CONTRIBUTION OF THE SARAL/Altika MISSION TO SEA-STATE ANALYSIS AND PREDICTION AT MESOSCALE AND IN COASTAL ZONES

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SARAL/Altika mission has been designed to provide information in coastal zones. It is expected that measurements from this mission should better contribute to the prediction of waves at meso-scale and in coastal areas through several aspects.

- **The first one is related to the validation of an atmospheric model at 2/3 km horizontal resolution over the Western Mediterranean Sea. The validation of wind speeds from high resolution (2.5 km horizontal mesh), non hydrostatic Numerical Weather Prediction (NWP) is an important issue, in particular in the coastal zone. Under the developing program HyMeX (HYdrological cycle in the Mediterranean Experiment), the AROME model (Bouttier et al. 2006) deployed over the France domain (AROME-France), will be deployed in the Western Mediterranean Sea (AROME-WestMed) over a period of several months.**

- **The second one is related to the improvement of the Meteo-france wave prediction system MFWAM with a new physics package (Ardhuin et al. 2010). The physics implemented in the new wave model has reduced significantly the model errors for various sea-state conditions. The downscaling of the model at mesoscale and close to the coast at a resolution close to AROME model is on going. The validation of such modeling and the understanding of the errors accumulated when waves are reaching the coast relies on a very few wave buoys and on the ability of an altimeter to measure waves in the coastal zones. It is expected that SARAL-Altika should be able to provide such measurements for validation. The data will be used after being validated and calibrated with procedures that will have been developed in the Laboratoire d'Océanographie Spatiale (LOS/IFREMER). Those data will be merged with an existing data base consisting in homogeneously calibrated measurements from the various altimeter missions (Queffelou et al., 2004, 2009).**

- **The third one is related to optimal use of remote sensed wind/Wave for data assimilation in wave models at global scale and regional scale. The impact of using additional data from SARAL/Altika for operational forecasting of waves in addition to existing sensors of the same type, in an optimal way, will be made in the continuity of the work undertaken with previous altimeters (Skandrani et al. 2004). This capacity will be developed in the context of assimilation combined with spectral data from previous existing sensors type like ASAR (Aouf et al. 2006, 2009) or future type with the CFOSAT mission (Hauser et al. 2001).**

- **The last one is related to the impact of waves on the turbulent fluxes.**

Turbulent fluxes are currently parametrized in the NWP models using bulk formulas. Recent studies (Semedo et al., 2009) showed that these parameterisations are not accurate enough, as fluxes (wind stress) depend on the sea state especially in low wind/swell conditions and/or far from neutral conditions. Within the Hymex campaign, we aim to better understand how waves have an impact on the turbulent fluxes .

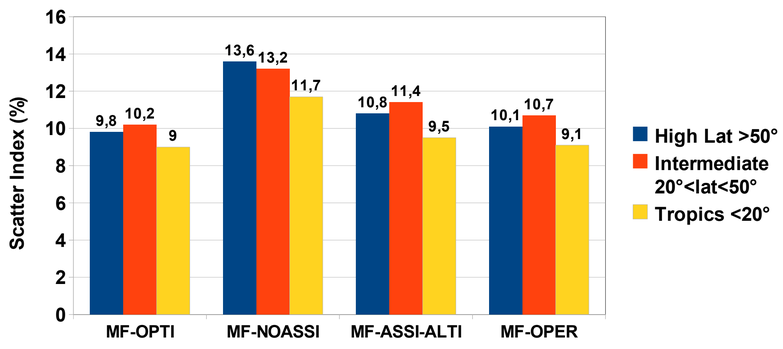
The present operational wave forecasting system of Meteo-France MFWAM has been developped thanks to joint efforts with ECMWF, SHOM, IFREMER with the support of CNES

The MFWAM model is based on ECWAM source code (model operated at ECMWF) modified for new wave physics (Ardhuin et al. 2010), including:

- -Non isotropic dissipation: -> Better adjustment of the mean direction and angular spreading
- -Threshold mechanism from the saturation spectrum , instead of mean wave steepness dependency Breaking term: -> better for for mixed wind sea-swell situations
- -New term for swell damping due to air friction, Drag Limitation (Zo max)

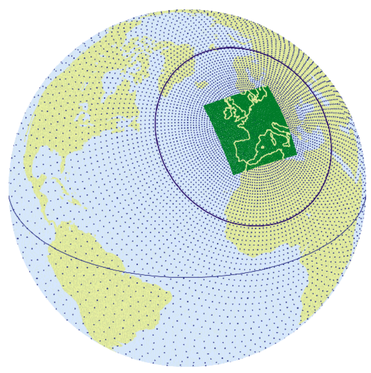
And with additional modifications:

- -introduction of ASAR LP2 and Altimeter data assimilation scheme (Aouf et al. 2006,2008)
- -Implementation of Multi-grid nesting: from Global to Regional models
- -Introduction of a partitioning scheme for swell components



Impact of the assimilation of SAR+ altimeter data (Jason2+ENVISAT) data, and altimeters alone, validation against Jason-1 Sig. Wave Height (not assimilated). Scatter Index is the normalized random error (standard deviation error).

MF-OPER: MFWAM with the assimilation of SAR + altimeters
MF-NOASSI : MFWAM without assimilation
MF-ASSI-ALTI : MFWAM with assimilation of altimeters only
MF-OPTI: MFWAM with recent improvement of the assimilation scheme, with assimilation of SAR+ altimeters



Meteo-France is running operational Global and Regional Numerical Weather Prediction models

•Global: ARPEGE/IFS (code shared with ECMWF)

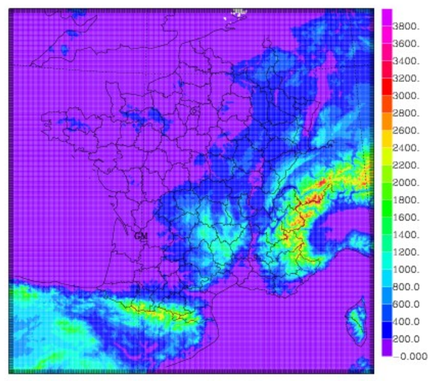
with stretched mesh **10-55** km (4 days forecasts/4 times a day, 4DVAR assimilation system). Grid shown on above figure.

•LAM (Limited Area Models):

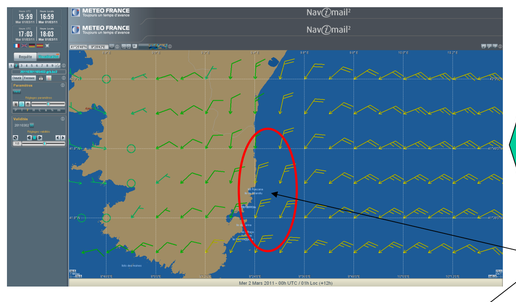
•ALADIN (**10 km**) nested in IFS(ECMWF)

to cover large overseas territories areas (3DVAR)

•AROME (**2.5 km**) nested in ARPEGE/IFS over France (3DVAR). Non Hydrostatique means that the vertical velocity is an explicite variable, the vertical accerelation is non zero in the dynamical equation. The convection is explicitly resolved.

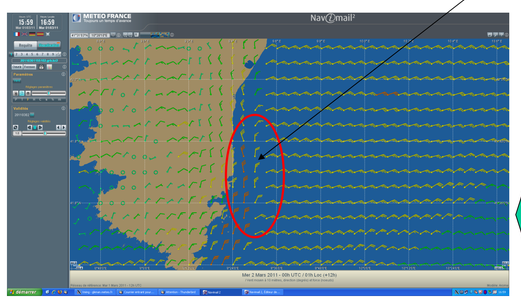


Domain of AROME-France with orography at 2.5 km resolution

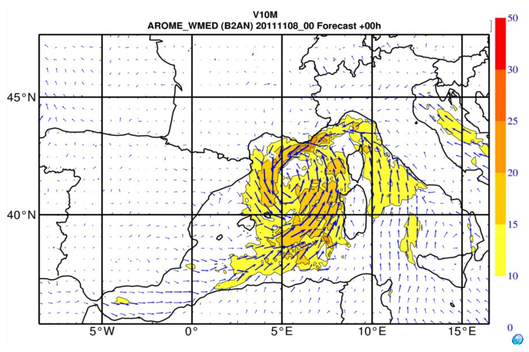


10m winds from ARPEGE global model with streched mesh (About 10 km over France)

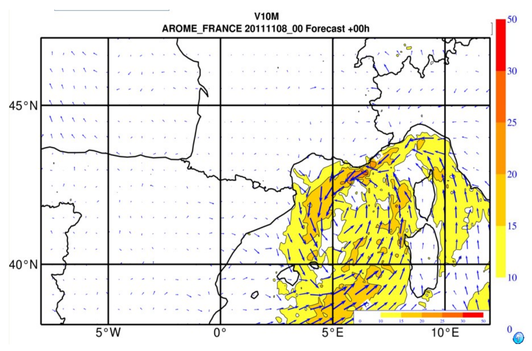
Larges differences in the wind partern close to the island (coastal zone). Wind speed increases much more when approaching coast with AROME (together with larger changes in wind direction).



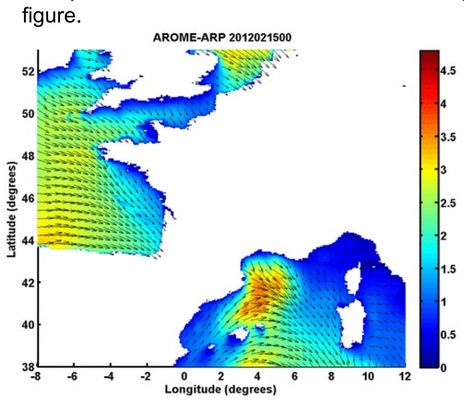
10 m winds from AROME model (2.5 km mesh).



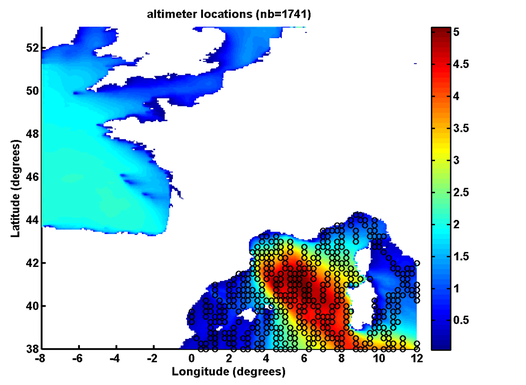
10 m winds from AROME-WestMed deployed for the HyMEX experiment. This version has additional data assimilated in with a dedicated 3D var assimilation scheme, resulting here in a better representation of the cyclogenesis, compared to the operational MFWAM/AROME-France on right figure.



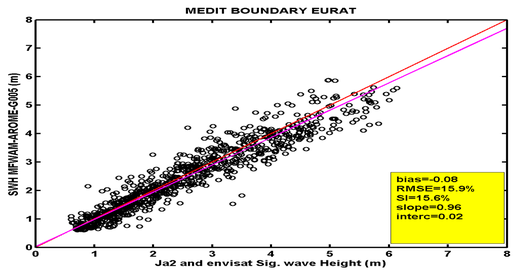
10 m winds from the operational MFWAM/AROME-France.

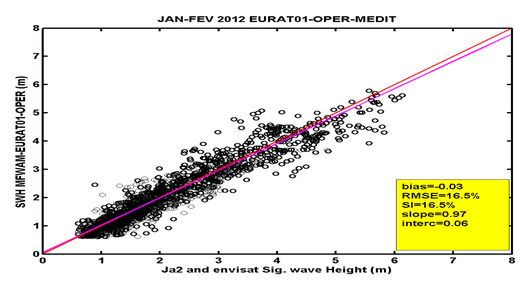


Domain of MFWAM/AROME-France (2.5 km resolution). Significant wave height field.



Locations of altimeter (Jason-2 and Envisat) super observations on the Meditteranean part of the AROME-France domain.





First validation results of MWAM/AROME-France (2.5 km resolution). The results are compared to those obtained with MFWAM/ARPEGE (10 km resolution). SWH model data are compared to Jason-2 and Envisat SWH data. The RMSE is reduced when increasing the model resolution.

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