Subsea Water Isotope Sensor

Towards *in situ* measurements of water isotopes for better understanding the melting of the Antarctic ice shelves

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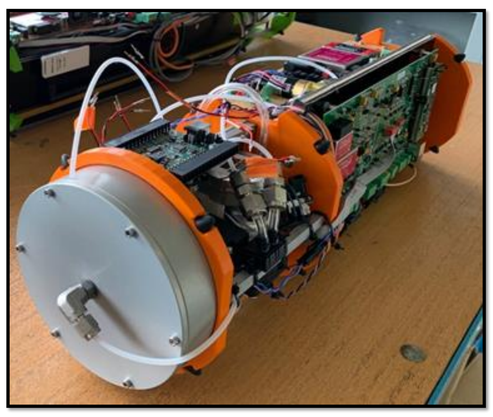
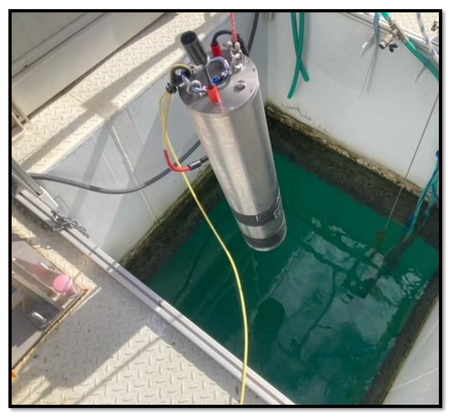
Instrument characteristics

Dimensions	90 cm ; Ø 19 cm
Weight (w/o casing)	55 kg (10 kg)
Sampling method	PDMS membrane
Casing	Titanium tube
Power consumption	~ 40 W
Battery	Li-Ion 24 VDC
Autonomy	~ 12 h
Communication	Ethernet/SHDSL

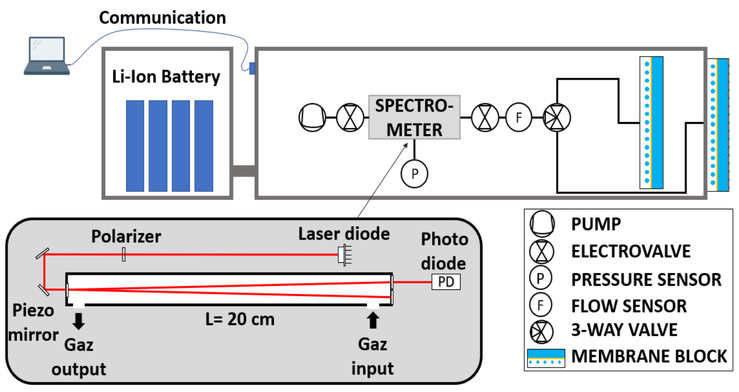


The SWIS instrument

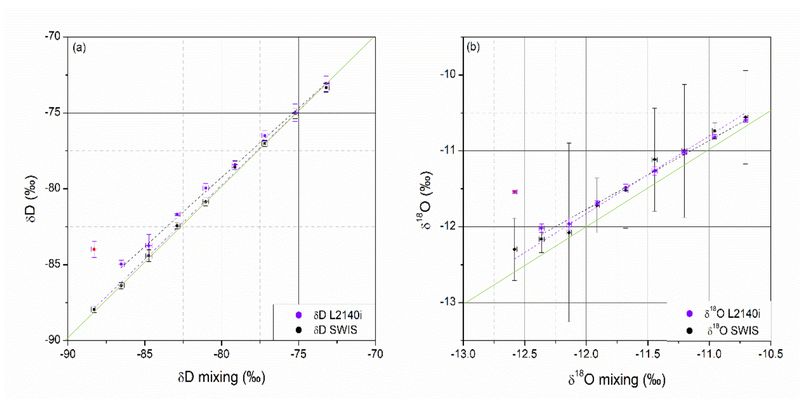


SWIS in its titanium casing, used during a field campaign at Geneva Lake

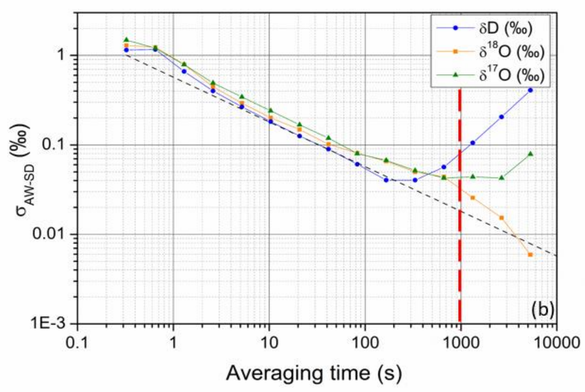
Spectrometer	OF-CEAS
Depth rating	3000 m
Optic cavity cleaning time	~ 3 min
Pressure stab. time	~ 1 min
Measuring time	~ 1 min
Total time (ref. + meas.)	~ 2 x 5 mim
Sensitivity for δD and $\delta^{18}O$	< 0.1 ‰



Operating diagram of SWIS. For Borehole applications the Li-Ion battery is integrated in the same Ti-housing of the instrument.



Comparison between SWIS and Picarro L2140i instruments *for the analysis of nine samples with respect to the expected values calculated from the volumetric mixing of the standard waters. Linear correlations were obtained with slopes of 0.981 ± 0.014 (SWIS) and 0.912 ± 0.014 (L2140i) for the δD (a), and 0.995 ± 0.046 (SWIS) and 0.909 ± 0.036 (L2140i) for the δ 18O (b).*



Evaluating long-term stability of the instrument using the Allan standard deviation statistical analysis on 5 hours continuous measurements of miliQ water at 20°C.

Fimbul ice-shelf : a first field campaign in Antarctica for SWIS !

Long term goal: improve space and time resolution of water isotopes measurement for better constraint and predict the melting and calving of an ice-shelf

- Access to the water granted by digging boreholes through the ice-shelf (up to 400m deep)
- Boreholes drilled using hot pressurized water
- SWIS designed for *in-situ* water isotopes measurements → better space/time resolution
- Measurements in the water below the ice-shelf, for capturing semi-diurnal variability and recoding depth profiles

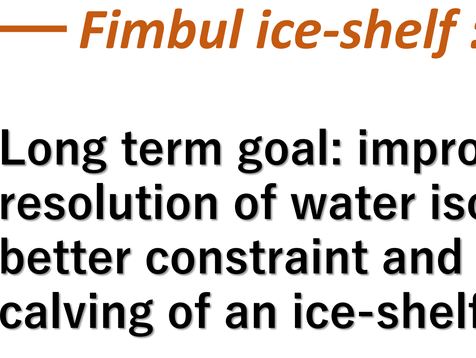


Diagram of the field operation

Potential future uses

- Increase in number of units and deployments
- Measurements from boats or autonomous vehicles
- Season-round measurements

Location of the field campaign

The Fimbul ice-shelf, *Credits: NPI*

Field location	Fimbul ice-shelf, Dronning Maud Land, East Antarctica
Mission type	Deep field mission
Nearest station	Troll station (Norwegian)
Operating institute	Norwegian Polar Institute
Period	15 nov. 2023 – 15 jan. 2023
Transport/logistics	Plane, terrestrial traverse
Organisations and countries involved	NPI,UiB (Norway), BAS (UK), Cornell University (USA), CNRS/IGE (France)

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