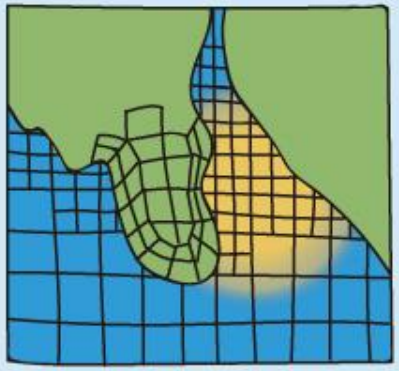

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PROJECT

Digital toolkit towards improved situational awareness & crisis management
- The Galician context -

Rodrigo Fernandes
Bentley Systems

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"Any sufficiently advanced technology is indistinguishable from magic."

- Arthur C. Clarke

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What is a digital twin?

- A digital twin is an exact digital replica of a product, process or service.
  - Digital replicas enable simulations, testing, modeling and monitoring based on the data collected by sensors.

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Digital twins to help planning and responding for disasters

- **Computer replica allows real-time testing of cities, seaports, and coastal infrastructures in the face of emergencies**
  - allow experts to perform real-time resilience testing to see how its infrastructure will perform in the face of challenges such as climate change, population growth, or contamination incidents

- **A digital twin needs to accurately reproduce the physical details of processes and systems**

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Riverine flooding

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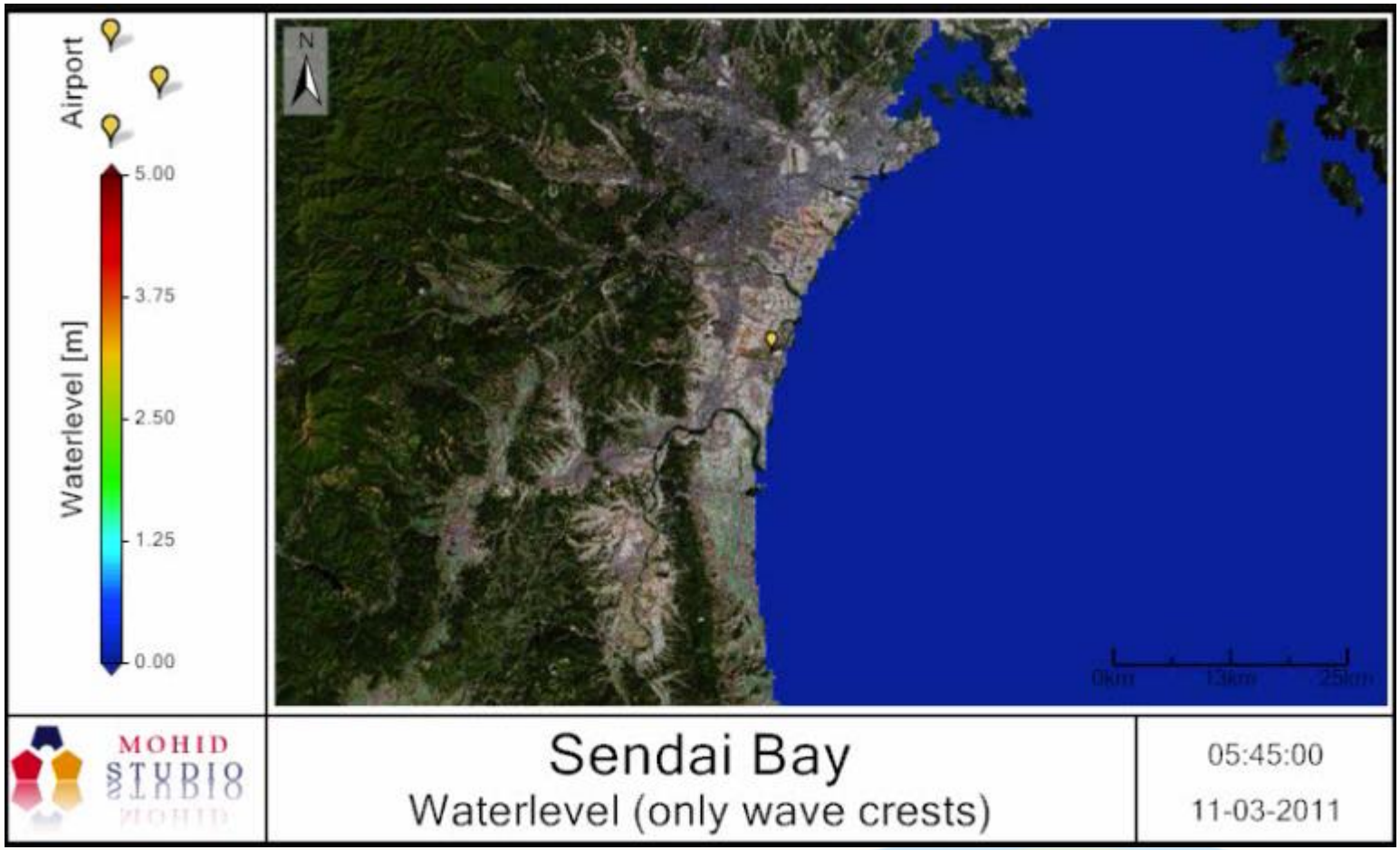
Coastal flooding - tsunamis



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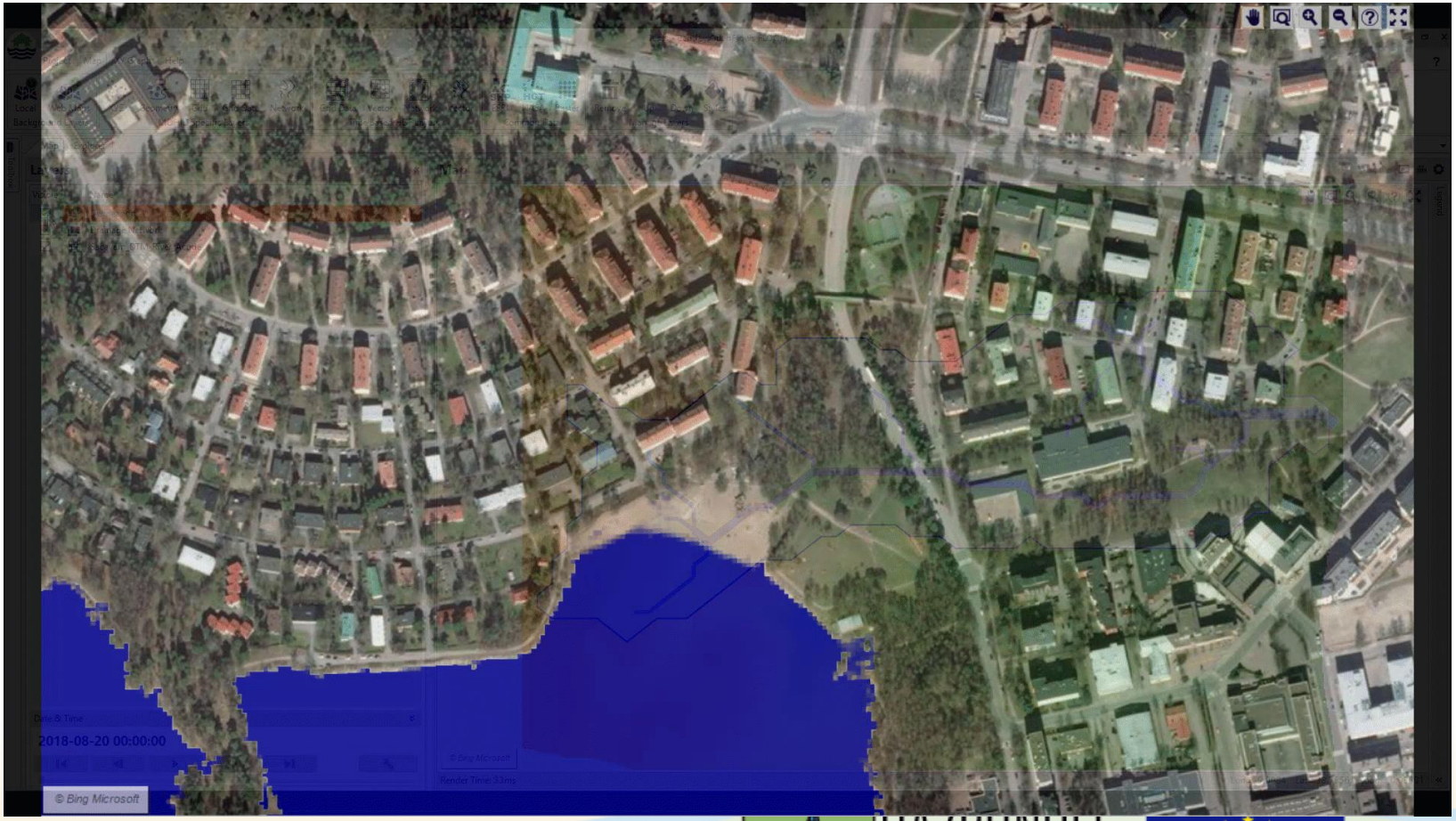
Coastal flooding - storm-surge



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Urban flooding: Rainwater (underground) overflow + surface overland flow

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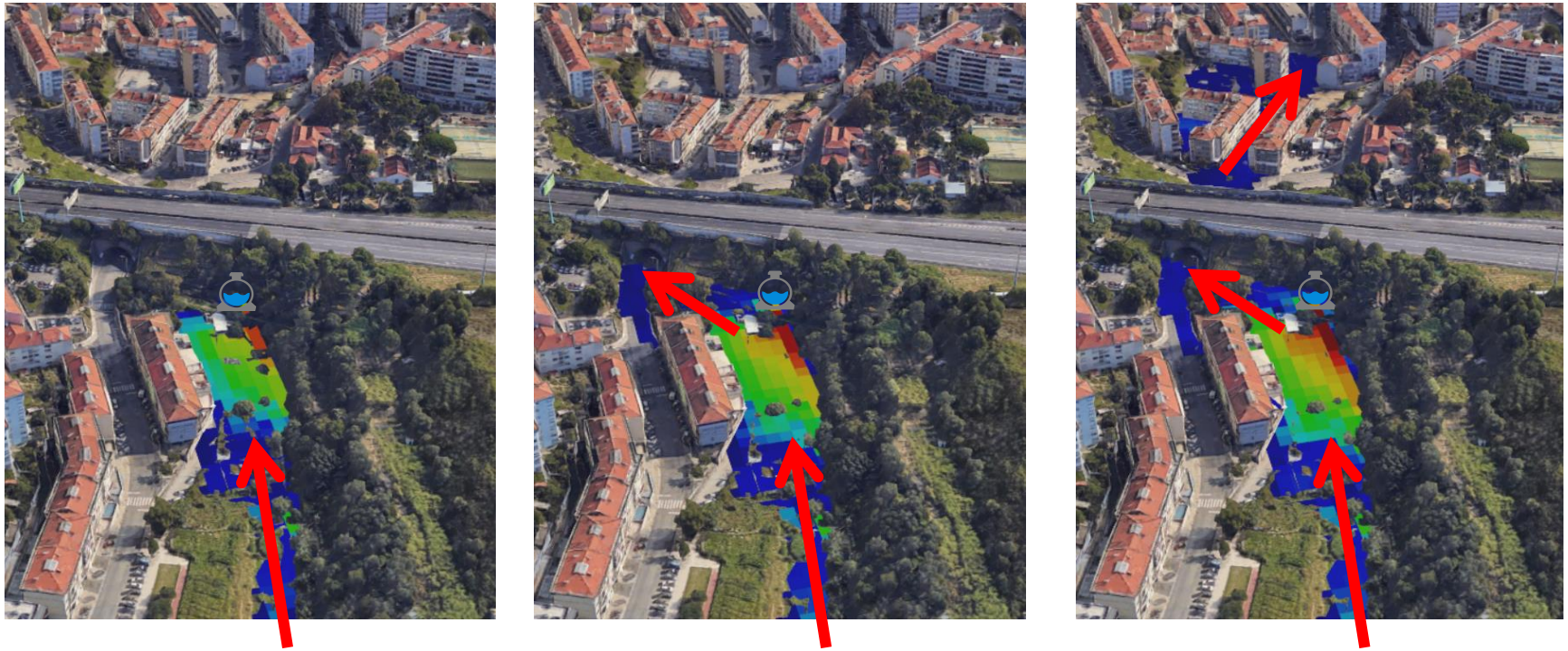
Urban flooding: Underground conduit surcharge and surface runoff



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Urban flooding: Retention basin with culvert

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Urban flooding: Retention basin with culvert

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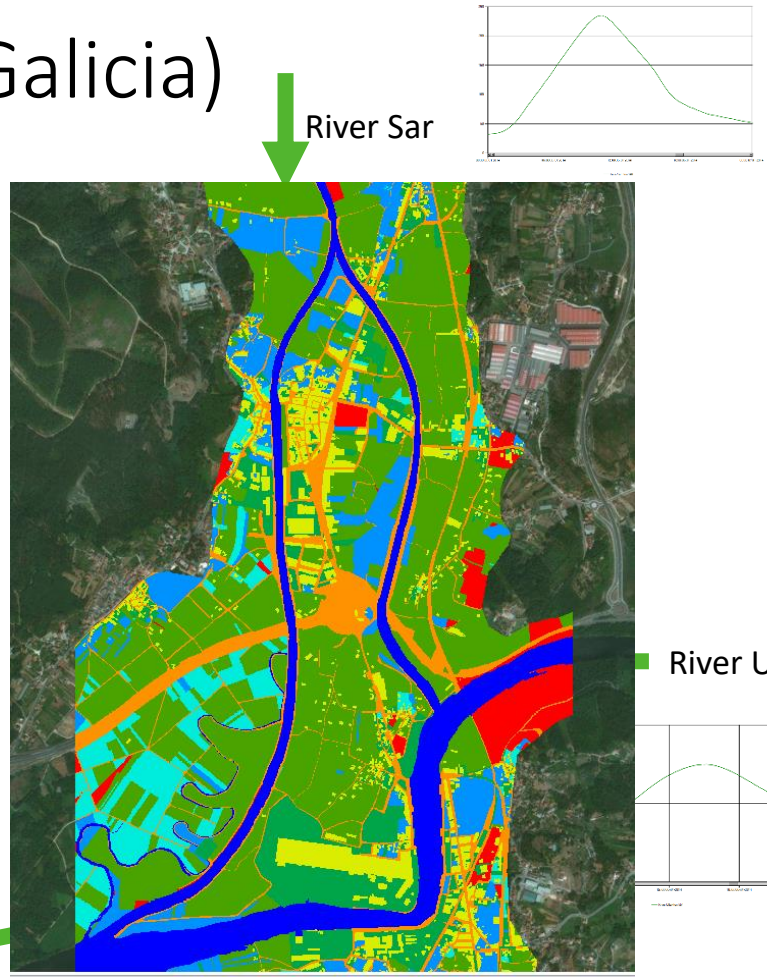
Flood modelling – Padrón (Galicia)

- High resolution DTM (Lidar)
- Rivers Sar & Ulla flows + High tide
- 10 year return period
- Manning's n (rugosity) from land use



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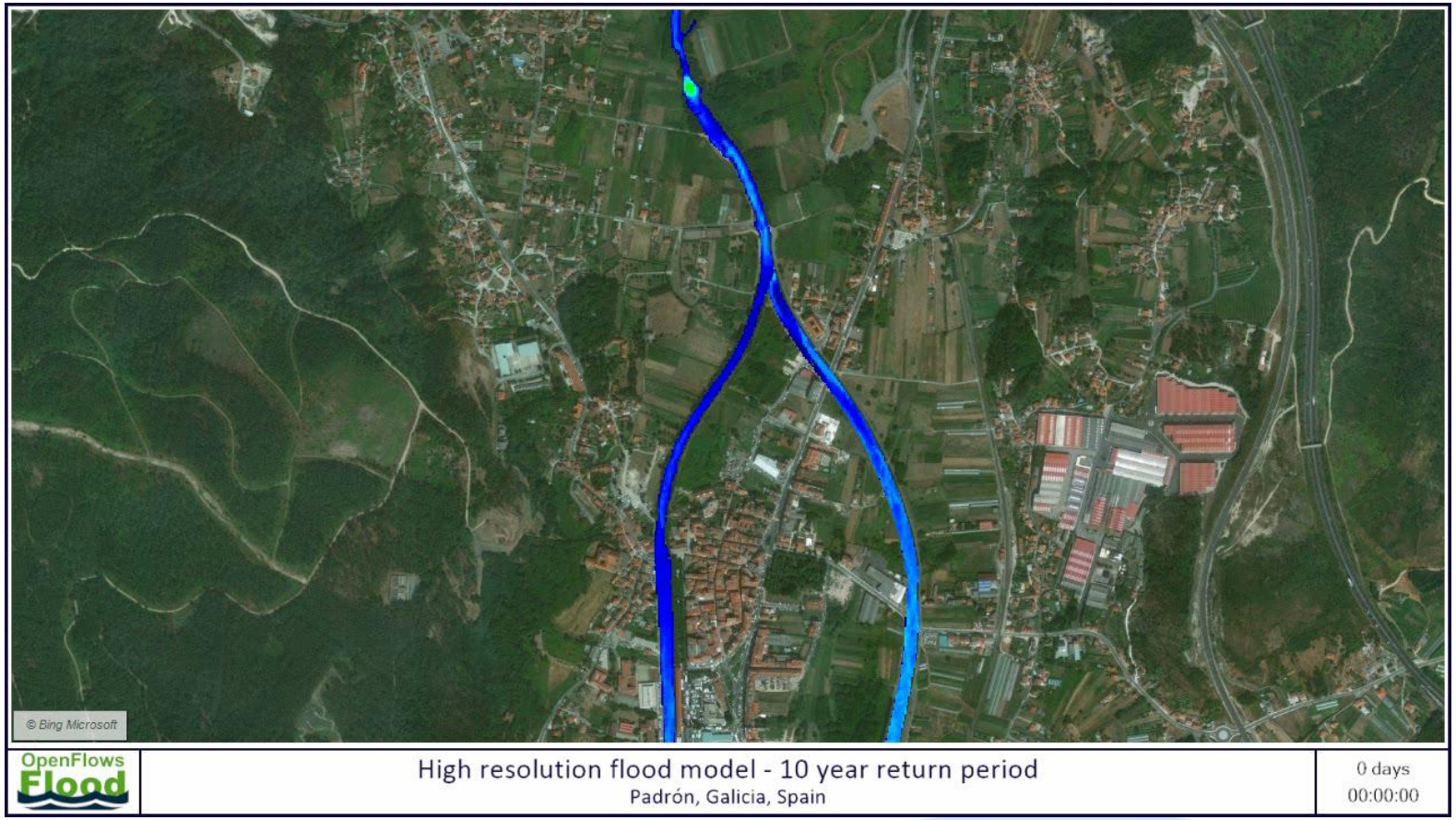
Flood modelling – Padrón (Galicia) (work in progress)



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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.

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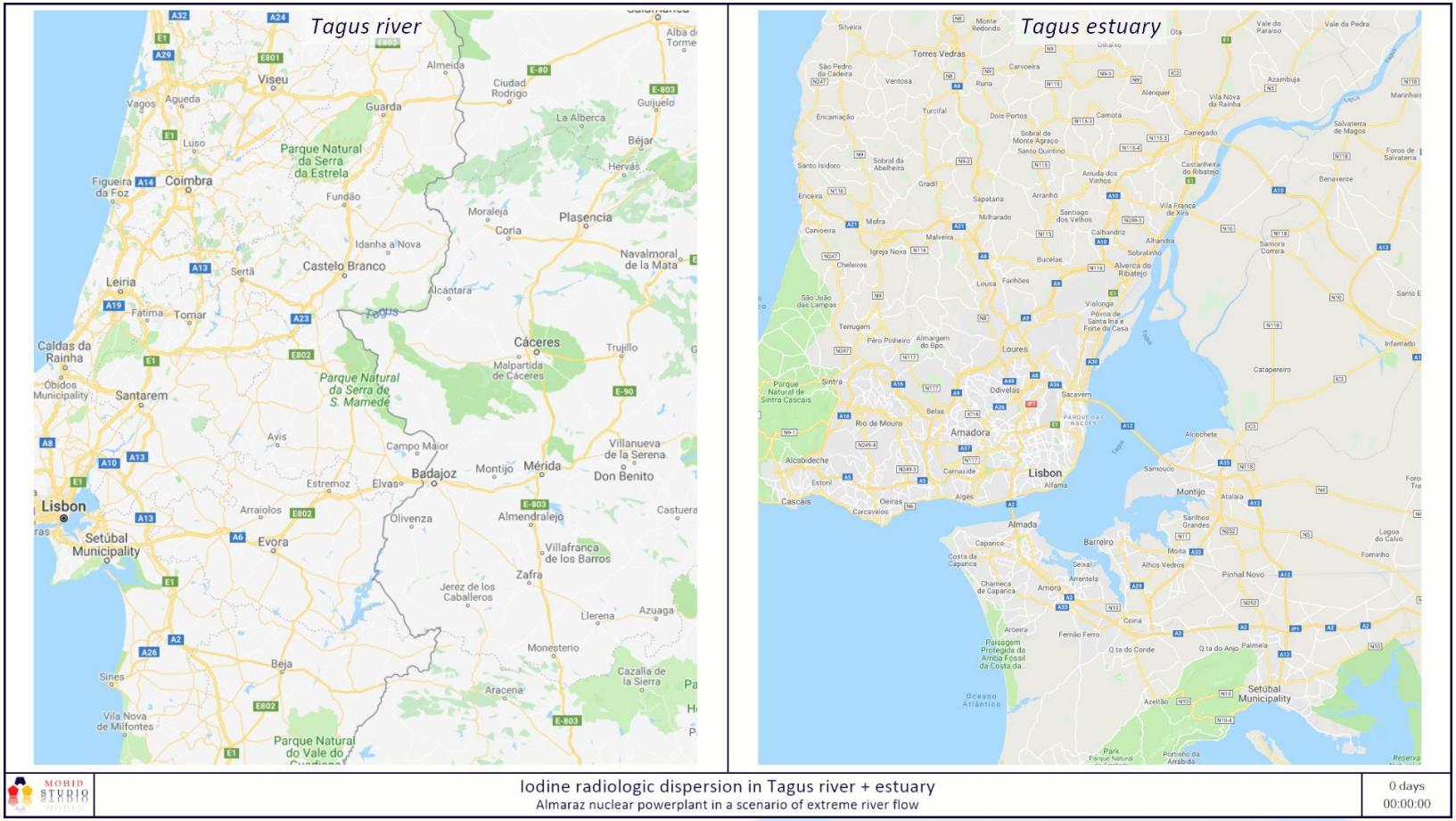
Virtual scenario of nuclear contamination in Almaraz



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What tools and technology support HazRunOff interfaces?

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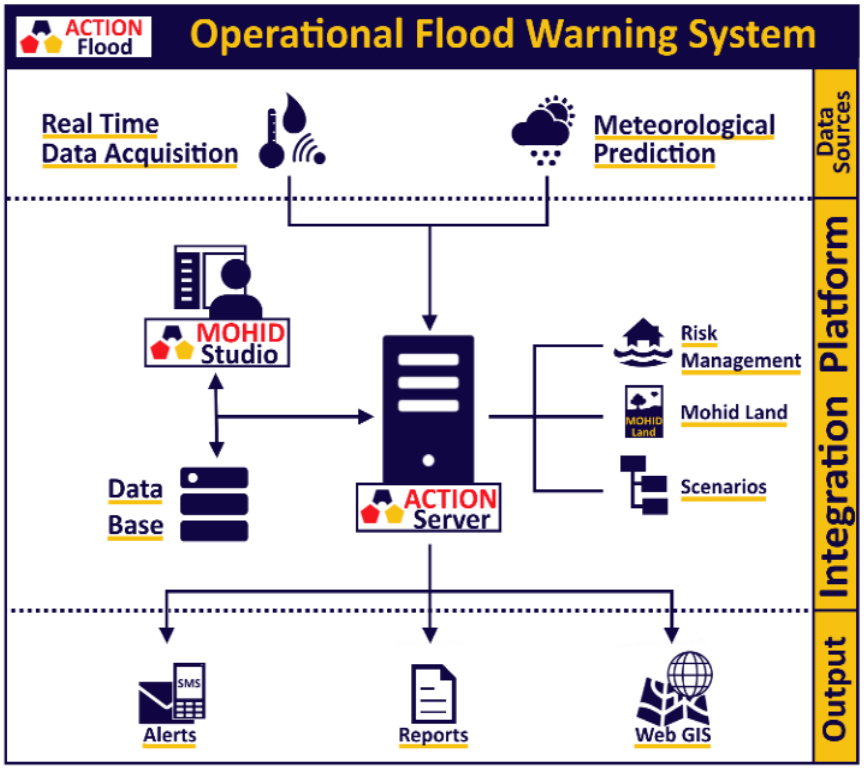
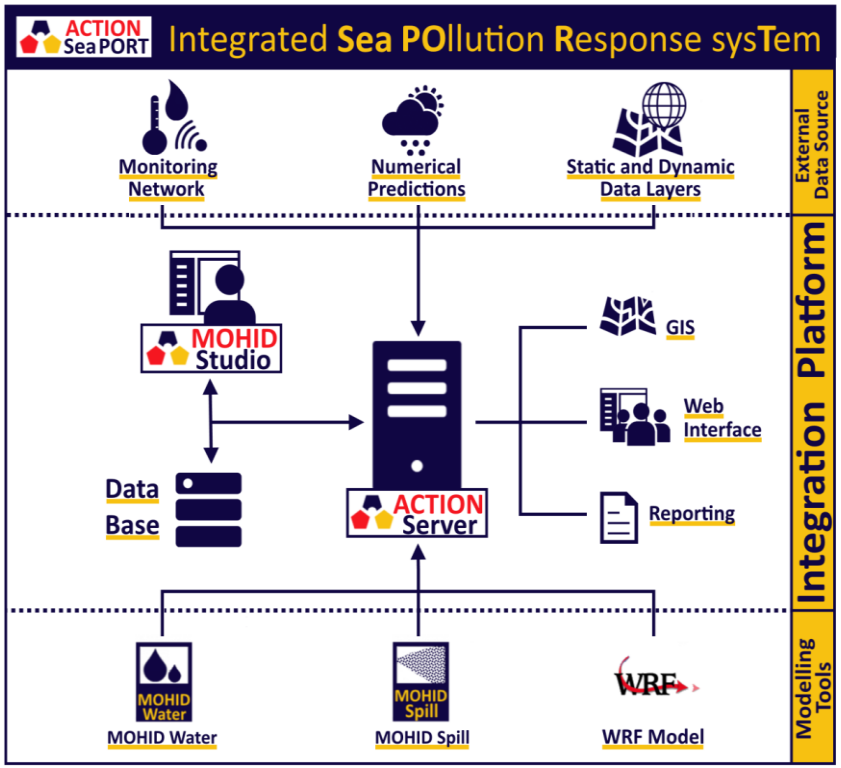
HazRunOff preparedness & response tools

- Predictive operational data analytics
- Based in previously developed technologies ACTION Flood and ACTION Seaport





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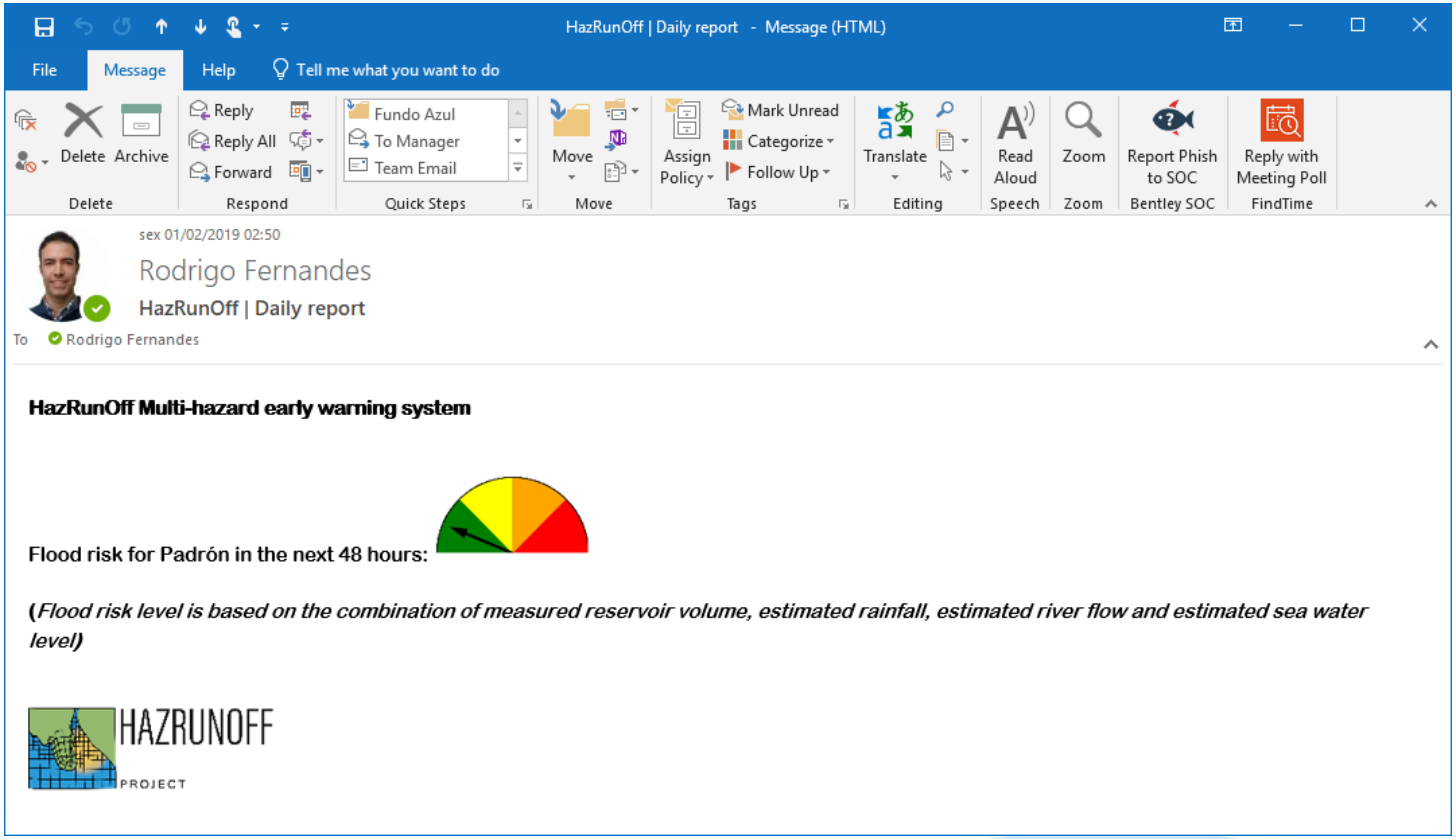
Multi-Hazard early warning system

- Daily reports / Event-triggered early warning notifications



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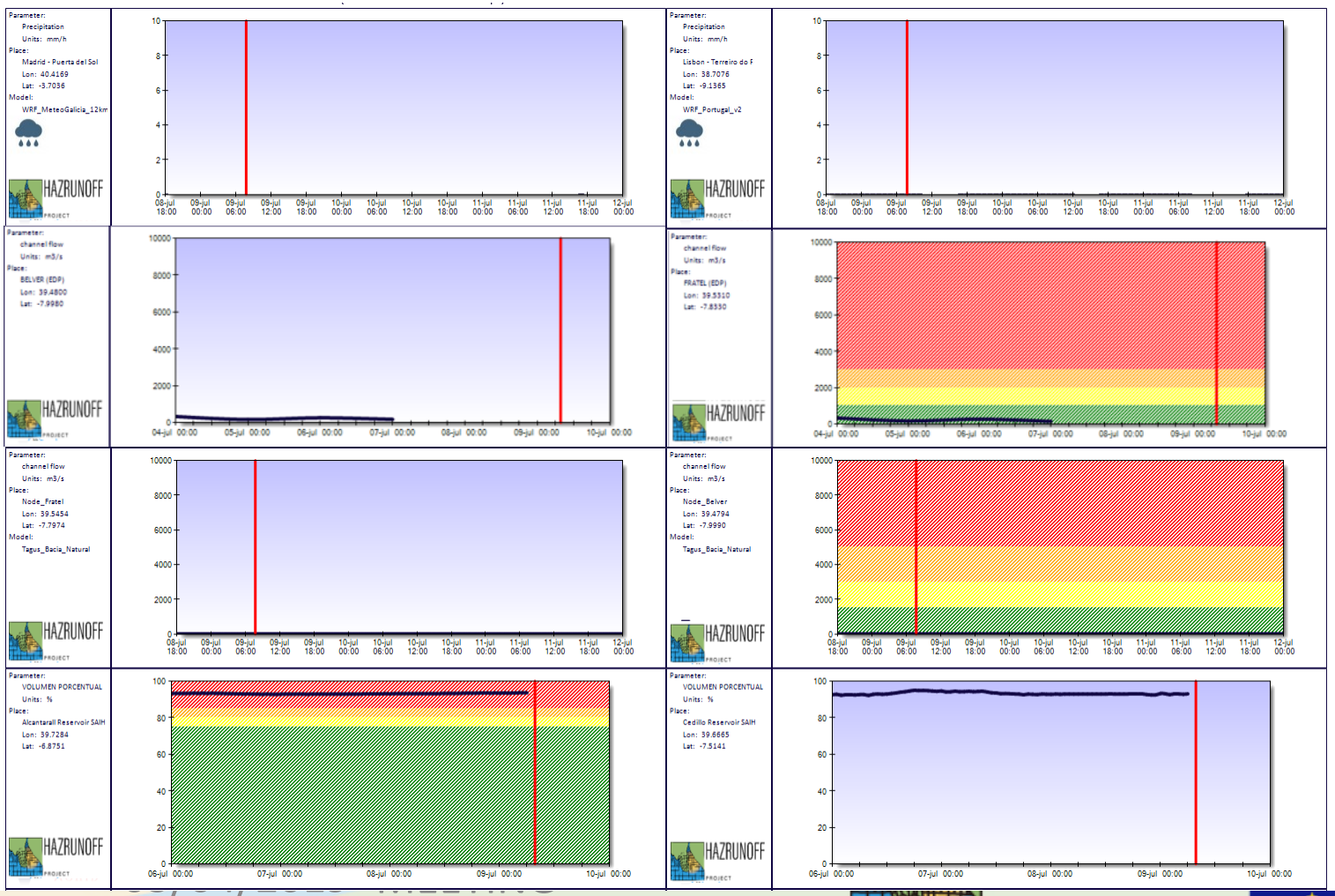
Multi-Hazard early warning system

- Daily reports / Event-triggered early warning notifications



Included parameters:

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

Web (& mobile-friendly) preparedness & response platform

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

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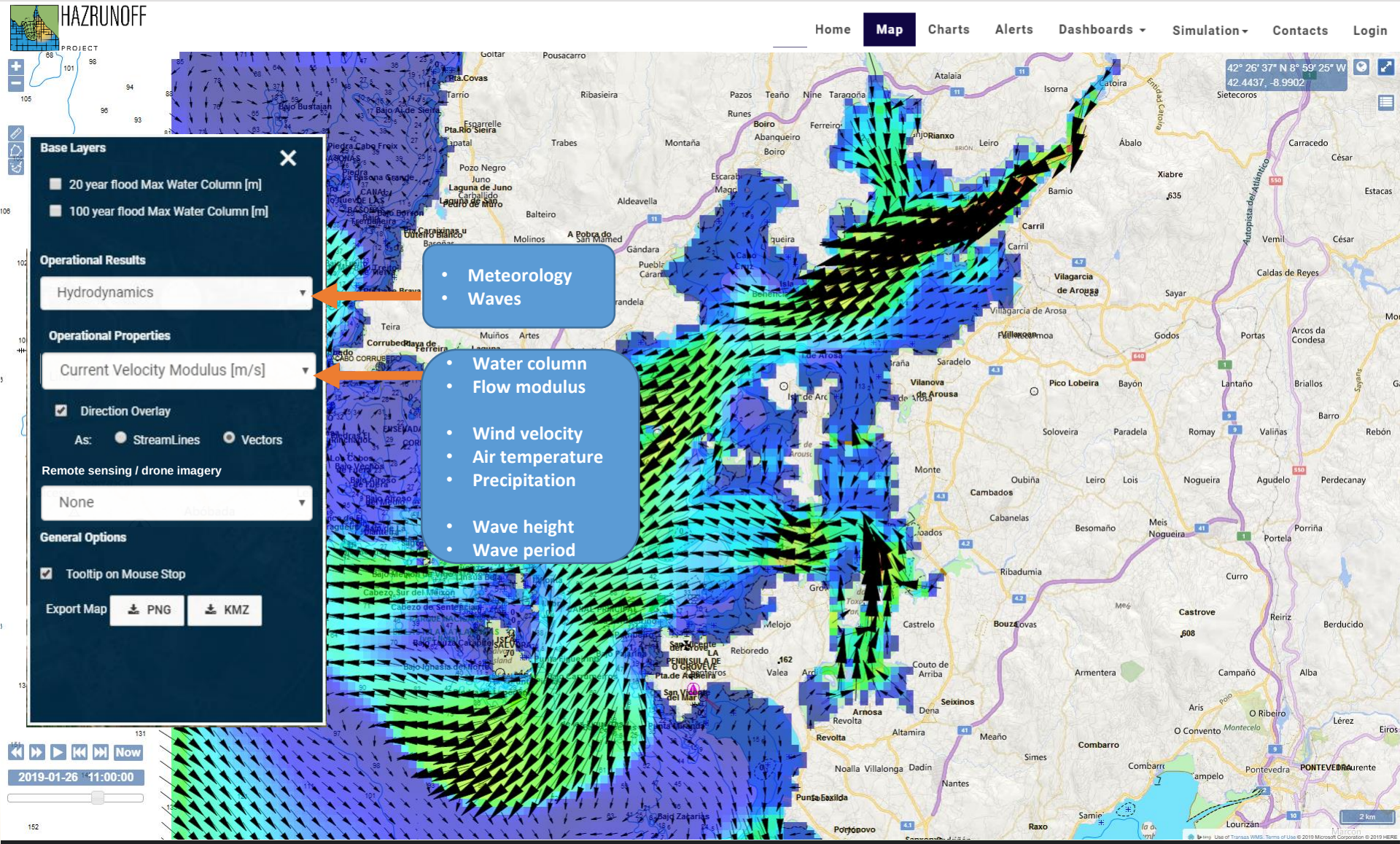
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42° 26' 37" N 8° 59' 25" W
42.4437, -8.9902
Base Layers
20 year flood Max Water Column [m]
100 year flood Max Water Column [m]
Operational Results
Hydrodynamics
Operational Properties
Current Velocity Modulus [m/s]
Direction Overlay
As: StreamLines Vectors
Remote sensing / drone imagery
None
General Options
Tooltip on Mouse Stop
Export Map
PNG
KMZ
Now
2019-01-26 11:00:00
• Meteorology
• Waves
• Water column
• Flow modulus
• Wind velocity
• Air temperature
• Precipitation
• Wave height
• Wave period

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Charts

This page shows timeseries of measured and modelled data for seleced points in form of charts and tabular data.

- Measured data is represented with yellow lines in the charts
- Modelled (forecasted) data is represented with blue lines in the charts
- The vertical line in the charts indicates current date
- The tabular data shows forecasted values
- The column of the current date is highlighted in yellow

Please select a station for which data should be displayed:

Villagarcia tidal gauge

Chart | Table

	Tue 07																							Wed 08											
Hours	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	0	1	2	3	4	5	6	7	8	9	10	11
Level m	3	2.6	2.1	1.6	1.3	1.1	1.2	1.5	1.9	2.3	2.7	2.9	2.9	2.7	2.3	1.8	1.4	1.2	1.1	1.3	1.7	2.2	2.7	3	3.2	3.1	2.8	2.2	1.7	1.3	1	1	1.3	1.7	2.2	2.7
Cur Vel knots	0.5	0.8	0.6	0.3	0.1	0.2	0.5	0.7	0.7	0.8	0.7	0.5	0	0.6	0.7	0.5	0.3	0	0.4	0.6	0.7	0.8	0.9	0.8	0.5	0.2	0.8	0.7	0.4	0.2	0.1	0.4	0.7	0.8	0.8	0.9
Cur Dir °																																				
Wind Vel knots	3.8	3.4	3.3	3.8	4.4	5	5.3	5.9	5.5	5.6	6.4	6.3	5.8	4.9	4.3	4.3	5.2	8	10.1	9.4	10.3	10.3	10	9.5	9.1	9.2	9.1	8.7	8.2	8	8.1	8.3	8.1	7.8	9	9
Wind Dir °																																				
Rain mm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Air Temp °C	12	11	12	12	12	12	12	12	12	12	12	13	15	17	18	19	20	20	20	17	15	14	14	13	13	13	12	12	11	11	11	10	10	11	14	16

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Charts

This page shows timeseries of measured and modelled data for seleced points in form of charts and tabular data.

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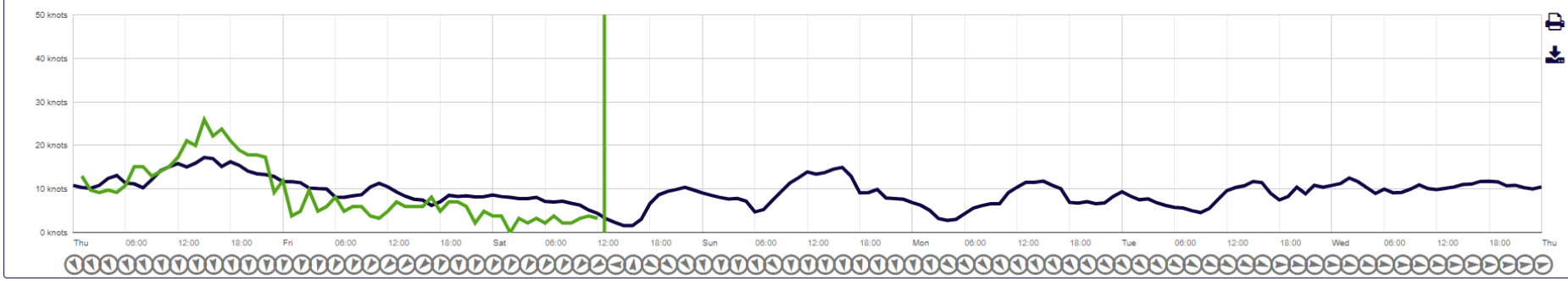
Please select a station for which data should be displayed:

Costa

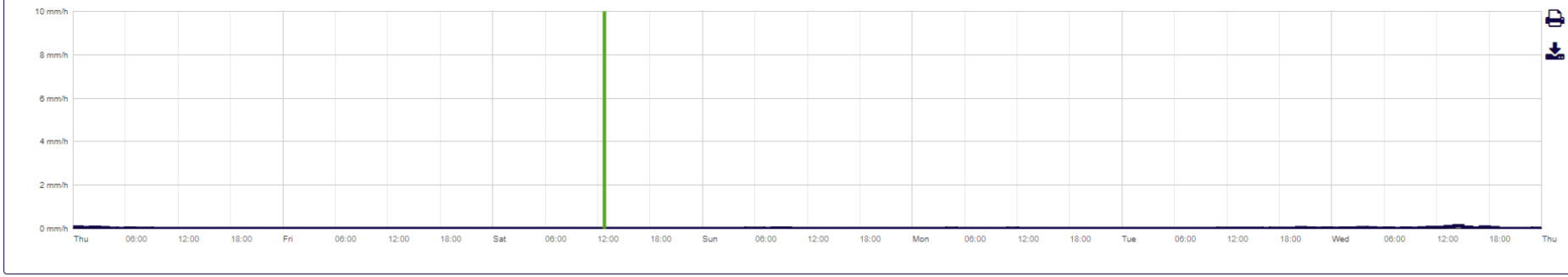
- Xesteiras
- Muralla
- Sar
- Portodemouros
- Plataforma de Cortegada
- Boia de Ribeira

Chart | Table

Wind Velocity [knots]



Rainfall [mm/h]



Alerts

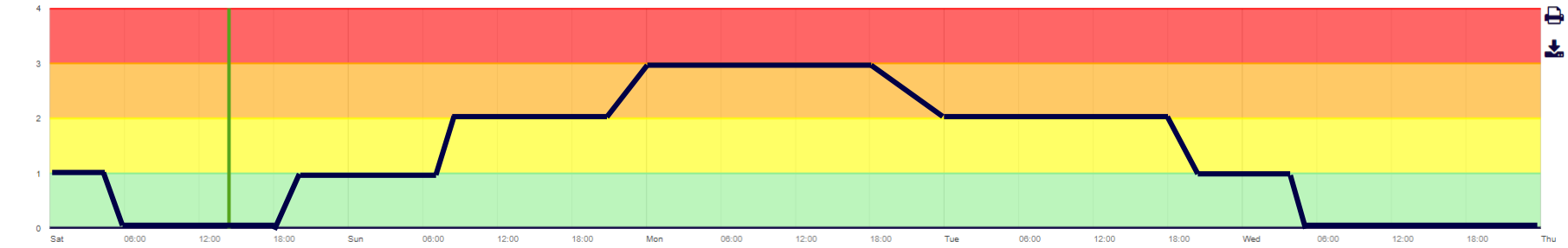
This page shows hydro-meteorological and metocean alerts of measured and modelled data for selected points

Alerts included:

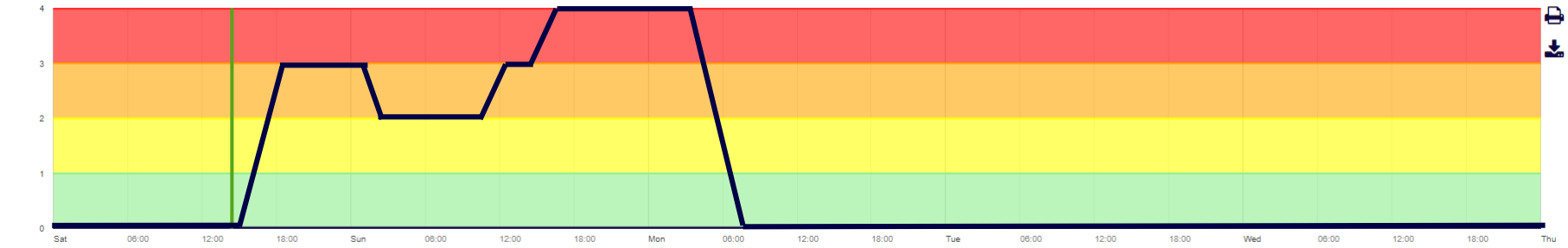
- River flow
- Water level
- Rainfall
- Wind

Costa

River flow



Rainfall



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Alerts

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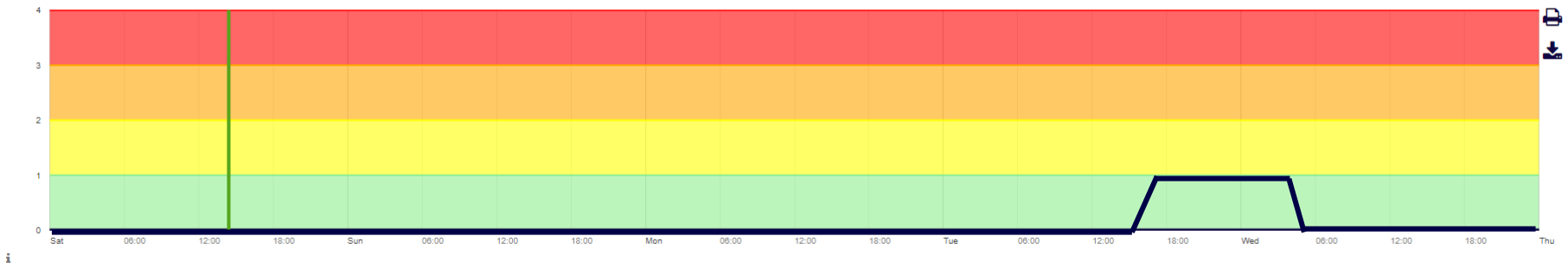
Alerts included:
- River flow
- Water level
- Rainfall
- Wind

Villagarcia tidal gauge

water level



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Alerts

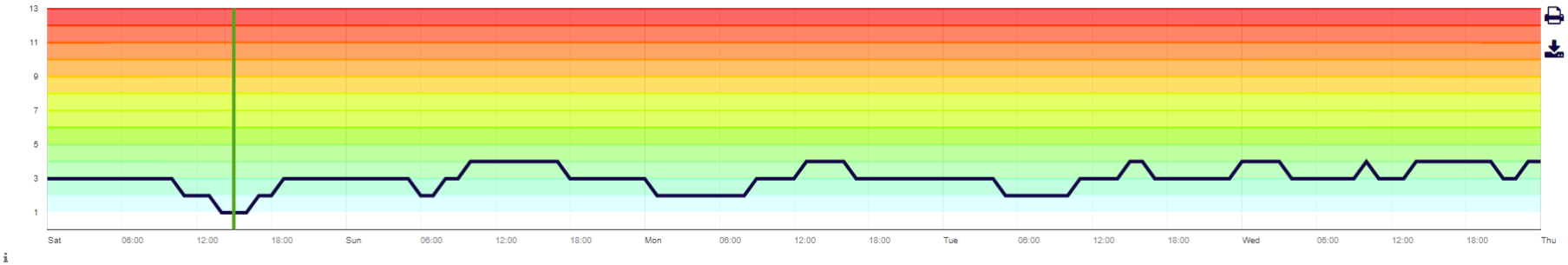
This page shows hydro-meteorological and metocean alerts of measured and modelled data for selected points

Alerts included:
- River flow
- Water level
- Rainfall
- Wind

Plataforma de Cortegada

- Xesteiras
- Muralla
- Sar
- Portodemouros
- Plataforma de Cortegada
- Boia de Ribeira

Beaufort wind scale



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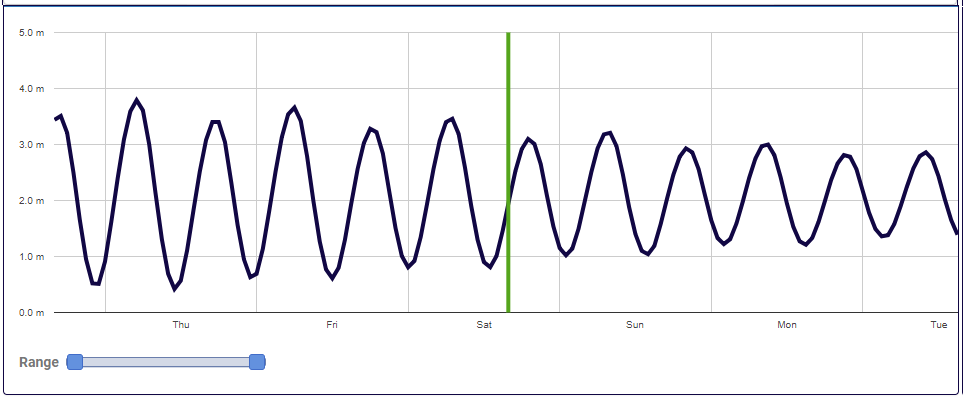
Water level [m] | Modelled: blue; Measured: green

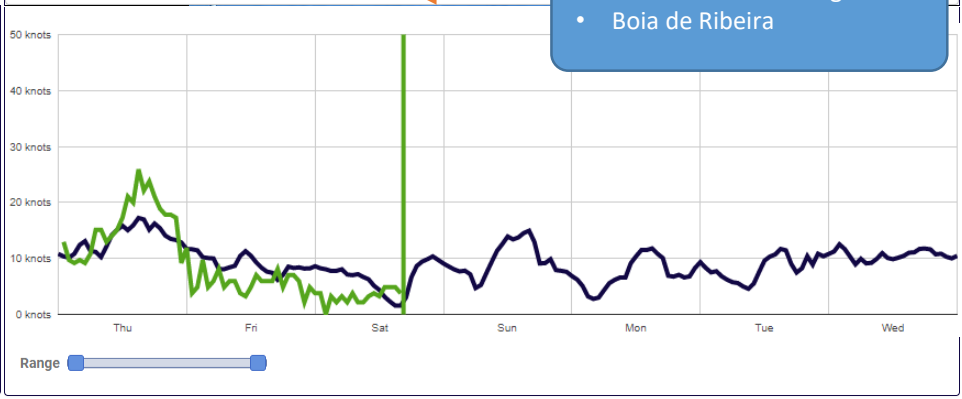
Villagarcia tidal gauge



Wind [knots] | Modelled: blue; Measured: green

Villagarcia tidal gauge

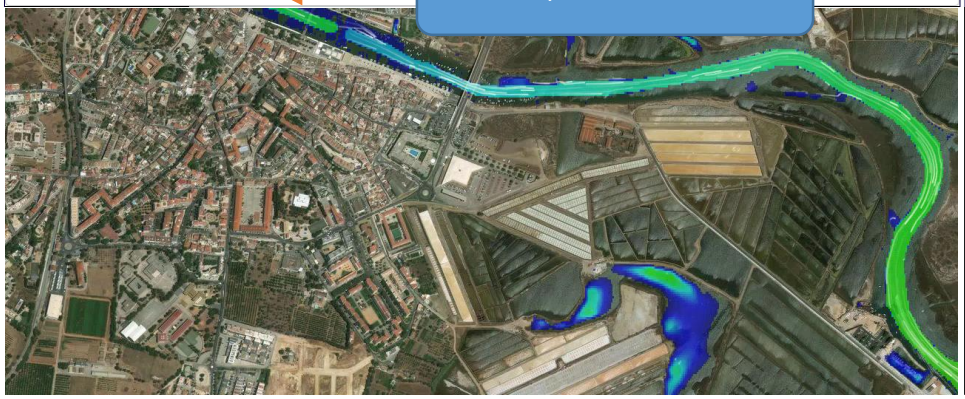
- Plataforma de Cortegada
- Boia de Ribeira



Water flow [m/s] & water column|

Area 1

- Padrón
- Estuary



Webcam

Playa Illa de Arousa

- Corón

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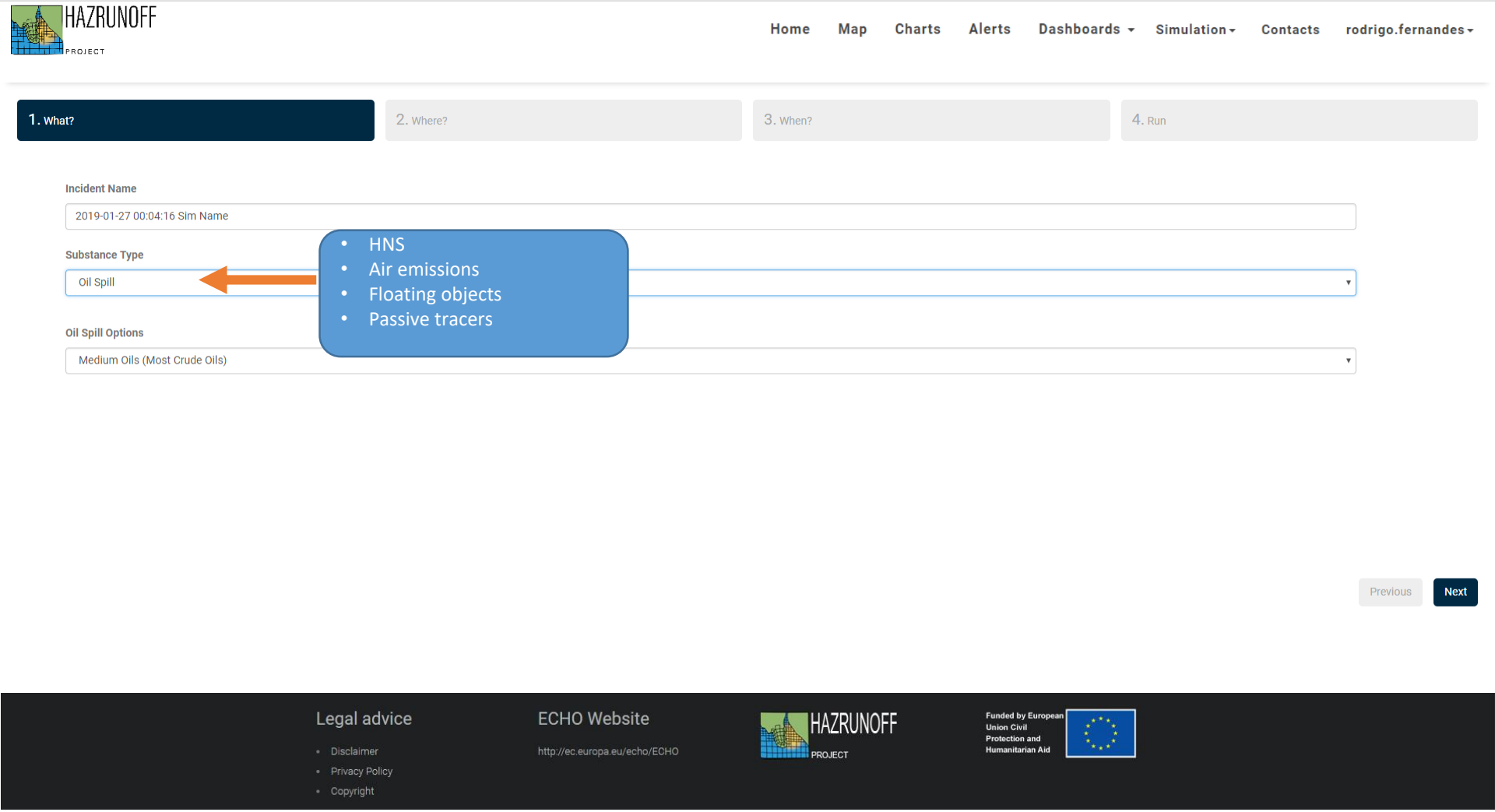
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Contacts
rodrigo.fernandes
1. What?
2. Where?
3. When?
4. Run
Incident Name
2019-01-27 00:04:16 Sim Name
Substance Type
Oil Spill
HNS
Air emissions
Floating objects
Passive tracers
Oil Spill Options
Medium Oils (Most Crude Oils)
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Next
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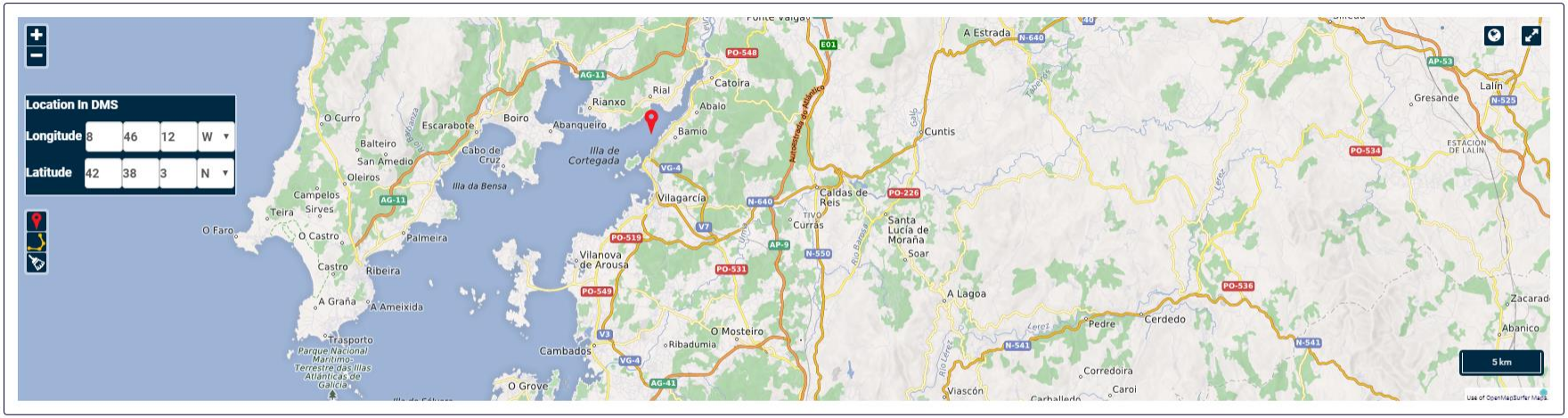
1. What? | 2. Where? | 3. When? | 4. Run

Pick Incident Locations Interactively



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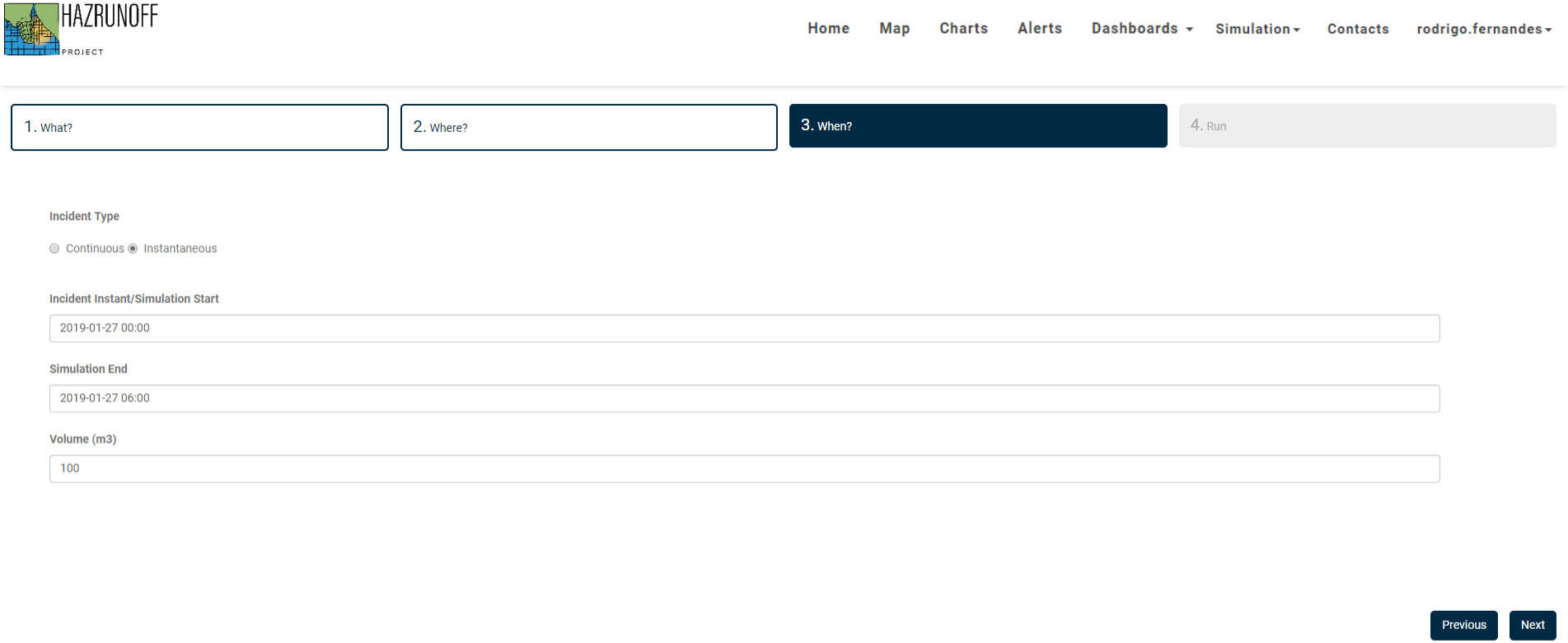

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1. What? | 2. Where? | 3. When? | 4. Run

Simulation Resume

Name : 2019-01-27 00:11:51 Sim Name
Substance : Oil Spill
Localization : -8.7687, 42.6342
Emission Type : instantaneous
Start Date : 2019-01-27 00:00
End Date : 2019-01-27 06:00
Expected Run Duration : 3 minutes

Previous Finish

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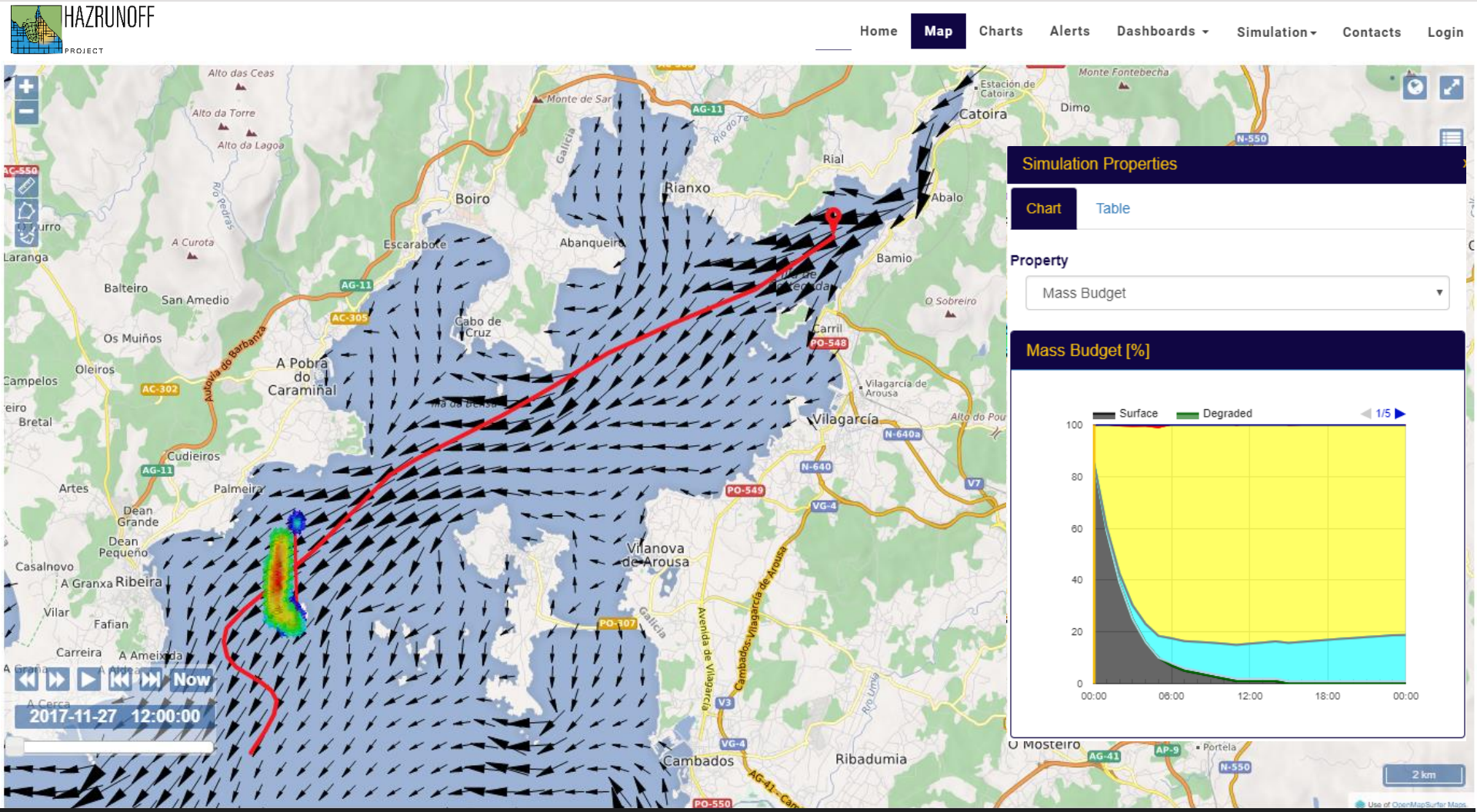

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Suggestions

- **Start now**
  - Create a digital strategy
  - put data at the core of your organization to create actionable information and actionable decisions.
  - Continuously raise the questions:
    - “What can I discover by analyzing this dataset?”
    - “Will that knowledge and information improve my decisions?”

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