1. Motivation:
The detection and attribution of oceanic O₂ loss due to anthropogenic warming remain uncertain in the tropics due to lack of in-situ [O₂] observations and poorly known effects of natural variability (e.g. ENSO).

Observed [O₂] change 1950-2010

Projected [O₂] change by 2100

2. APO as a tracer of Oceanic O₂ Flux:
We use observations of Atmospheric Potential Oxygen (APO=O₂+1.1CO₂), an atmospheric tracer of oceanic O₂, and hindcast CORE2 ocean simulations of CESM, IPSL, and GFDL to assess ENSO effects on air-sea O₂ flux.

3. Research Questions:
1. What can observations of APO (i.e. O₂ and CO₂) and models tell us about ENSO impacts on air-sea O₂ exchange and [O₂] variability?
2. What are driving mechanisms of ENSO-related O₂ variability?
3. What is role of atmospheric transport in observed APO variability?

4. Atmospheric Observations vs Models:

Both ocean models and atmospheric inversion show a positive correlation between Niño3.4 index and APO flux (R_INV=0.5; R_CESM=0.6; R_IPSL=0.6) with 3-5 months APO lead. APO is driven by O₂ flux (R_O2=0.8, 3 mo O₂ lead), suggesting outgassing of O₂ during El Niño.

5. Mechanism of ENSO-driven O₂ Variability:
ENSO variability of O₂ flux (F_O2) is dominated by transport processes (F_VENT), and is buffered by reduced biological production (F_NCP) and thermodynamic flux of O₂ (F_THERM).

6. Atmospheric Transport Effects
APO anomalies due to ENSO effects on air-sea O₂ flux are amplified by atmospheric transport (weakened easterlies). East-west dipole explains observed discrepancies between Scripps and Japanese networks.

7. Implications for TPOS
In the absence of continuous interior [O₂] observations, impacts of ENSO on interior [O₂] distribution and budget remain poorly understood. Additional BGC sensors can provide deeper understanding of changes in OMZs. In turn, new O₂ observations can provide insights on physical dynamics (e.g. tracer of water masses and changes in thermocline depth, constraints on EUC strength and ventilation, etc.).

References

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