A Preliminary Look at Variations in CERES-Terra Fluxes and Cloud Properties with SST Anomaly

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Acknowledgments

- Thanks to David Doelling and Michele Nordeen for help with CERES cloud property data.

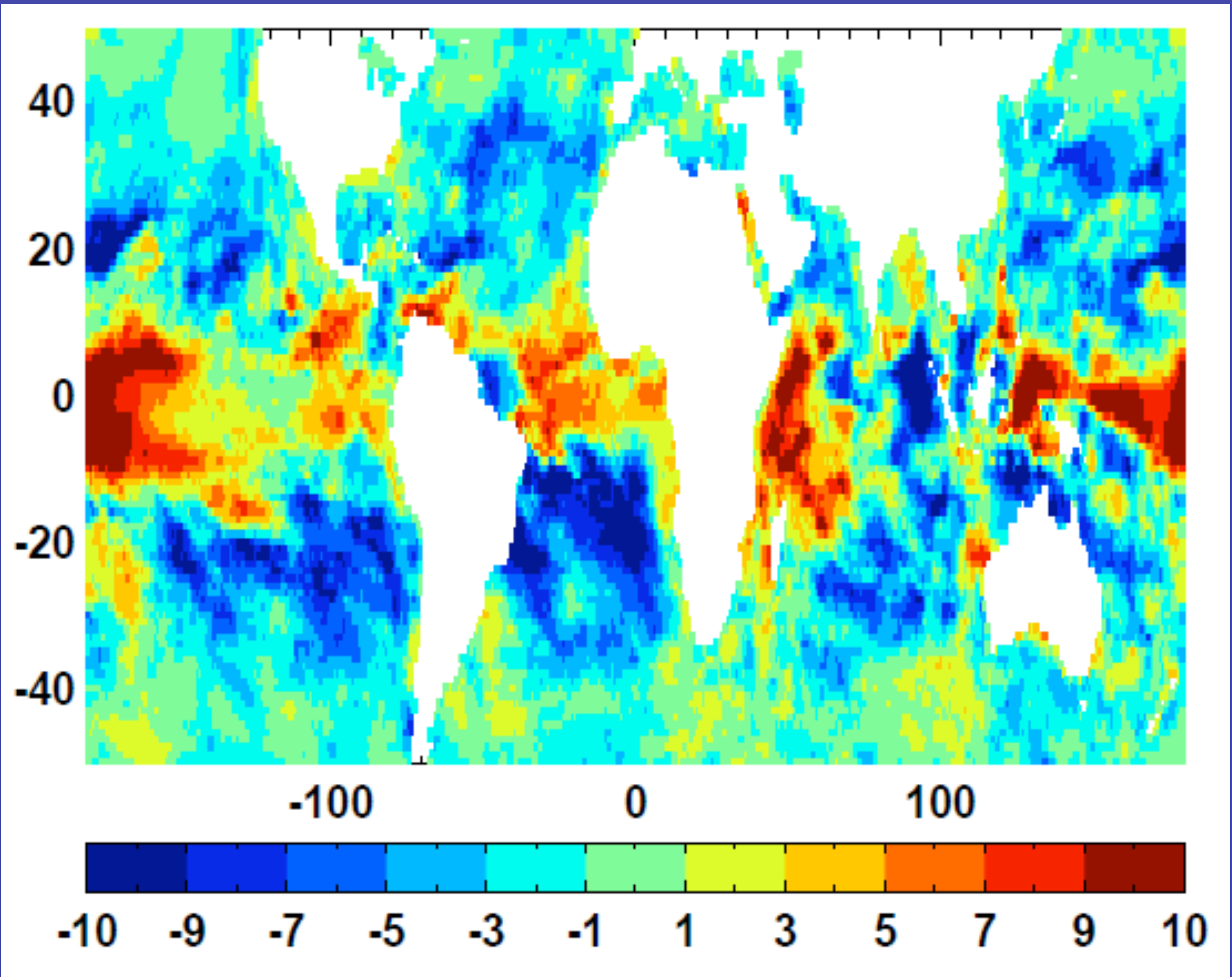
Motivation

- In a recent paper, Wagner et al. (2008, Atmos Chem Phys) used data from the GOME (Global Ozone Monitoring Experiment) instrument to examine cloud properties and their changes with SST anomaly.
- They found that cloud fraction increased with SST near the ITCZ, but decreased in most other regions. Cloud top height increased in most regions.
- In addition to these fields, we are interested in changes in LW and SW fluxes and optical depth.

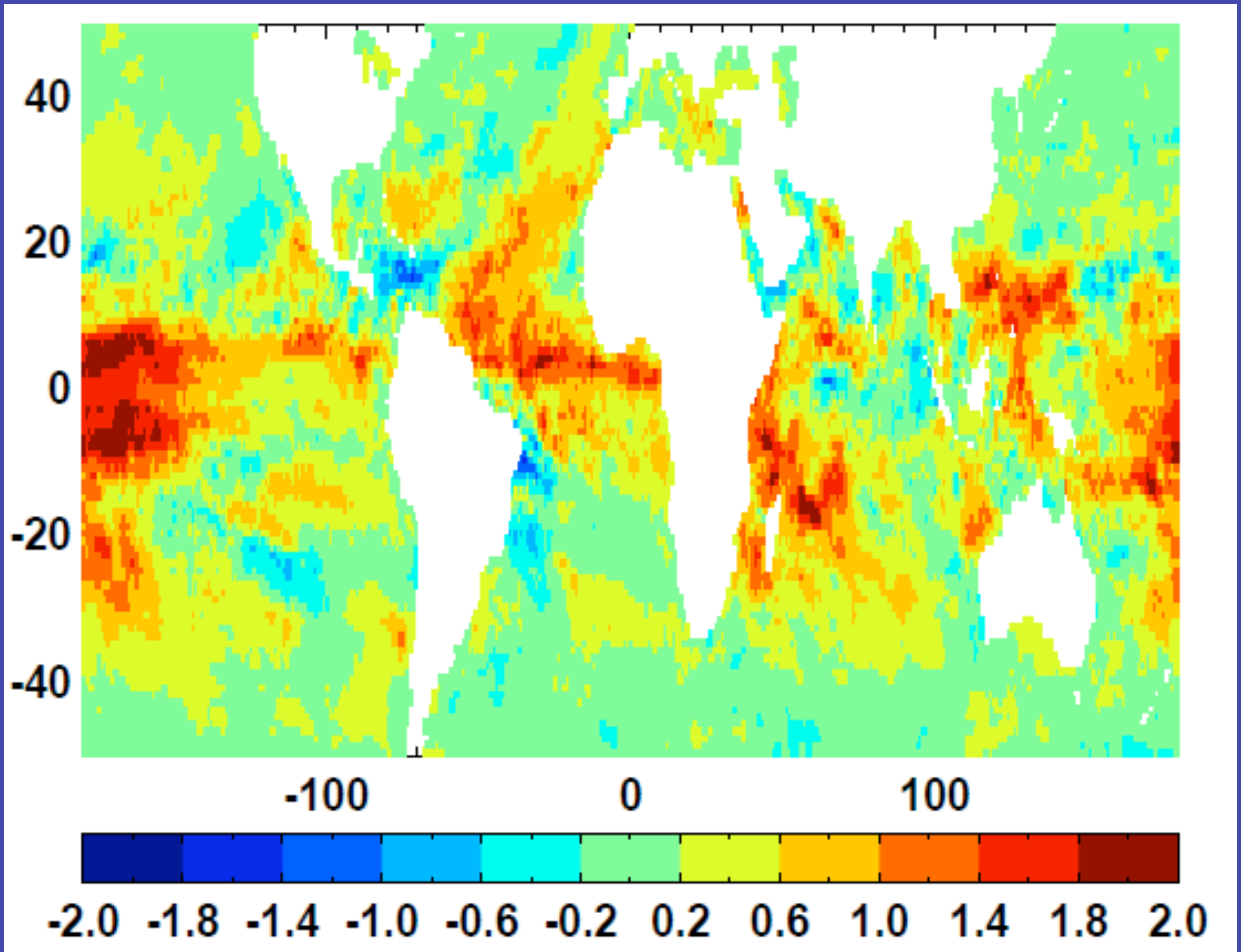
Data Sources

- All data is from March 2000-Feb 2005.
- Monthly mean 1x1 degree CERES-EBAF data is used for fluxes.
- Monthly mean 1x1 degree CERES Terra SRBAVG GEO data is used for optical depth and cloud fraction. Non-GEO data is used for cloud top height.
- Monthly mean Reynolds SSTs from NOAA.
- ECMWF-Interim data is used for meteorological data.
- Anomalies are calculated by subtracting each month’s value from the five-year mean for that month.

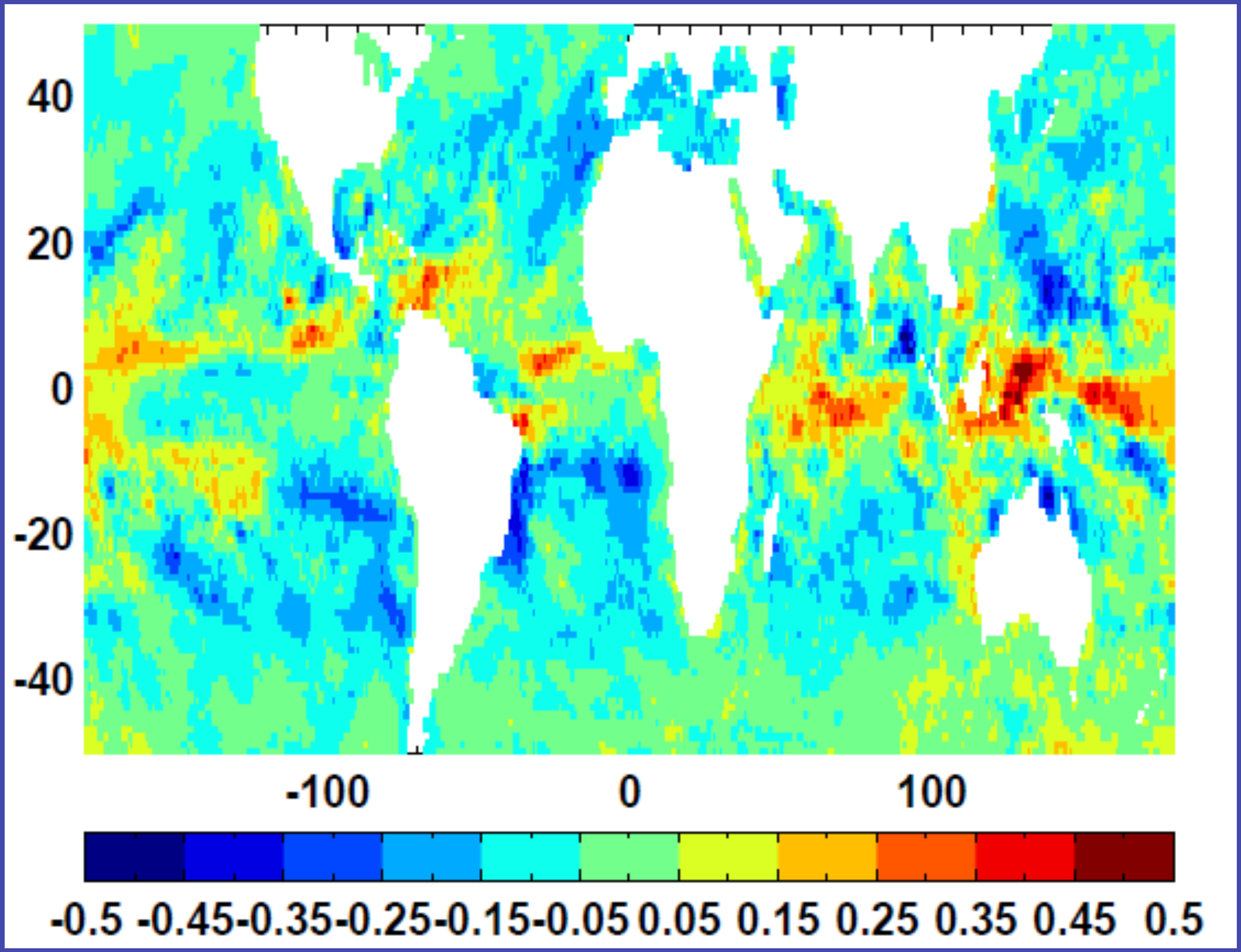
Change in total cloud fraction with SST (%/K)



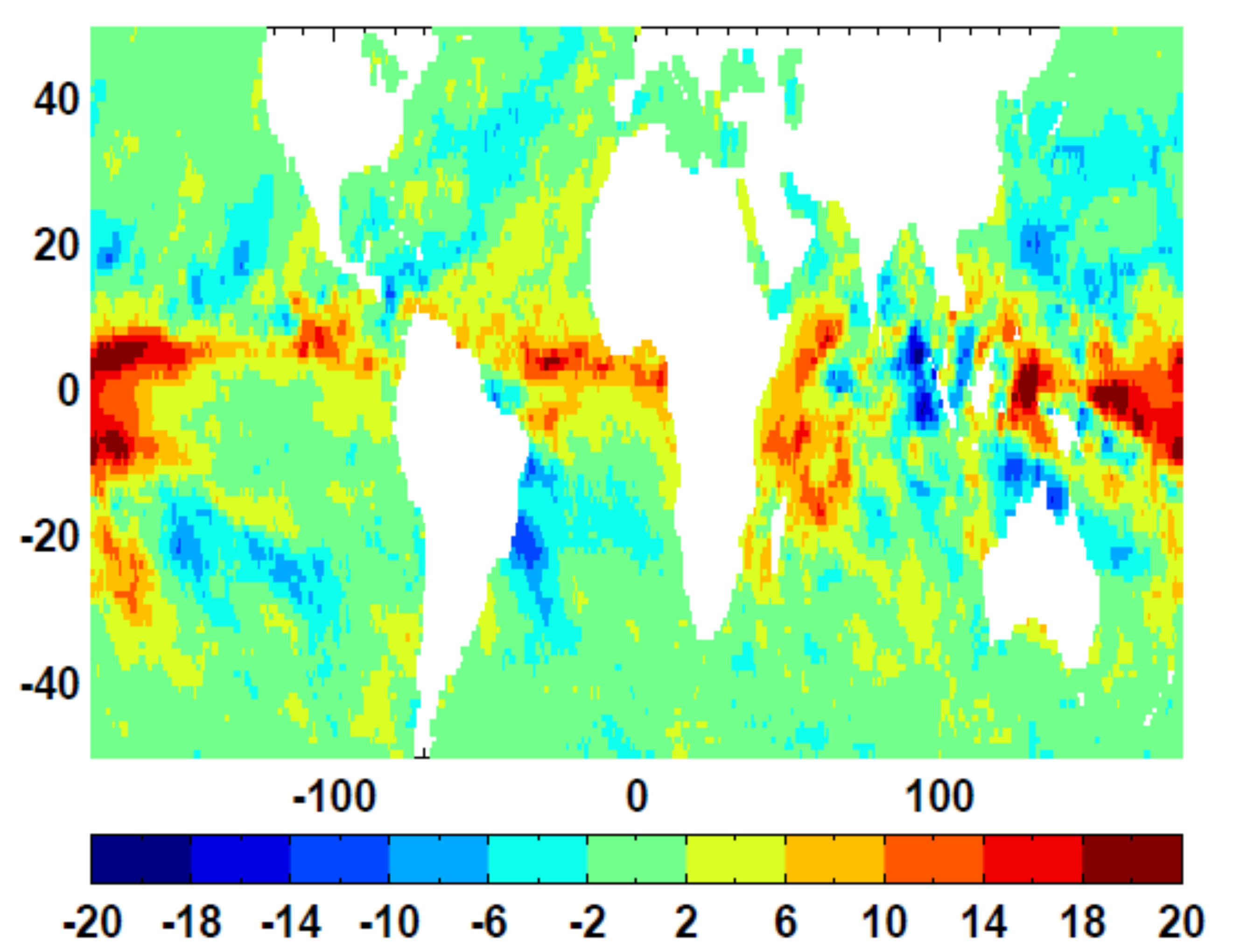
Change in cloud top height with SST (km/K)



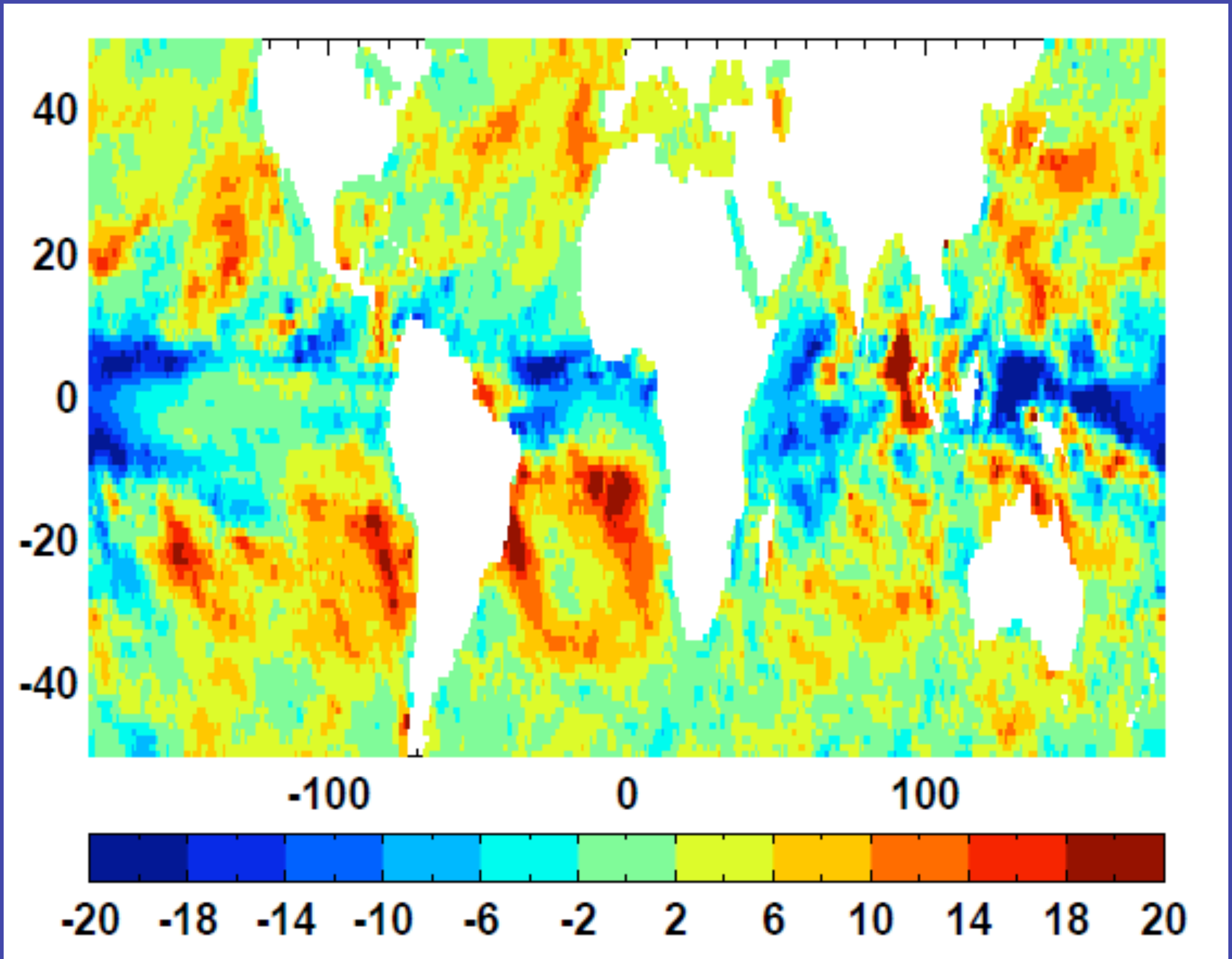
Change in ln(tau) with SST (K^{-1})



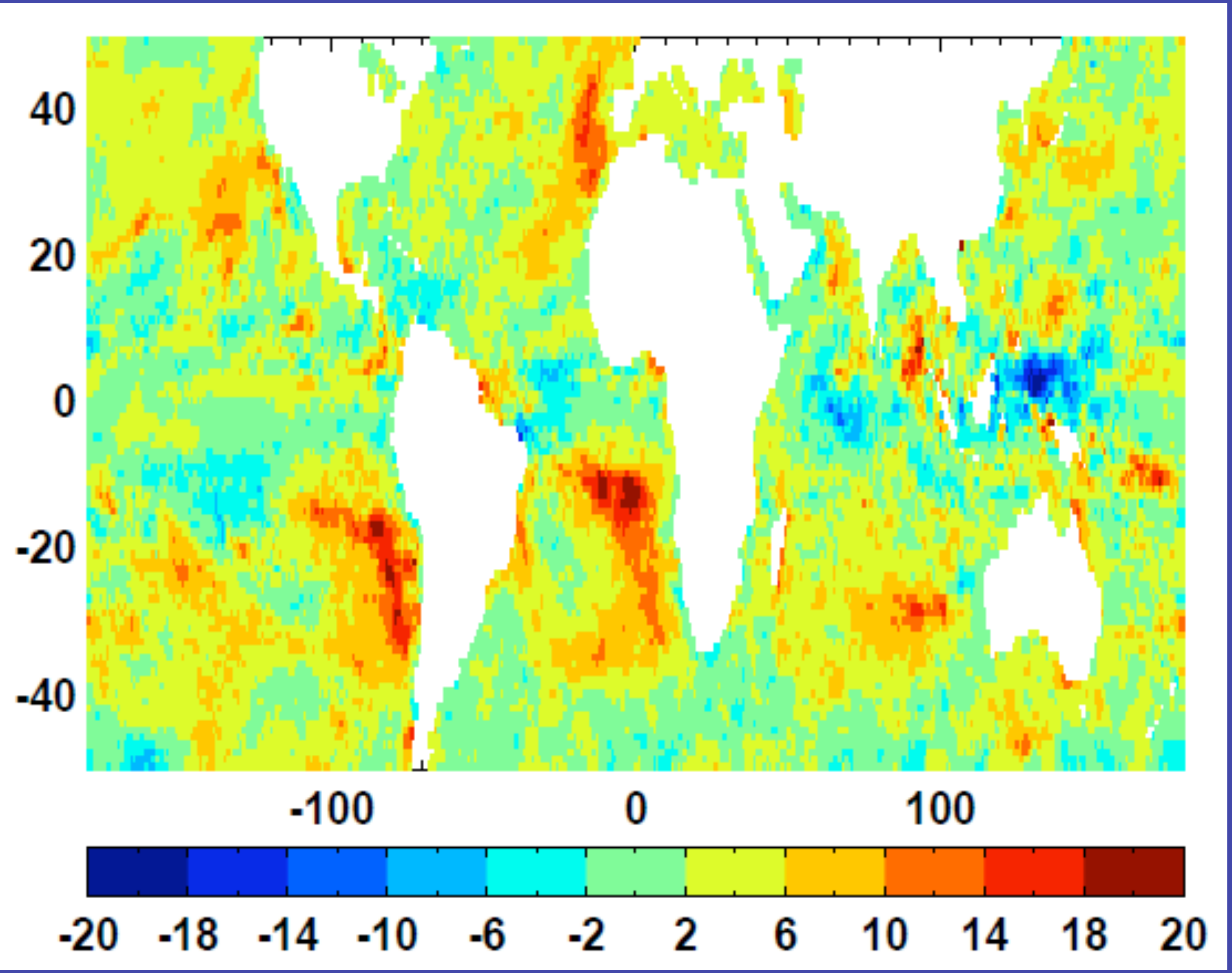
Change in LW CRE with SST (W m^{-2} K^{-1})



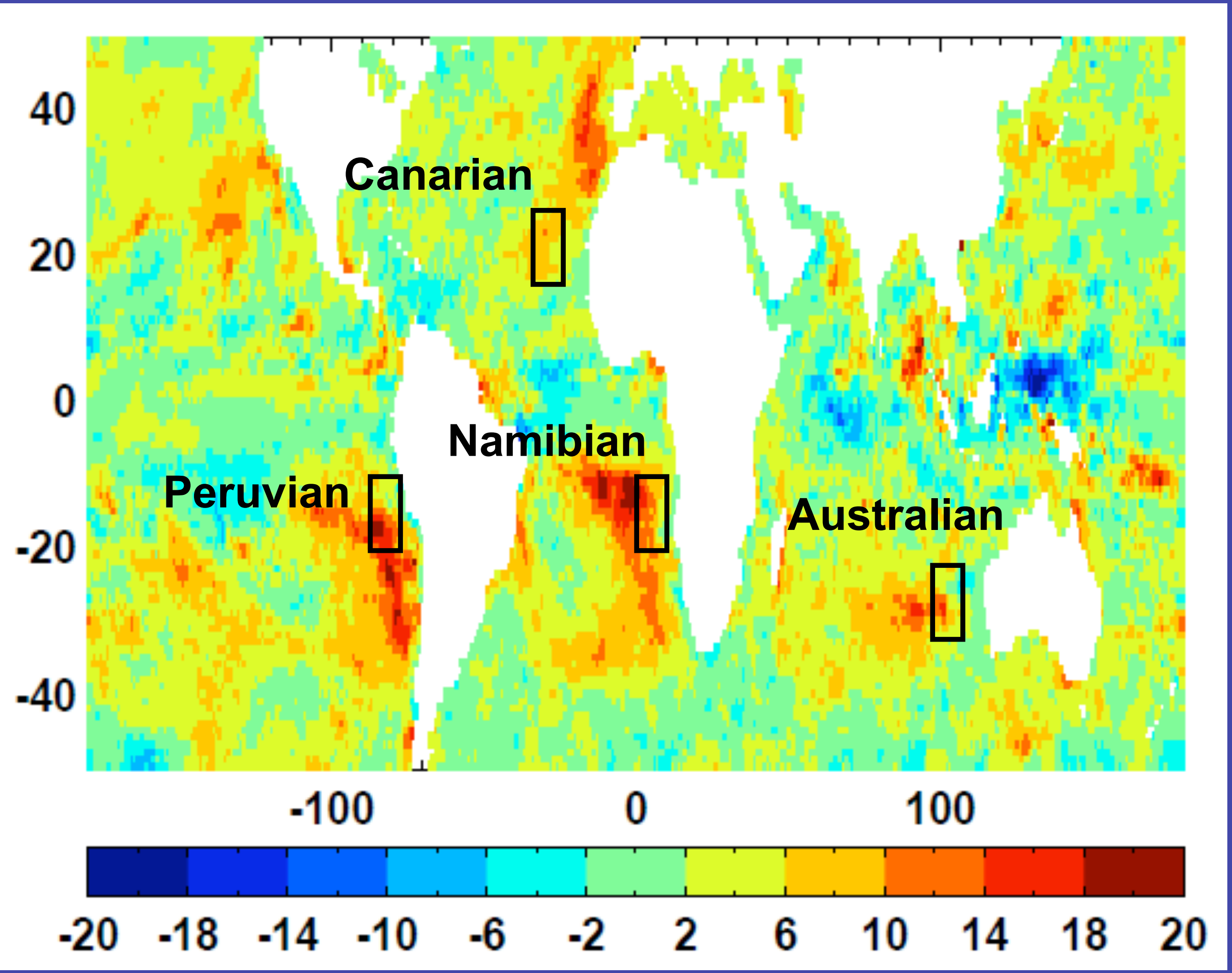
Change in SW CRE with SST (W m^{-2} K^{-1})



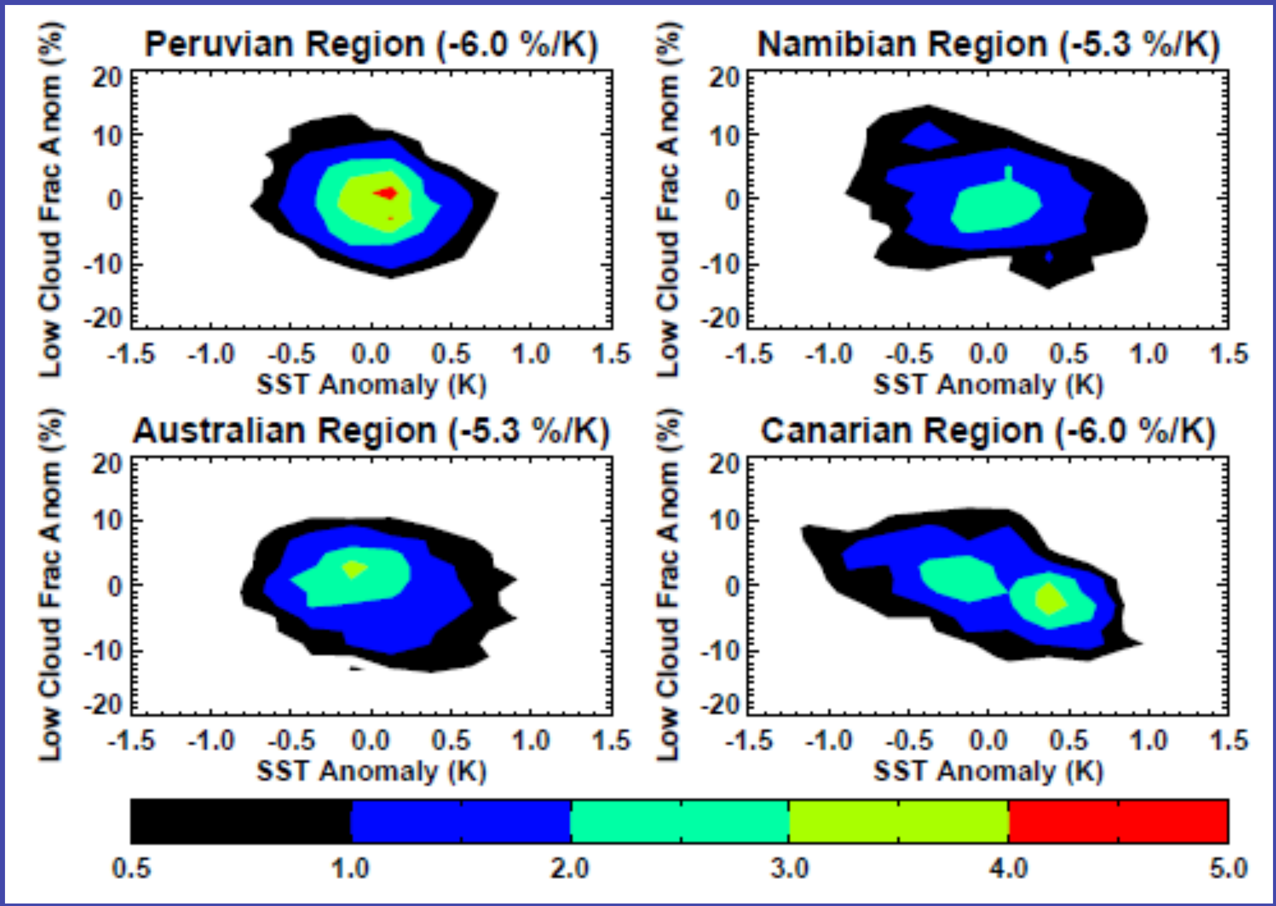
Change in Net CRE with SST (W m^{-2} K^{-1})



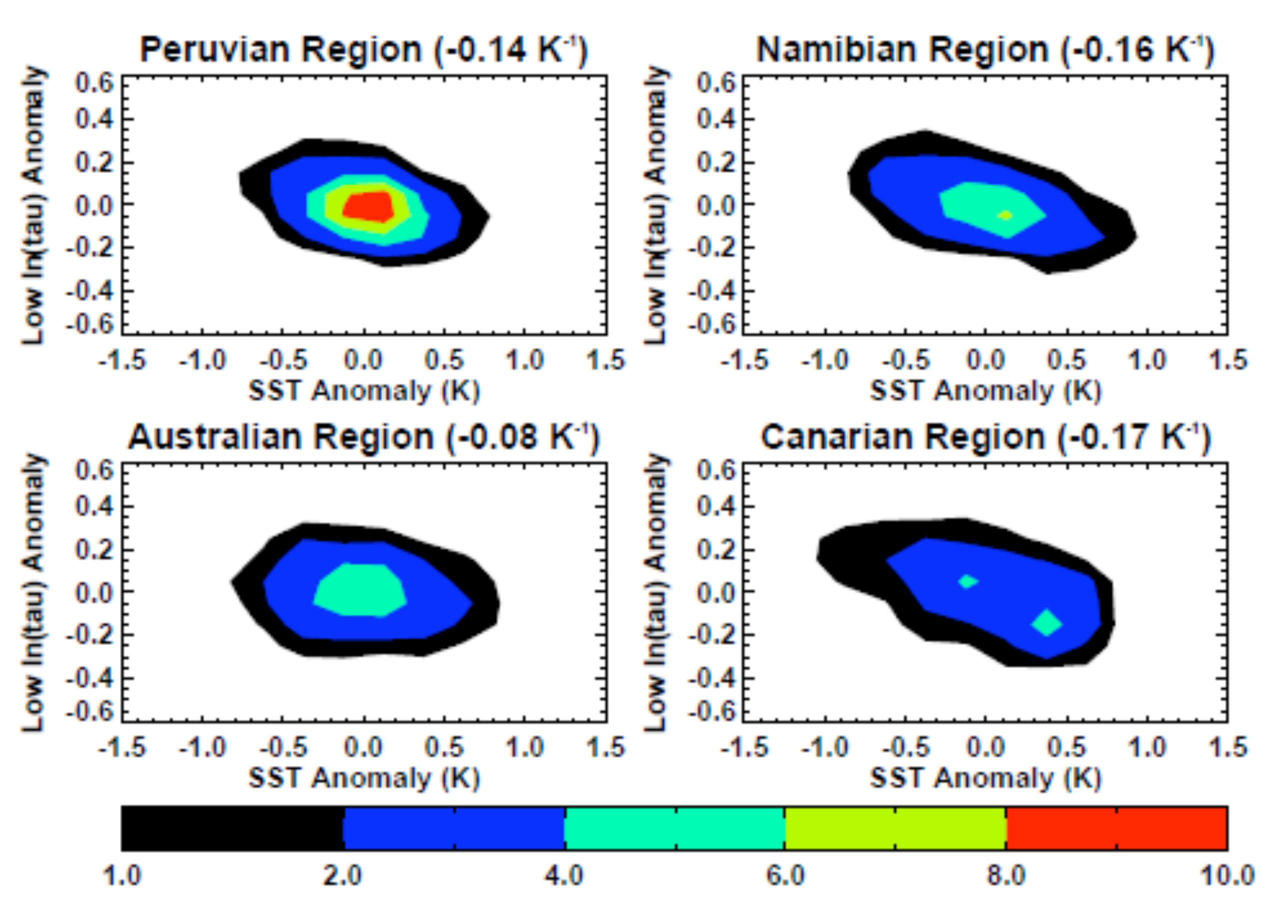
Change in Net CRE with SST (W m^{-2} K^{-1})



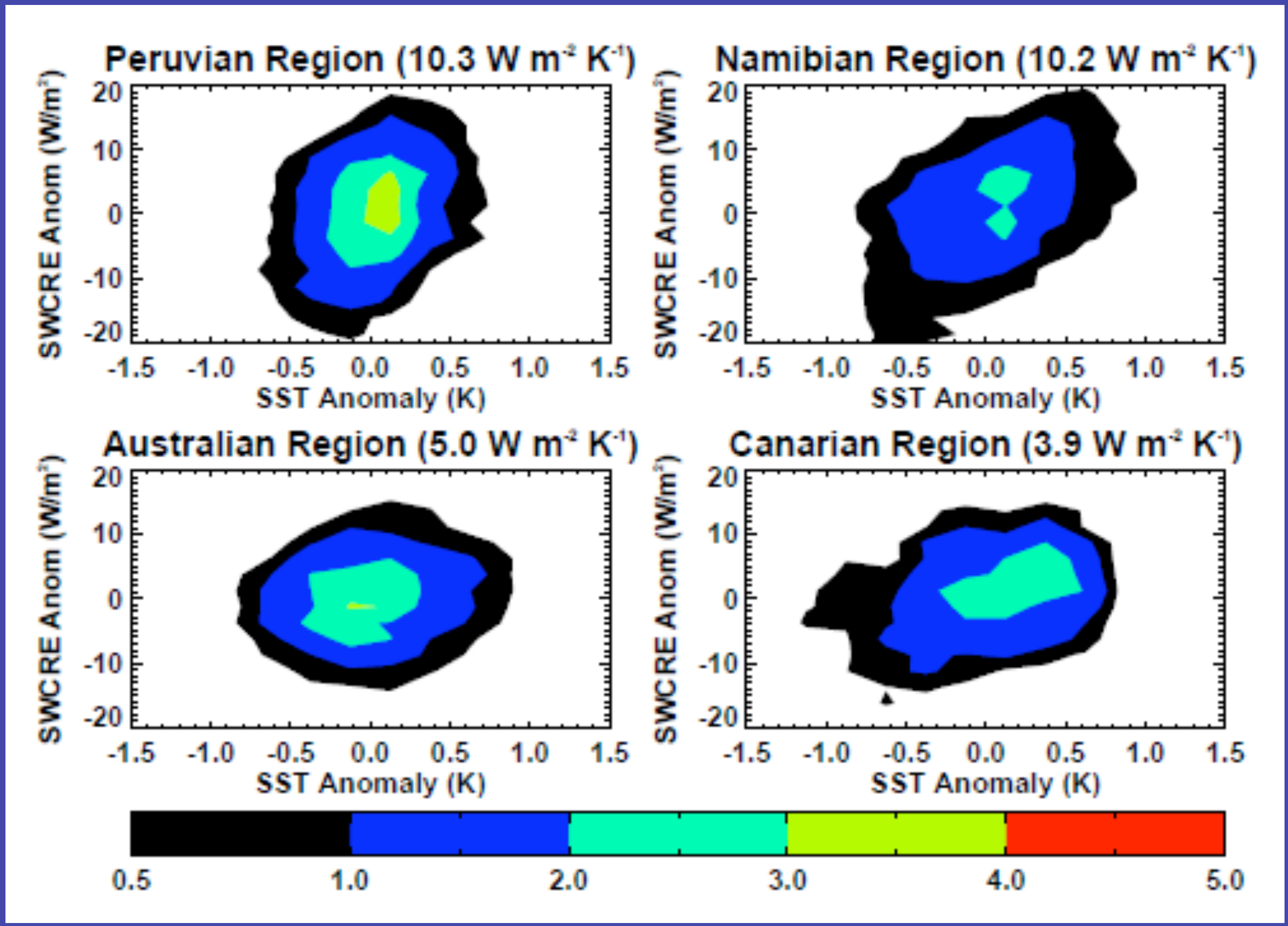
Joint distribution of low cloud fraction and SST anomalies



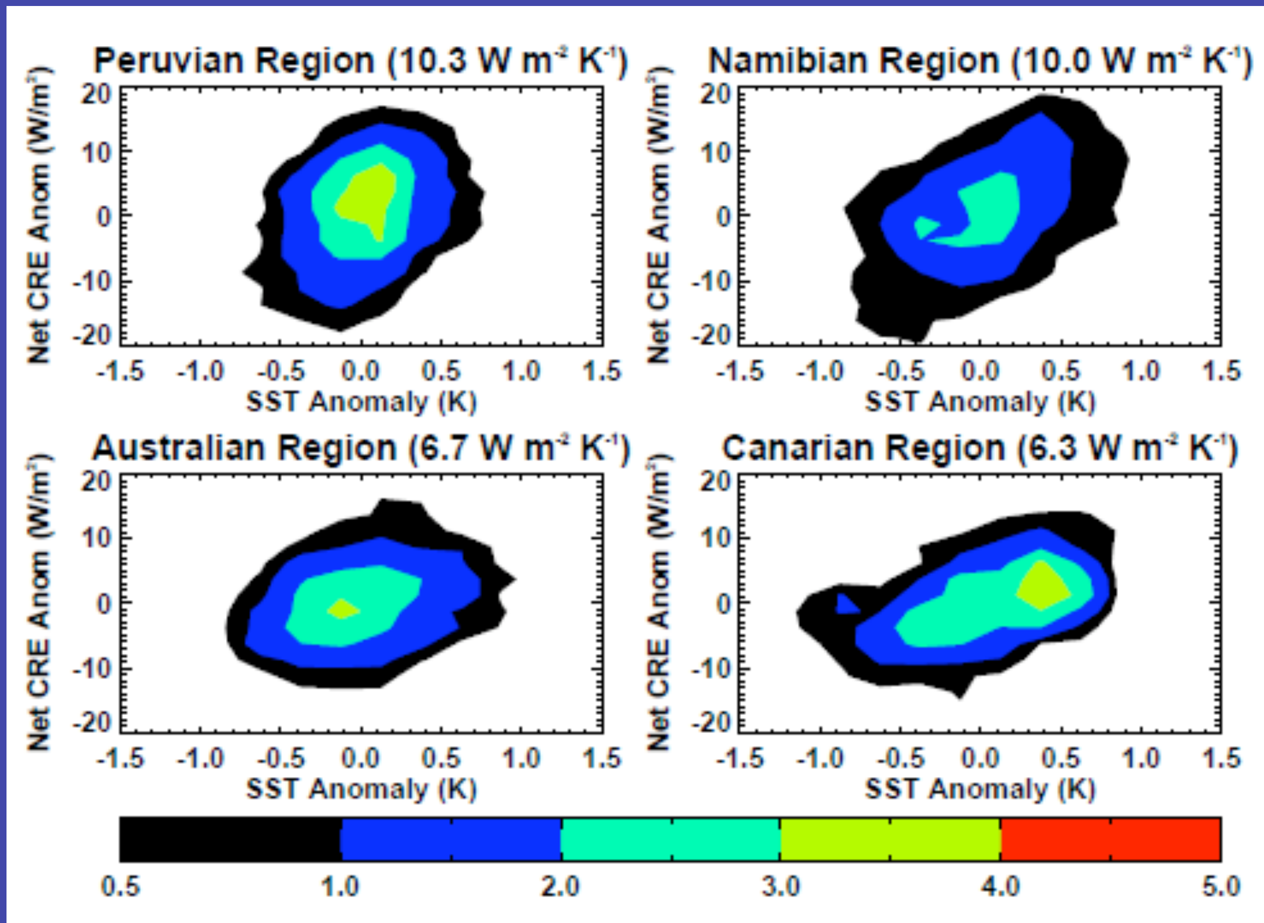
Joint distribution of ln(tau) and SST anomalies



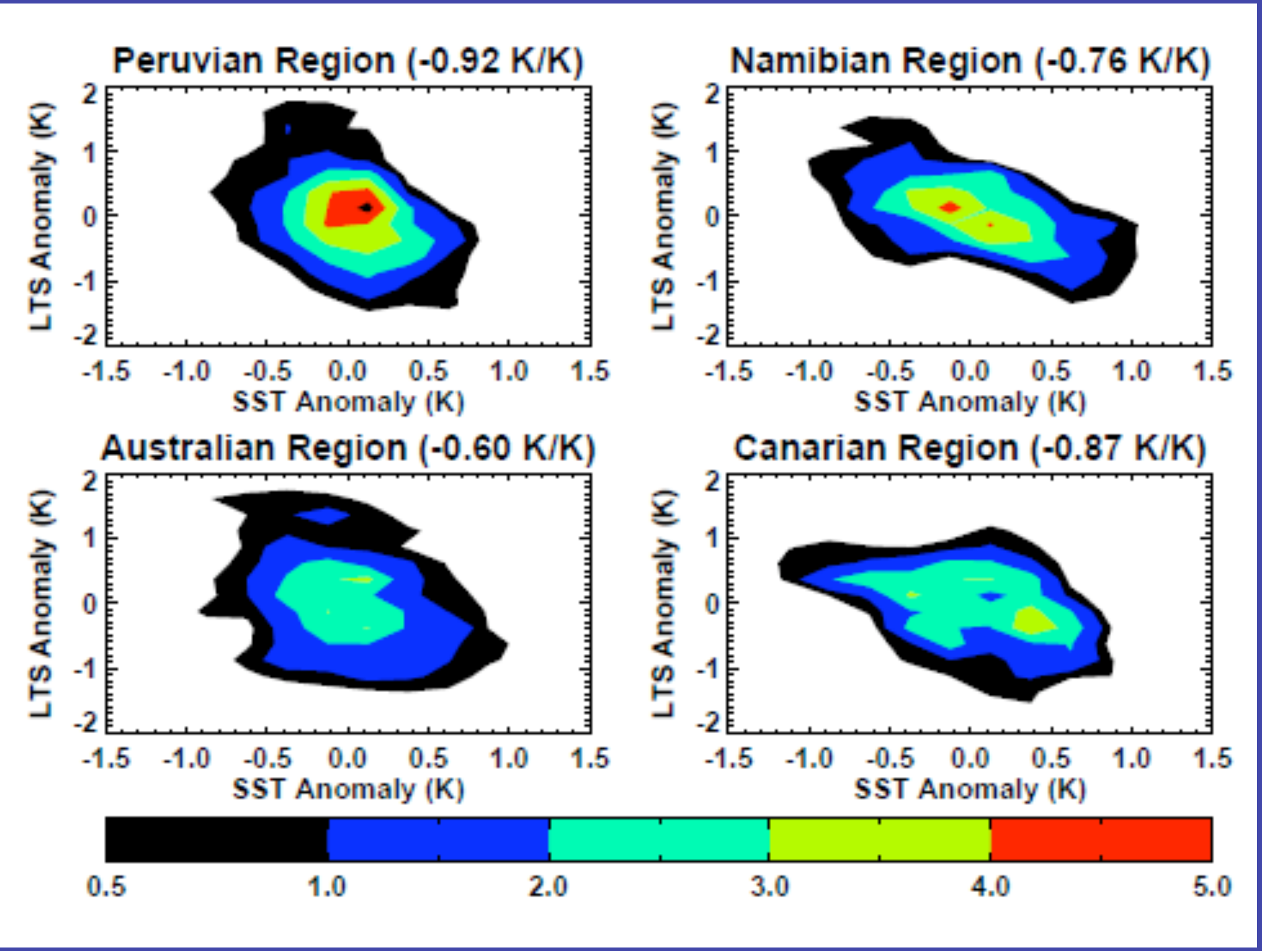
Joint distribution of SW CRE and SST anomalies



Joint distribution of net CRE and SST anomalies



Joint distribution of LTS (θ_{700}-θ_{sfc}) and SST anomalies



Summary

- Near the ITCZ, cloud top heights, cloud fraction and cloud optical depth all increase with SST, leading to little change in net CRE.
- In subtropical boundary-layer cloud regions, cloud fraction and cloud optical depth decrease with SST, leading to less shortwave cooling.
- Looking at individual boundary-layer cloud regions indicates that cloud property and flux anomalies have similar trends with SST anomaly across these regions. The decreases in cloud cover and optical depth may be due to decreases in lower-tropospheric stability.

Future Work

- Look at additional fields.
- Perhaps refine definition of boundary-layer cloud region to something based on low cloud occurrence.
- Are these results observable in terms of boundary-layer cloud objects? For example, do overcast cloud objects become thinner, and/or less frequent with increases in SST anomaly?