

Experiments with CANARI snow analysis (at 4.4 km resolution)

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CANARI for snow

- Univariate OI analysis scheme for snow reservoir
- Correlation function is split into vertical and horizontal part:

$$\mu(r,p) = \mu_h(r) * \mu_v(p)$$

– where

$$\mu_h(r) = \exp(-1/2 * (r/d)^2)$$

– and

$$\mu_v(p) = \exp(-1/2 * (dp_{ij}/P))$$

$$d = 60000\text{m}$$

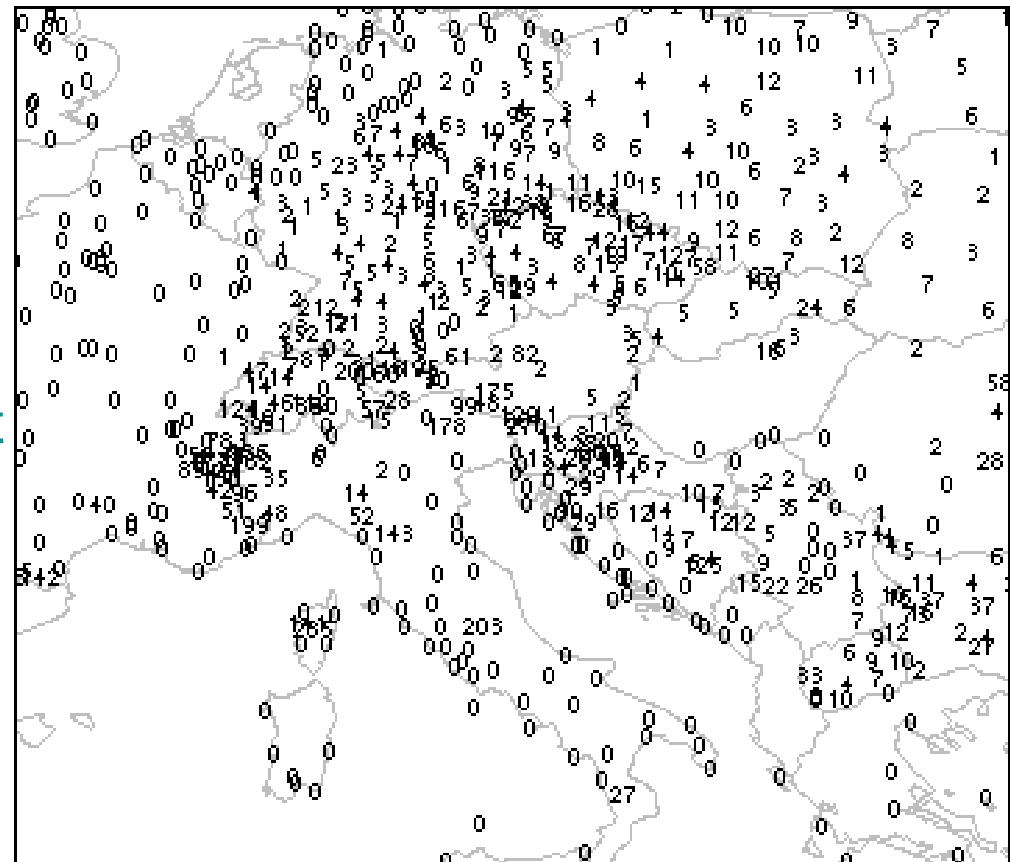
$$P = 0.05$$

$$\sigma_b = \sigma_o = 5\text{kg/m}^2$$

Experiment setup

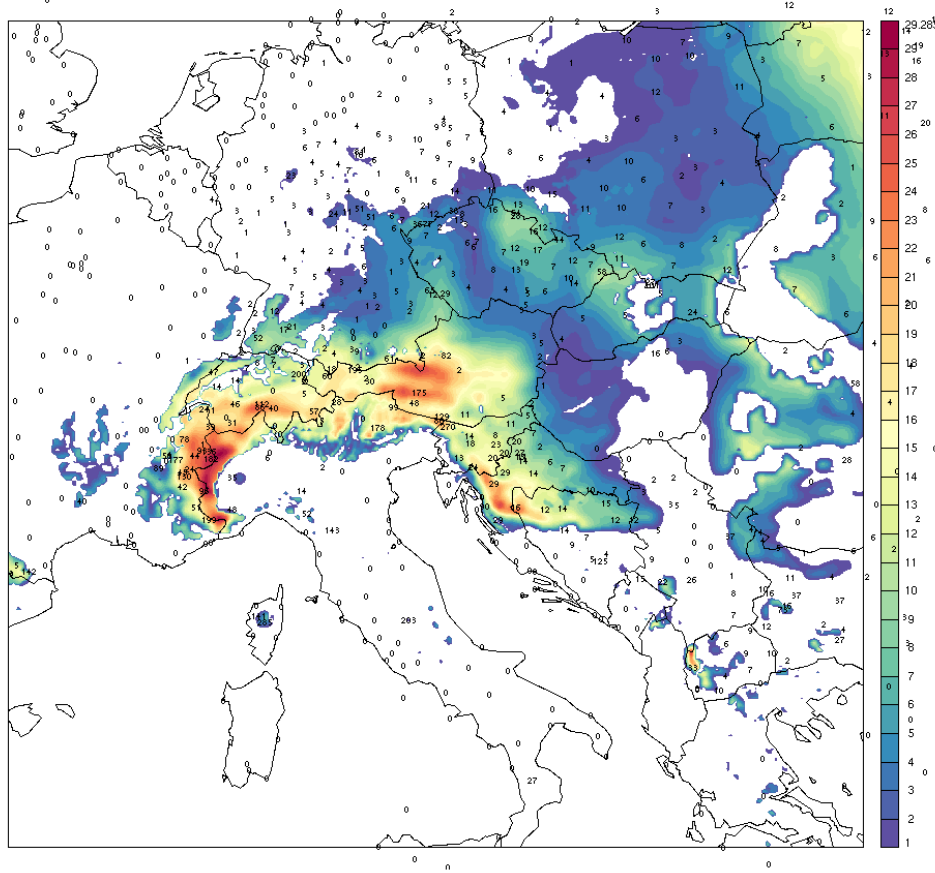
- ~450 x 450 points @ 4.4 km
= ~ 2000 x 2000 km
- ALADIN model with ALARO physics and setup
- Synop data from french operational system
(there are some measurement sparse areas!)

Snow Height Observations [cm] 2009011506

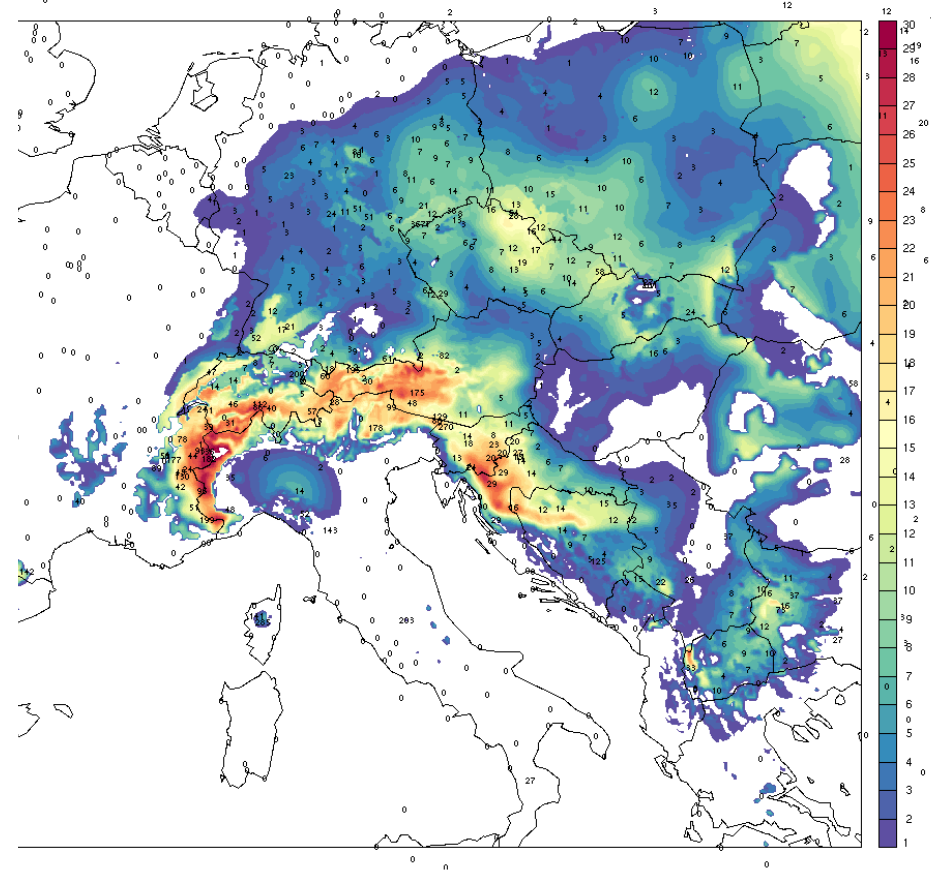


Test case, default settings

Snow reservoir [kg/m²], 6 hour guess based on downscaled ARPEGE init. cond. (at 4.4km res.) (shaded)
 SYNOP snow measurements [cm] (numbers)



Snow reservoir [kg/m²], CANARI analysis for 20090115 06 UTC based on 6hr guess (at 4.4km res.)
 with relaxation to climatology (RCLIMCA=0.045) and no vertical obs. op. (shaded)
 SYNOP snow measurements [cm] (numbers)

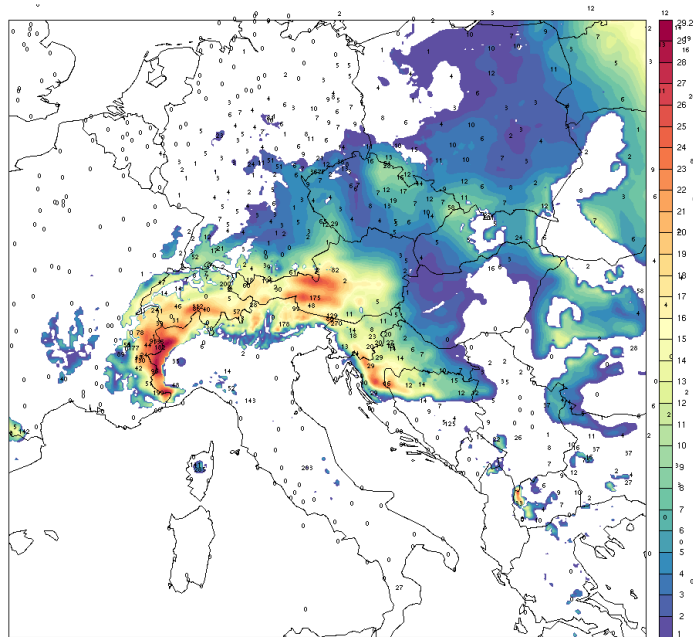


Tuning of some parameters

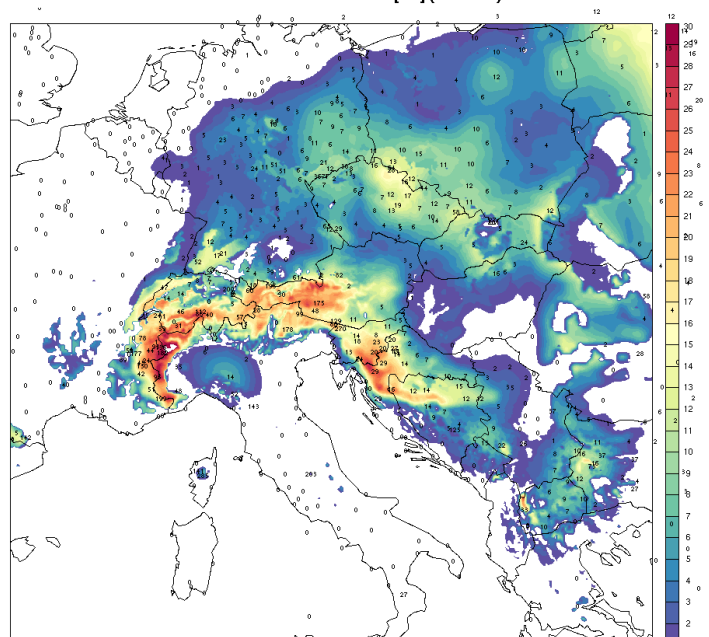
(following the work of Lora and Marikken)

- Reducing/disabling climatology relaxation (RCLIMKA)
- Constraints on observation and model point height above sea – simple filtering of observations (OROLIM and ORODIF)

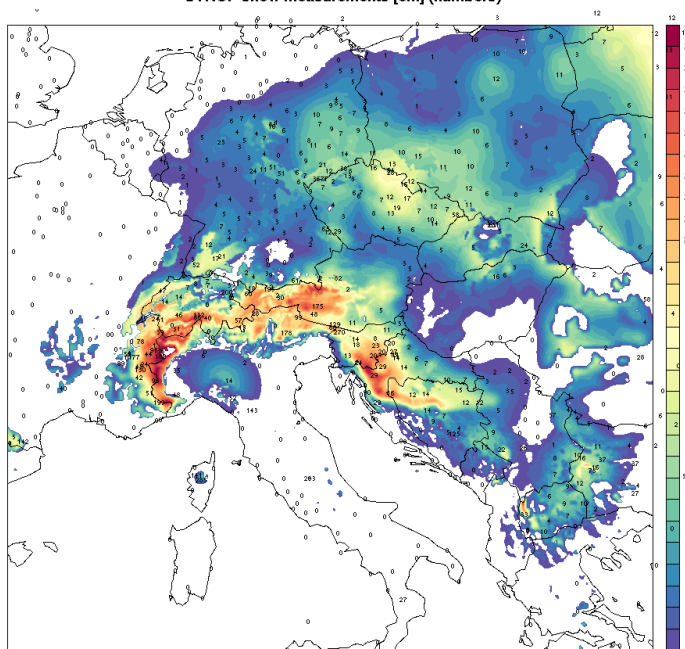
Snow reservoir [kg/m²], 6 hour guess based on downscaled ARPEGE init. cond. (at 4.4km res.)
SYNOP snow measurements [cm] (numbers)



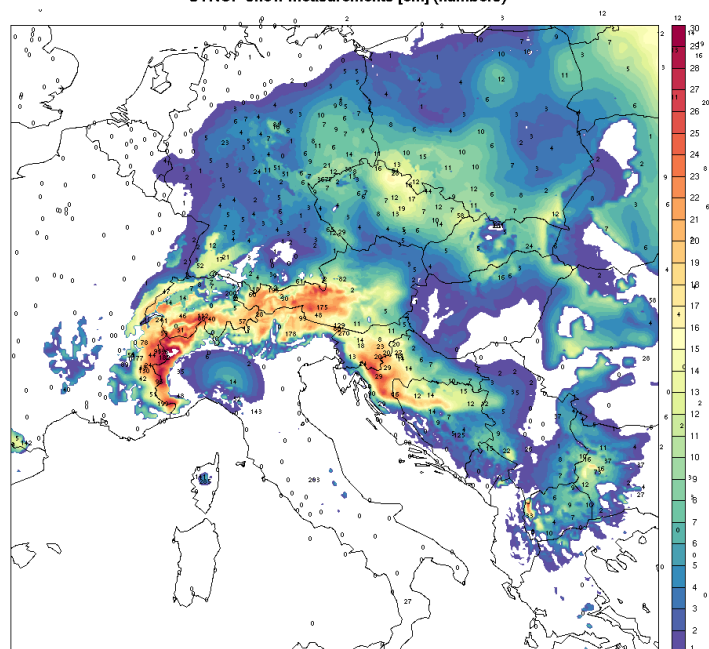
Snow reservoir [kg/m²], CANARI analysis for 20090115 06 UTC based on 6hr guess (at 4.4km res.)
with relaxation to climatology (RCLIMCA=0.045) and no vertical obs. op. (shaded)
SYNOP snow measurements [cm] (numbers)



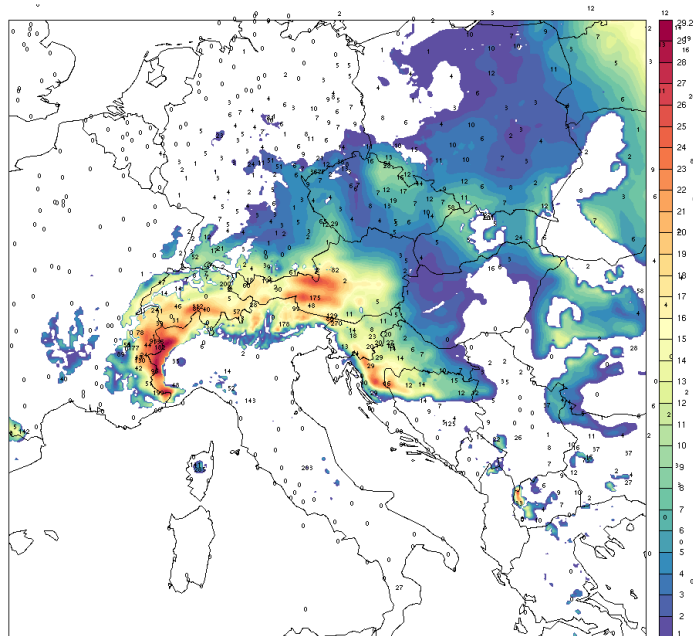
Snow reservoir [kg/m²], CANARI analysis for 20090115 06 UTC based on 6hr guess (at 4.4km res.)
with no relaxation to climatology (RCLIMCA=0.0) and no vertical obs. op. (shaded)
SYNOP snow measurements [cm] (numbers)



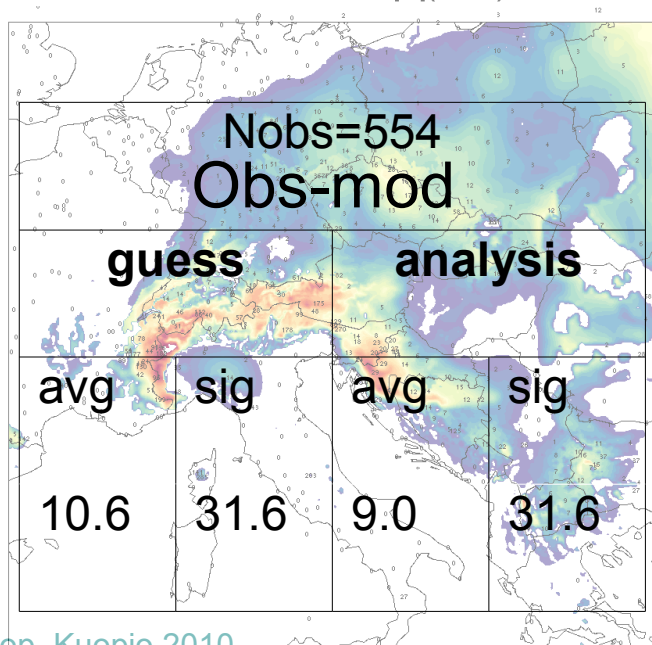
Snow reservoir [kg/m²], CANARI analysis for 20090115 06 UTC based on 6hr guess (at 4.4km res.)
with no relaxation to climatology (RCLIMCA=0.0) and OROG limits and no vertical obs. op. (shaded)
SYNOP snow measurements [cm] (numbers)



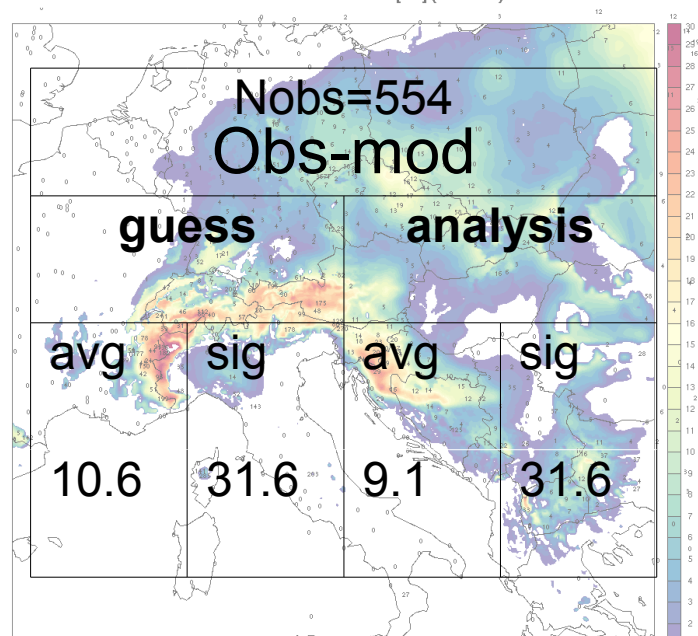
Snow reservoir [kg/m²], 6 hour guess based on downscaled ARPEGE init. cond. (at 4.4km res.) (shad
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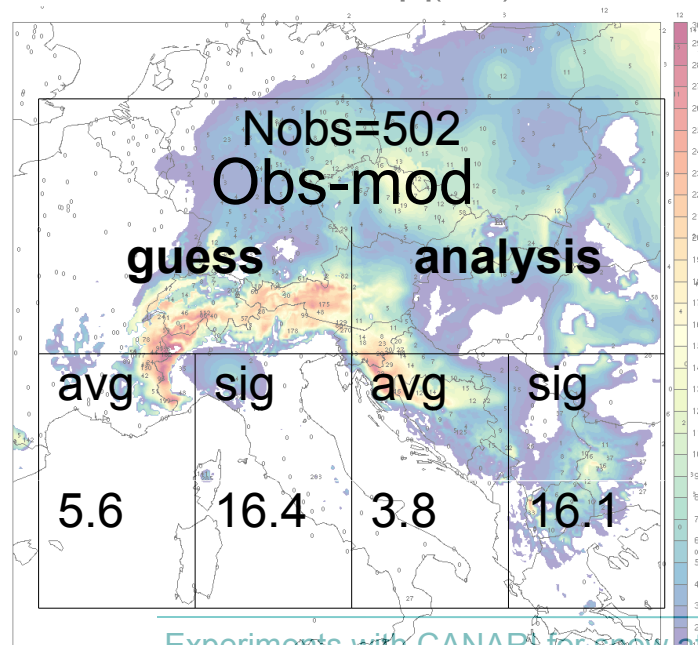
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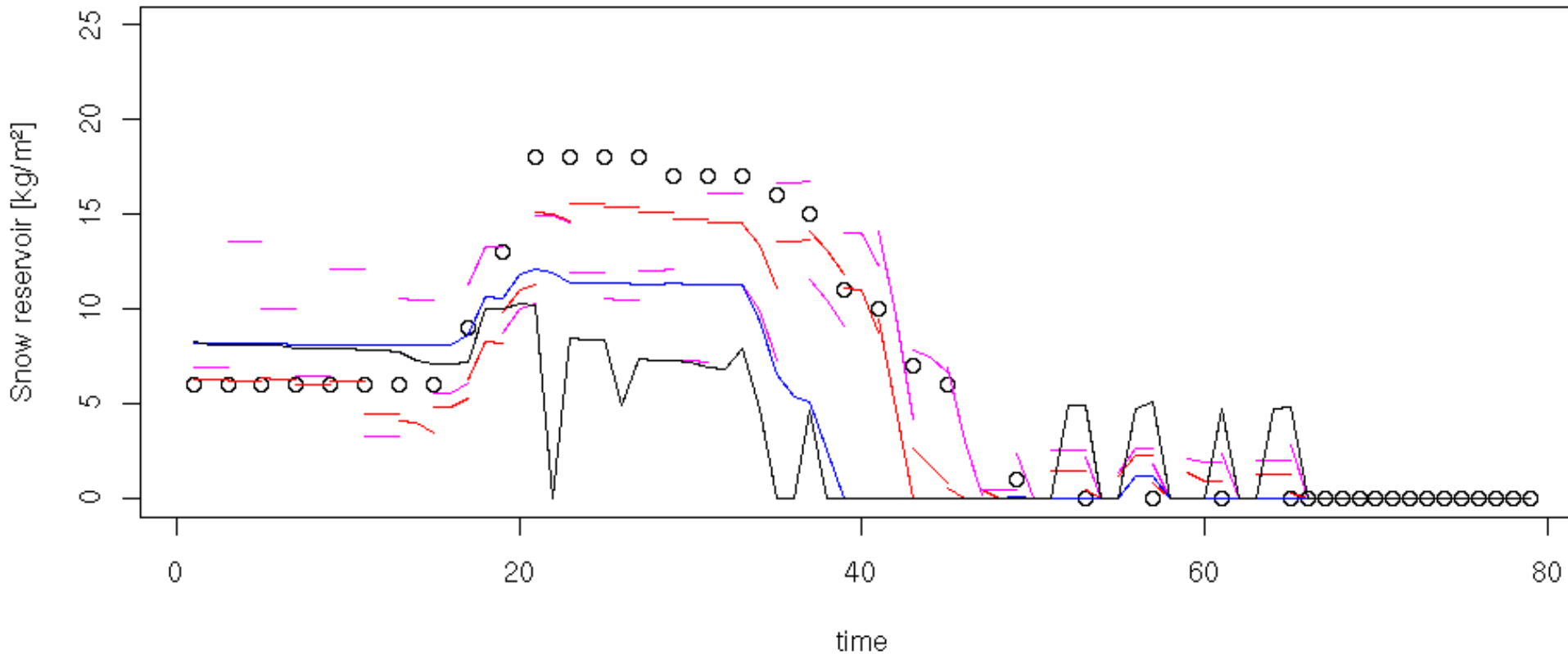
Runs in assimilation mode

- Cold start on January 11th, 2009
- (=> not a particularly good choice)
- 20 days cycle, lots of snow over Europe
- Only snow analysis (dynamical adaptation from ARPEGE for the other variables)
- Analysis every 6 hours – even though most observations are available at 6 and 18 UTC
- Comparison against downscaled ARPEGE and also full first guess snow initialization

Timeseries (I) – Ljubljana (SI)

Snow reservoir, Ljubljana (14015)

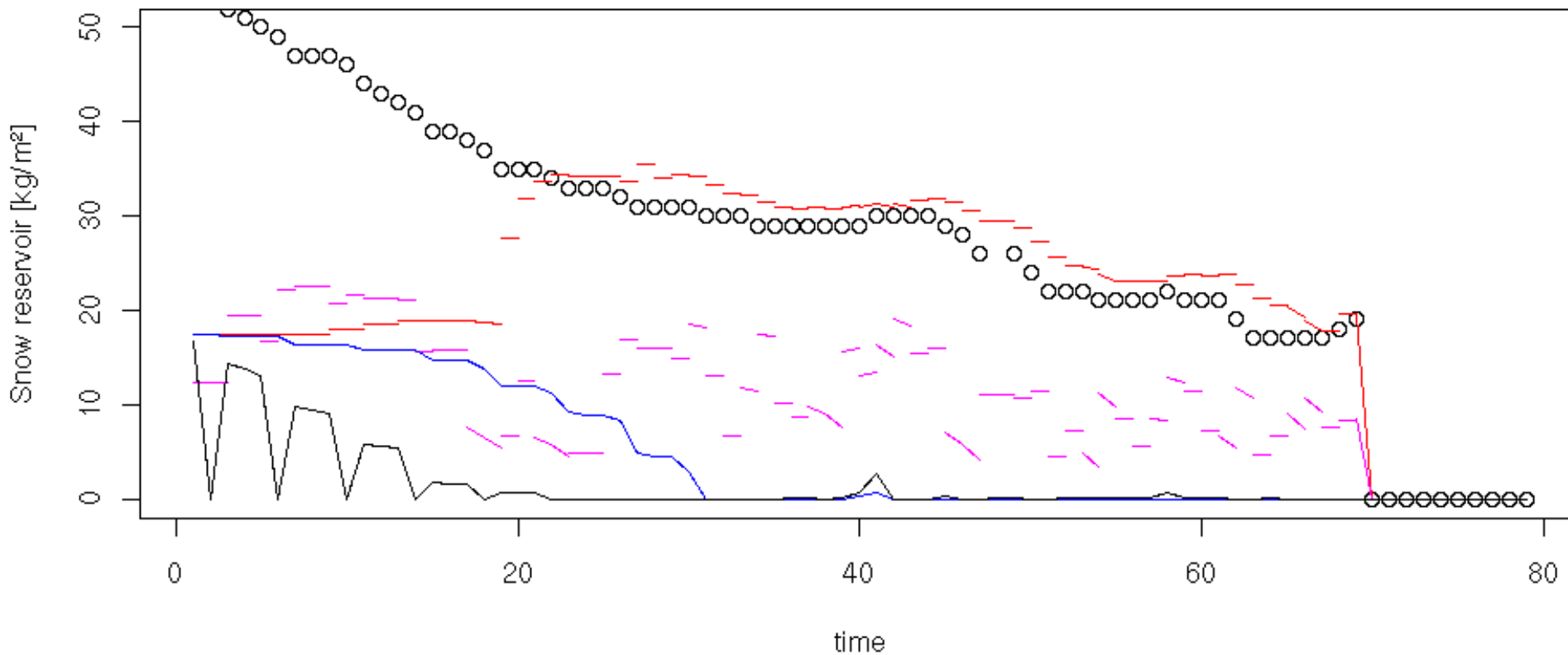
obs=circles, black=arpege, blue=FG init., red=CANARI analysis (noform), magenta=CANARI analysis



Timeseries (II) – Torino (IT)

Snow reservoir, Torino/Caselle (16059)

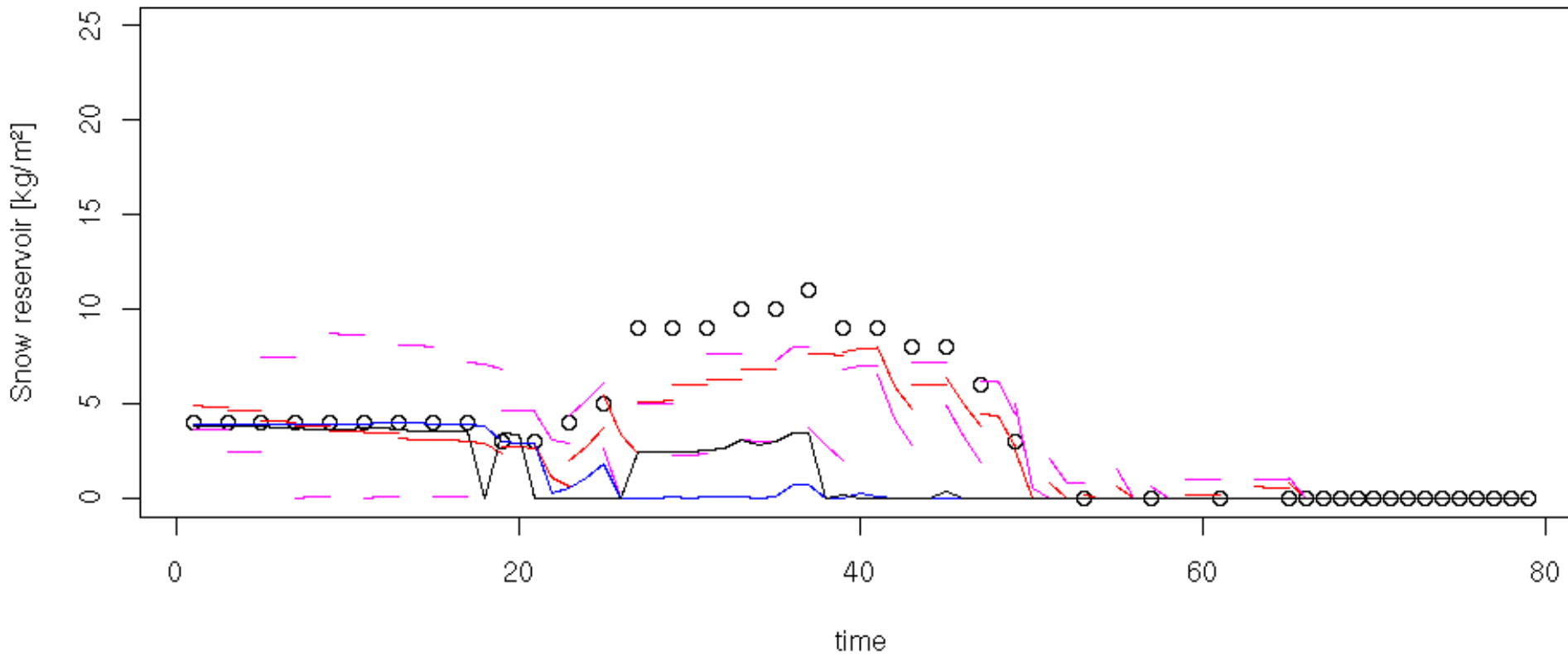
obs=circles, black=arpege, blue=FG init., red=CANARI analysis (noform), magenta=CANARI analysis



Timeseries (III) – Miskolc (HU)

Snow reservoir, Miskolc (12772)

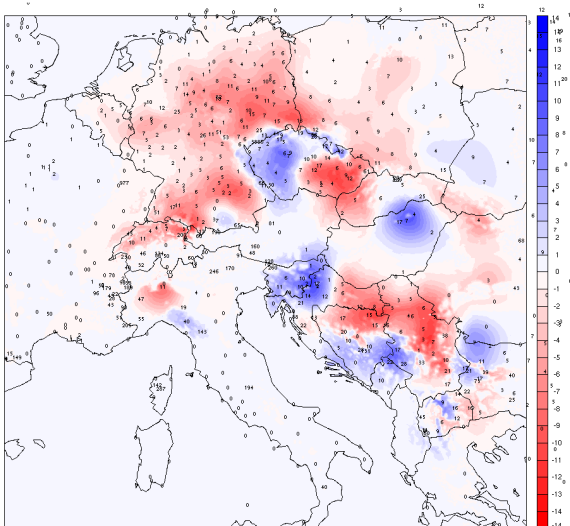
obs=circles, black=arpege, blue=FG init., red=CANARI analysis (noform), magenta=CANARI analysis



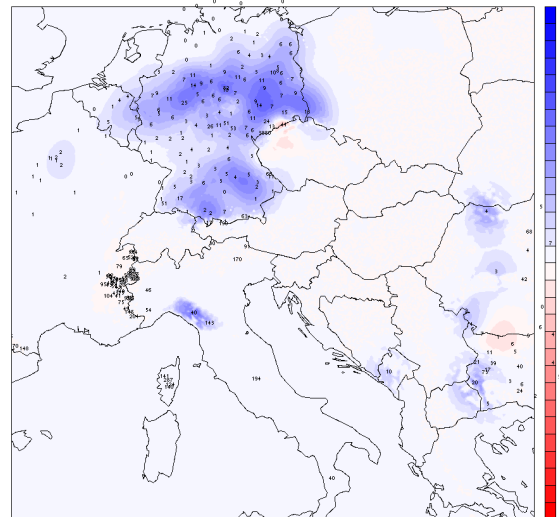
Unstable results with Urban formula

- Old and complicated formula for vertical interpolation of snow values (Urban, 1996)
- Takes into account climatology and vertical gradients of temperature
- Not much different (even a bit better) for a single case, but unstable behaviour of increments in assimilation mode
- Used by DEFAULT in cycle 35t2!

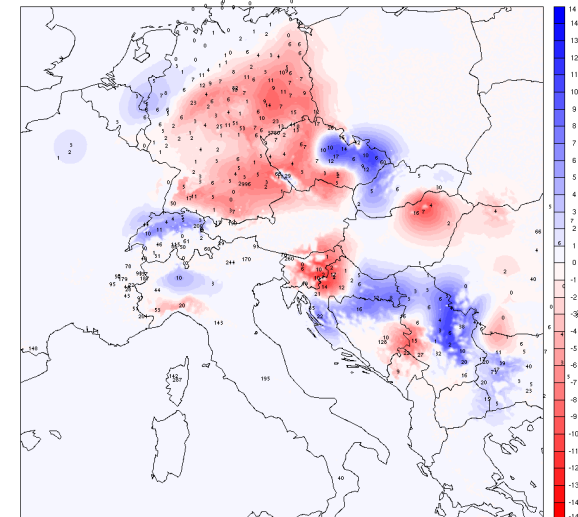
Snow reservoir [kg/m2], increment(4.4km res.) (shaded)
SYNOP snow measurements [cm] (numbers), for 2009011206



Snow reservoir [kg/m2], increment(4.4km res.) (shaded)
SYNOP snow measurements [cm] (numbers), for 2009011212

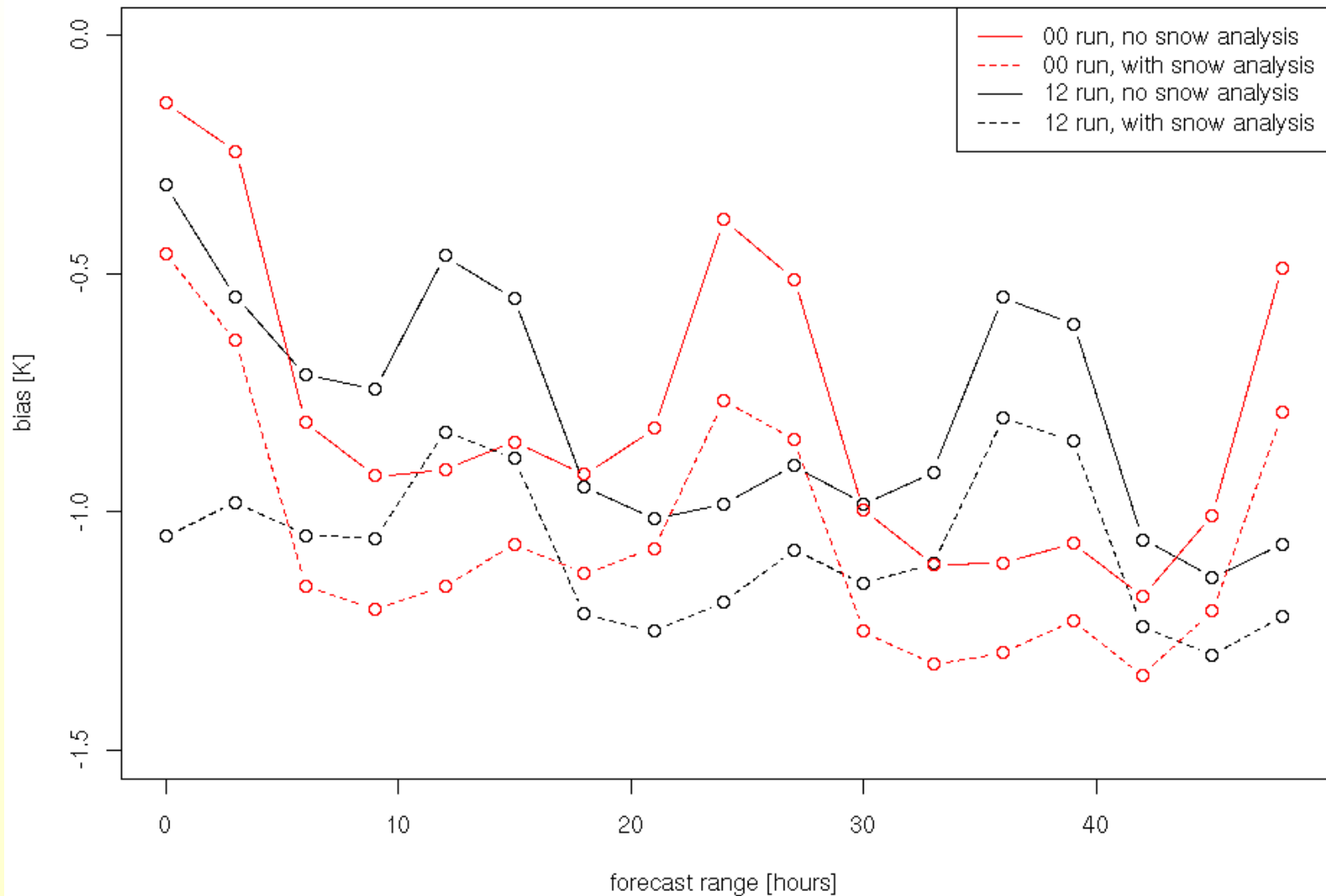


Snow reservoir [kg/m2], increment(4.4km res.) (shaded)
SYNOP snow measurements [cm] (numbers), for 2009011218



Production runs scores – screen level

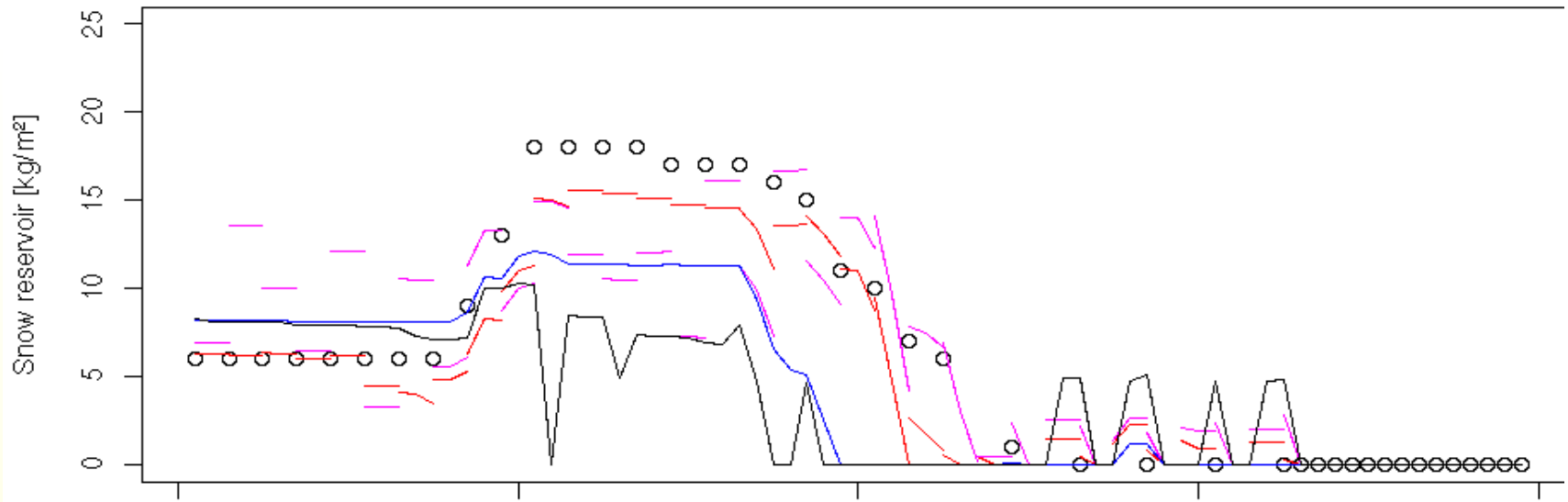
2m Temperature Bias
From Jan 11 until Jan 31 2009, N>2500



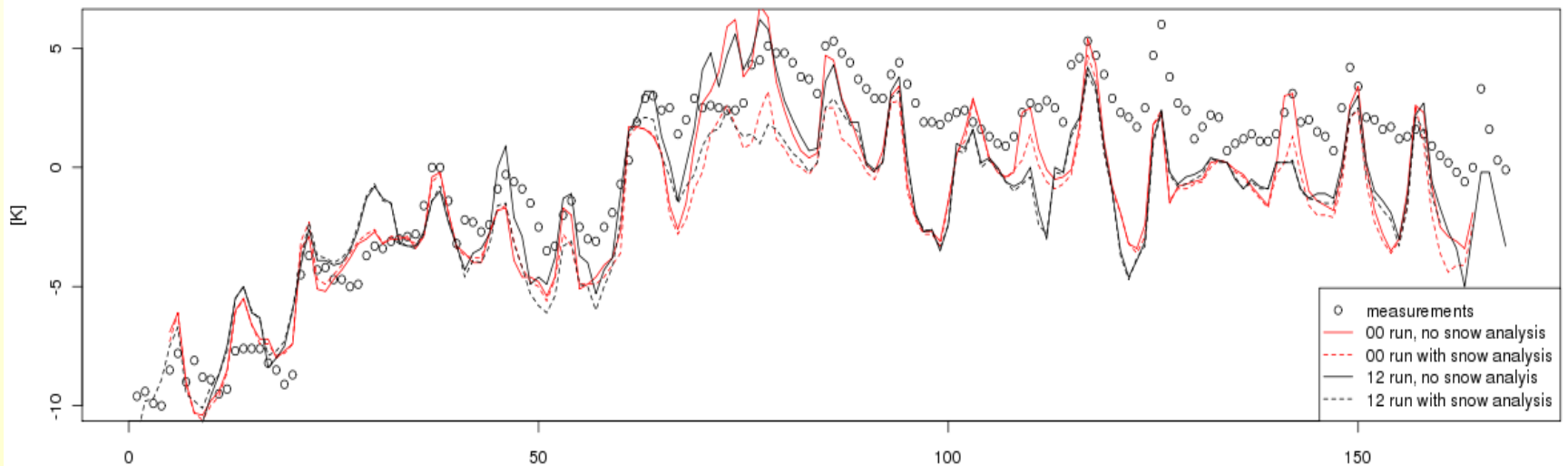
F

Snow reservoir, Ljubljana (14015)

obs=circles, black=arpege, blue=FG init., red=CANARI analysis (noform), magenta=CANARI analysis

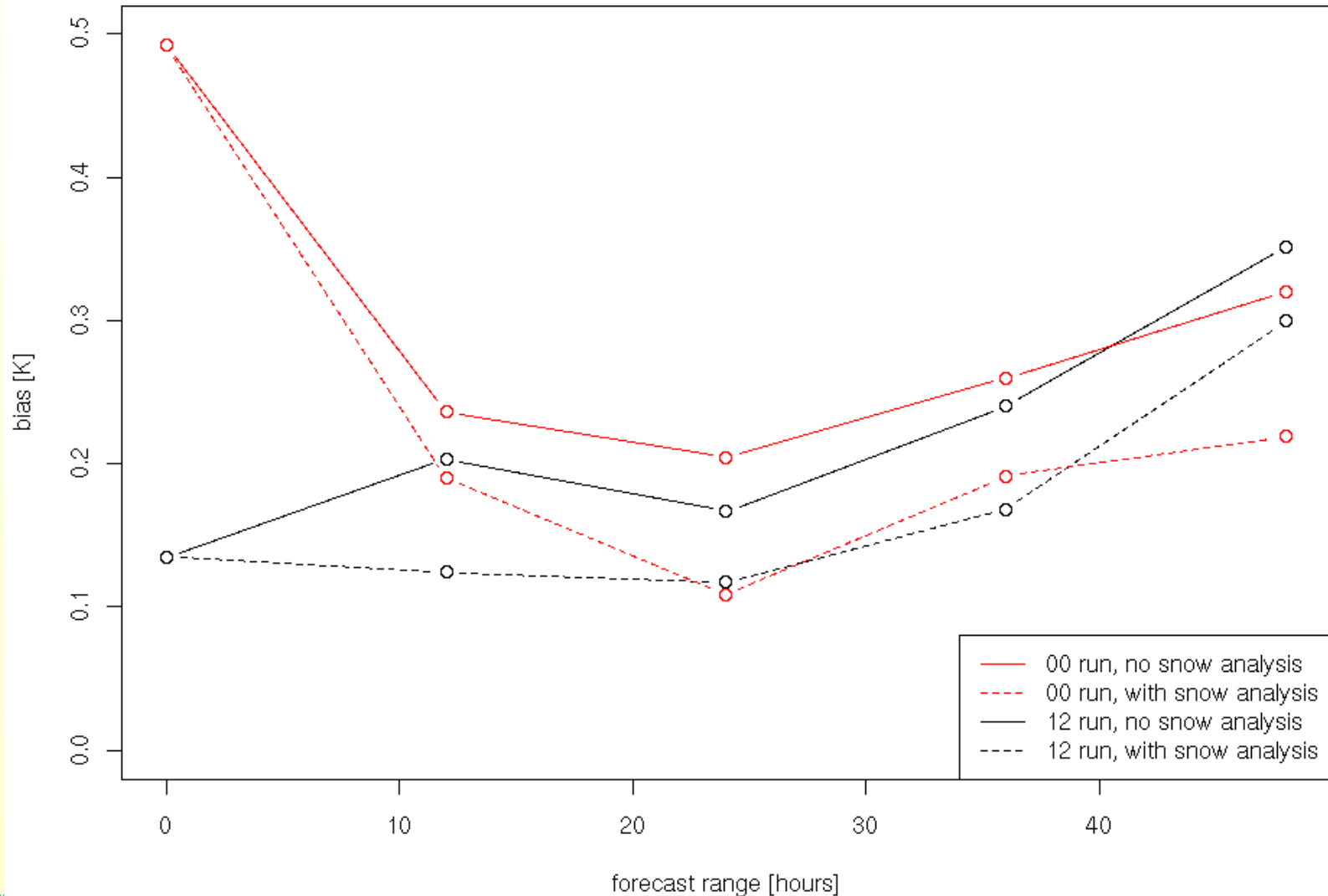


T2m Time Series, Ljubljana (14015)



Production runs scores – boundary layer

925 hPa Temperature Bias
From Jan 11 until Jan 31 2009, N~350



Conclusions

- 2m synop snow height measurements do have an impact -> cooling surface and PBL
- Neither FG initialization of snow or downscaling from the global model can produce and keep as much snow
- Quite simple in cost and implementation – shouldn't be an issue why not to use
- Simple filtering of obs-mod parameters (height of obs and model points) seems better than sophisticated interpolation
- Snow is mostly added -> cold bias
- Negative scores – are they due to tuning of 2m parameters?

Was the setup not good enough?

- no assimilation of other data – 3D or surface
- no surface temperature adjustment)