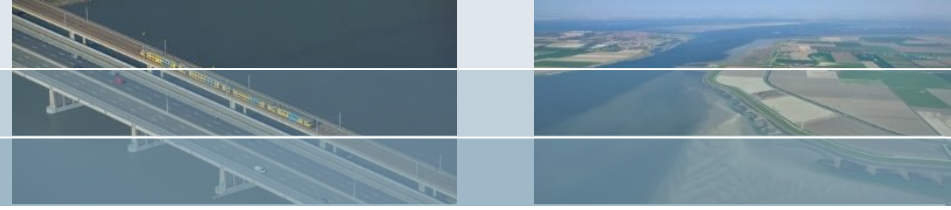




**Investigating the flood risk reduction potential of soft coasts and vegetated shorelines. The EU FAST project is zooming in.**

Mindert de Vries, Deltares  
FAST Project core team

# Why focus on foreshores?



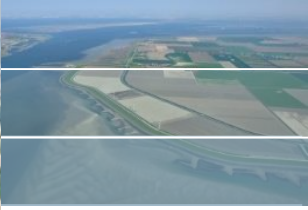
Sandy, muddy and vegetated foreshores contribute to the reduction of floodrisk by providing ecosystem services.

- Attenuation of waves
- Accumulation of sediment

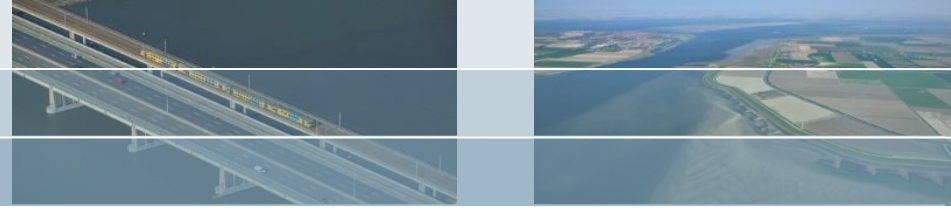
Meanwhile many other services are produced



# Zuidgors – Westerschelde



# Objectives and Product

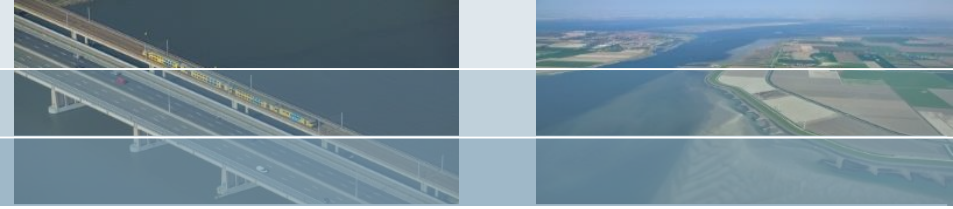


The main objectives of the FAST project are:

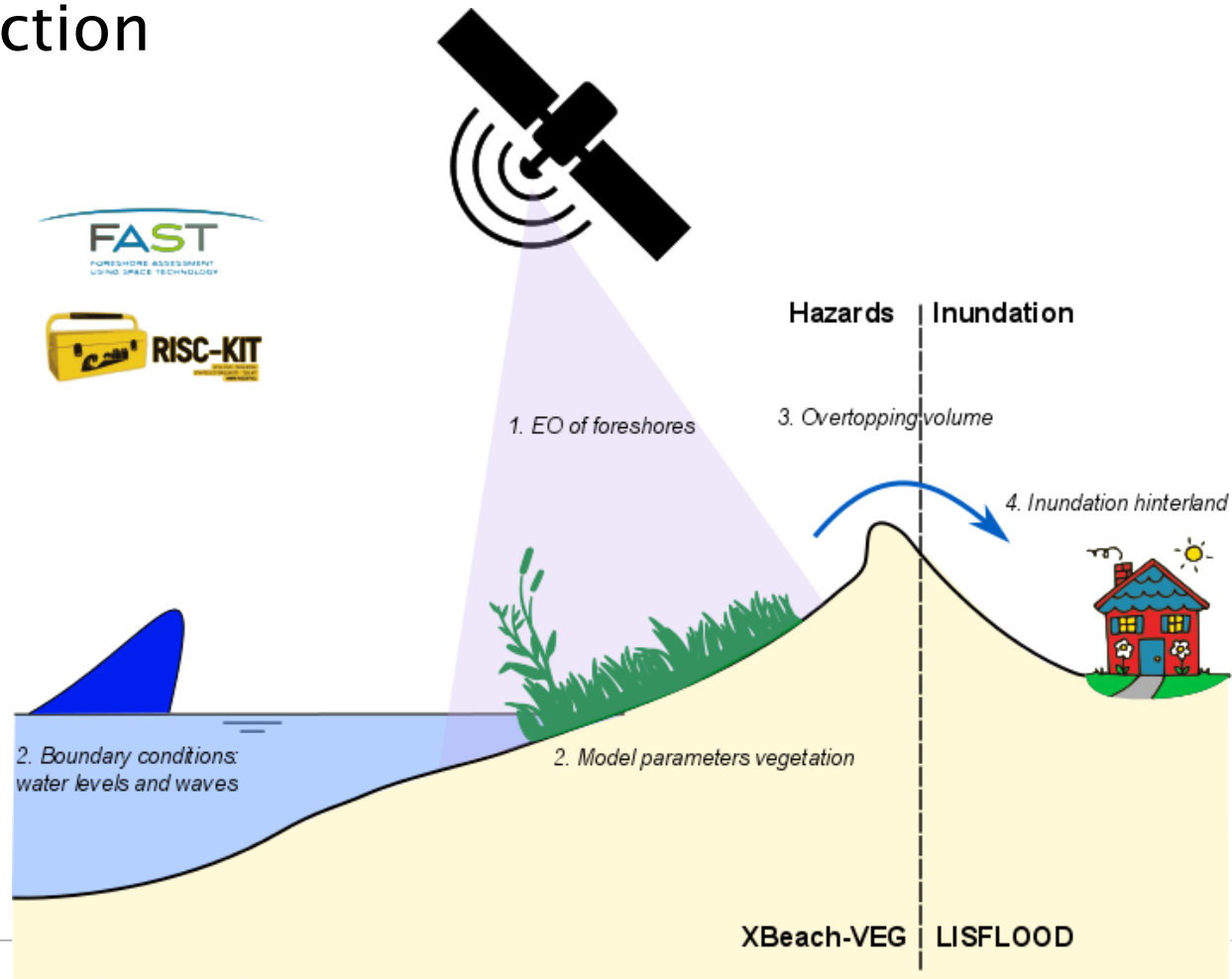
*“To develop a new GMES/Copernicus downstream service by developing open source products based on Sentinel data*

*“To gain from EO-data spatial information on foreshore and floodplain characteristics, such as morphology, sediment characteristics and vegetation properties”*



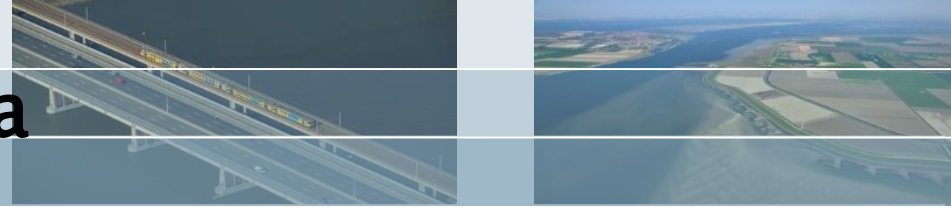


FAST has developed data and modelling services to support cost-effective, nature-based shoreline protection





# Ground truthing for Earth Observation data



# The Science behind

## The Science behind the MI-SAFE tool

Created by Gerit Hendriksen, last modified by Jasper Dijkstra on 31-03-2017



This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 607131.

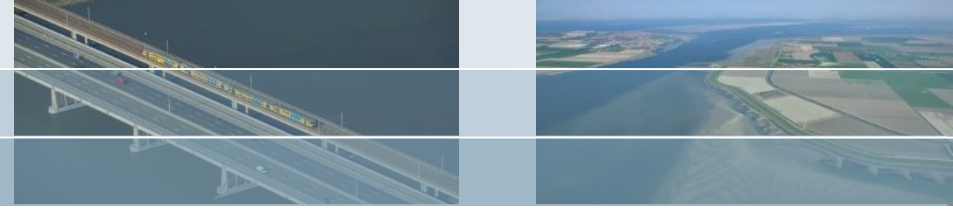
- Introduction
- MI-SAFE illustrative summary
  - Links to methodological videos and public documents:
- MI-SAFE data
  - Elevation
    - Field data, local coverage
    - Global SRTM coupled with GEBCO, Global coverage
    - Inter-tidal elevation (satellite-derived), Global coverage
      - Work flow protocol and algorithms
      - Application to the global coastline
      - Product specifications
      - Quality, validity and accuracy assessment
  - Waves
    - Field measurements, Local coverage
    - Era interim off-shore waves, translated to nearshore depth limited waves, Global/local coverage
  - Water levels, Global/local coverage
  - Vegetation
    - Field data, local coverage
    - Earth Observation products of vegetation, Global/local coverage
      - Vegetation presence/absence map, Global coverage
      - Vegetation type
        - Intertidal vegetation (salt marshes)
        - Inland marsh (reed beds)
        - Broadleaved forest (riparian willow forests and mangroves)
      - Biophysical characteristics of the vegetation
        - Biophysical characteristics: Normalised Difference Vegetation Index (NDVI) of the forest
        - Biophysical characteristics: Leaf Area Index (LAI) of the marsh vegetation
- MI-SAFE tool services
  - Wave attenuation modeling: General approach
  - Wave attenuation modeling: Characterising vegetation types
  - Required crest height modeling
  - The MI-SAFE viewer
    - Actual processes and data retrieved via the MI-SAFE tool
    - MI-SAFE viewer results: Conditions, Confidence, Context and Sensitivity tabs
- The case study sites
  - United Kingdom
  - The Netherlands
  - Spain
  - Romania
- References

### Introduction

The MI-SAFE software and webviewer are developed under the EU funded FP7 project FAST (Foreshore Assessment locations anywhere in the world. The MI-SAFE viewer is thus based on global datasets made available via open spatial data with XBeach for a range of different types of vegetated foreshores and a range of exposure to waves and tides. The results give a first estimate of the potential risk reduction that coastal vegetation has to offer with respect to specific coastal flooding.

For background information about the viewer, the project and all the partners involved, please visit our website - <http://www.deltares.nl>





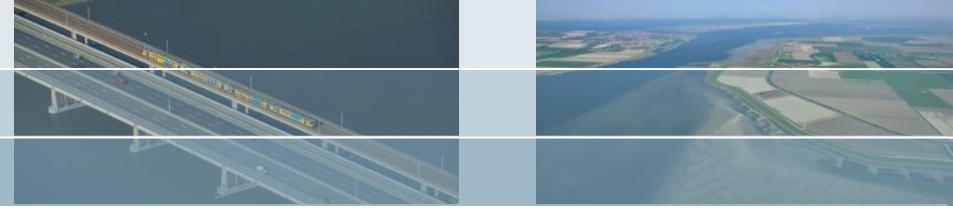
...the products and services generated by FAST

- MI-SAFE viewer
- New world wide map layers
- Open Data Structure
- Open Source Modeling
- Community





# MI-SAFE is online ([fast.openearth.eu](http://fast.openearth.eu))

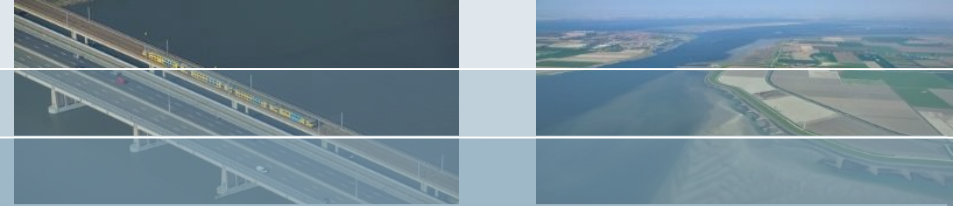


The MI-SAFE viewer helps to visualize generated products and services

- Maps
  - > Per study site in high resolution
  - > World wide
- Results of calculations
  - > Per study site in high detail
  - > Worldwide but less precise
- Wiki
  - > The science behind the data



# Any location on the world's coasts...



Contact - Deltares MI-SAFE fast.openearth.eu

MI-SAFE

Deltares FAST

Results Data Wiki

The Science behind The Value of MI-SAFE The Use of MI-SAFE

Vegetation present  Contribution to wave attenuation

Beware that the data is based on global datasets using average conditions and should not be used for detailed design and planning.

FAST Study Sites

- UK Tillingham
- UK Donna Nook
- NL Paulina
- NL Zuidgors
- RO Jurlovca
- RO Histria
- ES Cadiz

Zuidgors, Westerschelde

MI-SAFE Educational: once every 10 year storm event, 10% likelihood

Conditions Confidence Context Sensitivity

Left Y-Axis: Water Level [m] Elevation Profile [m] Foreshore Area Vegetation  
Right Y-Axis: significant wave height  $H_s$  [m]  $H_{s,levee,no\ veg}$  [m]  $H_{s,levee,veg}$  [m]

OK

0 0.5 1.0 KILOMETERS

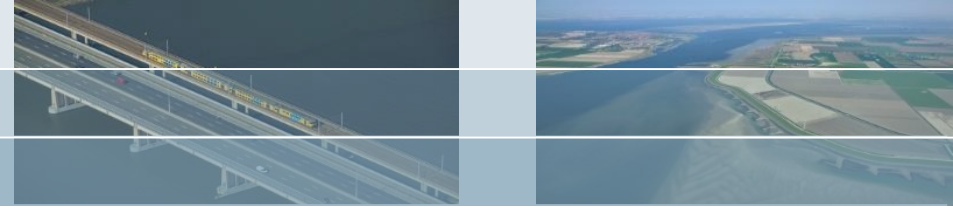
Issues Community

10:33 30-May-17





# Vegetation map (Sentinel 2016), world

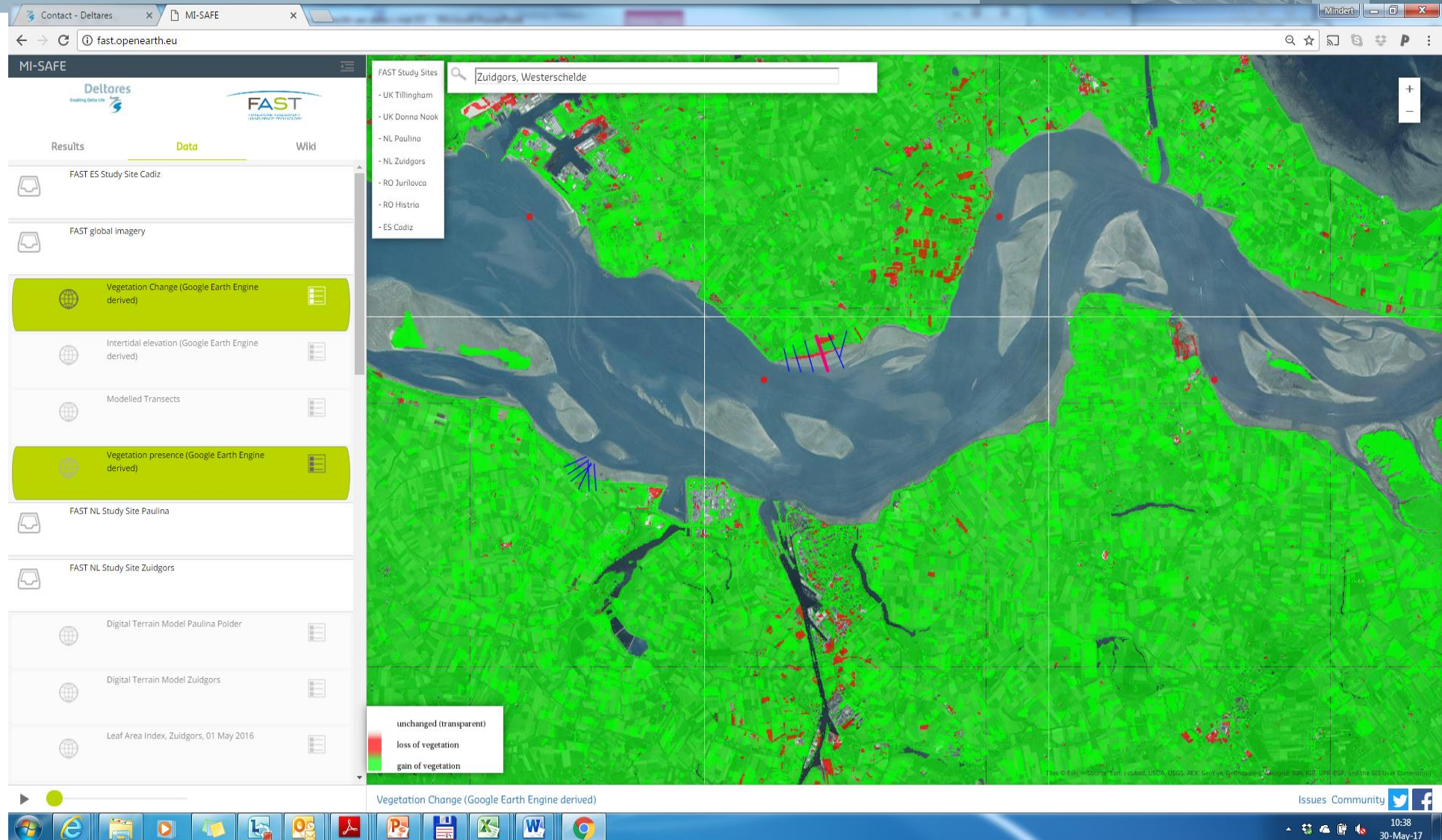


A screenshot of a web browser displaying a web application. The browser address bar shows 'fast.openearth.eu'. The application interface includes a sidebar on the left with a search bar containing 'Zuidgors, Westerschelde' and a list of FAST Study Sites: UK Tillingham, UK Donna Nook, NL Paulina, NL Zuidgors, RO Jurilovca, RO Histria, and ES Cadiz. The main map area shows a satellite-style view of a river delta with a green overlay representing vegetation. A legend in the bottom-left corner of the map area identifies the green color as 'Vegetation'. The sidebar also lists various data layers such as 'Vegetation Change (Google Earth Engine derived)', 'Intertidal elevation (Google Earth Engine derived)', 'Modelled Transects', 'Vegetation presence (Google Earth Engine derived)', 'FAST NL Study Site Paulina', 'FAST NL Study Site Zuidgors', 'Digital Terrain Model Paulina Polder', 'Digital Terrain Model Zuidgors', and 'Leaf Area Index, Zuidgors, 01 May 2016'. The bottom of the browser window shows a Windows taskbar with various application icons and a system tray with the time '10:38' and date '30-May-17'. The Deltares logo is visible in the bottom right corner of the browser window.



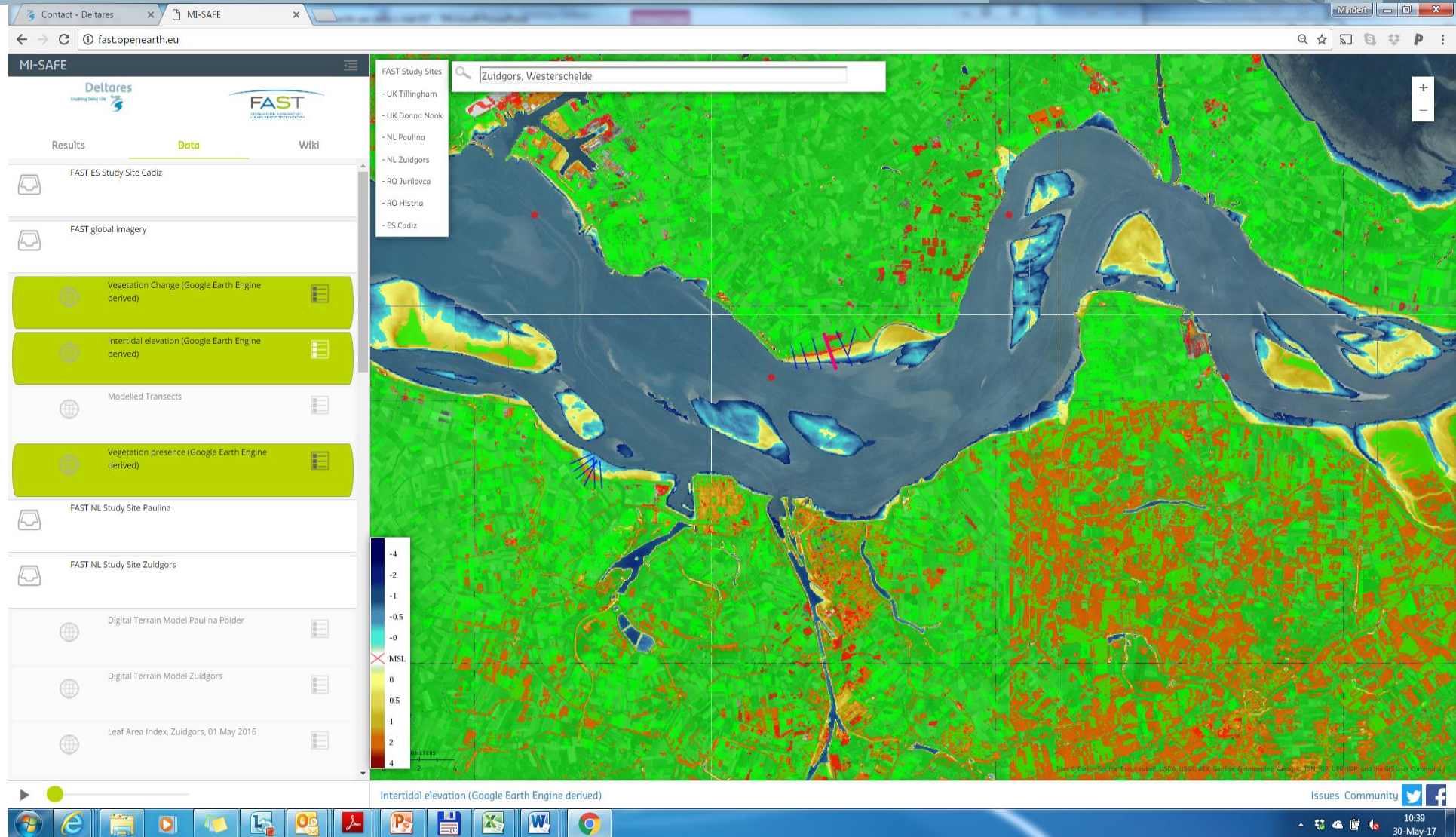


# Vegetation change map (1996–2016), world



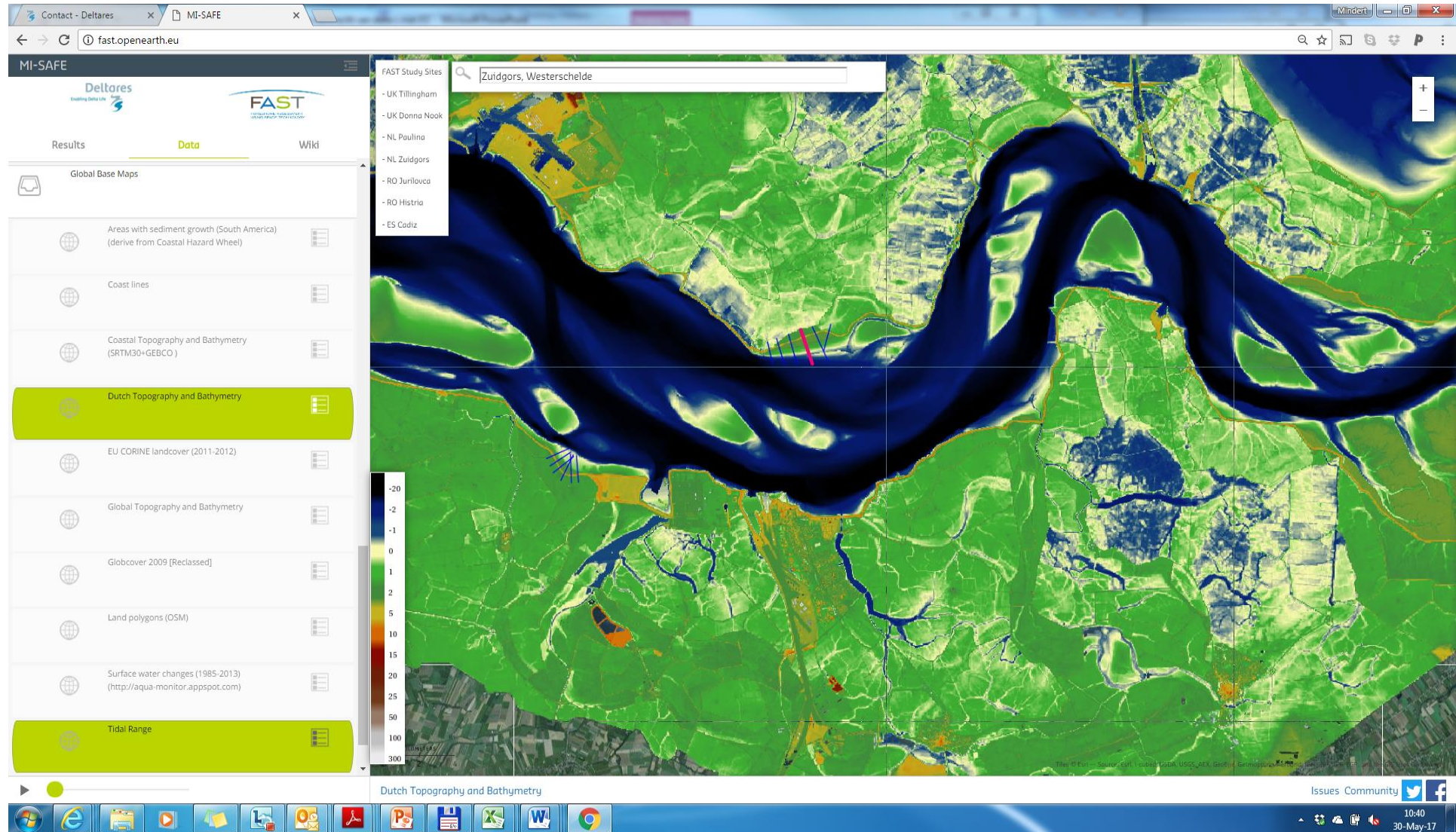


# Intertidal elevation map (2000–2016), world





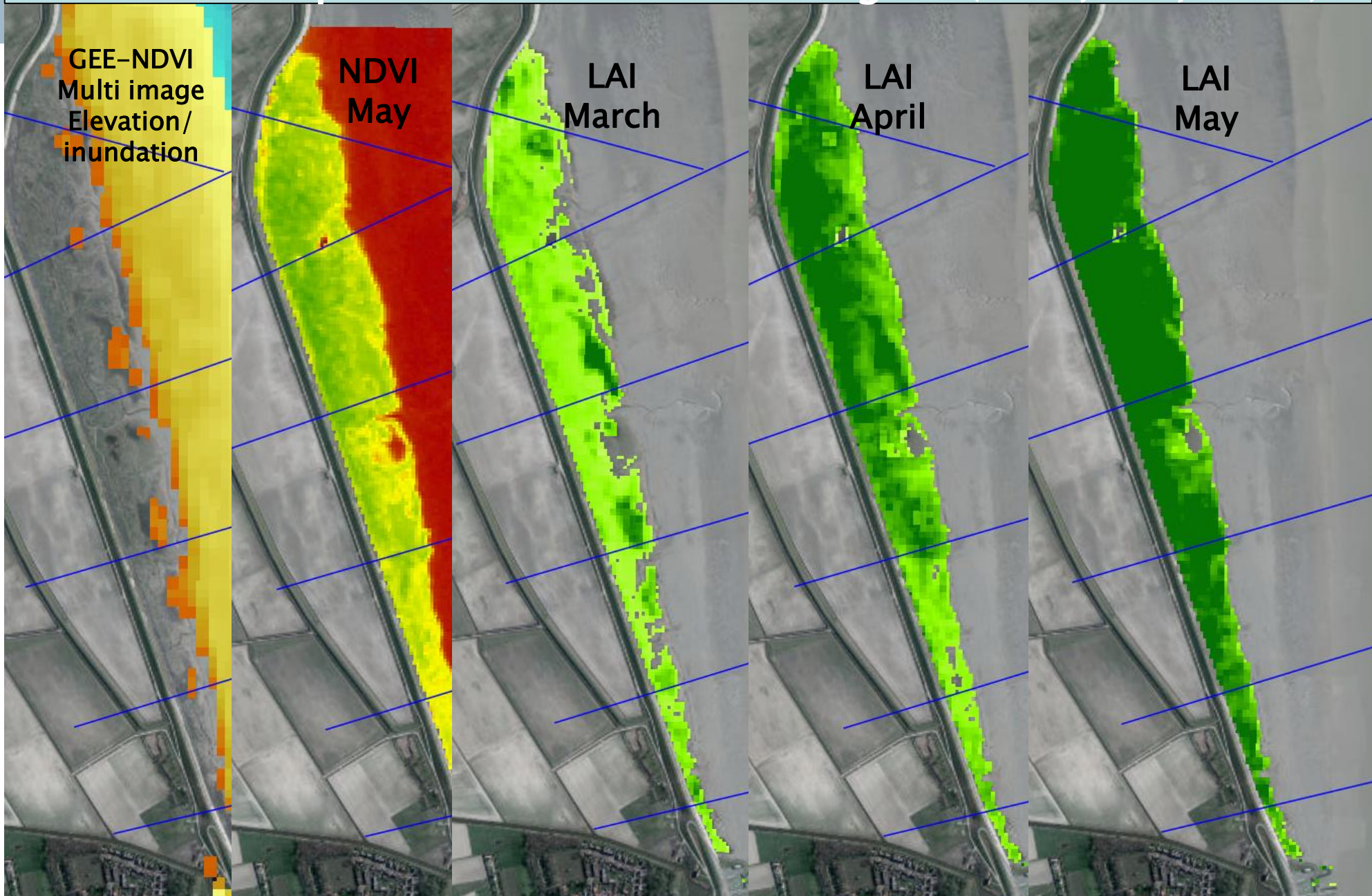
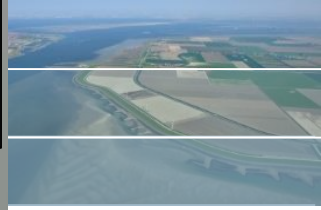
# Dutch detailed elevation and bathymetry maps



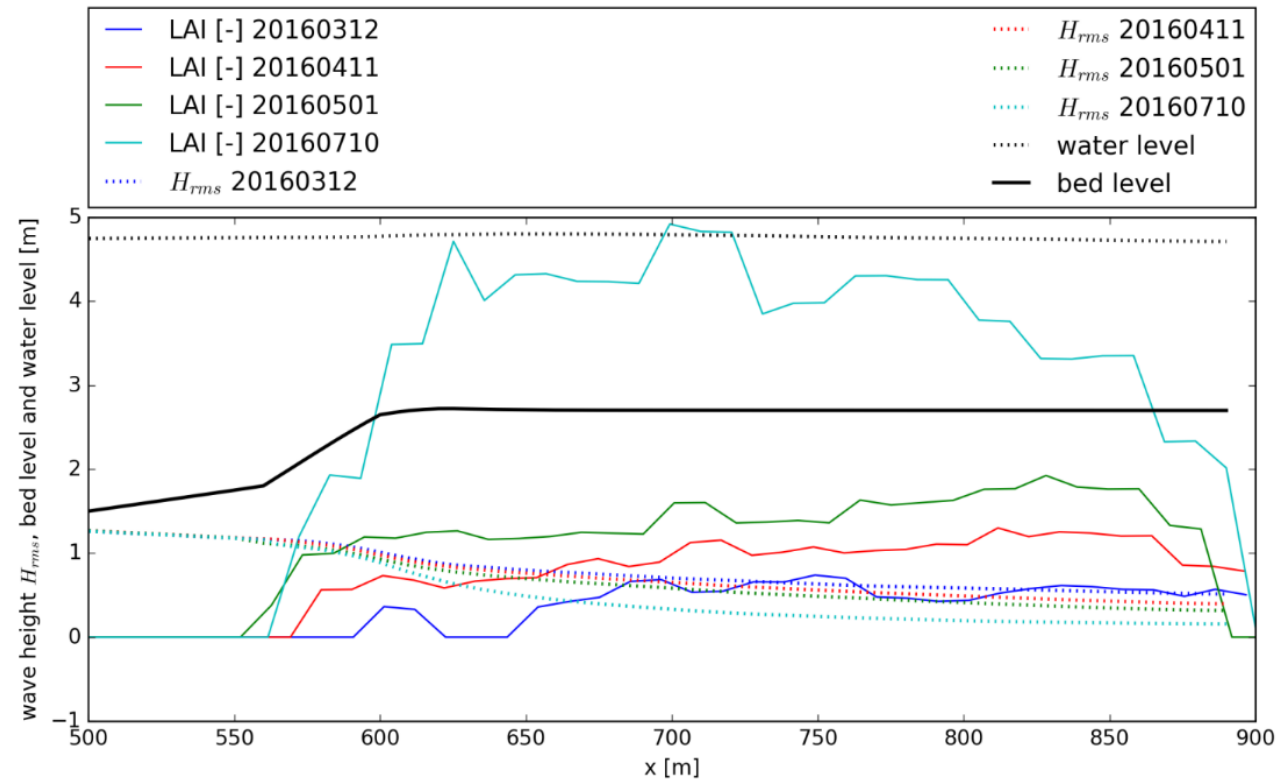
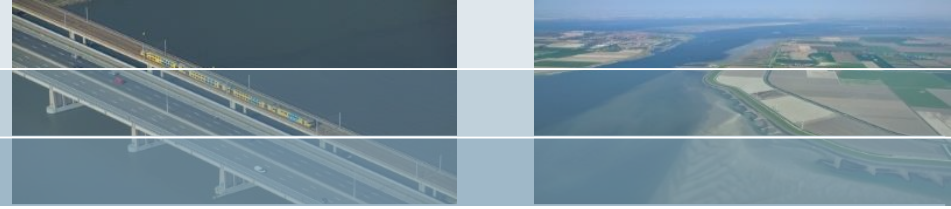


# Zooming in on study sites with SENTINEL

Temporal data of LAI for Zuidgors (10m, 2m, NIOZ)

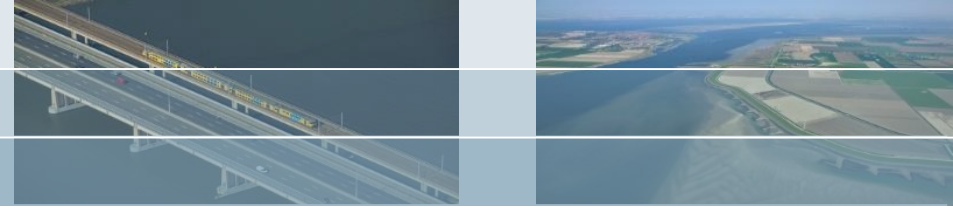


# Testing model sensitivity to LAI variability





# Zuidgors study site



Contact - Deltares x MI-SAFE x

fast.openearth.eu

MI-SAFE

Deltares

FAST

Results Data Wiki

The Science behind The Value of MI-SAFE The Use of MI-SAFE

Vegetation present

Contribution to wave attenuation

Beware that the data is based on global datasets using average conditions and should not be used for detailed design and planning.

FAST Study Sites

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Zuidgors, Westerschelde

MI-SAFE Expert: once every 100 year storm event, 1% likelihood

Conditions Confidence Context Sensitivity

Left Y-Axis: Water Level [m] Elevation Profile [m] Foreshore Area Vegetation

Right Y-Axis: significant wave height  $H_s$  [m] significant wave height  $H_{s, no\ veg}$  [m]

OK

Issues Community

10:32 30-May-17



# Impact of vegetation on storm events

MI-SAFE Expert: once every 100 year storm event, 1% likelihood

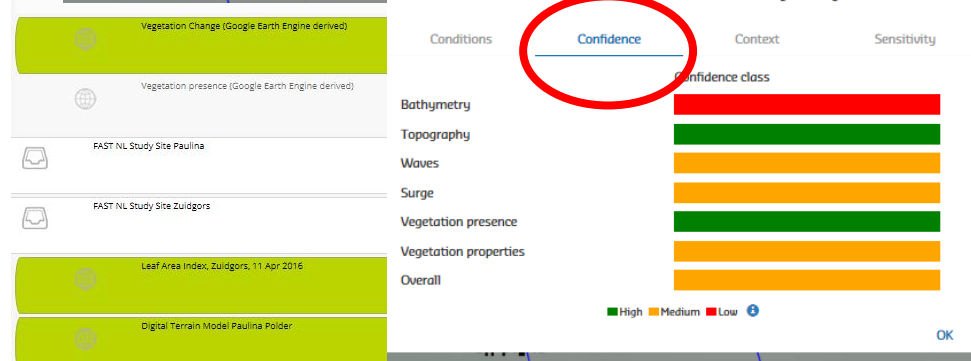
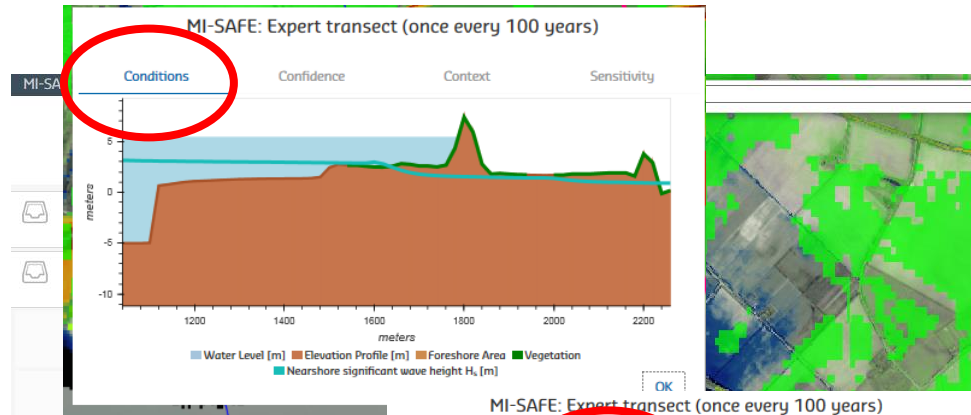
Conditions	Confidence	Context	Sensitivity
<b>Required sea defence crest height [m] per return period</b>			
<b>Vegetation density</b>	<b>10 years (10%)</b>	<b>100 years (1%)</b>	<b>1000 years (0.1%)</b>
Standard	2.53	3.94	5.41
High	2.05	3.39	4.72
Low	2.82	4.27	5.73
None	3.08	4.58	6.1
<b>10 years (10%)</b>			
Surge level [m]	4.57	5.27	5.96
Offshore wave height [m]	5.9	7.1	8.3
Peak period [s]	10.7	11.8	12.7

OK



# Zooming in for study sites

## XBEACH Results from the interface



MI-SAFE: Expert transect (once every 100 years)

Conditions	Confidence	Context	Sensitivity
Required crest height [m] per return period			
Vegetation density	10 years	100 years	1000 years
Standard	3.35	4.95	6.57
High	2.92	4.44	5.99
Low	3.62	5.21	6.81
None	3.84	5.46	7.12
Surge level [m]	4.57	5.27	5.96

MI-SAFE: Expert transect (once every 100 years)

Conditions Confidence Context Sensitivity

Your coastal transect of interest has a foreshore with **standard marsh** over a length of **260 m**. For a storm frequency of once every **100 years**, the local water level setup is **5.27 m** above Mean Sea Level and the near shore significant wave height  $H_s$  is **5.07 m**.

The significant wave height at the end of the vegetated foreshore (i.e. the foot of the levee) is **1.25 m**. For the same foreshore without vegetation, this would be **1.36 m**.

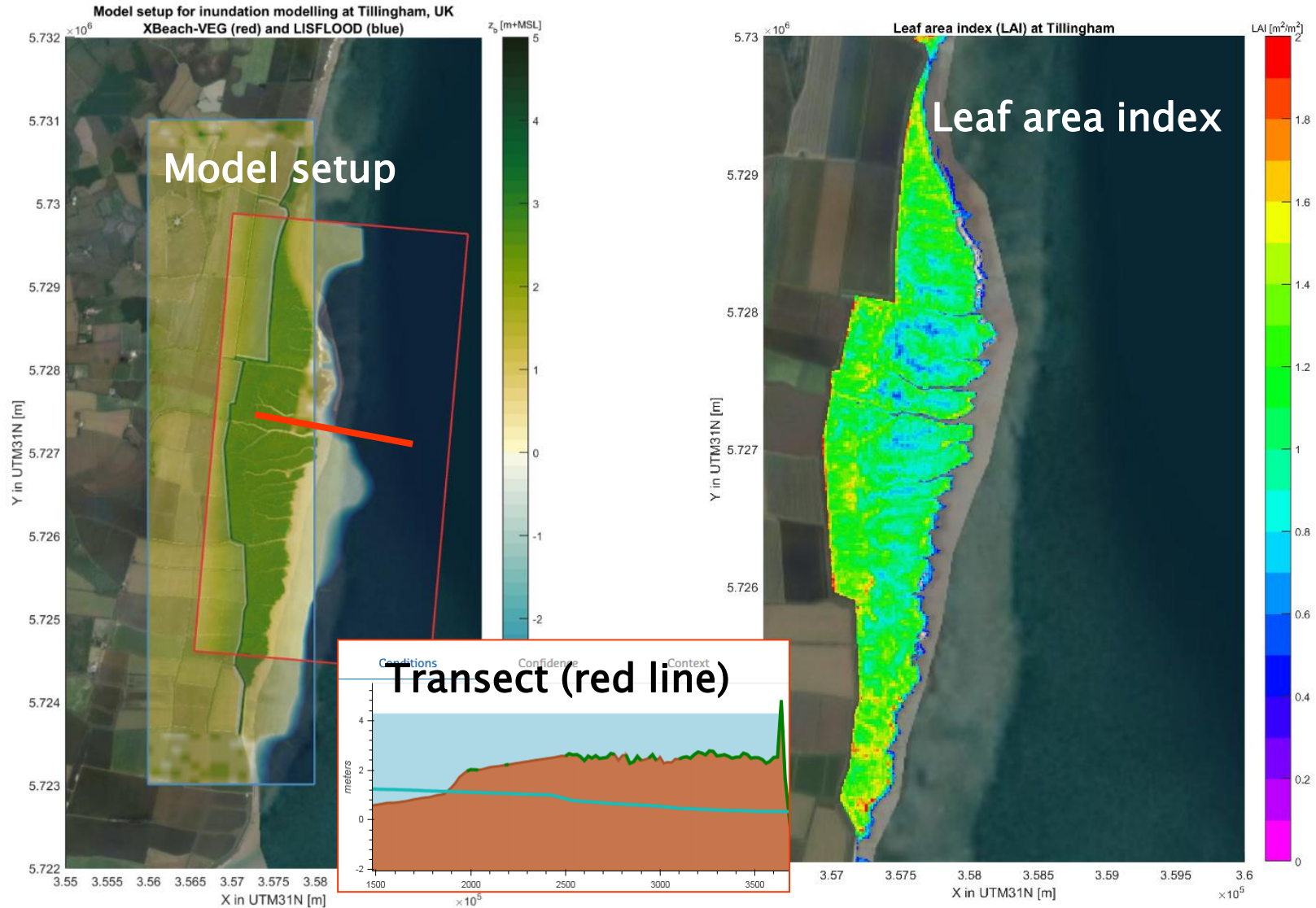
Related to flood risk reduction, the required crest height for these conditions would be **4.95 m** (above the water level setup), assuming an acceptable overtopping discharge of  $q=0.1$  l per m per s, which is a very conservative limit. If there would be no vegetation present on this foreshore transect, the required crest height would be **5.46 m** (above the water level setup) Using an allowed overtopping discharge of  $q=1$  l per m per s, the required crest height would be **3.7 m**, versus **4.1 m** for a bare foreshore.

The sensitivity tab gives insight in how the required crest height is affected by smaller or larger design storms and by the density of the vegetation cover.



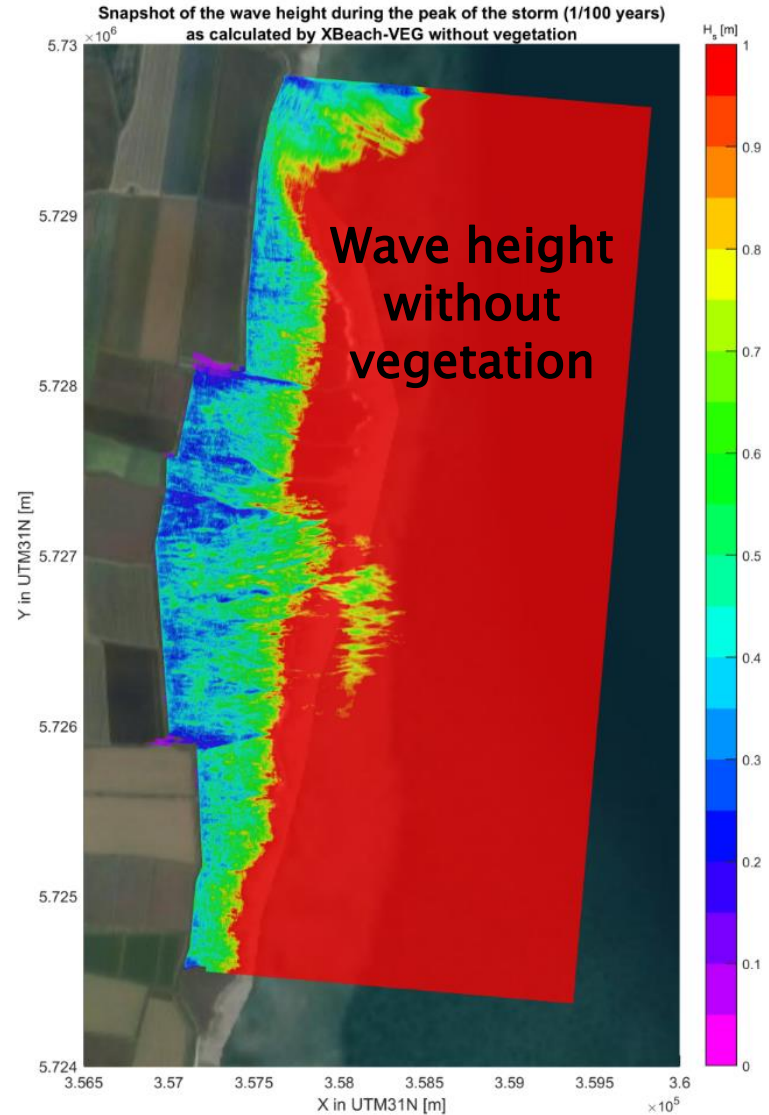
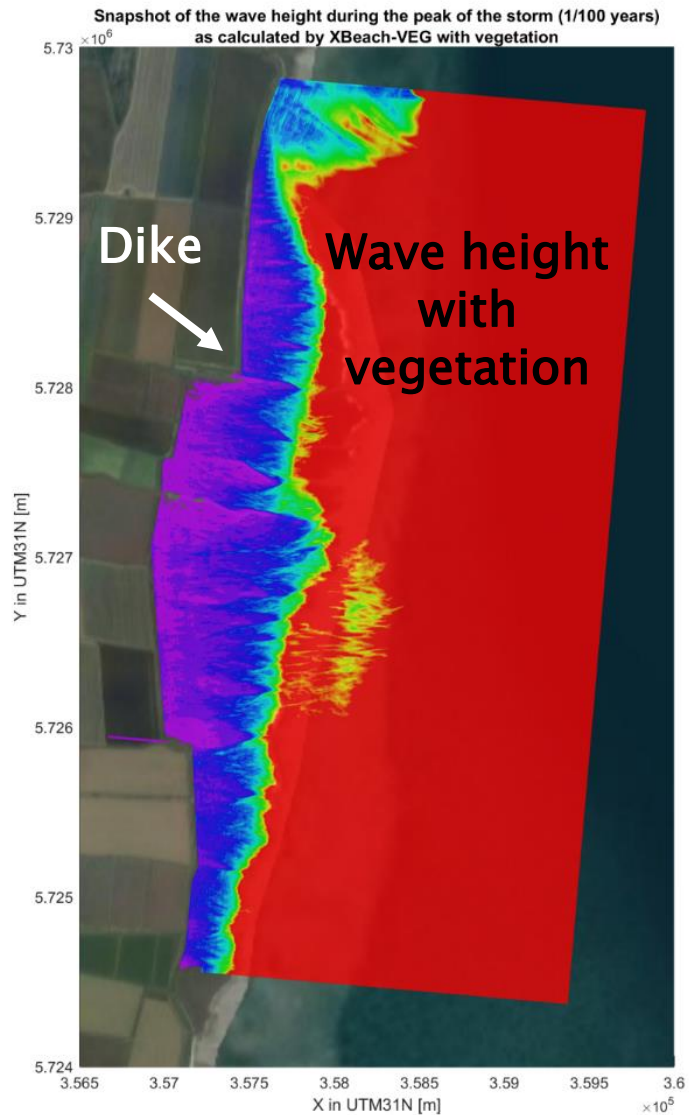
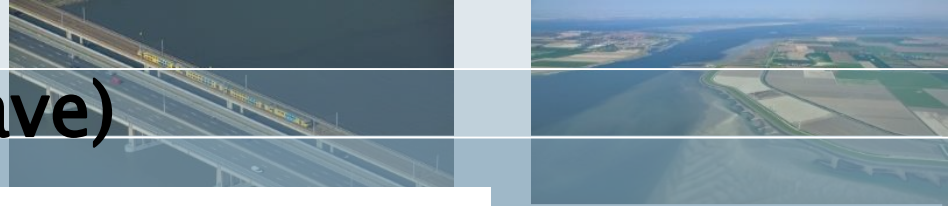


# Advanced analysis using 3D modelling

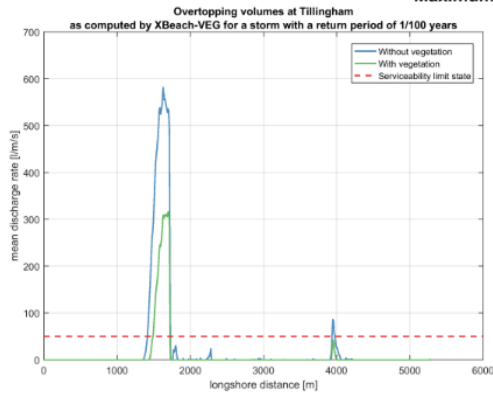




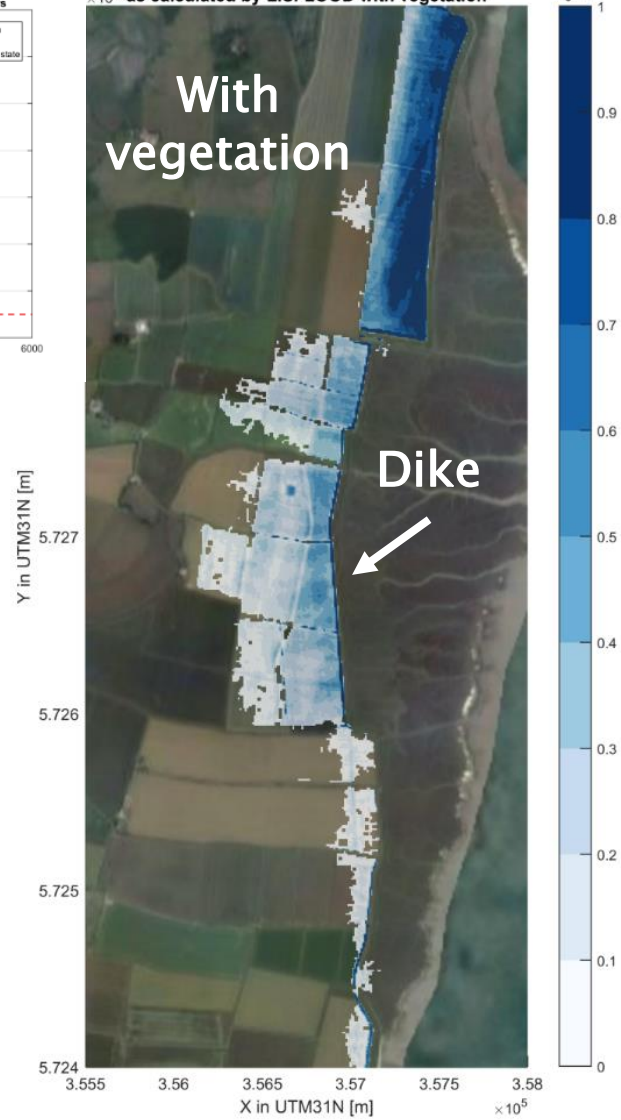
# Advanced analysis using 3D modelling (Wave)



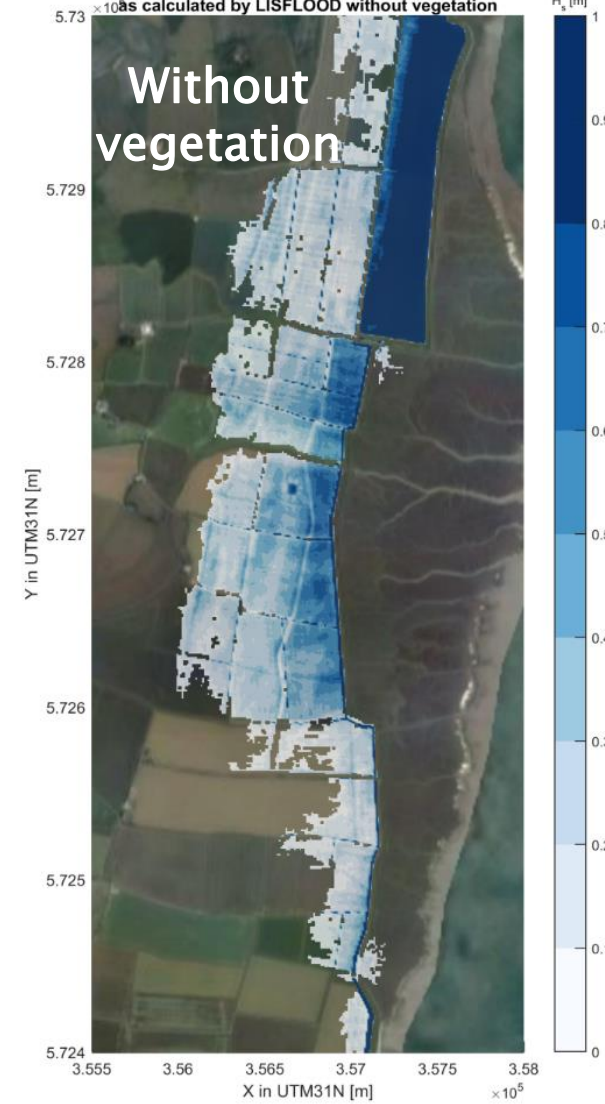
# Advanced analysis using 3D modelling (Flooding)



Maximum inundation depth as a result of a storm with a return period of 1/100 year as calculated by LISFLOOD with vegetation



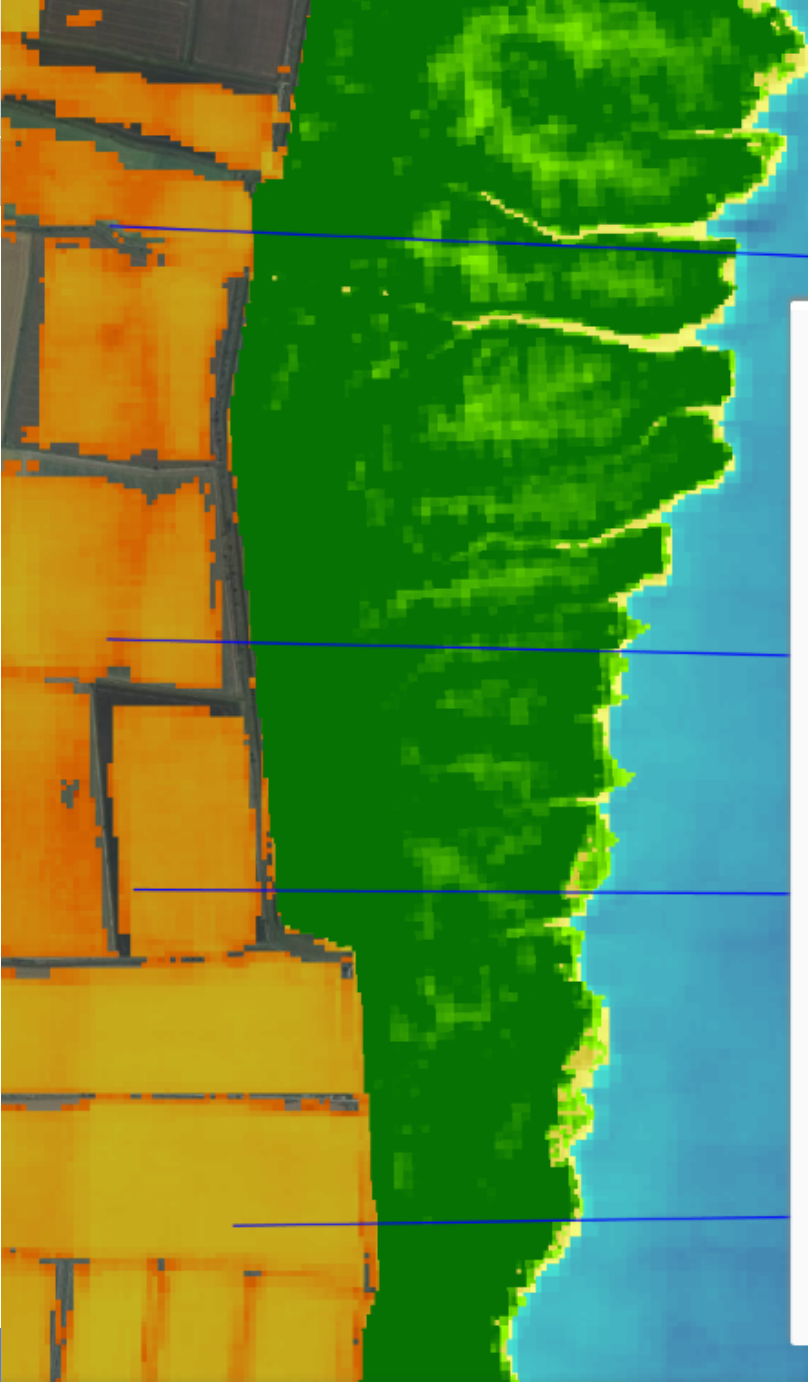
Maximum inundation depth as a result of a storm with a return period of 1/100 year as calculated by LISFLOOD without vegetation



Results show dramatic (50%) reduction in extent and depth of flooded area



# You could join the community!



## Community form

First Name\*

Last Name\*

Gender\*  Male  Female

Email\*

Phone\*

Job title

Organisation\*

Country\*

Question\*

Submit

By joining the FAST community we offer the following support services to you related to the MI-SAFE modality:

- The FAST community @MISAFE\_services and Facebook is ready for questions and feedback related to the tool, services and other online products;
- The news service will inform you on training opportunities, (advanced) applications and upgrades of products;
- The software support facilities provided by Deltares and the training provided during the international Delft Software Days are available;
- Within certain countries, you can get in touch with national contacts who are familiar with the tool.
- You get access to the RISC-KIT community and to more information and products related to flood risk reduction quantification.



CLOSE

