

NSF NCAR Oceanographic Aircraft Developments



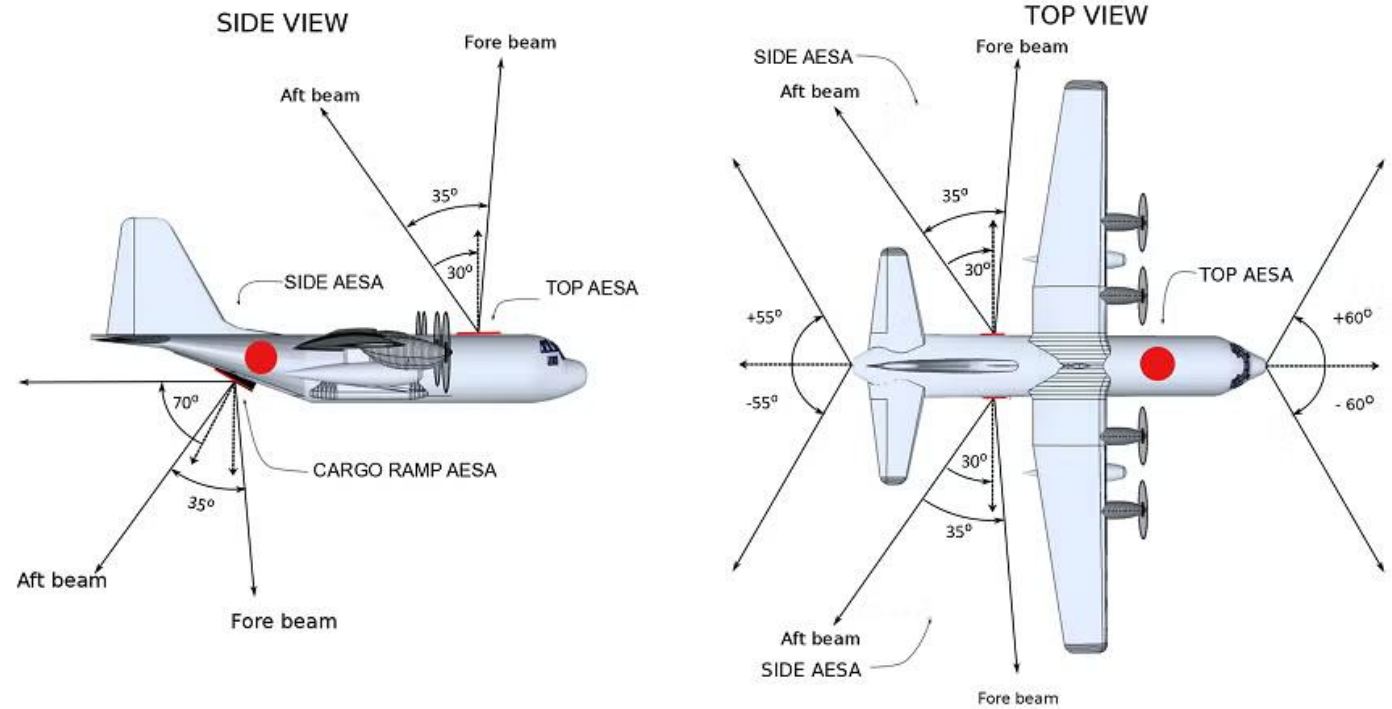
Outline

- NSF NCAR supported community campaigns
- NSF OPP / NCAR Southern Ocean Carbon Gas Observatory
- Analysis of past campaigns (NSF HIPPO, NSF ORCAS, and NSF ATom)
- Future plans



RECENT Campaigns						
Project	Facilities	Deployment Dates	Location	PI	Status	NSF Science Program
FY 2024						
CAESAR	NSF/NCAR C-130, AVAPS, HAIS, WCR, WCL	22 Feb-7 Apr 2024	Sweden	Zuidema	Approved	AGS/PDM
ACES-Eclipse	NSF/NCAR GV	27 Mar-8 Apr 2024	AZ, TX	Samra	Approved	Solar
MAIR-E II	NSF/NCAR GV	20 July-16 Aug 2024	PA, TX	Wofsy	Approved	AGS/ATC
UPCOMING Campaigns						
Project	Facilities	Deployment Dates	Location	PI	Status	NSF Science Program
APAR	NSF/NCAR C-130	TBD	Colorado	Joseph	Approved	AGS/ATC
CG WaveS FY25	NSF/NCAR GV, FO3, VCSEL	20 May-14 Jun 2025	Central U.S.	Fritts	Approved	AGS/PDM
GOTHAAM FY25	NSF/NCAR C-130, HAIS	1 Jul-12 Aug 2025	New York	Mak	Approved	AGS/ATC
MAIR-E III	NSF/NCAR GV	20 July-16 Aug 2025	PA, TX	Wofsy	Approved	AGS/ATC
FY 2026						
TI3GER II FY25	GV, FO3, VCSEL	~Spring 2026	Oregon	Volkamer	Approved	ATC
--	NSF/NCAR GV, HSRL, ISS, ISFS, MPD	~March - May 2026	Nauru	--	Facility Request	AGS/PDM
--	NSF/NCAR GV	June - July 2026	AK, MN	--	Facility Request	AGS/ATC
--	NSF/NCAR GV	Jul - Aug 2026	Iceland	--	Facility Request	Solar
--	NSF/NCAR GV, HCR, HSRL, VCSEL, ISS	Jul - Sep 2026	CO, AK and New Zealand	--	Facility Request	AGS/PDM
--	NSF/NCAR GV, AVAPS, HCR, HSRL	Aug - Oct 2026	Australia	--	Facility Request	AGS/PDM
FY 2027						
--	NSF/NCAR GV, HCR, HSRL	Jan - Mar 2027	ID	--	SOI	AGS

<https://www.eol.ucar.edu/facilities-instruments/field-campaign-schedules>



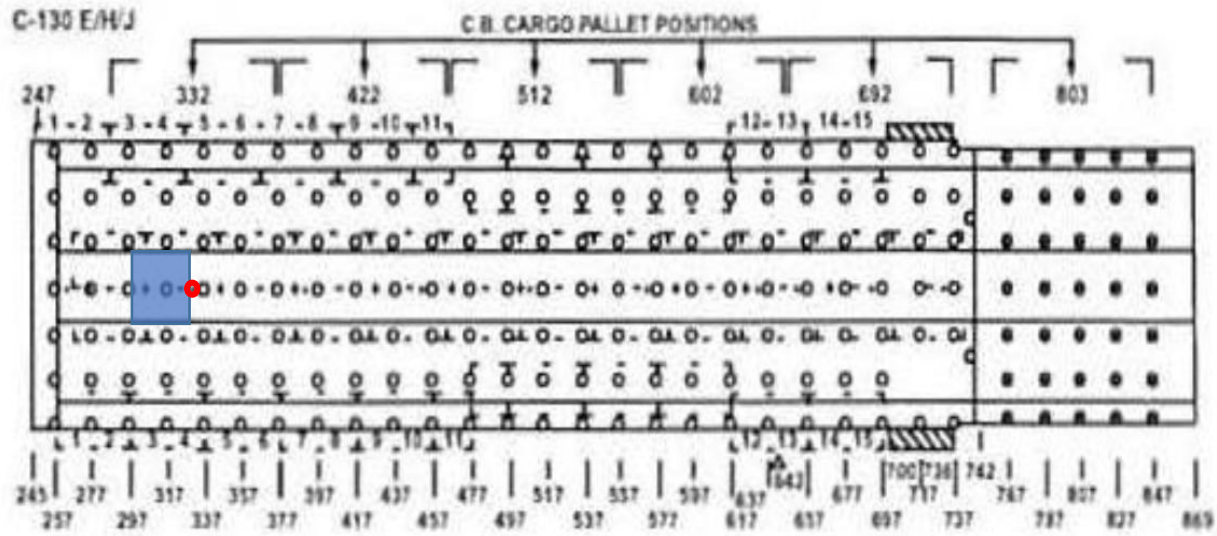
The C-130 is scheduled to be non-requestable for two years starting in September 2025.



NSF funded project to measure CO₂ from the LC-130s led by NCAR, CU, and NOAA

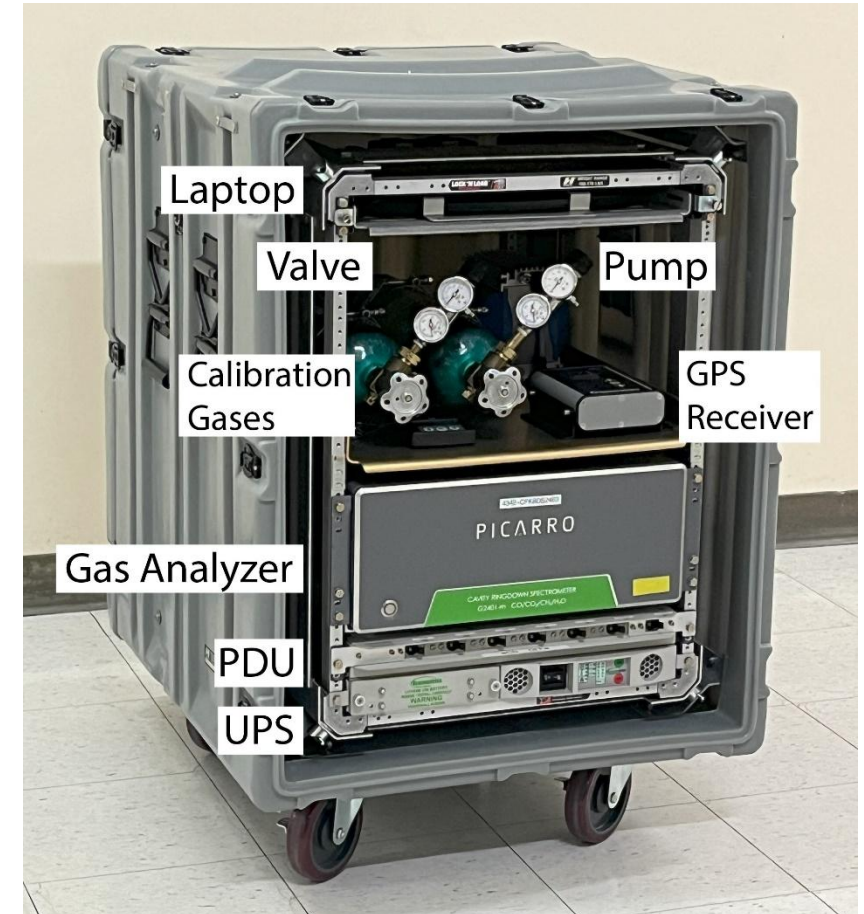


New stand-alone rack and location



Forward-most seat stanchion shown by red circle

- Easier roll-on / roll-off
- Shorter inlet tubing



SCARGO Project Timeline

May 2018: Proposal submitted for three full field seasons (2019/20, 2020/21, 2021/22)

March 2019: Proposal awarded

May 2019: AF1067 submitted

Oct 2021: Certification basis signatures

March 2022: Test phase in Schenectady, NY

Aug 2022: Approved for flight

Nov-Dec 2022: Test deployment to McMurdo

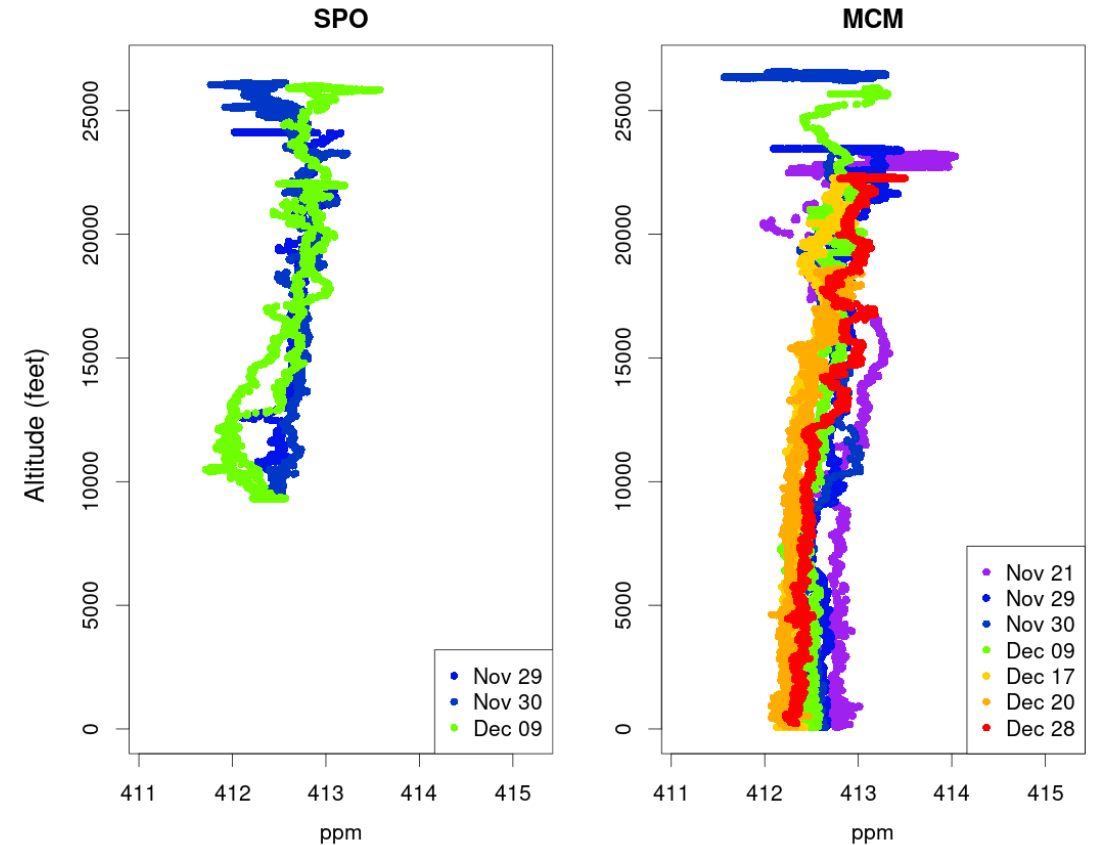
2023/24 Season: Deferred (USAP resources)

Sep. 2023: AF1067 modification submitted

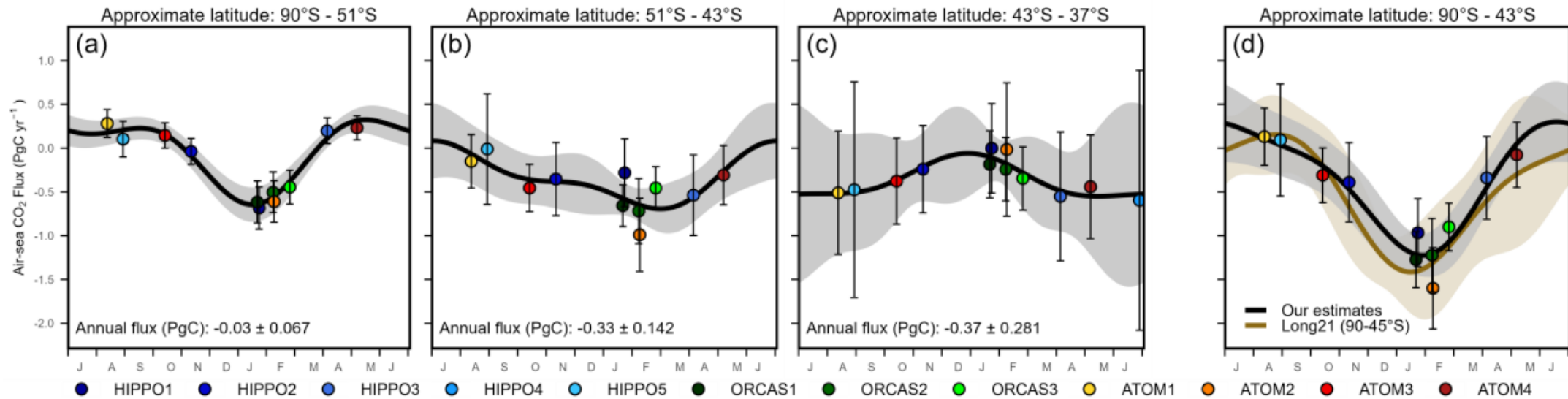
Sep. 2024: New rack approved

2024/25 Season: Deferred (USAP resources)

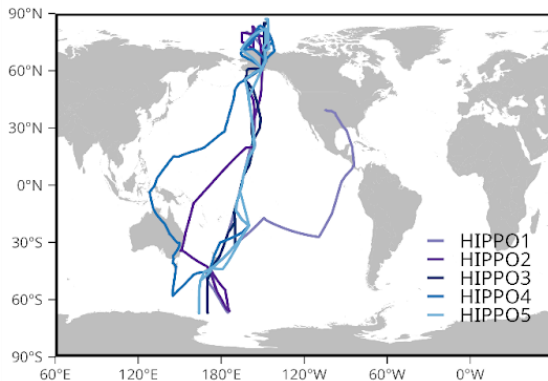
Feb. 2025: Planning to fly 2025/26, 2026/27, and 2027/28 seasons



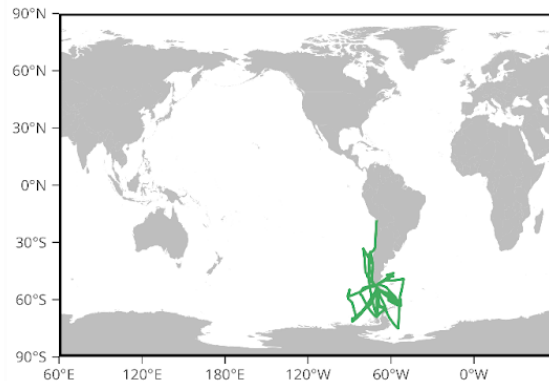
Southern Ocean CO₂ Fluxes from HIPPO, ORCAS, and ATom



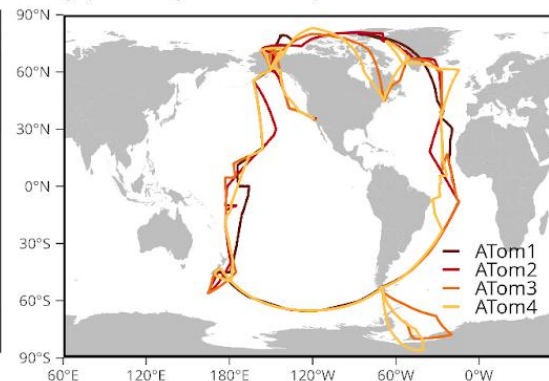
(B) HIPPO (2009 - 2011)



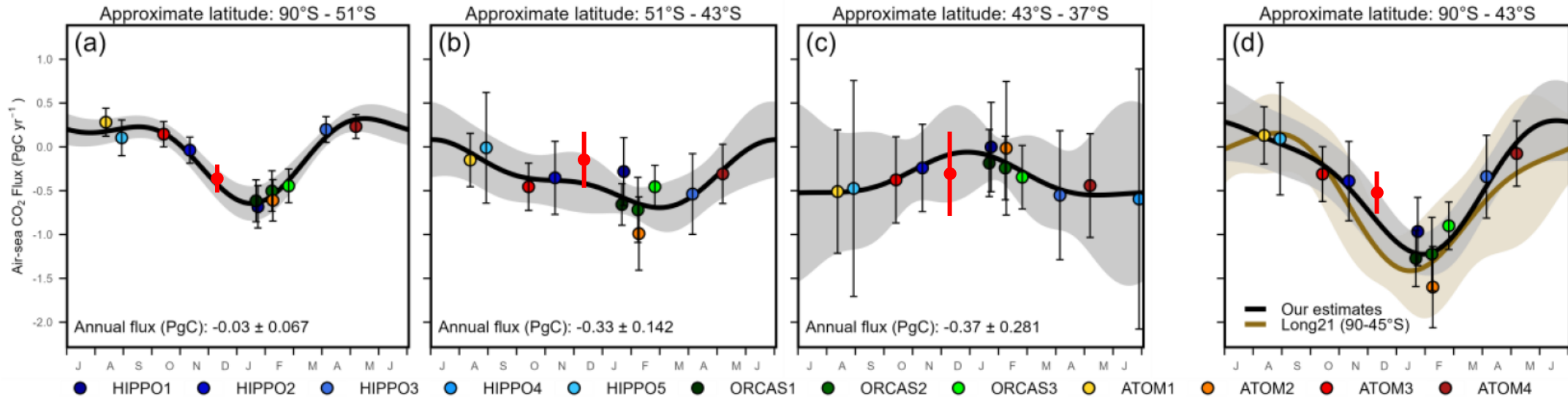
(C) ORCAS (2016)



(D) ATom (2016 - 2018)



Southern Ocean CO₂ Fluxes from HIPPO, ORCAS, and ATom



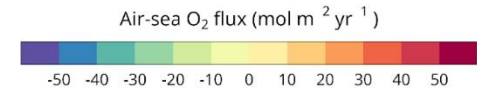
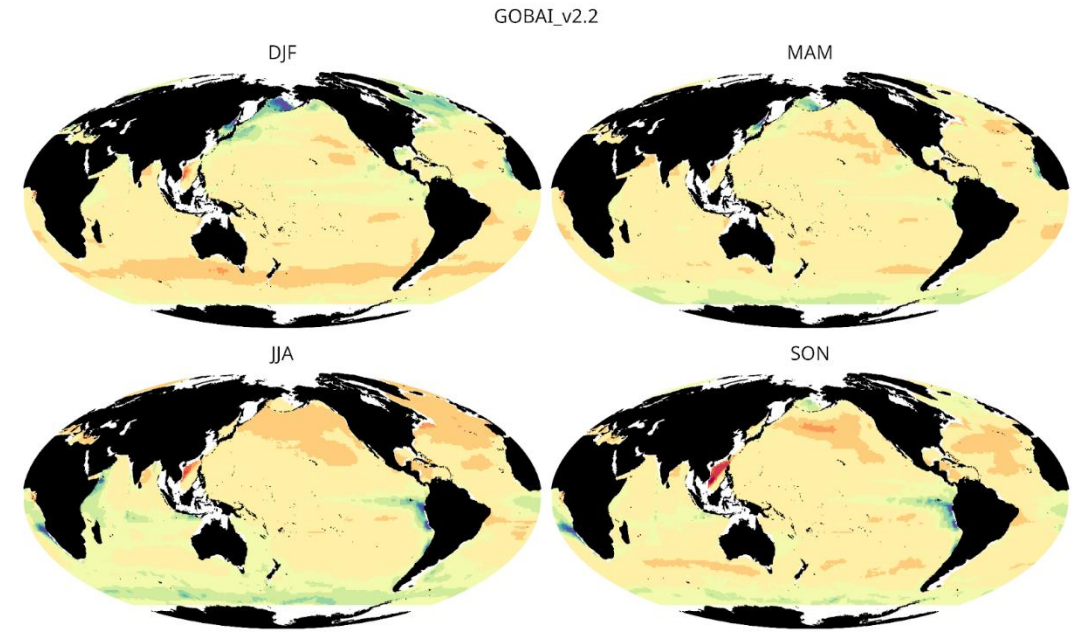
↓ = SCARGO 2022 estimates ($\pm 1-\sigma$)

- Generally consistent with climatology but with less uptake 51-43 °S
- Uncertainty budget is promising and will be reduced with denser temporal sampling

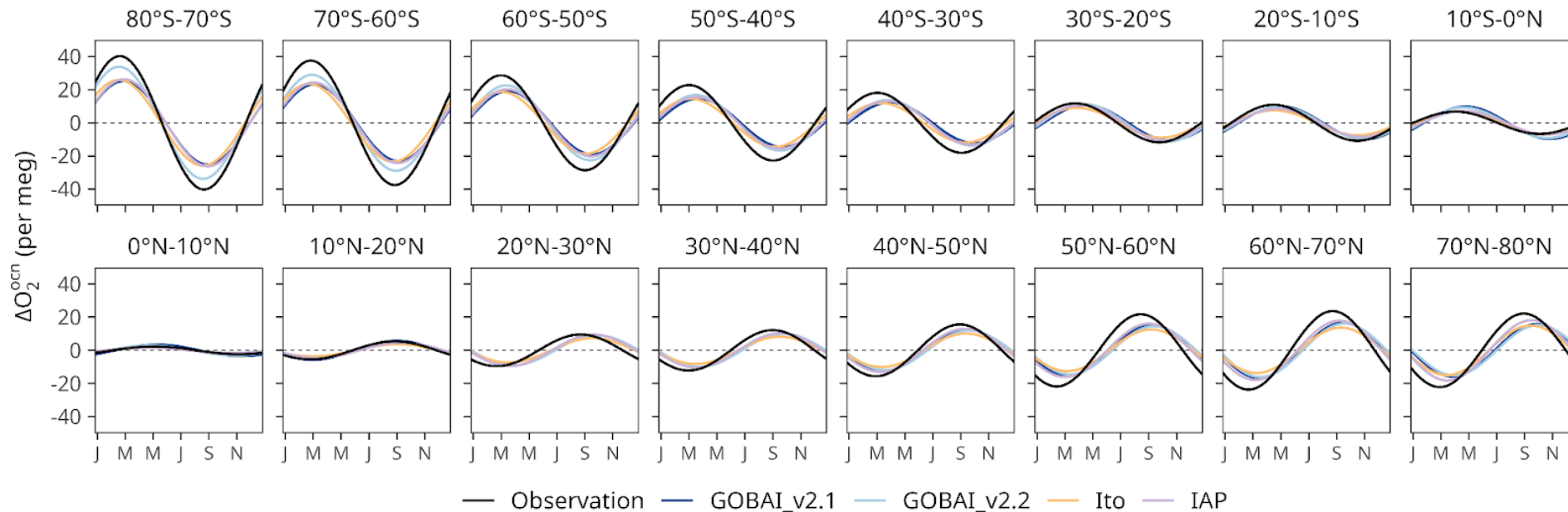
Stephens et al., in prep

Yuming Jin, et al., PNAS, 2024

Calibration of Global O₂ Flux Products, using Airborne Campaigns (HIPPO, ORCAS, and ATom)

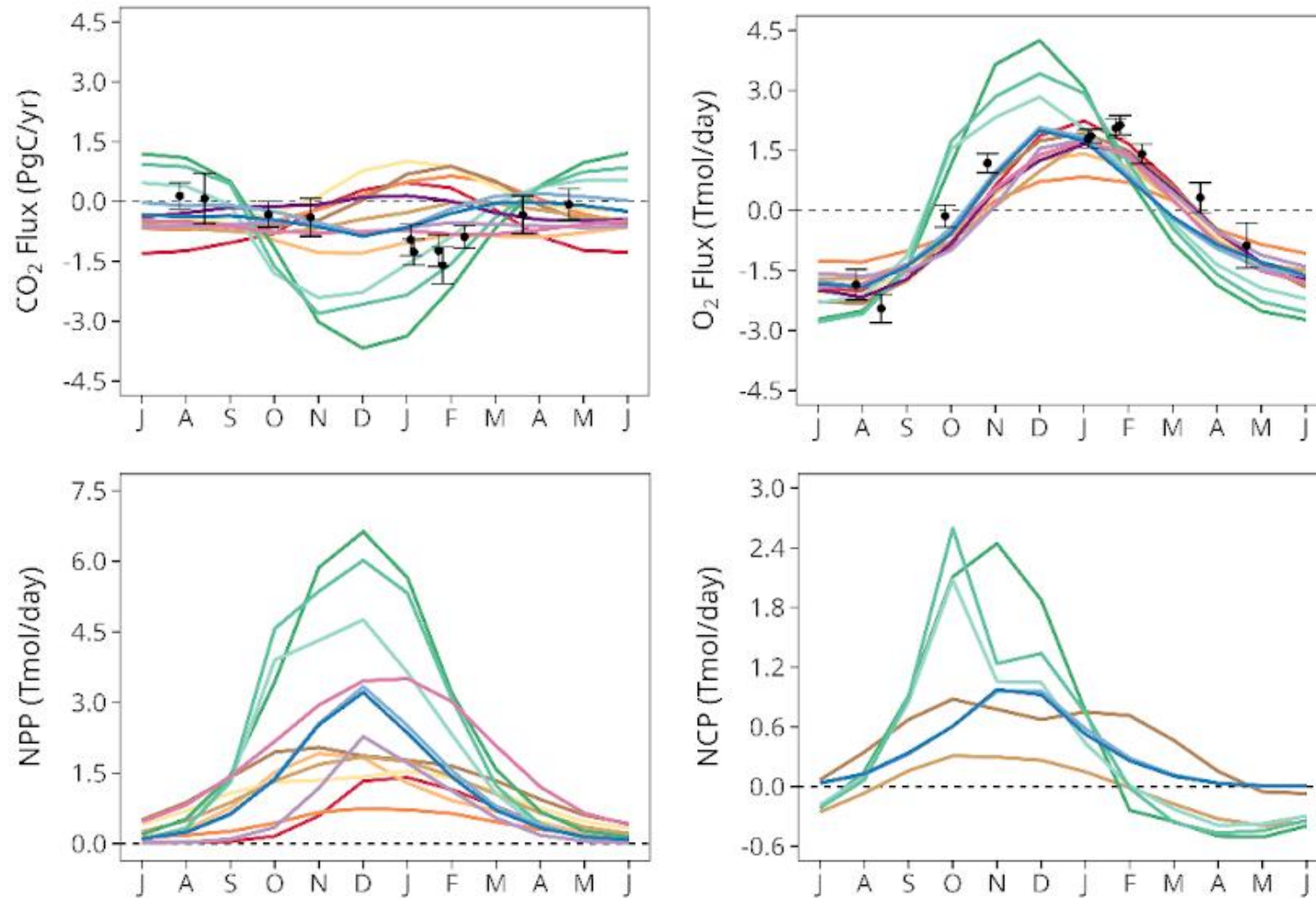


Tropospheric Column-Averaged Ocean O₂ Signal



Yuming Jin
NCAR ASP Fellow

Southern Ocean Air-Sea CO₂ and O₂ Flux from Airborne Campaigns (HIPPO, ORCAS, and ATom)



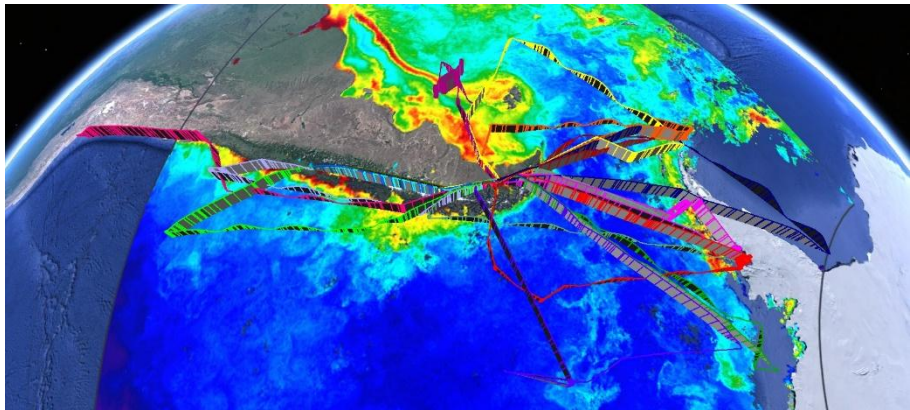
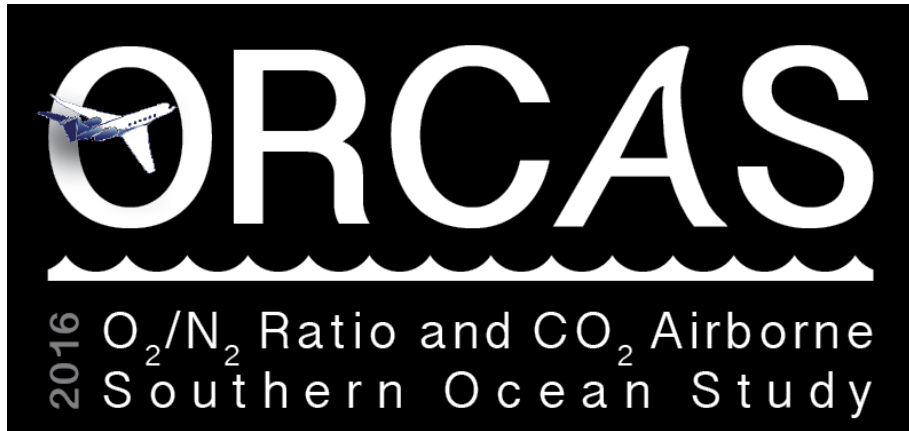
Yuming Jin
NCAR ASP Fellow

CMIP-6
Models:

- | | | | | | | |
|---------------|-------------|--------------|---------------|----------------|-------------|-------------|
| ACCESS-ESM1-5 | CMCC-ESM2 | EC-Earth3-CC | MPI-ESM1-2-HR | MPI-ESM1-2-HAM | NorESM2-MM | CESM2-OMIP1 |
| CanESM5 | CNRM-ESM2-1 | IPSL-CM6A-LR | MPI-ESM1-2-LR | MRI-ESM2-0 | UKESM1-0-LL | CESM2-OMIP2 |

Potential future activities:

- ORCAS-2: The Bloom (Patagonian Shelf in springtime, sulfur chemistry focus)
- CarbonBridge (lighter, faster, more frequent version of HIPPO)



January 2009

