ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

Validation of 2-meters temperature forecast at cold observed conditions by different NWP models

Evgeny Atlaskin

Finnish Meteorological Institute / Russian State Hydrometeorological University

OUTLINE

- **Background**
- **Verification against SYNOP observations**
- **Verification against Sodankyla mast measurements**
- **Verification methods intercomparisons using Helsinki Test Bed measurements**

Background

- **T2m forecast at observed cold temperatures has been a challenge for many of NWP models for few decades**
  - High model-measurements bias
  - Warm surface temperature
  - Weaker temperature vertical gradient
  - Higher surface fluxes
- **In many models T2m is a diagnostic variable contributed by soil-snow-atmosphere interaction, turbulence, cloud and radiation parameterization schemes... all, and apparently related to stable stratification.**
- **Problem of Modelling Nocturnal SBL is well overviewed in literature**
  - SBL physics is subtle and least subject to mathematical description
  - Local effects rise at increasing stability

Models	Center	Resolution	Winter
HIRLAM RCR	**FMI**	**0.15x0.15°**	**2008, 2009**
IFS	**ECMWF**	**0.25x0.25°**	**2008**
ARPEGE	**Meteo-France**	**0.5x0.5°**	**2008**
GFS	**NCEP**	**1x1°**	**2008**
AROME	**FMI**	**0.022x0.022°**	**2009**

Periods: December, 2007 – February, 2008 (Winter 2008)

December, 2008 – February, 2009 (Winter 2009)

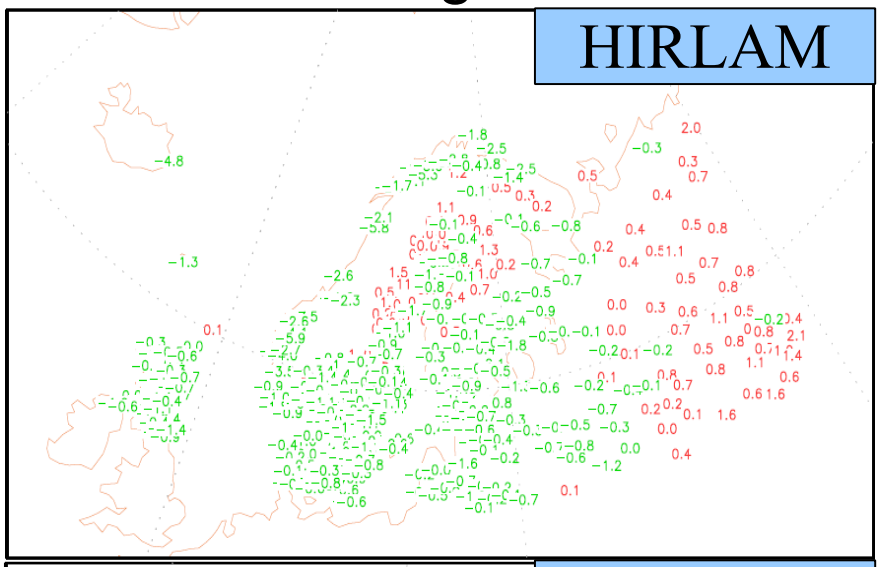
Domains: Europe and Finland

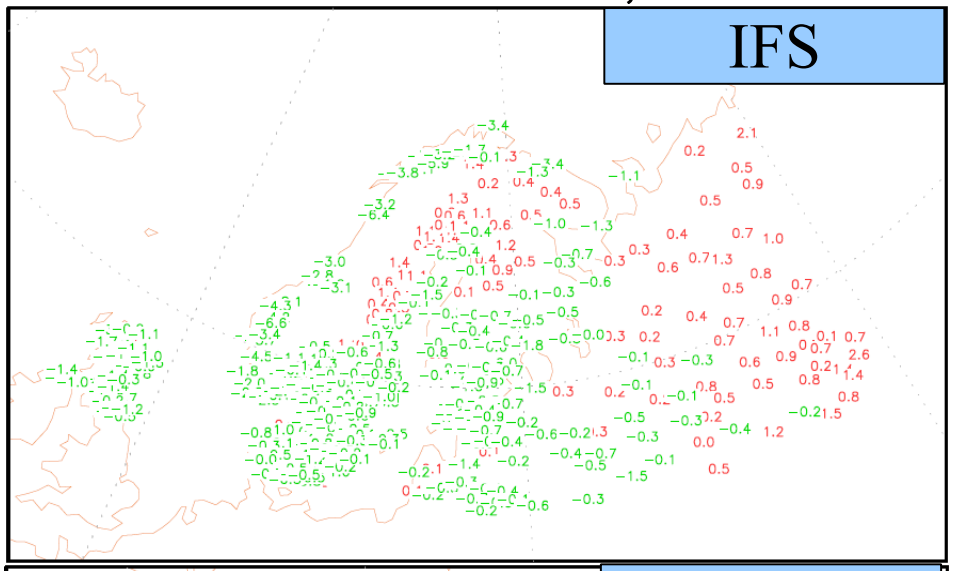
SYNOP stations elevation <= 300 meters

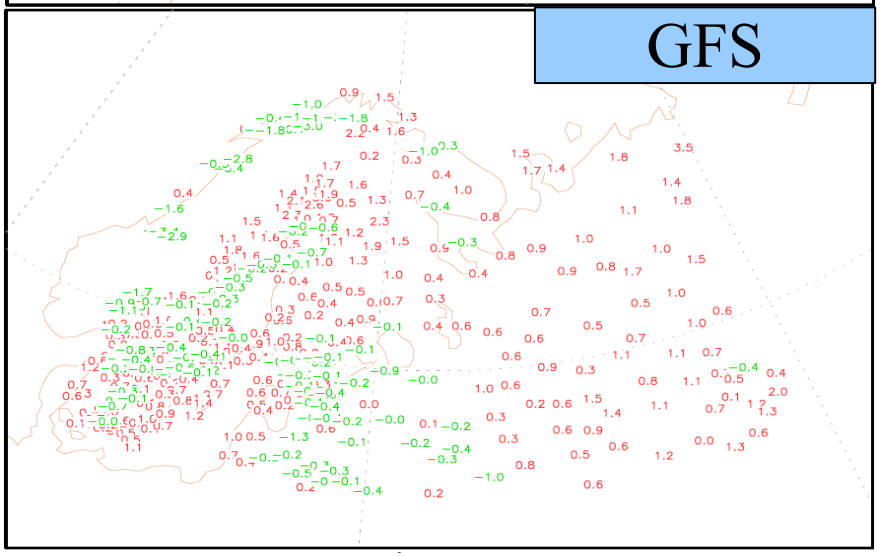
Exploited tool - «gl» (Ulf Andrae, SMHI)

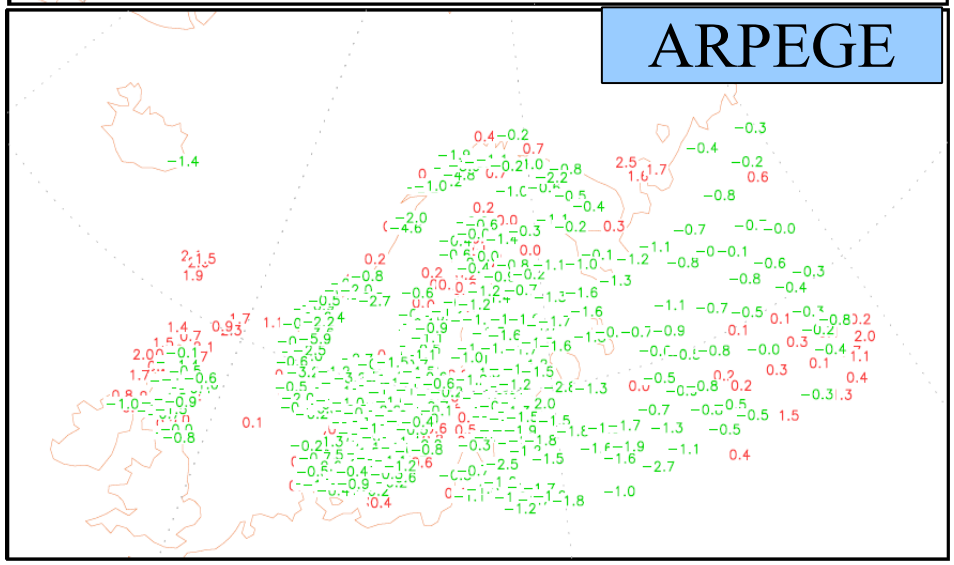
ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

Verification against SYNOP stations for winter 2008, 00 UTC



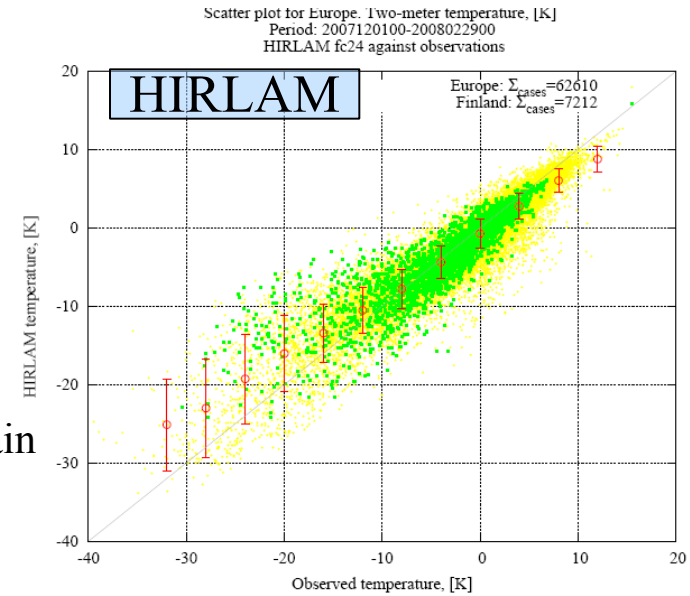


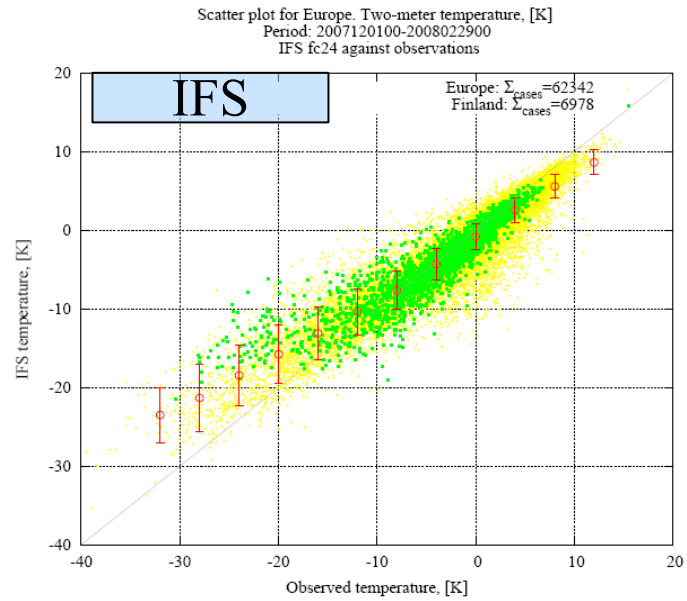


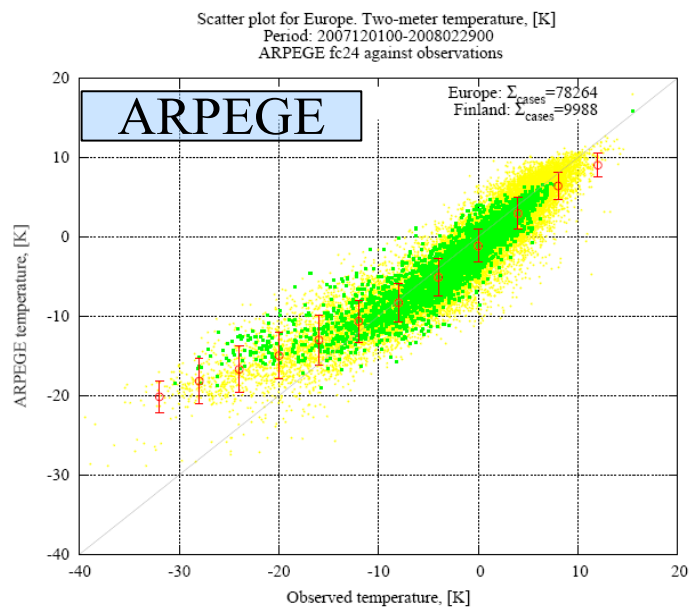


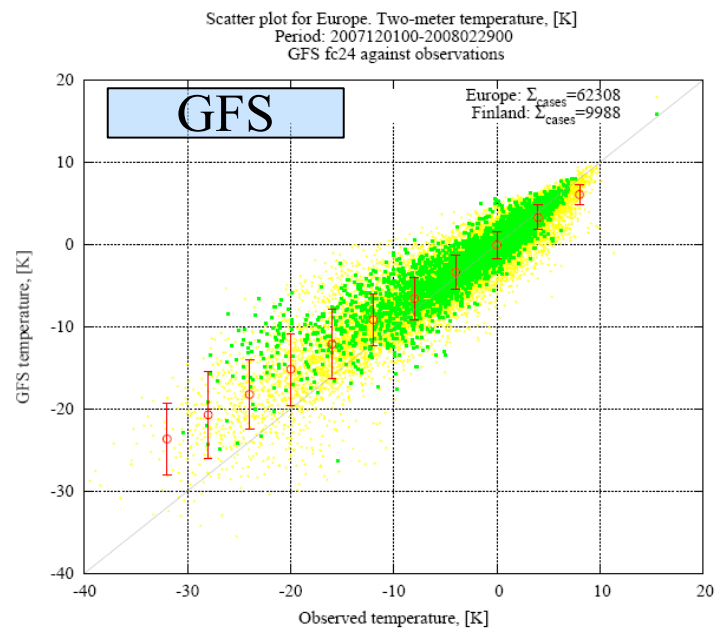
Scatterplots for winter 2007-2008, 00_UTC:

Yellow pts. - European domain
Green pts. - Finland domain
Red stripes - bin average for yellow pts.
Bin — 4K range in observed data





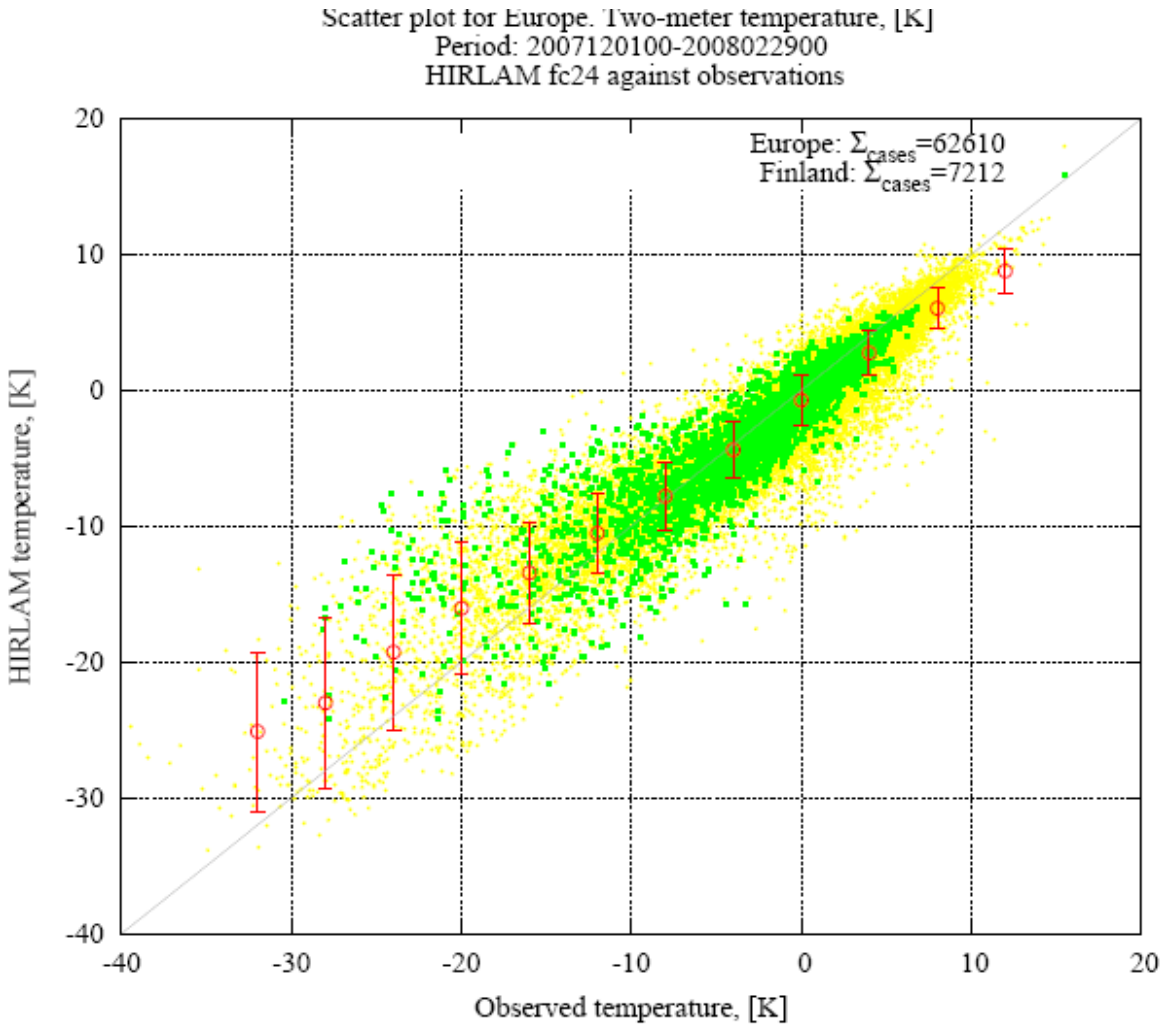




Verification against SYNOP stations in Europe and Finland

HIRLAM, Winter 2007-2008, 00UTC:

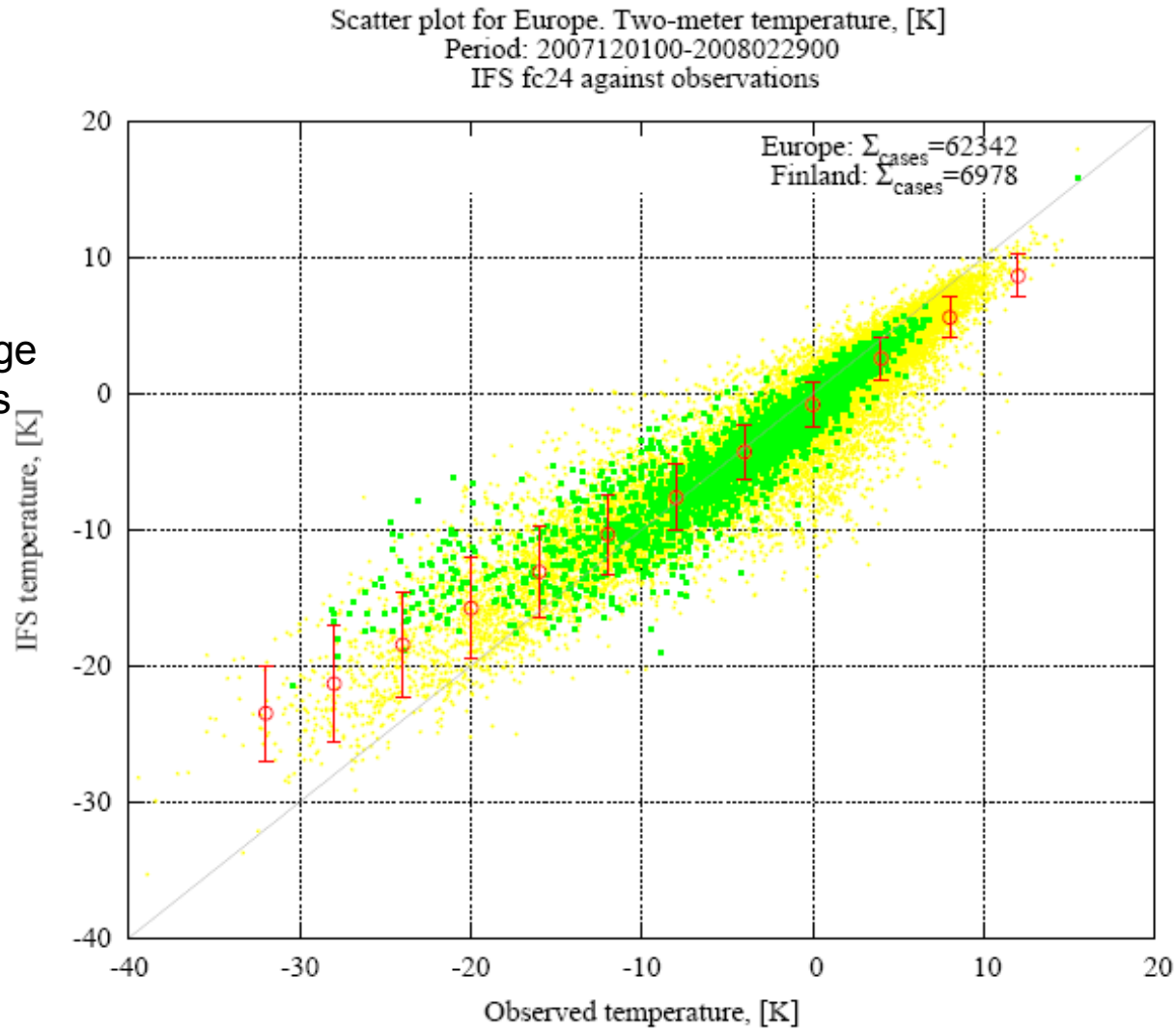
Yellow pts. - Europe
Green pts. - Finland
Red stripes - bin average for yellows



Verification against SYNOP stations in Europe and Finland

IFS, Winter 2007-2008, 00UTC:

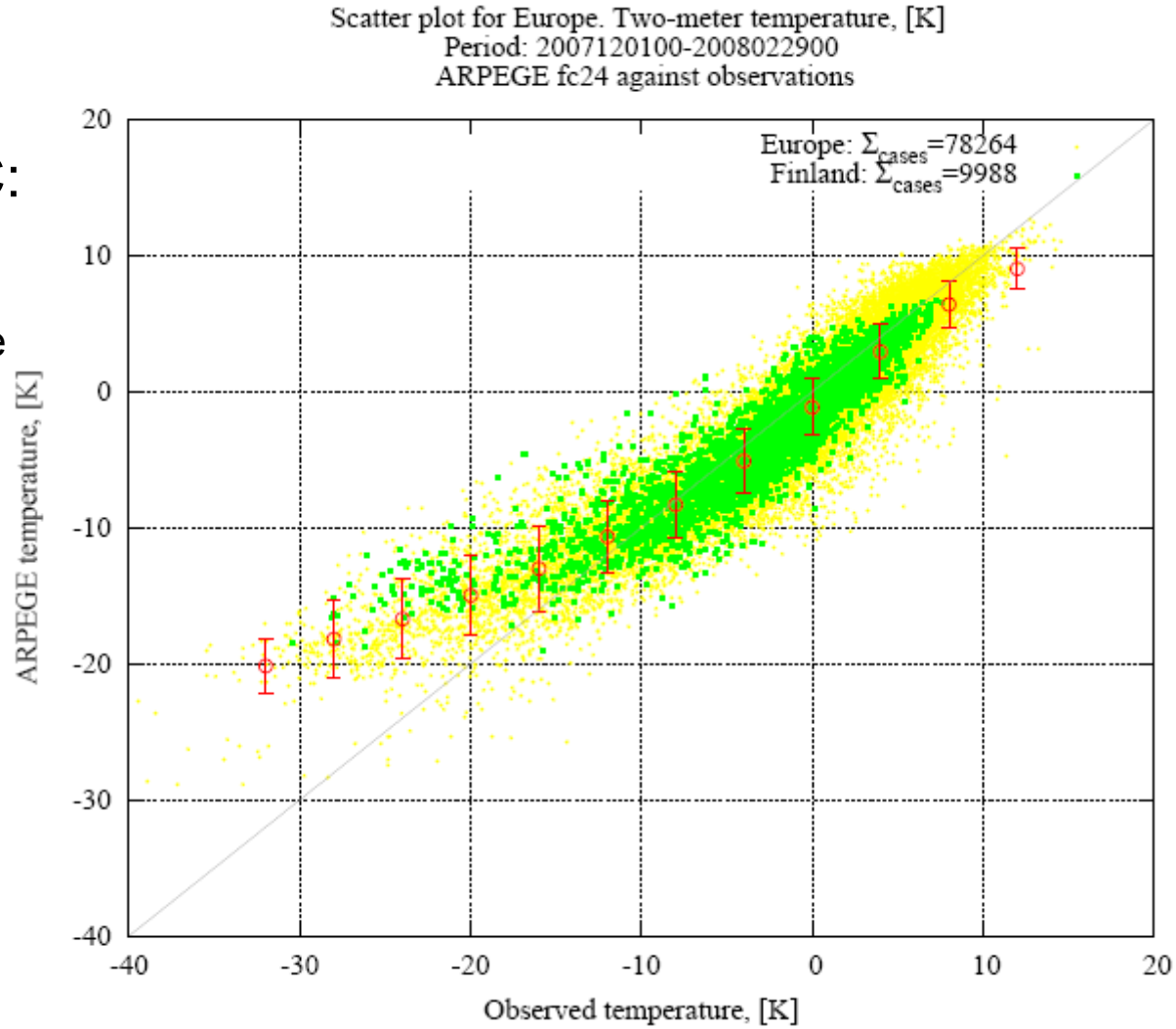
Yellow pts. - Europe
Green pts. - Finland
Red stripes - bin average for yellows



Verification against SYNOP stations in Europe and Finland

ARPEGE, Winter 2007-2008, 00UTC:

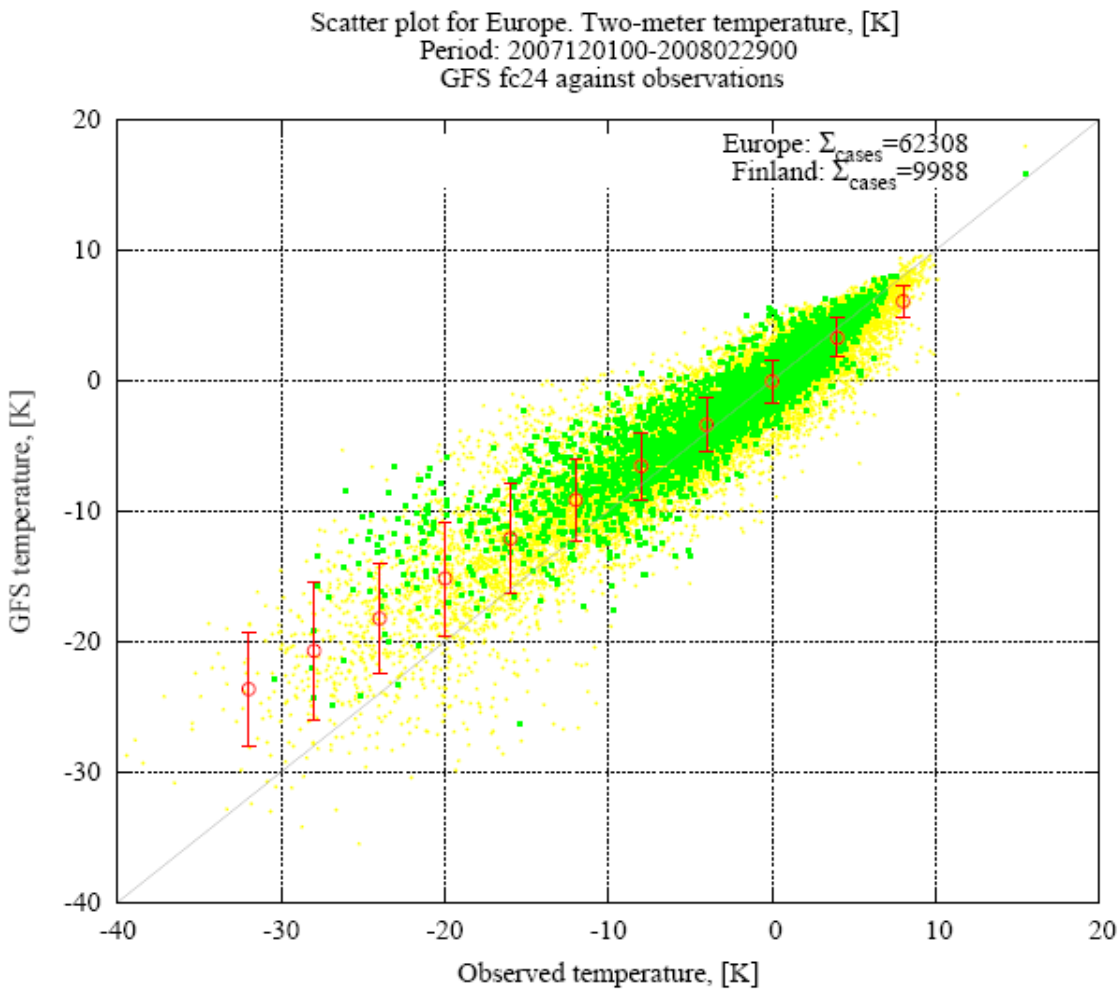
Yellow pts. - Europe
Green pts. - Finland
Red stripes - bin average for yellows



Verification against SYNOP stations in Europe and Finland

GFS, Winter 2007-2008, 00UTC:

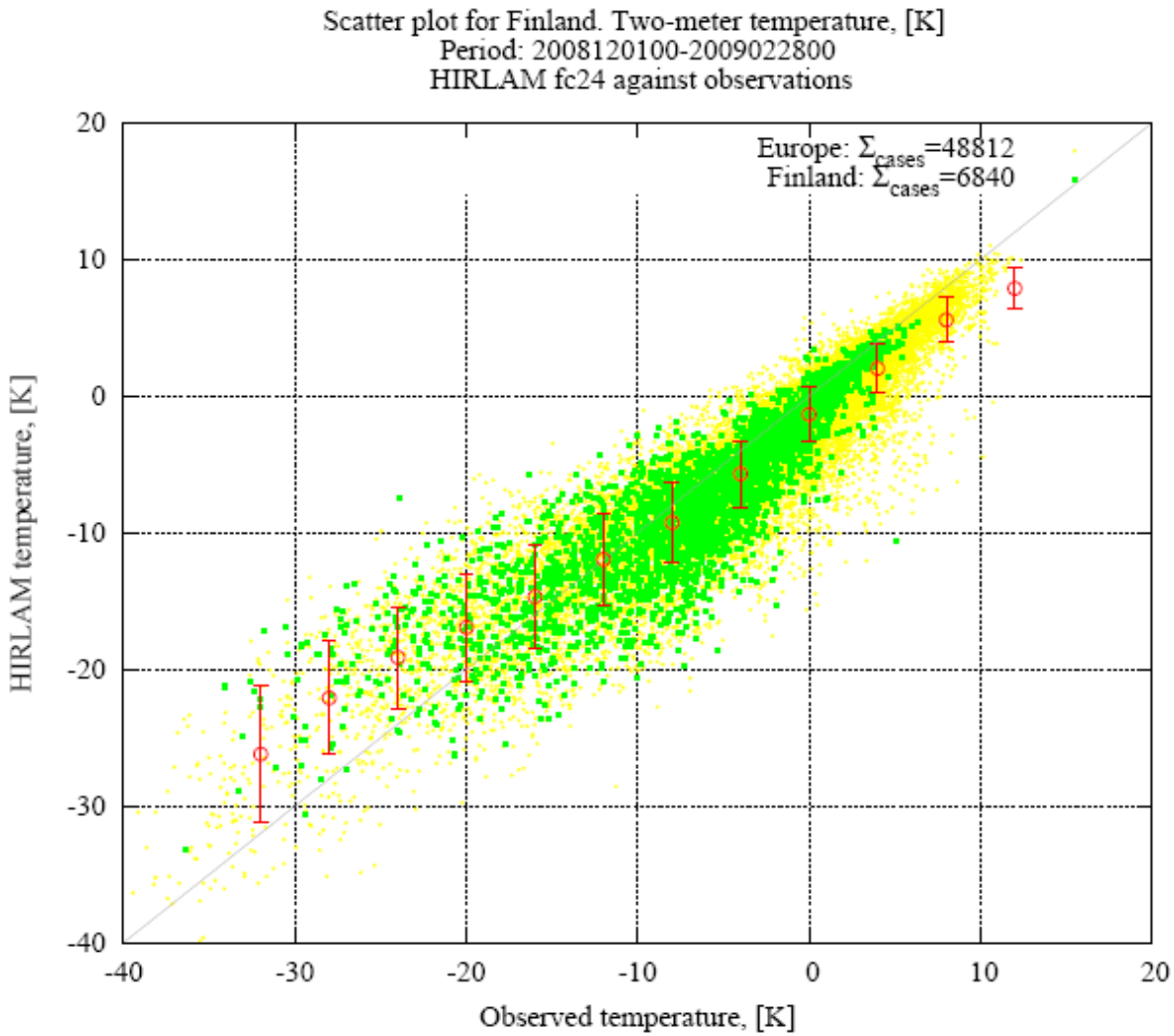
Yellow pts. - Europe
Green pts. - Finland
Red stripes - bin average for yellows



Verification against SYNOP stations in Europe and Finland

HIRLAM, Winter 2008-2009, 00UTC:

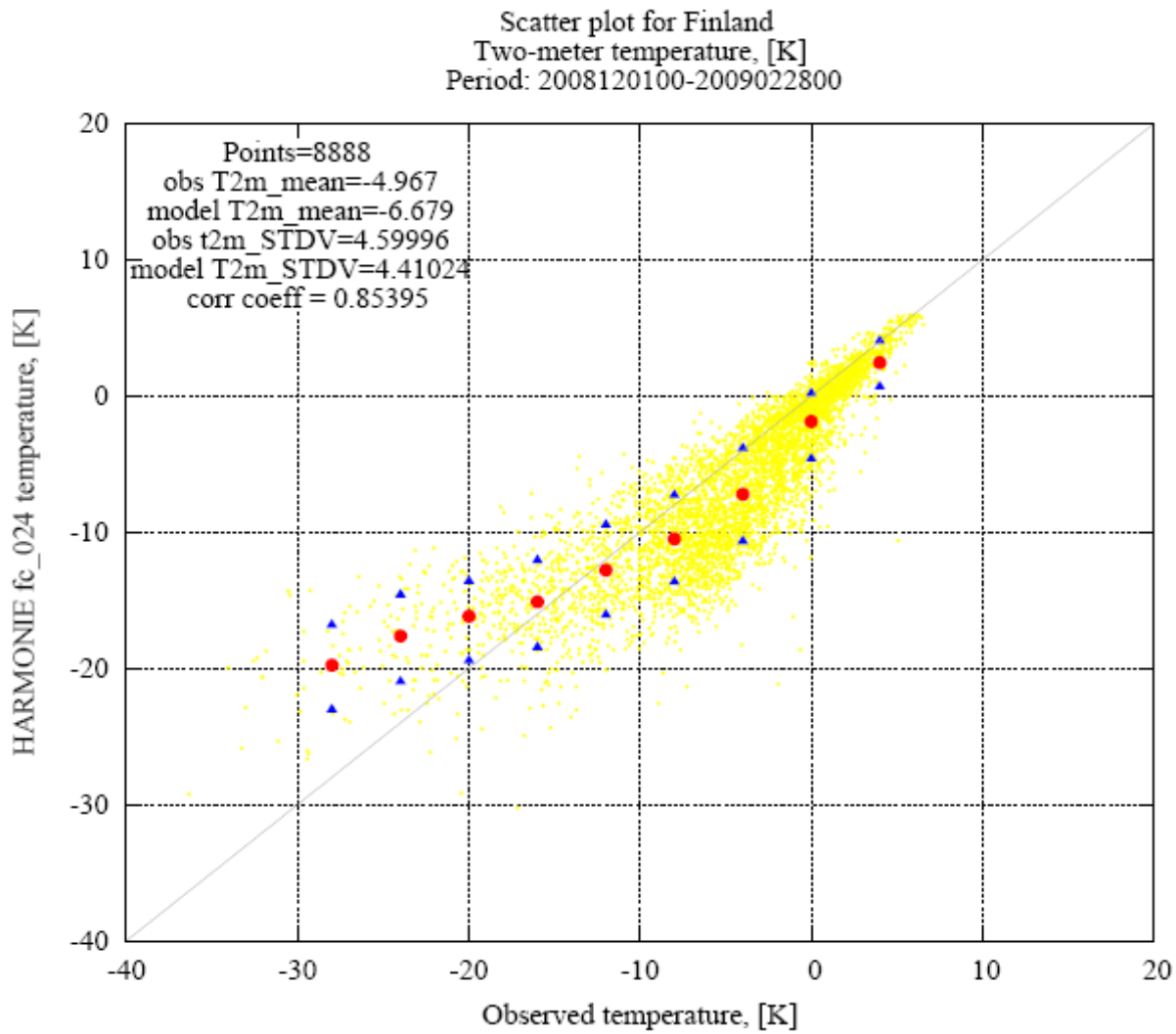
Yellow pts. - Europe
Green pts. - Finland
Red stripes - bin average for yellow pts.
Bin — 4K temperature interval in observational data



Verification against SYNOP stations in Finland

AROME, Winter 2008-2009, 00UTC:

Yellow pts. - Finland
Red pts. - bin average
Blue tri. - bin STDVs



Verification against Sodankyla mast measurements

- to validate a dependence of T2m bias on stability

General information

Mast height — 48 meters.

Location - Northern Finland, 67.22ºN, 26.38ºE

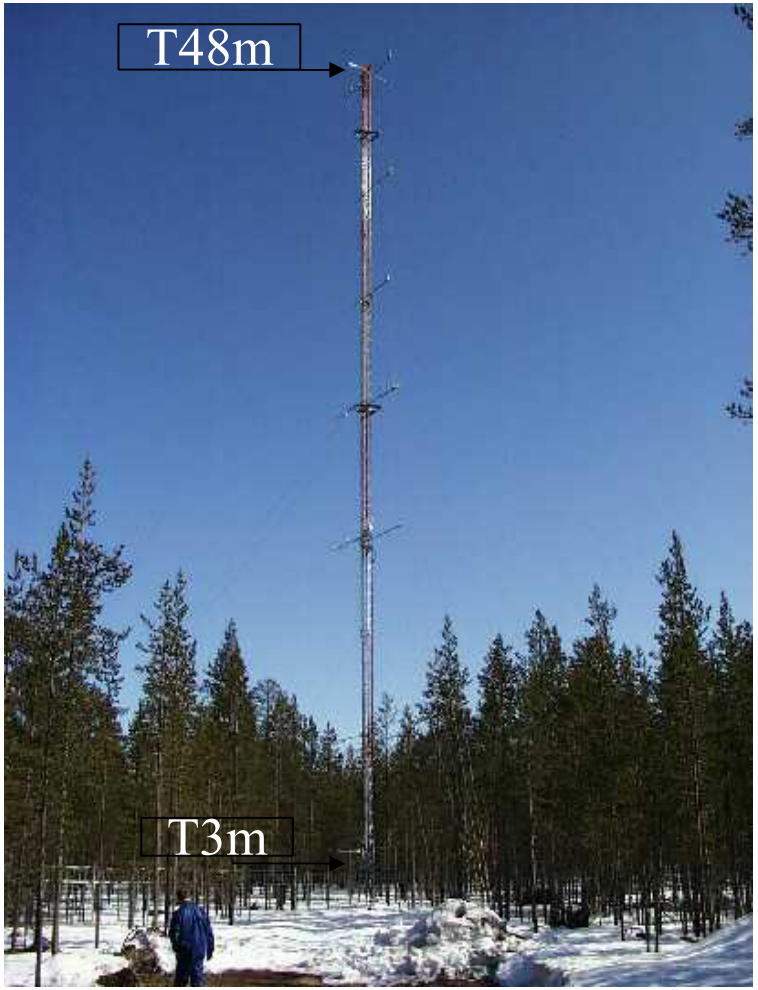
Altitude - 179 m a.m.s.l

Forested area with 15m trees top

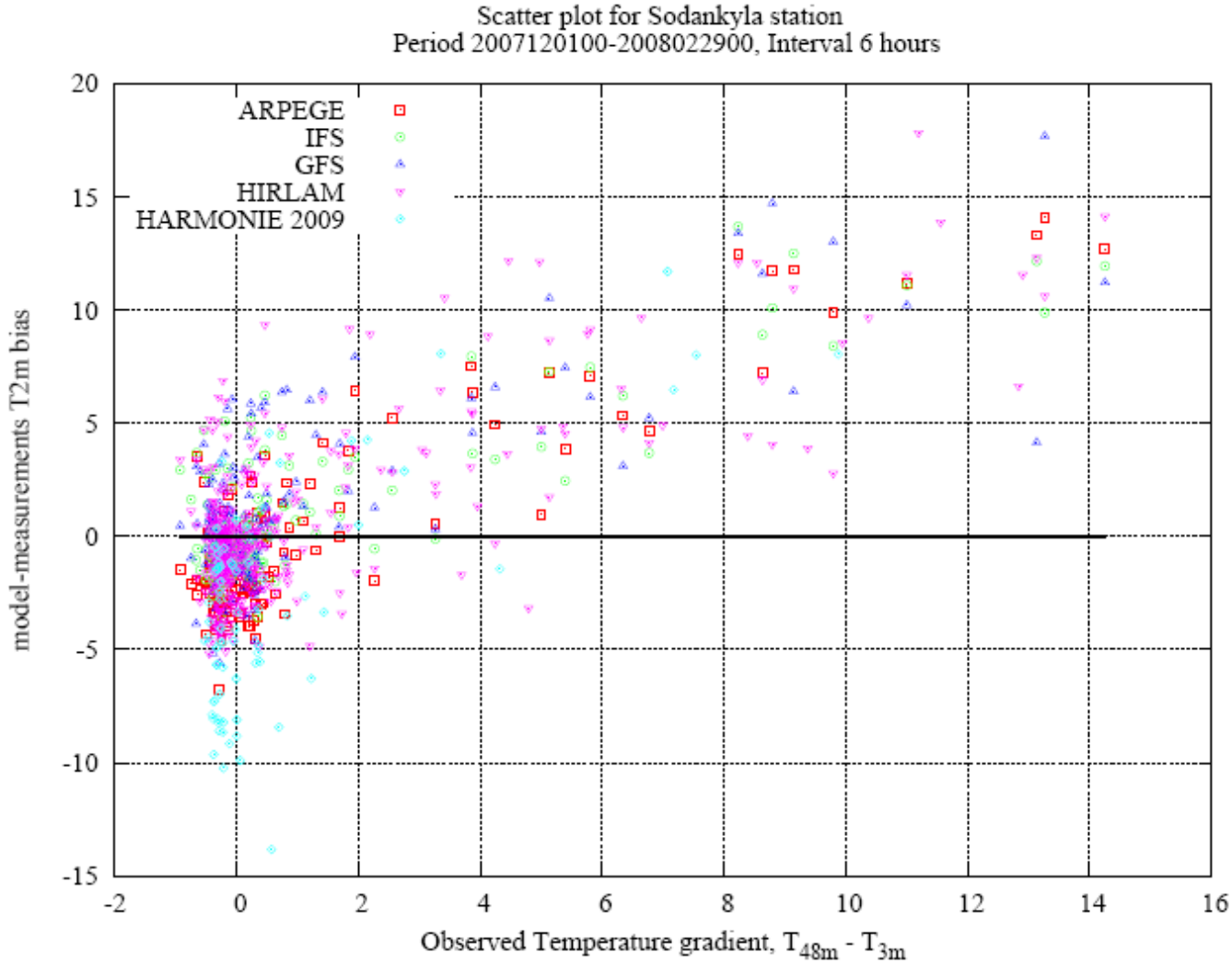
Flat terrain

Data used

Temperature measurements at 3 and 48 meters



Verification against Sodankyla mast measurements



Verification against Helsinki Test Bed measurements

Study

To compare methods:

1. verification against stations data

with

2. verification against mean observed value within a mode's grid cell

General Information

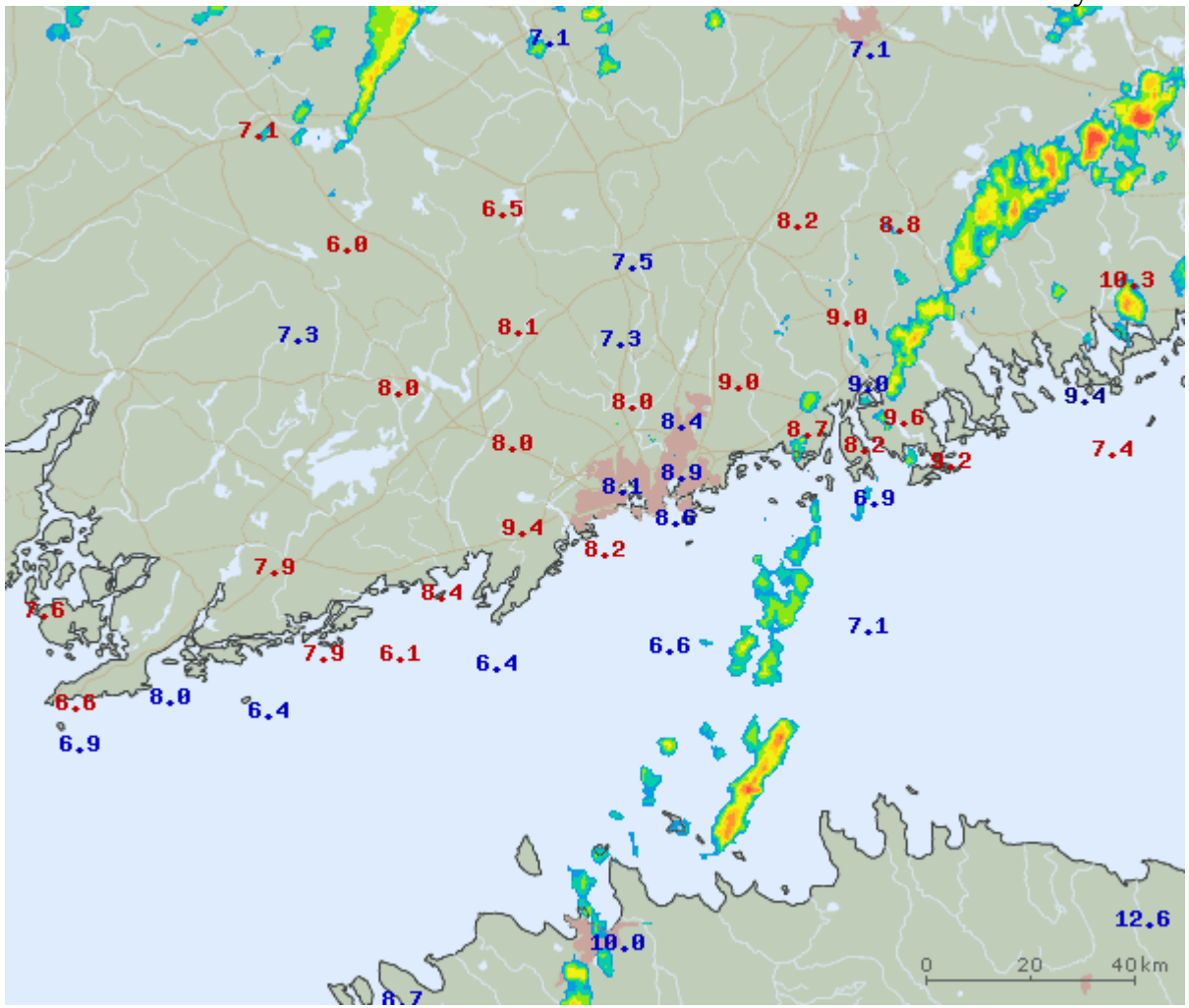
High dense measurements

Network intended for Meso-scale weather research, and models

Verification

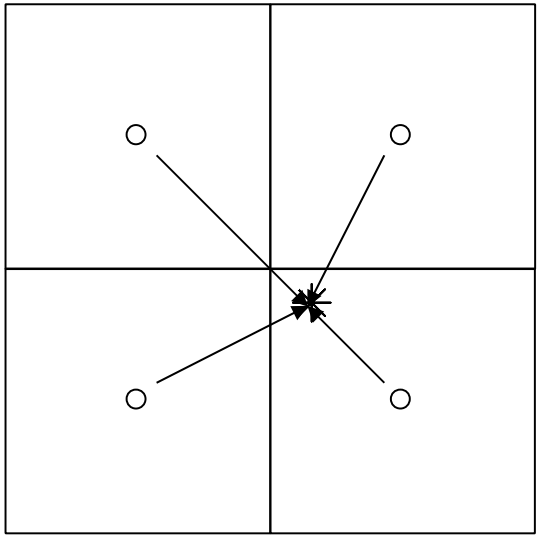
- 61 stations' data are used for current verificaton

11 May 2009



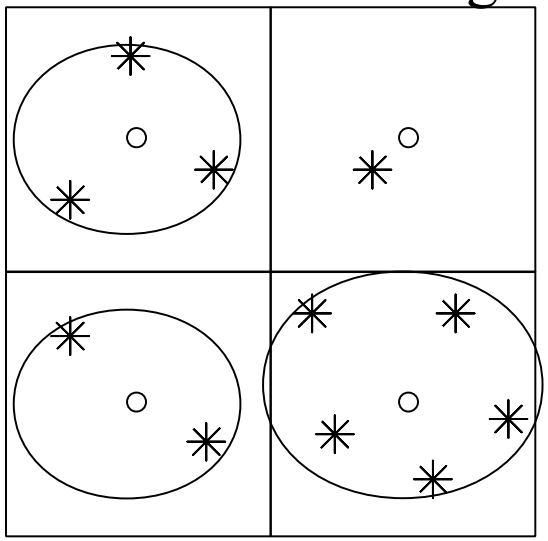
Verification against Helsinki Test Bed measurements

Interpolation of model grid data



✳ observations point
○ model's grid point

Averaging measurements within the model's grid

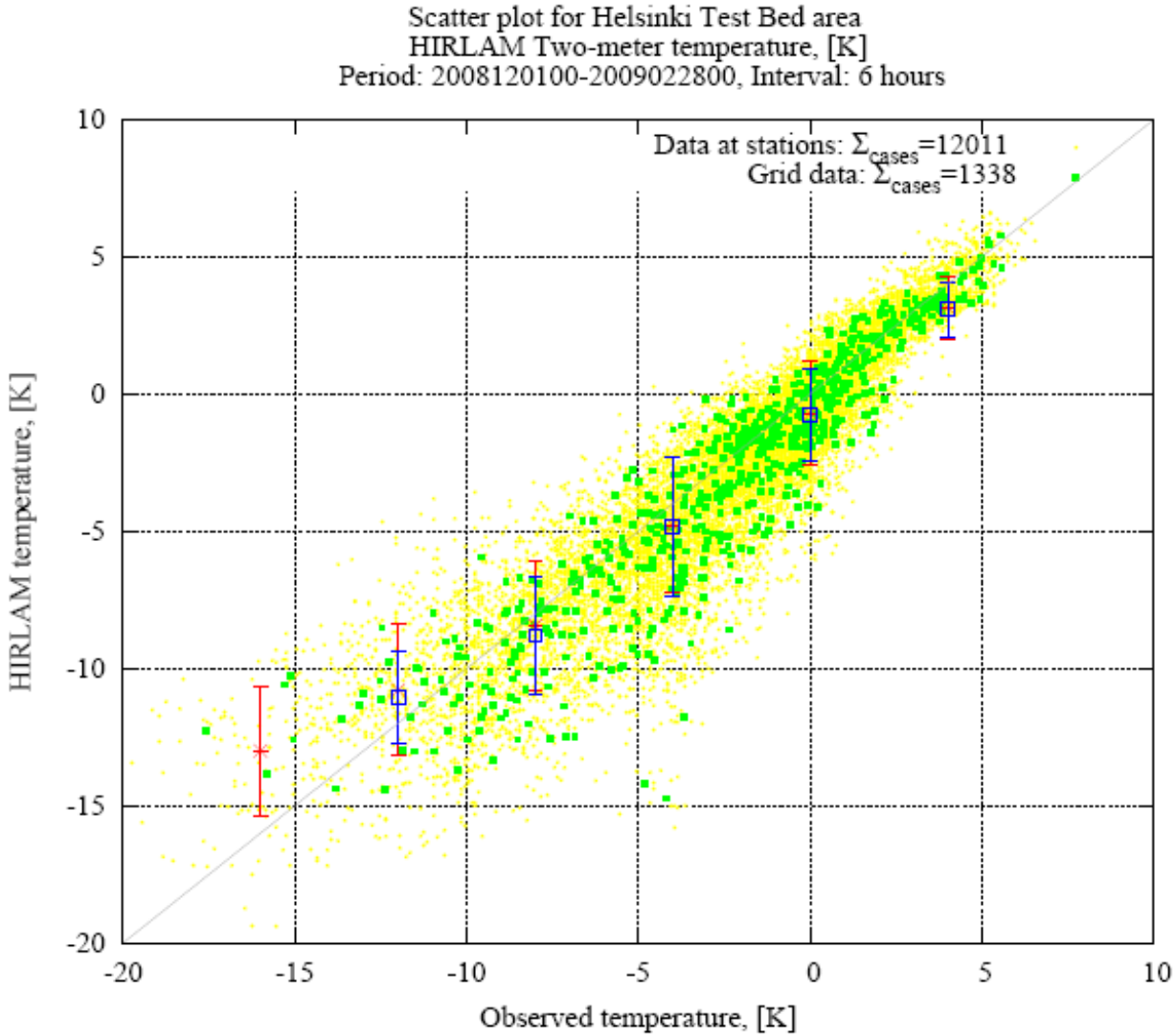


Grids embracing <3 observational stations are disregarded

Verification against Helsinki Test Bed measurements

HIRLAM, Winter 2008-2009, 00UTC:

Yellow pts. - data at stations
Green pts. - grid ave data
Red stripes - bin average for yellow pts.
Blue stripes - bin average for green points.
Red stripes — bin average for yellow points.



Conclusions

- **T2m temperature forecast is still a problematic at observed cold temperatures**
- **Warm temperature bias is correlated with stability**
- **Although the local effect rises at higher stability, still the grid mean observed value is lower than model's value**
- **The problem is complex and concerns**
  - Models' discretization in vertical and horizontal
  - Snow cover treatment
  - Turbulence parameterization
  - Cloud parametrization
  - Radiation
- **Near future work:**
  - More masts data are planned to be included
- **Model's data are welcome**


Thank you