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# The role of atmospheric rivers in anomalous snow accumulation in Dronning Maud Land, East Antarctica

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A few large snow accumulation events over Dronning Maud Land (DML) in 2009 and 2011 have been responsible for an anomalously high mass load over the East Antarctica. Previous studies showed that this regional mass gain partially compensated for some of the recent global ice mass losses that contribute to global sea level rise. Precipitation over the Antarctic ice sheet is mostly of synoptic origin and snowfall events of large magnitude require significant poleward moisture transport. We use in-situ measurements of snow accumulation at Princess Elisabeth (PE) base (72ºS, 23ºE, 1420 m asl) together with meteorological fields from the European Centre for Medium-Range Weather Forecast (ECMWF) re-analysis to investigate local accumulation patterns and associated poleward moisture transport. Year 2009 experienced an anomalously high transient eddies meridional moisture flux as observed in the coastal Indian Ocean (50-66ºS, 0-90ºE) sector, when compared to 1979-2012 period. We show that the anomalous moisture transport and resulting extreme snow accumulation in DML during 2009 can be attributed to several "atmospheric river" (AR) events. ARs are narrow enhanced water vapor bands known for bringing high amounts of moisture in the river-like pattern from the tropics to the middle latitudes and responsible for large amount of coastal precipitation. This work shows that ARs can reach as far as the Antarctic coast resulting in intensive snowfalls at the ascent to the Antarctic plateau.

The 19 May 2009 event is investigated in detail and used to modify existing definitions of ARs to apply to the Antarctic cases taking into account lower saturation capacity of the polar troposphere. According to 500-hPa geopotential heights analysis, an atmospheric river was steered towards DML along the eastern flank of a low-pressure system centered north of DML and blocked on the east by a high-pressure ridge. Five-day 3D back-trajectory analysis using the ECMWF APTRA model demonstrates the tropical origins of the water vapor arriving with the atmospheric river. Using the new AR definition adapted for Antarctica, we found that ARs were responsible for 40% (92 mm w.e.) of the annual total accumulation at PE during 2009. Extending our analysis to 2010-2013, we relate accumulation events to snowfall rate derived from the ground-based vertically pointing radar installed at PE in February 2010. Interannual variability of accumulation at PE is representative of a larger DML area as showed by comparison to the accumulation stake line from PE to the coast (installed within the French observation system GLACIOCLIM-SAMBA). The large contribution of ARs to accumulation within DML sector means that the difference in the total yearly accumulation can be caused by the fact that just a few large storms and associated with them ARs arrive or fail to arrive in Antarctica.