Use of Observation in Operational HIRLAM and Joint Monitoring & Model Inter-comparison

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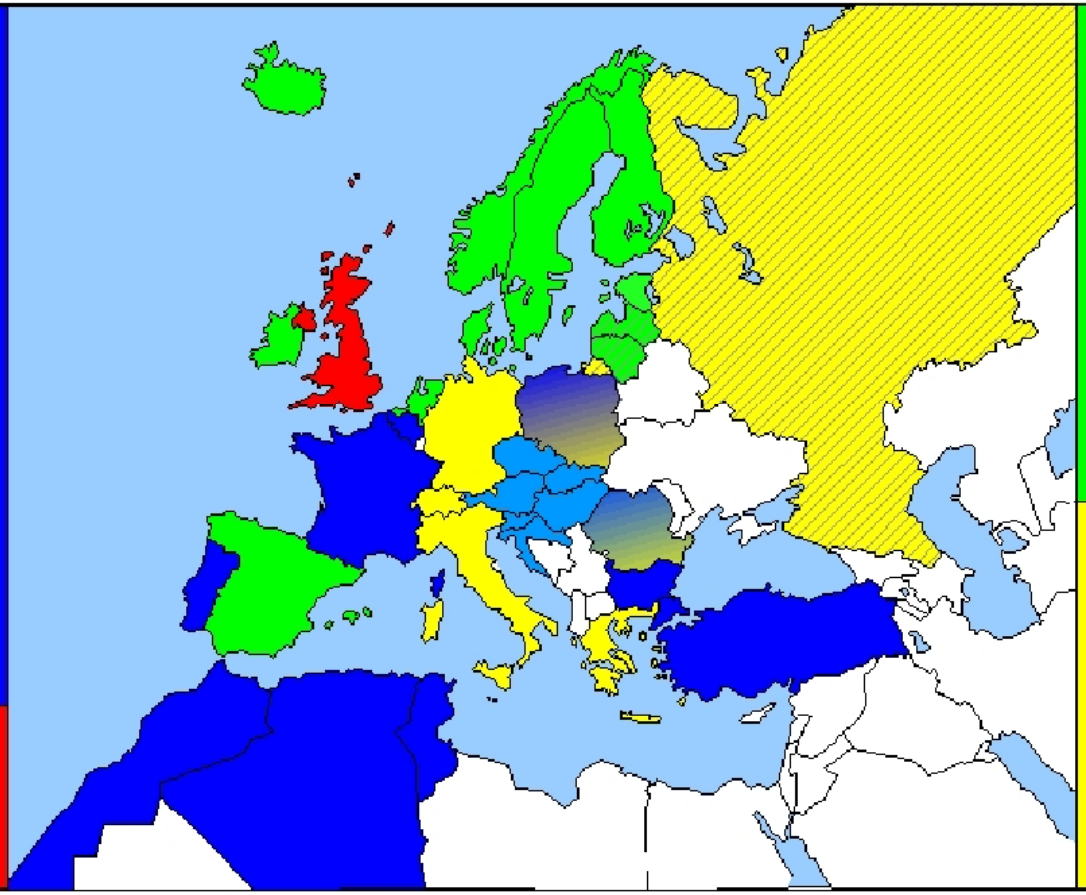
Outline

1. Hirlam-A & observation usage in operational systems
2. Joint operational monitoring and model inter-comparison

HIRLAM-A Programme

- Hirlam-A is a 10-NWS joint **research** programme with main deliverables on **reference systems** on three key areas
  - **Mesoscale NWP** system (HARMONIE)
    - via collaboration with ALADIN/MF consortia
  - Further development and quality assurance of **synoptic-scale HIRLAM**
  - Development of **short-range, limited area ensemble prediction system (GLAMEPS)**

SRNWP Consortia in Europe



ALADIN
Algeria
Belgium
Bulgaria
France
Morocco
Poland
Portugal
Tunisia
Turkey

Austria
Croatia
Czech Rep.
Hungary
Romania
Slovakia
Slovenia
LACE

UKMO
United Kingdom

HIRLAM
Denmark
Estonia
Finland
Iceland
Ireland
Netherlands
Norway
Spain
Sweden
(Latvia)
(Lithuania)

COSMO
Germany
Greece
Italy
Poland
Romania
Switzerland
(Russia)

Met Office

COSMO

Hirlam Data Assimilation (synoptic-scale)

- Hirlam is a hydrostatic, grid-point model
- Upper air analysis with 4D-VAR or 3D-VAR FGAT
- Observation data cut off time for operational suites: typically 1:30h to 2 h
- Assimilated observations in upper air analysis
  - Conventional: SYNOP, SHIP, TEMP, DRIBU, AIREP
  - Radiance data from AMSU-A/B/MHS
  - Quikscat wind
  - AMV wind
  - Experimental: ground-based GPS, VAD wind profiles, radar radial wind, Seviri cloud data, modis-wind
- Surface analysis with OI
  - Synop + Ship data
  - (OSI-SAF) SST and ice cover
  - Grided SST and ice analysis via ECMWF

Hirlam Data Assimilation Observation Data Handling

- Conventional data from GTS
  - Pre-processing software originated from ECMWF local adaptation at NWS
  - To meet the coming change of GTS data format to BUFR, an adapatation software has been developed through cooperation between SMHI and met.no, which can be shared by HIRLAM partners via open-source arrangement
- Remote sensing data
  - EARS and local reception
  - Radar data reception done at local level
- ECMWF/HIRLAM observation handling software OBSPROC used to pre-process various BUFR/ascii data to obtain observation data stream in CMA-format to feed 3D-VAR/4D-VAR

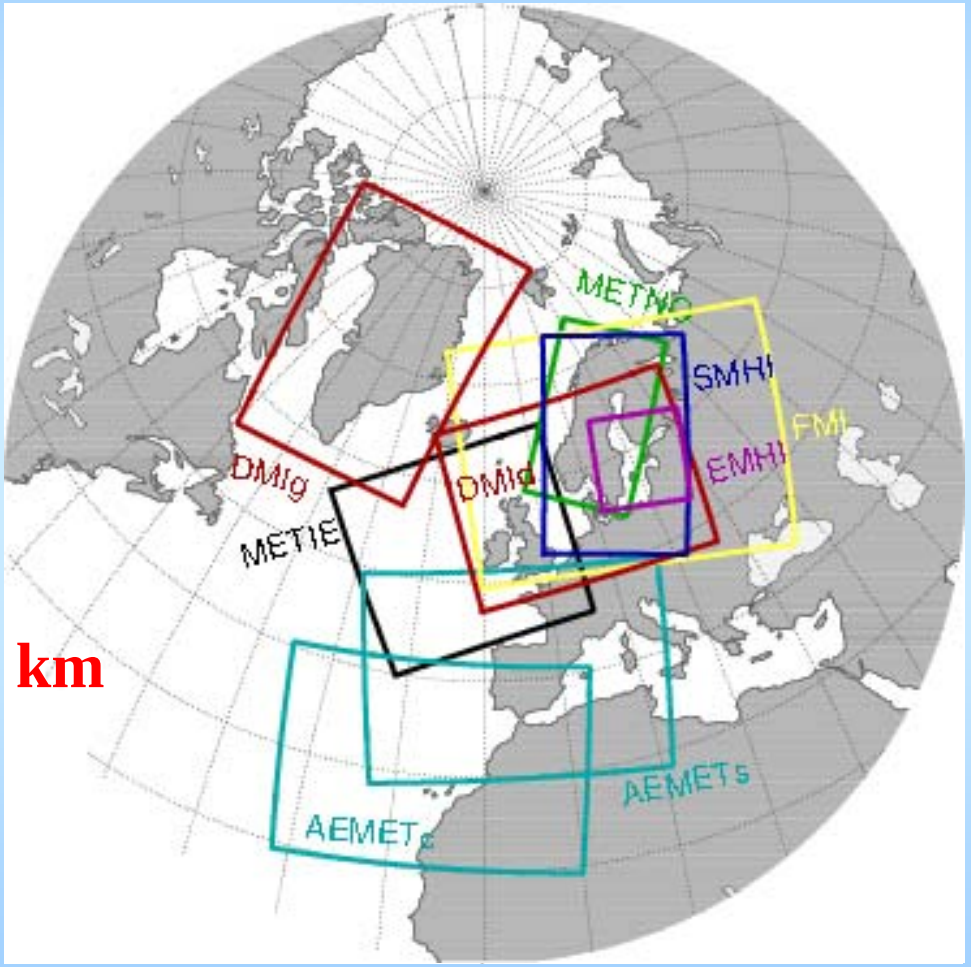
Harmonie Data Assimilation (meso-scale)

- HARMONIE is HIRLAM's meso-scale forecast system via full-code collaboration with IFS/ALADIN
- 3D-VAR in upper air analysis and OI for surface analysis (CANARI)
- Assimilated observations in real-time suites
  - Conventional: SYNOP, SHIP, TEMP, DRIBU, AIREP
  - Radiance data from AMSU-A/B/MHS
  - Quikscat wind, ASCAT wind
  - AMV wind
  - ground-based GPS, VAD wind profiler

Operational Implementation

- Reference Systems in Hirlam
  - Operationally feasible reference HIRLAM and HARMONIE system are regularly released after validation
- However, HIRLAM collaboration does not cover directly operational implementation
  - A large diversity in operational configuration
    - Both synoptic-scale (HIRLAM) and meso-scale (HARMONIE) models
    - Model versions
    - domain, resolution, scheduling
    - cycling method, assimilation method
    - use of observations
    - forecast options...
    - post-processing
  - Diversity in local observation data handling

Operational Hirlam Domains 2009



Fine scale, 3.3-7 km

(“Atlantic scale”, 9-17 km)

Joint Operational Hirlam Verification and Monitoring

A joint HIRLAM monitoring and model inter-comparison interface has been developed during the recent years, to address the needs in HIRLAM-A for regular model inter-comparisons and monitoring for operational models and among HIRLAM and HARMONIE systems

Main approach

use harmonised tools to present monitoring information in centralised way

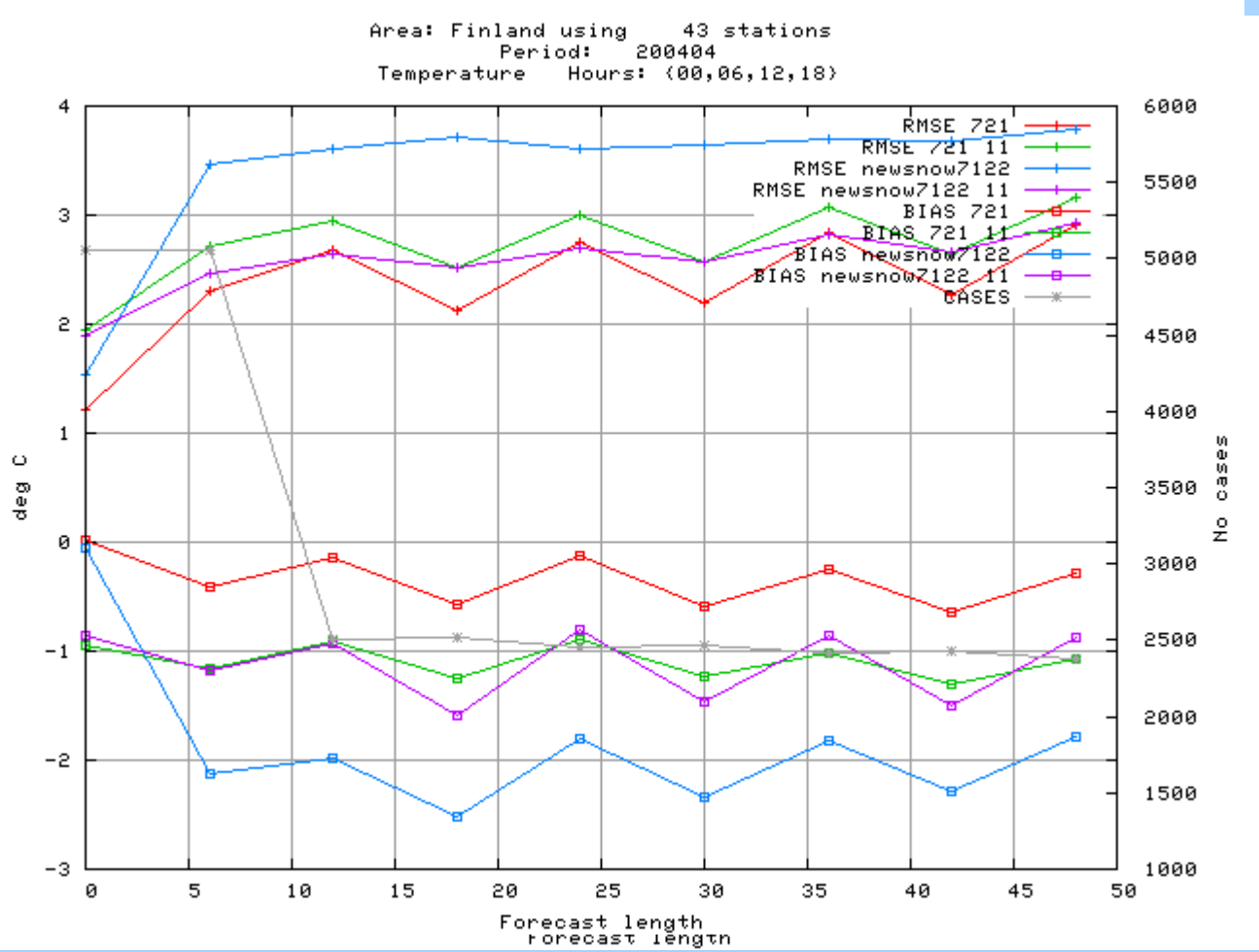
Why Joint Monitoring Interface?

- Hirlam-A needs a convenient tool to measure progresses in operational NWP and in new development. A large diversity of operational implementation of HIRLAM systems at member services make this especially interesting.
- Inter-comparison of model behavior has proven to be useful for developers.
- There is a large but distributed expertise among researchers in the HIRLAM services
- The joint monitoring interface does not replace regular local monitoring at NWS .The common interface is especially useful to help exposing irregularities, which is helpful for both operational work and for researchers
- There are many different tools existing...

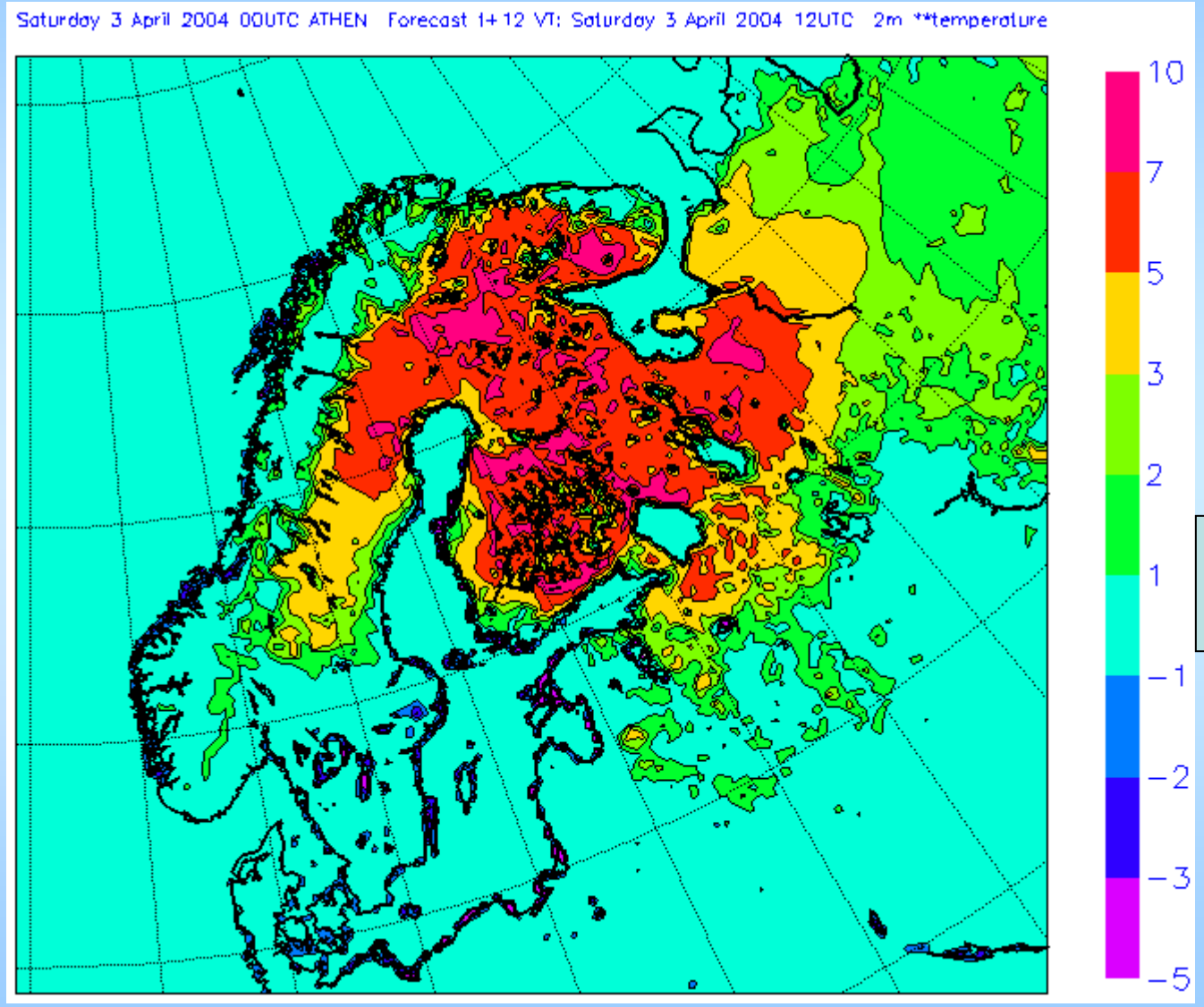
Observation Verification:
The need for harmonisation ...

- T2m.... Which T2m?
  - weighted grid average? (coastal effect?)
  - land fractions (forest/snow features?)
  - low vegetation tile only
- Saturation tables
  - water only based (handling in data assimilation) or total water based (Hirlam output)?
- Surface humidity.... Which humidity?
  - q2m, rh2m, dew point

Sensitivity of parameter selection in observation verification...



T2m: forest or no forest?



S. Tijm

Observation Verification:
Harmonisation in Definition

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Main features

- Daily collection of monitoring data from operational services
- Webgraf (U. Andrae) as main web interface
- Processed real-time monitoring information shown in the HIRLAM community webpage hirlam.org
- Monitoring of daily forecasts
  - Forecasts of interesting weather phenomena
- Monitoring of quality (and its evolution) in HIRLAM forecast systems
  - Observation verification
  - Field verification
- Detection of operational problems
  - Monitoring of analysis and forecast characteristics
- Same tool used by researchers for regular model inter-comparison

Joint Monitoring Interface

Featured Monitoring Information

- Forecasted synoptic charts
  - Selected parameters
- Meteograms together with real-time observation
- Observation verification
  - Multi-center/individual center
  - Long term verification trends
- Data assimilation monitoring
  - Analysis increment maps
  - Observation data usage map
  - Analysis characteristics monitoring
- Analysis/Forecast diagnosis
  - Domain averaged statistics: noise ratio, max wind, rain rate, surface fluxes
  - Minimisation monitoring
- Mast-profiles intercomparison
  - Sodankyla, Caubauw, Valladolid, Lindenberg

Monitoring and Verification Package

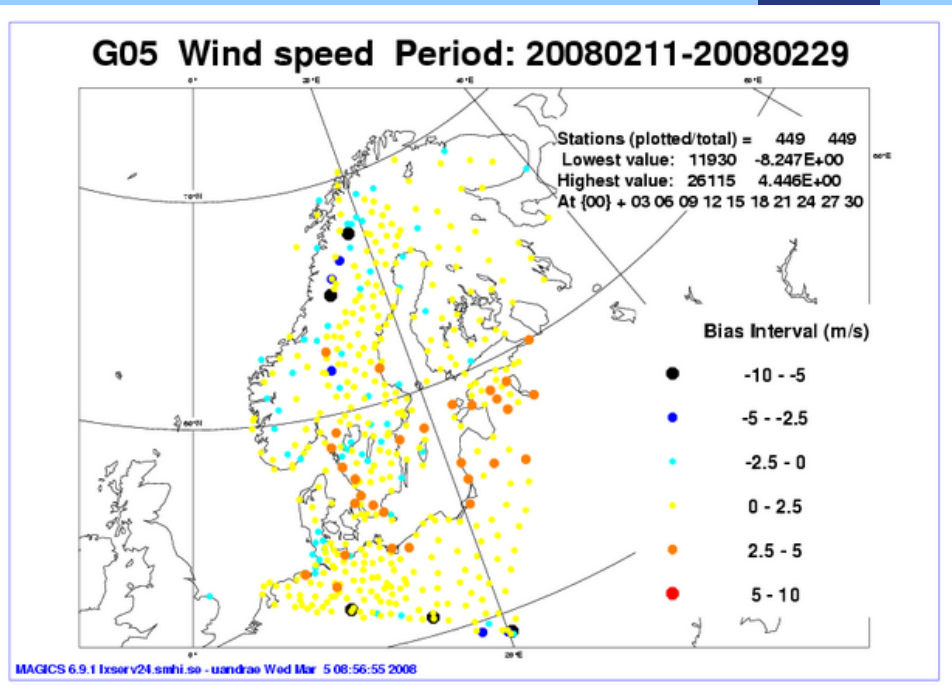
GL and MONITOR (Andrae et al)

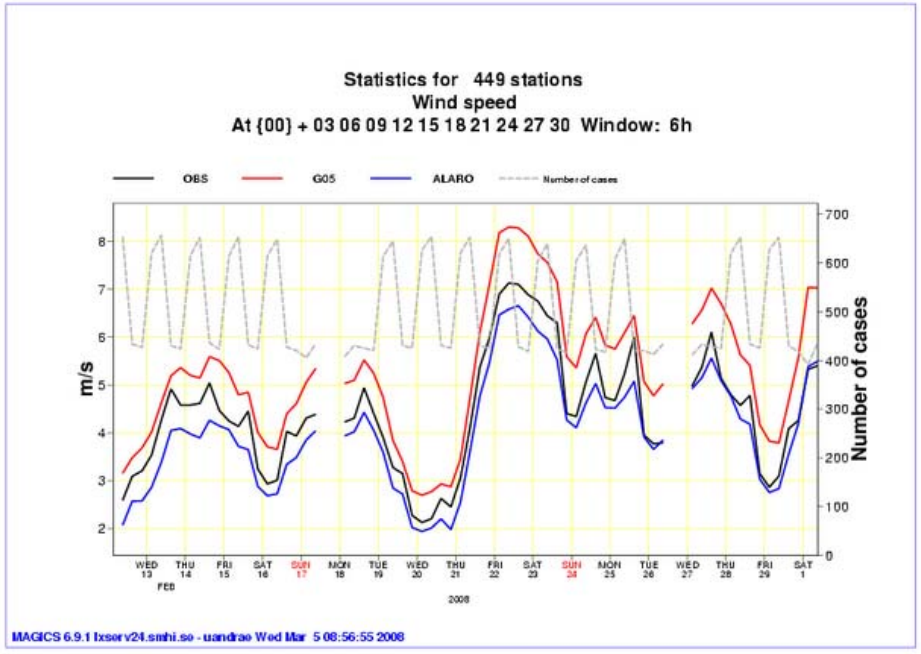
Purpose: model comparisons and against observations, e.g., surface and sonding data

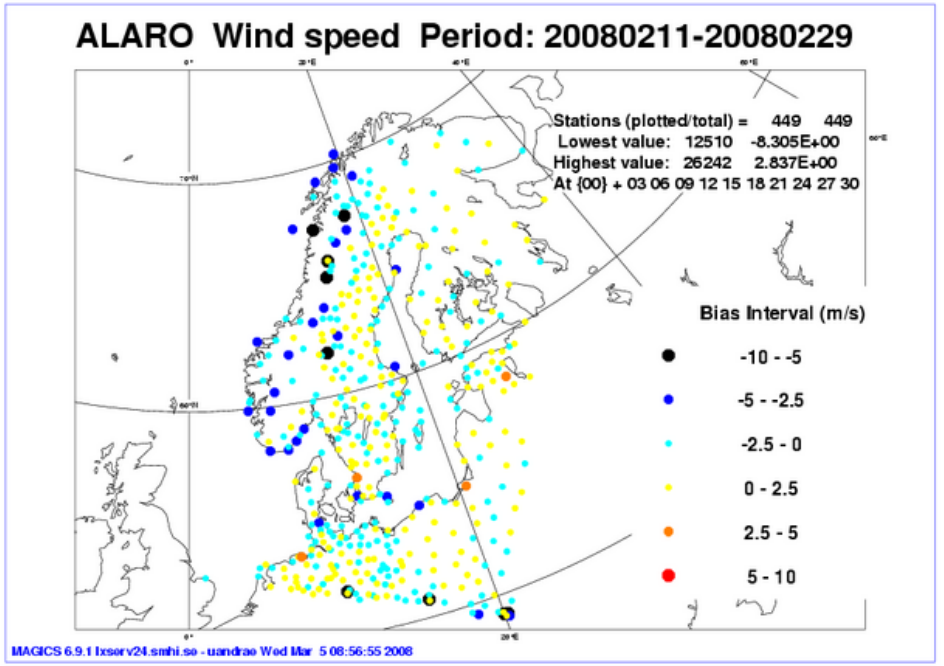
Features

- Data extraction method
  - extraction of measured and model equivalent of synoptic parameters to a comprehensive observation station lists (WMO station-lists covering the largest HIRLAM domains).
- Using extracted observation and model values to compute classic verification scores for various sub-area/station-lists
- Quality control of observation is done on the fly
  - Strict check to ensure equivalency in data samples
  - QC principle: maximum consent from model analysis
- Model independency: HIRLAM vs HARMONIE vs ECMWF vs ...

time series
error maps
average over forecasts
scatter plots
… …







File Edit View History Bookmarks Tools Help

Vertical profiles Fig: 2008...

../ Intercomp

Prof_Temp

Parameter

Temperature
Wind speed
Wind direction
Geopotential
Relative humidity
Specific humidity

Comparison

FMI_ECMWF
DMR_ECMWF
DMI_FMI_ECMWF
DMI_FMI_SMHI_ECMWF

Resize

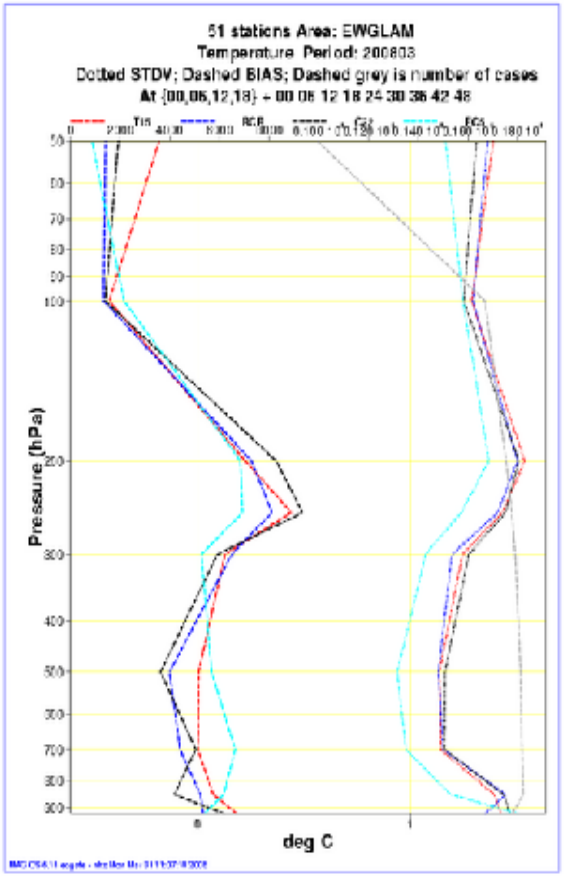
Send

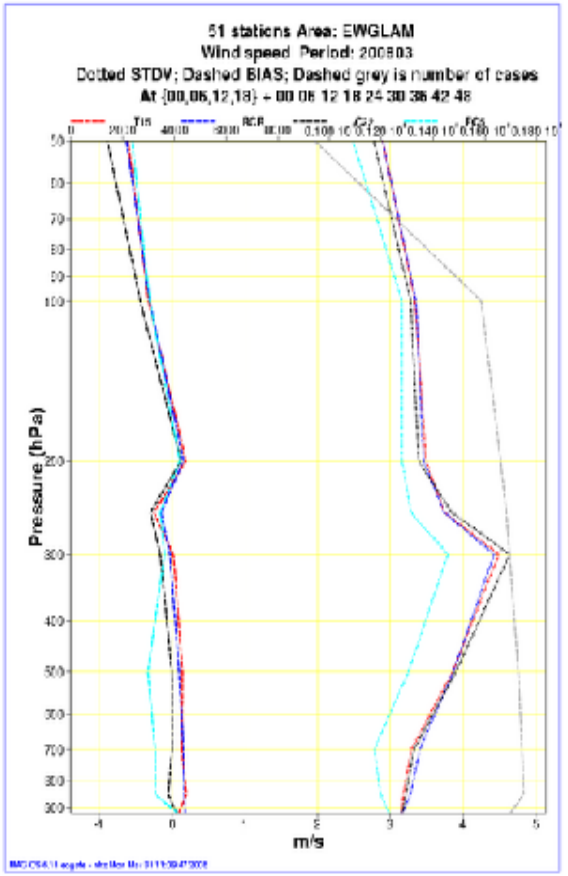
Statistics

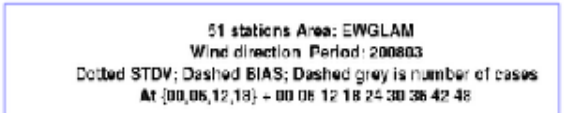
Quality control

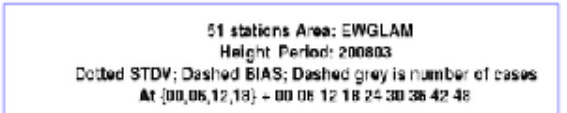
Vertical profiles

Year 2008 | Area EWGLAM | Month 03 | All Save Clear 2008;EWGLAM;Specific humidity;DMI_FMI_SMHI_E

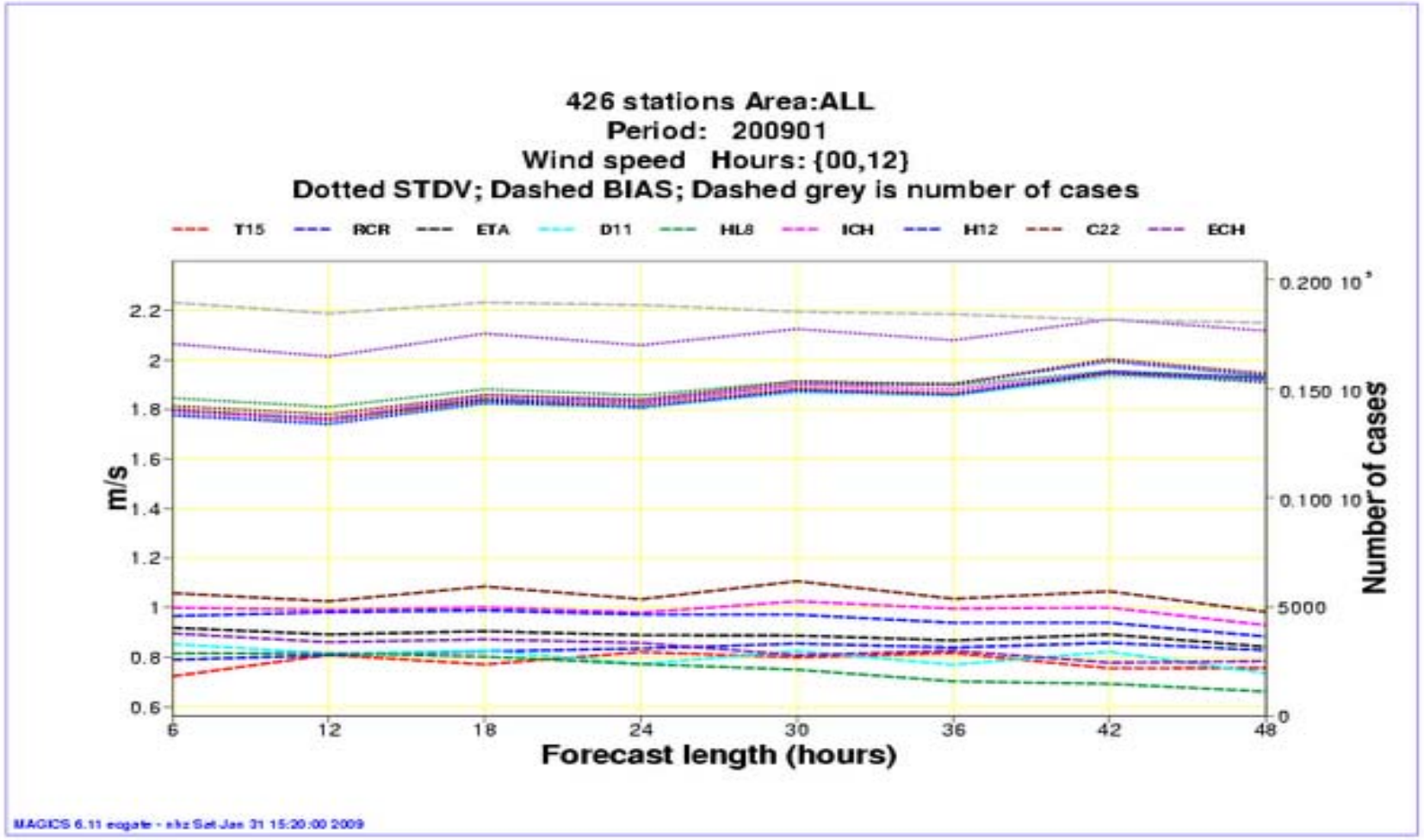




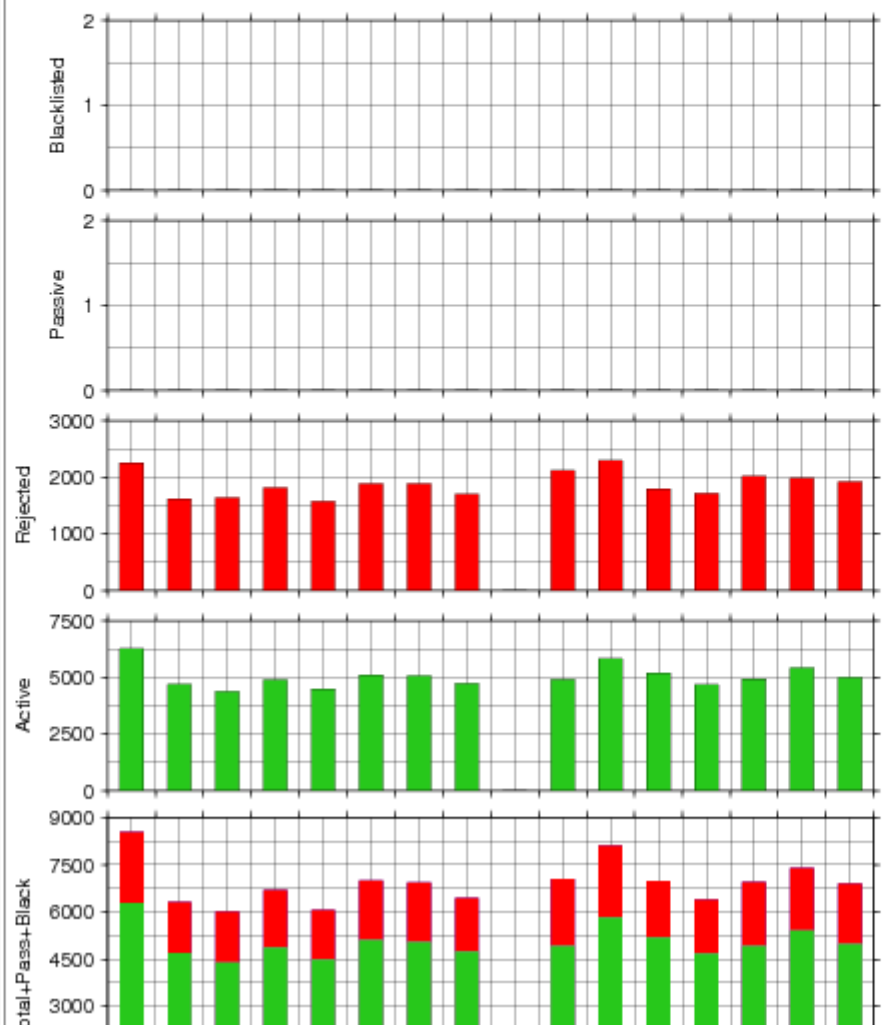




Performance of Operational HIRLAM
W10m



DA: ALD/3DVAR Exp: HIR20
Period: 2008.02.12–2008.02.27 HH: 12 UTC
Obs: AIREP Reports
Active Passive Rejected Blacklisted



Common Observation Usage Monitoring

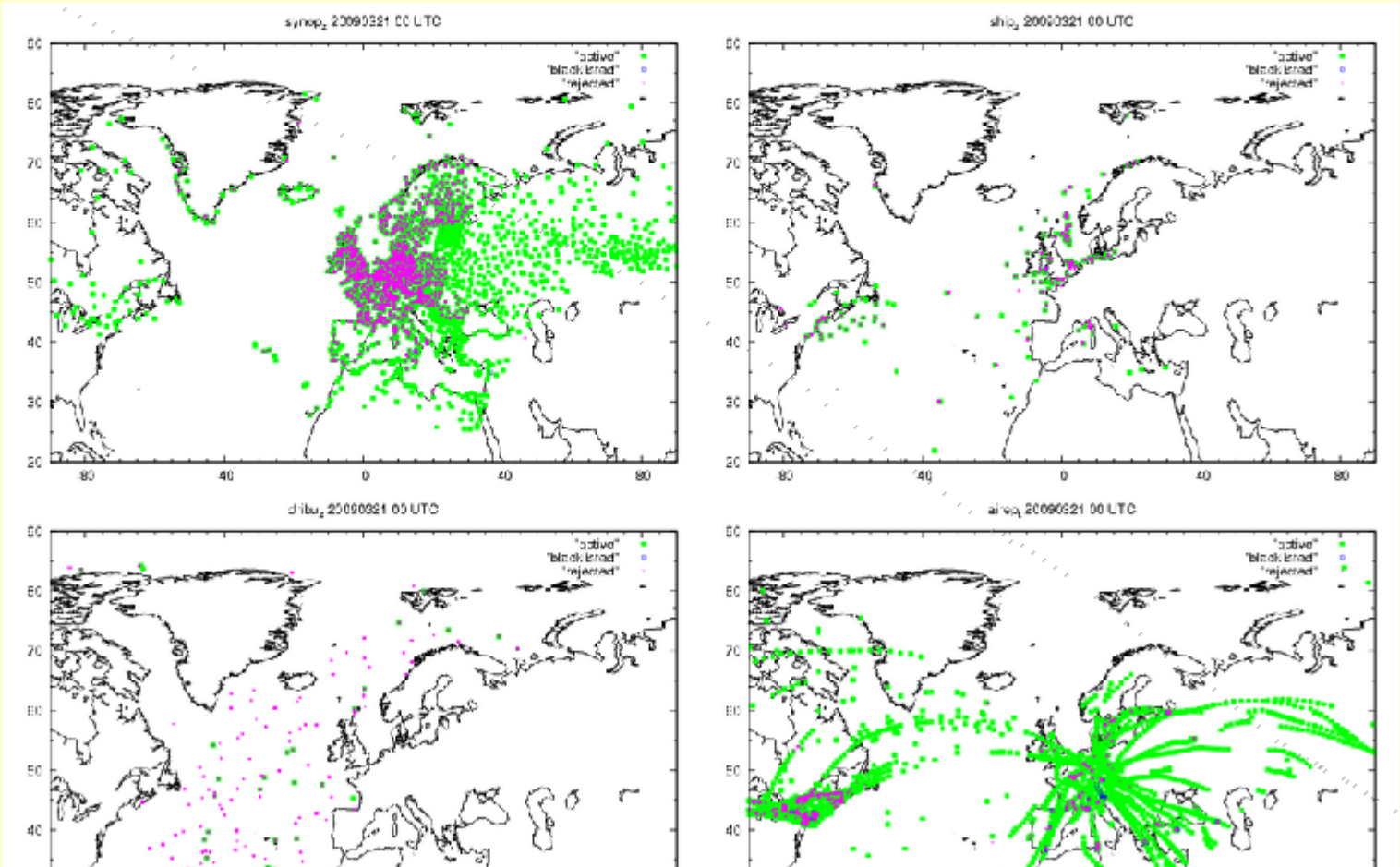
ObsUse
Obs_Map

Obs_parameter
SYNOP

size

Use of Observation

Period 200903 | Day 21 | Hour 00



Common Monitoring Interface

Type of Detected Deficiencies

- Observation data usage map
  - occasional loss of TEMP/ATOVS/SYNOP data at individual services
  - permanent lack of some OBS data (BUOY data/E-AMDAR/ACARS
  - incomplete temporal data coverage
  - abnormal obs data rejection
- Plot of analysis diagnosis plots (minimisation curves)
  - abnormal cost function behavior at around variational quality control
- Observation verification
  - sudden deviation of verification behavior from rest of models (use of climate SST and ICE cover due to script error)

Summery

- Diverisity in operational HIRLAM NWP configurations, including handling of observations, among HIRLAM member services
- The joint operational HIRLAM monitoring and inter-comparison interface is tailored for HIRLAM-A
  - Real or near-real time with daily updates
  - Useful in help detecting problems
  - Possibility to identify general trends
- Harmonisation important to enable adequate intercomparison
- Just present facts using harmonised tools

  --- Interpretation is up to everyone

End