

The NOAA SABRE Project

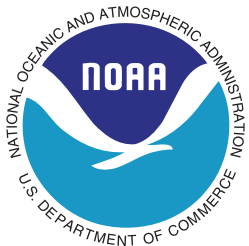
Stratospheric Aerosol processes, Budget and Radiative Effects



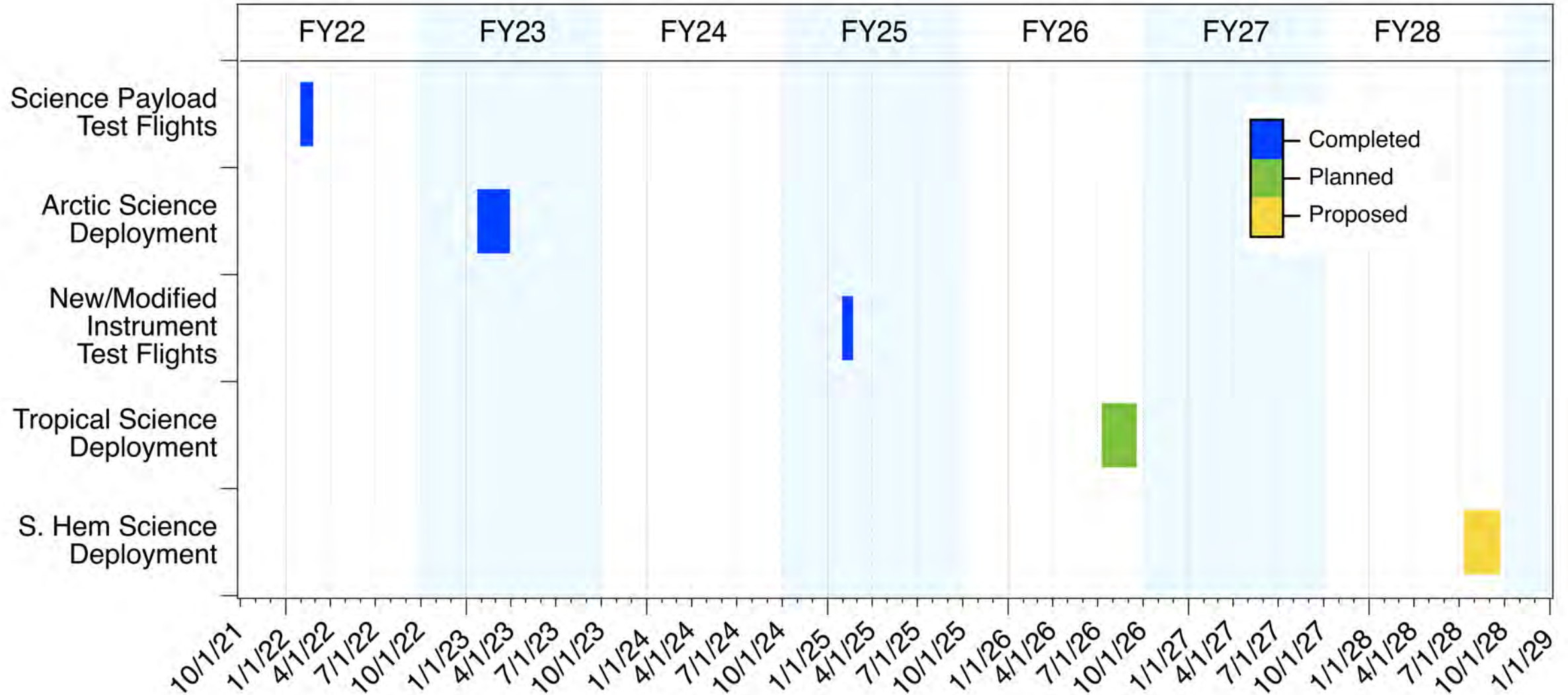
Science Leads: Troy Thornberry, Eric Jensen, Eric Ray

2025 New Instrument Test Flights

2026 Tropical Science Deployment



SABRE Timeline



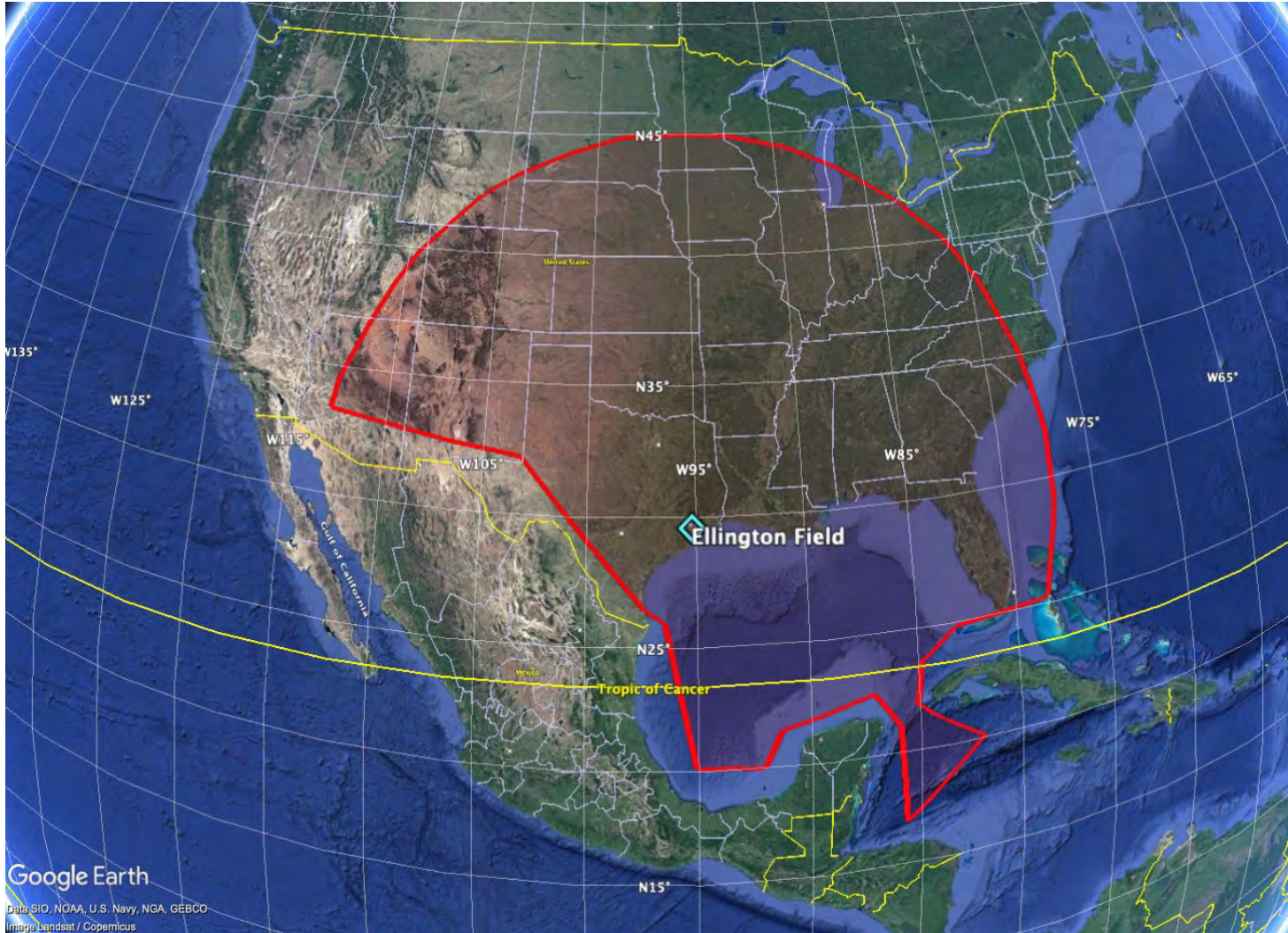
SABRE 2025 & 2026 Dates



- SABRE 2025 New/modified instrument test flight series window:
 - January 31 – February 21, 2025
 - 3 weeks
 - 4-5 flights, 20 flight hours

- SABRE 2026 Houston + Tropical Deployment mission window:
 - July 7 – September 19, 2026
 - ~ 9 weeks
 - 4 Houston flights, 2 transit flights, 15 tropical science flights

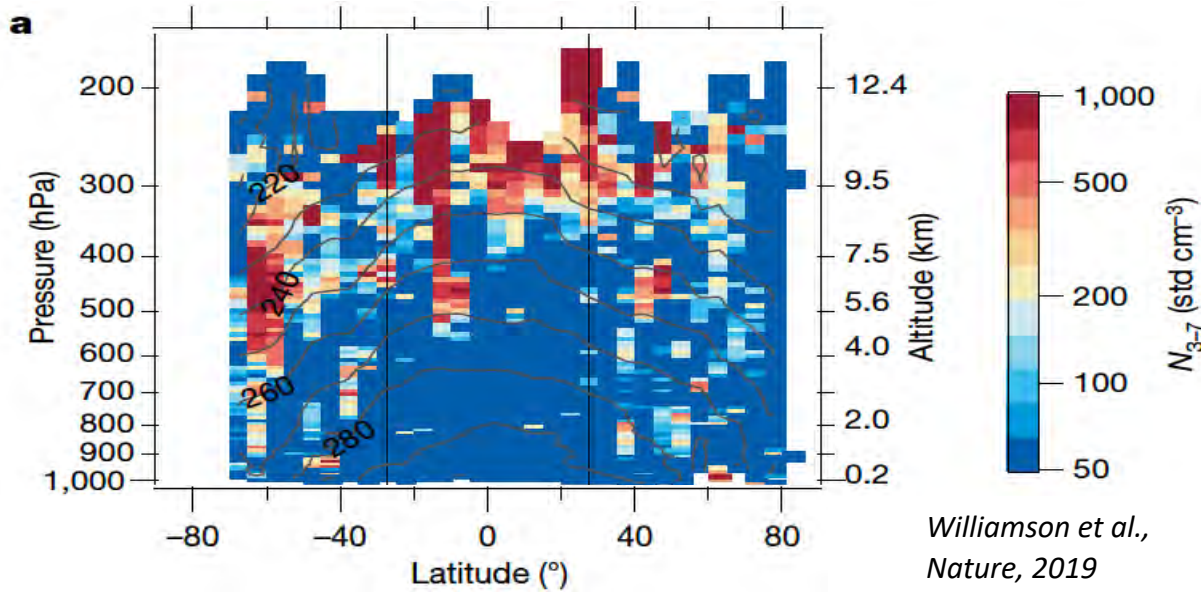
SABRE 2025 Test Flights



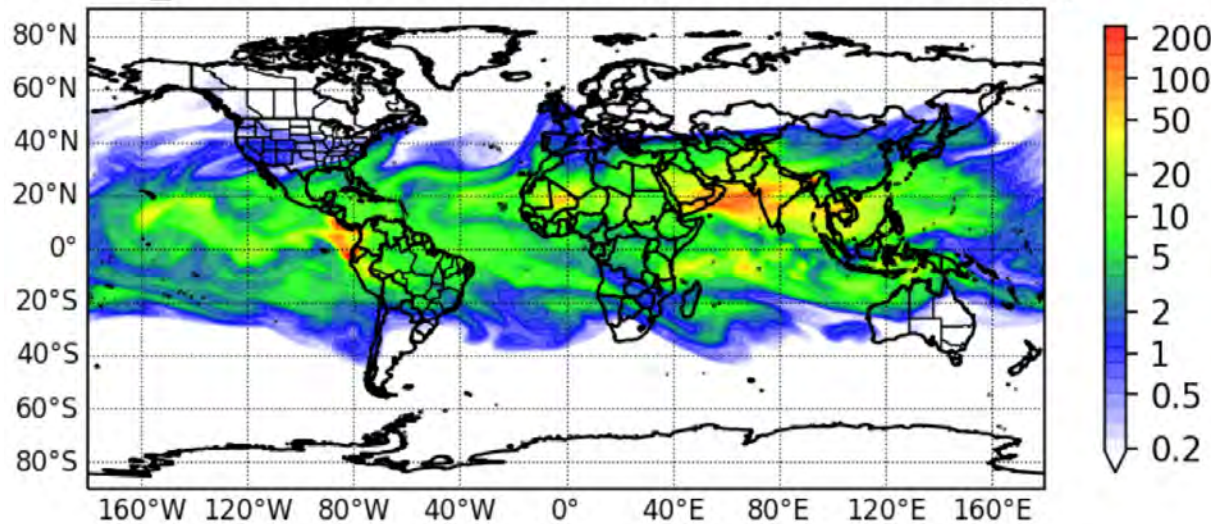
New / Modified Instrument Test Flights

- Airborne testing of new / modified / re-engineered instruments for science mission risk reduction
 - PALMS-NG (CVI and inlet tests)
 - StratCIMS (new front end)
 - NMASS-NG (new inst)
 - SP2 inlet (artifact source)
 - CO/CO₂/N₂O (new inst; GML)
 - NISSA aerosol inlet (new)
 - DLH (new NI hardware)
- Pallet inspection / maintenance

SABRE 2026 Tropical Science Mission



soa5_a1 at 100.5 hPa time 2024-08-12 00:00 (ppt)



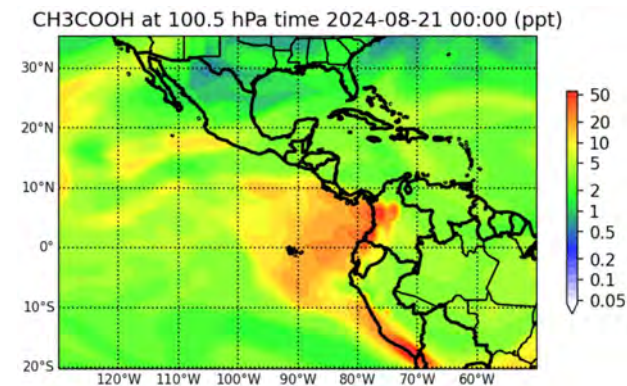
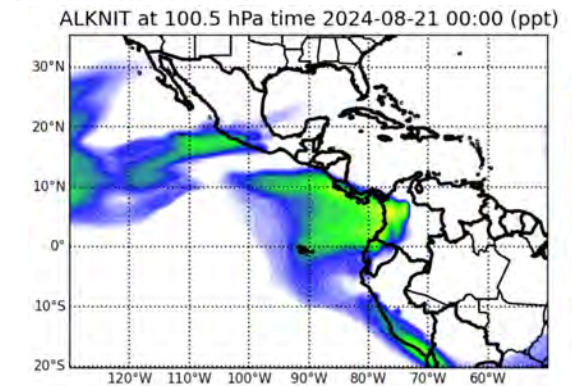
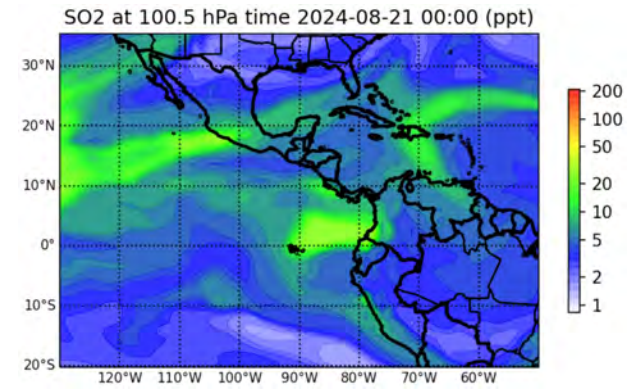
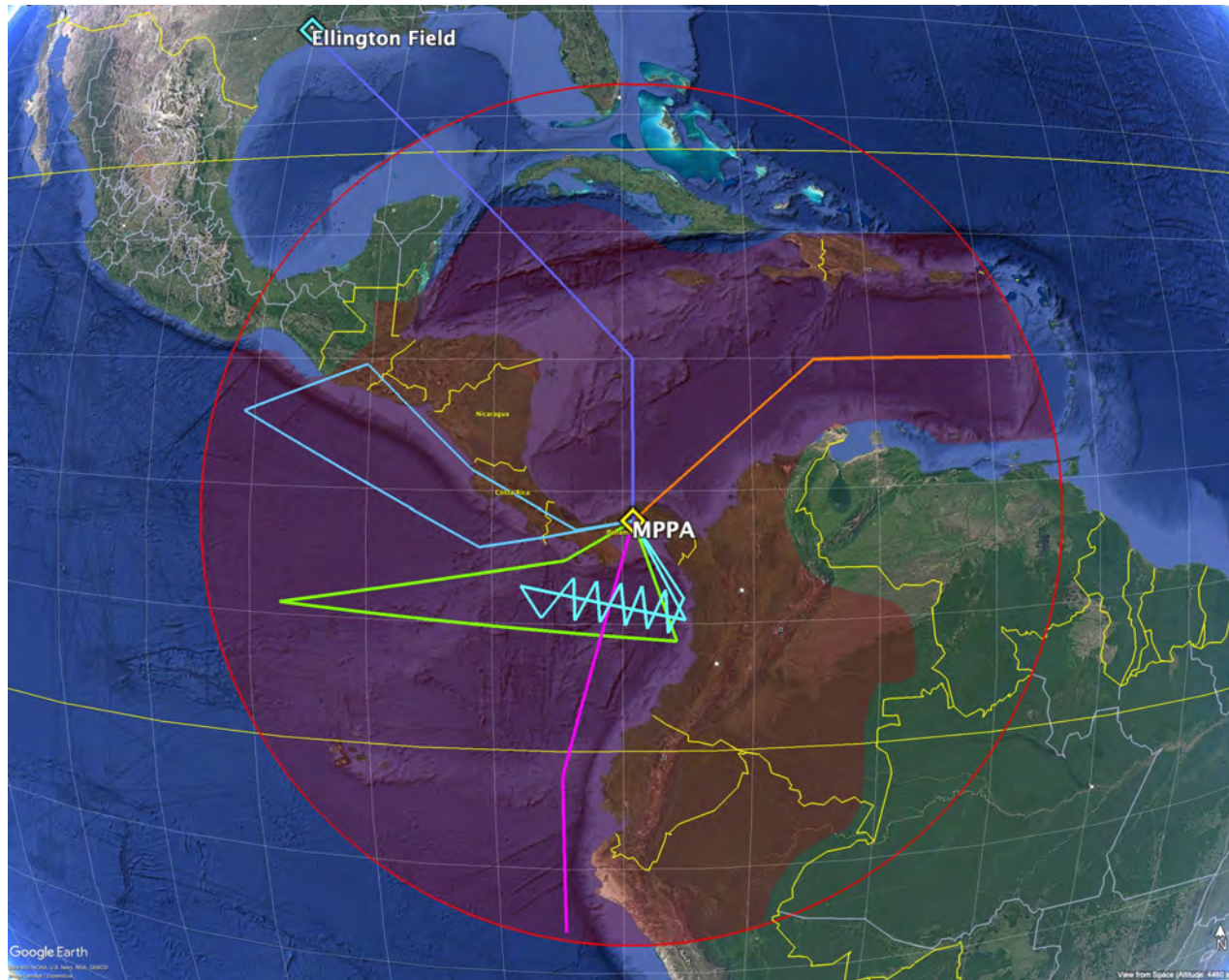
TTL / LS Aerosol process investigation

- The Tropical Tropopause Layer (TTL) is the dominant pathway for transport of material from the troposphere into the stratosphere
- WB-57 operations range 1000 nmi operational radius permits sampling +/- ~17° latitude from deployment location
- Access to recent outflow from deep continental tropical convection to sample convective lofting of aerosol precursor gases (SO₂, organics) into the TTL
- Influence of mixing vs production on the composition and microphysics of TTL aerosol

SABRE 2026 Tropical Deployment

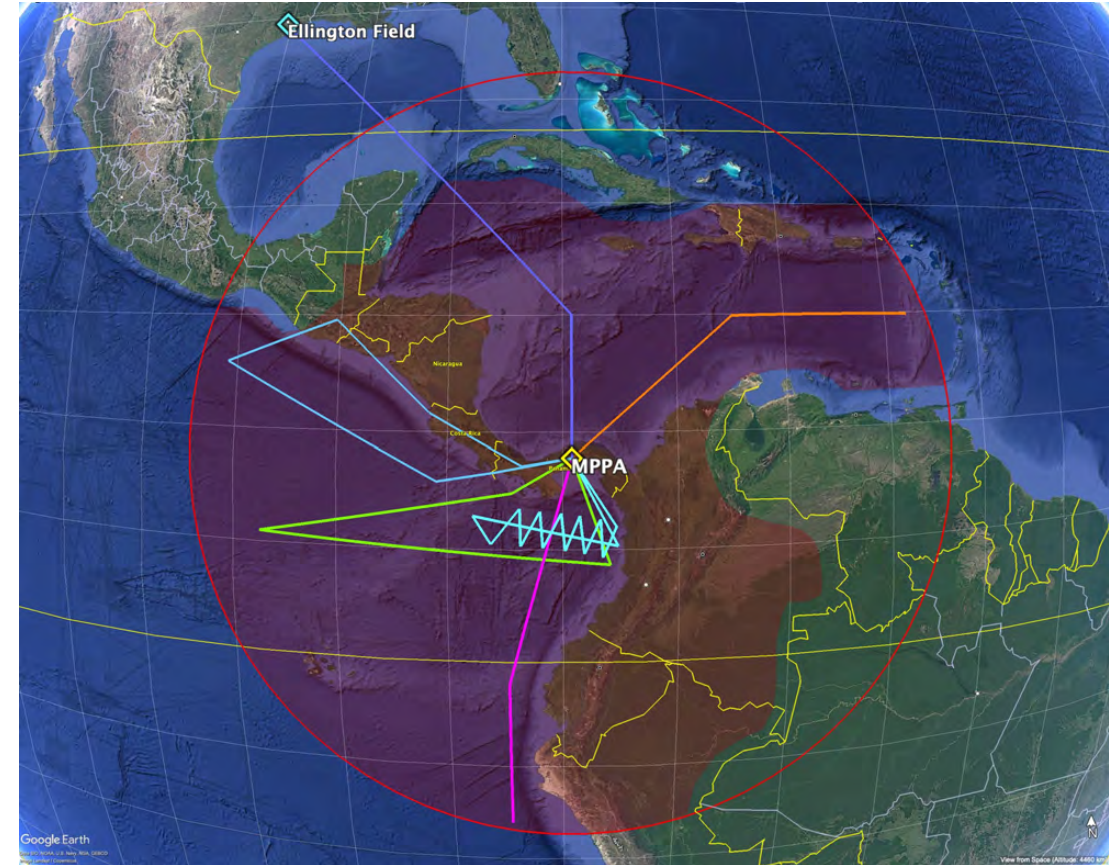
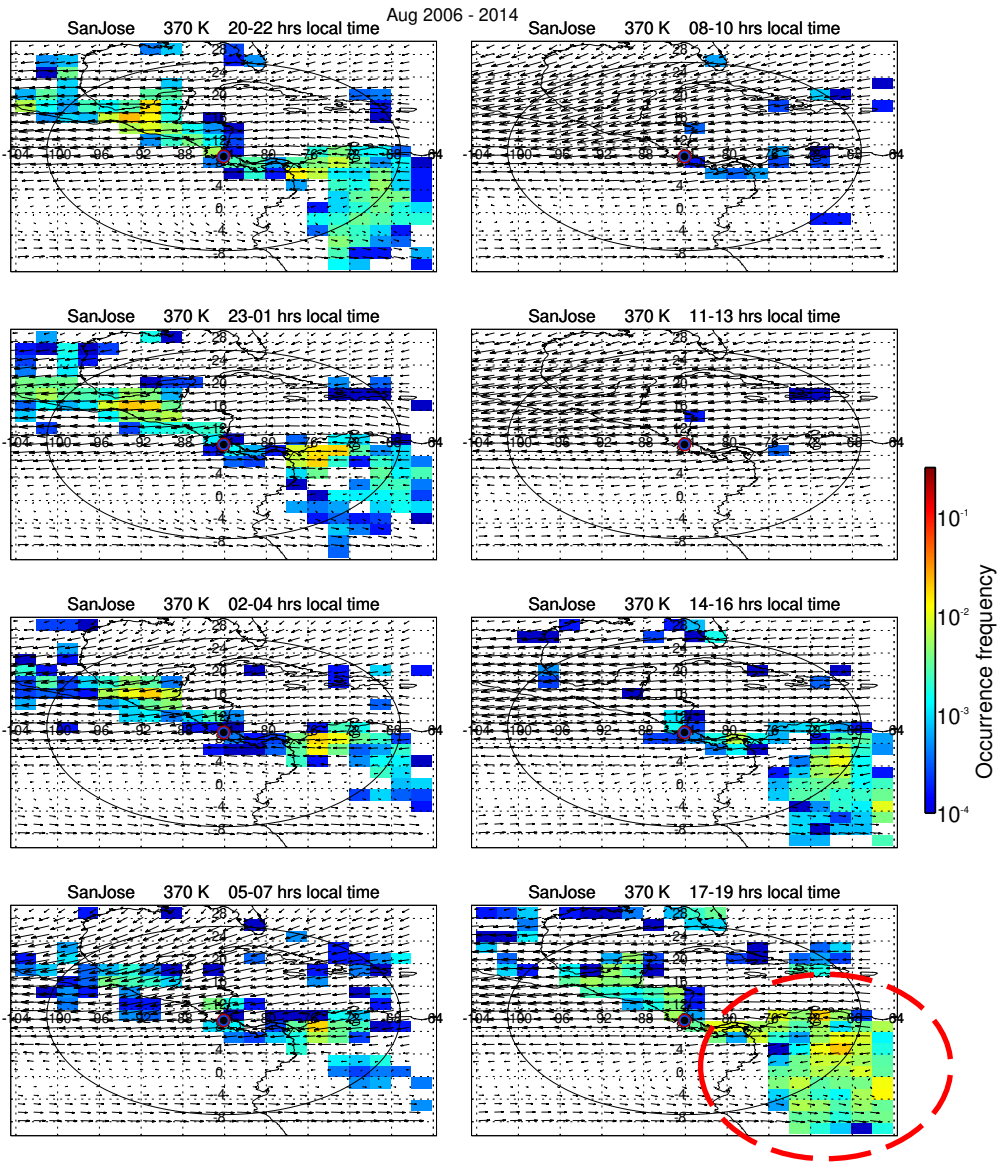


Panama Pacifico Airport, Panama



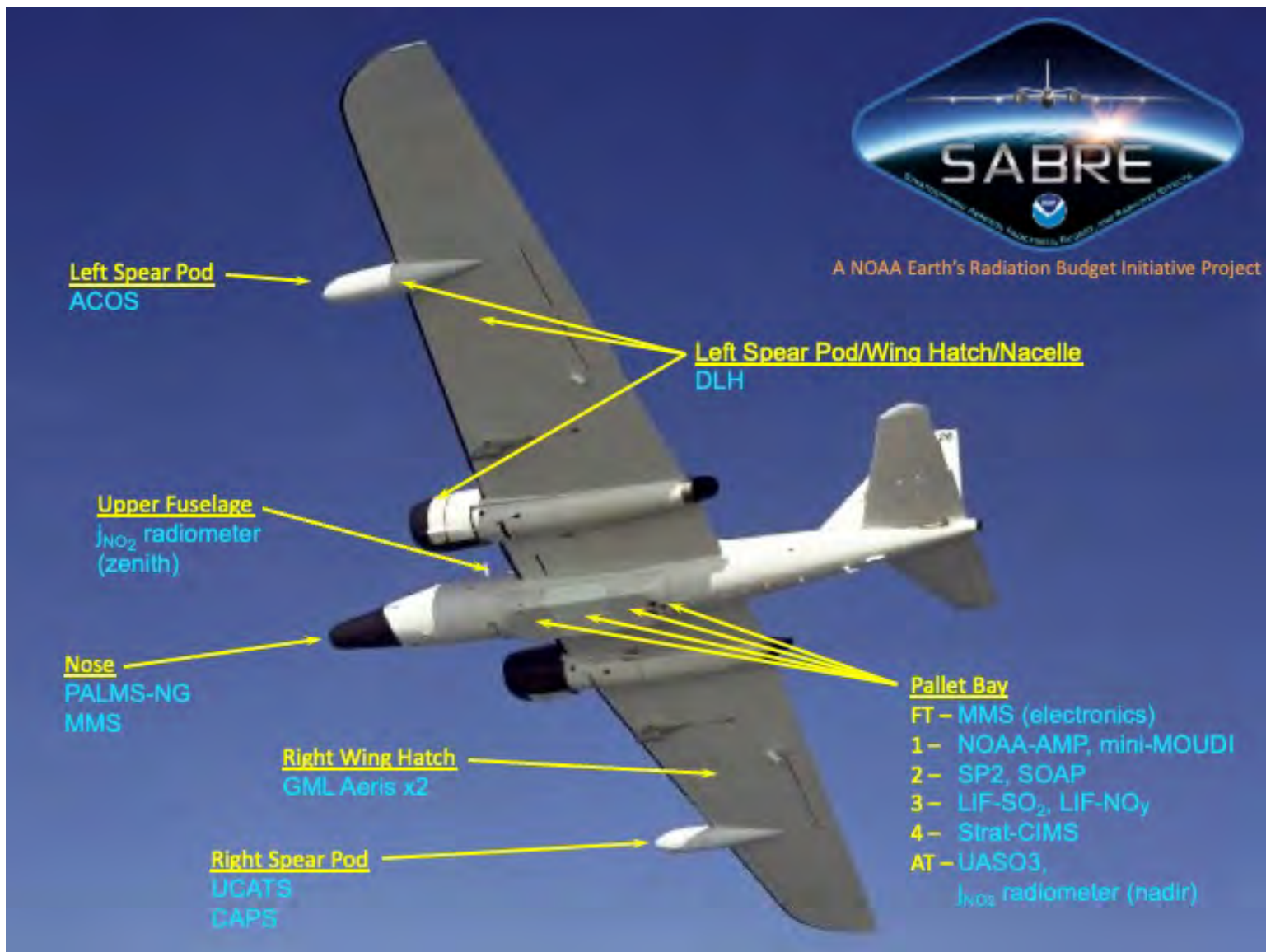
Models predict elevated levels of trace species in the TTL

August Deep Convection ($\Theta \geq 370$ K)



High frequency of very deep continental convection over northern South America

SABRE Science Payload



SABRE Payload for 2026 science flights

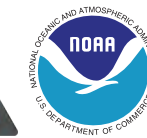
■ Additions since 2023

- ▶ New NMASS (8 channels vs 5)
- ▶ PALMS CVI inlet (cloud residual measurements)
- ▶ GML Aeris TDLs (higher time resolution transport tracers)

■ Changes from 2023?

- ▶ Mini-MOUDI relocated (improved sampling with other aerosol measurements)

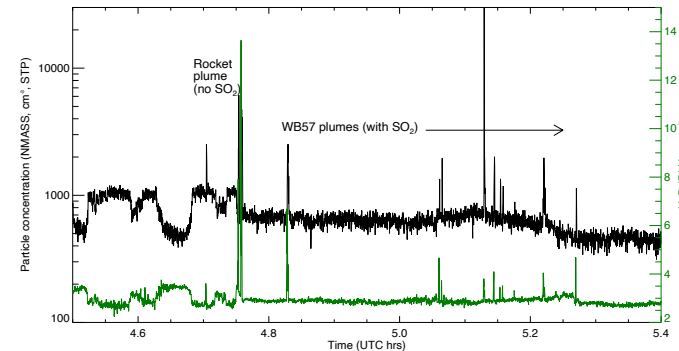
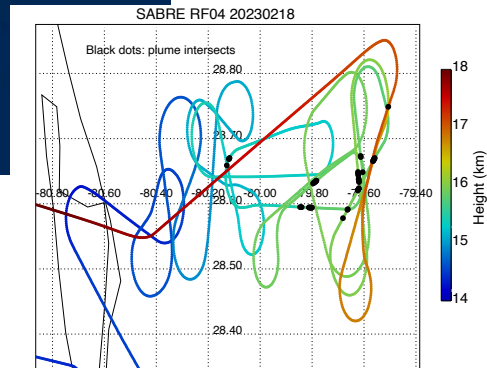
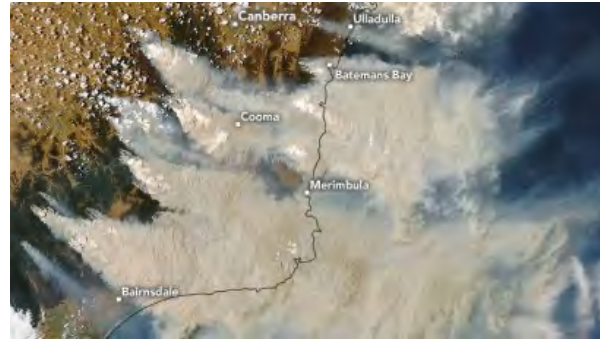
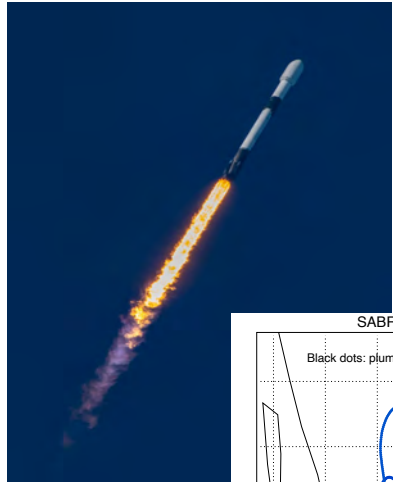
SABRE 2026 Science Payload



	Instrument	Measurement	Science
Aerosol:	NMASS condensation particle counter	Size distribution 4 – 55 nm	New particle formation
	UHSAS optical particle spectrometer	Size distribution 60 nm – 1 μ m	Fine mode aerosol
	CMASS optical particle spectrometer	Size distribution 400 nm – 4 μ m	Coarse mode aerosol
	SOAP cavity ringdown spectrometer	Aerosol extinction, aerosol absorption	Aerosol radiative properties
	PALMS-NG single particle laser ablation / ionization mass spectrometer	Aerosol composition	Aerosol types and formation processes (sources)
	SP2 intracavity laser incandescence spectrometer	Black carbon particle mass and number	Pyrogenic and primary anthropogenic aerosol tracer, radiatively important
	CAPS (Univ. Vienna) open path optical particle spectrometer	Cirrus cloud and coarse mode particle size and number	Radiative effects
	Mini-MOUDI (Harvard Univ.) aerosol impactor	Aerosol sample collector for offline analysis	Aerosol particle morphology and composition
Radiation:	J_{NO₂} filter radiometer	Shortwave (UV-vis) radiation	Photochemistry

	Instrument	Measurement	Science
State Parameters:	MMS (NASA ARC)	Temperature and pressure	Atmospheric state
Trace Gas:	UASO3 UV photometer	O ₃ mixing ratio	Stratospheric ozone layer, chemical coordinate
	LIF-SO2 laser induced fluorescence photometer	SO ₂ mixing ratio	Aerosol precursor, volcanic emissions
	ACOS integrated cavity tunable diode laser absorption spectrometer	OCS and CO mixing ratios	OCS is a key precursor for stratospheric sulfate aerosol; CO is a tracer for recent tropospheric influence
	LIF-NO laser induced fluorescence photometer	NO and NO ₂ mixing ratios, total reactive nitrogen (NO _y)	Stratospheric ozone chemistry, transport
	Strat-CIMS chemical ionization mass spectrometer	Halogen species, acids, reactive nitrogen species	Stratospheric ozone chemistry, aerosol precursors
	DLH (NASA LaRC) open path diode laser absorption spectrometer	Water vapor	Radiatively and photochemically important in the stratosphere
	UCATS + Aeris(x2) (NOAA GML) gas chromatograph and TDL spectrometers	N ₂ O, CO, CO ₂ , CH ₄ , SF ₆ , CFCs	Stratospheric dynamics (age of air)

SABRE Other Science Objectives



- A number of SABRE objectives would be addressed by opportunities to investigate stratospheric aerosol perturbations arising from natural or anthropogenic sources
 - Volcanic eruptions
 - Pyrogenic injections
pyrocumulonimbus (pyroCb)
 - Rockets
- Some may be addressed as part of the other planned SABRE missions