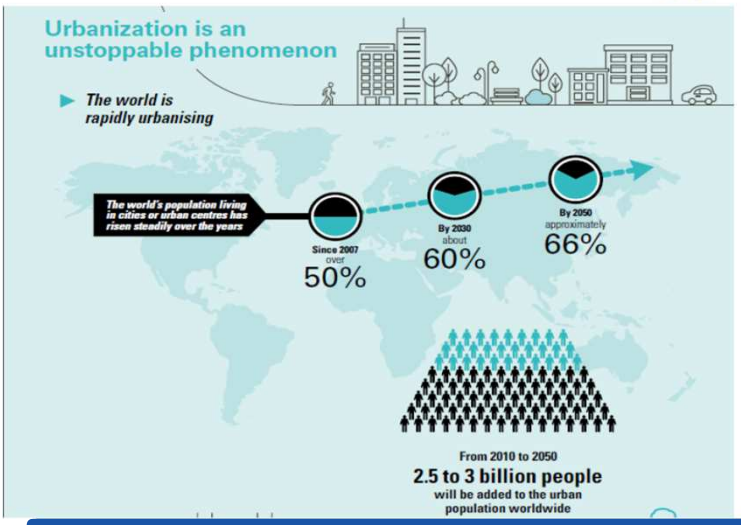
Earth Observation & GeoSpatial Big Data for Monitoring SDG Indicators

Yifang Ban, Professor

Director, Division of Geoinformatics
Vice Chair, Department for Urban Planning and Environment
KTH Royal Institute of Technology



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

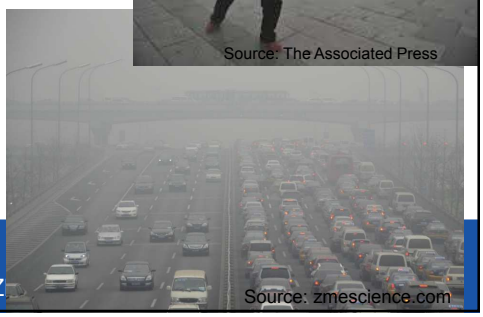
Environmental Consequences

High concentrations of aerosols, exhaust gases, pollution and dust

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


Source: The Associated Press


Source: Suicup via Wikimedia


Source: zmescience.com

Environmental Consequences

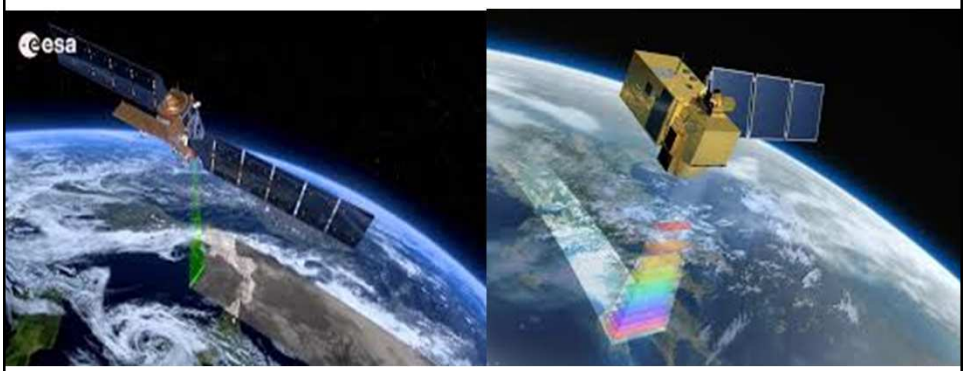
- **Paved surfaces -> rainfall water -> flooding**
  - Urbanization results in more impervious surfaces, thus reducing the area where infiltration to ground water can occur. Thus, more storm water runoff occurs.
  - 79 people died in July 2012 Beijing flooding

Source: rendezvous.blogs.nytimes.com

Source: BBC News

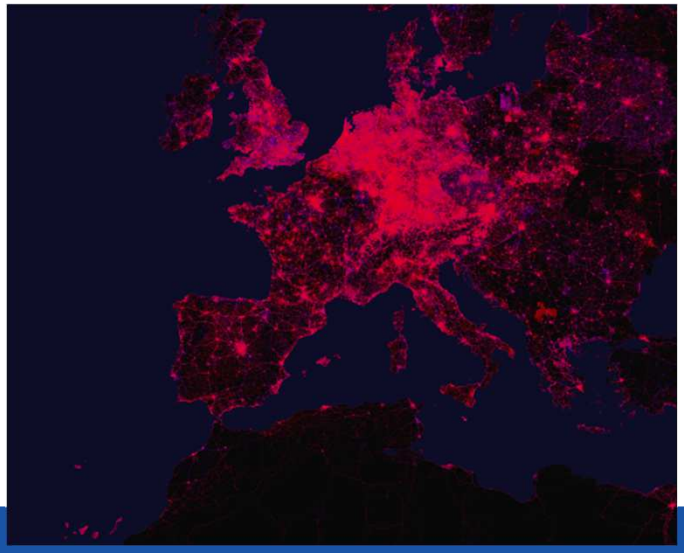
Source: www.theatlanticcities.com

Sentinel Big Data: Free

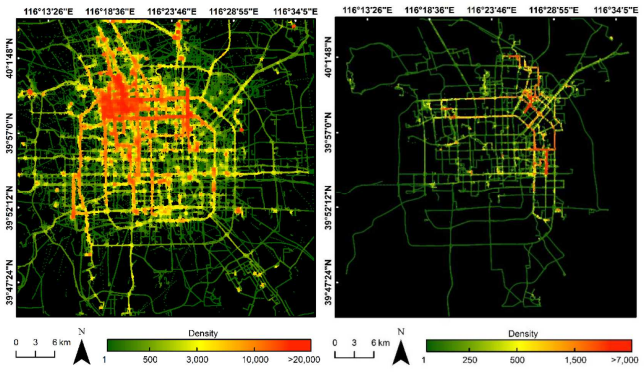


UNWGIC, 19-21 Nov., 2019, Deqing, Zhejiang, China

Volunteered Geographic Information



Mobility Data: GeoLife Beijing



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

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.

Indicator11.3.1 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

User Requirements: Urban Extent Maps

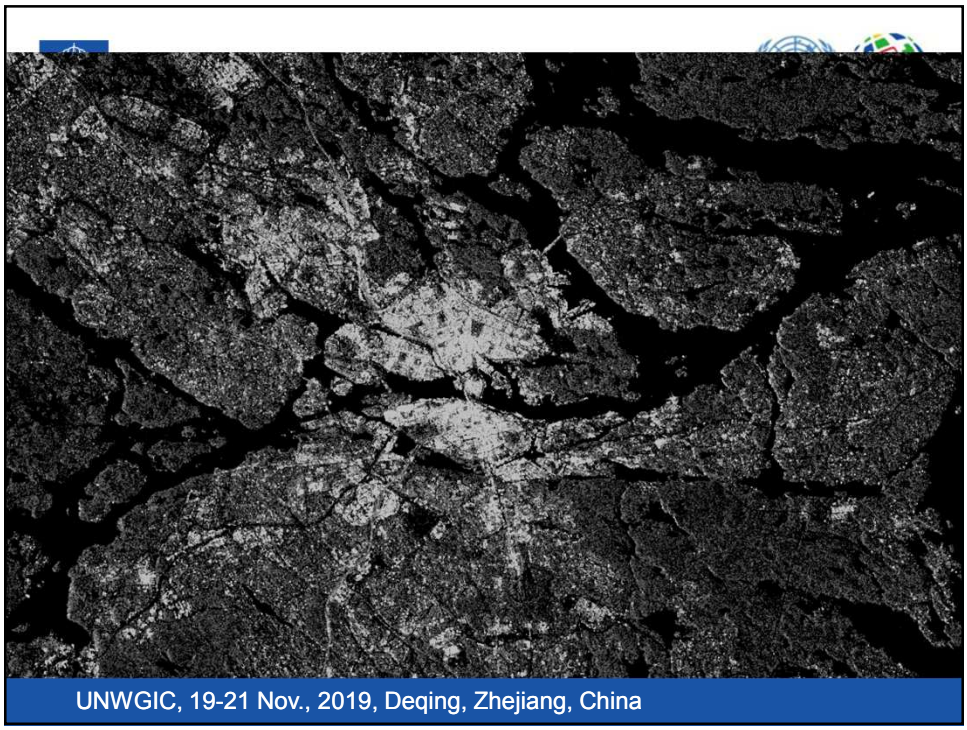
- 2015 and 2016 Urban extent maps for Stockholm and Beijing
- Minimum Mapping Unit at 30m x 30m.
- Historical urban extent maps from 1995, 2005 and 2010 if possible.

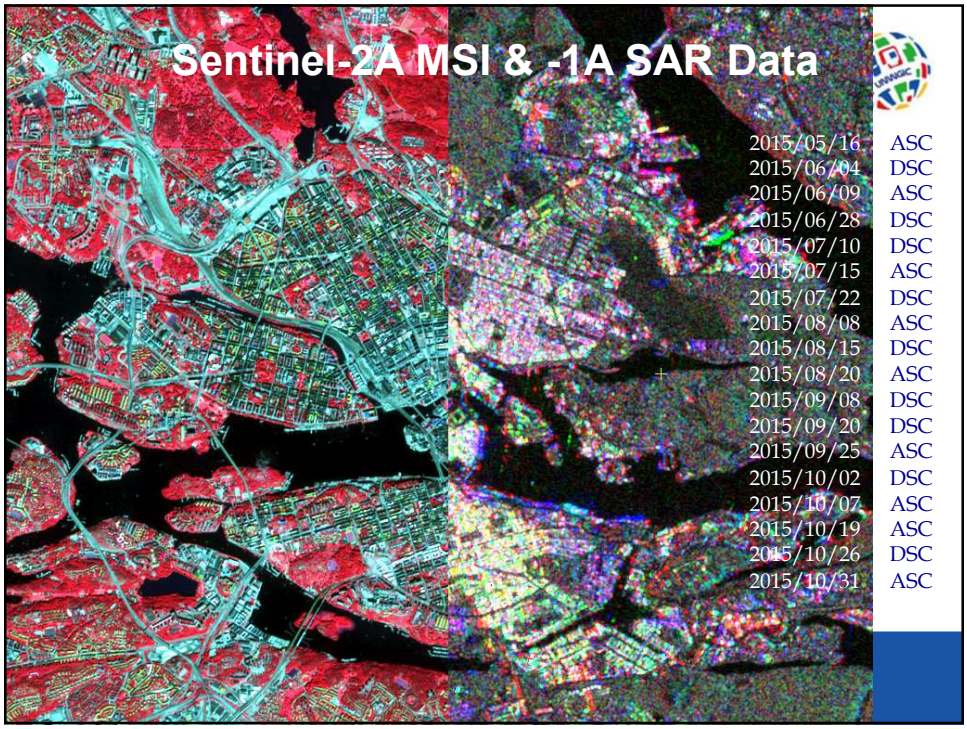
Zhejiang, China

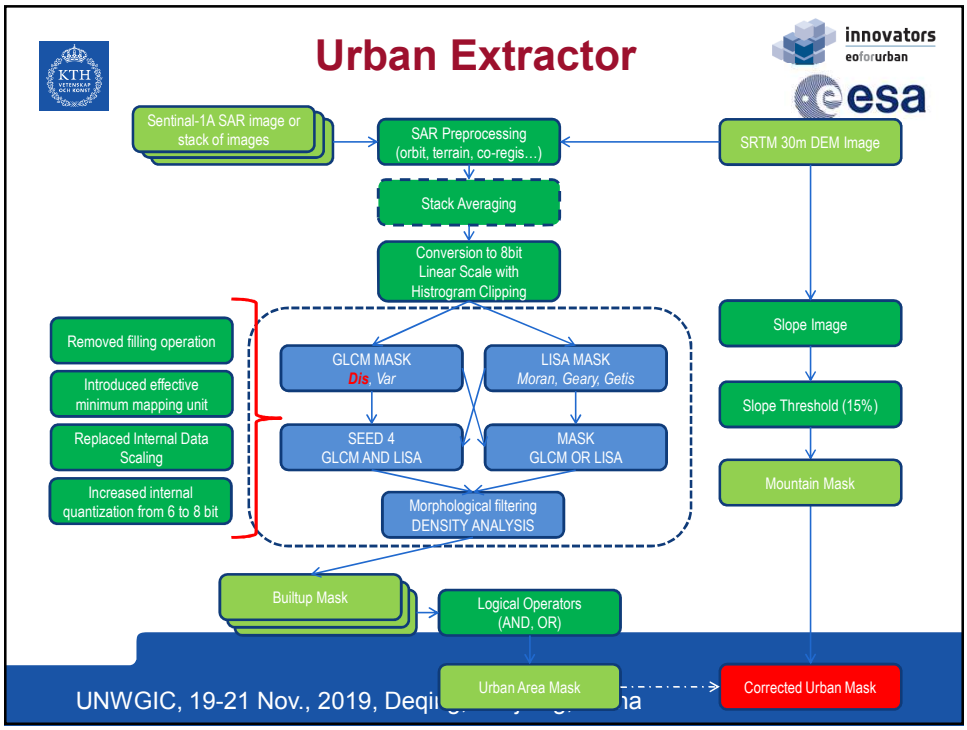
User Requirements: Urban Green Structure & Change Maps

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

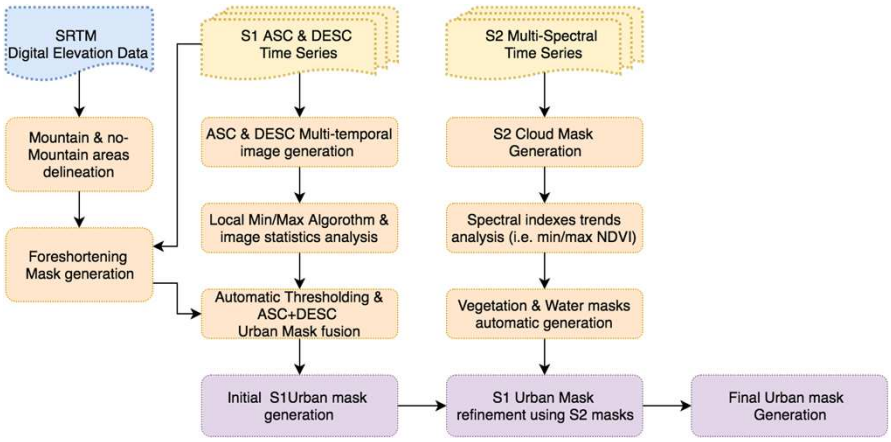
ng, Zhejiang, China


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

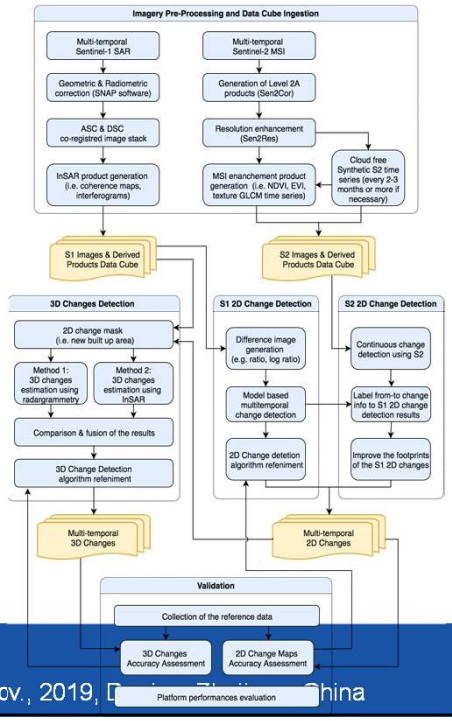

Urban Extractor
innovators
eoforurban
esa
Sentinal-1A SAR image or stack of images
SAR Preprocessing (orbit, terrain, co-regis…)
SRTM 30m DEM Image
Stack Averaging
Conversion to 8bit Linear Scale with Histrogram Clipping
Removed filling operation
Introduced effective minimum mapping unit
Replaced Internal Data Scaling
Increased internal quantization from 6 to 8 bit
GLCM MASK
Dis, Var
LISA MASK
Moran, Geary, Getis
SEED 4
GLCM AND LISA
MASK
GLCM OR LISA
Morphological filtering
DENSITY ANALYSIS
Slope Image
Slope Threshold (15%)
Mountain Mask
Builtup Mask
Logical Operators
(AND, OR)
Urban Area Mask
Corrected Urban Mask
UNWGIC, 19-21 Nov., 2019, Deqi

Sentinel Big Data for Urban Extent Extraction

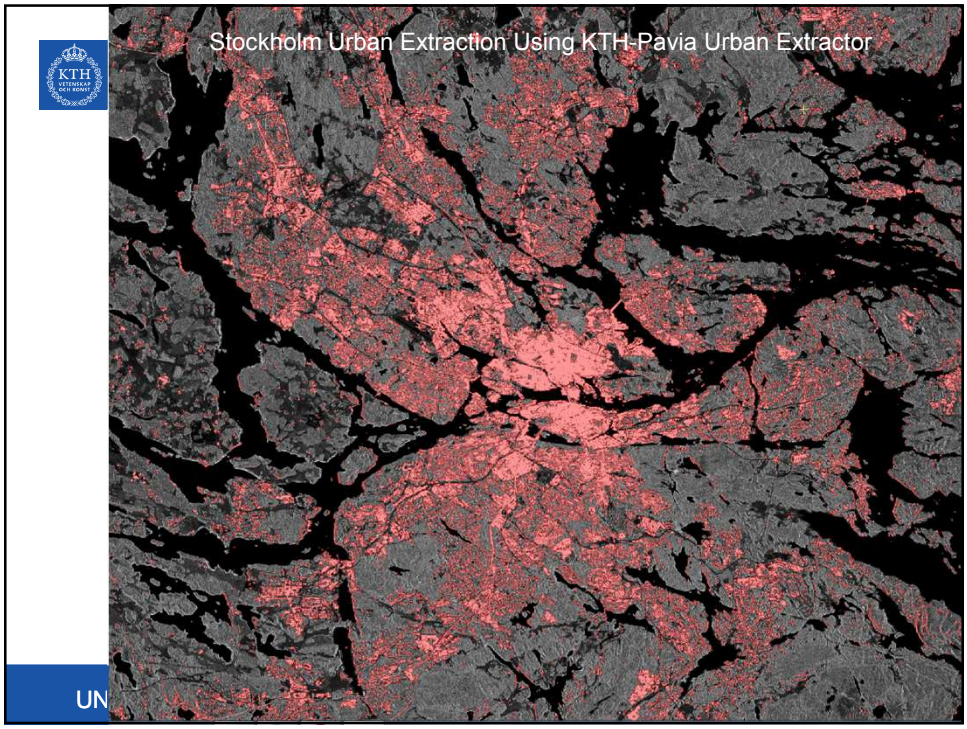


UNWGIC, 19-21 Nov., 2019, Deqing, Zhejiang, China

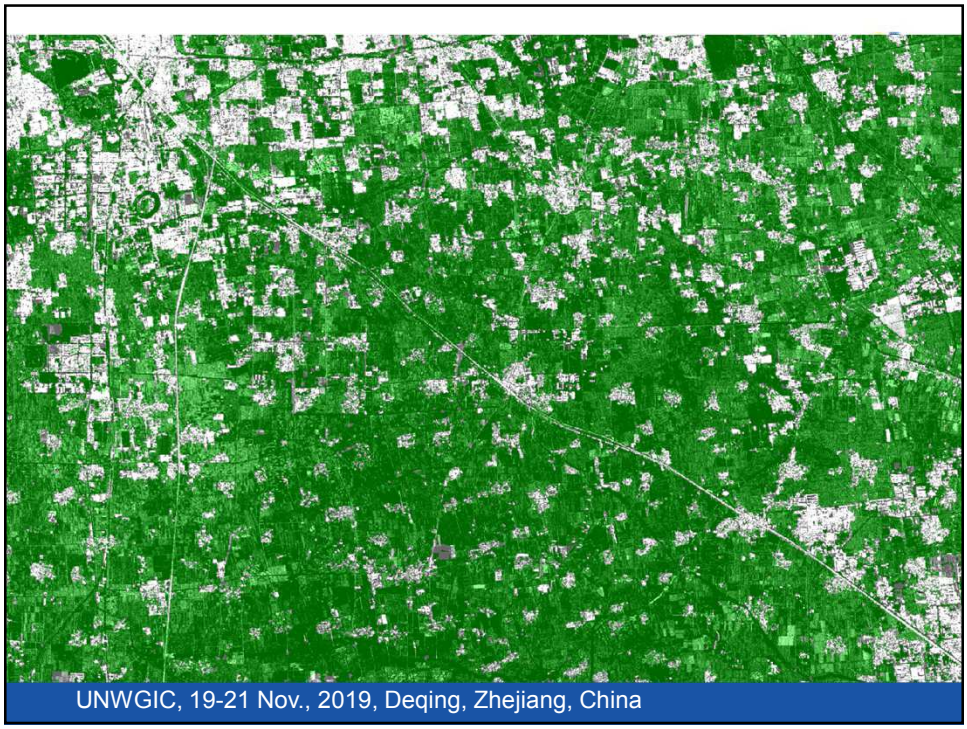
Sentinel Big Data for Urban Change Detection



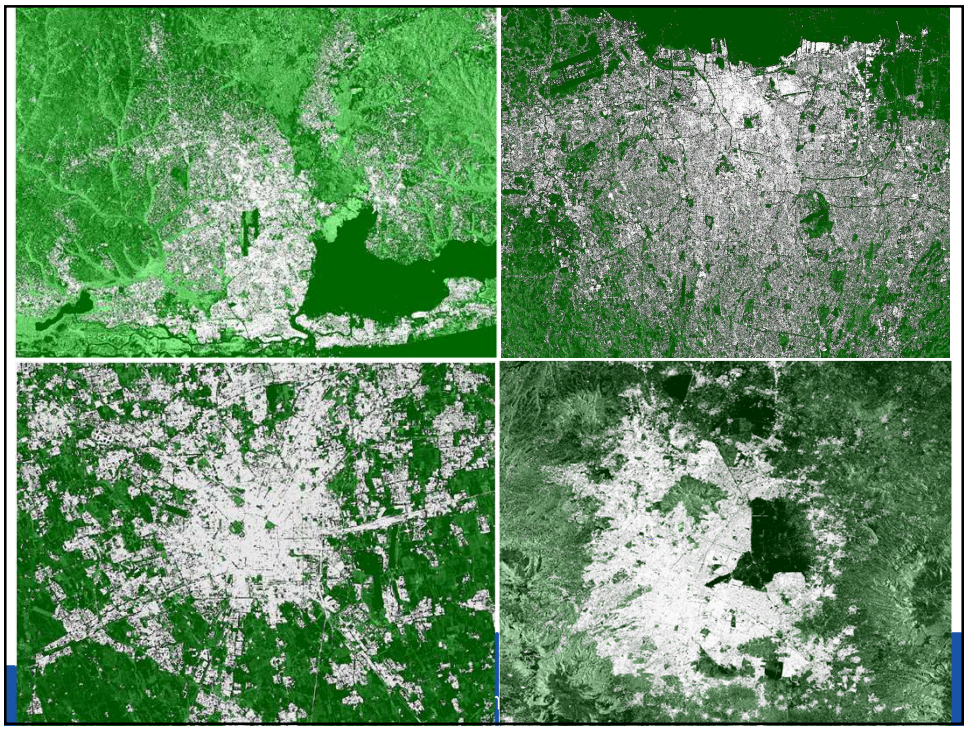
UNWGIC, 19-21 Nov., 2019, D hina


Stockholm Urban Extraction Using KTH-Pavia Urban Extractor
UN

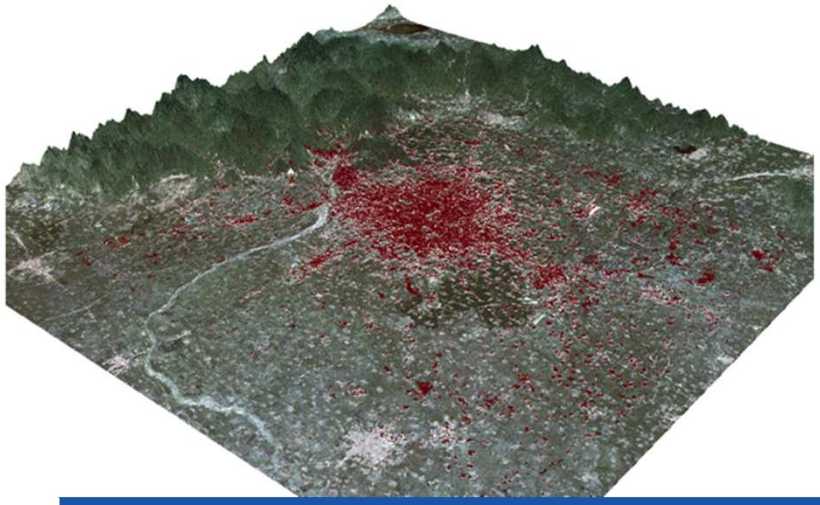

Urban Extraction: Beijing



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

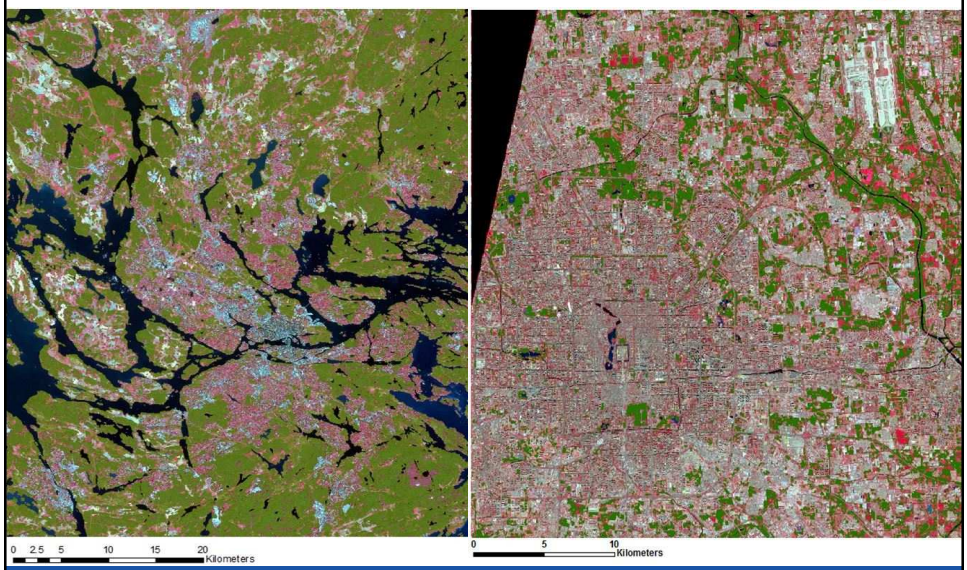


Urban Expansion in Beijing



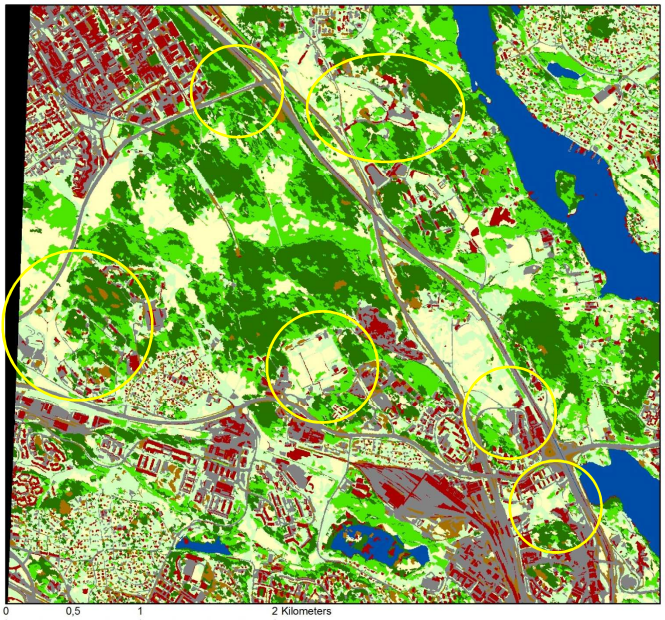
UNWGIC, 19-21 Nov., 2019, Deqing, Zhejiang, China

Urban Green Structure



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

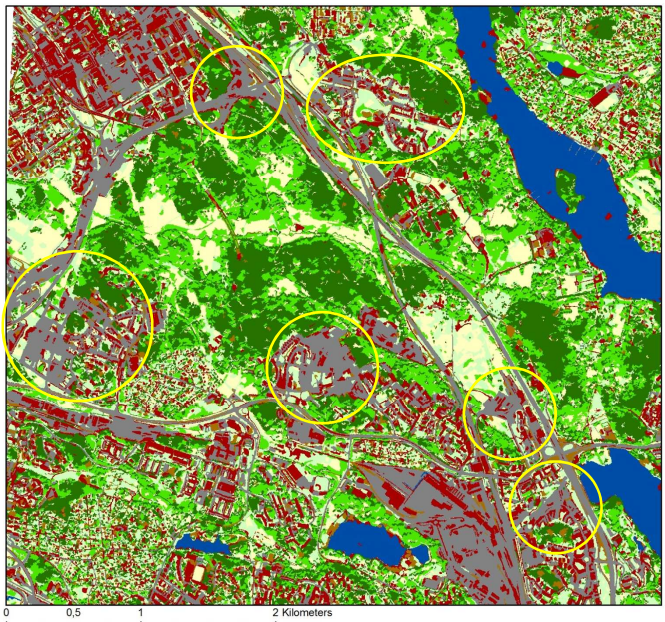
2001



UNW

27

2011



UNW

28

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

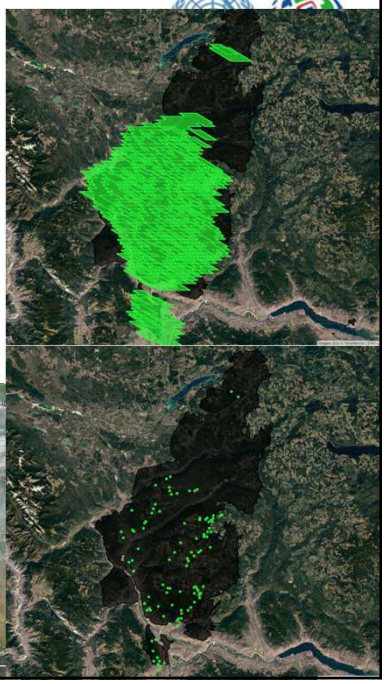
Climate Impact

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

Introduction

For active wildfire monitoring

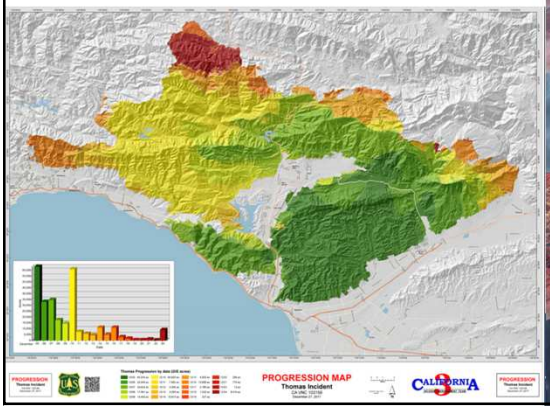
- Moderate Resolution Imaging Spectroradiometer (MODIS) Active Fire maps are often used for contextual awareness

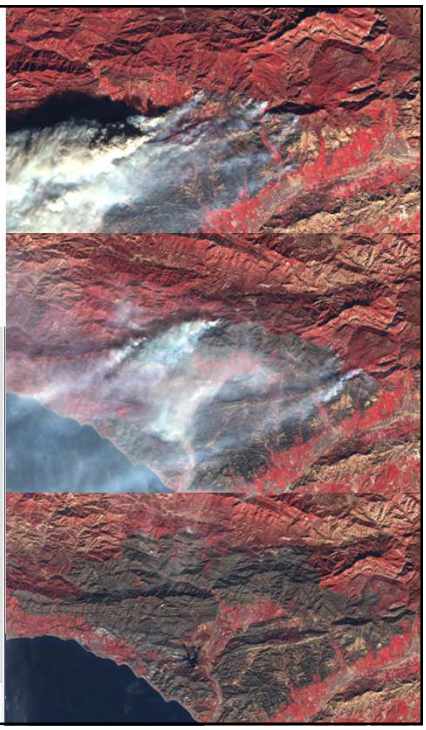


Introduction

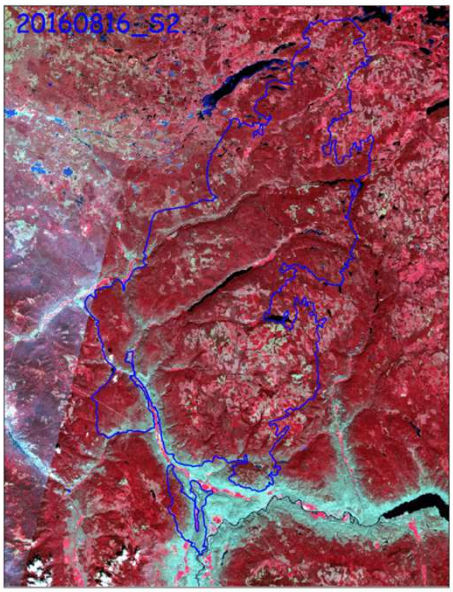
For active wildfire monitoring

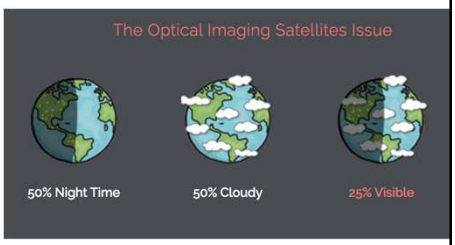
- Landsat data are often deployed for post-wildfire boundary determination and burn severity mapping





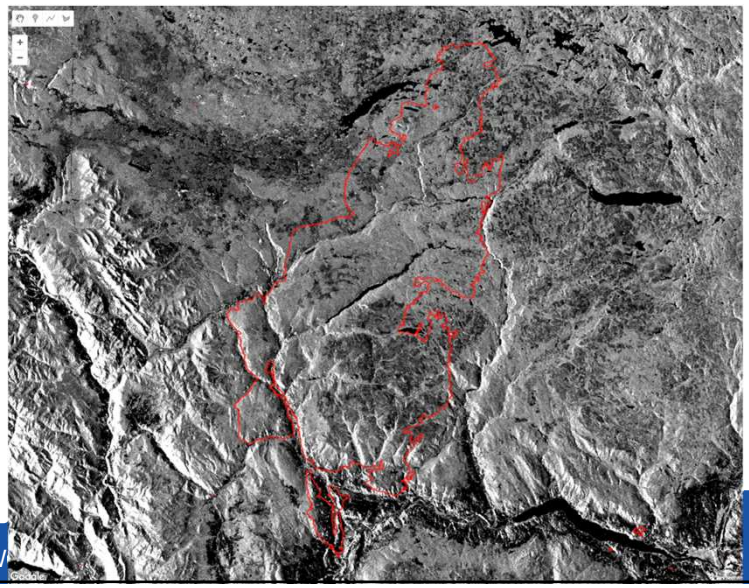
Limitation of Optical Images





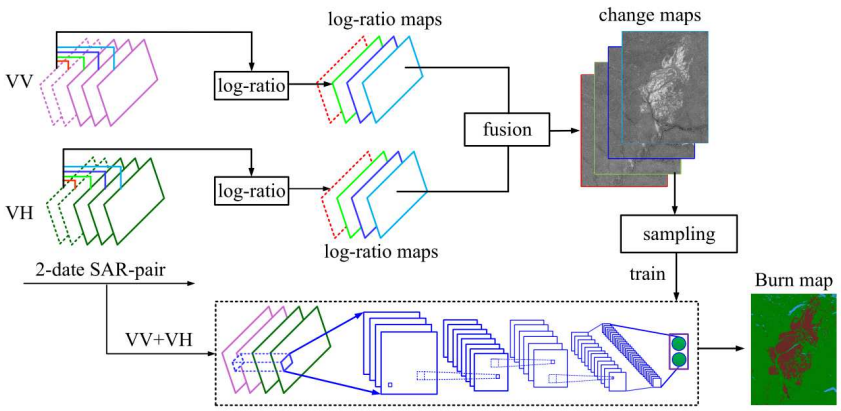
ejiang, China

Sentinel-1 SAR Time Series



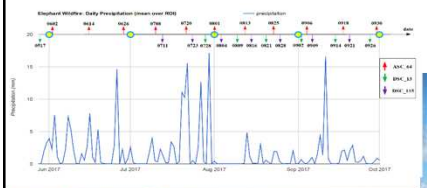
UNW

FireNet: A Deep Learning Framework



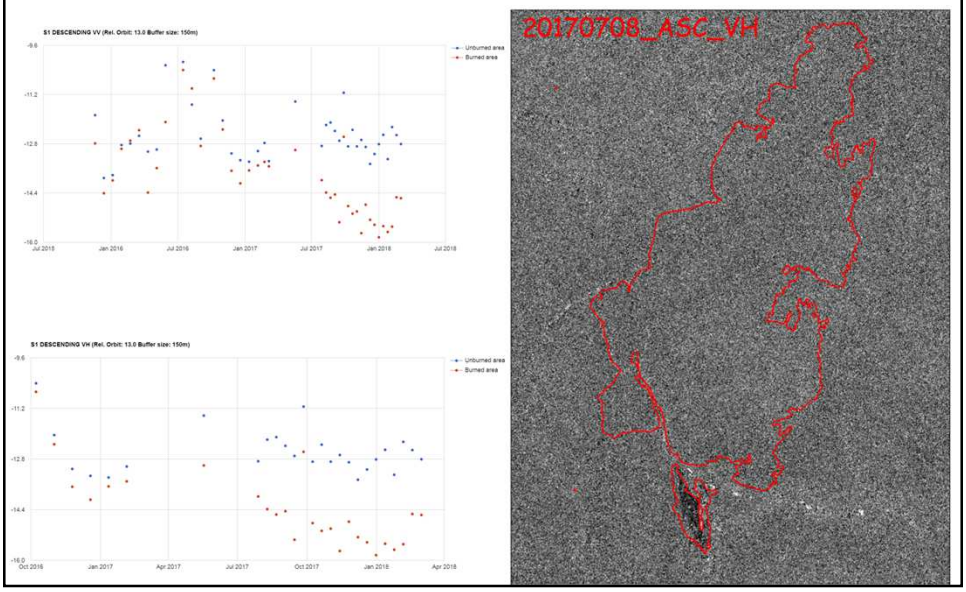
UNWGIC, 19-21 Nov., 2019, Deqing, Zhejiang, China

Validations



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

Results



Conclusions

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