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New methods of mapping sea ice thickness from buoys and satellites using waves.

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In this talk I review two new methods that we have employed to measure mean sea ice thickness in two quite different ice regimes. The first is the use of a two-axis tiltmeter array to measure the change in the dispersion relation of long ocean swell deep inside Arctic pack ice. Oscillations of small amplitude (a few mm) and long period (15-30 s) are observed within the Arctic Basin, originating from storms in the Greenland Sea. The dispersion relation is slightly different from swell in the open ocean, so if two such arrays are placed a substantial distance (100s of km) apart and used to observe the changing wave period of arrivals from a given storm, the time delay between the arrival of the same frequency at two sites gives the dispersion, and hence the modal ice thickness along the great circle route connecting the arrays.
The second method is the use of two-dimensional Fourier analysis of successive SAR scenes to track the major component of a wave field as it enters an ice edge, and again to map the thickness of the ice from the change in wave dispersion at the edge. This time the ice is pancake ice, however, for which a dispersion theory has been developed based on treatment as a highly viscous layer, and this method (already validated against field data) can be used to map frazil-pancake ice thickness in regions where this is the main ice regime at the ice edge (e.g. advancing Antarctic ice edge in winter; Greenland Sea; Bering Sea).
The two methods are quite different but both involve using ocean wave dispersion to infer sea ice thickness.