

HAZRUNOFF

PROJECT

Awareness & Response Tools: Using digital twins on water-related hazards

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David Brito, Frank Braunschweig, Douglas Miranda

Bentley[®]

Bentley Systems



Funded by
European Union
Civil Protection
and Humanitarian Aid

The ultimate goal of HazRunOff



- To allow realtime and simulated information on rivers, estuaries and coastal areas as a continuum environmental compartment
- Supported with fusion of model and data-oriented holistic view
- Providing smart and actionable information for better decisions in preparedness & response duties.

HazRunOff: Why?

- Why integrated approach is important?
 - multiple factors:
 - Several processes and scales
 - Many flood and pollution sources

System complexity can only be reproduced and understood following an holistic approach



HAZRUNOFF

PROJECT

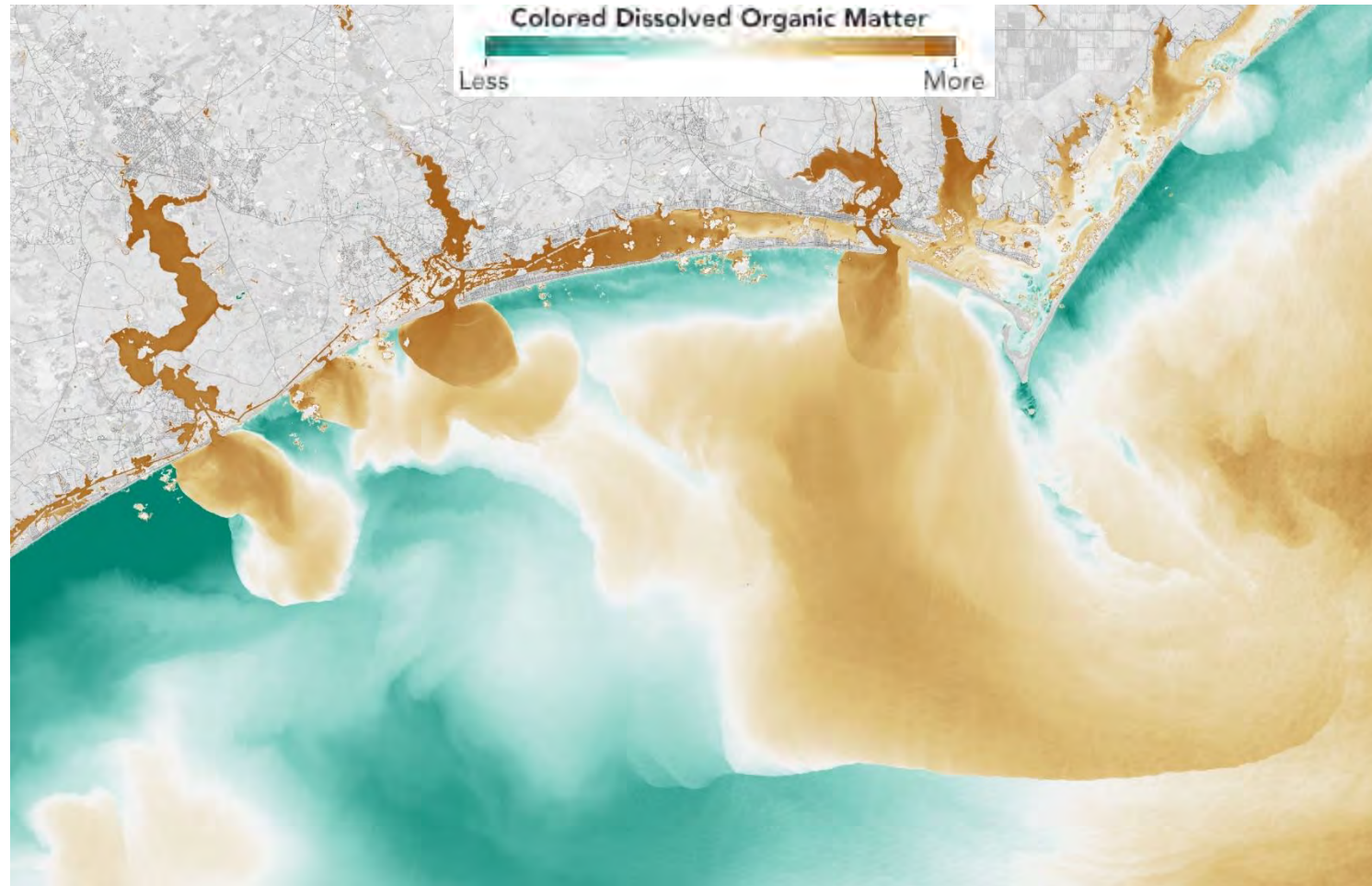


Floods & water pollution | Hurricane Florence



September 2018 | NASA's Landsat-8 satellite

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River flood in a nuclear power plant – Fort Calhoun, Nebraska (2011)



Dam breach = flood + pollution

Michigan

Emily Holden in
Washington

Wed 20 May 2020 20:42 BST



1,551

Michigan: threat of toxic contamination looms after dam failures trigger flooding

Catastrophic flooding could potentially release toxic pollution from site contaminated by Dow Chemical



▲ Michigan dam failures force thousands to flee flooding – video

Catastrophic flooding triggered by dam failures in **Michigan** could potentially release toxic pollution from a site contaminated by the industrial giant Dow Chemical.

Dow's facility in Midland, **Michigan**, where the company is headquartered along the Tittabawassee River, manufactured chlorine-based products beginning in the early 1960s. The company discharged dangerous chemicals

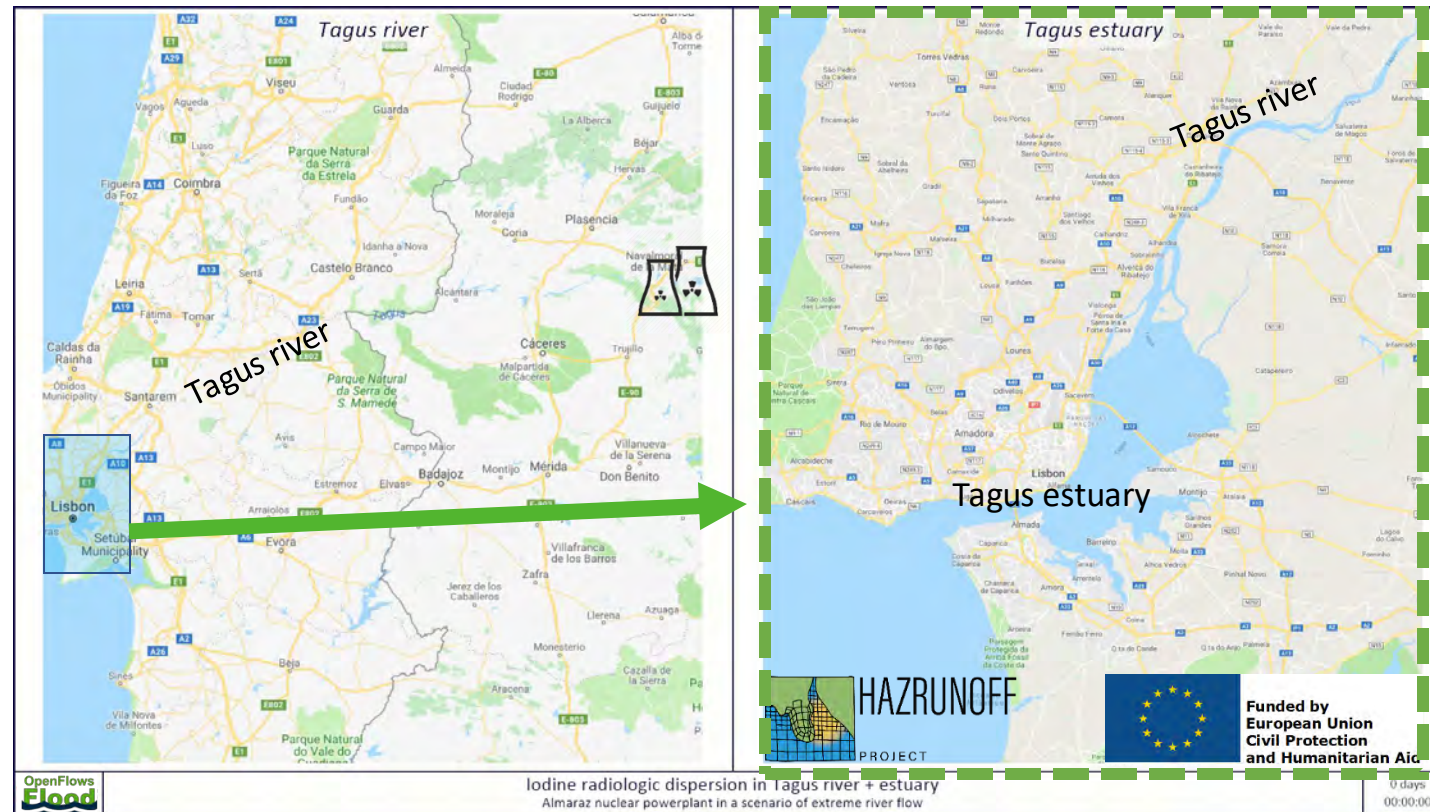


Integrated modelling = HazRunOff

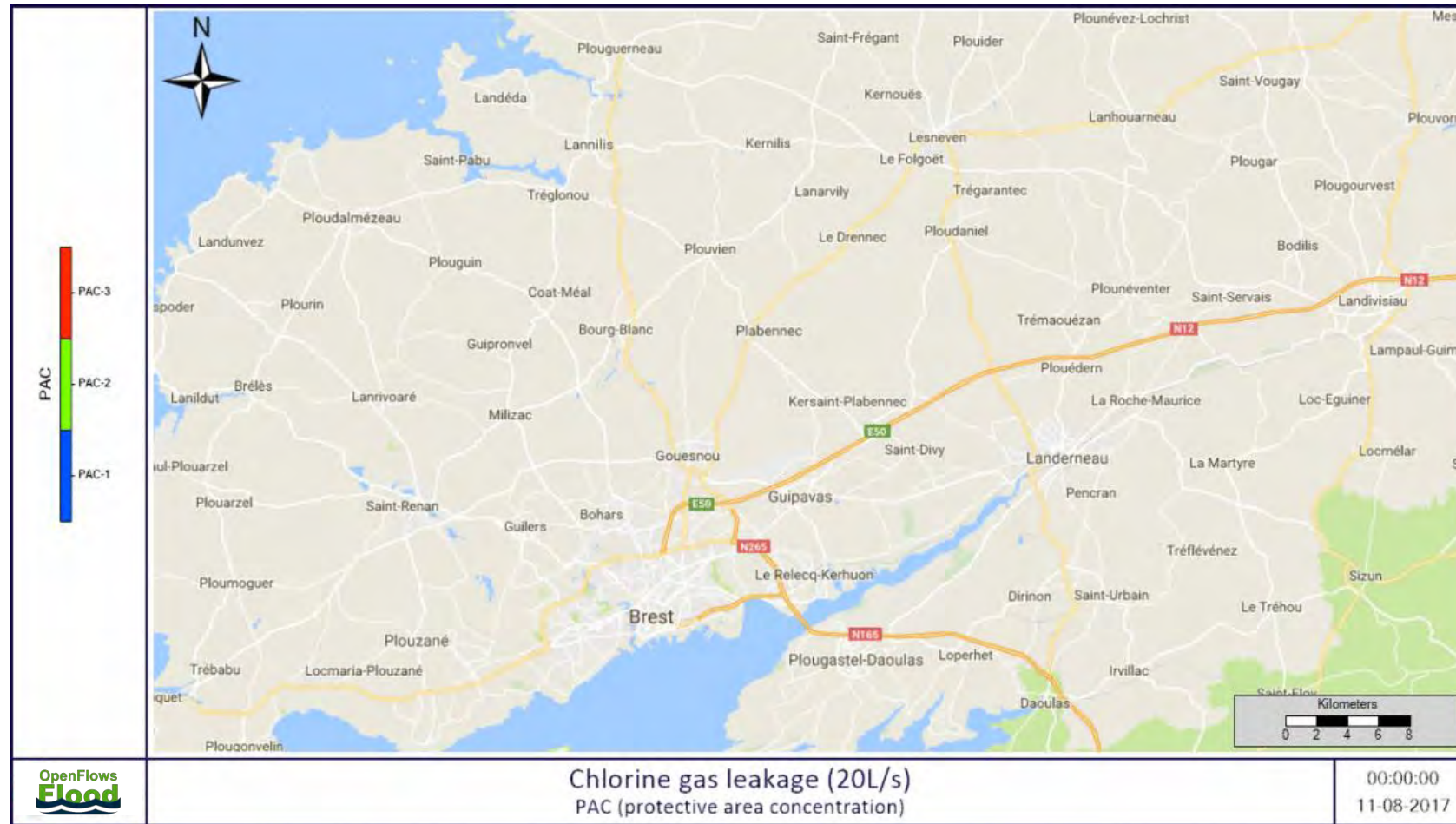
Floods & Water pollution: mixing scales and processes



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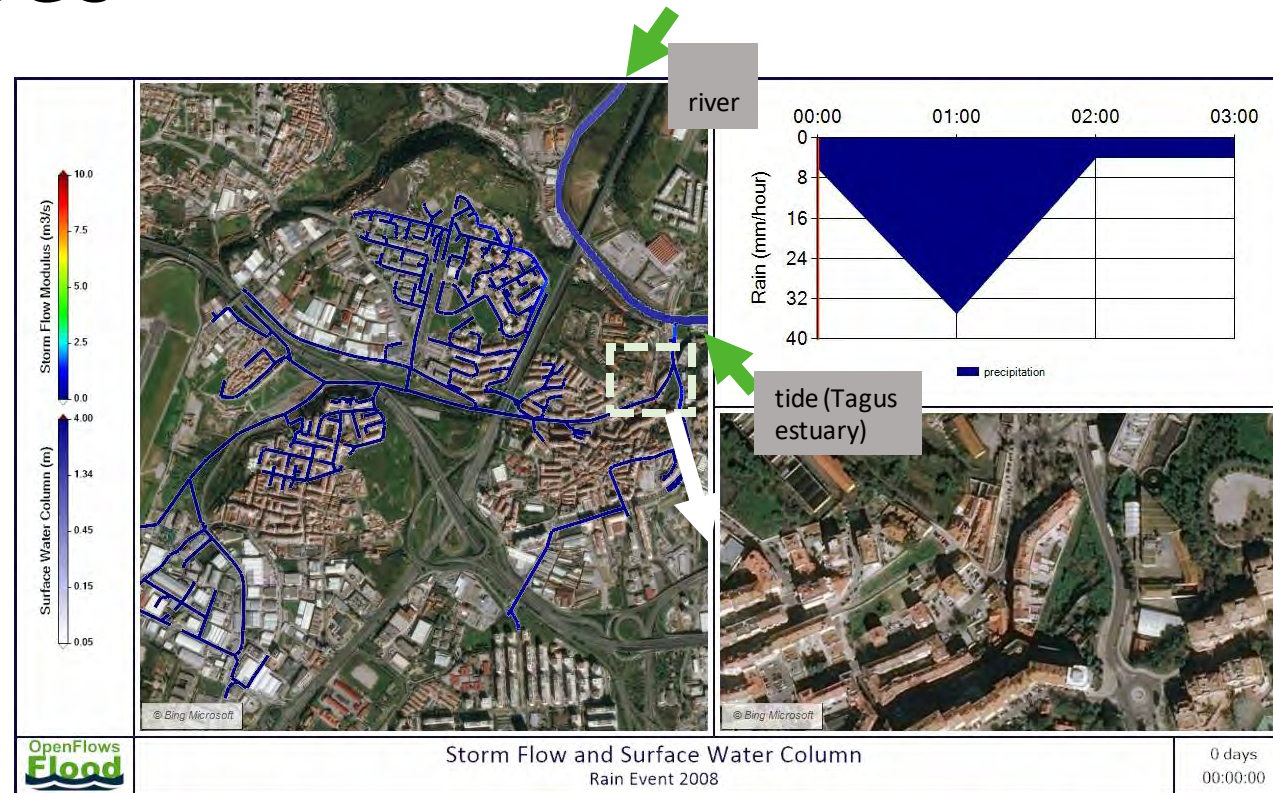


Floods & Water pollution: mixing scales and processes

- Urban drainage and fecal coliform concentration in coastal areas

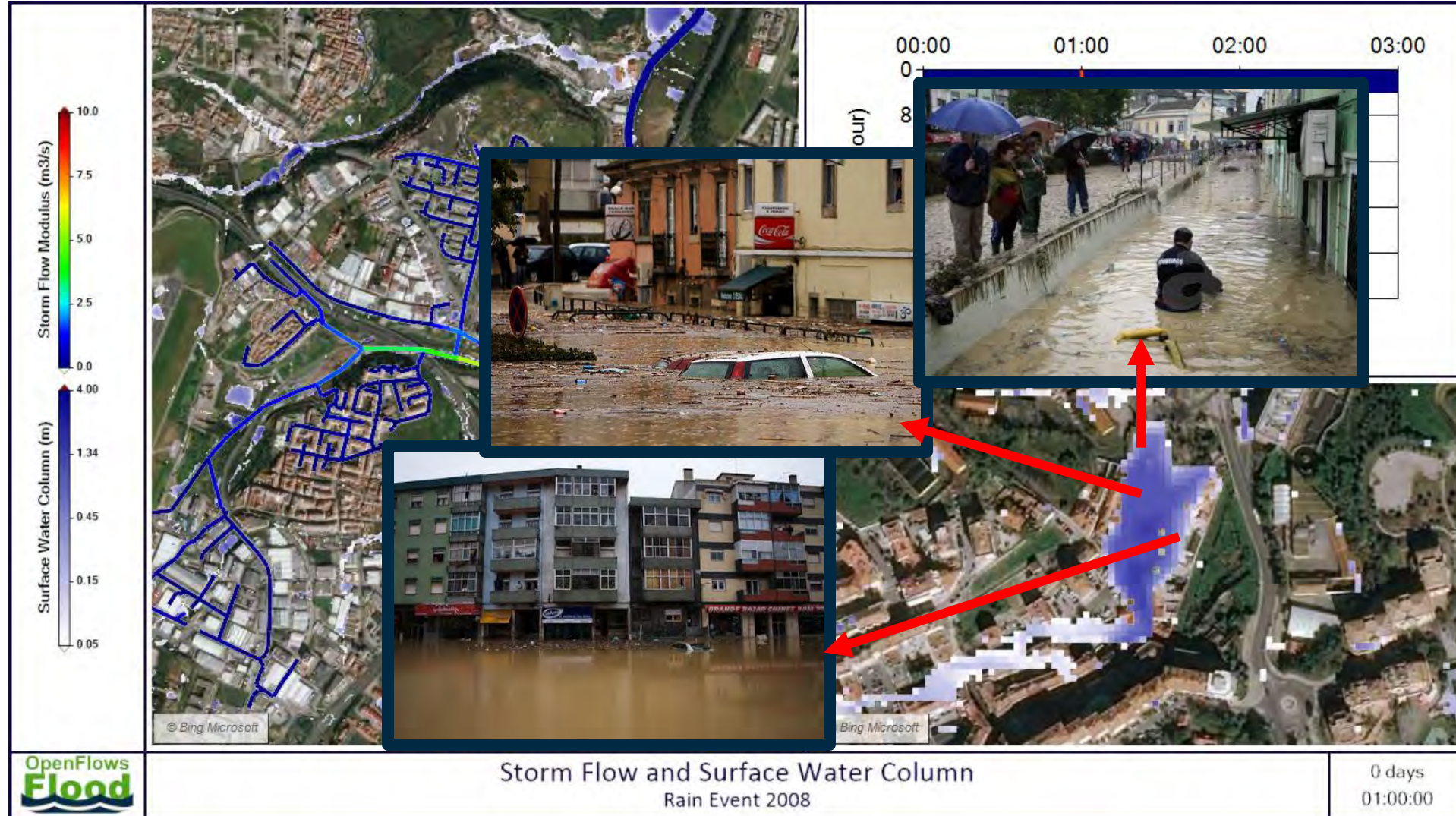


Floods & Water pollution: mixing scales and processes



Sacavém 3-way coupled modelling:
rivers, surface runoff, and subsurface collection systems

Floods & Water pollution: mixing scales and processes



HazRunOff: Why?

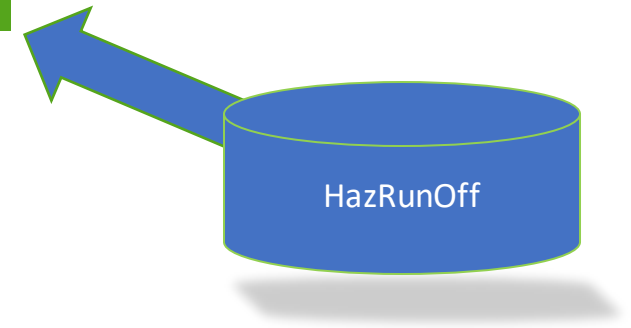
So, we can study processes and scales in an integrated way...



...But can we follow them in realtime, or even predict their evolution?

HazRunOff: Why?

- Preparing and responding to incidents - Non-structural mitigation measures
 - Risk mapping & zoning
 - Disseminate risk information
 - Flood & pollution forecasting & early warning systems
 - Insurance
 - Land use planning
 - Train emergency teams
 - Develop & test emergency management plans
 - ...



Our vision on resilient cities & critical infrastructure
(including seaports, water or power utilities, industry
plants, etc.)

Digital Twin Workflows & Connected Data Environment (CDE)





Infrastructure Digital Twin

Bridges the physical and virtual

Spans entire asset lifecycle

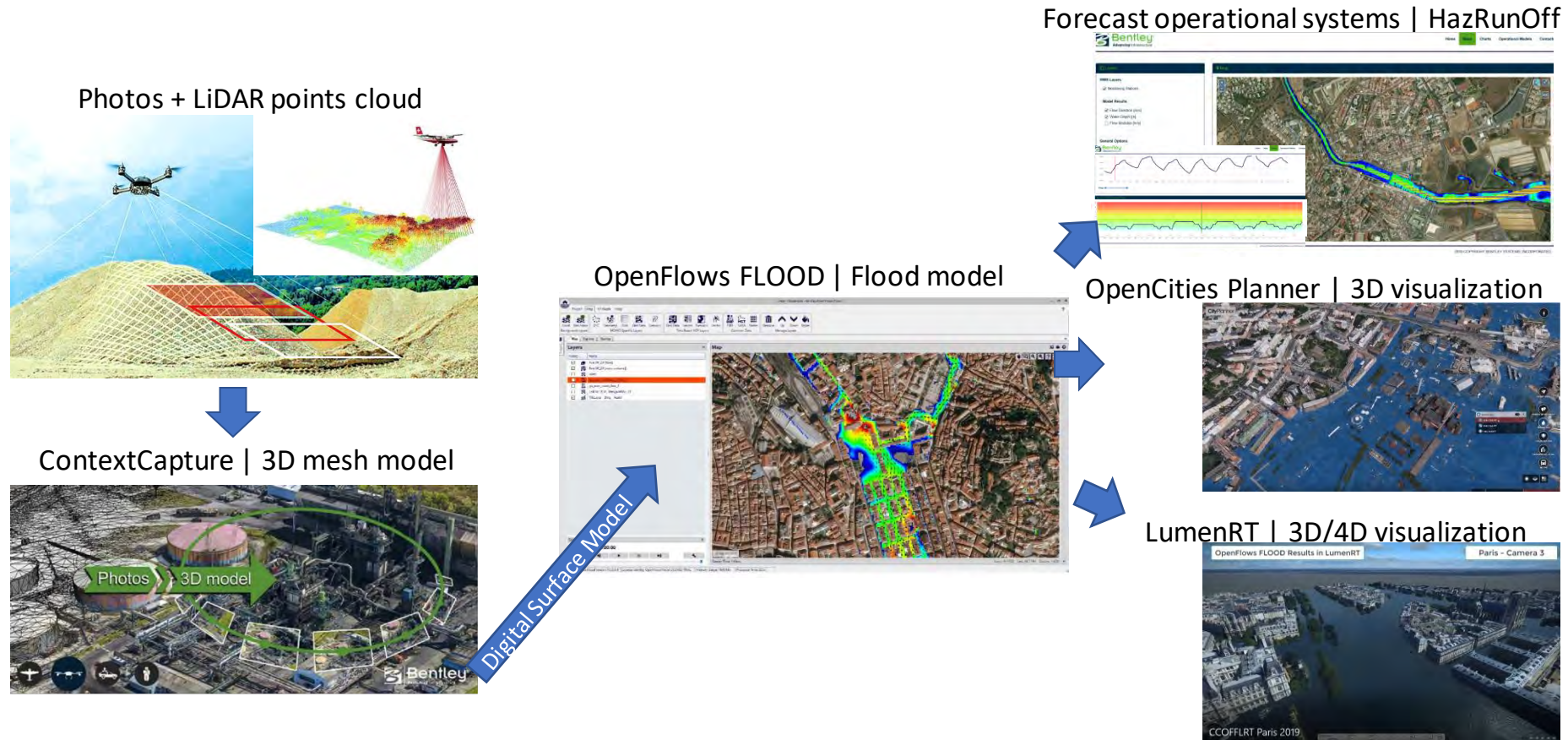
Is updated continuously

Is a way to visualize assets, check status, perform analysis and generate insights

Digital Twin Workflows & Connected Data Environment



Workflow in a Connected Data Environment



Lisbon: 3D mesh, surface runoff model, 4D
visualization

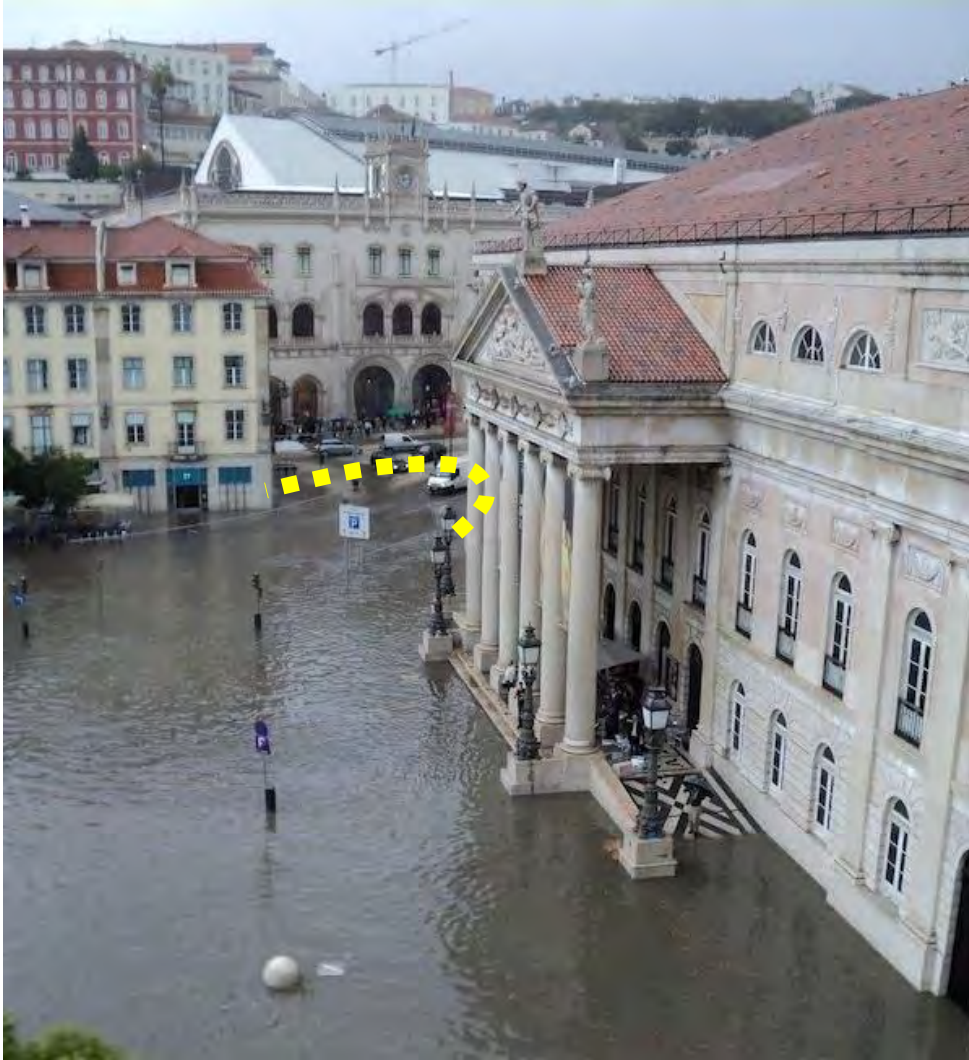
Lisboa – Downtown flooding



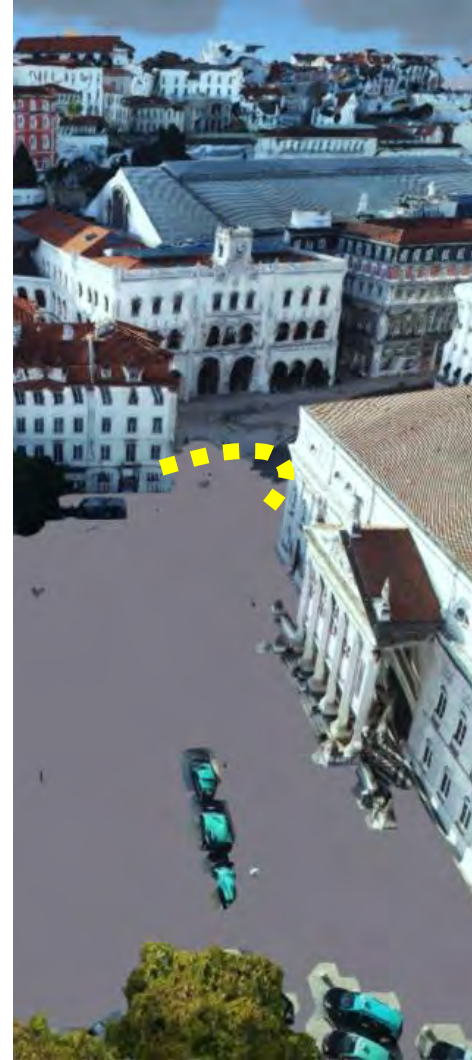
Lisboa – Downtown flooding



Lisboa – Downtown flooding



photo



model

Lisboa – Downtown flooding



photo



model

Lisboa – Downtown flooding



model



photo

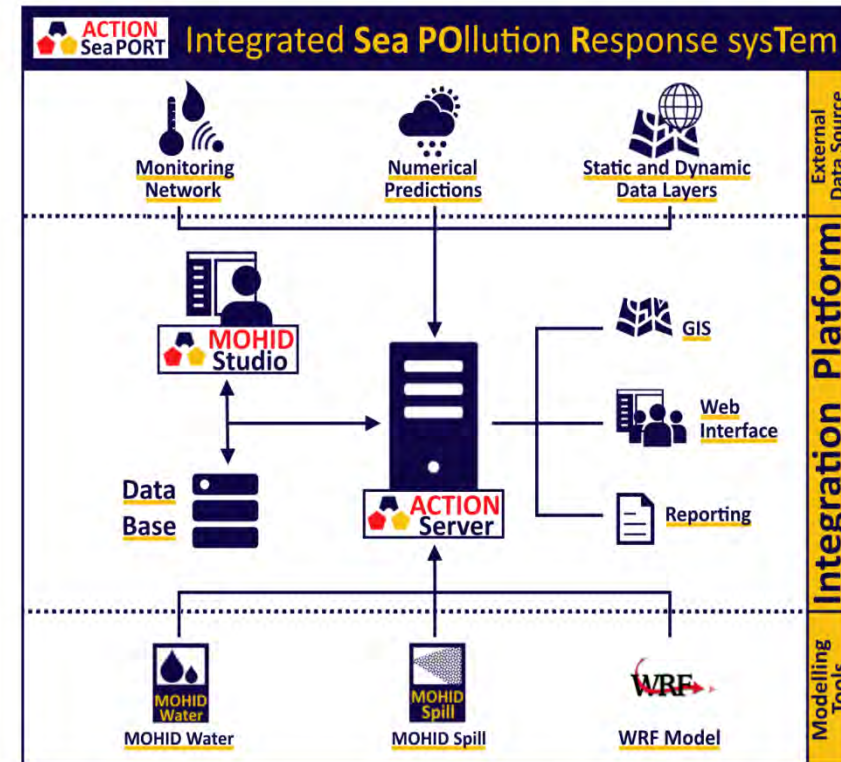
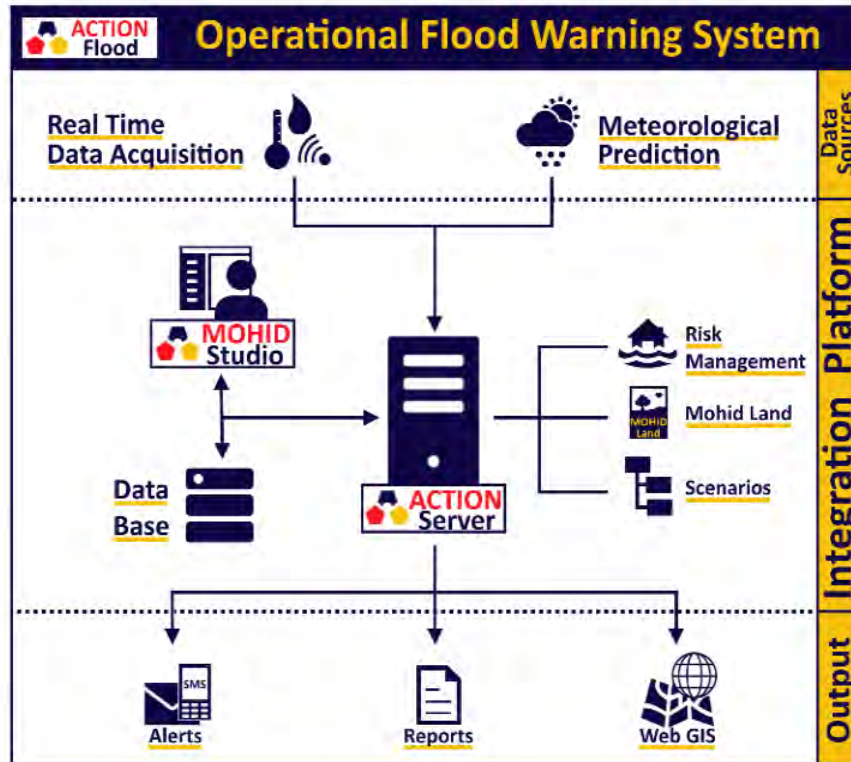


HazRunOff

Preparedness & response digital tools

HazRunOff preparedness & response digital tools

- Prototype based in previously developed technologies ACTION Flood and ACTION Seaport

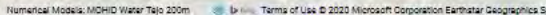


HazRunOff Platform:

- Map visualization of properties for integrated view
- Realtime dashboards for situational awareness
- Charts & Tables for point analysis
- On-demand pollutant dispersion system

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Domain

Portugal

Operational Results

Ocean/Coastal Circulation

Operational Properties

Current Velocity Modulus [m/s]

☒ Direction Overlay

As: ☐ StreamLines ☒ Vectors

Remote Sensing

None

Instants

None

Background Imagery

None

User Simulation Layers

For simulation layers please login first

⏮

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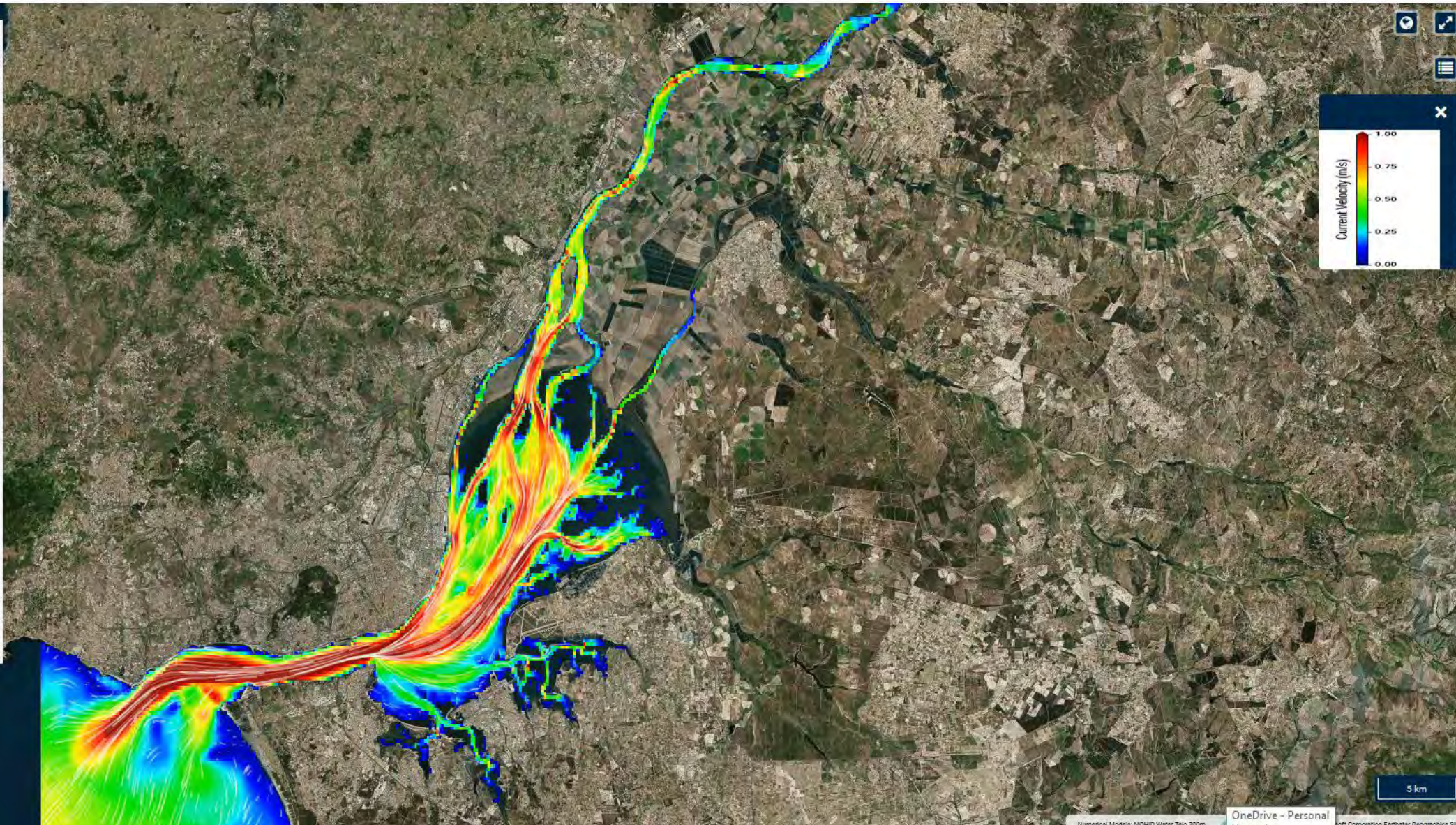
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Now

2020-05-26 23:00:00



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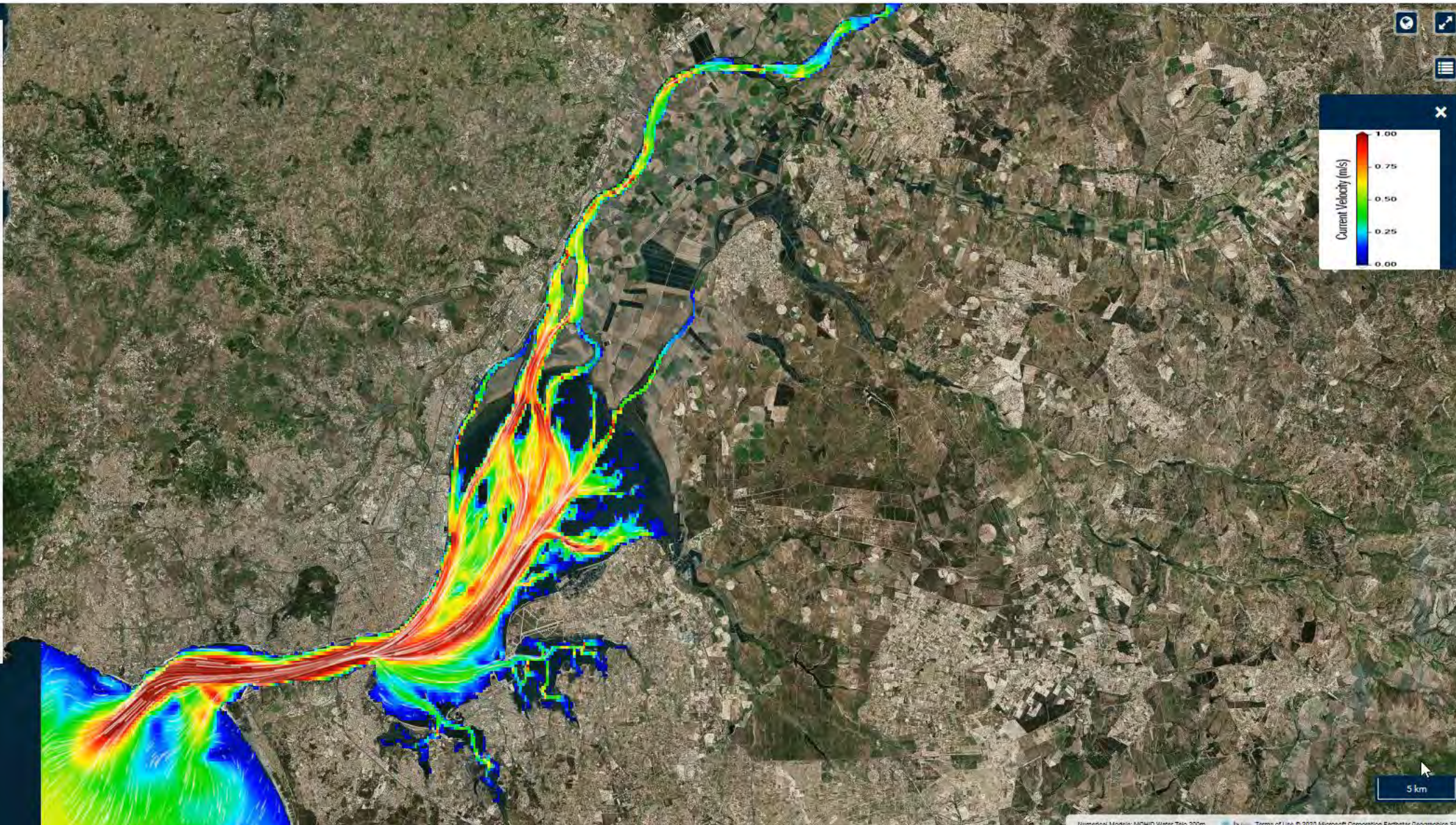
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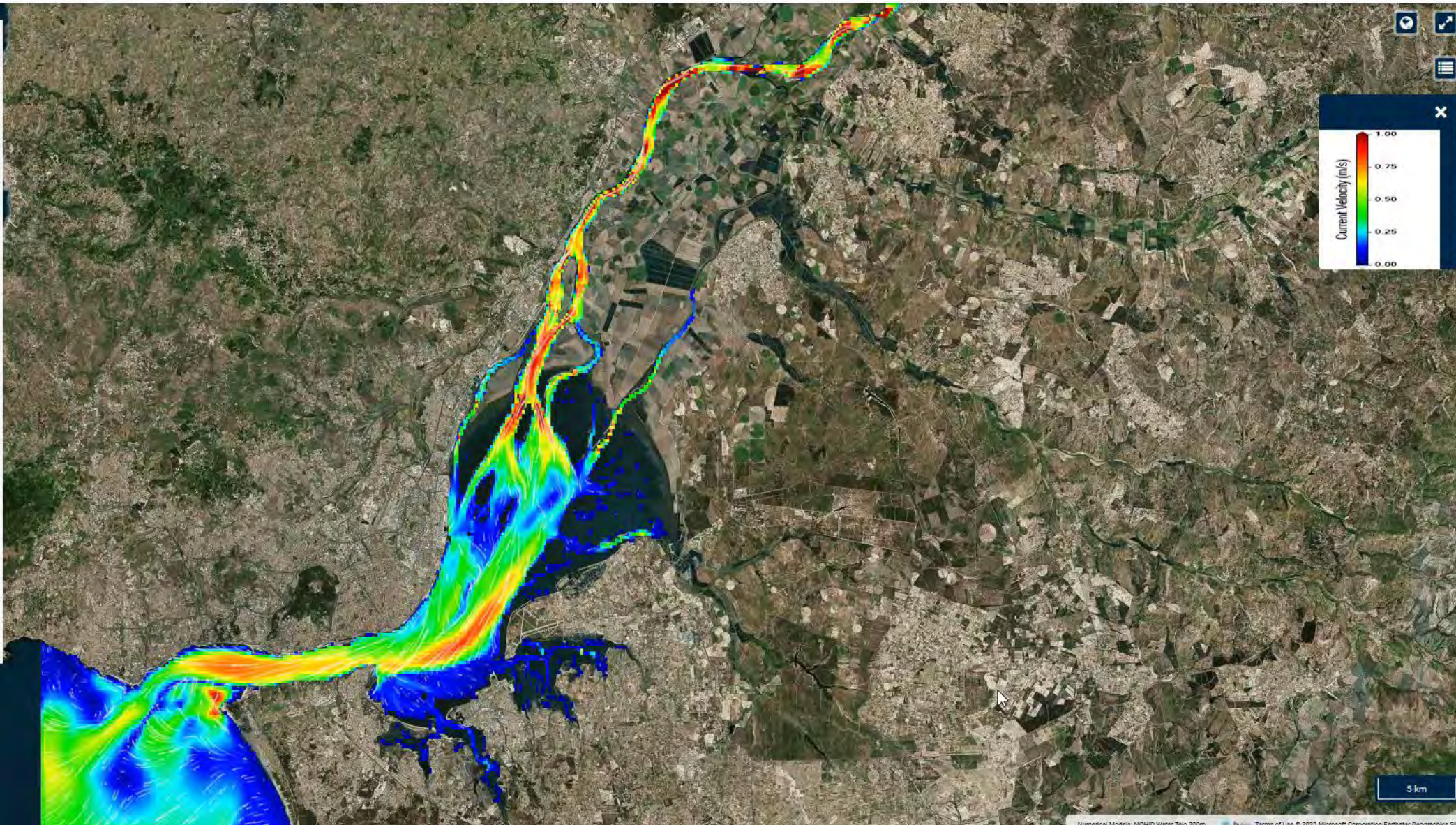
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Now

2020-05-27 01:00:00



“Feeders” / Data providers included

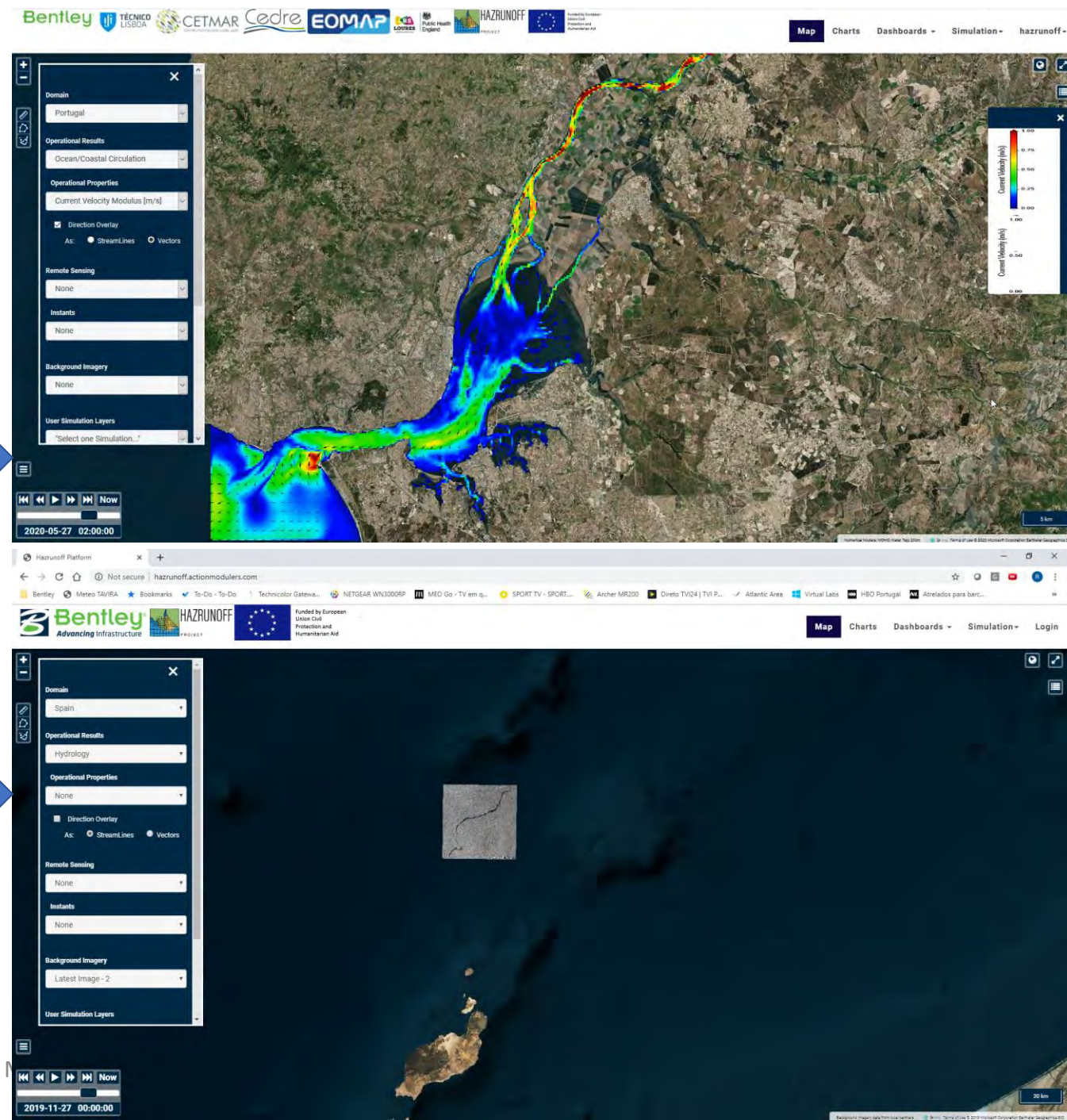
- EMODNET (All regions)
- CoastNet project (Portugal)
- GiP (France)
- SNIRH – APA (Portugal)
- SAIH (Spain)
- iAgua (Spain)
- Meo Beach Cams (Portugal)
- www.meteo-saint-brevin.fr (France)
- Camaramar.com (Spain)
- MARETEC (All regions)
- Meteogalicia (Spain)
- Bentley (All regions)
- EOMAP (All regions)
- CEDRE (France)
- CETMAR (Spain)



Tide gauges
Wave gauges
Weather stations
Flow meters
Stage meters
Webcams
Numerical models
Satellite-derived imagery
UAV(drone)-derived imagery

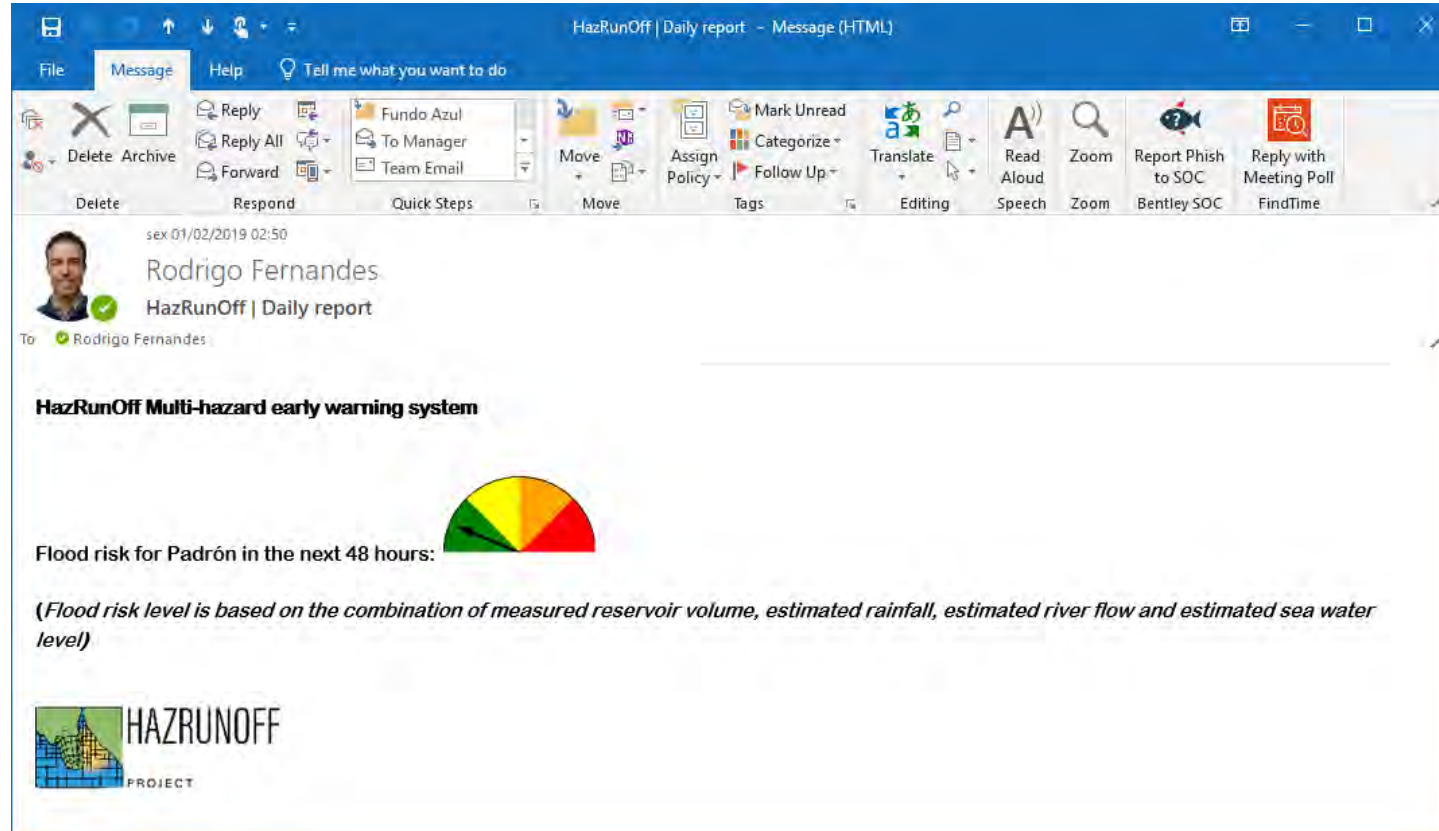
Interoperability

- Export to other formats:
 - PNG
 - KML
- (Up)load GeoTiff RASTER files:
 - Orthophotos from UAV's / drones, etc.
 - CLEANSEANET imagery



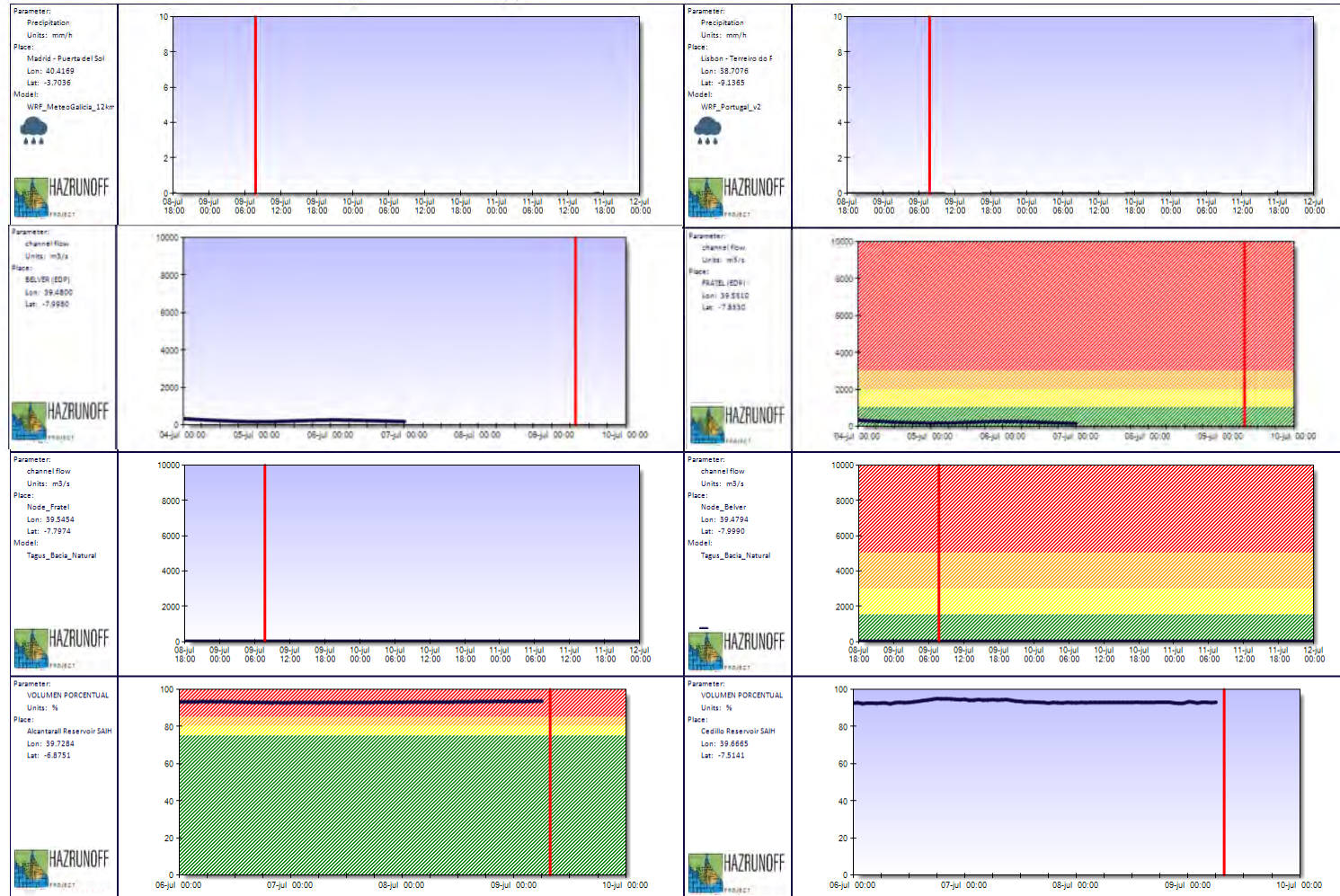
Multi-Hazard early warning system

- Daily reports / Event-triggered early warning notifications



Multi-Hazard early warning system

- Daily reports / Event-triggered early warning



Included parameters:

- River flow
- Water level
- Reservoir percentage
- Rainfall
- Wind speed
- Waves

Take-home messages

- HazRunOff: Holistic perspective – fully integrated modelling:
 - only way for reliable simulation of complex and compound flood and contamination hazards
- HazRunOff: Pragmatic approach
 - Integrated modelling and data is only relevant for operators and emergency responders if the information is easily and quickly accessible, so that decision-making process is improved and anticipated.





Thanks!

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