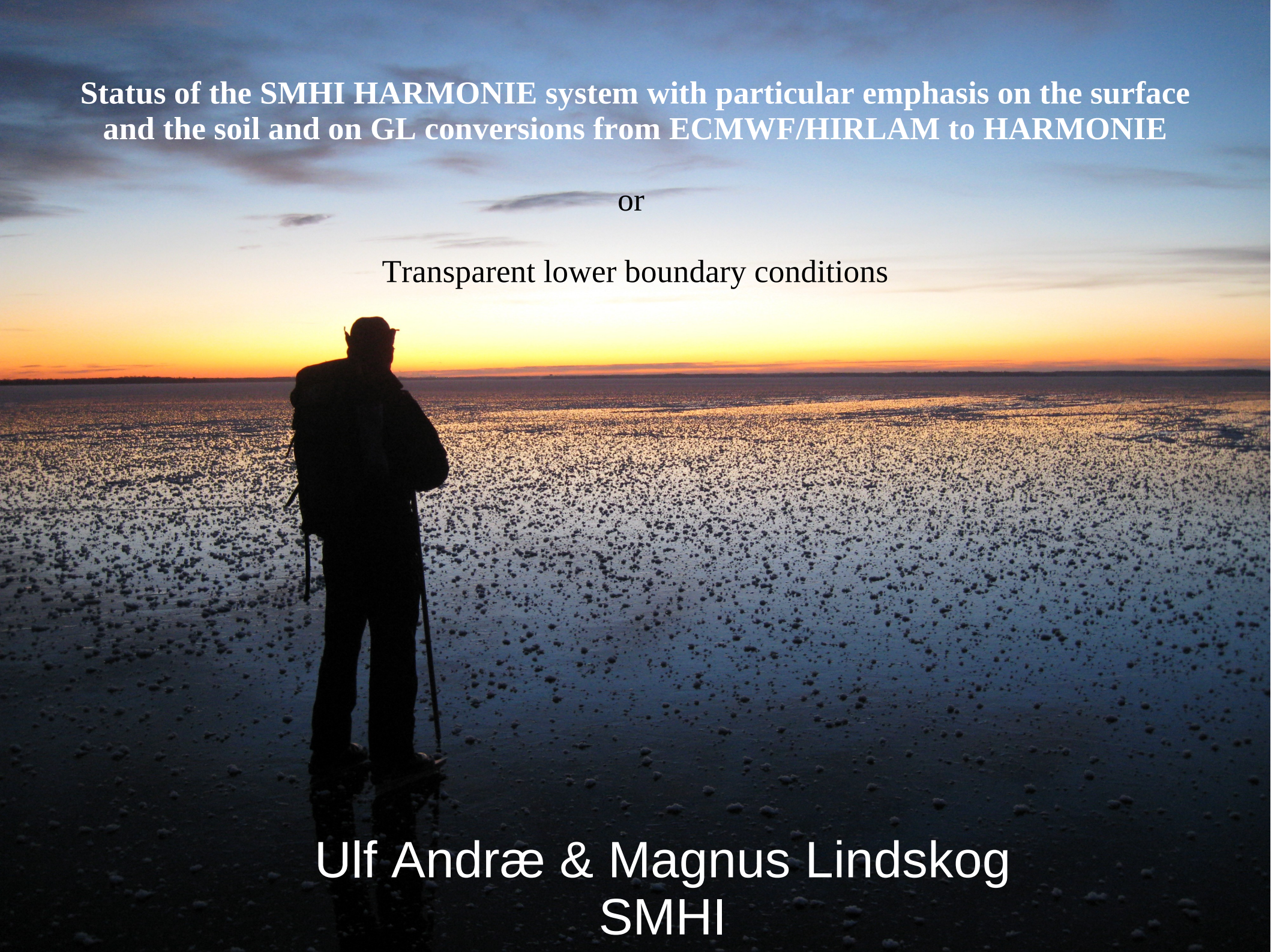


Status of the SMHI HARMONIE system with particular emphasis on the surface and the soil and on GL conversions from ECMWF/HIRLAM to HARMONIE

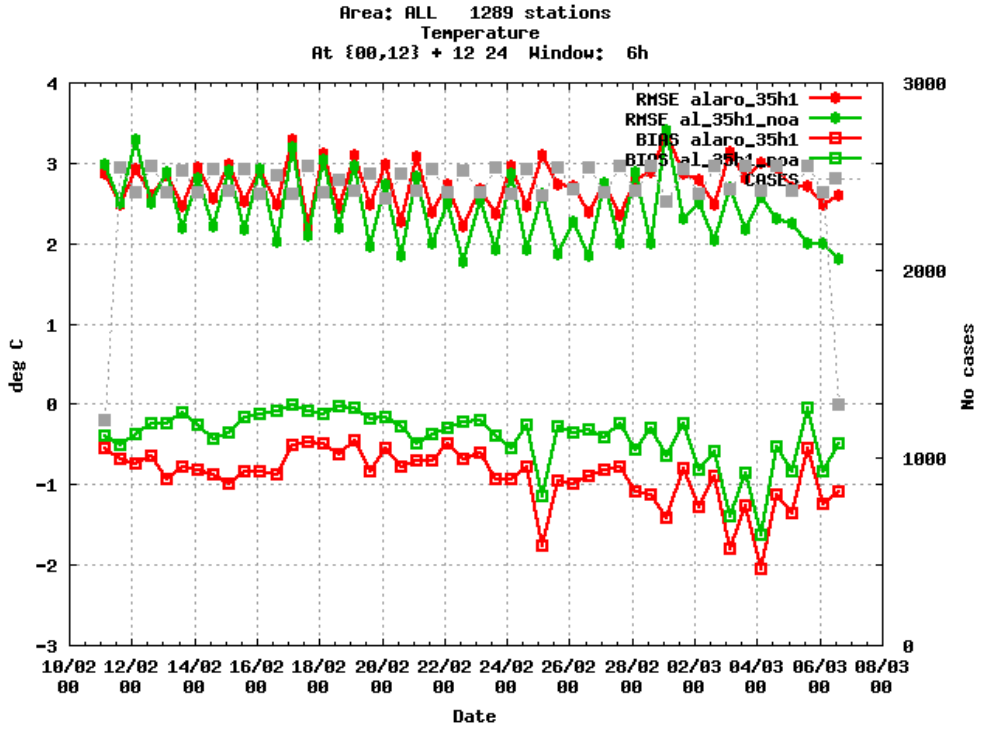
or

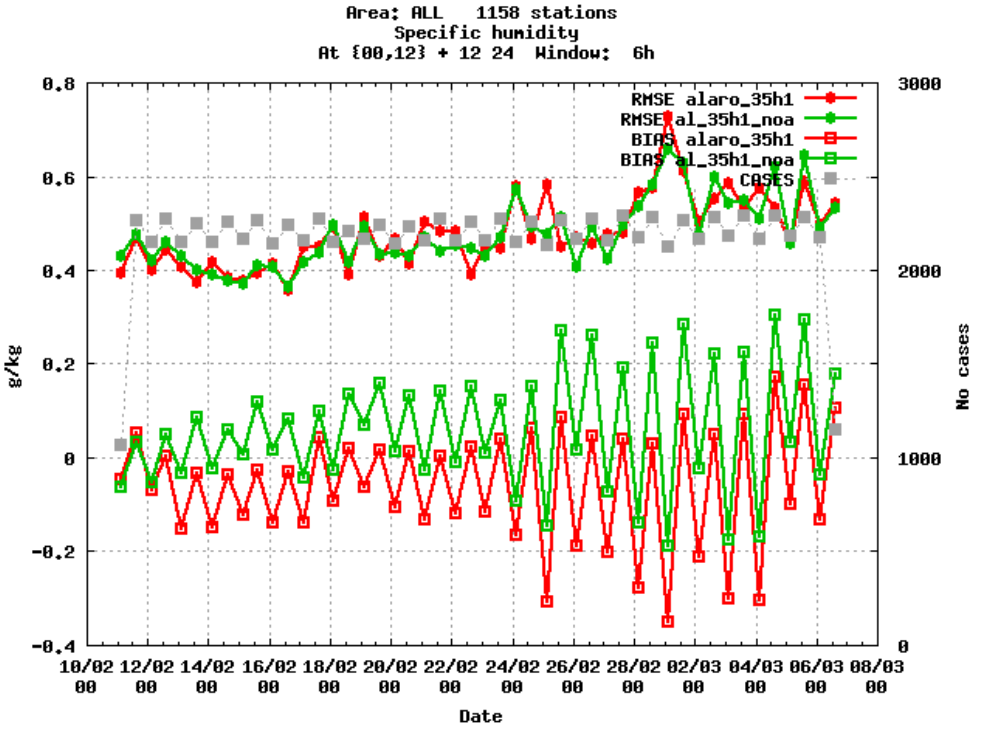
Transparent lower boundary conditions

Ulf Andræ & Magnus Lindskog
SMHI

Background

Red is with, green without assimilation





T2M Q2M

- We need to take second look on how we kick off the surface and how the assimilation works.

Content

- Description of the HARMONIE system
- Coupling opportunities and problems
- ALARO assimilation experiences at SMHI
- Suggested work areas

WARNING:This talk will give no solutions, it will most likely generate more problems!

Goals for the Harmonie system

- Self contained script (m)SMS system
  - Complete build system
  - Climate generation included. Before 35h1 SURFEX physiography file had to be generated at HPCE using “some script”
  - The NWP core tasks
  - Postprocessing and monitoring

Transparent!

- Provide a complete NWP system for a variety of choices
  - PHYSICS: ALADIN/HIRALD/ALARO/AROME
  - DYNAMICS: Hydrostatic/non-hydrostatic
  - SURFACE: SURFEX/non-SURFEX
  - ASSIMILATION: 3DVAR/CANARI on/off
  - COUPLING: Couple with ECMWF/HIRLAM/(ARPEGE)

For research and operational use. Not all combinations are “mature” or even valid.

Status of the Harmonie system

- **Cy35h1 to be released very soon**
  - **Experimental wavelet**
  - **Inline postprocessing**
  - **PGD file creation**
  - **ECMWT SST (off)**
  - **EDMFM (off)**
  - **Several other physics changes...**
  - **...**
- **cy35t2_bf.01 is loaded in to the trunk**
  - **Updated namelists**
  - **Namelists to enable IDFI,SSDFI (nonstandard option)**
  - **Correct ECMWF SST (script change)**
  - **Orographic smoothing**
  - **Oulan cleaning**
  - **Extract Maxwind,gust, visibility from HARMONIE**
  - **Land-sea mask interpolation**
  - **Porting to c1a**
  - **- Blending of surface analysis,ua analysis**
  - **...**

How to get the best initial conditions?

- Cold start, read U/V/T/Q/PS/Z from outer model and the surface constant/climate/prognostic fields from the climate file.
  - May be a bad choice but we don't need to worry about the format. Fields may be missing!
- Warm start, read U/V/T/Q/PS/Z and surface prognostic fields from outer model.
  - We hope to avoid spinup.
  - We may encounter problems (or hide problems) due to differences in the surface climate.
- A lot of experiments are run without assimilation so this is important

ECMWF/HIRLAM -> current surface scheme

- HIRLAM rotated lat/lon boundary file run through gl -> initial/boundary FA file
- There exists (at least) two options for couple ECMWF to ALADIN:
  - 901 + e927 i.e. generate an ARPEGE FA file from and ECMWF input and interpolate to model geometry using FULLPOS. Needs and ARPEGE climate file. Not available in HARMONIE
  - ECMWF (rotated) lat/lon boundary file run through gl -> initial/boundary FA file.

Surface fields needed

Climate fields

SURFZ0.FOIS.G
SURFALBEDO
SURFEMISSIVITE
SURFEPAIS.SOL
SURFET.GEOPOTENT
SURFVAR.GEOP.ANI
SURFVAR.GEOP.DIR
SURFIND.TERREMER
SURFAEROS.SEA
SURFIND.VEG.DOMI
SURFIND.FOLIAIRE
SURFPROP.ARGILE
SURFPROP.SABLE
SURFRESI.STO.MIN
SURFGZ0.THERM
SURFALBEDO.SOLNU
SURFALBEDO.VEG
SURFAEROS.SEA
SURFAEROS.LAND
SURFAEROS.SOOT
SURFAEROS.DESERT
SURFA.OF.OZONE
SURFB.OF.OZONE
SURFC.OF.OZONE

Read from boundary:

SURFTEMPERATURE
SURFRESERV.EAU
PROFTEMPERATURE
PROFRESERV.EAU
SURFRESERV.INTER

SURFRESERV.NEIGE**
SURFALBEDO NEIGE**
SURFDENSIT.NEIGE**

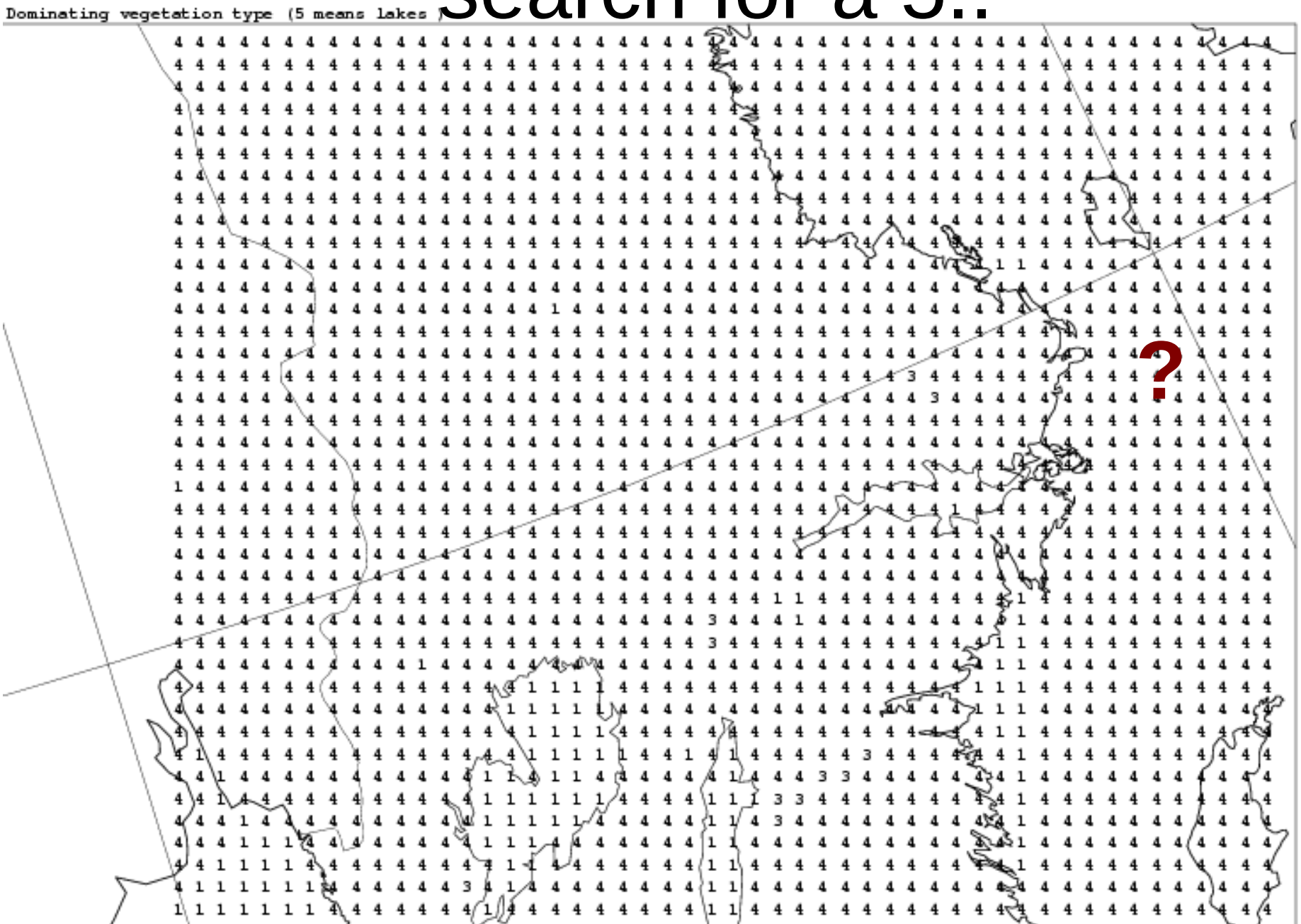
Set to constant:

SURFRESERV.GLACE*
PROFRESERV.GLACE*
SURFRES.EVAPOTRA

* Read from HIRLAM

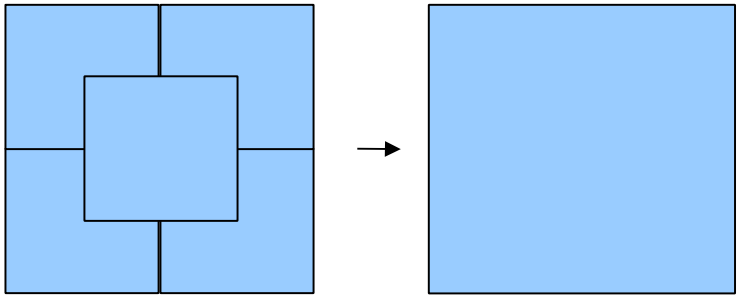
- ** Not available in the climate file

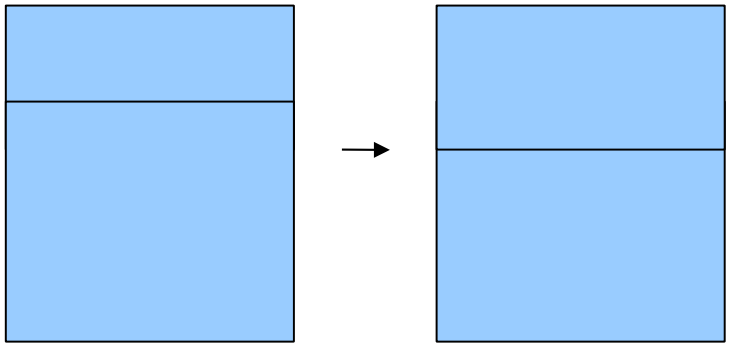
Absence of lakes in the climate file, search for a 5..



HIRLAM -> current surface scheme

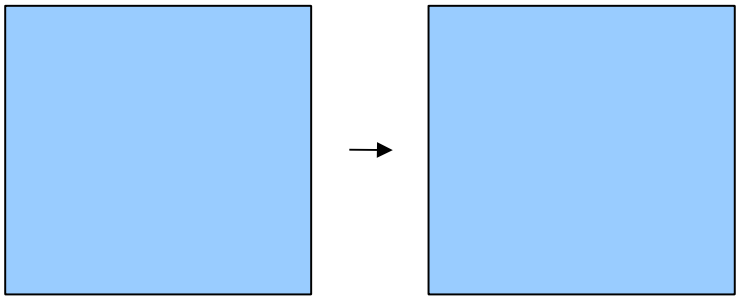
- HIRLAM has a tiled surface scheme (WATER/ ICE/SOIL/LOW WEG/FOREST)
  - Only use properties from meaningful tiles like interception water from the vegetation tiles.
  - Rescale soil water/ice to fit depth differences.
  - No heat/water content conservation
  - No treatment of LSM

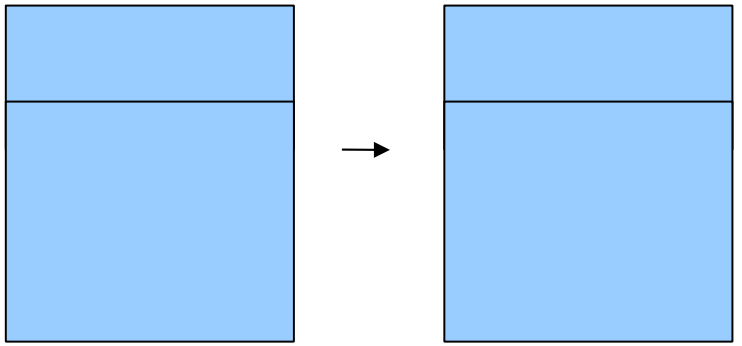




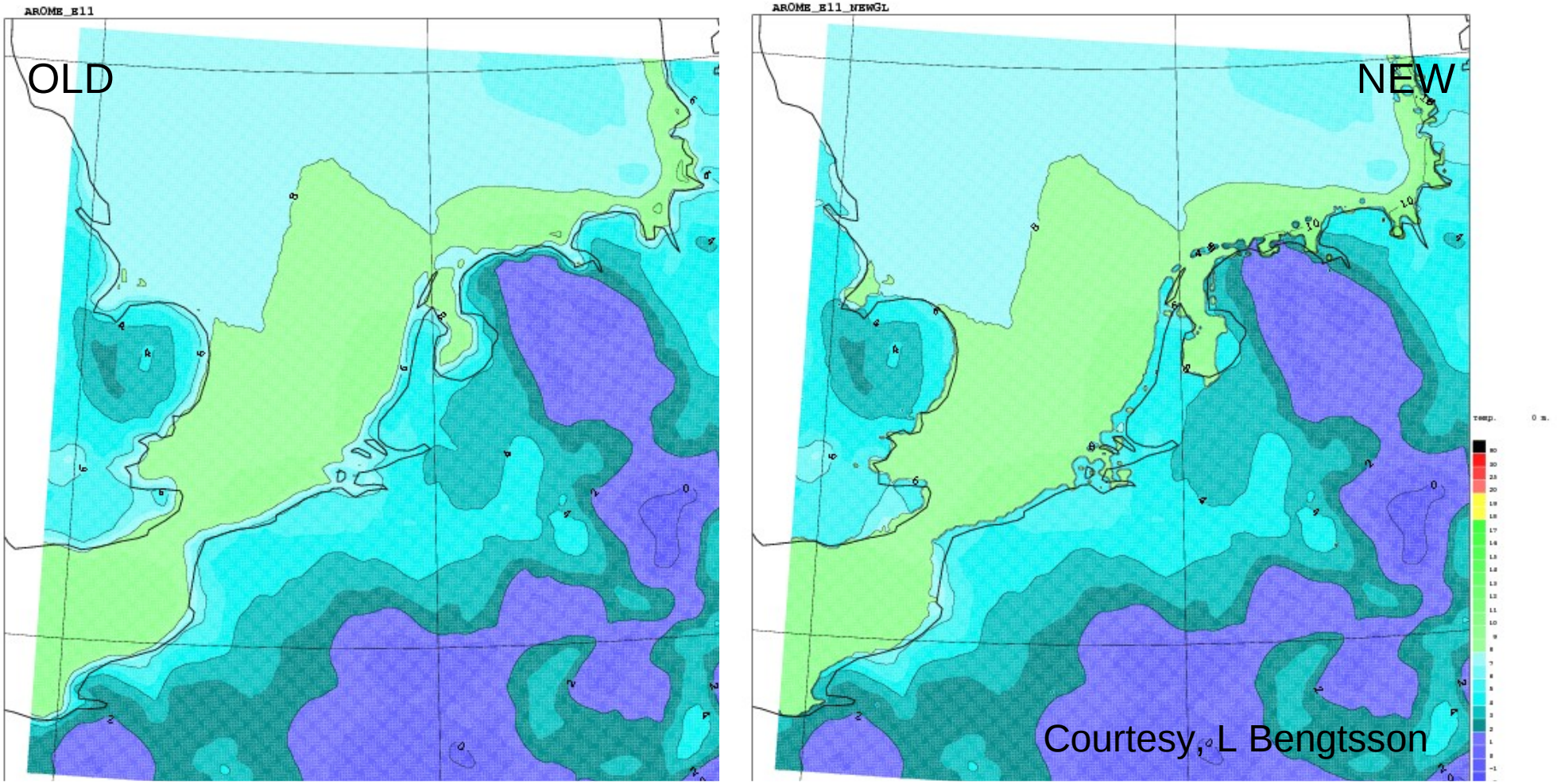
ECMWF -> current surface scheme

- Terribly simplistic, one to one correspondence.
- Alex Deckmyn coded a more 901 like solution but we had problems on our large domain so it never entered the system.
- Problems reported when trying to assimilate RH2M (MD later talk?)
- Needs to be changed!





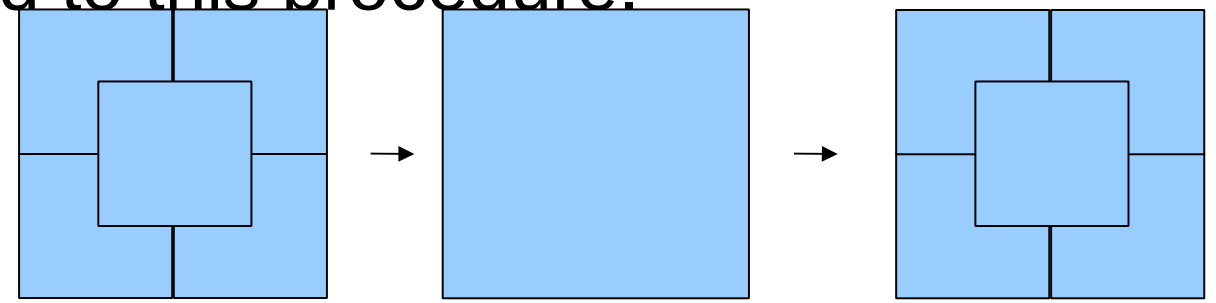
For both ECMWF and HIRLAM data a surface type consistent interpolation has been coded.



- Sharp gradients can be problematic but smoothing should not be carried out by mixing surfaces blindly.
- ECMWF MARS lat/lon fields are not necessarily surface type consistent, LSM != SST. Should be we start using the Gaussian grid?

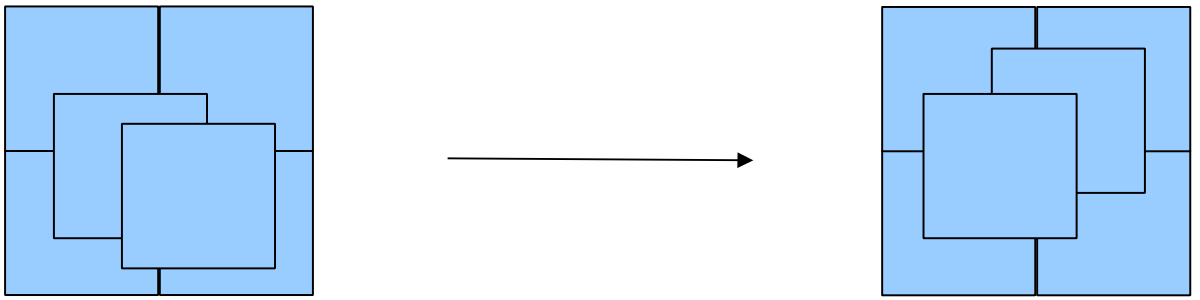
ECMWF/HIRLAM -> SURFEX

- Simplistic approach implemented, unfortunately it has survived.
- ECMWF/HIRLAM -> gl -> FA -> fullpos -> SURFXINI.lfi
  - What is a proper resolution of the intermediate FA file?
  - The intermediate FA file contains less information!
  - We have seen problems in AROME probably related to this procedure.



ECMWF/HIRLAM -> SURFEX Future needs

- Best possible initial conditions will always be important for research experiments
- We should remove the intermediate step
- With newsnow we have even more information that could potentially be used.

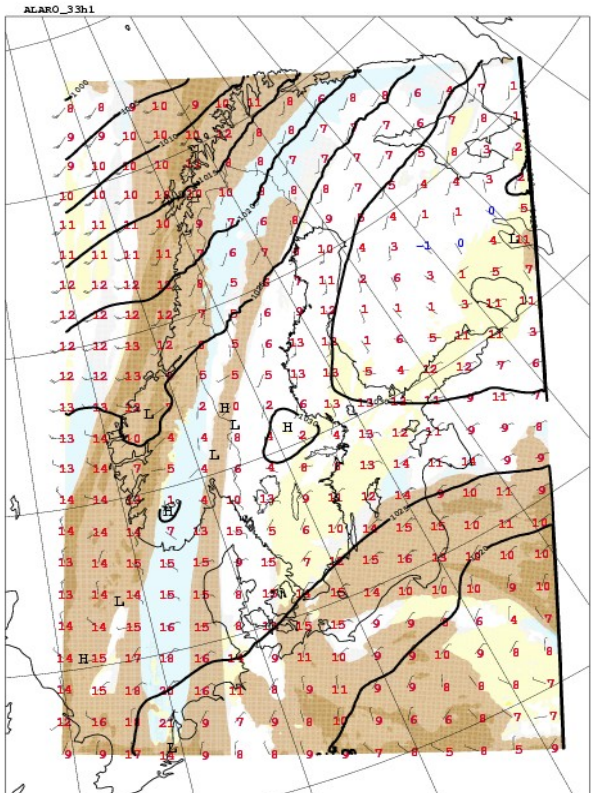


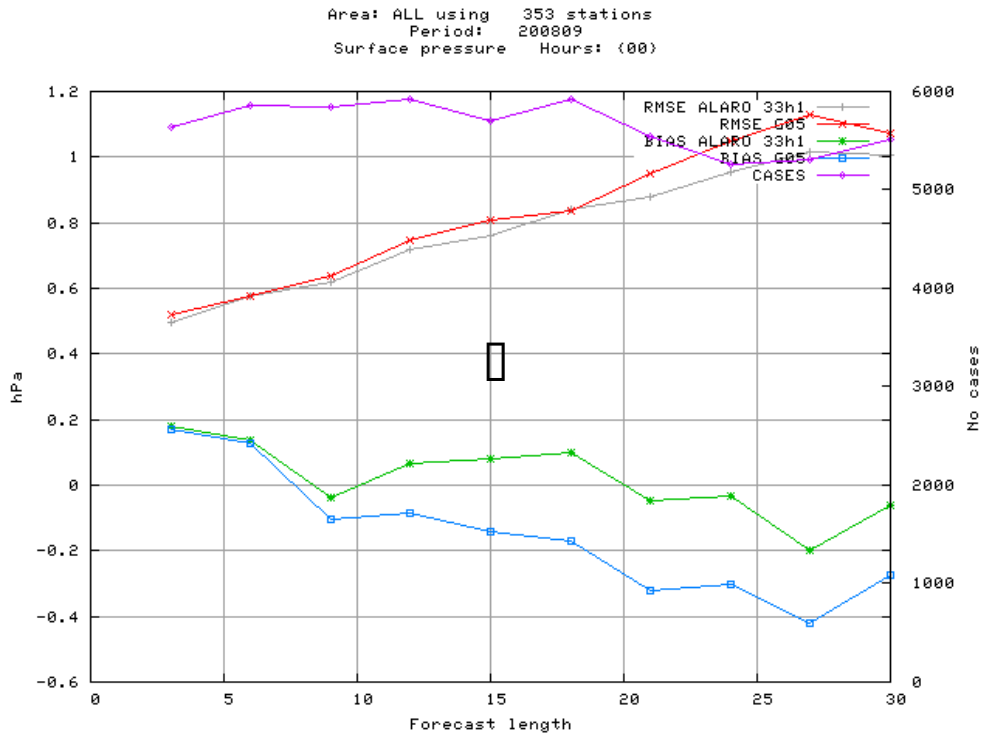
Future needs

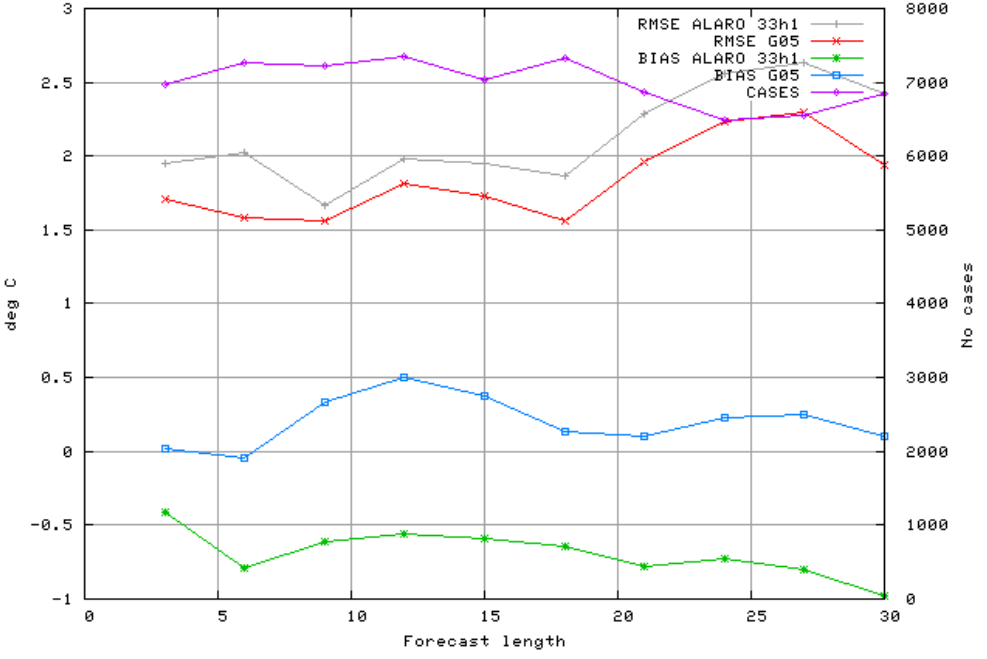
- Correct ECMWF/HIRLAM to non SURFEX surface. (Talk from RR/MH)
- Remove the intermediate step when creating SURFEX initial files. Perhaps JFM (next talk) ideas can be applied on HIRLAM fields as well?

SMHI choice for post HIRLAM

- Cannot go for 1-2km so ALARO was chosen.
- Results for 33h1 was comparable to our 5.5km HIRLAM. Especially summertime precipitation looked attractive

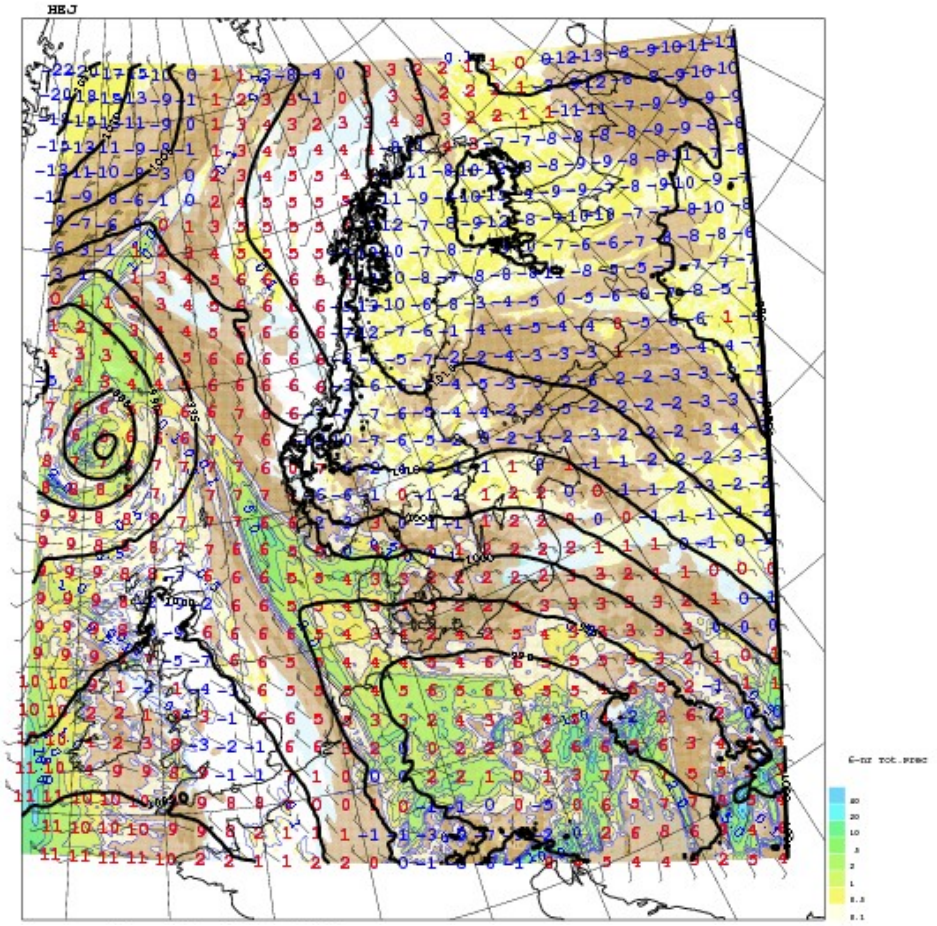


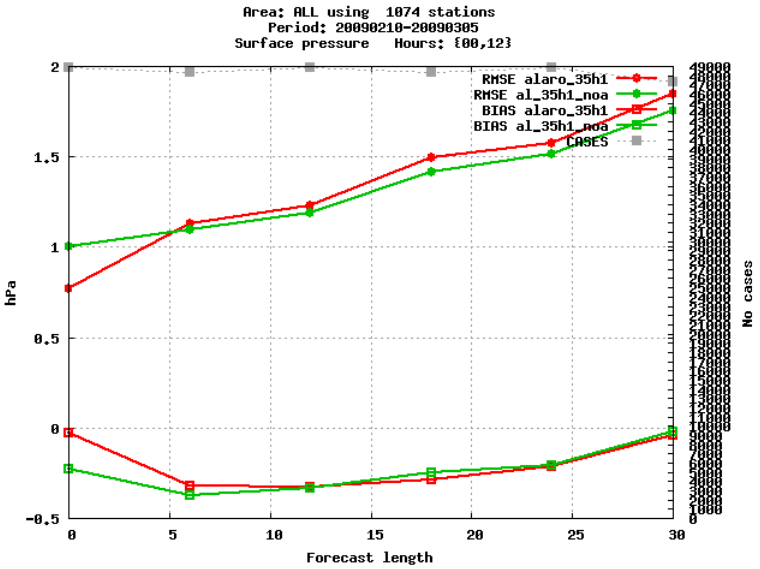




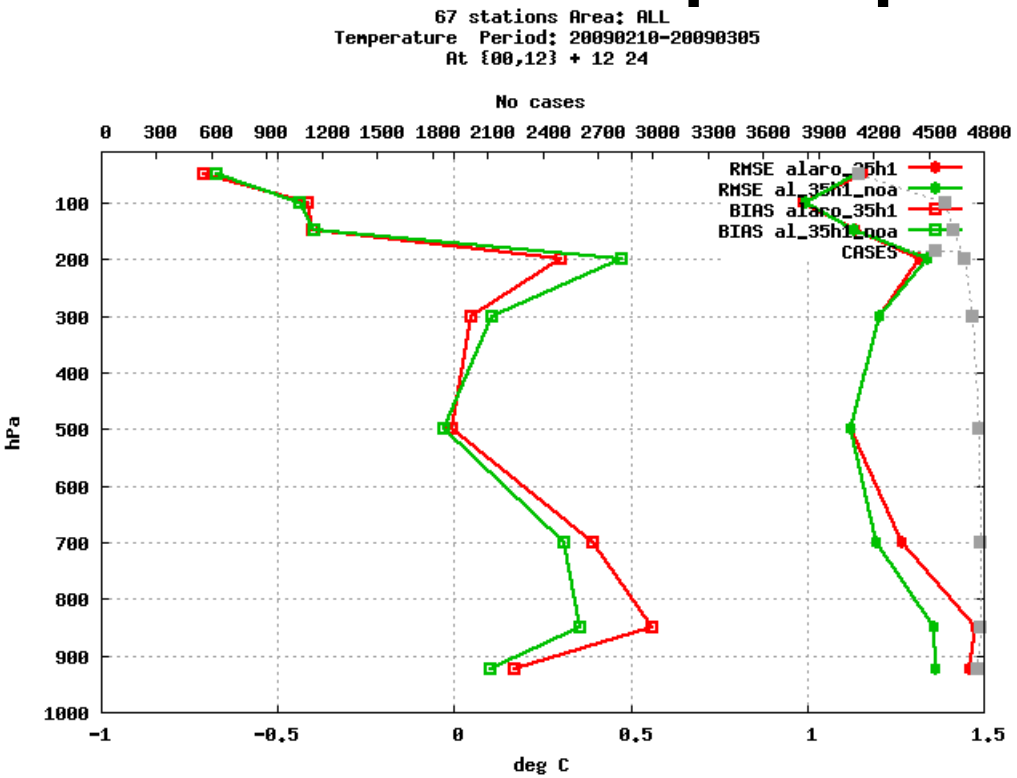
Assimilation experiments at SMHI

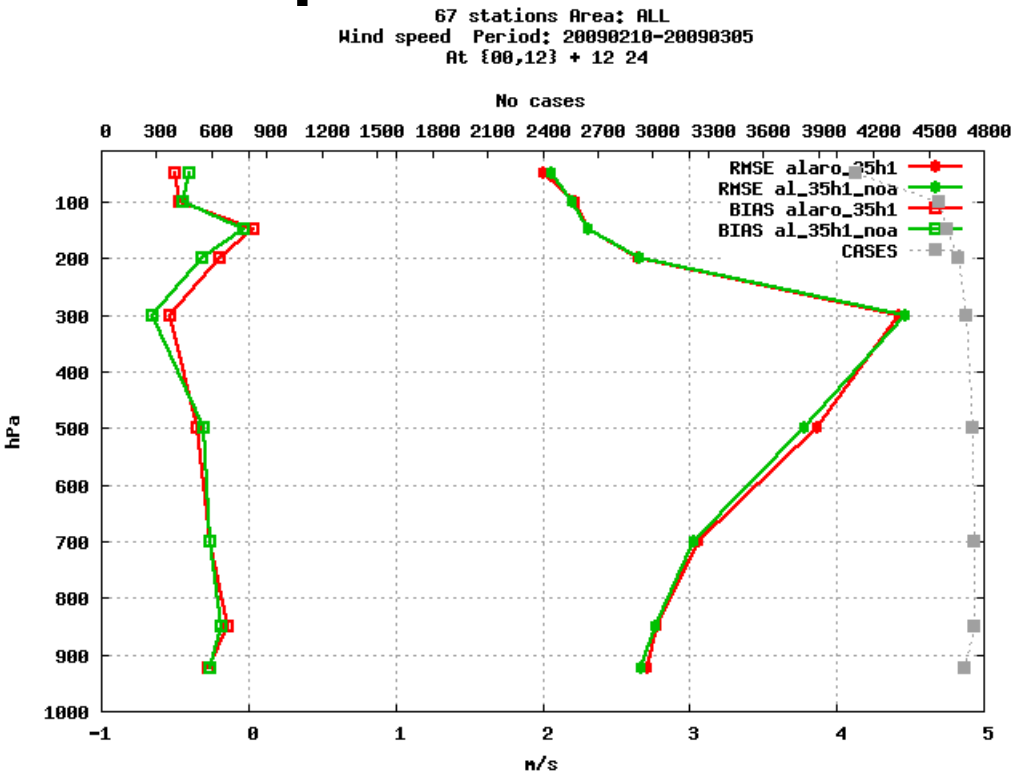
- ALARO@Cy35h1
- 60 levels, 5.5 km
- 3DVAR+CANARI,Conv observations,no SST assimilation, REDNMC=0.6
- 6h old HIRLAM C22 boundaries. +30h@{00,12}
- Feb 10th – Mar 6th 2009
  - **alaro_35h1 with assimilation**
  - **al_35h1_noa no assimilation**





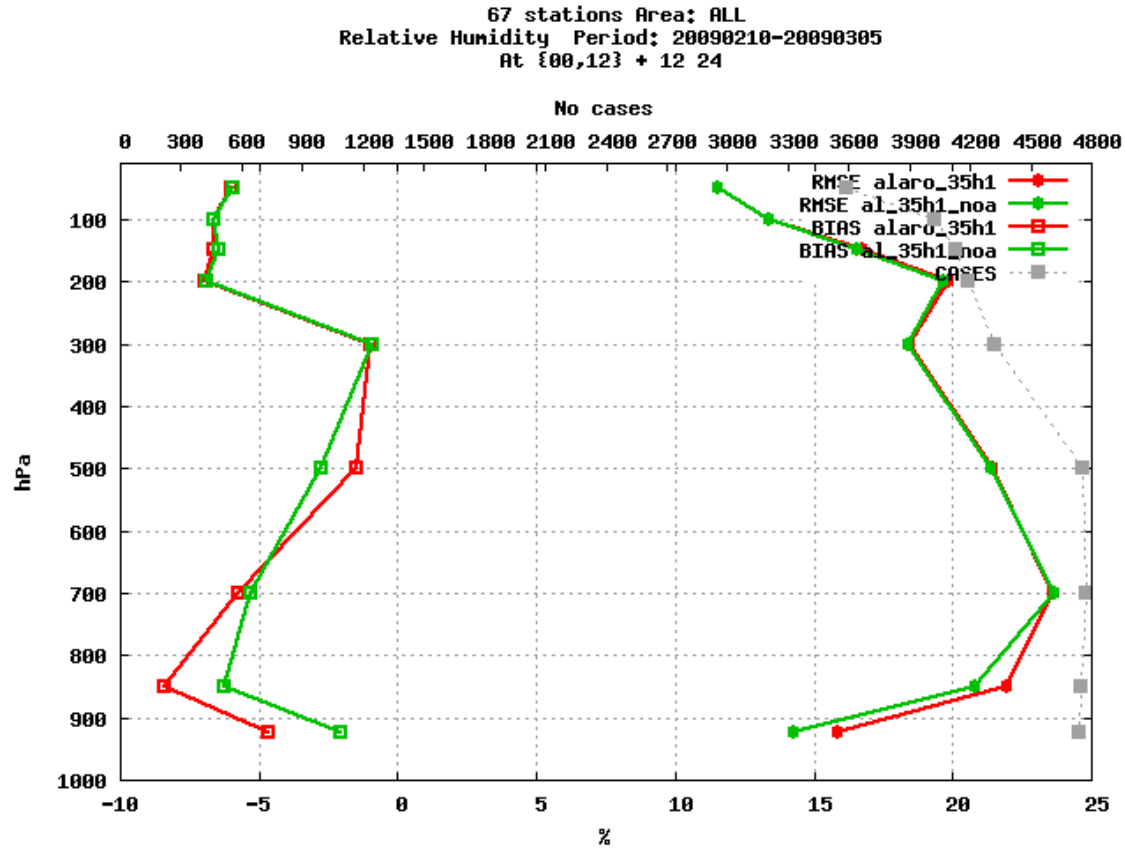
3DVAR, Positive upper, negative lower troposphere impact

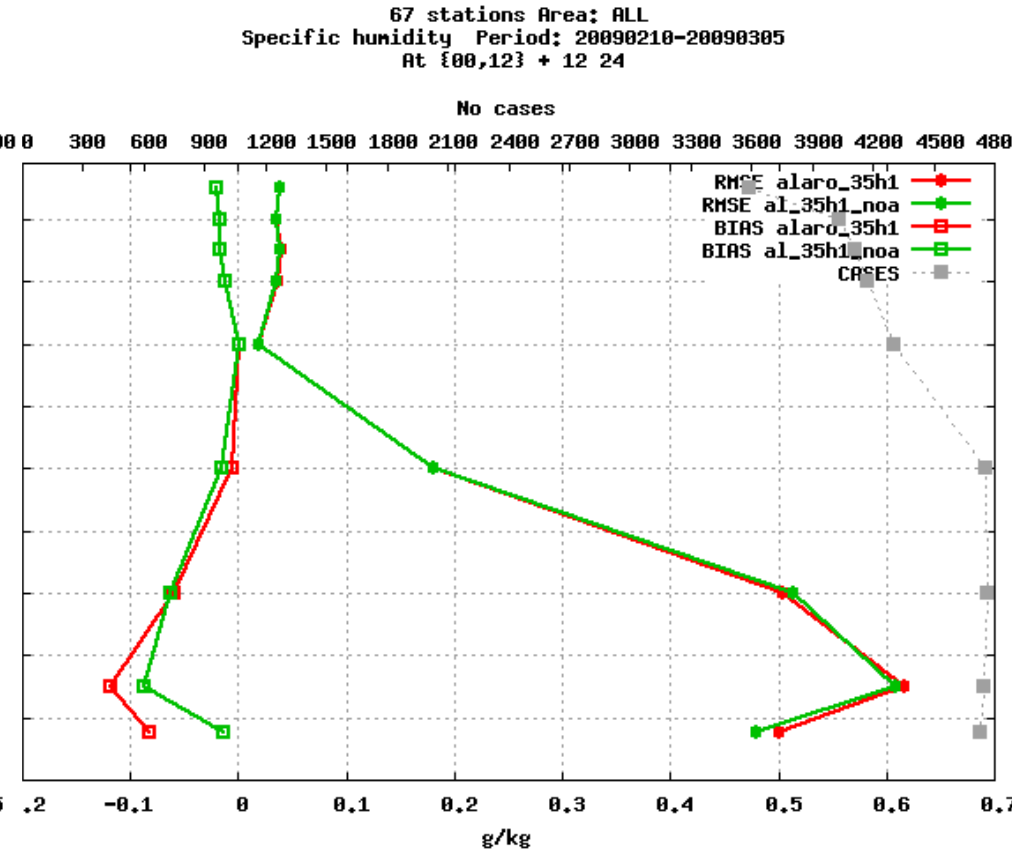




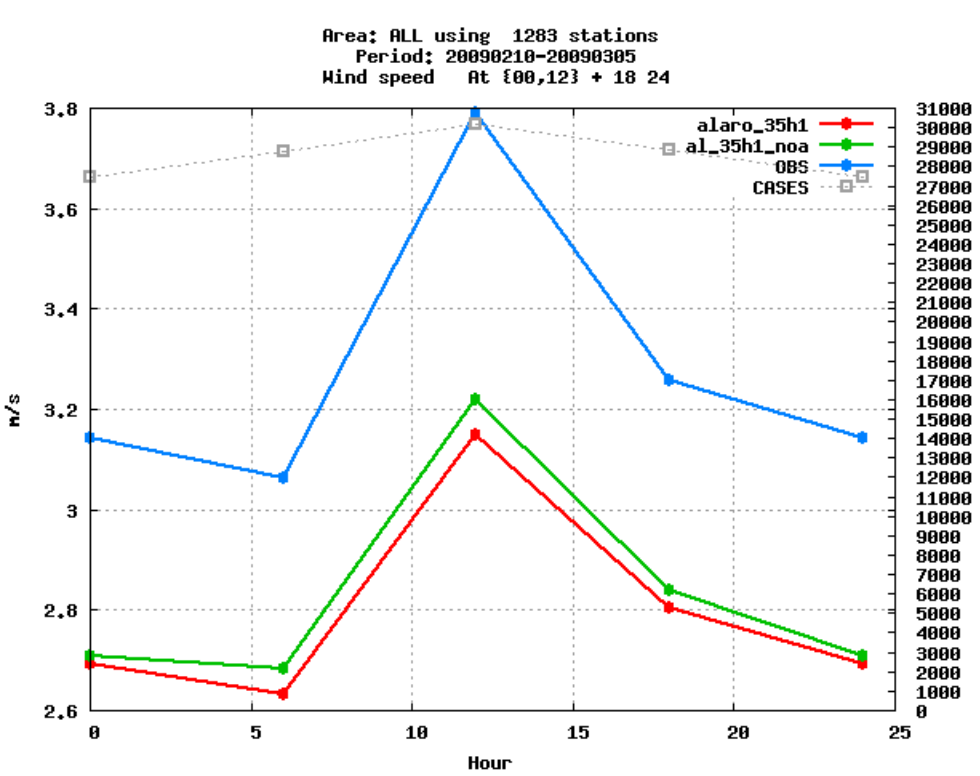
This is opposite to what was experienced with the RCR_polar domain with ALADIN physics.

Upper air humidity

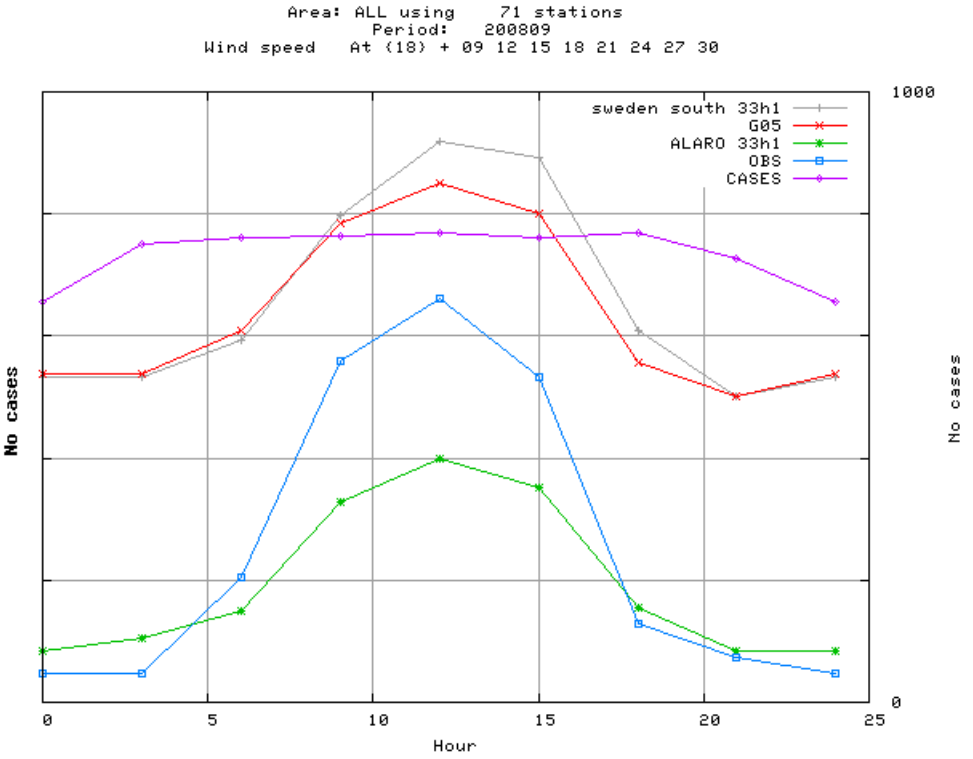




Wind is as alway to low



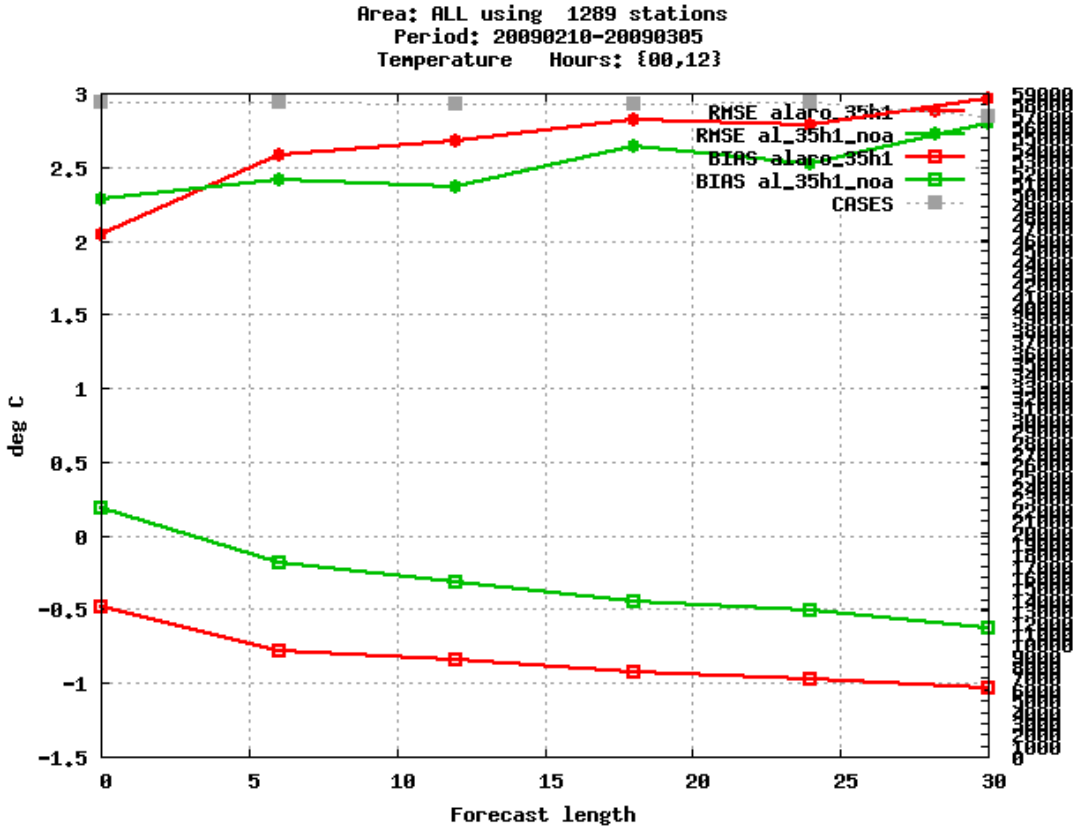
Current experiment experience

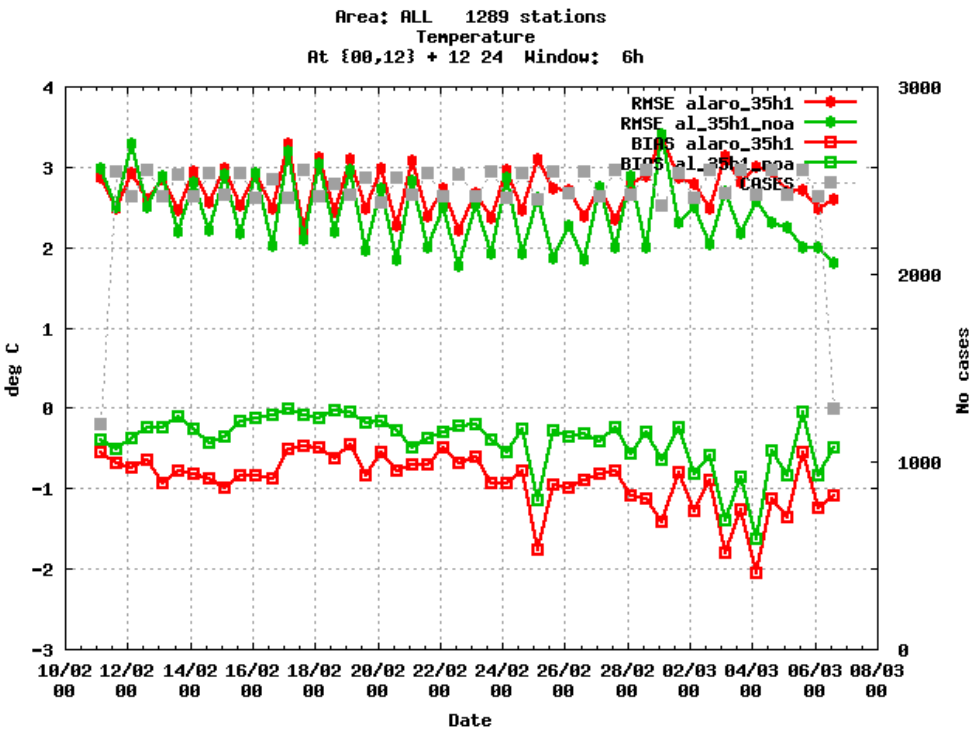


Old

Surface temperature

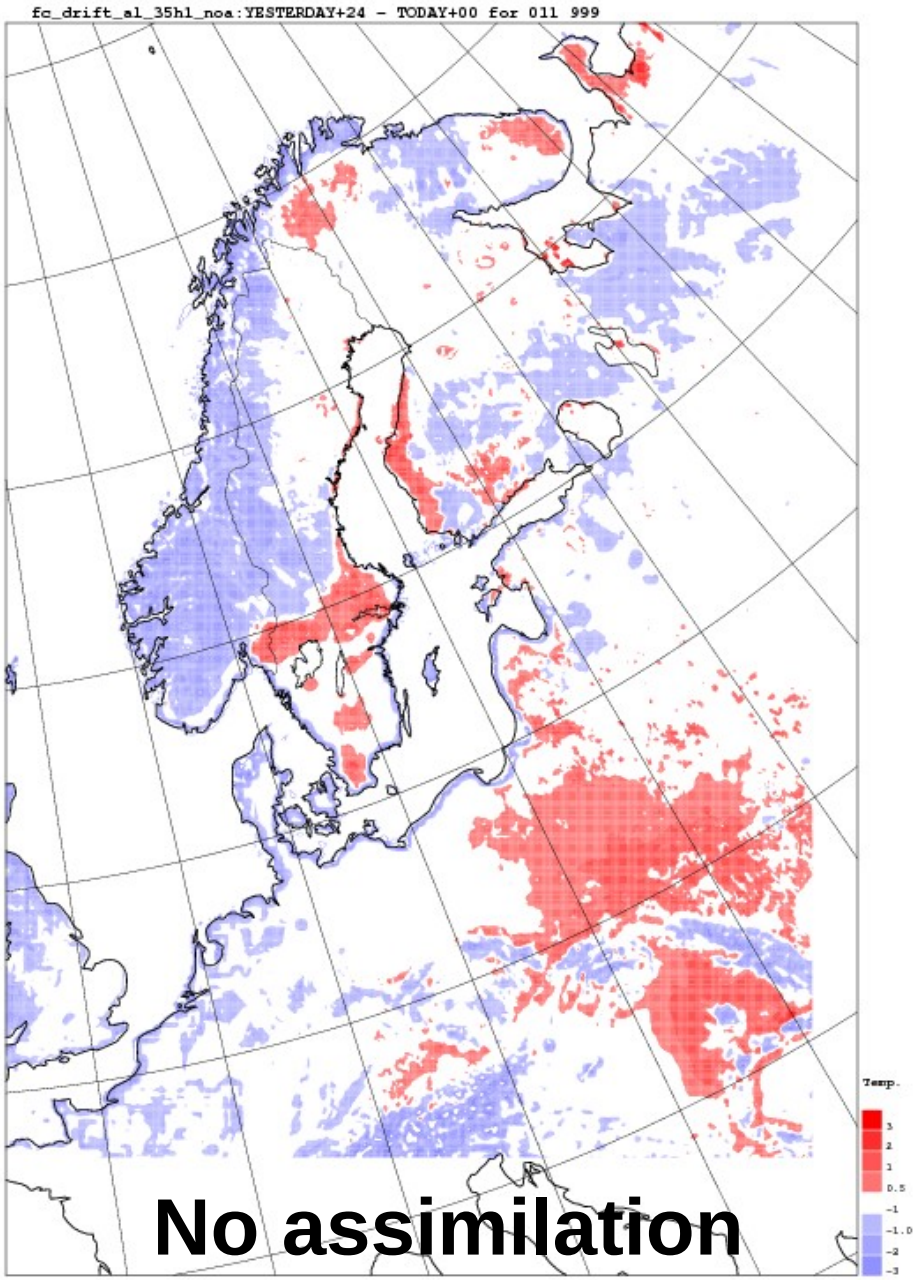
- Interpolating HIRLAM's temperatures actually gives better scores.



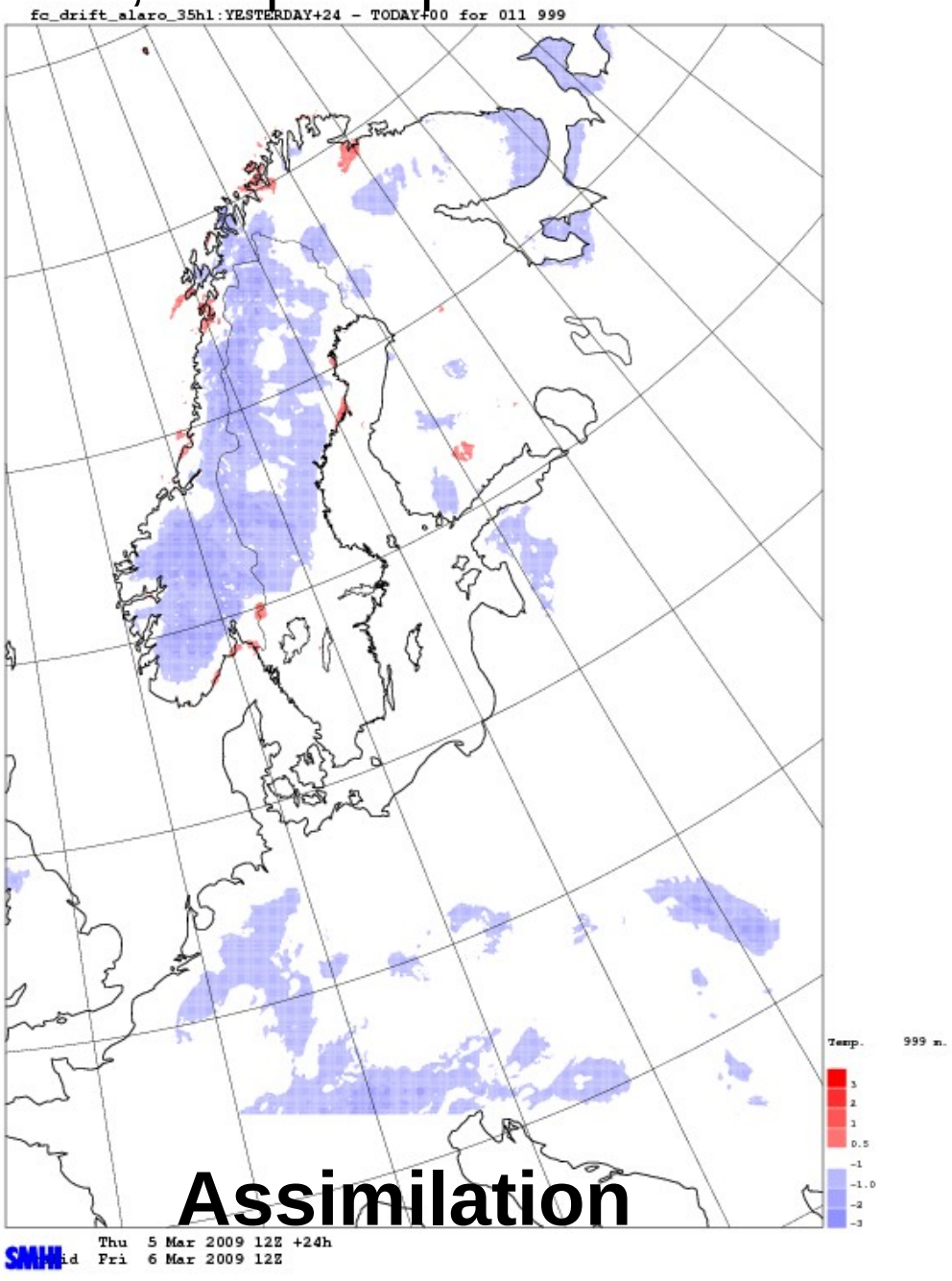


Forecast drift for the whole period

YESTERDAY+24 – TODAY+0, deep temperature



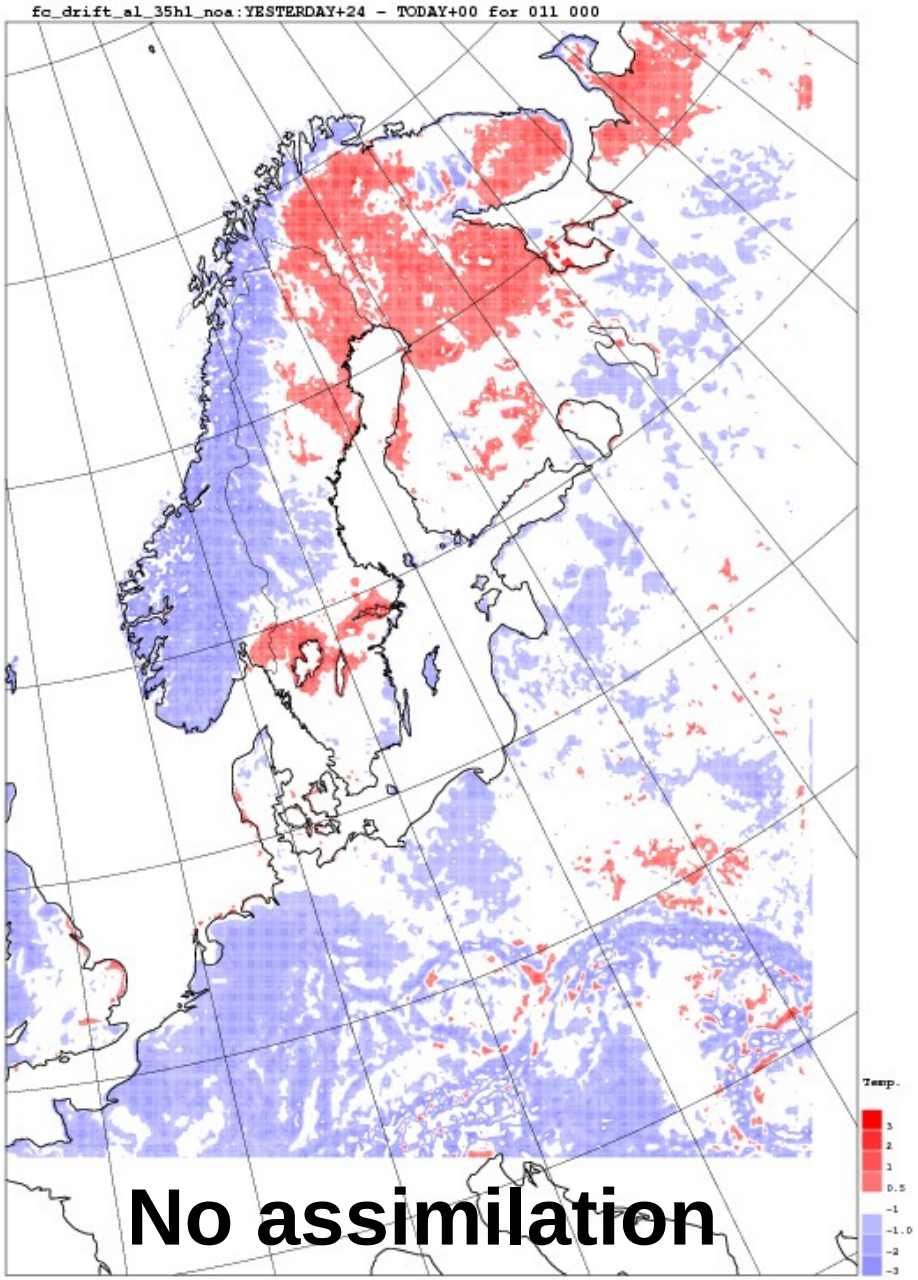
No assimilation



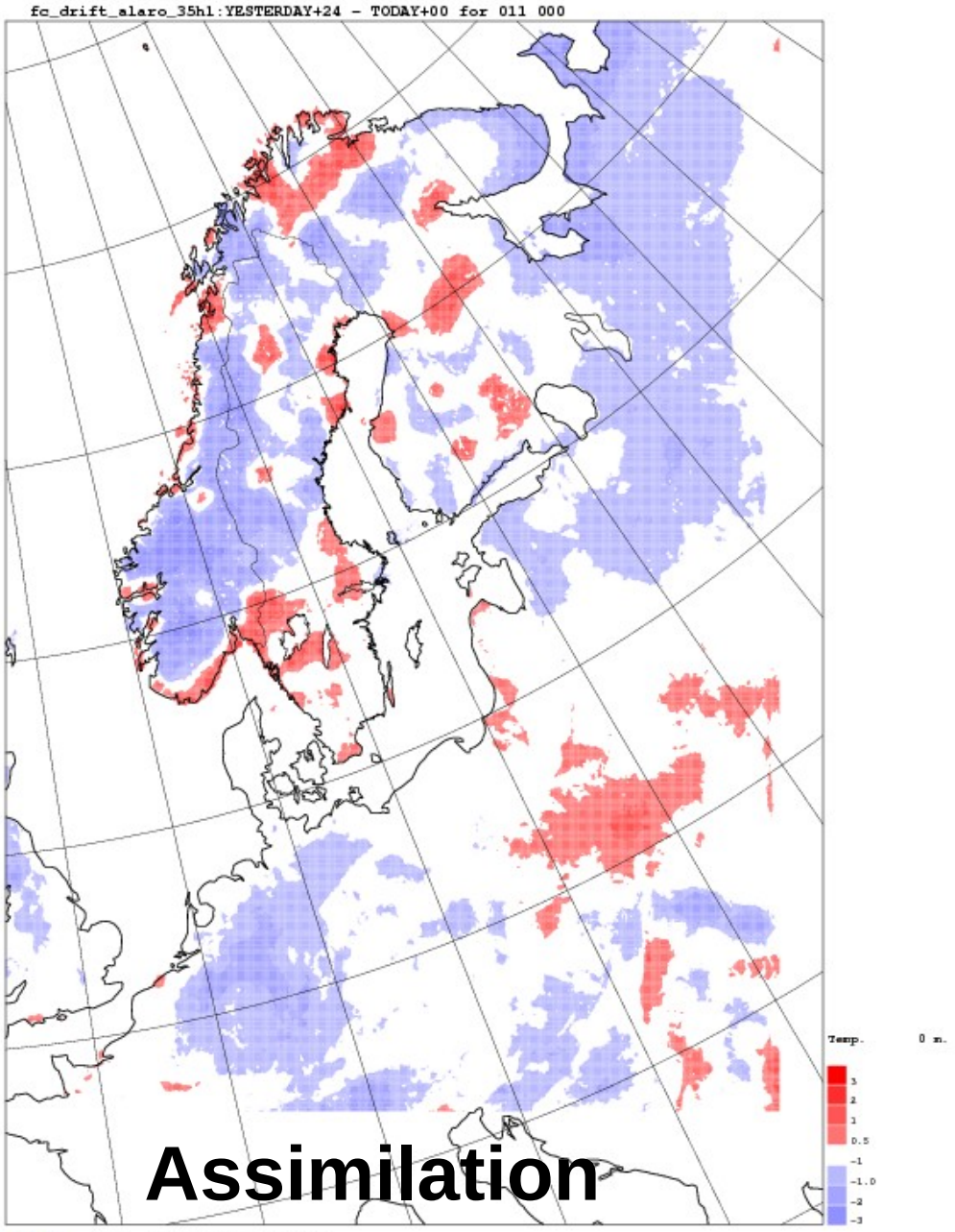
Assimilation

Forecast drift for the whole period

YESTERDAY+24 – TODAY+0, upper soil temperature

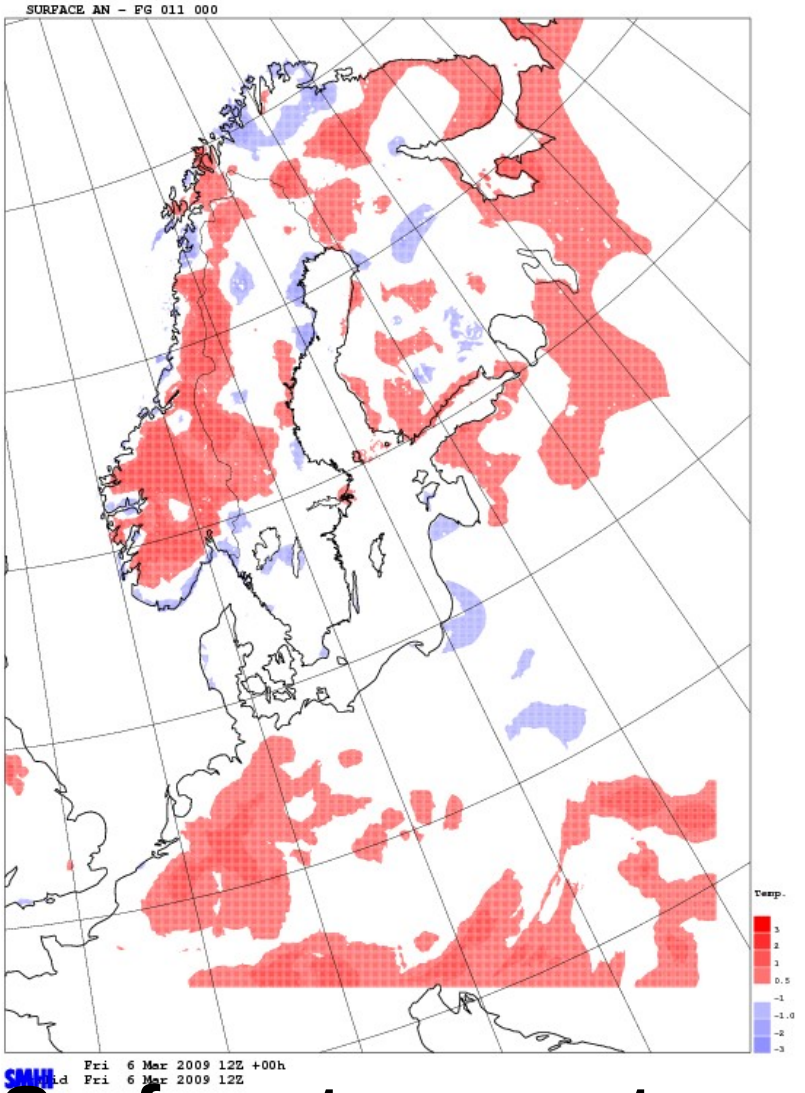


No assimilation

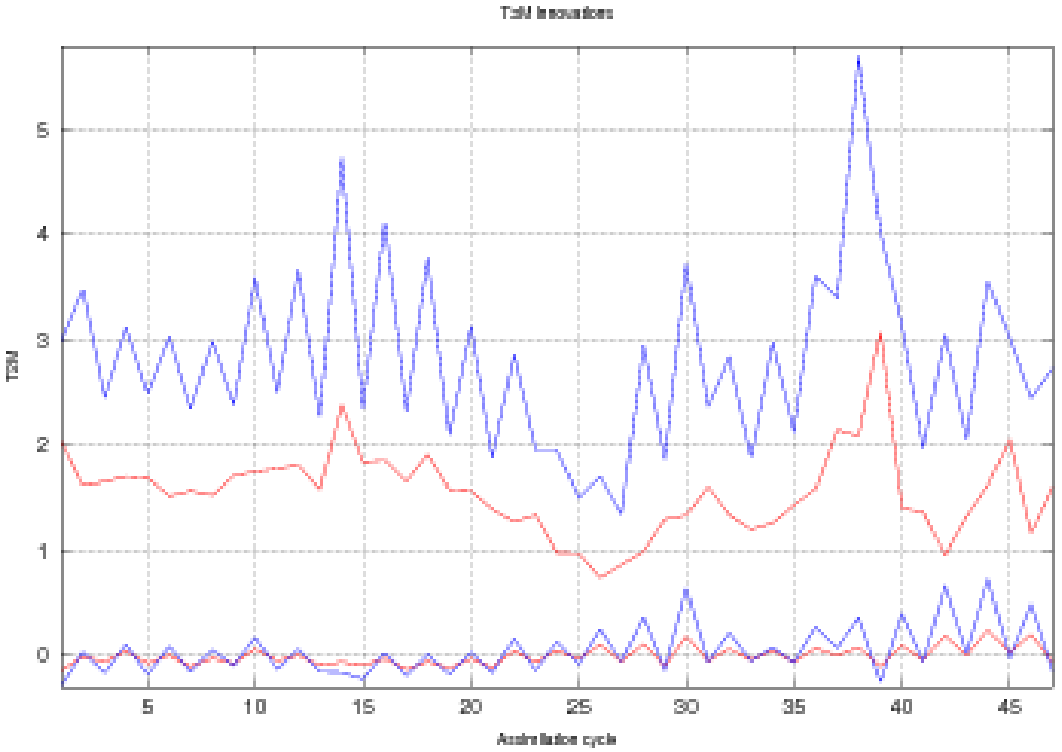


Assimilation

Analysis increments
Feb 10th – Mar 6th



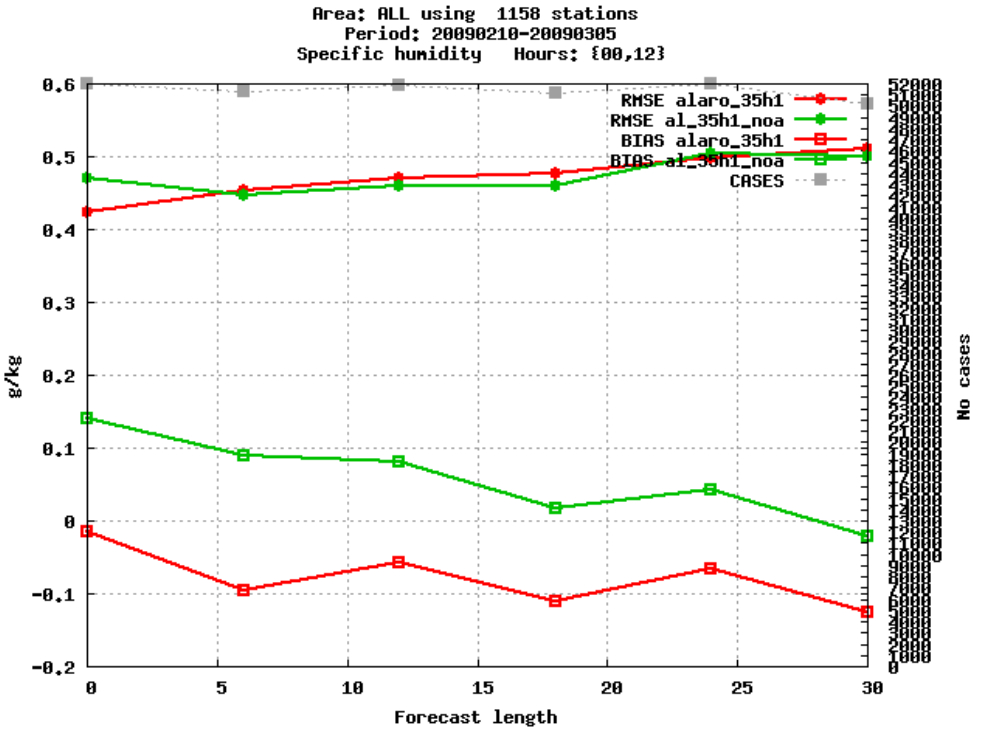
Surface temperature

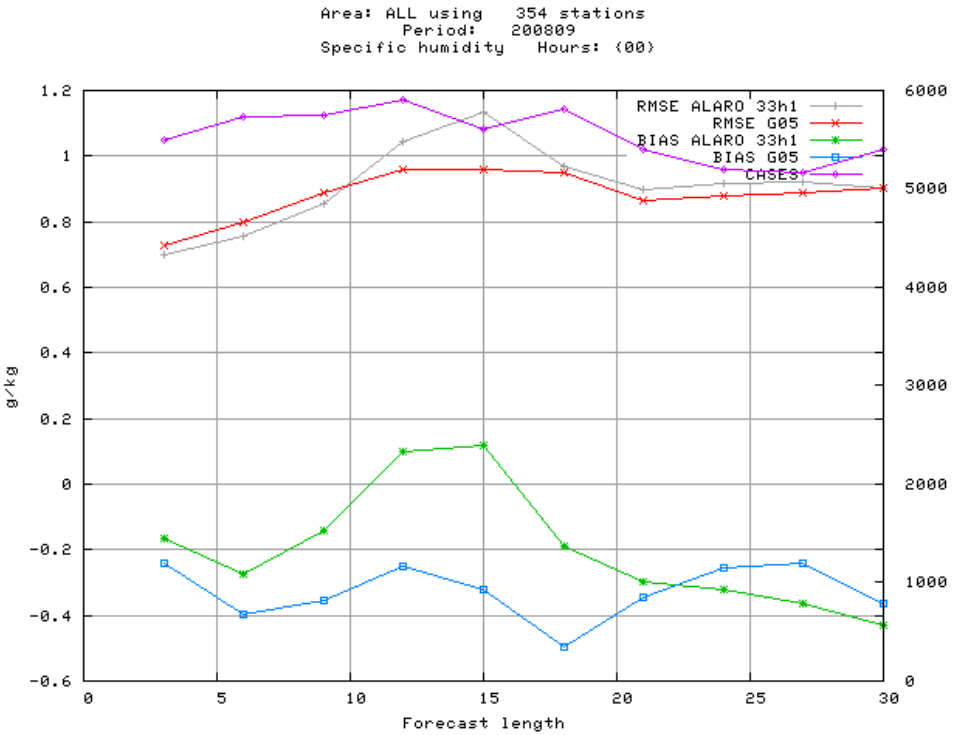


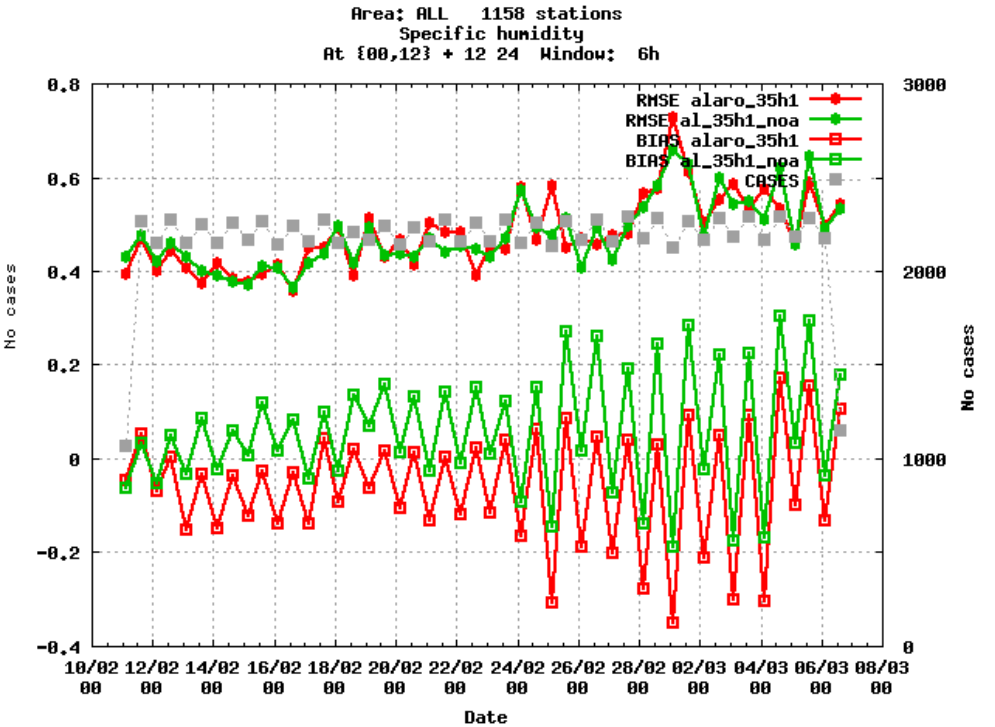
2m temperature

Surface humidity

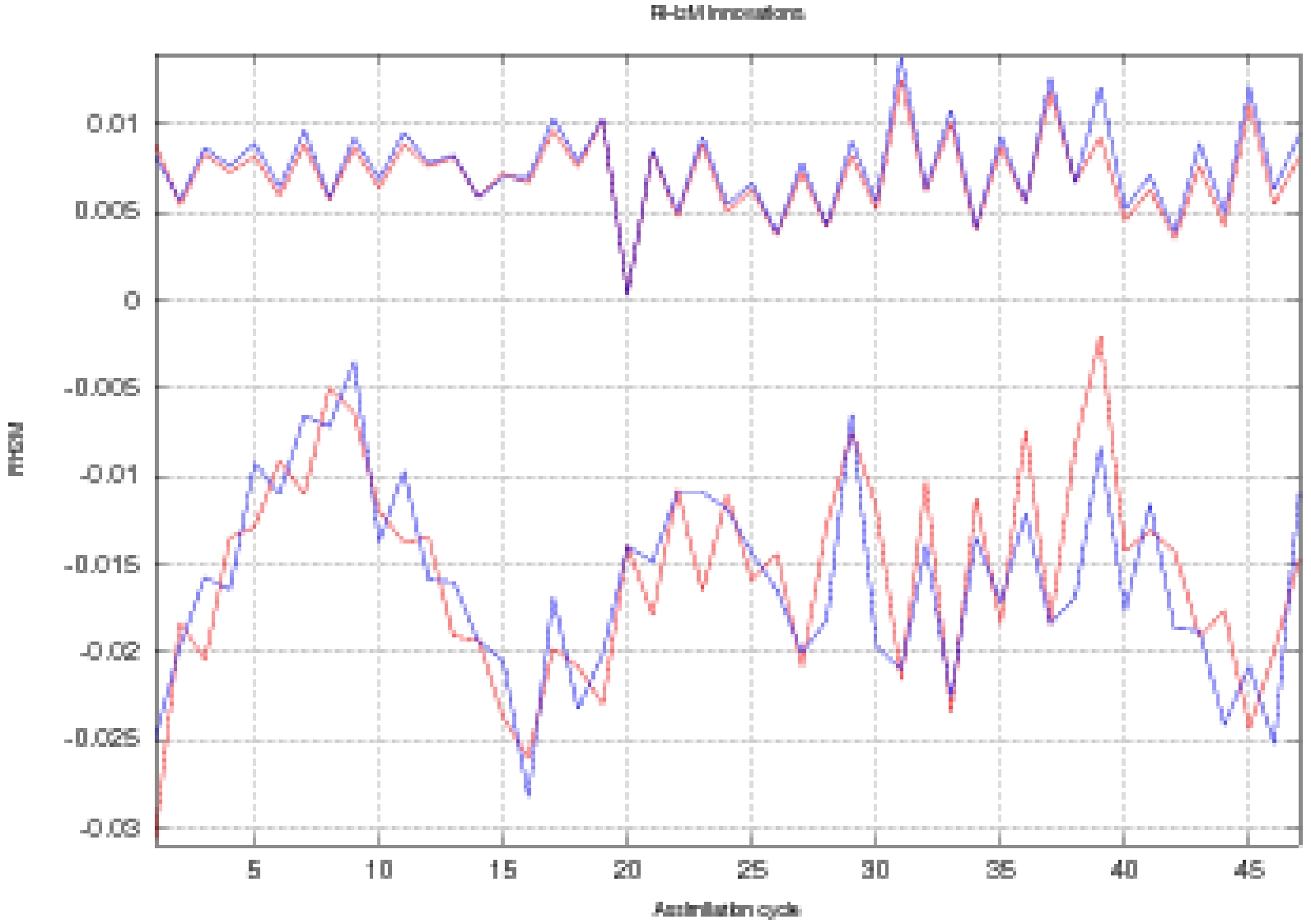
- Interpolation of HIRLAM's soil water (and ice) gives a slightly to wet environment. Assimilation changes the sign.







RH2M innovations

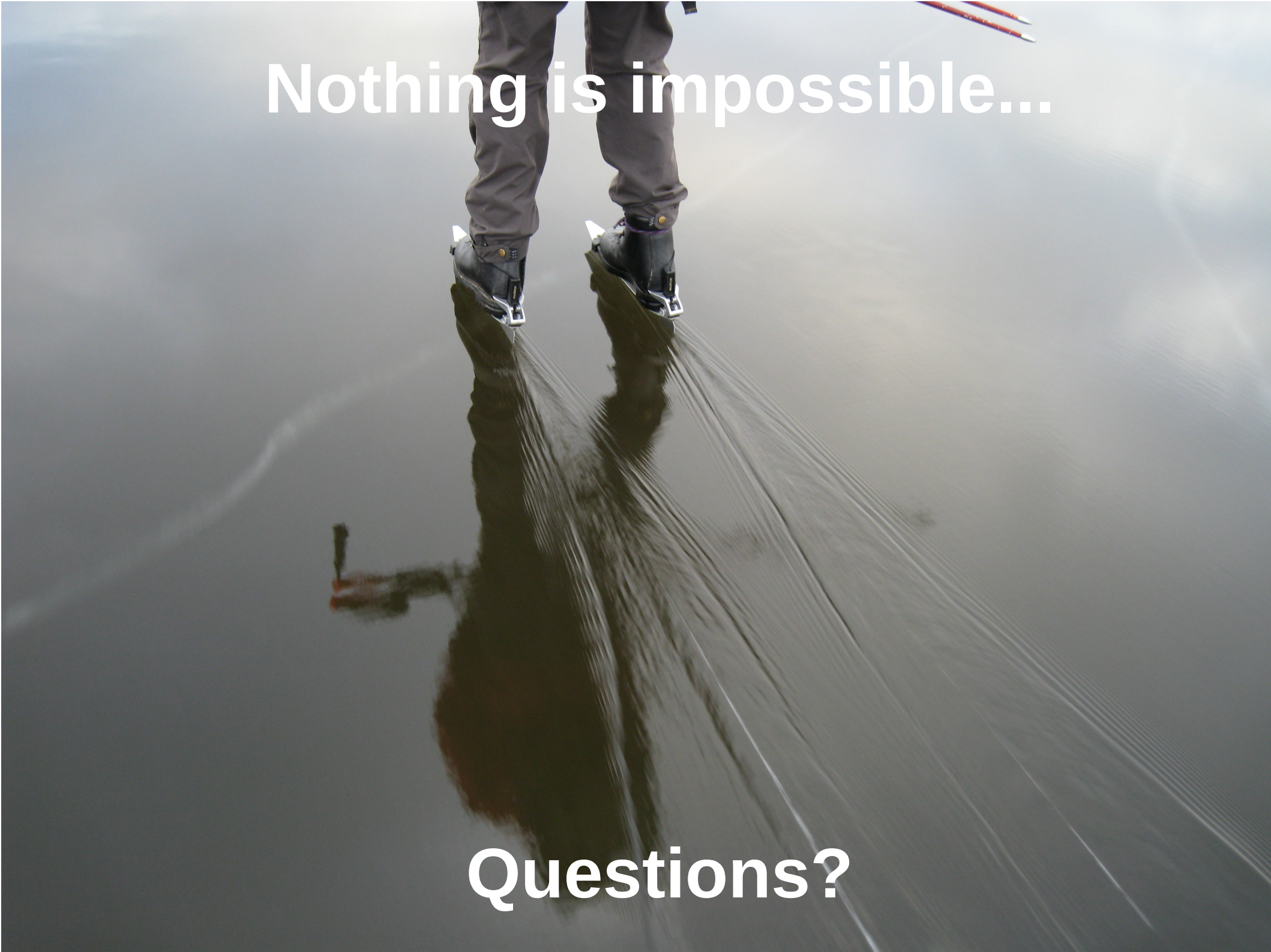


Conclusions I
About the assimilation

- Assimilation experiments with ALARO gives mixed impact in upper/lower troposphere.
- Surface assimilation makes a model cold T2M bias visible. Interpolation of HIRLAM soil temperatures hides this problem.
- Soil water differences are smaller. A summer period would have been more appropriate.

Conclusions II
About the surface interpolation

- We need to revise the translation of ECMWF surface properties using the old surface scheme.
- We need to put effort (manpower) on a new ECMWF/HIRLAM -> SURFEX interpolation
- Comment: Interoperability plans in ALADIN could be a starting point for cooperation. We have a common interest in handling both ECMWF/HIRLAM data properly.


Nothing is impossible...
Questions?