An operational ocean configuration on the Indonesian seas: Mid-long term performances of the biogeochemical component

Mercator Ocean — Ocean Forecasters

INDESO

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Context

➢**The INDESO solution**

- Build and operate an operational center for monitoring and forecast
- Implement an ambitious capacity building plan
- Develop result-oriented downstream applications

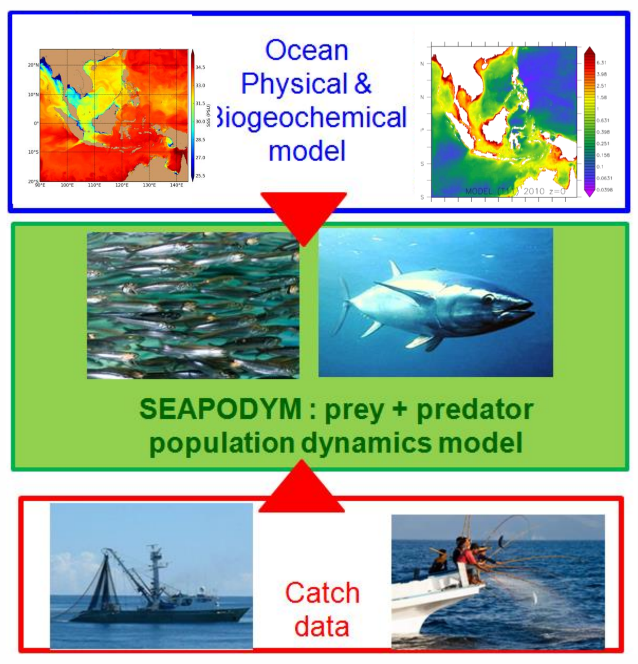
➢**In this context, an Operational Ocean Forecasting center** has been developed to undertake activities on a weekly routine basis in order to:

- Monitor the state of the Indonesian seas: ocean physics, biogeochemistry and fish population dynamics
- Assess how Indonesian seas can be healthy, safe, clean and productive

Suite of models

➢ **The Numerical models suite** consists of :

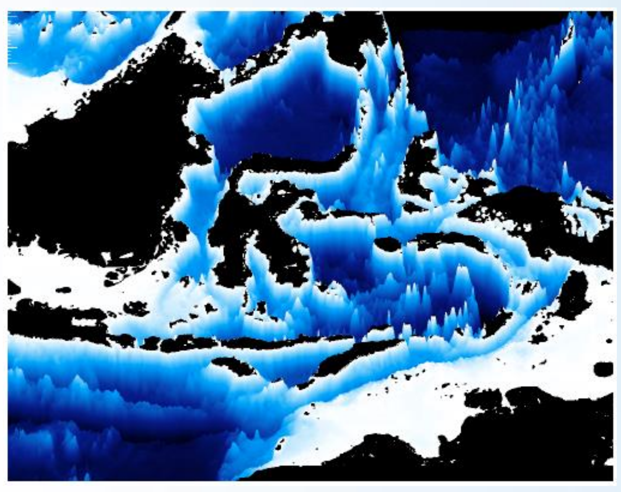
➢ocean physics,
➢biochemistry
➢fish population dynamics



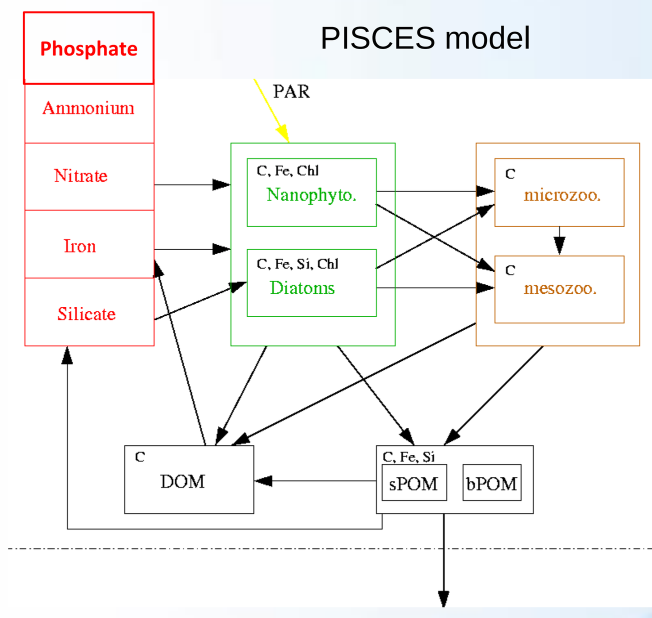
The suite of models :
→ Fully operational in Perancak (Bali) since September 2014

Physical/biogeochemical coupled model

➢**The Ocean model :**
➢Based on **NEMO2.3** for regional seas
•ORCA grid, 1/12° (9 km), 50 vertical levels, centered on Indonesian sea
•Bathymetry : ETOPO2V2g 2' + GEBCO 1' +changes in main straits
•Explicit tides
•Free surface: Explicit time-splitting
•Vertical mixing : k-ε + mixing due to waves
•Tidal mixing (Koch-Larrouy, 2007)



➢**The Biogeochemical model PISCES:**
(Aumont and Bopp, 2006)
•**marine biological productivity**.
•biogeochemical cycles of **carbon** and nutrients.
•**Dissolved oxygen content** and **carbonate system**.
•online-coupling at 1/12°



➢**Initial and Open Boundary Conditions:**
•**Physics:** 03/07/2007 + daily boundaries from the Global Ocean Forecasting System at ¼ of Mercator Ocean (PSY3V3R3)
•**Biogeochemistry:** climatologies, global models or analytical value

➢**External forcings:**
•**Atmospheric forcing** : 3h dynamic and radiative fluxes from ECMWF at 1/8°
•**Tidal forcing** : Astronomical from TPX0.7 (Egbert and Erofeeva, 2002).

Biogeochemical performances

1/ Chlorophyll-*a* variability:

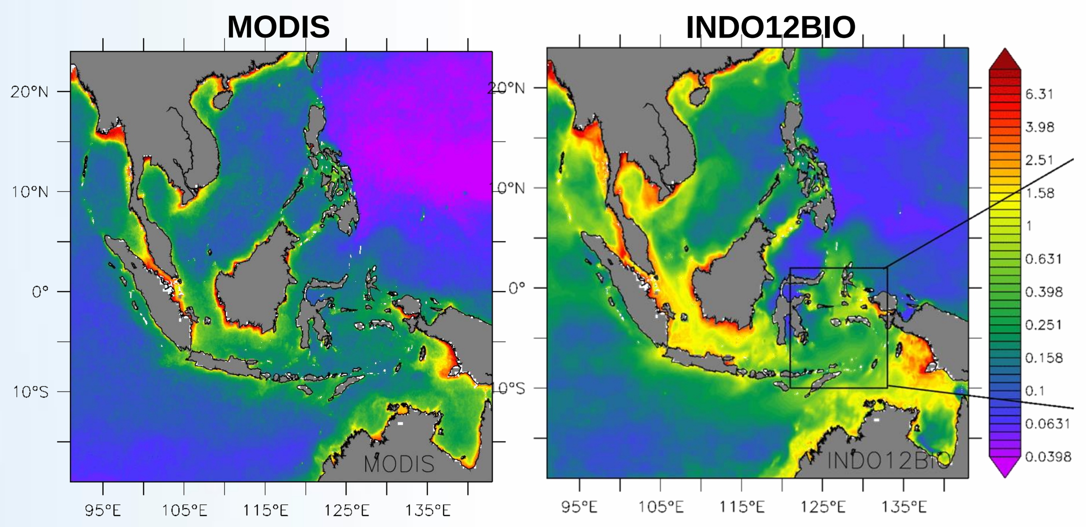


Fig. 1: Annual mean (2011) of surface chlorophyll-*a* (mg Chl m^{-3}).

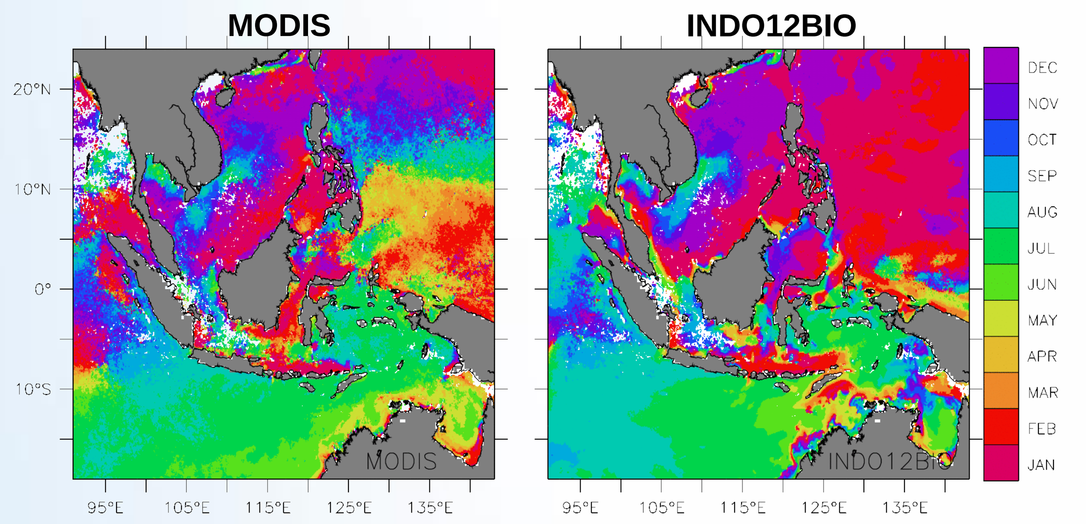
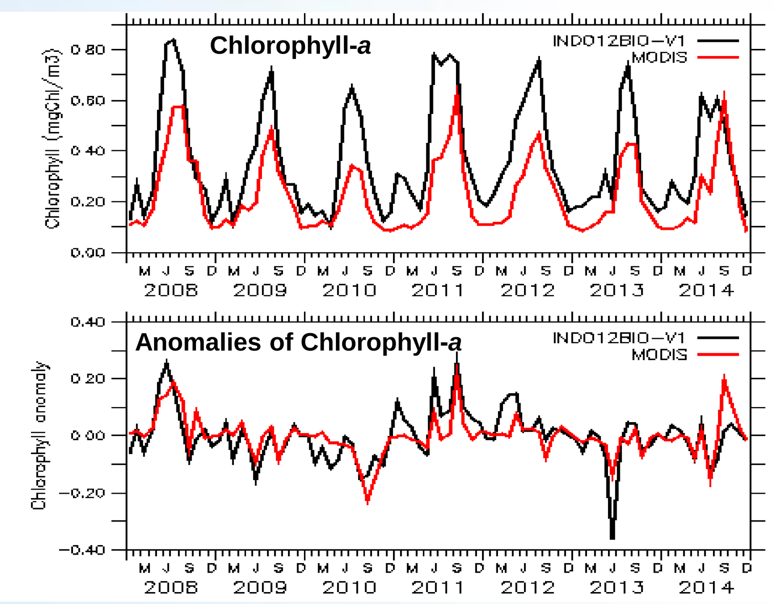


Fig. 2: Month of surface chlorophyll-*a* maximum.



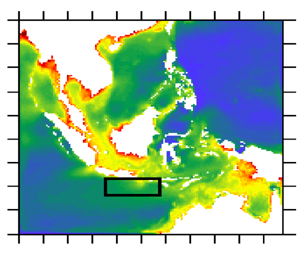


Fig. 3: Surface chlorophyll-*a* on Sunda area, and anomaly (monthly mean – monthly climatology).

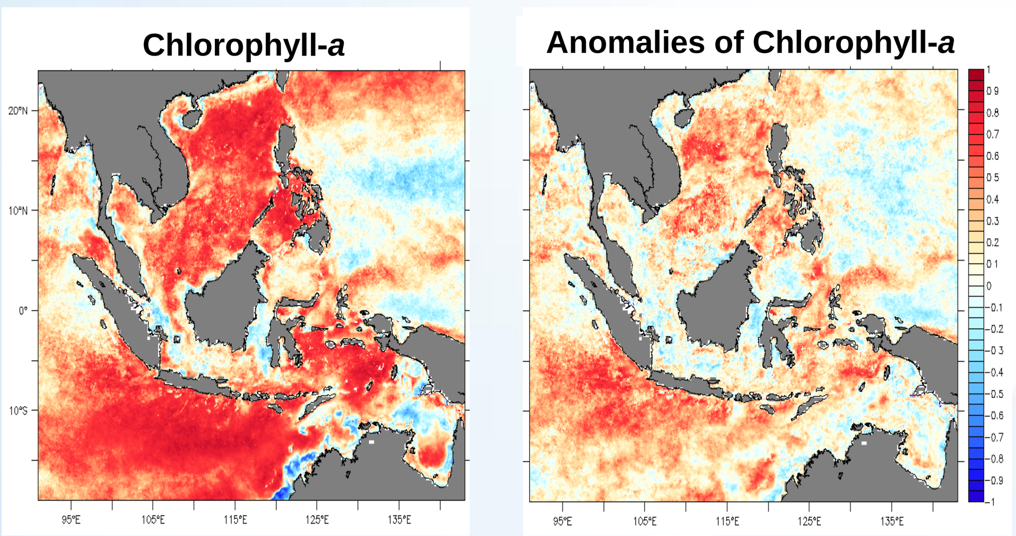


Fig. 4: Temporal correlation between the INDO12BIO and MODIS, between 2008 and 2014.

2/ Link with climate indexes (ENSO, IOD):

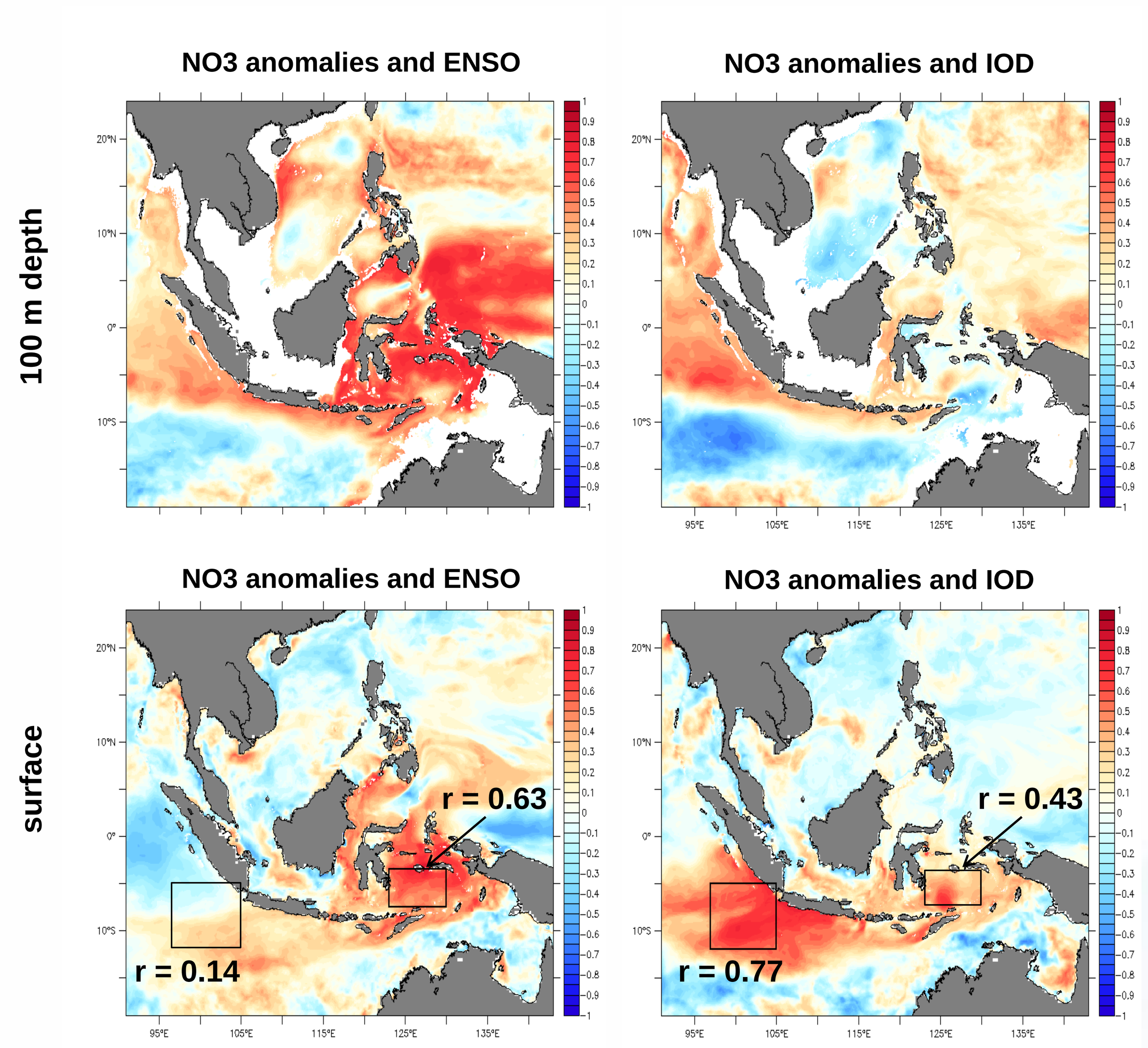


Fig. 5: Temporal correlation between anomalies of nitrate and ENSO (left), and IOD (right) indexes at 100m and to the surface, between 2008 and 2014.

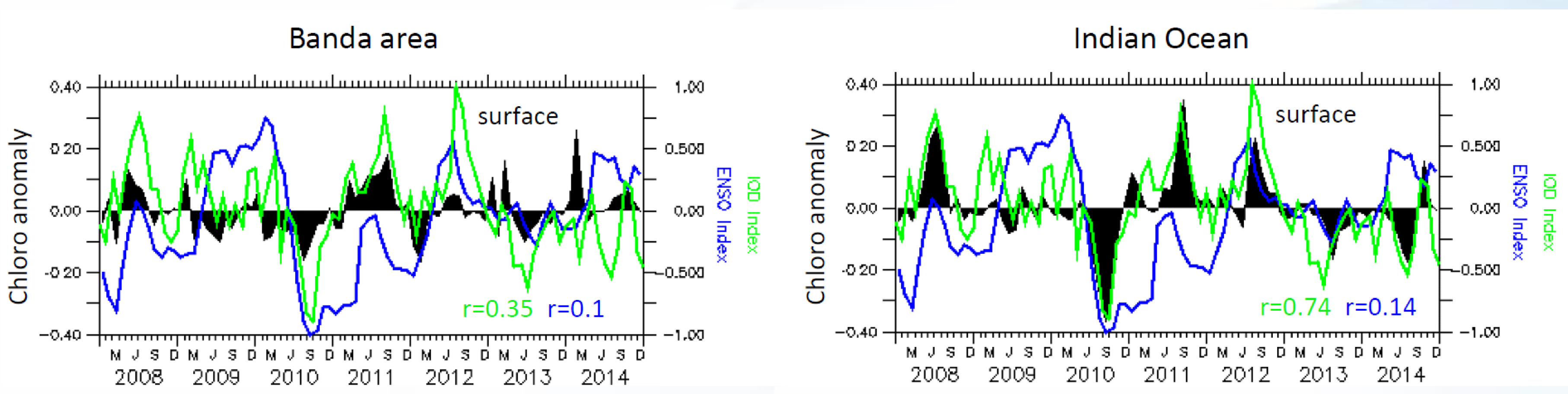


Fig. 6: Anomalies of chlorophyll-*a* at the surface on Banda (left) and Indian (right) areas. ENSO index is in blue, IOD in red.

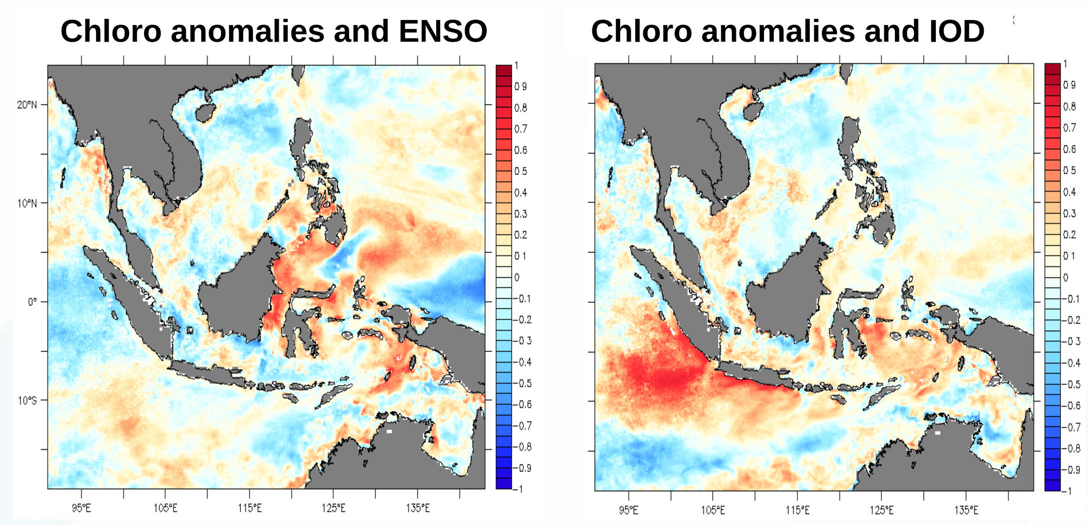


Fig. 7: Temporal correlation between the anomalies of chlorophyll-a and ENSO (left), IOD (right) indexes, between 2008 and 2014.

Same correlation using MODIS ocean colour product.

Seasonal cylce and interannual variations of chlorophyll-a
→ in agreement with satellite observations (amplitude and phase)
Expect in Pacific part

Seasonal cycle
→ driven by the monsoon system

Interannual variations
→ driven by climate phenomena (ENSO, IOD)

Impact of interannual phenomena onthe nutrient content:

ENSO → Western Pacific ocean (sub-surface) and Archipelago (first hundreds of meters due to vertical mixing)

IOD → Eastern Indian Ocean (first 30m)

Correlation:

Index		NO3 0m	Chloro 0m
IOD	- Indian	0.77	0.74
	- Banda	0.43	0.35
ENSO	- Indian	0.14	0.14
	- Banda	0.63	0.1

IOD :
+ index: - SST anomaly in the Eastern Indian due to stronger coastal upwelling (Java, Sumatra)
→ + NO3
→ phytoplankton bloom
→ IOD only affects the surface layer but spreads the first levels of the food chain

ENSO:
- affects hundreds of meters of the water column (nitracline in the Pacific, and up to surface in the archipelago due to mixing)
- But no straight effect on chlorophyll-a

Quid limitation by another nutrient ?

KEMENTERIAN KELAUTAN DAN PERIKANAN

CLS — COLLECTE LOCALISATION SATELLITES