Geophysical Research Abstracts,
Vol. 10, EGU2008-A-05867, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-05867
EGU General Assembly 2008
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Antarctic Sea Ice Thickness from Passive Microwave Retrievals of Snow Depth

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Antarctic sea ice thickness retrievals from satellite altimeters are critically dependent on accurate estimates of snow depth, particularly so because of the relatively high snow loads and thin ice. We assess the accuracy of passive microwave estimates of snow depth and their utility for ice thickness determination by comparison with shipboard observations. Using a simple model of snow depth evolution, the predicted occurrence of snow-to-ice conversion is used as a proxy indicator for near-zero freeboard, allowing the possibility of sea-ice thickness estimation directly from satellite snow depth retrievals. The satellite data provide a good indicator of snow depth over broad scales in most cases and for all areas except for the East Antarctic sector, although there is significant temporal variability. Using a modified algorithm for satellite snow-depth retrieval, we show that satellite snow depth can provide reasonable estimates of regionally-averaged level ice thicknesses. Moreover, expected errors are likely to be less than those for altimetric methods. The accuracy of the method is limited by the accuracy of estimates of precipitation and snow accumulation. This highlights the need for assimilation of models of snow-cover evolution to reduce uncertainty in satellite estimates of both snow and ice thickness.