On the use of a high resolution wind forcing in the operational coastal wave model WW3

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nov 2015

14th international workshop on wave hindcasting and forecasting

Key West

METEO FRANCE
Toujours un temps d'avance

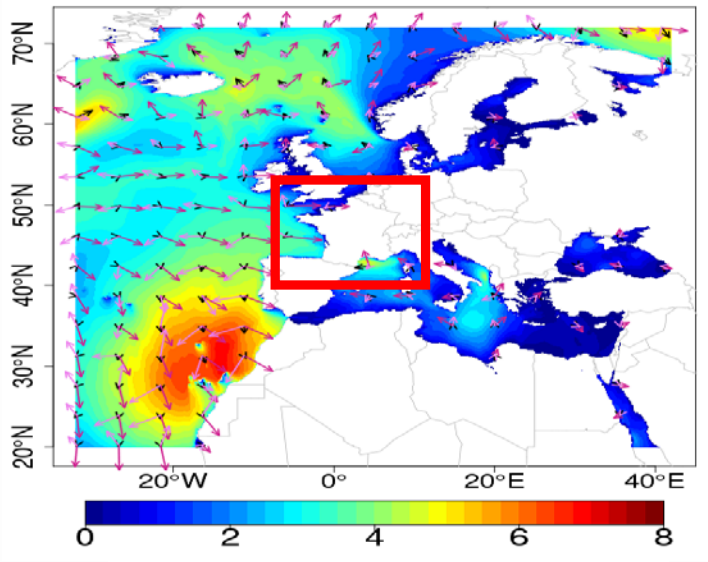
Outline

- Configuration of WW3 at Météo-France
- Simulation with a high resolution wind forcing
- Comparaison with the operational model
- Focus on choosed events
- Conclusion and perspectives

Operational wave forecasting system at Meteo-France

MFWAM : wave model of Meteo-France based on the IFS-ECWAM (IFS-38R2) code with the new physics for the dissipation terms developed by Ardhuin et al. (2010). Dissipation term recently adjusted in the project Mywave (Nov. 2014).

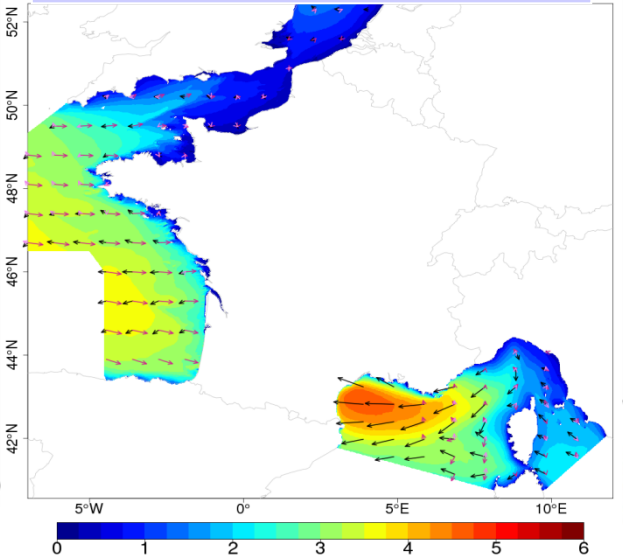
- Global scale at 0.5°
- Nested regional scale at 0.1° nested down to 0.025° on french coasts



Significant wave height (m)
2014/11/29 at 15h UTC

WW3 : since March 2015, coastal wave model on the french coasts

In the framework of the project HOMONIM (supported by the ministry of ecology and sustainable development)



Configuration of WW3

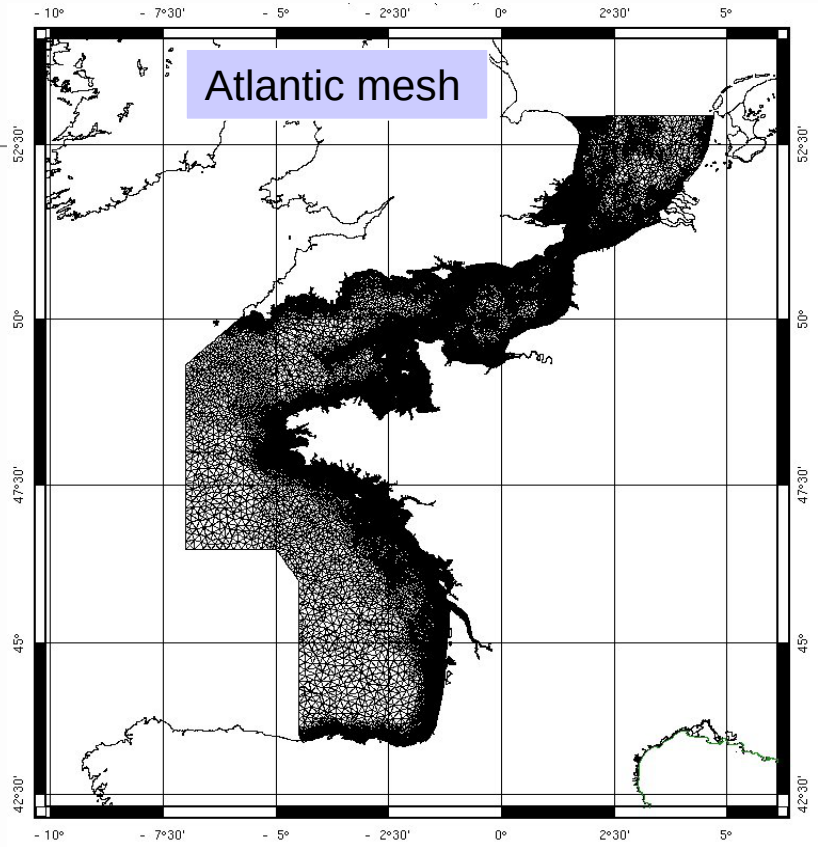
Same parametrisation as MFWAM in deep water

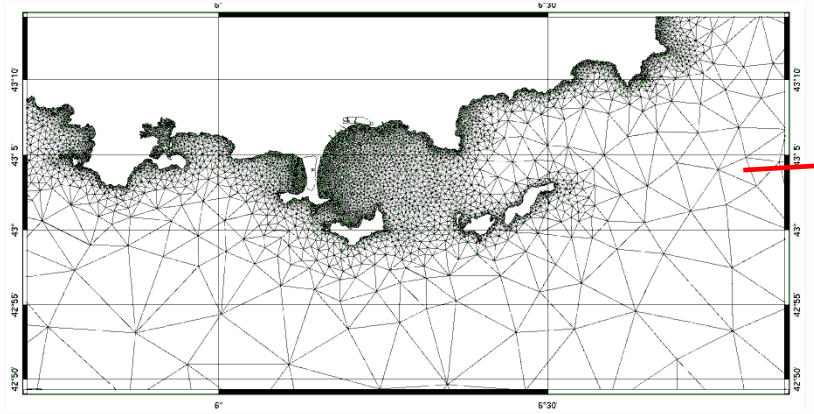
Physical coastal processes implemented

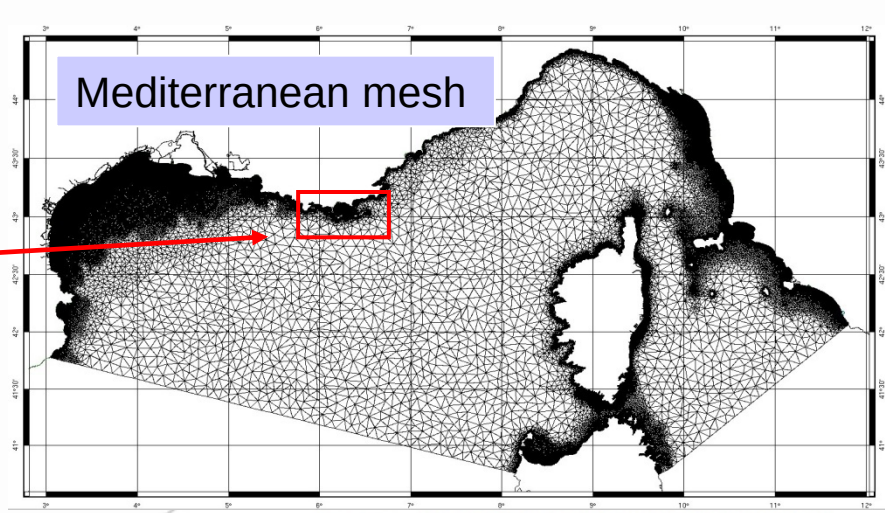
- Coast Reflection
- Refraction due to current and bathymetry
- Bottom friction

Irregular mesh on Atlantic and Mediterranean coasts

- From 200 m nearshore up to 10 km in deep water
- Adapted to geometry of coasts
- High resolution nearshore with an easy nesting and reasonable run time







Wind forcing in WW3

Use of the atmospheric model of Météo-France ARPEGE

- Hydrostatic model with a resolution of 0.1°
- Up to 4 days
- Quick availability for an operational use

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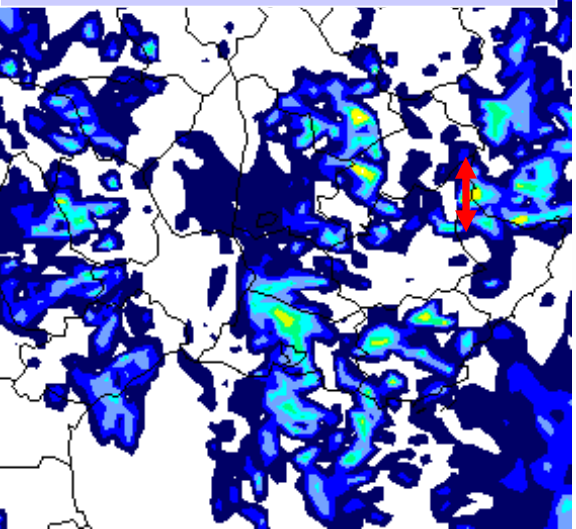
Compared with the high resolution atmospheric model **AROME**

- Non-hydrostatic model with a resolution of 0.0125°
- Up to 42 hours

- Since April modelisation of law layers up to 5 m

Reflectivity representing convective cells in Arome



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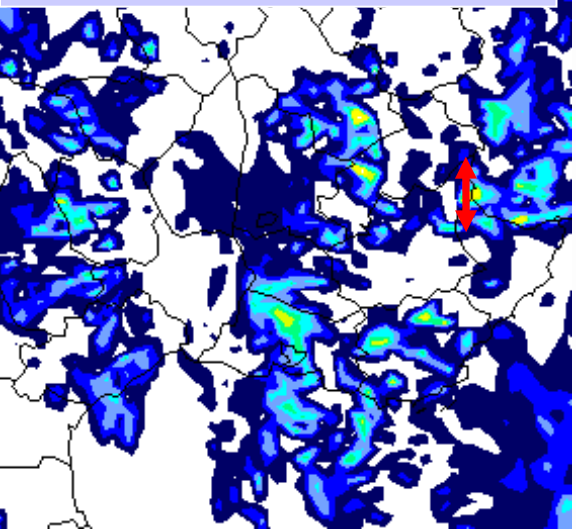

Encouraging for an use in WW3

New kind of wind resolution for a wave model
Which impact of convective cells on sea state ?
Raise of the dispersion ?

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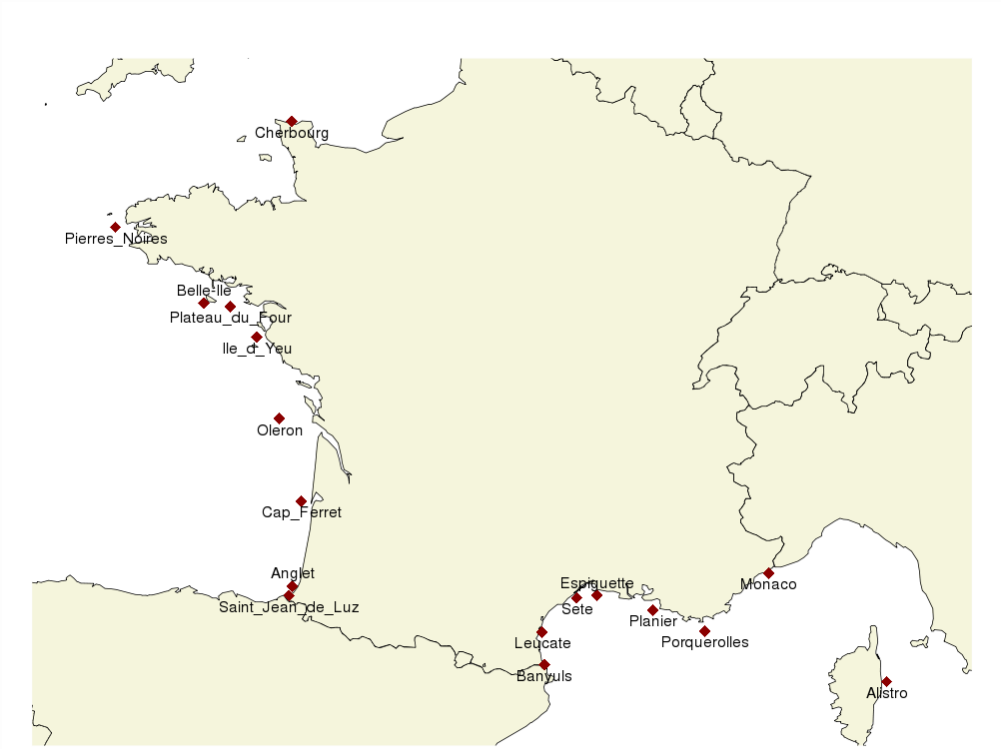
Simulation from May to July 2015

Run 1 : simulation with Arpege forcing at 0.1° (operational mode)
Run 2 : simulation with Arome forcing at 0.025°

nested in MFWAM as in operational, but without assimilation

Validation with altimeter data (Jason 2 and Saral) and coastal buoys from Cerema



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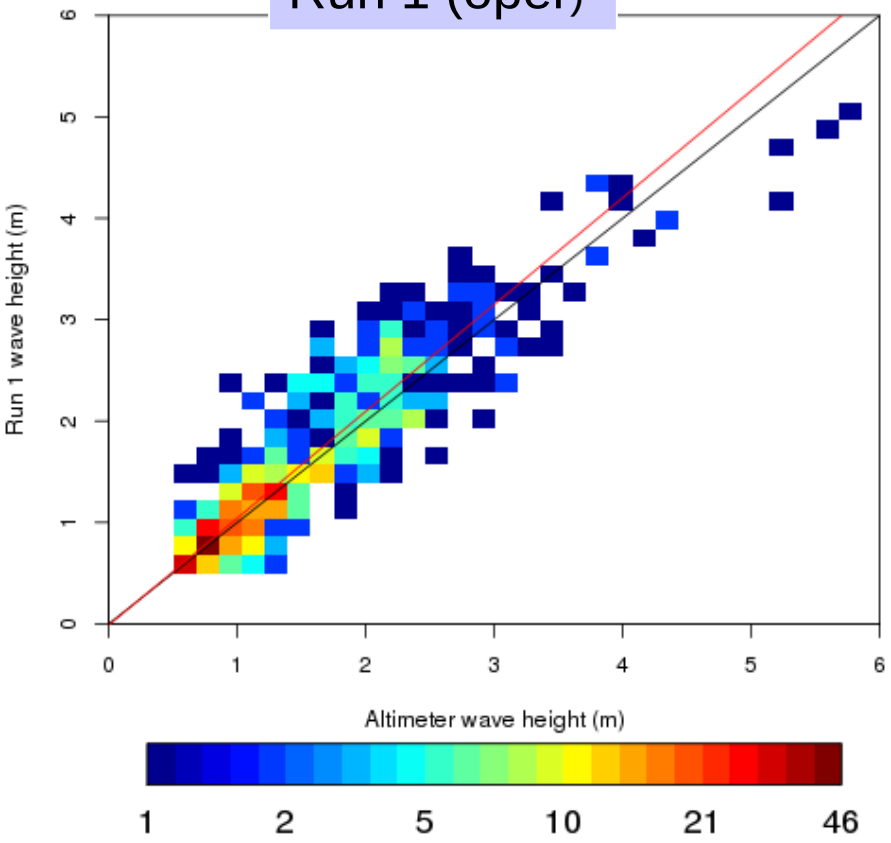
Scores with altimeters data on significant wave height for Mediterranean coast

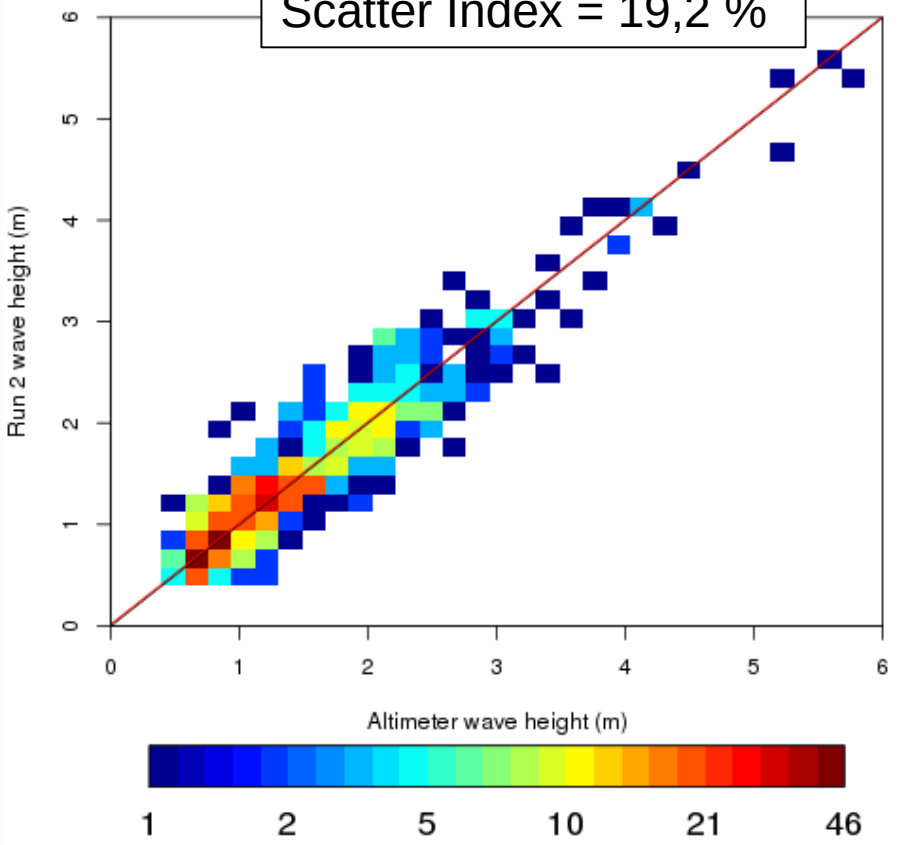
Run 1 (oper)



Density = *626*
Bias = 7 cm
RMSE = 35 cm
Scatter Index = 23,1%

Run 2 (Arome)

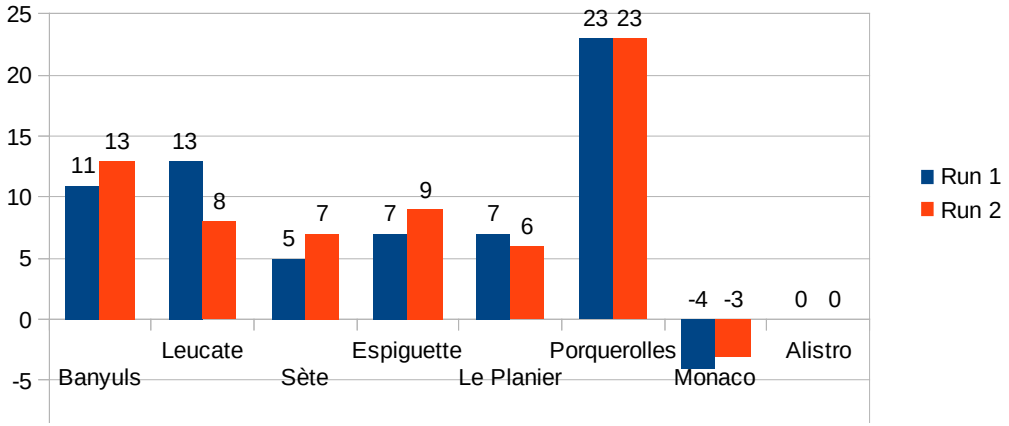
Density = *626*
Bias = 1 cm
RMSE = 29 cm
Scatter Index = 19,2 %



Significant improvement with Arome forcing on Mediterranean coast

Validation with coastal buoys data

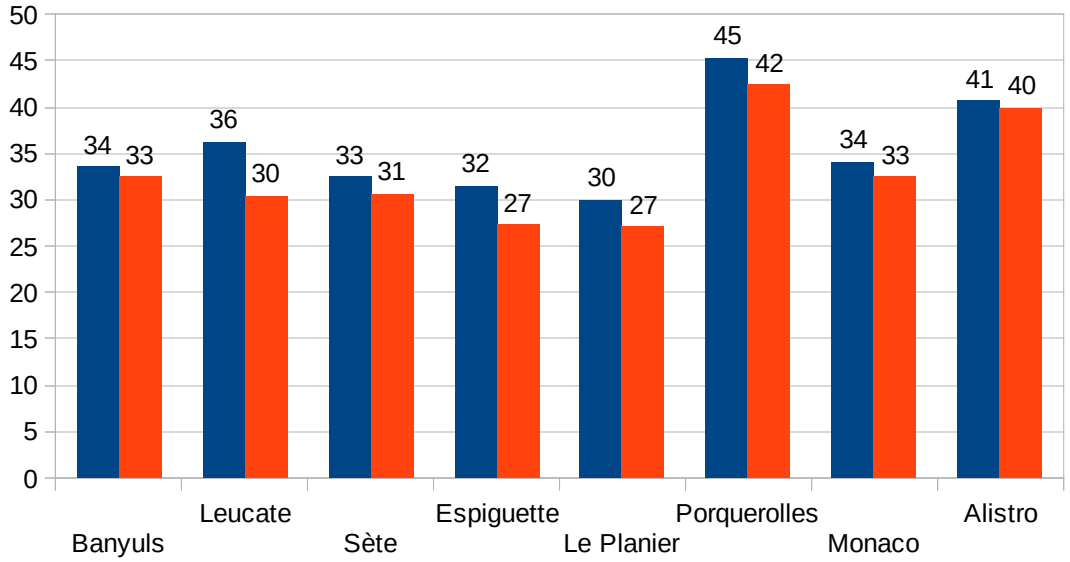
Mean bias of SWH in cm



No significant difference on Atlantic coast, but important improvement on Mediterranean coast

Weather on atlantic coast depends more on synoptic scale meteorology
the Weather on mediterranean area is more convective

Normalized Scatter index of SWH in %

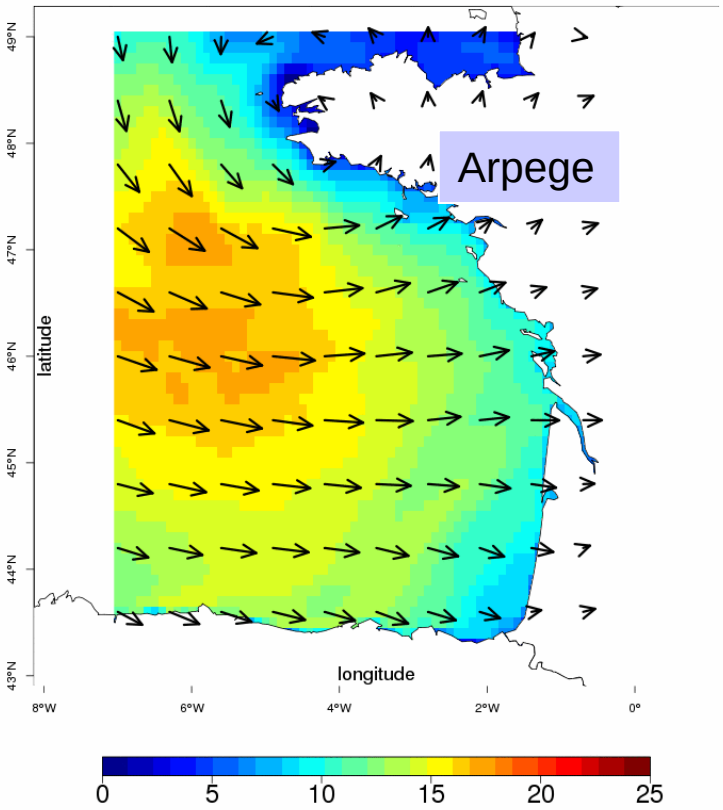


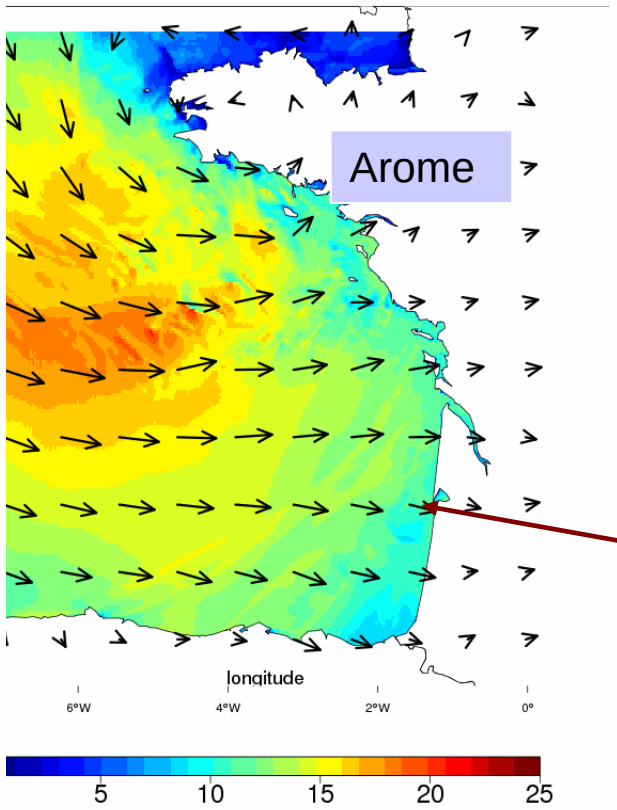
Run 1 with ARPEGE
Run 2 with AROME

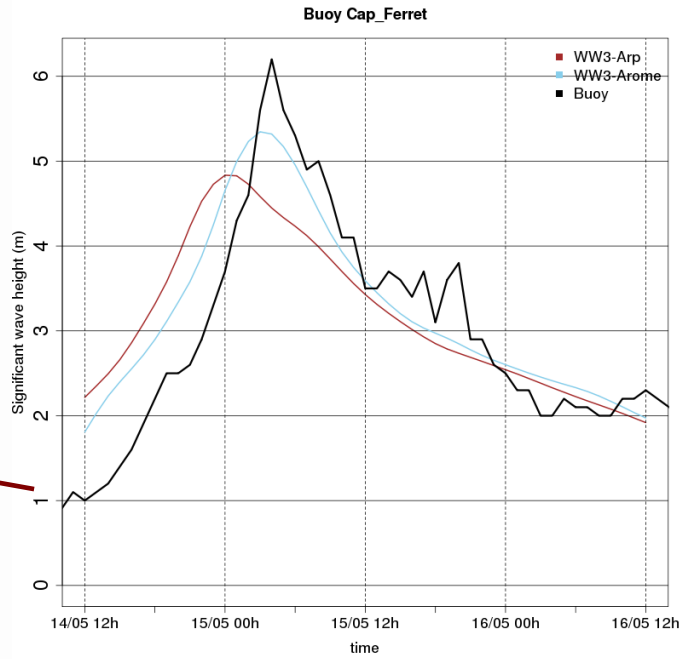
15th of May, an atlantic storm better simulated with Arome

Stronger and more precise wind structure in Arome

Higher sea state in WW3







Wind speed between 18h UTC the 14th and 06h UTC the 15th of May(m/s) - 6h step.

Only case with a significative difference on Atlantic coast

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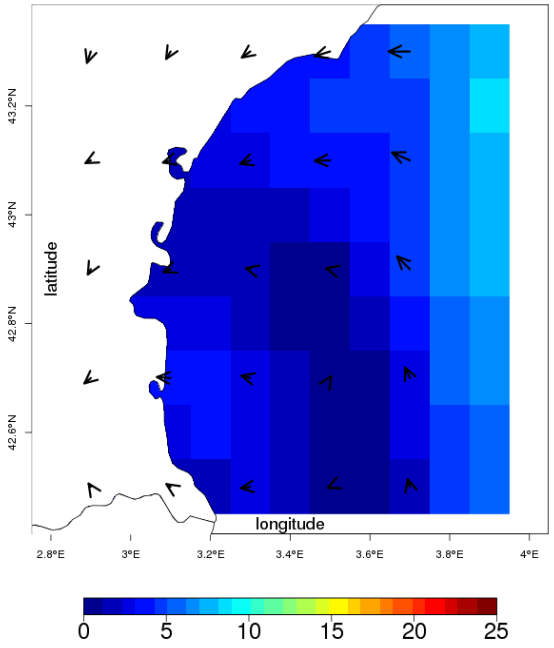
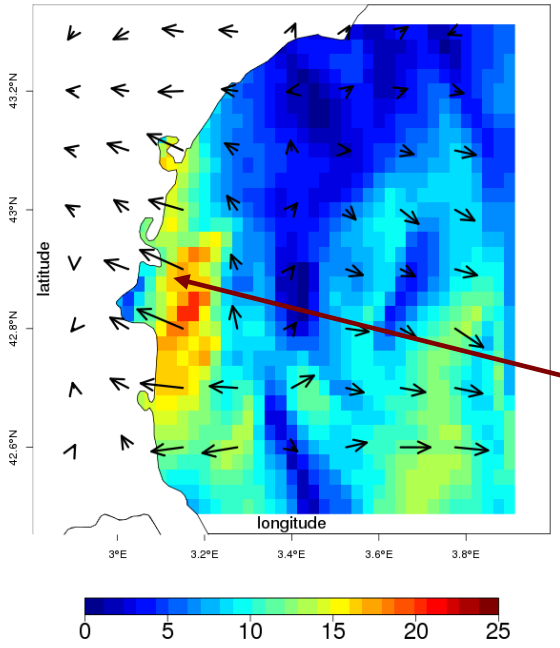
12th of June, example of a convective case on Mediterranean sea

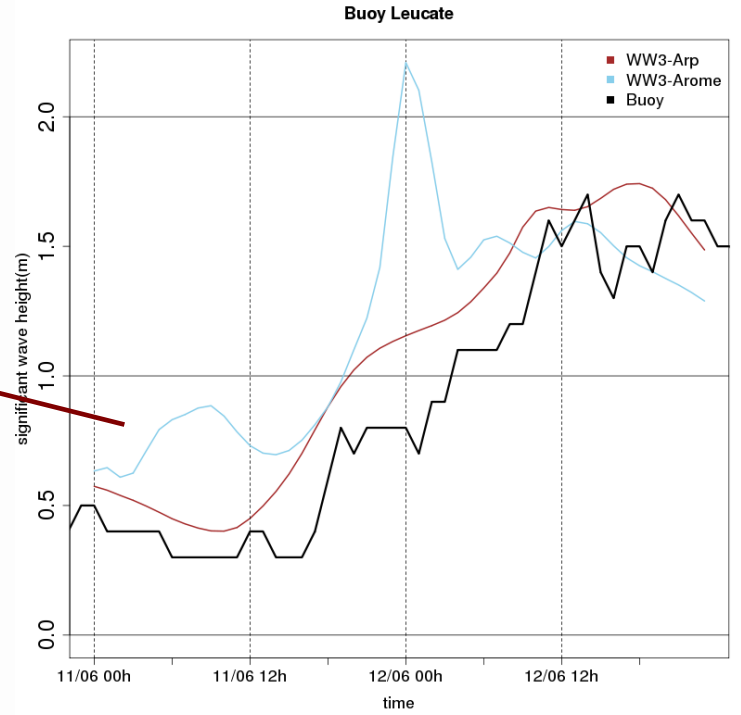
Bad simulation of convection by Arome at 00h UTC → **+ 1 meter on significant wave height**

ARPEGE



AROME





Wind speed at 00h UTC the 12th of June(m/s)

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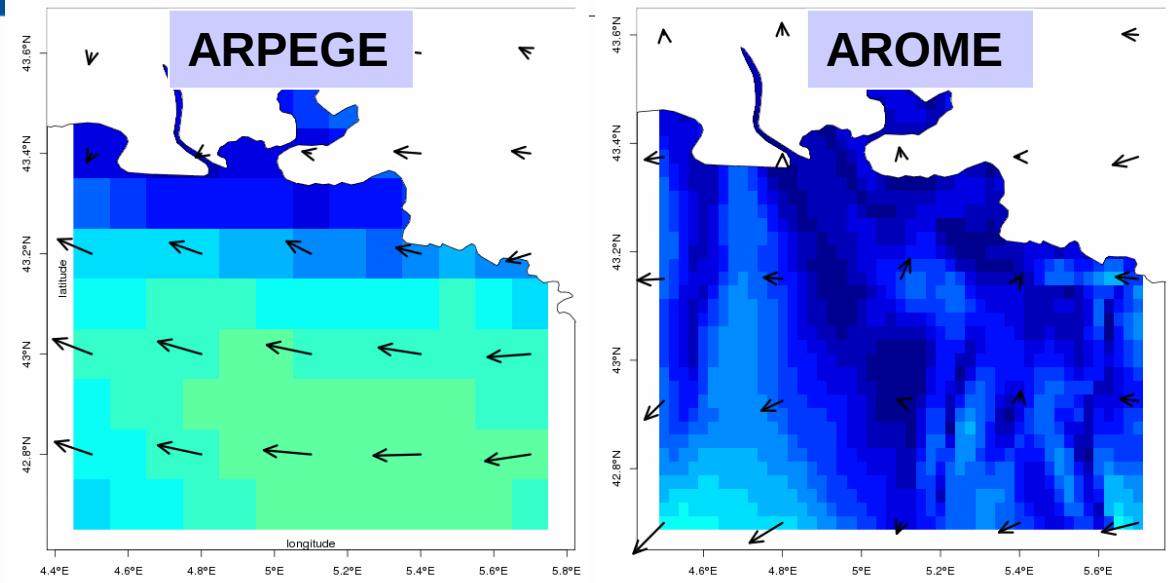
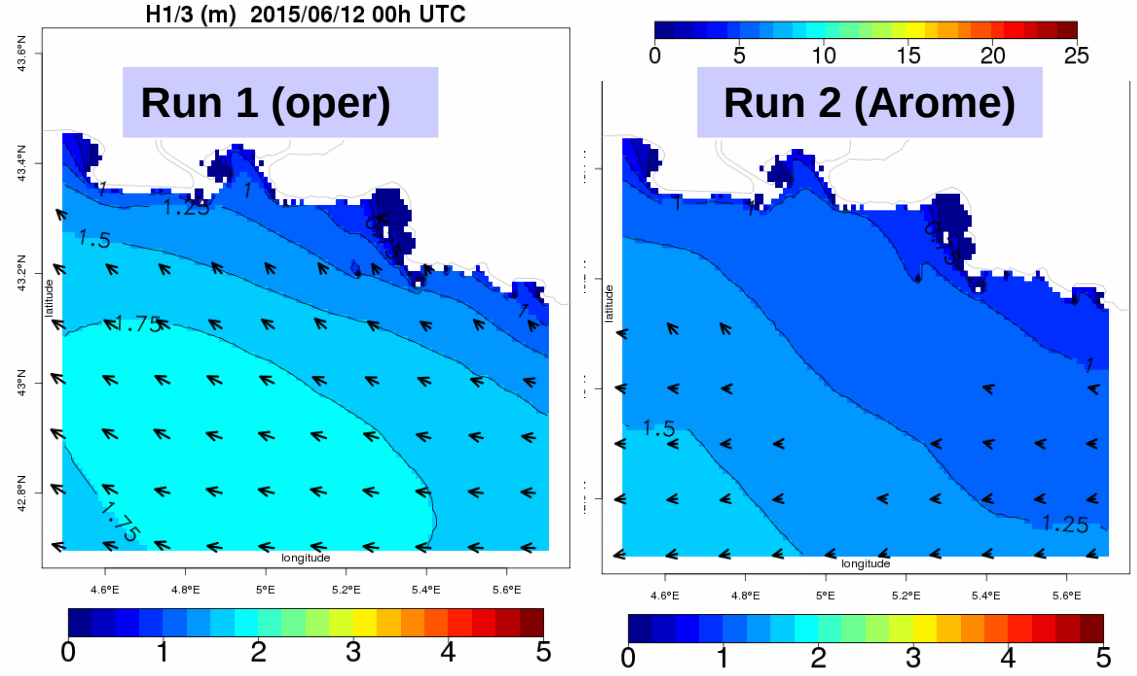


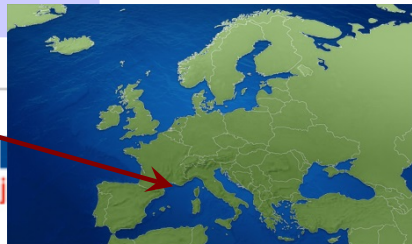
Wind speed at 12h UTC the 12th of June(m/s)

- **Difference of 75 cm between both runs because Arpege produce a more efficient fetch**
- **No observation to validate a model**



Significant wave height between 00h UTC and 12h UTC the 12th of June(m)

6h step



Conclusion and perspectives

• Significant improvement in deep and shallow water with Arome forcing on Mediterranean coast, which is known for its convective events. Less scatter in general.

⇒ Results to confirm in autumn and winter seasons
⇒ Tests are on going with better resolution of Arome forcing (1.2 km)

• WW3 with Arome winds is more realistic during a convective storm, with a moderate risk of important misfit.

⇒ In the perspectives, works on using ensemble forecast of Arome system.

Perspectives for WW3

- **Use of an implicite scheme => Talk of Fabien Leckler**

- **Coupling between water level / currents and waves**
  First one-way experiment on the Saint-Michel bay

. Implementation of coastal WW3 at 200 m on french West Indies, french Guyana and La Reunion (Indian ocean)