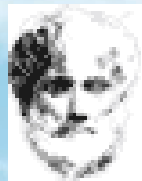


# COSMOGR(7&2) vs IFS over Greece

Dimitra Boucouvala, Flora Gofa

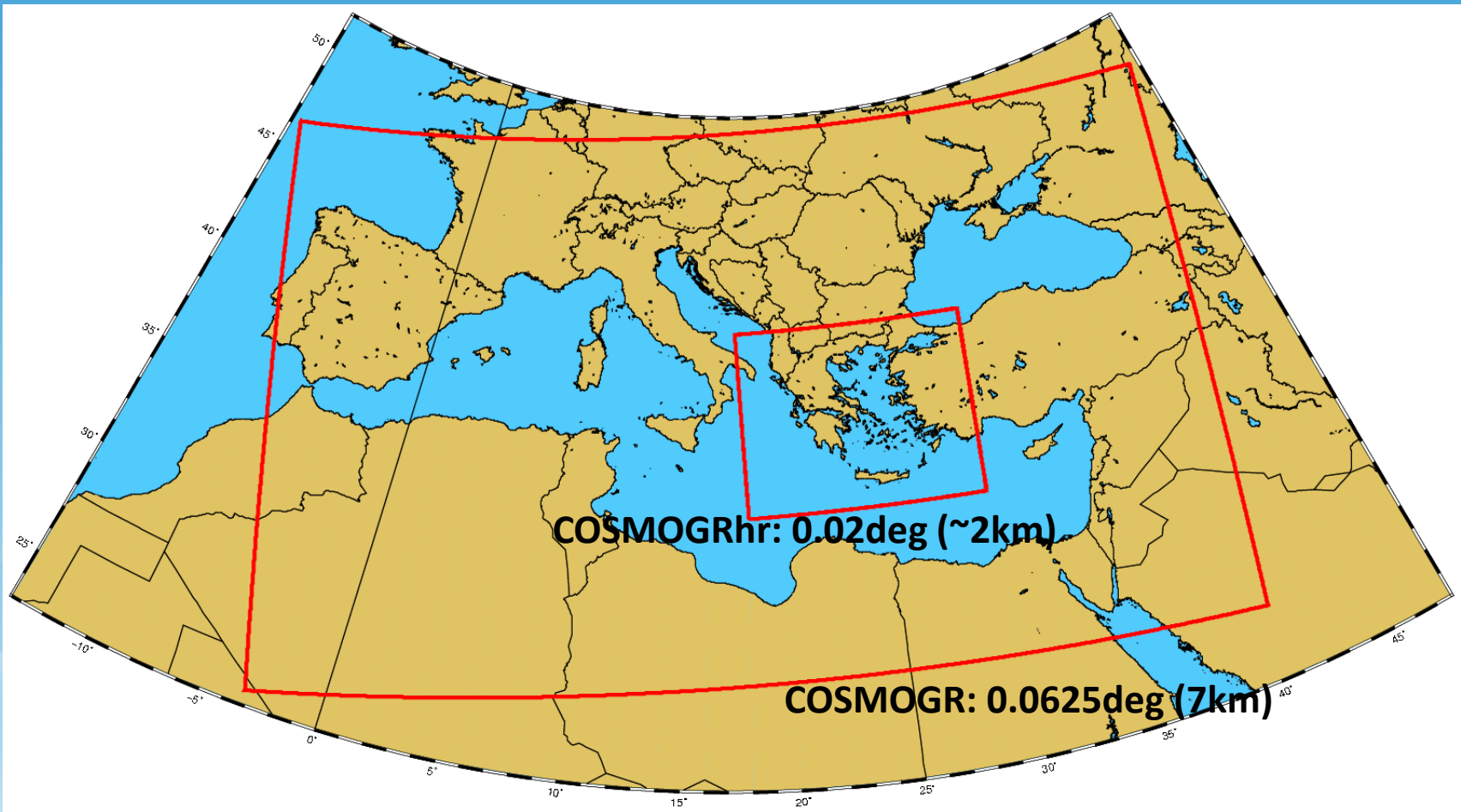


ΕΘΝΙΚΗ  
**ΜΕΤΕΩΡΟΛΟΓΙΚΗ**  
ΥΠΗΡΕΣΙΑ

HELLENIC NATIONAL METEOROLOGICAL SERVICE

# Contents

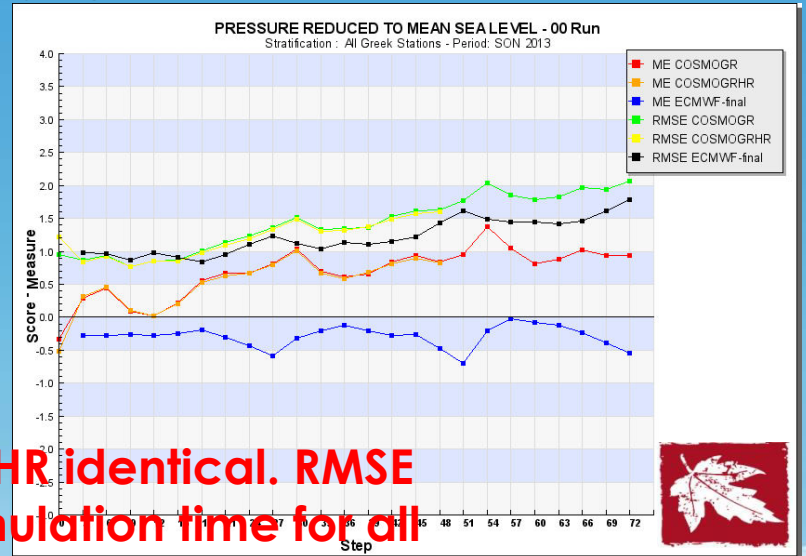
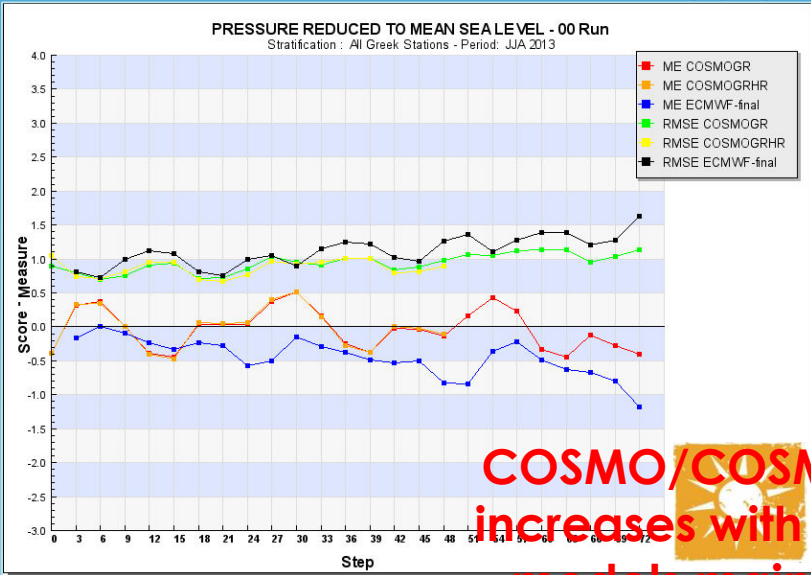
- 1. Comparison of COSMO, COSMOHR and ECMWF(IFS) seasonal performance for JJA 2013- MAM 2014 – conditional tests**
- 2. COSMO Upper air data performance for 2011-2012**
- 3. COSMO Weather Dependant Verification over a period of 20 months(in progress)**



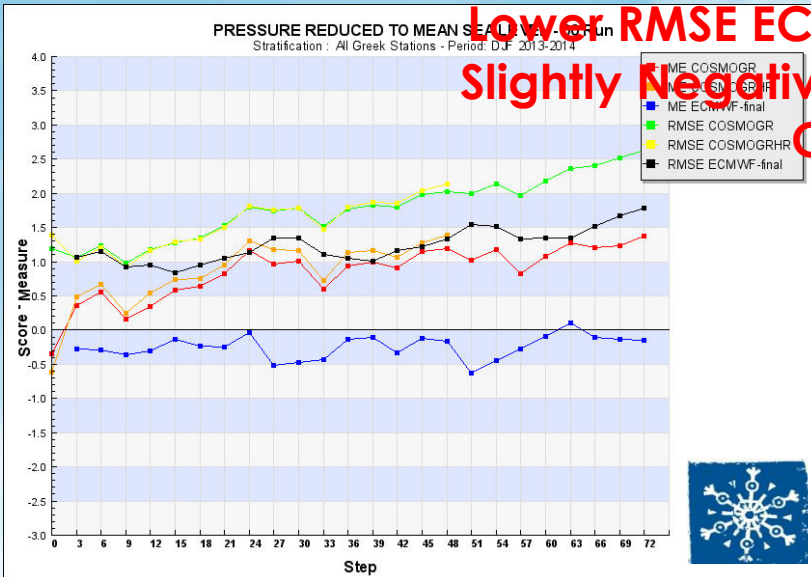
## COSMOGR (Vers. 4.18) Grid Area

# PRESSURE REDUCED TO MSL COSMO COSMOHR ECMWF

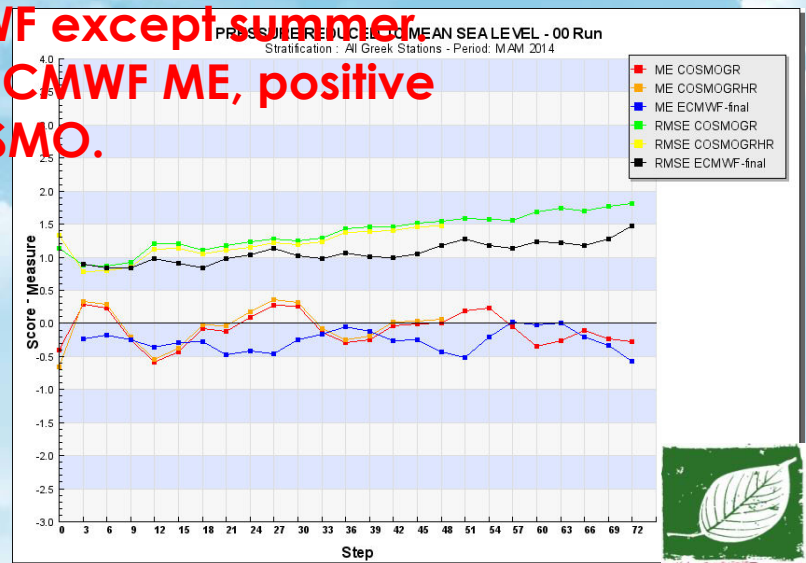
## 00 UTC RUNS



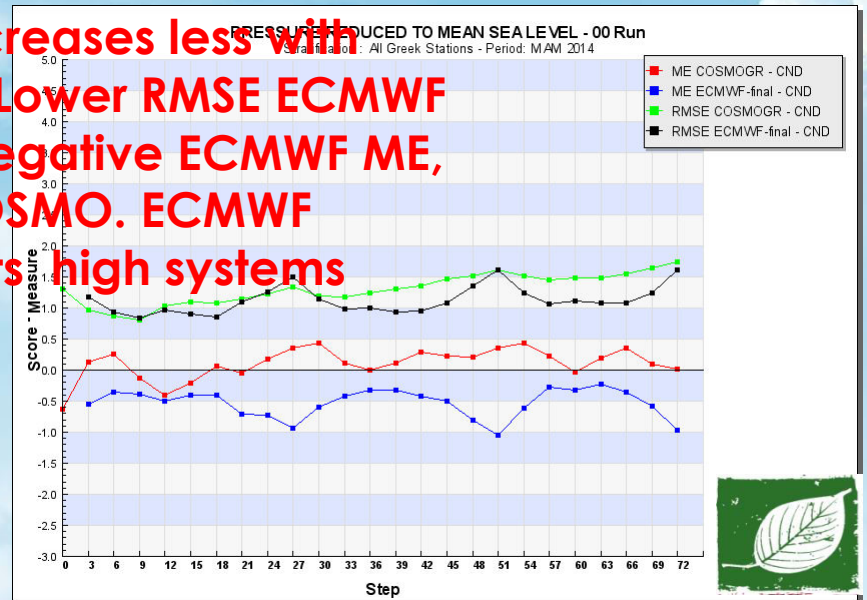
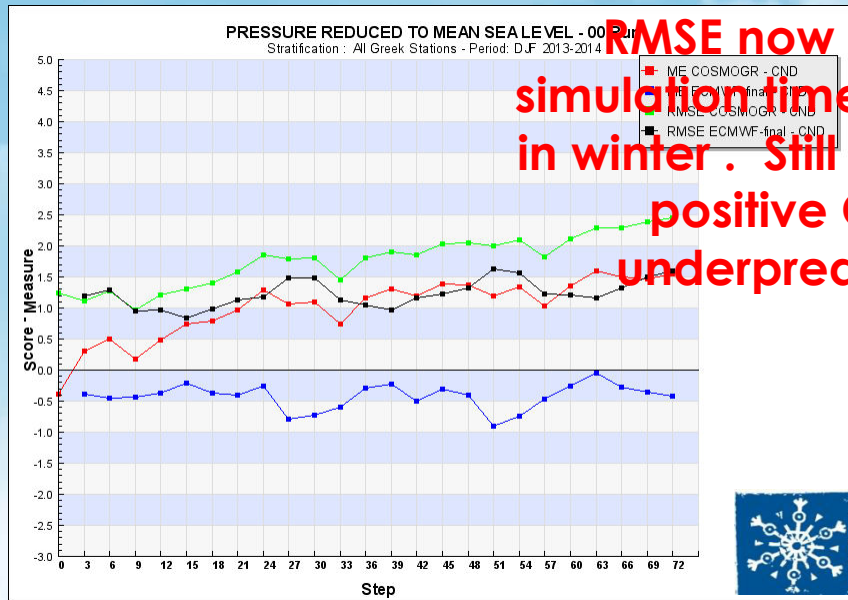
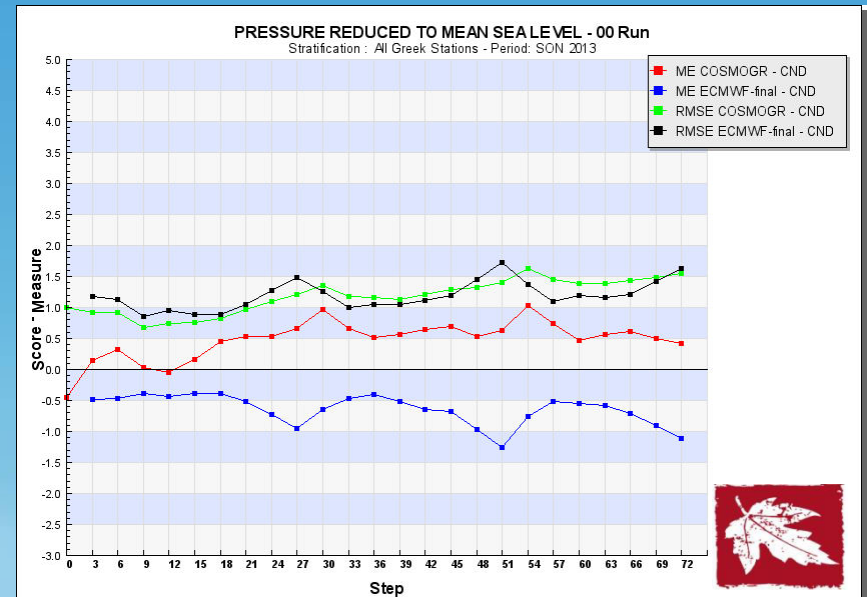
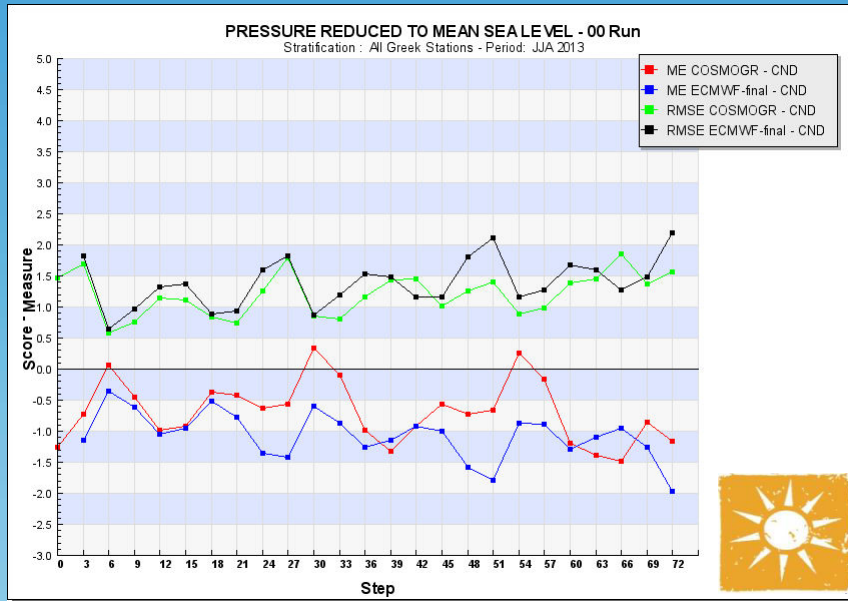
**COSMO/COSMOHR identical. RMSE increases with simulation time for all models mainly COSMO in winter.**



**Lower RMSE ECMWF except winter. Slightly Negative ECMWF ME, positive COSMO.**

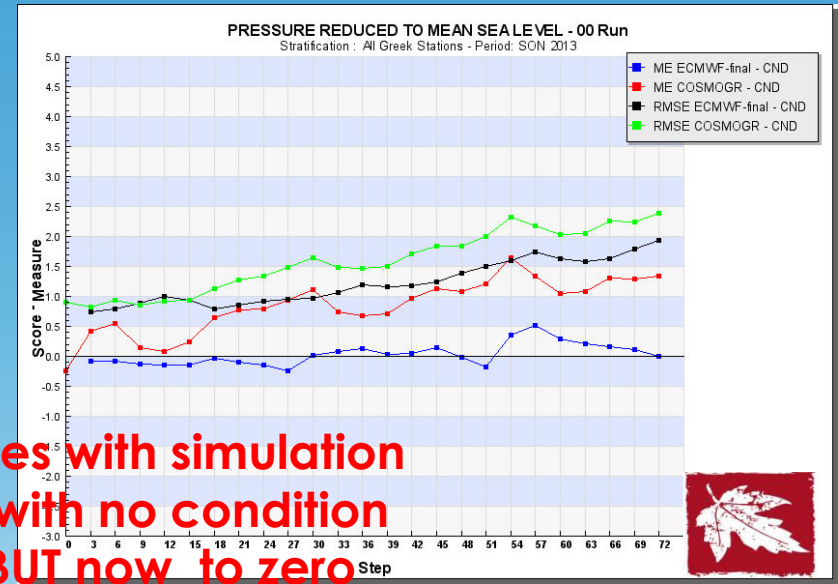
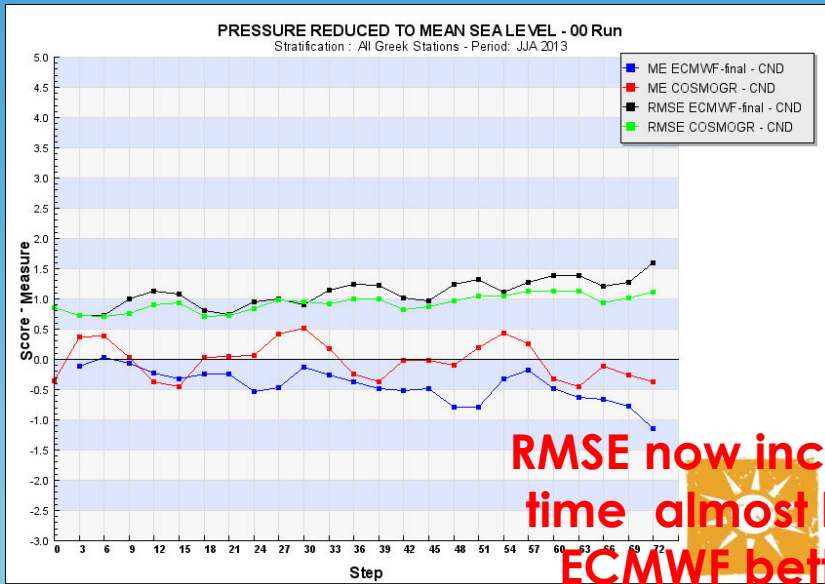


# PRESSURE MSL > mean COSMO ECMWF



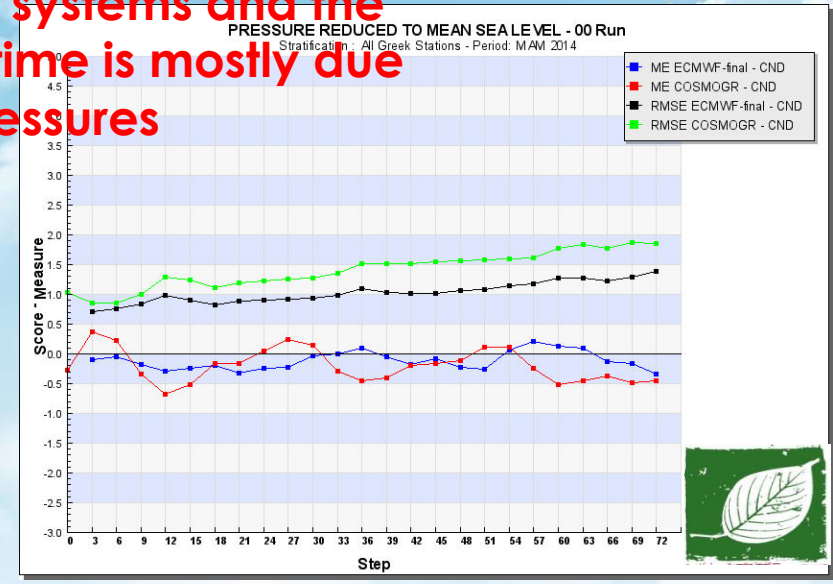
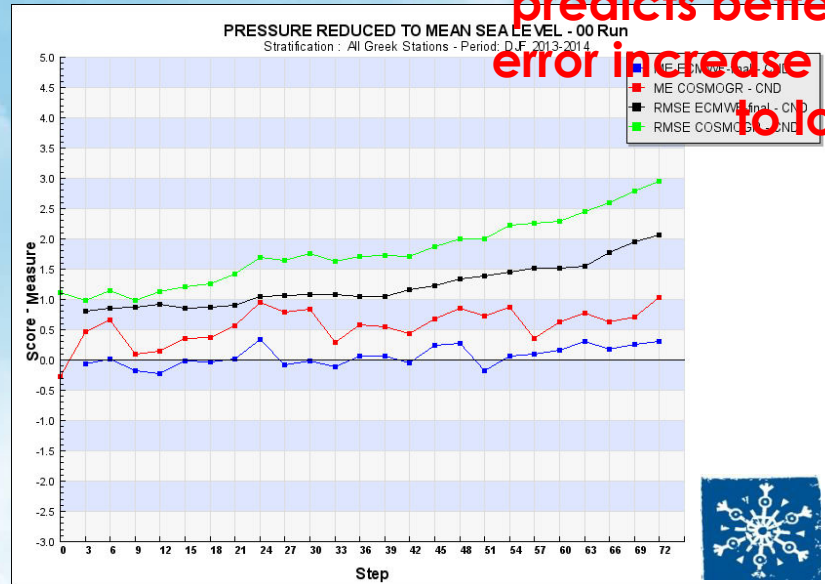
**RMSE now increases less with simulation time . Lower RMSE ECMWF in winter . Still Negative ECMWF ME, positive COSMO. ECMWF underpredicts high systems**

# PRESSURE MSL < mean COSMO ECMWF

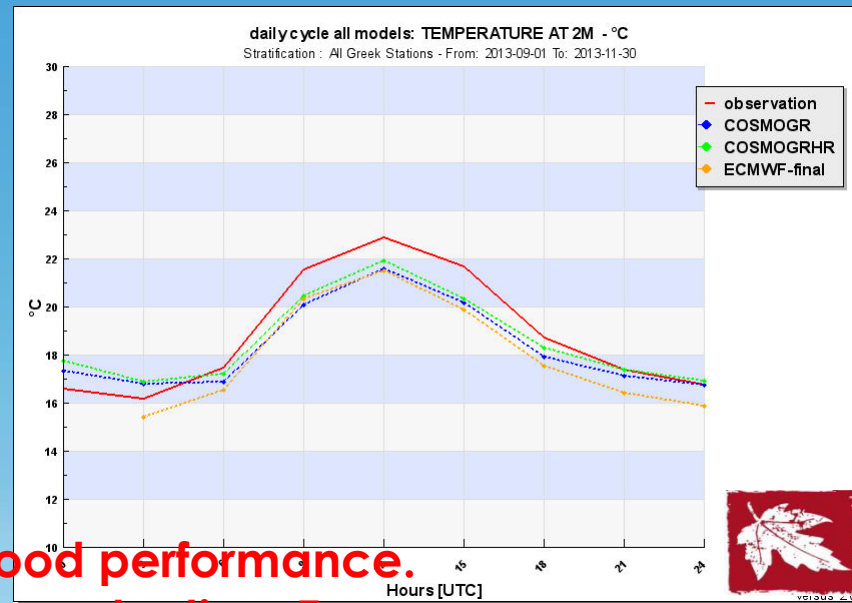
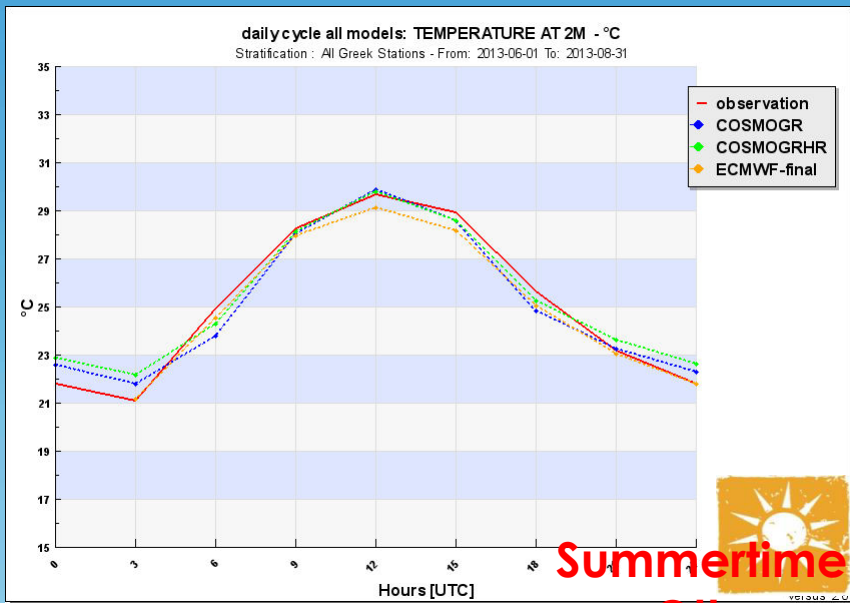


RMSE now increases with simulation time almost like with no condition  
ECMWF better. BUT now to zero

ECMWF ME, positive COSMO. ECMWF predicts better low systems and the error increase with time is mostly due to low pressures

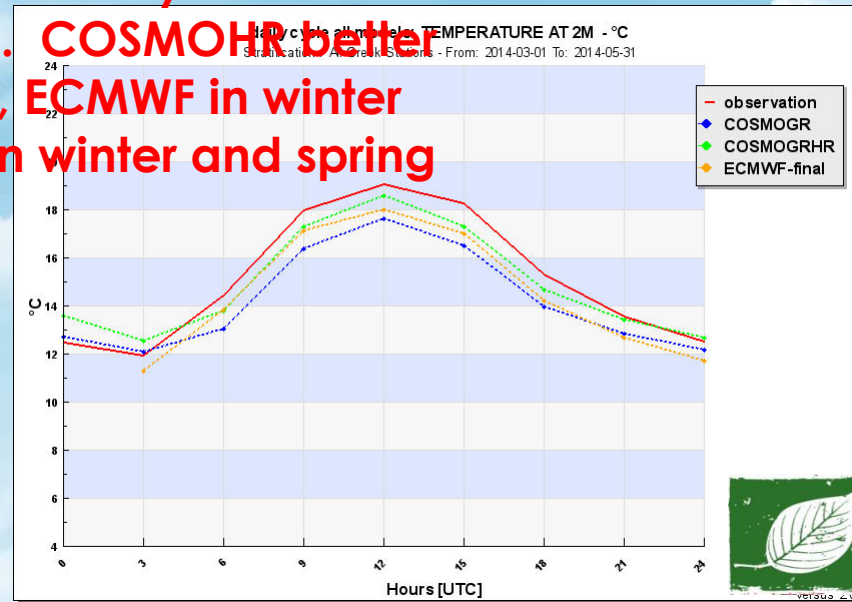
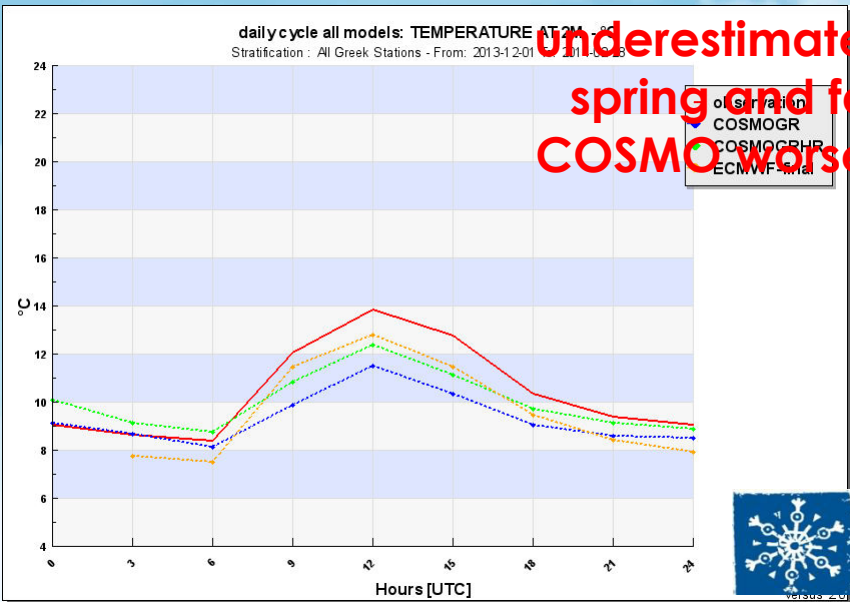


# 2m Temperature Daily Cycle (Day 1) OBS COSMO COSMOHR ECMWF

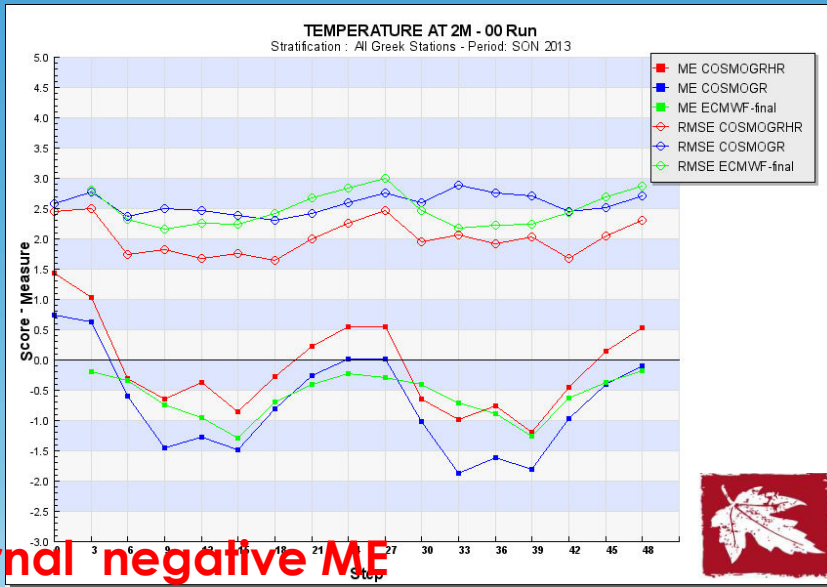
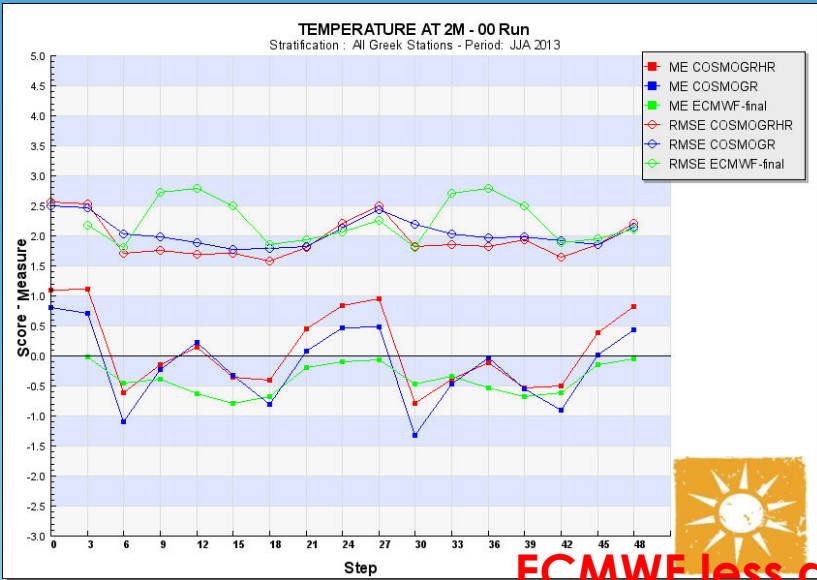


Summertime good performance.  
Other seasons daytime T

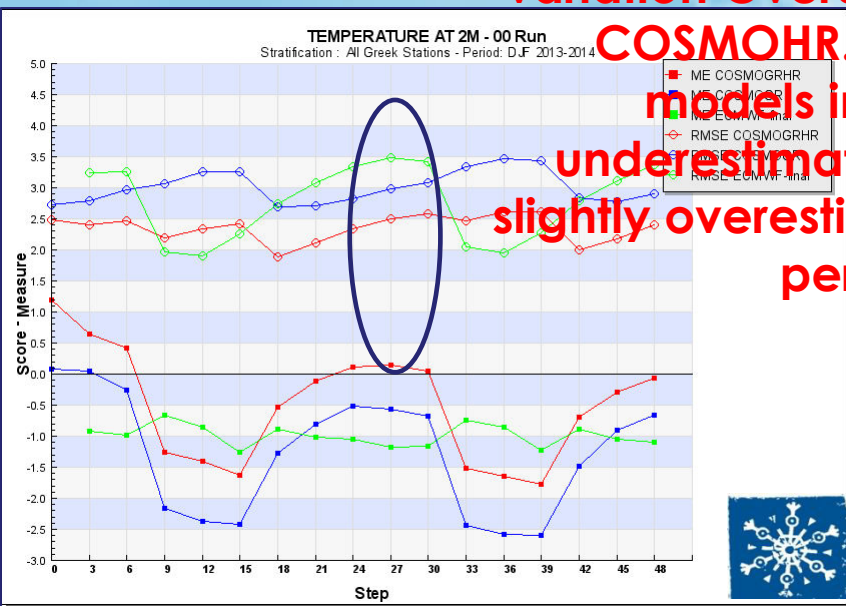
underestimated. COSMOHR better  
spring and fall, ECMWF in winter  
COSMO worse in winter and spring



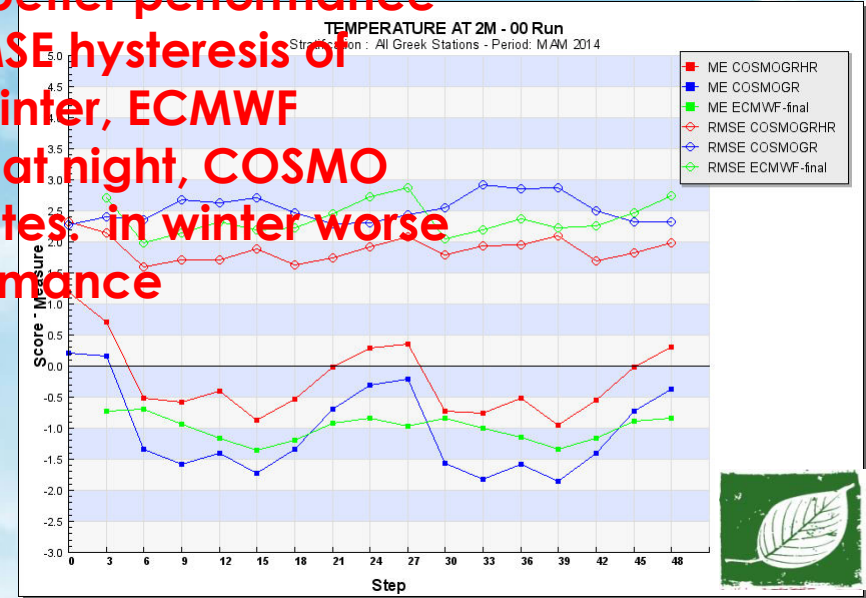
# 2m TEMPERATURE ME/RMSE COSMO/COSMOHR/ ECMWF



**ECMWF less diurnal negative ME variation Overall better performance**



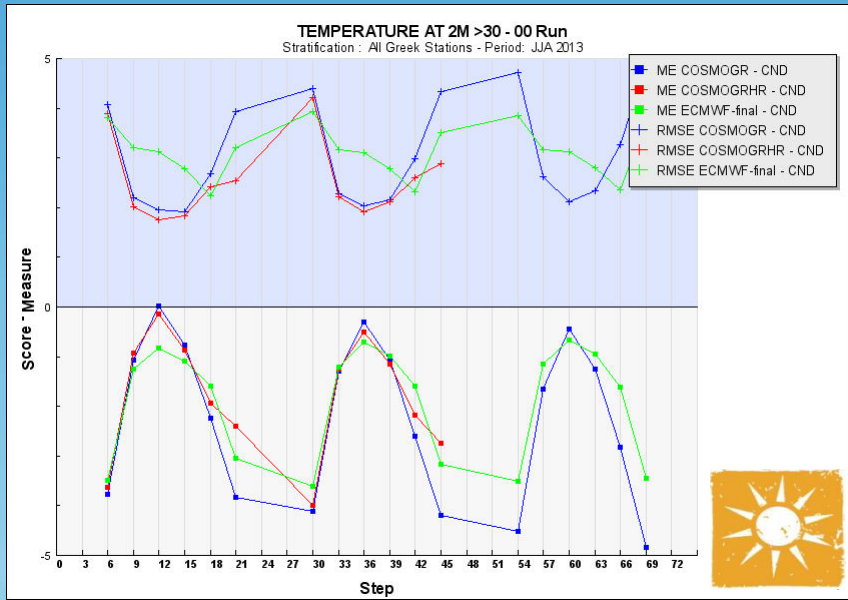
**COSMOHR RMSE hysteresis of models in winter, ECMWF underestimates at night, COSMO slightly overestimates. in winter worse performance**



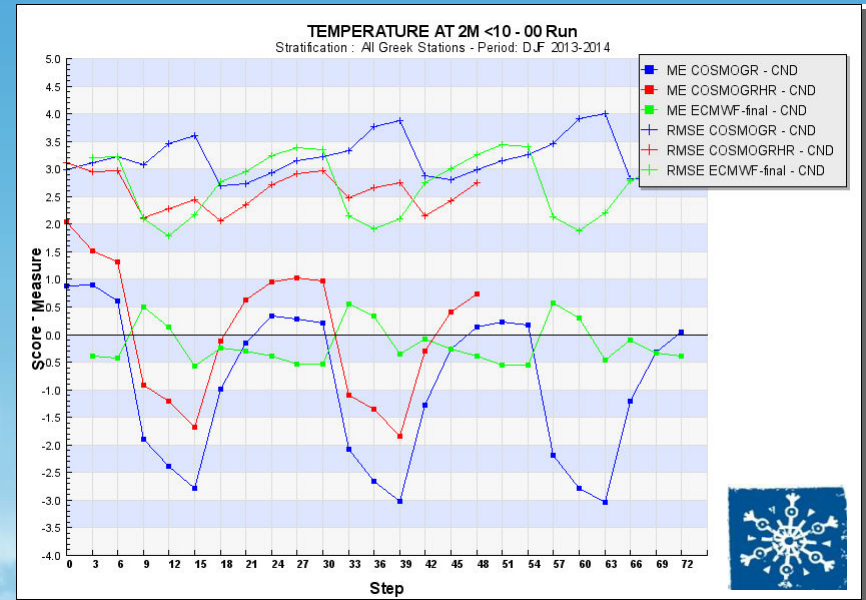


# CONDITIONAL 2m T ME/RMSE COSMO/COSMOHR/ ECMWF

T2m > 30°C



T2m < 10°C



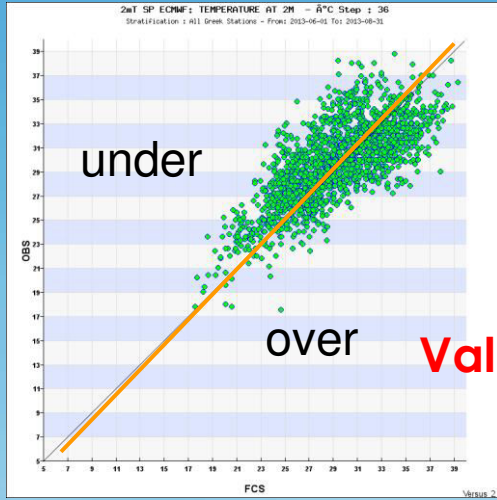
Night values not to trust due to low number of cases. Better performance for COSMO RMSE (2) and ME close to 0 during daytime

RMSE hysteresis comparable to no condition. ECMWF performs better in daytime with slight overestimation

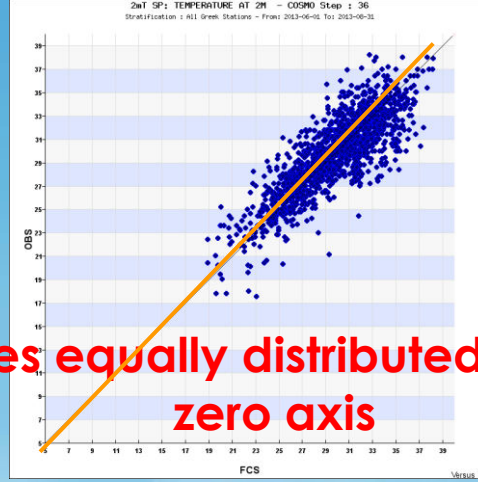


# T2m Scatter plots Summer 2013

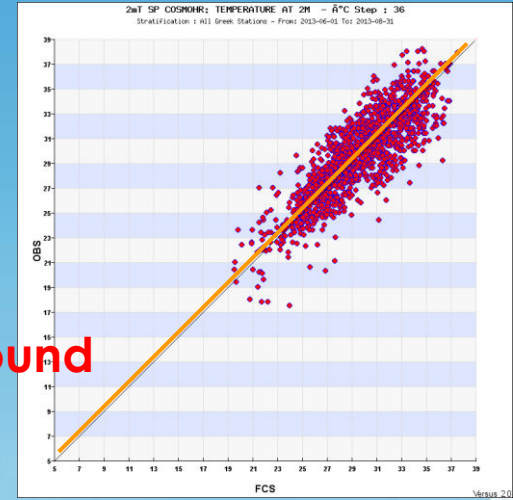
## 12 UTC (36 h of simulation)



**ECMWF**

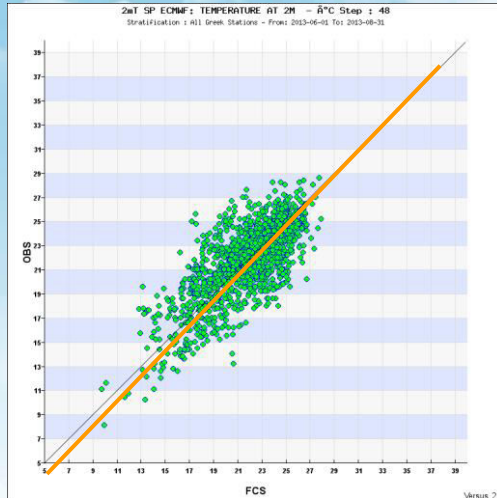


**COSMO**

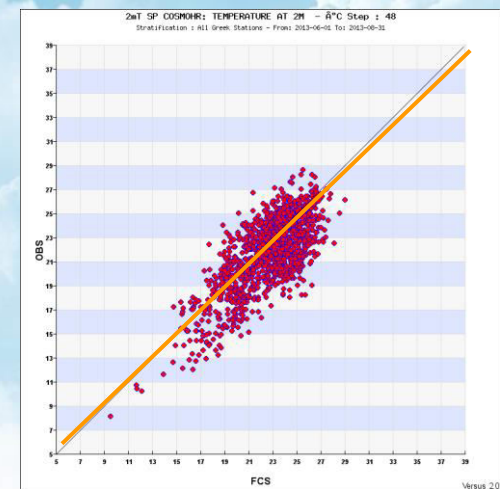
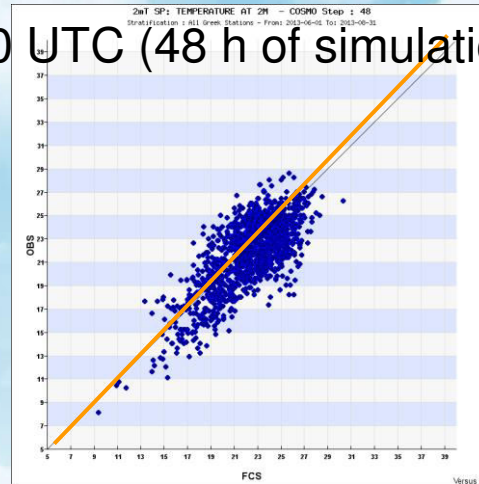


**COSMOHR**

**Values equally distributed around zero axis**



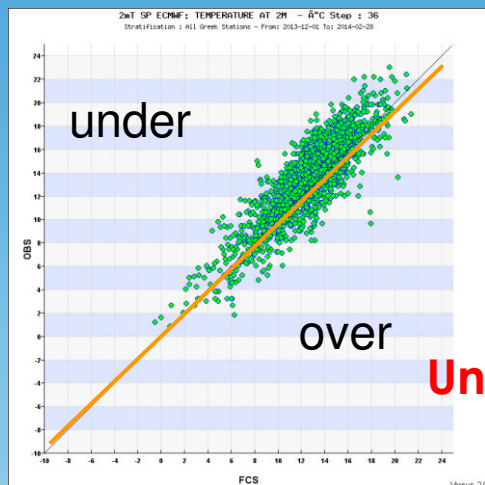
## 00 UTC (48 h of simulation)



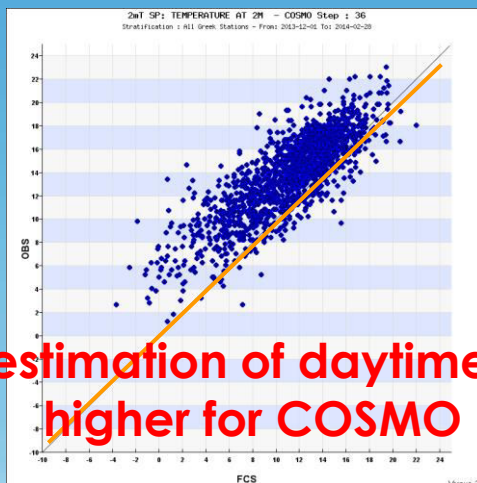


# T2m Scatter plots Winter 2013

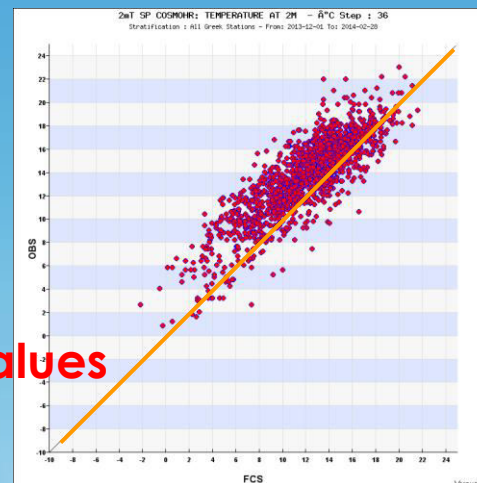
12 UTC (36 h of simulation)



**ECMWF**



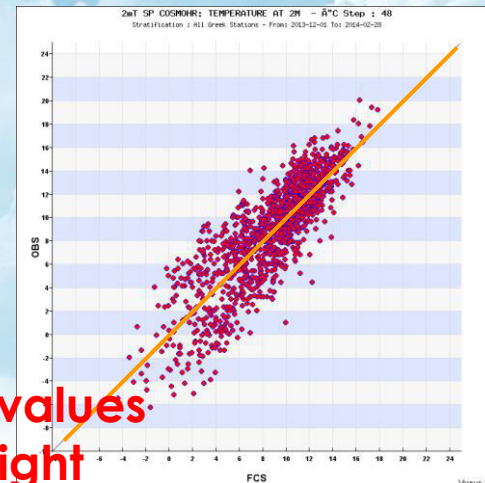
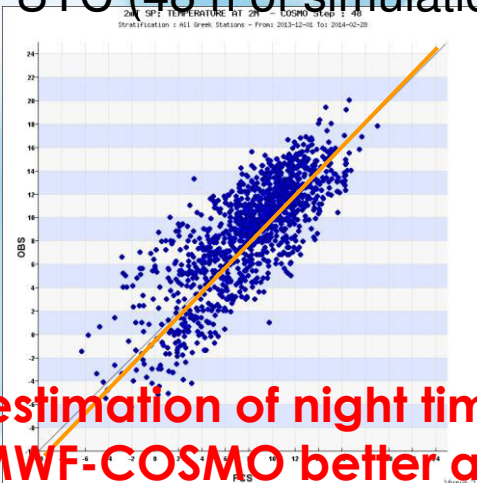
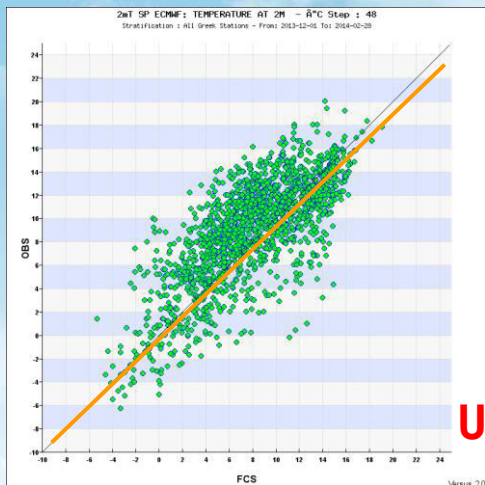
**COSMO**



**COSMOHR**

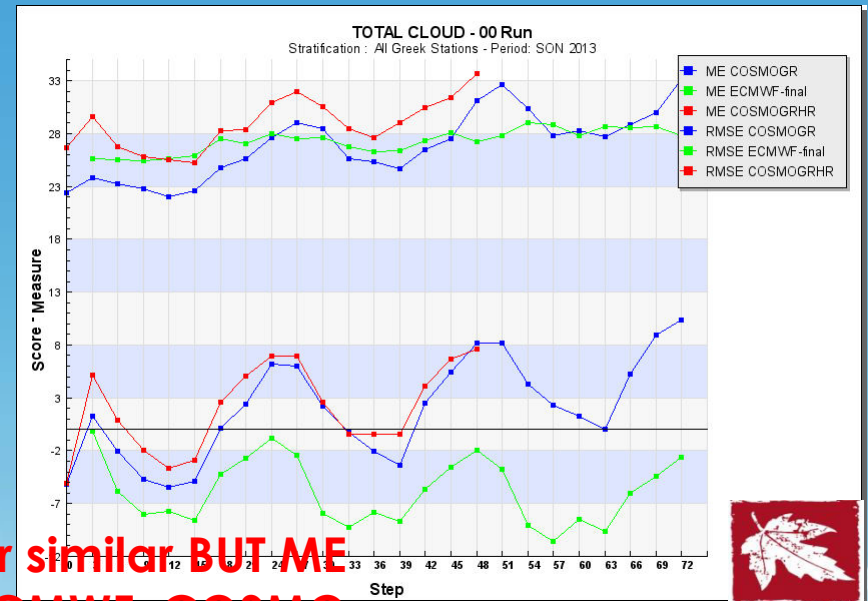
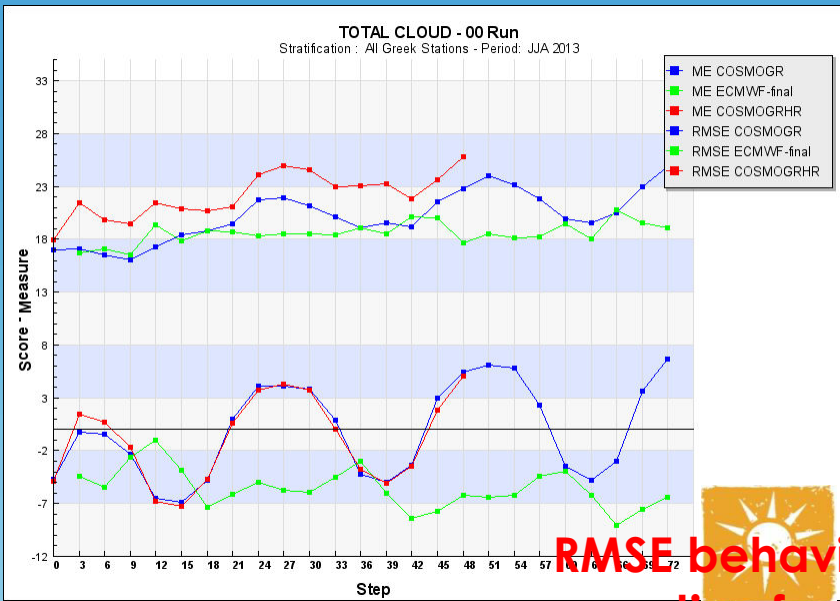
**Underestimation of daytime values  
higher for COSMO**

00 UTC (48 h of simulation)

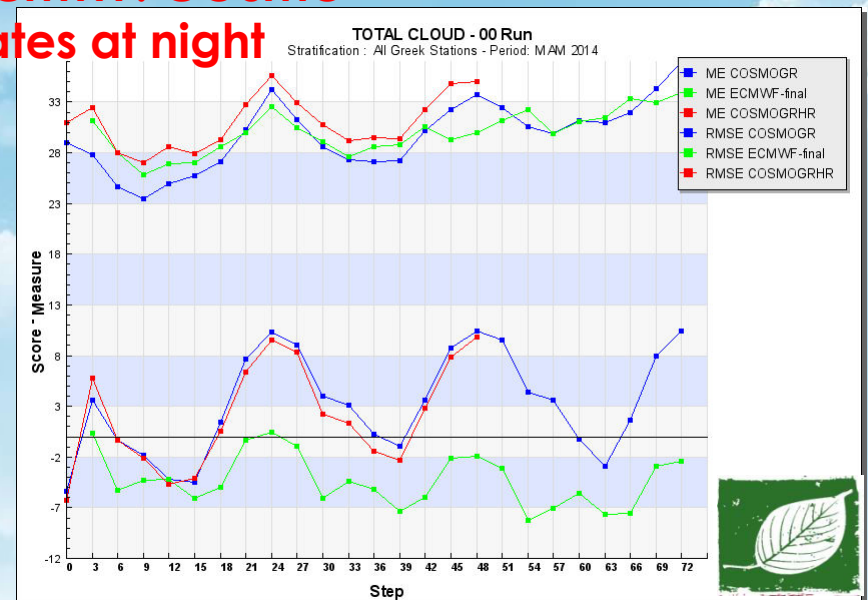
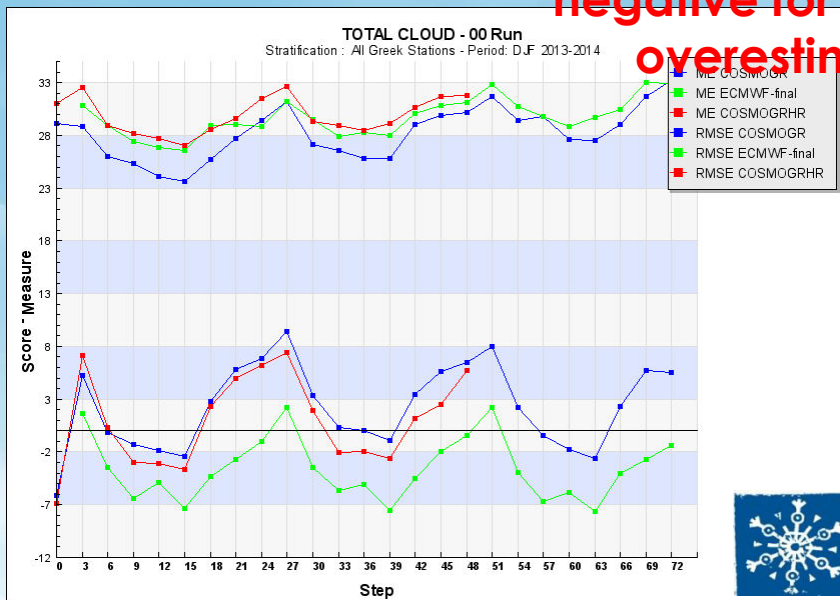


**Underestimation of night time values  
ECMWF-COSMO better at night**

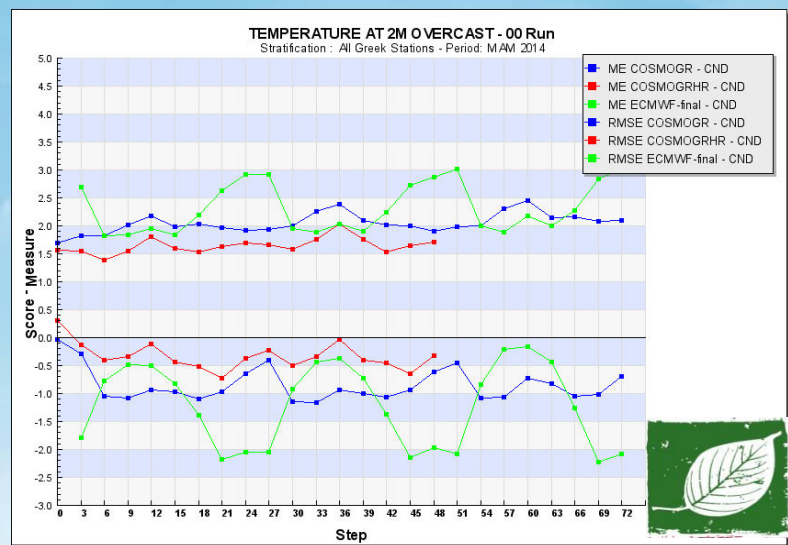
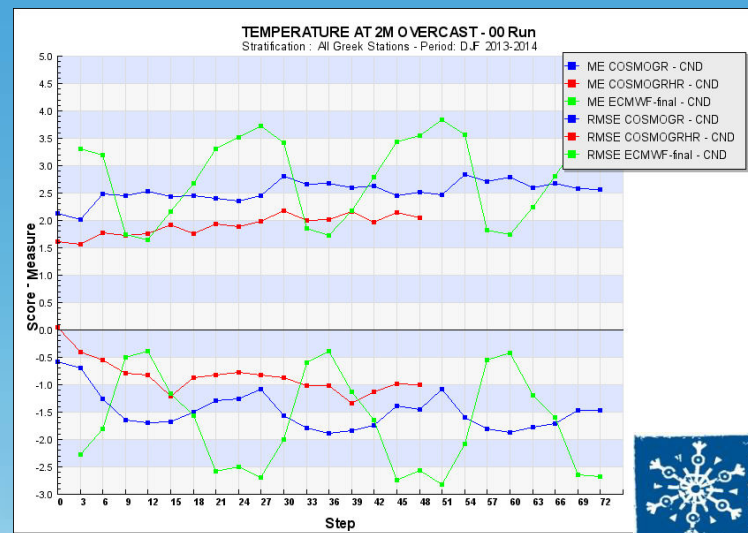
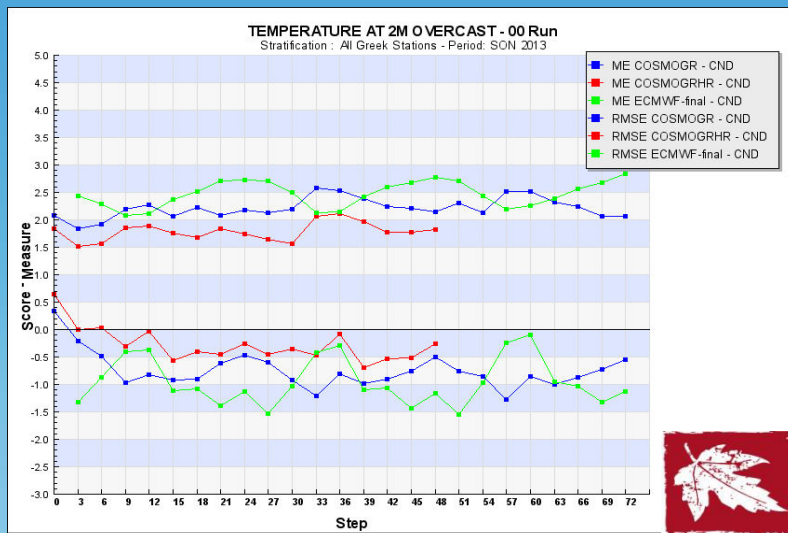
# CLOUD COVER ME/RMSE COSMO/COSMOHR/ ECMWF



**RMSE behavior similar BUT ME negative for ECMWF. COSMO overestimates at night**

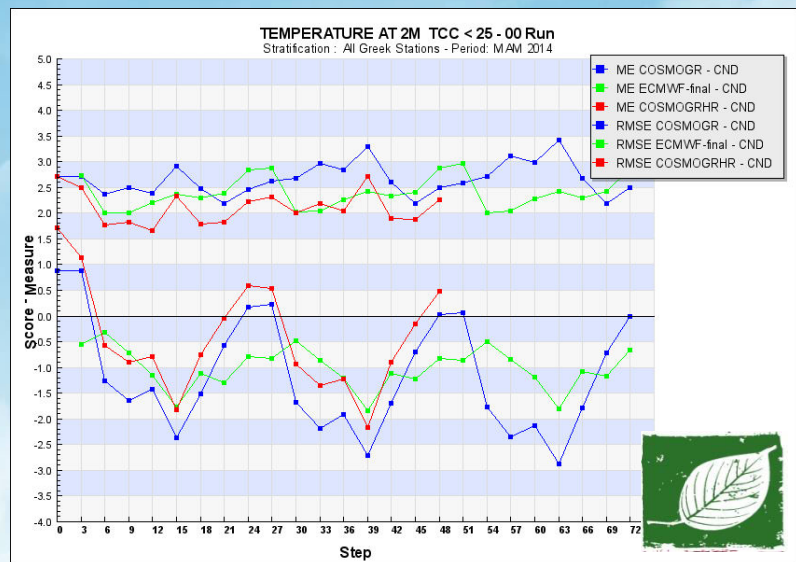
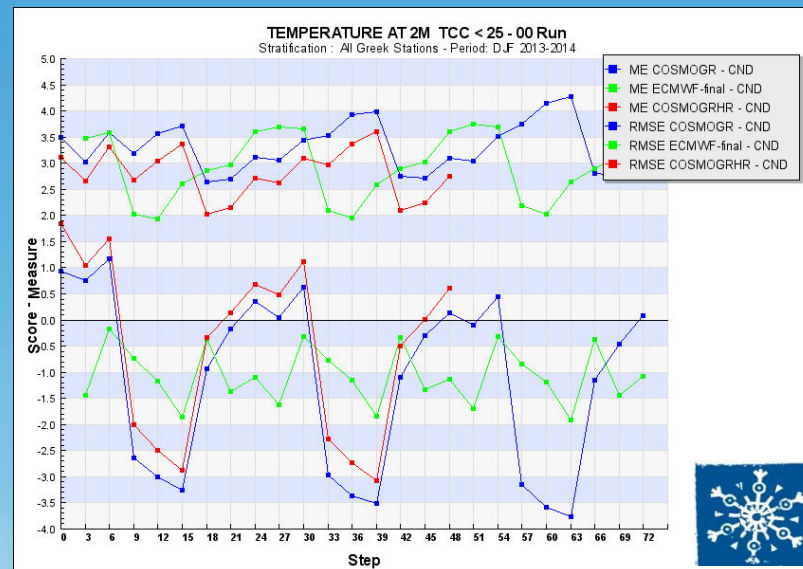
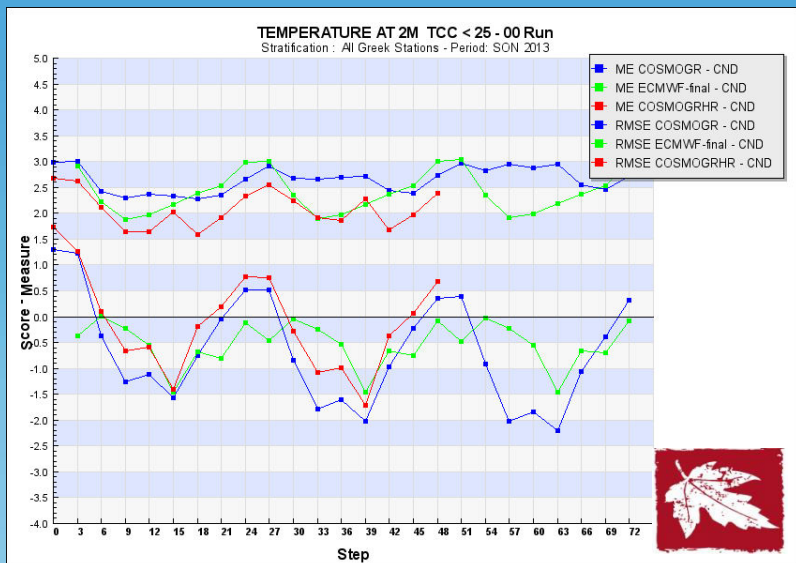


# Conditional T2m CC > 75% (obs) ME/RMSE COSMO/COSMOHR/ ECMWF



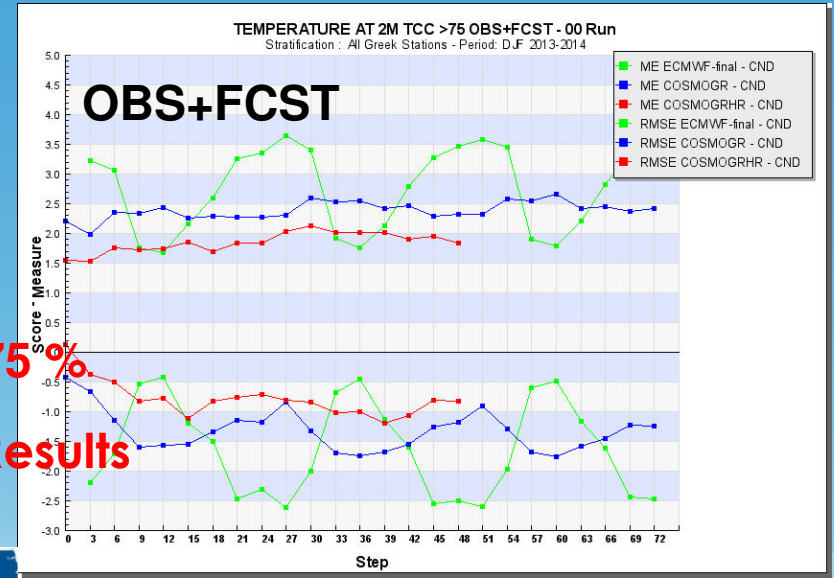
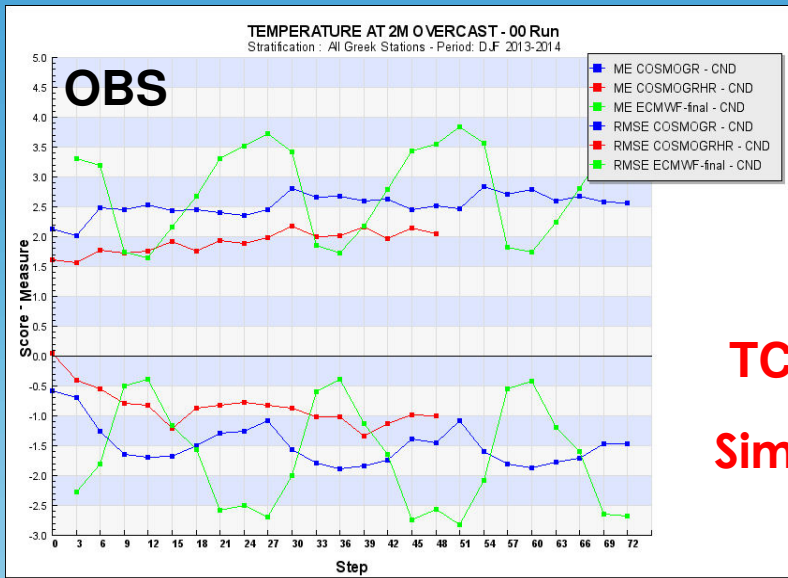
**Overcast: Better performance for COSMOHR. Small diurnal variation for COSMO, ECMWF diurnal variation and underestimation at night. (winter and spring)**

# Conditional T2m CC < 25% (obs) ME/RMSE COSMO/COSMOHR/ ECMWF

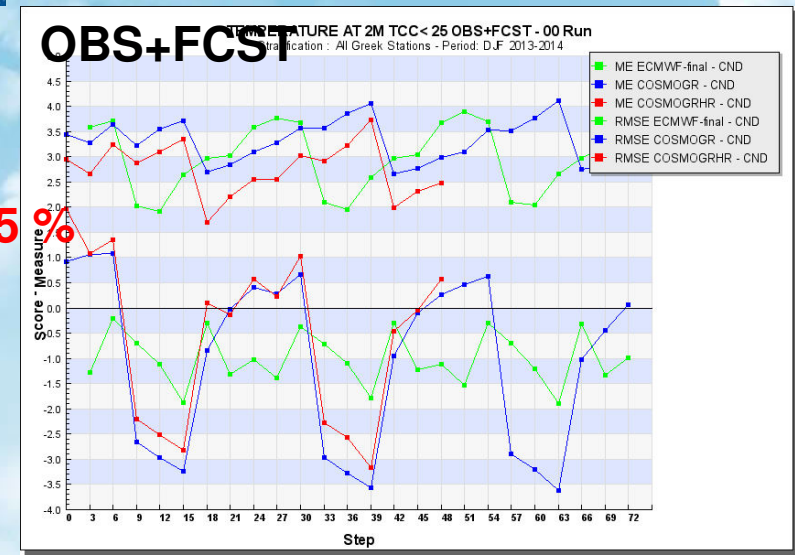
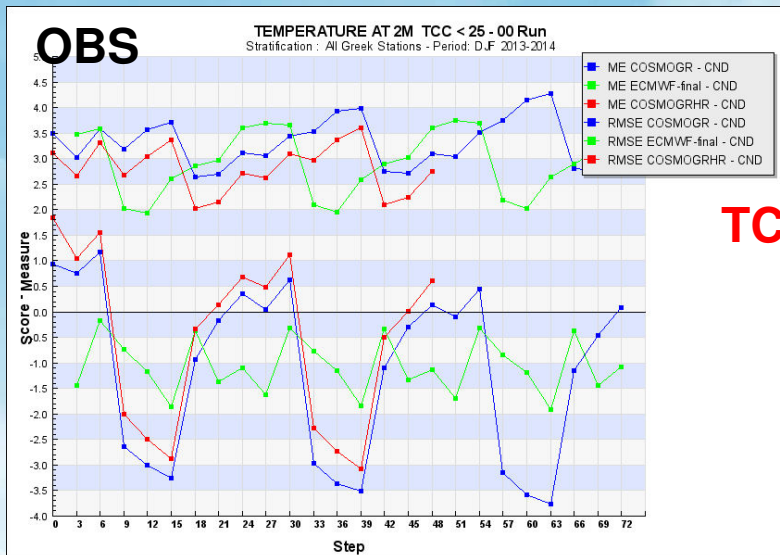


**Sky clear: COSMO ME diurnal variation, with daytime underestimation. Winter Hysteresis RMSE similar to T2m.**

# Conditional T2m based on OBS and OBS+FCST COSMO/COSMOHR/ ECMWF

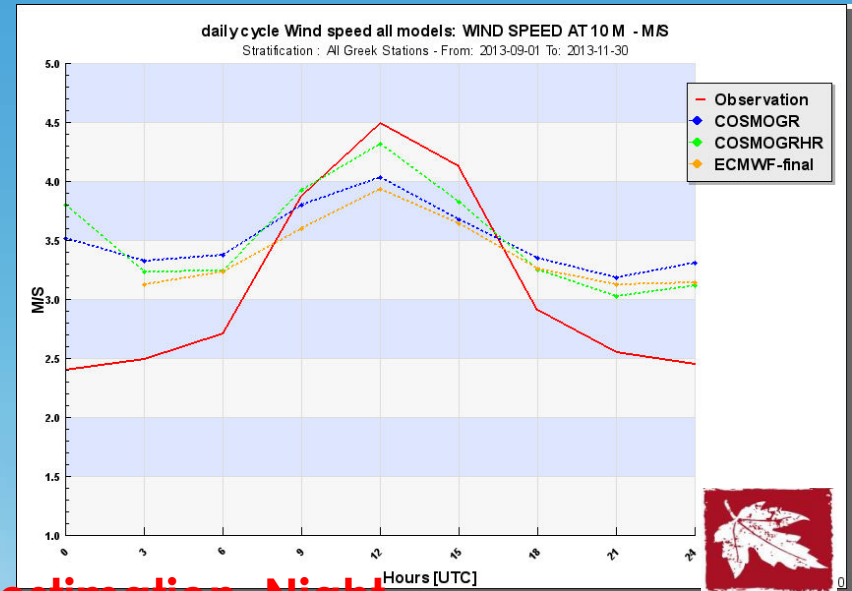
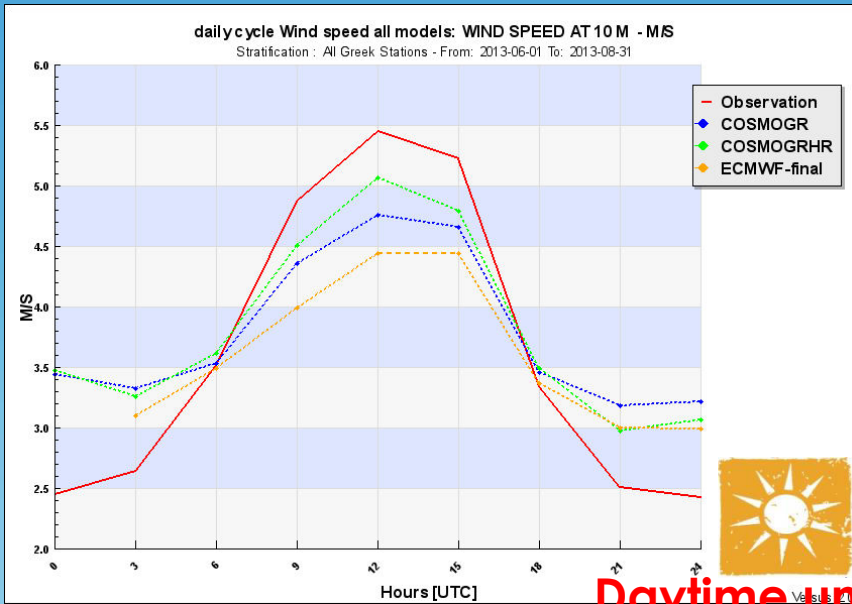


TCC > 75 %  
Similar Results

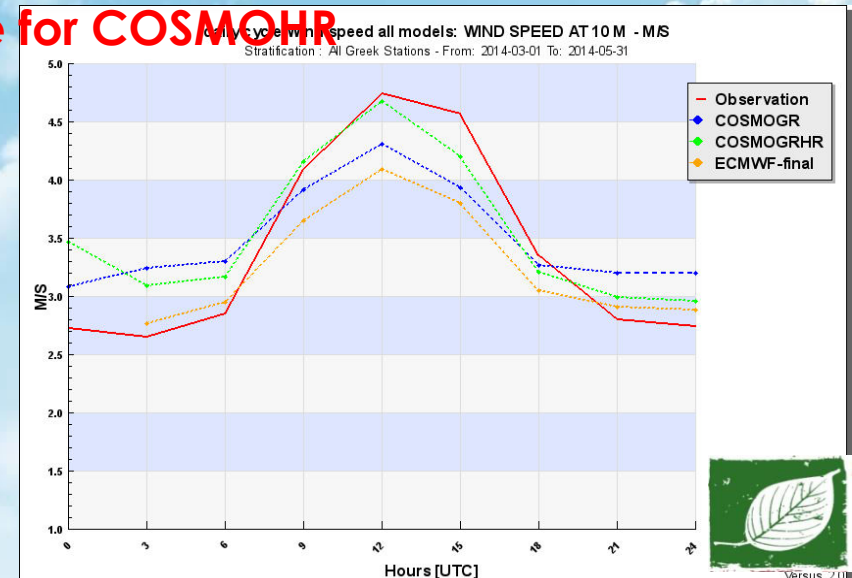
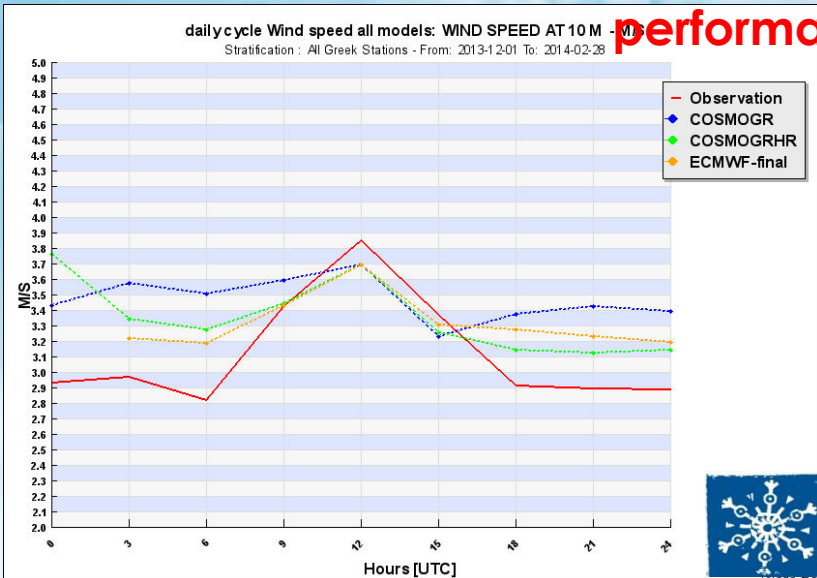


TCC < 25 %

# 10m WS Daily Cycle **OBS**/**COSMO**/**COSMOHR**/**ECMWF**

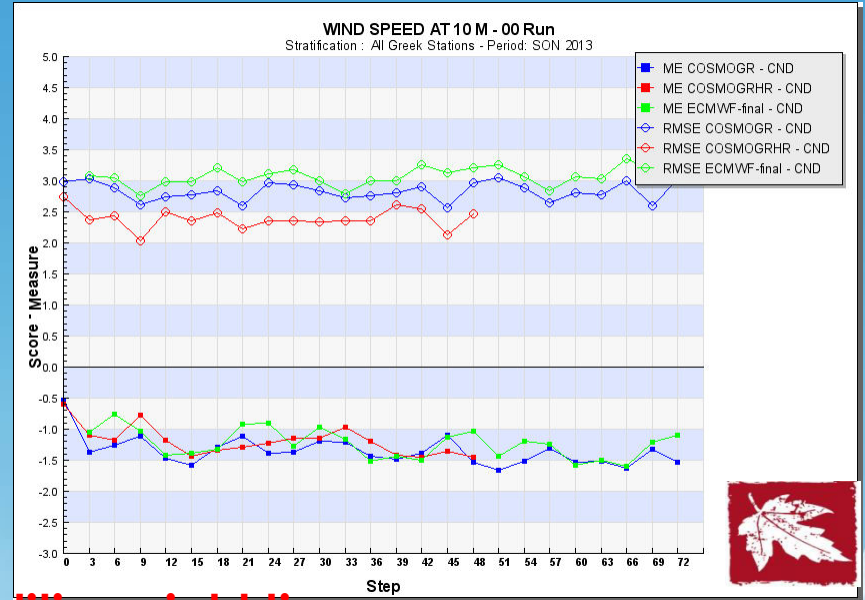
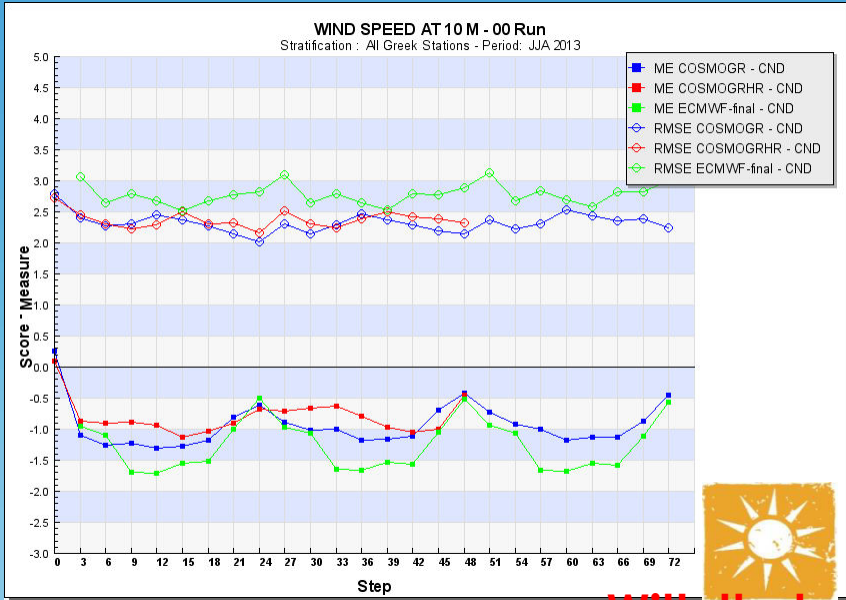


**Daytime underestimation. Night time overestimation. Better performance for COSMOHR**

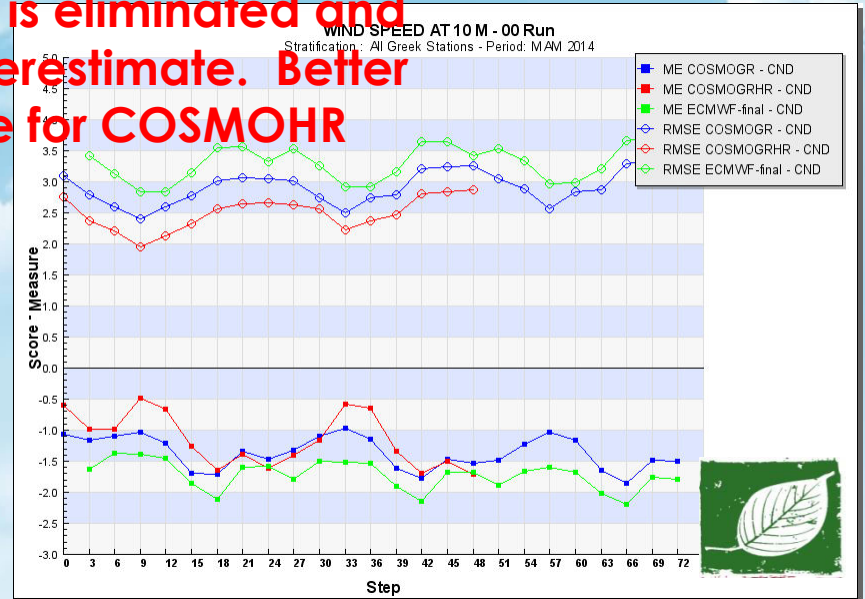
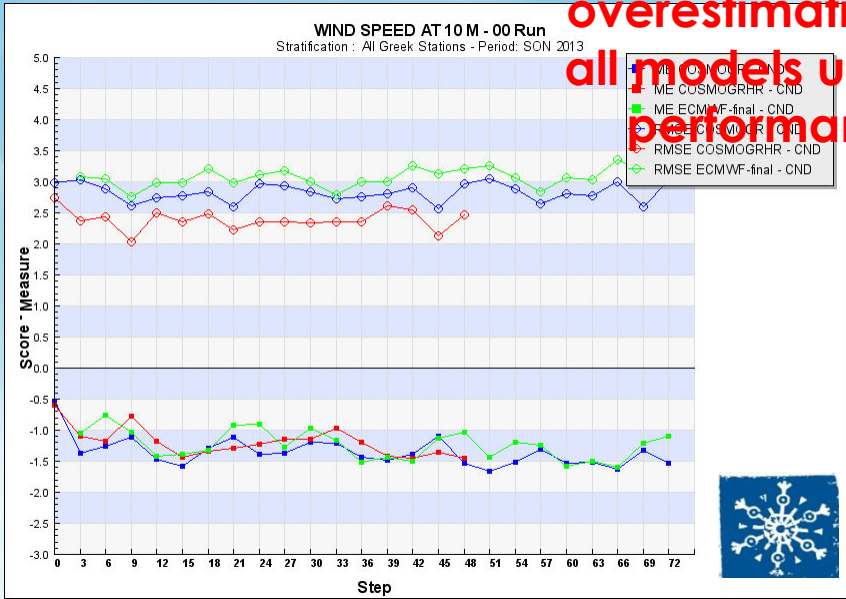




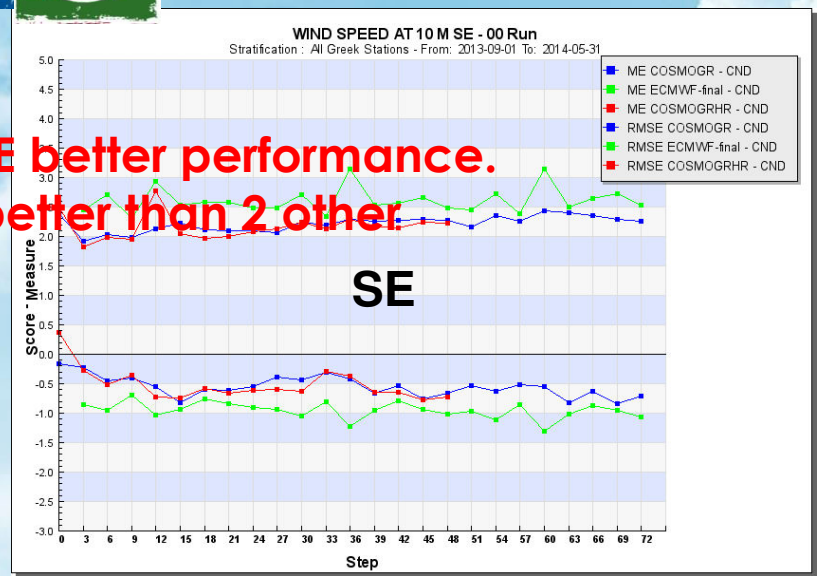
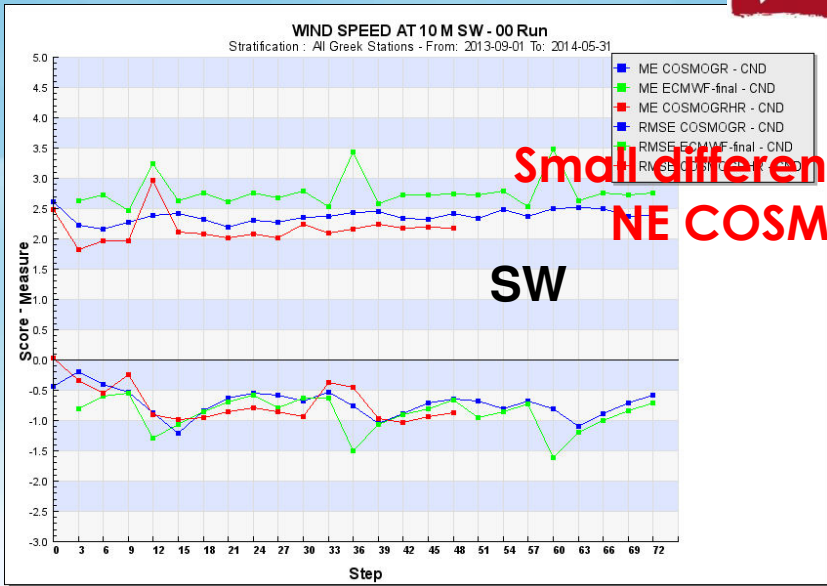
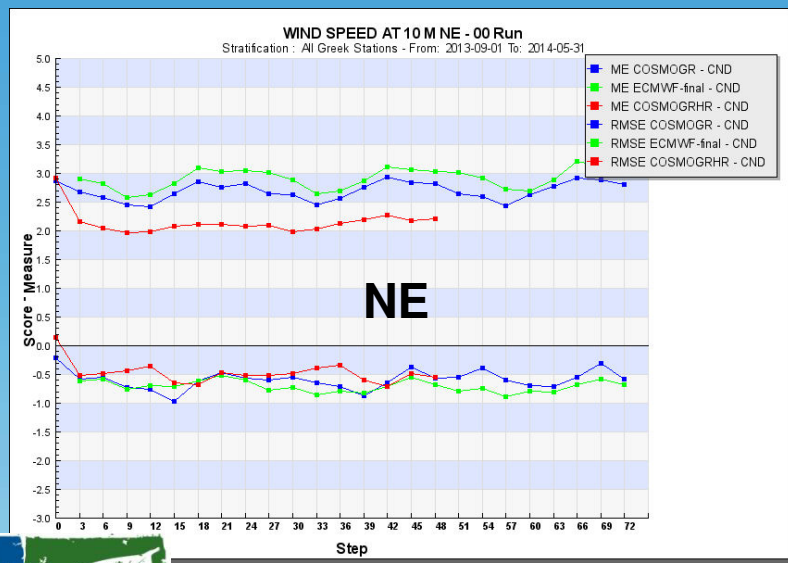
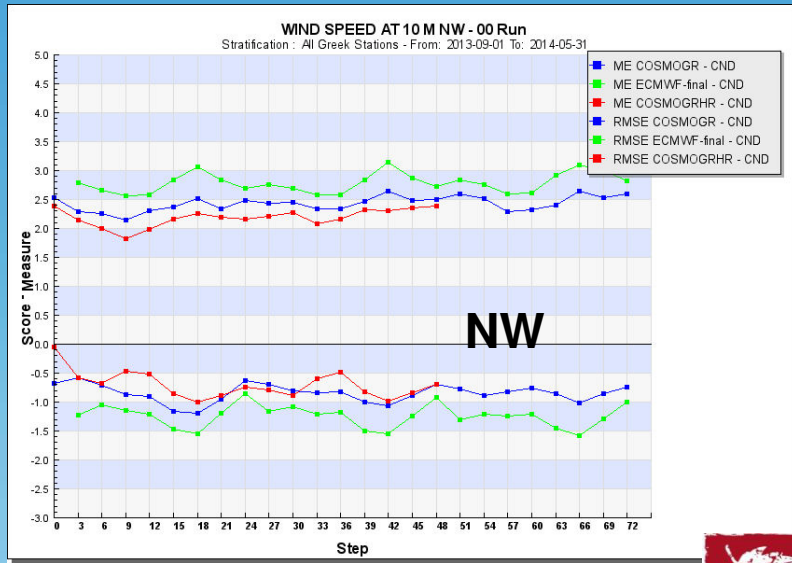
# 10m WS >10Kt ME/RMSE COSMO/COSMOHR/ ECMWF



**With that condition night time overestimation is eliminated and all models underestimate. Better performance for COSMOHR**

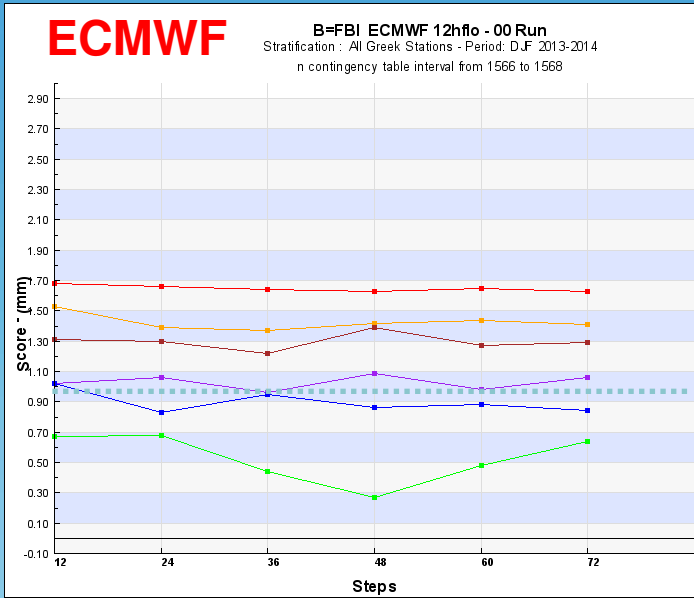


# Conditional WS >5Kt COSMO/COSMOHR/ ECMWF based on OBS WD

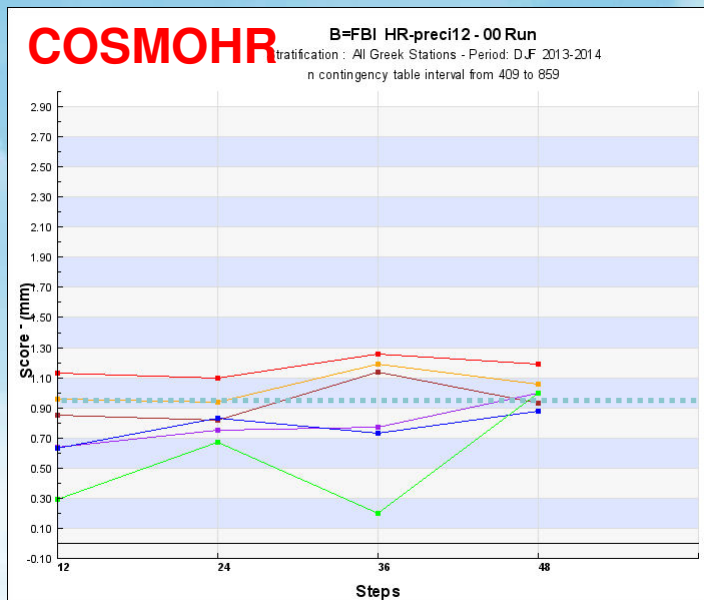
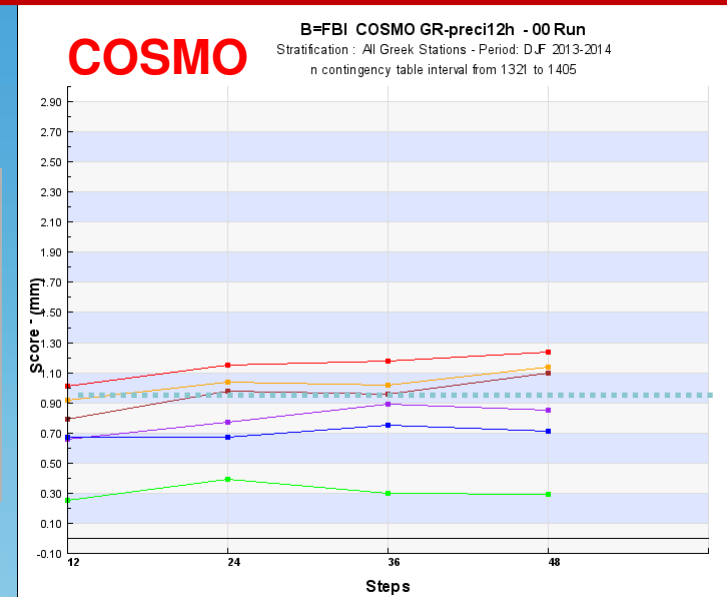


Small differences. SE better performance.  
NE COSMOHR better than 2 other.

# 12h PRECIPITATION FBI WINTER PLOTS BY STEP

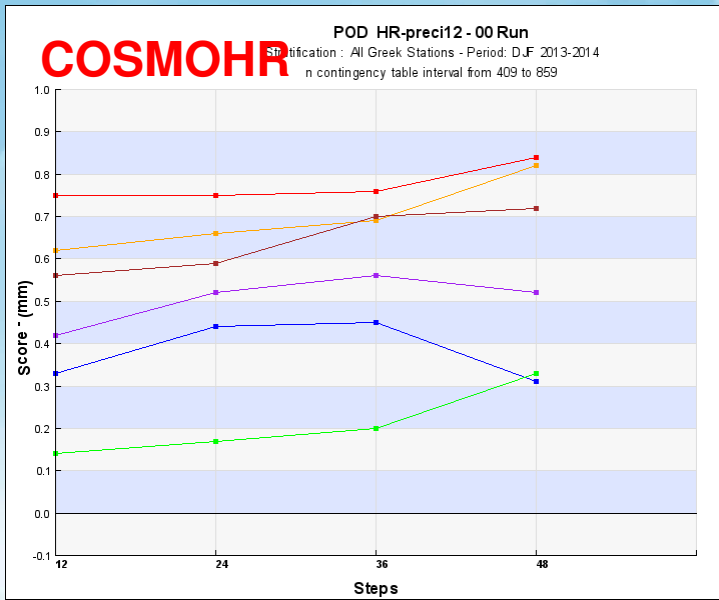
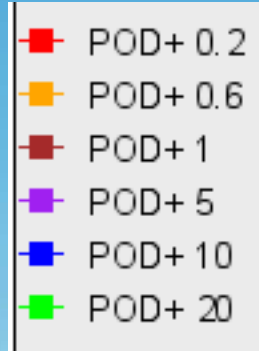
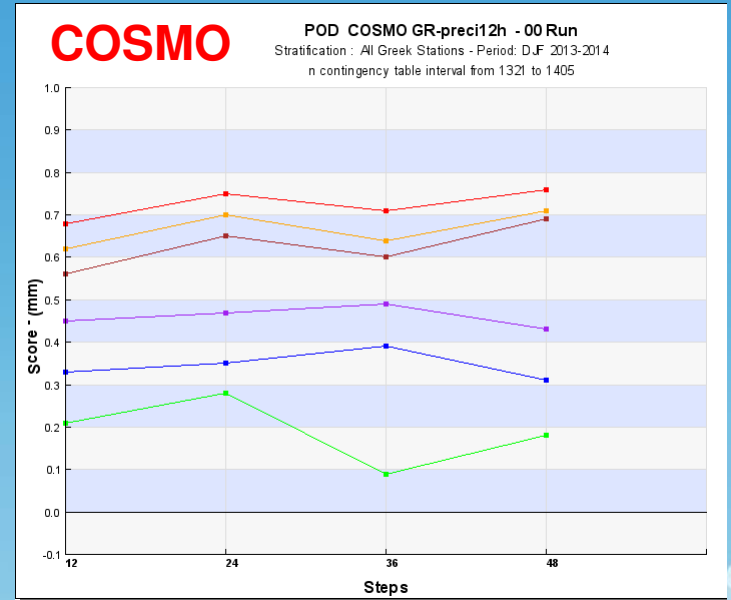
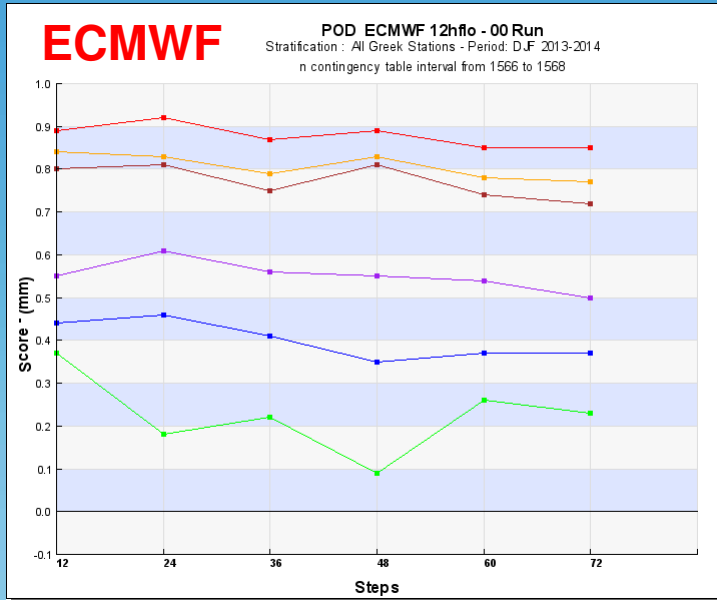


- B=FBI+ 0.2
- B=FBI+ 0.6
- B=FBI+ 1
- B=FBI+ 5
- B=FBI+ 10
- B=FBI+ 20



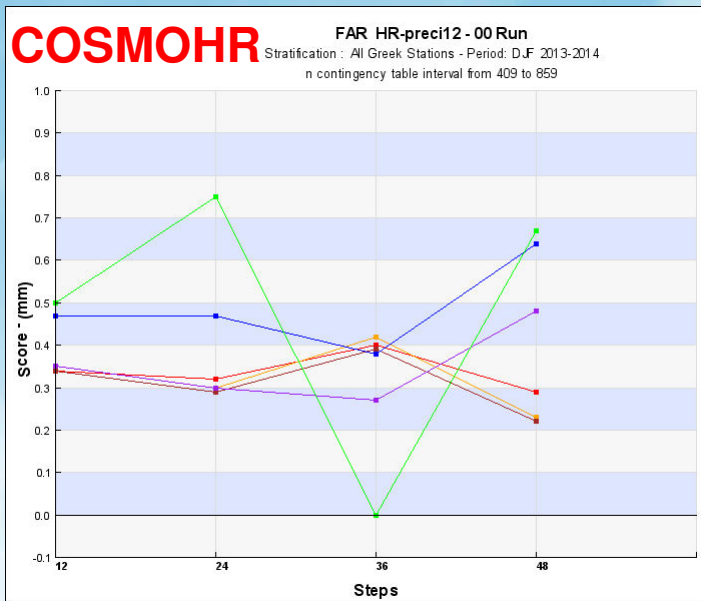
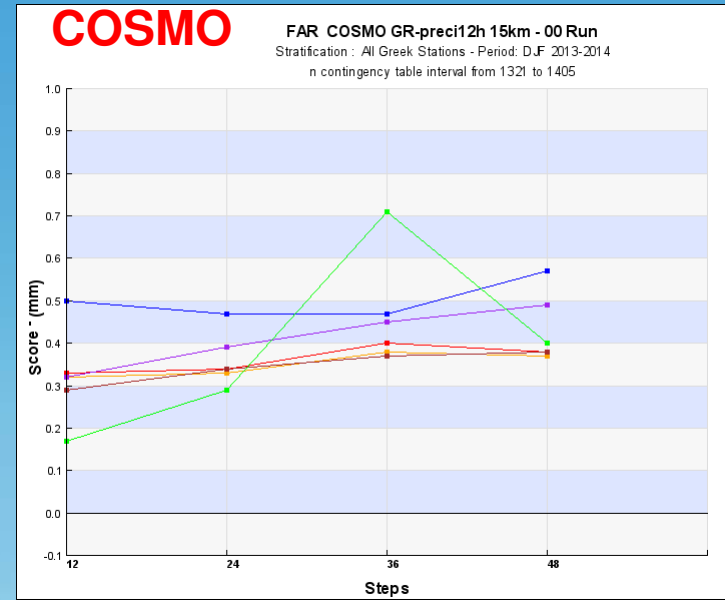
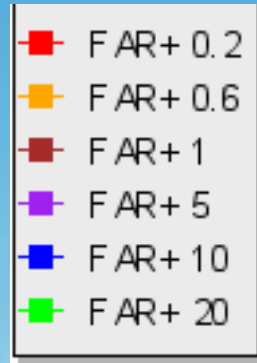
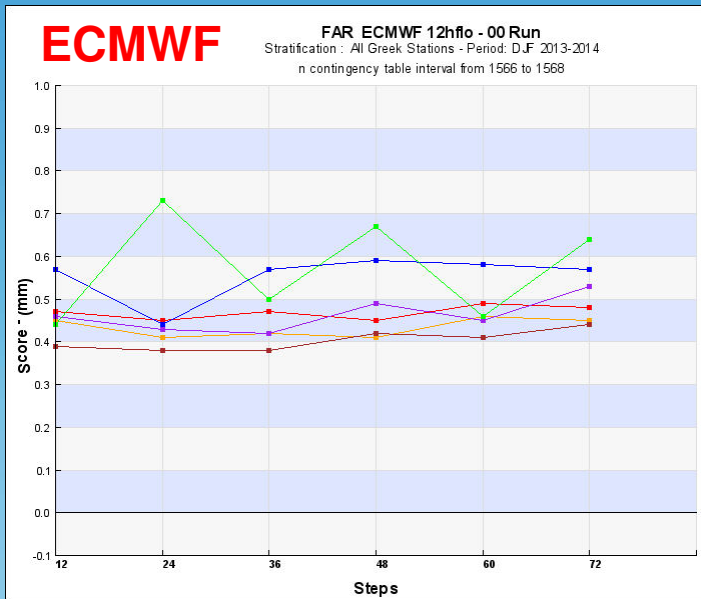
**Overestimation for low thresholds- bigger for ECMWF.**  
**Underestimation for high thresholds bigger for COSMO.**  
**Not significant change with simulation time.**

# 12 h PRECIPITATION POD WINTER PLOTS BY STEP



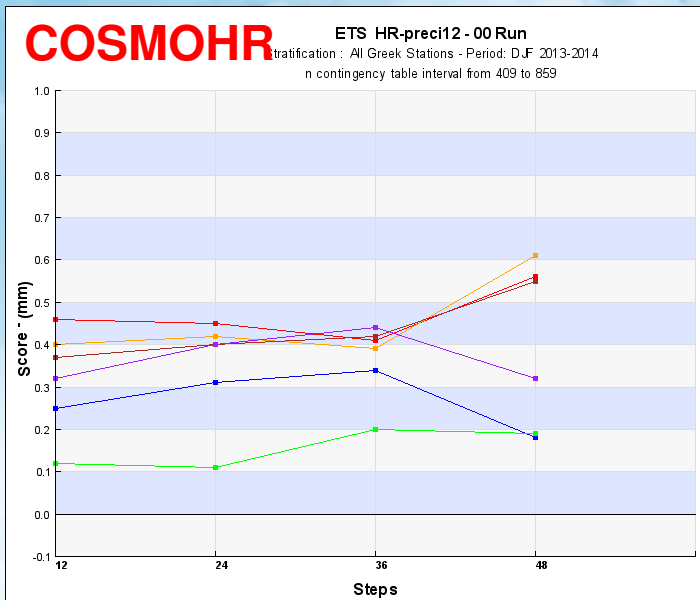
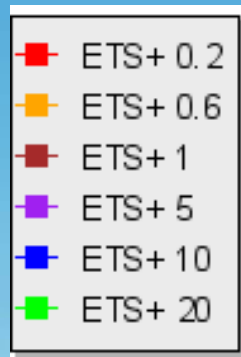
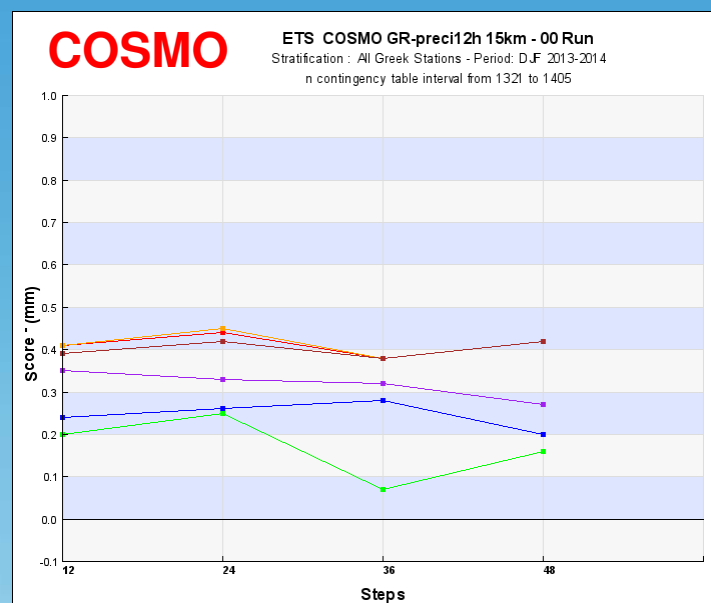
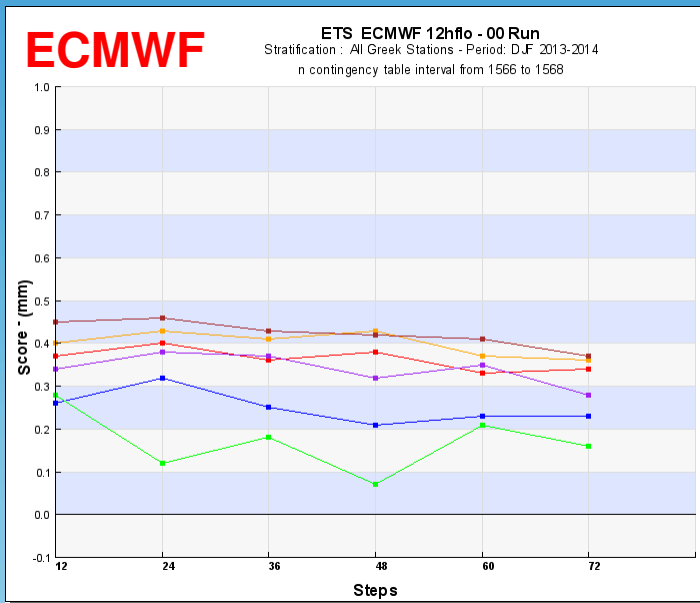
**ECMWF Better POD for low thresholds. Similar POD for high thresholds**

# 12h PRECIPITATION FAR WINTER PLOTS BY STEP



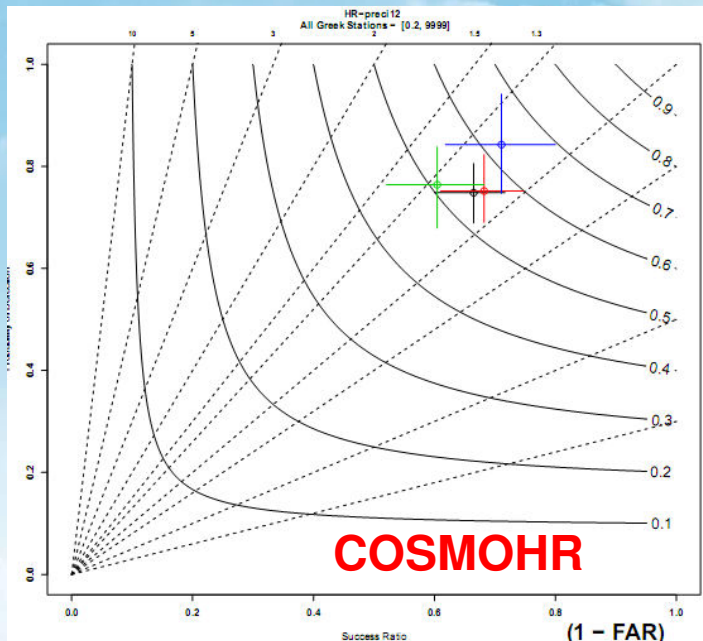
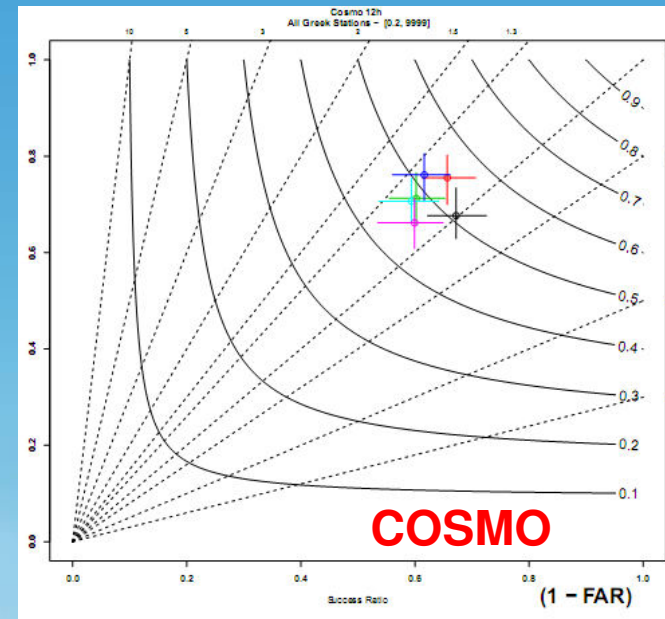
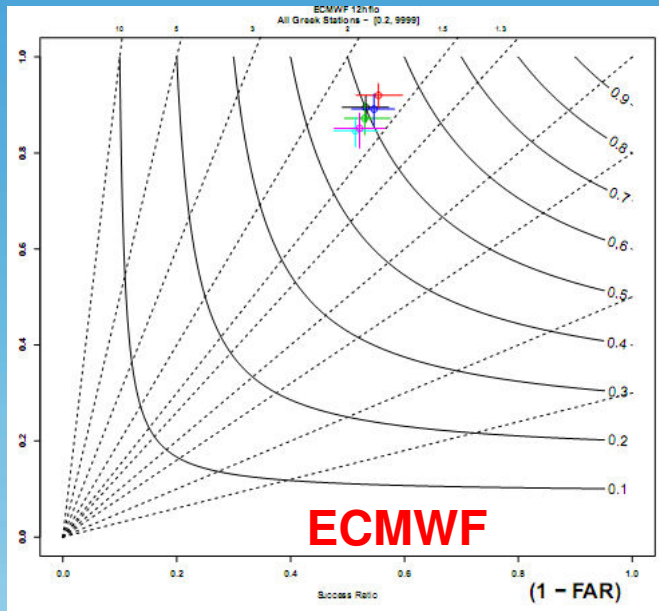
**COSMO lower FAR increasing with time. ECMWF lower FAR for threshold 1. High values for threshold 20.**

# 12h PRECIPITATION ETS WINTER PLOTS BY STEP



**ECMWF better ETS for threshold 1.  
Similar values for low thresholds  
for COSMO**

# 12h PRECIPITATION PERFORMANCE DIAGRAMS 0.2mm



● step 12 ● step 24 ● step 38 ● step 48 ● step 60 ● step 72

**Smaller Bias for COSMO. Better POD for ECMWF. Sample uncertainty COSMOHR. Time variability smaller for ECMWF.**

# Summarizing....

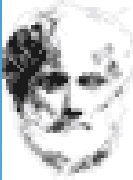
- ✓ Pressures : RMSE increases with time mainly for COSMO, winter and low pressures, ME+ for COSMO, ME- ECMWF
- ✓ Temperature: Daytime values underestimated mainly in winter. COSMOHR best, ECMWF better in winter daytime. ECMWF smaller diurnal ME variation. RMSE model hysteresis in winter.
- ✓ For  $T > 30$  COSMOHR is better for daytime, for  $T < 10$  model hysteresis
- ✓ For Overcast conditions the ME diurnal variation is bigger for ECMWF, the opposite for Sky Clear Conditions. No significant difference between condition based on OBS and OBS/FCST
- ✓ Cloud Cover is constantly underpredicted by ECMWF.
- ✓ Winds are overpredicted at night, underpredicted in the day, COSMOHR better. When condition  $> 10$ kt is applied, underprediction day and night. No significant dependence on wind direction.
- ✓ Precipitation: ECMWF overestimation of low thresholds, and better POD. COSMO lower FAR. Similar ETS values.



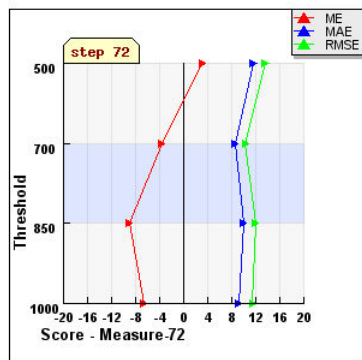
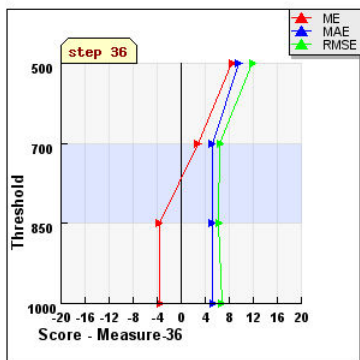
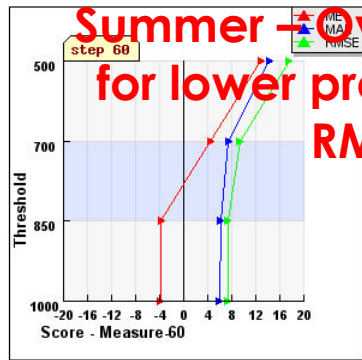
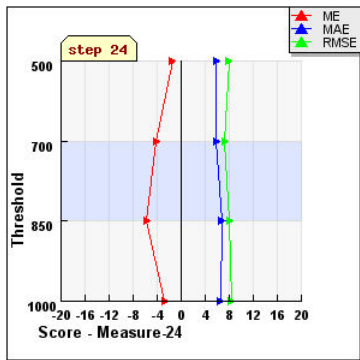
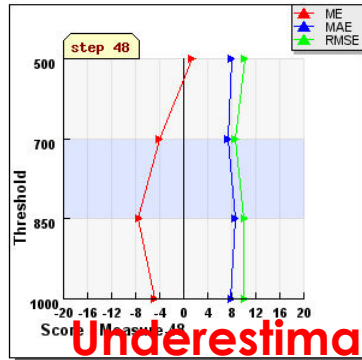
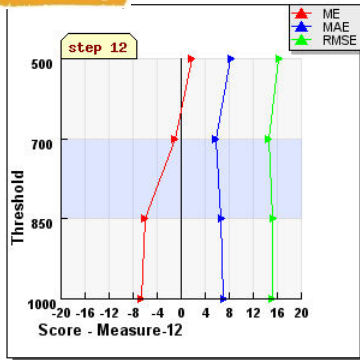
# Upper Air Data

**COSMOGR 2011-2012**

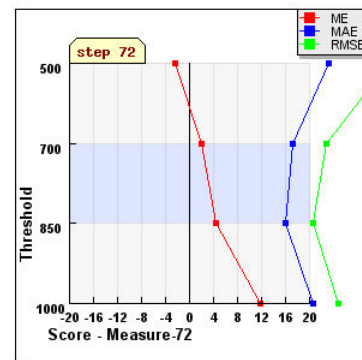
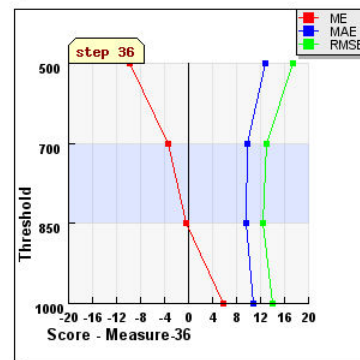
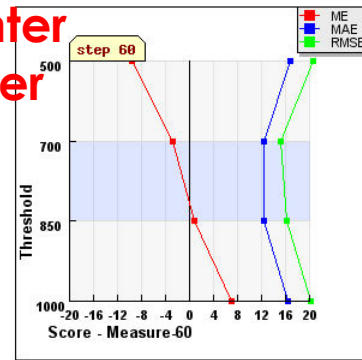
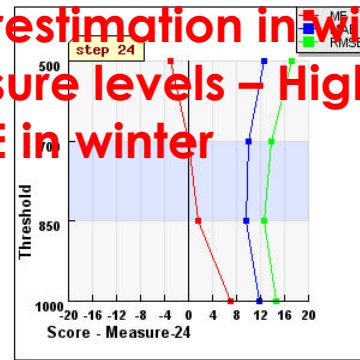
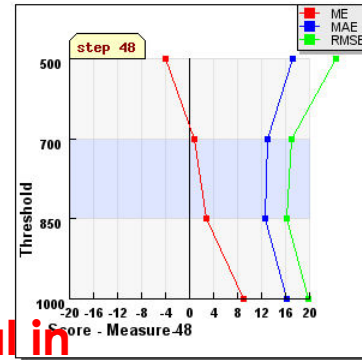
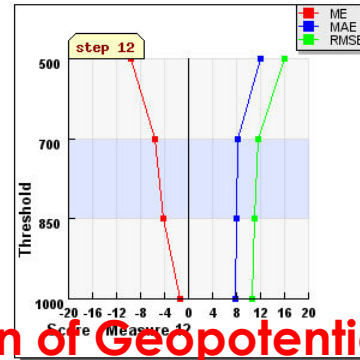
# UPPER AIR GEOPOTENTIAL ME MAE RMSE



GEOPOTENTIAL - 00 Run  
Stratification : All Greek Stations - Period: JJA 2011

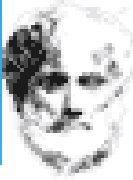


GEOPOTENTIAL - 00 Run  
Stratification : All Greek Stations - Period: DJF 2011-2012

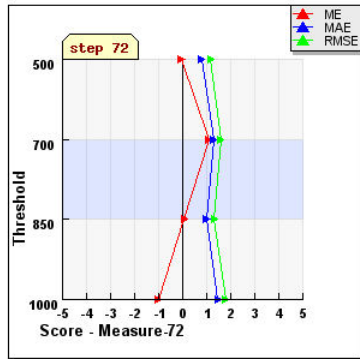
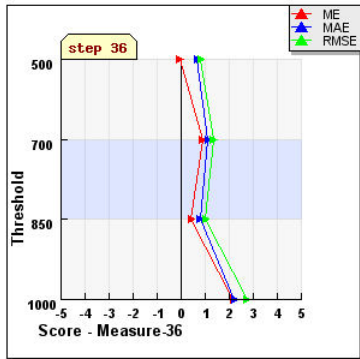
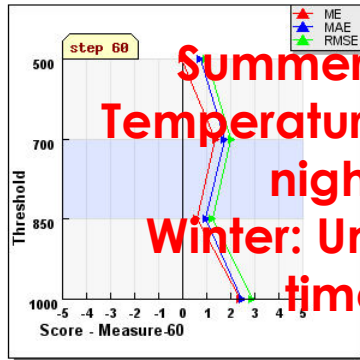
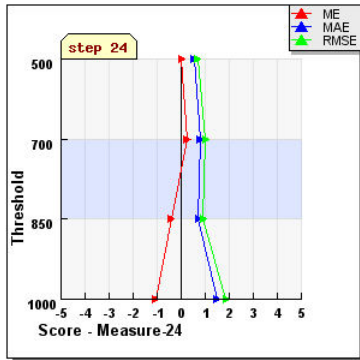
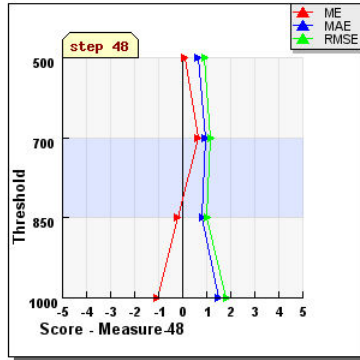
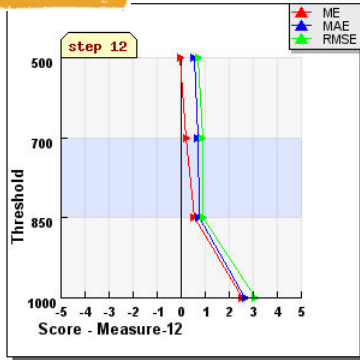


Underestimation of Geopotential in Summer – Overestimation in winter for lower pressure levels – Higher RMSE in winter

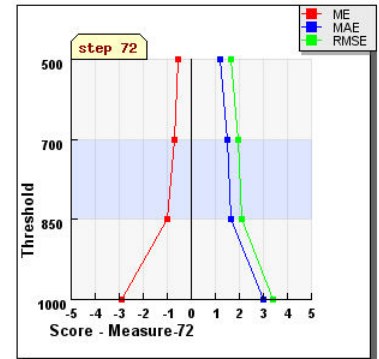
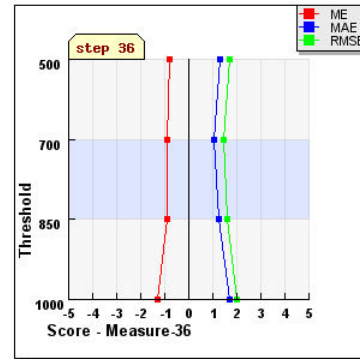
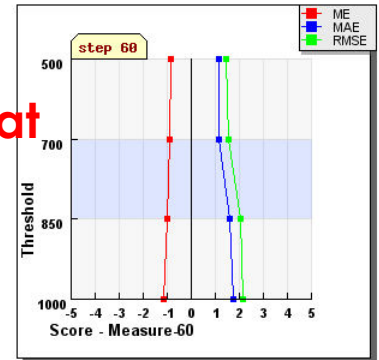
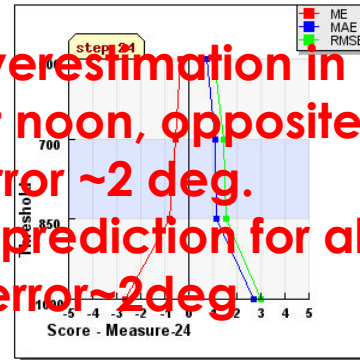
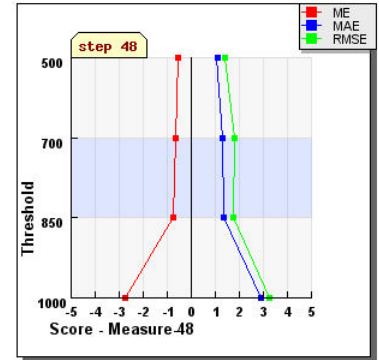
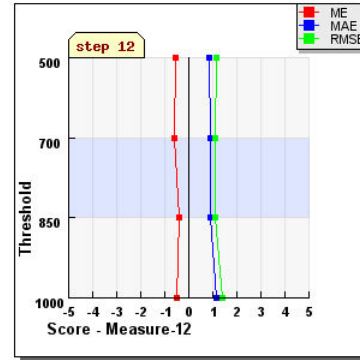
# UPPER AIR TEMPERATURE ME MAE RMSE



TEMPERATURE - 00 Run  
Stratification : All Greek Stations - Period: JJA 2011



TEMPERATURE - 00 Run  
Stratification : All Greek Stations - Period: DJF 2011-2012

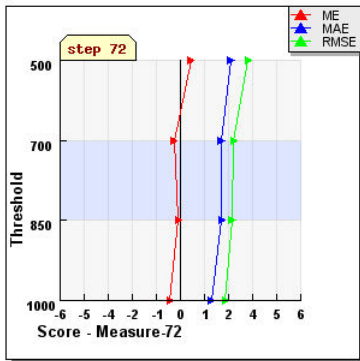
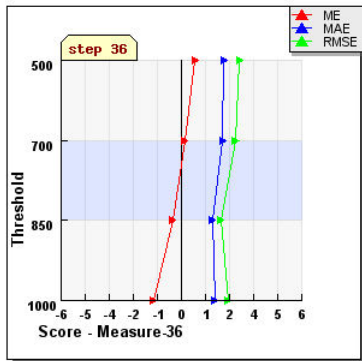
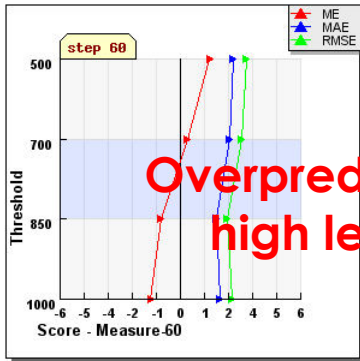
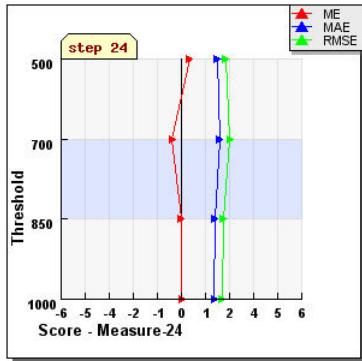
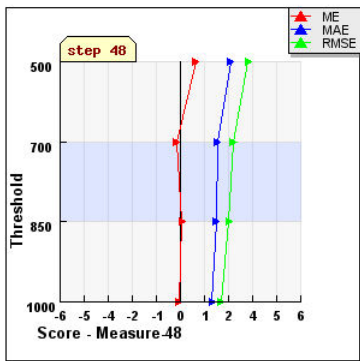
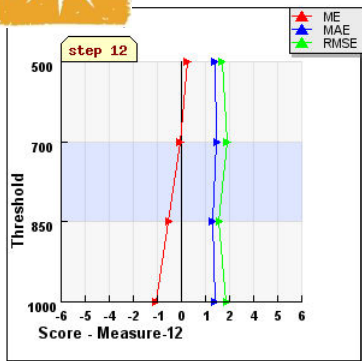


Summer: Overestimation in  
Temperature at noon, opposite at  
night, error ~2 deg.  
Winter: Underprediction for all  
times, error ~2deg

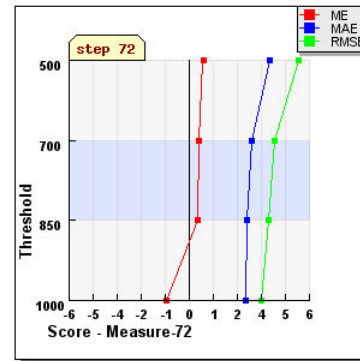
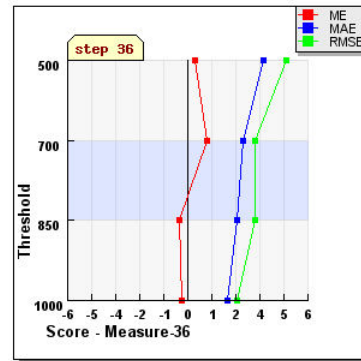
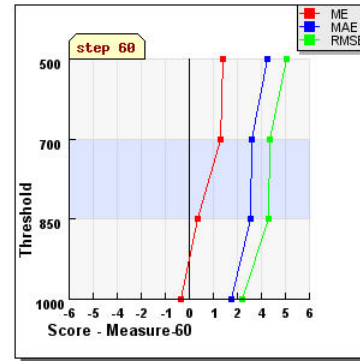
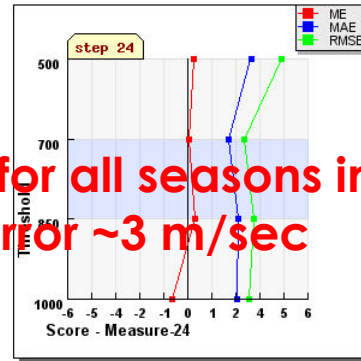
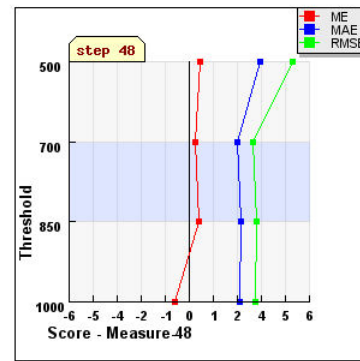
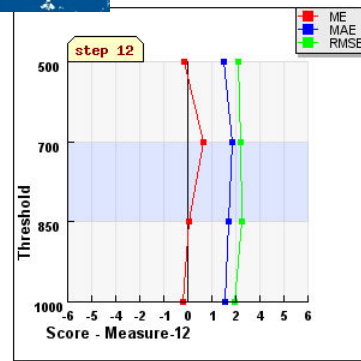
# UPPER AIR WIND SPEED ME MAE RMSE



WIND SPEED - 00 Run  
Stratification : All Greek Stations - Period: JJA 2011



WIND SPEED - 00 Run  
Stratification : All Greek Stations - Period: DJF 2011-2012

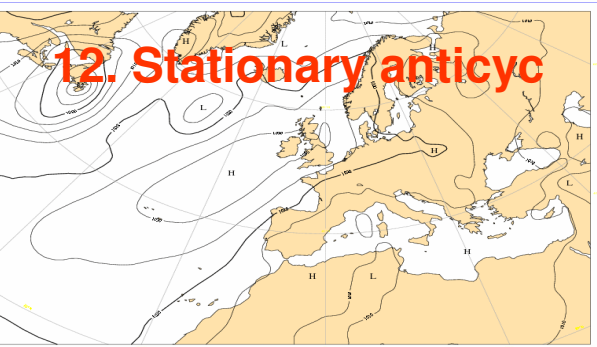
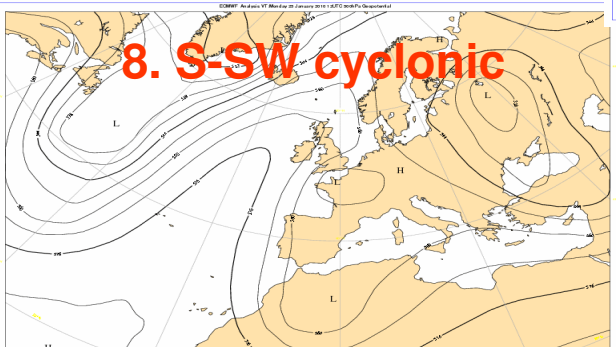
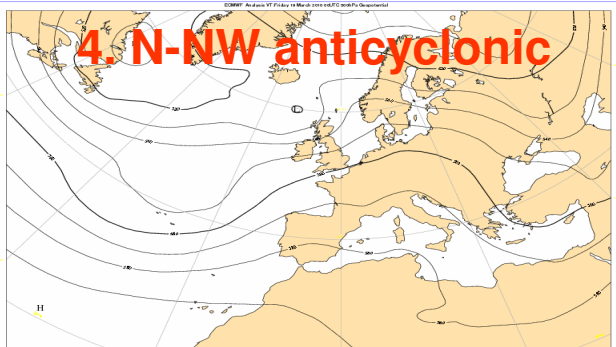
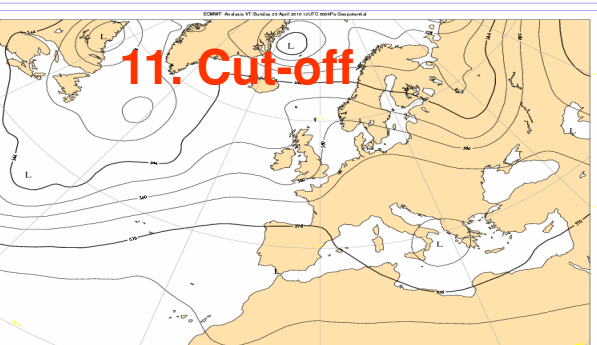
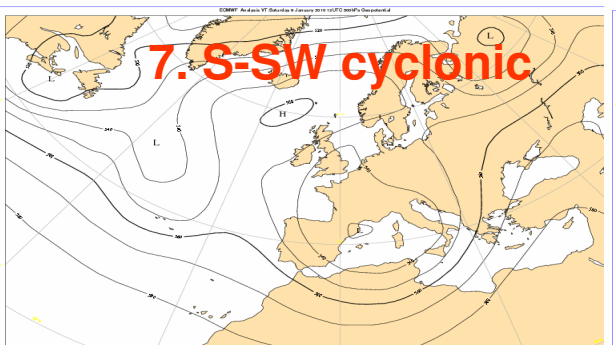
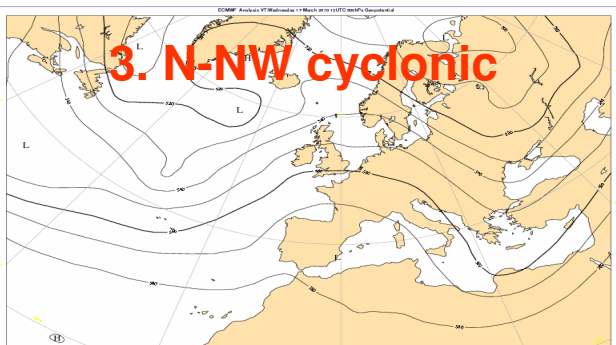
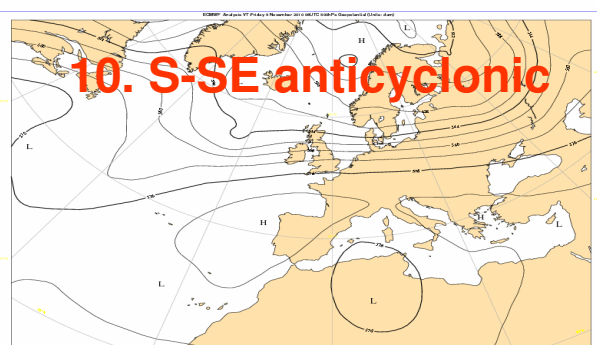
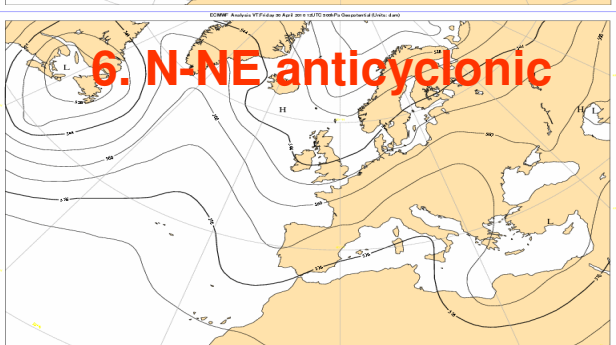
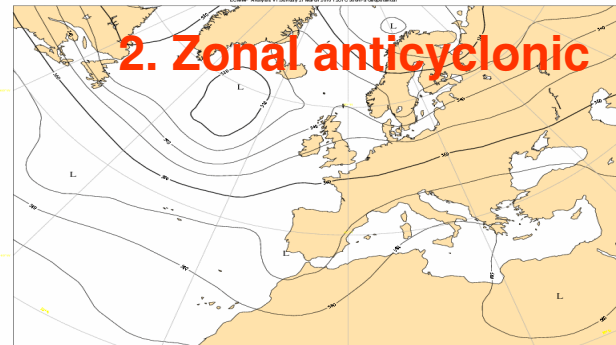
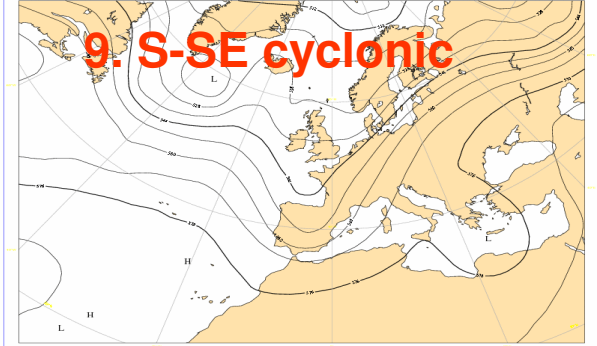
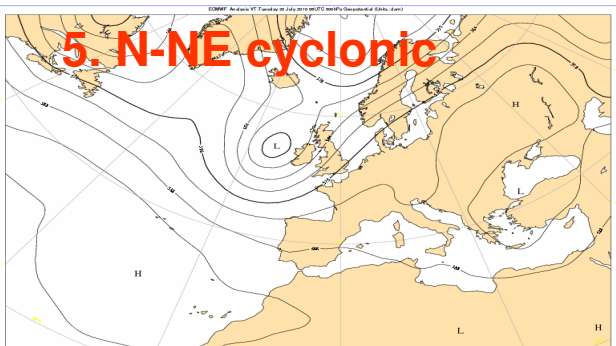
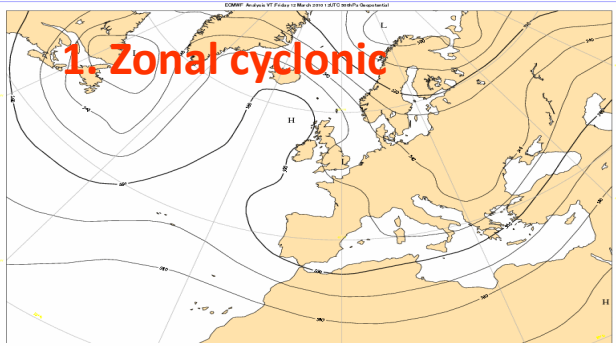


Overprediction for all seasons in high levels, error ~3 m/sec

**Weather dependent Verification...In progress**

**580 days classified in 12 Weather Regimes**

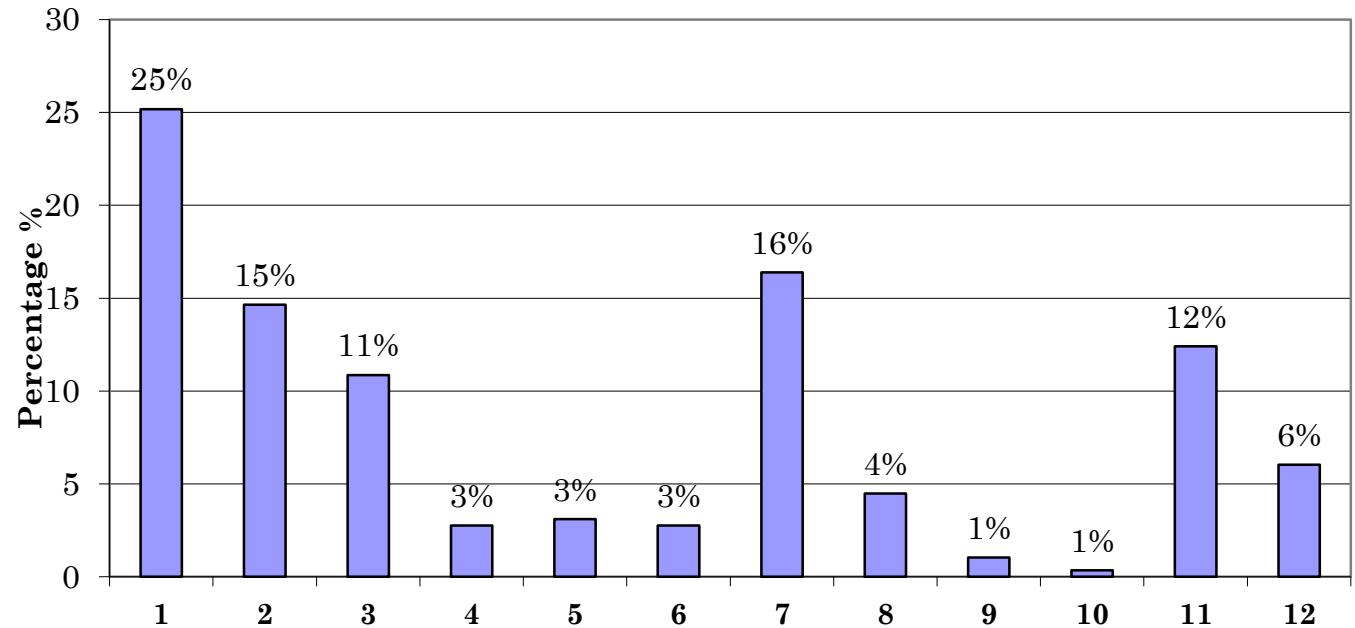
**COSMOGR**



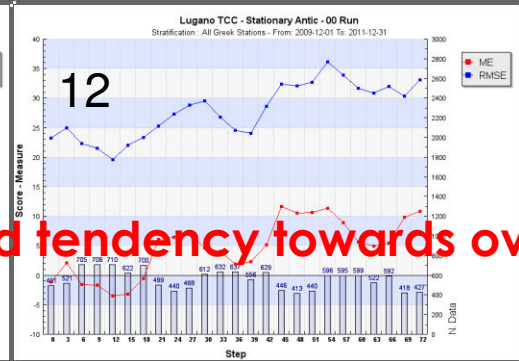
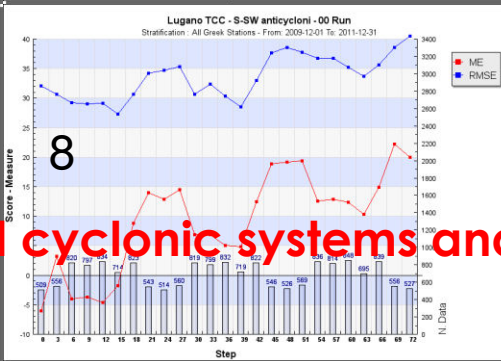
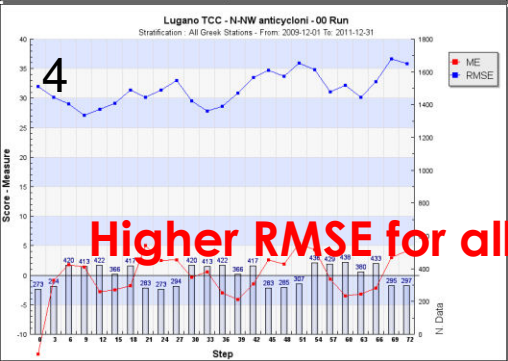
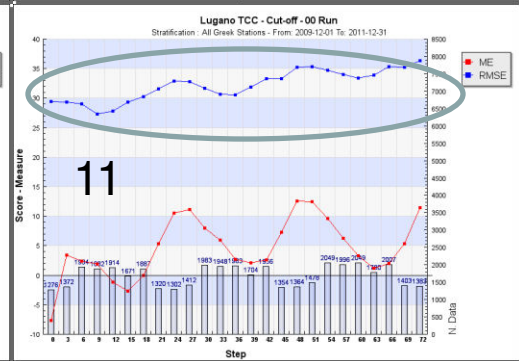
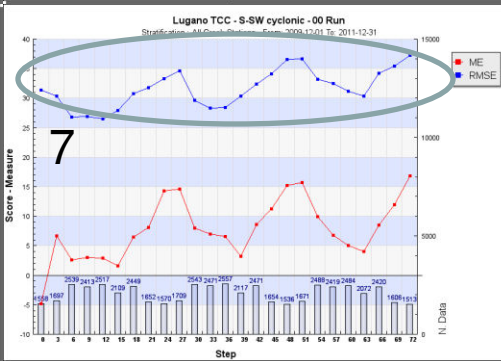
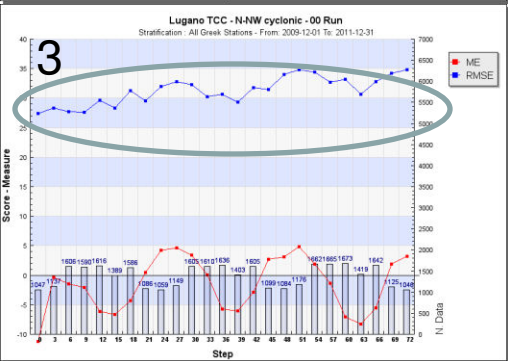
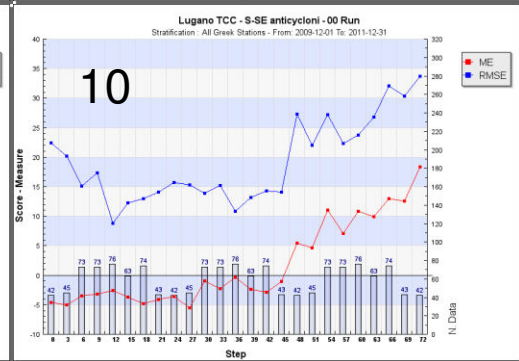
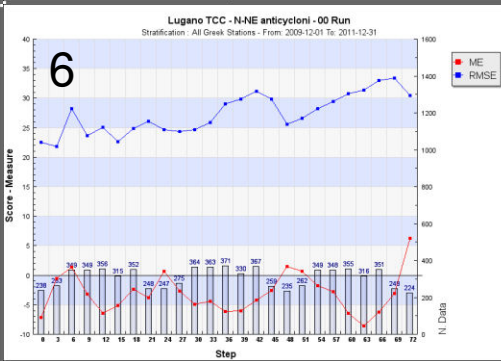
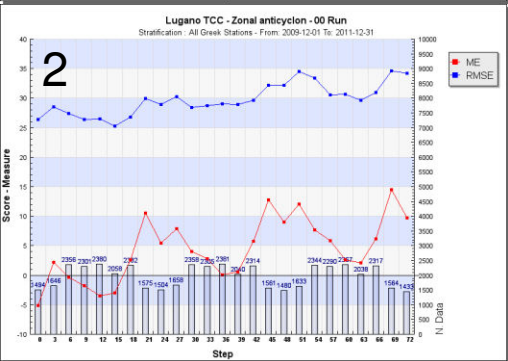
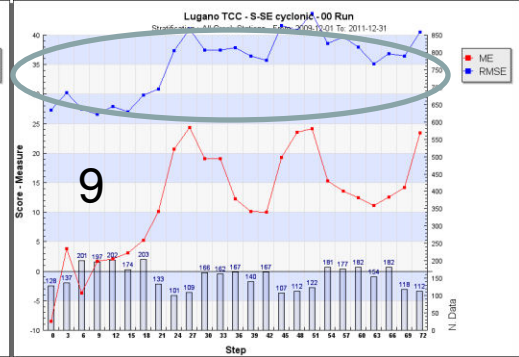
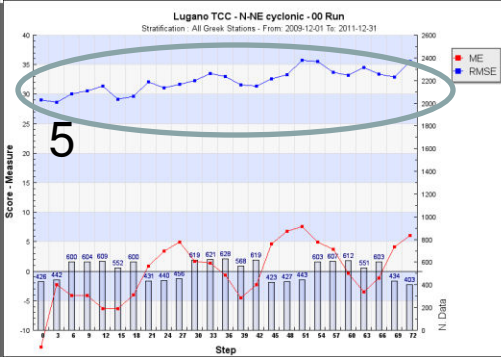
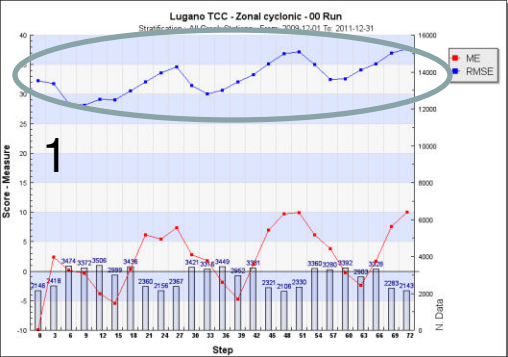
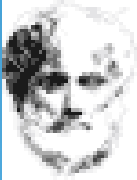
# Weather Classification: 01/09/2009-31/12/2011=580day



## Percentage of weather regimes



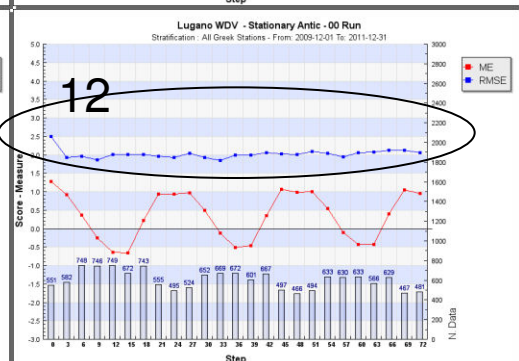
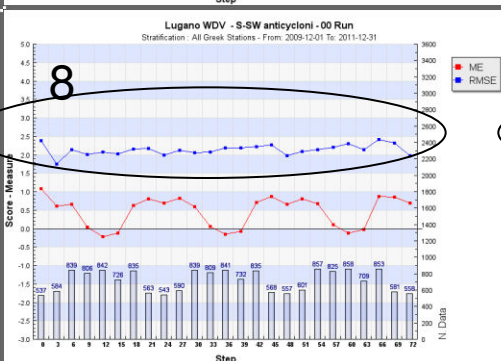
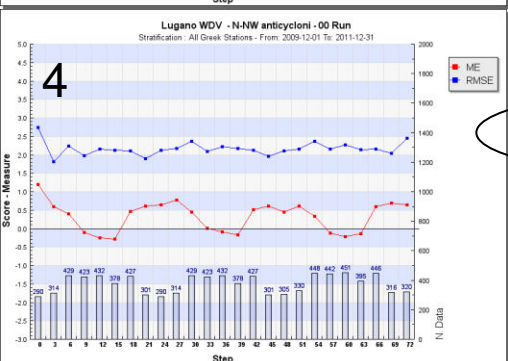
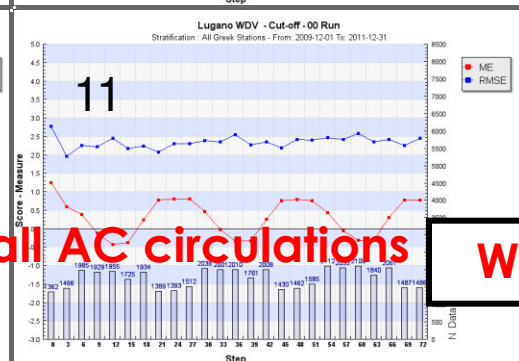
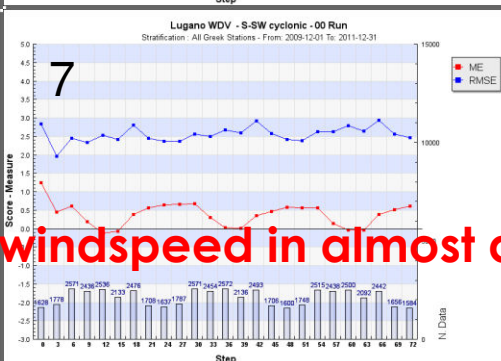
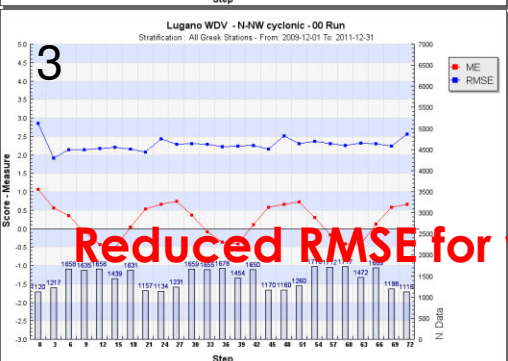
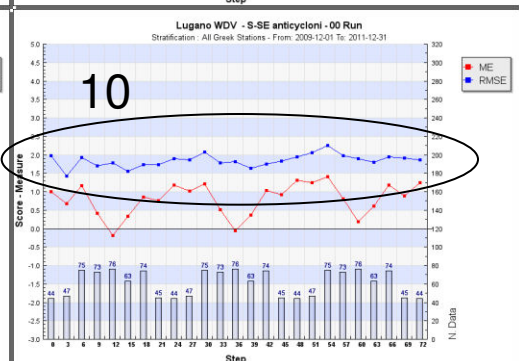
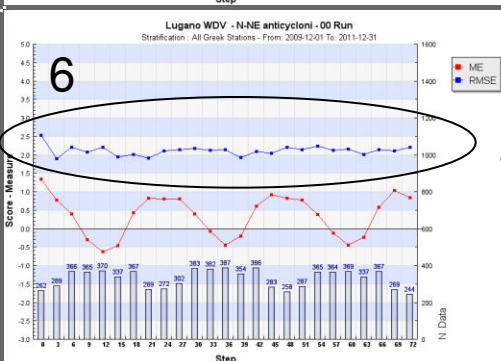
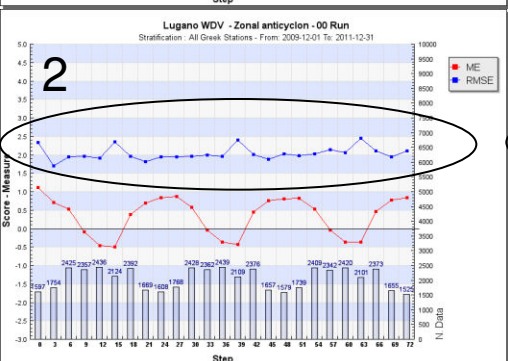
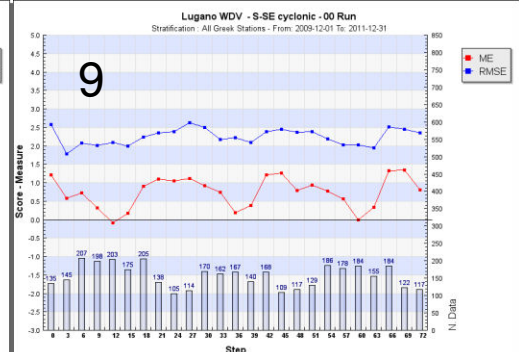
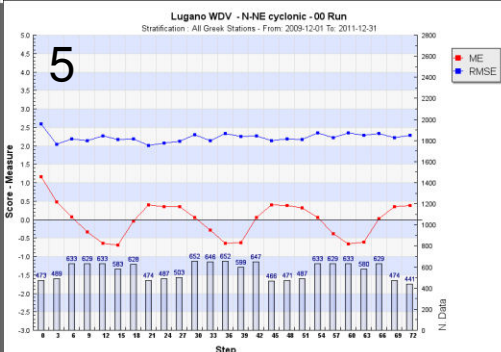
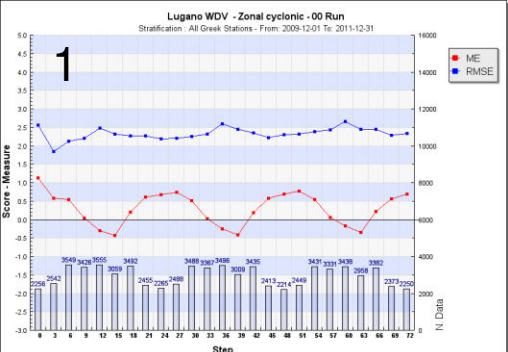
1	Zonal cyclonic
2	Zonal anticyclonic
3	N-NW cyclonic
4	N-NW anticyclonic
5	N-NE cyclonic
6	N-NE anticyclonic
7	S-SW cyclonic
8	S-SW anticyclonic
9	S-SE cyclonic
10	S-SE anticyclonic
11	Cut-off
12	Stationary Anticyclone



**TCC**

**Higher TCC for all cyclonic systems and tendency towards overprediction**

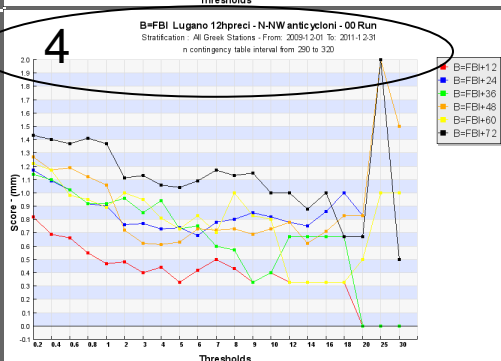
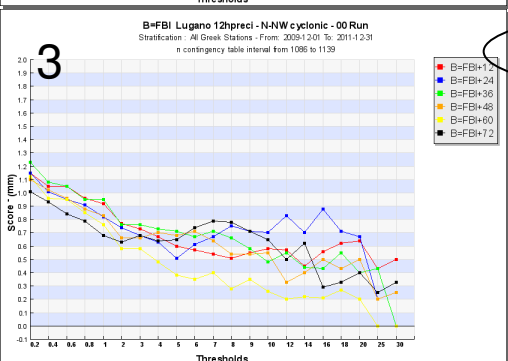
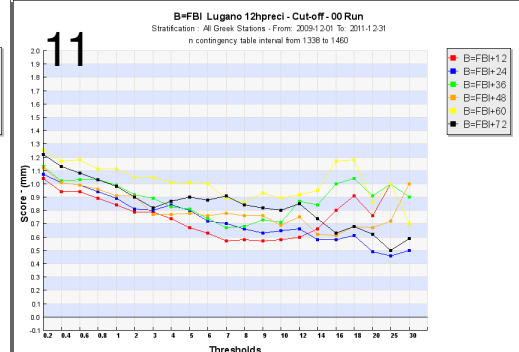
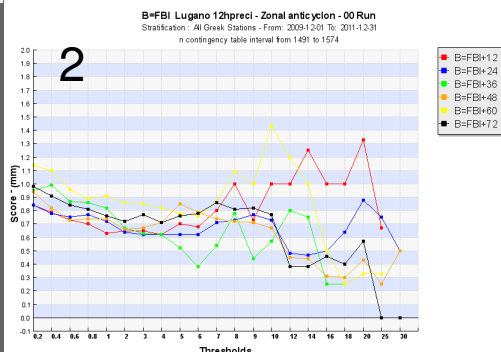
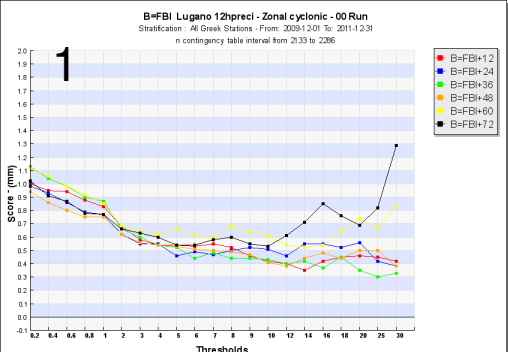
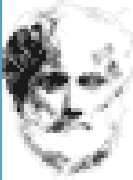




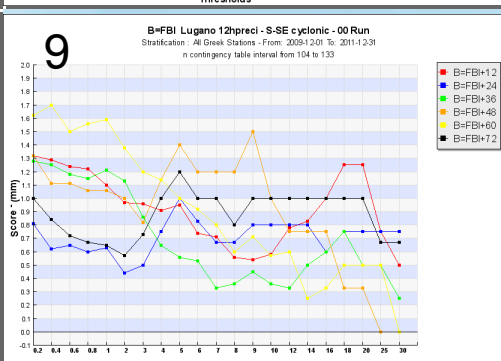
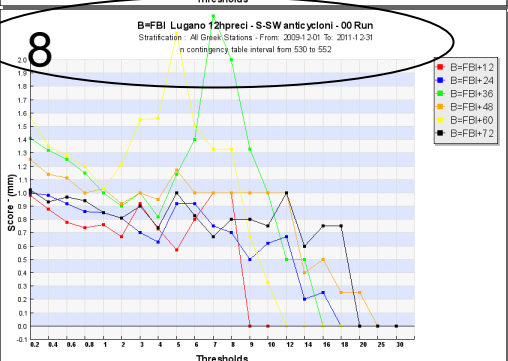
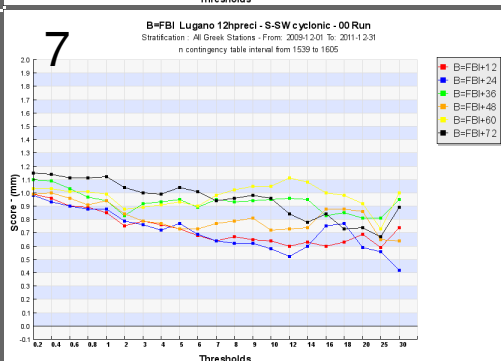
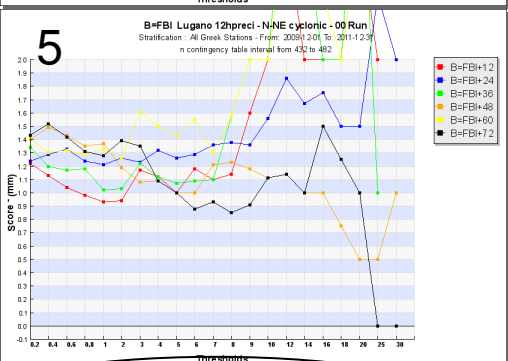
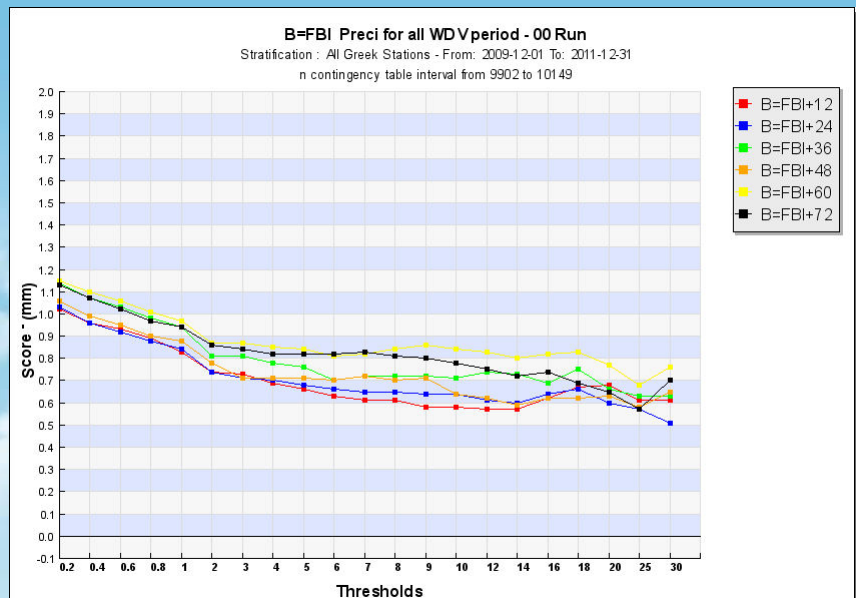
**Reduced RMSE for windspeed in almost all AC circulations**

**Wind Speed 10m**

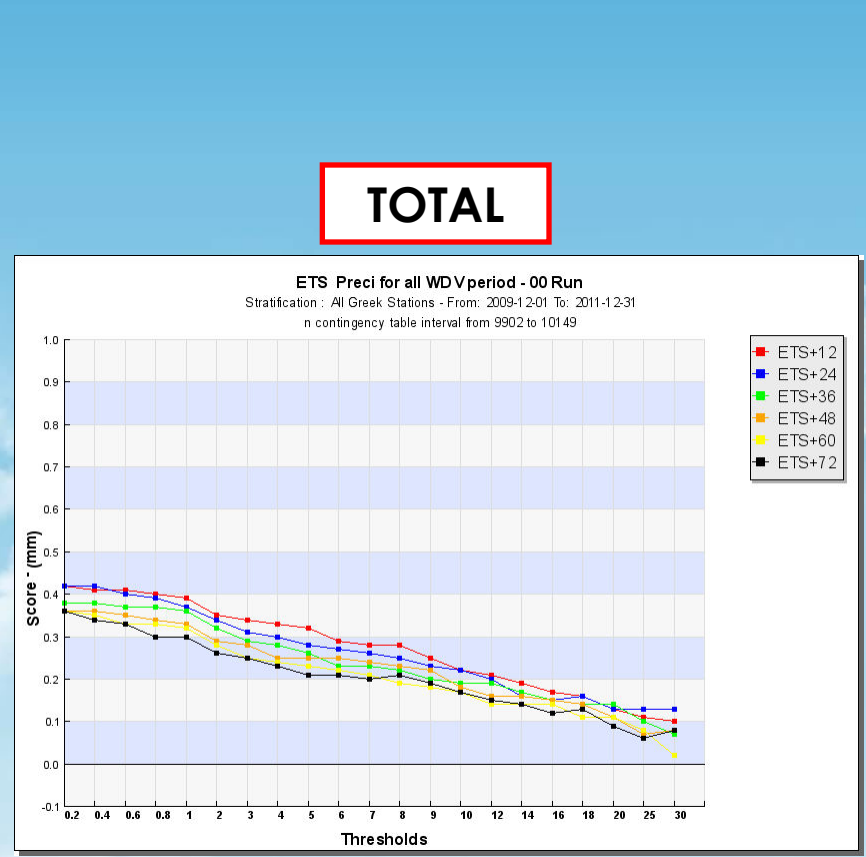
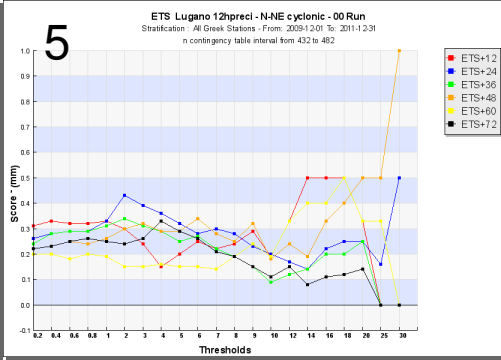
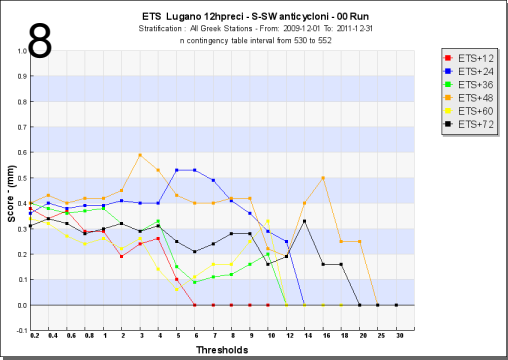
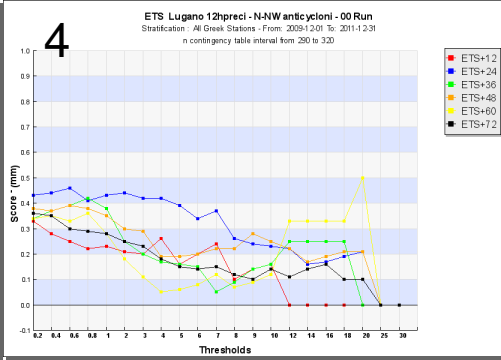
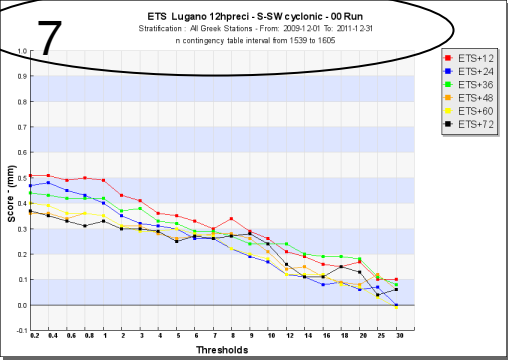
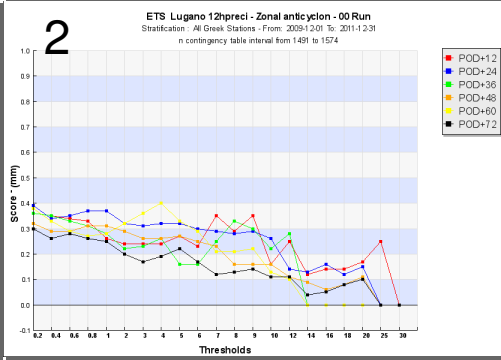
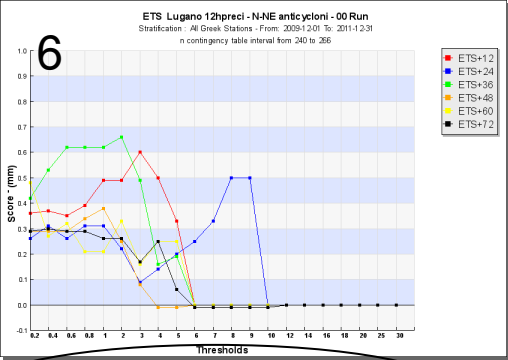
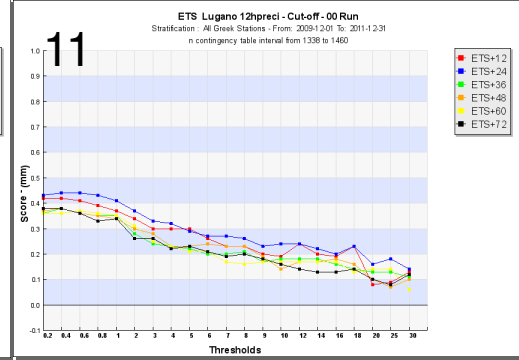
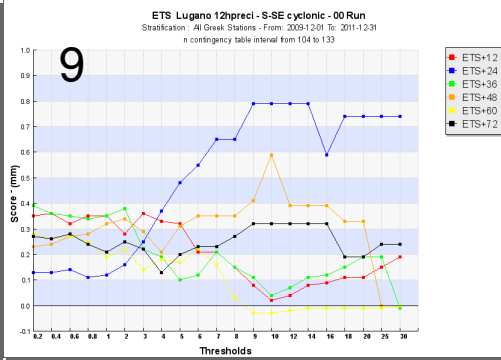
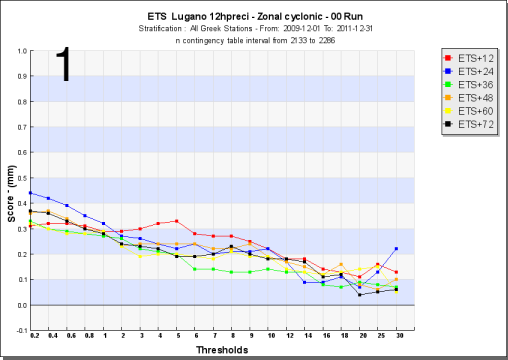




**TOTAL**



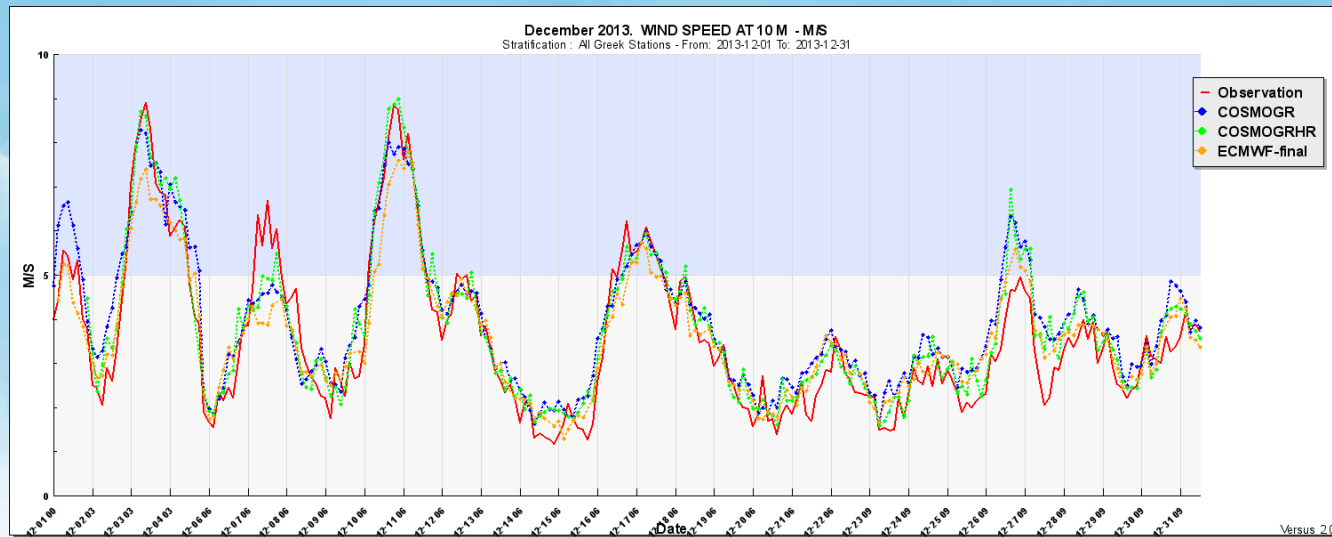
**Underprediction in the lower precipitation thresholds when present is an anticyclonic circulation-overprediction in cyclonic**



**ETS scores slightly better for SW cyclonic conditions**

# HNMS Activity started in 2013

Issue of a Report for Greek forecasters using ECMWF and COSMO models with description of guidelines and model comparison for every season with monthly and seasonal verifications.



Thank you !

