

## References

- Adam, O., T. Bischoff, and T. Schneider, Seasonal and interannual variations of the energy flux equator and itcz. part i: Zonally averaged itcz position, *J. Climate*, 29(9), 3219–3230, 2016a.
- Adam, O., T. Bischoff, and T. Schneider, Seasonal and interannual variations of the energy flux equator and itcz. part ii: Zonally varying shifts of the itcz, *J. Climate*, 29(20), 7281–7293, 2016b.
- Armour, K., N. Siler, A. Donohoe, and G. Roe, Meridional atmospheric heat transport constrained by energetics and mediated by large-scale diffusion., *J. Climate*, 32(12), 3655–3680, doi:10.1175/JCLI-D-18-0563.1, 2019.
- Atwood, A., A. Donohoe, D. Battisti, X. Liu, and F. Pausata, Robust longitudinally variable response of the itcz to a myriad of climate forcings., *Geophys. Res. Lett.*, p. In Press., 2020.
- Baggett, C., and S. Lee, Arctic warming induced by tropically forced tapping of available potential energy and the role of the planetary-scale waves, *J. Atmos. Sci.*, 72(4), 1562–1568, doi:10.1175/JAS-D-14-0334.1, 2015.
- Blanchard-Wrigglesworth, E., K. Armour, C. Bitz, and E. DeWeaver, Persistence and inherent predictability of arctic sea ice in a gcm ensemble and observations., *J. Climate*, 24, 231–250, 2011.
- Blanchard-Wrigglesworth, E., A. Donohoe, A. DuVivier, and D. Bailey, Sea ice variability across timescales in observations and earth system models., *Geophys. Res. Lett.*, 2020.
- Boos, W., and R. Koorty, Energy budget control of the regional itcz: A theory for mid-holocene rainfall., *Nat. Geo. Sci.*, 9, 892–897, 2016.
- Cardinale, C., B. Rose, A. Lang, and A. Donohoe, Stratospheric and tropospheric flux contributions to the polar cap energy budgets, *J. Climate*, p. In Review, 2020.
- Ceppi, P., Y. Hwang, D. Frierson, and D. L. Hartmann, Southern hemisphere jet latitude biases in cmip5 models linked to shortwave cloud forcing., *Geophys. Res. Lett.*, 39, L19,708, doi:10.1029/2012GL053115, 2012.
- Chiang, J., and A. Friedman, Extratropical cooling, interhemispheric thermal gradients, and tropical climate change, *Annu. Rev. Earth Planet. Sci.*, 40, 383–412, 2012.
- Cox, T., A. Donohoe, K. Armour, D. Frierson, and G. Roe, Radiative and dynamic controls on meridional heat transport under altered rotation rate, *J. Climate*, p. In Review, 2020.
- Czaja, A., and J. Marshall, The partitioning of poleward heat transport between the atmosphere and the ocean., *J. Atmos. Sci.*, 63, 1498–1511, 2006.
- Ding, Q., A. Schweiger, M. LŠHeureux, D. Battisti, S. Po-Chedley, N. Johnson, E. Blanchard-Wrigglesworth, K. Harnos, Q. Zhang, R. Eastman, and E. Steig, Influence of high-latitude atmospheric circulation changes on summertime arctic sea ice, *Nat. Clim. Chang.*, 7, 289–295, 2017.
- Donohoe, A., and D. Battisti, The amplitude asymmetry between synoptic cyclones and anticyclones: Implications for filtering methods in feature tracking, *Mon. Weath. Rev.*, 137(11), 3874–3887, 2009.
- Donohoe, A., and D. Battisti, Atmospheric and surface contributions to planetary albedo., *J. Climate*, 24(16), 4401–4417, 2011.

- Donohoe, A., and D. Battisti, What determines meridional heat transport in climate models?, *J. Climate*, 25, 3832–3850, 2012.
- Donohoe, A., and D. Battisti, The seasonal cycle of atmospheric heating and temperature, *J. Climate*, 26(14), 4962–4980, 2013.
- Donohoe, A., and A. Voigt, Why future shifts in tropical precipitation will likely be small: the location of the tropical rain belt and the hemispheric contrast of energy input to the atmosphere, in *Patterns of Climate Extremes; Trends and Mechanisms*, edited by S. Wang, J. Yoon, R. Gillies, and C. Funk, American Geophysical Union Books, 2015.
- Donohoe, A., D. Frierson, and D. Battisti, The effect of ocean mixed layer depth on climate in slab ocean aquaplanet experiments, *Climate Dyn.*, 26, 15 Pages, doi:10.1007/s00382-013-1843-4, 2013a.
- Donohoe, A., J. Marshall, D. Ferreira, K. Armour, and D. McGee, The inter-annual variability of tropical precipitation and inter-hemispheric energy transport, *J. Climate*, 27(9), 3377–3392, 2013b.
- Donohoe, A., J. Marshall, D. Ferreira, and D. McGee, The relationship between itcz location and atmospheric heat transport across the equator: from the seasonal cycle to the last glacial maximum, *J. Climate*, 26(11), 3597–3618, 2013c.
- Donohoe, A., A. Atwood, and M. Byrne, Controls on the width of tropical precipitation and its contraction under global warming., *Geophys. Res. Lett.*, 46, 9958–9967, doi:10.1029/2019GL082969, 2019.
- Donohoe, A., K. Armour, G. Roe, and D. Battisti, The partitioning of meridional heat transport from the Last Glacial Maximum to CO<sub>2</sub> quadrupling in coupled climate models, *J. Climate*, 33(10), 4141–4165, 2020a.
- Donohoe, A., E. Dawson, L. McMurdie, D. Battisti, and A. Rhines., Seasonal asymmetries in the lag between insolation and surface temperature, *J. Climate*, 33(10), 3921–3945, 2020b.
- Donohoe, A., J. Marshall, D. Ferreira, and D. McGee, Shifting contracting and intensifying modes of tropical precipitation changes in response to a myriad of external forcings., *Geophys. Res. Lett.*, p. In review, 2020c.
- Enderton, D., and J. Marshall, Controls on the total dynamical heat transport of the atmosphere and oceans., *J. Atmos. Sci.*, 66, 1593–1611, 2009.
- Eyring, V., S. Bony, G. A. Meehl, C. A. Senior, B. Stevens, R. J. Stouffer, and K. E. Taylor, Overview of the coupled model intercomparison project phase 6 (cmip6) experimental design and organization, *Geoscientific Model Development (Online)*, 9(5), doi:10.5194/gmd-9-1937-2016, 2016.
- Fasullo, J. T., and K. E. Trenberth, The annual cycle of the energy budget: Part 1. global mean and land-ocean exchanges., *J. Climate*, 21, 2297–2312, 2008.
- Frierson, D., I. Held, and P. Z. Gotor, A gray-radiation aquaplanet moist gcm. part i: Static stability and eddy scale, *J. Climate*, 63, 2548–2566, 2006.
- Frierson, D., I. Held, and P. Z. Gotor, A gray-radiation aquaplanet moist gcm. part ii: Energy transports in altered climates, *J. Climate*, 64, 1680–1693, 2007.
- Frierson, D., Y. Hwang, N. Fuckar, R. Seager, S. Kang, A. Donohoe, E. Maroon, X. Liu, and D. Battisti, Why does tropical rainfall peak in the northern hemisphere? the role of the oceans meridional overturning circulation, *Nat. Geo. Sci.*, 6, 940–944, 2013.

- Frierson, D. M. W., and Y.-T. Hwang, Extratropical influence on itcz shifts in slab ocean simulations of global warming., *J. Climate*, 25, 720–733, 2012.
- Gelaro, R., W. McCarty, M. Suárez, R. Todling, A. Molod, L. Takacs, C. Randles, A. Darmenov, M. Bosilovich, R. Reichle, K. Wargan, L. Coy, R. Cullather, C. Draper, S. Akella, V. Buchard, A. Conaty, A. da Silva, W. Gu, G. Kim, R. Koster, R. Lucchesi, D. Merkova, J. Nielsen, G. Partyka, S. Pawson, W. Putman, M. Rienecker, S. Schubert, M. Sienkiewicz, and B. Zhao, The modern-era retrospective analysis for research and applications, version 2 (merra-2), *J. Climate*, 2017.
- Graversen, R., T. Mauritsen, M. Tjernstrom, E. Kallen, and G. Svensson, Arctic amplification enhanced by latent energy transport of atmospheric planetary waves, *Quart. J. Roy. Meteor. Soc.*, 142(698), 2046–2054, 2007.
- Graversen, R., T. Mauritsen, M. Tjernstrom, E. Kallen, and G. Svensson, Vertical structure of recent arctic warming, *Nature*, 451, 53–56, 2008.
- Hersbach, H. B. B., P. Berrisford, S. Hirahara, A. Horanyi, J. M. Sabater, J. Nicolas, and C. Peubey, The era5 global reanalysis, *Quart. J. Roy. Meteor. Soc.*, doi:10.1002/qj.3803, 2020.
- Hill, S., Y. Ming, and I. Held, Mechanisms of forced tropical meridional energy flux change, *J. Climate*, 28, 1725–1742, 2015.
- Hwang, Y., and D. Frierson, Increasing atmospheric poleward energy transport with global warming., *Geophys. Res. Lett.*, 37, L24,807, 2010.
- Hwang, Y., and D. Frierson, Link between the double-intertropical convergence zone problem and cloud bias over southern ocean., *Proc. Nat. Acad. Sci. USA*, 110, 4935–4940, 2013.
- Hwang, Y., D. Frierson, and J. Kay, Coupling between arctic feedbacks and changes in poleward energy transport, *Geophys. Res. Lett.*, 38, L17,704, doi:10.1029/2011GL048546, 2011a.
- Hwang, Y., D. Frierson, B. Soden, and I. Held, Corrigendum for held and soden (2006), *J. Climate*, 24(5), 1559–1560, 2011b.
- Inoue, K., and L. Back, Gross moist stability analysis: Assessment of satellite-based products in the gms plane, *J. Atmos. Sci.*, 74, 1819–1837, 2017.
- Johnson, G., J. Lyman, and N. Loeb, Improving estimates of earth’s energy imbalance, *Nat. Clim. Chang.*, 6(7), 639–640, 2009.
- Kalnay, E., M. Kanamitsu, R. Kistler, W. Collins, D. Deaven, L. Gandin, M. Iredell, S. Saha, G. White, J. Woollen, Y. Zhu, A. Leetmaa, B. Reynolds, M. Chelliah, W. Ebisuzaki, W. Higgins, J. Janowiak, K. C. Mo, C. Ropelewski, J. Wang, R. Jenne, and D. Joseph, The NCEP/NCAR 40-year reanalysis project., *Bull. Amer. Meteor. Soc.*, [accessed 07-January-2018, <https://www.esrl.noaa.gov/psd/data/gridded/data.ncep.reanalysis.html>], 1996.
- Kang, S., I. Held, D. Frierson, and M. Zhao, The response of the itcz to extratropical thermal forcing: idealized slab-ocean experiments with a gcm., *J. Climate*, 21, 3521–3532, 2008.
- Kaspi, Y., and T. Schneider, The role of stationary eddies in shaping midlatitude storm tracks, *J. Atmos. Sci.*, 70(8), 2596–2613, 2013.

- Kato, S., N. Loeb, F. Rose, D. Doeling, D. Rutan, T. Caldwell, L. Yu, and R. Weller, Surface irradiances consistent with CERES-derived top of atmosphere shortwave and longwave irradiances, *J. Climate*, *26*, 2719–2741, 2013.
- Kay, J., M. Holland, and A. Jahn, Inter-annual to multi-decadal arctic sea ice extent trends in a warming world, *Geophys. Res. Lett.*, *38*(L08503), doi:10.1029/2011GL048008, 2011.
- Kim, H., S. Kang, K. Takahashi, A. Donohoe, and A. Pendergrass, Mechanisms of tropical precipitation biases in climate models, *Climate Dyn.*, p. In Press, 2020.
- Kwok, R., Observational assessment of arctic ocean sea ice motion, export, and thickness in cmip3 climate simulations., *J. Geophys. Res.*, *116*(C8), doi:10.1029/2011JC007004, 2011.
- Liang, M., A. Czaja, R. Graversen, and R. Tailleux, Poleward energy transport: is the standard definition physically relevant at all time scales?, *Climate Dyn.*, *50*, 1785–1797, 2018.
- Liu, C., R. Allan, P. Berrisford, M. Mayer, P. Hyder, N. Loeb, and D. Smith, Combining satellite observations and reanalysis energy transports to estimate global net surface energy fluxes 1985–2012, *jgr*, *18*, 9374–9389, 2015.
- Liu, X., D. Battisti, and G. Roe, The effect of cloud cover on the meridional heat transport: Insights from varying rotation rate experiments, *J. Climate*, *30*, 7465–7479, 2017.
- Lucarini, V., and F. Ragone, Energetics of IPCC4AR4 climate models: energy balance and meridional enthalpy transports., *Rev. Geophys.*, *49*, RG1001, 2011.
- Mahlstein, I., and R. Knutti, September arctic sea ice predicted to disappear near 2 degrees c global warming above present., *J. Geophys. Res.*, *117*(D06104), 2012.
- Marshall, J., A. Donohoe, D. Ferreira, and D. McGee, The oceans role in setting the mean position of the inter-tropical convergence zone, *Climate Dyn.*, p. 14, doi:10.1007/s00382-013-1767-z, 2013.
- Mayer, M., L. Haimberger, J. Edwards, and P. Hyder, Toward consistent diagnostics of the coupled atmosphere and ocean energy budgets, *jcli*, *22*(30), 9225–9246, 2017.
- McGee, D., A. Donohoe, J. Marshall, and D. ferreira, Changes in tropical precipitation, itcz location and hemispheric energy budgets at the last glacial maximum, heinrich stadial 1, and the mid holocene, *Earth Planet Sci Lett.*, *390*, 69–79, 2014.
- Notz, D., A. Jahn, M. Holland, E. Hunke, F. Massonnet, J. Stroeve, B. Tremblay, and M. Vancoppenolle, The cmip6 sea-ice model intercomparison project (simip): understanding sea ice through climate-model simulations, *Geoscientific Model Development*, *9*, LA–UR–16–25,878, 2016.
- Pithan, F., and T. Mauritsen, Arctic amplification dominated by temperature feedbacks in contemporary climate models, *Nat. Geo. Sci.*, *7*, 181–184, 2014.
- Polvani, L., and K. Smith, Can natural variability explain the observed antarctic sea ice trends? New modeling evidence from CMIP5, *Geophys. Res. Lett.*, *40*(2), 3195–3199, 2013.
- Rencurrell, M., and B. Rose, Exploring the climatic response to wide variations in ocean heat transport on an aquaplanet, *J. Climate*, *31*(16), 6299–6318, 2018.

- Rienecker, M., M. Suarez, R. Gelaro, R. Todling, J. Bacmeister, E. Liu, M. Bosilovich, S. Schubert, L. Takacs, G.-K. Kim, S. Bloom, J. Chen, D. Collins, A. Conaty, A. da Silva, W. Gu, J. Joiner, R. Koster, R. Lucchesi, A. Molod, T. Owens, S. Pawson, P. Pegion, C. Redder, R. Reichle, F. Robertson, A. Ruddick, M. Sienkiewicz, and J. Woollen, Merra: Nasa's modern-era retrospective analysis for research and applications, *J. Climate*, 24, 3624–3648, 2011.
- Roe, G., N. Feldl, K. Armour, Y.-T. Hwang, and D. Frierson, The remote impacts of climate feedbacks on regional climate predictability., *Nat. Geo. Sci.*, 8, 135–139, doi:10.1038/ngeo2346, 2015.
- Schneider, T., T. Bischoff, and G. Haug, Migrations and dynamics of the intertropical convergence zone, *nature*, 513, 45–53, 2014.
- Shaw, T., and Z. Tan, Revisiting the storm track intensity-baroclinicity puzzle for cold, icy climates, *AMS AOFD Conference*, 2019.
- Shaw, T., P. Barpanda, and A. Donohoe, A moist static energy framework for zonal-mean storm-track intensity, *J. Atmos. Sci.*, 75(6), 1979–1994, 2018.
- Siler, N., K. Armour, and G. Roe, Insights into the zonal-mean response of the hydrologic cycle to global warming from a diffusive energy balance model, *J. Climate*, 31, 7481–7493, doi:10.1175/JCLI-D-18-0081.1, 2018.
- Stone, P., Constraints on dynamical transports of energy on a spherical planet., *Dynam. Atmos. Oceans*, 2, 123–139, 1978.
- Taylor, K., R. Stouffer, and G. Meehl, An overview of cmip5 and the experiment design., *Bull. Amer. Meteor. Soc.*, 93, 485–498, 2012.
- Trenberth, K. E., Using atmospheric budgets as a constraint on surface fluxes., *J. Climate*, 10, 2796–2809, 1997.
- Trenberth, K. E., and J. M. Caron, Estimates of meridional atmosphere and ocean heat transports., *J. Climate*, 14, 3433–3443, 2001.
- Trenberth, K. E., and D. P. Stepaniak, The flow of energy through the earth's climate system, *Quart. J. Roy. Meteor. Soc.*, 130, 2677–2701, 2004.
- Vallis, G., and R. Farnetti, Meridional energy transport in the coupled atmosphere–ocean system: scaling and numerical experiments, *Quart. J. Roy. Meteor. Soc.*, 135, 1643–1660, 2009.
- Woods, C., and R. Caballero, The role of moist intrusions in winter arctic warming and sea ice decline, *J. Climate*, 29(12), 4473–4485, 2016.
- Wu, T., and P. Tan, Changes in gross moist stability in the tropics under global warming, *Climate Dyn.*, 41, 2481–2496, 2013.
- Yang, H., Q. Li, K. Wang, Y. Sun, and D. Sun, Decomposing the meridional heat transport in the climate system., *Climate Dyn.*, 44(9), 2751–2768, 2015.
- Zelinka, M., T. Myers, D. McCoy, S. Po-Chedley, P. Caldwell, and P. Ceppi, Causes of higher climate sensitivity in cmip6 models, *Geophys. Res. Lett.*, 47(1), e2019GL085,782, 2020.