



# Circulation in the oxygen minimum zone of the eastern tropical South Pacific

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Thanks to Franziska Schwarzkopf and Ben Giese

# Introduction: Oxygen Minimum Zones (OMZ)

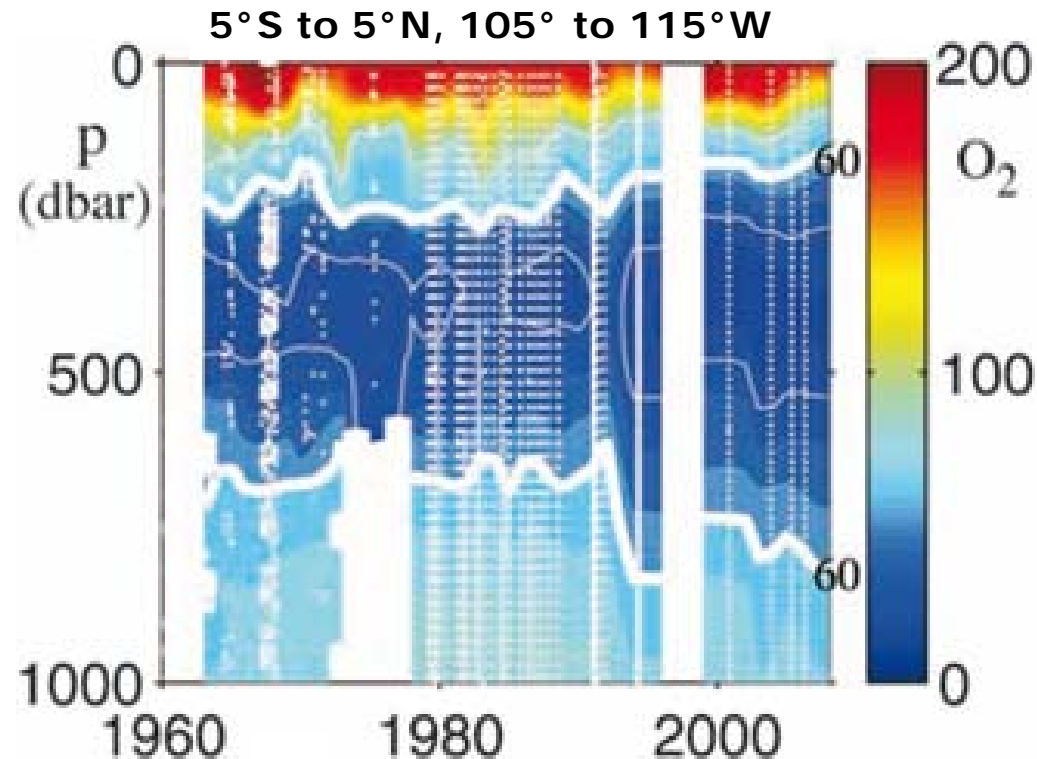
Ventilated Thermocline Model (Luyten et al., 1983):

In the subtropical oceans the subtropical gyres leave the eastern boundaries far polewards of the equator.

Streamlines in the southward limb of the subtropical gyre curve anticyclonically away from eastern boundary.

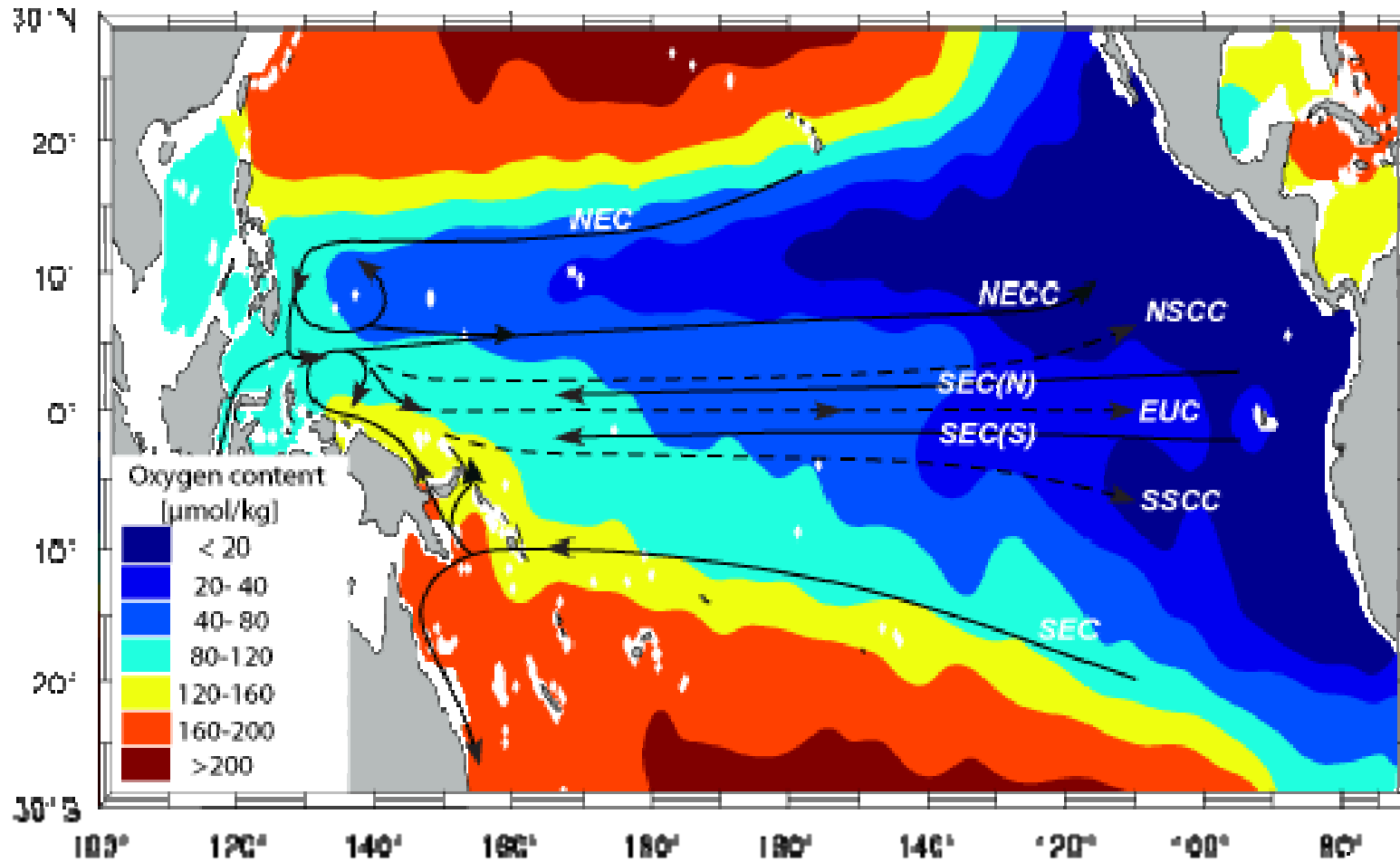
- leaving unventilated shadow zones extending westward from the boundary
- sluggish ocean ventilation
- formation of low oxygen layers

# Motivation: expanding OMZs



- time series documents an oxygen decrease in the 300-700 m layer and a vertical expansion of the intermediate depth low oxygen zones during the last 50 years
- consequences for the ecosystem and coastal economies
- Thought to be connected to variability in zonal currents (Stramma et al., 2008)
- Important to understand the present-day circulation in the low-oxygen areas

# Introduction: Oxygen Minimum Zone (OMZ)



(after Schott et al., 2004)

Mean oxygen content in 400 m depth and schematic representation of Pacific equatorial current system  
➤ supply paths of the OMZ

# Outline:

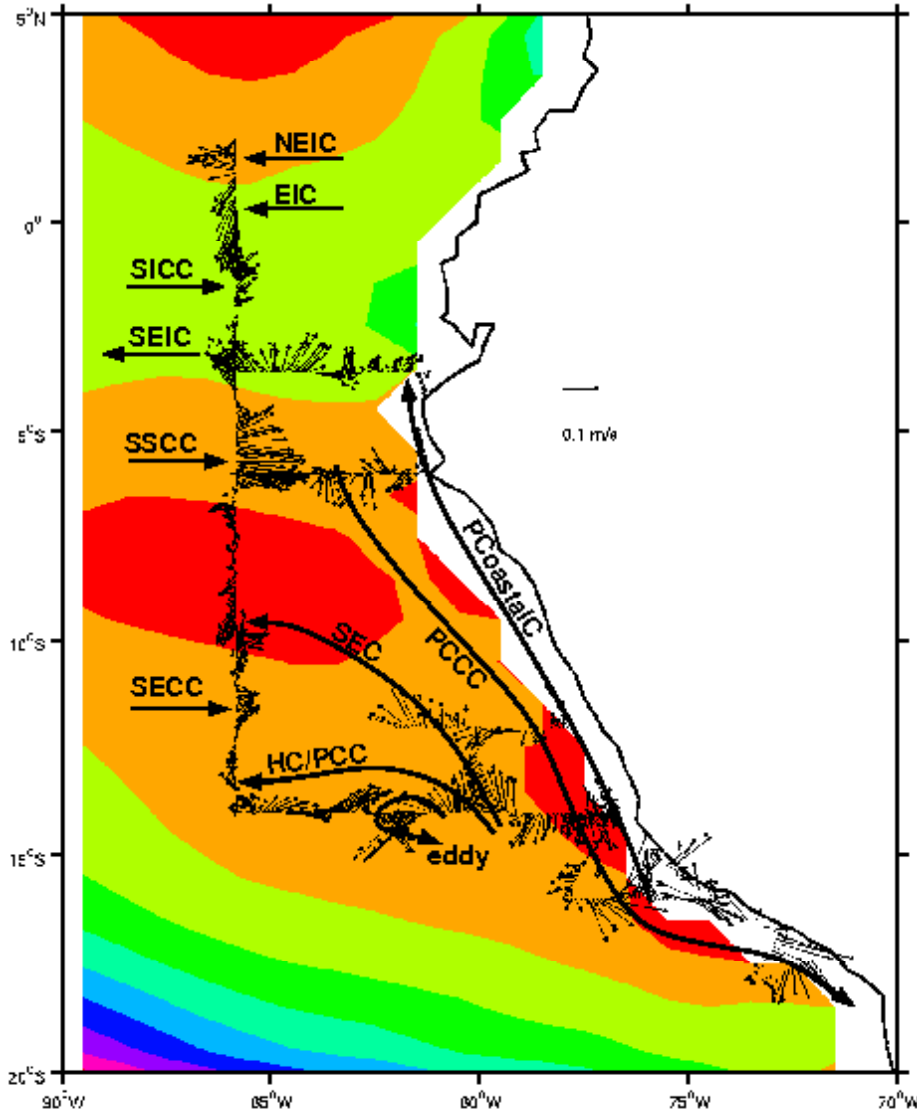
Subsurface currents of the OMZ in the eastern tropical South Pacific are investigated from:

- ADCP sections
- profiling floats with oxygen sensors

Observations are compared to model fields:

- ORCA-nest: Ocean-only hindcast simulation with horizontal resolutions of  $1/10^\circ$  nested
- SODA 2.1.6: Assimilation model, horizontal resolution of  $\frac{1}{2}^\circ$

# Eastern tropical Pacific: horizontal distribution



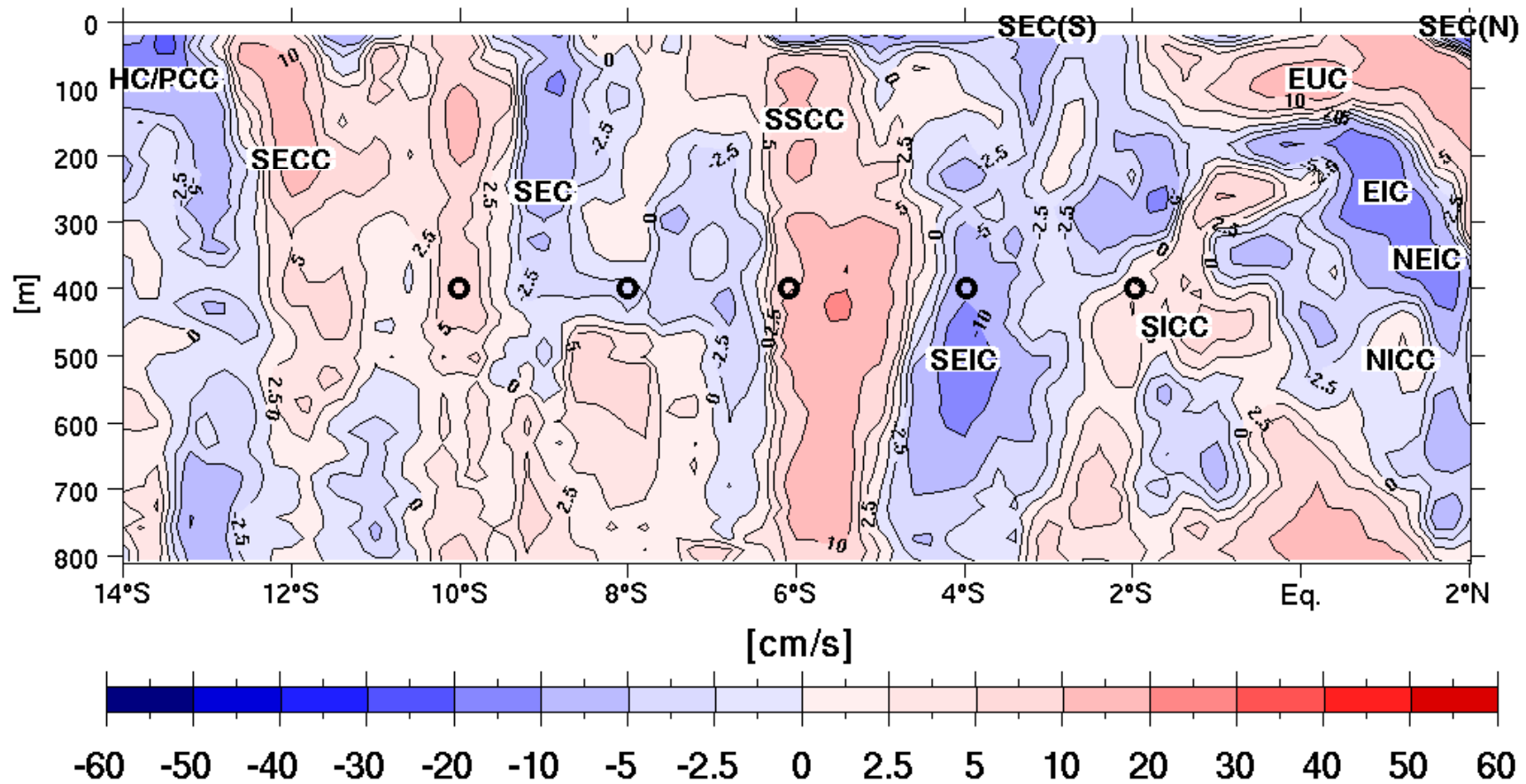
(from WOA05 [Boyer et al., 2006])

Mean climatological oxygen distribution at 400 m (core of the OMZ)

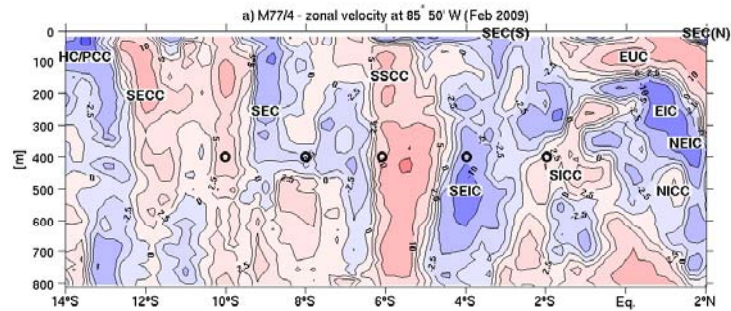
ADCP velocity at 400 m depth (January/February 2009)

➤ ADCP velocities reproduce several of the zonal equatorial intermediate current bands

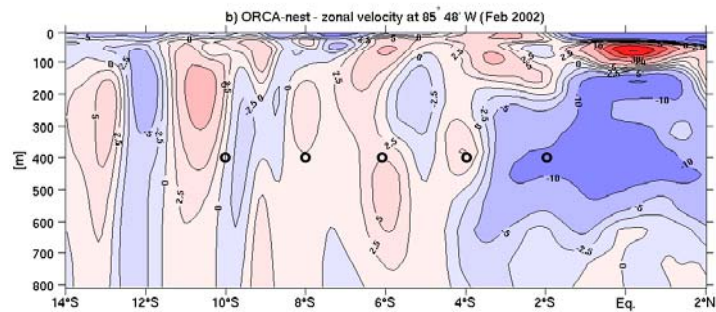
# ADCP measurements at 85°50'W in Feb 2009



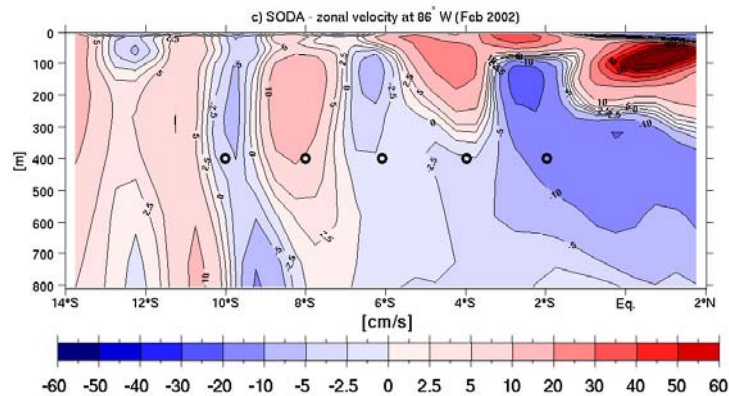
# Compare Observations to Model Output



Observations



ORCA Tropical Pacific Nest  
(1/10°)

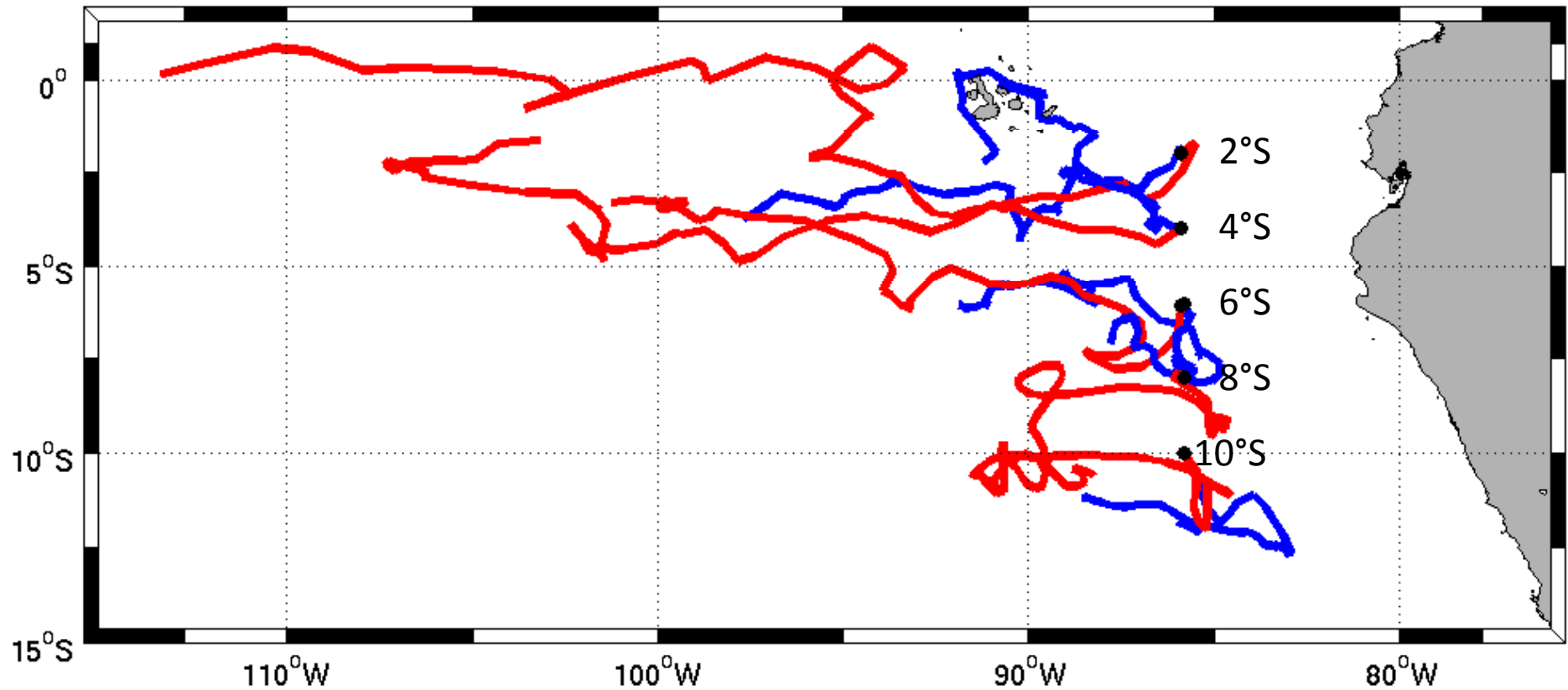


SODA Assimilation Model  
(1/2°)

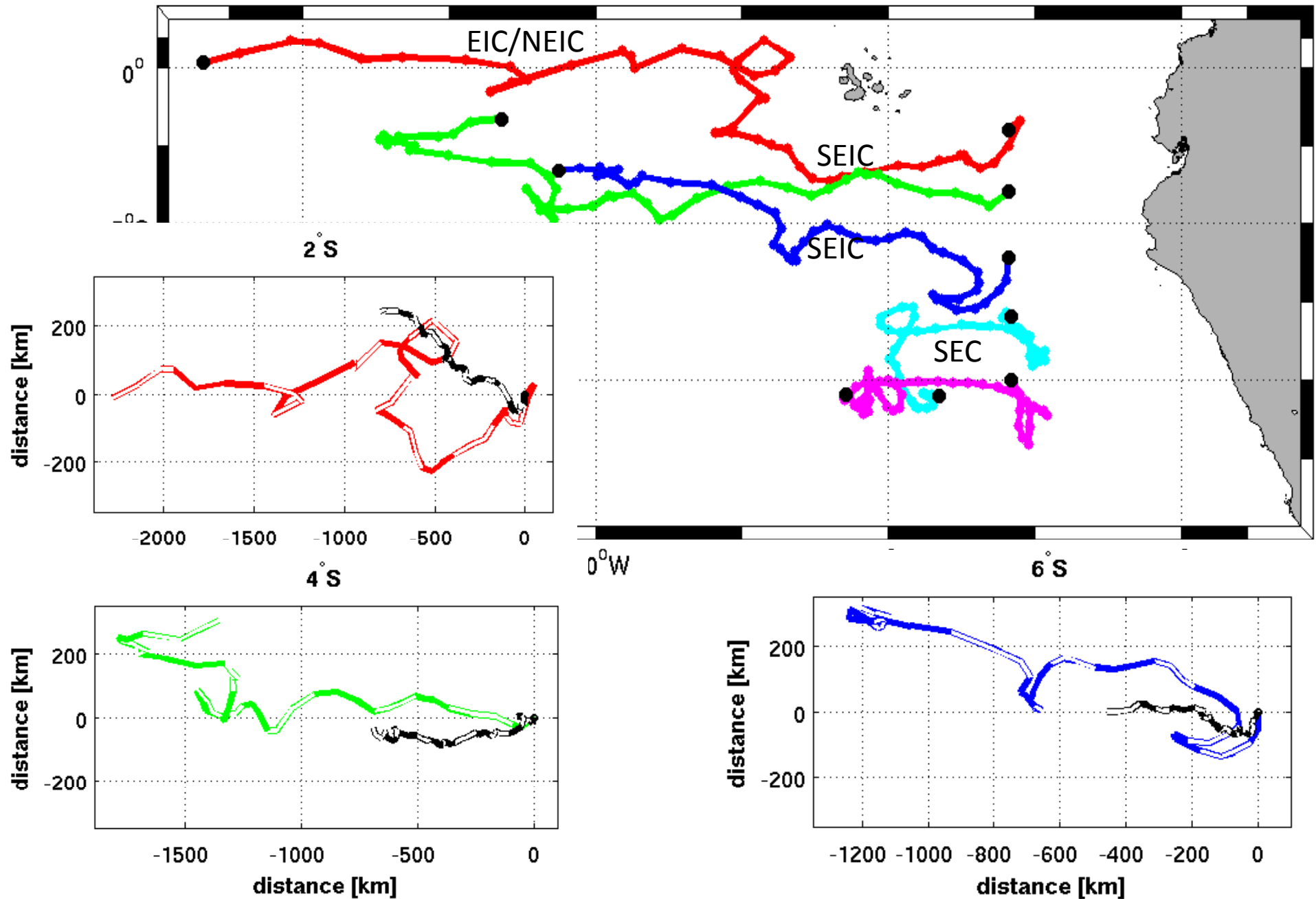
➤ Models capture observed structure



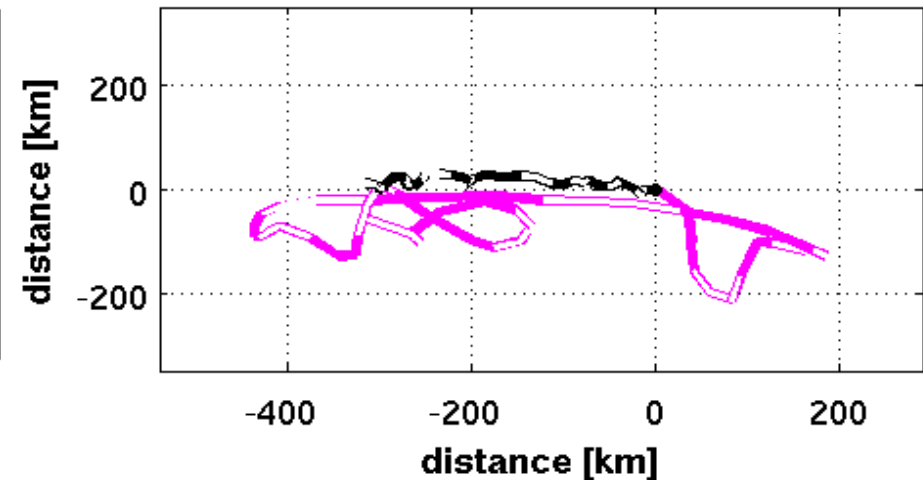
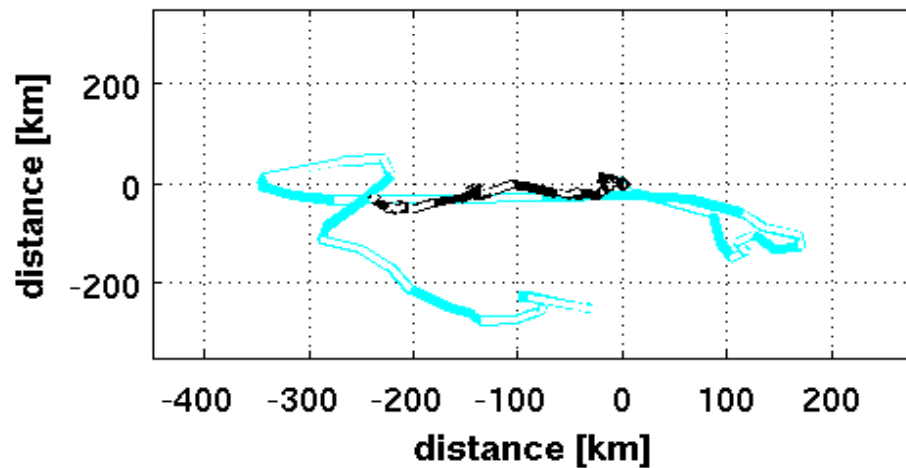
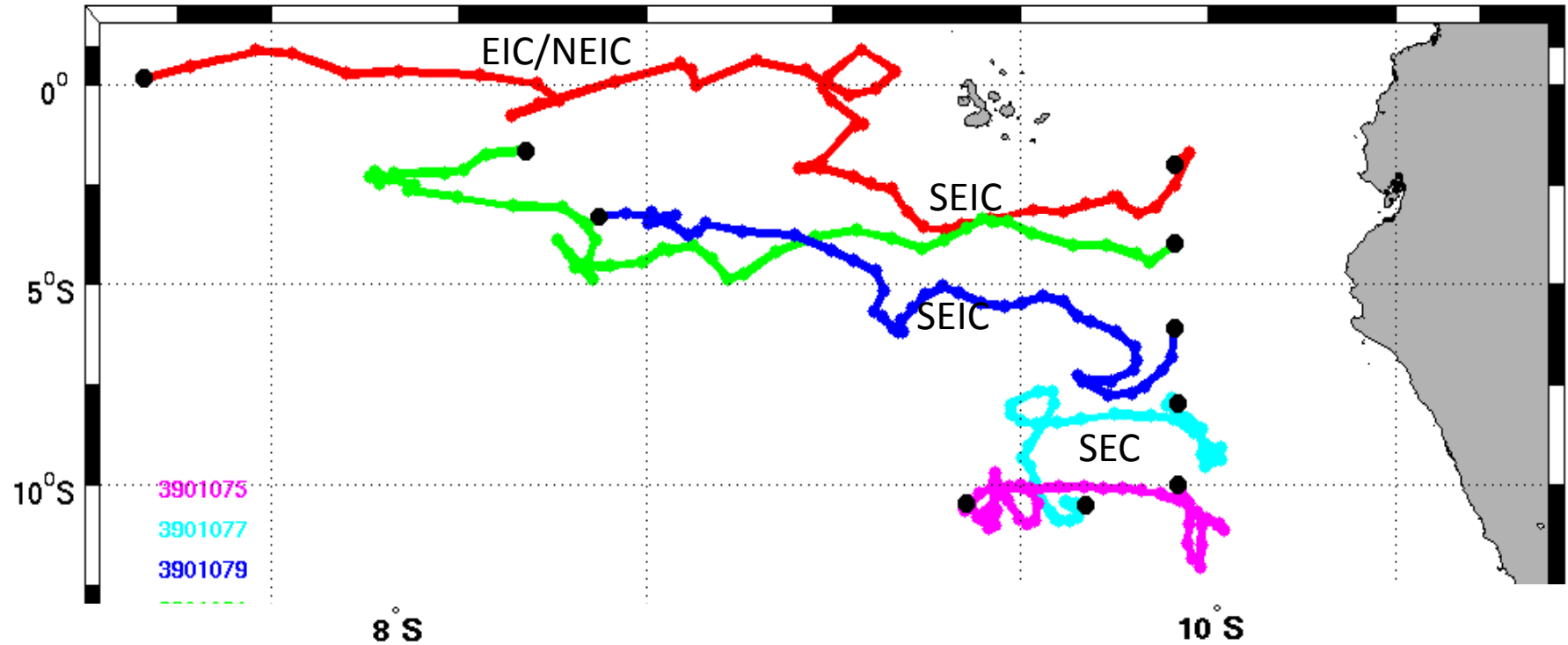
Float Paths in  
400 m and 1000 m depth  
(February 2009 – June 2010)



# Float Tracks in 400 m depth



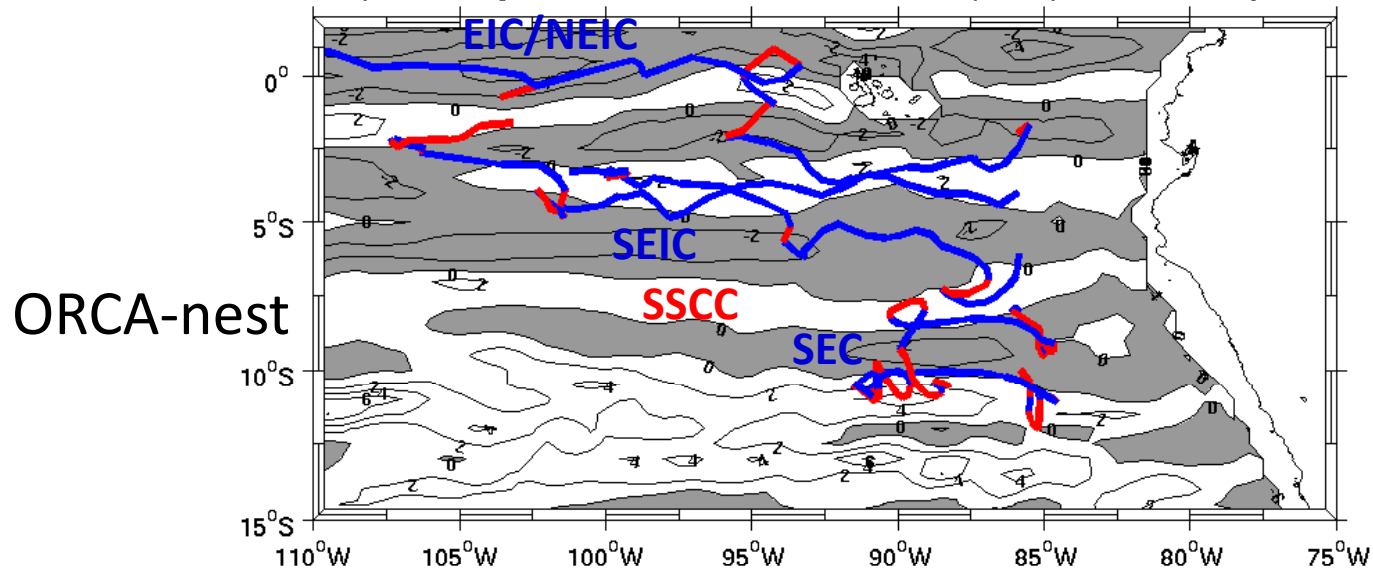
# Float Tracks in 400 m depth



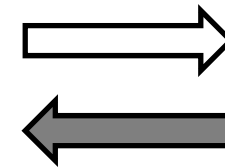
➤ stagnant currents at 400 m in the center of the OMZ

# Compare Observations to Model Output

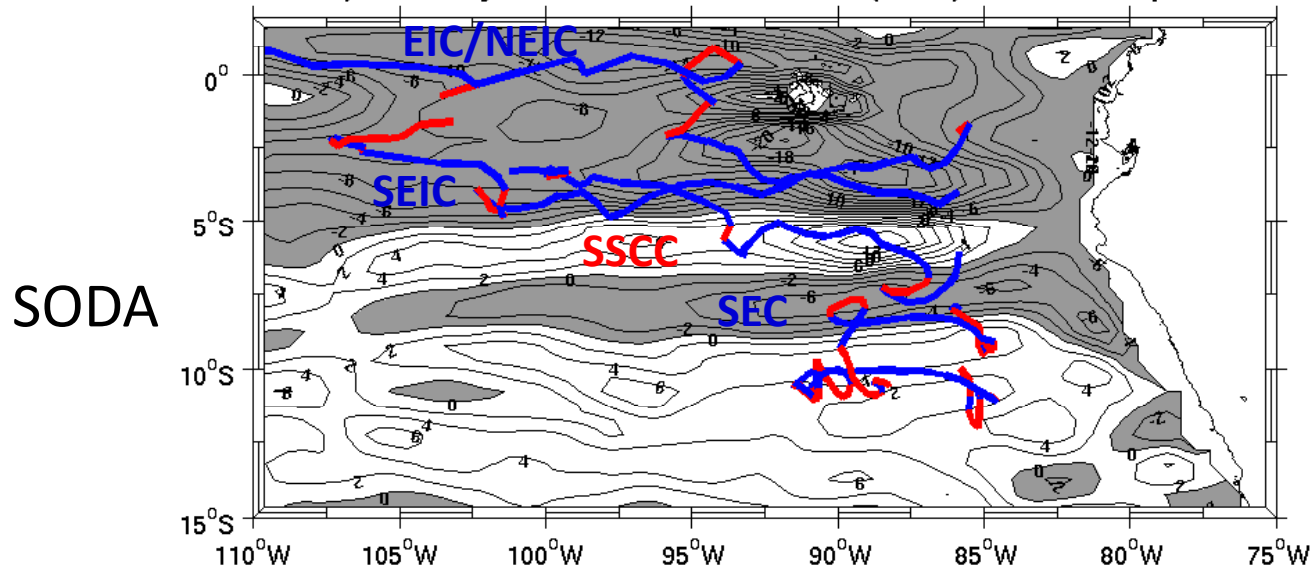
a) Velocity from floats and ORCA-nest (2002) in 400 m depth



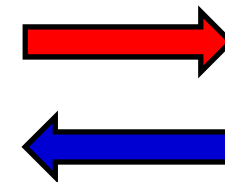
Models:  
Zonal velocity



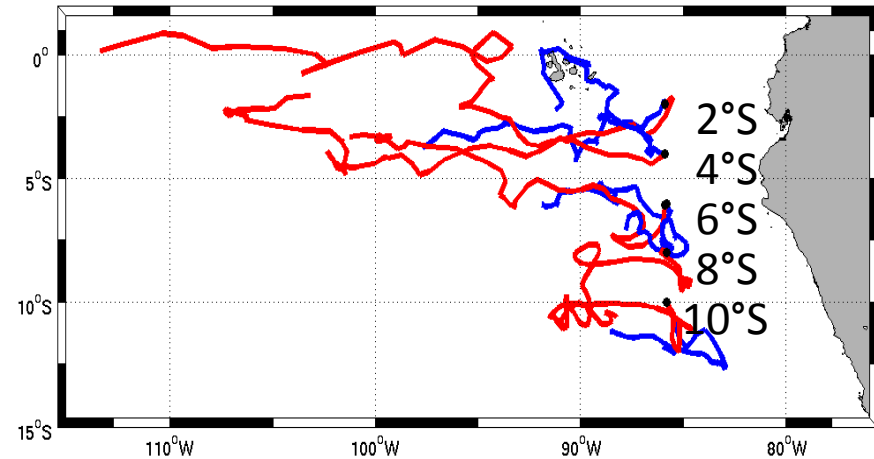
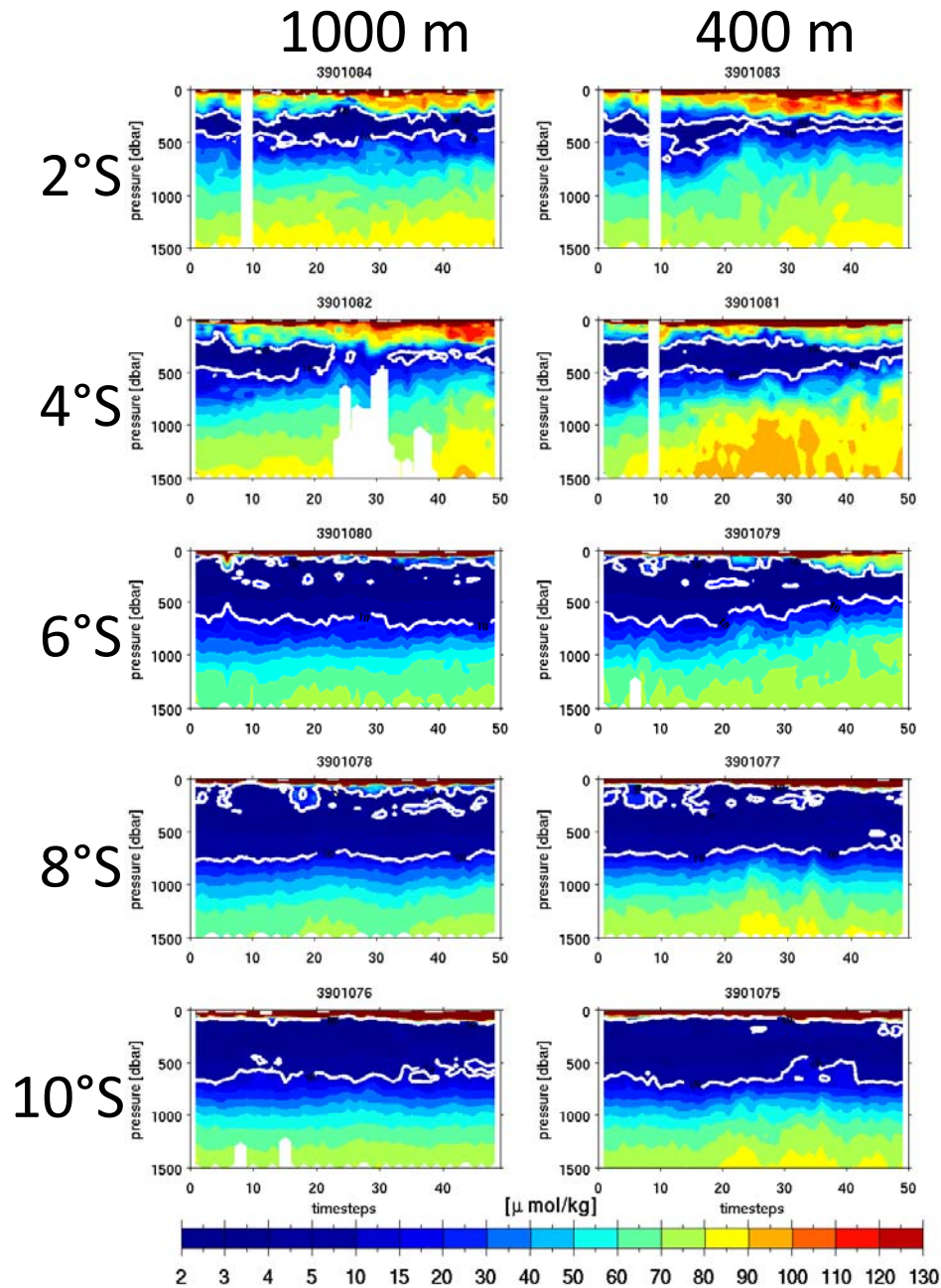
b) Velocity from floats and SODA (2002) in 400 m depth



Float Tracks:



# Oxygen profiles of the upper 1500 m

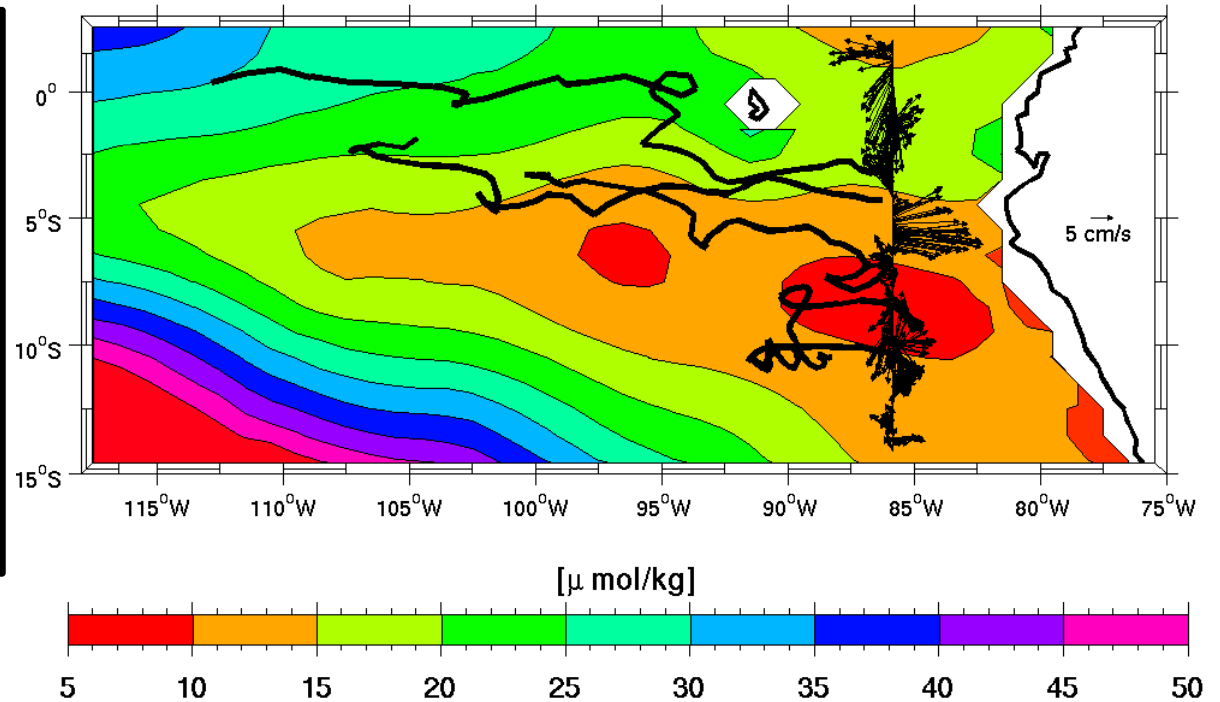


- depth level of low oxygen between 100-700m
- oxygen layer does not change very much in the center of the OMZ (8°S, 10°S)
- oxygen profiles change in time along its paths westward (2°S, 4°S)

# Conclusion

Circulation in the eastern tropical South Pacific OMZ was investigated using

- ADCP measurements
- float tracks
- model output



- large agreements for the model field and the observed data
- currents in 400 m near the core of the OMZ are quite stagnant
- floats at 8°/10°S reverse in zonal direction which support that they stay in the region

