Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Department of Home Affairs FDHA
Federal Office of Meteorology and Climatology MeteoSwiss

The role of LAI in COSMO

Andreas Pauling, Jean-Marie Bettems

COSMO GM, Israel, September 2017

The topic

- Currently, LAI climatology is used in COSMO (based on sine-curve)
- In European spring, LAI can vary substantially depending on the weather
- LAI influences transpiration and latent heat flux and thus temperature and many more variables

- Main research questions to be answered :

  What is the sensitivity of COSMO to LAI?
  Does the performance improve if actual LAI is used?

The experimental design

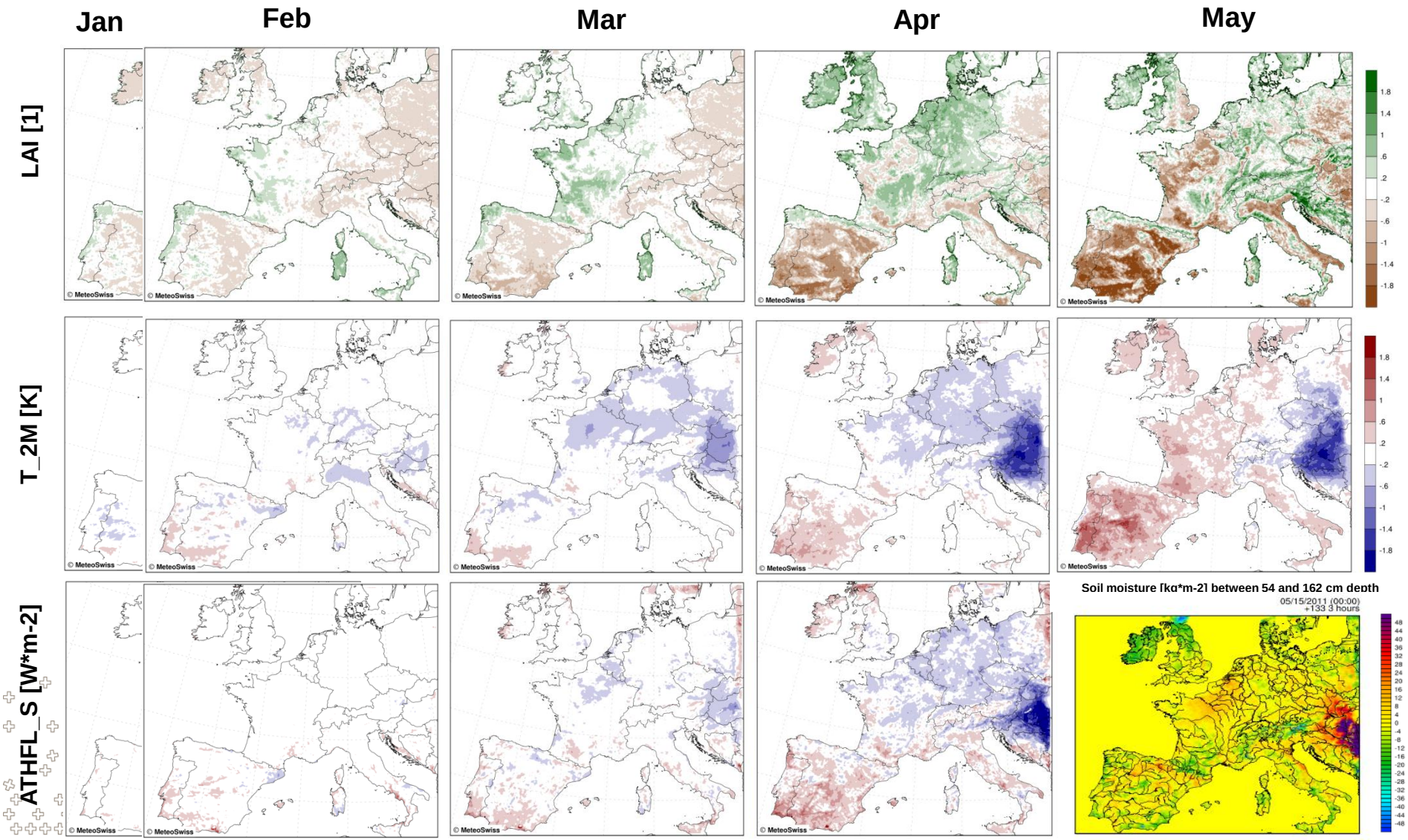
- phenology model by Stöckli et al. (2011)* provides daily LAI maps (based on MODIS data with Ensemble Kalman Filter)

- 2 parallel runs with COSMO-7 restarted every 24 hours with fresh start field from the archive over the period 15 Jan 2011 – 31 October 2011 (very warm and early spring)
  - 1 reference run with operational (climatological) LAI
  - 1 experimental run with actual LAI merged every 24 hours; soil moisture and soil temperature run freely

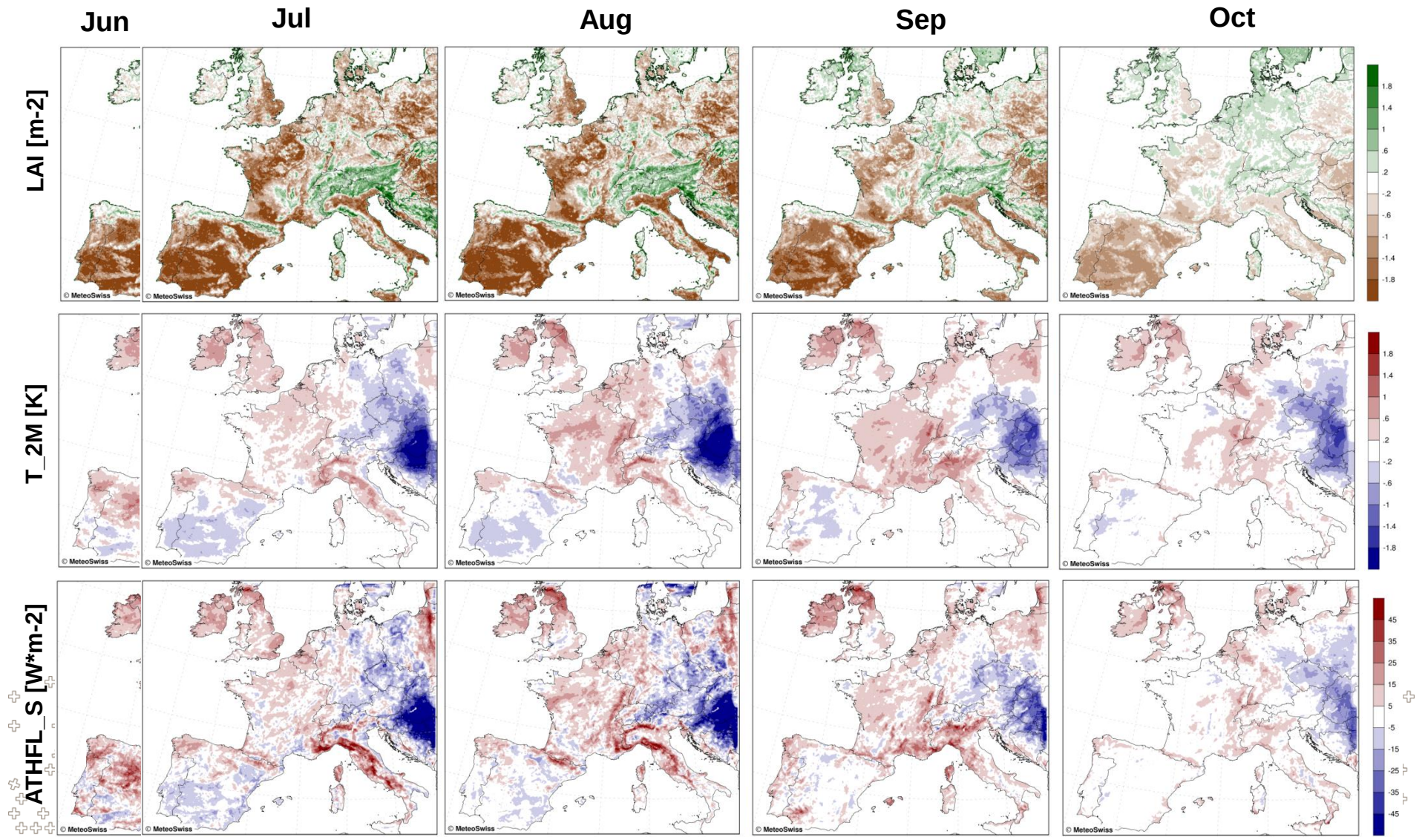
$\Rightarrow$ 2 parallel runs with only difference LAI (plus soil feedback!) => look at impact on T_2M and ATHFL_S

* Stöckli, R., T. Rutishauser, I. Baker, M. A. Liniger, and A. S. Denning (2011), A global reanalysis of vegetation phenology, J. Geophys. Res., 116, G03020, doi:10.1029/2010JG001545

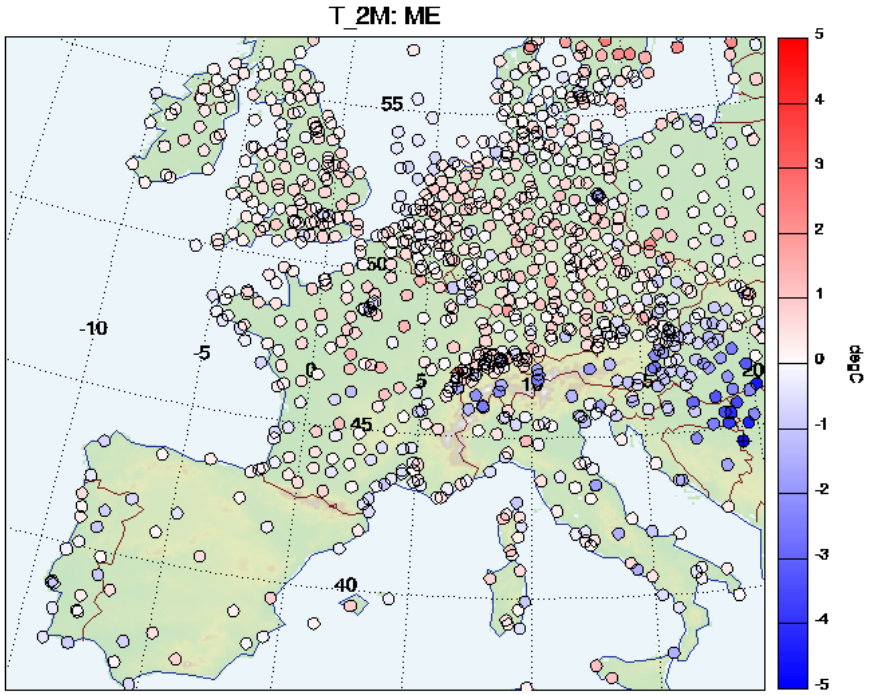
monthly means of daily 15h UTC values year 2011. exp minus ref



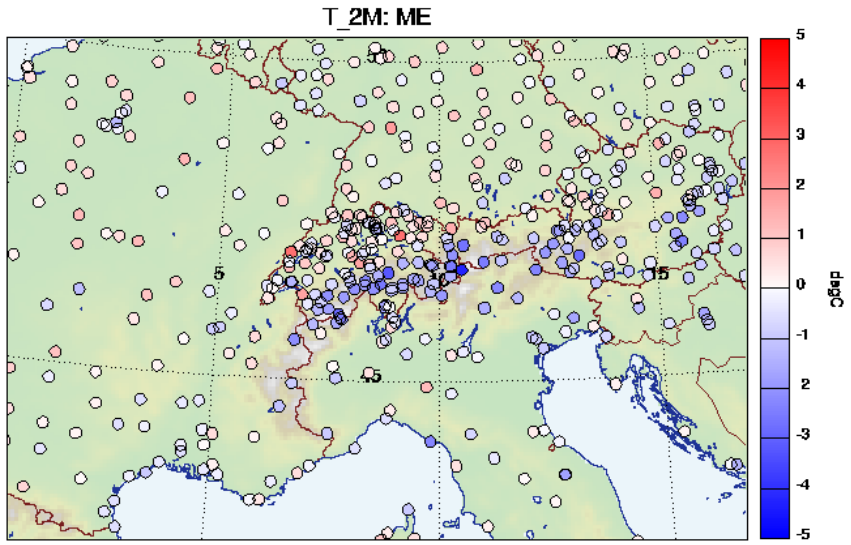
monthly means of daily 15h UTC values year 2011. exp minus ref



domains and stations for T_2M verification

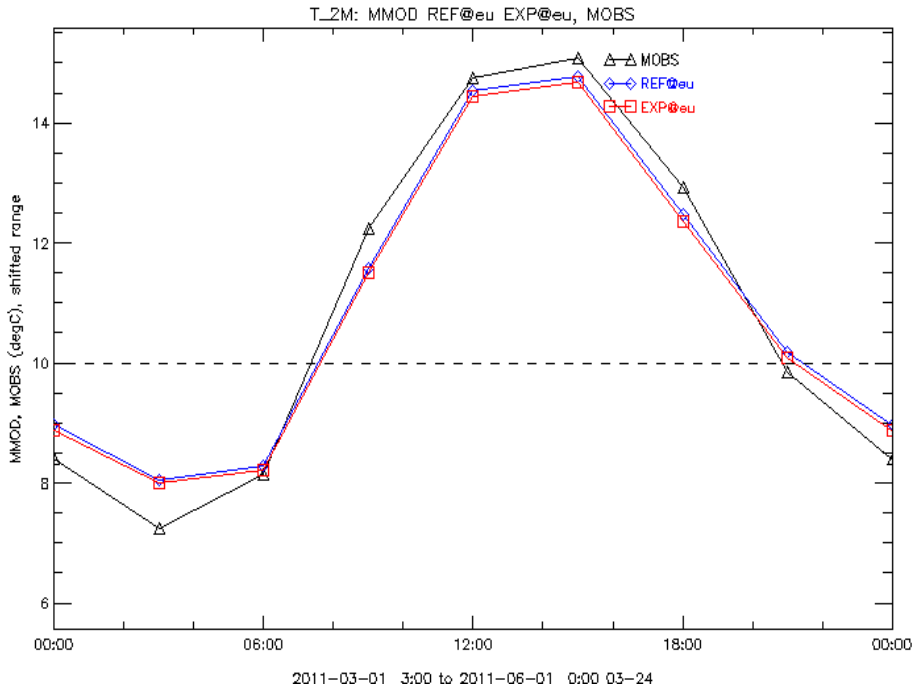


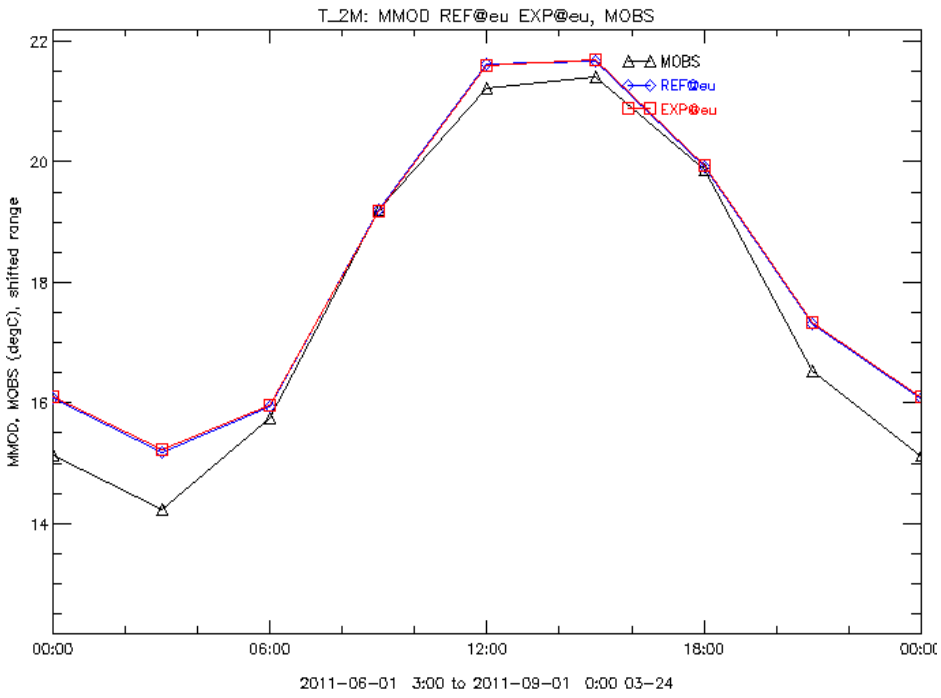
REF@eu 2011-03-01 3:00 to 2011-06-01 0:00 03-24
+Min: -4.793 degC at station 13262 +Max: 2.753 degC at station 06617



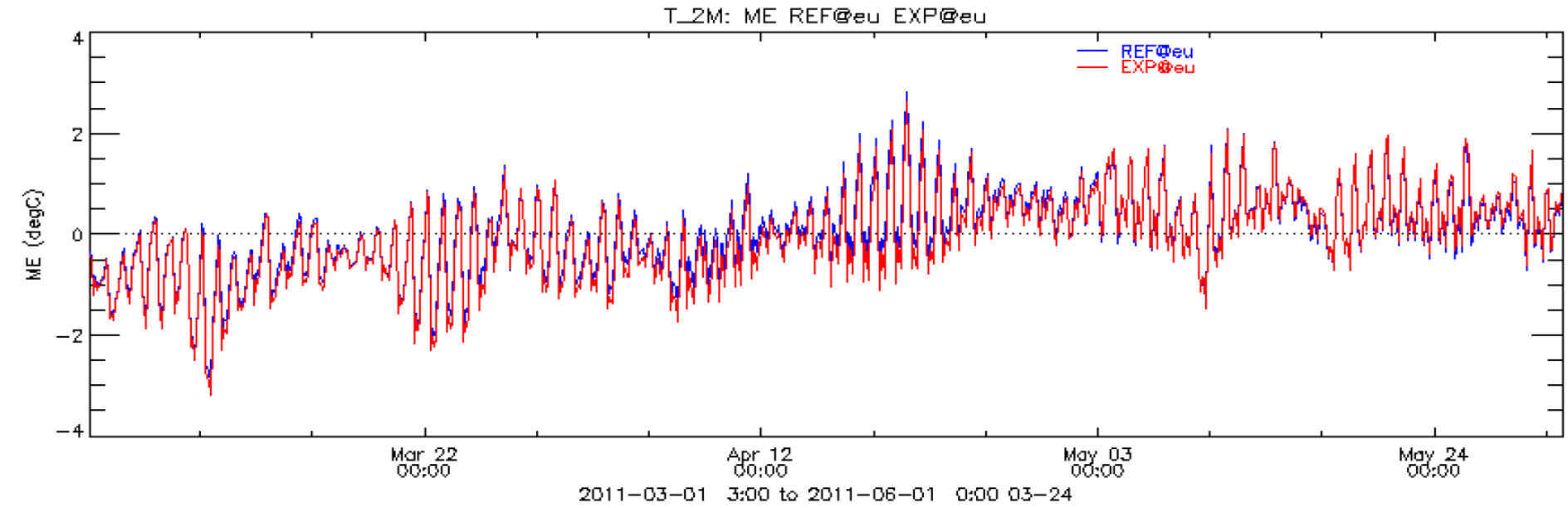
REF@alps 2011-03-01 3:00 to 2011-06-01 0:00 03-24
+Min: -4.793 degC at station 13262 +Max: 2.983 degC at station 16459

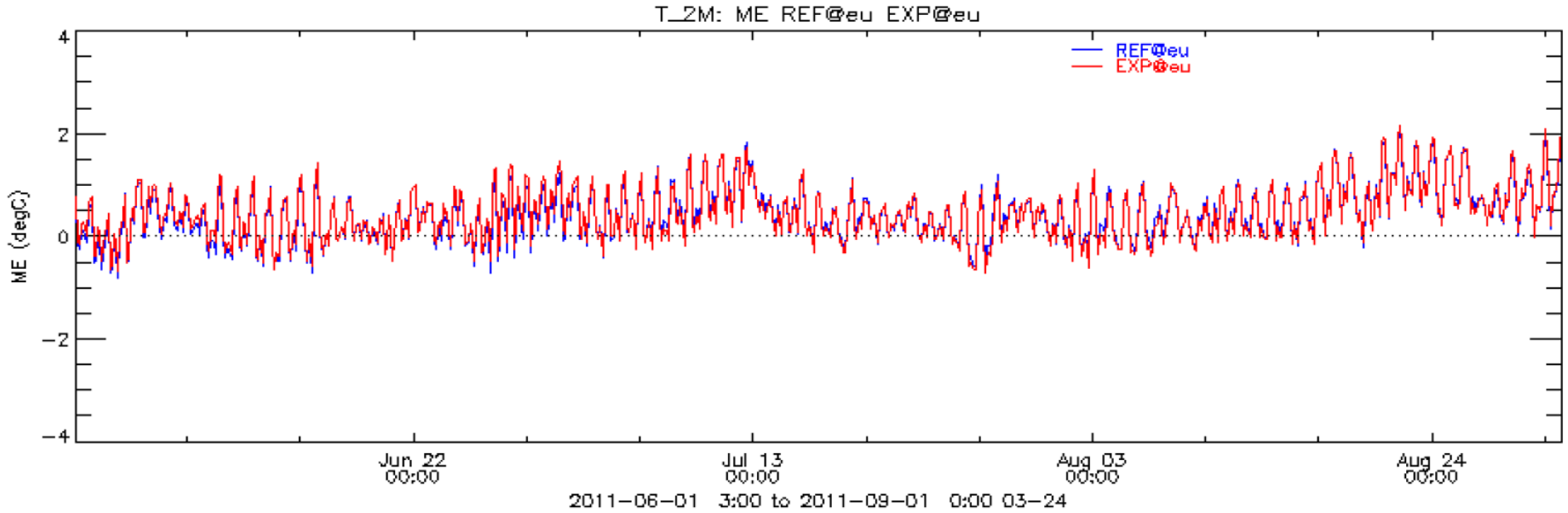
Verification of T_2M (MAM and JJA)



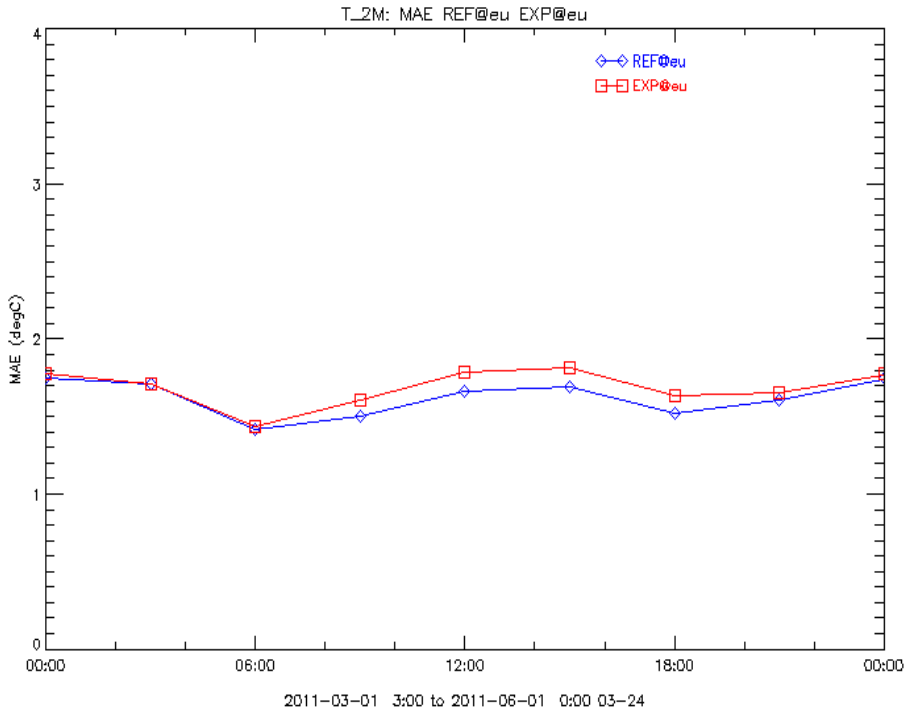


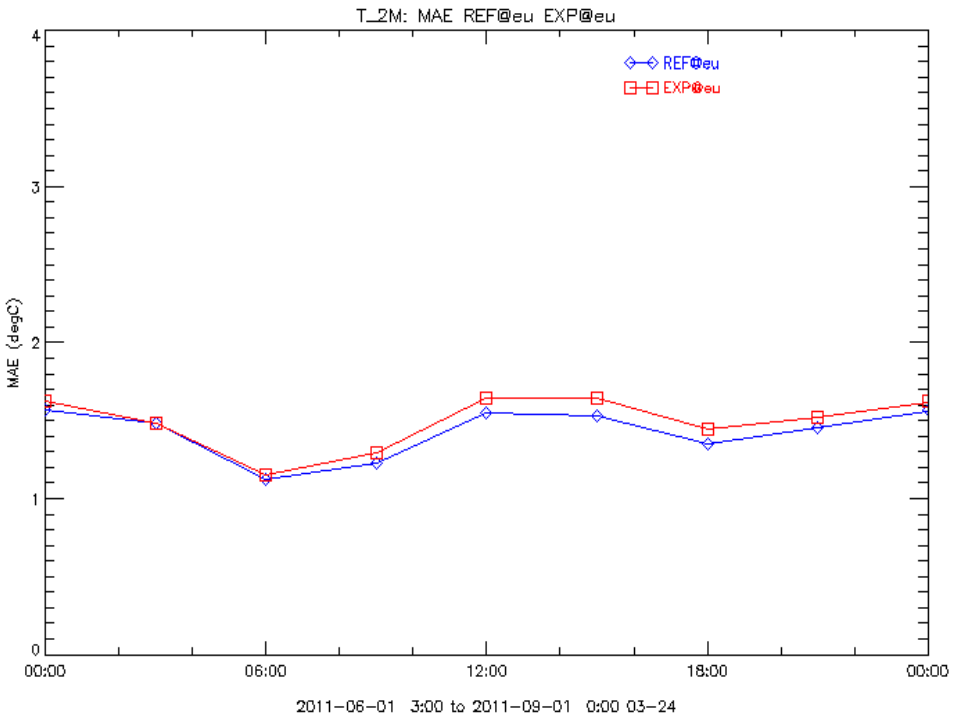
Verification of T_2M (MAM and JJA)



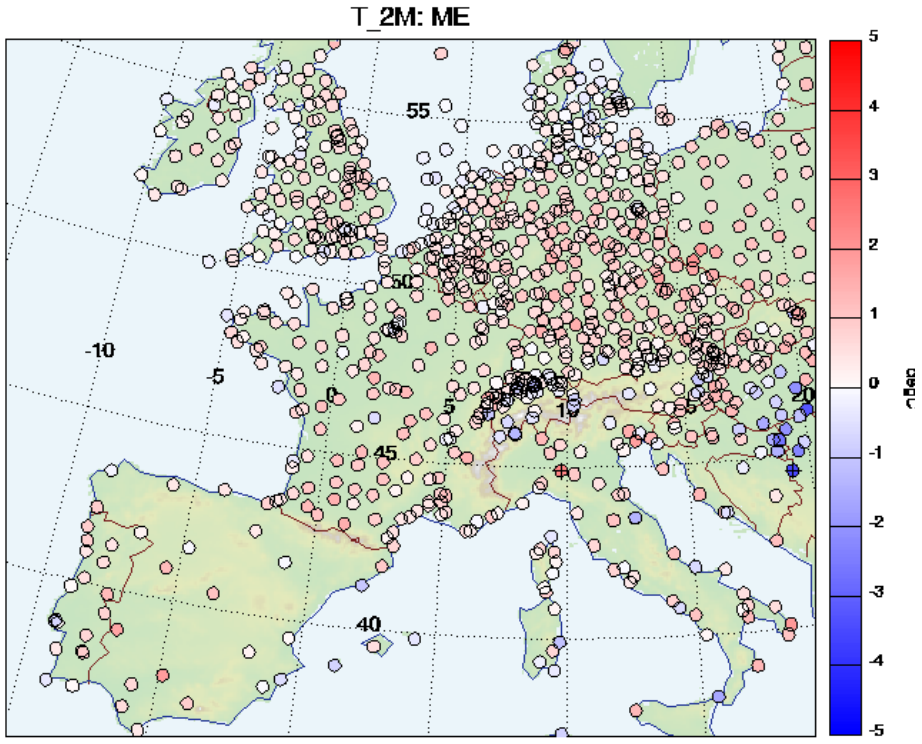


Verification of T_2M (MAM and JJA)

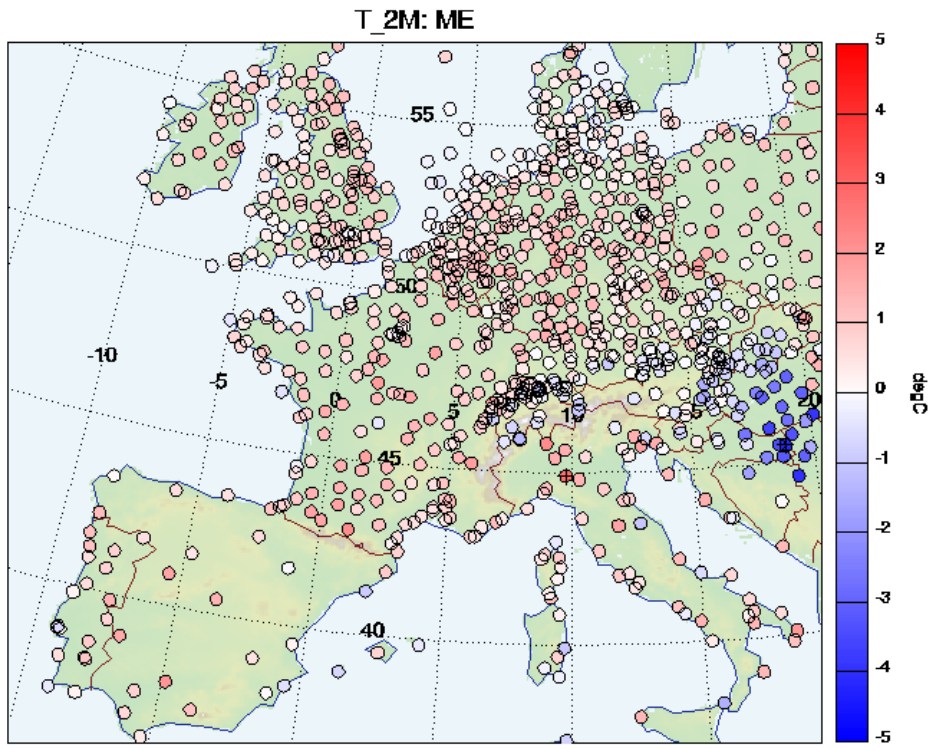




Spatial verification



REF@eu 2011-06-01 3:00 to 2011-09-01 0:00 03-24
+Min: -3.504 degC at station 13262 +Max: 2.380 degC at station 16084



EXP@eu 2011-06-01 3:00 to 2011-09-01 0:00 03-24
+Min: -4.203 degC at station 14284 +Max: 2.803 degC at station 16084

Conclusions and Outlook (1)

- What is the sensitivity of LAI changes in COSMO?

=> T_2M: spatially variable, roughly 1 K / 2 LAI (April 2011). 2 LAI is what we can expect in extreme years.

=> ATHFL_S: 40 Wm^{-2} / 3 LAI.

- Does the performance improve if actual LAI is used?

=> Yes and No… BUT: COSMO tuned for ref and need more years (e.g. also a year with late phenology)

Conclusions and Outlook (2)

1. It would be good to continue to work on this topic (large sensitivity of COSMO to LAI, potential for improvement) => COSMO PP with additional TERRA improvement (e.g. canopy layer, …)?
2. CALMO calibration for new configuration
3. Soil moisture plays also an important role
4. The two major technical tasks for operational use of the prognostic phenology scheme are:
   - transfer the phenology model from TERRA offline to the latest fully coupled model (involves new I/O fields and new prognostic variables)
   - translate PFTs to COSMO land use classes (GLOBCOVER)
   - Estimated working time: 3 months for first bullet, one month for second bullet (for someone who knows TERRA…)