JOINT EUROPEAN RESEARCH INFRASTRUCTURE NETWORK FOR COASTAL OBSERVATORIES

Land based remote sensing techniques

19th June 2017

Deltares
Enabling Delta Life

The coast: a variety of functions

- Safety against flooding
- Recreation
- Accommodate communities
- Nature conservation
- Ports

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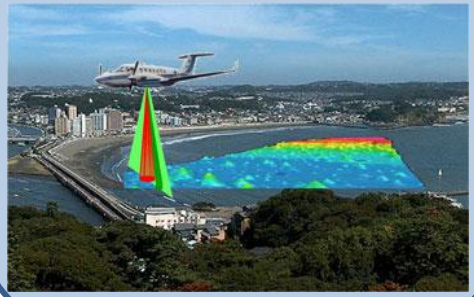
Monitoring Coastal Physics







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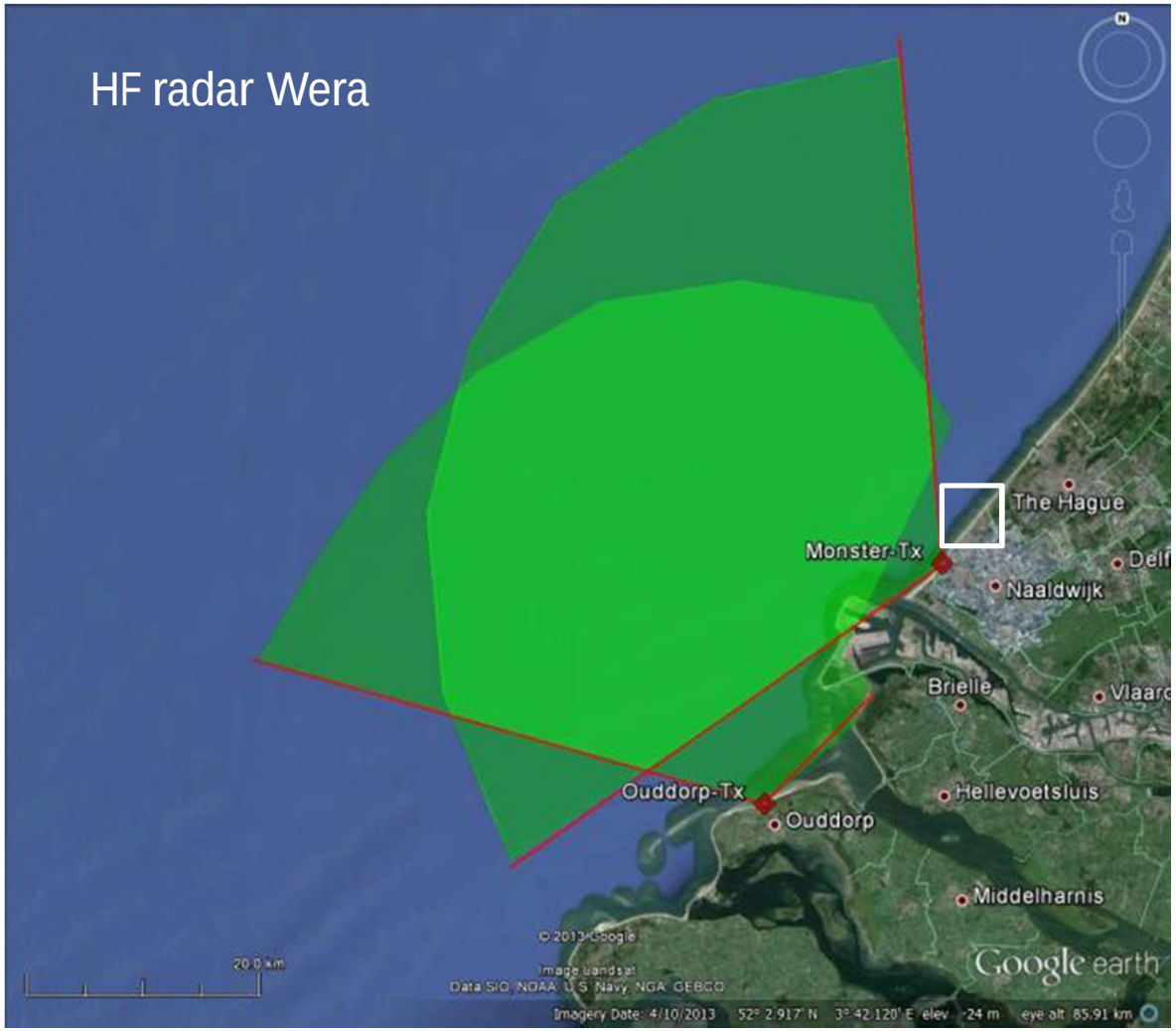
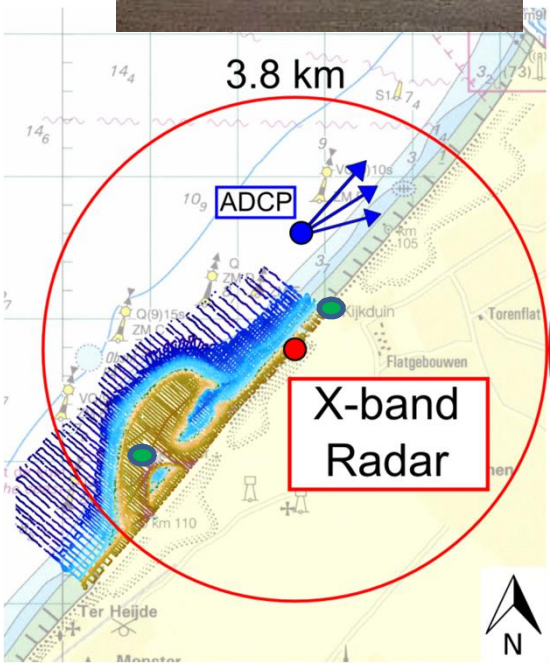
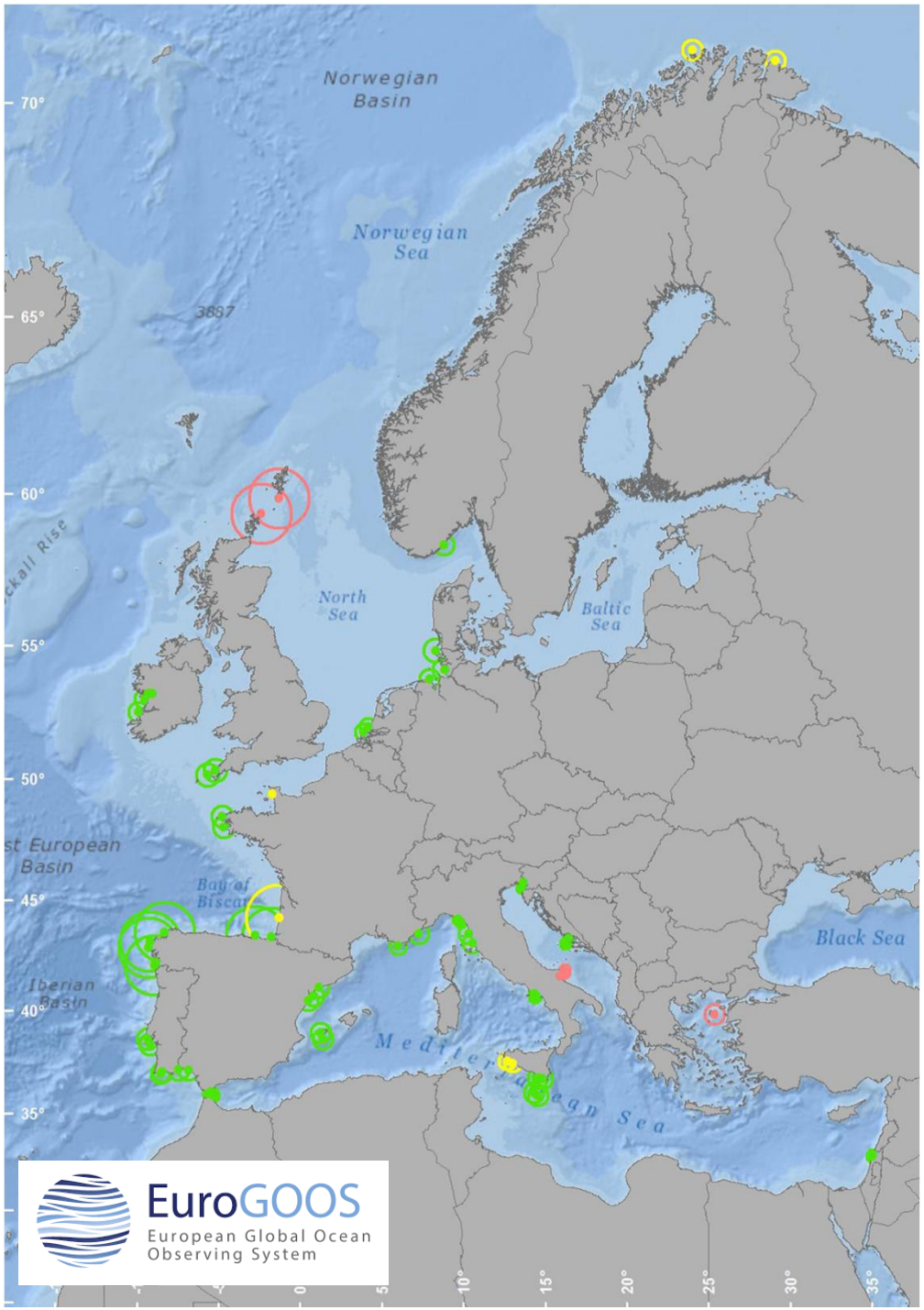
HF radar-X-band radar –Video





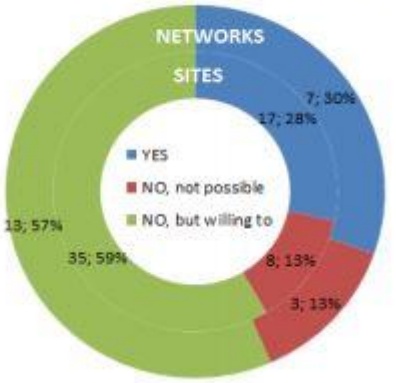


HF radar sites

Surface Currents (and waves)

52 Europe

Number of connected networks/sites



GREEN: ONGOING
RED: PAST
YELLOW: FUTURE

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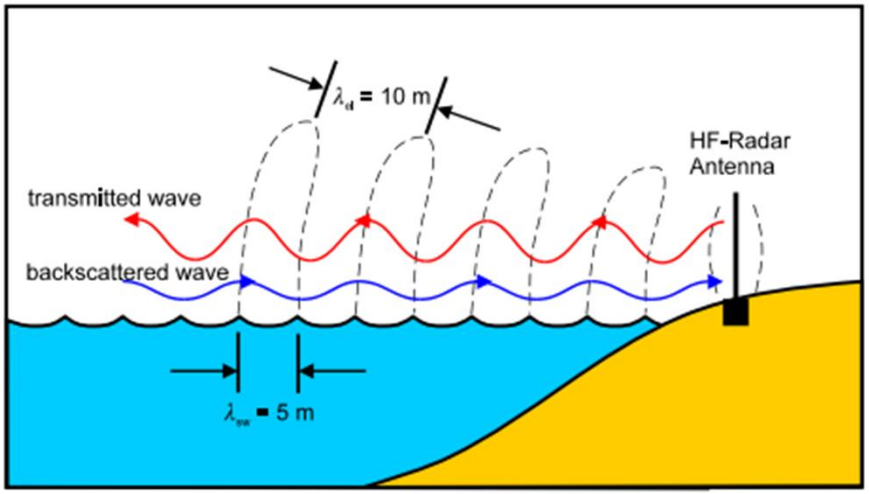
Array
Antenneopstelling met 4 antennes
Restaurant
Signaalkabel
90 m lineaire antennerij
Google earth


Transmitters


Receivers


Single Transmitter
Receiver

Bragg reflection



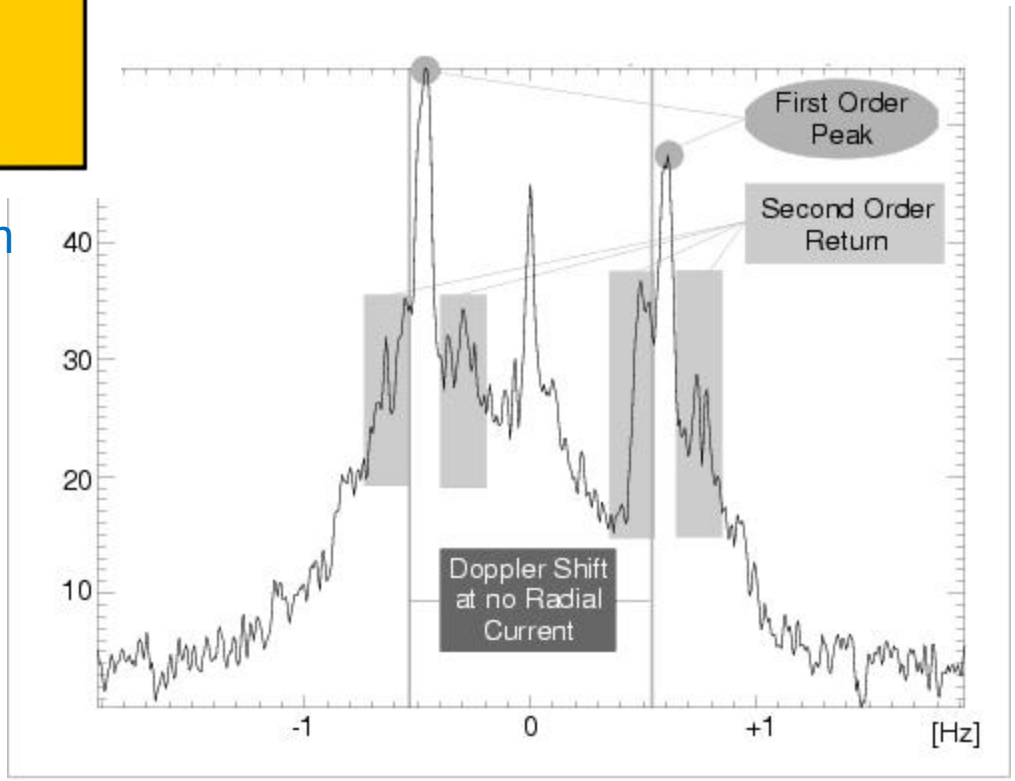
3 to 30 MHz

Reflection from waves at ½ wavelength

Moving away from source
and coming towards source

Result in opposite shifts

Additional shift in same direction
due to currents



You can only detect the component coming towards or moving away from yo

The port of Rotterdam

95.000 movements of sea going vessels p/y

400.000 movements of inland freighters p/y

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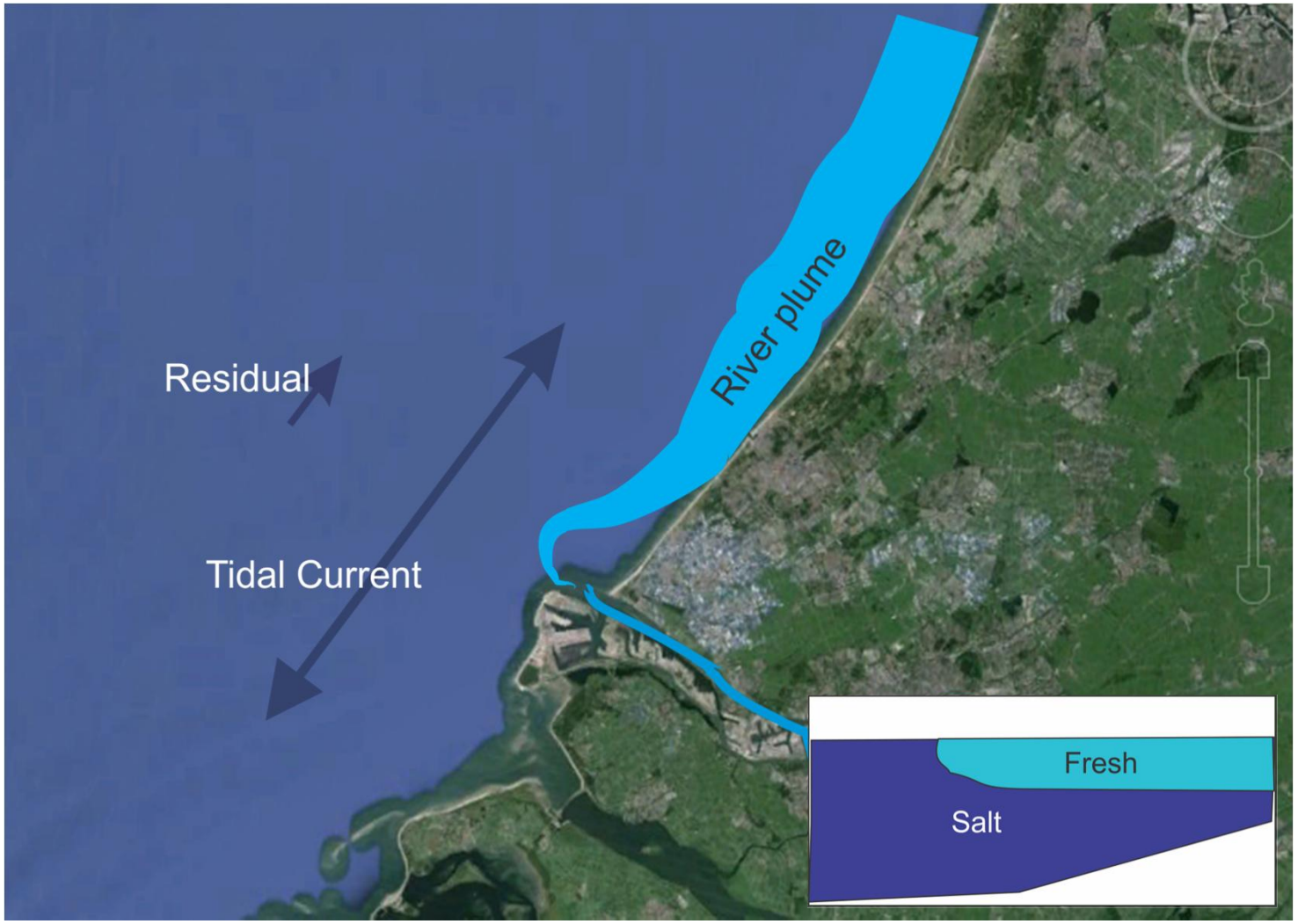
Hydrodynamics at outflow of river Rhine



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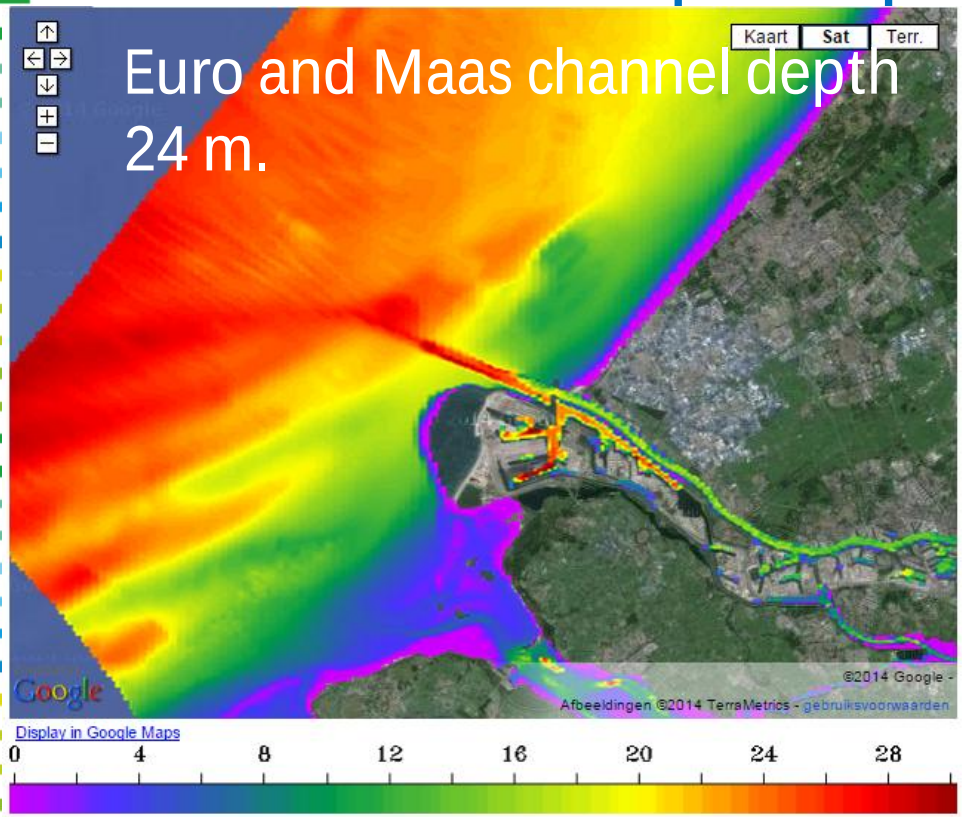
Hydrodynamics at outflow of river Rhine

Access to the port Rotterdam: pilots perspective



Tide

Swell

Cross currents

time window

Rijkswaterstaat
Ministry of Infrastructure and the Environment

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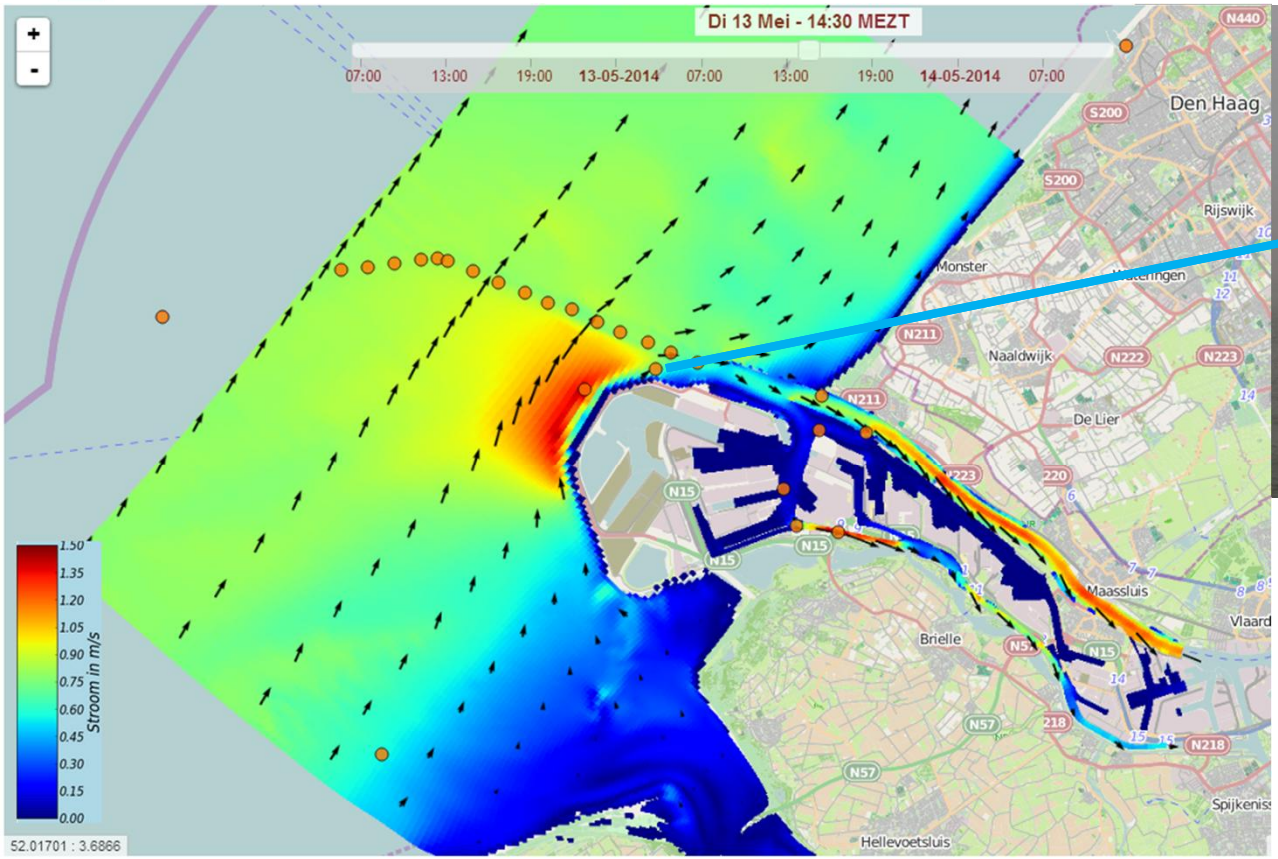
Previous set-up current infromation



Pole with ADCP's

2D hydrodynamic forecast model → depth averaged currents

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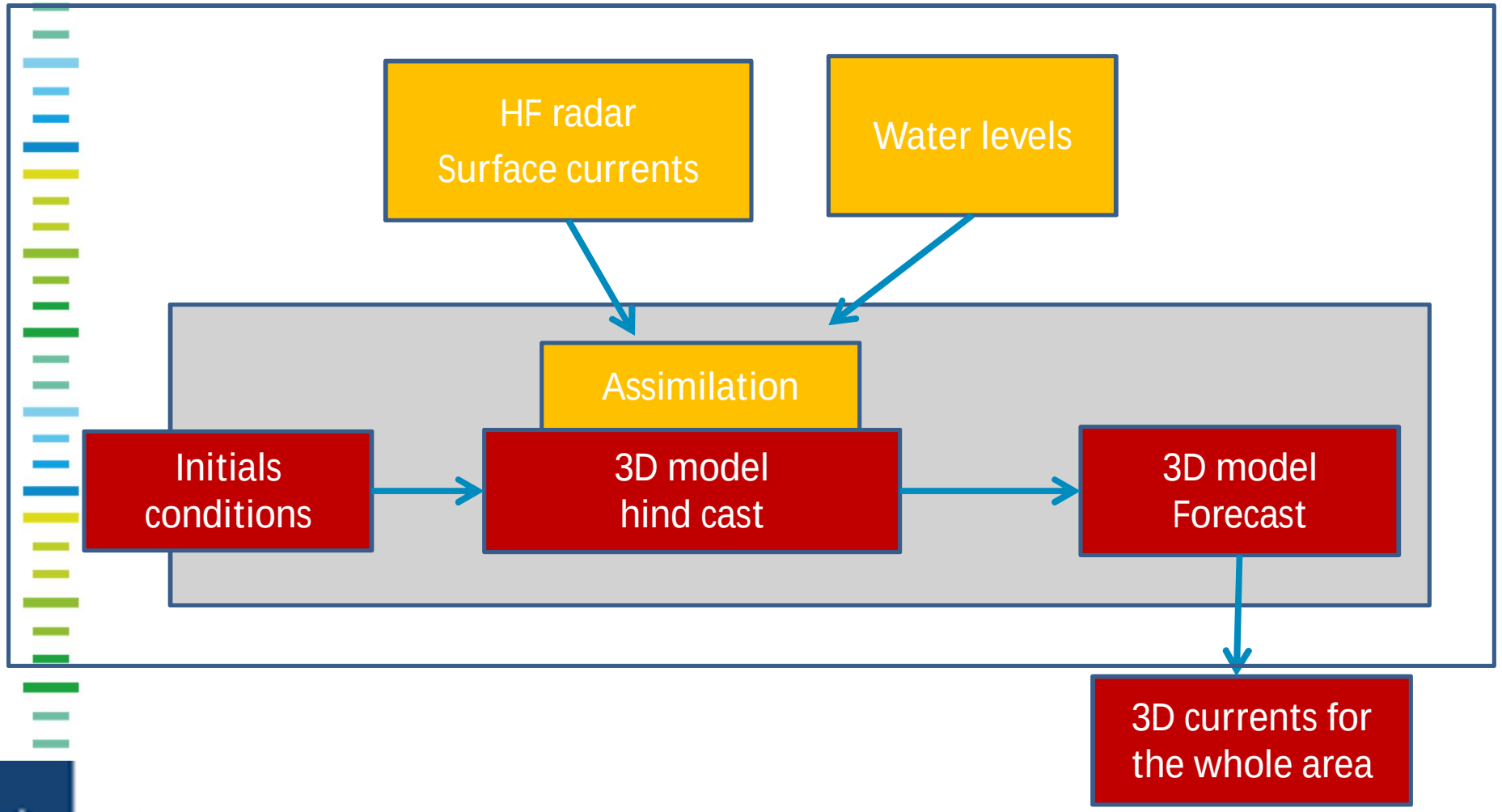
Proposal 2014
3D forecast & HF radar



Rijkswaterstaat
Ministry of Infrastructure and the Environment

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Why HF radar?

- Spatial current measurements supply:
  - Better option to fit with spatial model (compared to points)
  - Captures features not fully resolved by hydrodynamic model
- Low “down time” due to:
  - High stability/performance of the technique
  - Easy access to equipment in case of failures
- Draw back:
  - Only surface current in highly 3D flow environment

Challenges:

- Stability at high wave conditions
- Resolving gradients
- Shadowing effect of land reclamation
- Anchored and moving ships/ cranes etc.

Functional specs HF radar

Area of interest

A: vectors

A+B: radials

Representative depth:

0.5 m

Spatial resolution

around 1.5 km

Maximum uncertainty

20 cm/s in 30 min.

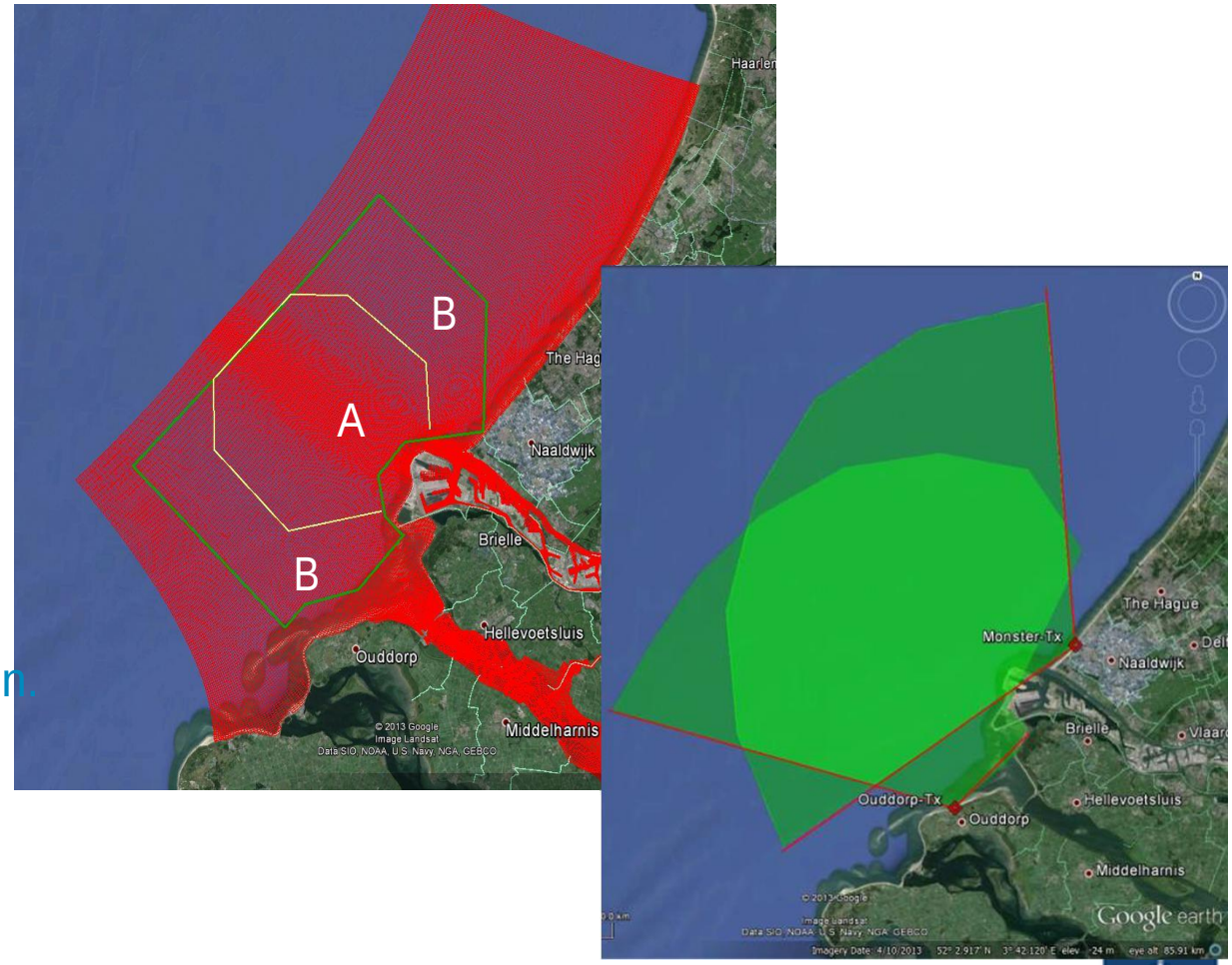
Data availability

Average 95%

up to Hs 5 m

Time resolution

30 minutes



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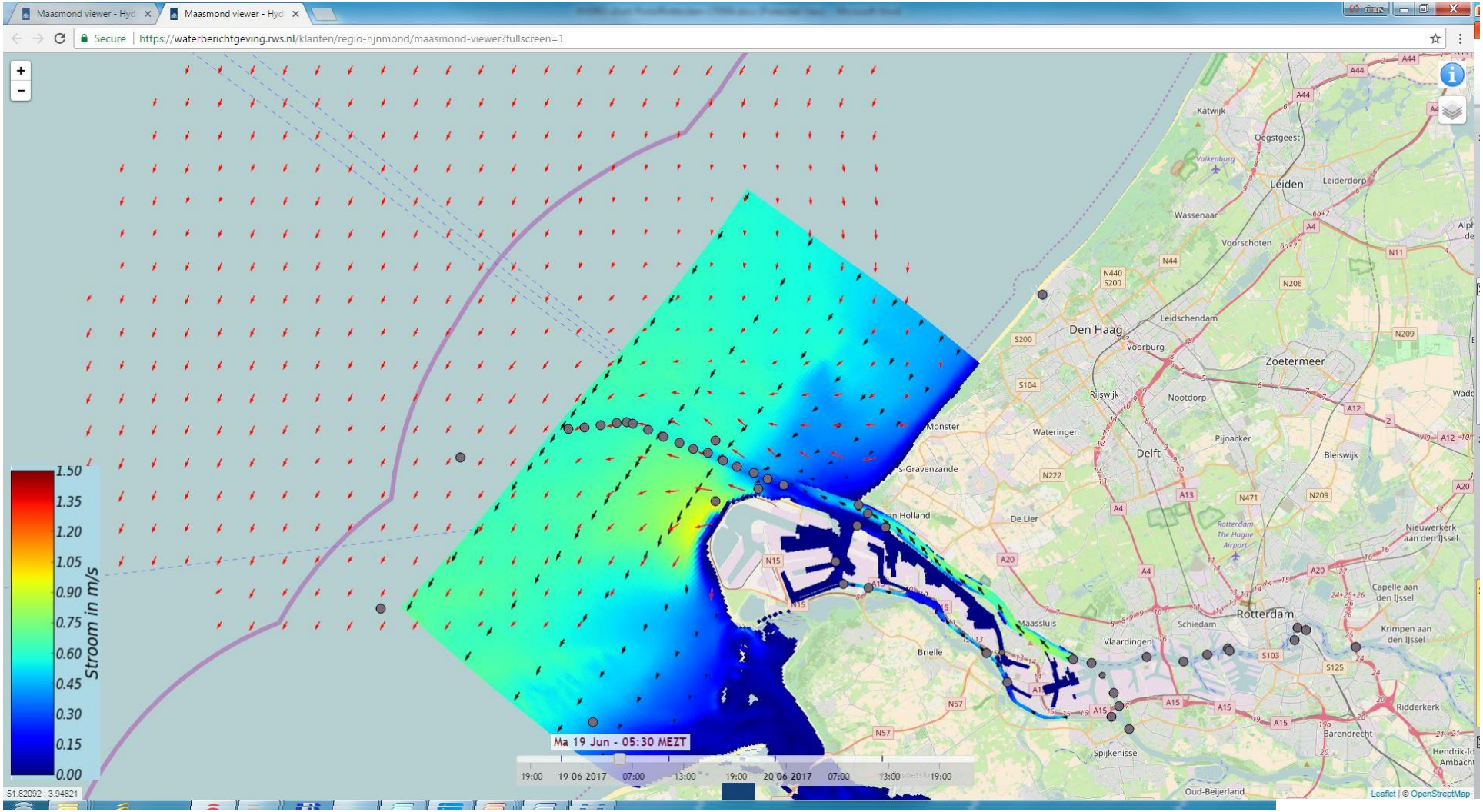
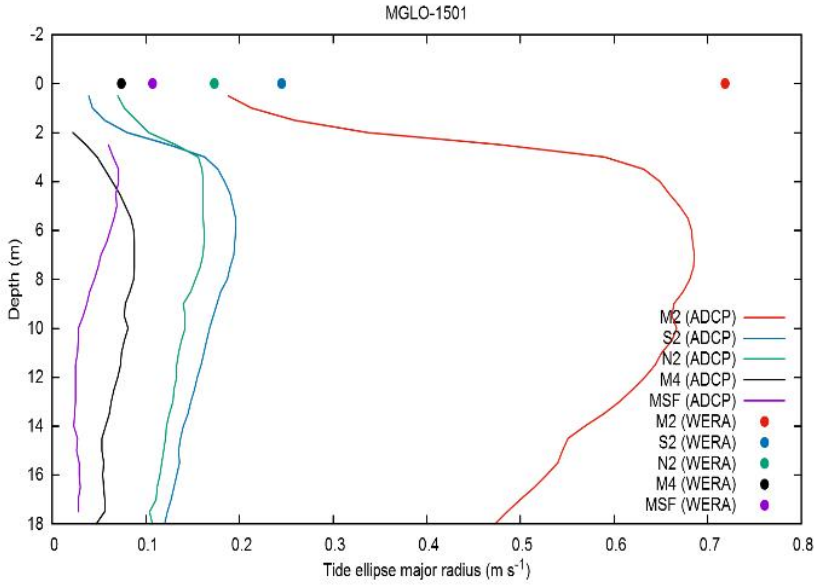
HF radar & 2D model



How to validate?

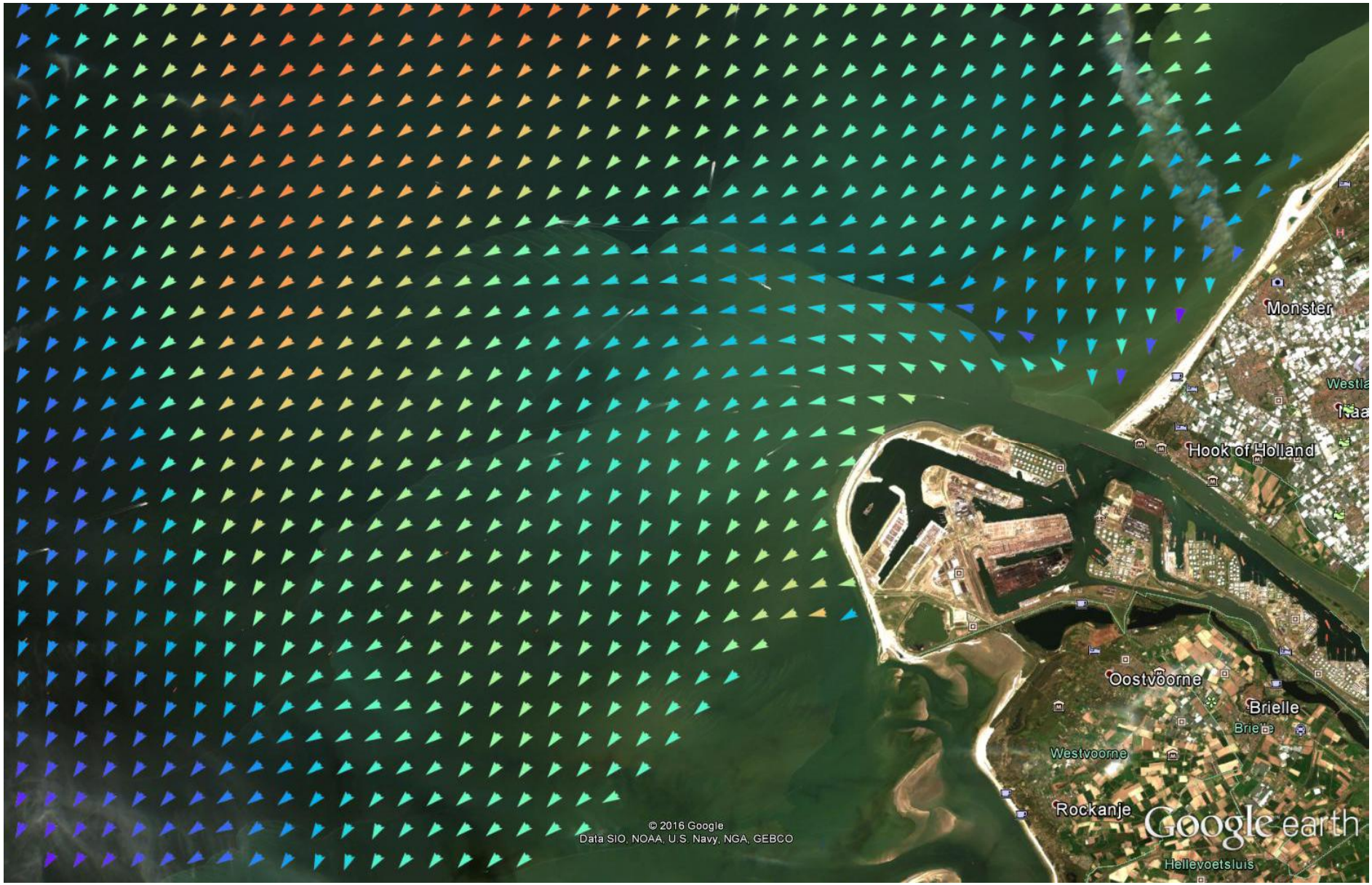
How to validate?

- Surface floats → shipping lane
- Fixed ADCP data → no surface measurement
- Ship based ADCP data → no surface measurement
- ….



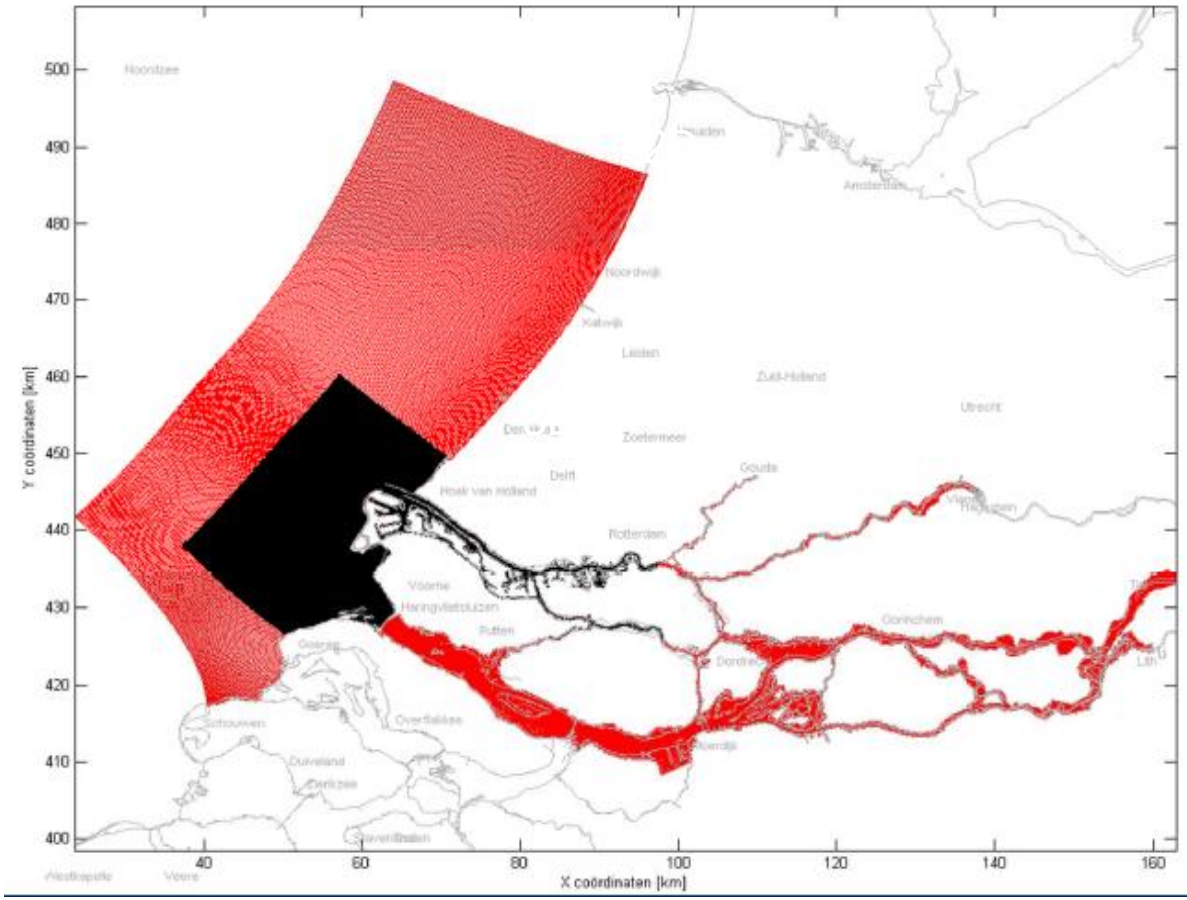
Tidal components in currents:
Herron et al. 2016

Satellite images



Short term model solution

1. Operational Flow model Port Rotterdam (nested 3D)
2. New D-Flow FM based on existing grids



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Present status and planning

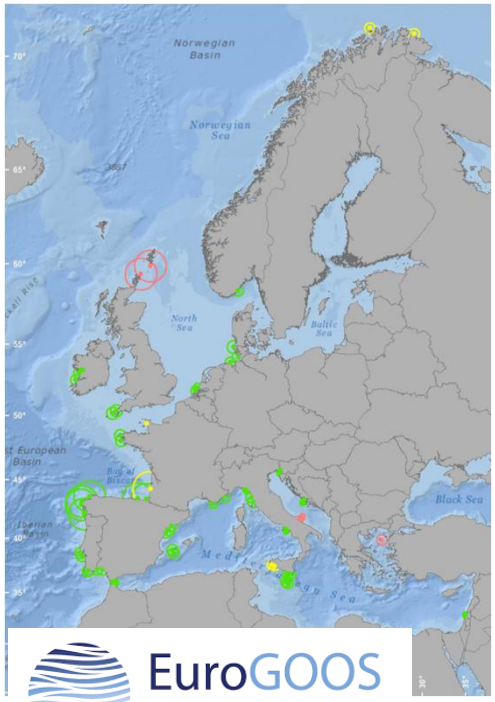
- 2014
  - HF radar specs (Deltares)
  - Two temporary ADCP buoys installed
- 2015
  - HF radars operational mid 2015

Future?

- First 3D model operational (short term solution)
- Data assimilation trials
- Full data assimilation of HF radar in model
- High end 3D model

HF radar work JERICO next

Harmonization & knowledge transfer



High Frequency radar task team

Documents

- New network systems: status of HF-radar systems and cabled coastal observatories.
- Best Practice for new network systems: HF-radar /cabled coastal observatories.
- Improved Radar DA technology for biochemical transport analysis
- Recommendation Report 1 for HFR data implementation in European infrastructures
- Recommendation Report 2 on improved common procedures for HFR QC analysis

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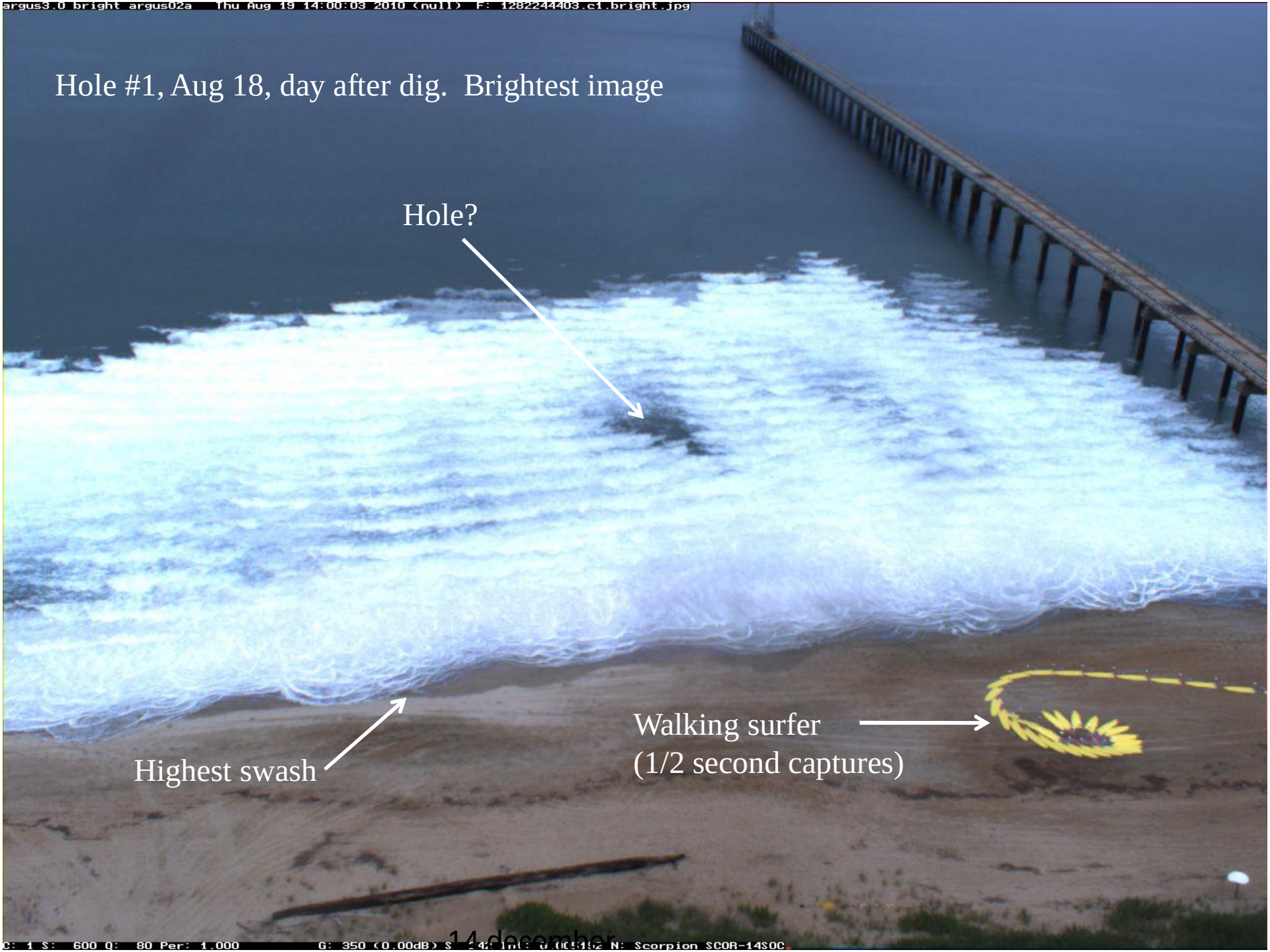
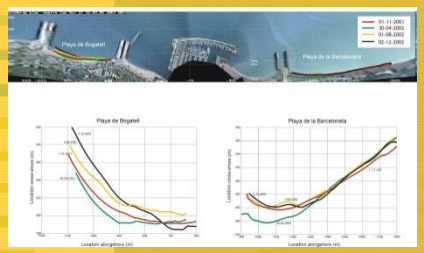
argus3.0 snap argus02a Wed Aug 18 07:00:00 2010 (null) F: 1282132800.c1.snap.jpg
Digging hole #1, Aug 18
C: 1 S: 1 Qual: 80 Gain: 350 (0.00dB) Shutter: 176 IntTime: 0.001599 Name: Scorpion SCOR-14SOC


argus3.0 timex argus02a Wed Aug 18 08:00:01 2010 (null) F: 1282136401.c1.timex.jpg
Hole #1, Aug 18, immediately after dig. Timex image
Cool megaripple features
Removed sand
C: 1 S: 600 Q: 80 Per: 1.000 G: 350 (0.00dB) Sh: 179 In: 9.0(7.65) N: Scorpion SCOR-14SOC

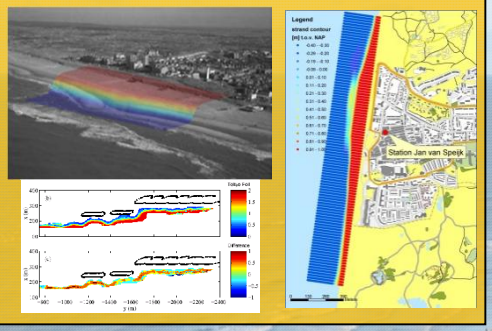

argus3.0 bright argus02a Thu Aug 19 14:00:03 2010 (null) F: 1282244403.c1.bright.jpg
Hole #1, Aug 18, day after dig. Brightest image
Hole?
Highest swash
Walking surfer
(1/2 second captures)
C: 1 S: 600 Q: 80 Per: 1.000
G: 350 (0.00dB) S
N: Scorpion SCOR-14SOC

Argus Coastal video monitoring applications

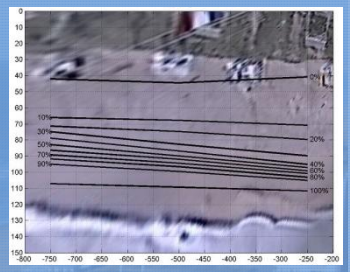
Storm-driven shoreline erosion



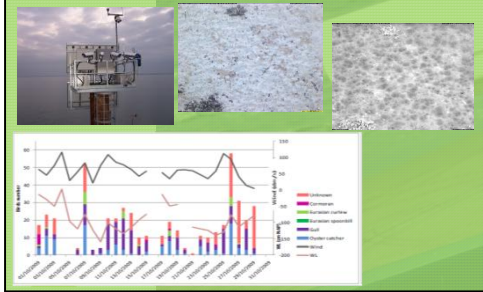
Nourishments impact eval. : Auto-shoreline mapping



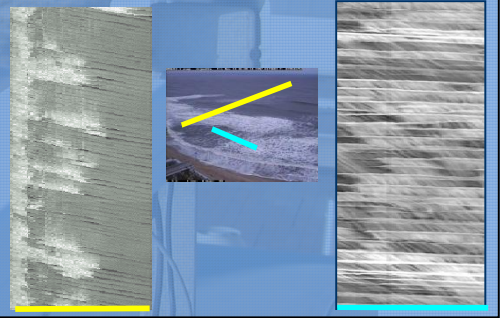
All year exploitation : HW exceedance line



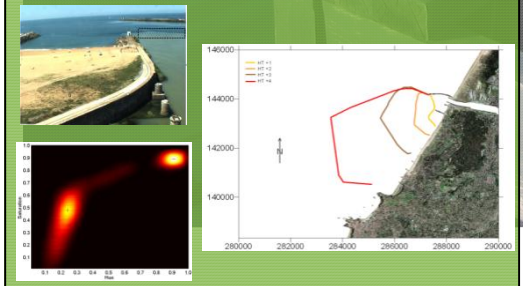
Biology/Ecology



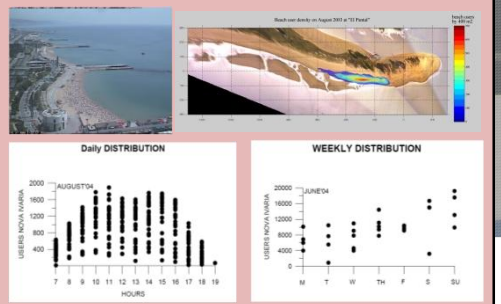
Hydrodynamics



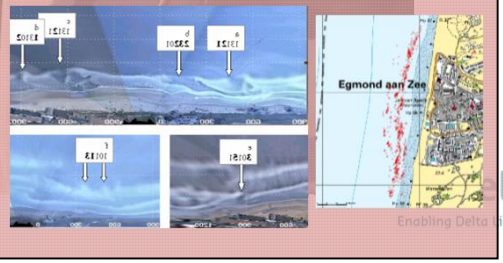
Plume development



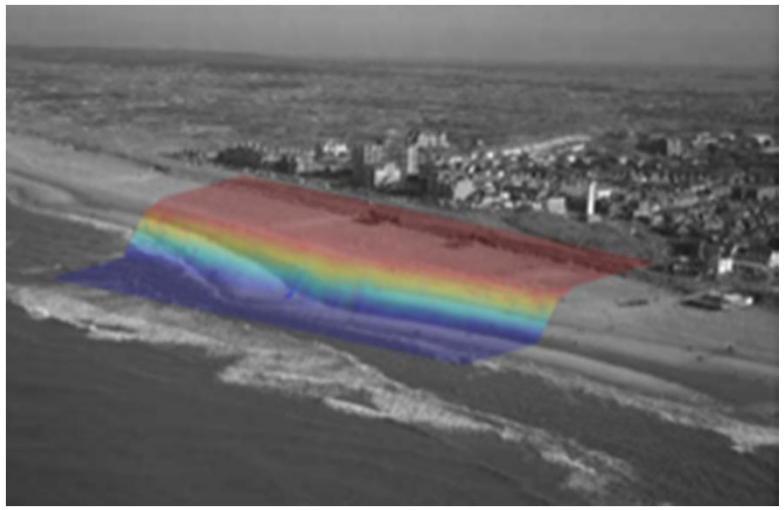
Beach Recreation planning

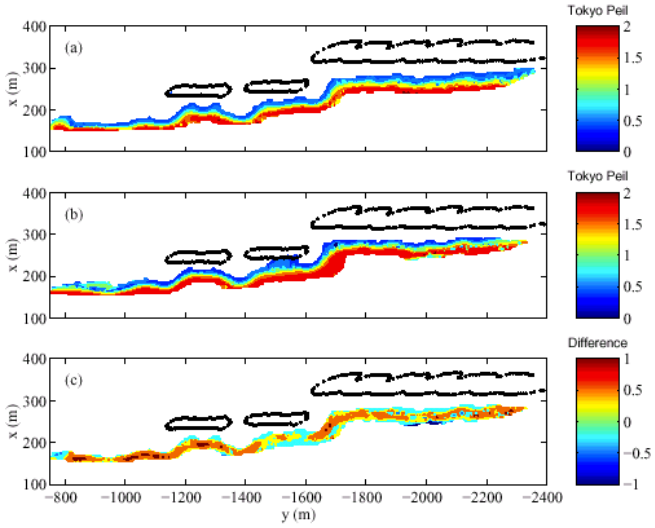


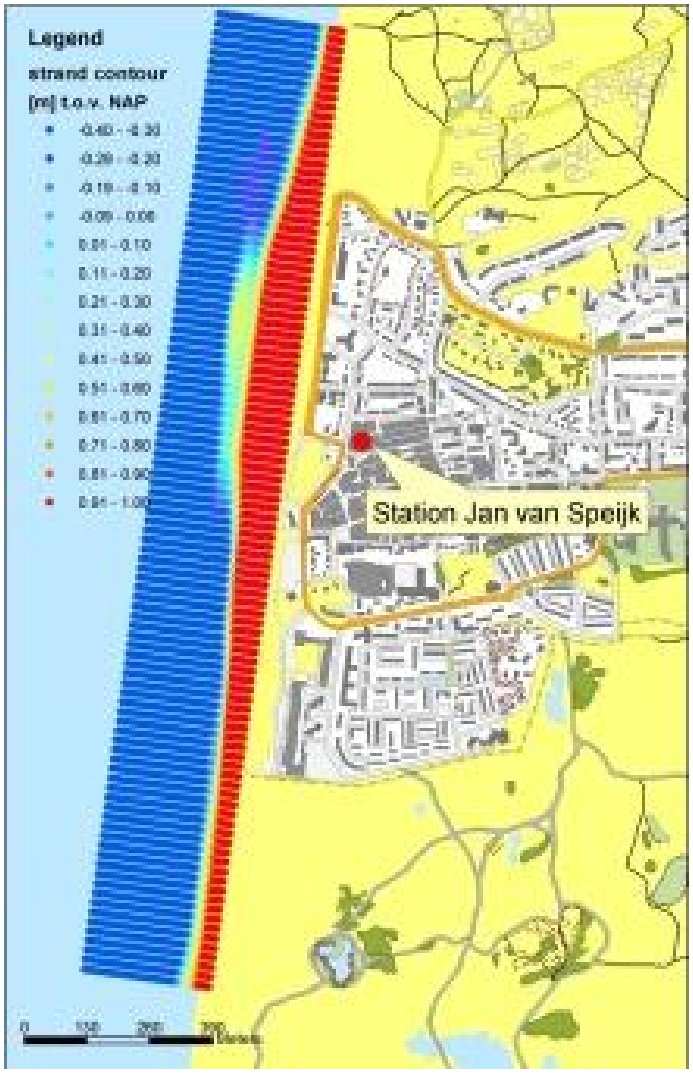
Swimmer safety : Occurence of rip currents



Shoreline development

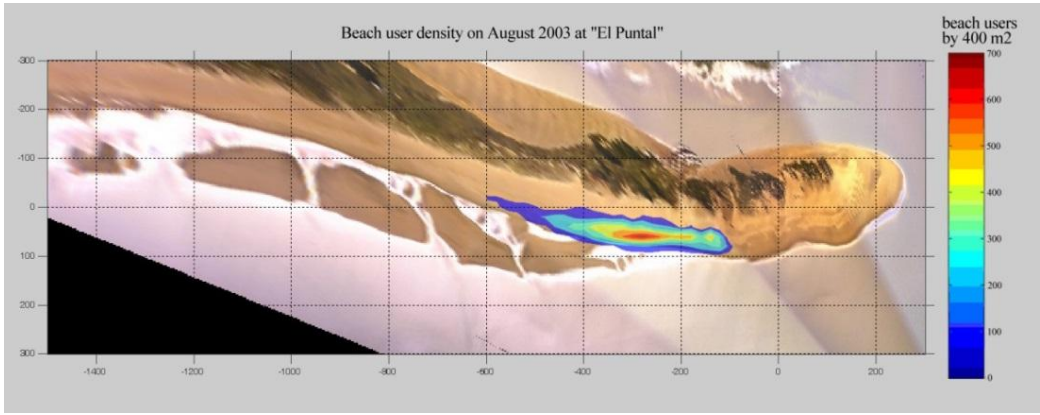






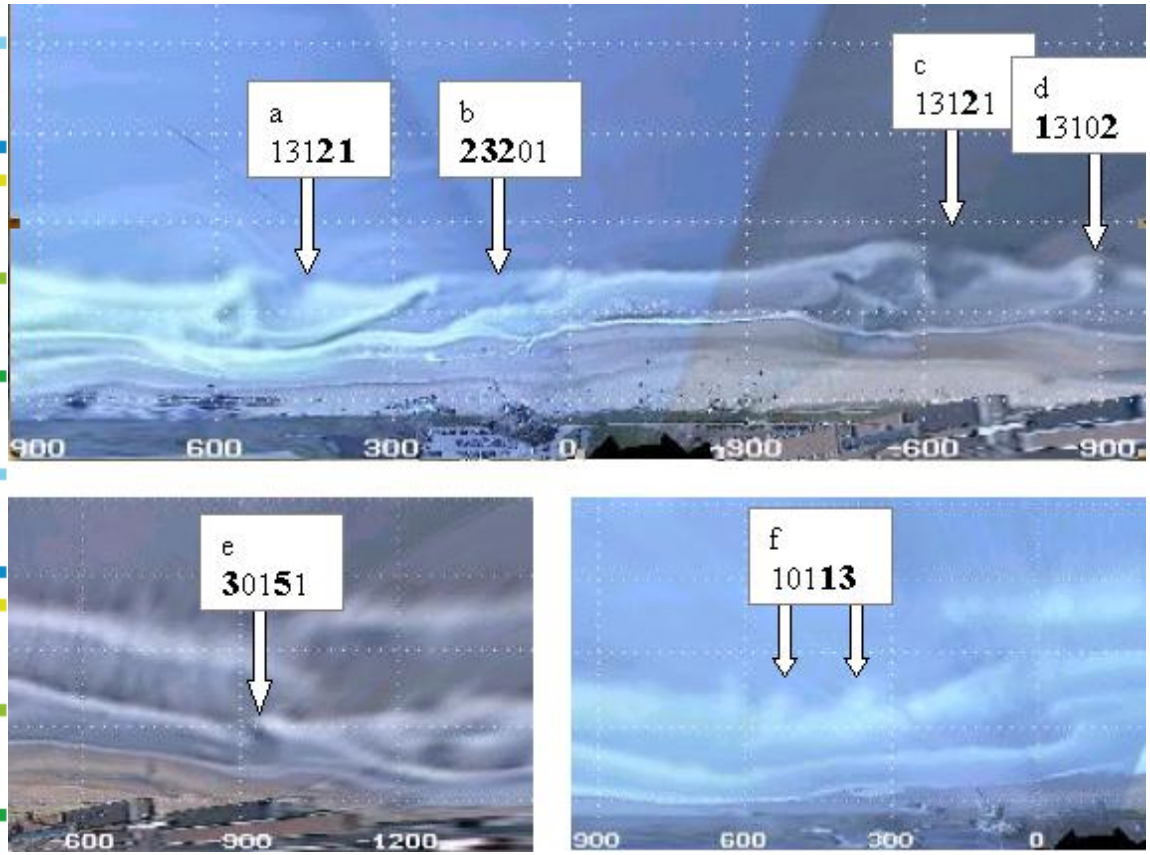
Recreation: beach use

Barcelona
Dr. Jorge Guillen

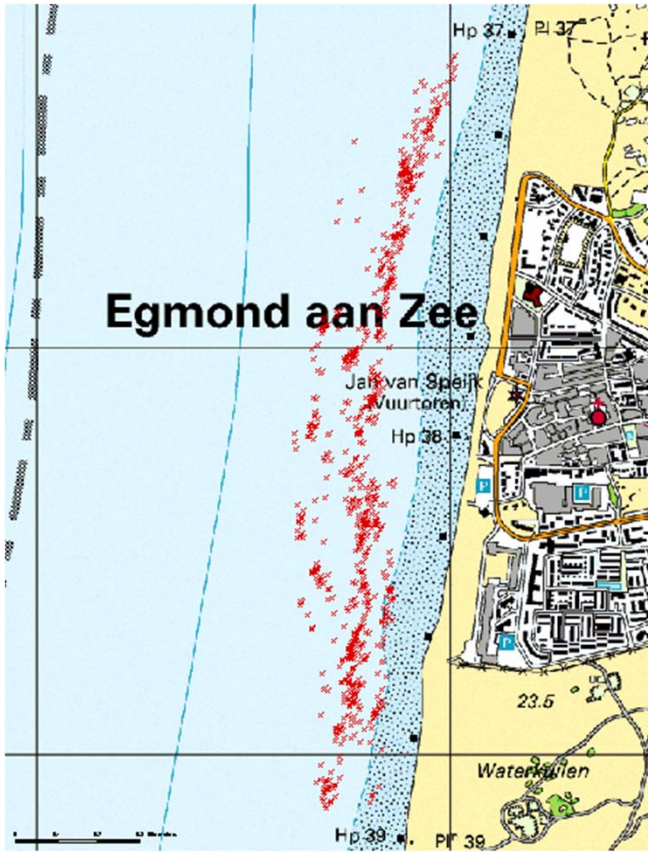


Santander
Raul Medina and Andres Osario

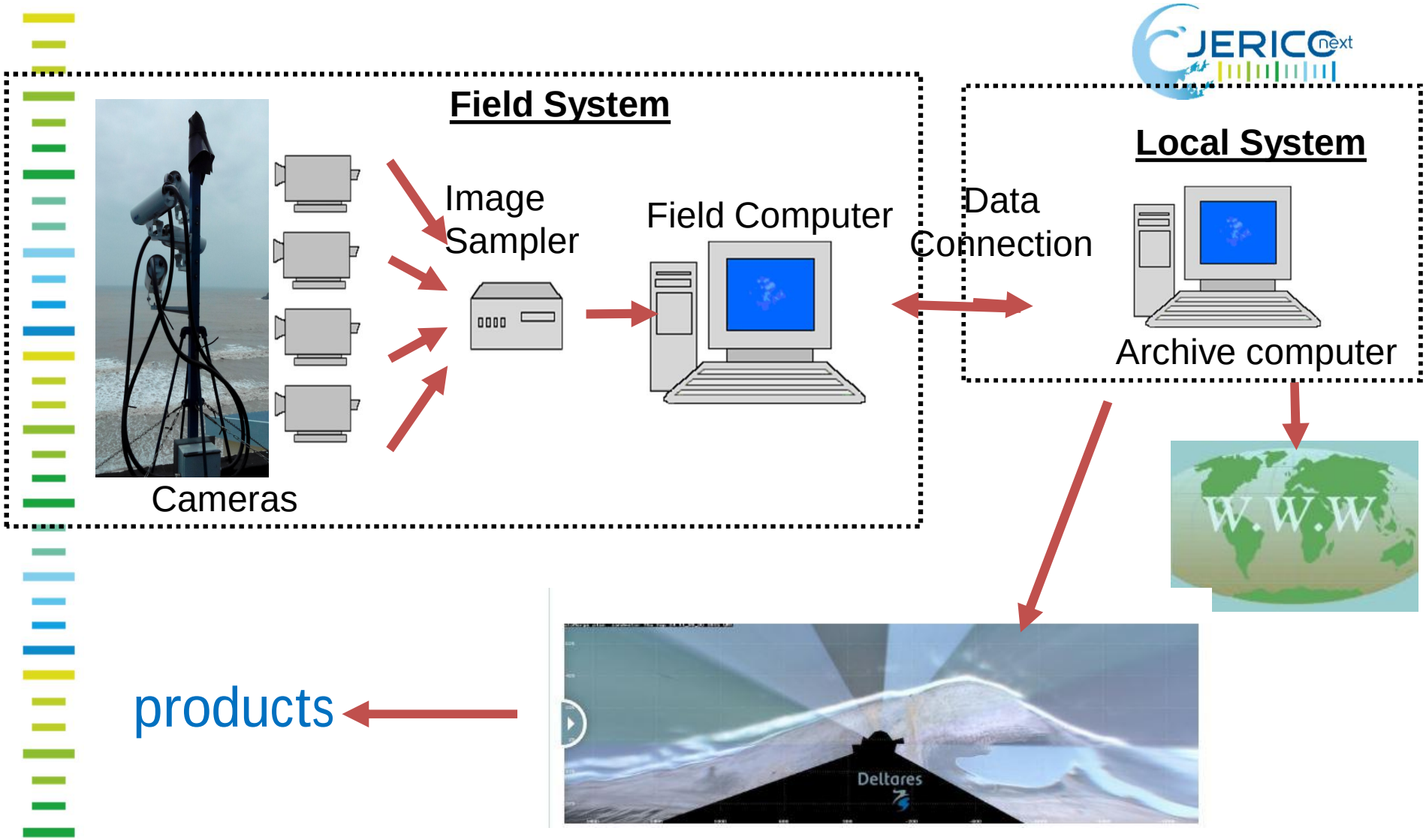
Recreation: Swimmer safety - Rip currents



Rip detection & classification



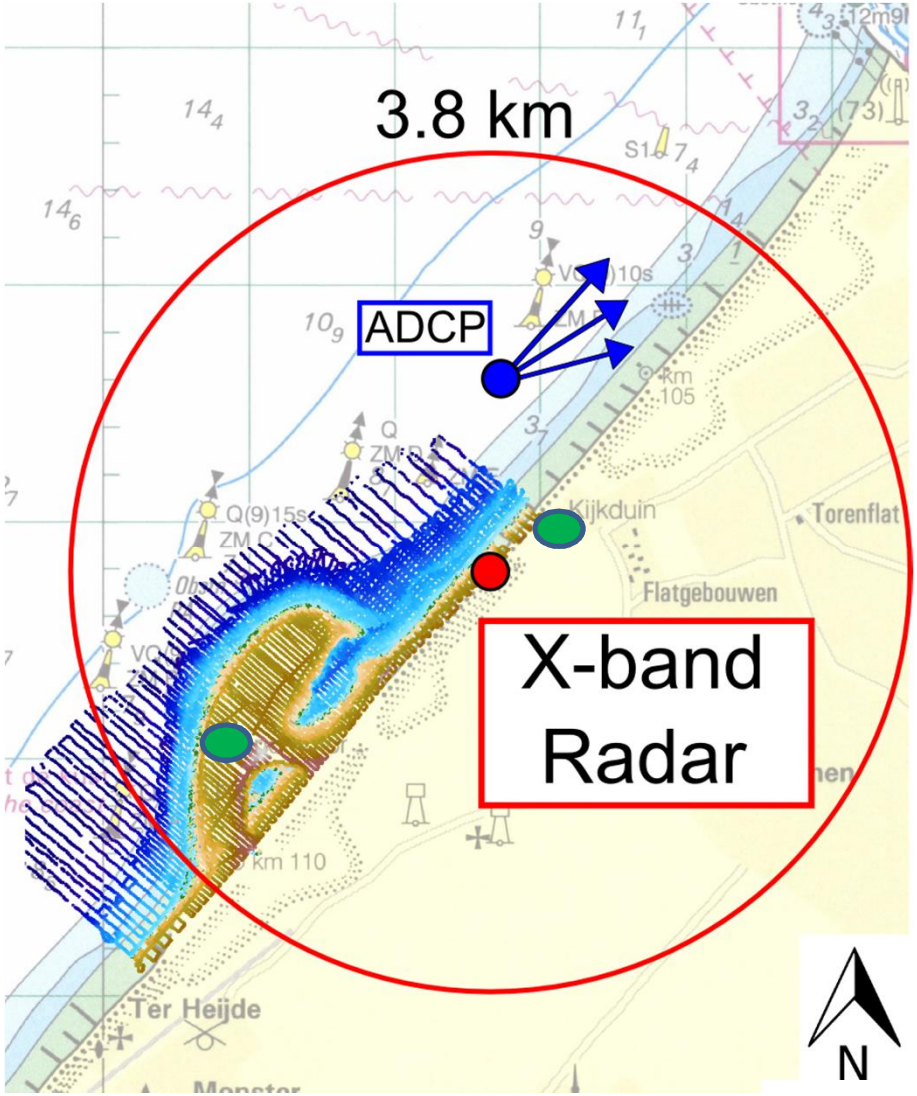
Rip occurrence Egmond,
May 1999 – June 2001



Pros: *High-resolution, automated, low-cost, quick estimates*

Cons: *Exact numbers take effort,*
Complex due to multiple cameras

Monitoring Sand Motor



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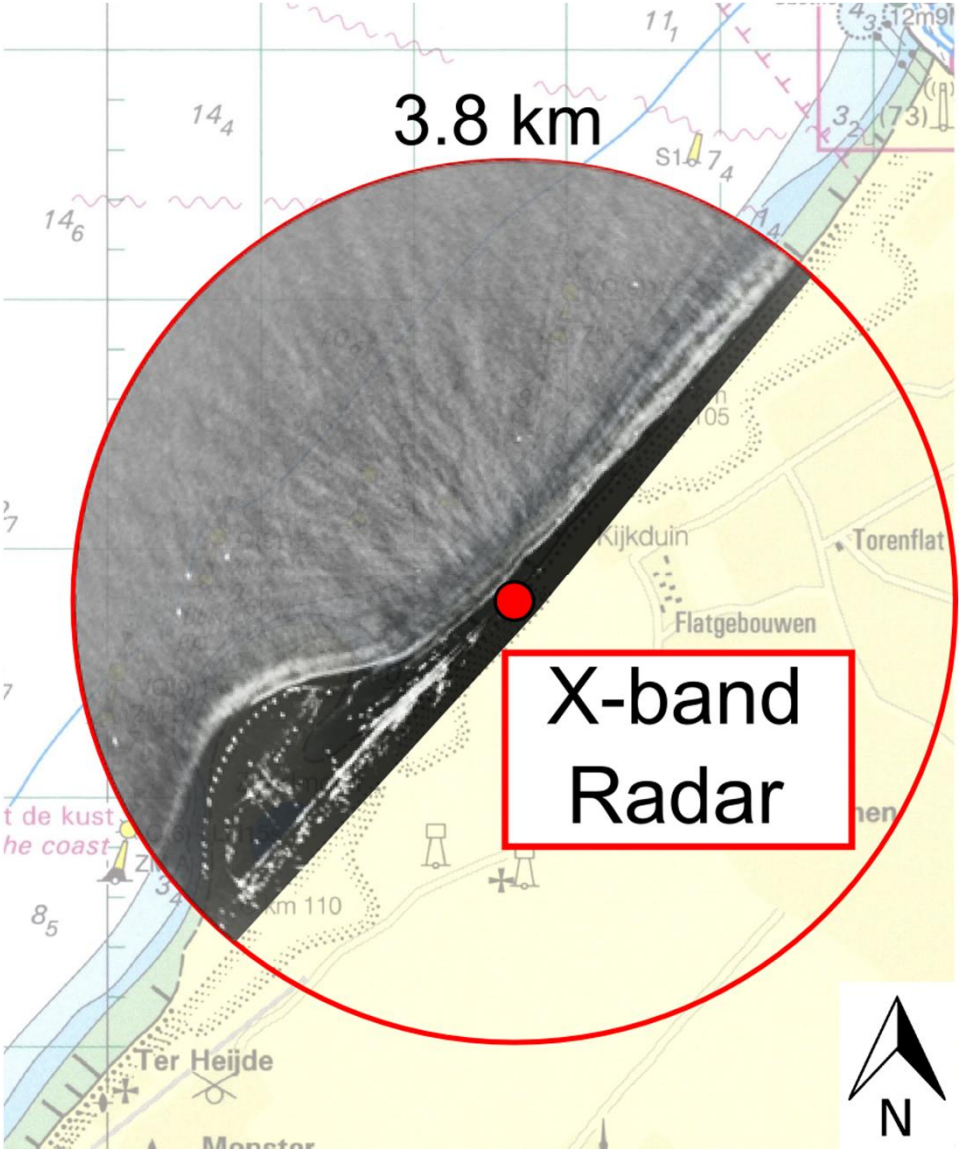
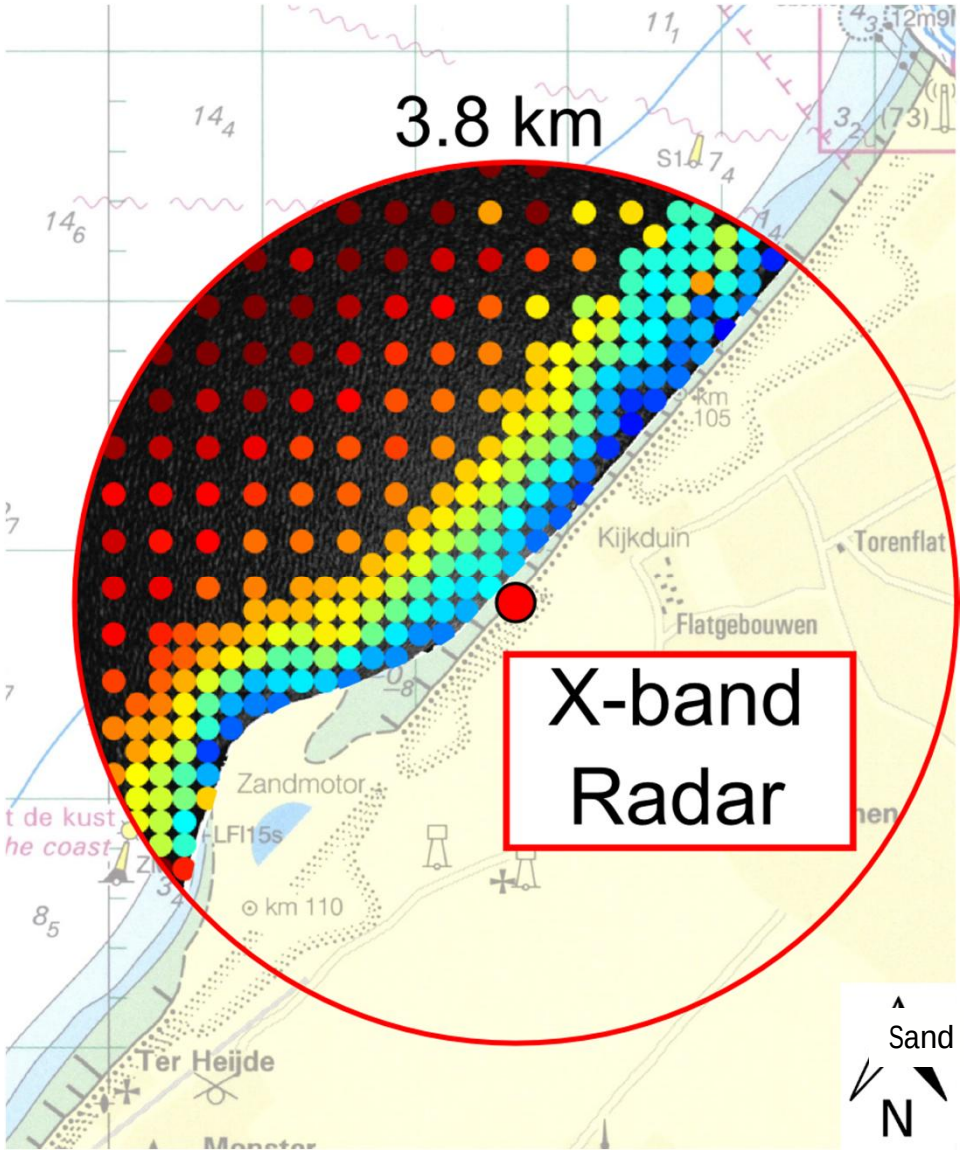
X-band raw data

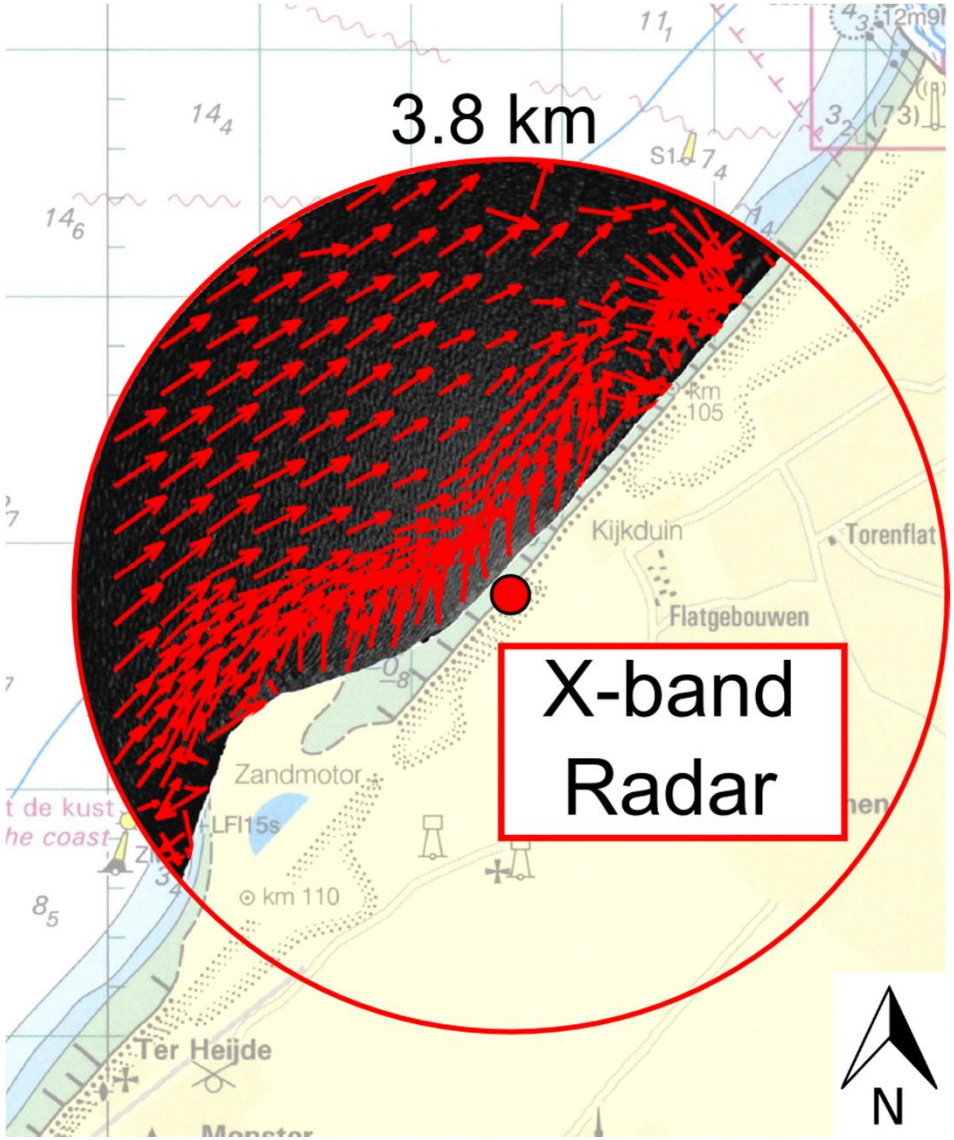


X-band radar → Bathymetry



Sand Motor, Bathymetry Estimate

X-band radar → currents

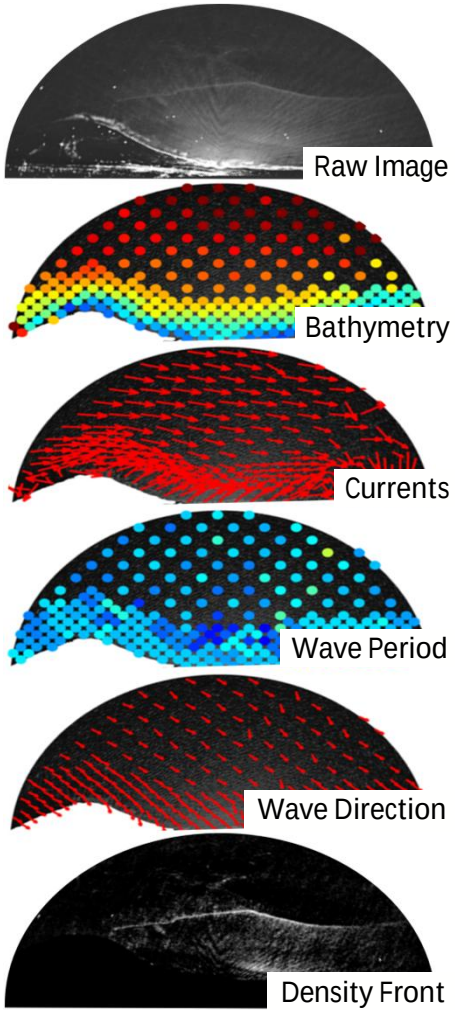


Raw data!

Sand Motor, Hydrodynamics Estimate

Application and potential users

- Existing hardware can be used to extract high resolution bathymetry and hydrodynamics
- Requires radar software for depth inversion
- Potential end users include:
  - Port authorities – dredging management, metocean limits, entrance channel navigability
  - Coastal engineers – implement in difficult coastal environments opposed to *in situ* measurements, use to validate numerical models
  - Researchers – improve the capabilities of depth inversion algorithms and quantify their uncertainty



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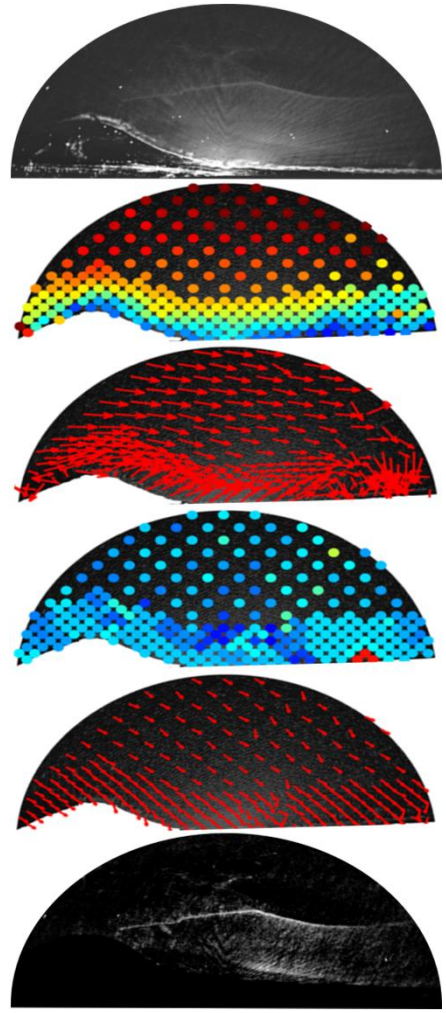
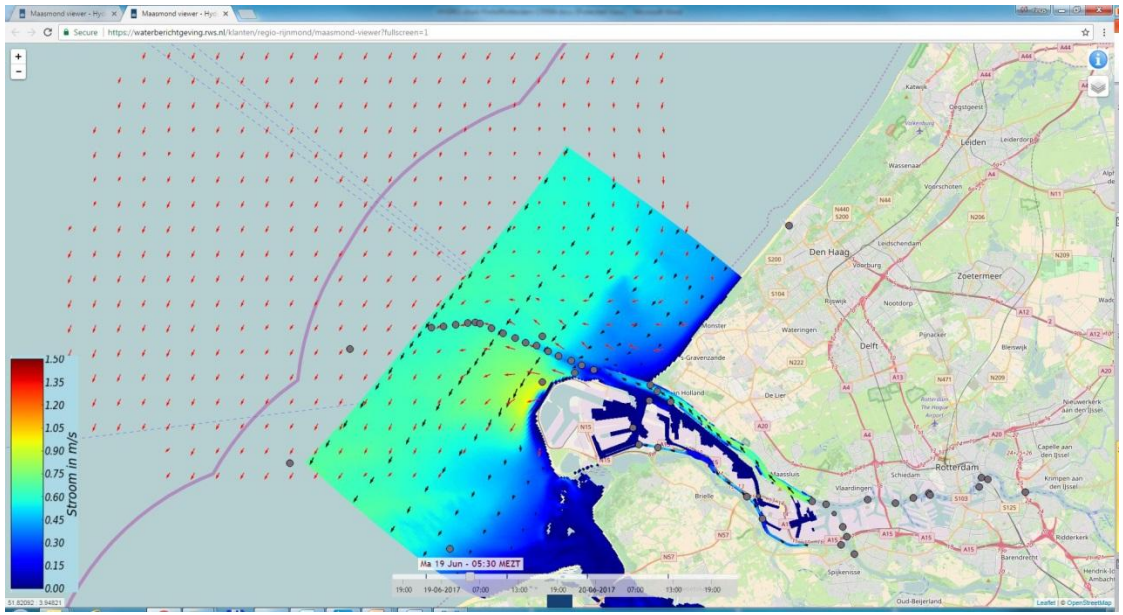
Challenge: Combing RS data





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Thank You

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