Basal Crevasses on the Larsen C ice shelf: Implications for ice shelf stability

Daniel McGrath[1], Konrad Steffen[1], Ted Scambos[2], Eric Rignot[3,4], Jose Rodriguez[5], Waleed Abdalati[1,6]

[1] CIRES, University of Colorado at Boulder, Boulder, Colorado, 80309
[2] NSIDC, University of Colorado at Boulder, Boulder, Colorado, 80309
[3] University of California, Earth System Science, Irvine, California, 92617
[4] Jet Propulsion Laboratory, Pasadena, California, 91109
[5] CECS, Valdivia, Chile
[6] NASA Headquarters

We identify a population (n = 27) of basal crevasses along a 31 km transect on the northern sector of the Larsen C Ice Shelf using ground penetrating radar. In total, approximately 100 basal crevasses are identified by their surface expression in visible satellite imagery. The basal crevasses form in the vicinity of Churchill Peninsula and initially extend from a region of shallow but highly fractured basal ice to form widely spaced (0.5 to 2.0 km) and deeply incised (70 to 134 m) features. Hydrostatically equilibrated surface depressions opposite in phase and smaller in amplitude than the basal crevasses are preferential locations for meltwater ponding. Surface crevasses are found at the topographic crests between the subsequent troughs. We assess these features using in situ kinematic GPS, airborne altimetry and high-resolution visible imagery. A linear elastic fracture mechanics (LEFM) model, dependent on ice shelf thickness, ice temperature and strain rate, accurately predicts observed basal crevasse height. Model results show that basal crevasse penetration height can also be expected to increase in response to the observed trends of ice shelf thinning and acceleration. We examine the possibility that a combination of basal crevassing, and enhanced surface crevassing due to meltwater hydrofracture, can explain recent ice shelf disintegration events on the Antarctic Peninsula.