



ARM ACME PROJECT

ARM Airborne Carbon Measurements

Sébastien Biraud, Margaret Torn,
Colm Sweeney (NOAA), Chip Miller
(NASA/JPL), Steve Wofsy (Harvard U.),
the AAF team

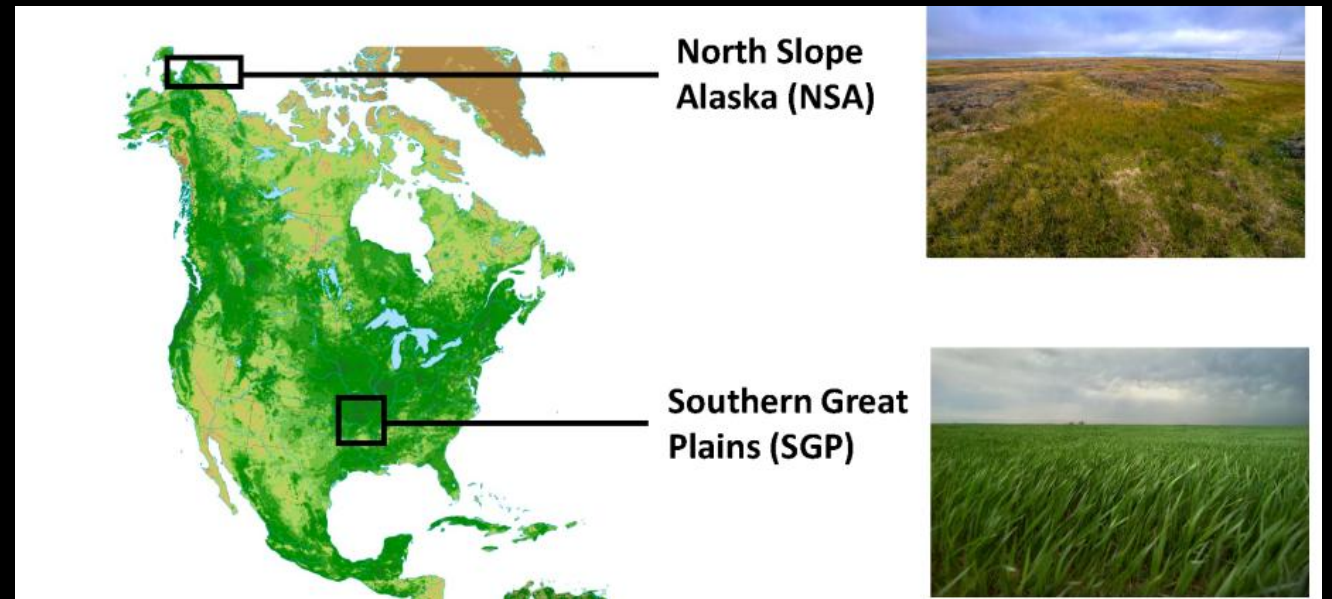
OUTLINE

ACME-SGP

- Scientific Objectives
- Results and Highlights

ACME-NSA

- Scientific Objectives
- Campaign Overview
- Links with NGEE-Arctic, ARM, and ASR objectives
- Feedback



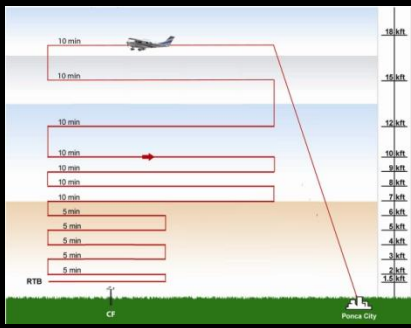
ACME IN THE SGP

SCIENTIFIC OBJECTIVES

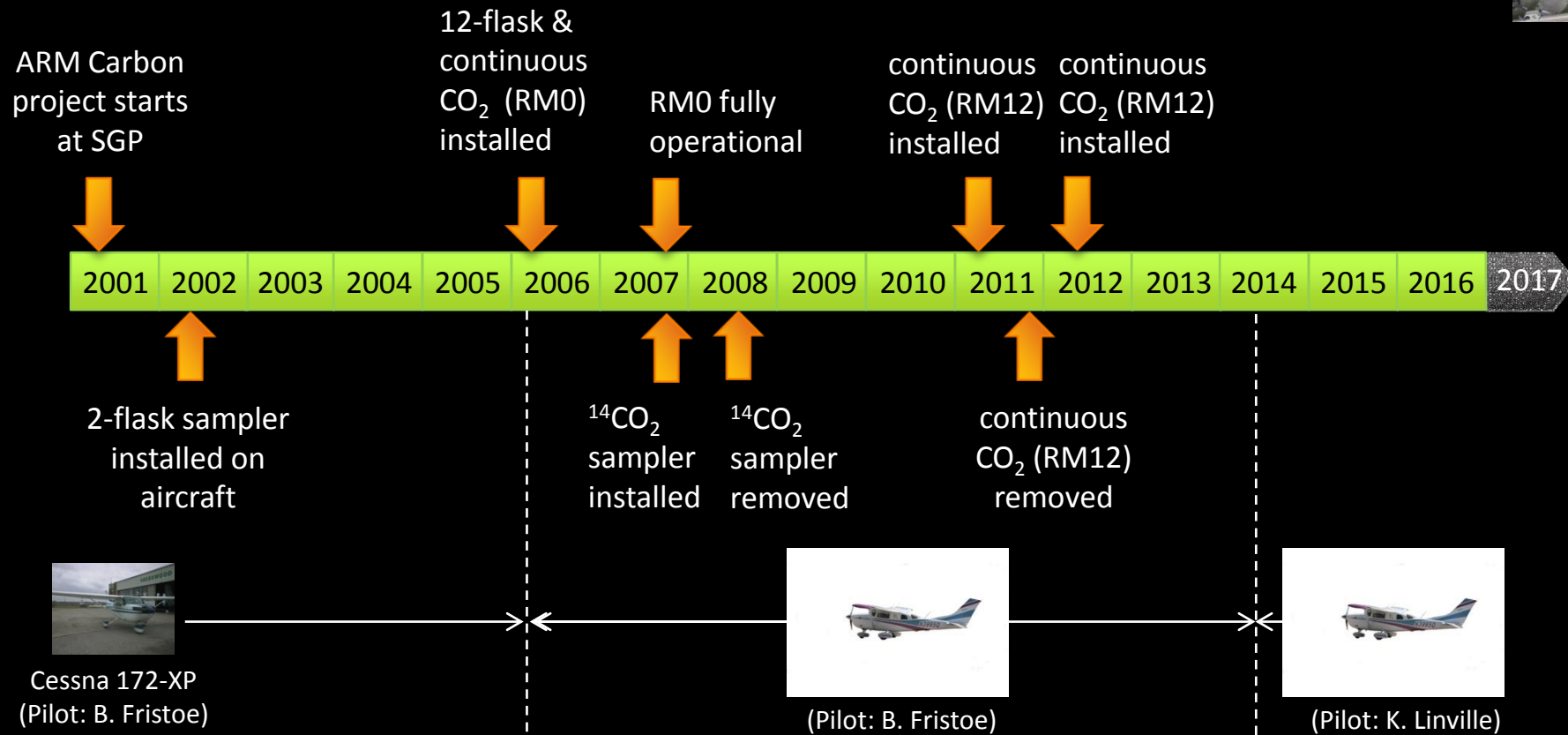


- Document changes in atmospheric concentrations of GHGs
- Contribute to multi-agency effort for validation of satellite- and ground-based column CO₂ estimates
- Close gap in U.S. CH₄ emissions estimates





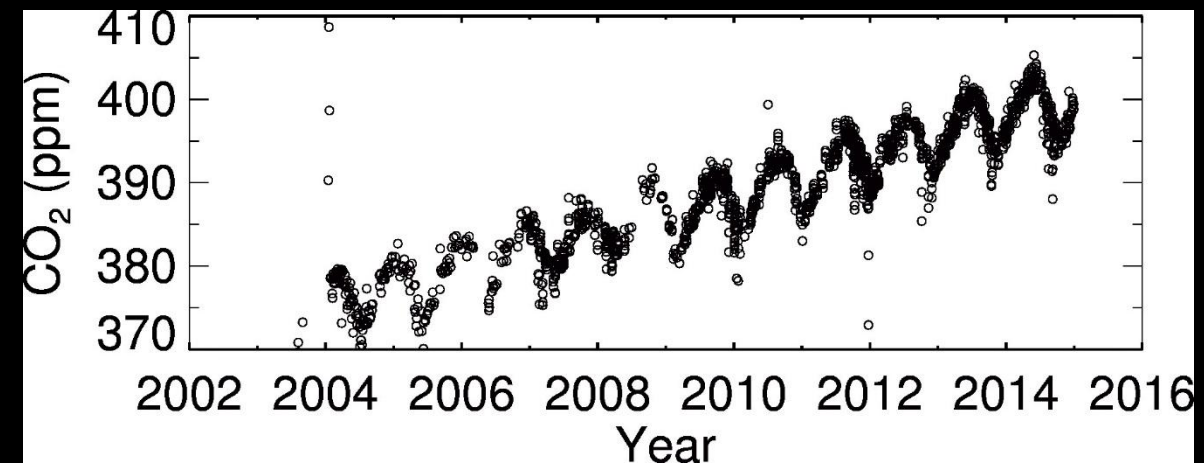
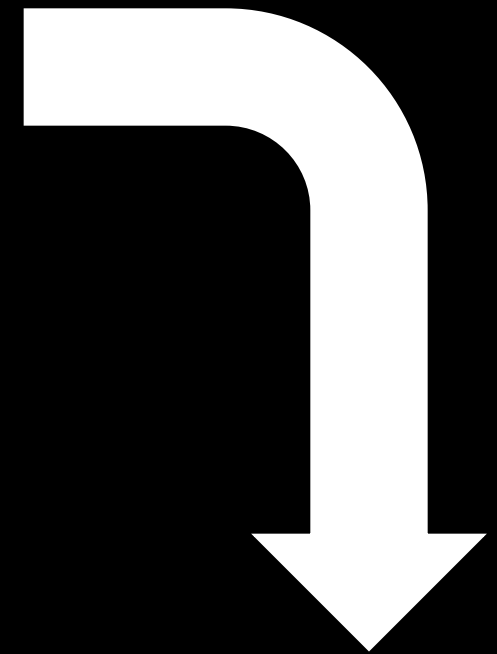
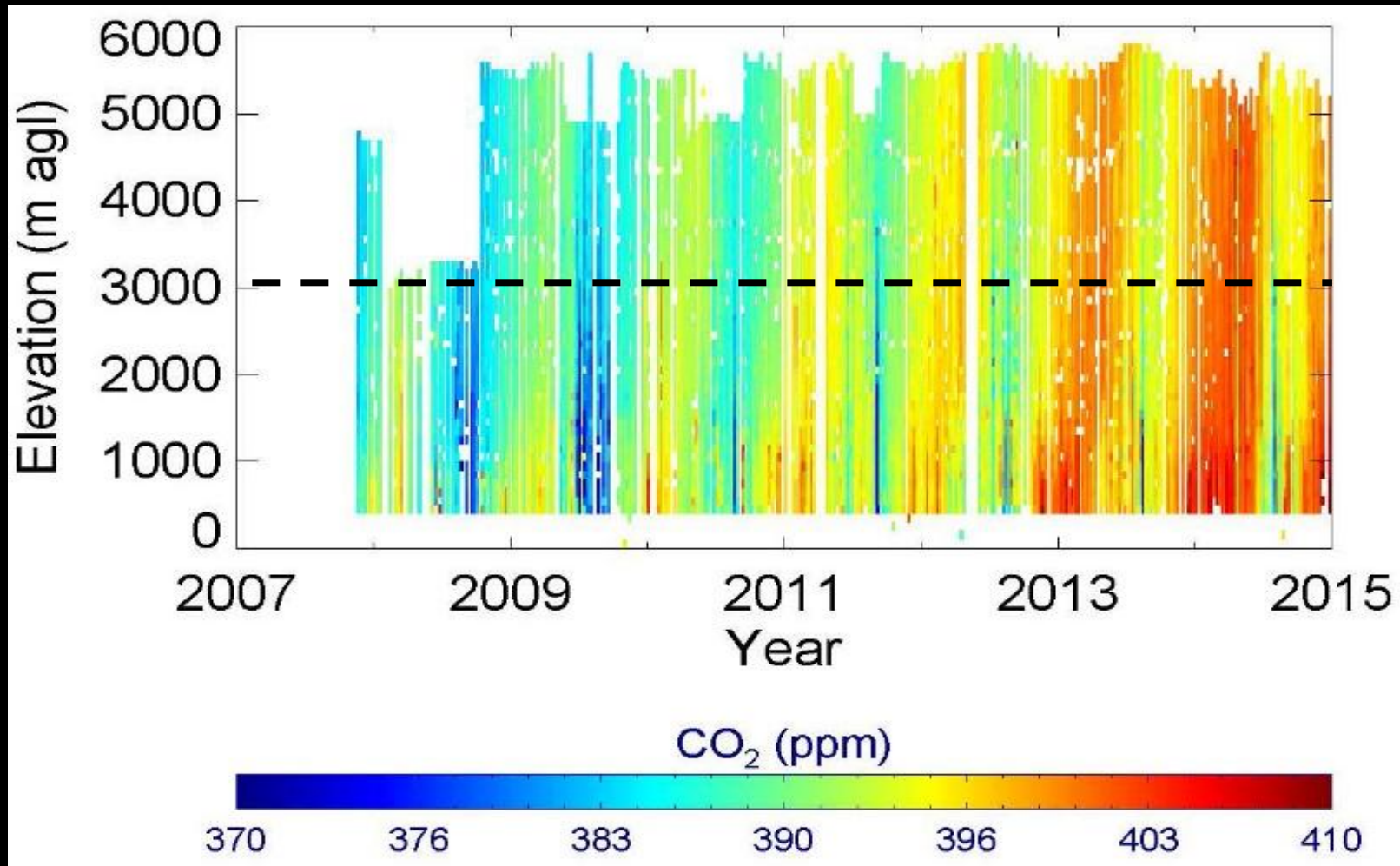
ACME IN THE SGP



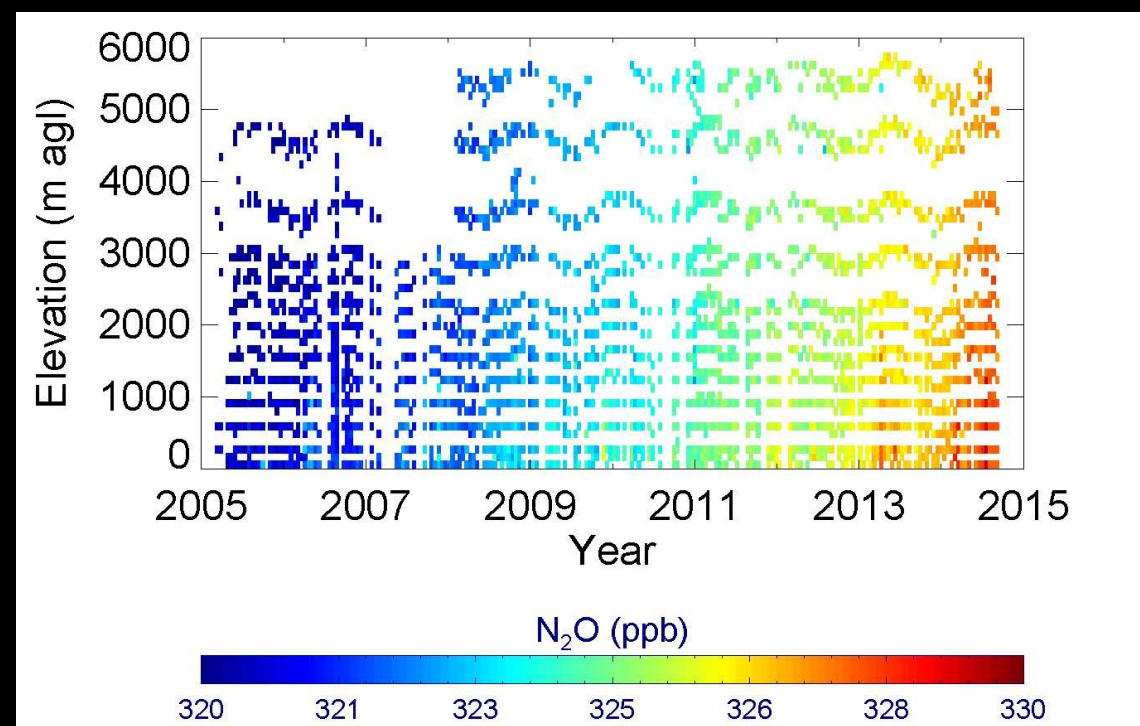
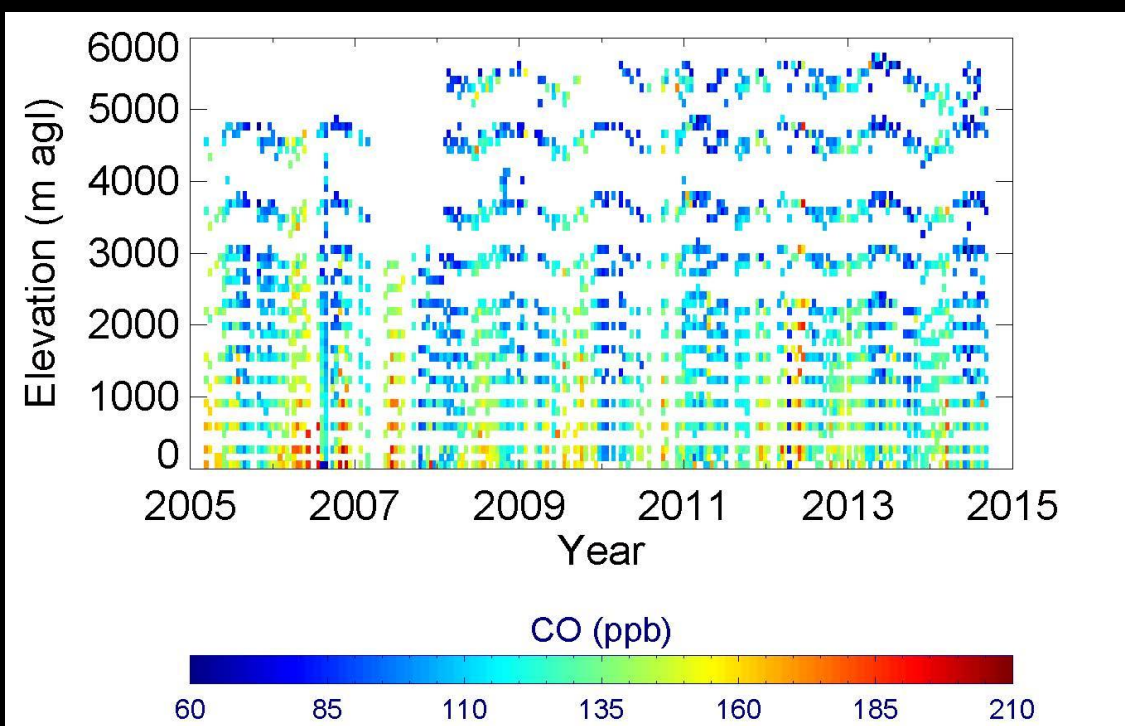
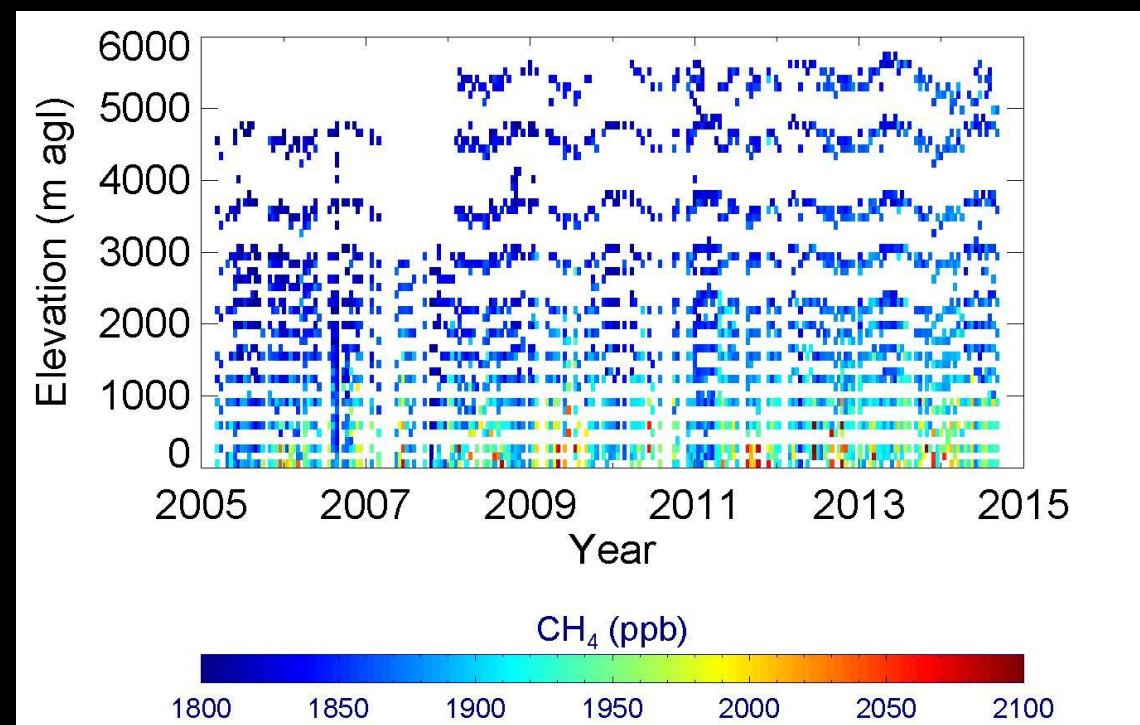
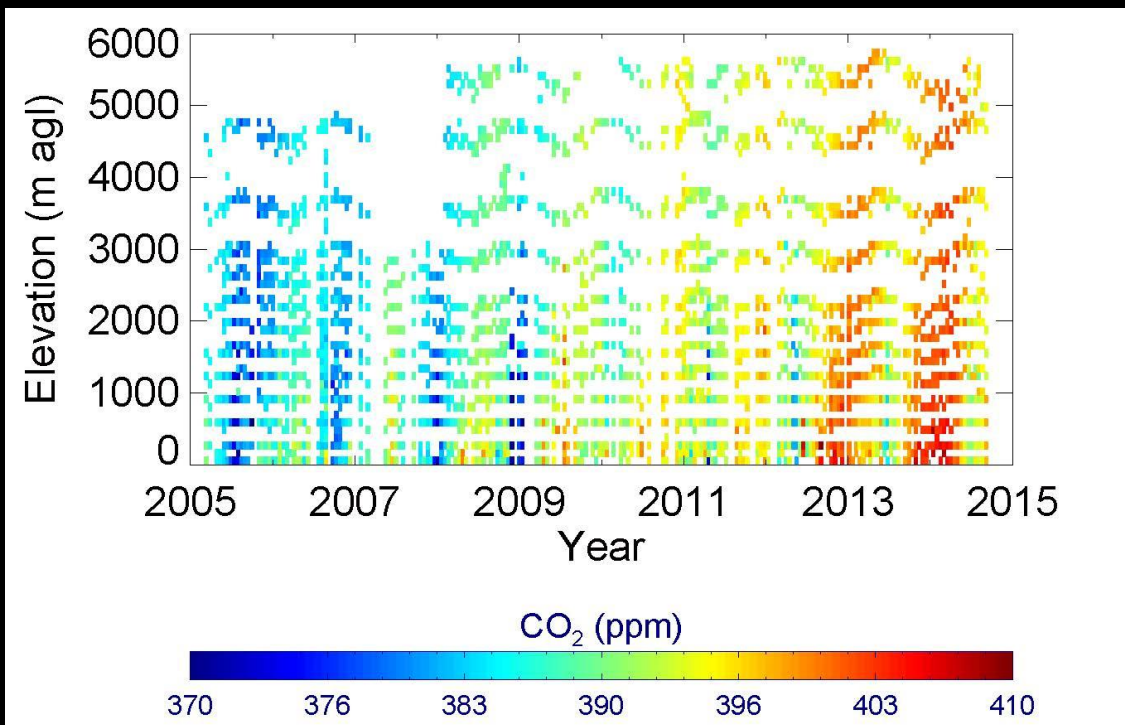
- IAP (PI: J. Ogren). March 1, 2000 – June 30, 2006
- Aircraft Carbon (PI: M. Torn). July 1, 2006 – September 1, 2008
- ACME (PI: S. Biraud). October 1, 2008 – December 31, 2011
- ACME II (PI: S. Biraud). January 1, 2012 – September 30, 2012
- ACME III (PI: S. Biraud). October 1, 2012 – September 30, 2013
- ACME IV (PI: S. Biraud). October 1, 2013 – September 30, 2014
- ACME V (PI: S. Biraud). October 1, 2014 – September 30, 2016
- ACME VI (PI: S. Biraud). October 1, 2016 – September 30, 2017?



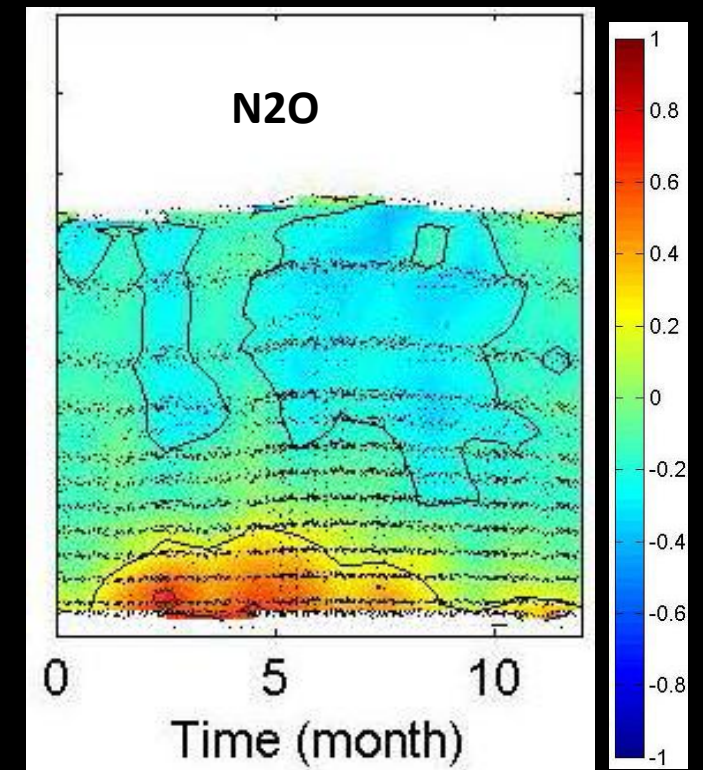
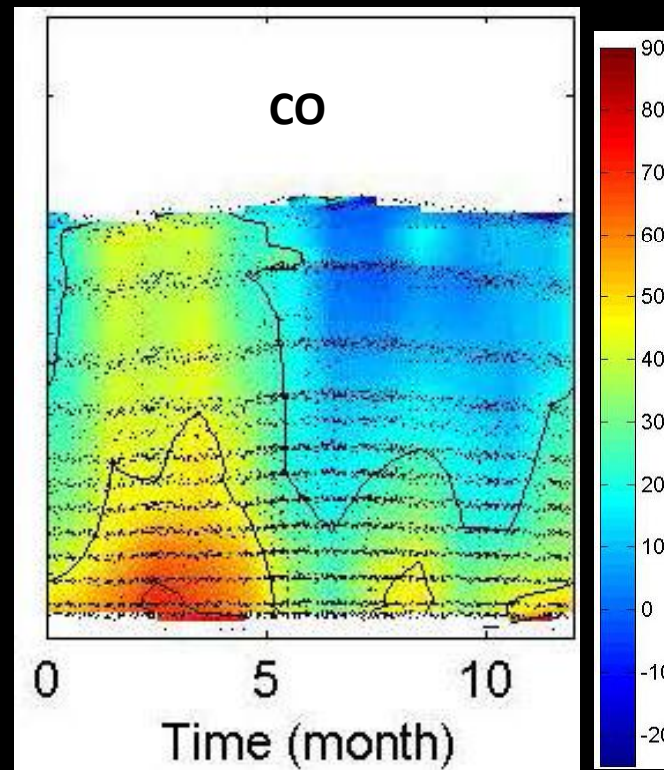
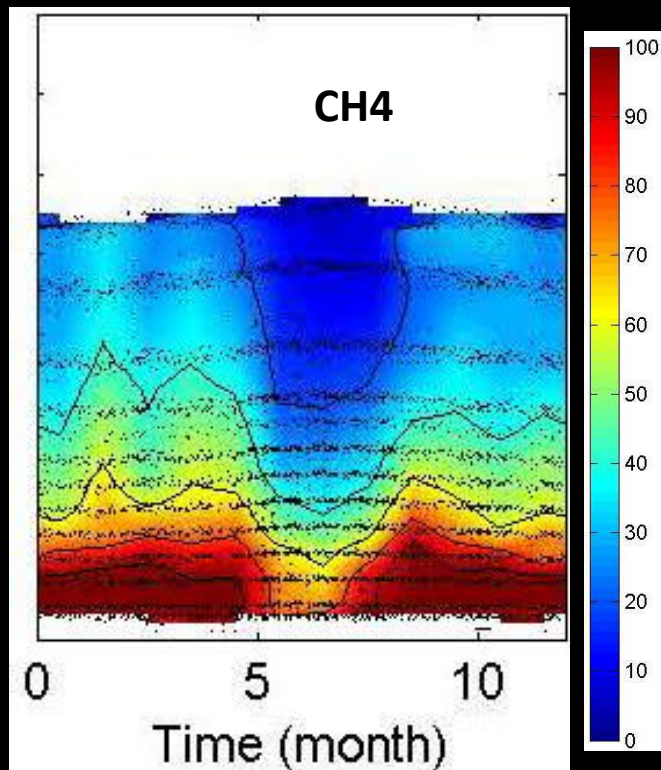
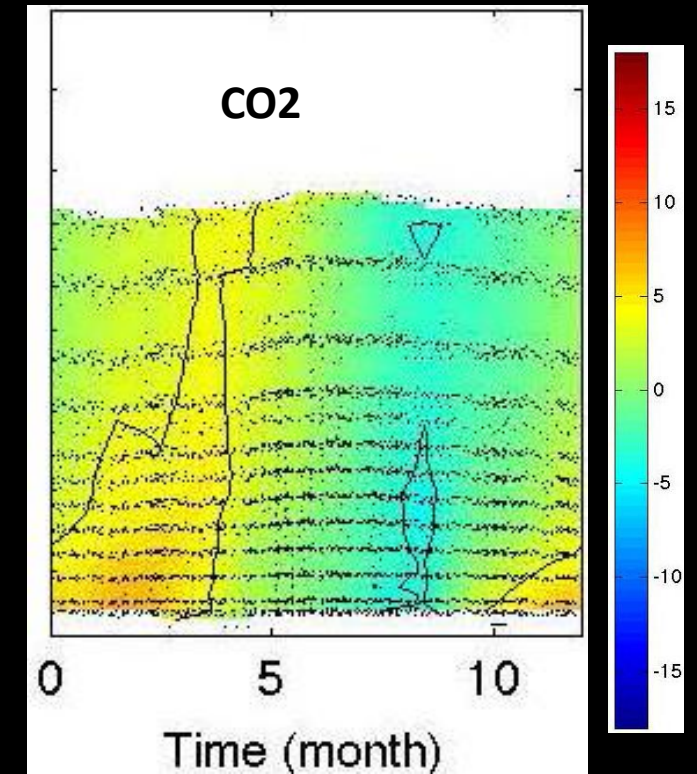
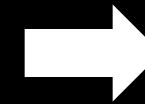
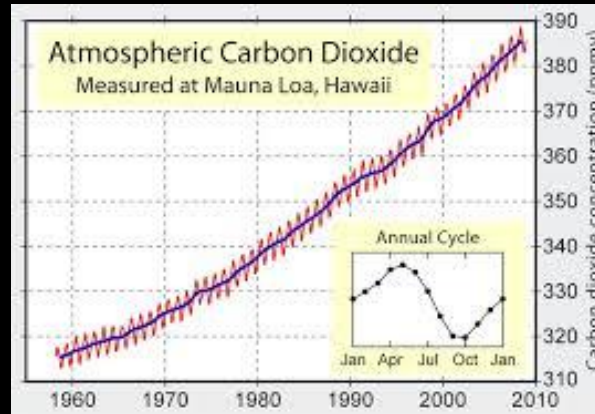
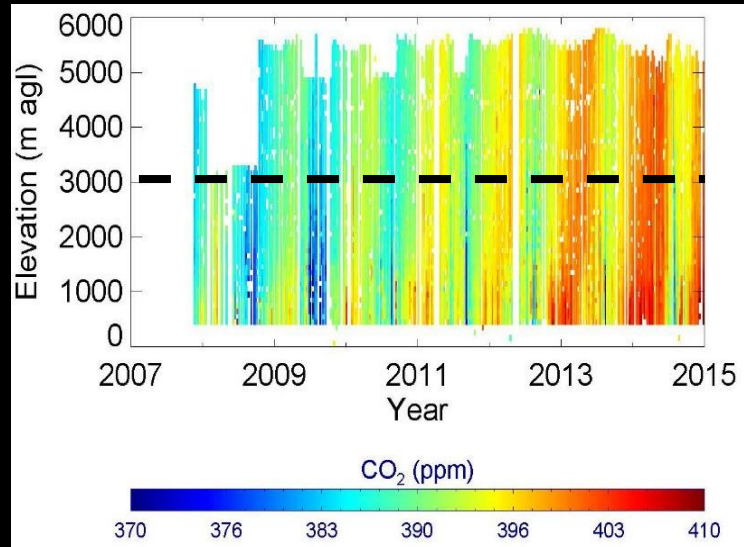
ACME IN THE SGP - RESULTS



ACME IN THE SGP - RESULTS

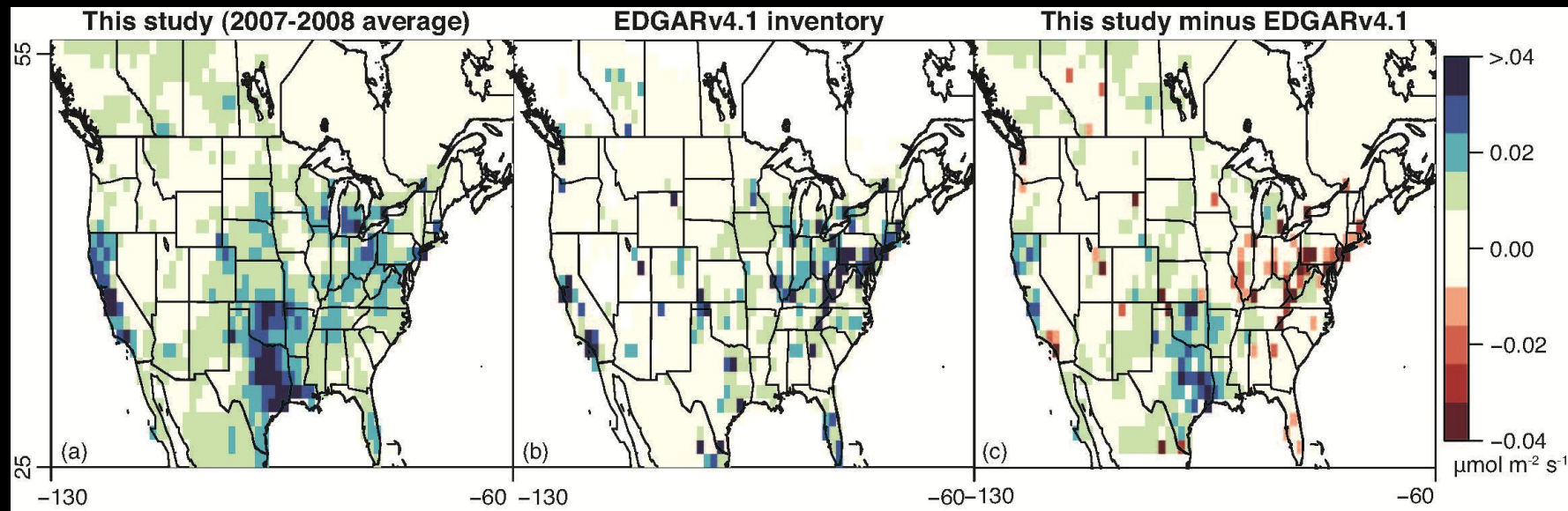


ACME IN THE SGP - RESULTS

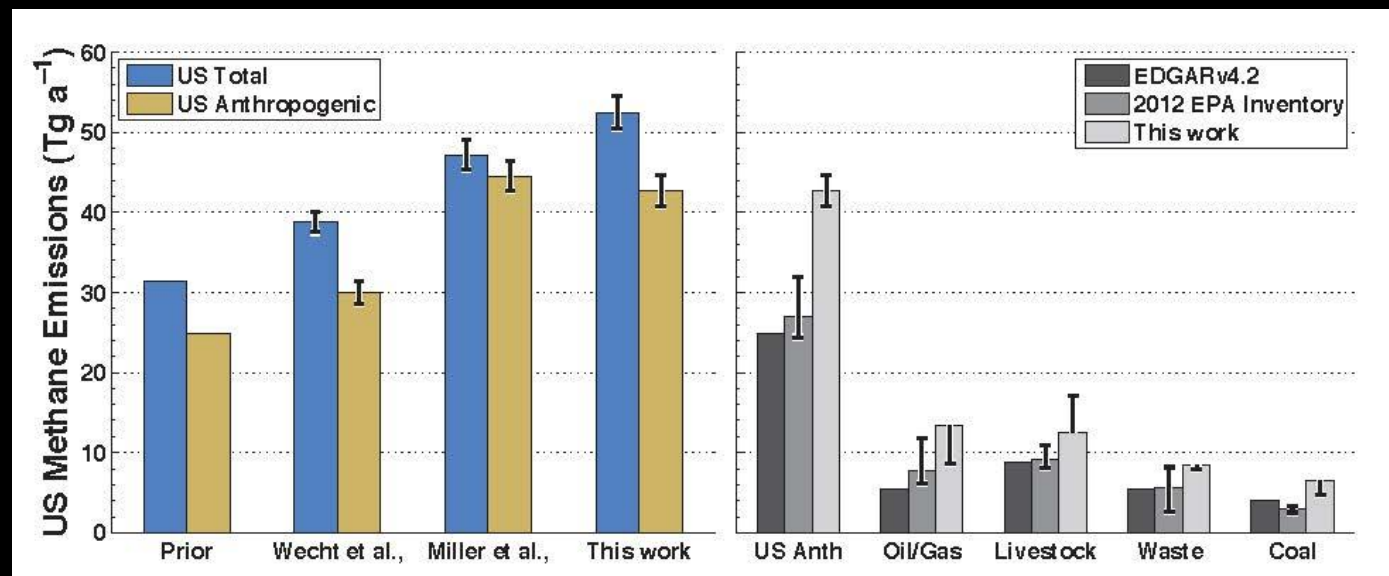


HIGHLIGHTS (FOR CH₄)

- Miller et al., 2013 (PNAS)



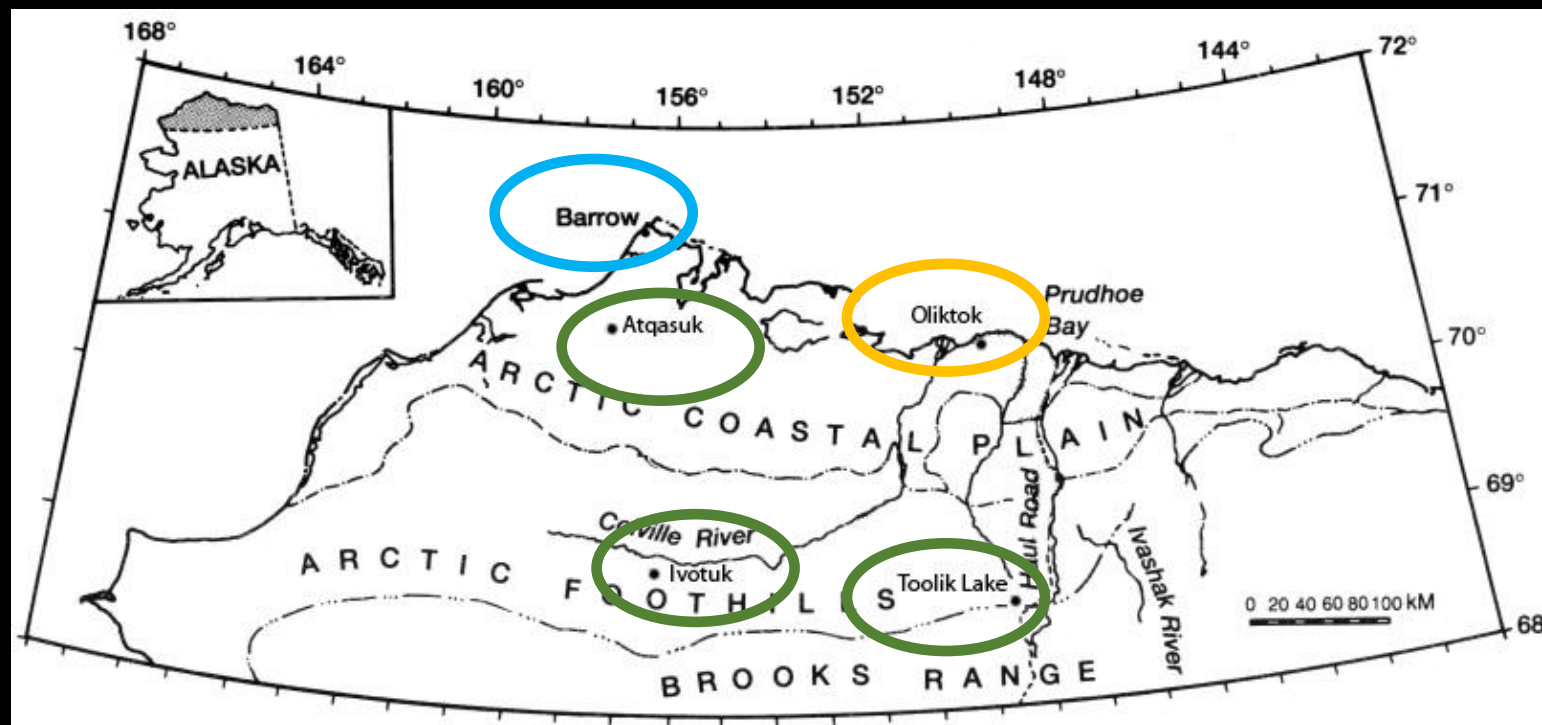
- Turner et al., 2015 (ACP)



GROUND-BASED OBS. IN THE NSA

Established ground sites provide ground truth and temporal context for ACME airborne measurements

- DOE/ARM sites (**Barrow** and **Oliktok**)
- DOE/NGEE-Arctic site (**Barrow**)
- NOAA/GMD operational site (**Barrow**)
- NSF/LTER Arctic (**Toolik Lake**)
- San Diego U. Flux towers (**Atqasuk** and **Ivotuk**)





NGEE-ARCTIC

Next Generation Experiment in the Arctic
PI: Stan Wullschleger (ORNL)

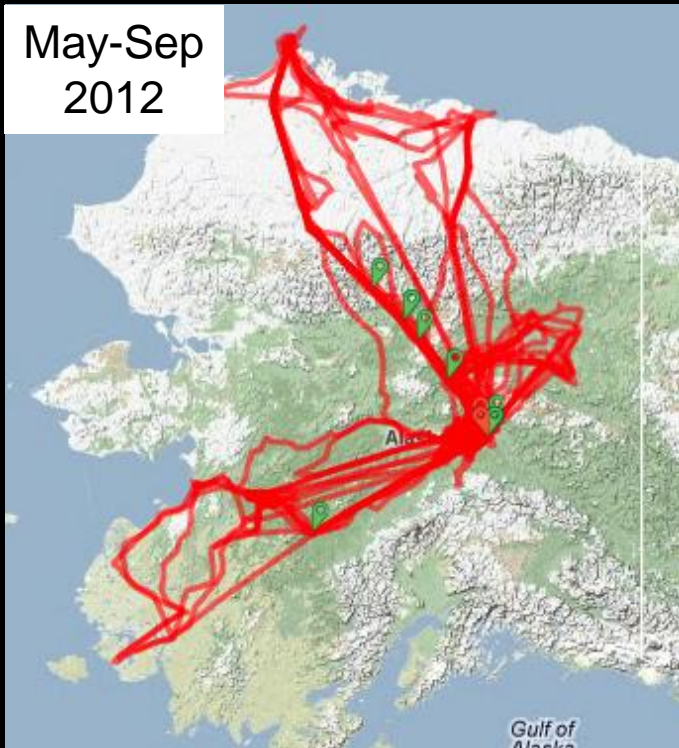
Overarching science question: “How does permafrost thaw and processes associated changes in hydrology, soil biogeochemical processes and plant community succession affect feedbacks to the climate systems?”

Period of observations: 2012-2015 (phase 1)

Study Domain: Barrow

CARVE IN THE NSA

May-Sep
2012



**Carbon in Arctic Reservoirs
Vulnerability Experiment
(CARVE)**
PI: Charles Miller (NASA/JPL)



C-23 Sherpa

Campaign Dates: May – Oct (2012-2015)

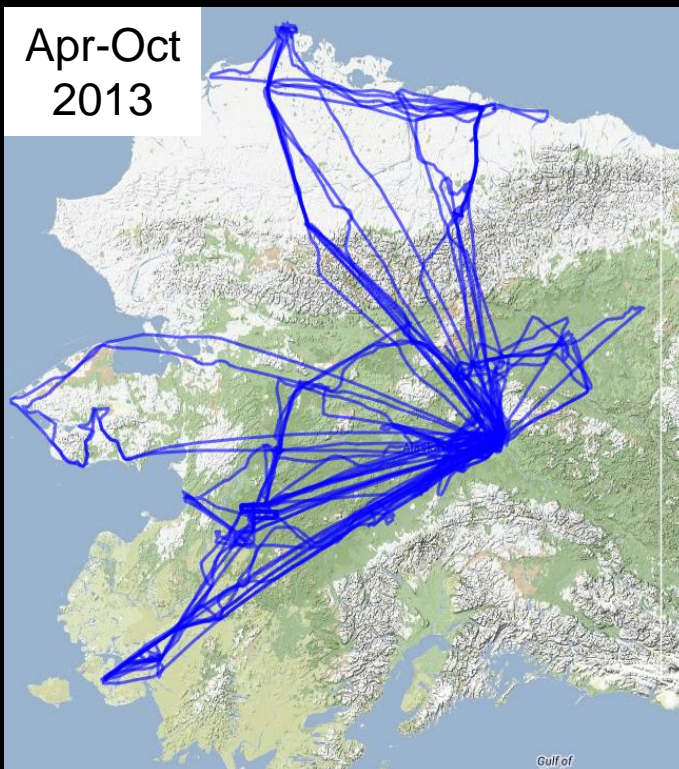
Science Payload

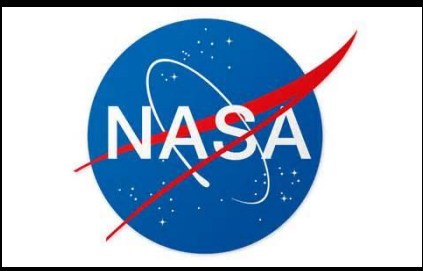
- Picarro: continuous CO₂, CH₄, H₂O
- 12-Flask Package: ~50 trace gases
- FTS: Column CO₂, CH₄, and CO
- Other: O₃ and IR temp

Results (Chang et al., 2014)

- Net CO₂ was ~0 in 2012 and represents a small sources in 2013.
- Total CH₄ emissions from Alaska are small compare to global emissions (2 vs. 550 Tg CH₄·yr⁻¹)

Apr-Oct
2013





ABOVE IN THE NSA

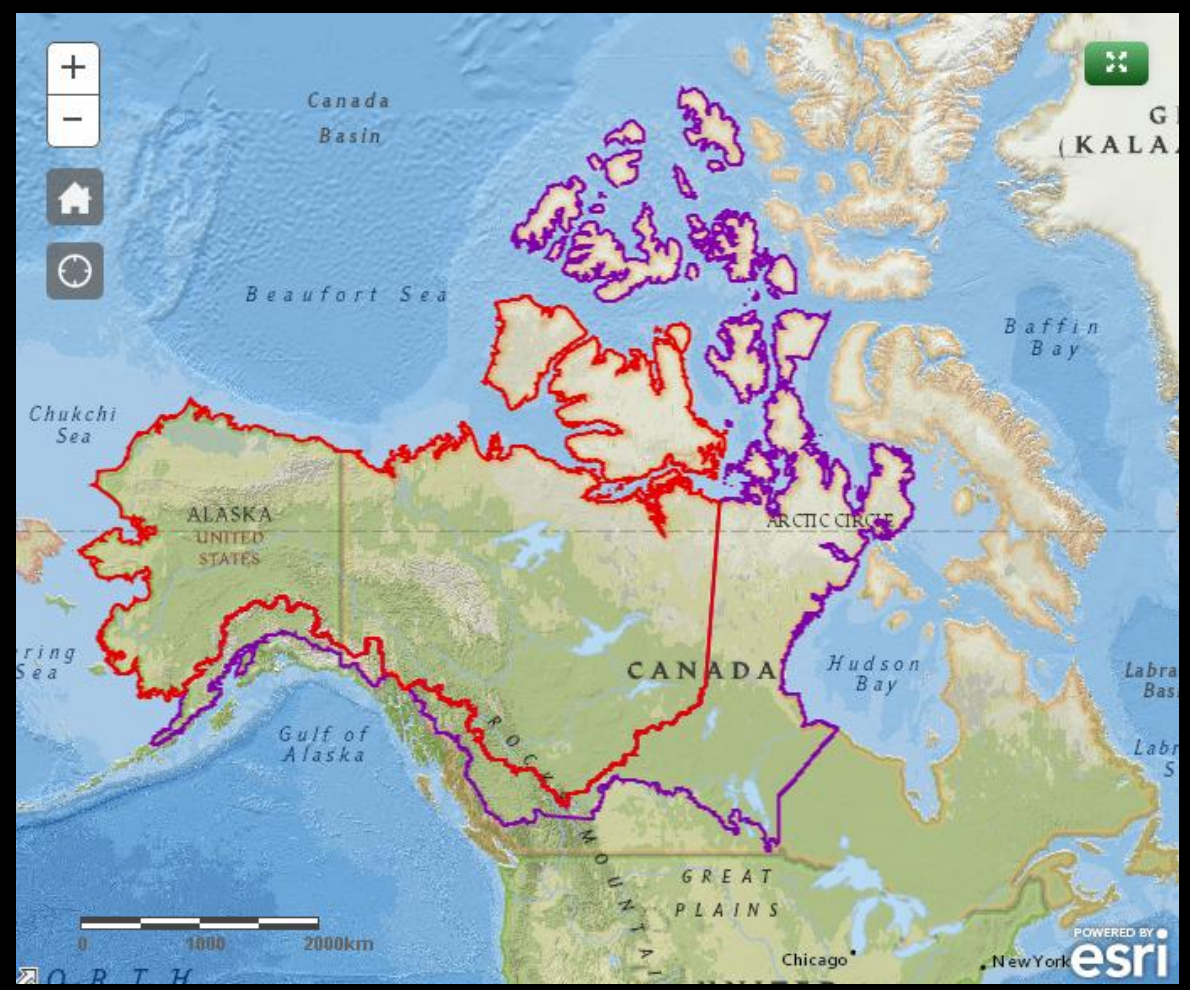
Arctic-Boreal Vulnerability Experiment (ABOVE)

Overarching science question: “ How vulnerable or resilient are ecosystems and society to environmental change in the Arctic and boreal region of western North America?”

Proposed intensive airborne observations: 2017 and 2019

Study Domain:
Alaska and Northwest Canada

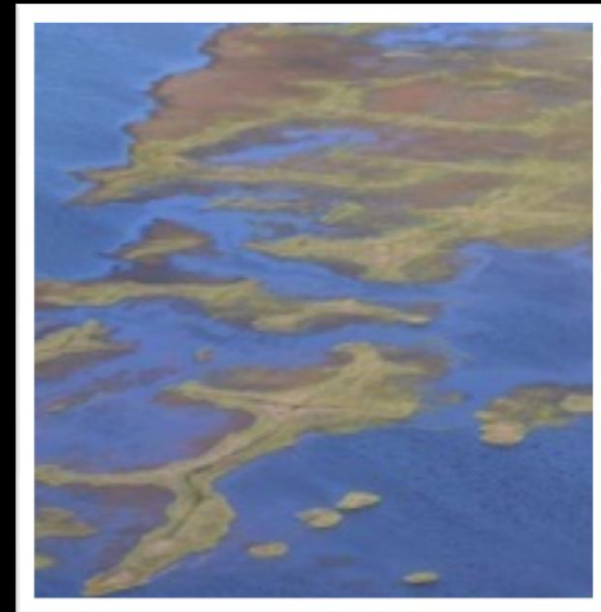
Science Payload: TBD



ACME IN THE NSA

SCIENTIFIC OBJECTIVES

- Characterize spatial variability of CO₂ and CH₄ mixing ratios and link to ecosystem dynamics
- Evaluate representativeness of site measurements at regional scales
- Impact of Oil/gas emissions around Prudhoe Bay



ACME IN THE NSA

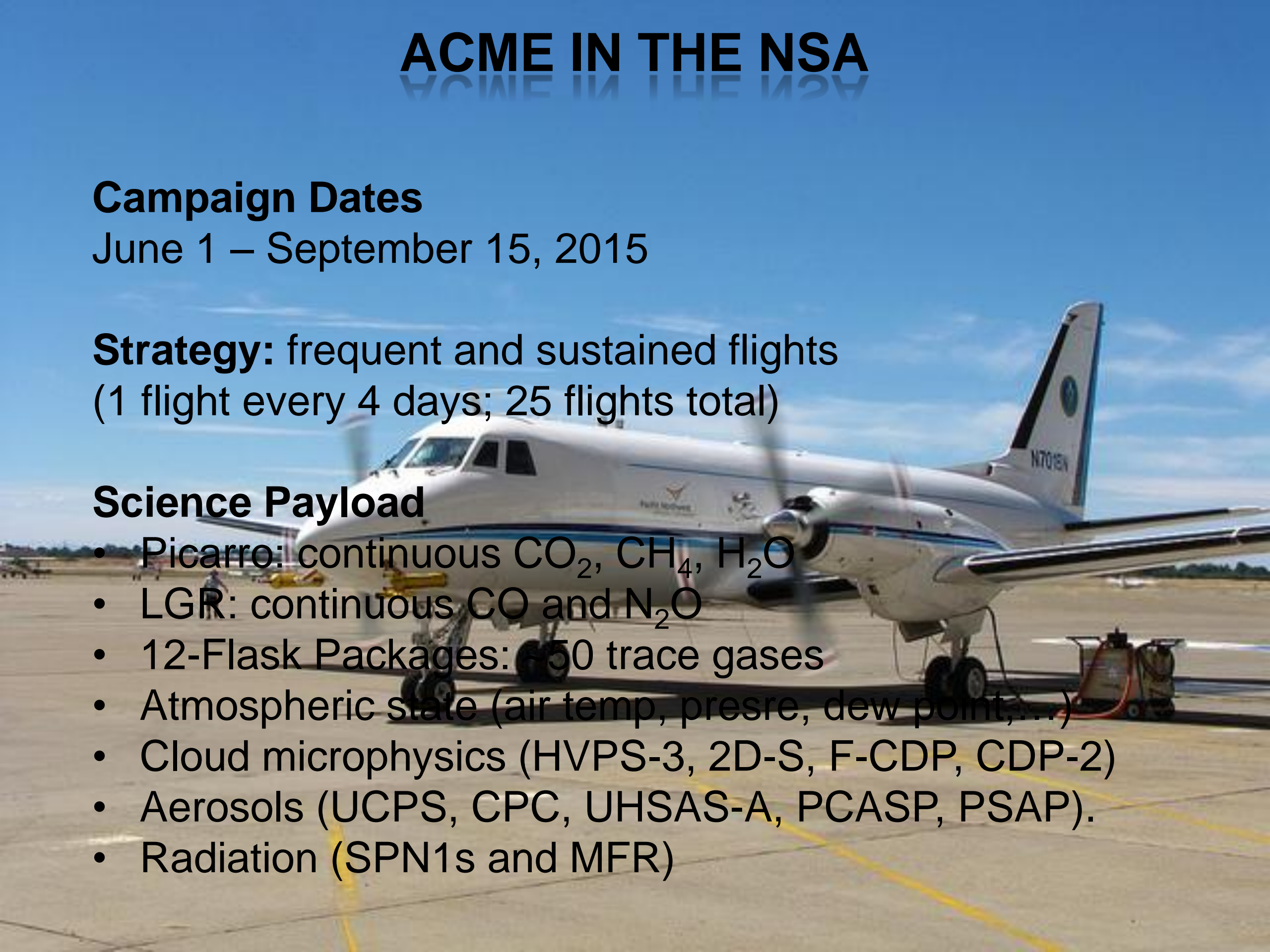
Campaign Dates

June 1 – September 15, 2015

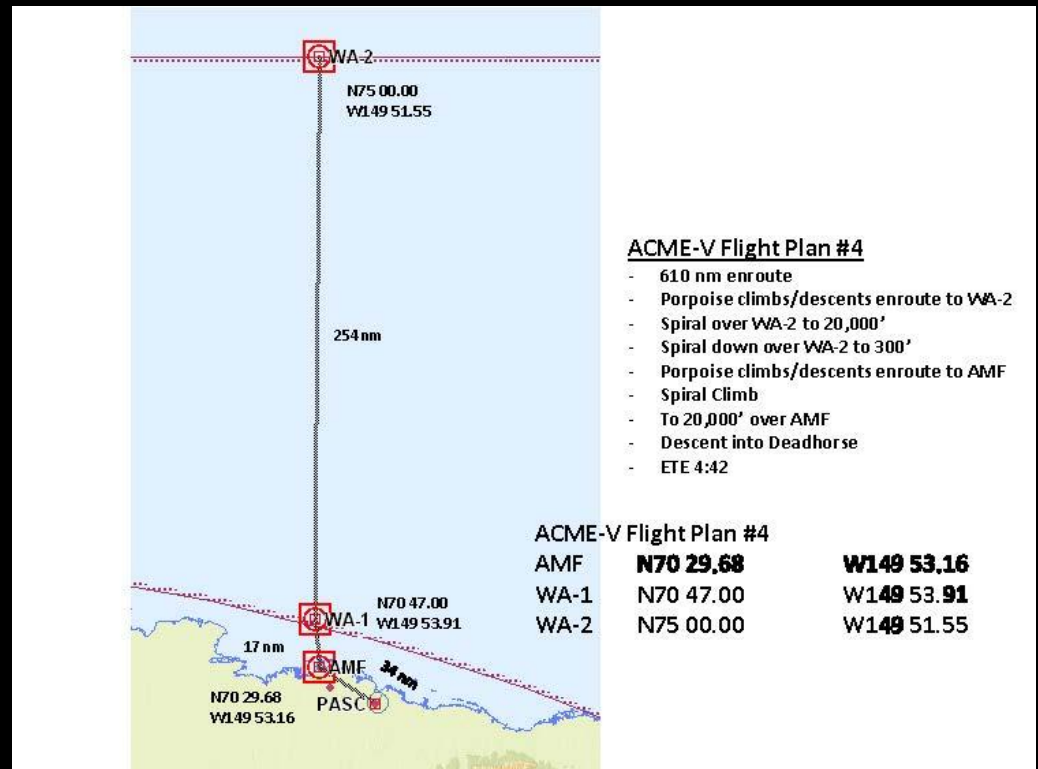
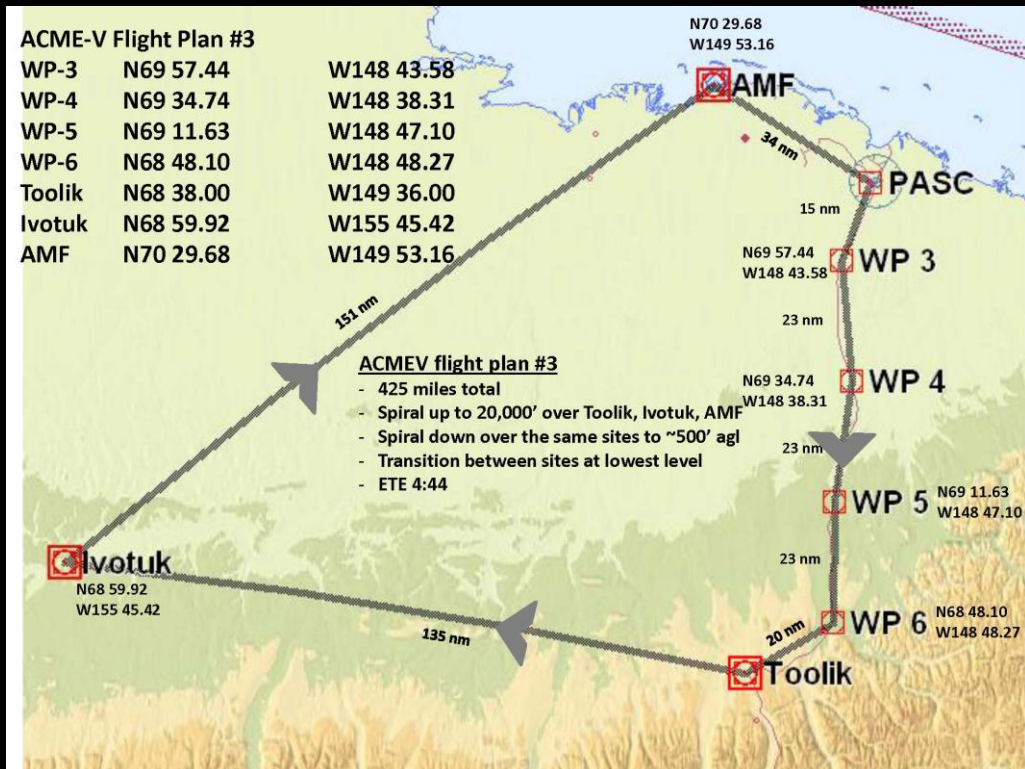
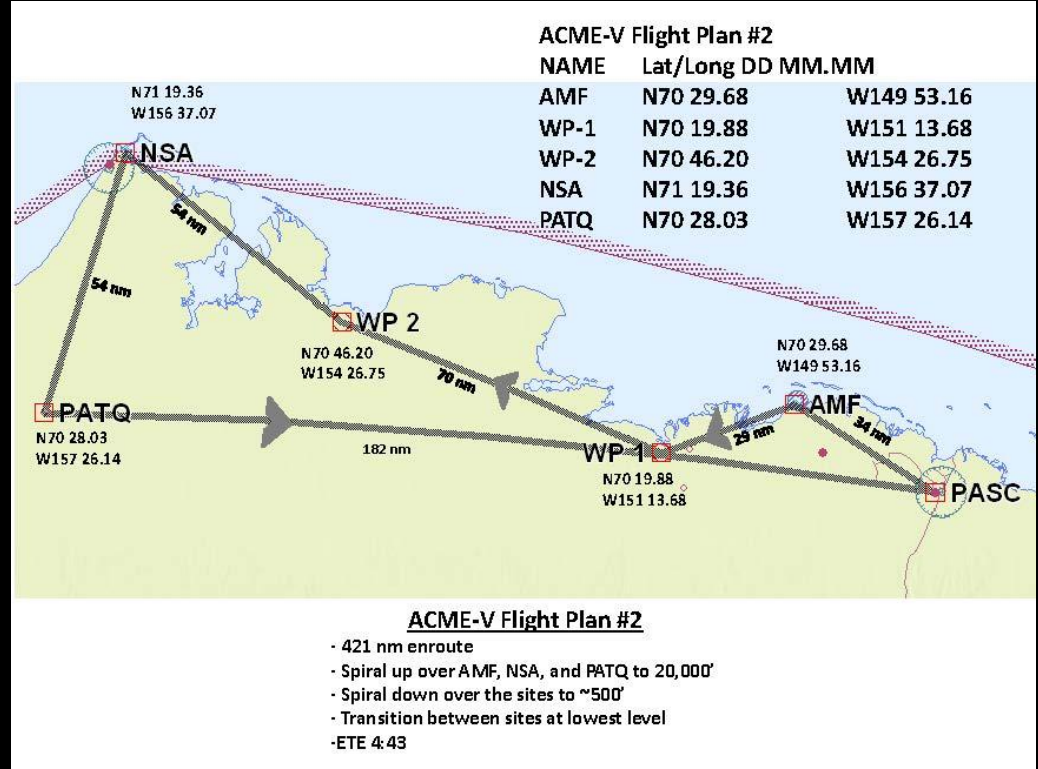
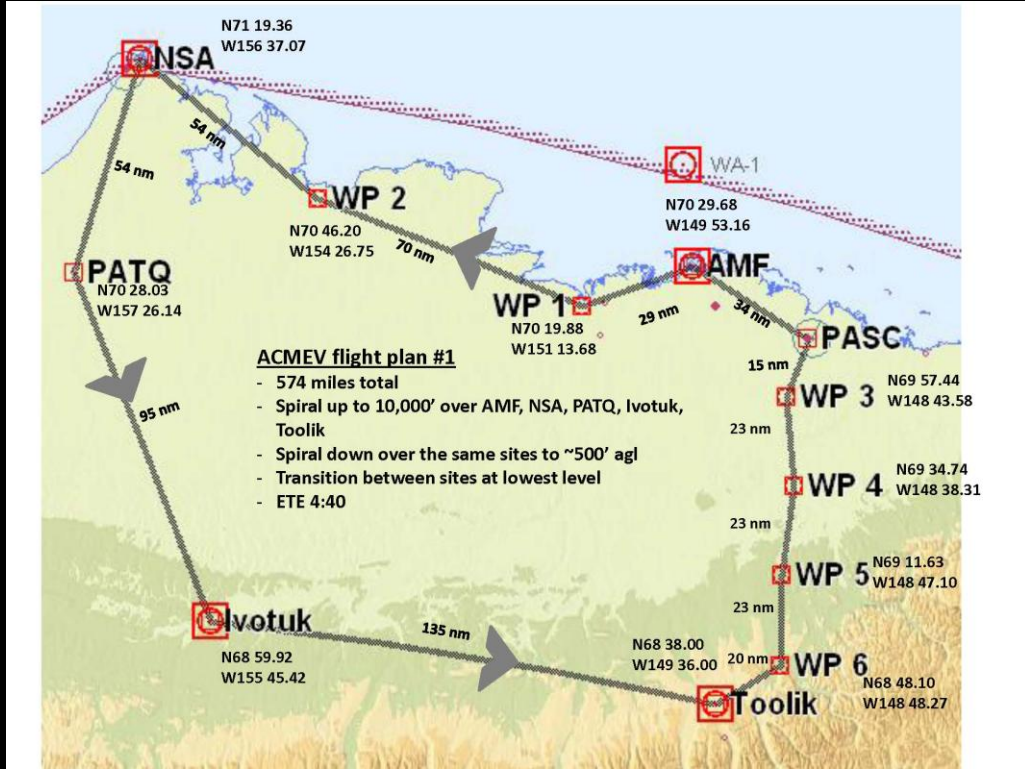
Strategy: frequent and sustained flights
(1 flight every 4 days; 25 flights total)

Science Payload

- Picarro: continuous CO_2 , CH_4 , H_2O
- LGR: continuous CO and N_2O
- 12-Flask Packages: ~50 trace gases
- Atmospheric state (air temp, pressure, dew point, ...)
- Cloud microphysics (HVPS-3, 2D-S, F-CDP, CDP-2)
- Aerosols (UCPS, CPC, UHSAS-A, PCASP, PSAP).
- Radiation (SPN1s and MFR)



ACME IN THE NSA



ACME IN THE NSA

- How to be involved?

Email: SCBiraud@lbi.gov