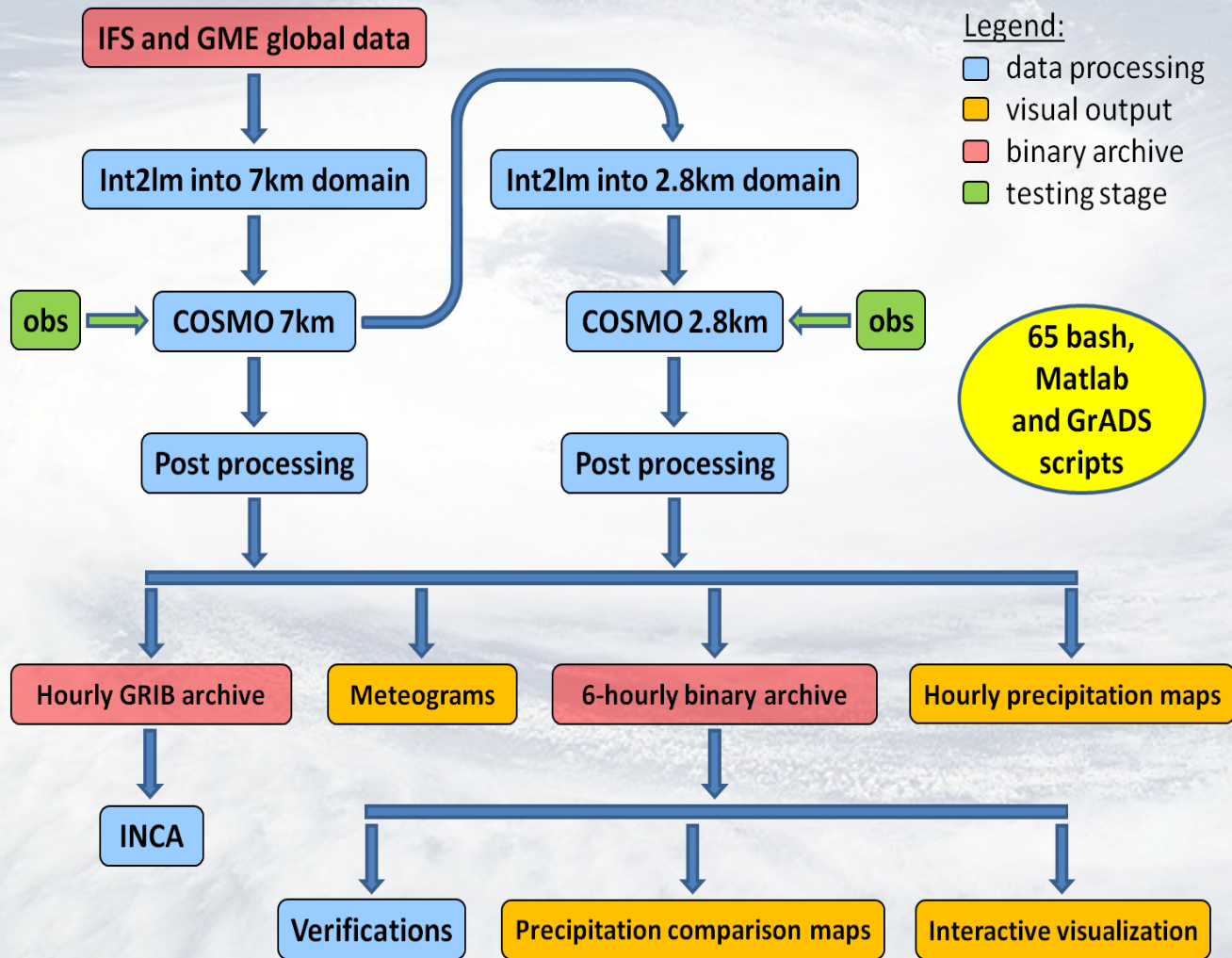


COSMO model at the Israel Meteorological Service: Implementation and Verification

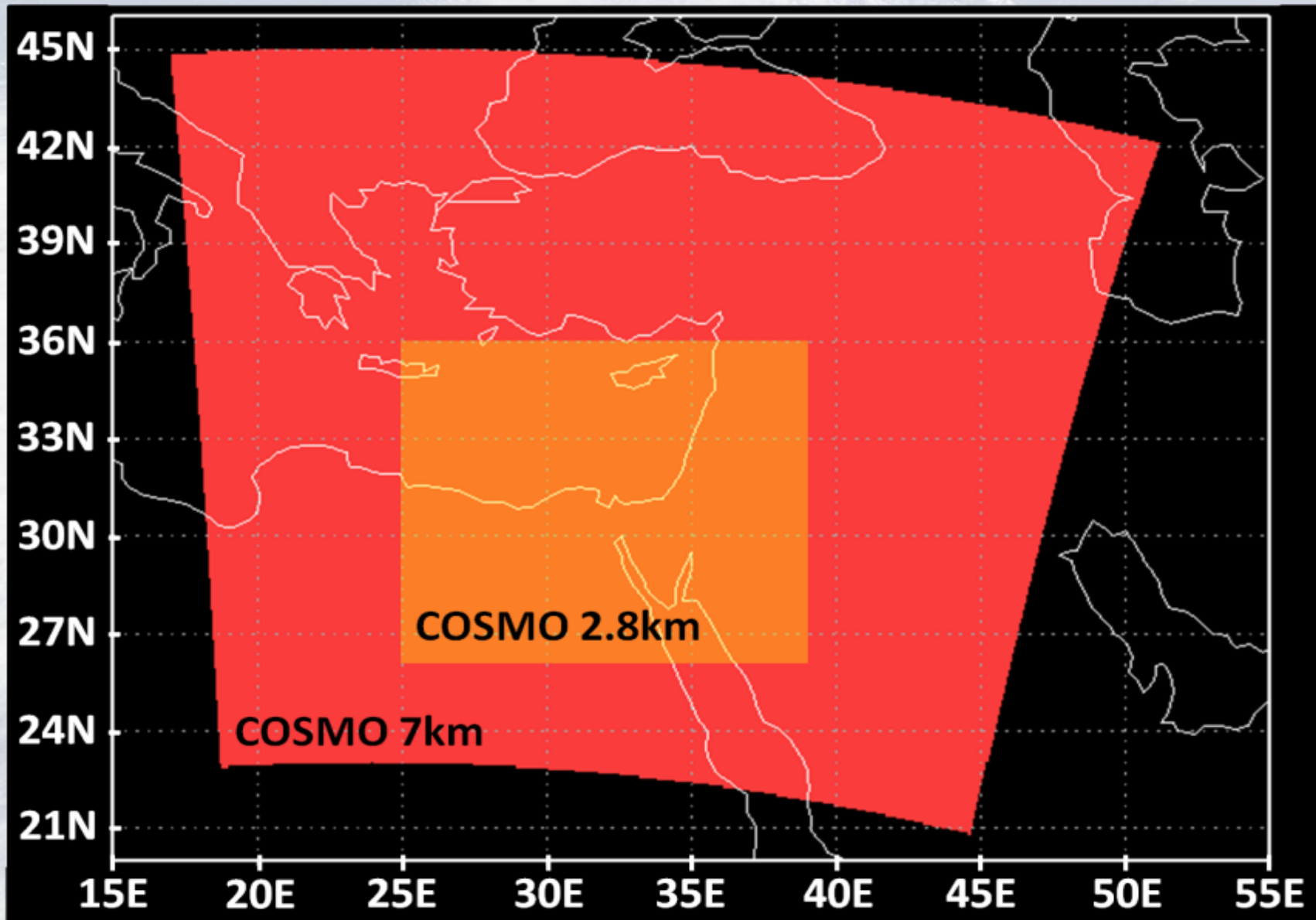
**P. Khain, A. Shtivelman, I. Carmona, S. Krichak and Y. Levi
Israel Meteorological Service**

COSMO work flow in IMS



- Version 4.26 • resolutions: 7-km and nested 2.8-km • 50 vertical levels • twice daily runs
- Driving data: IFS and GME • Recently: applied DA from the local and GTS data

Model domains

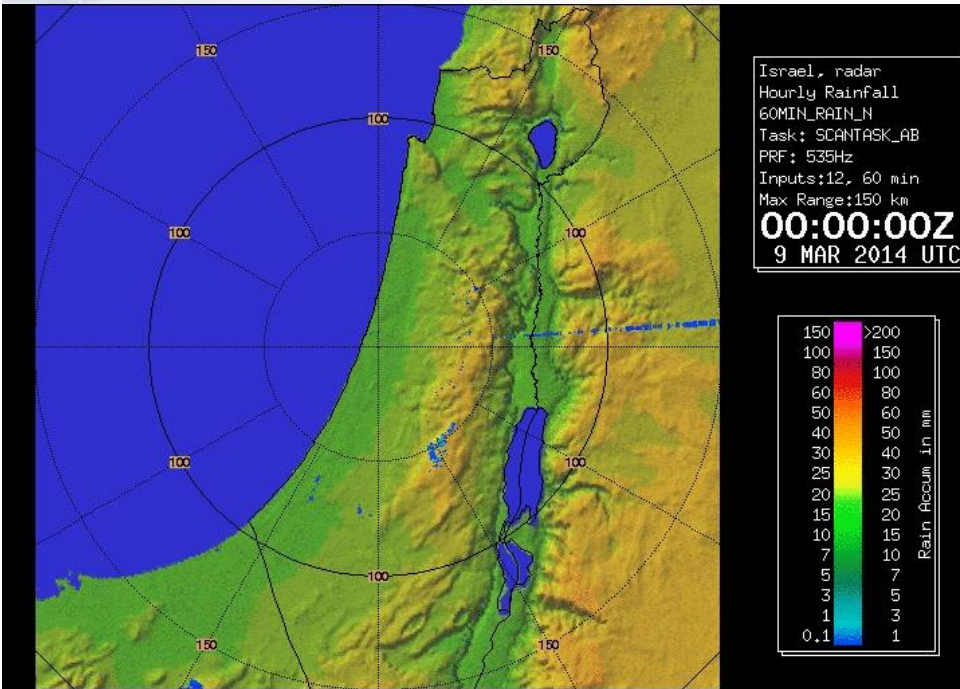


Main characteristics

	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	256	319
Run time	1:40h	
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

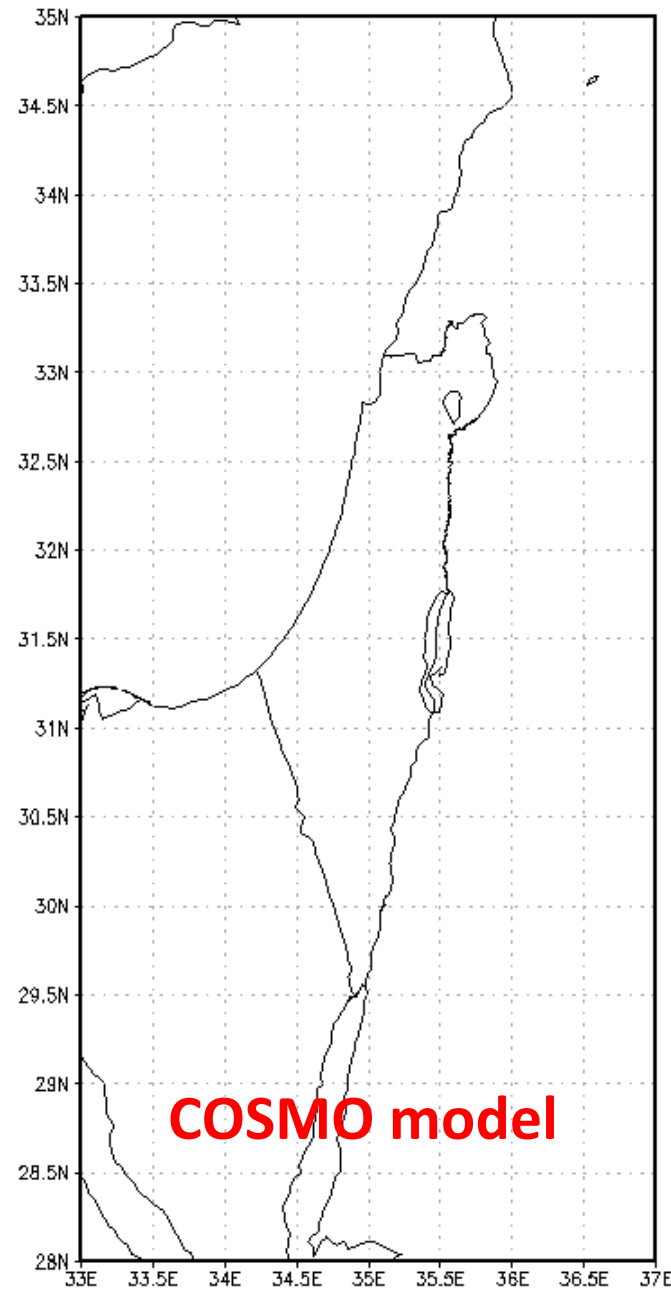
Example (animation) ...

Precipitation over Israel 9-11/3/2014



Radar

C3 rain to Sun 09 MAR 00Z



mm/h



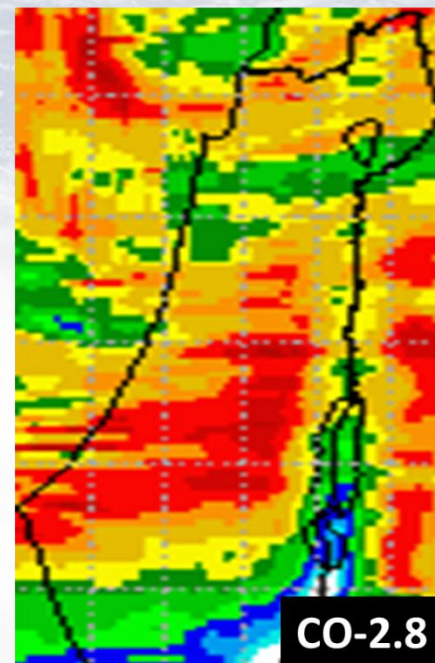
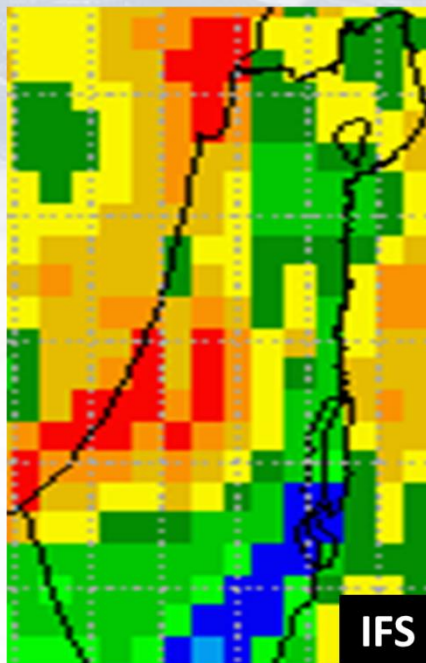
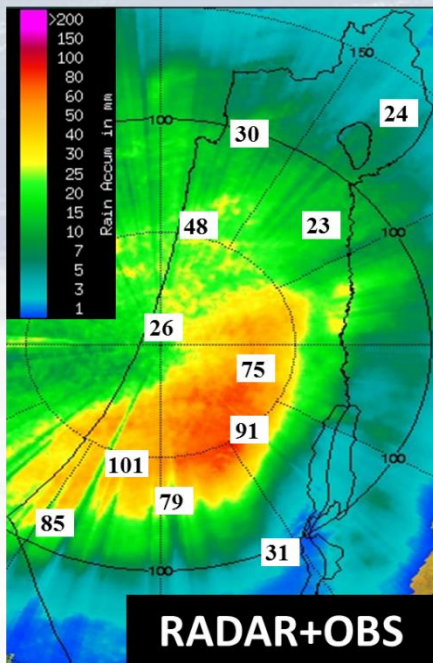
Verification highlights

An aerial satellite-style photograph of a tropical cyclone. The storm features a prominent, dark, circular eye at its center, surrounded by a dense, white ring of clouds. Further out, there are several concentric bands of white clouds, with some spiral-like patterns extending from the eye. The surrounding ocean surface is visible as a darker, textured area.

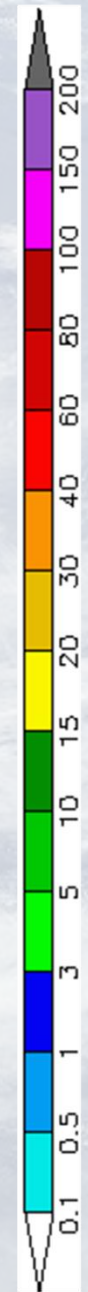
1. Precipitation forecasts

Heavy rainfall from winter cyclone

13-14/12/2013

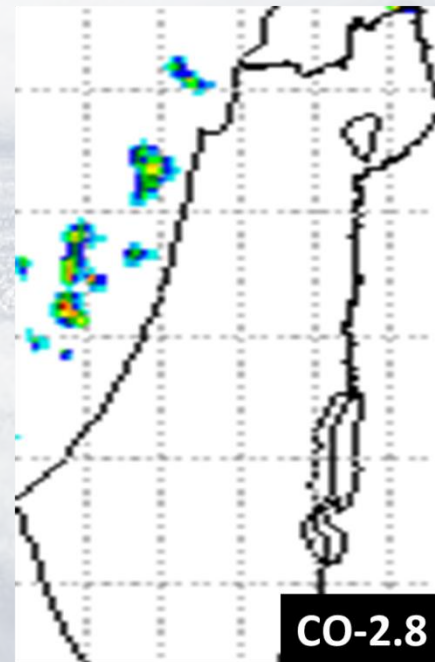
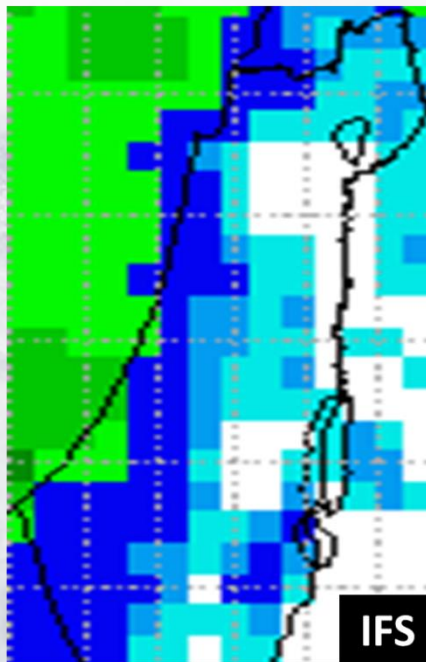
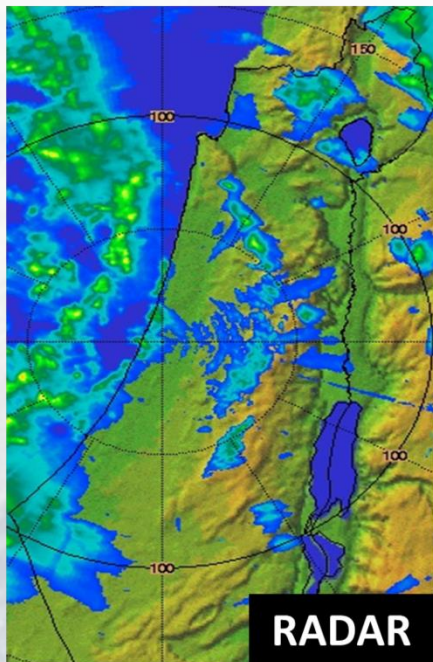


mm/24h



Unorganized Alto-Cb convection

17-18/11/2013

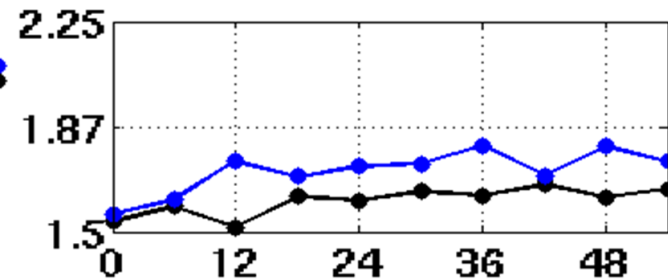
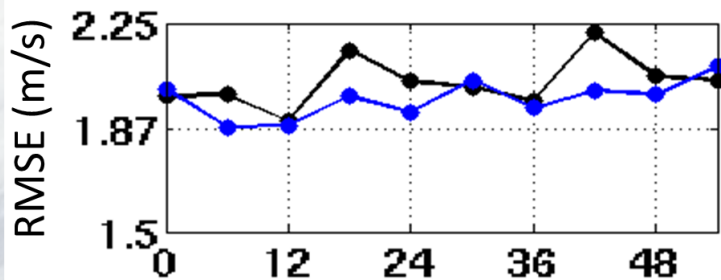
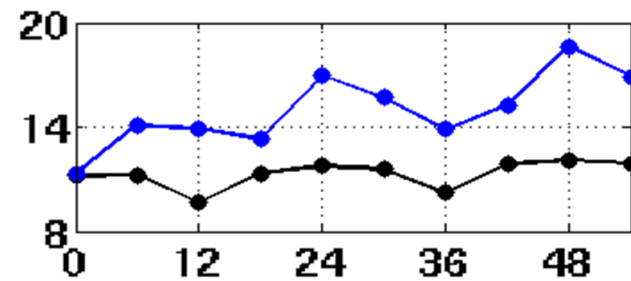
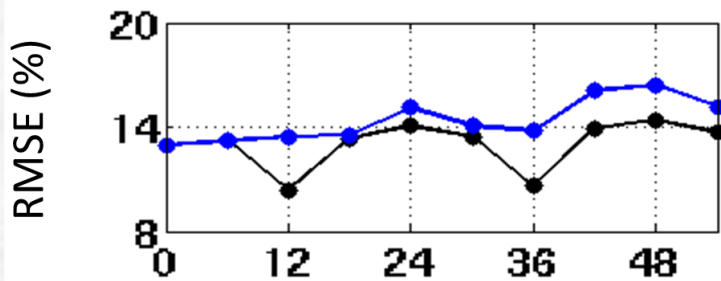
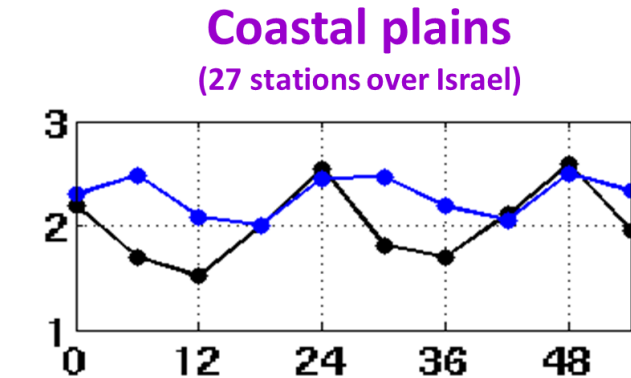
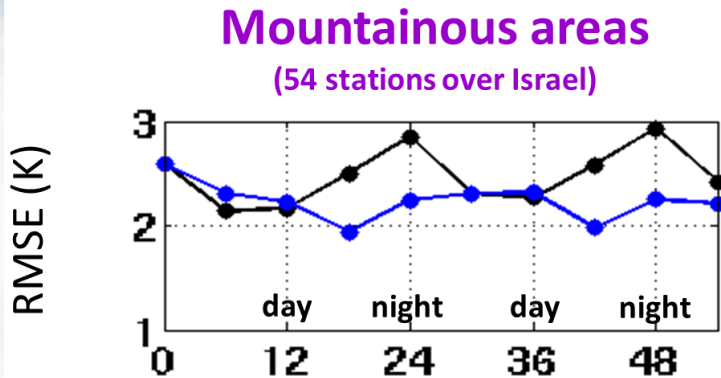


An aerial photograph of a tropical cyclone, showing a distinct central eye surrounded by dense, swirling cloud bands. The eye is a bright, circular area in the center, while the surrounding clouds are darker and more textured. The overall scene is captured from a high altitude, providing a clear view of the storm's structure.

2. Surface fields in coastal plains and mountainous regions

- Generally, CO-2.8 / IFS “beats” IFS in mountainous areas and “loses” to IFS in coastal plains.
- Temperature and wind speed usually depend directly on the height. Because of better resolution, CO-2.8 / IFS predicts these fields better than IFS. On contrary, relative humidity does not depend directly on height.
- The high RMSE in rel. humidity of CO-2.8 / IFS is due to strong negative bias of -10% at night (not shown here).

Temp.
(at 2m)



Wind
speed
(at 10m)

Forecast range (hr)

Forecast range (hr)

● IFS
● CO-2.8 / IFS

00 UTC
runs,
Dec13
to
Feb14

An aerial photograph of a tropical cyclone, showing a distinct central eye surrounded by a dense, swirling cloud structure. The clouds are white and contrast sharply with the darker ocean surface. The overall scene is captured from a high altitude, providing a clear view of the storm's circular geometry.

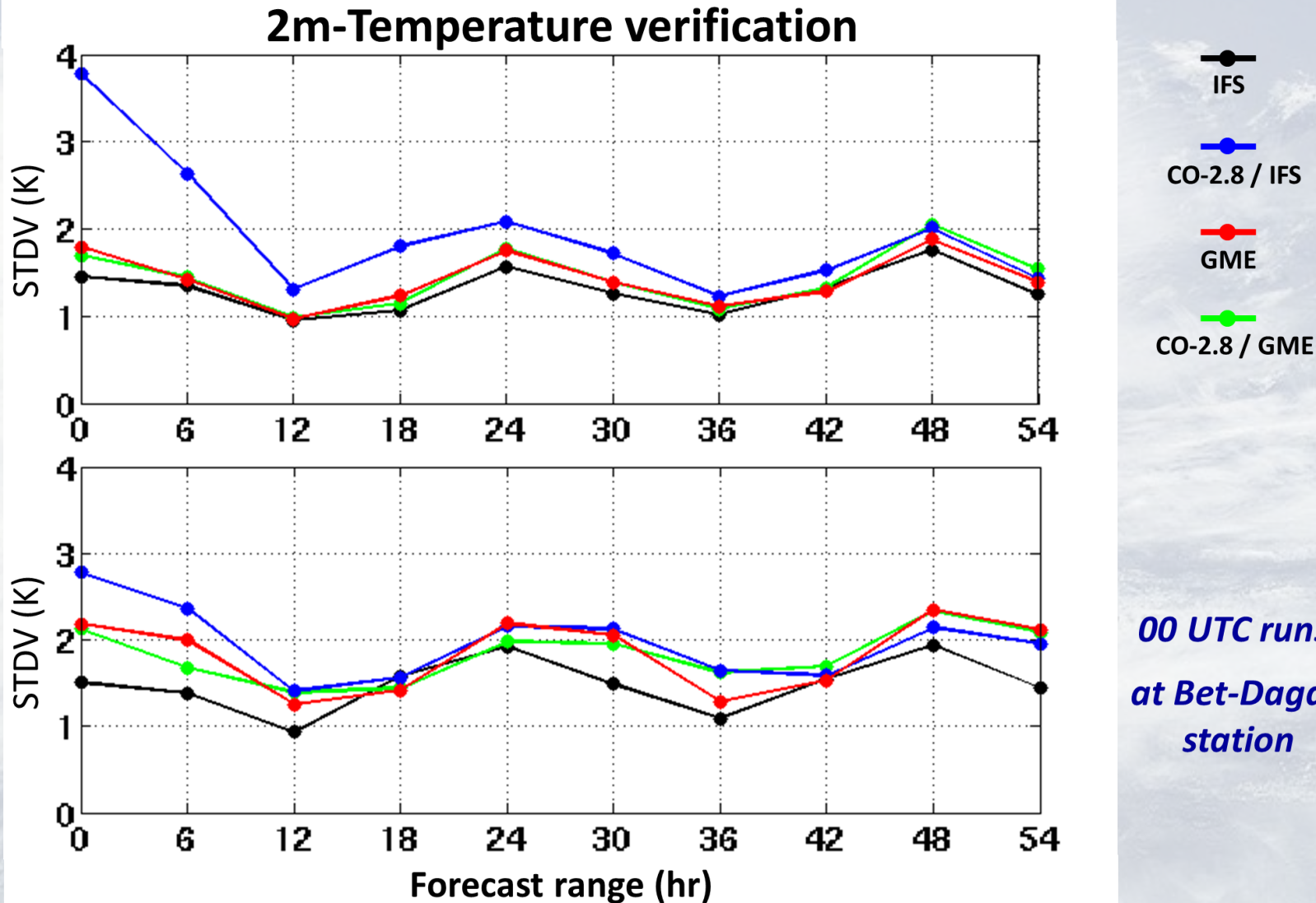
3. Spin-up problems

➤ *CO-2.8 / IFS shows significant temperature (at 2m) errors during the first 6-12 hours of forecast (in contrast to CO-2.8 / GME).*

➤ *Bad interpolation of "soil fields" from IFS ?!*

➤ *Possible solutions: Applying int2lm-2.0 (with improved soil interpolation from IFS) ? Assimilation cycle / warm start ?*

*Sep13
to
Nov13*



*Dec13
to
Feb14*

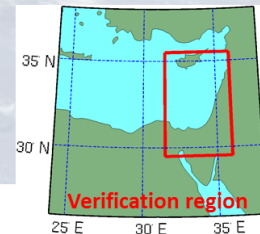
*00 UTC runs,
at Bet-Dagan
station*

An aerial photograph of a tropical cyclone, showing a distinct eye in the center surrounded by dense, swirling cloud bands. The image is used as a background for the text.

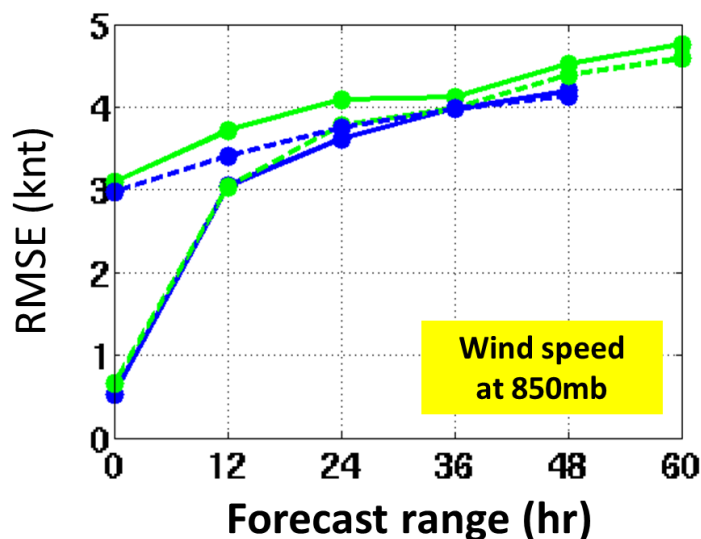
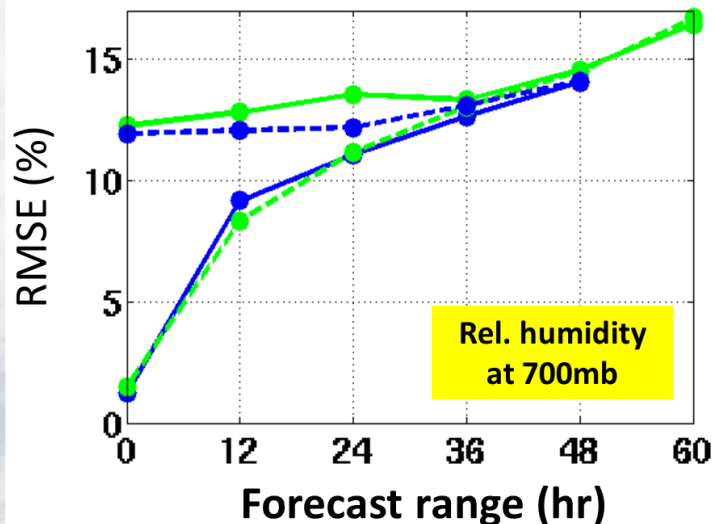
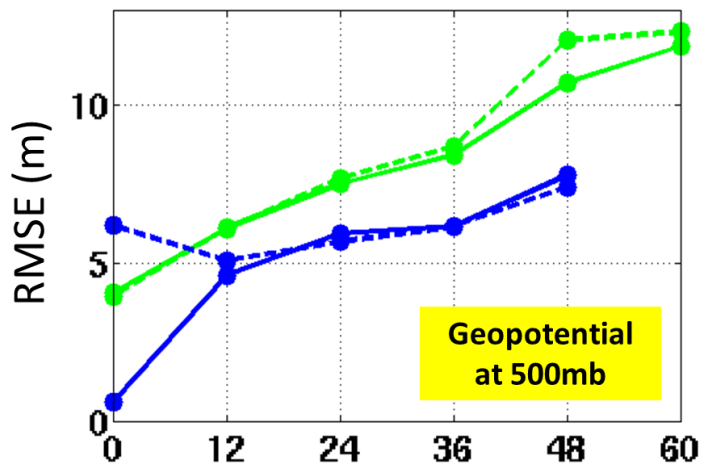
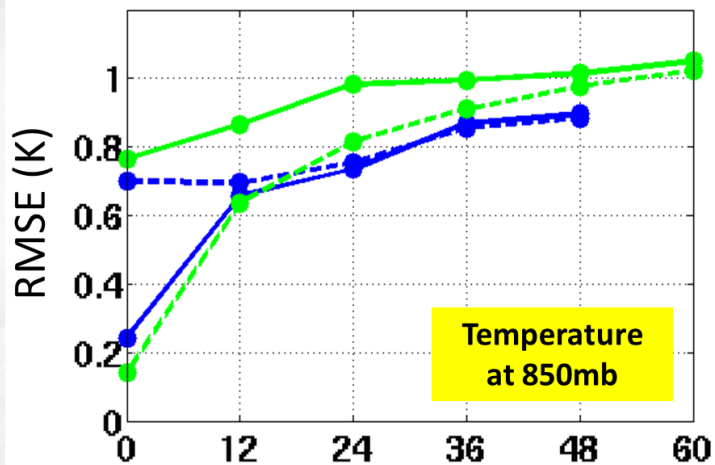
4. Verification vs. analyses for upper-air fields

➤ Generally, CO-2.8 / IFS shows better results than CO-2.8 / GME.

➤ Strong dependence on the type of the analysis (IFS or GME). "Built-in" advantage when verifying against the own driving-model analysis. Generally, the results are reliable after forecast range of about 24h.



Verification vs. IFS and GME analyses



00 UTC runs,
Dec13 to Feb14

- CO-2.8 / IFS vs. IFS analysis
- CO-2.8 / IFS vs. GME analysis
- CO-2.8 / GME vs. IFS analysis
- CO-2.8 / GME vs. GME analysis

Conclusions

COSMO model V4.26, 7-km and nested 2.8-km horizontal resolution, with 50 vertical levels, has been adopted for twice daily semi-operational testing at the Israel Meteorological Service (IMS). The model runs are performed using IFS (ECMWF) driving data over a “rotated” domain covering the eastern Mediterranean region. COSMO model verification analysis was performed during the last year over Israel.

Main findings:

1. Precipitation forecasts perform well in deep winter cyclones, but are less accurate in local unorganized convective situations.
2. The near surface fields are well predicted in mountainous areas, but are less accurate in coastal plains (comparing to IFS).
3. COSMO forecasts of the near surface fields show spin-up of 6–12 hours, implying that initialization of soil fields from IFS might be problematic.
4. COSMO verification against IFS analyses was also performed. This verification suffers from “built-in” advantage at the early forecast ranges. Here, we show that verification vs. analyses is reliable for forecast ranges $> \sim 24\text{h}$.