

Modelling the stratification and circulation in a shallow embayment off Peru: the case of Paracas bay

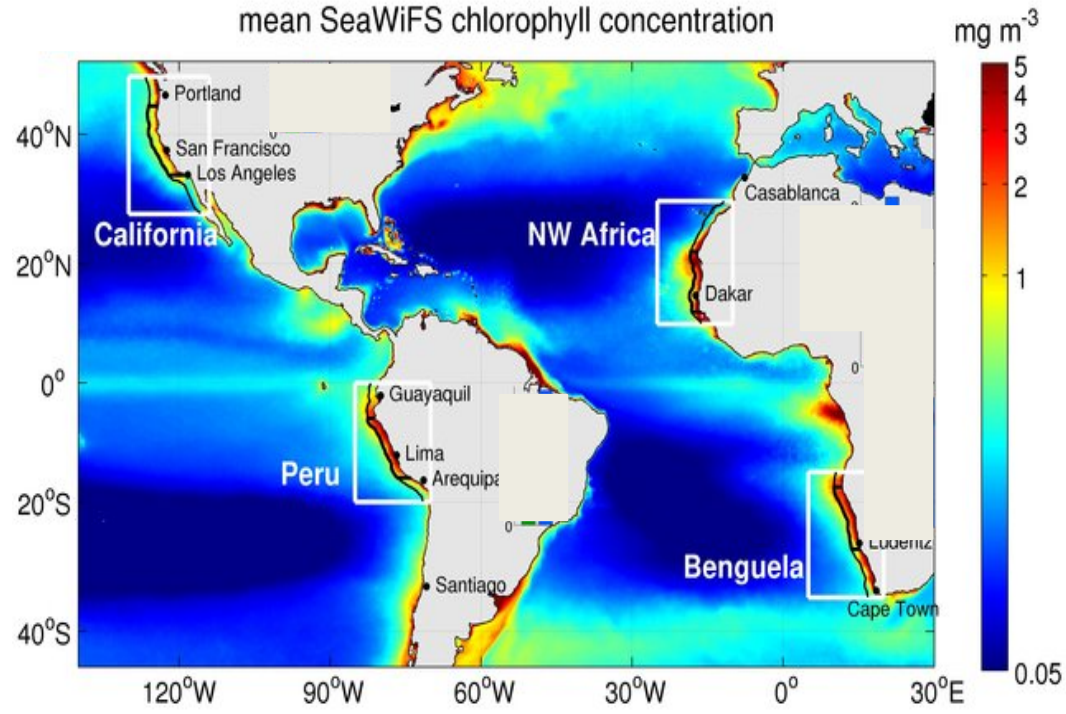
Cinthia Arellano, Vincent Echevin, Adolfo Chamorro, Lander Merma, Dimitri Gutierrez, Jorge Tam and Francois Colas

LOCEAN-IPSL, IRD/Sorbonne Université/CNRS/MNHN, Paris, France
Instituto del Mar del Peru (IMARPE)

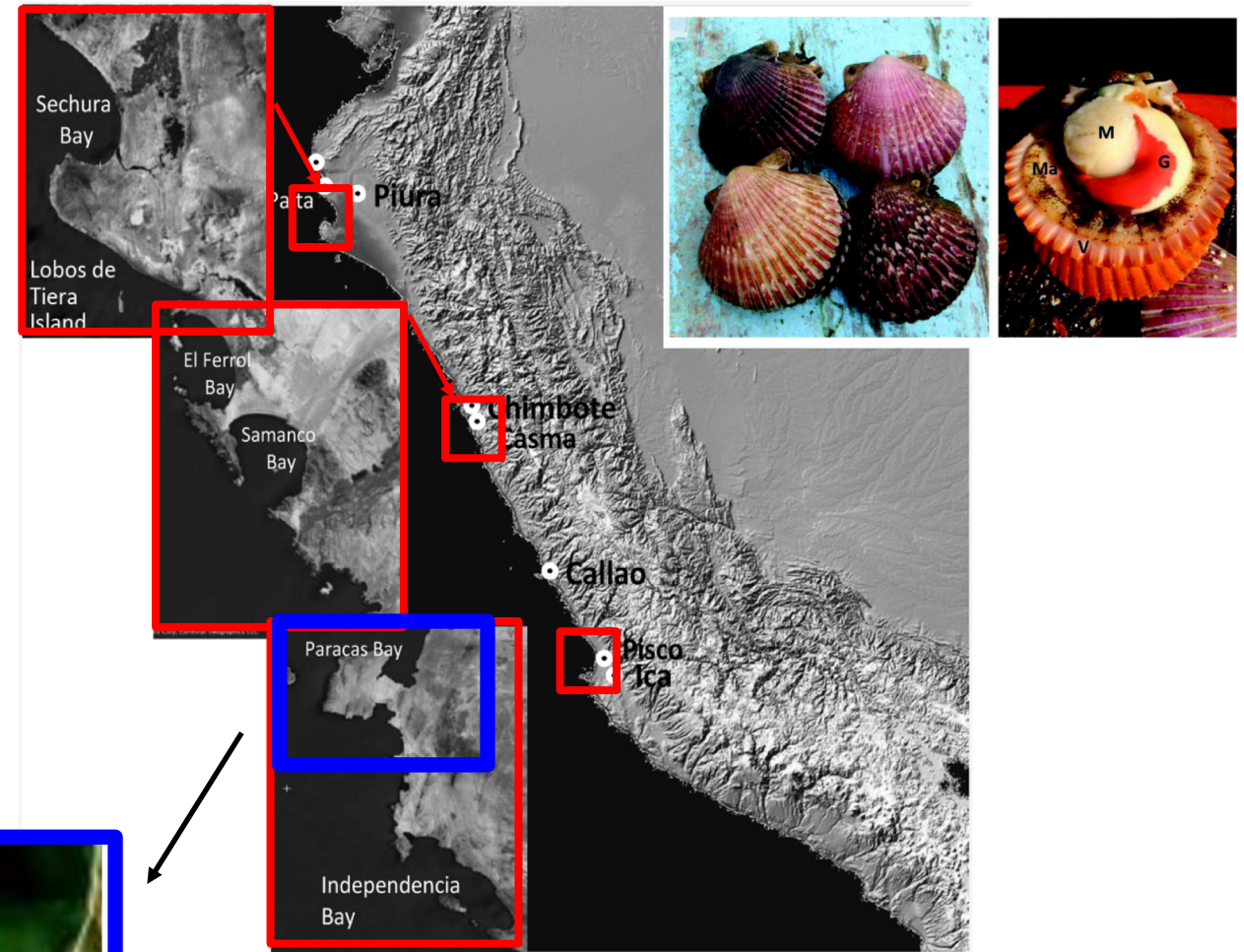
Peruvian upwelling

One of the most productive EBUS

mean SeaWiFS chlorophyll concentration



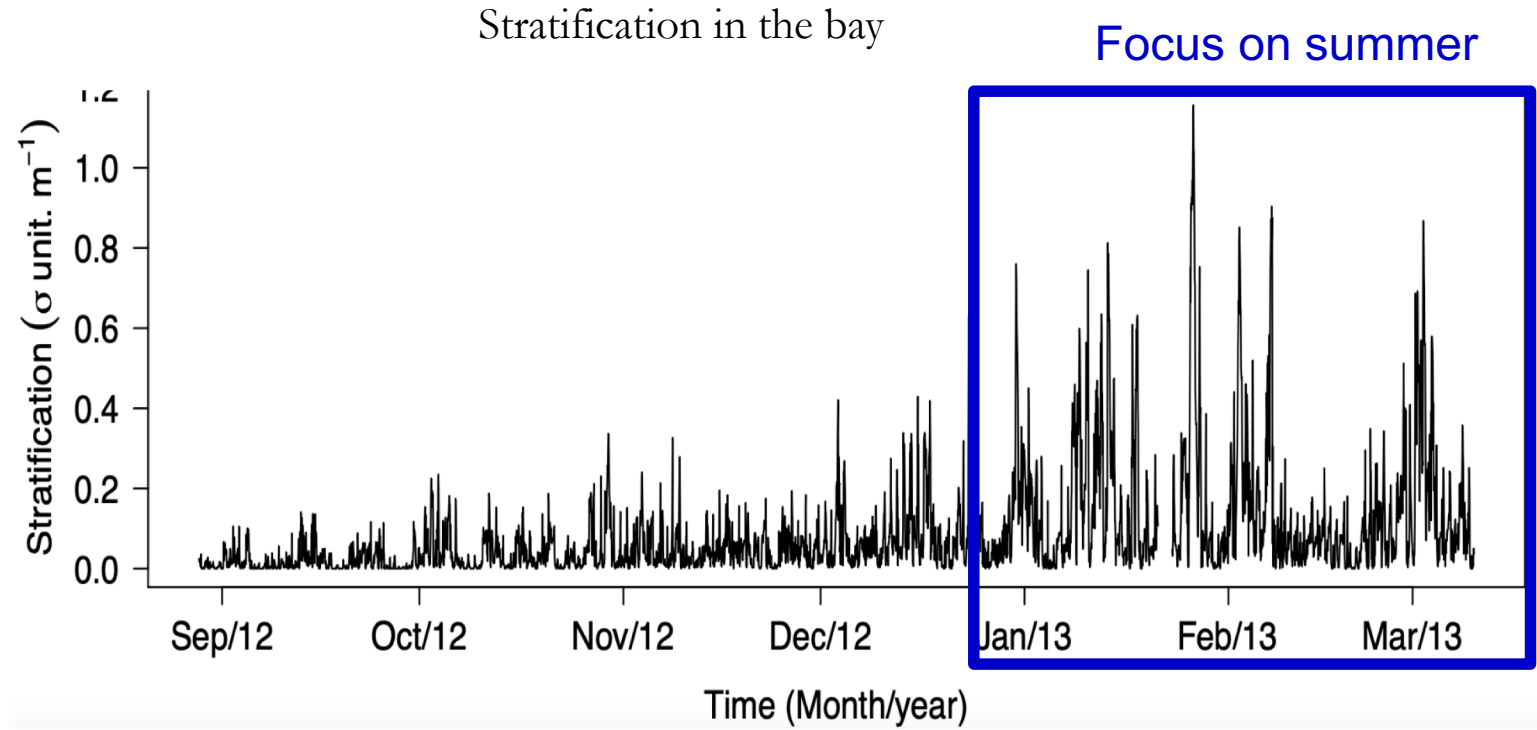
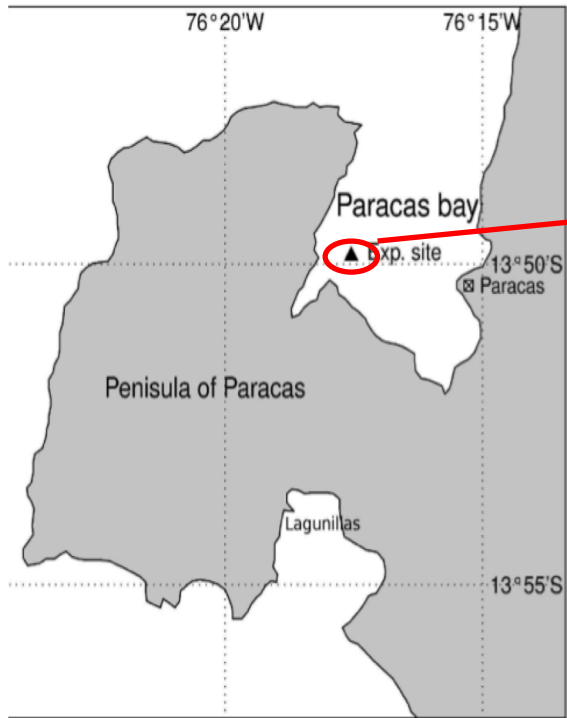
Messié & Chavez (2014)



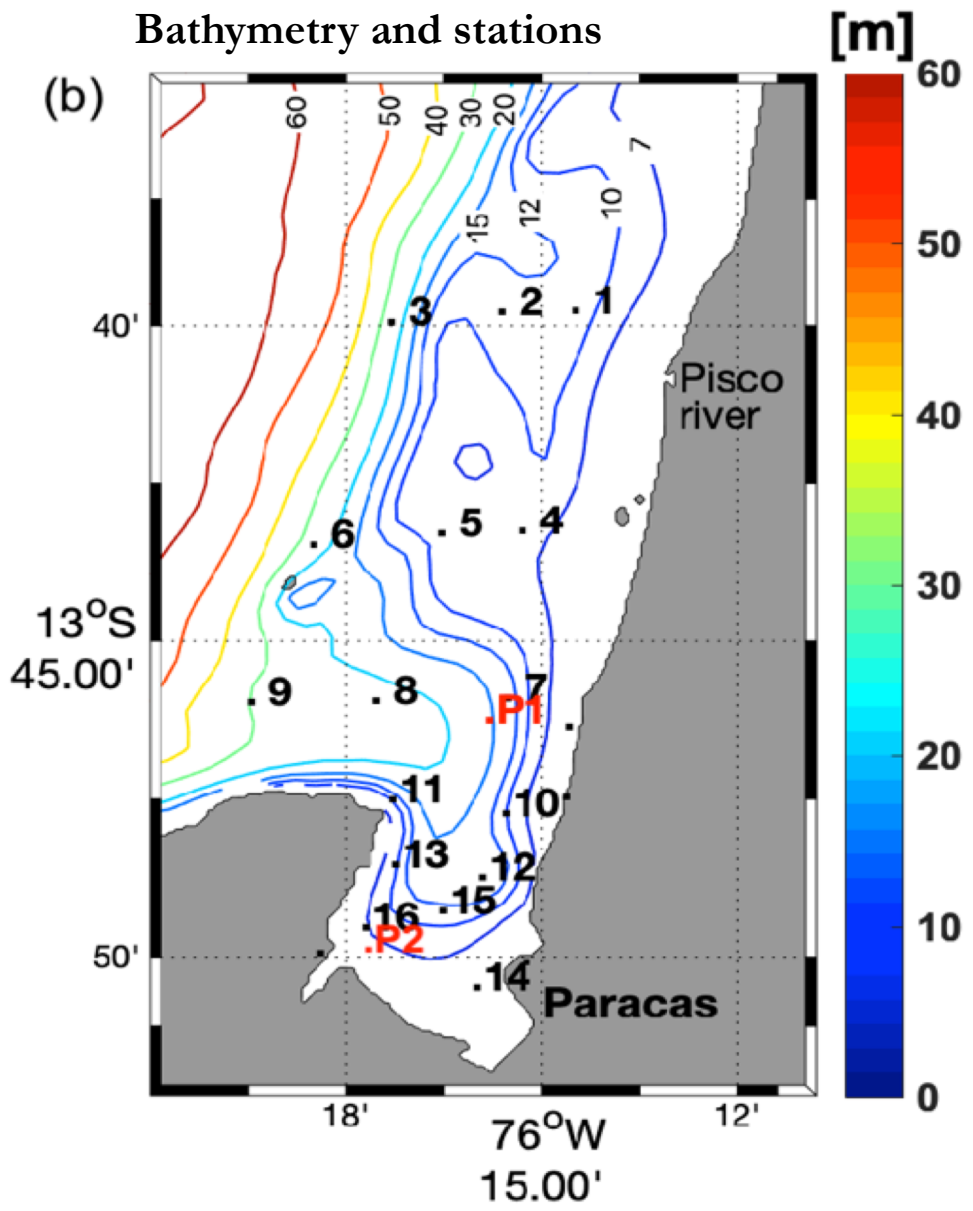
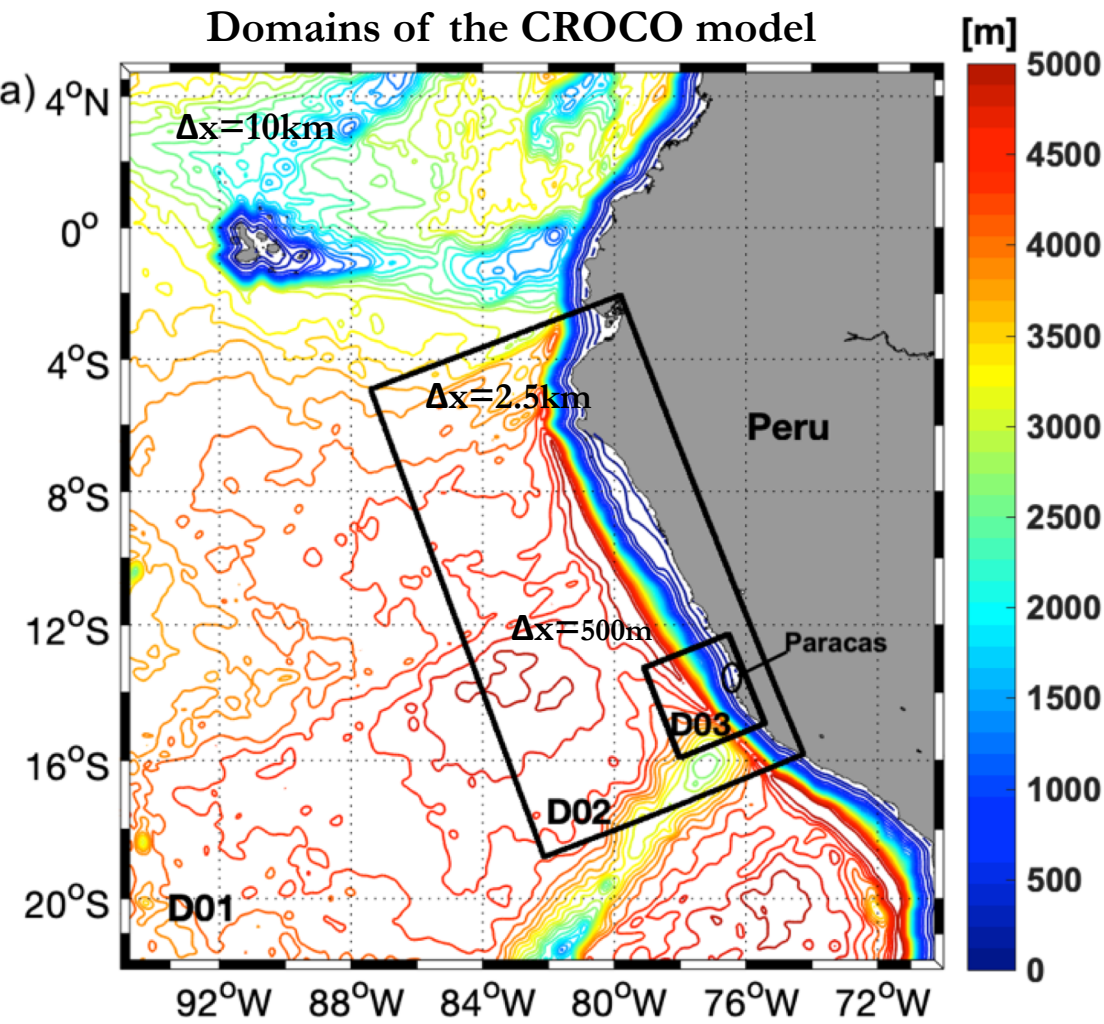
Extreme biogeochemical events:

- Hypoxia
- Toxic “Milky Waters”
(precipitation of H₂S in surface waters)

The Paracas bay dynamics: impact on stratification



Adapted from Aguirre et al. (2015, 2019).

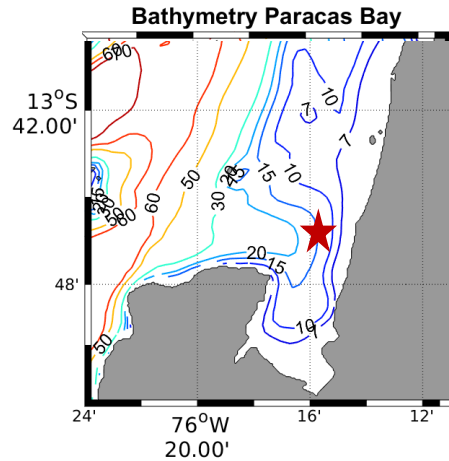


- Wind forcing = WRF 7km resolution, Chamorro et al., 2021

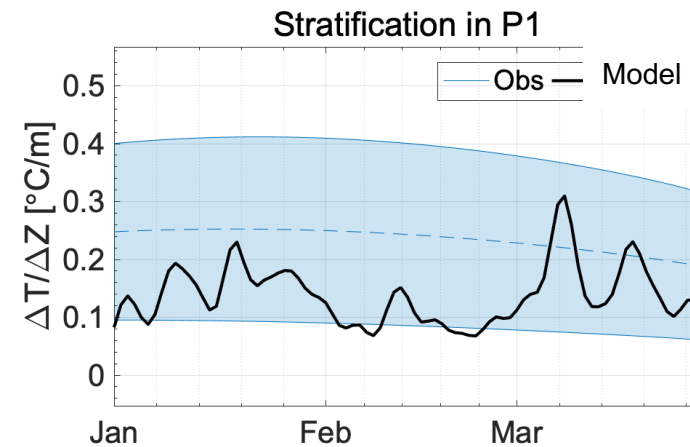
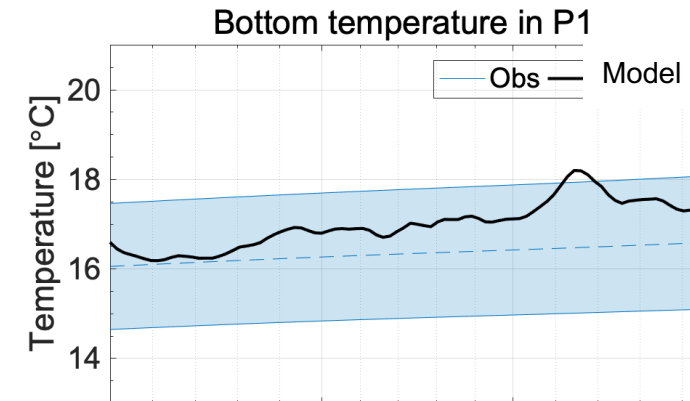
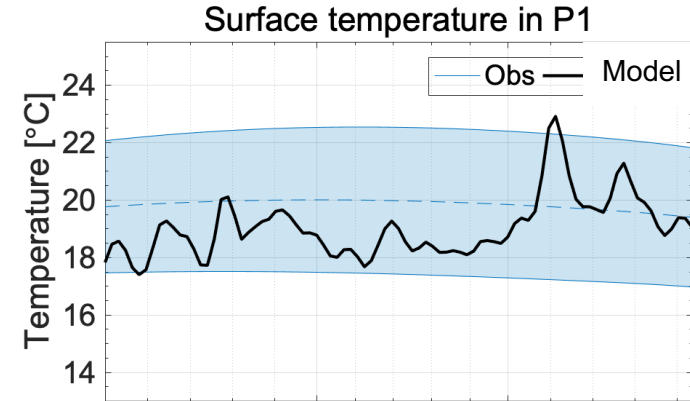
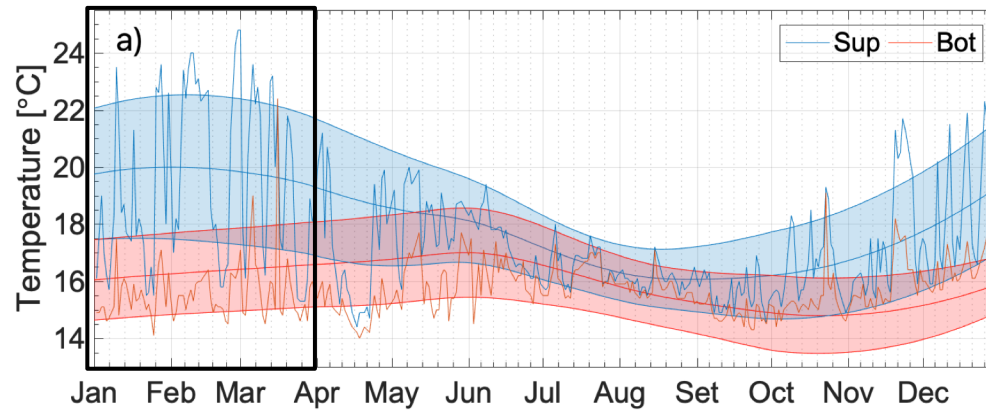
Results: model evaluation

Data to evaluate the model:

- Surface and bottom temperature, daily, 2006-16 at fixed mooring (P1, show it on the map)



*Observations from 2006-2016

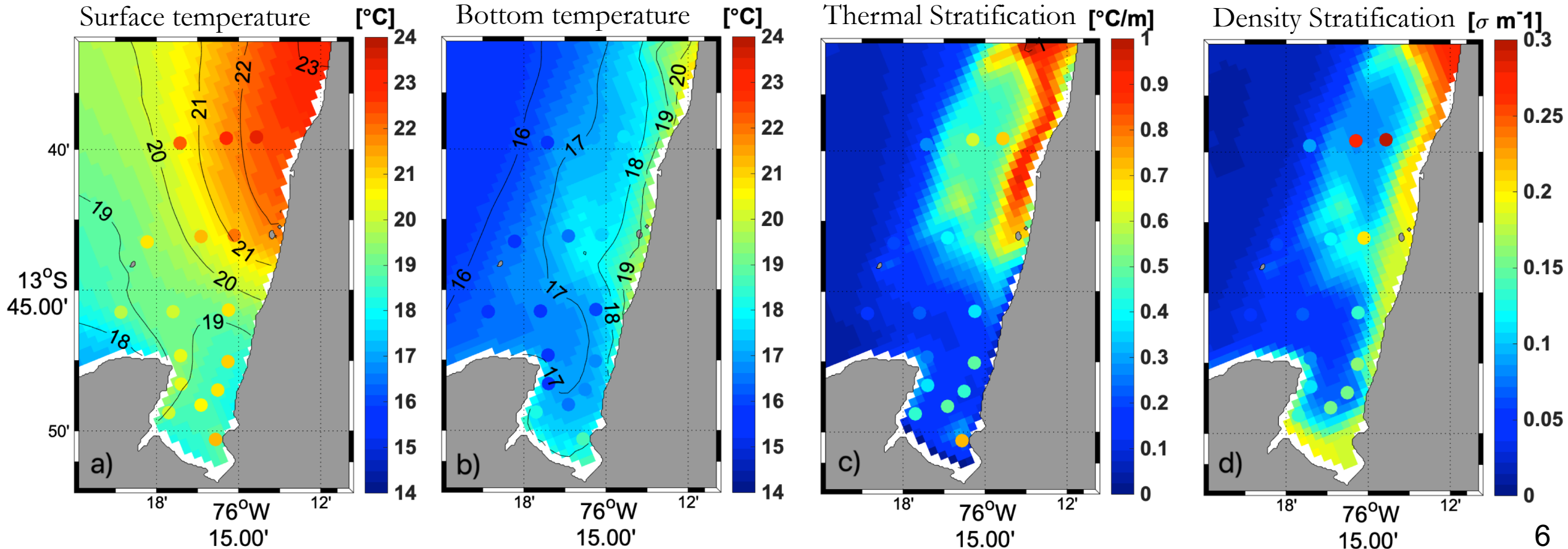


Results: model evaluation

Data to evaluate the model:

- 16 surface stations, surface and bottom Temp/Salinity climatology (2005-17) from Pisco IMARPE lab

Base case simulation and data (disks)

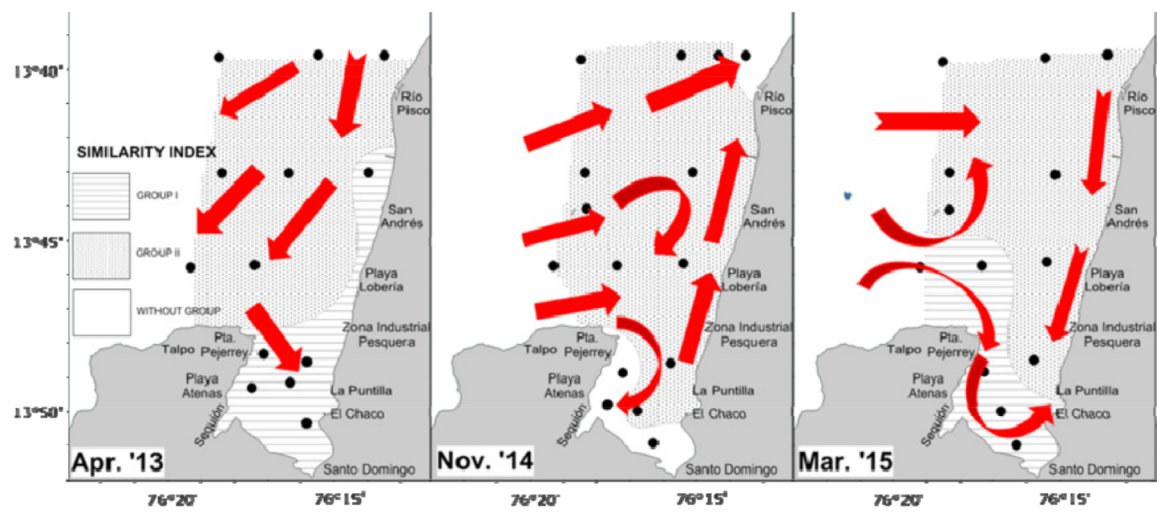


Impact of different parameterizations and forcings

Simulation name	Impact of forcing/parameterization (%)
Wind diurnal cycle	19% increase
Chlorophyll-dependent shortwave absorption depth	20% increase
Tidal forcing	0%
River forcing	10% increase
WRF forcing, Bias correction	40% increase

Results: Circulation in the bay

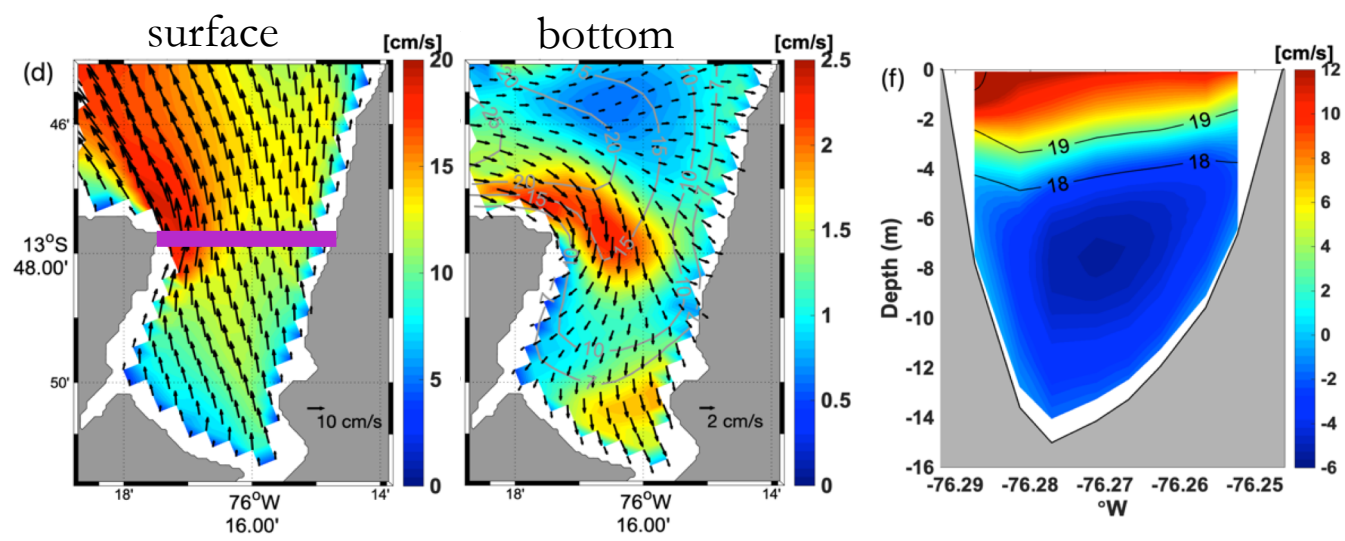
Surface current schematics in different months and years (ADCP)



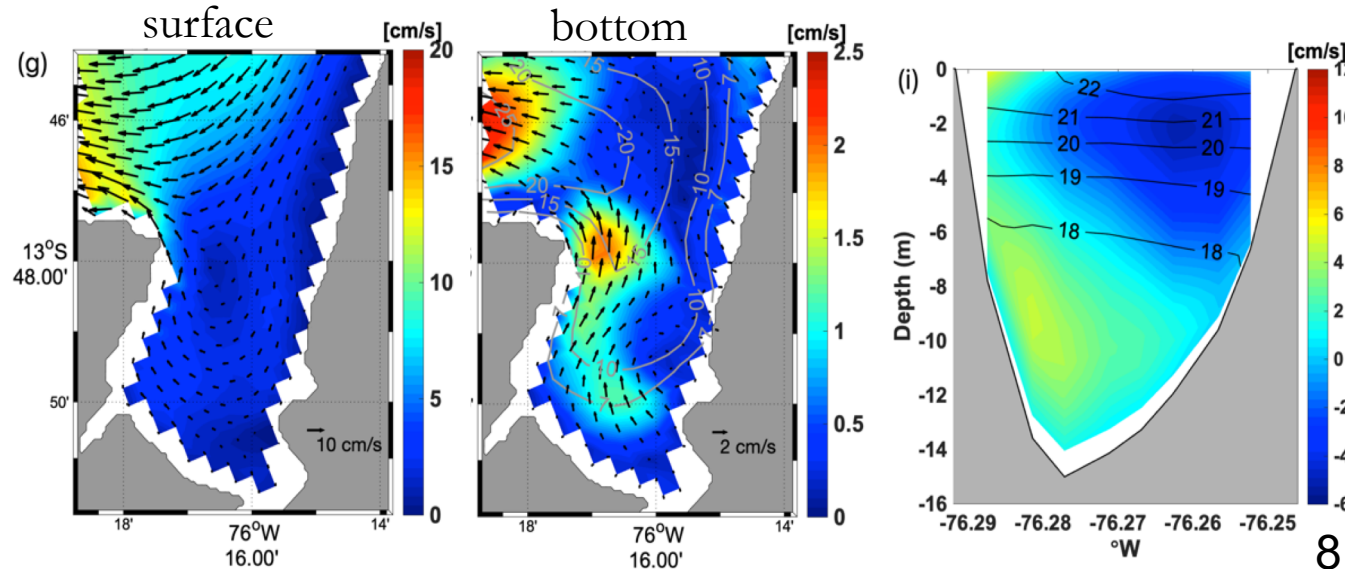
Adapted from Sanchez et al. (2019)

=> Circulation not well known

Strong wind events



Weak wind events



- Reducing the wind forcing bias offshore and in the bay had a major impact on the model SST cold bias and stratification.
- The parametrization of the shortwave flux penetration and wind diurnal cycle induced increased stratification moderately.
- Freshwater discharge increased stratification only during weak windy days.
- Cold deep waters are upwelled in the bay during windy days.
- Warm surface waters flow southward into the bay during weakly windy days
- Using a more accurate wind forcing and a higher resolution in the bay is key to improve the realism of the simulation.

Thanks!

cinthia.arellano@locean.ipsl.fr