PROJECTS

WNISAT-1R

Sea Ice, Typhoons, Volcanos. The Latest Data, Straight from Space.

WNISAT-1R (WNISAT-1 Revised) is a 43kg microsatellite mainly aiming at the observation of sea ice in the Arctic polar area. It is the successor and evolution of the WNISAT-1 spacecraft launched in 2013, and was jointly developed by Axelspace and Weathernews. WNISAT-1R will carry out the following three missions:

1. Optical observation of sea ice, typhoons and other environmental phenomena
2. Observation of the Earth's surface with GNSS-R (Global Navigation Satellite System – Reflectometry) technology, using signals of global positioning satellites reflected on the surface
3. Validation of laser communication technology to increase data throughput of future micro-satellite missions

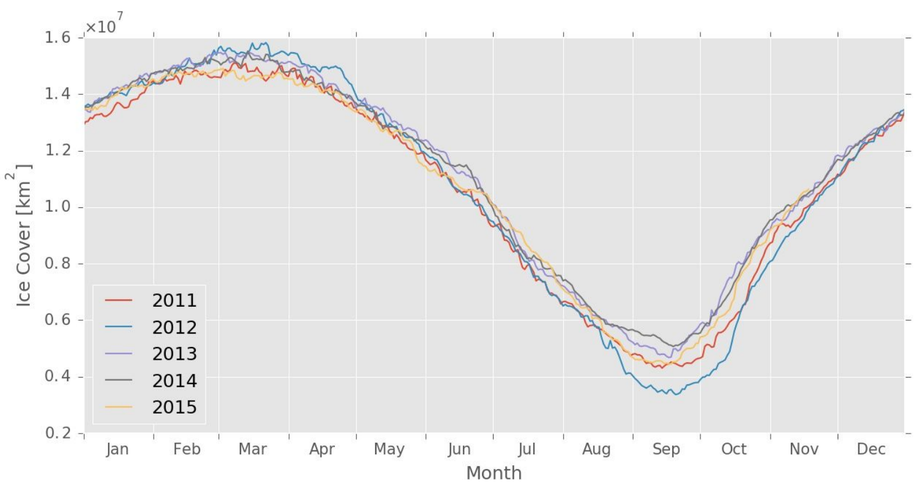
We developed this spacecraft based on the bus technology of Hodoyoshi-1 micro-satellite (launched in 2014). This allows for great performance gains and new capabilities compared to WNISAT-1, while at the same time lowering costs and reducing development time.

Optical Observation Mission

The recent climate change has caused a gradual decrease in the amount of ice in the Arctic Sea. Until a few decades ago, navigating in the sea was difficult due to pack ice, but the summer temperatures are now high enough to temporarily allow for ships to transit. These new routes are called "Northern Sea Routes."

When considering, for example, cargo shipment between Japan and Europe, these new pathways allow for voyages that are 30% shorter than the traditional ones through the Strait of Malacca and the Suez Canal, and only half as long as those around Cape Point. Using these northern routes means faster shipments, reduced fuel expenses and a smaller impact on the environment. This is why shipping companies are becoming more and more interested in this new option.

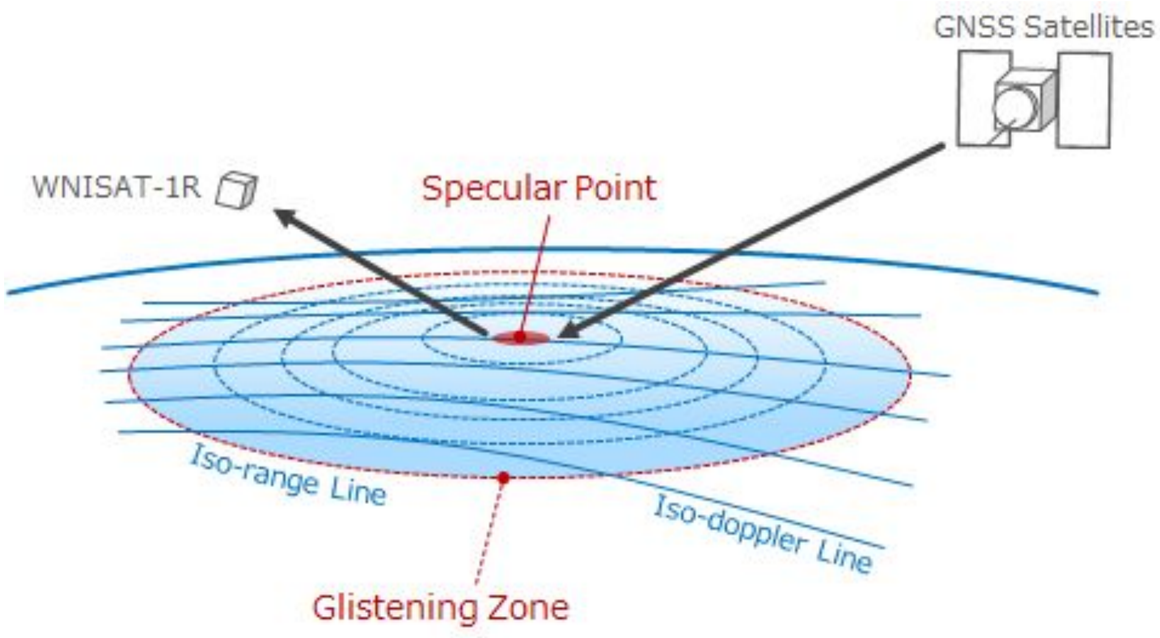
However, vessels still need safety information to sail there, because infrequent observation makes it difficult to spot dangerous icebergs floating in the sea, even in midsummer. Responding to this situation, Weathernews decided to develop their own satellite together with Axelspace in order to monitor icebergs in the Arctic Sea and to make voyaging in the area safer.

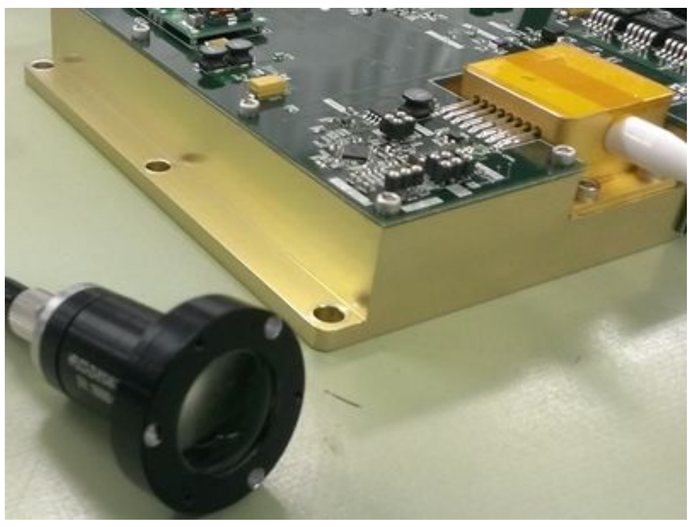


GNSS-R Mission

While optical imagery provides high quality information about the Earth's surface, lighting conditions and clouds greatly constrain its applications. Although traditional radio wave observation technologies like radars and microwave radiometers are able to overcome these limitations, these methods require large antennas or high amounts of power, making their application to micro-satellites difficult.

Rather than trying to transmit radio waves by itself, WNISAT-1R will observe the signal emitted by GNSS satellites (including GPS satellites) and then reflected on the Earth's surface, obtaining information about the surface features of sea and land. In a collaborative effort, Weathernews has provided the GNSS reflectometry antenna, while Axelspace has developed the associated signal processing technology.





Optical Communication Mission

As microsatellite sensor technology advances, the amount of mission data collected is increasing rapidly. Normally spacecraft transmit their data to the ground with radio waves like most of terrestrial wireless devices do. Considering that the number of satellites is growing and the limited frequency resources must be shared by all satellites in space, the saturation of those frequency bands could become a serious problem.

To avoid aggravating this situation, engineering interest is now increasing in the field of optical communication, which is more directional and has wider bandwidth than radio waves. However optical communication is only possible when the ground station and the satellite are pointing at each other with high precision, implying some complex technological challenges. While research institutes around the world have been researching this field, WNISAT-1R will validate low-cost optical communication technology for future use on commercial satellites.

We have substantially upgraded WNISAT-1R mission cameras compared to those on WNISAT-1. WNISAT-1's optical camera had a single sensor capable of observing red, green and blue colors, just like a common camera in everyday use. WNISAT-1R, on the other hand, has four separate cameras dedicated to four separate wavelength bands, leading to a greater resolution and wavelength selectivity.

Number of Cameras	4 (independent bands)	
Spectral Bands	Panchromatic[1]	450-650nm
	Green	535-607nm
	Red	620-680nm
	Infrared	695-1005nm
Pixel Count	2048 × 2048	
Bit Depth	12 bit	
Ground Resolution	Infrared and Red	400m
	Green and Panchromatic	200m

1. *Panchromatic* here means a band covering the whole visible range of wavelengths.

WNISAT-1R is based on the flight-proven 50kg-scale bus technology introduced by Hodoyoshi-1, the Axelspace's satellite launched in 2014.

Dimensions	524 × 524 × 507 mm (excluding protrusions)	
Mass	43 Kg	
Downlink Rate	X-band: 10-20 Mbps	
Generated Power	55-59 W (averaged)	
Attitude Control	Three-axis control (0.1° pointing accuracy)	Despin
		Sun-pointing
		Earth-pointing （nadir or off-nadir）
		Ground point tracking

Launch Date and Time	July 14, 2017 3:36:49 PM (Japan Standard Time)
Launch Vehicle	Soyuz
Launch Site	Baikonur Cosmodrome, Kazakhstan
Orbit	Sun synchronous, 600 Km altitude