Tuning of the humidity backgroud error profile in ALD/HU assimilation system

Kristian Horvath, DHMZ, CRO
Gergely Bölöni, OMSZ, HU

with much help from Loïk, Claude and Roger

CONTENTS

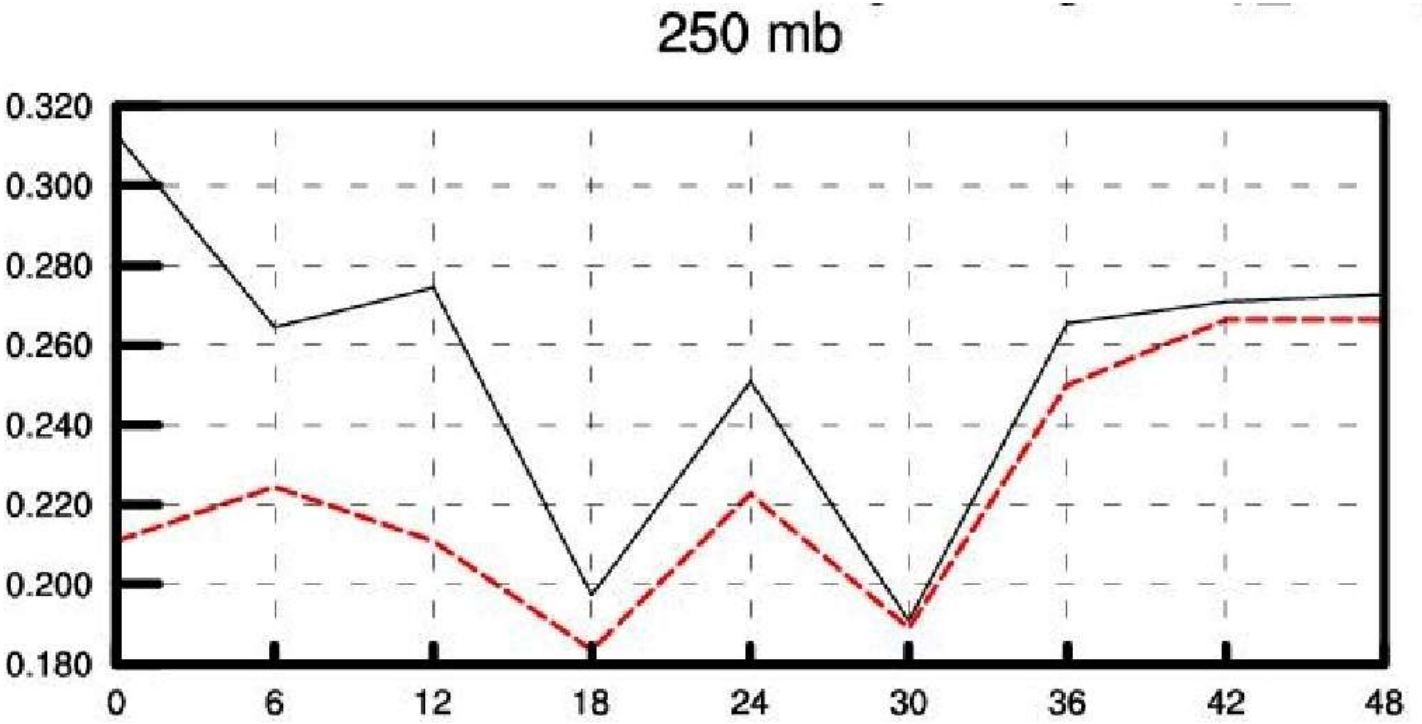
- introduction
- evidences of a need for sb(q) modification
- LH estimation method
- verification
- conclusions

INTRO

- ALADIN/HU 3dvar system
  - standard NMC statistics background error covariance B
  - multivariate formulation
  - operational since May 2005

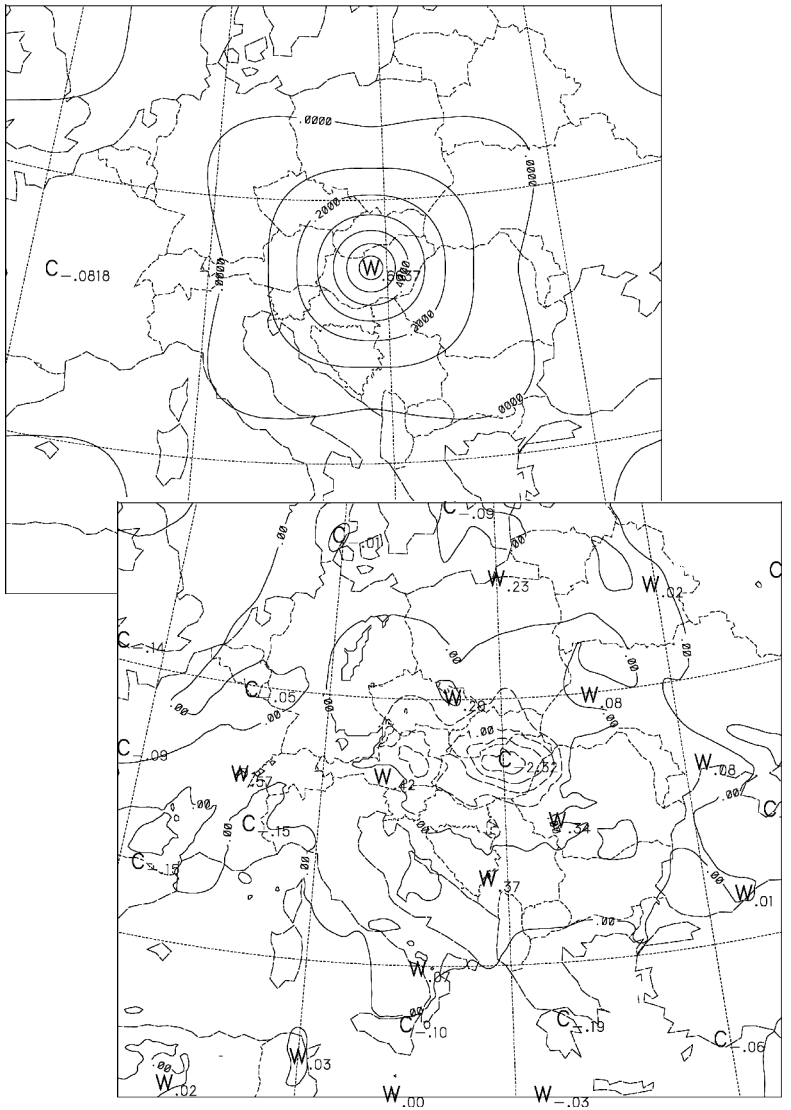
INTRO (2)

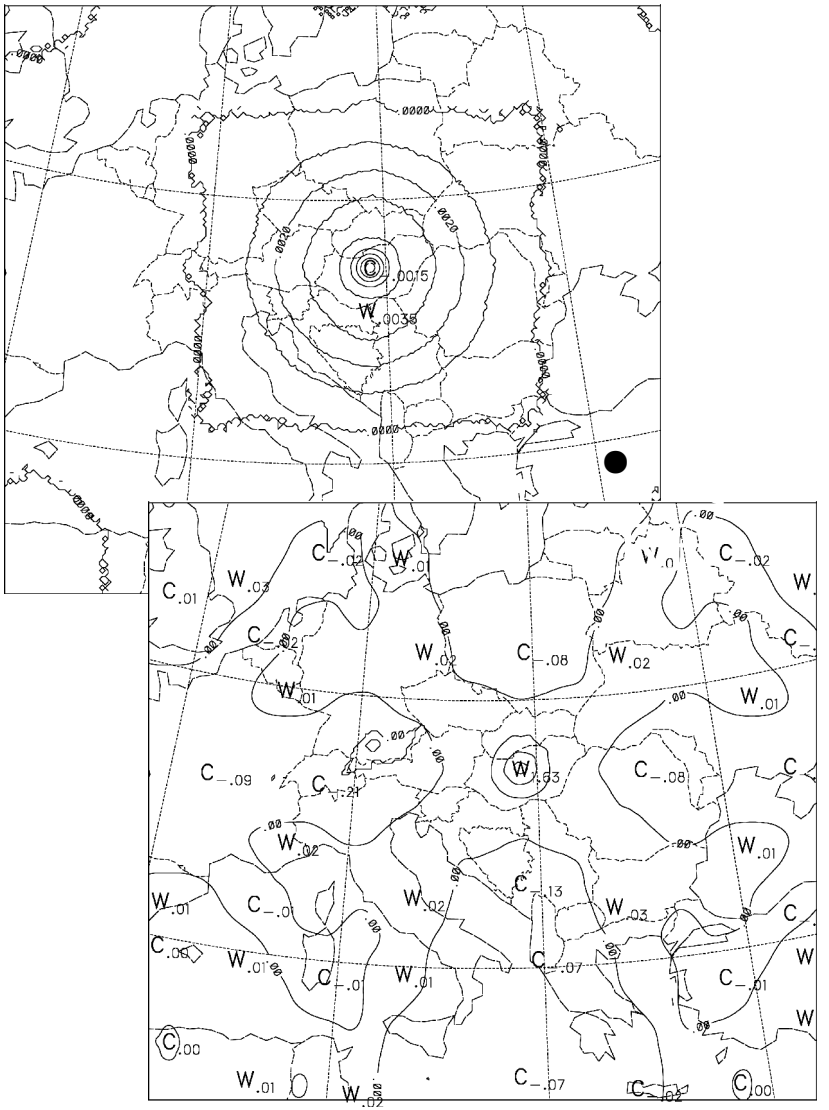
- growing evidence that sb(q) is inaccurate/overestimated:
  - univariate vs. multivariate experiments



single observation experiments (1)

- Single observation exp’s (SNMC)





single observation experiments (2)

- $$dT = \frac{sb(T)^2}{sb(T)^2 + so(T)^2} * \Delta T$$

- $$dq = cor(eb(q), eb(T)) * \frac{sb(q)}{sb(T)} * dT$$

- $$dq = \frac{sb(q)^2}{sb(q)^2 + so(q)^2} * \Delta q$$

- $$dT = cor(eb(T), eb(q)) * \frac{sb(T)}{sb(q)} * dq$$

single observation experiments (3)

$$S(A/B) = \frac{\left(\frac{dq}{dT}\right)_{Tinn}}{\left(\frac{dT}{dq}\right)_{Qinn}} = \left(\frac{sb(q)}{sb(T)}\right)^2 \qquad P(A*B) = \left(\frac{dq}{dT}\right)_{Tinn} * \left(\frac{dT}{dq}\right)_{Qinn} = cor(eb(q), eb(T))^2$$

- experimental values for T and RH

$$\sqrt{S(A/B)} = \frac{sb(RH)}{sb(T)} = 60.57\,\frac{\%}{K} \qquad \sqrt{P(A*B)} = cor(eb(T), eb(RH)) = 0.0537$$

- overestimation of S(A/B) can occur because of:
  - overestimation of sb(q)
  - overestimation of so(q)

Lönnberg – Hollingsworth method

- new, intependent method for estimating background errors
- 1. evaluate in observation space statistics of the innovation vector y-H (xb)
  - assuming that
    - errors are unbiased
    - observation and background errors are uncorrelated

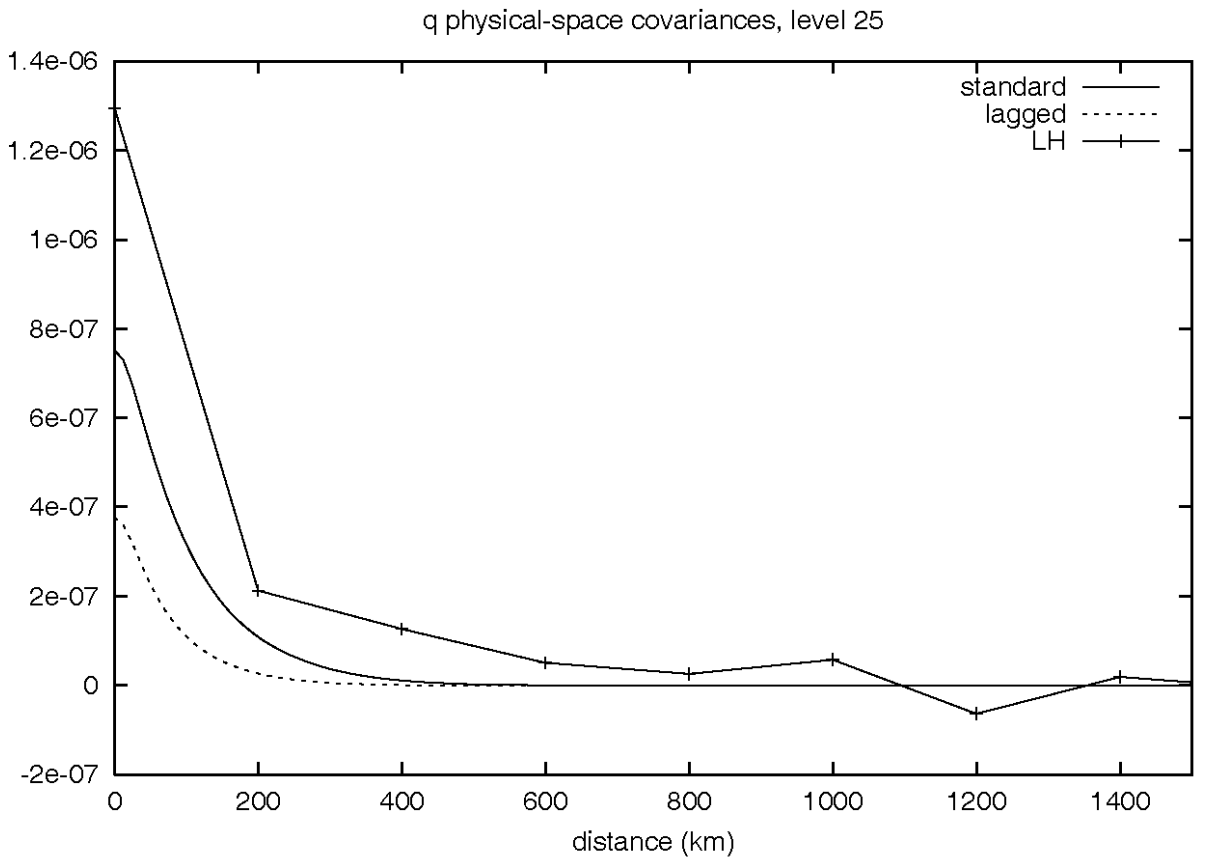
Lönnberg – Hollingsworth method

- 2. make extra assumptions
  - most prominent that observation errors are not spatially correlated
- 3. sort in bins (distance intervals)
- 4. function fitting

- -as a byproduct get observation error covariance estimation!

Lönnberg – Hollingsworth method

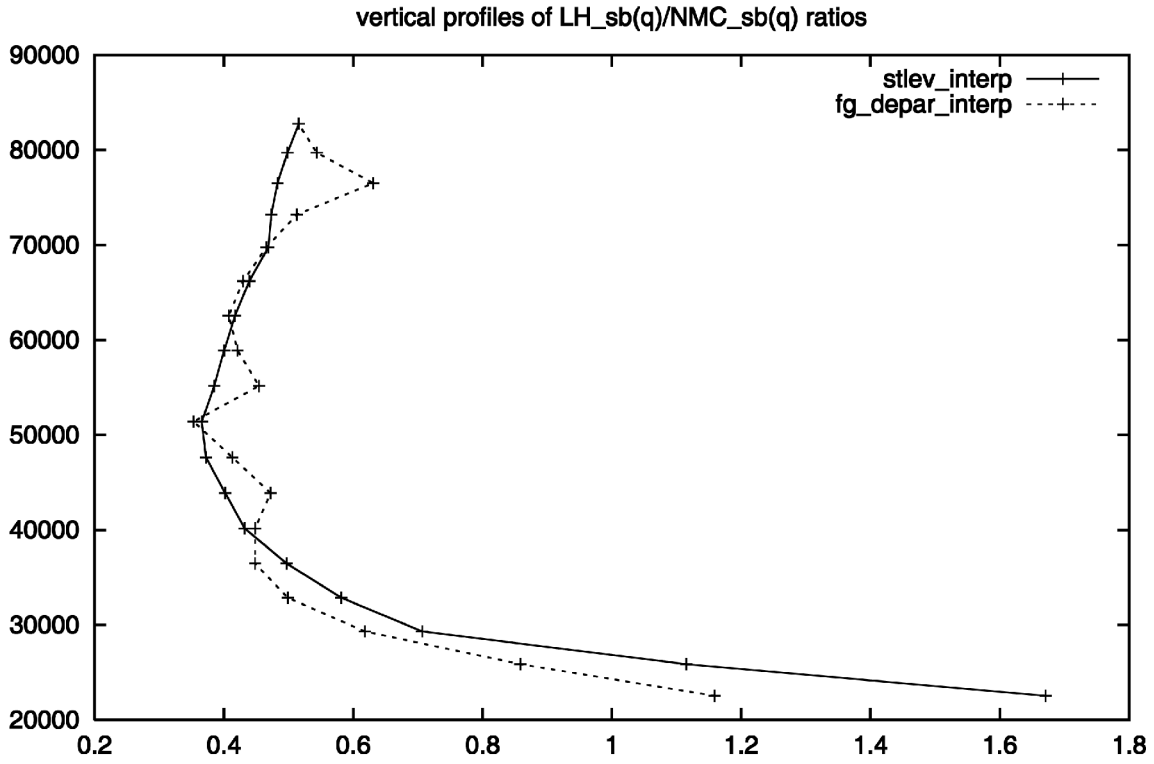
- TEMP measurements
- period: May 02 – Sept 09 (2004)



sb(q) vertical profile

- calculation of the profile on model levels
- two methods tested
  - interpolation of first guess departs to model levels followed by covariance calculation
  - covariance calculation at standard TEMP levels and interpolation to model levels

sb(q) vertical profile



- untouched under level 28 (820 hPa)
- severely touched above tropopause to reduce the humidity propagation into stratosphere

Single-observation experiments - LH tuning

- SO experiments with reducing sb(q) and so(q) at level 18

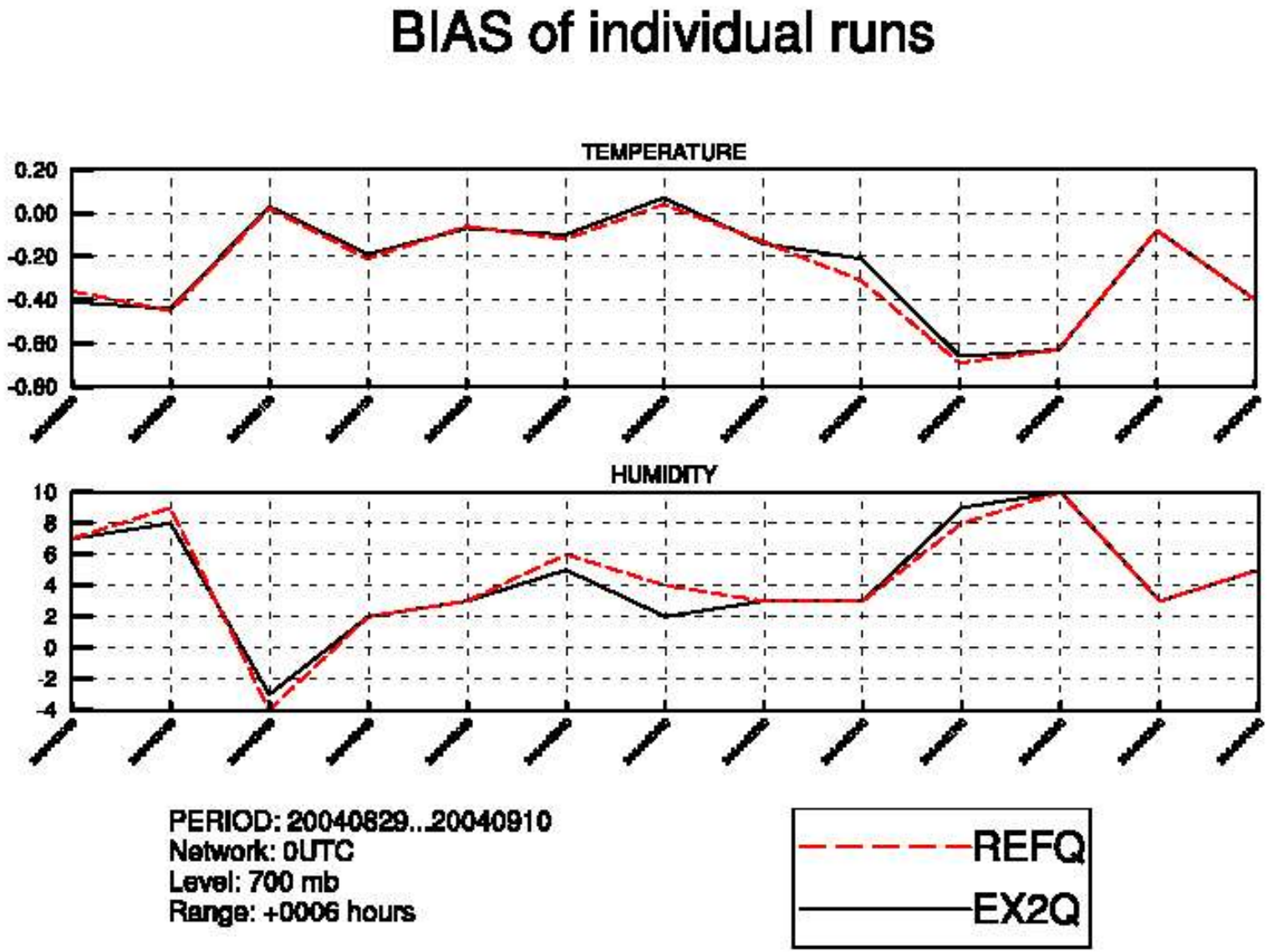
EXP	1	2	3	4
sb(q)	NMC	NMC	LH	LH
so(q)	orig	orig*0.5	orig	orig*0.5
S(A/B)^0.5 [%/K]	60.57	60.1	35.54	33.9
P(A*B)^0.5	0.0537	0.0542	0.085	0.0893

$$\sqrt{S(A/B)} = \frac{sb(RH)}{sb(T)} \qquad \sqrt{P(A*B)} = cor(eb(T), eb(RH))$$

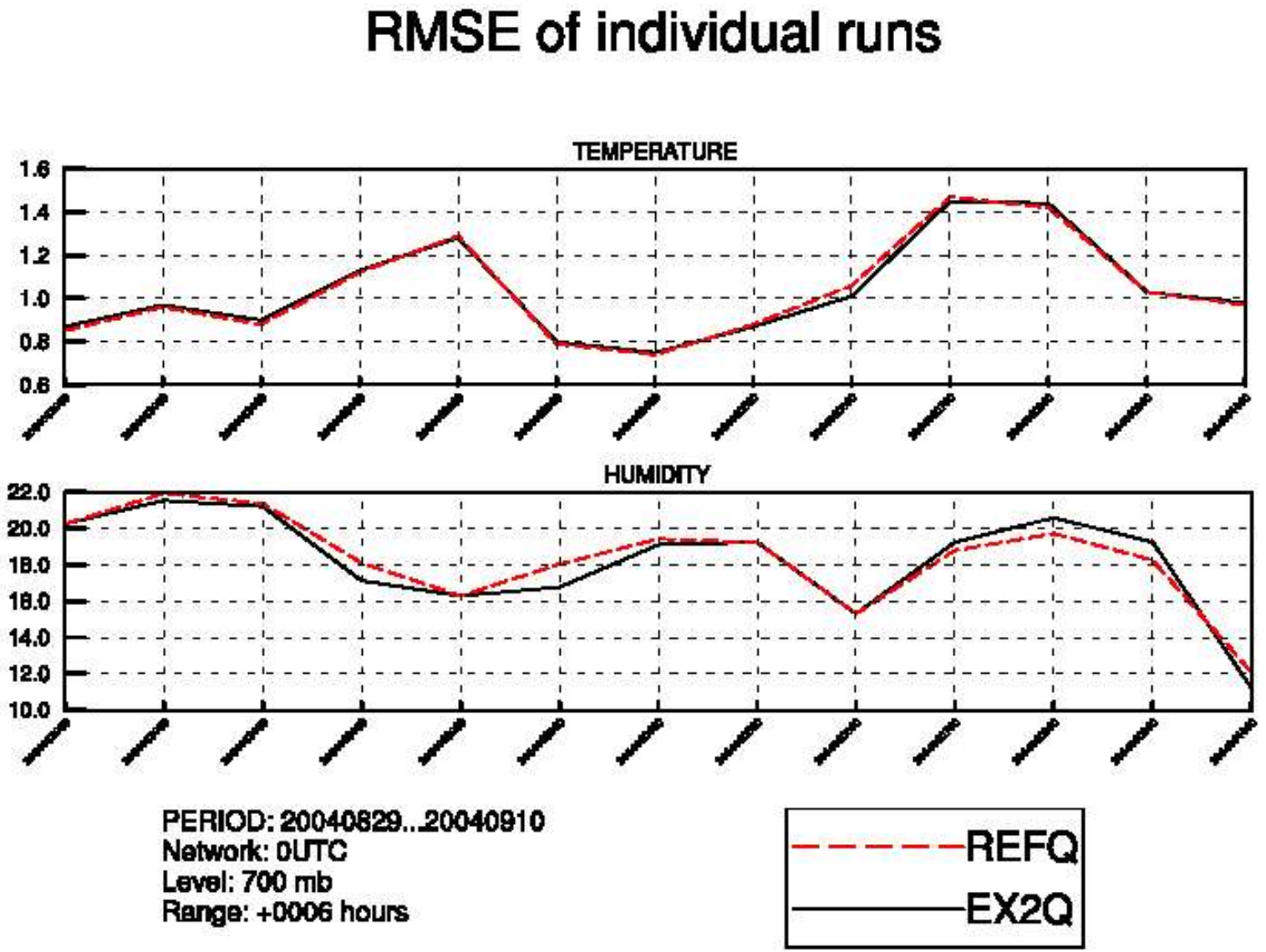
Parallel tests - Full observation experiments (FO)

- full observation experiments using old and new humidity profiles
- TEMP, SYNOP, ATOVS, AMDAR data
- 2 periods:
  - wet: May 31 – Jun 13
  - dry: Aug 29 – Sept 11

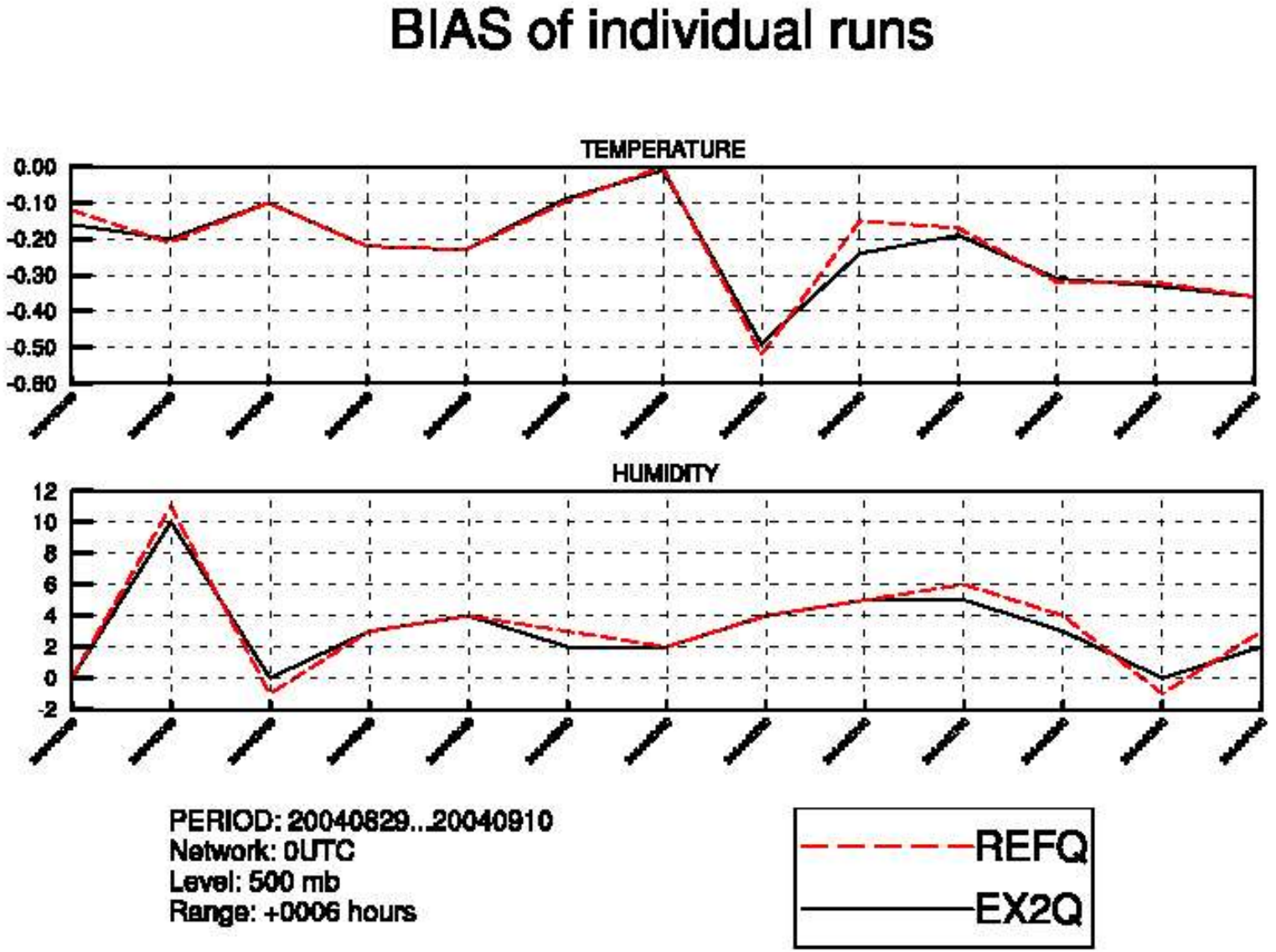
FO experiments - work in progress



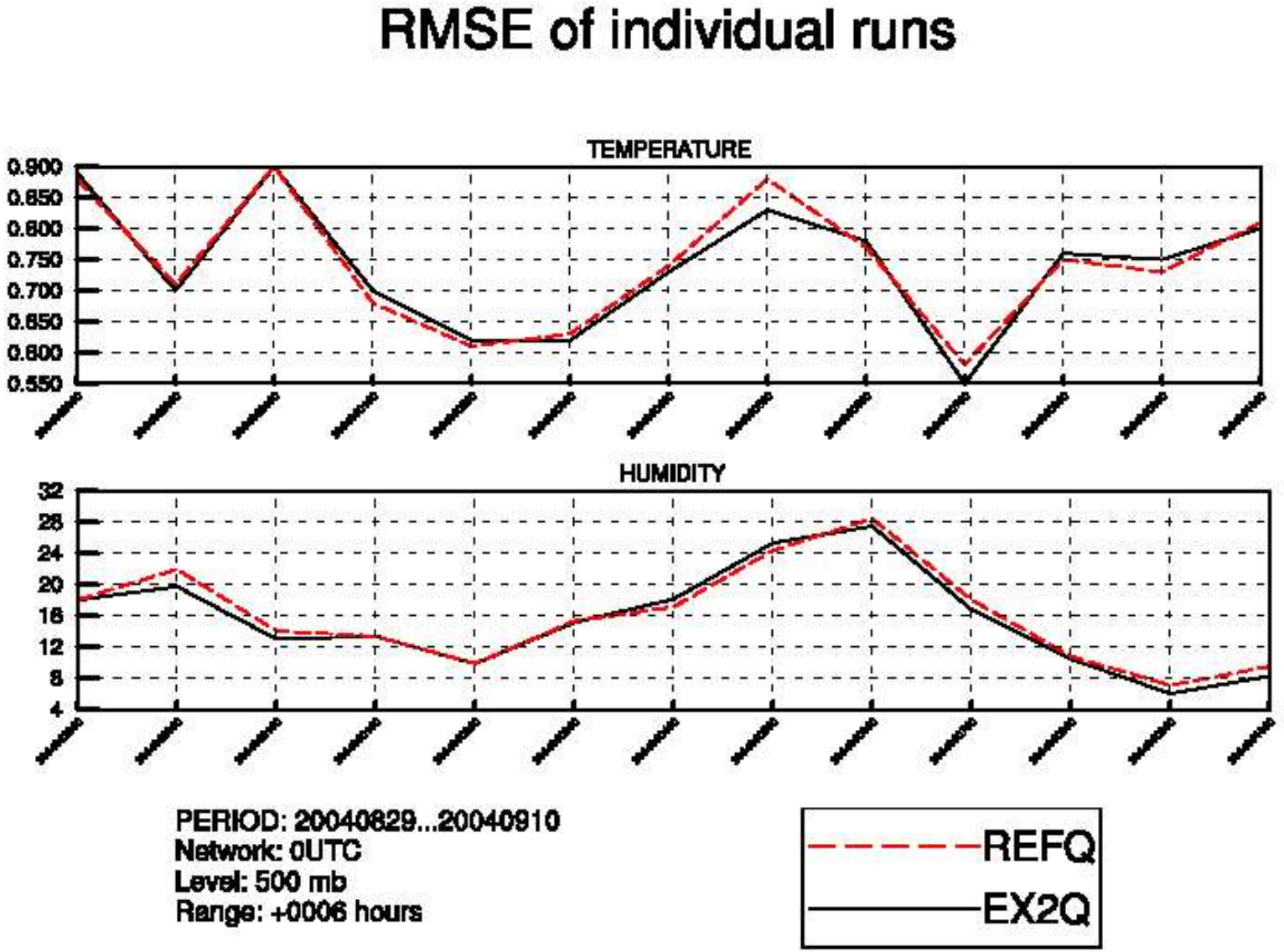
FO experiments - work in progress



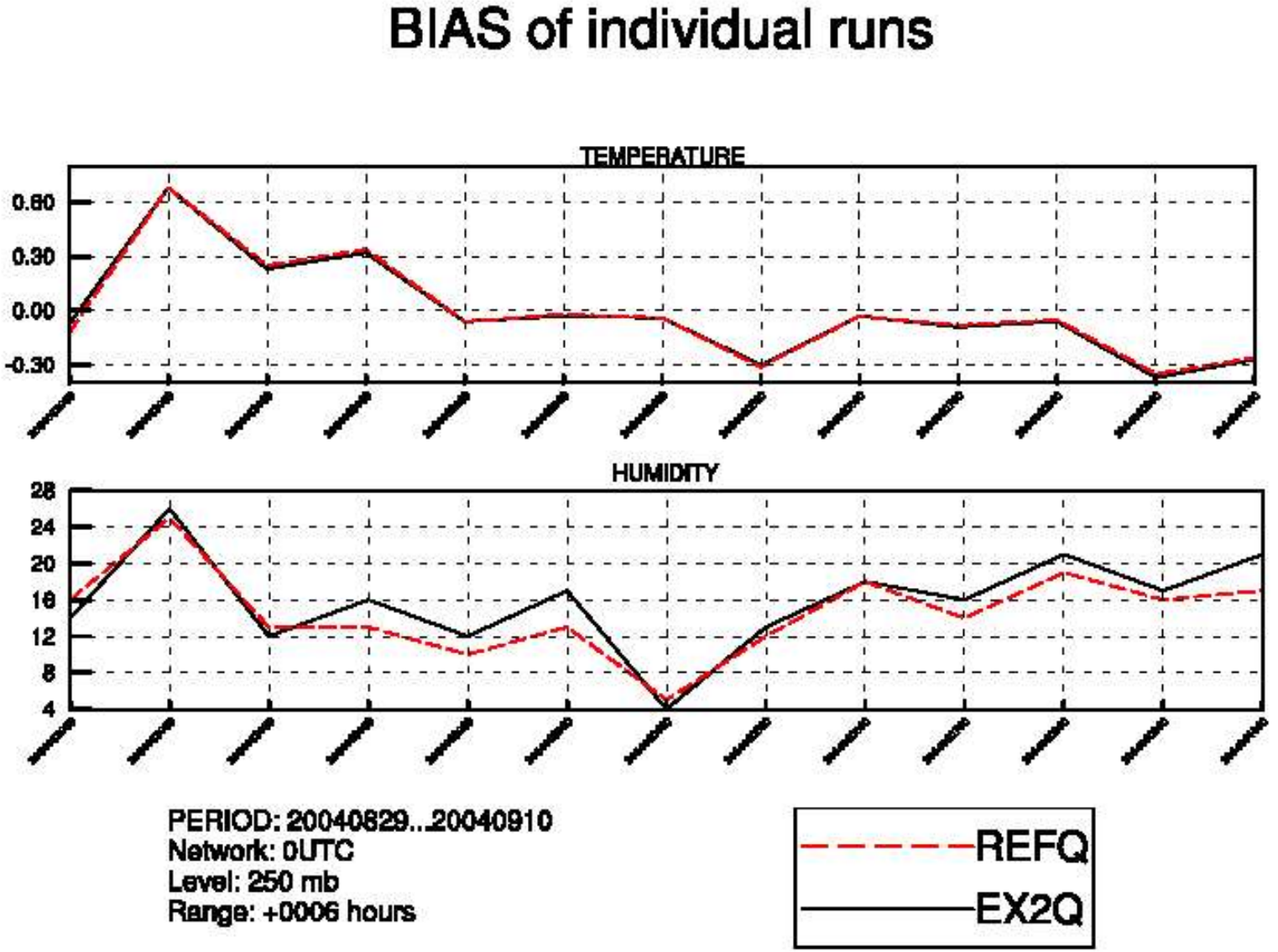
FO experiments - work in progress



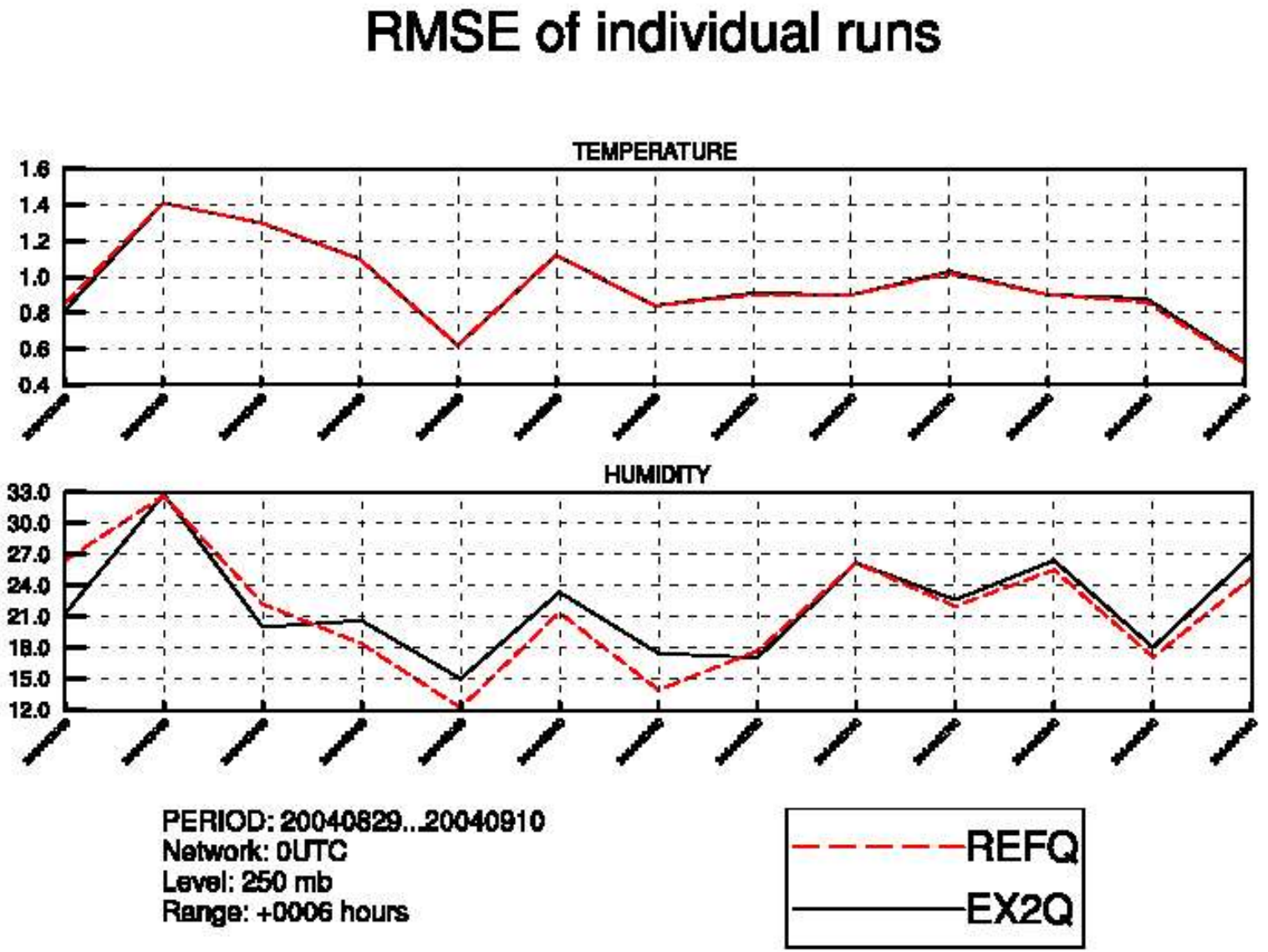
FO experiments - work in progress



FO experiments - work in progress



FO experiments - work in progress



Conclusions

- LH tuning of the propagation steps in middle levels:
  - a positive impact on humidity
  - a slightly positive impact on temperature
- reduction of propagation steps at upper levels needs modifications
- more tests running...