

Preface to Part 2

This issue of Dynamics of Atmospheres and Oceans (DAO) is the second of a two-part special issue devoted to the subject of the general circulation of the atmosphere. The first part contained 7 papers that sampled a variety of general circulation issues from regional to large scale. Topics were: principle balances and empirical deduction of the broad aspects of the circulation¹, a historical view of the tropical divergent circulations², large scale factors affecting east African rainfall³, how a midlatitude long wave interacts with the tropics⁴, some properties of midlatitude storm tracks are captured in two different models discussed in two papers^{5,6}, and finally the exchange of momentum across the tropopause is detailed⁷. Clearly this list does not exhaust the subject areas of the general circulation. In part two it remained challenging to find authors willing and able to cover a comprehensive range of current issues regarding the general circulation.

Subjects here fill in some significant gaps left by part 1. Part 2 of the special issue begins with an accounting (by Grotjahn) of the differences between two datasets that are widely used in general circulation studies: ERA-40 and NCEP/DOE AMIP-II reanalyses, in terms of both input data and output fields. The article stresses differences and sidesteps the sensitive issue of evaluation, though there are some peculiar properties in each dataset. The second article (by Salby) examines the wintertime interannual variability of temperature, T and ozone, O₃ in the stratosphere. He finds the changes in T and O₃ to be consistent with vertical motions and horizontal transport respectively, that consistent changes occur in the troposphere, and are driven by anomalous wave activity. The third article (by Wang and Ding) broadens the concept of the word 'monsoon' from southeast Asia to search for monsoon-like circulations across the globe; such broadening may be consistent with the word's Arabic origins (the word for season). They base their analysis on 3 modes that describe 5/6 of the tropical precipitation variability and that these modes are better represented in a combination of 3 major reanalyses (ERA-40, NCEP/DOE AMIP-II, and Japanese Reanalysis 25) than in any individual reanalysis. The fourth article (by Vallis and Gerber) draws connections between the zonal index (of zonally-averaged zonal wind), extra-tropical low-frequency 'annular modes', and the related

North Atlantic Oscillation (NAO). Perhaps oversimplifying their results, they find that the variability of the NAO is intertwined with the variability of the Atlantic storm track which in turn is intertwined with the polar front ('eddy-driven') jetstream. The fifth article (by Bromwich and Wang) looks deeper into the reanalysis datasets in developing a comprehensive overview of the circulations in the polar regions. Bromwich and Wang is largely a review and is intended to bring together a variety of thoughts about the polar circulations in a single location, giving equal standing to the Arctic and Austral polar regions. Their discussion of the Arctic may be compared and contrasted with complementary passages in the book about the Arctic by Serreze and Barry⁸. Finally, the special issue concludes with an article by Stone derived from two decades of teaching a general circulation course. Stone discusses three unresolved issues regarding the zonal mean thermal balance of the general circulation.

Schneider and Sobel⁹ (hereafter SS2007) was published between the 2 parts of this special issue (hereafter DAO2007); the timing allows the reader to compare and contrast differing views of the general circulation. One expects some difference in presentation since Schneider and Sobel state in their preface that SS2007 emphasizes theory. So, one will not find analyses of the observational data comparable to Grotjahn here, even though articles in both collections have a mixture of theory and observations. SS2007 has a more comprehensive treatment of circulations covering the tropical half the earth. However, other topics may be surprising by their absence in SS2007.

The two collections provide a range of opinions about aspects of the general circulation. The clearest illustration may be the differing views of the midlatitude storm tracks. SS2007 includes a chapter by Swanson¹⁰ which has a somewhat different view of the storm tracks than two papers^{5,6} in part 1 of DAO2007. A portion of Vallis and Gerber here raises issues not included in Swanson's review. Swanson states that his chapter will study how simple models are used to understand the storm tracks; he summarizes results from normal mode (eigenvalue/eigenvector), stochastically forced, and "heuristic" models. While Swanson sees a minor role for the first category of models, James⁵ applies a barotropic model to the problem and uses the eigenfunction solutions to interpret the

results of his initial value calculations. Mak and Deng⁶ use a combination of models from quasi-geostrophic to primitive equation to understand observations they present of the Atlantic and North Pacific storm tracks. SS2007 and DAO2007 each have an article relating to the subject of tropical-midlatitude interaction. In SS2007, Robinson¹¹ emphasizes the zonal mean response to a tropical event and chooses ‘el nino’ as his prime example. In contrast, Knippertz⁴ focuses on the causes of penetration of midlatitude upper level troughs into the deep tropics and the consequences (tropical convection, tropical plumes, etc.) that ensue. Knippertz thereby develops shorter time scale connections than Robinson and Knippertz emphasizes the zonally-varying structure (instead of the zonal mean). So, the two works have little overlap, except that Knippertz also includes a discussion of interannual variability. Robinson has a brief discussion of tropical forcing of annular modes and that may be compared and contrasted with more thorough analysis in the fourth article (by Vallis) here. The tropics and the monsoons are subjects found in SS2007 and DAO2007. Plumb¹² discusses some largely theoretical aspects related to maintaining the Asian monsoon while Neelin¹³ touches upon the monsoons in the wider context of large scale tropical convective circulations. The reader may contrast and compare those discussions with the article by Wang and Ding here and papers^{2,3} by Hastenrath. Absent from SS2007 is a comprehensive discussion of the stratosphere, while DAO2007 has a discussion of momentum exchange across the tropopause (Egger and Hoinka) and a discussion of the Brewer-Dobson circulation in the second paper (by Salby) here. Taken together, DAO2007 and SS2007 give the reader a good sampling of current issues in understanding the general circulation of the atmosphere.

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Footnote References:

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- ³ Hastenrath, S., 2007: Circulation mechanisms of climate anomalies in East Africa and the equatorial Indian Ocean. *Dyn. Atmos. Oceans*, 43: 24-35.
- ⁴ Knippertz, P., 2007: Tropical-extratropical interactions related to upper-level troughs at low latitudes. *Dyn. Atmos. Oceans*, 43: 36-62.
- ⁵ James, I., 2007: A barotropic model of storm tracks. *Dyn. Atmos. Oceans*, 43: 63-79.
- ⁶ Mak, M., Deng, Y., 2007: Diagnostic and dynamical analyses of two outstanding aspects of storm tracks. *Dyn. Atmos. Oceans*, 43: 80-99.
- ⁷ Egger, J., Hoinka, K.-P., 2007: Stratosphere-troposphere exchange: A zonal mean perspective of angular momentum. *Dyn. Atmos. Oceans*, 43: 100-121.
- ⁸ Serreze, M., Barry, R., 2005: The Arctic Climate System, Cambridge Univ. Press, 385 pp.
- ⁹ Schneider, T., Sobel, A., eds. 2007: The Global Circulation of the Atmosphere. Princeton Univ. Press, 385 pp.
- ¹⁰ Swanson, K., 2007: Storm track dynamics. In: The Global Circulation of the Atmosphere. Princeton Univ. Press, Schneider, T., Sobel, A., eds., 78-103.
- ¹¹ Robinson, W., 2007: Eddy-mediated interactions between low latitudes and the extratropics. In: The Global Circulation of the Atmosphere. Princeton Univ. Press, Schneider, T., Sobel, A., eds., 104-142.
- ¹² Plumb, A., 2007: Dynamical constraints on monsoon circulations. In: The Global Circulation of the Atmosphere. Princeton Univ. Press, Schneider, T., Sobel, A., eds., 252-266.
- ¹³ Neelin, D., 2007: Moist dynamics of tropical convection zones in monsoons, teleconnections, and global warming. In: The Global Circulation of the Atmosphere. Princeton Univ. Press, Schneider, T., Sobel, A., eds., 267-301.