



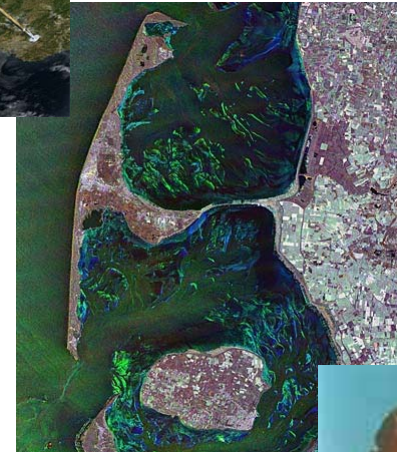
Extraction of Flood Masks Using Satellite Based Very High Resolution SAR Data For Flood Management And Modeling

Stefan Voigt, Sandro Martinis, Hendrik Zwenzner, Thomas Hahmann, André Twele and Tobias Schneiderhan

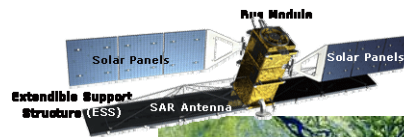
DLR – German Remote Sensing Data Center

A new sensor class – VHR SAR Imagery from Space

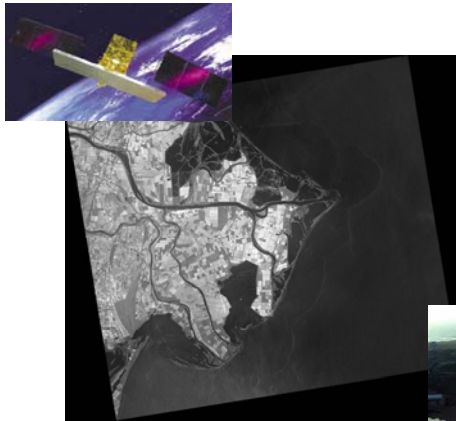
- TerraSAR – X
- Radarsat-2
- Cosmo-SkyMed



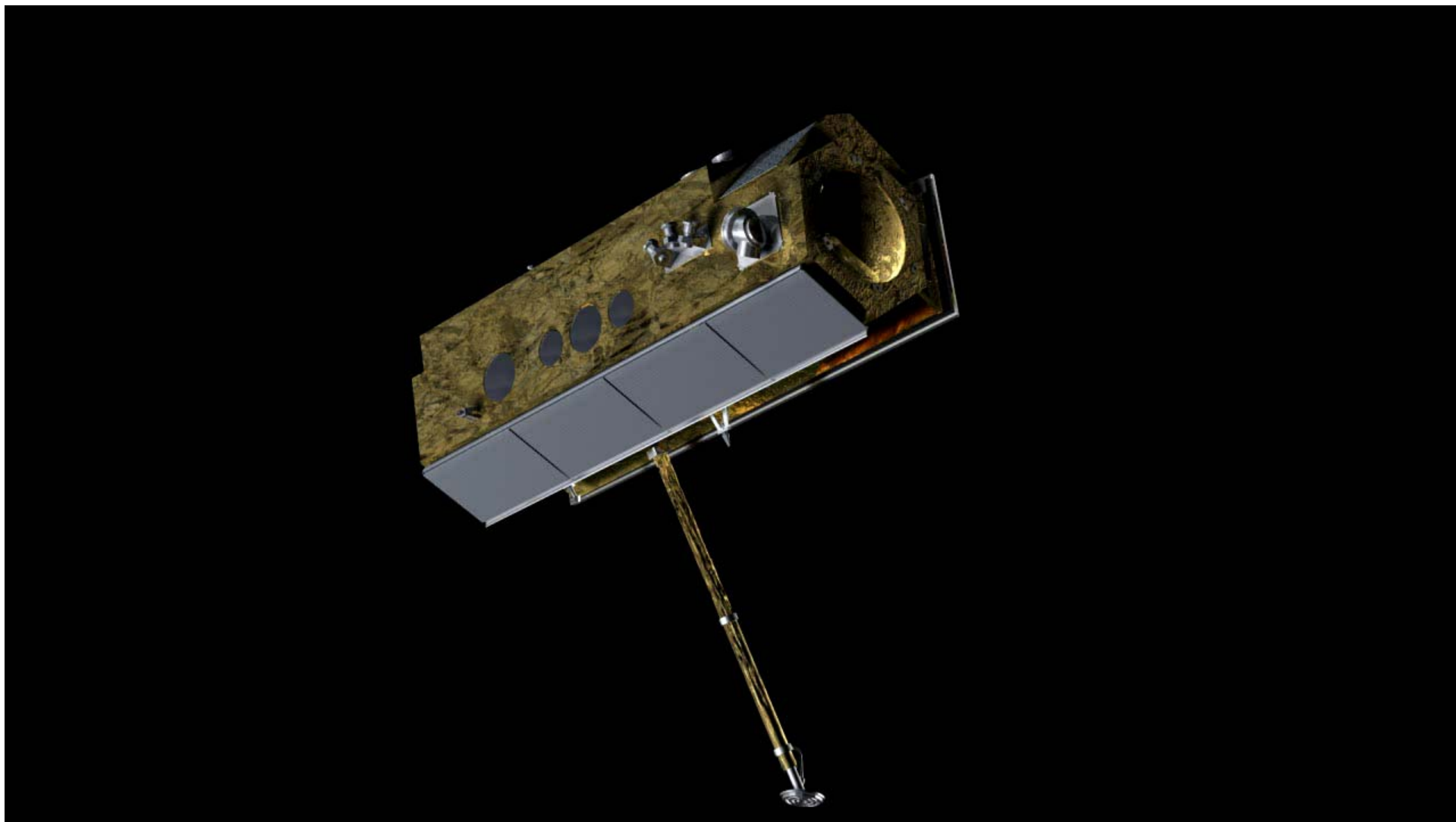
Source: <http://www.dlr.de>



Source: <http://www.radarsat2.info>



Source: <http://www.telespazio.it>



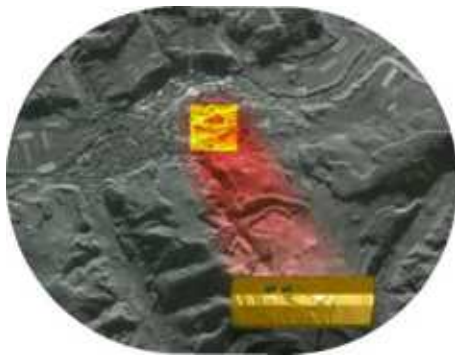
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in der Helmholtz-Gemeinschaft

www.zki.dlr.de



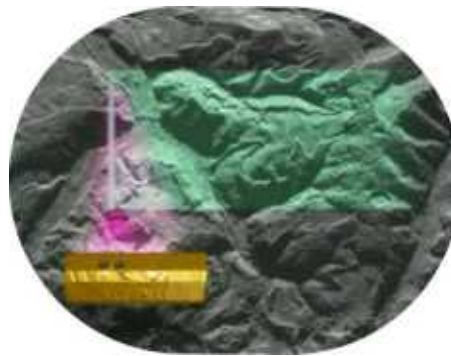
TerraSAR-X Data Modes

- Catalogue search and order service
- New acquisition (“future products”) order service



SpotLight Mode

Pix.Spacing: **1 m × 1,5 m ... 3,5 m**
Scene Size: **5 km...10 km × 10 km**
[Range × Azimuth]



StripMap Mode

Pix.Spacing: **3 m × 1,5 m ... 3,5 m**
Scene Size: **100 km × 30 km**
[Range × Azimuth]



ScanSAR Mode

Pix.Spacing: **16 m × 16 m**
Scene Size: **100 km × 100 km**
[Range × Azimuth]



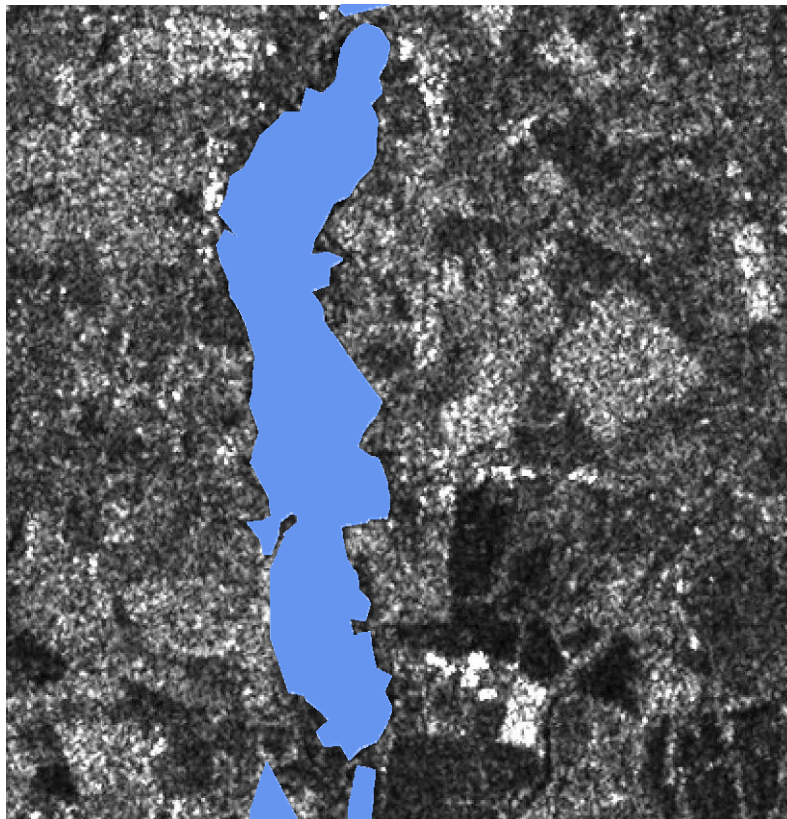
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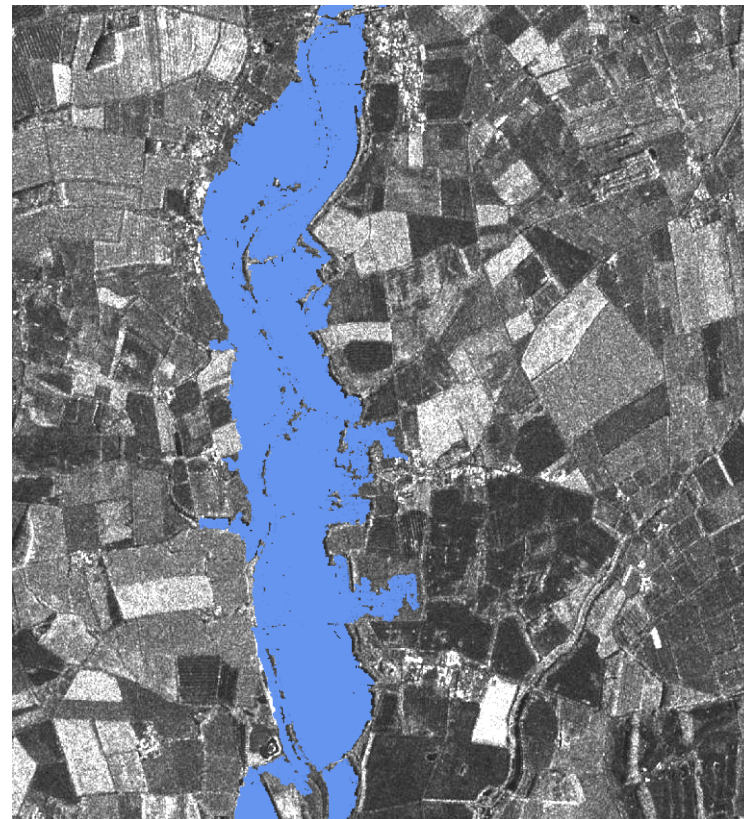
Comparison of flood masks from England, July 2007

RADARSAT-1



12,5 m

TerraSAR-X



pixel spacing

3m



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Aspects of Flood Mapping from SAR data

Verification

- topographic maps
 - airborne imagery
 - in-situ data
 - DEM

Scale

- temporal
- spatial

Classification Approach

- object- $\leftrightarrow$ pixel-based
- supervised/unsupervised
- thresholding
- snake/region growing algorithms

Water / Flood Features

- wind, roughness
- vegetation (double bounce)
- flood type (e.g. flash flood)

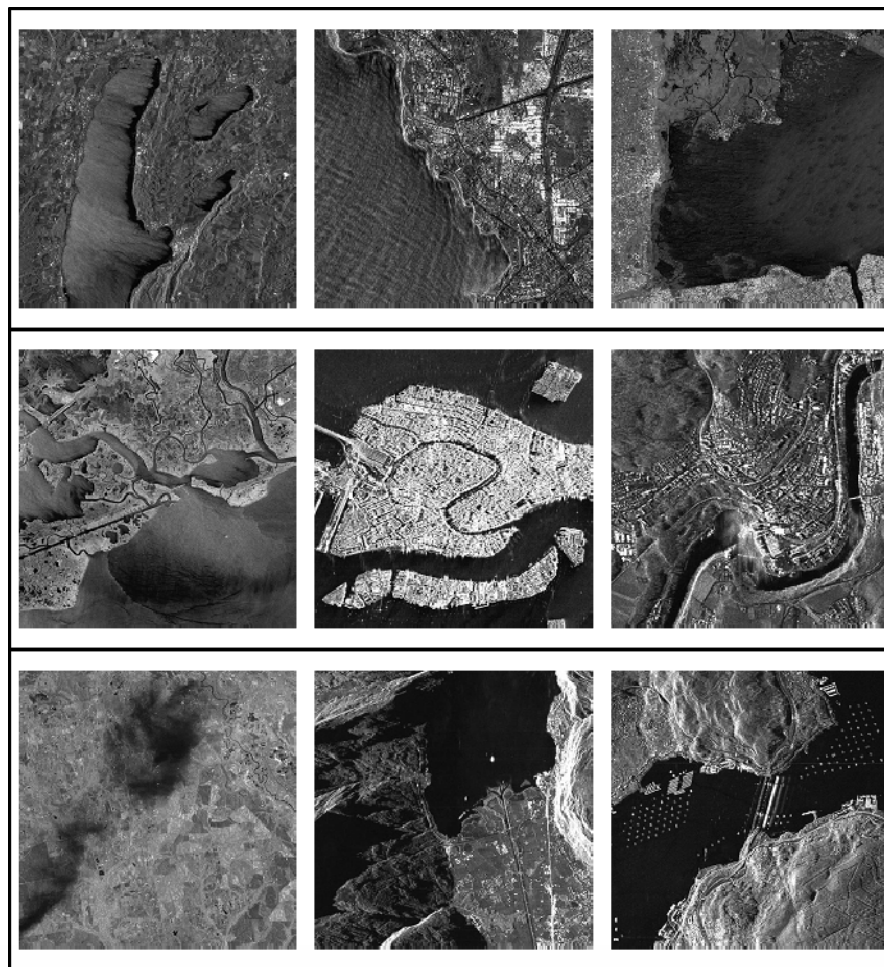
Sensor Parameters

- repetition rate
 - spatial resolution
 - incidence angle
 - wavelength
 - polarization





Water features in high resolution SAR Imagery





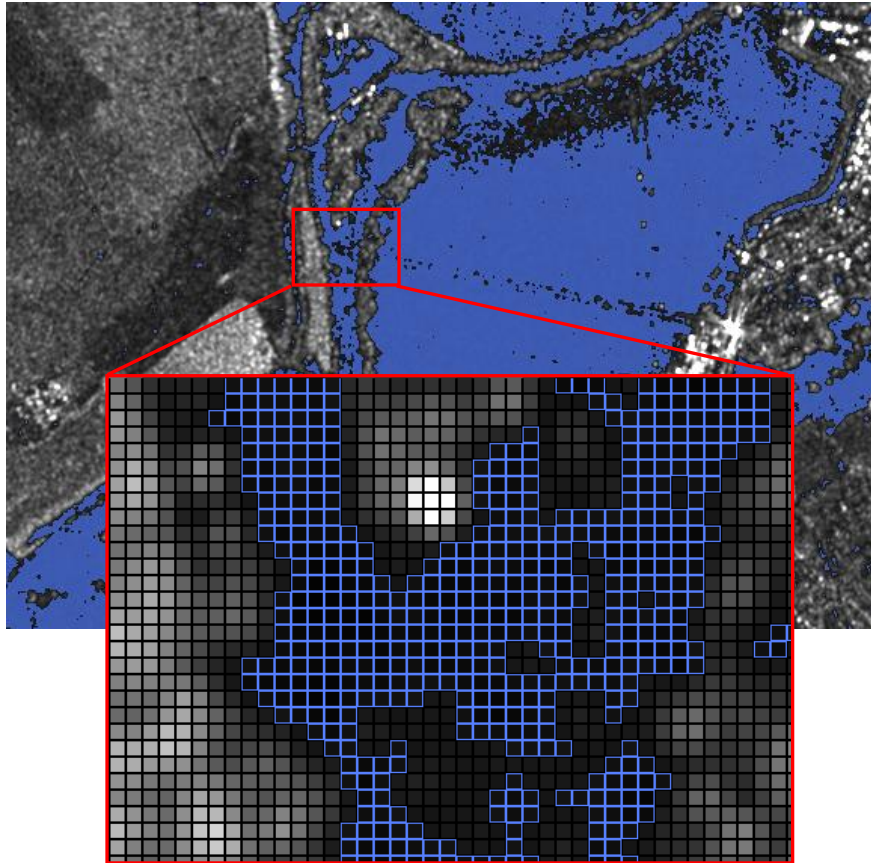
Flood at Black River Arkansas, Terra SAR-X



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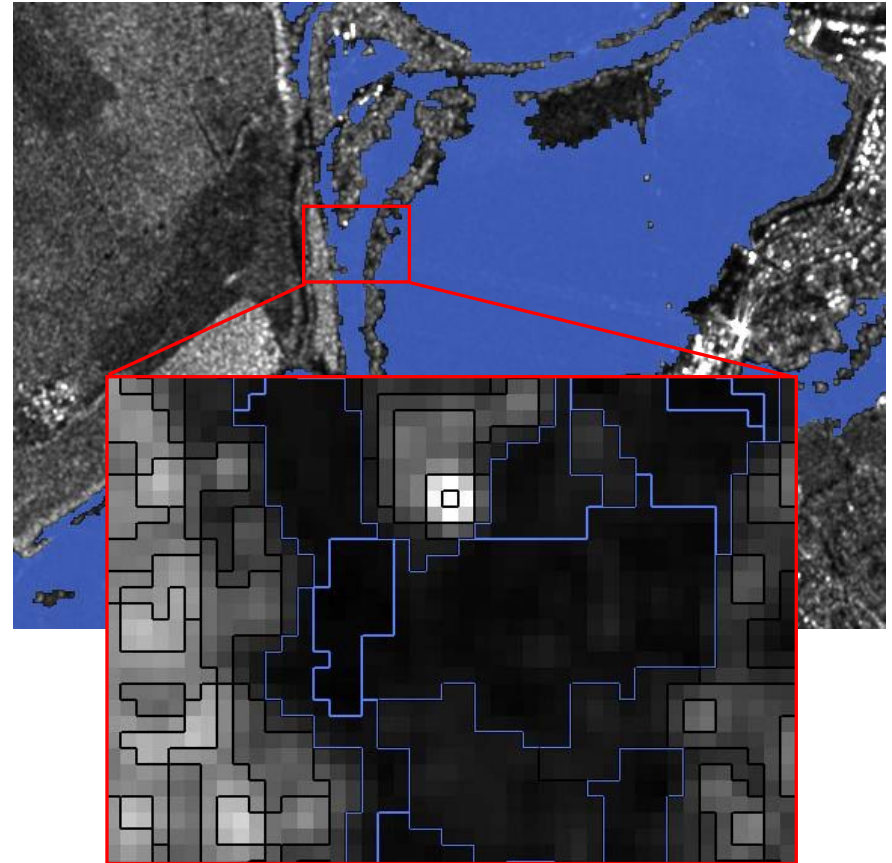
Pixel-based classification



Pixel-based classification parameters

- Brightness/Backscatter
- Texture (moving window)

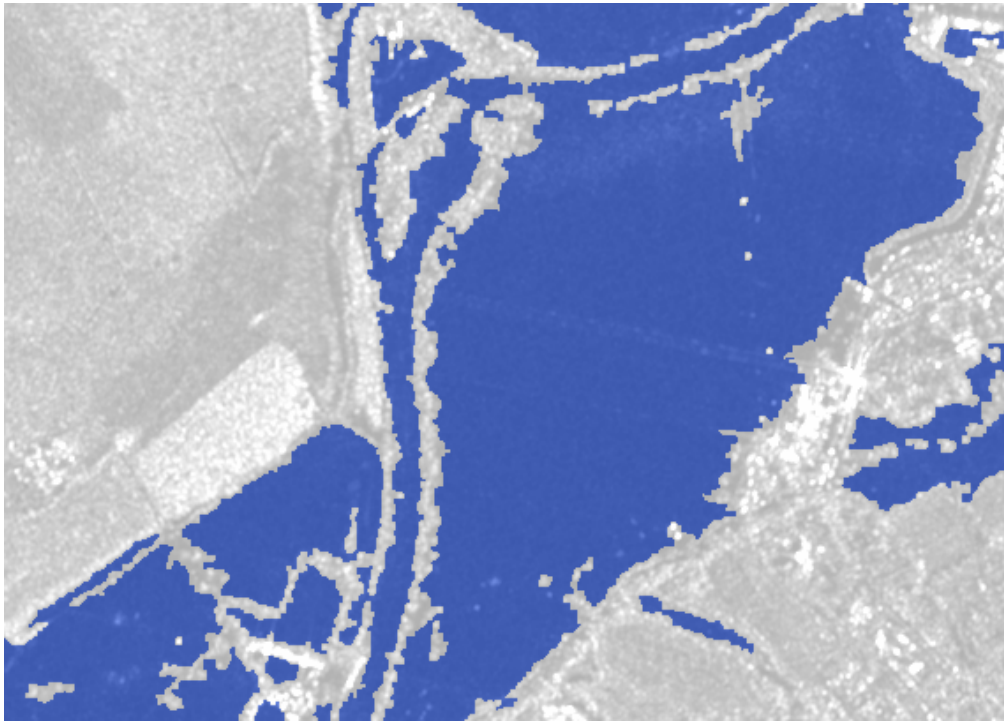
Object-based classification



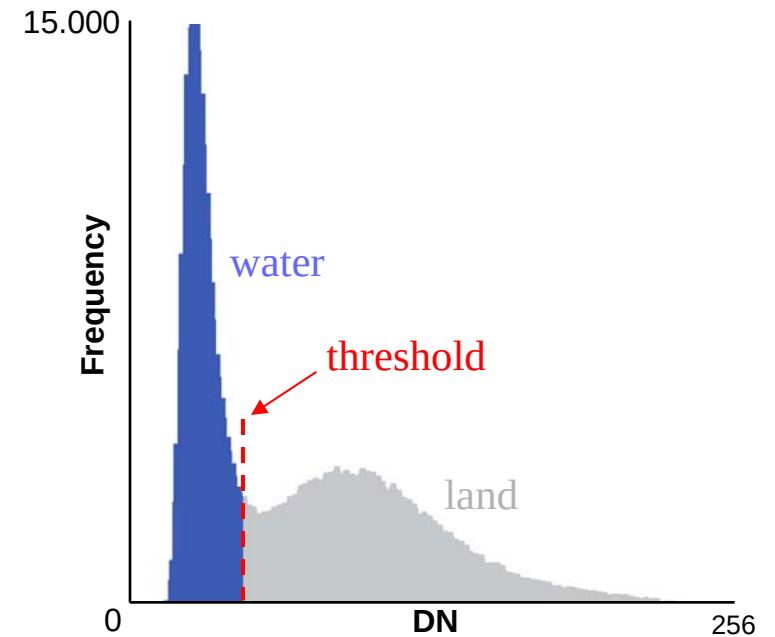
Object-based classification parameters

- Statistical properties (mean, std. dev., texture, etc.)
- Topology (Relation to neighboring objects)
- Shape/Size
- Object Hierarchy

Examples: Pixel based thresholding

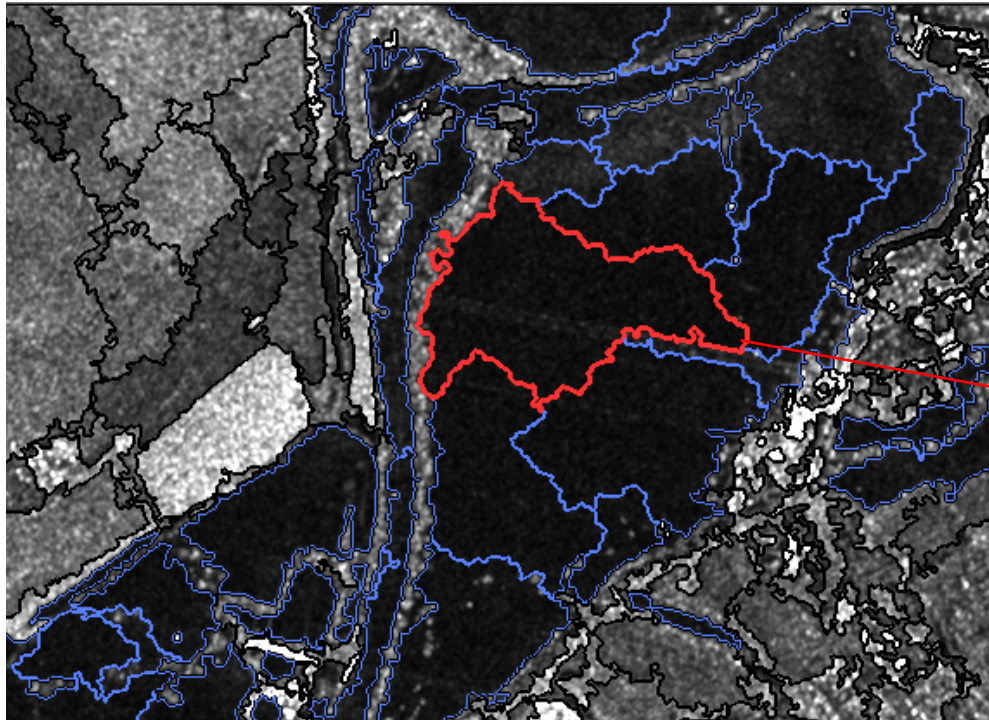


TerraSAR-X Stripmap scene



Grey level histogram

Examples: Segmentation based classification

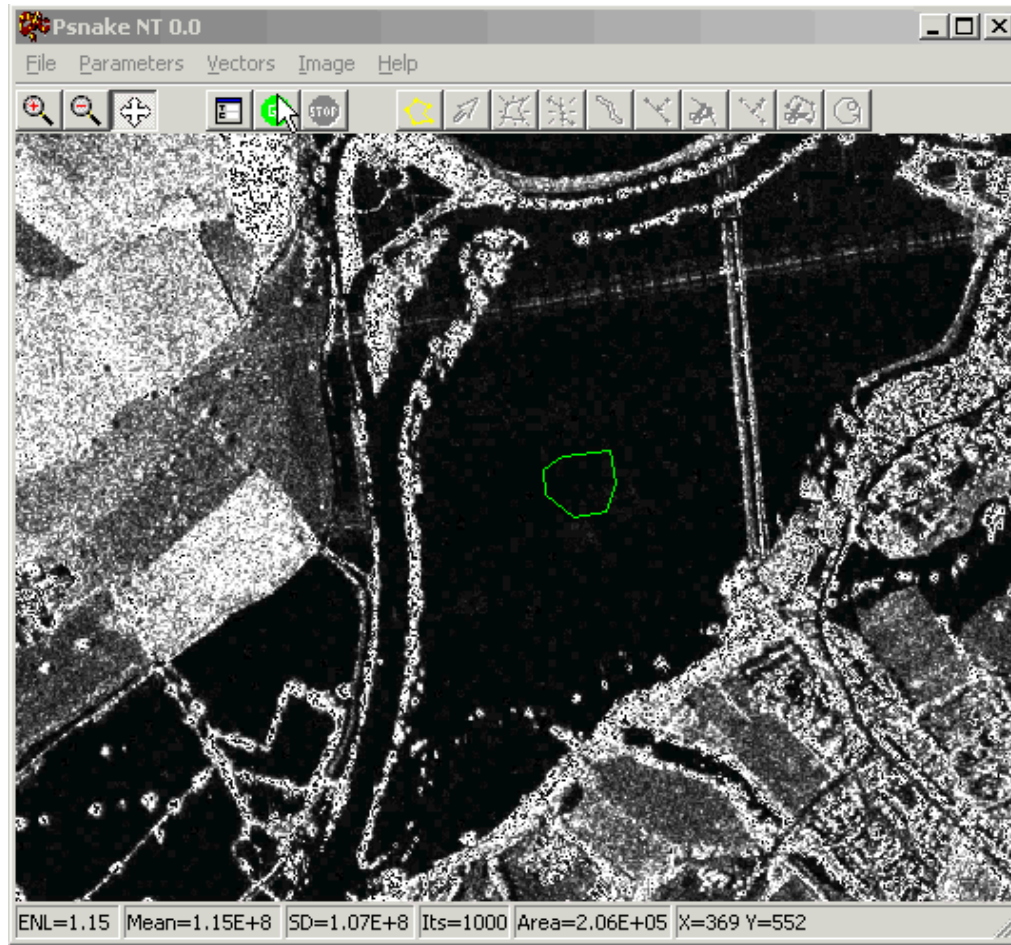


Object properties:

- Mean brightness: 12,3
- Standard deviation: 2,5
- Size: 12.800 m²
- Entropy: 4,1
- Common border to neighboring water objects: 643 pixels

Segmented TerraSAR-X Stripmap scene

Examples: Snake/Active contour algorithms

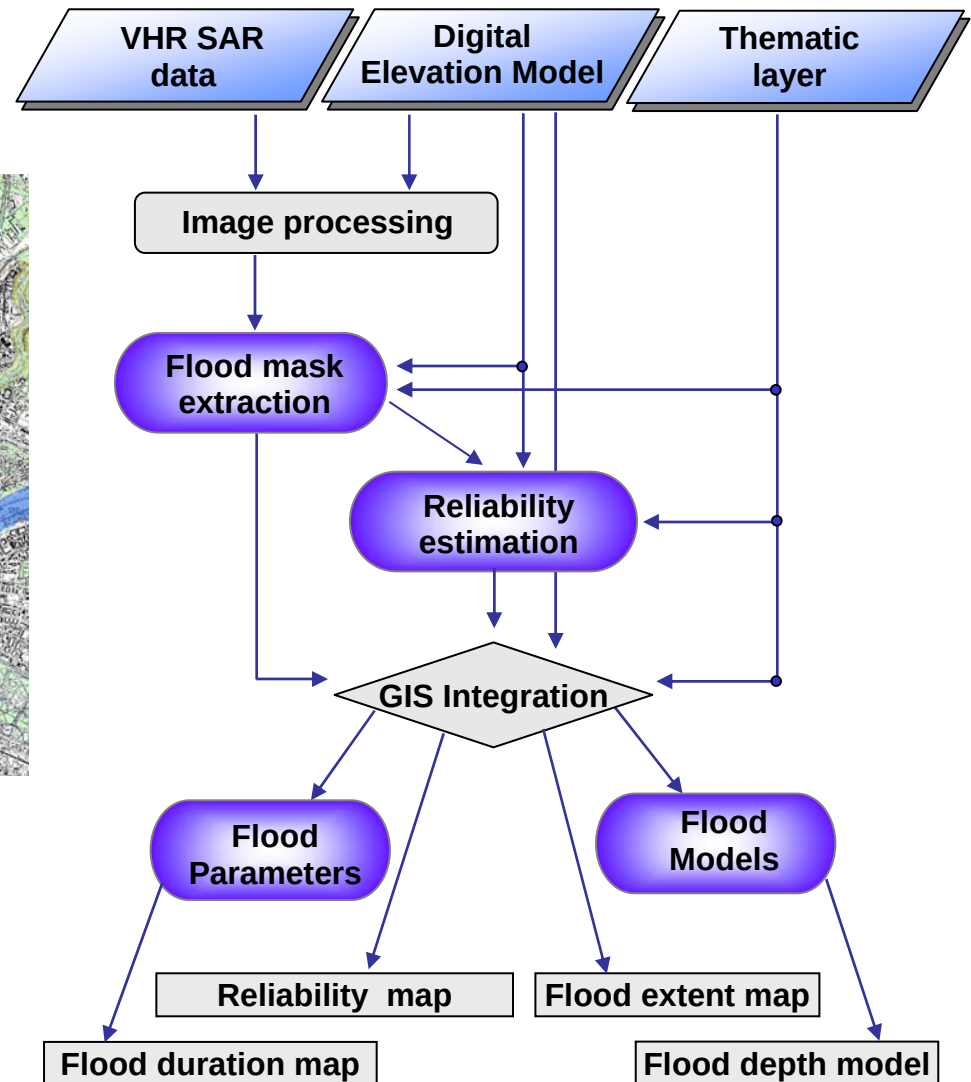
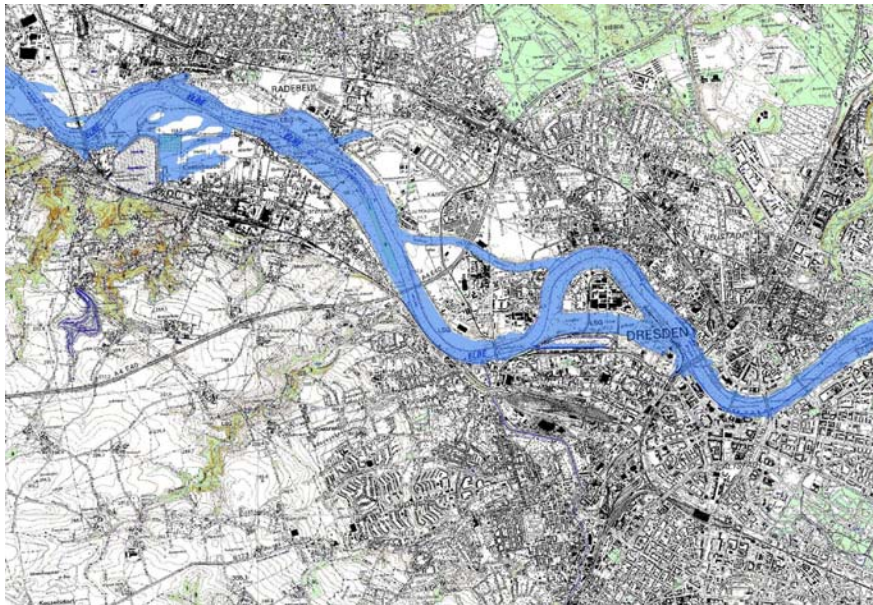


Snake algorithm courtesy of Dr. David Mason (University of Reading), Matthew S. Horritt and JRC-IES.

Horritt (1999) - Horrit, Mason & Luckman (2001):

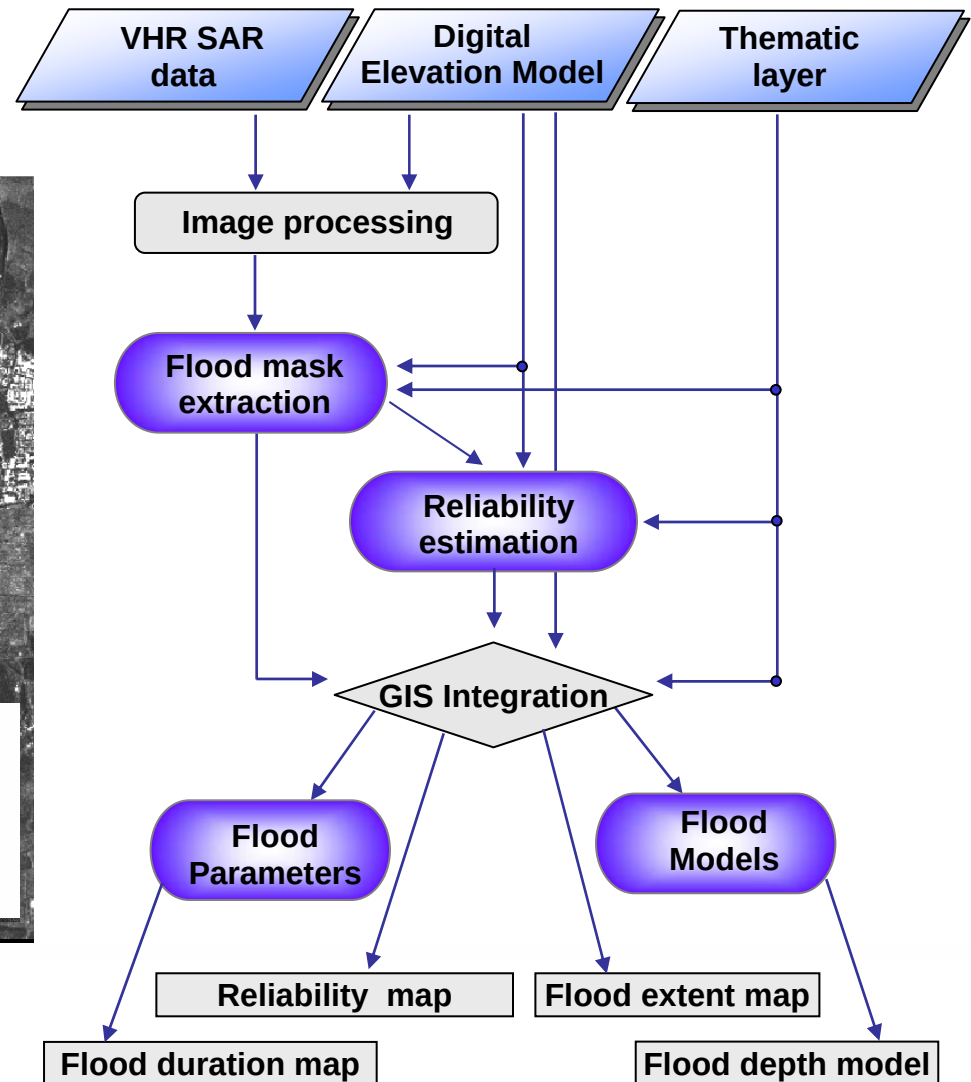
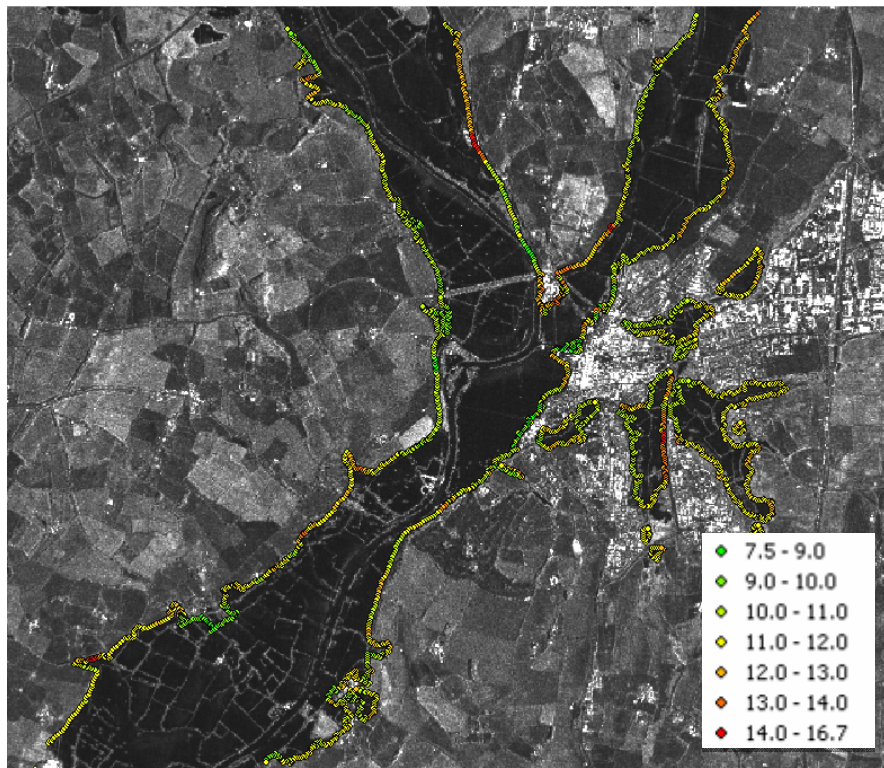
Combining flood masks with reference information

➤ Topographic map



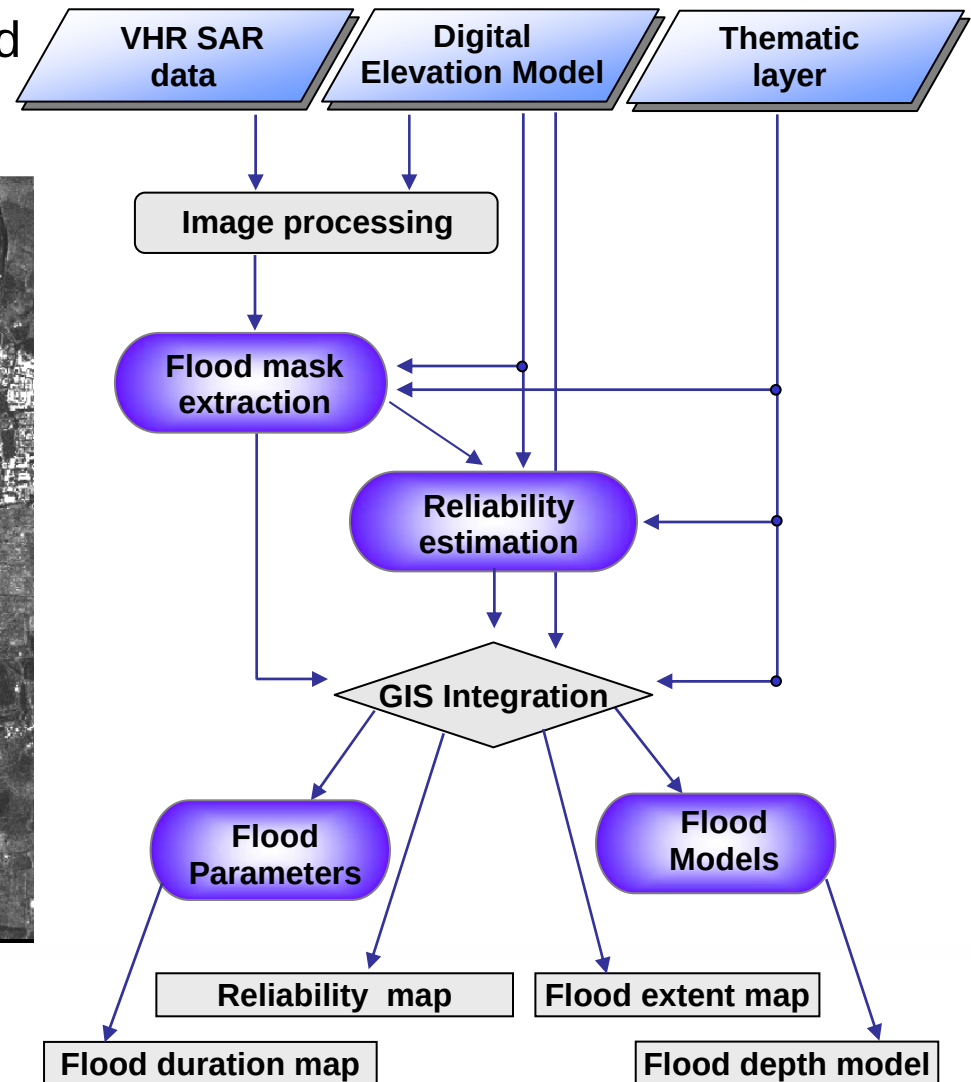
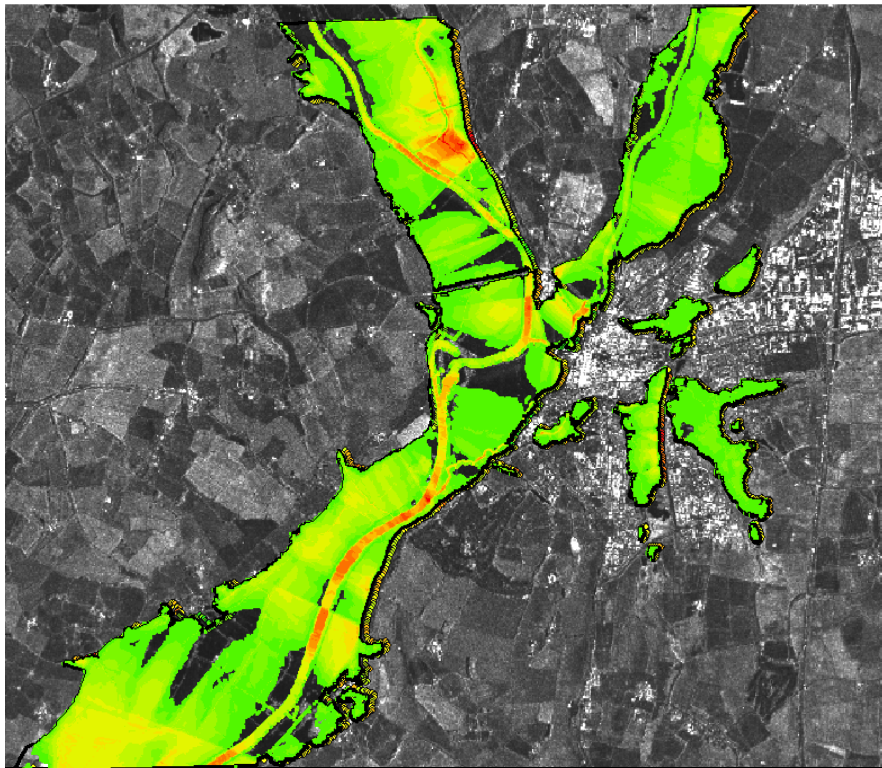
Combining flood masks with reference information

➤ Digital Elevation Model

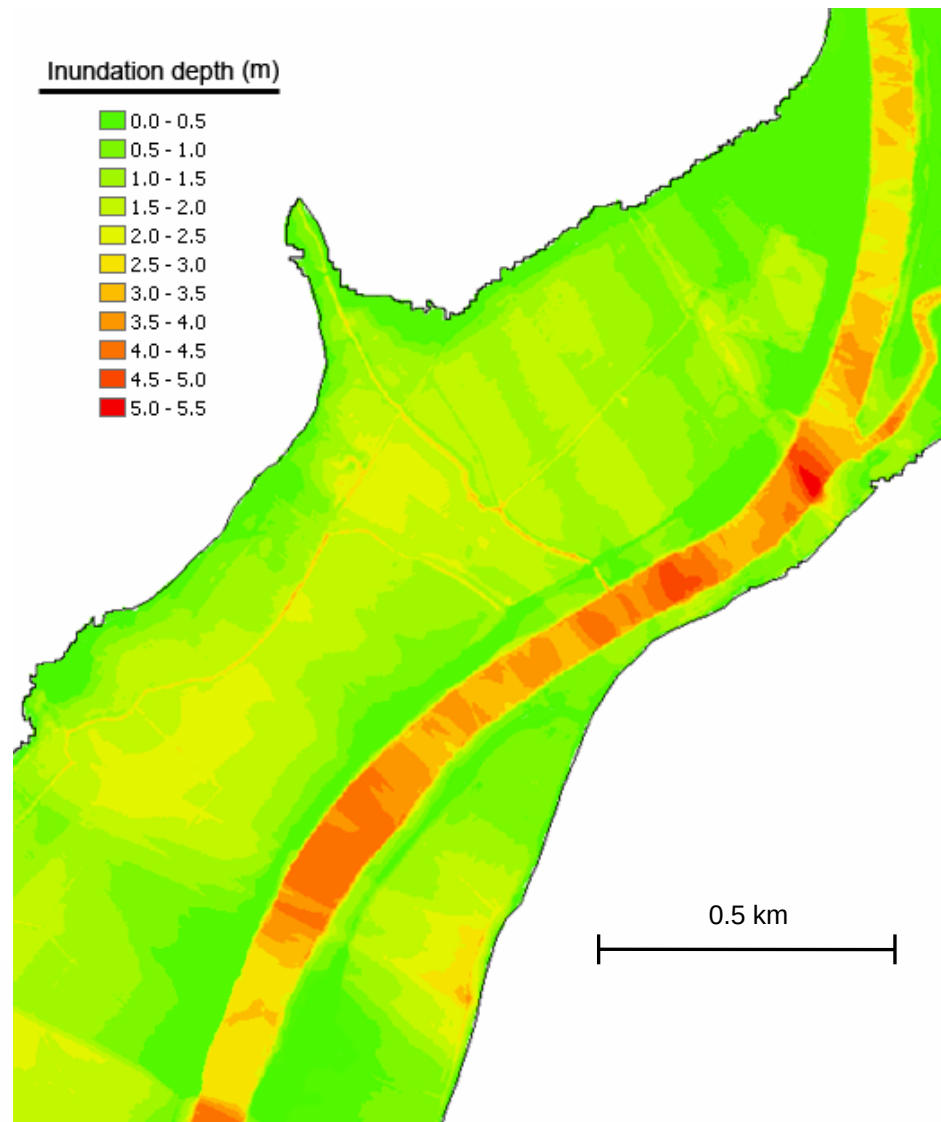


Modelling inundation depth

- by linking flood observation and river bed geometry

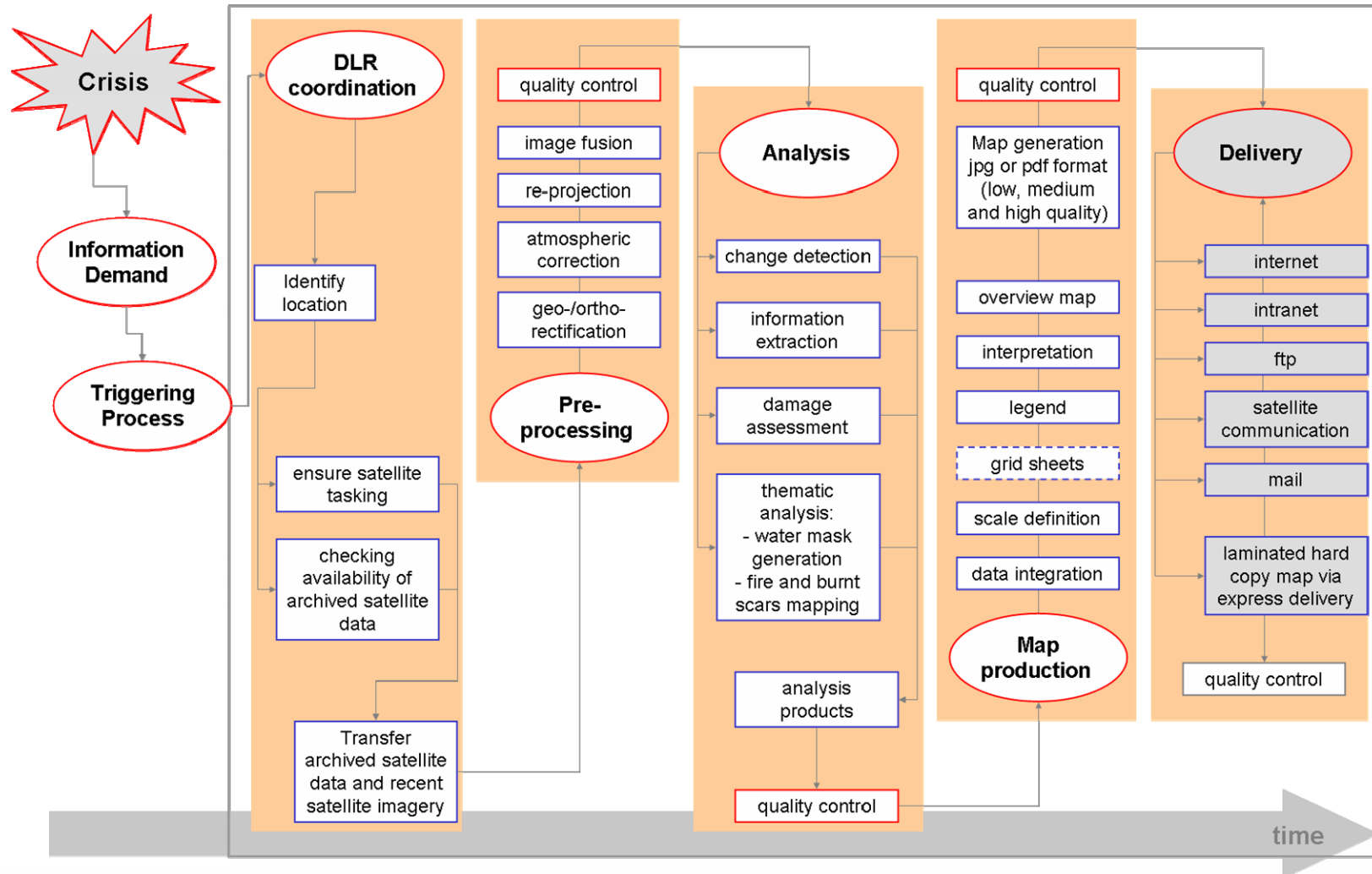


Modelling inundation depth

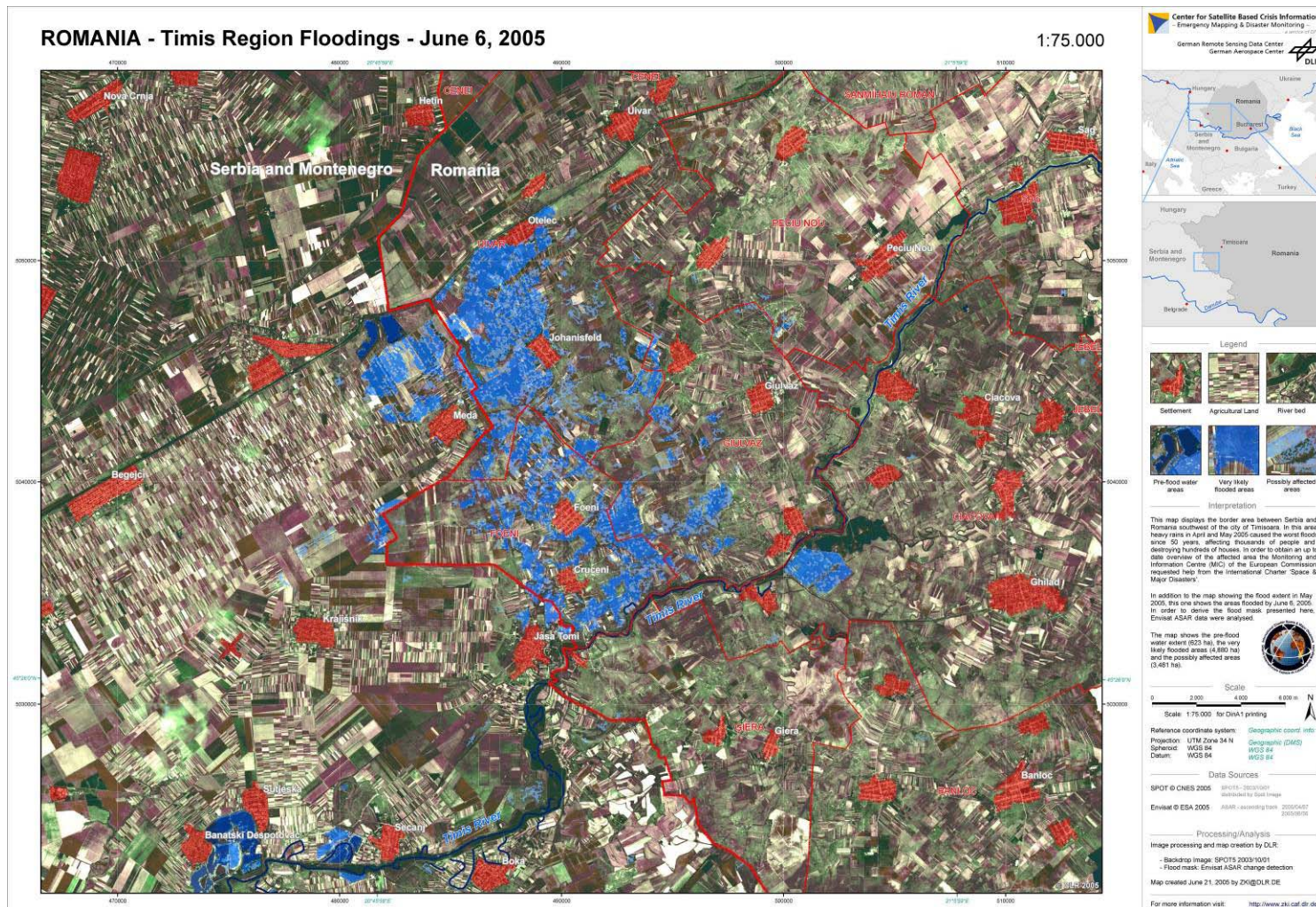




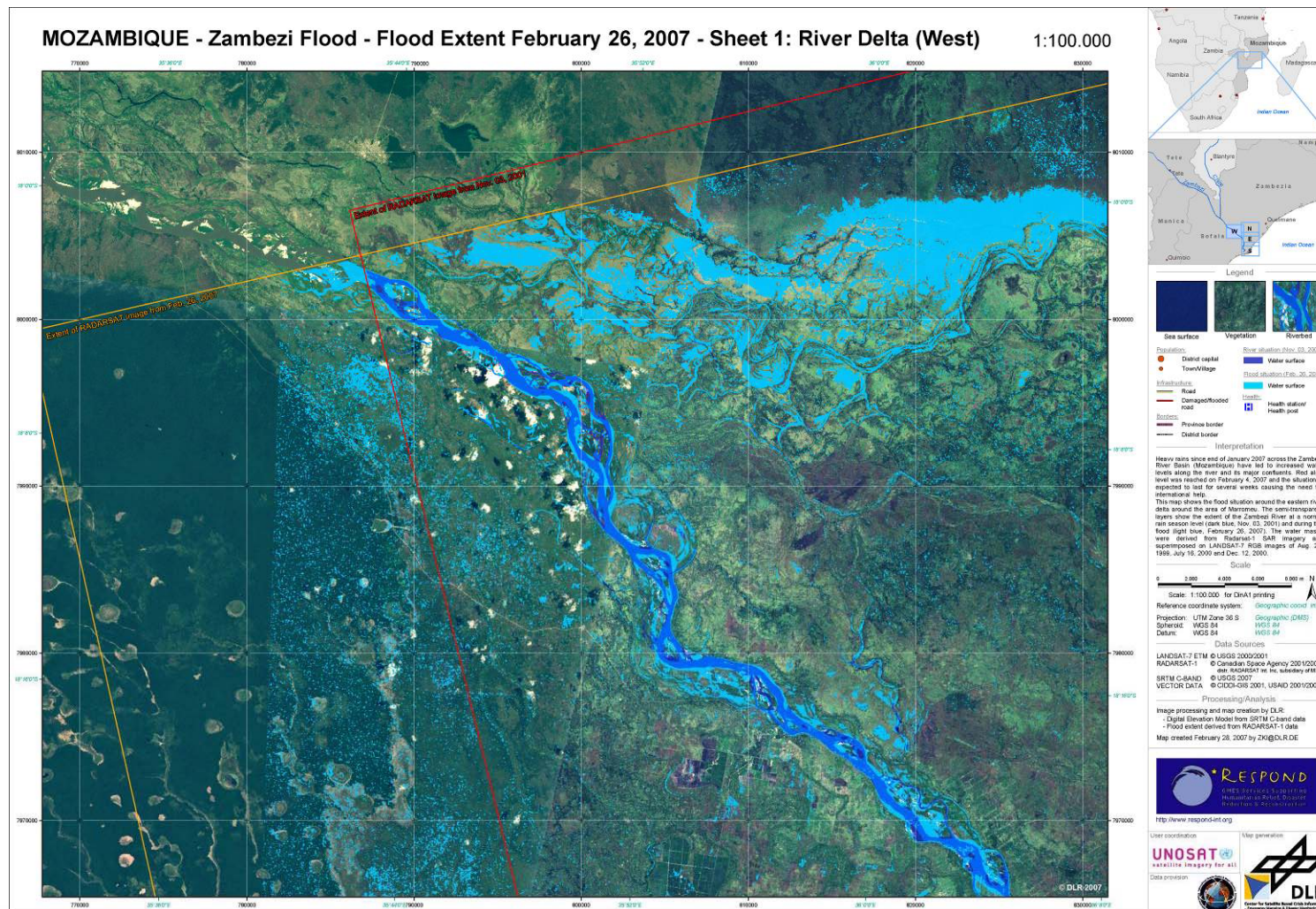
RAPID MAPPING Workflow



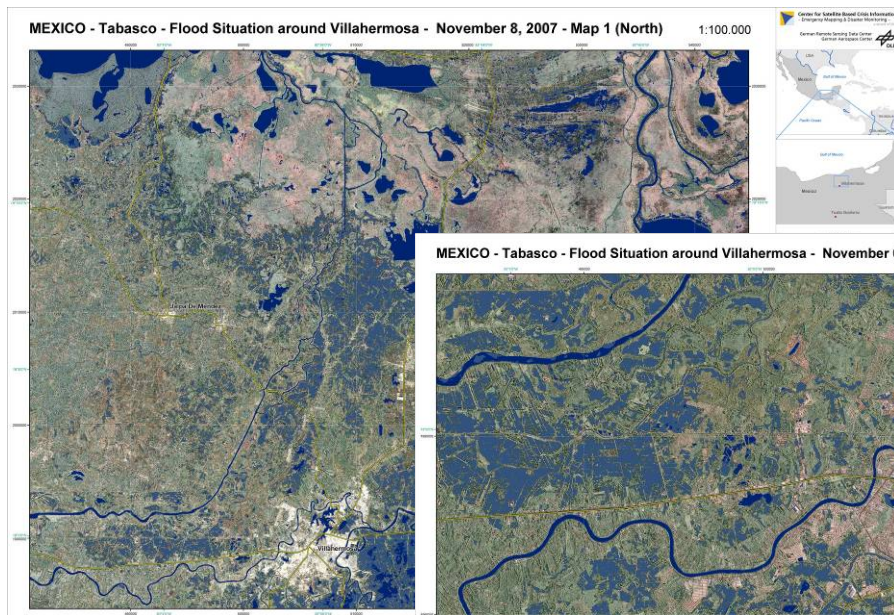
Flood map for Timis region/Romania, May 2005



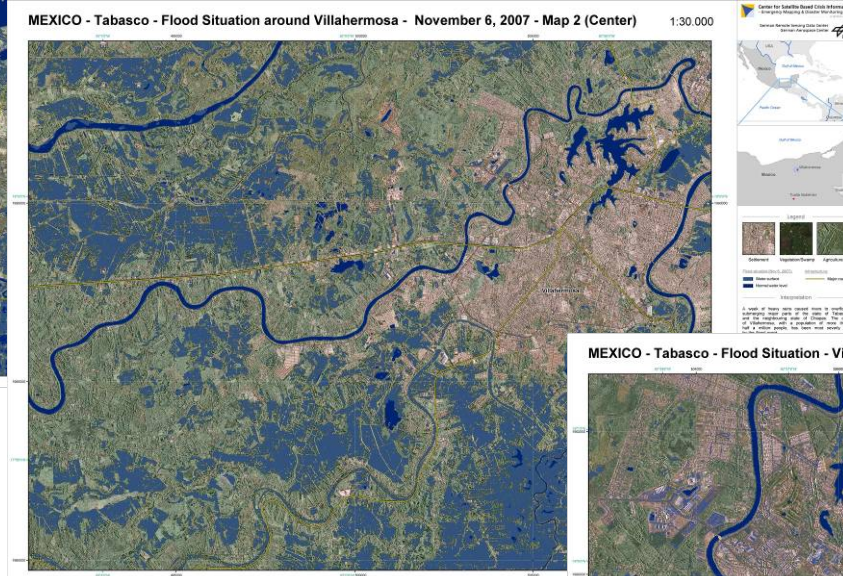
Zambezi flood Mozambique 2007



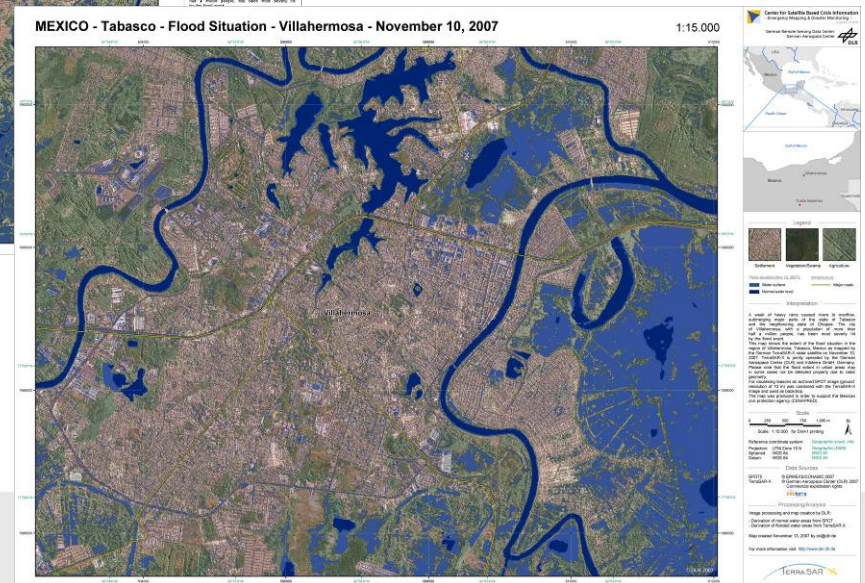
TSX mapping examples, Flood in Mexico, Nov 2007



➤ ScanSAR

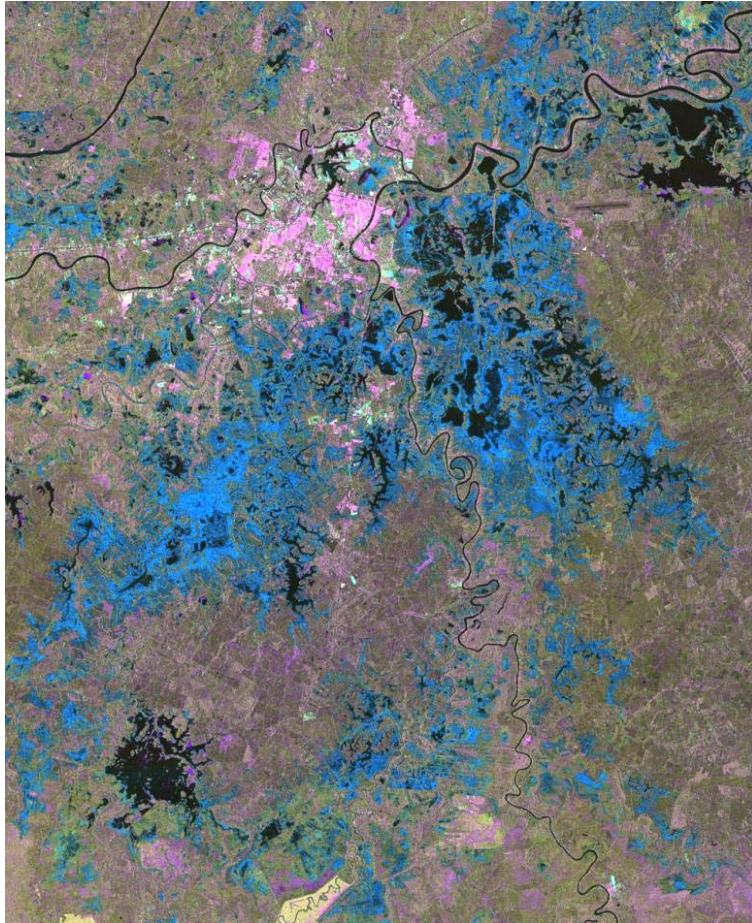


➤ Stripmap



➤ Spotlight

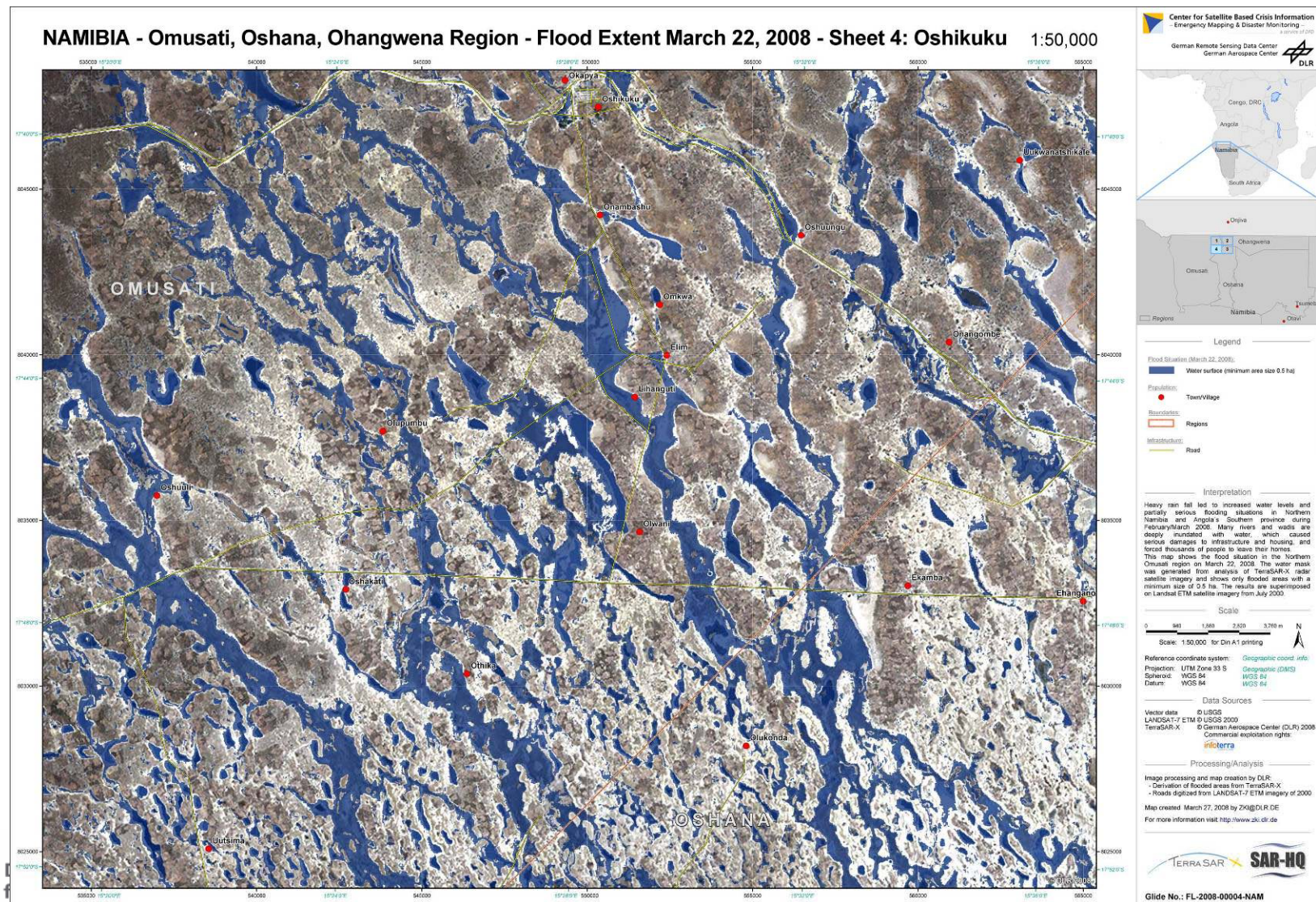
TSX mapping examples, Flood in Mexico, Nov 2007

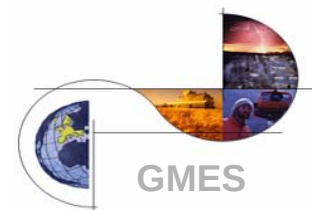


- Flood duration and temporal dynamic between 8.11. and 2.12. 2007
 - Blue: changes in flooded area
 - Black: inundated at both times

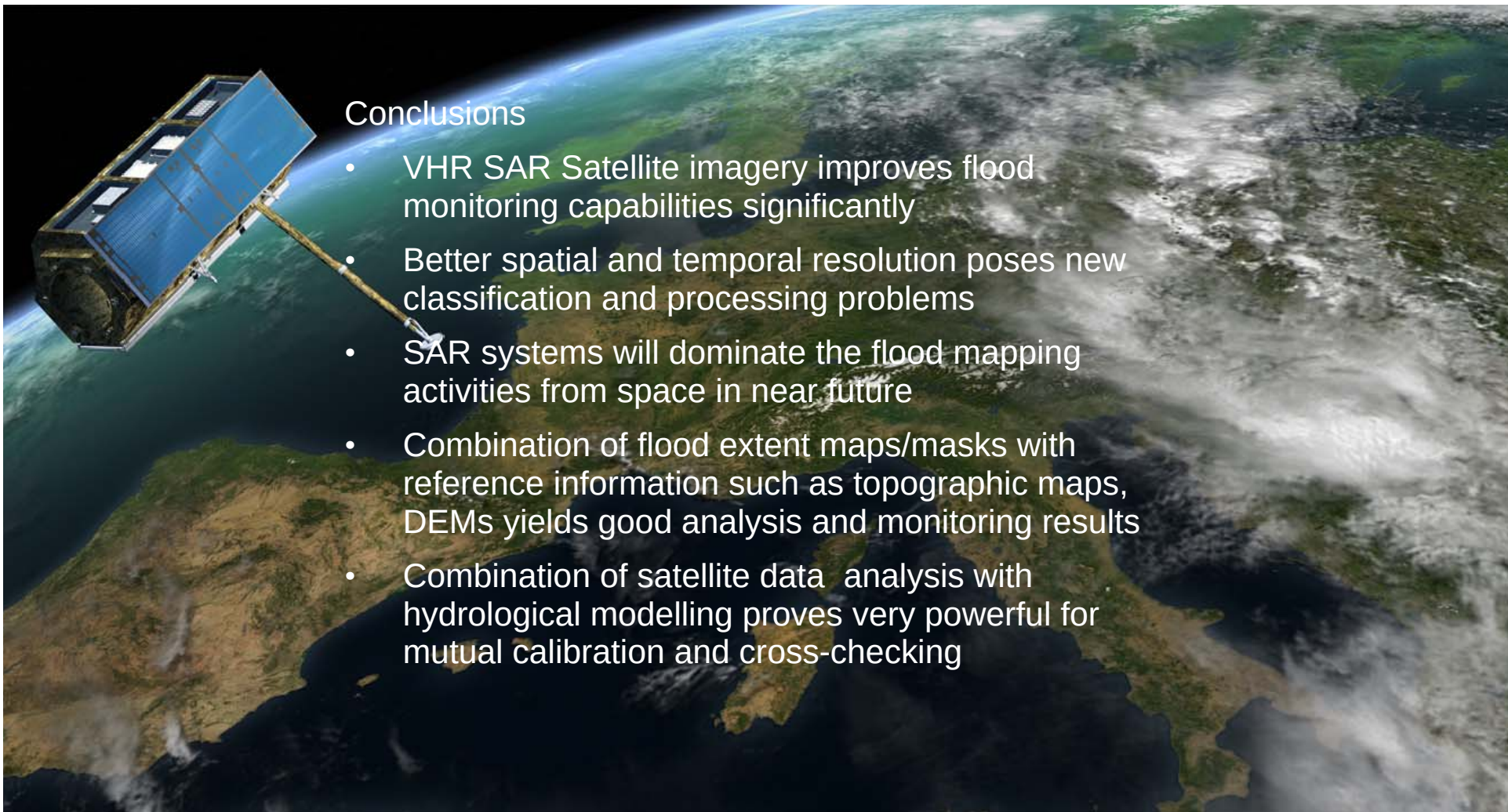
- Increased dynamic monitoring capacities with multiple high resolution SAR missions!

TSX mapping examples, Flood in Namibia, March 2008





Project activities and Acknowledgments



Conclusions

- VHR SAR Satellite imagery improves flood monitoring capabilities significantly
- Better spatial and temporal resolution poses new classification and processing problems
- SAR systems will dominate the flood mapping activities from space in near future
- Combination of flood extent maps/masks with reference information such as topographic maps, DEMs yields good analysis and monitoring results
- Combination of satellite data analysis with hydrological modelling proves very powerful for mutual calibration and cross-checking



DLR-ZKI Home Page - Mozilla Firefox

Datei Bearbeiten Ansicht Chronik Lesezeichen Extras Hilfe

[http://www.zki.caf.dlr.de/intro_en.html](#)

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Center for Satellite Based Crisis Information
- Emergency Mapping & Disaster Monitoring -

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- Flood in Namibia 2008
- Respond User Training 2008
- Oil spill in Antarctica 2007
- Cyclone 'Sidr' in Bangladesh 2007
- Oil pollution in the Black Sea 2007
- Demonstration of GITEWS DSS Prototyp
- GNEOX7 Exercise
- Fires in Southern Europe 2007
- Fires on the Canary Islands 2007
- Flood in the UK 2007
- TerraSAR-X data for flood in England
- G8 Summit Heiligendamm 2007
- Earthquake in Indonesia 2007
- Flood in Mozambique 2007
- GNEOX6 Exercise
- Environmental Assessment in Ivory Coast 2006
- Oil Spill in the Mediterranean 2006

Operational Services

- Fire Service
- Fire Service Statistics

ZKI Applications

- European
- International

ZKI Archive

- 2006
- 2005
- 2004
- 2003 and earlier

Projects
Partner area

Fertig

Center for Satellite Based Crisis Information
- Emergency Mapping & Disaster Monitoring -
a service of DFD

The "Center for Satellite Based Crisis Information" (ZKI) is a service of DLR's German Remote Sensing Data Center (DFD). Its function is the rapid acquisition, processing and analysis of satellite data and the provision of satellite-based information products on natural and environmental disasters, for humanitarian relief activities, as well as in the context of civil security. [more ...](#)

This page as [RSS 2.0 Newsfeed](#)

Floods in Namibia
March 17, 2008
In January and February, 2008, heavy and long lasting rain fall led to partially serious flooding in Northern Namibia and Southern Angola. Many rivers and wadis were deeply inundated with water, which has caused serious damages to infrastructure and housing, and forced thousands of people to leave their homes. [more ...](#)

Invitation to all users and potential users of Respond maps and information
March 11, 2008
In the frame of the GMES initiative Respond, DLR invites the humanitarian actors with interest in geo-information to a technical user training at DLR premises Oberpfaffenhofen, Germany, on May 28th - 29th, 2008. [more ...](#)

Oil spill in Antarctica from sunken ship MV Explorer
December 20, 2007
On November 23, the MV Explorer, an ad... hit an iceberg whilst passing through pack ice in the Bransfield Strait about 50 nautical miles south of King George Island, Antarctica. [more ...](#)

ZKI produces maps of affected regions after tropical cyclone 'Sidr' in Bangladesh
November 21, 2007
During the nights of 15 and 16, 2007, tropical cyclone 'Sidr' swept over the the southwestern part of Bangladesh, leaving behind a trail of destruction. With wind speeds of up to 240 km/hr at the coast and up to 160 km/hr at the capital Dhaka, Sidr forced three million people to flee from their homes in 15 coastal districts of Bangladesh. [more ...](#)

Oil spill at the Kerch Strait between Ukraine and Russia
November 21, 2007
A storm on Sunday, 11 November, broke a small Russian oil tanker, the Volgoneft-139, in half spilling at least 1,300 tonnes of fuel oil in the Kerch strait between the Black Sea and the Sea of Azov. The same storm sank at least four freighters, three carrying sulphur and one with a cargo of scrap metal. On the shore near port Kavkaz, the environmental consequences of the heavy oil spill are disastrous. [more ...](#)

ZKI maps flooding in Mexico with high-resolution radar satellite TerraSAR-X
November 7, 2007 - updated on November 9, 2007
In early November, heavy rainfalls lasting for a whole week led to devastating floods in the Mexican states of Tabasco and Chiapas, displacing about one million people and approximately half of Tabasco's overall population. About 80% of the state of Tabasco's surface (overall area: 25,000 km²) has been temporarily flooded. The region around the city of Villahermosa with its population of approx. 600.000 was hit most by the floods. [more ...](#)

ZKI activations

more ...

ELBE 2006
Flooding in Germany

Dresden - Post-Disaster
Source: IRS-P6/LISS III

more ...

Risk-EOS
Int. Charter (cc116)

TSUNAMI 2004
Damages of flood wave in Indonesia

B. Aceh - Pre-Disaster

For more information visit: www.zki.dlr.de