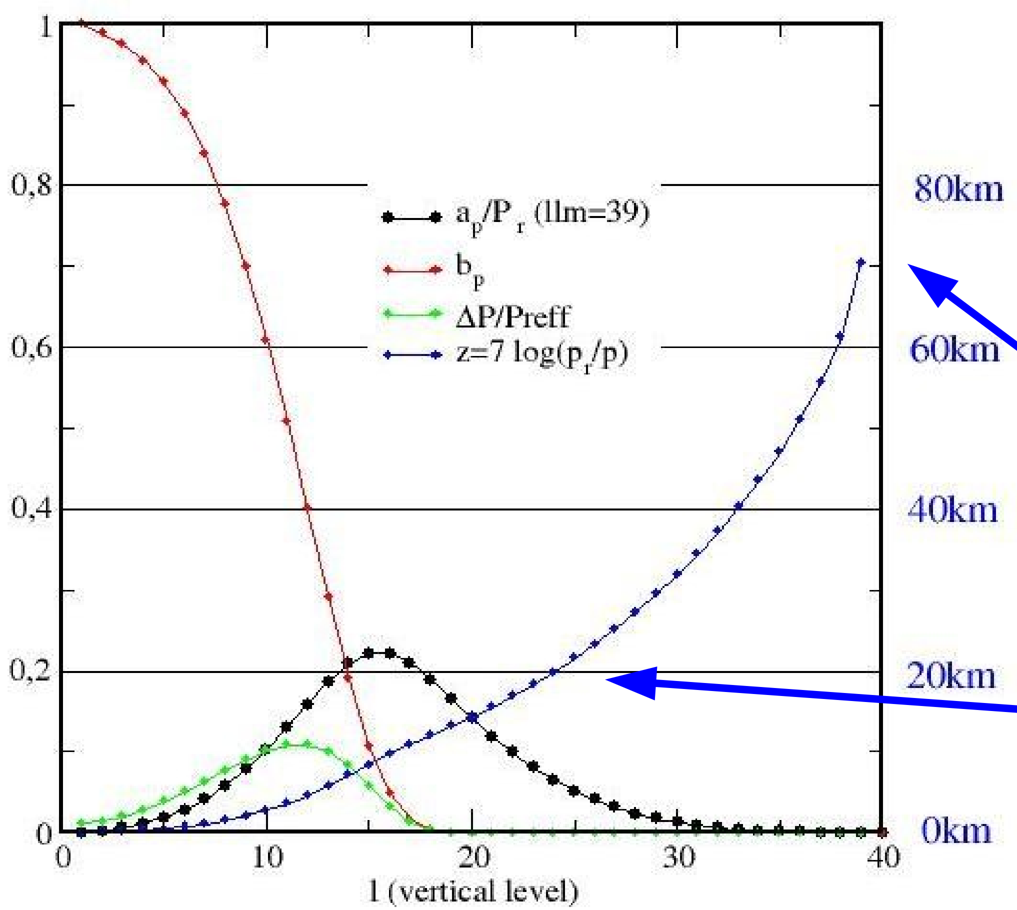
The tropical variability in the ongoing CMIP5 simulations at IPSL

Contacts for those diagnostics: F. Lott, P. Maury and L. Guez
LMD/IPSL, Ecole Normale Supérieure, Paris France

All the simulations done with the ESM IPSLCM5, include the stratosphere

The equilibrium pre-industrial 1000yrs, starting in 1800 control is done with the stratosphere. Historical runs and scenarios are also completed.



Ocean model: NEMO-LIM,2°x2°x31 levels with sea-ie model

Vegetation model: Orchidée

Coupling: OASIS from CERFACS

Atmospheric model: LMDz, 96x95x39

The experiments extent up to Z_{top}=70km, and includes orographic and non-orographic GWs parameterizations

The resolution in the low stratosphere is around 1.5-2km

Aerosols and volcanoes prescribed using INCA, Stratospheric Ozone prescribed via REPROBUS

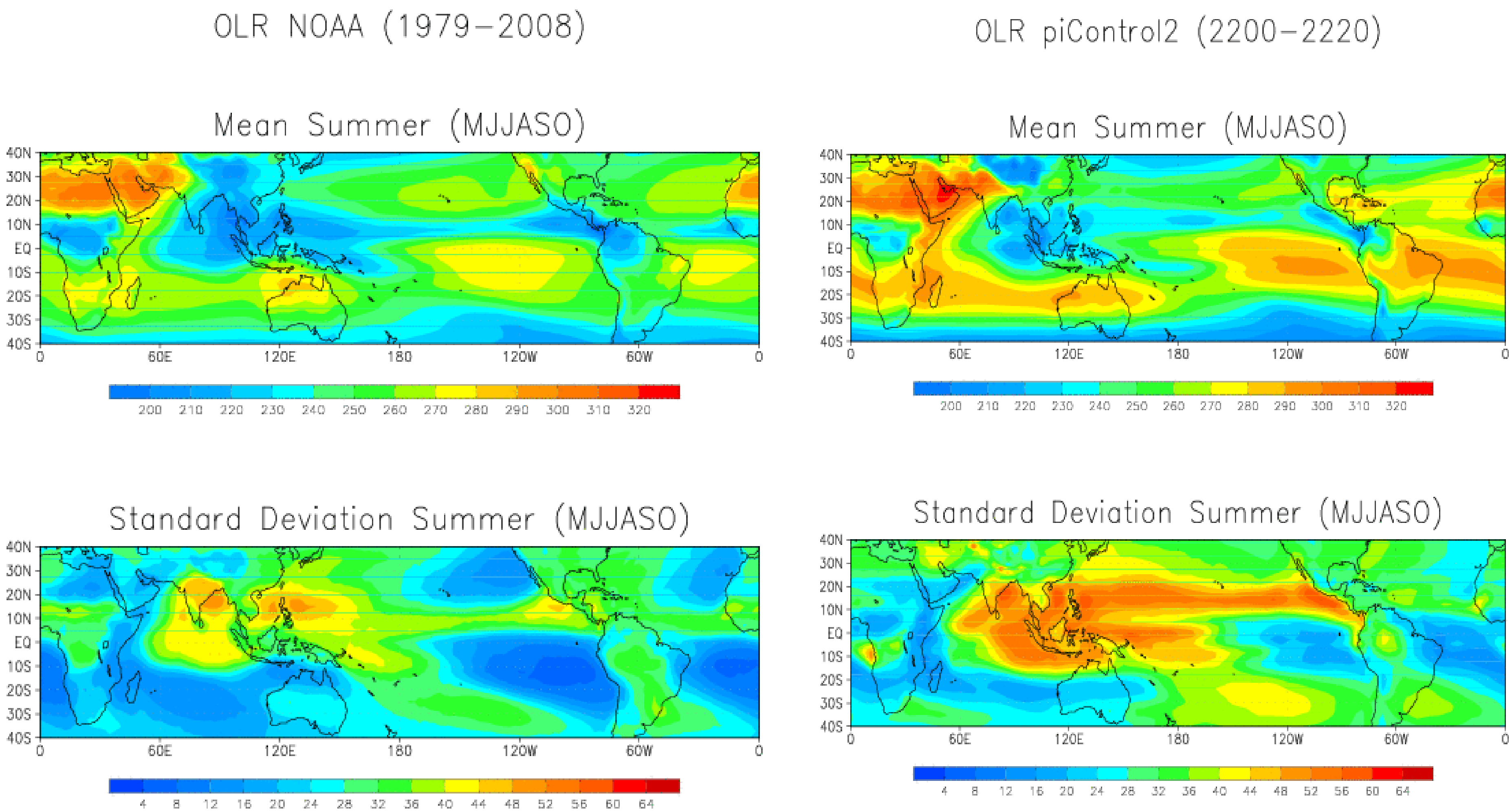
Stratosphere and chemistry in LMDz: Lott et al. 2005, Jourdain et al. 2008

Performances in the midlatitudes: Nikulin and Lott (2010)

The tropical tropospheric variability in the ESM IPSLCM5

The model needs to have realistic tropospheric climate and variability
(ENSO, MJO, and stratospheric PWs depend on theses)
Also needed if one wishes to adress which amount of waves needed for the
QBO forcing are explicitely solved by the model

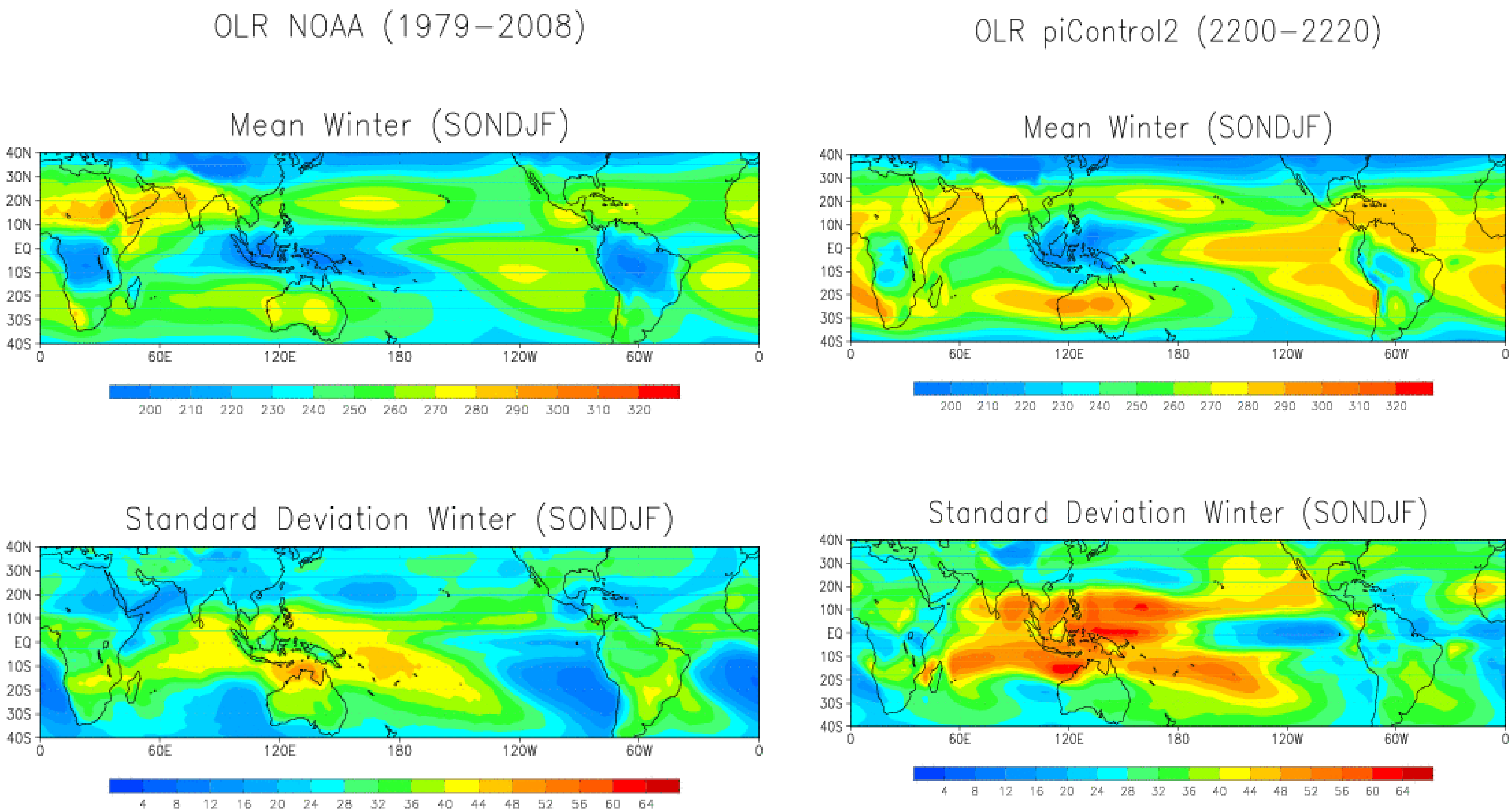
OLR diagnostics from the control run (1800-2350)



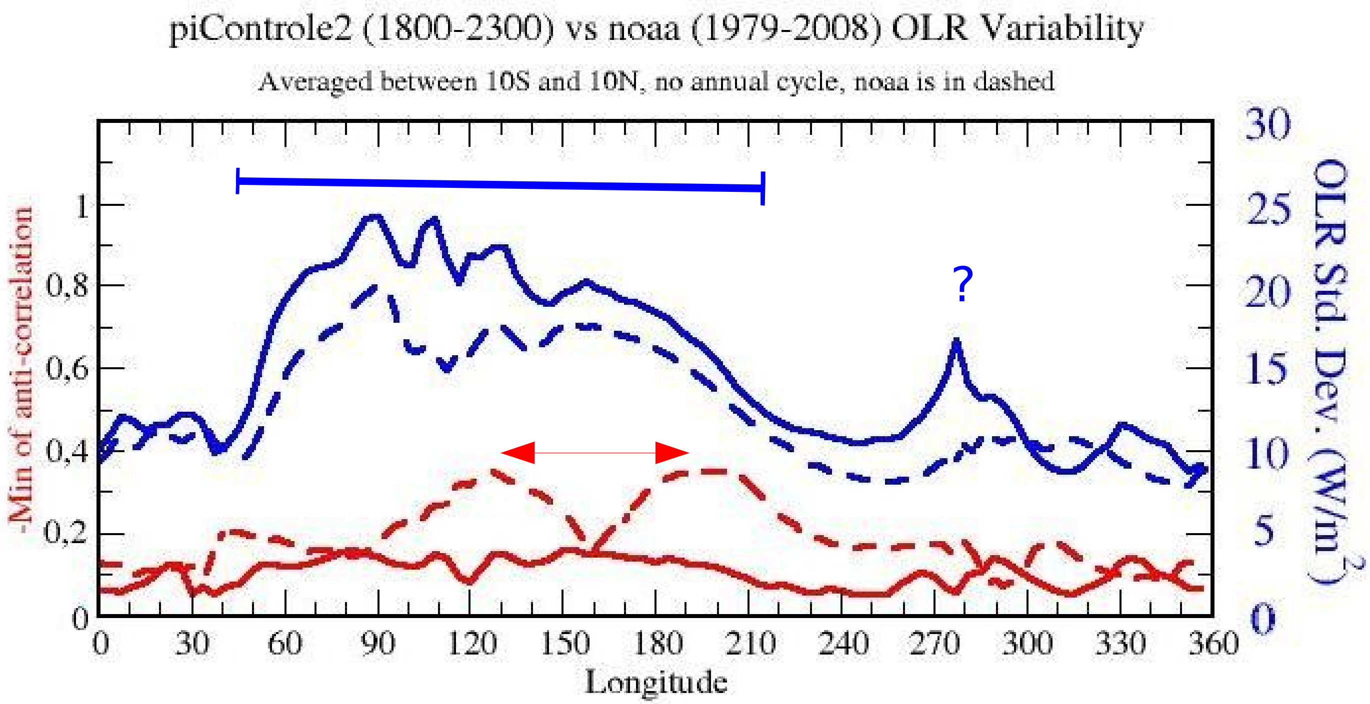
The tropical tropospheric variability in the ESM IPSLCM5

The model needs to have realistic tropospheric climate and variability
(ENSO, MJO, and stratospheric PWs depend on theses)
Also needed if one wishes to adress which amount of waves needed for the
QBO forcing are explicitely solved by the model

OLR diagnostics from the control run (1800-2350)



The tropical tropospheric variability in the ESM IPSLCM5

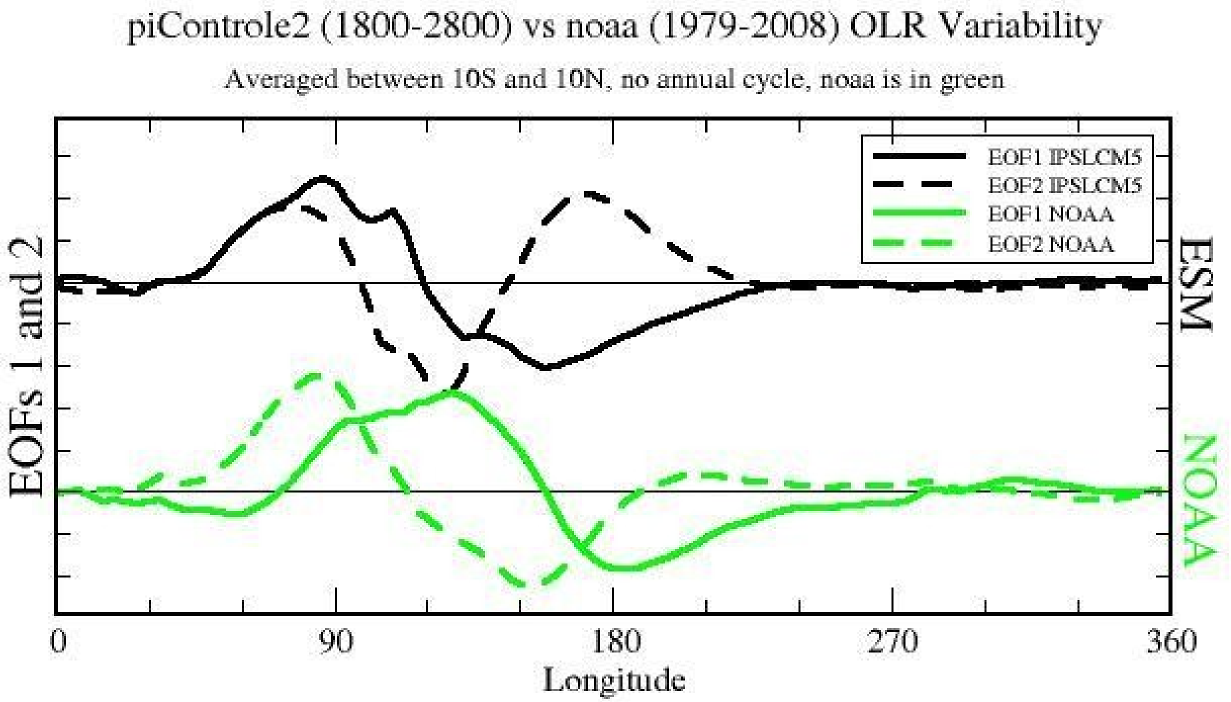


The model has enhanced variability from the Southern Indian ocean to the Mid-pacific, as in the Obs.

But a spurious peak of enhanced variability over Central and South America (?)

There is a significant underestimation of the anticorrelation between the maritime continent and the central pacific, remember that this anticorrelation is a signature of the Madden-Julian Oscillation (see the teleconnection arrow)

The tropical tropospheric variability in the ESM IPSLCM5

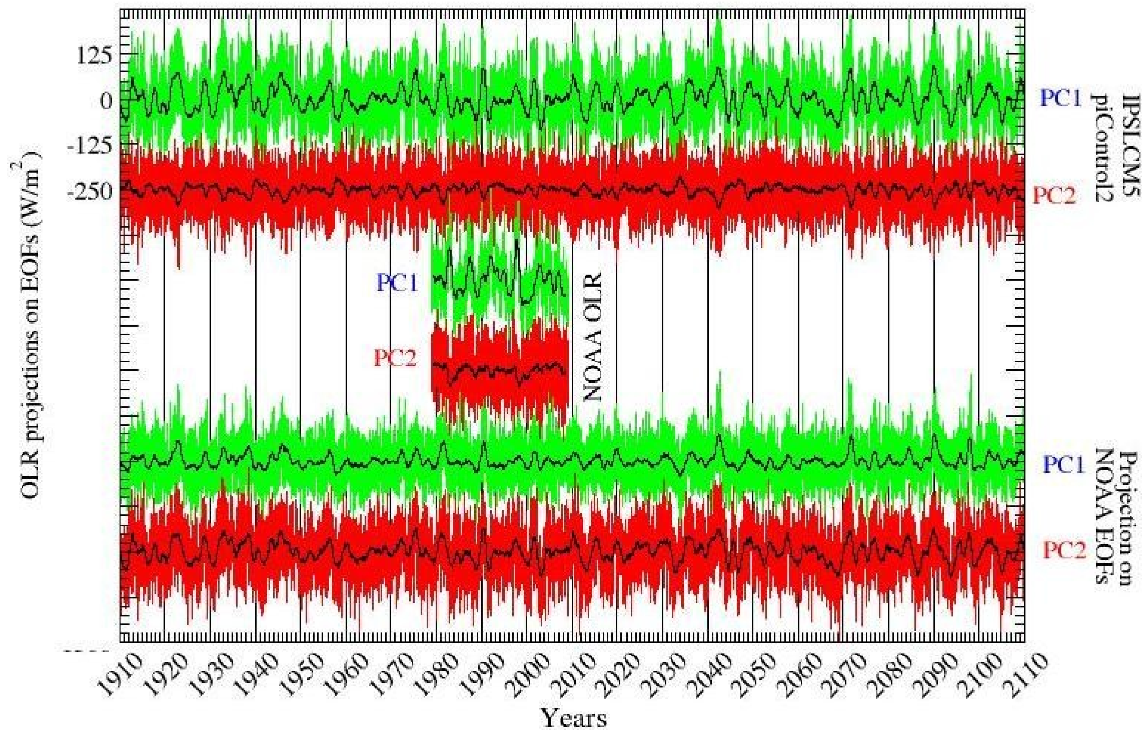


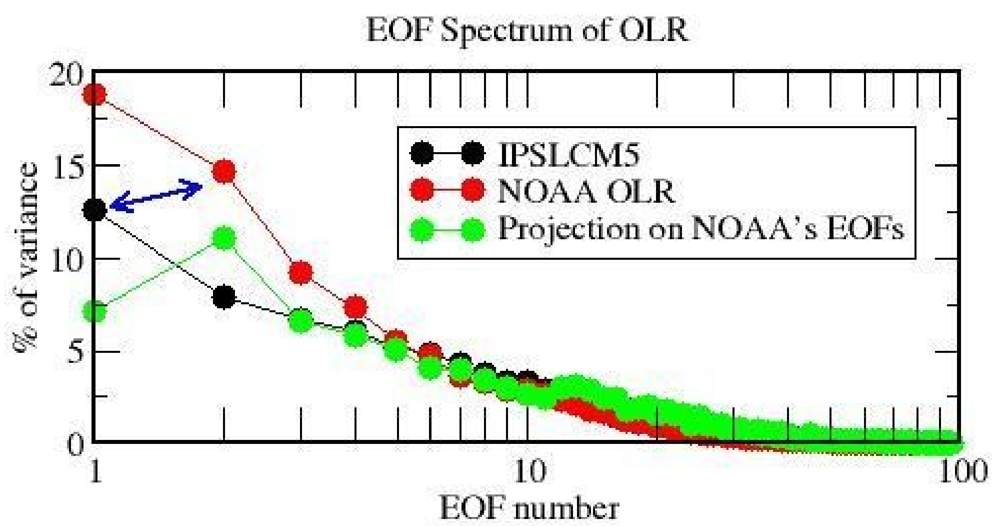
EOF1 in IPSLCM5 is more like the EOF2 from observations
Both correspond to an excess in precips. over the western and central pacific;
and a deficit over the Equatorial Indian Ocean

EOF2 in IPSLCM5 slightly reminiscent of like EOF1 from observations
(but this is only true for that they are both associated with excess precipitation over the maritime continent; for the western Indian ocean this is not clear at all!

The relative short scale of EOF2 (3 pronounced extrema) in IPSLCM5 call for
a more regional analysis.

The tropical tropospheric oscillations in the ESM IPSLCM5





ENSO type:

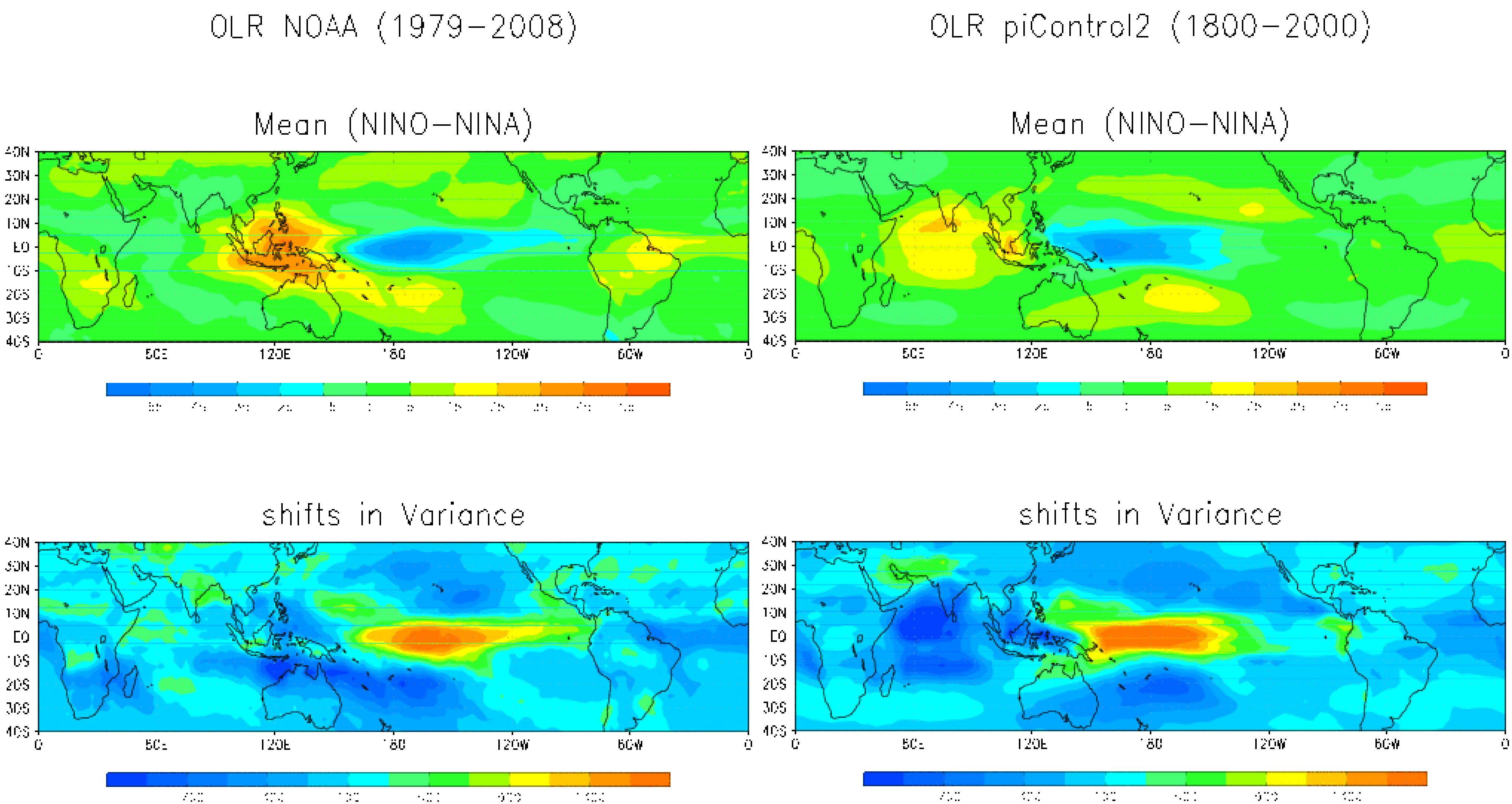
PC1s in IPSLCM5 and NOAA shows more inter-Annual variability than PC2s

This is despite the fact that EOF1 in IPSLCM5 is More like EOF2 in NOAA!

The Inter-Annual variability seems more confined to The western Pacific

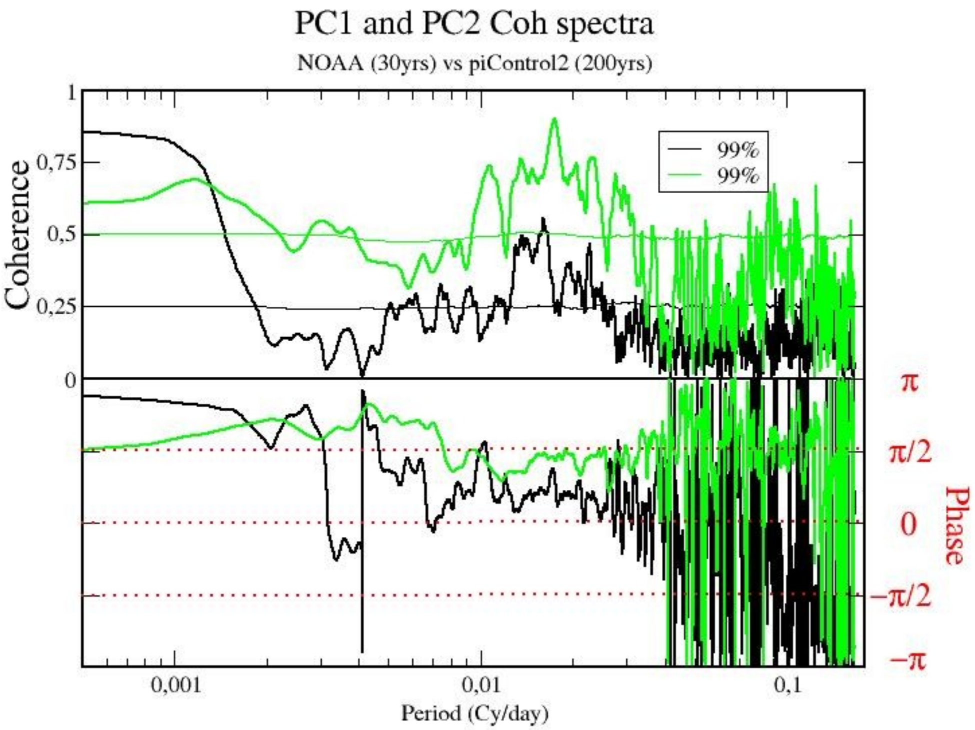
The selected years are rather Insensitive if we choose EOF 1 from model or from observations to Attribute Nino years

The tropical tropospheric oscillations in the ESM IPSLCM5



The tropical tropospheric oscillations in the ESM IPSLCM5

Coherency spectrum between
PC1 and PC2,
NOAA OLR Dashed (20 yrs)
PiControl2 (200yrs only, sorry!) Solid

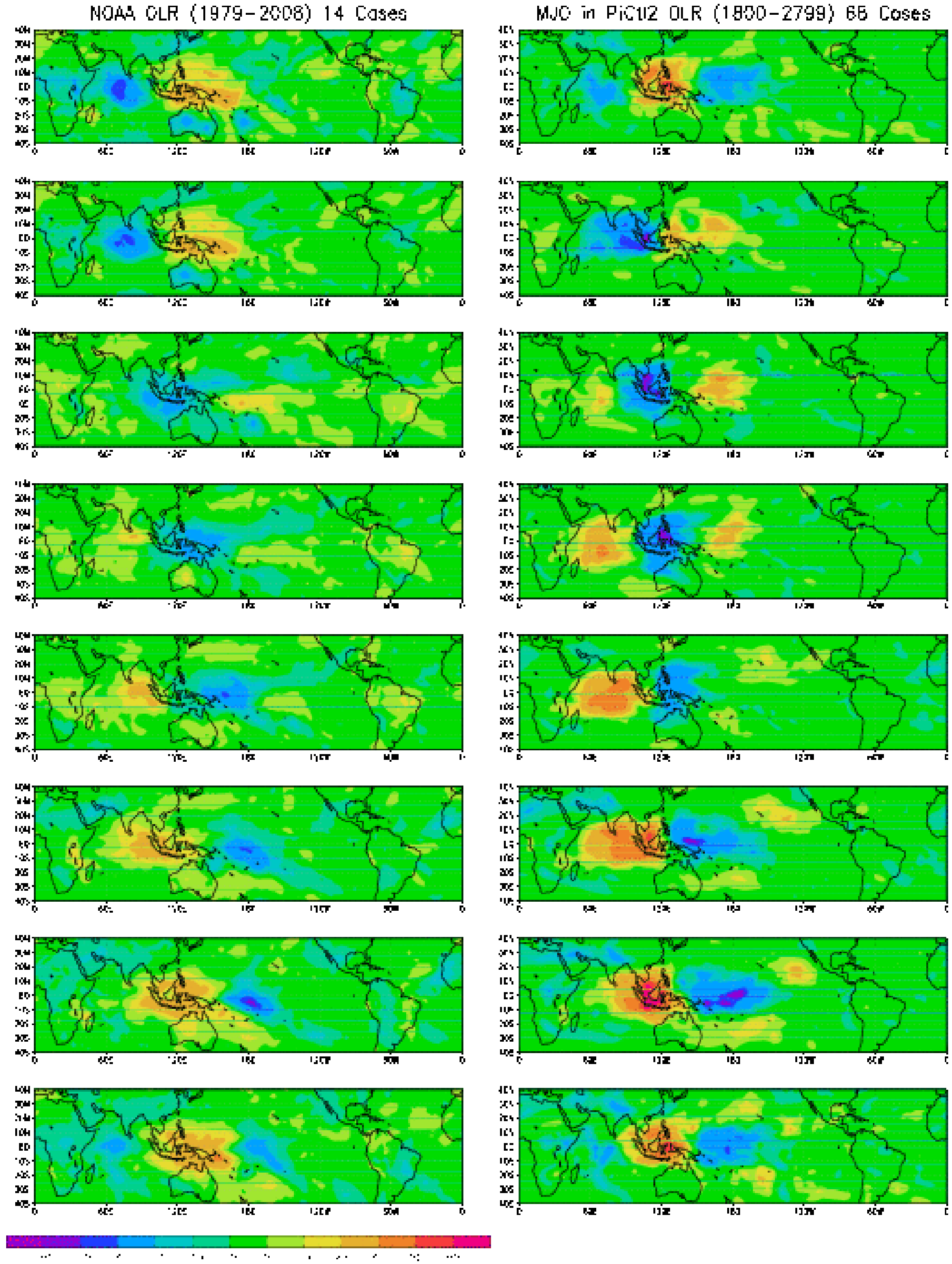


MJO-type:
The intraseasonnal variability is characterised in the NOAA OLR by the fact that the PC1 and PC2 signals are significantly coherent and in quadrature.
This is almost absent from IPSLCM5

More precisely and in the IPSLCM5, the coherency is weak and the PC1 and 2 signals are almost in phase: the signal is more a standing oscillation than an Eastward propagating one.

The tropical tropospheric oscillations in the ESM IPSLCM5

NOAA-OLR   πctl2-OLR



Composite maps of OLR keyed to the amplitude of the (PC1,PC2) vector, filtered in the IS band.

Only events lasting more then 30 days are kept

Composite MJO out of piCtl2 (68 cases out of 1000yrs!).

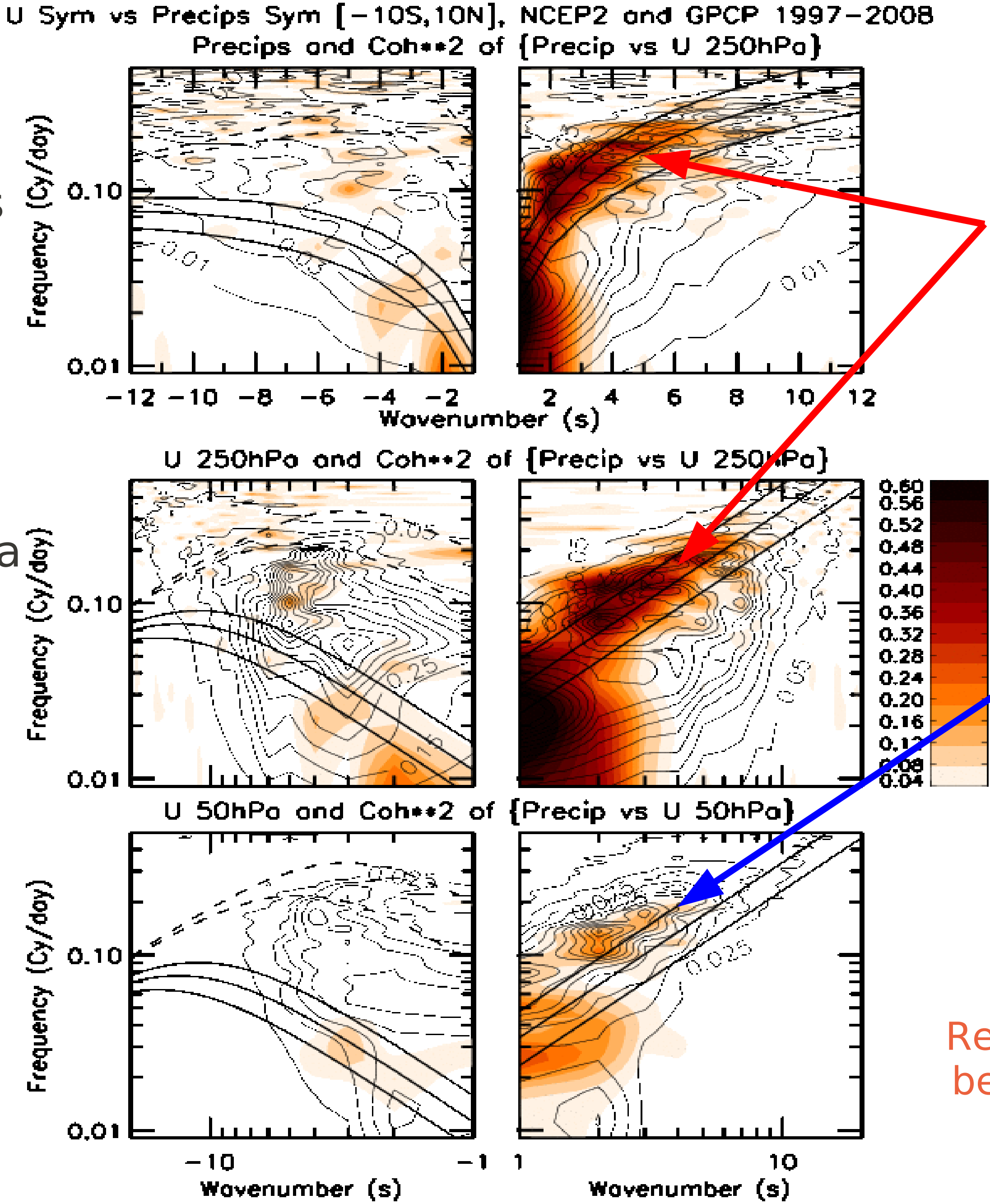
Long lasting ones propagate properly, but there are very few!

The tropical waves in the ESM IPSLCM5

Precips from GPCP

U250hPa from NCEP

U50hPa from NCEP



The tropospheric convectively coupled equatorial waves (here of Kelvin wave type)

are not so distinct from

The freely propagating Stratospheric waves

Is it critical for the model Stratospheres since CCEWs are known to be weak in models?

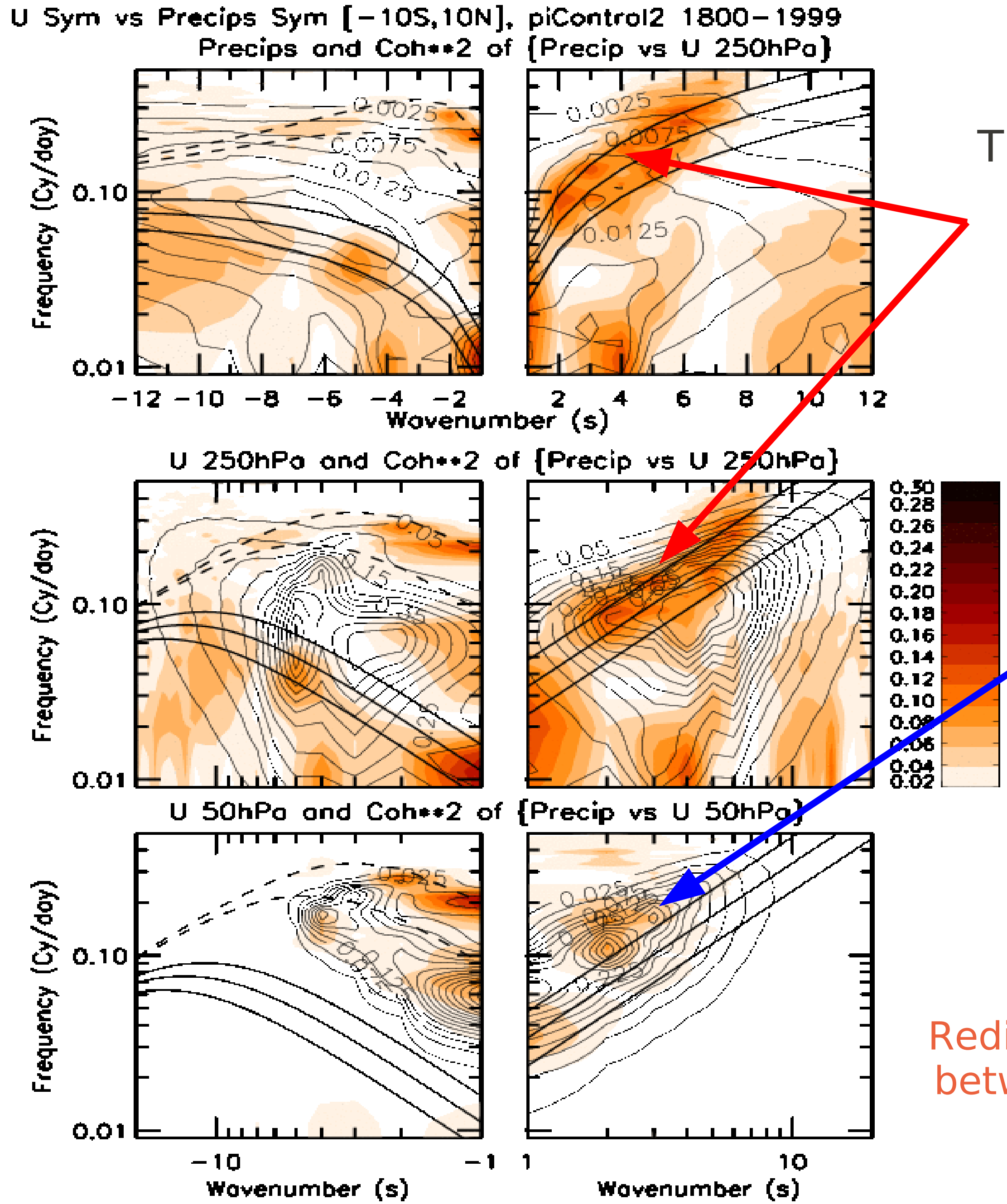
Redish shadings are for coherencies between speeds and precipitations

The tropical waves in the ESM IPSLCM5

Precips from πCtl2

U250hPa from πCtl2

U50hPa from πCtl2



The tropospheric convectively coupled equatorial waves (here of Kelvin wave type)

are not so distinct from

The freely propagating Stratospheric waves

Is it critical for the model Stratospheres since CCEWs are known to be weak in models?

Redish shadings are for coherencies between speeds and precipitations

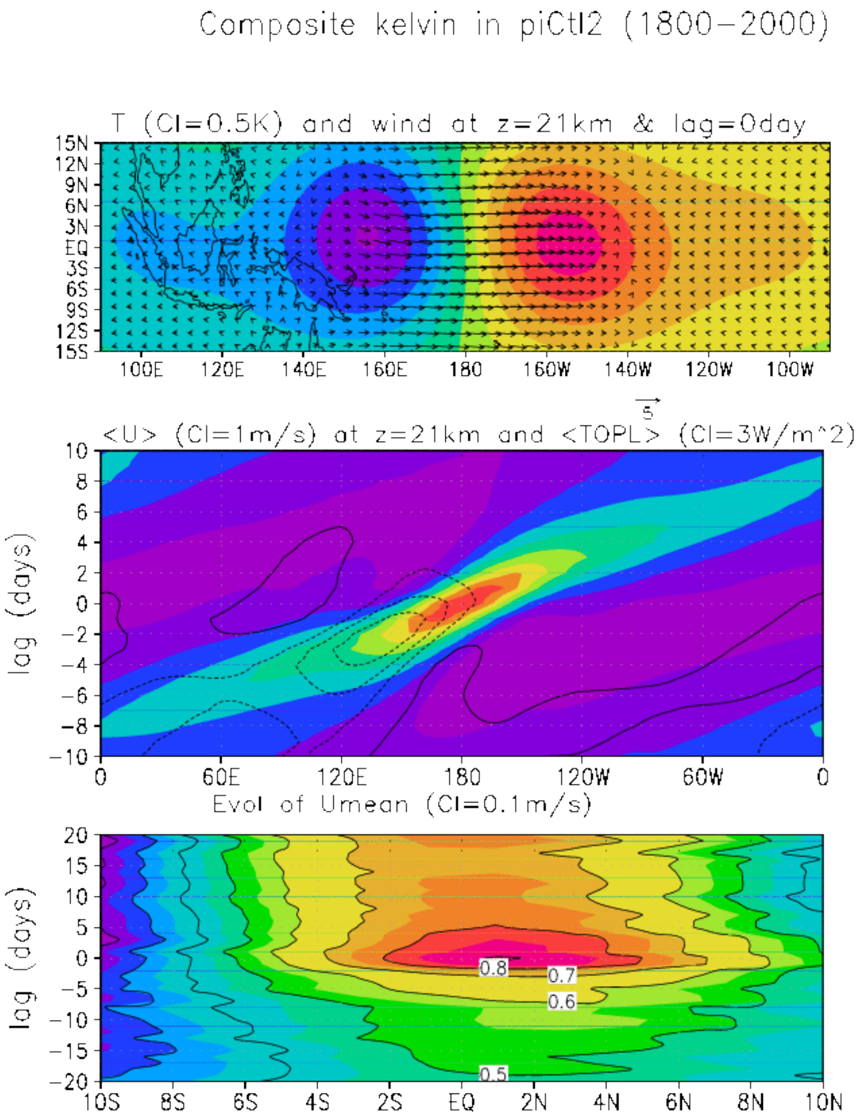
The tropical waves in the ESM IPSLCM5

Wave-Mean flow interactions

T is in color,

U is in color,
OLR in contours

Zonal mean
of U



Composite analysis illustrates better the structure of the waves

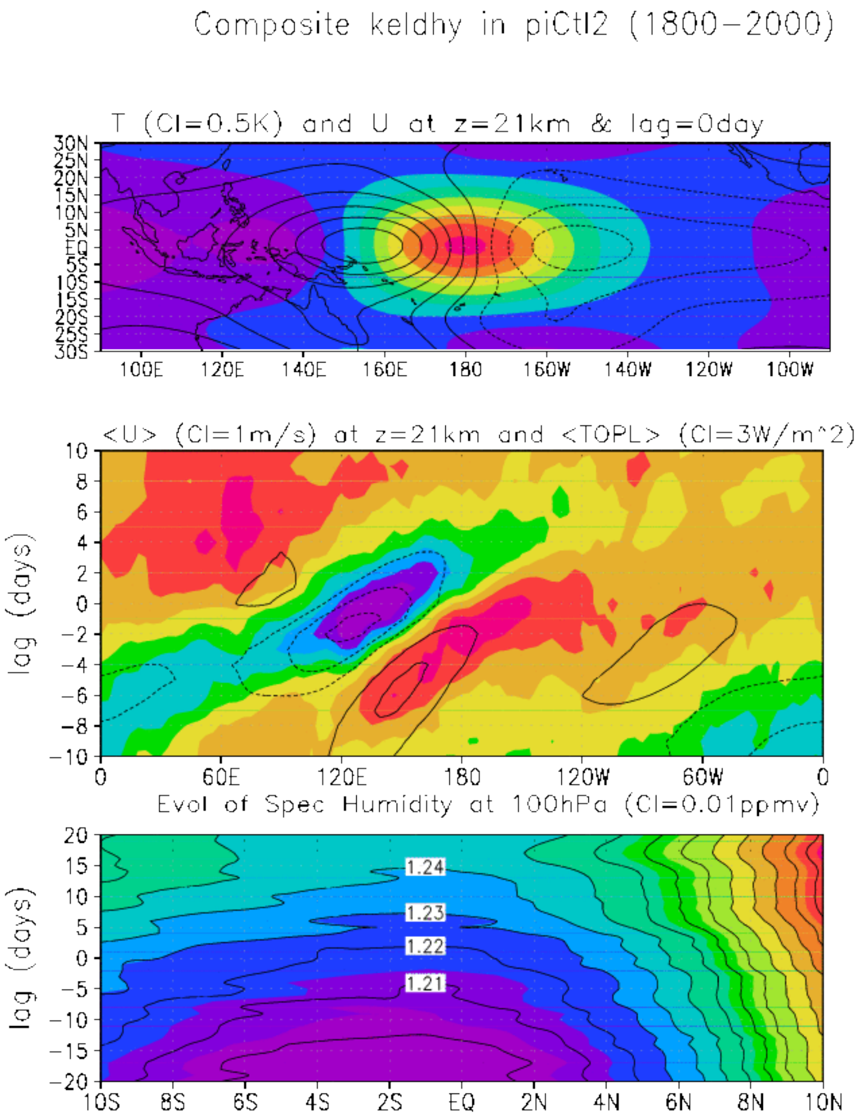
(here at 50hPa, except for the OLR)

Evolution of the zonal mean wind during the passage of the Kelvin waves (wave-mean flow interaction clearly visible here)

Amplitude comparable to those documented in Lott et al. (2009)

The tropical waves in the ESM IPSLCM5

Dehydratation (here more a moistering!)



T is in color,
U in shades

U is in color,
OLR in contours

Zonal mean
of U

Composite analysis
illustrates better the
structure of the waves

(here at 50hPa, except
for the water vapour which
Is at 100hPa)

Evolution of the water vapor
mixing ratio at 100hPa
(stratospheric moistering
clearly visible here)

Amplitude comparable to those documented in Lott et al. (2009)

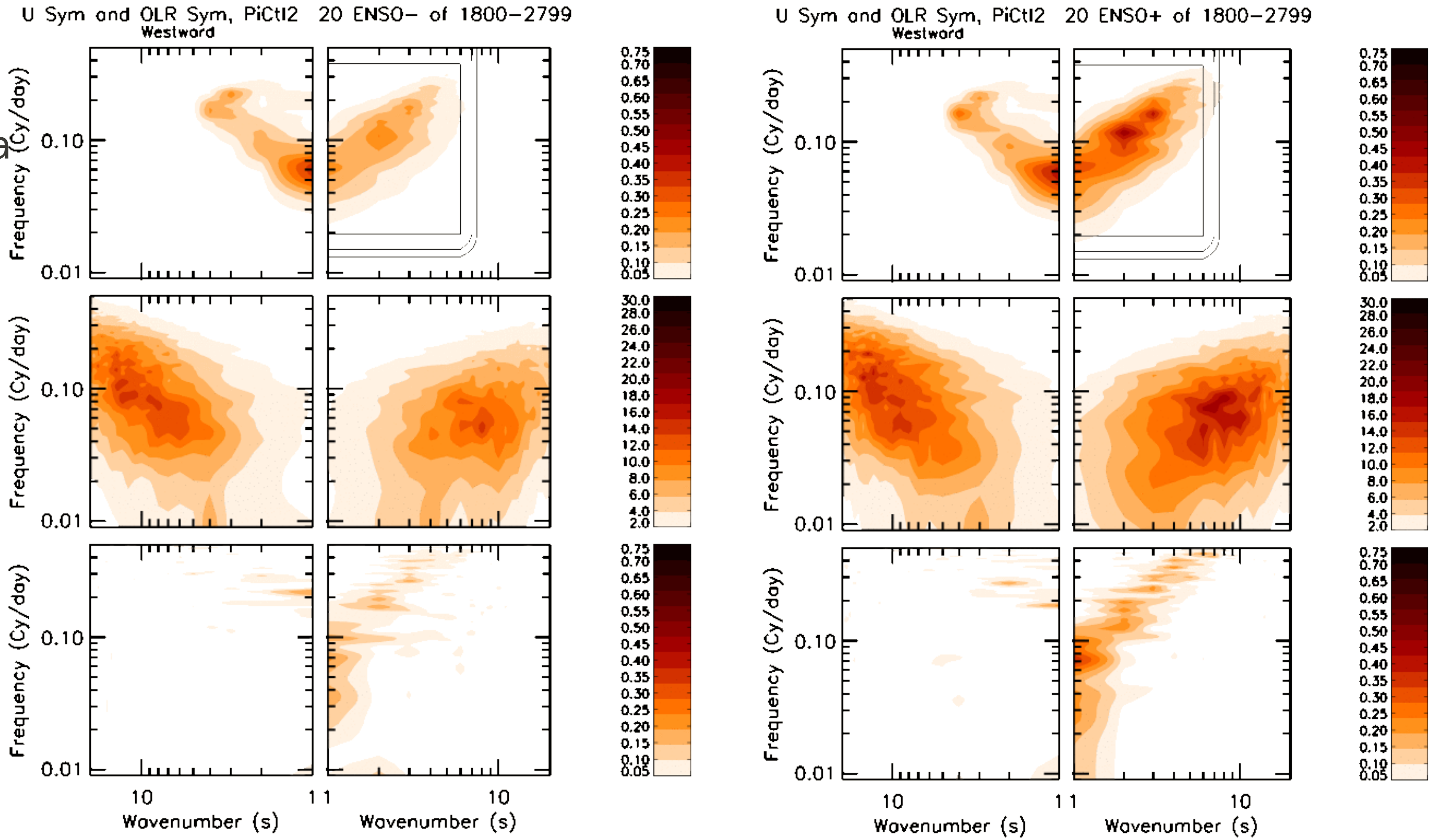
The tropical waves in the ESM IPSLCM5

Weak sensitivity to ENSO! (is there is an ENSO to QBO relation?)

U 50hPa

OLR

Cohe
rencies



The tropical variability in the ongoing CMIP5 simulations at IPSL

Contacts for those diagnostics: F. Lott, P. Maury and L. Guez
LMD/IPSL, Ecole Normale Supérieure, Paris France

Take care when you look at the impact of El-Nino in Southern America or elsewhere; the principal center of variabality is very significantly shifted westward; this can affect remote impacts via Rossby waves propagation from this center.

Can we do regional modeling over south America from this runs?