Estimating water vapor feedback from interannual variability

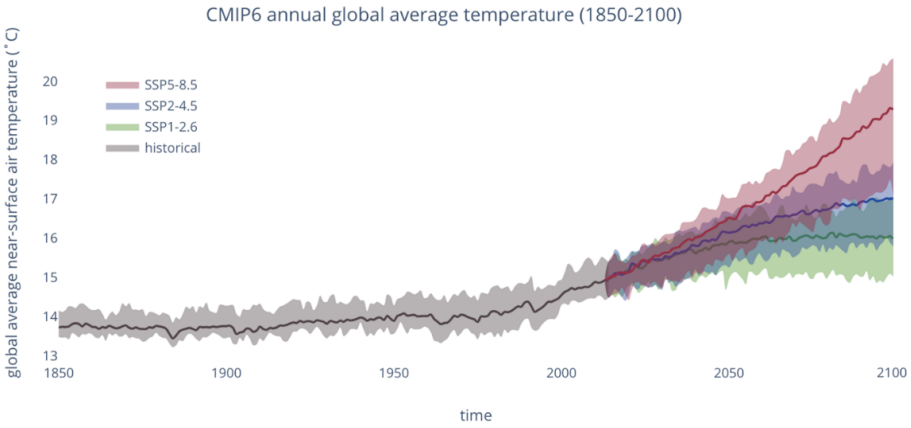
Robert Eerenstein[1],
Felix Plöger[1,2], Martin Riese[1,2], Jörn Ungermann[1]

[1]Institute of Energy and Climate Research: Stratosphere (IEK-7),
Forschungszentrum Jülich, Jülich, Germany

[2]Institute for Atmospheric and Environmental Research,
University of Wuppertal, Wuppertal, Germany

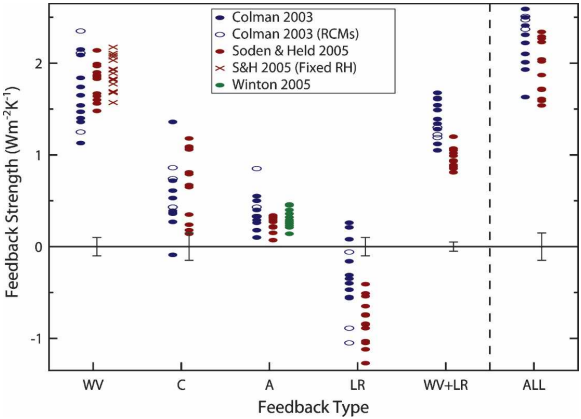
May, 27th, 2022

Uncertainties in climate projections



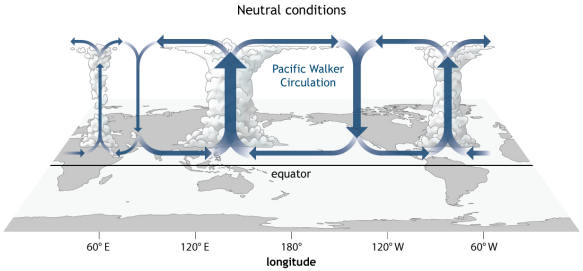
(Copernicus Climate Change Service, ECMWF)

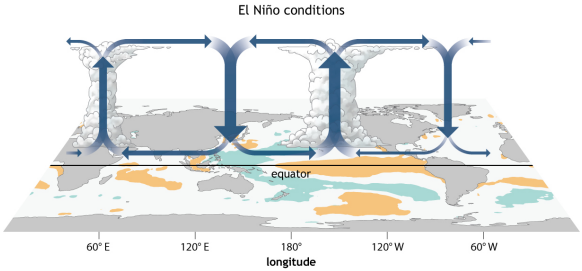
Feedback strengths are not well constrained



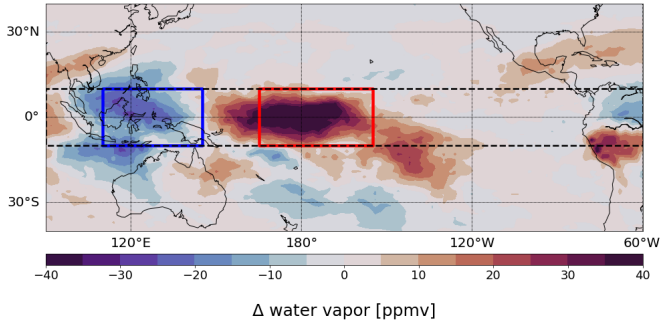
(Bony et al. 2006)

El Nino as a source of water vapor variability

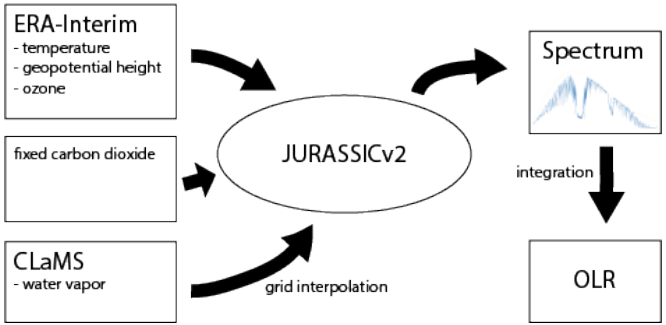




Example of water vapor shift at 300 hPa (CLAMS)

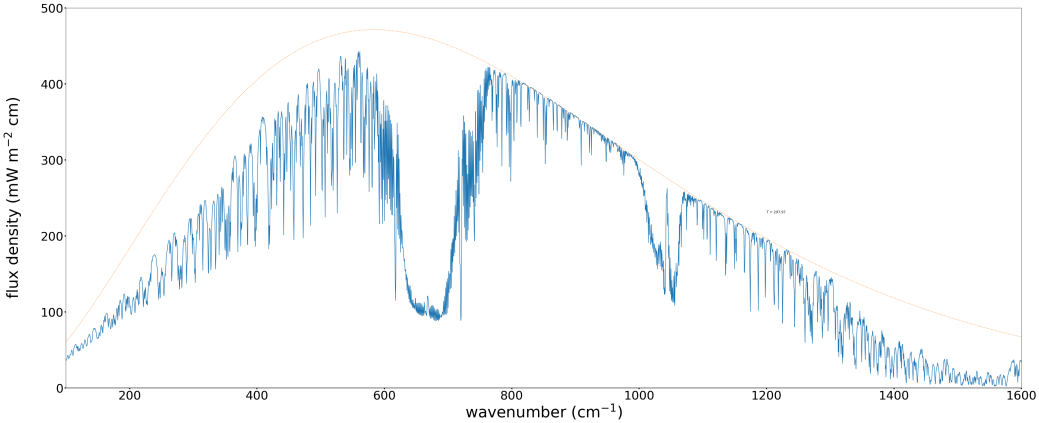


JURASSIC

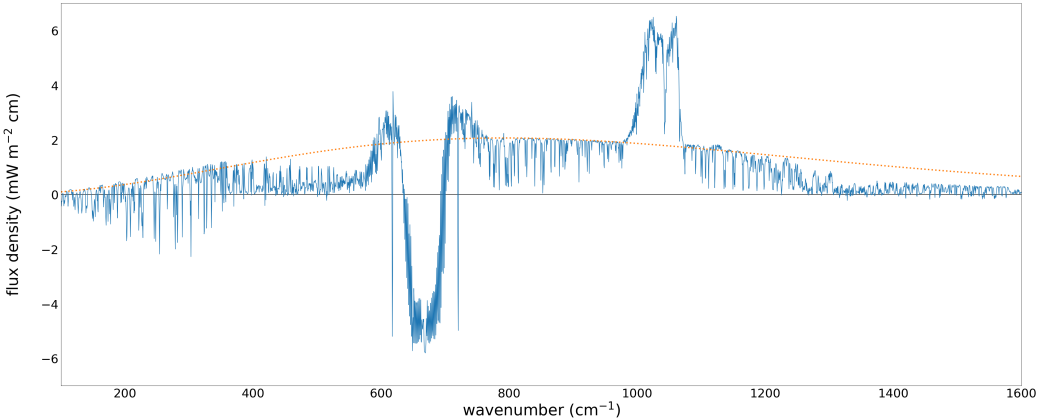


- nadir view
- 0.5 - 10 cm^{-1} wavenumber resolution
- 1x1 degree spatial resolution
- only clearsky

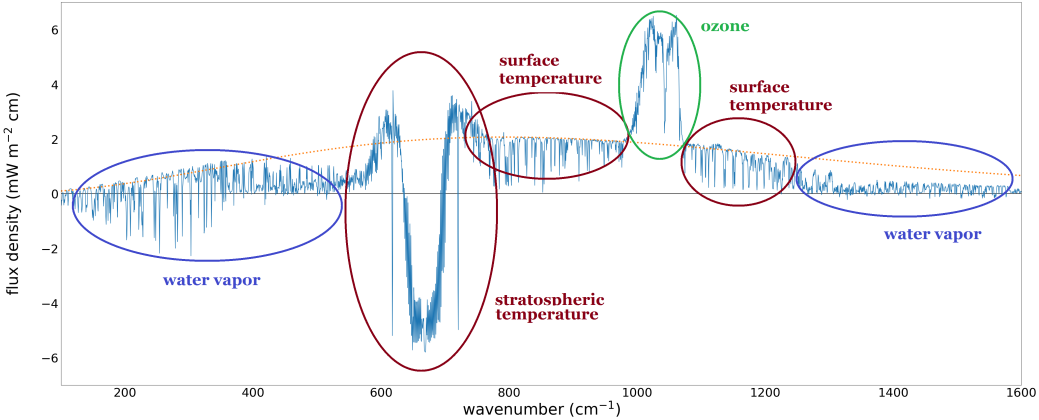
Example spectrum calculated with JURASSIC



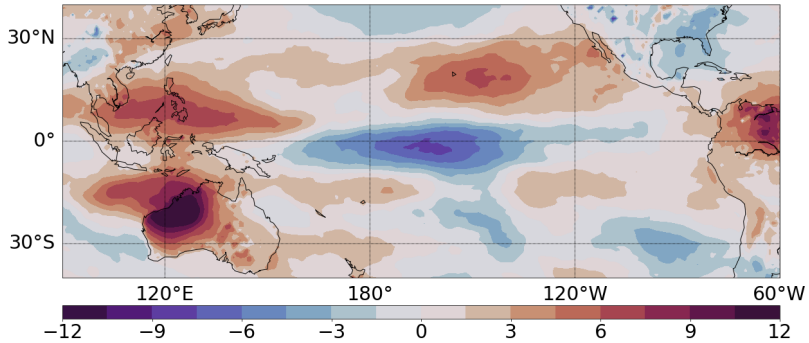
Example difference-spectrum (El Nino - Reference)



Example difference-spectrum (El Nino - Reference)



OLR difference maps from El Nino composite (97/98, 06/07, 09/10, 15/16)



⇒ we see a clear and consistent signal from El Nino

Comparison with Dessler et al. 2008

Partial Radiative Pertubation Method (PRP)

$$\lambda_q = \frac{\partial R}{\partial q} \frac{\Delta q}{\Delta T_s}$$

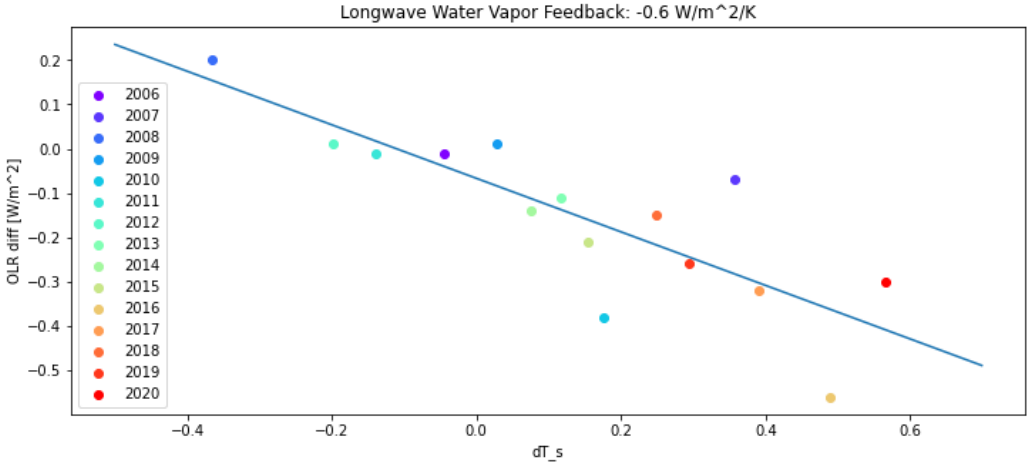
year	λ_q Dessler	ΔT	λ_q JURASSIC	ΔT	$\Delta\lambda_D/\Delta\lambda_J$
2003	1.67	0.44	1.07	0.46	1.56
2004	2.11	0.41	1.36	0.30	1.55
2005	1.37	0.49	0.91	0.50	1.51
2006	2.09	0.28	0.87	0.32	2.40
2007	0.74	0.60	1.03	0.72	0.72
mean	1.60	0.44	1.05	0.46	1.55

Comparison of the long wavelength water vapor feedback calculated with JURASSIC and Dessler et al. 2008.

$\Rightarrow$ calculated feedback with JURASSIC is smaller

Feedback from a 20y timeseries

2001 - 2005 as reference time



Conclusions

- we simulated typical OLR variations during ENSO
- it was possible to calculate a water vapor feedback from interannual variations
- there are still open questions if the feedback can be calculated this way
- if working correctly this would be a interesting concept to calculate the feedback from FORUM observations