Transport Studies in the Summer Stratosphere 2003 Using MIPAS Observations

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Introduction

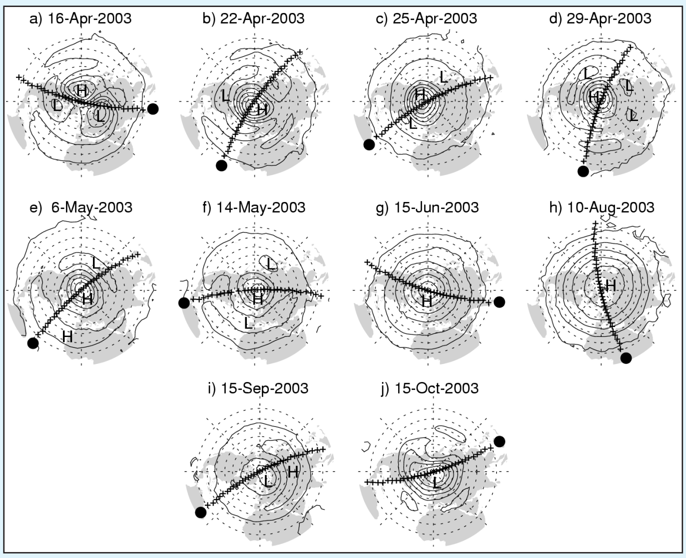
The structure and evolution of the summer stratosphere in the Northern Hemisphere (NH) has been relatively little studied compared to stratospheric winter. A major motivation for studying the summer stratosphere is that changes in the thinner stratospheric ozone layer, and in particular low-ozone episodes, have a stronger effect on UV radiation reaching the ground, and impact on human health and ecosystems, than in the winter (*Orsolini et al. 2003; Orsolini and Nikulin 2006*). The summer stratosphere may also still carry signatures of the springtime polar ozone depletion (*Fioletov and Shepherd 2005*).

This poster is based on the articles **Lahoz, W.A., A.J. Geer, and Y.J. Orsolini**, Northern hemisphere strastospheric summer from MIPAS observations, submitted to Quart. J. of the Roy. Meteor. Soc., May 2006, and **Orsolini, Y. J. and G. Nikulin,** A low-ozone episode during the European heat wave of August 2003, Quart. J. of the Roy. Meteor. Soc., 132, 667-680, 2006.

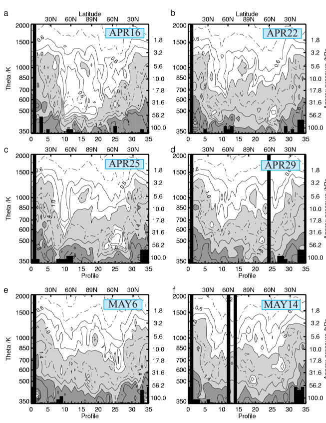
Spring-to-summer transition at high latitudes

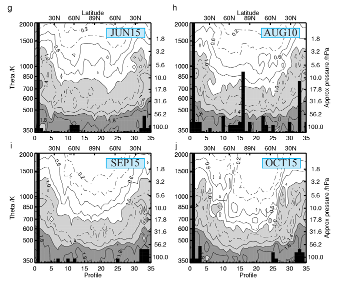
The evolution of the NH circulation in the spring-to-summer transition in 2003 is followed using synoptic maps of 10-mb geopotential height (Met Office analyses). It reveals:

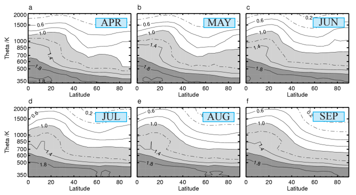
- Vortex weakening by mid April
- all signature of cyclonic circulations disappears by mid June
- the anticyclone grows, displaces the vortex off the Pole, and eventually becomes the summertime high and the dominant feature from early June to August



Methane distribution from MIPAS







We follow the evolution of the MIPAS CH4 (ESA product), using monthly-mean latitude/potential temperature cross-sections, and then we adopt a pole-centred view (*Lahoz et al., 1996*), and examine along-track cross-sections on 10 selected orbits (viewing tracks as above.

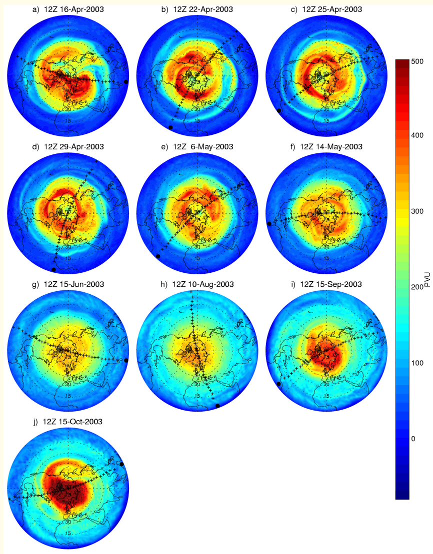
Features:

- W-shape pattern (i.e. raised CH4 levels at the pole), fading by August
- Elevated polar CH_4 can clearly be traced in along-track data until mid-June
- Polar vortex filamentation, lasting for 2-3 weeks

"Frozen-in" anticyclones

Using data from MLS from the spring and summer 2005, Manney et al. (2006) describe a frozen-in mid stratosphere anticyclone (FrIAC), which remains coherent while being slowly advected around the North Pole by the prevailing high latitude easterlies. Originating in the poleward transport of mid latitude air during the April final warming, the air masses confined in the anticyclone rotated around the Pole with a variable period of 2 or 3 weeks, before disappearing in August 2005. Frozen-in vortex remnants have been reported in models (*e.g. Orsolini 2001*) and observations (*Durry and Hauchecorne 2005*). FrIACs can be regarded as the opposite of vortex remnants, as the former are long-lived anticyclonic vortices originating from low latitudes, whereas the latter are long-lived cyclonic vortices originating from high latitudes.

We see a FrIAC in 2003 developing out of the poleward transport of low-latitude air during the vortex breakdown in mid-April,



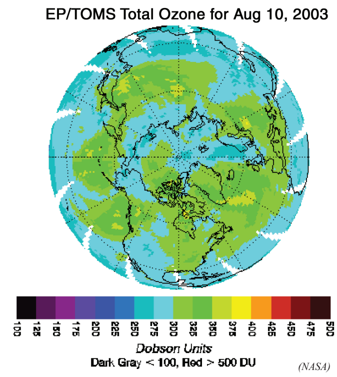
and then as a low PV small-scale anomaly circling the pole until mid-May. E.g.:

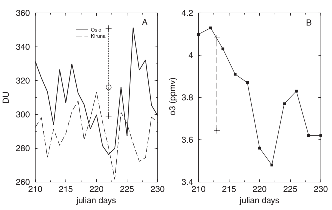
- potential vorticity at 850K (ECMWF operational analyses)
- corresponding MIPAS CH_4 along-track cross-sections

Low-ozone arctic pool

A low-ozone pool of air resides over the Arctic in summer due to ozone photochemical (NO_X) destruction during long insolation days. Low-ozone summer episodes occur in conjunction with high-tropopause, anticyclonic conditions in the troposphere and the off-pole displacement of this pool of low-ozone Arctic air, aloft of the anticyclone (*Orsolini et al., 2003*). We show another example during the August 2003 European Heat wave,

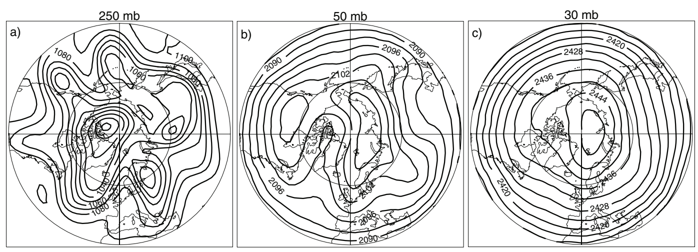
- TOMS col O_3 and MIPAS 650K O_3 (60N-70N, 0-36E) on AUG 10 (see Orsolini and Nikukin, 2006)





The tropospheric circulation is very disturbed by a persistent blocking over Europe, part of a prominent, quasi-stationary Rossby wave train across the Atlantic-Europe region. Its influence is felt up to 50-30 mb, where the stratospheric circulation is very disturbed.

- geopotential height (dam) at 250mb, 50bm and 30mb on AUG 10. Note the split polar High at 50mb.



Reference

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