

# **Limited Area Modelling Activities at Portuguese Meteorological Service (2001-2002)**

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## **1. Summary of main activity**

During the mentioned period the main effort has been put on the local maintenance of actual tools and no substantial changes occurred on the operational scheme of ALADIN/Portugal. A continuous effort is happening on the implementation of an operational objective limited area analysis scheme using CANARI. Human resources have been dedicated to the development and verification activities. Concerning verification two studies were done, the AL12\_bf cycle versus AL11T2 cycle and the annual objective verification of ALADIN/Portugal. Other developments took place on the diagnostic tools, in particular some improvements on the stability indexes. An objective validation of those tools is now being undertaken. On the data assimilation field there was a first trial with CANARI (AL11) for training purposes. Support was given to ocean modelling activities.

## **2. Workstation version of ALADIN/Portugal**

### **2.1 History of the main events**

Since 24 of April 2000, IM has a Limited Area Model (LAM) running in operational mode. This NWP model is a local installation of the ALADIN model, hereafter called ALADIN/Portugal model. As a brief history, we refer the following operational changes:

Apr 2000	cycle AL09
Jun 2000	cycle AL11T2 (CYCORA included)
Jul 2001	cycle AL12_bf02 (CYCORA_bis included)
Apr 2002	change of the time step (540s to 600s)
Pre-operational:	
Aug 2001	interface between Portuguese meteorological database and OULAN and installation of MANDALAY
Mar 2002	installation of CANARI (AL12_bf02)

### **2.2 Foreseeable activities**

- Maintenance of ALADIN/Portugal WS actual operational version
- Validation and operational installation of CANARY
- Validation and operational implementation of diagnostic tools

## 2.3 Operational version

The operational environment and main characteristics of ALADIN/ Portugal are:

### Computer characteristics

DEC Alpha XP1000 (Compaq), 500MHz, 1 Gb memory  
DIGITAL UNIX V4.0  
DIGITAL F90 and 77 Compiler V5.1, native C Compiler

### Model characteristics

Spectral hydrostatic model  
Hybrid vertical co-ordinates  
DF initialisation  
Semi-Implicit Semi-Lagrangian two-time-level advection scheme  
ISBA surface parametrisation scheme  
Initial and lateral boundary conditions from the latest ARPEGE forecast  
6 hour coupling frequency from ARPEGE

Integration domain:

Size: 100x90 points  
Number of vertical levels: 31  
Horizontal resolution: 12,7 km  
Time step: 600 s

Integration frequency: twice a day

Forecast range: 48 hours

Output frequency: 1 hour

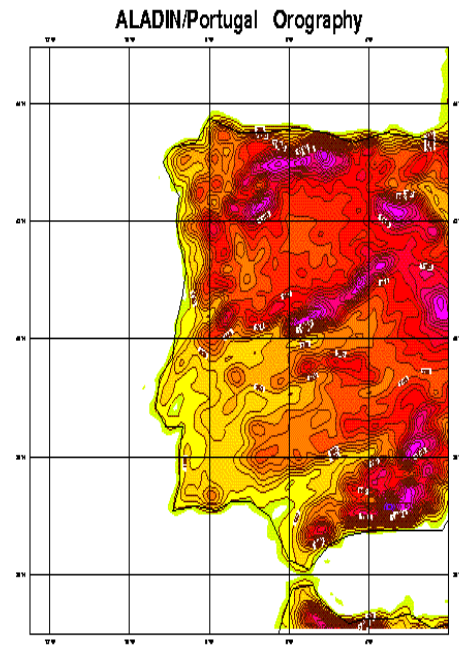


Figure 1 Orography of ALADIN/Portugal

### Available configurations

001, e927, e923 and 701

### Graphical software

The METVIEW/MAGICS graphical software (ECMWF) is used to display ALADIN/Portugal products under a development environment. Besides, a user-friendly visualisation tool for PC's was designed to display up to a maximum of three overlapped meteorological fields coming from the last two operational runs of the model.

## 3. Derived fields and validation of diagnostic tools

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Further post-processing of direct model output has been developed to derive additional fields that can be useful, for instance, to diagnostic extreme weather events. These fields are being validated and tested with some extreme event cases, using ALADIN/ Portugal fields.

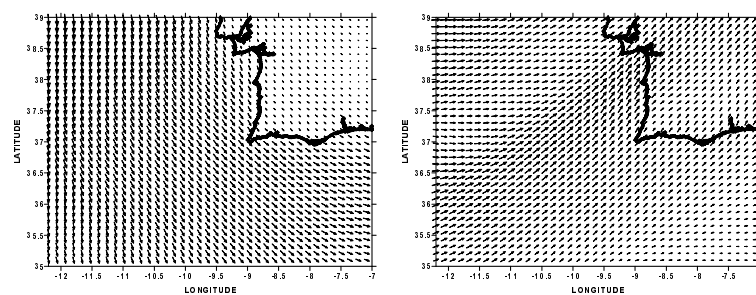
In particular,

- Quasigeostrophic vertical forcing (Q vector divergence)
- Geostrophic frontogenetic function
- Stability indexes (energy index, convective instability index, Jefferson index, modified K index, severe weather threat index and modified total totals)
- Surface moisture convergence and moisture convergence in the layer 1000-850hPa
- Temperature advection and vorticity advection at 1000, 925, 850, 700 600, 500, 400 and 300hPa and differential temperature advection between those levels

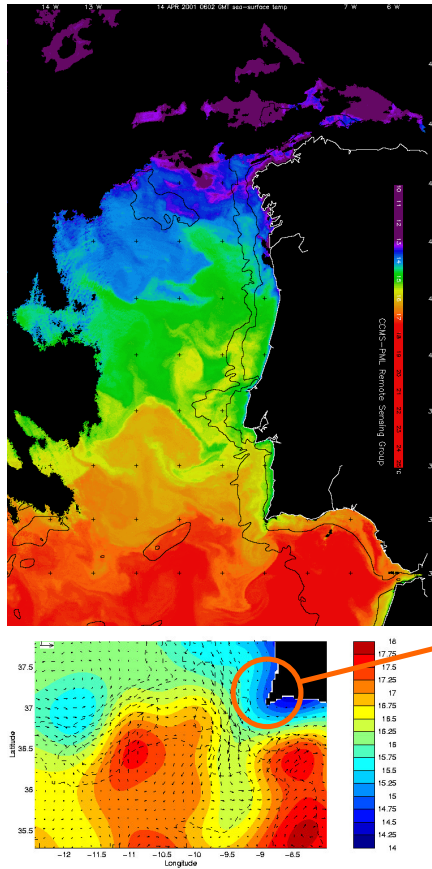
#### 4. Support for ocean modelling

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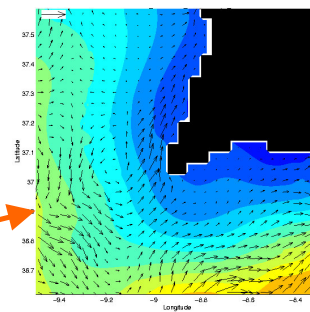
The region offshore cape S. Vicente, in the SW tip of Portugal, is characterised by complex coastline and topography. Recently (April 2001), a navy exercise – Swordfish 2001 – was conducted by the Portuguese navy in this area. Forecasts of the oceanographic conditions were provided to the navy forces through a combination of hydrographic observations (CTD) and modelling using an oceanographic model with data assimilation (HOPS). High resolution wind fields, provided by the ALADIN/Portugal model were used to explore details of the upwelling dynamics around the Cape São Vicente region. The period under study is from the 18th to the 28th April 2001.



**Figure 2** ALADIN/ Portugal 10m wind fields at 00UTC, 18 April (left); and 12UTC, 24 April (right)



**Figure 3** Sea surface temperature from the 14 April 2001 by a NOAA satellite (Satellite images were received by the NERC Dundee Satellite Receiving Station and processed by Peter Miller at the Plymouth Marine Laboratory Remote Sensing Group)



**Figure 4** Near surface (20m depth) T and current fields obtained by 18 April 2001: small domain results

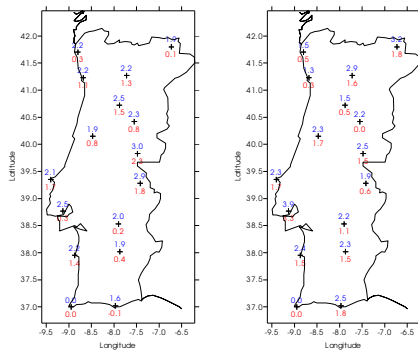
**Figure 5** Near surface (20m depth) temperature and current fields obtained by 18 April 2001: large domain results

“...the results obtained for the surface layers of the ocean reflect the general upwelling conditions that characterised the month of April 2001.”

## 5. Objective Verification

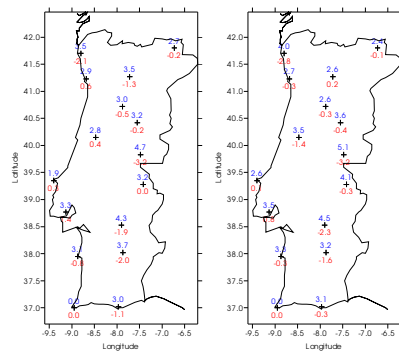
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Since August 1999 ALADIN/Portugal forecasts are objectively verified on a regular basis. All the computations use the nearest grid point from the observation station point (SYNOP or TEMP observations). An annual report is usually published in English.



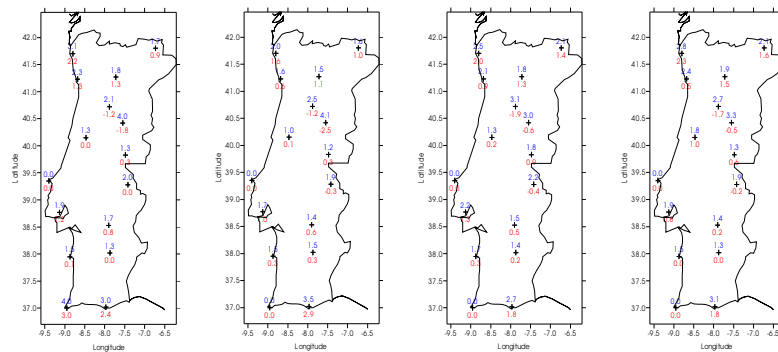
**Figure 6** Spatial distribution of RMSE (blue) and ME (red) 2m temperature for 16 synoptic stations over Portugal at H+48 (12 UTC) for fall and winter (values in Celsius) from the period March 2001 to February 2002

“...there is a warm bias in the 48h forecast (valid at 12UTC) over all Portugal...”



**Figure 7** Spatial distribution of RMSE (blue) and ME (red) dew point temperature for 16 synoptic stations over Portugal at H+48 (12UTC) for fall and winter (values in Celsius) from the period March 2001 to February 2002

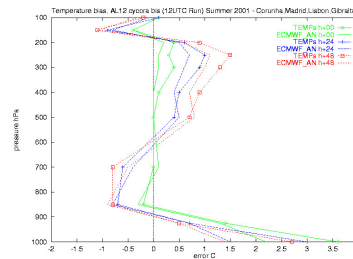
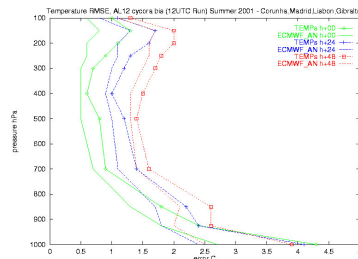
“...there is a tendency to underestimate 2m dew point temperature almost everywhere during fall and winter seasons...”



**Figure 8** Spatial distribution of RMSE (blue) and ME (red) 10m wind speed for 16 synoptic stations over

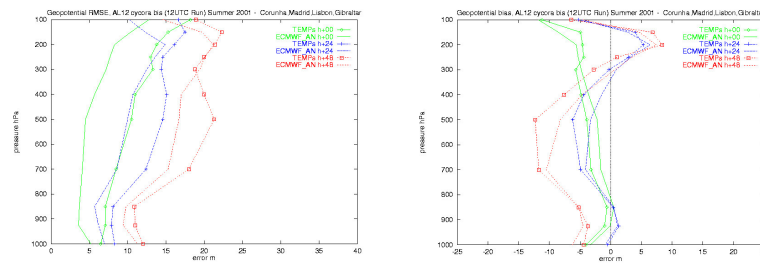
Portugal at H+42 (06UTC) for spring, summer, fall and winter (values in m/ s) for the period March 2001 to February 2002

“...tendency to overestimate the wind speed from the 42h (6UTC) forecasts for all seasons, except in a few highest stations...”



**Figures 9** The RMSE and ME respectively of temperature forecasted by ALADIN/Portugal verified against TEMP observations and ECMWF analyses for different forecast ranges (H+00, H+24 and H+48) and seasons

“...ALADIN/ Portugal has a warm bias in lower and upper troposphere, mainly during summer...”



**Figures 10** The RMSE and ME respectively of geopotential forecasted by ALADIN/ Portugal verified against TEMP observations and ECMWF analyses for different forecast ranges (H+00, H+24 and H+48) and seasons

“...geopotential ME is negative in all troposphere for all seasons and forecast ranges, except for H+24 during summer in the PBL...”