

SCAR ISMASS Workshop, July 14, 2012

Mass Gains of the Antarctic Ice Sheet Exceed Losses

H. Jay Zwally¹, Jun Li², John Robbins², Jack L. Saba², Donghui Yi², Anita Brenner³, and David Bromwich⁴

Abstract

During 2003 to 2008, the mass gain of the Antarctic ice sheet from snow accumulation exceeded the mass loss from ice discharge by 49 Gt/yr (2.5% of input), as derived from ICESat laser measurements of elevation change. The net gain (86 Gt/yr) over the West Antarctic (WA) and East Antarctic ice sheets (WA and EA) is essentially unchanged from revised results for 1992 to 2001 from ERS radar altimetry. Imbalances in individual drainage systems (DS) are large (-68% to +103% of input), as are temporal changes (-39% to +44%). The recent 90 Gt/yr loss from three DS (Pine Island, Thwaites-Smith, and Marie-Bryd Coast) of WA exceeds the earlier 61 Gt/yr loss, consistent with reports of accelerating ice flow and dynamic thinning. Similarly, the recent 24 Gt/yr loss from three DS in the Antarctic Peninsula (AP) is consistent with glacier accelerations following breakup of the Larsen B and other ice shelves. In contrast, net increases in the five other DS of WA and AP and three of the 16 DS in East Antarctica (EA) exceed the increased losses. Alternate interpretations of the mass changes driven by accumulation variations are given using results from atmospheric-model re-analysis and a parameterization based on 5% change in accumulation per degree of observed surface temperature change. A slow increase in snowfall with climate warming, consistent with model predictions, may be offsetting increased dynamic losses.