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# The Need to Develop Semi-disposable Surface Flux Stations for Polar Sea-ice Studies.

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Recent scientific interest in predicting the behaviour of sea ice in both Polar Regions has swelled, with many nations and international consortia funding large deep ice and marginal ice zone (MIZ) field campaigns. Unlike pure atmospheric circulation studies, with a history of highly structured need to improve physical parameterisation within global climate models, ocean–sea ice-atmosphere field campaigns are only recently becoming process-study rather than discovery driven. An indication of this evolution is the recent change of emphasis from sea-ice stations that "observe the weather" (for example, the Russian North Pole drifting stations) to those that measure the surface energy balance (SEB) (for example, Ice Station Weddell and the Surface Heat Budget of the Arctic Ocean deployment), the latter emphasis being the key component to validating and improving numerical models.

The SEB comprises terms representing fluxes of heat through radiative, turbulent, and conductive processes. The conductive flux is not difficult to measure, and the recent availability of reliable, polar-proof, fast-response 3D sonic anemometer/thermometers has made obtaining the turbulent flux terms feasible. "Sonics" are *de facto* core sensors for manned, static polar field campaign SEB studies (Summit, Barrow, Alert, Halley, South Pole) and have been used on ship-borne sea-ice stations (SHEBA, ASCOS) and large ocean buoys (Scripps, and Woods Hole). While quality measurements of radiative fluxes are obtained at manned polar research stations, they are notoriously difficult at unmanned sites because of icing.

We believe it is now necessary and feasible to develop a semi-disposable automatic "flux buoy", based on relatively cheap "sonics", high-quality de-icing radiometers, inexpensive communications, flotation platforms, batteries and Inertial Measurement Units (IMU). This cost feasibility is due to

- the relatively high cost of ship operations,
- the reduced real-term costs of the flux buoy components,
- the enhanced science data return from a distributed, simple sensor array.

There are a number of technical issues that must be solved when transferring automatic polar SEB technology from a manned, static field station or ship to a small floating unmanned platform. These include

- developing effective de-icing for the radiometers,
- developing "smart" power regulation based on sensor diagnostics (the "de-ice or sleep" dilemma),
- integrating the sonic with an IMU to correct for buoy movement.
- designing a cheap platform capable of withstanding a triple mixed phased environment: the MIZ, where ice, open water, and the atmosphere all interact.

We believe these challenges are all solvable, with prototypes existing that solve some of these issues.