Ice-y Breakups: How I Lost My AMIGOS in Antarctica

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A field and remote sensing study of two icebergs drifting northward from the Antarctic Peninsula towards South Georgia Island reveals details and rates of processes that lead to both iceberg and ice shelf disintegration. The study made extensive use of new robotic observing systems, termed AMIGOS, for Automated Met-Ice-Geophysics Observing Stations. Data gathered from the two AMIGOS units includes multiple daily in situ digital images, air temperatures, radio echo soundings of ice thickness, and iceberg position, uploaded daily by Iridium data-phone transmission. Supporting this study was a host of remote sensing data, gathered from the MODIS and ICESat sensors. Results show that calving rates and shelf break-ups are highly dependent on two parameters: water temperature and firn water saturation. While icebergs were located within the sea ice back, rates of ice loss were near-zero. These rates increased, scaling with surface ocean temperature, as soon as the icebergs emerged from pack ice; but icebergs retained their shape to a high degree even though repeated calvings occurred (edge-parallel calvings). Rates then increased 10-fold upon the observation of firn water saturation, and shape was not well-preserved. Previous analysis of ICESat data suggests a mechanism for the calving based on waterline erosion of the iceberg plates. The very rapid increase in calving after firn saturation supports the contention that surface water drives rapid fracturing of an ice plate. Other mechanisms, such as wave action and thinning of the ice plate, may play a role. We will review the relationship of iceberg evolution to the current ideas for ice tongue retreat and ice shelf collapse.