ATS 750: Climate dynamics: Atmospheric variability
Spring 2023
Monday/Wednesday: 11:00-12:15

Instructor
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Recommended materials
- *Dennis Hartmann's notes for Objective Analysis*
    Recent edition of notes available online at:
    https://atmos.washington.edu/~dennis/552_Notes_ftp.html
- *Vallis, GK: Atmospheric and Oceanic Fluid Dynamics : Fundamentals and Large-scale Circulation*
    Available via CSU libraries at:
    https://ebookcentral.proquest.com/lib/csu/detail.action?docID=321097
- *Holton, JR and Hakim, GJ: An Introduction to Dynamic Meteorology*
    Available via CSU libraries at:
    https://www.sciencedirect.com/book/9780123848666/an-introduction-to-dynamic-meteorology
- *Hartmann, DL, 2016: Global physical climatology*
    Available via CSU libraries at:
    https://www.sciencedirect.com/book/9780123285317/global-physical-climatology

Format
Lessons will involve the discussion of key research papers. Discussion leaders will rotate through the papers. The discussion format will be determined by the discussion leader. The key is that the class sessions should be very interactive. I will lecture during the discussions as needed to ensure the class fully understands all the key concepts in a paper.

Office hours
By appointment.

Evaluation
1) Participating and contributing to paper discussions (50%).
2) Term project (50%). The term project will include the development of a "GRL-style" research paper. It should address a novel aspect of large scale climate variability. Topics could include atmosphere/ocean interaction, stratosphere/troposphere interaction, coupling between radiation/large-scale dynamics, identifying structures of internal variability, etc. The papers should include novel analyses of either observations or numerical output. Proposals are due March 20. Final papers are due May 8.

Outline

The following list is likely to change as the semester progresses. Papers are chosen for their creative use of simple analysis techniques, influence on the field, and insights into the physics of climate variability and change.

Large scale internal climate variability (focusing on the extratropics)

Northern Hemisphere atmosphere

Quadrelli, R., and J. M. Wallace, 2004: A Simplified Linear Framework for Interpreting Patterns of Northern Hemisphere Wintertime Climate Variability. J. Climate, 17, 3728-3744.

Southern Hemisphere atmosphere

Lorenz, D.J., and D.L. Hartmann, 2001: Eddy-Zonal Flow Feedback in the Southern Hemisphere, J. Atmos. Sci., 58, 3312-3327.

The role of the extratropical ocean in climate

Clement, A., K. et al., 2015: The Atlantic Multidecadal Oscillation without a role for ocean circulation. Science, doi:10.1126/science.aab3980.

TBD

The role of the stratosphere in extratropical climate

TBD

Climate response to anthropogenic forcing

Hydrologic cycle

Isaac M. Held and Brian J. Soden, 2006: Robust Responses of the Hydrological Cycle to Global Warming. J. Climate, 19, 5686–5699, doi: 10.1175/JCLI3990.1.

Cloud feedbacks

Hartmann, D. L. and K. Larson, 2002: An Important Constraint on Tropical Cloud-Climate Feedback. Geophys. Res. Lett., 29(20), 1951-4.

S. Bony, et al. 2016: Thermodynamic control of anvil cloud amount. Proceedings of the National Academy of Science, 113:8927-8932..

Meridional heat transport

Armour KC, N Siler, A Donohoe and GH Roe, 2019: Meridional atmospheric heat transport constrained by energetics and mediated by large-scale diffusion, Journal of Climate, 32, 3655–3679, doi: 10.1175/JCLI-D-18-0563.1

Stormtracks

Chemke, R., Ming, Y. & Yuval, J. The intensification of winter mid-latitude storm tracks in the Southern Hemisphere. *Nat. Clim. Chang.* **12**, 553–557 (2022). https://doi.org/10.1038/s41558-022-01368-8.

Key concepts in climate sensitivity

Gregory, J. M., W. J. Ingram, M. A. Palmer, G. S. Jones, P. A. Stott, R. B. Thorpe, J. A. Lowe, T. C. Johns, and K. D. Williams, 2004: A new method for diagnosing radiative forcing and climate sensitivity, Geophys. Res. Lett., 31, L03205, doi:10.1029/2003GL018747.

Gregory, J. M., Andrews, T., Ceppi, P., Mauritsen, T. and Webb, M. J., 2020. How accurately can the climate sensitivity to CO_2 be estimated from historical climate change?. Clim. Dyn., 54, 129-157.

Andrews, T., Bodas-Salcedo, A., Gregory, J. M., Dong, Y., Armour, K. C., Paynter, D., et al. (2022). On the effect of historical SST patterns on radiative feedback. *Journal of Geophysical Research: Atmospheres*, 127, e2022JD036675. https://doi.org/10.1029/2022JD036675