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Indications of thin cirrus clouds in the stratosphere at mid-latitudes

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Abstract. This study is devoted to the possible presence of cirrus clouds in the stratosphere. Three months of lidar data collected in the south of France (44° N) for detection of stratospheric cirrus are carefully analyzed. Most of the cirrus clouds appear to be located in the troposphere below the dynamical tropopause even when the cloud top is close to the thermal tropopause. Ten cirrus cases are found to be unambiguously located above the local dynamical tropopause according to high-resolution PV advection calculations. The highest cloud detected above the local tropopause (nearly 3 km above) is observed inside air masses that originate from the sub-tropical regions and are then transported rapidly to mid-latitudes through isentropic transport. The details of the air mass history is described with a 3-D trajectory model. The back-plumes indicate that the air mass, moist with respect to typical stratospheric air, was transported from the subtropical troposphere to the lowermost stratosphere in 4 days before detection above France. A continuous cooling of 5–10° along the trajectory took place during its transit. This cooling could have been partly responsible for the thin cirrus layer detected.

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