

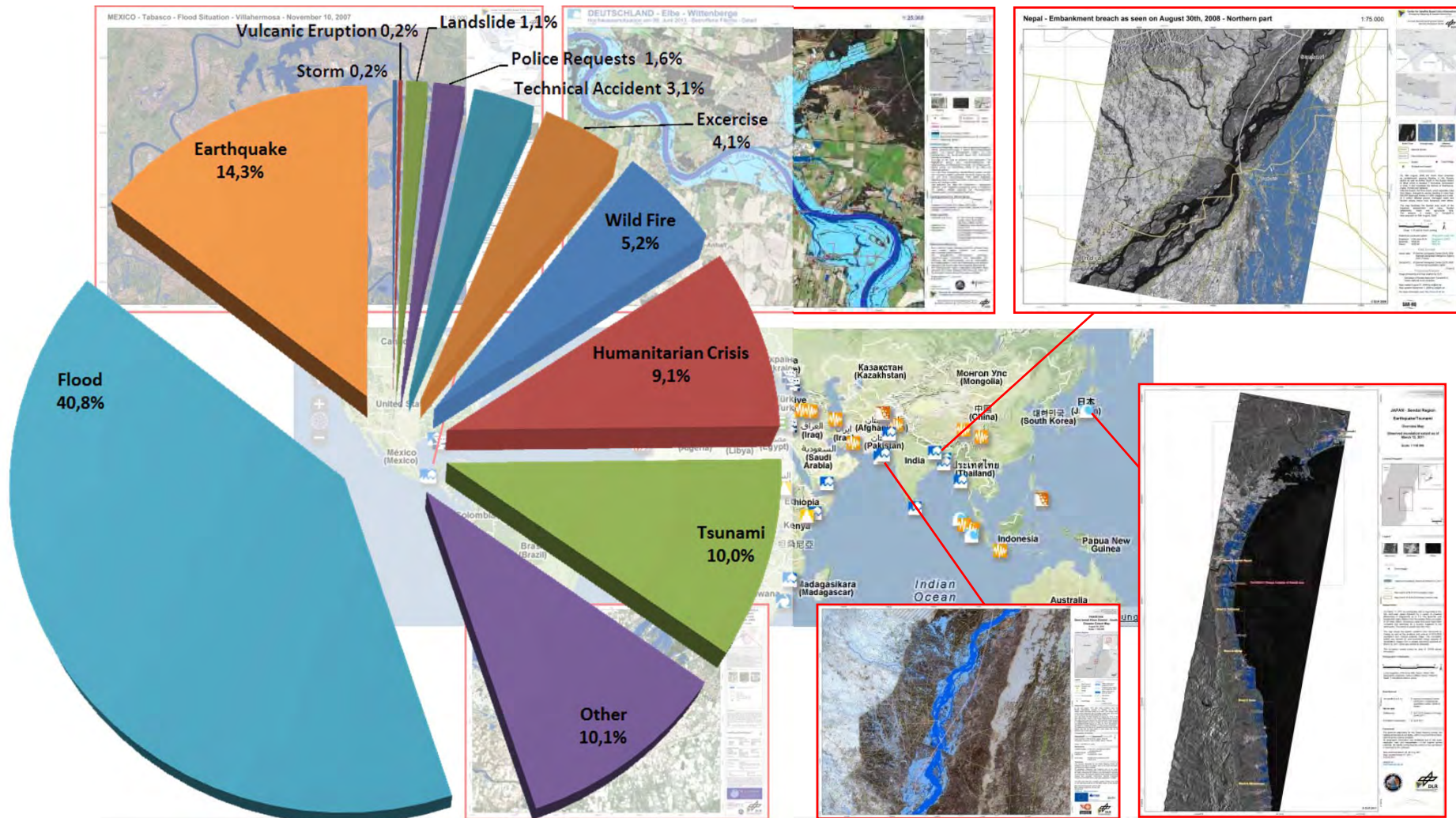
Combining automated satellite based flood mapping with exposure mapping for flood risk assessment and management

André Twele & Franz Hummel, German Aerospace Center (DLR)

United Nations/Germany Expert Meeting "Space-Based Information for Flood and Drought Risk Reduction", 5-6 June 2014



Flood mapping – from semi-automatic tools to fully automatic services



ZKI-activations (since 2003): regions and disaster types (www.zki.dlr.de)

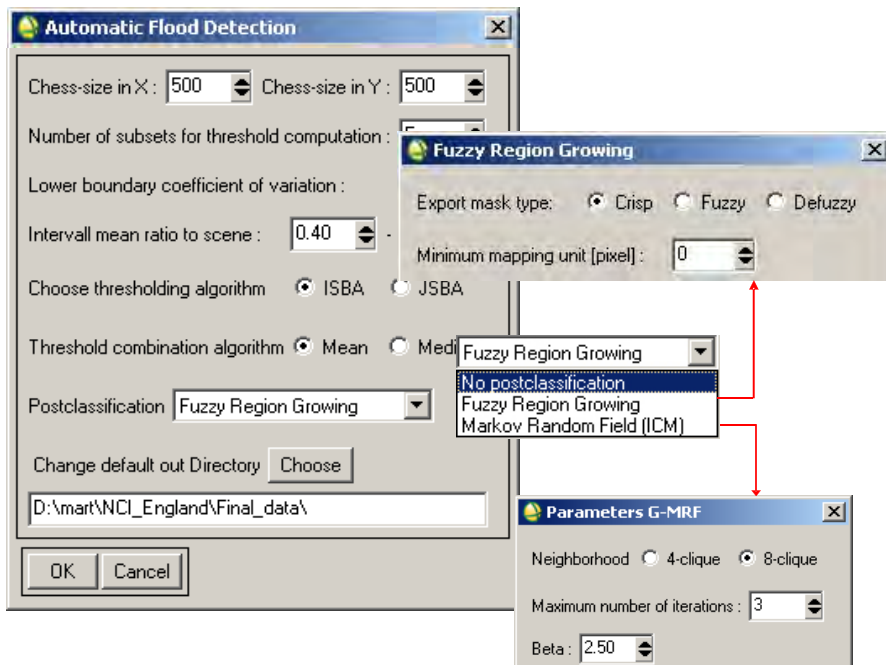


Flood mapping – from semi-automatic tools to fully automatic services



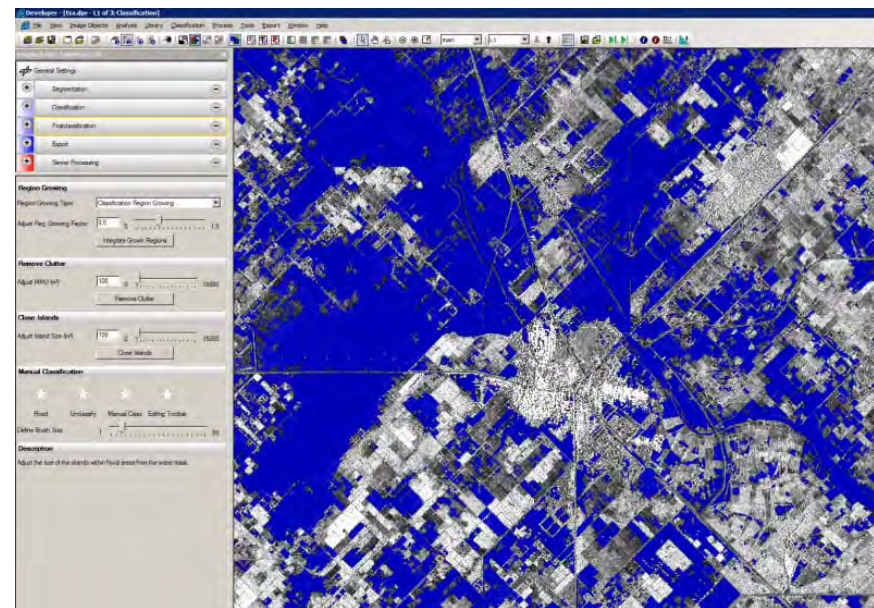
ENVI/IDL:

- Automatic split-based thresholding
- Pixel-based



eCognition Developer:

- Automatic and semi-automatic
- Segment-based (multi-scale)

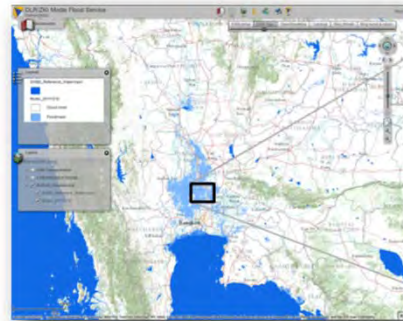


Martinis, S., Twele, A. & Voigt, S., 2011 - IEEE TGRS, 49 (1)
 Martinis, S. & Twele, A., 2010 - Remote Sensing, 2 (9)
 Martinis, S., Twele, A., Voigt, S., 2009 - NHSS, (9)

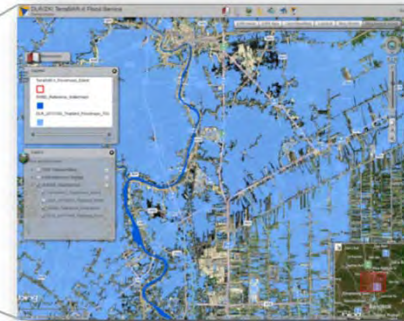


DLR/ZKI flood monitoring services

Automated EO-based processing chains and services



MODIS Flood Service



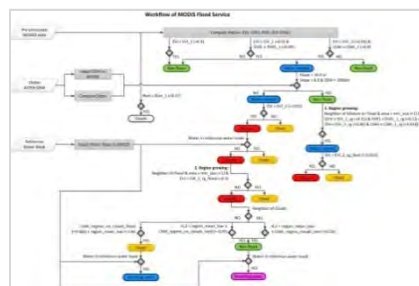
TerraSAR-X Flood Service



Current focus:

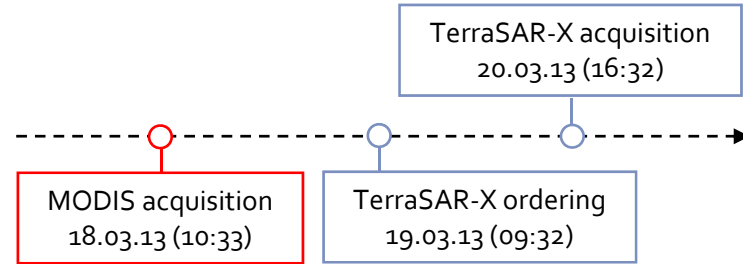
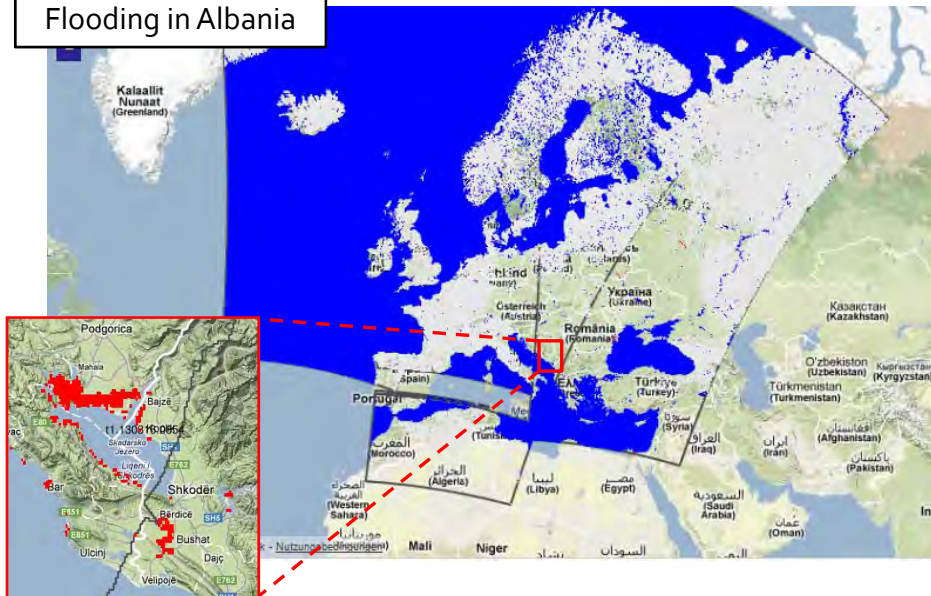


Sentinel-1

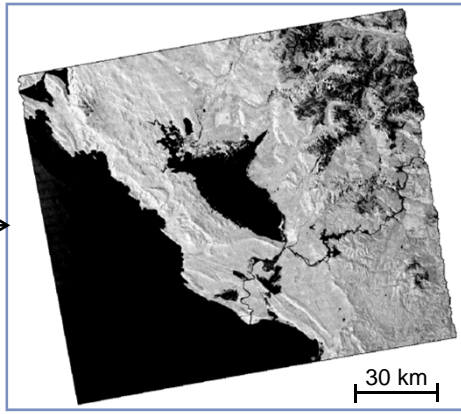


Linking both scales

Flooding in Albania



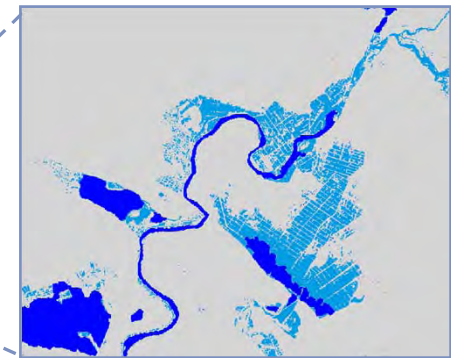
Alert



TerraSAR-X SC (20/03/2013)



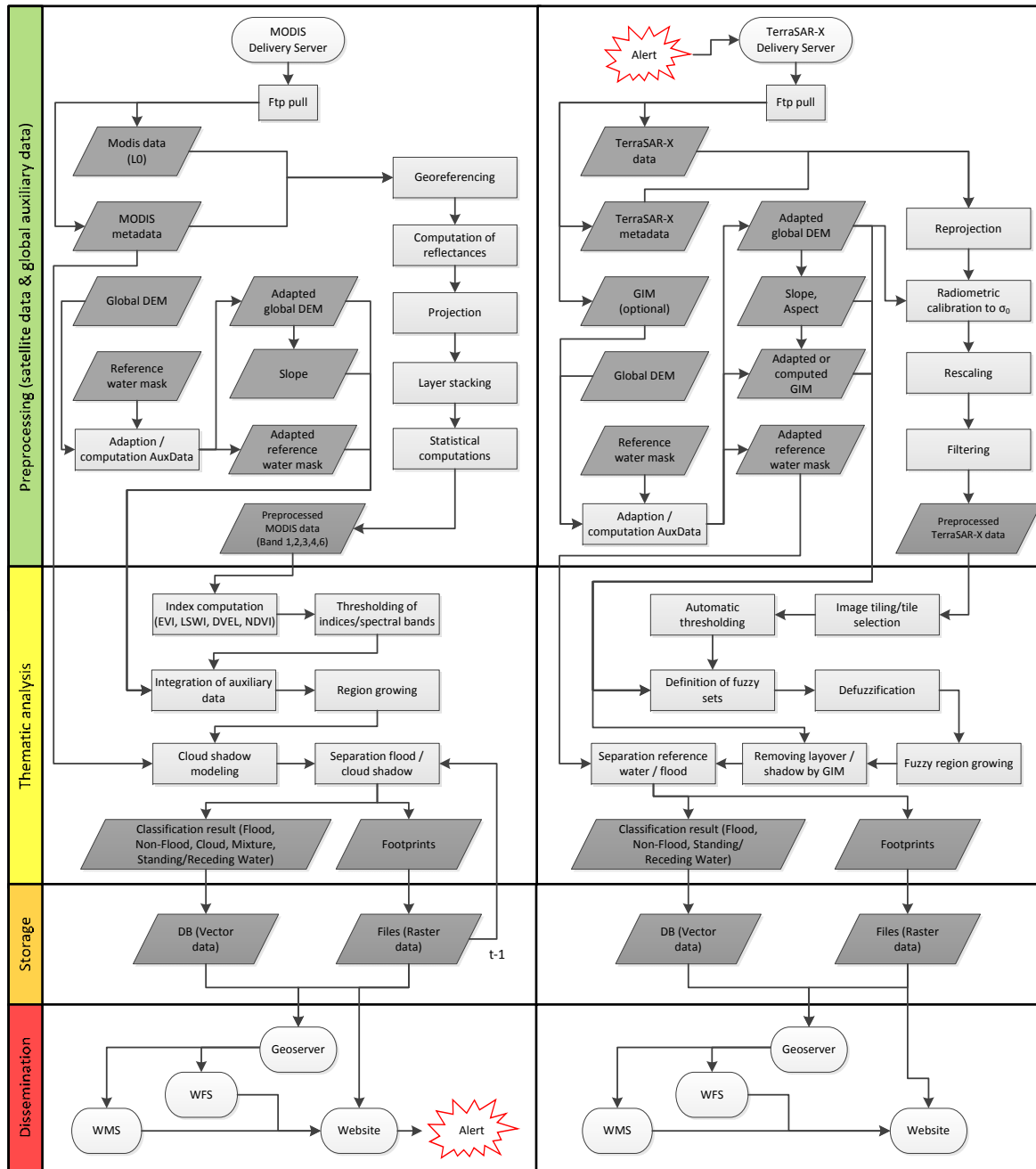
TerraSAR-X flood mask



- Flood
- Standing water
- No water



MODIS flood service



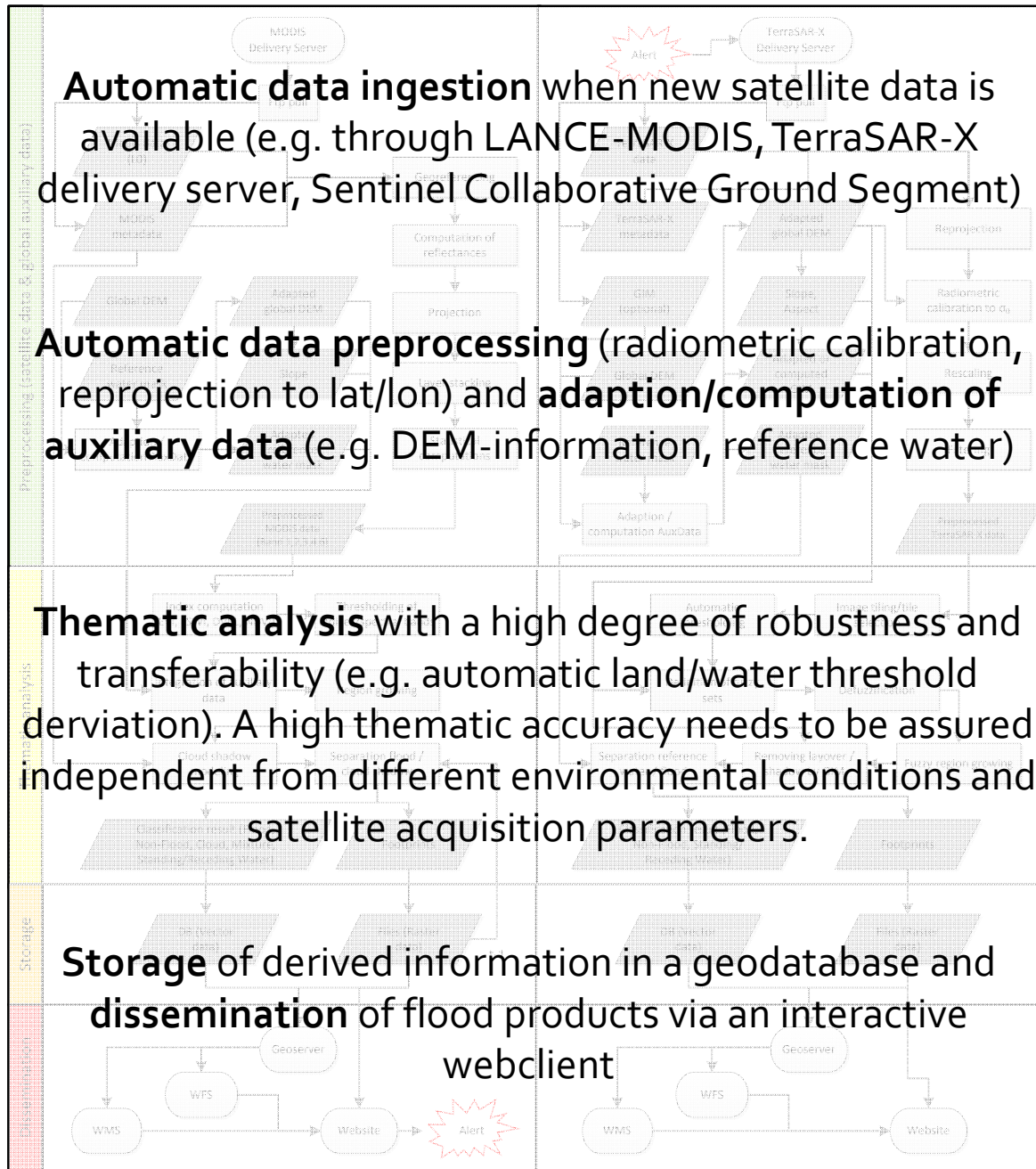
TerraSAR-X flood service

Martinis, S., A. Twele, C. Strobl, J. Kersten, and E. Stein. 2013. A multi-scale flood monitoring system based on fully automatic MODIS and TerraSAR-X processing chains. Remote Sensing



MODIS flood service

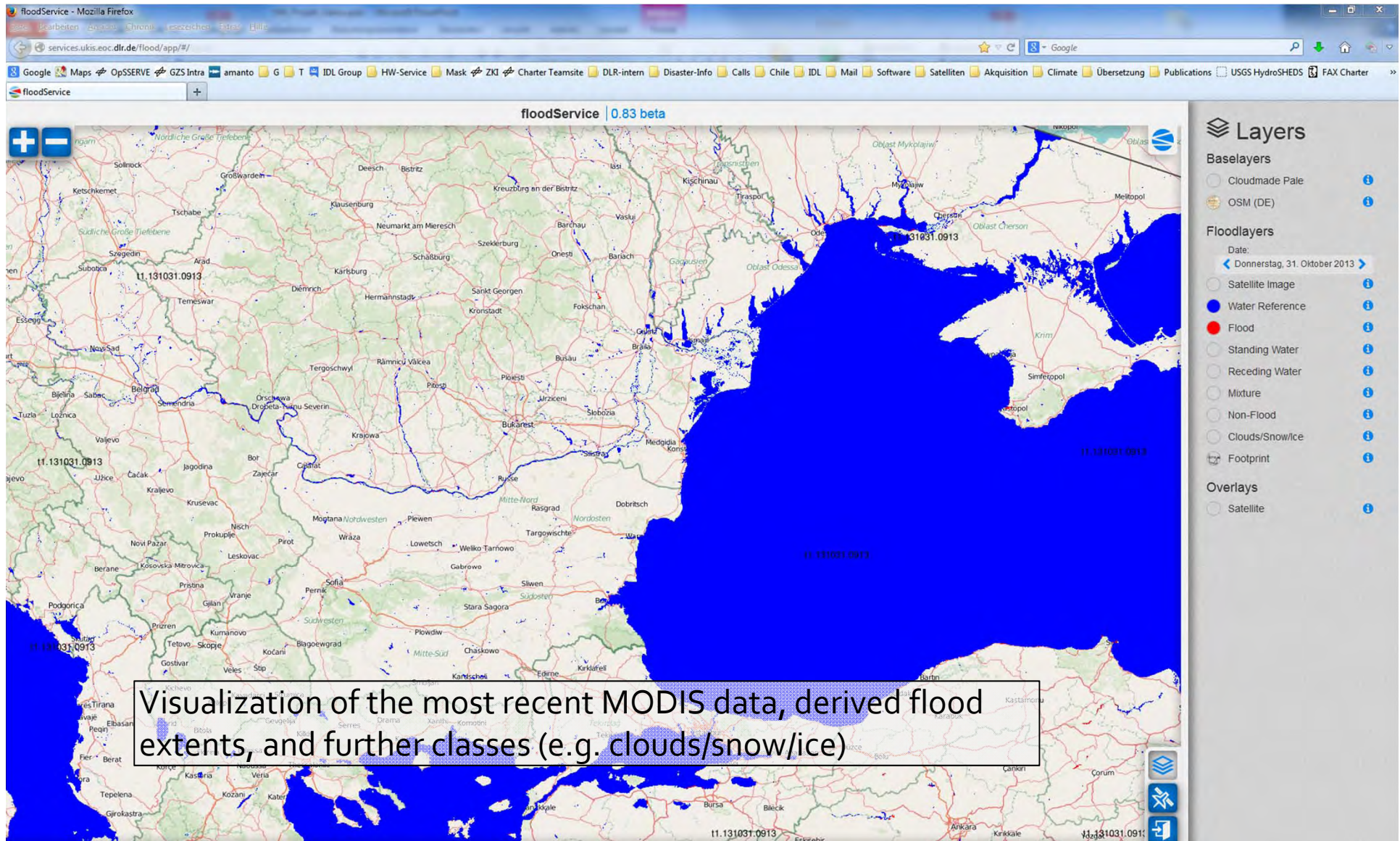
TerraSAR-X flood service



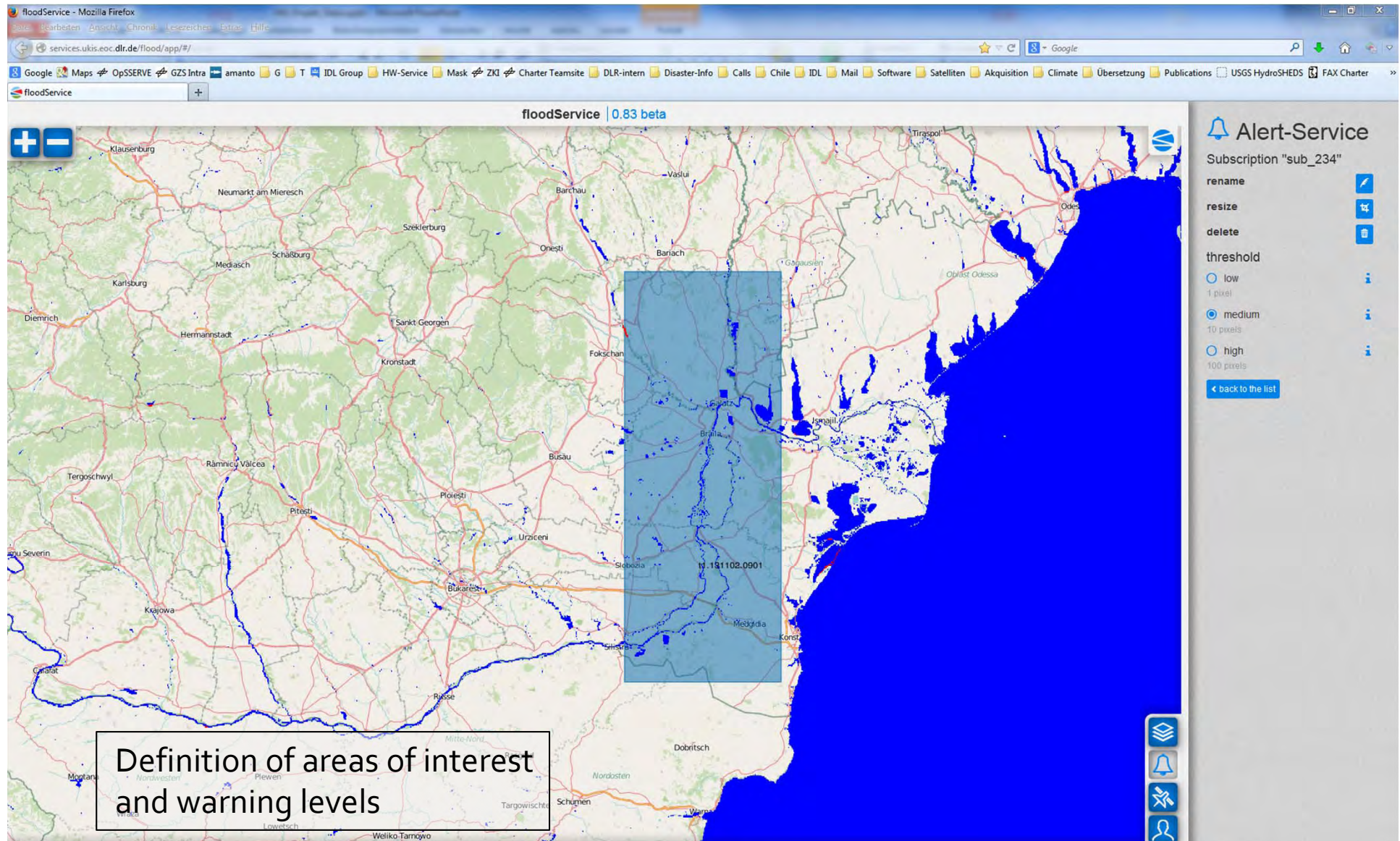
Martinis, S., A. Twele, C. Strobl, J. Kersten, and E. Stein. 2013. A multi-scale flood monitoring system based on fully automatic MODIS and TerraSAR-X processing chains. Remote Sensing



Example: MODIS Flood Service



Example: MODIS Flood Service



The screenshot displays the floodService web application in a Mozilla Firefox browser. The browser's address bar shows the URL `services.ukis.eoc.dlr.de/flood/app/#/`. The application header includes the text "floodService | 0.83 beta". The main content area features a satellite-style map of Eastern Europe, with a large blue-shaded region indicating a flood area. A text box at the bottom left of the map contains the text "Definition of areas of interest and warning levels". On the right side of the interface, there is an "Alert-Service" panel. This panel shows a subscription for "sub_234" and provides options to "rename", "resize", and "delete" the alert. It also includes a "threshold" selection with three radio buttons: "low" (1 pixel), "medium" (10 pixels, which is selected), and "high" (100 pixels). A "back to the list" button is located at the bottom of the alert panel. The browser's toolbar and various extension icons are visible at the top of the window.



Example: MODIS Flood Service

floodService | 0.83 beta

Von: uadm, Funktional
Gesendet: Sonntag, 13. Oktober 2013 14:39
An: Plattner, Stefan
Betreff: [Summary] Flood Alert Summary for Italien on 10/13/2013 12:39 UTC

Summary of Flood Alerts for 10/13/2013 12:39 UTC

We have detected possible flooded areas in on or more AOI for which you have subscribed:

Flood Alert for Italien (Abruzzo, Italy) on 10/13/2013 12:39 UTC

We have detected possible flooded areas in the AOI for which you have subscribed:

AOI=POLYGON ((4.328613 37.857507, 4.328613 45.98867, 24.257813 45.98867, 24.257813 37.857507, 4.328613 37.857507))

Threshold=Medium

Further information can be found here: <http://s.dlr.de/cbbo/flood/app/#?center=41.9231,14.2932&date=1381667956>

You will continue to receive alerts for this subscription.

Edit your subscriptions here: <http://s.dlr.de/cbbo/flood/app/#/>

Alert-Service
 Subscriptions
 sub_234
 + add a subscription

Settings

- immediate (per subscription) ⓘ
- immediate (per overpass) ⓘ
- daily digest ⓘ
- Email notifications ⓘ
- SMS notifications ⓘ

**Monitoring & Alerting Service:
 Automatic alert notifications by SMS or Email
 according to user-defined parameters/AOIs**

Example: TerraSAR-X flood service

The screenshot displays the 'tsx flood-client' web application interface. At the top, it shows the version '0.1' and logos for 'UKIS' and 'DLR'. The main area is a grayscale SAR strip map of a river region. On the right side, there is a 'Layers' panel with the following settings:

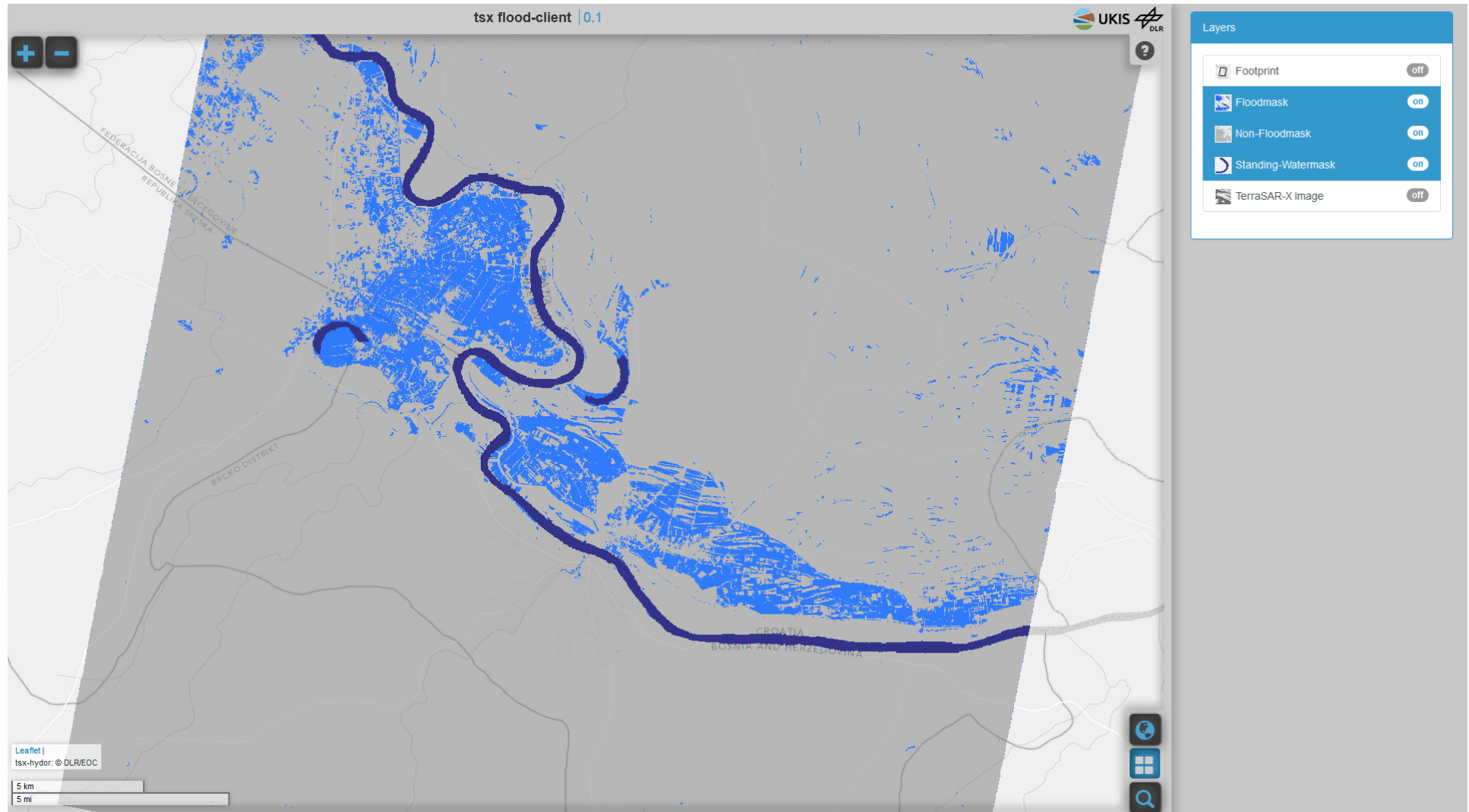
Layer Name	Status
Footprint	off
Floodmask	off
Non-Floodmask	off
Standing-Watermask	off
TerraSAR-X Image	on

At the bottom left, there is a scale bar showing 5 km and 5 mi, and a small text box with 'Leaflet | tsx-hydor: © DLR/EOC'. The bottom right corner of the map area contains navigation icons for home, full screen, and search.

TerraSAR-X StripMap, 26-05-2014, Bosnia and Herzegovina/Croatia



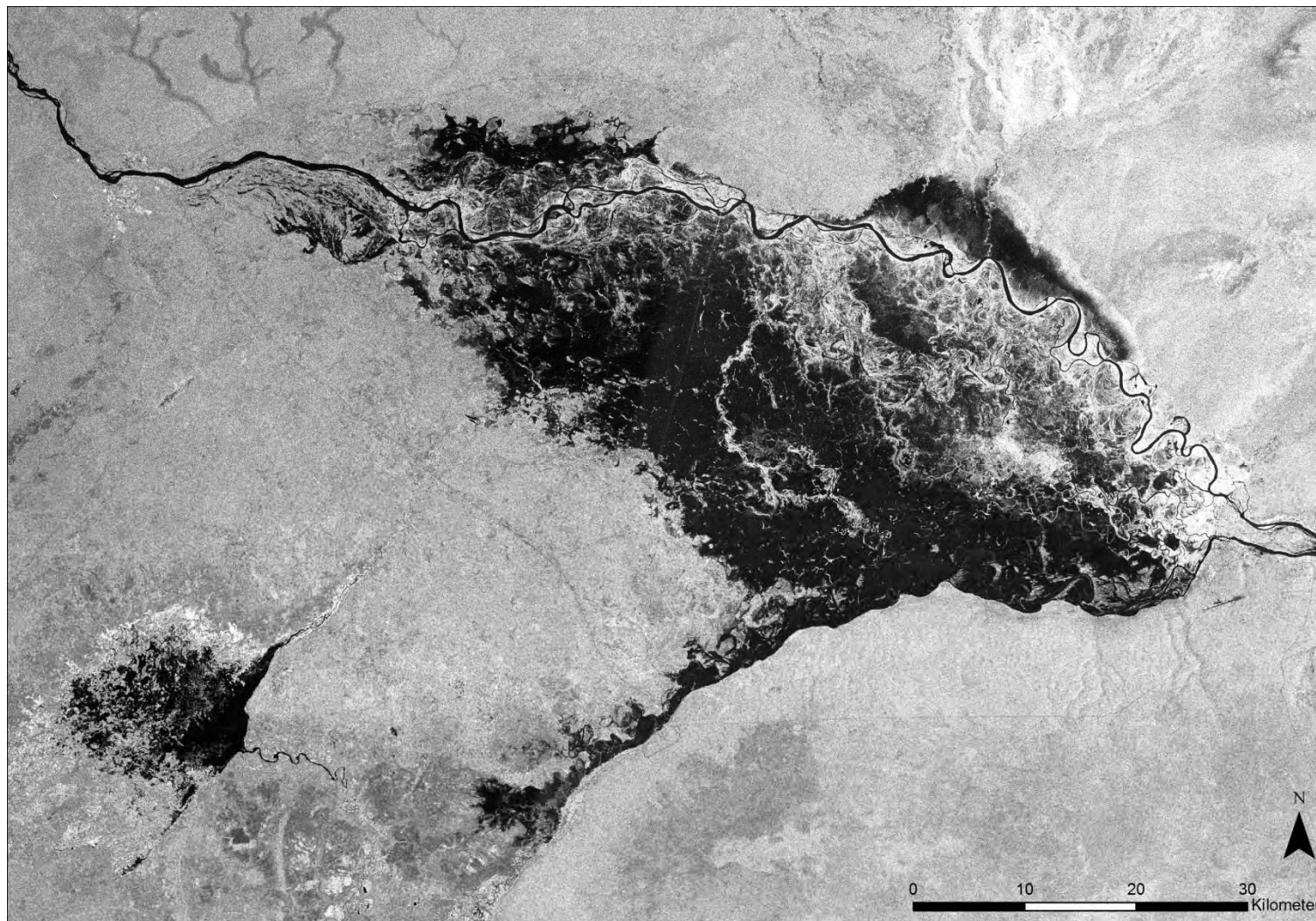
Example: TerraSAR-X flood service



TerraSAR-X StripMap, 26-05-2014, Bosnia and Herzegovina/Croatia

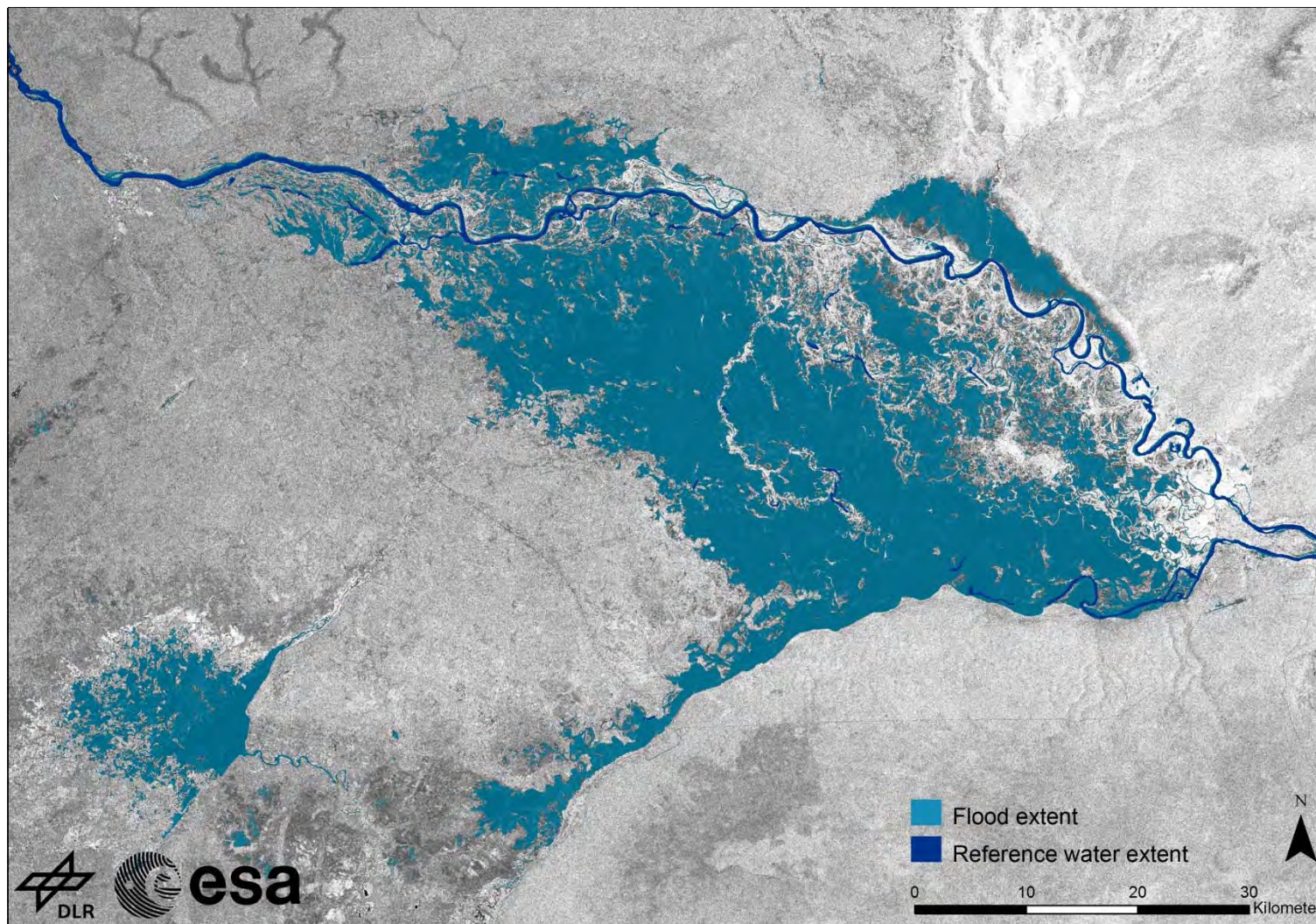


Outlook: Sentinel-1 flood service



Sentinel-1 IWS
13-04-2014
Namibia, Zambezi river

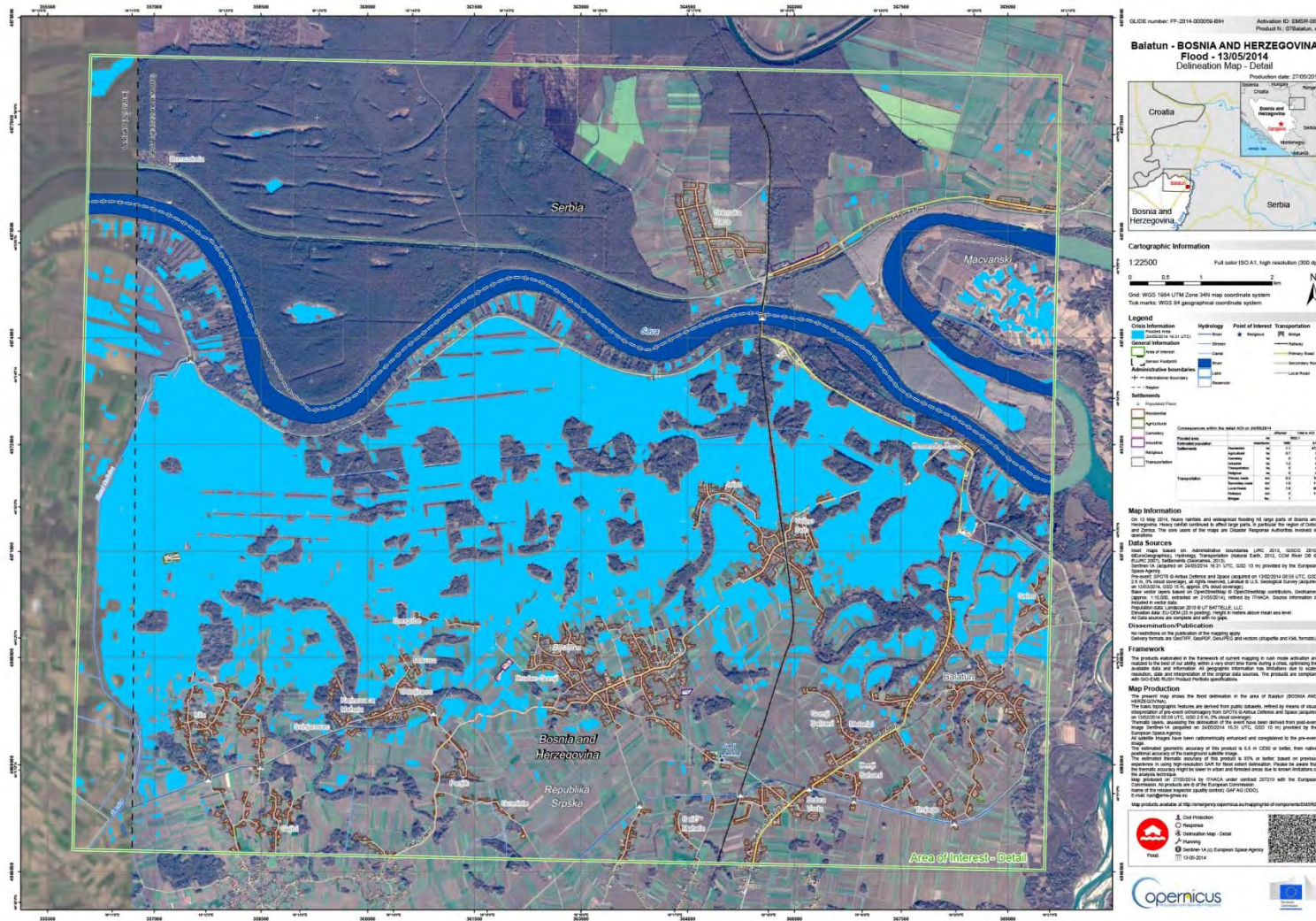
Outlook: Sentinel-1 flood service



Sentinel-1 IWS
13-04-2014
Namibia, Zambezi river



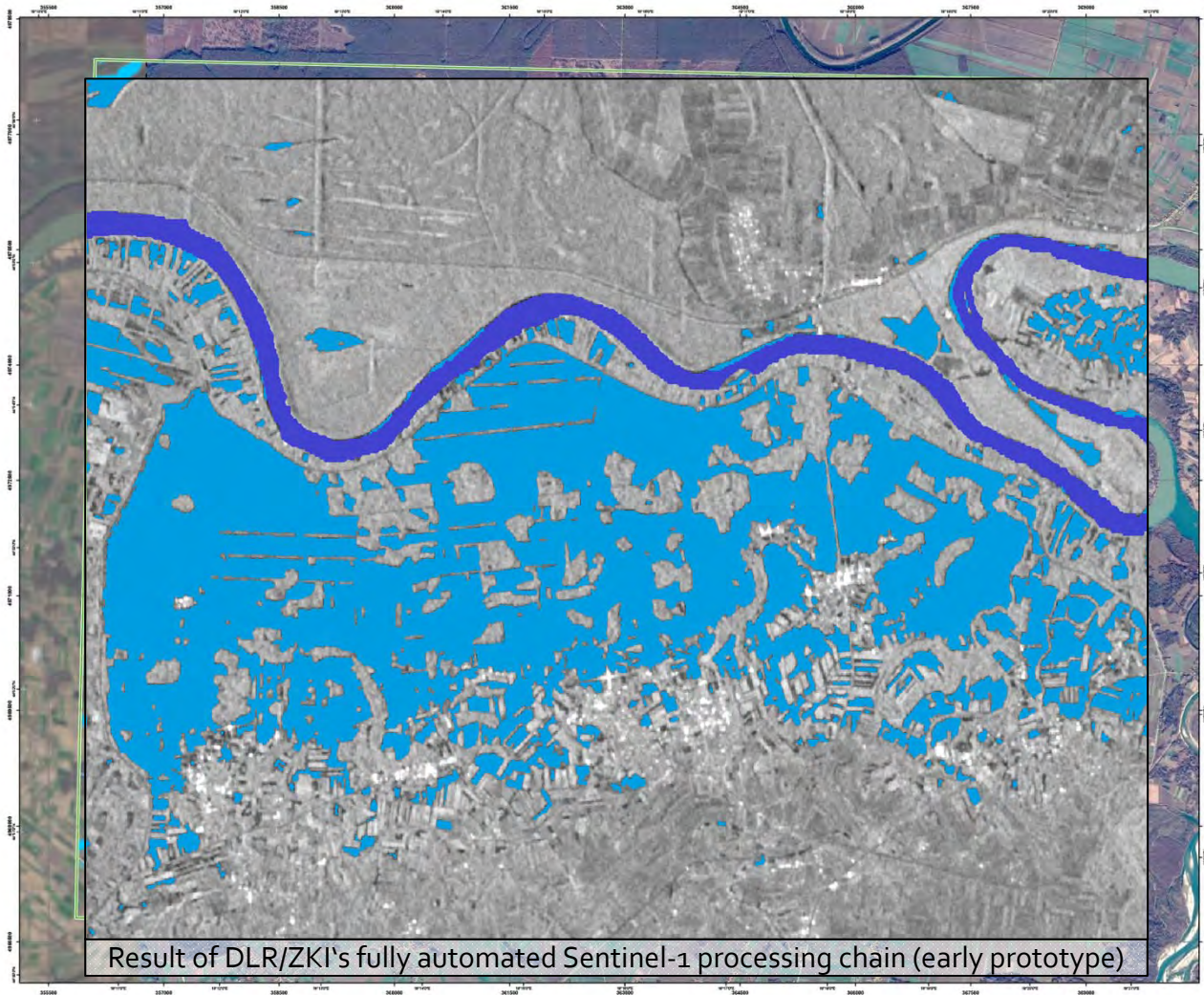
Outlook: Sentinel-1 flood service



Sentinel-1 IWS, 24-05-2014
 Map produced by
 Copernicus Emergency
 Management Service (EMS)



Outlook: Sentinel-1 flood service



GLDCE number: FF-2014-000209-B0H Activation ID: EM509-GSF Product N.: 075Balatun_V1

Balaton - BOSNIA AND HERZEGOVINA Flood - 13/05/2014 Delineation Map - Detail
 Publication date: 27/05/2014

Cartographic Information
 1:22500 Full color (SQA), high-resolution (300 dpi)

Legend

Graphic Information	Hydrology	Point of Interest	Transportation
<ul style="list-style-type: none"> Legend title (if any) Legend symbols 	<ul style="list-style-type: none"> Stream Canal Water Swamp 	<ul style="list-style-type: none"> Point of interest 	<ul style="list-style-type: none"> Road Railway Primary Road Secondary Road Local Road

Settlements

Proposed Town	Urban Area
Settlement	Urban Area
Proposed Town	Urban Area
Settlement	Urban Area

Data Sources

On 13 May 2014, teams in Croatia and independent flooding to large parts of Bosnia and Herzegovina, where flooded areas to about large parts, in particular the region of the city of Zadar. The same case of the map are Disaster Response Authorities involved in the flood.

The main geographic features are derived from public datasets, refined by means of visual interpretation of satellite imagery from Sentinel-1A (Sentinel-1A) and Copernicus Emergency Management Service (EMS) products. The map is produced by the Copernicus Emergency Management Service (EMS).

Map Production

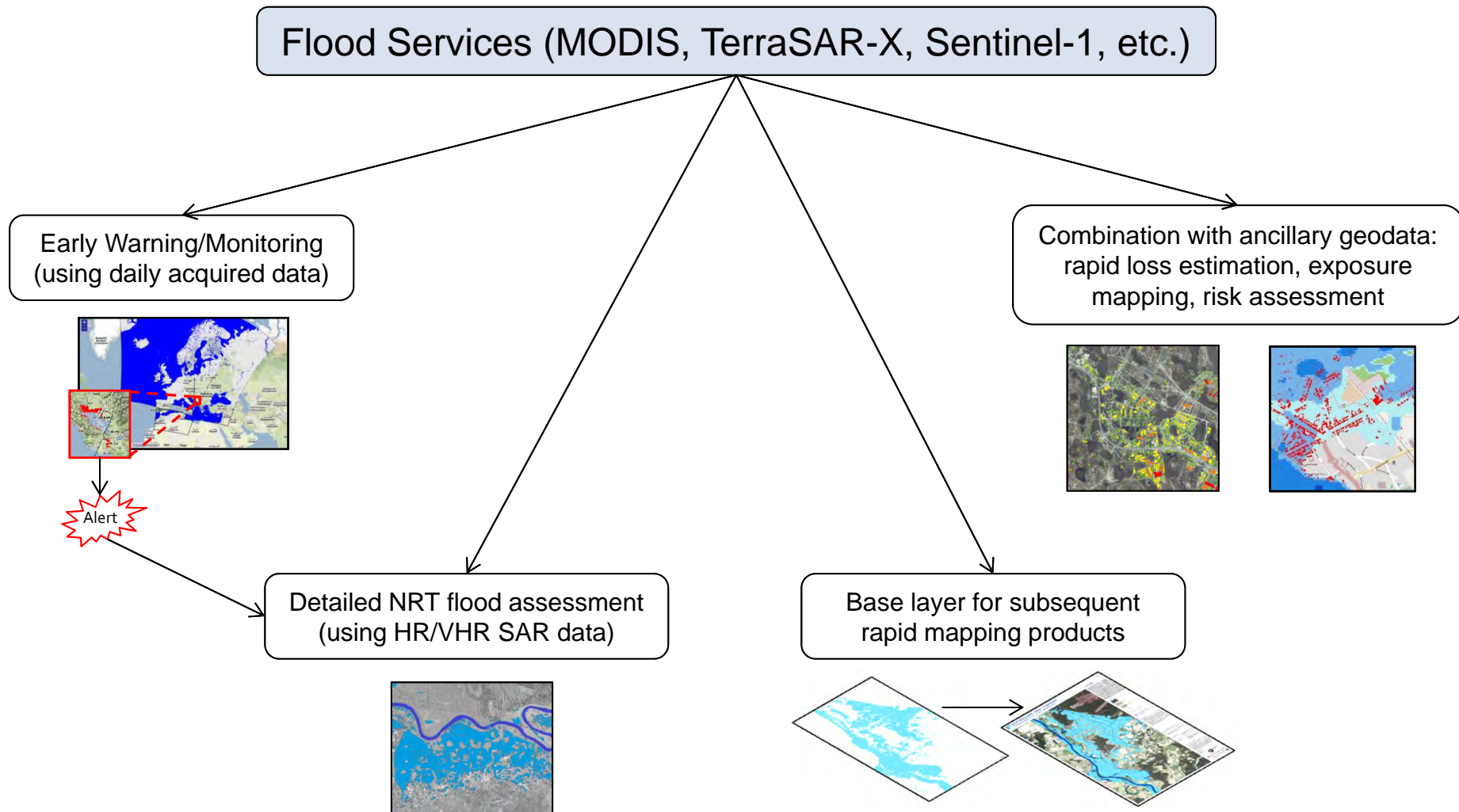
The present map shows the best available in the area of Balaton (000000 and 460000N).

The main geographic features are derived from public datasets, refined by means of visual interpretation of satellite imagery from Sentinel-1A (Sentinel-1A) and Copernicus Emergency Management Service (EMS) products. The map is produced by the Copernicus Emergency Management Service (EMS).

Sentinel-1 IWS, 24-05-2014
 Map produced by
 Copernicus Emergency
 Management Service (EMS)



Application cases of flood services



Quantifying Risk

$$\text{Risk} = f \{ \text{Hazard}, \text{Exposure}, \text{Vulnerability} \}$$

Potentially damaging event

- Likelihood
- Magnitude
- Duration
- Speed
- Spatial extent



Sentinel-3



Sentinel-1



MODIS Flood Service



TerraSAR-X Flood Service



Objects potentially adversely affected

- People
- Property
- Infrastructure

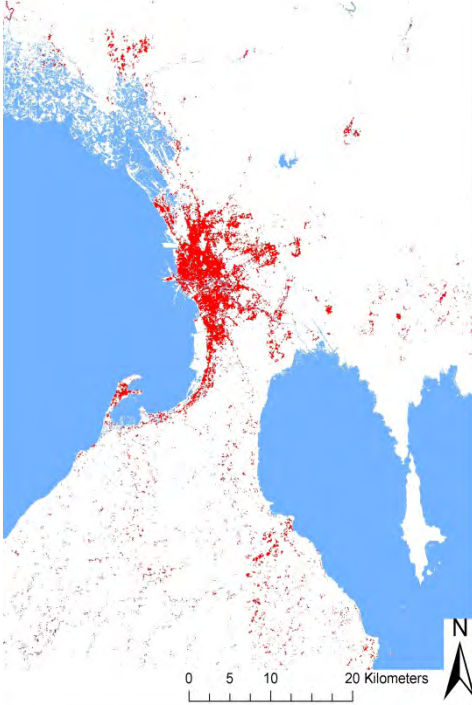


Present attribute that describes possible future harm

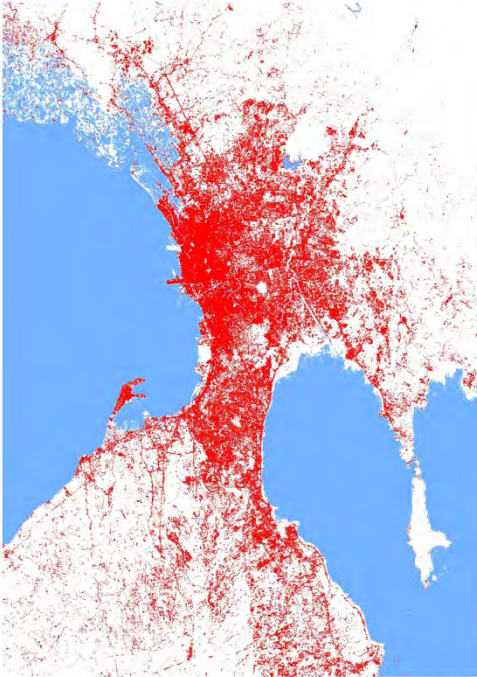
- Physical
- Social
- Economic



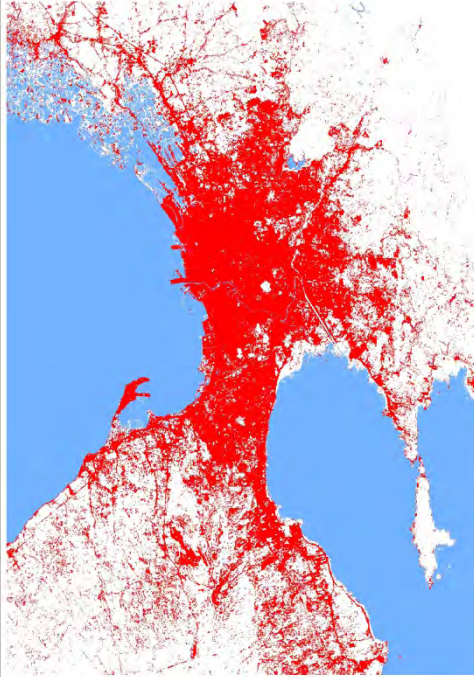
Manila, 1975



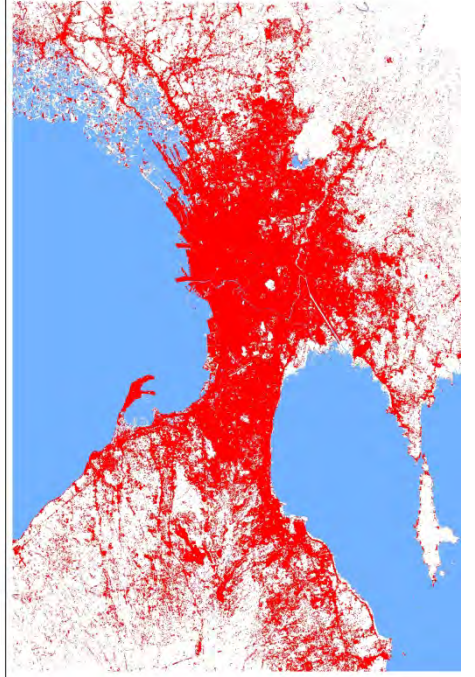
Manila, 1990

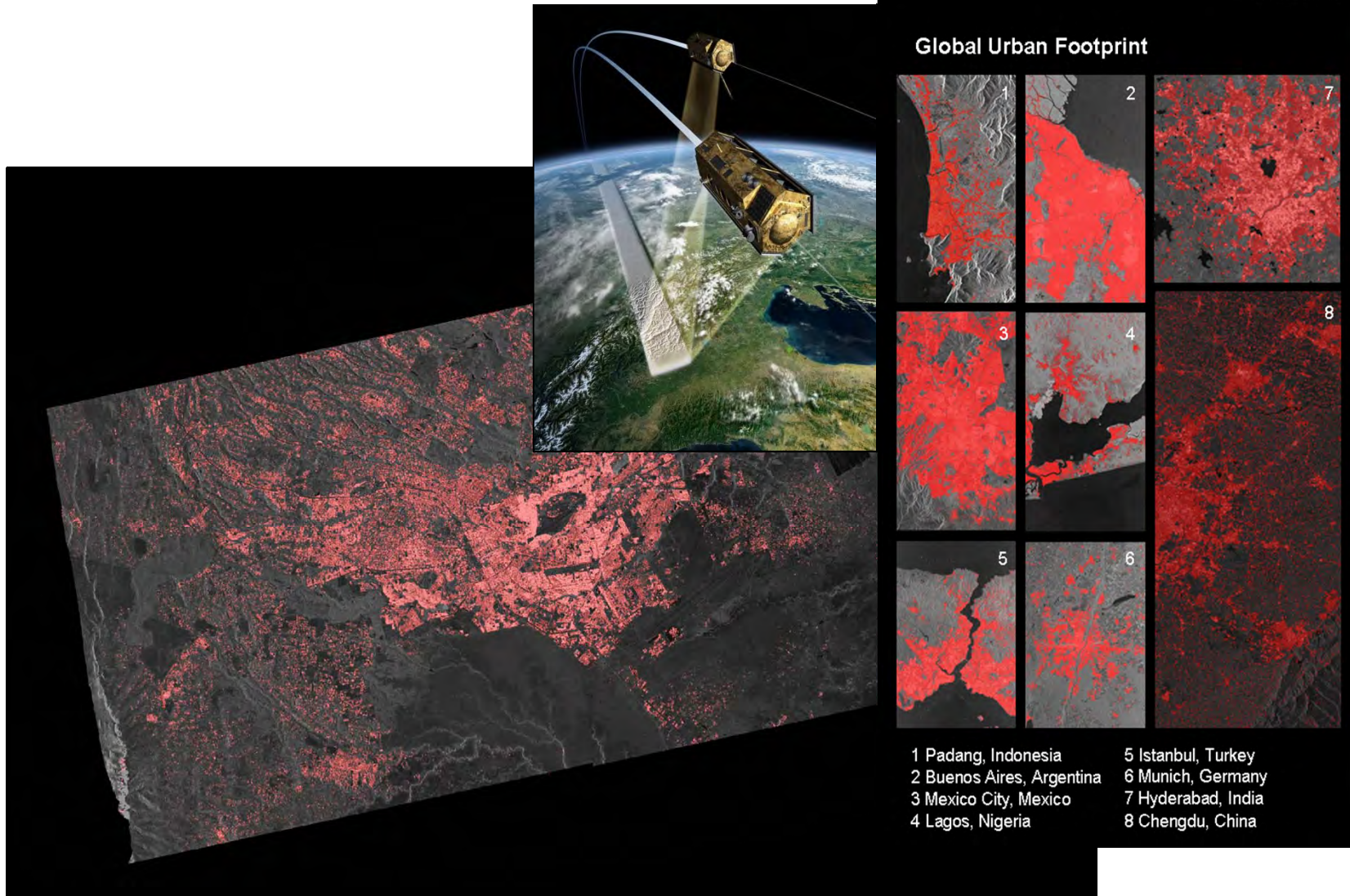


Manila, 2000

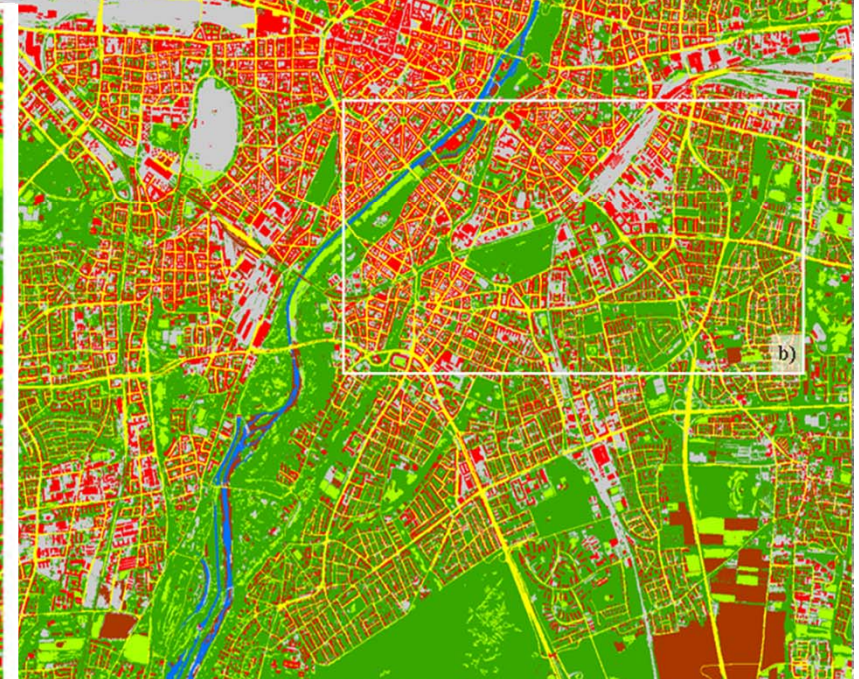
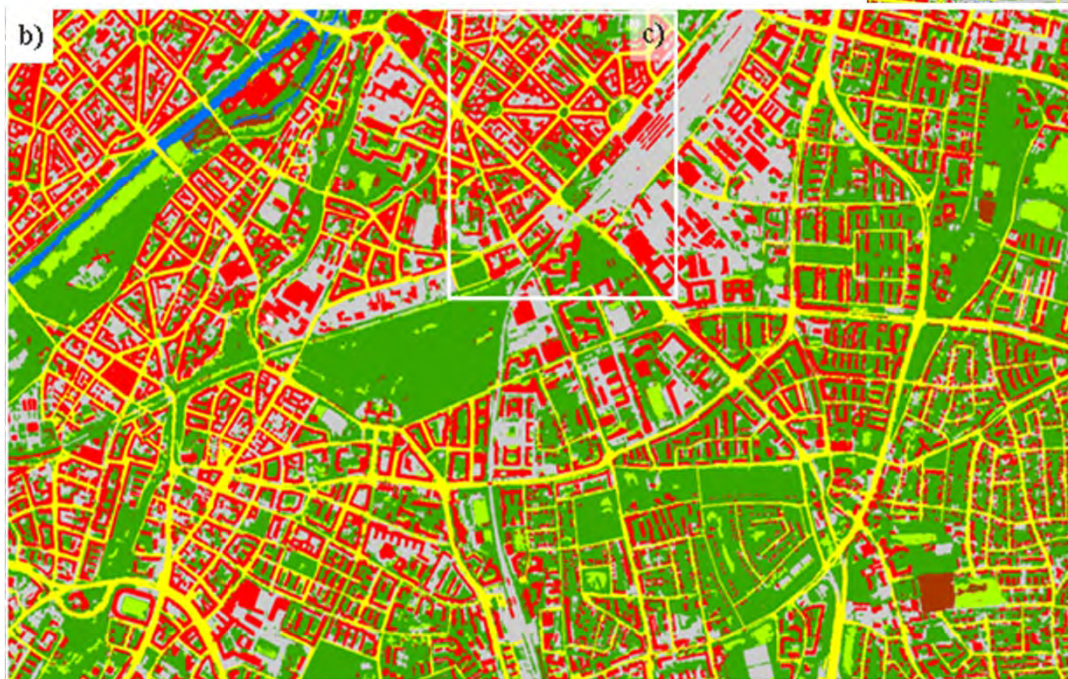
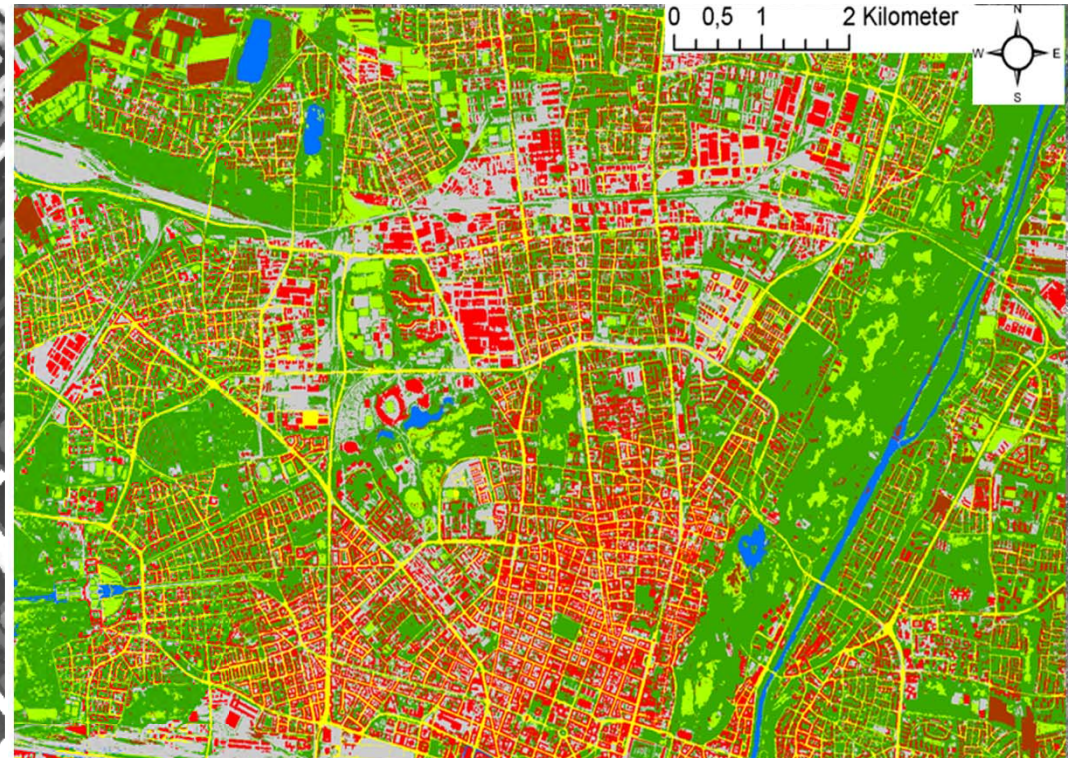
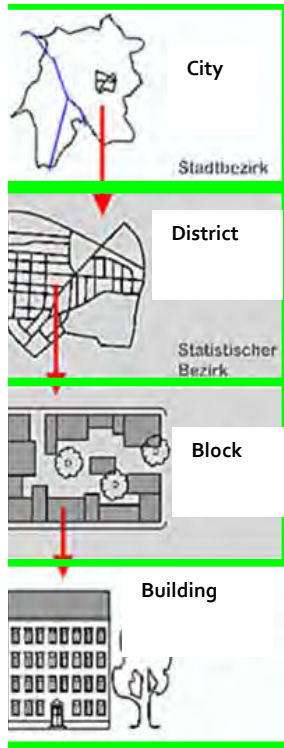


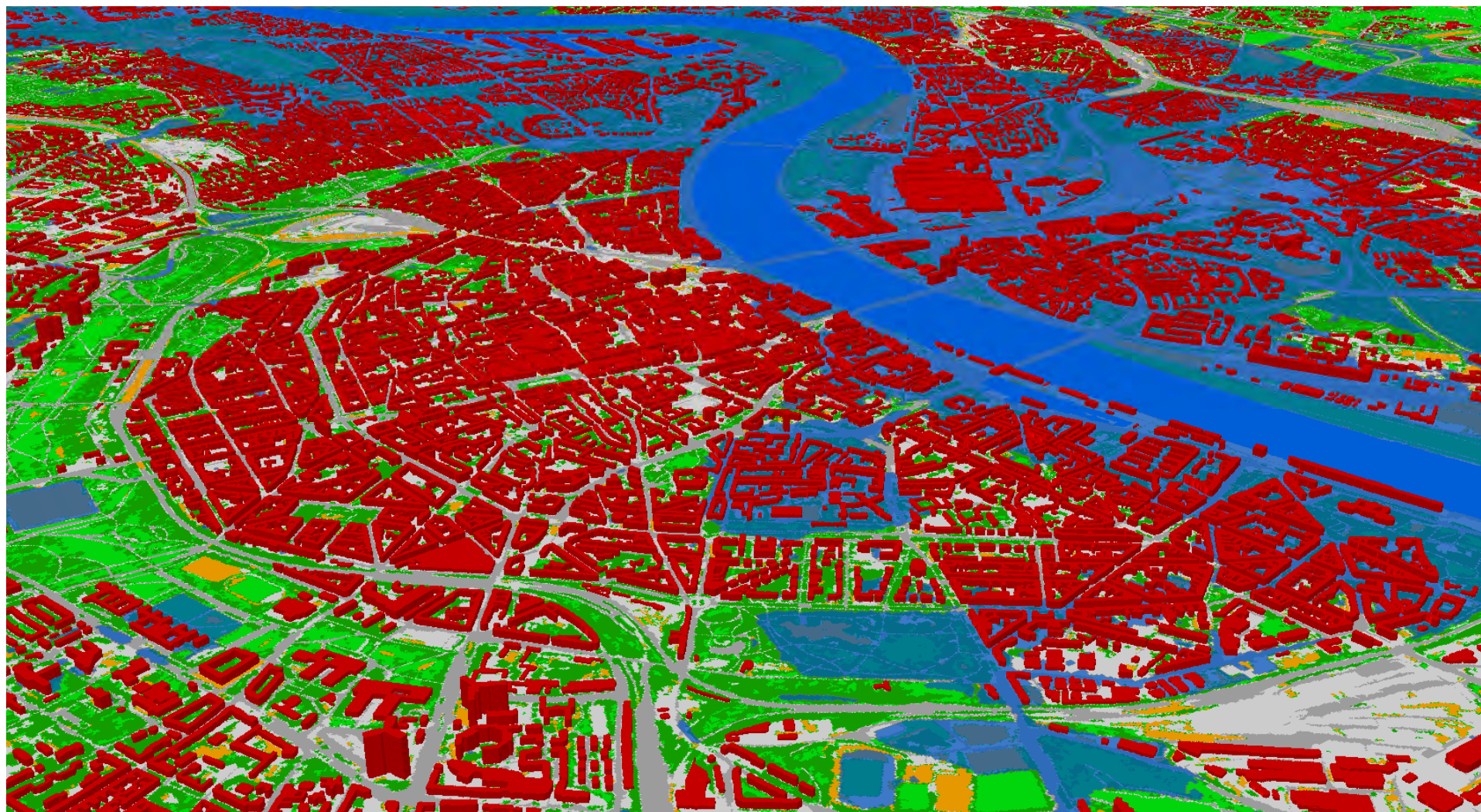
Manila, 2010





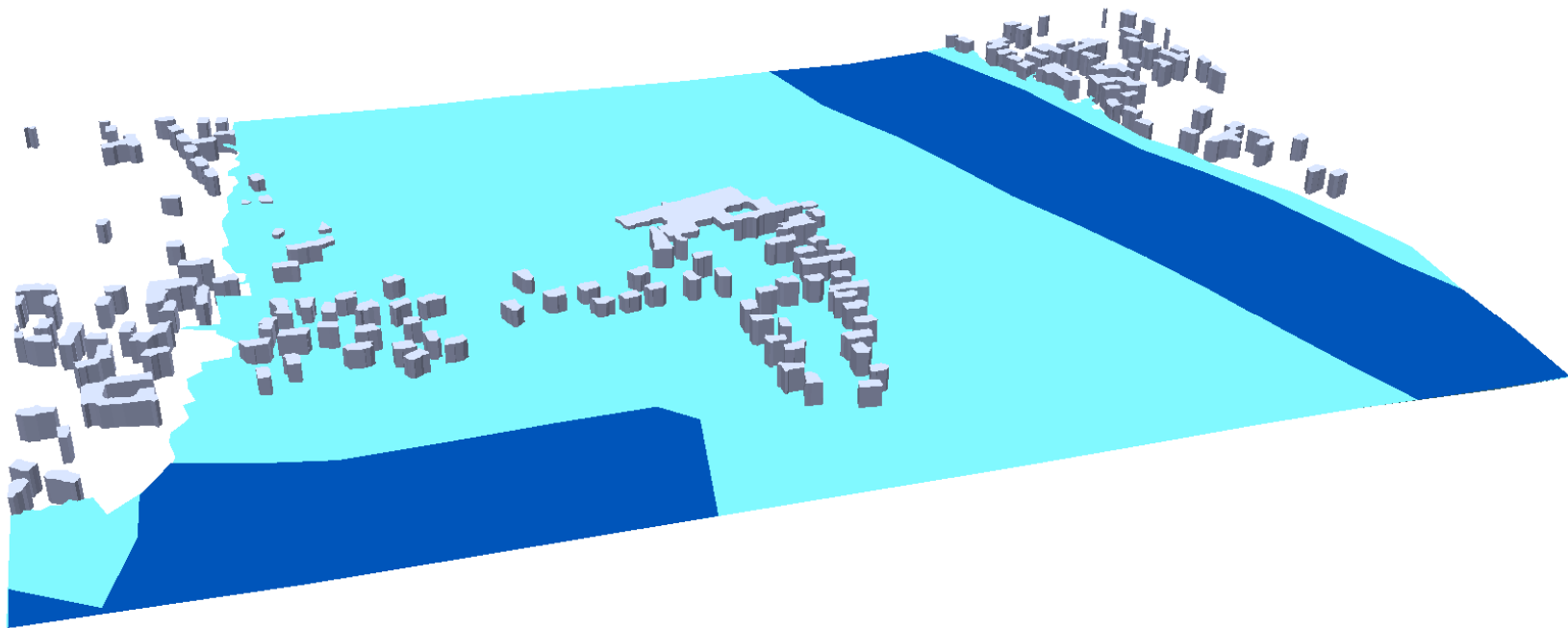
Mapping of urban areas from TerraSAR-X data (3m), Nairobi, Kenya





 Flood extent





Building	Number	Percentage
Sum	156	100,00%
< 100 m ²	7	4,5%
100 m ² – <250 m ²	17	10,9%
250 m ² – <500 m ²	122	78,2%
>500 m ²	10	6,4%

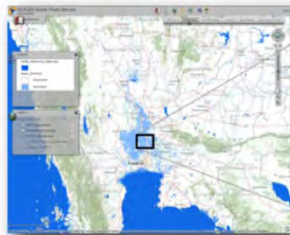
Rapid Flood Loss Estimation



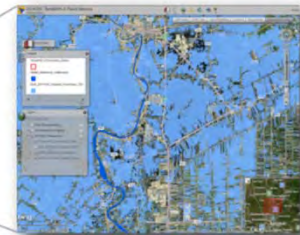
Sentinel-3



Sentinel-1

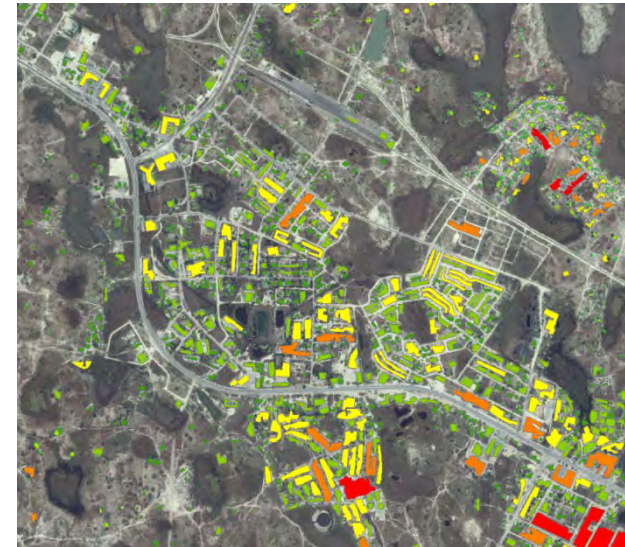


MODIS Flood Service



TerraSAR-X Flood Service

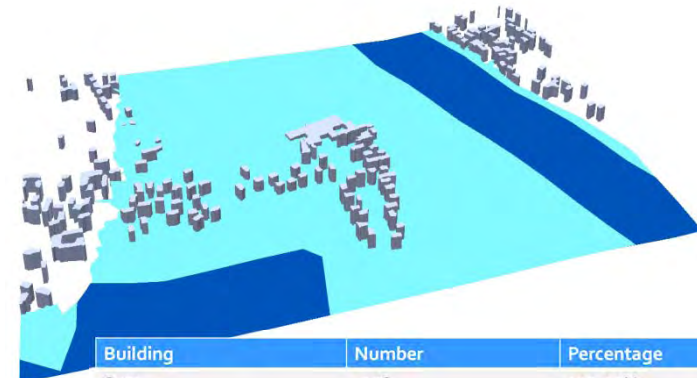
+



Building inventory / Population information



→



Building	Number	Percentage
Sum	156	100,00%
< 100 m ²	7	4,5%
100 m ² - <250 m ²	17	10,9%
250 m ² - <500 m ²	122	78,2%
>500 m ²	10	6,4%



Thank you very much for your attention!

Andre.Twele@dlr.de
Franz.Hummel@dlr.de

