Arctic sea ice geodesy using SATICE-type GPS ice drifters

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ABSTRACT

Abstract: SATICE-type buoys are geodetic-quality GPS systems capable of collecting continuous high-precision GPS data while drifting on sea ice. The buoy core sensor is a dual-frequency, carrier-beat-phase GPS receiver that provides continuous (0.1 Hz), three-dimensional position estimates with cm-level precision in a well-defined geodetic reference frame. Besides high-quality GPS measurements, other geophysical auxiliary observations such meteorological, ice, and upper ocean are also acquired. Herefore, we have designed, built, deployed, and operated five SATICE buoys, in the Western Arctic (Chukchi Sea and Beaufort Sea), two of which are currently active in the Beaufort. Data from these buoys are helping us gain an improved understanding of Arctic sea ice physics and ocean dynamics. As part of our contribution to ICE-ARC, we will build a new series of improved SATICE buoys and deploy them pan-Arctic. SATICE buoy technology is described below.

PAST

SATICE was conceived as a high-precision positioning at a high-rate system operating autonomously on the Arctic Ocean during at least an entire year.

The acquired data is beamed down to the Project servers in Barcelona in near real time.

The system has already been evolving since 2010, adding feedback from each deployment to the next one. Major changes on the design can be seen in figure 1.

Figure 1. The two generations of the SATICE platform and the update of the second one.

PRESENT

SATICE-type drifters are anchored to the ice with a power supply build large enough to provide power for the long Arctic Winter night, were no solar power will be available. The system once deployed is never recovered and it is linked back through a satellite data link, the cost of recovery exceeds the cost of fabrication.

The system uses data merging from several independent sensors, as seen in figure 2. The freeboard is measured indirectly by measuring were is the surface of the ice related to the GNSS antenna with the surface acoustic ranger and were is the surface of the sea, again related to the GNSS antenna, with the underwater CTD measurements.

The resolution of the freeboard and the ice dynamics is few cm-level after post-processing of the raw data measurements in the local server in Barcelona.

Figure 2. SI05 (Mark 2.1 SPGB)

Figure 3. Tracks of SI04 (G) and SI05 (R) up to last week of October 2014.

Figure 4. Deployment of SI04, photo by Phil Hwang

Figure 5. Amount of data downloaded.

Figure 6. Type of datasets downloaded.

Figure 7. Amount of data downloaded.

Figure 8. The Fram tethered to ice (1896)

Figure 9. An example of a SATICE SPGB with a shallow hull floater.

FUTURE

Data from these buoys are helping us gain an improved understanding of Arctic sea ice physics and ocean dynamics. As part of our contribution to ICE-ARC, we will build a new series of improved SATICE buoys and deploy them pan-Arctic. SATICE buoy technology is described below.

Figure 9. An example of a SATICE SPGB with a shallow hull floater.

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