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- Recent Final Revised Papers
- Volumes and Issues
- Special Issues
- Library Search
- Title and Author Search

Online Library ACPD
Alerts & RSS Feeds
General Information
Submission
Review
Production
Subscription
Comment on a Paper

Volumes and Issues | Contents of Issue 1

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The water vapour distribution in the Arctic lowermost stratosphere during the LAUTLOS campaign and related transport processes including stratosphere-troposphere exchange

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Abstract. Balloon-borne water vapour measurements during January and February 2004, which were obtained as part of the LAUTLOS campaign at Sodankylä, Finland, 67° N, were used to analyse the water vapour distribution in the wintertime Arctic lowermost stratosphere. A 2.5 km thick layer (or 30 K in the potential temperature scale) above the tropopause is characterized by a significant water vapour variability on a synoptic timescale with values between stratospheric and tropospheric, which is in good agreement with previously reported measurements. A cross-correlation analysis of ozone and water vapour confirms that this layer contains a mixture of stratospheric and tropospheric air masses. Some of the flights sampled laminae of enhanced water vapour above the tropopause. Meteorological analyses and backward trajectory calculations show that these features were related to filaments that had developed along the flanks of cut-off anticyclones, which had been active at this time over the Northern Atlantic. The role of the filaments was however not to transport water vapour from the troposphere to the stratosphere but rather to transport it within the stratosphere away from regions where intensive two-way stratosphere-troposphere exchange (STE) was identified. Intensive STE occurred around cut-off anticyclones in regions of strong winds, where calculations suggest the presence of clear-air turbulence (CAT). Evidences that CAT contributes to the troposphere-to-stratosphere transport (TST) are presented. However, statistically, relation between TST and CAT during the studied period is weak.

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