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A case study on the formation and evolution of ice supersaturation in the vicinity of a warm conveyor belt's outflow region

P. Spichtinger¹, K. Gierens¹, and H. Wernli²

¹Deutsches Zentrum für Luft- und Raumfahrt, Institut für Physik der Atmosphäre, Oberpfaffenhofen, Germany

²Johannes Gutenberg-Universität, Institut für Physik der Atmosphäre, Mainz, Germany

Abstract. A case study is presented on the formation and evolution of an ice-supersaturated region (ISSR) that was detected by a radiosonde in NE Germany at 06:00 UTC 29 November 2000. The ISSR was situated in the vicinity of the outflow region of a warm conveyor belt associated with an intense event of cyclogenesis in the eastern North Atlantic. Using ECMWF analyses and trajectory calculations it is determined when the air parcels became supersaturated and later subsaturated again. In the case considered, the state of air parcel supersaturation can last for longer than 24h. The ISSR was unusually thick: while the mean vertical extension of ISSRs in NE Germany is about 500m, the one investigated here reached 3km. The ice-supersaturated region investigated was bordered both vertically and horizontally by strongly subsaturated air. Near the path of the radiosonde the ISSR was probably cloud free, as inferred from METEOSAT infrared images. However, at other locations within the ISSR it is probable that there were cirrus clouds. Relative humidity measurements obtained by the Lindenberg radiosonde are used to correct the negative bias of the ECMWF humidity and to construct two-dimensional maps of ice supersaturation over Europe during the considered period. A systematic backward trajectory analysis for the ISSRs on these maps shows that the ISSR air masses themselves experienced only a moderate upward motion during the previous days, whereas parts of the ISSRs were located just above strongly ascending air masses from the boundary layer. This indicates qualitatively that warm conveyor belts associated with mid-latitude cyclogenesis are disturbances that can induce the formation of ISSRs in the upper troposphere. The ISSR maps also lead us to a new perception of ISSRs as large dynamic regions of supersaturated air where cirrus clouds can be embedded at some locations while there is clear air at others.

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