MOHID-water for the Nervión estuary: modelling *Escherichia coli* concentration

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Nervión estuary context

Over the last 150 years the Nervion-Ibaizabal river and estuary :

- received wastes from many sources : urban effluents, industrial wastes, mineral sluicing
- suffered many morphological pressures
- original estuary rapidly reduced in size through land reclamation, to form a tidal channel completed by 1885.

System degraded: bad odor and color, low oxygen, high levels of bacteria and contaminants, disappearance of fauna
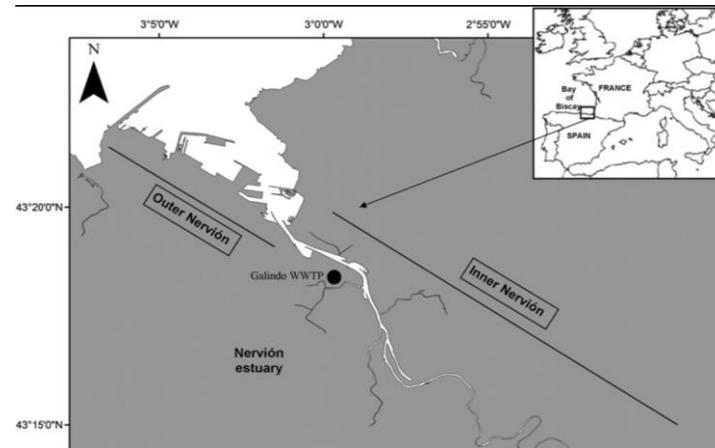
➔ classified as **Heavily Modified Water Body** at the beginning of the 90s'

1991: water physic-chemical treatment
2001: biological treatment
➔ **Objective: discovery of the biological communities**
1990 monitoring program

# Process-based model MOHID-water for the Nervión estuary

Downscalling solution
Tide is the main mechanism forcing the flow in the estuary, determining current directions and water level variations

Domain and grid for the Nervión estuary

- 2 nested levels domains
    - 2D parent grid level-1 500x500 m
    - 3D children grid level-2
- spatial resolution of the level-2 3D grid
    - horizontal: 100 m
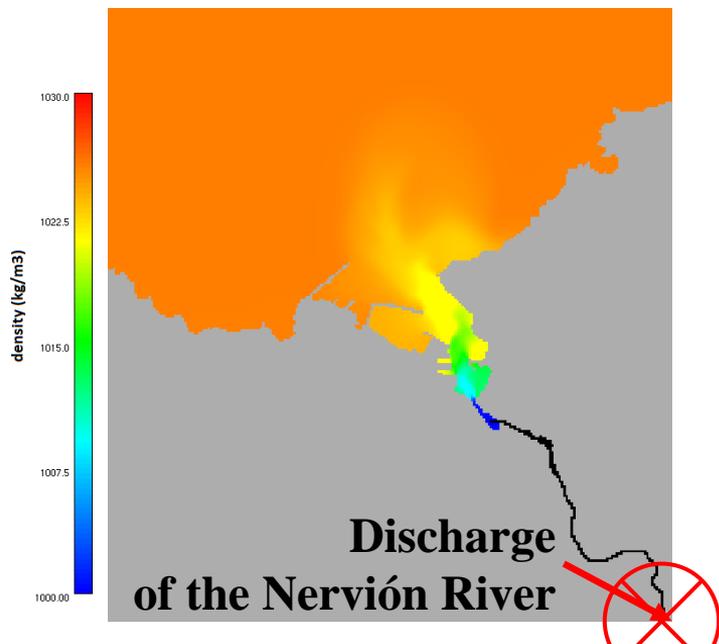   - vertical : 4 s-levels layers

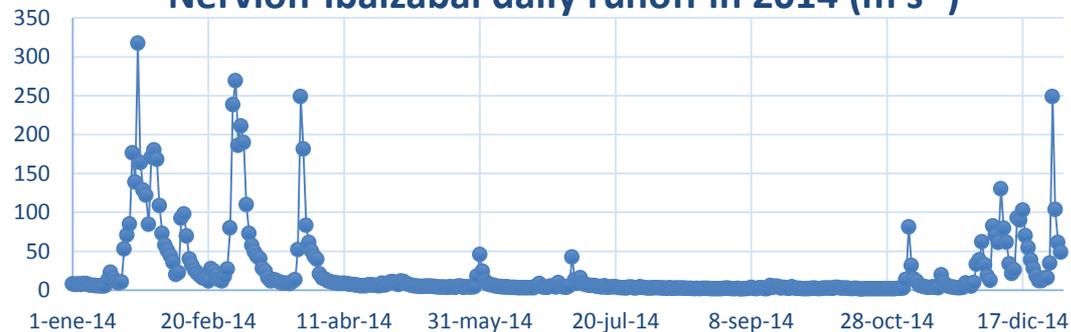➔ *Escherichia coli* concentration and transport in the Nervión estuary
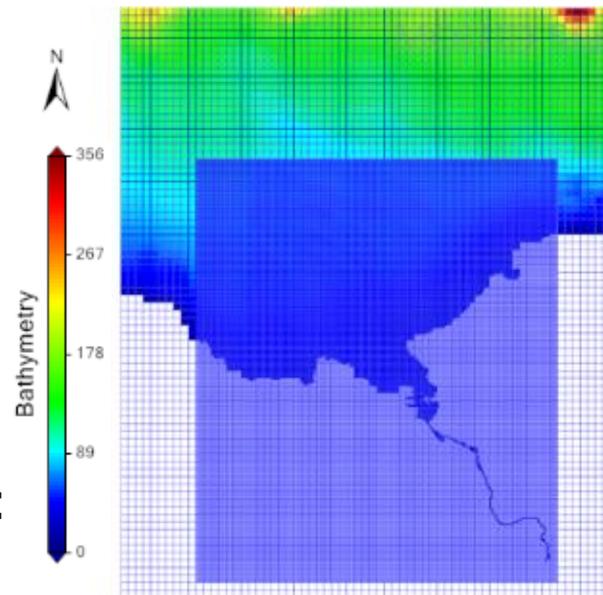
Nervión-River runoff
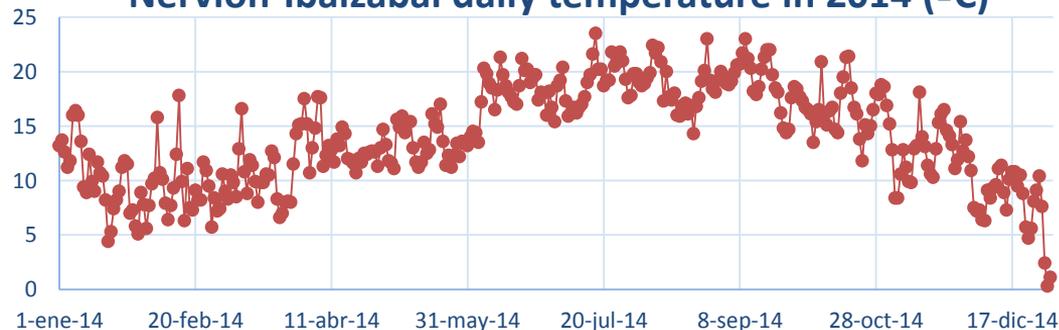
From database of Diputación Foral de Bizkaia
- daily observed Nervión-Ibaizabal runoff
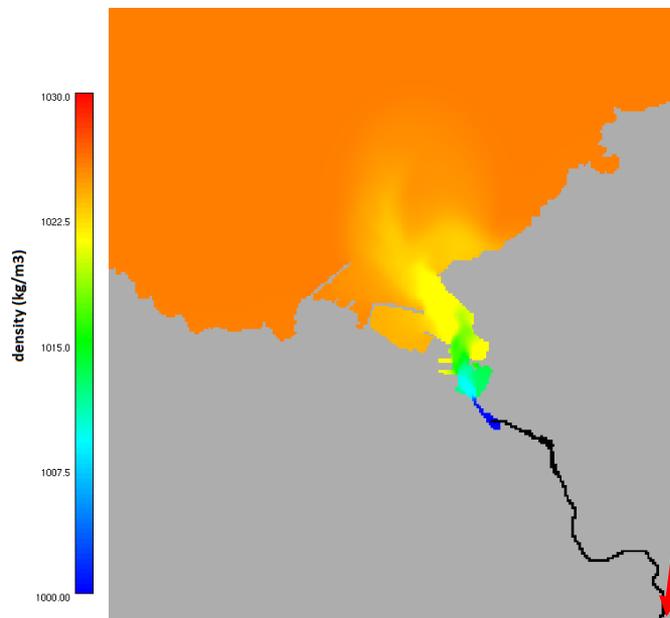- daily observed river temperature

Discharge of the Nervión River

Nervión-Ibaizabal daily runoff in 2014 (m s^{-1})

Nervión-Ibaizabal daily temperature in 2014 (ºC)

Nervión-River discharges: *E. coli*

Loads of faecal coliforms concentration (FC) into the estuary converted into *E. coli* concentration according the regression relationship :

Log$_{10}$ FC = 0,968 Log$_{10}$ E.coli + 0,376   R^2 = 0,81
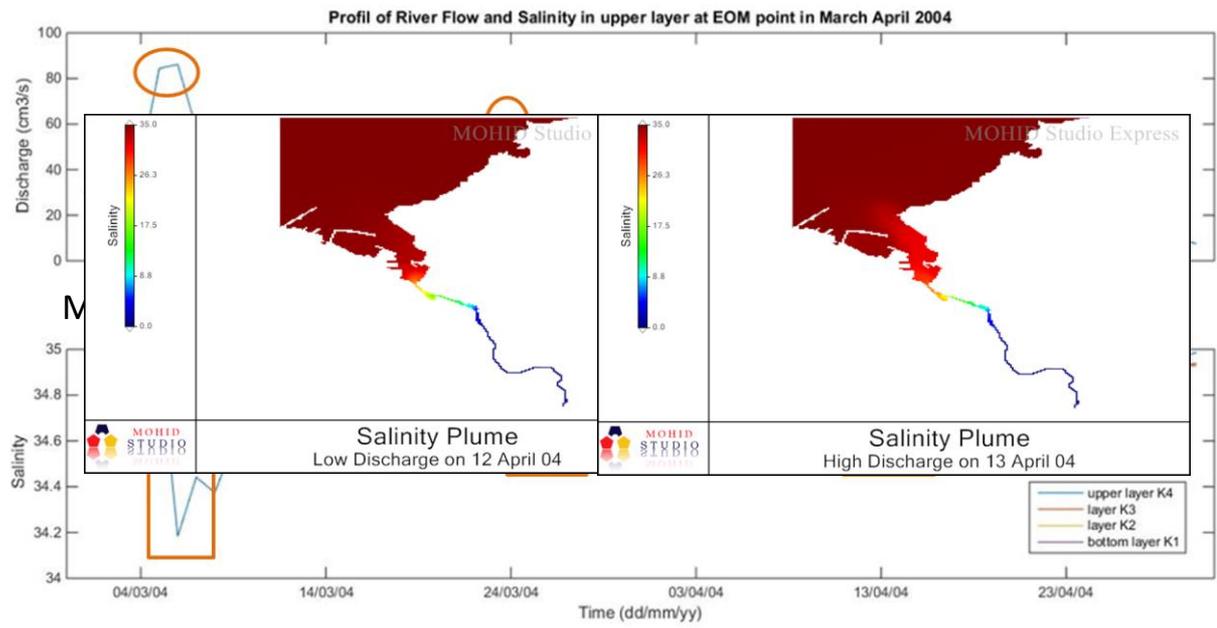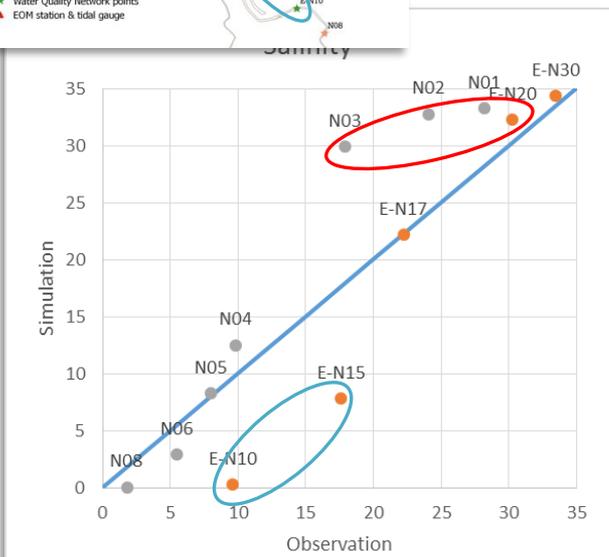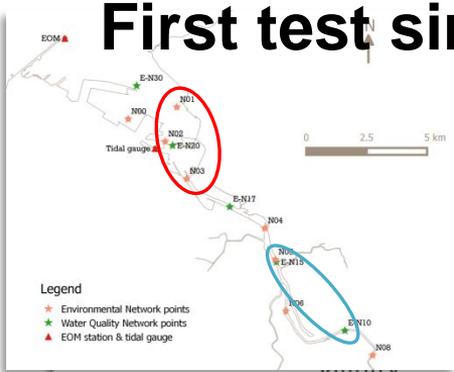
(*M. Revilla, pers. com.*)

***E.Coli* decay** (*Mateus et al., 2013; Canteras et al., 1995*)

expressed with the time T90 in which 90% of population is no longer detectable :

T90 = 2.303/k with: *k* = 2.533 × 1.04(*T*−20) × 1.012*S* + 0.113*iz*

T=temperature (ºC) ; S=salinity ; iz=radiation (W.m⁻²) at depth z (m)

First test simulations in 2004: MOHID salinity validation
river discharges + tides

Profil of River Flow and Salinity in upper layer at EOM point in March April 2004

Salinity Plume
Low Discharge on 12 April 04

Salinity Plume
High Discharge on 13 April 04

upper layer K4
layer K3
layer K2
bottom layer K1

Sitti Whoallia Annu Noor Master Thesis "Application of MOHID-water modelling system to the Nervion estuary (North Spain)"

First test simulations in 2004: light sensibility of *E. coli*
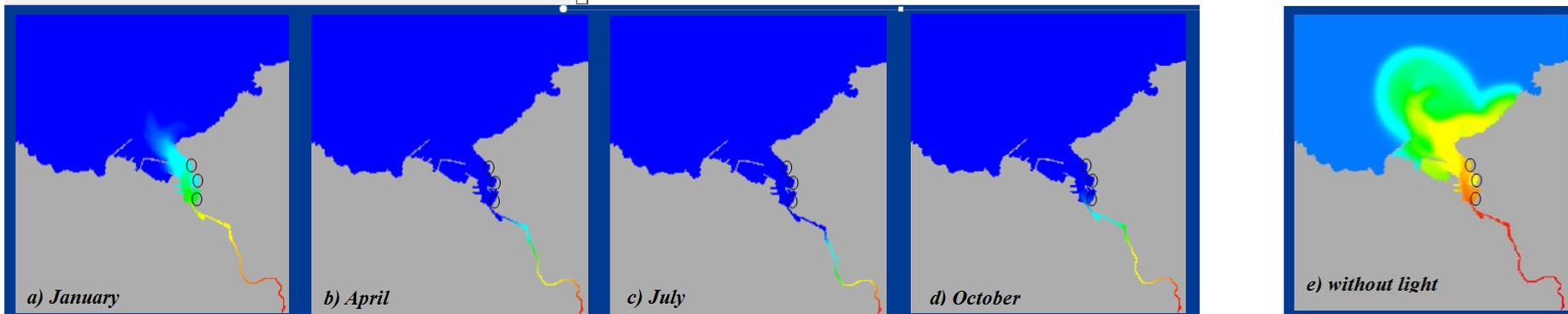
river discharges + tides + atm & tp scenarios:

constant conditions of

- the Nervión river temperature
- solar radiation / without light

➔ typical of January, April, July and October 2004

	January	**April**	**July**	**October**
River temp. (ºC)	7.3	12.5	22.7	16.7
Solar radiation (W m^{-2})	46.6	183.9	263.3	118.5

E. coli conc. after 3,5 days of run

a) January b) April c) July d) October e) without light

- "high values" > legal water quality limit of 500 MNP/100ml, only for January conditions (a)
- October (d): small amount of *E. coli* is simulated at the mouth of the river
- scenario without light (e): strong *E. coli* plume with values higher than 3000 MPN/100ml along the beaches

1-year 2014 simulation *ongoing*: atmospheric forcing

Atmospheric variables from NCEP Climate Forecast System v2 (CFSv2)

- solar (shortwave) radiation => ***used for temperature & light in the water column***

- latent & sensible heat flux
- upward & downward longwave radiation ― *not used – under development*
- wind *(=> still instabilities*)

Solar radiation for year 2014
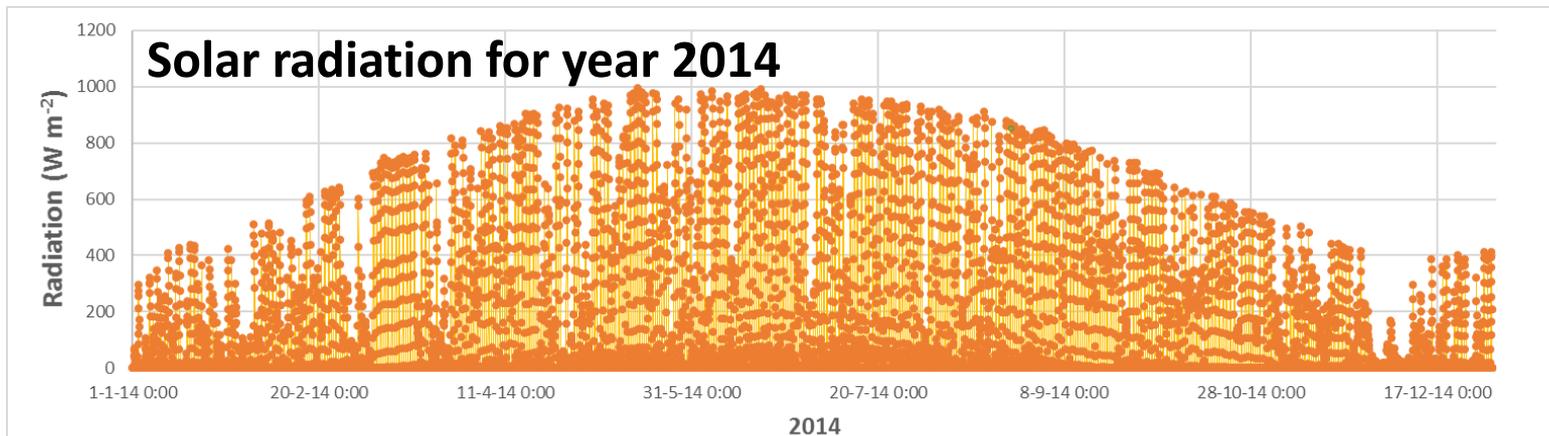
1-year 2014 simulation *ongoing*: preliminary results
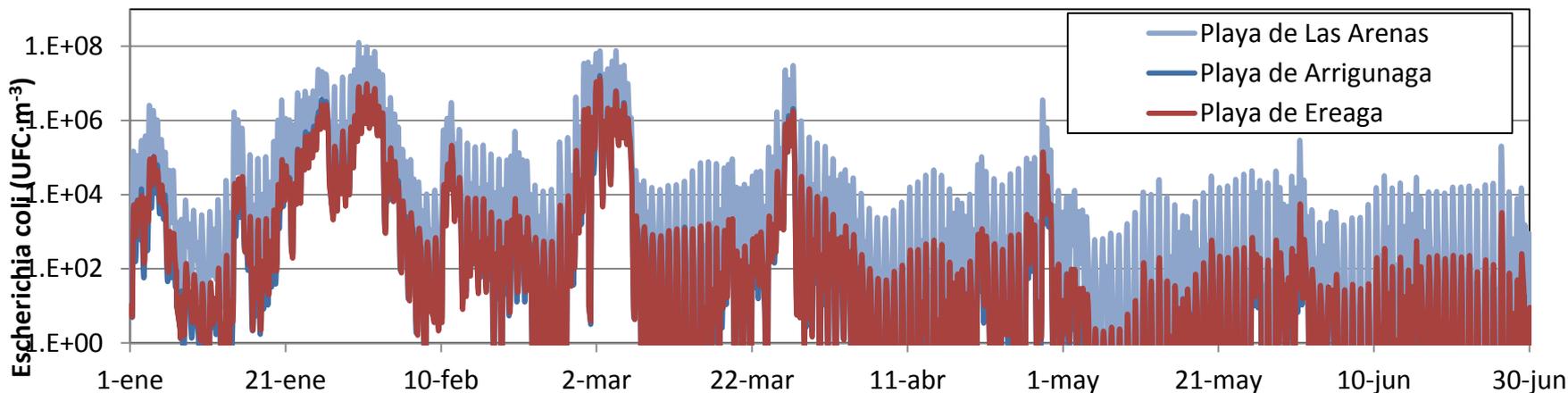
Conclusions

- MOHID-water configuration for the Nervión estuary, performing current calibration and salinity plume validation
- time lag of the salinity in response to the discharge => dispersion of contaminants from the river
- *E. coli* concentration simulated on the critical beaches/zones of the estuary ; sensibility to light and temperature

➔ This first step is promising for the development of a numerical tool able to assess the water quality of the beaches in the Nervión estuary.

Perspectives

- finish the 2014 one-year simulation of *E.coli* concentration with river discharges and temperature, and real light forcing
- More observation points to validate the model (temperature)
- Linux….

Salinity Plume