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Linkages between atmospheric circulation and mass partitioning over the Greenland ice sheet

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Total mass loss from the Greenland ice sheet can be partitioned into surface mass (e.g., runoff) and ice dynamics (e.g., calving) losses with recent studies pointing to an increase in the relative contribution of runoff to the total mass loss culminated in the summer of 2012, which set new records both in terms of surface melt extent and meltwater production. Here we show, using a combination of satellite gravimetry measurements (GRACE) and the outputs of regional climate models, that changes in the spatial distribution of the partitioning between surface and volume losses over Greenland occurred since 2013 with respect to the period 2002 – 2012. This new state is manifested at the whole-ice sheet scale in the slowdown of the total mass loss recorded by GRACE and in the increased relative contribution of ice dynamics to the total mass loss, especially over the eastern and southern regions of the ice sheet. The regional climate model outputs are filtered to be consistent with the gravimetry data (e.g., masscons) so that a coherent, robust analysis of the surface mass balance components driving the partitioning changes can be performed at regional scale. To our knowledge, this is the first time that such a robust approach is applied to study mass partitioning at regional scale. Our results suggest the dominant role of atmosphere circulation, accumulation and runoff on the inter-seasonal variability of the mass partitioning between ice dynamics and surface on the total mass loss. This aspect is important to better estimates past and future contribution of surface and ice dynamic losses to total mass loss from Greenland.