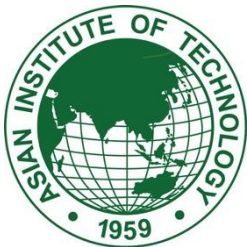


New Fields of Geospatial Applications



Manzul Kumar Hazarika, Ph.D.

Director, Geoinformatics Center (GIC)
Asian Institute of Technology (AIT)

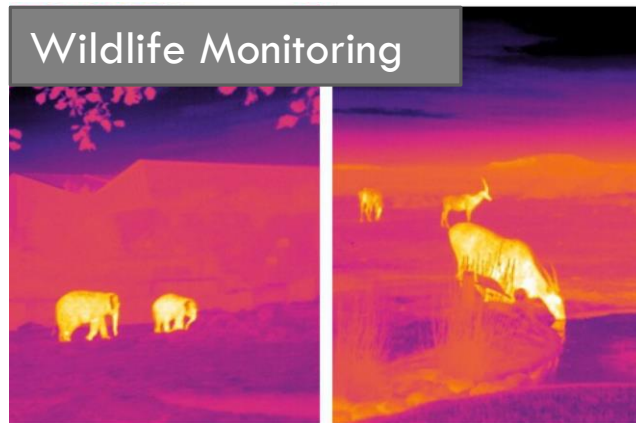
manzul@ait.asia



Contents

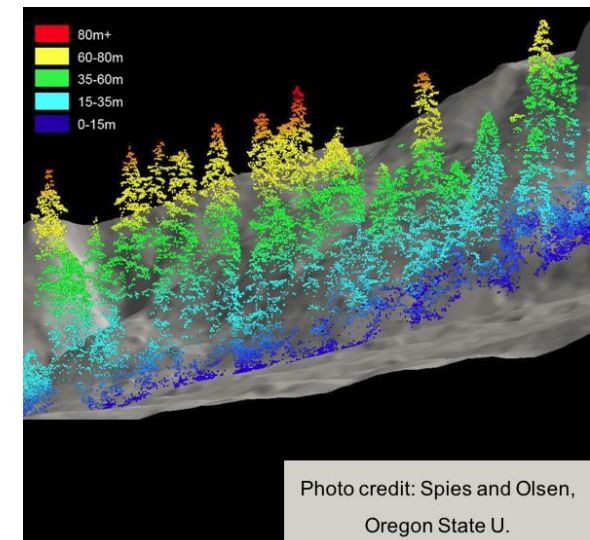
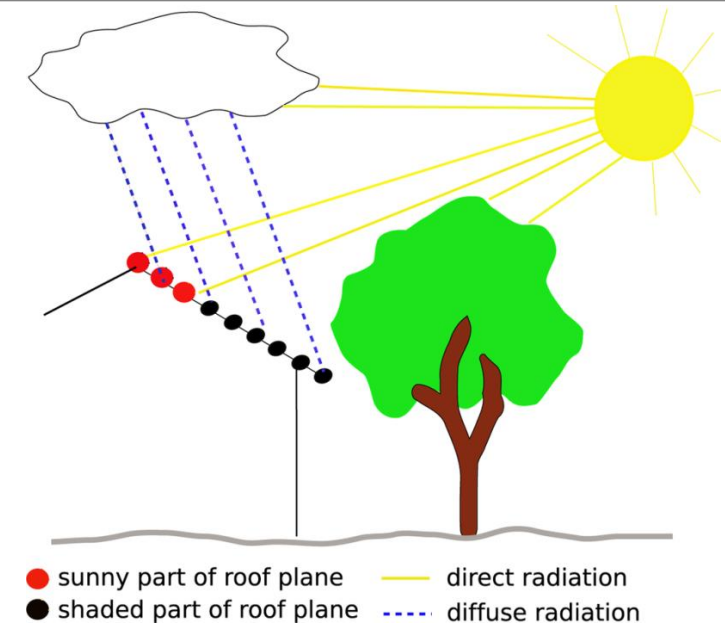
- New technologies
- New Sensors
- Availability of free satellite data
- Advances in data processing
- Advances in data sharing and visualization
- Applications

New Technology - Drone



New Sensor - LiDAR

- Light Detection And Ranging (LIDAR) technology uses active sensors;
- Information obtained from lasers are - the three dimensional distribution of vegetation canopies as well as sub canopy topography;
- Tree/stand height, volume, biomass, etc. can be estimated from LiDAR data;



Availability of Free Satellite Data – Sentinel 1

Sentinel-1 is a two satellite constellation (C band Microwave)

Observation Modes and Resolution

- Strip Map Mode: 5 x 5 m
- Interferometric Wide Swath: 5x20 m
- Extra-Wide Swath Mode: 25 x 100 m
- Wave-Mode: 5 x 20 m

Revisit Time: 12 Days for one satellite

Sentinel-2 mission is a land monitoring 2 satellite constellation

Spatial Resolution: Various Resolution for different bands (10 m, 20 m and 60 m spatial resolution)

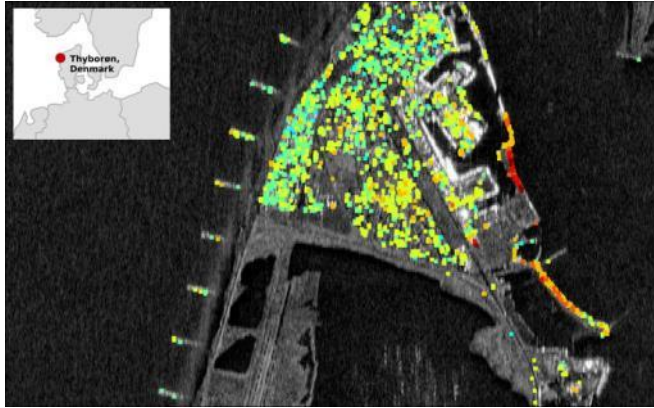
Revisit Time: 10 days with one satellite and 5 days with 2 satellites



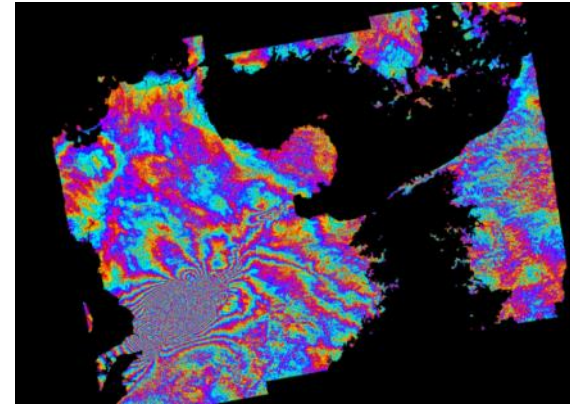
Applications of Sentinel 1 & Sentinel 2

Sentinel 1

Subsidence In Denmark
(PS InSAR)



Surface Deformation from Kumamoto
Earthquake (InSAR)



Flood in Bangladesh



Sentinel 2

Leaf Area Index (LAI)

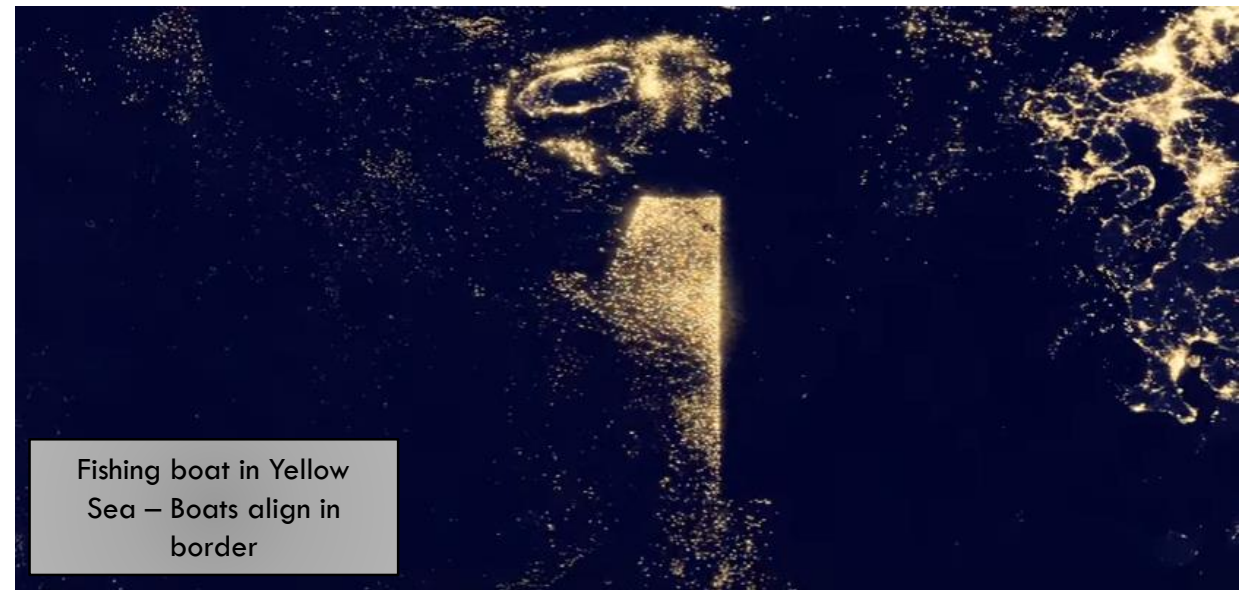


Land Cover classification



VIIRS Successor of MODIS

Day and Night Observations



Advances in Data Processing - Cloud Computing

Advantages: Simplified access, quick analysis, improved decision making

Data hosts in the cloud and Quick analysis can be conducted in Cloud and only the results will be transferred to the client.

Another good example for free satellite data is **Google Earth Engine**

Cloud Computing - Google Earth Engine

The screenshot displays the Google Earth Engine Playground interface. The top section contains a code editor with a JavaScript script:

```
1 Imports (5 entries)
2
3 // load the most recent MODIS composite
4 var modis = ee.Image(imageCollection
5   .sort('system:time_start', false)
6   .first());
7
8 // print metadata to the console
9 print(modis);
10
11 var sld = "\
12   <RasterSymbolizer>\
13   <ContrastEnhancement><Normalize/></ContrastEnhancement>\
14   <ChannelSelection>\
15     <RedChannel>\
16       <SourceChannelName>sur_refl_b01</SourceChannelName>\
17     </RedChannel>\
18     <GreenChannel>\
19       <SourceChannelName>sur_refl_b04</SourceChannelName>\
```

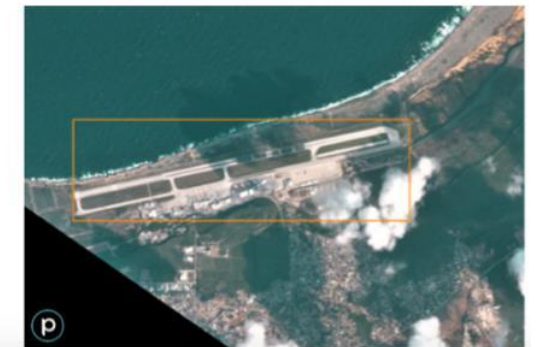
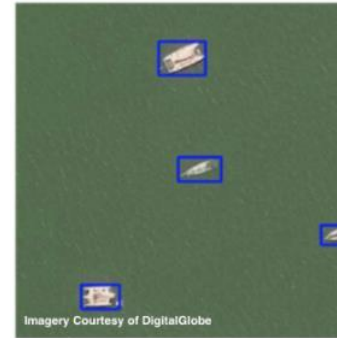
The right-hand side of the interface shows the Inspector panel with the following structure:

- Point (13.54, 23.56) at 20Km/px
- Pixels
 - MODIS composite: Image (3 bands)
 - DEM: Image (2 bands)
- Objects
 - MODIS composite: Image (3 bands)
 - type: Image
 - bands: List (3 elements)
 - properties: Object (5 properties)
 - DEM: Image NOAA/NGDC/ETOP01 (2 bands)
 - type: Image
 - id: NOAA/NGDC/ETOP01
 - version: 1406914481423000
 - bands: List (2 elements)
 - properties: Object (17 properties)

The bottom section of the interface shows a satellite map of the world. The map is overlaid with a dark blue, semi-transparent grid pattern. The Google logo is visible in the bottom-left corner, and the text "Map data ©2015 Google, INEGI | 1000 km | Terms of Use" is visible in the bottom-right corner.






Advances in Data Processing - Artificial Intelligent

This advancement of deep learning allow scientist to detect various objects from high resolution satellite data successfully which was not possible from conventional classification algorithms



Advances in Data Sharing and Visualization - Web-GIS Platform

Emergency Response Data Viewer - Sri Lanka Floods 2017

Geoinformatics Center     


Flood extent Photo gallery Death and Loss **Satellite images** River water levels Contributors

Search Places

Map controls: +, -, Home, Layers, Full Screen, Refresh

Map labels: Maduru Oya, Kandy, Gal Oya, Badulla, Uva, Kuda Oya, Uda Walawe, Yala, Yala East, Sabaragamuwa, Ratnapura, Moratuwa, Western, Colombo, Negombo, Beruwala, Galle, Matara, Kalmunai

Scale: 20mi, 81.063 7.613 Degrees

POWERED BY 

Earthstar Geographics | Esri, HERE, Garmin, FAO, USGS






Layer List

Operational layers

- Sentinel 2 - 28 May 2017 (True colour)
- Sentinel 2 - 28 May 2017 (False colour)
- TerraSAR-X - 28 May 2017
- RADARSAT-2 - 29 May 2017
- ALOS-2 - 30 May 2017
- RADARSAT-2 - 02 June 2017
- Sri Lanka Flood by RADARSAT-2

Sri Lanka Flood - Image from the Sentinel 2 (28 May 2017)

Emergency Response Data Viewer - Sri Lanka Floods 2017

Geoinformatics Center     

Flood extent Photo gallery Death and Loss **Satellite Images** River water levels Contributors


Search Places

Layer List

Operational layers

- Sentinel 2 - 28 May 2017 (True colour)
- Sentinel 2 - 28 May 2017 (False colour)
- TerraSAR-X - 28 May 2017
- RADARSAT-2 - 29 May 2017
- ALOS-2 - 30 May 2017
- RADARSAT-2 - 02 June 2017
- Sri Lanka Flood by RADARSAT-2

2mi
80.555 6.137 Degrees

Earthstar Geographics, CNES/Airbus DS | Esri, HERE, Garmin, USGS 

Extracted Flood Area from Satellite Images

Emergency Response Data Viewer - Sri Lanka Floods 2017

Geoinformatics Center



Disaster Management Center



AIT

Flood extent

Photo gallery

Death and Loss

Satellite images

River water levels

Contributors

The flooded area is extracted from following satellite images.

- ALOS-2 (30 May 2017)
- RADARSAT-2 (29 May 2017)
- SENTINEL-2 (28 May 2017)
- TerraSAR-X (28 May 2017)

Note: The accuracy of the extracted flood extent is not tested against the ground data. Therefore, the actual flooded area might be different from what is shown on the map.

[Download the flood extent shapefile](#)

*Version 2 of the flood extent will be updated soon.

Flood extent (version 1)



Flood Photo Around Colombo City

Emergency Response Data Viewer - Sri Lanka Floods 2017

Geoinformatics Center



1983-
+91 87

Flood extent

Photo gallery

Death and Loss

Satellite images

River water levels

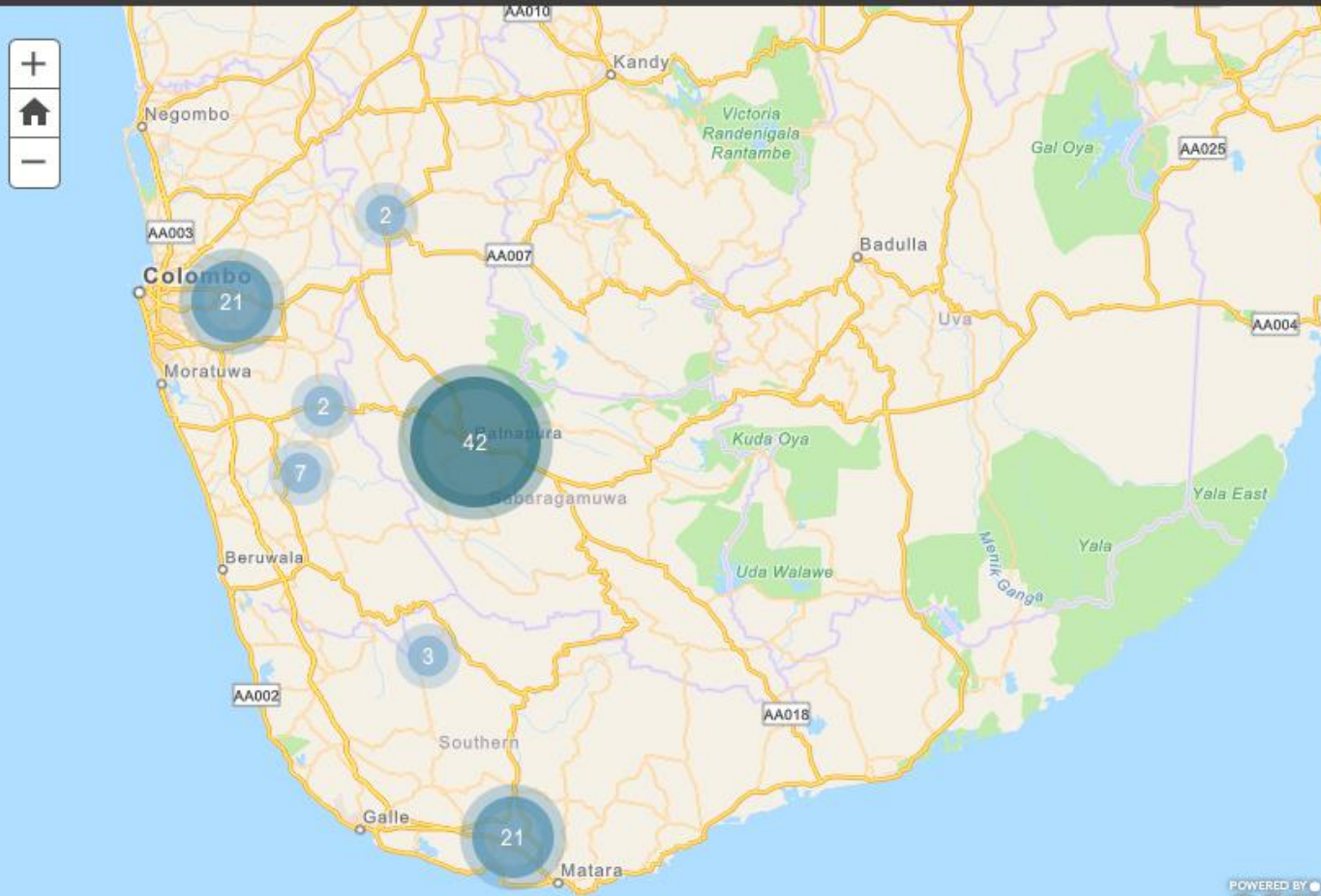
Contributors



GIC

Sri Lanka Floods 2017

+ Upload Photo



27 May 2017

27 May 2017



27 May 2017



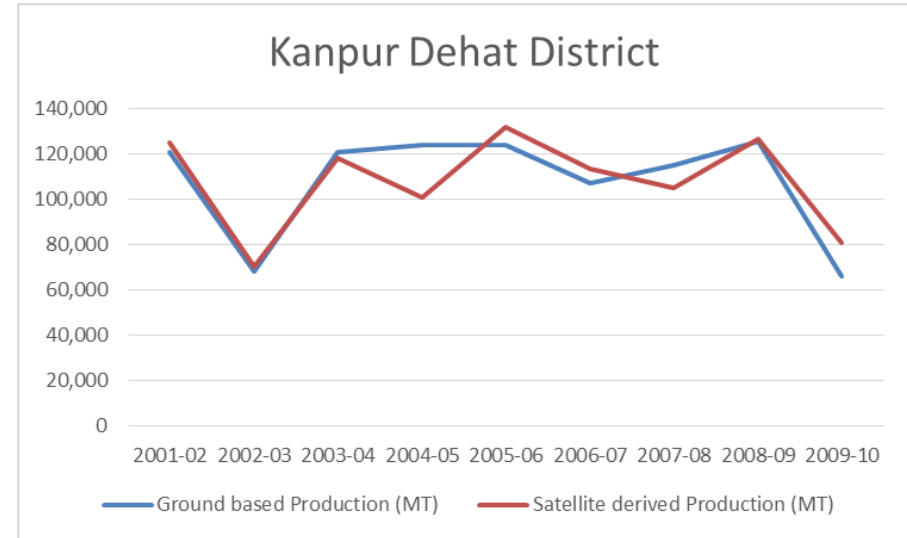
27 May 2017



Agriculture Crop Yield Forecasting

Rice

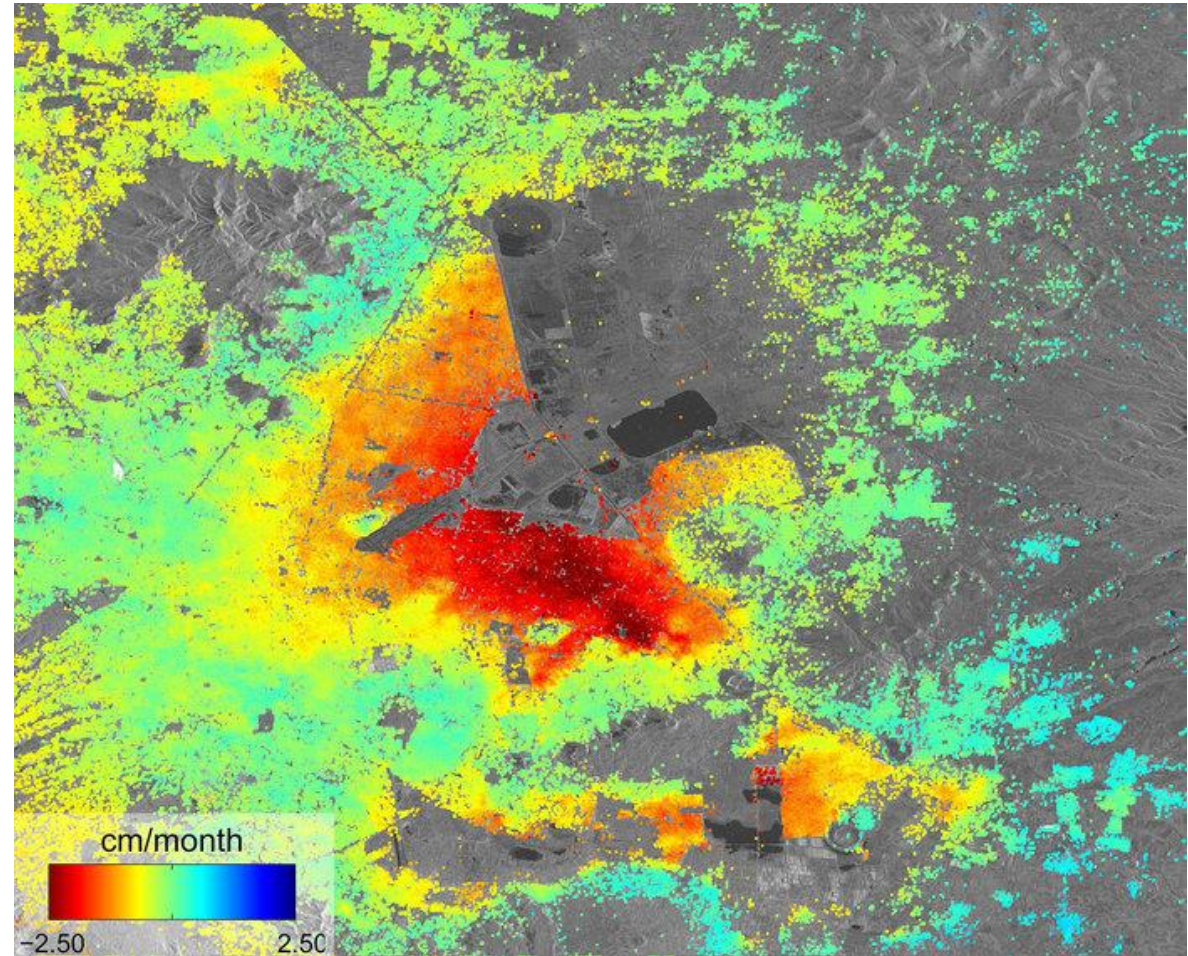
| Year | Actual | Predicted | Remarks |
|---------|---------|----------------|--------------|
| 2001-02 | 198,290 | 170,547 | Drought year |
| 2002-03 | 68,752 | 71,657 | |
| 2003-04 | 156,972 | 169,631 | |
| 2004-05 | 102,142 | 130,878 | |
| 2005-06 | 120,765 | 145,804 | |
| 2006-07 | 136,425 | 151,165 | |
| 2007-08 | 158,258 | 163,413 | |
| 2008-09 | 182,139 | 140,101 | |
| 2009-10 | 133,410 | 113,956 | |
| 2010-11 | - | - | |
| 2011-12 | - | - | |
| 2012-13 | - | 155,625 | |



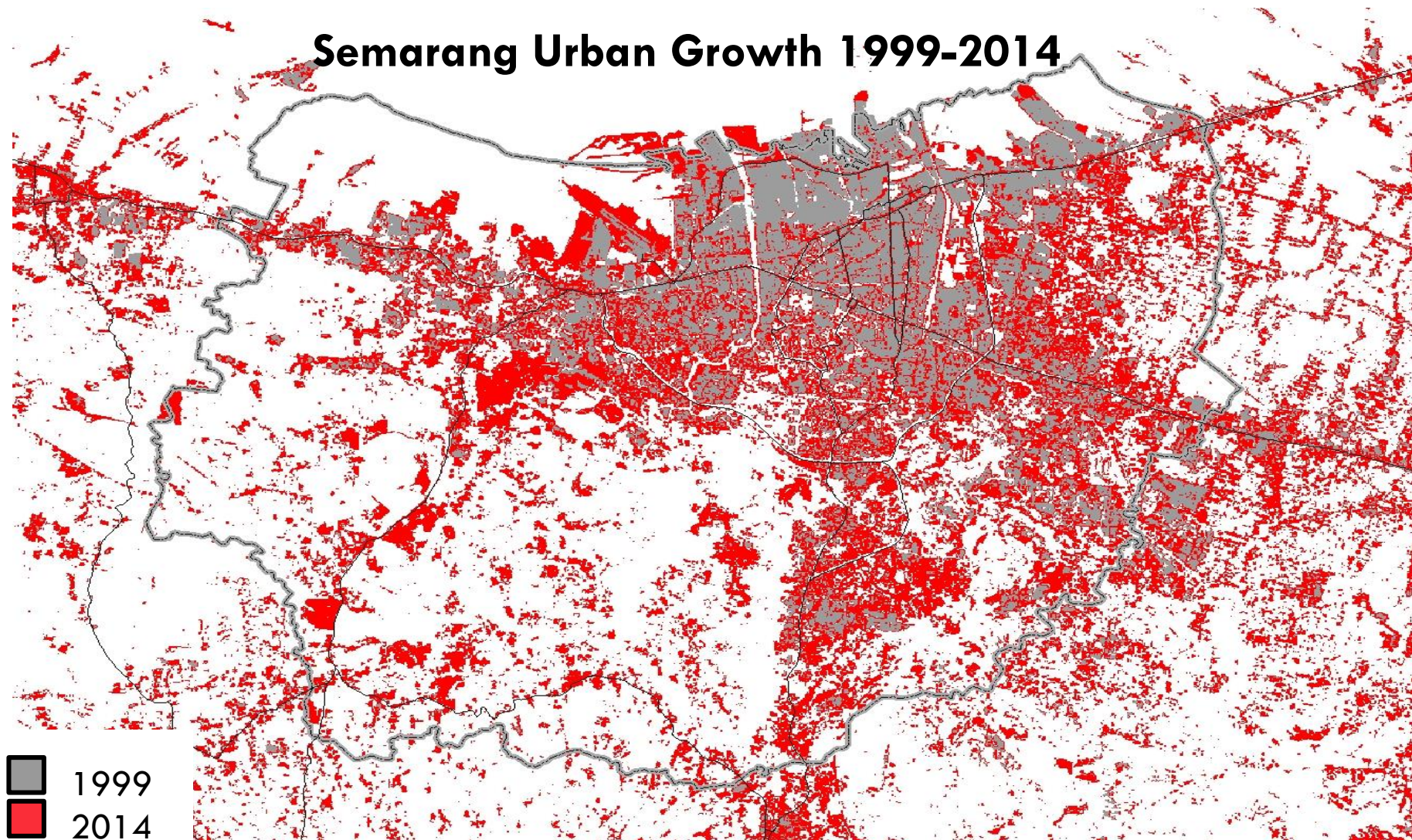
Applications - Urban Area Monitoring

Mexico City subsidence

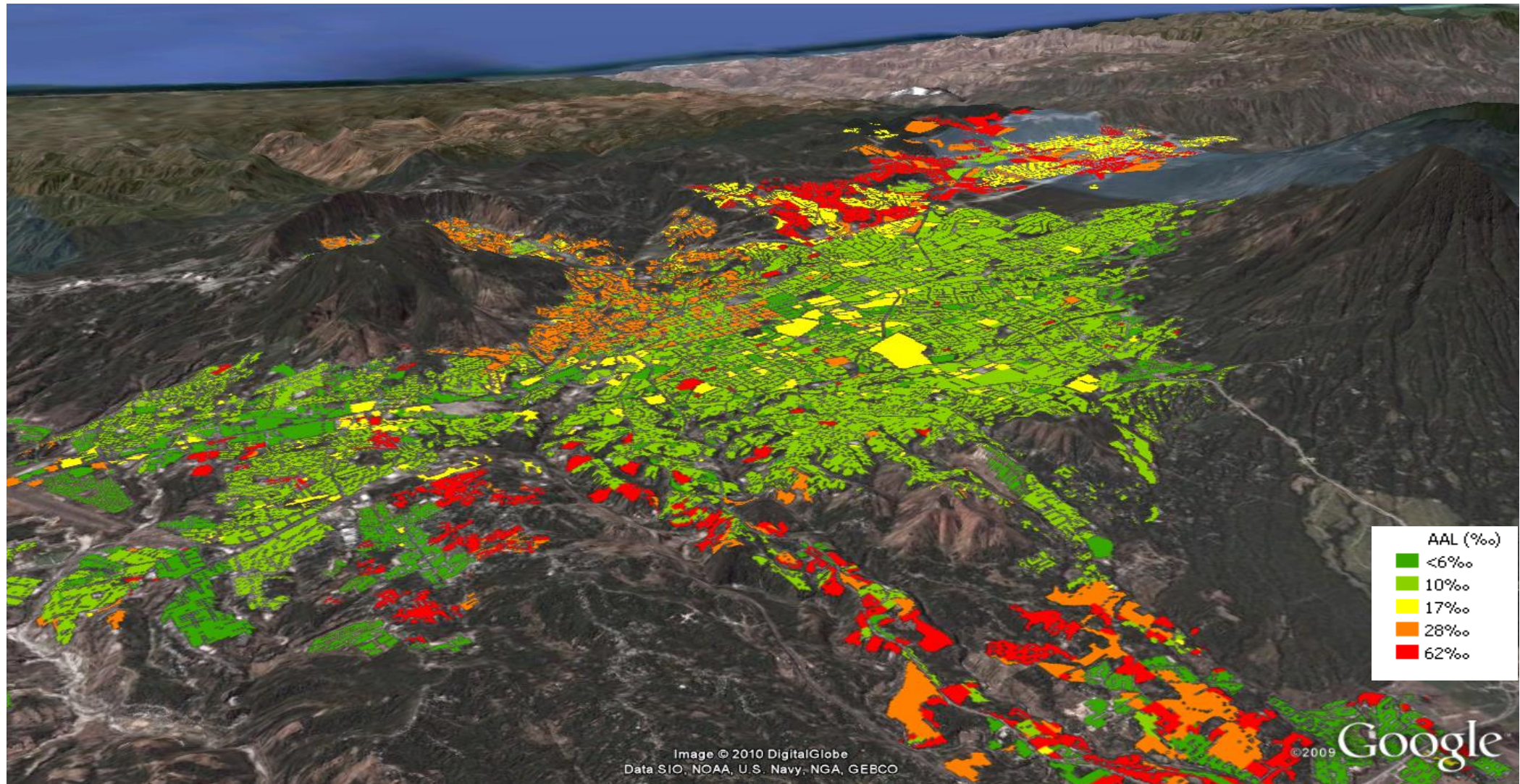
- Five Sentinel-1A radar scans acquired between 3 October and 2 December 2014 were combined to create this image of ground deformation in Mexico City.
- The deformation is caused by ground water extraction, with some areas of the city subsiding at up to 2.5 cm/month



Applications - Urban Growth Monitoring



Applications - Disaster Risk Assessment



Geospatial Skills Required

Degree: Bachelor Degree in Science and Engineering with RS and GIS/WebGIS skills

Master's/Ph.D. Degree in RS and GIS

Programming Skills: Python, JavaScript, HTML, CSS

Special Skill: SAR Data Processing, LiDAR Data Processing, Digital Photogrammetry

Specific Areas: Artificial Intelligence, Big Data

Selected Trainings We Offer

- 1) Mapping with Free Satellite Data and Open Source RS/GIS Tools
- 2) Introduction to Mapping with Drones
- 3) Applications of Drones in Agriculture
- 4) GIS for Disaster Risk Management
- 5) Global Navigation Satellite System (GNSS)

Thank you for your kind attention
