

A MEETING IN CELEBRATION OF THE LIFE AND WORK OF JIM HOLTON

WEDNESDAY 16 NOVEMBER 2005

Stratospheric sudden warmings: Jim Holton's insights – Prof Alan O'Neill,
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The stratospheric sudden warming (SSW) is the most dramatic meteorological phenomenon to take place in the stratosphere. Temperatures in the stratosphere may rise by up to 80C in a few days, the stratospheric polar vortex is broken down, and air is transported over large distances and mixed at mid latitudes. There is increasing evidence that the anomalous state of the stratosphere during sudden warmings affects surface weather. SSWs are commonly believed to be caused by upward-propagating, growing planetary waves in the troposphere. Nevertheless, a precise link between SSWs and transient events in the troposphere is elusive. A classic and influential paper by Jim Holton and his student Clifford Mass (Stratospheric Vacillation Cycles, JAS, 33, 2218-2225, 1976) offers an explanation:

"...oscillations in stratospheric long waves do not necessarily reflect oscillating tropospheric forcing but may occur even in the presence of steady forcing." The paper well illustrates Holton's deft touch in constructing illuminating, simplified models of complex situations.

After illustrating examples of SSWs and their effects, the talk will outline the approach and findings in the paper, and will consider wider ramifications.

The extra-tropical quasi-biennial oscillation (QBO) – Prof Lesley Gray, Univeristy of Reading l.j.gray-at-reading.ac.uk

The influence of the quasi biennial oscillation (QBO) on the extra tropics was first identified by the work of Holton and Tan (1980, 1982) and has since been confirmed with over 20 years more data. A short review of the equatorial quasi biennial oscillation (QBO) will be presented and the 'Holton-Tan relationship' will be summarised. The presentation will concentrate on the Northern Hemisphere winter-time temperatures, winds and ozone amounts. The contribution of Jim Holton to our understanding of the processes that transfer the QBO signal to higher latitudes will be emphasized, and some recent insight into these processes from both modelling studies and observations will be described.

References

Holton, J R and H -C Tan, 1980. The influence of the equatorial quasi-biennial oscillation on the global circulation at 50 mb, J Atmos Sci, 37, 2200-2208, 1980.

Holton, JR and H -C Tan, The quasi-biennial oscillation in the Northern Hemisphere lower stratosphere, J Meteor Soc Jpn, 60, 140-148.

Further Information

Baldwin, MP and LJ Gray, 2005. Tropical Stratospheric Winds in ECMWF ERA-40 Reanalysis, Rocketsonde Data and Rawinsonde Data. *Geophys Res Lett*, 32, doi:10.1029/2004GL022328.

Pascoe, CL, LJ Gray, SA Crooks, MN Jukes and MP Baldwin, 2005. The Quasi Biennial Oscillation: Analysis using ERA-40 Data. *J Geophys Res*, 110, D08105
Gray, LJ, S Crooks, C Pascoe, S Sparrow and MA Palmer, 2004. Solar and QBO Influences on the Timing of Stratospheric Sudden Warmings. *J Atmos Sci*, 61, 23, 2777-2796.
web: <http://www.cgam.nerc.ac.uk/>

The stratospheric water vapour puzzle – Prof Peter Haynes, University of Cambridge
P.H.Haynes-at-dampt.cam.ac.uk

The title of the talk is based on the title of a paper by Jim Holton that appeared in proceedings of the 1982 US-Japan seminar on the dynamics of the middle atmosphere. Concentrations of stratospheric water vapour have important implications for climate and chemistry, but precise understanding of the processes that set those concentrations has been elusive. The talk will review how understanding of the processes that set stratospheric water concentrations has evolved in the last 20 years. Jim Holton made several key contributions to that evolution. Recent results from trajectory-based investigations will be described and their implications for season and interannual variability and long-term changes in stratospheric water vapour will be discussed.

For more details of recent work see:

Fueglistaler, S., Bonazzola, M., Hatsushika, H., Haynes, P., Peter, T., Wernli, H., Yamakaki, K., 2005: Tropical Troposphere-to-Stratosphere Transport: A Lagrangian Perspective. *SPARC newsletter*, 25.
(<http://www.atmosphysics.utoronto.ca/SPARC/News25/tropical.html>)

Bonazzola, M, Haynes, P.H., 2004: A trajectory-based study of the tropical tropopause region. *J. Geophys. Res.*, 109, D20, D20112, 10.1029/2003JD004356.

Fueglistaler, S., Bonazzola, M., Haynes, P., Peter, T., 2005: Stratospheric water vapor predicted from the Lagrangian temperature history of air entering the stratosphere in the tropics. *J. Geophys. Res.*, 110, doi:10.1029/2004JD005516.

Fueglistaler, S., Haynes, P.H., 2005: Control of interannual and longer-term variability of stratospheric water vapor. *J. Geophys. Res.*, 110, doi:10.1029/2005JD006019.

Chemistry in the upper troposphere, lower stratosphere - Prof John Pyle, University of Cambridge
John.Pyle-at-atm.ch.cam.ac.uk

Understanding the details of the exchange of air between troposphere and stratosphere

has been a major research aim for 50 years. Jim Holton's contributions in this area are immense and iconic. Much of his work was aimed at understanding stratospheric water vapour in the 'overworld'. Here we will look at troposphere-to-stratosphere exchange, using model tracers and air parcel trajectory analyses, with emphasis on the possible transport of very short lived species which can influence the lower stratospheric ozone abundance. This emphasis provides an interesting complementary approach to the study of water vapour exchange.

Satellite instruments: Jim Holton's role in pioneering new measurements – Dr John Barnett, University of Oxford j.barnett1-at-physics.ox.ac.uk

Jim Holton was an a leading dynamicist who made extensive use of satellite measurements particularly once the Upper Atmosphere Research Satellite data became available. He was co-author of many papers that used the data, particularly in areas of tropospheric-stratospheric exchange and the stratospheric residual circulation. He was also heavily involved with the conception of and planning for the HIRDLS instrument that was launched on the NASA Aura satellite a few months after his death. The talk will expand on his contribution in these areas and show briefly how HIRDLS is progressing.

Jim Holton and the fundamentals of atmospheric dynamics: four editions of 'an introduction to dynamic meteorology' and other writings – Dr David Andrews, University of Oxford andrews-at-atm.ox.ac.uk

This talk will present a short overview of the major contributions made by Jim Holton to the teaching of atmospheric dynamics, with particular reference to his influential textbook "An Introduction to Dynamic Meteorology", which went through four editions between 1972 and 2004. Some of Jim's other expository writings on atmospheric dynamics will also be mentioned briefly.