Remote Sensing for Disaster Management

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Geospatial World Forum 2012

DLR

Earthquake Turkey, October 2010

© http://img.youth-fm.de/images/newsbilder/tuerkei.jpg

© Photo courtesy of M. Celebi, 2011
http://earthquake.usgs.gov/research/turkey/usgsteam2/pages/f3-34.html

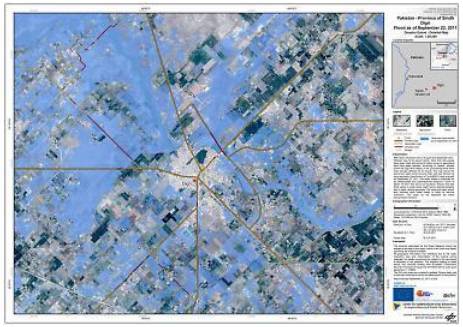
Famine East Africa, July 2011

Tsunami Japan, March 2011

Center for Satellite Based Crisis Information

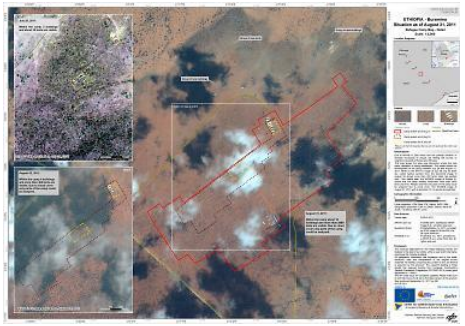
ZKI

Responsibilities and tasks of ZKI



- **Acquisition** and **provision** of satellite based crisis information
    - Rapid generation of user-driven information products in case of a disasters → Maps

- **24 hours / 7 days** on-call duty
- Established contact points in Germany and Europe as well as in international institutions



Linking space and technology

Technical Expertise

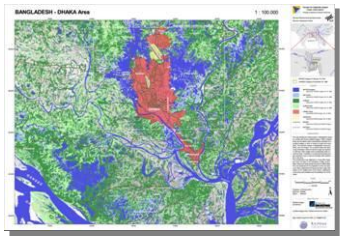
- Data Reception
- Data Archiving
- Data Management

Applications Competence

- Environment & Geoinformation
- Crisis Information

Political Decision Makers

Situation Centers



Relief Organisations

Public

Networks and Partnerships

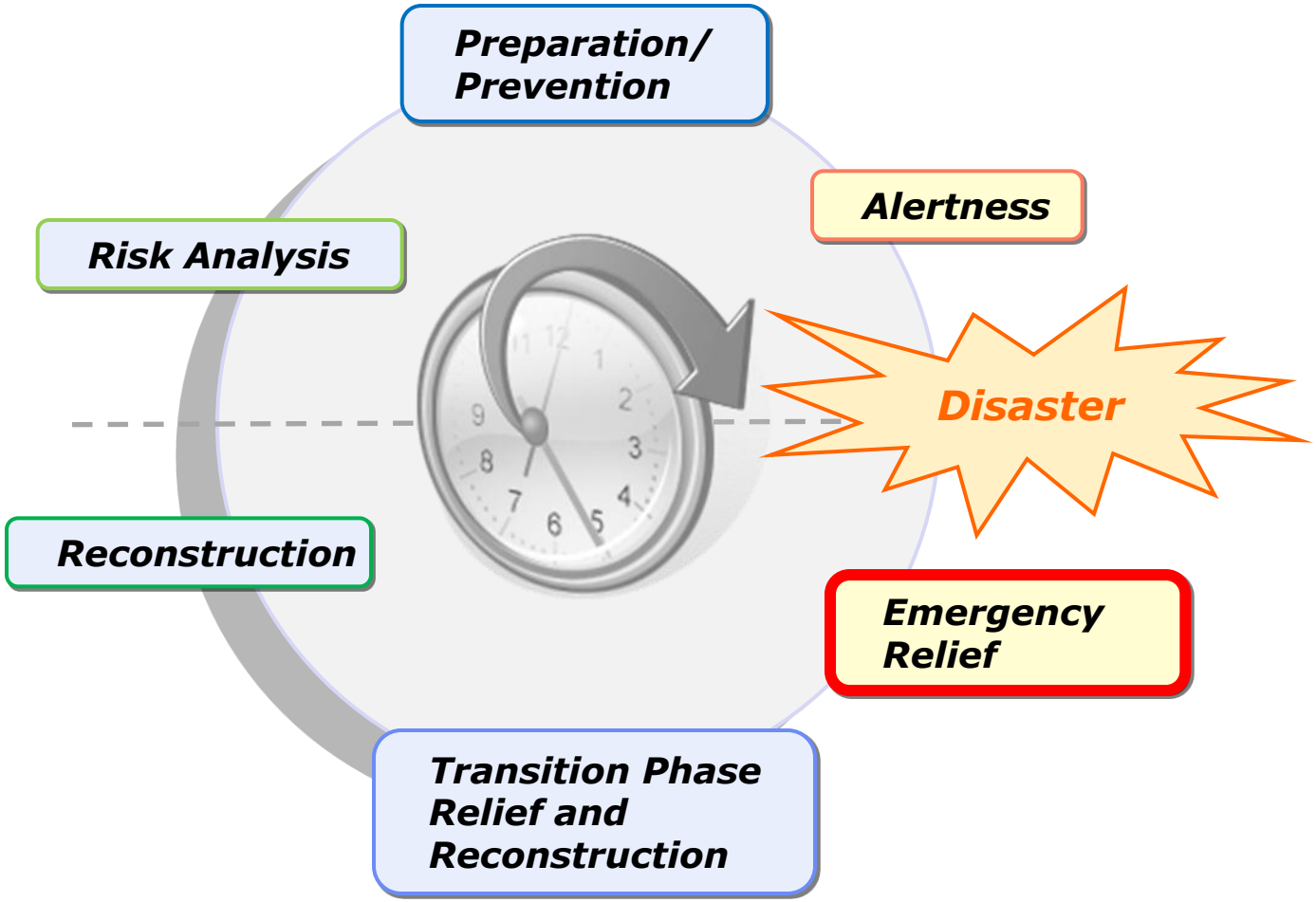
Space Agencies and Industry

Projects, Services

Users

Research Partners

Disaster cycle



Satellite Based Crisis Mapping

Crisis or Disaster

①Mobilization

- *triggering process*
- *situation briefing*

②Data acquisition

- *satellite tasking*
- *archive search*
- *auxiliary data*

③Pre-Processing

- *geometric correction*
- *image enhancement*

④Analysis

- *data fusion*
- *information generation*

Integration of auxiliary data

⑤Map Production

- *quality control*
- *maps (printed; online)*
- *GIS-ready geodata*
- *information dossiers*

Integration in collaborative platform

⑥Dissemination

- *Cooperation with national/local authorities*
- *Relief organisations, NGOs*
- *Public,…*

Planning and Decision Support

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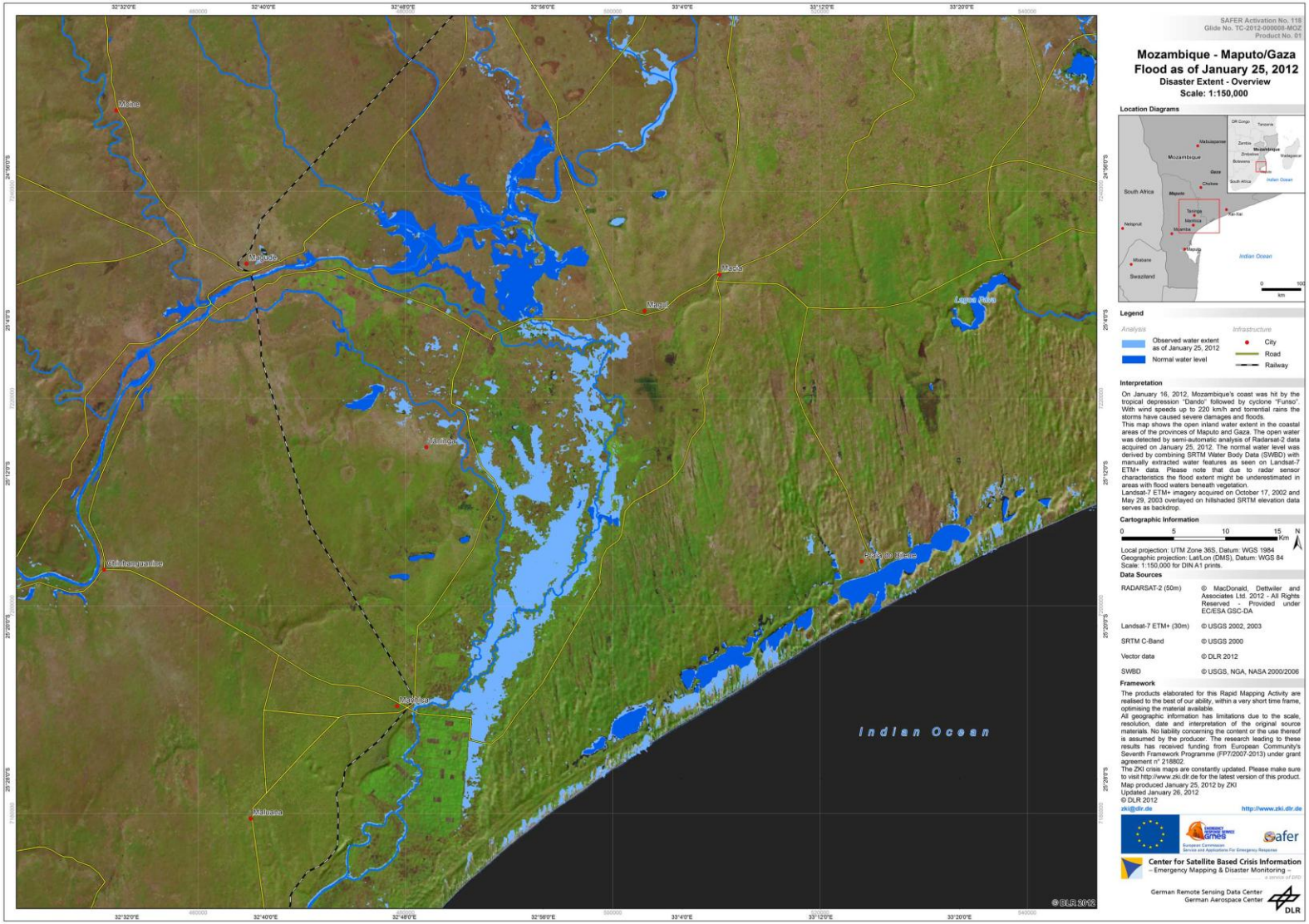
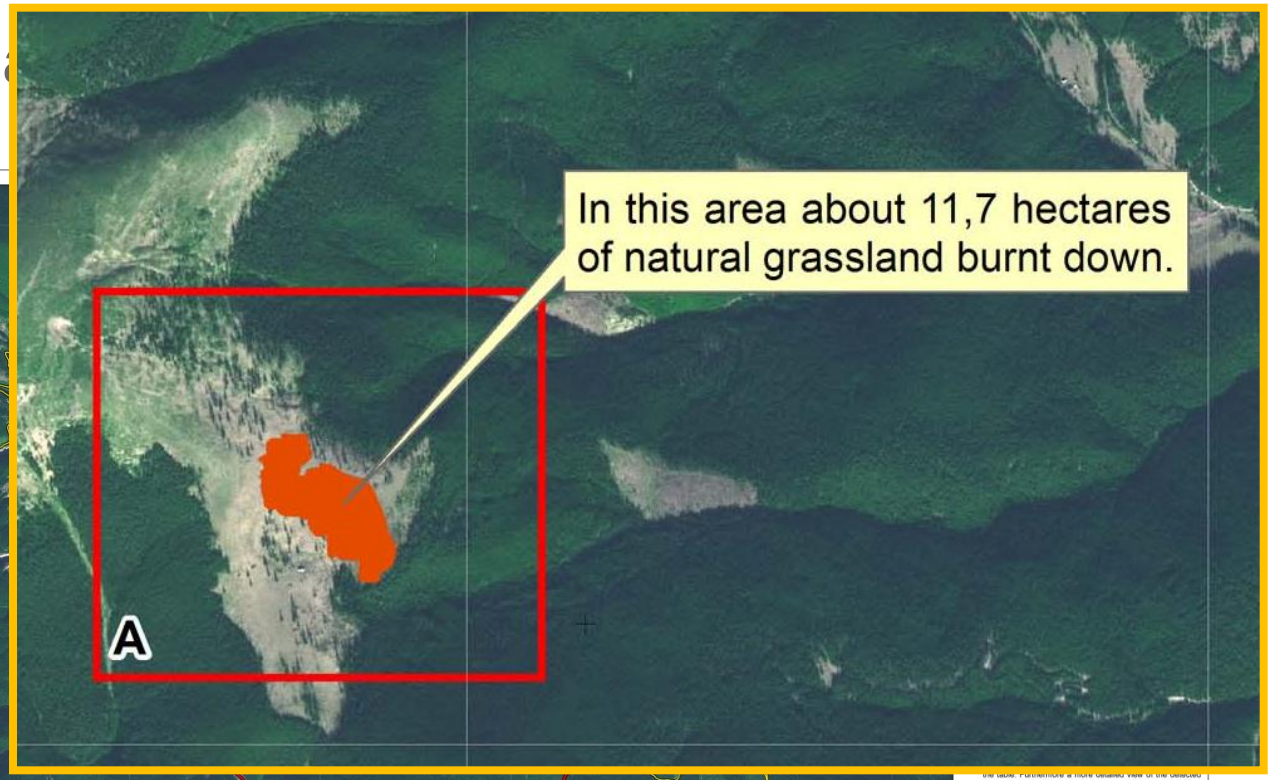
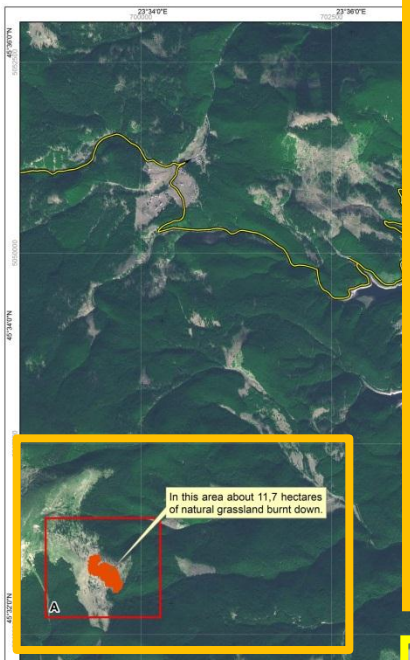
Flood Mozambique, January 2012

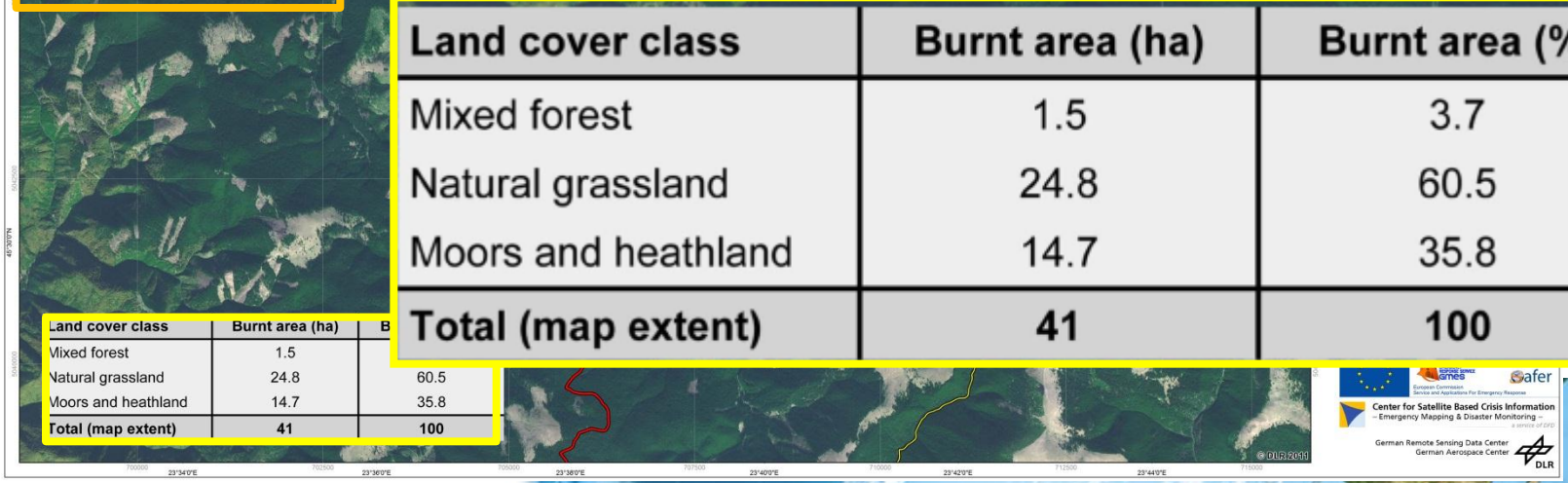


Fires Roma

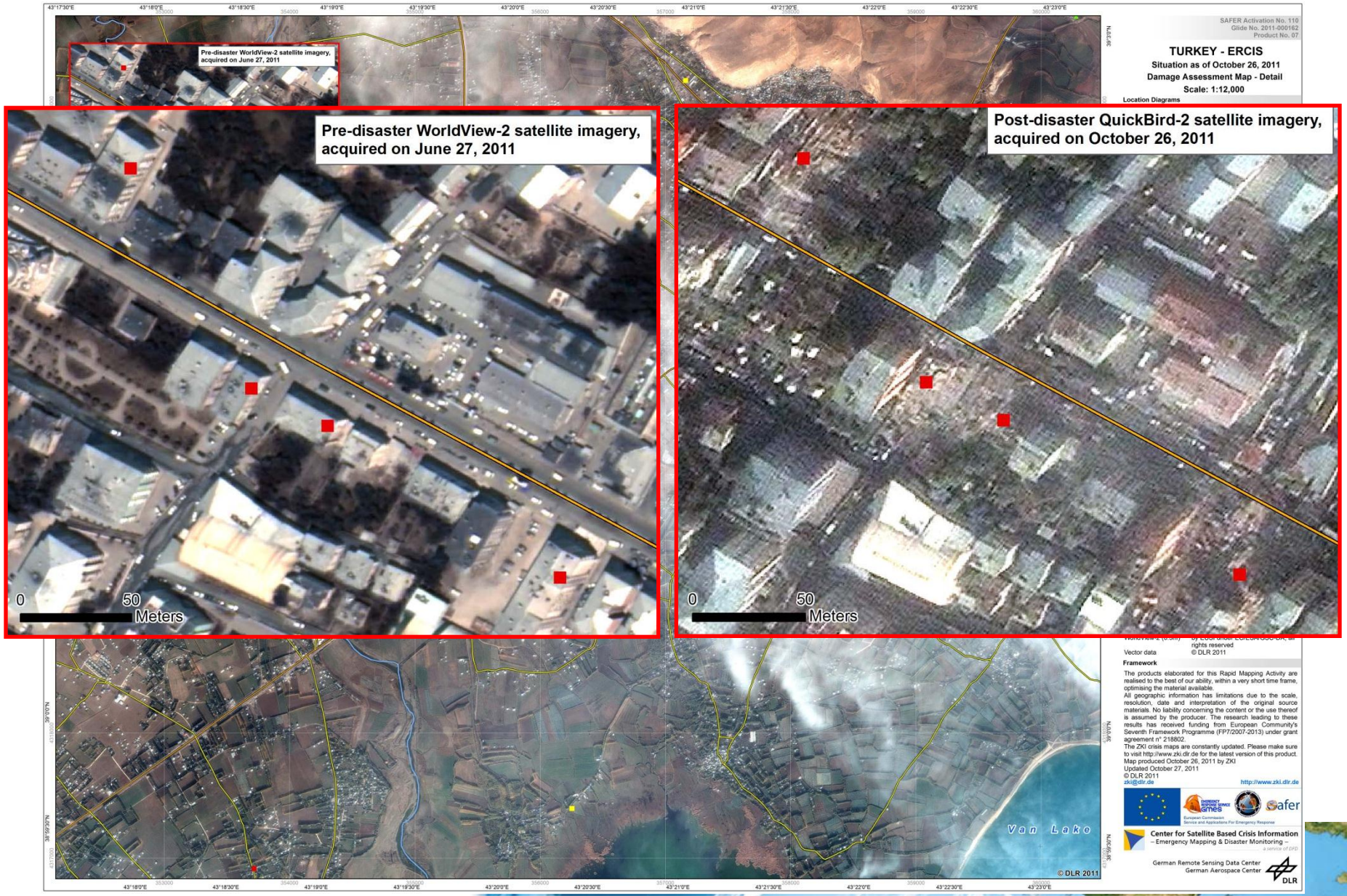


Land cover class	Burnt area (ha)	Burnt area (%)
Mixed forest	1.5	3.7
Natural grassland	24.8	60.5
Moors and heathland	14.7	35.8
Total (map extent)	**41**	**100**

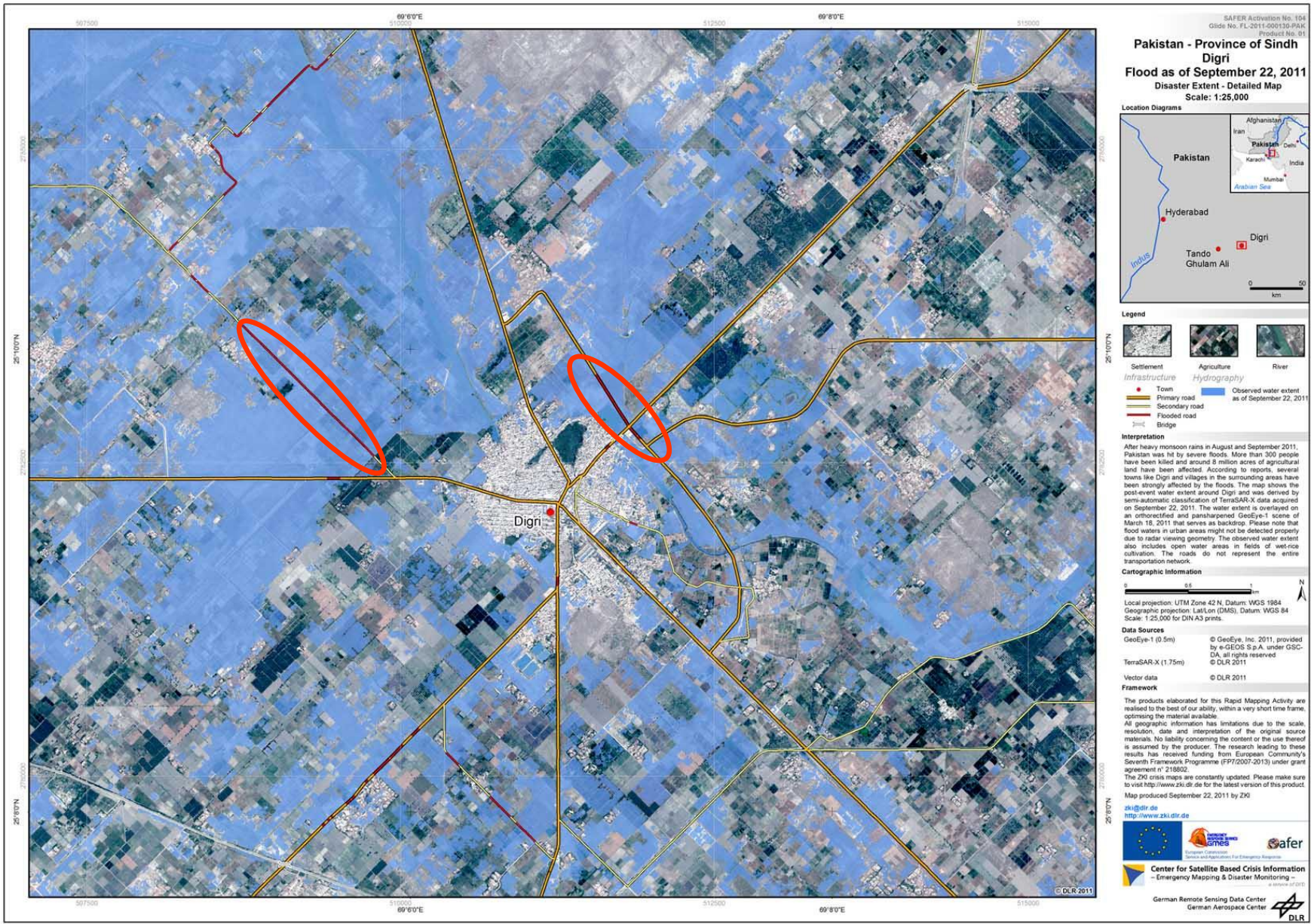




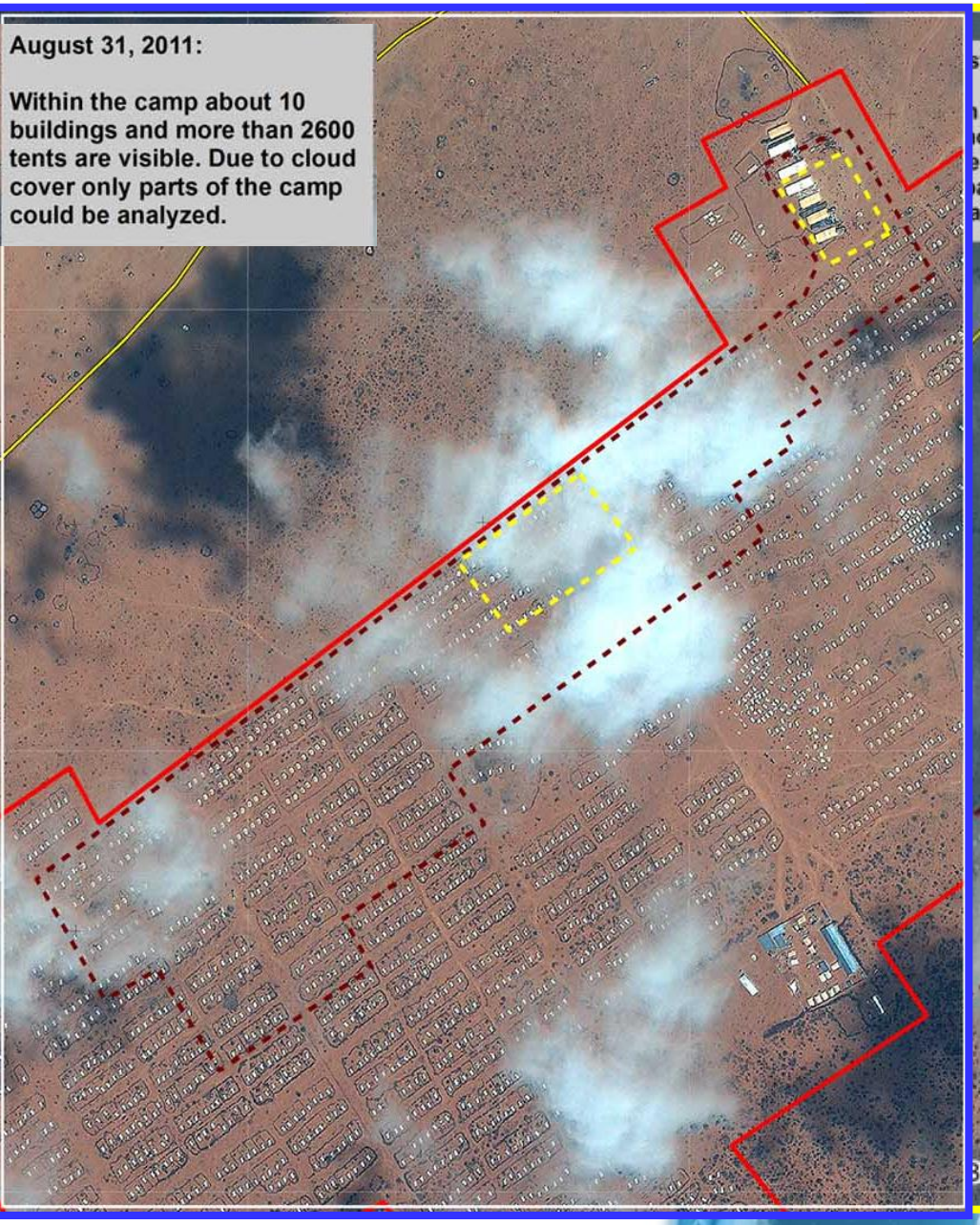
Earthquake Turkey, October 2011

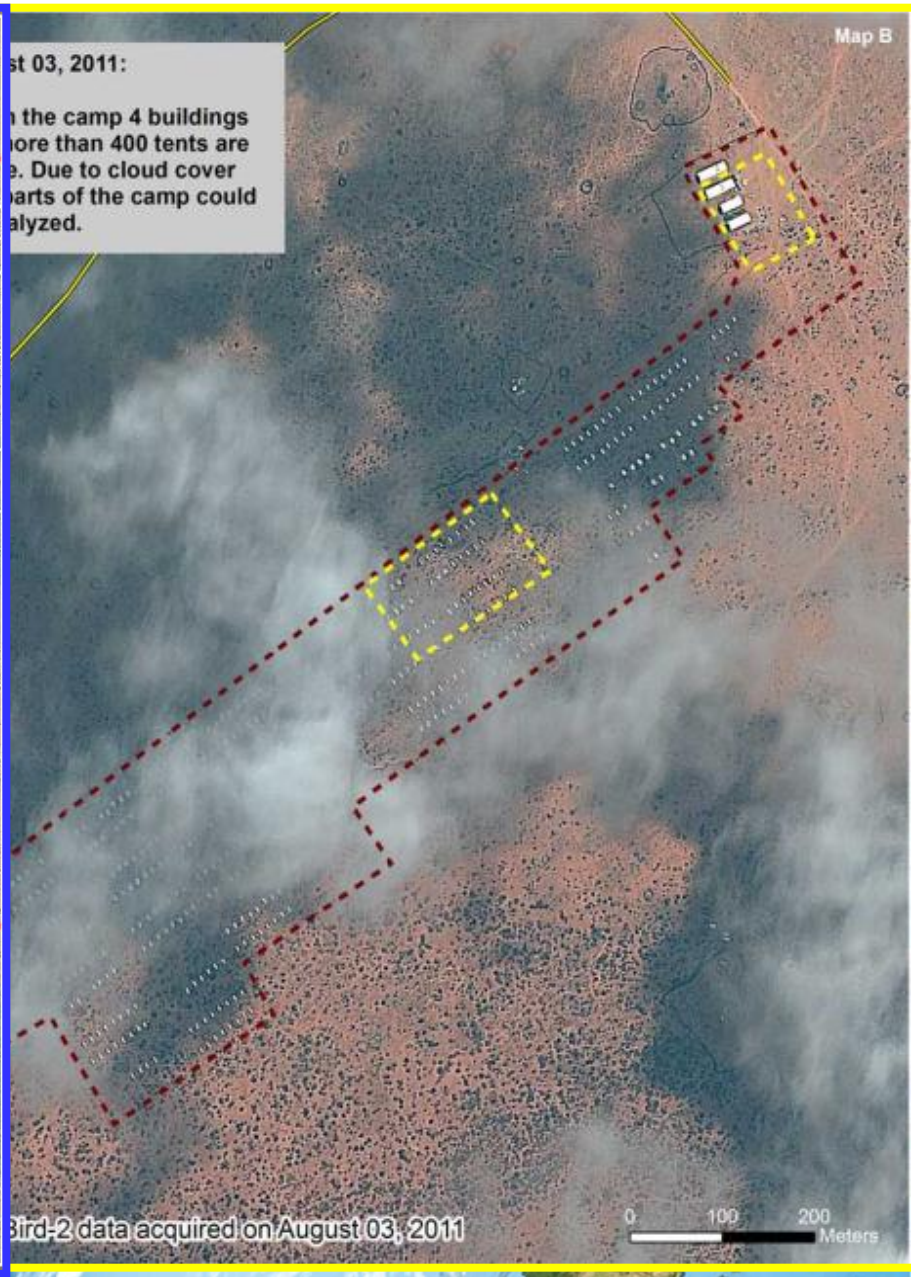


Flood Pakistan, September 2011

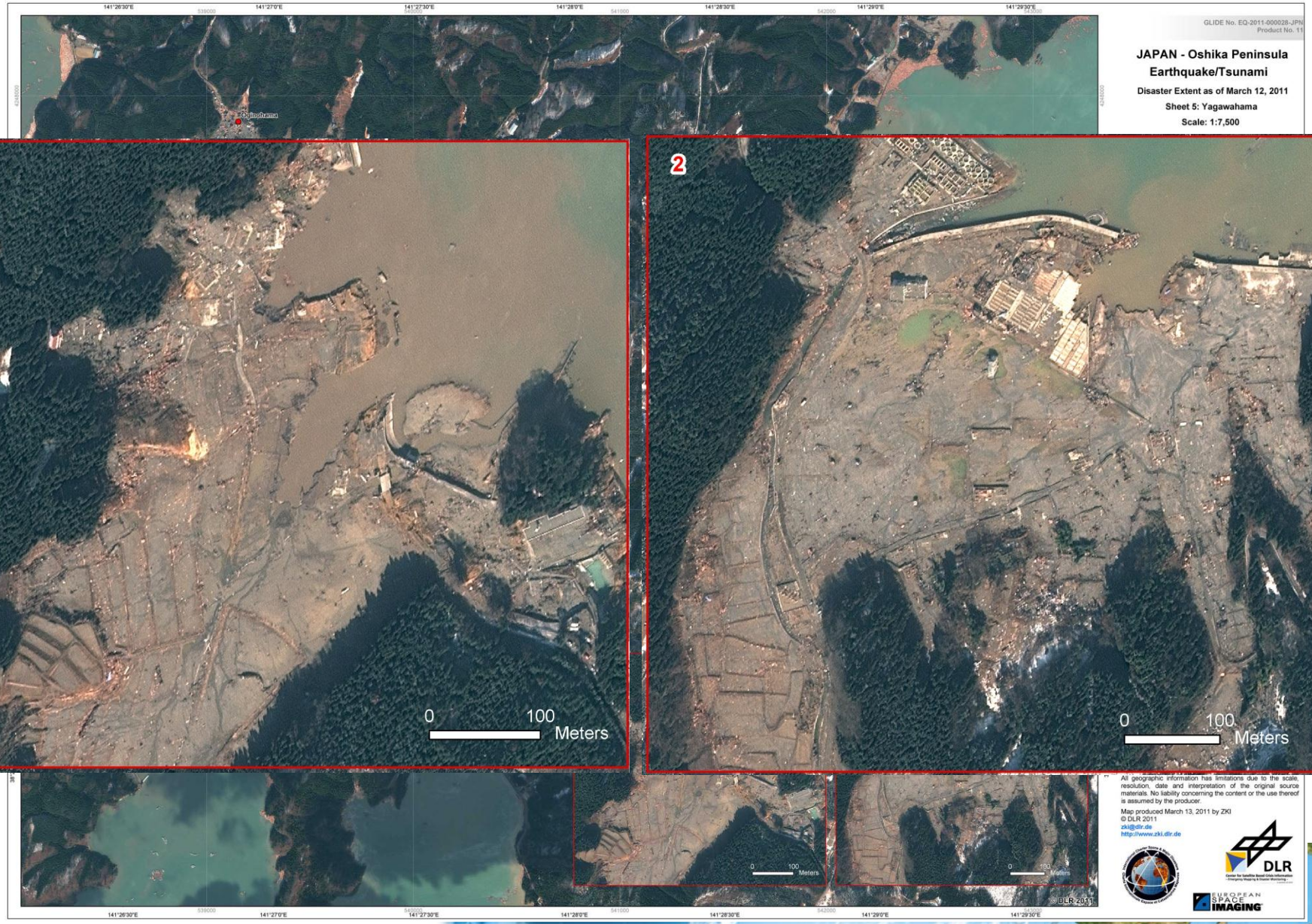


Famine Ethiopia, August 2011

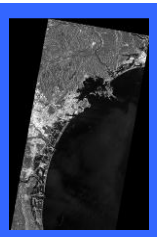




Earthquake – Tsunami Japan, March 2011



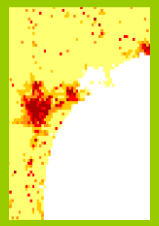
Tsunami Japan, March 2011



Radar data

Satellite data

Flood mask

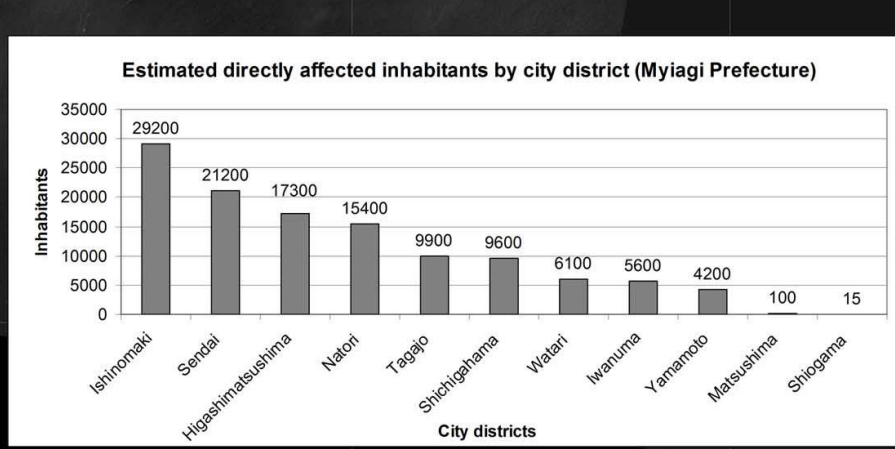


Population data

Administrative Boundaries

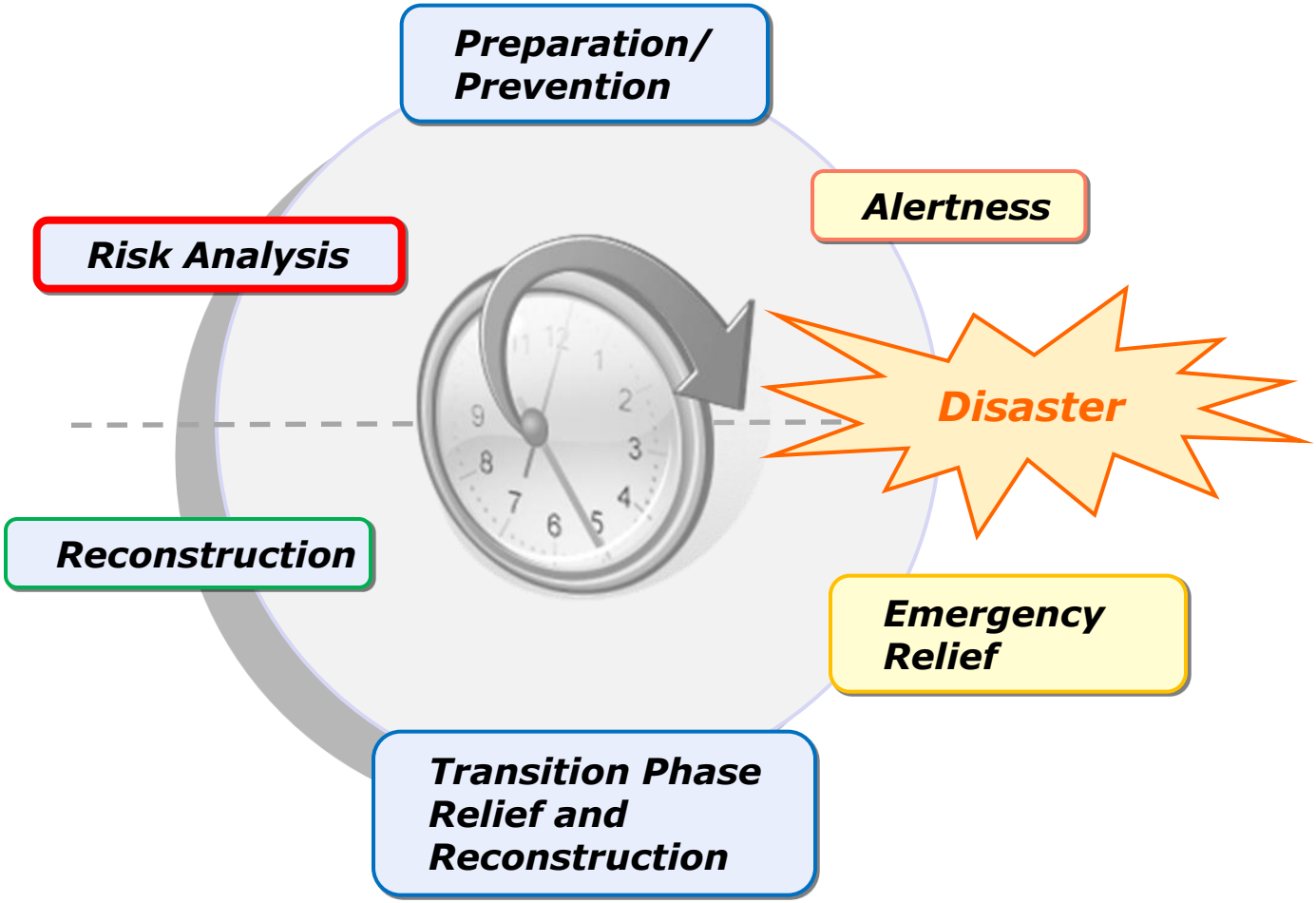
GIS data

District (N → S)	Area [km²]		Inhabitants	
	entire district	tsunami affected	entire district	tsunami affected
Tagajo	18.70	5.04 (26.94%)	36000	9900 (28%)
Ishinomaki	553.27	19.18 (3.47%)	88000	29200 (33%)
Higashimatsushima	107.48	51.45 (47.87%)	24400	17300 (71%)
Matsushima	51.95	2.63 (5.06%)	7000	100 (1%)
Shiogama	15.51	0.07 (0.46%)	32000	15 (0%)
Shichigahama	16.11	15.49 (96.15%)	11800	9600 (81%)
Sendai	787.95	48.39 (6.14%)	700600	21200 (3%)
Natori	98.03	29.47 (30.06%)	38800	15400 (40%)
Iwanuma	55.67	23.66 (42.51%)	32700	5600 (17%)
Watari	63.74	33.67 (52.82%)	18800	6100 (32%)
Yamamoto	69.28	12.69 (18.31%)	10100	4200 (42%)
Sum	**1837.69**	**241.74 (13.15%)**	**1000200**	**118615 (12%)**

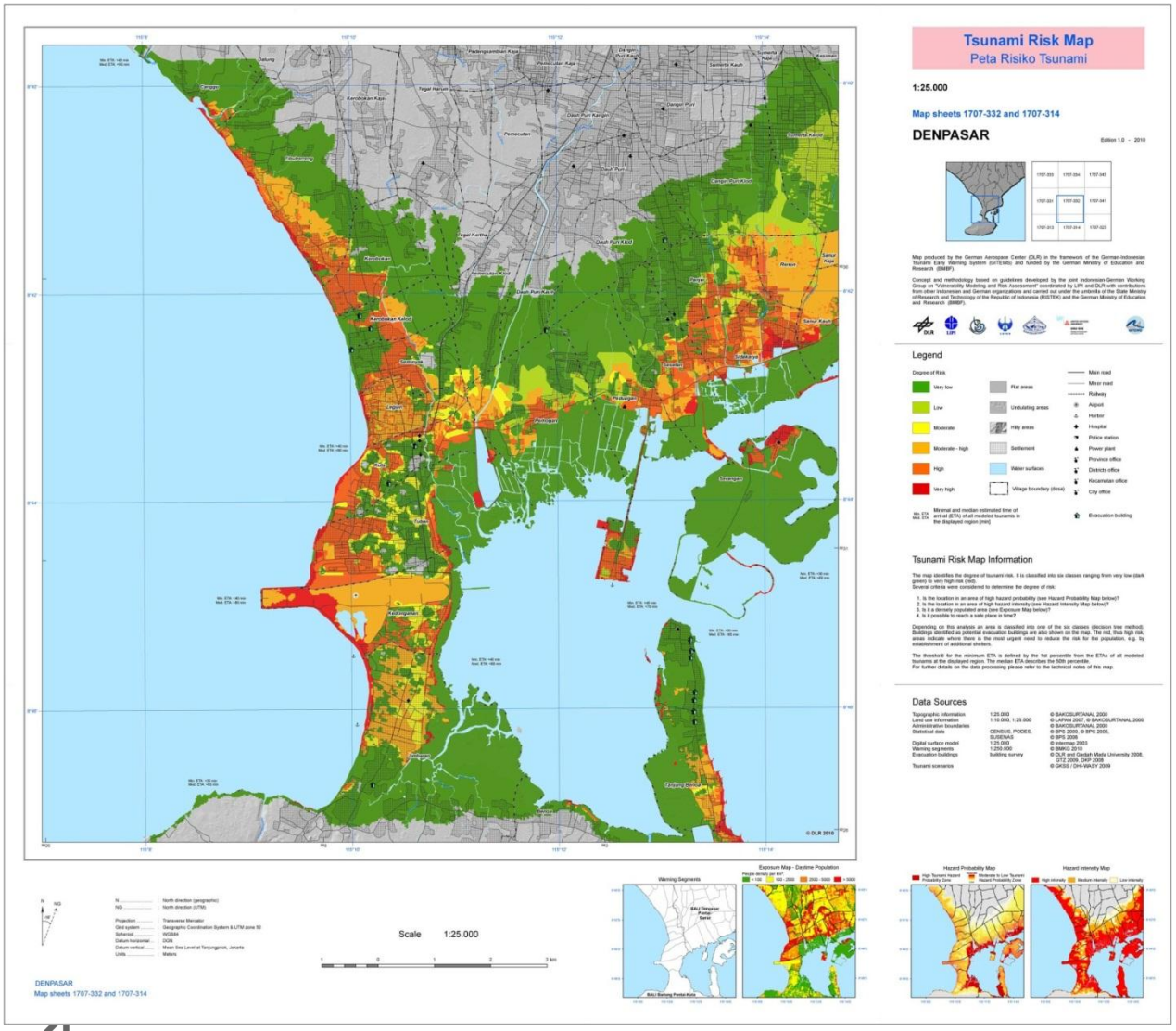


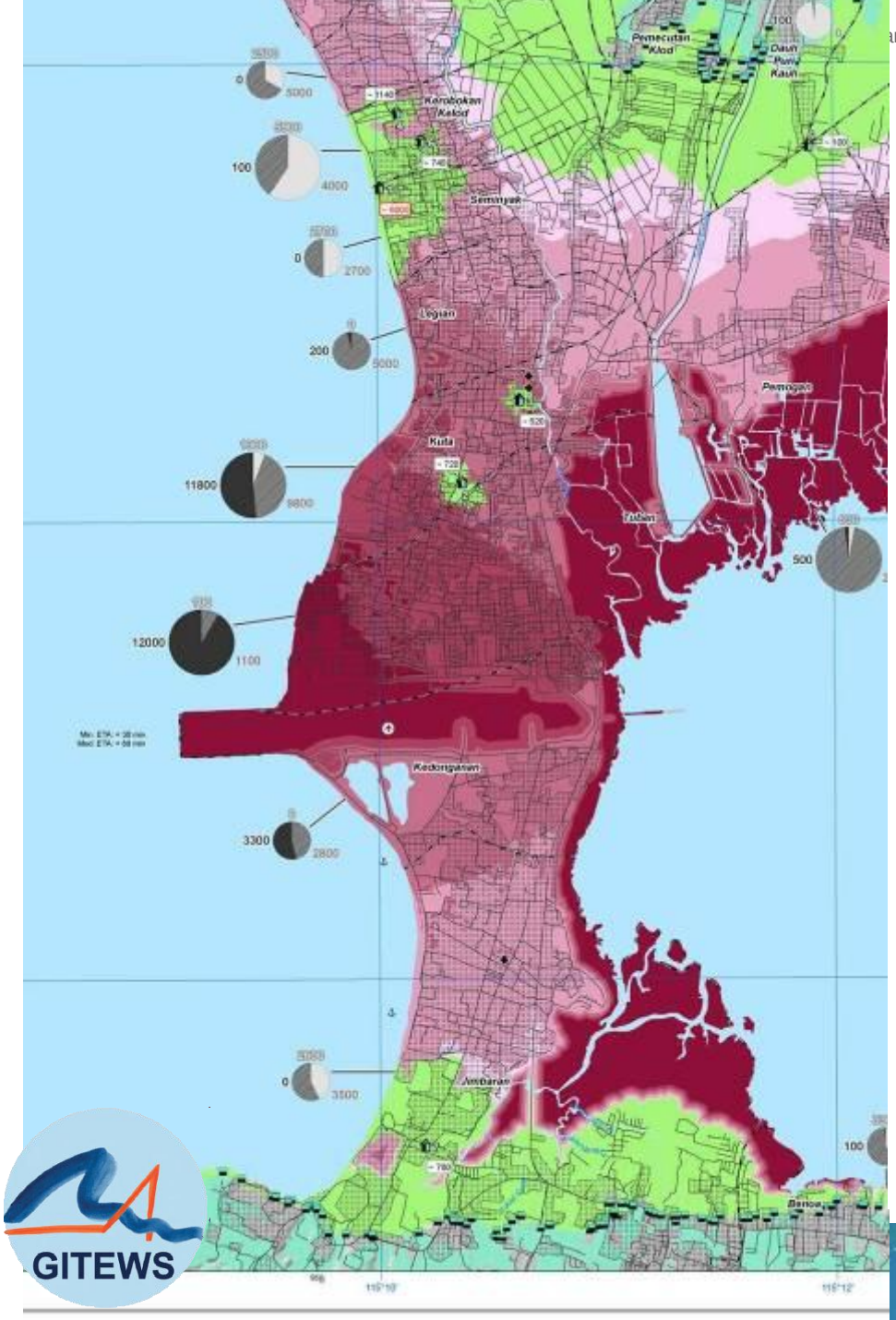
Earthquake Haiti, January 2010

Responsibilities and tasks of ZKI



Risk- and vulnerability analysis, Indonesia





Evacuation Time Map - Major Warning

Peta Waktu Evakuasi - Peringatan Utama

Legend

- 0 - 30 min. evacuation time
- 30 - 60 min. evacuation time
- 60 - 90 min. evacuation time
- 90 - 120 min. evacuation time
- > 120 min. evacuation time
- Temporary shelter area
- Evacuable area - evacuation possible due to the available capacity of evacuation buildings and the available evacuation time (minimal ETA)
- Flat areas
- Undulating areas
- Hilly areas
- Settlement
- Water surfaces
- Village boundary (desa)
- Main road
- Minor road
- Railway
- Airport
- Harbor
- Hospital
- Police station
- Power plant
- Province office
- Districts office
- Kecamatan office
- City office
- Horizontal evacuation target point

Min. ETA / Med. ETA — Minimal and median estimated time of arrival (ETA) of all modeled tsunamis in the displayed region [min]

~ 500 / 9 — Evacuation building with building ID, capacity (approximate amount of evacuees) and available evacuation time as limiting factor

~ 780 / 7 — Evacuation building with building ID, capacity (approximate amount of evacuees) and capacity as limiting factor

Amount of people to evacuate per desa

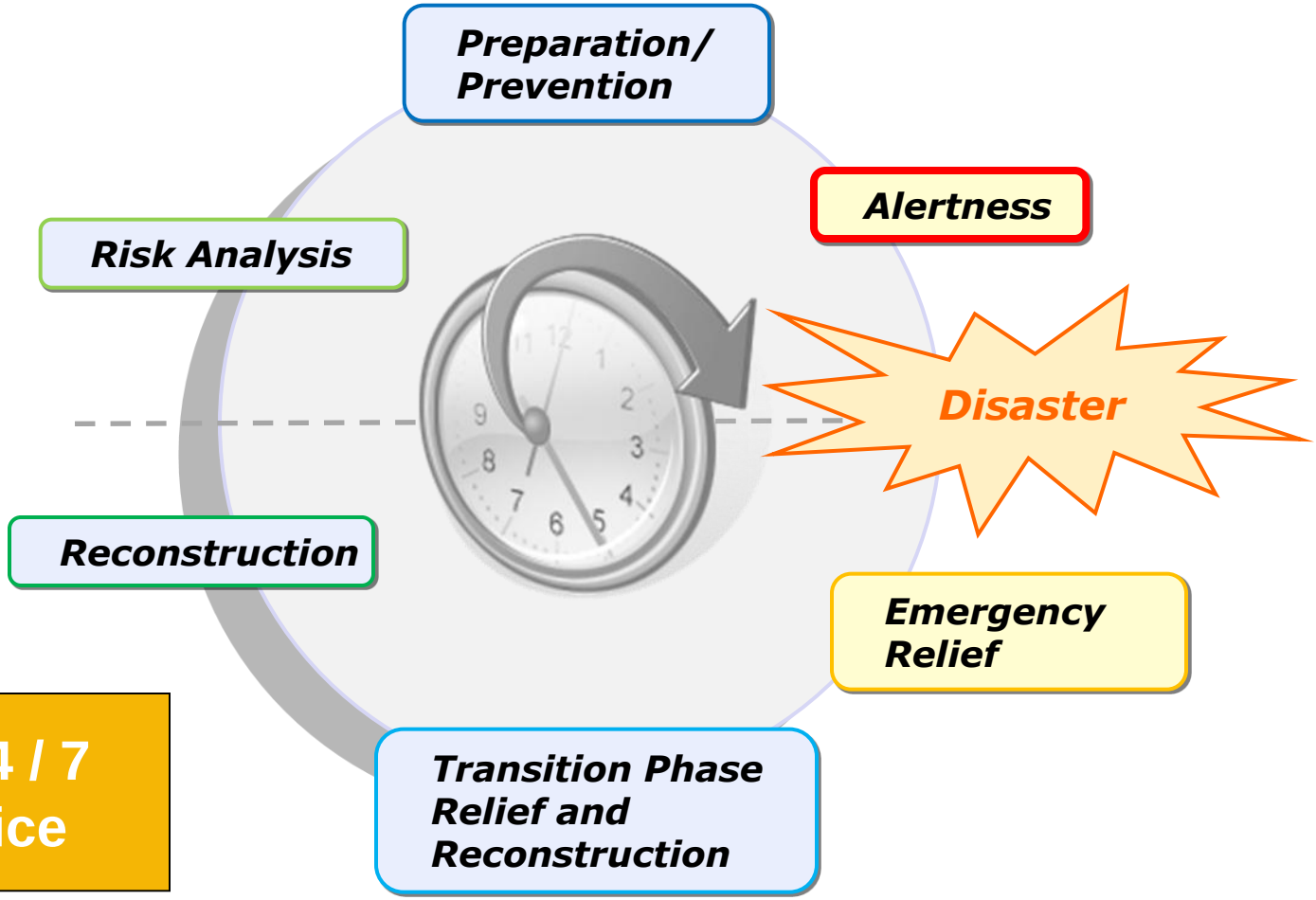
- > 10,000
- 5,001 - 10,000
- < 5,000

Portion and number of people per desa

- 400 — Able to evacuate within 20 minutes
- 4000 — Needing more than 80 minutes to evacuate
- 3200 — Able to evacuate within 80 minutes

GITEWS

Responsibilities and tasks of ZKI



ZKI 24 / 7 Service

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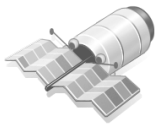
Limitations of satellite remote sensing



- Limited number of available satellite imagery within a certain time frame

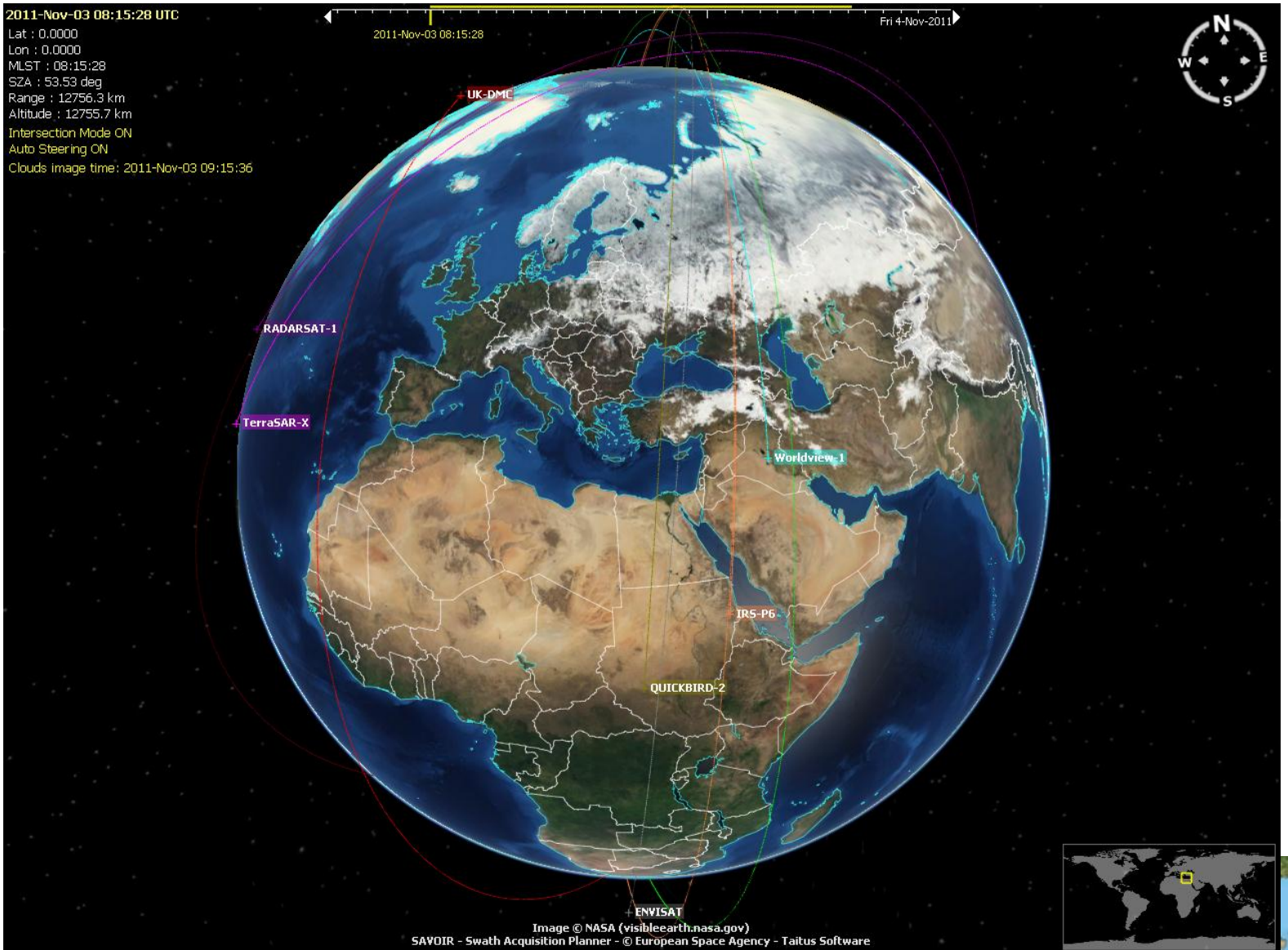
- Weather constraints for optical data (clouds, haze, etc.)

- Spatial resolution versus large scale coverage

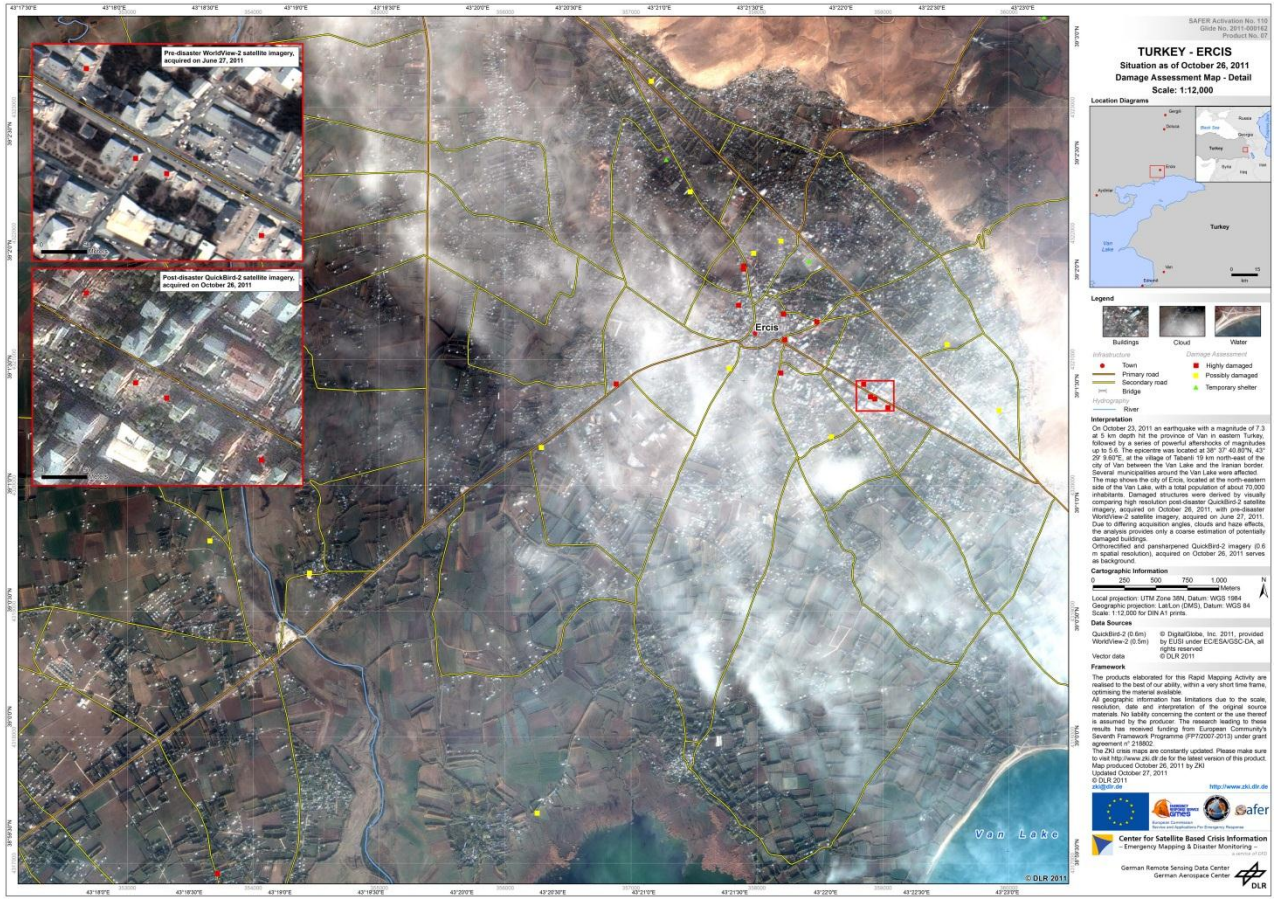
- response time (new acquisitions)

- Costs

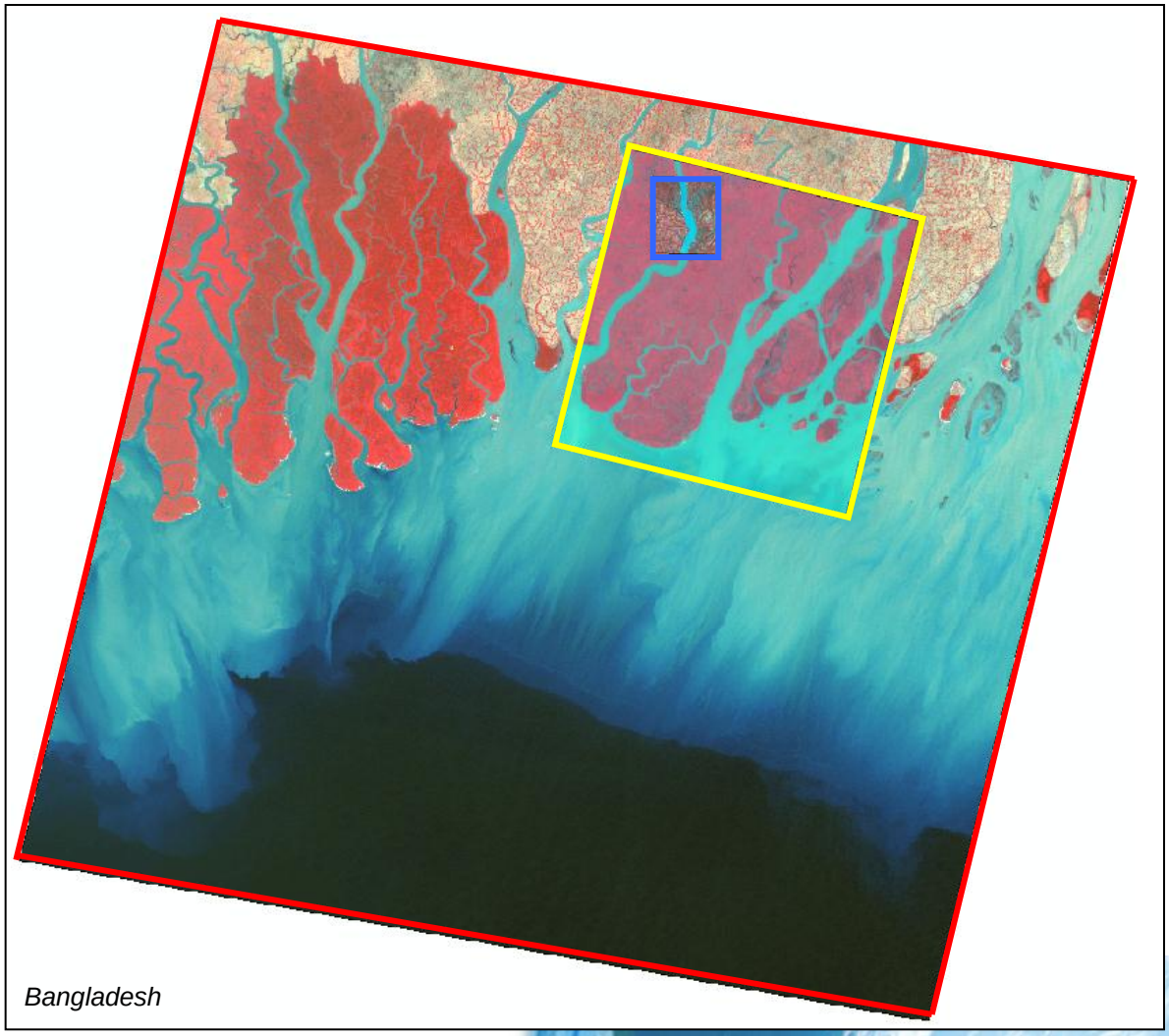
Limited number of available satellite images



Weather constraints



Spatial resolution versus large scale coverage

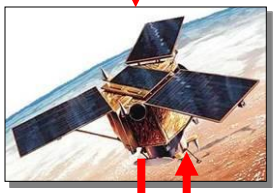


IKONOS: 13 x 13 km coverage 1 m spatial resolution

SPOT: 60 x 60 km coverage 15 m spatial resolution

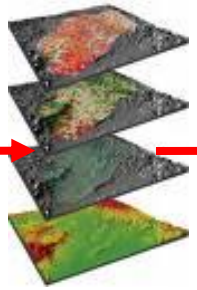
LANDSAT: 160 x 160 km coverage 30 m resolution

Response time



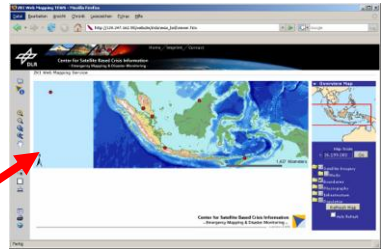
Data acquisition

Pre-processing



Data interpretation

Analysis



Dissemination

Airborne real-time monitoring system

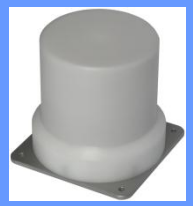
Platform

3K Kamera System

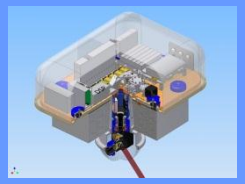
F-SAR

Data downlink

Microwave data link
20 MBit/sec



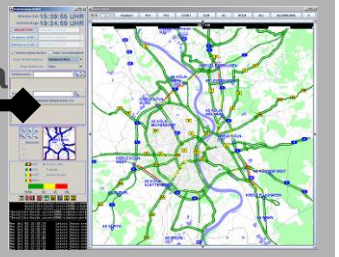
Optical data link
1.25 GBit/sec



Mobile ground station

Traffic data
Images

EmerT-Portal



Infrastructure
Images

ZKI Portal

Images

DMT

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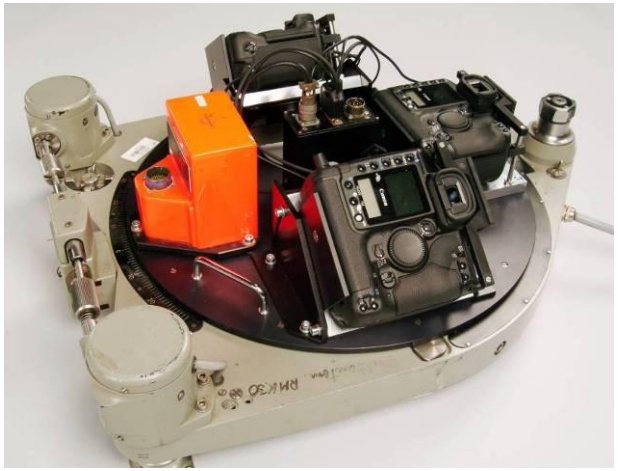
System for Mass Events and Desasters

3K Camera System



-3 Canon EOS Mark III, 21MPix

-Max. framerate: 5Hz

-Realtime INS / D-GPS onboard

-Oblique angle max 35˚

-Traffic modus:

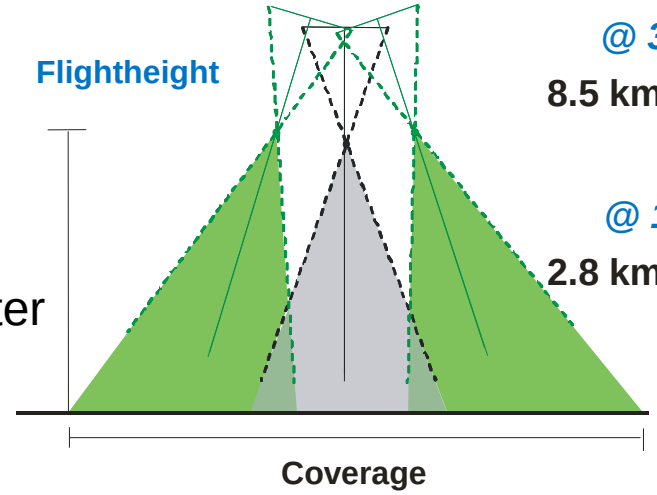
- 3x bursts with pause

-Mapping modus

- Continuous acquisition

-Direct georeferencing

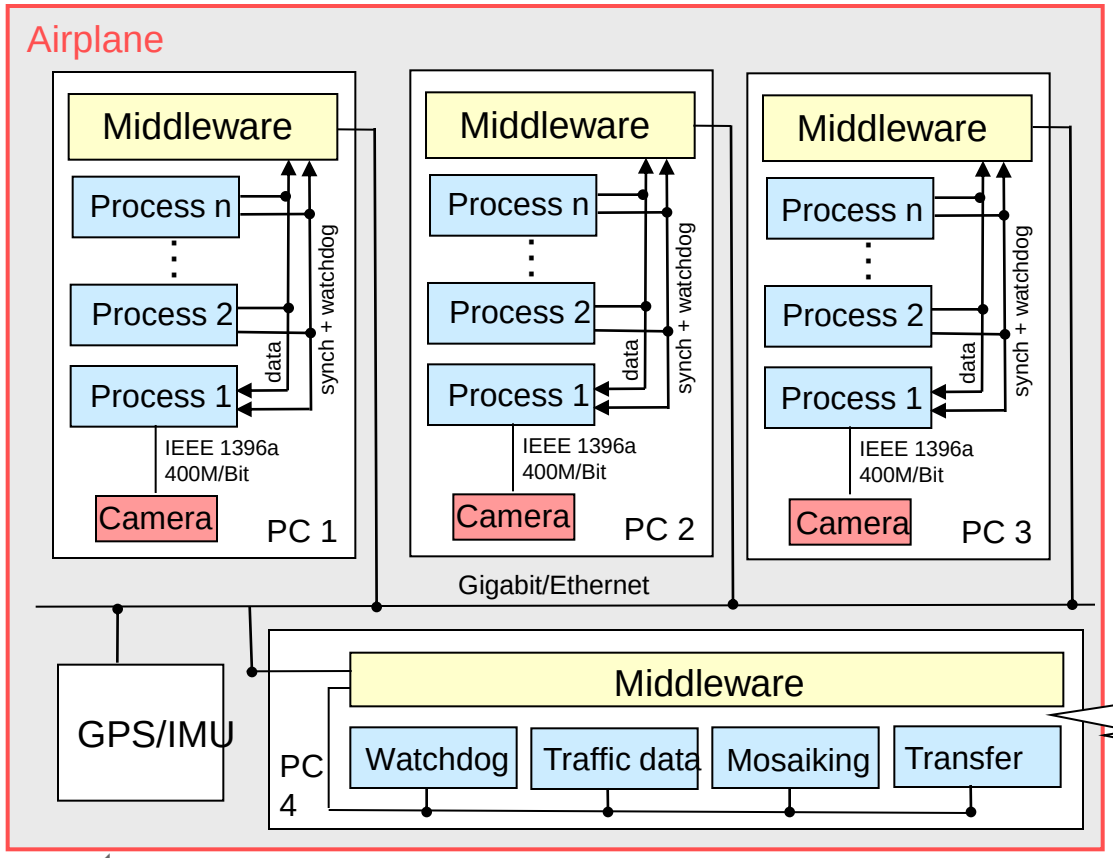
- Position accuracy < 1 meter



	Coverage	GSD	
@ 3000 m	8.5 km	0.40 m	(1:60.000)
@ 1000 m	2.8 km	0.13 m	(1:20.000)

DLR

Image processing and downlink onboard

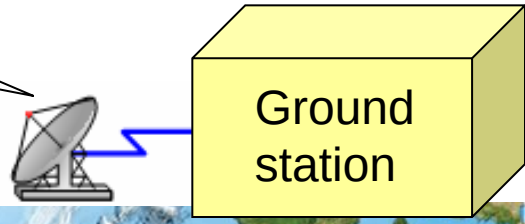


Process 1 — Read image

Process 2 — Ortho rectify

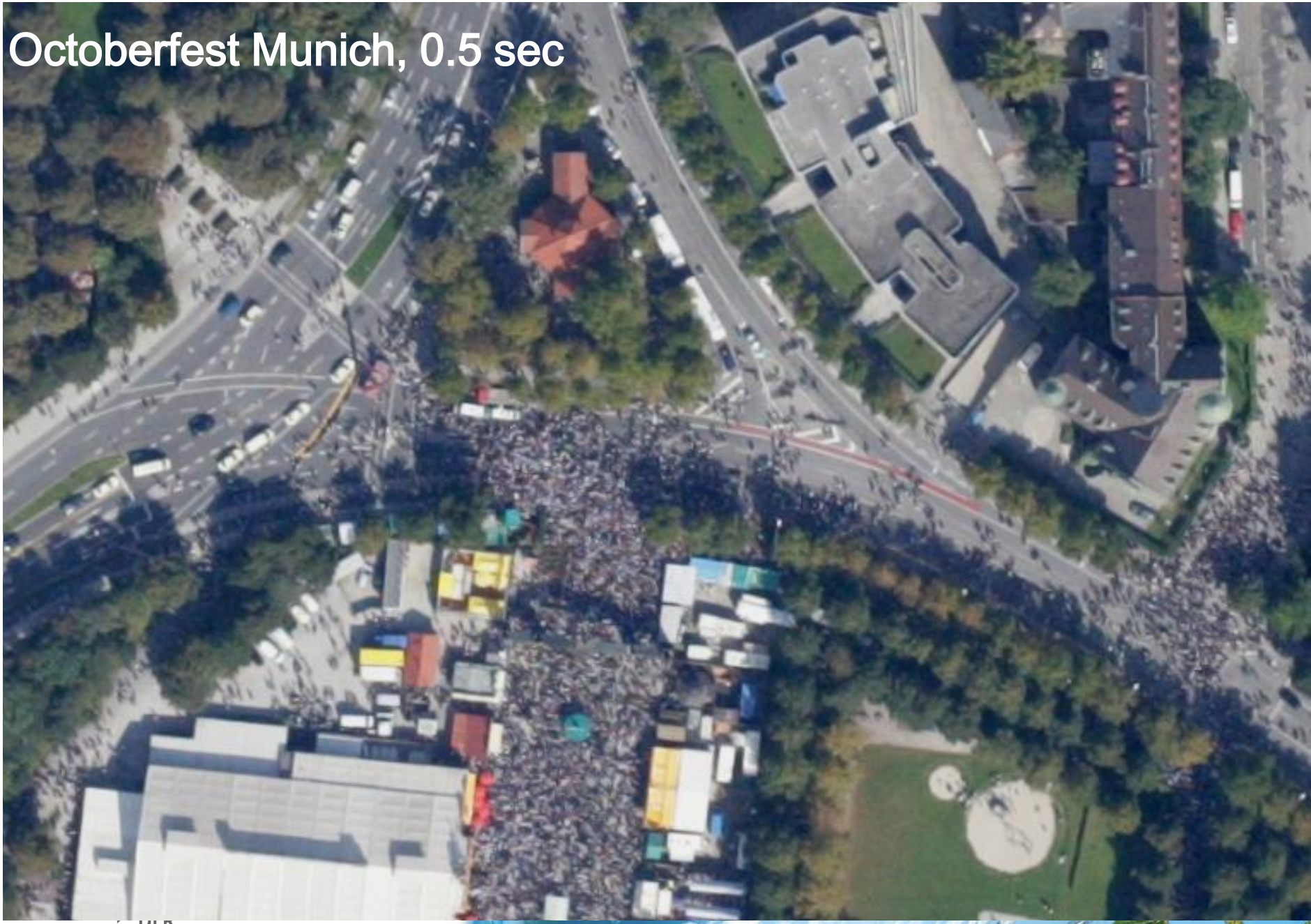
Process 3 — Tile image for downlink

Camera — Canon EOS Mark III 21 MPix



DLR

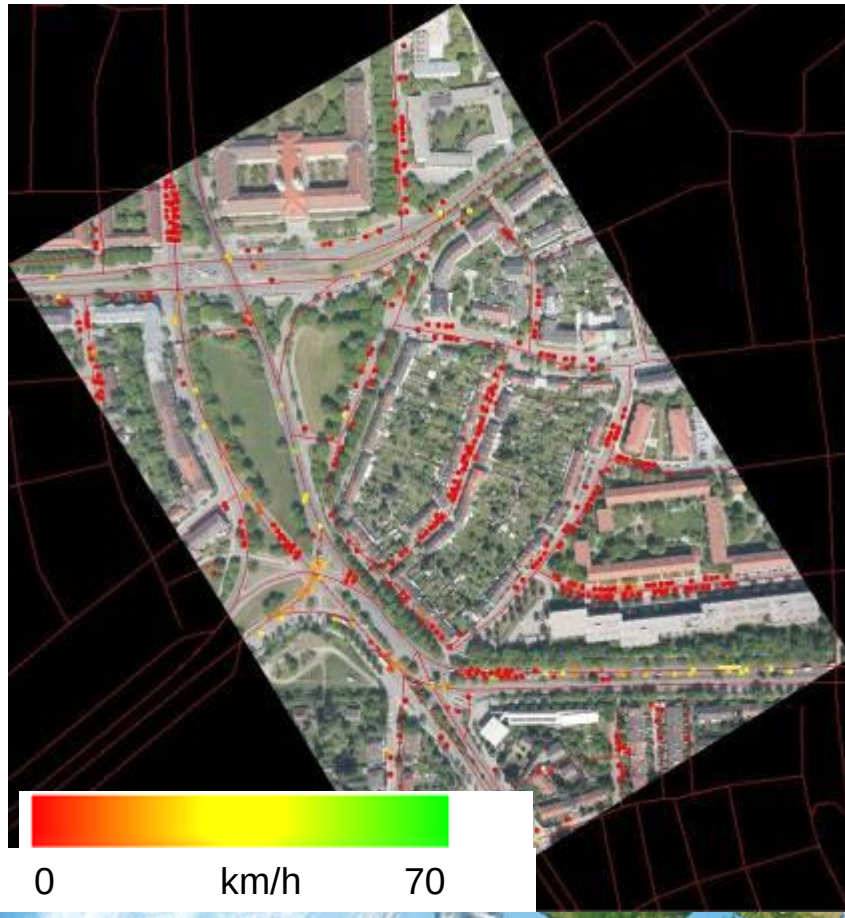

Three flight strips 1000m a. g.
Radiometrical adjustment


Octoberfest Munich, 0.5 sec

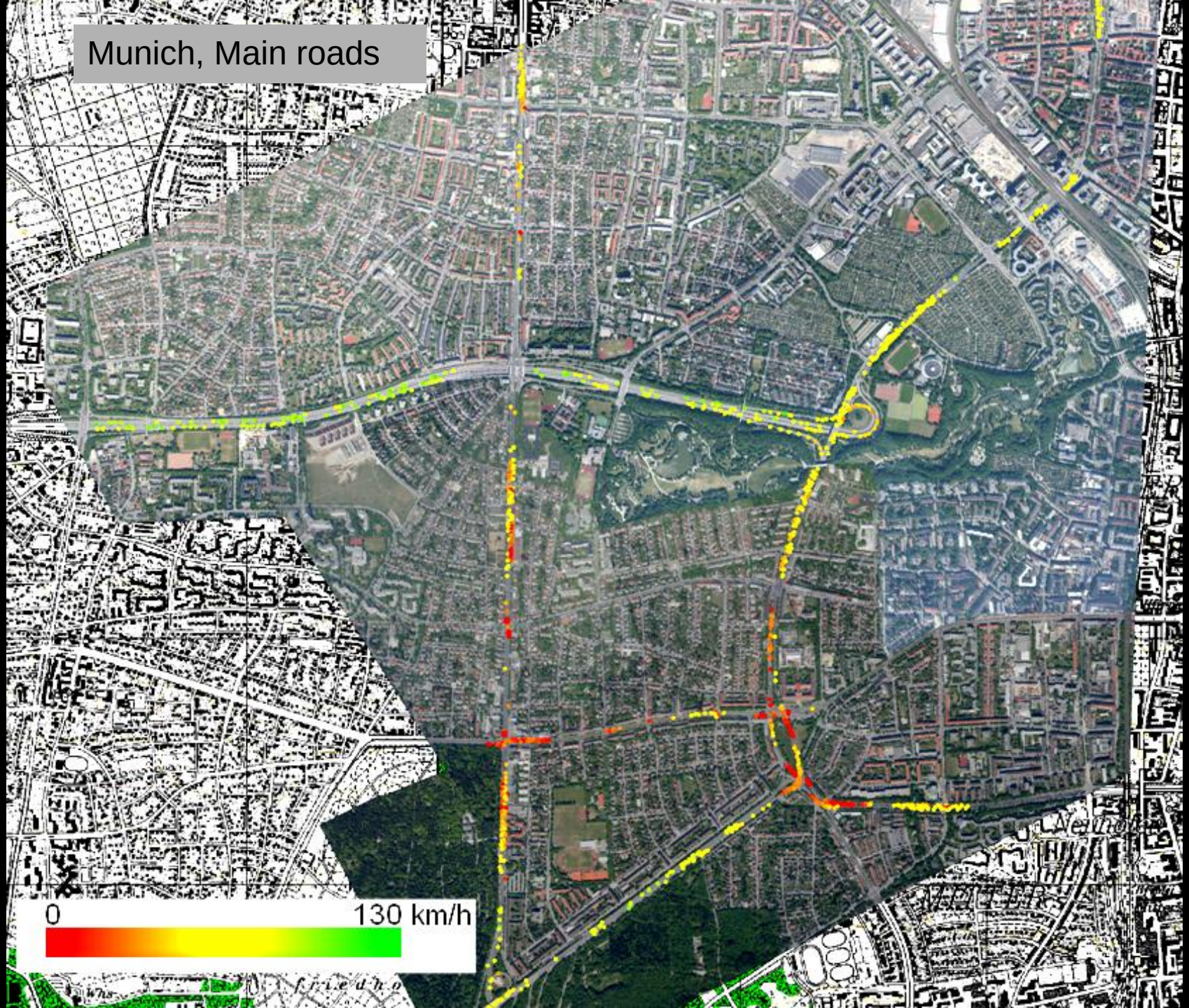
Automatic real time traffic parameter extraction from optical images

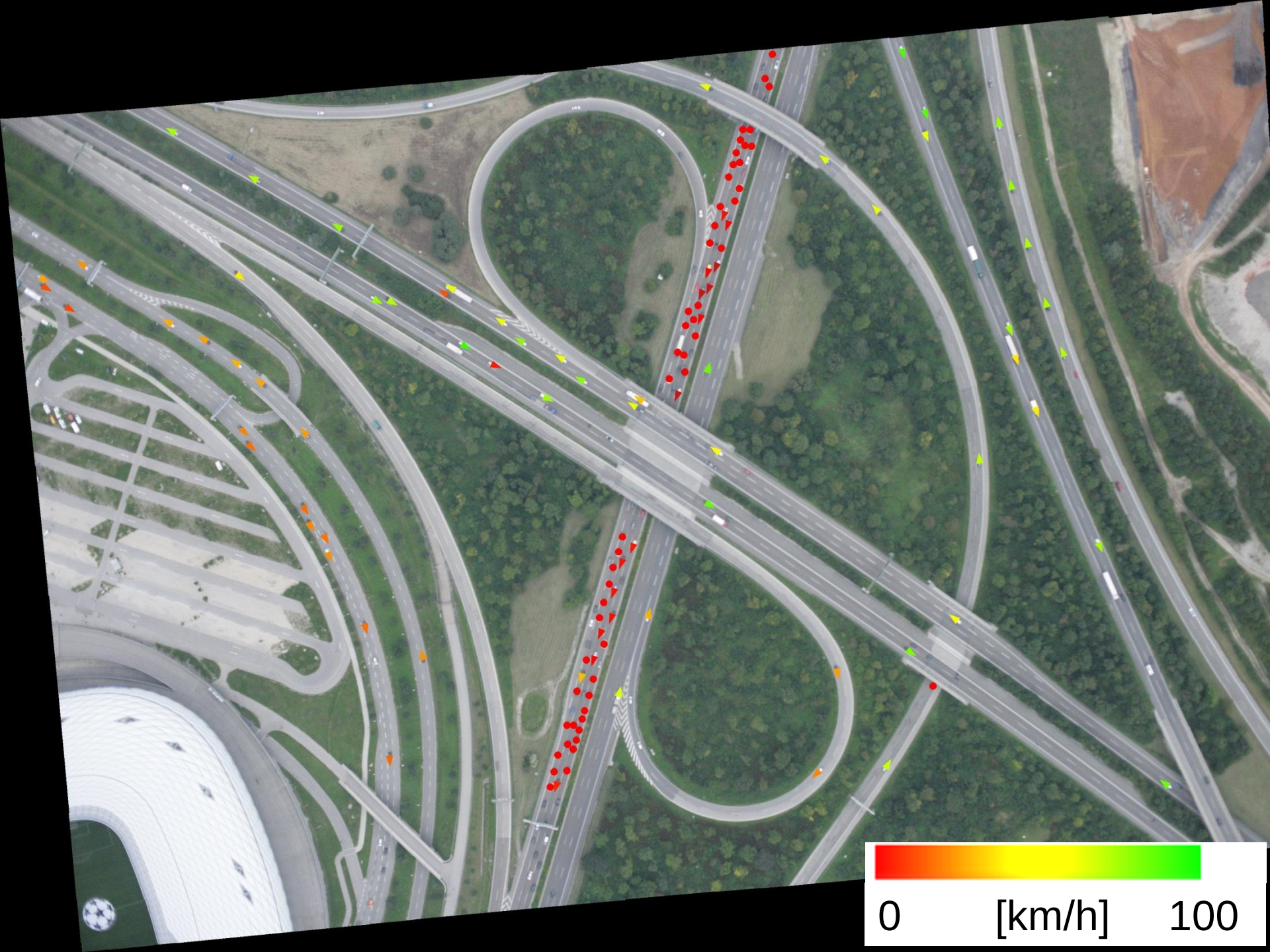
1. Fast geocoding
2. Overlay of geocoded images with road database
3. Vehicle detection
4. Vehicle tracking in image time series
5. Vehicle speed

   v = driven distance/ time distance



DLR

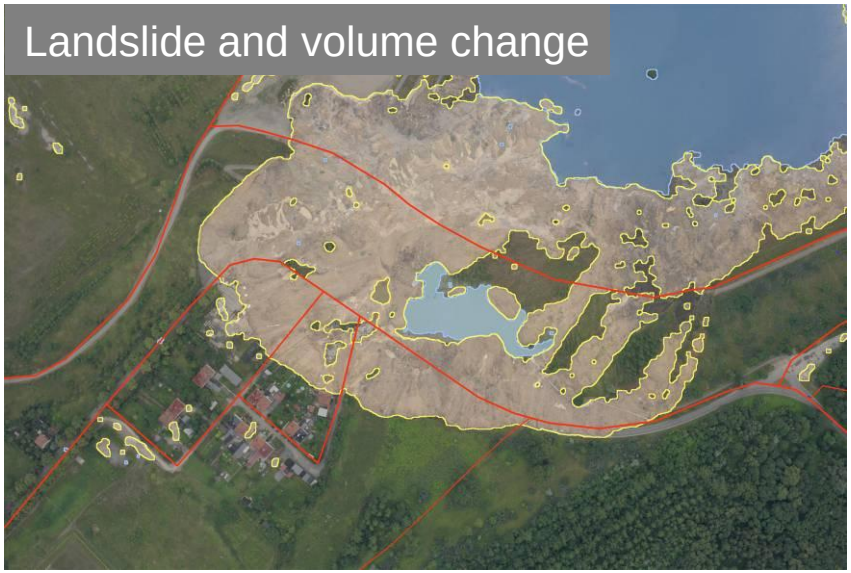

Munich, Main roads
0
130 km/h


0
[km/h]
100

Infrastructure- und Situation Monitoring

- Semi-automatic image analysis
  - Algorithm trained by user

    ⇒ Adaptable to different conditions

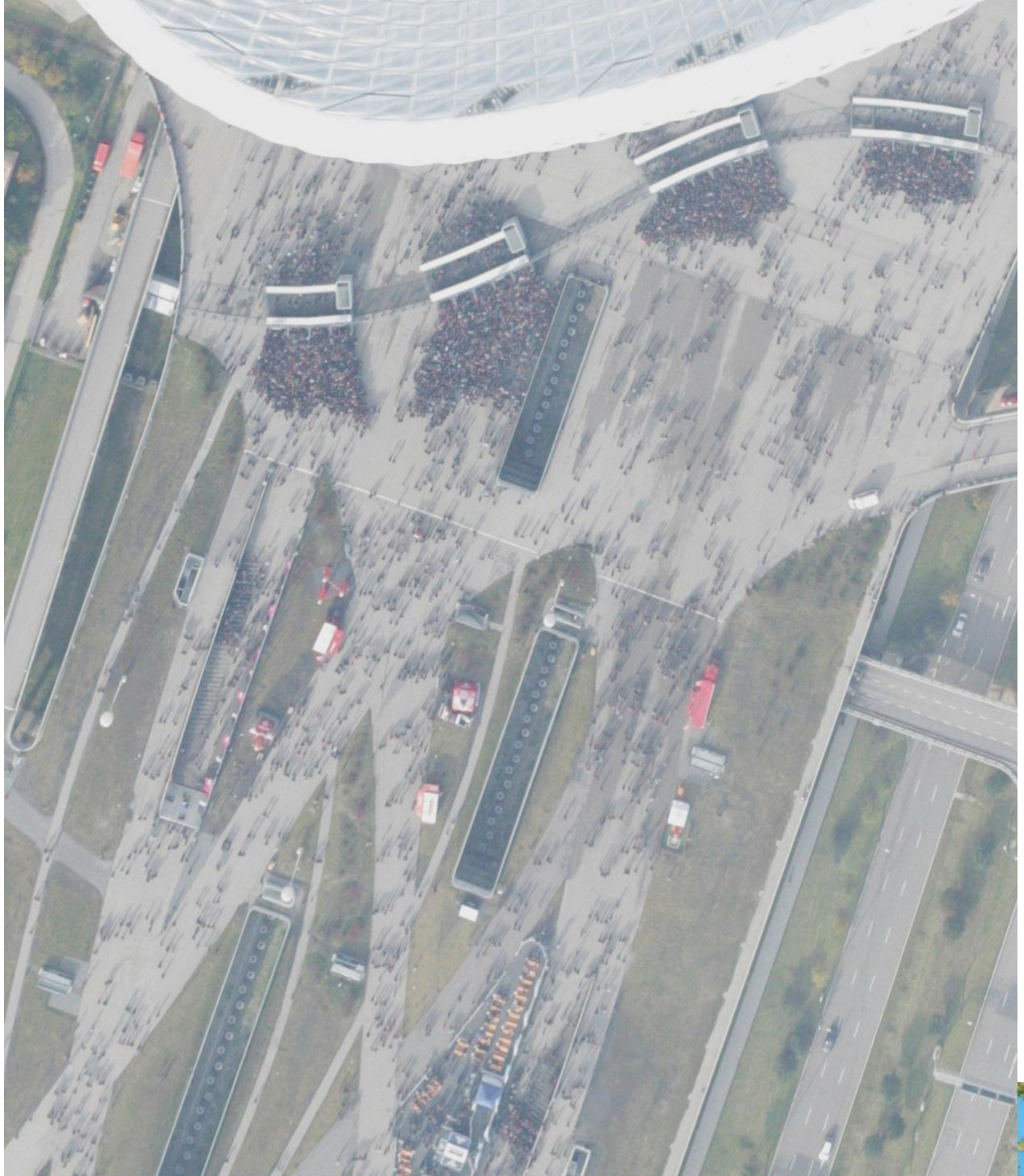


Volume: 1,4 Mio m³

DLR

Oder Flood: EU-Project SAFER
Flood Map of Frankfurt/Oder 30.05.10

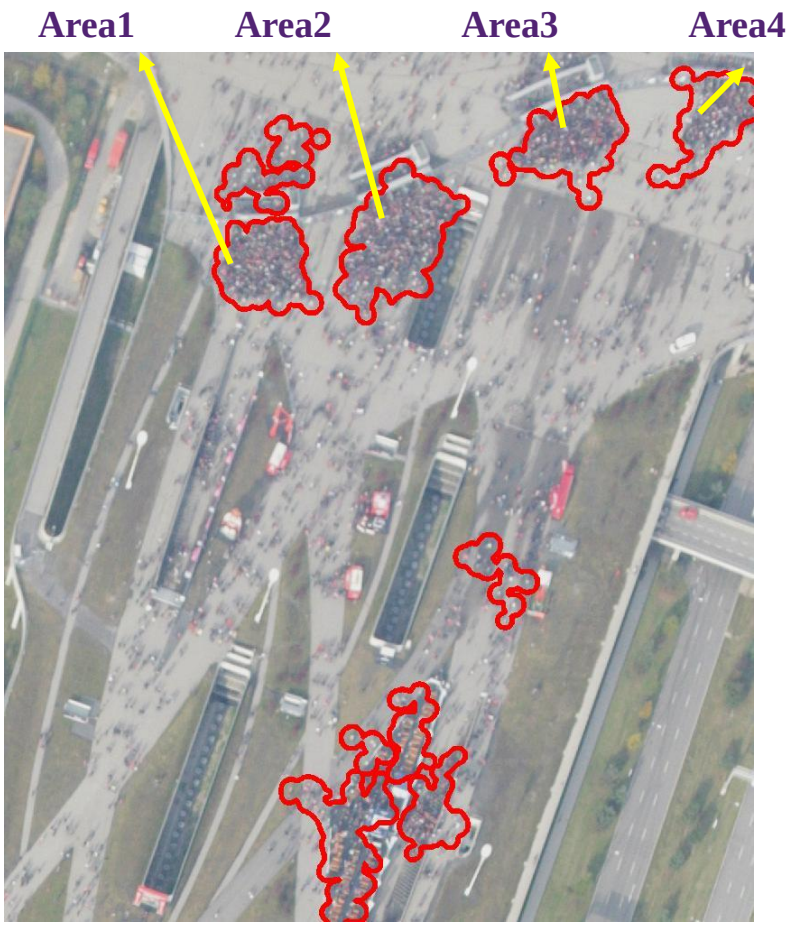
People tracking at Allianz Arena Munich



Flight altitude:
1000 m a.g.

DLR

Automatic Crowd Monitoring



Automatically crowd detection result and test regions

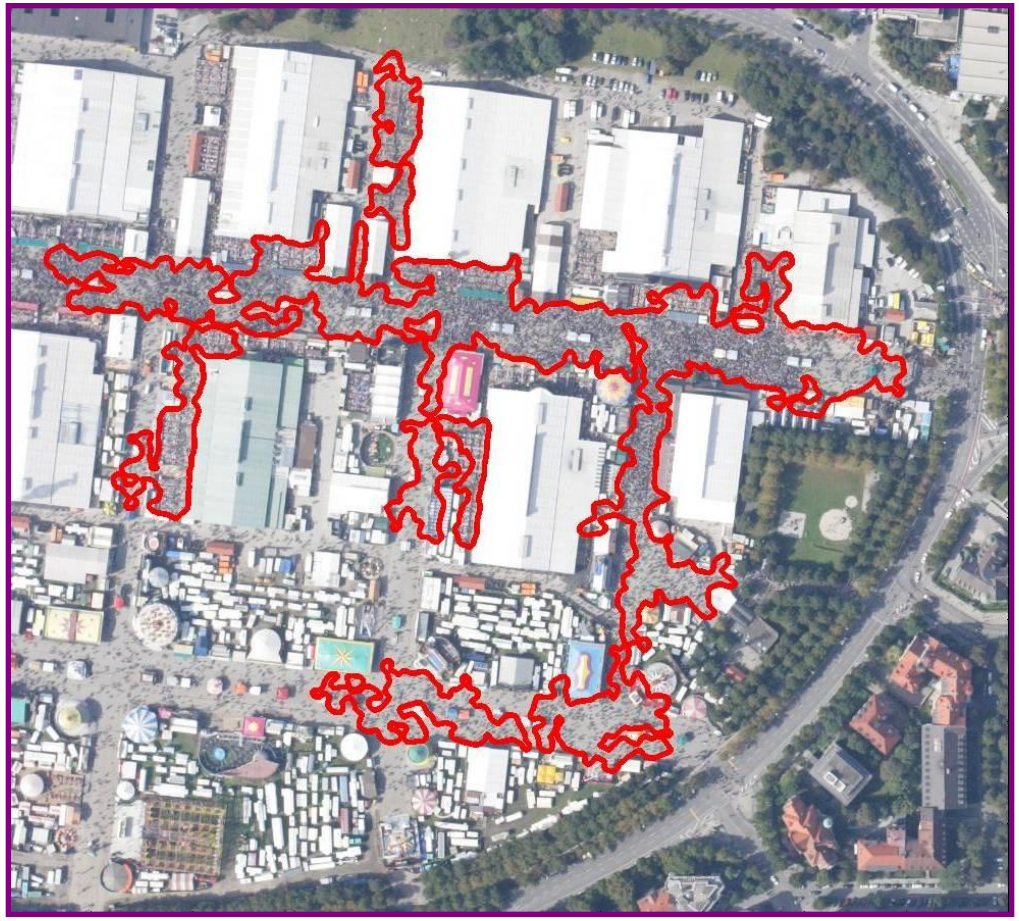
We count number of connected FAST features in crowded areas to find number of people in this region.

Performance table indicating number of people in test regions counted by three different students. Automatically detected number of people is given in the last column;

	Student1	Student2	Student3	Mean of Student Answers	Algorithm Result
Area1	136	143	116	132	139
Area2	177	187	175	180	211
Area3	101	123	119	114	115
Area4	93	96	106	98	102

DLR

Experimental Results:



Oktoberfest complete test image

*Sirmacek, Beril und Reinartz, Peter (2011). Automatic crowd density and motion analysis in airborne image sequences based on a probabilistic framework. ICCV Nov. ,11, ARTEMIS-Workshop, Barcelona, Spain

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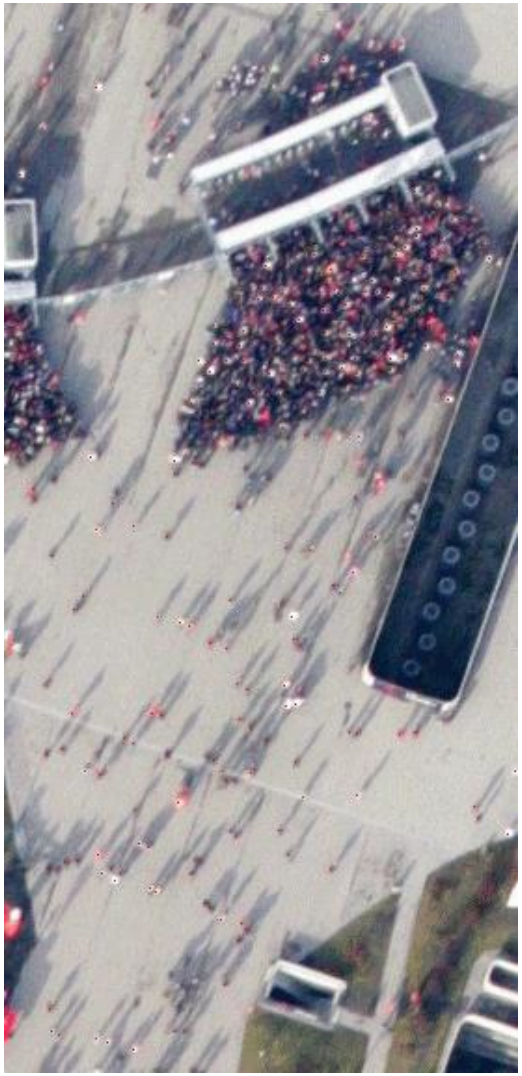
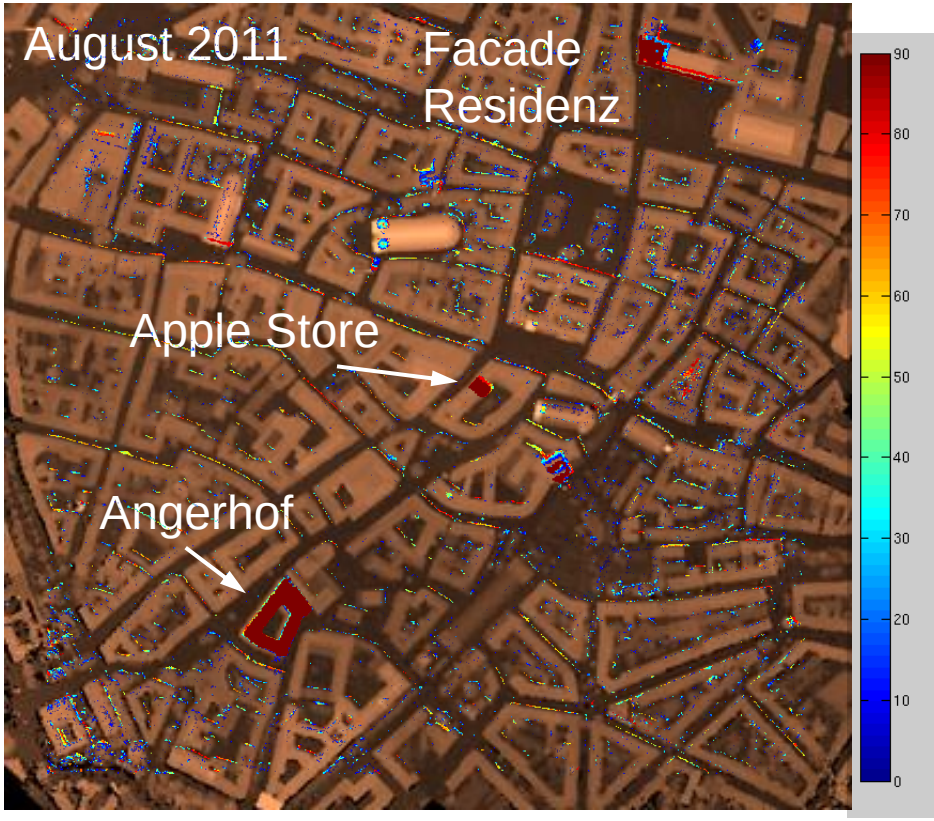
Tracking of persons



„3D change detection“ (Downtown Munich)



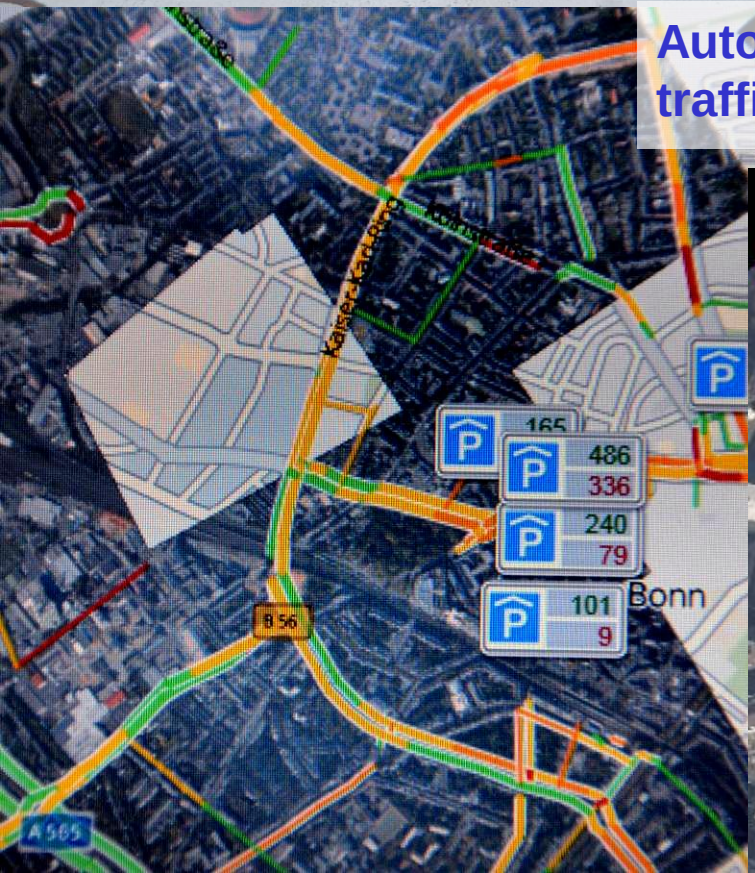
Negative Change

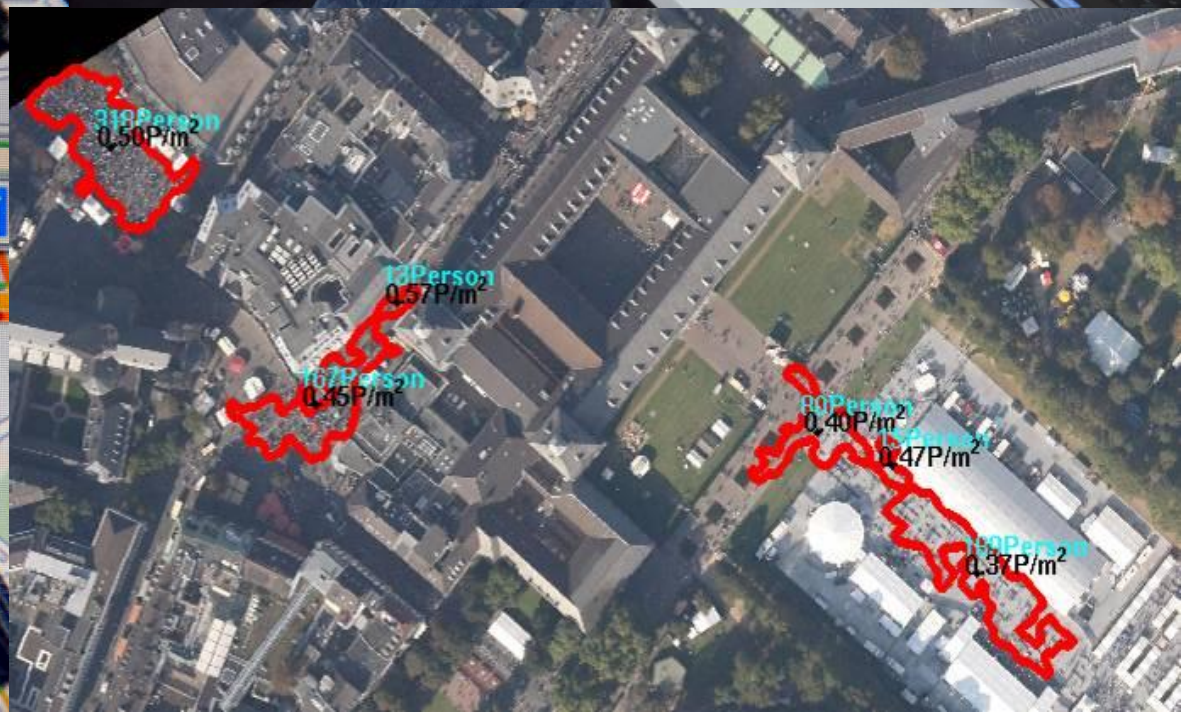
Positive Change

DLR

VABENE „Tag der Deutschen Einheit“, Bonn, Germany
Support of traffic police, 3.10.2011

Automatic airborne monitoring of parking areas, traffic situation and crowd density movements





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Welcome to the Center for Satellite Based Crisis Information

The *Center for Satellite Based Crisis Information* (ZKI) presents a service of the *German Remote Sensing Data Center* (DFD) of DLR. It provides a 24/7 service for the rapid provision, processing and analysis of satellite imagery during natural and environmental disasters, for humanitarian relief activities and civil security issues worldwide. The resulting satellite based information products are provided to relief organisations and public authorities and are also freely available on the ZKI website.

Read more

ZKI Latest News

Tropical storm in Mozambique
2 March 2012, 23:59 CET

On March 2, 2012, Tropical storm IRINA struck Madagascar at about 00:00 GMT and is forecasted to strike Mozambique as a tropical cyclone at about 20:00 GMT on March 3.

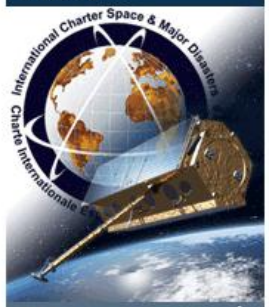
According to the information supplied by the Joint Typhoon Warning Center (JTWC), the point of landfall will be north the border of Mozambique and South Africa. IRINA is expected to bring 1-minute maximum sustained winds to the region of around 129 km/h (80 mph). The cyclone is expected to cause heavy rain and flash flooding in Mozambique, and storm surges generally between 1.2 and 1.5 metres (4-5 feet).

Full article

Flood in Bulgaria
10 February 2012, 21:55 CET

Due to heavy snow that has covered Bulgaria in the beginning of February 2012, several dams were overflowing. On

Feature



DLR joins International Charter 'Space and Major Disasters'

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