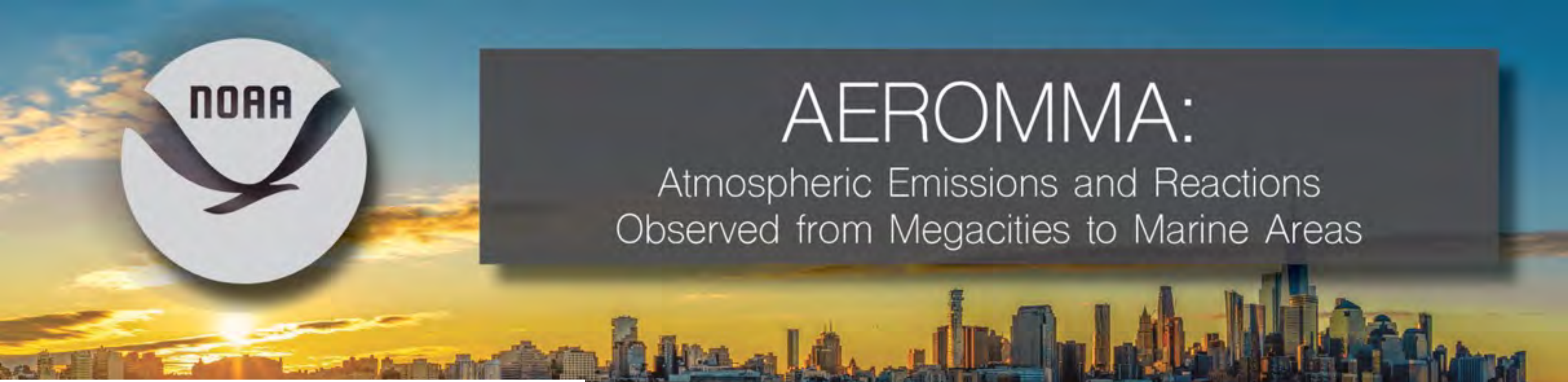
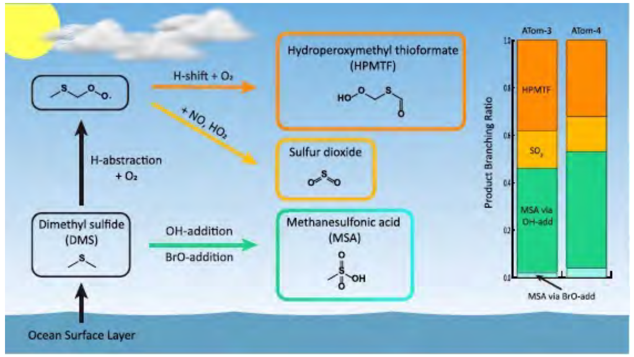


AEROMMA:

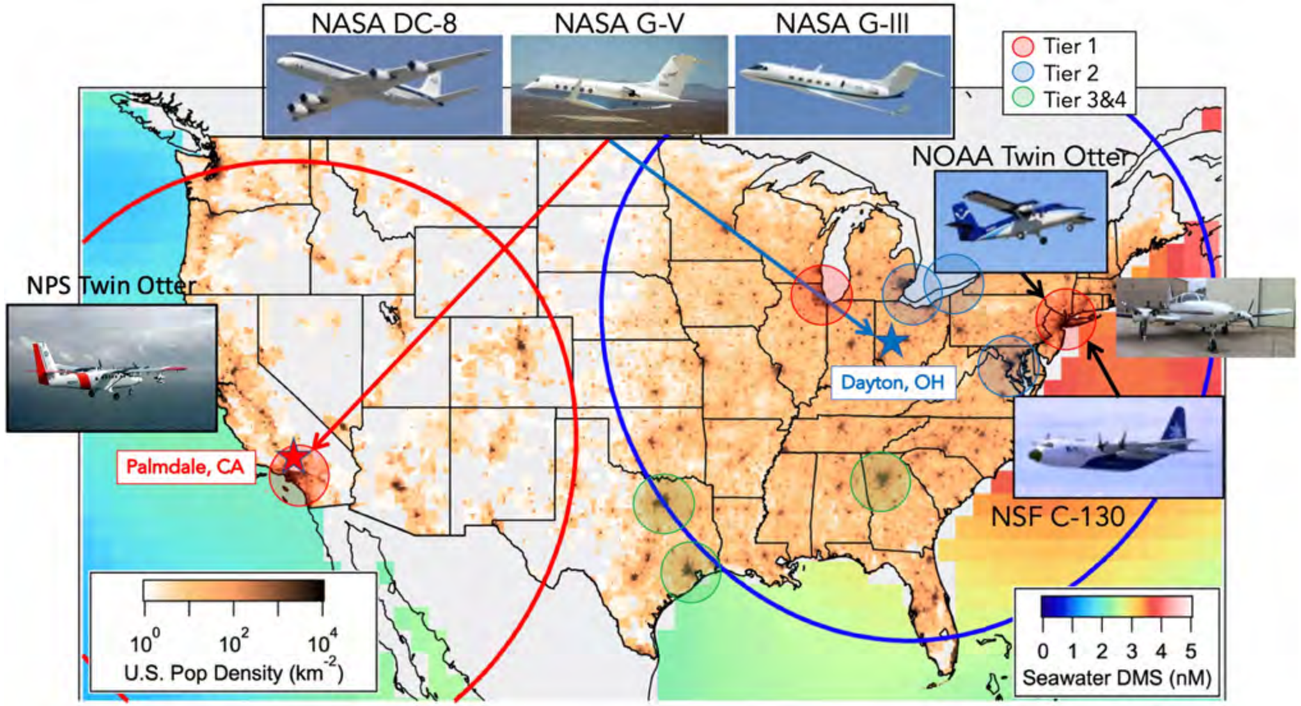
Atmospheric Emissions and Reactions Observed from Megacities to Marine Areas

https://csl.noaa.gov/projects/aeromma/

New insights into the marine sulfur cycle and its feedback on climate



Veres et al., PNAS 2020
Novak et al., PNAS 2021



Understanding urban air quality using aircraft and geostationary satellites

McDonald et al., Science 2018

NOAA CSL Points of Contact for 2023 Field Work

Patrick Veres

Andrew Rollins

Carsten Warneke

Rebecca Schwantes

Chelsea Stockwell

Brian McDonald

Steve Brown

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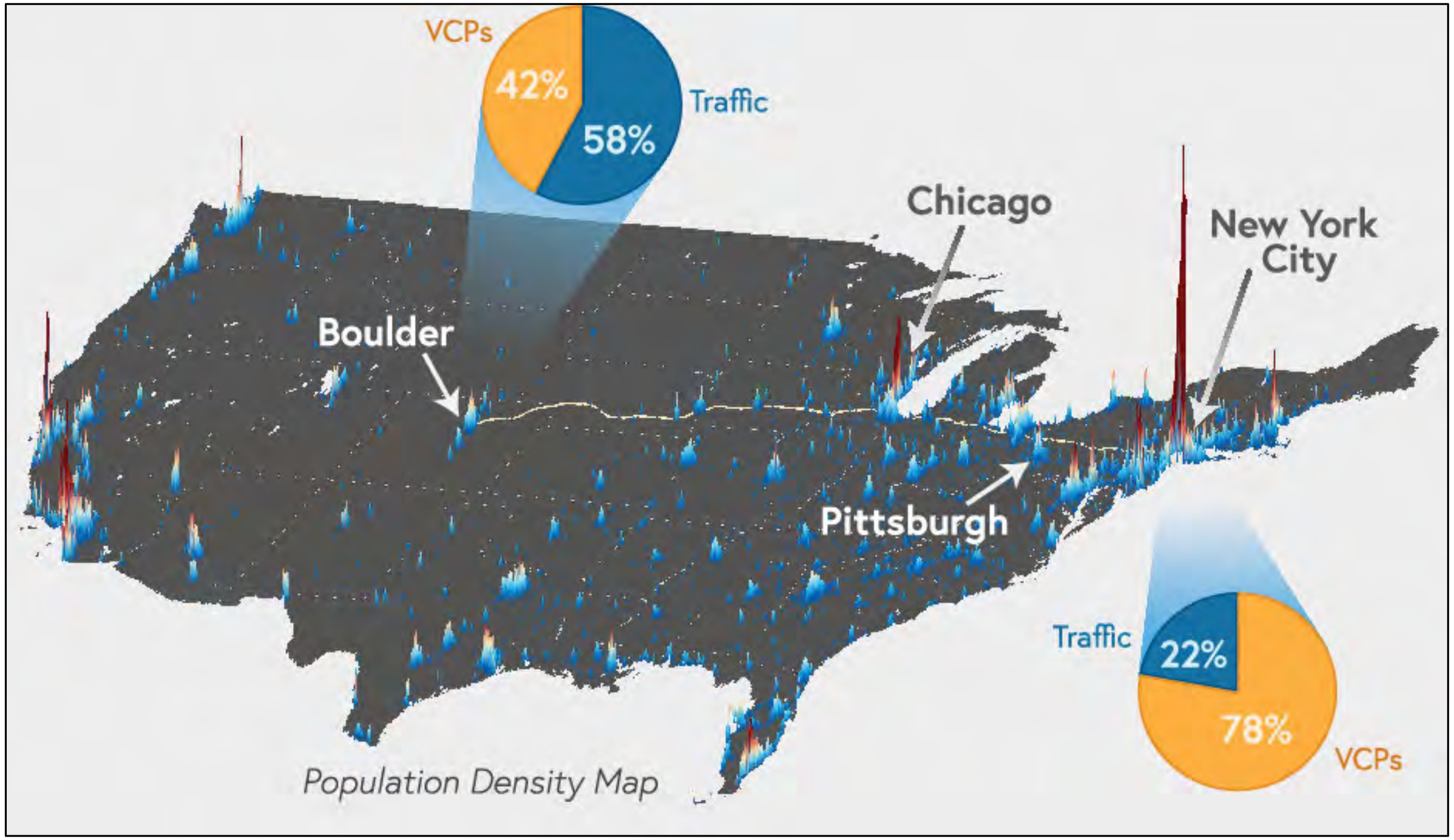
AEROMMA Ground Site Coordination

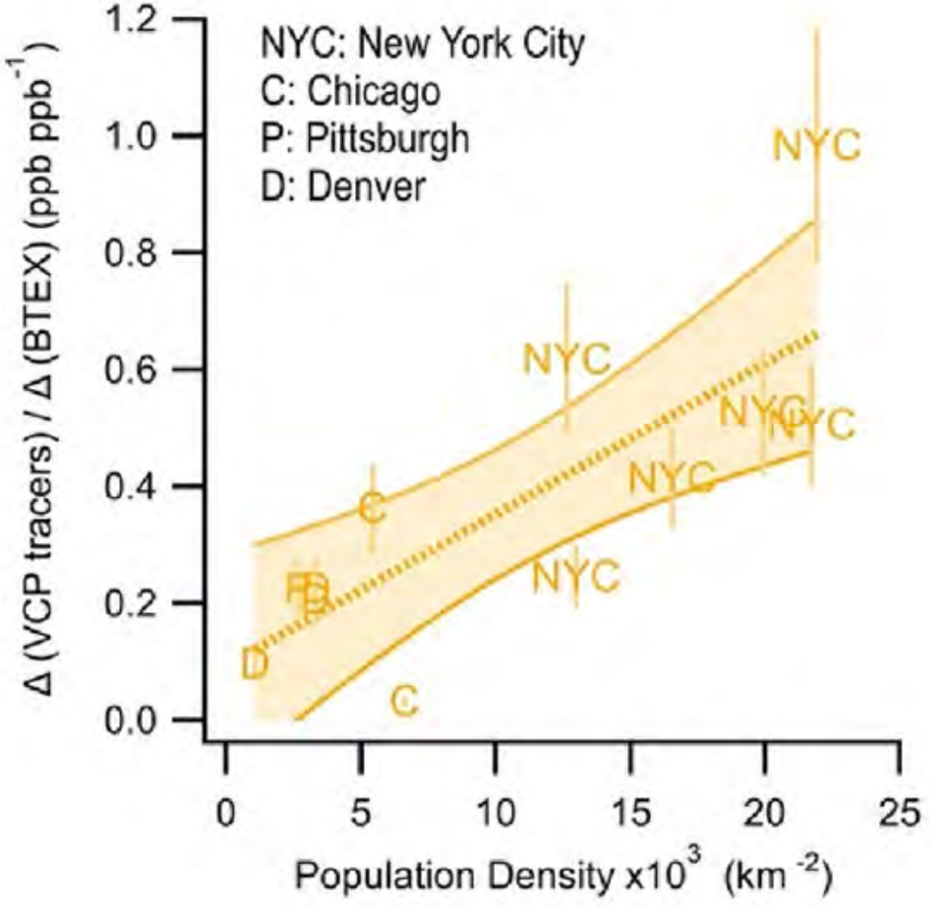
Chelsea Stockwell (chelsea.stockwell@noaa.gov)

AEROMMA Programmatic Liaison

Steven Brown (steven.s.brown@noaa.gov)

VCPs are in cities big and small (Source Apportionment)





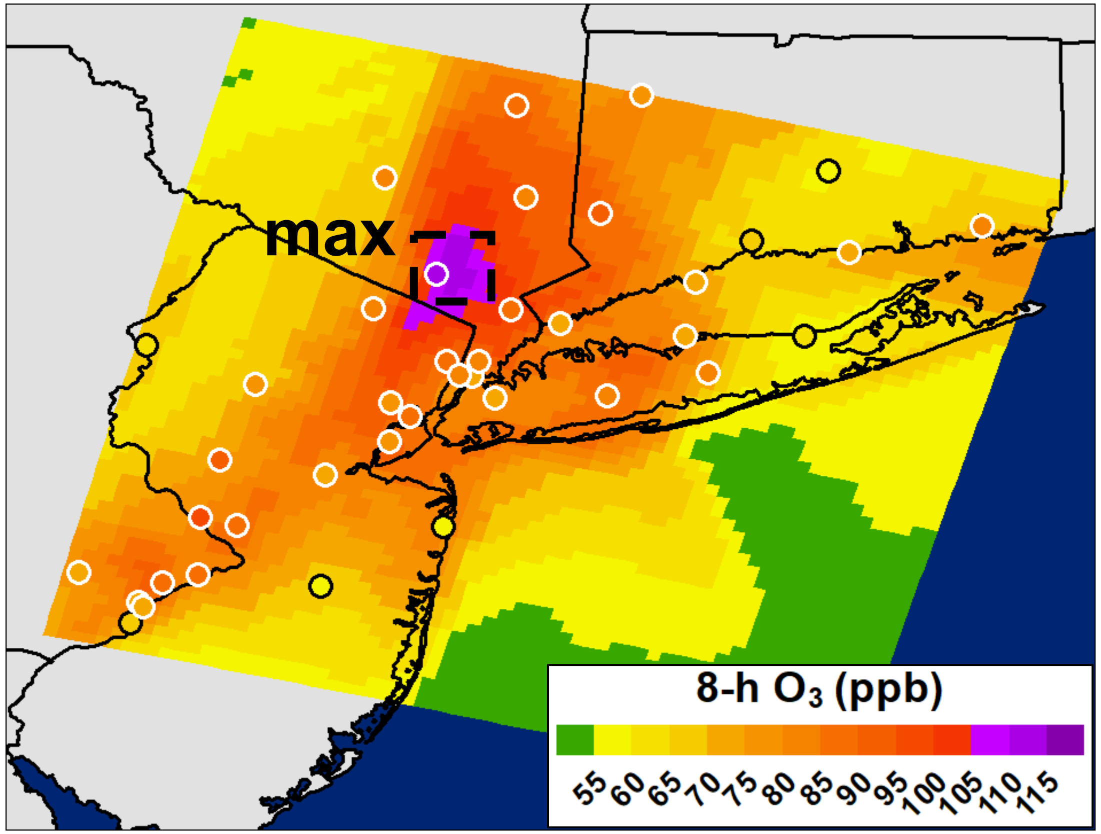
The fraction of VCP emissions increases with population density. Even in a place as small as Boulder, VCP emissions are nearly as abundant as mobile source VOCs

Based on mobile lab measurements

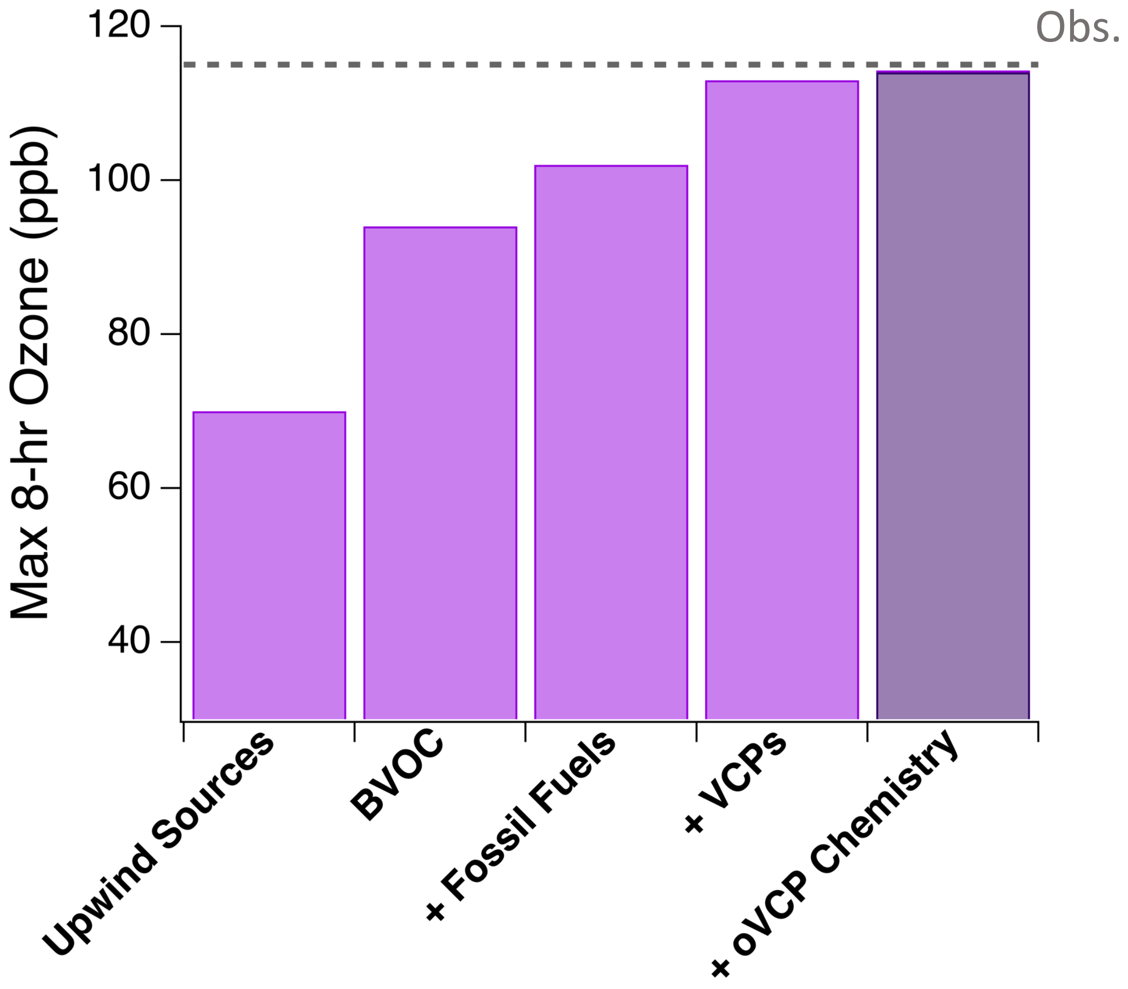
Gkatzelis et al. (2021), ES&T

WRF-Chem model: VCPs Needed to Explain Ozone

Ozone during heatwave, July 2, 2018



VOC sensitivity analyses at ozone maximum



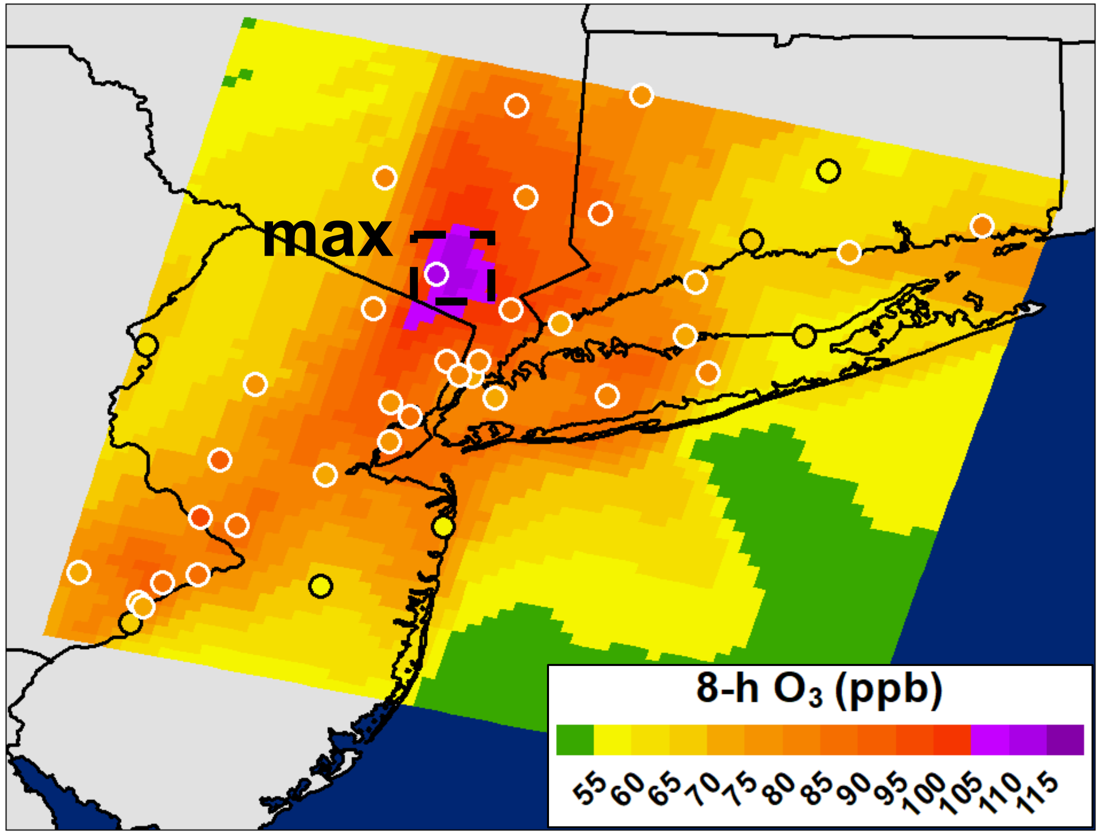
Key Takeaways

- Significant fraction of ozone attributed to VCPs, which are not well quantified

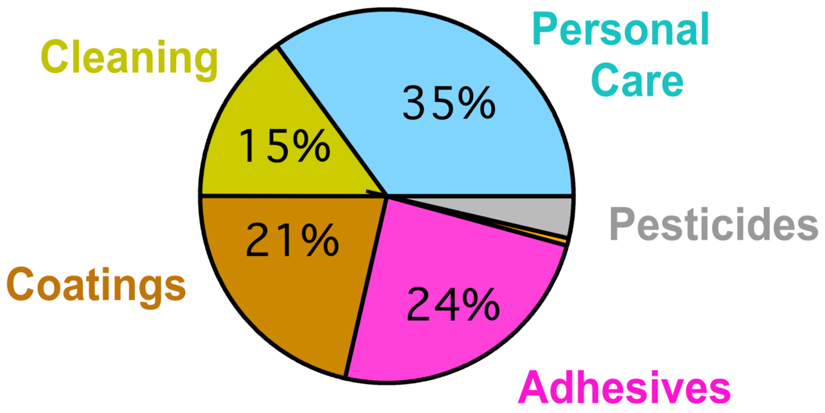
Learn more: *Coggon et al. (2021), PNAS*

Box model: Attribution of ozone

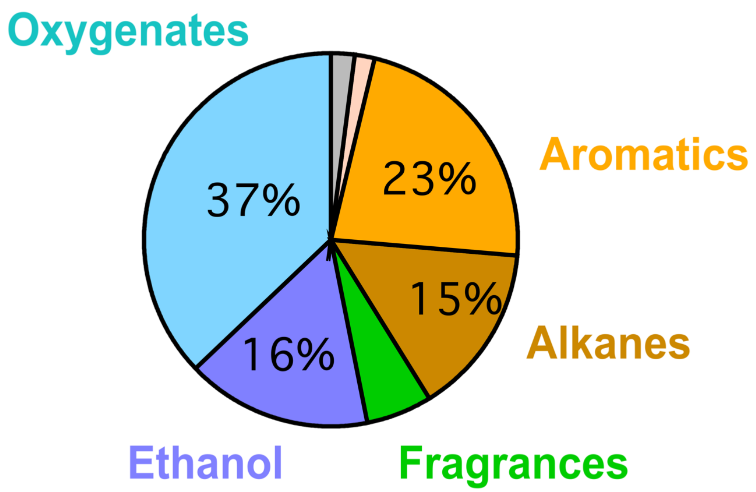
Ozone during heatwave, July 2, 2018



Breakdown of VCP ozone by category



Breakdown of VCP ozone by functionality

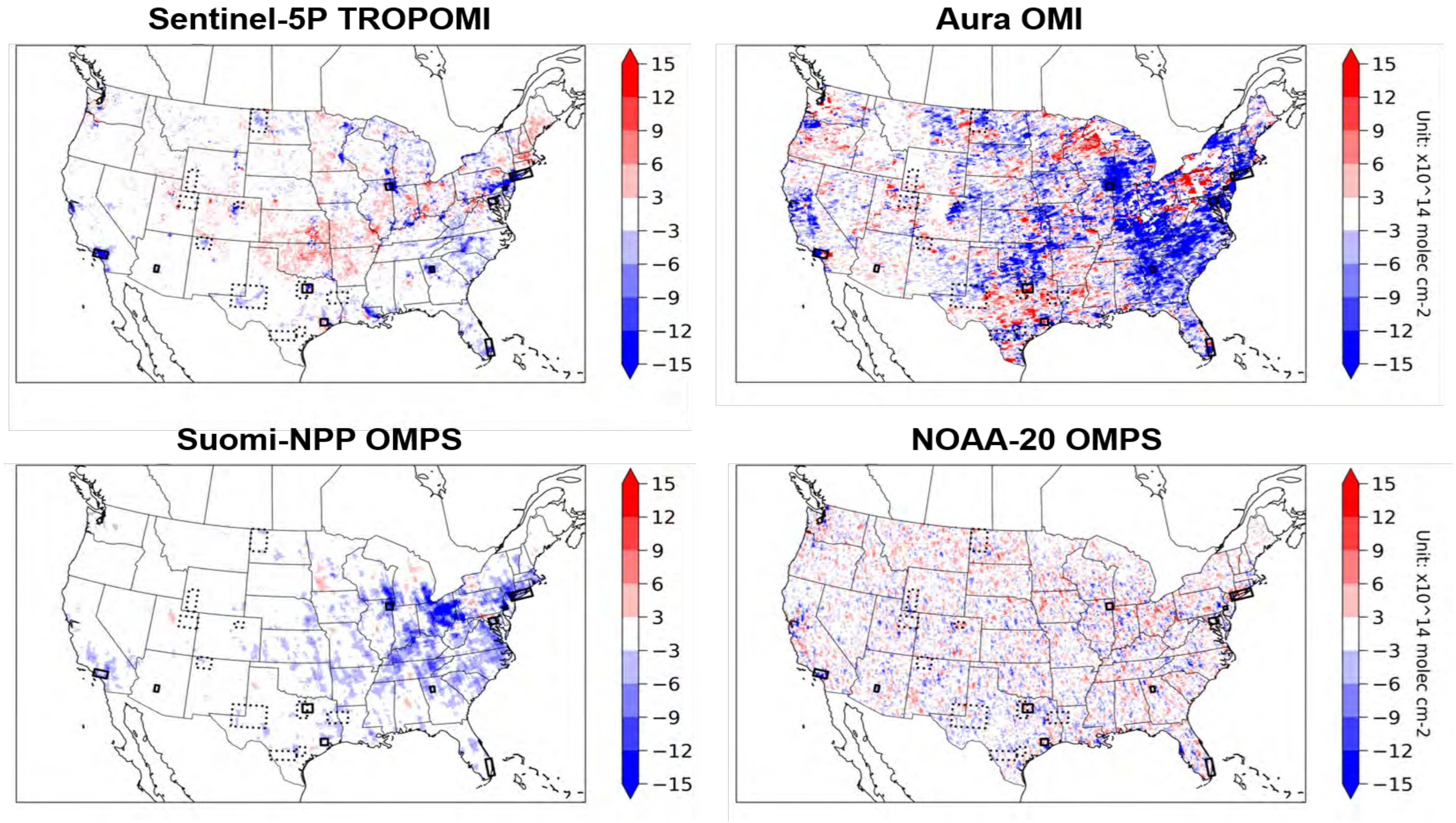


Key Takeaways

- Most VCP sectors contribute to ozone formation

Learn more: *Coggon et al. (2021), PNAS*

Four Different Satellite Products



The four different satellite instruments clearly do not agree well on their observations on how NO_2 changed due to COVID lockdown measures.

J. He (NOAA CSL)

AEROMMA Urban Science Goals

1. Determine organics emissions and chemistry, including of understudied VCPs and cooking in the most populated urban areas in the United States

2. Determine reactive nitrogen emissions and chemistry in major urban corridors (i.e., urban core to suburban and outlying rural areas) to understand the current importance of combustion and non-combustion sources

3. Determine co-benefits between managing air quality and the carbon cycle

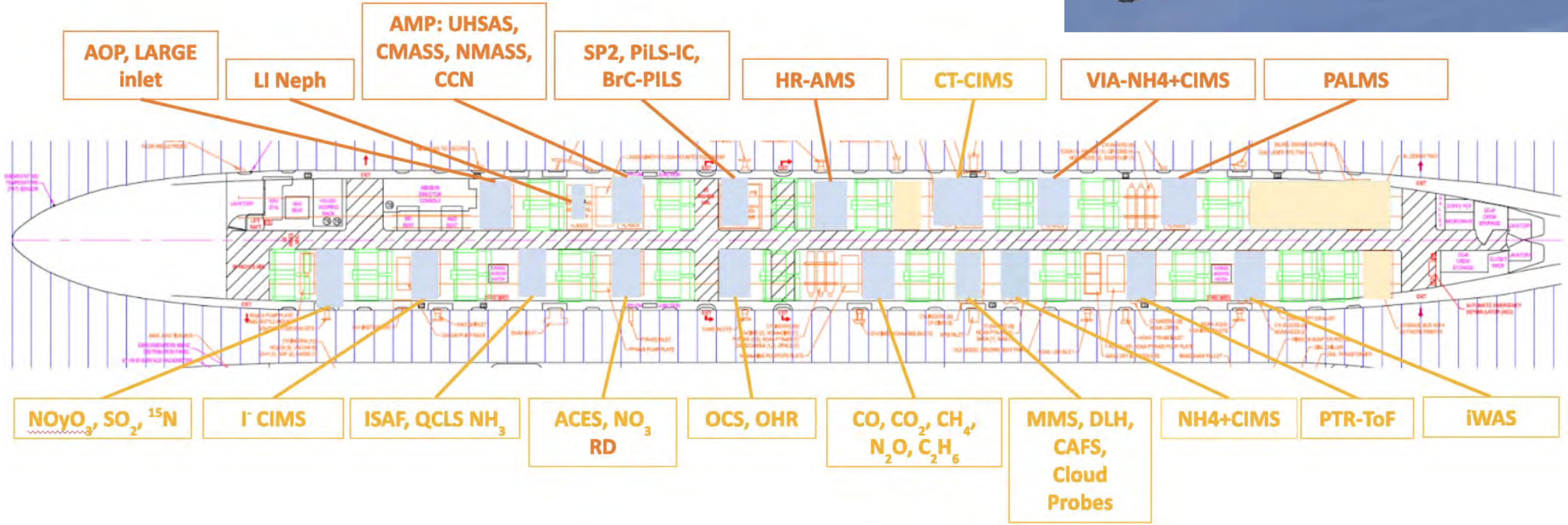
4. Provide observations for proving and reducing risk of TEMPO, JPSS, and GOES-R science and near real-time trace gas and aerosol products

5. Provide field observations for evaluating NOAA's next generation weather-chemistry models and chemical data assimilation of atmospheric composition satellite data

6. Provide observations from heavy-lift in-situ aircraft, airborne remote sensing, and ground-based networks for geostationary trace gas (NO_2, HCHO, O_3) and aerosol (AOD and ALH) products evaluation

AEROMMA DC-8 Instrument Payload

(Tentative, September 2022)



Majority of instruments from NOAA CSL:

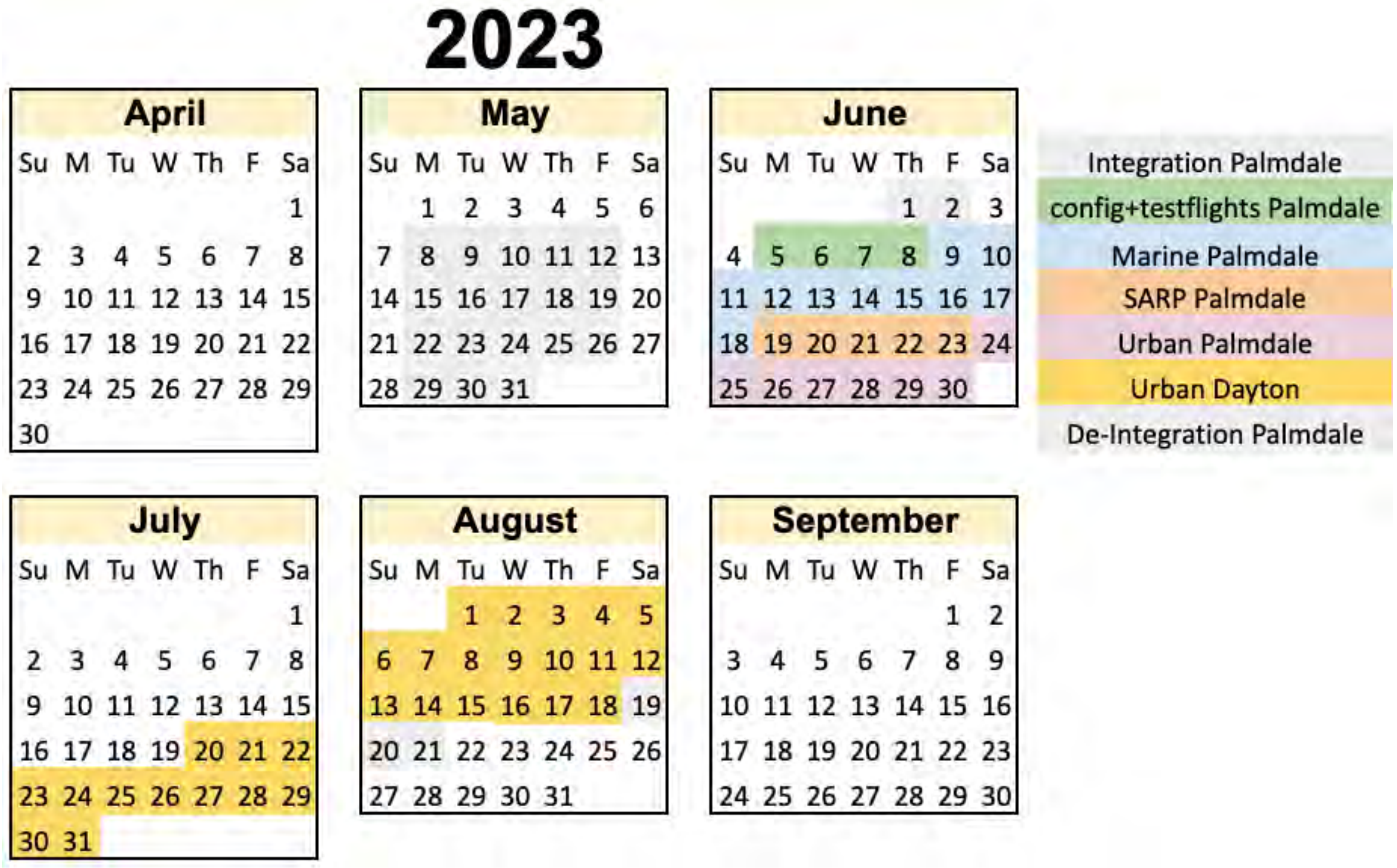
- Gas phase: GHG, NO_x, VOCs, halogens, sulfur, etc.
- Aerosol phase: number, size, mass, composition, and optical properties

AEROMMA DC-8 Instrument Payload

Species Measured	Technique	PI-name	Institution
Gas phase measurements			
O_3, NO, NO_2, NOy, 15N isotopes	$NOyO_3$, ^{15}N	Andrew Rollins, Steven Brown	NOAA CSL
HPMTF, PANs, HONO, OVOCs, $ClNO_2$, organic nitrogen	Iodide ToF-CIMS (I^- CIMS)	Patrick Veres	NOAA CSL
CO, CO_2, CH_4, H_2O	Cavity Enhanced Absorption (LGR+Picarro)	Jeff Peischl	NOAA CSL
CO, CO_2, CH_4, H_2O	DLH, DACOM	Glenn Diskin	NASA Langley
SO_2	Laser Induced Fluorescence	Andrew Rollins	NOAA CSL
OCS	Cavity Enhanced Absorption	Andrew Rollins	NOAA CSL
NH_3	QC-TILDAS (QCLS NH_3)	Ilana Pollack	CSU
CH_3COCHO, CHOCHO, NO_2, UV aerosol extinction	Cavity Enhanced Spectrometer (ACES)	Carrie Womack	NOAA CSL
Speciated hydrocarbons and OVOCs	H3O+ Vocus ToF-CIMS (PTR-ToF)	Carsten Warneke	NOAA CSL
C_2-C_{10} Alkanes, C_2-C_4 Alkenes, C_6-C_9 Aromatics, C_1-C_5 Alkylnitrates, etc.	Whole Air Sampling (iWAS)	Jessica Gilman	NOAA CSL
Hydro- and halocarbons	Portable Flask Package (PFP)	John Miller	NOAA GML
Formaldehyde (HCHO)	Laser Induced Fluorescence (ISAF)	Jennifer Kaiser	Georgia Tech
Highly Oxygenated VOCs	NH4+ Vocus ToF-CIMS (NH4+CIMS)	John Liggio	ECCC Canada
OH reactivity	Direct OH loss rate by LP–LIF (OHR)	Hendrik Fuchs	FZ Juelich
H_2O_2, organic peroxides, organic acids, isoprene oxidation products, etc.	CalTech-CIMS (CT-CIMS)	Paul Wennberg	CalTech
Aerosol measurements (physical/optical/chemical)			
Bulk aerosol composition, HNO_3	Filter sampling and mist chamber (PiLS-IC)	Amy Sullivan	CSU
BrC	Spectro-photometer (BrC PiLS)	Rebecca Washenfelder	NOAA CSL
Aerosol absorption and extinction at multiple wavelengths and RH	Cavity ringdown extinction and photoacoustic absorption spectrometers (AOP)	Charles Brock	NOAA CSL
Aerosol scattering phase function at UV and visible (blue) wavelengths	Laser Imaging Nephelometer (Li-Neph)	Dan Murphy	NOAA CSL
Aerosol number density, size dist., and physical properties, CCN	Particle counters, nephelometers, etc. (UHSAS, CMASS, NMASS, CCN) (AMP)	Charles Brock	NOAA CSL, NASA LaRC
BC concentration, size, mixing state	Humidified-Dual SP2	Joshua Schwarz	NOAA CSL
Submicron aerosol composition	Aerosol mass spectrometer (HR-AMS)	Ann Middlebrook	NOAA CSL
Submicron aerosol composition	Vocus Inlet for Aerosols with NH4+ CIMS detection (VIA-NH4+CIMS)	Carsten Warneke	NOAA CSL
Single particle composition	PALMS	Daniel Cziczo	Purdue
Radiation			
Zenith/nadir solar actinic flux and photolysis frequencies	4π-sr spectroradiometry (CCD)	Birger Bohn	FZ Juelich

AEROMMA DC-8 Deployment Schedule

(Tentative, September 2022)



May – June: >2 weeks marine flights

Mid June: 1 week NASA SARP flights coordinated with STAQS

June-July: ~3 weeks Break

July – August: >5 weeks urban flights, east coast midwest, coordination with other airborne assets (STAQS, CUPIDS, GOTHAAM, ground sites)

AEROMMA DC-8 Alternative Schedule

(Dependent on TEMPO Launch)

2023

April

Su	M	Tu	W	Th	F	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

May

Su	M	Tu	W	Th	F	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

June

Su	M	Tu	W	Th	F	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

- Integration Palmdale
- config+testflights Palmdale
- Marine Palmdale
- SARP Palmdale
- Urban Palmdale
- Urban Dayton
- De-Integration Palmdale

July

Su	M	Tu	W	Th	F	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

August

Su	M	Tu	W	Th	F	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

September

Su	M	Tu	W	Th	F	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

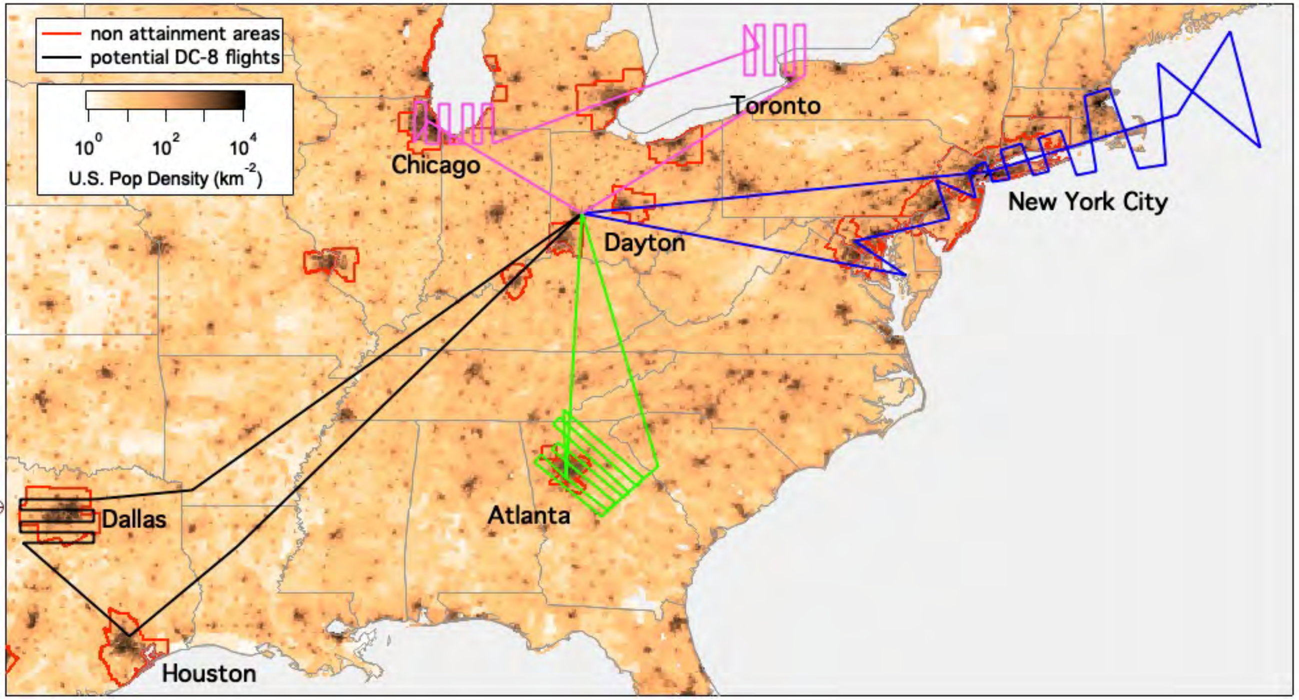
May – June: >2 weeks marine flights

Mid June: 1 week NASA SARP flights coordinated with STAQS

June-July: 4 weeks Break

August: >5 weeks urban flights, east coast midwest, coordination with other airborne assets (STAQS, CUPIDS, GOTHAAM, ground sites)

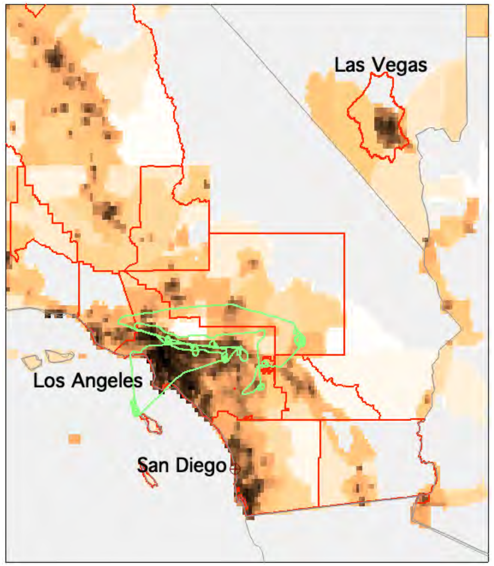
Work in progress: Flight Planning

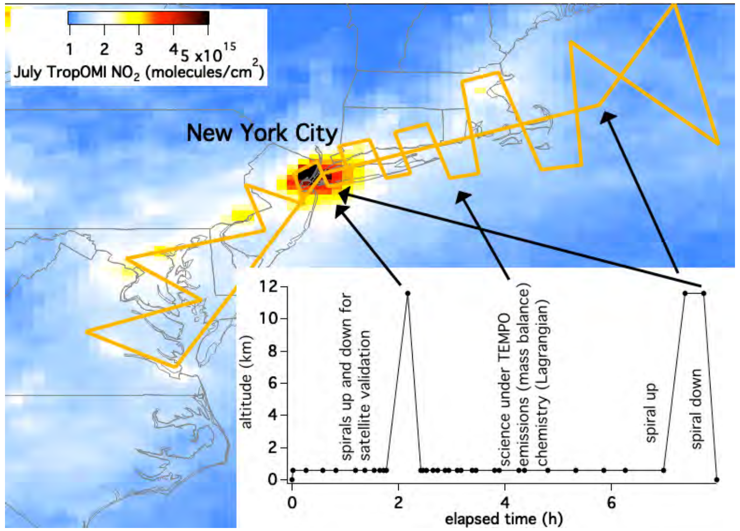


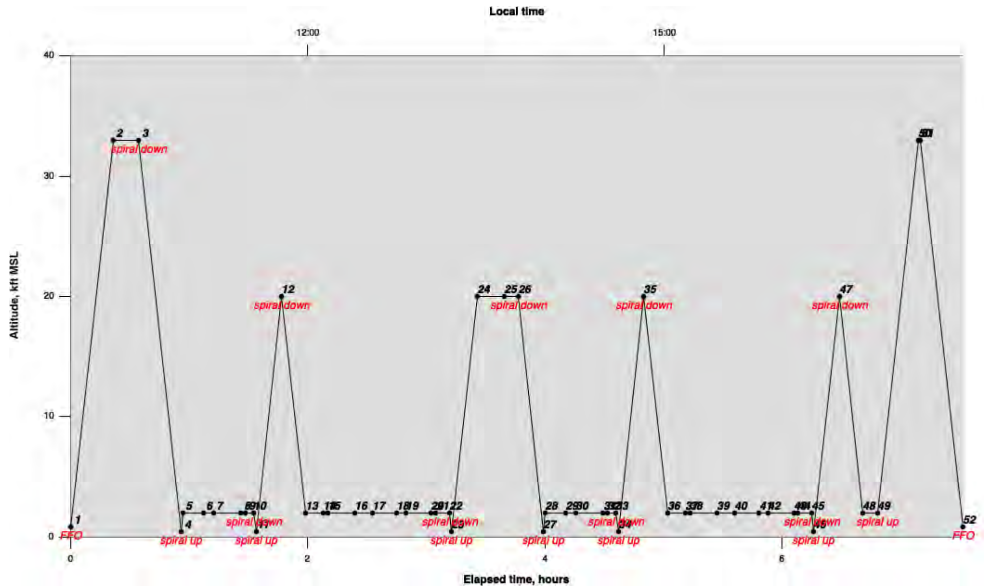
Tier 1: Los Angeles ~3 flights + SARP
New York (~4 flights)
Chicago (~4 flights)

Tier 2: Toronto (~3 flights)

Tier 3: Houston (up to 1 flight)
Atlanta (up to 1 flight)







We thank

NOAA NESDIS

for supporting
AEROMMA2023