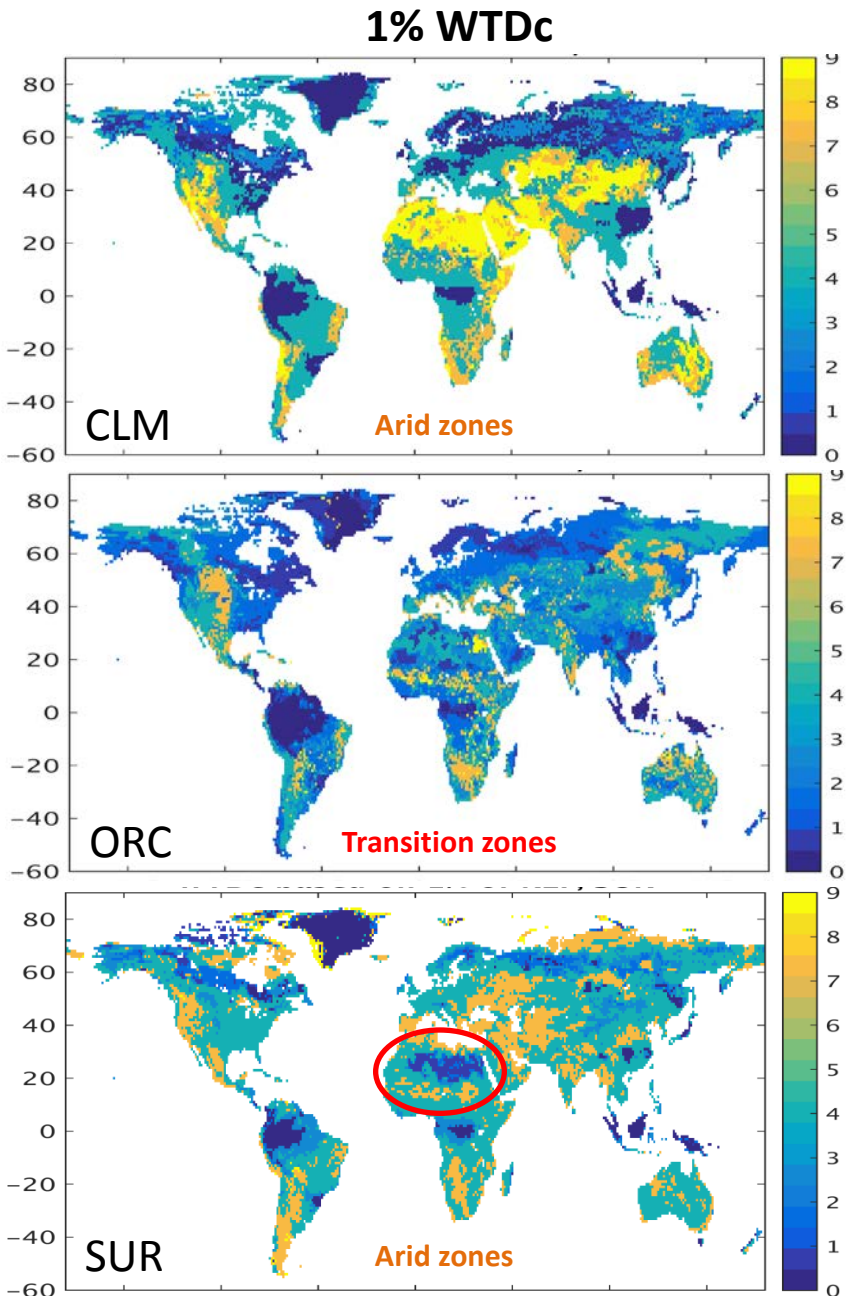
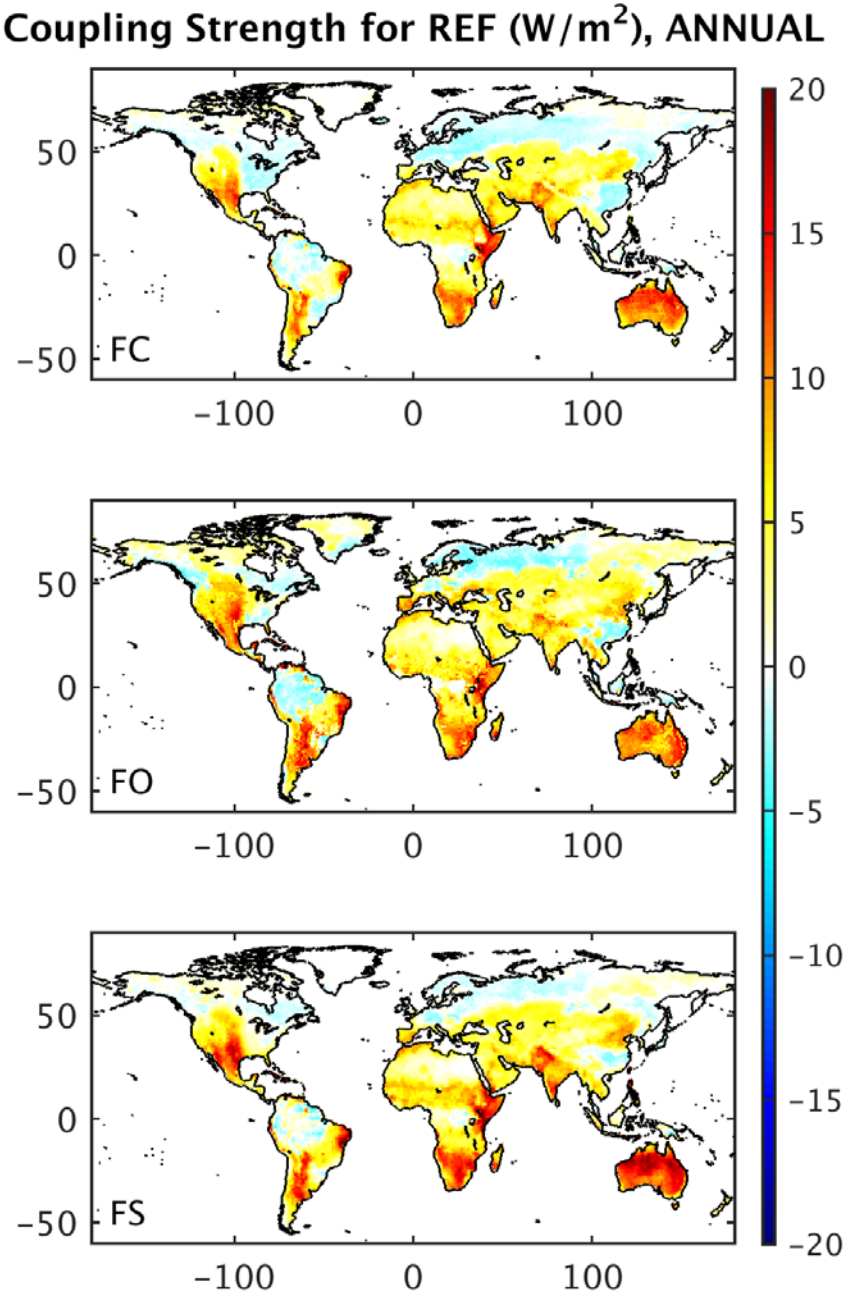
IGEM
Multi-partner meeting
09/12/2016

- **French info**: ANR meeting on January 16; 2nd report due by end of March 2017
- **Short reminder of the results presented at workshop** (next slides)
  - WTDc off-line and online, link with coupling strength (Agnès, Rong-You, Fuxing)
  - Response of atmospheric general circulation (Chia-Wei, Min-Hui)
  - Convection in the Amazon (Rong-You, Min-Hui)
- **Publication strategy for T1:**
  - Drafts: GRL: WTDc offline; ClimDyn: IPSL online
  - Paper based on Chia-Wei? WTDc offline vs online? Based on Rong-You?
- **Additional simulations for T1 ?**
  - Coupled WTD10 ? Done at IPSL.
  - Coupled with fractional WTD1 over 15% of grid cells : in progress at IPSL
- **T2-T3:**
  - Thomas Verbeke hired at UPMC on March 1st, 2017 (Fuxing now with Jan)
  - Which model version ? Link with CMIP6 ?

Off-line results





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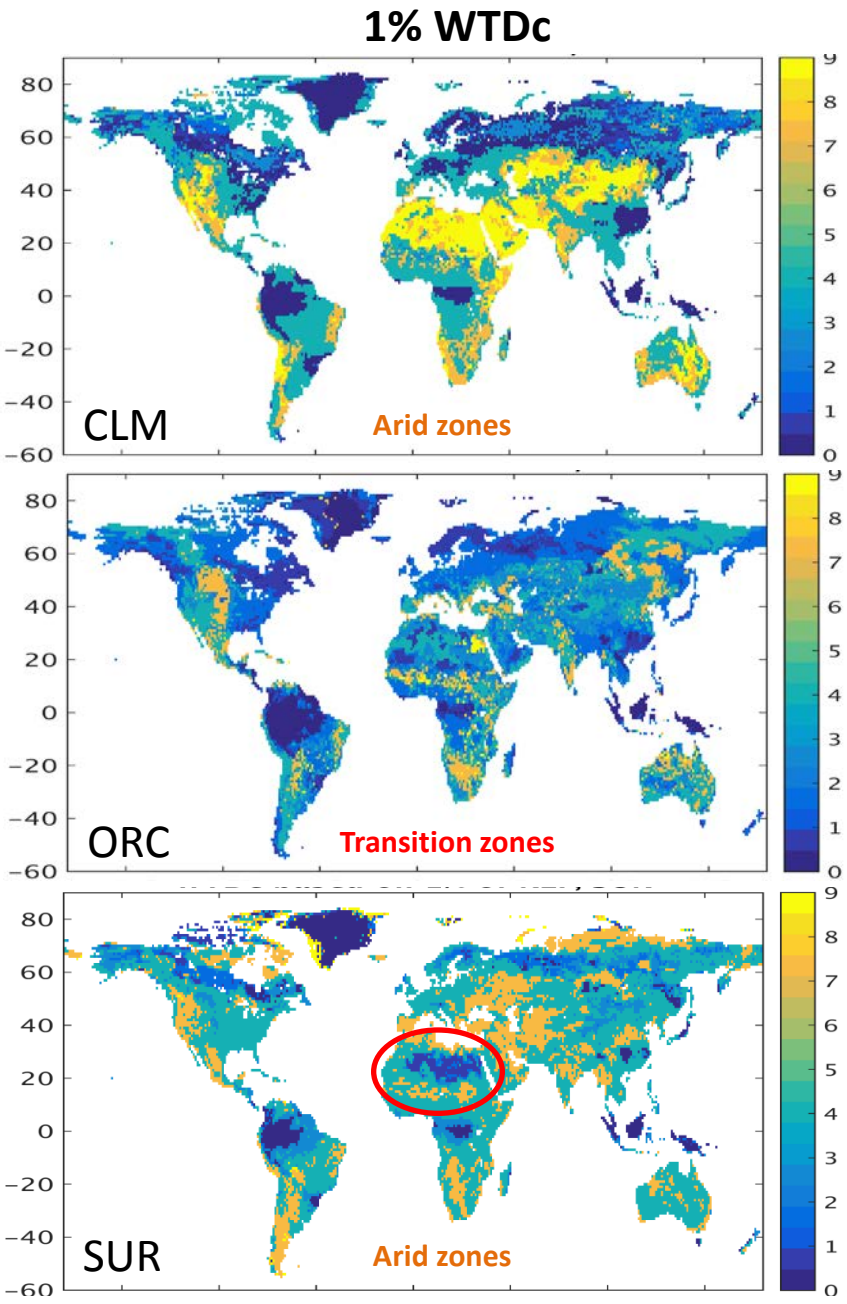


Main conclusions based on offline results:

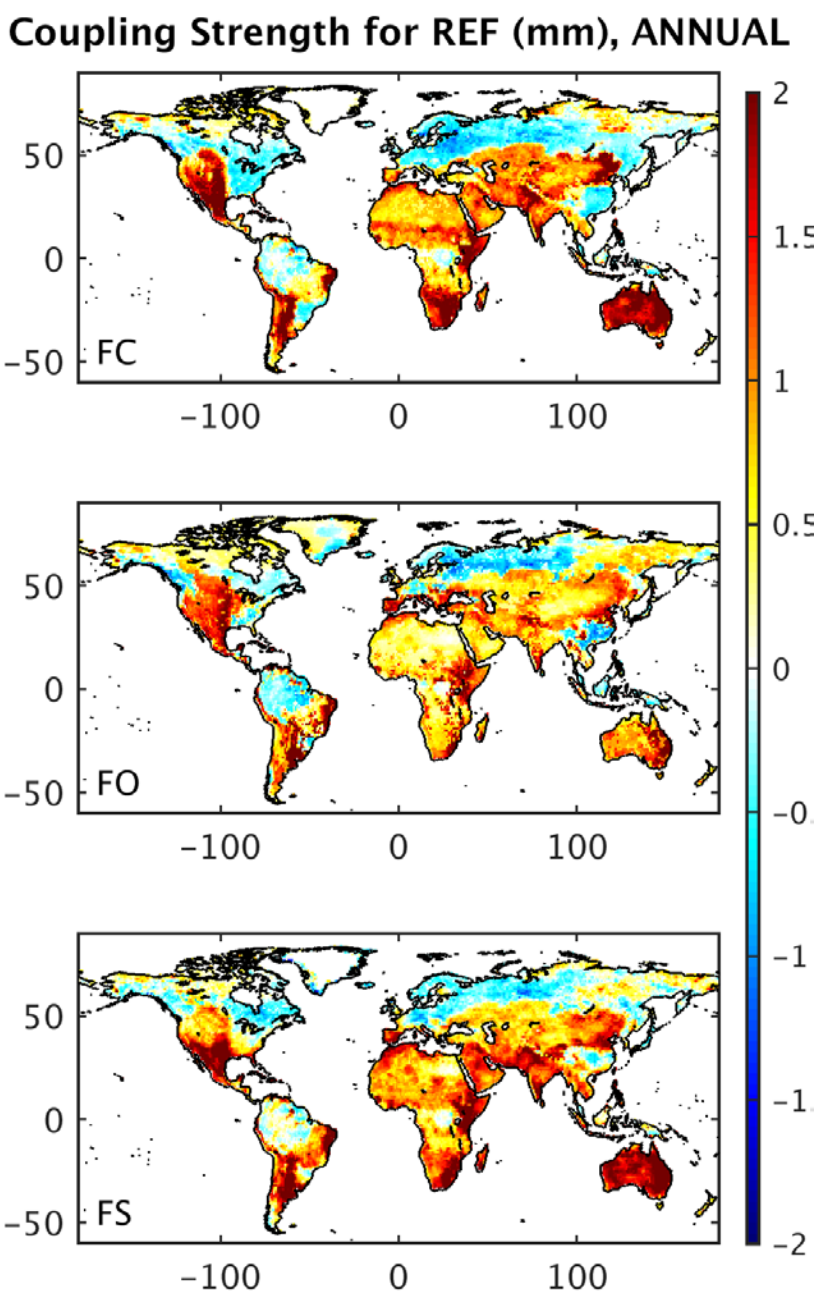
1. Introducing the WTDc
2. It helps comparing the sensitivity of surface fluxes to GW between different regions and models
3. Models need WTDs down to 5 - 10 m to represent the effect of GW on SM and ET in arid and semi-arid zones
4. The WTDc is small in wet zones, where having a shallow WTD can thus make a difference : good conclusion?

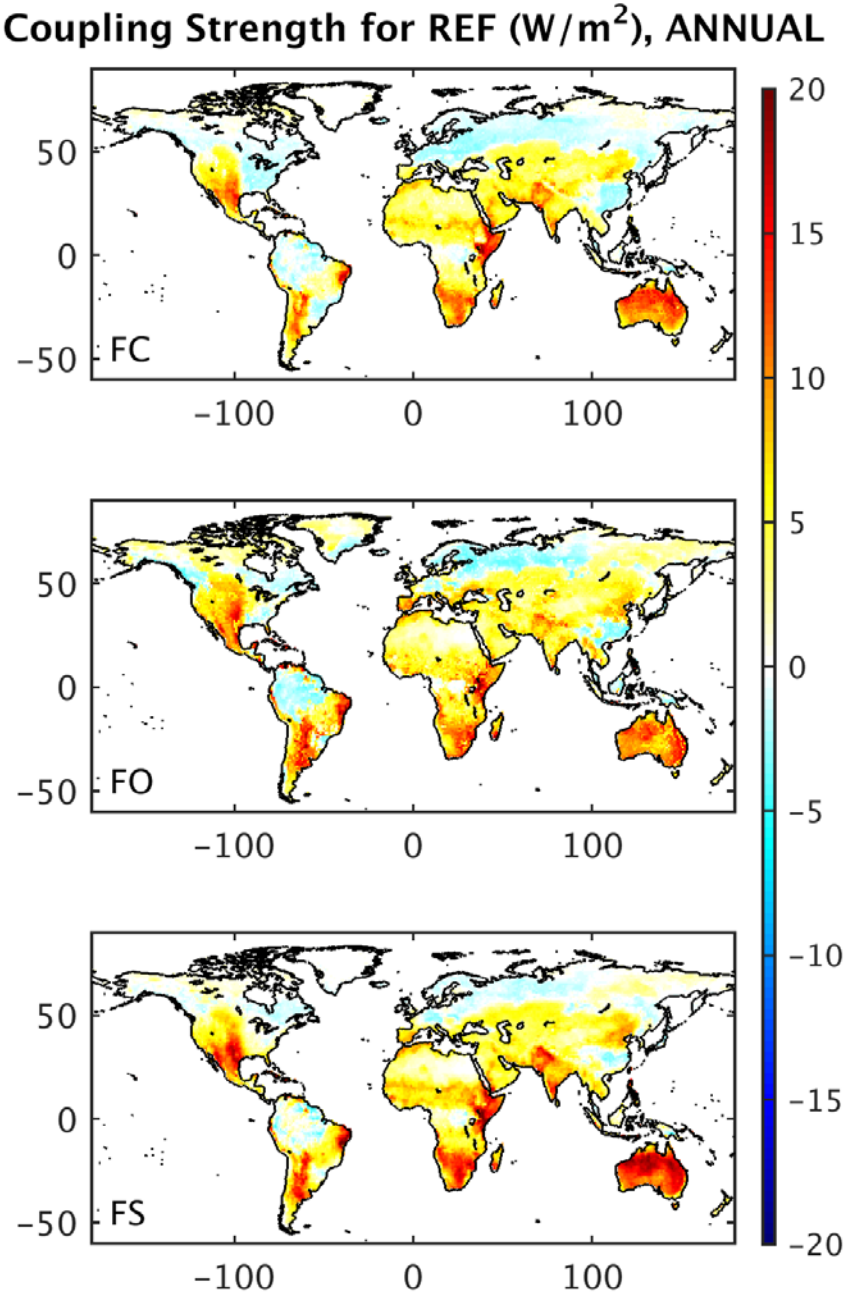
5. Link with coupling strength to explore a bit more (based on SM, REF-WTD1? scatter plots?)

Coupling strength

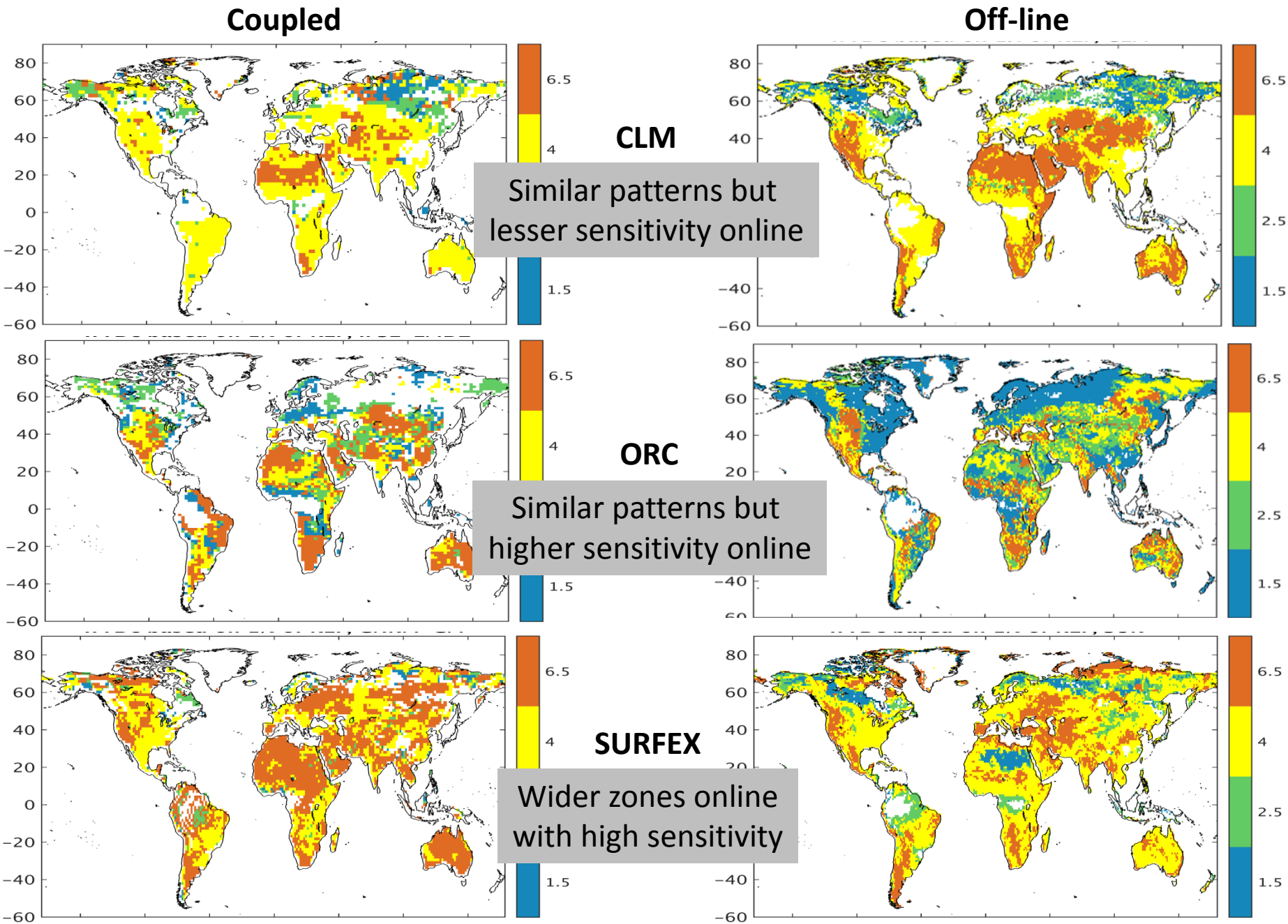
Based on SM ?

Based on LE





Coupled simulations : multi-model & WTDc



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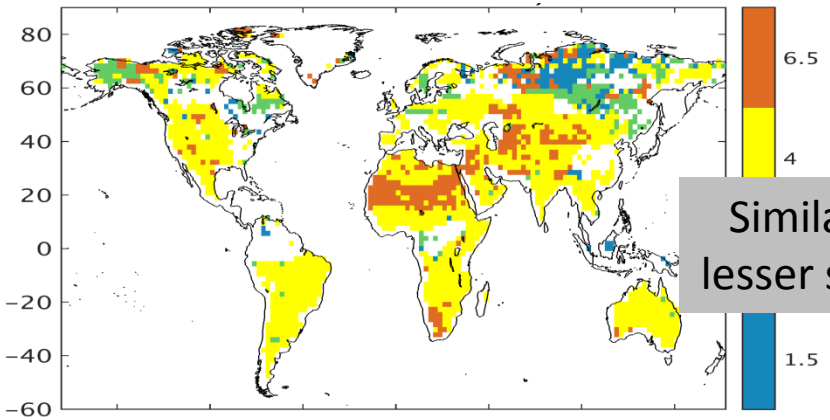
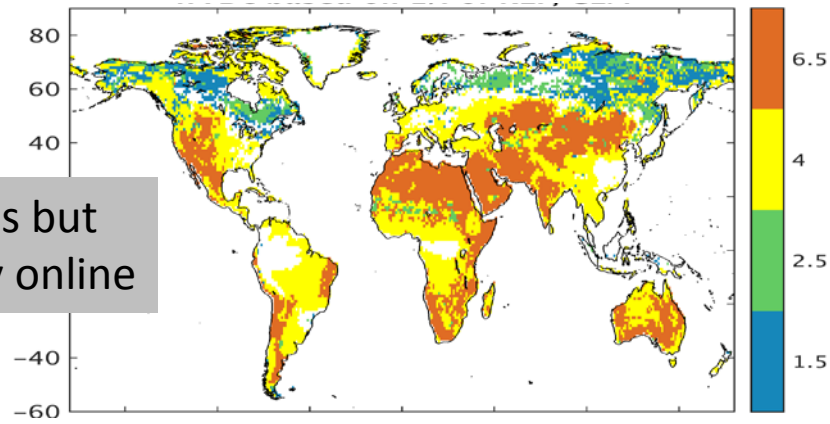
Coupled

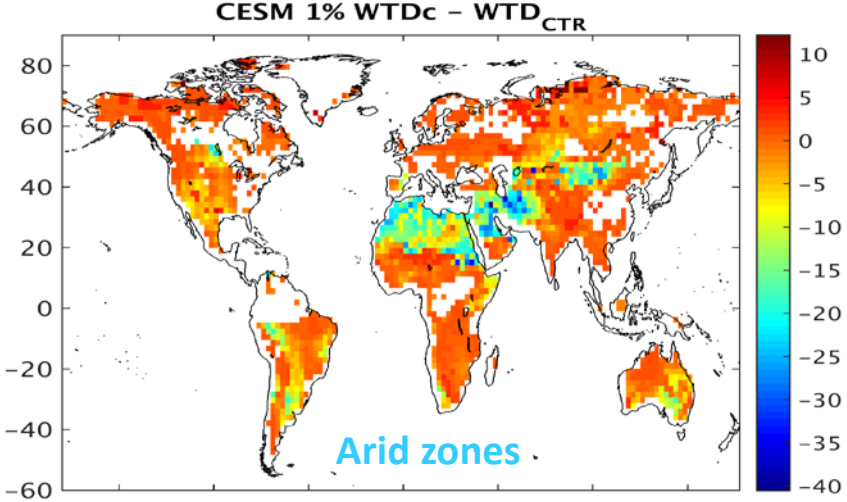


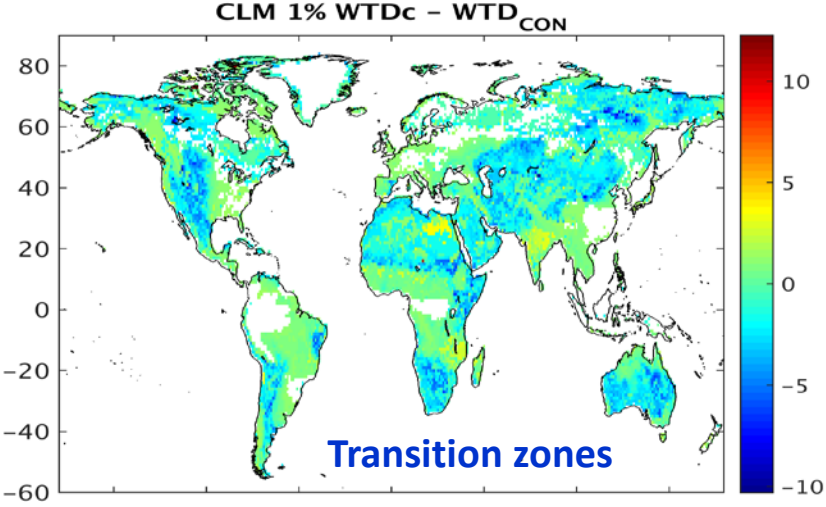
Off-line



CLM

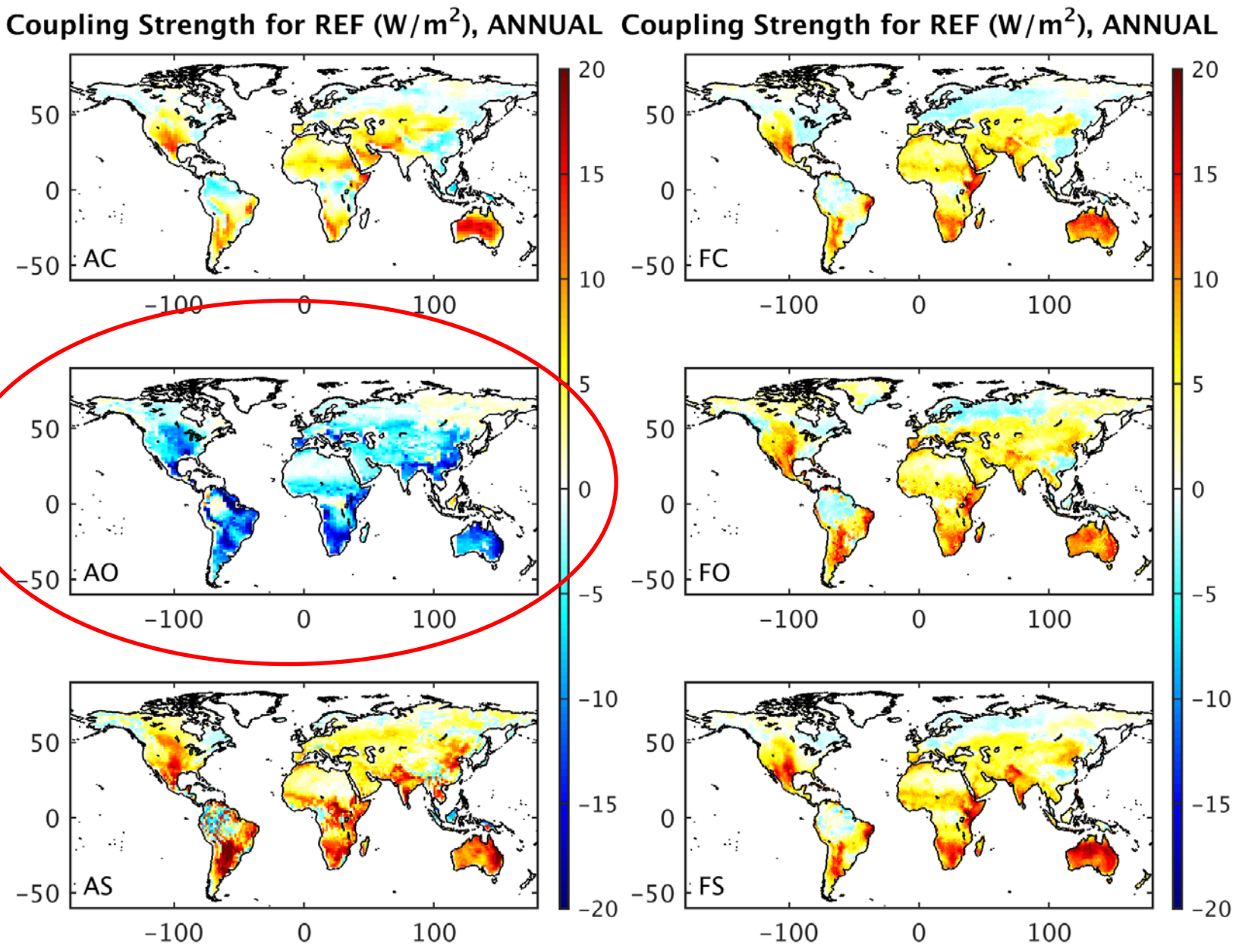
Similar patterns but lesser sensitivity online



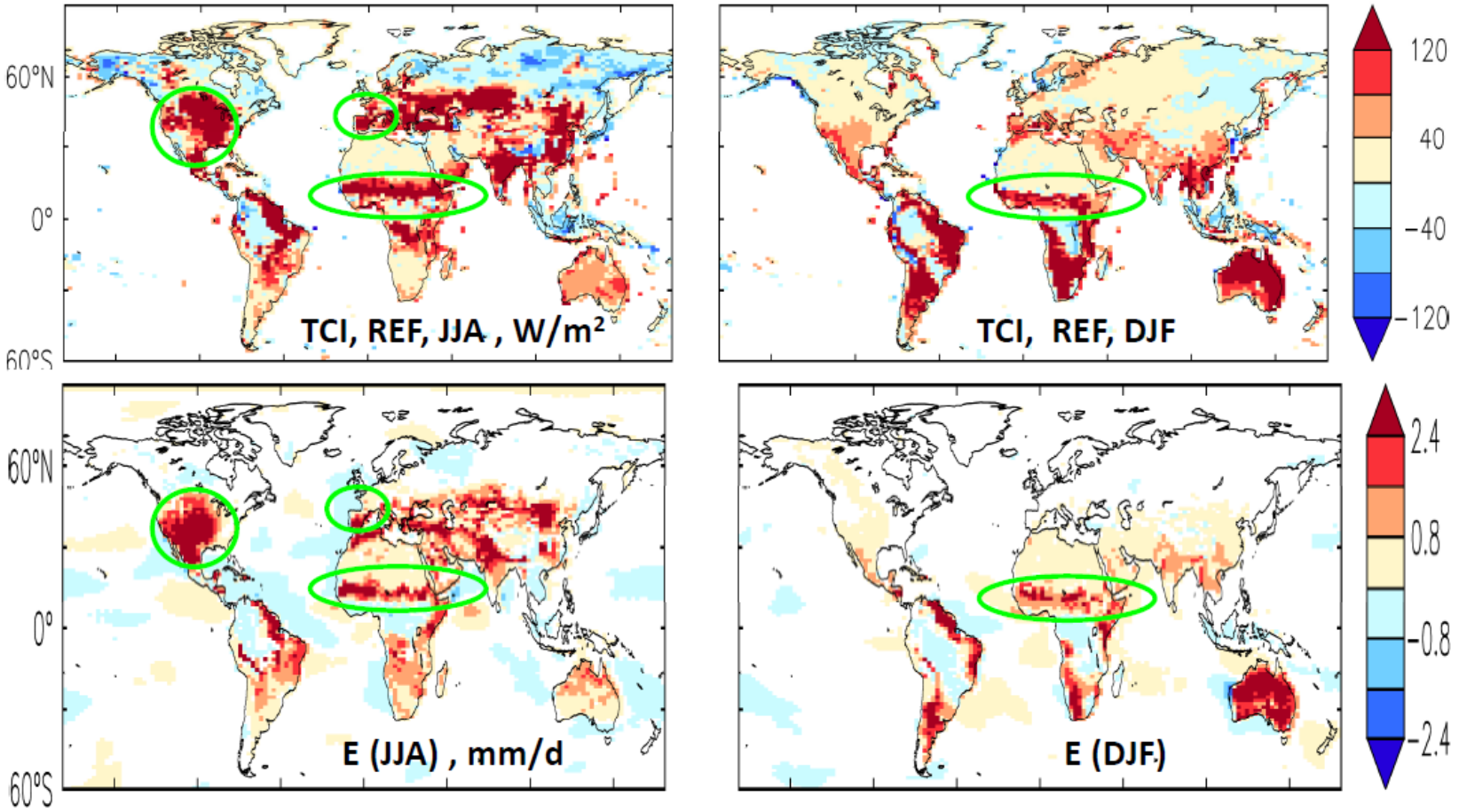


Blue values → WTD in CLM(ref) is deeper than WTDc
→ climate/surface fluxes « insensitive » to dynamical WTD (at least based on mean values)

Coupled simulations : Link with Coupling strength

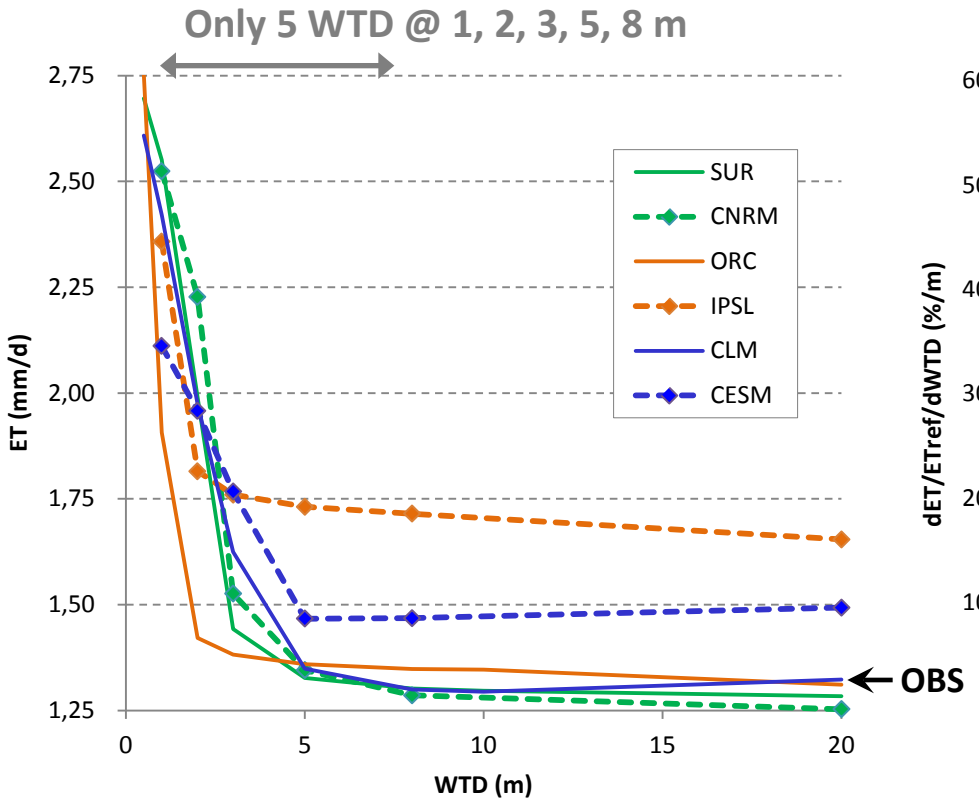


ΔE (WTD1-REF) vs. SM-E coupling strength

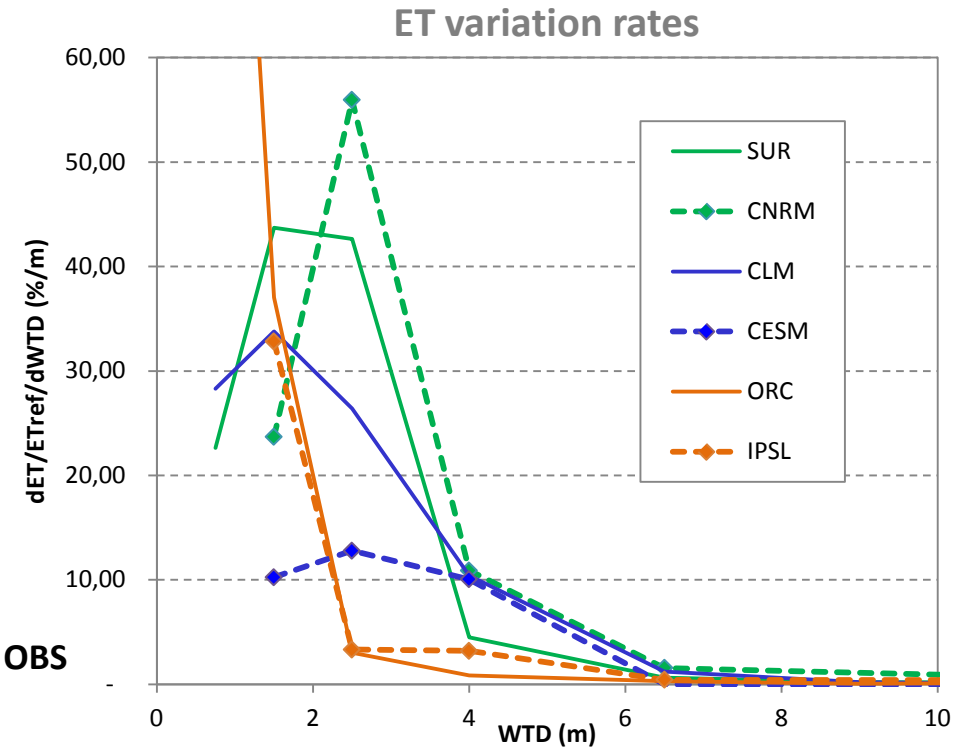


- Terrestrial Coupling Index (*TCI*) [*Dirmeyer*, 2011]: $TCI = -\frac{\sigma'_{E_{m,y}} Cov(SM'_{m,y} \cdot E'_{m,y})}{\sigma'_{SM_{m,y}} \sigma'_{E_{m,y}}}$
- positive → SM controls *E*; negative → energy controls *E*.
- The patterns of positive TCI are similar to **Δ***E*.

Land averages: ET

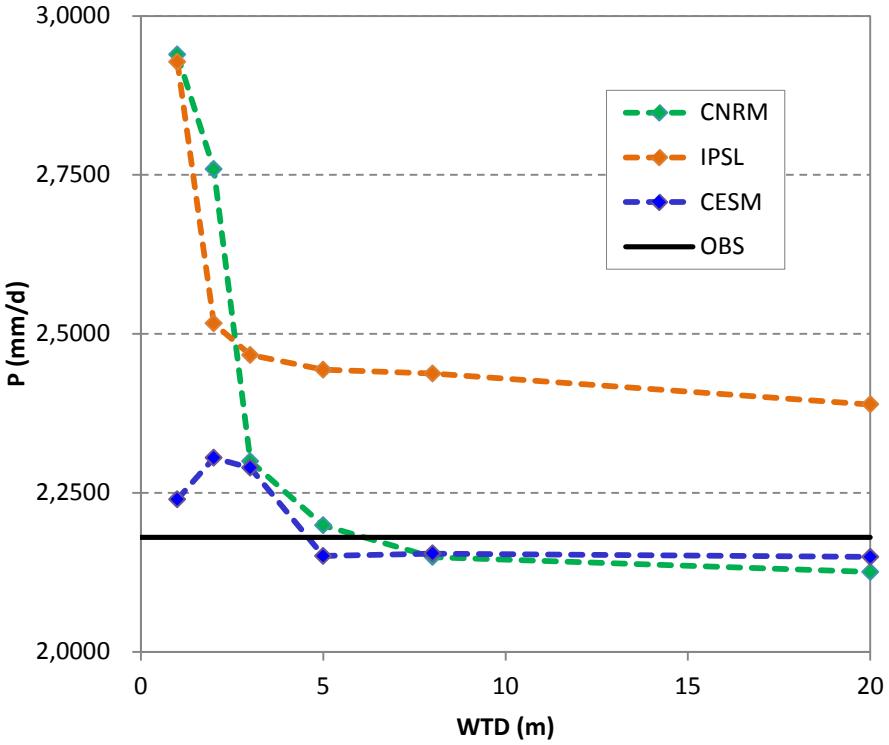


CLM and ORC have a larger reference ET in coupled mode than offline



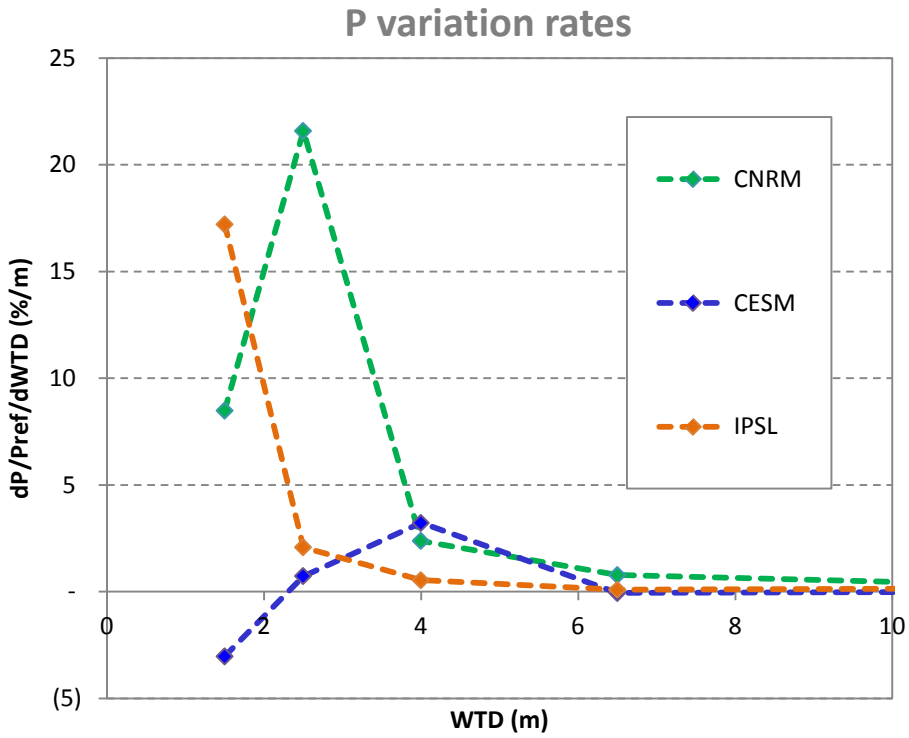
CLM shows smaller variations rates to shallow WTD in coupled mode

Land averages: Precipitation



CLM shows a decrease of precipitation between WTD2 and WTD1

?



P variations rates // ET variation rates
The negative value for CLM corresponds to a negative feedback

Responses of Atmospheric General Circulation to Groundwater Dynamics

Chia-Wei Lan, Min-Hui Lo, Agnès Ducharne,
Bertrand Decharme, Rong-You Chien, Fuxing Wang

Department of Atmospheric Sciences, National Taiwan University, Taiwan





I-GEM 1st Workshop Oct 3th-5th, 2016

Summary

Water Table Depth Sensitivity Experiments

CNRM-CM, CESM, and IPSL-LMDZ

Shallower Water Table Depth

Increased surface latent heat flux

Decreased surface temperature in mid-latitude

Increased meridional low level temperature gradient

Stronger global Hadley circulation

Precipitation over Land

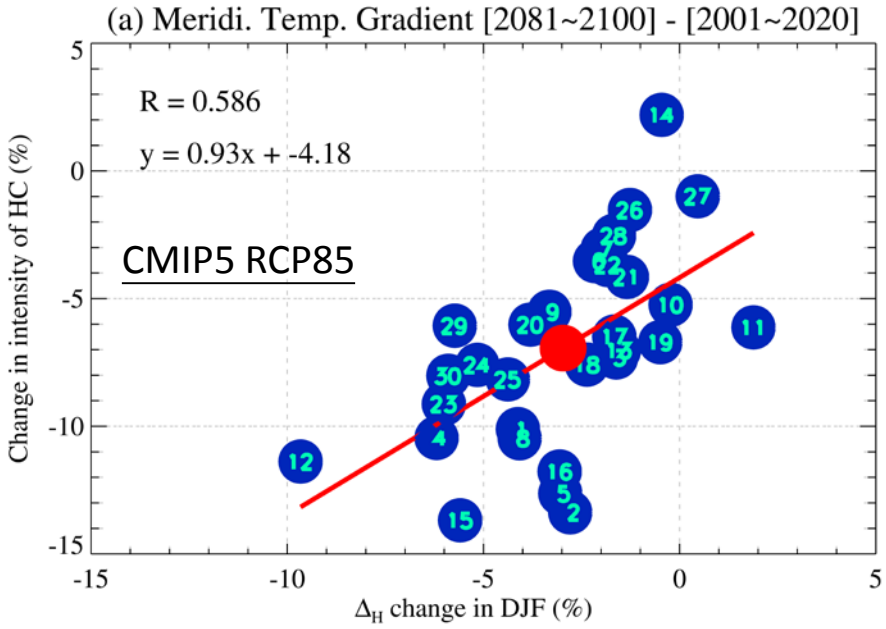
Shallower water table depth has **higher precipitation over land** due to more latent heat flux over land, consistent results with Chou et al. in 2001; Lo and Famiglietti, 2011

Monsoon Index (WYMI)

Cooling over land reduces the land-sea temperature contrast, and then lead to weaker Indian monsoon. **Less precipitation over the monsoon regions**.

Introdu

- The strength of the Hadley Circulation
  - The meridional potential temperature gradient
  - Gross static stability
  - Tropopause height



[Seo et al., 2014]

➢ **HC widening from 1997 to 2012 is associated with increased mid-latitude temperatures and hence reduced temperature gradients.**

[Adam et al., 2014]

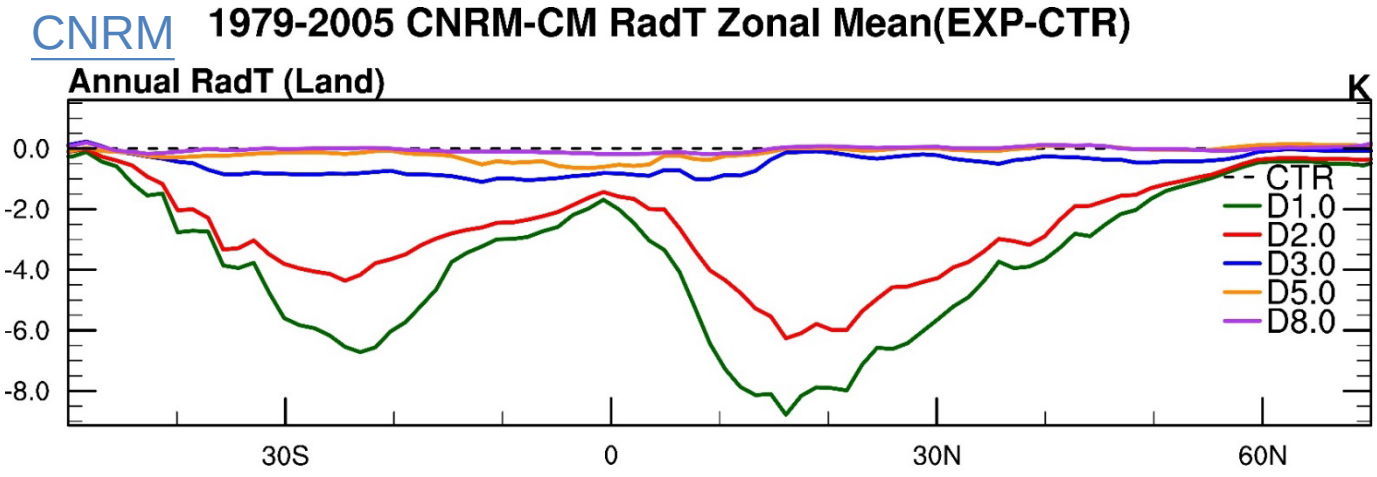
Increased latent heat in mid-latitude

Decreased surface temperature in mid-latitude

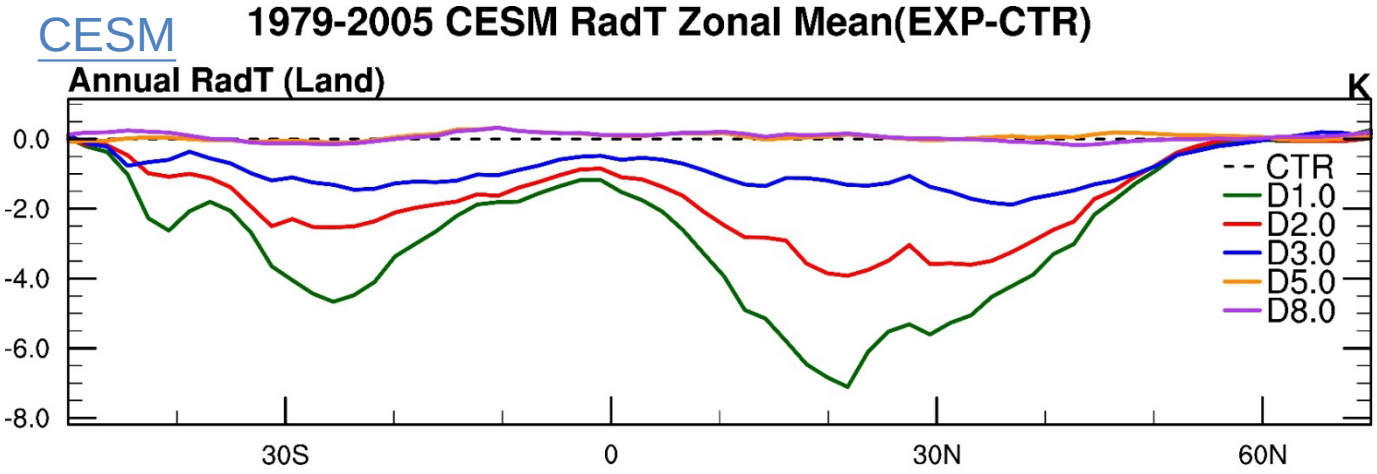
Increased meridional temperature gradient

Stronger global Hadley circulation

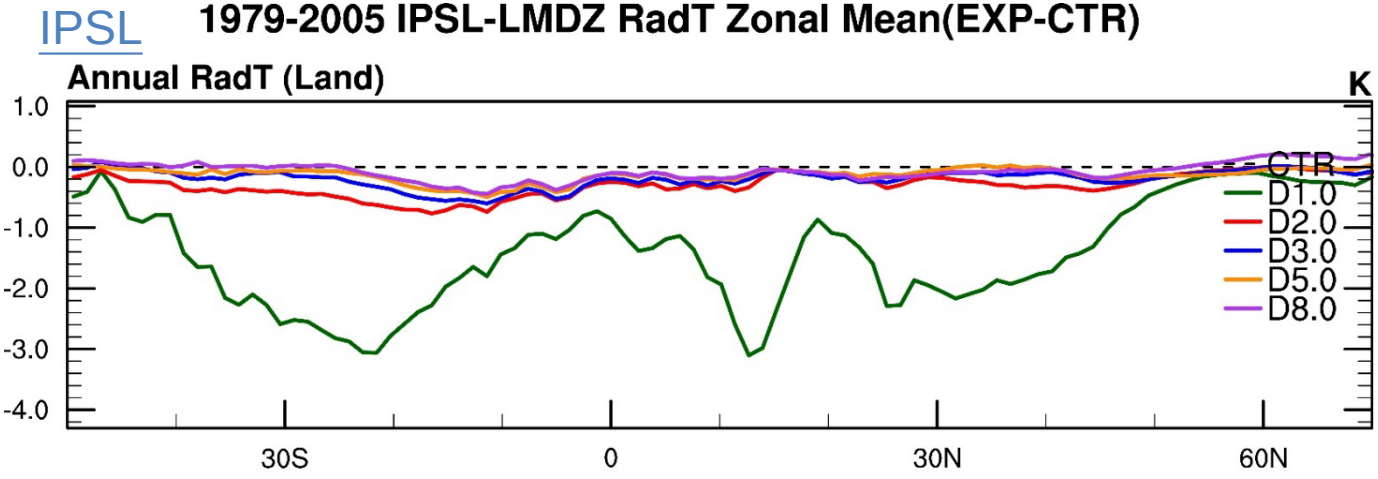
CNRM

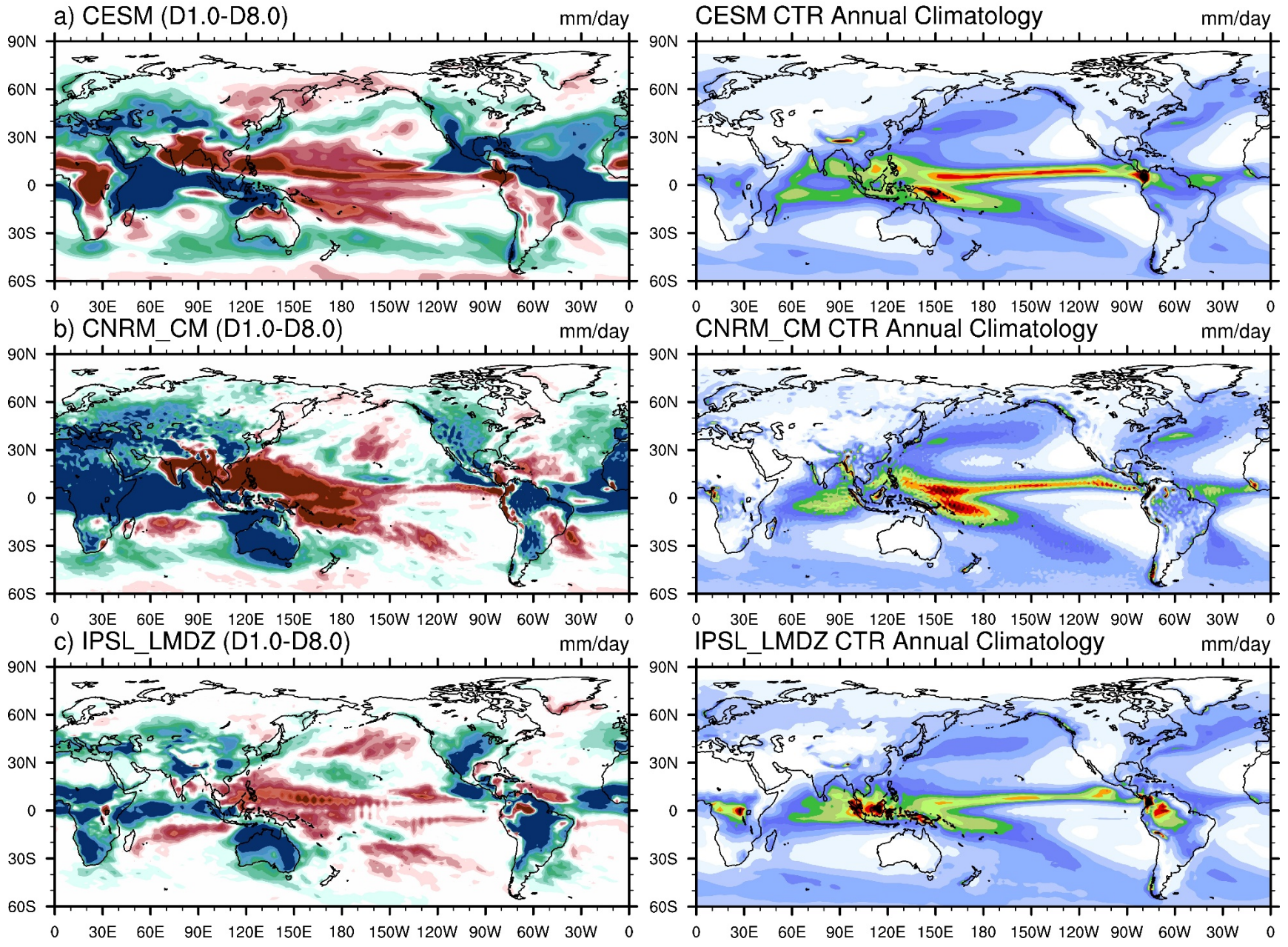


CESM

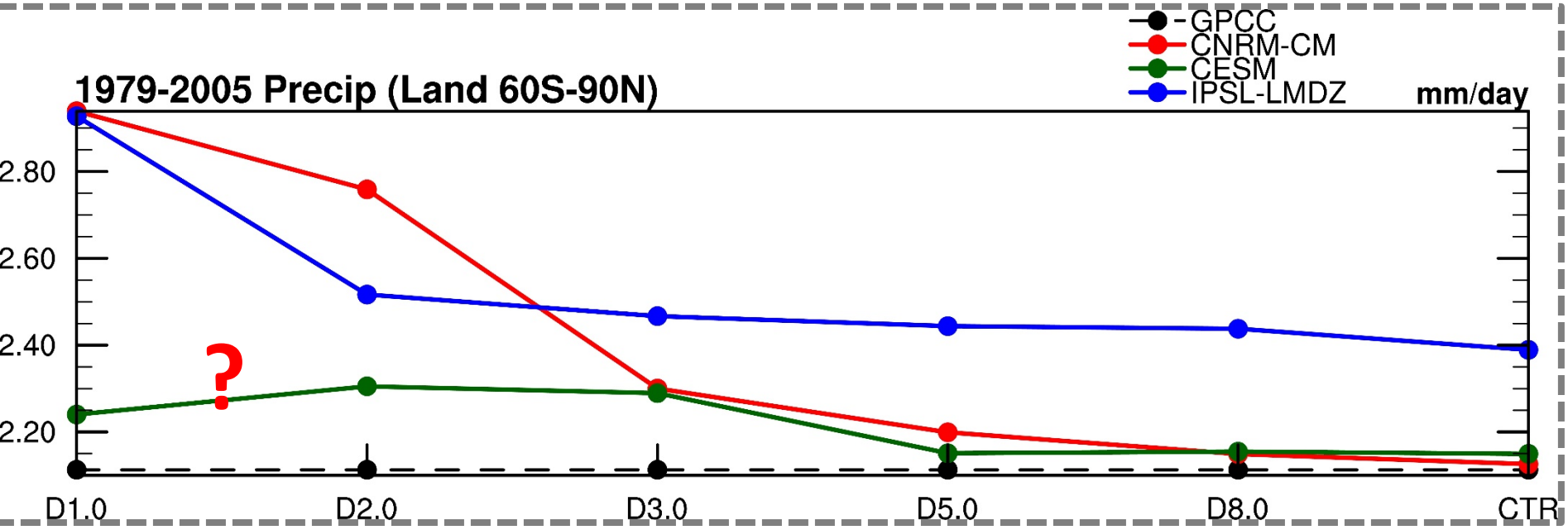


IPSL




1979-2005 Annual Precip D1.0-D8.0 and CTR Climatology
a) CESM (D1.0-D8.0)
mm/day
CESM CTR Annual Climatology
mm/day
b) CNRM_CM (D1.0-D8.0)
mm/day
CNRM_CM CTR Annual Climatology
mm/day
c) IPSL_LMDZ (D1.0-D8.0)
mm/day
IPSL_LMDZ CTR Annual Climatology
mm/day
90N
60N
30N
0
30S
60S
0 30E 60E 90E 120E 150E 180 150W 120W 90W 60W 30W 0
-0.8 -0.6 -0.4 -0.2 0 0.2 0.4 0.6 0.8
1 2 3 4 5 6 7 8 9 10 11 12

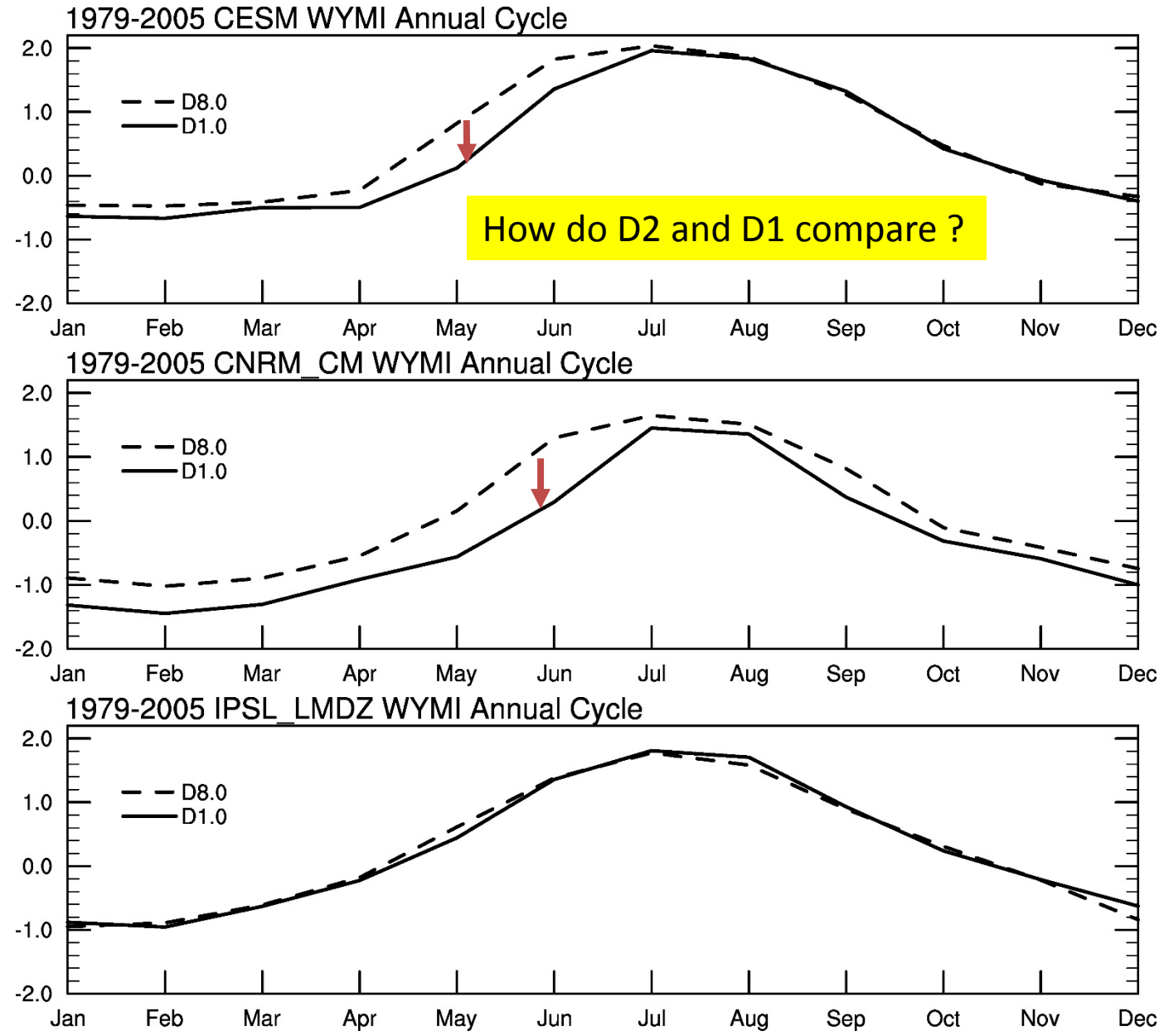
Precipitation changes over global land



Shallower water table depth → More surface latent heat flux over land → More precipitation over the land when including GW in CLM (Lo and Famiglietti, 2011)

More precipitation move to land from the ocean, consistent results with Chou et al. in 2001

Monsoon Index Annual Cycle (WYMI)



Cooling over land in mid-latitude

Decreased land-sea temperature contrast

Weaker Indian monsoon

Reduce the precipitation over the monsoon regions

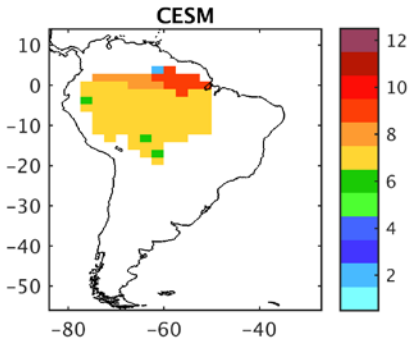
Impacts of groundwater on the atmospheric convection in Amazon using multi-GCM simulations from I-GEM project

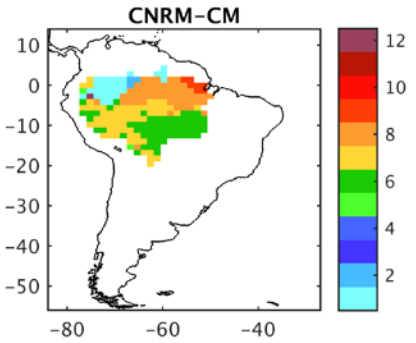
Rong-You Chien, Min-Hui Lo, Agnès Ducharne, Bertrand Decharme, Chia-Wei Lan, Fuxing Wang

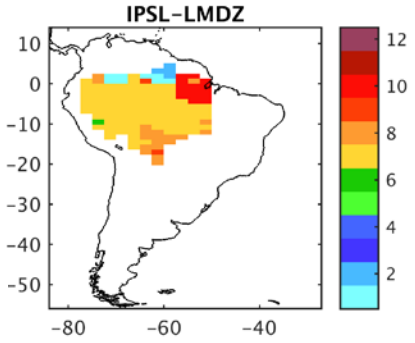
科技部
Ministry of Science and Technilogy

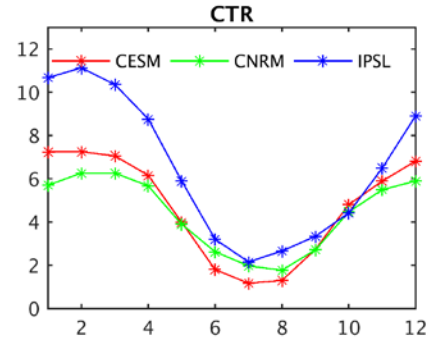
IV. Model results

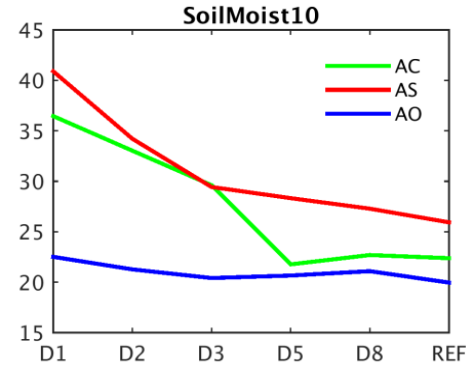
- Three models have different driest months, but all in JJA

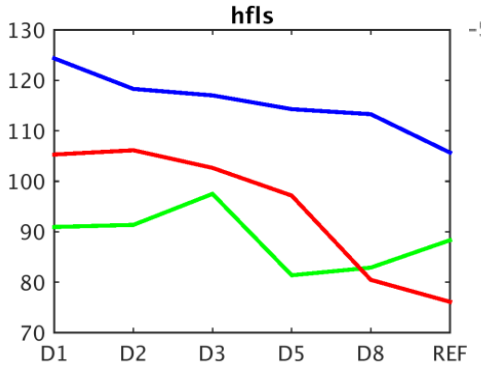




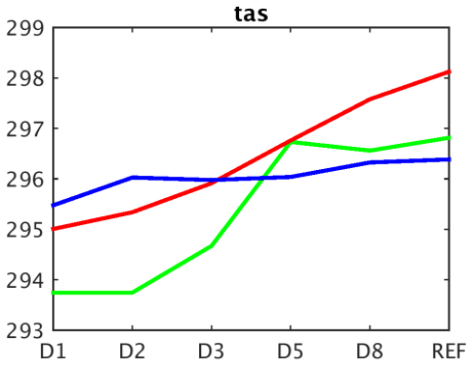


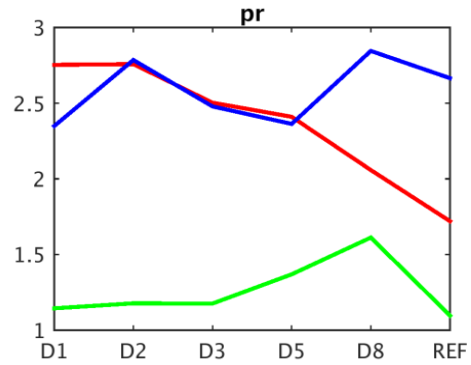






- Weird performance in latent heat in CESM



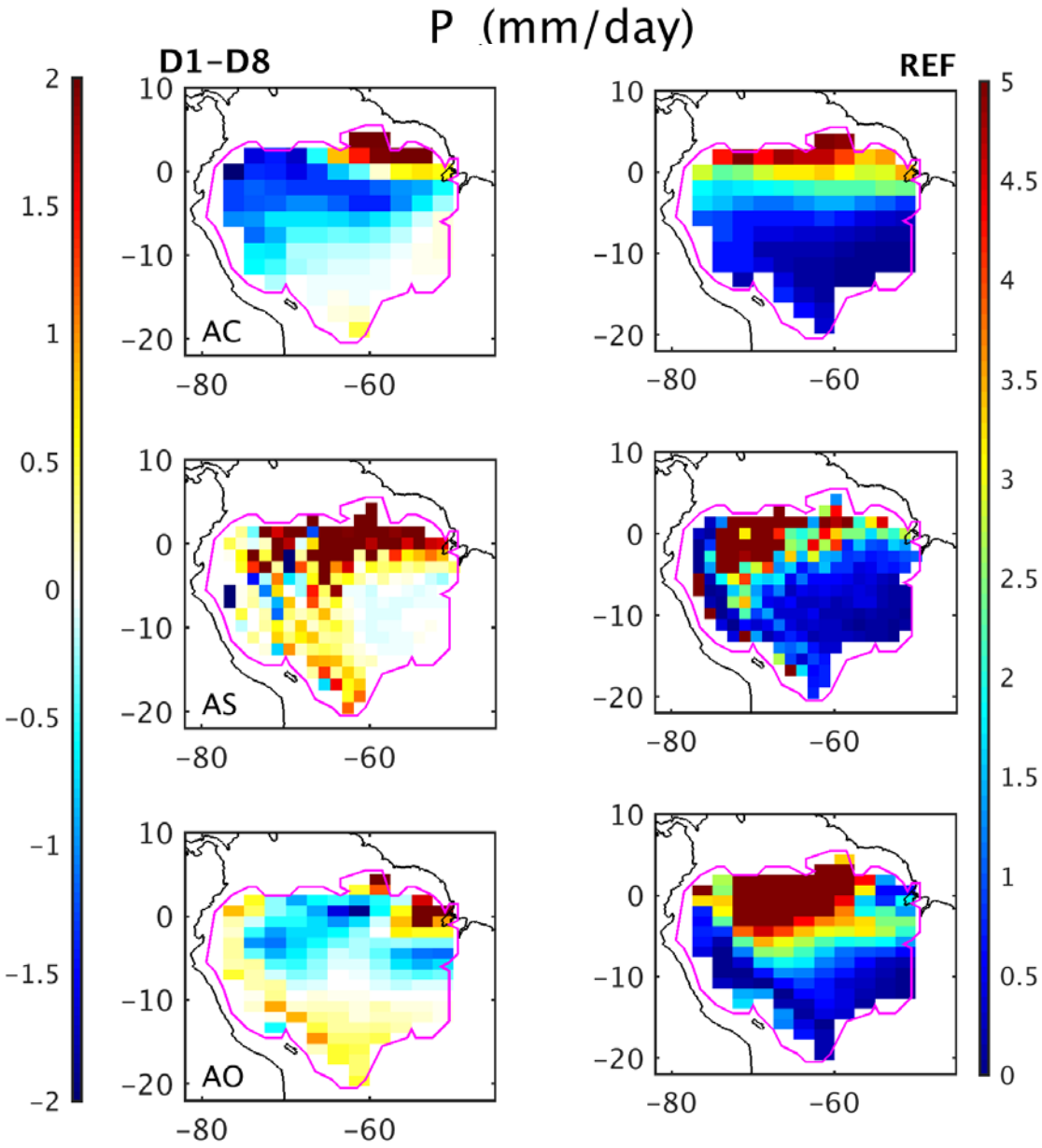


- CESM and IPSL have more precipitation in drier land

  = weakly sensitive?

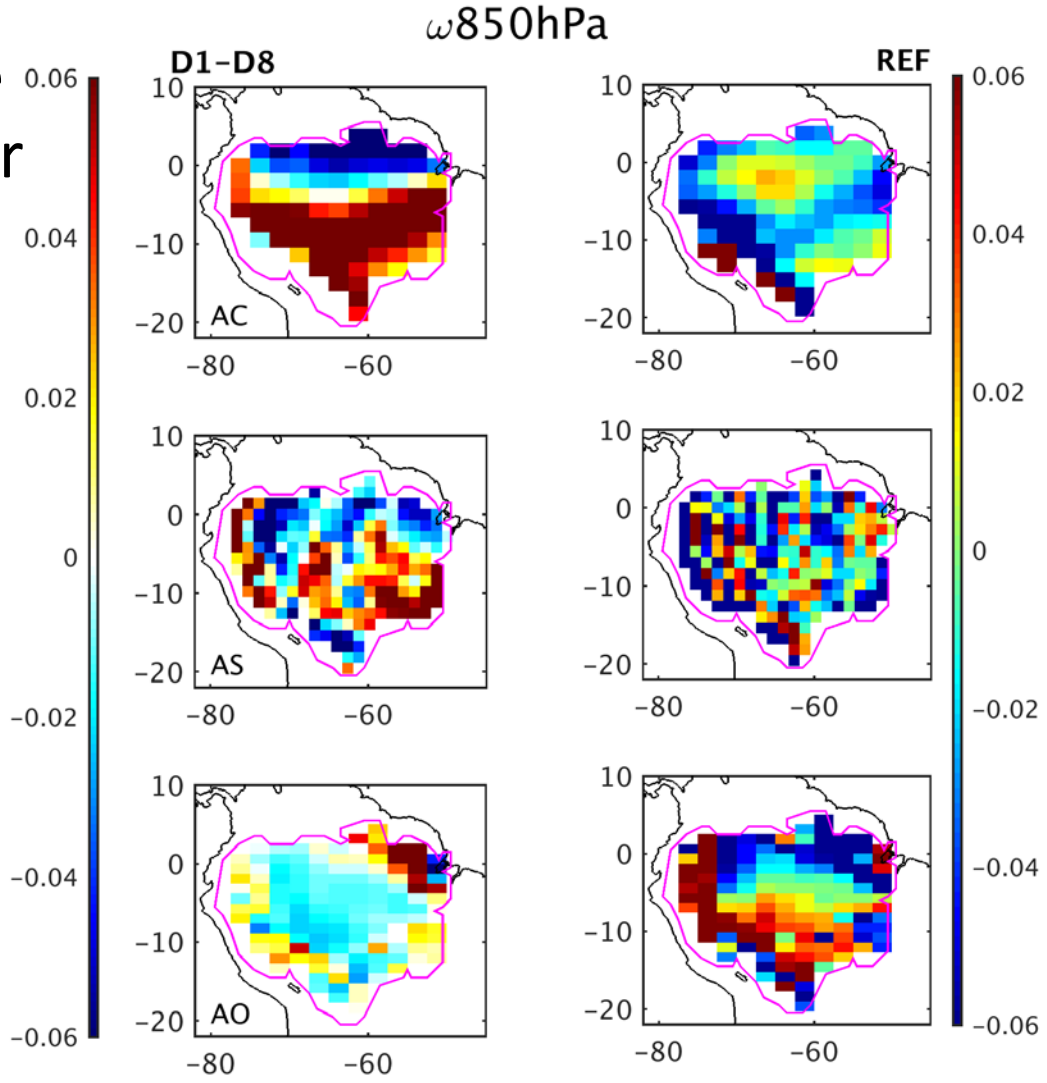
V. Discussion

- CESM has most precipitation in North hemisphere in ARB region
- CNRM and IPSL showed the similar pattern with REF but opposite changes



V. Discussion

- Cooling effect can enhance downward velocity in lower layer which suppress the circulation, and will lower the precipitation
- **This kind of phenomenon can be seen in CESM and IPSL, but not in CNRM**
- But CESM and IPSL show weak P sensitivity to WTD in the ARB



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Do we need a WTD10 online ?