# High Risk Water Pollution Hazards Affecting Aveiro Coastal Lagoon – a Habitat Risk Assessment Using InVEST

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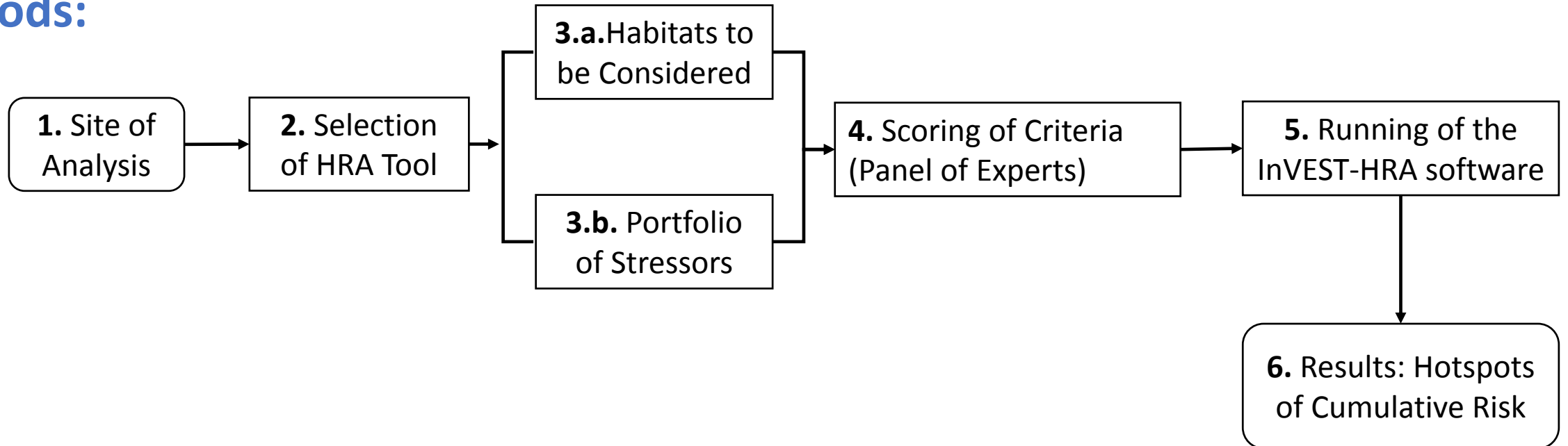
Goal and Objectives:

1. To support and inform a balanced EBM in the region;
2. To contribute to the sustainable management of socioeconomic stressors produced by RoA population and industries.
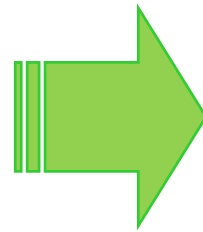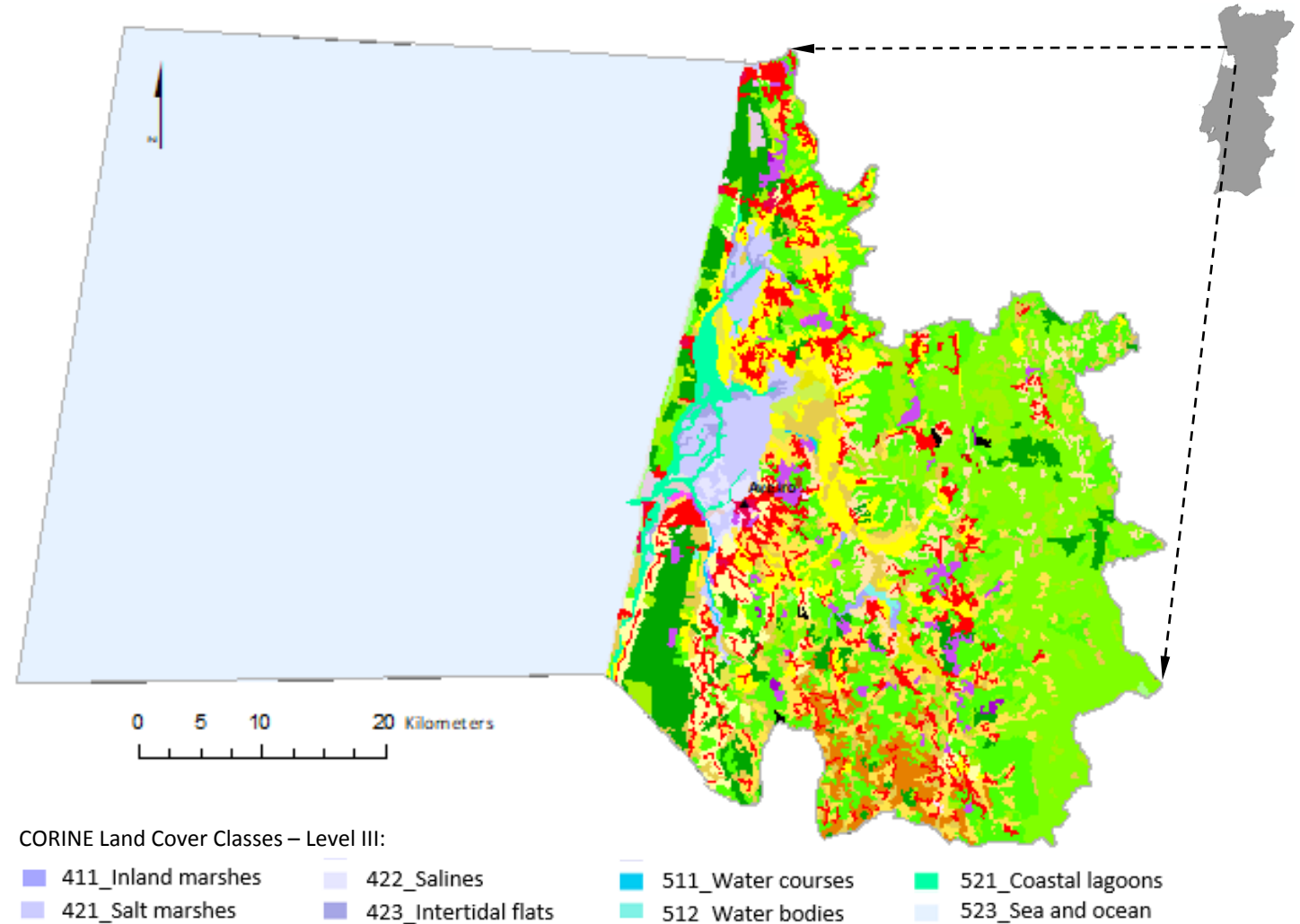
1. to perform a **spatially explicit assessment** of HRWP stressors putting pression on RoA MCE-SES water quality;
2. to determine where are the most important high-risk water pollution **(HRWP) hotspots**;
3. to determine the most important **anthropogenic activities** putting pressure on RoA habitats;
4. to establish which are the RoA **habitats at risk**;
5. to produce effective information on how RoA habitats and local socio-economic activities relate to each other;
6. to generate new data to support regional EBM and help decision-making *vis-à-vis* **"produce or protect" policies**.

Methods:

1. Site of Analysis → **2.** Selection of HRA Tool → **3.a.** Habitats to be Considered / **3.b.** Portfolio of Stressors → **4.** Scoring of Criteria (Panel of Experts) → **5.** Running of the InVEST-HRA software → **6.** Results: Hotspots of Cumulative Risk
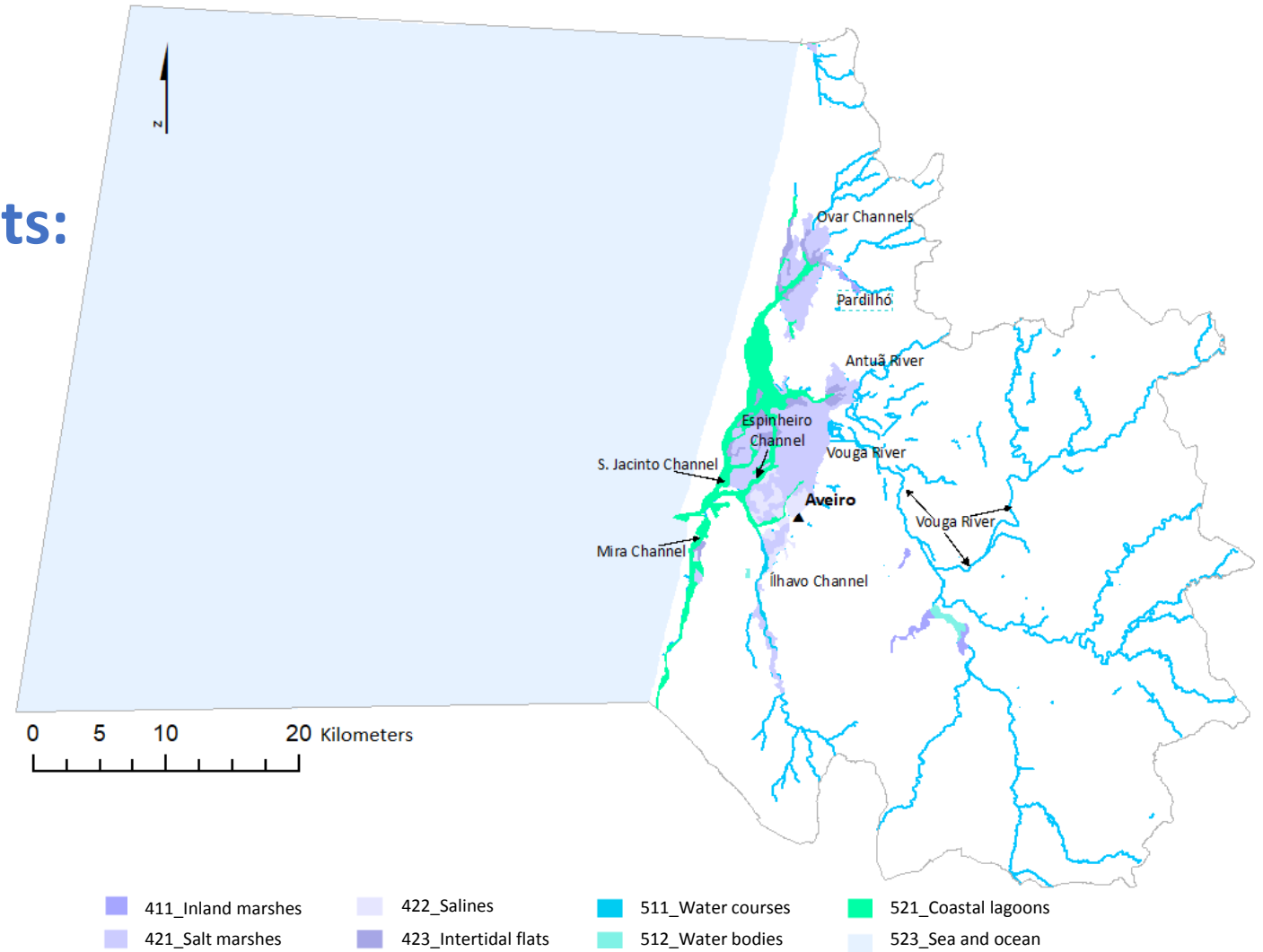
Methods - the Study Area:

The focus of our analysis is the Ria of Aveiro (RoA) coastal lagoon and its adjacent territory (**NUT - level 3: Region of Aveiro**)
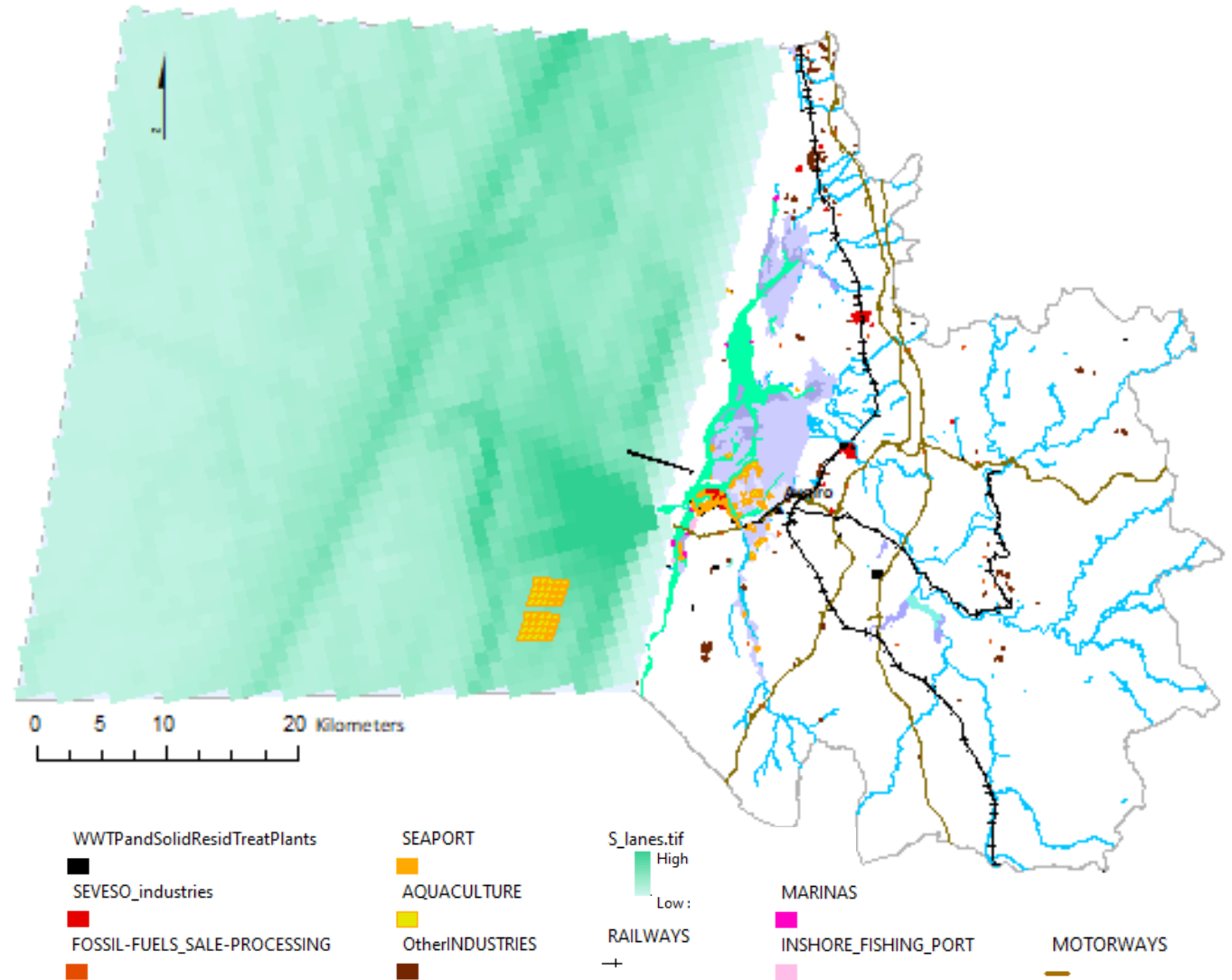

CORINE Land Cover Classes – Level III:

411_Inland marshes	422_Salines
421_Salt marshes	423_Intertidal flats

511_Water courses	521_Coastal lagoons
512_Water bodies	523_Sea and ocean

Methods – RoA Selected Habitats:

Inland marshes (CLC-411),
Saltmarshes (CLC-421),
Salines (CLC-422),
Intertidal flats (CLC-423),
Watercourses (CLC-511),
Waterbodies (CLC-512),
Coastal lagoons (CLC-521), and
Sea and ocean (CLC-523)

411_Inland marshes	422_Salines
421_Salt marshes	423_Intertidal flats
511_Water courses	521_Coastal lagoons
512_Water bodies	523_Sea and ocean

Methods – RoA HRWP Stressors:

SEVESO Industries;
WWTPs, Solid Residues TP, Landfills and Sewage
Submarine Emissaries;
NON-Seveso Industries;
Fossil Fuel Processing, Storage and Sale Units (FFPSSUs);
Commercial/Industrial Seaport;
Inshore Fishing Port;
Marinas and Recreational Ports;
Aquaculture Industrial Units;
Motorway Traffic Lanes;
Road Traffic Lanes;
Railways;
Shipping Lanes.

WWTPandSolidResidTreatPlants
SEVESO_industries
FOSSIL-FUELS_SALE-PROCESSING
SEAPORT
AQUACULTURE
OtherINDUSTRIES
S_lanes.tif
High
Low
RAILWAYS
MARINAS
INSHORE_FISHING_PORT
MOTORWAYS

Methods – Computing Risk for RoA's Habitats:

$$R_{jkl} = \sqrt{\left(E_{jkl} - 1\right)^2 + \left(C_{jkl} - 1\right)^2}$$

InVEST-HRA computes risk through four stages:

1. the estimation of the probability of the habitats to be exposed to each stressor and resulting consequences;

2. the estimation of corresponding risk values for each pairing of stressor-habitat;

3. the estimation of the cumulative risk produced by all stressors on each habitat;

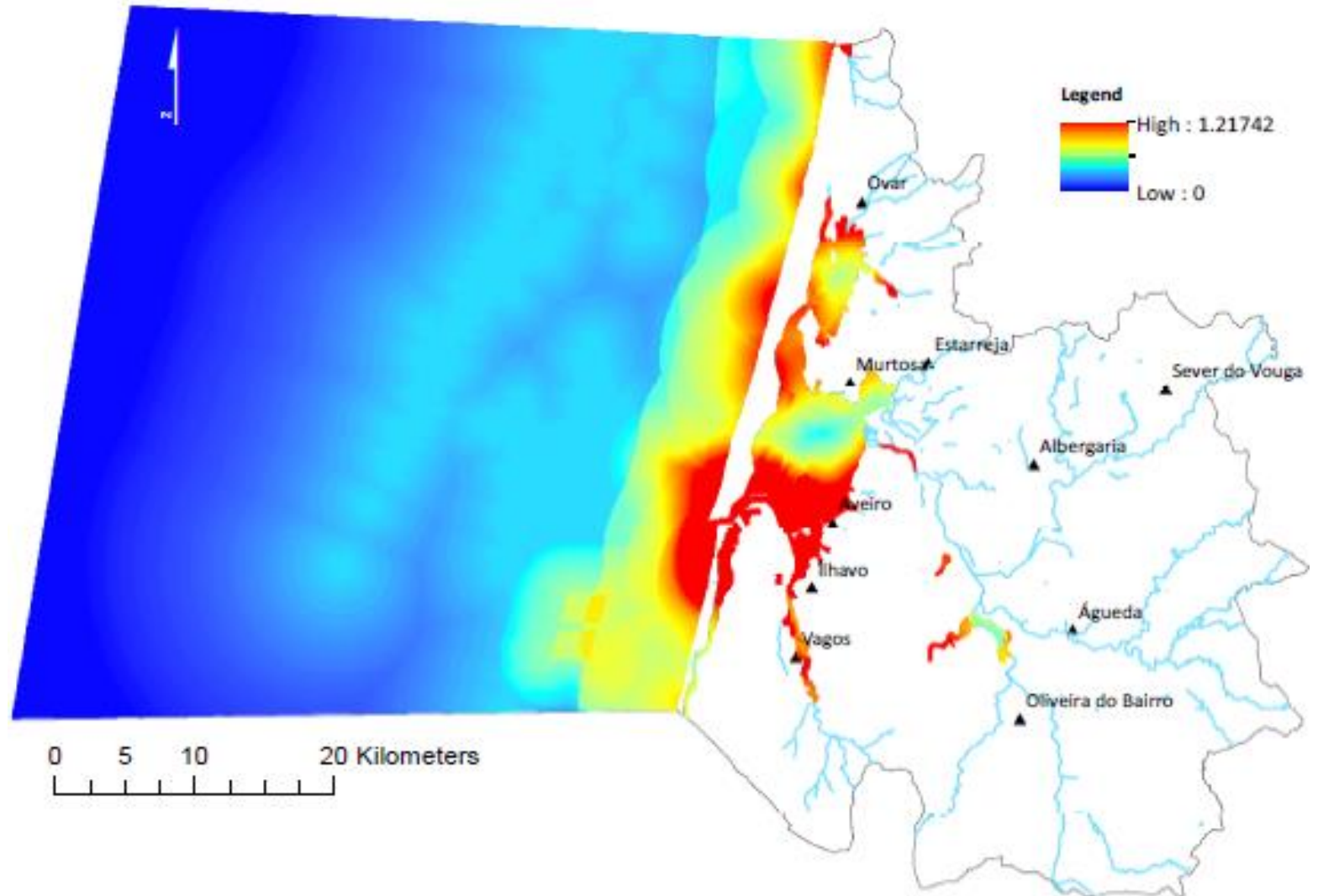**4.** the generation of maps with "risk hotspots" areas.

$$E_{jkl} = \frac{\sum_{i=1}^{N} \frac{e_{ijkl}}{d_{ijkl} \times w_{ijkl}}}{\sum_{i=1}^{N} \frac{1}{d_{ijkl} \times w_{ijkl}}} \qquad C_{jkl} = \frac{\sum_{i=1}^{N} \frac{c_{ijkl}}{d_{i}jkl \times w_{ijkl}}}{\sum_{i=1}^{N} \frac{1}{d_{ijkl} \times w_{ijkl}}}$$

where e_{ijkl} and c_{ijkl} are respectively exposure and consequence values for criterion i, d_i refers to data quality rating for criterion i, w_i refers the weighting assigned to criterion i, all of them specific to habitat j, from stressor k in location l, and N is the number of criteria taken into account for each habitat.
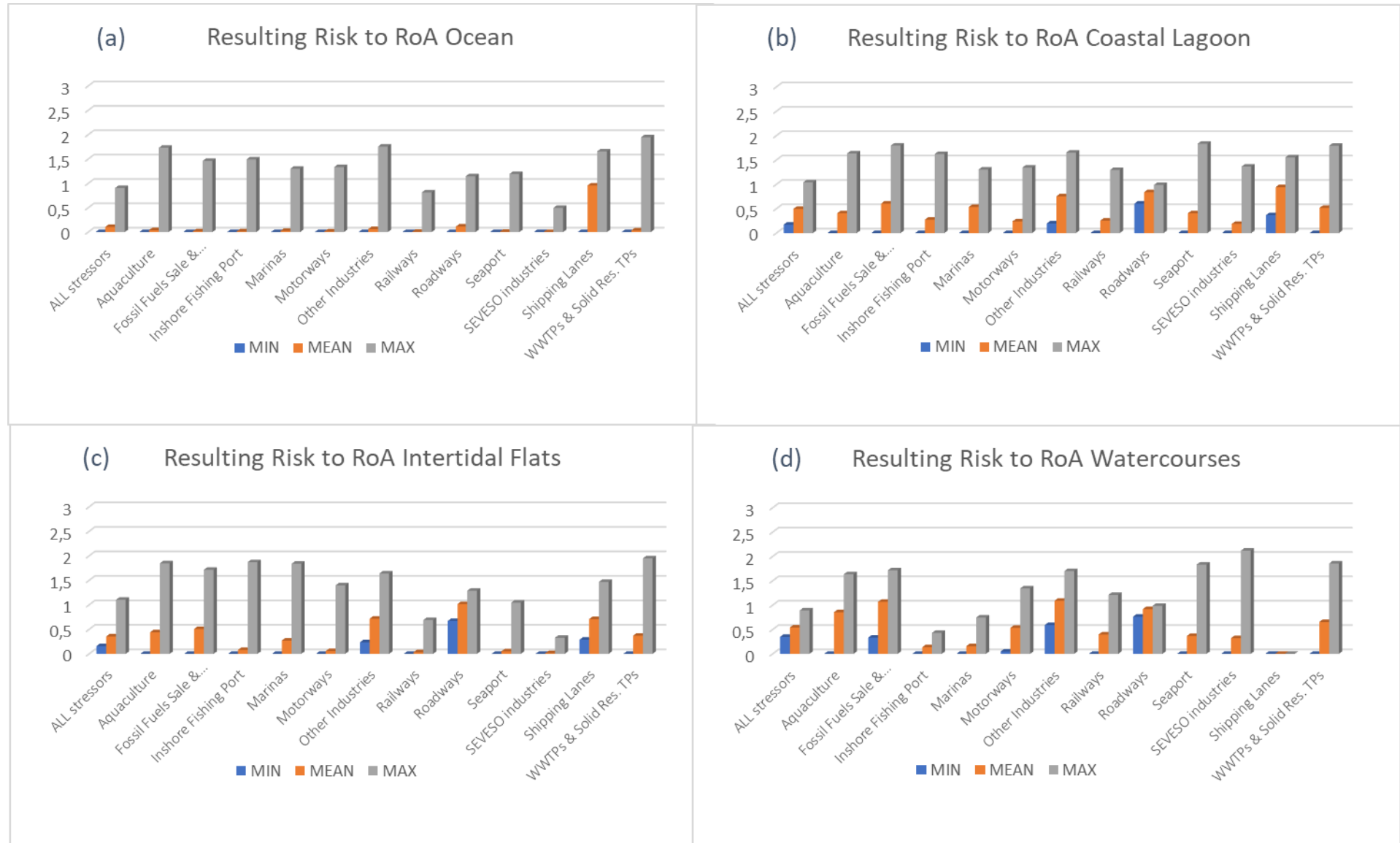
Results - RoA MCE-SES Global Risk:
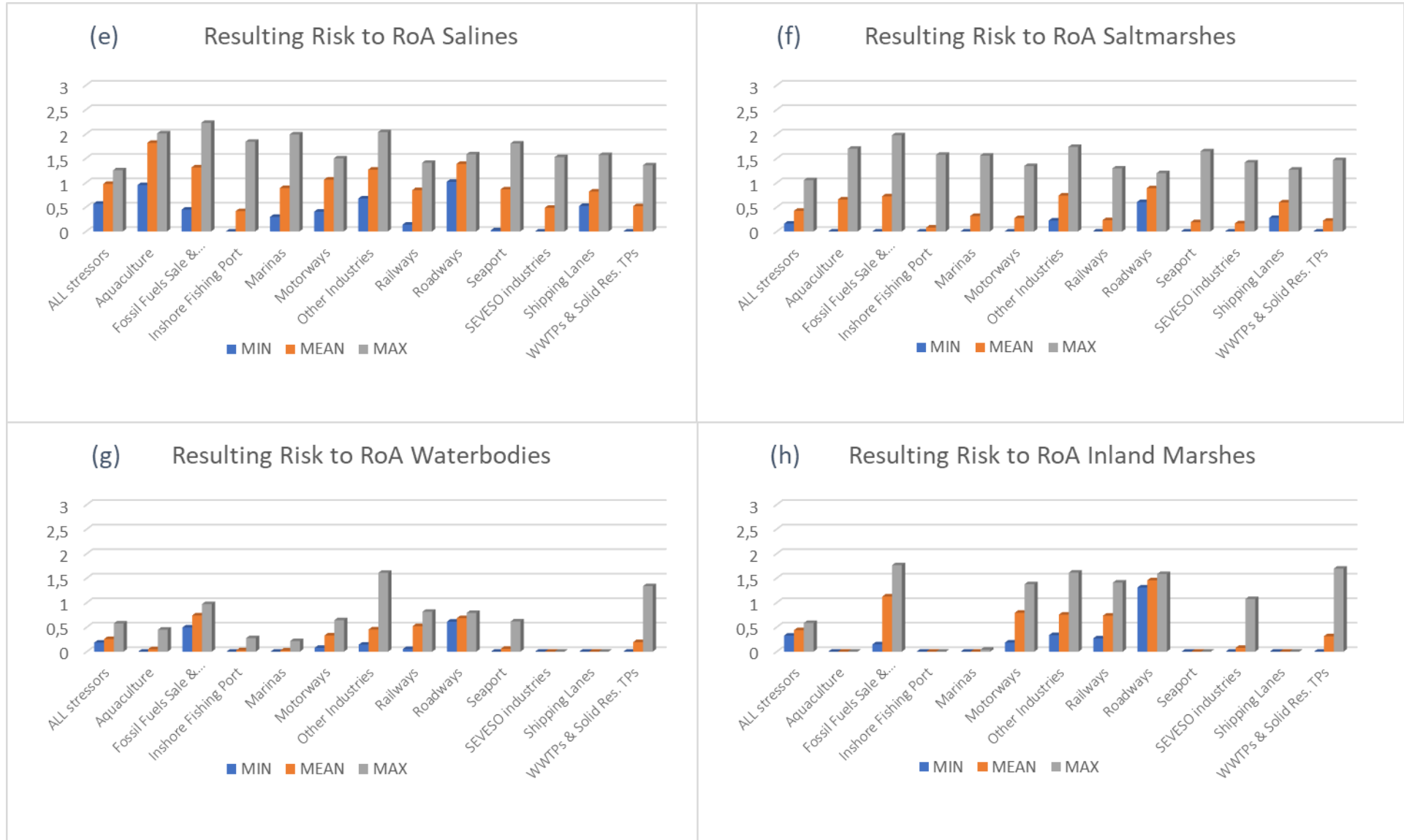
Region of Aveiro MCE-SES Total Risk
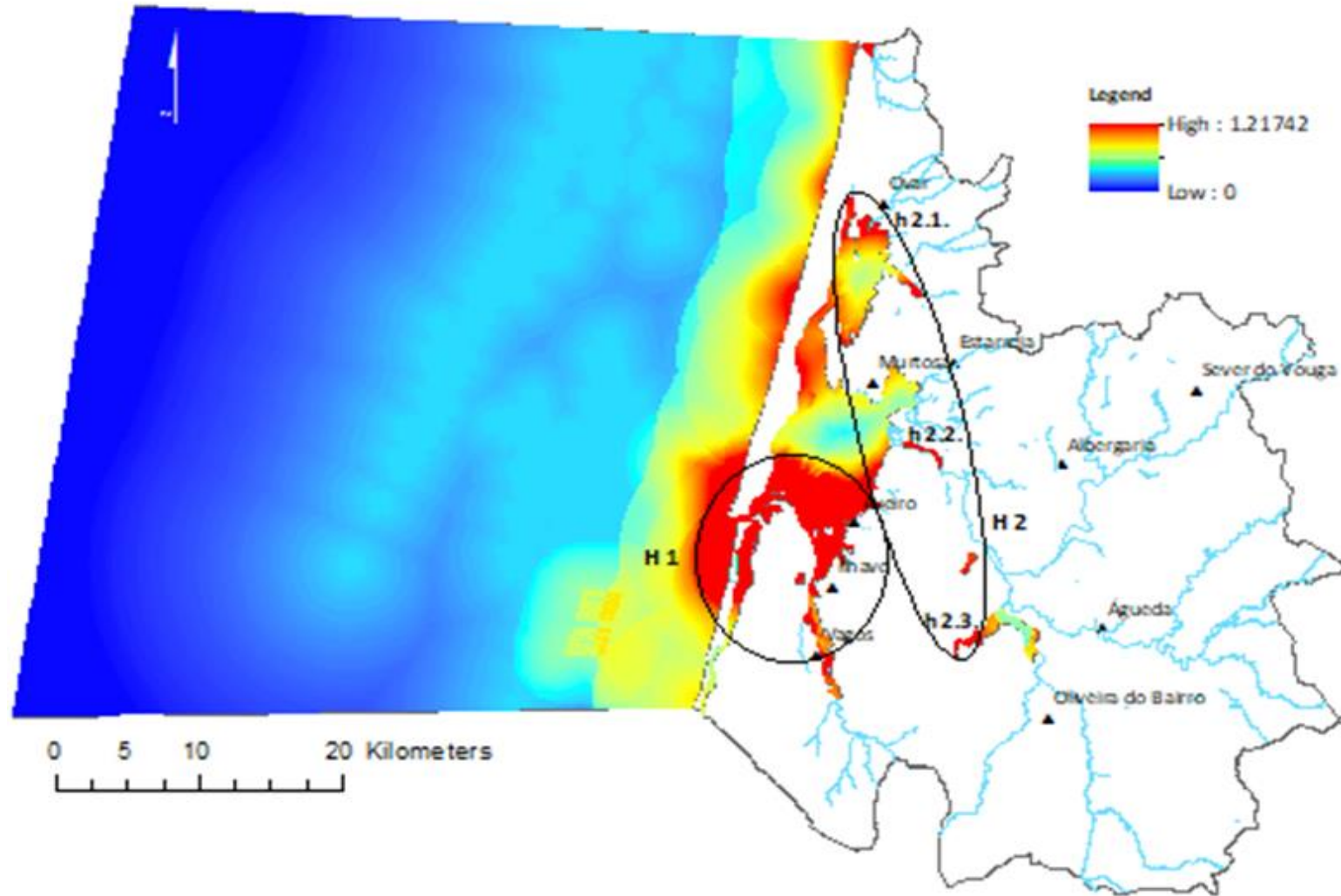
Results - Risk for each of RoA MCE-SES Habitats:

(a) Resulting Risk to RoA Ocean

(b) Resulting Risk to RoA Coastal Lagoon

(c) Resulting Risk to RoA Intertidal Flats

(d) Resulting Risk to RoA Watercourses

Results - Risk for each of RoA MCE-SES Habitats:

(e) Resulting Risk to RoA Salines

(f) Resulting Risk to RoA Saltmarshes

(g) Resulting Risk to RoA Waterbodies
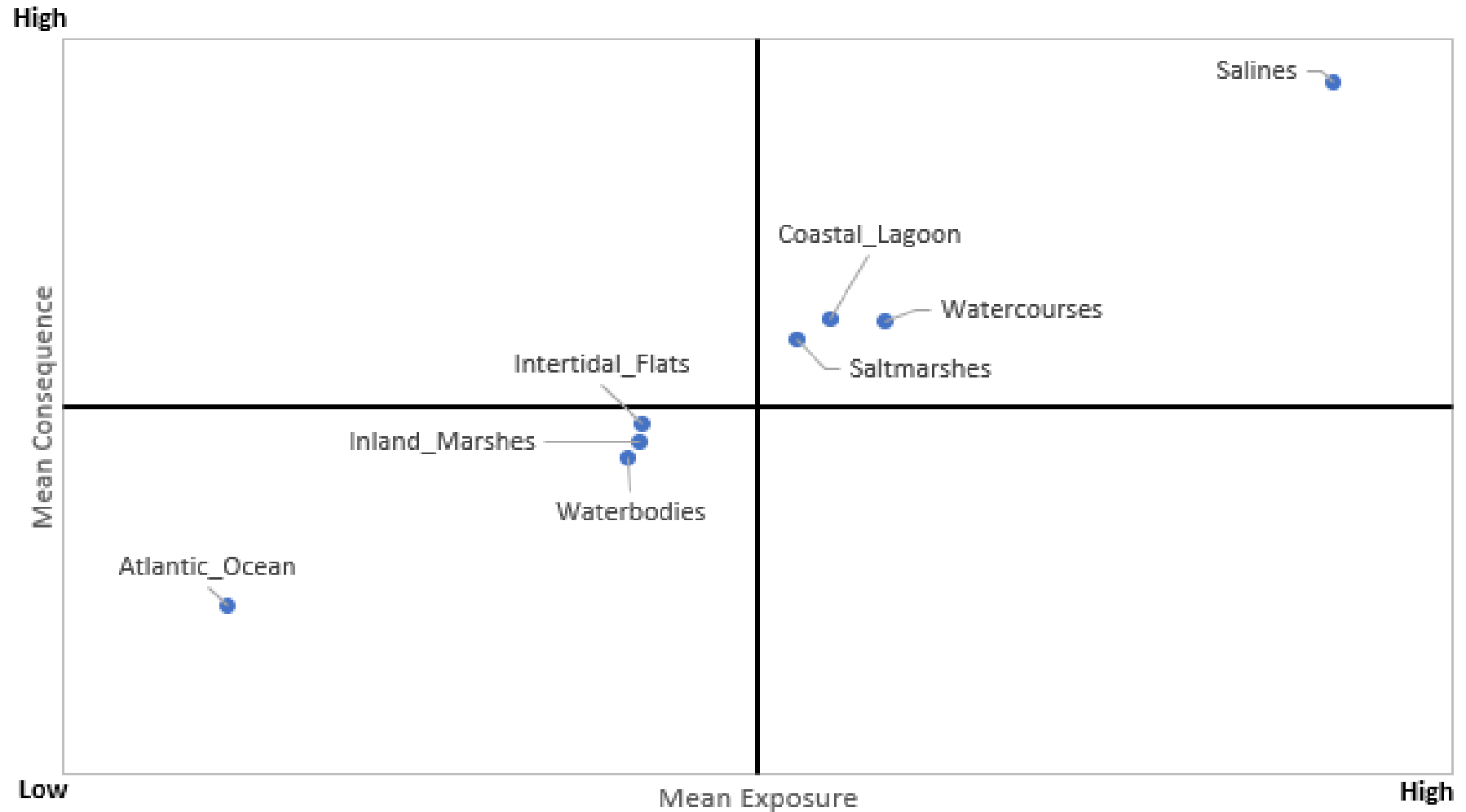
(h) Resulting Risk to RoA Inland Marshes

Discussion:

Region of Aveiro MCE-SES Total Risk

Discussion:

RoA Habitats Mean Exposure-Consequence to HRWP Hazards

Conclusions:

1. At RoA there are two levels of **risk hotspots**: (a) at the center of our area of interest, around the regional capital – Aveiro – and the seaport (covering the entire length of Ílhavo Channel, the Northern section of Mira Channel, the Paraíso Lake and the Atlantic Ocean strip between S. Jacinto Nature Reserve and the South of Costa Nova Beach, and (b) at the whole of Ovar Channels, at Rio Príncipe Channel and at the wetlands of Pateira de Fermentelos;

2. RoA **Salines** are **the most threatened habitat** (followed, at some distance, by Watercourses, Coastal Lagoon and Saltmarshes);

3. Globally, the most significant **HRWP risk sources** to RoA MCE-SES' structures and functions vary widely, depending on the location of each specific habitat;

4. The most significant HRWP risk sources to RoA Salines are: Aquaculture, NON-Seveso Industries, Fossil Fuel Units and Roadways;

5. All the stressors seem to contribute to HRWP risk pressure on RoA Coastal Lagoon and RoA Saltmarshes, even if exerting a lower pression than with the case of Salines and Watercourses.

Thank You for
Your Attention!

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