



WG 4 CORSO

Data assimilation system based on nudging for COSMO- Ru7/Ru2

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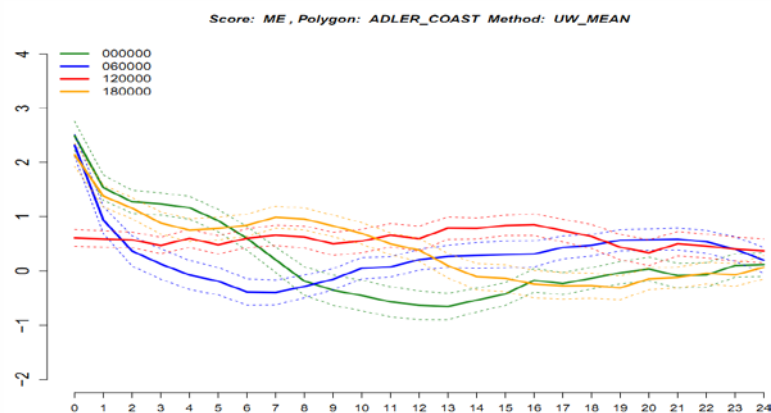
- Motivation
- Data Assimilation System (DAS) based on nudging
 - Initial conditions for COSMO-Ru
 - Observation
 - Configuration
- Verification for period 1 February – 16 March
 - PMSL
 - Wind Speed at 10m
 - Dew point at 2m
 - Temperature at 2m
 - Standard verification
 - Clear and cloud weather
 - Problem with temperature in PBL and soil
 - Comparison with DAS from DWD
- Conclusions
- Future plans

Motivation

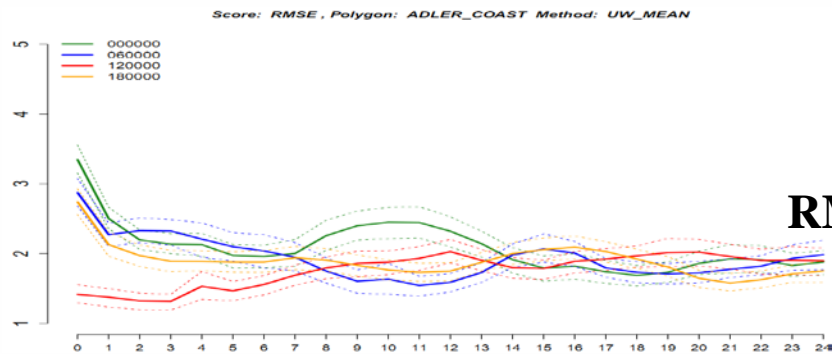
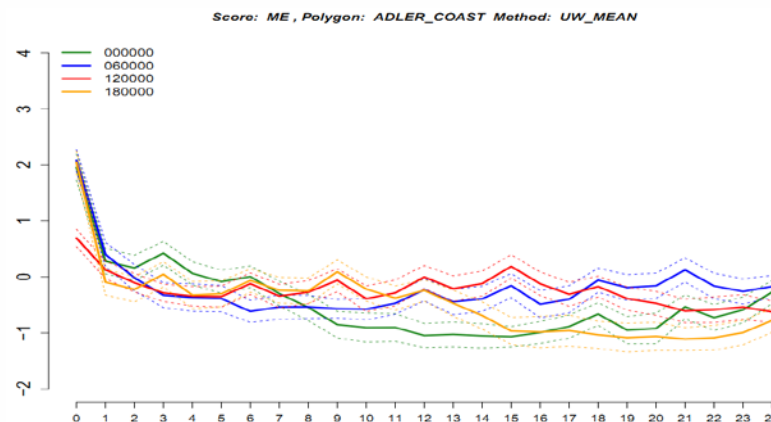
Disadvantages of using initial data from global model GME

- Sometimes initial data from GME have significant errors for temperature at surface and T_PBL for domain COSMO-Ru;
- Often this error lead for big errors in all time forecast;
- Low resolution is no good for nowcasting;
- Errors in the initial data associated with all 3 types of fields: external parameters, atmospheric and surface fields;

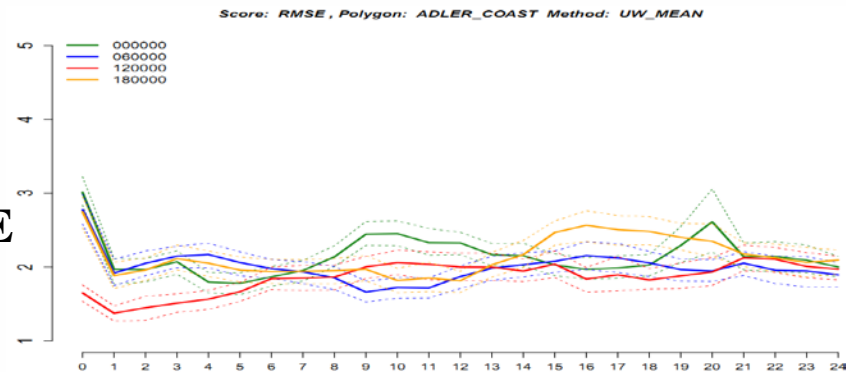
Verification T_{2m} for Sochi coastline stations (Adler-cluster);
 model COSMO-Ru2; 00, 06, 12, 18 UTC runs;
 for winter 2011/2012 (left) and 2012/2013 (right)



ME



RMSE



Data Assimilation System (**DAS**) for COSMO-RU prepare initial conditions (IC) from the interpolated data **GME** (h=20 km) and from **nudging scheme** assimilation are concluded:

- ❖ atmosphere fields (U, V, P, W, T, QV);
- ❖ soil fields (T_SO, W_SO, T_S);
- ❖ snow analyses (T_SNOW, H_SNOW, T_S);
- ❖ sea surface temperature (T_ICE, H_ICE, T_S).

➤ external parameters.

- The scheme Nudging in Cosmo is correcting atmosphere fields T, PS, H, QV, U, V
- DAS uses observations SYNOP, TEMP, SHIP, BUOY, AIREP, RASS
- On first step DAS is based on 6 hour cycle - Main Run (MR)
- On the next step DAS will included on continuous cycle - Recalculate Run (RR) for Cosmo-Ru2
- Cold start for COSMO-Ru2 run from 16 October 2013

Parameters	DA-M Ru7	DA-R Ru2	DA-M Ru2
data_ini (U, V, P, W, T, QV)	GME — 6 h	DA-R — 6 h	DA-R — 6 h
data_bd	GME — 6 h	Ru7 — 6 h	Ru7 — 6 h
data_ini_surf (T_S, T_SNOW, T_ICE, H_ICE, T_SO, W_SO)	GME — 6 h	GME — 6 h	GME — 6 h
hstop	6	6	6
number of runs	4	4	4
cut-off time	02:45	06:50	01:10
hnudgend	10	10	10
synop	2600	145	145
temp	119	6	6

The operational schemes

COSMO-Ru7 и COSMO-Ru2

download GME	00UTC	06UTC	12UTC	18UTC
start	02:50	08:50	14:50	20:50
end	03:25	09:10	15:25	21:10
Time work	00:35	00:20	00:35	00:20

00UTC	06UTC	12UTC	18UTC
02:50	08:50	14:50	20:50
03:30	09:10	15:30	21:10
00:40	00:20	00:40	00:20

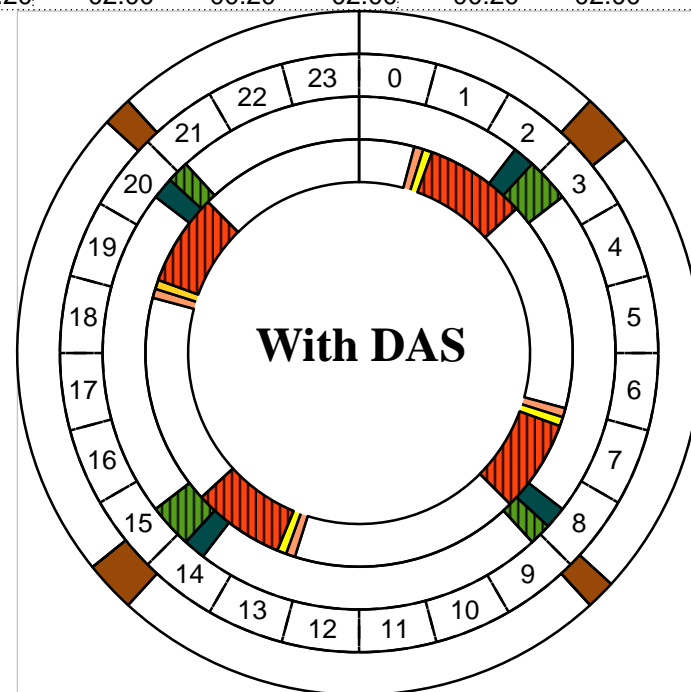
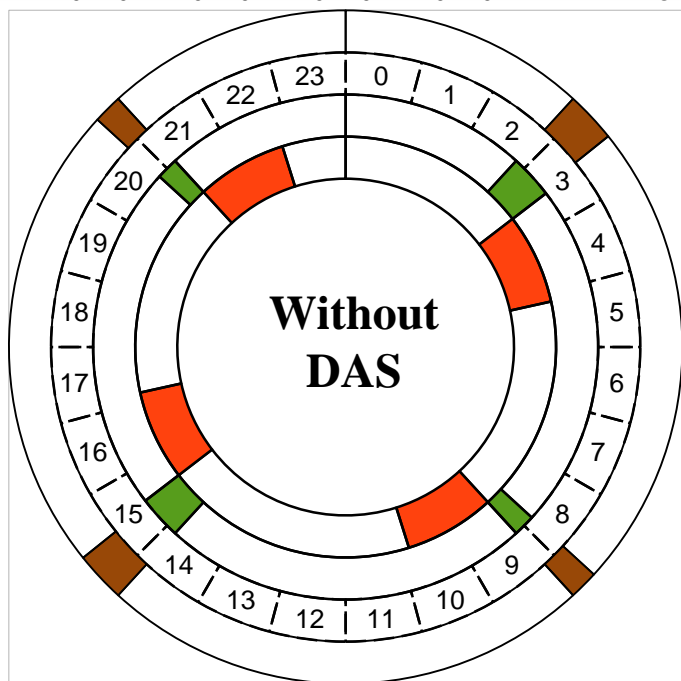
Ru7
start
end
Time work

00UTC		06UTC		12UTC		18UTC	
02:30	02:50	08:30	08:50	14:30	14:50	20:30	20:50
02:50	03:30	08:50	09:10	14:50	15:30	20:50	21:10
00:20	00:40	00:20	00:20	00:20	00:40	00:20	00:20

00UTC	06UTC	12UTC	18UTC
03:30	09:10	15:30	21:10
05:10	10:50	17:10	22:50
01:40	01:40	01:40	01:40

Ru2
start
end
Time work

00UTC		06UTC		12UTC		18UTC	
02:40	03:00	08:40	09:00	14:40	15:00	20:40	21:00
03:00	05:00	09:00	11:00	15:00	17:00	21:00	23:00
00:20	02:00	00:20	02:00	00:20	02:00	00:20	02:00



Model grids and used observations

Domain COSMO	Count horizontal grid points	OBSERVATIONS	
		Temper. (TEMP)	wind, pres., humid. (TEMP + SYNOP)
Ru7	434 000	119	2700
CFO02	197.400	10	190
Ru2	197 400	6	170
VFO02	211.500	9	161
ENA13	500.000	295	4368
SIB14	90.000	78	1006



The number of grid points of the model COSMO-Ru7 more than stations in ~1600 for the temperature and ~32000 for COSMO-Ru2.

Not enough of upper-air stations for successfully correcting temperature.

You must use t_2m observation from SYNOP.

Names of experiments for COSMO-Ru:

- das7, das2 (forecast with IC from DAS)
- ref7, ref2 (forecast with IC from GME)

Period testing:

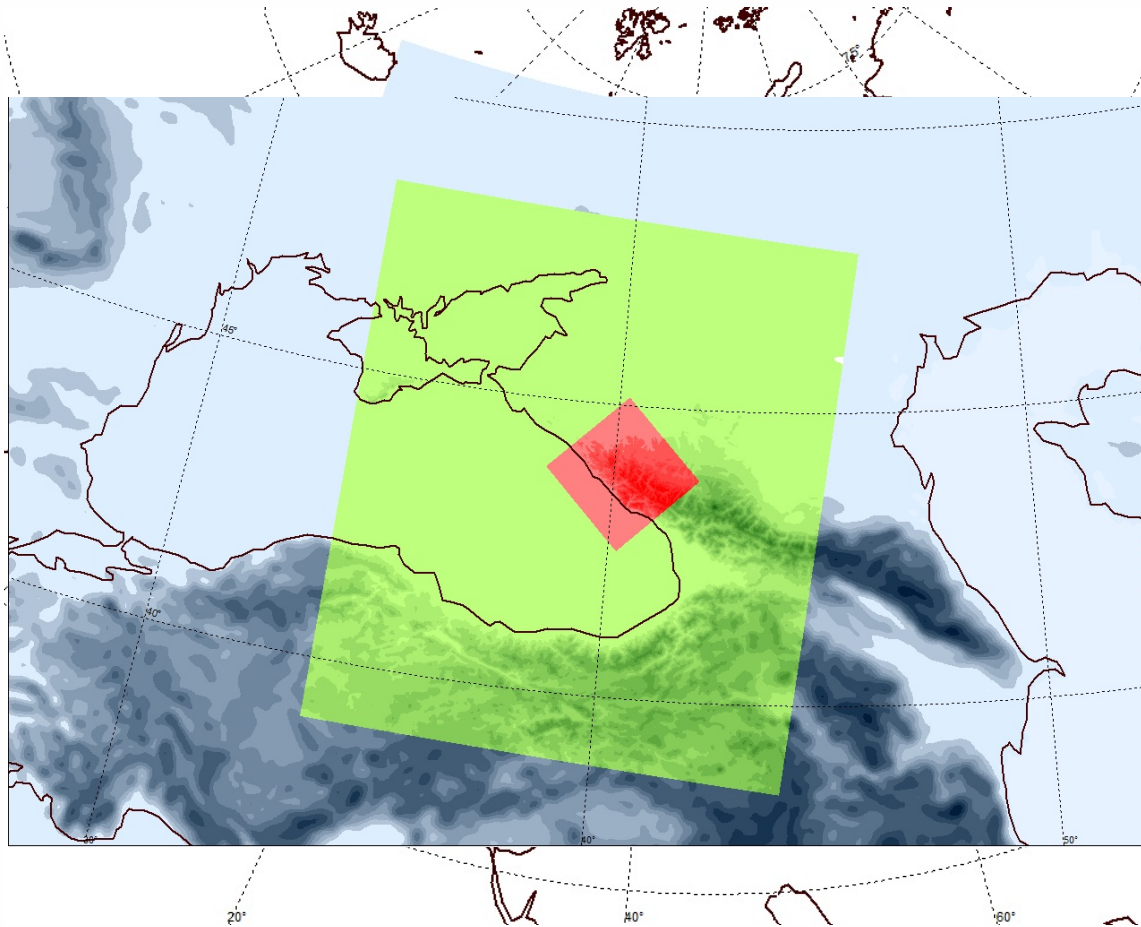
1 February 2014 – 16 March 2014

also February 2012, July 2012, December 2012

Selected stations for verification

Name	Number of stations	Area
EU1845	1845	domain COSMO-Ru7
SFO02	145	domain COSMO-Ru2
SFO01	65	domain COSMO-Ru1 (coastline and mountain near Olympic object)

Model domain



COSMO-Ru7

Domain: 4900 km x 4340 km
Grid: 700 x 620 x 40
Space step: 7 km
Time step: 40 s
Forecast: 78 h

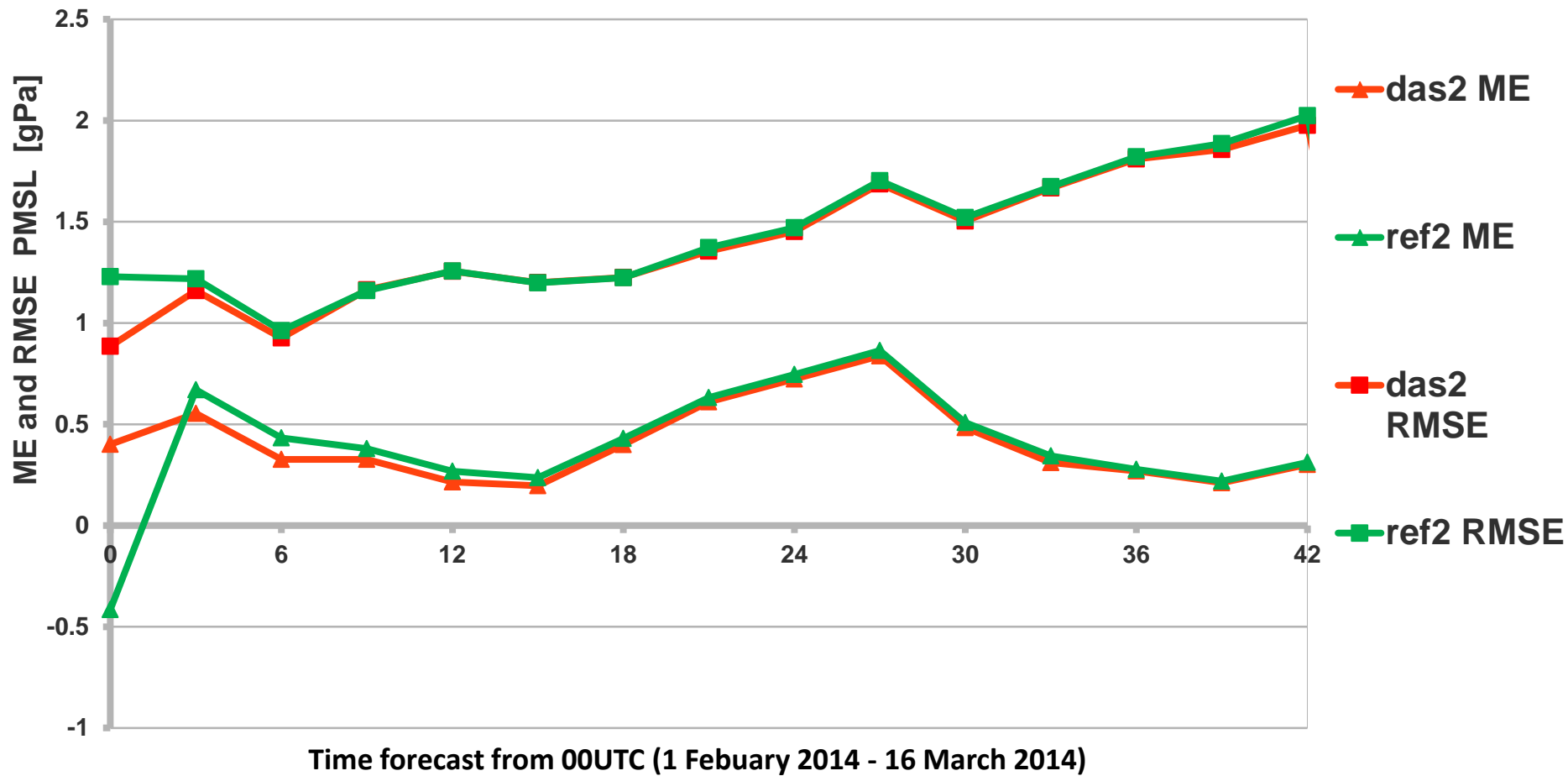
COSMO-Ru2

Domain: 900 km x 1000 km
Grid: 420 x 470 x 50
Space step: 2.2 km
Time step: 20 s
Forecast: 48 h

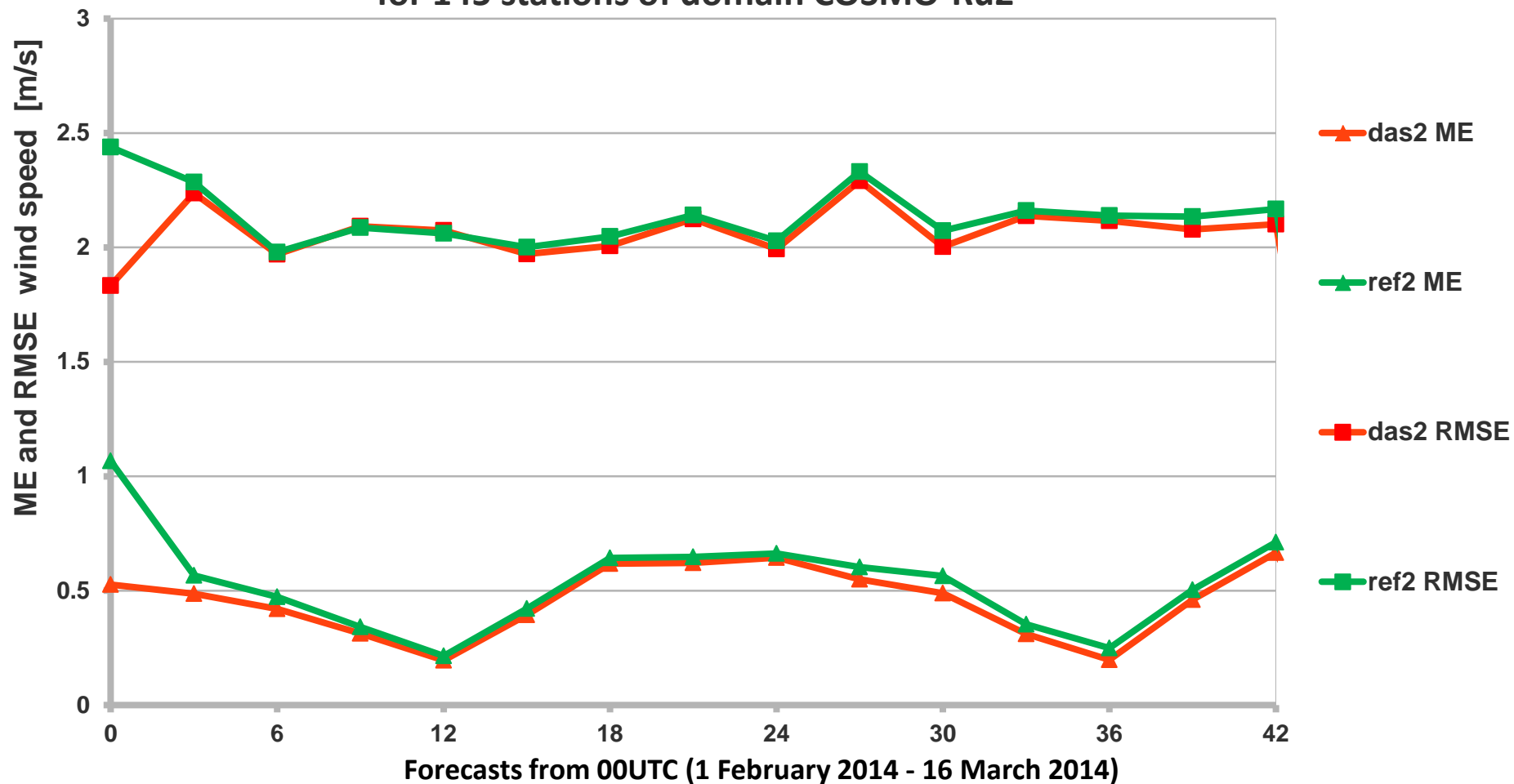
COSMO-Ru1

Domain: 495 km x 495 km
Grid: 450 x 450 x 50
Space step: 1.1 km
Time step: 5 s
Forecast: 36 h

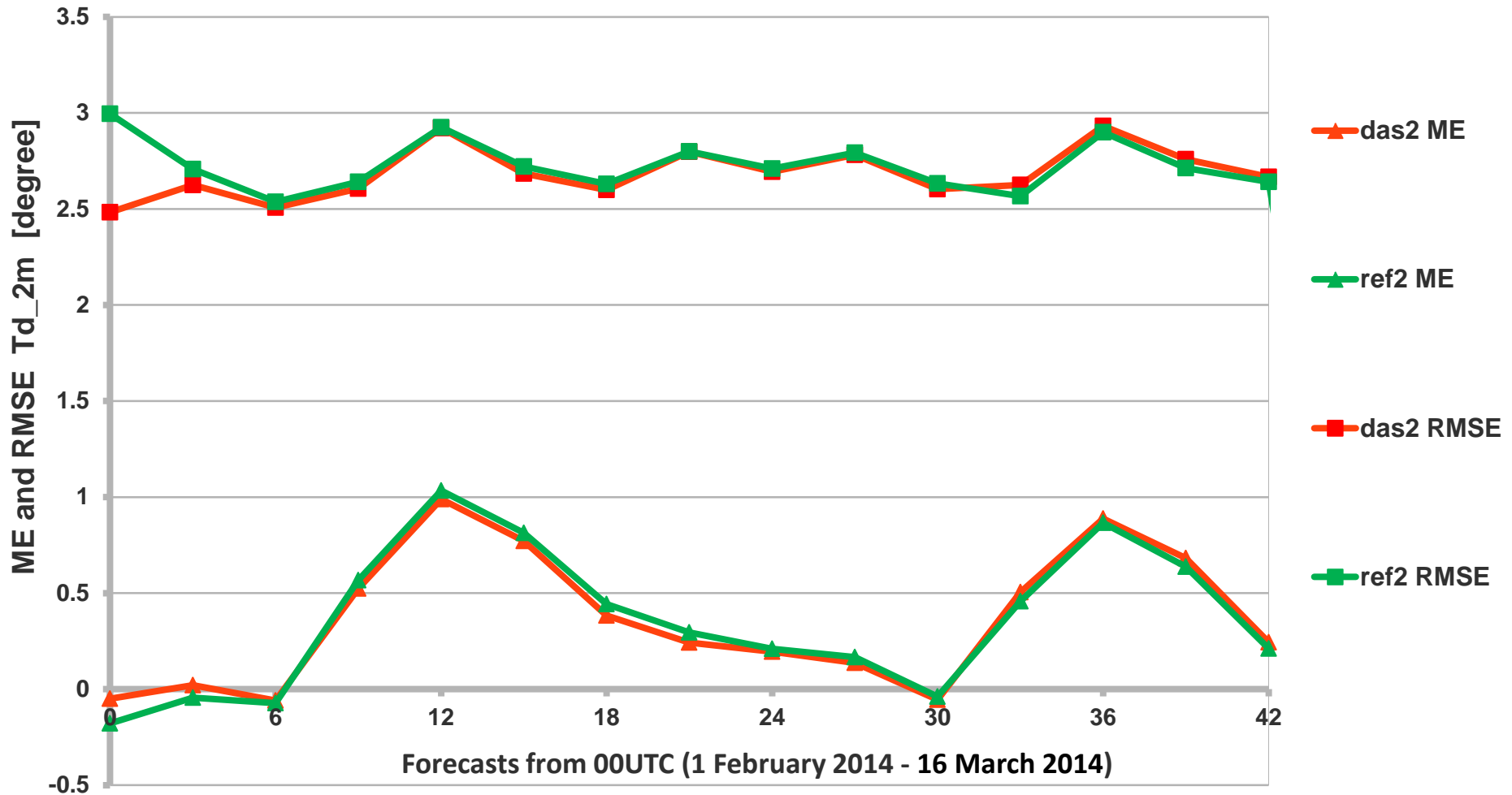
Mean Error and RMSE of the PMSL for 145 stations of domain COSMO-Ru2



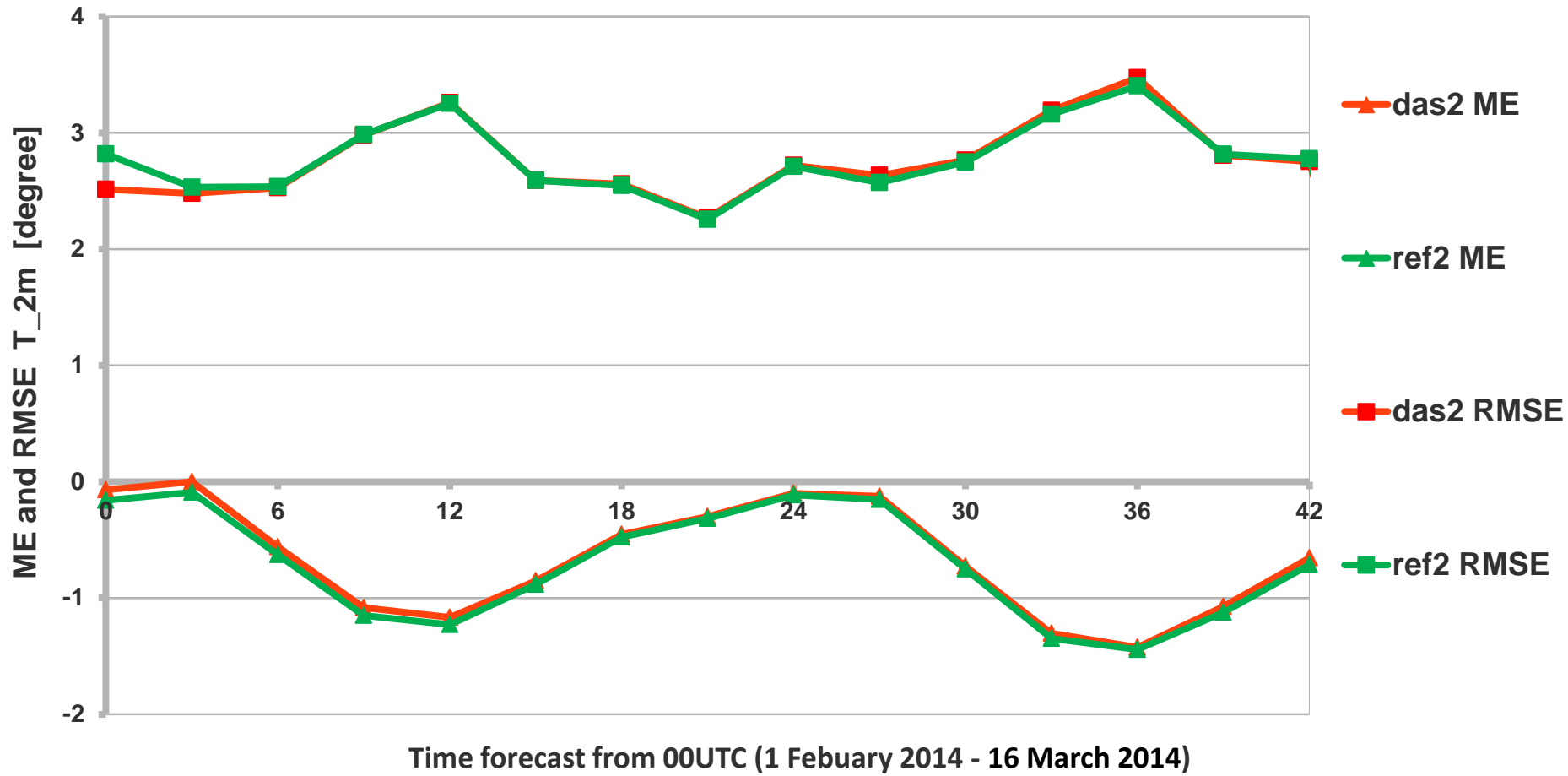
Mean Error and RMSE of the wind speed at 10m for 145 stations of domain COSMO-Ru2



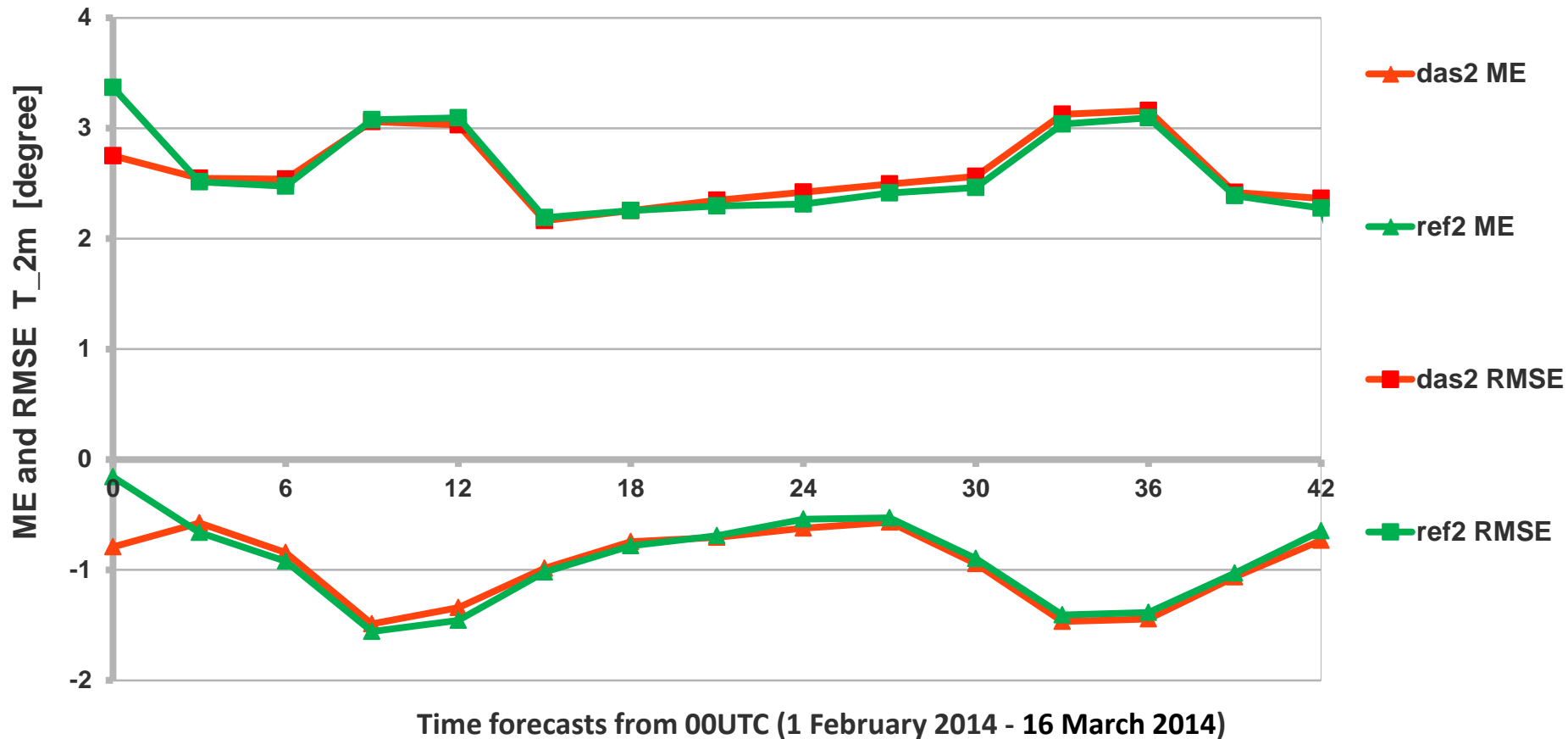
Mean Error and RMSE of the dew point at 2m for stations of domain COSMO-Ru2



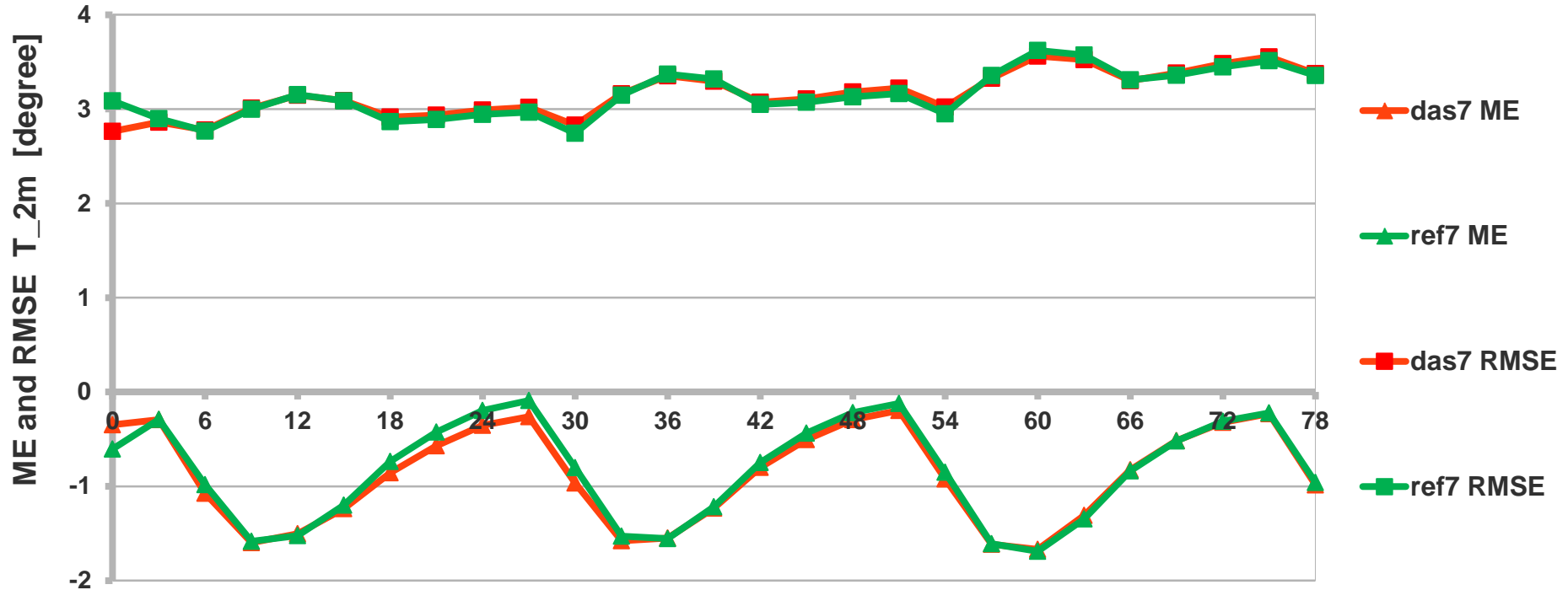
Mean Error and RMSE of the temperature at 2m For 145 stations of domain COSMO-Ru2



Mean Error and RMSE of the temperature at 2m for 145 stations of domain COSMO-Ru1



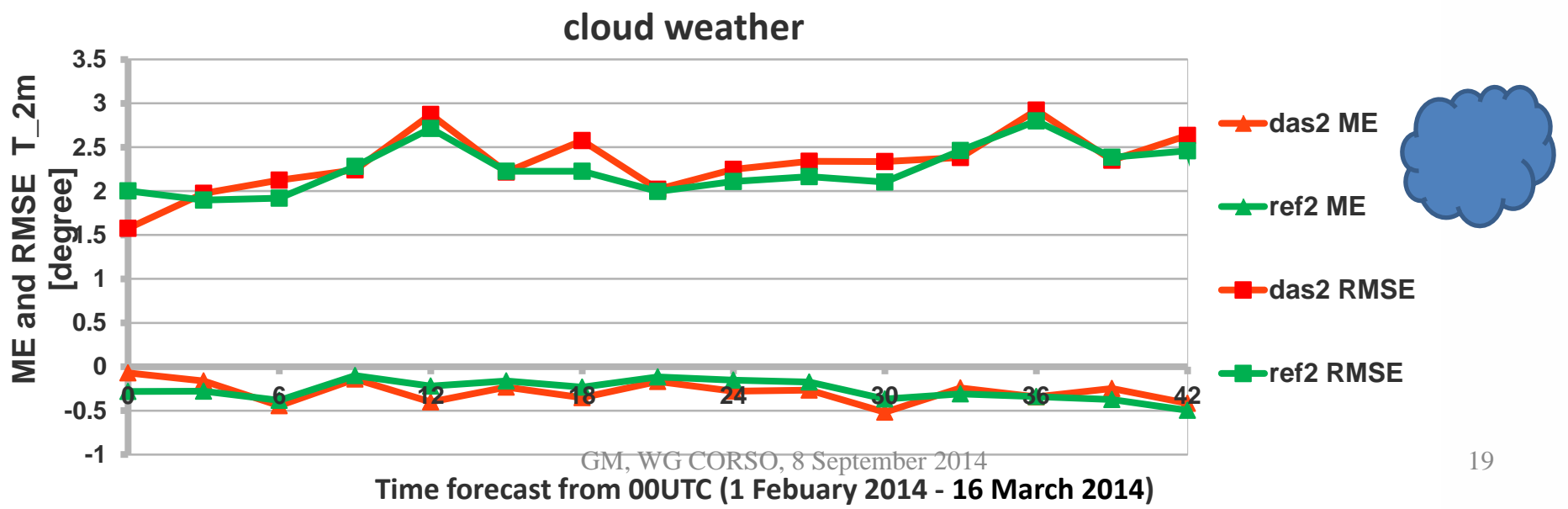
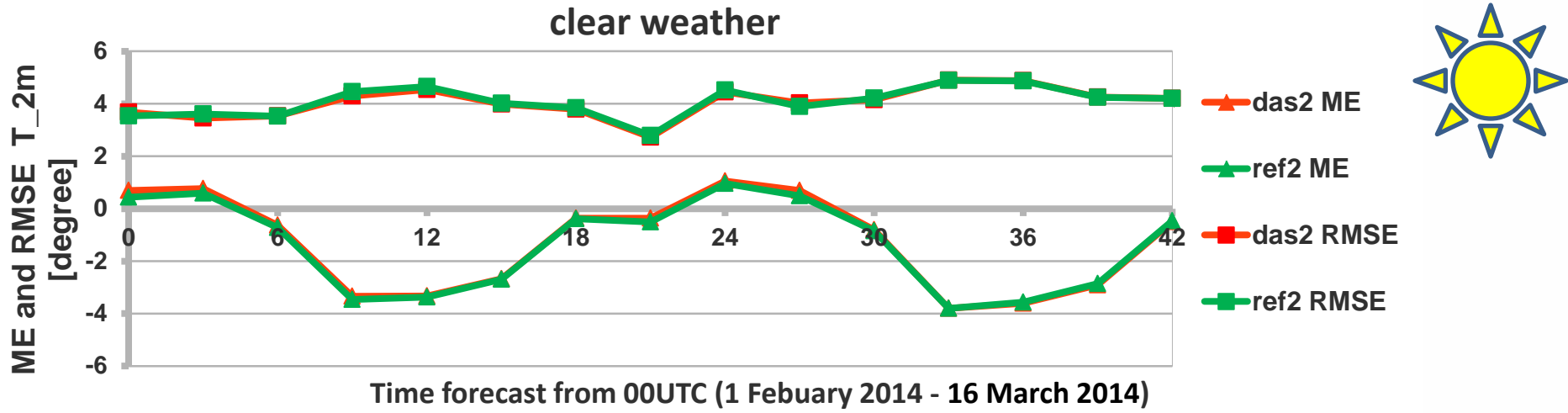
Mean Error and RMSE of the temperature at 2m
for 1845 stations of domain COSMO-Ru7



Time forecast from 00UTC (1 February 2014 - 16 March 2014)

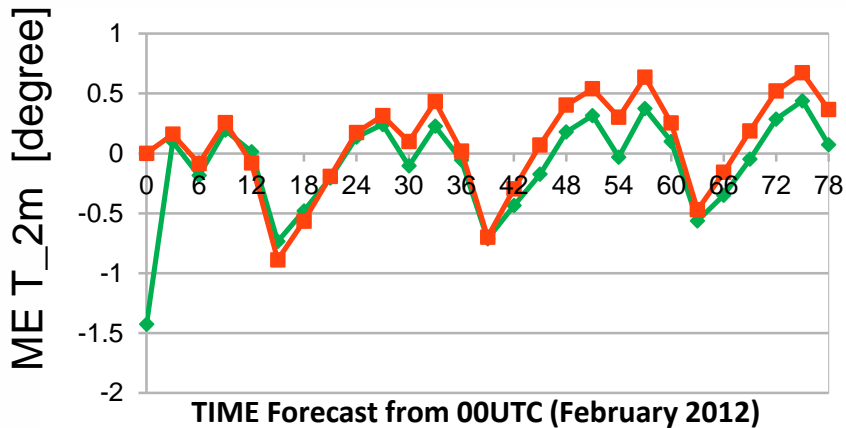
Summary conclusion: ME and RMSE better for experiments **DAS** for all selected stations and for all models (Ru7 and Ru2)

Mean Error and RMSE of the temperature at 2m for clear sky (top) and cloud weather (bottom) for 145 stations of domain COSMO-Ru2

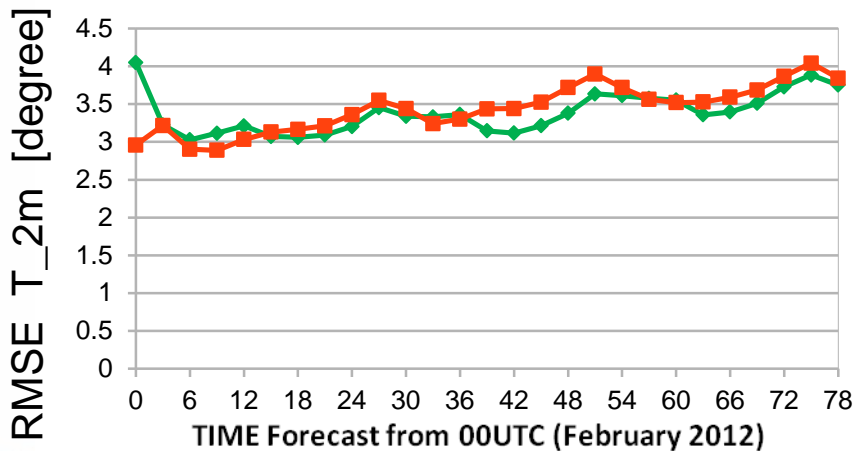
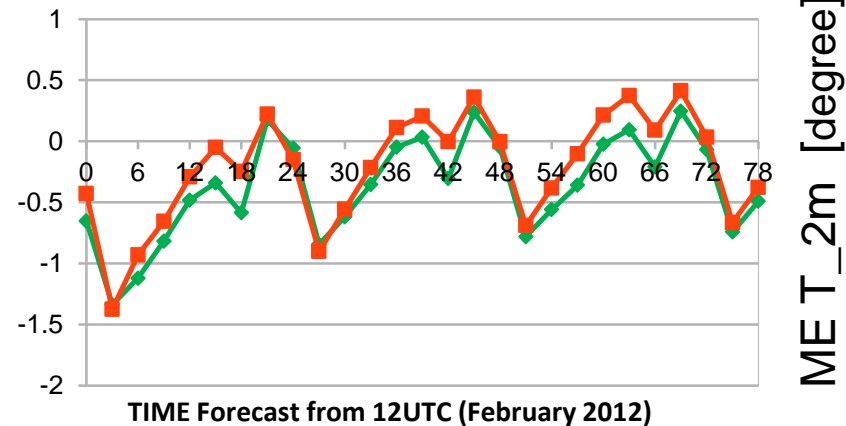


GM, WG CORSO, 8 September 2014

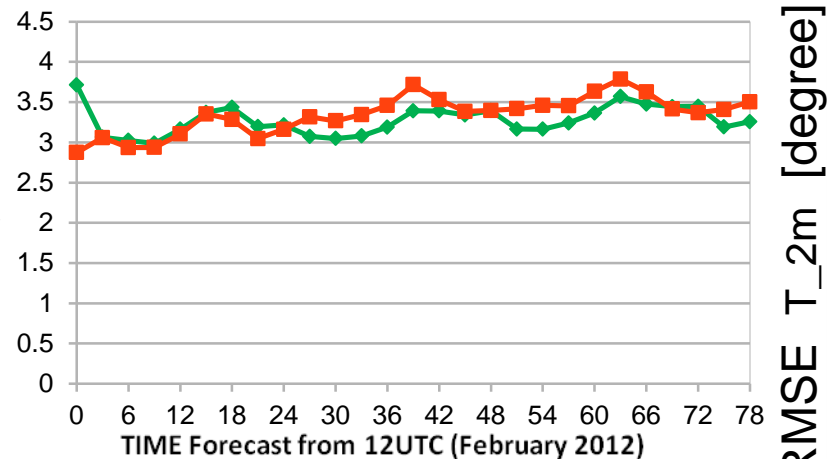
Experiments with **DWD assimilation** and **without** for COSMO-Ru7, February 2012, for 145 station of domain COSMO-Ru2 (SFO)



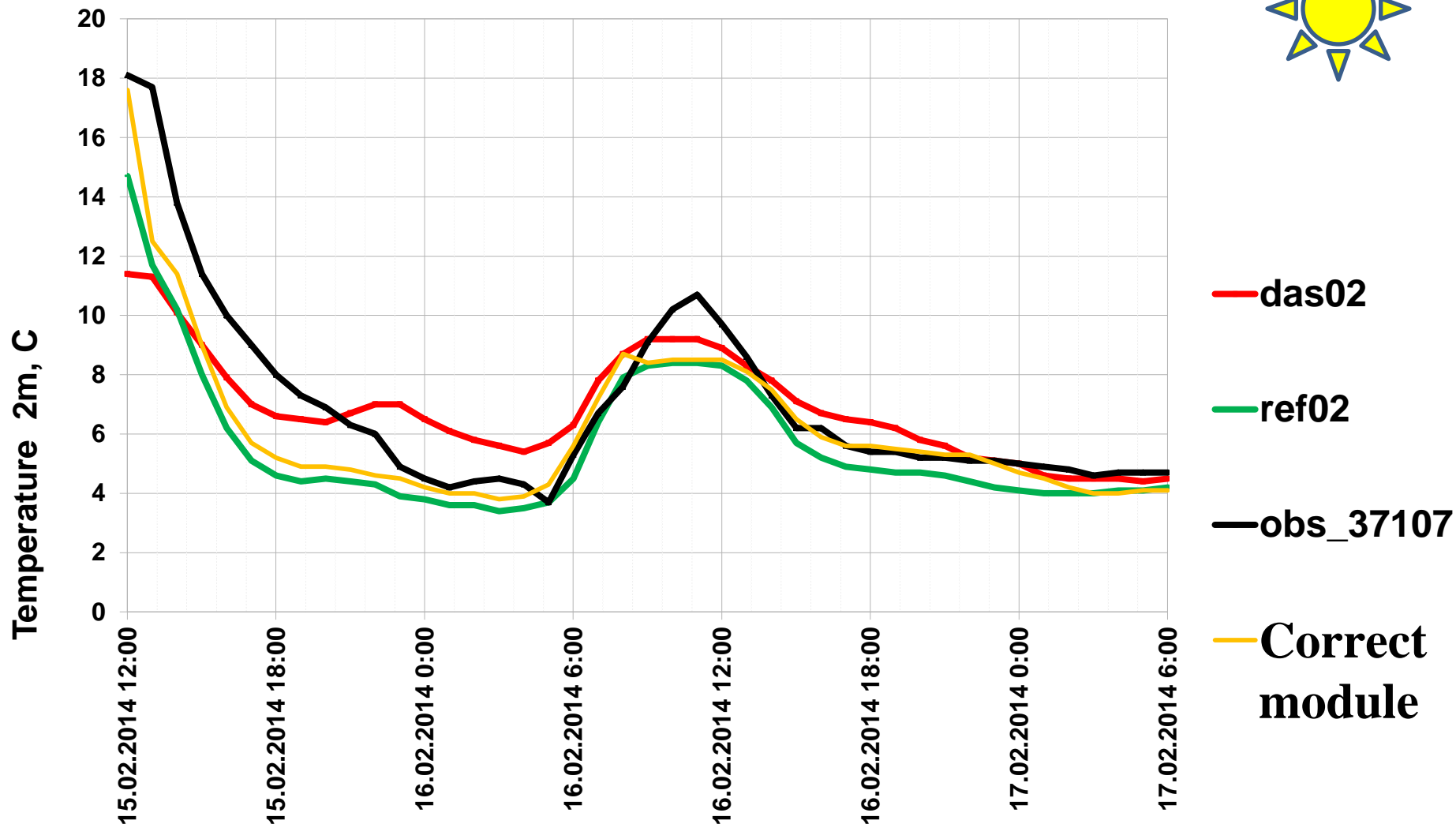
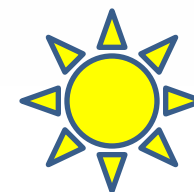
ME



RMSE

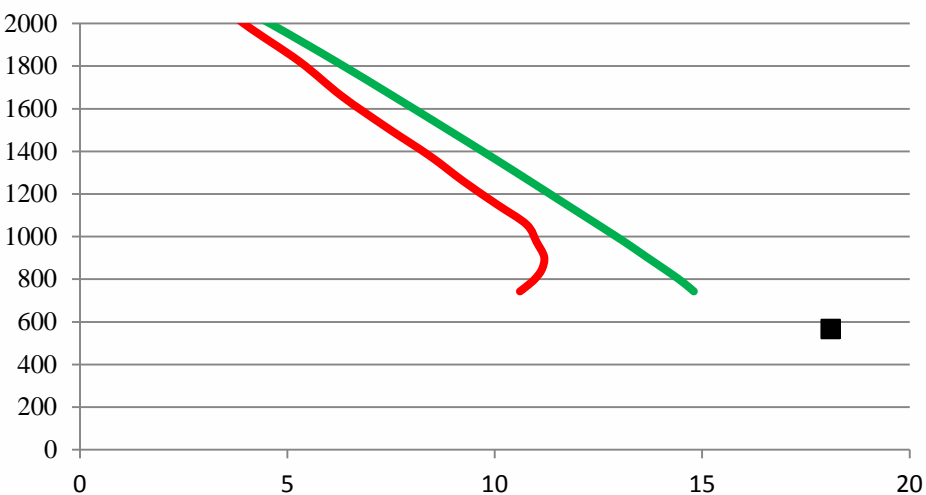


Forecast T_2M for Krasnaya Polyana from 12:00 15 February 2014

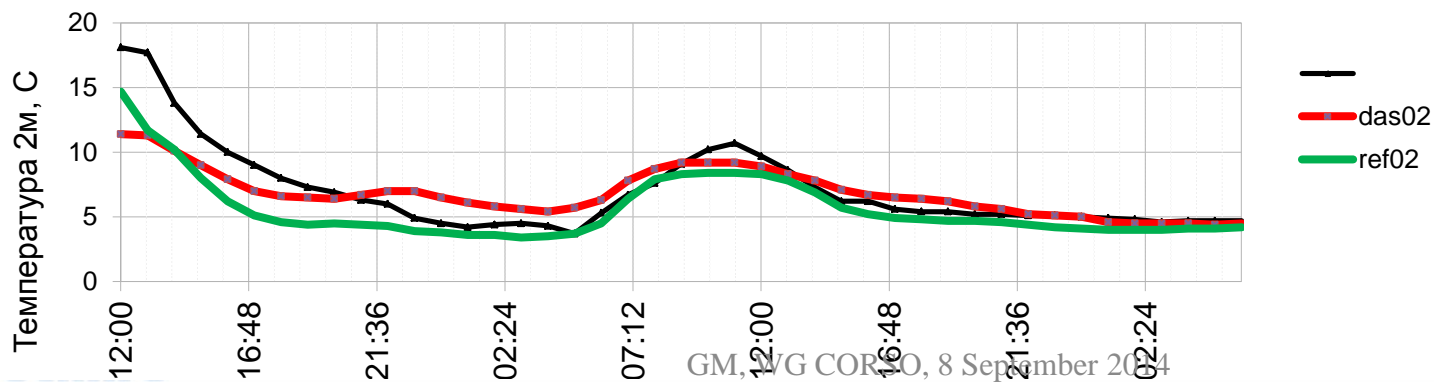
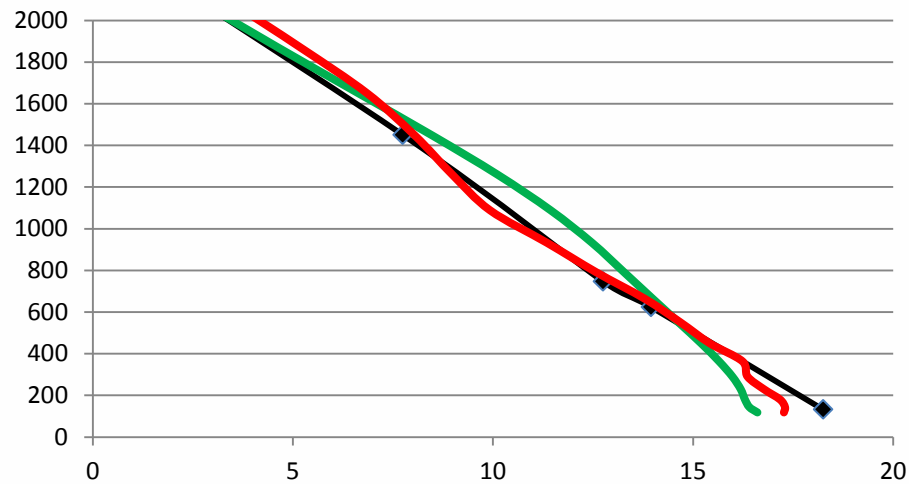


Temperature profile for KrPolyana(left) and Sochi(right)

ref02_KrPol das02_KrPol t2m_37107



temp37099 15.02.2014 12:00:00



Errors in field temperature

- The daytime temperature is underestimated for all terms and for all seasons;
- Such behavior is often observed in clear weather and strongly stable stratification. Probably this is the model errors connected with physical parametrizations;
- In result T_S and T_PBL colder than initial data from GME. Because of this temperature at 2m sometimes better from IC of GME than DAS.
- On a 12-h forecast error temperature is minimal in GME, because for initial data of GME exist surface analyze.

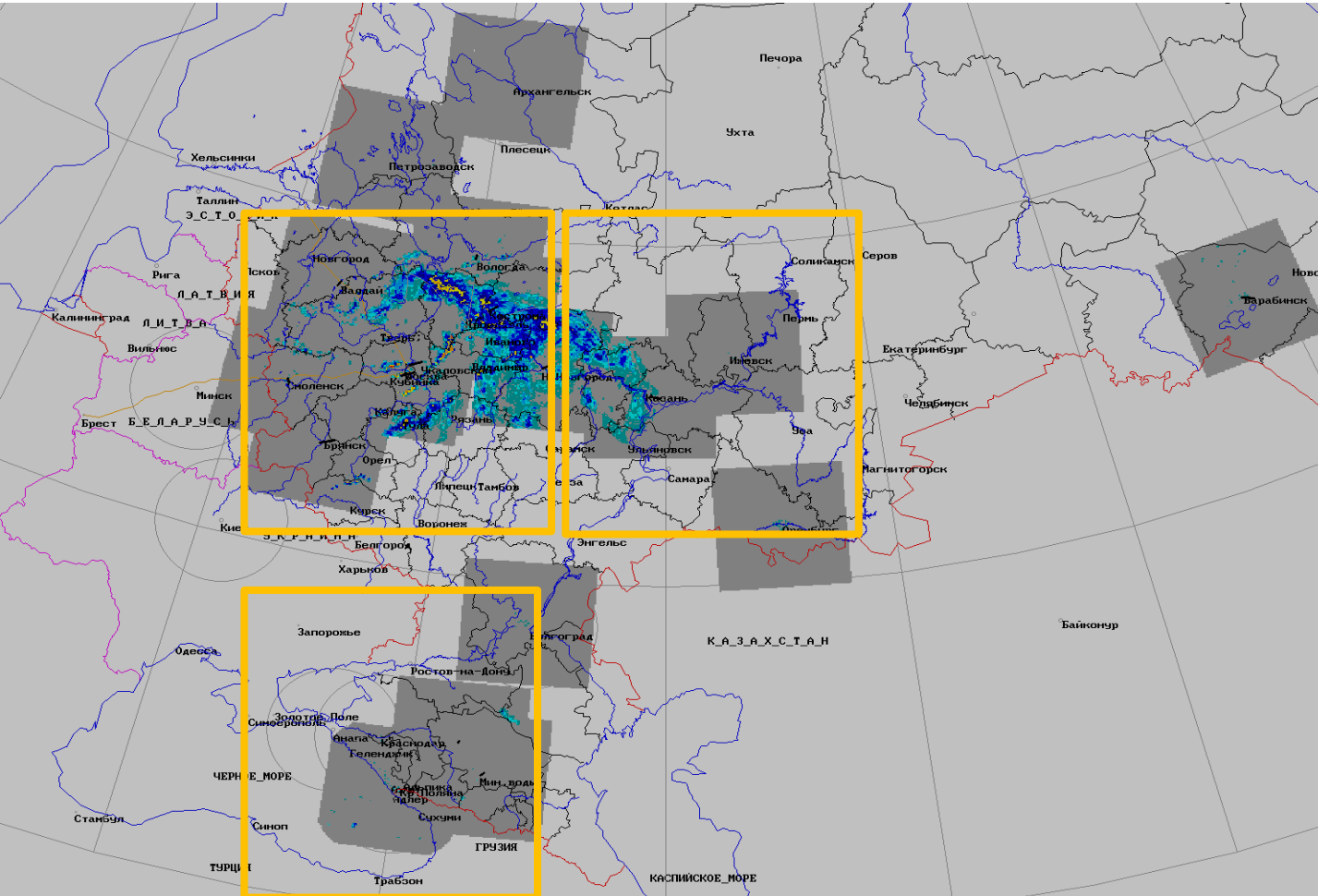
- Mainly large errors for the beginning of the forecast disappear;
- Fields T_2m, Td_2m, PSML, Wind Speed 10m is better with DAS in 0-3 hours forecast time;
- For any cases initial conditions for T_PBL , T_S in DAS is not so good in clear weather. It is necessary to correct/change the temperature of the soil (T_SO) and Planetary boundary layer (T_PBL), because not enough upper-air stations, especially for the mountain regions;
- It is necessary to use more observations and analyzed scheme.

- Use more observation (RASS, Wind profilers) for nudging
- Use radar data for Latent Heat Nudging
- Use Flake in DAS
- Use «Module of Correction» (RHM) for correction T_SO and T_PBL using T_2M observations

Future Plans

Map Russian DMRL

from 2014-09-02 (<http://orm.mipt.ru/RAD/dmrl.html>)



For European part of Russia exist more 10 DMRL and will be even more. Soon we will have operative digital radar data. But we need interpolation software.

«Module of Correction»

- Observations T_2m and model T_PBL are used for preparing analyze field T_2m for grid COSMO-Ru
- Method Cressman is used for horizontal spreading increment observation
- Corrected fields of soil temperature and temperature in PBL
- Correction helped to get better result for Moscow region in February 2012
- Now the module is tested. Results of experiment are evaluated.
- Need coupling with DAS



Acknowledgement



Christoph Schraff (DWD) for help and consultation about nudging scheme;

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Thank you for attention!