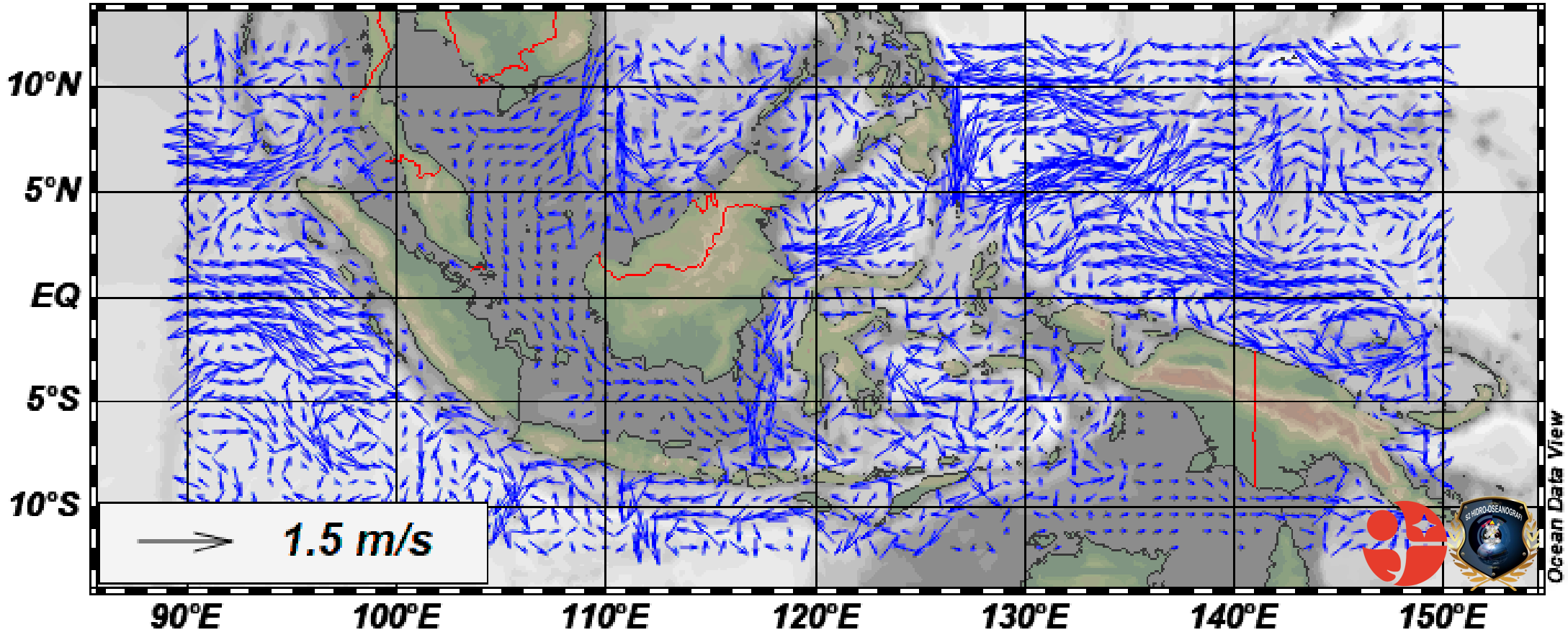
WHY WE NEED TO MONITORING EDDY CURRENTS VARIABILITY IN THE INDONESIAN SEAS: TOWARDS NATIONAL COLLABORATION BETWEEN MET-OCEAN RESEARCH AND OPERATIONAL INSTITUTIONS

World Meteorological Organization & Intergovernmental Oceanographic Commission of UNESCO
Data Buoy Cooperation Panel Thirty Eighth Session
Hybrid meeting, 1 - 4 November 2022

Widodo Setiyo Pranowo, Albertus Sulaeman, Nugroho Dwi Hananto, Nelly Florida Riama, Andri Ramdhani, Furqon Alfahmi, Nurhidayat, Johar Setiyadi, Erma Yulihastin, Noir Primadona Purba, Angga Ferdyan, Ivonne Milichristi Radjawane

Sea Surface Current in Indonesian Seas



The complexity of its ocean circulation is generated by:

- *Bathymetric features*
- *Coastlines*
- *Tidal*
- *Monsoonal winds*
- *River discharges*
- *Ocean teleconnections (ENSO & IOD)*

Continuity equation

$$\frac{\partial h}{\partial t} + \nabla \cdot (\vec{v}(h+H)) = 0$$

Momentum equation

$$\frac{\partial \vec{v}}{\partial t} + (\vec{v} \cdot \nabla)\vec{v} + f \times \vec{v} + g\nabla h + \frac{C_d \vec{v}|\vec{v}|}{\rho(h+H)} - \nabla \cdot (A_h \nabla \vec{v}) = 0$$

Advection term
Coriolis term
"Pressure gradient"
Bottom friction
Viscosity term

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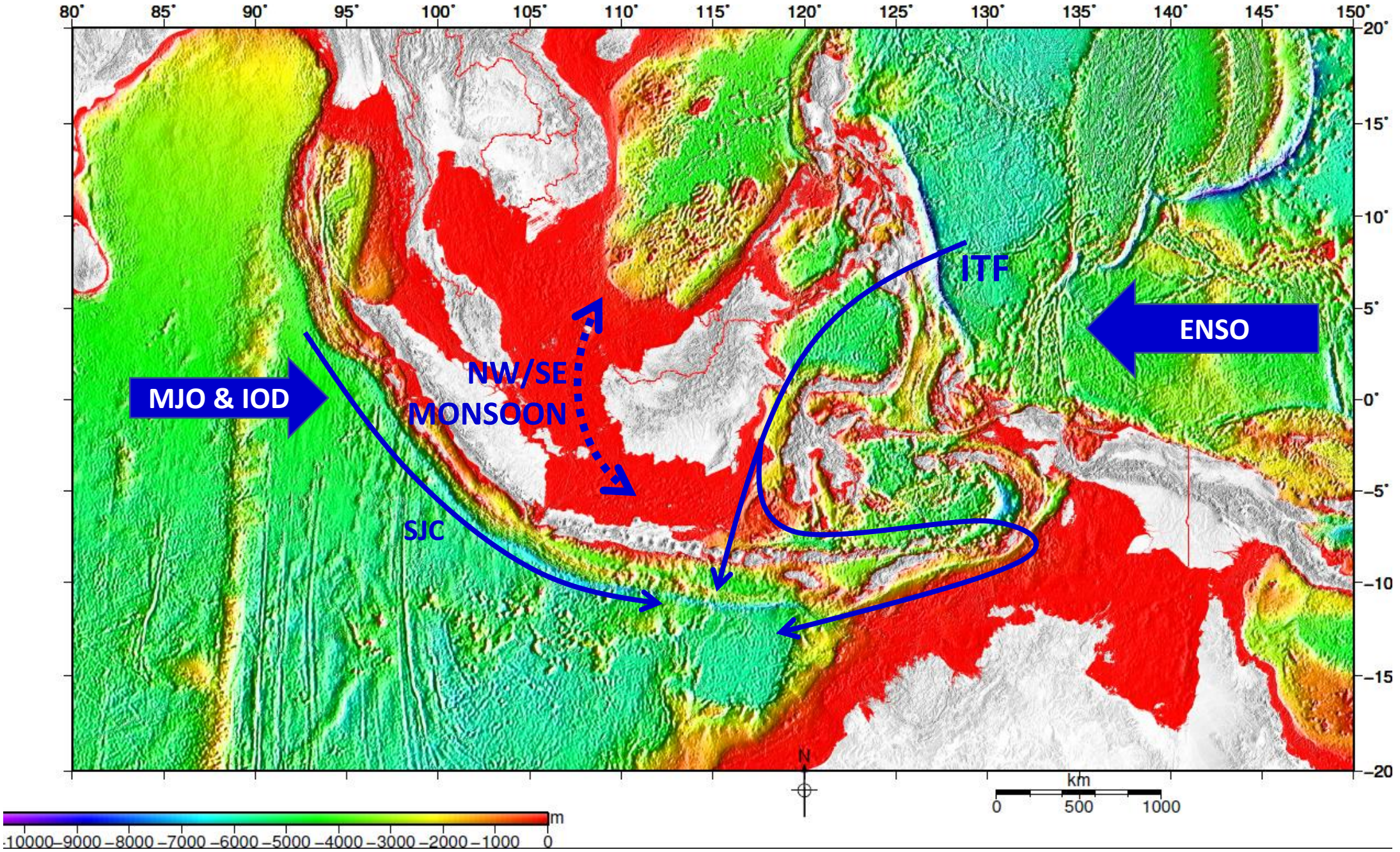

Bathymetry GEBCO 30 arcsec

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INDONESIAN THROUGH-FLOW (ITF)

Gordon et al., GRL, Vol. 39, L11602, 2012

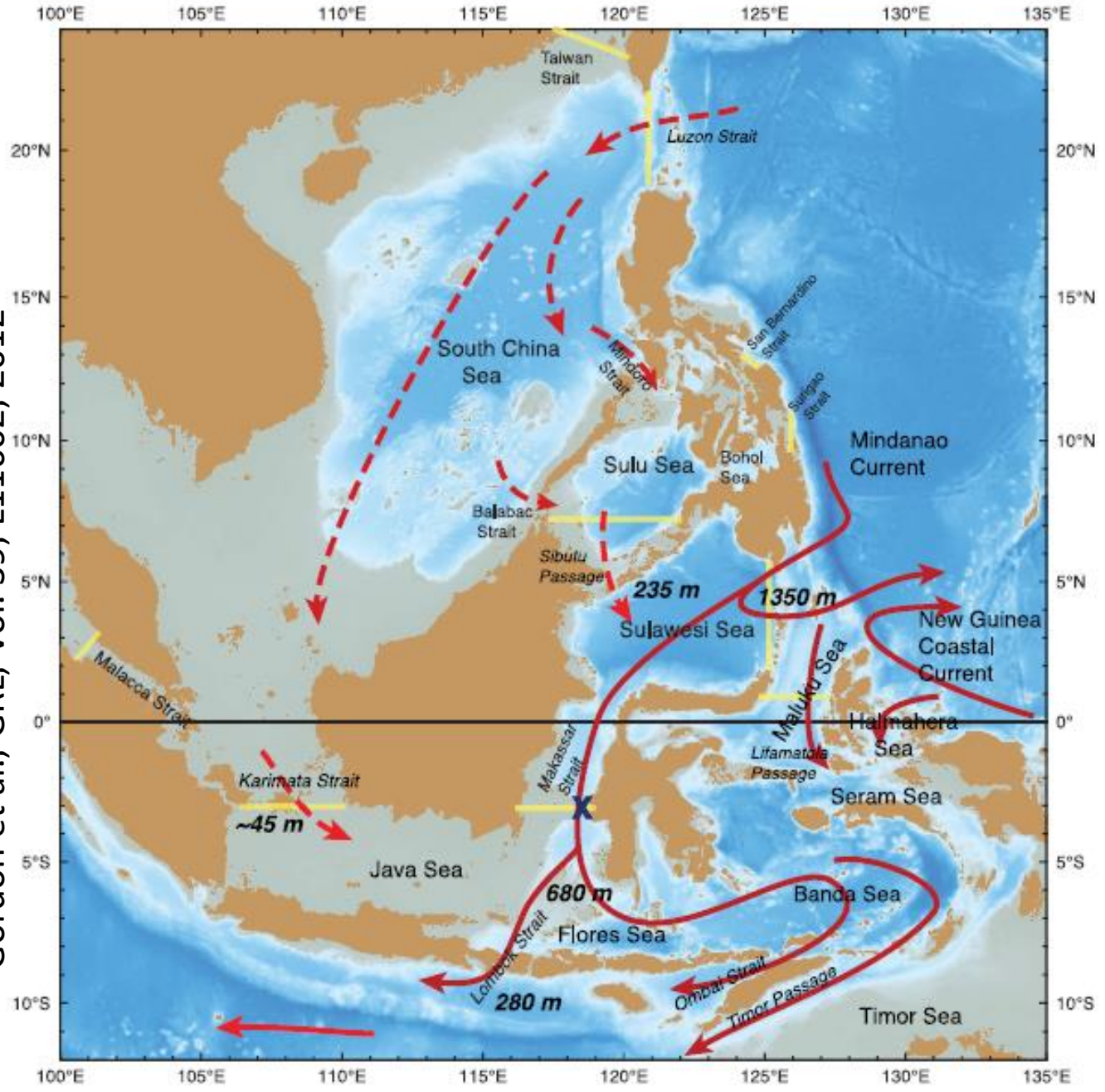
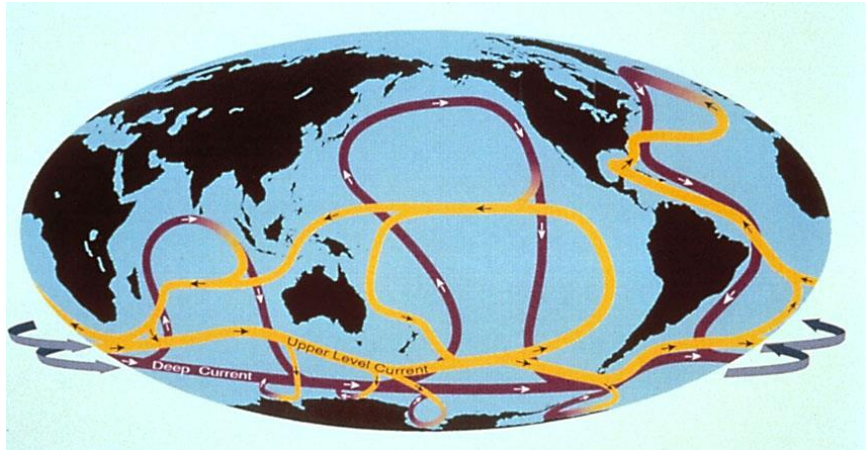


Figure 1. Schematic of the South China Sea throughflow (dashed red arrows) and the Indonesian throughflow (solid red arrows) circulations. Topographic sill depths are given in black italics. The X indicates Makassar Strait mooring site.



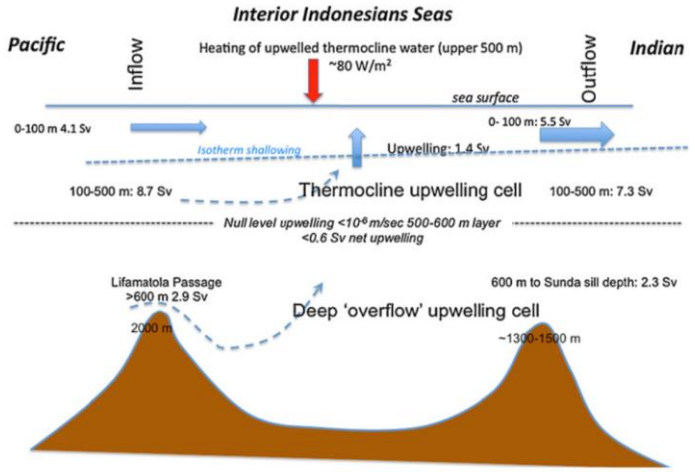


Fig. 4. Schematic of the Indonesian Throughflow inflow/outflow pattern within the interior Indonesian Seas and resulting upwelling inferred from the 2004–2006 INSTANT observations.

Gordon, A., J. Sprintall, H. M. Van Aken, D. Susanto, S. Wijffels, R. Molcard, A. Ffield, **W. Pranowo**, & S. Wirasantosa. **2010**. **The Indonesian Throughflow during 2004-2006 as observed by the INSTANT program**, *Dyn. Atmosph. Ocean*, 50(2): 115-128. doi:10.1016/j.dynatmoce.2009.12.002.

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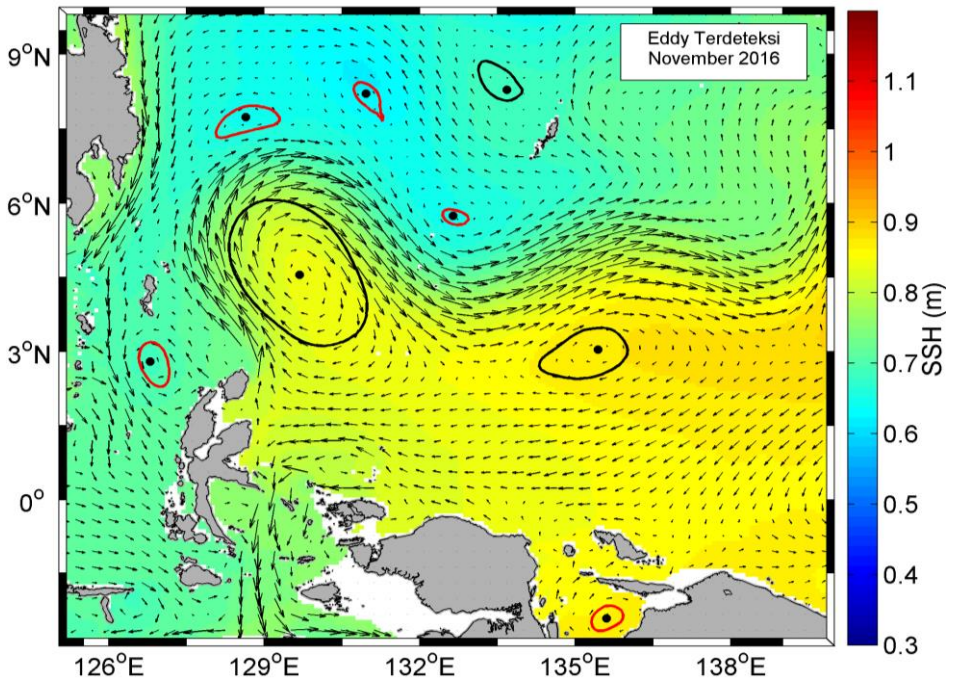
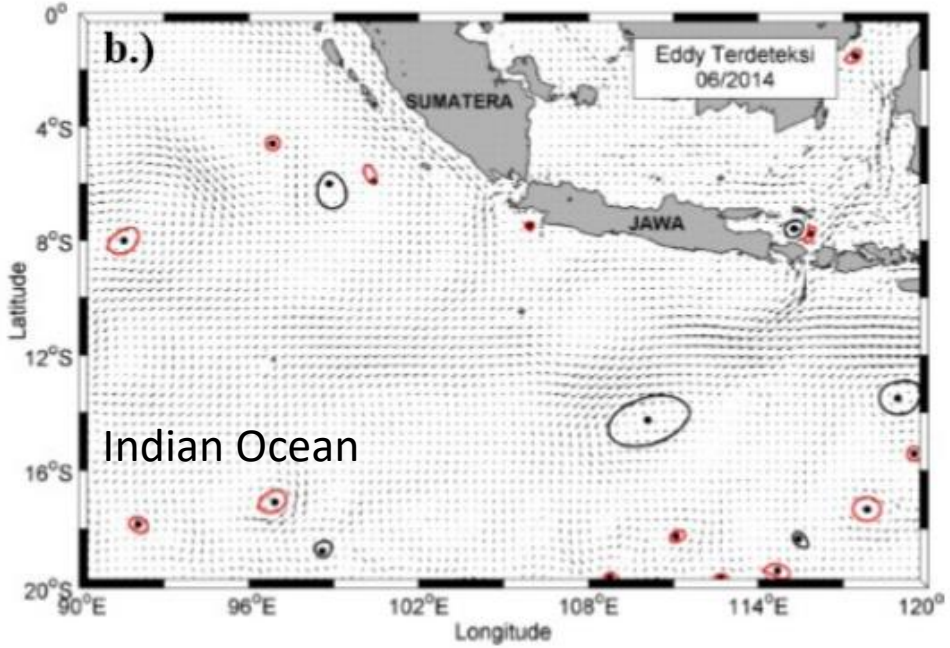


Northern Hemisphere

Red Circle	: Cyclonic Eddies Current ***Counter clockwise***
Black Circle	: Anti-cyclonic Eddies Current ***Clockwise***

*Y.A. Simanungkalit, **W.S. Pranowo**, N.P. Purba, I. Riyantini, Y. Nurrahman.: **Influence of El Nino Southern Oscillation (ENSO) phenomena on eddies variability in the Western Pacific Ocean**. IOP Conf. Ser.: Earth Environ. Sci. 176 (1): 012002. **2018**. doi: 10.1088/1755-1315/176/1/012002.*



Southern Hemisphere

Red Circle	: Cyclonic Eddies Current ***Clockwise***
Black Circle	: Anti-cyclonic Eddies Current ***Counter Clockwise***

***Pranowo, W.S.**, A. Tussadiah, M.L. Syamsuddin, N.P. Purba, I. Riyantini.: **Karakteristik dan Variabilitas Eddy di Samudera Hindia Selatan Jawa**. J. Segara 12(3): 159-165. **2016**.*

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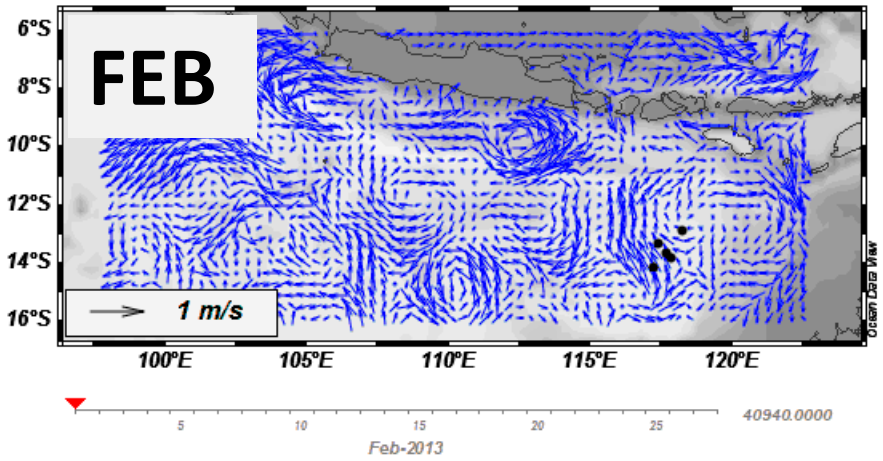

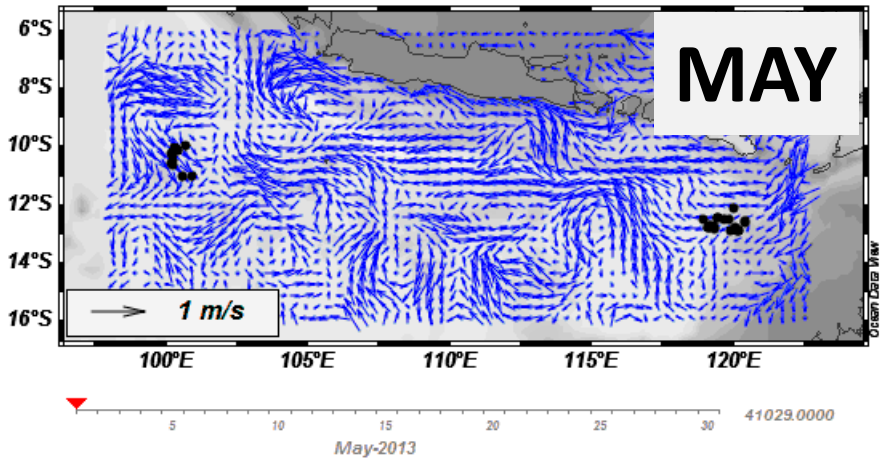

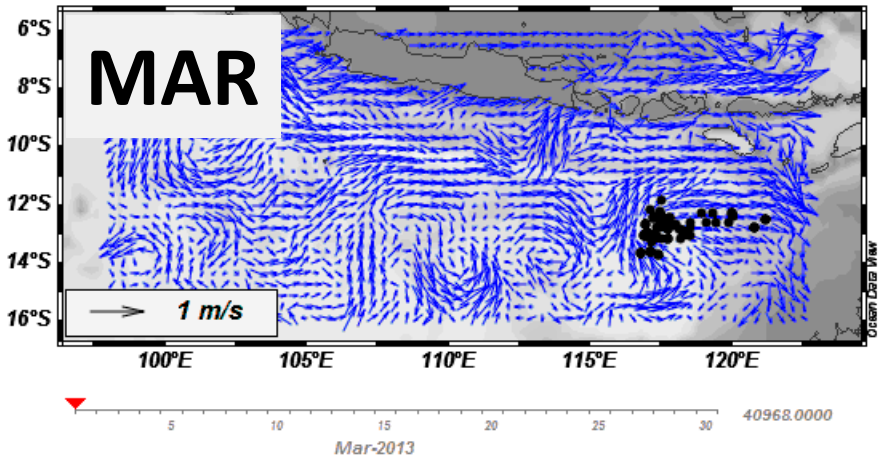

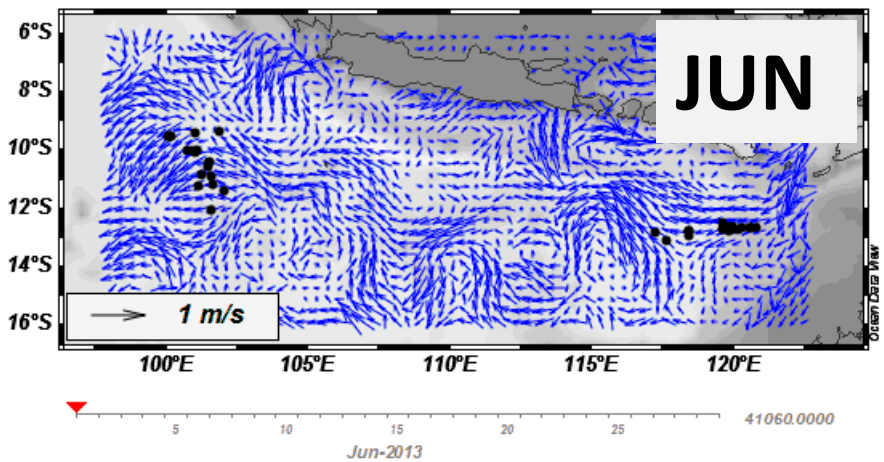

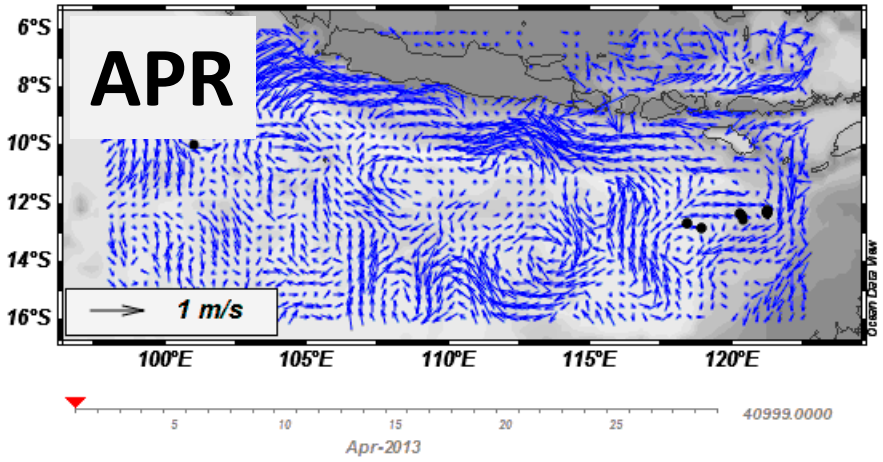

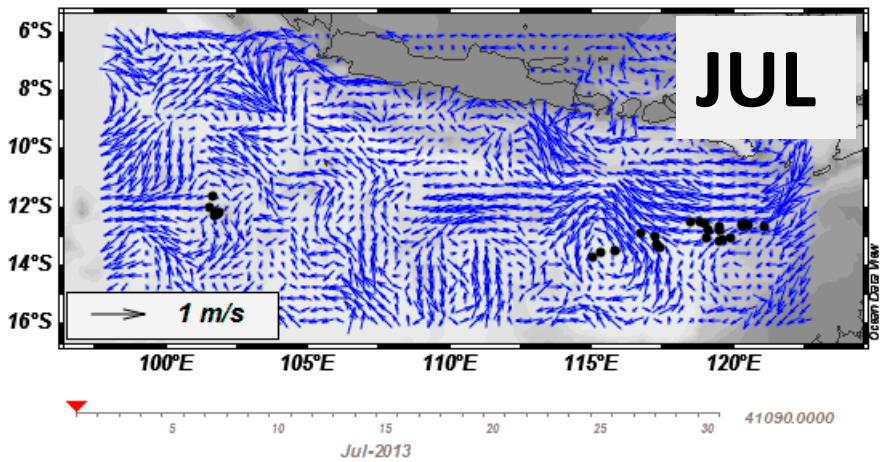

Pranowo, W.S., A.R.T.D. Kuswardani, B. Nugraha, D. Novianto, U. Muawanah, H. Prihatno, W. Yu.: **Ocean-Climate Interaction of South Eastern Indian Ocean for Tuna Fisheries & Its Socio-Economy Impacts**. *International Journal of Science & Research* 5(4):1956-1961. **2016**. Paper ID: NOV163005.

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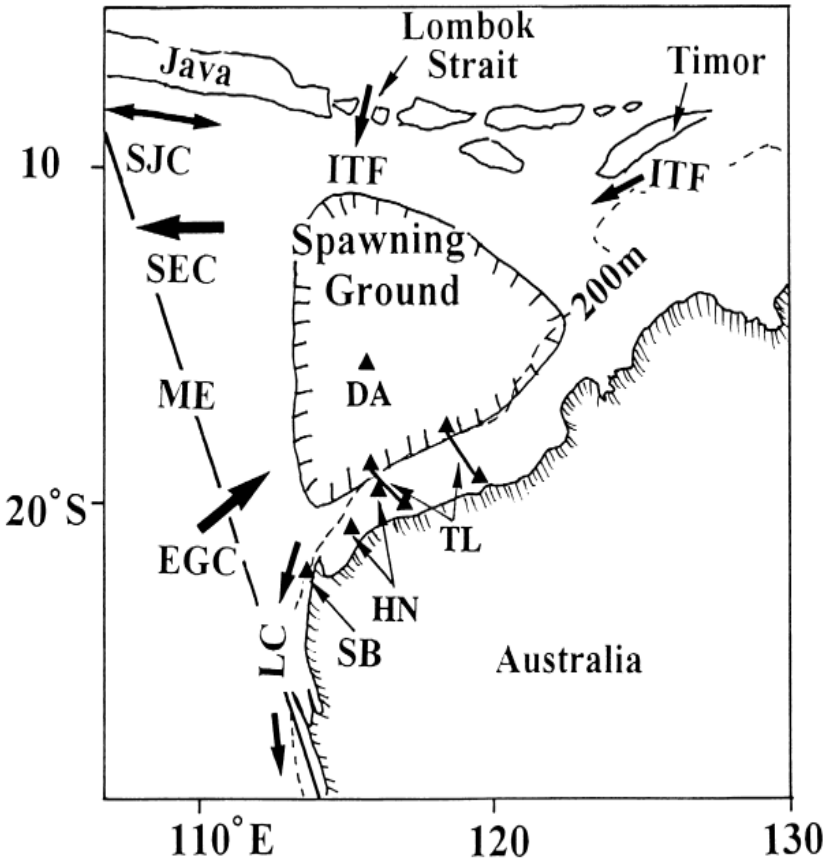
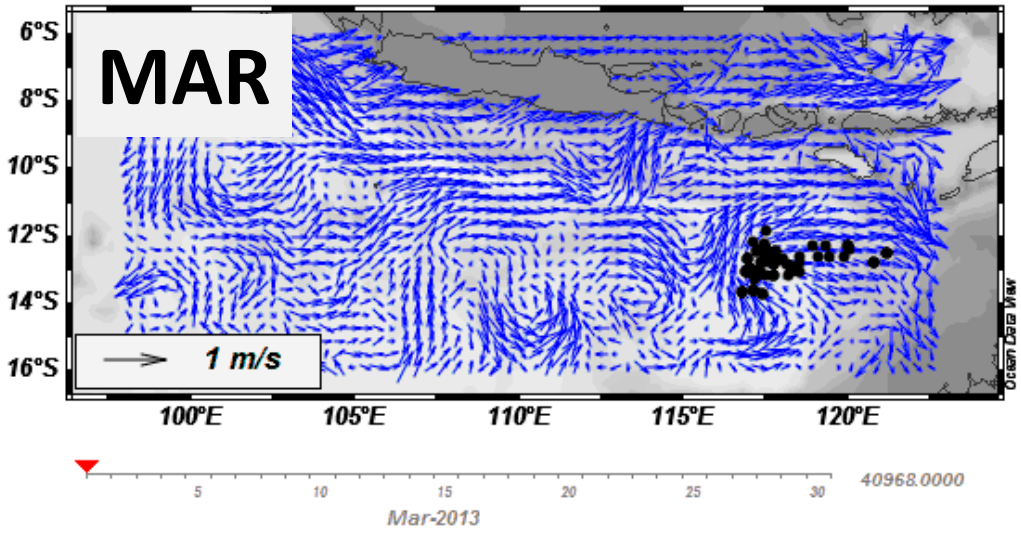
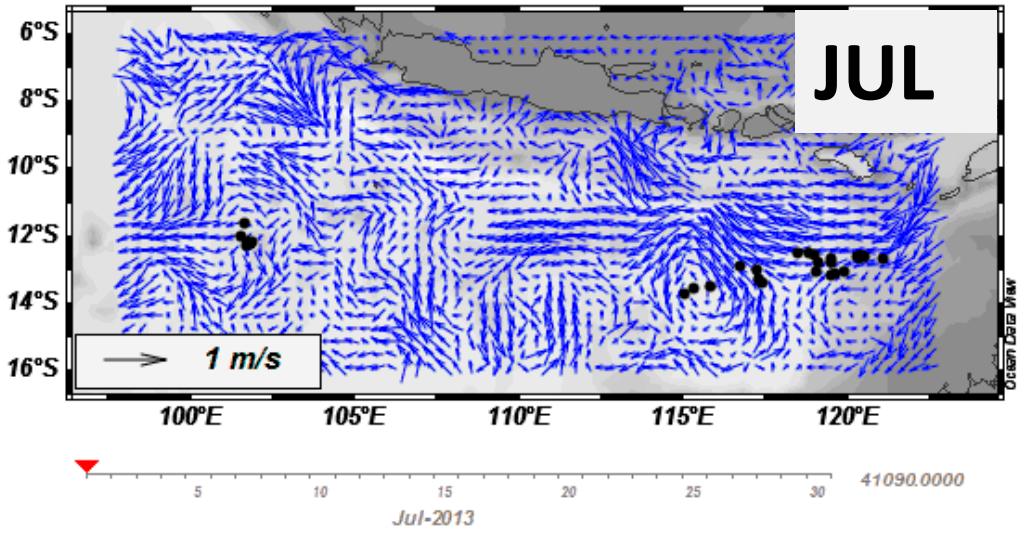


A location of the Southern Bluefin Tuna (SBT) spawning ground southern of Java-Nusa Tenggara (Matsuura et al., 1997). Thick arrows indicate major surface currents. Solid triangles and lines indicate positions of observations of past research. ITF (Indonesia Through-Flow), SJC (South Java Current), SEC (South Equatorial Current), EGC (Eastern Gyral Current), SB (Mooring), LE (Leeuwin Current), HN (Current Meter), DA (Surface Drifter), TL (CTD & Water Quality), ME (XBT).





Tuna vessels (black dots) are mostly fishing in the eddies curents zone. Coordinate tuna vessels collected by LPPT, while ocean current is derived from HYCOM archieve dataset.

Pranowo, W.S., A.R.T.D. Kuswardani, B. Nugraha, D. Novianto, U. Muawanah, H. Prihatno, W. Yu.: **Ocean-Climate Interaction of South Eastern Indian Ocean for Tuna Fisheries & Its Socio-Economy Impacts**. *International Journal of Science & Research* 5(4):1956-1961. **2016**. Paper ID: NOV163005.

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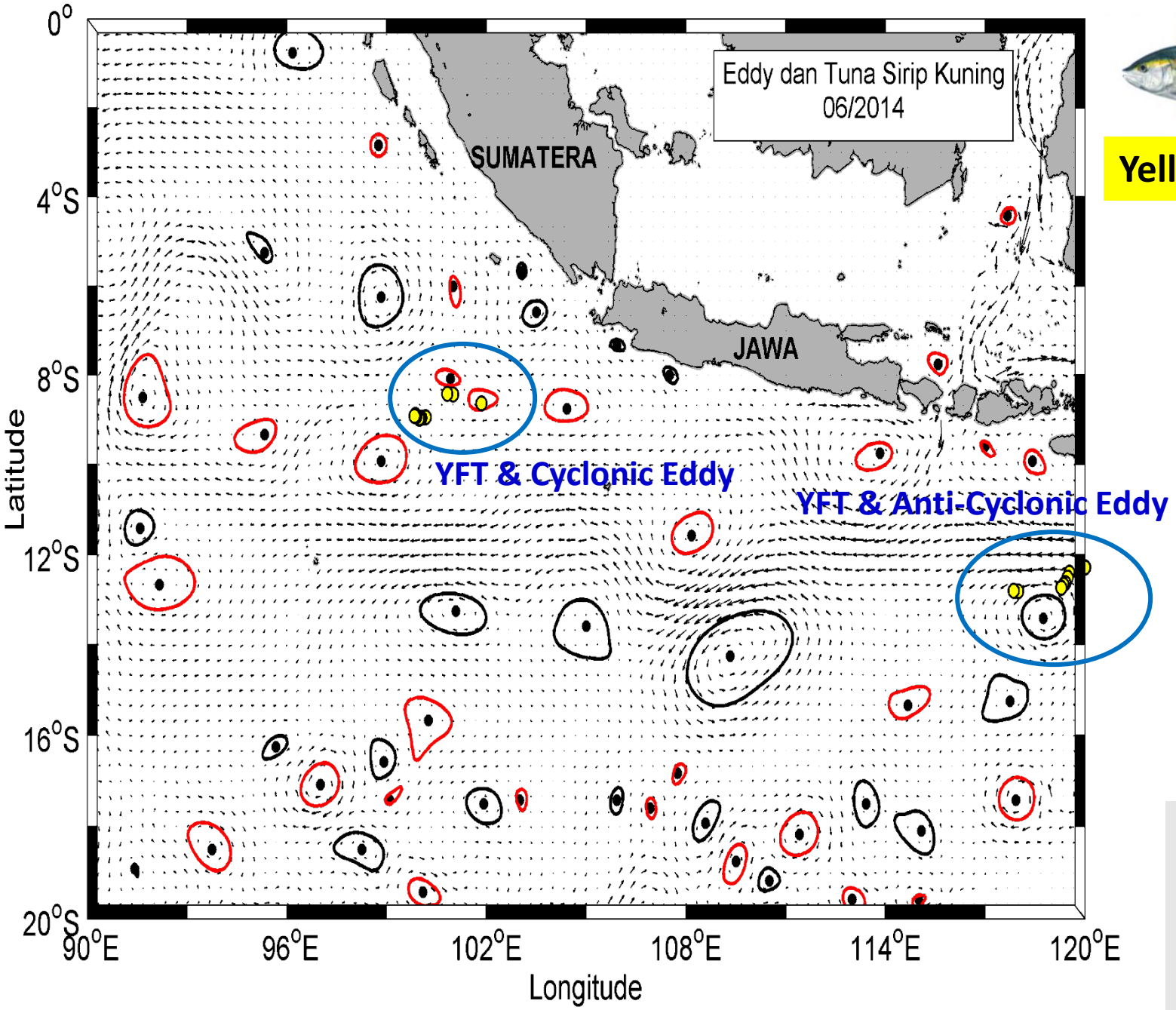

Yellow dots = Yellow Fin Tuna

A. Tussadiah, **W.S. Pranowo**, M.L. Syamsuddin, I. Riyantini, B. Nugraha, D. Novianto.: **Characteristic of eddies kinetic energy associated with yellowfin tuna in southern Java Indian Ocean**. *IOP Conf. Ser.: Earth Environ. Sci.* **176** (1): 012004. **2018**. doi:10.1088/1755-1315/176/1/012004.

Argo Float Preparation & Deployment

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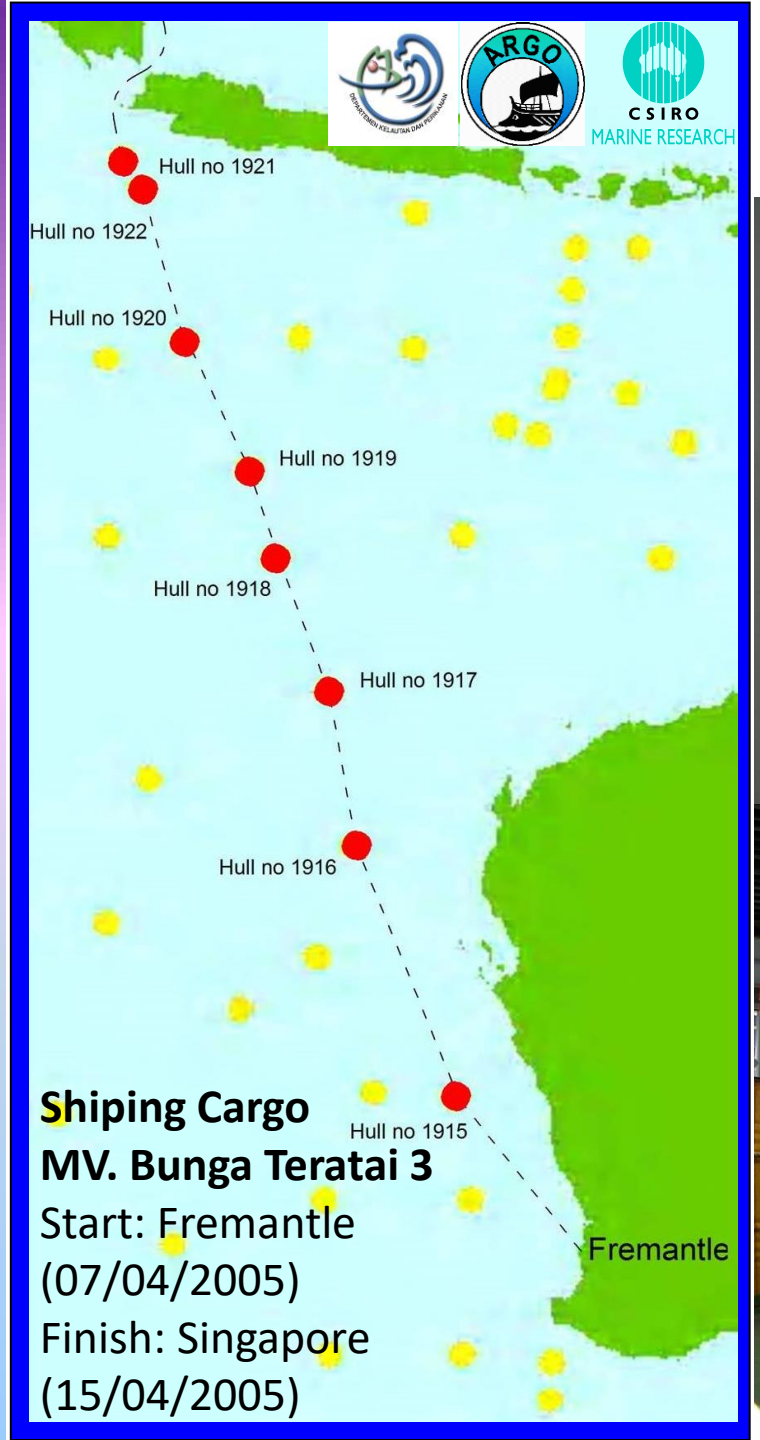

2005 @ Indian Ocean

2004 @ CSIRO Marine Labs - Hobart

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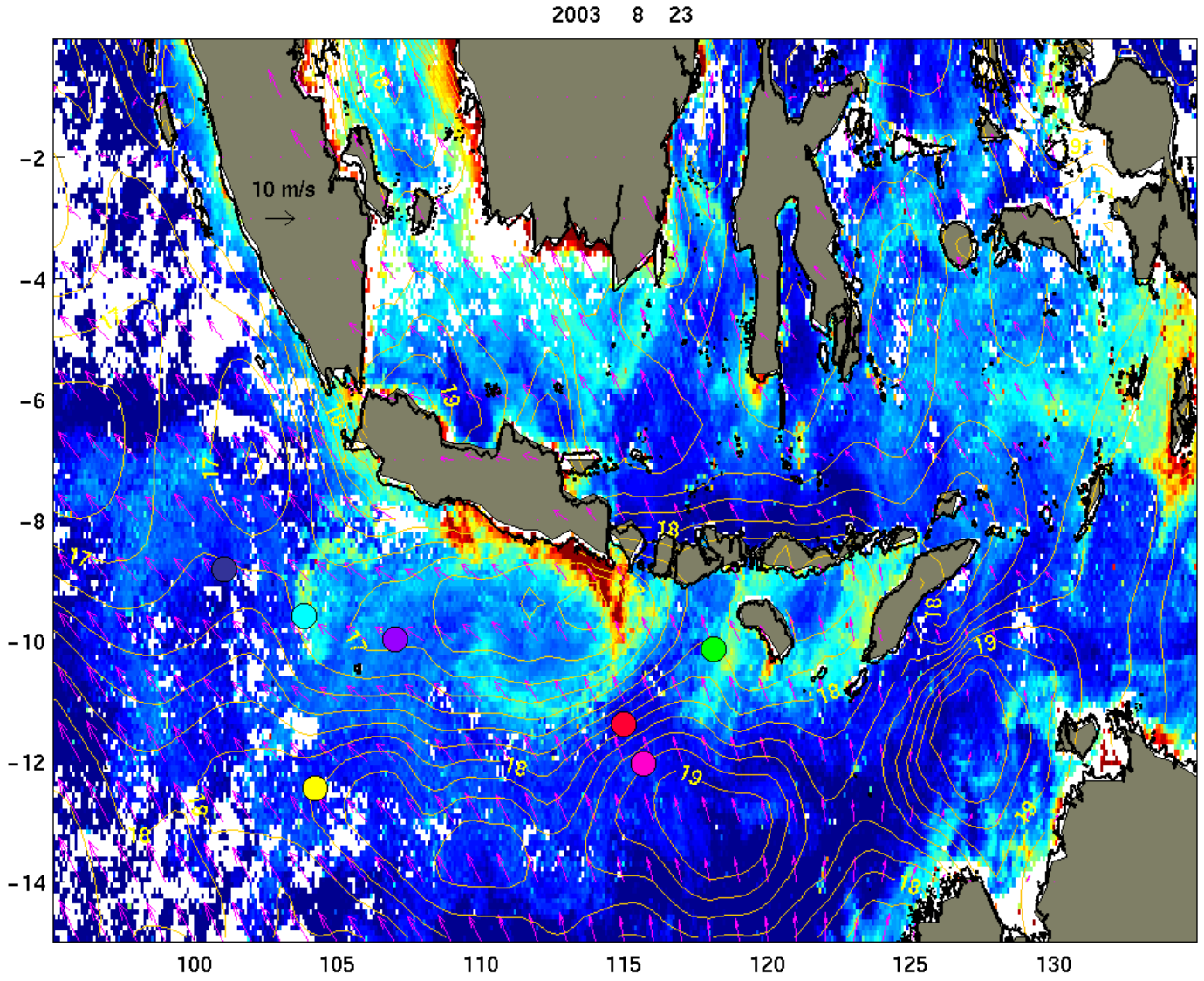
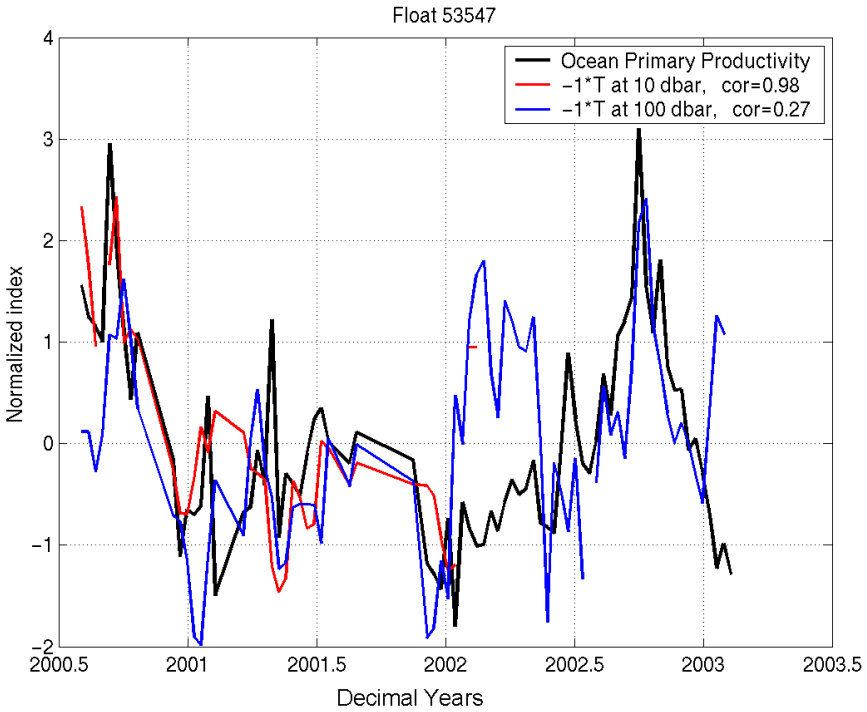
Wind, SSH, SST, Chlorophyll



Pranowo, W.S., H. Phillips, S. Wijffels. 2005. **Upwelling Event 2003 Along South Java Sea & The Sea of Lesser Sunda Islands**. *J. Segara* 1(3): 116-123.

Ocean Primary Productivity & Temperature @ ~10 m [Correlation = 0.98]



Pranowo, W.S., B. Hendrajana, A. Supangat. 2003. **Temperature & Ocean Primary Productivity Correlation in The Indian Ocean (South Java Sea)**. *The First Argo Workshop, Tokyo, Japan.*

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Gambar 3. Desain GERNED.
Figure 3. GERNED Design.

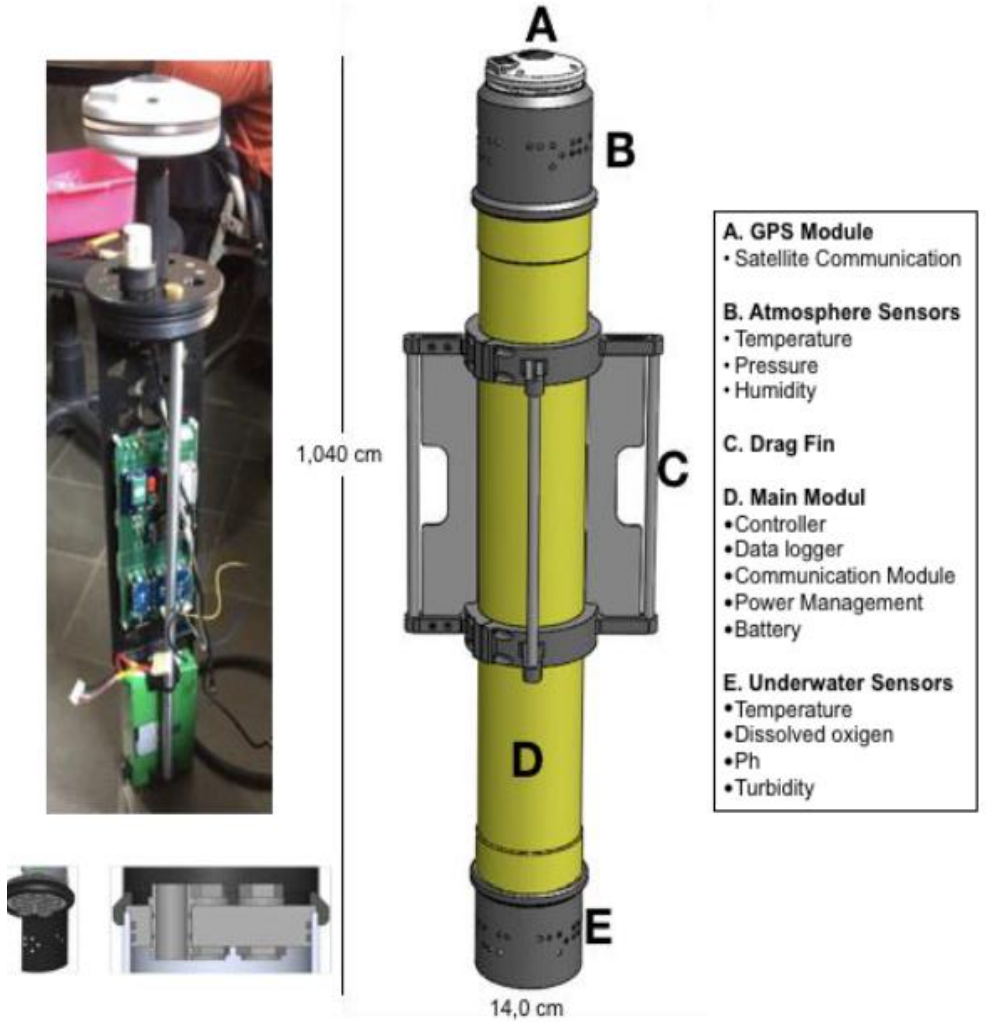

Figure 1. RHEA Design (top) sensor location, housing, and atmospheric sensor, (bottom) structure of water sensor

Noir P. Purba, S.A. Harahap, D.J. Prihadi, Ibnu Faizal, P.G. Mulyani, C.A. Fitriadi, I.F. Pangestu, P.D. Atmoko, A.Alfath, J.T. Sitio.: **Development Of Lagrangian Instrument GPS Drifter Combined (GERNED) For Ocean Observation**. *J. Kelautan Nasional* 12(3):109-116. **2016**. DOI:10.15578/jkn.v12i3.6323

Noir P. Purba, Ibnu Faizal, P.G. Mulyani, N. Prayogo, T. Prasetyo, Alexander M. A. Khan.: **Performance of Lagrangian DrifteR OceanograpHy CoverageE Area (RHEA): Second Phase**. *International Journal of Oceans and Oceanography* 13(2): 353-361. **2019**.

Conclusion Remarks

- **Eddy currents** are important because it can be **associated with upwelling** which **correlated with primary productivity** to support the fisheries sector, and it can be also **related to navigation/shipping safety**.
- Up to now, there is not any operational meteorology-oceanography existed in Indonesia that specifically monitors and provides information about the eddy currents.
- The progress that has been achieved so far is still in the level research studies of eddy current and its modeling, partial in several seas in Indonesia.
- **The national level requires collaboration among institutions and universities**. The collaboration can be conducted by releasing drifters/floats (**in South Java, West Sumatra, North Papua, Natuna Sea**), improvement the drifter/floats made in Indonesia, improvement of the eddy currents modeling, and sharing its information from drifters/floats directly to public who have an interest in activities in the Indonesian seas (**in South Java, West Sumatra, North Papua, Natuna Sea**).

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Center

Thank You
Terima Kasih

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