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

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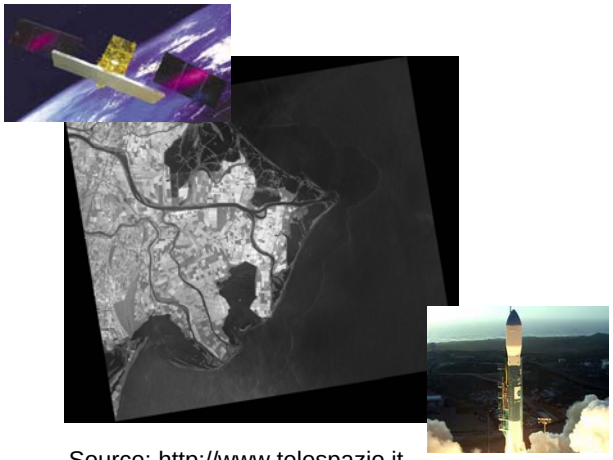
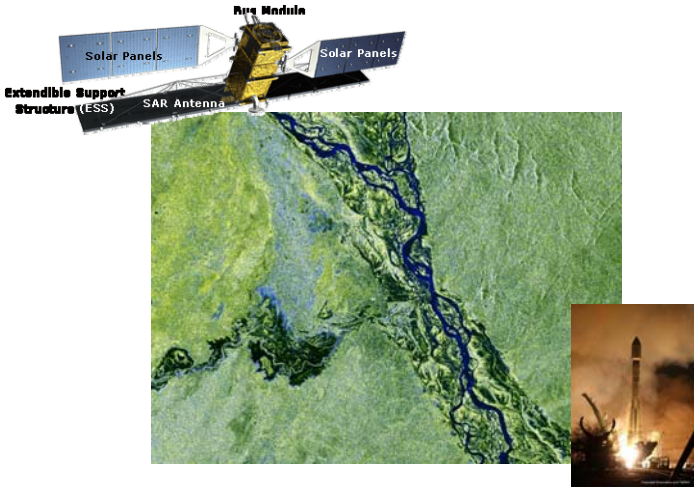
in der Helmholtz-Gemeinschaft

A new sensor class – VHR SAR Imagery from Space

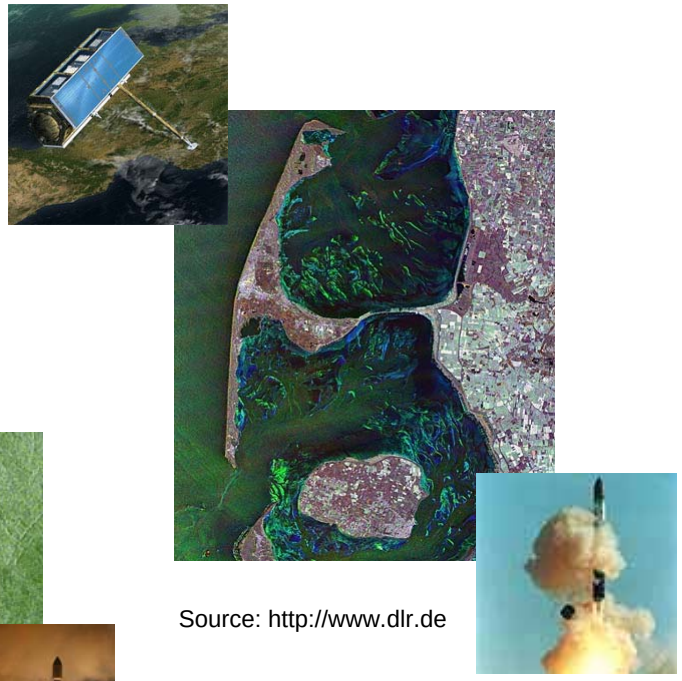
- TerraSAR – X
- Radarsat-2
- Cosmo-SkyMed



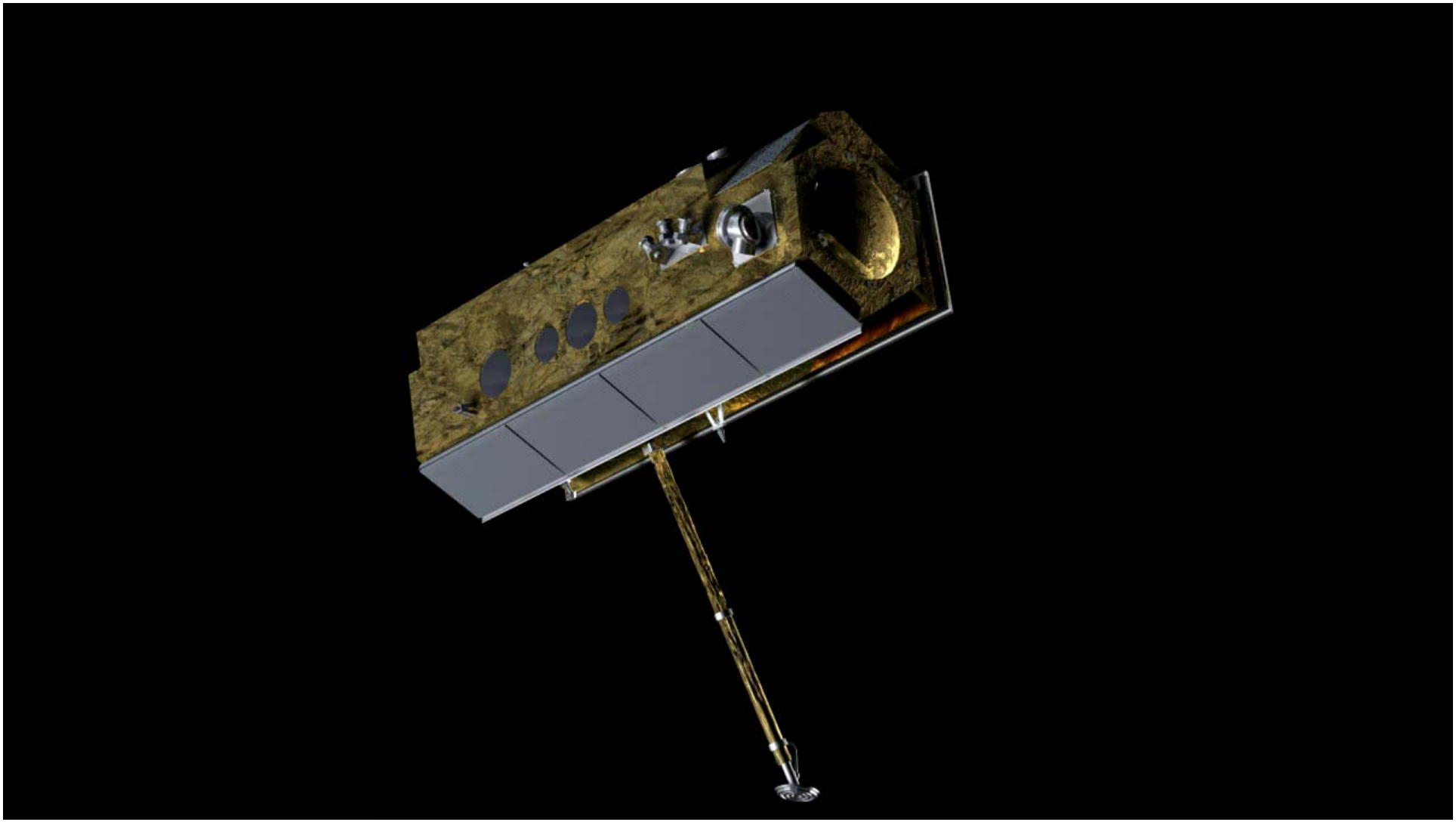
Source: http://www.telespazio.it



Source: http://www.radarsat2.info

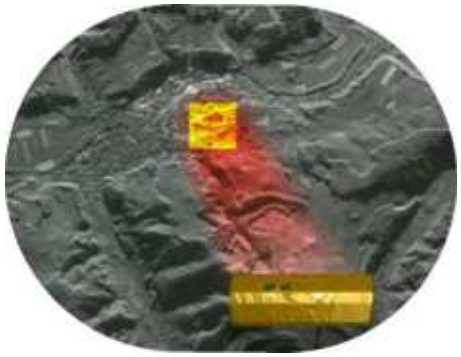


Source: http://www.dlr.de



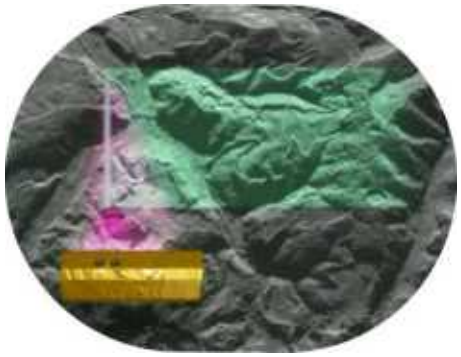
TerraSAR-X Data Modes

- 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

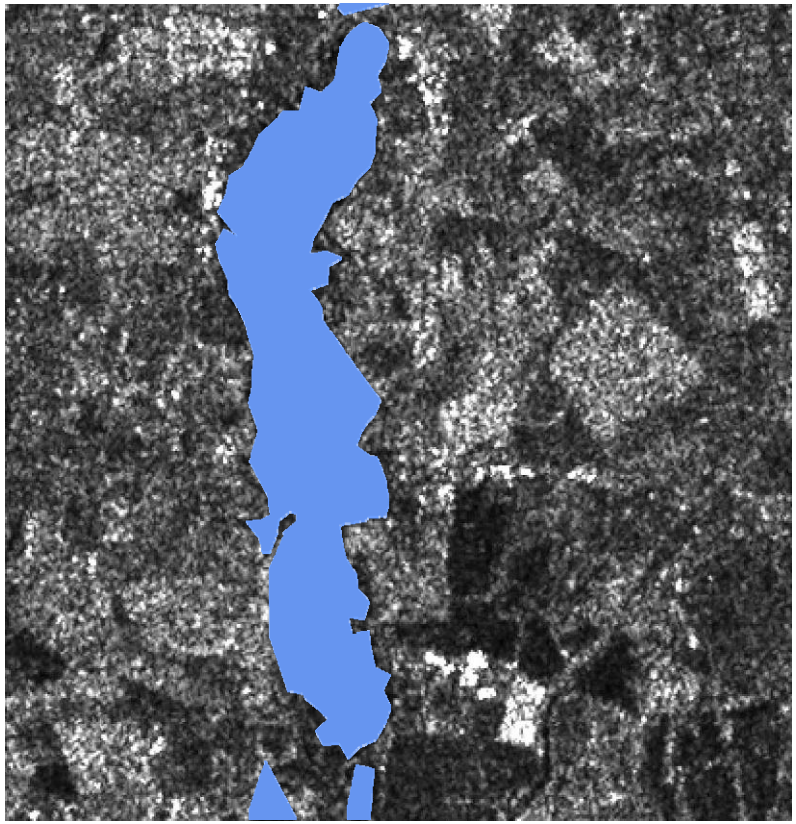
Pix.Spacing: 3 m × 1,5 m ... 3,5 m
Scene Size: 100 km × 30 km
[Range × Azimuth]

ScanSAR Mode

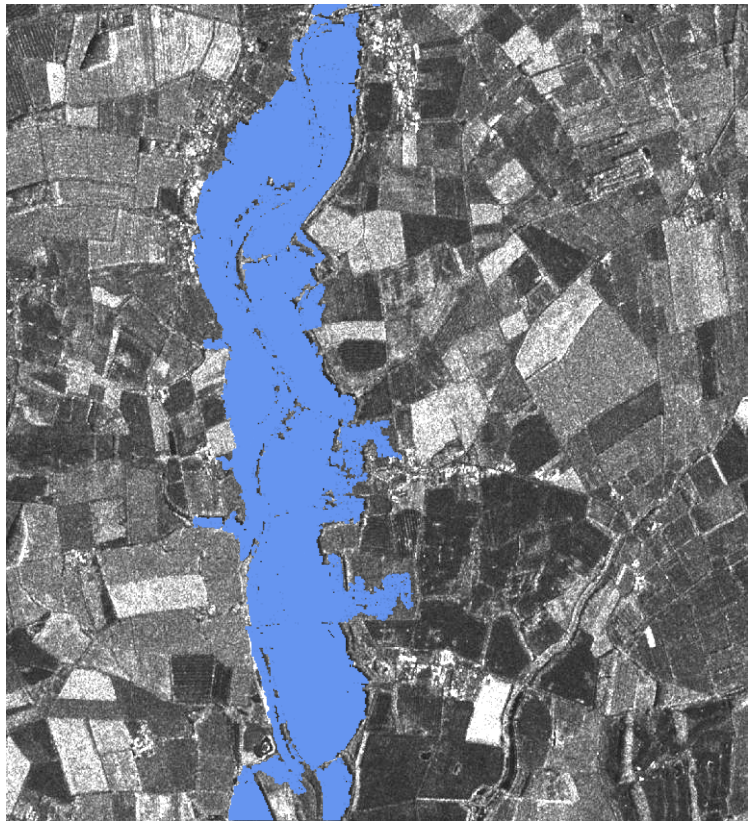
Pix.Spacing: 16 m × 16 m
Scene Size: 100 km × 100 km
[Range × Azimuth]

Comparison of flood masks from England, July 2007

RADARSAT-1

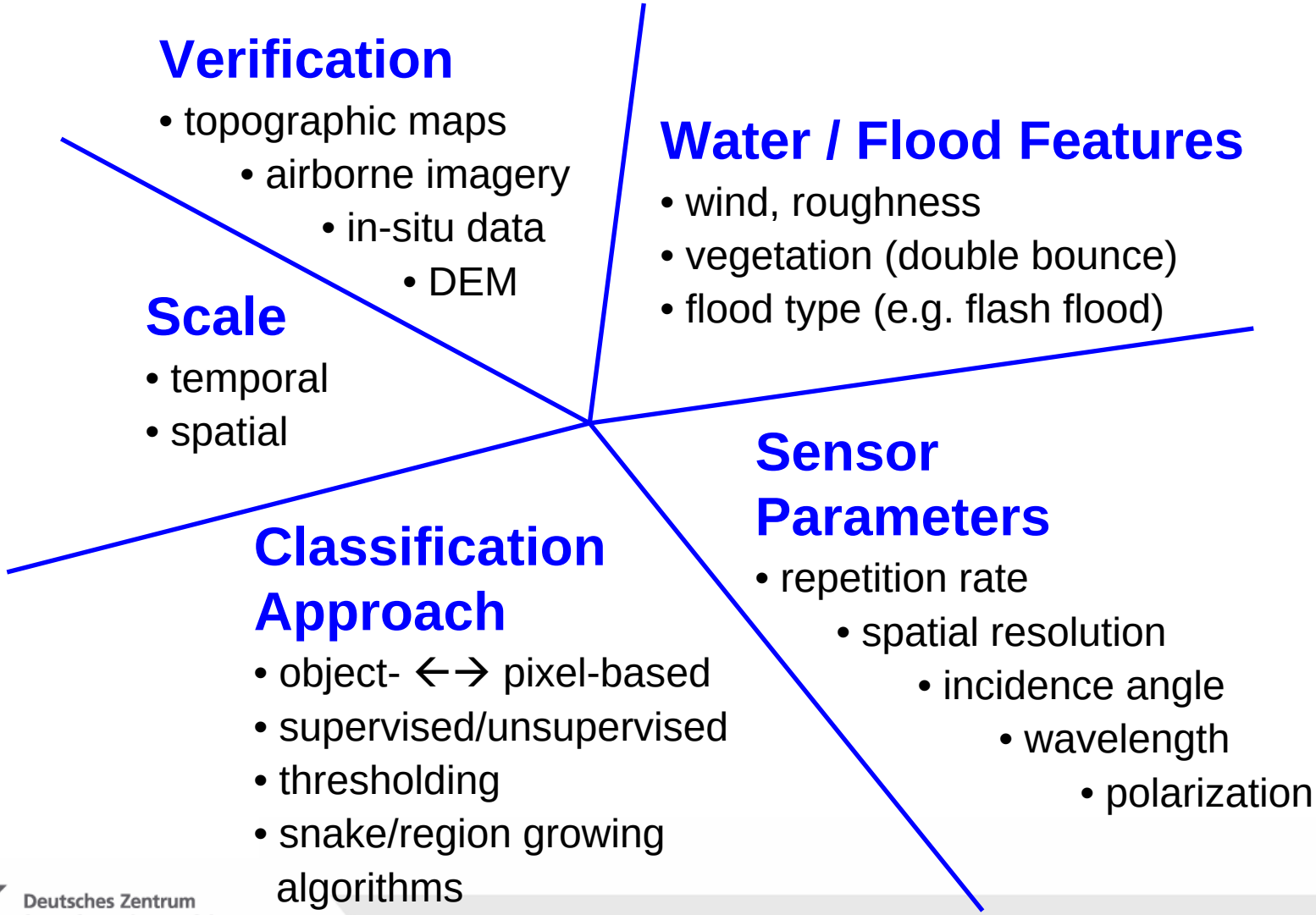


TerraSAR-X

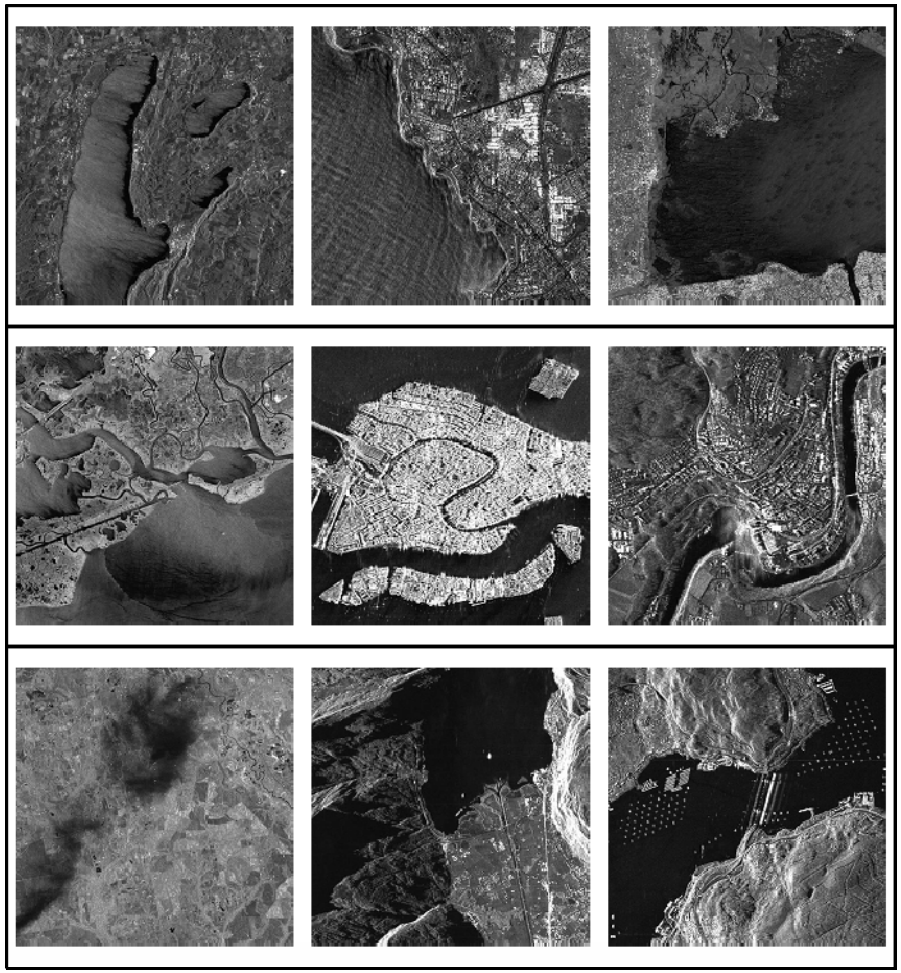


12,5 m pixel spacing 3m

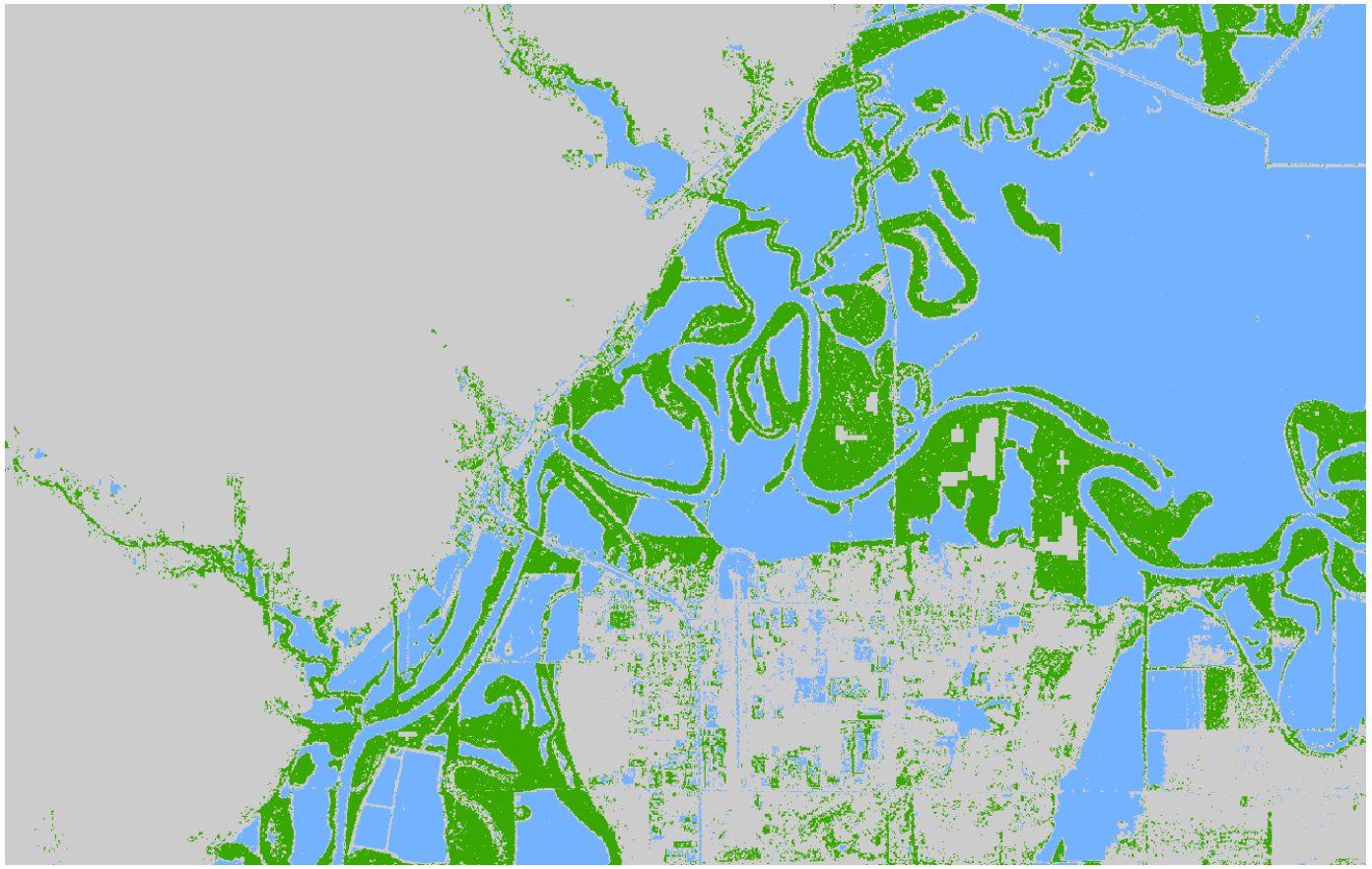
Aspects of Flood Mapping from SAR data



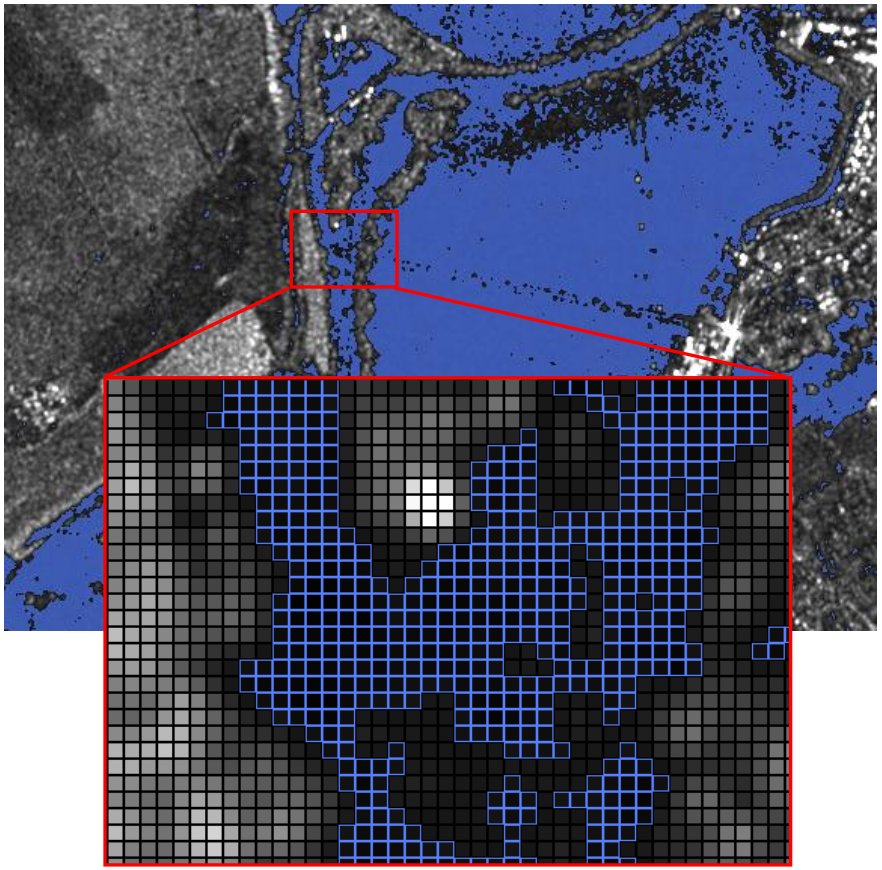
Water features in high resolution SAR Imagery



Flood at Black River Arkansas, Terra SAR-X



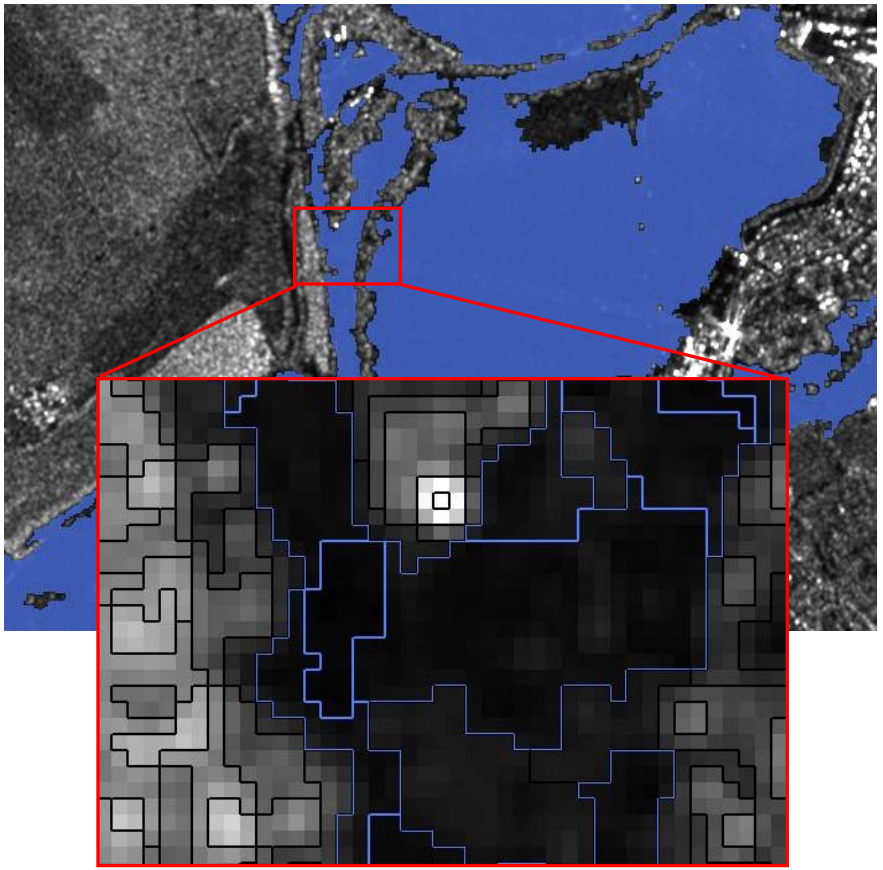
Pixel-based classification



Pixel-based classification parameters

- Brighness/Backscatter
- Texture (moving window)

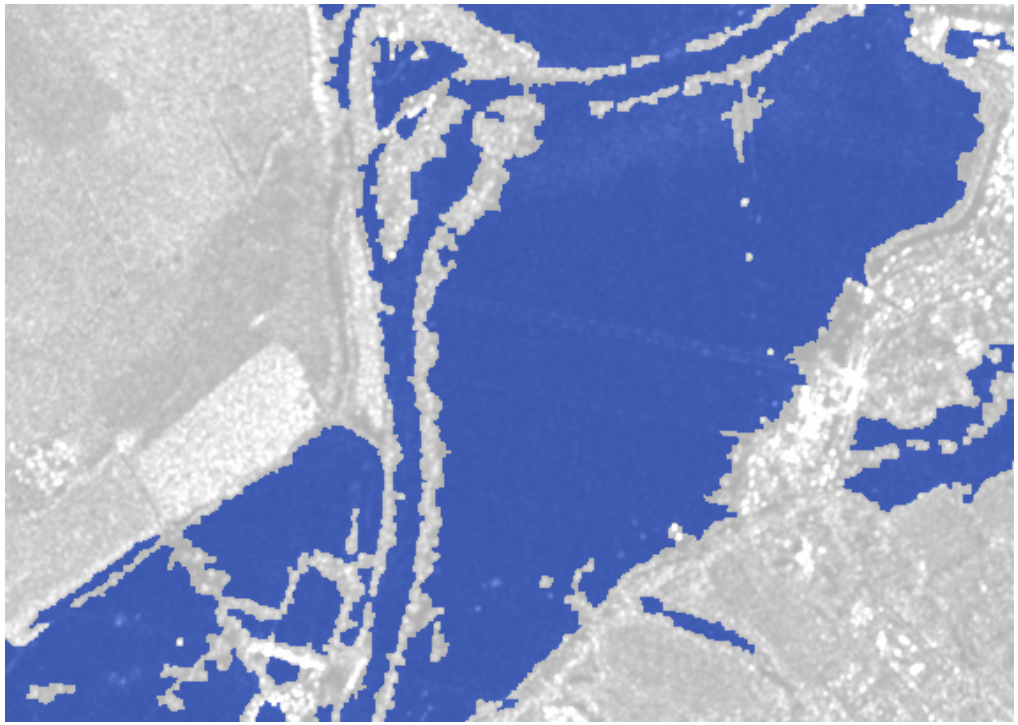
Object-based classification



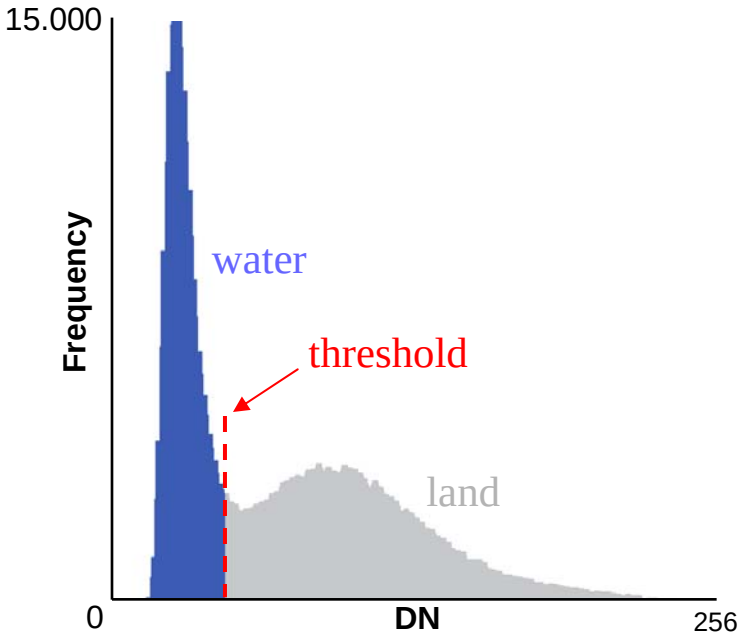
Object-based classification parameters

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

Examples: Pixel based thresholding

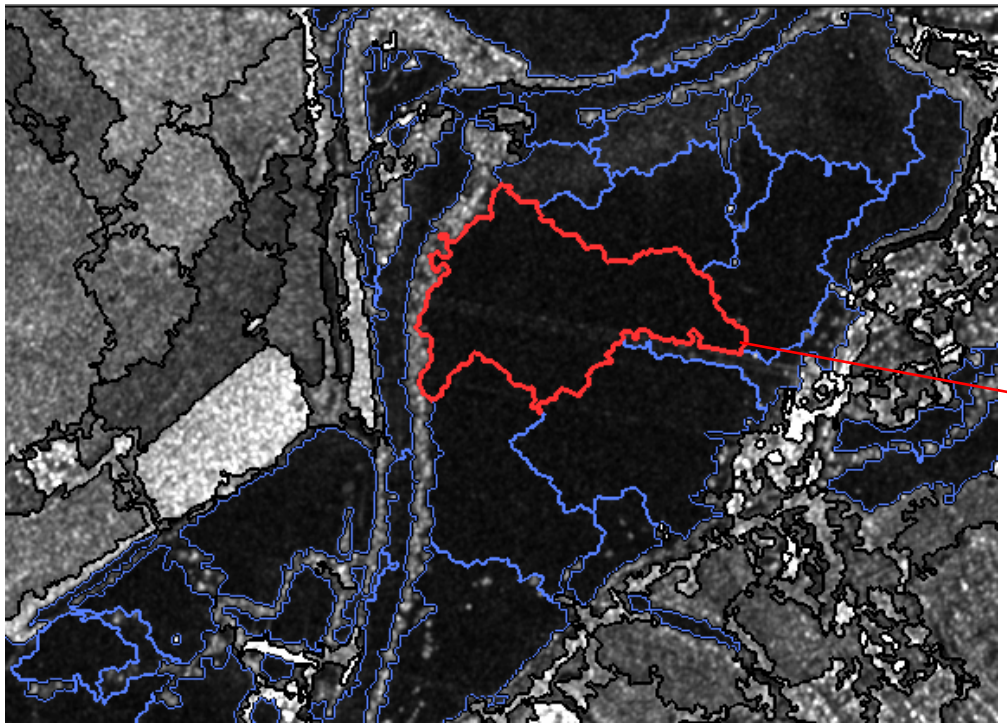


TerraSAR-X Stripmap scene



Grey level histogram

Examples: Segmentation based classification

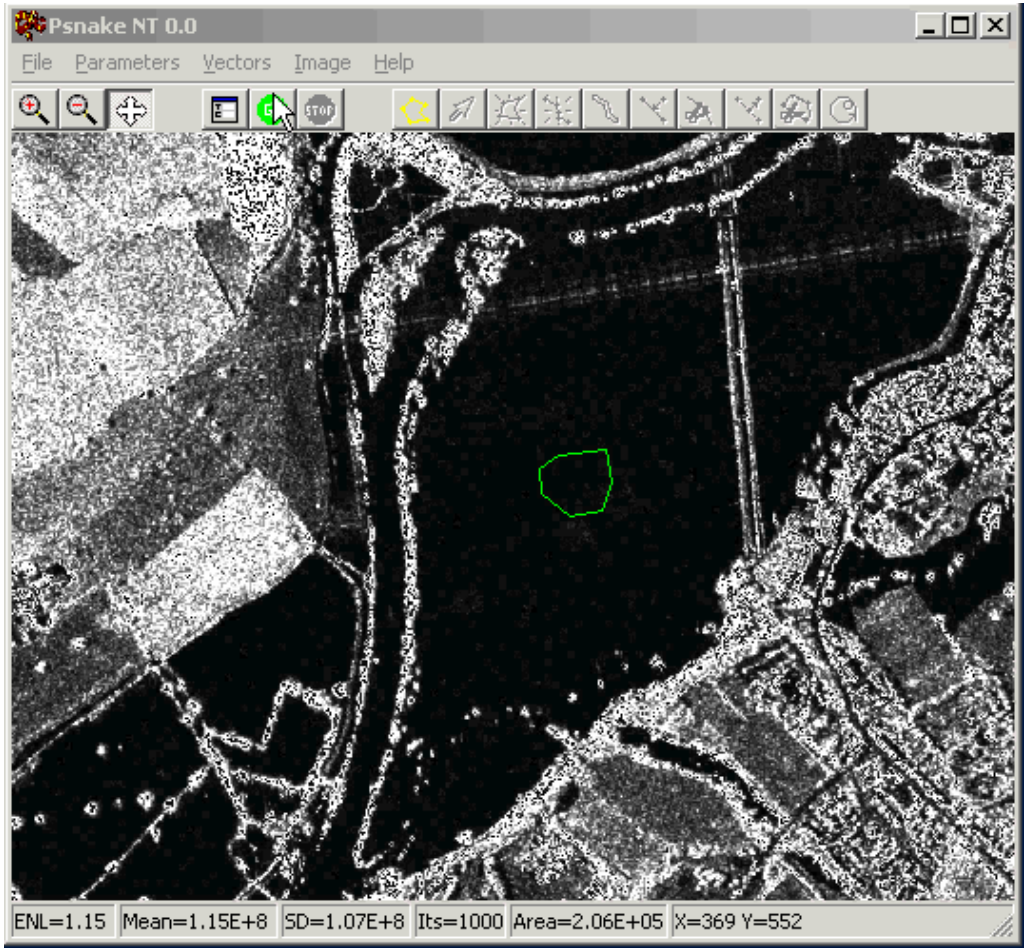


Segmented TerraSAR-X Stripmap scene

Object properties:

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

Examples: Snake/Active contour algorithms

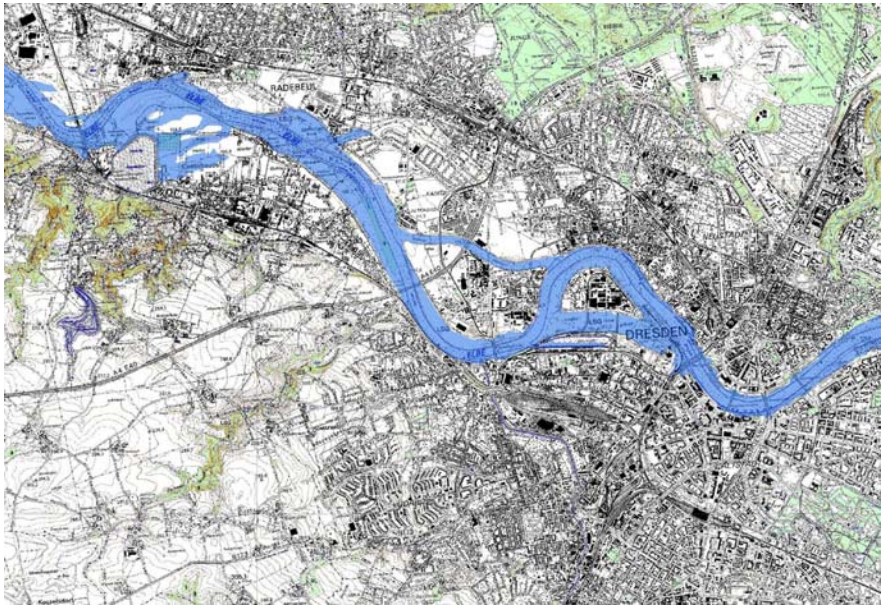


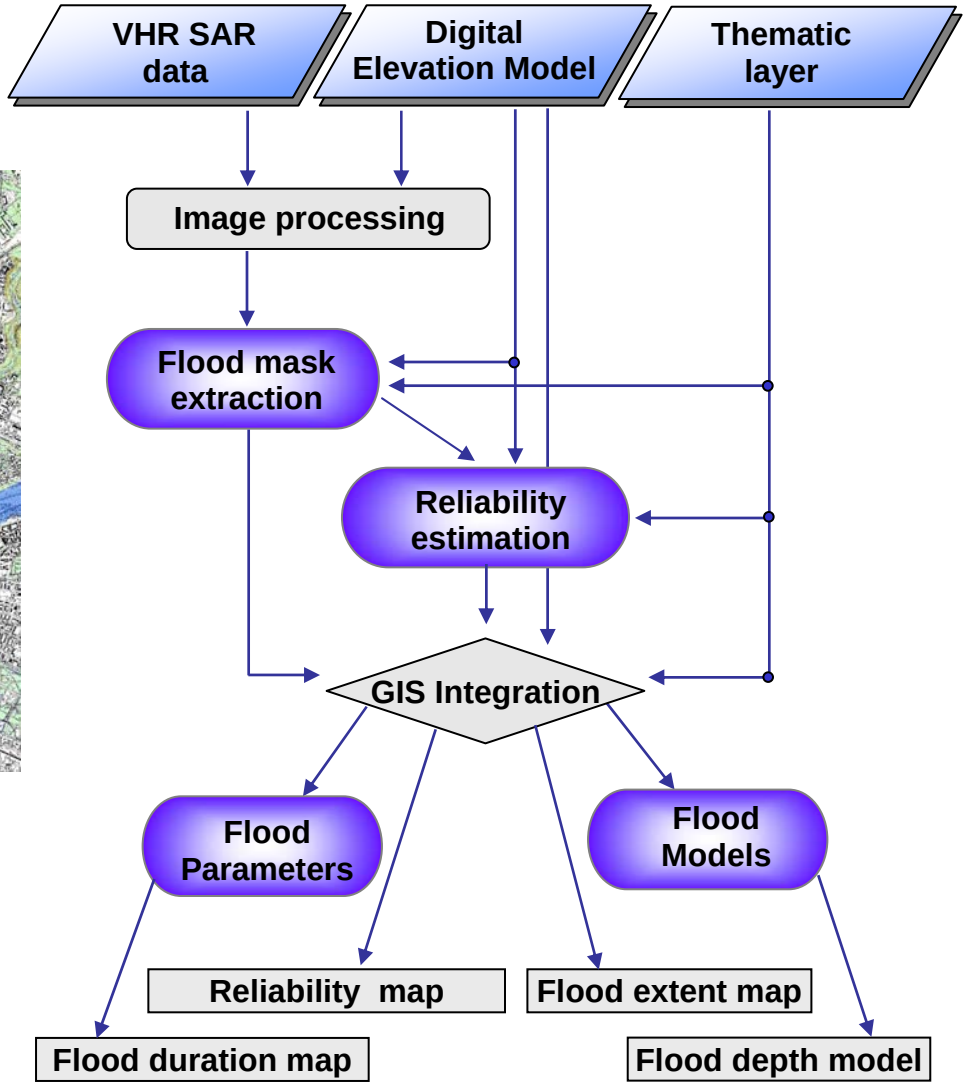
Snake algorithm courtesy of Dr. David Mason (University of Reading), Matthew S. Horritt and JRC-IES.

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

Combining flood masks with reference information

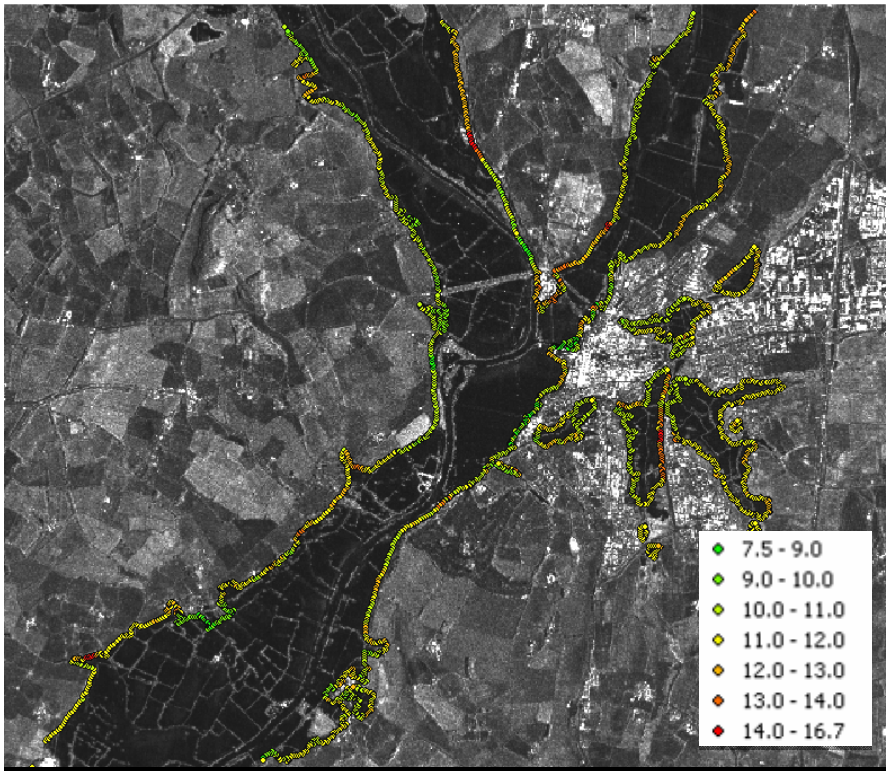
- Topographic map

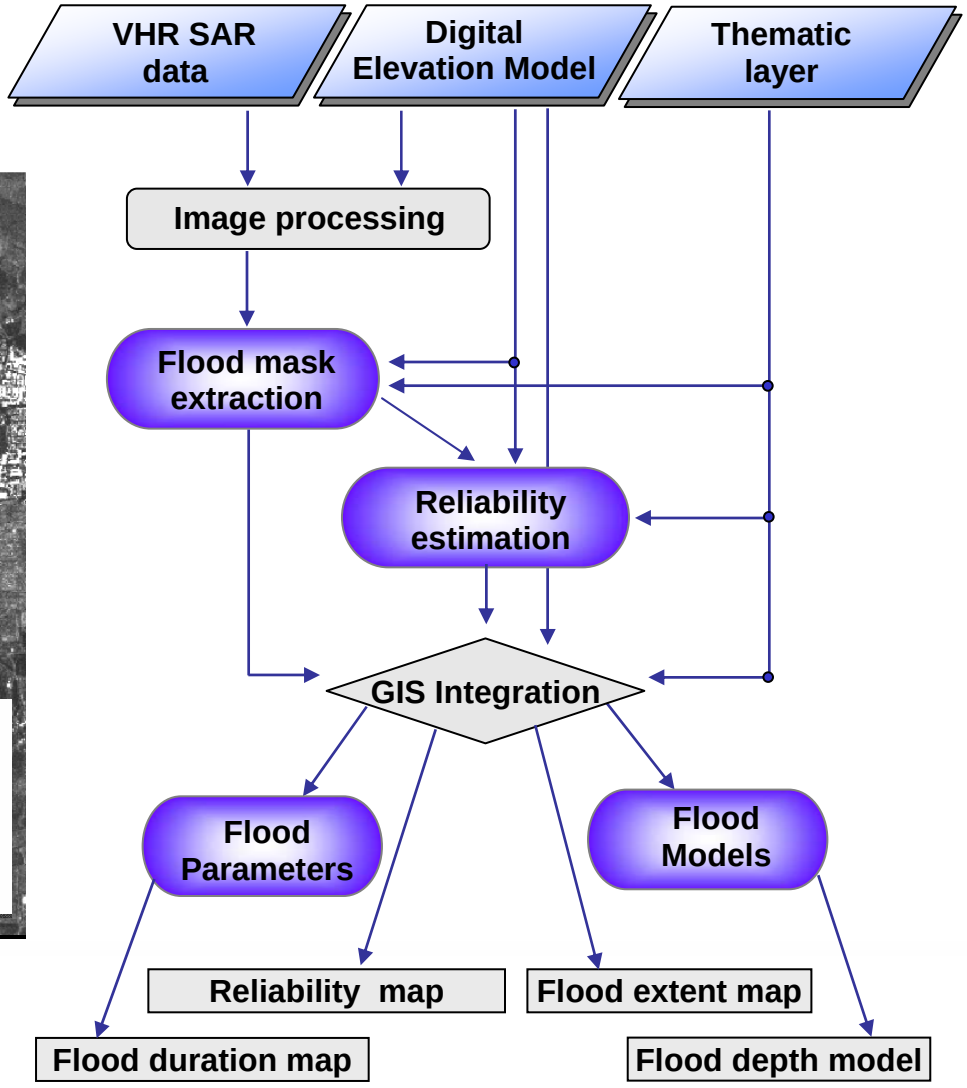




Combining flood masks with reference information

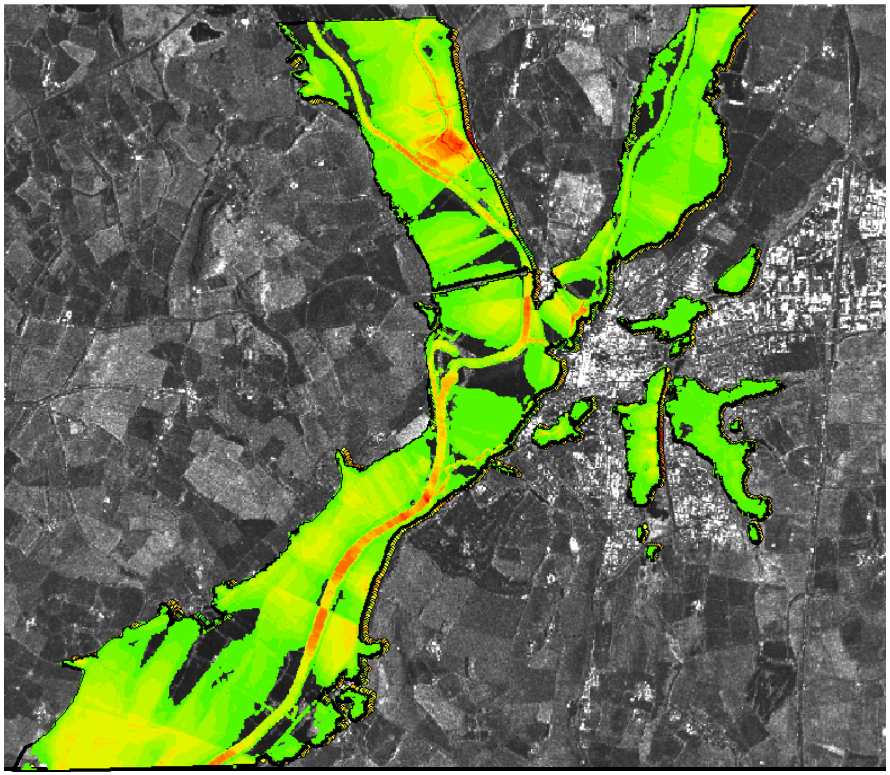
- Digital Elevation Model

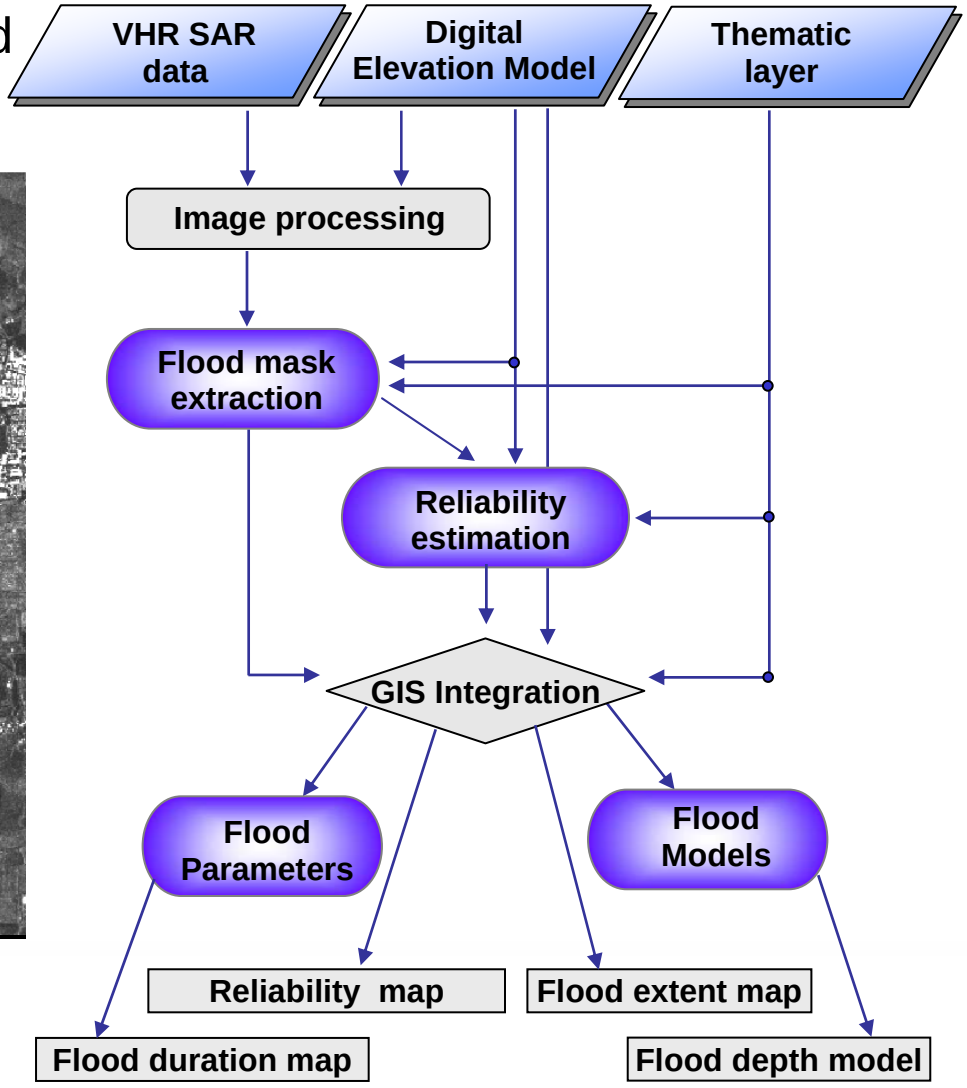




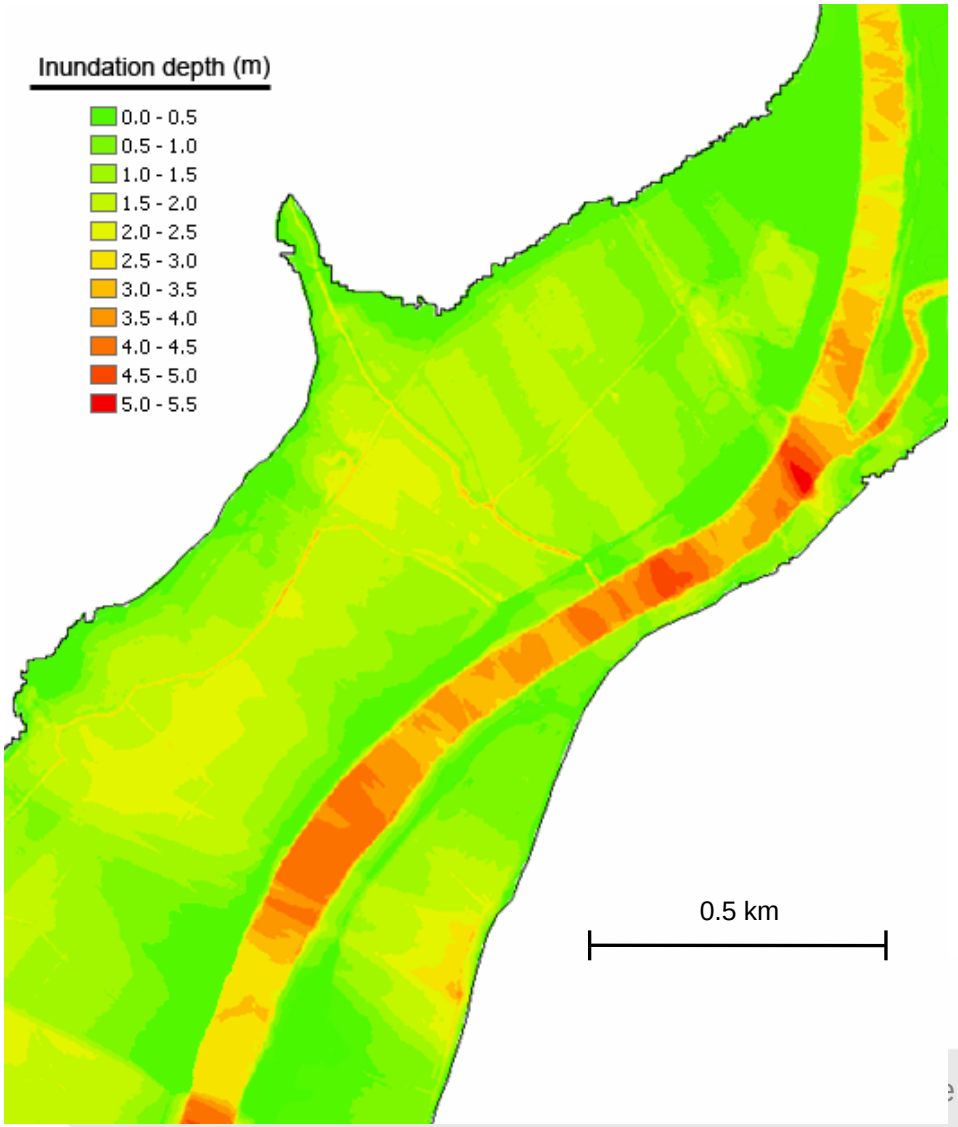
Modelling inundation depth

- by linking flood observation and river bed geometry

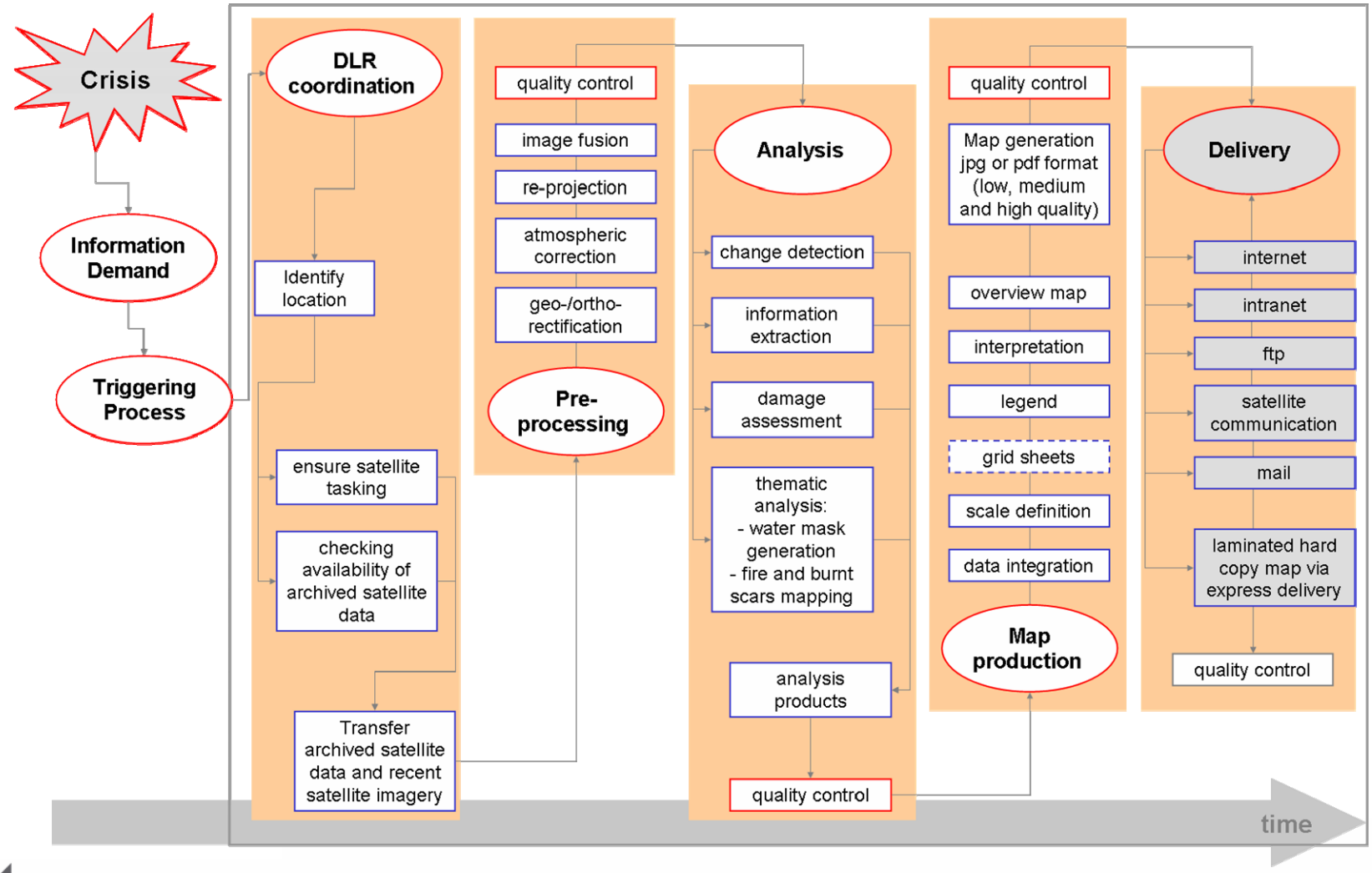




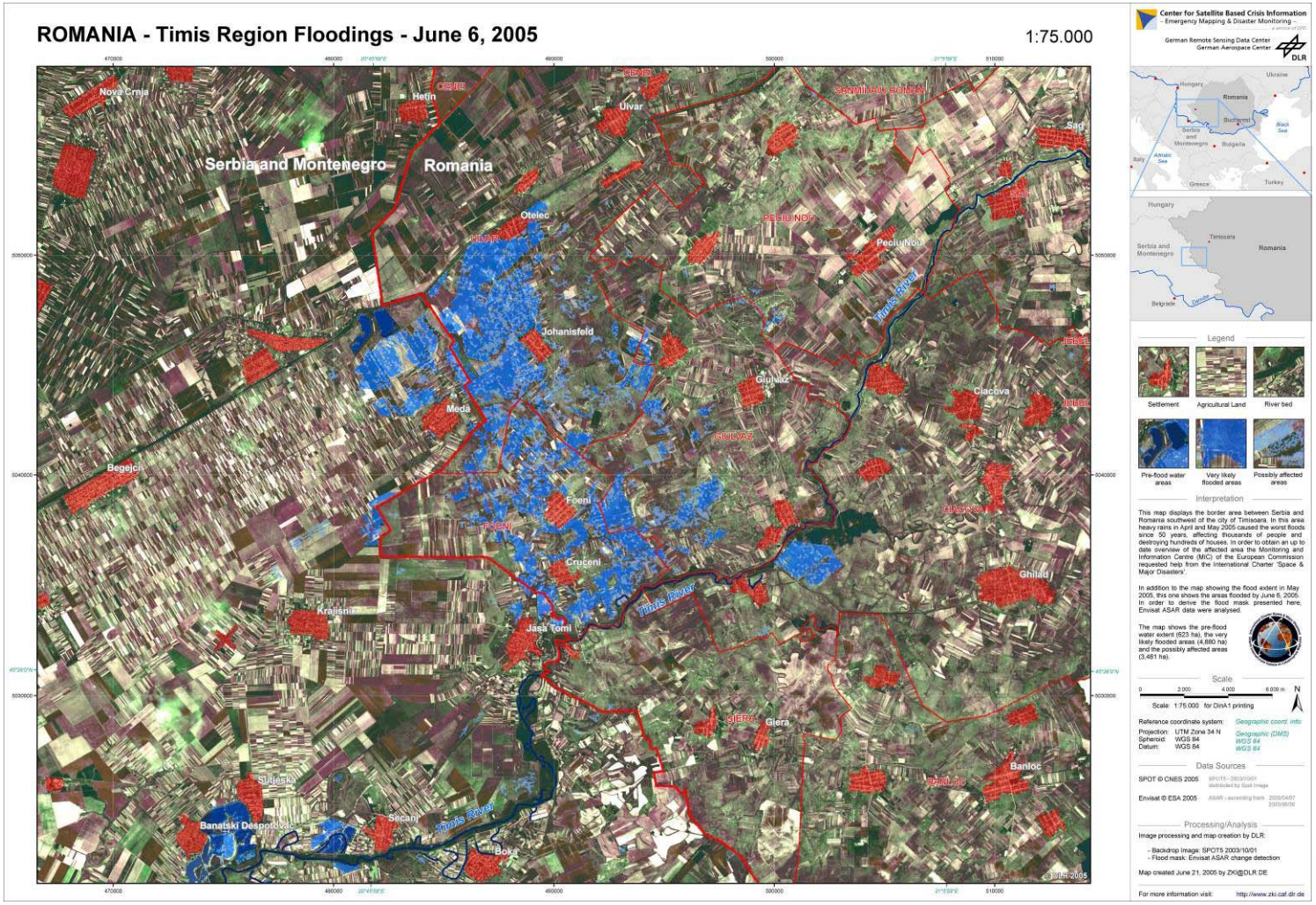
Modelling inundation depth



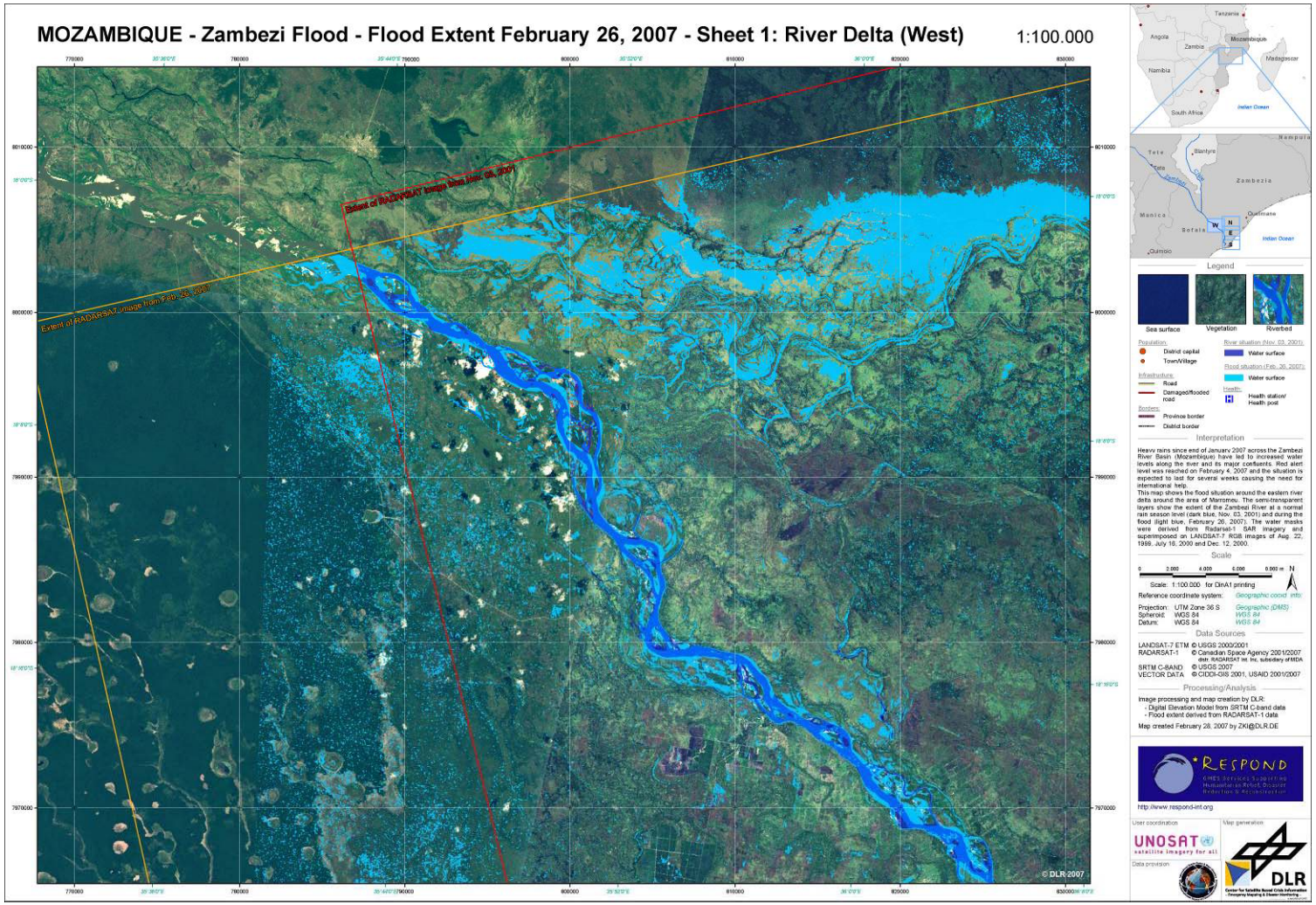
RAPID MAPPING Workflow



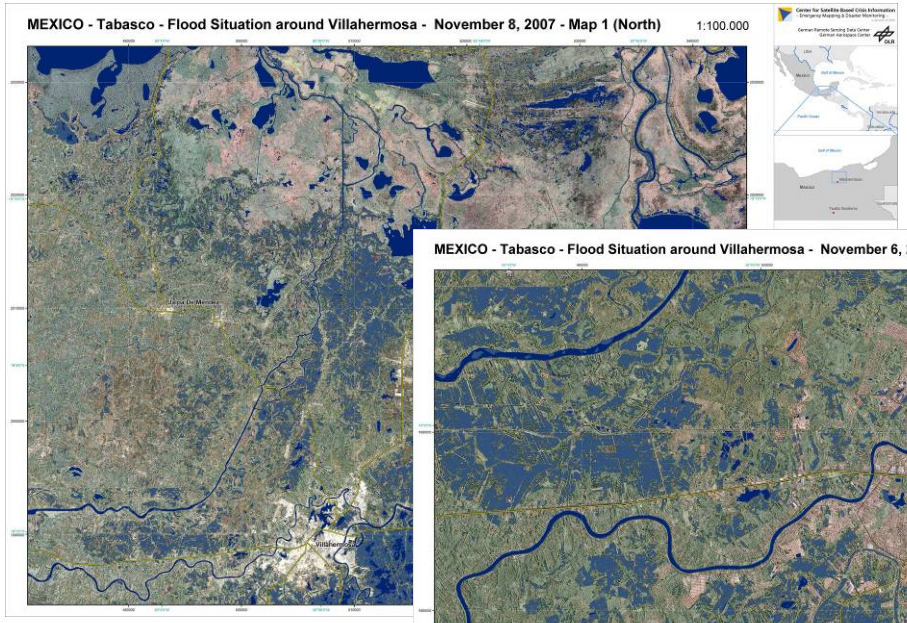
Flood map for Timis region/Romania, May 2005



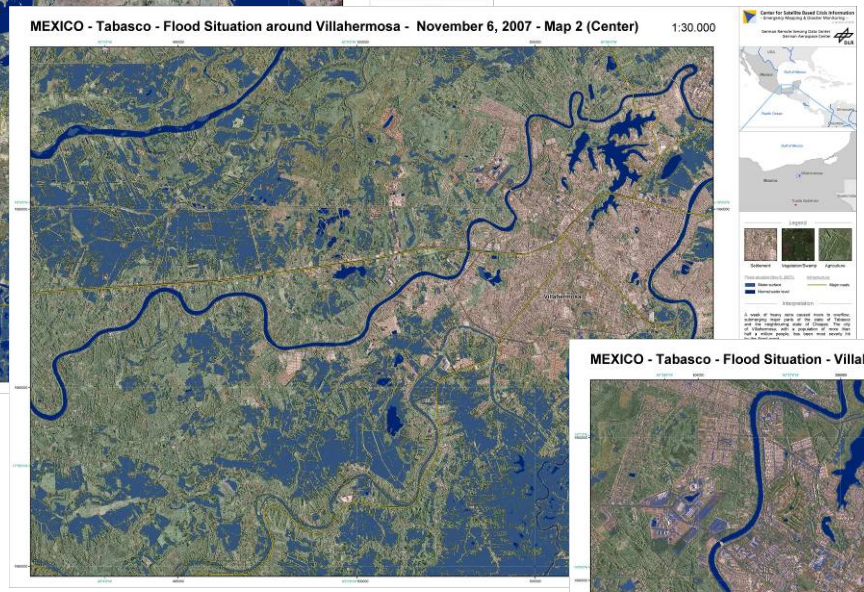
Zambezi flood Mozambique 2007



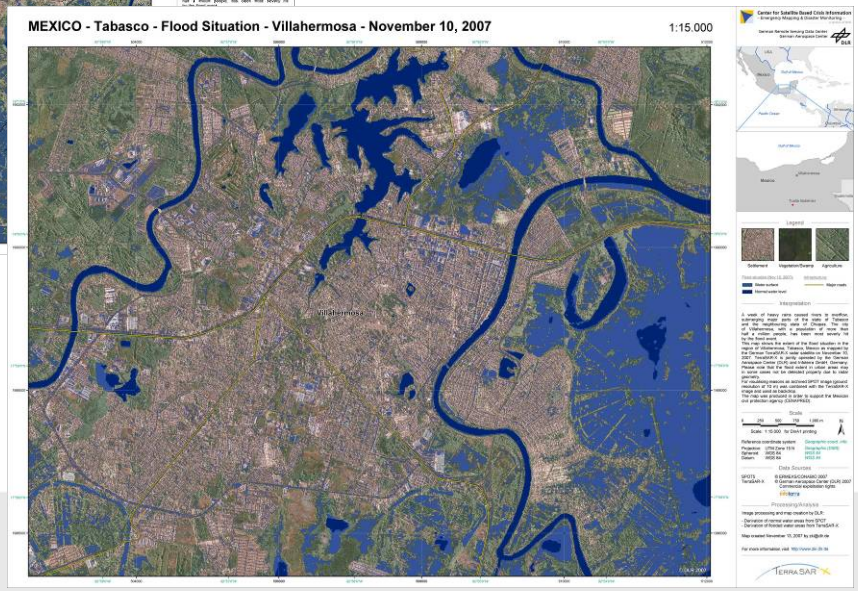
TSX mapping examples, Flood in Mexico, Nov 2007



- ScanSAR

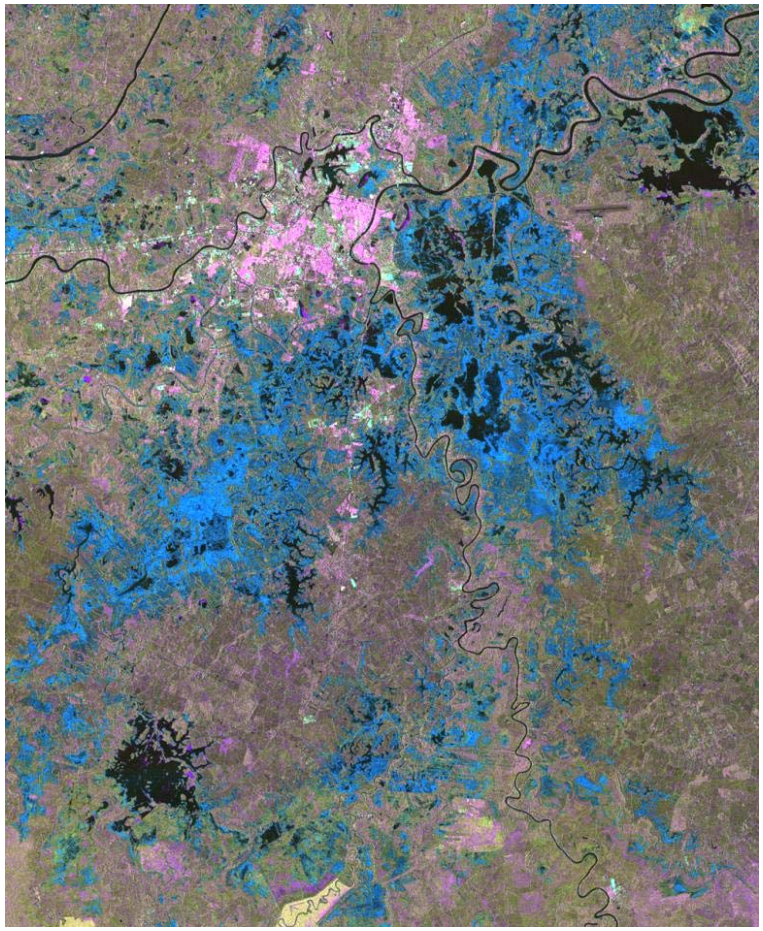


- Stripmap



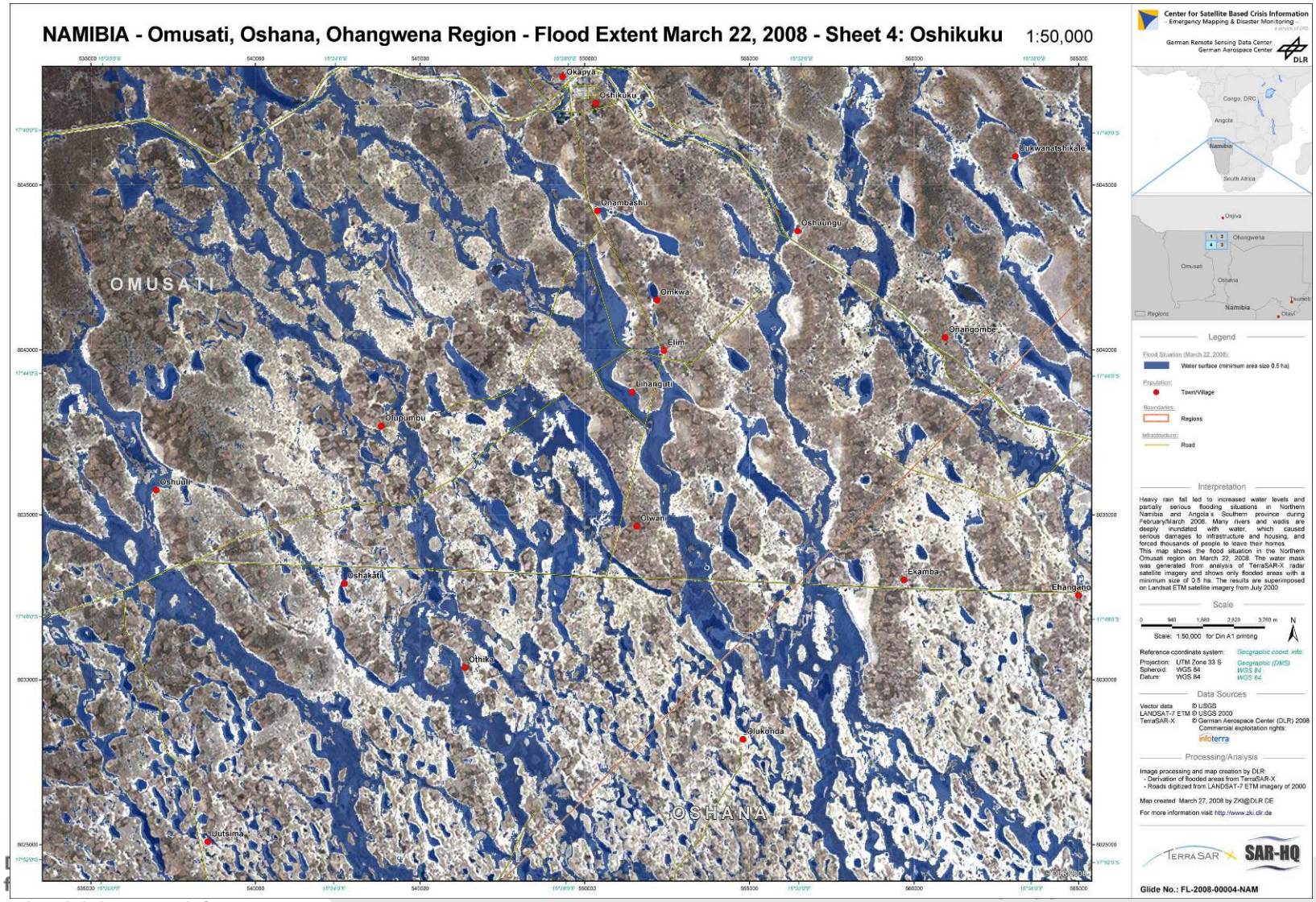
- Spotlight

TSX mapping examples, Flood in Mexico, Nov 2007

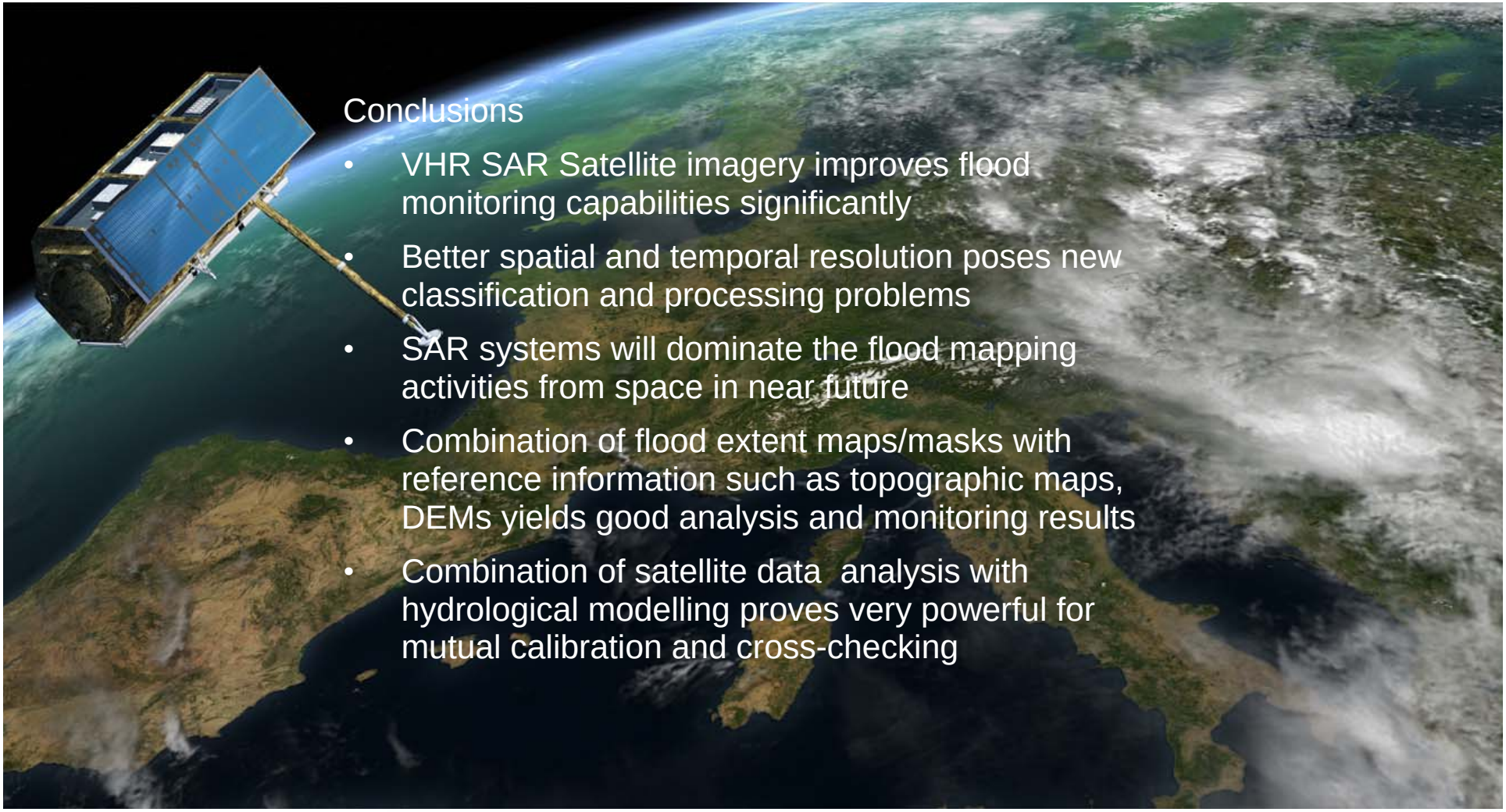


- Flood duration and temporal dynamic between 8.11. and 2.12. 2007
  - Blue: changes in flooded area
  - Black: inundated at both times
- Increased dynamic monitoring capacities with multiple high resolution SAR missions!

TSX mapping examples, Flood in Namibia, March 2008

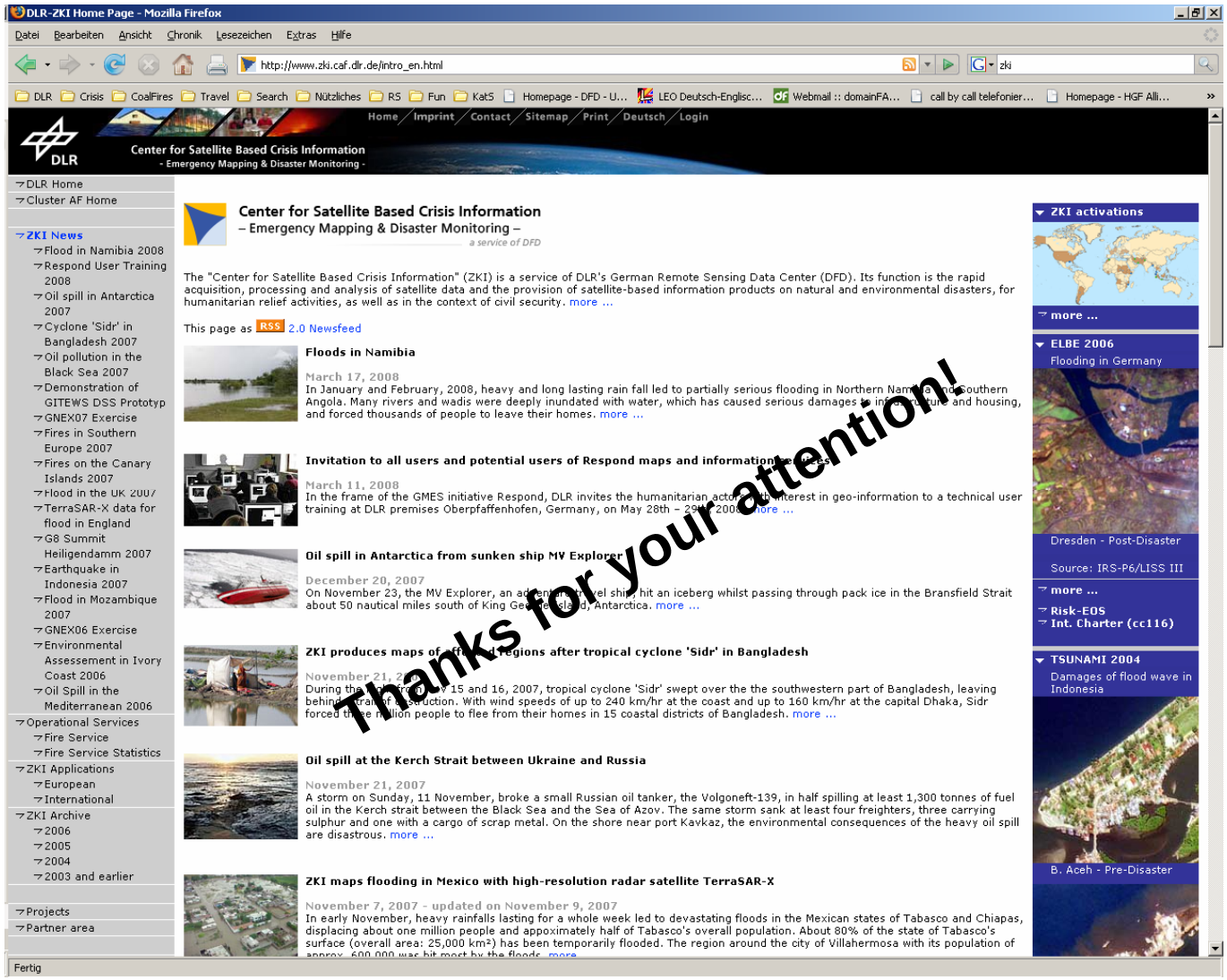


Project activities and Acknowledgments



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



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