

MAPPING THE VULNERABILITY OF THE LISBON METROPOLITAN AREA TO POTENTIAL CLIMATE CHANGE

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Itajaí, SC

Background and Importance

Climate Change:

- Sea Level Rise
- Temperature

(IPCC 2007)

These impacts vary spatially throughout urban environments

(UNEP 2008)

Vulnerability: “The extent to which a natural or social system is susceptible to sustaining damage from climate change” *(IPCC, 2002)*

Background and Importance

Climate Change – Sea Level Rise:

Accelerated sea level rise is of grave concern to all coastal centers (Hansen 2007).

Lisbon and Setubal (Targus and Sado Estuaries) are highly vulnerable to the effects of sea level rise (Ferreira, et al 2008).

- Erosion at Caparica Beach
- Vulnerable to flooding by tsunamis, several of which have been experienced in the past (Viana-Baptista, *et al.* 2006)

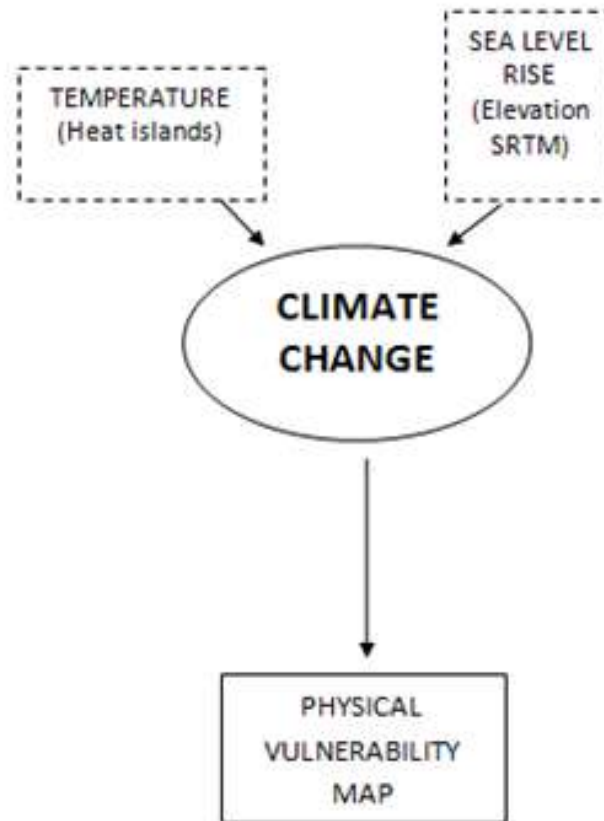
Careful adaptation planning and strong commitment to coastal management are imperative to minimize the future impacts of sea level rise (Allen, *et al.* 2005).

Portugal lacks any specific adaptation policies for accelerated sea level rise (Ferreira, *et al.* 2008).

Objectives

- ❑ Assess the spatial vulnerability of the LMA to climate change factors
- ❑ Inform climate change adaptation strategies for the LMA
- ❑ Use free and widely available data

Methodology



Methodology

Temperature

Landsat 7 ETM+ – June 8, 2000



Band 6 (10.4 - 12.5 μm)

- Spatial resolution of 60m at nadir
- Captures the intra-urban temperature

Methodology

Sea Level Rise

SCENARIOS

Much argument within the literature

PROJECTED SEA-LEVEL RISE BY 2100:

- IPCC WGI, 2007: RANGE: **0.18 – 0.59** m
- MOORE *ET AL*, 2008 : **0.8 - 1.5** m (Based on changes over the past 300 years)
- HANSEN 2007: **5** m (Based on ice sheet contribution)
22 m (with storm surge and waves)

Methodology

□ Data used:

- SRTM (Jarvis, 2008)
- Tidal Information (Porto de Lisboa, 2009)
- Prediction Scenarios

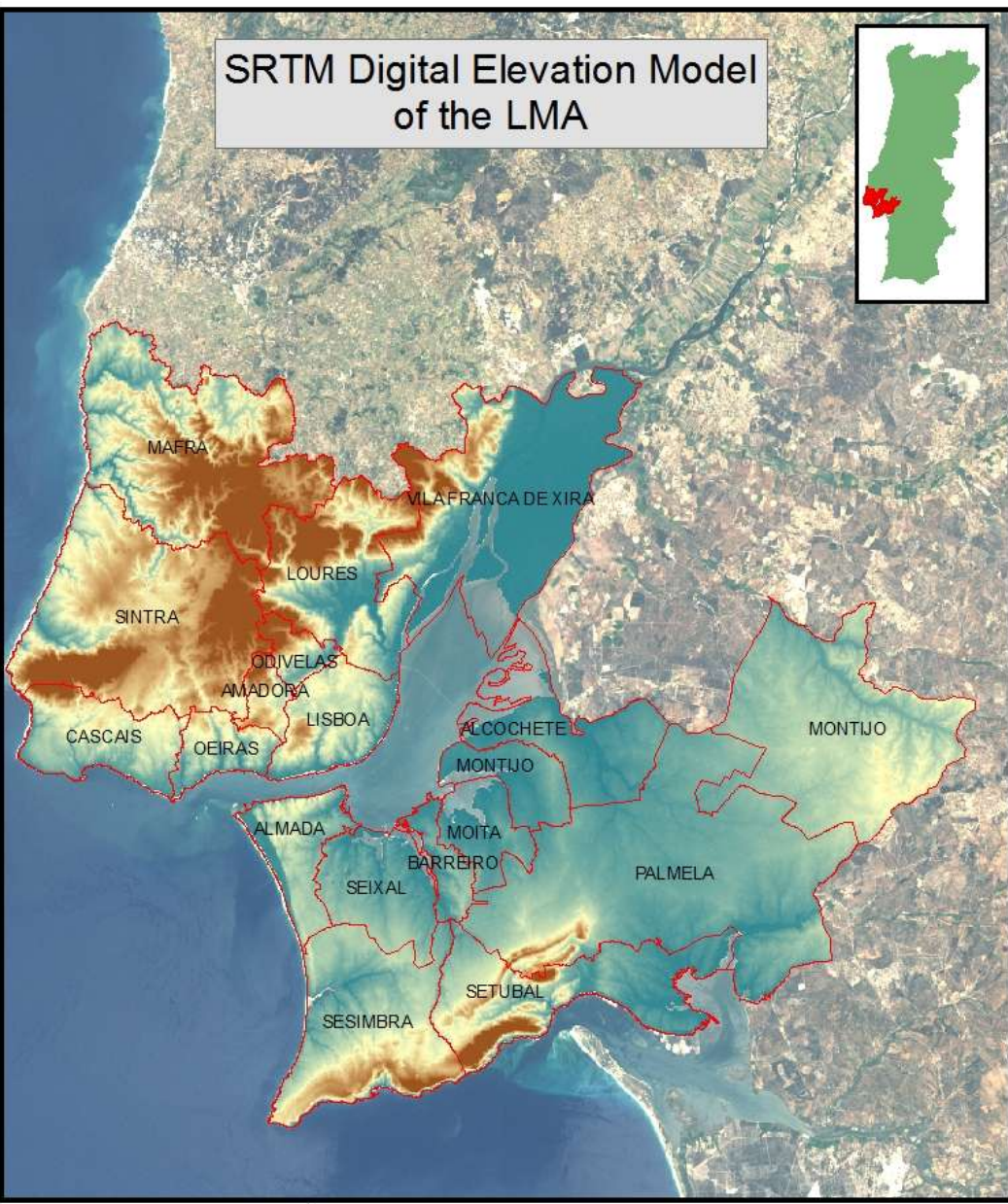
□ Method:

- 90 m SRTM
- Extracted points for each pixel
- Interpolated using Ordinary Kriging and make 20x20 m grid
- Convert tidal levels into the same datum.
- Reclassify DEM at appropriate elevation levels to determine levels of vulnerability to sea level rise.

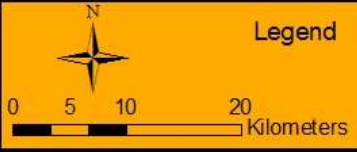
Scenarios used: 0.59 m, 1.5 m, 5 m, 22 m (Storm Surge and Waves)



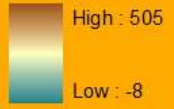
SRTM Digital Elevation Model of the LMA



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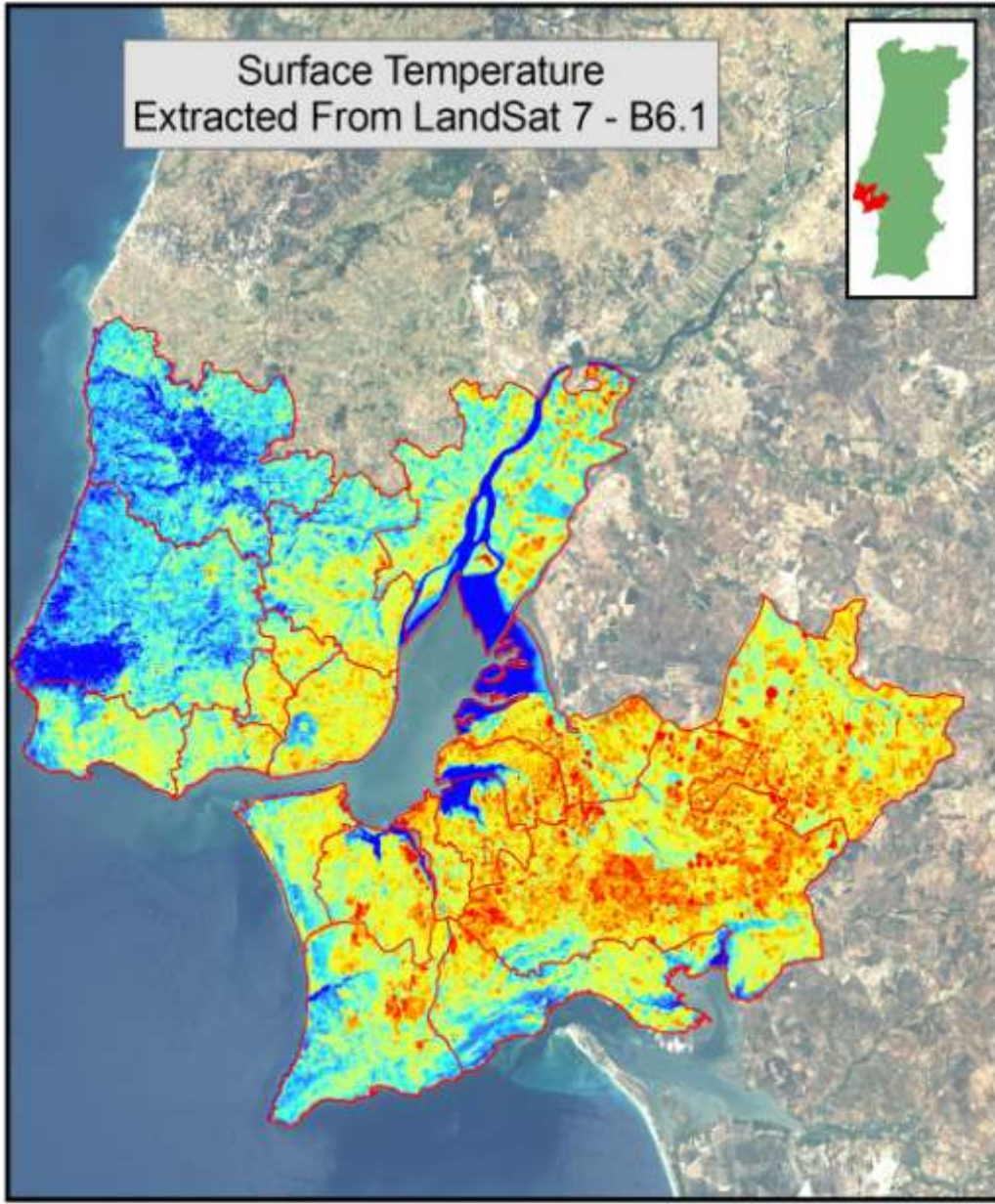
Legend





The RESULTS

- Land Surface Temperature
- Sea Level Rise



Land Surface Temperature

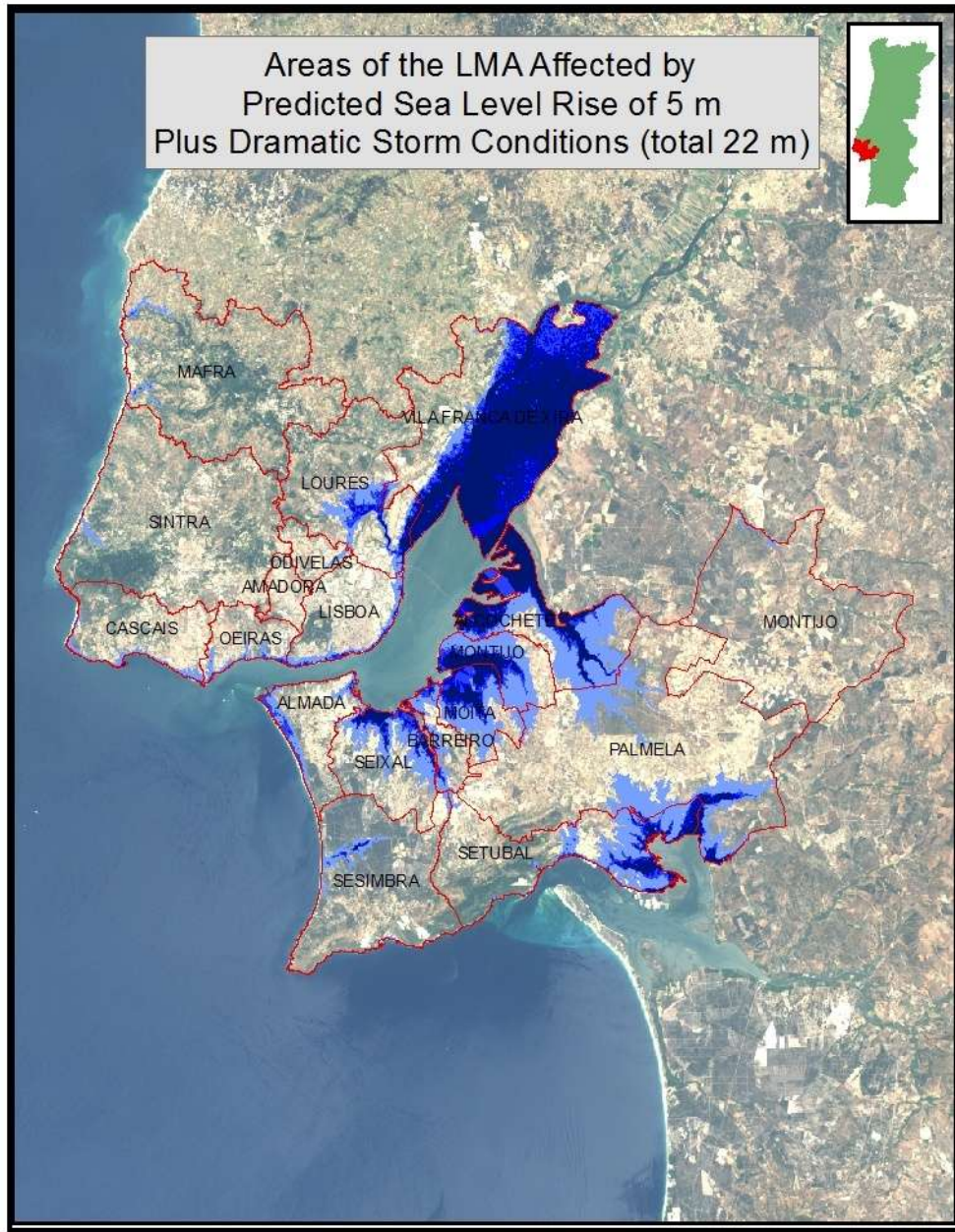
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Legend Surface Temp (°C)
AML High : 30,13
Low : 25,08

A scale bar showing 0, 5, 10, and 20 Kilometers, and a north arrow.



Areas of the LMA Affected by Predicted Sea Level Rise of 5 m Plus Dramatic Storm Conditions (total 22 m)



Sea Level Rise

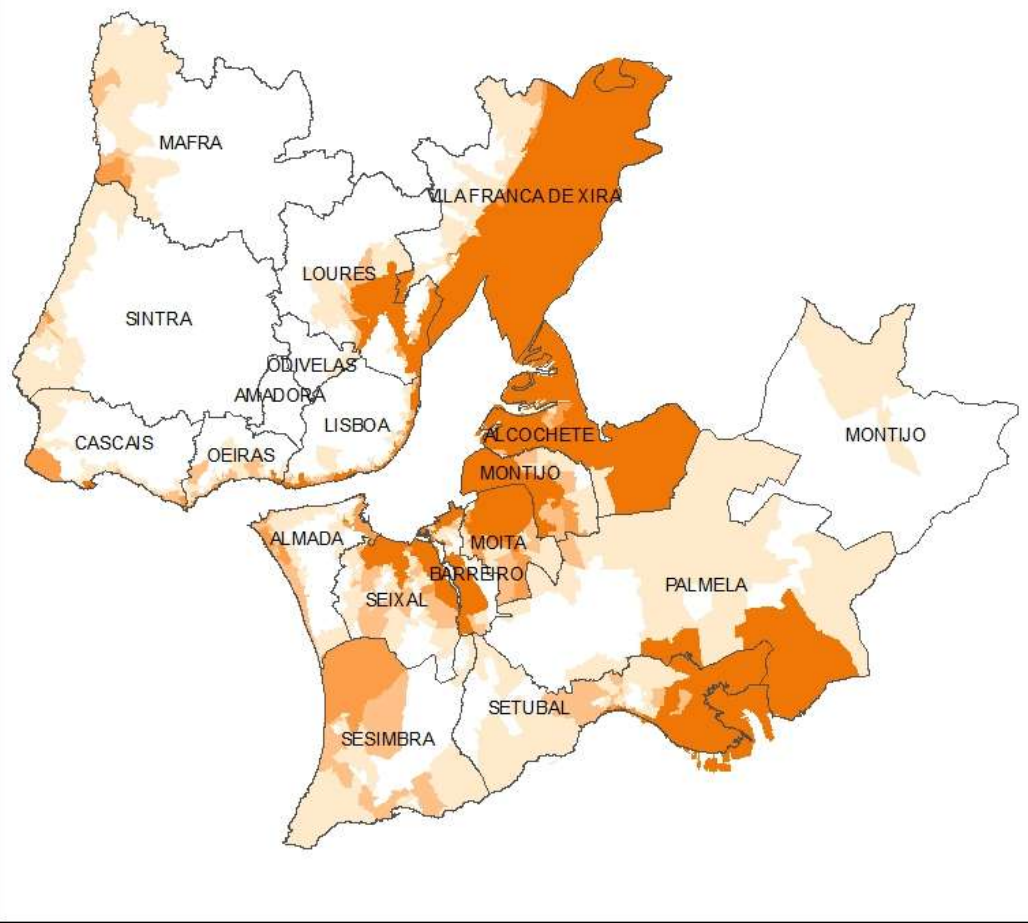
Need to remember:

These predictions are arbitrary, based on elevation. Water needs to be able to access the areas. Hydrodynamics are not taken into account.





Districts Vulnerable to Sea Level Raise



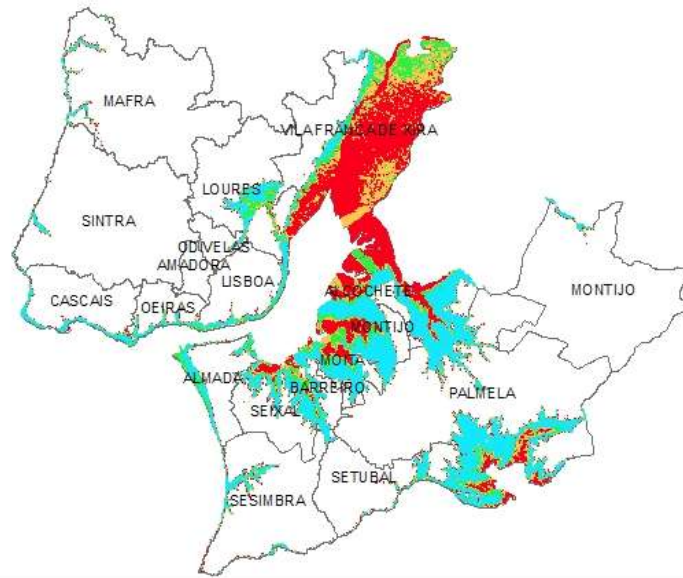
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LMA Vulnerability to Climate Change

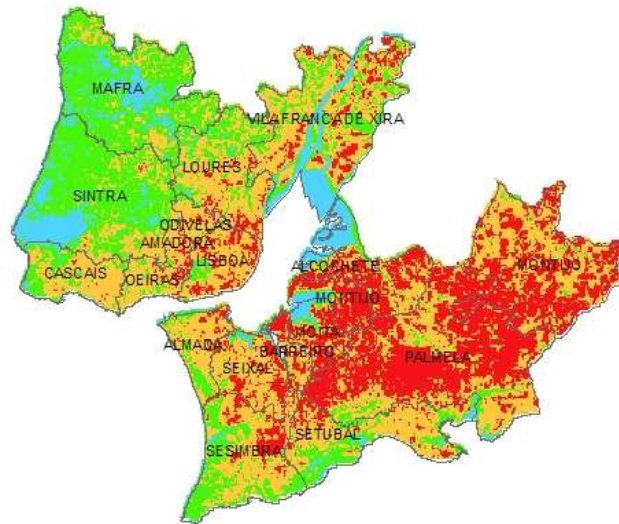


a)



a) SLR

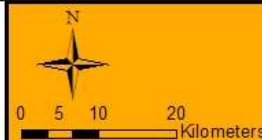
b)



b) Temperature increases

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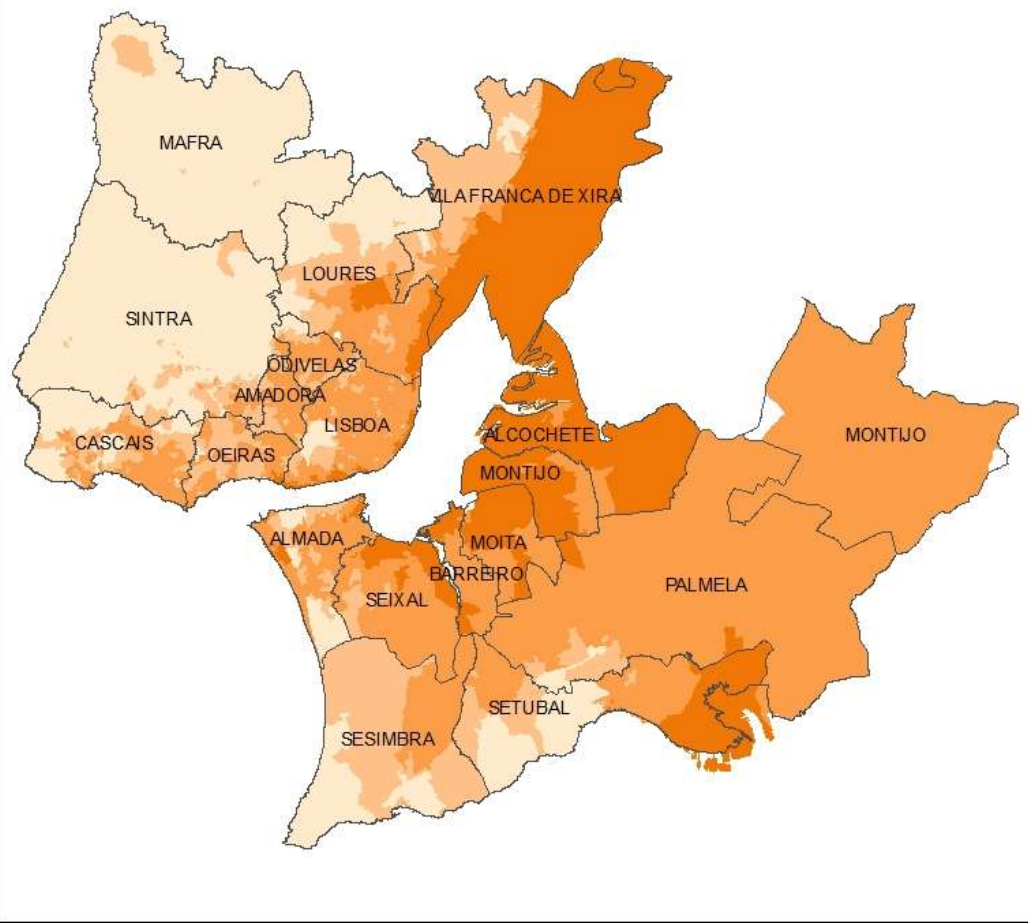




Vulnerable Areas to Climate Change



Combined Vulnerability Map



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CONCLUSION

- The most vulnerable areas to temperature increases are on the Peninsular Setubal where there is a lot of industrial lands and around the Lisbon city where urbanization and impermeable surfaces are high.
- ~27% of the population of the LMA would be effected under drastic sea level rise and storm scenarios.
- Approximately 3 – 8% of the population will be effected in more conservative estimates.
- This study provides invaluable information to decision makers and planners and may lead to improvement in the general quality of life throughout the LMA

RECOMMENDATIONS

- Measures such as groynes, sea walls, renourishment and retreat should be considered.
- Ensure that new developments are not undertaken on areas identified as being vulnerable to sea level rise.
- Increase the number of green areas

MUITO OBRIGADO!

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- Prof. Dr. Pedro Cabral
- Prof.ª Dra. Ana Cristina Costa
- Prof. Dr. Fernando Bação
- Roberto Henriques
- ISEGI
- Antonio Nunes of IGEO

