

Satellite Coastal & Oceanic Atmospheric Pollution Experiment (SCOAPE): Project Goals & Focus Area

Project Goal: NASA Support of BOEM Mission

- The Outer Continental Shelf Lands Act (OCSLA) requires BOEM to ensure compliance with the National Ambient Air Quality Standard (NAAQS) so that OCS oil and gas exploration, development, & production do not significantly impact the air quality of any state.
- NASA/GSFC are evaluating the potential for using satellite data to monitor offshore air quality with a focus on the Gulf of Mexico.

Scope of SCOAPE:

- Who:** NASA & BOEM.
- Where:** Current Focus - Gulf of Mexico (GOM).
- What:** Feasibility report on satellite product coastal applications & satellite product delivery (i.e. OMI/TROPOMI NO₂).
- How:** (1) Evaluation of current satellite & ground column data offshore using related coastal campaign datasets (ex. KORUS-OC, OWLETS) & (2) SCOAPE validation cruise in GOM (this poster)

Focus: Gulf of Mexico

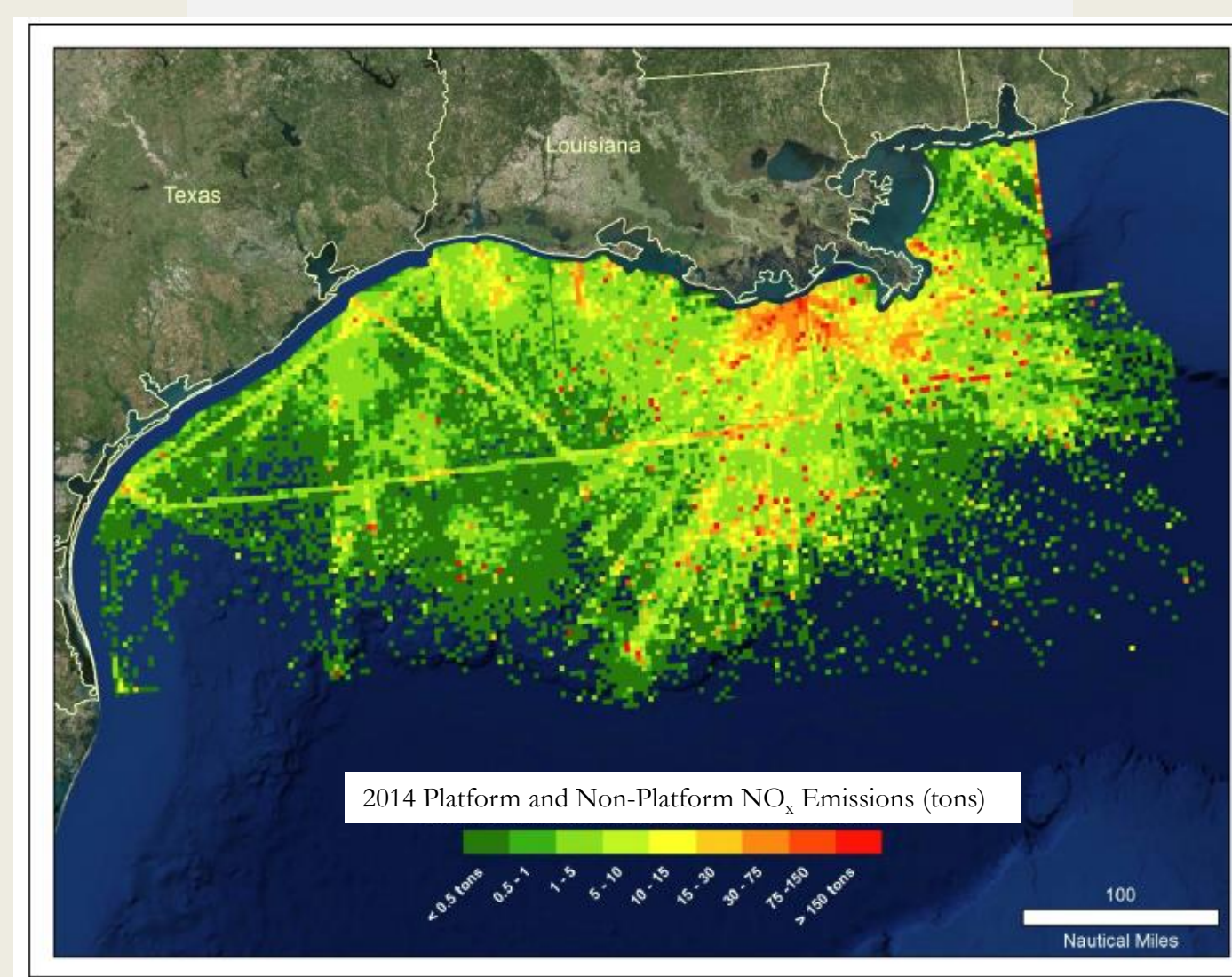
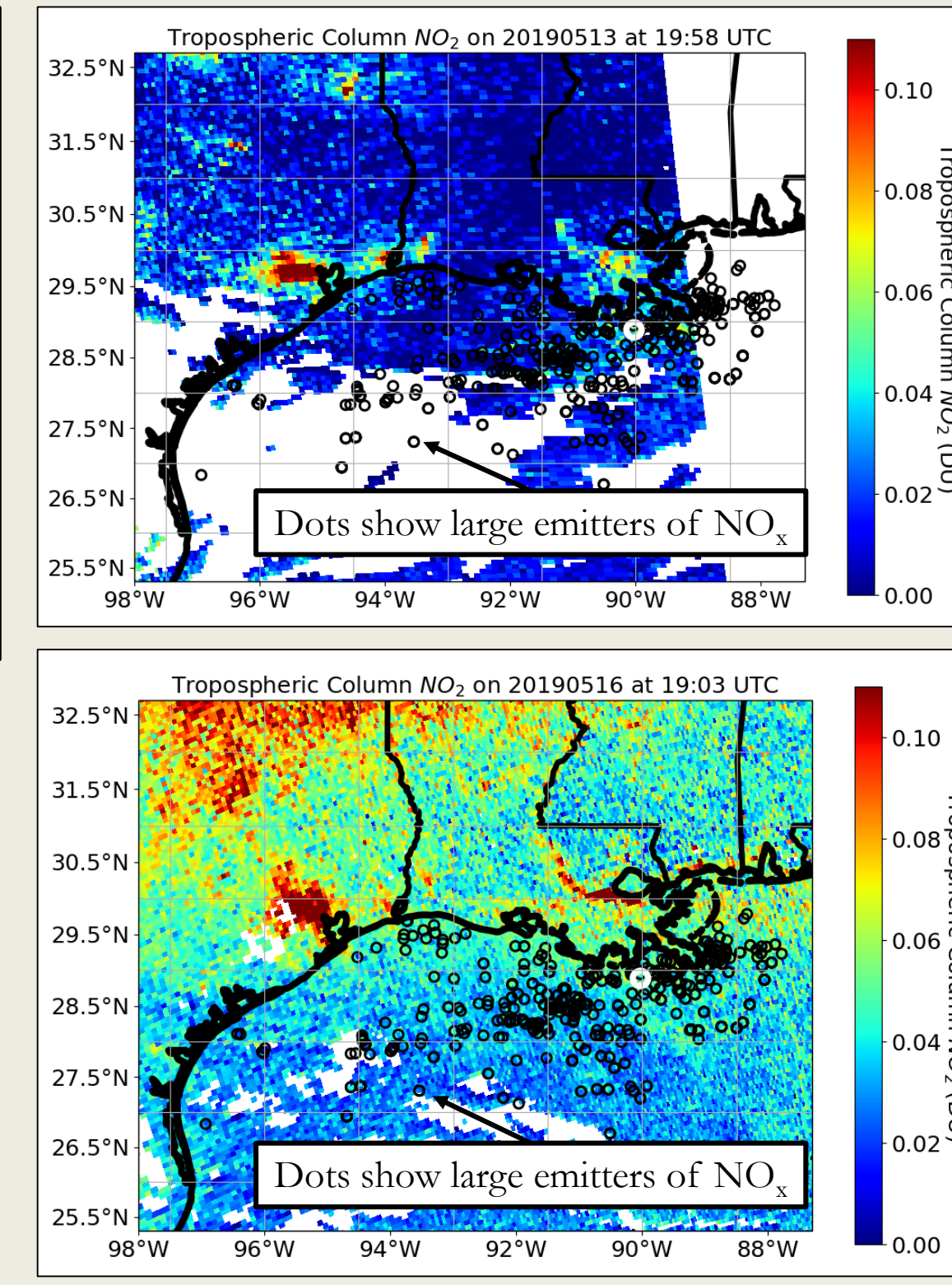


Figure 1: Cover image from BOEM OCS Study 2017-044. GOM Platform and Non-Platform NO_x emissions in 2014.

SCOAPE Cruise Goal: Satellite Validation in GOM

ESA TROPOMI View of GOM

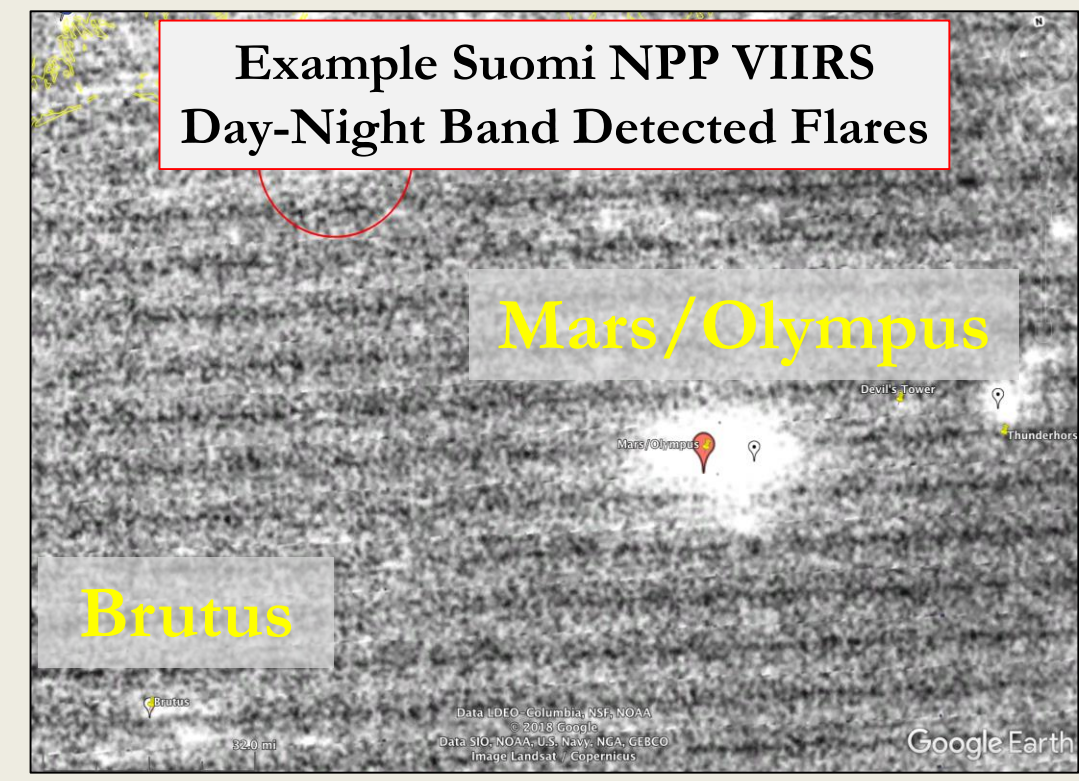
- 1x/day: NO₂, O₃ (0-2 km vertical), aerosol, clouds, formaldehyde, glyoxal, SO₂, CO, & CH₄.
- Global Coverage with Sub-urban resolution (3.5 x 7 km² for NO₂).
- Point Sur Pandora NO₂ and O₃ total column measurements will be posted to SCOAPE archive



Figures 7-10: (Left) Contrasting “clean” (13 May) and “polluted” (16 May) TROPOMI tropospheric NO₂ column measurements over the GOM region. (Right) Petronius platform flaring on the morning of 15 May; S-NPP satellite images of flaring activity at night over the GOM region (indication of enhanced emissions targets).



“Petronius” on 15 May



Example Suomi NPP VIIRS Day-Night Band Detected Flares

Mars/Olympus

Brutus

SCOAPE Cruise: 10 – 18 May 2019

- R/V *Point Sur* (USM-owned, LUMCON-operated) sailed in May 2019. May is favorable for onshore flow & clear skies for satellite measurements. Measurements were located at LUMCON (Cocodrie, Louisiana) to capture land/water gradients.
- Coastal deployment of two Pandoras will provide total column NO₂ to test reproducibility at the LUMCON site.
- BOEM emissions estimates (2014 & 2017) and TROPOMI gave guidance for sampling strategies during the cruise.
- Goals: (1) Capture regions where maximum & minimum NO₂ (plus CO₂, VOCs, CH₄) expected. (2) Validate gradients.

Species	Instrument	Collaborator
NO ₂ (and gas calibrator)	<i>In-situ</i> (Point Sur and LUMCON)	NASA GSFC (Thompson and Sullivan)
Column NO ₂ and O ₃	Pandora (1 on <i>Point Sur</i> and 2 at LUMCON)	NASA GSFC (Swap)
NO ₂	Sondes (coastal mobile measurements)	KNMI (den Hoed)
O ₃	<i>In-situ</i>	NASA GSFC
	Ozonesondes	NASA GSFC
Temperature, RH, winds, etc.	Met system	<i>Point Sur</i>
Aerosol (AOD) & O ₃ columns	MicroTops Sunphotometer	NASA GSFC
VOCs (plus CH ₄)	<i>In-situ</i> flasks	UCI (Blake)
CH ₄ , CO ₂ , H ₂ O	Picarro	NASA GSFC (Kawa/Hanisco)
PBL height	Remote sensing ceilometer (<i>Point Sur</i> and LUMCON)	UMBC (Delgado) and Univ. of Houston (Flynn)
Aethalometer (black carbon)	<i>In-situ</i>	Conny (NIST)





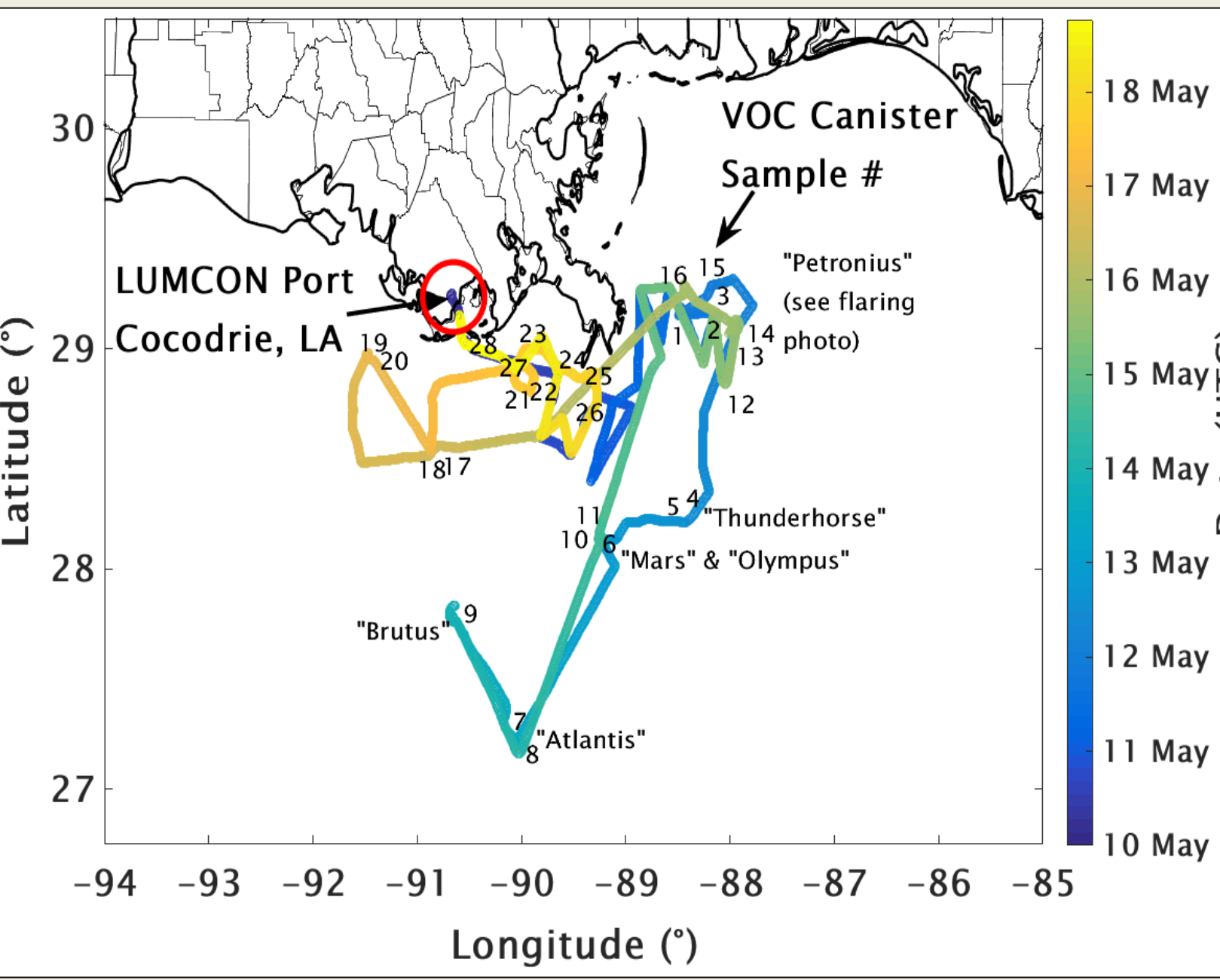
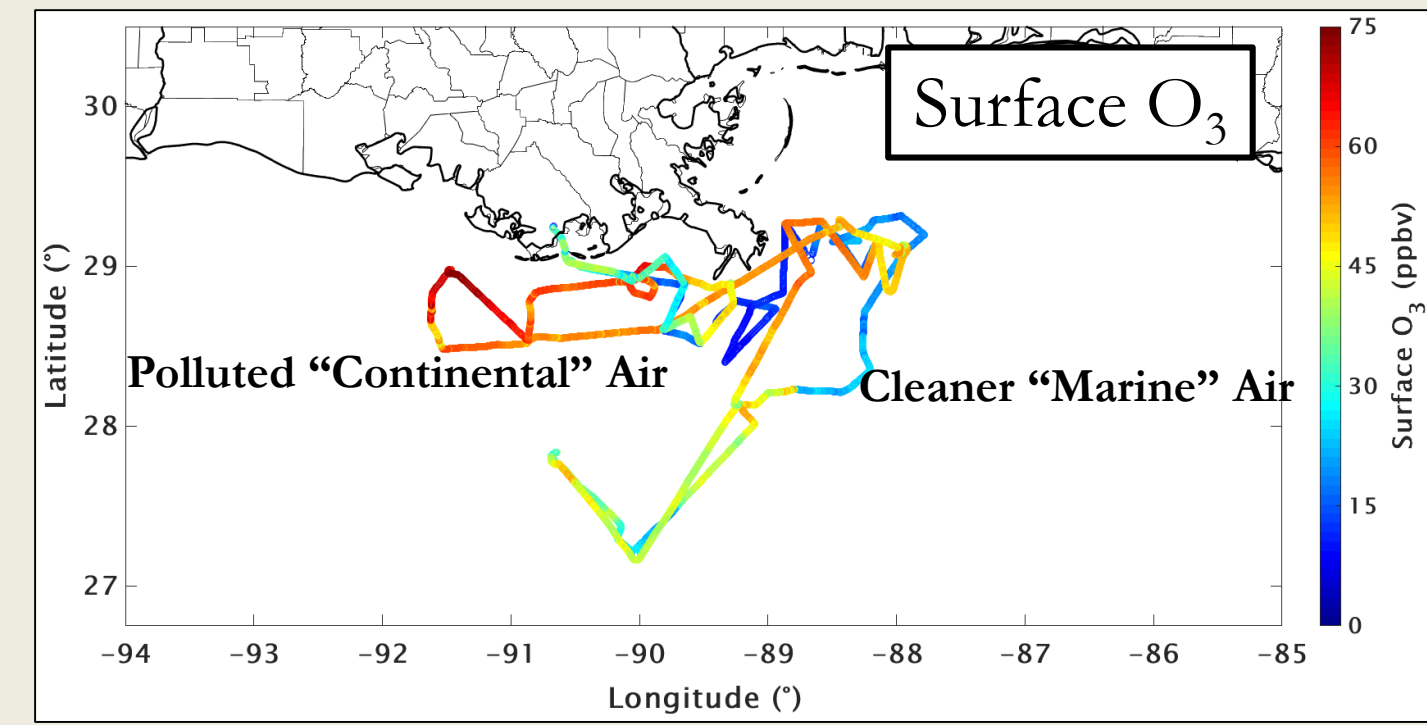


Figure 2-6: (Left) Suite of instrumentation and measurements collected on SCOAPE cruise and at LUMCON. (Center) SCOAPE scientists and R/V *Point Sur* crew; The R/V *Point Sur*; Pandora spectrometer collecting measurements at sunset on the *Point Sur*. (Right) SCOAPE cruise track, VOC canister sample locations, and named deep water platform points of interest.

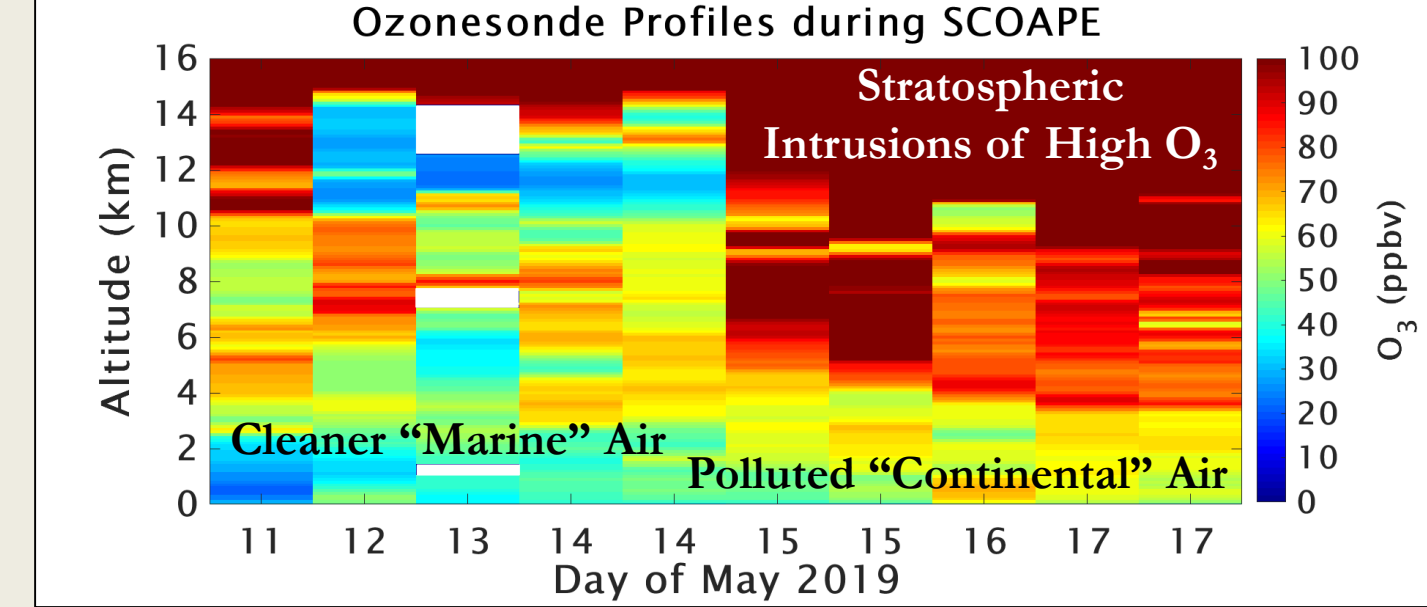
Marine vs. Continental Influences during SCOAPE Cruise



Surface O₃

Polluted “Continental” Air

Cleaner “Marine” Air

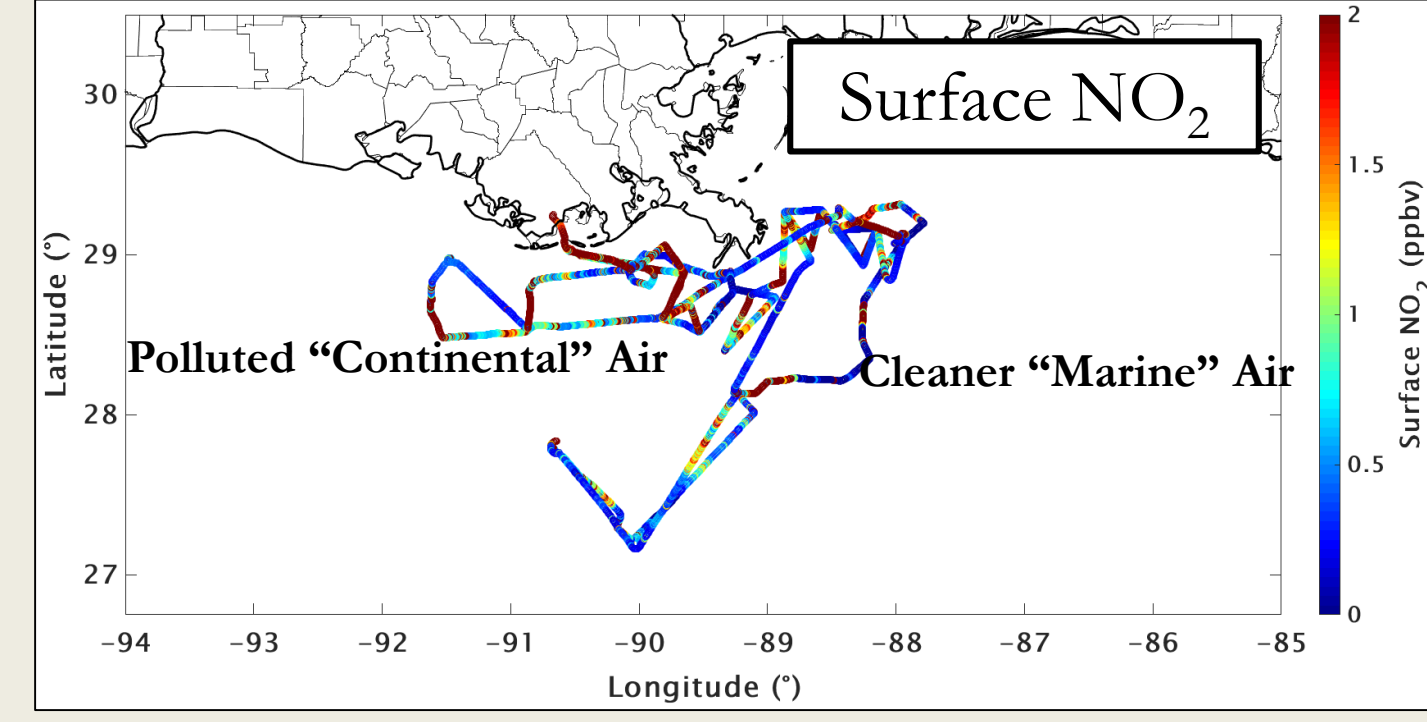


Ozonesonde Profiles during SCOAPE

Stratospheric Intrusions of High O₃

Cleaner “Marine” Air

Polluted “Continental” Air



Surface NO₂

Polluted “Continental” Air

Cleaner “Marine” Air

- Surface measurements (and TROPOMI NO₂ maps; above panel) indicate two contrasting “marine” and “continental” air masses during SCOAPE
- Ozonesondes (*middle left*) show a transition after 14 May, with higher near-surface O₃, and stratospheric intrusions into the free troposphere
- Additional measurements (CO₂, CH₄, H₂O), VOC analyses, and all data will be posted to the SCOAPE archive, hosted at NASA/LARC: <https://www-air.larc.nasa.gov/missions/scope/index.html>

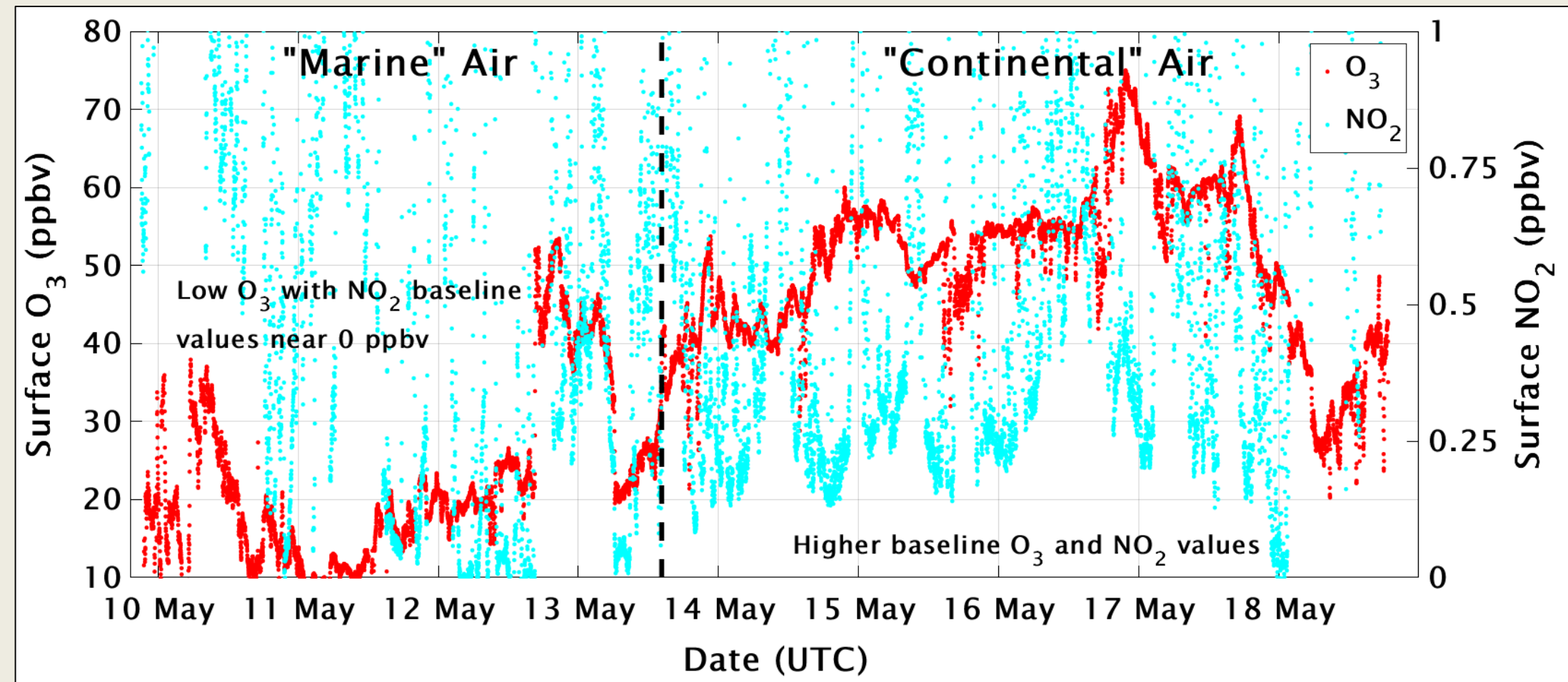


Figure 11-14: (Left) Surface O₃, ozonesonde profile “curtain”, and surface NO₂ data indicating differing regimes between the first and second half of the cruise. (Above) Time series of surface O₃ and NO₂ showing the shift from clean, marine air (southerly wind directions) to more polluted, continental air (northerly wind directions) around 14 May.