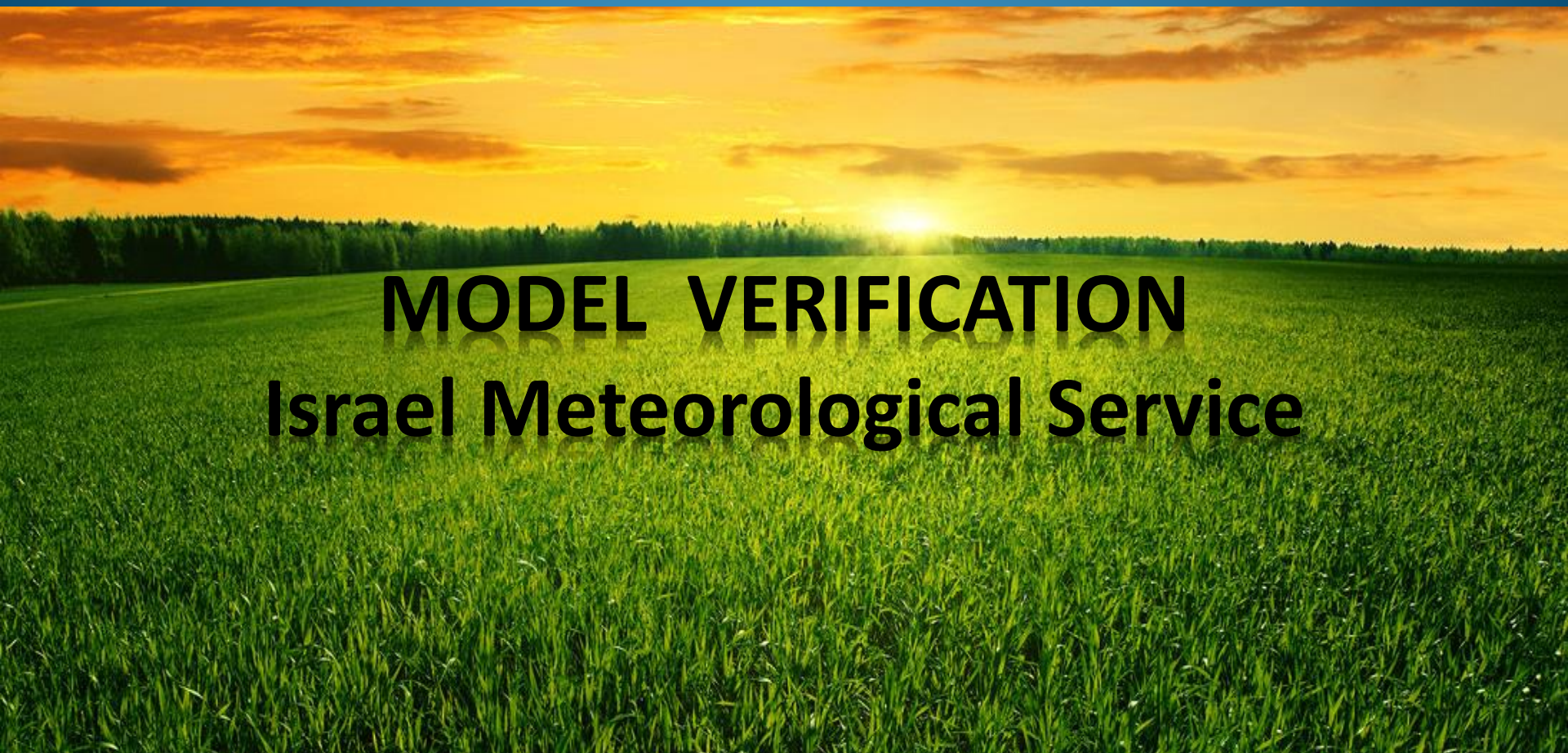




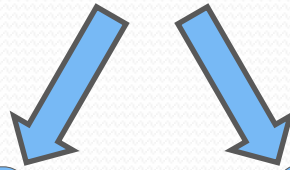
MODEL VERIFICATION

Israel Meteorological Service

Yiftach Ziv
R&D Department
Israel Meteorological Service

COSMO General Meeting
11 -14 September 2017 Jerusalem, Israel

MOTIVATION



Is It Any Good?

- Result Oriented
- Operational

How Do We Improve?

- Process Oriented
- Research



OPERATIONAL

RESEARCH

Forecasters & Models

COSMO (compared to EC,ICON,GFS...)

T, RH, Wind

Precipitation, Fog, Upper air, T, RH, Wind

15 locations

Large Area

78h

78h

Model – Raw & Bias Corrected

Model

Continuous

Test Case Approach

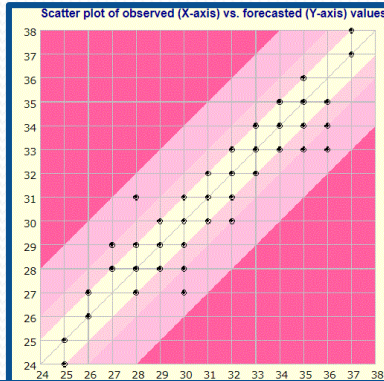
ME, RMSE

ME, RMSE, Fractional Skill Score (Brier)

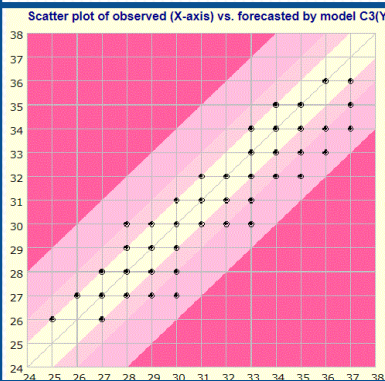


T max

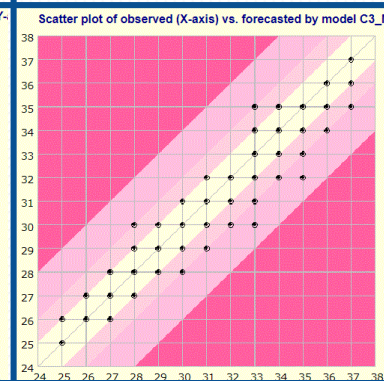
Forecaster



COSMO 3km



COSMO 3km
Bias Corr.



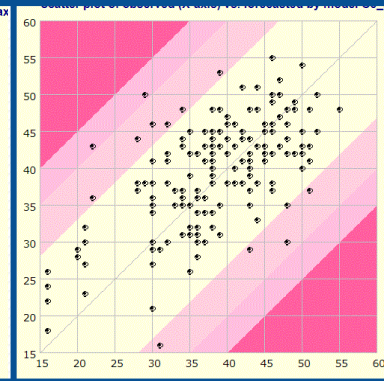
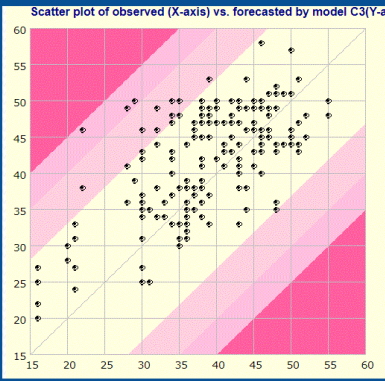
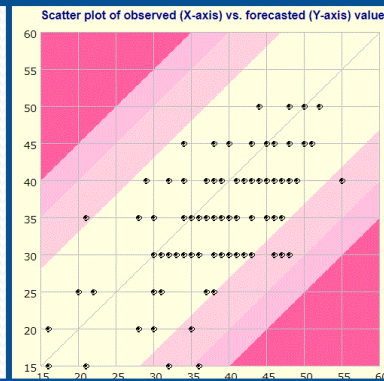
Hit 

Success 

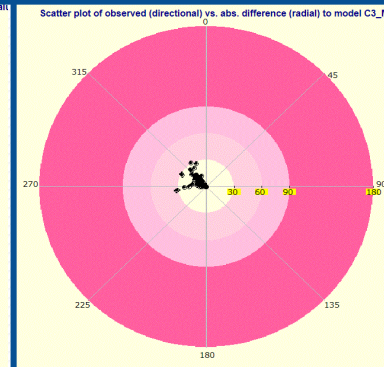
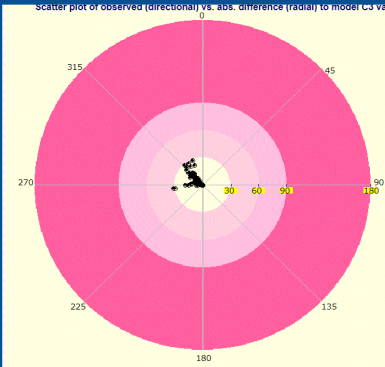
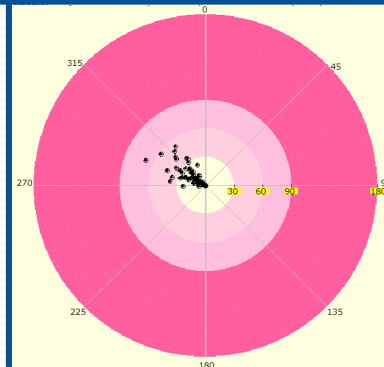
Failure 

Fiasco 

RH min



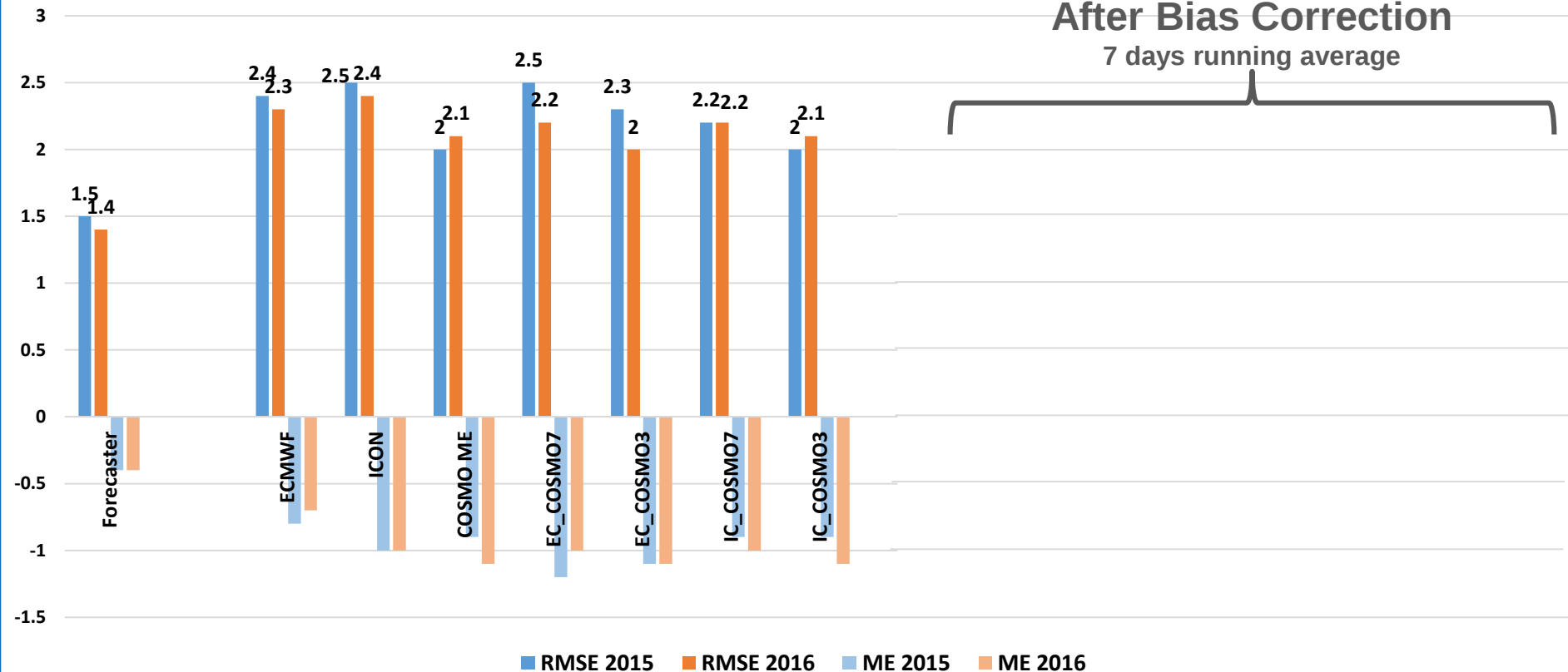
Wind
direction



Daily Tmax in years 2015-2016

After Bias Correction

7 days running average



precipitation

Radar

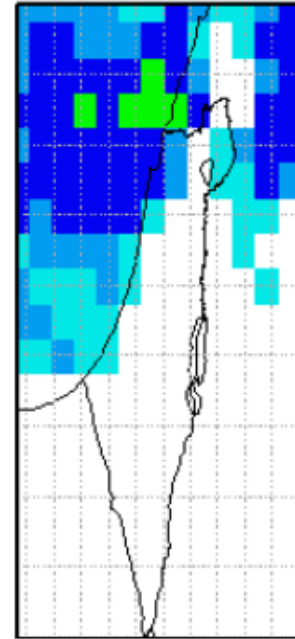
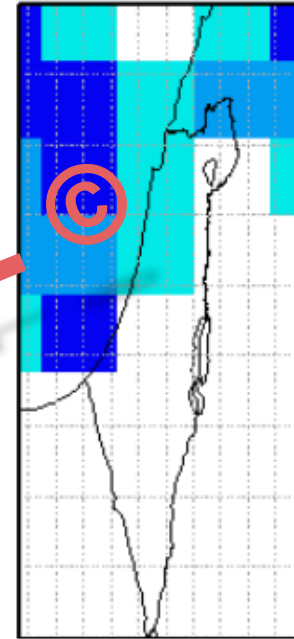
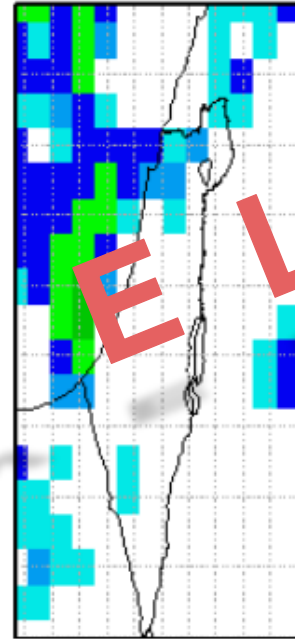
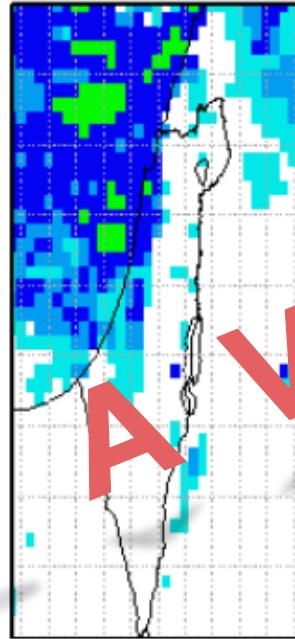
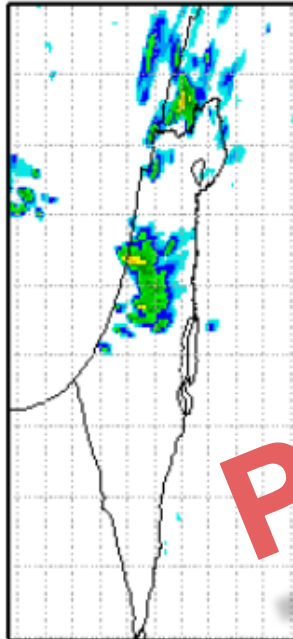
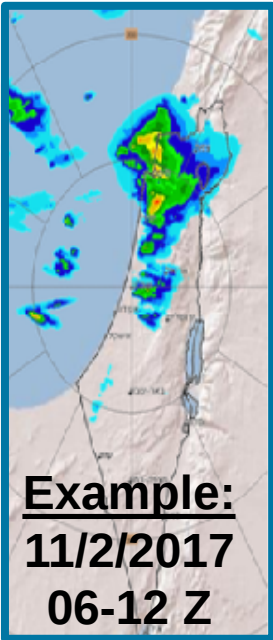
COSMO
2.5km

ECMWF
9km

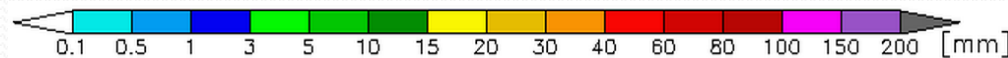
GFS
13km
(25km)

UKMET
17km
(60km)

ICON
13km
(25km)



P A V E L



- 5 models Vs. gauges adjusted radar data
- 6 hours timestep
- Global models: expected lower intensities and reasonable spatial accuracy
- COSMO: expected more accurate intensities, yet double spatial errors

precipitation

Radar

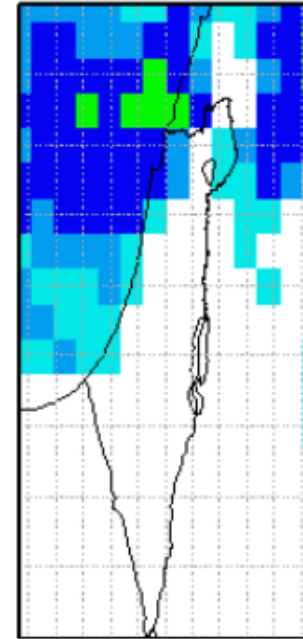
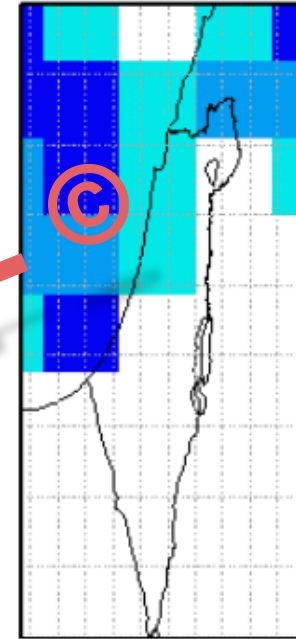
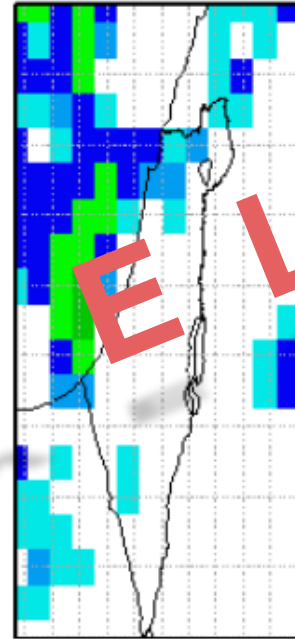
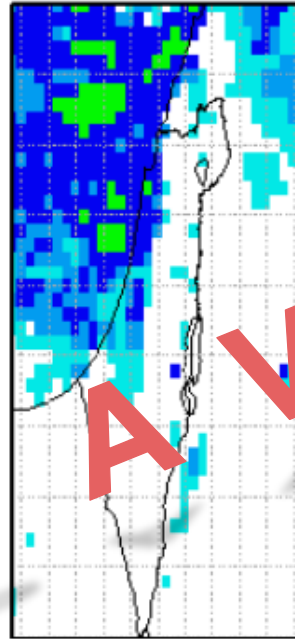
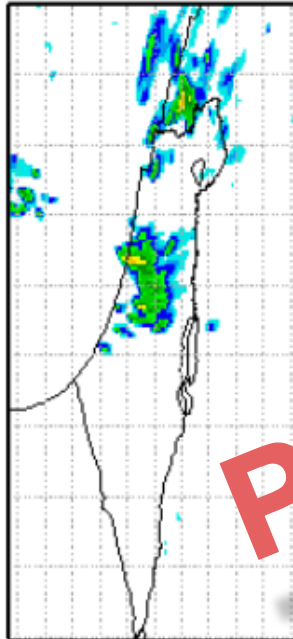
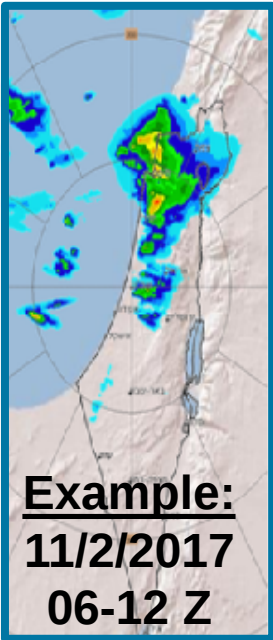
COSMO
2.5km

ECMWF
9km

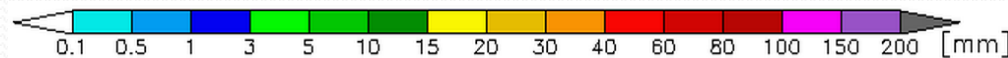
GFS
13km
(25km)

UKMET
17km
(60km)

ICON
13km
(25km)



P A V E L



- 5 models Vs. radar data adjusted with gauges
- 6 hours timestep
- Global models: expected lower intensities and reasonable spatial accuracy
- COSMO: expected more accurate intensities, yet double spatial errors

precipitation

Radar

COSMO

2.5km

ECMWF

9km

GFS

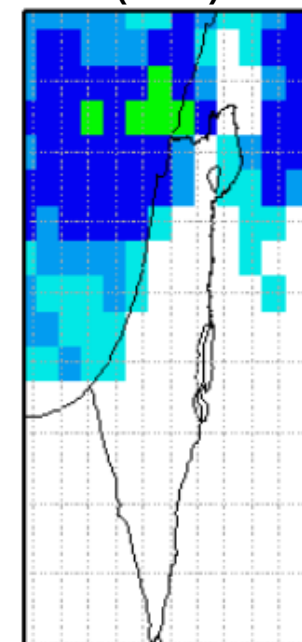
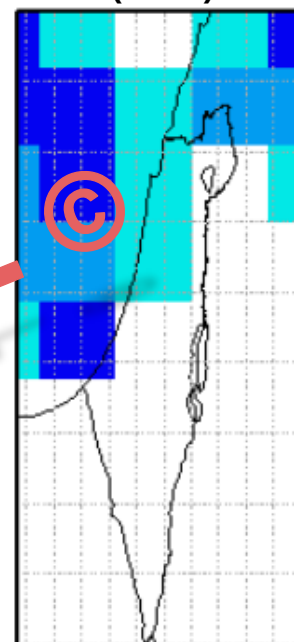
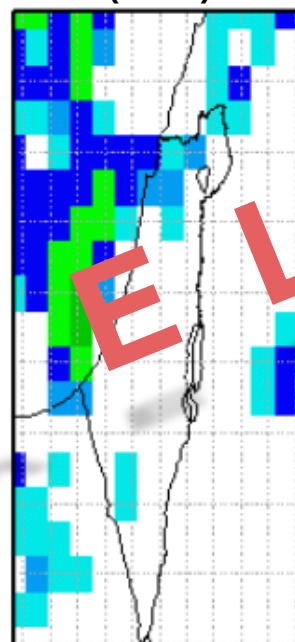
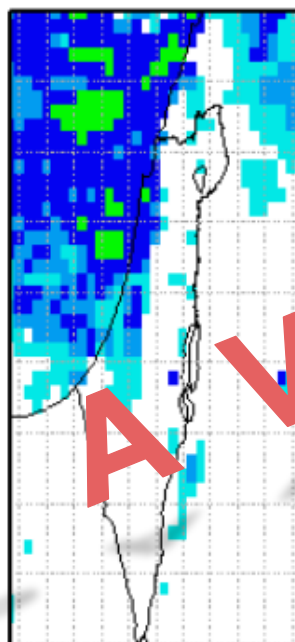
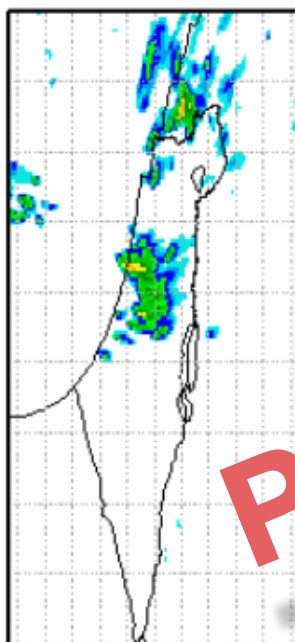
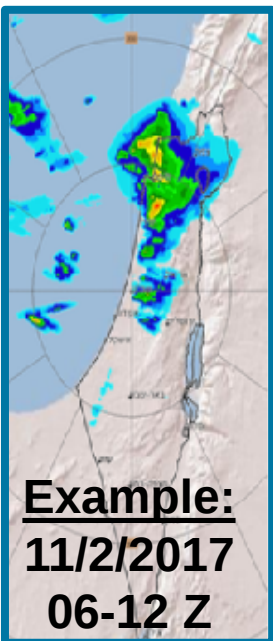
13km
(25km)

UKMET

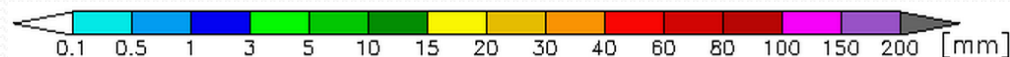
17km
(60km)

ICON

13km
(25km)



P A V E L



- 5 models Vs. gauges adjusted radar data
- 6 hours timestep
- Global models: expected lower intensities and reasonable spatial accuracy
- COSMO: expected more accurate intensities, yet double spatial errors

precipitation

Fractional Skill Score (Brier)
for each threshold and radius:

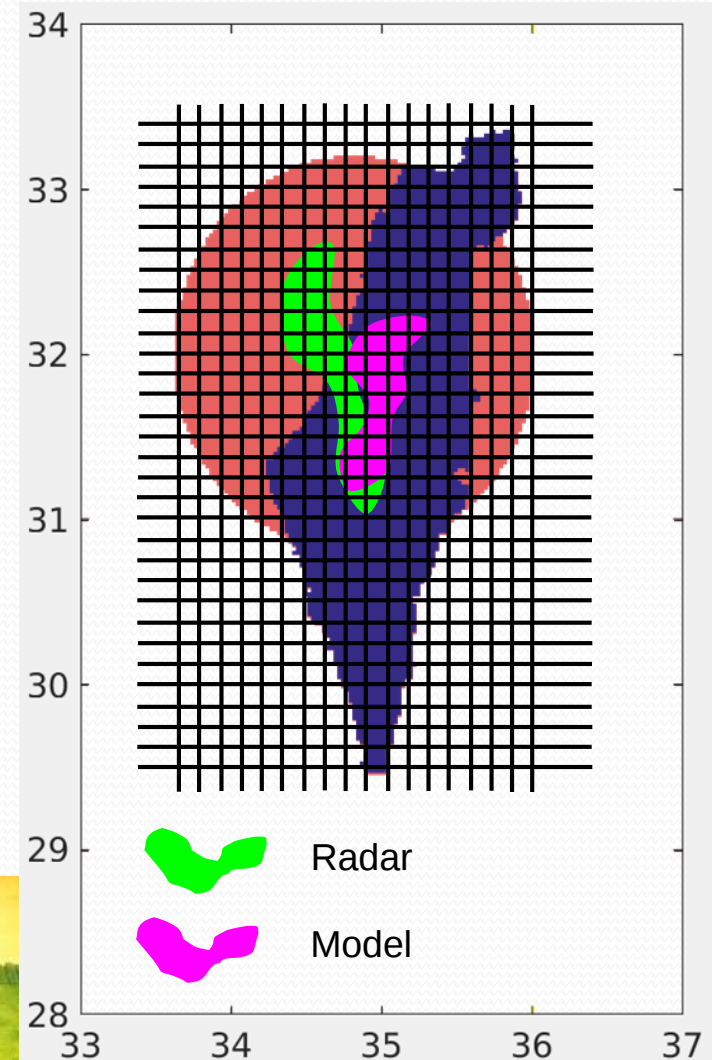
Brier score:
$$FBS(Tr, R) = \frac{1}{N} \sum_{i,j} (M_{i,j} - O_{i,j})^2$$

Worst Brier score:
$$FBS_{worst}(Tr, R) = \frac{1}{N} \sum_{i,j} (M_{i,j}^2 + O_{i,j}^2)$$

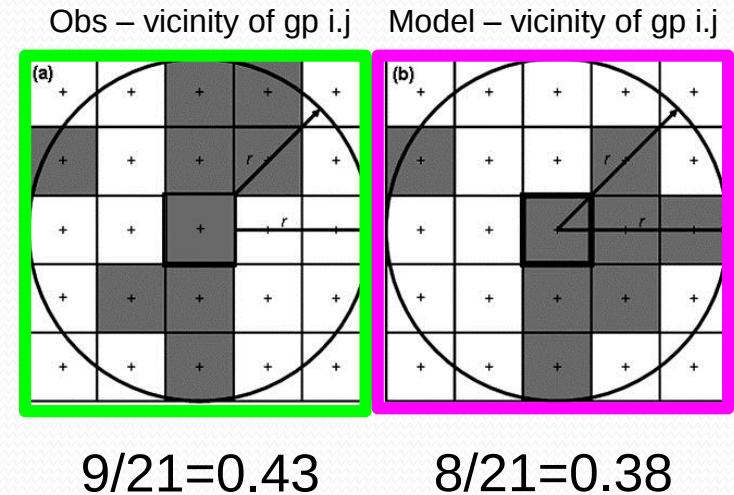
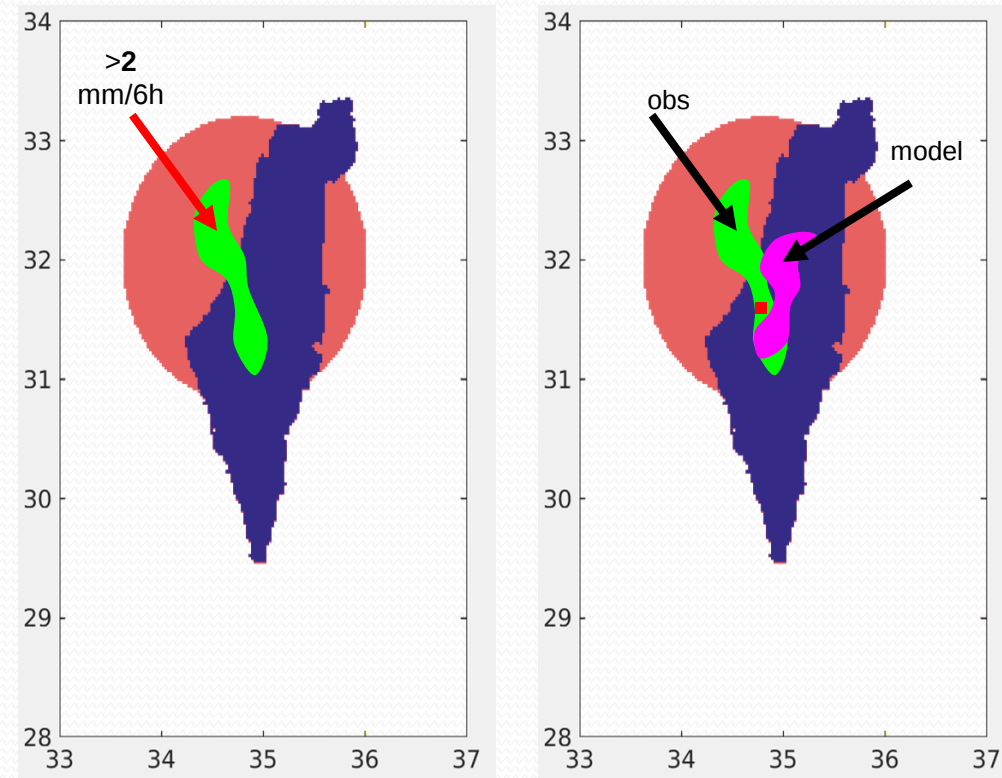
Fractional Skill Score:
$$FSS(Tr, R) = 1 - \frac{FBS(Tr, R)}{FBS_{worst}(Tr, R)}$$

$$\left\{ \begin{array}{ll} \text{BEST} & \longrightarrow FSS(Tr, R) = 1 \\ \text{WORST} & \longrightarrow FSS(Tr, R) = 0 \end{array} \right\}$$

Roberts et al. (2008), Ebert (2009), Mittermaier et al. (2010,2013)



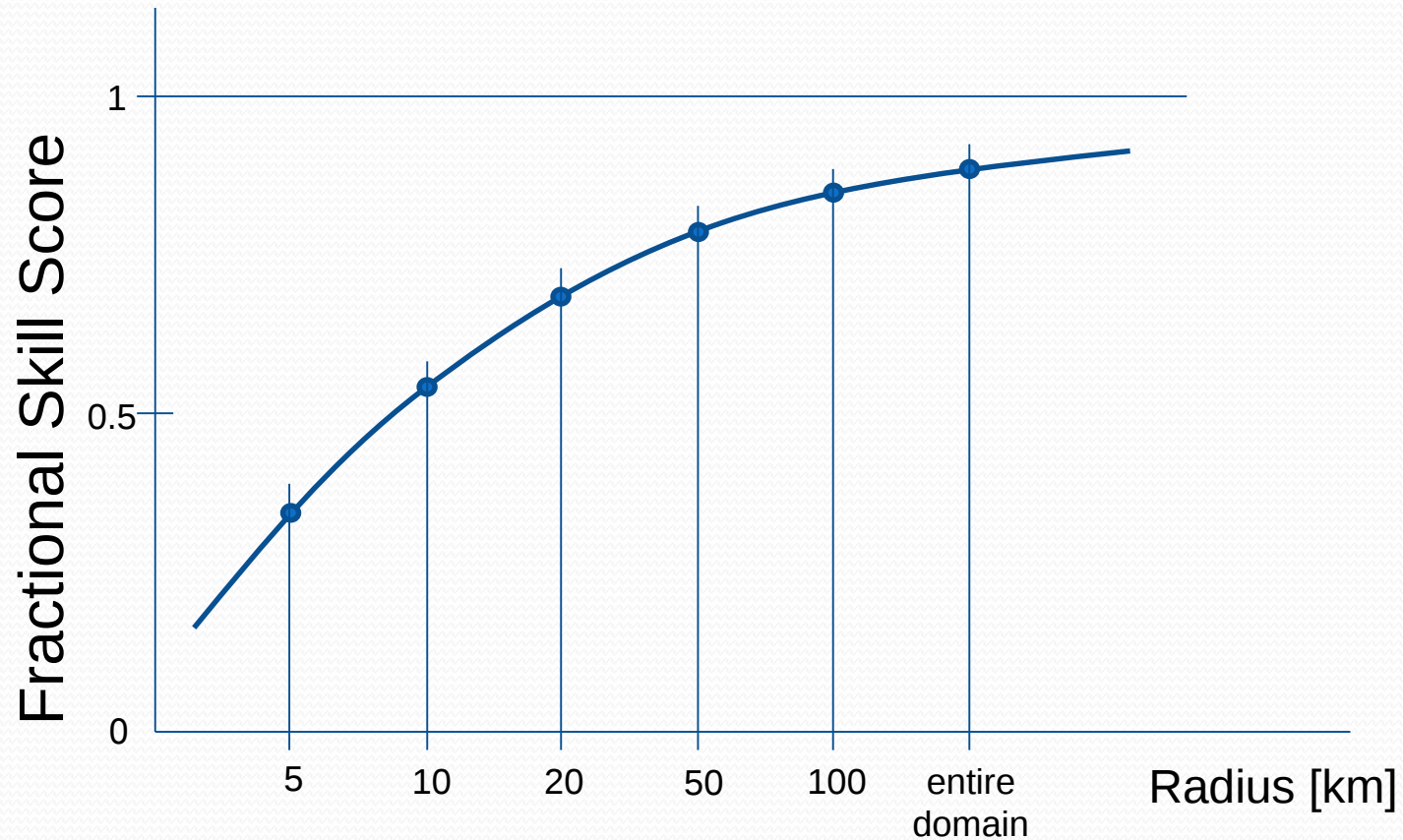
precipitation



Error at gp i,j is:
 $0.43 - 0.38 = 0.05$



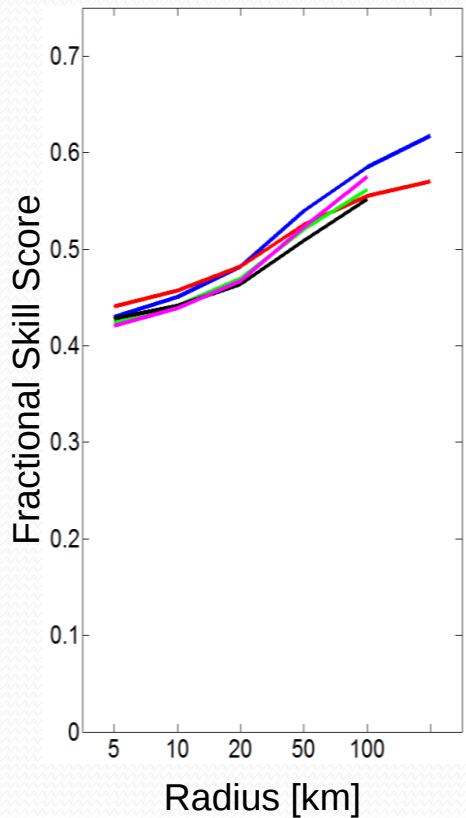
precipitation



precipitation

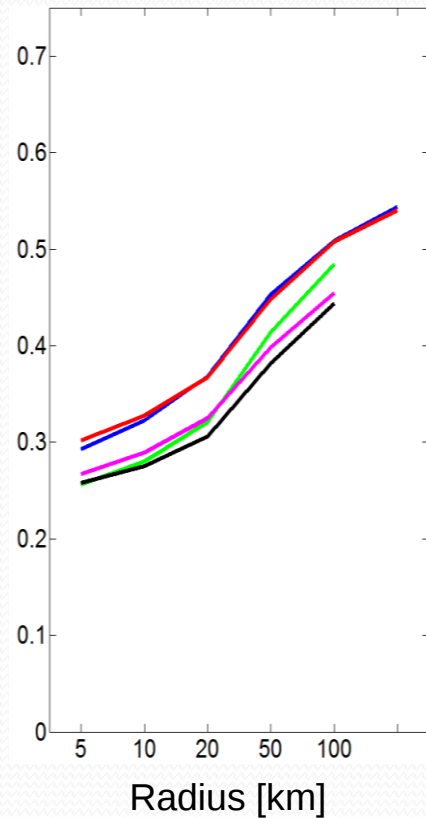
Rain > **0.1** mm/6h

N = ~1200



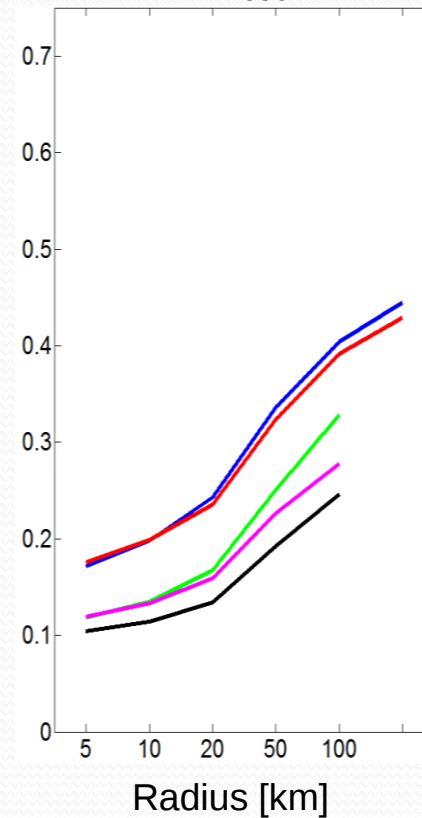
Rain > **2** mm/6h

N = ~800



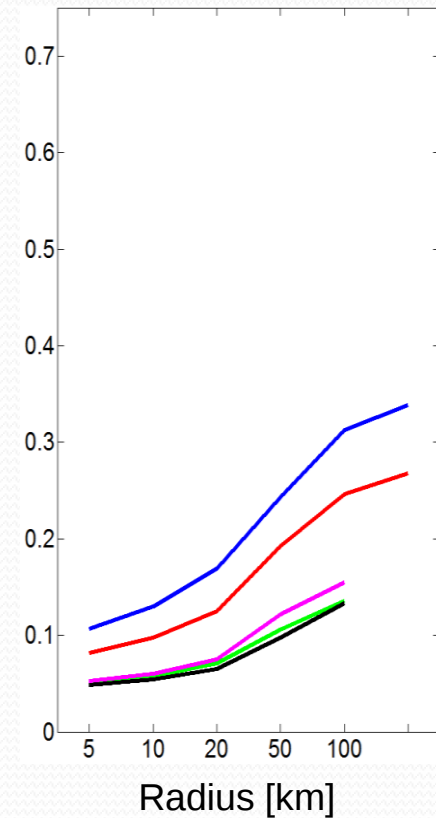
Rain > **5** mm/6h

N = ~650



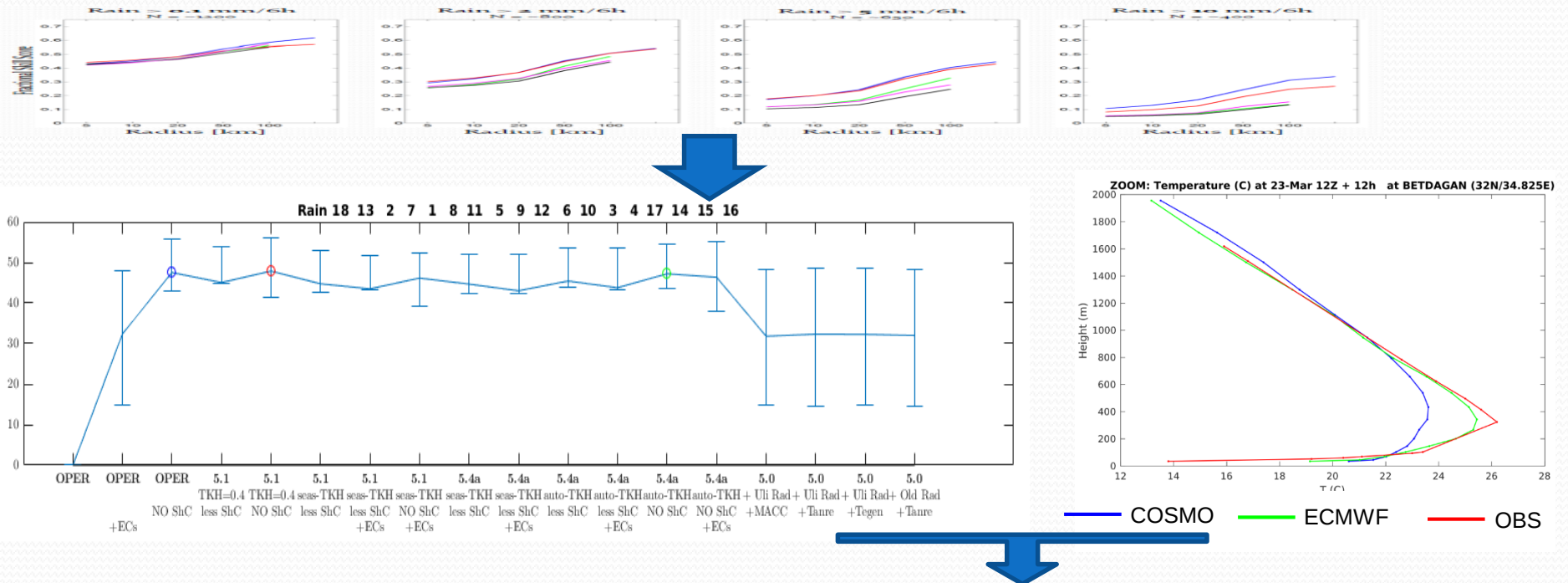
Rain > **10** mm/6h

N = ~400



— COSMO (2.5)
 — ECMWF (9)
 — GFS (13/25)
 — UKMET (17/60)
 — ICON (13/25)





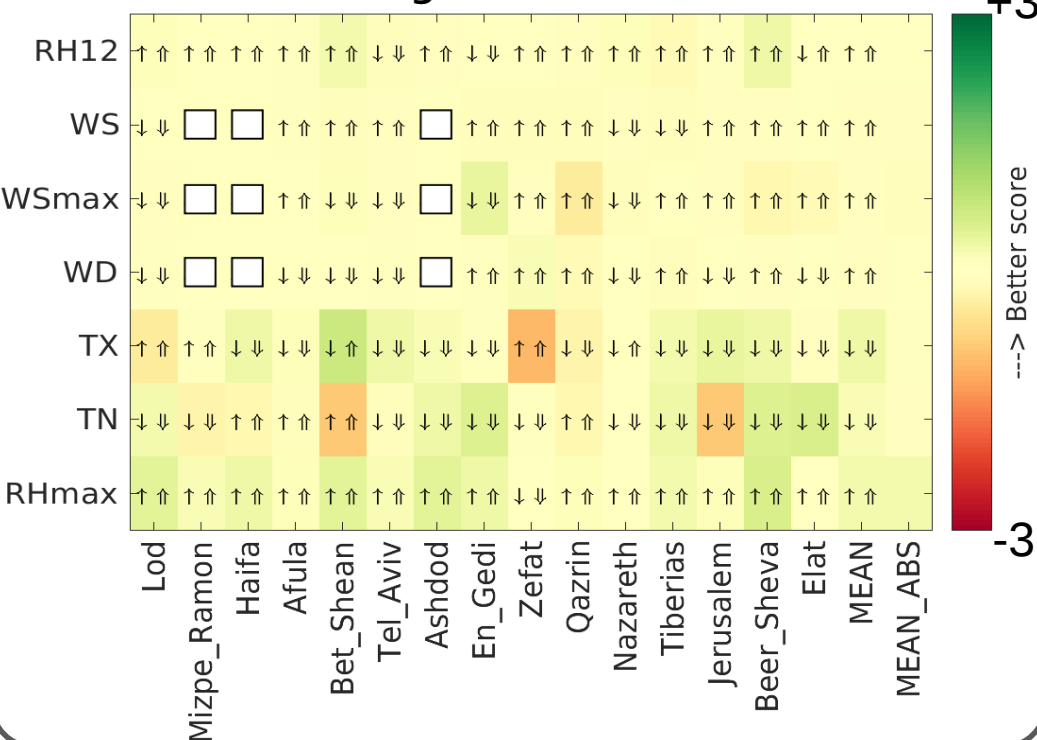
	Rainy	Dry winter	Summer
COSMO version	5.1	5.4	5.1
lconv	FALSE	TRUE	TRUE
thick_sc	-	100mb	250mb
entr_sc	-	0.001	0.0003
pat_len	500	AUTO	500
tkhmin	0.4	AUTO	0.4

Research Verification

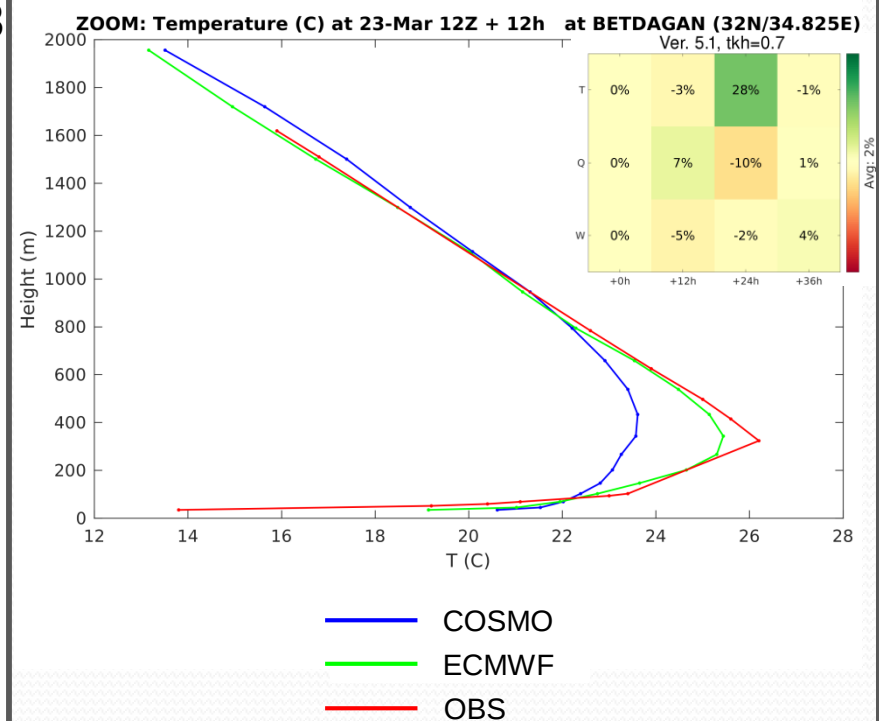
Ground & Upper Air Observations

Ground

Average score: 0.03709



Upper Air



plans

- Operational verification as benchmark
- Introduction of Rfdbk
- Formulating a “Unified Field” Model





THANK YOU



THANK YOU ©
P A V E L



THANK YOU ©
P A V E L