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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Tracking B-31 iceberg with two aircraft deployed sensors" *by* D. H. Jones and G. H. Gudmundsson

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Suggested modifications to paper, in response to review.

The ability to instrument large expanses of sea ice or iceberg fields from fixed wing aircraft has been of interest to military and maritime scientists for 44 years. In 1970 and 1971 the US coastguard tested an aircraft deployed ice penetrator designed to measure ice thickness. The military potential saw the US Naval Ordnance Laboratory and Sandia labs test larger ice penetrators in 1973 (Penetration of Sea Ice by air-dropped projectiles, C. W. Young, Sandia Labs). The first operational ice tracking sensors were developed for ice pack drifting experiments and deployed in 1978 (Brown, W. P, 1978). These Air droppable Remote Access Measurement System (ADRAMS)

buoys were shaped like a 22" diameter sphere and adapted for deployment from a Hercules aircraft. Development of systems subsequent to ADRAMS has been in response to increasing air safety regulations, the improvement of battery technologies and the availability of more advanced and compact electronics. Current commercial systems are made by CANATEC (http://www.canatec.ca/index.php/products/ice-drift-beacons/) and METOCEAN (http://www.metocean.com/Upfiles/Products/PDF/CALIB.pdf). The METOCEAN CALIB buoy is currently in use by the Canadian Ice Service and have been used in the past as part of the International Ice Patrol.

The CALIB is a commercially available iceberg tracking device that can be dropped from a fixed wing aircraft. It is a 0.9m long sonobuoy designed to partially penetrate the snow pack and stand upright.

There a a number of limitations of the CALIB design.

1) The CALIB is designed to stand upright in a snow pack, so it will be less effective on an iceberg without snow cover. However the lack of a snow braking mechanism means the depth to which it penetrates the snow is sensitive to the depth and density of the snow pack on the surface of the ice. If the snow pack is less dense the CALIB may completely bury itself and no longer achieve satellite reception. 2) The top of the CALIB sonobuoy is an open container for packing the parachute in, so after deployment this can fill up with accumulating snow and potentially block the satellite antenna transmission. 3) Likewise the lack of an antenna mast means it is limited to operating in regions without accumulating snow. Thus it is not suited to instrumenting Antarctic icebergs where snow accumulation is ongoing. 4) The CALIB is significantly more expensive than ADIOS, and the reported reliability in tracking icebergs achieved by the Canadian Ice service has been limited. Perhaps as a result, this system has not yet featured in large-scale safety-critical surveys.

This paper discusses the necessity of iceberg tracking in the Antarctic for maritime safety purposes, describes a system that can contribute to such a programme, and

then demonstrates its operation with a case study tracking the B-31 iceberg. The analysis of the subsequent GPS track data of this iceberg is likely to be of interest to a more general study of iceberg behaviour, and we would look forward to sharing this data, and working with scientists in this field. However we believe this to be the subject of a future paper.

Specific comments.

P4610 line 23. Furthermore global warming and its disproportionate impact on polar regions have led to increased iceberg populations (Smith et al., 2013), though this may in turn be offset by the increased melt rates of icebergs due to warming surface sea temperatures.

P4611. see above P4612, line 12. We can consistently drop ADIOS sensors within a 10m square so the iceberg size limitation is not significant. Of the 43 ADIOS deployed during 2012/13, 31 survived impact and started operations. Due to the highly crevassed nature of the target areas (Pine Island Glacier, Scar Inlet) we suspect most of the failures were due to them falling down a crevasse.

The operating range of fixed-wing aircraft make large scale surveys possible. Helicopters are more sensitive to detrimental weather conditions and have limited range. As such the advantages of fixed wing aircraft, especially in polar regions where the weather is often poor and the number and location of airports is limited, are significant.

P4613. Agreed P4616. The accuracy of GPS-based positions is typically within a 10m radius, the accuracy of iridium position calculations varies between a 1 and 100 km.

P4617. Prior to calving, we achieved 91% GPS precision daily transmissions from 2 ADIOS over 316 days.

After calving, we achieved 29.4% GPS precision daily transmisssions, 21.2% low power transmissions and 49.4% transmissions were missing. Over a period of 326 days.

P4617.1-3. Its not clear why the beacons started struggling so soon after calving, however the reported battery voltage has remained consistently high so the electronics integrity is not an issue.

P4167.5 Agreed.

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