The NWP verification at the IMS

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Israel Meteorological Service

COSMO General Meeting, Eretria, September 2014

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

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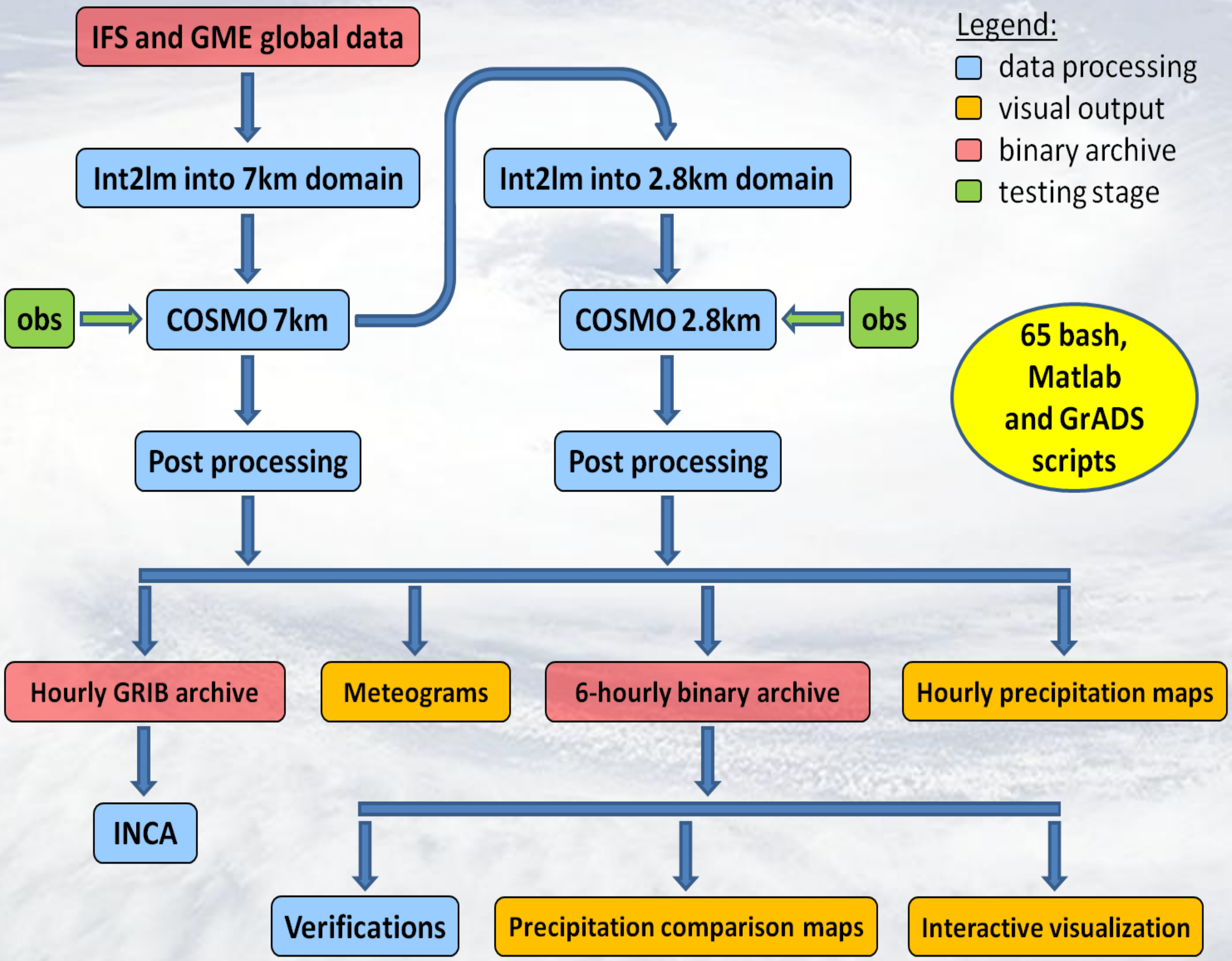
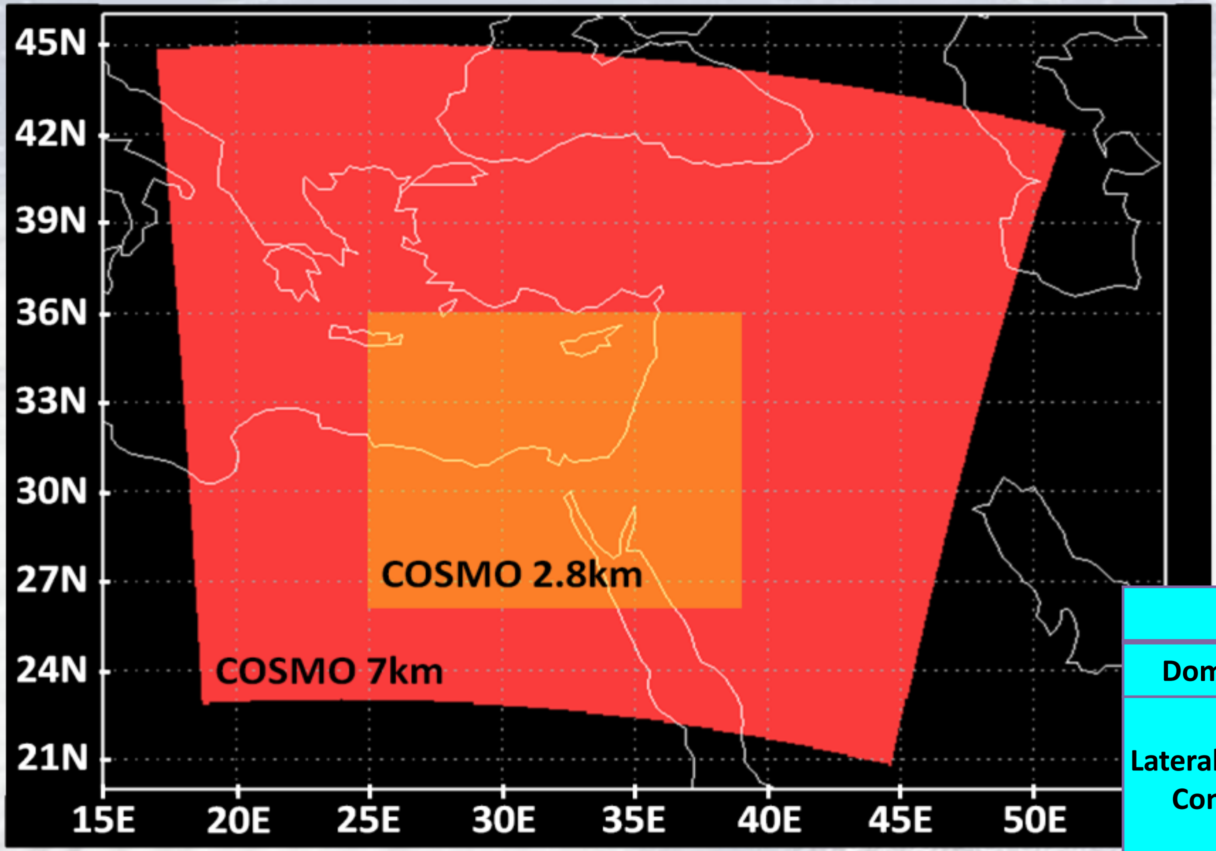
COSMO work flow in IMS



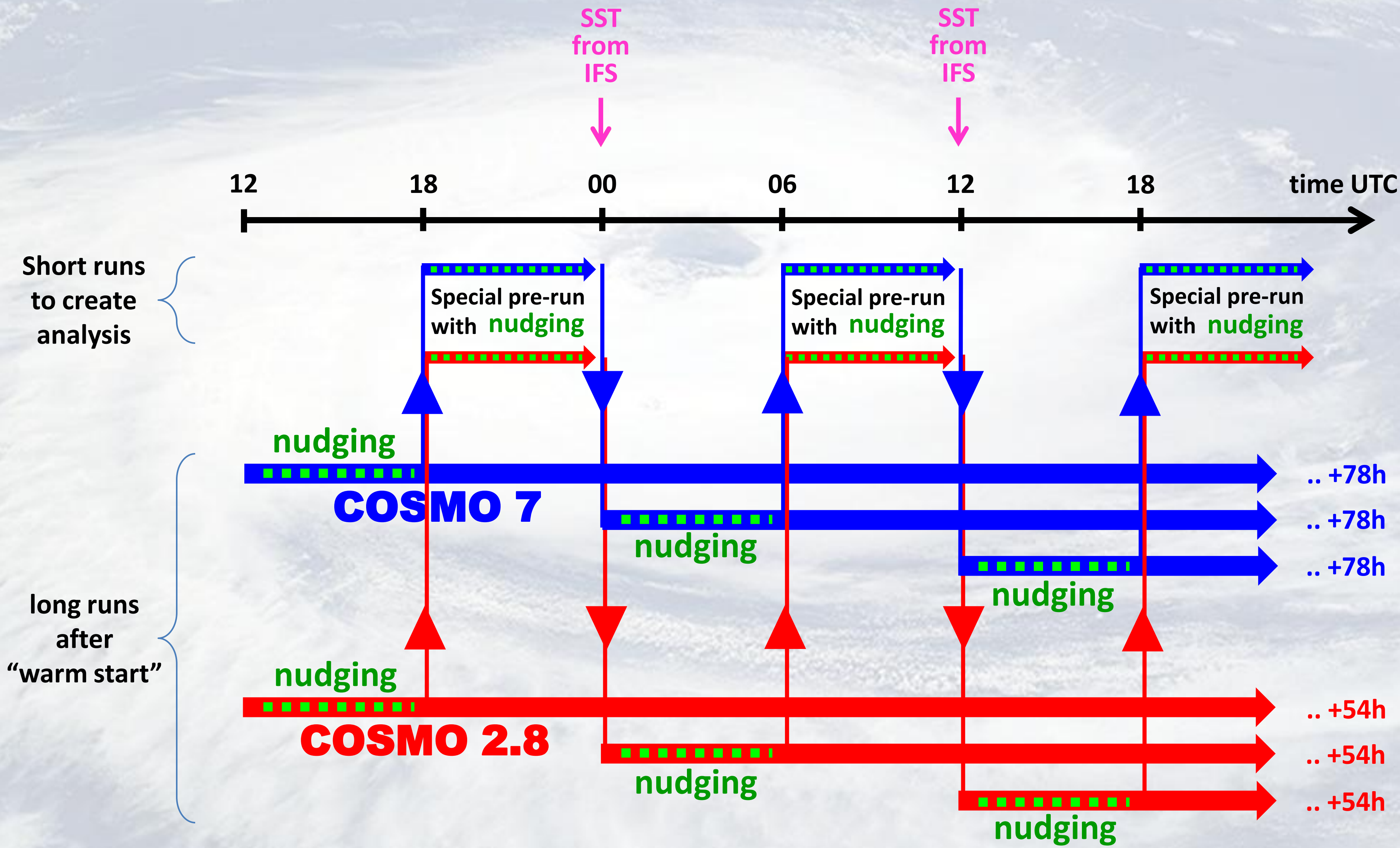
- **Version 5.0** • **resolutions: 7-km and nested 2.8-km** • **60 vertical levels** • **twice daily runs**
- **Driving data: IFS and GME** • **Recently: applied DA from the local and GTS data**

Model Configuration

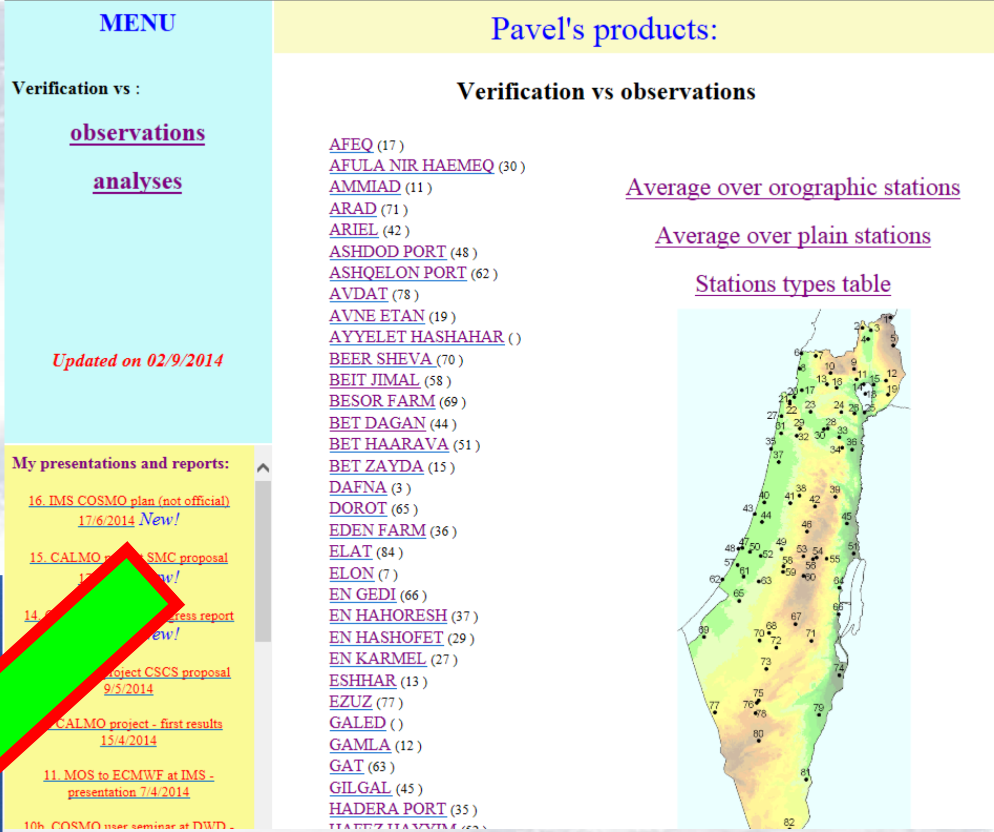


	COSMO-7km	COSMO-2.8km
Domain Size	401 X 353 X 50	561 X 401 X 50
Lateral Boundary Conditions	IFS/GME 3-h intervals, on frame	COSMO-7km 1-h intervals, whole domain
Forecast range	78h	54h
No. of processors	160	416
Run time	3:40h	
Hardware	SGI Linux Cluster 1024 AMD cores	
Time step	60 sec	25 sec
Time-integration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

Under test: Assimilation cycle in IMS



Current verification interface at IMS



Near future: move to VERSUS (Alon Shtivelman)

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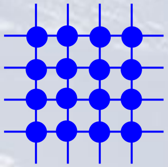
Temperature verification over complex terrain (for CALMO project)

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

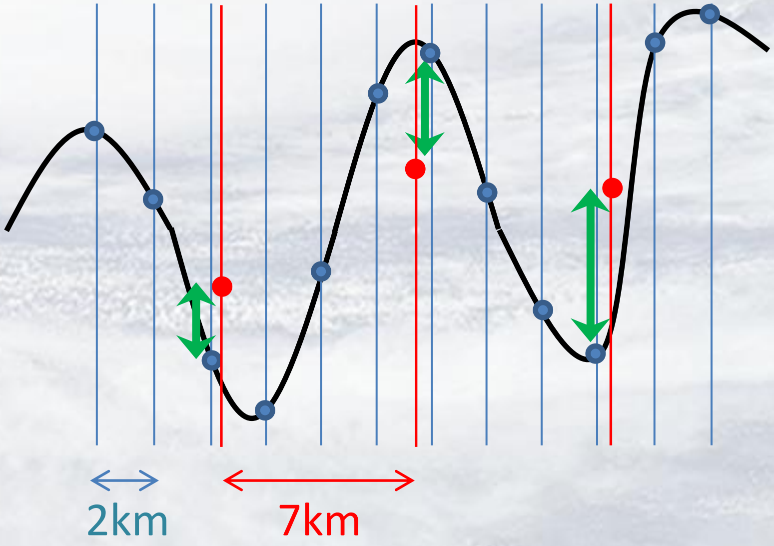


Goal: verify coarse grid model (ex: COSMO-7km)

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

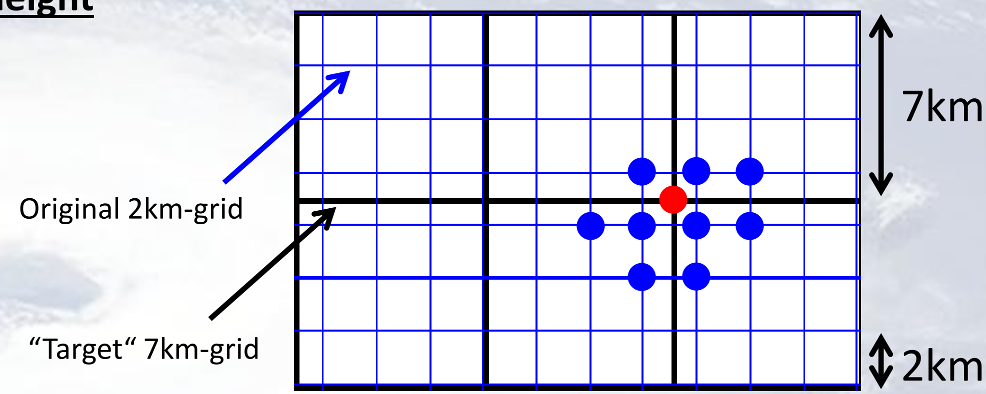
If the coarse grid point is too low
→ temperature too high
If the coarse grid point is too high
→ temperature too low

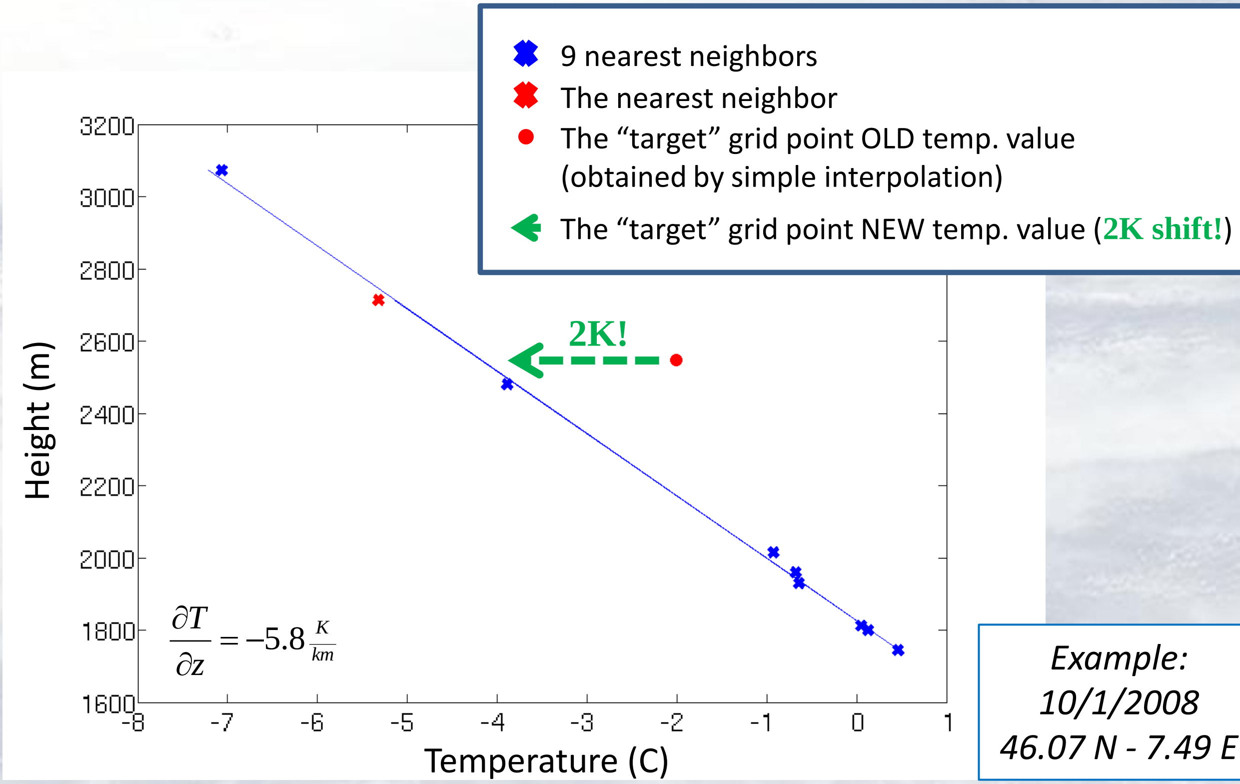
Must adjust the observations to the model smoothed grid **before** verification! But … ***How?***

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





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

Local profile:
works even for inversions!

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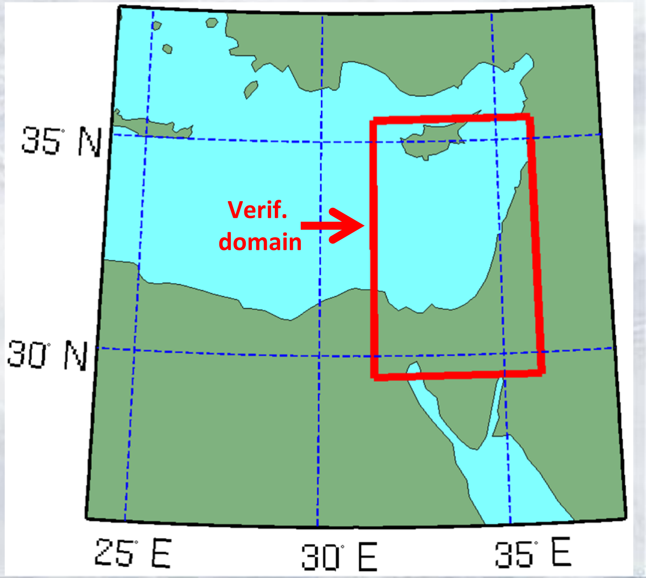
Model verification using analyses

- **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

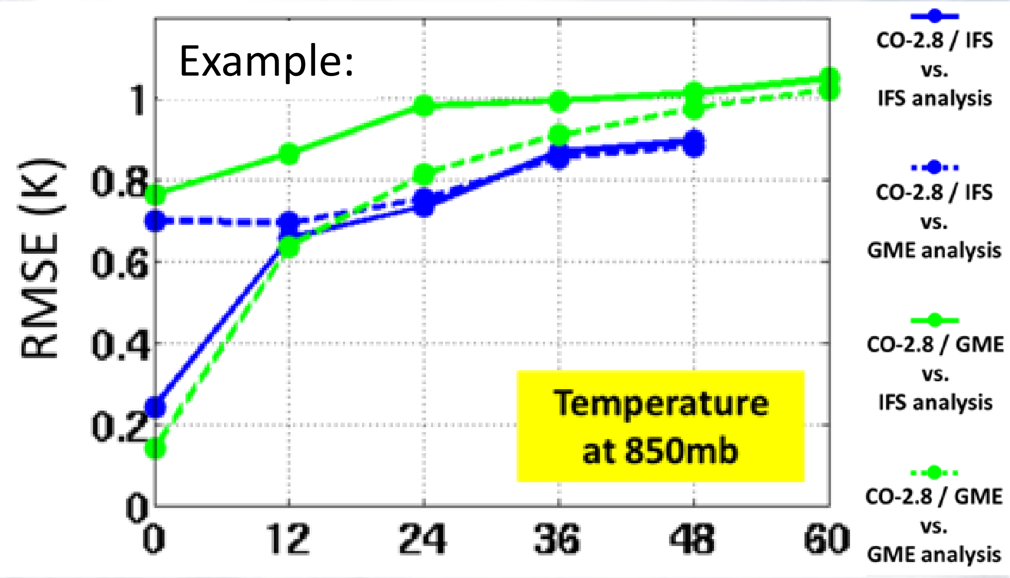
- Method:

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

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

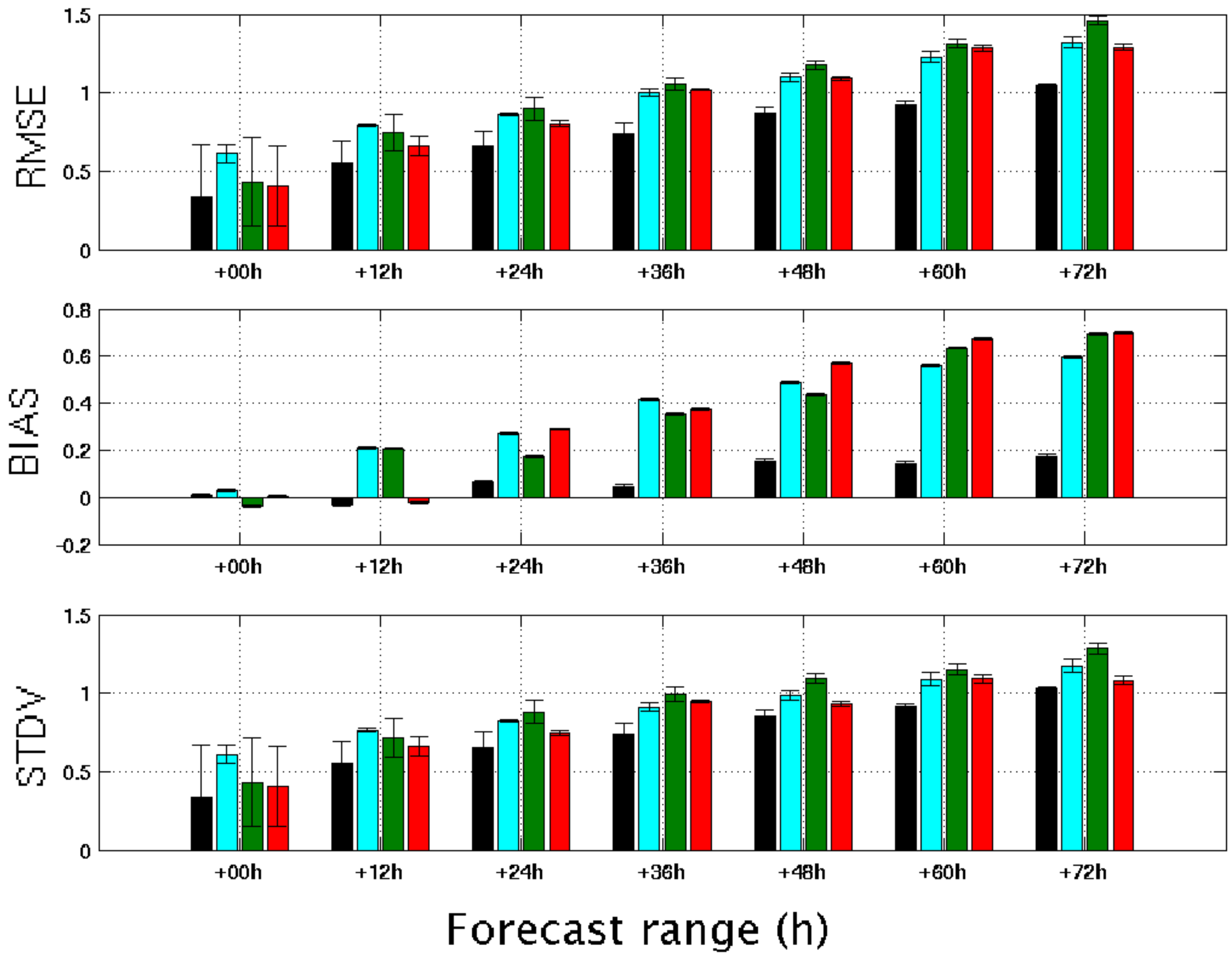
S_{IFS} smaller for models running over IFS

S_{GME} smaller for models running over GME



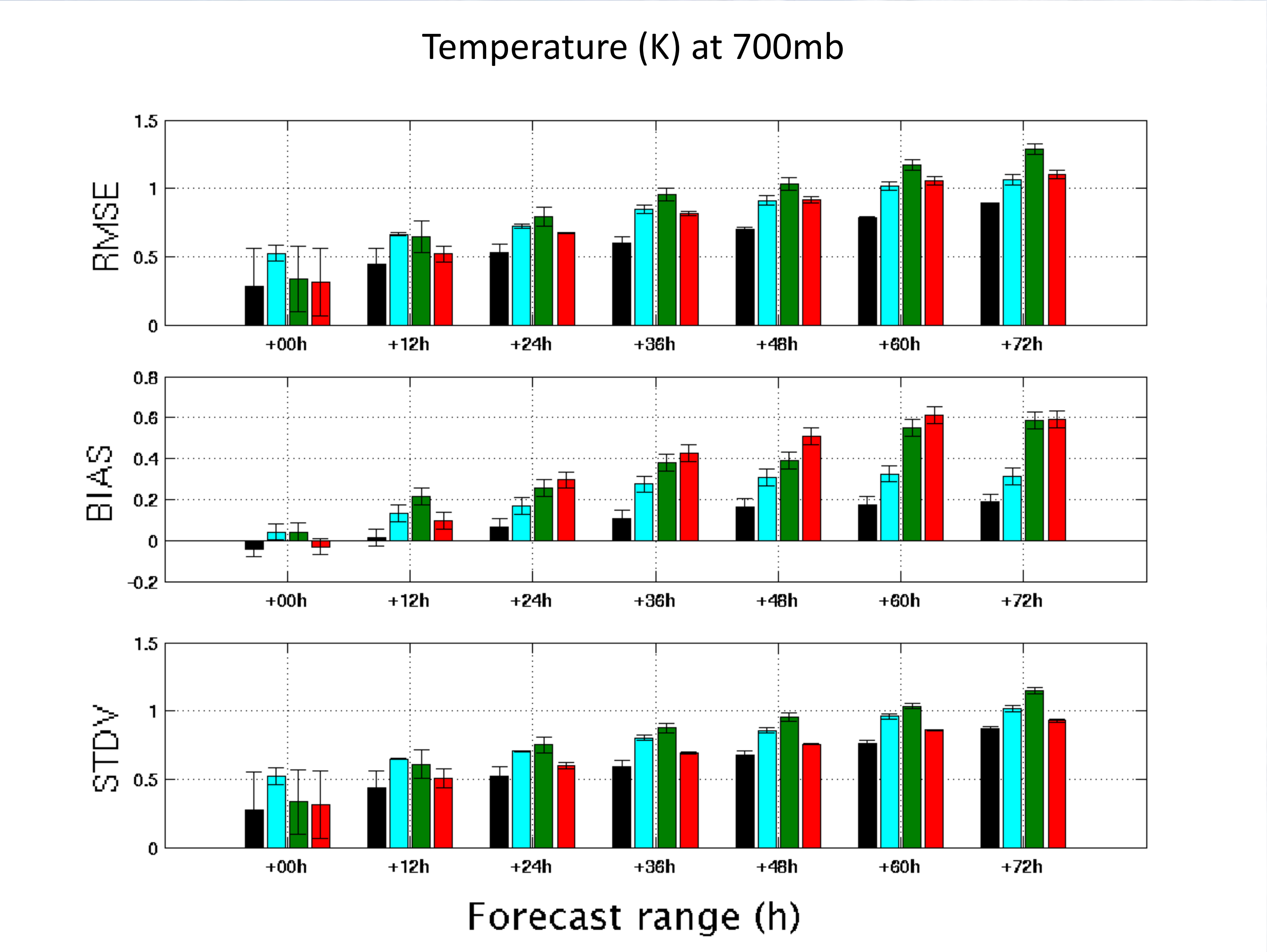
4. Plot (S_{IFS} + S_{GME})/2 with error-bars between S_{IFS} and S_{GME}

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…)



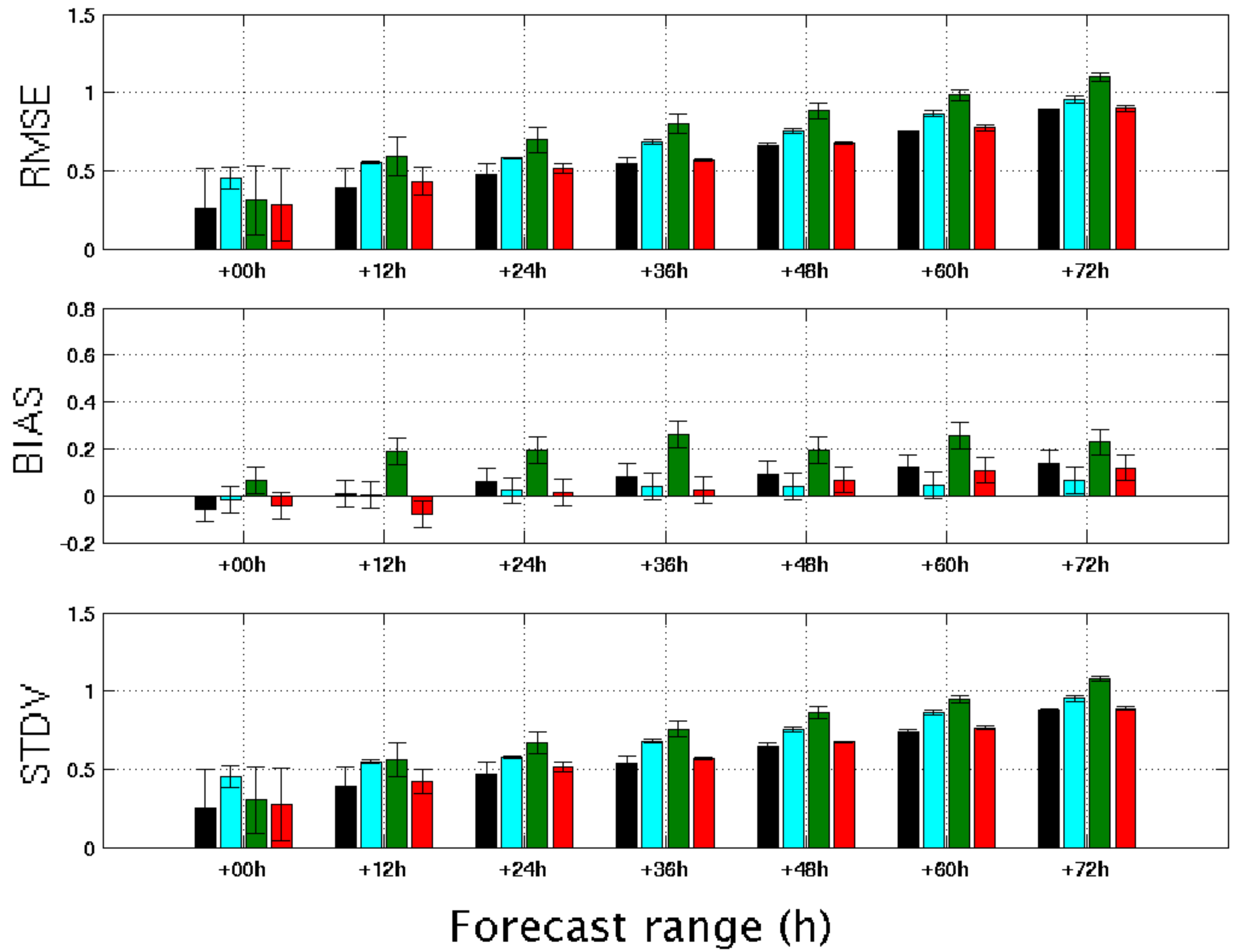
IFS (ECMWF)

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

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

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

Temperature (K) at 500mb



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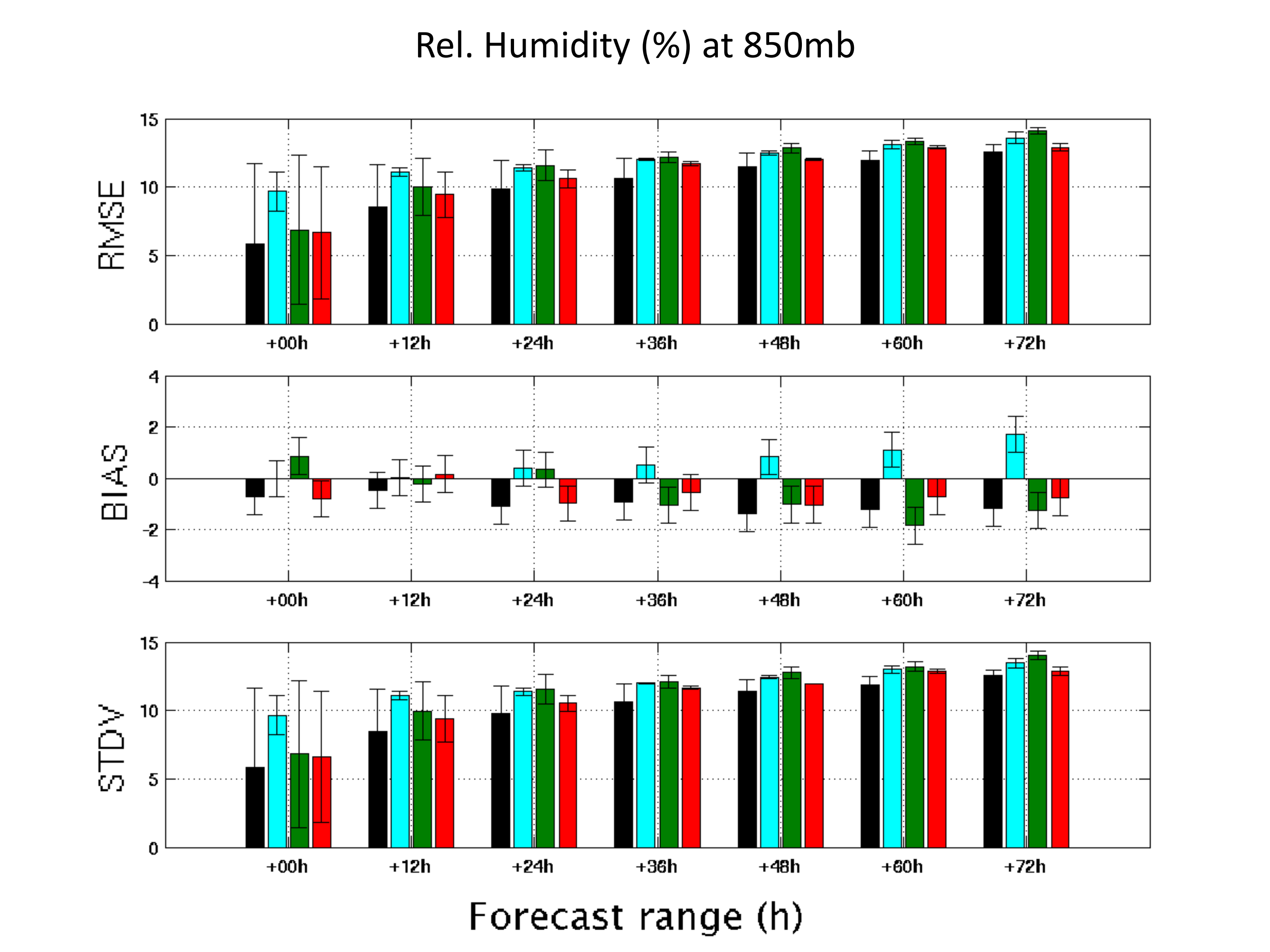
Temp. at 500mb is determined mainly by large scale advection (easier to predict)
Temp. at 850mb is affected by surface – local effects (difficult to predict)



IFS (ECMWF)

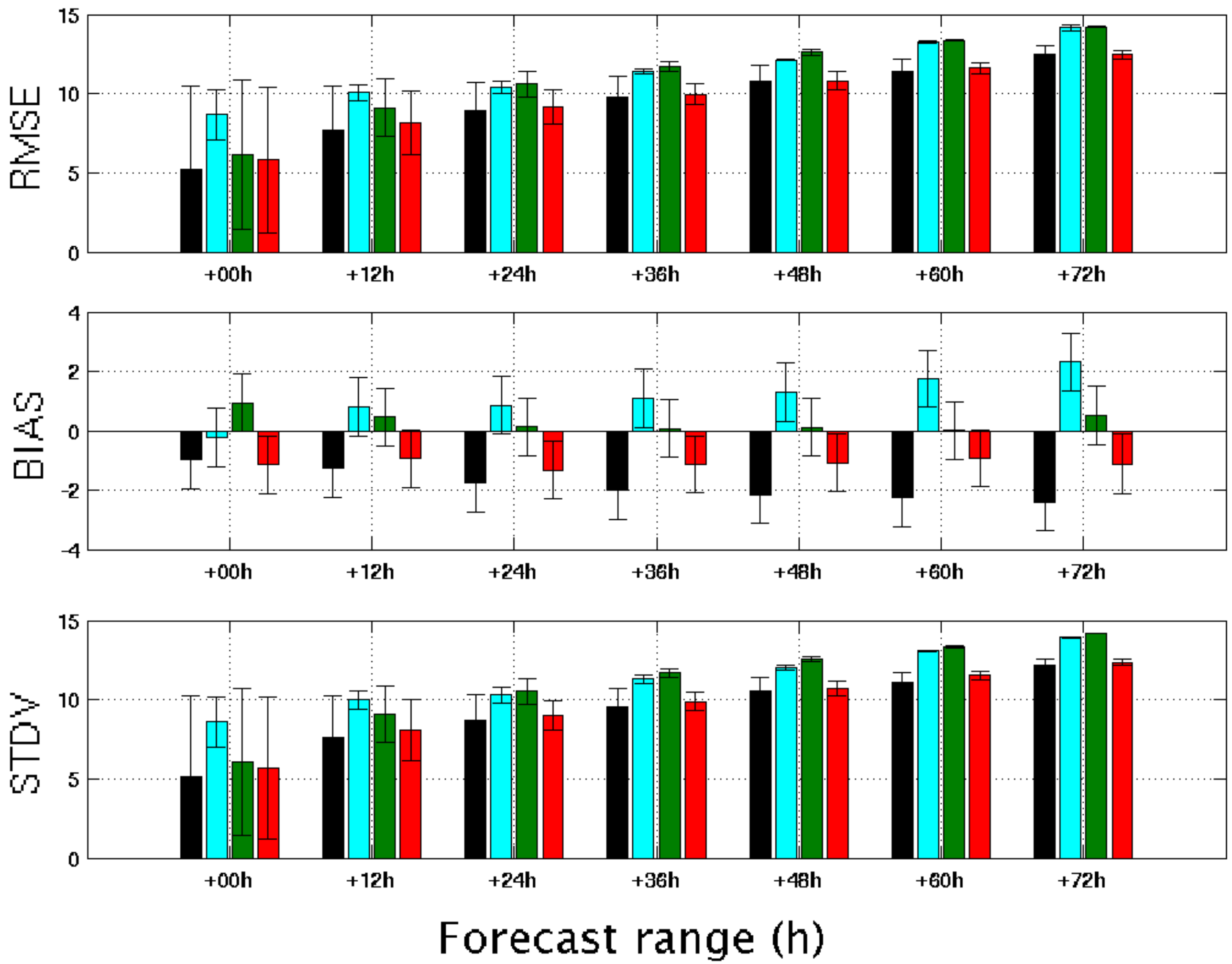
COSMO-ME (7km, over IFS) Italian Met Service

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



IFS (ECMWF)

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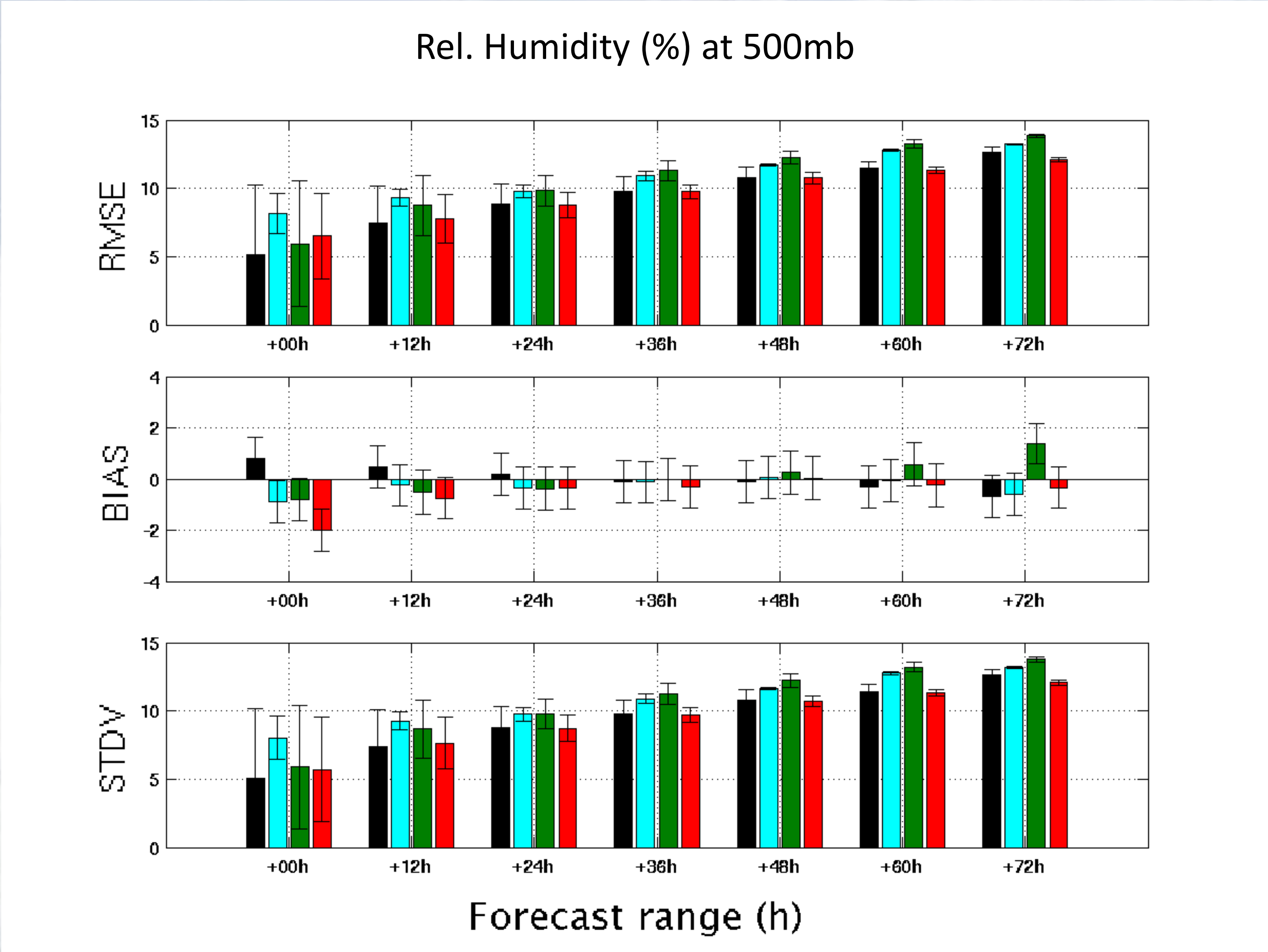
COSMO-IL (7km, over GME) Israel Met Service

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



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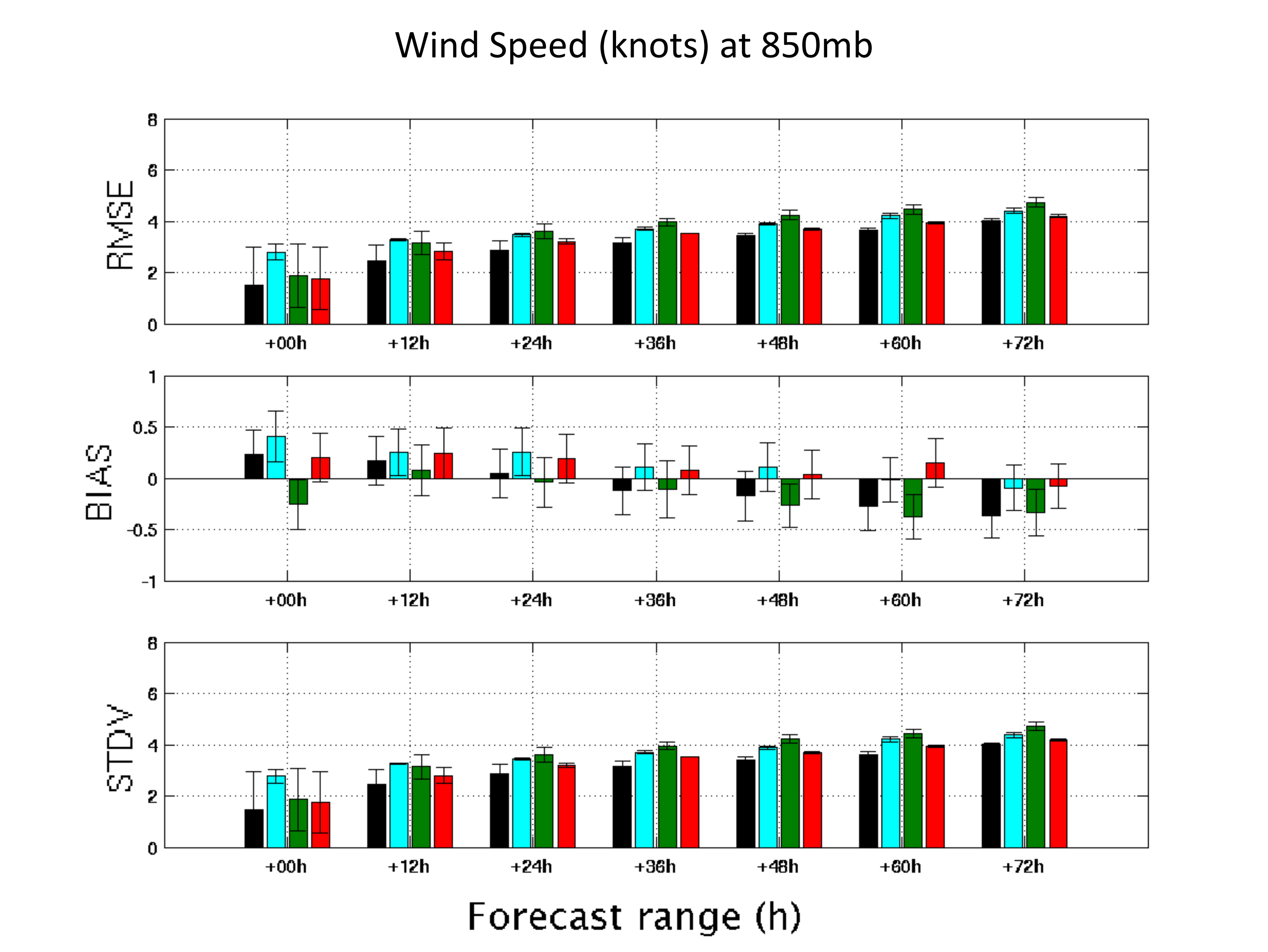
RH at 500mb is determined mainly by large scale advection (easier to predict)
RH at 850mb is affected by surface – local effects (difficult to predict)



IFS (ECMWF)

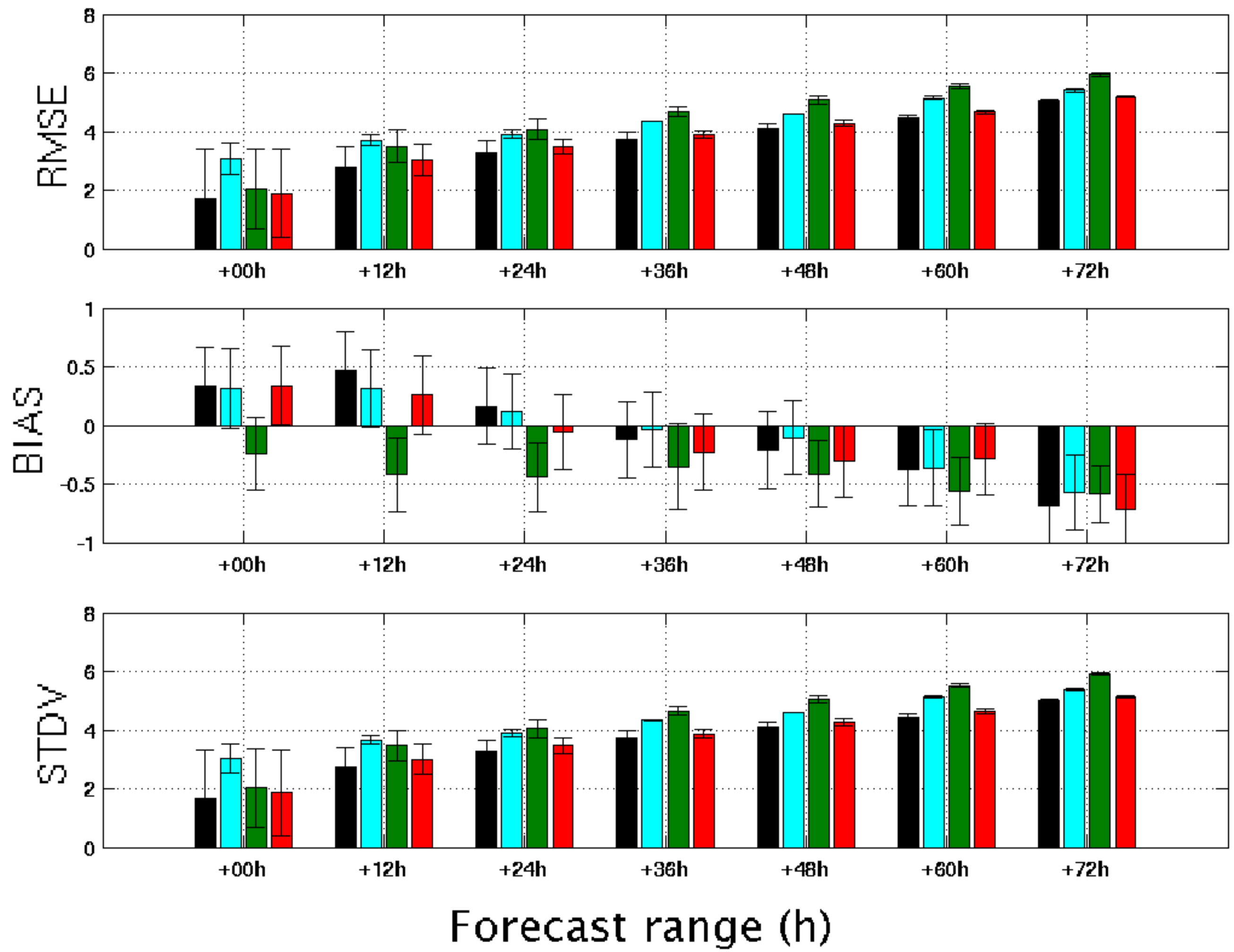
COSMO-ME (7km, over IFS) Italian Met Service

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



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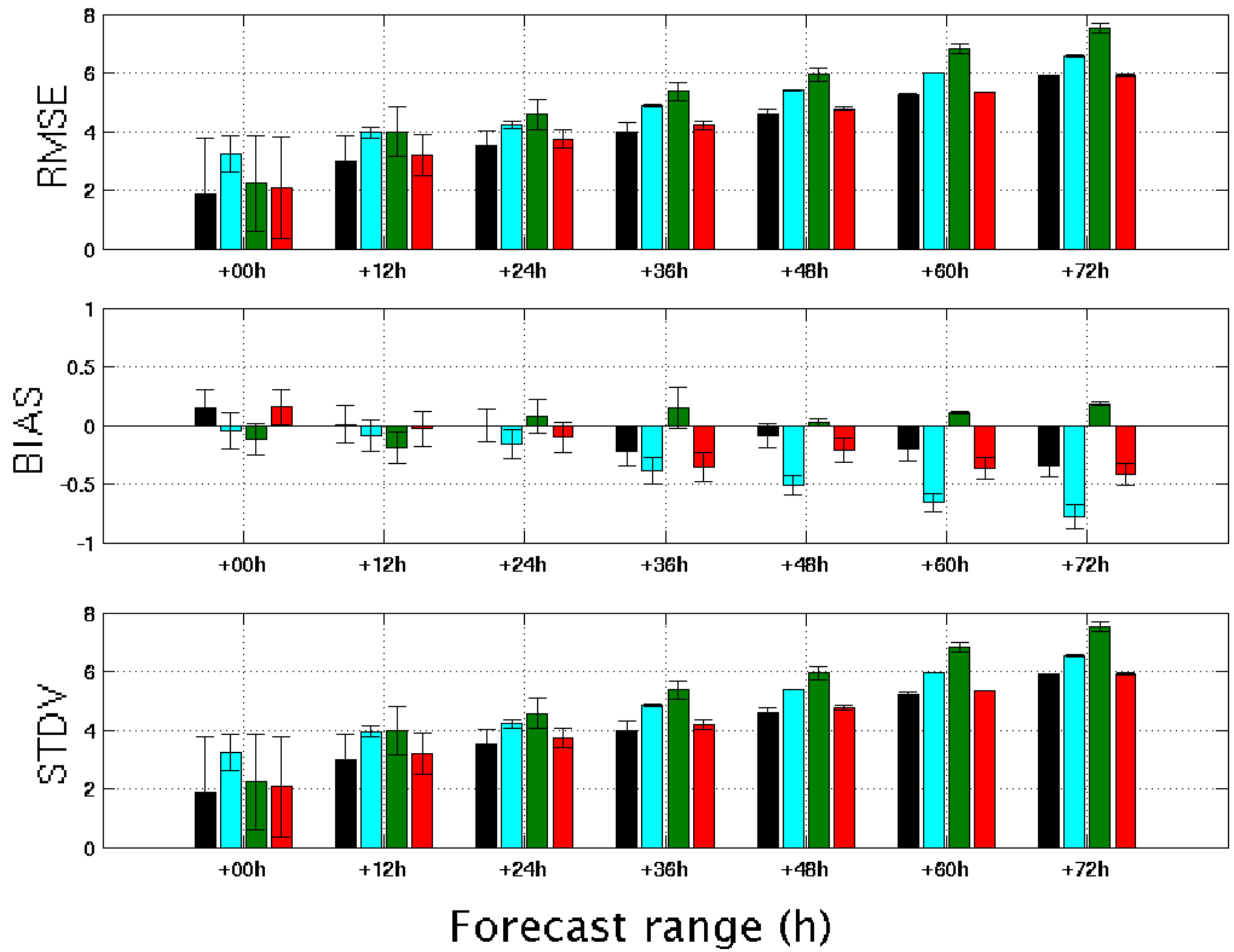
Wind Speed (knots) at 500mb



IFS (ECMWF)

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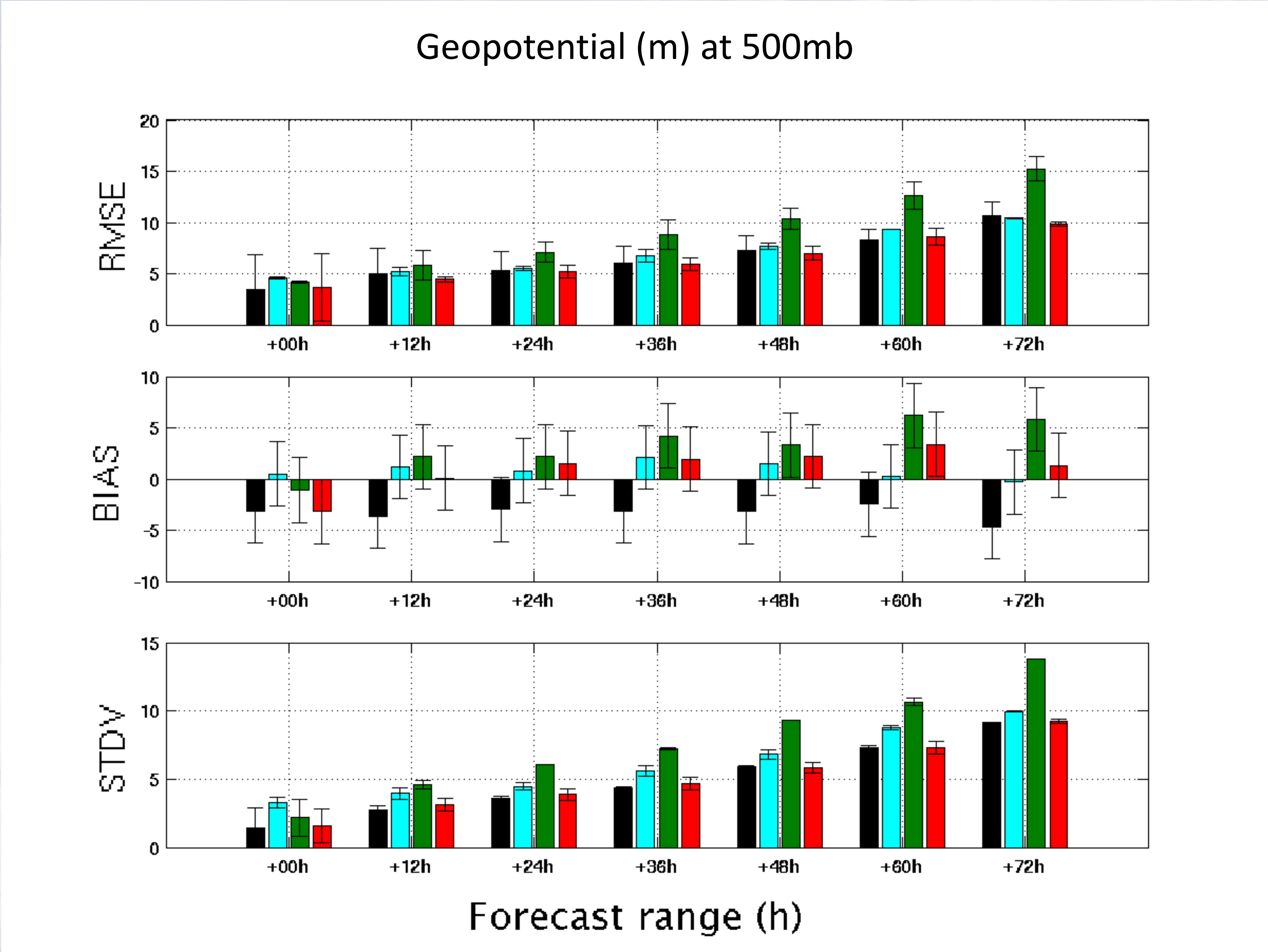
COSMO-IL (7km, over IFS) Israel Met Service

The wind speed increases with height
→ The errors obviously increase



IFS (ECMWF)

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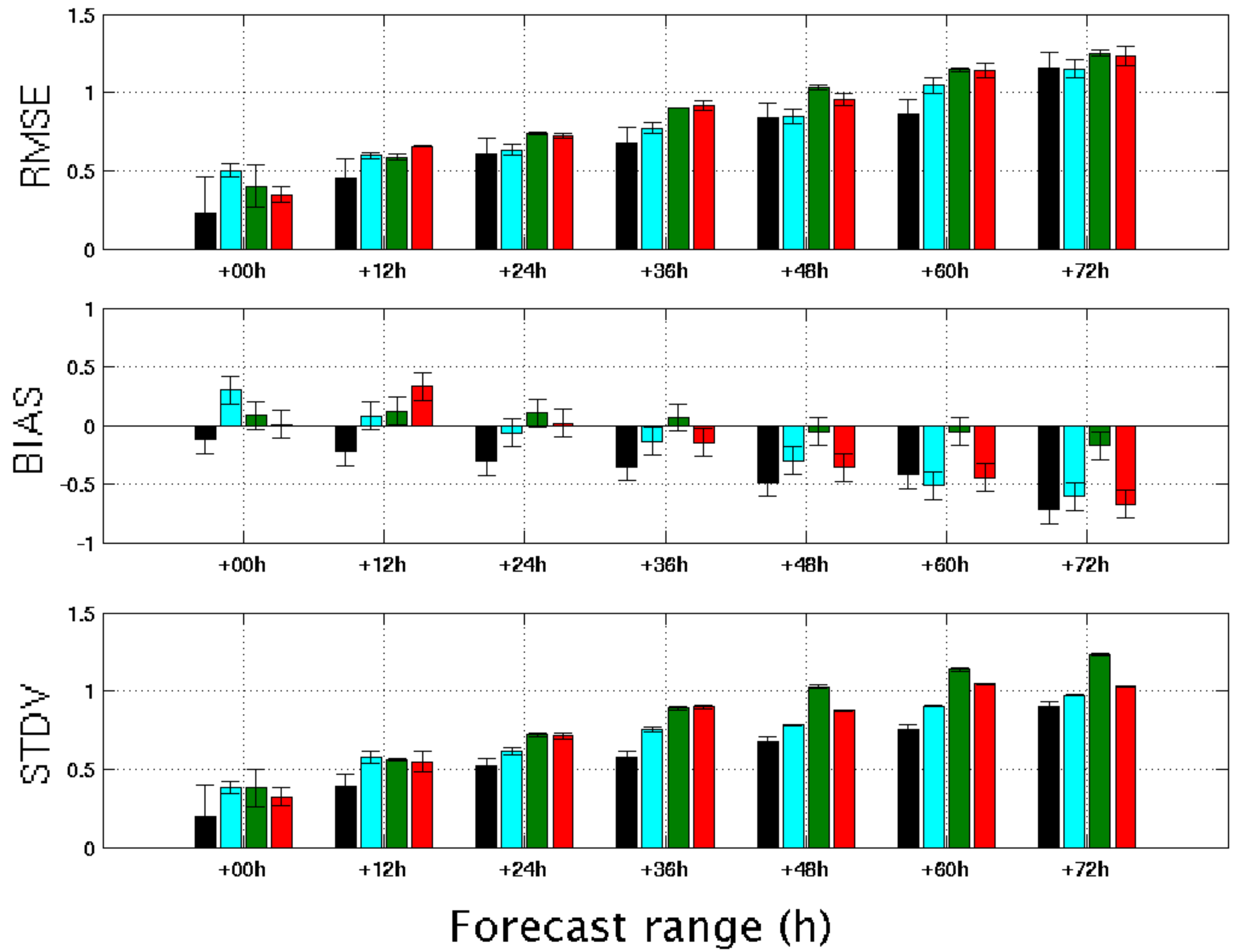
COSMO-IL (7km, over GME) Israel Met Service

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)



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- 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 !