



# Modelling water and nutrient transport in Ria Formosa

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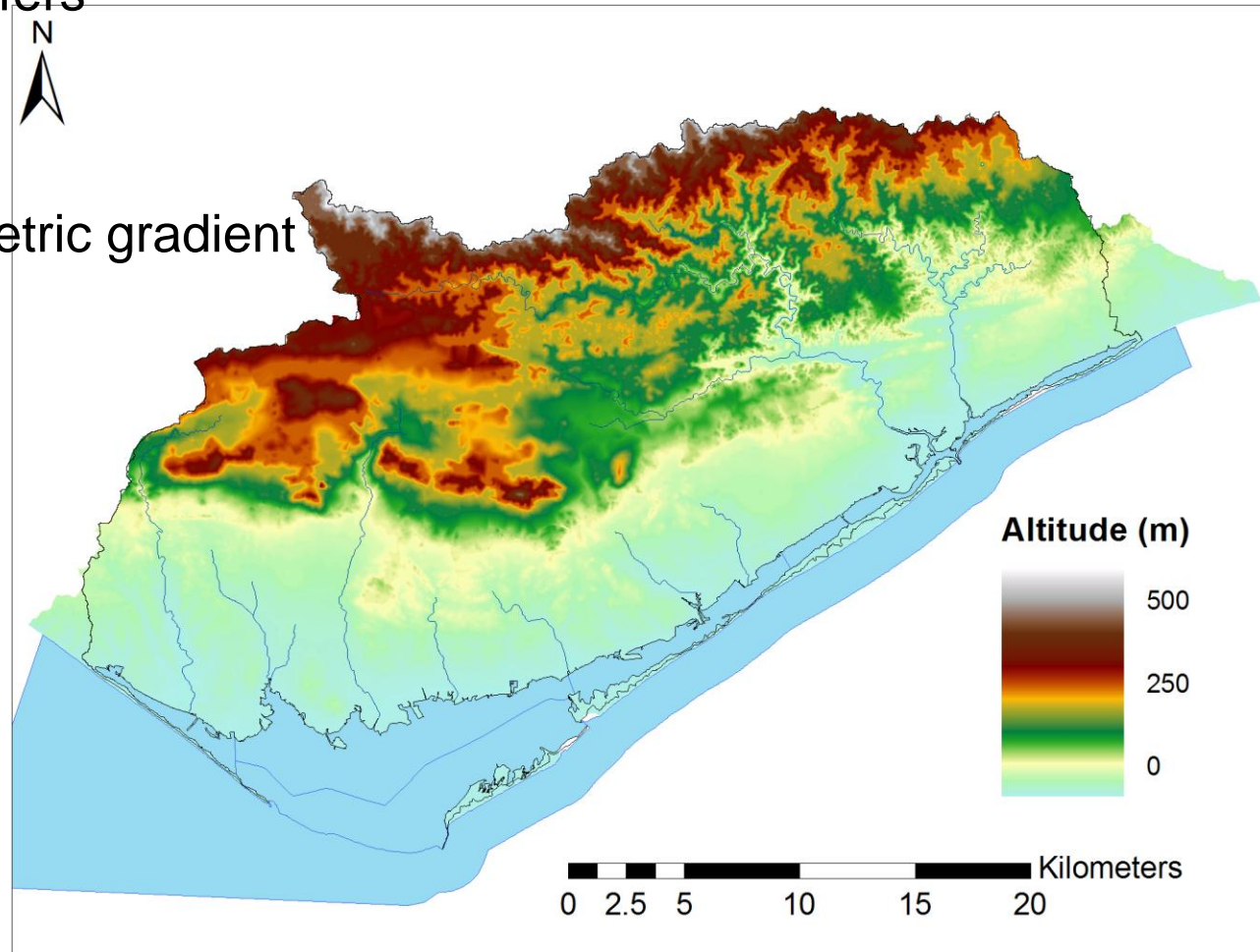
**CESAM**

Centre for Environmental and Marine Studies  
[www.cesam.ua.pt](http://www.cesam.ua.pt)

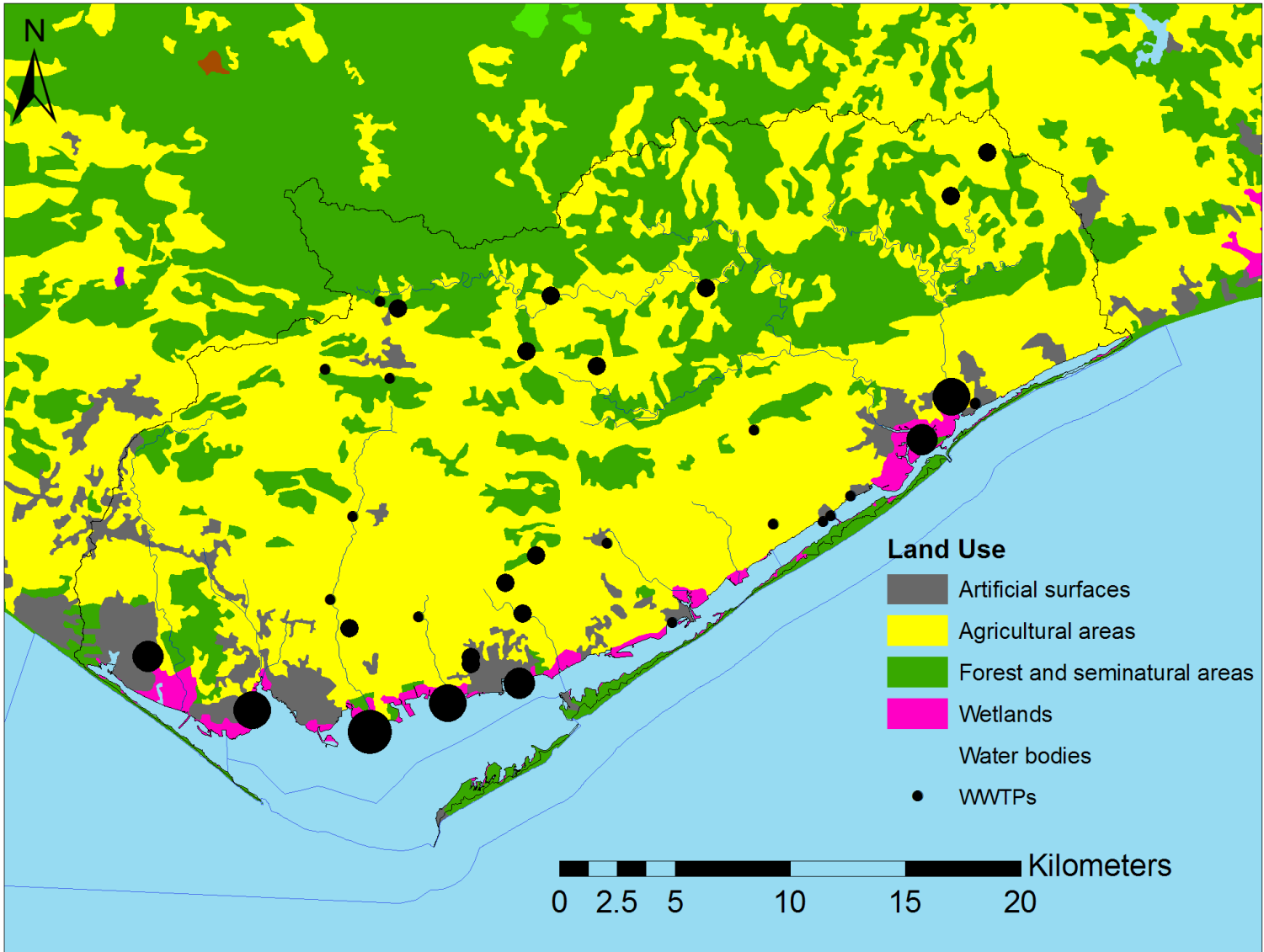
Olhão, 21<sup>st</sup> of February 2011

# Catchment

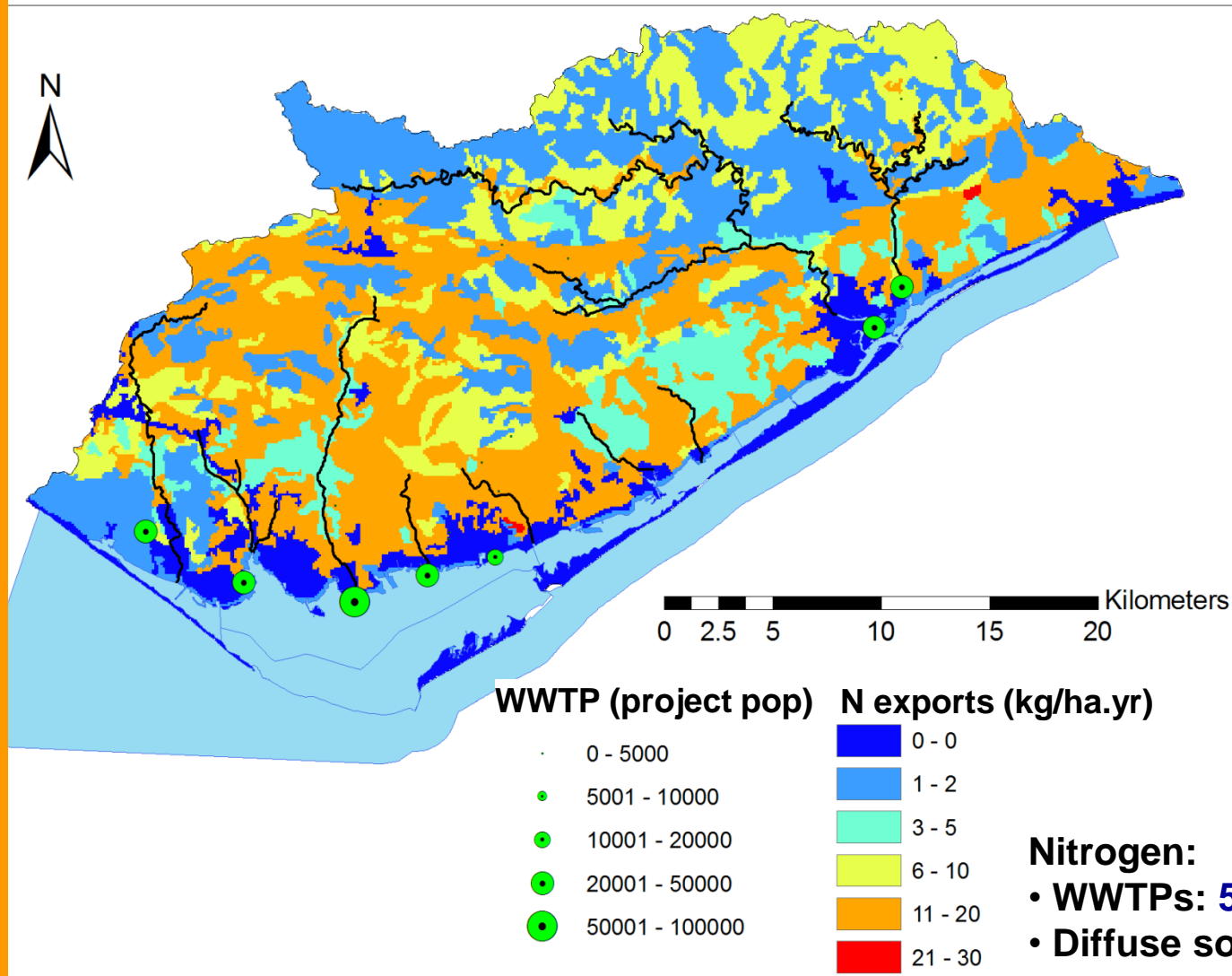
- Morphology:
  - 745 Km<sup>2</sup>
  - N-S topographic gradient
  - Coastal aquifers
- Rainfall
  - Semi-arid
  - N-S pluviometric gradient



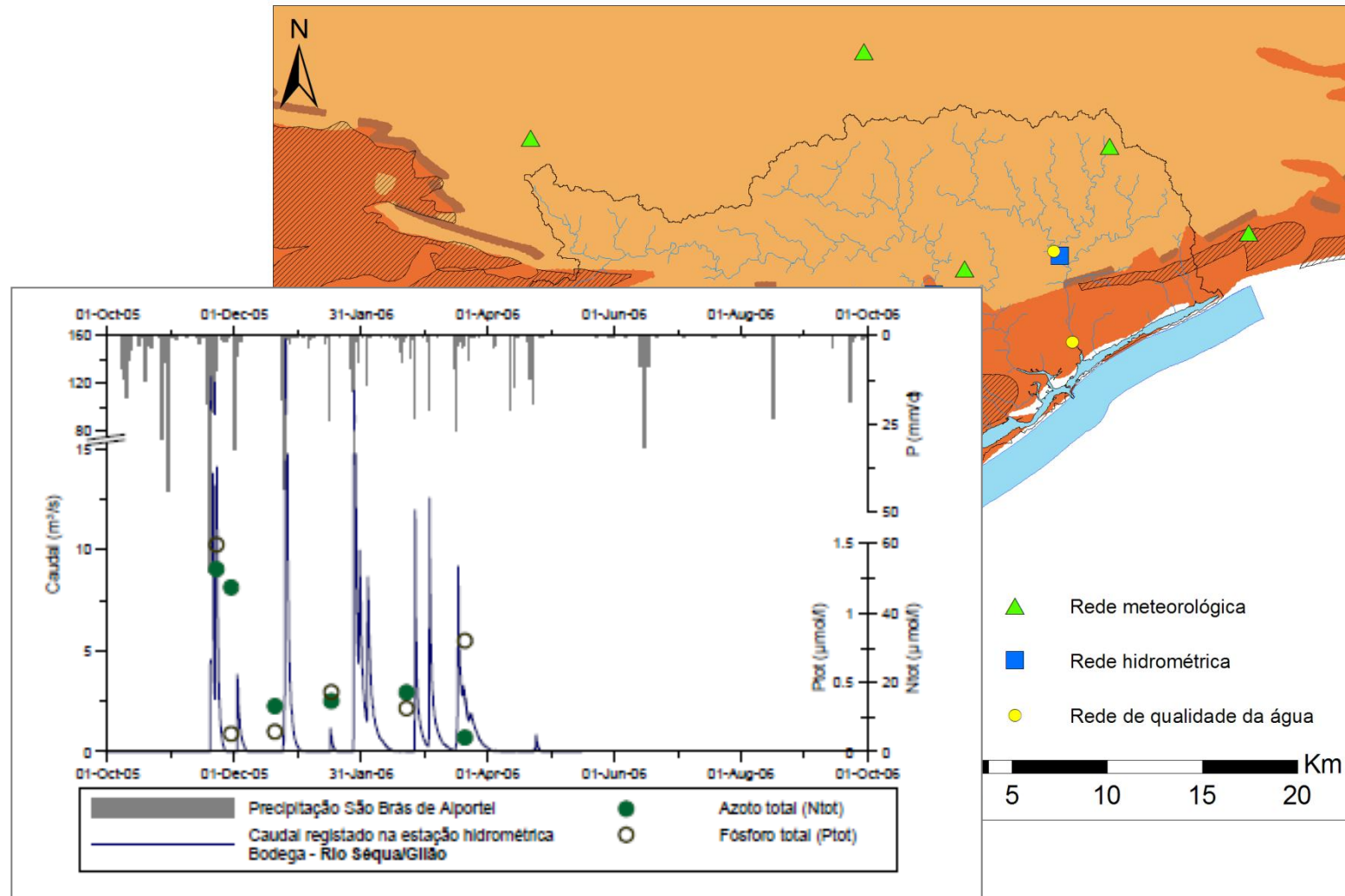
# Catchment



# Catchment: Nutrient Load

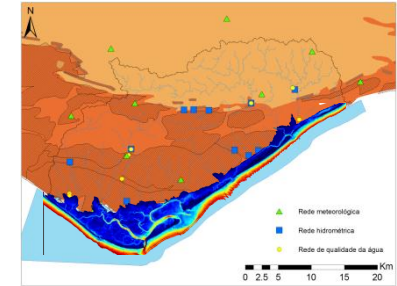


# Temporal complexity: rainfall events

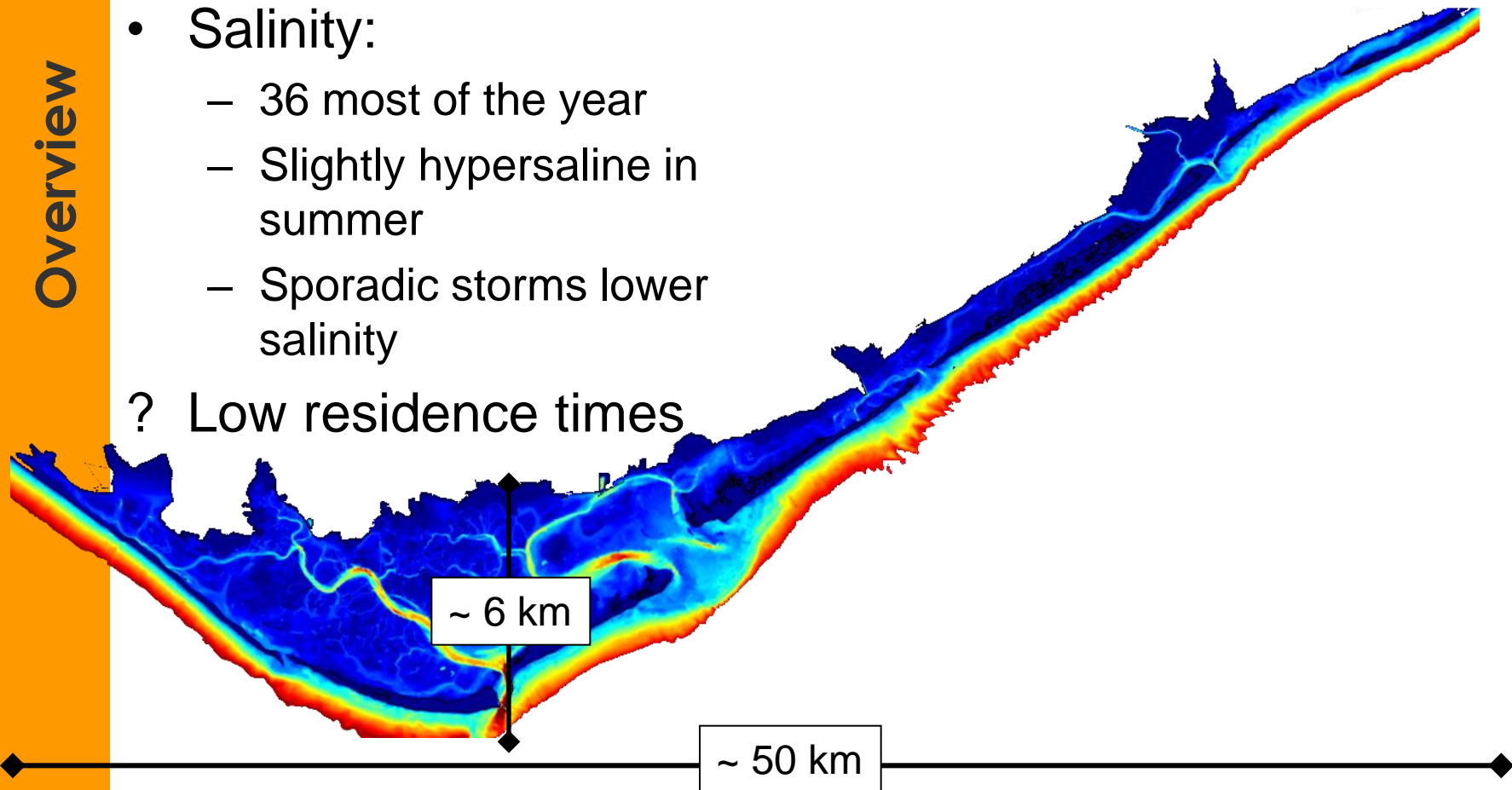


# Lagoon

- Area: 18 – 91 km<sup>2</sup>
- Volume: 45 – 210 x 10<sup>6</sup> m<sup>3</sup>
- Main forcing:
  - Tide: 1 – 3.5 m
- Salinity:
  - 36 most of the year
  - Slightly hypersaline in summer
  - Sporadic storms lower salinity

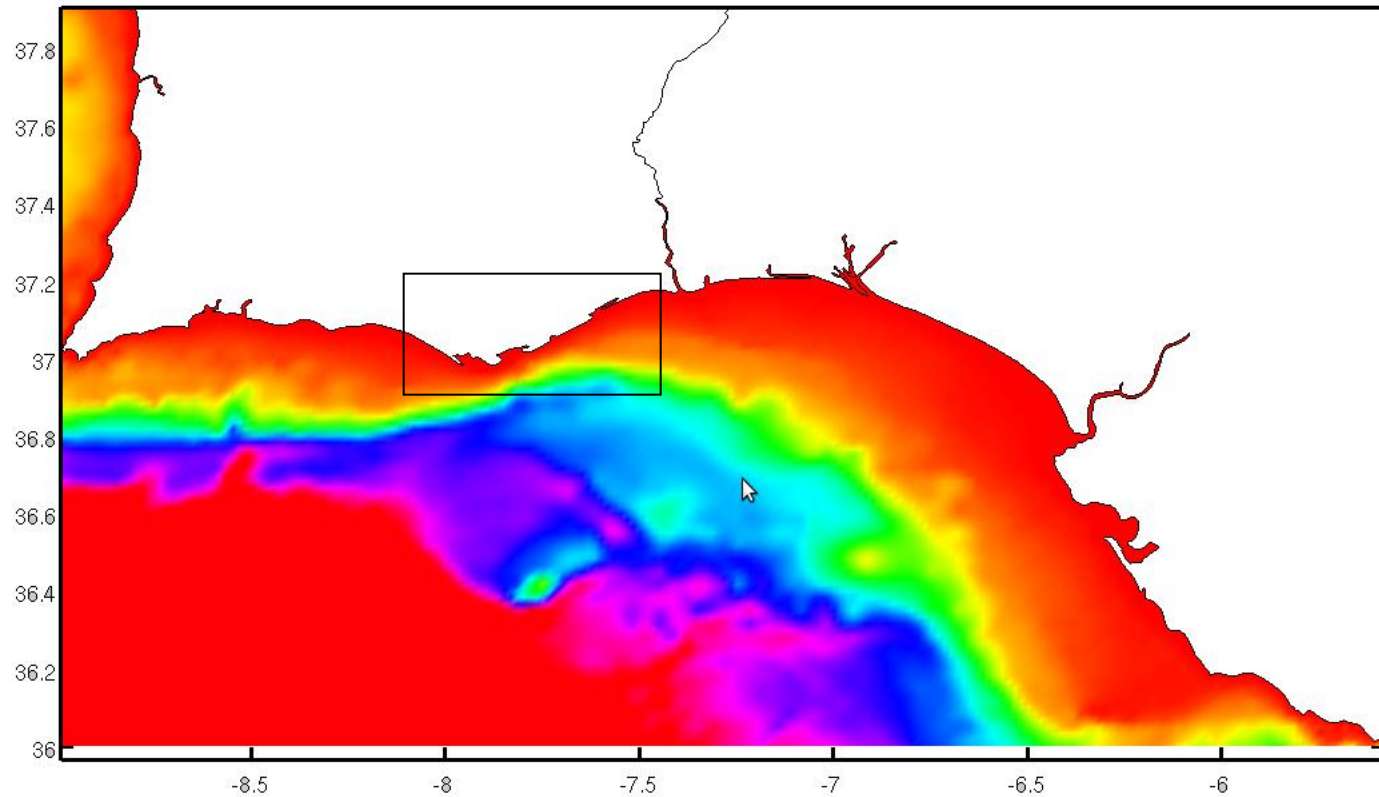


? Low residence times



# Shelf

- Gulf of Cadiz
- Narrow shelf
- Main forcing:
  - Wind
  - Heat fluxes
  - Meso-scale circulation





# Eco-hydrological model



SWAT: Soil and Water Assessment Tool

Hydrological Response Units (HRUs)

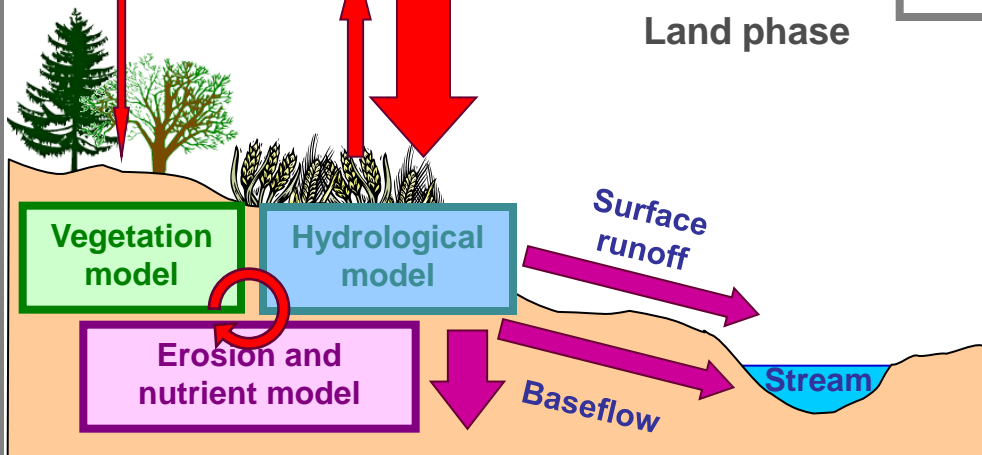


Agriculture management



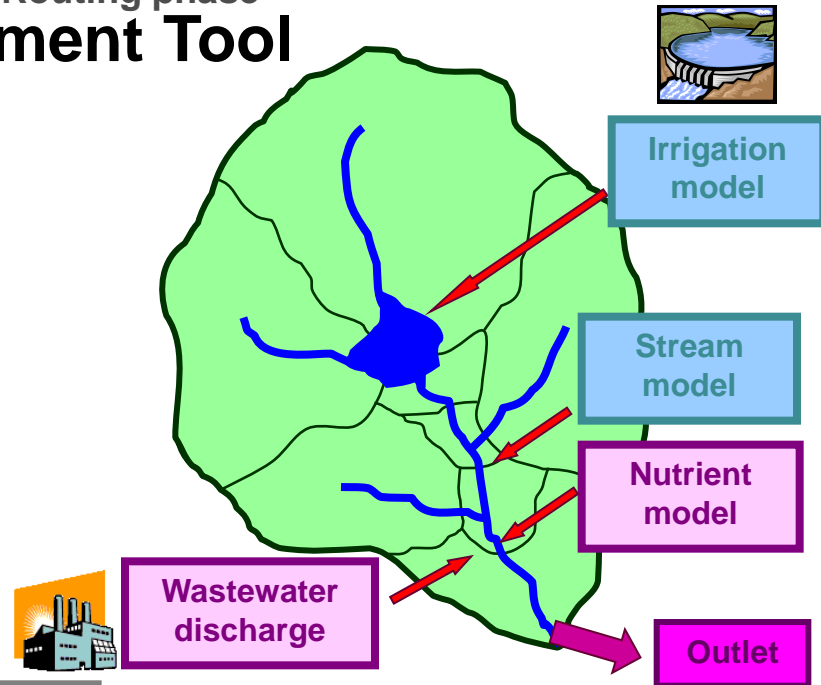
Climate

Land phase



Aquifer recharge

Routing phase



Irrigation model

Stream model

Nutrient model

Wastewater discharge

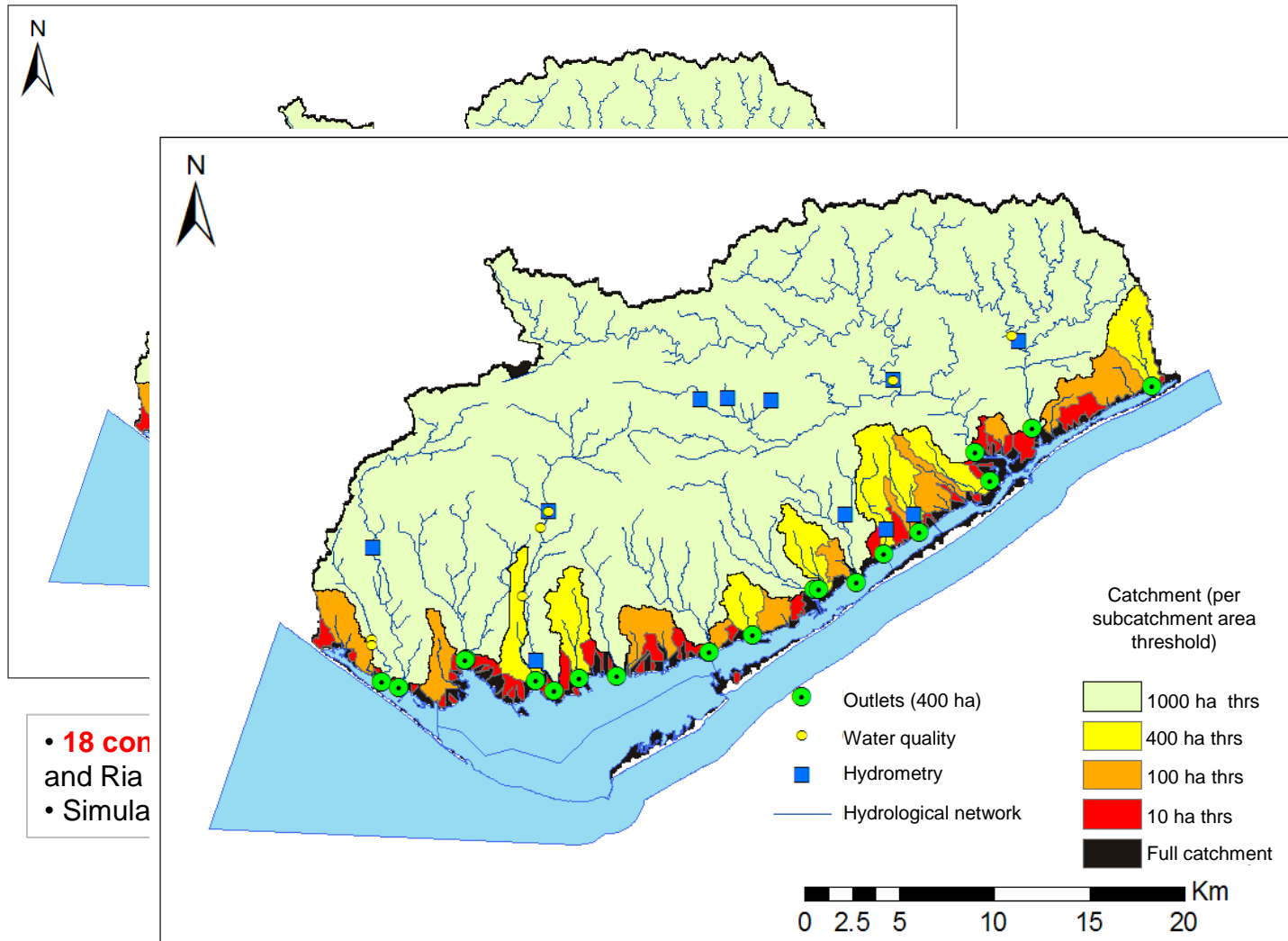
Outlet

Watersheds

Modelling



# SWAT domain



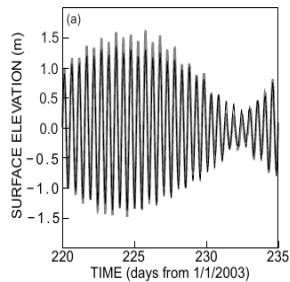
- 18 con
- and Ria
- Simula

**allenges:**  
tidal influence

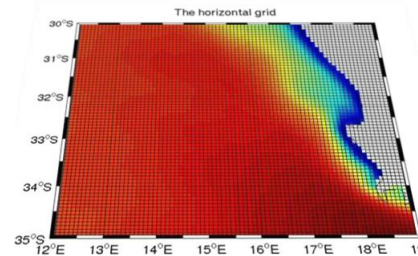
Dune barrier  
Salt pans  
Urban areas

# Hydrodynamic model

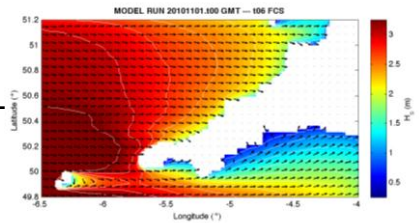
## Delft3D - Flow



Tide



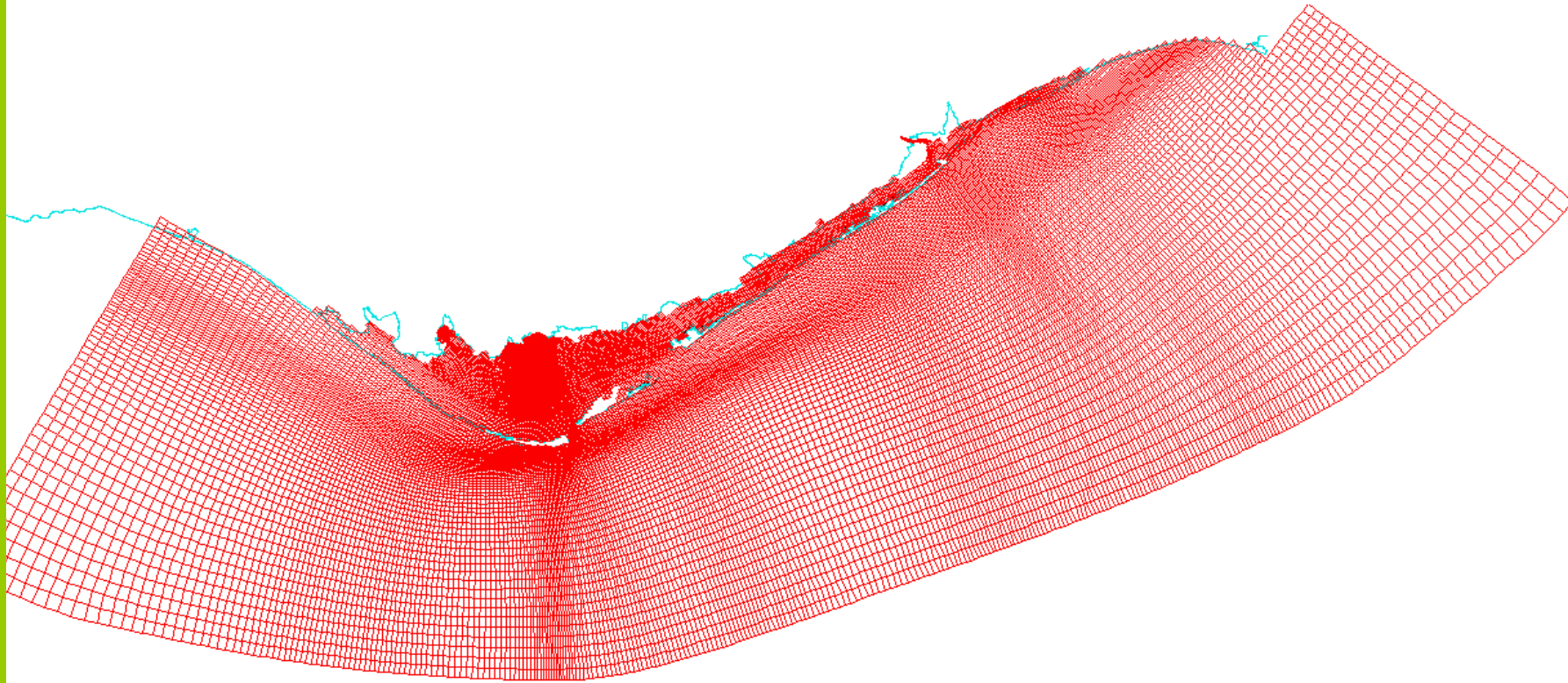
Flow



Waves

Water Quality / Ecological Modelling

# Delft3D-Flow domain



## Cell size:

- ~ 30 m in narrows
- ~ 100 m in the lagoon
- ~ 500 m at the shelf

## Extent:

- 80 km E-W
- 20 km N-S
- $30 \times 10^3$  grid points

## Simulation challenges:

- Drying and flooding
- Evaporation
- Coupling with meso-scale processes

# Lagoon and Shelf

- Key processes
  - Tidal response
  - Drying and flooding
  - Evaporative processes
  - Inner-shelf circulation
  - Stratification at the shelf
- Boundary conditions
  - Tide: global tide model (FES2004)
  - Wind : local weather station
  - Heat: NCEP reanalysis
  - Runoff: SWAT
  - Meso-scale: regional model (ROMS)
- Upscaling:
  - From  $30 \times 10^3$  cells to 52 boxes

# Products

- Catchment
  - Daily series of water flow and nutrients
  - Calibrated catchment model
- Lagoon and shelf
  - Upscaled water flows
  - Calibrated hydrodynamic model

# Conclusions and outlook

## Progress

Concluded work	Compilation and analysis of available information  Delft3D-Flow design
Ongoing work	SWAT design  Delft3D-Flow calibration
Future work	SWAT application Delft3D-Flow scenario runs Transport upscaling