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Operational setup

Operational suite consists of several model configurations:

- ALADIN-HR8: 8km horizontal grid spacing, 37 levels, ALARO phy.; CANARI+3DVar with 6h cycle (no DFI); 72h fcs., (with DFI) ECMWF LBC (lagged mode), 4 runs per day (00, 06,12 and 18 UTC);
- ALADIN-HR4: 4km horizontal grid spacing, 73 levels, ALARO phy.; CANARI+3DVar with 3h cycle (no DFI); 72h fcs. (with DFI), ECMWF LBC (lagged mode), 4 runs per day (00, 06,12 and 18 UTC);
- ALADIN-HR2: 2km horizontal grid spacing, 37 levels, SSDFI, 24h fcs. hours, ALADIN-HR8 LBC, 1 run per day (06 UTC)
- DADA: 2km horizontal grid spacing dynamical adaptation of wind

Operational LBC

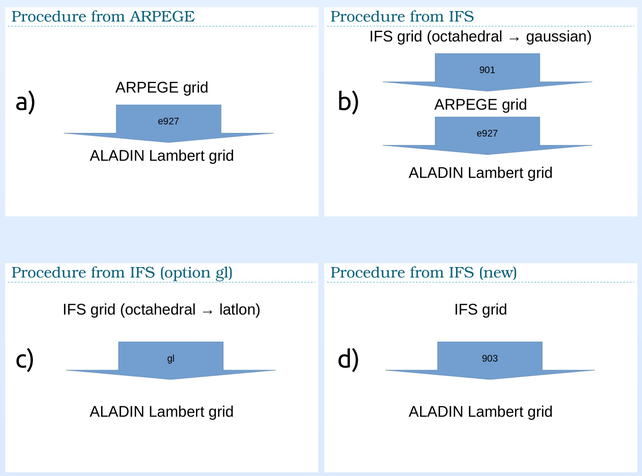
Current operational set-up:

- ARPEGE: 8 km resolution, 105 levels
- IFS: 15.4 km resolution, 60 levels
- LBCs are on a quadratic grid
- We get LBC files from IFS dissemination
- We can experiment using IFS data from MARS archive
- These are not identical (but should not be very different)

Options that work with MARS and are meaningful grid values for HRES (and for EPS too):

- current oper octa grid O1280 (O640)
- Reduced GG for GP fields N640
- Reduced GG for SP fields T1279
- Latlon 0.07/0.07 (0.15/0.15)
- Full GG F1280
- 901 works with N grids
- Use MIR (mars -m) for SST (Ulf Andrae)

- Cubic grid LBCs from IFS are better than quadratic.
- Smoothing introduced by vertical interpolation actually reduces the error when compared to TEMP.
- Use hourly LBCs if you can afford it!
- 903 works since summer, testing started (Ryad El Khatib)



The procedures for obtaining LBCs: from ARPEGE (a) uses only configuration e927, from IFS HRES (b) uses configurations 901 and 927, from IFS ENS (c) uses gl and conf 927, and new option for IFS HRES and ENS (d) is configuration 903. Options (b) and (c) involve one more interpolation step before running the model configuration.

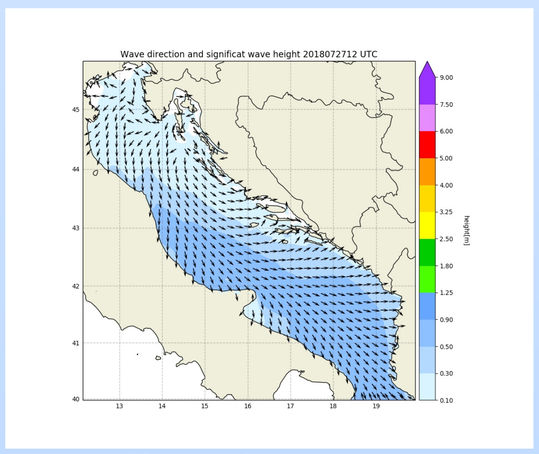
Wave model

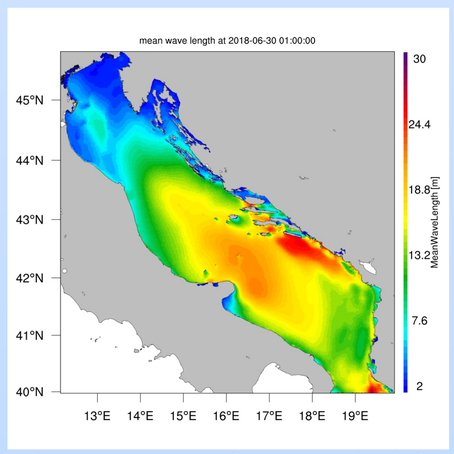
Wind Wave Model III was implemented in the DHMZ. Some characteristics of the model:

- wind forcing comes from dynamical adaptation of wind to 2km grid spacing over the 3-day forecast range (DADA)
- The boundary condition at the Otranto Strait - WAM model forecasts computed at ECMWF
- unstructured grid

Verification results showed underestimate of significant wave height by 8 cm, an absolute error of 21 cm and a correlation of 91% when comparing with the altimeter of the SARAL satellite.

More details can be found in paper: Sikirić, Mathieu Dutour, et al. "Operational Wave Modelling in the Adriatic Sea with the Wind Wave Model." Pure and Applied Geophysics: 1-15 (https://doi.org/10.1007/s00024-018-1954-2).





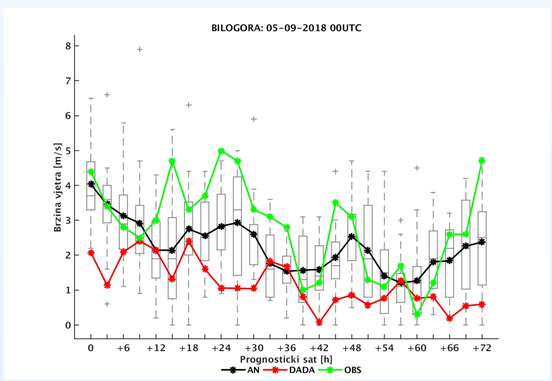
Example of forecast from Wind Wave Model III: wave direction and significant height (left), mean wave length (right).

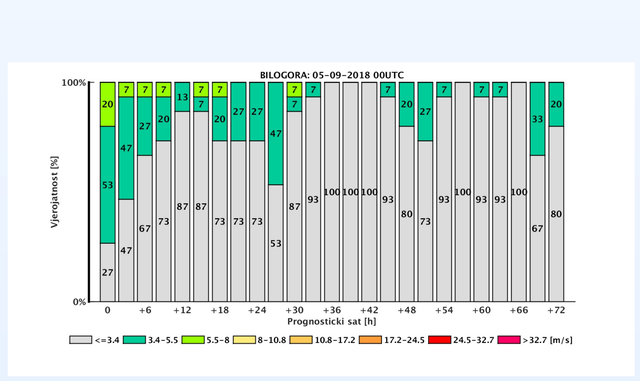
Postprocessing

From the end of November 2016 the analog-based post-processing method is used to provide forecast of wind speed for 16 locations.

The operational analog-based method uses four 2 km HRDA operational output products as predictor variables: wind speed and direction, vorticity and divergence. To produce 3-hourly deterministic analog-based wind speed forecast (up to +72 hours), the members of 15-member analog ensemble are averaged for every lead time. The analog-based method is used to forecast the probability within 8 prespecified wind speed categories. The forecasted probability for every category is estimated from the members of the analog ensemble.

The application of analog-based method has been thoroughly tested and the results are published at Journal of Applied Meteorology and Climatology (Odak Plenkovic et al., 2018). Currently, the new algorithms are being developed to expand the number of locations and the forecast variables.



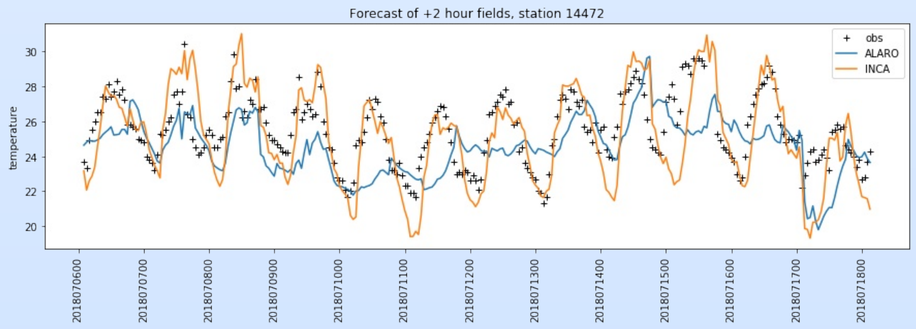


Deterministic (left) and probabilistic (right) forecast with analog-based method for station Bilogora. On left figure observations are denoted with green, DADA forecast with red and analog-based forecast with black color.

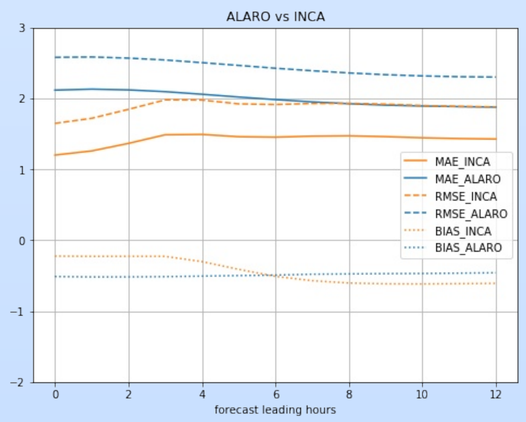
Nowcasting

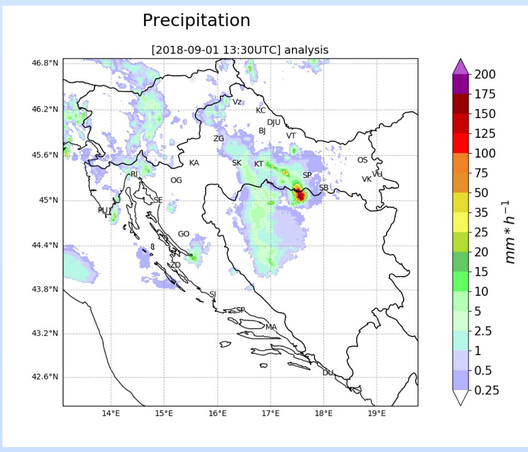
INCA system was implemented and verified against ALADIN-HR4 forecast. Seven stations (4 of them not used for analysis calculation) were used for the INCA forecast field verification and its comparison to the ALADIN-HR4 forecast fields (also used as INCA background).

Comparison showed overall improvement over ALADIN during first six hours of INCA run initiation. Two significant ALADIN forecast runs (00 and 12 UTC) were also isolated and compared to the INCA forecast fields. It was shown that ALADINs cold temperature bias during the day and warm temperature bias during the night were significantly corrected by the INCA nowcasting system (picture not shown).



2m temperature +2h forecast from INCA (orange), ALADIN-HR4 (blue) and observations (black cross) for 10 days in July 2017 for station 14472.





Left: Mean apsolute error (MAE), bias (BIAS) and root mean square error (RMSE) for INCA (ORANGE) and ALADIN-HR4 (BLUE) plotted against INCA forecast hour and calculated over 7 stations and time period 20.06.2018. - 20.08.2018. Right: example of one precipitation analysis field.

INCA precipitation module was set up, using the 15 min OPERA (Operational Programme for the Exchange of weather RAdar information) radar composites as background and automatic rain gauge network for corrections. Despite the lack of radar measurements along the Croatian coast, first results look promising.