Experiences with current high resolution sensors and preparation of operational water quality services for Sentinel 2+3

K. Hartmann
hartmann@eomap.de

CoastColour and SeaSWIR User Consultation Meeting
09.-10.05.2013
EUMETSAT premises, Darmstadt

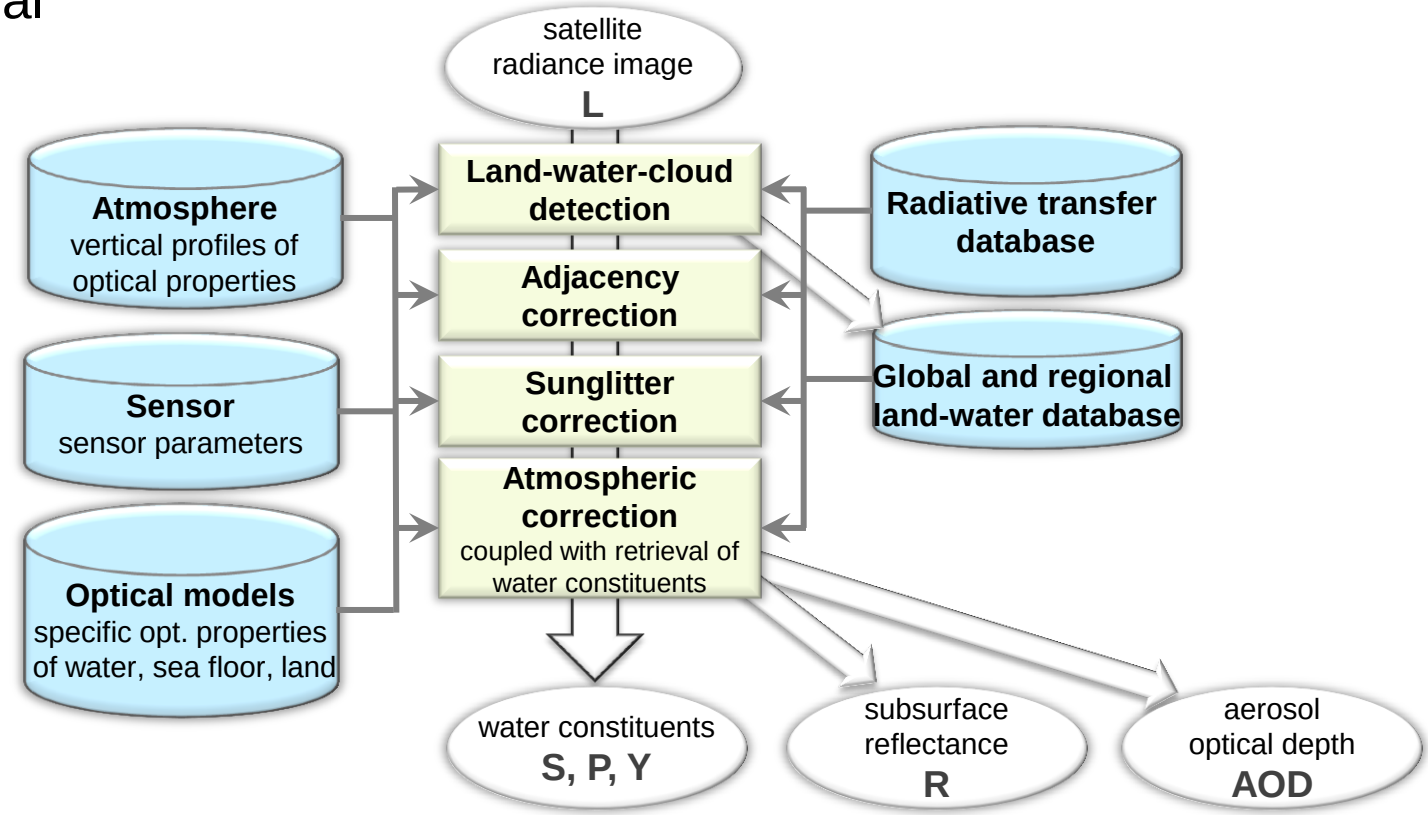
Earth Observation & Mapping

Content

1. Technical challenges: High resolution imagery
2. Example of high resolution Water Quality products
3. Preparation for Sentinel 2 and 3

EOMAPs MIP system

- Sensor independent
- Physics based
- Operational
- Modular



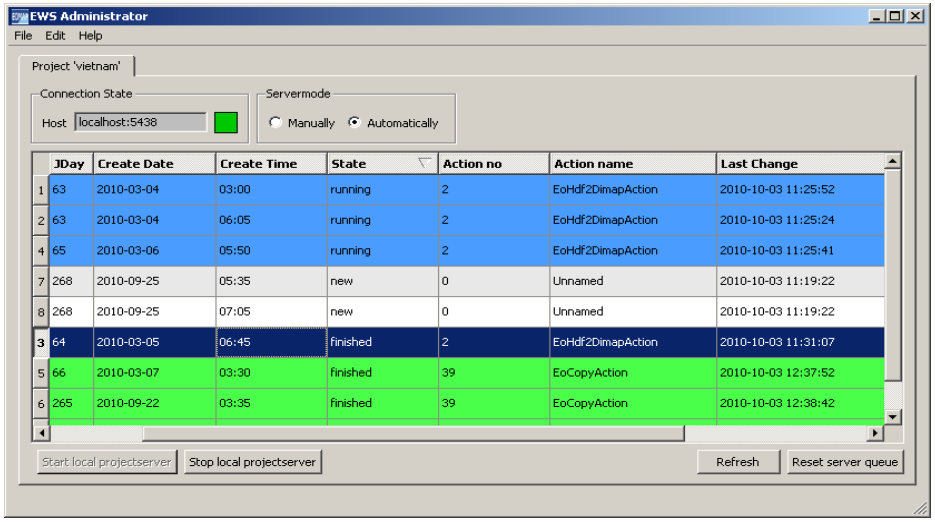
Operational WQ processor: EWS

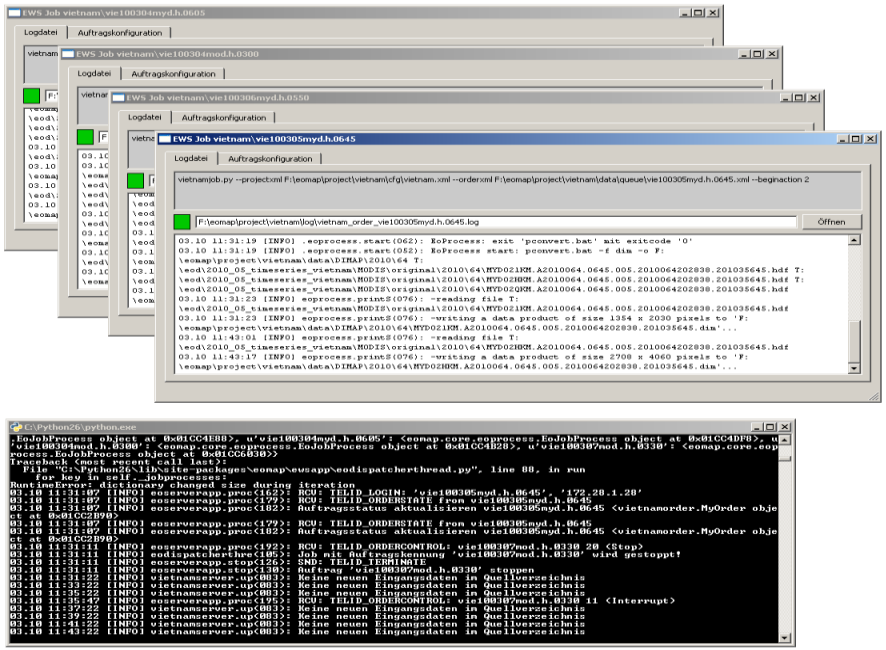
Operational satellite data value adding software EWS and MIP

Framework processor EWS (**E**OMAP **W**orkflow **S**ystem)

The EWS integrates and controls different automated VA processes.

- Event based job scheduling
- Import and distribution of input and output data
- Job control and job distribution to available processor cores
- Workflow contains > 100 processing steps (for high res. data)





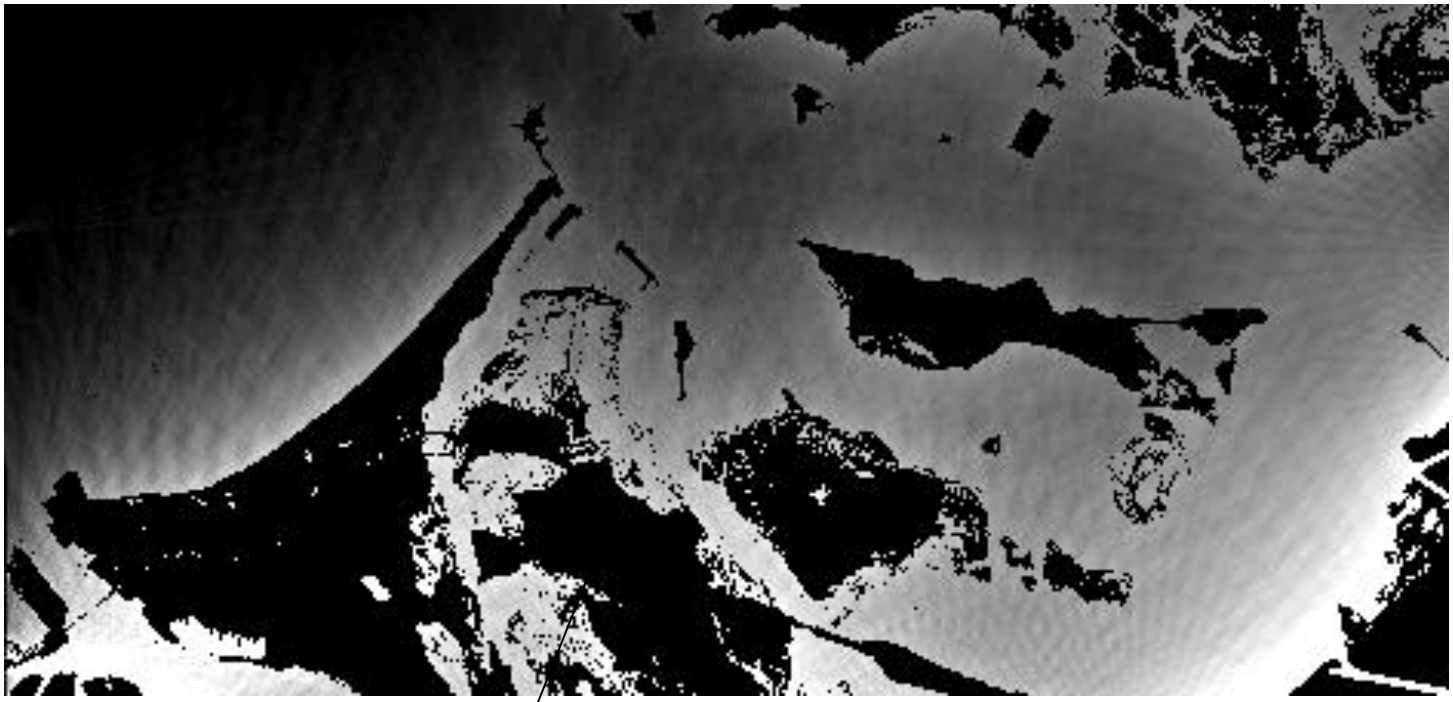
Technical challenges: High resolution imagery

Operational Processing Challenges: High Res.

- Correction for adjacency effects
- Sunglitter correction:
  - Challenging spectral discrimination aerosol-sunglitter-variations
- Pixel wise quality estimations to improve
- Cloud shadow detection (with individual cloud heights)
- Cirrus detection
- Adaptive filters for noise and artifacts
- High res products: TUR, TSM, Z90 and SOA (Y+CHL). CHL not yet stable, may be with Sentinel 2 under certain conditions if radiometric stable and sensitive

Adjacency effect

- MIP correction: Accounts for all BDRF effects of the atmosphere
- Coupled with atmospheric correction
- Land albedo calculated by the sat. scene
- AOT assumed for 1st iteration but can be adapted for 2nd



Radiance RGB Channels 3,2,1

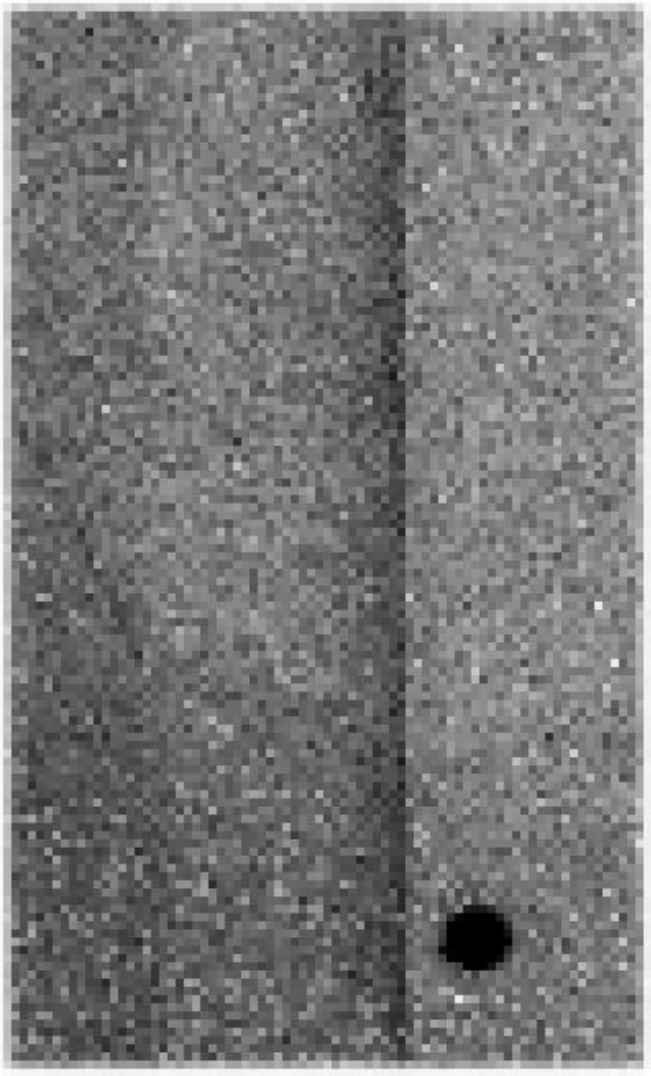
Adjacency Corrected

Subsurface Reflectance

Adjacency Effect Channel 1

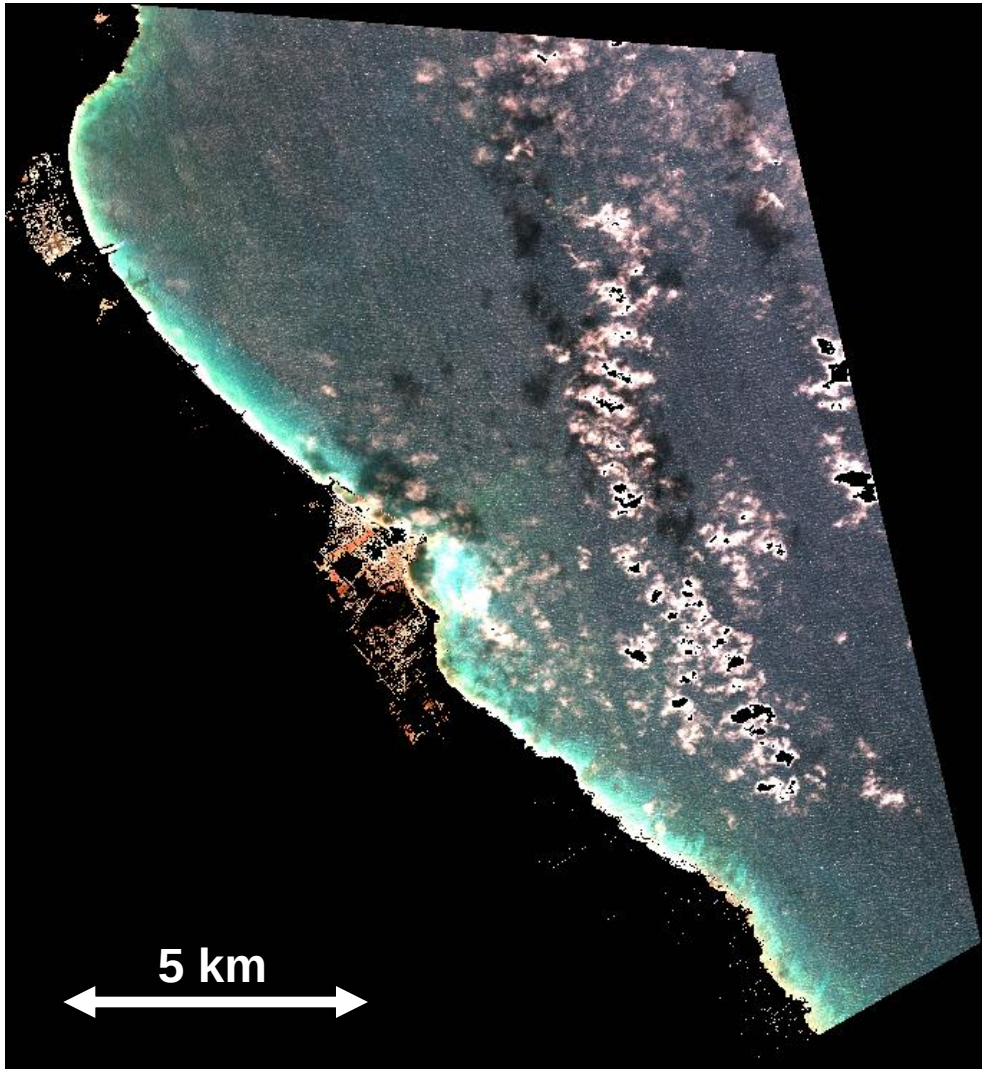
Bright sediment

Noise and artifacts

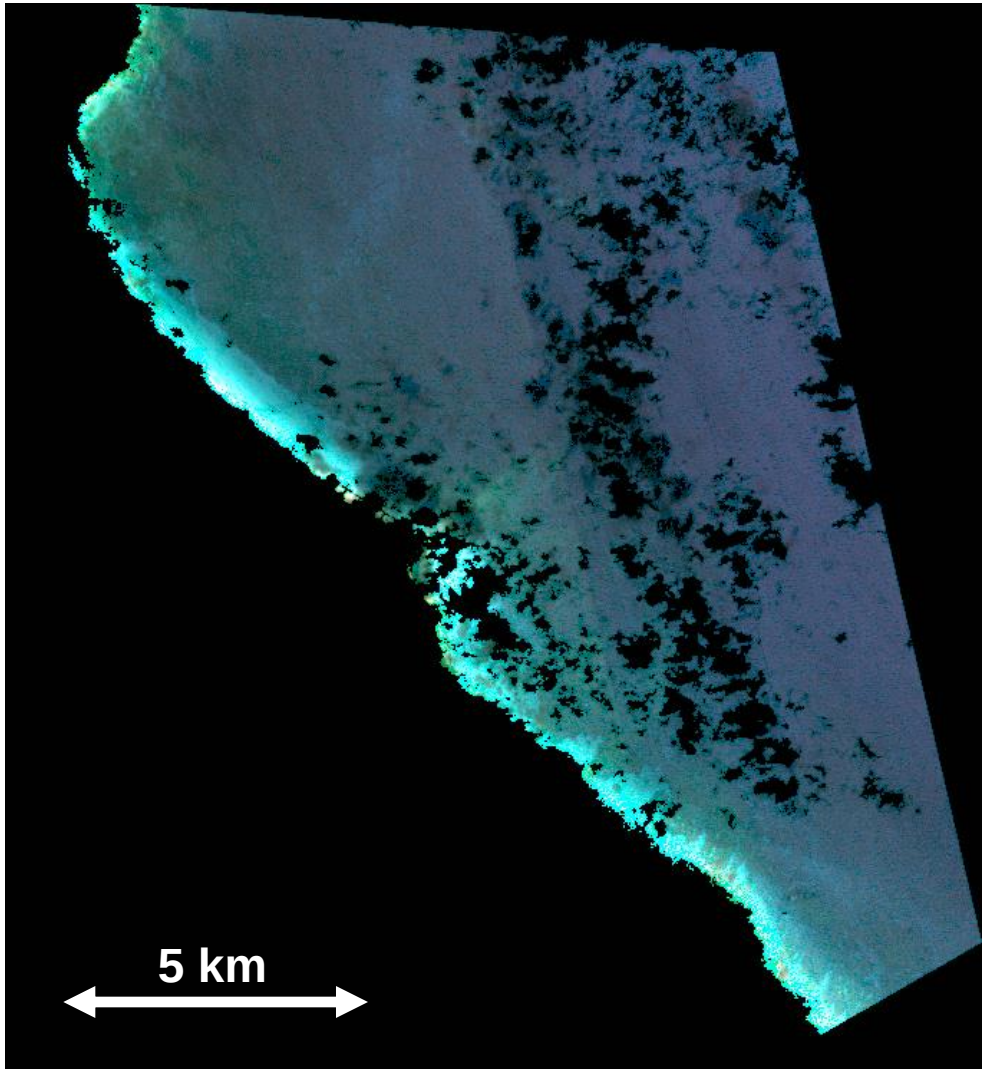


Clouds, Haze, sunglitter

Satellite Sensor QuickBird, 2.8 m MS



Clouds, Haze, sunglitter

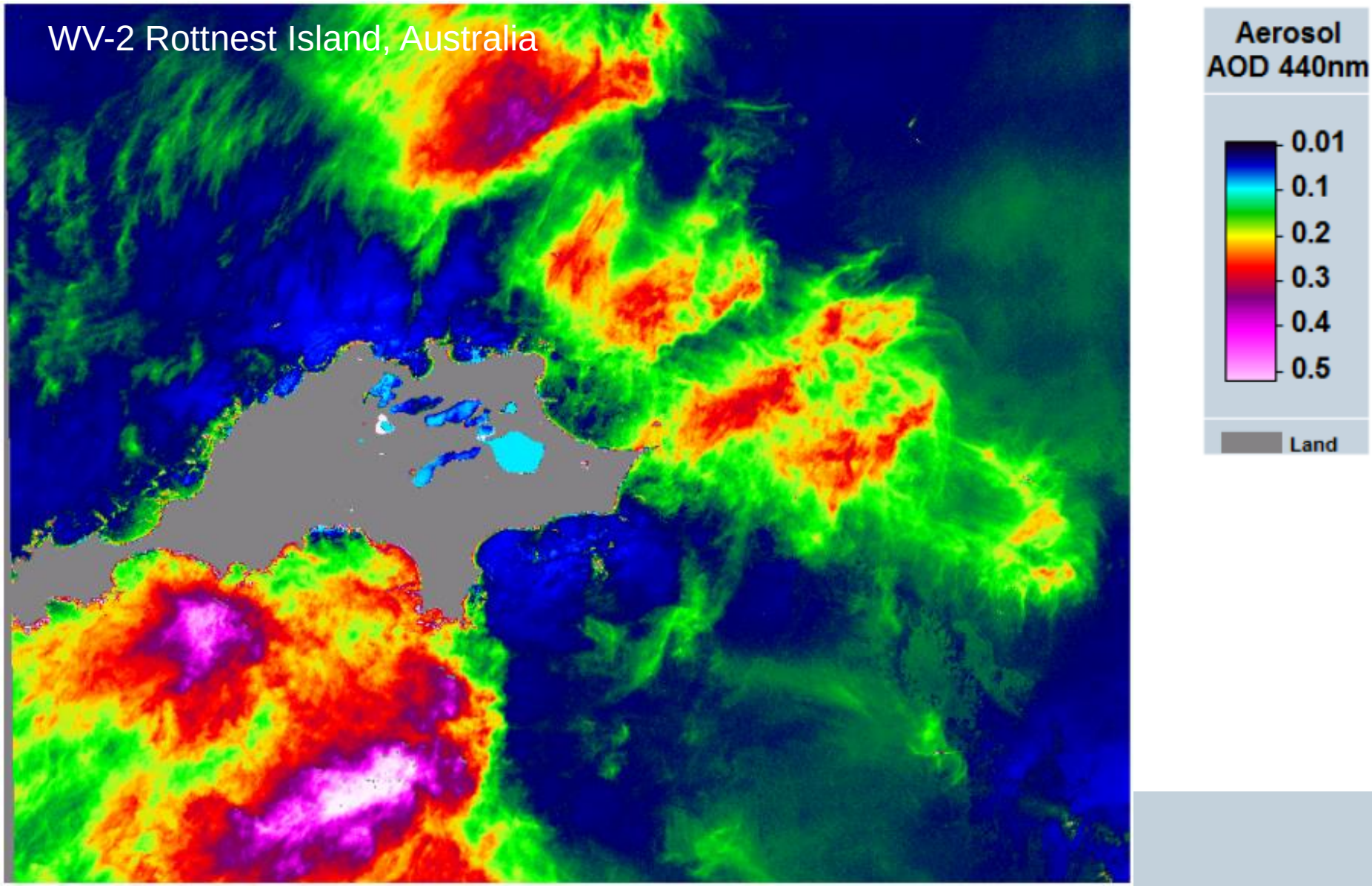


Challenge:

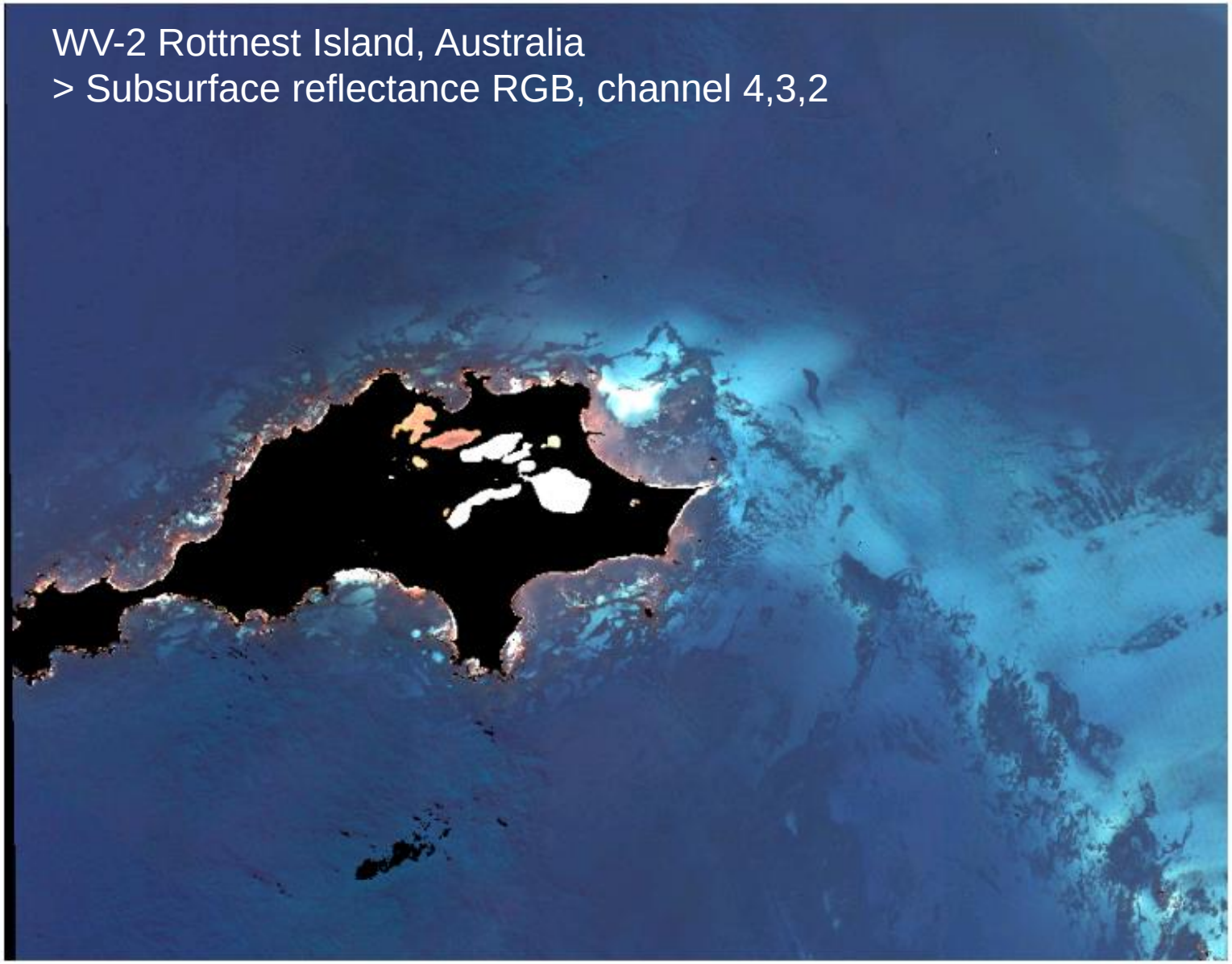
Coupled sunglitter and aerosol retrieval, Sentinel-2 might lead to improvements

Atmospheric correction

Atmospheric correction



Atmospheric correction

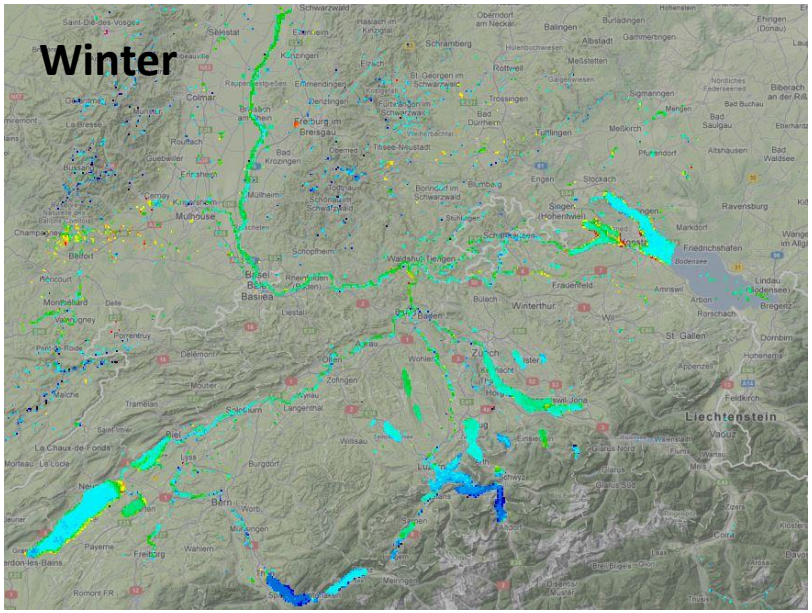


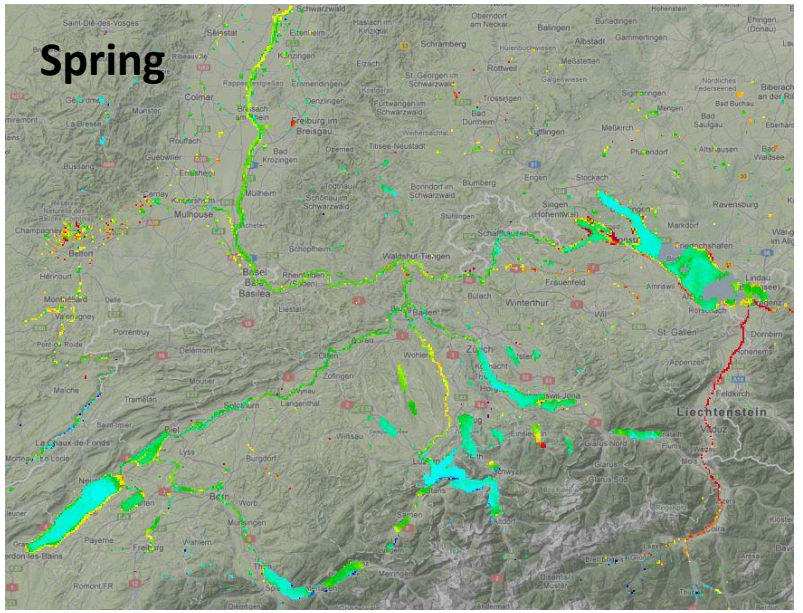
Examples of high resolution Water Quality products

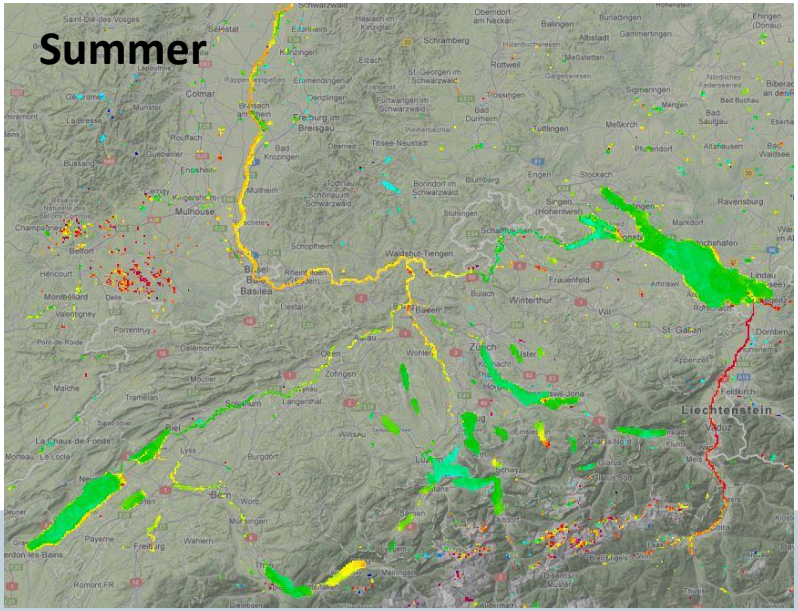
Current experience

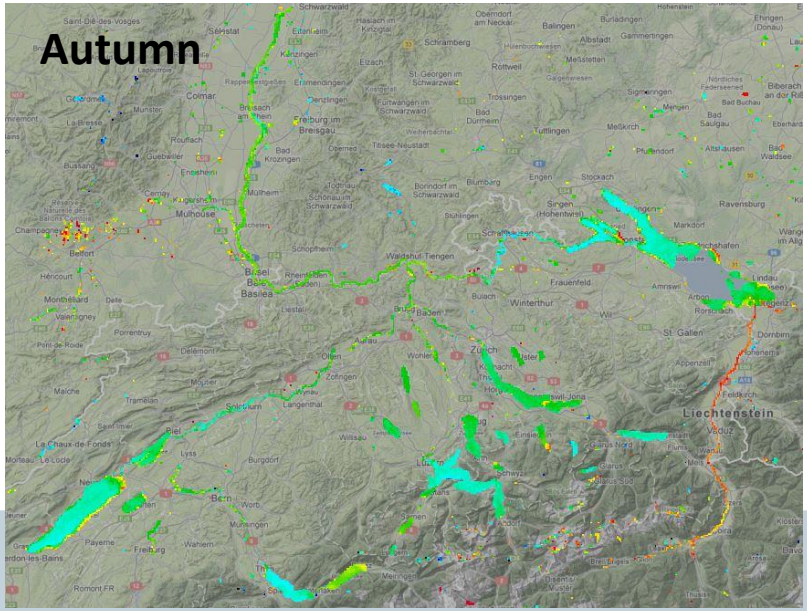
- Several 1000 high res WQ products produced based on **high res**. imagery, worldwide (Landsat 5, Landsat 7, RapidEye, Theos, Spot 4 and 5, …)
- Several 10000 moderate WQ products based on **moderate res.** imagery (MODIS, MERIS) with MODIS-NRT capabilities for Europe, Australia, central America
- Running EOMAP WQ algorithms at several MODIS ground-segments

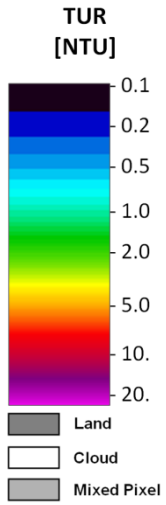
High Res: Landsat 7 Time Series







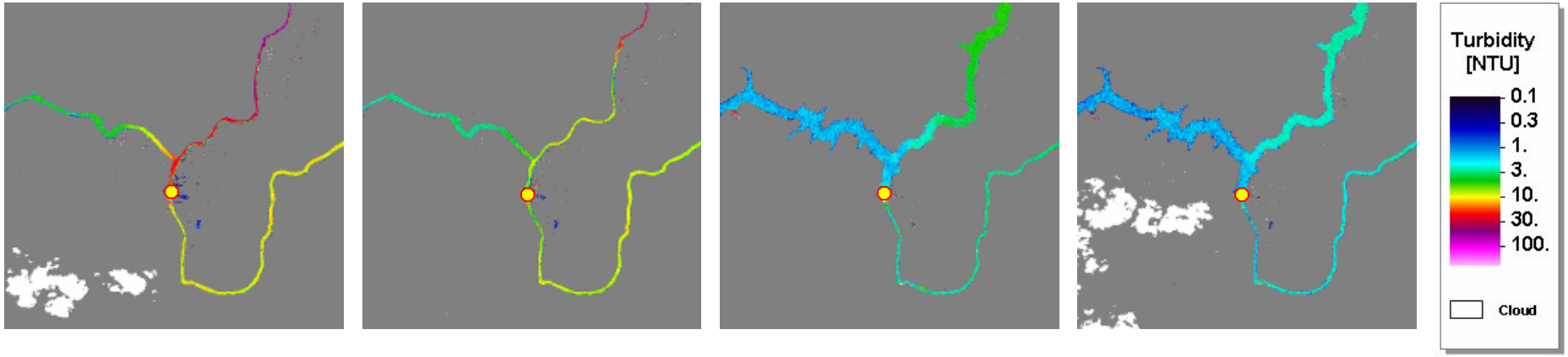




High Res: Turbidity Monitoring

Effects of the Xiaowan Dam (Lancang/China) on turbidity

Water-quality application studies with Landsat 7 ETM+ (30m)

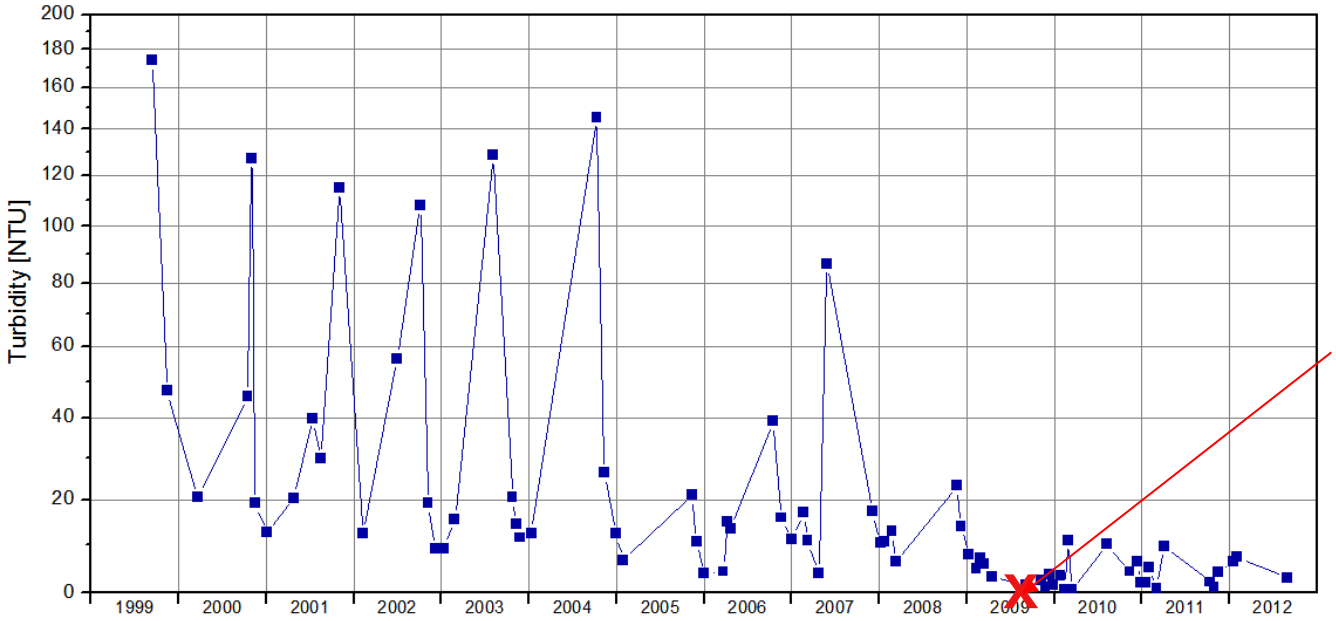


2009-01-09 2009-02-10 2009-11-09 2009-11-25

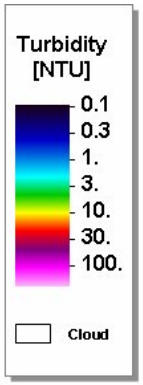
Location of Xiaowan Dam

High Res: Turbidity Monitoring

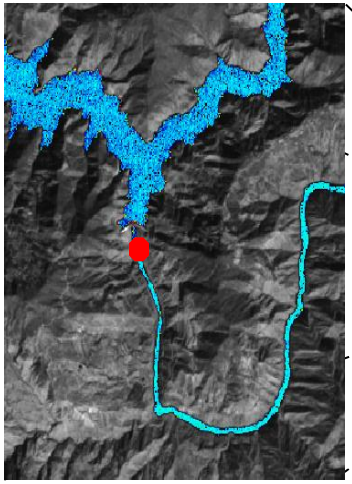
Effects of the Xiaowan Dam (Lancang/China) on turbidity

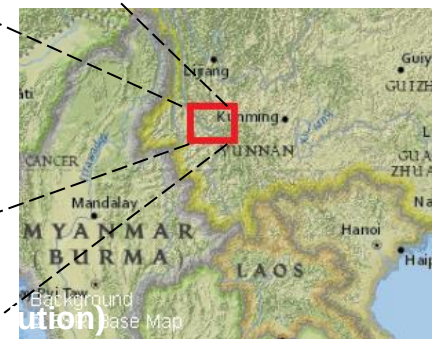


closure of Xiaowan Dam



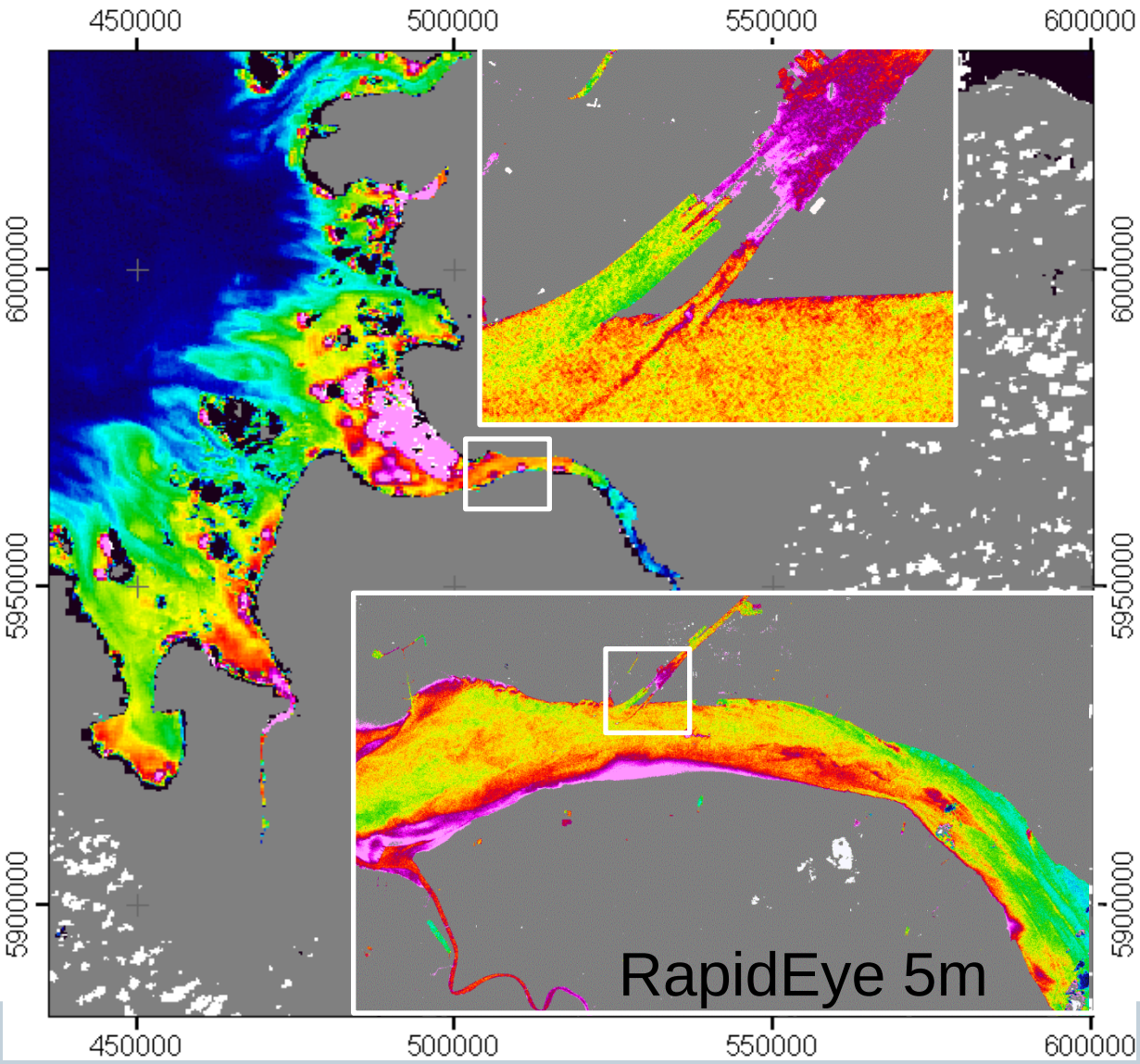
Point of measurement





Current situation
2013-Jan-20

Multi-sensor water quality monitoring
Contracts by water authorities Germany



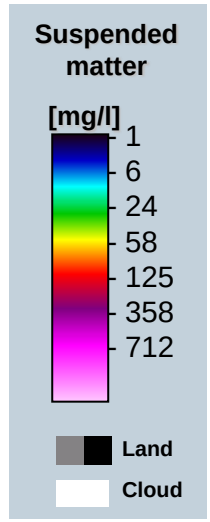
River Elbe / Germany

Suspended matter monitoring

Satellite sensors:

MODIS Terra, Aqua

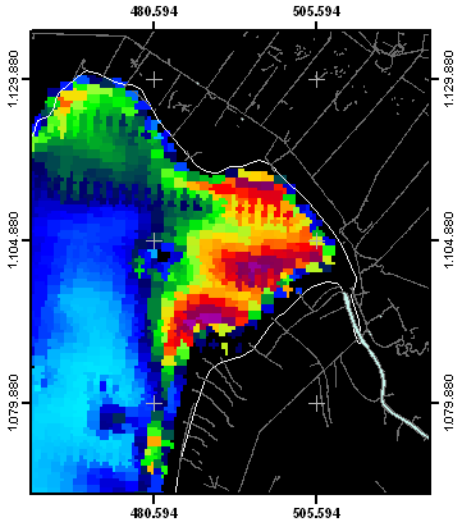
MERIS, RapidEye



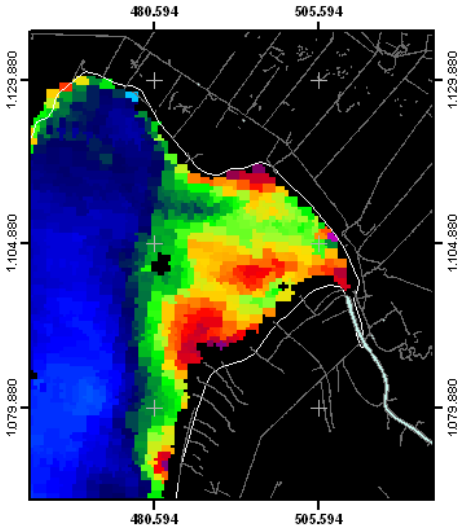
Turbidity, Mekong Delta (Vietnam)

MODIS Terra and SPOT, 08 Januar 2008, MIP processor

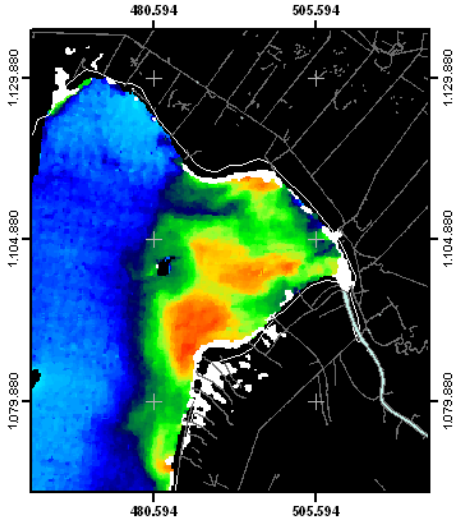
1000 m



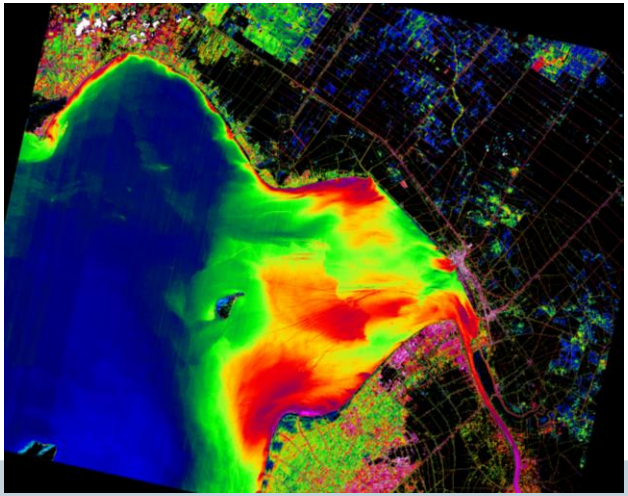
500 m



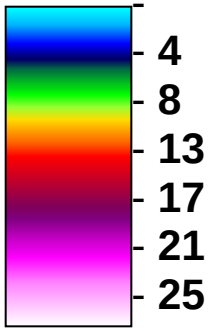
250 m



20 m SPOT

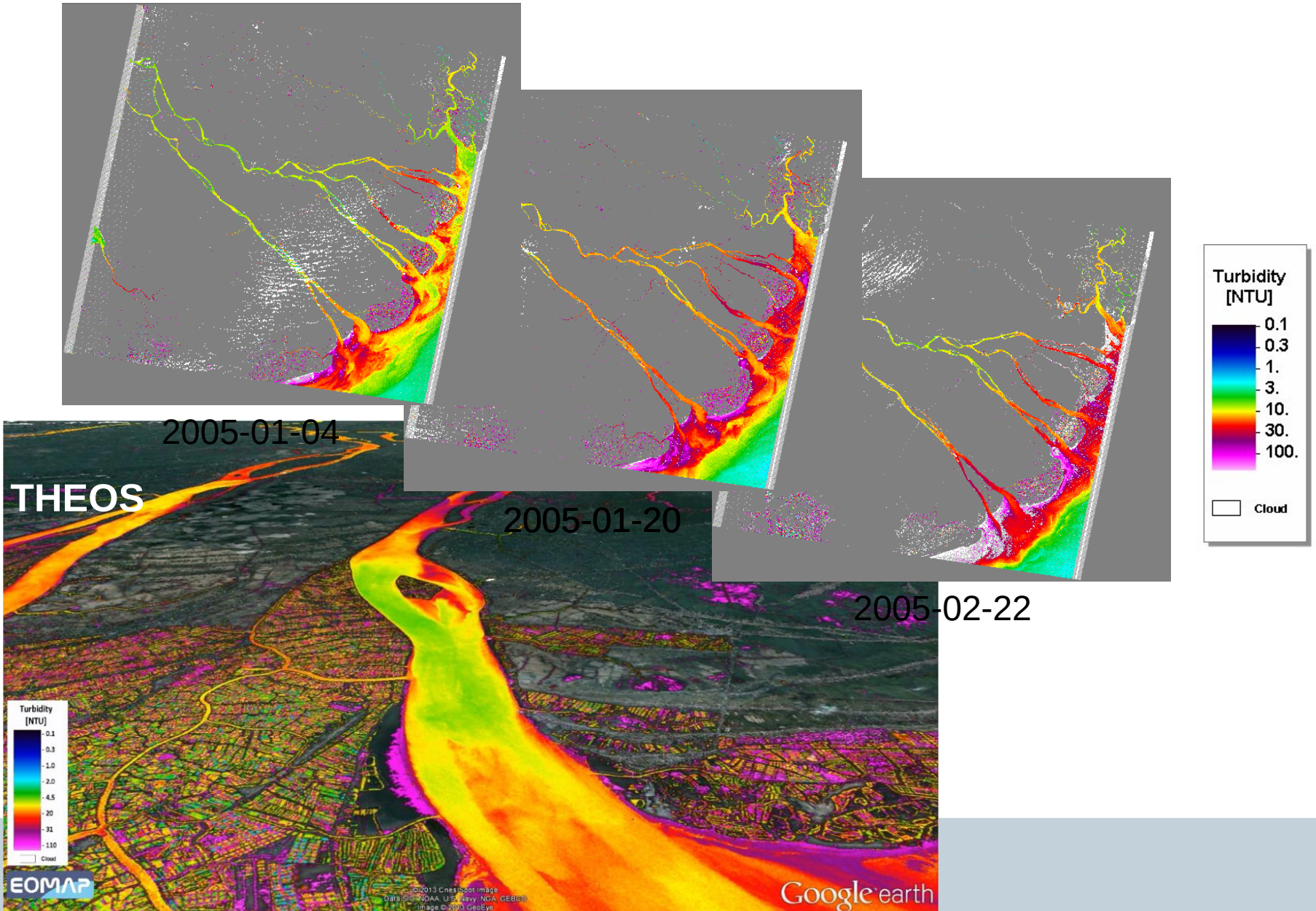


Turbidity [NTU]



WISDOM project Mekong Delta

Bilateral project Vietnam - Germany



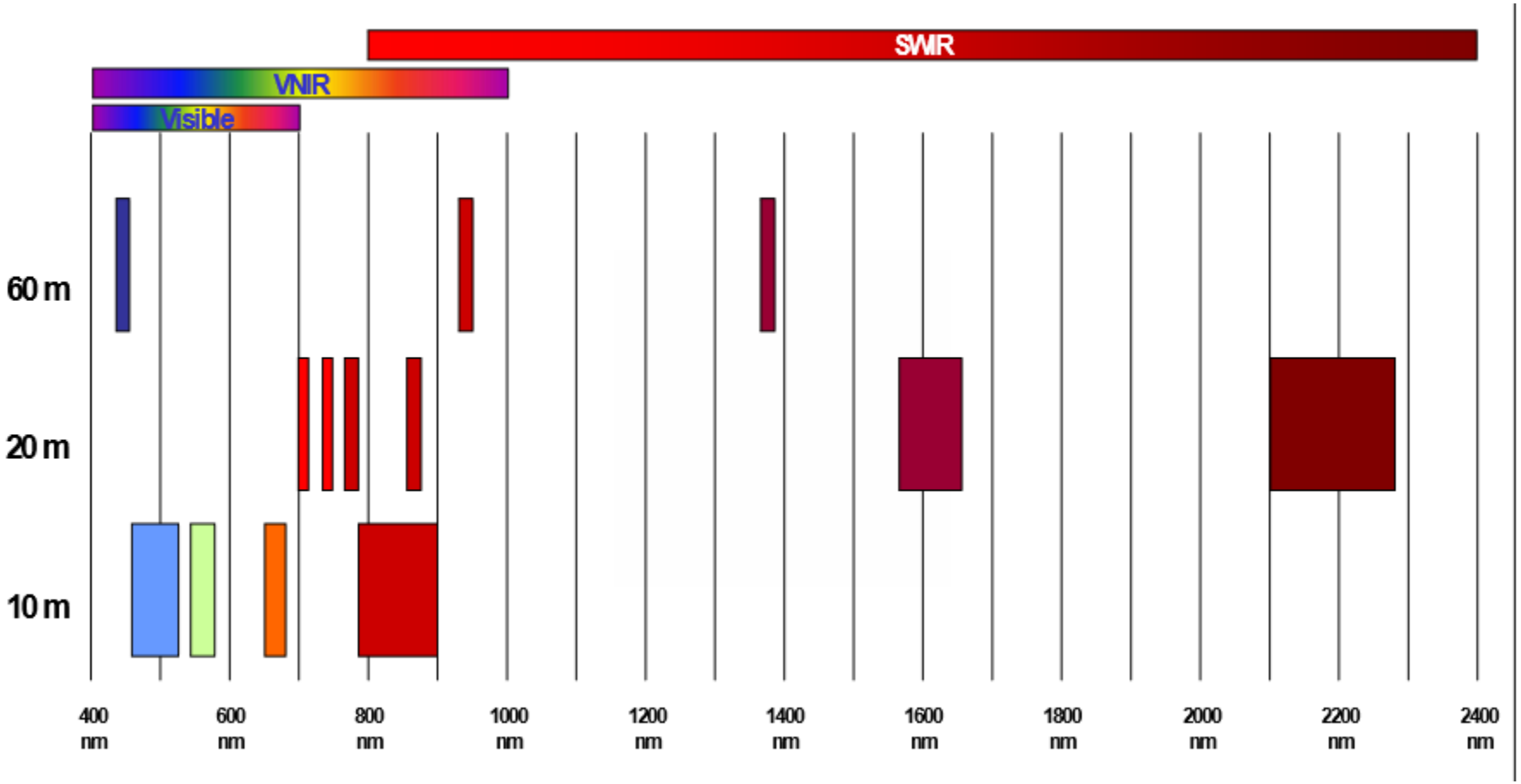
Preparation for Sentinel 2 and 3

Preparation

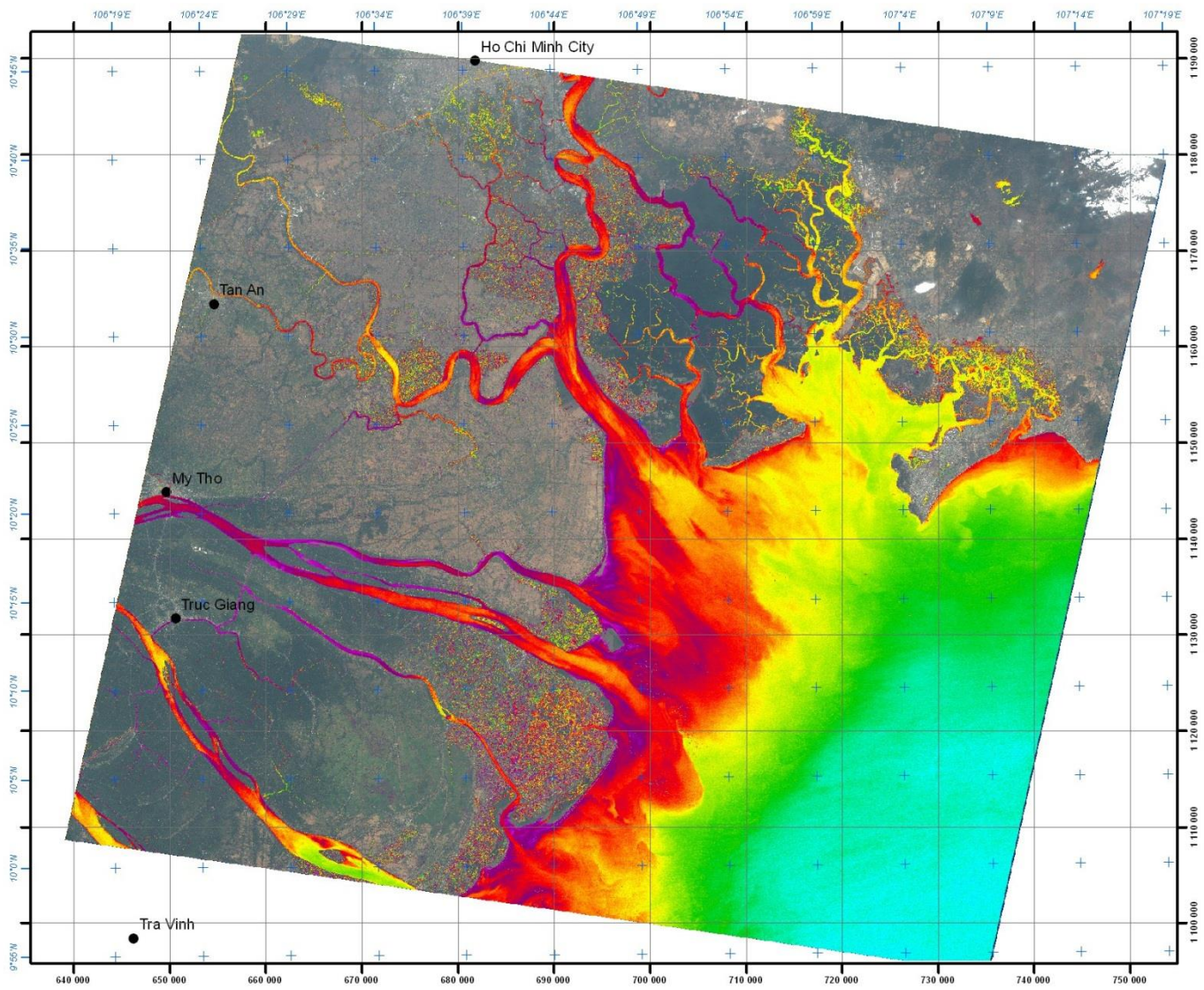
1. Setup of cloud processing environment in cooperation with T-Systems.
2. Installation of WQ-Workflow Systems at Groundsegments (Sentinel + Landsat 7 and 8):
   (Currently MODIS NRT capability for central America, Europe, Australia)
3. Collaboration with the DLR to support setup of German GMES infrastructure
4. Processing of extend coverages of Landsat 7 and 8 archives and NRT data (e.g. EU inland waters and coastal regions starting in summer/autumn 2013)
5. Setup of online marketing platforms (Geostore)

THANK YOU

Sentinel-2


SWIR
VNIR
Visible
60 m
20 m
10 m
400 nm
600 nm
800 nm
1000 nm
1200 nm
1400 nm
1600 nm
1800 nm
2000 nm
2200 nm
2400 nm

Turbidity, Mekong Delta (Vietnam)



DATA SOURCES

THailand Earth Observation System (THEOS) Development Program started in July 2004. THEOS satellite images is fully operated by GISTDA. The THEOS satellite provides imagery in the visible and near infrared region.

THEOS provides four-band multispectral image data at a ground resolution of 15 m. The data analysed were recorded on April 07. 2011, 02:56:04 (UTC).

PROCESSING / ANALYSIS

Data were processed the Modular and Inversion System (MIP) by EOMAP.
MIP is designed for the physically based assessment of hydro-biological parameters from multi- and hyperspectral remote sensing data.
The results of the Total Suspended Matter are displayed. The data were processed at a pixel resolution of 15 m.

LEGEND

Turbidity [NTU]

0.1
0.3
1.
3.
10.
30.
100.

cities
cloud

SCALE

0 3 6 12 18 Kilometers

1 : 560 000 AT DIN A4

COORDINATE SYSTEM

Reference coordinate system		*Geographic (DMS)*
Projection:	UTM Zone 48 N	*WGS 84*
Spheroid	WGS 84	*WGS 84*
Datum:	WGS 84	

Projection: Transverse_Mercator
False_Easting: 500000.000000
False_Northing: 0.000000
Central_Meridian: 57.000000
Scale_Factor: 0.999600
Latitude_Of_Origin: 0.000000
Linear Unit: Meter (1.000000)

N

- Land AC correction included
- Accounts for all bidirectional effects

  sensor-target-sun-geometry,

  but land still approximated as Lambert-Reflector
- Accounts for aerosol concentration,

  but AOT for AdjCorr only as 1st guess before full ac retrieval
- For High-Res-Scenes: Surrounding land areas not covered by the scene is taken into account with Global Land-water Mask and extrapolated land albedo.