



# Earth Observation & GeoSpatial Big Data for Monitoring SDG Indicators

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## Urbanization is an unstoppable phenomenon

► *The world is rapidly urbanising*



*The world's population living in cities or urban centres has risen steadily over the years*



Since 2007  
over  
**50%**



By 2030  
about  
**60%**



By 2050  
approximately  
**66%**



From 2010 to 2050  
**2.5 to 3 billion people**  
will be added to the urban  
population worldwide

High concentrations of aerosols, exhaust gases, pollution and dust

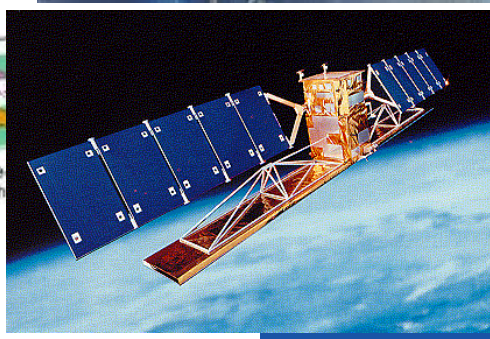
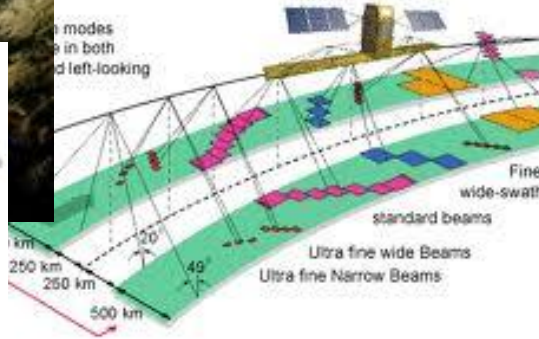
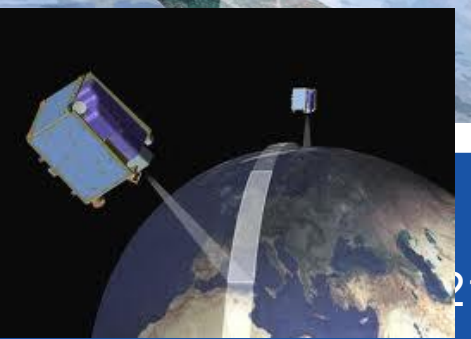
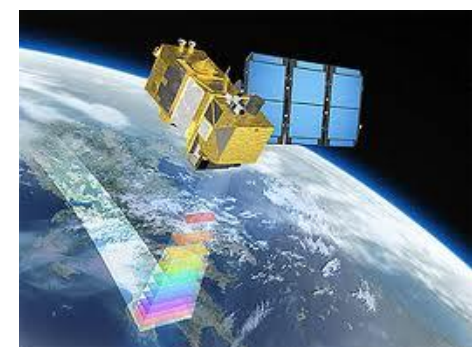
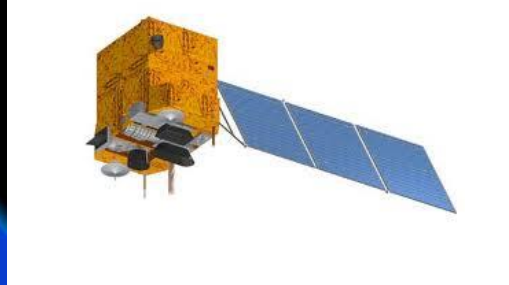
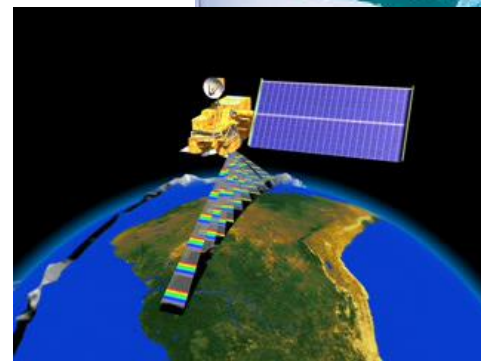
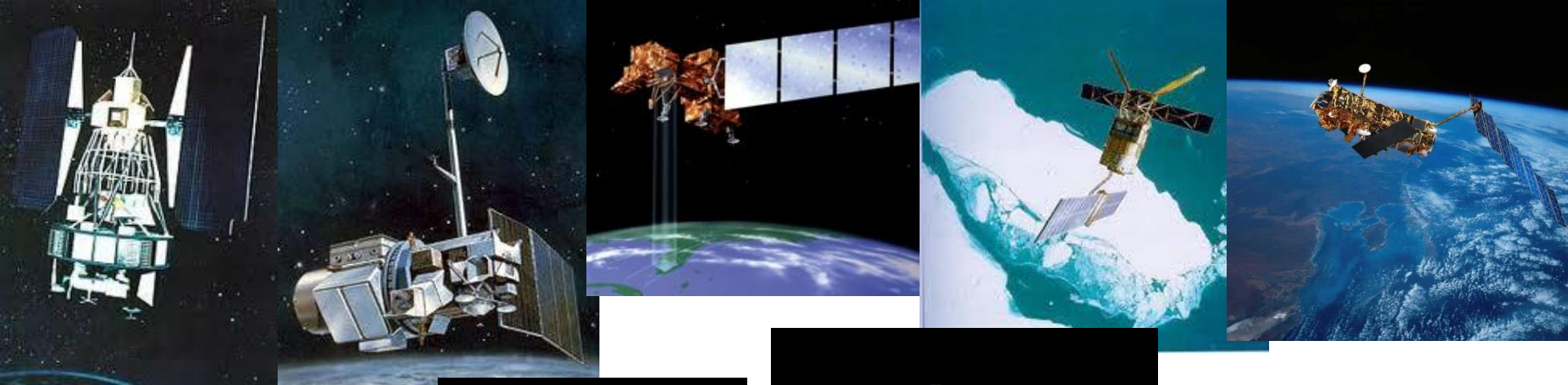
- Hazardous to health
- Increased smog, haze, fog, clouds



## ➤ Paved surfaces -> rainfall water -> flooding

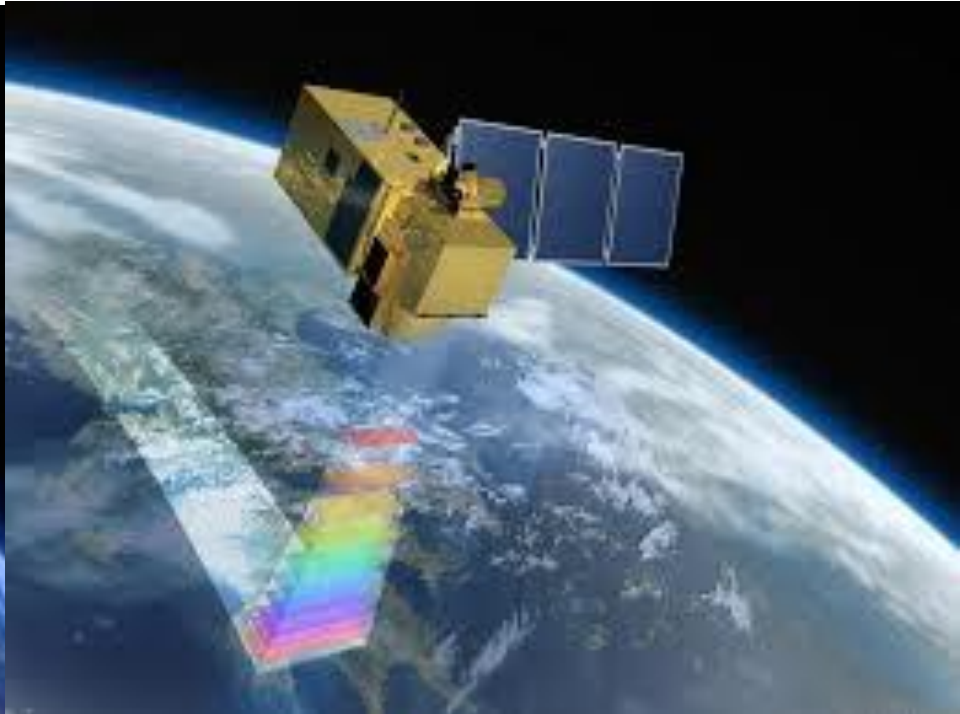
- Urbanization results in more impervious surfaces, thus reducing the area where infiltration to ground water can occur. Thus, more storm water runoff occurs.
- 79 people died in July 2012 Beijing flooding







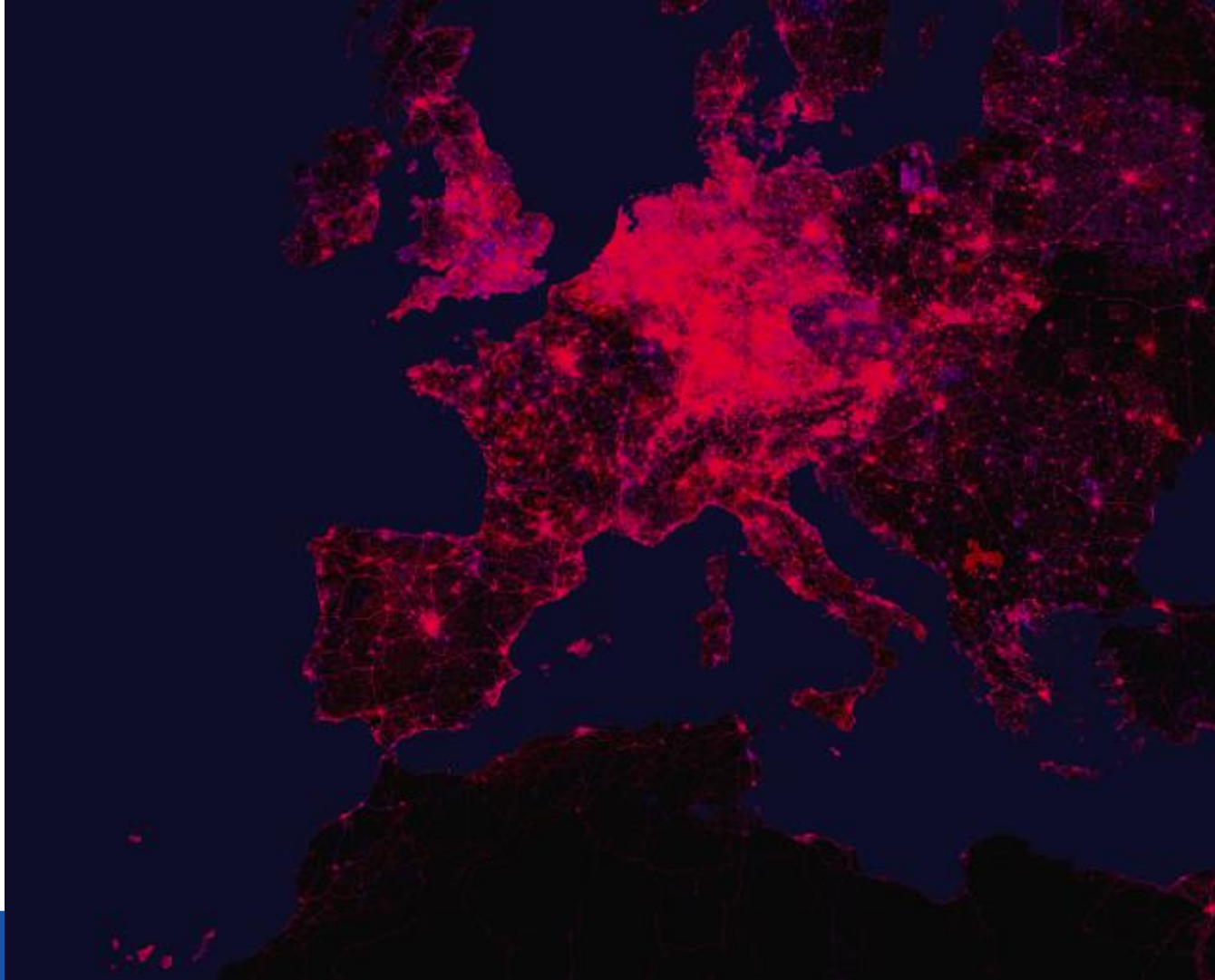
# Sentinel Big Data: Free



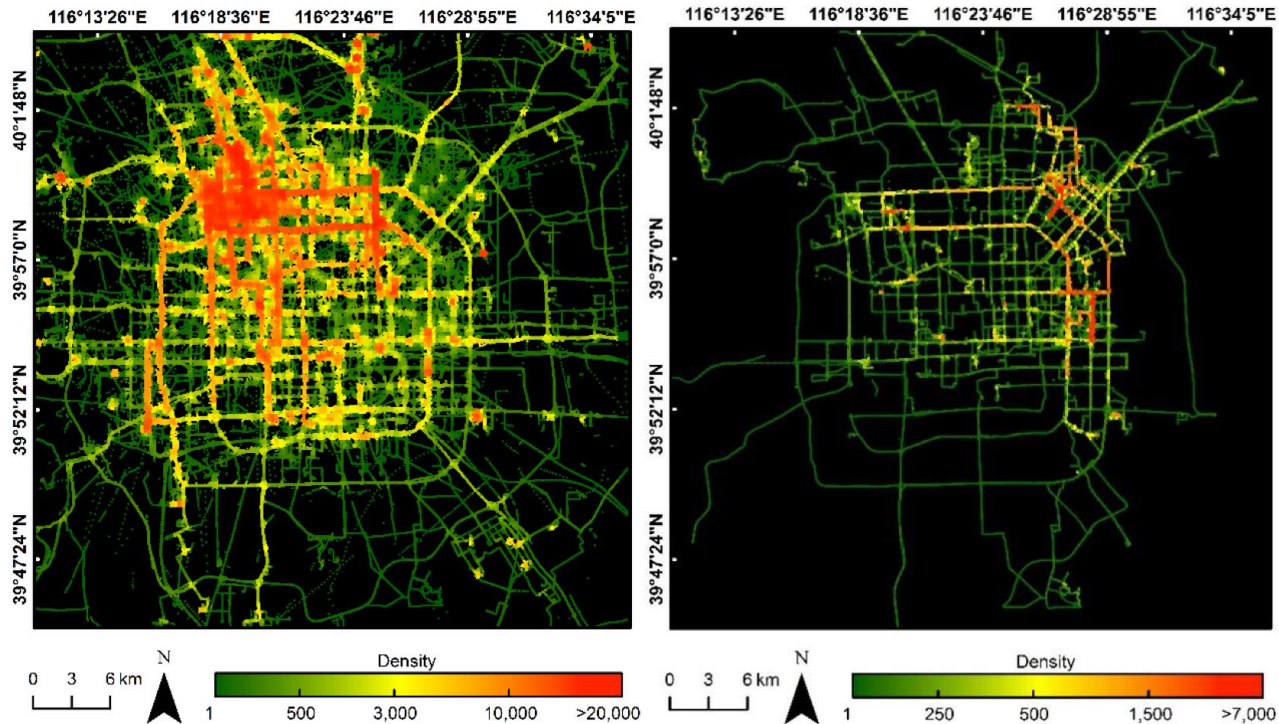
UNWGIC, 19-21 Nov., 2019, Deqing, Zhejiang, China



# Volunteered Geographic Information



UNWGIC, 19-21 Nov., 2019, Deqing, Zhejiang, China







# Mobility Data: Cycling footprint of Madrid





# Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable



## SUSTAINABLE DEVELOPMENT GOALS





# UN Urban SGD Indicators



## Goal 11: Make cities inclusive, safe, resilient & sustainable

**Target 11.3:** By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.

*Indicator 11.3.1 Ratio of land consumption rate to population growth rate – Land use efficiency*

**Target 11.7:** is providing universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities.

*11.7.1 Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities*





# EO4Urban



- The overall objective is to evaluate multi-temporal multi-resolution Sentinel-1A SAR and Sentinel-2A MSI data for developing a **pilot global urban services** based on user requirements to support **smart and sustainable urban development**.

**Team** KTH Royal Institute of Technology, Sweden  
University of Pavia, Italy

**Users** Stockholm County Administrative Board, Sweden  
National Geomatics Center, China



SUSTAINABLE  
DEVELOPMENT  
GOALS



, 19-21 Nov., 2019, Deqing, Zhejiang, China

11 SUSTAINABLE CITIES  
AND COMMUNITIES



# User Requirements: Urban Extent Maps



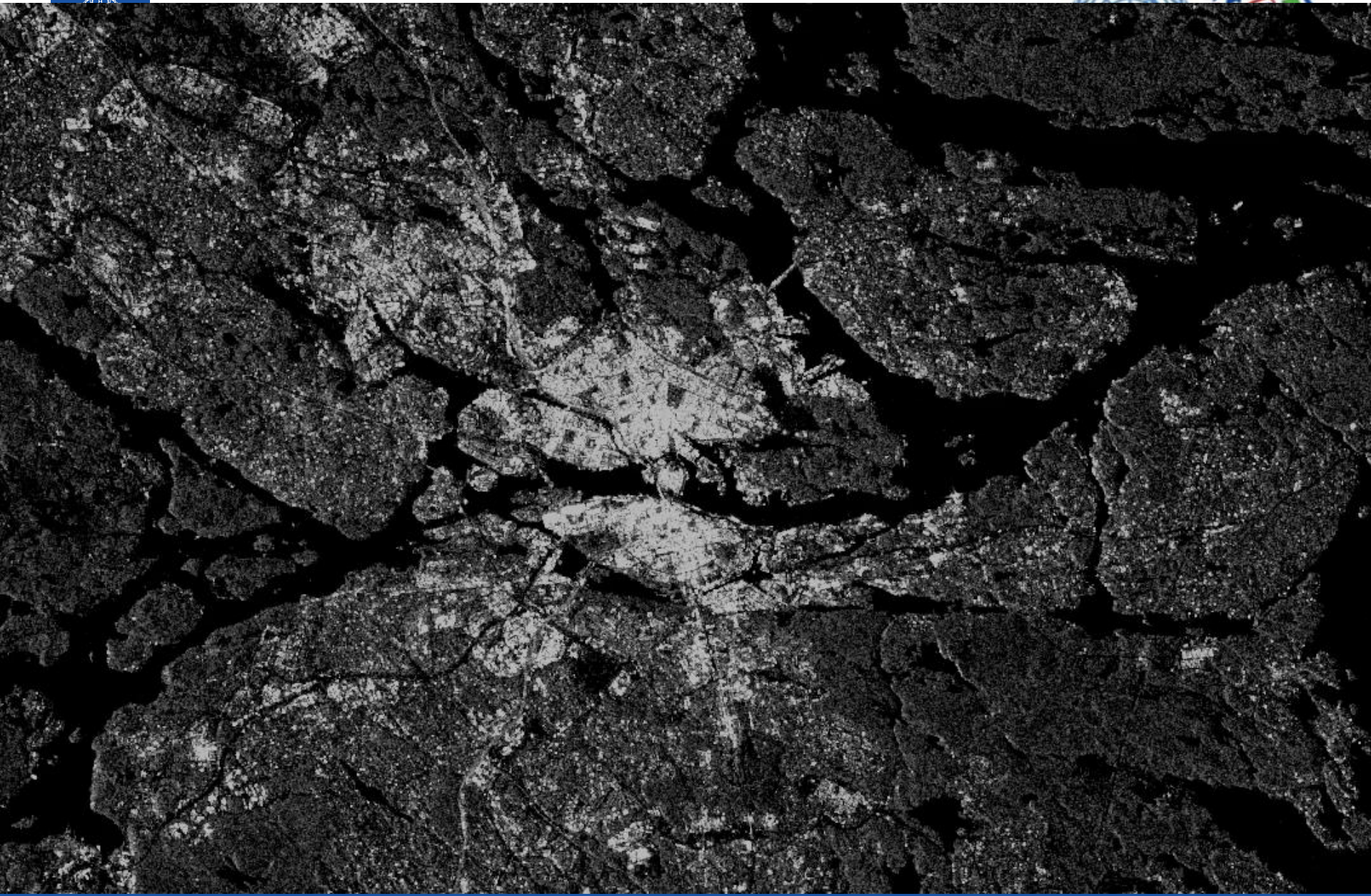
- 2015 and 2016 Urban extent maps for Stockholm and Beijing
- Minimum Mapping Unit at 30m x 30m.
- Historical urban extent maps from 1995, 2005 and 2010 if possible.

An aerial photograph of an urban area with various green structure overlays. The overlays include green spaces, parks, and water features, illustrating the urban green structure. The city grid and buildings are visible in the background.

# User Requirements: Urban Green Structure & Change Maps

- Maps of urban green structure changes in 2015 and updated yearly
- Minimum Mapping Unit at 30m x 30m.

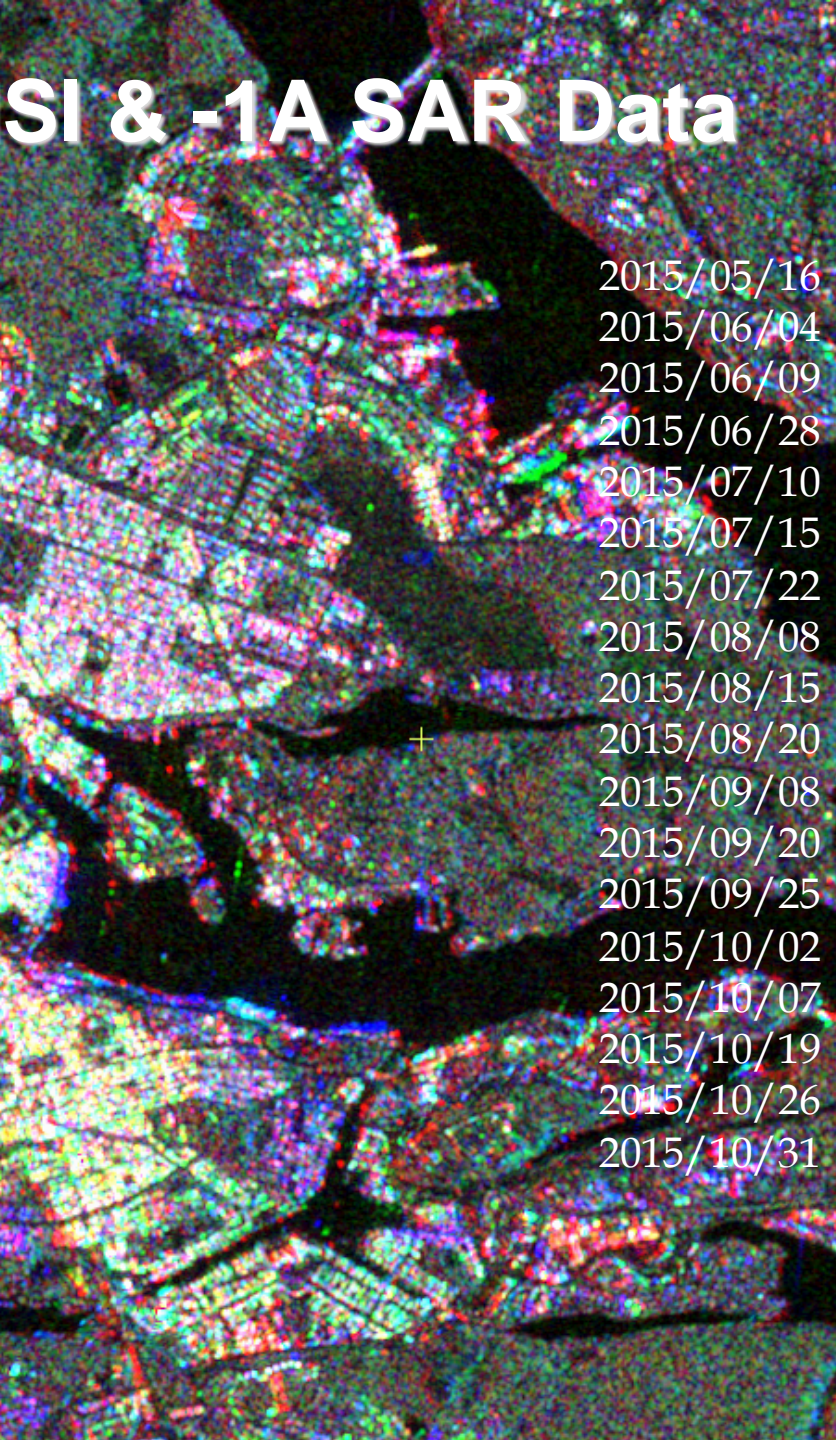
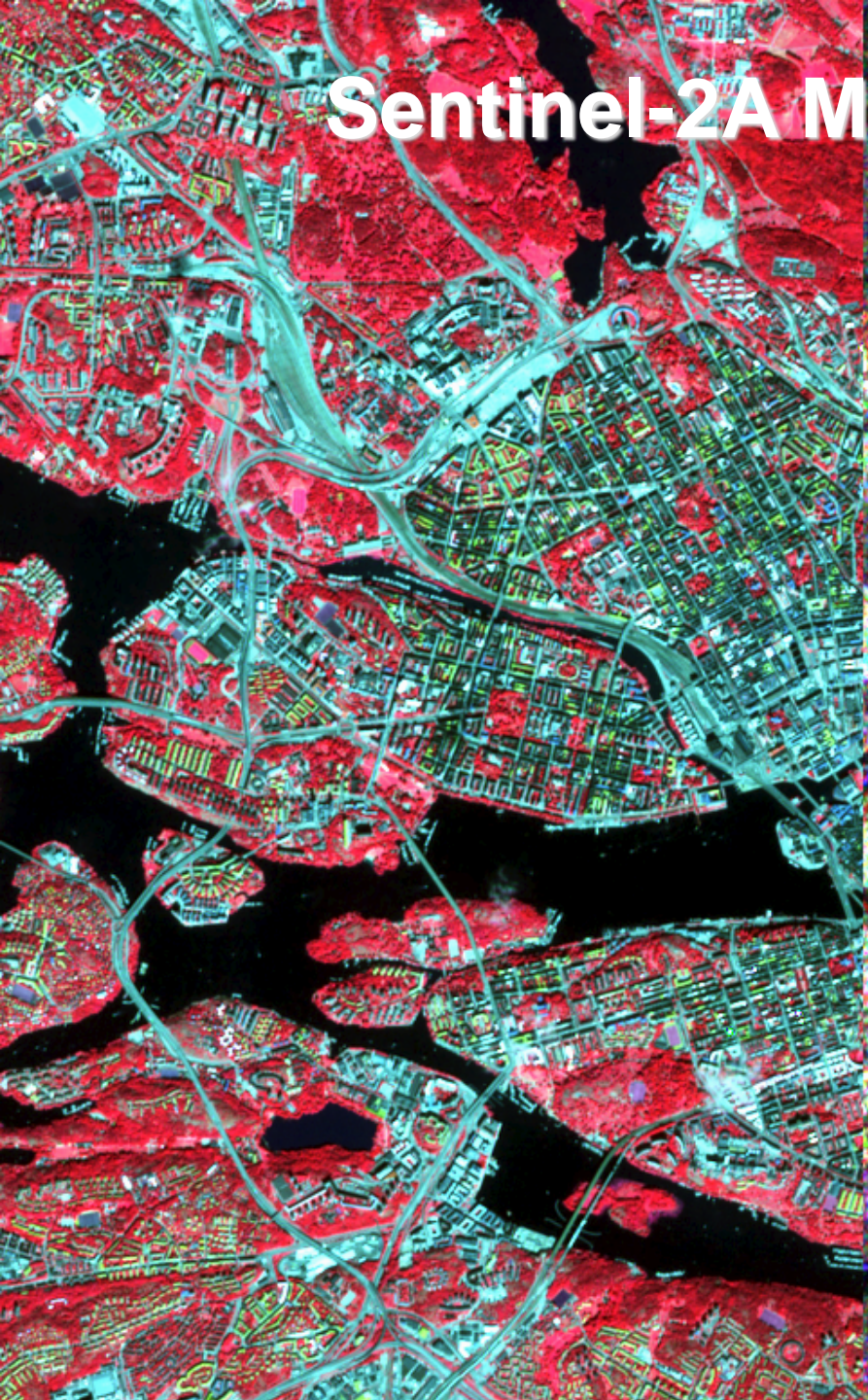




UNWGIC, 19-21 Nov., 2019, Deqing, Zhejiang, China



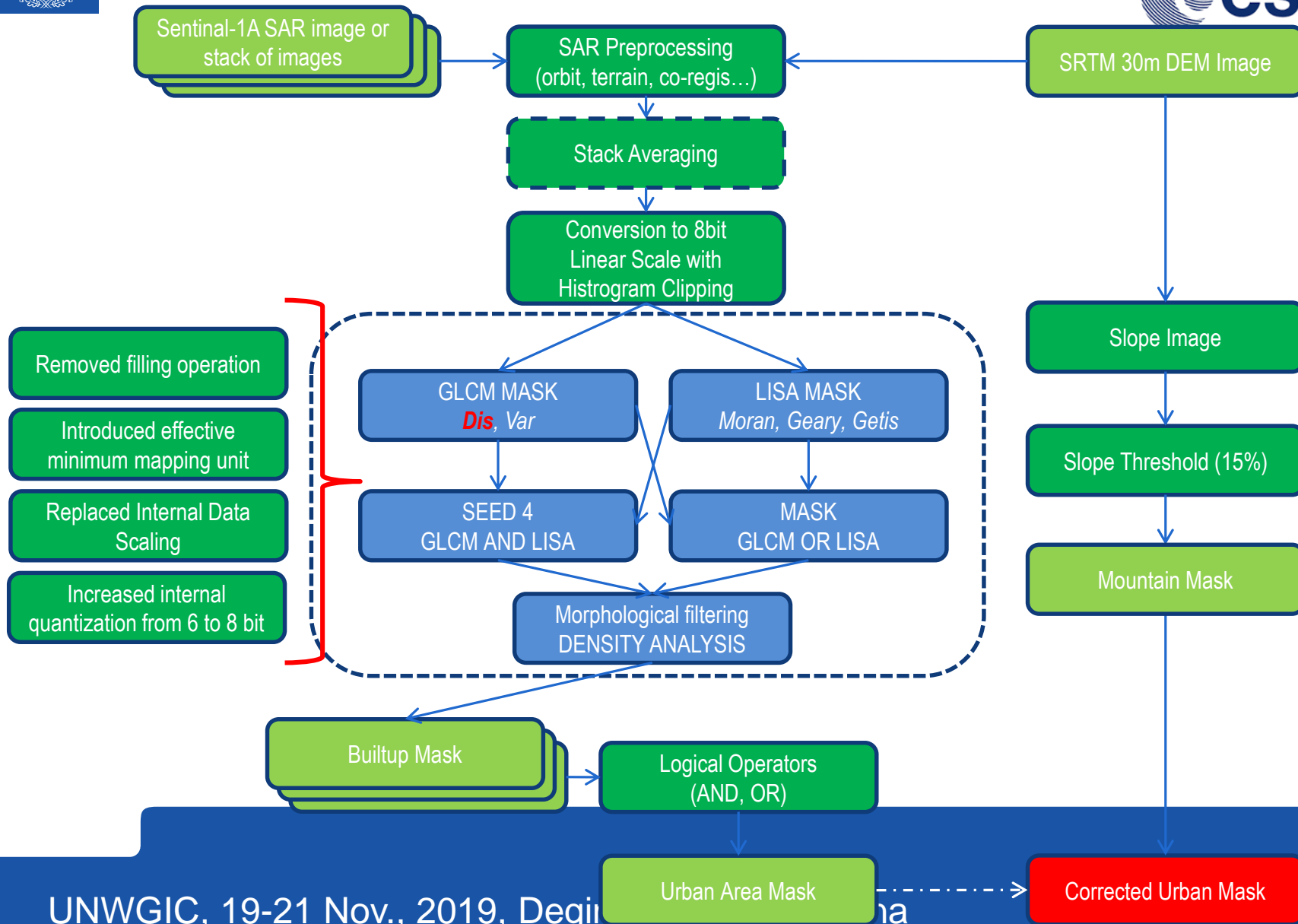
# Sentinel-2A MSI & -1A SAR Data



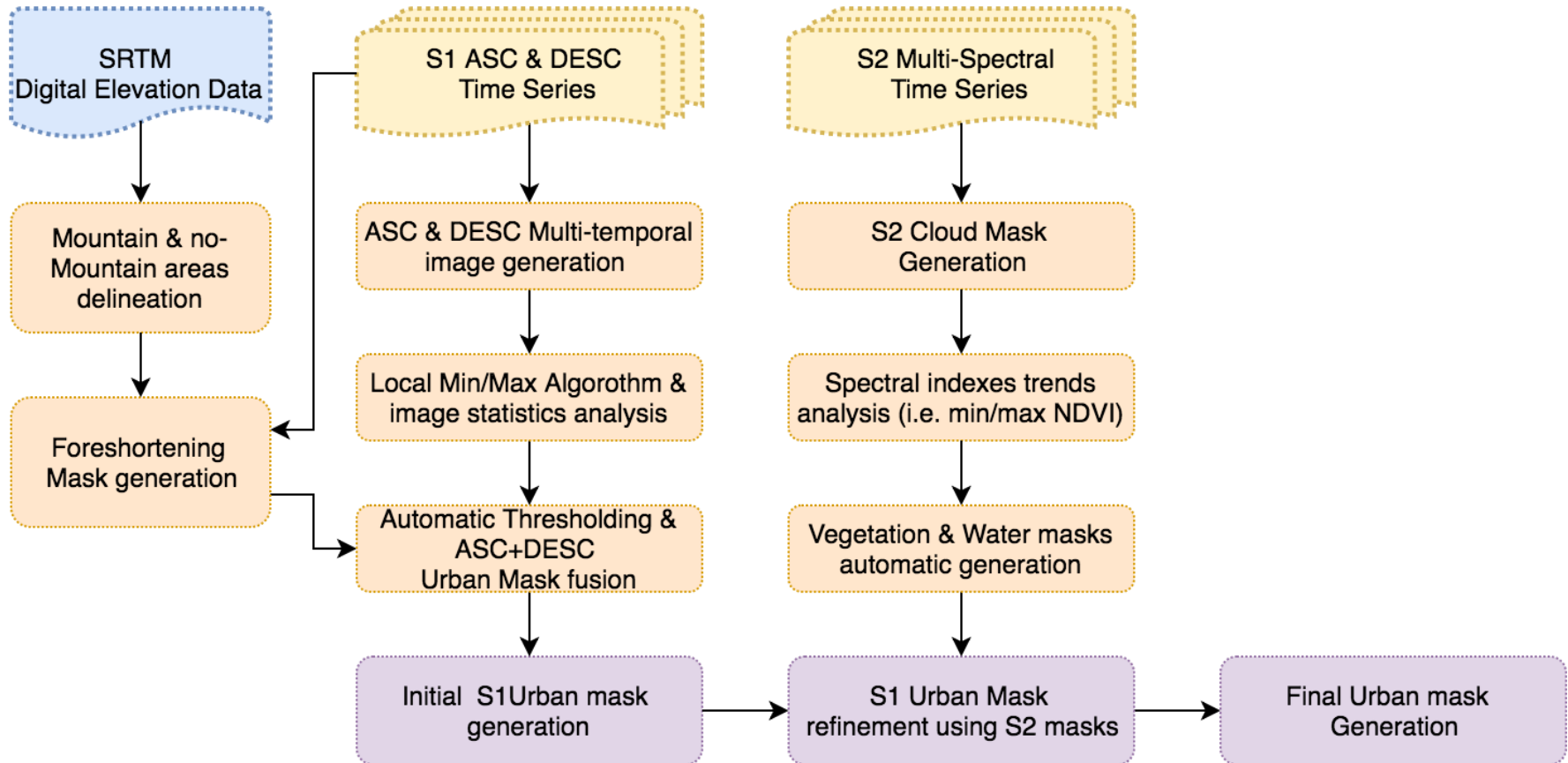
+

2015/05/16	ASC
2015/06/04	DSC
2015/06/09	ASC
2015/06/28	DSC
2015/07/10	DSC
2015/07/15	ASC
2015/07/22	DSC
2015/08/08	ASC
2015/08/15	DSC
2015/08/20	ASC
2015/09/08	DSC
2015/09/20	DSC
2015/09/25	ASC
2015/10/02	DSC
2015/10/07	ASC
2015/10/19	ASC
2015/10/26	DSC
2015/10/31	ASC

# Urban Extractor

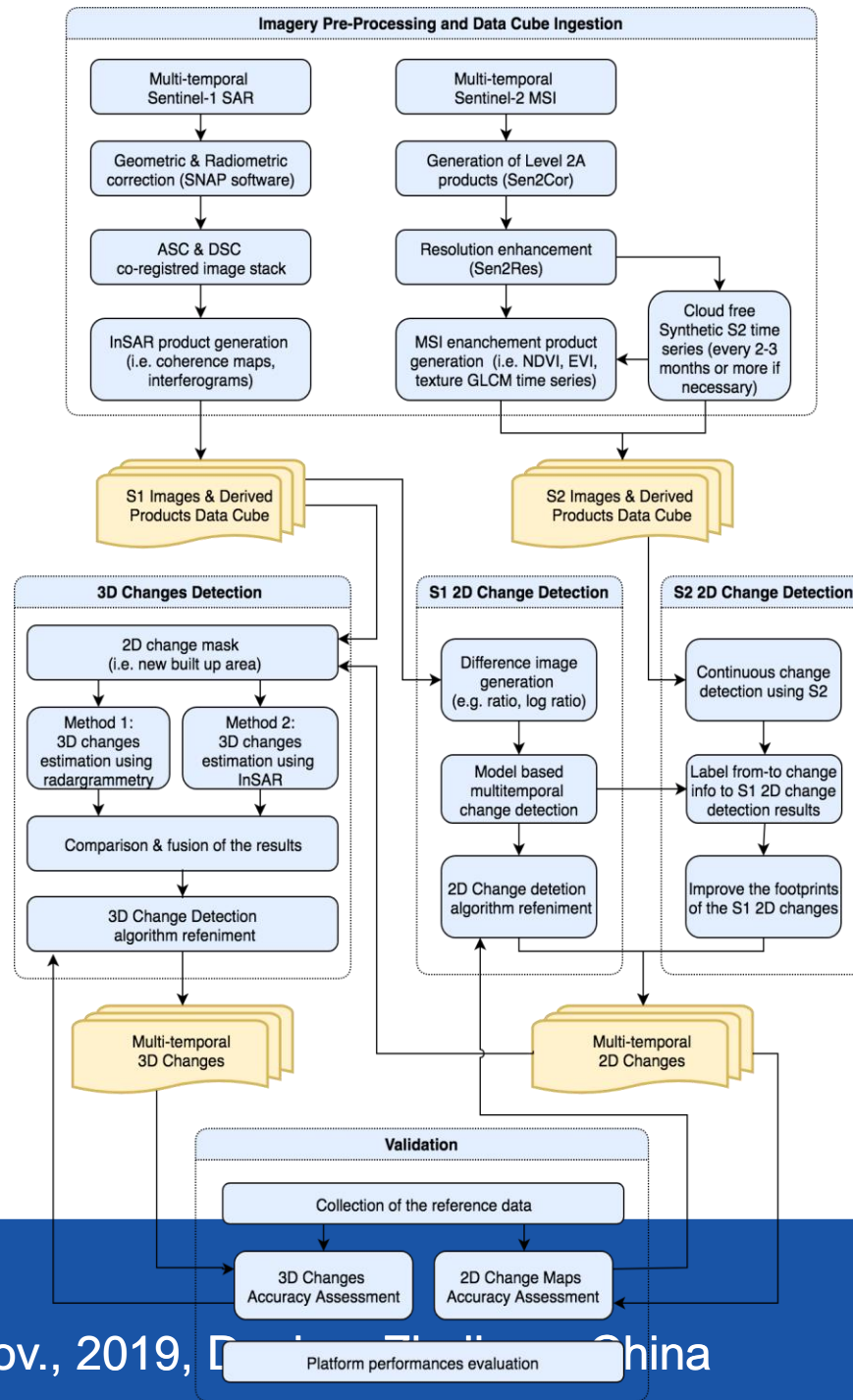


# Sentinel Big Data for Urban Extent Extraction

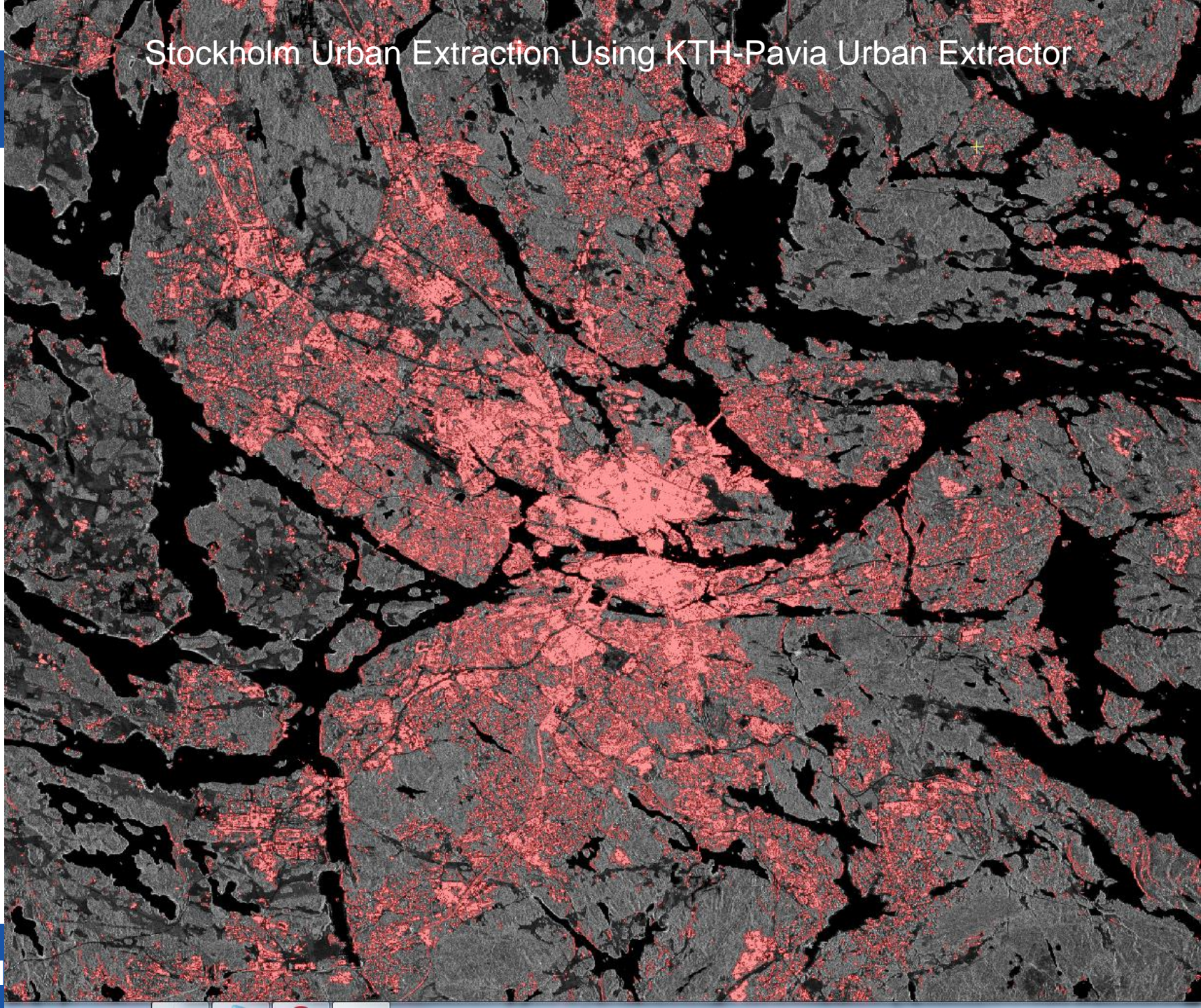




# Sentinel Big Data for Urban Change Detection

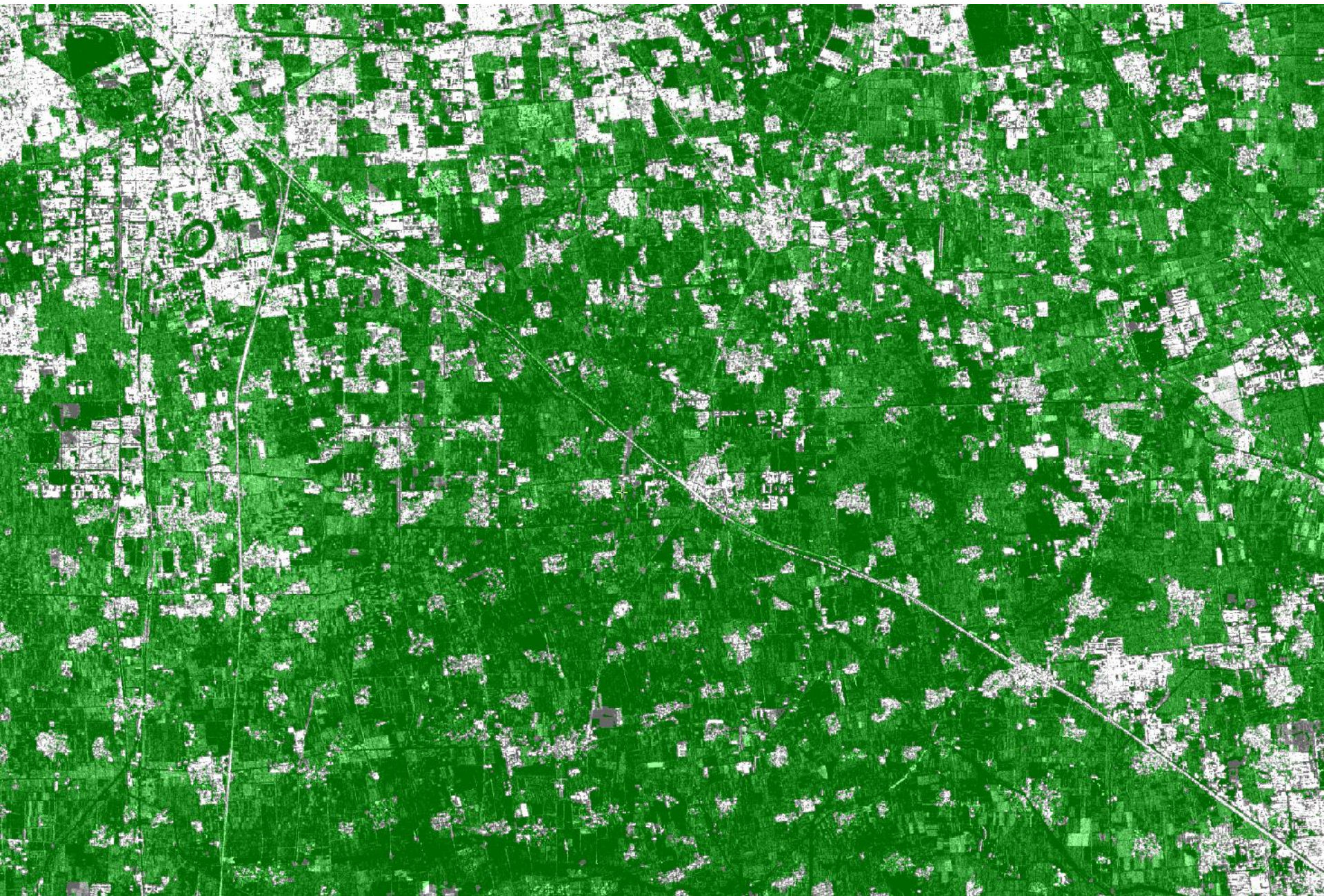


# Stockholm Urban Extraction Using KTH-Pavia Urban Extractor

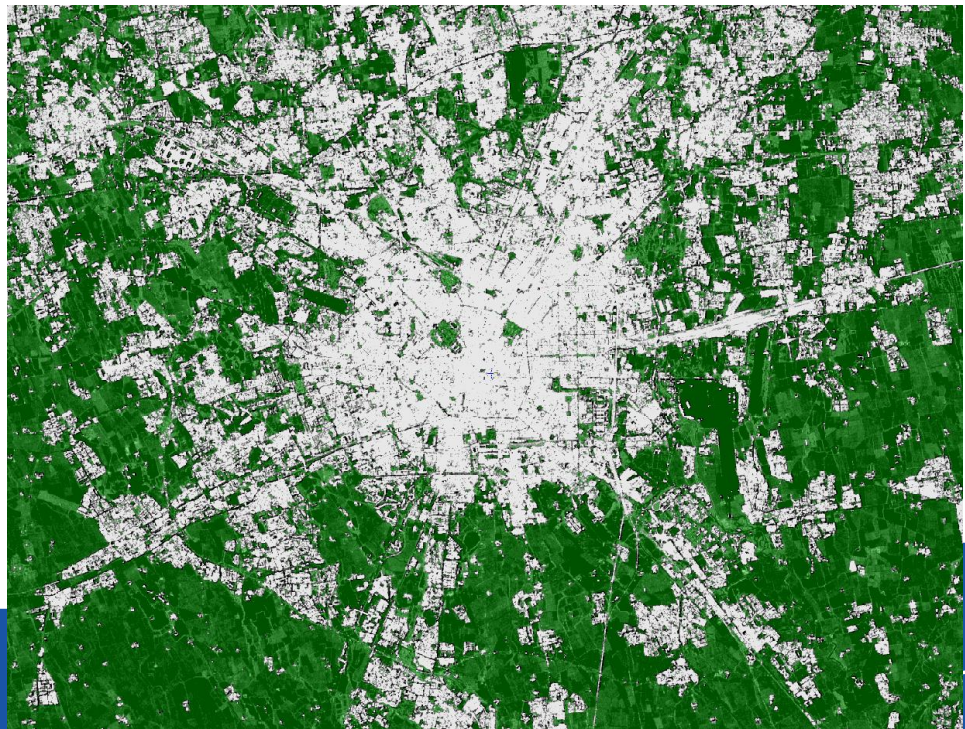
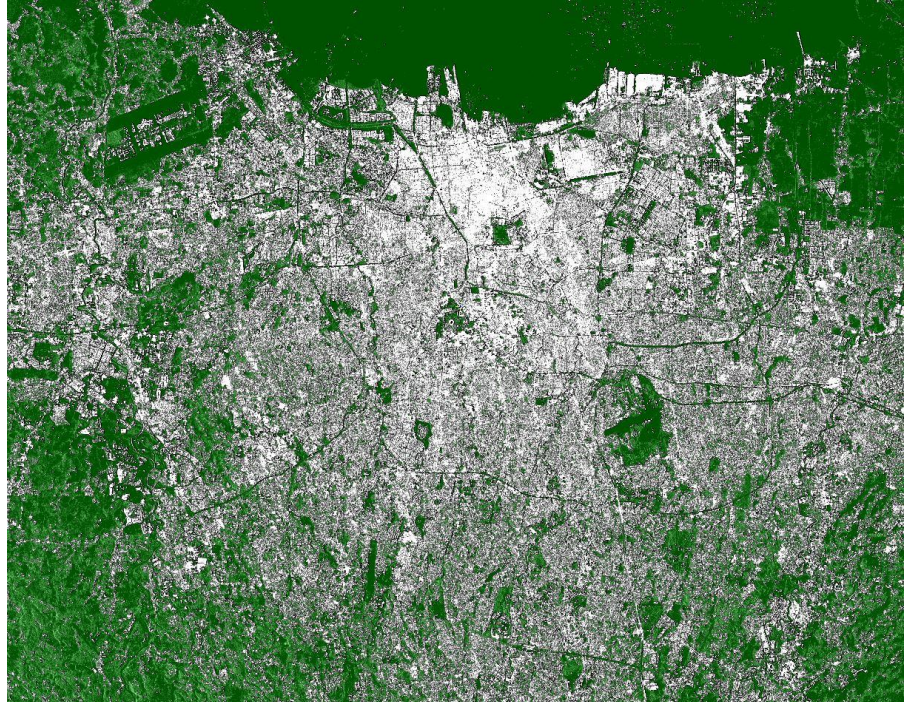
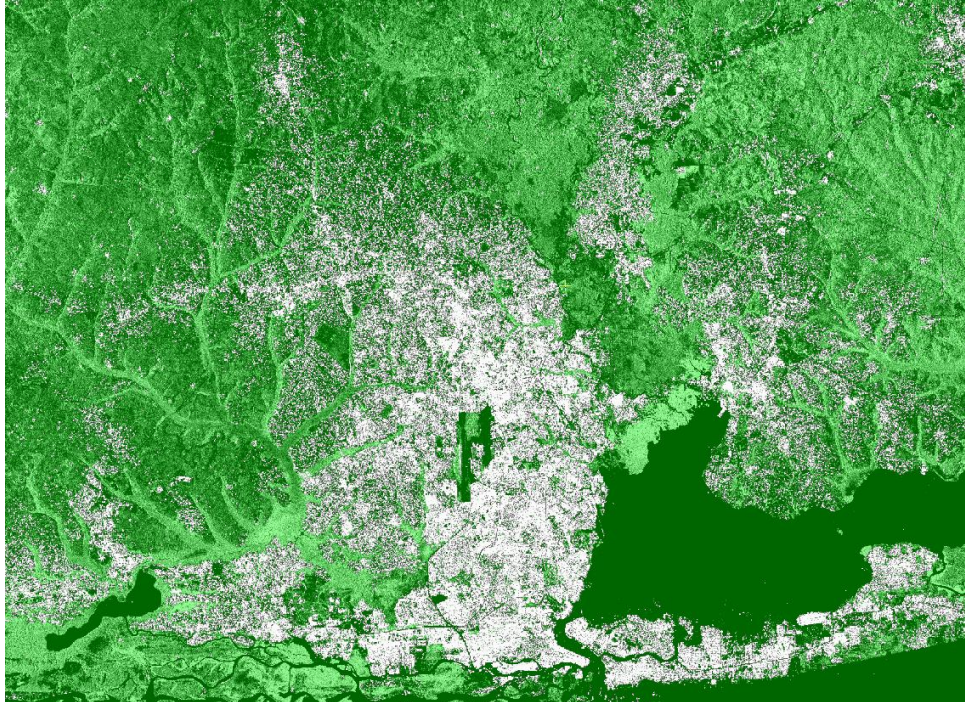


# Urban Extraction: Beijing





UNWGIC, 19-21 Nov., 2019, Deqing, Zhejiang, China





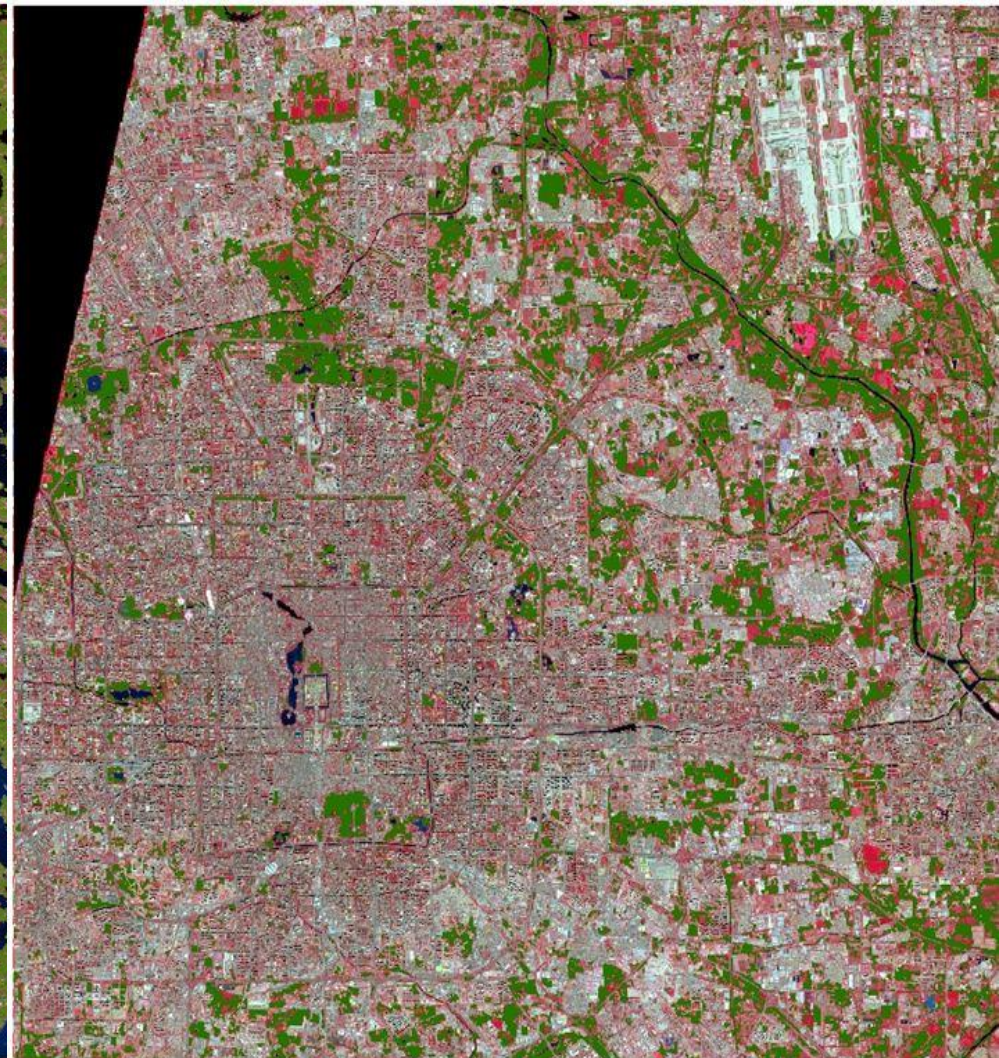
# Urban Expansion in Beijing



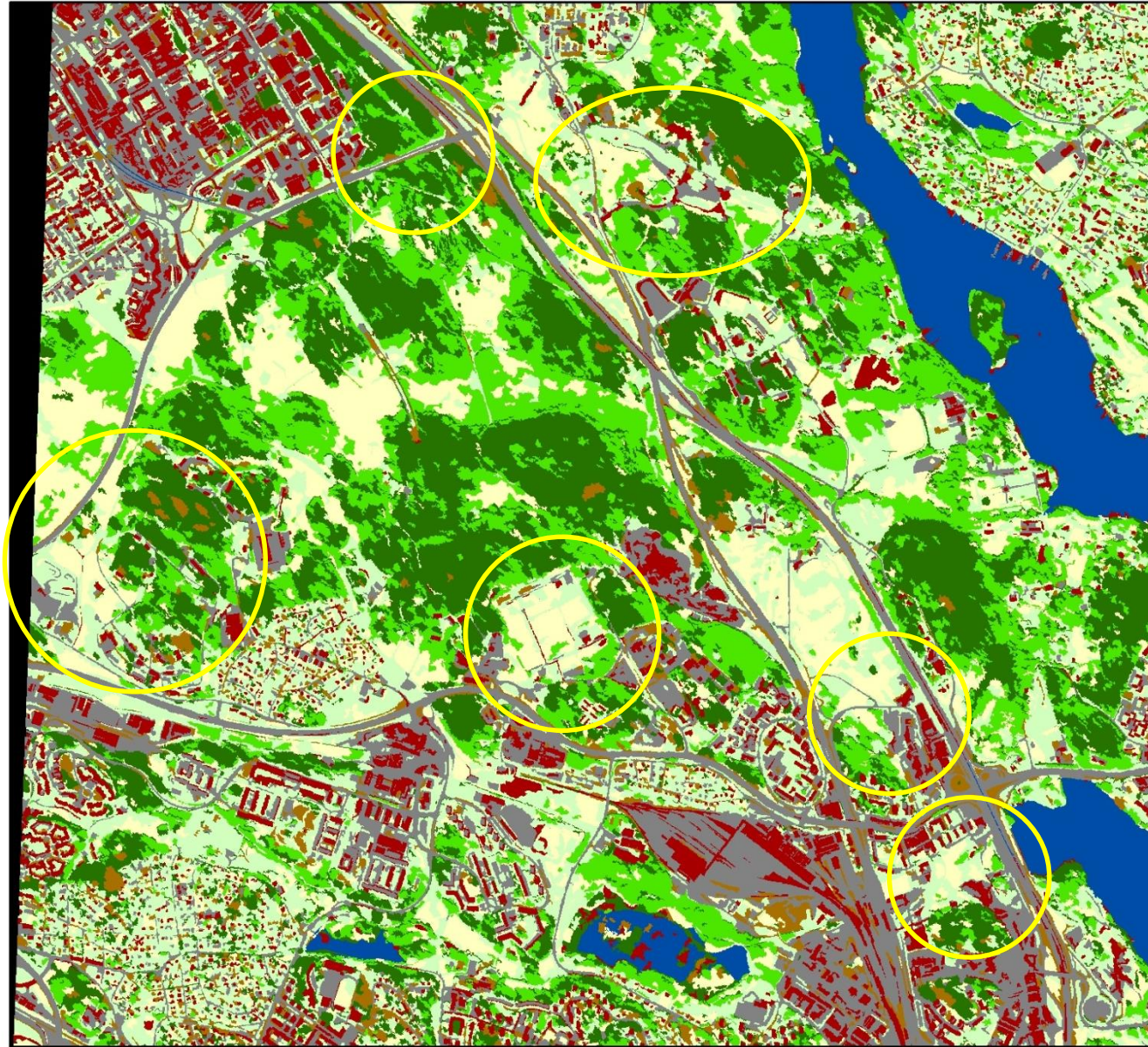
# Urban Green Structure



0 2.5 5 10 15 20 Kilometers

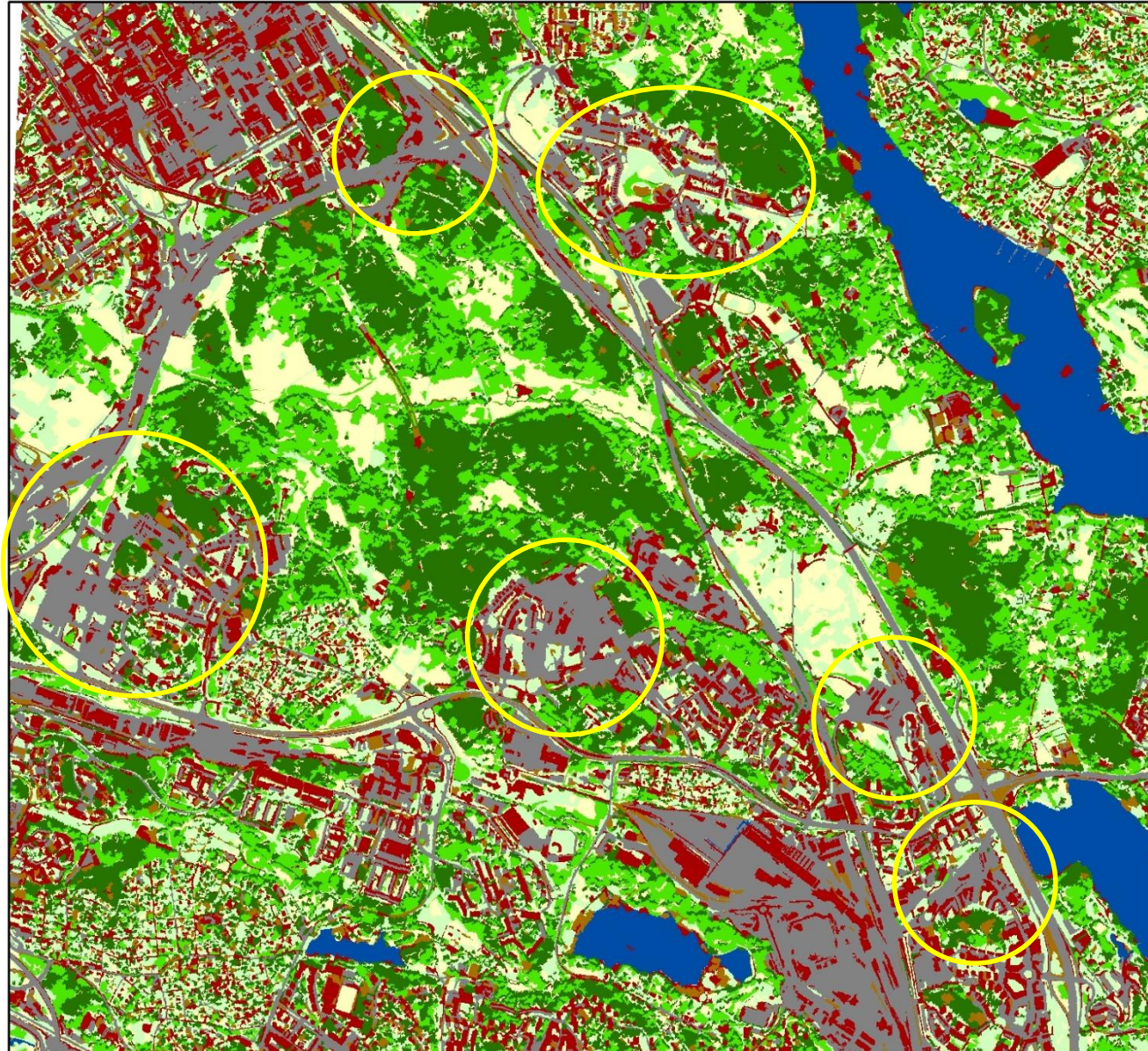


0 5 10 Kilometers



0 0,5 1 2 Kilometers





0 0,5 1 2 Kilometers





# Goal 13. Take urgent action to combat climate change and its impacts



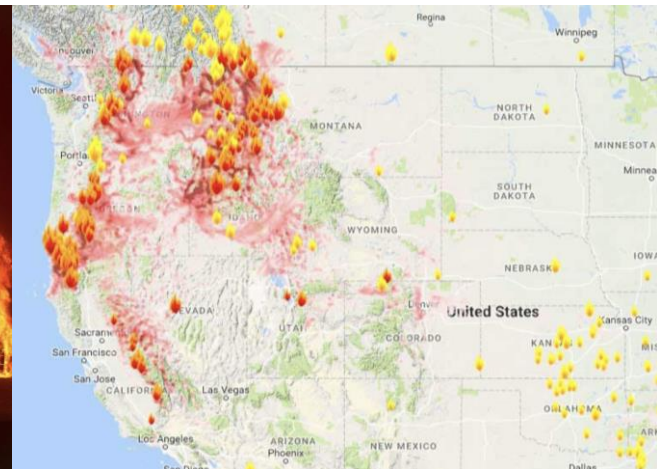
## SUSTAINABLE DEVELOPMENT GOALS



# Climate Impact



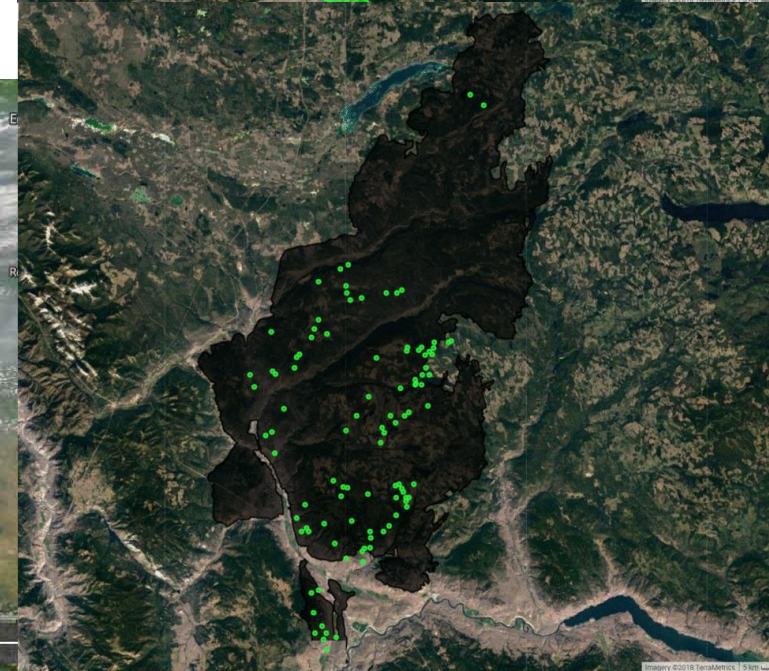
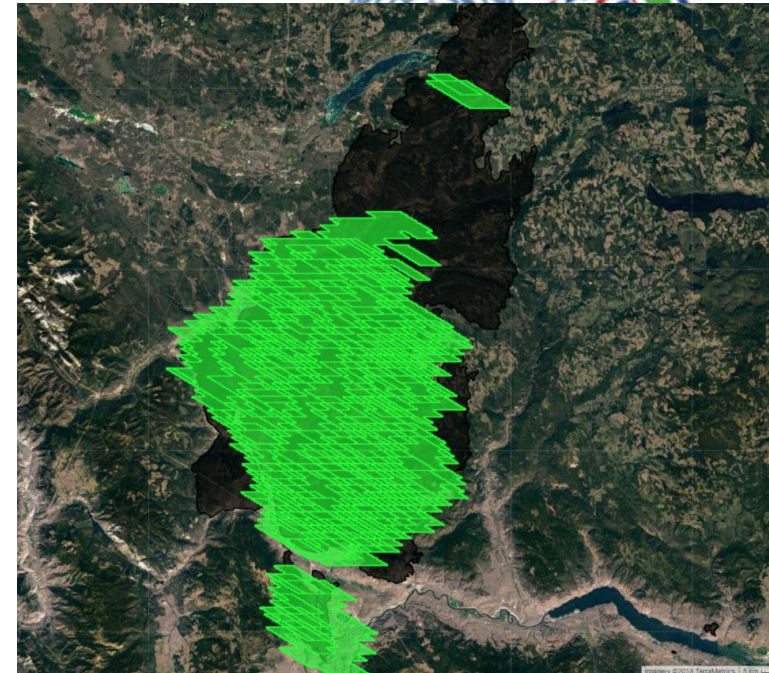
- 13.1 Strengthen resilience and adaptive capacity to climate-related ***hazards and natural disasters*** in all countries



# Introduction

For active wildfire monitoring

- Moderate Resolution Imaging Spectroradiometer (MODIS) Active Fire maps are often used for contextual awareness

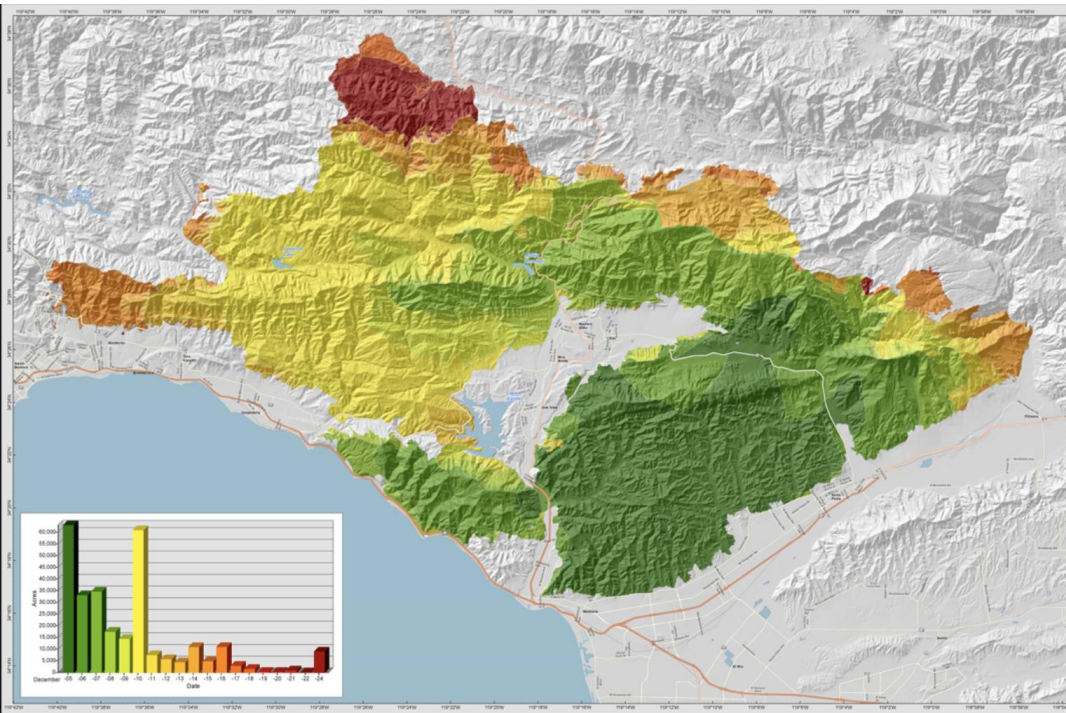
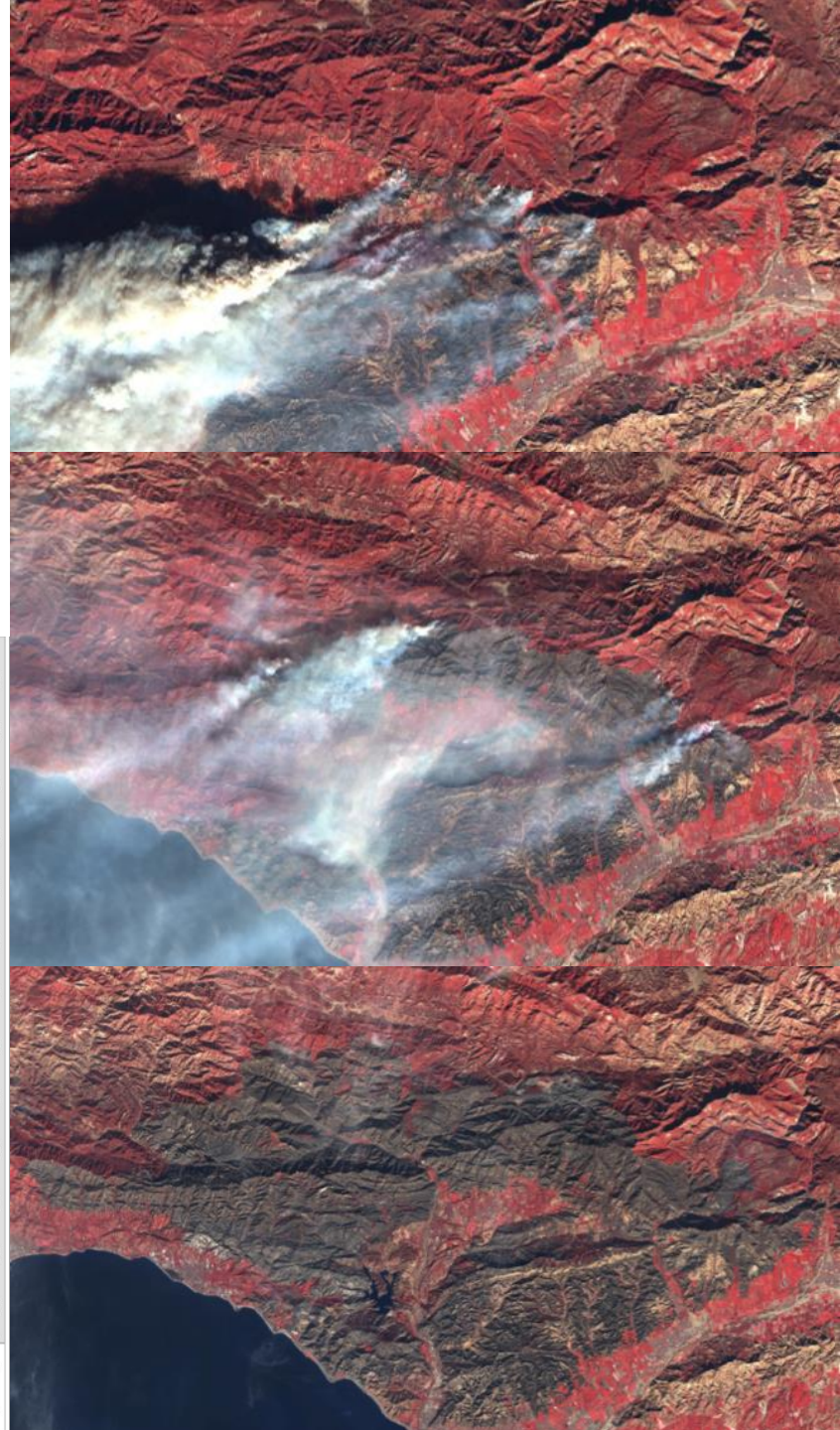




# Introduction

For active wildfire monitoring

- Landsat data are often deployed for post-wildfire boundary determination and burn severity mapping



**PROGRESSION Thomas Incident** CA VNC 103156 December 27, 2017

**UAS**

**Thomas Progression by date (GIS acres)**

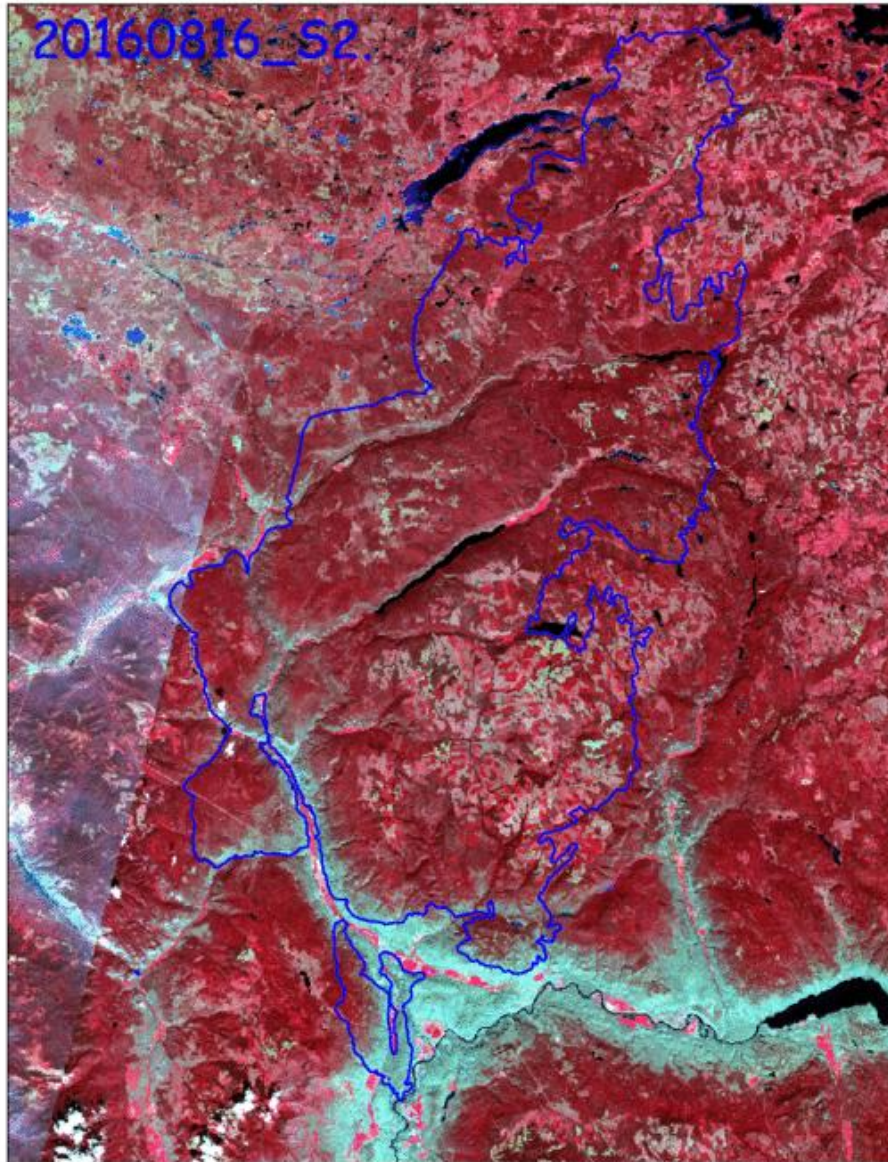
12-05 40,000 ac	12-10 16,800 ac	12-15 4,800 ac	12-20 280 ac
12-06 30,000 ac	12-11 7,400 ac	12-16 18,000 ac	12-21 790 ac
12-07 30,000 ac	12-12 3,800 ac	12-17 2,700 ac	12-22 33 ac
12-08 15,000 ac	12-13 4,200 ac	12-18 1,000 ac	12-24 8,070 ac
12-09 10,000 ac	12-14 16,970 ac	12-19 27 ac	

**PROGRESSION MAP Thomas Incident** CA VNC 103156 December 27, 2017

**CALIFORNIA** PROGRESS TEAM



# Limitation of Optical Images



## The Optical Imaging Satellites Issue



50% Night Time



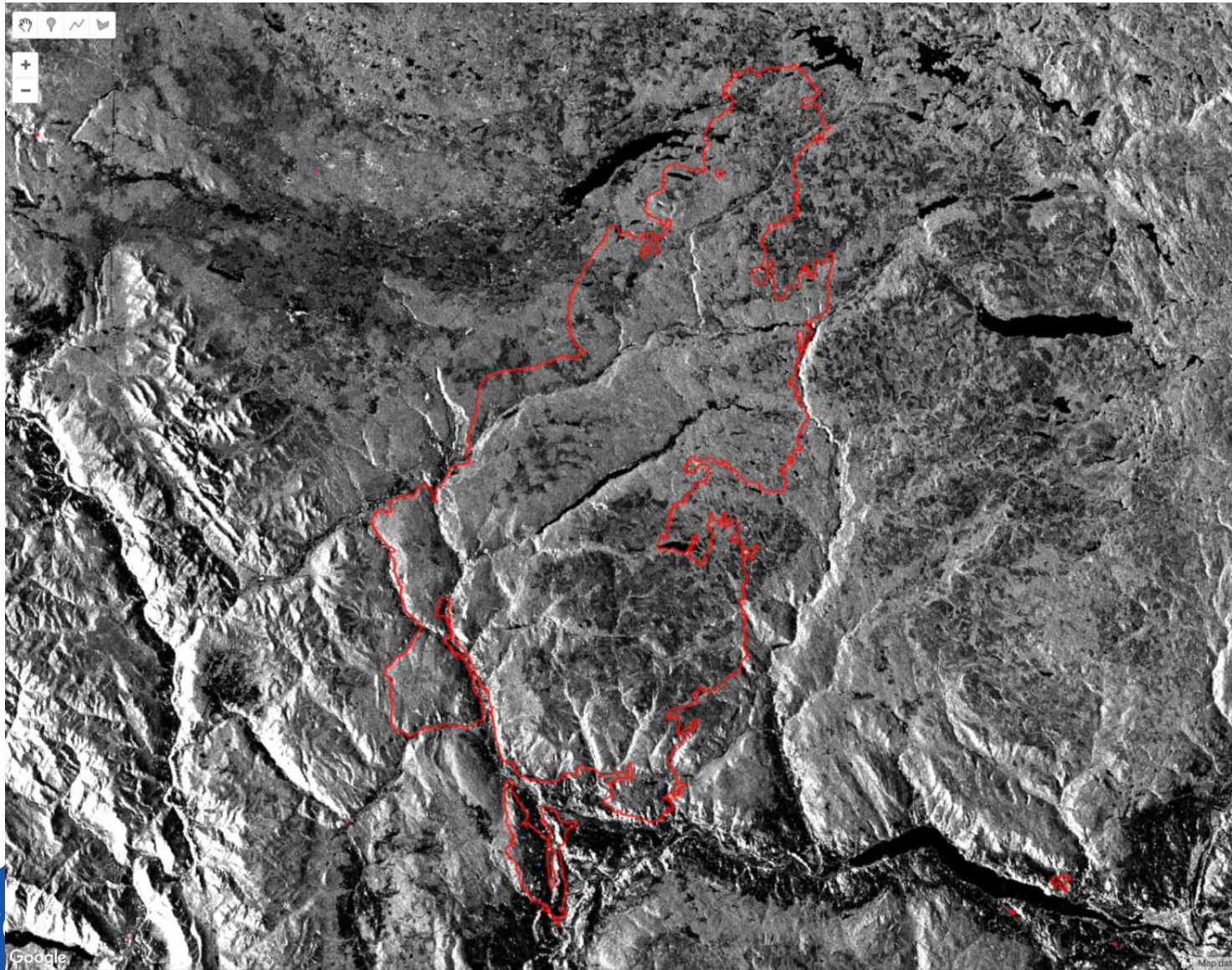
50% Cloudy



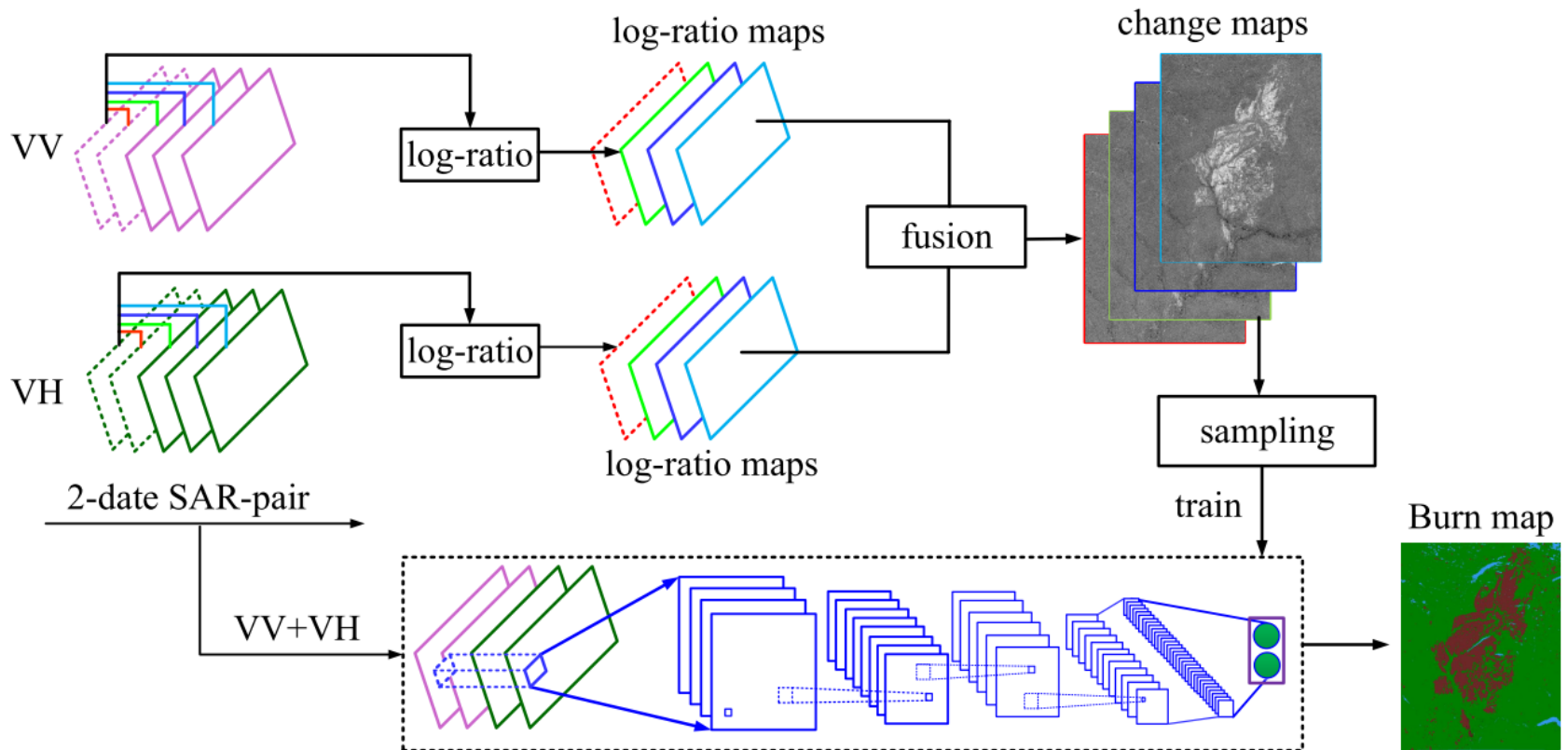
25% Visible

Zhejiang, China

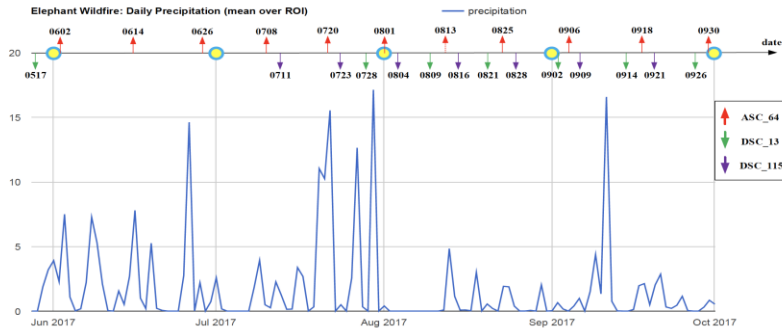
# Sentinel-1 SAR Time Series



# FireNet: A Deep Learning Framework

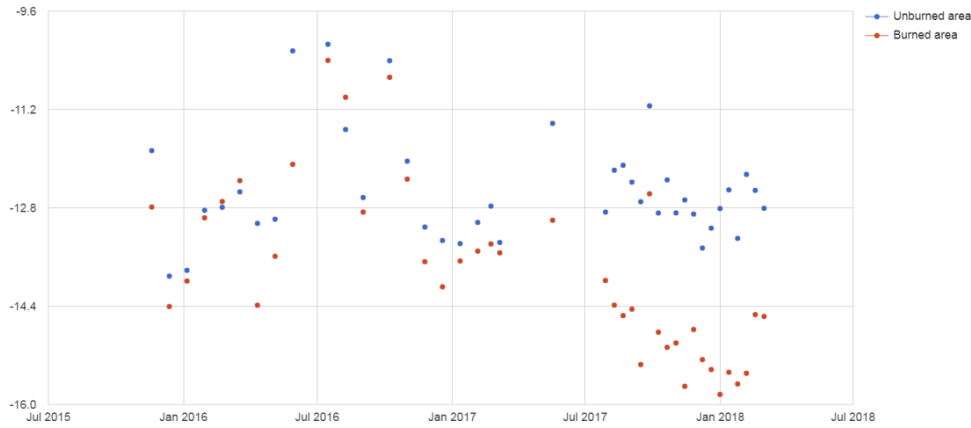


# Validations

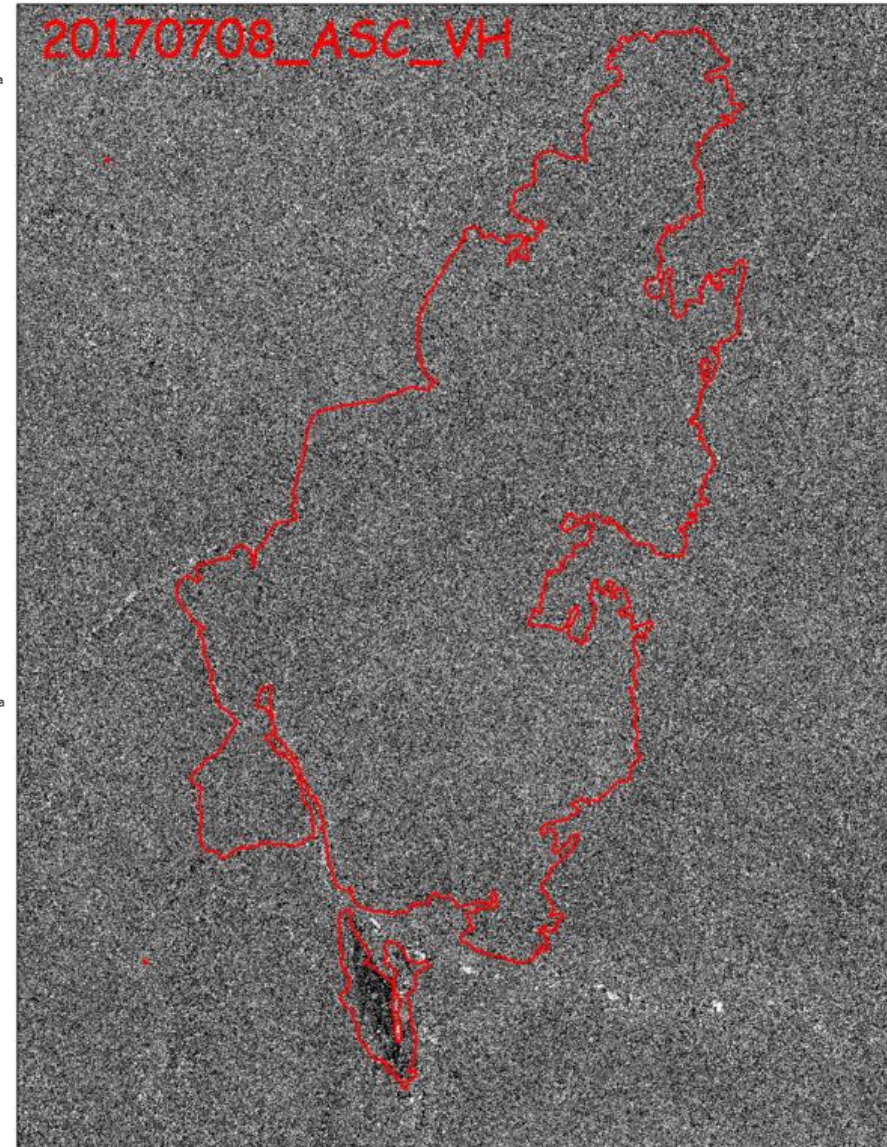
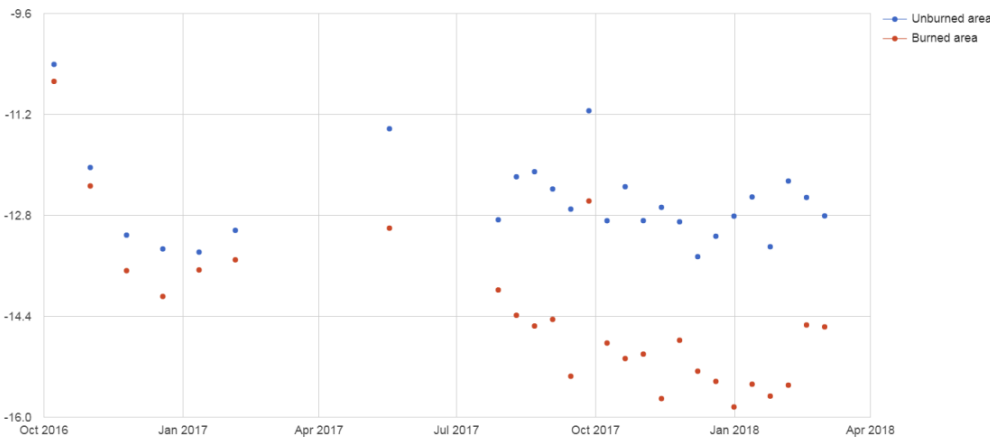


# Results

S1 DESCENDING VV (Rel. Orbit: 13.0 Buffer size: 150m)



S1 DESCENDING VH (Rel. Orbit: 13.0 Buffer size: 150m)



# Conclusions

- EO and geospatial big data and analytics can play a significant role in measuring and monitoring SDG indicators.

