MAGNITUDE AND SYMMETRY OF DIVERGENT HEAT FLUX ANOMALIES ASSOCIATED WITH THE EL NIÑO-SOUTHERN OSCILLATION

Presented by: Evan Kutta

Co-authors: Jason Hubbart, Tim Eichler, and Anthony Lupo

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OUTLINE

- Motivation
- Materials and Methods
- Results
- Directions for Future Work
- Conclusions
- Acknowledgements

MOTIVATION

- ENSO alters surface heat fluxes and horizontal transport
  - Surface temperature and precipitation anomalies
  - Equal and opposite impacts during ENSO phases?
- Limited and irregularly spaced observations
  - Modelling efforts are needed
  - Subgrid-scale parameterizations
- Residual of energy budget is physical proxy
  - Latent heat → precipitation and evaporation
  - Sensible heat → surface temperatures

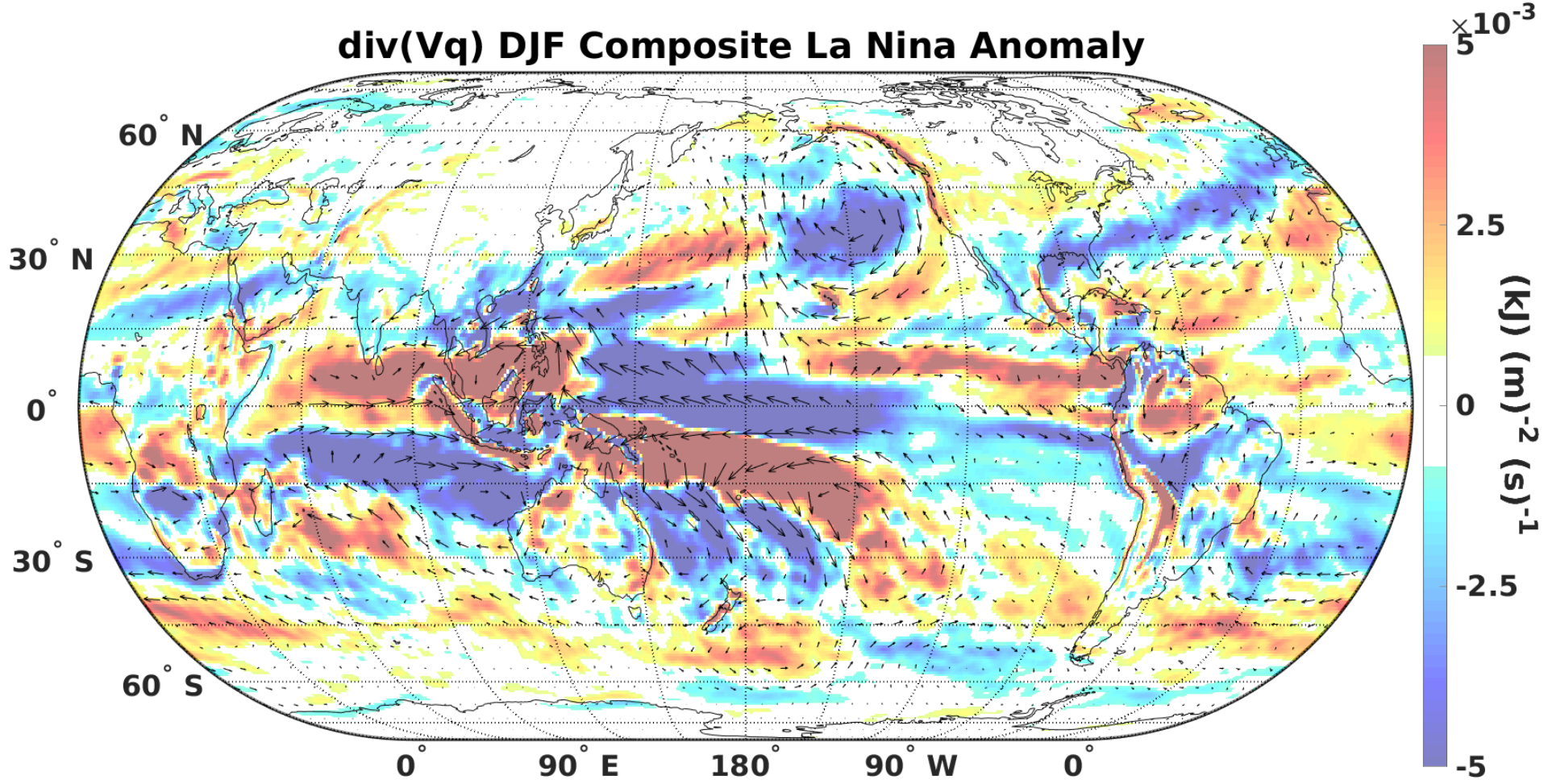
MATERIALS AND METHODS

- ERA-Interim Reanalysis: 1979 to 2016
- Temperature (T), specific humidity (q), and wind (v) on lowest 30 model levels
  - High spatial (~80km) and temporal (6-hourly) res.
- Mass-weighted vertical averages
  - Sensible $\langle vT \rangle$ and latent $\langle vq \rangle$ heat flux
  - Divergence → sources and sinks
  - Units converted to kJ m^{-2} s^{-1}

ENSO AND SYMMETRY

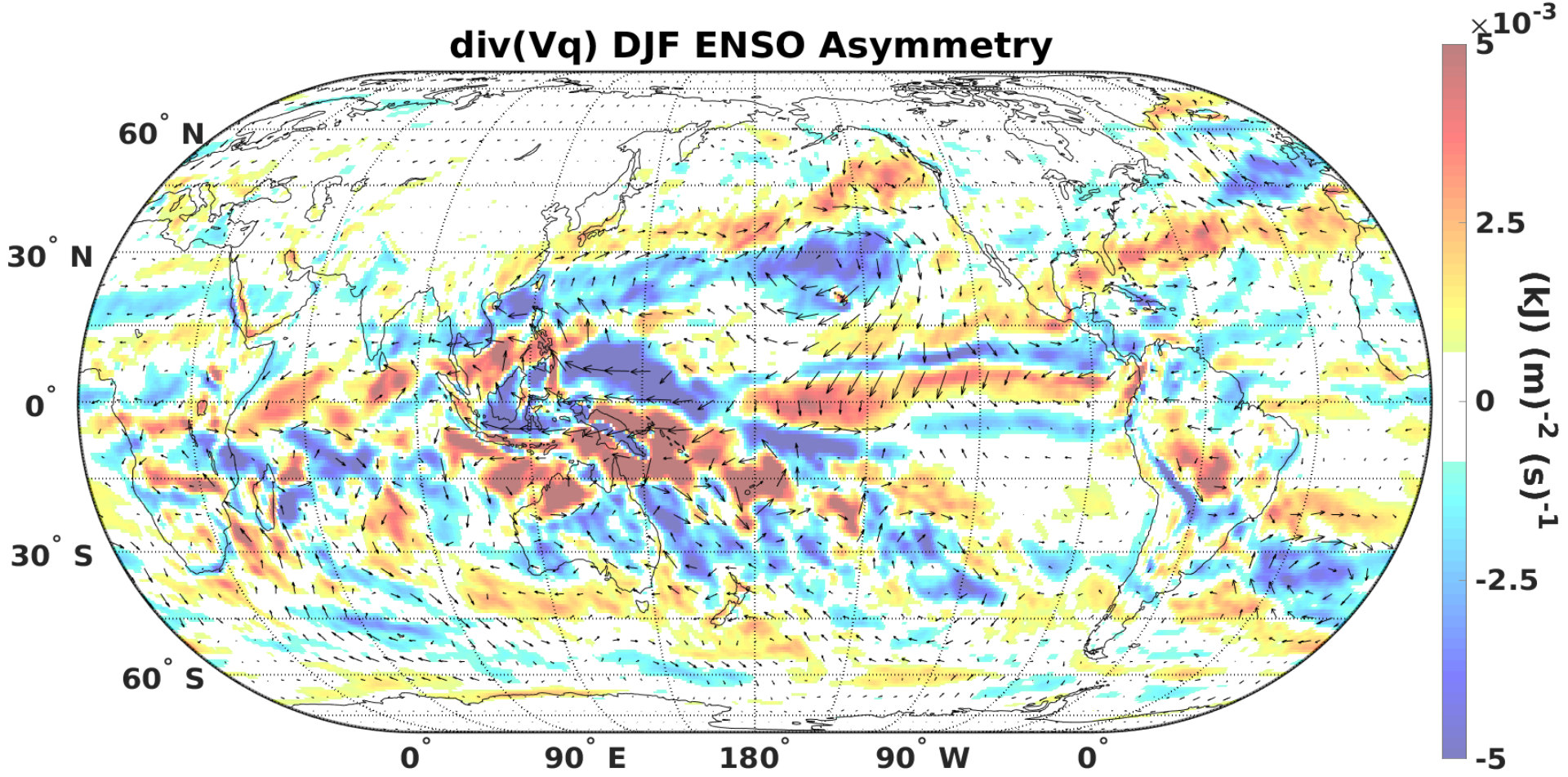
- ONI values used to identify ENSO events
  - 13 El Nino and 12 La Nina events
  - Composite analyses during DJF
- Symmetry = El Nino – La Nina
  - (+) – (-)
- Asymmetry = El Nino + La Nina
  - (+) + (-)

Latent Heat Flux Divergence



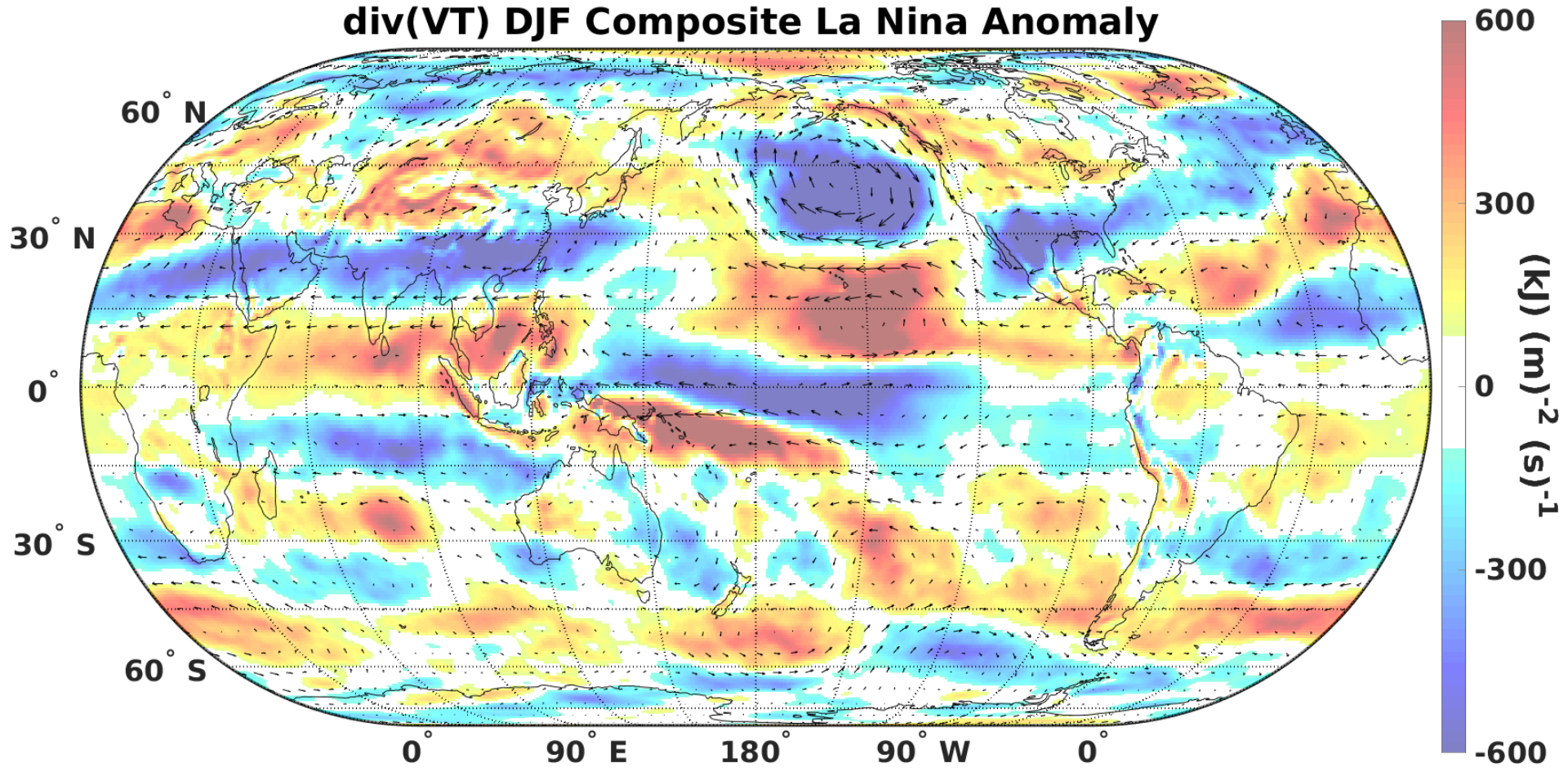
- Divergence → below normal precip and vice versa
- Decreasing magnitude with increasing latitude
  - Larger values over oceans and near coastlines

Latent Heat Flux Symmetry



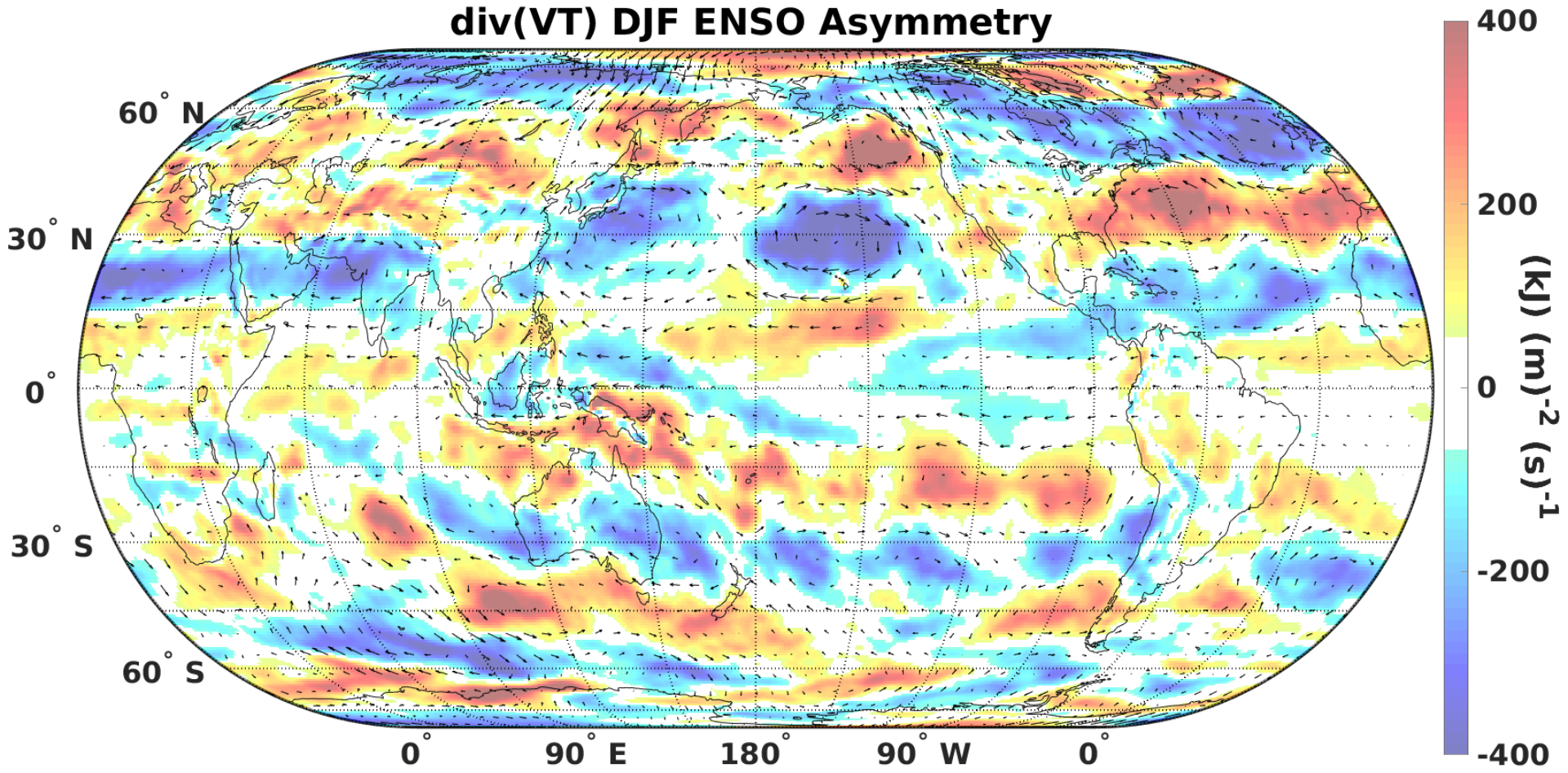
- Symmetric component is often larger
  - Both components same order of magnitude
- Asymmetry → differences in position or magnitude

Sensible Heat Flux Divergence



- Divergence → warmer than normal and vice versa
- Alternating sign with increasing latitude
- Larger northern hemisphere anomalies

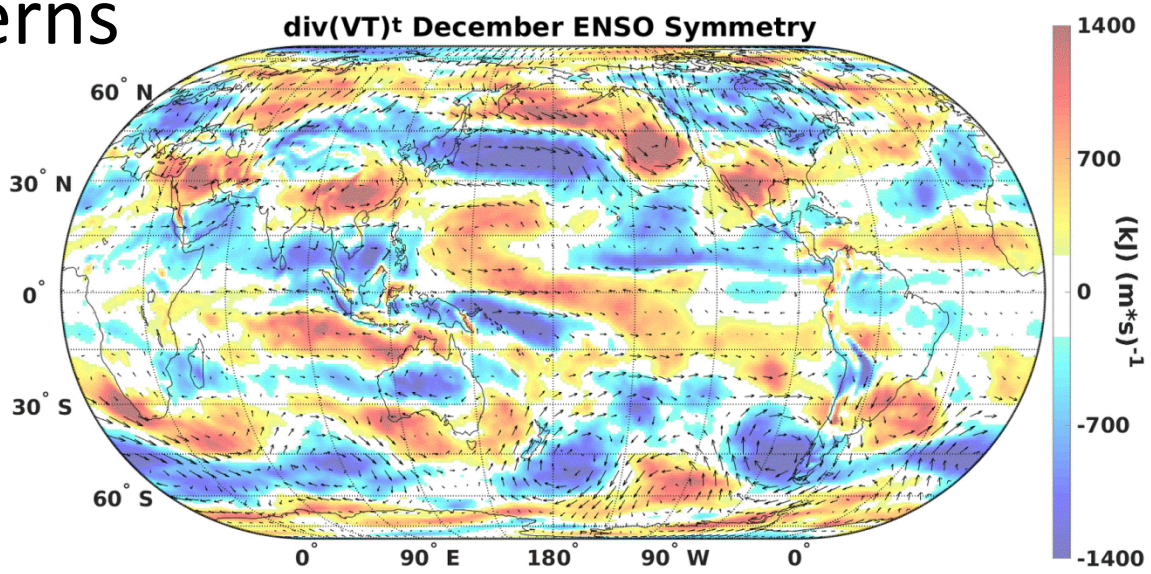
Sensible Heat Flux Symmetry

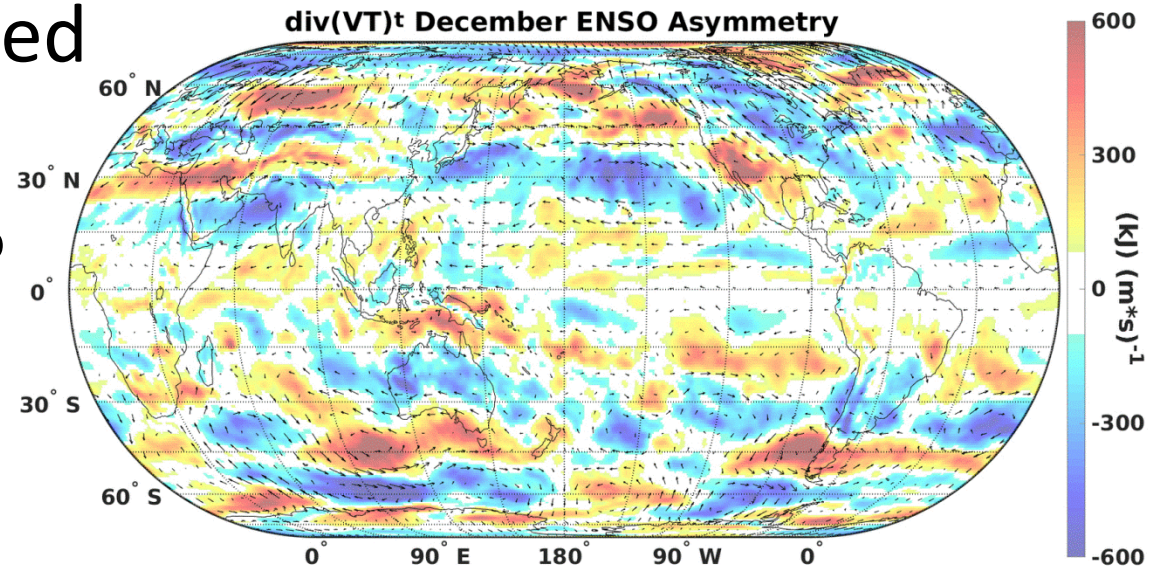


- Symmetry may show PNA and NAO patterns
- Generally more asymmetric at higher latitudes
  - Aleutian and Icelandic low positioning

Directions for Future Work

- Intra-seasonal patterns
- Different ENSO classifications
  - MEI or SOI
- ENSO diversity
  - East vs. West based
- Metric for climate model assessment?





CONCLUSIONS

- Physically based proxy of temperature and precipitation anomalies that circumvents parameterizations
- Symmetry and asymmetry are fundamental to ENSO-induced temperature and precipitation anomalies
  - ENSO phases aren't equal and opposite
- Horizontal redistribution of anomalous surface heat fluxes
  - Similar magnitude in both hemispheres

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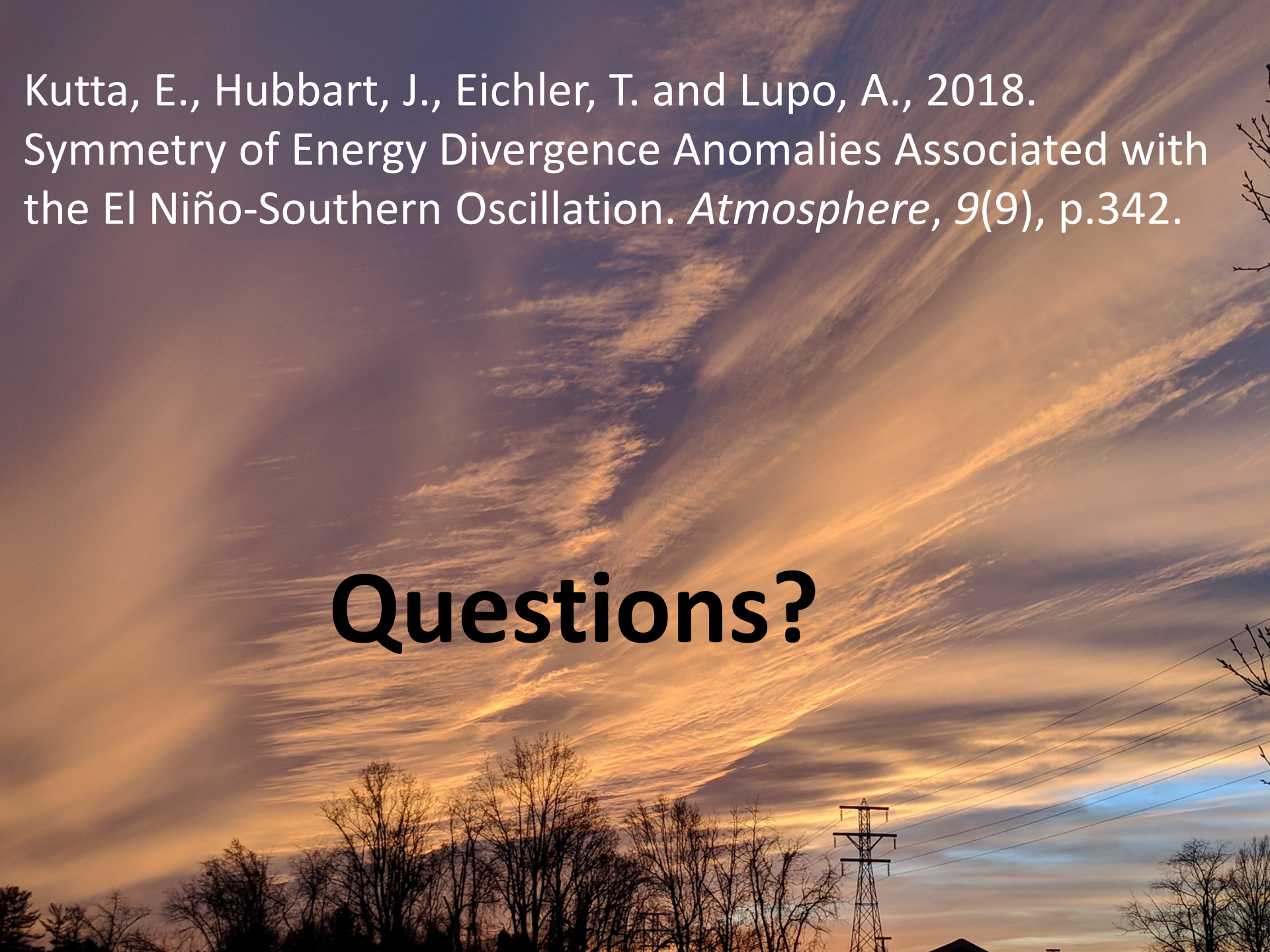
Kutta, E., Hubbart, J., Eichler, T. and Lupo, A., 2018. Symmetry of Energy Divergence Anomalies Associated with the El Niño-Southern Oscillation. *Atmosphere*, *9*(9), p.342.
Questions?