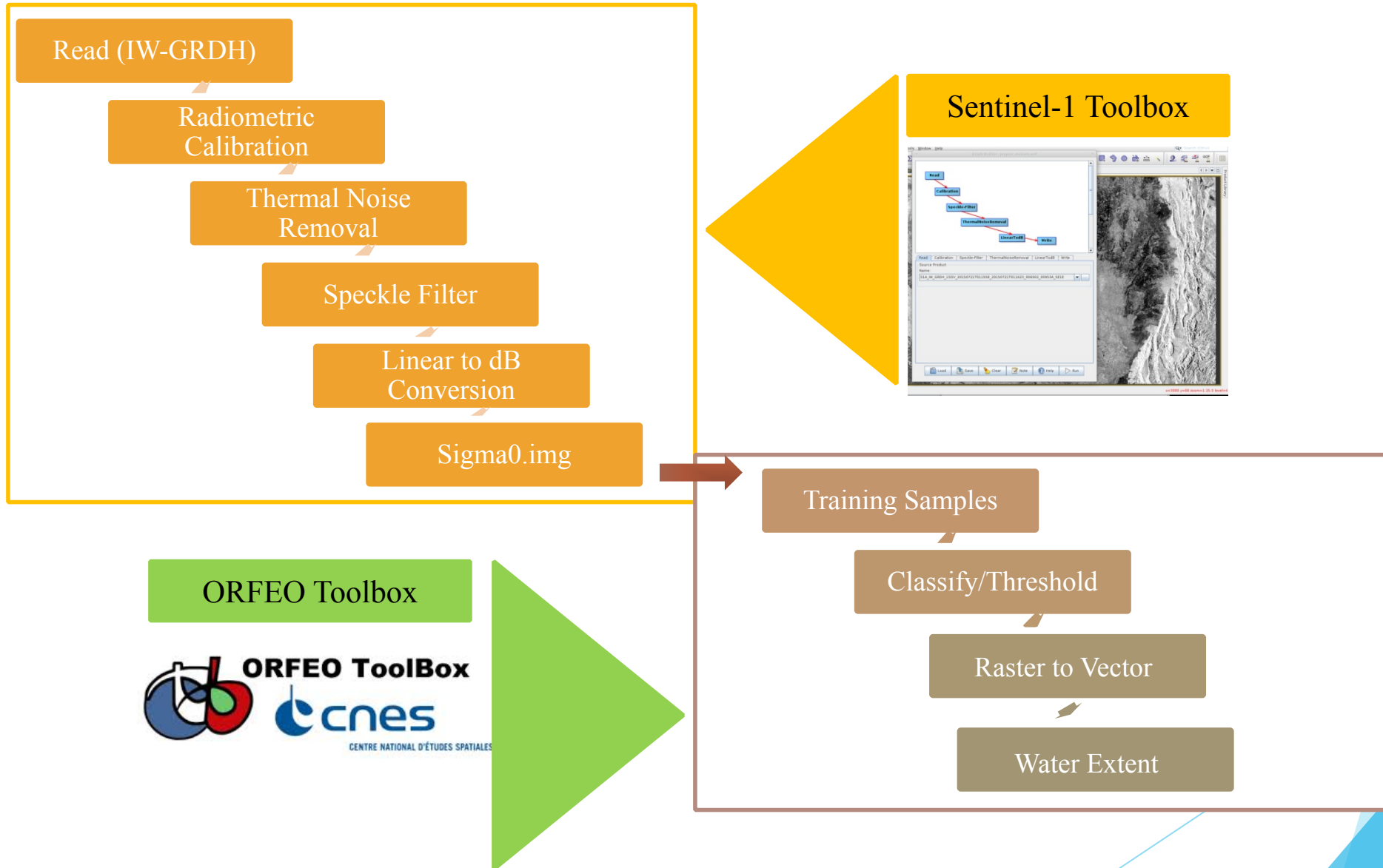
- First assessment of daily flood damage based on MODIS rapid datasets.
- Disseminated to flood management stakeholders at every level through web-based visualization platform (DisasterWatch), printed maps and statistics.
- Within 1 hour of MODIS data availability.

OPERATIONAL SUPPORT BASED ON NRT MONITORING OF FLOODS

SENTINEL-1/ALOS-2 PALSAR DATA PROCESSING WORKFLOW



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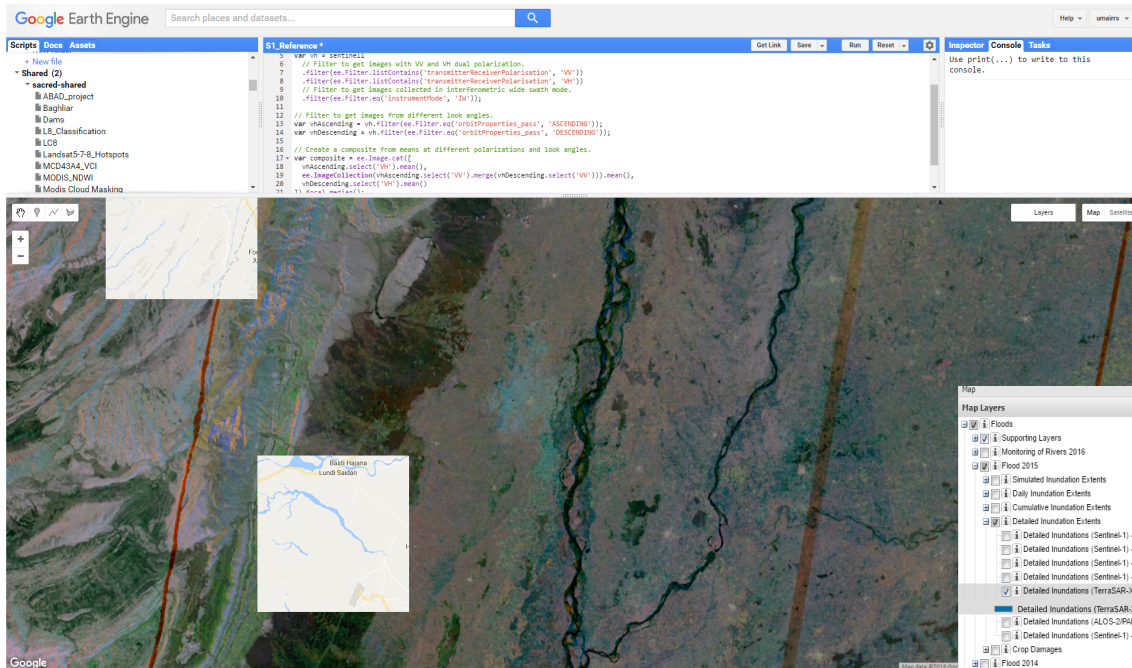


OPERATIONAL SUPPORT BASED ON NRT MONITORING OF FLOODS

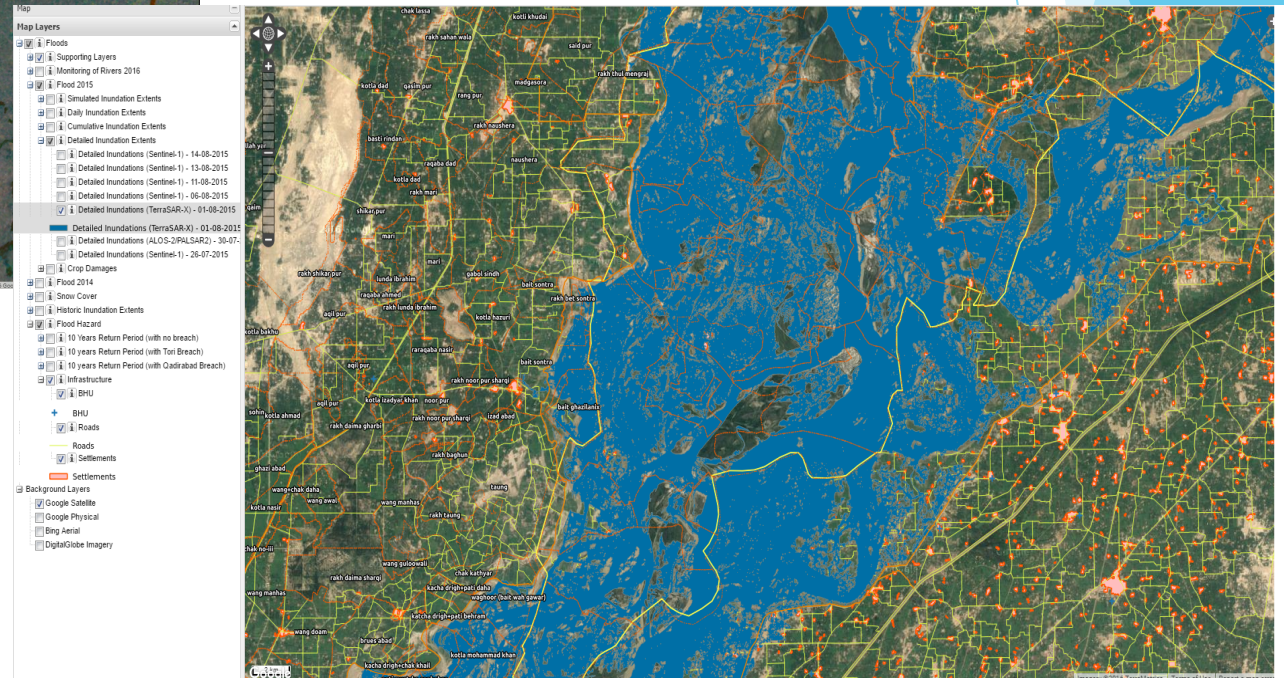
CLOUD PROCESSING FOR SENTINEL-1 AND LANDSAT 8



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DETAILED INUNDATION & DAMAGE ASSESSMENT

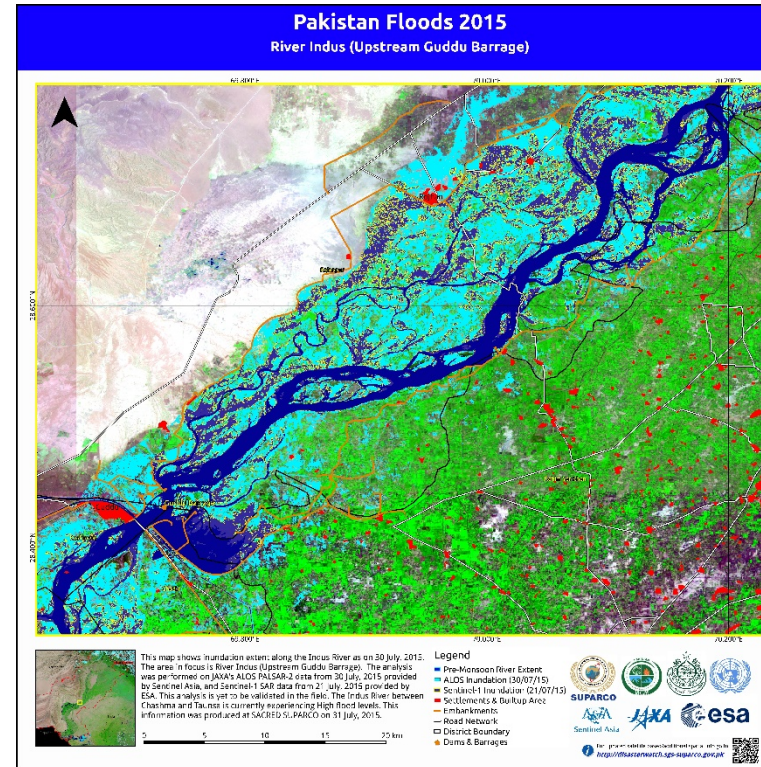
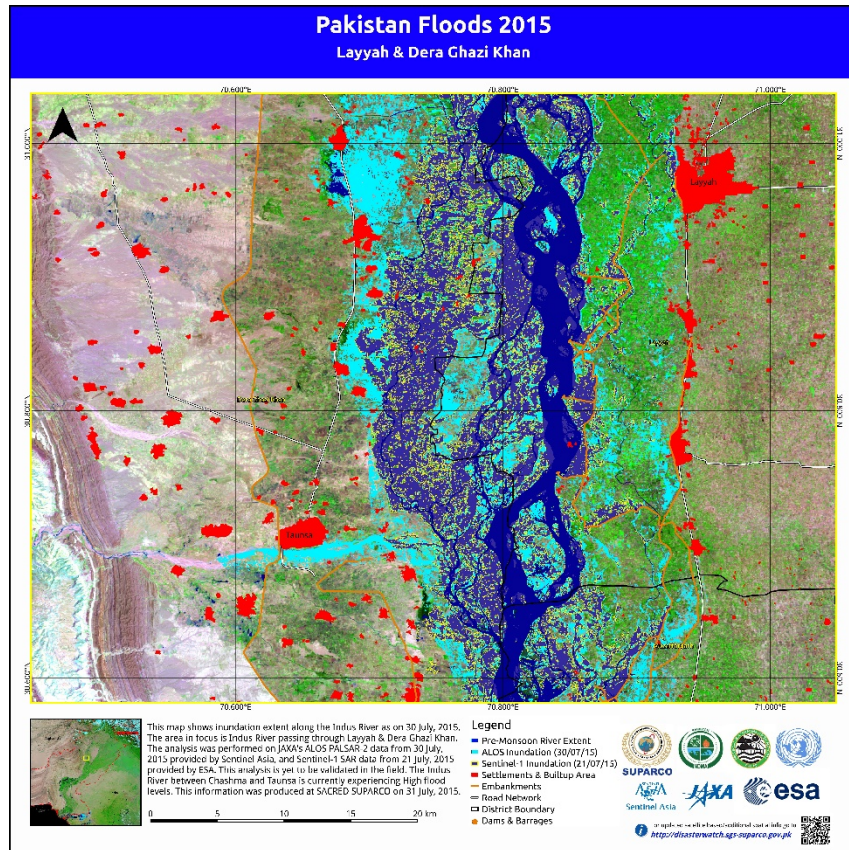


OPERATIONAL SUPPORT BASED ON NRT MONITORING OF FLOODS

DETAILED FLOOD ASSESSMENT THROUGH SATELLITE BASED DATASETS



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Maps showing analysis based on ALOS PALSAR-2 SAR data, and Sentinel-1 SAR data:

Left - Inundations along Lala creek and Indus in Layyah District

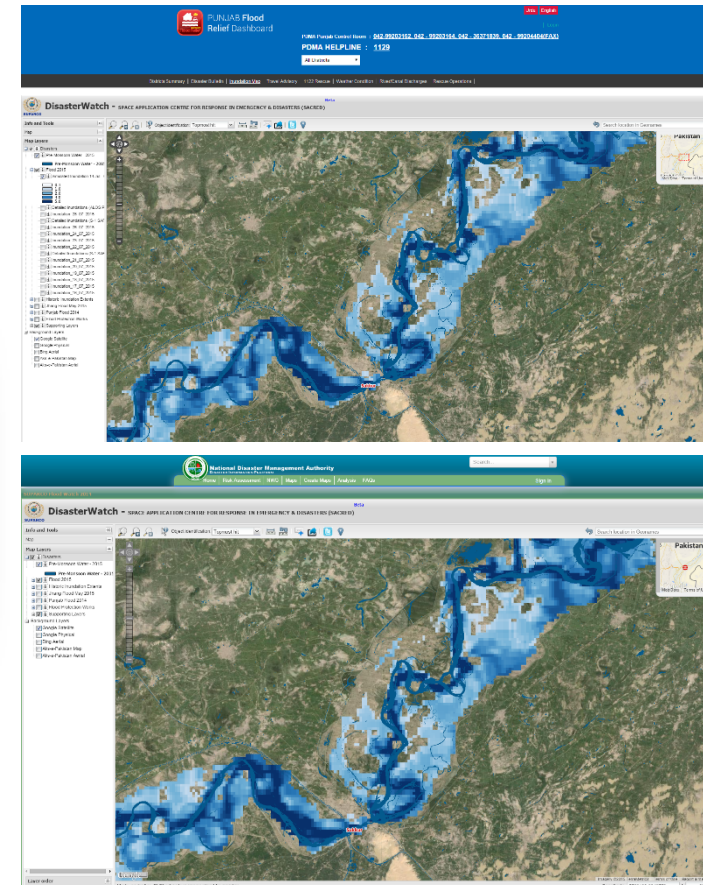
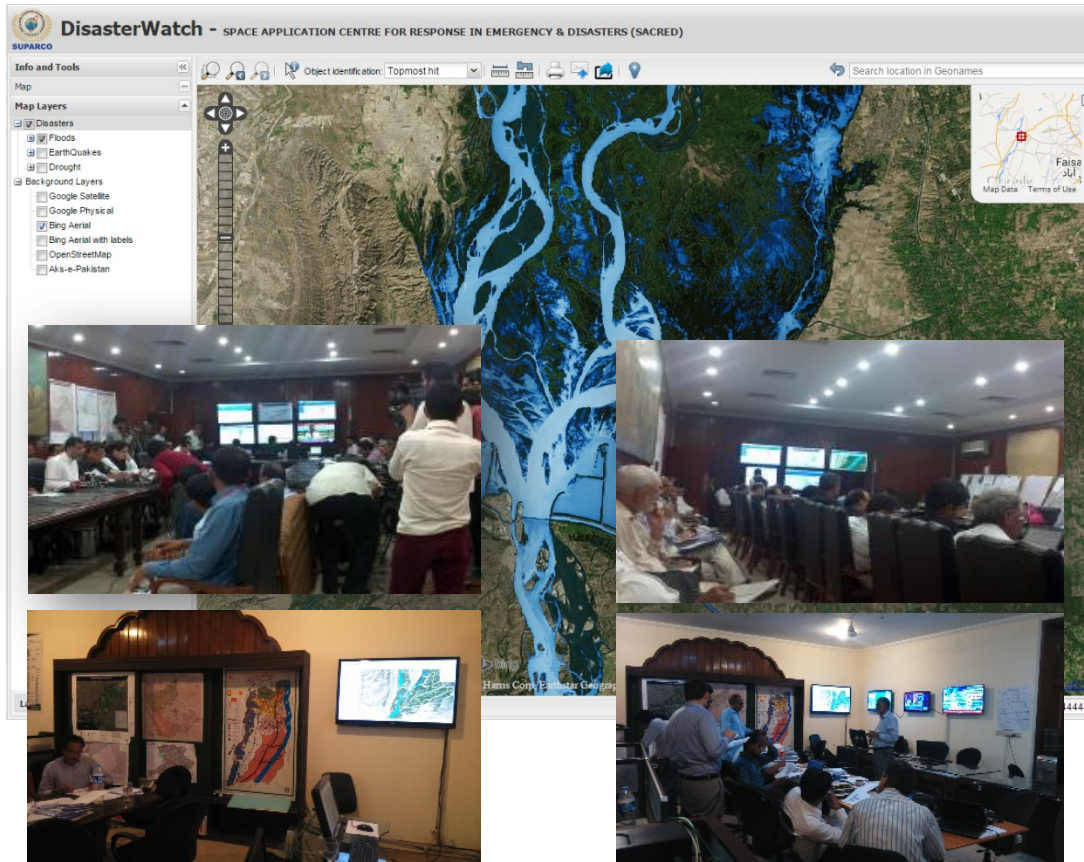
Top - Inundations in Rajanpur District due to flash floods and riverine flooding in Indus

- Combination of hyper temporal coarse resolution imagery (MODIS), high resolution imagery (LC8), SAR datasets S-1, TerraSAR-X, ALOS2-PalSAR.

NEAR REAL-TIME SUPPORT THROUGH DISASTERWATCH



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Integration with Govt. of
Punjab's Flood Relief portal.

Integration with NDMA's disaster
information portal.

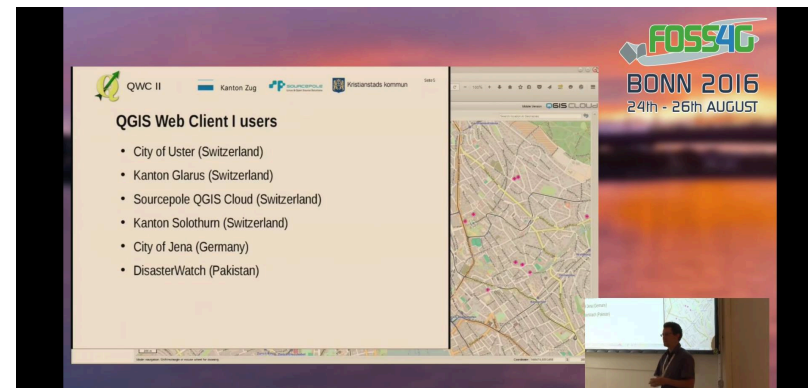
- Helpful for flood management stakeholders at every level through web, printed maps and statistics.
- DisasterWatch portal has additionally been integrated at with the NDMA and Punjab Government's official websites, through which, rescue / relief and flood management organizations such as RESCUE 1122, PID, BoR, P&D access latest satellite based dataset and spatial information for planning and relief activities.
- Complete picture to the disaster management stakeholders and relief agencies.

DISASTERWATCH

- ▶ QGIS WebClient I
- ▶ Geoserver
 - ▶ Simulation based raster layers
 - ▶ Satellite based raster layers
- ▶ PostgreSQL/PostGIS
- ▶ Ubuntu Server 16.04
 - ▶ QGIS, QGIS Webclient
 - ▶ QGIS Atlas Mapbook
 - ▶ GRASS/GIS
 - ▶ GDAL/OGR
 - ▶ OrfeoToobox
 - ▶ Google Earth Engine Python API



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Thank You