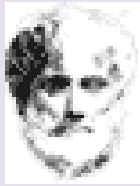
CONSORTIUM FOR SMALL SCALE MODELING
COSMO



ΕΘΝΙΚΗ
ΜΕΤΕΩΡΟΛΟΓΙΚΗ
ΥΠΗΡΕΣΙΑ
HELLENIC NATIONAL METEOROLOGICAL SERVICE

Soil Conditional Verification

TEMPERATURES

DEW POINT TEMPERATURES

5 SOIL TYPES

SON/DJF/MAM

10 Soil Types in COSMO

Soil Types (used in COSMO model)	
Soil Type 1	Ice
Soil Type 2	Rock
Soil Type 3	Sand
Soil Type 4	Sandy Loam
Soil Type 5	Loam
Soil Type 6	Clay loam
Soil Type 7	Clay
Soil Type 8	Peat
Soil Type 9	Sea water
Soil Type 10	Sea Ice

Methodology

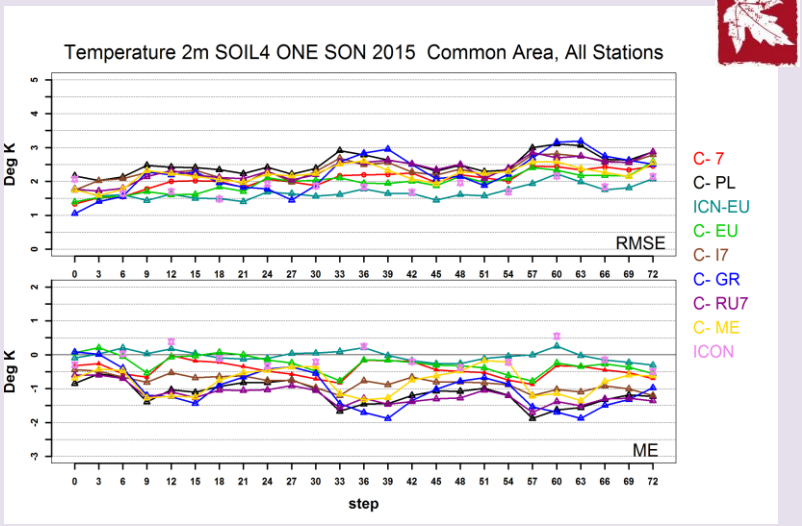
- After a preliminary analysis, it was found that only soil types 4, 5, 6, 7, 8 are represented from the 97 Common Area Stations.
- For the purpose of this experiment, one only station was chosen to represent each category.(station with same soil type for all participating models)
- For Soil Type 5 that is the most populated, a stratification based on the station height (<200m, >800m) is applied.

Soil characteristics for each type

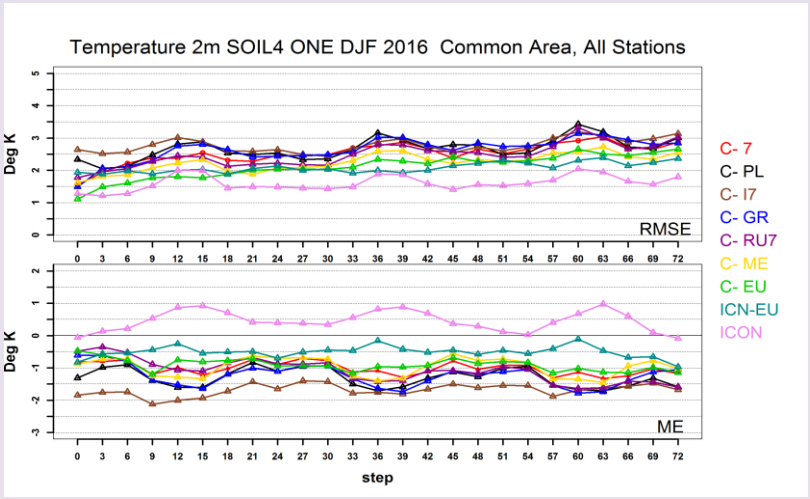
soil type	1 ice	2 rock	3 sand	4 sandy loam	5 loam	6 loamy clay	7 clay	8 peat
volume of voids w_{PV} [1]	-	-	0.364	0.445	0.455	0.475	0.507	0.863
field capacity w_{FC} [1]	-	-	0.196	0.260	0.340	0.370	0.463	0.763
permanent wilting point w_{PWP} [1]	-	-	0.042	0.100	0.110	0.185	0.257	0.265
air dryness point w_{ADP} [1]	-	-	0.012	0.030	0.035	0.060	0.065	0.098
minimum infiltration rate I_{K2} [kg/(m^2 s)]	-	-	0.0035	0.0023	0.0010	0.0006	0.0001	0.0002
hydraulic diffusivity parameter D_0 [10^{-9} m^2/s]	-	-	18400	3460	3570	1180	442	106
hydraulic diffusivity parameter D_1 [1]	-	-	-8.45	-9.47	-7.44	-7.76	-6.74	-5.97
hydraulic conductivity parameter K_0 [10^{-9} m/s]	-	-	47900	9430	5310	764	17	58
hydraulic conductivity parameter K_1 [1]	-	-	-19.27	-20.86	-19.66	-18.52	-16.32	-16.48
heat capacity $\rho_0 c_0$ [10^6 J/(m^3 K)]	1.92	2.10	1.28	1.35	1.42	1.50	1.63	0.58
heat conductivity								
λ_0 [W/(K m)]	2.26	2.41	0.30	0.28	0.25	0.21	0.18	0.06
$\Delta\lambda$ [W/(K m)]	0.0	0.0	2.40	2.40	1.58	1.55	1.50	0.50
exponent B [1]	1.0	1.0	3.5	4.8	6.1	8.6	10.0	9.0

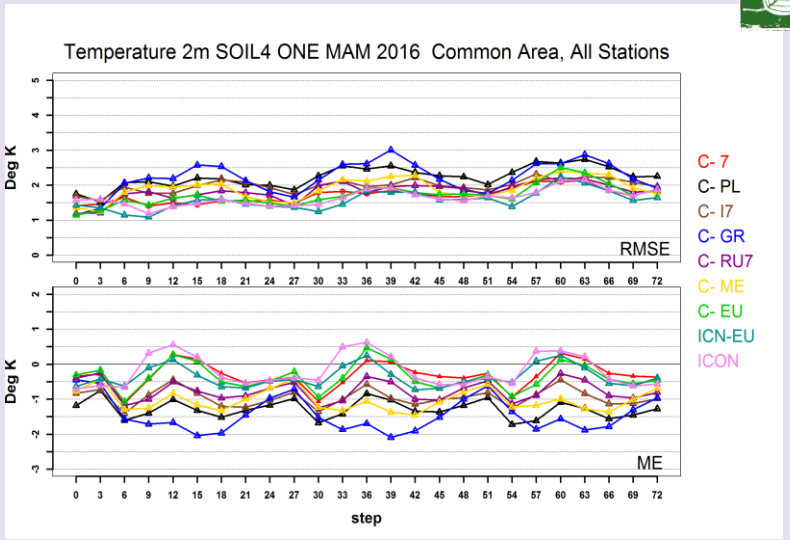
Each soil Type has different characteristics, eg. Sandy soils have increased hydraulic diffusivity and infiltration rate

- Bias mostly negative with slight diurnal variation.
- Sharper diurnal cycle in MAM
- Slight bias positive tendency for ICON and ICON-EU

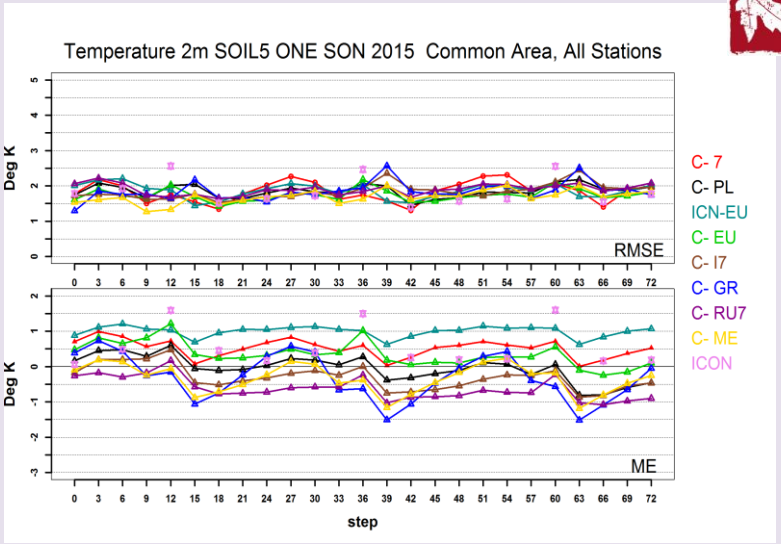


Temperatures for SOIL 4 (Sandy Loam)

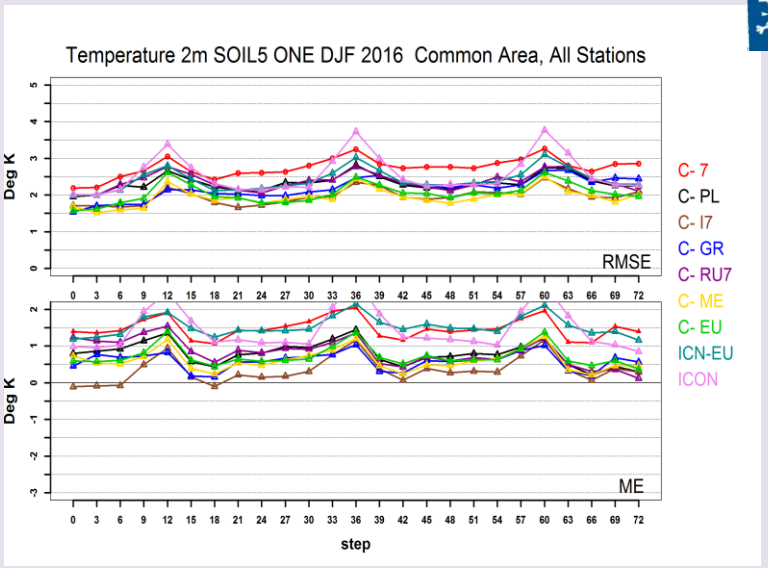


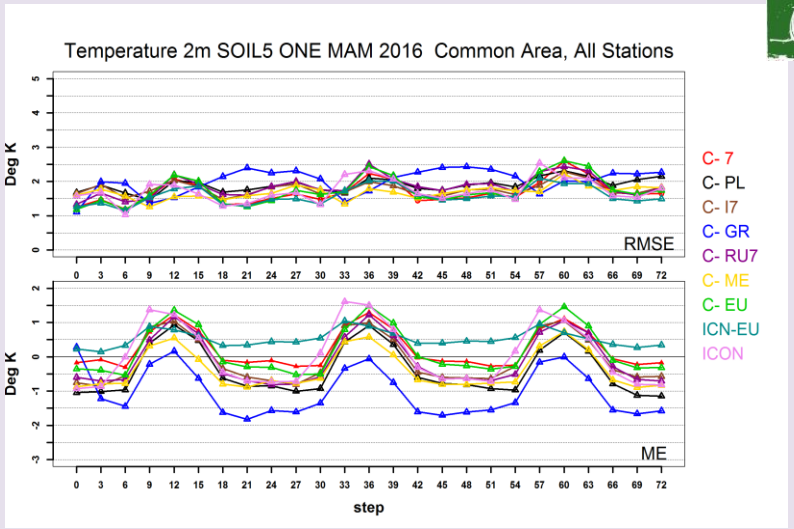


- Overestimation in DJF (all models)
- Higher Positive bias for ICON, ICON-EU
- Sharper diurnal cycle in MAM with positive peaks in the day.

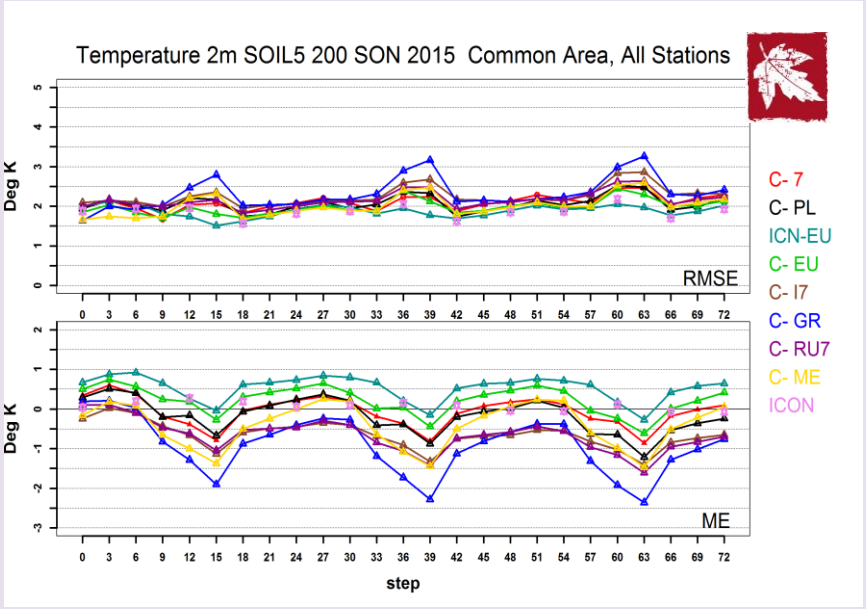


Temperatures for SOIL 5 (Loam)

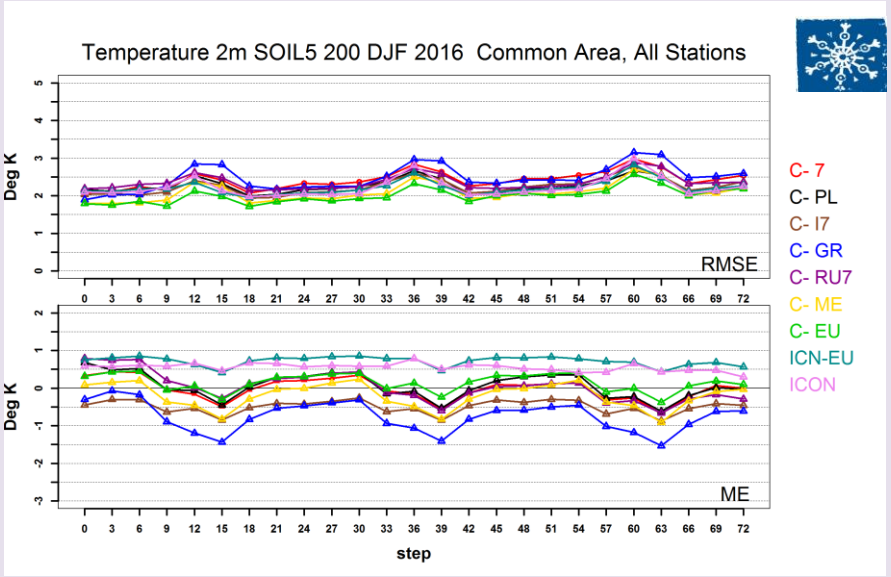


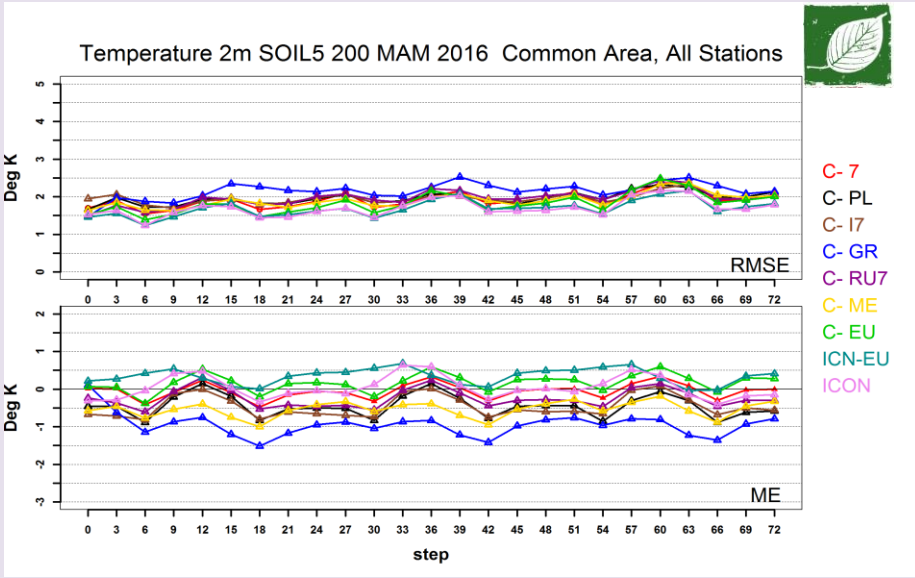


- Smooth bias diurnal cycle with negative trend in the day (SON and DJF)
- But slightly positive trend in the day for MAM.
- Slight overestimation for ICON-EU, ICON,C-EU, and underestimation for C-GR

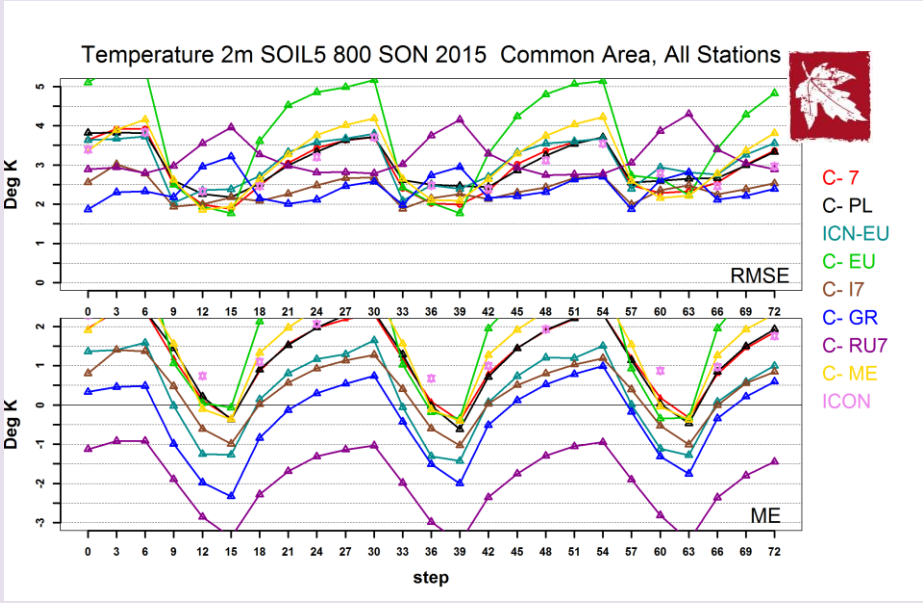


Temperatures for SOIL 5 (Loam) <200m

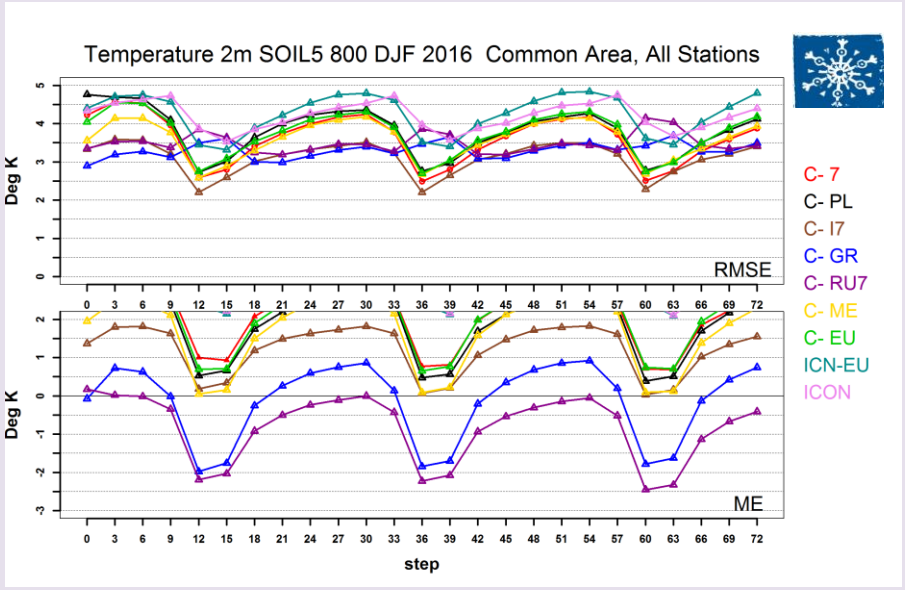


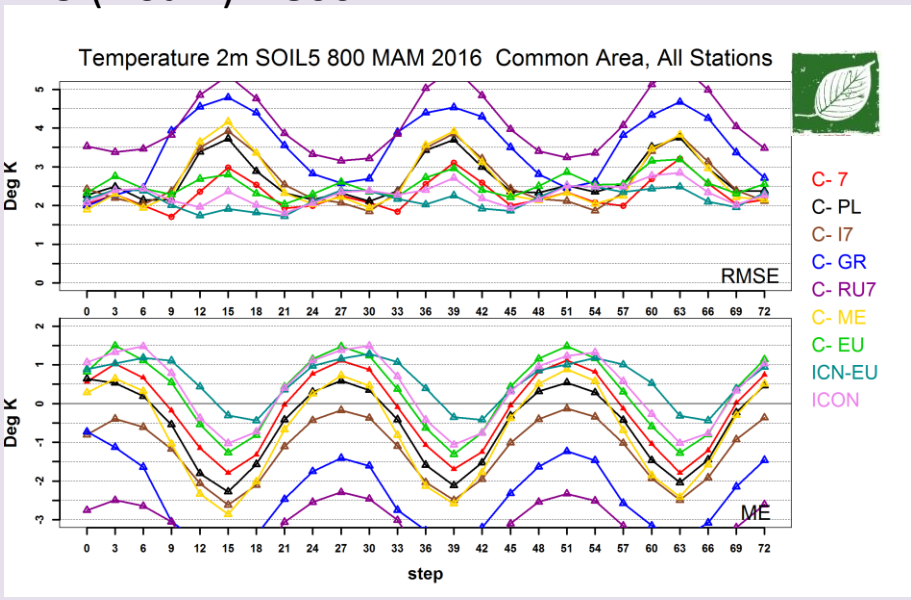


- Sharp diurnal ME cycle with negative trend in the day (all seasons)
- shift to negative values for MAM
- More positive values for ICON-EU, ICON, more negative for C-GR, C-RU7
- RMSE MAM peaks in the day- DJF night, SON variable

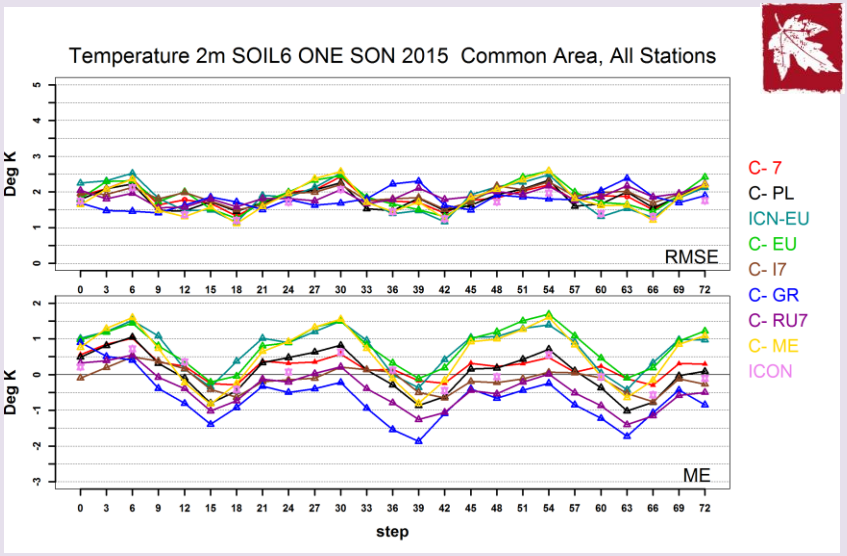


Temperatures for SOIL 5 (Loam) > 800m

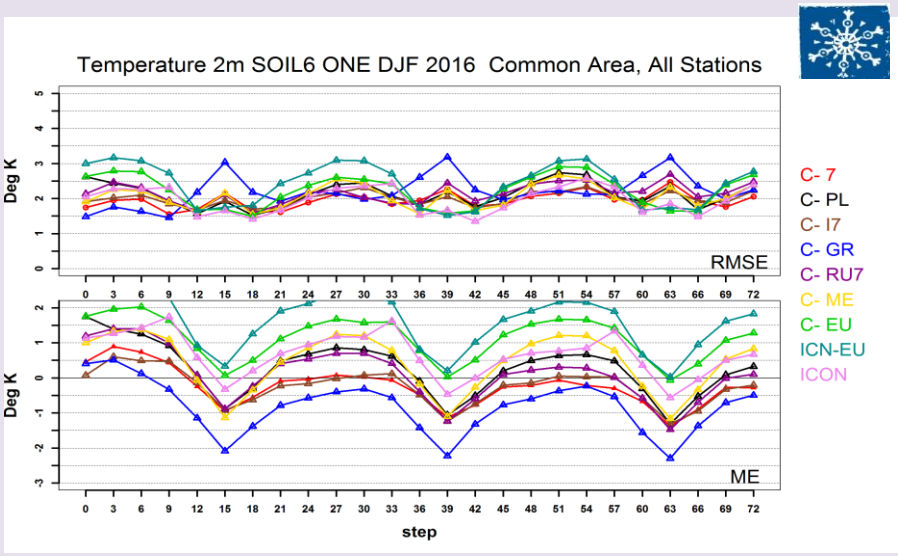


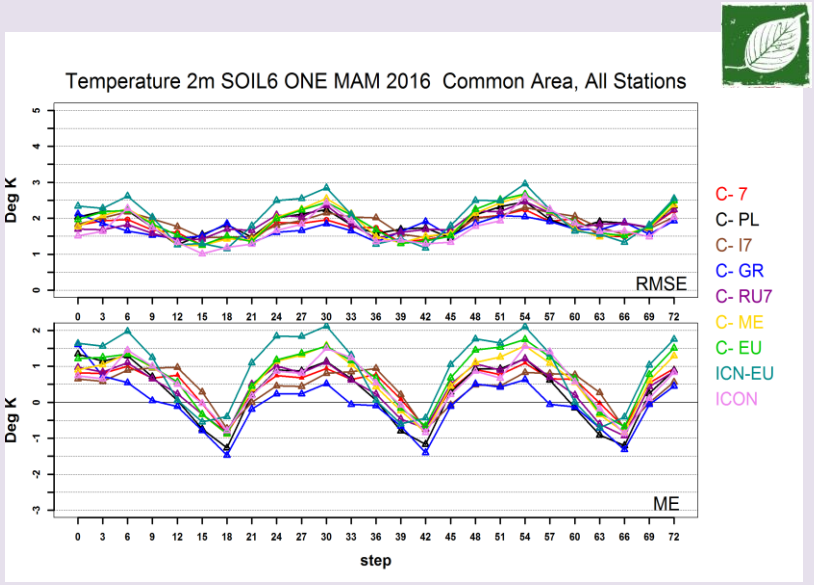


- Similar diurnal bias cycle with negative trend in the day (all seasons)
- More positive values for ICON-EU, C-EU, C-I7 and more negative for C-GR

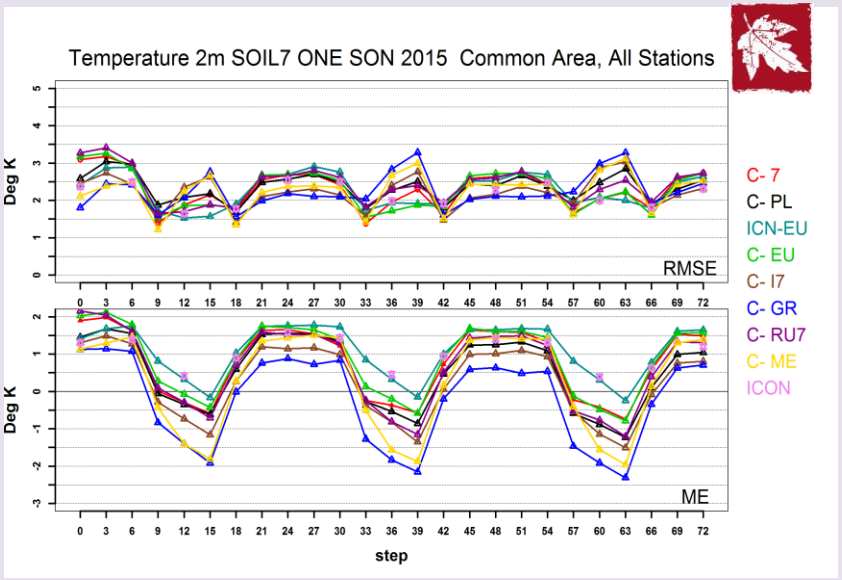


Temperatures for SOIL 6 (Clay Loam)

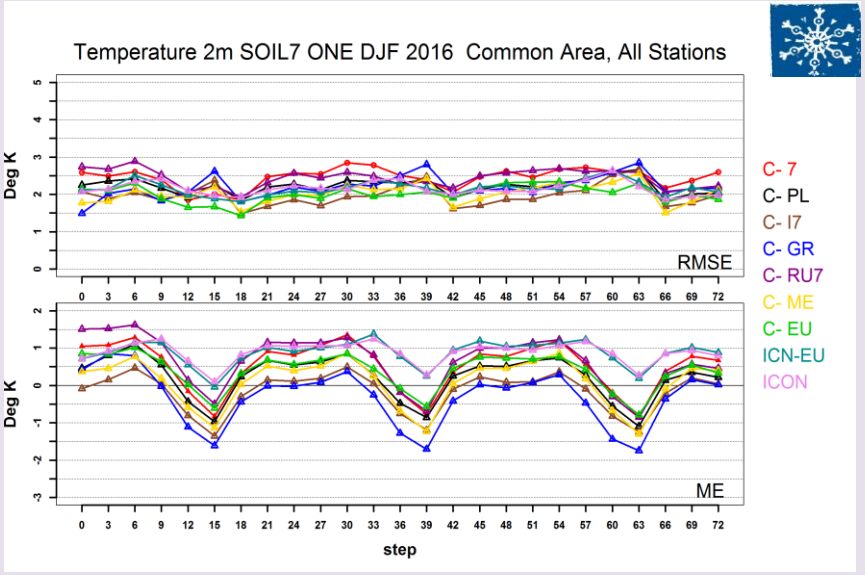


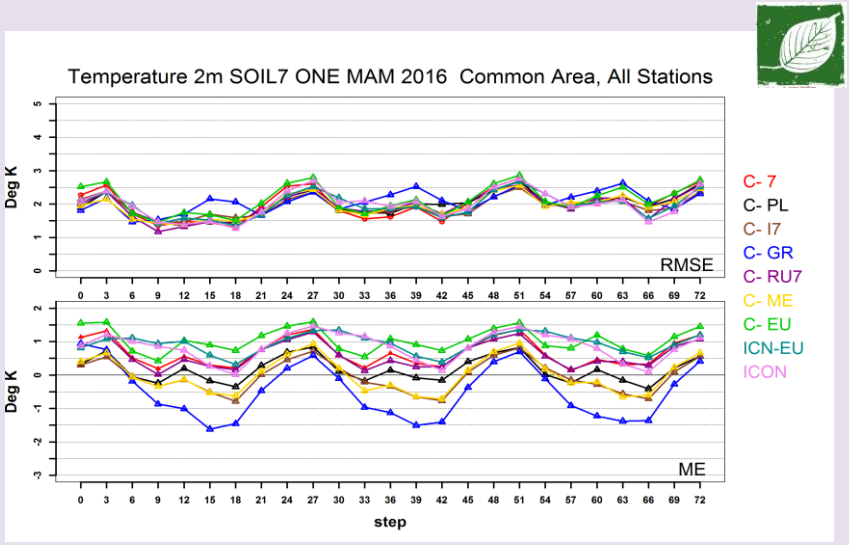


- Similar diurnal ME cycle with negative trend in the day (all seasons)
- sharper diurnal cycle for SON with RMSE peaks, smoother in MAM.

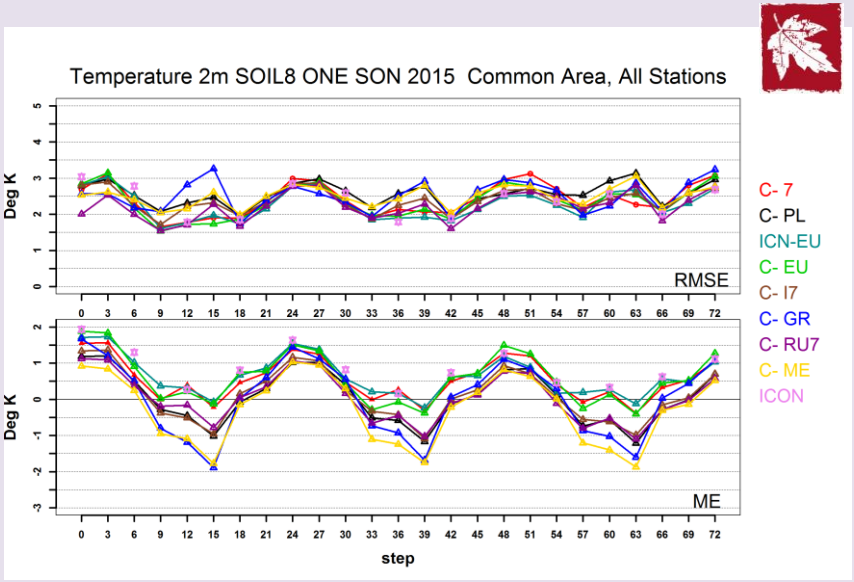


Temperatures for SOIL 7 (Clay)

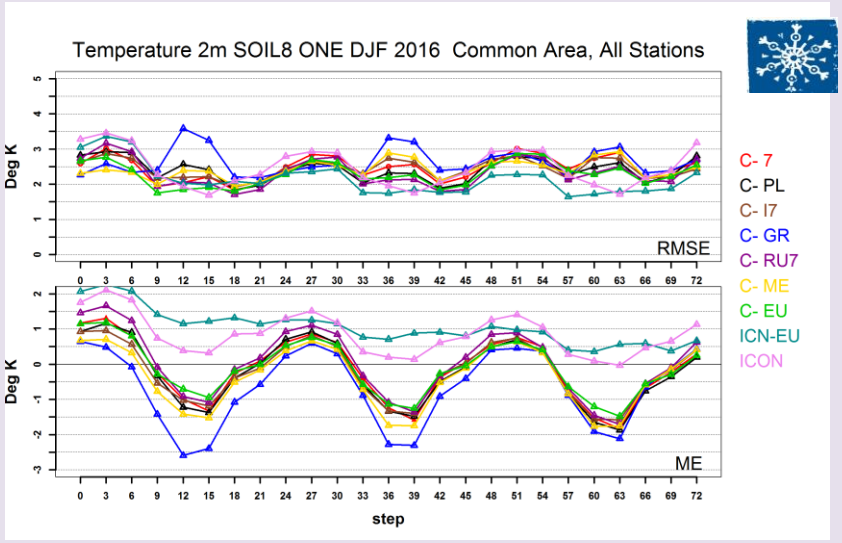


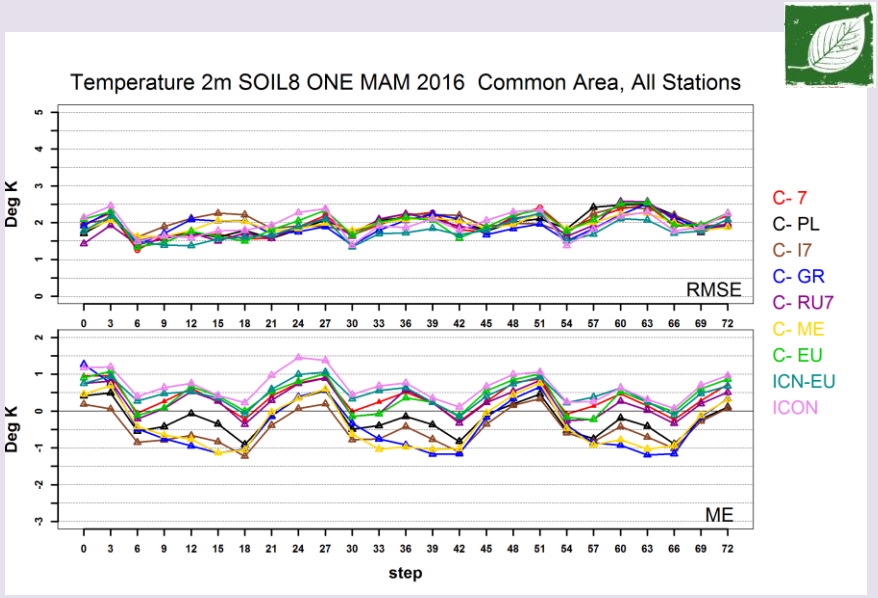


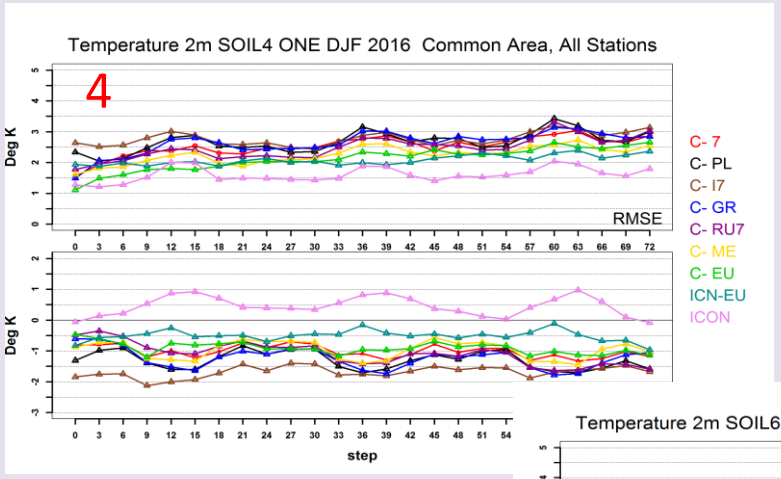
- Similar diurnal ME cycle with negative trend in the day (SON and DJF)
- ICON and ICON-EU almost no diurnal cycle in DJF, with ME >0
- MAM smooth cycle with slight positive peaks in the day.

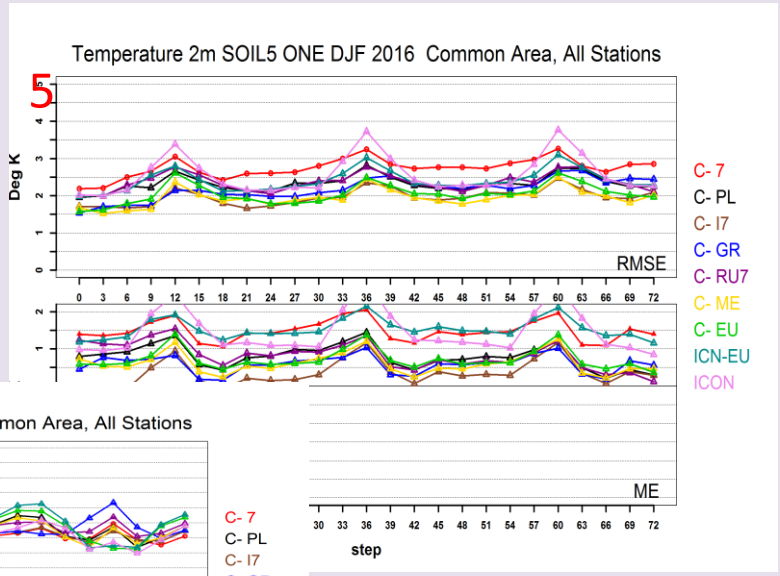


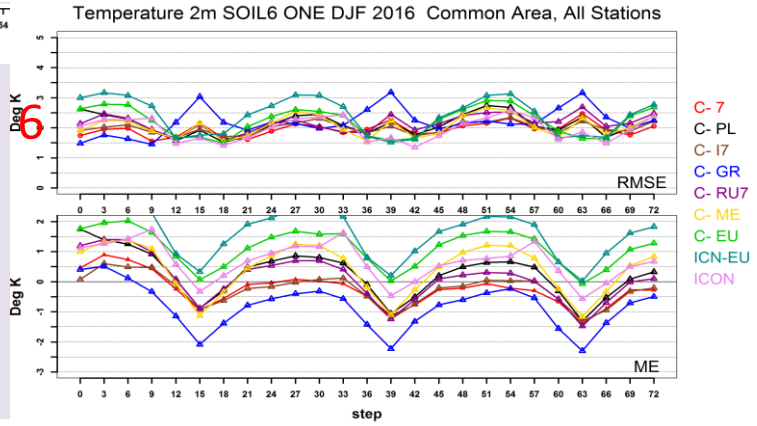
Temperatures for SOIL 8 (Peat)

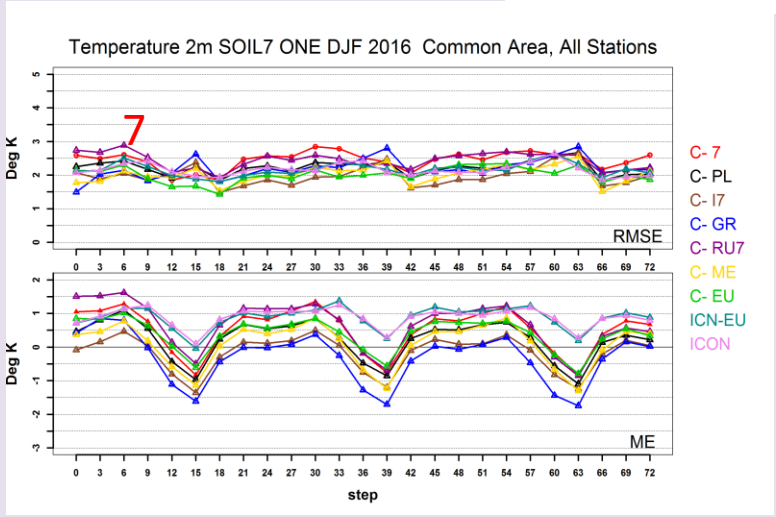


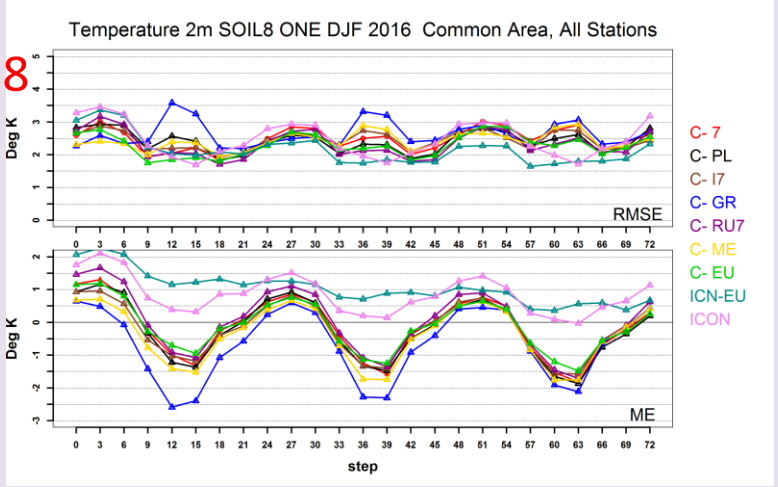



Temperature 2m SOIL4 ONE DJF 2016 Common Area, All Stations
4
RMSE
ME
Deg K
step
C- 7
C- PL
C- I7
C- GR
C- RU7
C- ME
C- EU
ICN-EU
ICON

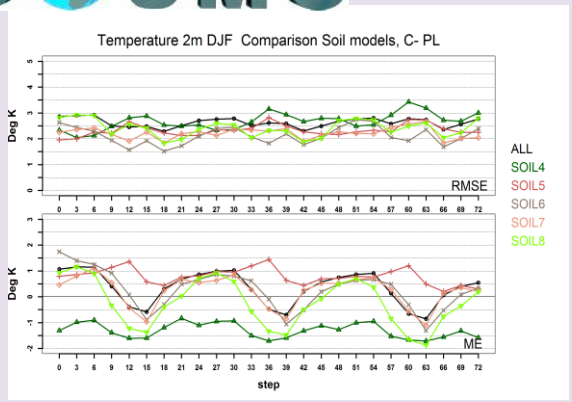

Temperature 2m SOIL5 ONE DJF 2016 Common Area, All Stations
5
RMSE
ME
Deg K
step
C- 7
C- PL
C- I7
C- GR
C- RU7
C- ME
C- EU
ICN-EU
ICON

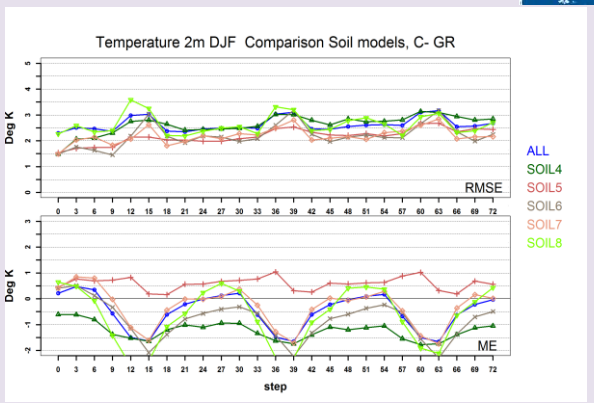

Temperature 2m SOIL6 ONE DJF 2016 Common Area, All Stations
6
RMSE
ME
Deg K
step
C- 7
C- PL
C- I7
C- GR
C- RU7
C- ME
C- EU
ICN-EU
ICON

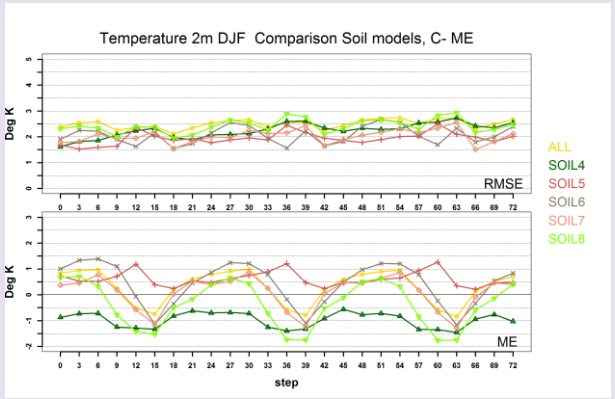

Temperature 2m SOIL7 ONE DJF 2016 Common Area, All Stations
7
RMSE
ME
Deg K
step
C- 7
C- PL
C- I7
C- GR
C- RU7
C- ME
C- EU
ICN-EU
ICON

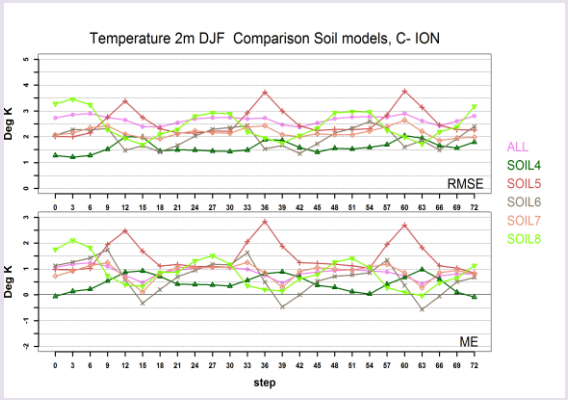

Temperature 2m SOIL8 ONE DJF 2016 Common Area, All Stations
8
RMSE
ME
Deg K
step
C- 7
C- PL
C- I7
C- GR
C- RU7
C- ME
C- EU
ICN-EU
ICON

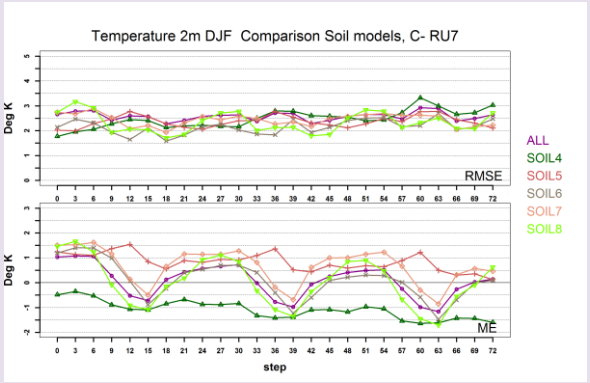
Conditional Verification

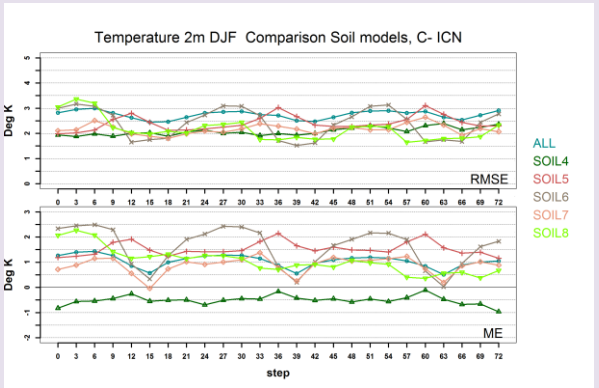


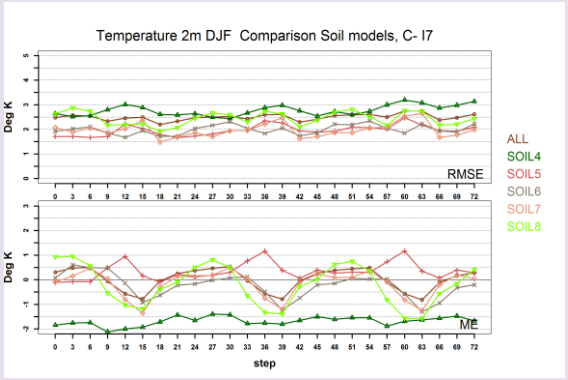


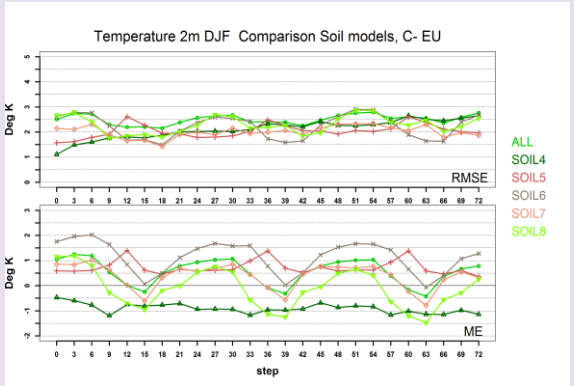


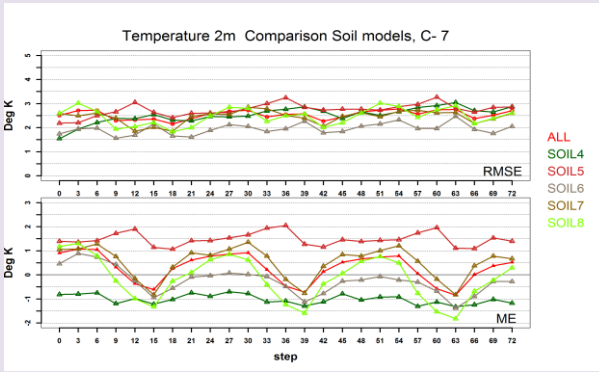




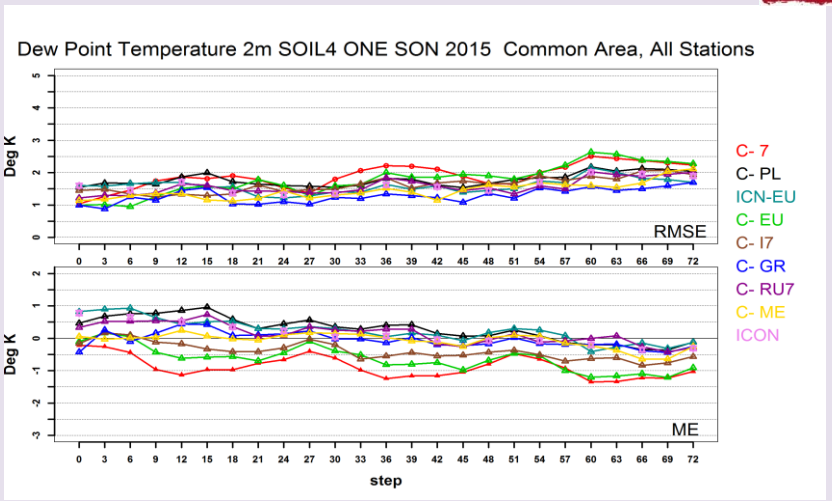




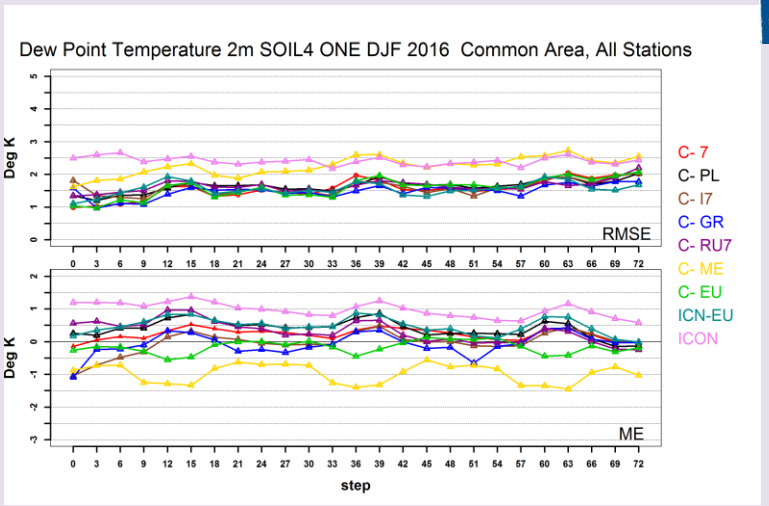


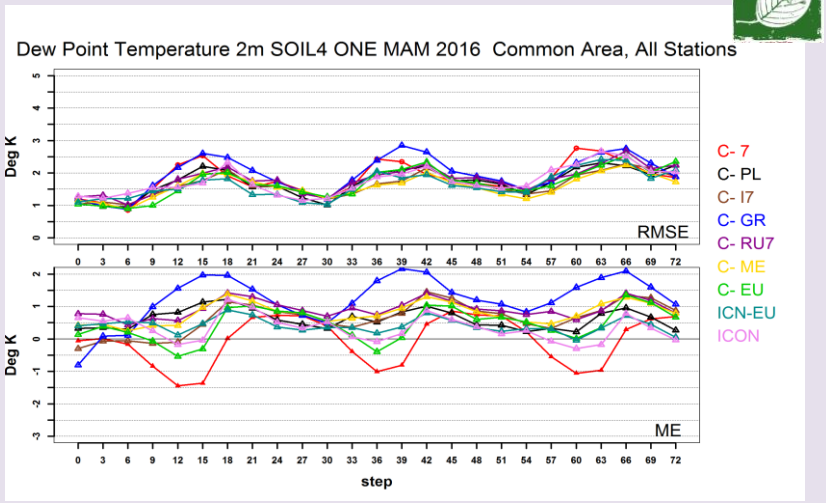


- Td bias slight diurnal cycle SON, DJF Sharper diurnal cycle in MAM with RMSE max and extreme ME for C-GR, C-7.
- ME >0 ICON ME <0 C-I7 in DJF

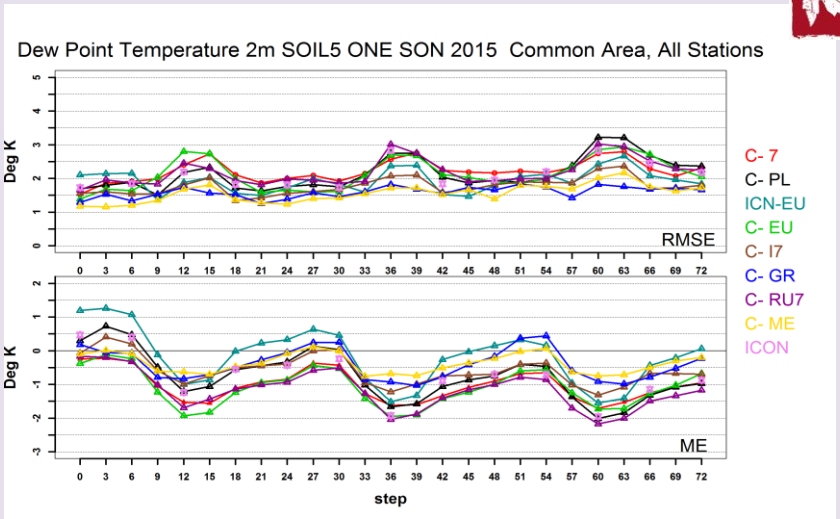


Dew Point Temperatures for SOIL 4 (Sandy Loam)

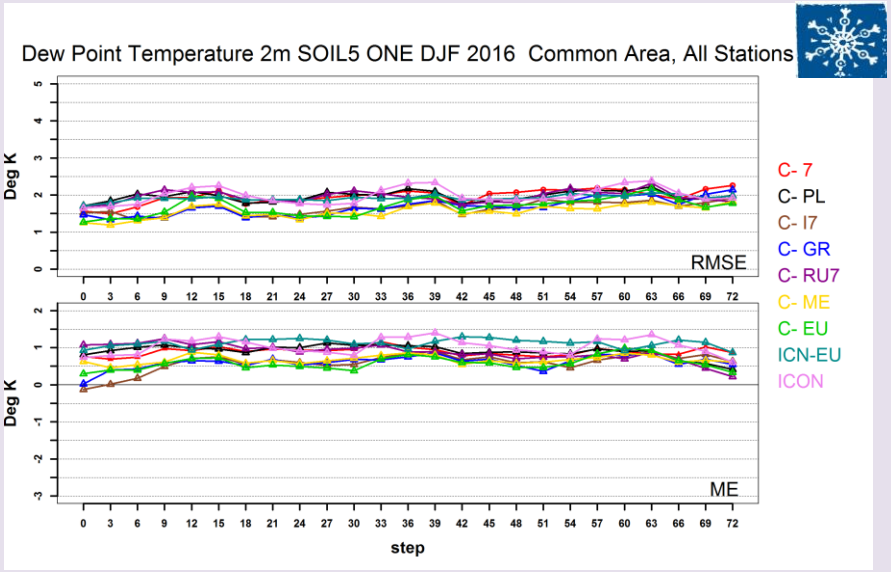


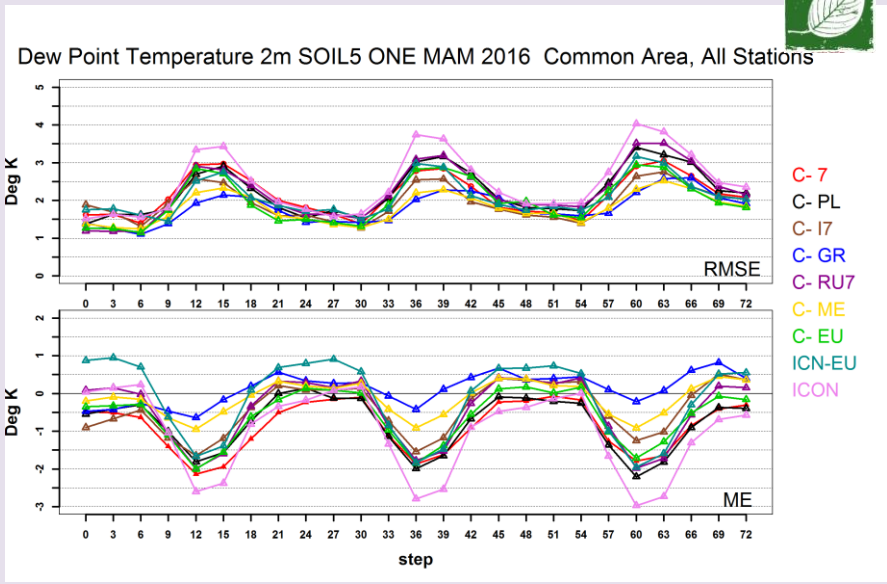


- Bias and RMSE diurnal cycle for SON and MAM
- Constant Overestimation in DJF.

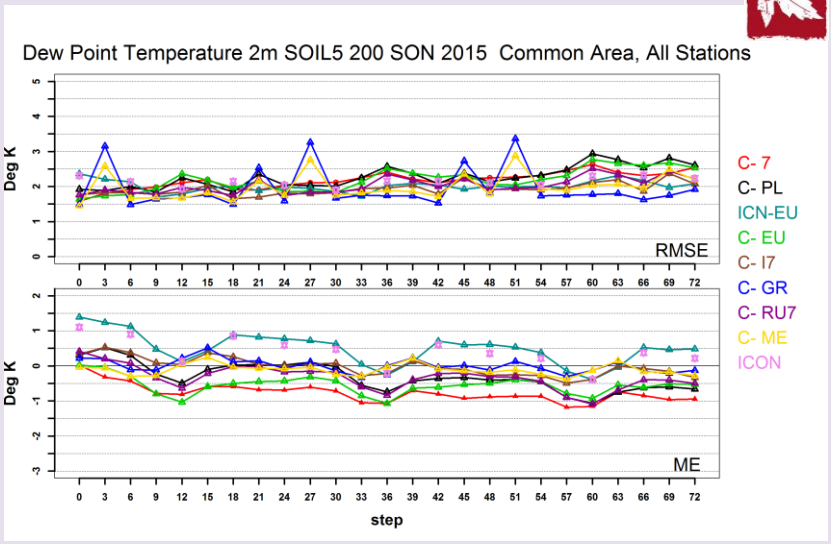


Dew Point Temperatures for SOIL 5 (Loam)

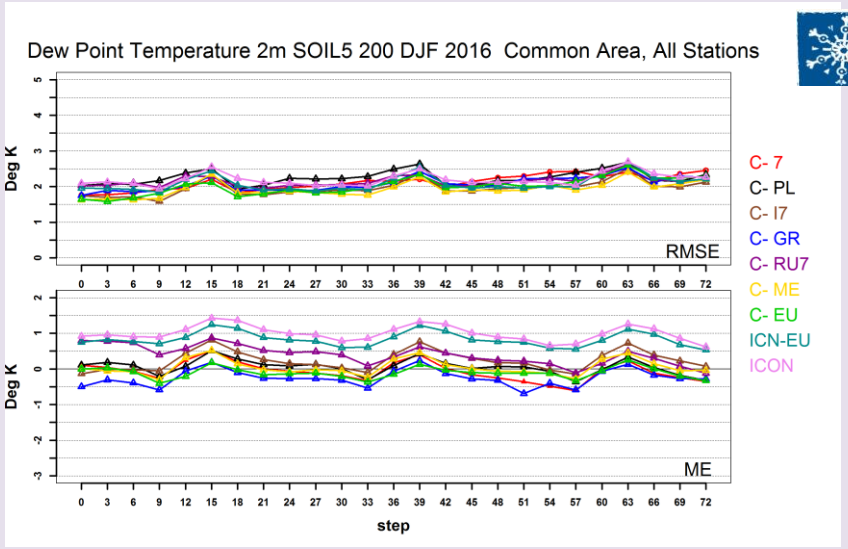


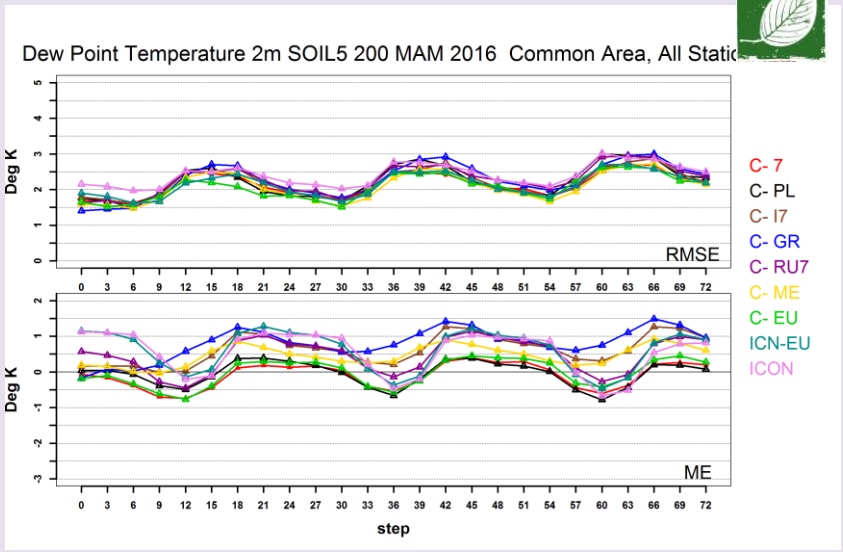


- ME similar smooth diurnal cycles for SON and MAM with negative ME trend in the day.
- Positive daytime ME trend for DJF.
- Sharper diurnal RMSE cycle in MAM

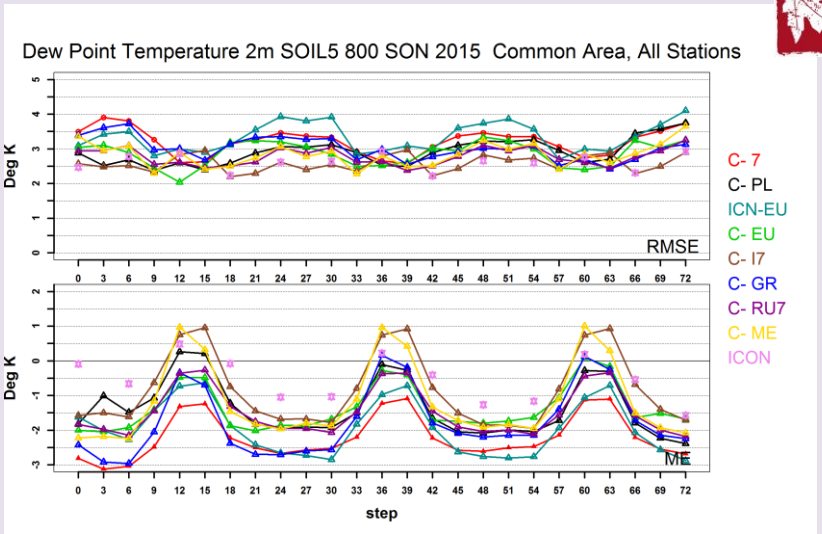


Dew Point Temperatures for SOIL 5 (Loam) < 200m

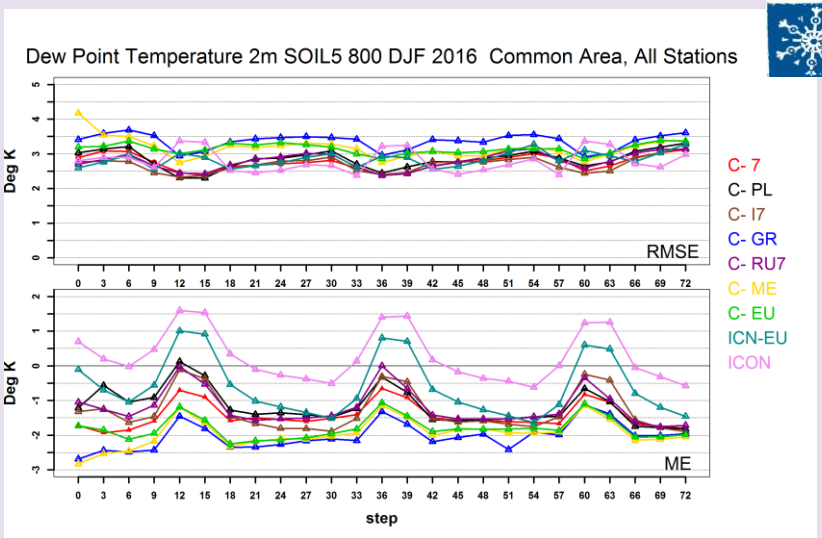


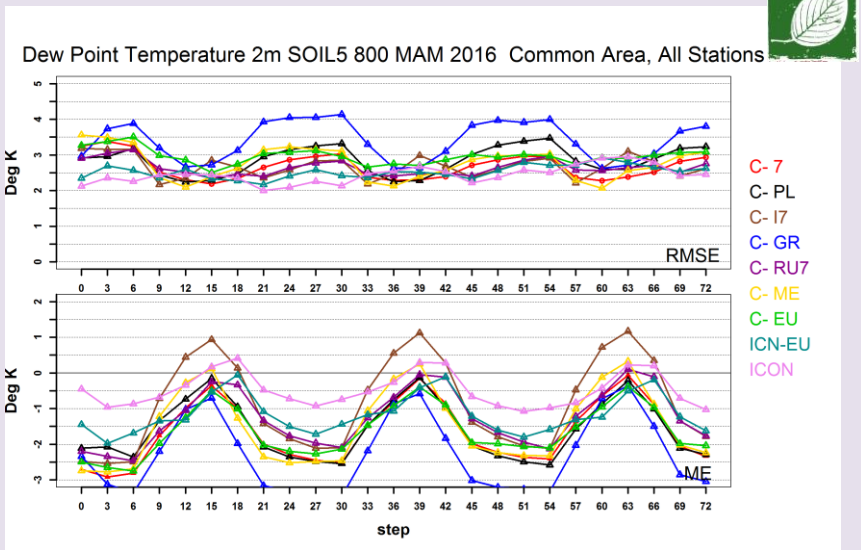


- similar sharp diurnal cycles with negative bias and positive trends in the day.
- Slightly more positive ME for DJF with ICON and ICON-EU ME >0 in the day.

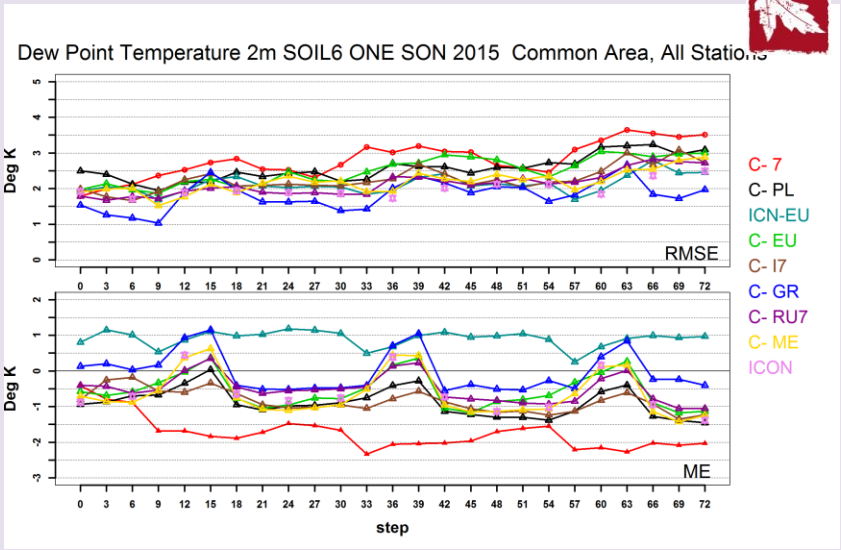


Dew Point Temperatures for SOIL 5 (Loam) > 800m

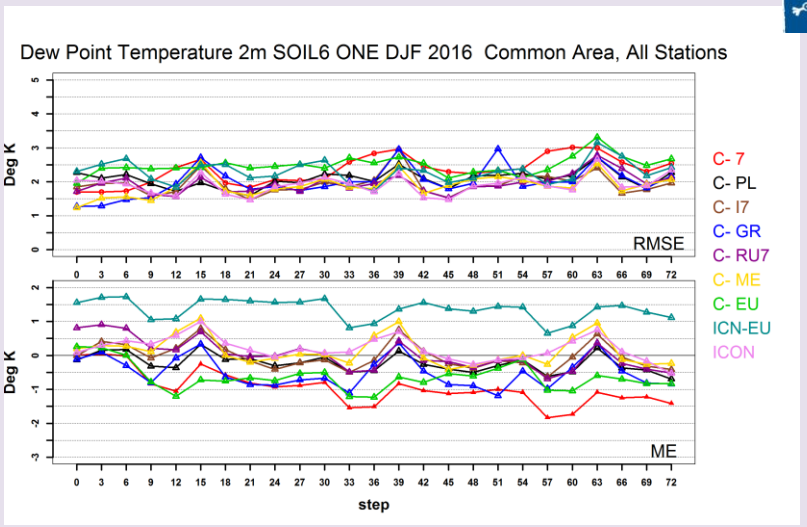


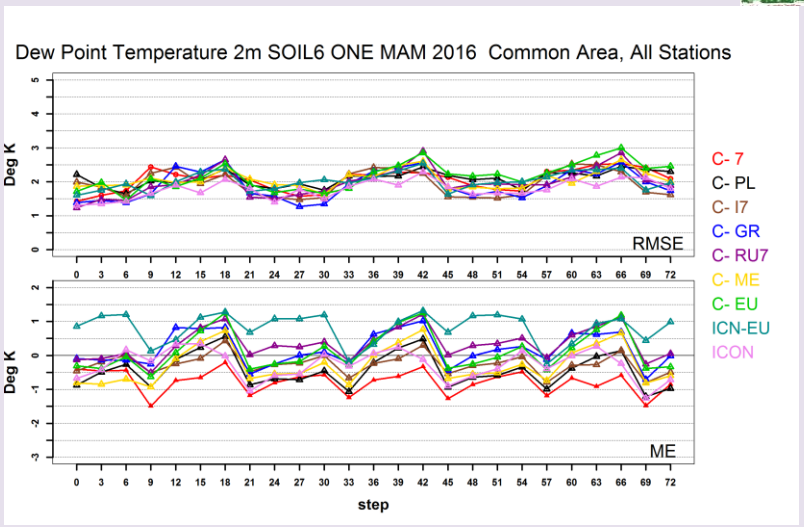


- ME similar diurnal cycles for SON and DJF with positive peaks in the day. ICON-EU ME >0 C-7 ME <0.
- RMSE increases with time in SOIL6 max C-7)

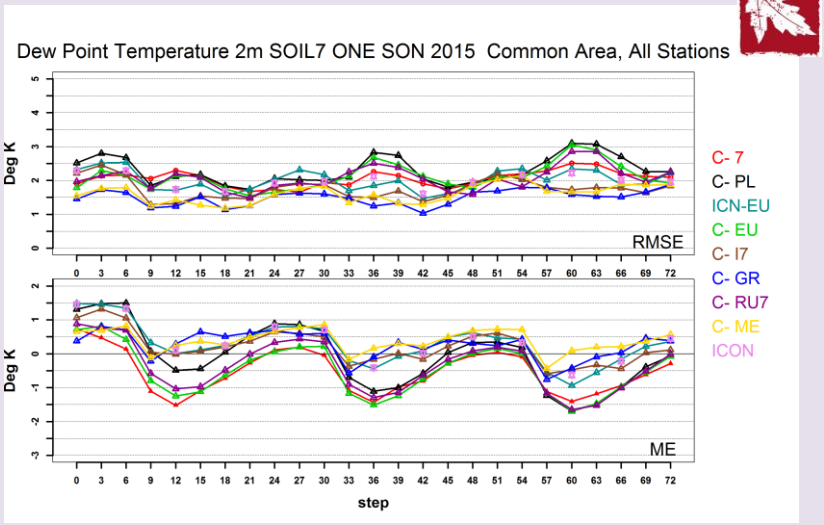


Dew Point Temperatures for SOIL 6 (Clay Loam)

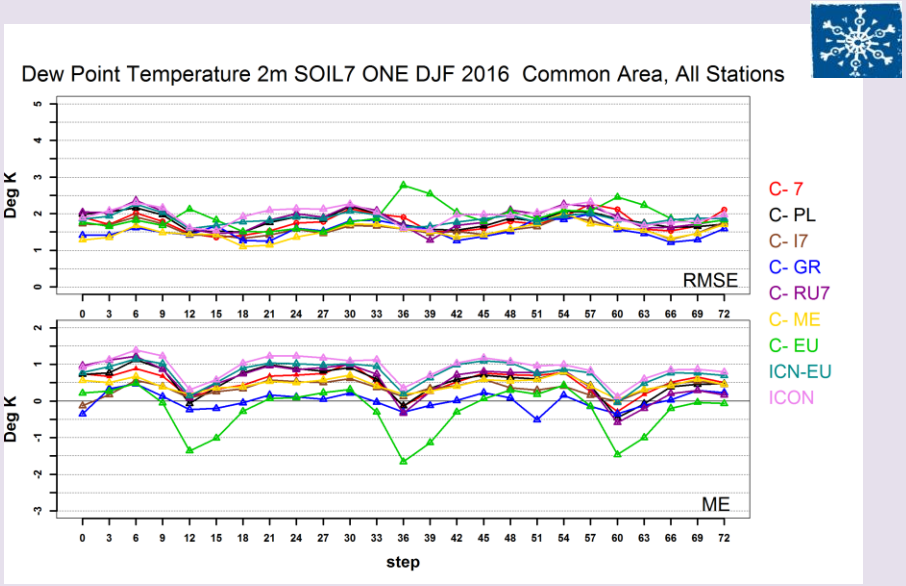


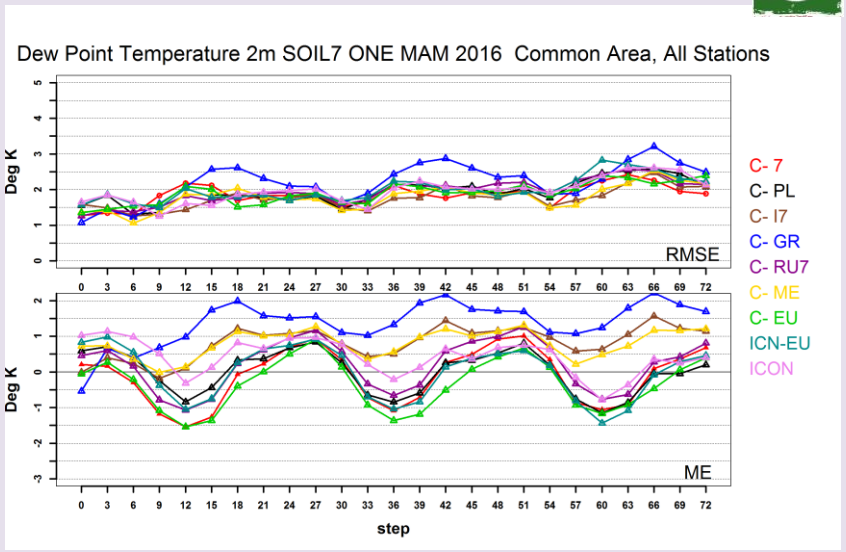


- ME similar diurnal cycles for SON and MAM with positive peaks in the day. Smoother cycle for DJF.

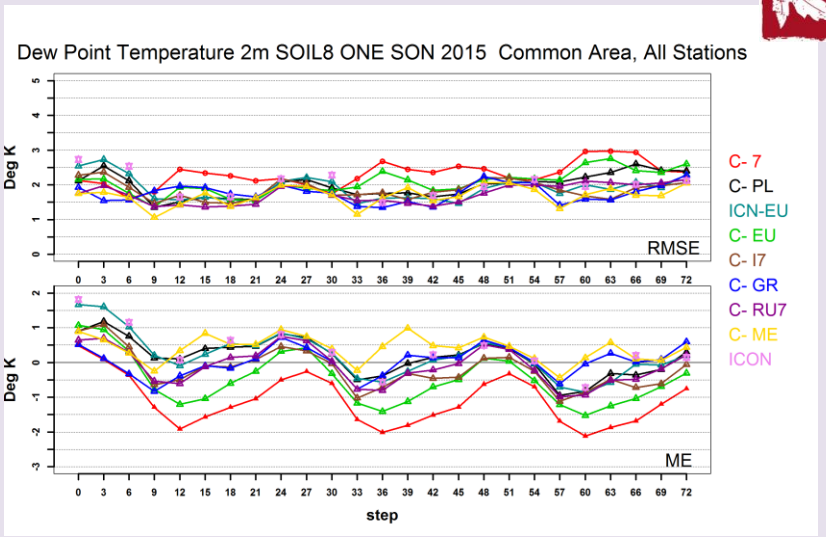


Dew Point Temperatures for SOIL 7 (Clay)

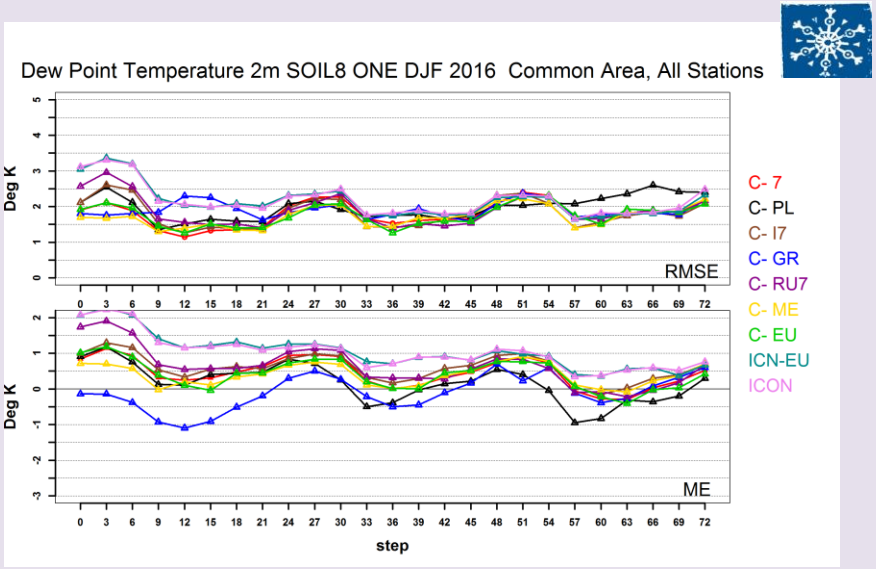


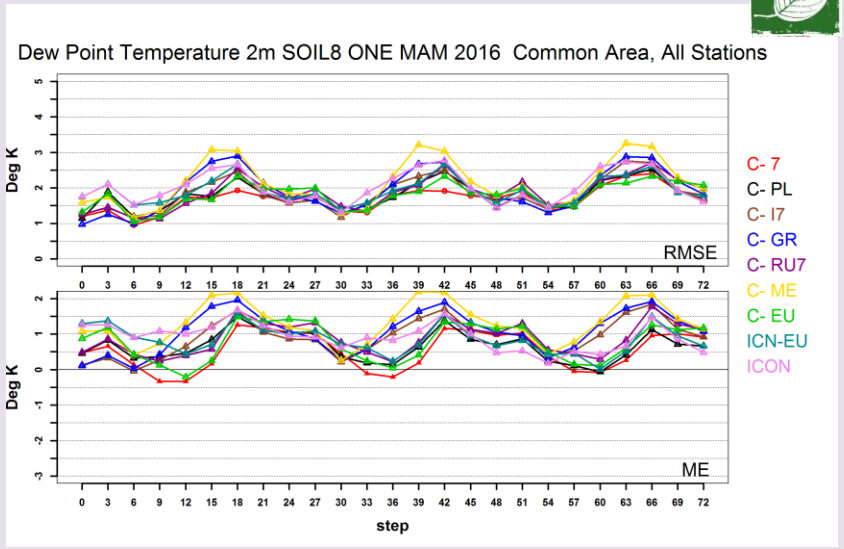


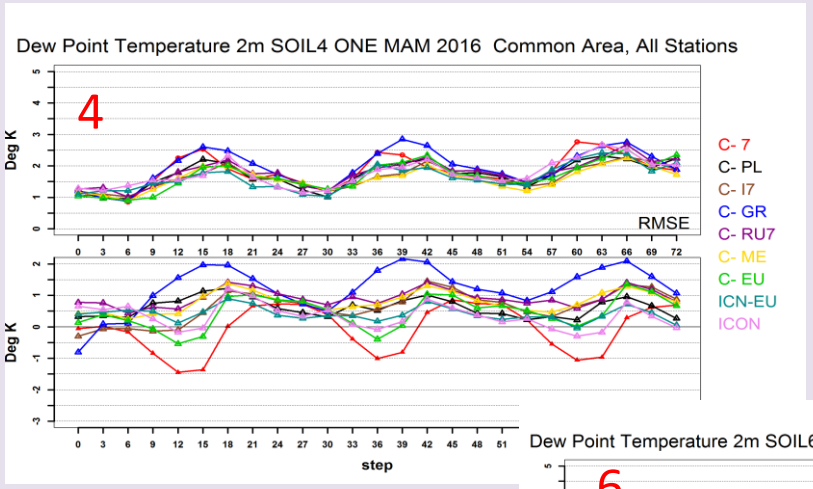
- Bias >0 in MAM positive peaks around 18 UTC.

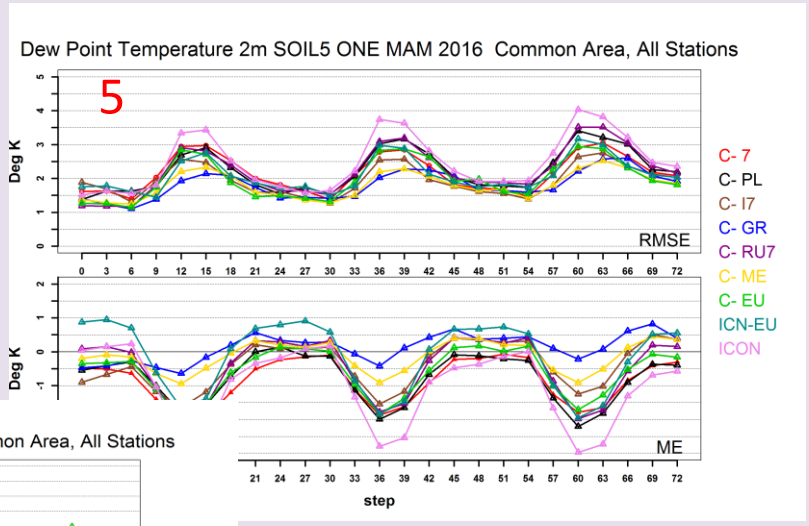


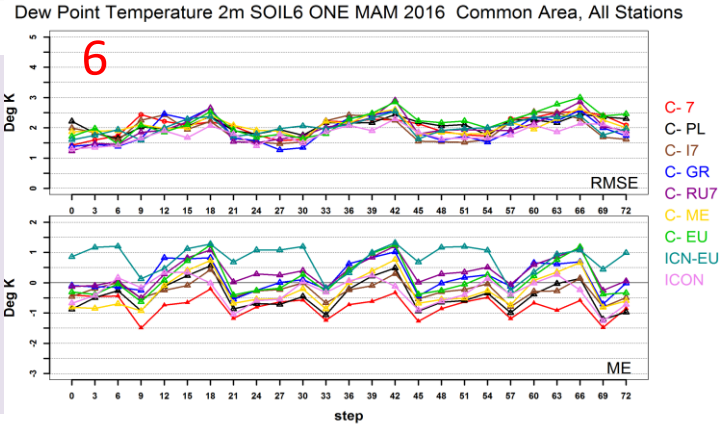
Dew Point Temperatures for SOIL 8 (Peat)



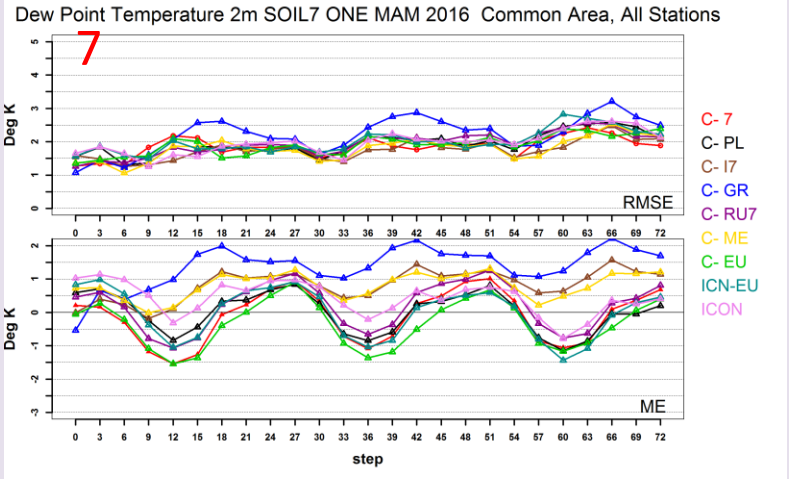


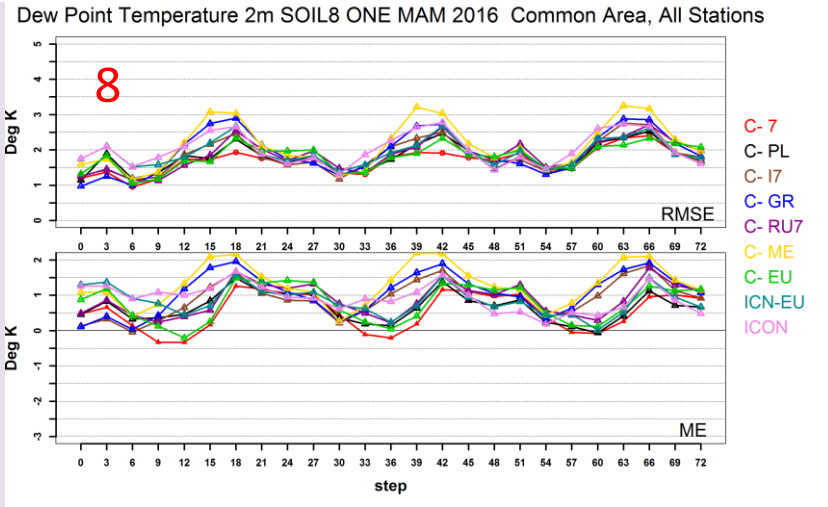

Dew Point Temperature 2m SOIL4 ONE MAM 2016 Common Area, All Stations
4
RMSE
ME
Deg K
step
C- 7
C- PL
C- I7
C- GR
C- RU7
C- ME
C- EU
ICN-EU
ICON


Dew Point Temperature 2m SOIL5 ONE MAM 2016 Common Area, All Stations
5
RMSE
ME
Deg K
step
C- 7
C- PL
C- I7
C- GR
C- RU7
C- ME
C- EU
ICN-EU
ICON

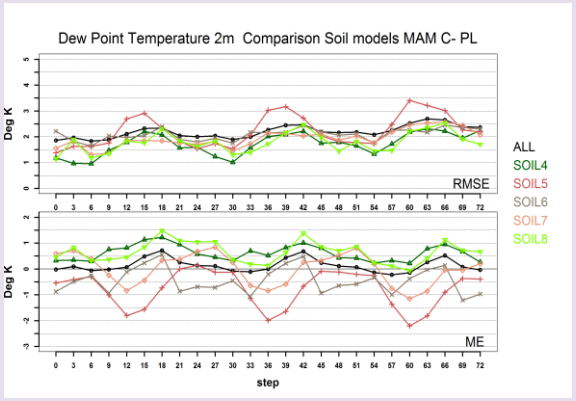

Dew Point Temperature 2m SOIL6 ONE MAM 2016 Common Area, All Stations
6
RMSE
ME
Deg K
step
C- 7
C- PL
C- I7
C- GR
C- RU7
C- ME
C- EU
ICN-EU
ICON

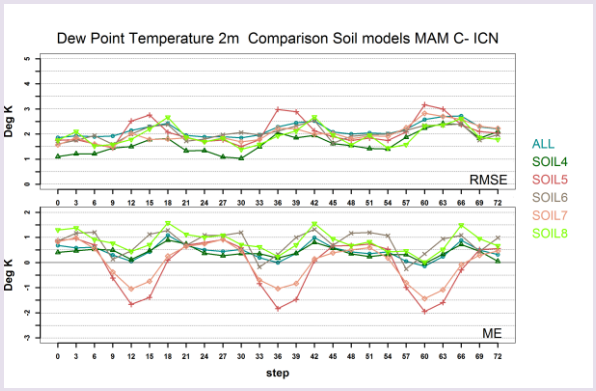
Td

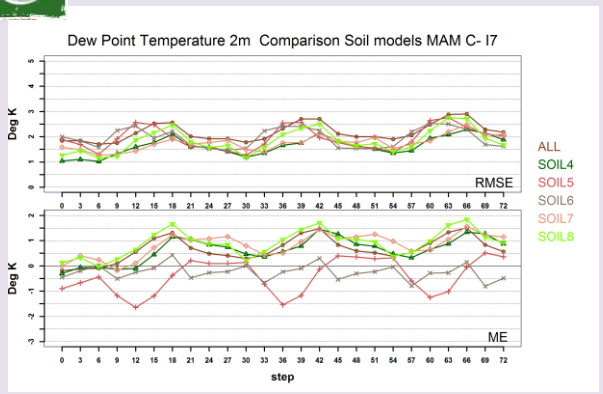

Dew Point Temperature 2m SOIL7 ONE MAM 2016 Common Area, All Stations
7
RMSE
ME
Deg K
step
C- 7
C- PL
C- I7
C- GR
C- RU7
C- ME
C- EU
ICN-EU
ICON

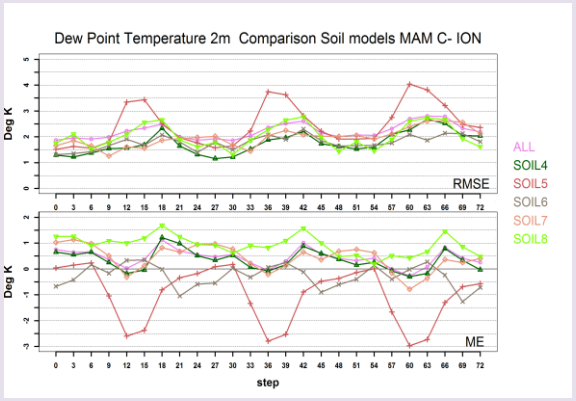

Dew Point Temperature 2m SOIL8 ONE MAM 2016 Common Area, All Stations
8
RMSE
ME
Deg K
step
C- 7
C- PL
C- I7
C- GR
C- RU7
C- ME
C- EU
ICN-EU
ICON

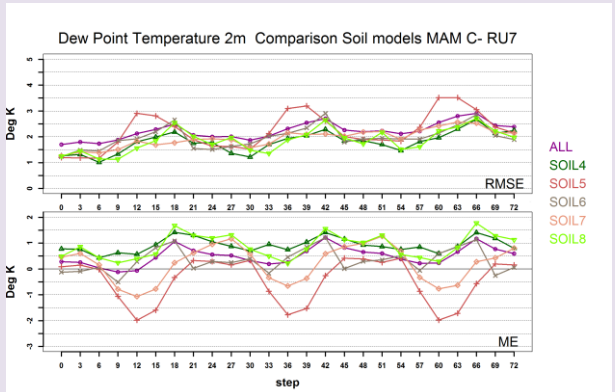
Td Conditional Verification

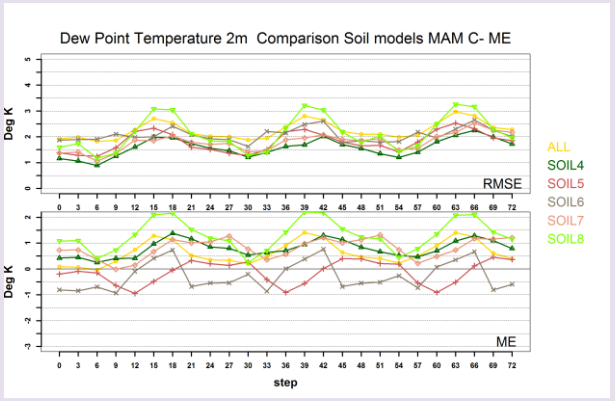


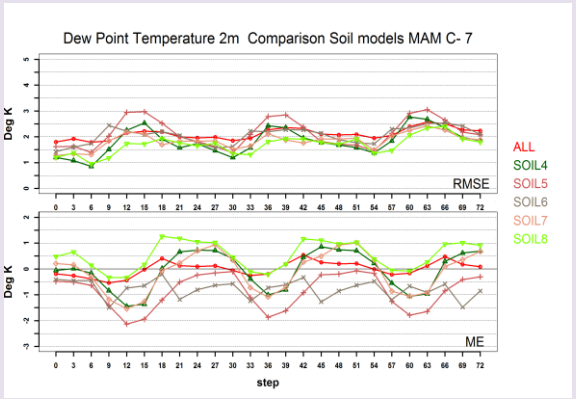


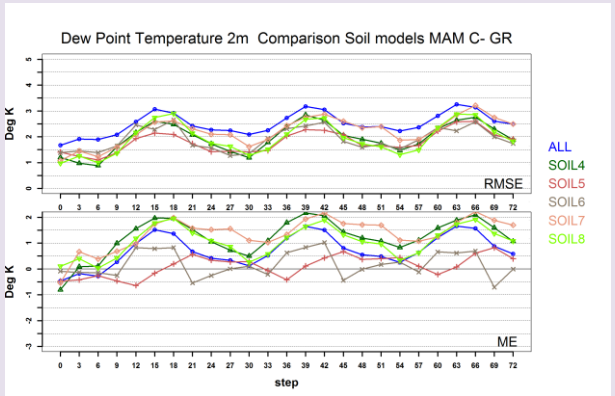


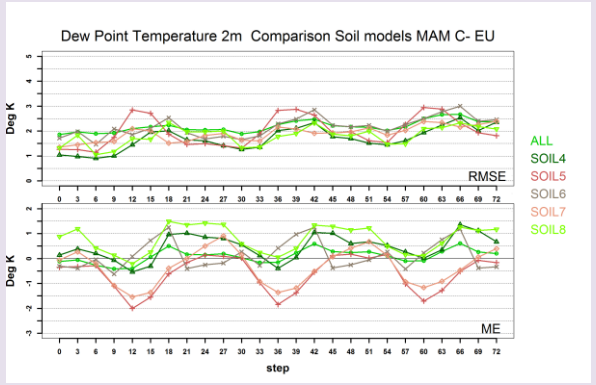












Conclusions

Temperatures

- For Sandy loam soil (Soil Type 4) there is a tendency of T negative bias with almost no diurnal cycle.
- For loam (Soil Type 5), in DJF season, there is a tendency of T overestimation, with bias positive peaks in the daytime, (while other soil types underestimate in the day).
- For Soil Type 5 and stations >800m bias diurnal cycle is very sharp with more negative values in MAM.
- For all soil Types (but less for Soil 6), ICON and ICON-EU T bias is more positive than COSMO models.

Dew Point Temperatures

- For loam (Soil Type 5), in DJF season, ME is positive and constant , (while other soil types exhibit a diurnal cycle).
- Sharp ME negative peaks in MAM in the daytime (especially for ICON driven models)
- For Soil Type 5 and stations >800m sharp bias cycles with negative bias and positive tendency in the day,