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Nonlinear dynamics of false bottoms

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Nansen from his observations in the Beaufort Sea published in 1897 noted that heat transfer from the fresh water to the arctic salt water is the only source of ice accretion during the polar summer. This transfer mechanism, unusual at first sight, is responsible for the initiation and evolution of a false bottom ice, changing ice properties to a great extent and affecting various processes while interacting with the ocean and the atmosphere. A false bottom represents a thin layer of ice which forms in summer underneath the floe where fresh water lies between the salt water and the ice. Details of how this process occurs in nature are now emerging from different laboratory and field experiments. The false bottoms appearing at the interface between the fresh and salt water as a result of double-diffusive convection normally lie below surface and under-ice melt ponds. Such false bottoms represent the only significant source of ice growth in the Arctic during the spring-summer period. Their evolution influences the mass balance of the Arctic sea-ice cover recognized as an indicator of climate change. However, the quantity, aerial extent and other properties of false bottoms are difficult to measure because coring under the surface melt ponds leads to direct mixing of surface and under-ice water. This explains why their aerial extent and overall volume is still not known despite the fact that the upper limit of the ice coverage by the false bottom is approximately half of the ice surface. The growth of false bottoms also leads to other important consequences for different physical, chemical and biological processes associated with their dynamics. This study addressed to a broad community of readers is concerned with non-linear behavior of false bottoms including their stochastic dynamics due to possible fluctuations of the main process parameters in the ocean and the atmosphere.