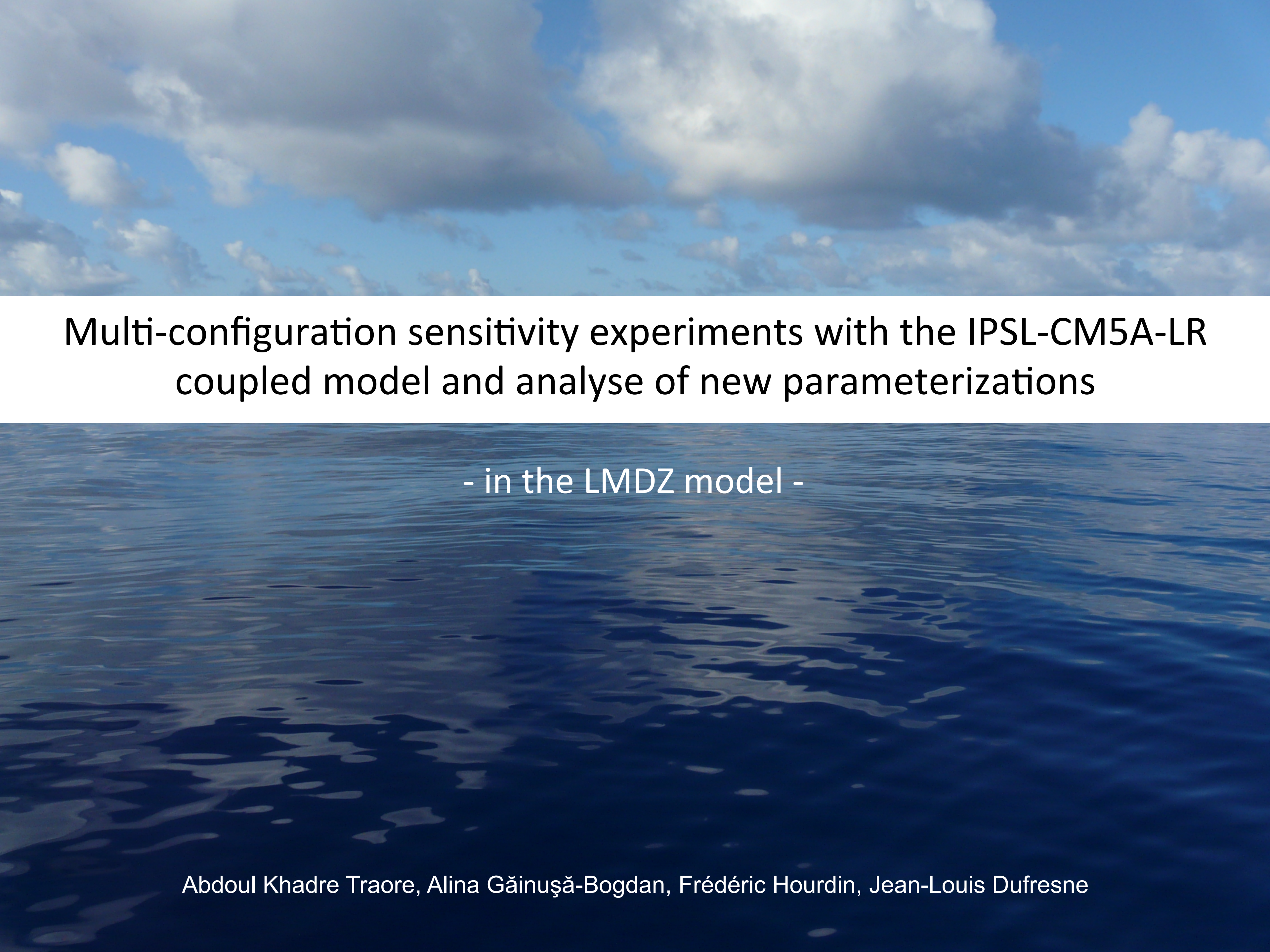
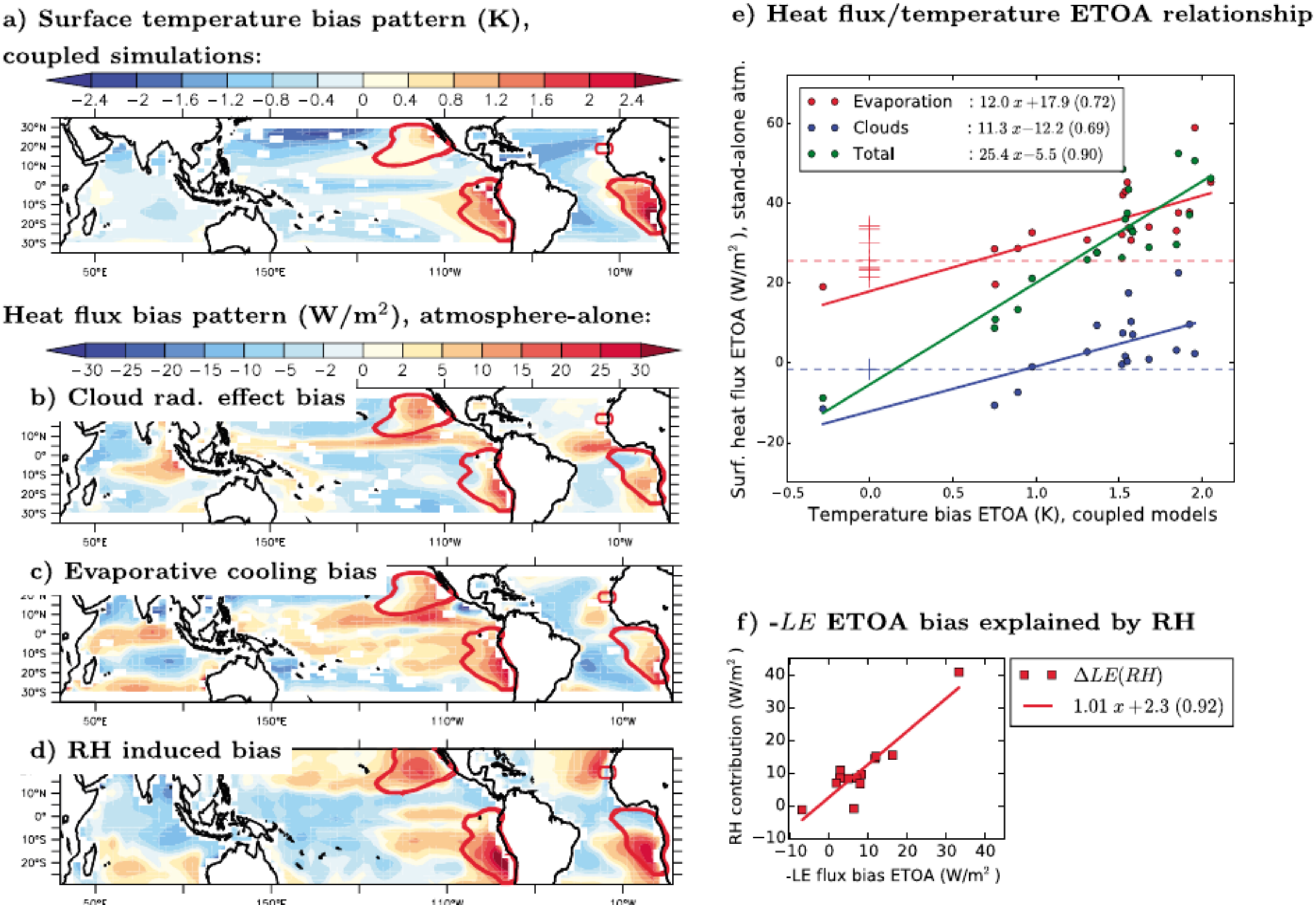


Multi-configuration sensitivity experiments with the IPSL-CM5A-LR coupled model and analyse of new parameterizations

- in the LMDZ model -

Abdoul Khadre Traore, Alina Găinuşă-Bogdan, Frédéric Hourdin, Jean-Louis Dufresne

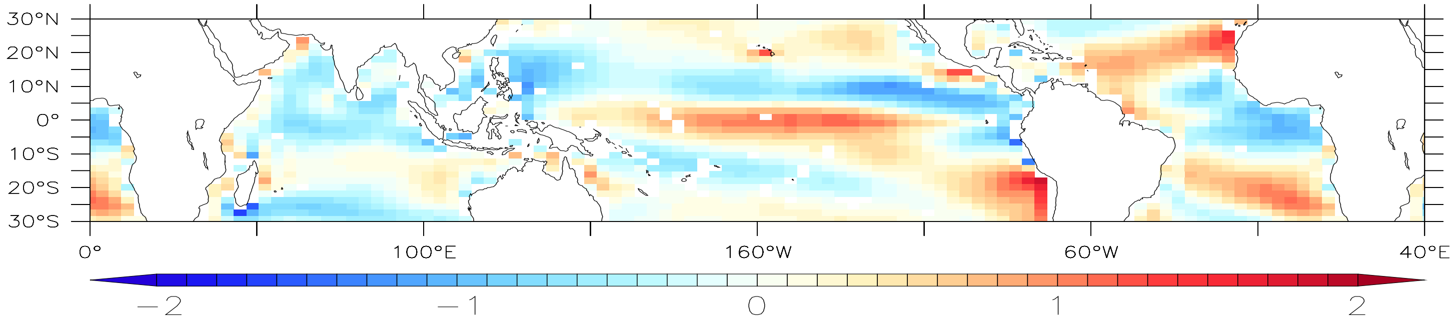


Les biais de SST de bord Est sont causés en grande partie par des biais de latent et de rayonnement visible dans les simulations forcées

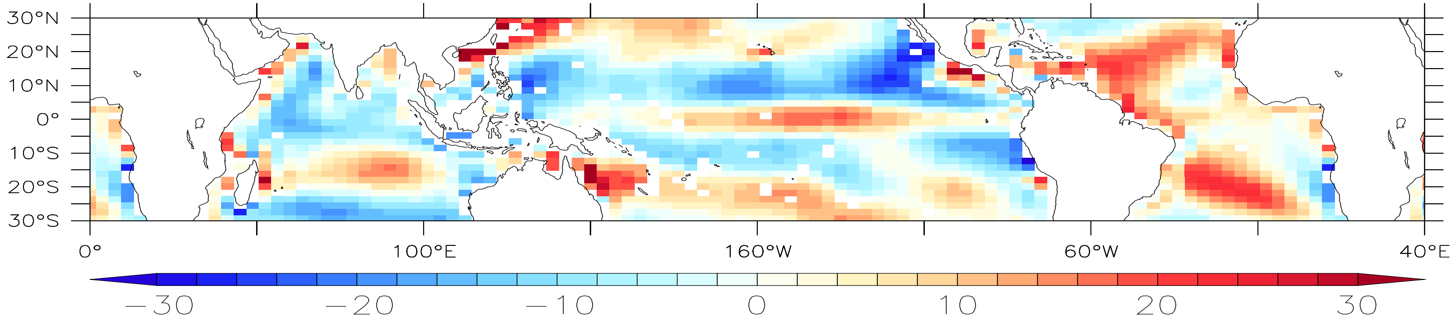
Hourdin et al. 2015

Possible sources of the AMIP LH bias : role of the surface wind

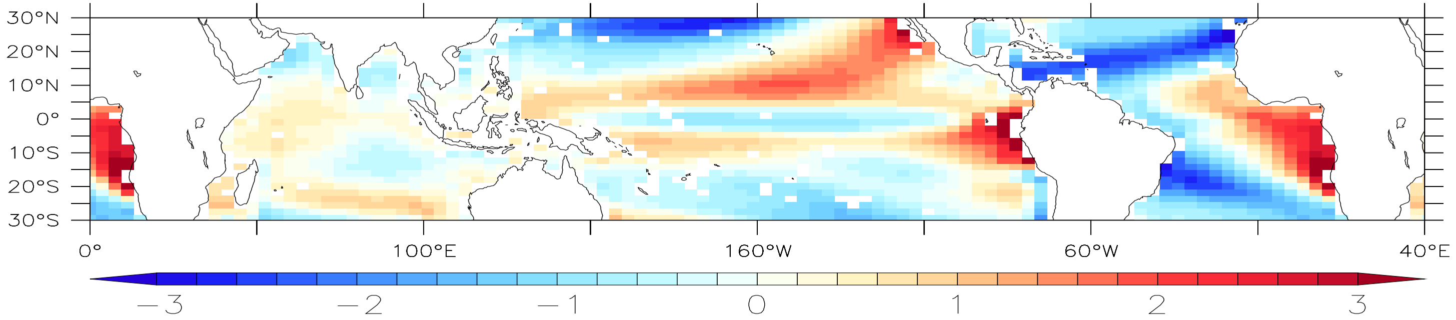
(a) W10m (AMIP−OBS) pattern (ms^{-1})


30°N
20°N
10°N
0°
10°S
20°S
30°S
0°
100°E
160°W
60°W
40°E
−2
−1
0
1
2

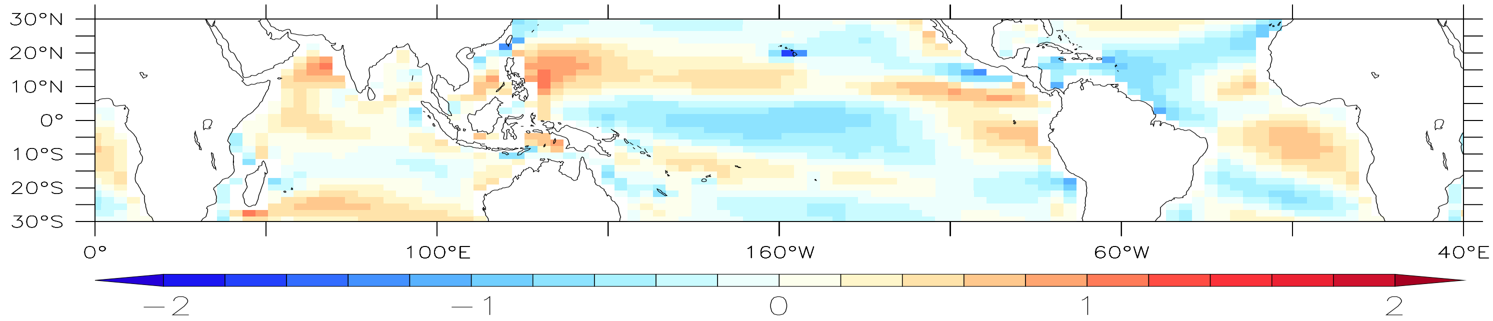
(b) LH (AMIP−OBS) pattern (Wm^{-2})

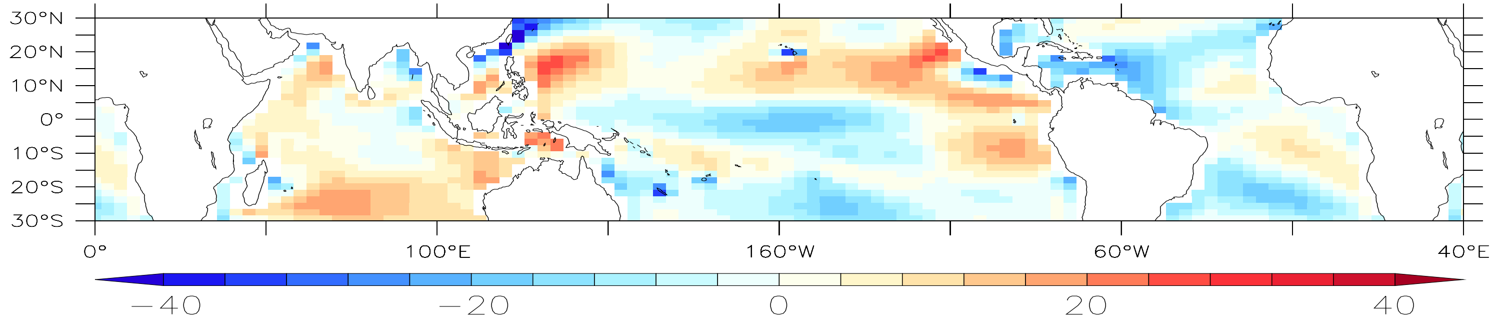

30°N
20°N
10°N
0°
10°S
20°S
30°S
0°
100°E
160°W
60°W
40°E
−30
−20
−10
0
10
20
30

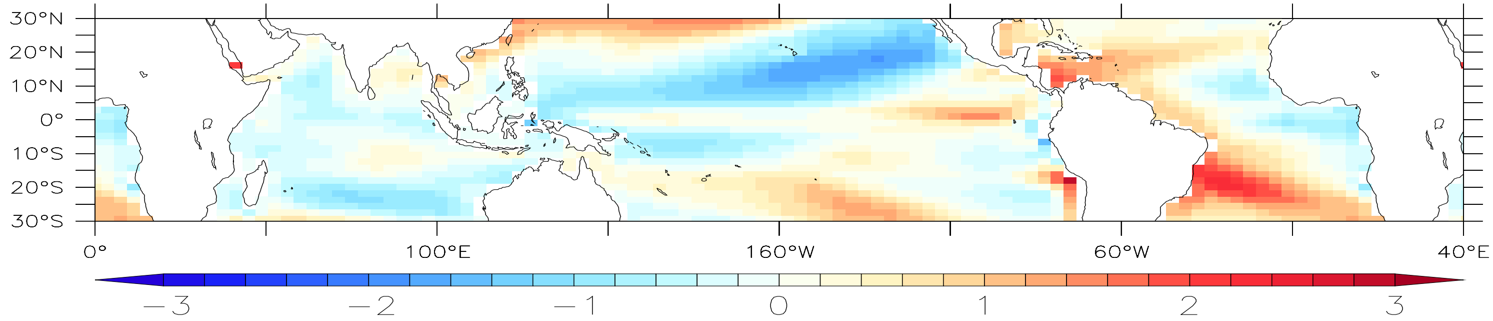
(c) SST (CM5A−OBS) pattern (°C)


30°N
20°N
10°N
0°
10°S
20°S
30°S
0°
100°E
160°W
60°W
40°E
−3
−2
−1
0
1
2
3

Possible sources of the AMIP LH bias : role of the surface wind


(a) W10m AMIP (WND−CTRL) pattern (ms^{-1})
30°N
20°N
10°N
0°
10°S
20°S
30°S
0°
100°E
160°W
60°W
40°E
−2
−1
0
1
2


(b) LH AMIP (WND−CTRL) pattern (Wm^{-2})
30°N
20°N
10°N
0°
10°S
20°S
30°S
0°
100°E
160°W
60°W
40°E
−40
−20
0
20
40


(c) SST CPL (WND−CTRL) pattern (°C)
30°N
20°N
10°N
0°
10°S
20°S
30°S
0°
100°E
160°W
60°W
40°E
−3
−2
−1
0
1
2
3

Possible sources of the AMIP LH bias : role of relative humidity

Formule du flux latent dans LMDZ :

$$LE = \rho L C_E |V_a| [\alpha q_{sat}(T_s) - q_a]$$

$$LE \approx \rho L C_E |V_a| q_{sat}(T_a) [\ \alpha \frac{L}{R_v T_a^2} \delta T + \alpha - RH_a\ ]$$

Le biais du LE peut s'écrire:

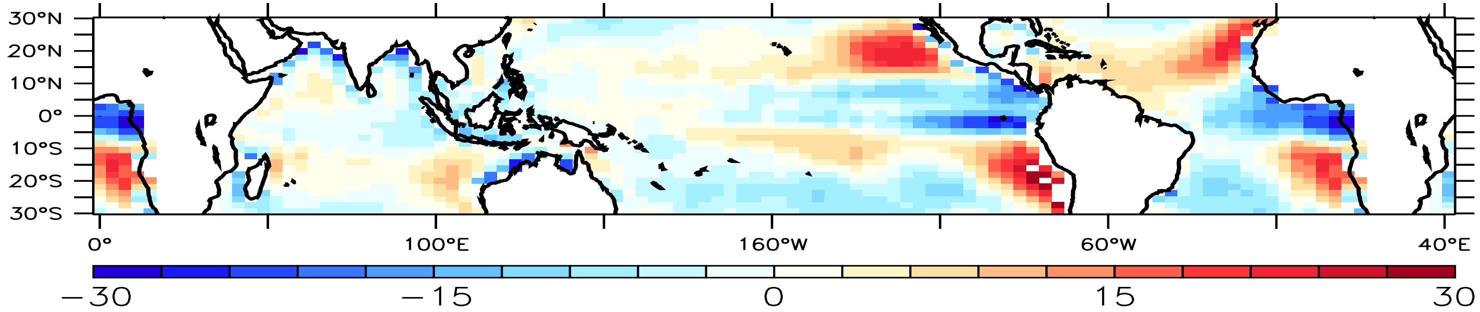
$$\Delta LE = L_m - L_{OBS} = \Delta LE_{dyn} + \Delta LE_{RH} + \Delta LE_{rad} + \Delta LE_{\delta T}$$

Correction du biais de LE lié à RH :

$$\xi LE = LE_m - \Delta LE_{RH} + \overline{\Delta LE_{RH}}$$

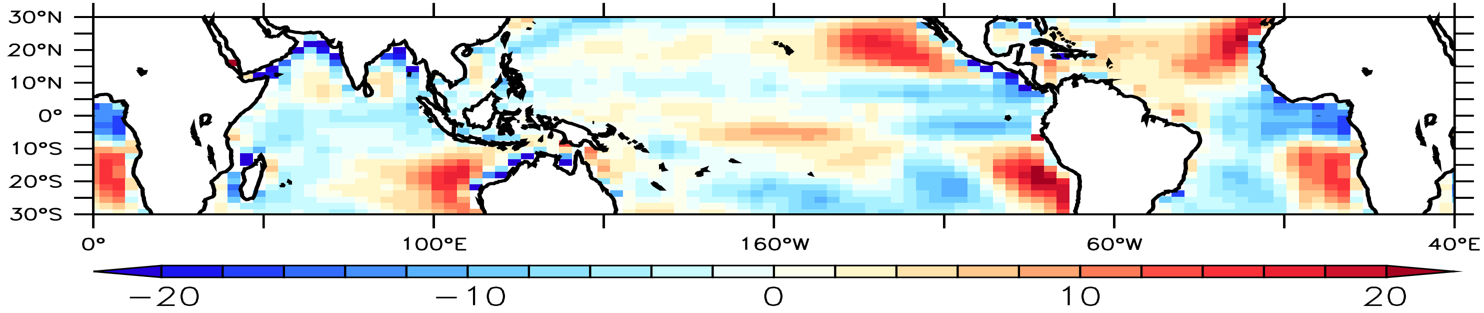
Possible sources of the AMIP LH bias : role of relative humidity

(a) ξ parameter pattern (%)



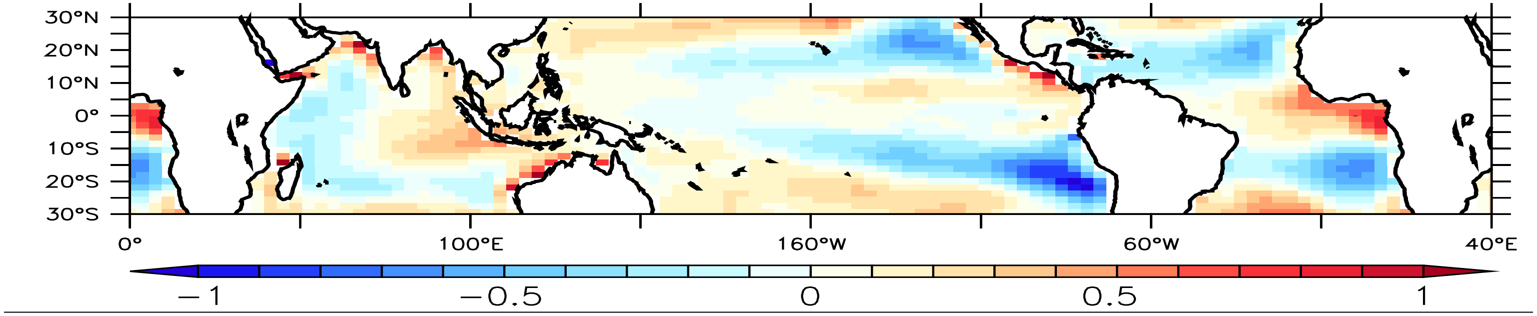
30°N
20°N
10°N
0°
10°S
20°S
30°S
0°
100°E
160°W
60°W
40°E
−30
−15
0
15
30

(b) LH AMIP (PERT−CTRL) pattern (Wm^{-2})



30°N
20°N
10°N
0°
10°S
20°S
30°S
0°
100°E
160°W
60°W
40°E
−20
−10
0
10
20

(c) SST CPL (PERT−CTRL) pattern (°C)



30°N
20°N
10°N
0°
10°S
20°S
30°S
0°
100°E
160°W
60°W
40°E
−1
−0.5
0
0.5
1

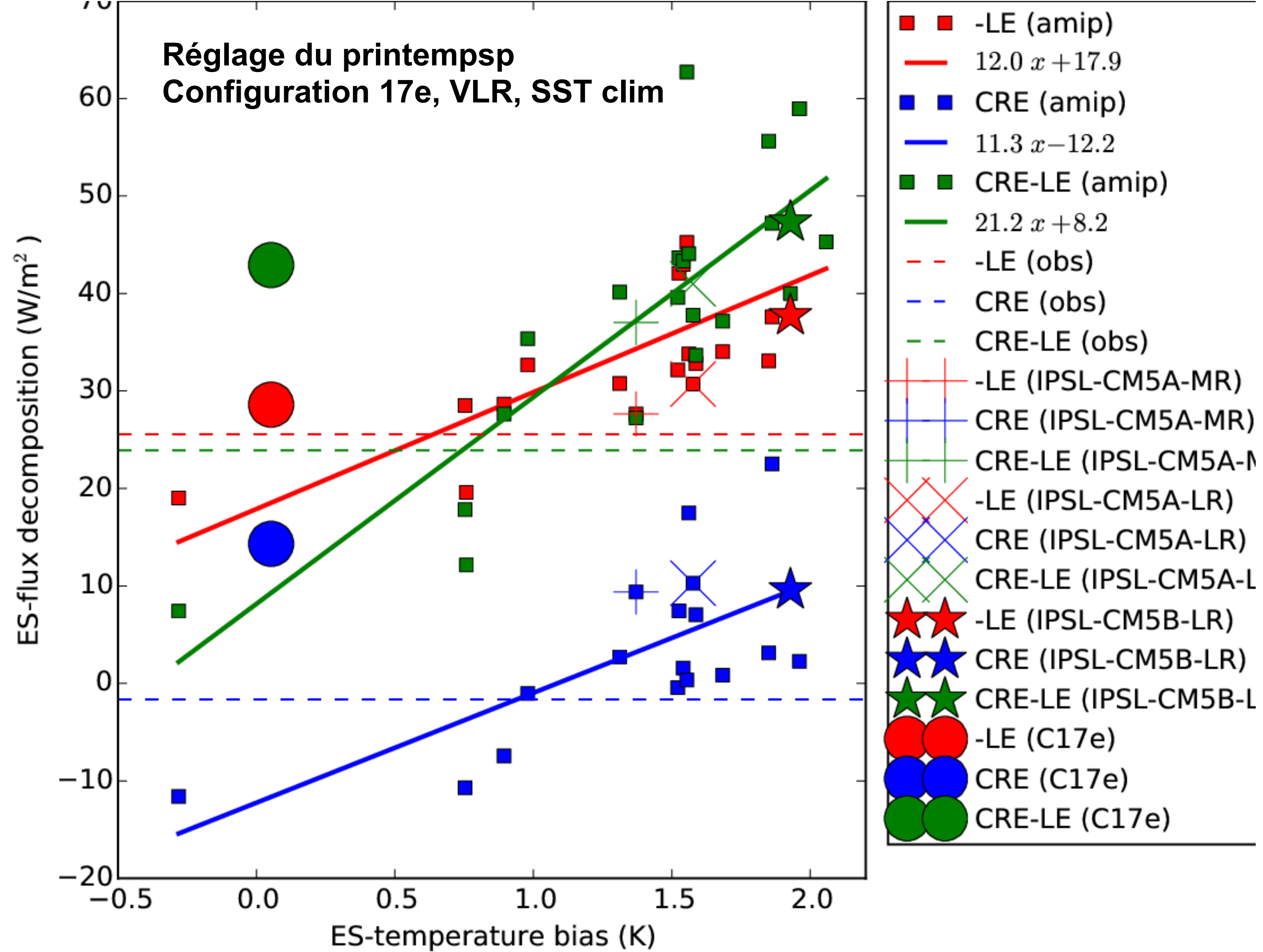
Nouvelle paramétrisations dans LMDZ: cas des rafales de vent

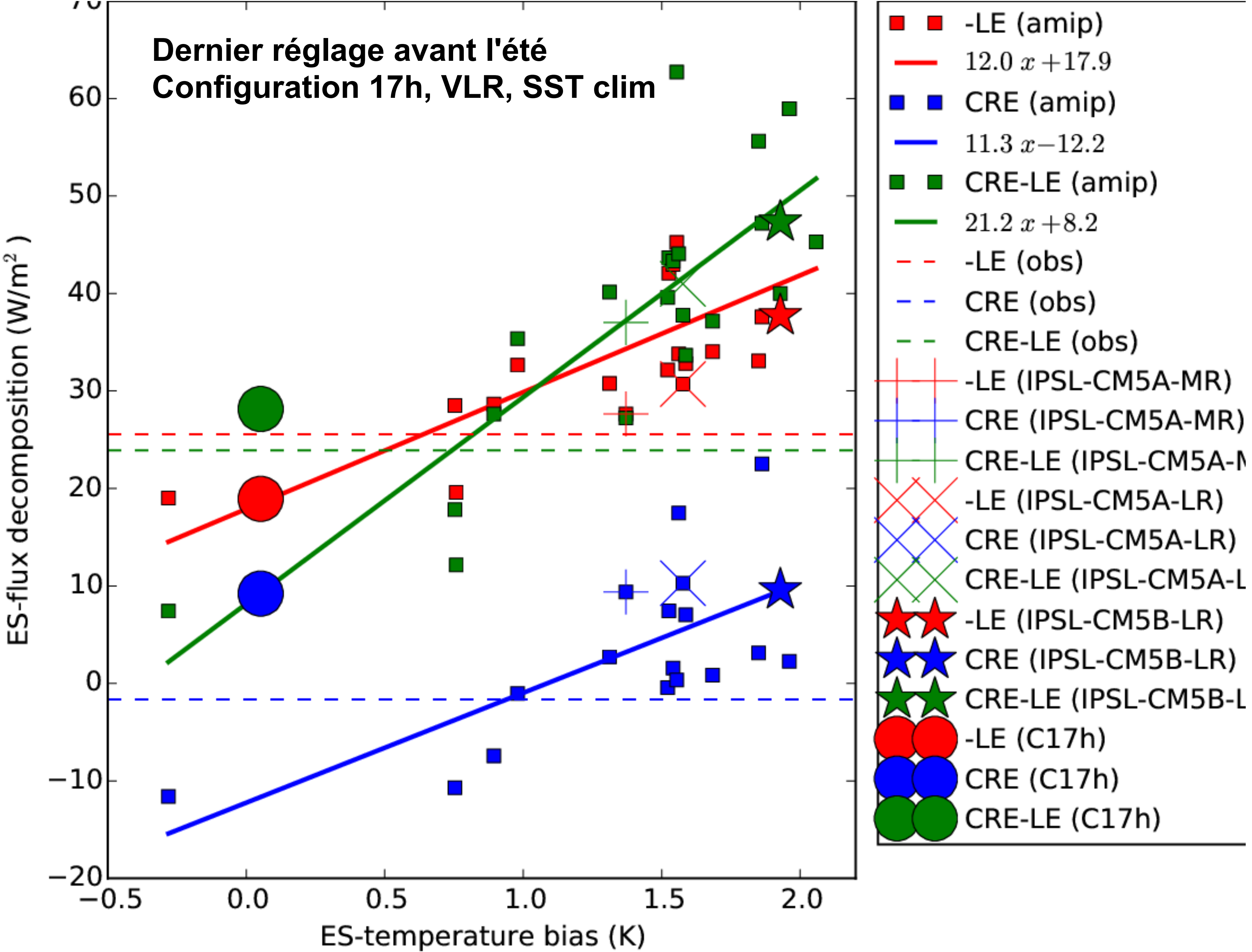
- ✓ **17e** : paramétrisation de la thermodynamique de la glace pour les nuages

Prenant. Prise en compte du déclenchement stochastique de la convection et de la modification de la spécification de la plage de température pour la phase mixte liquide/glace des nuages.

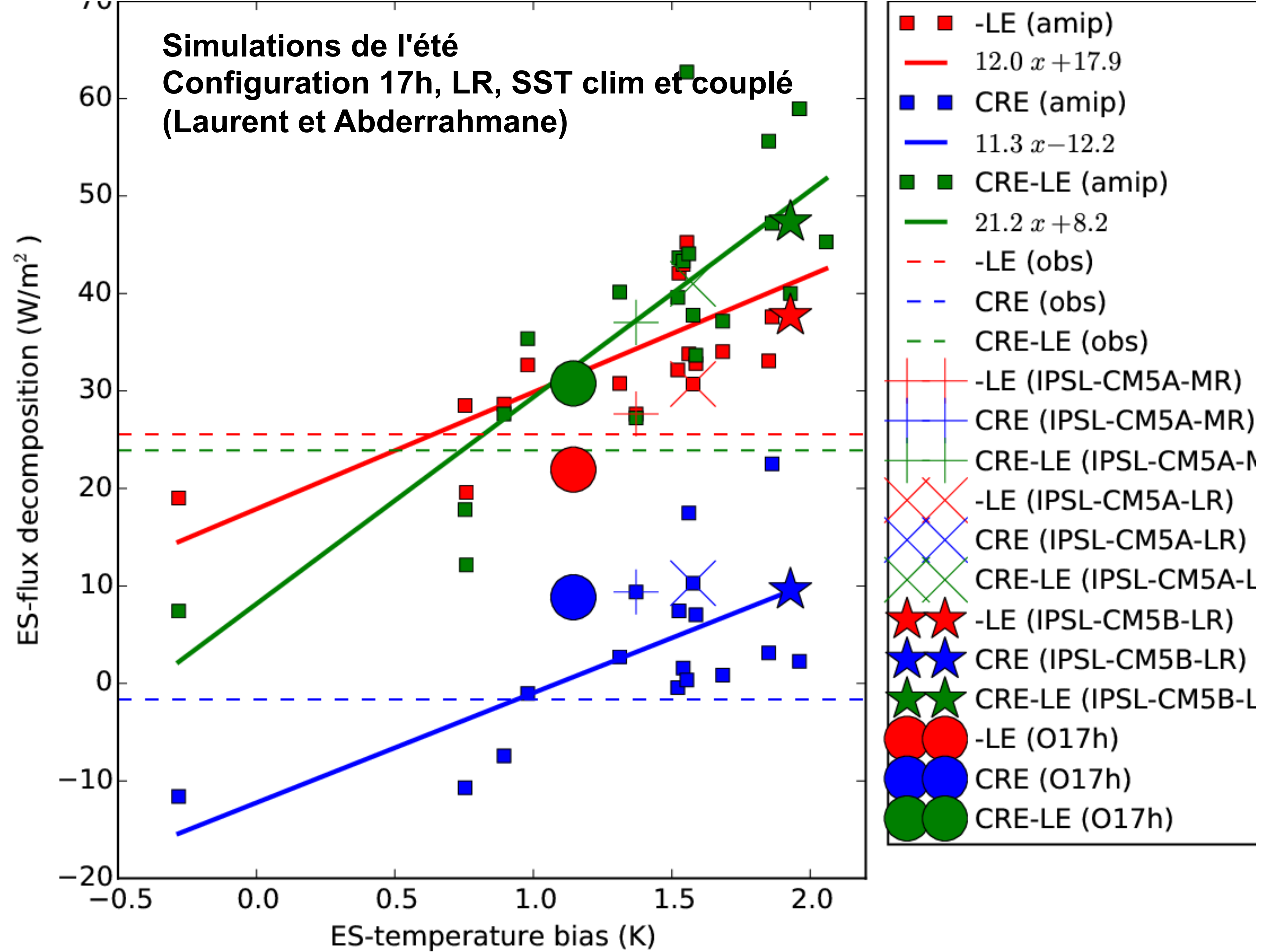
- ✓ **17g:** = **17e** + renforcement les stratocumulus de bord Est; une diminution de forçage nuageux sur l'ITCZ et de part et d'autre du continent maritime

Le nouvel albédo océanique


Réglage du printempsp
Configuration 17e, VLR, SST clim

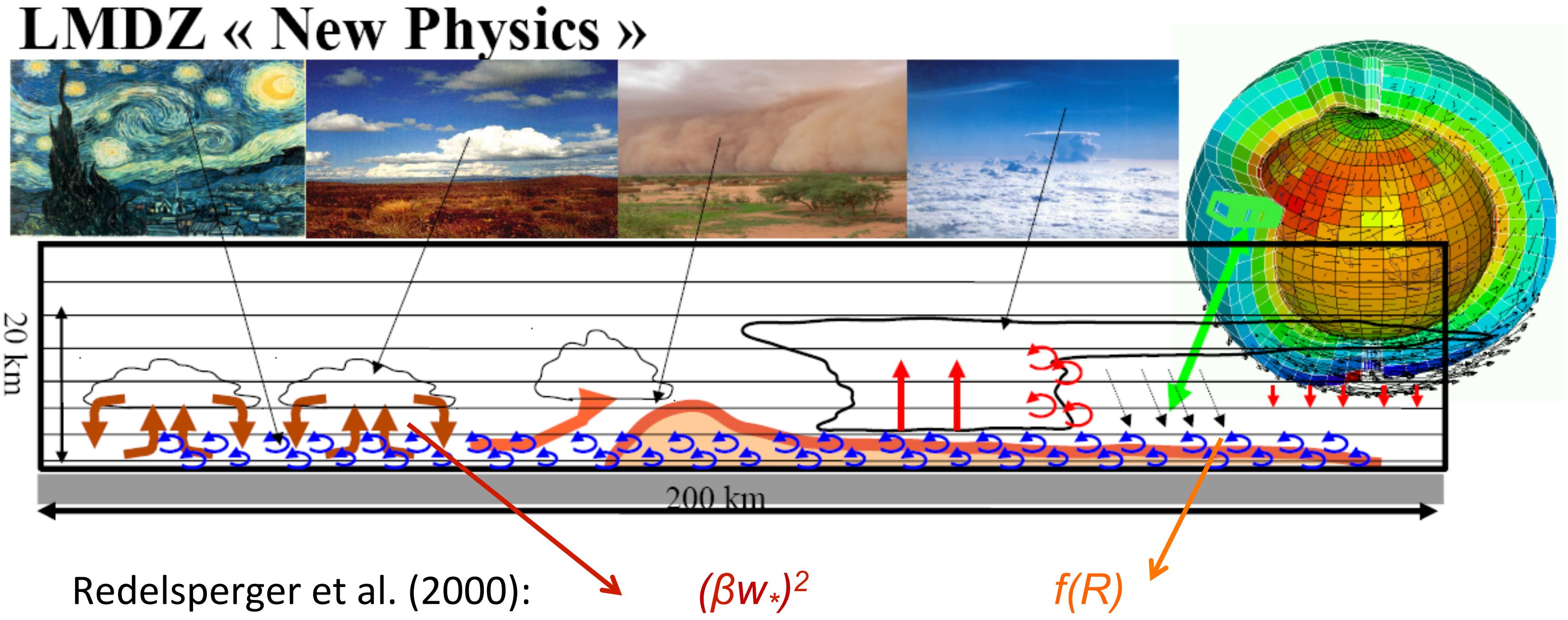


Dernier réglage avant l'été
Configuration 17h, VLR, SST clim



Simulations de l'été
Configuration 17h, LR, SST clim et couplé
(Laurent et Abderrahmane)

How can we parameterize gustiness?


LMDZ « New Physics »
20 km
200 km

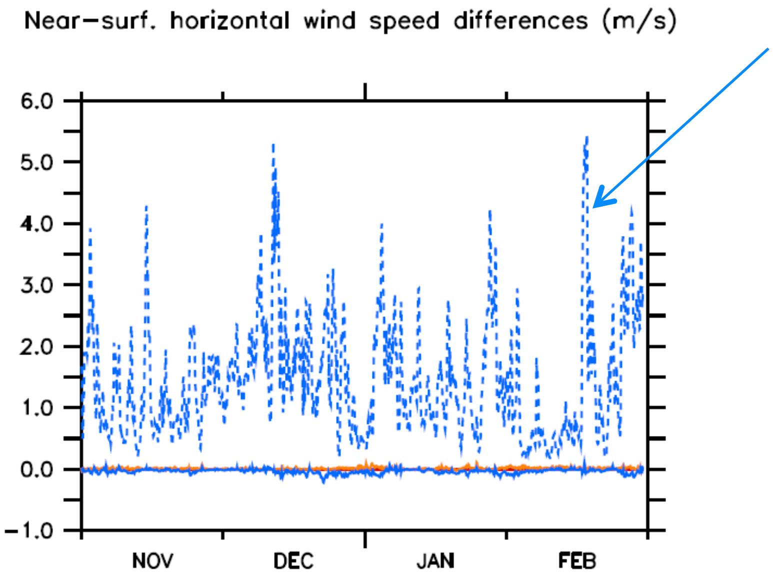
Redelsperger et al. (2000): $(\beta w_*)^2$ $f(R)$

$$U_{eff}^2 = U_0^2 + \beta^2\, 2ALE_{BL} + \alpha\, 2ALE_{WK}$$

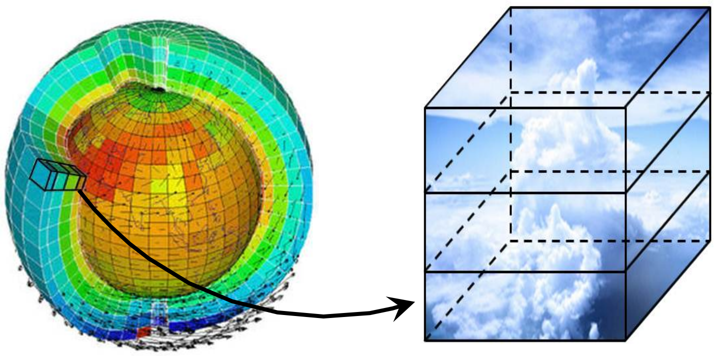
ALE = Available lifting energy

Simulations

- “ Old parameterization ” - contained ad-hoc C_H enhancement at low wind speeds under unstable conditions – eq.9/Miller et al. (1992)
- No parameterization - de-activation of eq.9/Miller et al. (1992)
- New parameterization - replacement of Miller et al. eq. 9 with full gustiness (BL+WK)



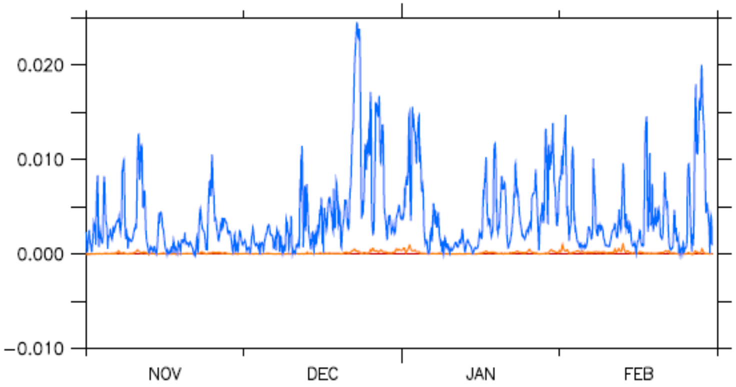
Effective wind speed difference



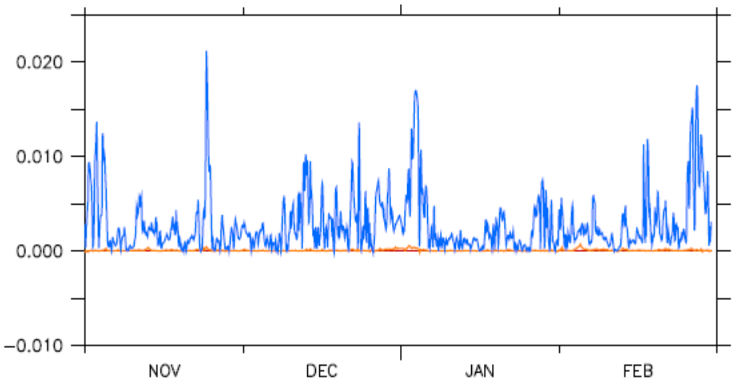
1D case TOGA

Results - fluxes

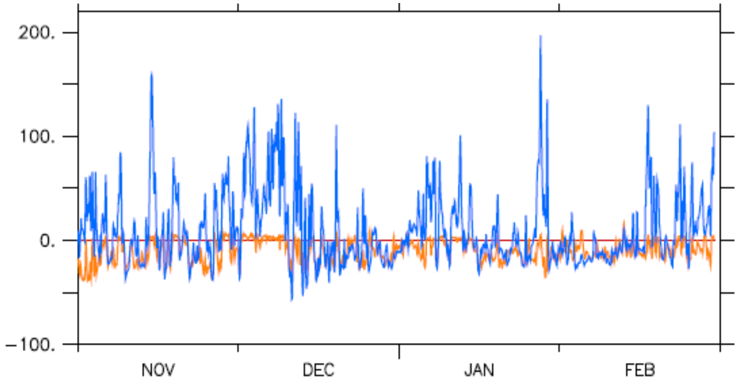
Surface zonal wind stress (N/m²)



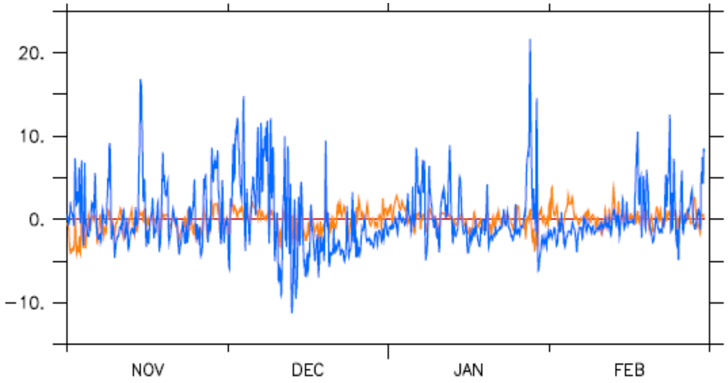
Surface meridional wind stress (N/m²)



Latent heat flux (W/m²)



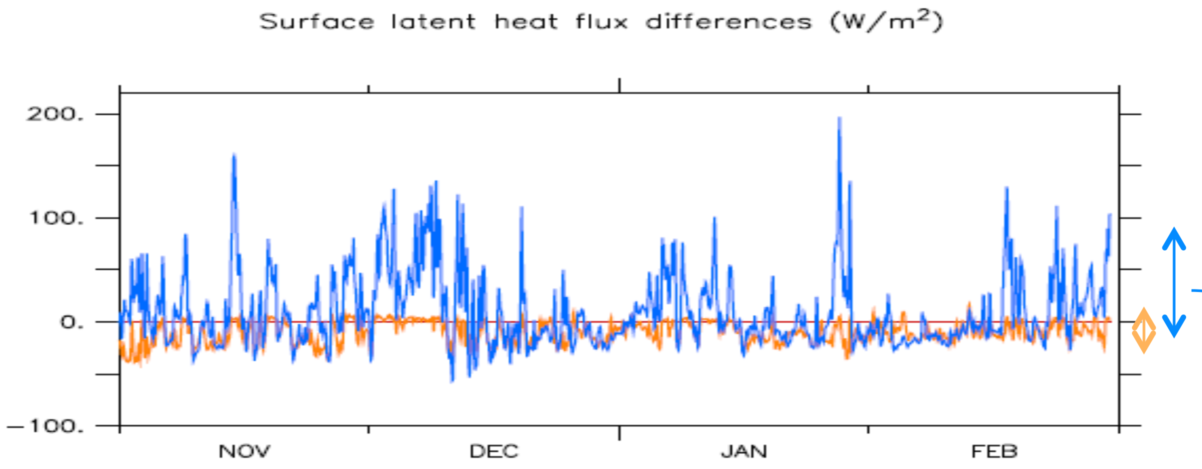
Sensible heat flux (W/m²)



none - old
new - old

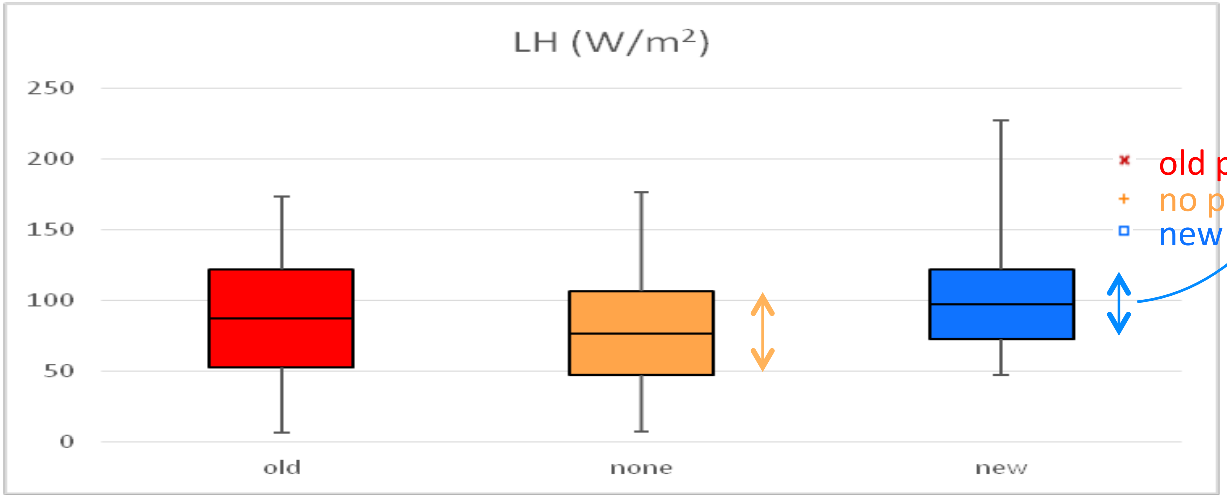
Gustiness : augmentation du stress de vent et du flux latent

Results - fluxes



none - old
new - old

?



✖ old parameterization
+ no parameterization
□ new parameterization

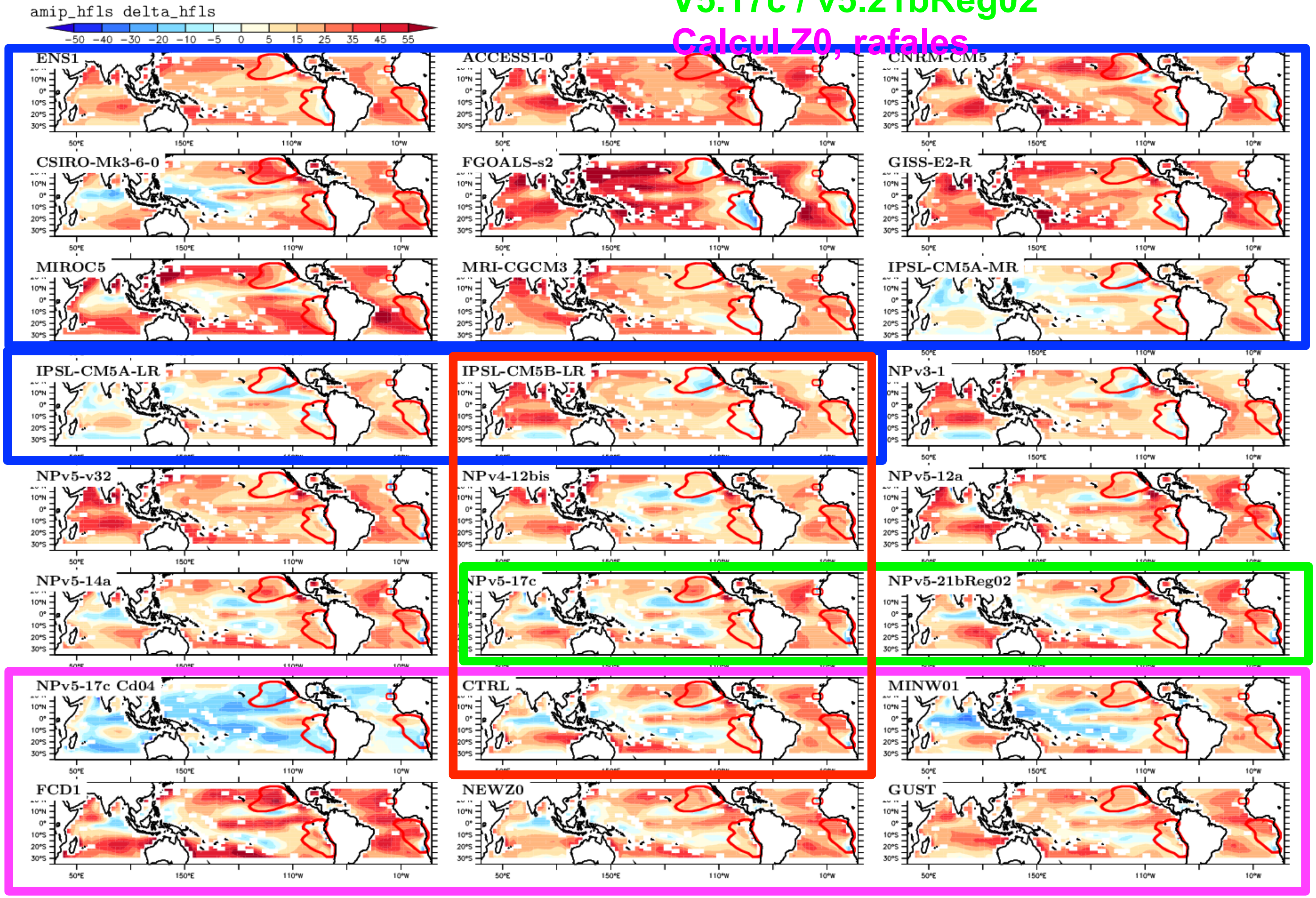
Flux latent (W /m2)
+ = refroidissement océan

CMIP5

5B → v4.12 → v5.17c = CTRL(betaclim)

V5.17c / v5.21bReg02

Calcul Z0, rafales.


amip_hfls delta_hfls
-50 -40 -30 -20 -10 -5 0 5 15 25 35 45 55
ENS1
ACCESS1-0
CNRM-CM5
CSIRO-Mk3-6-0
FGOALS-s2
GISS-E2-R
MIROC5
MRI-CGCM3
IPSL-CM5A-MR
IPSL-CM5A-LR
IPSL-CM5B-LR
NPv3-1
NPv5-v32
NPv4-12bis
NPv5-12a
NPv5-14a
NPv5-17c
NPv5-21bReg02
NPv5-17c Cd04
CTRL
MINW01
FCD1
NEWZ0
GUST
10°N
0°
10°S
20°S
30°S
50°E
150°E
110°W
10°W

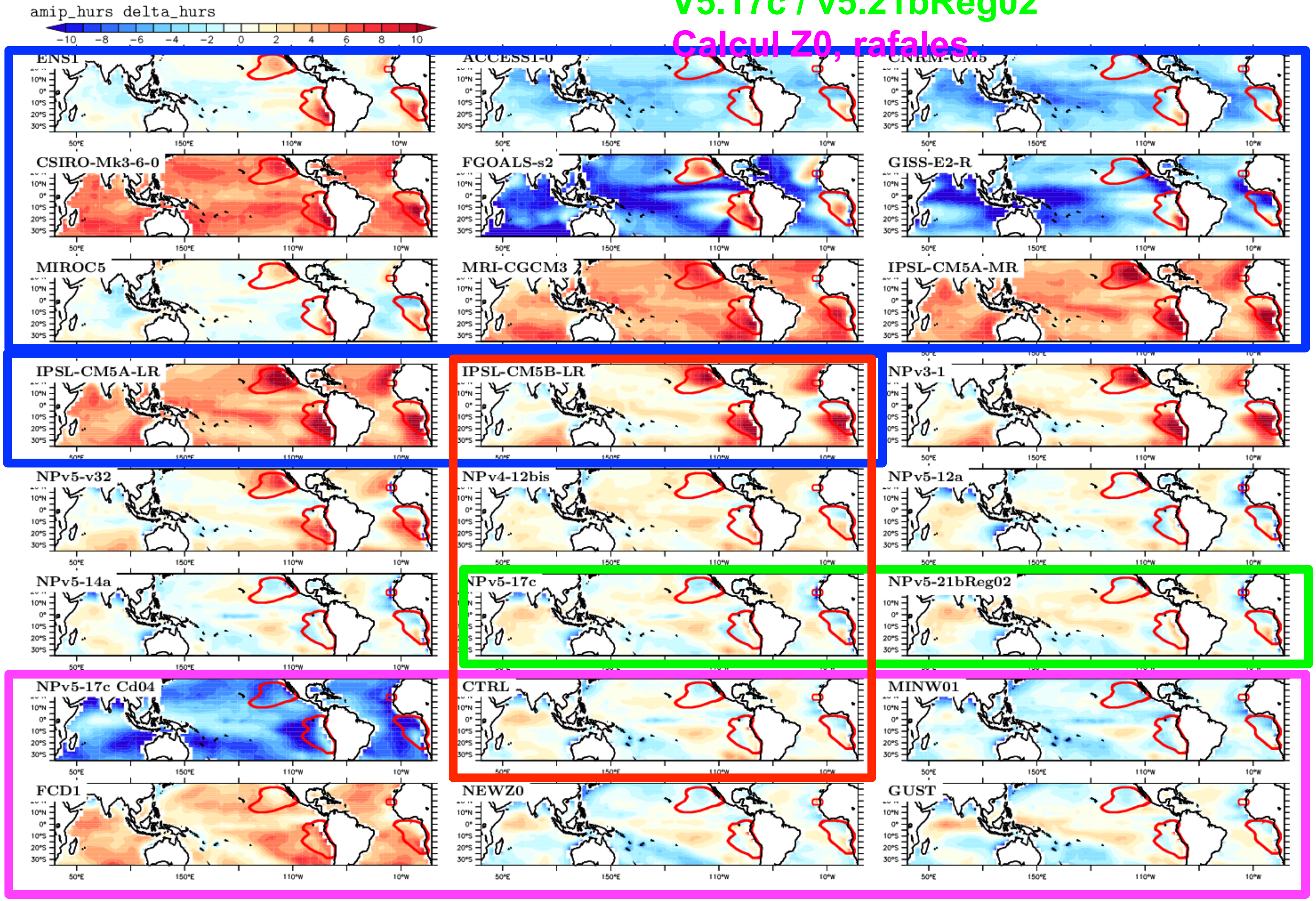
RH (%)

CMIP5

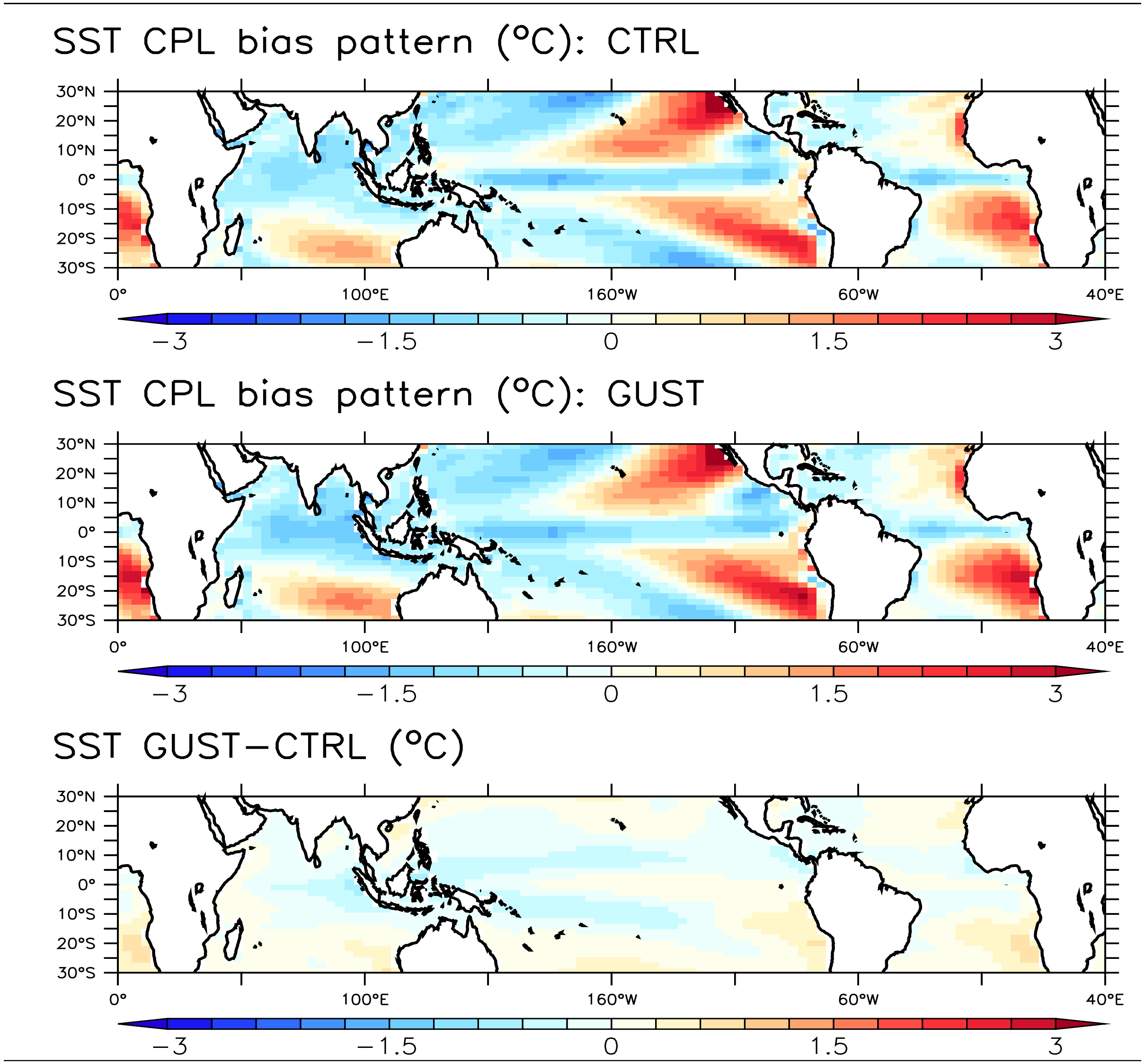
5B → v4.12 → v5.17c = CTRL(betaclim)

V5.17c / v5.21bReg02

Calcul Z0, rafales.


amip_hurs delta_hurs
−10
−8
−6
−4
−2
0
2
4
6
8
10
ENS1
ACCESS1-0
CNRM-CM5
CSIRO-Mk3-6-0
FGOALS-s2
GISS-E2-R
MIROC5
MRI-CGCM3
IPSL-CM5A-MR
IPSL-CM5A-LR
IPSL-CM5B-LR
NPv3-1
NPv5-v32
NPv4-12bis
NPv5-12a
NPv5-14a
NPv5-17c
NPv5-21bReg02
NPv5-17c Cd04
CTRL
MINW01
FCD1
NEWZ0
GUST
10°N
0°
10°S
20°S
30°S
50°E
150°E
110°W
10°W

Impact des Gust sur les SST



SST CPL bias pattern (°C): CTRL

SST CPL bias pattern (°C): GUST

SST GUST−CTRL (°C)

30°N
20°N
10°N
0°
10°S
20°S
30°S
0°
100°E
160°W
60°W
40°E
−3
−1.5
0
1.5
3

Conclusions

- Hourdin et al. 2015 : biais de SST de bord Est sont causés en grande partie par des biais de latent et de rayonnement visible dans les simulations forcées

- Les bias du flux latent dans les simulations forcées sont fortement controlés par les biais de vent dans les modèles

- La seconde source d'erreur identifiée est celle liée à l'évaporation au niveau des bords est.

- Une modification du cdrag de 30% entraine une diminution du biais de LH d'environ 15W/m2 et plus de 0.5° sur le biais de SST en couplé

La paramétrisation des rafales de vent tend à renforcer faiblement le biais de SST dans le couplé.

- On note un renforcement du stress de vent et un renforcement du flux