Current status of the Japanese Altimetry Mission

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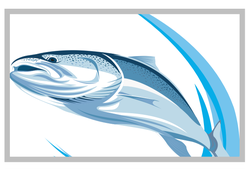
Introduction

The Japan Aerospace Exploration Agency (JAXA) has studied a new altimetry mission, Coastal and Ocean measurement Mission with Precise and Innovative Radar Altimeter (COMPIRA), since 2009. It passed Mission Definition Review (MDR) as the primary review in June 2012 and raised the mission status from prephase-A to phase-A. The major aim of MDR is to define the significance and the purpose of mission. The significance of the mission was confirmed through the relation between requirements from relevant ministries and mission specifications. For further consideration, we have a plan to conduct airplane experiments to measure sea surface height for our main sensor, SAR Height Imaging Oceanic Sensor with Advanced Interferometry (SHIOSAI). In the paper, we will present current status of COMPIRA.

Mission | COMPIRA
Coastal and Ocean measurement Mission with Precise and Innovative Radar Altimeter
Sensor | SHIOSAI
SAR Height Imaging Oceanic Sensor with Advanced Interferometry

Objectives

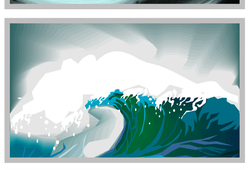


Fishery

- **Contribution to search fertile fishing grounds**
- **Improvement the efficiency with saving fuel and hour of operation**

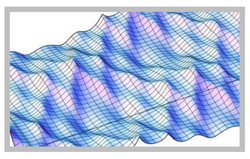
Ocean current forecast

- **Wide swath observation of SSH by In-SAR**
- **Improving ocean current forecast in coastal region and coastline sea**
- **Contribution to marine salvage (current drift), efficiency of marine navigation with improved ocean current forecast**



Science

- **Challenge to observe mesoscale eddies, Tsunami by distant earthquake and storm surge**



Technical demonstration

- **Technical development of sea surface height measurement with in-SAR technology**

Requirements

User requirements

Fishery
spatial resolution：5km
accuracy：2～5cm
frequency：once per 10days
observational sea：0°～360°, 65°N～42°S
product：sea level anomaly, absolute sea surface height

Ocean current forecast
spatial resolution：1～10km
accuracy：several centimeter
frequency：once per 5days
observational sea：the Japanese coast, the seas surrounding Japan
distance to coastal line：5～10km
rain error：0%
coverage：100%
product：sea level anomaly、GDR

Science
spatial resolution：1～5km
accuracy：～5cm
frequency：once per 1~3days
observational sea： the Japanese coast, the Pacific ocean
product： sea level anomaly

Mission requirements

specific items	mission requirements		
spatial resolution	5km		
time to offer products	near-real-time products 6~12hours later	general products 3days later	high-precision products 60days later
accuracy ※average within swath	relative		
	5.4cm※	5.4cm※	5.3cm※
	absolute		
	12.2cm※	7.5cm※	6.9cm※
frequency	twice per 10days observe twice per 10days in over 80% ocean area at latitude 35 degrees		
observational sea	the sea around Japan, and from the Gulf to West Coast America		
distance to coastal line	10 k m		
rain error	1%		
coverage	98% cover 98% of ground track at latitude 35 degrees per period (10days)		
product	sea surface height, sea level anomary, absolute sea surface height, Geophysical Data Record		
tide	observation for computable harmonic constant of main tide		

System requirements

Satellite system
orbit：altitude 937km, inclination 51degrees, anti sun-synchronous, 10days period
design life：7years
weight：wet 2.45t or less
electric power：2,600W or more
orbit keeping：±1km or less at ground track

Sensor
SHIOSAI
swath：80km×2
frequency：9.6GHz
spatial resolution：5km×5km
accuracy：4.2cm

Orbit
orbit determination accuracy
10cm（12hours later）
4cm（3days later）
3cm（60days later）

Ground system
processing data rate
near-real-time：6～12hours later
general：3days later
high-precision：60days later

About COMPIRA

金比羅

Compira is the god of water. It has been dedicated as the ancient guardian deity of maritime transportation. There are many shrines for Compira on hilltop overlooking the port in Japan.

Products

Table 1. Requirement and accuracy for general products

Products		Sensor	Level	Latency	Resolution	Accuracy	Remarks
Geophysical Data Record (GDR)	SLA	SHIOSAI	Standard (L2)	3 days	5km in along-track 5km in cross-track	7.5cm*1	※New tide model from COMPIRA data will be included in TBD month after launch. ※Accuracy of nadir altimeter is from results of Jason-2
	SLA	Nadir-type Radar Altimeter			11km in along-track 4km in cross-track *2	5.1cm *1	
	Sigma-0	SHIOSAI			5km in along-track 5km in cross-track	TBD dB	
	Sigma-0	Nadir-type Radar Altimeter			11km in along-track 4km in cross-track *2	0.7 dB	※from results of Jason-2
	SWH	Nadir-type Radar Altimeter			11km in along-track 4km in cross-track *2	10% or 0.4m	※from results of Jason-2
	Wind speed	Nadir-type Radar Altimeter			11km in along-track 4km in cross-track *2	1.5m/s	※from results of Jason-2
Corrected SLA		SHIOSAI	Standard (L2)	3 days	5km in along-track 5km in cross-track	7.5cm (relative)*1	※from results of Jason-2
		Nadir-type Radar Altimeter			11km in along-track 4km in cross-track *2	5.1cm (absolute)*1	
SLA/ Geostrophic Current maps		SHIOSAI Nadir-type Radar Altimeter	L2B	3+TBD days	TBD (0.05×0.05º)	N/A	※Gridded maps are created from 5-day data. ※ Geostrophic Current is calculated from SLA map.

*1 Accuracy is defined as an average over swath and under the conditions of 2m SWH and 11dB Sigma-0. Accuracy of SHIOSAI is achieved under the normal condition of correction sensors.
*2 Spatial resolution of nadir-altimeter is defined under the condition of 2m SWH.

Observable Ocean Area

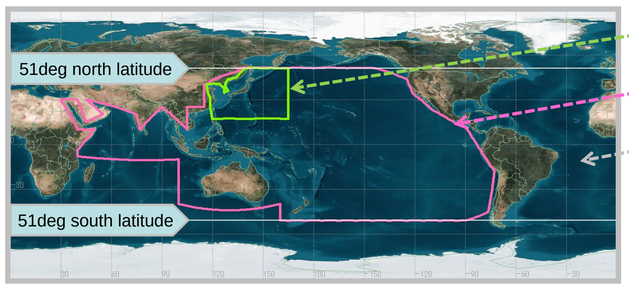


Figure 1. Observable ocean area.

The area is based on the requirements and the transmission capacity of JAXA. We will discuss methods of data transmission for all ocean area in the inclination.

Payload

- **SHIOSAI**
- **Nadir radar altimeter**
- **Microwave radiometer**
- **GPS receiver**
- **Corner cube reflector**
- **DORIS**
  - **for near-real-time products**

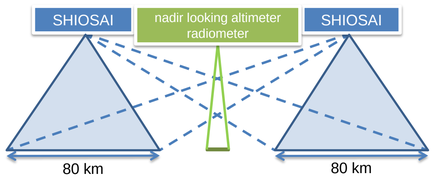


Figure 2. Main configuration

Cooperation

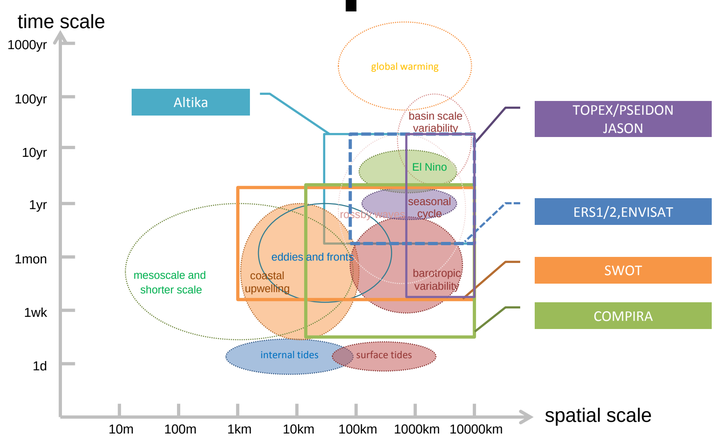
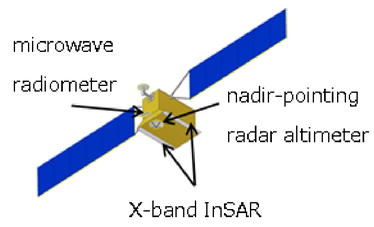


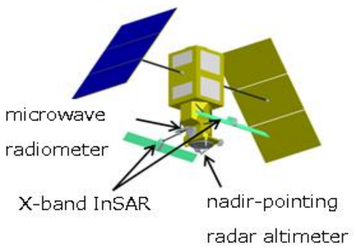
Figure 3. Representative altimeter and wide swath altimeter

The observation frequency is insufficient relative to oceanic phenomenon observed with 5km resolution. Cooperative observation is essential for COMPIRA.

Sensor Concepts



Concept 1: Passive array antennas mounted on the satellite bus structure



Concept 2: Reflectarray antennas attached to the deployable booms.

Schedule

Table 2. Long-term schedule.

	2012 (FY24)	2013 (FY25)	2014 (FY26)	2015 (FY27)	2016 (FY28)	2017 (FY29)	2018 (FY30)	2019～ (FY31)	
Review	MDR Mission Definition Review	SRR	SDR		PDR	CDR		PQR	LRR
Phase	prephase-A	phase-A		phase-B	phase-C	phase-D		phase-E	
	Conceptual study	Conceptual design		Preliminary design	Critical design	Production Test		Operation	

- **Mission status**
  - **phase-A**
- **Mission Definition Review**
  - **MDR for COMPIRA was complete on June 28, 2012.**
- **Airplane experiment**
  - **on the sea around Japan from Dec. 2012 to Jan. 2013**