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Large fluctuations of tropopause moisture over the Maritime Continent induced by a Kelvin wave during the SCOUT-O3 campaign in Darwin, Australia

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The SCOUT-O3 aircraft measurement campaign was conducted in Darwin, Australia in November and December 2005 using two research aircraft, the German Falcon and the Russian high-altitude (up to 21 km) aircraft Geophysica. One the main goals of the campaign was to study the processes determining transport of water vapour into and through the tropical tropopause layer and the processes contributing to the drying of air before it finally enters the stratosphere. Fluctuations in tropopause temperatures associated with large-scale equatorial Kelvin waves have been reported previously to modulate the occurrence of cirrus clouds and hence to play an important role in dehydrating air in the tropical tropopause region. A pronounced Kelvin wave passed over Indonesia between 17 and 22 November lowering tropopause temperatures over the entire Tropical Warm Pool between about 15S and 20N by 7 Kelvin relative to the temperatures a few days earlier. The wave had a marked influence on the moisture content of the tropopause region as observed from the Geophysica with three different humidity sensors (two Lyman-alpha and one frost-point hygrometer). Water vapour mixing ratios observed at and just above the cold-point tropopause were in good agreement with the coldest temperatures encountered by the air masses as traced with 10-day backward trajectories, both before and during the passage of the wave. These observations with highly accurate water vapour instruments lend strong support for the hypothesis that Kelvin waves play an important role in dehydration. They also support the assumption made in a number of recent numerical studies that knowledge

about the Lagrangian temperature history is usually sufficient to predict the moisture content of air parcels entering the stratosphere.