DMI-HIRLAM

Danish Meteorological Institute, Meteorological Research Division

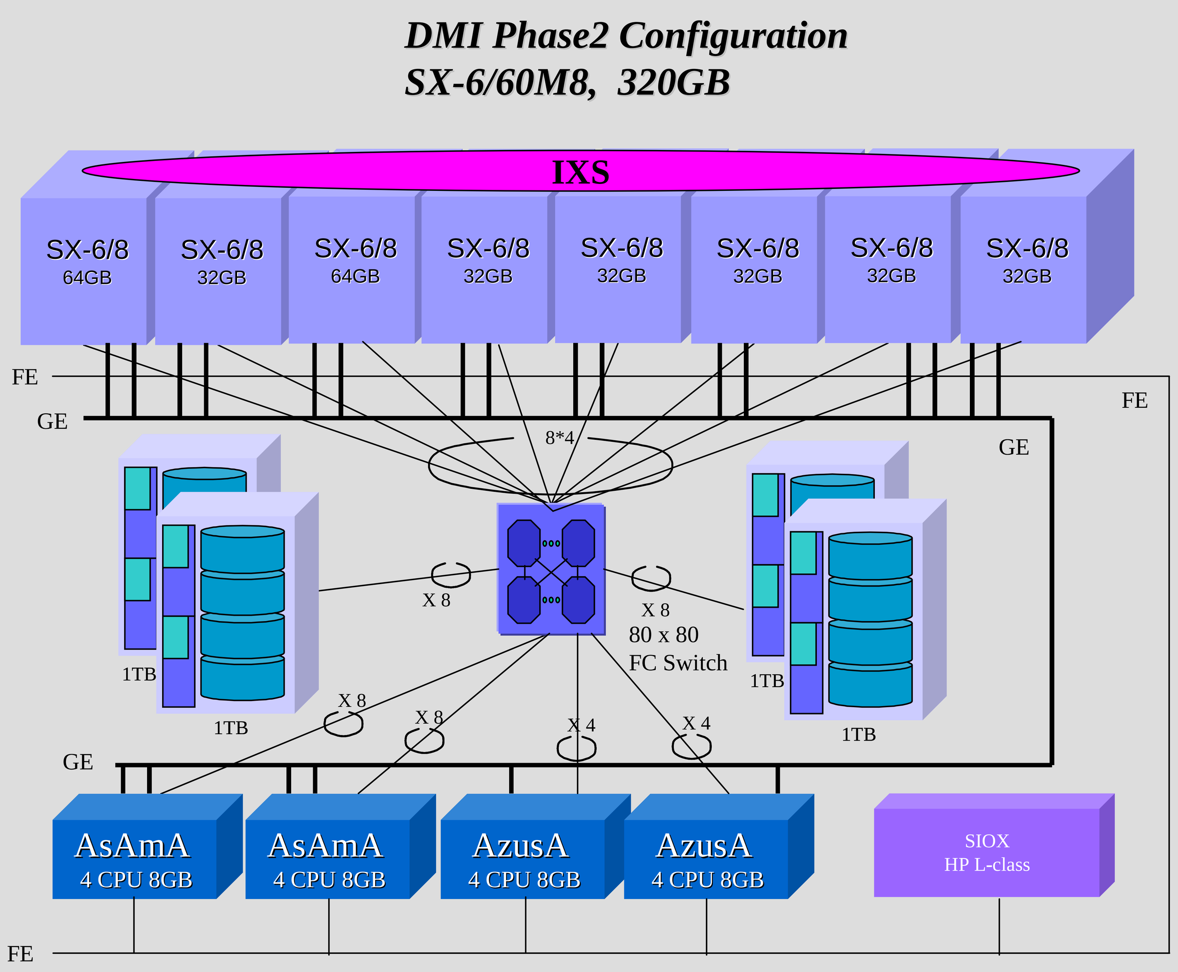

Fig. 1

DMI-HIRLAM upgrades 2003

- More ATOVS data used, from EUMETSAT's ATOVS retransmission service (EARS) with data from both NOAA16 and NOAA17
- Use of QuikScat data giving information about the wind field over sea.
- Use of higher resolution SST fields from ECMWF (0.5 deg. compared to 1.0 deg. previously).
- First guess at appropriate time (FGAT) is implemented.
- Seasonal dependency of structure functions introduced in 3D-VAR.
- AMDAR/ACARS data ±90 min. compared to ±30 min. previously.
- Retrospective assimilation runs at 00 UTC and 12 UTC extended to other models than DMI-HIRLAM-G. (DMI-HIRLAM documentation available at www.dmi.dk)

New supercomputer

- The DMI-HIRLAM models became operational on the phase 1 installation of the new NEC-SX6 super computer in September 2002.
- Installation of the phase 2 configuration took place in March 2003 and stability test was passed in July 2003. The computer configuration is shown in Fig. 1.
- A planned model upgrade primo 2004 involves the HIRLAM reference system (6.2) in an ambitious setup. The required code optimization has been done together with NEC. The speedup on the multi node system compared to the original code is illustrated in Fig. 2. The horizontal resolution of the original large model area (Fig. 3) is increased by a factor of 3 (0.15°) and the number of vertical levels will be increased from 40 to 60.
- It is planned to implement a new high resolution area for the version of DMI-HIRLAM run at a resolution of 0.05° (Fig. 3a) The previous model setup with several model areas is shown in Fig. 3b. The new high resolution configuration is tentatively scheduled to May 2004. Parameterization upgrades, e.g. to turbulence, clouds and condensation might also be introduced.

Parallel Speedup on NEC SX-6

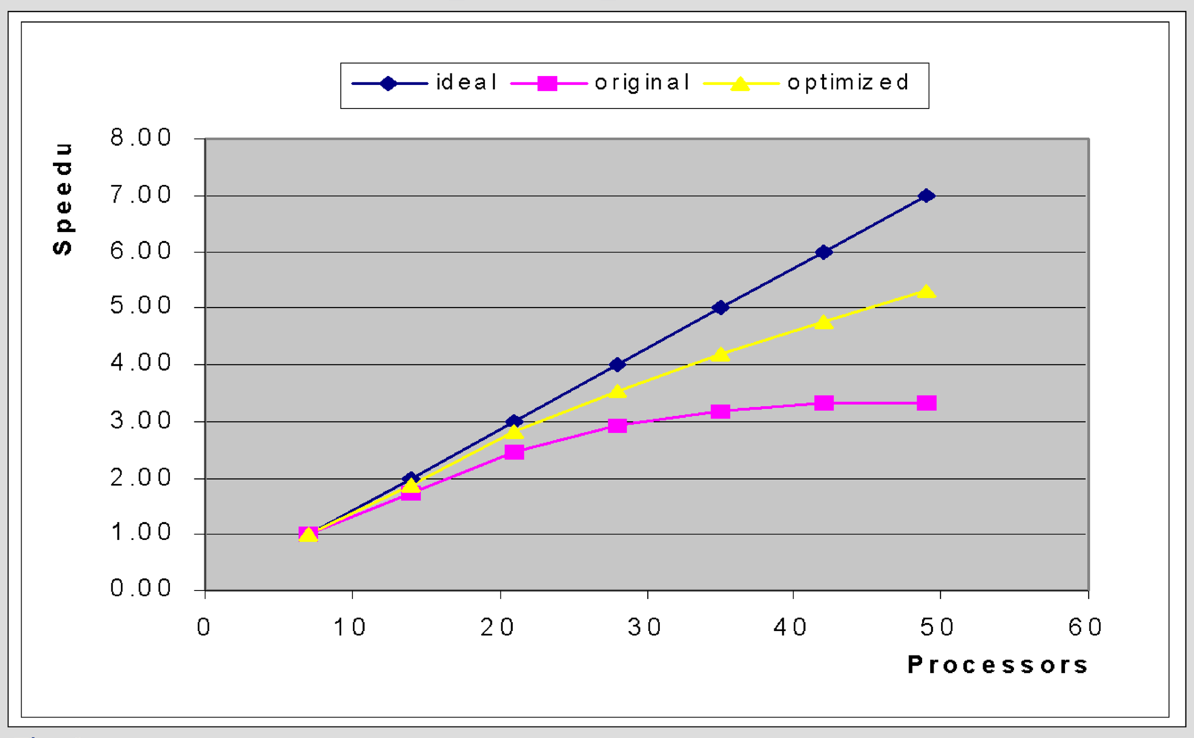

Fig. 2

- Cluster of 8 NEC SX-6 nodes at DMI
- Up to 49 processors: 7 nodes, using 7 processors per node

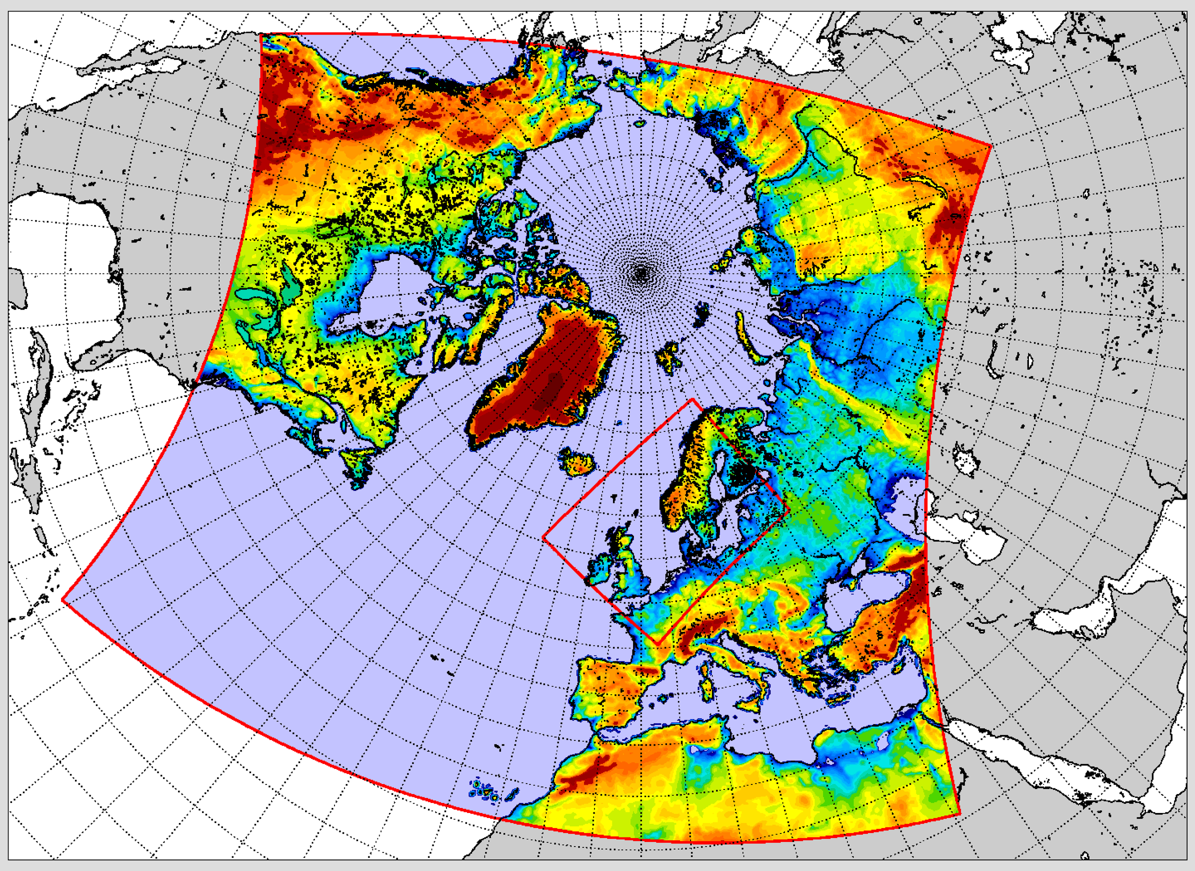

Fig. 3a

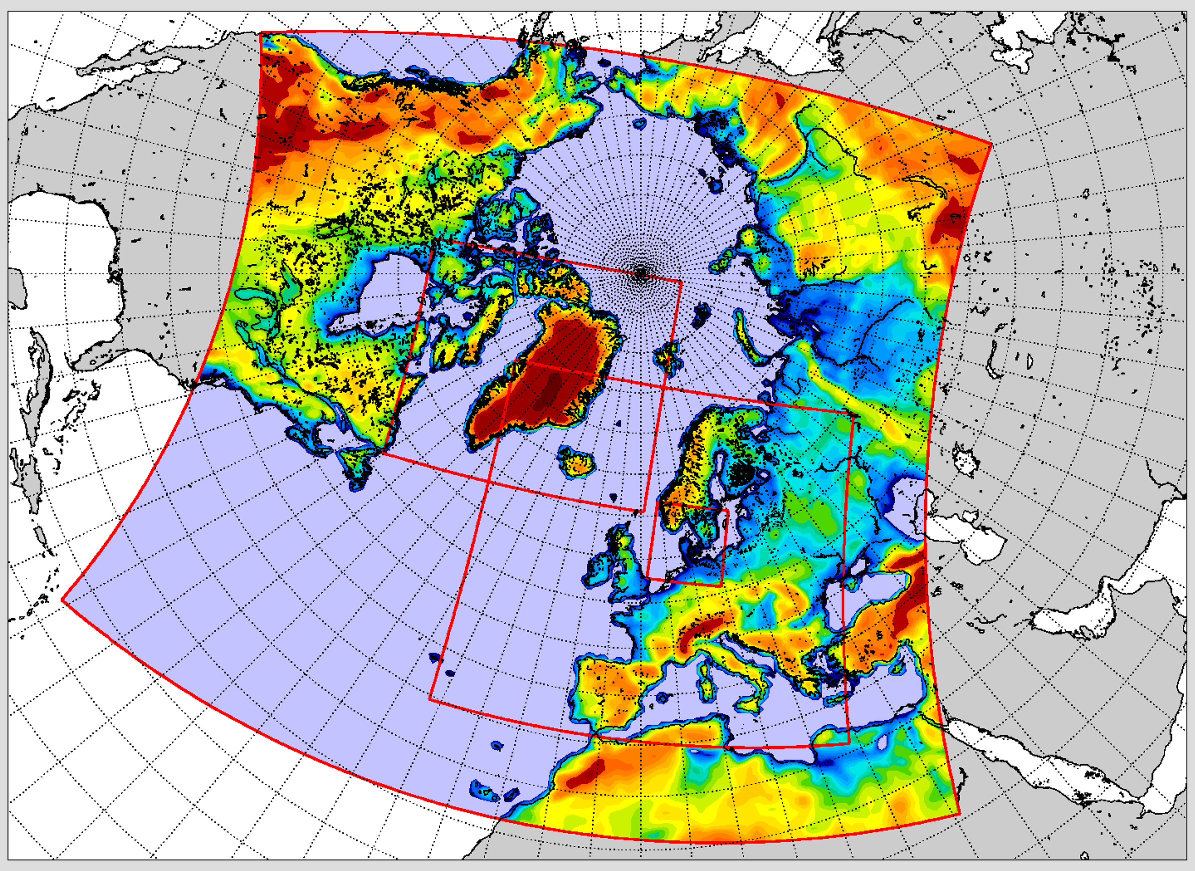

Fig. 3b

Current developments

DMI participates in the HIRLAM-6 collaboration and is active in both data assimilation and model developments.

There has been significant efforts in connection with Observation System Experiments (OSE) where around 50 experiments have been made. The results are currently being investigated and reported.

There is an increased activity connected to the use of satellite data as revealed by the DMI-HIRLAM upgrade in 2003.

Developments in the area of model physics are illustrated by recent results from a statistical cloud cover parameterization tested for shallow convective cumulus clouds, see Fig. 4a-b and the associated text.

A specific example illustrating the possible benefit of using ground based GPS data is provided in Fig. 5a-c with the associated text.

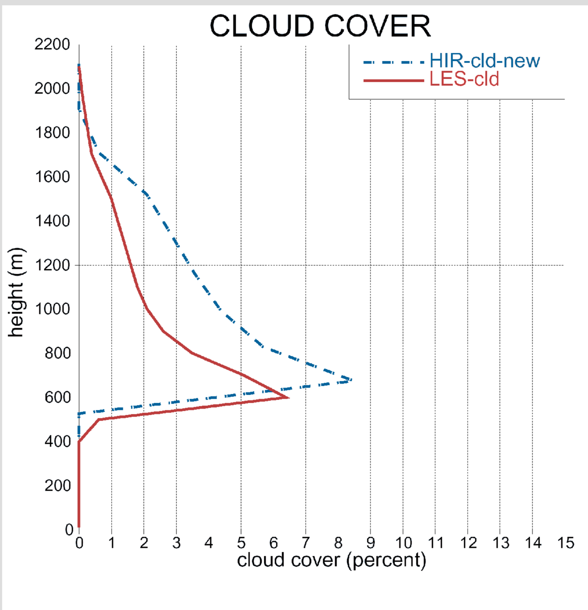

Fig. 4a

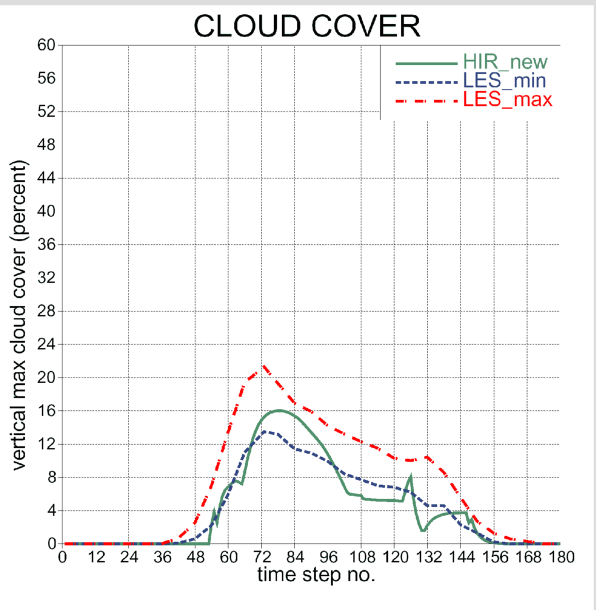

Fig. 4b

A new parameterization of convective cloud cover (DMI Technical Rep. No 02-10) has been tested for conditions of shallow cumulus convection. Results of comparisons of 1-D column tests with associated output from large-eddy simulations (Fig. 4a-b) is seen to give good agreement. Appropriate dynamical forcing has been used as input to the 1-D simulations carried out at a vertical resolution (40 levels) typical for operational NWP models.

Fig. 4a shows the results for the BOMEX case which applies to quasi-stationary tradewind cumulus conditions in the Atlantic ocean. (Siebesma and Cuijpers, JAS Vol. 52, 1995). The cloud amount, in particular cloud profile (dashed curve), agrees well with the results of LES (solid curve). Forecast length is 5 hours.

Fig. 4b shows the simulation result for the EUROCS shallow cumulus case (A.R.Brown et. al., Q.J.R.Met.Soc., Vol. 128, 2002). This case simulates the diurnal course of cumulus clouds at the ARM site in the central part of the U.S. The curves apply to maximum cloud cover at a model level. The dashed curve and fine dashed curve display the highest and the lowest estimates, respectively, from LES with different models. The solid curve shows the cloud cover from a 1-D simulation using the new cloud cover parameterization.

GPS meteorology

For a number of years DMI has taken part in research projects (such as MAGIC, COST 716, and TOUGH) on the use of ground based GPS (Global Positioning System) data in NWP. The data take the form of zenith total delays (ZTDs), which are related mainly to the local pressure and the integrated water vapour above the sites of the GPS measurements. Contrary to radiosondes the measurements are not degraded by rain and ice and the time frequency is high, e.g., every quarter. On the other hand, the ZTD is a single number, not a humidity profile, which makes it less straight forward to utilise the data in an optimal way in data assimilation. Delivery of ZTDs in near real time has been proven feasible, and is currently running on an experimental basis in the COST 716 project.

Software has been made for assimilation of ground based GPS data, in collaboration with other HIRLAM partners. The general finding at present is that statistically the impact is neutral, for example verified against EWGLAM list station data. Subjective verification of 12 hour accumulated precipitation indicates improved forecast of rain at higher rain rates. The figures 5a-c provide an example. Fig. 5a shows rain gauge observations on 11 February 2002. The corresponding model forecasts with and without use of GPS ZTD data are shown in Fig. 5b and Fig. 5c, respectively.

Further information can be found at http://tough.dmi.dk.

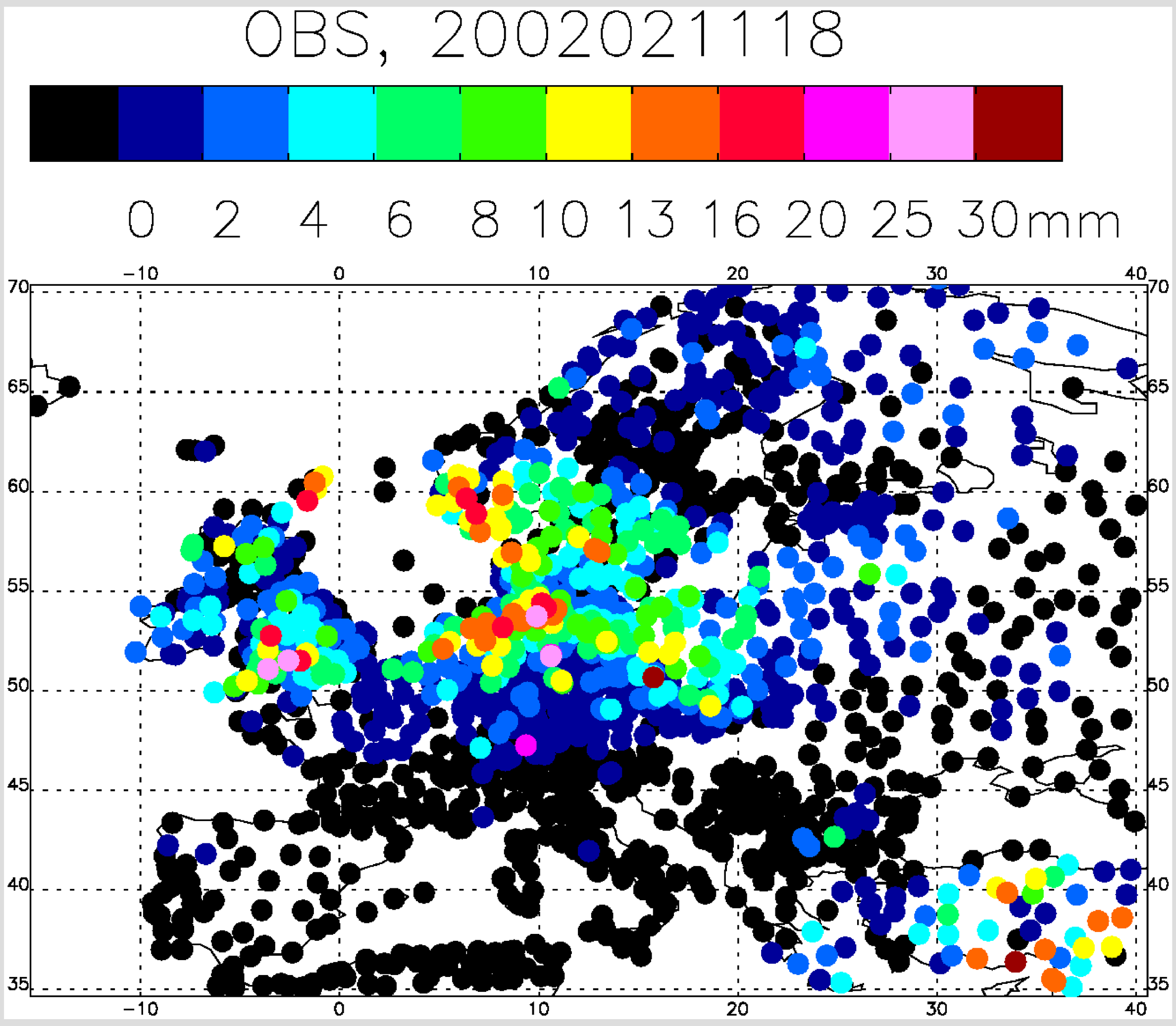

Fig. 5a

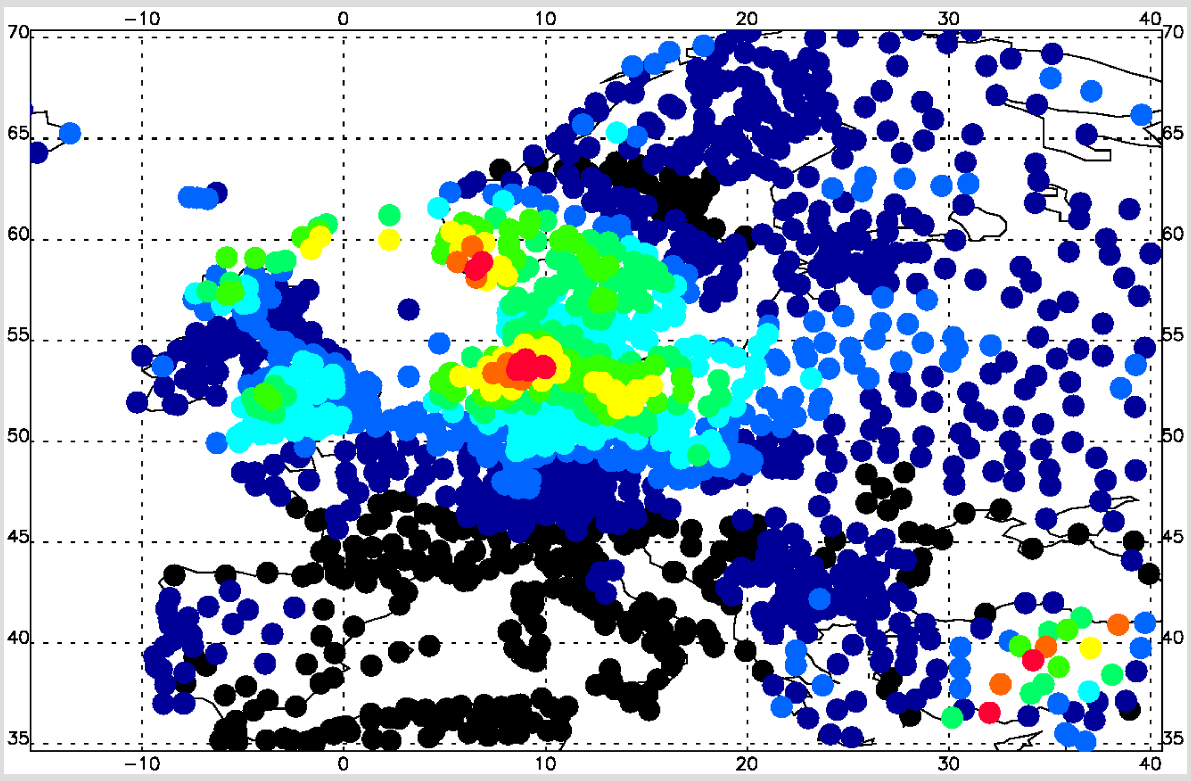

Fig. 5b

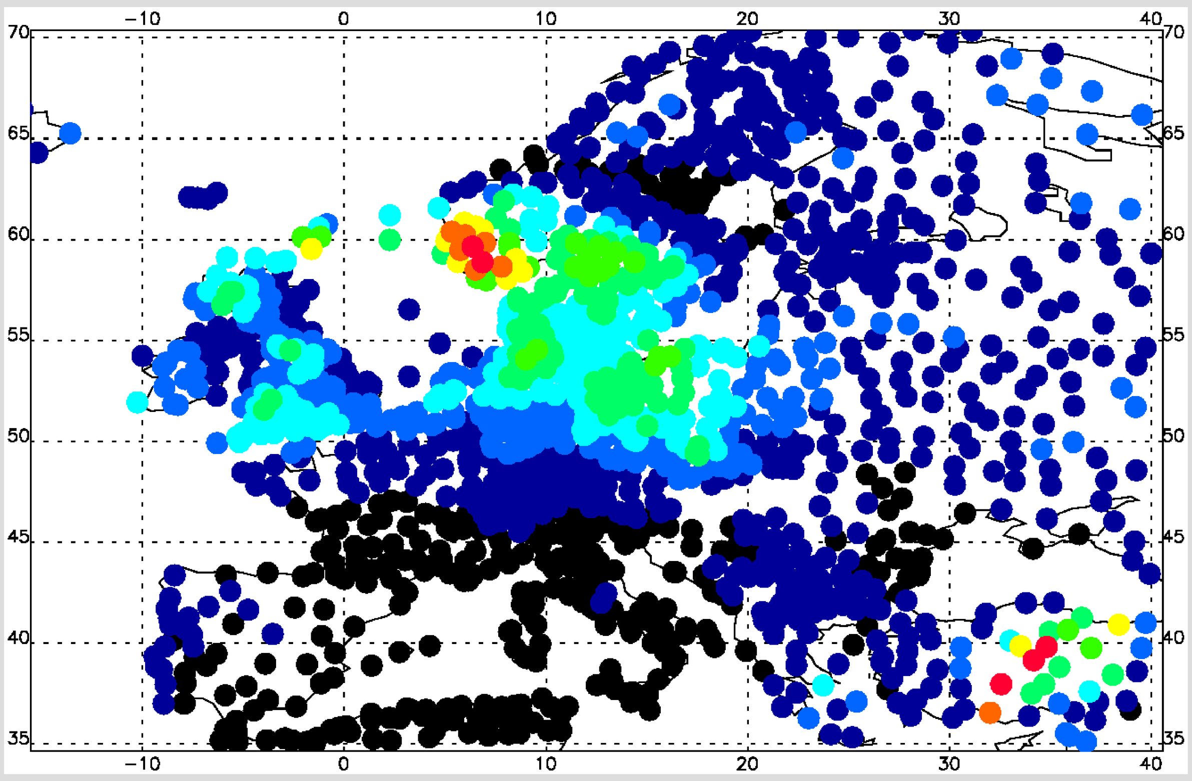

Fig. 5c

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