



## **Dynamics of the exceptional warming events during the Arctic winters 2003/04, 2005/06 and 2008/09**

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Sudden stratospheric warmings (SSW) are common features of the Arctic meteorology. During a major SSW, polar temperature rises and the zonal mean flow weakens dramatically over a short period of time. This situation causes displacement, distortion or split of the polar vortex. The Arctic winters 2003/04, 2005/06 and 2008/09 were characterized by major midwinter warming of different proportions. The major warming occurred in early January in 2003/04 and in mid-January in the other winters in the lower stratosphere. The winter 2003/04 was remarkable in that a stable vortex formed again in March 2004 after two months of severe disturbance. No vortex was evident in other winters after the mid-January major warming. The planetary waves 1 and 2 play a key role in warming events and in vortex distortions as they control the stratospheric circulation. The dominating presence and amplitude of these waves were also different in each winter.

In this presentation, we characterize the winters 2003/04, 2005/06 and 2008/09 in terms of chemical and dynamical situation during the winters. In order to illustrate, we exploit the heat flux, zonal wind characteristics, Eliassen-Palm vectors and planetary wave analyzes for the winters in a comparative perspective. The dynamical parameters are derived from ECMWF analyzes and the chemical realm are discussed in terms of the measurements from MLS (Microwave Limb Sounder) and POAM (Polar Ozone and Aerosol Measurement) as well as simulations from the Mimosa-Chim global three-dimensional chemical transport model.