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Antarctica sea-ice thickness distributions derived from surface elevation compared to measured thickness values

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For Antarctic sea ice, computing ice thicknesses from known parameters such as snow depth and ice freeboard is still in a developmental state. In this study, data from fifteen Antarctic cruises that had measurements of surface elevation (or snow depth), ice freeboard (height above or below sea level of the ice surface) and ice thickness were compiled and standardized. The relations between snow depth, ice /snow freeboard and ice thickness for each cruise were derived and analyzed. Those relations were separated into each sea sector for the entire Antarctic. Single mean values for each of the profiles (tens to hundred meters) of ice thickness, elevation and ice freeboard were computed. The ice thickness was then estimated using an isostatic relationship with prescribed values for the snow, ice, water densities and the measured values of snow depth and mean ice freeboard. We then estimated ice thickness and took into account the increased density of flooded snow, if the ice freeboard was negative (below sea level). We found that errors in thickness prediction compared to measured values were excessive if the flooded condition of the surface was not taken into account. However, we also found, unlike for Arctic sea ice, that snow elevation and snow depth are well correlated for Antarctic sea ice. This correlation implies that snow elevation from satellite laser altimetry or airborne lidar may alone suffice for the crucial estimate of snow depth, necessary for estimating ice thickness from space, over Antarctic sea ice. In this paper, these new algorithms for estimating Antarctic sea ice thickness from snow elevation, derivable from satellite laser altimetry or airborne lidar , will be presented.