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Influence of ice supersaturation and dynamics on cirrus occurrence near the tropopause

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With an occurrence of more than 30% cirrus (ice clouds at high altitude) play a key part in the determination of the Earth's energy balance. However processes of their formation are still under investigation. Using collocated satellite observations and ERA40 reanalyses of the European Centre for Medium Range Weather Forecasts (ECMWF), we study relationships between ice supersaturation in the upper troposphere and the presence of sub-visible cirrus and cirrus under different dynamical situations.
Relative humidity with respect to ice is determined from the TOVS Path-B dataset, providing atmospheric temperature and water vapor profiles as well as cloud properties over the globe, from 1987 to 1995. The spatial resolution of the TOVS Path-B dataset is 1° latitude $\times$ 1° longitude. This relative humidity is integrated over atmospheric layers between 500 and 300 hPa and between 300 and 100 hPa due to the relatively coarse resolution of the HIRS channels sensitive to water vapour. In order to determine ice supersaturation within these 200 hPa thick layers which are much thicker than most of the thin cirrus, a threshold scaling has been determined considering the expected relative humidity distribution within a cirrus.
The occurrence of thin cirrus is provided by the TOVS Path-B dataset, and the Stratospheric Aerosol and Gas Experiment (SAGE) II extends these data to the occurrence of subvisible cirrus, with optical thickness less than 0.03, which can be detected by limb sounding of sun occultation by the atmosphere. The vertical resolution of the SAGE dataset is 1 km, and the horizontal pathlength is 200 km. We use data covering the period from 1985 to 1991, prior to the eruption of Mount Pinatubo, and a latitudinal extent of about $\pm 60^\circ$. Large-scale (at a resolution of 1.25° latitude $\times$ 1.25° longitude) vertical and horizontal winds in the upper troposphere have been extracted from the ERA40 reanalyses.