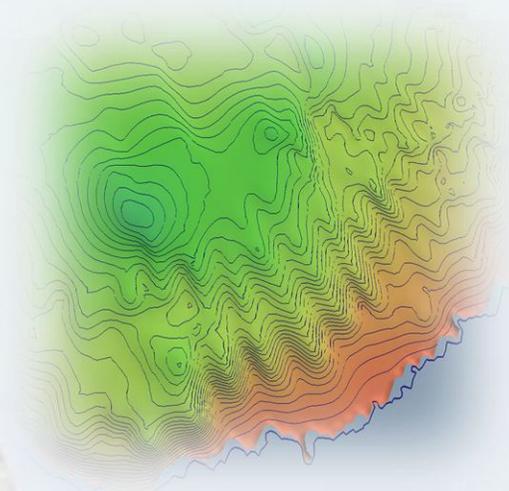


Mapping Arctic lakes: a challenge for the 79°N parallel

(Ny-Ålesund campaign - summer 2023)



David Rossi

**Filippo Azzaro, Giulio Careddu, Michele Marasco,
Daniele Montecchio, Nicolas Guyennon, Emanuele Romano,
John Tamplin & Edoardo Calizza**

State of the Art

The utilization of hydrographic Uncrewed Survey Vessels is becoming increasingly prevalent in ocean research endeavours, particularly in extreme environments.

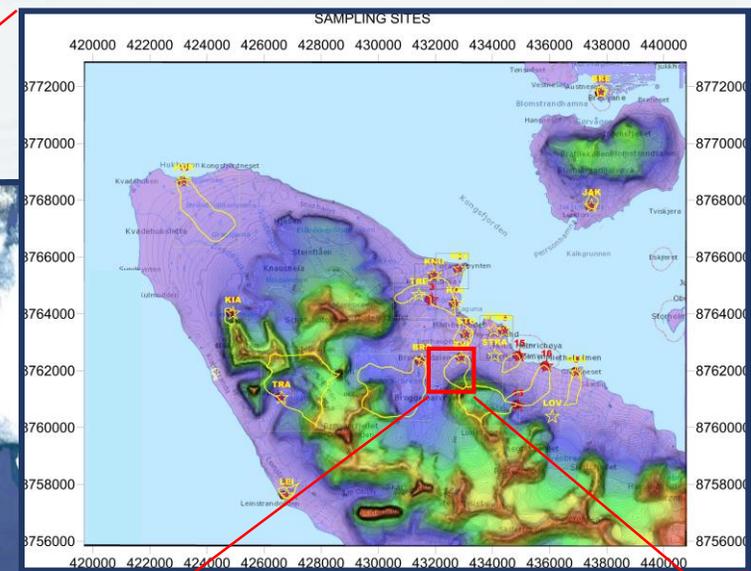
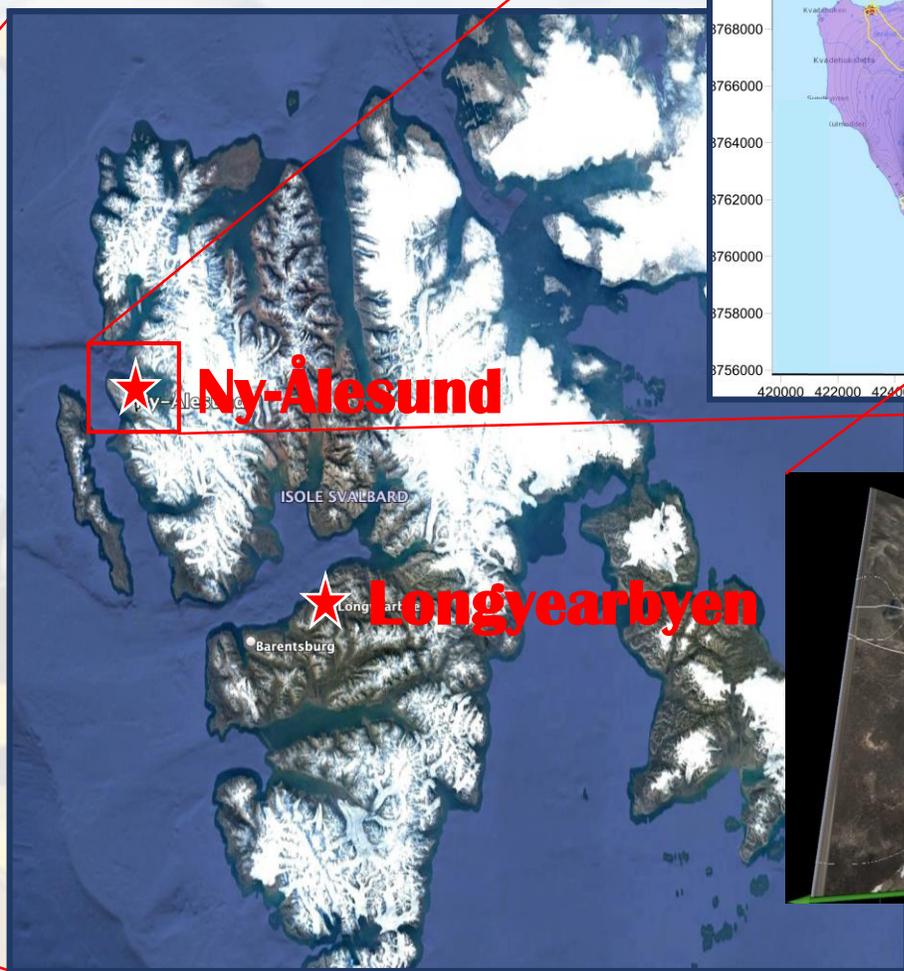
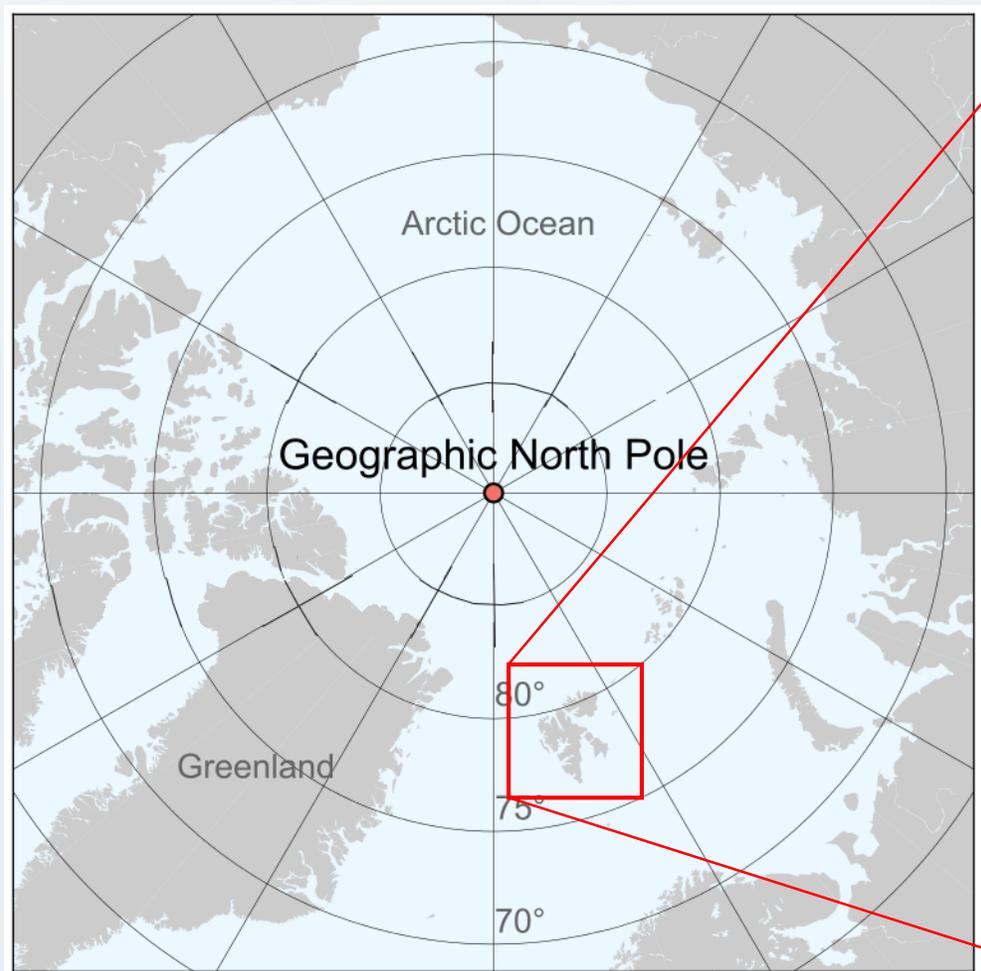
This study describe the use of a compact USV, that has been employed inland for the first time, for mapping unexplored Arctic lakes at the 79°N Parallel.

The Project

“Nutrient cycling, ecosystem functioning and climate change in arctic lake ecosystems”
(Eco-Climate, RIS: 11696)

The Project provide a mechanistic understanding of nutrient cycling and food web functioning in high Arctic ecosystems, and their vulnerability to changes in snow cover, primary productivity and abundance of migratory birds.

79°N parallel



79°N parallel

Isolated on the polar archipelago of Svalbard at 78° North, Longyearbyen is the world's northernmost permanent settlement.

despite this!

At only 1100 km from North Pole Ny-Ålesund Research Station (79°N) represents the northernmost inhabited area of the planet.

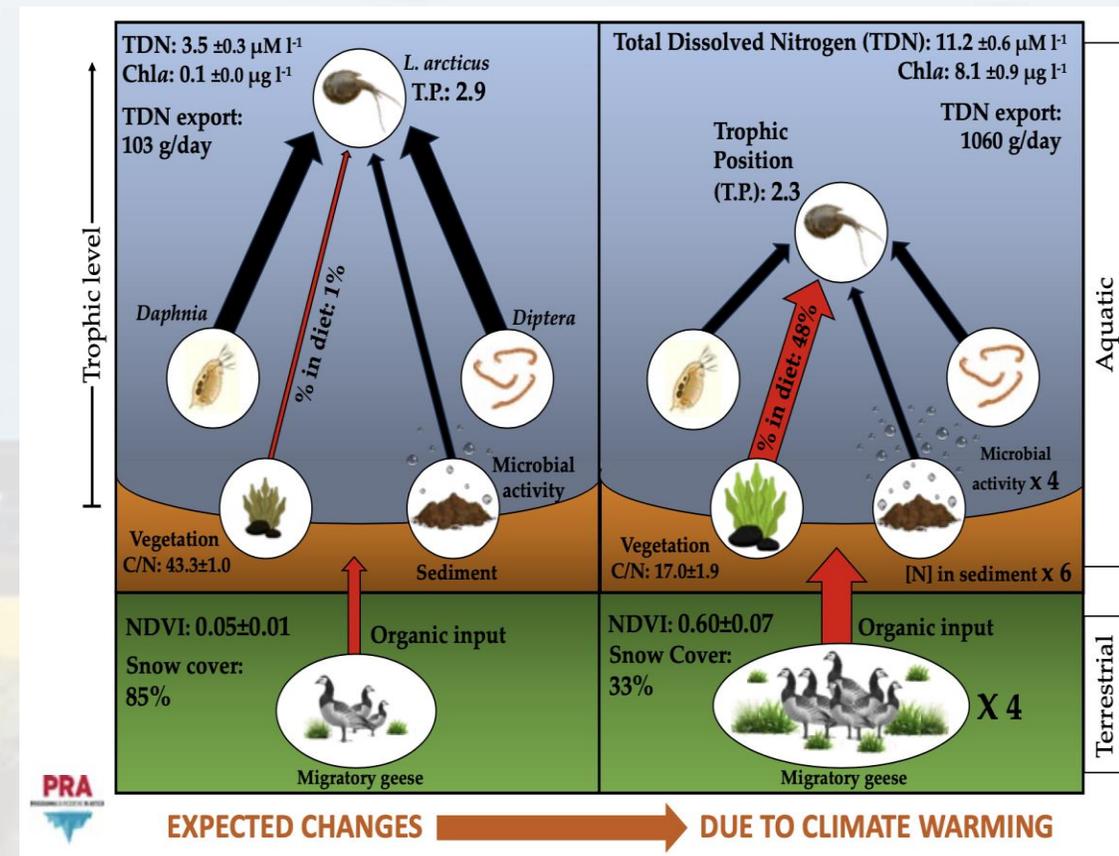
Italian Base «Dirigibile Italia»



Why we choose Svalbard?

Understand how climate changes could influence the structure and functioning of the arctic lakes ecosystems, considered biodiversity hotspots and carbon sinks at the highest latitudes.

Some Result



The challenge

Taking advantage of cutting-edge tools, including a Portable Hydrographic USV, sponsored by *Seafloor System Inc.* and a third-generation GNSS antenna sponsored by *Microgeo*, we were able to reach and reconstruct the bathymetries of 22 unexplored lakes. (with only one being previously known).



Fieldwork on Ny-Ålesund

Working in field on Svalbard Island and in particular around Ny-Ålesund Research Station mean to resolve two main big problems:

The threat of polar bears and the Radio Silent



Illegal use of wireless devices in Ny-Ålesund

Do you have a mobile phone, a smart-watch, an Apple TV, a smart-TV, wireless speakers, a wireless headset or other wireless devices using Bluetooth or Wi-Fi? Are you aware that such devices are illegal to use in Ny-Ålesund unless you turn off the wireless functions?



In addition to scientific equipment, it is necessary to be always armed with rifle and flare gun, and be ready to shoot!

USV (Tridrone)

To obtain detailed lakes-bed geometry, water volumes and evaluate nutrient concentrations a portable Unmanned Surface Vessel was necessary. The TRIDRONE was the perfect solution.



USV



USV

Length: 121.92 cm
Folded Width: 32.5 cm
Unfolded Width: 86.36 cm
Weight: 10 kg
Payload: 11 kg
Power: 1 x 14.8 VDC 16Ah Battery LiPo
Battery Endurance: 8 Hours at Survey Speed
Motor: 1 x Brushless Thruster with Weed Guard
Echosounder: Seafloor HydroLight-DFX
Transducer: ECT400
Frequency: 450KHz
Beam width: 5° conical
Ranges: 0.15m to 100m
Ping rate: 10Hz
Tilt sensor: Dual axis

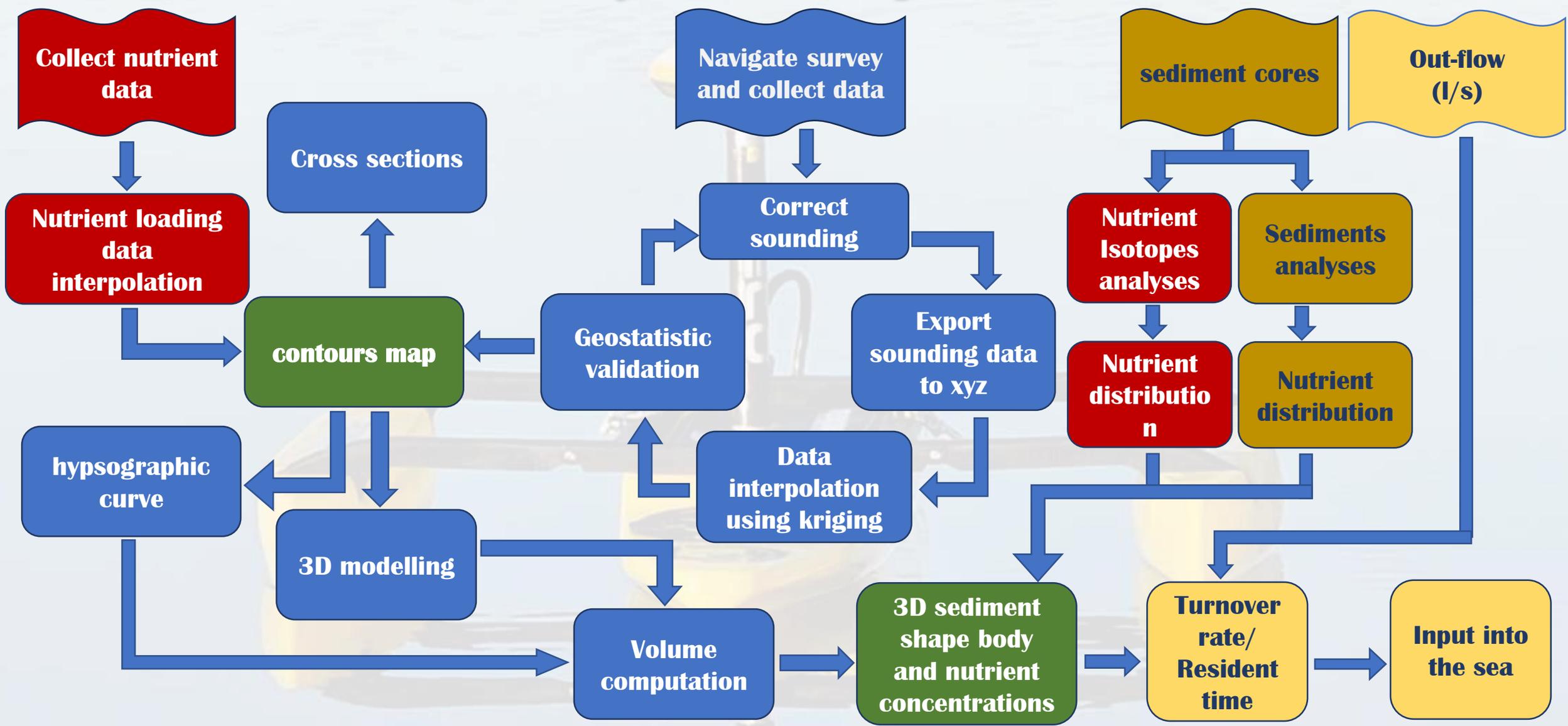
GNSS

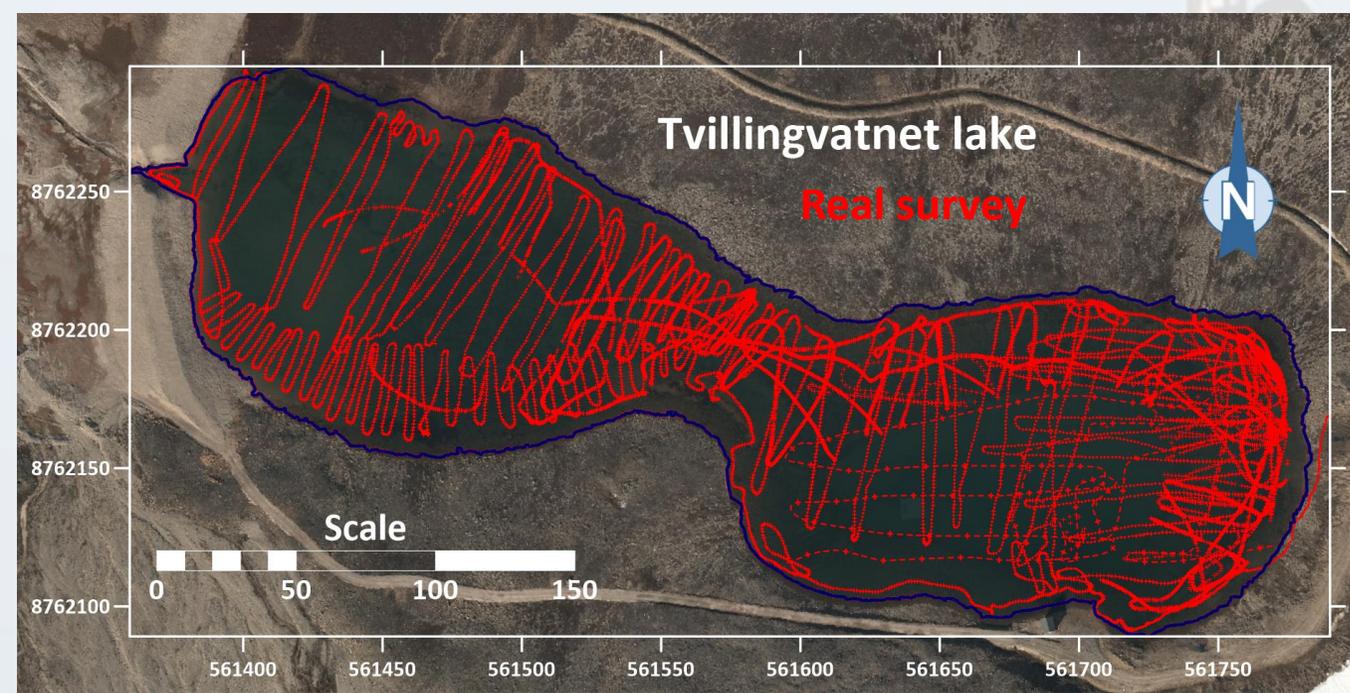
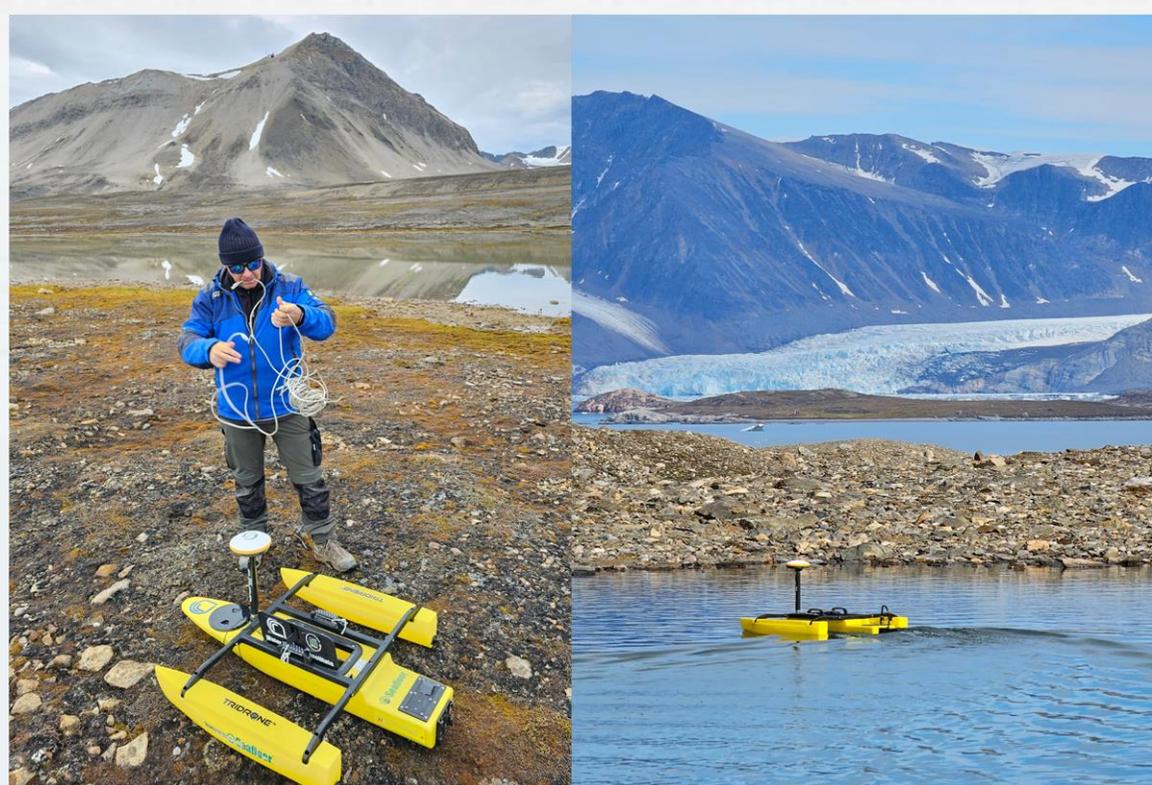
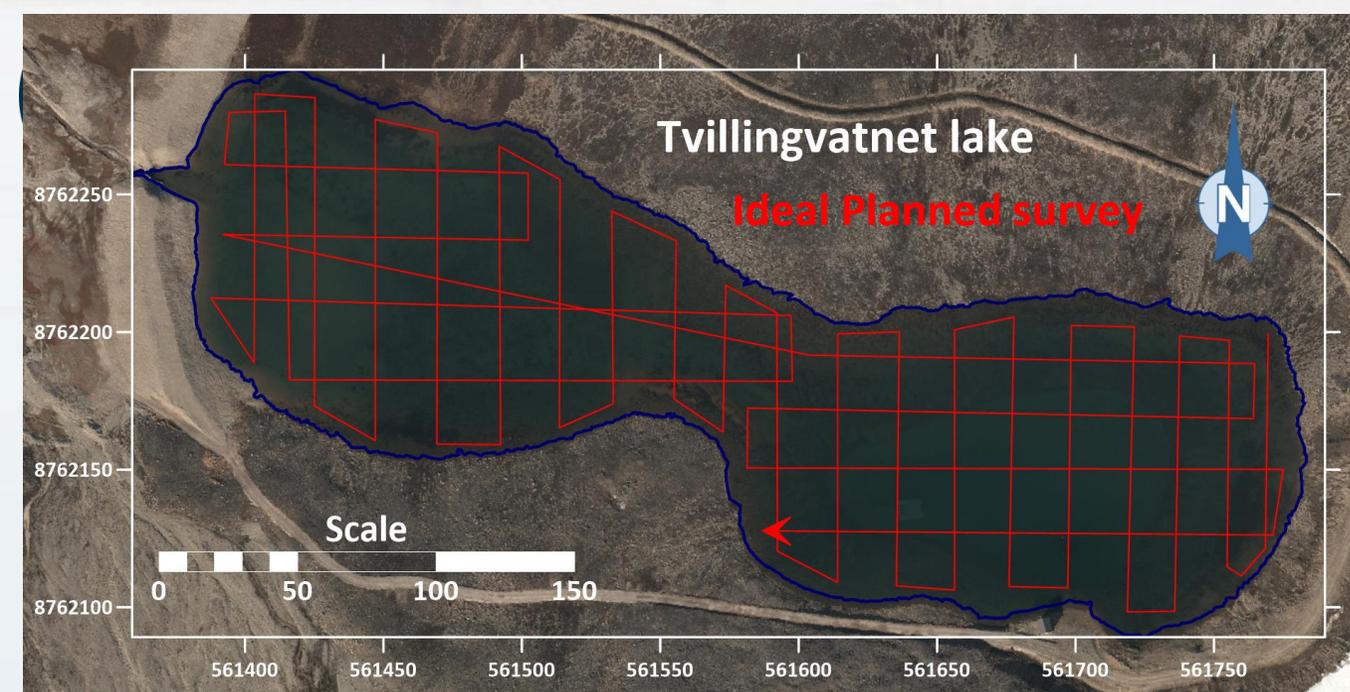
Dimension: D-158mm x H-53mm
Weight: 940g
Satellites: GPS (L1CA/L1P/L1C/L2P/L2C/L5) BDS (B1I/B2I/B3I/B1c/B2a/B2b/ACEBOC) GLONASS (G1/G2/G3/P1/P2) GALILEO (E1/E5a/E5b/E6/ALTB0C) QZSS (L1CA/L1C/L2C/L05/LEX) IRNSS (L5) SBAS (L1/L5) Channels: 800 L-Band: Atlas H10/H30/Basic Power: IoN 7,2V 6800mAh Battery Endurance: 12 Hours Communication: Bluetooth 5.0 - Wifi 802,11 - nano SIM - Type C - TNC antenna - cable Precision: 0,25m

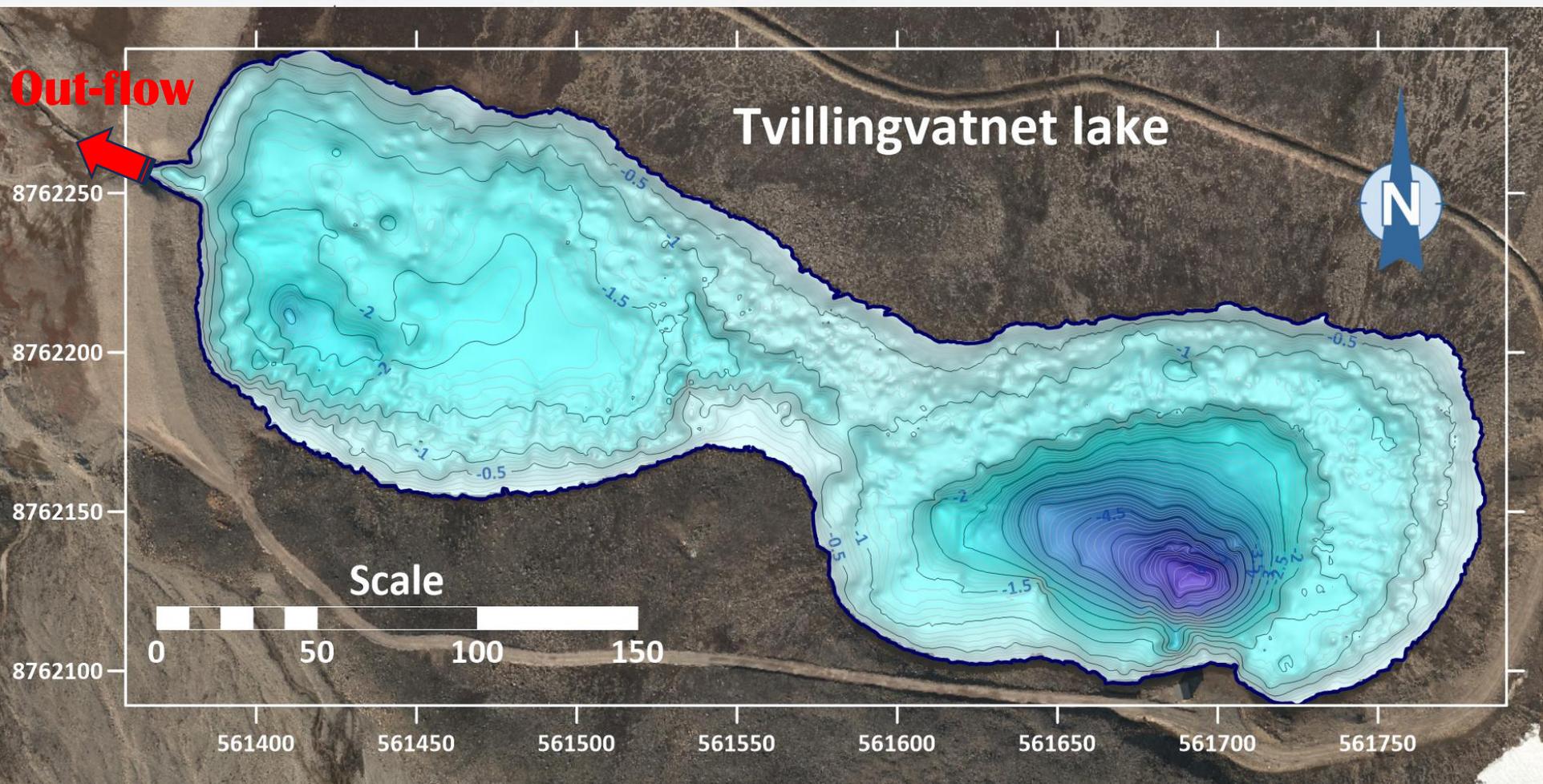
Wild environment



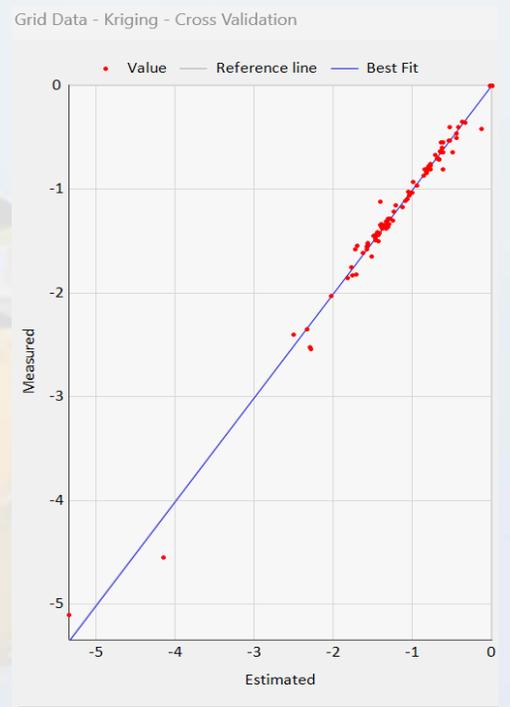
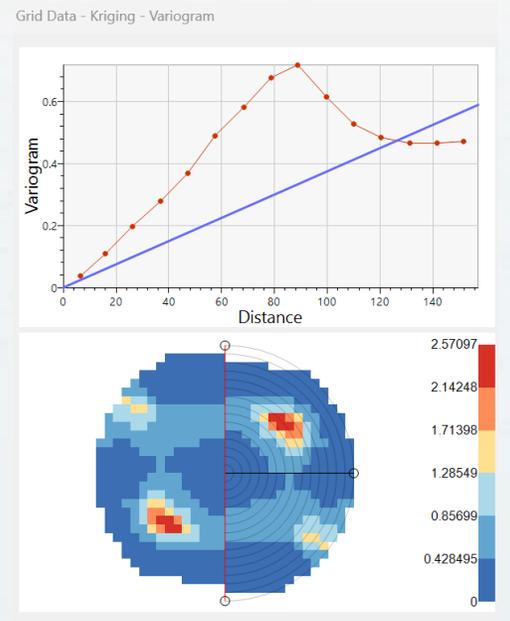
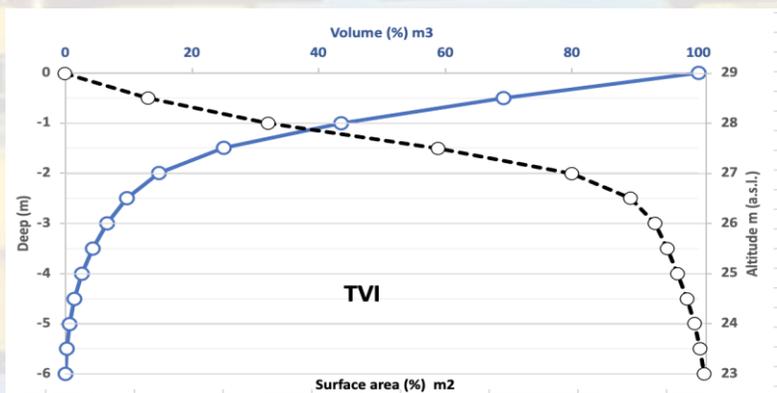
Survey to final product

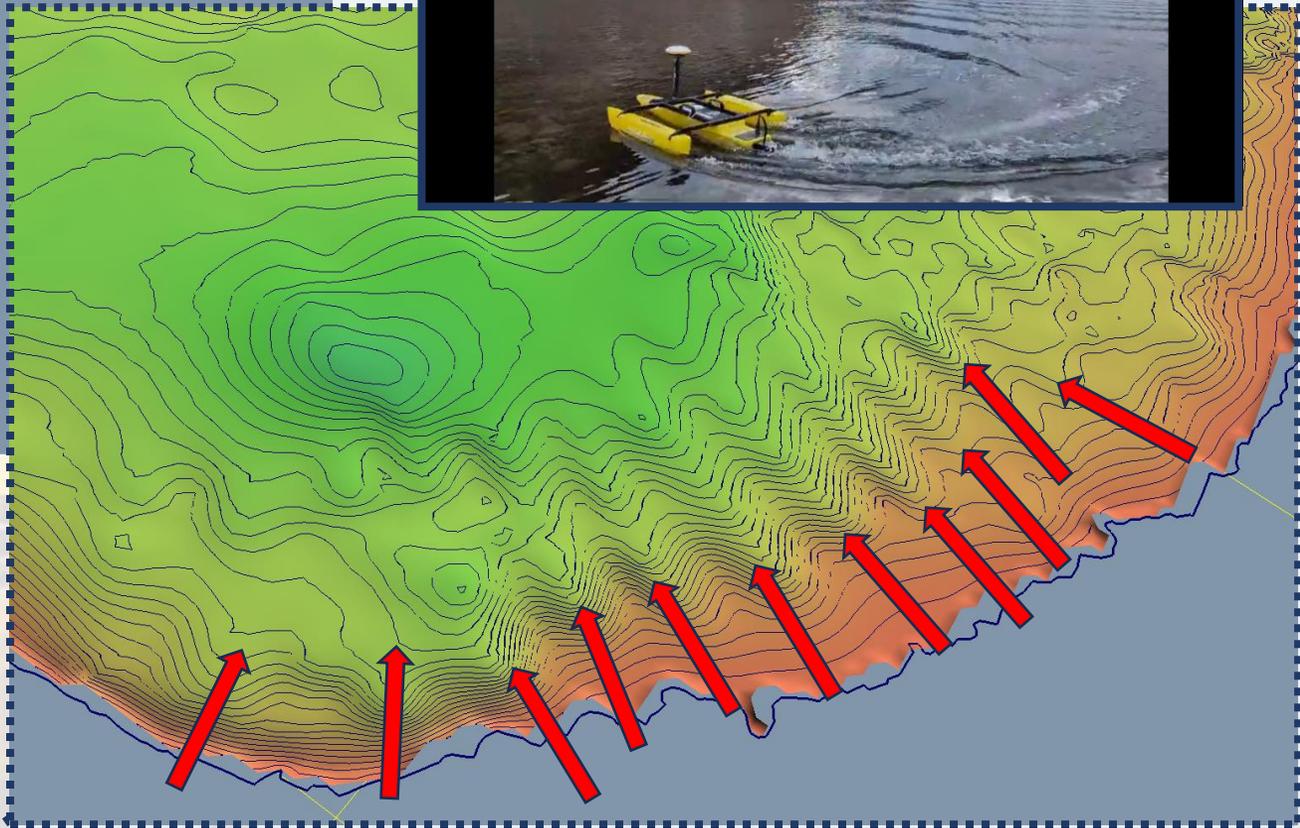
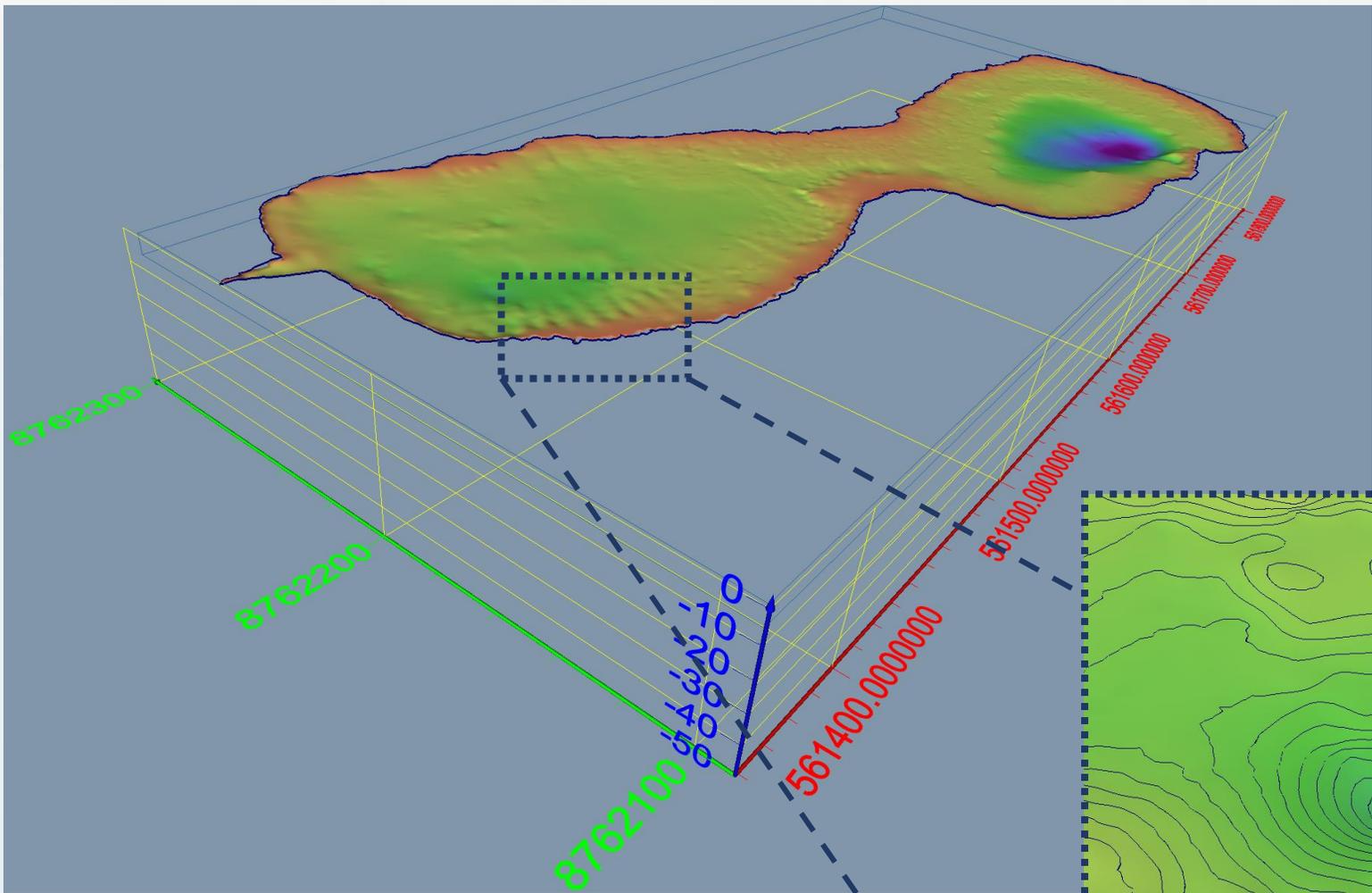




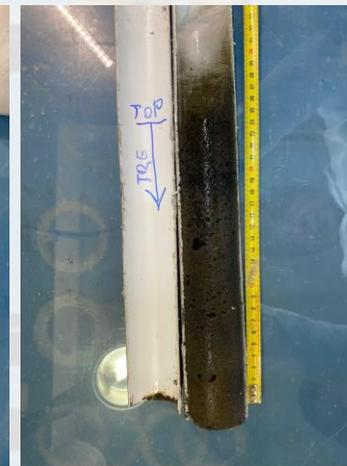
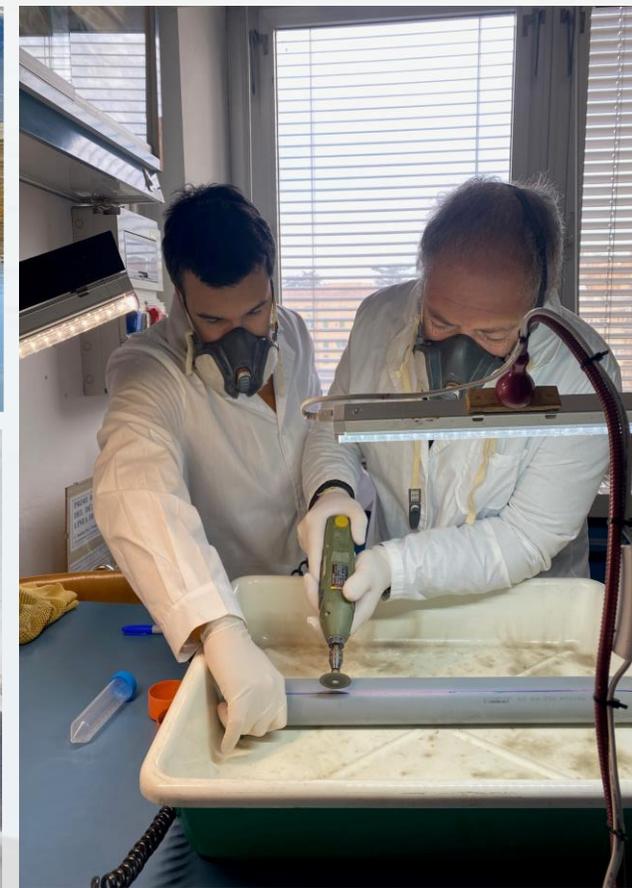
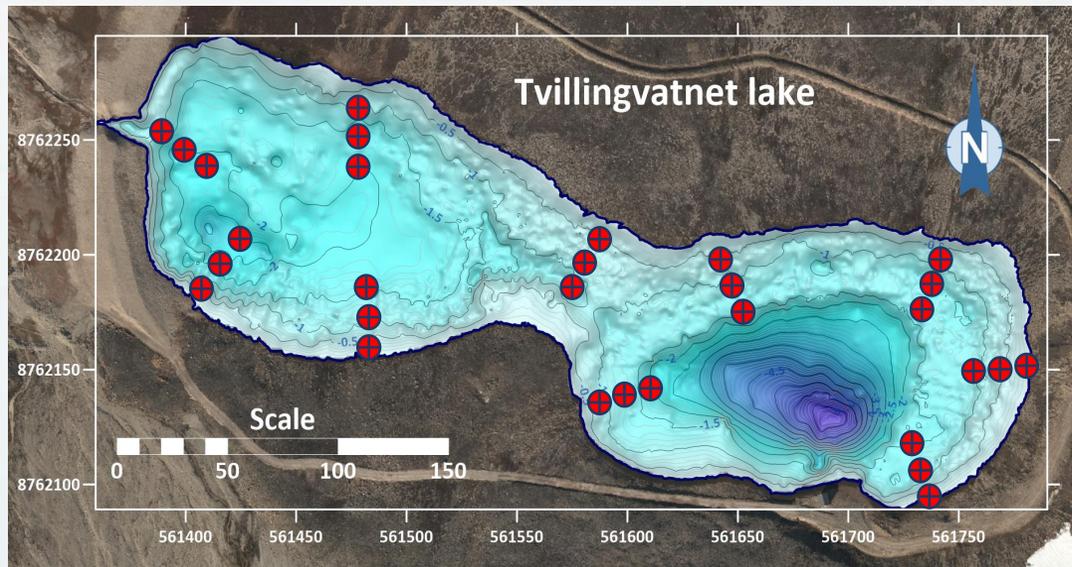


Volume: 63540,39m³
Planar area: 41696,08m²
Surface area: 41898,61m²
Out-flow: 26,71 l/s (Velocity Meter)
Resident time: 33,36 days



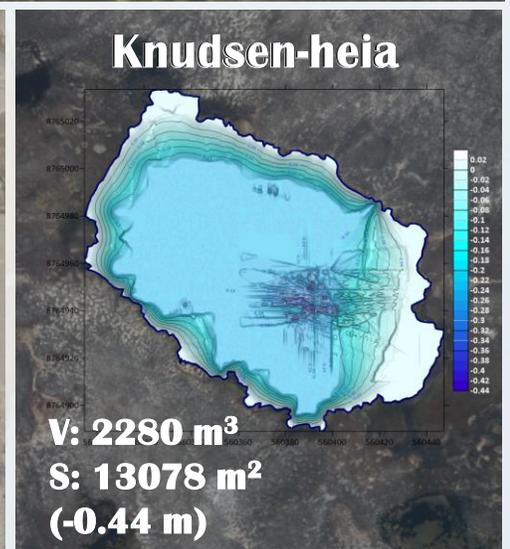
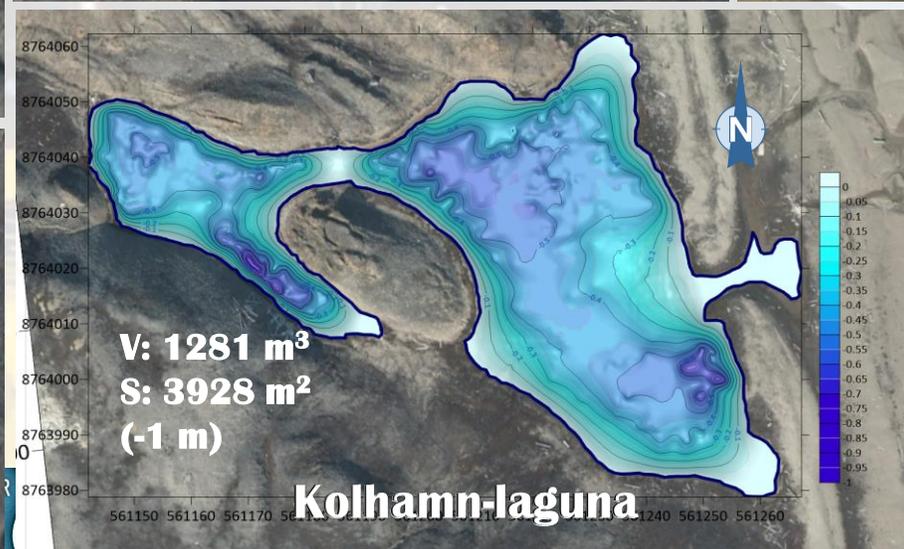
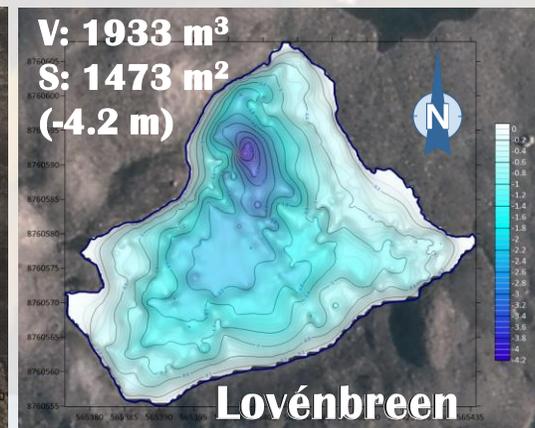
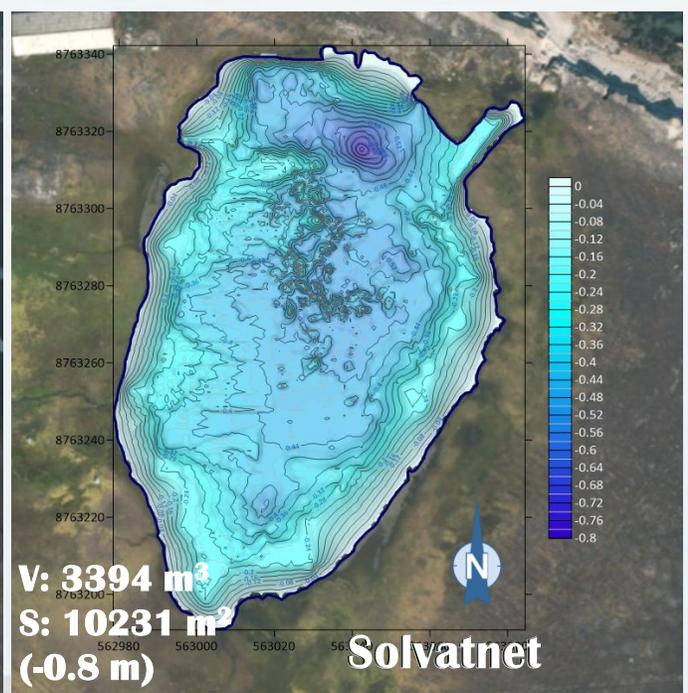
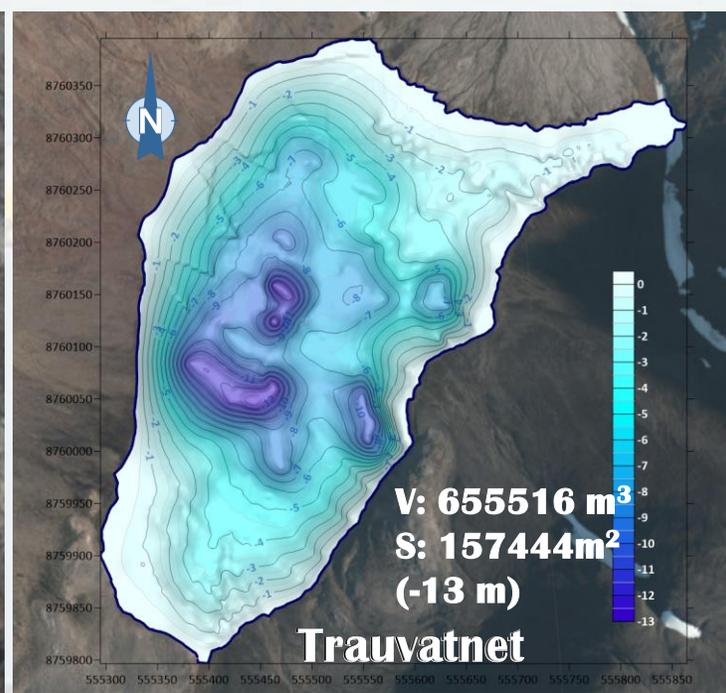
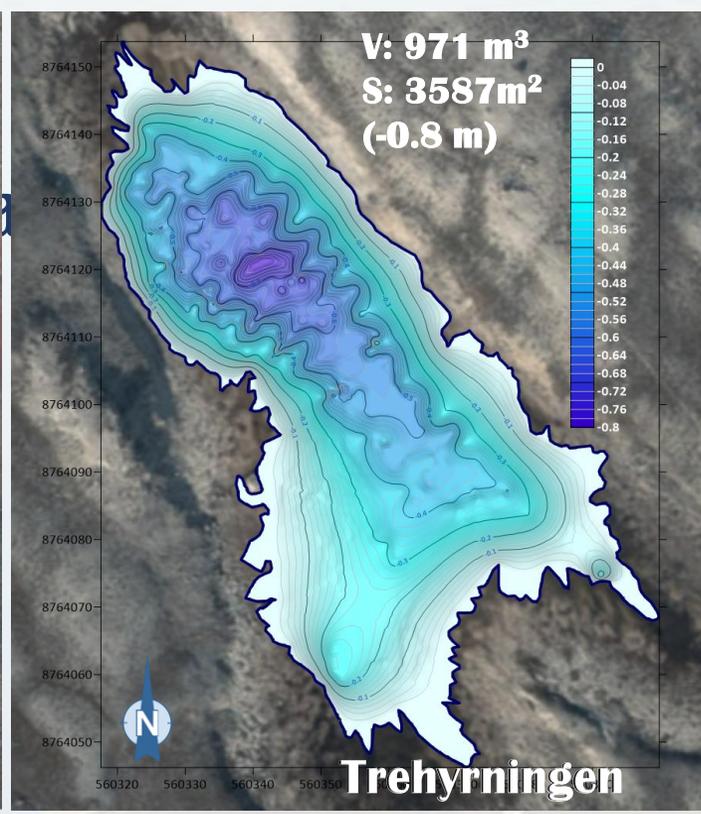
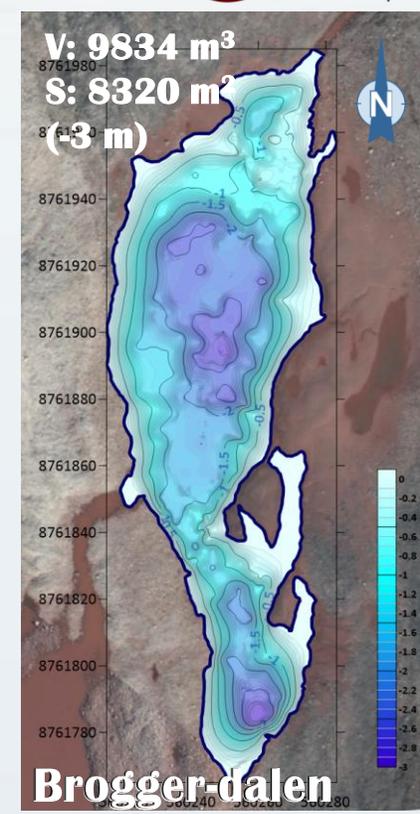


**Drainage channels
produced by
melting glaciers**

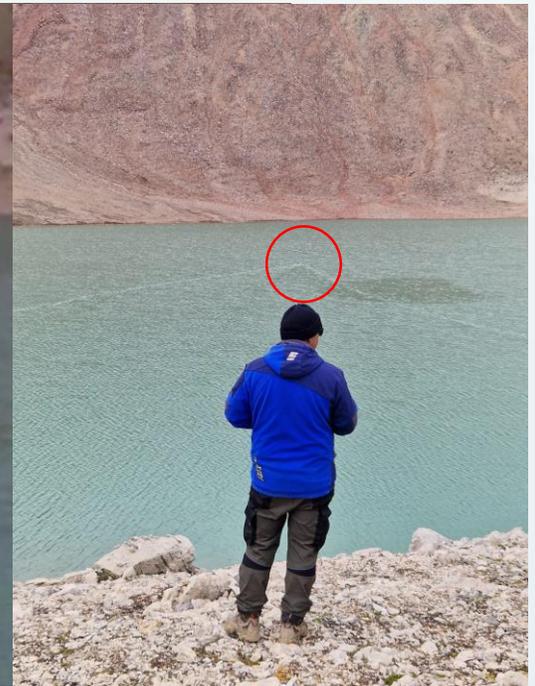
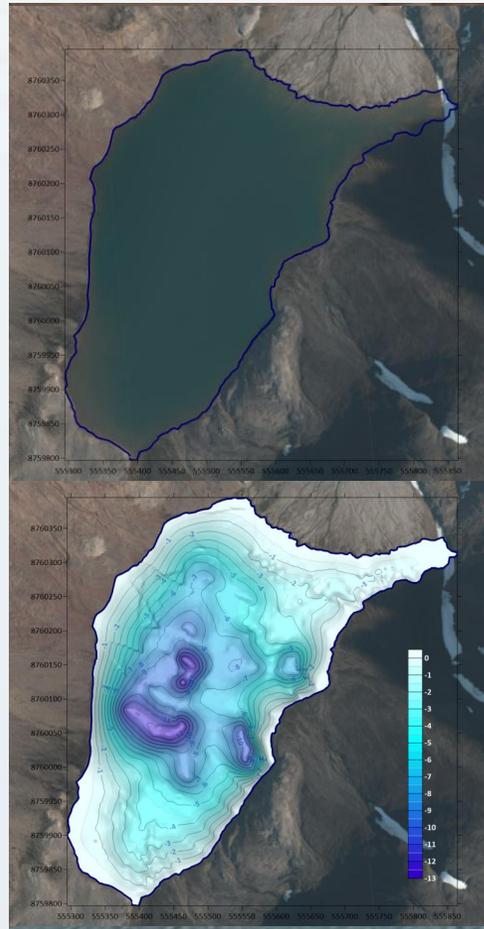


3x10 undisturbed sediment cores were taken orthogonally from the lake shoreline to identify nutrient.

This silty-clayey sediment represents the portion of the lake bed used as carbon sinks.

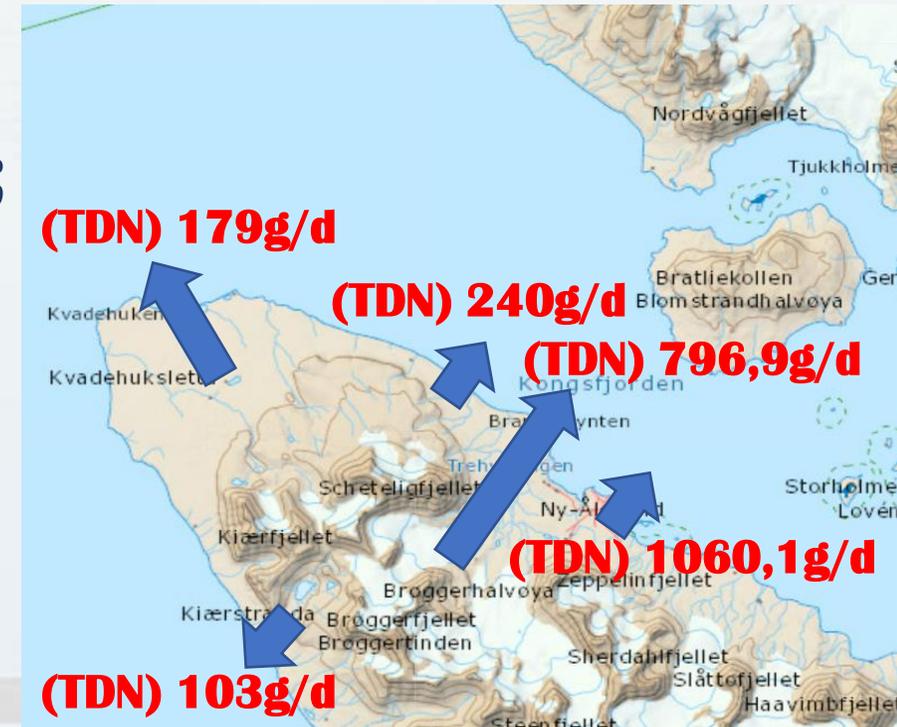


Trauvatnet Lake

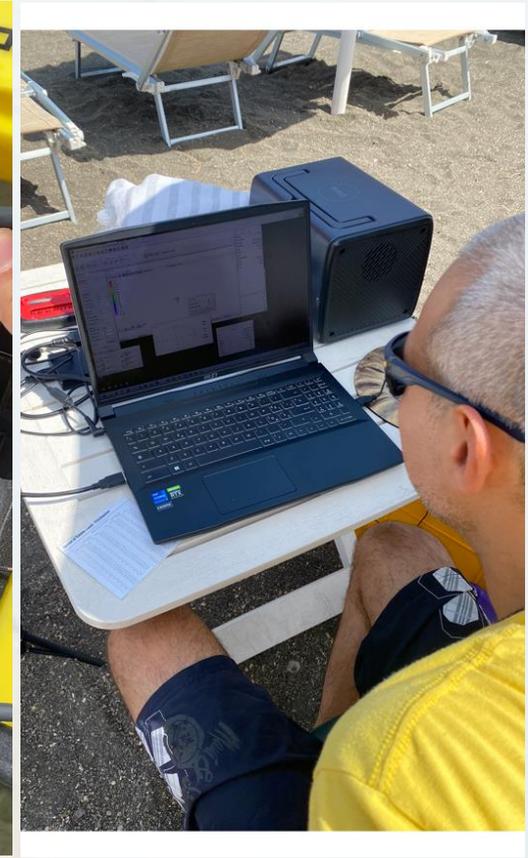


Result

- **Reduction of snow cover from June;**
- **Increase of primary productivity (NDVI);**
- **6X increase of migratory birds;**
- **6X (N) increase in sediments (due to migratory birds);**
- **4X increase in microbial activity;**
- **TDN export to the sea reach 1060 g/d from a single lake:**
- **No relationship between dimension/volume/position of lakes and (N) export;**
- **Close relationship between numbers of migratory birds and (N) export.**



Ready for future challenges



we have equipped the Tridrone with new i7 PC, Hypack Environmental mapping, an EX01s multiparametric probe and telemetry. All powered by the Tridrone's battery.

A bit of fun....

**The last day, in the last lake,
during the last 100m
a submerged stone broke the propeller.**

**A new challenge comes...
don't worry....**

**we suddenly switch the survey mode:
from unmanned to manned
and completed the lake.**



Starring

Field Crew



**Daniele
Montecchio**



**Simonetta
Montaguti**
(Station Leader)



**Nicolas
Guyennon**

**Tessa
Viglezio**
(Station Leader)



**Camilla
Capelli**



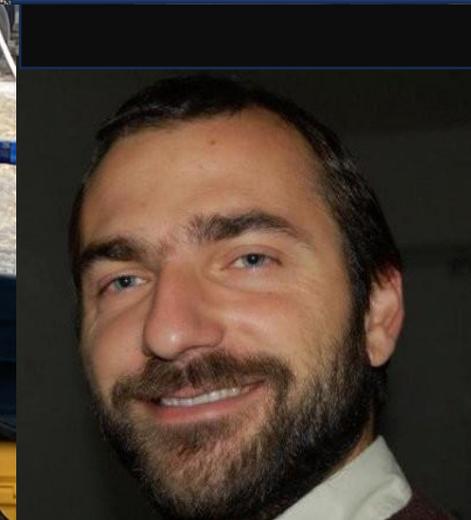
**Edoardo
Calizza**



**Giulio
Careddu**



**Bruno
Benedetti**



**Mauro
Mazzola**