

COMPIRA mission



- COMPIRA is the Japanese new **wide-swath** altimetry mission.
- COMPIRA is mainly designed for **opeational oceanography** in mid-latitude region.
(for Fishery, Ocean current forecast)
- Scientific application is also considered.
(COMPIRA science white paper has been established.)

Mission name: COMPIRA

Coastal and Ocean measurement Mission with Precise and Innovative Radar Altimeter

Main sensor: SHIOSAI (X-band radar interferometer)

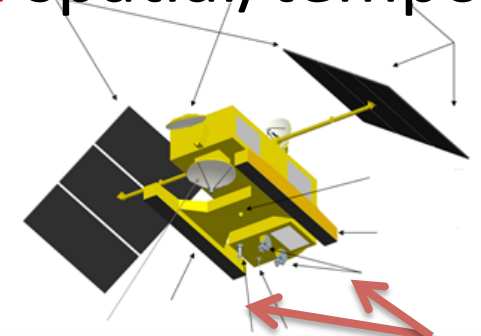
SAR Height Imaging Oceanic Sensor with Advanced Interferometry

Uniqueness of the COMPIRA mission



- **COMPIRA has unprecedentedly high spatial/temporal coverage in the mid-latitude region**

- 80 km x 2 (left /right) @ 5 km resolution /7.5cm accuracy
X-band wide-swath (side-looking) SAR altimeter with Ku/C-band nadir altimeter
> the same coverage as 33 nadir altimeters
- 51 deg. orbit inclination
- 10 days revisit time



Two X-band SAR antennas are directly mounted on the satellite to REDUCE motion error/risks.



Suitable for operational oceanography in mid lat.

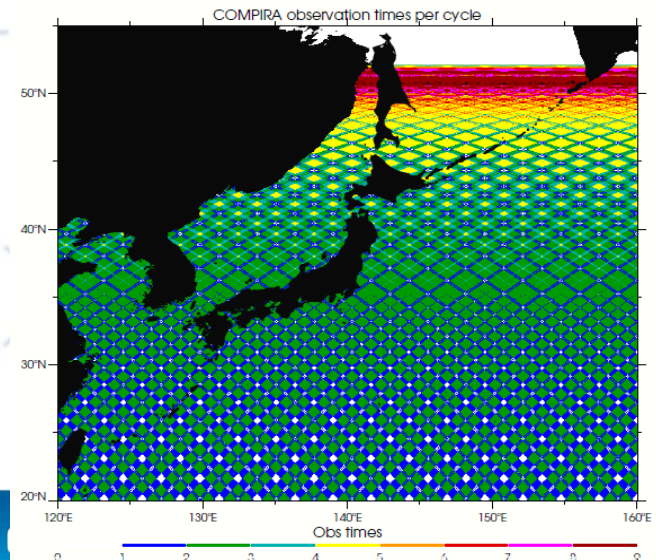
Spatial coverage:

Almost NO gaps (98 % @ 35 deg N)

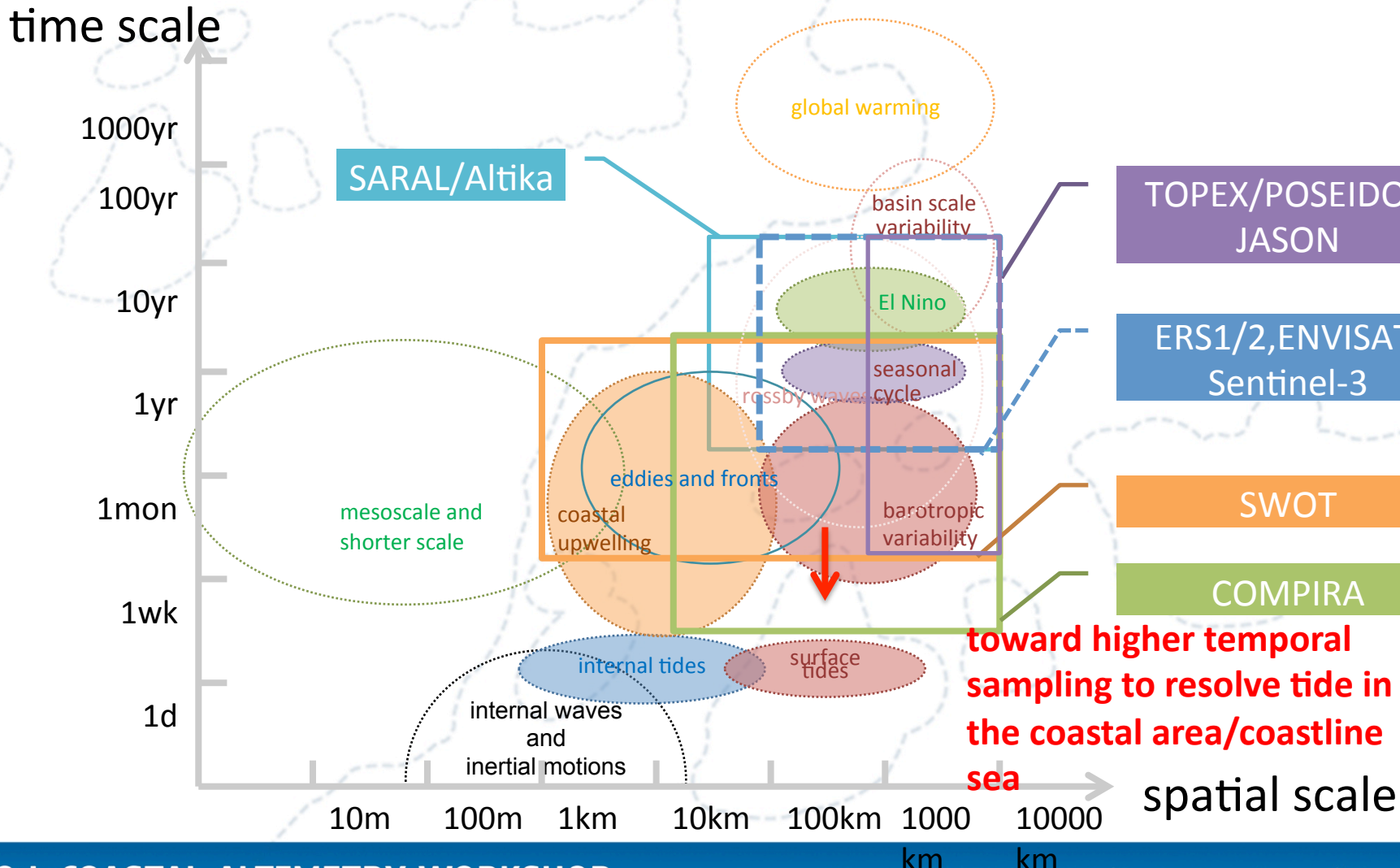
Temporal coverage:

2-4 times per 10 days @ mid latitude

+ Less rain attenuation (X-band radar)



Target temporal/spatial scale

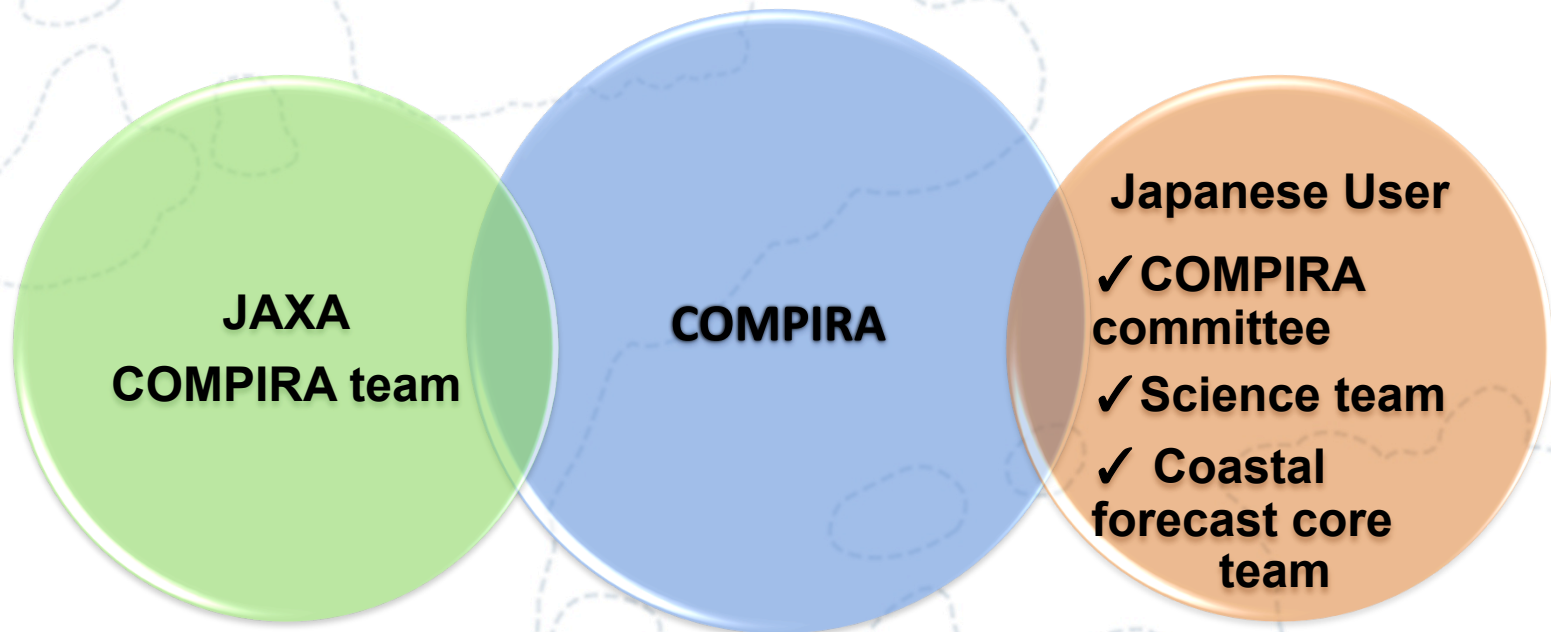


COMPIRA recent and near term events



- Apr 2009: JAXA started to study altimeter mission.
- Apr 2010: The technical committee for COMPIRA was established.
- Jun 2012: Mission Definition Review (MDR)
 - The primary review to define the meaning and purpose of new mission
- Oct 2012: The COMPIRA team was organized.
- Dec 2012-Jan 2013, Feb/Mar 2014: Airplane experiments were conducted.
- Jun 2013: The COMPIRA Science Team was organized.
- Aug 2013: The Coastal Forecast Core Team was organized.
- Aug 2014: COMPIRA science white paper was established.
- **Current Mission status : Phase-A**

COMPIRA community



The role for each committee/team is:

COMPIRA committee : Discussion about specification for COMPIRA mission (including **operational usage** and technical discussions)

Science team : Discussion about maximization of **scientific outcomes** using COMPIRA data

Coastal forecast core team : Development of **coastal forecast system** through pre-launch activities toward COMPIRA data

COMPIRA applications overview



OPERATIONAL OCEANOGRAPHY

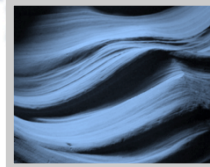
1. Fishery

- To search fertile fishing grounds efficiently
- To save fuel consumption and to reduce duration of operation



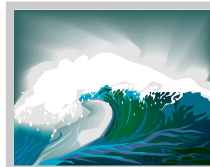
2. Ocean current forecast

- To improve ocean current forecast **especially in coastal region and coastline sea mainly** by improving tidal model
- To contribute to marine salvage (current drift) and ship navigation



SCIENCE

- To improve of ocean forecast, To understand meso/submesoscale phenomena, regional sea level rise, etc.



COMPIRA target applications and user requirements for operational oceanography - (1) **Fishery**

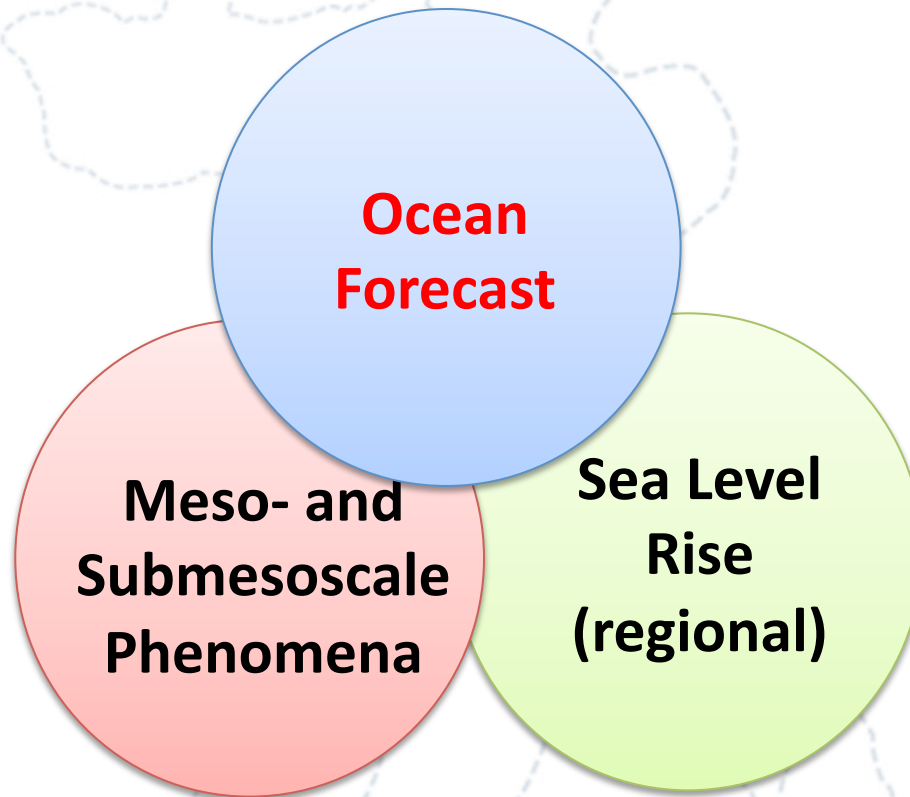
No	theme	User requirements (excerpt)		
		spatial resolution	accuracy	frequency
1	Searching fertile fishing grounds	5km	relative : 5cm	once per 10days
2	Improvement of fishing grounds forecast	5km	relative : 2 - 10cm	once per several days
3	Understanding of transport processes of young fish by current	5km	absolute : 5cm	one or more times per 5days

JAXA has collected user requirements for various operational applications to construct mission requirements during 2011-2012.

COMPIRA target applications and user requirements for operational oceanography - (2) **Ocean Current Forecast**

No	theme	User requirements (excerpt)			
		spatial resolution	accuracy	frequency	coverage
1	Detection of current disturbance and small scale eddies	5km	absolute: 3 - 9cm	once per 5days	-
2	Monitoring of coastal current variation	1~5km	absolute: ~5cm	once per 3days	-
3	Construction of basic dataset of ocean current / height for ocean management	10~30km	absolute: 10cm	once per several days	-
4	Improvement of tidal model	10~20km	absolute: several centimeter	-	100%
5	Forecast of hydrographic conditions	5 km	absolute: 7cm~10cm	once per several days	-

Additional applications: Scientific targets



In addition to operational oceanography, COMPIRA will provide useful dataset to scientific communities.

COMPIRA Science White Paper (Aug 2014, from the COMPIRA Science Team)

Three primary scientific targets (1)



Interested research areas for **Ocean Forecast** from the scientific point of view
(Example):

Coastal Region

- Investigation of outer seas/marginal seas/coastal area change under collaboration with south-east asia countries
- Assimilation of wide-swath altimeter data to derive detailed ocean current fields and investigation of influences for coastal sea level change

Coastline (Marginal) Seas

- Relationship between High-resolution sea surface height distribution and ocean currents
- Ocean Forecast in the Japan Sea and the East China Sea

Tide

- Improvement of ocean tidal model

Improvement of data assimilation technique using the COMPIRA data

- Production of high-accuracy high-resolution integrated dataset in the coastal region
- Improvement of coastal research based on high-resolution assimilation products
- Improvement of ocean current forecast using wide-swath altimeter data

Three primary scientific targets (2)



Interested research areas for **Meso/Submesoscale Phenomena** (Example):

Clarification of spatial-temporal ocean variation

- Investigation of temporal-spatial variability of meso/submesoscale phenomena
- Simultaneous observation of COMPIRA sea surface height and inner structure
- Clarification of submesoscale disturbance with high resolution radar altimeter, automated in-situ observation, and high resolution modeling

Fields becoming evident thanks to clarification of meso/submesoscale phenomena

- Distribution of fishery resources and formation of fishery fields
- Interaction between climate change mode and meso/submesoscale phenomena

Three primary scientific targets (3)

Interested research areas for **(regional) sea level rise** (Example):

Investigation of sea level change from outer sea to coastal region

- Statistical analyses of sea level change with wide-swath altimeter data

Investigation of sea level change/forecast

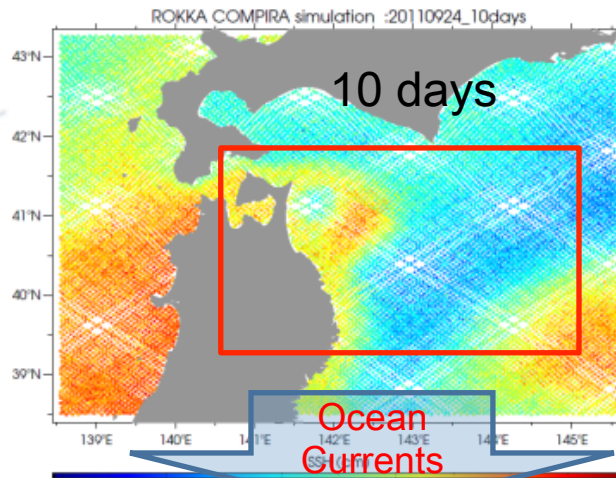
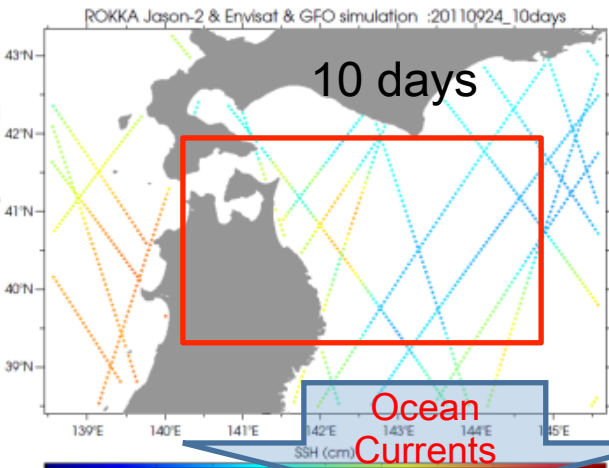
- Mechanism of long-term (10-year scale) change in the Japanese coastal area
- Combining regional ocean model and the COMPIRA data for sea level change studies

Demonstration: Effects of COMPIRA data for current derivation

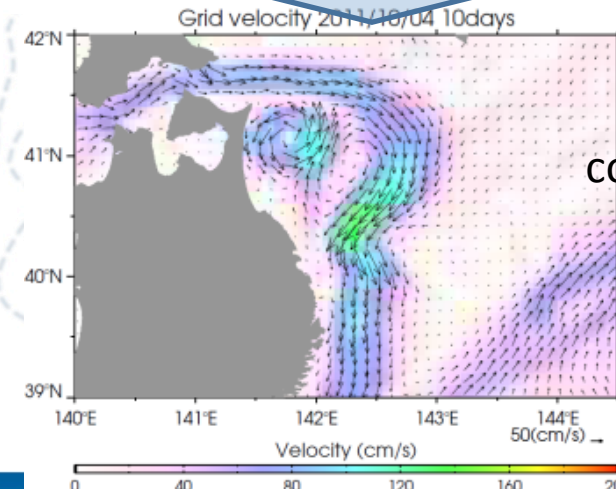
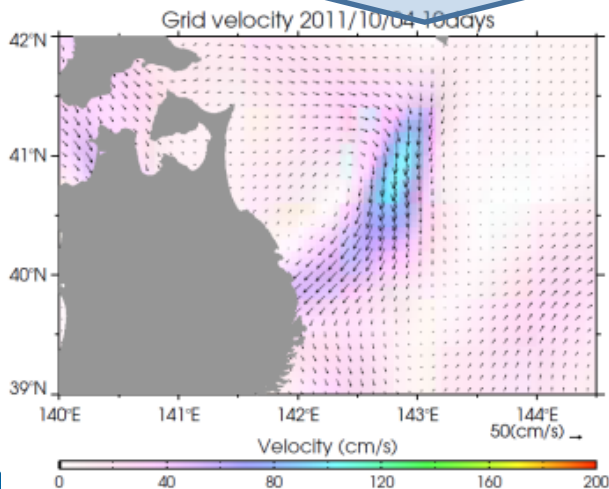


Constellation of nadir altimeters
(Jason-2, Envisat, GFO)

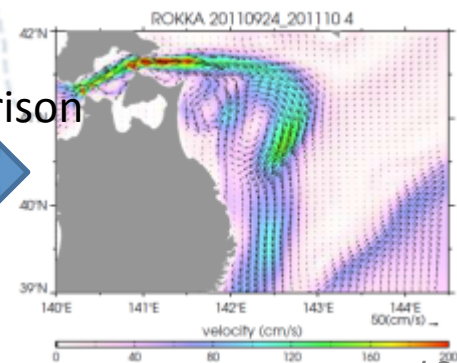
COMPIRA-simulated
data



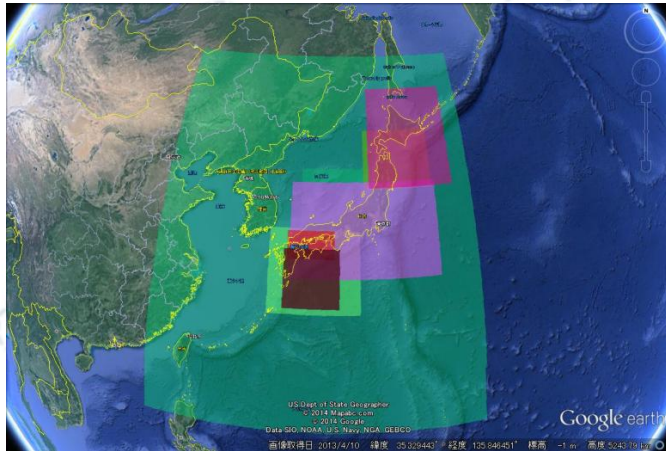
Model Outputs
(Simulated 'actual'
ocean currents)



comparison



Generation of standard products from various regional models



Merged



Standard Products

Duration: past data (1 week) & forecast data (1 week)
Temporal period: 1 time/day

Target area of various Japanese models
(NOT indicating satellite coverage)

Multi-model ensemble implementation

Specification of output of merged model

Region: Around Japan (30.75-47.75N, 127.5-143.67E)

Period (year): 2011, Grid: 1/12 degrees, Temporal period: 1 day

Satellite data for comparison (Merged gridded data)

Sea surface height: Nadir altimeter merged SLA (Aviso)

Sea surface temp.: Microwave radiometer objective analysis SST(MW OI SSTs)



Kingair B200
(Diamond Air Service Inc.)

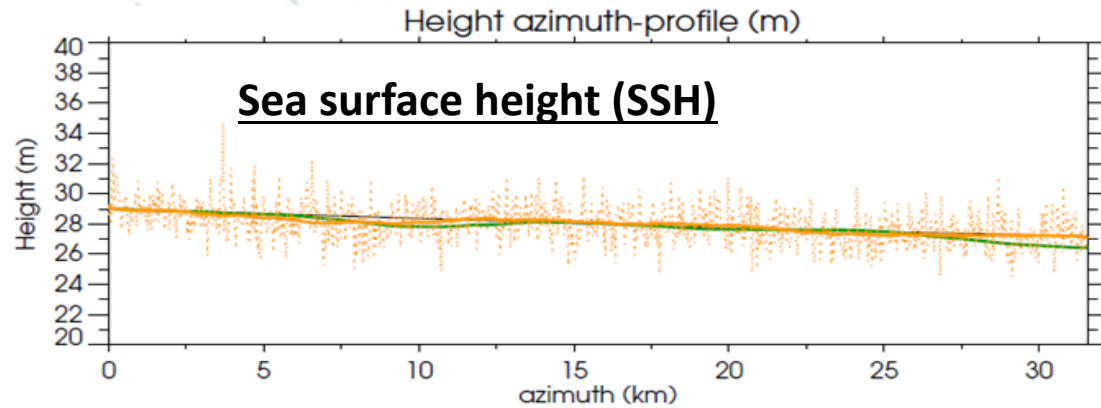
X-band airborne SAR
(Alouette Technology Inc.)



Observations were conducted in Dec 2012, Jan 2013 and Feb/Mar 2014 as the following specifications;

- 9.6 GHz airborne FM-CW SAR
- Cross-track In-SAR (2 antennas)

Airplane experiments



Sea surface height measured by

- X-band airborne SAR (obtained by interferometric SAR, the same technique as COMPIRA/SHIOSAI)
- X-band airborne SAR (obtained by using propagation time, the same technique as Jason-2)
- Jason-2

- Height result with COMPIRA/SHIOSAI technique coincides well with conventional radar altimeter technique.

Summary



- COMPIRA mission is designed for operational oceanography, especially for fishery and ocean forecast, while COMPIRA will also provide useful dataset for scientific use.
- Unprecedentedly high spatial/temporal coverage enables us to improve models and forecasts especially in the coastal area and coastline seas.

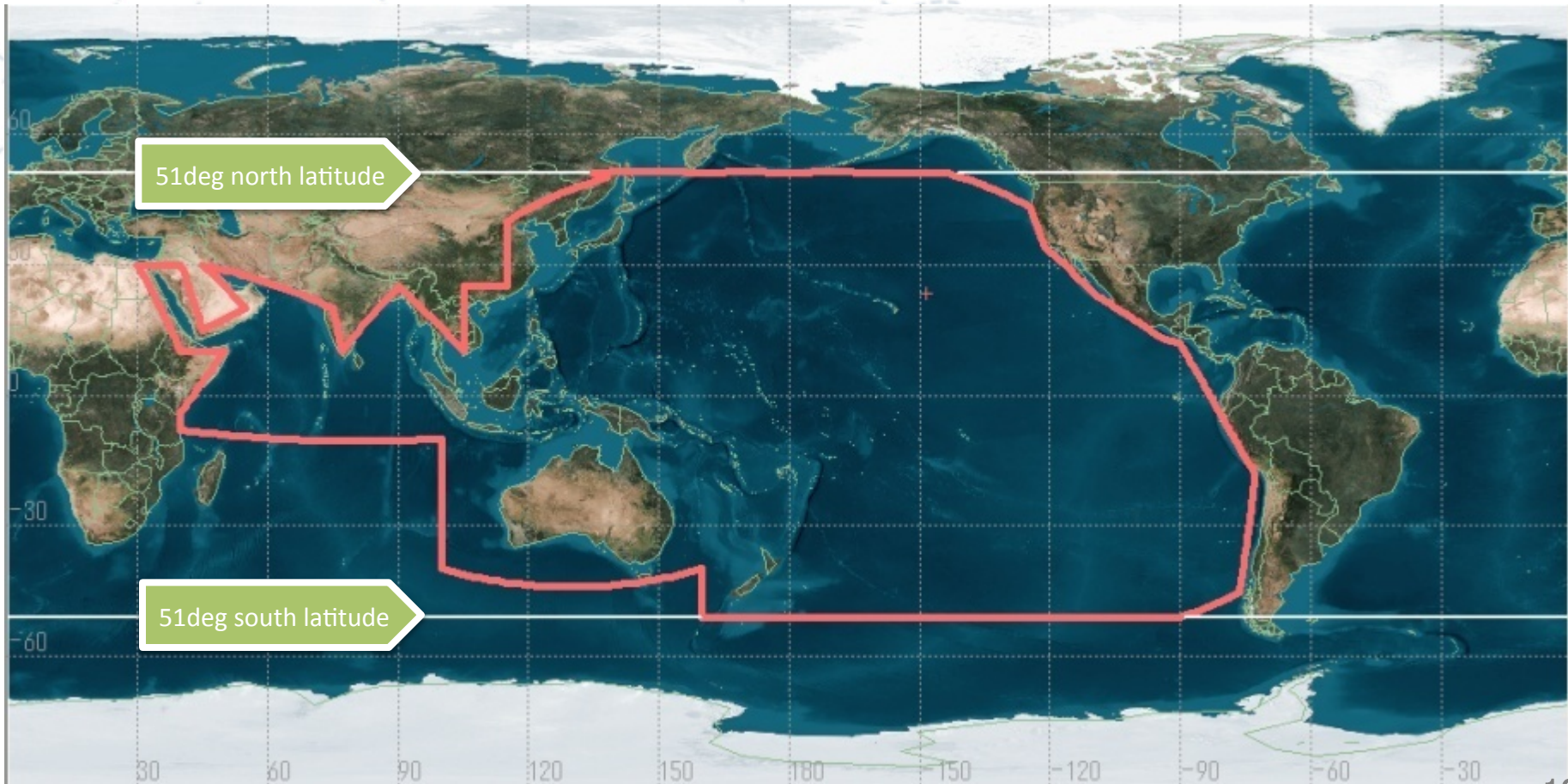
BACKUP

COMPIRA Mission Requirements (excerpt)

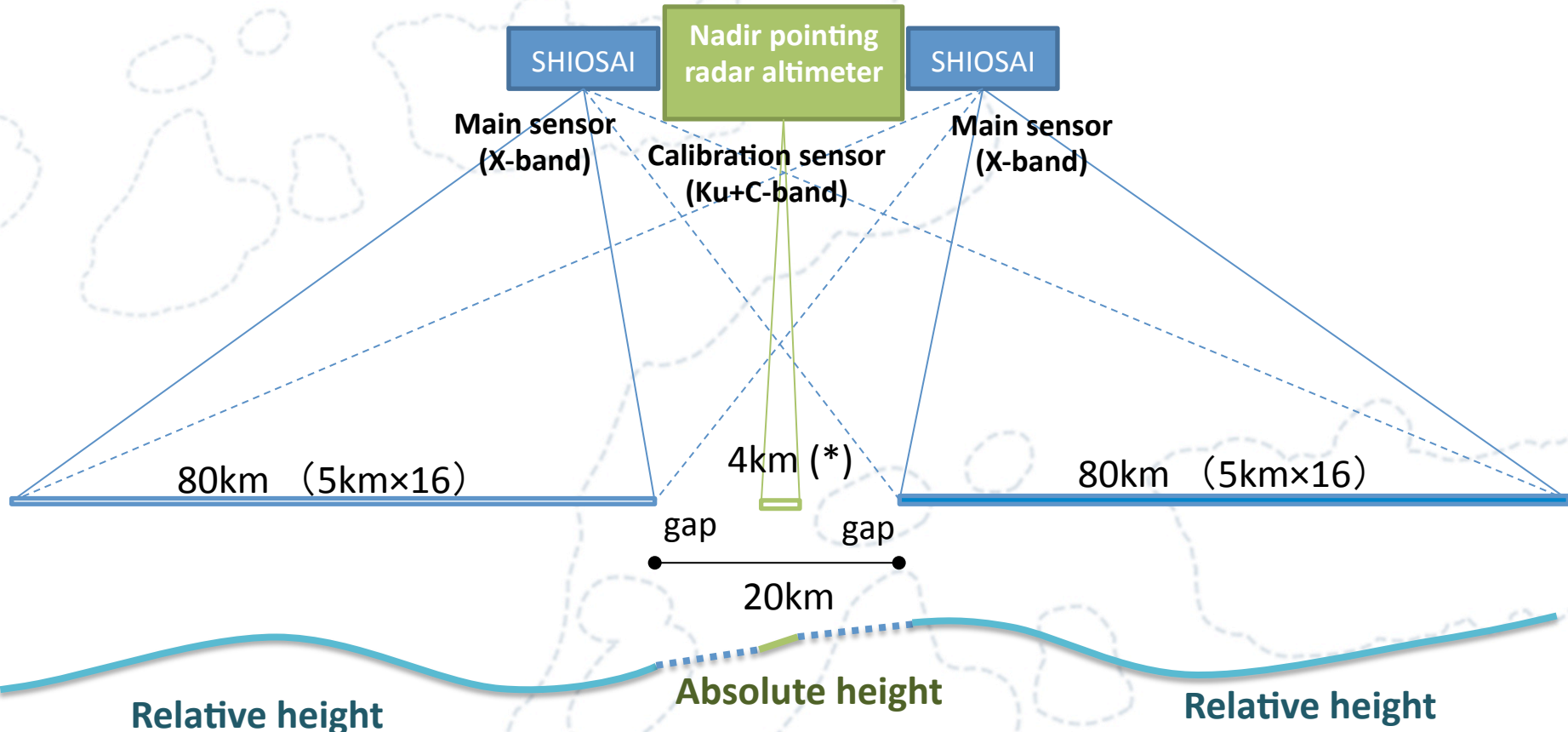


specific items	mission requirements		
spatial resolution	5km		
time to offer products	near-real-time 6~12hours later	general 3days later	high-precision 60days later
accuracy ✂average within swath	relative		
	5.4cm✂	5.4cm✂	5.3cm✂
	absolute		
	12.2cm✂	7.5cm✂	6.9cm✂
frequency	twice per 10days (observe twice 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 km		
rain error	1%		
coverage	98% (cover 98% of ground track at 35 deg per period (10days))		

Observational Sea Area



Sensor system



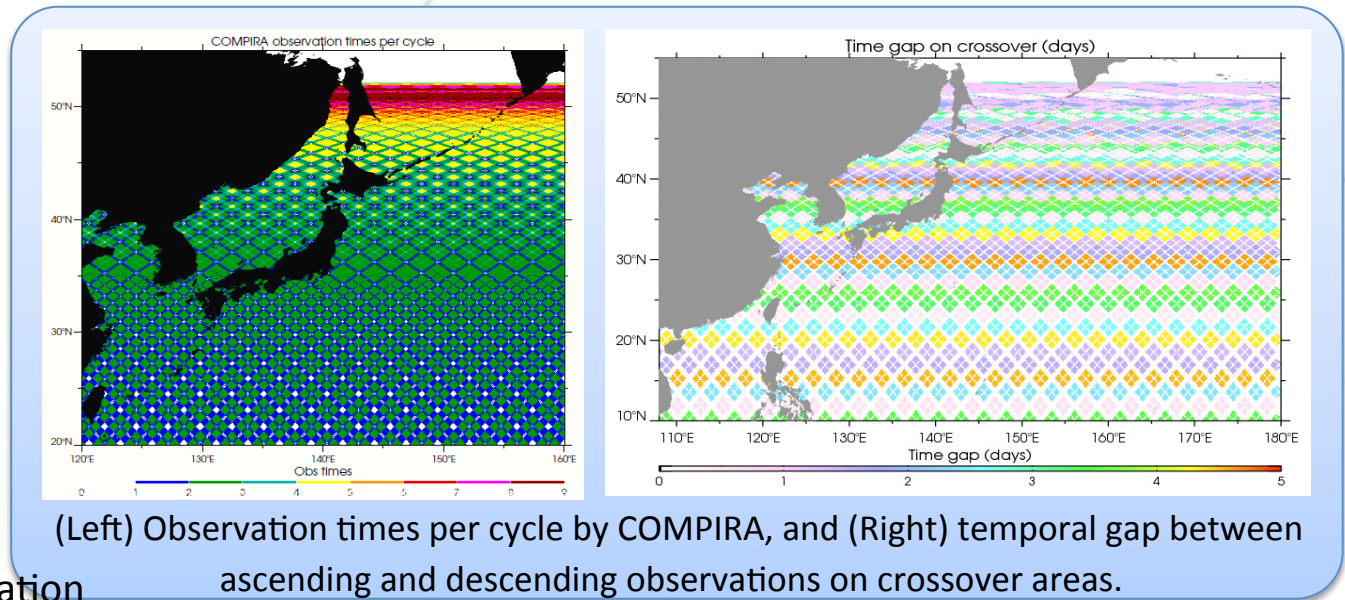
COMPIRA's coverage is equivalent to 33 nadir altimeters.

(*) with significant wave height of 2 m

COMPIRA orbit configuration



- Orbit specifications are designed to be better for *operational oceanography* including coastal forecast.
- A spatial grid sampling is 5km / times per revisit period (about 10 days) is 2 to 3 times.
- In order to meet both sampling frequency and spatial coverage requirements in mid-latitudes as much as possible, orbit inclination was set relatively low, 51 degrees.



COMPIRA orbit configuration

ascending and descending observations on crossover areas.

Parameters	Revisit time	Inclination	altitude	swath	grid size
	9.8671 days	51 deg.	937 km	80km × 2	5km