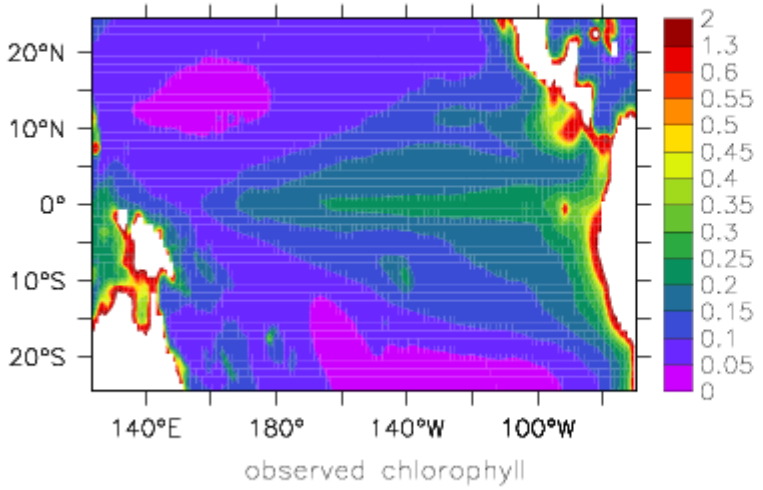
Quantification of the feedback between phytoplankton and ENSO

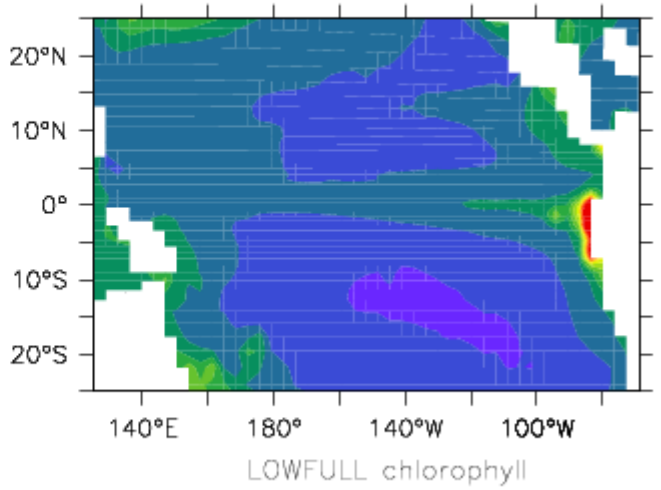
Jochum, Yeager, Lindsay, Moore & Murtugudde

NCAR, 2010

Annual mean surface chlorophyll

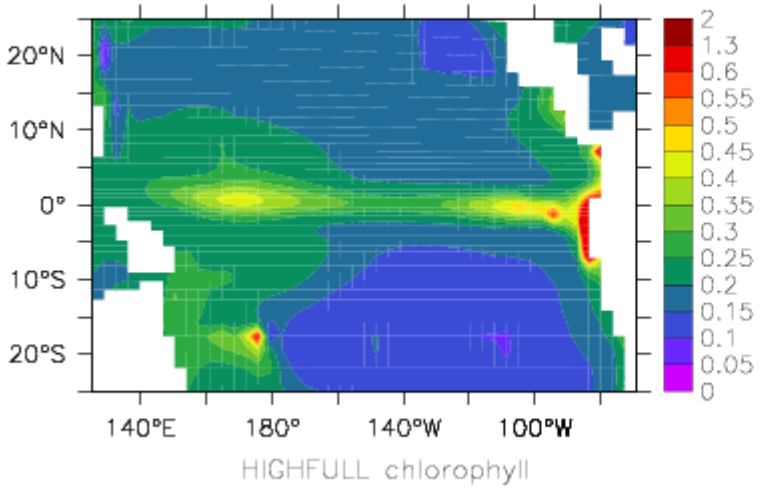
obs

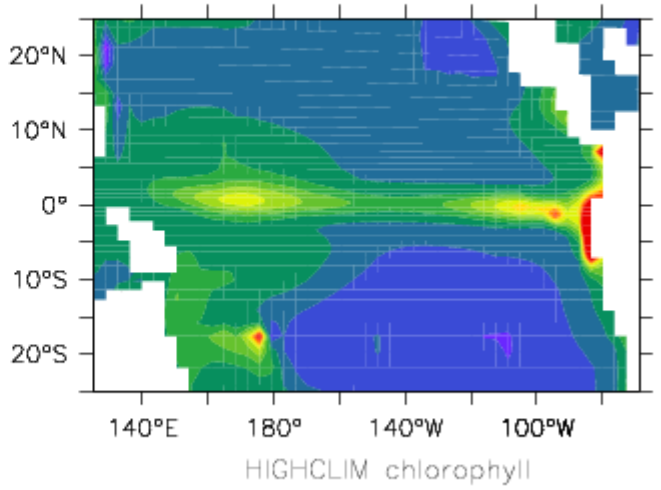




low

high

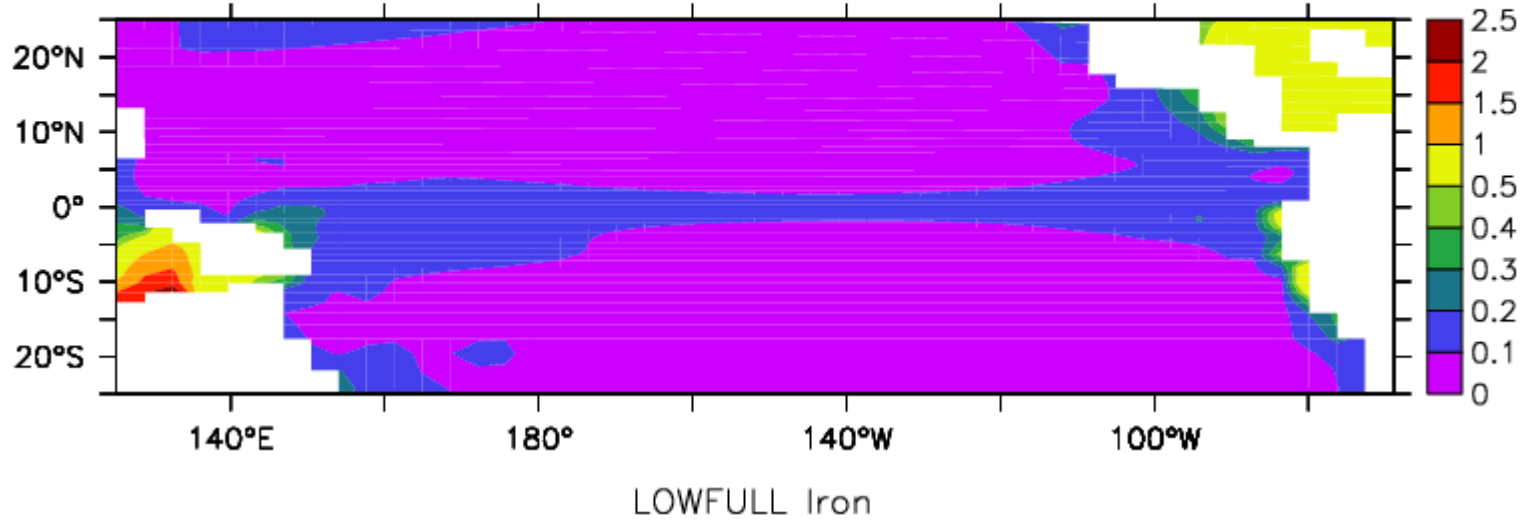




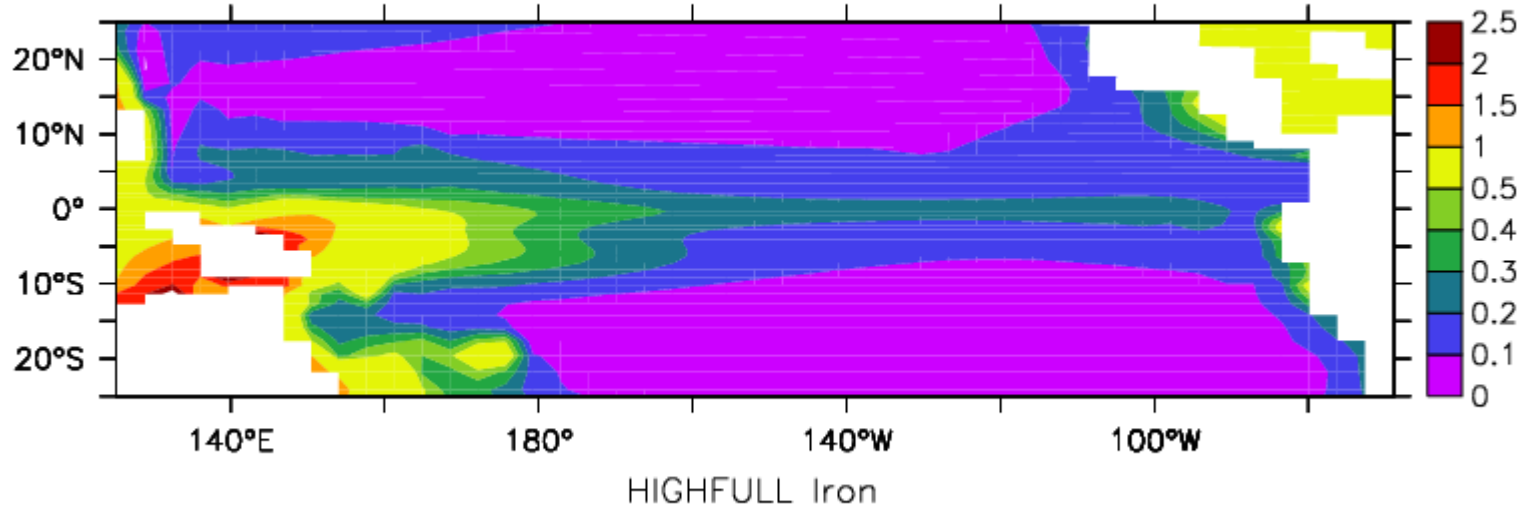
highclim

Iron in the upper 150m

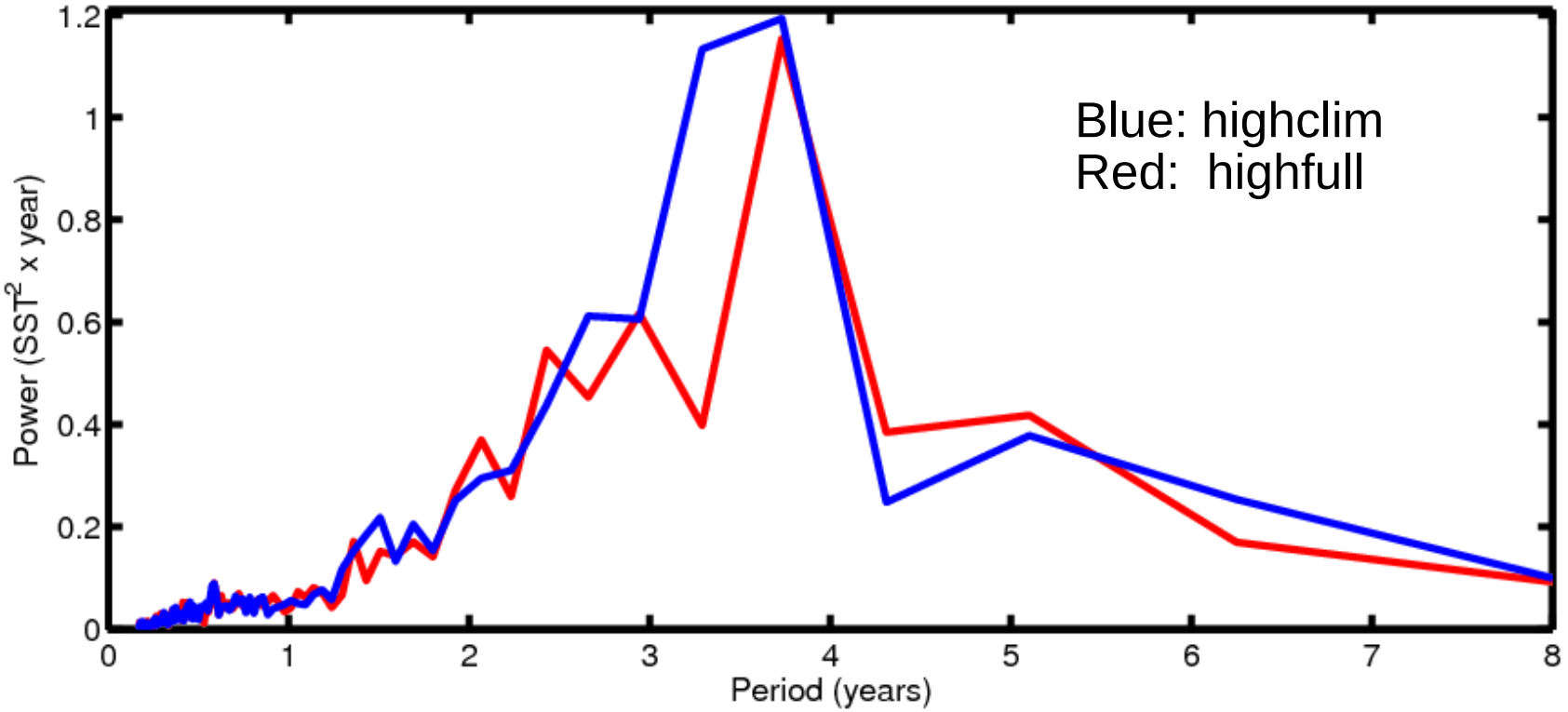
Low



high



Spectra of NINO3 SST (yrs 250-500)

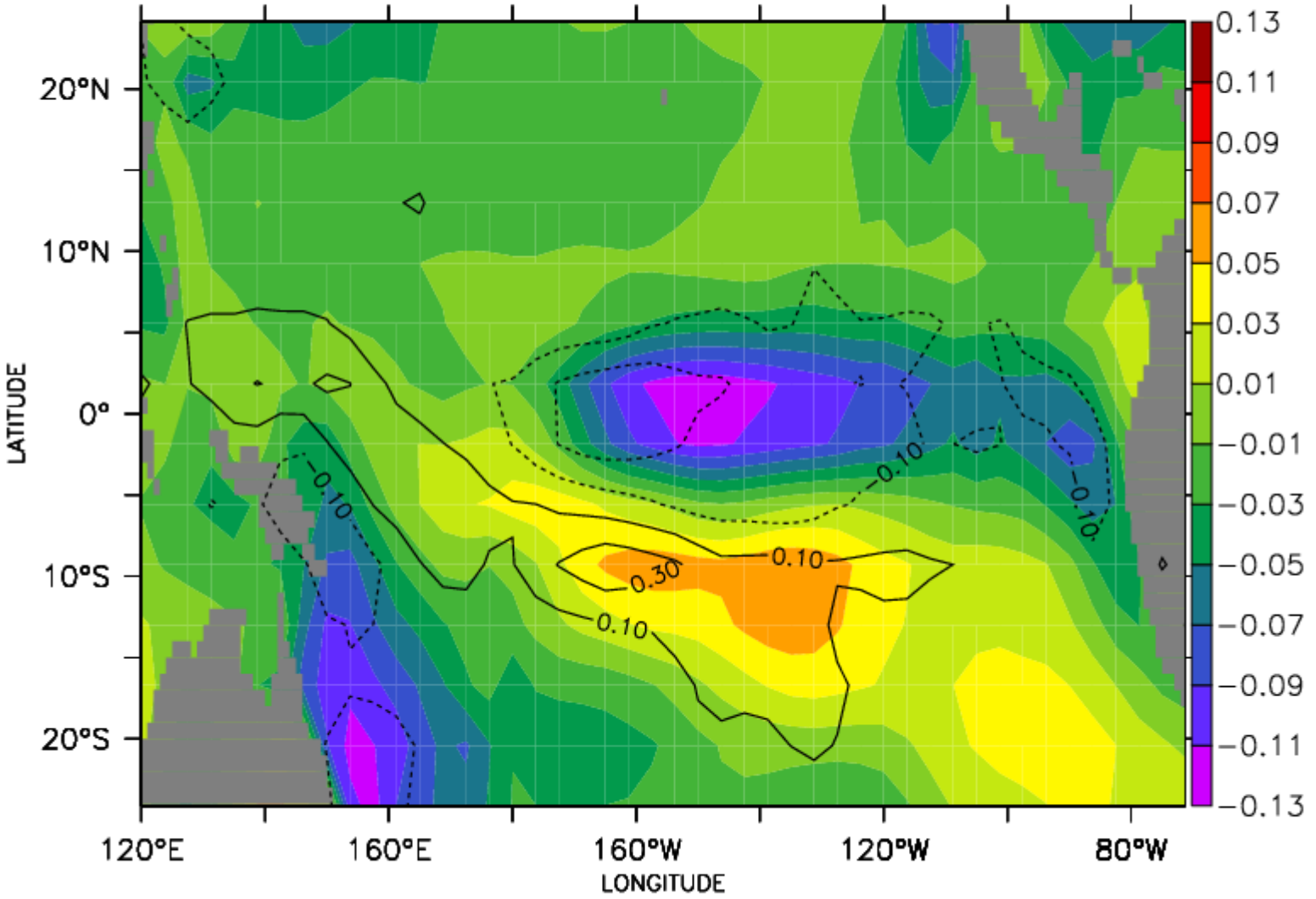


ENSO with full BGC is 9% weaker than ENSO with identical but prescribed chlorophyll climatology (with 98.5 % significance).

This is true for the HIGH-set as well as the LOW-set.

The heat trapping effect of phytoplankton and its feedback with ENSO has been observed by Strutton & Chavez (1994). We quantified it for CCSM.

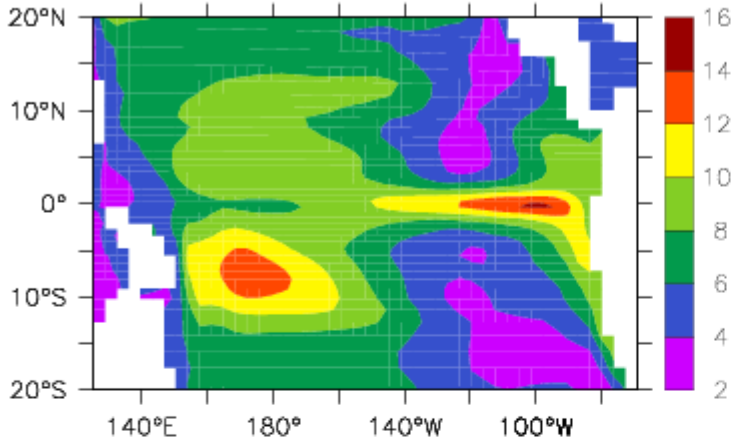
But why is it insensitive to the mean background values?



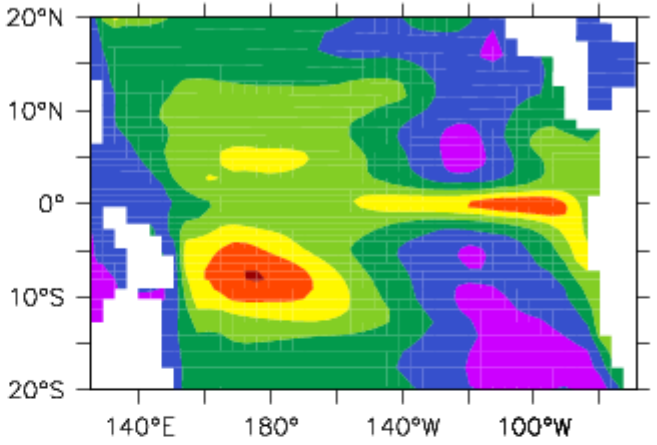
Difference in SST and precipitation between HIGH and LOW.

Standard deviation of thermocline depth

LOW



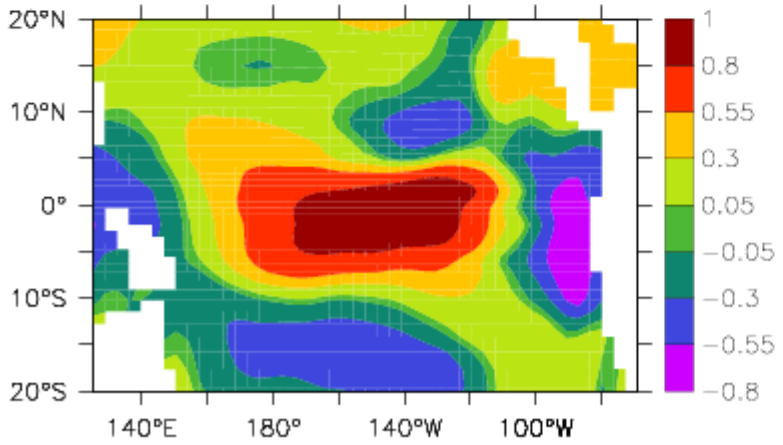
LOWFULL

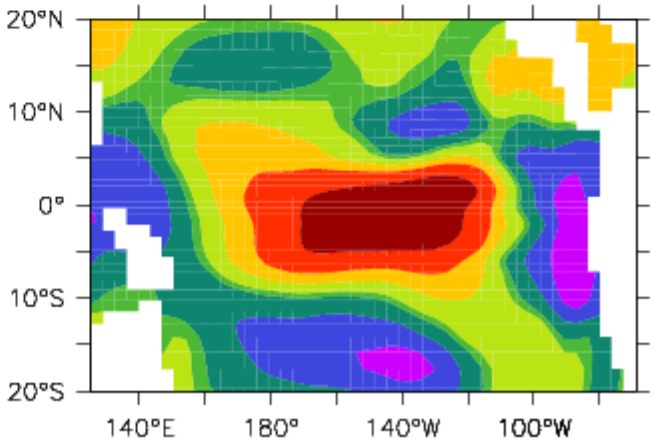


HIGHFULL

HIGH

LOW





HIGH

Correlation between NINO3 SST and zonal wind stress

Conclusions

- ignoring the ENSO-phytoplankton feedback in GCMs leads to a 9% overestimation of ENSO strength
- off-equatorial feedbacks are potentially important, but have not been well studied yet
- the amplitude of the phytoplankton feedback should also be established for other scenarios of interannual variability or trends (NAO, LGM, 21st century) ...
- ... and maybe a simplified mixed layer chlorophyll model should be added to CCSM