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Upscaling geographical impacts of Extreme Sea Level Rise and Salinization

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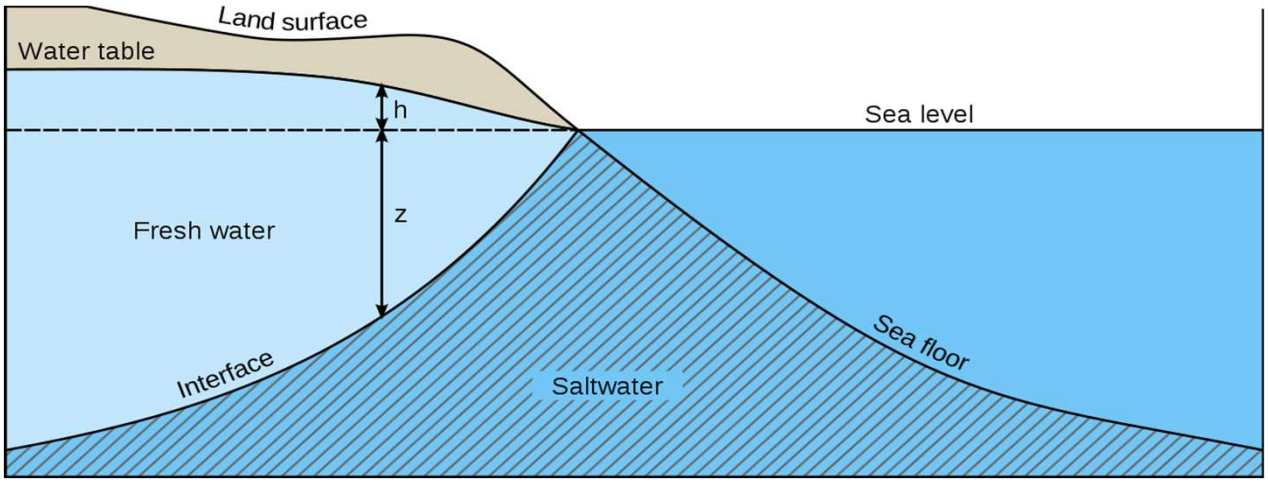
What have we focused on:

- Salinisation – status quo
- Sea Level Rise – future scenarios
- Salinisation – future scenarios

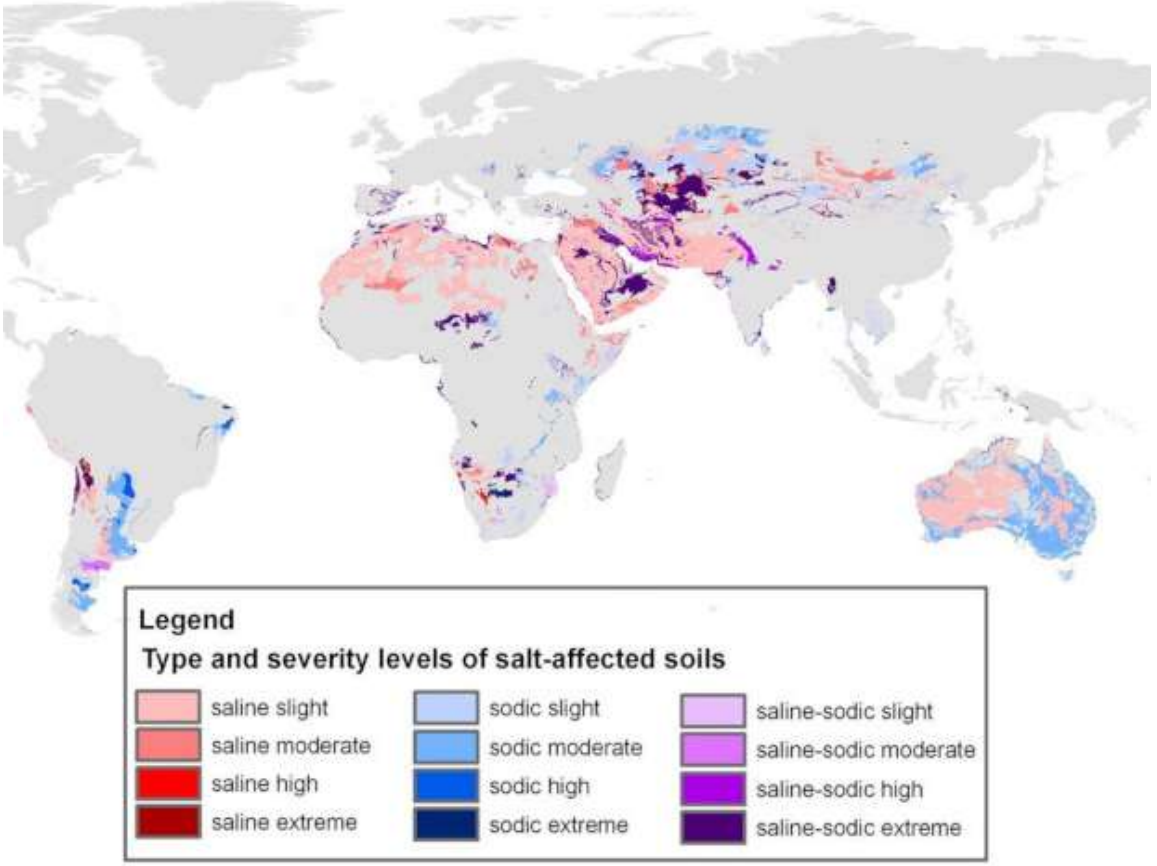
Salinisation – status quo

Sea Level Rise – future scenarios



Just to recap...

- Global scale problem
- 833 million hectares are affected by salinization over tolerance threshold
- Which adds up to ~ 9% of world above sea level land

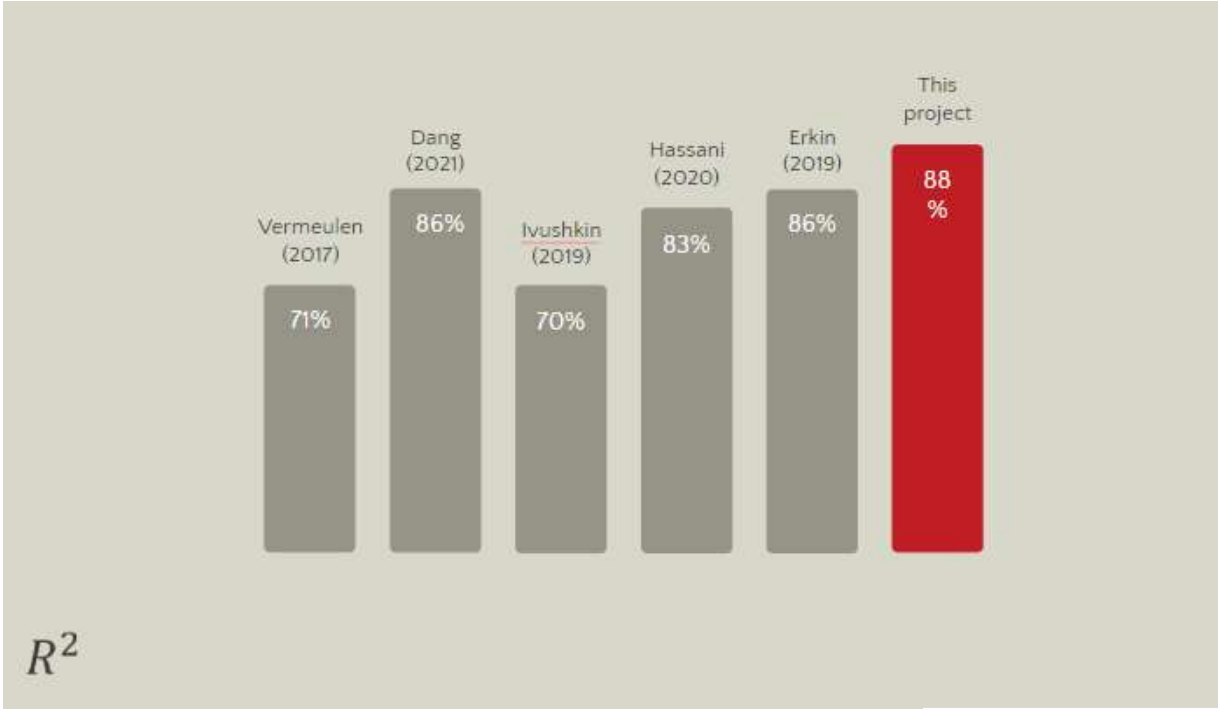


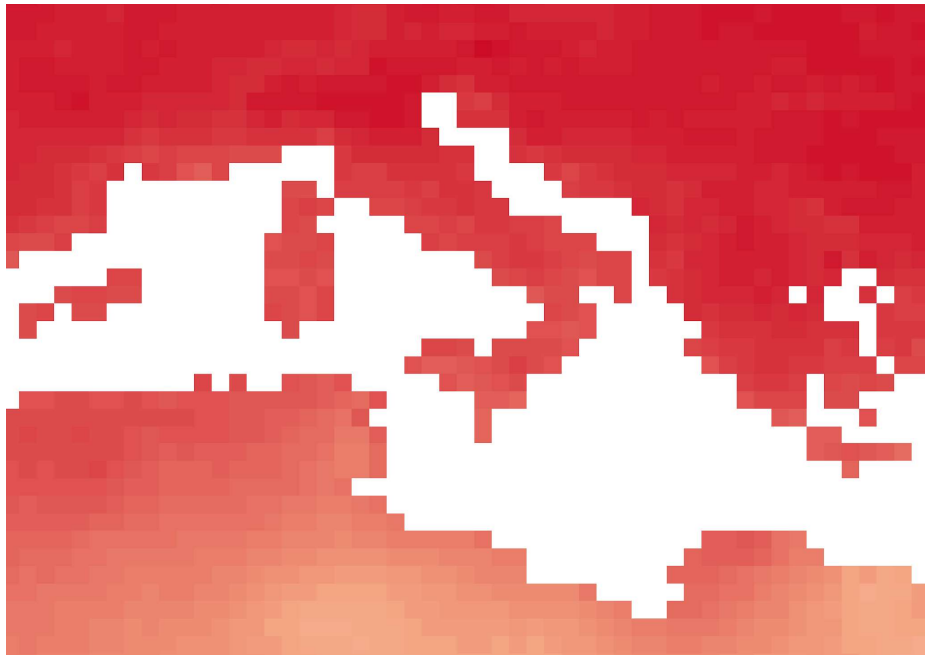
Salinisation: what we have done

- Version 1.0: same dataset for samples of explanatory variables, and same model from the Hassani et al paper, different and better data on status quo on Europe and the Mediterranean

- Version 2.0: same dataset for samples of explanatory variables from the Hassani et al paper, improved model different and better data on status quo on Europe and the Mediterranean

- Version 3.0: we reconstructed and coupled a more spatially and up to date dataset for sampling explanatory variables to those from the Hassani et al paper.





PREVIOUS DATASET (Hassani et al, 2021)

NEW DATASET (Dalle Vaglie et al, 2023)

Sea Level Rise: where are we at:

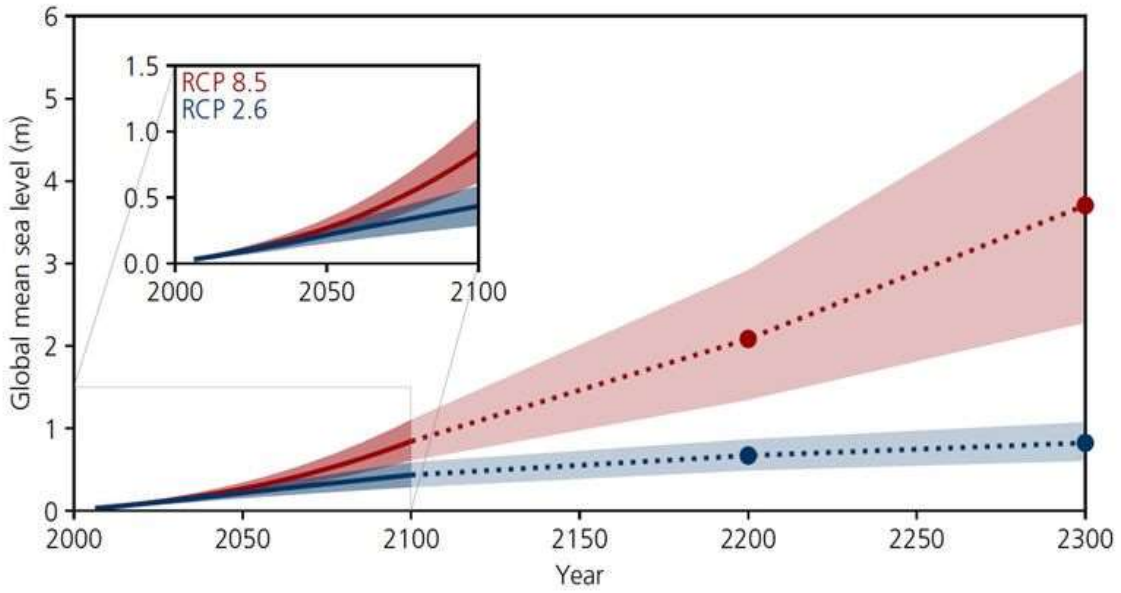
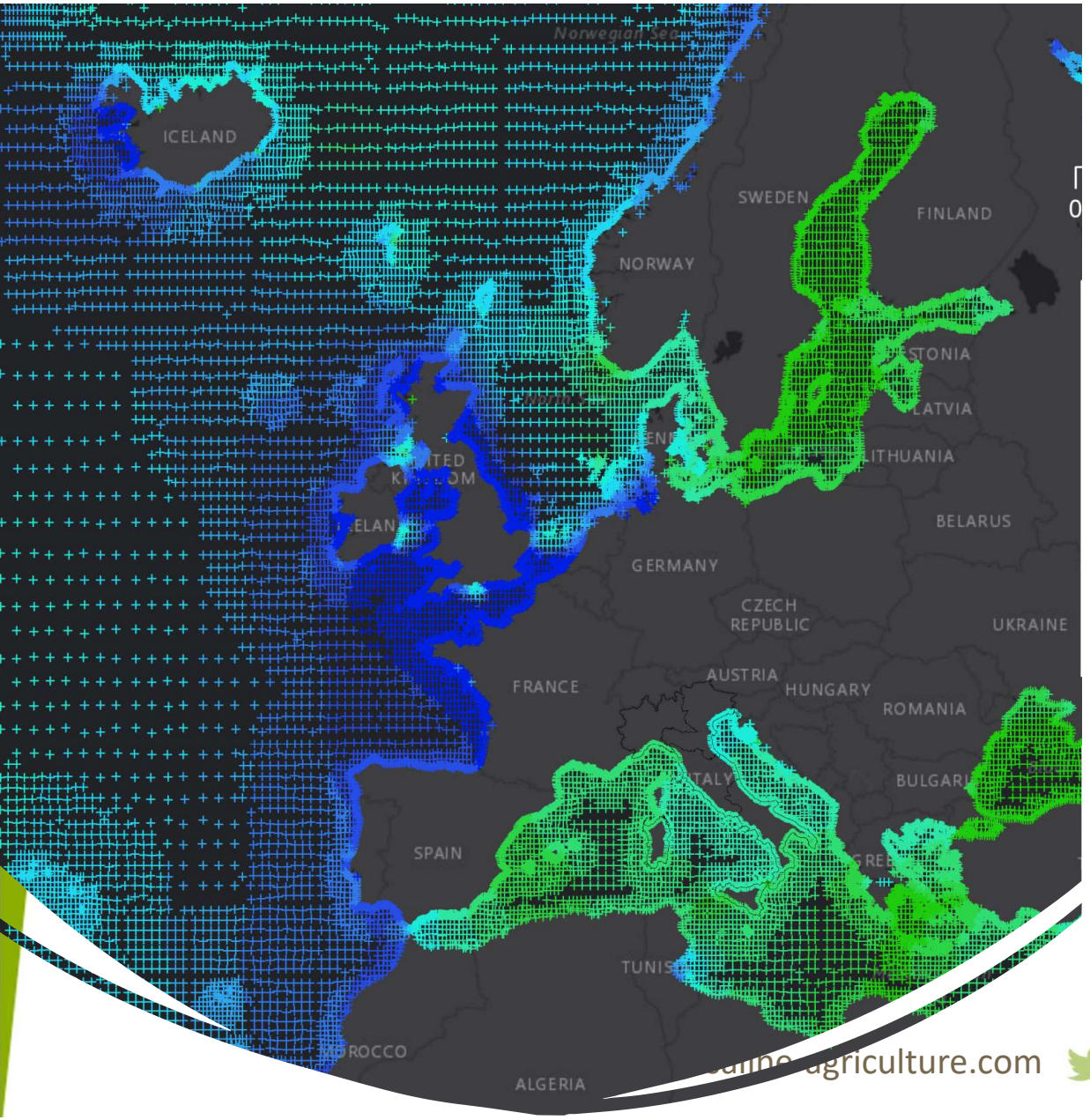


Figure 1. Projections of possible sea-level rise for the low and high emission scenarios, RCP2.6 (blue) and RCP8.5 (red), respectively. The shaded areas indicate the uncertainty in the projections. Figure from (SROCC, 2019).

http://www.coastalwiki.org/wiki/Sea_level_rise

- The aims is to map the extent inland that JRC forecast would have for the following scenarios below
- To derive vulnerability maps for these scenarios

		2050	2100
RCP 4.5		5° percentile	"
		50° percentile	"
		95° percentile	"
RCP 8.5		5° percentile	"
		50° percentile	"
		95° percentile	"



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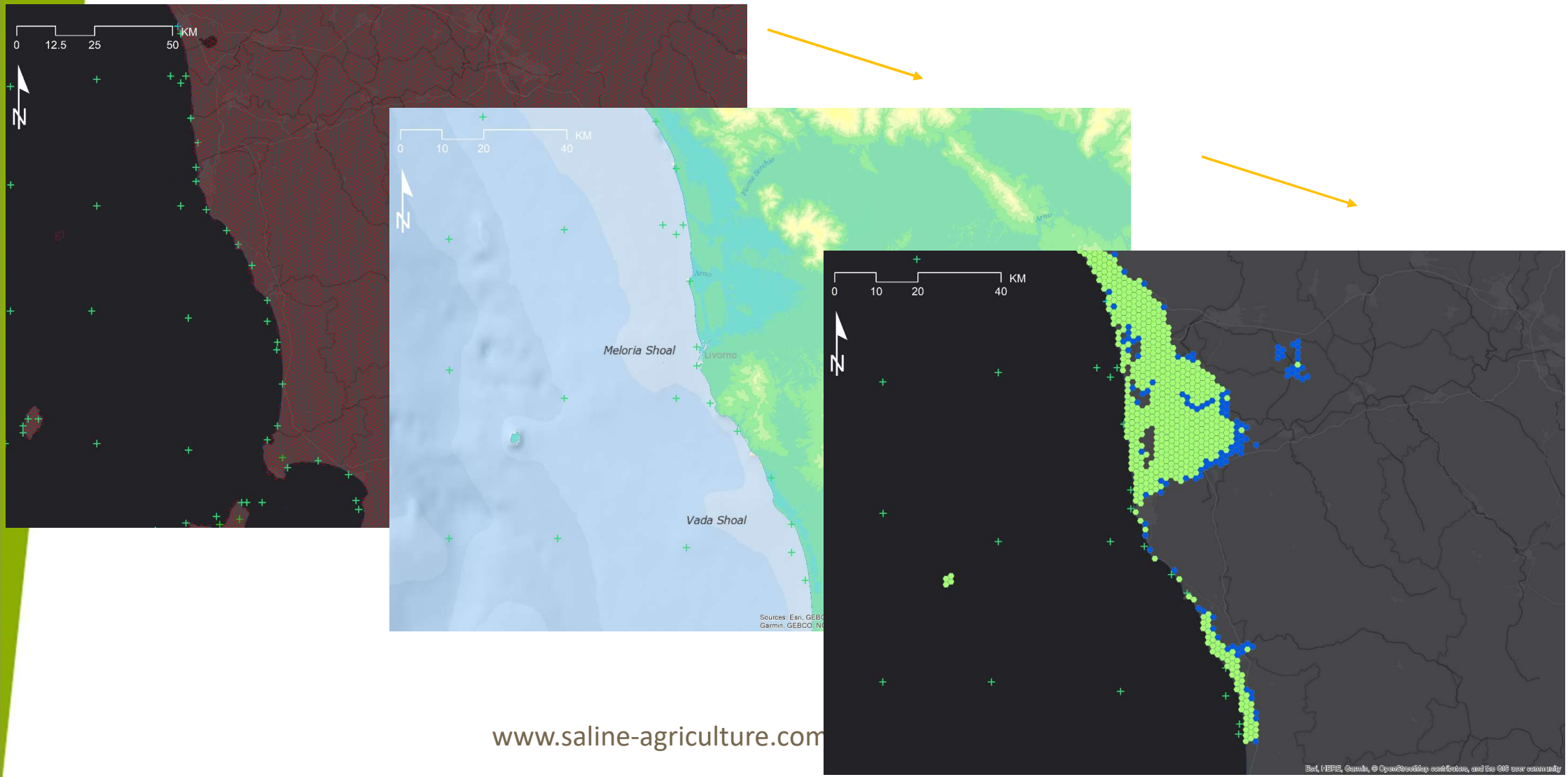
Sea level rise definition, drivers and components

Extreme sea levels, Mean sea levels, Total water level

Most coastal zones are more vulnerable to extreme sea levels than to the mean sea level. This holds in particular for coasts situated on broad continental shelves (North Sea, East China Sea, for example) where extreme levels are much higher than the mean sea level, due to amplification of the ocean tides and water-level setup by strong winds (storm surges). Rise of the local mean sea level is always the major component of the projected rise of the local extreme sea level (for any given long return period), although climate-induced change in extreme wind and wave conditions can influence extreme sea levels significantly in some regions[. Climate models predict, for example, that extreme wind and wave conditions will be less frequent along the eastern African coast, whereas in northern Europe (especially the Baltic region in the RCP8.5 scenario) extreme levels will increase more than the mean sea level.

Bath-tub rationale



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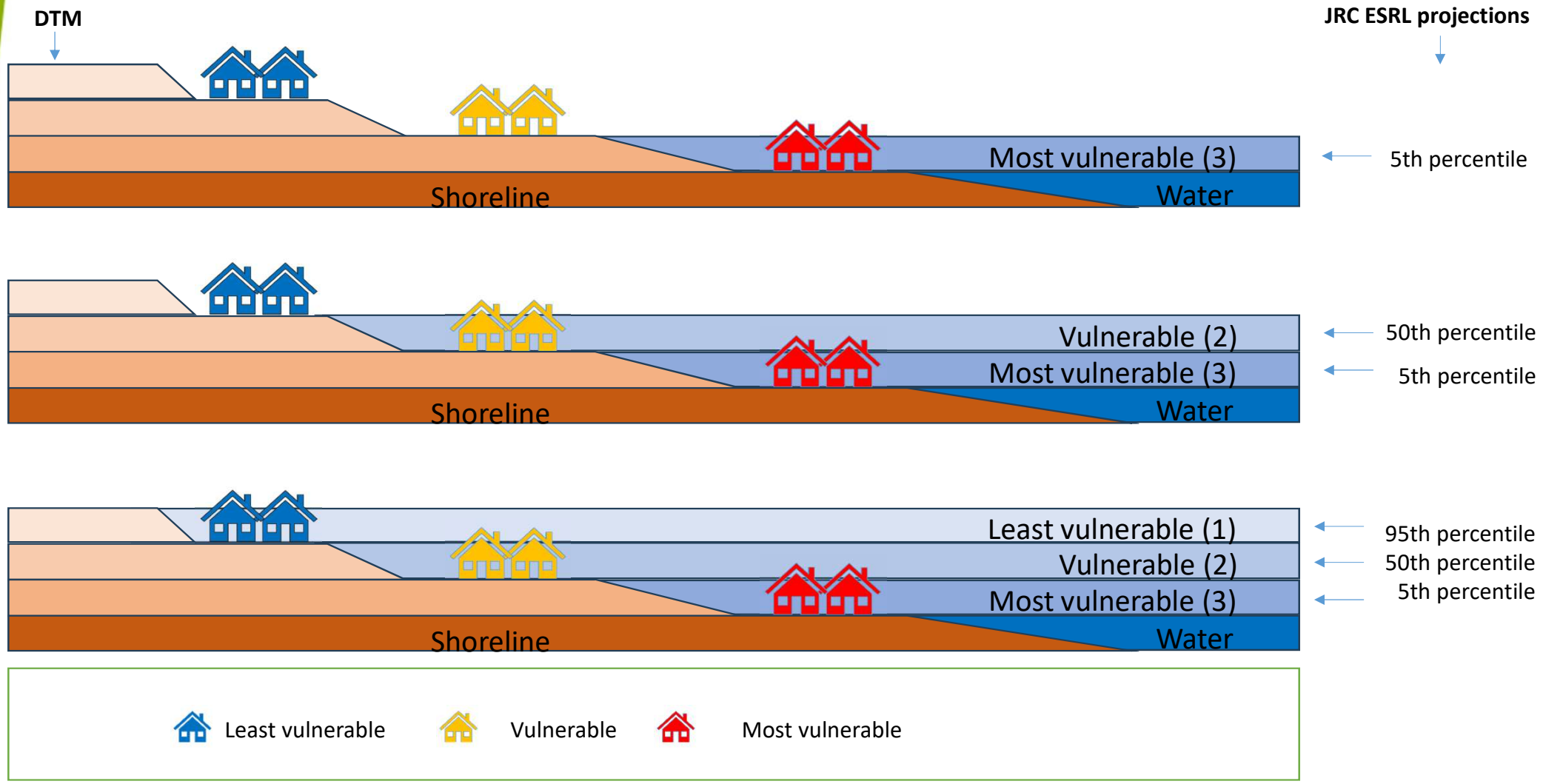
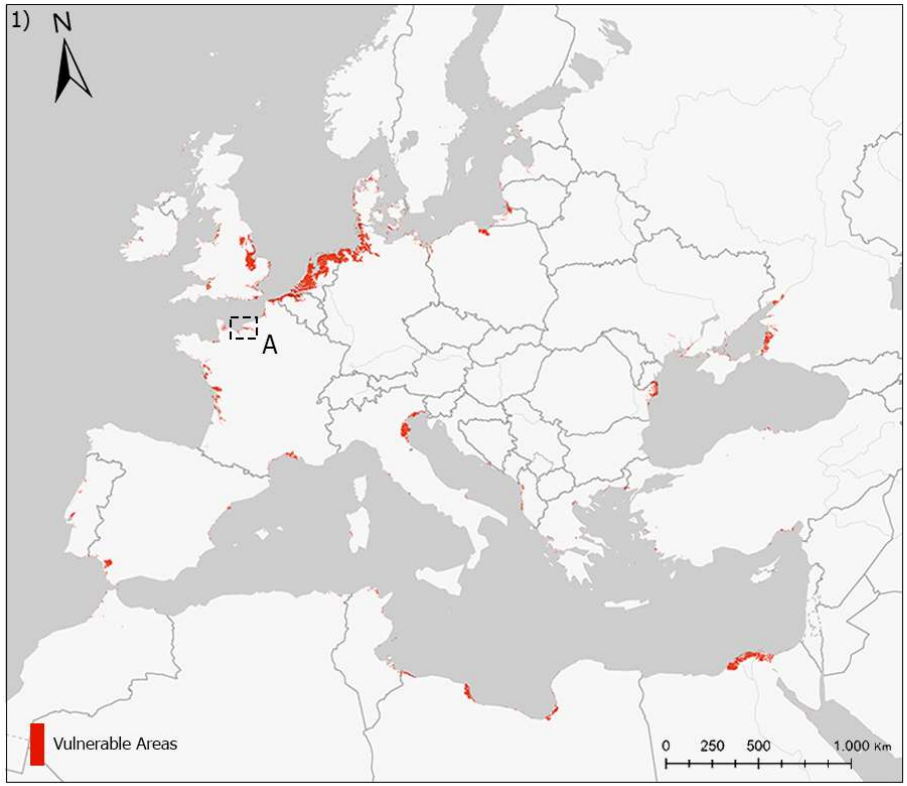
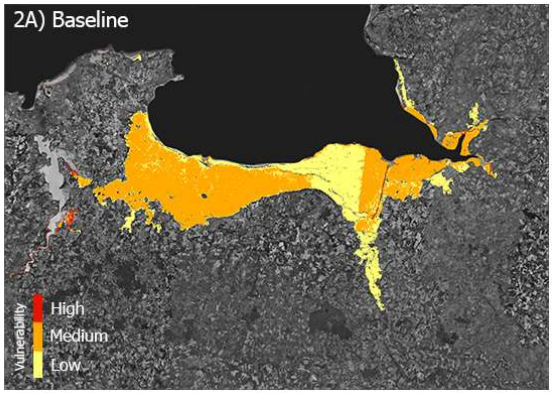
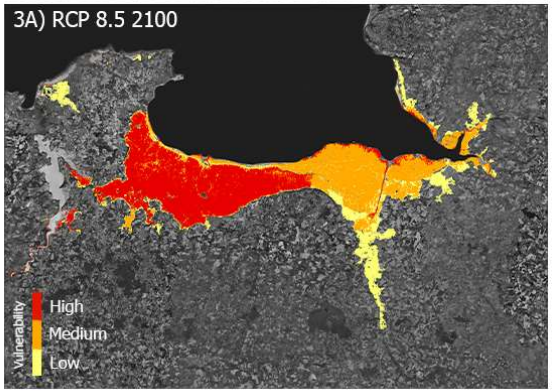
Vulnerability definition

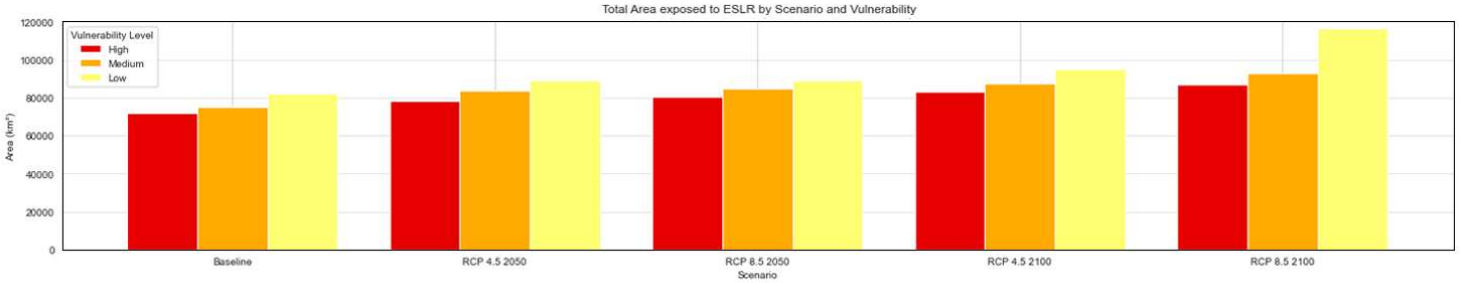


Preliminary mapping results









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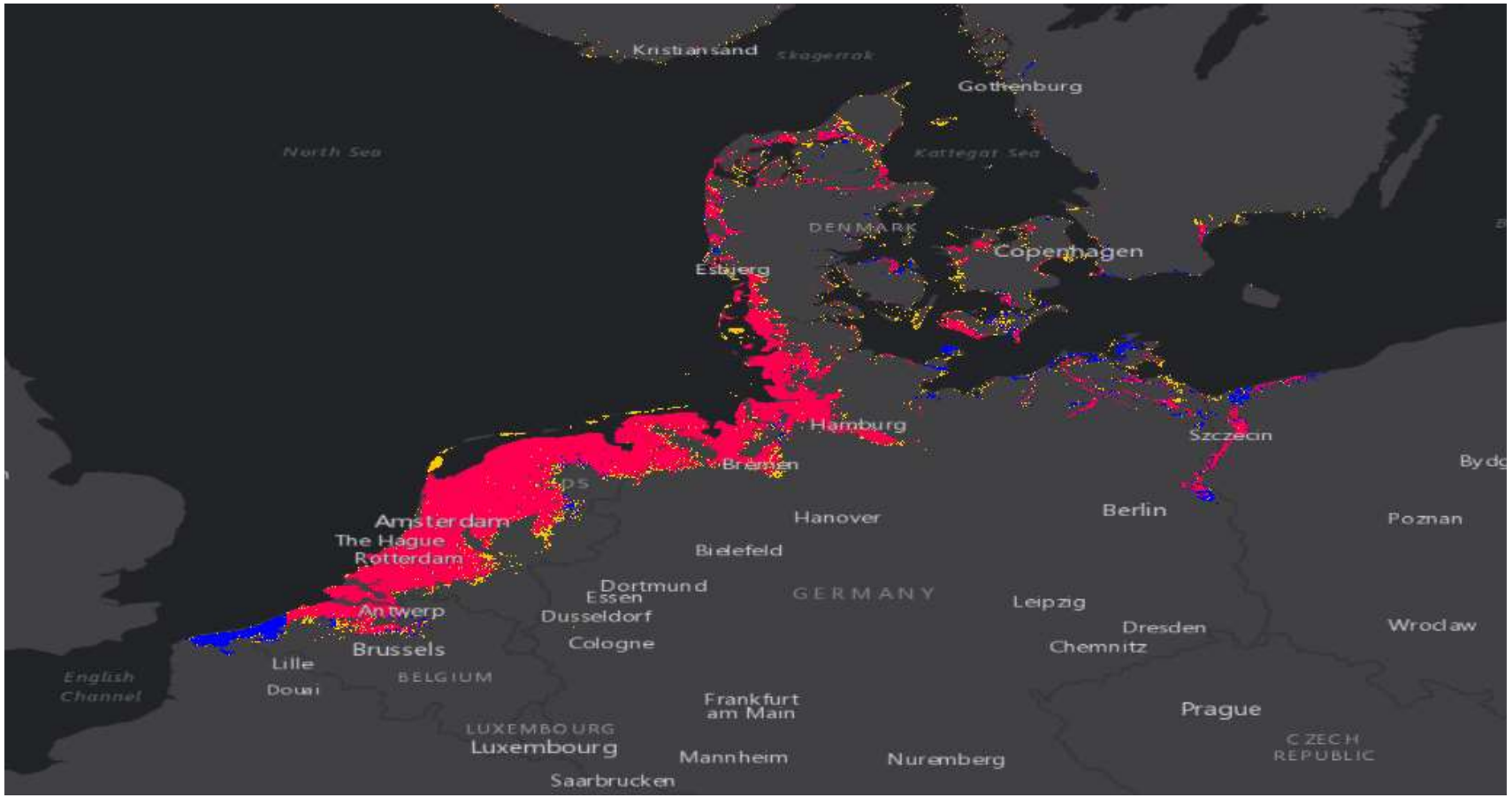
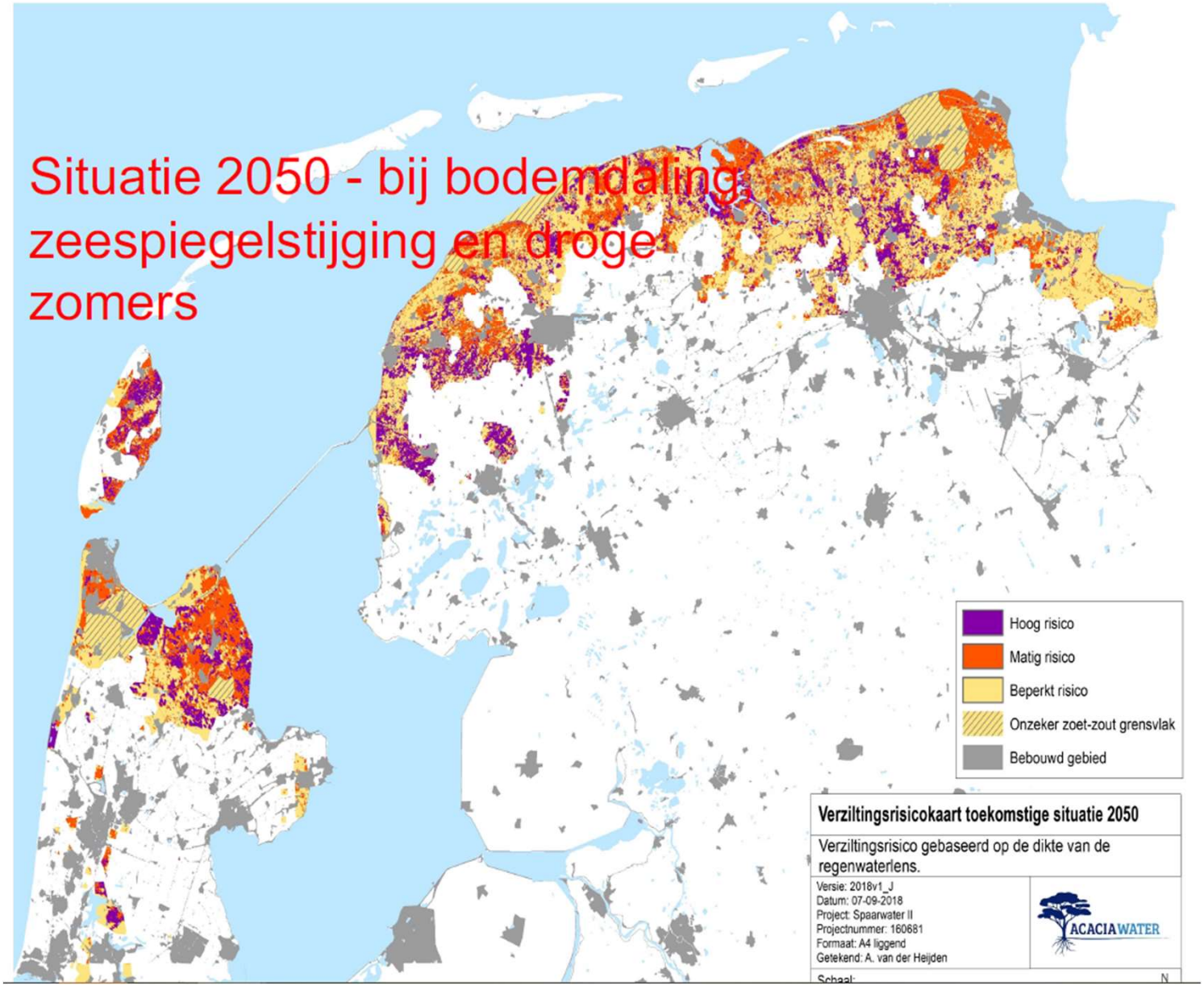
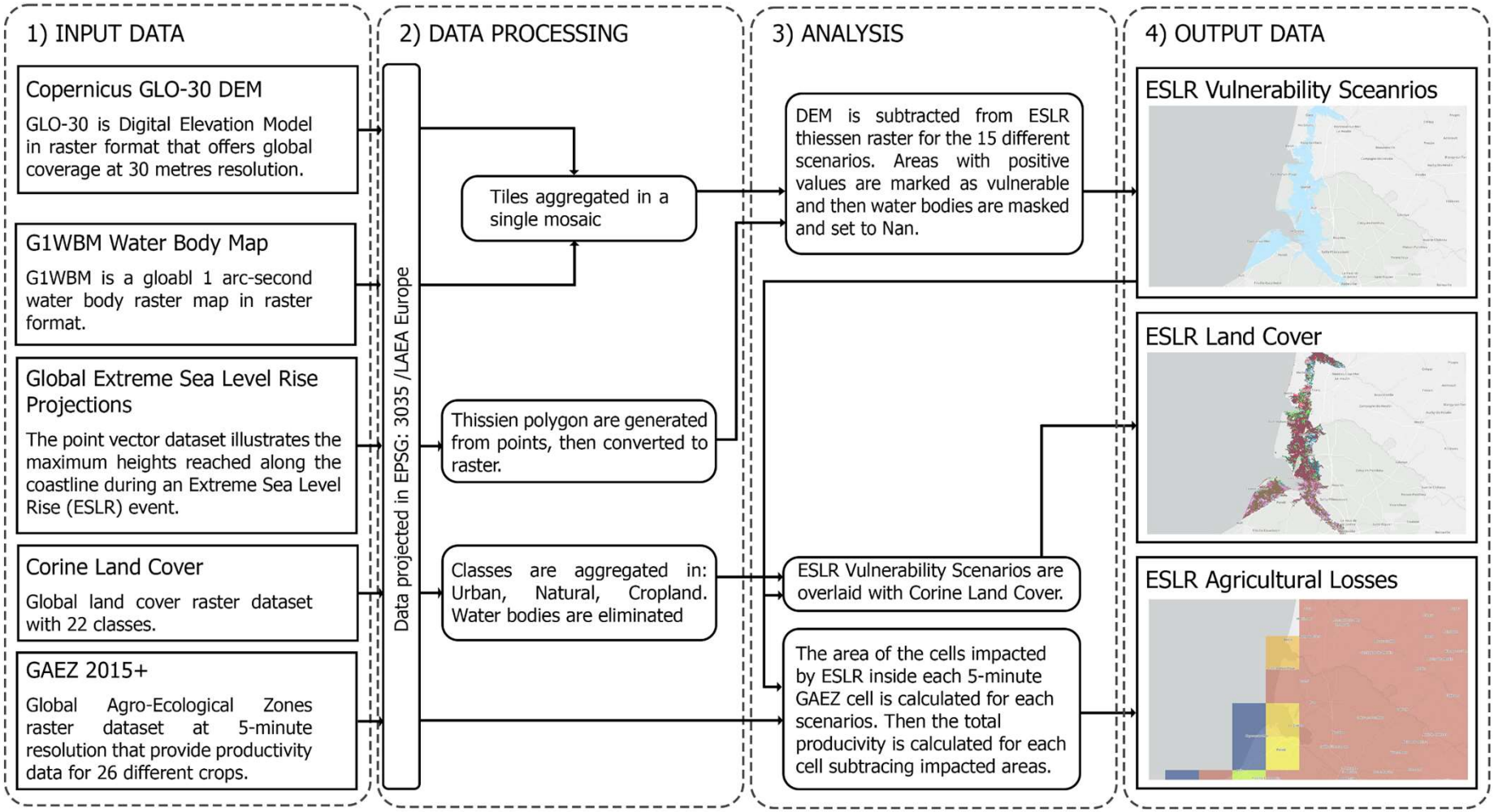
Less vulnerable (1)
Vulnerable (2)
Highly vulnerable (3)



Situatie 2050 - bij bodemdaling, zeespiegelstijging en droge zomers

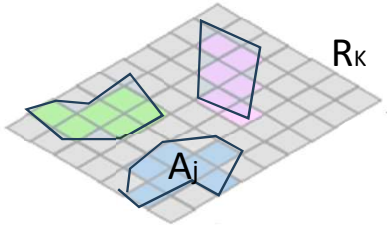



1) INPUT DATA
Copernicus GLO-30 DEM
GLO-30 is Digital Elevation Model in raster format that offers global coverage at 30 metres resolution.
G1WBM Water Body Map
G1WBM is a gloabl 1 arc-second water body raster map in raster format.
Global Extreme Sea Level Rise Projections
The point vector dataset illustrates the maximum heights reached along the coastline during an Extreme Sea Level Rise (ESLR) event.
Corine Land Cover
Global land cover raster dataset with 22 classes.
GAEZ 2015+
Global Agro-Ecological Zones raster dataset at 5-minute resolution that provide productivity data for 26 different crops.
2) DATA PROCESSING
Data projected in EPSG: 3035 /LAEA Europe
Tiles aggregated in a single mosaic
Thissien polygon are generated from points, then converted to raster.
Classes are aggregated in: Urban, Natural, Cropland. Water bodies are eliminated
3) ANALYSIS
DEM is subtracted from ESLR thiessen raster for the 15 different scenarios. Areas with positive values are marked as vulnerable and then water bodies are masked and set to Nan.
ESLR Vulnerability Scenarios are overlaid with Corine Land Cover.
The area of the cells impacted by ESLR inside each 5-minute GAEZ cell is calculated for each scenarios. Then the total producivity is calculated for each cell subtracing impacted areas.
4) OUTPUT DATA
ESLR Vulnerability Sceanrios
ESLR Land Cover
ESLR Agricultural Losses

Agricultural Vulnerability to ESLR:

- 1) Mapped inland extent of JRC - Global Extreme Sea Level Projections
- 2) Agricultural Production: EarthStat - Harvested Area & Yield for 175 Crops

ESLR vulnerability scenarios



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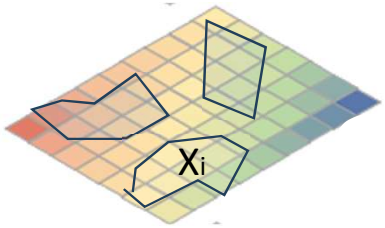
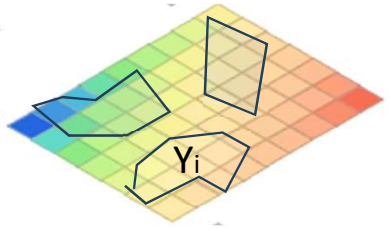
Crop specific harvested area



Crop specific yield



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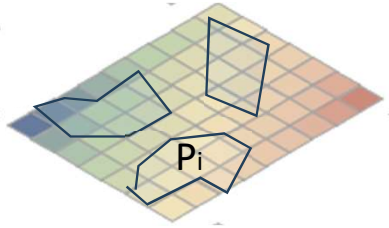
Crop current value



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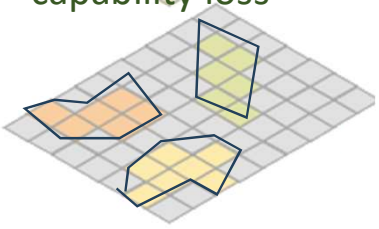
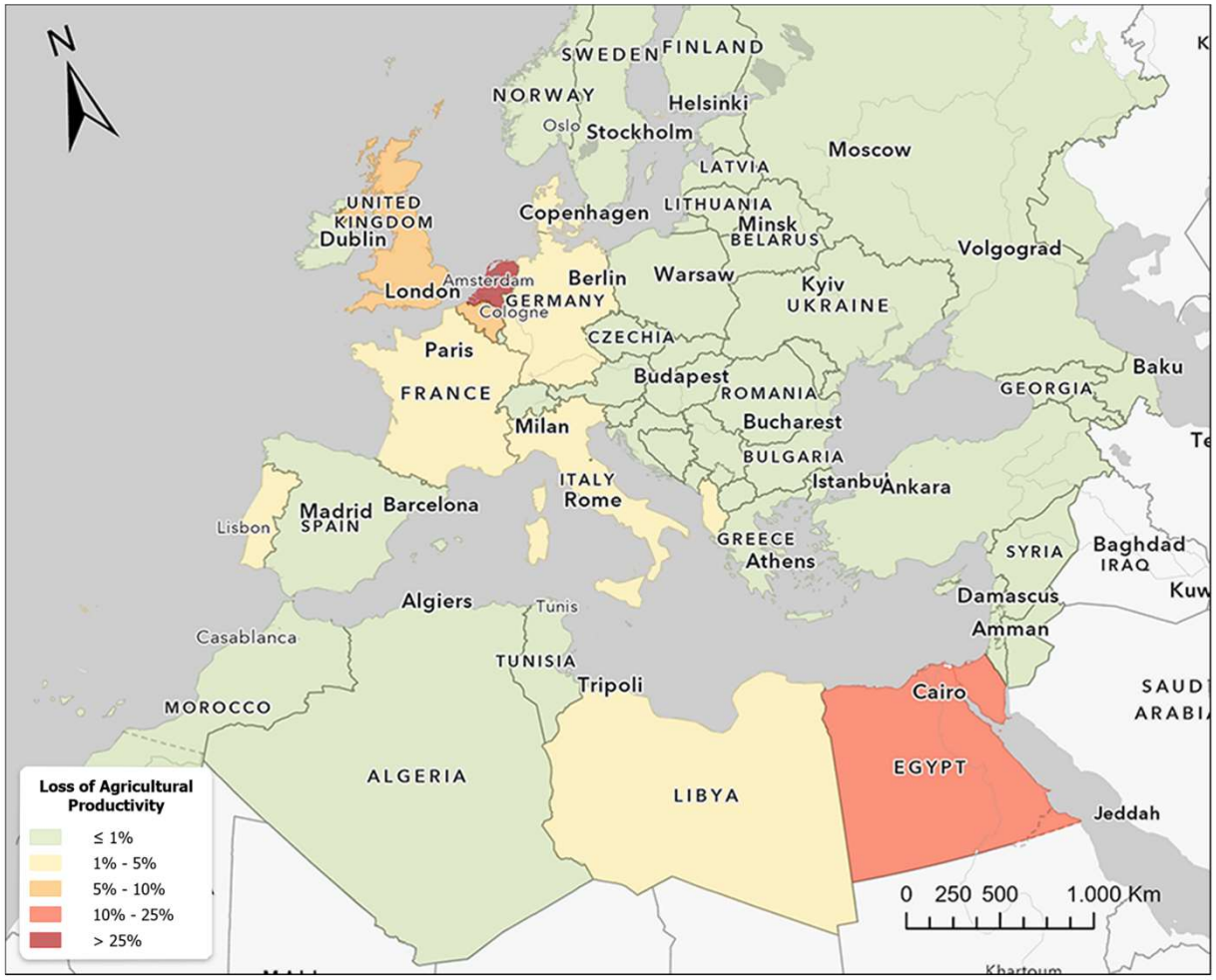
Agricultural potential capability loss



AG_PL_K

$$AG\_PL_K = \sum_{j=1}^{m} Aj \left(\sum_{i=1}^{n} x_i y_i p_i \right) \quad \forall R_K$$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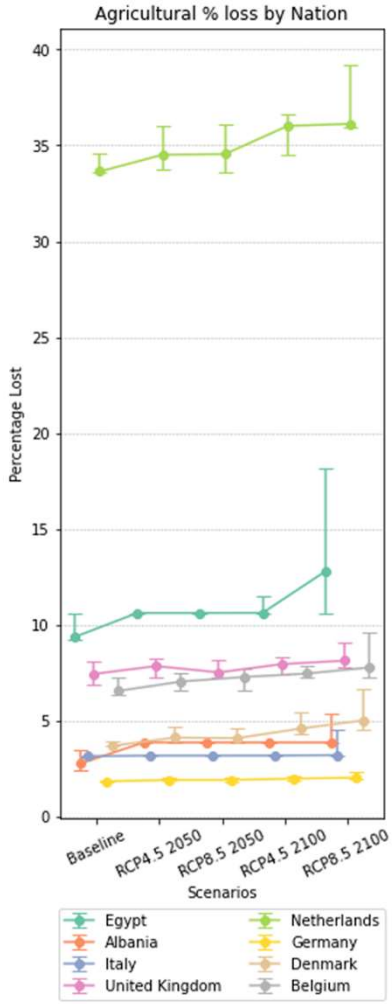
Baghdad
IRAQ
Damascus
Amman
Algiers
Tunis
Casablanca
TUNISIA
Tripoli
Cairo
MOROCCO
EGYPT
ALGERIA
LIBYA
Jeddah
0 250 500 1.000 Km
Khartoum
Loss of Agricultural Productivity
≤ 1%
1% - 5%
5% - 10%
10% - 25%
> 25%

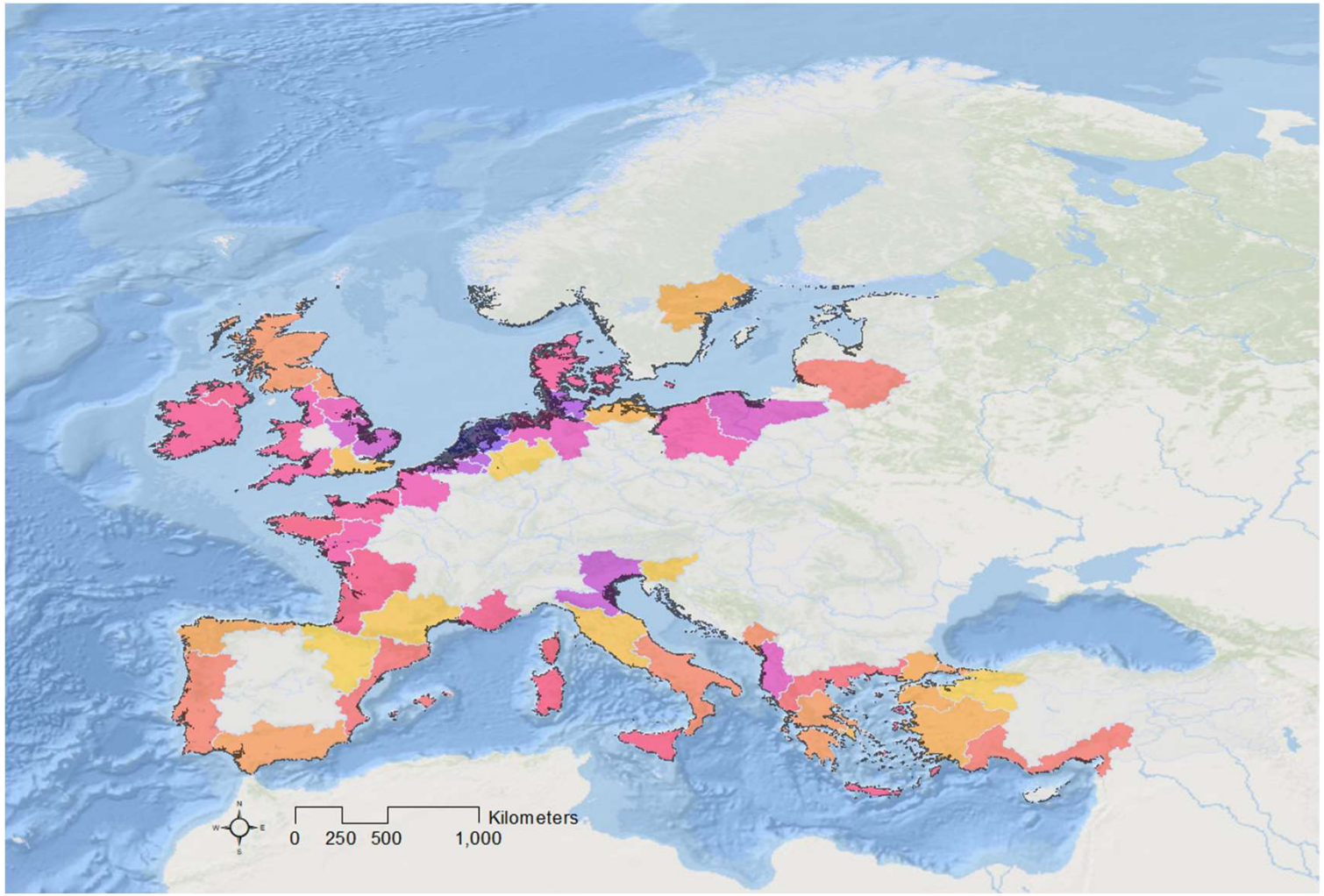

Agricultural % loss by Nation
Percentage Lost
0
5
10
15
20
25
30
35
40
Baseline
RCP4.5 2050
RCP8.5 2050
RCP4.5 2100
RCP8.5 2100
Scenarios
Egypt
Albania
Italy
United Kingdom
Netherlands
Germany
Denmark
Belgium

Distribution of wheat potentially vulnerable production in the EU region at the NUTS1 level

(year 2020, % of prod.)

0 *~ 97 %*

ESLR inland extent
Scenario RCP 4.5
Year 2050
Vulnerability 2



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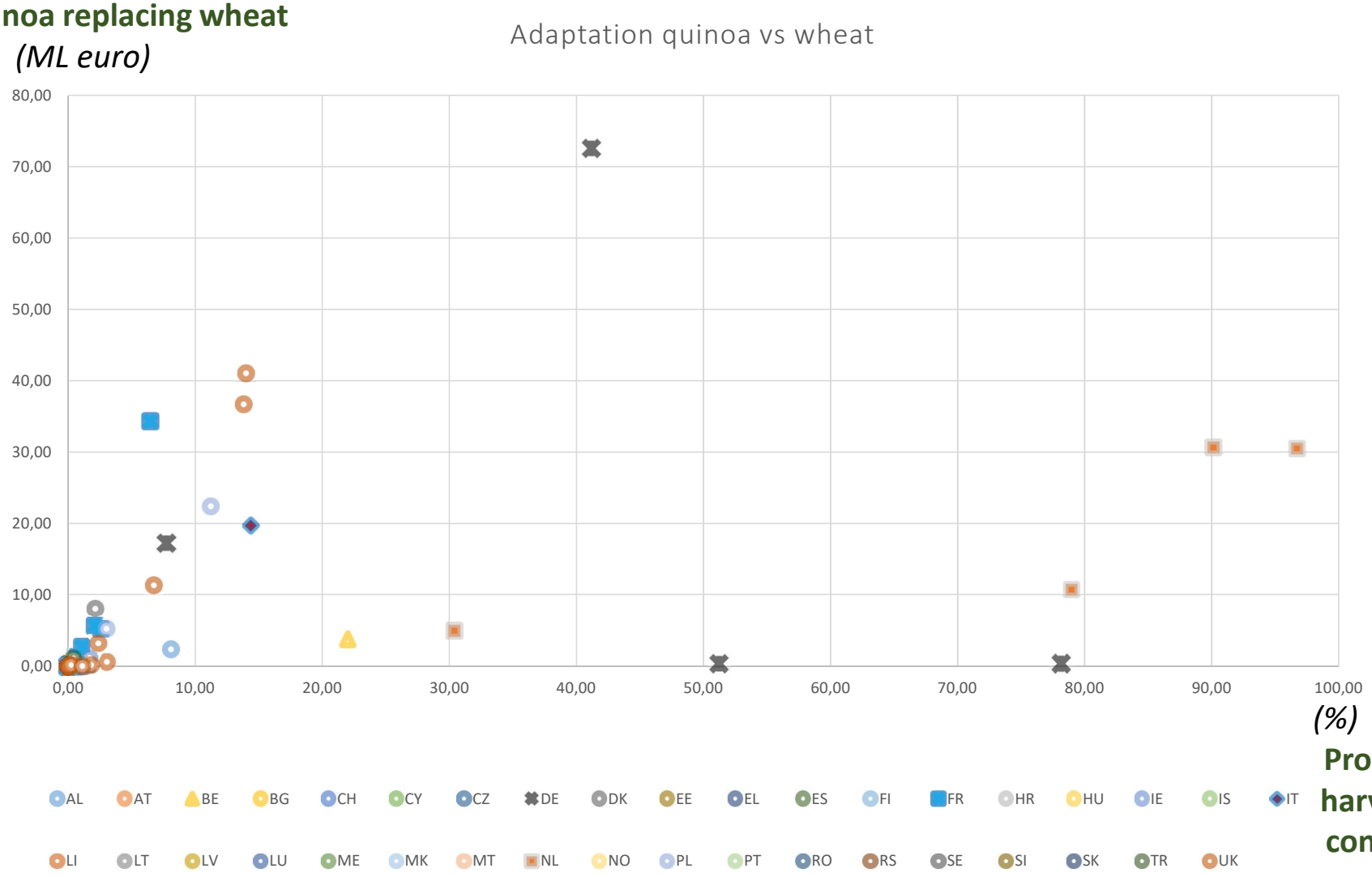
Estimated surplus production value with quinoa replacing wheat

(ML euro)



Proportion of wheat harvested area to be converted to quinoa

Building up resilience

Thank you!

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