Operational DMI-HIRLAM 2003-2004

The Danish Meteorological Institute

Summary of highlights

There have been several operational changes at DMI during 2003. In particular new sources of satellite data have been successfully assimilated in the operational models. Also changes in run schedule have been made in connection with modifications to the data-assimilation. The main changes are briefly summarized in the items below: A detailed description of the operational system used at DMI is available at www.dmi.dk.

* Use of more ATOVS data, e.g. from EUMETSAT's ATOVS retransmission service (EARS) with data from both NOAA16 and NOAA17. In December 2003 NOAA15 ATOVS AMSU-A data has been used instead of NOAA17 ATOVS AMSU-A due to instrumental failure of the latter in October 2003.
* Use of QuikScat data giving information about the wind field over sea.
* The data window for AMDAR/ACARS has been increased from 30 min. to 90 min.
* A seasonal dependency of the structure functions has been introduced in the variational data assimilation (3D-VAR).
* First guess at appropriate time (FGAT) has been implemented.
* Changes have been made to the run schedule, e.g. the high resolution model (0.05° resolution) is now run 4 times a day compared to 2 times a day previously.
* SST fields from ECMWF used for surface analyses are received at improved resolution (0.5° compared to 1.0° previously).
* The NEC-SX6 supercomputer system has been upgraded to its final configuration by the end of 2003, consisting of 8 nodes with 8 processors each.

Table 1 shows important parameters characterizing the operational setup. It is noted that the DMI operational setup (primo 2004) is run with a special time stepping which

Table 1: Basic information related to model grid, resolution, time step, coupling strategy, forecast length and number of forecasts per day.

Model identification	G	N	E	D
grid points (mlon)	202	194	272	182
grid points (mlat)	190	210	282	170
number of vertical levels	40	40	40	40
horizontal resolution(deg)	0.45	0.15	0.15	0.05
time step (dynamics)	120 s	50 s	50 s	18 s
time step (physics)	360 s	300 s	400 s	216 s
host model	ECMWF	G	G	E
boundary age(forecast)	6 h	0 h	0 h	0 h
boundary age (assimilation)	0 h-6 h	−3 h - 0 h	−3 h - 0 h	−3 h - 0 h
boundary update cycle	3 h	1 h	1 h	1 h
data-assimilation cycle	3 h	3 h	3 h	3 h
forecast length (long)	60 h	36 h	54 h	36 h
long forecasts per day	4	2	4	4

is different from the HIRLAM reference system. The dynamics are run in Eulerian mode and the physics time step is longer than the dynamics time step.

The run schedule is rather complex and is shown in table 2. The first column shows the model startup time in UTC. A given run is indicated by a letter followed by two digits describing model initial time and finally an indication of forecast length in hours. For example, 'G00+60h' means a 00 UTC analysis followed by a 60 hour forecast carried out for model 'G'.

The initial states of the DMI forecasts are produced by analyses valid at 00 UTC, 06 UTC, 12 UT and 18 UTC respectively. The analysis states at 00UTC and 12 UTC are achieved by retrospective analysis cycles (see below). The first guess of the analyses at 00 UTC and 12 UTC is a 3 hour forecast while a 6 hour forecast is used to the analyses valid at 06 UTC and 18 UTC. Forecasts with model 'N' ('Greenland' model) is run only twice a day from the 00 UTC and 12 UTC analyses.

Assimilation runs with cycling of 3 hours are managed through a sequence of retrospective analyses which are run twice a day in delayed mode. The first series of runs starts at 11.50 UTC. Model 'G' starts from the ECMWF 00 UTC analysis data prepared by an increment method where the available analysis for 'G' is interpolated to a coarse mesh data grid with ECMWF analysis data. The difference between this interpolated field and the new ECMWF analysis is an increment ('large scale increment') which is interpolated back to the DMI-HIRLAM field in normal resolution and added to get an updated HIRLAM analysis. Normal HIRLAM 3D-VAR cycles then follows after (valid at 03 UTC, 06 UTC and 09 UTC) to produce an 'up-to-date' state of the atmosphere. The short forecasts providing information to the analyses are

run out to +5 hours in order to give the required information to the FGAT setup. The retrospective runs with 'G' model are used as boundaries for the nested models 'N' and 'E'. These models also run with FGAT option. Currently, however, the high resolution model 'D' is using an analysis increment method only. In this case the first guess of model 'D' is corrected using analyses of model 'E'. This method is applied to all the 3-hourly cycles of model 'D'.

The second series of retrospective runs are carried out around midnight , using the 12 UTC ECMWF analysis data in the processing along the same principles as mentioned above. These runs produce 3D-VAR analyses valid at 15 UTC, 18 UTC and 21 UTC, respectively.

Along with the operational setup described above a new setup to be used from April or May 2004 has been under testing and development during 2003-2004. This new setup is based on the HIRLAM reference system as implemented on a multinode NEC-SX6 supercomputer system. The horisontal resolution of model 'G' gas been tripled. This model is now called 'DMI-HIRLAM-T'. The models 'N' and 'E' have been eliminated since they are covered by the new 'T'-model. Also the high resolution model 'D' has been extended to a larger area. This new model is called 'DMI-HIRLAM-S'. The status and plans for the new setup are summarized below.

Status and Plans February 2004

* A new multinode setup is now available and will be used in the forthcoming operational upgrade in April or May 2004.
* In the new operational system the previous operational models 'G', 'N' and 'E' will be discontinued since these model areas are covered by the new 'T'- model having the same area as 'G' but with a horizontal resolution of 'E' and 'N' (0.15°)
* A new enlarged 'D' model domain will be introduced, using the same horizontal resolution as previously (0.05°).
* The forecast model will be based on the HIRLAM reference system with changes suitable for operational applications at DMI.
* A vertical resolution increase (60 levels) is planned for late 2004.

Table 2: Operational time schedule used (G_E denotes restart from ECMWF analysis. See text for details)

UTC	G	N	E	D
1:40	G00+60 h			
1:53			E00+54 h	
2:20				D00+36 h
2:55		N00+36 h		
ECMWF 00 UTC				
7:40	G06+60 h			
7:53			E06+54 h	
8:20				D06+36 h
ECMWF 06 UTC				
	G_E00+05 h			
11:50	G03+05 h			
	G06+05 h			
	G09+05 h			
			E00+05 h	
			E03+05 h	
12:09			E06+05 h	
			E09+05 h	
				D00+05 h
				D03+05 h
12:31				D06+05 h
				D09+05 h
		N00+05 h		
		N03+05 h		
12:40		N06+05 h		
		N09+05 h		
13:40	G12+60 h			
13:53			E12+54 h	
14:20				D12+36 h
14:55		N12+36 h		
ECMWF 12 UTC				
19:40	G18+60 h			
19:53			E18+54 h	
20:20				D18+36 h
ECMWF 18 UTC				
	G_E12+05 h			
23:55	G15+05 h			
	G18+05 h			
	G21+05 h			
			E12+05 h	
			E15+05 h	
24:15			E18+05 h	
			E21+05 h	
				D12+05 h
				D15+05 h
24:38				D18+05 h
				D21+05 h
		N12+05 h		
		N15+05 h		
24:45		N18+05 h		
		N21+05 h		