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Investigation of the Arctic upper troposphere and lower stratosphere by mm-wave and infrared limb sounding during the PremierEx campaign

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The candidate Earth Explorer 7 core mission PREMIER (PRocess Exploration through Measurements of Infrared and millimetre-wave Emitted Radiation) focuses on the exploitation of the complementary measurement capabilities of infrared and mm-wave limb sounders to investigate transport processes and interactions between chemistry and climate in the mid/upper troposphere and lowermost stratosphere (5-25 km height range). A field campaign with the high altitude research aircraft M-55 Geophysica, embarking the MARSCHALS and the MIPAS-STR instruments as simulators of the PREMIER payload in the mm-wave and in the infrared region respectively, was carried out in the Arctic (Kiruna, Sweden) in March 2010 (PremierEx campaign) immediately after the RECONCILE scientific flights. A dedicated study was conducted using the datasets obtained from MARSCHALS and MIPAS-STR limb measurements during the PremierEx flight on March 10^{th}, 2010. The results of mm-wave data processing for the retrieval of Temperature, Water Vapour, O_3, HNO_3, N_2O and CO vertical profiles are reported, demonstrating the full capabilities of the MARSCHALS upgraded configuration and showing the limited impact of clouds at low and high altitude in different legs of the flight compared to the measurement performances in clear sky conditions. Moreover, a better insight in the potential of combined use of IRLS and MWLS observations was gained by comparing the results of individual and synergistic retrieval processing. The comparison was performed by using different approaches to data fusion: the (L1+L2) method, consisting in the inverse processing of MARSCHALS spectra using Optimal Estimation with MIPAS-STR Level 2 products adopted as a priori information and the Measurement Space Solution (mss) method, relying on the optimal exploitation of the information obtained from infrared and mm-wave measurements that is feasible with the innovative MSS algorithm. An overview of the study will be provided, along with a summary of the main results and conclusions from MARSCHALS data analysis and from investigation of infrared and mm-wave data fusion.