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Satellite Ocean Tracking Currents for Marine Searching and Rescue

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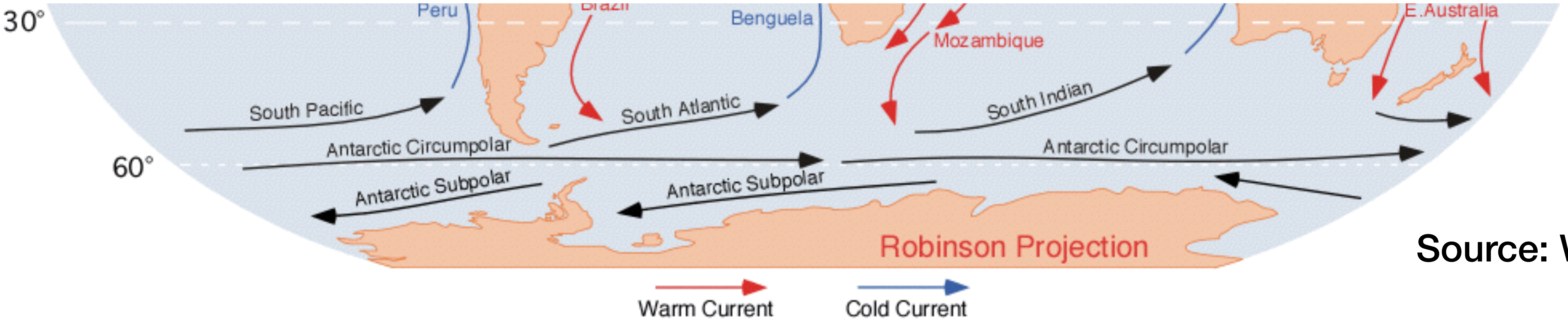
71% of the Earth is ocean

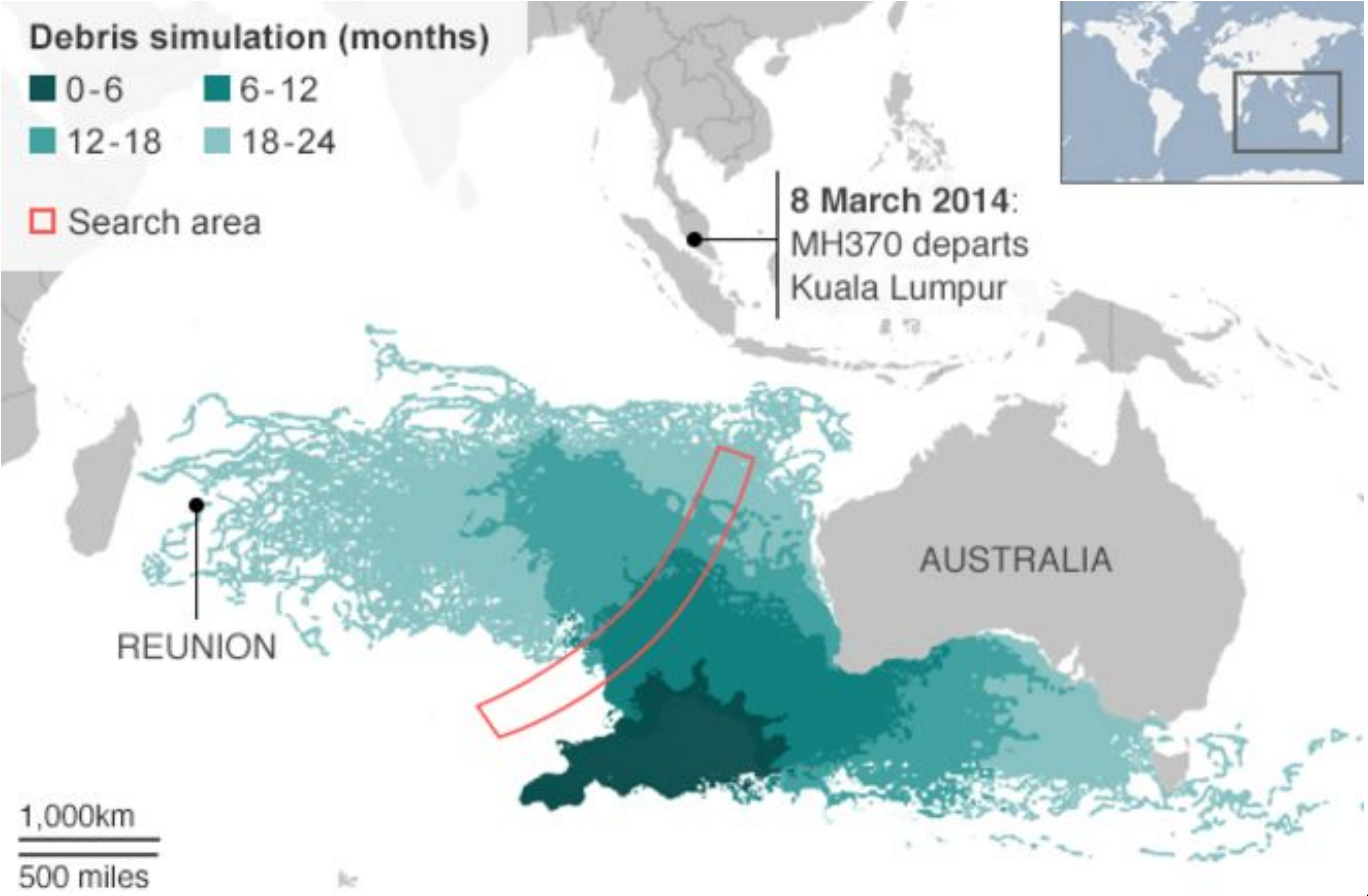
What is Ocean Currents?

Why is it important to observe the ocean currents?



Source: Wikipedia

Marine accident: Ship sinking



Reunion debris: Boeing 777 flaperon from flight MH370

Aircraft accident: Aircraft Crash

Marine accident: Oil/Chemical Spill

Objectives

❖ Primary Objectives

- To predict ship/airplane positions in the ocean in emergency situation
- To analyze oil/chemical spill movement direction.

❖ Secondary Objective

- To monitor the ocean current changing for the Earth’s climate

Key Performance Parameters

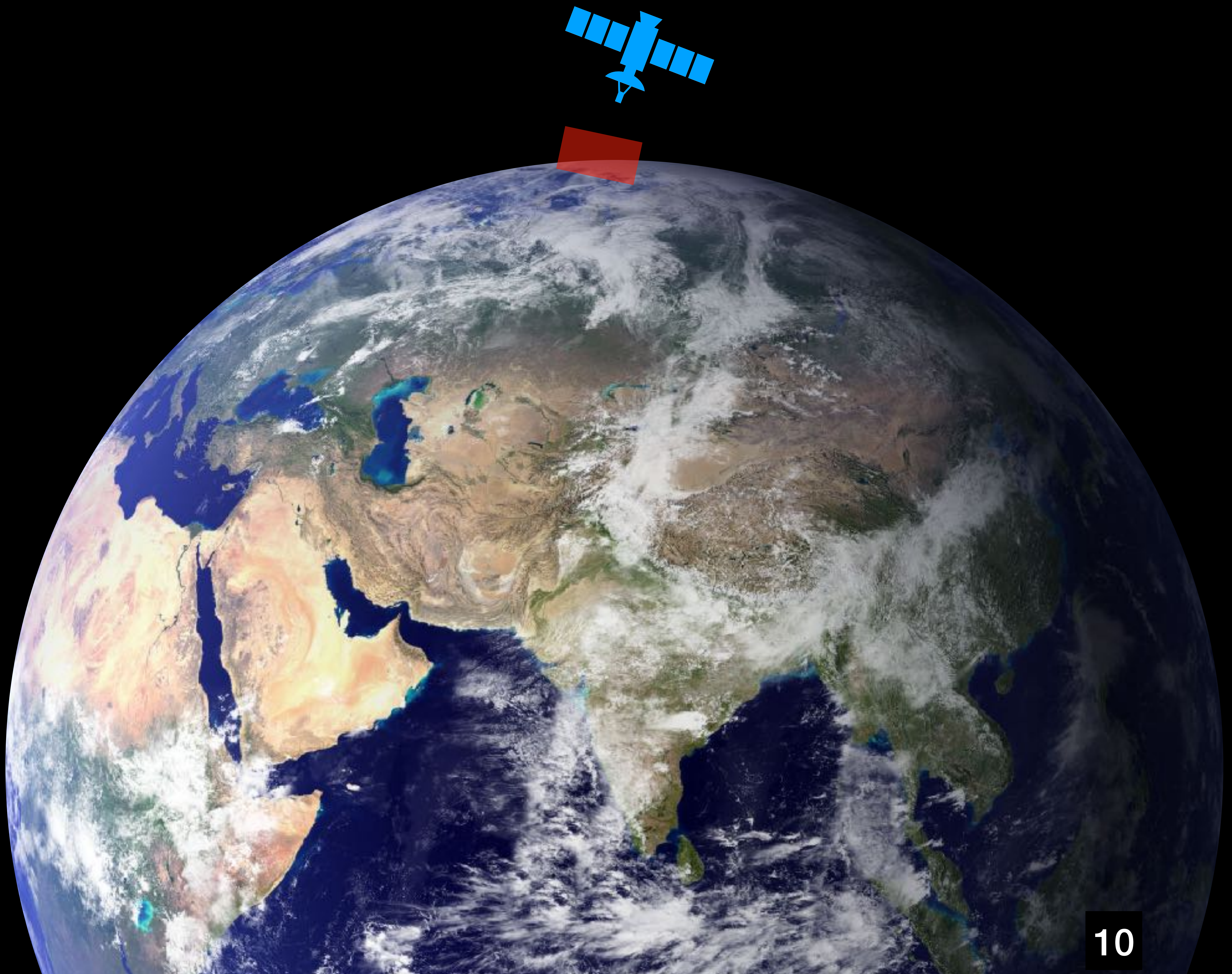
- To acquire the Sea Surface Temperature (SST) using infrared camera
- To update the data every hour

How hypothermia affects most adults

Water Temperature (Fahrenheit)	Exhaustion or Unconsciousness	Expected Time of Survival
32.5 degrees	Under 15 minutes	Under 15 to 45 minutes
32.5 to 40 degrees	15 to 30 minutes	30 to 90 minutes
40 to 50 degrees	30 to 60 minutes	1 to 3 hours
50 to 60 degrees	1 to 2 hours	1 to 6 hours
60 to 70 degrees	2 to 7 hours	2 to 4 hours
70 to 80 degrees	2 to 12 hours	3 hours to indefinite
Over 80 degrees	Indefinite	Indefinite


Communication
Electrical Power System
Command & Data Handling
Structure
Attitude Determination and Control System
Imaging Payloads
Source: Clyde Space

Ground Resolution



Mid-Wave Infrared Camera

Orbital Parameter

- Altitude: 550 km
- Inclination: 98^{o}

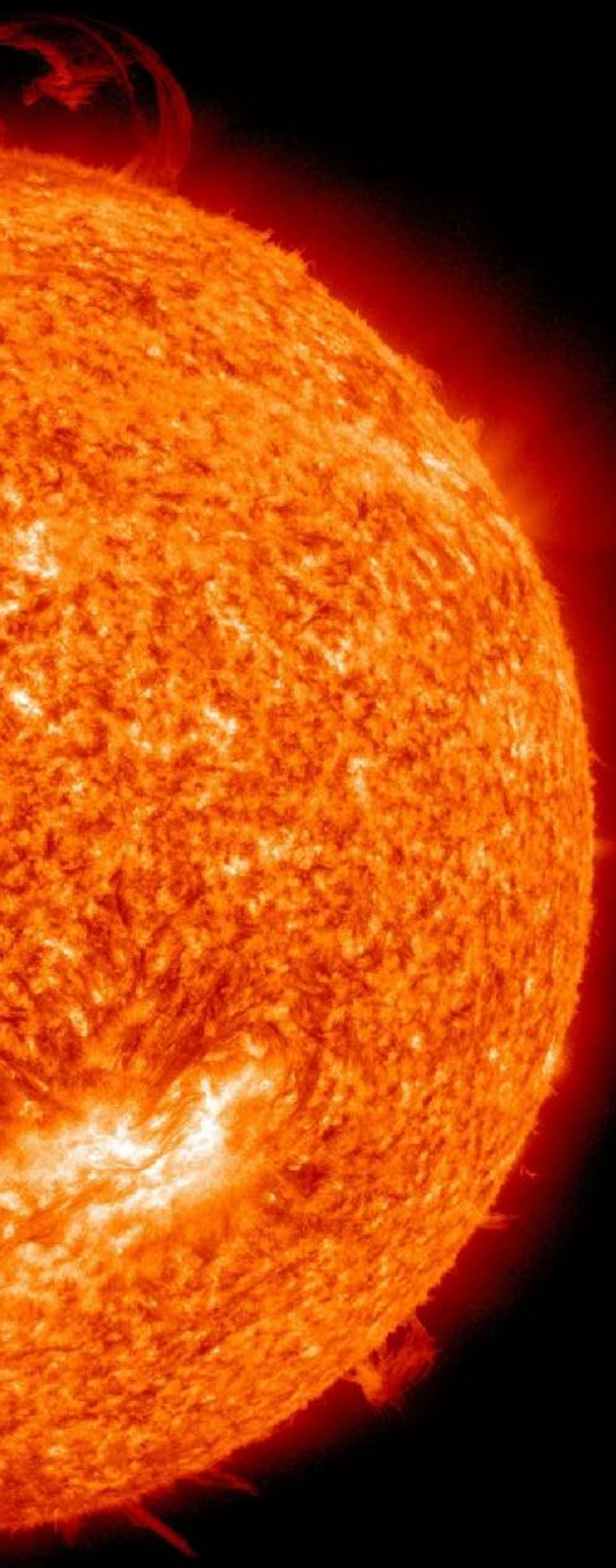
Ground Resolution

- 492 m^2

Image size

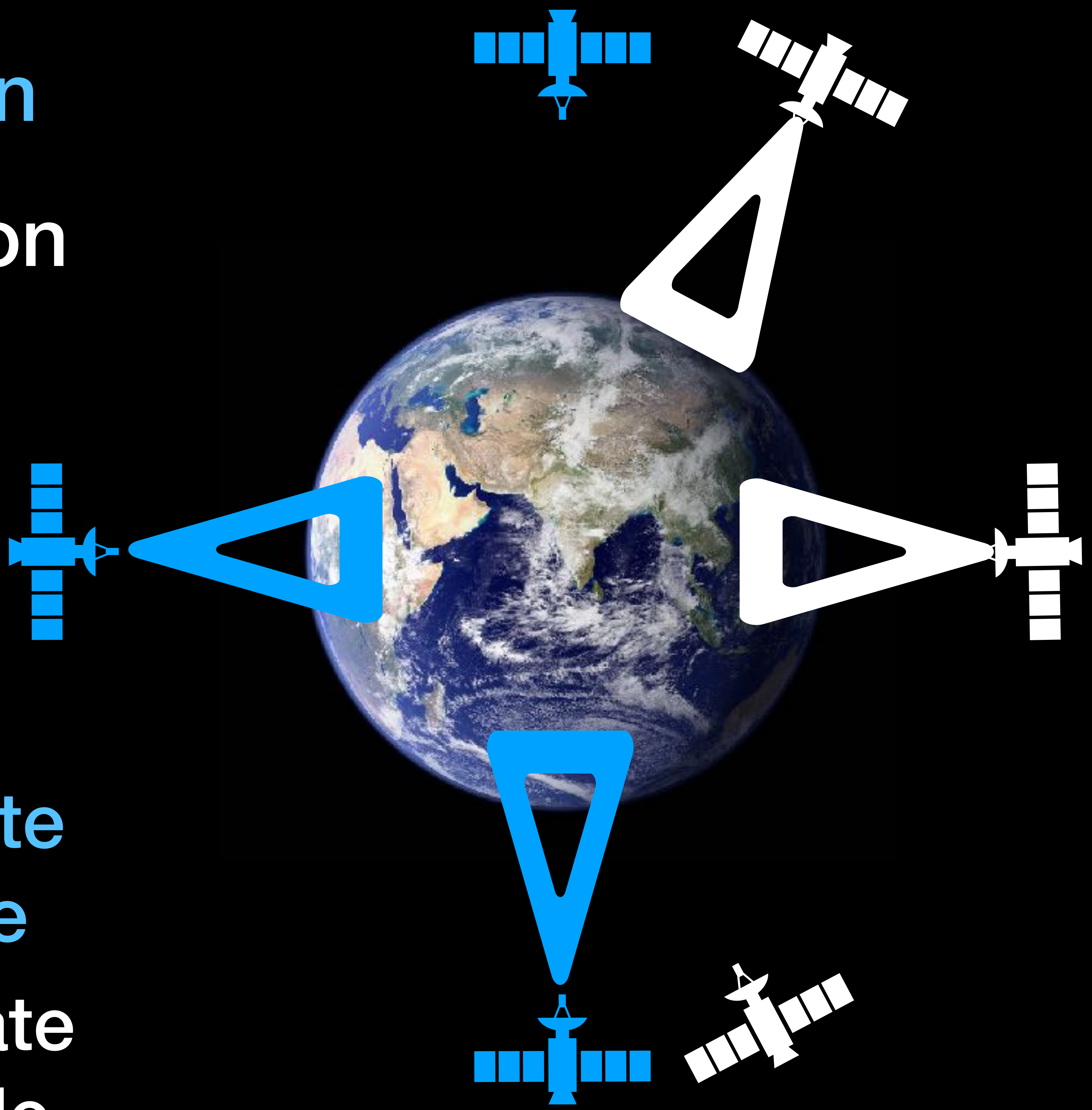
- 314.8km x 251.9km at nadir pointing

Concept of system operation



LWIR operation

MWIR operation

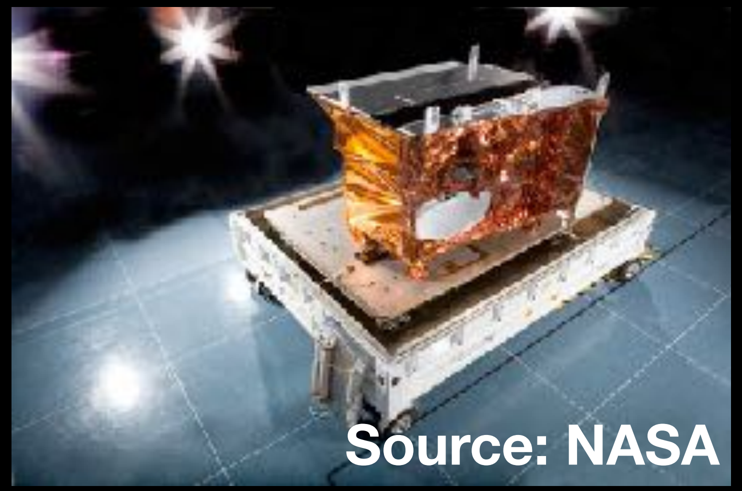


LWIR will operate during day side

MWIR will operate during night side

Satellite infrared radiometers for SST

MODIS sensor



VIIRS sensor

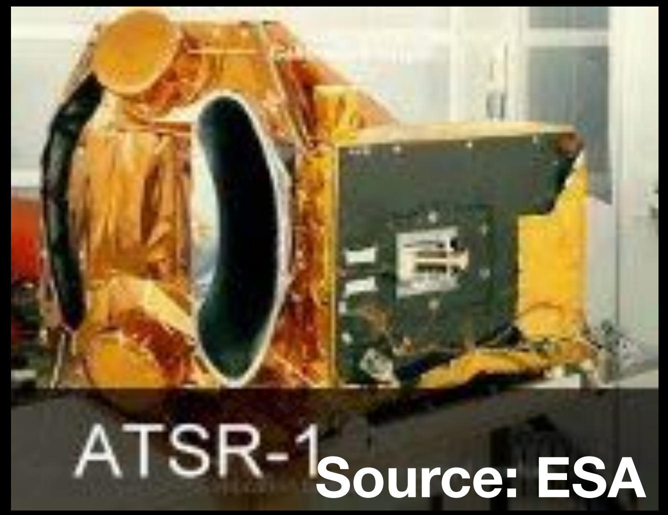
EnviSat Satellite

Broad swath (~ 500km)

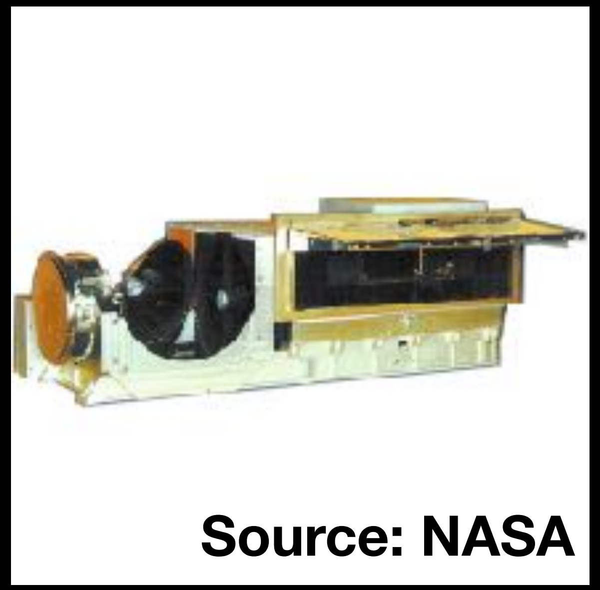
~1km^2 resolution

Broad swath (~2330km)

~1km^2 resolution



(A)ATSR sensor

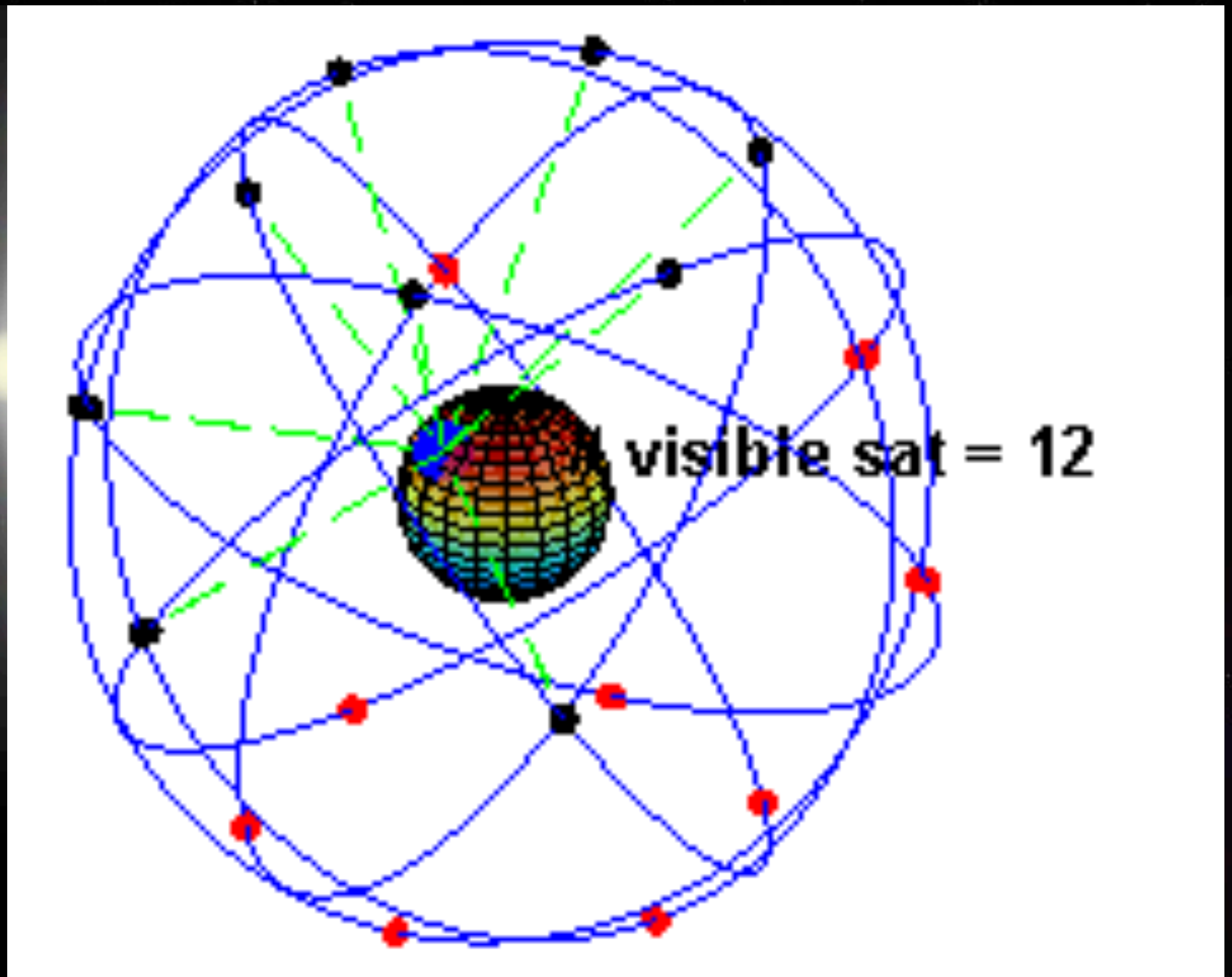


AVHRR sensor

Bird Ground Station Network

- Japan
- Ghana
- Nigeria
- Bangladesh
- Mongolia
- Taiwan
- Thailand
- Bhutan
- Philippine
- Malaysia

Orbit/Constellation Description

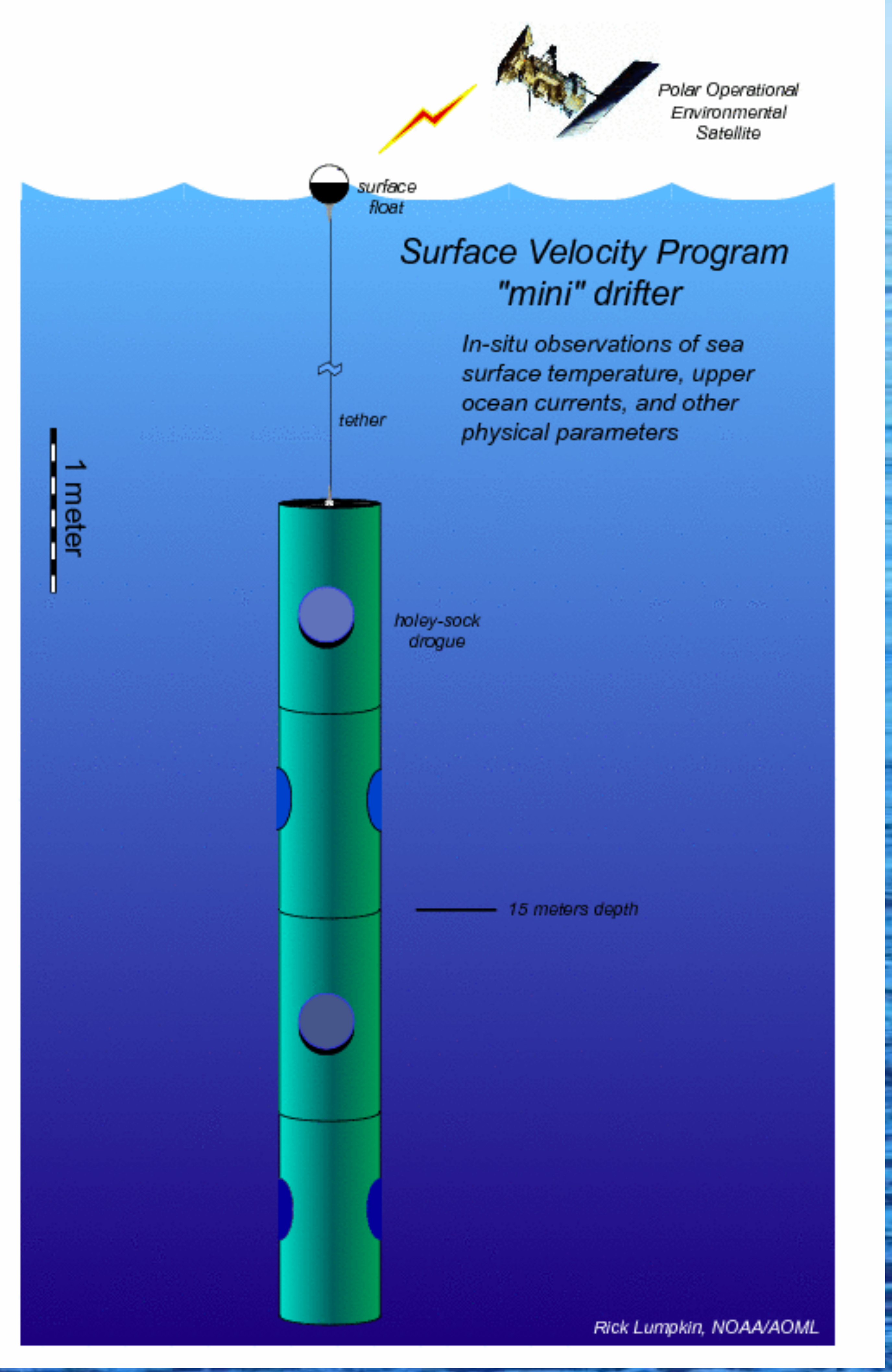


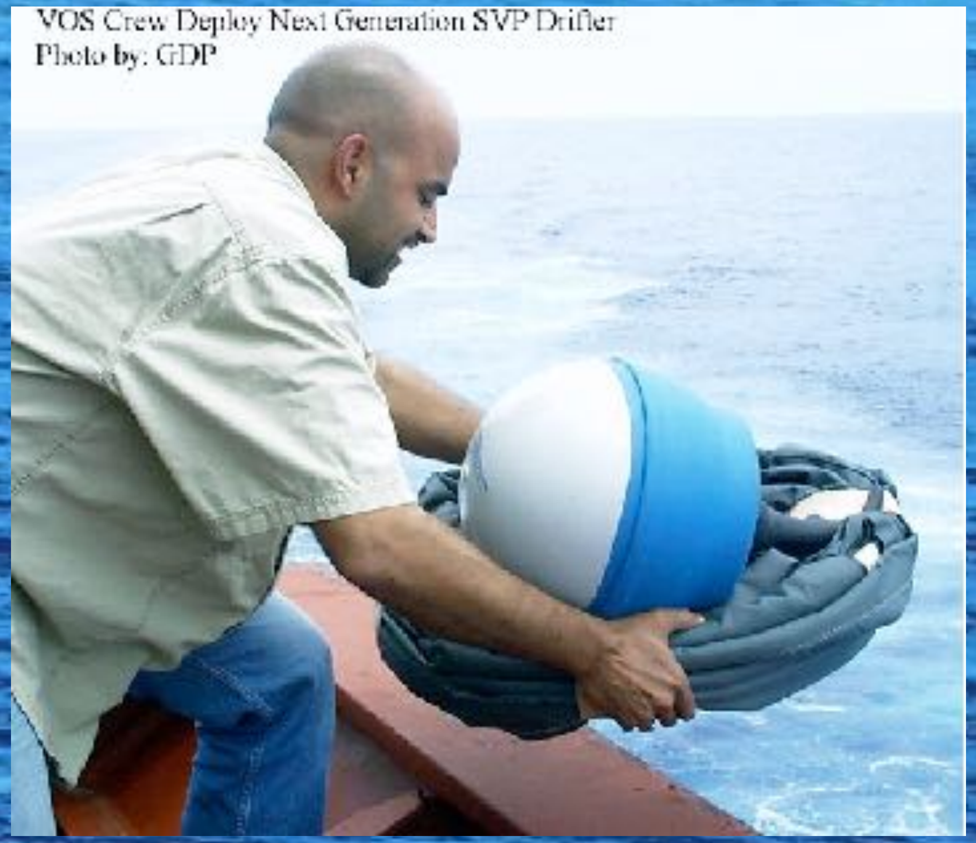
Source: wikipedia

Global Positioning System Constellation

- 24 satellite GPS constellation
- Six orbit planes
- 55^{o} inclination
- 60^{o} right ascending node of each orbit

Drifter Buoys

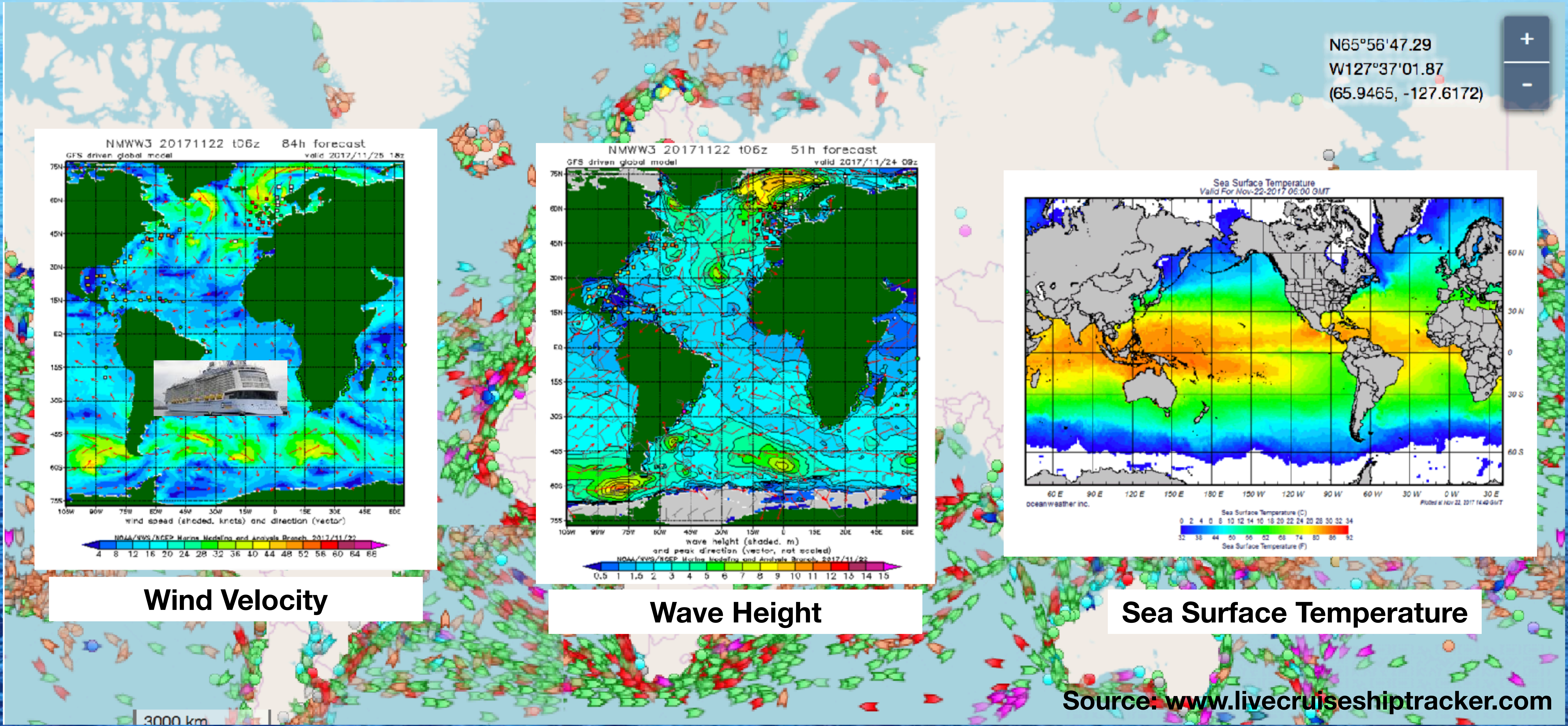




Drifter Buoys Data:

- Sea Surface Temperature
- Air pressure
- Wind
- Salinity
- Subsurface Temperature

Cruise Weather Ships



Concept of Operation

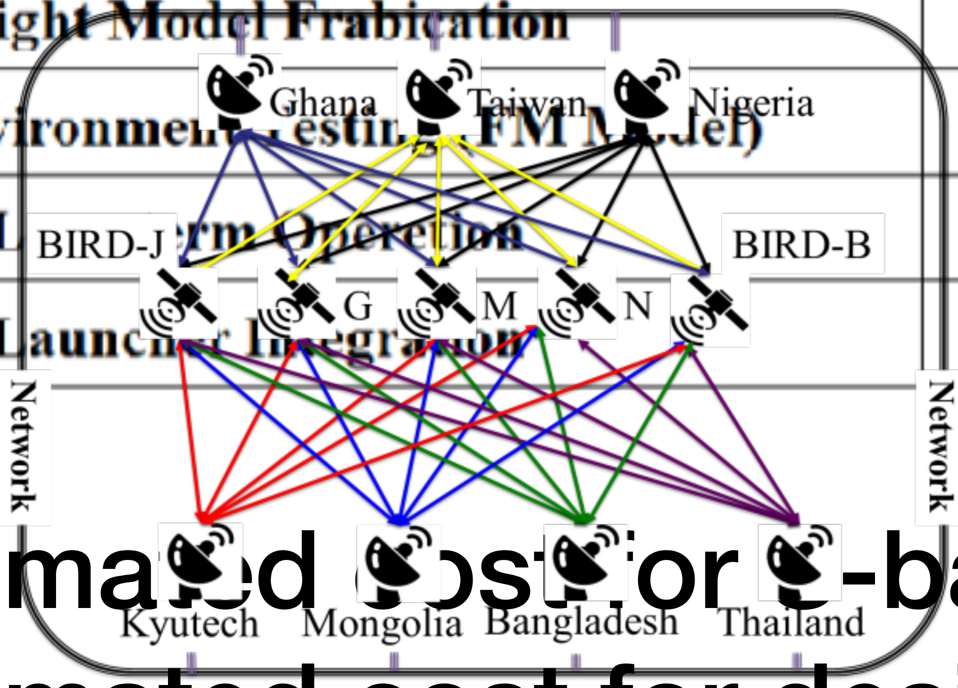
How to predict the object direction?

How to predict the object direction?

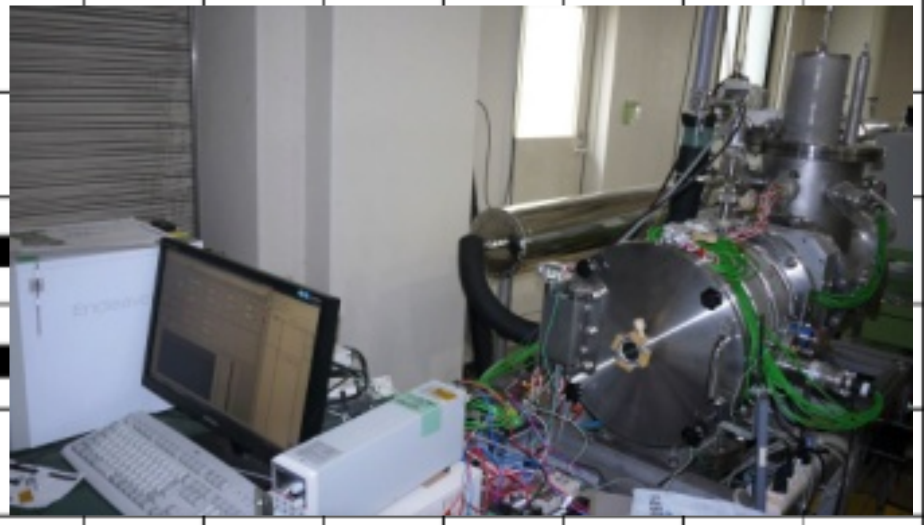
Implementation Plan

Organization and Management

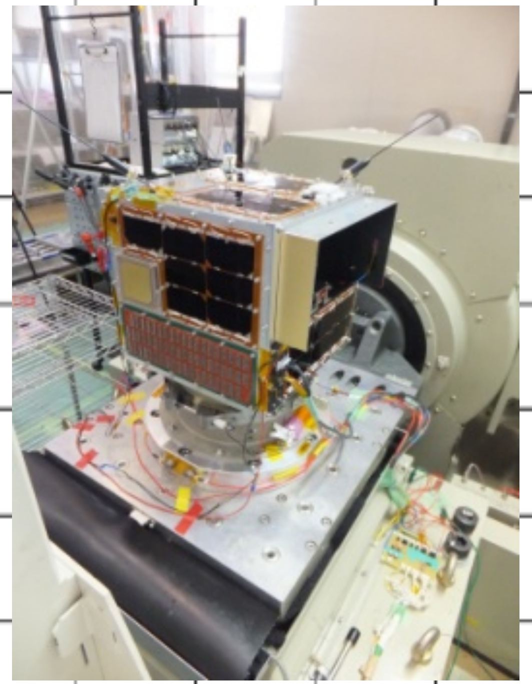
Implementation Plan
2018
1 2 3 4 5 6 7 8 9 10 1 1 12
BBM System Design
Preliminary
EM Syst
Space Environment
Critical De
Flight Model Frabication
Space Environment
Launch



Bird Ground Station Network



Thermal Vacuum Chamber



Vibration Machine

Clean Room

The estima d -band Ground station is er ground station

The estimated cost for design phase is 1.33M US phase is 3.6 M USD

Source: cent.ele.kyutech.ac.jp

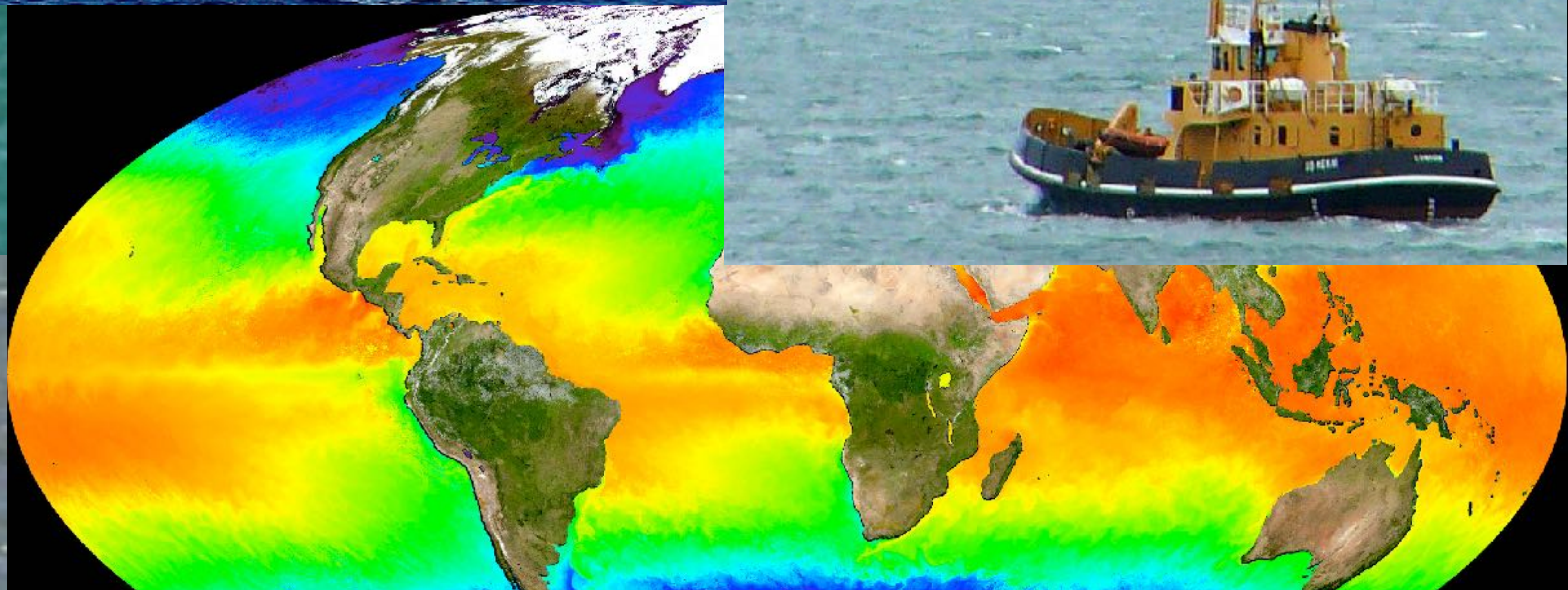
THE GLOBAL GOALS
For Sustainable Development

LIFE BELOW WATER

LIFE ON LAND

CLIMATE ACTION

GOOD HEALTH AND WELL-BEING



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Thank you for your attention

Question?

Appendix

Sea Surface Temperature Algorithm

- The form of the daytime and night-time algorithm for measurements in the long wave atmospheric window is:

$$SST = c_1 + c_2 * T_{11} + c_3 * (T_{11}-T_{12}) * T_{sfc} + c_4 * (\sec(\theta)-1) * (T_{11}-T_{12})$$

where T_n are brightness temperatures measured in the channels at n mm wavelength, T_{sfc} is a ‘climatological’ estimate of the SST in the area, and θ is the satellite zenith angle.

- The MODIS night-time algorithm, using two bands in the 4mm atmospheric window is:

$$SST4 = c_1 + c_2 * T_{3.9} + c_3 * (T_{3.9}-T_{4.0}) + c_4 * (\sec(\theta)-1)$$

Note, the coefficients in each expression are different. They can be derived in three ways:

– empirically by regression against SST values derived from another validated satellite instrument
– empirically by regression against SST values derived surface measurements from ships and buoys
– theoretically by numerical simulations of the infrared radiative transfer through the atmosphere

Source: Satellite Oceanography: Sea-Surface Temperature and Climate Data Records
Peter J Minnett Rosenstiel School of Marine and Atmospheric Science, University of Miami, USA