

The NWP verification at the IMS

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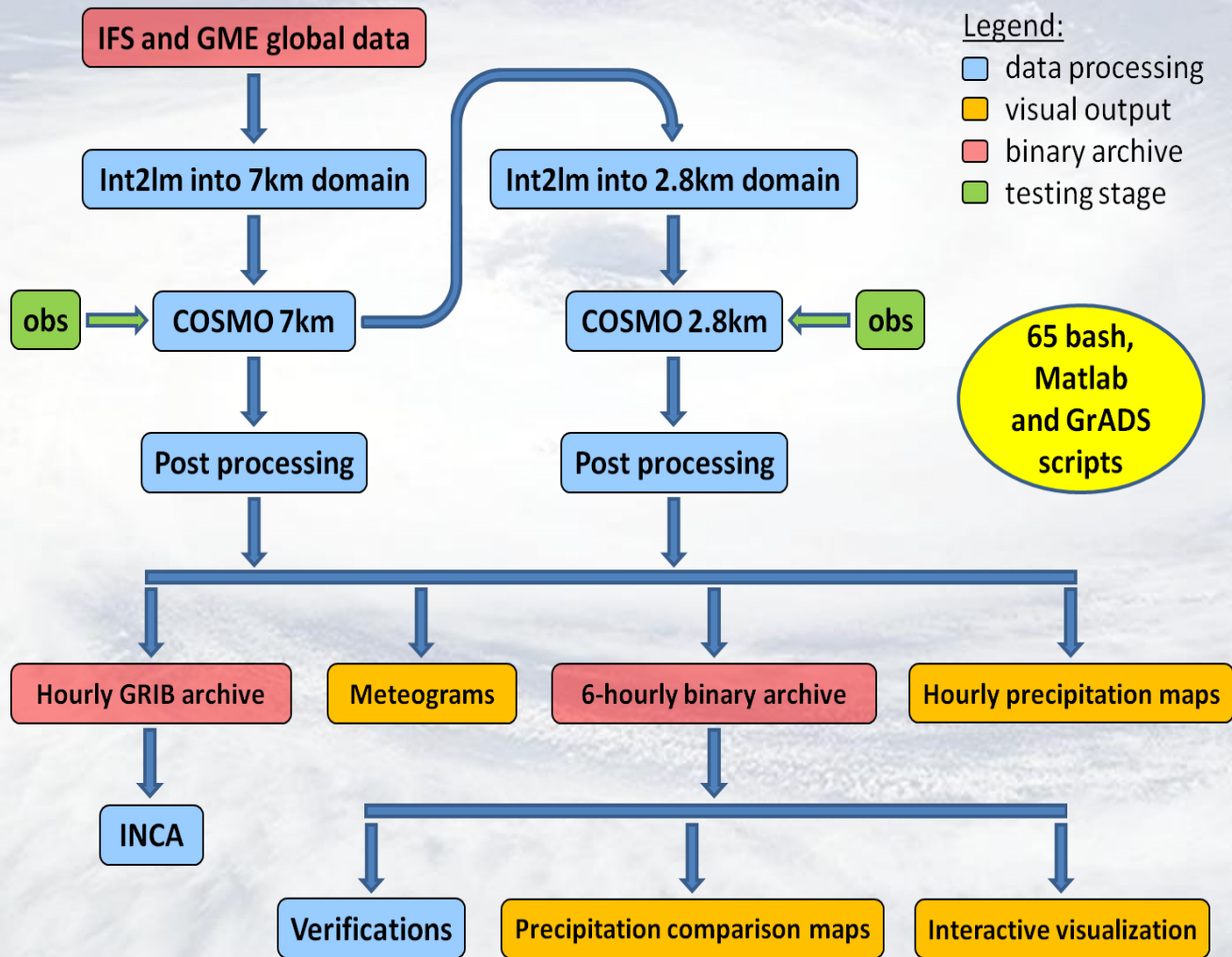
Outline

1. COSMO model in Israel Met. Service (IMS)
2. New ideas on verification methods
 - A. **Surface**: Temperature verification over complex terrain (as part of CALMO PP)
 - B. **Upper air**: verification using analyses
3. Conclusions

Outline

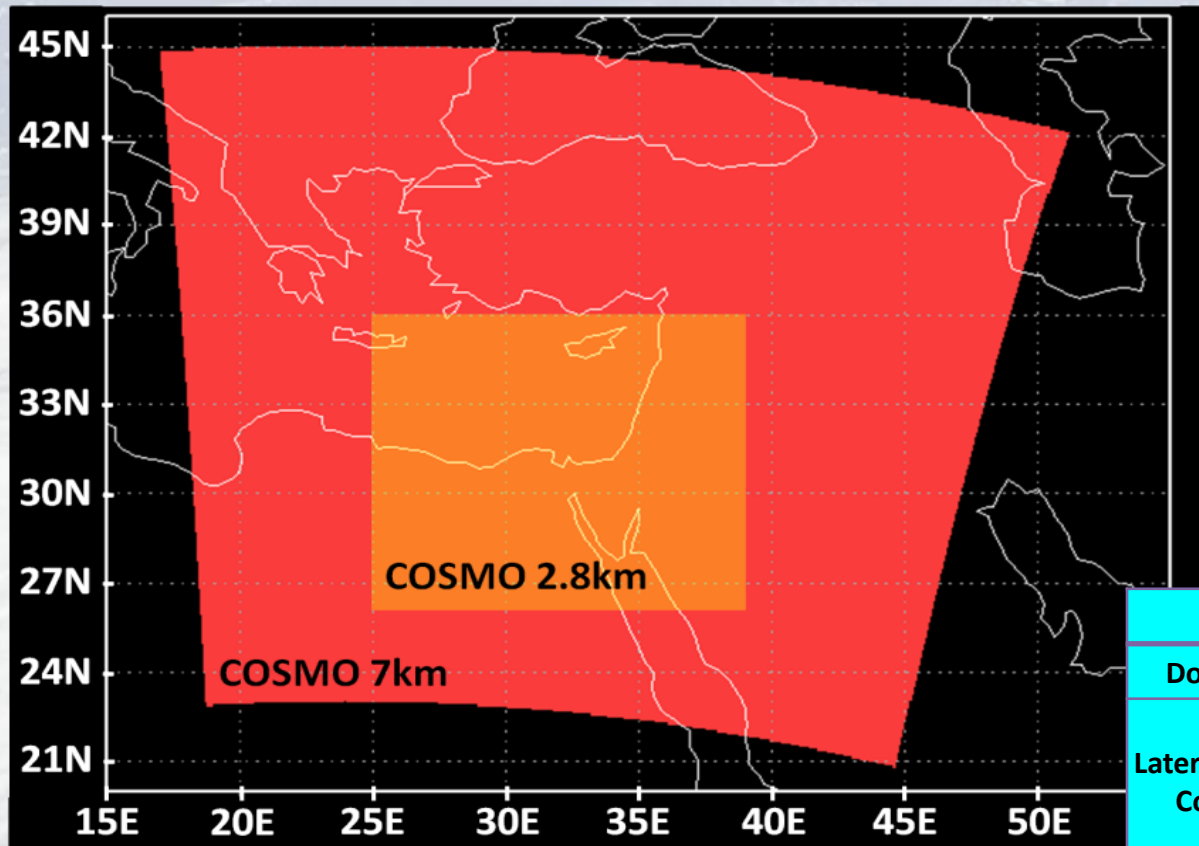
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COSMO work flow in IMS



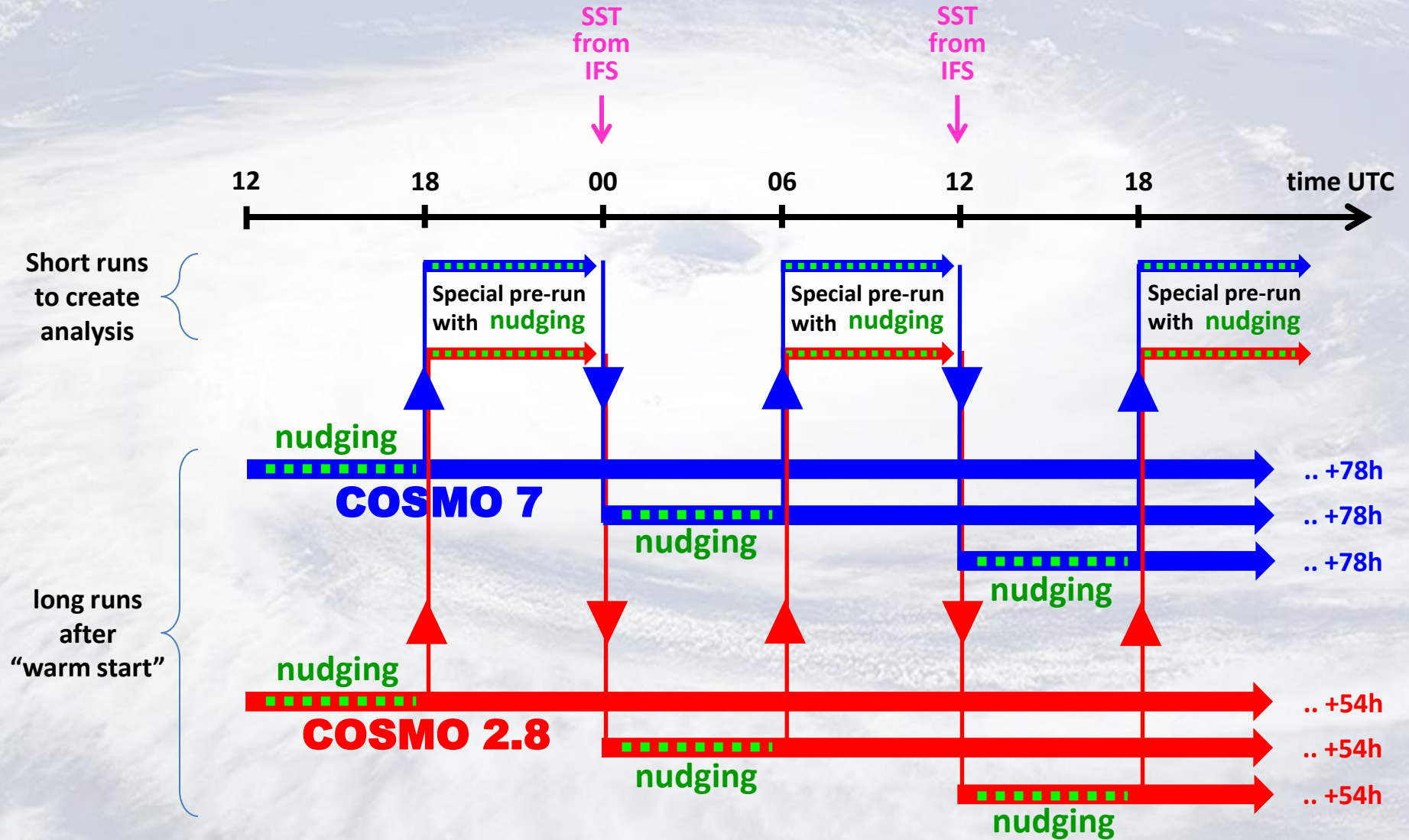
- Version 5.0 • resolutions: 7-km and nested 2.8-km • 60 vertical levels • twice daily runs
- Driving data: IFS and GME • Recently: applied DA from the local and GTS data

Model Configuration



	COSMO-7km	COSMO-2.8km
Domain Size	401 X 353 X 50	561 X 401 X 50
Lateral Boundary Conditions	IFS/GME 3-h intervals, on frame	COSMO-7km 1-h intervals, whole domain
Forecast range	78h	54h
No. of processors	160	416
Run time	3:40h	
Hardware	SGI Linux Cluster 1024 AMD cores	
Time step	60 sec	25 sec
Time-integration	Runge-Kutta	
Moist convection	Tiedtke (1989)	“Shallow” Tiedtke
Graupel scheme	no	yes

Under test: Assimilation cycle in IMS



Current verification interface at IMS



MENU

Verification vs :

observations

analyses

Updated on 02/9/2014

My presentations and reports:

- 16. IMS COSMO plan (not official) 17/6/2014 *New!*
- 15. CALMO project SMC proposal 15/4/2014 *New!*
- 14. ... stress report ... *New!*
- ... project CSCS proposal 9/5/2014
- ... CALMO project - first results 15/4/2014
- 11. MOS to ECMWF at IMS - presentation 7/4/2014
- 10h. COSMO user seminar at DWD -

Pavel's products:

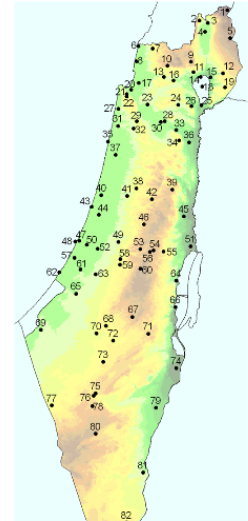
Verification vs observations

- [AFEQ](#) (17)
- [AFULA NIR HAEMEQ](#) (30)
- [AMMIAD](#) (11)
- [ARAD](#) (71)
- [ARIEL](#) (42)
- [ASHDOD PORT](#) (48)
- [ASHQELON PORT](#) (62)
- [AVDAT](#) (78)
- [AVNE ETAN](#) (19)
- [AYYELET HASHAHAR](#) ()
- [BEER SHEVA](#) (70)
- [BEIT JIMAL](#) (58)
- [BESOR FARM](#) (69)
- [BET DAGAN](#) (44)
- [BET HAARAVA](#) (51)
- [BET ZAYDA](#) (15)
- [DAFNA](#) (3)
- [DOROT](#) (65)
- [EDEN FARM](#) (36)
- [ELAT](#) (84)
- [ELON](#) (7)
- [EN GEDI](#) (66)
- [EN HAHORESH](#) (37)
- [EN HASHOFET](#) (29)
- [EN KARMEL](#) (27)
- [ESHAR](#) (13)
- [EZUZ](#) (77)
- [GALED](#) ()
- [GAMLA](#) (12)
- [GAT](#) (63)
- [GIL GAL](#) (45)
- [HADERA PORT](#) (35)
- [HAERZEL HAYIM](#) (60)

Average over orographic stations

Average over plain stations

Stations types table

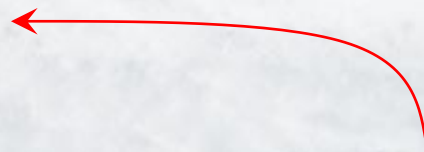


Name	Process	Status	Acq Files	Error Files	Backup Files	Report	Modify	Logs	Delete
All AreaTEMP Station	Stopped	Online	0	0	0	[icon]	[icon]	[icon]	[icon]
Common area bufr	Stopped	Online	0	0	0	[icon]	[icon]	[icon]	[icon]
FE_BUOY	Stopped	Online	0	0	0	[icon]	[icon]	[icon]	[icon]
FE_CA_ALL	Stopped	Online	0	0	0	[icon]	[icon]	[icon]	[icon]
FE_CA_PREC	Stopped	Online	0	0	0	[icon]	[icon]	[icon]	[icon]
FE_CA_TCC	Stopped	Online	0	0	0	[icon]	[icon]	[icon]	[icon]
FE_ECMWF	Stopped	Online	0	0	0	[icon]	[icon]	[icon]	[icon]
FE_FCS_S_ALL	Stopped	Online	0	0	0	[icon]	[icon]	[icon]	[icon]
FE_FCS_S_PREC	Stopped	Online	0	0	0	[icon]	[icon]	[icon]	[icon]
FE_FCS_S_TCC	Stopped	Online	0	0	0	[icon]	[icon]	[icon]	[icon]
FE_FCS_U_ALL	Stopped	Online	1	0	0	[icon]	[icon]	[icon]	[icon]
FE_SURFACE_BUFR	Stopped	Online	0	1	1	[icon]	[icon]	[icon]	[icon]
FE_SURFACE_GRIB	Stopped	Online	0	0	0	[icon]	[icon]	[icon]	[icon]
FE_SYNOP	Stopped	Online	0	0	0	[icon]	[icon]	[icon]	[icon]
FE_TEMP	Stopped	Online	0	0	0	[icon]	[icon]	[icon]	[icon]
FE_UPPER_BUFR	Stopped	Online	0	0	2	[icon]	[icon]	[icon]	[icon]
FE_UPPER_GRIB	Stopped	Online	0	0	0	[icon]	[icon]	[icon]	[icon]

Results: 17

Start Stop Refresh

Near future: move to VERSUS (Alon Shtivelman)



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2. **New ideas on verification methods**

A **Surface:** Temperature verification over complex terrain

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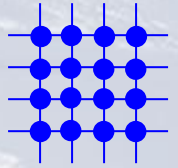
Temperature verification over complex terrain (for CALMO project)

Consider 2m-temperature observations from nearby located stations



or:

“Observations grid”
Ex: 2m-temperature observations grid over Switzerland (C. Frei)
resolution: 2km, on real terrain



Goal: verify coarse grid model (ex: COSMO-7km)

But: there are no observations located exactly on the coarse grid

Option: **linearly interpolate** the observations to the coarse grid points. **Bad...**

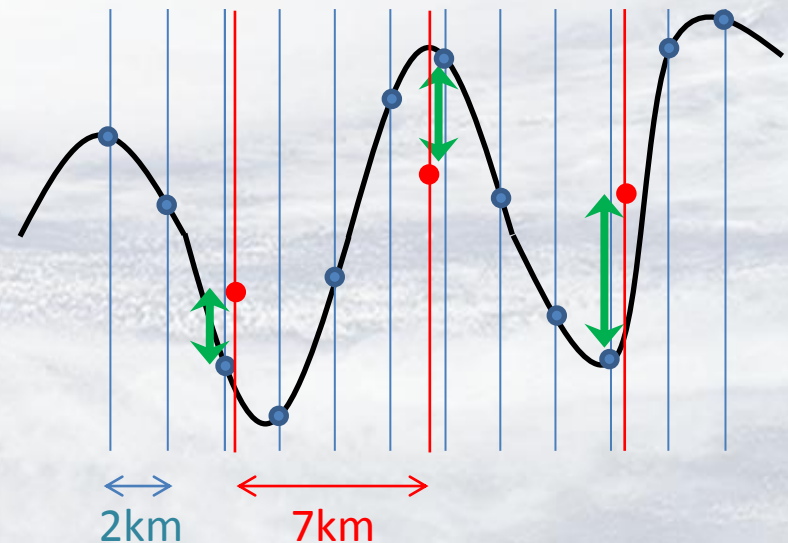
The coarse grid has smoothed terrain!

The model will not be able to correctly predict the observations

2m-temperature very much depends on height. Usually: higher = colder

If the coarse grid point is too low
→ temperature too **high**

If the coarse grid point is too high
→ temperature too **low**



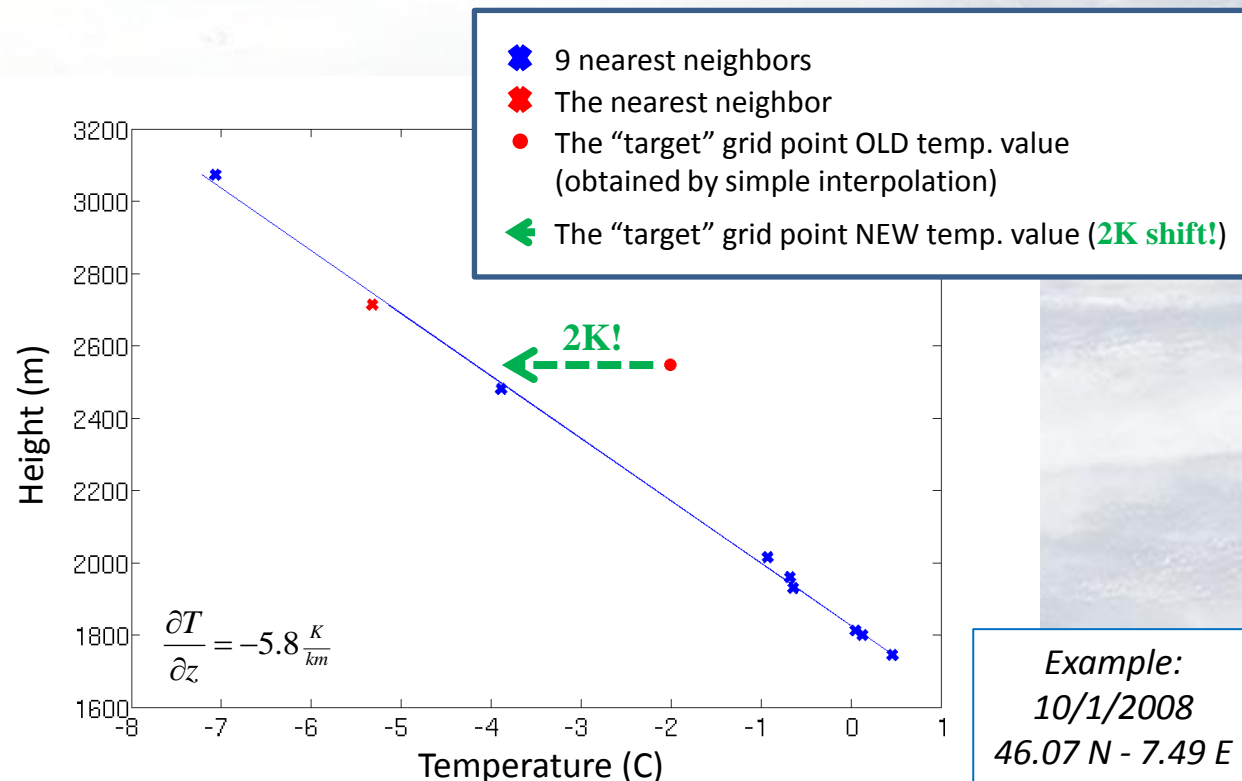
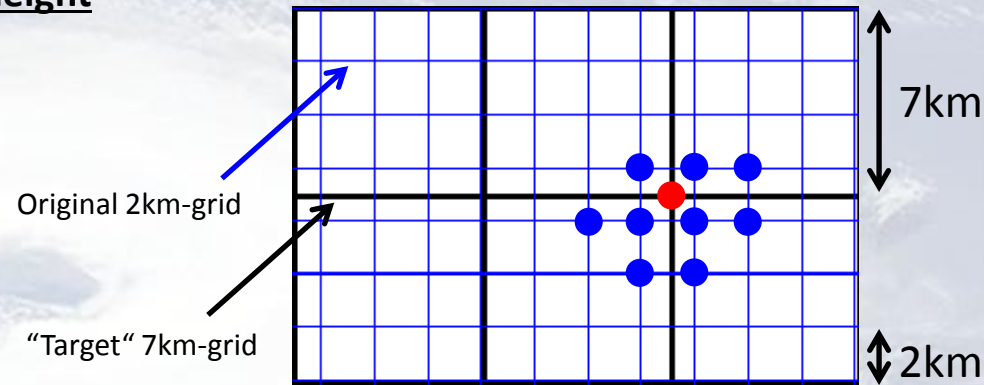
Must adjust the observations to the model smoothed grid **before** verification! But ... **How?**

2m-temperature adjustment to the (smoothed) model grid

- C. Frei: Interpolate considering the “neighbors” height

1. For every grid point in the “target” grid (red dot), find the nearest 9 neighbors on the original 2km-grid (blue dots)
2. Plot the 2m-temperature values of these neighbors vs. their altitude (blue and red “x”).
3. Perform a linear fit of the data, which will be the local 2m-temperature profile
4. Having the altitude of the “target” grid point, use the linear regression, to calculate its 2m-temperature
5. Perform this operation (1-4) for every “target” grid point, for every day

**Local profile:
works even for inversions!**



Example:
10/1/2008
46.07 N - 7.49 E

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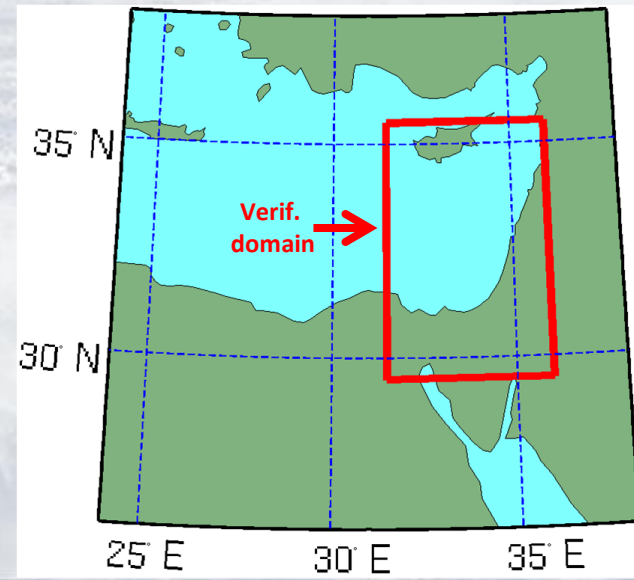
Model verification using analyses

- ❖ Fields: Temperature, Rel. humidity, Wind speed at: *Surface*, 925mb, 850mb, 700mb, 500mb, Geopotential at 500mb, Mean sea level pressure
- ❖ Verif. using: IFS (ECMWF) and GME analyses
- ❖ Scores: RMSE, BIAS, STDV, MAE, Tendency correlation, S1 score
- ❖ Period: Sept. 2013 – Aug. 2014
- ❖ Models: IFS (ECMWF), COSMO-ME (7km, over IFS) Italian Met Service, COSMO-IL (7km, over GME) Israel Met Service, COSMO-IL (7km, over IFS) Israel Met Service

See presentations of:

Ulrich Damrath (CUS 2014, Offenbach)

Takafumi Kanehama (WGNE 2014, Melbourne)



Model verification using analyses

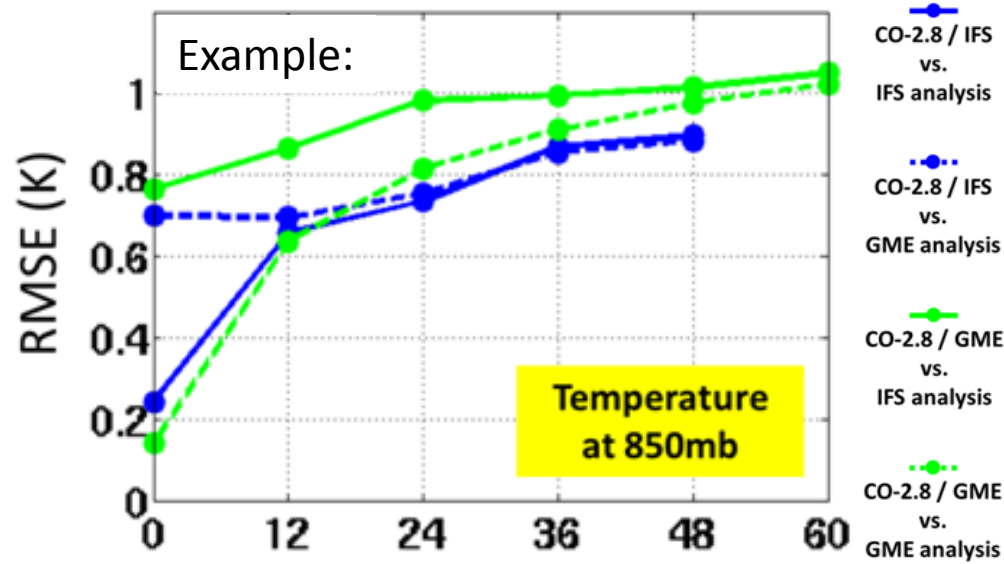
❖ Method:

1. "Box-average" each model to GME coarse grid.
2. Verify each (averaged) model against GME analysis $\rightarrow S_{GME}$ (ex: S is RMSE)
3. Verify each (averaged) model against IFS analysis $\rightarrow S_{IFS}$

S_{IFS} and S_{GME} differ for **early** forecast ranges!

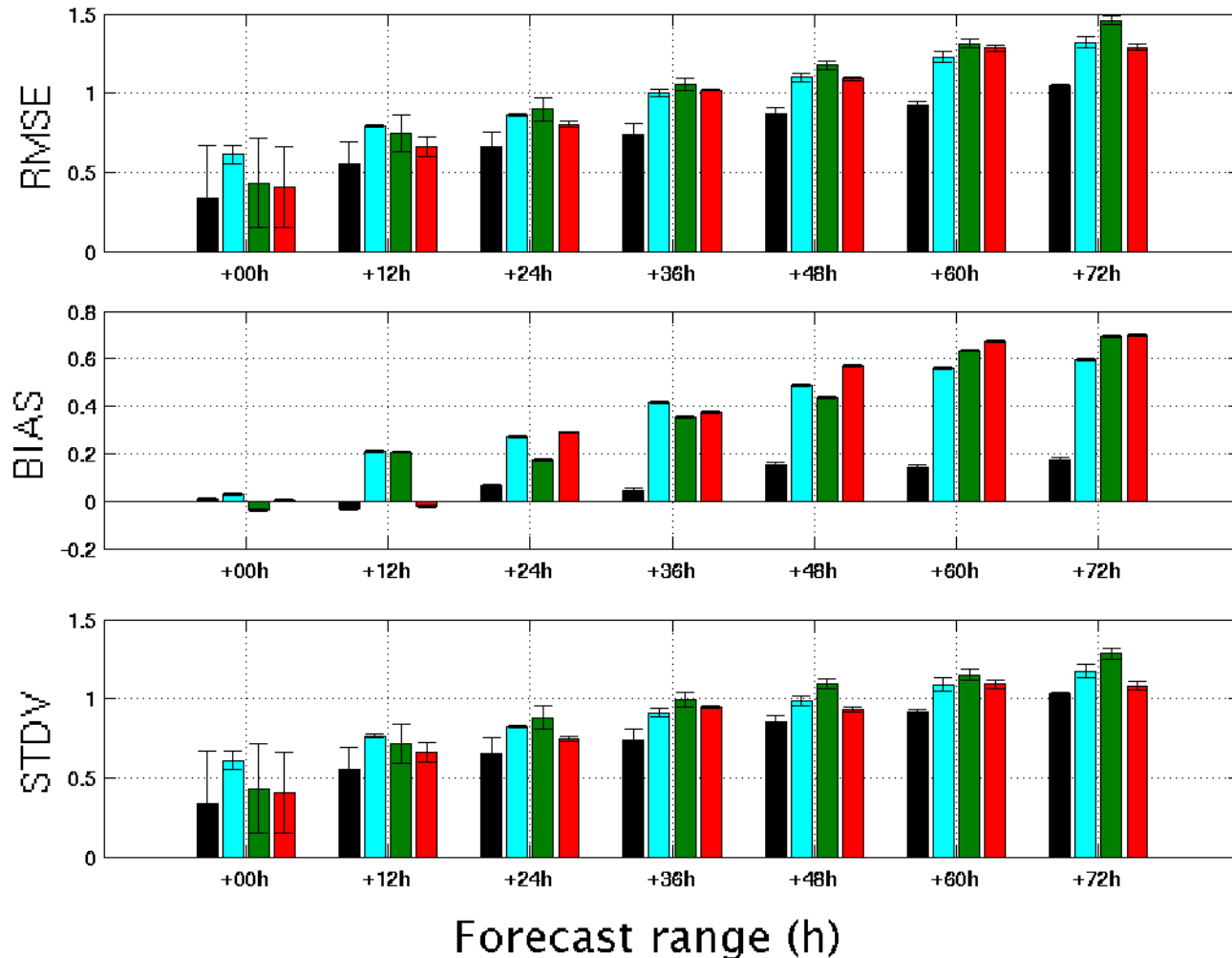
S_{IFS} smaller for models running over IFS

S_{GME} smaller for models running over GME



4. Plot $(S_{IFS} + S_{GME})/2$ with error-bars between S_{IFS} and S_{GME}

Temperature (K) at 850mb



- IFS (ECMWF)
- COSMO-ME (7km, over IFS) Italian Met Service
- COSMO-IL (7km, over GME) Israel Met Service
- COSMO-IL (7km, over IFS) Israel Met Service

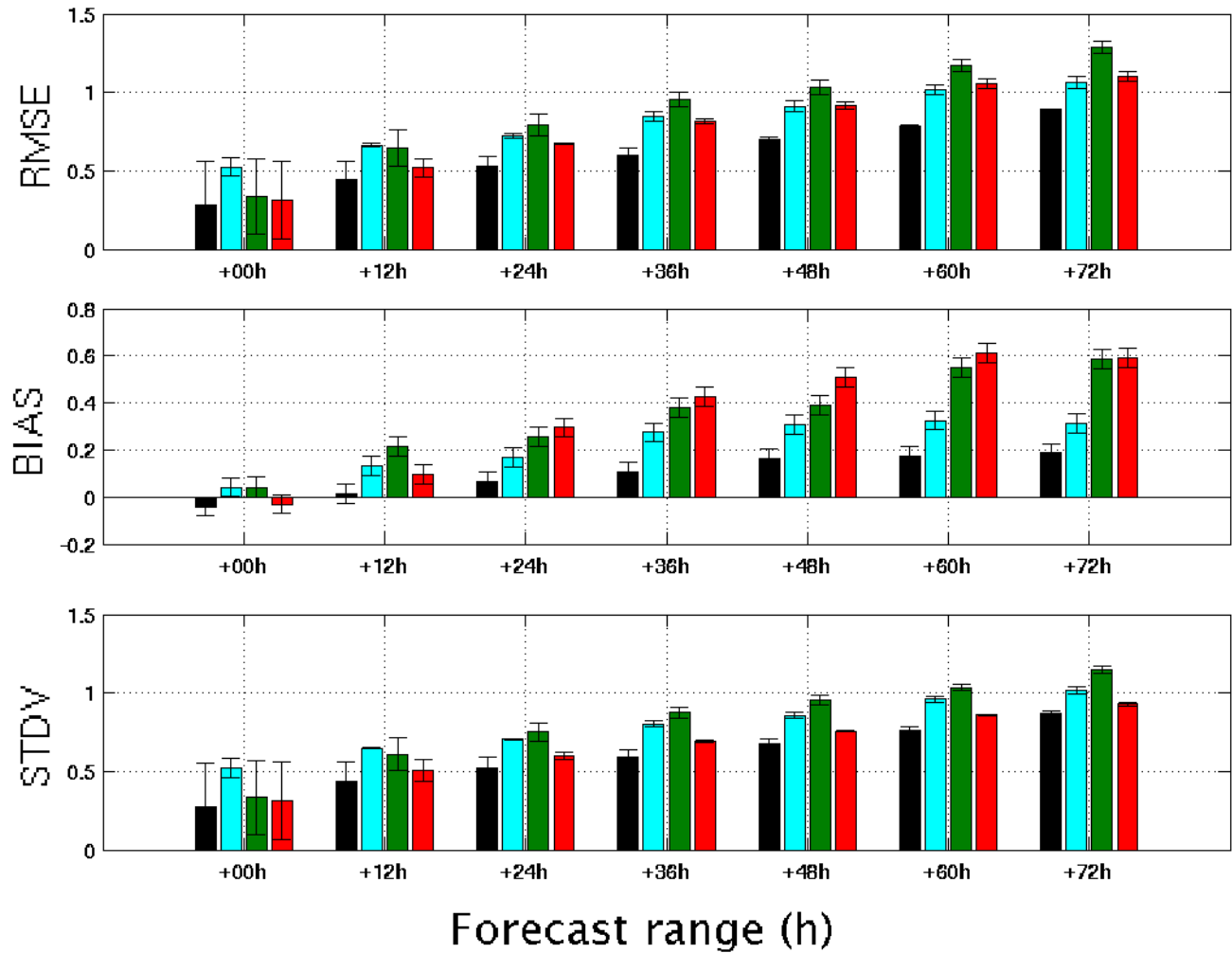
Forecast errors: ~0.5-1K ;
IFS is the best ;

Well defined scores for forecast ranges > ~24h

Interesting:

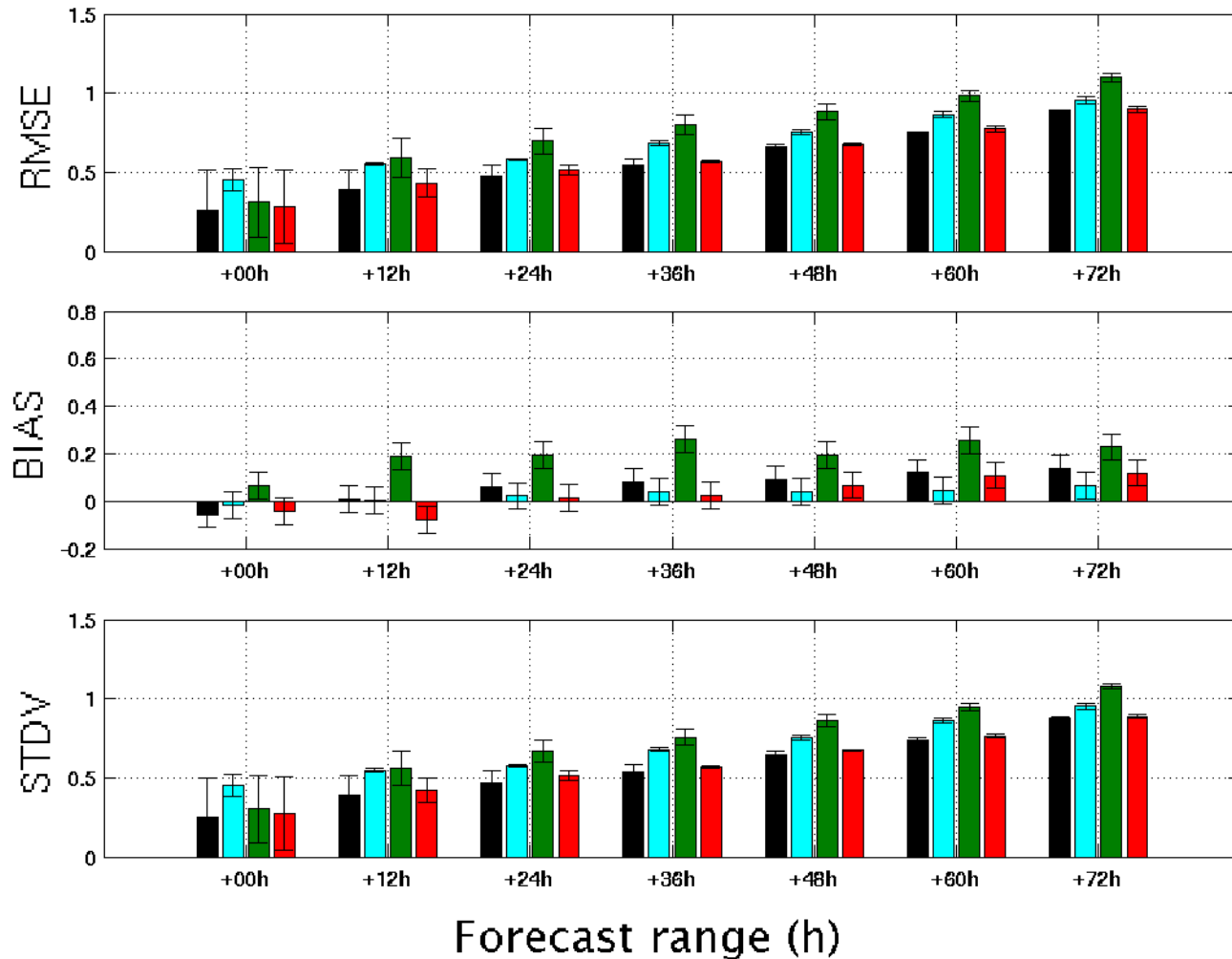
The forecast improves with height (see next slides...)

Temperature (K) at 700mb



- IFS (ECMWF)
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- COSMO-IL (7km, over GME) Israel Met Service
- COSMO-IL (7km, over IFS) Israel Met Service

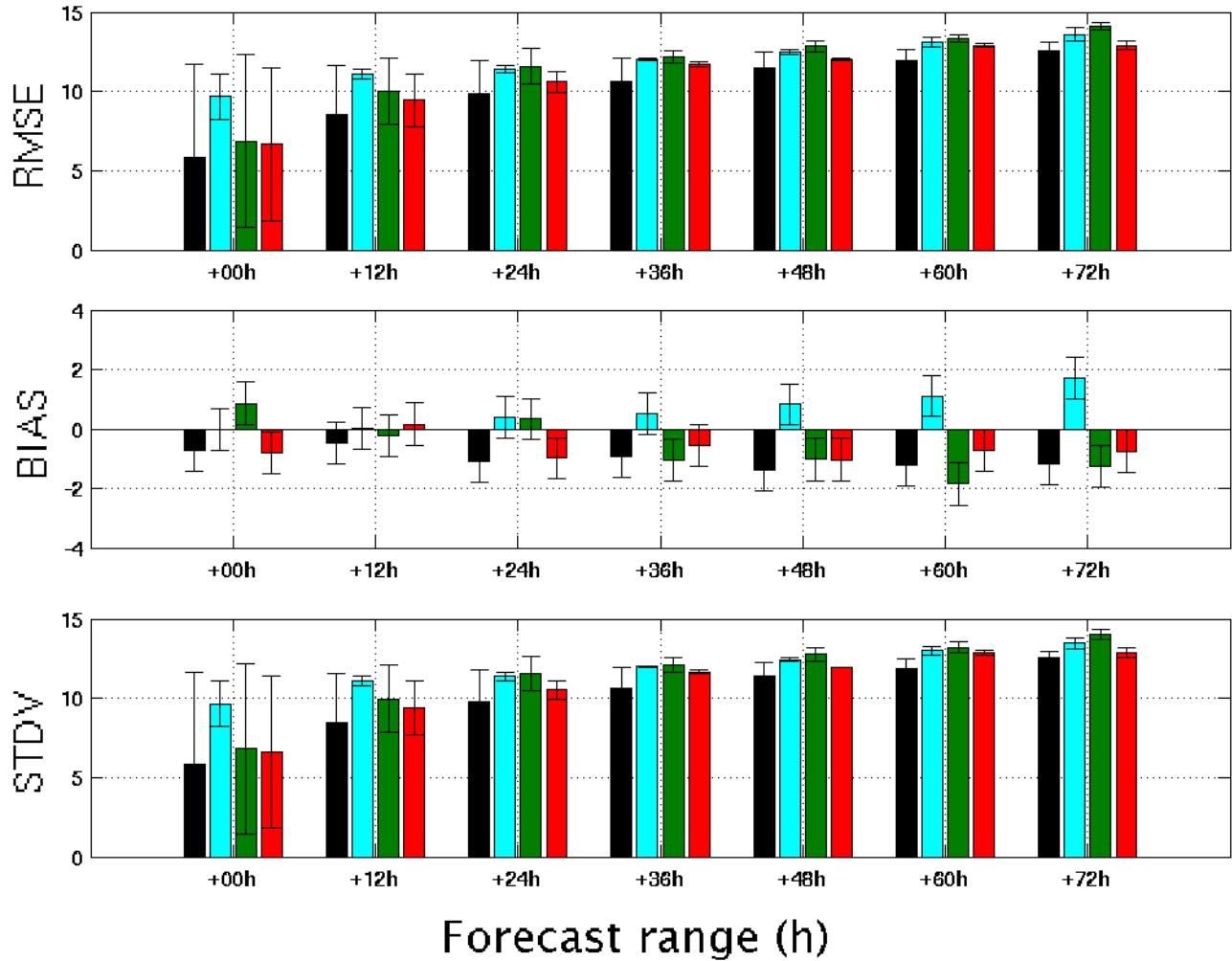
Temperature (K) at 500mb



- IFS (ECMWF)
- COSMO-ME (7km, over IFS) Italian Met Service
- COSMO-IL (7km, over GME) Israel Met Service
- COSMO-IL (7km, over IFS) Israel Met Service

Temp. at 500mb is determined mainly by large scale advection
(easier to predict)
Temp. at 850mb is affected by surface – local effects
(difficult to predict)

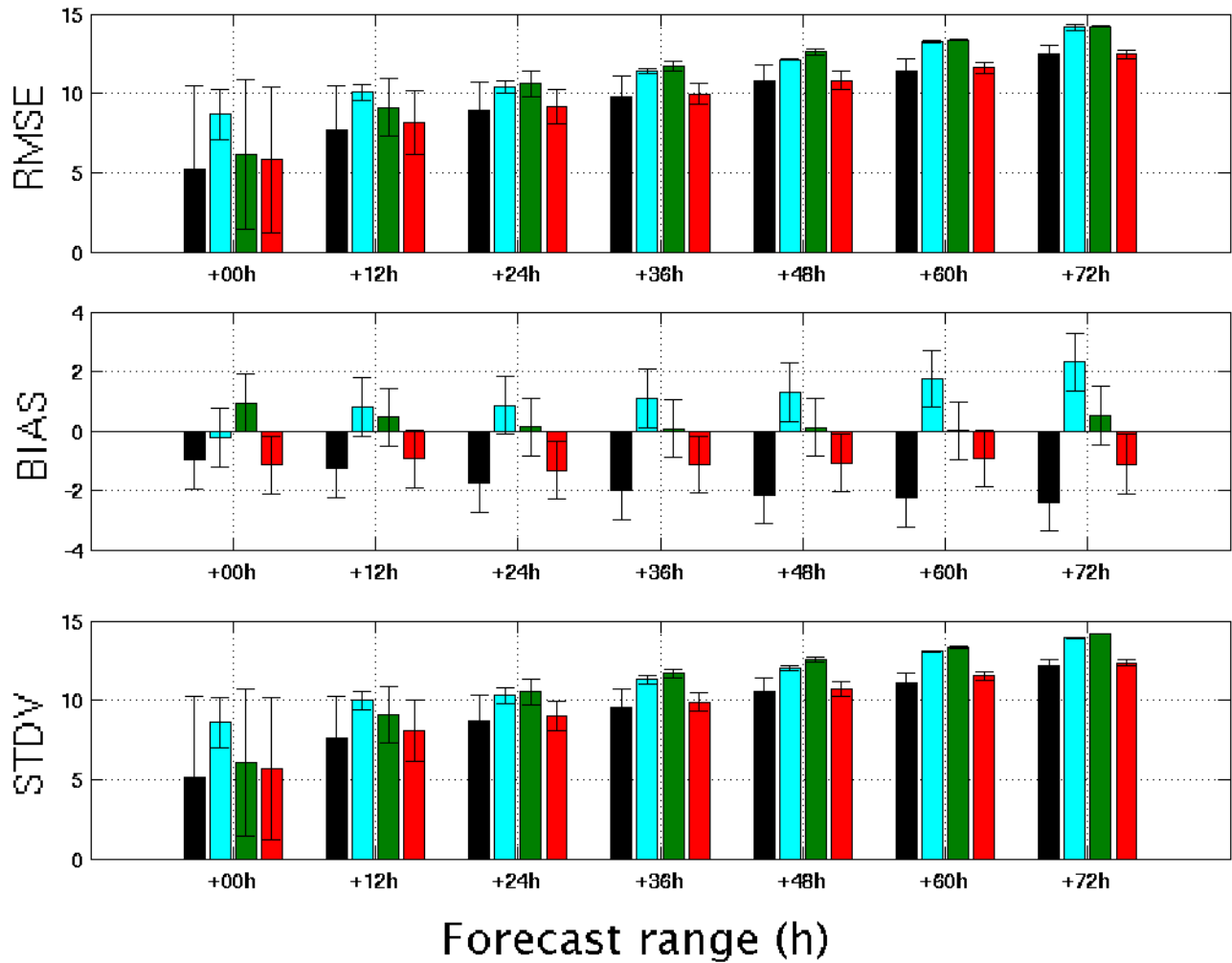
Rel. Humidity (%) at 850mb



- IFS (ECMWF)
- COSMO-ME (7km, over IFS) Italian Met Service
- COSMO-IL (7km, over GME) Israel Met Service
- COSMO-IL (7km, over IFS) Israel Met Service

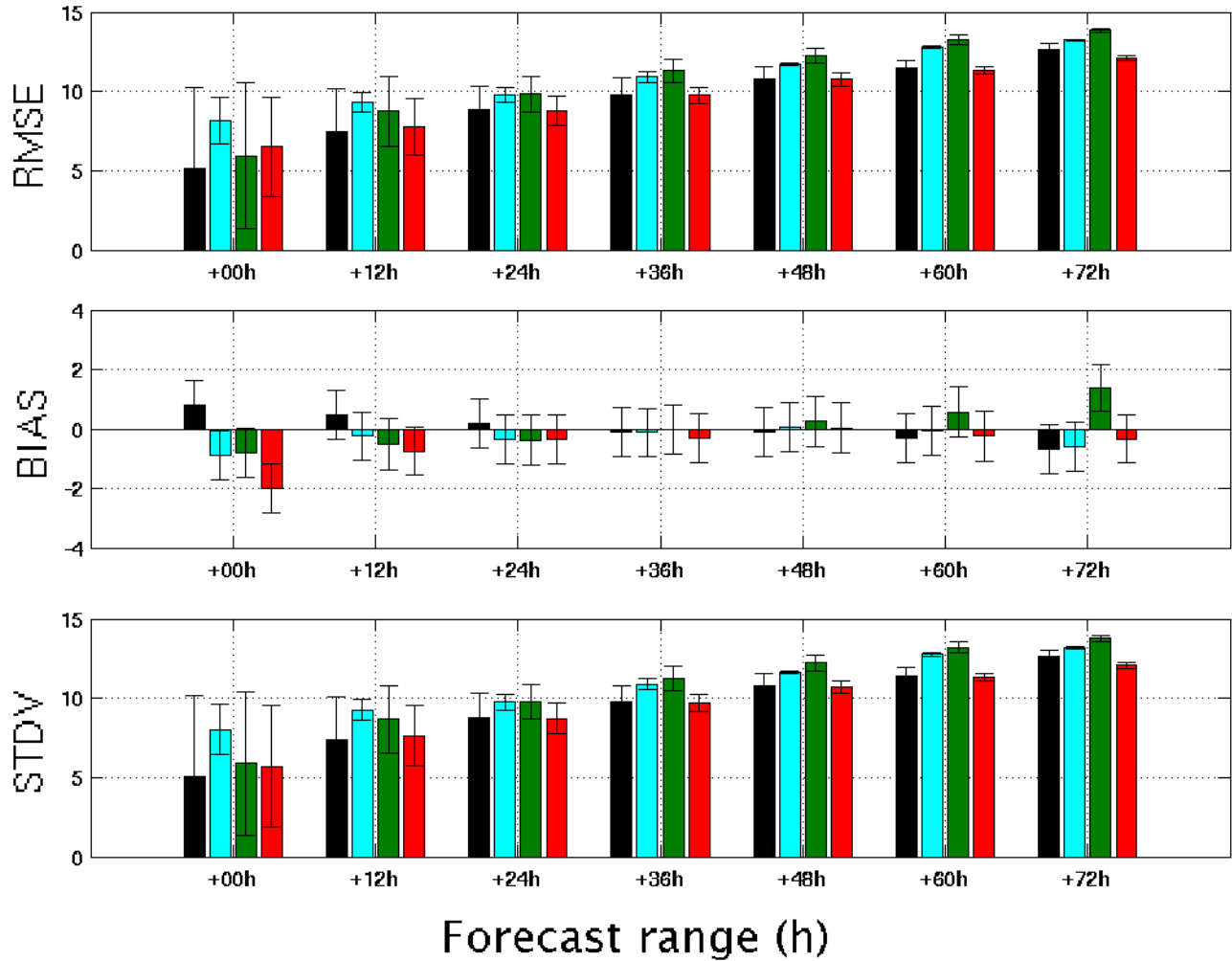
Forecast errors: ~10% ;
IFS is the best ;
again:
The forecast improves with height (see next slides...)

Rel. Humidity (%) at 700mb



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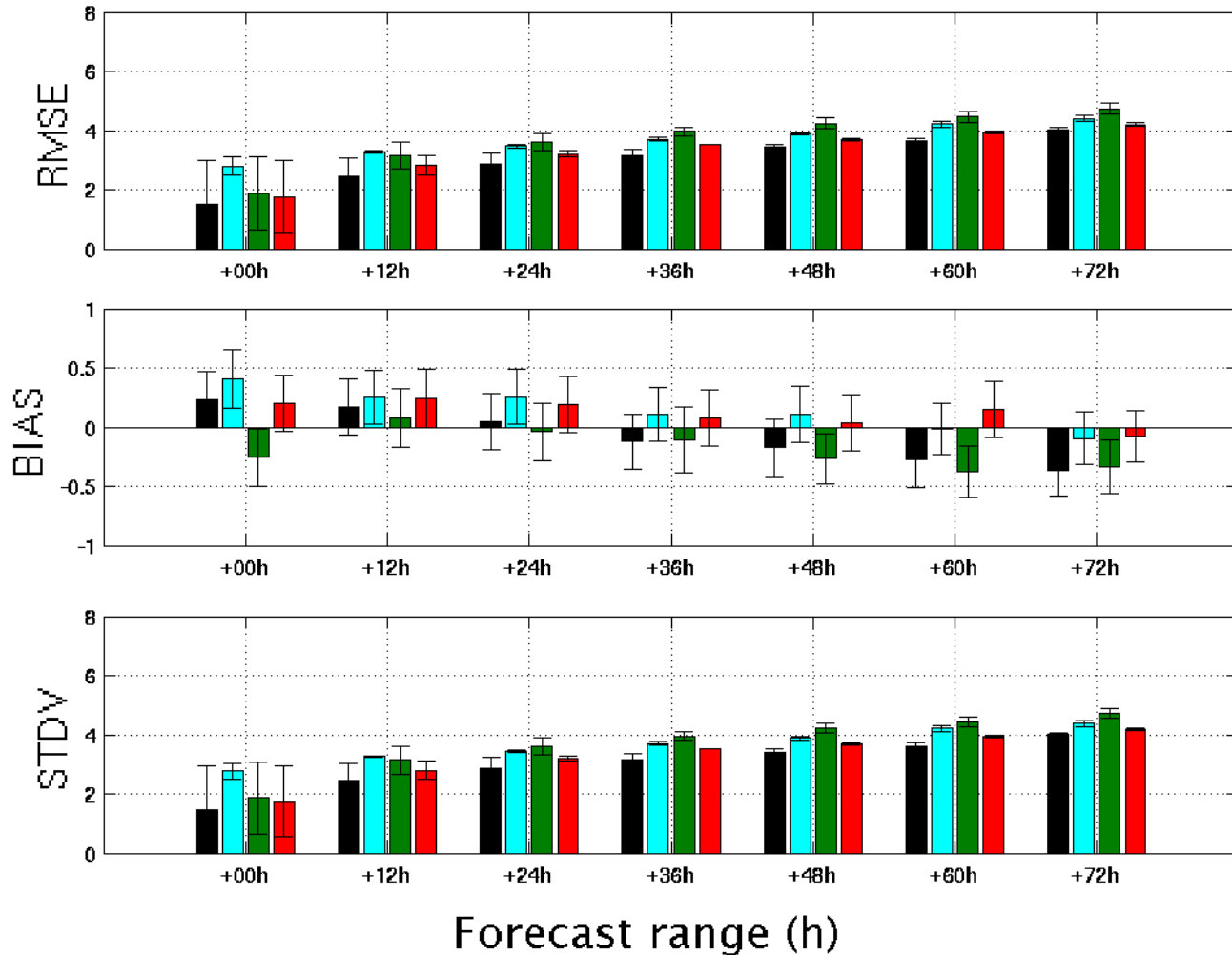
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RH at 500mb is determined mainly by large scale advection (easier to predict)
RH at 850mb is affected by surface – local effects (difficult to predict)

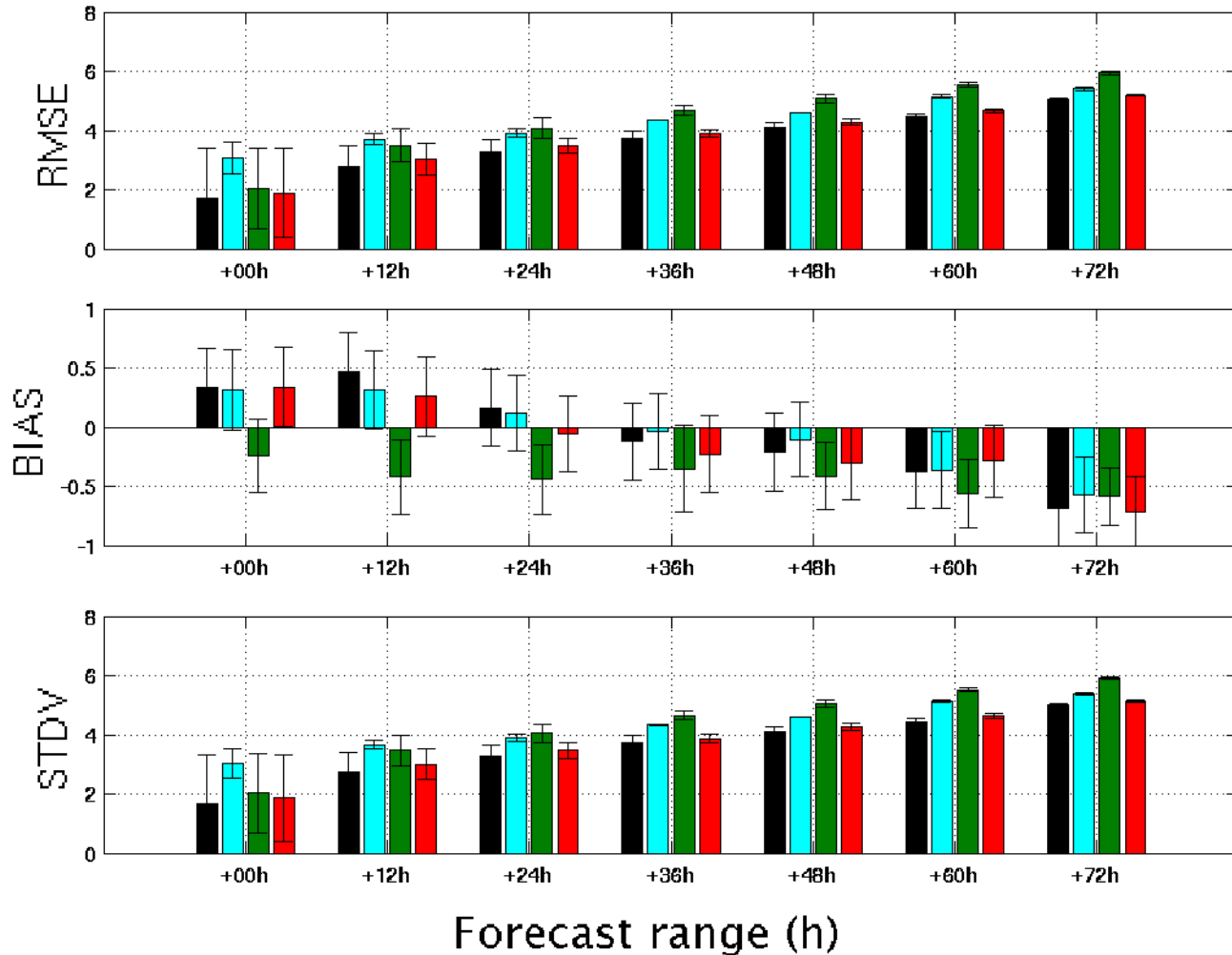
Wind Speed (knots) at 850mb



- IFS (ECMWF)
- COSMO-ME (7km, over IFS) Italian Met Service
- COSMO-IL (7km, over GME) Israel Met Service
- COSMO-IL (7km, over IFS) Israel Met Service

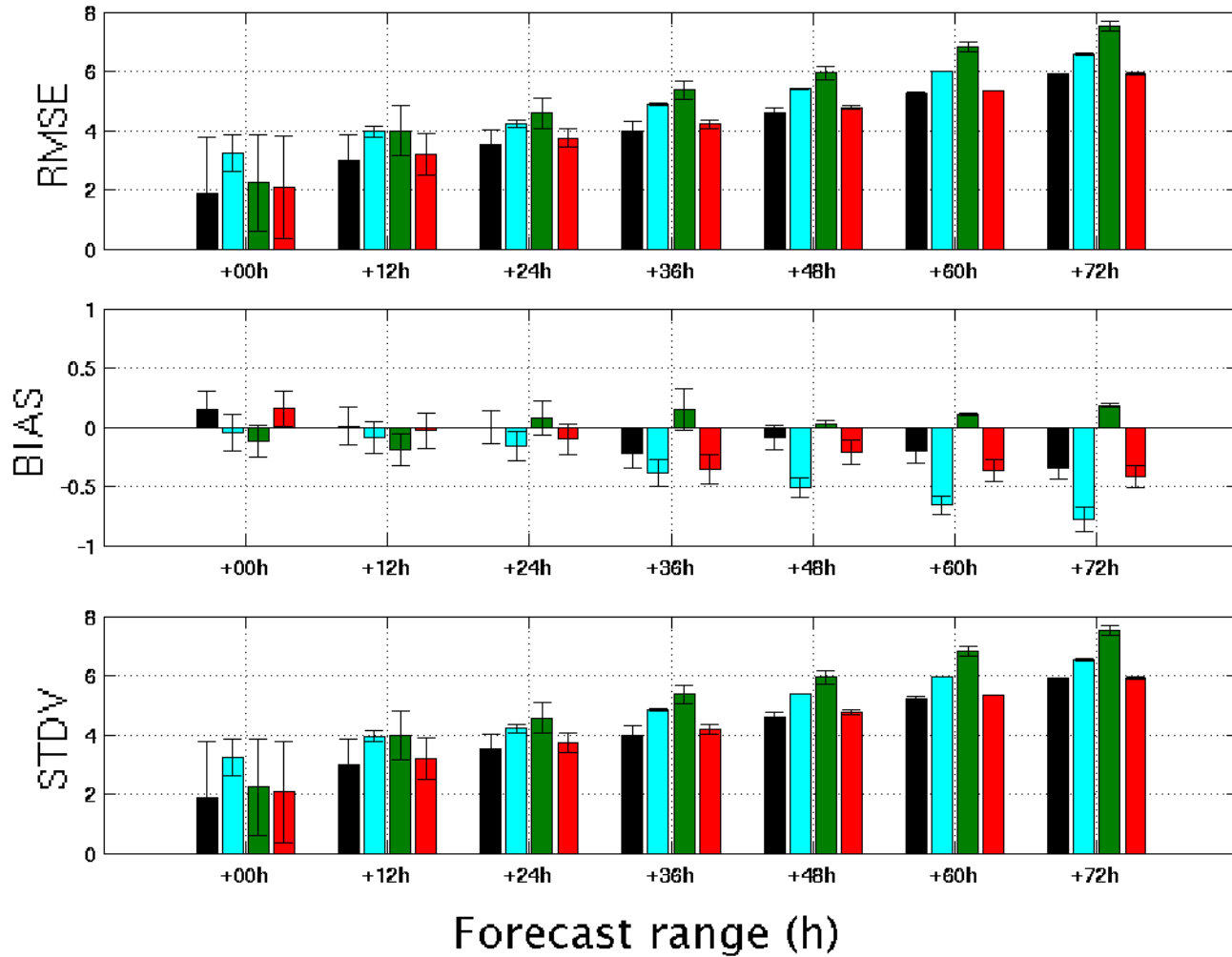
Forecast errors: ~3-4 knt = ~2 m/s ;
 IFS is the best ;
Does the forecast improves with height ?

Wind Speed (knots) at 700mb



- IFS (ECMWF)
- COSMO-ME (7km, over IFS) Italian Met Service
- COSMO-IL (7km, over GME) Israel Met Service
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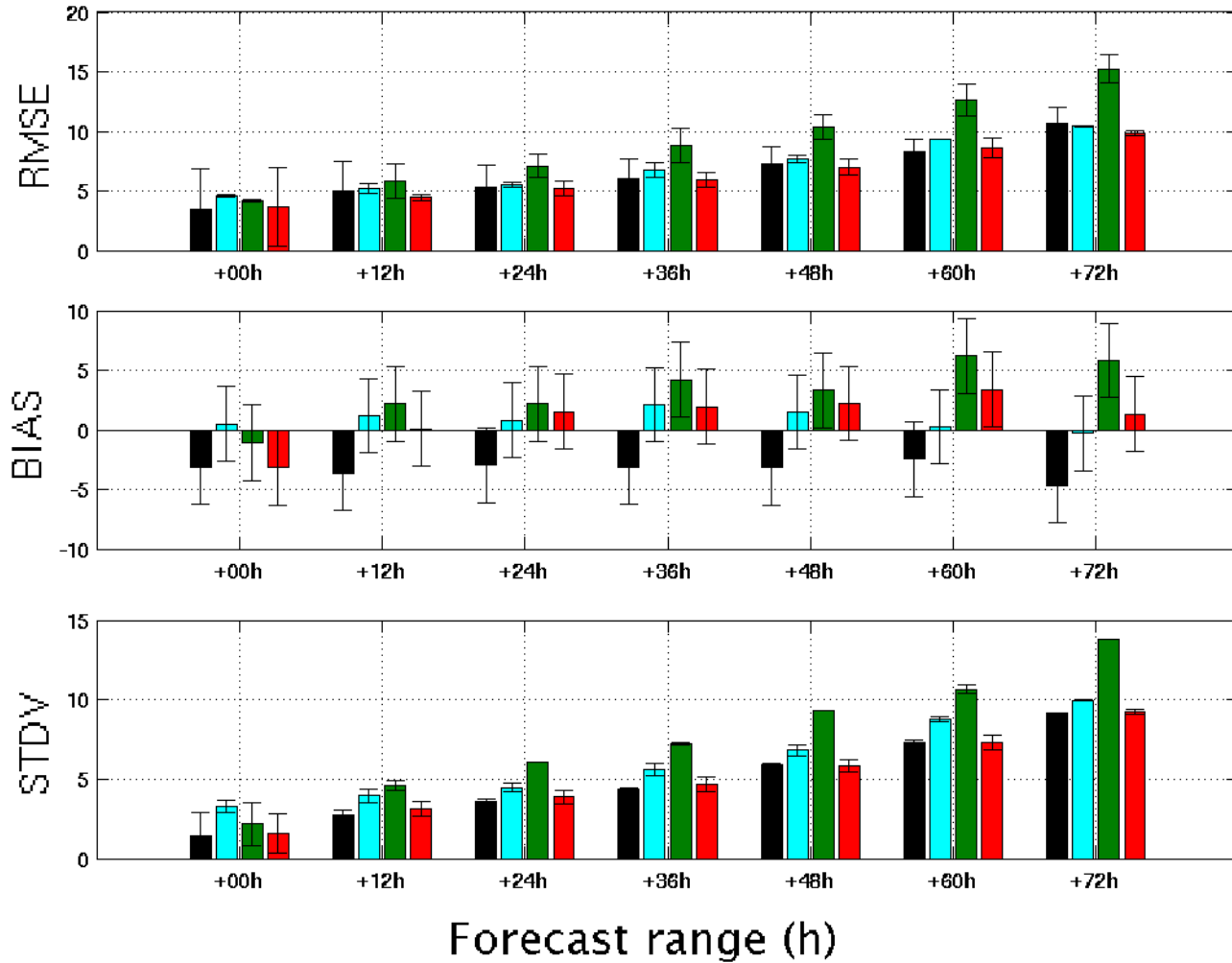
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The wind speed increases with height
→ The errors obviously increase

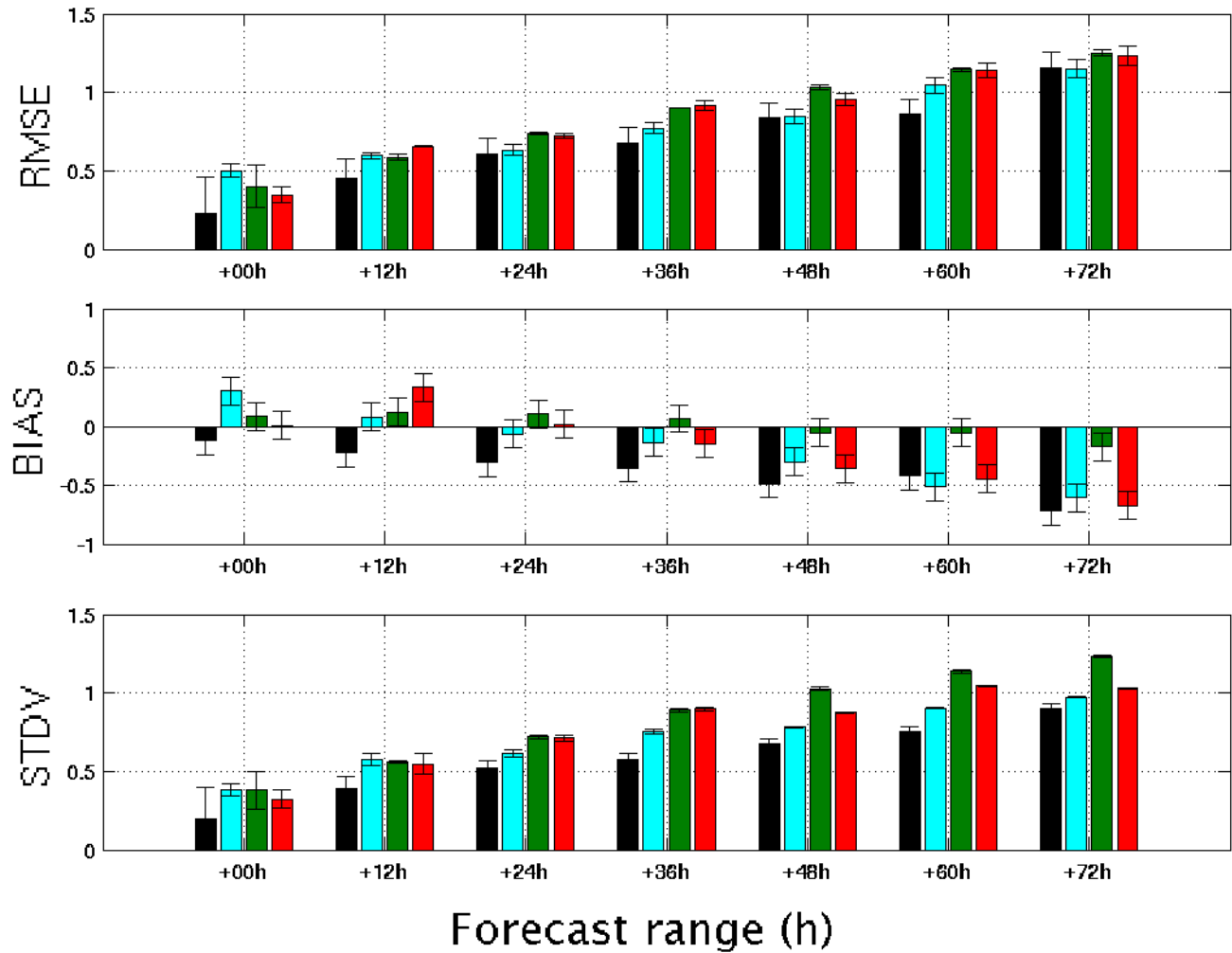
Geopotential (m) at 500mb



- IFS (ECMWF)
- COSMO-ME (7km, over IFS) Italian Met Service
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- COSMO-IL (7km, over IFS) Israel Met Service

Forecast errors: ~5-10m ;
IFS,CO-IL/IFS,CO-IT have similar skill

Mean Sea Level Pressure (mb)



- IFS (ECMWF)
- COSMO-ME (7km, over IFS) Italian Met Service
- COSMO-IL (7km, over GME) Israel Met Service
- COSMO-IL (7km, over IFS) Israel Met Service

Forecast errors: ~0.5-1mb ;
IFS is slightly better than others

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Conclusions

- COSMO model in IMS: 7km and nested 2.8km versions, driven by IFS/GME
 - ✓ Under test: Assimilation Cycle
- Currently: own verification interface. Near future: move to VERSUS
- 2m-temperature verification method was developed (part of CALMO PP):
 - ✓ Before verifying the model, adjust the observations to smoothed model grid using **LOCAL** 2m-temperature profiles
- Upper-air fields were verified using both IFS and GME analyses
 - ✓ The verification scores are well defined for the forecast ranges > ~**24h**
 - ✓ Temperature and rel. humidity forecasts improve with the height
 - ✓ IFS is better than other verified models.

THANK YOU!