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Ice-shelf height variability in Amundsen Sea linked to ENSO

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Atmospheric and sea-ice conditions around Antarctica, particularly in the Amundsen and Bellingshausen seas, respond to climate dynamics in the tropical Pacific Ocean on interannual time scales including the El Nino-Southern Oscillation (ENSO). It has been hypothesized that the mass balance of the Antarctic Ice Sheet, including its floating ice shelves, also responds to this climate signal; however, this has not yet been unambiguously demonstrated. We apply multivariate singular spectrum analysis (MSSA) to 18-year (1994-2012) time series of ice-shelf height derived from satellite radar altimetry in the Amundsen Sea (AS) region. This advanced spectral method distinguishes between regular deterministic behavior ("cycles") at sub-decadal time scale and irregular behavior ("noise") at shorter time scales. Although the long-term trends in ice-shelf height change are much larger than the range of interannual variability in the AS region, the short-term rate of change dh/dt can vary about the trend by more than 50%. We extract the principal modes of variability (EOFs) based on common spectral properties from a set of 140 height time series. The mode of interannual variability in the AS ice-shelf height is strongly correlated with the low-frequency mode of ENSO (periodicity of ∼4.5 years) as represented by the Southern Oscillation Index. This interannual mode in ice-shelf height, represented by the two leading EOFs, is responsible for about 25% of the variance in the de-trended data set. The ice-shelf height in the AS is expected to respond to changes in precipitation and inflows of warm subsurface Circumpolar Deep Water (CDW) into the ocean cavities under the ice shelves, altering basal melt rates. While we find a correlation between modeled precipitation anomalies and ice-shelf height, we are investigating (a) errors in model precipitation, (b) radar backscatter and firn-density issues, and (c) ocean contribution correlated with atmosphere through wind-stress forcing. We will describe the spatial structure of AS ice-shelf height response to ENSO, and attempt to distinguish the precipitation signal from basal mass balance due to changing CDW inflows.