Idealized river plume study

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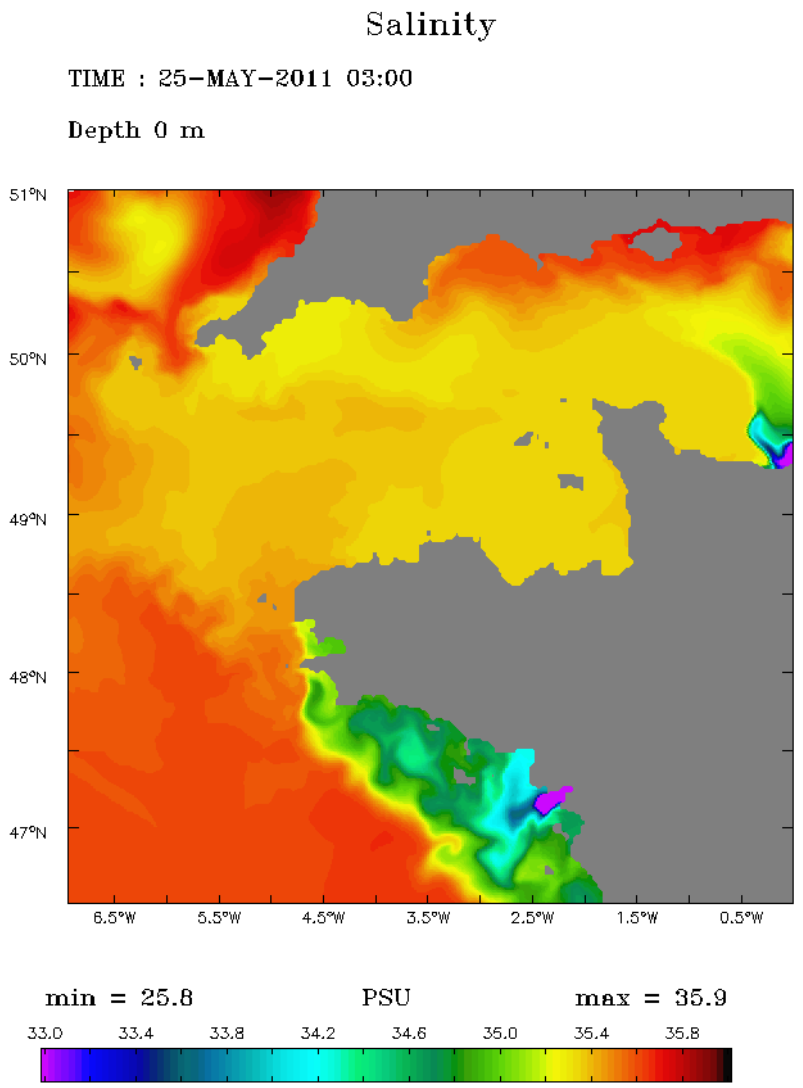
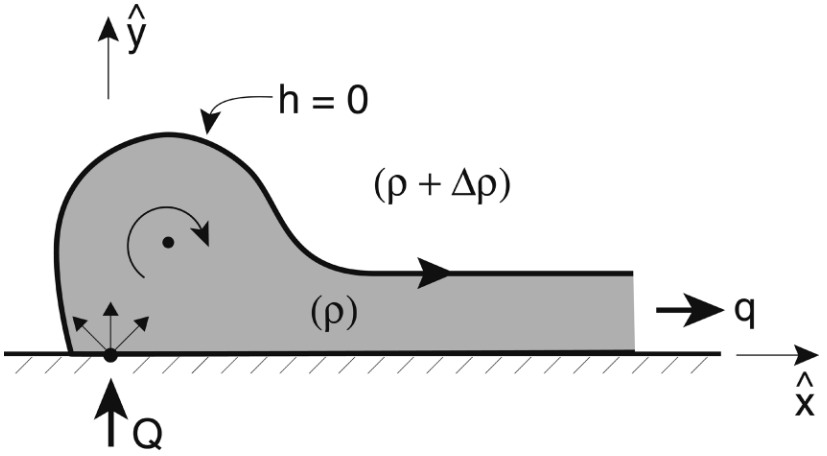
Introduction

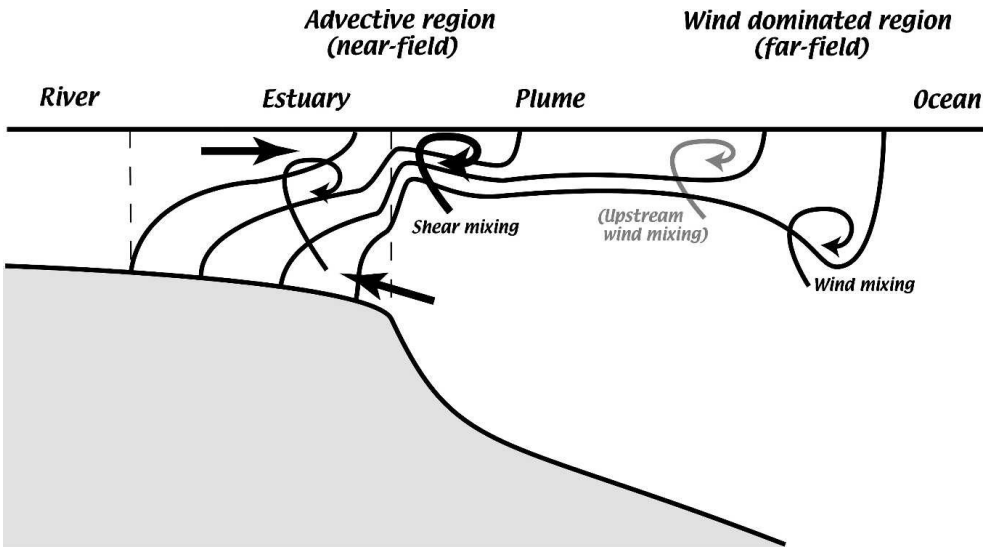
- Increasing needs for resolving coastal processes in models, such as dynamics of rivers plumes
- Exemple of river debit in Bay of Biscay : Loire (900 $m^3.s^{-1}$), Gironde (900 $m^3.s^{-1}$)



Litterature

- Observations: anticyclonic bulge and coastal current
- Theory: *Nof and Pichevin*: a steady state cannot be reached
- Modelling:
  - *Garvine*: plume development sensitive to estuary dynamics
  - *Hetland*: different mixing mecanisms
  - *Schiller*: little impact of vertical mixing scheme and vertical coordinate





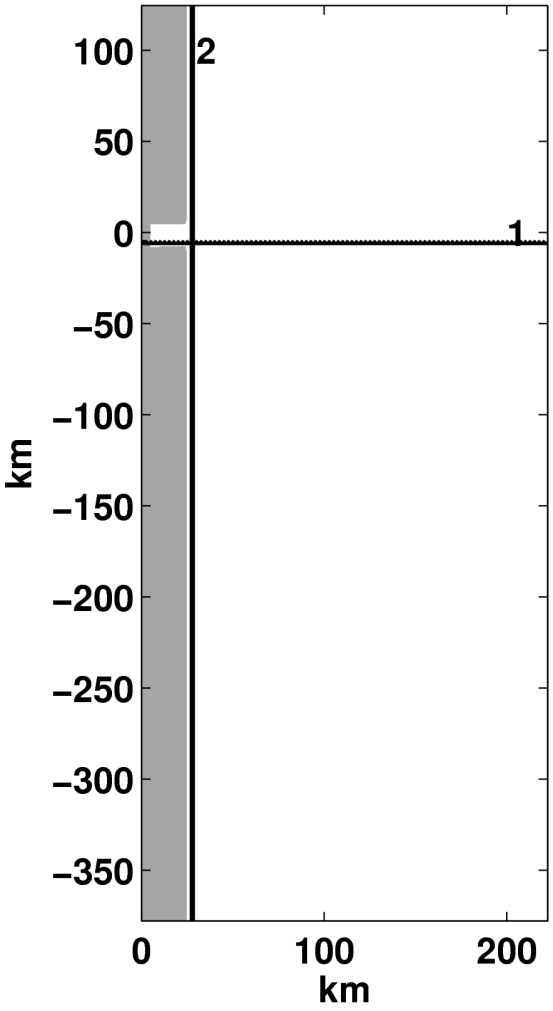
Open questions

1- What are the differences on the river plume dynamics due to the numerical implementation ?

2- What is the impact of the model vertical resolution ?

Approach to solve open questions

- Idealized configuration of river plume based on S*chiller* (2010)
- HYbrid Coordinate Ocean Model (HYCOM) :
  - Use of **z-coordinates** (δx=2.5 km, estuary is 6 grid points)
  - Precipitation *vs* Mass flux
  - KPP vertical mixing scheme
  - Varying vertical resolution (16, 50 and 100 equally spaced layers)
  - 60 day simulations, output 12 hours
  - Closed basin or relaxation at the boundaries

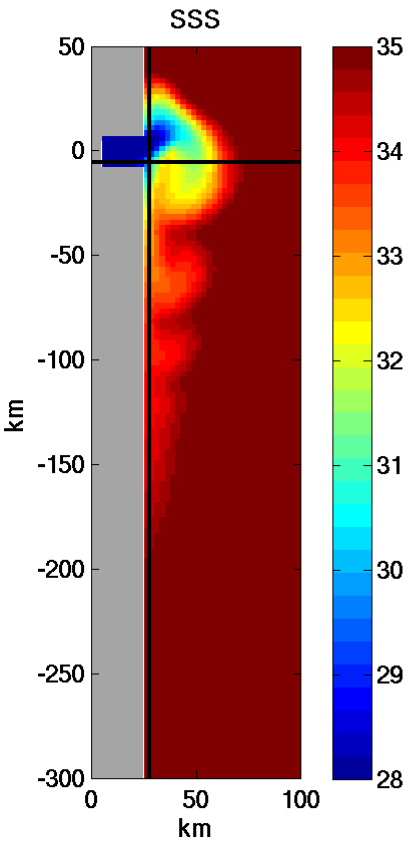


- **H=constant=20m**
- **Initial salinity: S=35 PSU**

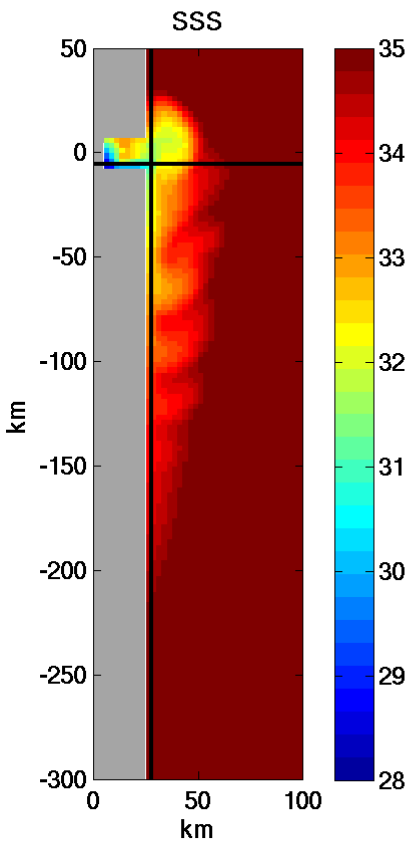
River implementation

1- What are the differences on the river numerical implementation : impact of moment ?

E-P

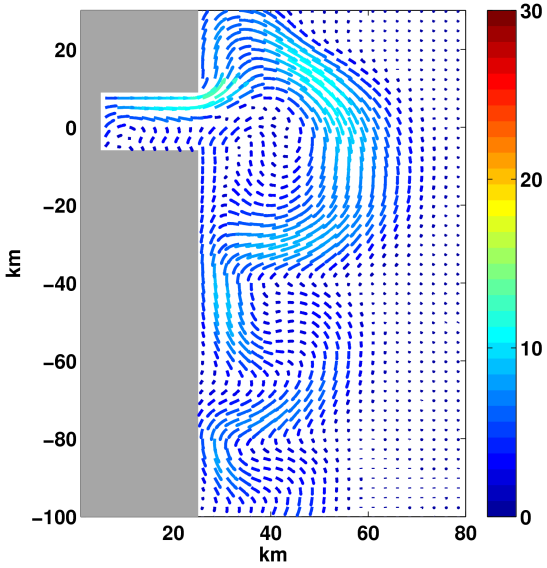


True Inflow

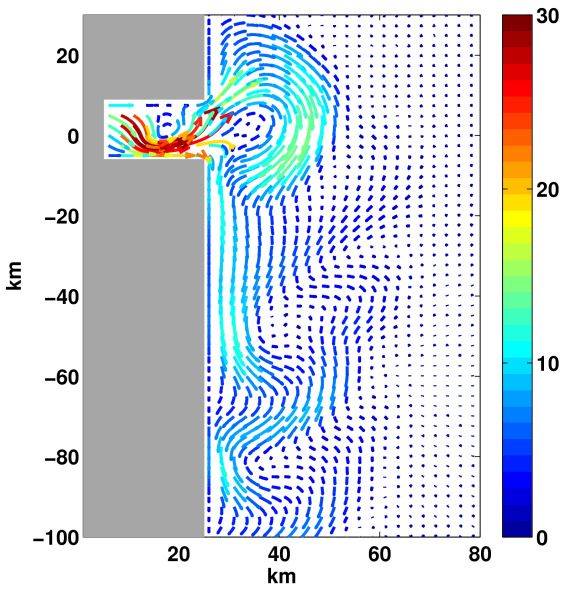


Sea Surface Salinity (PSU) at day 60

E-P



True Inflow

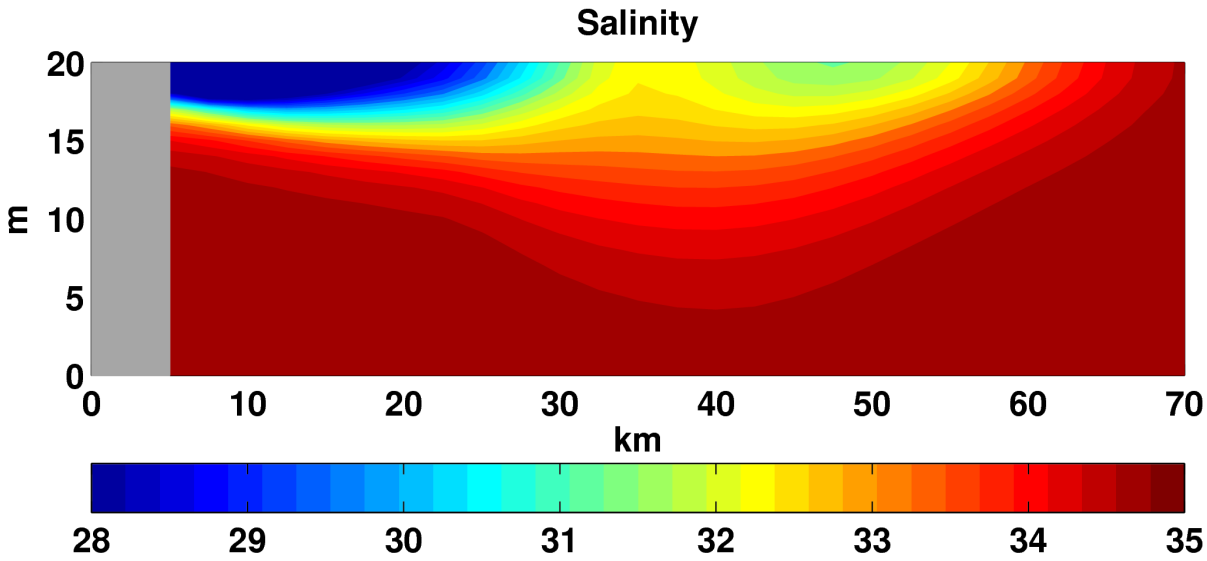


Sea Surface Velocities (cm s^{-1}) at day 60

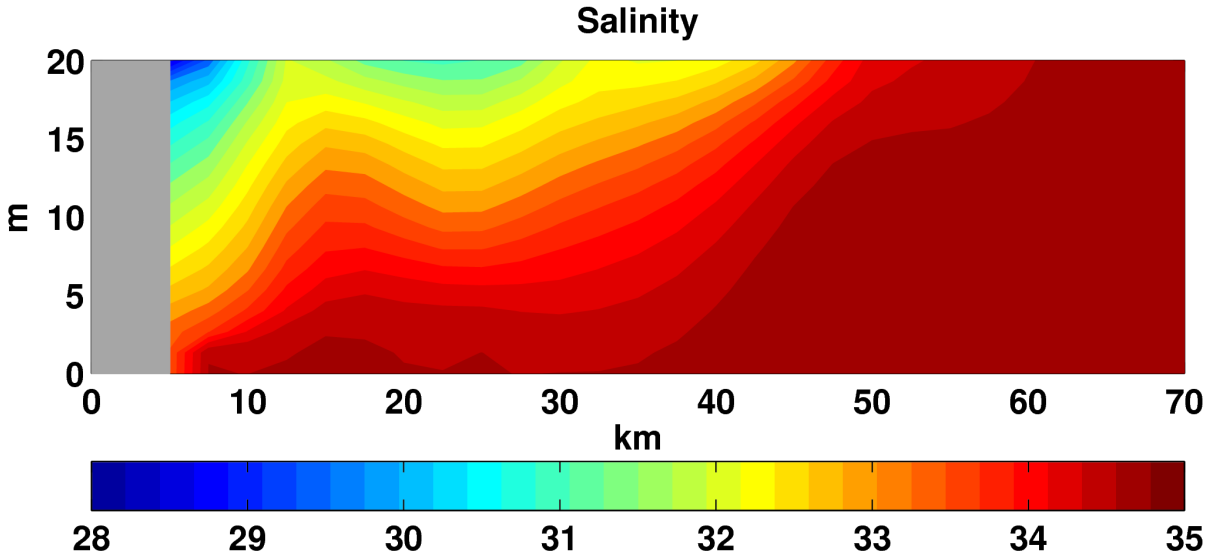
River implementation

1- What are the differences on the river numerical implementation : impact of moment ?

Across-shore salinity (PSU) vertical sections at the estuary at day 60



E-P

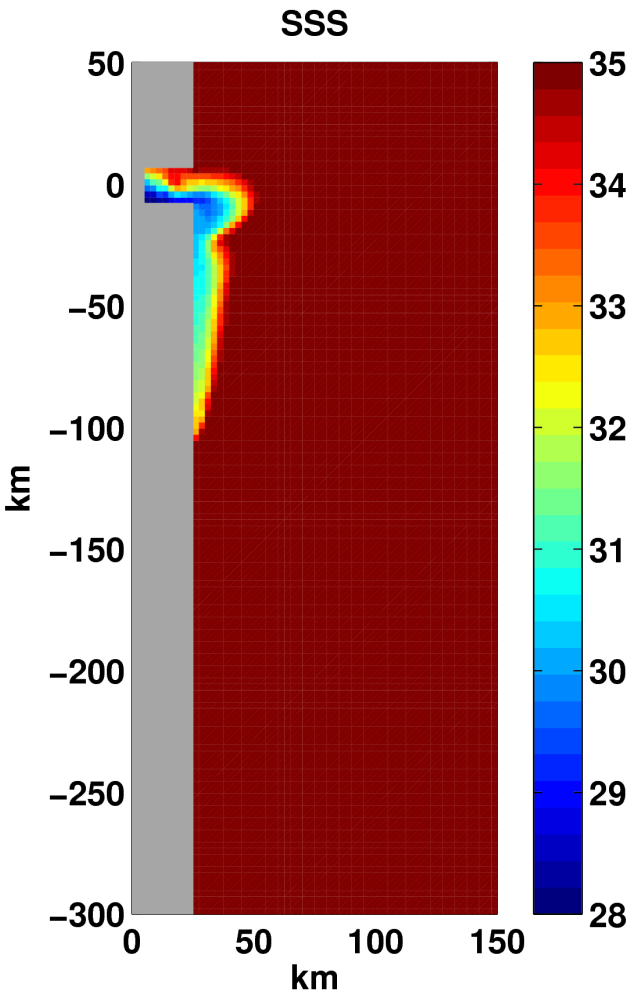


True Inflow

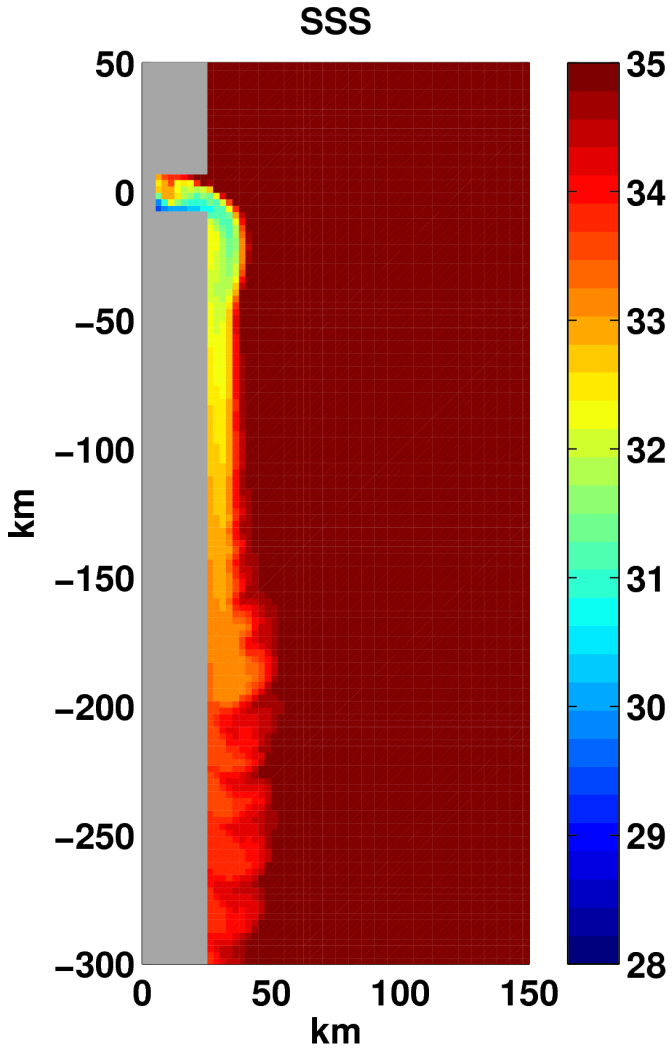
Vertical resolution

2- What is the Impact of vertical resolution ?

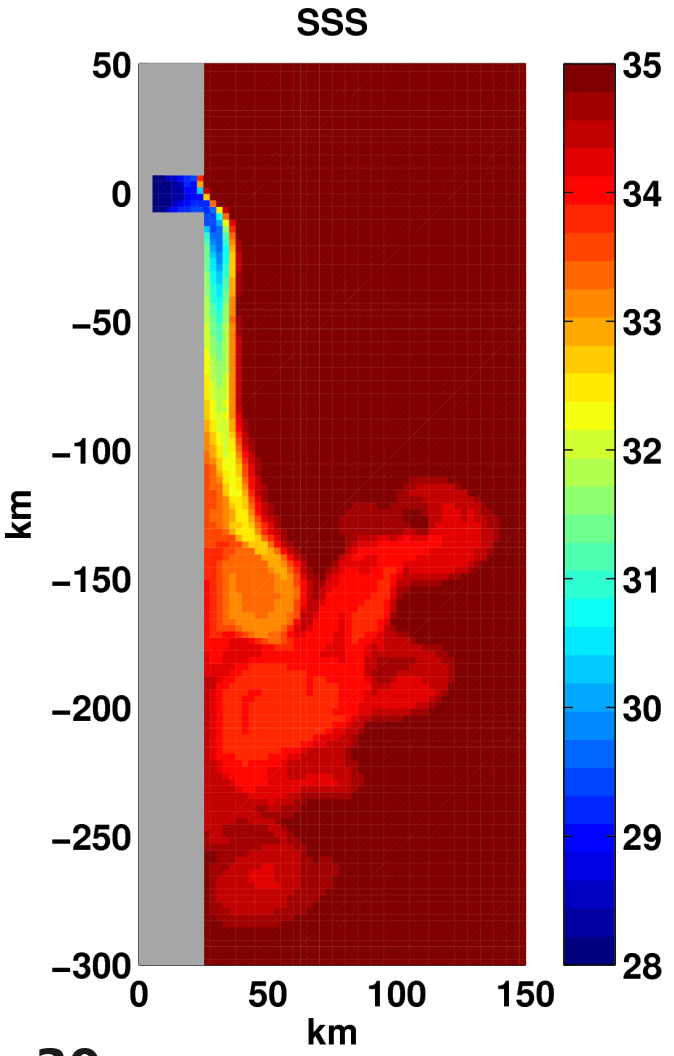
16 layers



50 layers



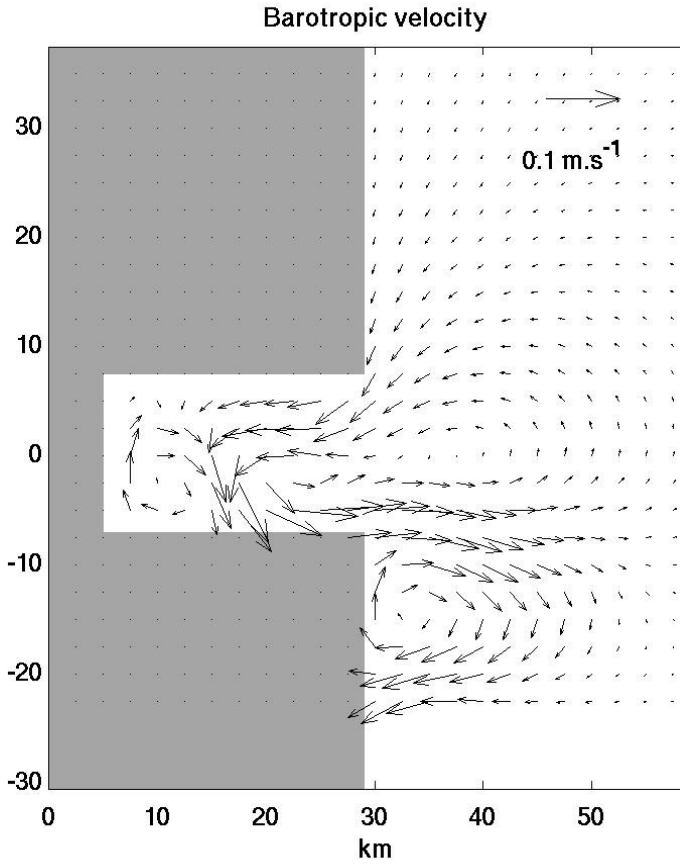
100 layers



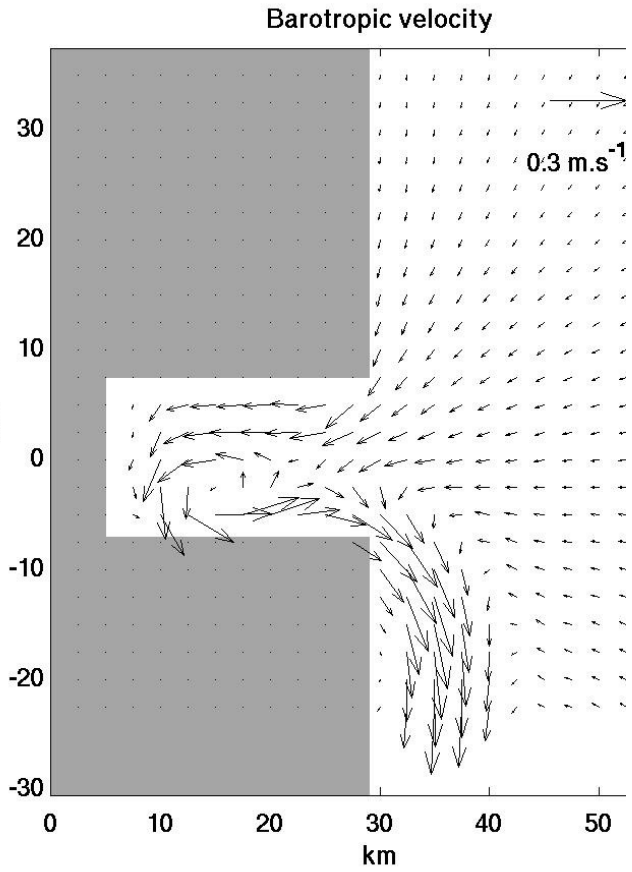
Sea Surface Salinity at day 30

2- What is the impact of vertical resolution ?

16 layers



50 layers



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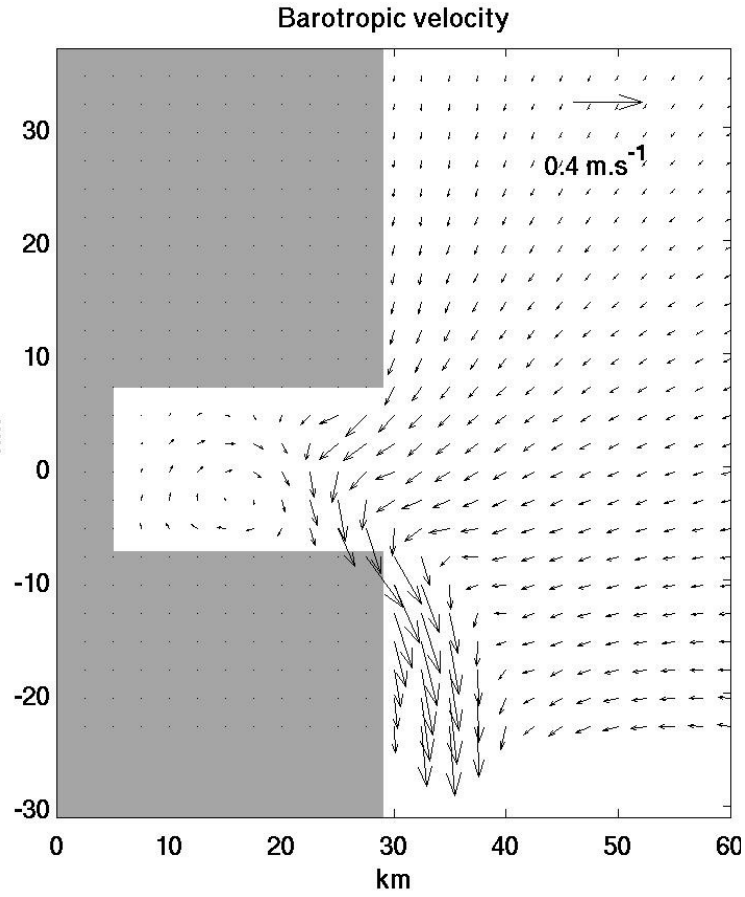
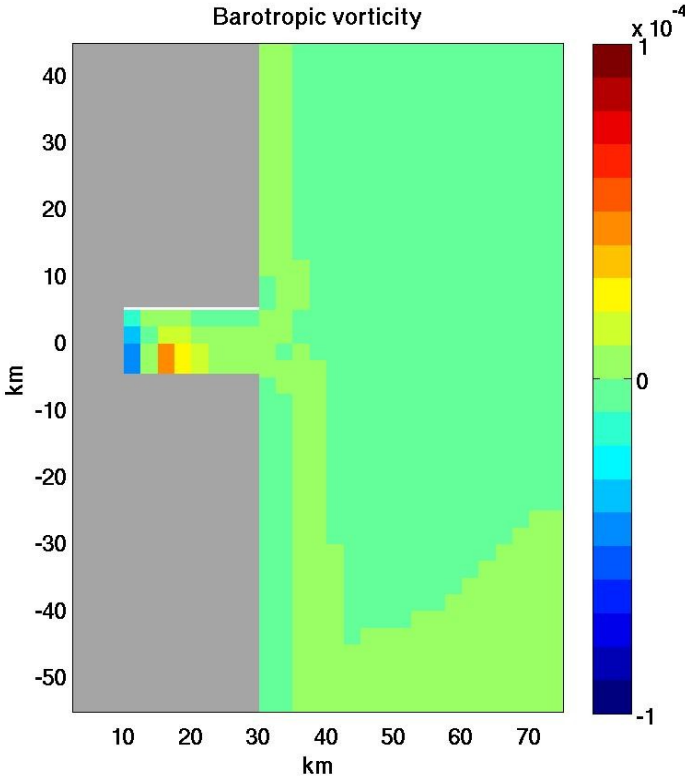


Barotropic velocity at day 20

2- What is the impact of vertical resolution ?

16 layers



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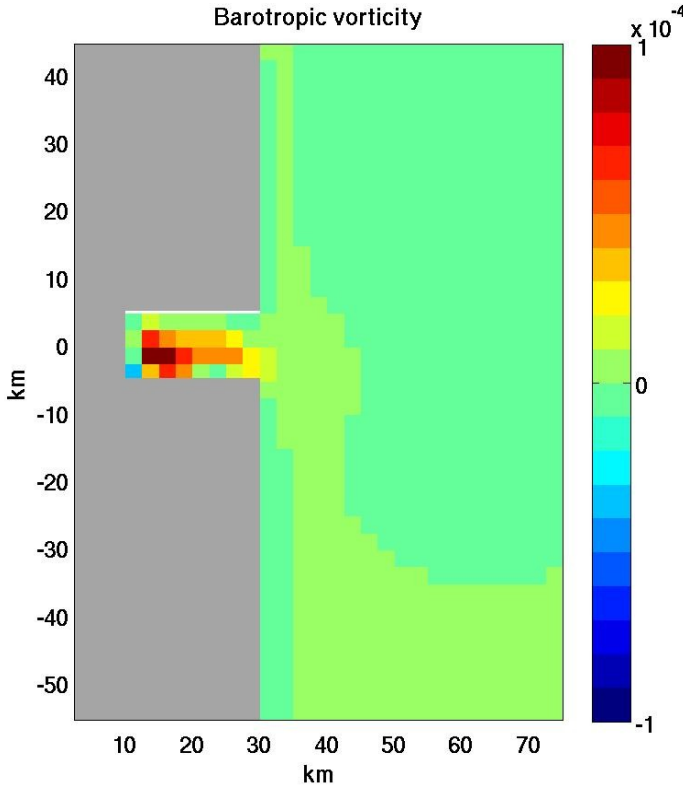

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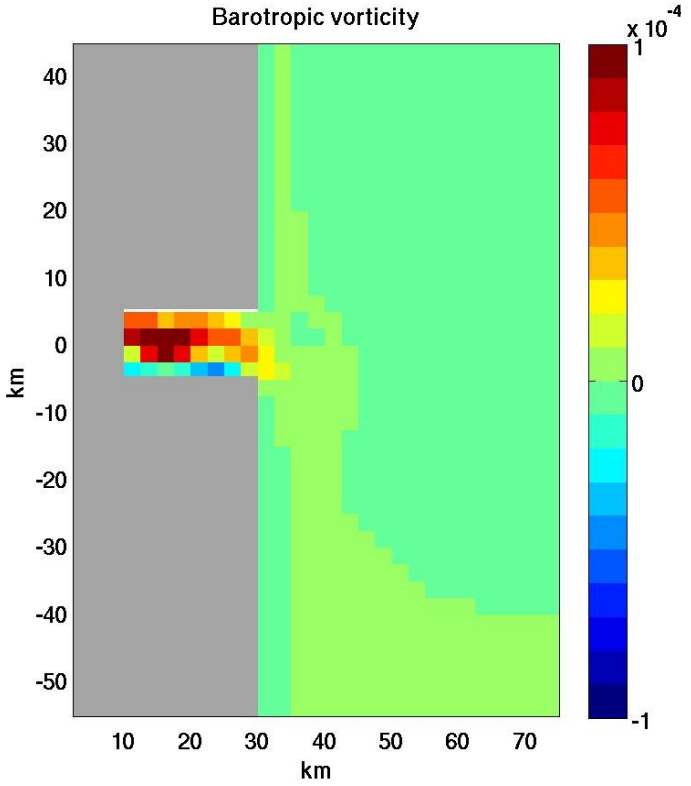
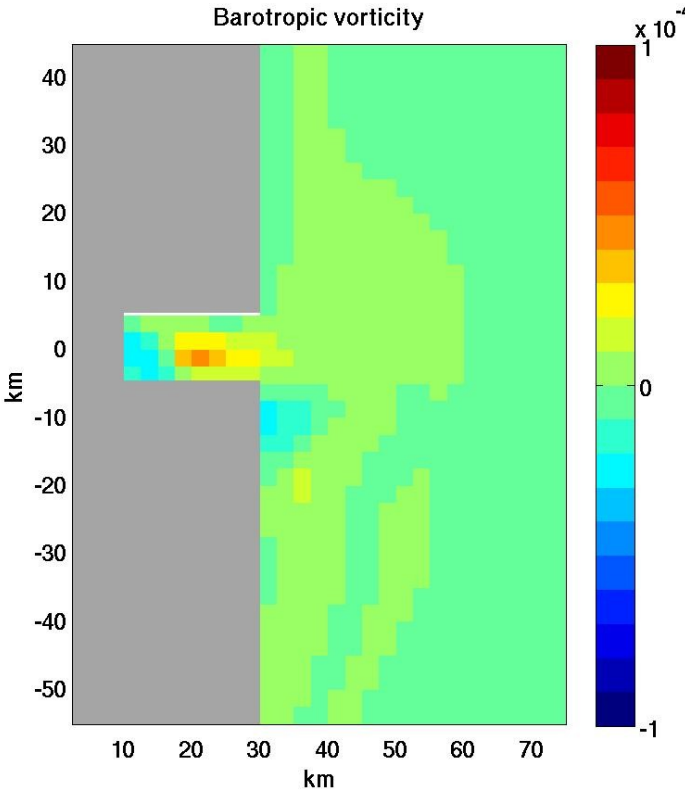


Barotropic vorticity at day 1.5

2- What is the impact of vertical resolution ?

16 layers



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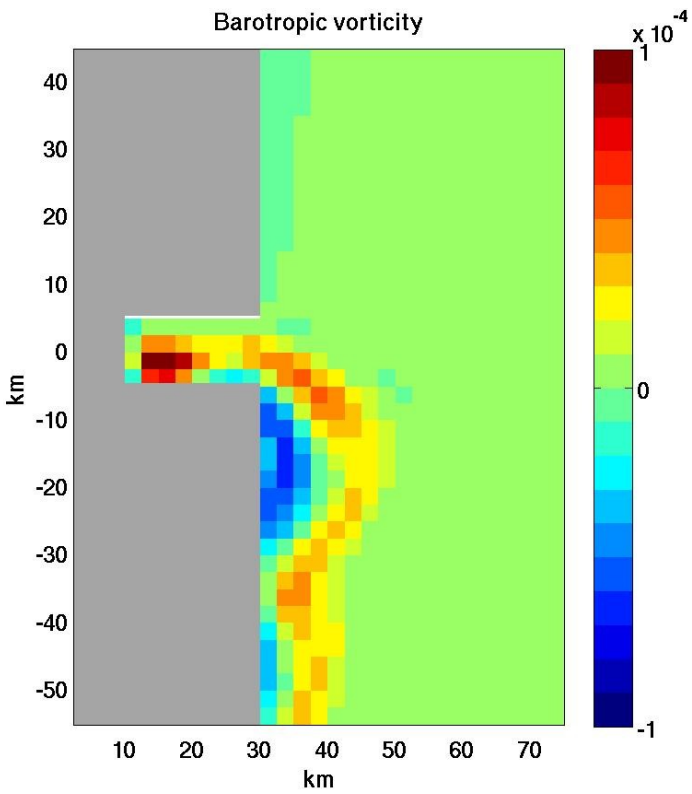

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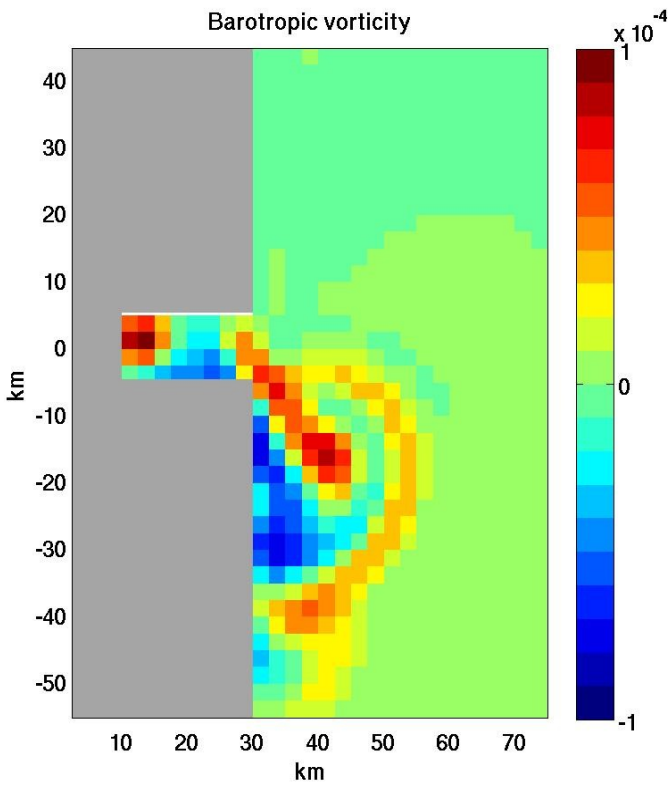
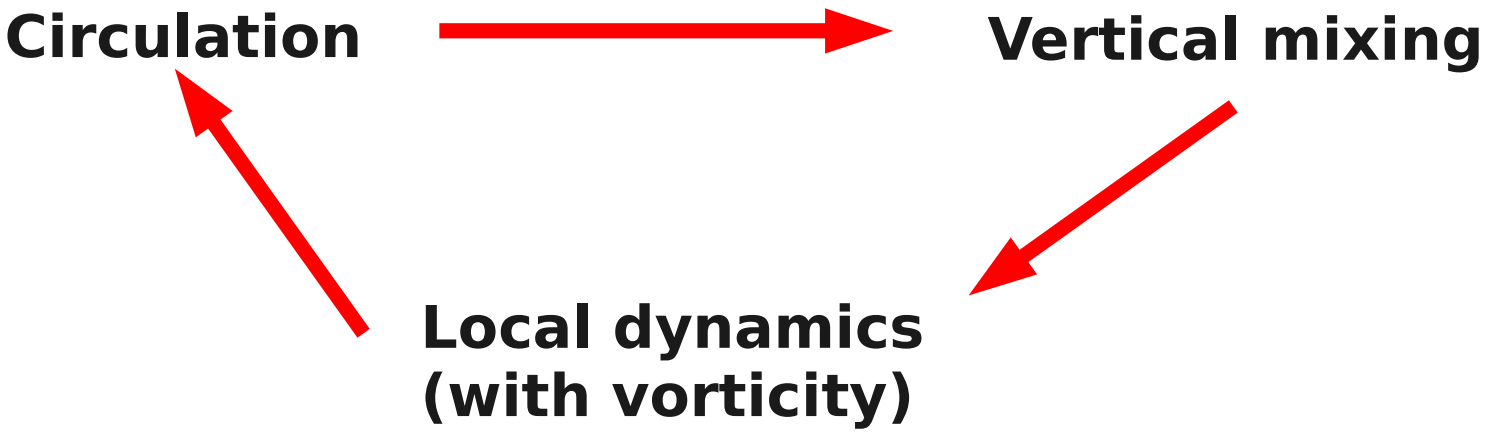


Barotropic vorticity at day 5

Conclusion

- River plume very sensitive to the river representation
- River plume dynamics highly influenced by vertical resolution



FUTURE WORK

- Comparison of different vertical mixing schemes
- Study of plume dynamics with baroclinic potential vorticity