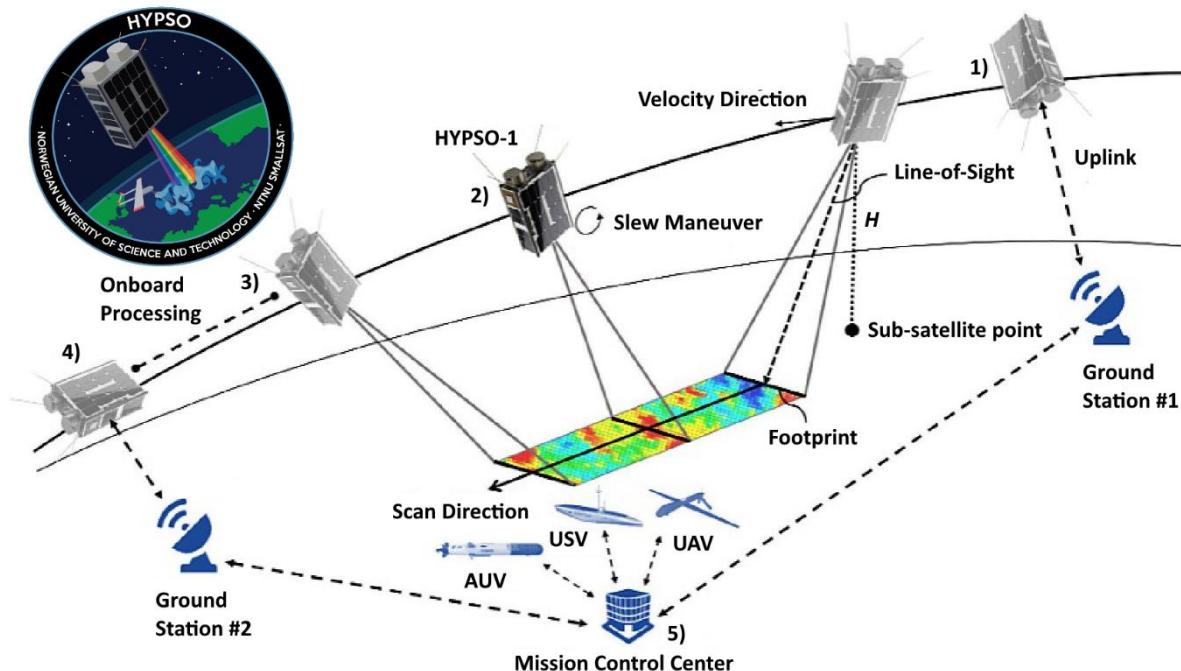


NORWAYS FIRST RESEARCH SATELLITE WORKS!

As head of the Kjell Henriksen Observatory ([KHO](#)) I am proud to show data over Svalbard's Nordenskiöld land by our satellite named HYPSO-1 (HYPer-spectral Satellite for ocean Observation 1). Under the leadership of Prof. Tor Arne Johansen and a large team of students at [NTNU AMOS](#) (Centre for Autonomous Marine Operations and Systems), the satellite was launched 13 January from Florida by a Falcon-9 rocket from SpaceX. It is the first Norwegian research satellite. The event has got little attention in the arctic media circus, which is the reason why I write these words.

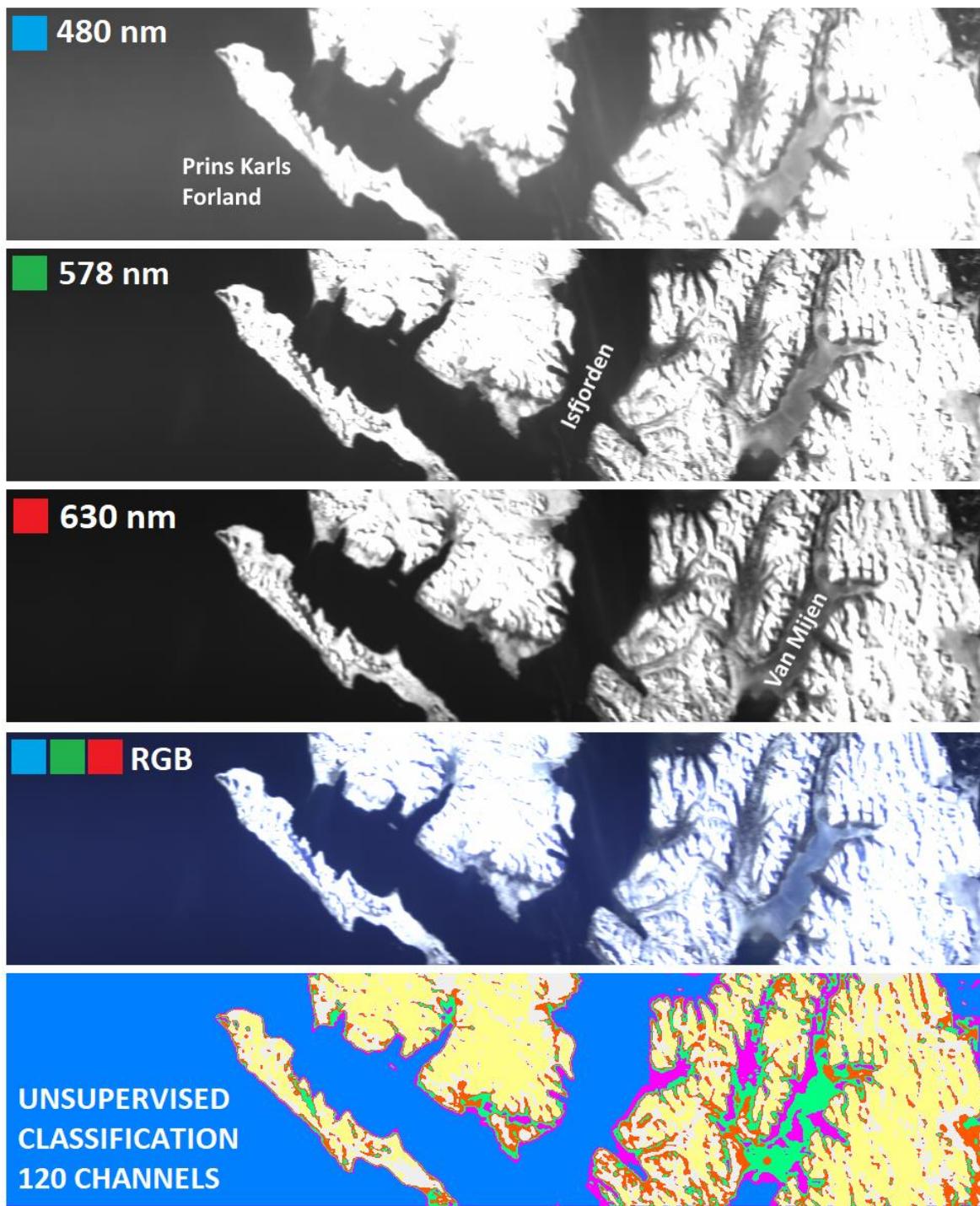


Concept of Operation where 1) HYPSO-1 satellite receives uplinked configurations from a nearby ground station; 2) acquires hyperspectral images for a short duration under a slew maneuver; 3) processes the images onboard immediately; 4) downlinks the data to nearby ground stations; and 5) in-situ assets in the vicinity may be deployed for closer investigation at the observed scene (image credit: NTNU)

The satellite is small in size ($10 \times 20 \times 30 \text{ cm}^3$) and weighs only 7 kg. It contains two camera systems. One ordinary color camera and one so-called hyperspectral camera. The latter is designed at UNIS and further developed by NTNU students to survive a life out in space. That is in polar orbit. It tumbles around at an altitude of 540 km with a speed of 7.6 km per second. The satellite is activated under the command of students at the NTNU Small satellite lab in Trondheim. Magneto torquers and reaction wheels are used to control and stabilize the satellite to aim it towards ground targets. The hyperspectral camera is then activated to scan the ground target area as a function of wavelength or colors of light. The camera records for about 1 minute 120 color channels. A huge amount of data is then downloaded to Trondheim. A task SVALSAT at Platåberget will take over. After mission complete, the spin wheels and the magneto torquers are turned off to save energy, and the solar panels recharge the batteries for the next mission.

The image below shows data from Svalbard. Prince Karl's Forland, Isfjorden, Van Mijenfjorden and several other land marks are easily identified. Only 3 of the 120 channels are presented. The top panel shows the image at wavelength 480 nm which represents blue colored reflected light from a narrow bandpass of 3.3 nm. Also shown is the green (578 nm) and red (630 nm) channels. It is now easy to assemble a color image (RGB). In the bottom image all channels are used. An artificial color palette is created to highlight equal classes in the target area.

HYPSO - 1 SVALBARD 17:30 UT 29.05.2022



The image shows hyperspectral data from the satellite HYPSO-1 (HYPer-spectral Satellite for ocean Observation 1). Top panel shows blue reflected light at wavelength 480 nm. Also shown is the corresponding channels for green (578 nm) and red (630 nm) light. The color RGB image is a composite using the above 3 channels. The bottom color palette image represents an automatically machine generated map where all 120 channels of the instrument are used.

Or in other words, the instrument creates a map of the different areas such as deep and shallow ocean, ice, vegetation, and mountains automatically. The main objective of the satellite is to see if we can detect algal blooms in the ocean.

The instrumental technique has been used at KHO from the start of the revolutionary development of electronical image sensors back in the early days of the 80's. A high degree of precision and control of attitude with the help of motors and gyros are necessary in order to form hyperspectral images. Until now, hyperspectral satellites have been large as trucks and very expensive to launch into space. HYPSO-1 represents a giant leap in miniaturization and puts Norway in the front of developing this type of highly advanced mini satellites,

Student project leaders as so far been scientist Roger Birkeland and project leader Evelyn Honoré-Livermore. The latter should in my opinion been met as Nansen when she returned home from Kennedy Space Center after a successful launch of the satellite. She defended her PhD with «flying colors» 27th of May.

Prof. UNIS / KHO / Prof. II NTNU AMOS Fred Sigernes

Prof. NTNU Tor Arne Johansen

AMOS PhD candidate Marie Bøe Henriksen