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Verification tools and graphics in the HIRLAM system

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Introduction

- **Hirlam reference system contains a package to collect basic verification statistics on daily basis as a part of the normal run**
  - Verification against observations is done default
  - Field verification if requested
- **Many Hirlam institutes use their own verification packages, especially in operational implementations**
- **Possible reasons?**
  - No tools to compute summaries or present results in graphical form
  - Care is needed in interpreting results, for instance
    - Are the same observations used in verifying different experiments
    - Is similar qc-control applied in different experiments
- **In Hirlam 7.1 a set of tools is implemented**
  - Compute summaries
  - Present them in graphical form

Purpose of this presentation

- **Show the basic verification data produced by HIRLAM reference system**
- **Show the possibilities of the new tools**
  - Making summaries
  - Graphical products
- **Plans for developments**

Purpose of the HIRLAM verification system

- **Use synoptical observations**
- **Verification in synoptic scale**
- **Routine, long-term monitoring as an indication of progress in Hirlam system**
- **Model intercomparison**
  - Validation in impact/sensitive studies
  - Regular intercomparison between Hirlam systems
- **Not planned for**
  - Mesoscale studies
  - EPS
  - Process studies

Products of the verification system on daily basis

- **Verification against observations**
  - Surface observations and sounding observations
  - In principle, any observation type can be verified
  - Verification scores (bias, rms-error, std, no of cases) are computed (ve-files)
    - List of stations
    - Polygon defined by corners
    - Normally a set of different areas are computed at the same time
  - Contingency tables for precipitation (pct-files)
    - 6, 12 and 24 hour precipitation depending on observations

Products of the verification system, continued

- **Observed/forecast values on stations (Zobs-files)**
  - Simple ASCII files
  - Contains for every observation
    - Station identification
    - Coordinates of the station
    - Observed value
    - Forecast value
    - Forecast error
  - At the moment only for surface parameters, the same as in ve-files

Products of the verification system, continued

- **Fields verification (not default but can be required)**
  - Every experiment is verified against its own analysis
  - For every parameter in the given GRIB-file
    - Bias, rms-error and mean value (“climate”)
  - Surface fields, constant pressure level fields, model level fields
  - Accumulates statistics over the given time period

- **All this has been done as a part of the experiment**
- **Collecting of verification can be run afterwards as a separate job**

- **Everything up till now has been long in the Hirlam reference system**

General features of the package for summaries and graphics

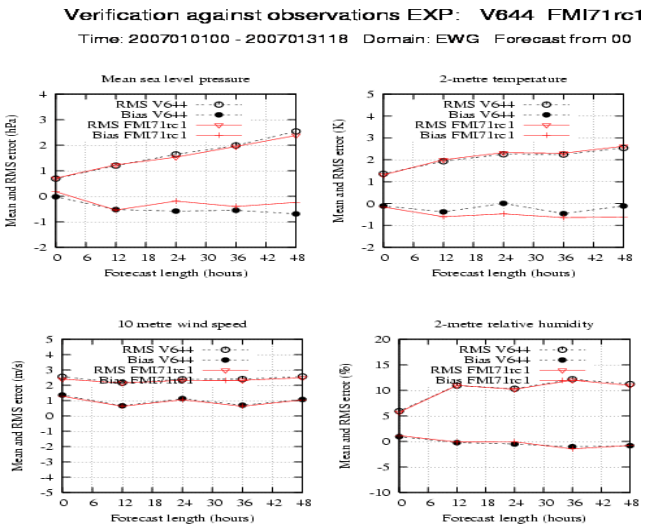
- **Implemented in the Hirlam 7.1 reference**
- **Is running using miniSMS**
  - `Hirlam start DTG=2007010100 DTGEND=2007013118 PLAYFILE=verif_summary`
  - The run is controlled by the file `scripts/Env_verif_sum`
    - Editing this file the user can select what he/she waants to be computed
- **Languages**
  - Shell-script
  - Perl
- **Graphical packages**
  - Gnuplot
  - Grads

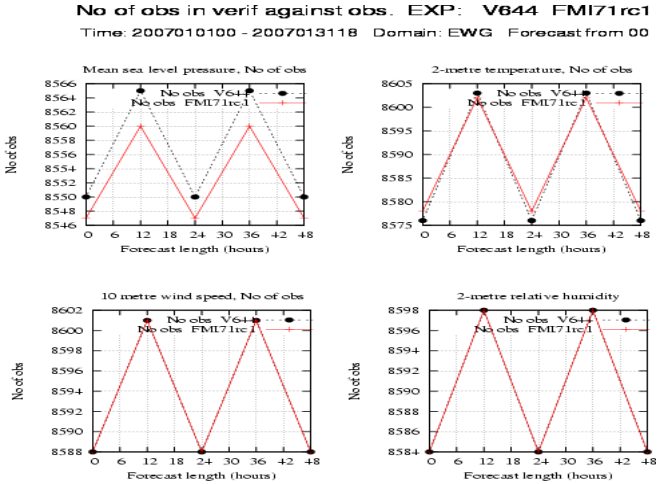
Examples of products that can be produced

- **Verification against observations**
- **Verification against observations on station basis**
- **Time-series of verification scores**
- **Field verification products**

Verification against observations

- **Surface observations**
  - Bias and rms-error
  - Pmsl, T-2m, Wind speed, Rh-2m
  - Several experiments can be compared
  - Can be selected, which daily forecasts and forecast lengths are included
  - No of observations as a separate figure (will be included in the same figure later)
  - Different areas depending what has been produced when computing the daily statistics





Verification against observations (continued)

- **Precipitation data**
  - By default eight classes
  - The classes are defined in the basic verification run
  - Marginal distributions of observations and forecasts
  - Contingency tables
  - Both in percentages and number of cases
  - 6, 12 and 24 hour precipitation as in observations
  - Domains as earlier

Forecast length: 42 Accumulation period: 12hr Domain: EWG

Identification: EWG__ECM71rc1_2006030100-2006033118_CY_00

Marginal distributions: 8

Limits	<0.1	<0.3	<1.0	<3.0	<10.0	<30.0	<100.0	>100.0
Forecast	3124	1446	1541	1193	712	89	2	0
In %	39	18	19	15	9	1	0	0
Observed	5147	586	944	663	615	149	2	1
In %	63	7	12	8	8	2	0	0

Contigency table in percent: obs:--> forec |

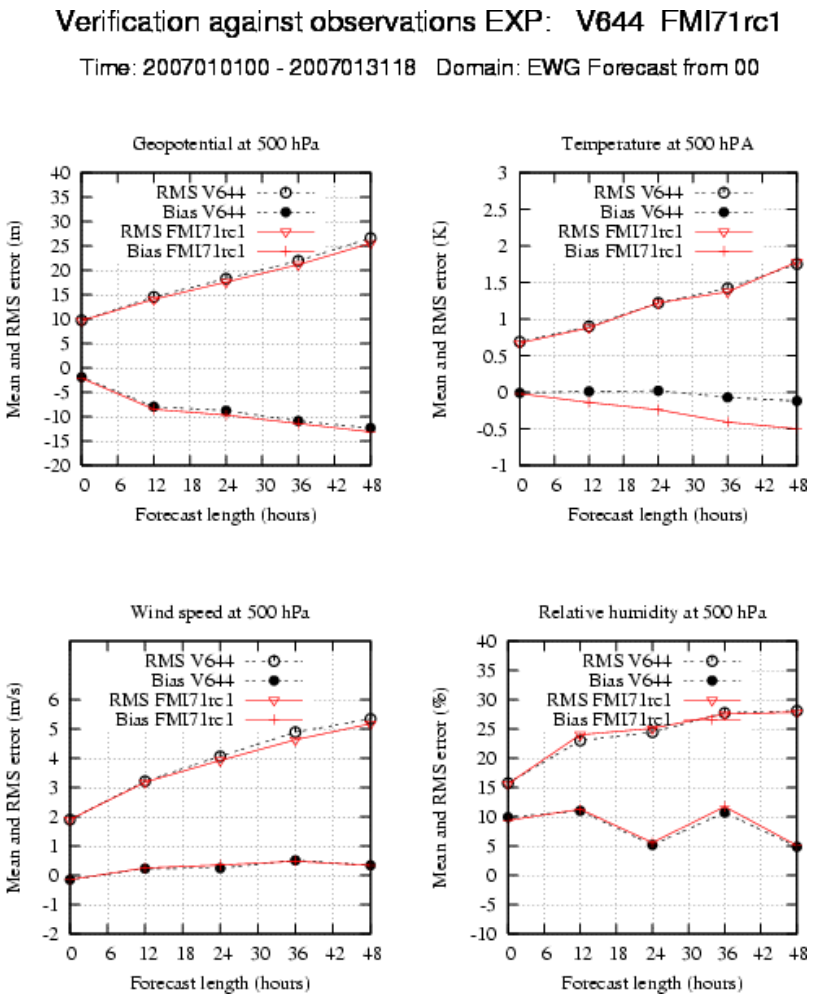
Limits	<0.1	<0.3	<1.0	<3.0	<10.0	<30.0	<100.0	>100.0
<0.1	35	1	1	0	0	0	0	0
<0.3	13	2	2	1	0	0	0	0
<1.0	10	2	4	2	1	0	0	0
<3.0	4	1	3	3	2	0	0	0
<10.0	1	1	1	2	3	1	0	0
<30.0	0	0	0	0	0	0	0	0
<100.0	0	0	0	0	0	0	0	0
>100.0	0	0	0	0	0	0	0	0

Contigency table: obs:--> forec |

Limits	<0.1	<0.3	<1.0	<3.0	<10.0	<30.0	<100.0	>100.0
<0.1	2869	113	89	37	11	4	0	1
<0.3	1049	129	163	70	32	3	0	0
<1.0	783	181	298	158	109	12	0	0
<3.0	346	115	274	231	198	28	1	0
<10.0	91	46	115	156	239	65	0	0
<30.0	9	2	5	11	25	36	1	0
<100.0	0	0	0	0	1	1	0	0
>100.0	0	0	0	0	0	0	0	0

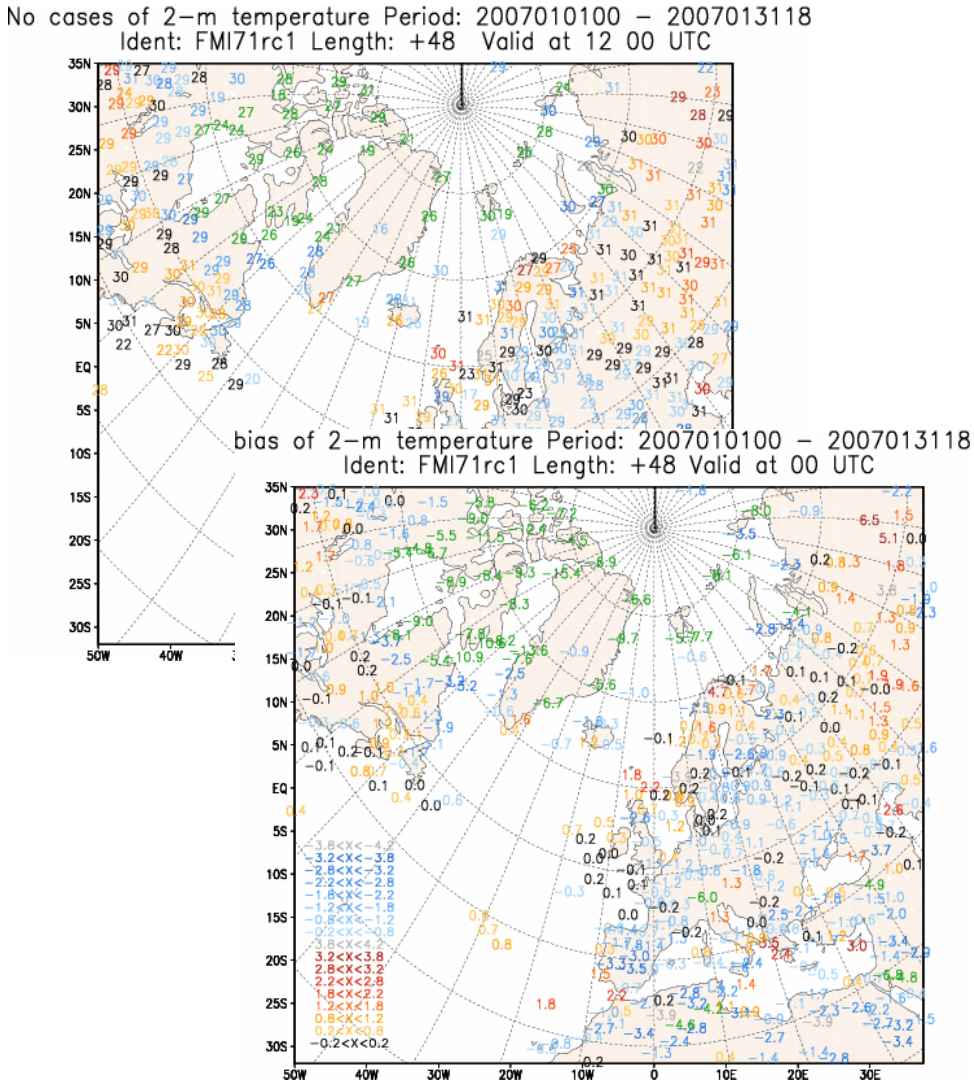
Verification against observations (continued)

- **Sounding observations**
  - Bias and rms-error on selected constant pressure levels
  - By default, 850 hPa, 500 hPa and 250 hPa pressure levels
  - Geopotential, temperature, wind speed and relative humidity
  - Several experiments can be compared
  - No of observations as a separate figure (to be included in the same figure)



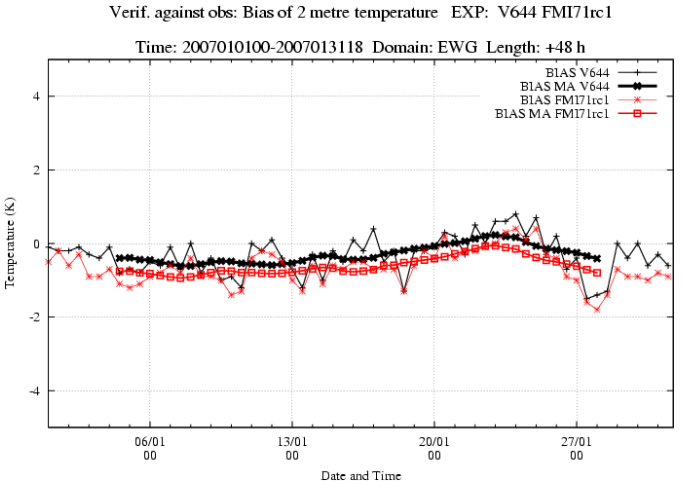
Scores on station basis

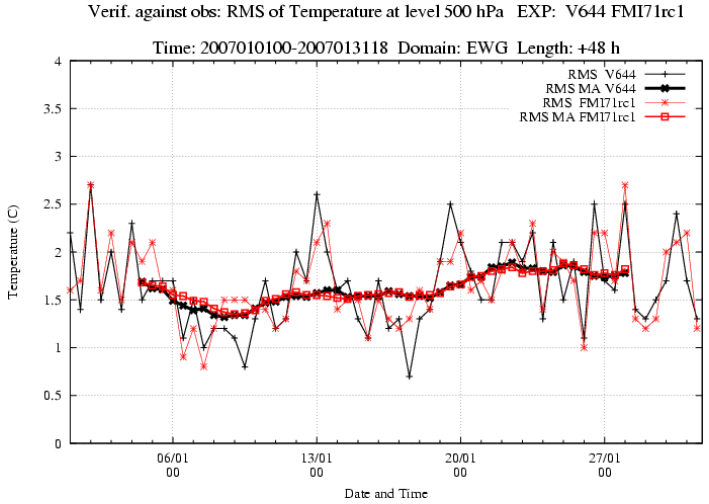
- **Bias and rms-error of surface variables on stations**
- **Also number of cases available, colored according to bias**
- **Forecast length and valid time can be selected**
- **Colors according to the values**
- **Bias and rms-error separate maps**



Time-series of verification scores

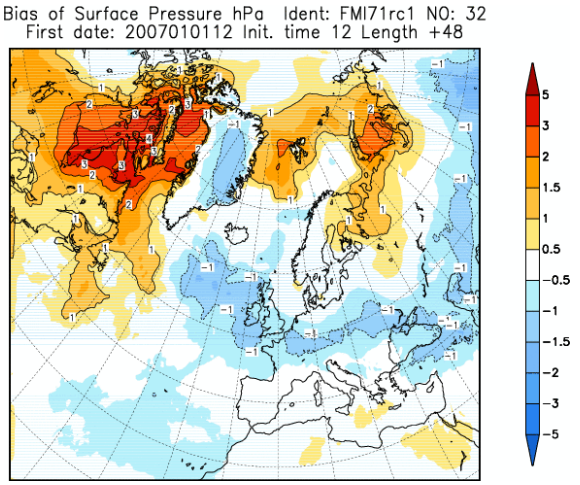
- **Time-series of verification (bias and rms-error) scores**
- **Moving averages if required**
- **Surface parameters and sounding observations**
- **Separate figures for rms-error and bias**
- **Several experiments in the same figure**

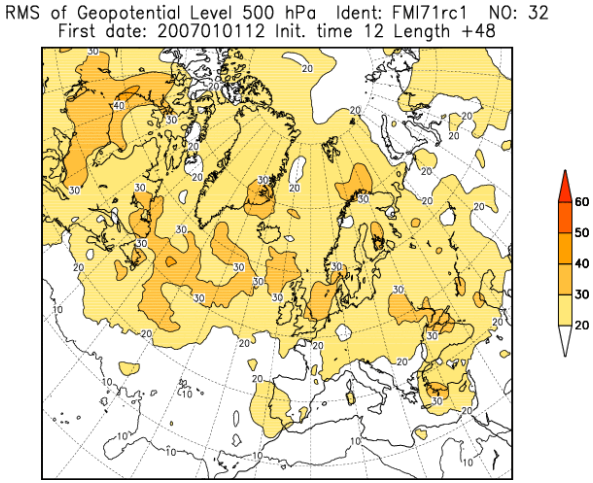




Field verification

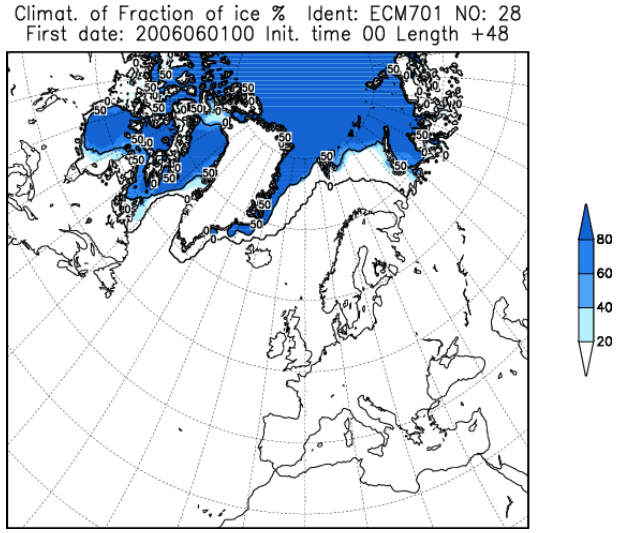
- **Bias and rms-error of any parameter, which has been accumulated**
- **Initial time of forecasts can be selected**
- **Forecast length can be selected**

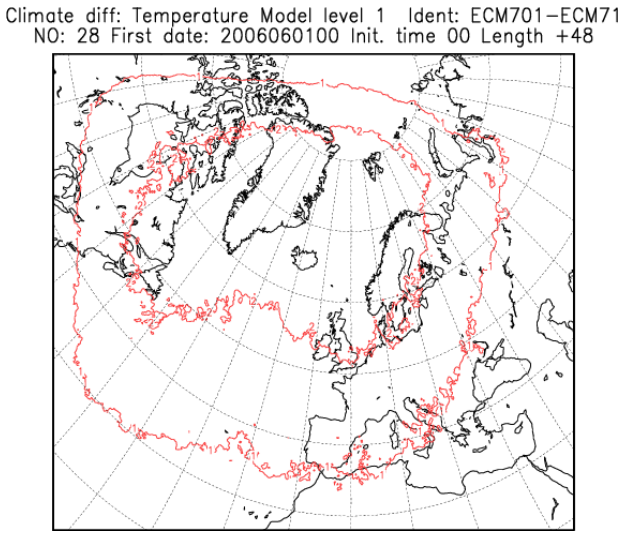




Field verification, climates

- **"Climates" of analysis or for instance +48 hours' forecasts**
  - Example: mean fraction of ice in +48 hours' forecasts in June 2006
- **Differences of "climates" between experiments**
  - Example: temperature differences between two experiments on highest model level
  - Limitation at the moment: areas must be the same





Todo-list

- **In the verification system**
  - Clarify the verification procedure: do things in a more sound way
    - Comparing operational Hirlam implementations
    - Model validation
  - Visibility and cloudiness to be added, contingency tables
- **Summaries and graphics**
  - WEB interface: easier to study the results
  - Scatter-plots
  - Plots of marginal distributions of precipitation
  - More plots
  - …

Summary

- **Hirlam reference system now contains a set of tools for**
  - Making summaries
  - Plotting summaries

  of the verifcation scores
- **Synoptical scale verification using normal observations**
- **The verificatiuon system will be developed to be more sound and easy to use**
  - Operational verification
  - Validation
- **After that easier to motivate new development in the graphics and tools**
  - New products will added
- **At the moment no user manual (an old draft exists)**

Yhteystiedot

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