JAXA's Ocean Environment Monitoring Activities and Himawari Monitor

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Research Themes & Missions

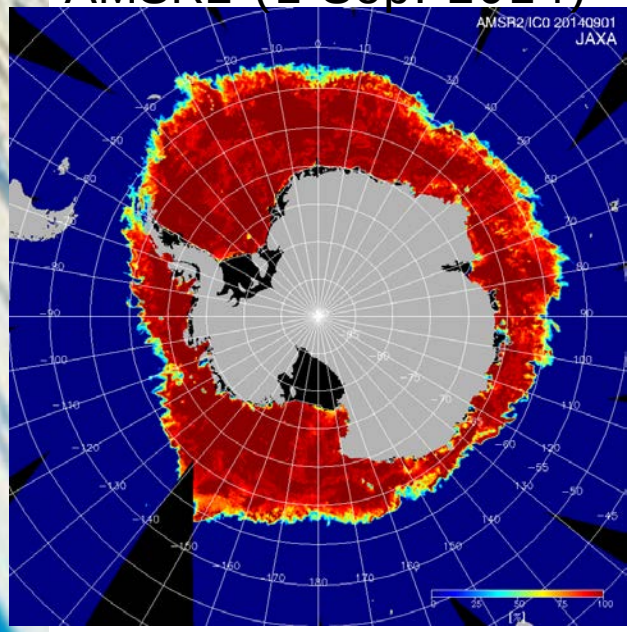
- JAXA has launched thematic research activities that cover multiple missions.

Research theme \ Satellite mission	ALOS2	GPM TRMM	Earth CARE	GCOM W&C	GOSAT	Collaborating agencies
Ocean Environment Monitoring		☺		☺		**JAMSTEC, NIPR, MRI**
Water Cycle & Resource Management		☺		☺		Univ. Tokyo, ICHARM
Air Pollutant Monitoring			☺	☺	☺	MRI, NIES, Kyushu Univ., JMA
Infrastructure Displacement Monitoring	☺					IDI, etc.
Climate System & Radiative Process		☺	☺	☺	☺	Univ. Tokyo
Ecosystems	☺	☺		☺	☺	Tsukuba Univ., NIES, Hokkaido Univ. JAMSTEC
Agriculture	☺	☺		☺		NIAES, Univ. Tokyo
Public Health	☺	☺		☺		NCGM, Nagasaki Univ., Univ. Tokyo

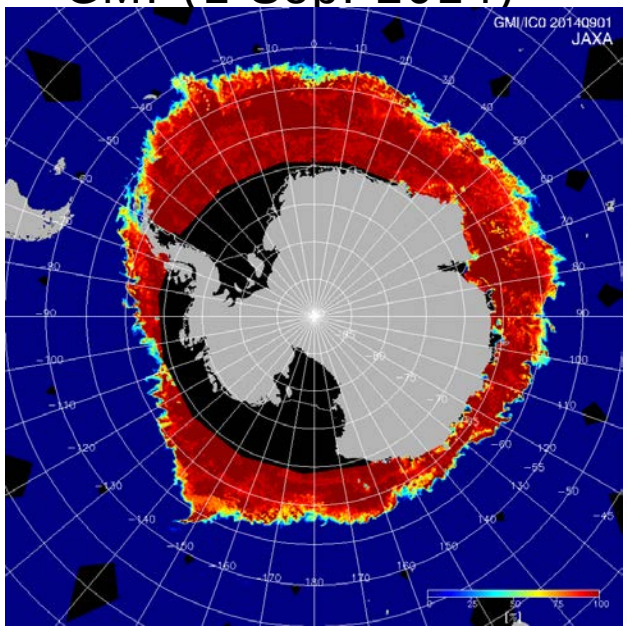
DPR & GMI Sea Ice Concentration

- GMI Sea ice concentration (SIC) algorithm was developed based on that for AMSR2 except using 36-GHz V as weather filter instead of 6-GHz V.
- DPR Sea ice concentration was produced by comparing noise power of KuPR and AMSR2 SIC. Finer resolution SIC maps (5 km) can be obtained although the coverage is limited.
- DPR SIC has been included to DPR standard product V04 released in March 2016.

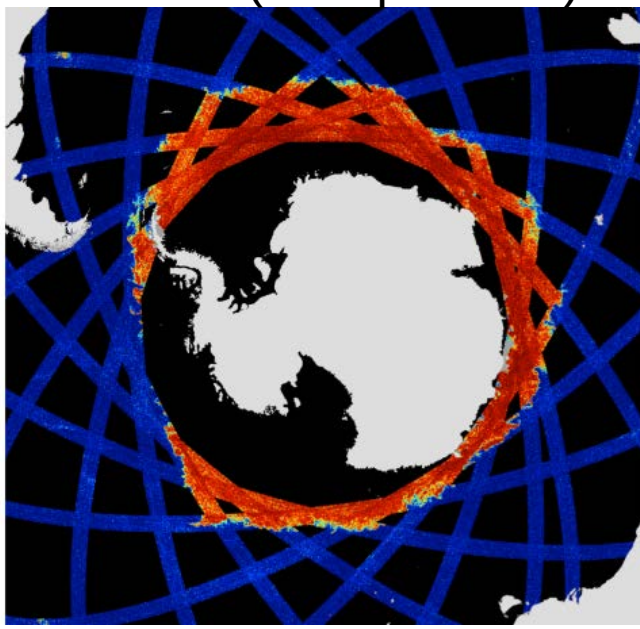
AMSR2 (1 Sep. 2014)



GMI (1 Sep. 2014)



KuPR (1 Sep. 2014)



(DPR sea ice concentration: Motooka et al., in preparation)

Development of DPR Sea Ice Product

Data: Apr. 1, 2014 – Sep. 30, 2014

- GPM DPR L1B/L2 product
- GCOM-W AMSR2 L2 SIC product

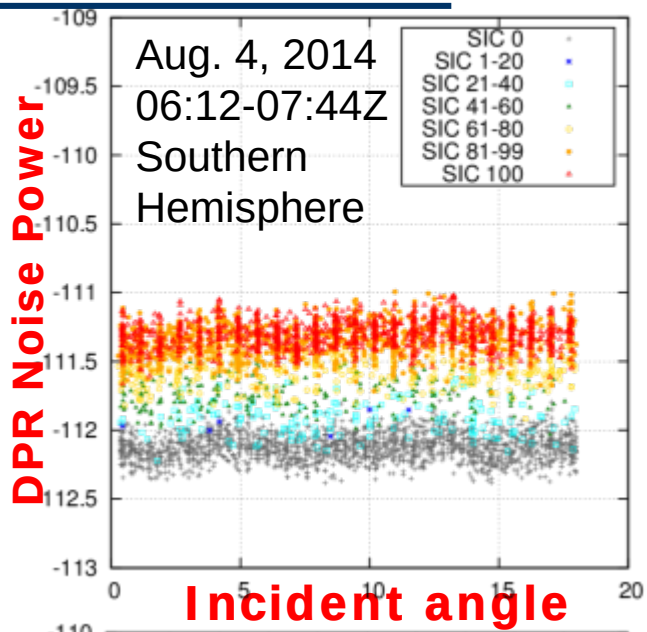
Method:

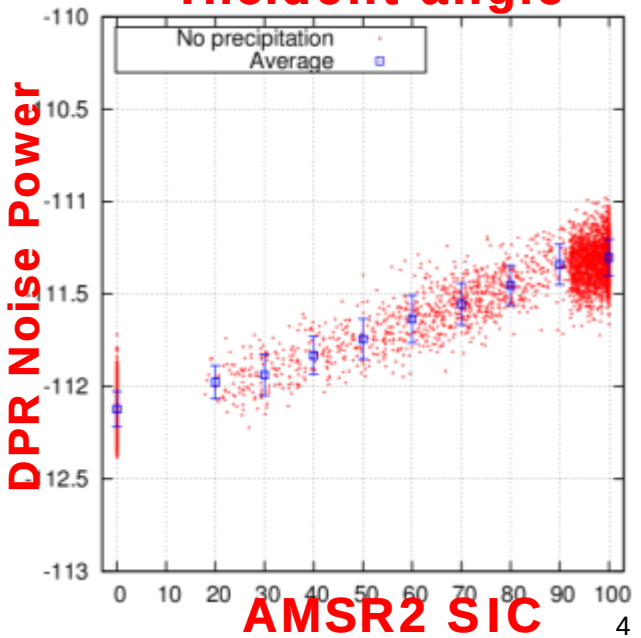
1. Mean value of the DPR data points matching the following conditions:
   - Distance: < 5 km from AMSR-2 points
   - Observation time: < +/- 30 minutes
   - Number of points: > 3 points
   - Region: Southern hemisphere, Okhotsk sea, etc.
2. Mean/deviation of the derived samples were calculated for each SIC/incidence-angle class.

Result:

Noise power shows linear relationships with SIC:

- SIC estimated by a regression model, RMSE = 2.65%, bias = 0.03% (Aug. 4)



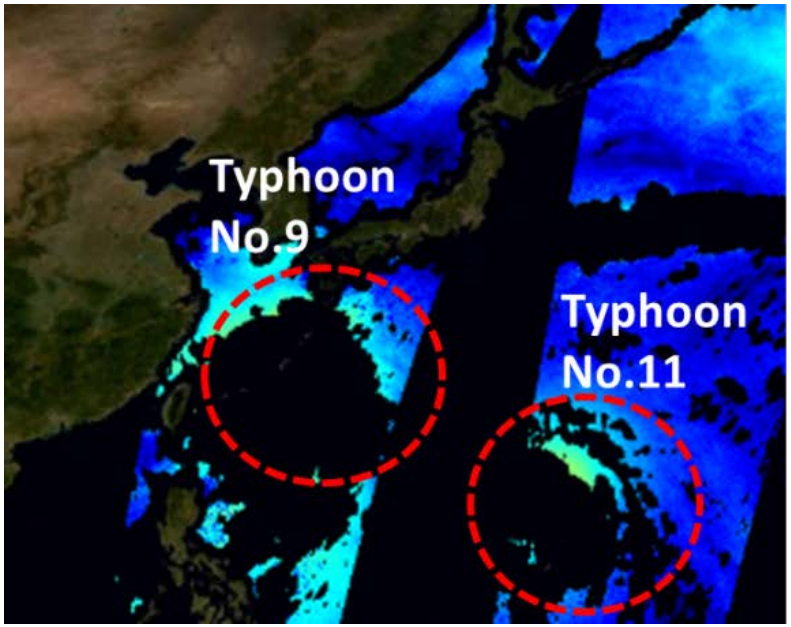


Motooka et al. (2014)

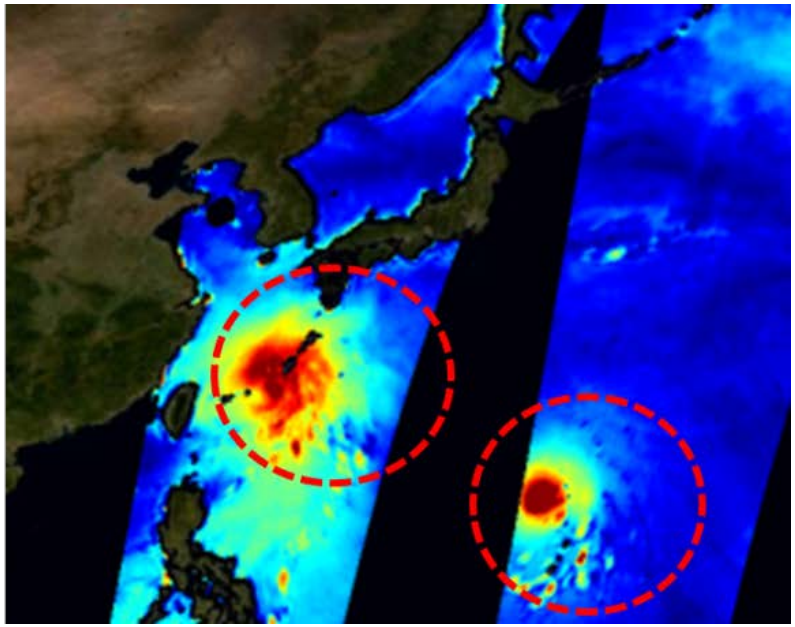
All-weather Sea Surface Wind Speed

- Use 6-GHz/10-GHz channels to avoid influence of rainfall (Shibata, 2006), corresponding to wind speed at best track released by JMA and NHC.
- Algorithm is applied to AMSR2, AMSR-E and Windsat.
- AMSR2 all-weather SSW Released to public in October 2015 at http://suzaku.eorc.jaxa.jp/GCOM_W/research/terms.html
- Used in JMA's operational typhoon analysis.

AMSR2 Standard SSW



AMSR2 All-weather SSW

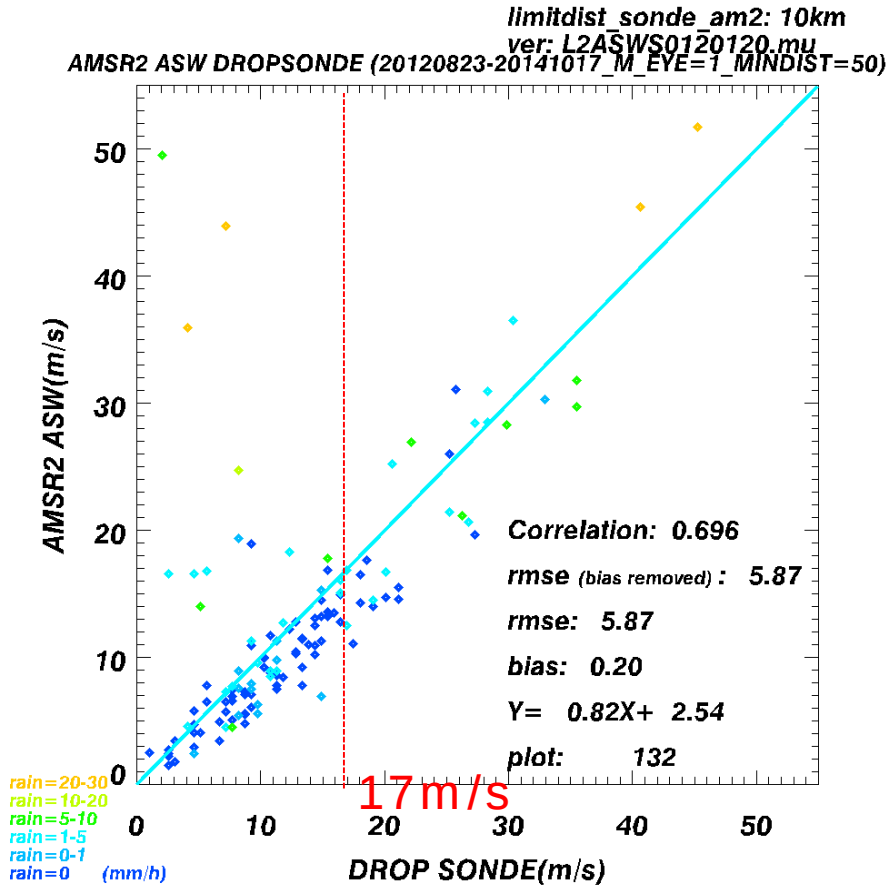


1 July, 2015 (Desc)

Validation by Dropsodne

- Compared with NOAA GPS dropsonde wind speed with distance within 10km and time difference within 90 minute
  - Removed data at EYE_EYEWALL, less than 50km from best track
- Validation result for all-wind range
  - Bias 0.20 m/s
  - RMSE 5.87 m/s
- Validation result of strong wind range (more than 17m/s
  - Bias -1.51 m/s
  - RMSE 4.18 m/s
- Negative bias will be improved in future version

Period:Jul. 2012 – Oct. 2014

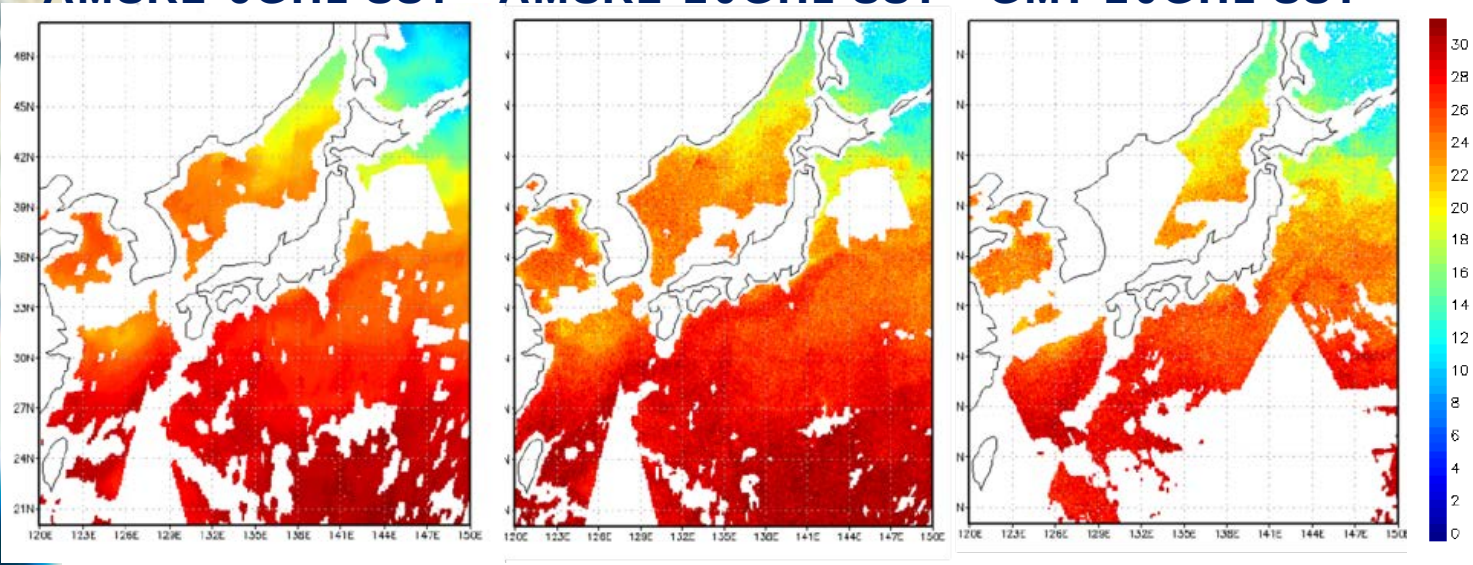


GPS-dropsonde data are provided courtesy of the NOAA/AOML/Hurricane Research Division in Miami, FL (USA).

10GHz Sea Surface Temperature

- 10GHz SST has advantage that it has finer (30km) resolution compared to that of standard 6GHz SST (60km).
- Disadvantage is poor sensitivity to low temperature range, less than 10 degC. SST less than 9 degC is set as missing.
- 10GHz observed SST is included in the AMSR2 SST V2 product in addition to standard SST, in order to provide complementary information to users, since March 2015.
- Same algorithm was applied to GPM-Core/GMI and product was released to public in April 2015.
- GMI & Windsat SSTs in NetCDF are available at JAXA GHRSST server http://suzaku.eorc.jaxa.jp/GHRSST/index.html

AMSR2 6GHz SST **AMSR2 10GHz SST** **GMI 10GHz SST**

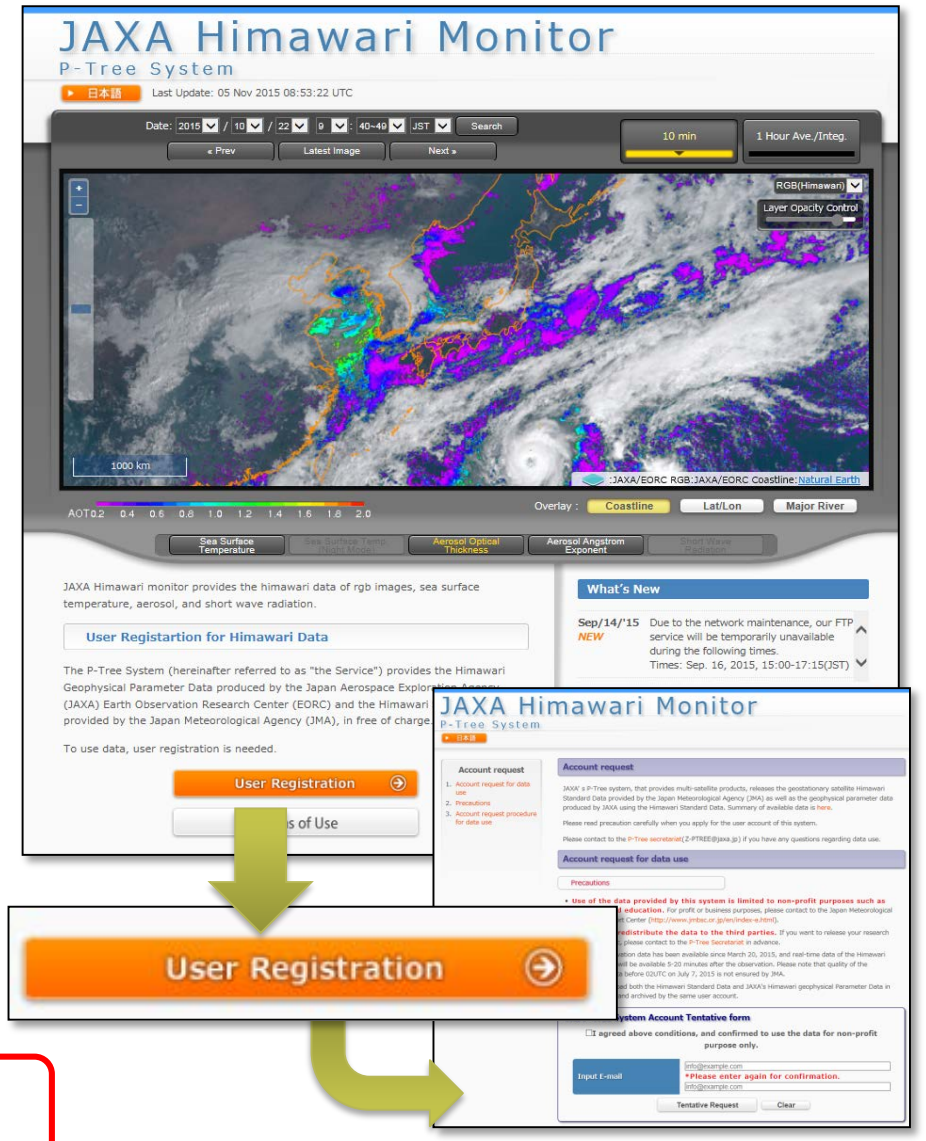


Validation with iQuam buoy

Product	RMSE
AMSR2 6GHz SST	0.58℃
AMSR2 10GHz SST	0.61℃
GMI 10GHz SST	0.63℃

JAXA Himawari Monitor

- To seek synergies between Himawari-8 and JAXA's Earth Observation Missions by applying same algorithm to produce consistent dataset
- Opened the webpage on 31st August, 2015
- Registration: 300 people (as of 17th May, 2016)
- Brose images of Himawari-8 RGB and geophysical parameters on the Webpage
- Disseminates Himawari Standard data and JAXA produced geophysical data via FTP
  - SST, Ocean Color, PAR, SWR
  - Aerosol Properties
- Data can be downloaded with simple user registration



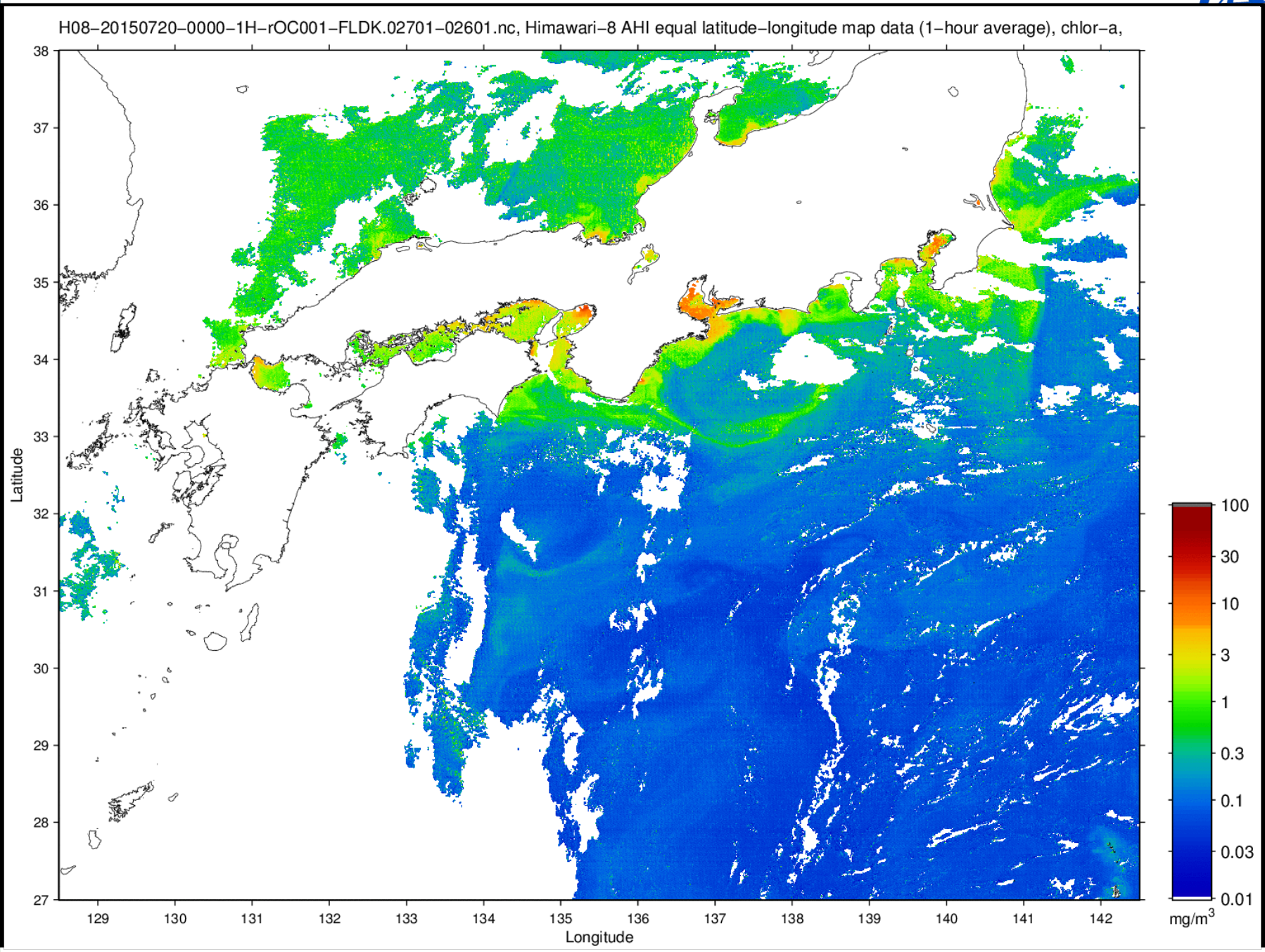
http://www.eorc.jaxa.jp/ptree

Himawari-8 Ocean Products

- Developed based on the GCOM-C/SGLI algorithms
- Himawari Ocean Products
  - NetCDF-CF format
  - Sea Surface Temperature (2km res., 10-min/1-hr ave.)
  - Night-time SST (2km res., 1-hr ave.)
  - Ocean Color (Chlorophyll-a) (5km (full-disk)/1km (near Japan) res., 1-hr ave.)
  - Short Wave Radiation & Photosynthetically Available Radiation (PAR) (5km (full-disk)/1km (near Japan) res., 10-min/1-hr ave.)

SST Validation by NOAA iQuam buoy (Kurihara *et al.*, 2016)

Year/month	RMSE	Bias	STD	Number
2015/06	0.58	-0.16	0.55	143,714
2015/07	0.59	-0.14	0.57	150,020
2015/08	0.56	-0.15	0.54	148,107
2015/09	0.59	-0.15	0.57	189,148


H08-20150720-0000-1H-rOC001-FLDK.02701-02601.nc, Himawari-8 AHI equal latitude-longitude map data (1-hour average), chlor-a,
Latitude
38
37
36
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Longitude
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131
132
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134
135
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100
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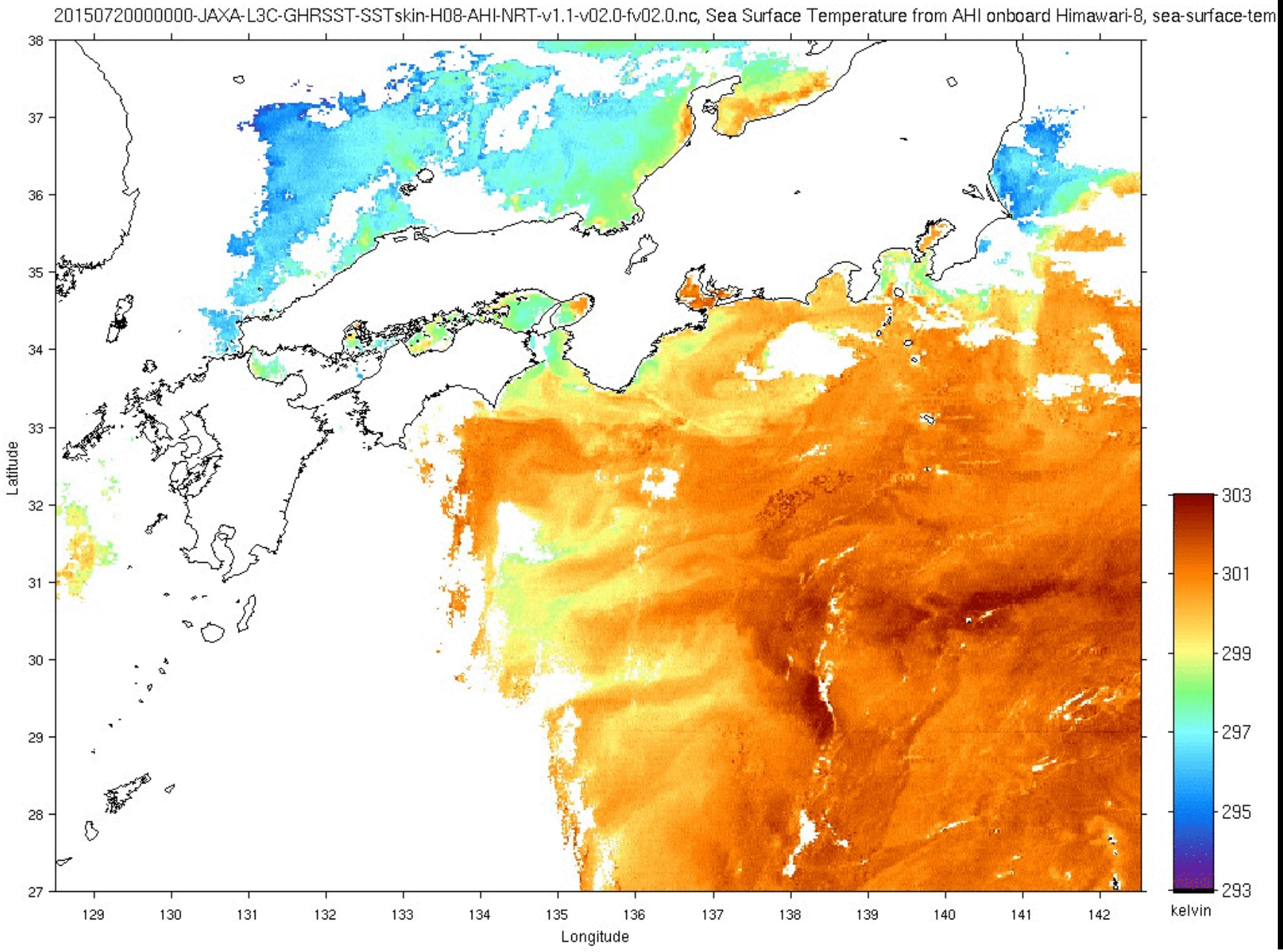
0.1
0.03
0.01
mg/m3


20150720000000-JAXA-L3C-GHRSST-SSTskin-H08-AHI-NRT-v1.1-v02.0-fv02.0.nc, Sea Surface Temperature from AHI onboard Himawari-8, sea-surface-tem
Latitude
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Longitude
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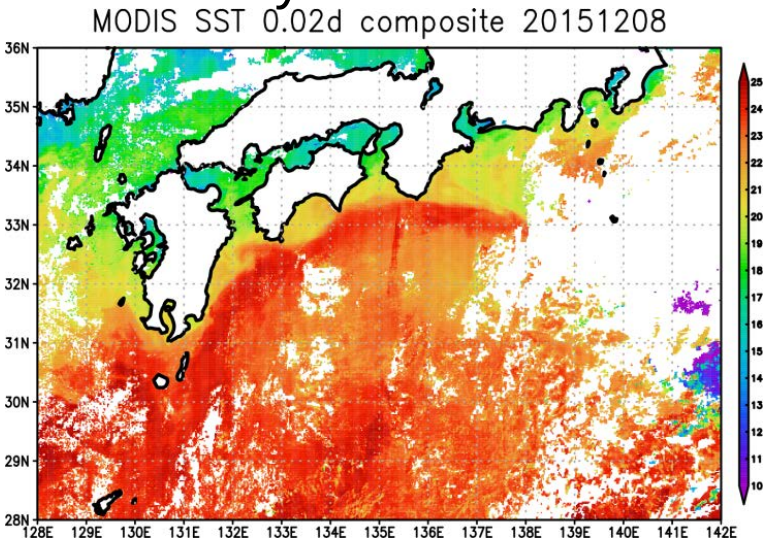
293
kelvin

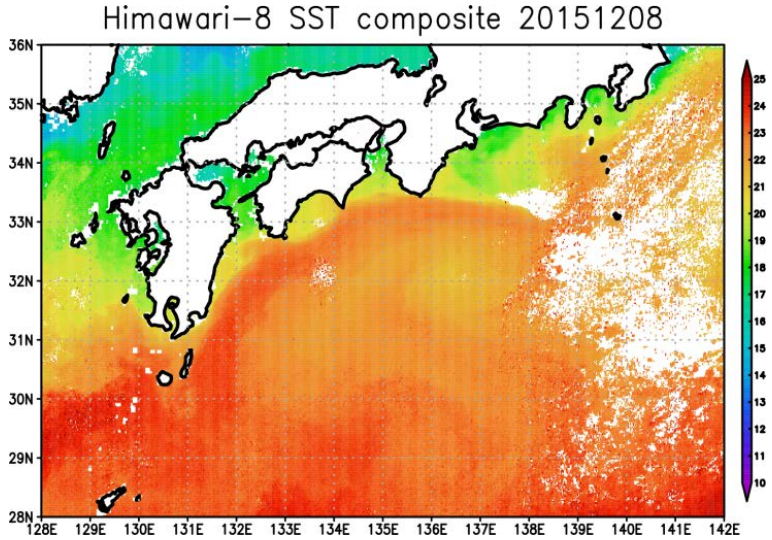
Development of SST Data Assimilation System with JAMSTEC

- JAMSTEC currently operates ocean forecast model over the south of Japan, called JCOPE2 (Japan Coastal Ocean Predictability Experiment 2), with 1/12 deg. grid, and has switched its data assimilation system input since the end of February 2016
- We are also developing Himawari SST data assimilation system onto JAMSTEC's future regional ocean forecast model "KFSJ" (Emsemble Kalman-Filter for South of Japan) with 1/36 deg. grid

Daily MODIS SST



Daily Himawari SST



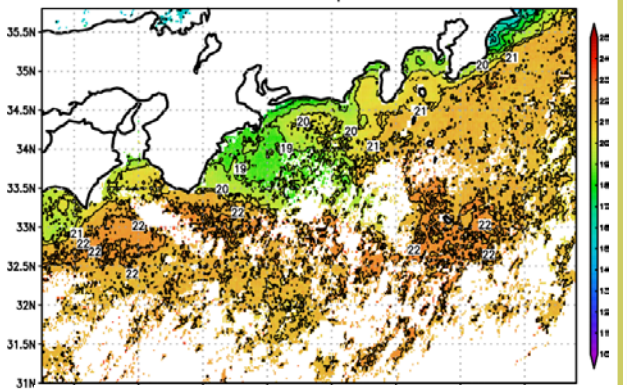
JAXA/JAMSTEC

Himawari SST Assimilation in KFSJ

Effect of Himawari SST assimilation (4km interval)

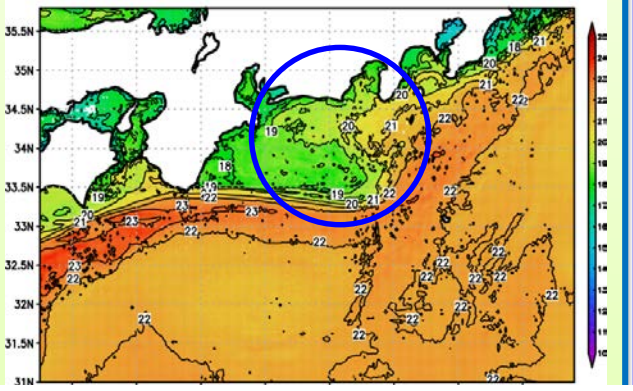
Himawari SST

Himawari-8 SST composite 20151216



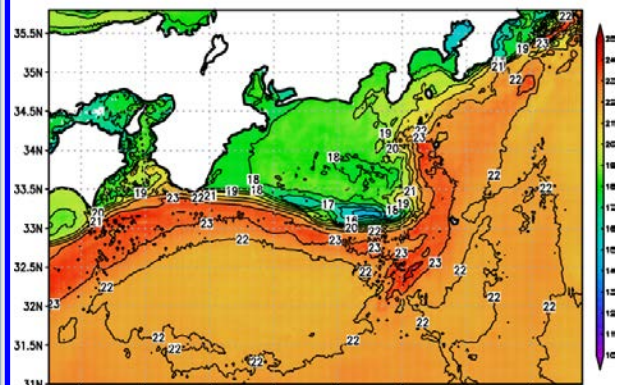
KFSJ with Himawari

SST 20151216



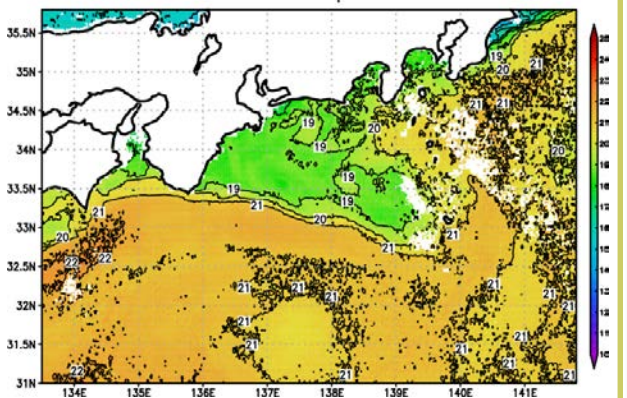
KFSJ w/o Himawari

SST 20151216

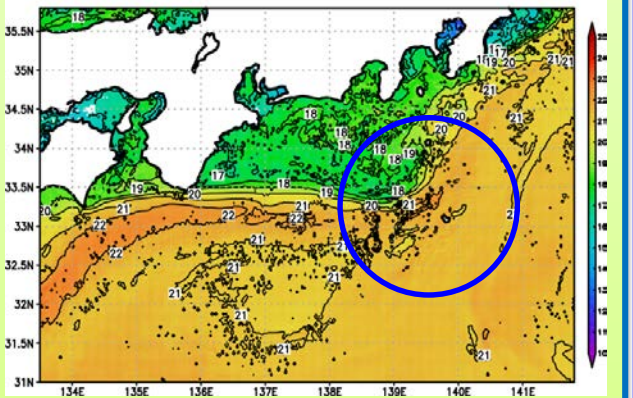


Successfully demonstrate SST variation with Kuroshio front

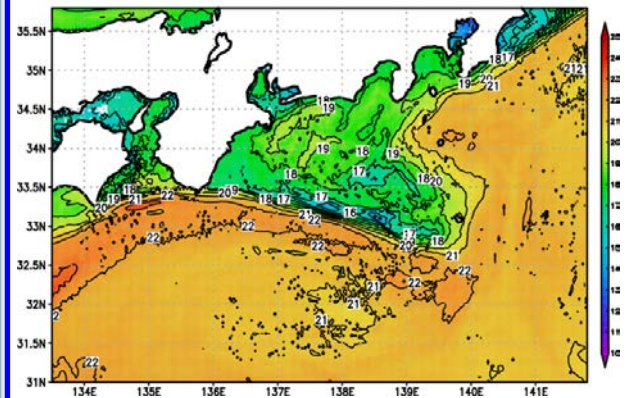
Himawari-8 SST composite 20151222



SST 20151222



SST 20151222



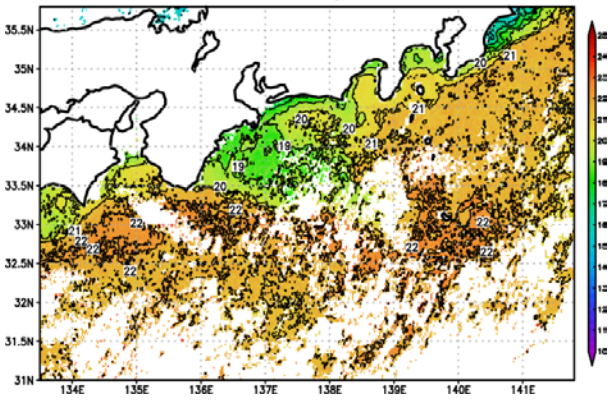
In some cases, Kuroshio flow shows worse expression with Himawari SST assimilation. Under investigation. (JAXA/JAMSTEC)

Comparison with Current Model

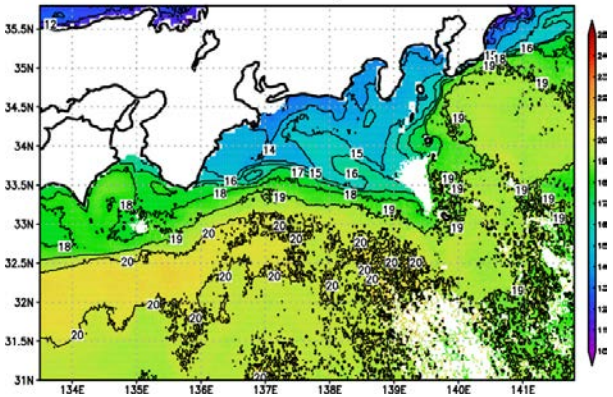
Comparison with KFSJ (1/36 deg.) and JCOPE2 (1/12 deg.)

Himawari SST

Himawari-8 SST composite 20151216

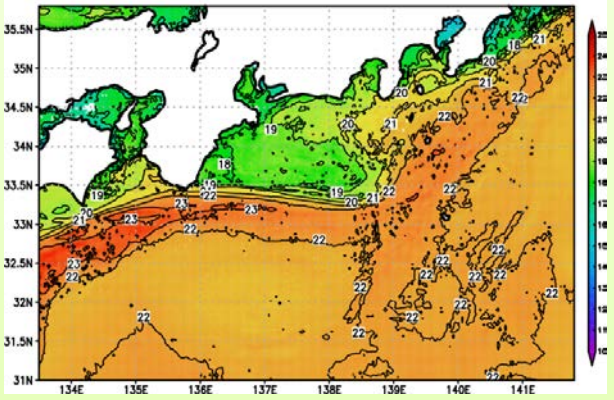


Himawari-8 SST composite 20160210

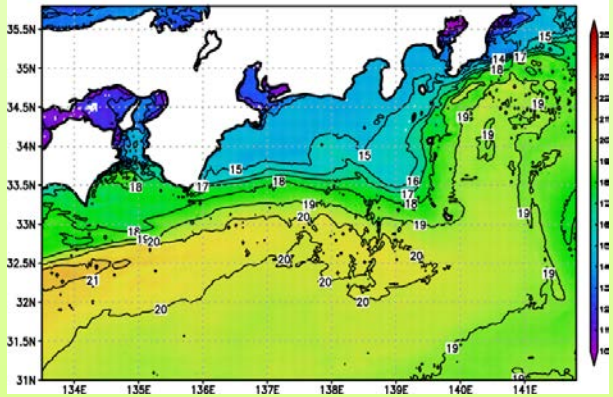


Himawari+KFSJ

SST 20151216

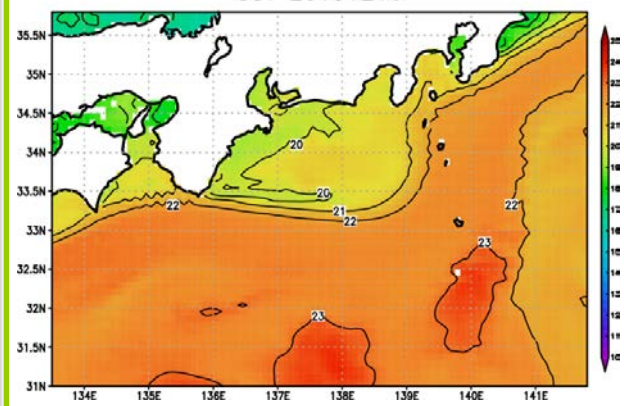


SST 20160210

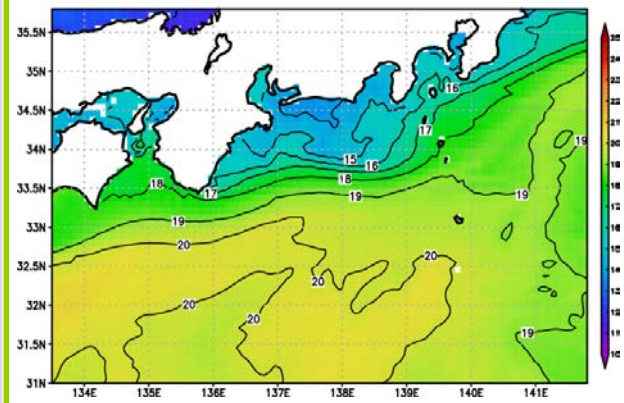


MODIS+JCOPE2

SST 20151216



SST 20160210



KFSJ shows Kuroshio front better than JCOPE2.
Positive bias of MODIS affects to JCOPE2 --> Switched to use Himawari SST in JCOPE2.

(JAXA/JAMSTEC)

Summary

- JAXA recently started cross-cutting research activities among multiple satellite missions including non-JAXA missions, such as Himawari-8.
  - “Ocean Environment Monitoring” is one of the research theme.
- PMW ocean products are produced based on AMSR2 algorithms.
  - AMSR-E, Windsat, GMI & DPR sea ice concentration
  - GMI & Windsat SST, new AMSR2 10-GHz SST
  - New AMSR2 & Windsat all-weather sea surface wind speed
- VIS/NIR/IR ocean products are produced based on SGLI algorithms
  - Himawari-8 SST, Ocean color, SWR & PAR
  - Aqua/Terra MODIS & NPP/VIIRS SST are underway
- JAXA and JAMSTEC is developing ocean forecast system with Himawari SST data assimilation into 1/36 degree resolution regional ocean model, Ensemble Kalman-Filter for South o Japan (KFSJ).
  - Early results shows good demonstration of Kuroshio front in the model forecast. Further investigation will be needed in some bad demonstration cases.
  - Start working with local experimental fishery stations to evaluate Himawari SST and model forecasts in their operational sea state analysis.