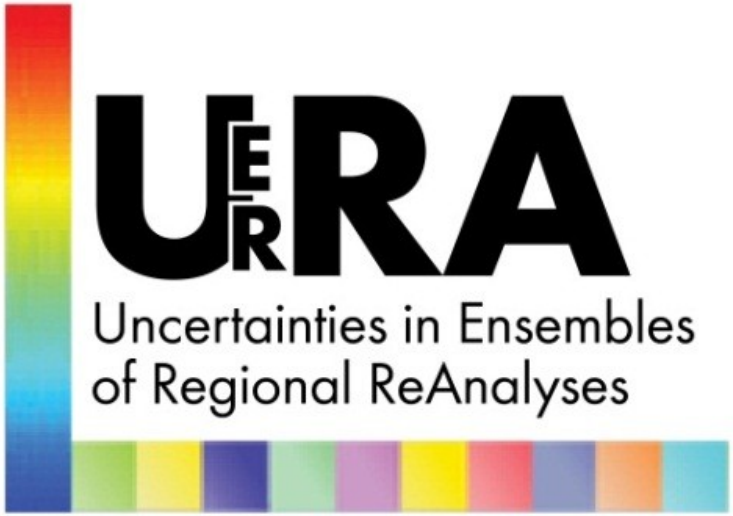
SMHI



Martin Ridal

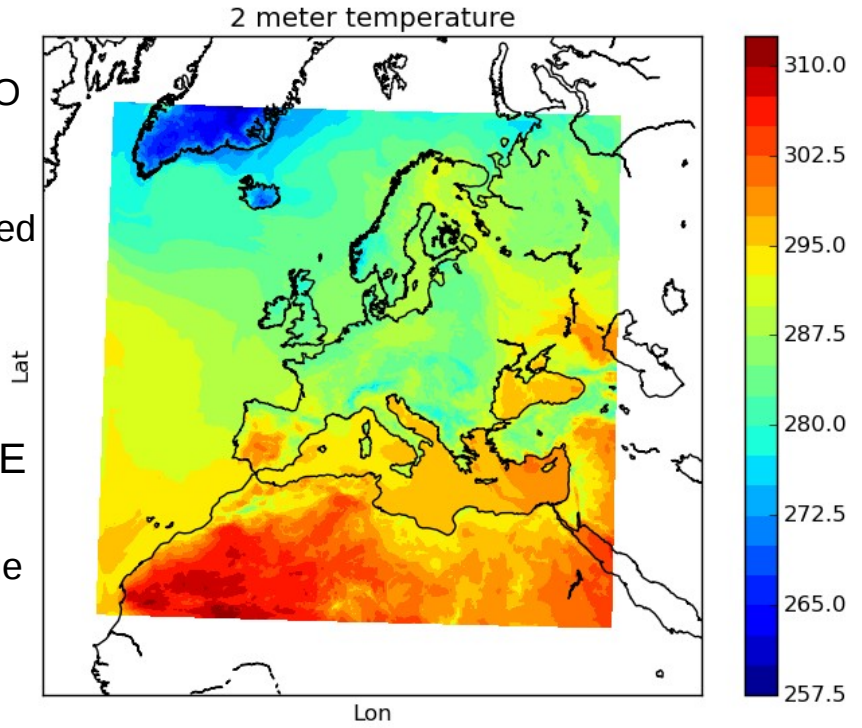
Per Unden, Esbjörn Olsson, Heiner Körnich, Ulf Andrae, Jelena Bojarova, Patrick Samuelsson and Tomas Landelius

WP2: Ensemble Data Assimilation Regional Reanalysis Data set – SMHI

- 82 pm over 4 years (~27 consumed), plus 8 (WP4 downstream services), plus ~17 (WP5, 6, 7, 9 scientific coordination, management, outreach...)

- 5 year HARMONIE mini ensemble
  - Preparation for the longer re-analysis
  - Run from 2006-2010 using ALADIN and ALARO physics
  - 11 km, 576x576 grid points
  - Problems with large scale mixing (Jk) discovered
  - Needs to be re-run
  - Report (D2.5) is almost ready

- 50+ years regional reanalysis with HARMONIE
  - ALADIN physics will be used
  - Just started, but will be restarted when the large scale mixing problems are solved



WP2: Ensemble Data Assimilation Regional Reanalysis Data set – SMHI

- SURFEX leaf area index (LAI) sensitivity
  - Sensitivity studies of prognostic
  - Investigate the possibility to assimilate LAI

- 30 years MESAN cloud analysis
  - 2D analysis of cloud fraction for 30 years
  - 5.5 km resolution 1982-2013
  - Super observations on 22 km grid created for one SEVIRI year (2009)
  - A new cloud mask for pre-SEVIRI period is under construction by the CM-SAF
  - Test analysis of cloud fraction made for 2009 at 22 km, using OI with super observations and NWP (HIRLAM and EURO4M)
  - Estimates of B and R matrices using Desroziers method converges.
  - After some remaining corrections (bias & obs weights) the analysis will be made on 5.5 km grid

HARMONIE (HIRLAM ALADIN Regional/Mesoscale Operational NWP In Europe)

- HARMONIE setup
  - Cy38h1.1
  - 3DVar data assimilation for upper air with added large scale constraint
  - SURFEX with OI assimilation for surface
  - Semi implicit, semi Lagrangean, hydrostatic dynamics
  - ALADIN and ALARO physics

- ALADIN – ALARO differences
  - Turbulence schemes
  - Shallow and deep convection
  - Clouds and microphysics
  - Radiation schemes
  - ALARO is multiscale, ALADIN synoptic scale

5 year HARMONIE mini ensemble

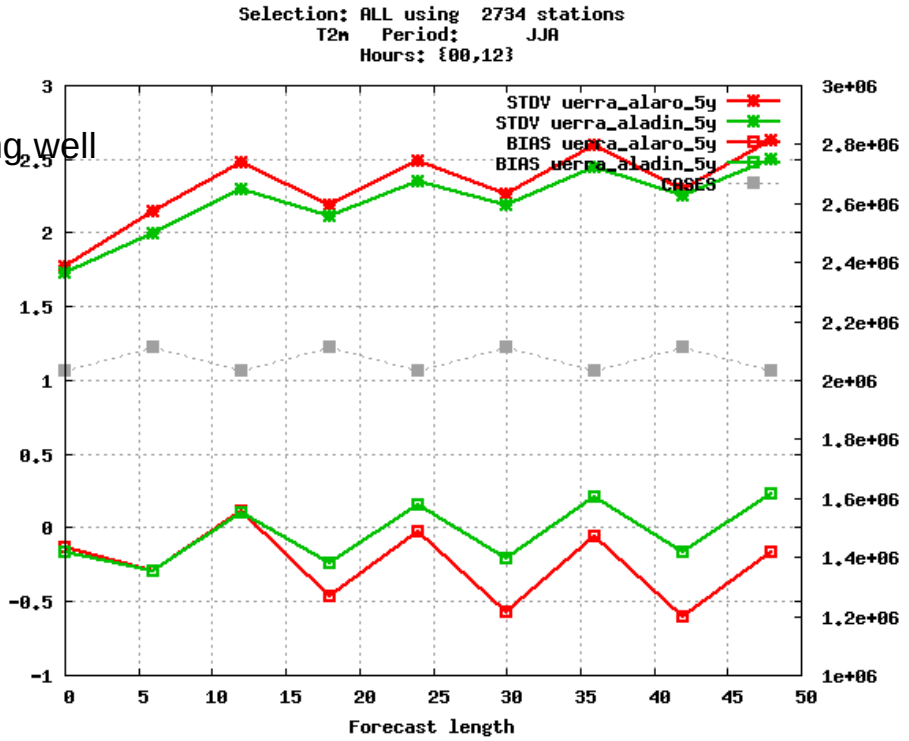
- Results and verification will be presented by Esbjörn

- Some discovered bugs and problems
  - Some radiative fluxes were wrong and the surface analysis (FA-file) was not archived
  - Very dry areas was found in the surface analysis – RH2m and other near surface variables is better taken from “fc00”
  - ALARO was run without TEB – Does not affect results over the area
  - Re-run as part of the long run

- Problems with minimisation
  - The large scale mixing through Jk is not working well

- Verification
  - Verification show that ALADIN performs better
  - Will the minimisation problem change this?

- Report
  - Soon to be delivered
  - As part of the deliverable

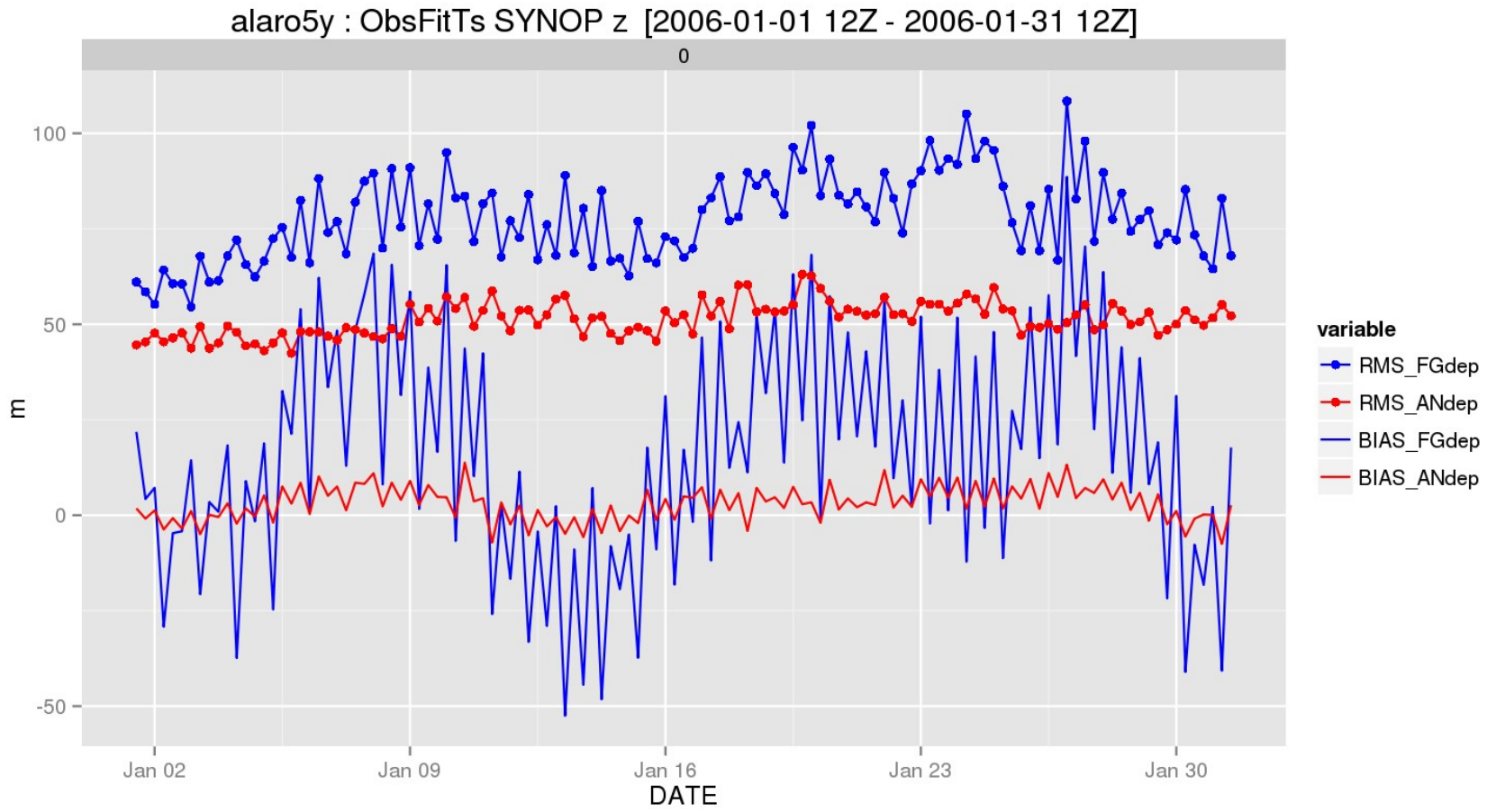


Minimisation problem

$$J(x) = J_b + J_o + J_k = \frac{1}{2}(x - x_b)^T B^{-1}(x - x_b) + \frac{1}{2}(y - H(x))^T R^{-1}(y - H(x)) + \frac{1}{2}(x - x_{ls})^T V^{-1}(x - x_{ls})$$

- When run with Jk the minimisation does not converge
- I areas with many observations it seems to work fine
  - The Jo-term dominates the cost function
  - It adapts to the observations, Obs-An is smaller than Obs-Fg
- In areas with few observations or “much orography” problems arise
  - Verification scores will probably not be very much
  - Verification is made against observations
- Using a more simple large scale mix gives better results
  - Only test runs so far

Observation – First Guess (blue)
Observation – Analysis (red)



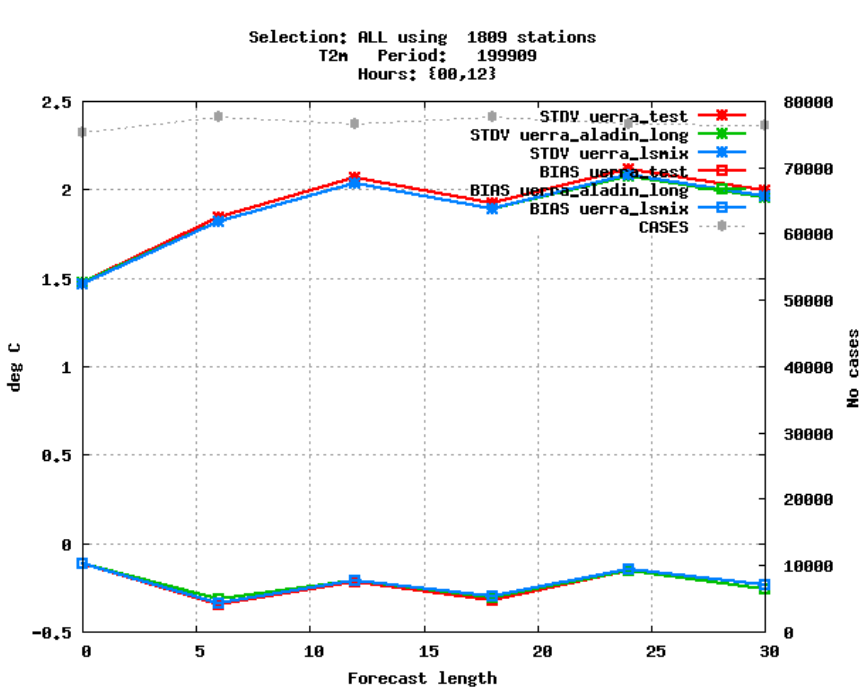
Minimisation problem

$$J(x) = J_b + J_o + J_k = \frac{1}{2}(x - x_b)^T B^{-1}(x - x_b) + \frac{1}{2}(y - H(x))^T R^{-1}(y - H(x)) + \frac{1}{2}(x - x_{ls})^T V^{-1}(x - x_{ls})$$

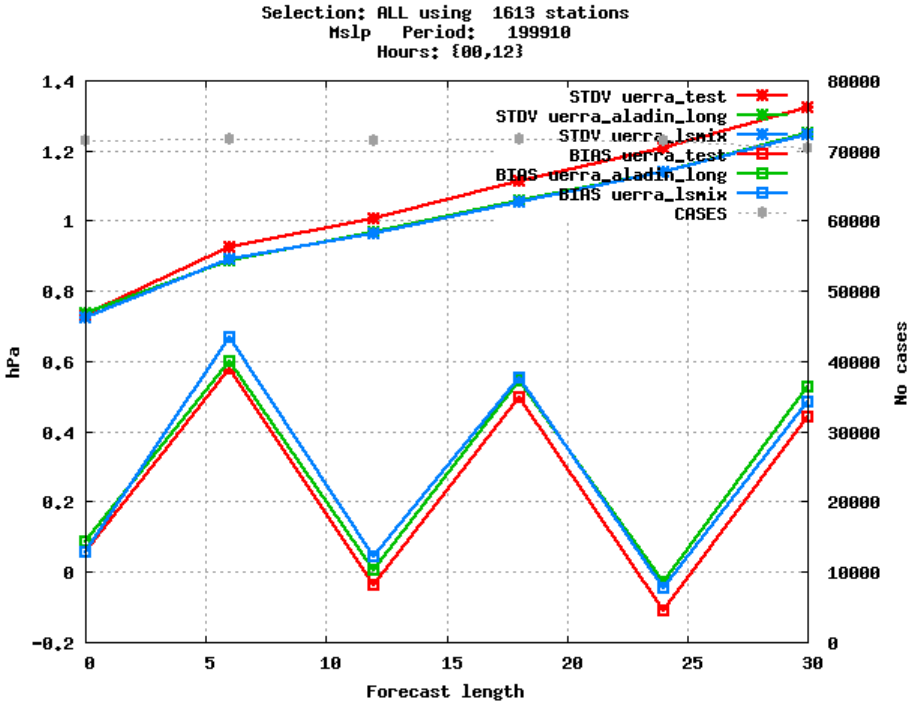
- When run with Jk the minimisation does not converge
- I areas with many observations it seems to work fine
  - The Jo-term dominates the cost function
  - It adapts to the observations, Obs-An is smaller than Obs-Fg
- In areas with few observations or mountainous terrain problems arise
  - Verification scores will probably not be very much affected
  - Verification is made against observations
- Using a more simple large scale mix gives better results
  - Only test runs so far

One month period, September 1999
Red: No large scale mix
Green: Jk-run
Blue: Large scale mix

T2m

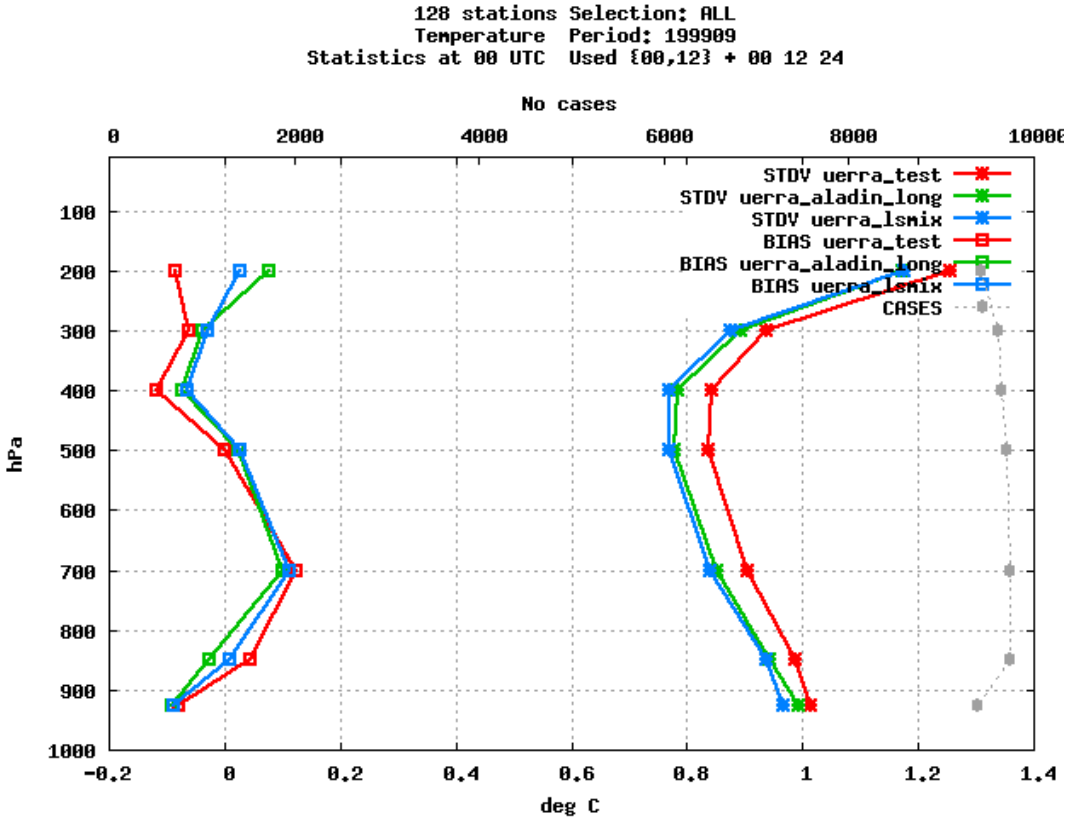


MSLP



One month period, September 1999
Red: No large scale mix
Green: Jk-run
Blue: Large scale mix

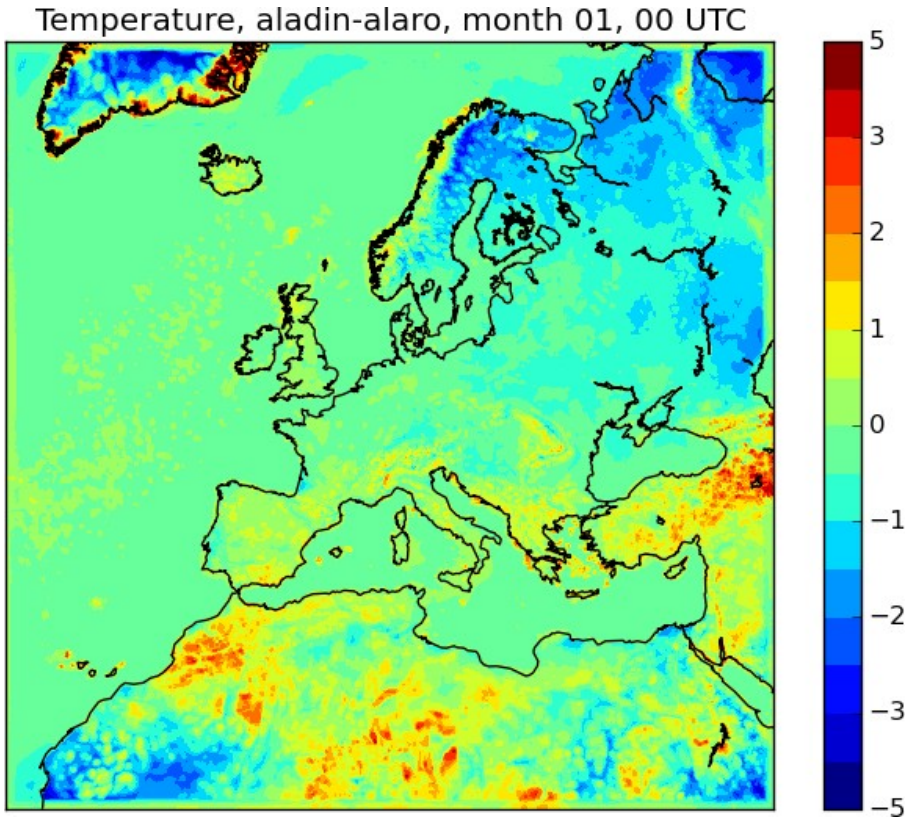
Temperature profile



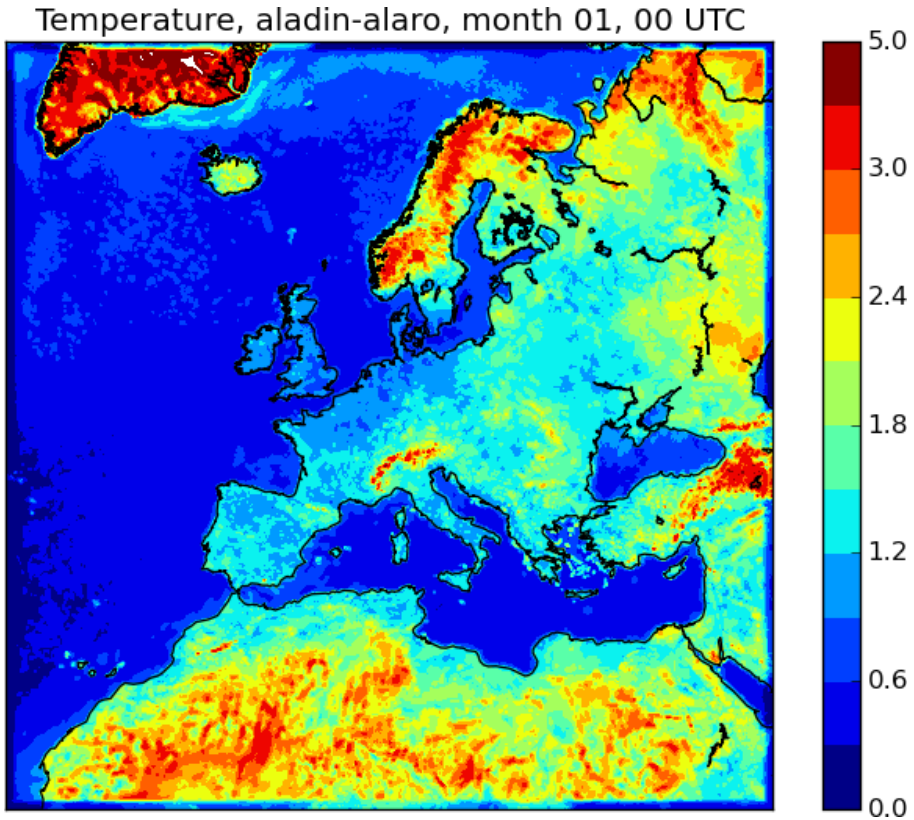
T2m difference between ALADIN and ALARO

January at 00

Mean difference



STD

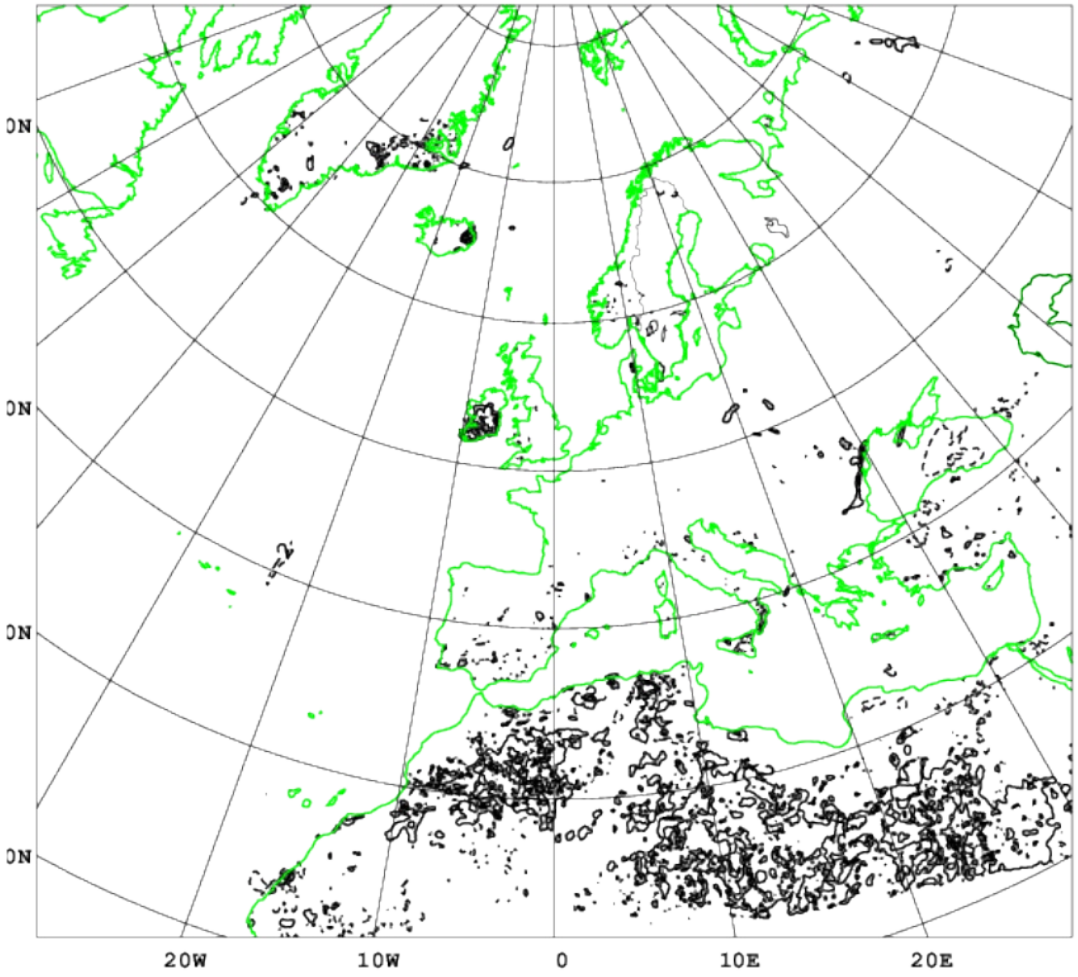


SMHI

T2m difference between a run with Jk and one without

Starting from the same initial data

Run for three months



SMHI

Friday last week:

Problem solved!

It turned out to be a factor 2 too much in the Jk gradient calculations.
This messed up the cost function calculations

A few more tests and some tuning are still needed.

50+ year re-analysis, 1961-2014

- Will be run using ALADIN physics
  - Showed better scores in the verification
- Run in several parallel streams
  - 10 years per stream, except for the 5 year re-run, with 3 months overlap
  - 10 years runs in 7-9 months
  - At least 4 users
- Observations and boundaries
  - 1961-2001 we will use ERA40 observations with addition of Swedish and French observations in the early years. After that operational data
  - 1961-1979 we will use ERA40 boundaries. After that ERAinterim
- Progress
  - Already started and stopped after 1-2 years per stream
  - It will be restarted when the new Jk calculation is ok

Some technical aspects

- Run time
  - One year takes slightly less than one month
  - 5 years was run in 3-4 months using ~50 milj. SBU
  - Special project at ECMWF with 30 milj. SBU per year for three years

- Data storage
  - The archiving question is not really solved
  - 2×5 years produces ~80 Tb of data. Can probably be reduced significantly.

- Factors to consider
  - Machine load
  - Access to EFCS is sometimes slow
  - ...

Summary

- 5 year mini ensemble
  - The minimisation does not work properly
  - Effect on the results and conclusions are still to be investigated
  - Will be re-run as part of the long re-analysis

- 50+ year re-analysis
  - Bugs discovered are fixed, missing observations (early years) are in place
  - Currently on hold but will be started rather soon
  - Data amount needs to be reduced

- Cloud analysis
  - Very good progress
  - More in upcoming presentation by Jelena