Variability of Accumulation Rates from ERA-Interim and RACMO and Impacts on West Antarctic Mass Balance Estimates

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Time-series of ice-sheet accumulation rates, A(t), such as those provided by ERA-Interim re-analysis and RACMO regional climate modeling, are very important for studies of current changes in mass balance. In addition to providing essential information on the temporal variability of the surface mass input, time series of A(t) along with observed temperatures, Ts(t), provide important information for modeling of surface elevation changes caused by changes in the rate of firn compaction driven by accumulation and temperature variations. Firn-compaction elevation changes, which do not involve changes in mass, provide significant corrections to the surface elevation changes, dH/dt, observed by satellite altimetry. For studies of current ice-sheet mass changes, the accuracy of the temporal variability of $\delta A(t) = A(t) - A_{mean}$ is more important than the accuracy of the mean, A_{mean}. Results from comparison of the temporal variability (1980 to 2009) of accumulation from snow radar measurements in West Antarctic with accumulation from four meteorological data sets showed a much higher temporal correlation of 0.93 for ERA-interim than the 0.68 for RACMO (Medley et al., 2013). We compare the accumulation driven mass changes, dM_a/dt, derived from the two data sets in West Antarctica for two periods: the 1992-2001 period of ERS1&2 radar-altimeter measurements, and the 2003-2008 period of ICESat laser-altimeter measurements. For 1992-2001, a pattern of reduced dM_a/dt in the WA drainage systems (DS) near the base of the Antarctic Peninsula is similar for both data sets, as is the near zero dM_a/dt for the principal Siple Coast ice streams. The principal differences in 1992-2001 are the larger dM_a/dt in the coastal DS of Marie Byrd Land and in the interior Mercer ice stream using RACMO. For 2003-2008, a pattern of increased dM_a/dt in the WA drainage systems (DS) near the base of the Antarctic Peninsula in both data sets is much stronger using RACMO, although the near zero dM_a/dt for the principal Siple Coast ice streams is again the same for both. The principal differences in 2003-2008 are the increased dM_a/dt in the coastal DS of Marie Byrd Land and the interior Mercer ice stream using RACMO versus decreased dM_a/dt in both those DS using ERA-Interim. Since RACMO uses the ERA-interim reanalysis data, the differences between the two data sets presumably lie in the regional climate modeling included in RACMO. For 1992-2001, the net dM_a/dt from the anomalies is -17 Gt/yr in West Antarctic using ERA-Interim and -9 Gt/yr using RACMO. For 2003-2008, the net dM_a/dt is +17 Gt/yr using ERA-Interim and +32 Gt/yr using RACMO. In addition to the snow radar comparison, other aspects of the temporal variability in the two data sets indicate that ERA-interim provides a better representation of the temporal accumulation anomalies than RACMO.