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Results and special features of experimental regular 1km runs over the Alps

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with contributions from Oliver Fuhrer, Pirmin Kaufmann and
Francis Schubiger

COSMO/CLM, User Seminar, 5.3.2013



Motivation for 1km Model

- COSMO-1 is **one** part of the **Novel Expert Tool (COSMO NExT)** project (2012-2015) at MeteoSwiss (see also Philippe's talk on Thursday afternoon)
- Short term (**NOW, experimental** since end of **August 2012**)
 - **Initial Conditions:** own COSMO-1 assimilation cycle with **longer** cut-off
 - **Lateral Boundary Conditions** from COSMO-7
- Long term:
 - **Initial Conditions** from **downscaled** KENDA analysis
 - **Lateral Boundary Conditions** directly from IFS (~10 km)



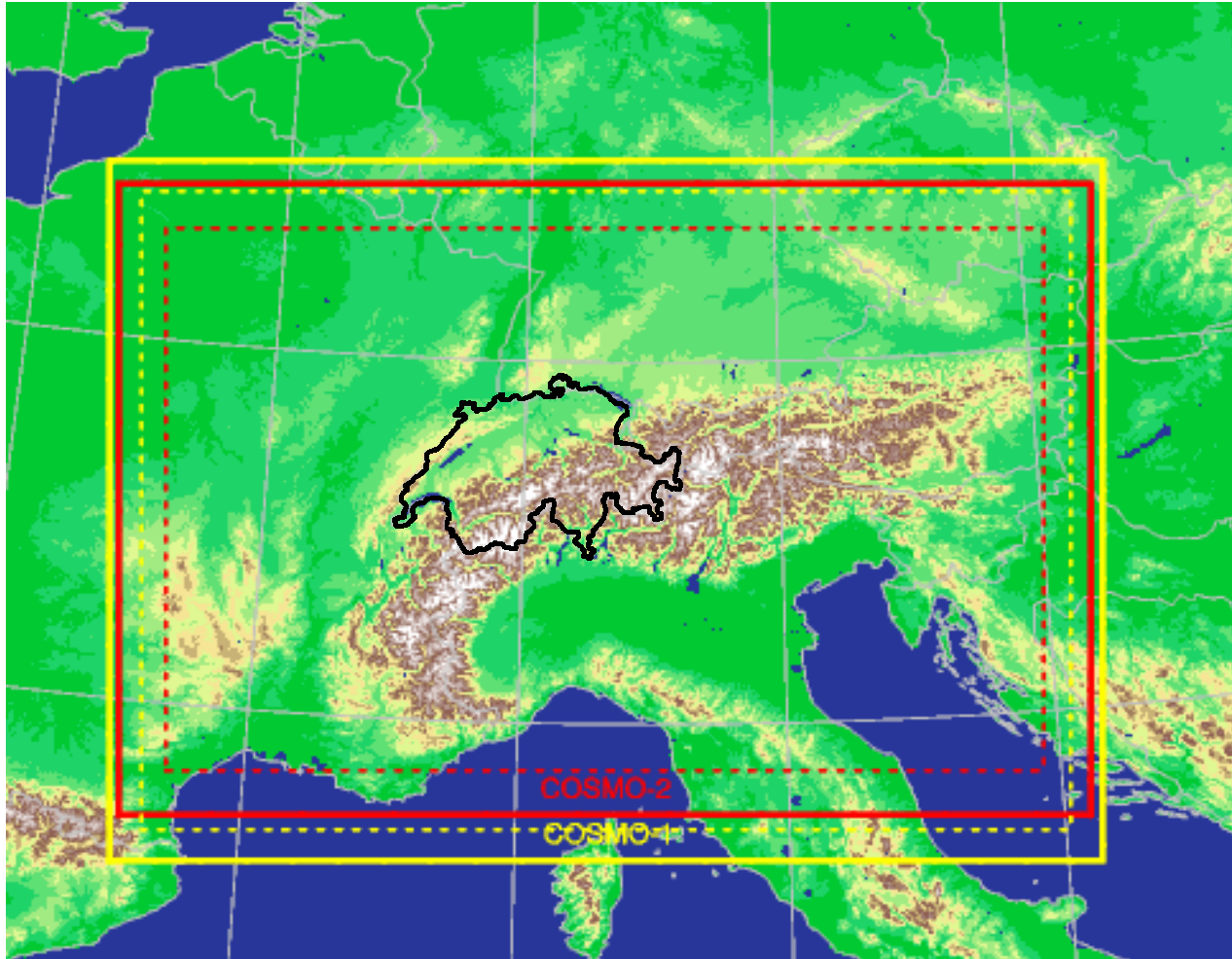
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- Motivation
- COSMO-1 Setup
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COSMO-1 Setup (1) Domain

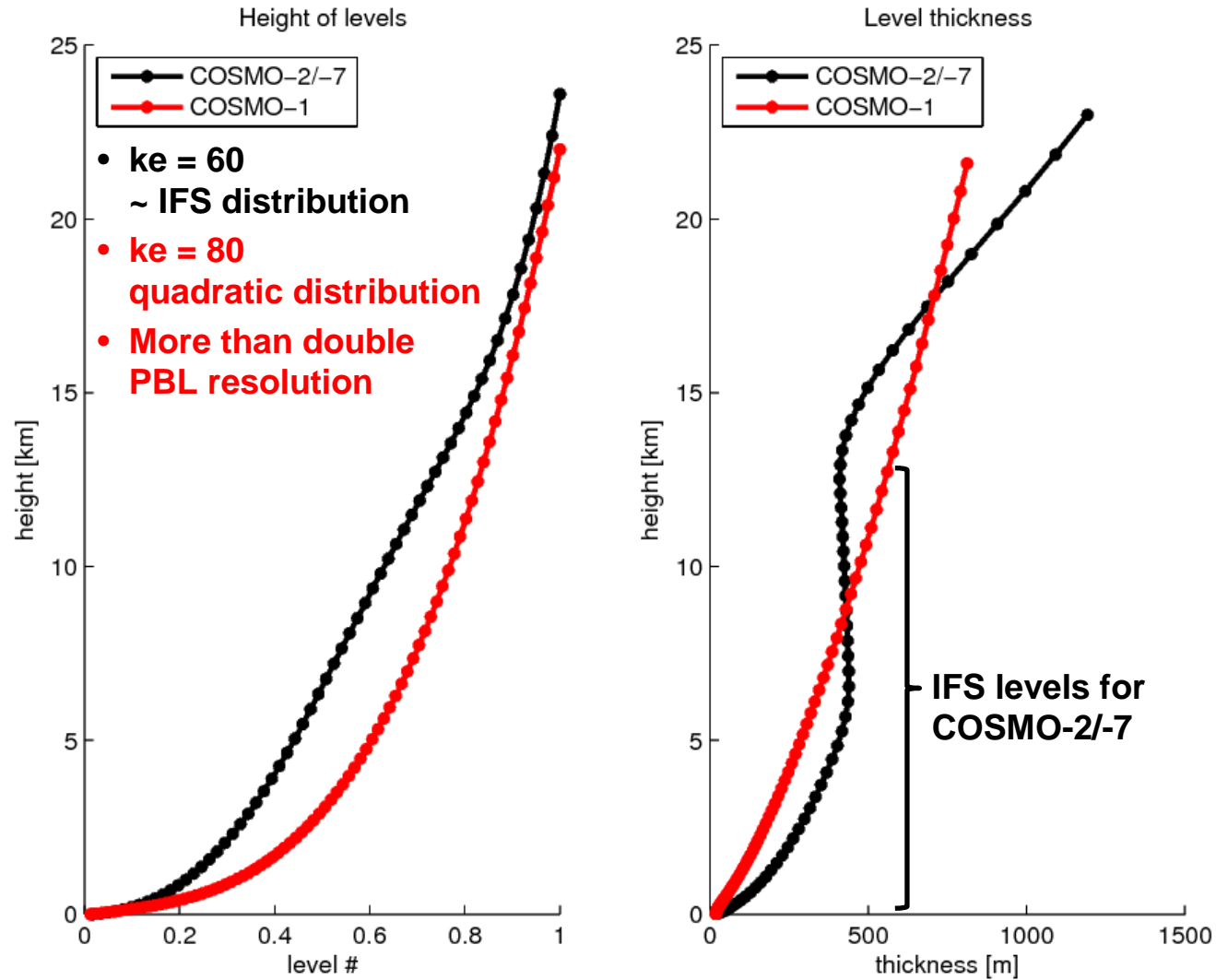
- $d_{lon} = d_{lat} = 0.01$, $i_e \times j_e = 1062 \times 774$





COSMO-1 Setup (2)

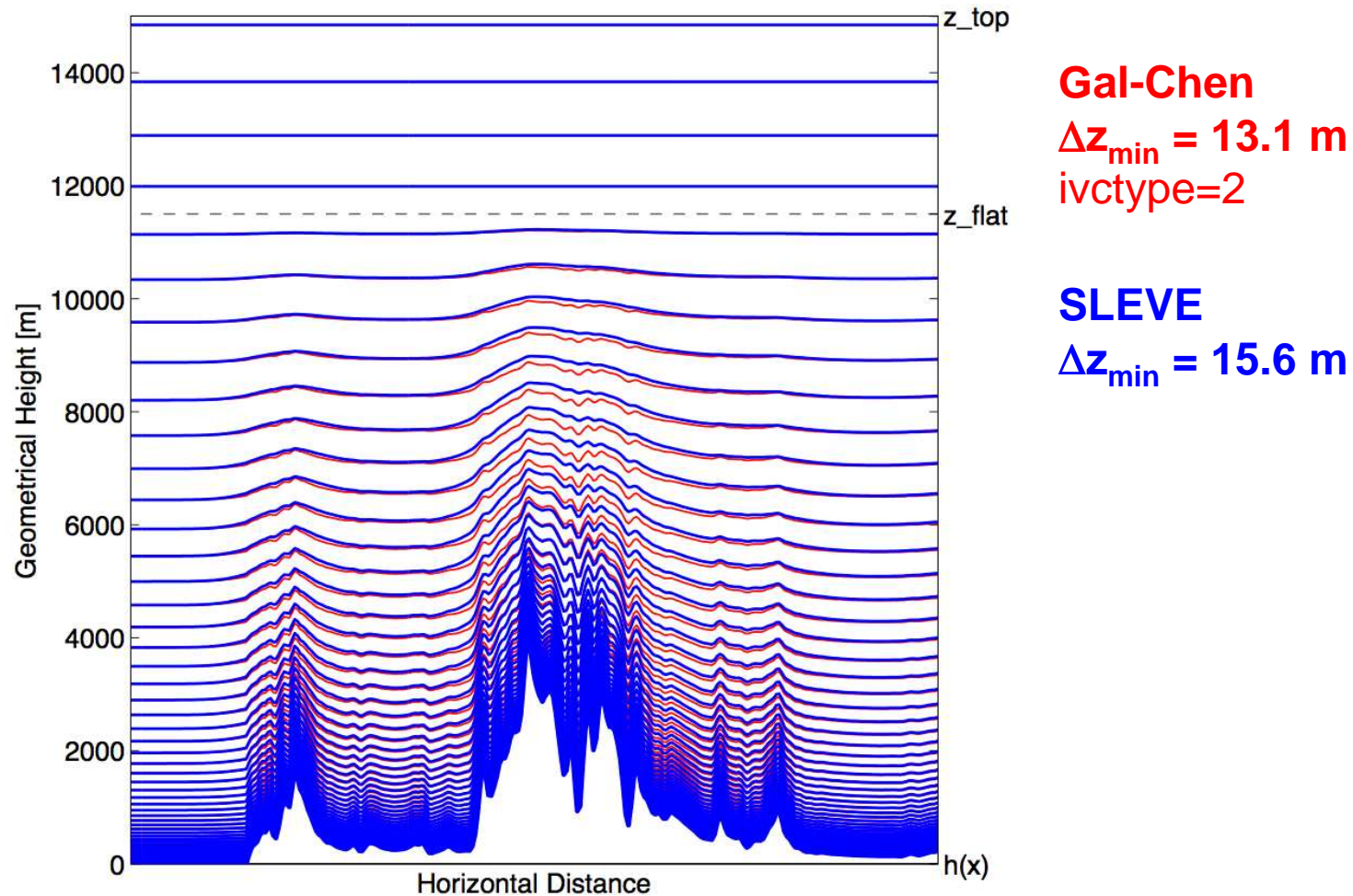
Vertical Grid





Coordinate Transformation

- Generalized **SLEVE** (after Leuenberger et al. 2010)
($ivctype=4$, $svc1=10\text{km}$, $svc2=3.5\text{km}$, $nflvc=100$, $n=1.35$)





Gradients of filtered orography

Compared to: Maximum Gradient in x- and y-direction [degrees]

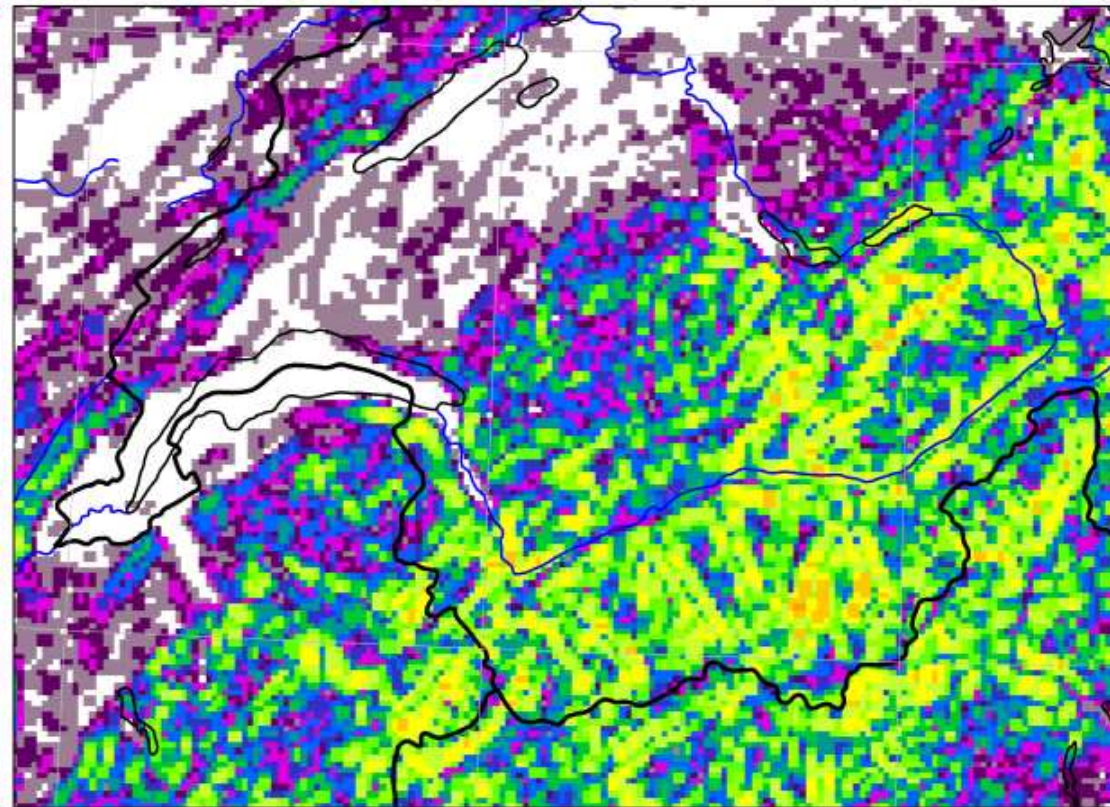
COSMO-7: max.4°

COSMO-2: max.15°

COSMO-1 ASTER Orography, mean=3.386, max=35.962

11/12/2010 (00:00)
+0 hours

```
lfilter_oro = .F.  
lxso_first = .F.  
ilow_pass_oro= 4  
numfilt_oro = 1  
ilow_pass_xso=5  
numfilt_xso = 1  
rxso_mask = 750
```





Namelist choices for Dynamics

Bold for COSMO-2 operational

Red COSMO-1

Code with new fast wave solver in COSMO V4.24+:

`i_type_fast_w = 2` and **`irefatm = 2`**

- ✓ **Gal-Chen** (`ivctype = 2`) **SLEVE2** (`ivctype = 4`)
- ✓ time step ($\Delta t = 20\text{sec}$; $\Delta t = 10\text{sec}$)
- upper boundary condition (`nrdtau = 5`; **3**)
- **NO horizontal diffusion**; **2D-Smagorinsky** (**`l_diff_Smag=.True.`**)
- **θ advection and limiter**; **NOT in COSMO-1**
- `ldyn_bbc = .True.` (dp/dz with metric terms, cf. A. Gassmann)
- `itype_bbc_w = 2` (use hhl adv. as bottom boundary cond. for w)
M. Baldauf recommends **.False.** and 114 (lin. extr. and 4th ord. h.gr.)



Namelist choices for Physics

Radiation: **COSMO-2** **COSMO-1**

- **Increased** frequency from every **0.25h** to **0.1h**

Vertical diffusion (since Dec. 2012):

- **Reduced** minimum diff. coefficient of heat and momentum
tkhmin, tkmmin = 1 → 0.4 and 0.1 in extra run

Convection:

- **Both models only shallow** convection parameterization

Subgrid Scale Orography:

- **ON** for COSMO-2; **OFF** for COSMO-1 (no ext. parameters)

Same Microphysics:

- 4-category scheme (ice, rain, snow, graupel)

Same Land Surface Scheme.



Results of COSMO-1 for September-October-November 2012

0 and 12 UTC runs up to 24h

- ~ 6 times more grid points than COSMO-2
- 1h40' elapsed time with 2470 cores on CRAY XE6

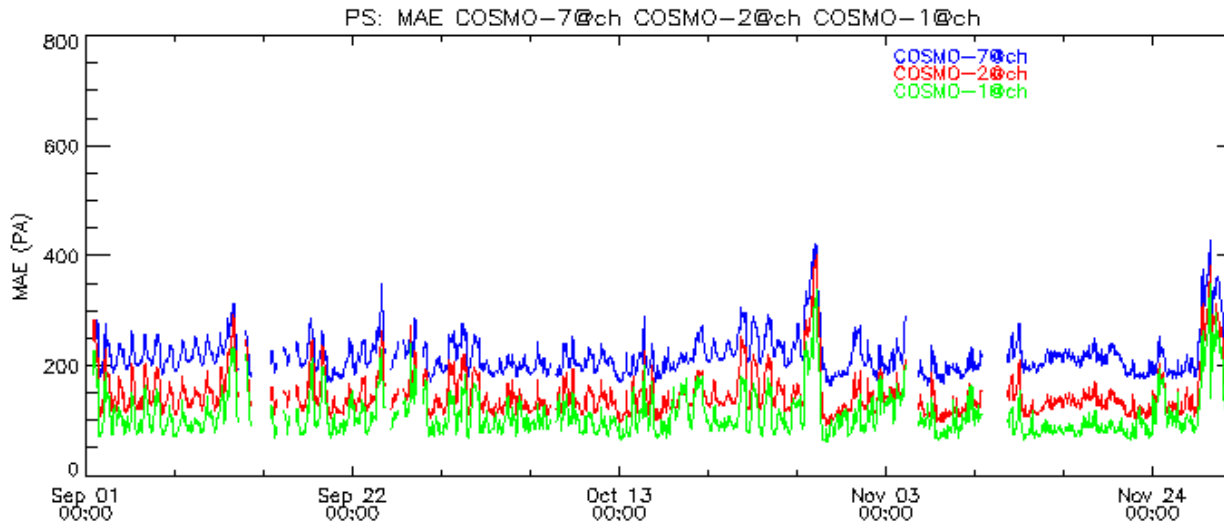
Comparison over Switzerland and Alps with the colours codes:

- **COSMO-7**
- **COSMO-2**
- **COSMO-1**

**Thanks to
Primin Kaufmann and
Francis Schubiger !**

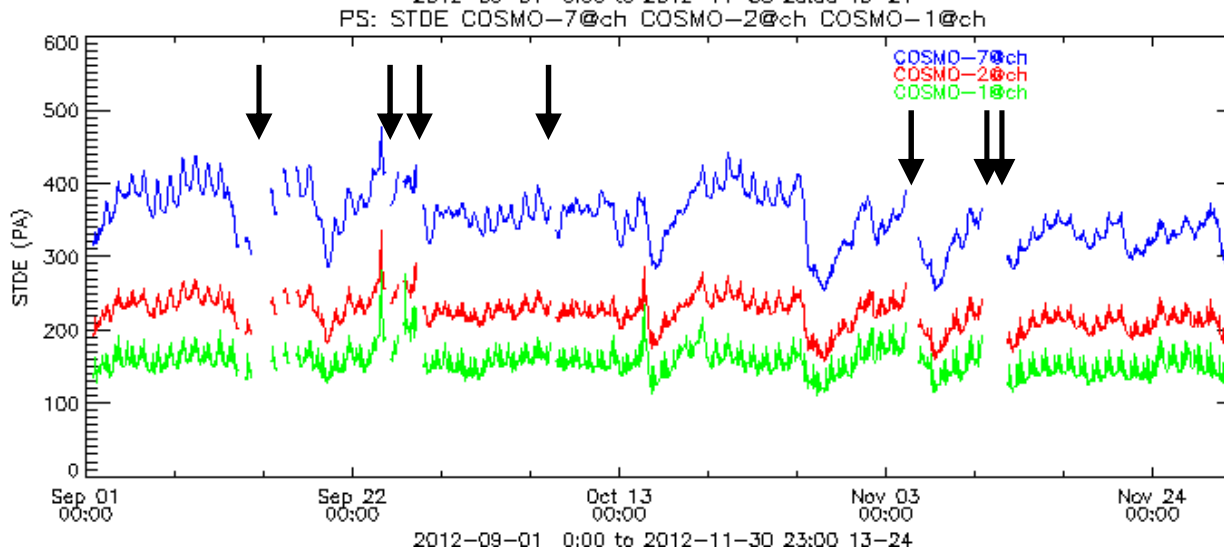


Surface pressure of **COSMO-1** for September-October-November 2012



**Mean
Absolute
Error**

**COSMO-7
COSMO-2
COSMO-1**



**Standard
Deviation**



Tuning of special cases

- 17 cases crashed (in assimilation and/or in forecast mode; 10 analyzed)
- **Used $\Delta t = 8$ sec** to continue COSMO-1 assimilation

Tests with the following options (not Namelists) :

- **c_Smag** = 0.1 and 0.06 instead of 0.03 (Baldauf, 2012)
- **divdamp_slope** of new fast wave solver
30, 40, 50, 60, 100 instead of 20

After testing also Storms **Lothar** (Christmas Dec. 26, 1999)
and **Carmen** (Nov. 12, 2010) finally put:

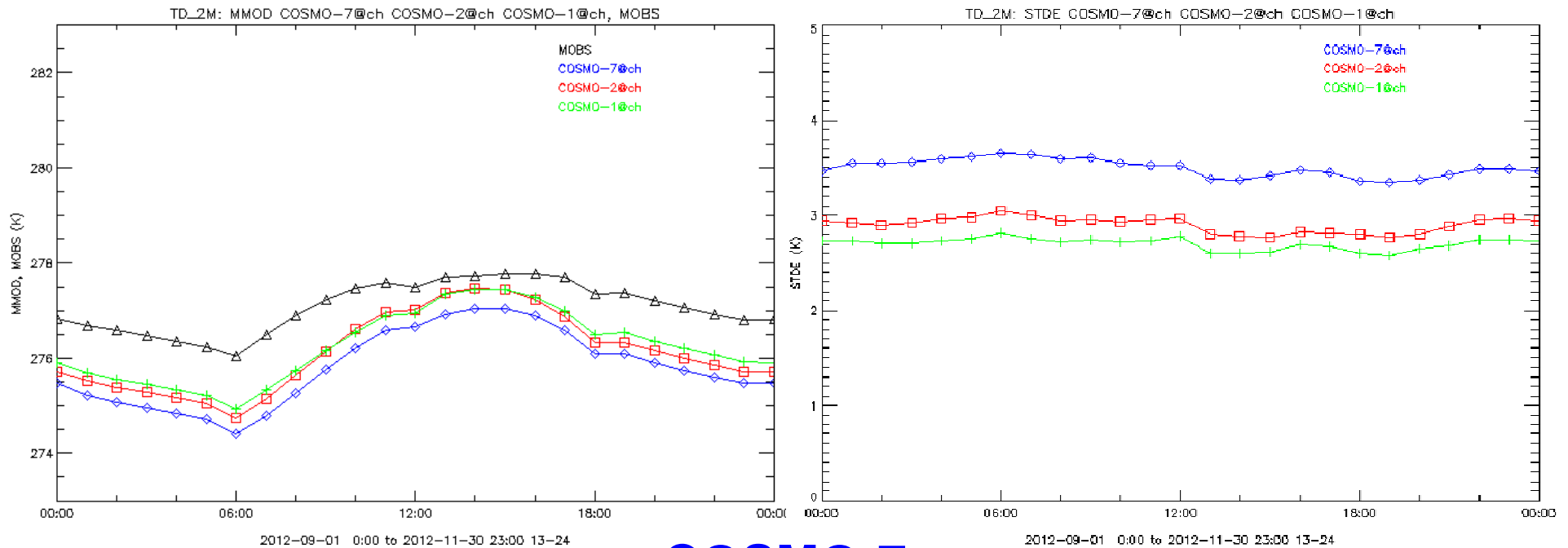
divdamp_slope = 60 operational in Dec. 2012

- **No** unstable case since !
- Come back to the verification results ...



Dewpoint @ 2m of COSMO-1 for September-October-November 2012

Observation values +13-24h Standard Deviation

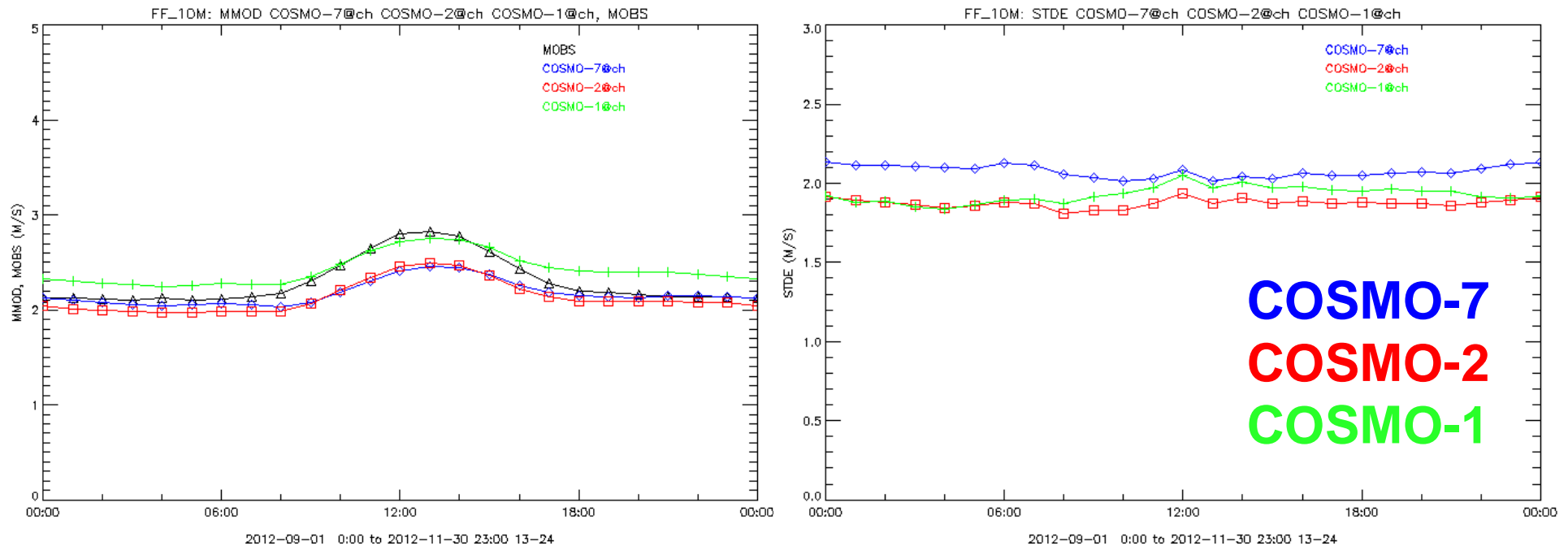


COSMO-7
COSMO-2
COSMO-1



10m Wind Speed of COSMO-1 for September-October-November 2012

Observation values +13-24h Standard Deviation

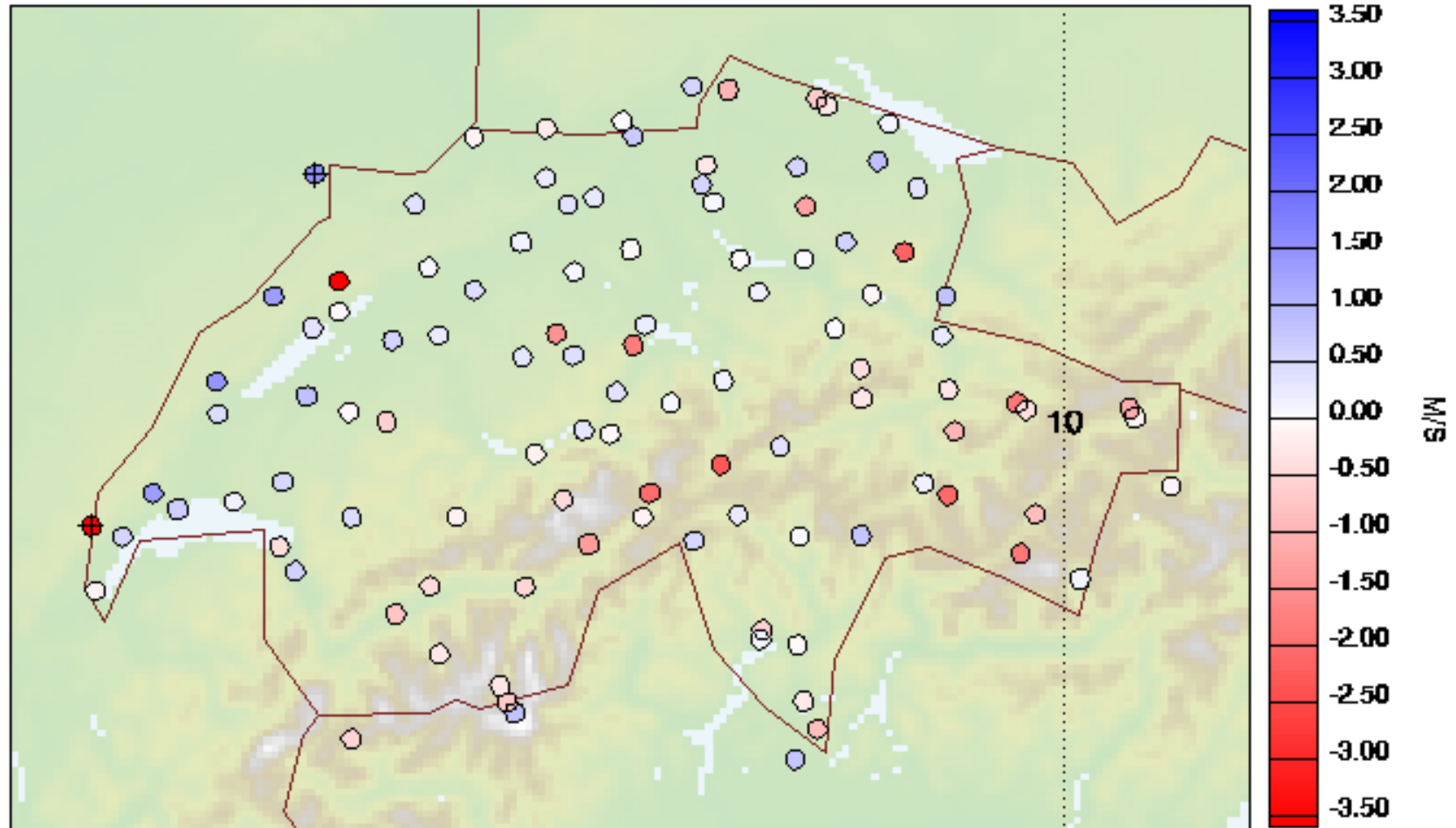


Higher wind speed due to lack of low level friction



10m-Wind Speed COSMO-2

FF_10M: ME

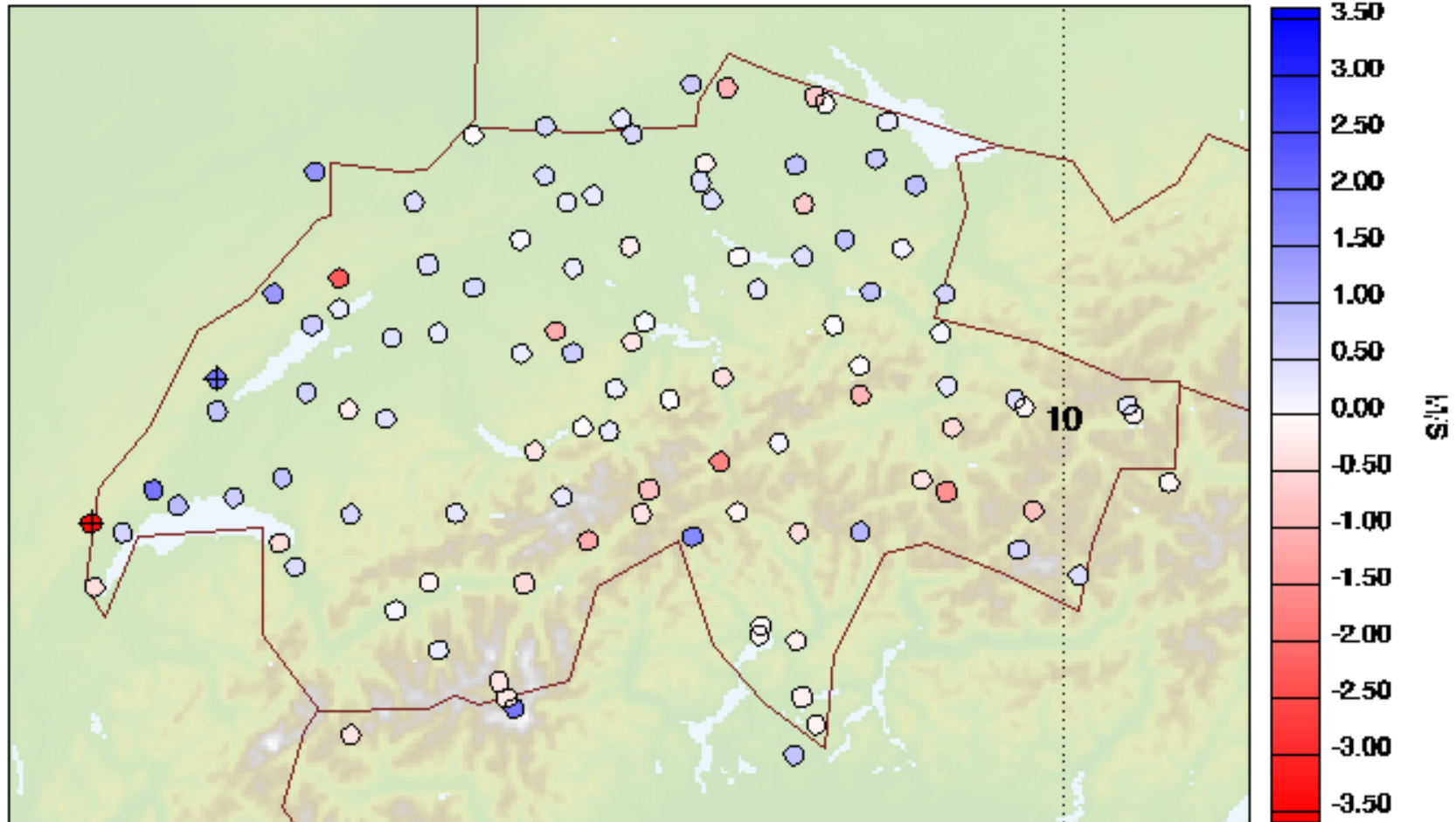


COSMO-2@ch 2012-09-01 0:00 to 2012-11-30 23:00 13-24
+Min: -4.259 M/S at station 06702 +Max: 1.501 M/S at station 06616



10m-Wind Speed COSMO-1

FF_10M: ME



Higher windspeed in COSMO-1 mainly on mountain stations

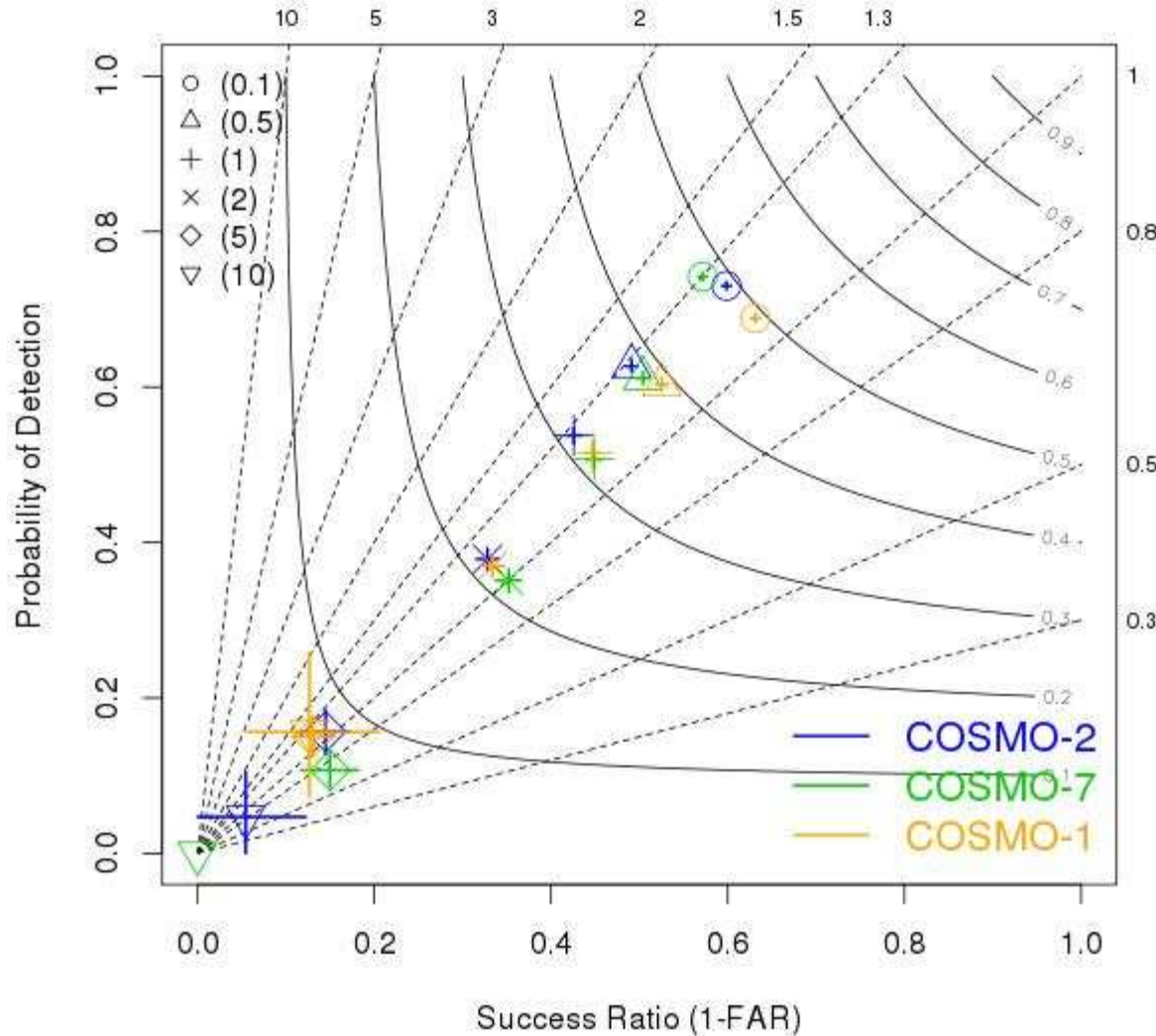
COSMO-1@ch 2012-09-01 0:00 to 2012-11-30 23:00 13-24

+Min: -3.421 M/S at station 06702 +Max: 1.911 M/S at station 06619



Precipitation of COSMO-1 for Sept.-Nov. 2012

COSMO-2 vs COSMO-7 vs COSMO-1 @ch for TOT_PREC1 & It 13



Freq. Bias-----

+13h-24h

1h

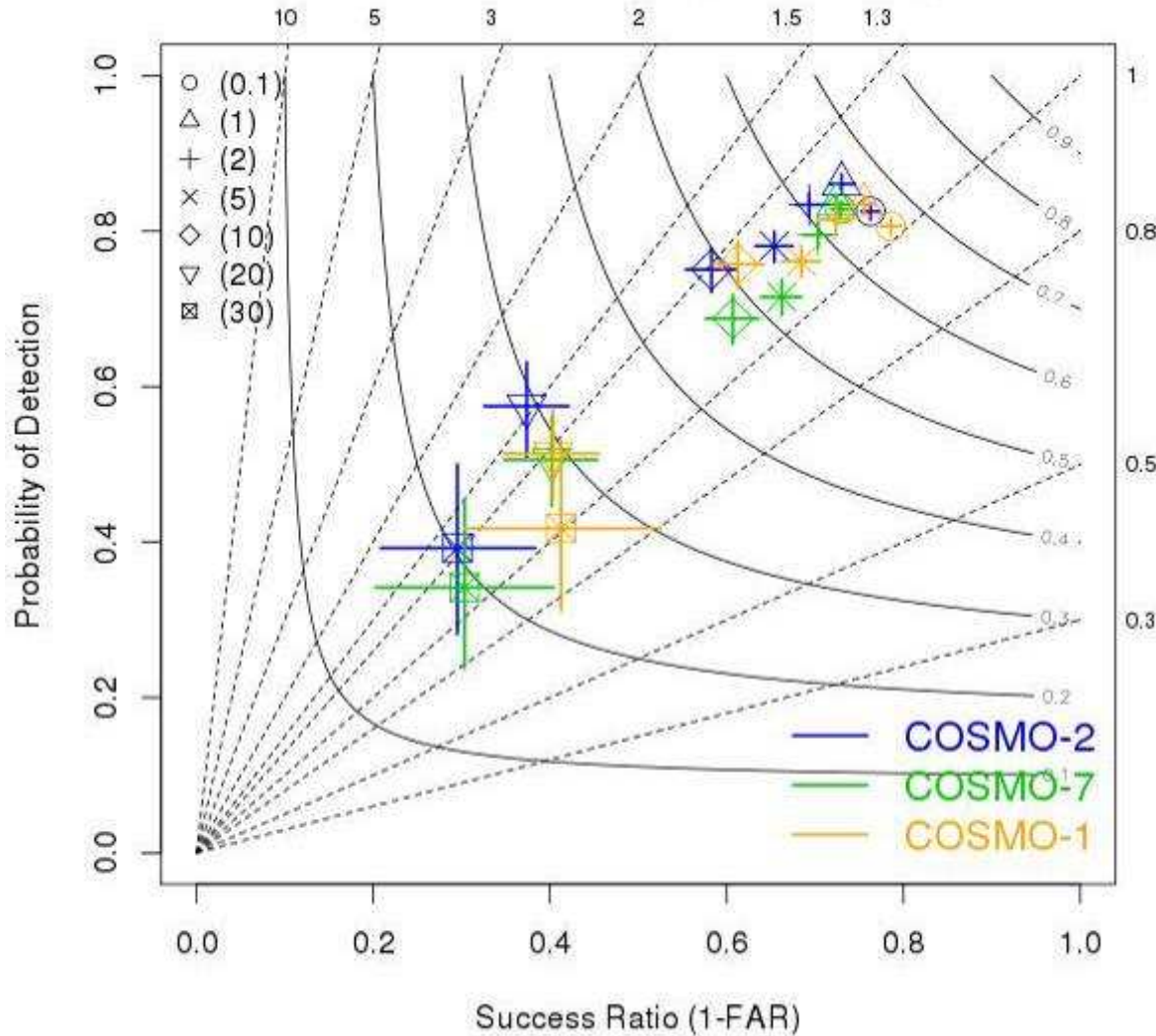
accumulation

(9 grid point averaging)



Precipitation of COSMO-1 for Sept.-Nov. 2012

COSMO-2 vs COSMO-7 vs COSMO-1 @ch for TOT_PREC12 & It 1:



Freq. Bias-----

+6h-18h

12h

accumulation

(9 grid point averaging)

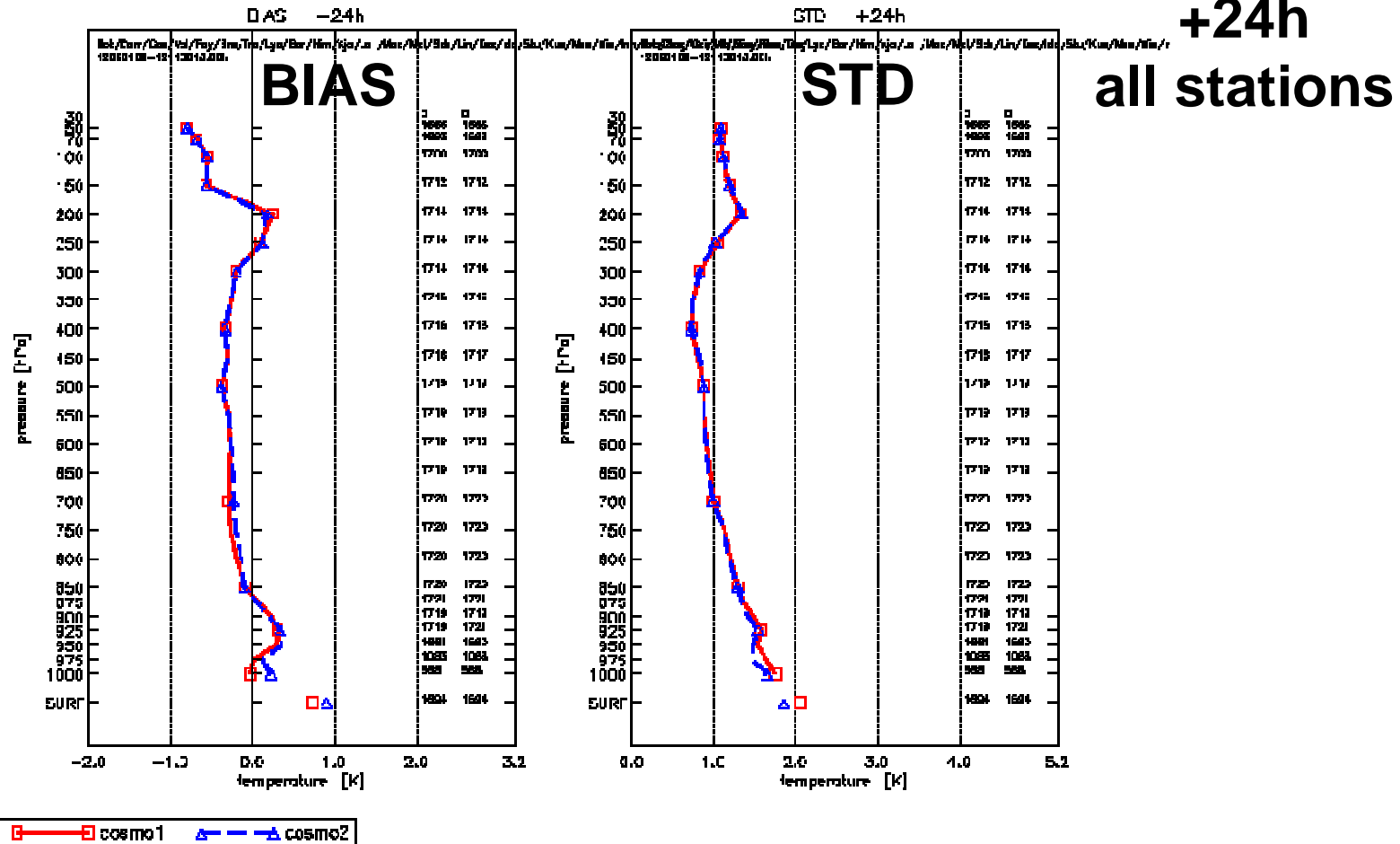


Upper Air Temperature Verification

COSMO-1 vs. COSMO-2 for Sept.-Nov. 2012

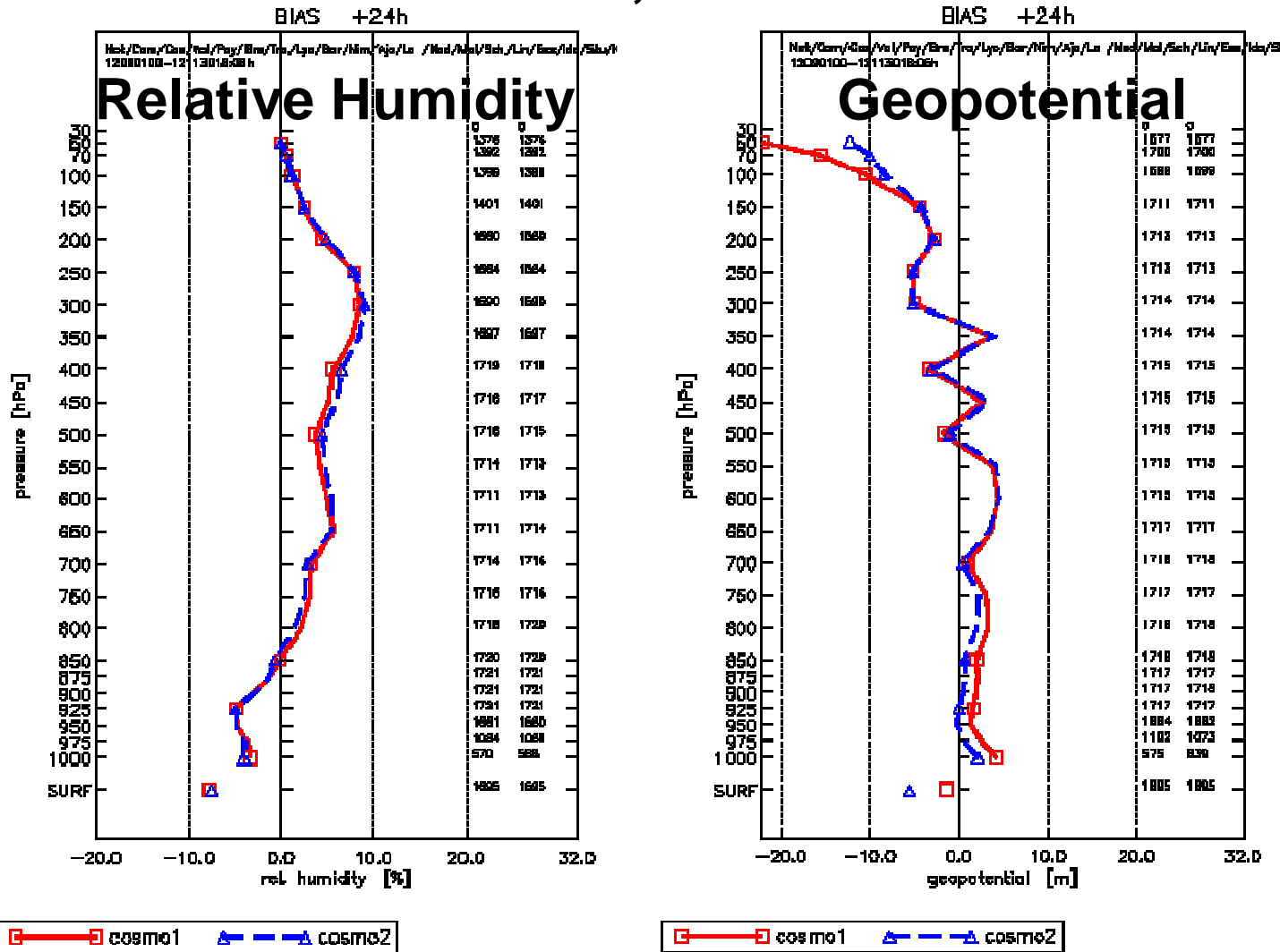
UA verification: COSMO-1 vs. COSMO-2 for Sep/Oct/Nov 2012 (yyymm - 2012s4)

The include: wrf-2-for/cosmo1-2006-cosmo2012s4-in: wrf-2-for/cosmo1-2006-cosmo2012s4-out





COSMO-1 vs. COSMO-2 for Sep.-Nov. 2012 +24h BIAS, all stations





Summary

- **Stable** assimilation and forecast system
- **SYNOP** verification of COSMO-1 shows **good** results:
 - **Better humidity** specially in the standard deviation
 - Too **strong 10m winds** from small roughness lengths (Martina Messmer has worked on new external parameters for COSMO-1, see today's talk @ 14:10)
 - **Good precipitation scores**
- **Upper-air:** similar scores as COSMO-2

➤ **COSMO-1 as good as COSMO-2**



Outlook

- **Neighbourhood** verification of precipitation
- Verify **December 2012 – February 2013**
- Evaluate the **two COSMO-1 runs** with reduced minimum turbulent coefficients
- **Use better external parameters (soon ...)**
- **Check** use of shallow convection

THANK YOU FOR YOUR ATTENTION !