UNSW
THE UNIVERSITY OF NEW SOUTH WALES

Never Stand Still

Satellite Oceanography Users Workshop 2015

Application of the Geostationary Ocean Color Imager to Mapping the Seasonal and Diurnal Dynamics of Suspended Particulate Matter in Coastal Waters

Reported by **Zhixin Cheng**

School of Physical, Environmental and Mathematical Science

Contents

- **Introduction**
- **Data & Methodologies**
- **Results**
- **Limitation of GOCI data**
- **GOCI-II**

Contents

- **Introduction**
- **Data & Methodologies**
- **Results**
- **Limitation of GOCI data**
- **GOCI-II**

GOCI

Geostationary Ocean Color Imager(GOCI), an ocean color sensor carried on the satellite COMS (Communication Ocean and Meteorological Satellite) was recently launched in 2010 by KOSC (Korean Ocean Satellite Center). It acquires data at **8 spectral bands** (6 visible, 2 NIR(Near Infrared Reflection)) with a spatial resolution of **500 m**.

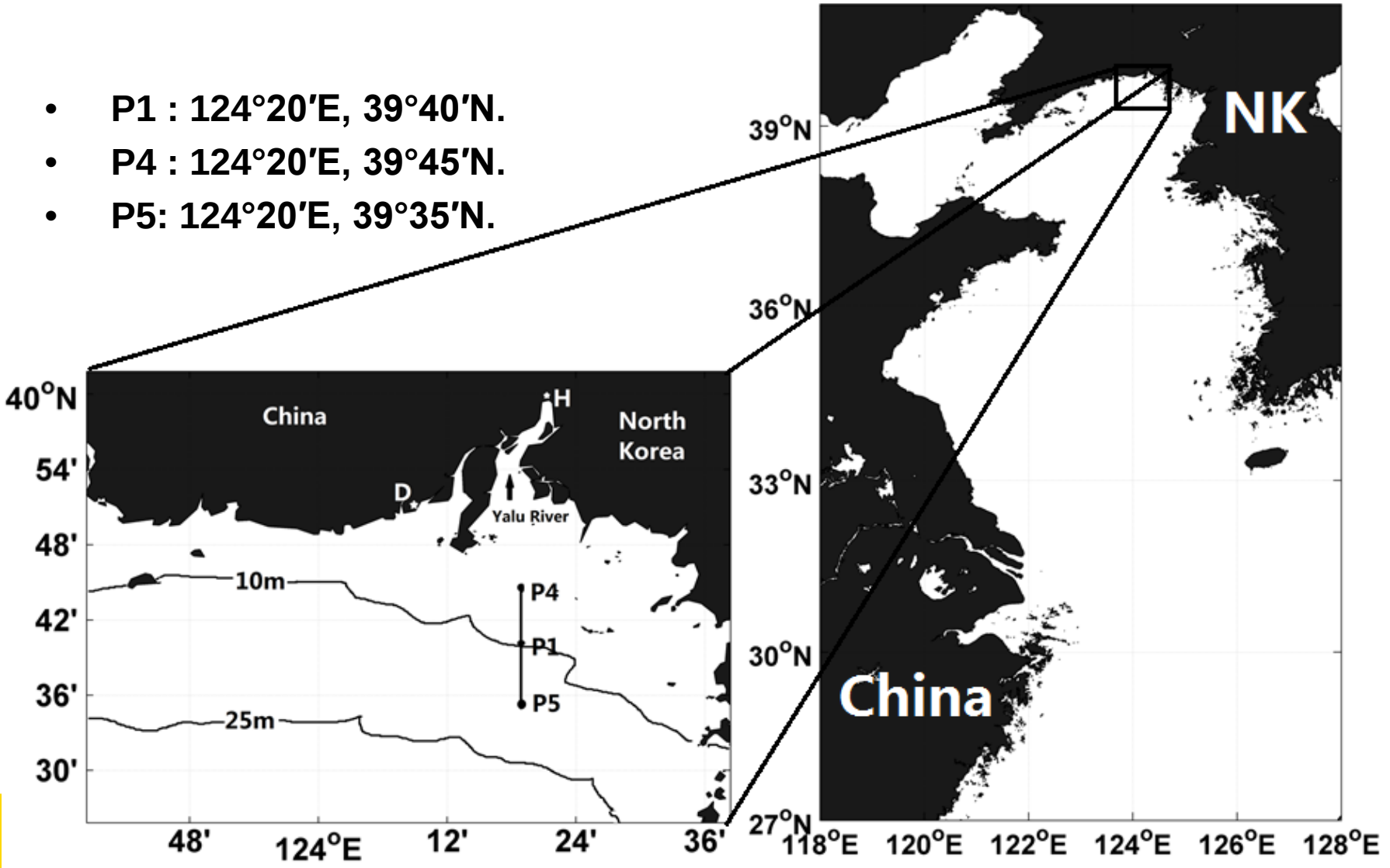
GOCI can acquire **8 measurements** from GMT 00 to 07h everyday with a coverage of the East China Seas and Korean Seas.

Characteristics of the spectral bands on GOCI

Band	Band Center(nm)	Bandwidth (nm)	SNR(Signal to noise ratio)	Primary Use
1	412	20	1,000	Yellow substances and turbidity
2	443	20	1,090	Chlorophyll
3	490	20	1,170	Pigment,Chlorophyll
4	555	20	1,070	Turbidity,Suspended sediment
5	660	20	1,010	Fluorescence signal,ChlorophyII,Suspended sediment
6	680	10	870	Atmospheric Correction, Fluorescence signal
7	745	20	860	Atmospheric Correction, Fluorescence signal
8	865	40	750	Aerosol, Vegrtation, Water vapour reference over the ocean

Study Area & Selected Stations

- **P1 : 124°20′E, 39°40′N.**
- **P4 : 124°20′E, 39°45′N.**
- **P5: 124°20′E, 39°35′N.**



Contents

- Introduction
- **Data & Methodologies**
- Results
- Limitation of GOCI data
- GOCI-II

Data type	Source
GOCI L1B data	Korean Ocean Satellite Center
Water and sediment discharge data of the Yalu River	Huanggou hydrological station
Observations of wind speed and direction, tidal height	Dadong Harbour hydrological station
Daily area-averaged significant wave height and wind speed at 10 m	European Centre for Medium-Range Weather Forecasts (ECMWF)

TSM retrieval algorithm [Yu,2013]:

$$\lg C_{TSM} = 4.8581 + 0.8206 \cdot \frac{B7}{B3} - 0.9998 \cdot \frac{B4}{B3} - 3.6504\sqrt{\frac{B3}{B5+B4}}$$

Here C_{TSM} is surface total suspended particulate matter concentration in the ocean, B represents the R_{rs} (remote sensing reflectance) corresponding to the central wavelengths of related bands.

Contents

- Introduction
- Data & Methodologies
- **Results**
- Limitation of GOCI data
- GOCI-II

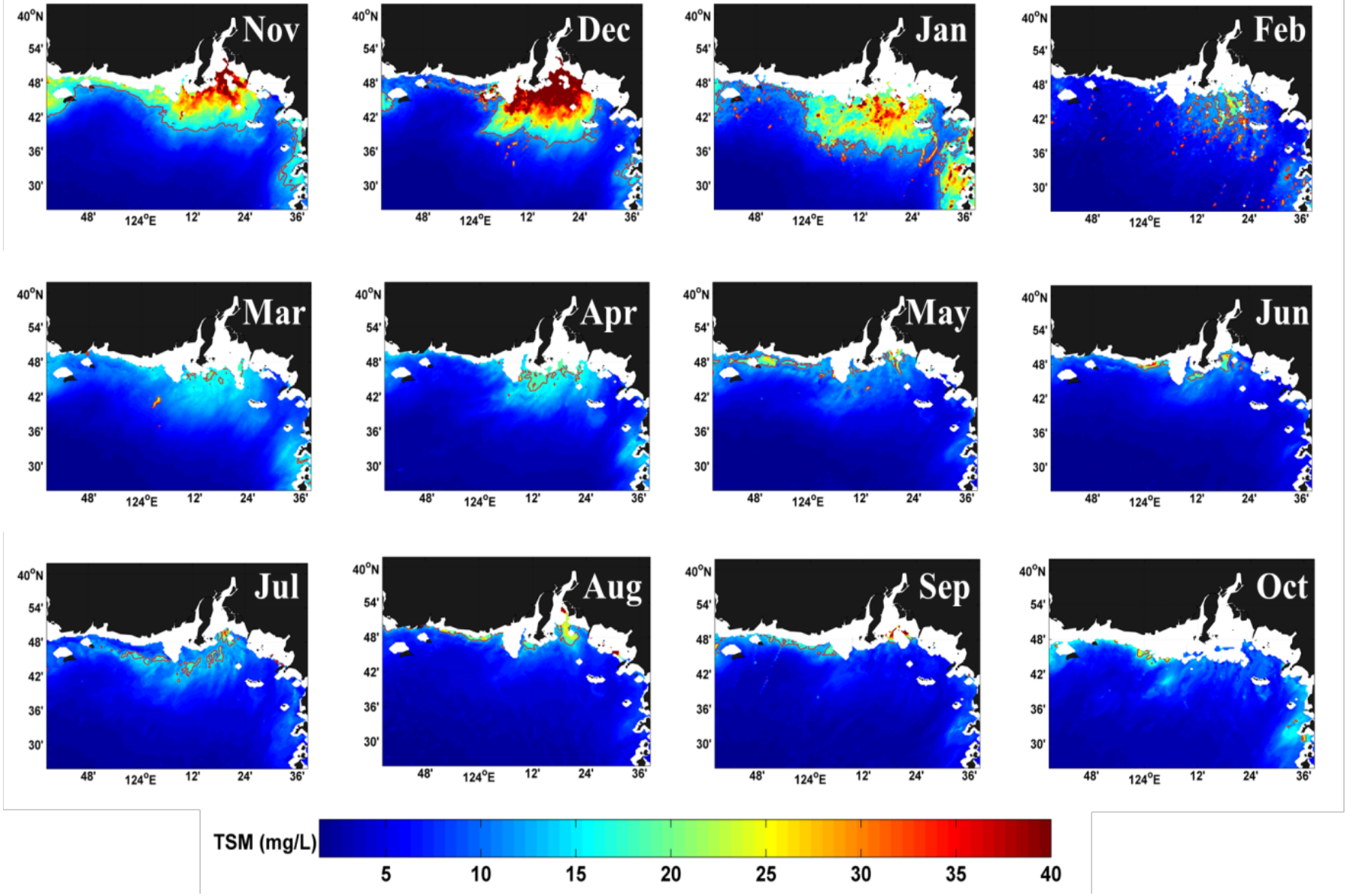
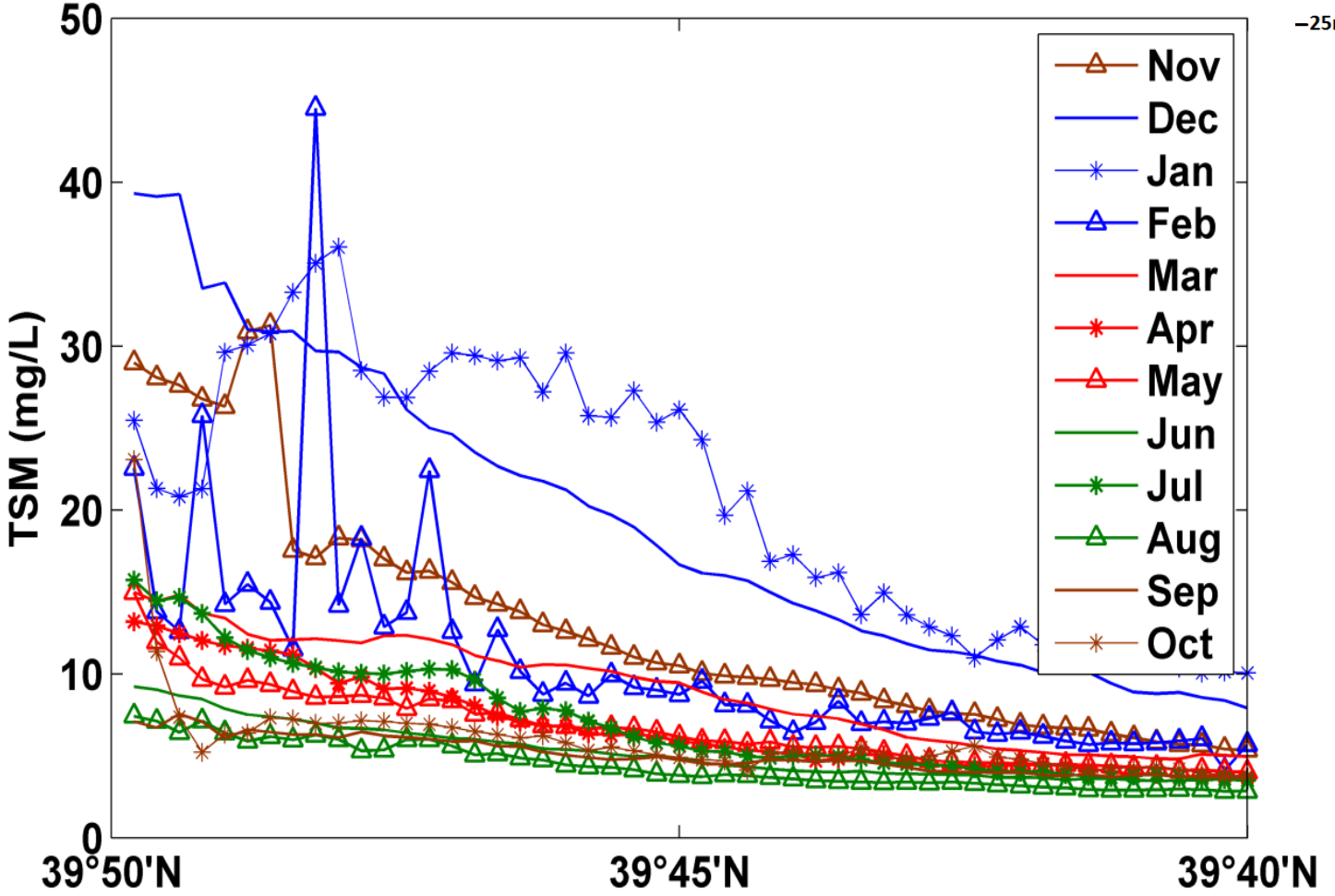


Fig. 2. Monthly mean Total Suspended particulate Matter (TSM) maps retrieved from GOCI in the Yalu River Estuary from November 2013 to October 2014. Red lines demark the extent of the turbidity maxima zone (>15 mgL^{-1} TSM concentration)

UNSW
THE UNIVERSITY OF NEW SOUTH WALES



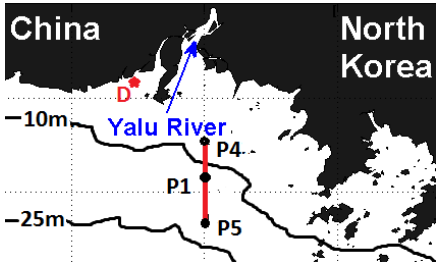
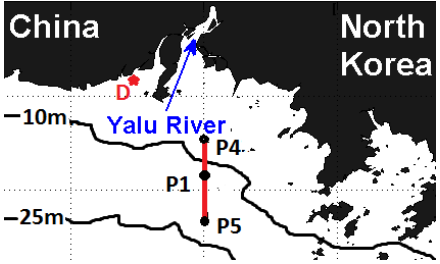


Fig. 4. Monthly mean Total Suspended particulate Matter (TSM) across Section 1 from November 2013 to October 2014.

UNSW

Seasonal variability of surface SSC from 2011-2014



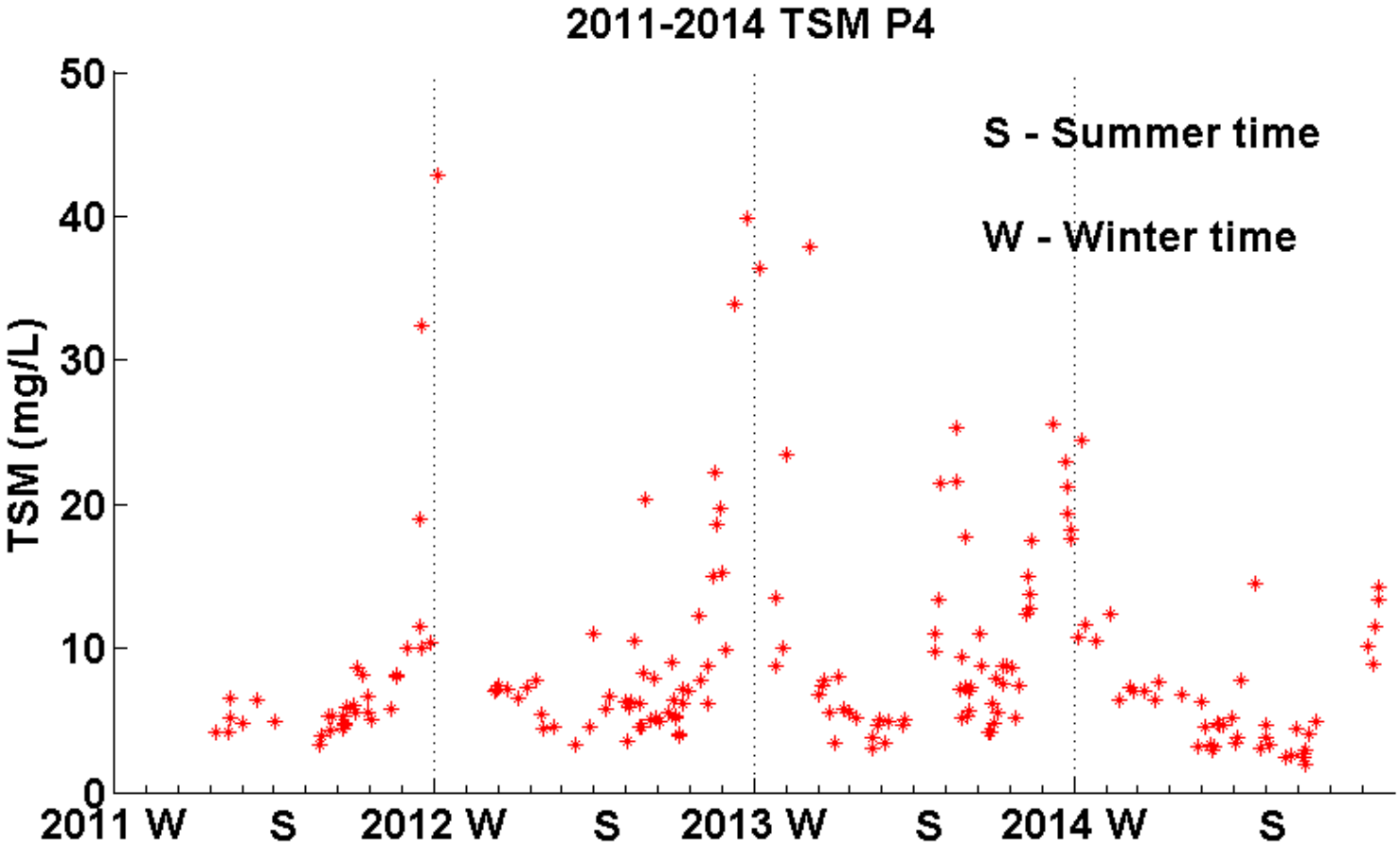


Fig. 3. Daily Total Suspended particulate Matter (TSM) retrieved from GOCI at P4 from April 2011 to December 2014.

UNSW
THE UNIVERSITY OF NEW SOUTH WALES

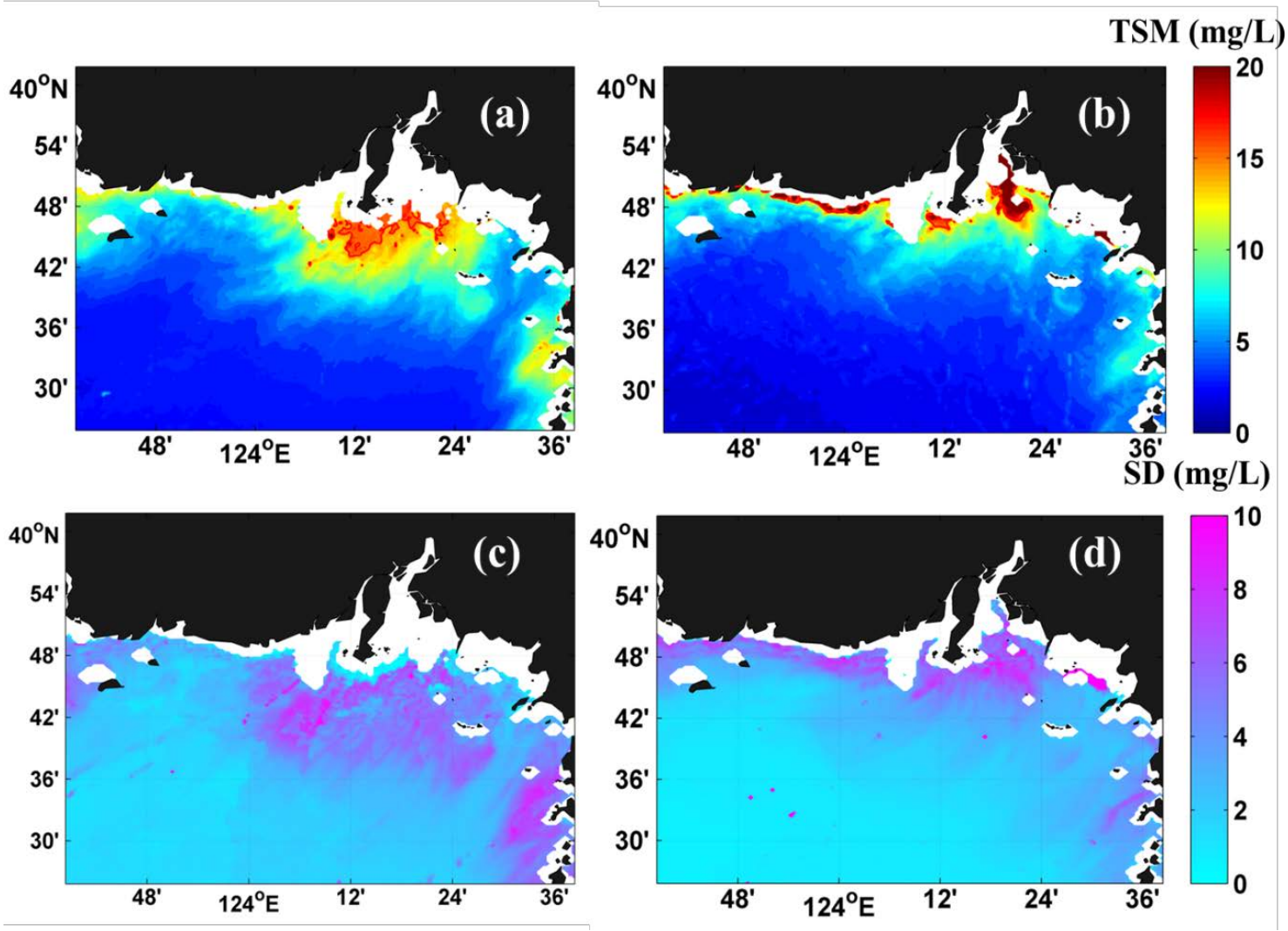
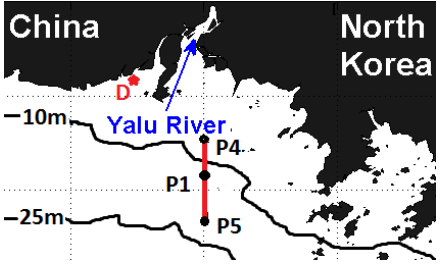


Fig. 5. Spatial distributions of monthly mean Total Suspended particulate Matter (TSM) on (a) April 2014 and (b) August 2014. Standard deviation of TSM on cloud-free days in April 2014 and (d) August 2014

Scatterplot between daily averaged TSM and wind speed/significant wave height



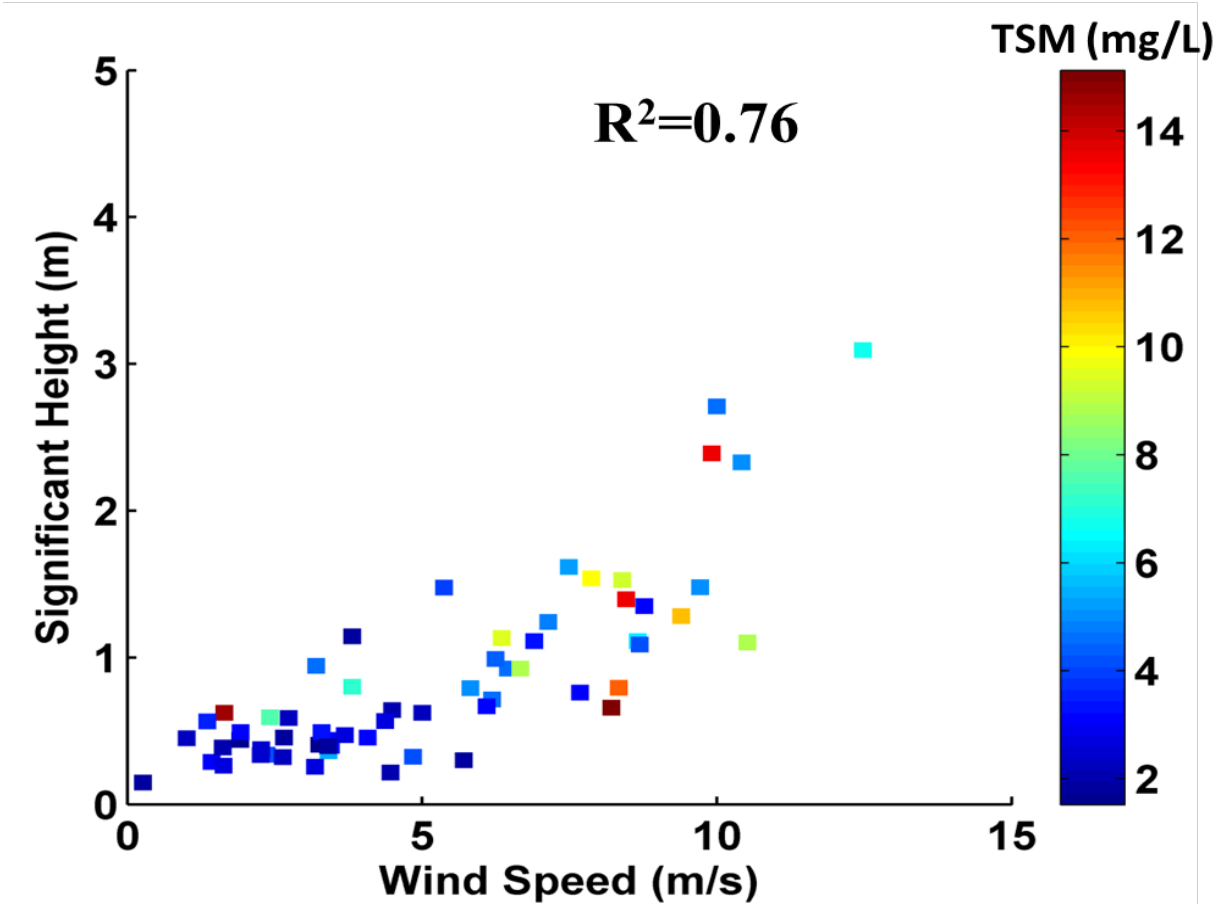


Fig. 7. Relationship between daily Total Suspended particulate Matter (TSM) and corresponding wind speed/significant wave height for all cloud-free days in 2014.

UNSW

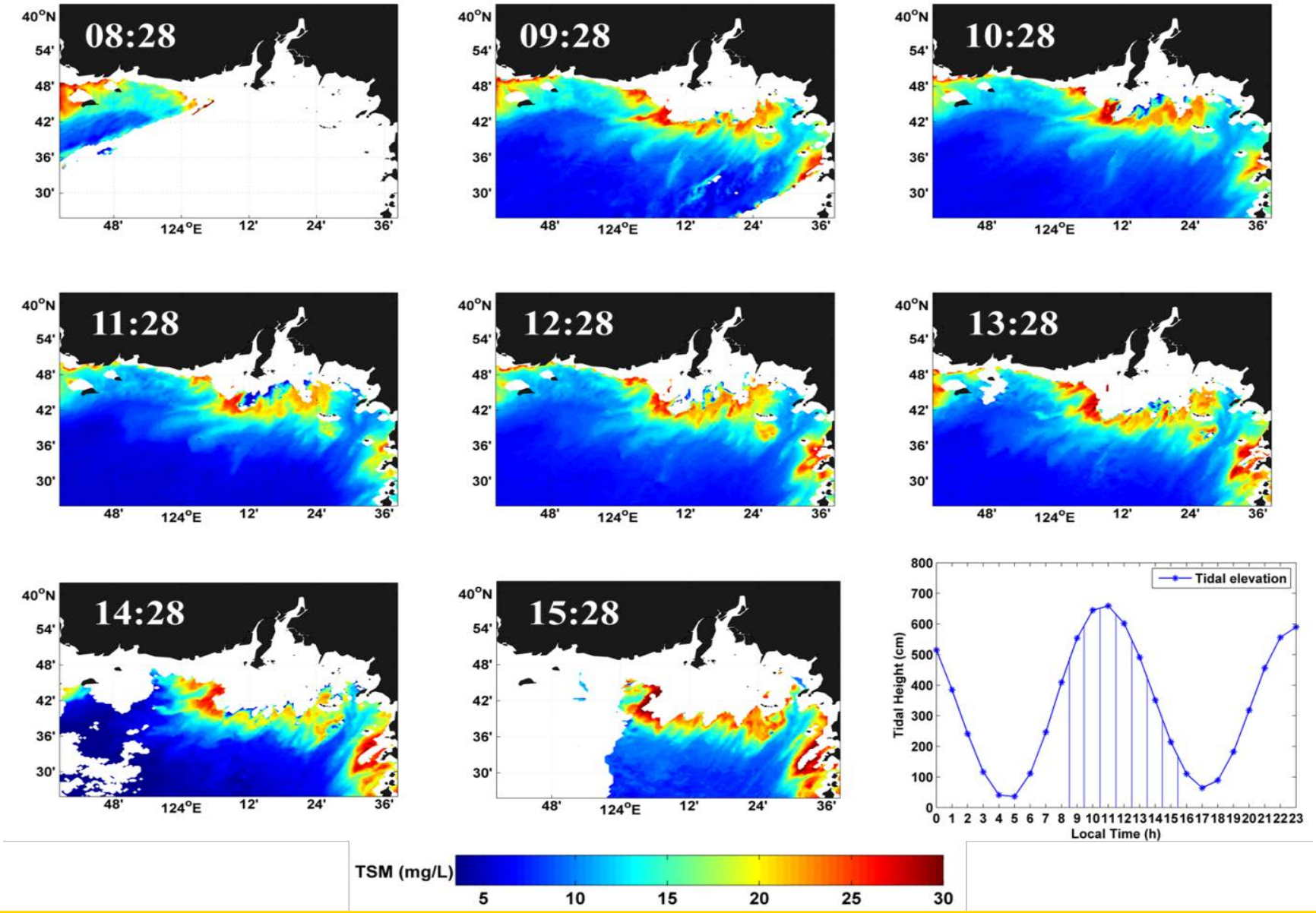


Fig. 8. Hourly maps of Total Suspended particulate Matter (TSM) from 08:28 to 15:28 (local time) in the Yalu River Estuary on 3 April 2014. The graph shows the hourly tide elevation on the same day.

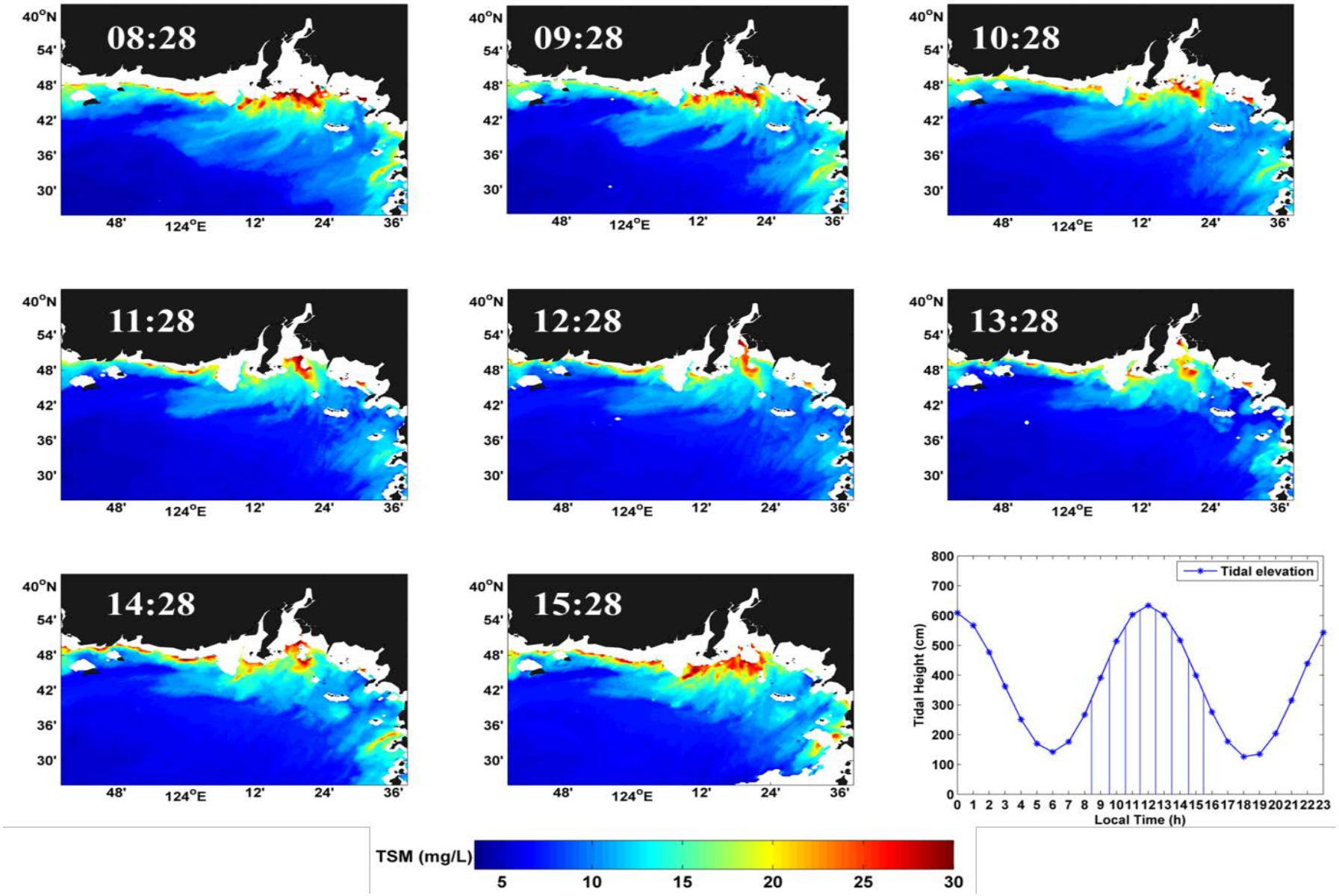
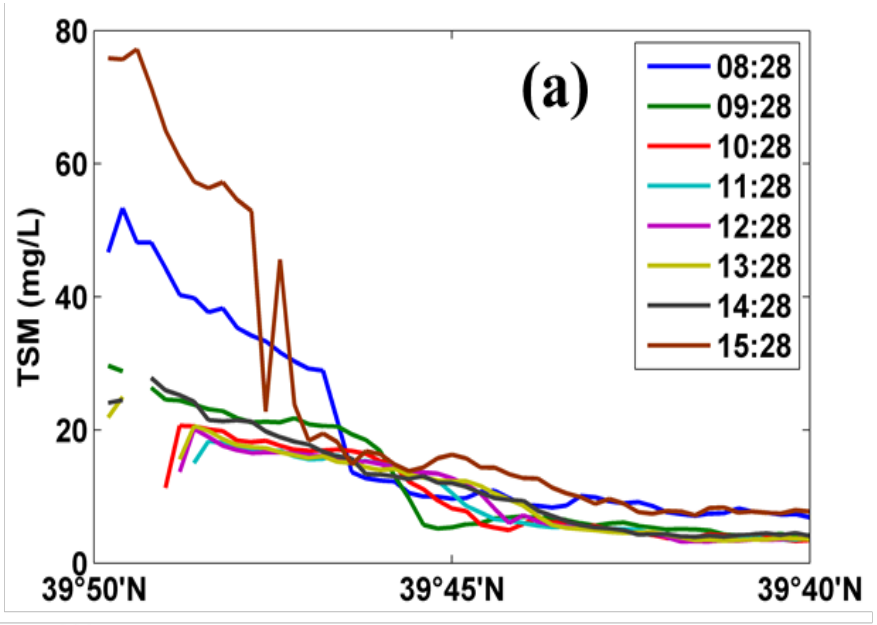
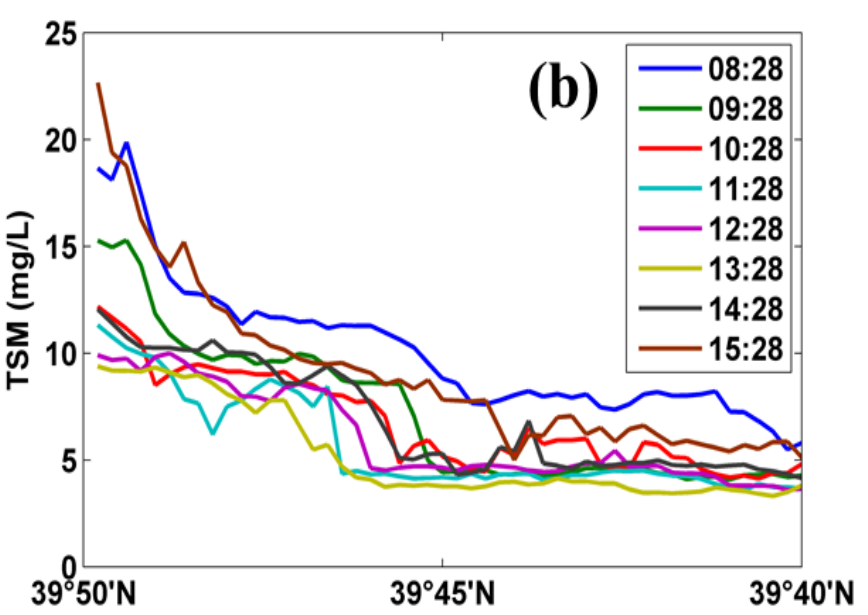
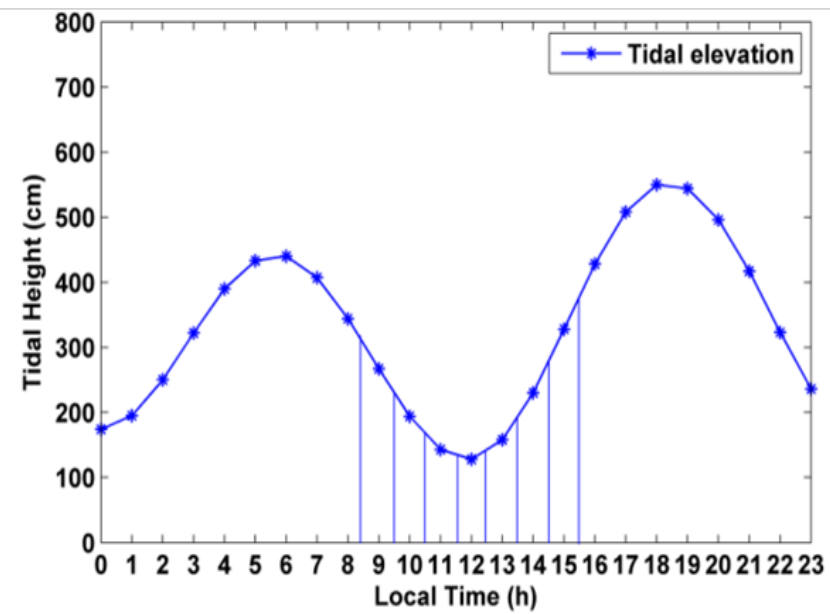


Fig. 9. Hourly maps of Total Suspended particulate Matter (TSM) from 08:28 to 15:28 (local time) in the Yalu River Estuary on 2 August 2014. The graph shows the hourly tide elevation on the same day.







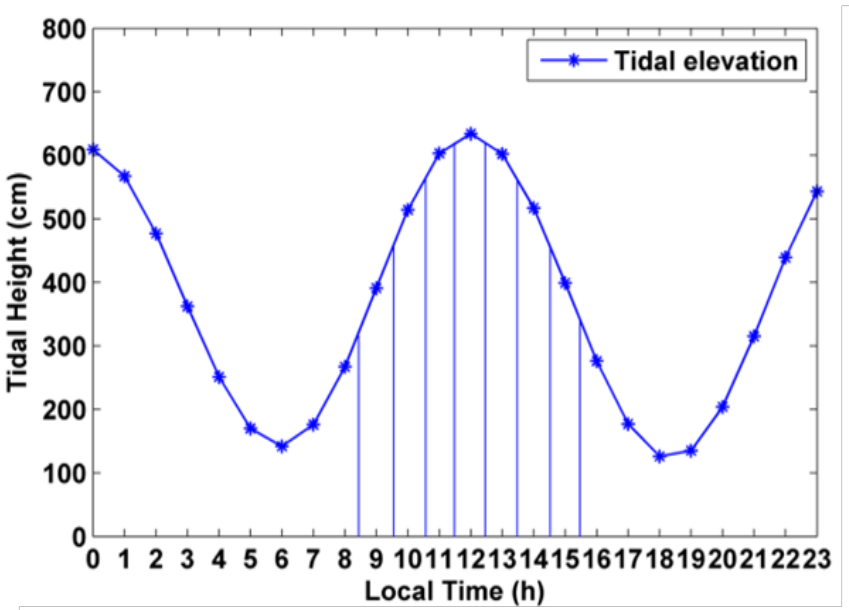


Fig. 10. Total Suspended particulate Matter (TSM) hourly results across Section 1 on (a) 12 January 2014 and (b) 2 August 2014, with corresponding tidal elevations in local time.

UNSW

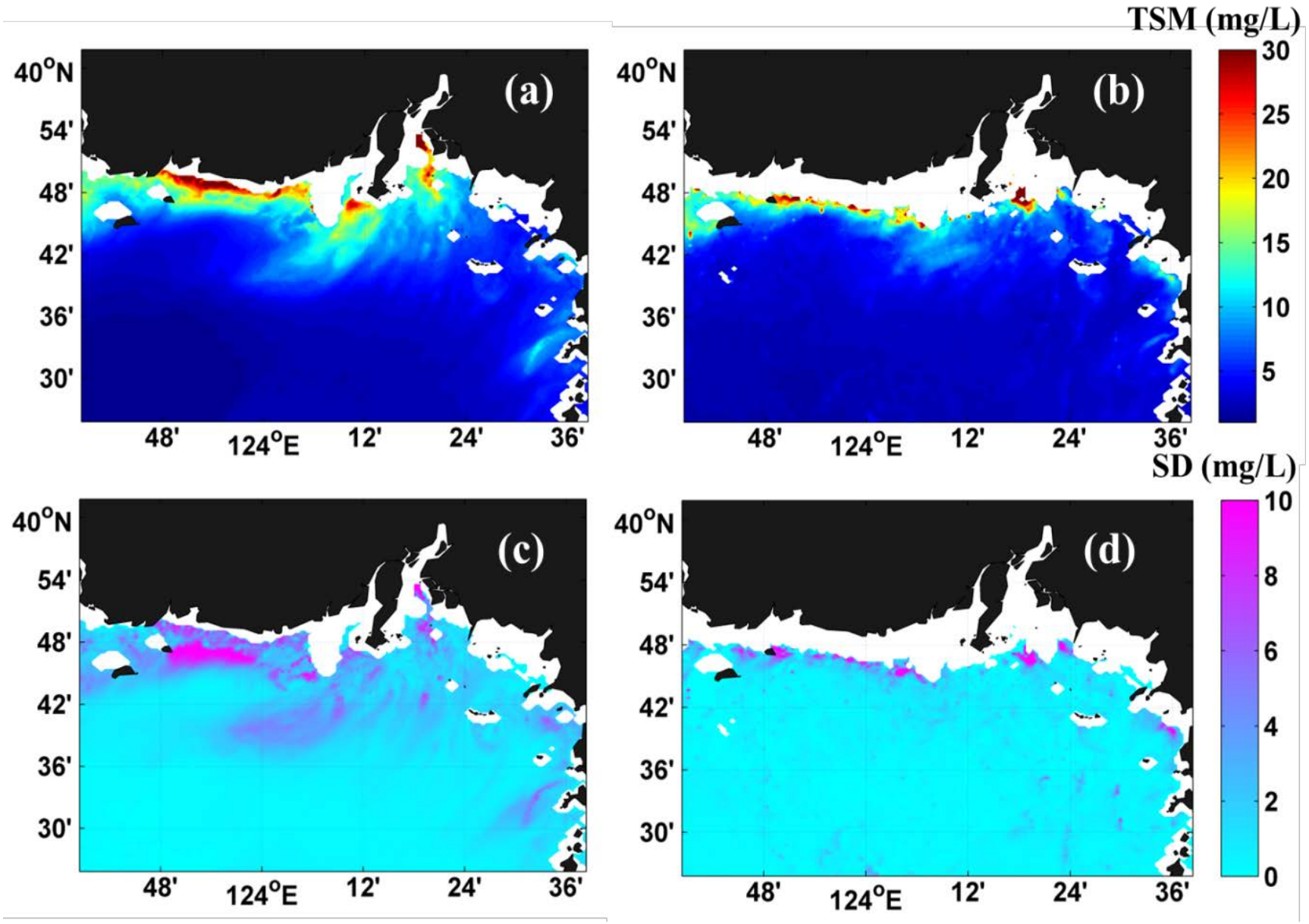


Fig. 11. Spatial distributions of daily averaged Total Suspended particulate Matter (TSM) on (a) 30 May 2014 and (b) 8 June 2014. Standard deviation of TSM on (c) 30 May 2014 and (d) 8 June

UNSW
THE UNIVERSITY OF NEW SOUTH WALES

Contents

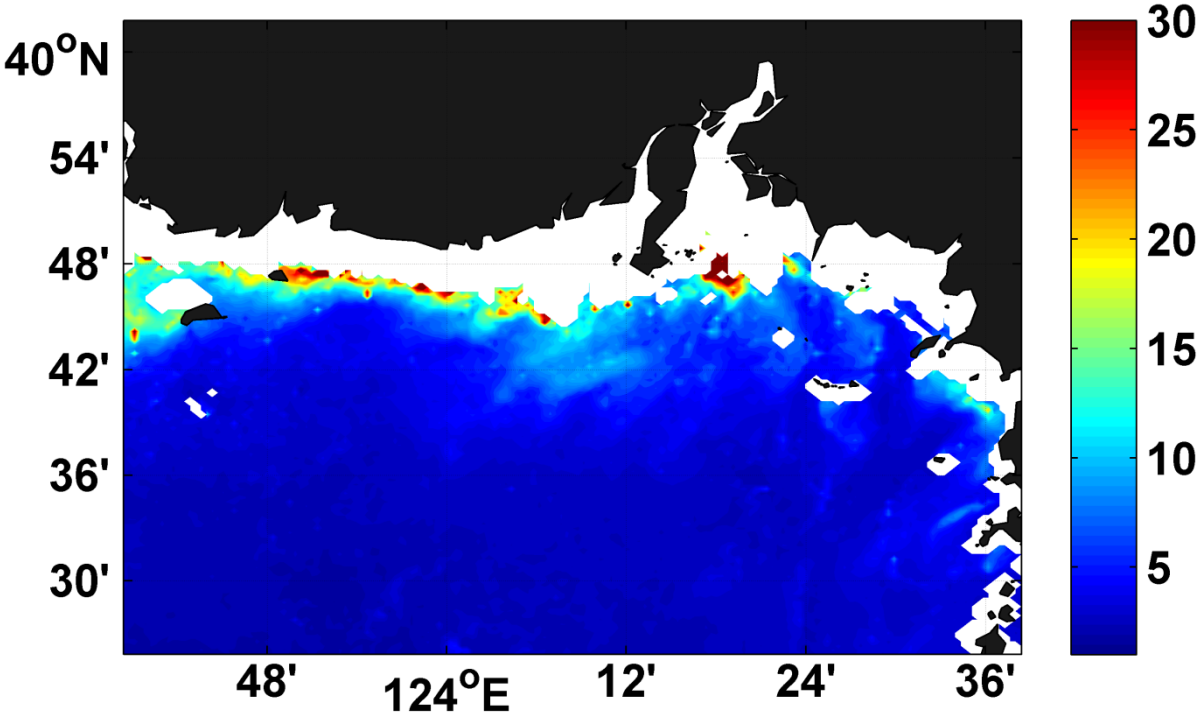
- Introduction
- Data & Methodologies
- Results
- **Limitation of GOCI data**
- GOCI-II

The limitation of data coverage in coastal

Standard atmospheric correction algorithm of GOCI is basically the same one applied for SeaWIFs which is for open ocean and does not perform well in coastal area.

The current **cloud-masking** of GOCI is too tight.

Cloud detection of GOCI



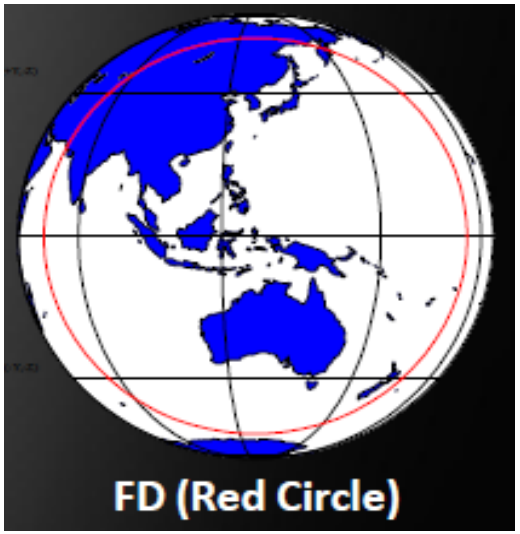
	M	M	M	
M	M	M	M	M
M	M	M	M	M
M	M	M	M	M
	M	M	M	

Fig. 12. Example(2014-06-08).

Contents

- Introduction
- Data & Methodologies
- Results
- Limitation of GOCI data
- **GOCI-II**

GOCI-II [Ryu,KOSC]



- GOCI-II is focused on the coastal and global ocean environment monitoring with better spatial resolution **(300m)** and spectral performance for the succession and expansion of the mission of GOCI.
- GOCI-II will be launched in **2018**.
- GOCI-II will have **13 spectral bands** and perform observations 8 times daily.
- The main difference between GOCI-II and GOCI is the **global-monitoring** capability which can cover both local area and full disk area. Daily global observation once is planned for GOCI-II. [Ryu, KOSC].

- **Choi J.-K.,** Park, Y. J., Ahn, J. H., Lim, H. -S., Eom, J., & Ryu, J. -H. 2012, GOCI, the world's first geostationary ocean color observation satellite, for the monitoring of temporal variability in coastal water turbidity. Journal of Geophysical Research, Vol.117, C09004.
- **Ryu J.-H.,** Han H.-J., Cho S., Park Y.-J., and Ahn Y.-H. 2012, Overview of Geostationary Ocean Color Imager (GOCI) and GOCI Data Processing System (GDPS).Ocean Sci. J. Vol.47 No.3 pp.223-233.

Thank you!

UNSW
THE UNIVERSITY OF NEW SOUTH WALES