BRIEF DESCRIPTION OF OPERATIONAL ATMOSPHERIC MODELS AT NIMH-BAS

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The official numerical forecasting tool in NIMH is the ALADIN model. The name of the model means "Aire Limitée Adaptation dynamique Développement InterNational". The model is common development of scientists from 15 meteorological services.

This is a spectral model for regional forecasting of meteorological fields.

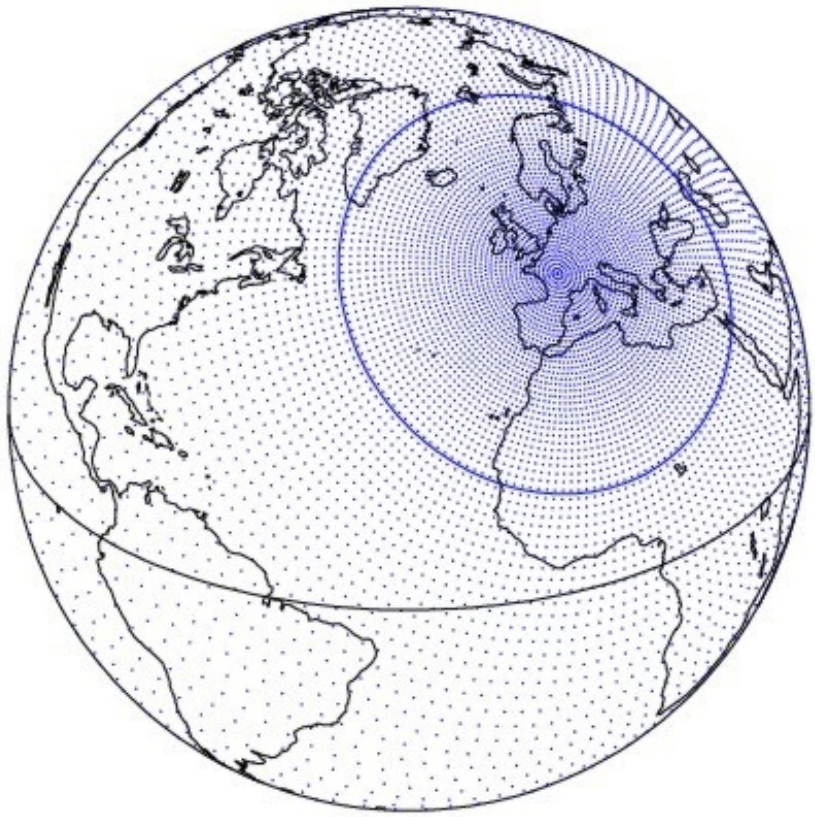
Initial and boundary conditions are provided global model ARPEGE, which is a result of the common development between ECMWF and Meteo France.

This two models are close related, so it will be nice idea to give a brief description of them for end users of data, they are producing.

Brief description of ARPEGE, ALADIN

ARPEGE/IFS: ARPEGE is the acronym of "Action de Recherche Petite Echelle Grande Echelle". This model is used both at METEO-FRANCE and ECMWF; at ECMWF it is named IFS (Integrated Forecasting Sys-tem). ARPEGE is a global spectral model, with a Gaussian grid for the grid-point calculations. The vertical discretisation is done according a following-terrain pressure hybrid coordinate. There is a possibility to have an horizontal variable-mesh: the change of horizontal representation is defined by a change of pole (one defines a high resolution pole which can be different from the northern pole), and a conformal transformation done according to (Schmidt, 1977). If one denotes by c the stretching factor of the conformal transformation, the mapping factor M writes $M = 0.5(c +1/c)\mu+0.5(c-1/c)$ where μ is the sine of the apparent latitude on the transformed sphere. M varies between c at the high resolution pole and 1/c at the low resolution pole. ARPEGE contains different models (a 3D primitive-equation model, a 3D non-hydrostatic model and a 2D sha-llow-water model), different assimilation schemes (optimal interpolation, 3D variational, 4D variational), an internal post-processing scheme (FULL-POS) and some other diagnostics, different initialisation schemes (adiabatic normal mode initialisation, digital filter initialisation). A tan-gent linear code and an adjoint code have been coded for most applica-tions. ARPEGE/IFS can work with different physics packages; there is one physics package used at METEO-FRANCE and one other at ECMWF. ARPEGE can be used for climate applications and in this case it uses a slightly different physics package. It is planned to harmonize the physical packages as far as possible between the operational version of

ARPEGE (used for routine forecasts) and the climate version of ARPEGE. ARPEGE is used operationally at METEO-FRANCE (two versions, ARPEGE-FRANCE with a stretched coordinate (on 46 vertical levels and truncation 358) and ARPEGE - TROPIQUE with a regular re-solution); IFS is used operationally at ECMWF. Next picture illustrates the stretched geometry, used in ARPEGE.



ALADIN is a limited-area version of ARPEGE. It is still a spectral mo-del; its horizontal domain covers only a limited area, so the fields are ``bi-periodicised'' to be made able to match with a spectral representation. The vertical coordinate is the same as the one of ARPEGE. ALADIN needs to be forced by a global model which has to provide lateral boundary conditions; the lateral forcing is done according to a Davies relaxation (Davies, 1976).

ALADIN is generally used with a plane projection (one can currently use a conformal Lambert projection or a Mercator projection). When using ALADIN with a domain which is not too big, the horizontal grid is a quasi-regular grid (the mapping factor M has only weak variations and remains close to 1). Some applications can require a big domain where M can become significantly greater than 1. ALADIN can work with most of the options of ARPEGE (but the shallow-water model and the 4D-VAR assimilation scheme are not coded in ALADIN). Most of the code is common to ALADIN and ARPEGE, but there are specific applications which require different parts of code. ALADIN currently uses the same package of physics as ARPEGE: this

strategy will change in the future where it will be made possible for ALADIN to use physical parameterizations designed for 2 km mesh-size models. ALADIN is used operationally at METEO-FRANCE but also in Morocco and Tunisia, some ``European Community'' countries and some non-European Community Eastern countries.

The version of the model, currently used as operational in Bulgaria now is CY29T2OP2. Here are some details about it configuration:

Horizontal resolution – 9.0 km, linear grid

Number of vertical levels – 46

Advection scheme – two time-level semi-Lagrangian

Time step – 400 s

Integration domain – 122x92 points without so called extension zone.

Coupling frequency – 3h (6h before beginning of july 2006)

Forecasting range – 72 hours (48 h before may of 2006)

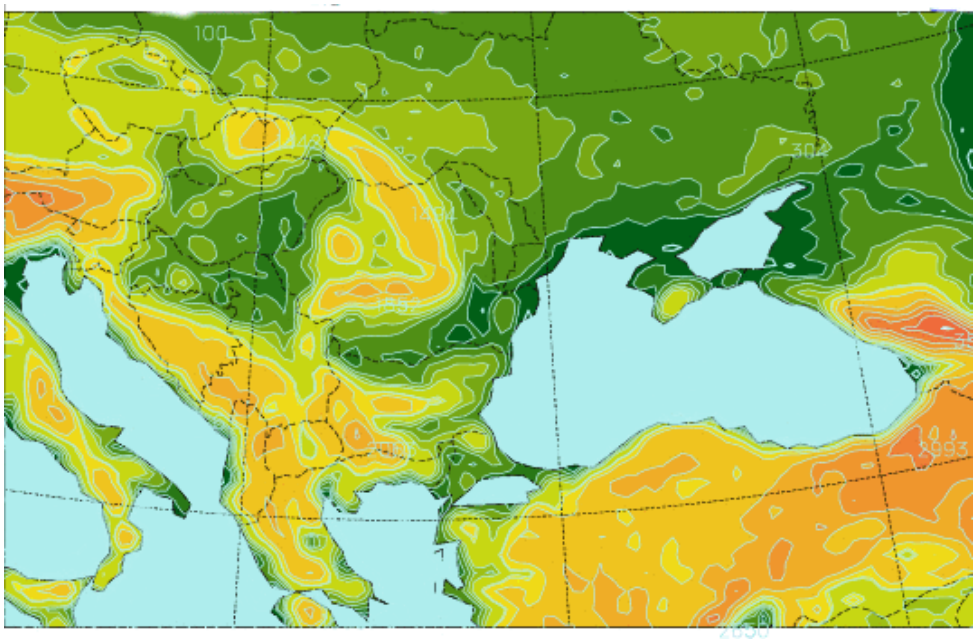
The model is running on two processor LINUX PC.

The domain of the coupling files has the following characteristics:

Horisontal resolution: 24.031481km quadratic grid

Number of points 120x90

Next picture shows the region covered by coupling domain.



The reasons to have such big coupling domain on relatively low resolution are three:

1. Bulgaria and Rumania use the same coupling domain
2. The wish of the both countries to have date for the whole region of the Black sea.
3. Lower telecommunication expenses.

Due to the spectral presentation of the fields in the model, each coupling file contains the full set of the fields, necessary for the running of the mo-del. Thus we have the possibility to obtain the fields for forcing of the sea wave model(s), oil spill drift model and other related without running the full 48 hours forecast over the Black sea, but in cheaper manner.

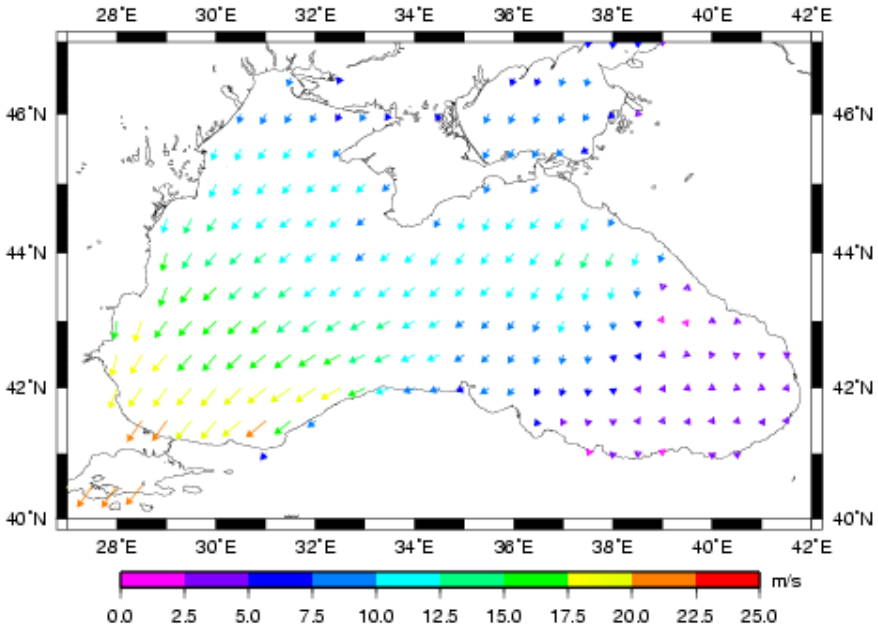
The technology of obtaining necessary fields looks like follows:

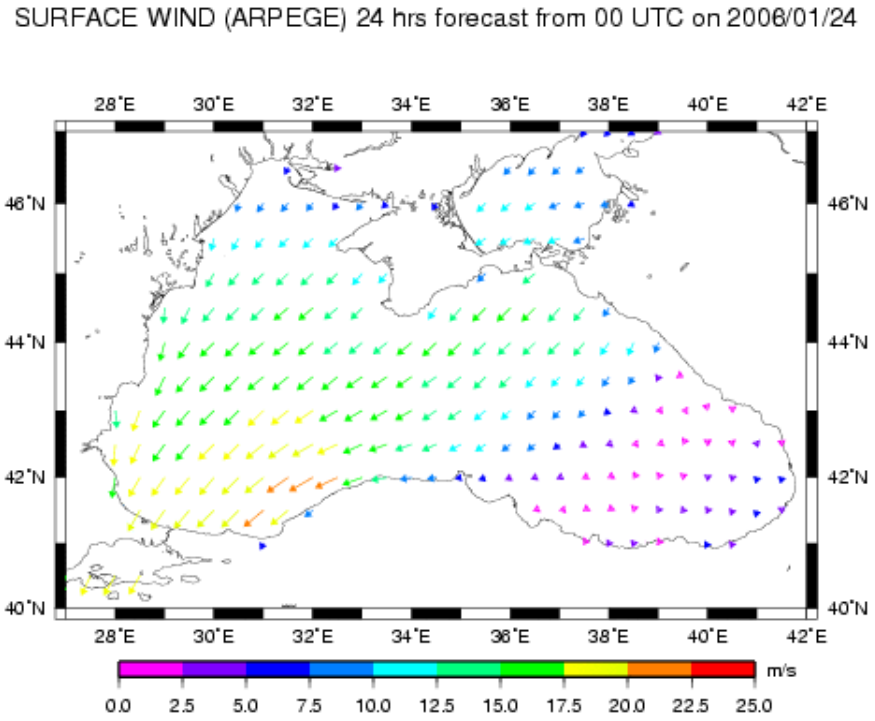
Run one time step of the model over coupling domain with each coupling file as initial condition to obtain the values of surface elements like 10m wind, mean sea level pressure, land sea mask et cetera. After words we post process the required fields on domain, which covers the Black sea region with resolution 0.25x0.25 degree and sent the prepared file to colleagues working on marine forecast.

Thus, if we are saying, that the sea models are forced with ARPEGE fields, this is correct only in the mean, that the coupling files are ARPEGE production. But obtaining of the forcing fields is done using ALADIN model on the grid of the coupling domain.

With introducing of the three hours coupling frequency we obtain the possibility to prepare forcing files for the sea models with the corresponding frequency, keeping the 6 hours forcing as a back up possibility. The next two pictures show the evolution of the sea wind during the winter storm from January this year.

SURFACE WIND (ARPEGE) 12 hrs forecast from 00 UTC on 2006/01/24





It clearly can be seen that, the area with the highest values of wind velocity moved from Bulgarian sea coast to the east.

The forcing fields might be prepared according to the will of the end user like dedicated ASCII files, or GRIB files.

One additional possibility is using forcing obtained from ALADIN-BG domain with resolution 0.1x0.1 degrees for the Western region of the Black sea.

In conclusion it should be mentioned, that with introducing of each new cycle of the model code in operational we are obtaining better results as in forecast and more reliable forcing files for the sea models.