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Dynamical mechanisms of anomalous moisture transport towards East Antarctica

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During the last decade Antarctic ice sheet accumulation patterns exhibited large regional differences. While the total ice-sheet mass of Antarctica declined, East-Antarctica experienced increases in ice mass. During 2009 and 2011, this increase was caused by only a handful of intense precipitation events. In this study, we investigate such an episodic accumulation event, thereby exploring the atmospheric linkages between oceanic evaporation in subtropical regions and Antarctic ice-sheet accumulation. As Antarctic ice-sheet accumulation, and thus sea-level change, is contingent on episodic snow events, understanding the underlying dynamical mechanisms is instrumental for assessing global sea-level changes.

We use both Eulerian and Lagrangian analysis to demonstrate that moisture transport was facilitated by several cyclones of different scales. Moisture transport towards East-Antarctica occurred in coherent air-streams, manifested initially as intense low-level jets embedded in the warm sector of the cyclone(s), followed by a transition to slantwise (pseudo-isentropic) ascent before reaching the continent. Water vapor loading of this moist-conveyor-belt was driven by low-level convergence in the warm sector along the advancing cold-front, whereas the slantwise ascent phase of the moisture transport was characterized by moisture removal (precipitation). Oceanic evaporation along the filamentary structured, anomalous moisture transport area was virtually absent, indicative for long-range moisture transport during the event. In addition to the moisture transport mechanisms we identified moisture source regions associated with the event.