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Precipitation regime and stable isotopes at Dome C and Dome Fuji, East Antarctica

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Dome Fuji and Dome C, both deep ice-core drilling sites in East Antarctica, are the only stations, for which direct daily precipitation measurements and stable isotope ratios of the precipitation samples are available. Whereas the Dome F series encompasses only one year of measurements, the Dome C series has been started in 2006 and is ongoing. For Dome C, the type of precipitation (diamond dust, hoar frost, snowfall) was determined based on crystal type analysis. The weather situations causing precipitation at the stations were analysed using data from the Antarctic Mesoscale Prediction System (AMPS). At both sites, major snowfall events were always related to an amplification of Rossby waves in the circumpolar westerlies, which led to an increased meridional transport of moisture and energy. Furthermore, increased amounts of diamond dust were observed after such event-type precipitation. The stable isotope data of the precipitation samples were related to the different weather situations and precipitation types and also simulated using a simple Rayleigh-type model (MCIM) and compared to output from the global isotopic-enhanced model ECHAM5wiso. Possible moisture sources were estimated using the synoptic analysis combined with back-trajectory calculation. MCIM was better in reproducing the annual cycle of deuterium excess, whereas ECHAM5wiso generally showed a smaller bias of the isotope ratios. Hoar frost shows isotope signals very different from diamond dust and snowfall, which hints at a more local cycle of sublimation and deposition for this type of precipitation, whereas both snowfall and diamond dust are related to large-scale moisture transport. Contrary to the literature, a more northern moisture source was found to be not necessarily associated with more depleted snowfall. This is explained by the strong warm air advection accompanying snowfall events, which decreases the temperature difference between source area and deposition site and thus leads to weaker distillation.