

On the validation of the high resolution wave model with altimeters data under hurricanes and storm conditions for the West Indies

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(1)Météo-France (2)SHOM



Matthew hurricane 01/10/2016



nov 2016

*Ocean Surface
Topography
Science Team*

La Rochelle

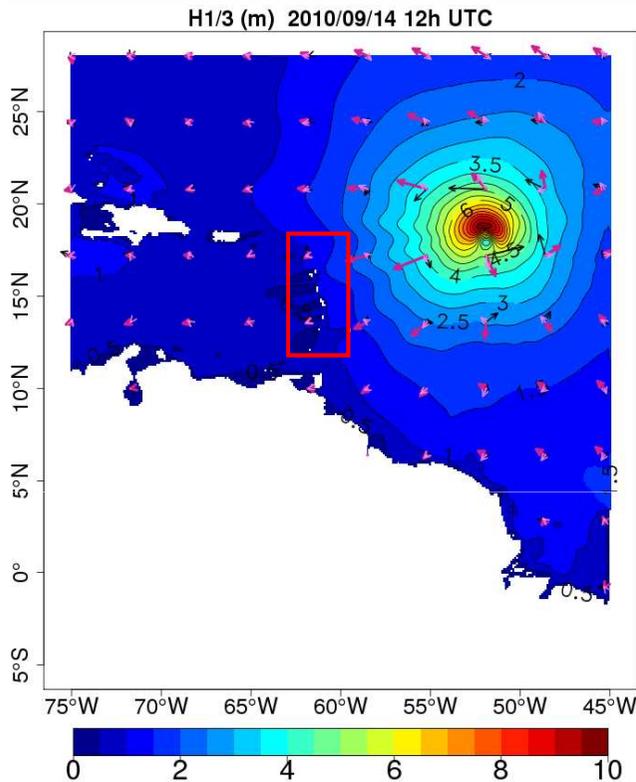




Outline

- Configuration of WW3 in the West Indies at Météo-France
- Validation with altimeters for a long run
- Validation with altimeters during storm events
- Impact of the assimilation at the boundaries
- Conclusion and perspectives

Operational wave forecasting system at Meteo-France in the West Indies

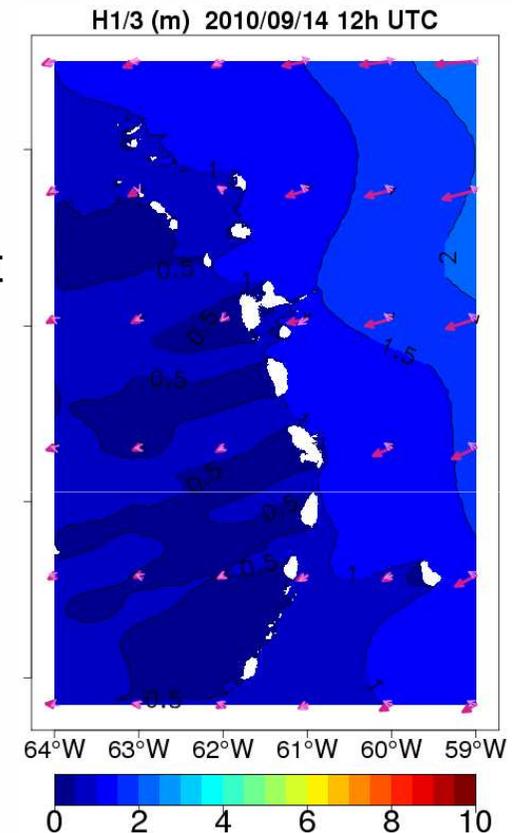


MFWAM : wave model of Meteo-France based on the IFS-ECWAM (IFS-38R2) code with the new physics for the dissipation terms developed by Ardhuin et al. (2010). Dissipation term recently adjusted in the project Mywave (Nov. 2014). Assimilation of altimeters.

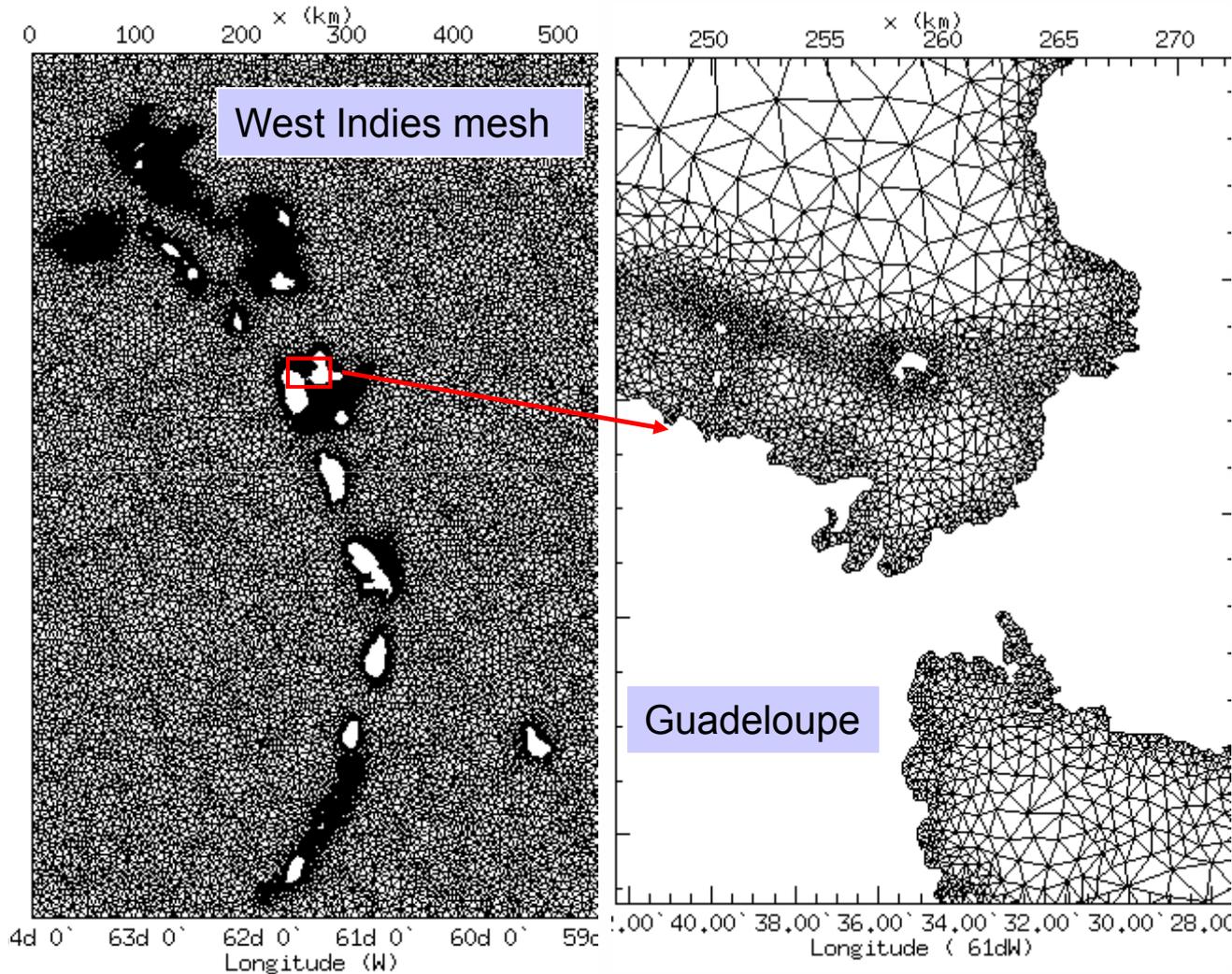
- Global scale at 0.5°
- Nested regional scale at 0.1

WW3 : in december 2016, coastal wave model on the West Indies and the french Guyana

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 coasts

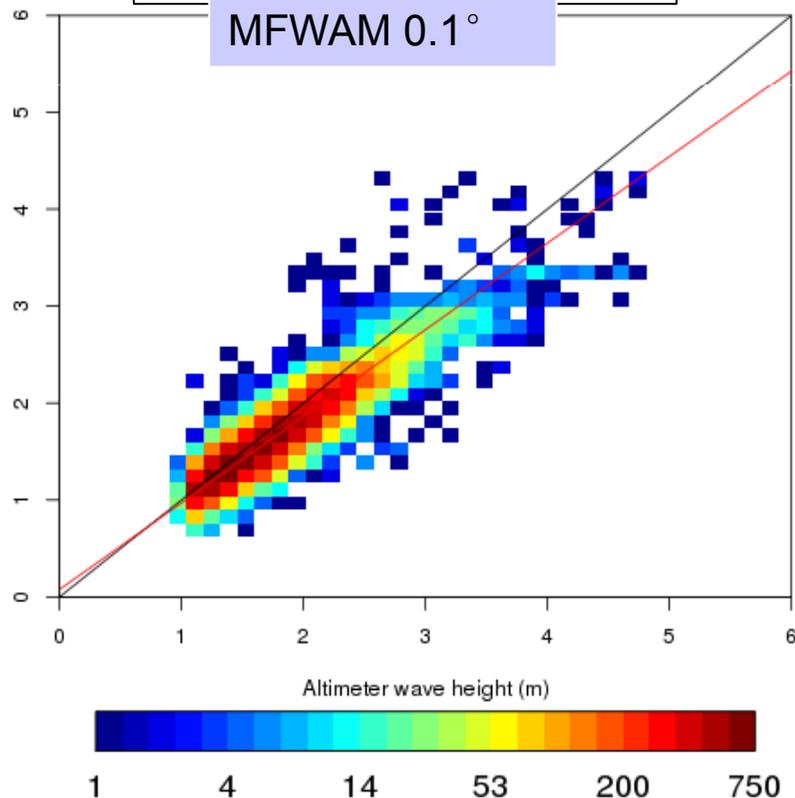
- From 200 m nearshore up to 10 km in deep water
- Adapted to geometry of coasts
- High resolution nearshore with an easy nesting and reasonable run time

Long run from July 2012 to July 2013

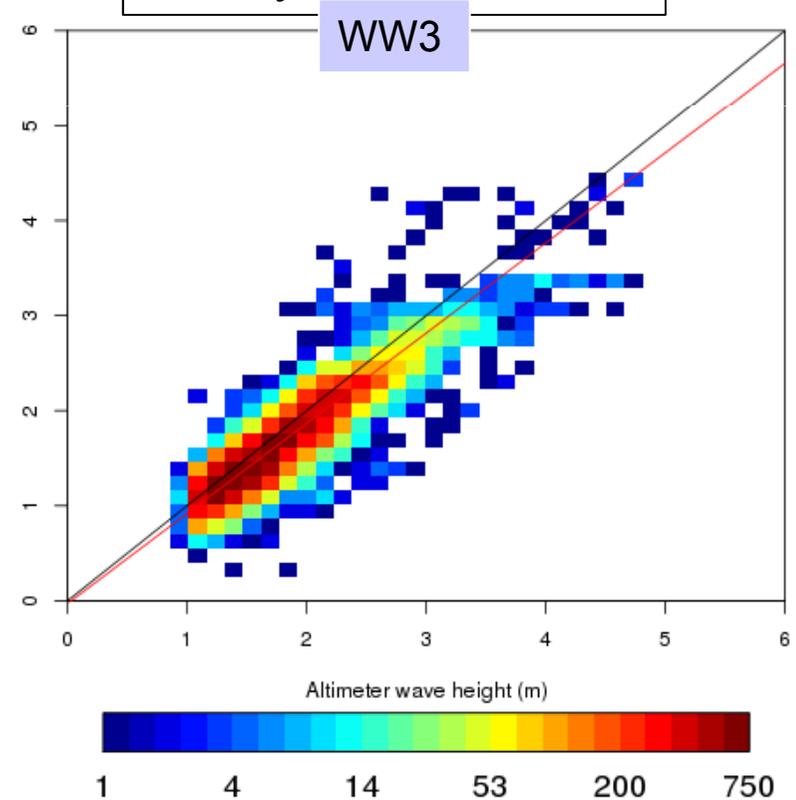
Comparison with altimeters

- Wind forcing from the atmospheric model of ECMWF at 0.125°
- Bounding conditions from MFWAM 0.1° without assimilation
- Validation with the altimeters wave height database of Cersat Ifremer

Bias = -11 cm
RMSE = 23.9 cm
Scatter Index = 11.8%
Density = 18398



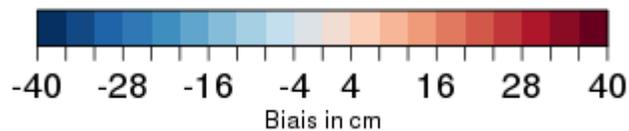
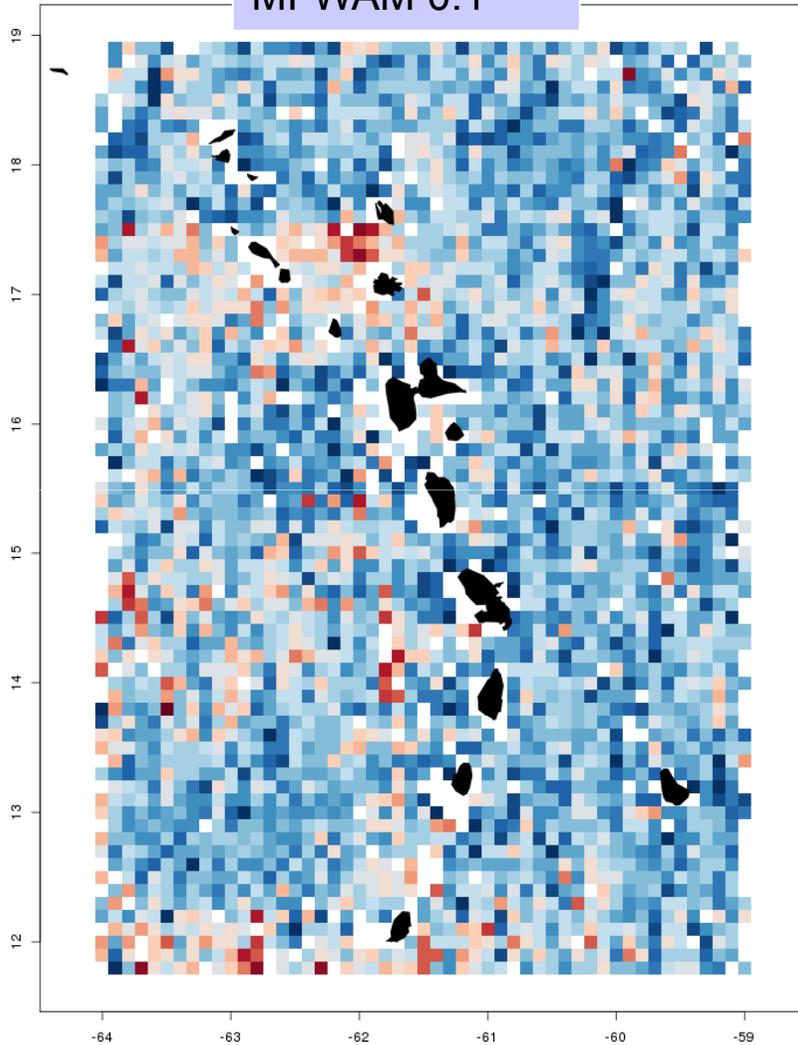
Bias = -12 cm
RMSE = 25 cm
Scatter Index = 12.2%
Density = 18398



Long run from July 2012 to July 2013

Comparison with altimeters

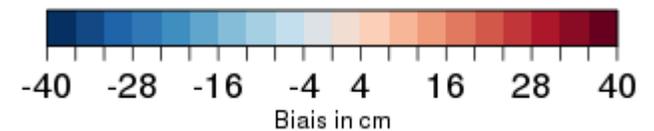
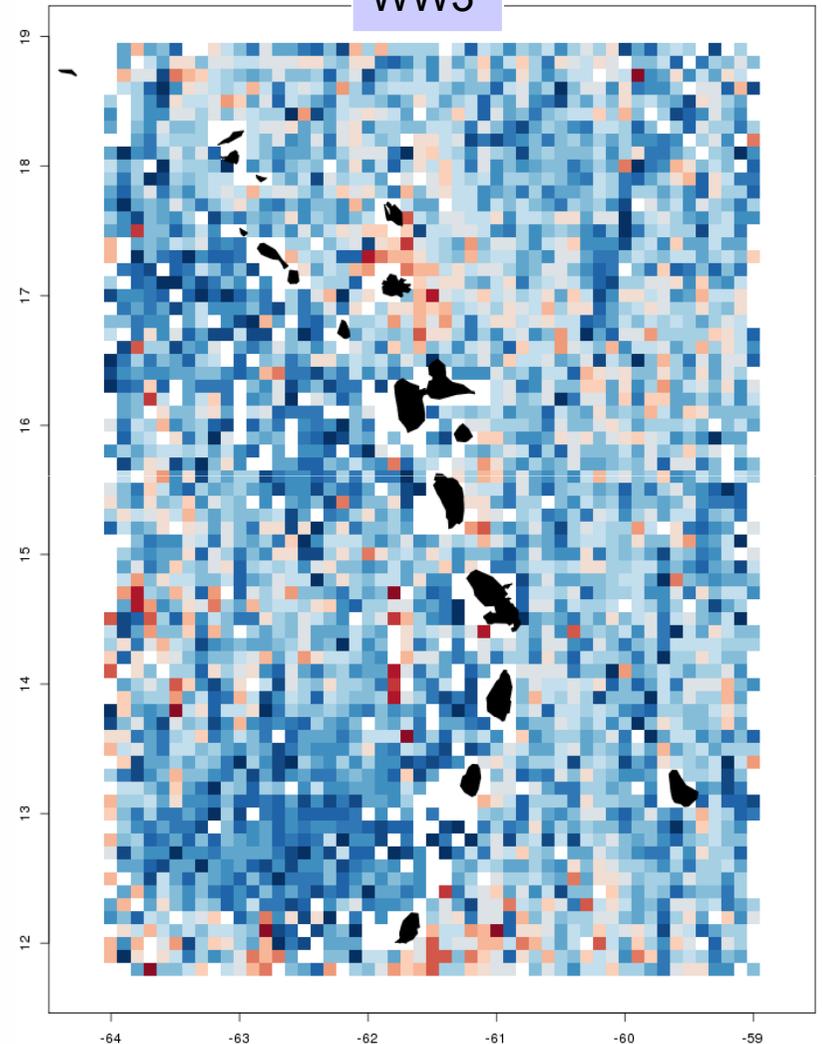
MFWAM 0.1°



Mean bias of
significant wave
height (cm)

- Some areas are better seen by MFWAM and others by WW3
- Underestimation of WW3 in Caribbean sea

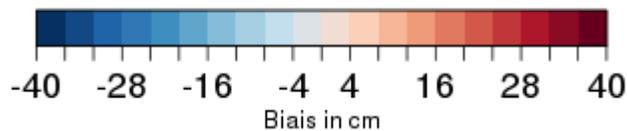
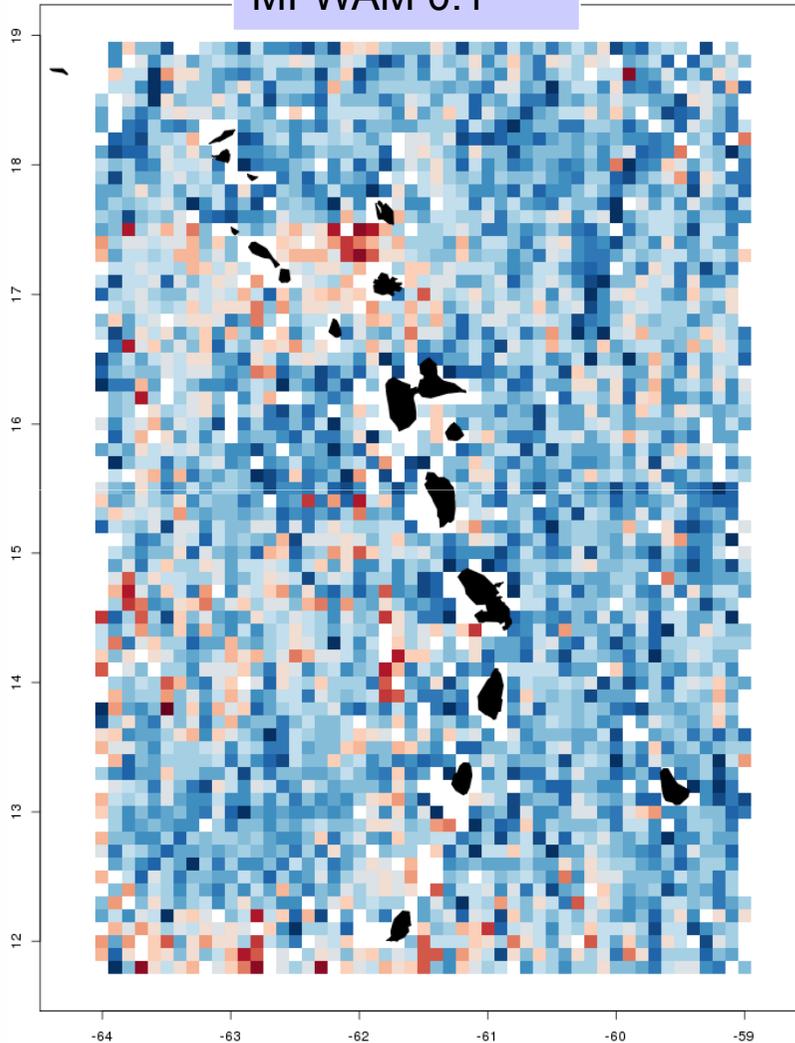
WW3



Long run from July 2012 to July 2013

Comparison with altimeters

MFWAM 0.1°

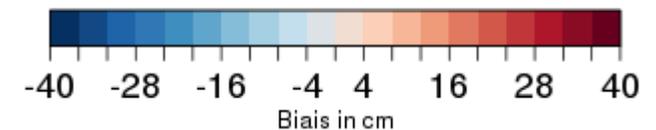
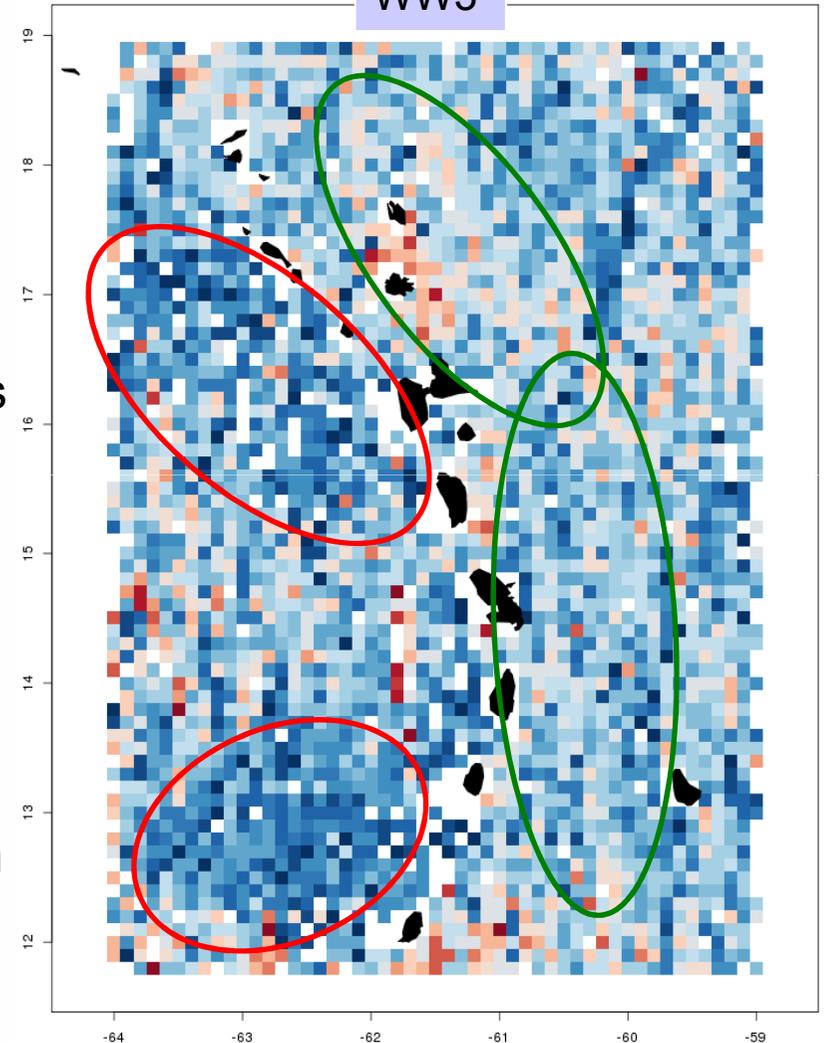


Mean bias of significant wave height (cm)

Several hypothesis of the underestimation of WW3:

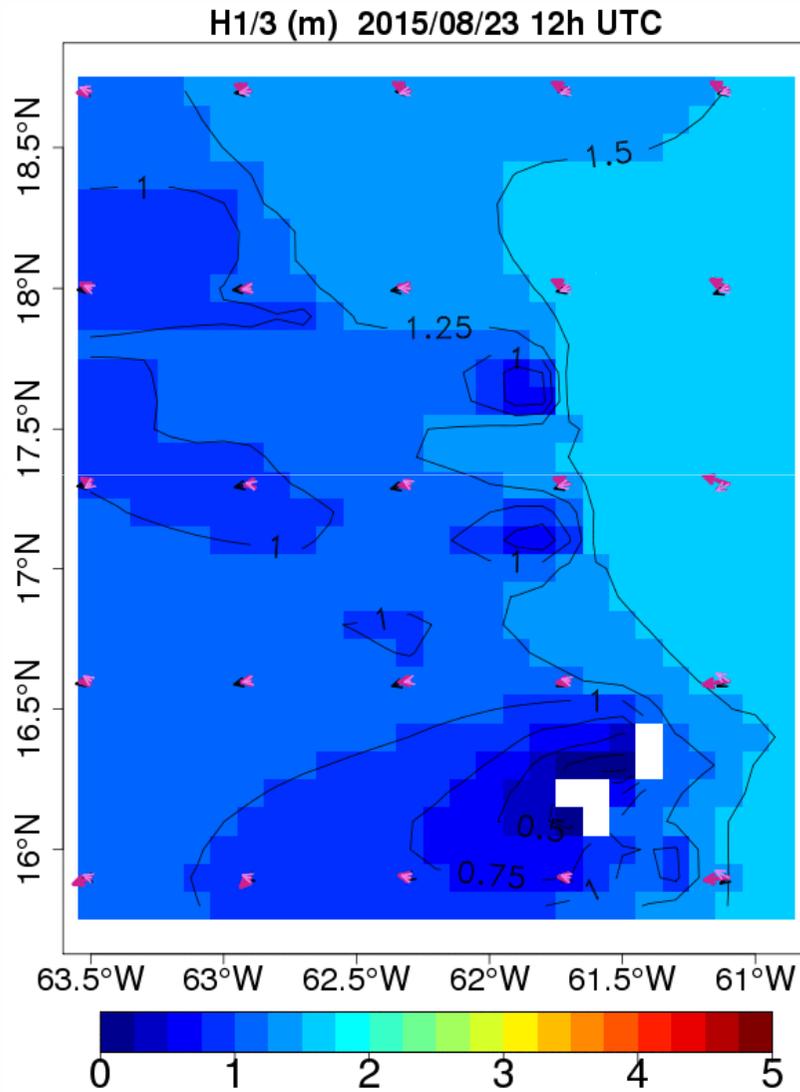
- an approximative bathymetry
- a too strong bottom friction
- a parametrisation of dissipation not adapted

WW3



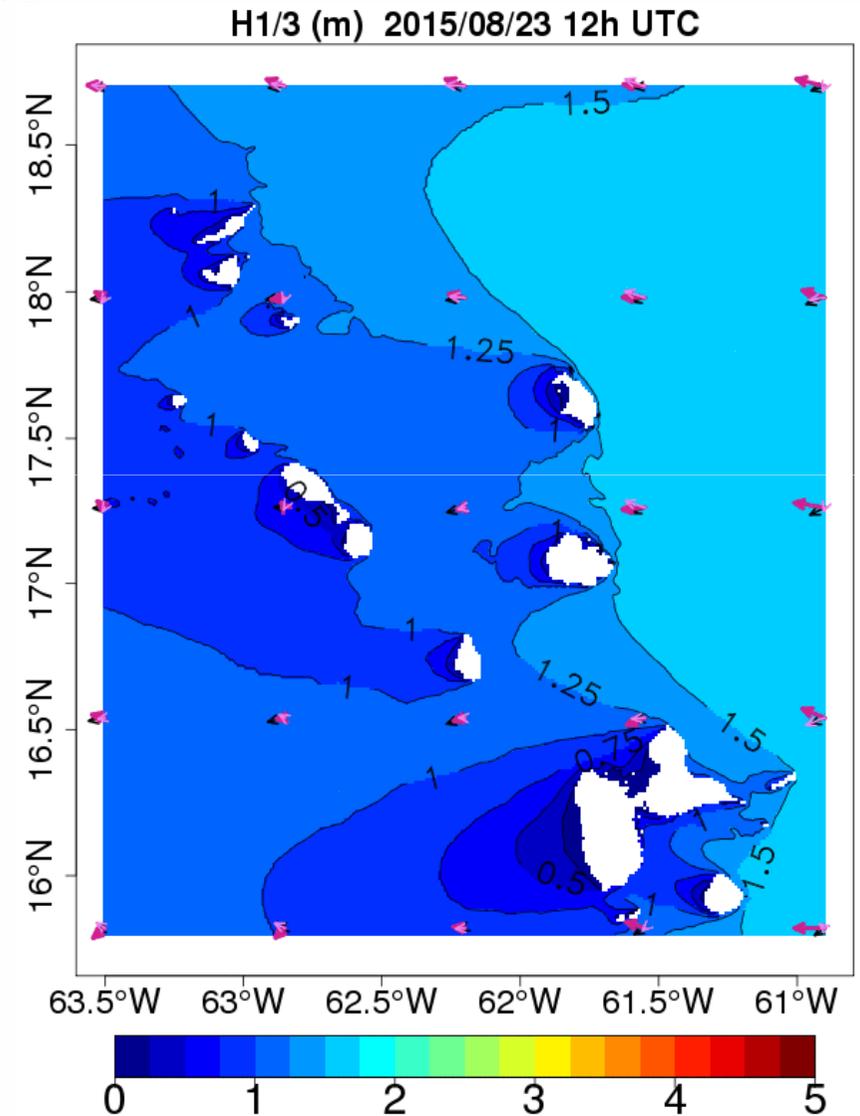
In coastal area

Case of Danny hurricane 24th of august 2015



Significant wave
height (m)

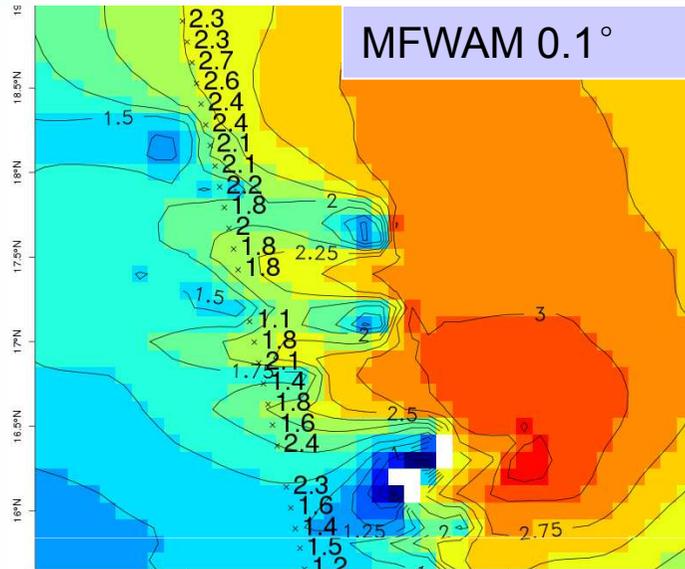
- Better description of the islands effects on sea state with WW3



ours un temps à avance

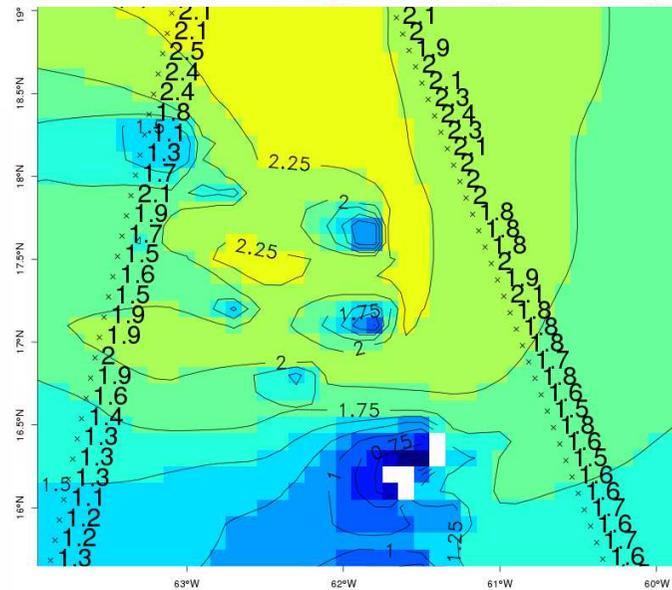
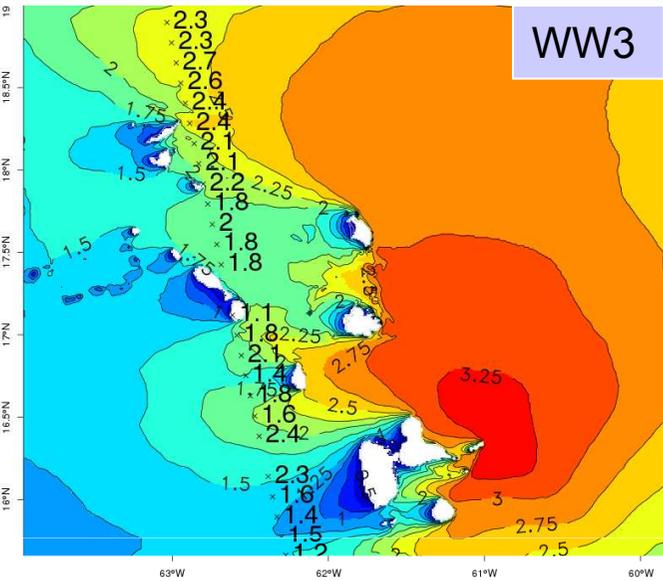
In coastal area

Case of Danny hurricane 24th of august 2015

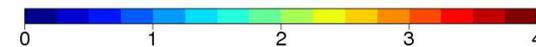
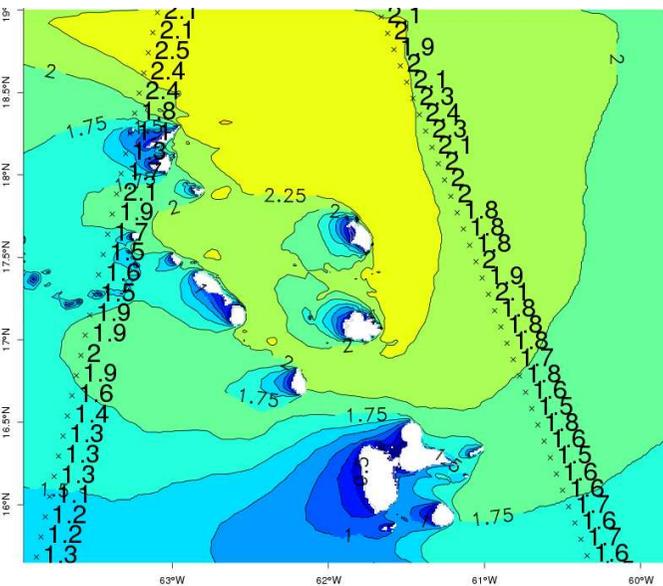


Significant wave height (m)

24/08 à 09h UTC

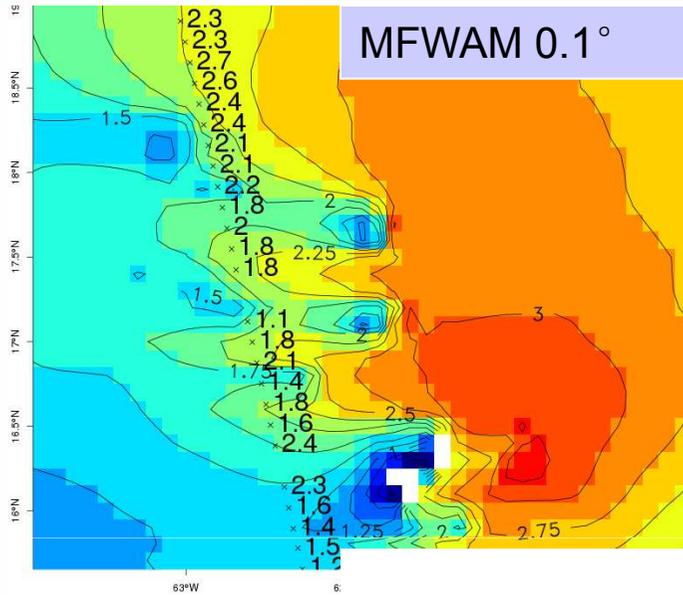


24/08 à 21h UTC



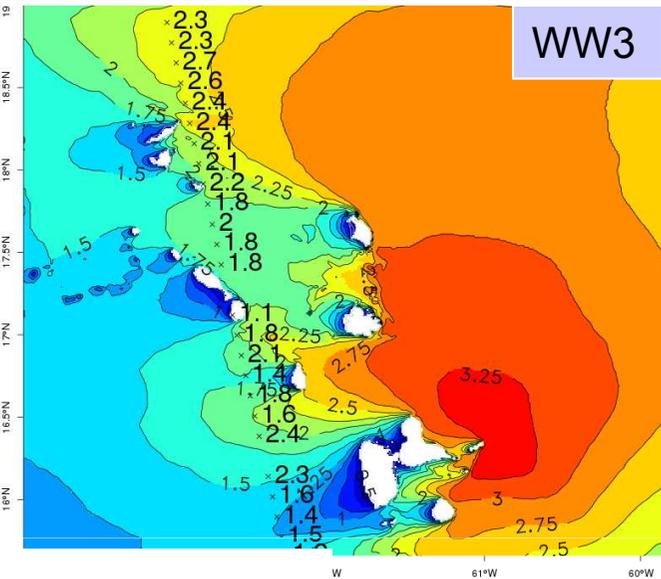
In coastal area

Case of Danny hurricane 24th of august 2015

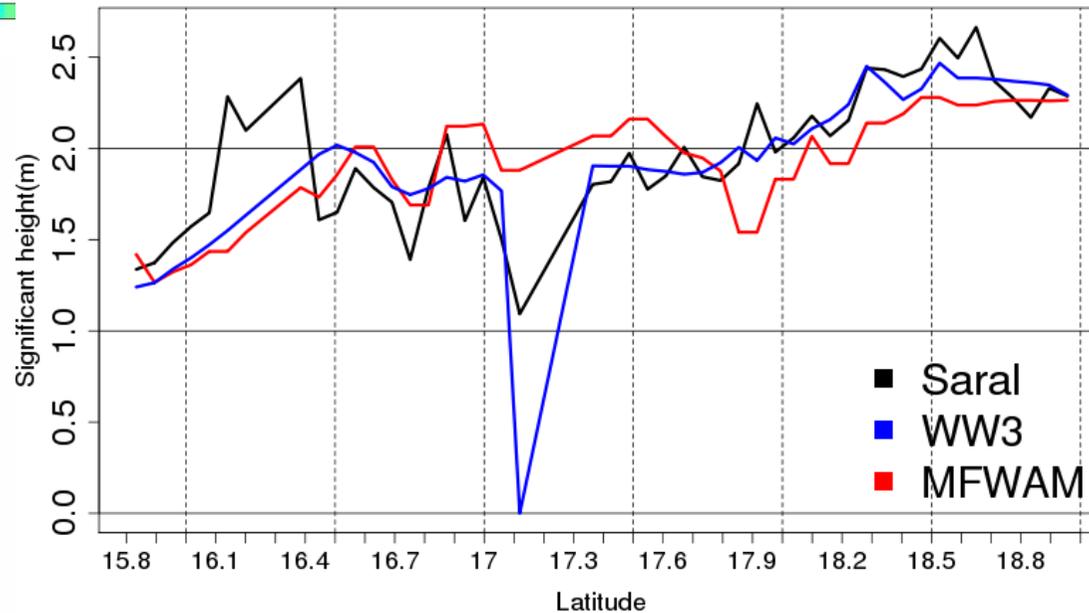
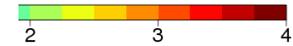
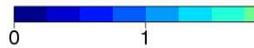


Significant wave height (m)

24/08 à 09h UTC



Saral track



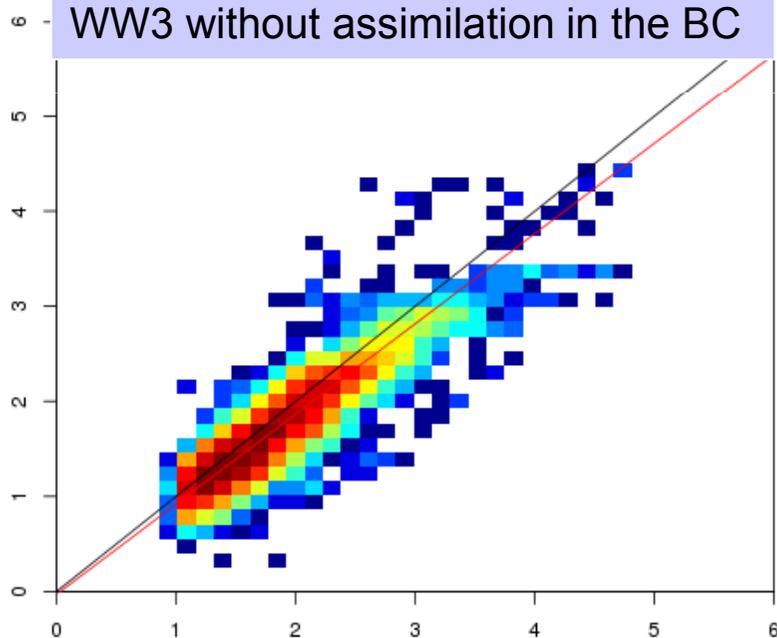
Long run from July 2012 to July 2013

Impact of assimilation at the boundaries

- Wind forcing from the atmospheric model of ECMWF at 0.125°
- Bounding conditions from MFWAM 0.1° with assimilation
- Validation with the altimeters wave height database of Cersat Ifremer

Bias = -12 cm
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Scatter Index = 12.2%
Density = 18398

WW3 without assimilation in the BC

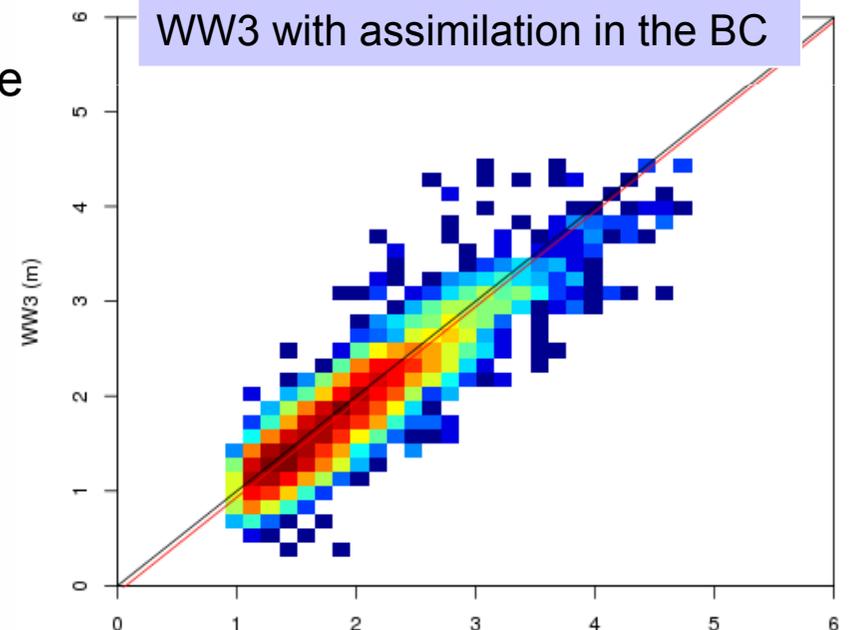


Significant wave height (m)

- Better slope with the assimilation

Bias = -6 cm
RMSE = 21.6 cm
Scatter Index = 11.6%
Density = 18398

WW3 with assimilation in the BC



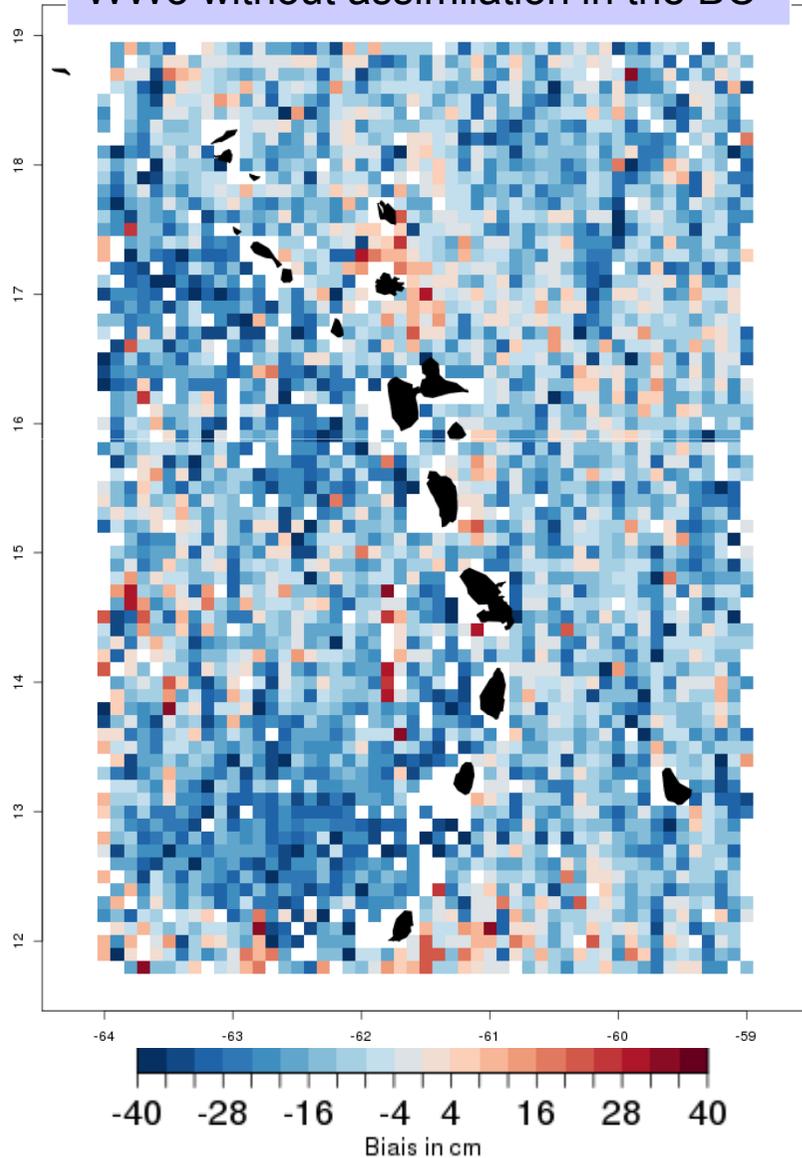
1 4 14 53 200 750

1 4 17 67 272 1107

Long run from July 2012 to July 2013

Impact of assimilation at the boundaries

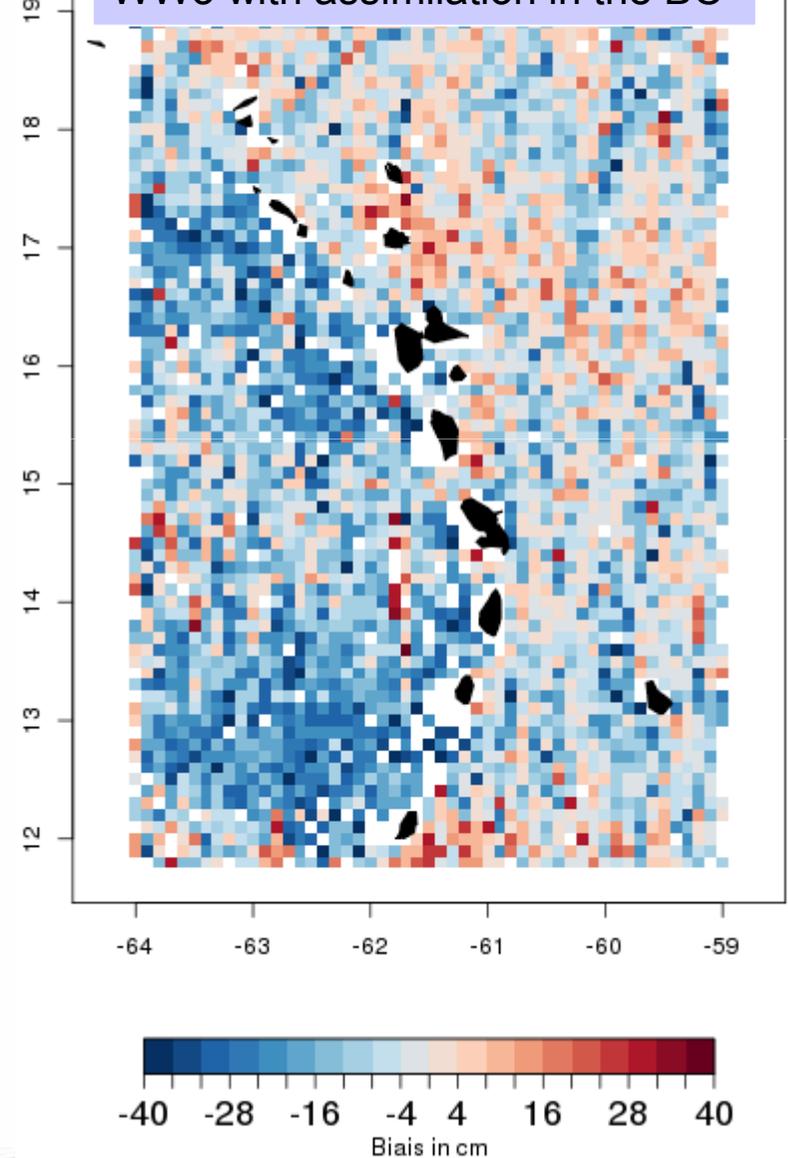
WW3 without assimilation in the BC



Mean bias of
significant wave
height (cm)

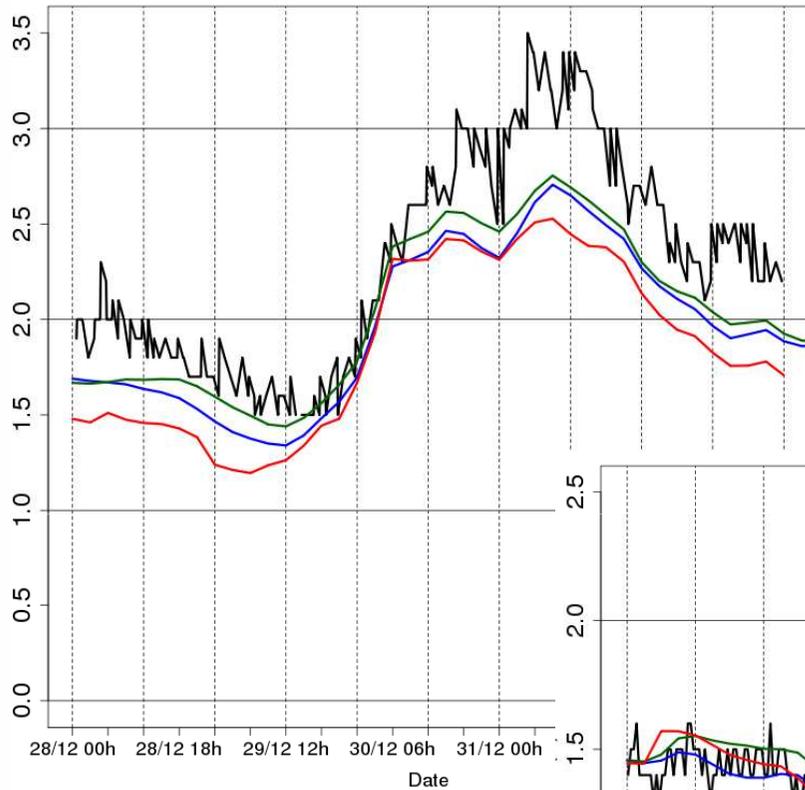
- Global improvement
- Less bias but still an underestimation in Caribbean sea

WW3 with assimilation in the BC



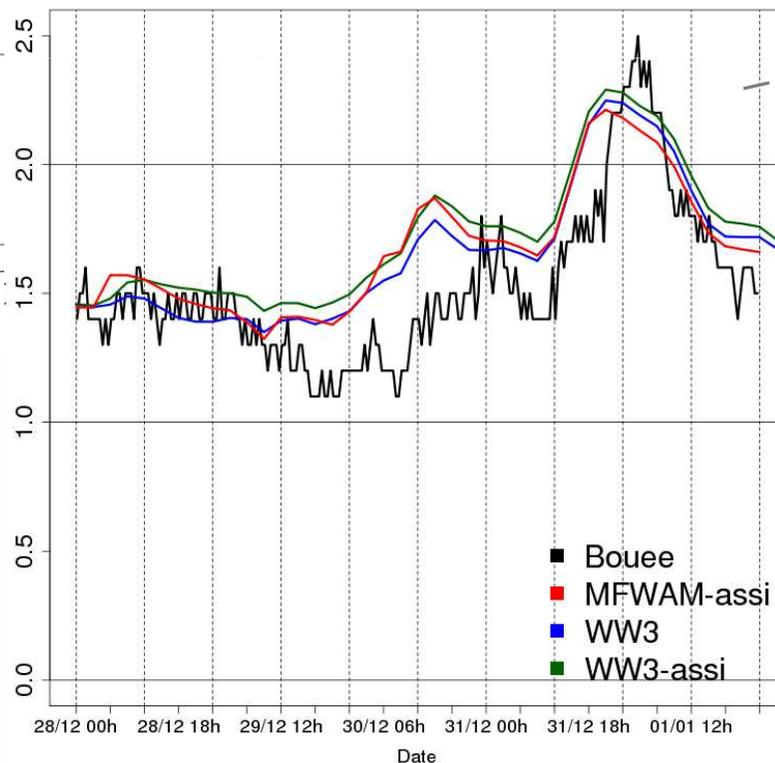
Impact of assimilation at the boundaries

Case of a northerly swell – Decembre 2010



Validation with buoys

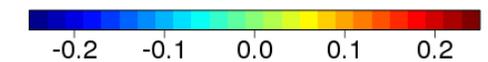
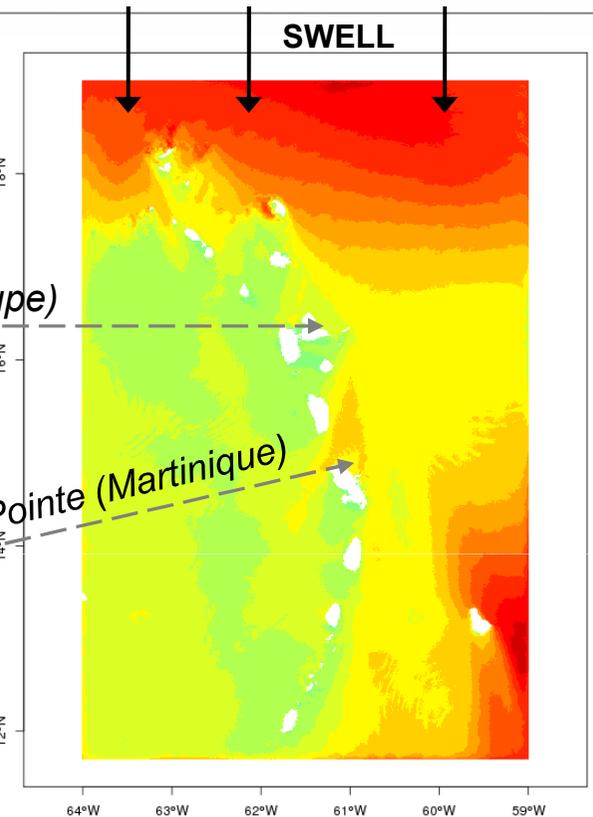
Thanks to Cerema for its buoy data



Correction of 5 cm to 20 cm in SWH of WW3 thanks to assimilation in the global model

Grande Vigie (Guadeloupe)

Basse-Pointe (Martinique)



Difference in SWH (m)

WW3 assi – WW3 ref

31/10/2010 at 12h UTC

Conclusion and perspectives

- **Good description of sea state by high resolution WW3, with a scatter index of 11,6%, thanks to altimeters data (2012/2013)**

⇒ **The validation with altimeters showed an underestimation of SWH in the caribbean sea (western part of the french islands). To overcome this uncertainty, test runs are ongoing with better bathymetry and ajustement of the dissipation source terms.**

- **Island effect is well described by the coastal WW3 and this agrees well with altimeters data at nearshore tracks.**

- **The use of boundary conditions improved by the assimilation of altimeters data, induces a better scatter index (improved by 5 %) and reduces by half the bias (long run 2012/2013).**

⇒ **Future works will focus on improvement for Guyana domain and implementation of a high resolution WW3 on french islands in Indian ocean.**

Thank you for your attention



Questions ?