ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

SRNWP@FMI

32nd EWGLAM and 17th SRNWP meetings

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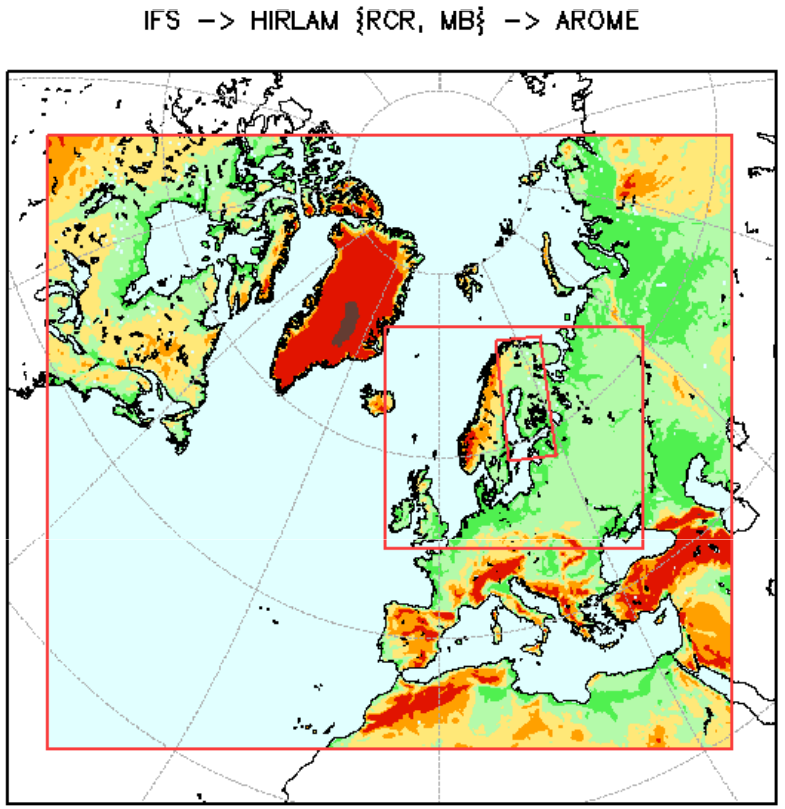


Details of the HFS version 7.2

Analysis		Forecast model	
Upper air analysis	4-dimensional variational data assimilation	**Forecast model**	Limited area grid point model
Version	HIRLAM 7.2	Version	HIRLAM 7.2
Parameters	surface pressure, wind components, temperature, specific humidity	Basic equations	Primitive equations
Horizontal grid length	0.15 degrees on rotated lat-lon grid	Independent variables	longitude, latitude, hybrid level, time
Domain	582 x 448 grid points	Dependent variables	surface pressure, temperature, wind components
Levels	60 hybrid levels		sp. humidity, sp. cloud condensate, turbulent kinetic energy
Observation types	TEMP, PILOT, SYNOP, SHIP, BUOY, AIREP, AMDAR, ATOVS AMSU-A over sea	Horizontal grid	Arakawa-C
		Horizontal grid length	0.15 degrees on rotated lat-lon grid
Background	3 h forecast from previous cycle	Integration domain	582 x 448 grid points
Assimilation window	6 hours	Levels	60 hybrid levels
Observation windows	1 hour	Integration scheme	Semi-Lagrangean semi-implicit, time step 360 s.
Data cut-off time	2 h for main cycles, 4 h 20 min for the re-analysis cycles	Orography	Hirlam physiographic data base, filtered
Assimilation cycle	6 h cycle, reanalysis step every 6 h to blend with large-scale features of the ECMWF analysis.	Physics	* Savijärvi radiation scheme * Turbulence based on turbulent kinetic energy * Rasch-Kristjansson condensation scheme * Kain-Fritsch convection scheme * Surface fluxes according to drag formulation * Surface and soil processes using mosaic approach
Surface analysis	Separate analysis, consistent with the mosaic approach of the surface/soil treatment * sea surface temperature, fraction of ice * snow depth * screen level temperature and humidity * soil temperature and moisture in two layers	Horizontal diffusion	Implicit fourth order
		Forecast length	54 hours
		Output frequency	Hourly
		Boundaries	* "Frame" boundaries from the ECMWF optional BC runs * Projected onto the HIRLAM grid at ECMWF * Boundary file frequency 3 hours * Updated four times daily

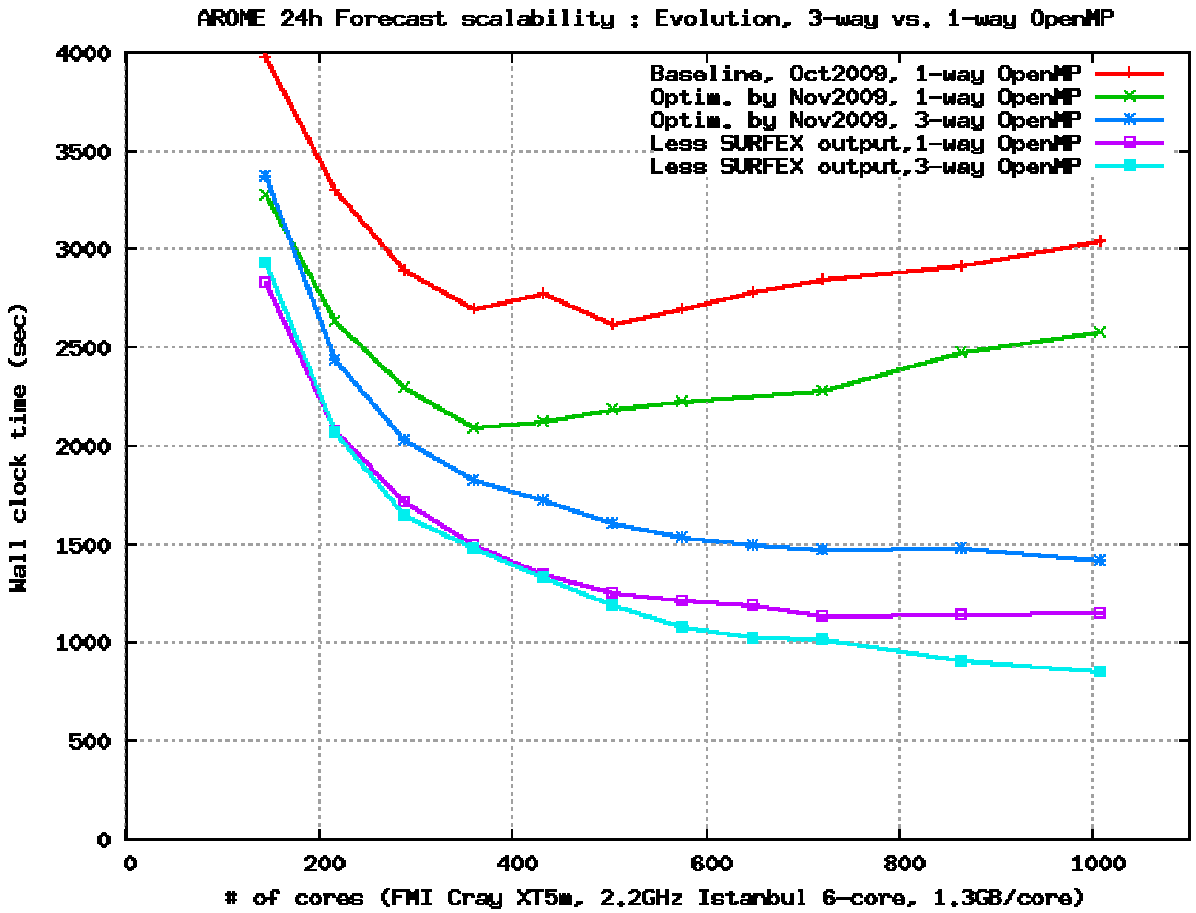
The HARMONIE Forecasting System

- **AROME cycle cy35h1, http://www.cnrm.meteo.fr/arome/**
- **Initial state and LBCs: HIRLAM MB**
- **24 hour forecasts initialized at 00, 06, 12 and 18 UTC**
- **300x600 grid points, distance 2.5 km**
- **60 levels**
- **Output every 15 minutes**
- **Post porcessing includes a radar reflectivity simulator and comparison whith measurments in real time**

Computing and data handling 1/2

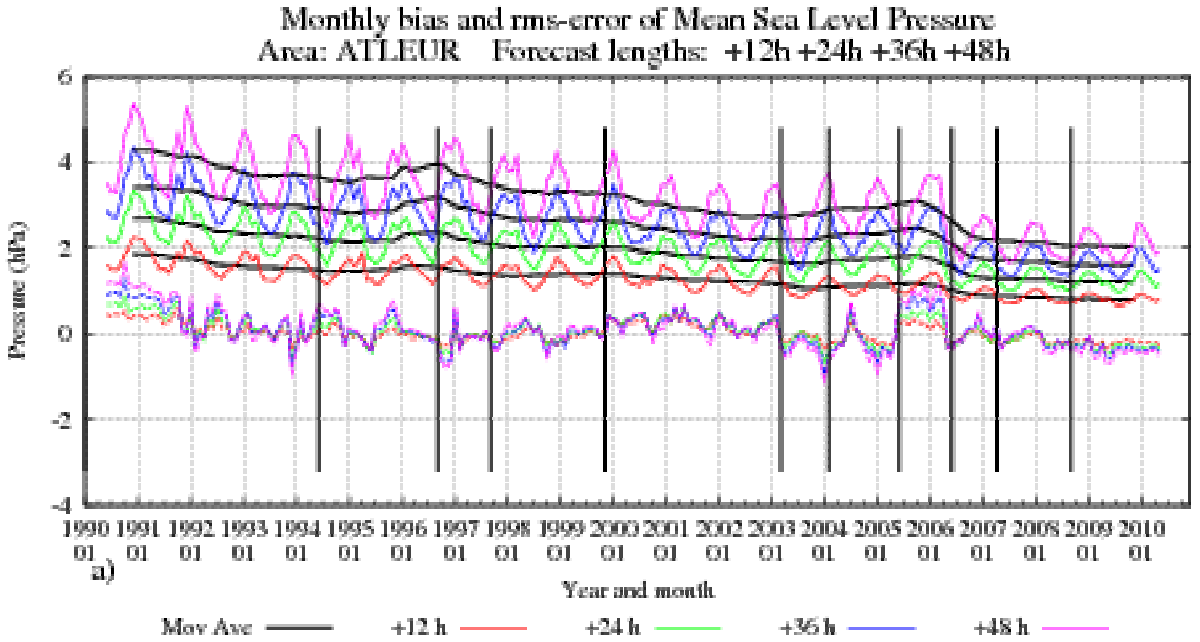
- **The operational forecasts are produced in-house on a system of two identical Cray XT5m clusters:**
- **Peak performance 17.3 TFlop/s for each, ca 35 Tflops/s total**
- **Hex-core AMD Opteron 2.2GHz Istanbul chip**
  - 12 (= 2 x 6) cores in a shared memory node
  - 8.8 GFlop/s peak per core, 105.6 Gflop/s peak per node1
  - 64 nodes x 12 cores = 1968 cores per each cluster
  - 16 GB shared memory per node (~1.3GB per core)
- **2D-torus SeaStar-1 interconnection network**
- **Local Lustre file-system on each cluster: 2 X 60TB raw = 2 X 43TB formatted**
- **Suse Linux operating system**
- **PBS batch job control**

Computing and data handling 2/2



Elapsed time as a function of number of cores for a 24-hour forecast of the FMI HARMONIE/AROME suite. From: Niemelä, S., N. Sokka, and S. Saarinen: AROME forecast migration & optimization at FMI, HIRLAM all staff meeting in Krakow, 13-16 April 2010, www.cnrm.meteo.fr/aladin/spip.php?action=autoriser&arg=1594

20 years of HIRLAM



Monthly bias and rms-error values of mean sea level pressure in the FMI Hirlam forecasts from June 1990 to December 2009. The scores of +12, +24and +48 hours' forecasts are shown for the Atlantic-European area. The vertical lines show the implementation times of new versions and thick black curve is a 12 months' moving average.