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Airborne remote sensing of surface waves in the marginal ice zone

Peter Sutherland (1) and Jean-Claude Gascard (2)

(1) Laboratorie d'Océanographie Physique et Spatiale, Ifremer, Plouzane, France (peter.sutherland@ifremer.fr), (2) Laboratoire d'Océanographie et du Climat, Université Pierre et Marie Curie, Paris, France

The propagation of ocean surface waves into sea ice is an important physical process in an increasingly ice-free Arctic basin. Wave-fetch-ice feedbacks are a key unknown in climate-scale simulations of Arctic sea ice, and wave effects are one of the greatest sources of uncertainty in operational ice models. We will present a technique developed for measuring waves in sea ice using airborne scanning lidar. Applying this technique to data taken during the CryoSat Validation Experiment, 2006, we were able to observe the spatial directional spectra of surface waves propagating tens of kilometres into the marginal ice zone. Wave energy attenuation and the evolution of spectral spreading were observed. Co-located visible imagery was then used to relate floe size distributions to the wave spectra. The broader-scale implications of our results, which are particularly relevant to discerning between scattering-based and dissipative wave attenuation models, will be discussed. Suggestions for minor modifications to future airborne campaigns, that would allow significantly improved capture of wave processes, will also be presented.