

Evaluation of LMDZOR in the framework of CMIP6

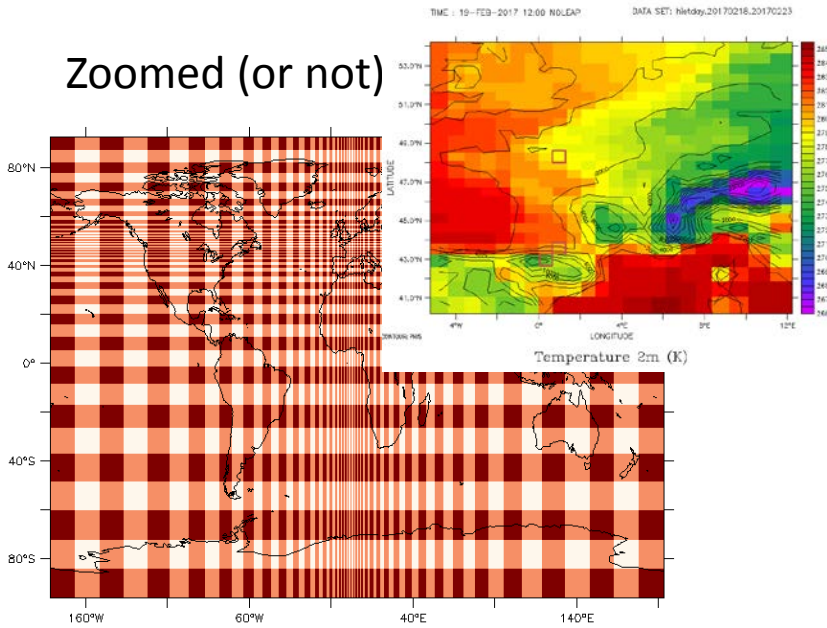
F. Cheruy, A. Ducharne, JL Dufresne, J Ghattas, C. Magand , P. Passy, Y. Zhao
discussion with the LMDZ and the ORCHIDEE Teams

- Different simulations : fully coupled, AMIP, nudged, nudged and zoomed, even 1D
- Why we need also to evaluate ORCHIDEE when coupled with the atmosphere
- Some remarks on the temperature evaluation
- Seasonal biases, regional biases, in CMIP6
- Mid-latitude summer: A long temperature standing bias
- A tentative of comprehensive evaluation of the coupling

Different simulations : Fully coupled, AMIP, Nudged, Nudged and zoomed and even 1D

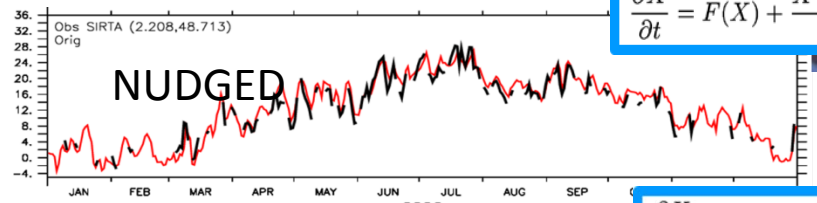
- ✓ AMIP= SST from observations (forced), Atmosphere and LSM coupled
- ✓ Nudged : AMIP+ large scale dynamics relaxed towards the analysis (u,v).
 - less internal variability (shorter runs)
 - horizontal advection is under control
- ✓ Zoomed :Grid stretched
- ✓ Zoomed and nudged to derive meteorological time series which can be confronted on a day-by-day basis to observations with much smaller errors than using a free GCM, but still degrees of freedom (instrumented sites)

Zoomed (or not)

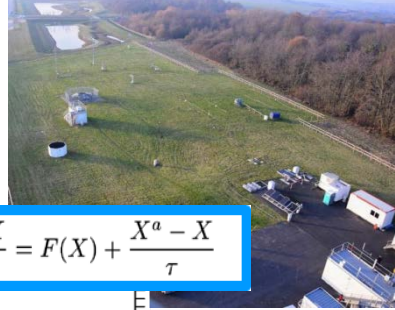
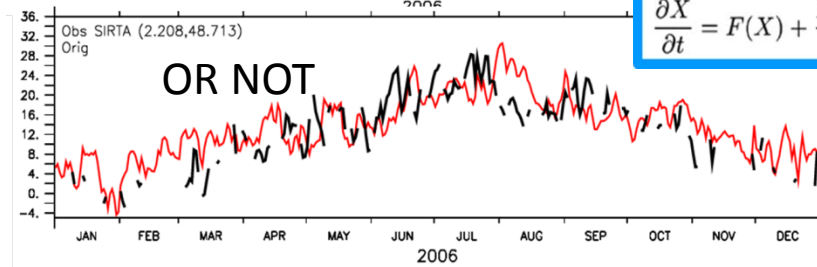


Surface air temperature

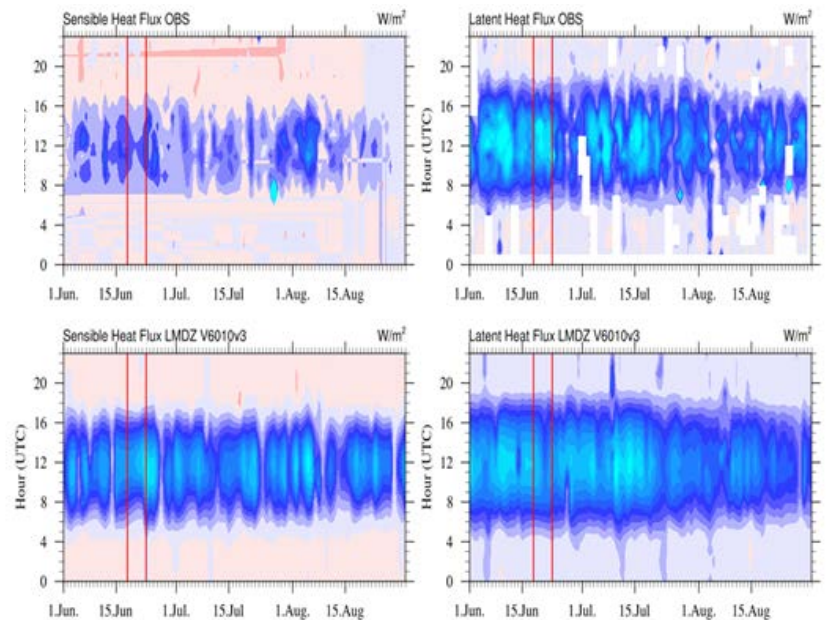
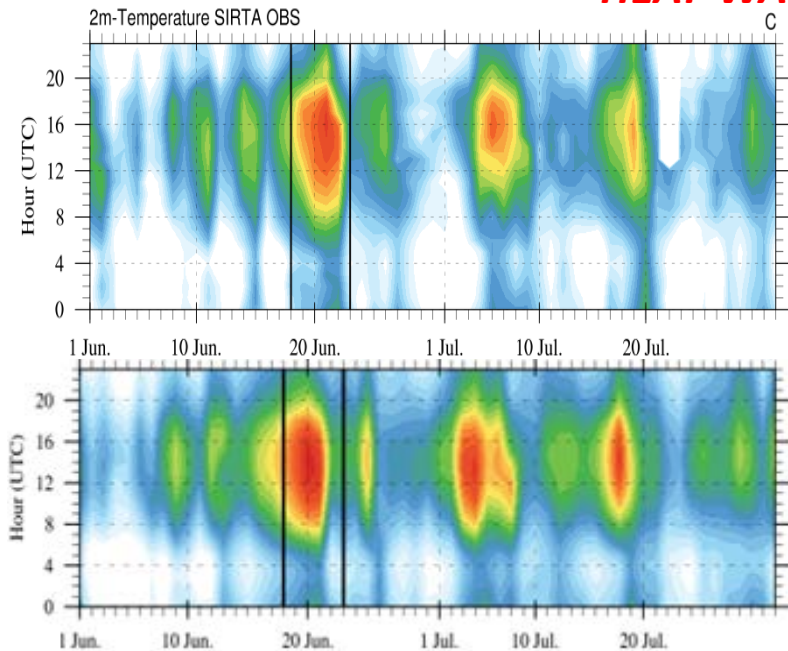
$$\frac{\partial X}{\partial t} = F(X) + \frac{X^a - X}{\tau}$$



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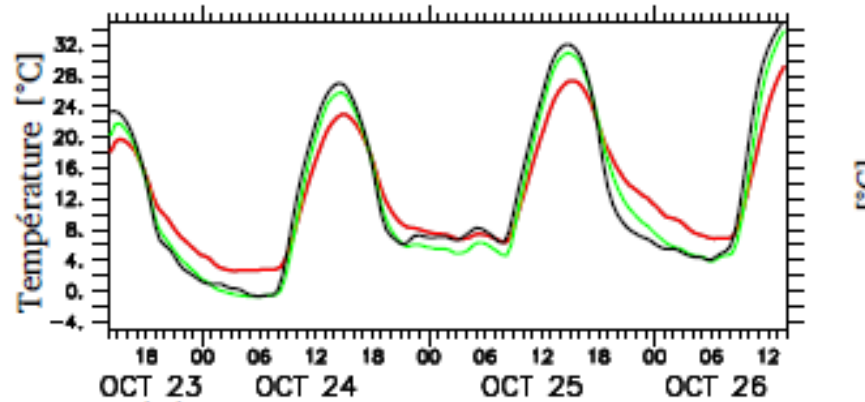


HEAT-WAVE SUMMER 2017

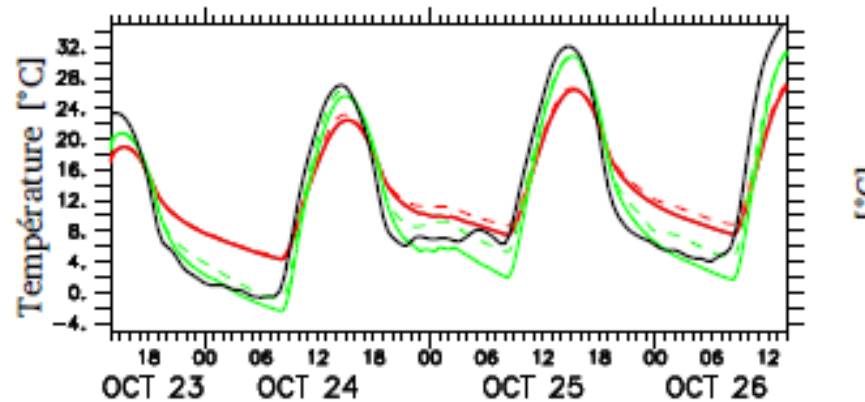


Why we need also to evaluate ORCHIDEE when coupled with the atmosphere

Single Column Model (Diurnal Land Atmosphere Coupling Experiment) DICE



(a) Modèle de surface forcé



(c) Modèle de surface couplé

Standard physics



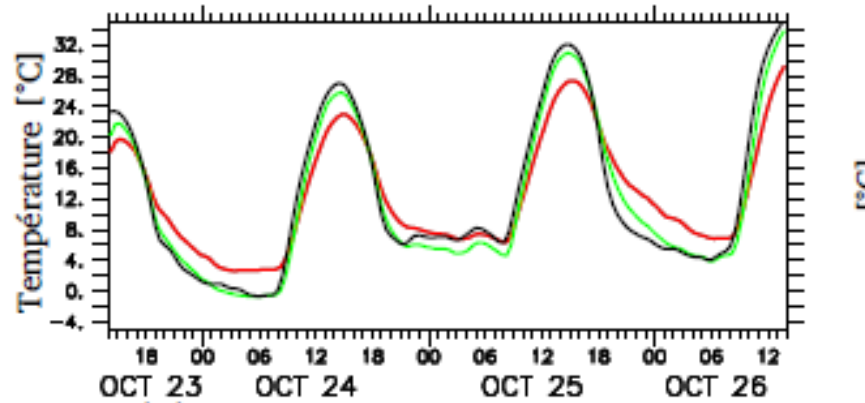
New physics (less mixing
When stable)

ORC2

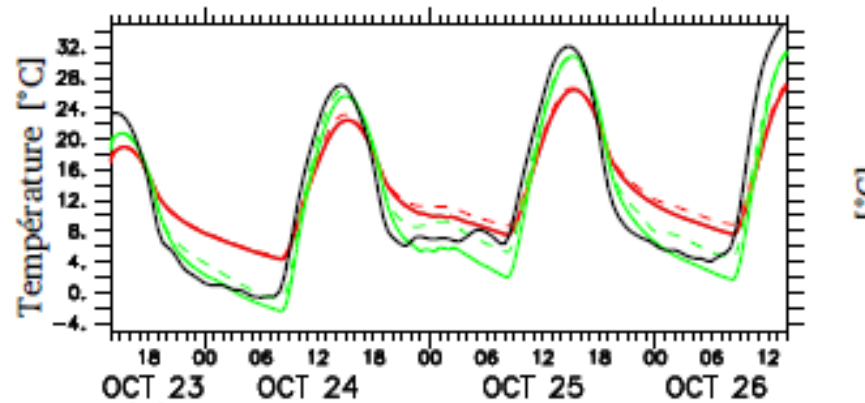
ORC11

Why we need also to evaluate ORCHIDEE when coupled with the atmosphere

Single Column Model (Diurnal Land Atmosphere Coupling Experiment) DICE



(a) Modèle de surface forcé

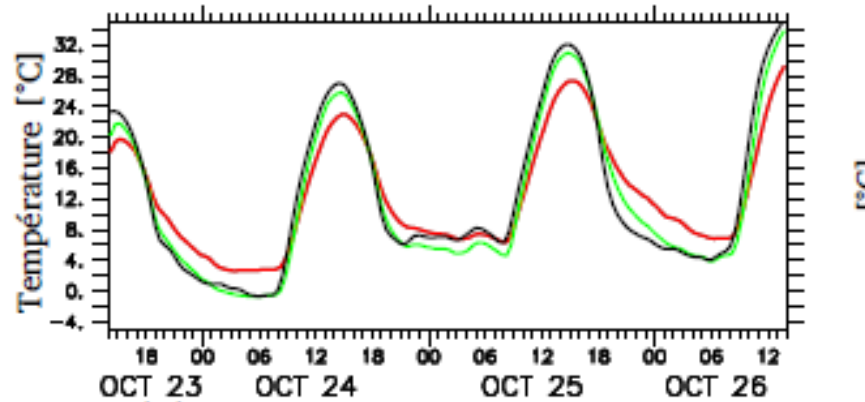


(c) Modèle de surface couplé

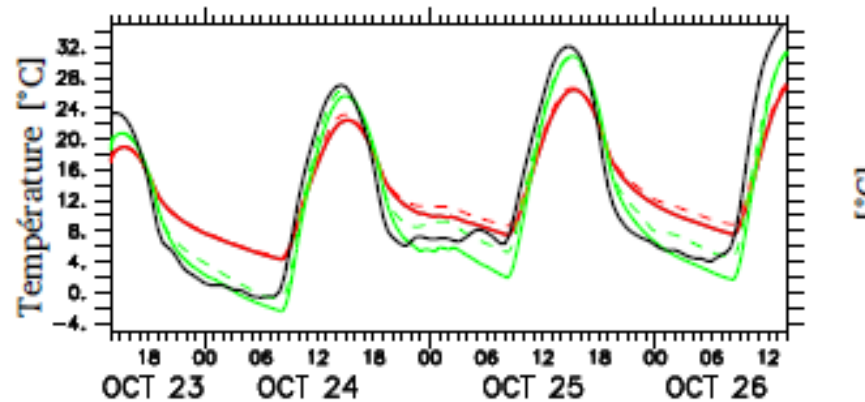
Why we need also to evaluate ORCHIDEE when coupled with the atmosphere

Single Column Model (Diurnal Land Atmosphere Coupling Experiment) DICE

Relatively dry, no cloud, no precip



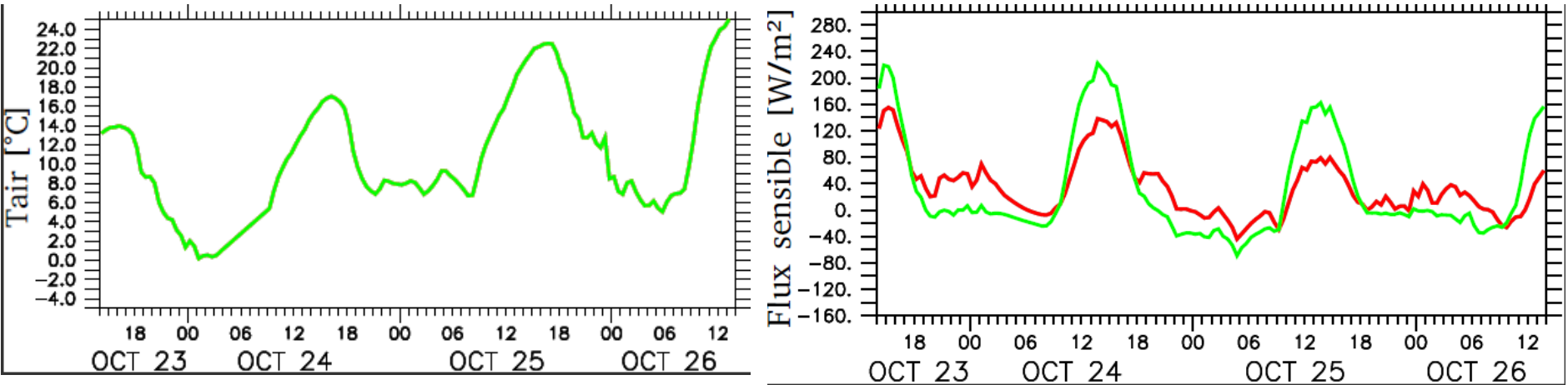
(a) Modèle de surface forcé



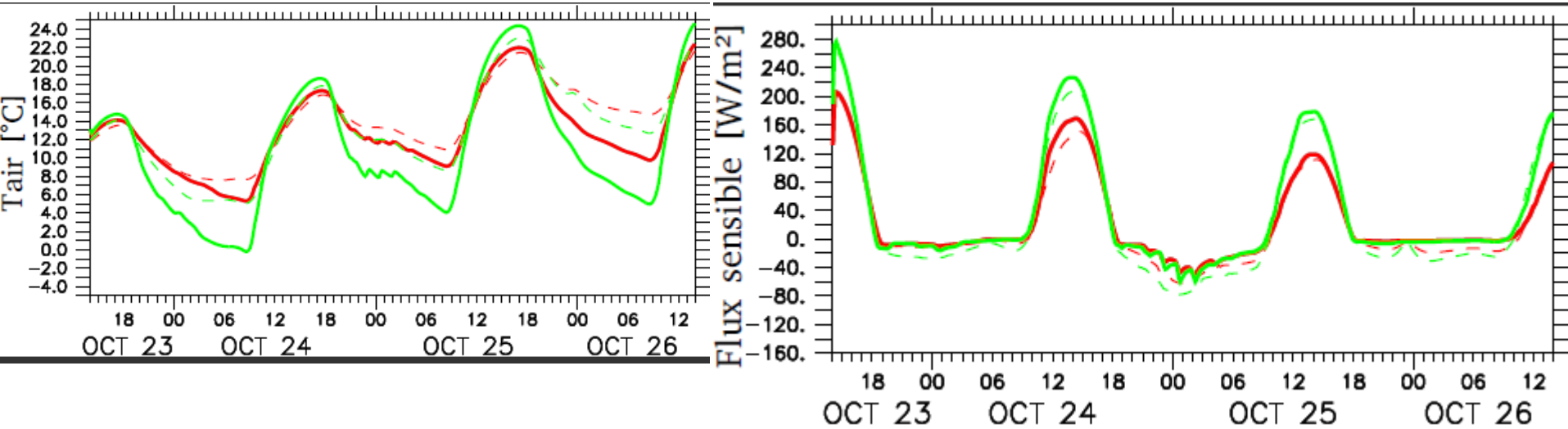
(c) Modèle de surface couplé

Why do we need also to evaluate ORCHIDEE when coupled with the atmosphere

FORCED

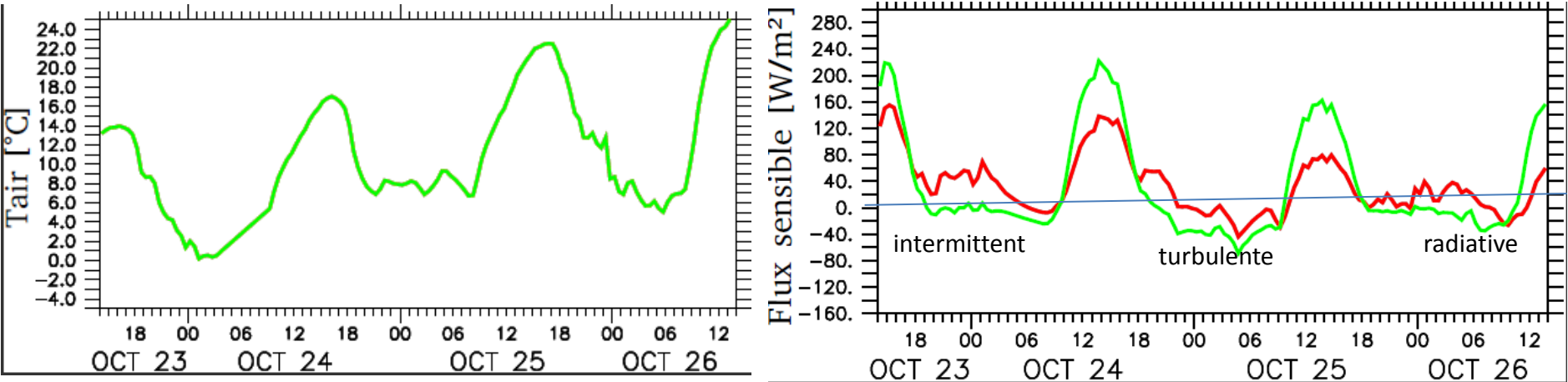


COUPLED

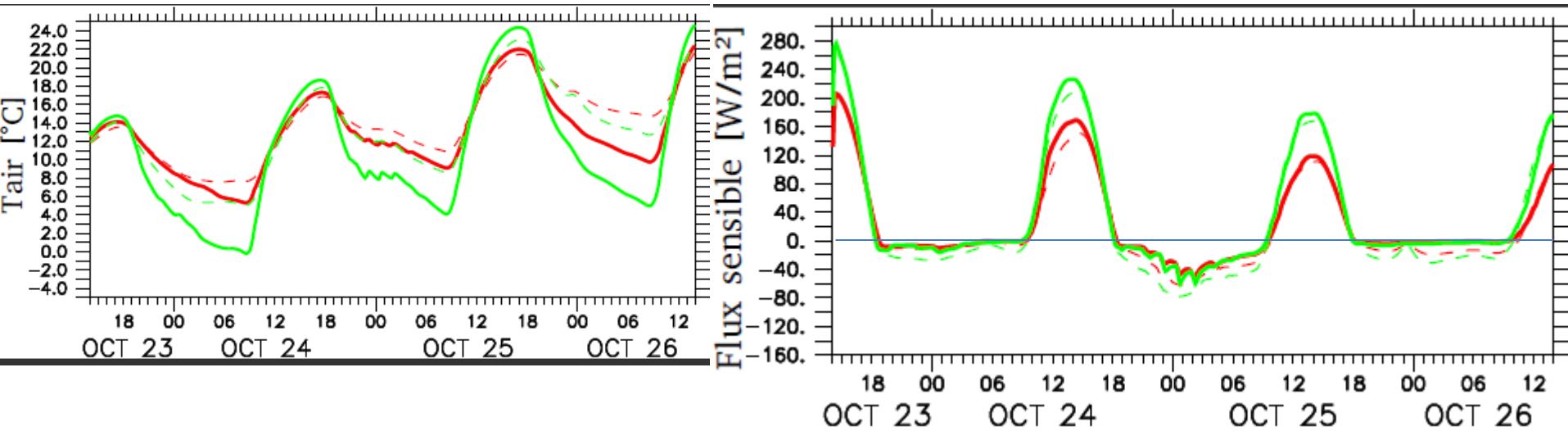


Why do we need also to evaluate ORCHIDEE when coupled with the atmosphere

FORCED



COUPLED

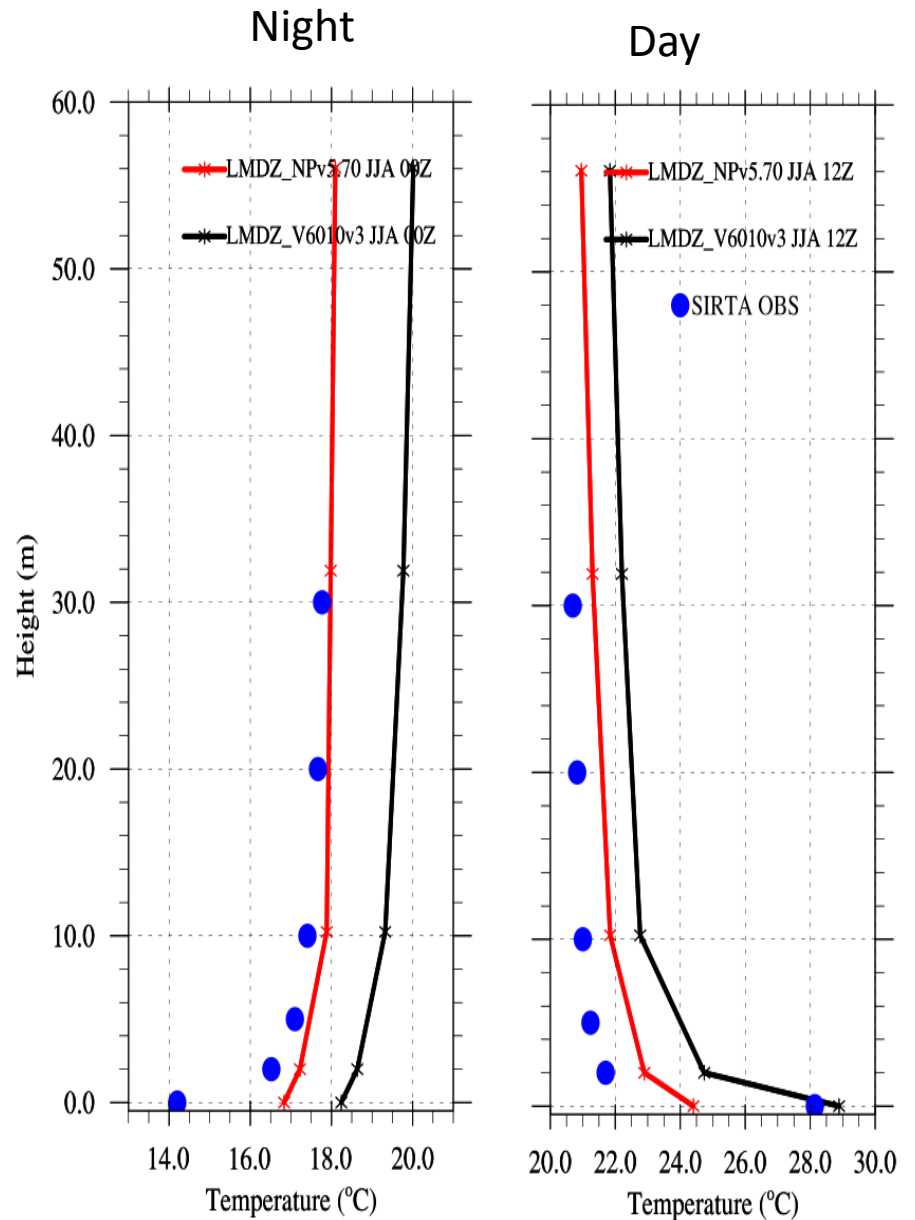


AIR temperature cannot respond, the sensible heat flux adjusts, giving unrealistic night-values

About the near surface air temperature

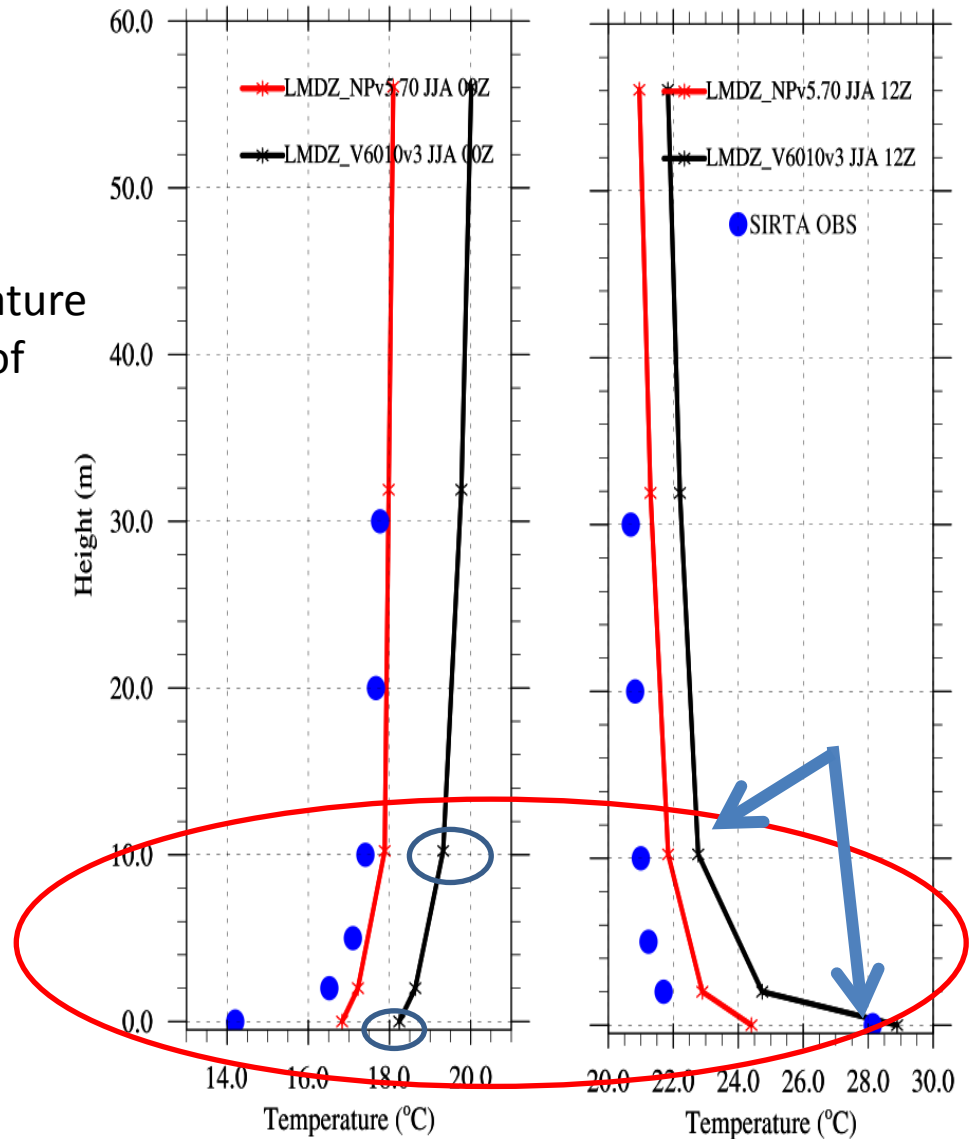
Real time LMDZOR simulations over France, here SIRTA grid box during Summer 2017

Surface layer, turbulence



About the near surface air temperature

Near surface:
Simulated value: 10m and surface temperature
(2m, diagnostics with hypothesis on form of
the profil).
Surface temperature : retrieved data no
straight-forward

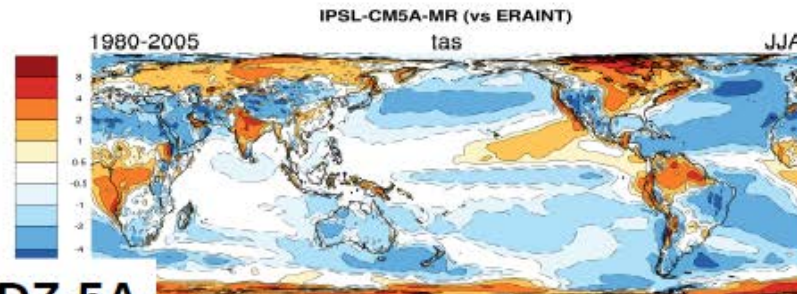
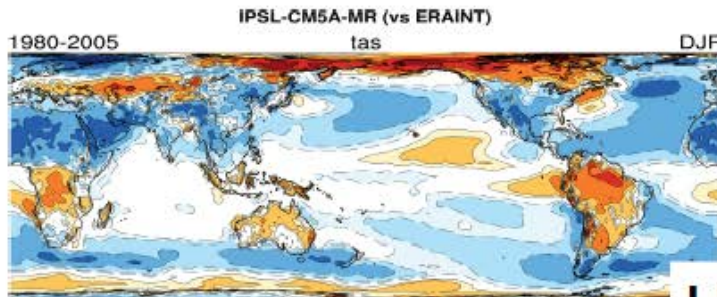


Représentation de la couche
de surface, turbulence

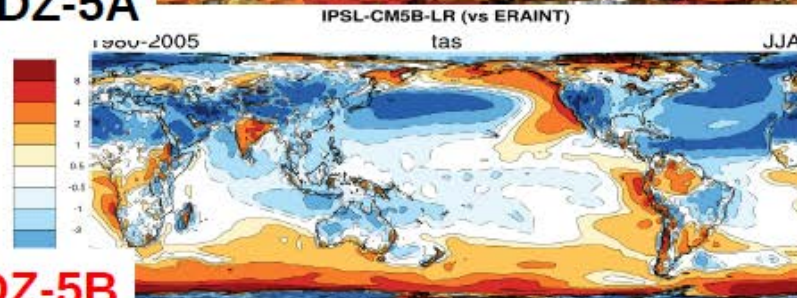
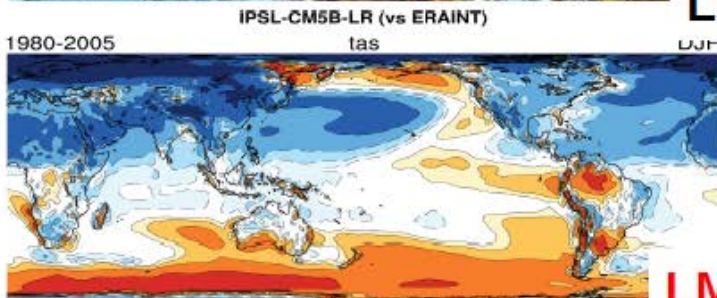
Air surface temperature bias (°C), coupled simulations

Dec.-Jan.-Feb.

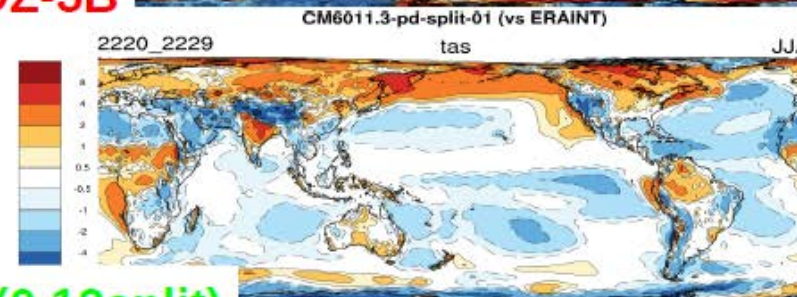
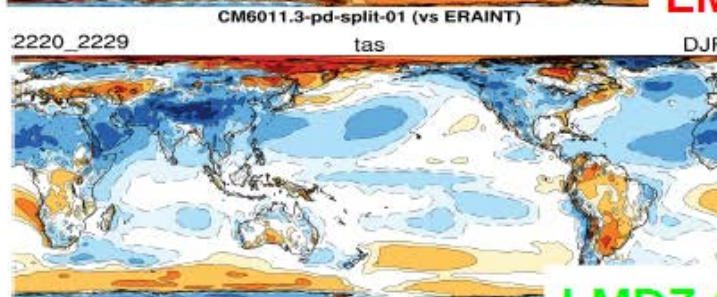
Jun.-Jul.-Aug.



LMDZ-5A



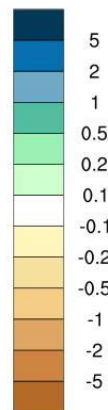
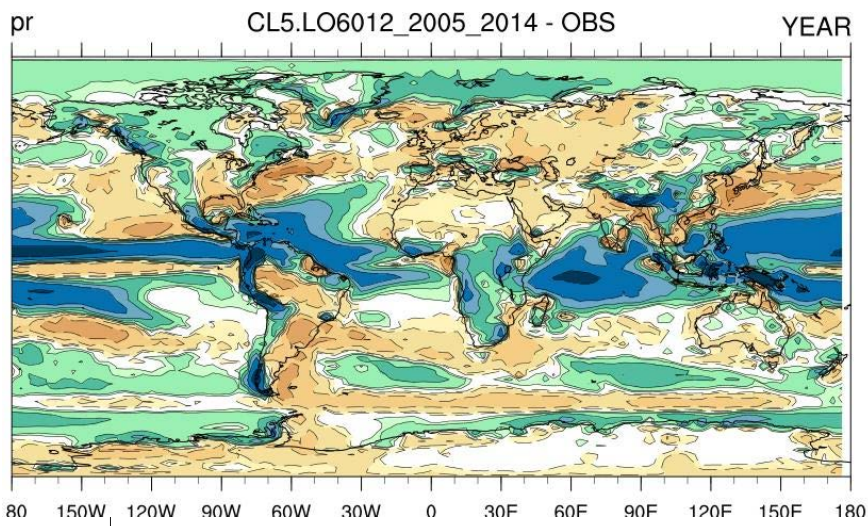
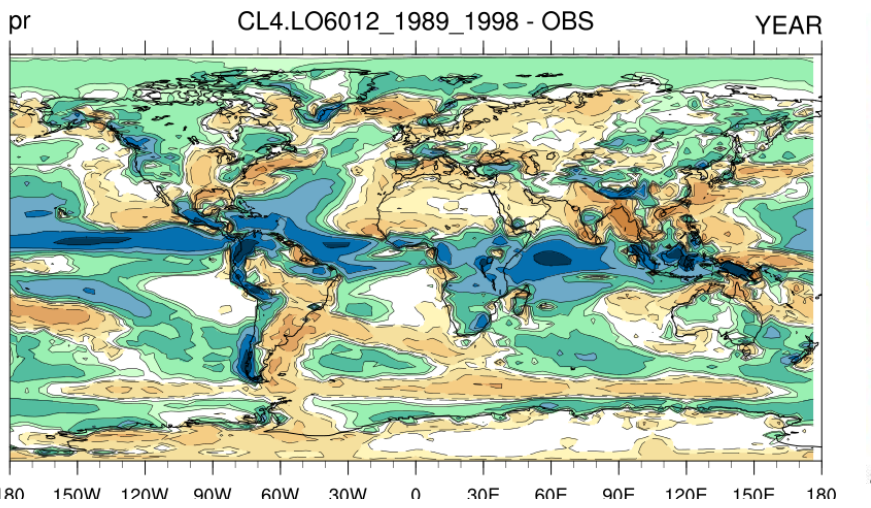
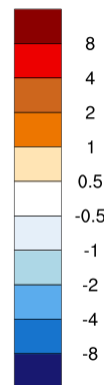
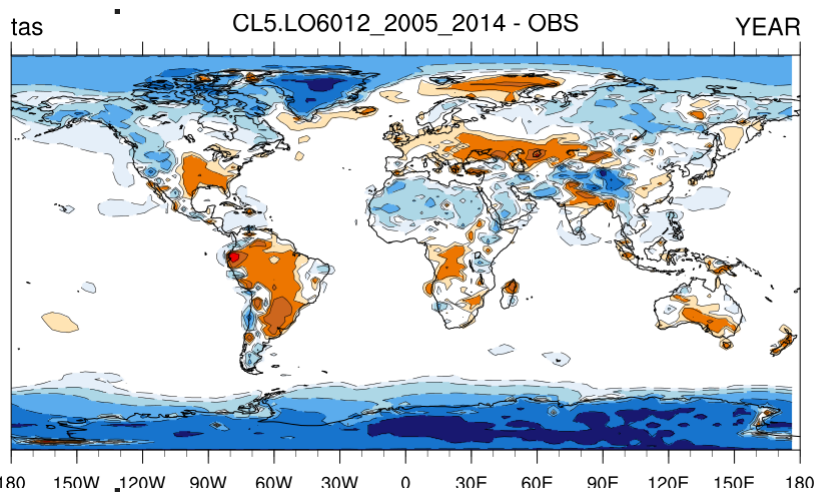
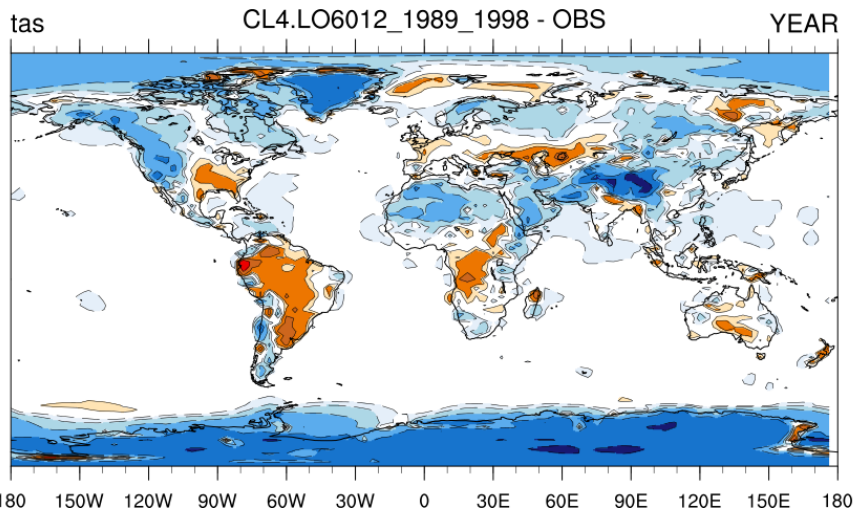
LMDZ-5B



LMDZ-6 (0.12split)

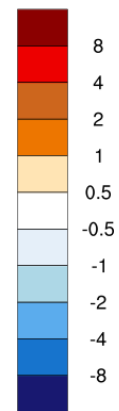
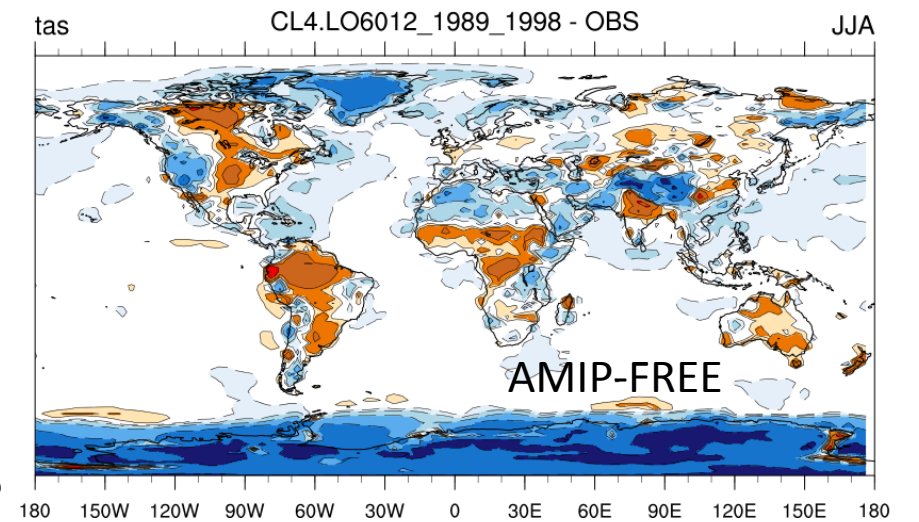
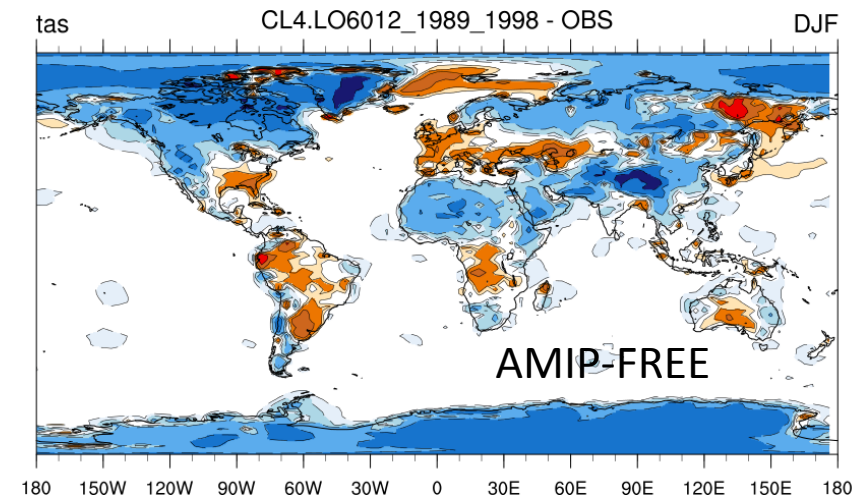
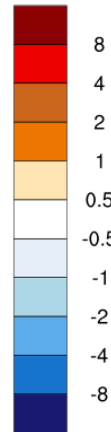
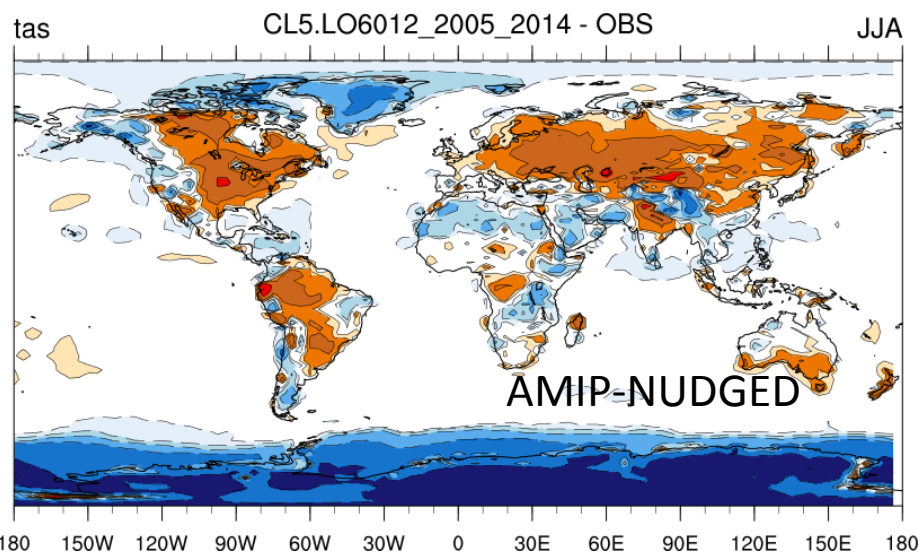
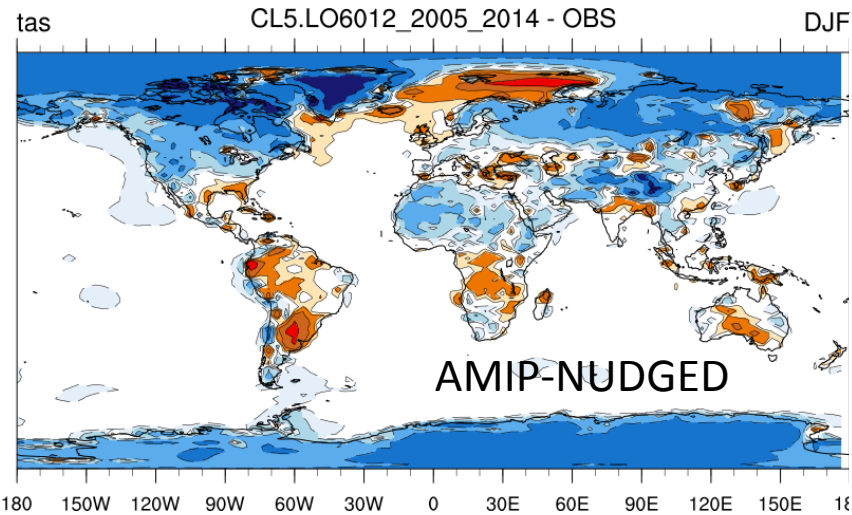
AMIP – free

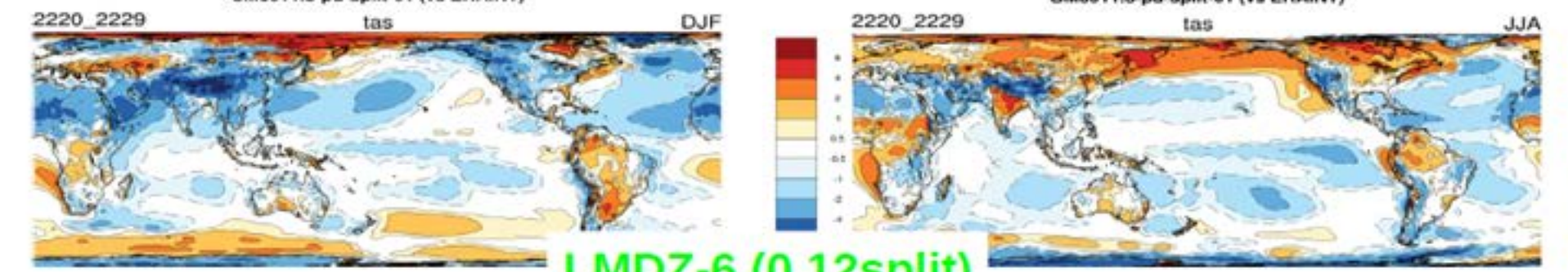
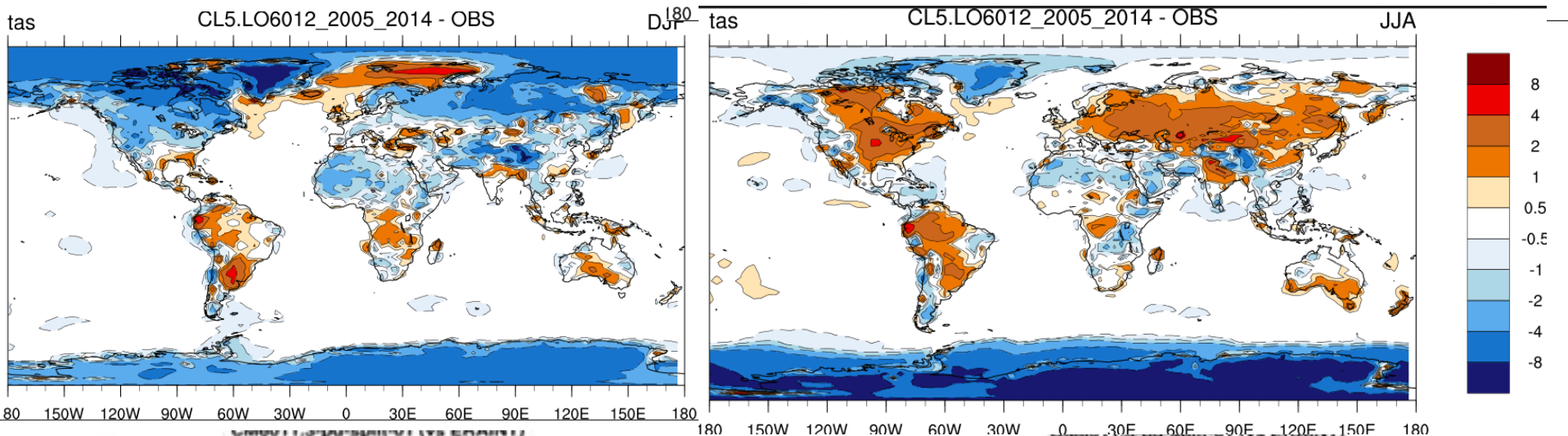
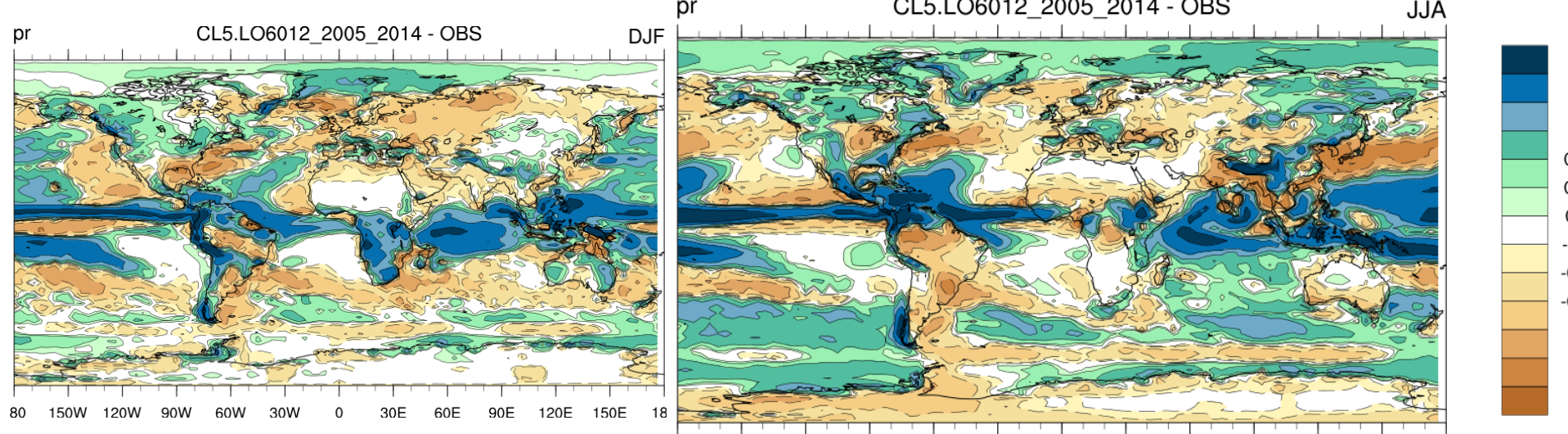
AMIP- nudged



DJF

JJA





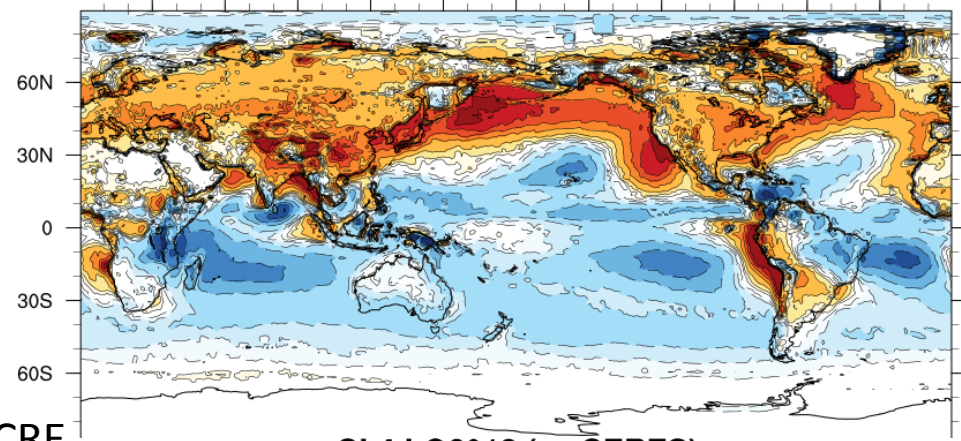
LMDZ-6 (0.12split)

CM6012-LR-amip-ttop-G-02 (vs CERES)

2005-2014

crest

JJA



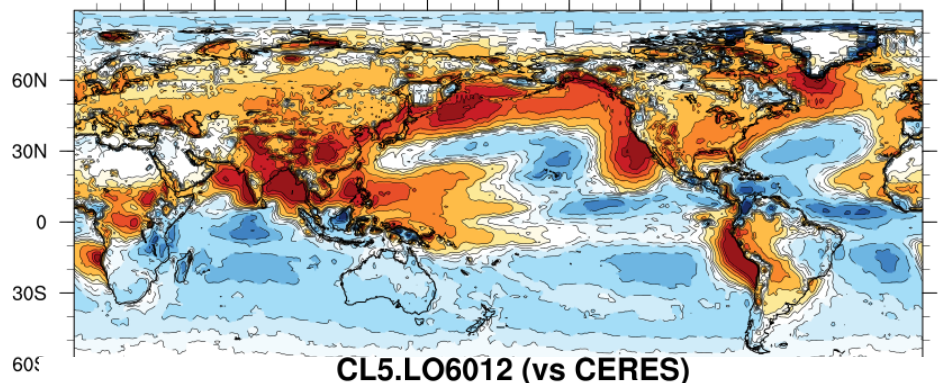
NOT ENOUGH SWCRE

CL4.LO6012 (vs CERES)

1999-2008

crest

JJA

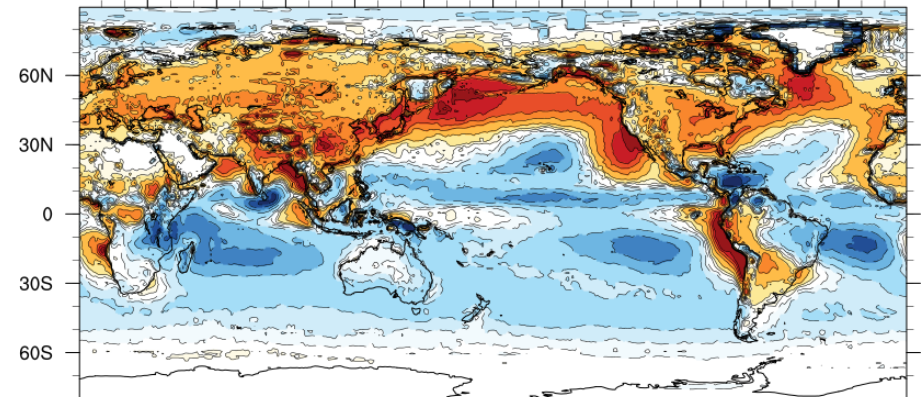


CL5.LO6012 (vs CERES)

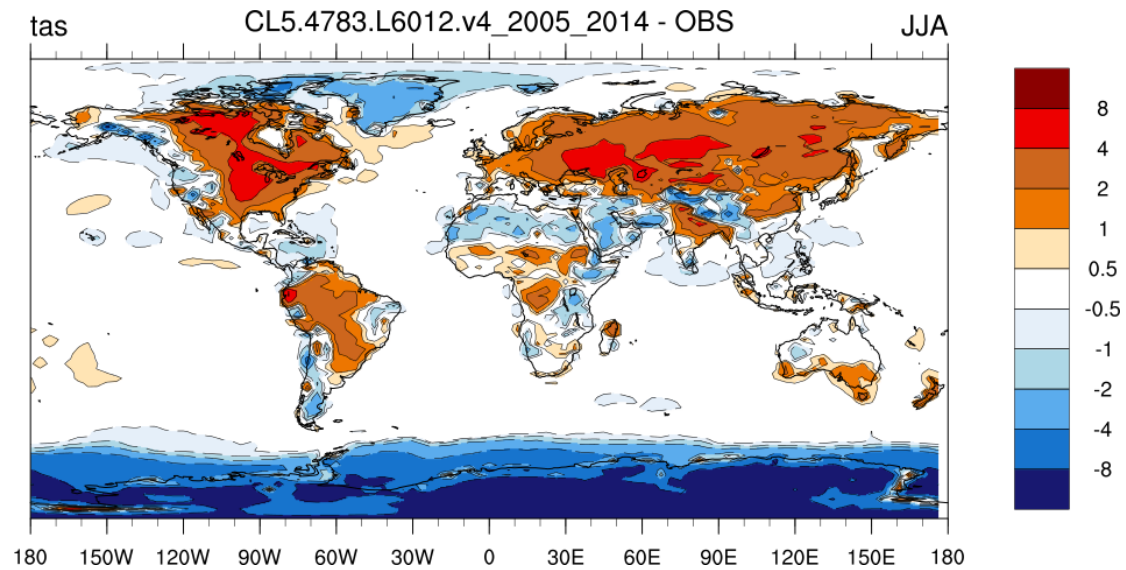
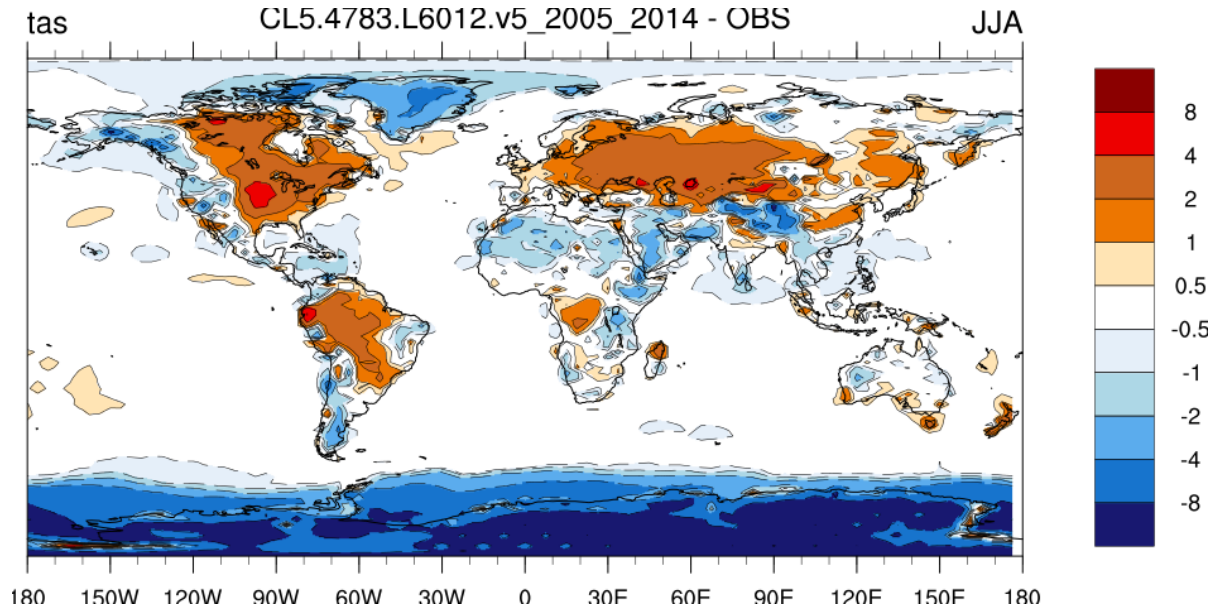
2005-2014

crest

JJA



HIGH SENSITIVITY TO THE RESISTANCE TO BARE SOIL EVAPORATION



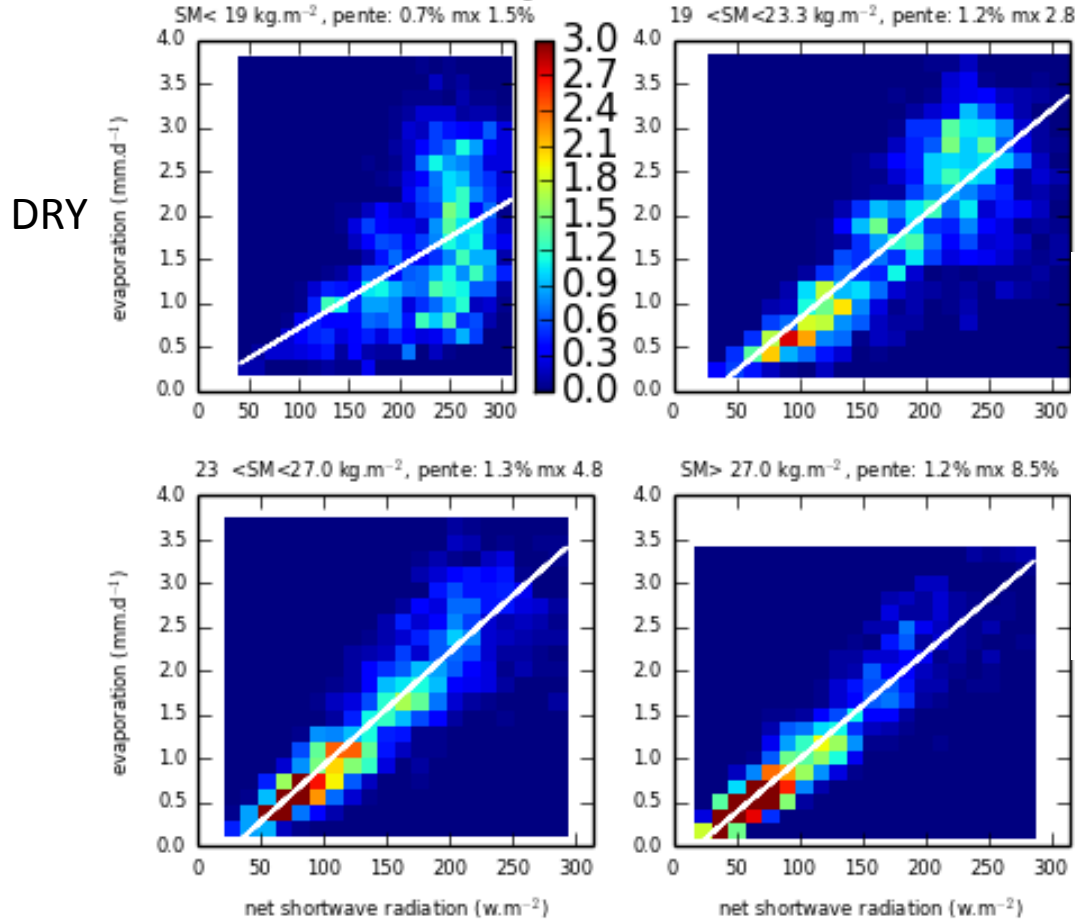
Understand regionals behavior

Characterizing Soil-moisture - Evaporation Regimes using the observational products

2D-histograms Simultaneous (Evap, Swnet) per SM quartile (monthly, 10years)

Evap (JUNG E) VS SW (CERES 4.0) according to classes of SM (ESACCI 3.2) on the period 2001-2011

for the region Mediterranean sea (15)



DRY

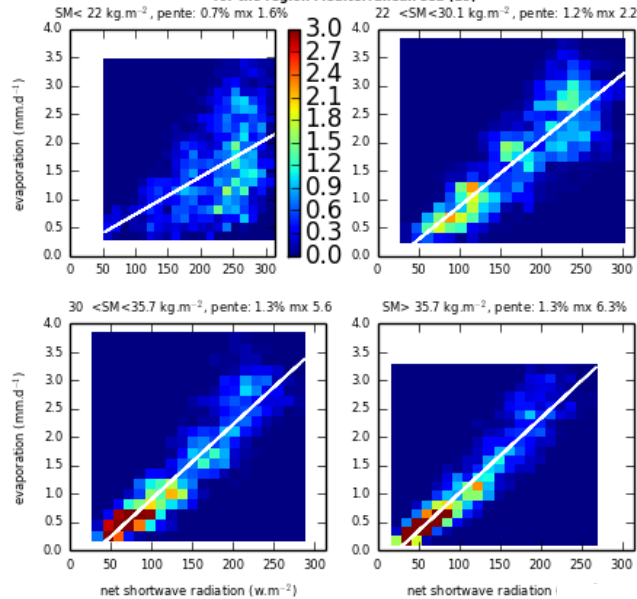
MEDITERANEAN AREA



MOIST

Evap (JUNG E) VS SW (CERES 4.0) according to classes of SM (GLEAM 3.1a)
on the period 2001-2011

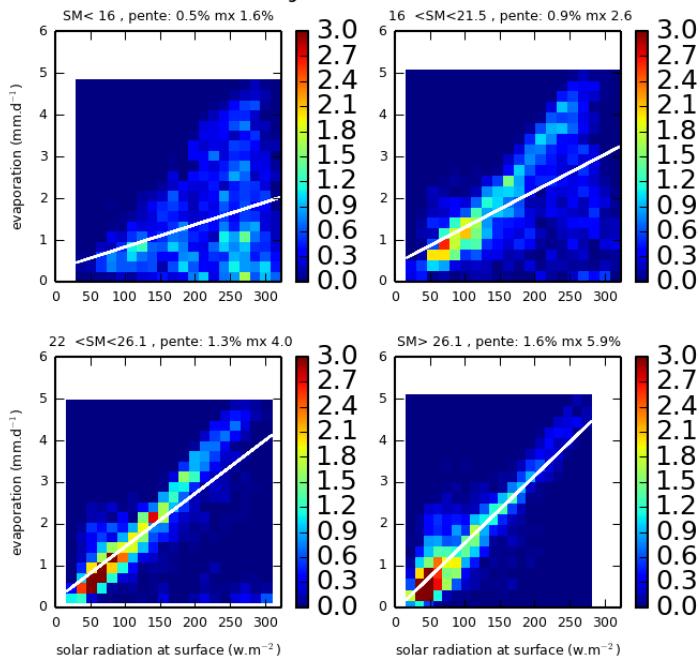
for the region Mediterranean sea (15)



OBS

do_rsol=n

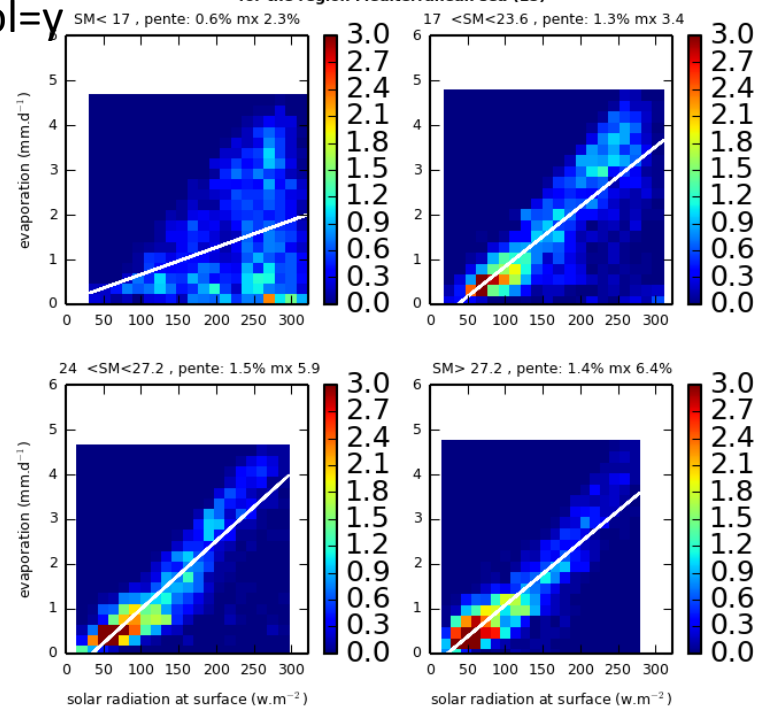
Simulation used: CL5.3977.L2729.v3 on the period 2001-2012
for the region Mediterranean sea (15)



NUDGED

do_rsol=y

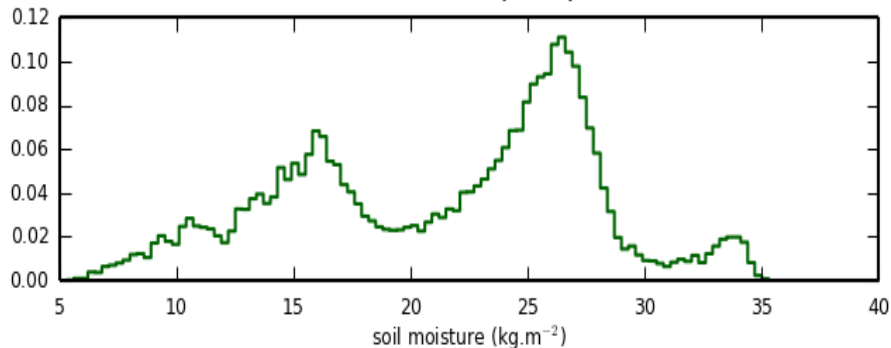
Simulation used: CL5.3977.L2729.c.v3 on the period 2001-2012
for the region Mediterranean sea (15)



WESTERN EUROPE

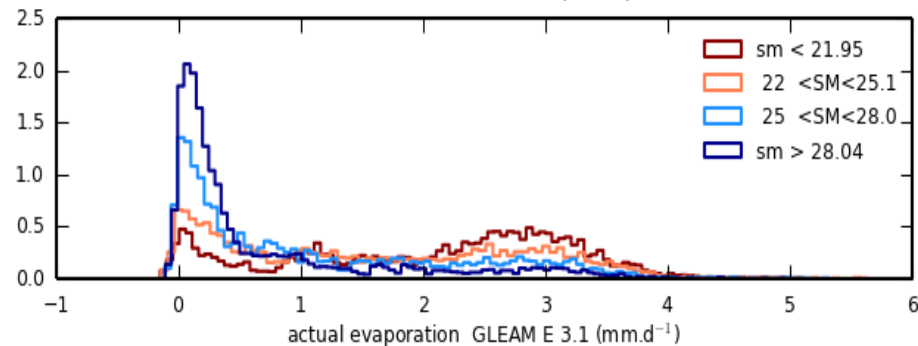
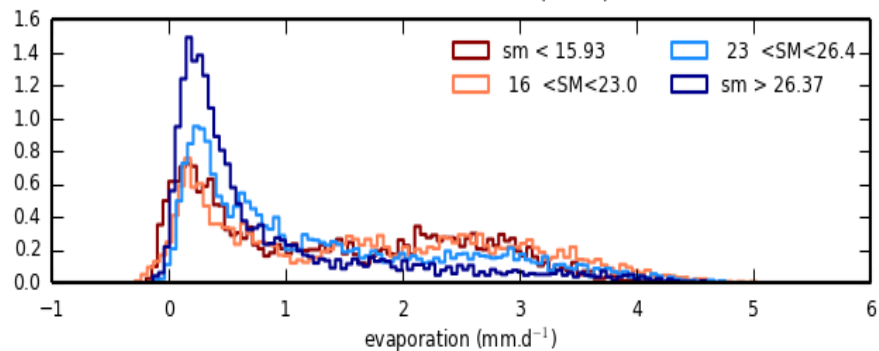
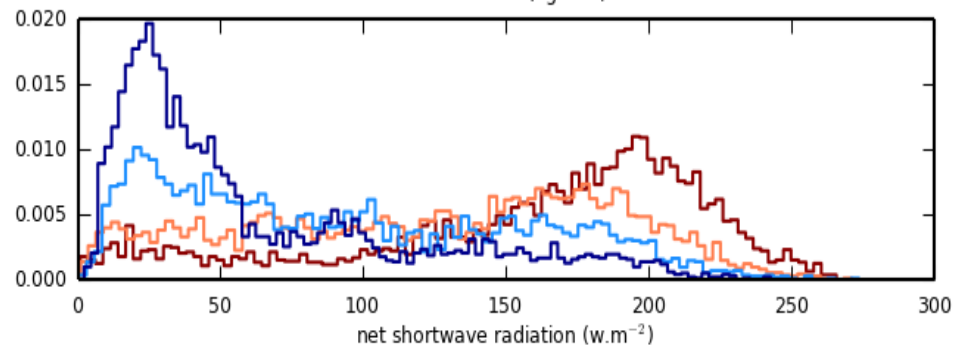
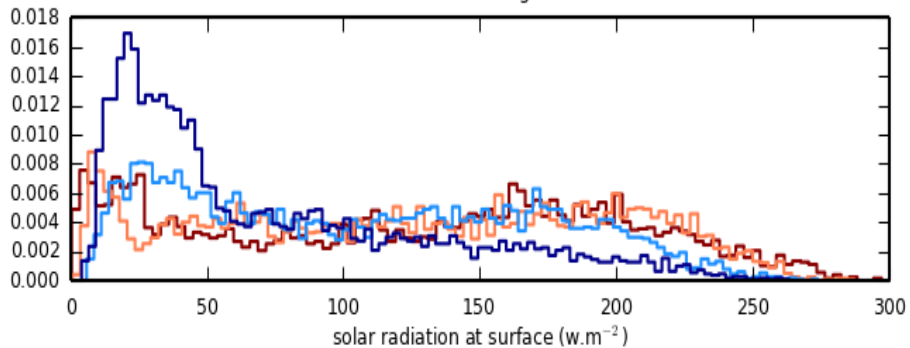
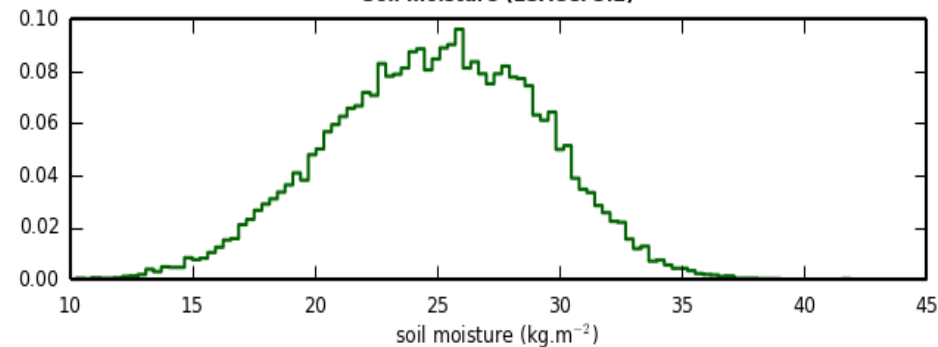
Simulation CL5.3977.L2729.c.v3 for the region 21 Western Europe
(2001 - 2012)

Soil moisture (mrsos)

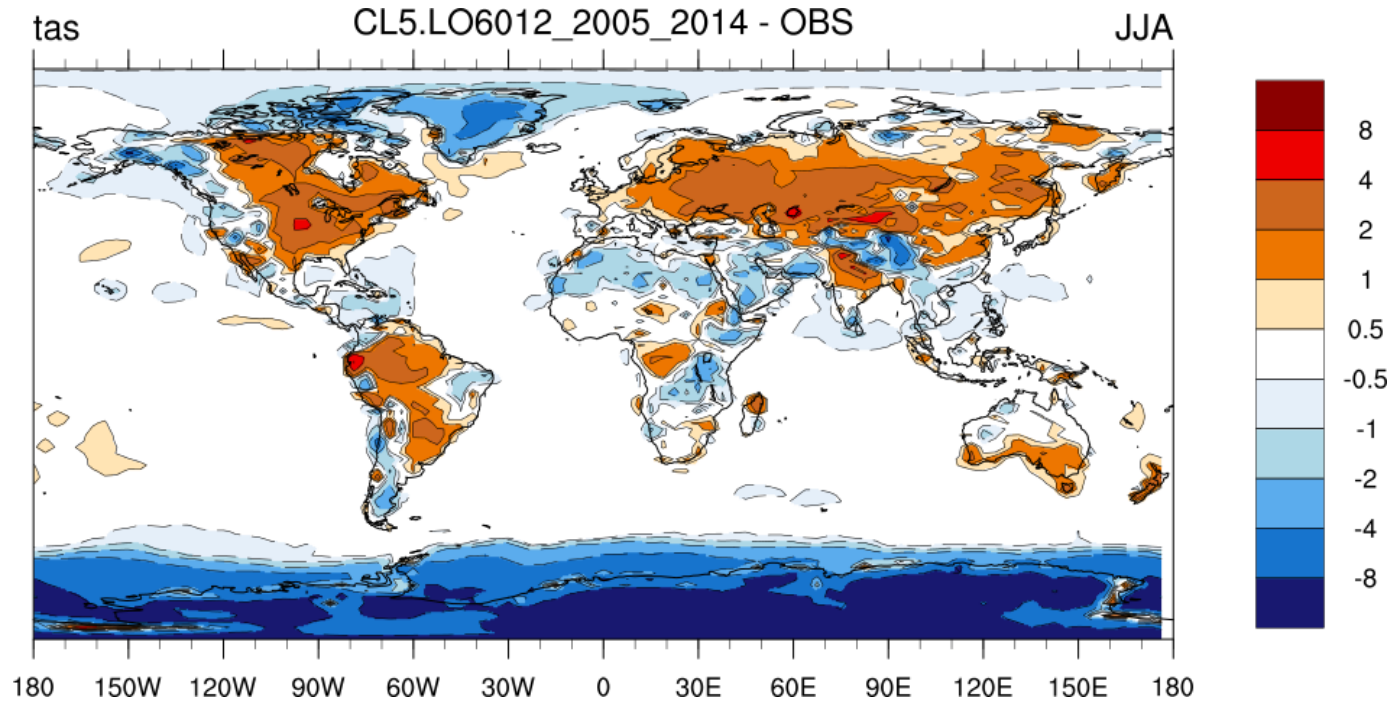


Observations for the region 21 Western Europe
(2001 - 2012)

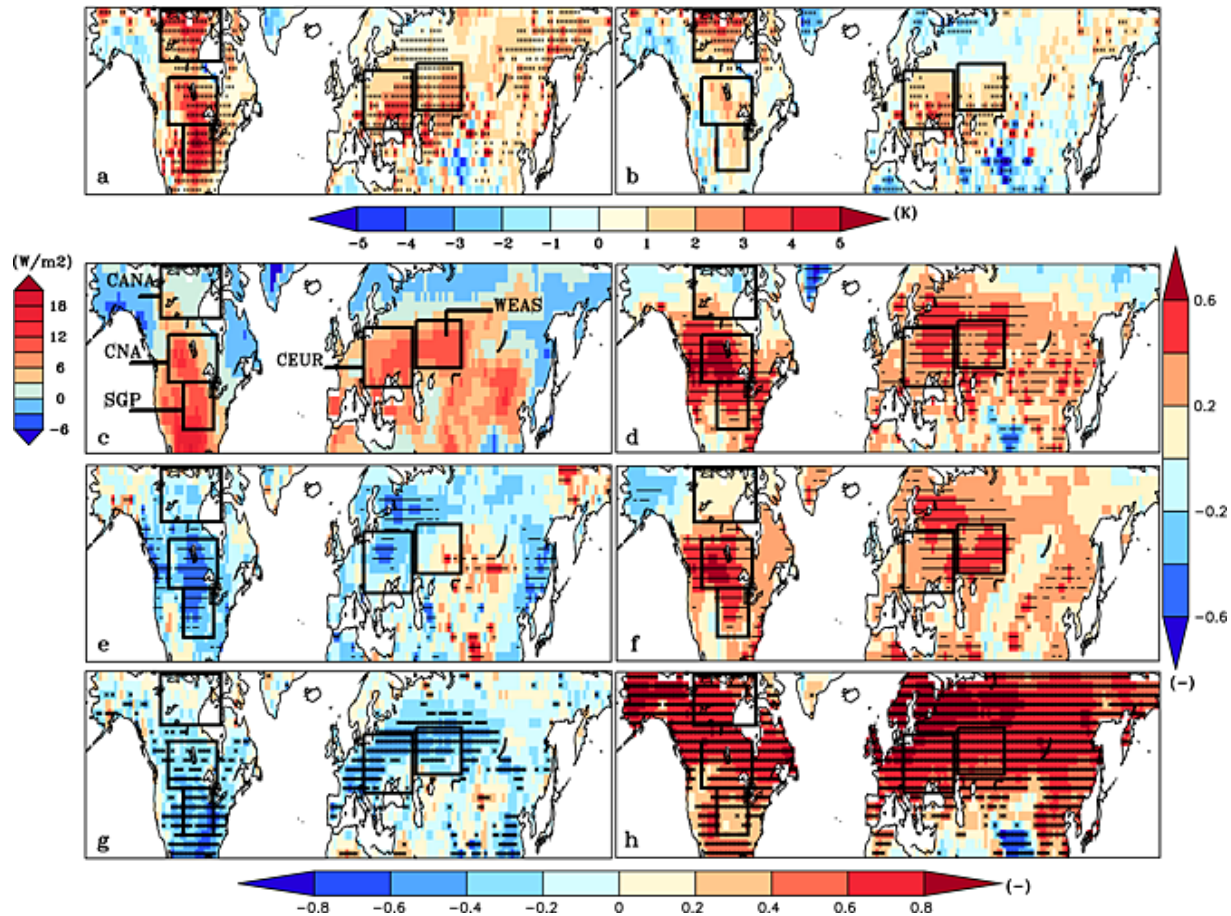
Soil moisture (ESACCI 3.2)



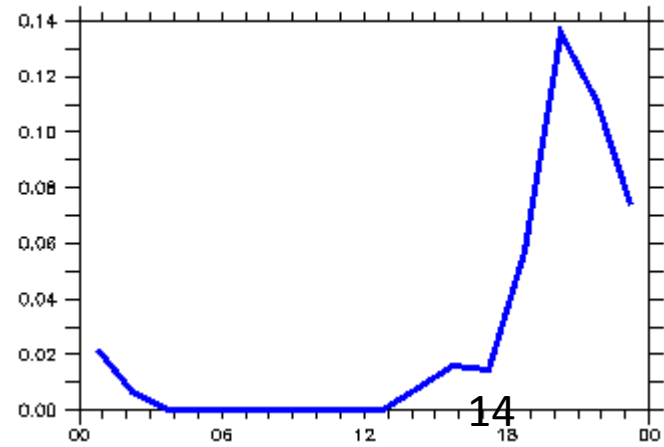
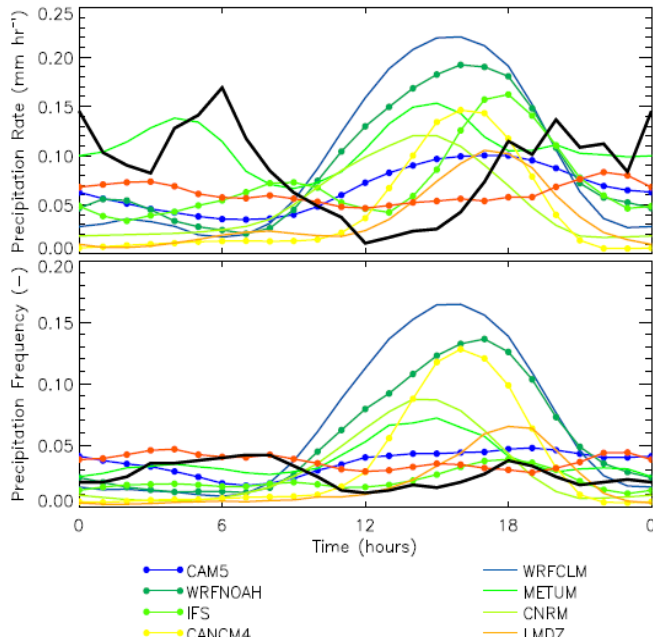
SOUTHERN GREAT PLAINS



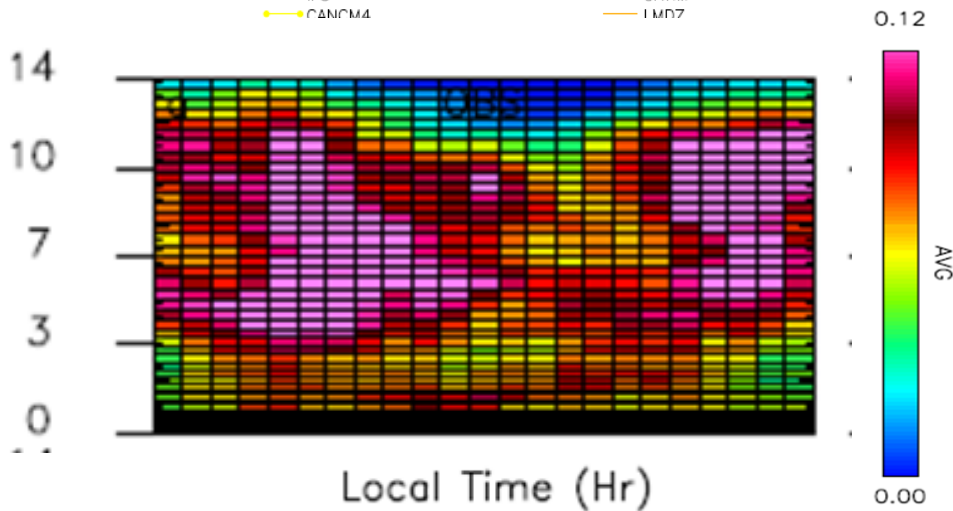
Role of clouds and land-atmosphere coupling in midlatitude continental summer warm biases and climate change amplification in CMIP5 simulations



Southern Great Plains: Nocturnal precip. Missing and not enough clouds

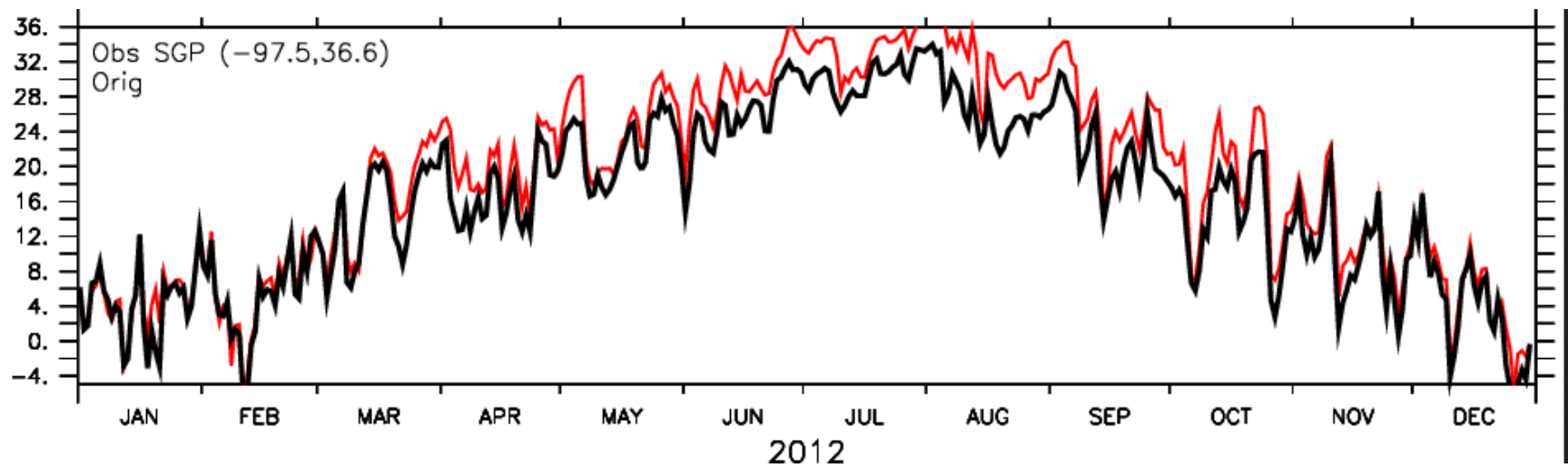
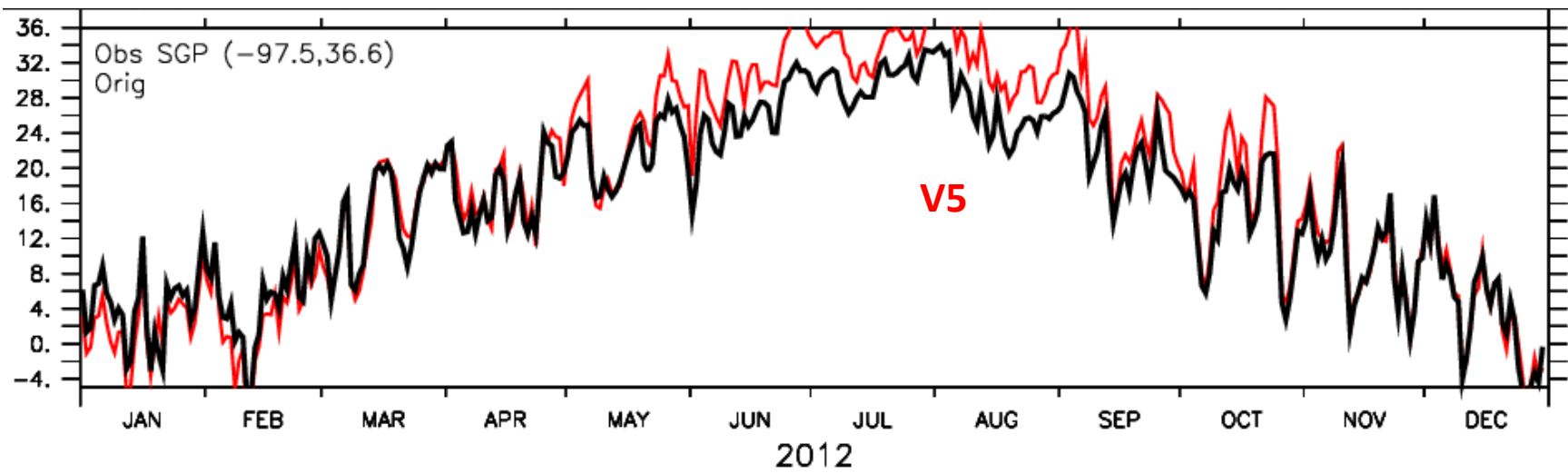


Precipitation rate CM611 (nudged)

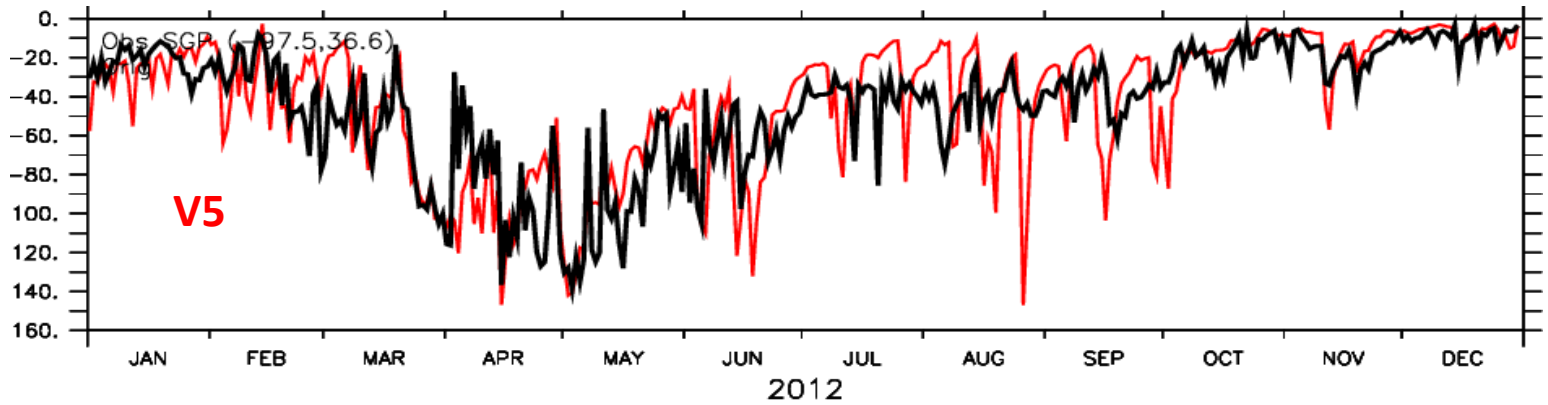
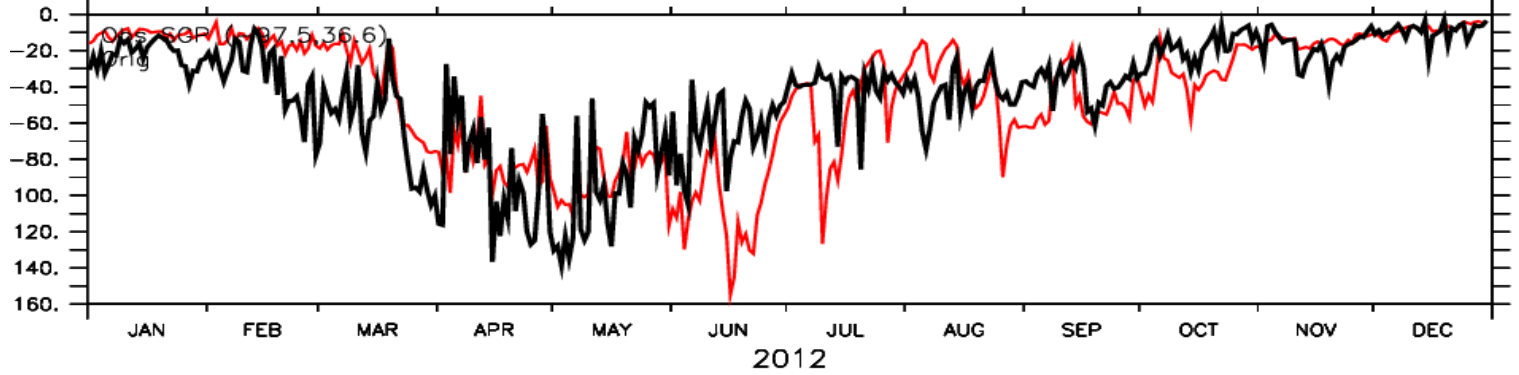


CAUSES,
Vanweverberg et al. JGR 2018

Active Remote Sensing of Clouds (ARSCL) ARM Value- Added Product (VAP) provides very detailed vertically distributed information of clouds, based on cloud radar, lidar, ceilometer and radiometer data



latent



Summary

- Using nudged simulations helps the comparison with observations.
- But in summer the nudging amplifies biases
(compensating errors ?)
- From the processes level point of view, evaporation might be too elevated especially for low SM levels , is the resistance to bare soil evaporation the correct way to handle with it?
- SW Cloud Radiative effect is under-estimated over continents.
- Surface albedo over Himalaya too high
- Long lasting bias summer continental bias (CMIP5) are still there.
(SGP, Eurasian plains) It is likely that the LSM is not the first responsible for them, but the Land-surface/atmosphere coupling is important.