

# Monitoring Arctic Methane: Aircraft Measurements over Alaska



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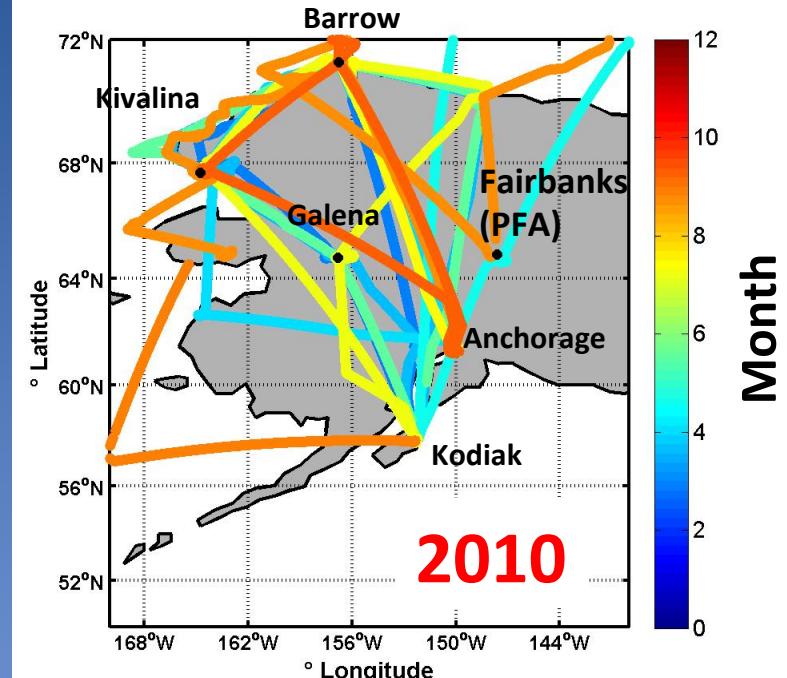
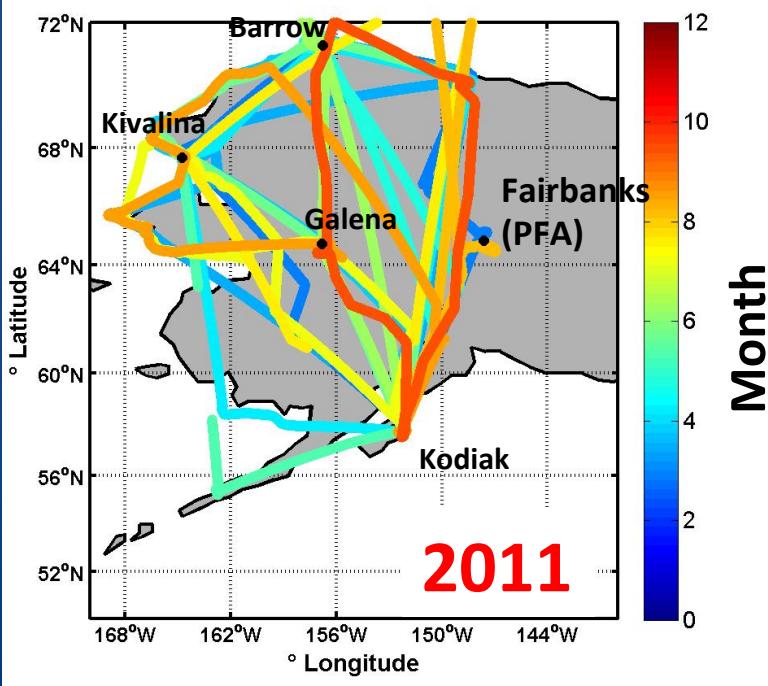
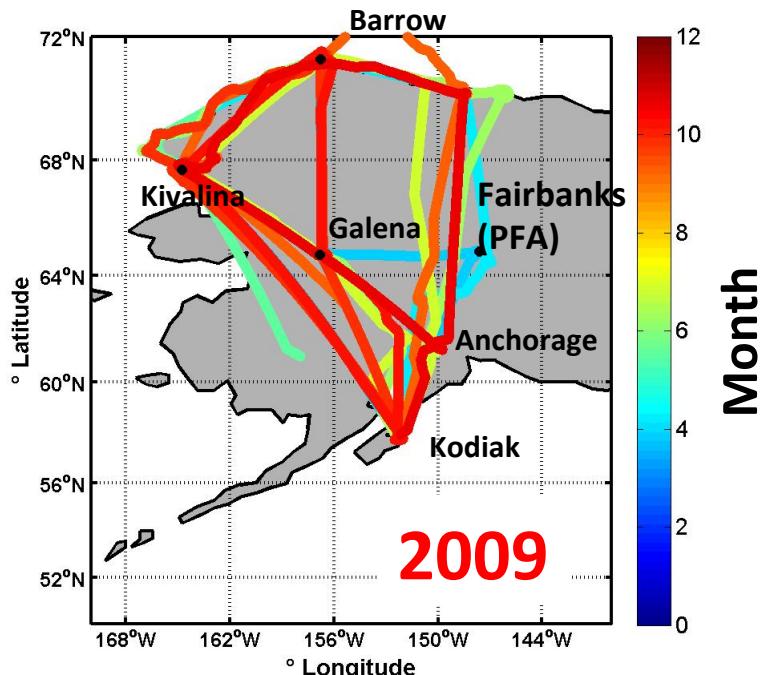
HIPPO Science Team Meeting March 13 2012



# Alaska Coast Guard (ACG) Aircraft Site

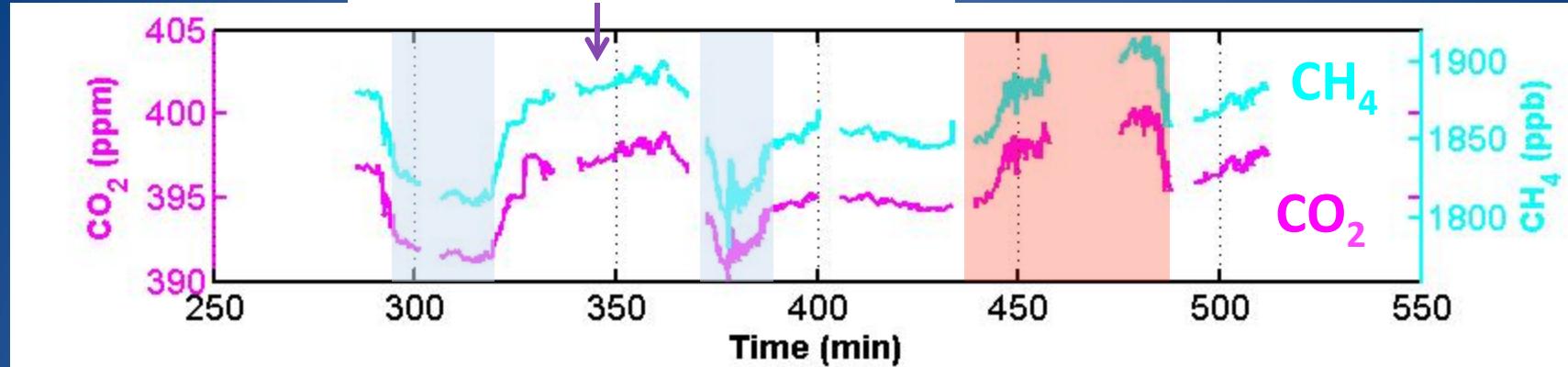


- U.S. Coast Guard conducts regular flights across Alaska for **Arctic Domain Awareness (ADA)**; for search and rescue operations as sea ice melts.
- Unprecedented scientific opportunity
  - monitoring Arctic response to warming and sea ice melting
  - establish baseline and monitor inter-annual variability
  - stratospheric/tropospheric exchange



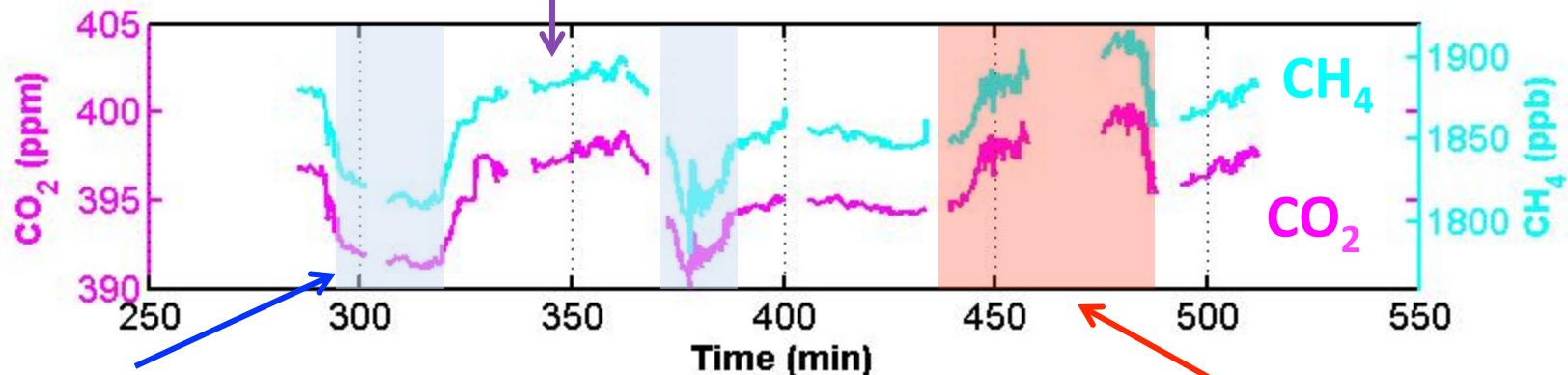
- Bi-weekly 8-hour flights on C-130
- March – November
- **38 flights so far**
- large spatial extent (> 3000 km & 1-3 profiles per flight)
- much of the sampling occurs at high altitude (~8000 m)

### Dip into BL for profile over Kivalina



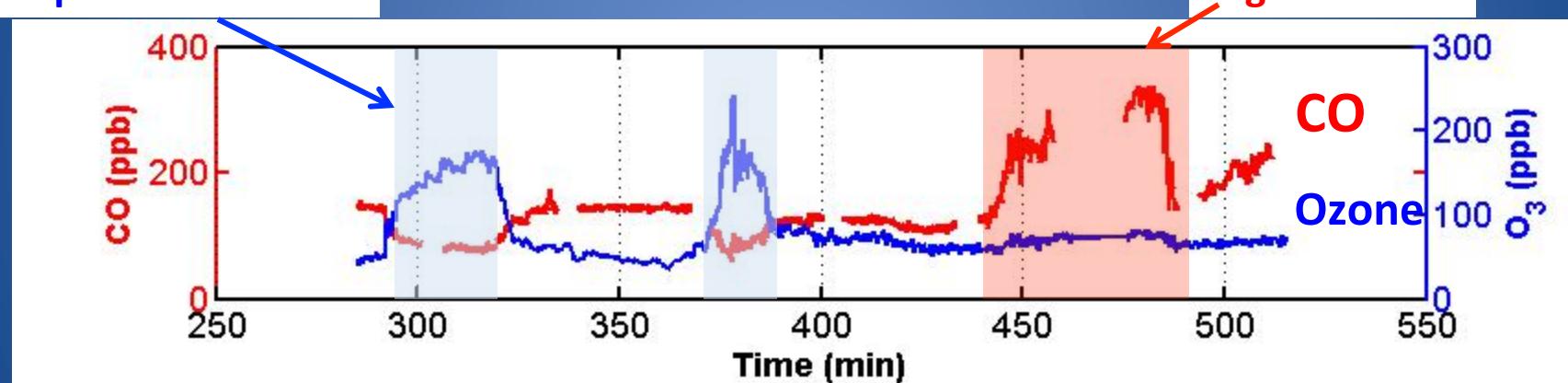
4 April 2011

### Dip into BL for profile over Kivalina



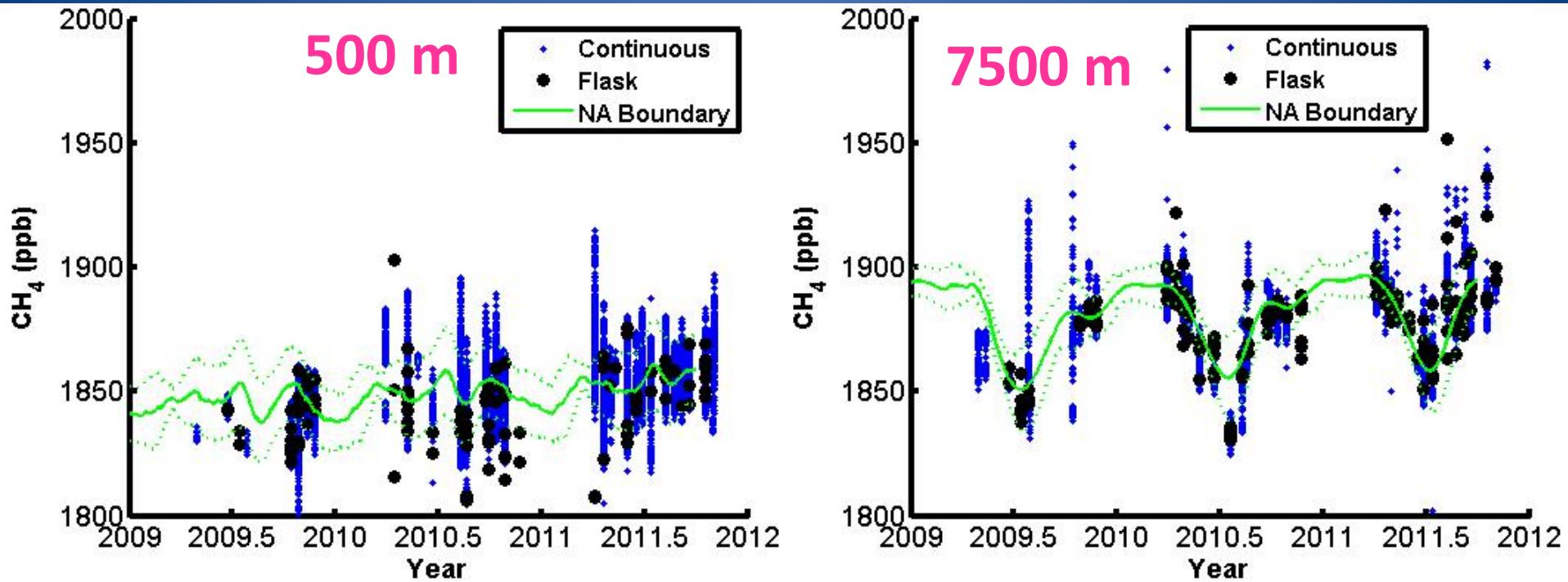
stratospheric influence

High CO band



4 April 2011

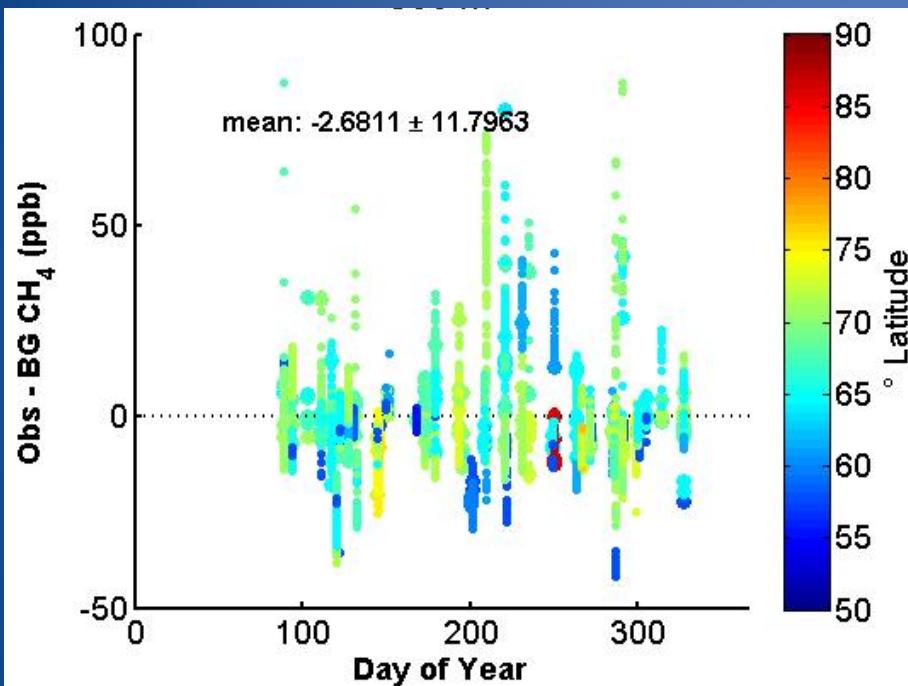
# Comparison with Empirical Boundary Curtain



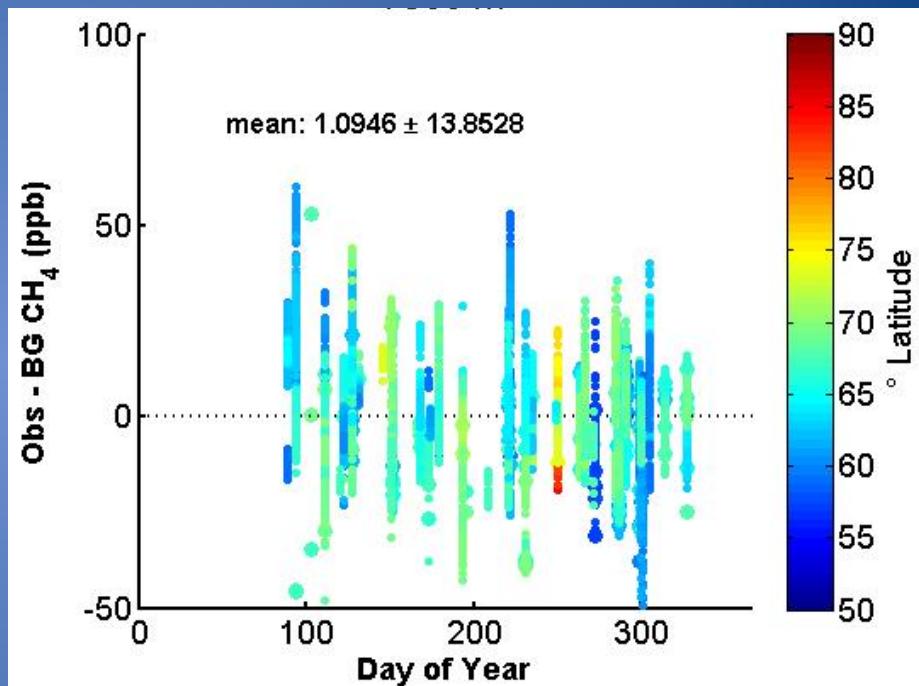
Data-derived boundary condition for inflow to North America using NOAA marine boundary layer sites and aircraft sites (not this one). Extends to  $65^{\circ}\text{N}$  and to 7500 m ( $65^{\circ}\text{N}$  shown).

# Comparison with Empirical Boundary

500 m

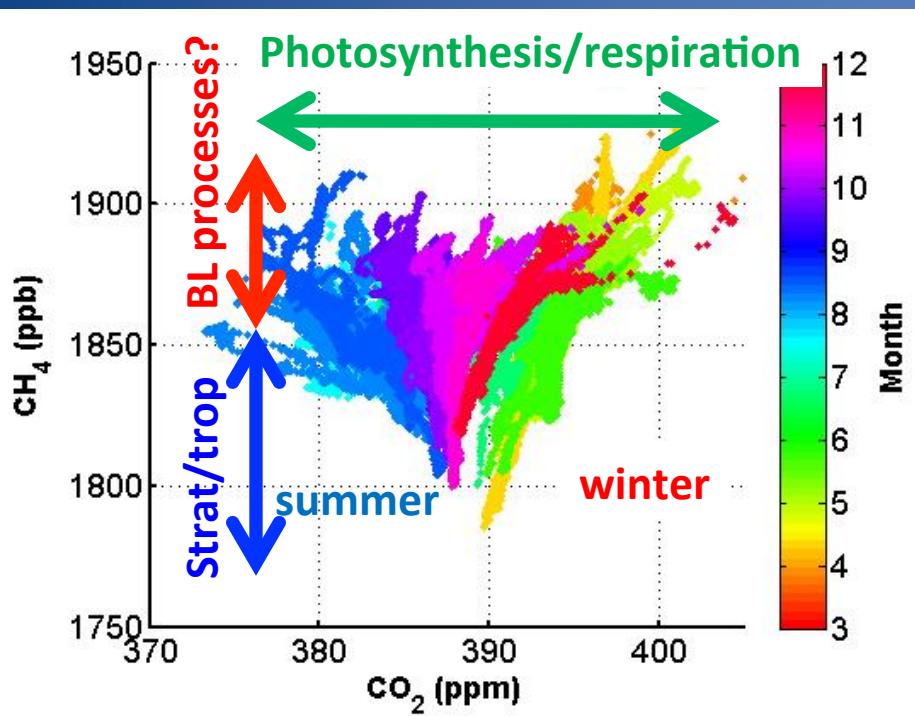


7500 m

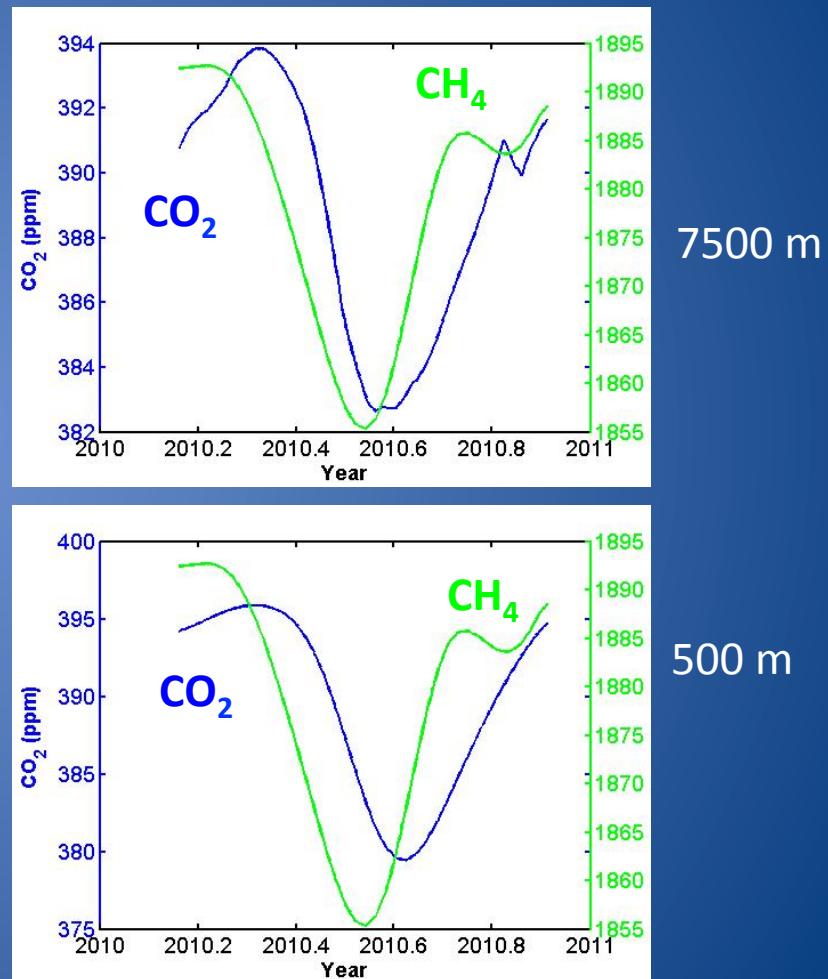


Comparison of each data point with the boundary condition at that latitude and altitude (or at 65°N if the flask was sampled farther north)

# Seasonal Cycle in CO<sub>2</sub> and CH<sub>4</sub>

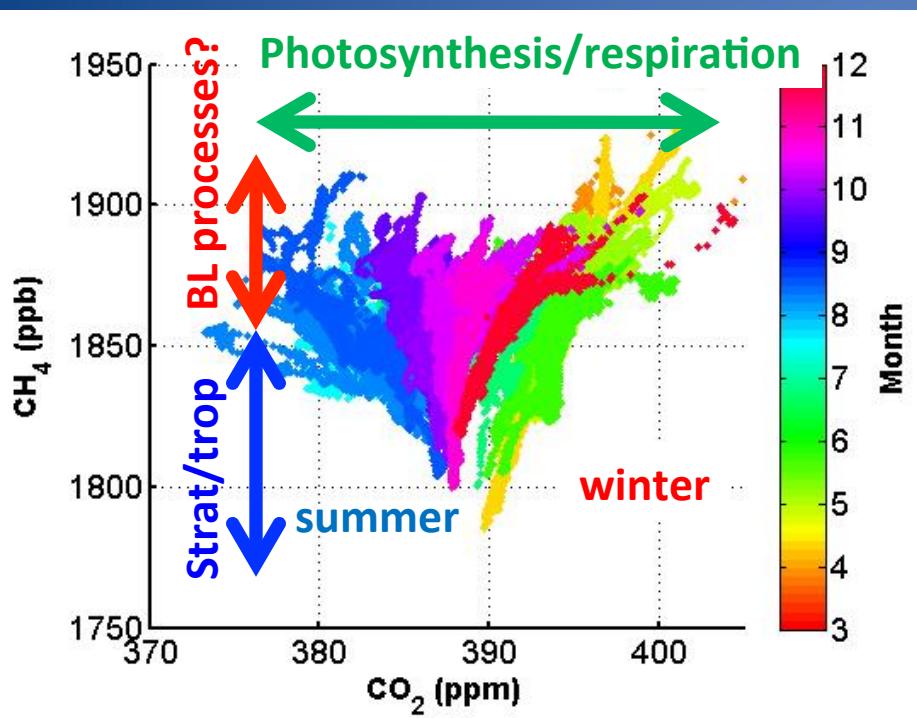


2010 Continuous CRDS Data  
(All Altitudes)

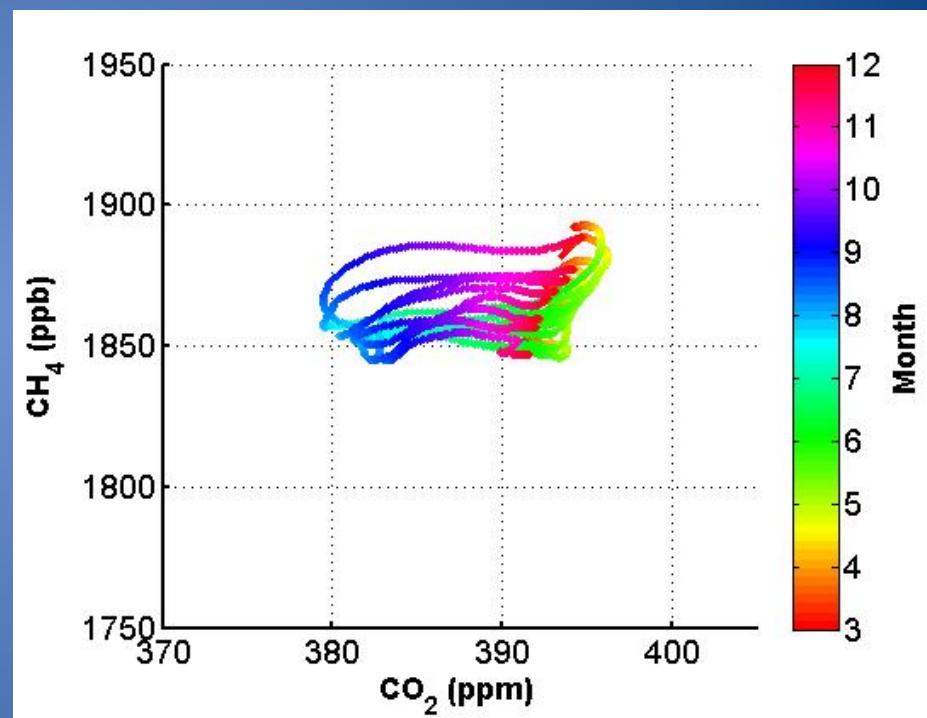


2010 Empirical Boundary at 65°N

# Seasonal Cycle in CO<sub>2</sub> and CH<sub>4</sub>



2010 Continuous CRDS Data



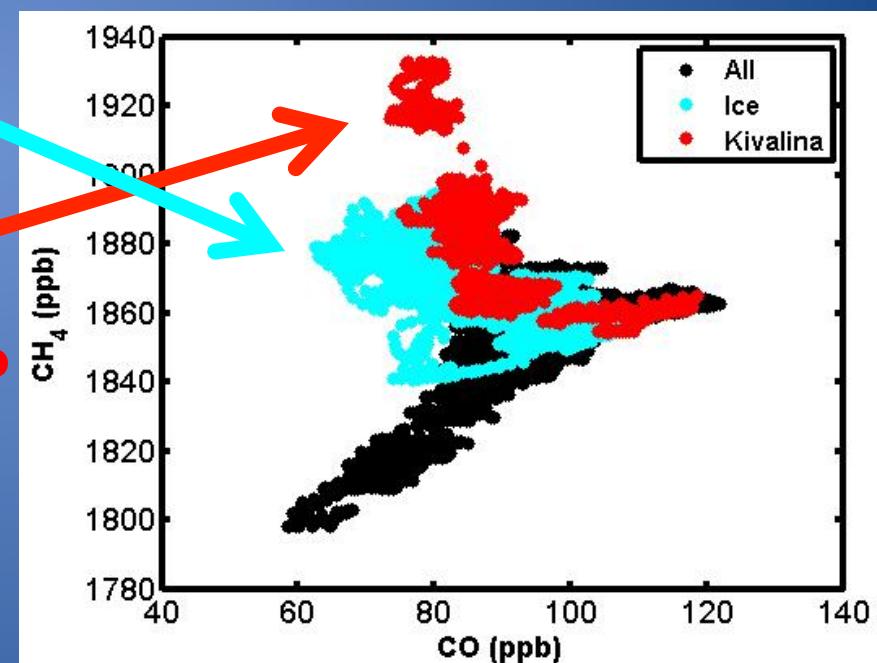
2010 Empirical Boundary at 65°N

# Local Signals of CH<sub>4</sub>



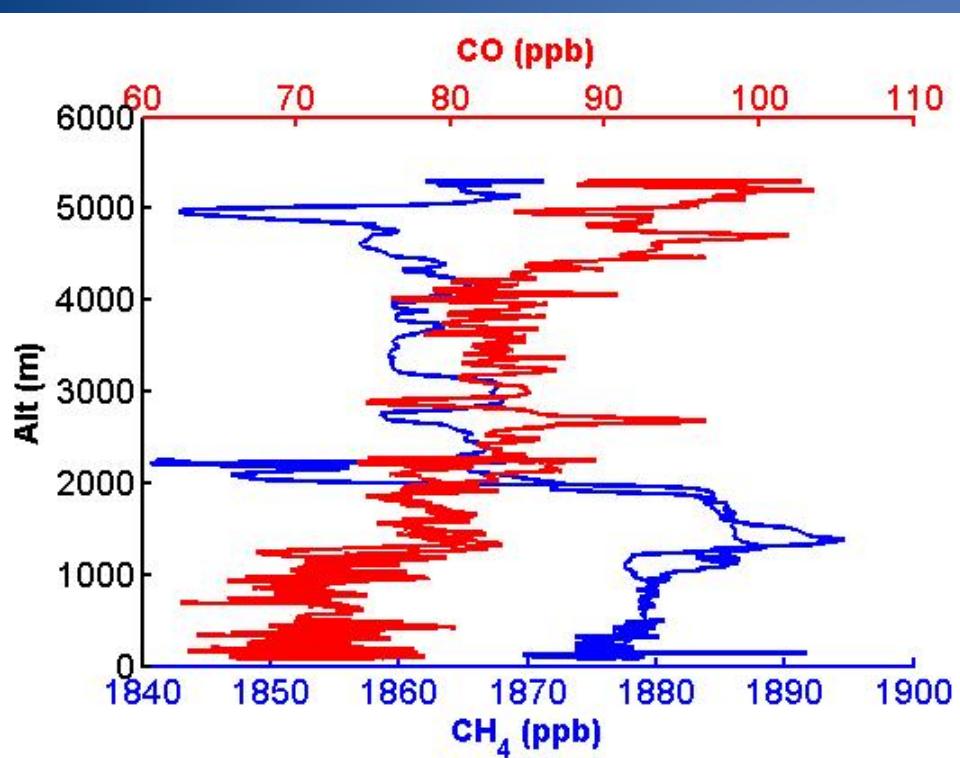
Arctic Ocean?

Wetlands?

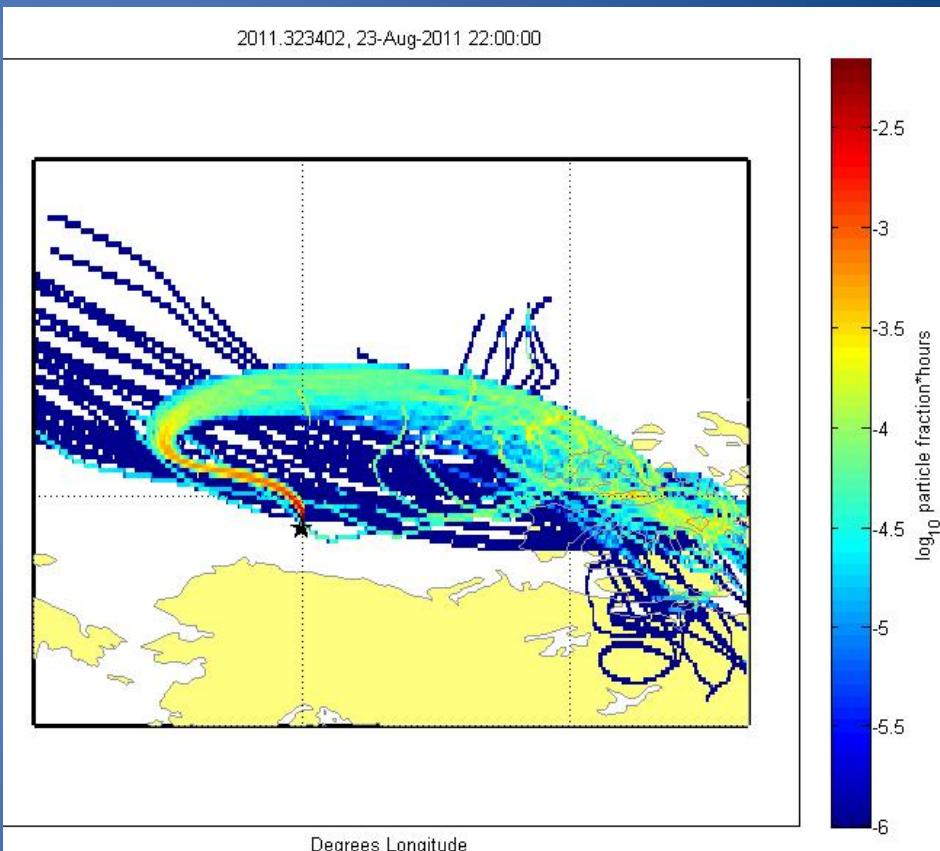


(Both show elevated CH<sub>4</sub> with no corresponding CO)

# 8/23/2011: Profiles Over Arctic Ocean at 73° N



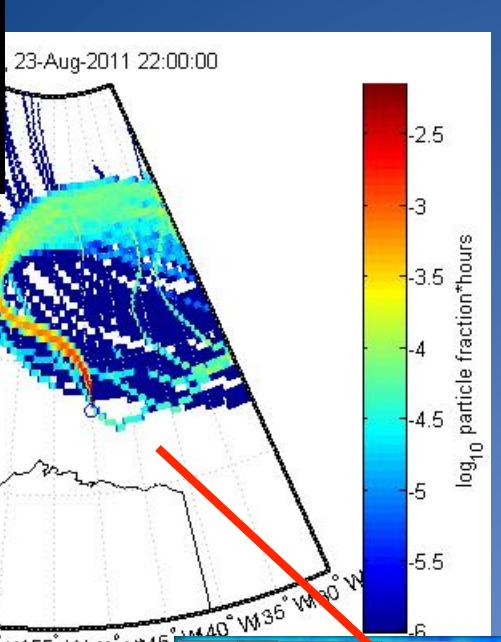
Enhanced CH<sub>4</sub> below 2000 m with no enhancement in CO



HYSPLIT Footprint from 100 m receptor

GCMS (HATS) gases may help resolve source of signal

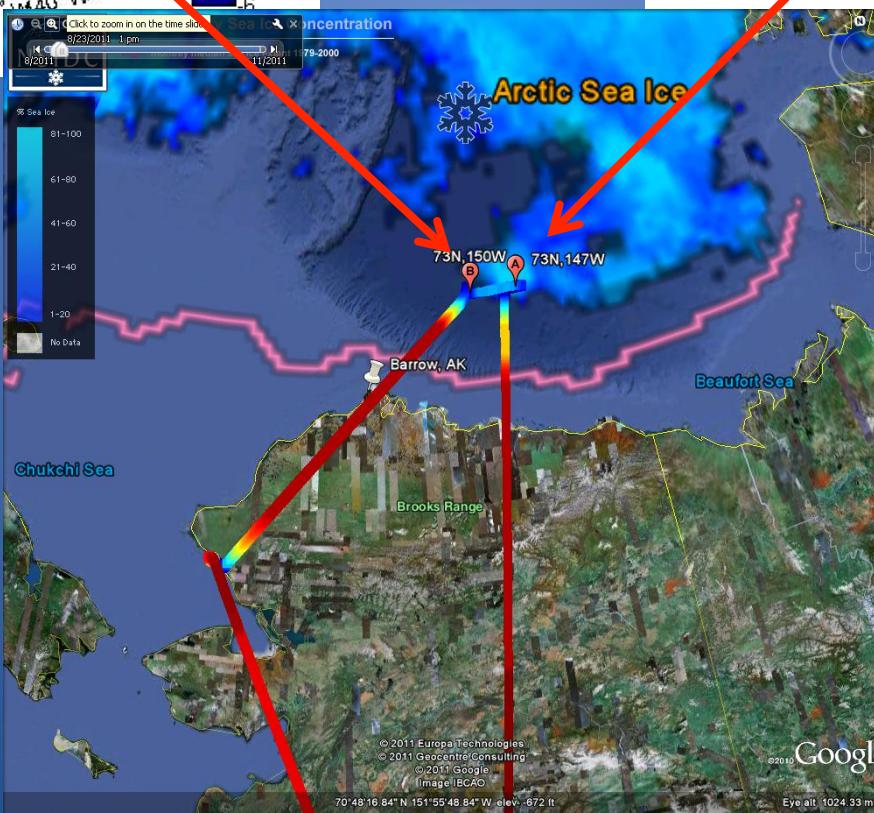
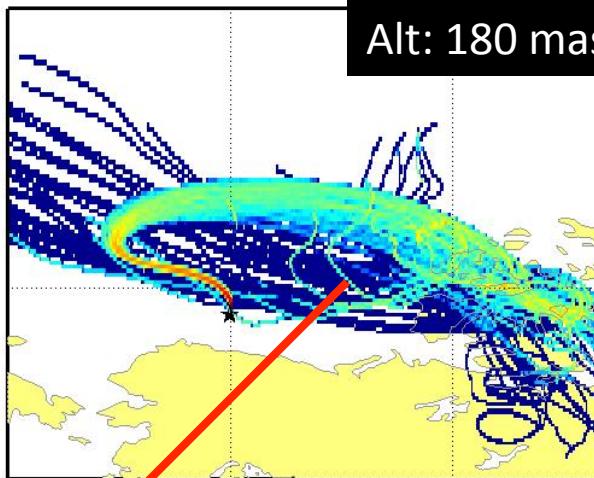
Lat: 73°N  
Lon: 150°W  
Alt: 160 masl



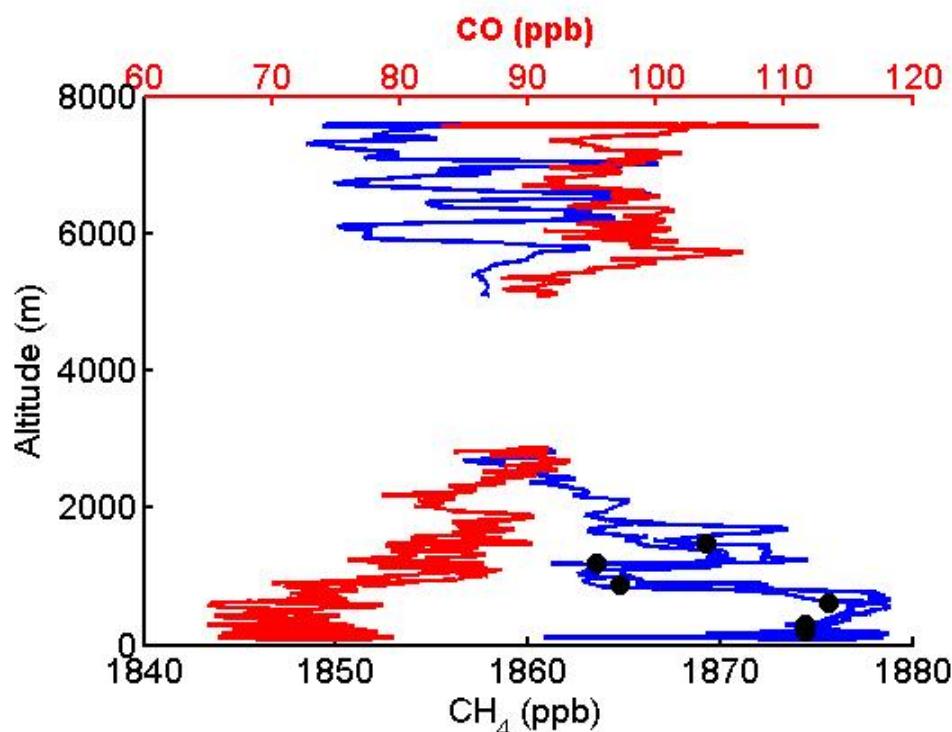
8/23/2011

2011.323402, 23-Aug-20

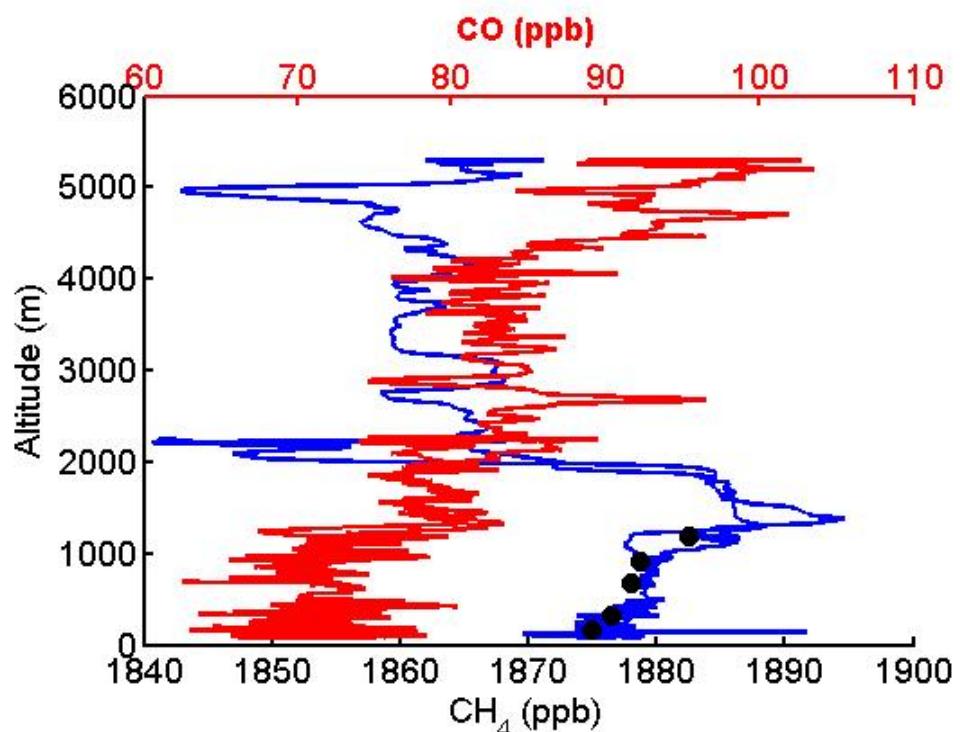
Lat: 73°N  
Lon: 147°W  
Alt: 180 masl



# 8/23/2011

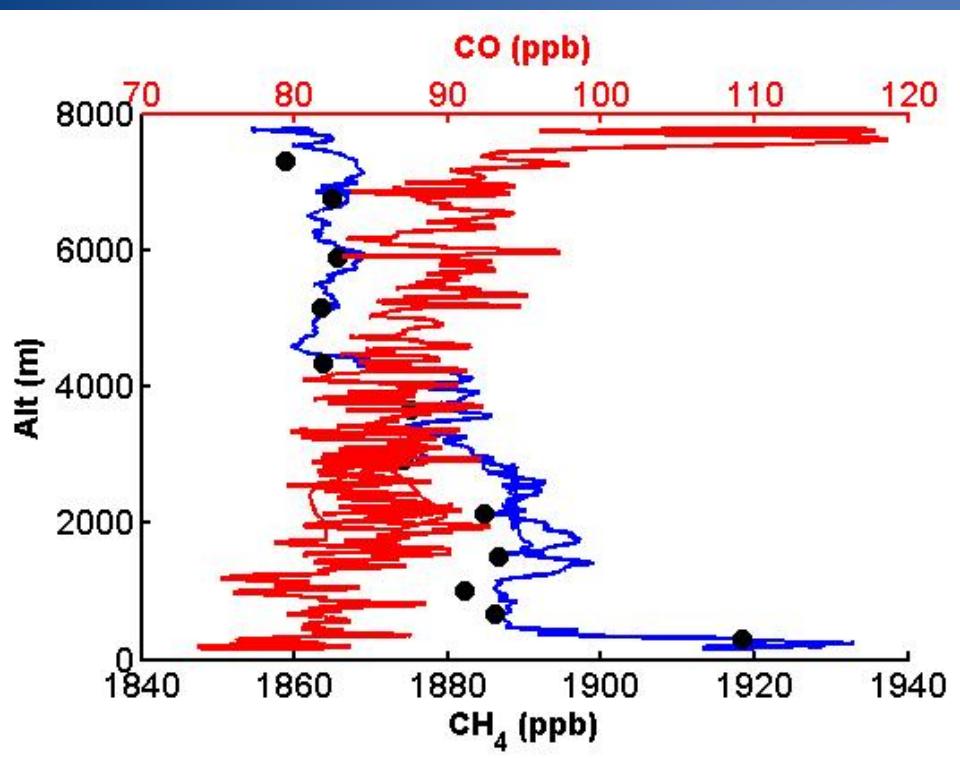


Lon:  $150^{\circ}\text{W}$

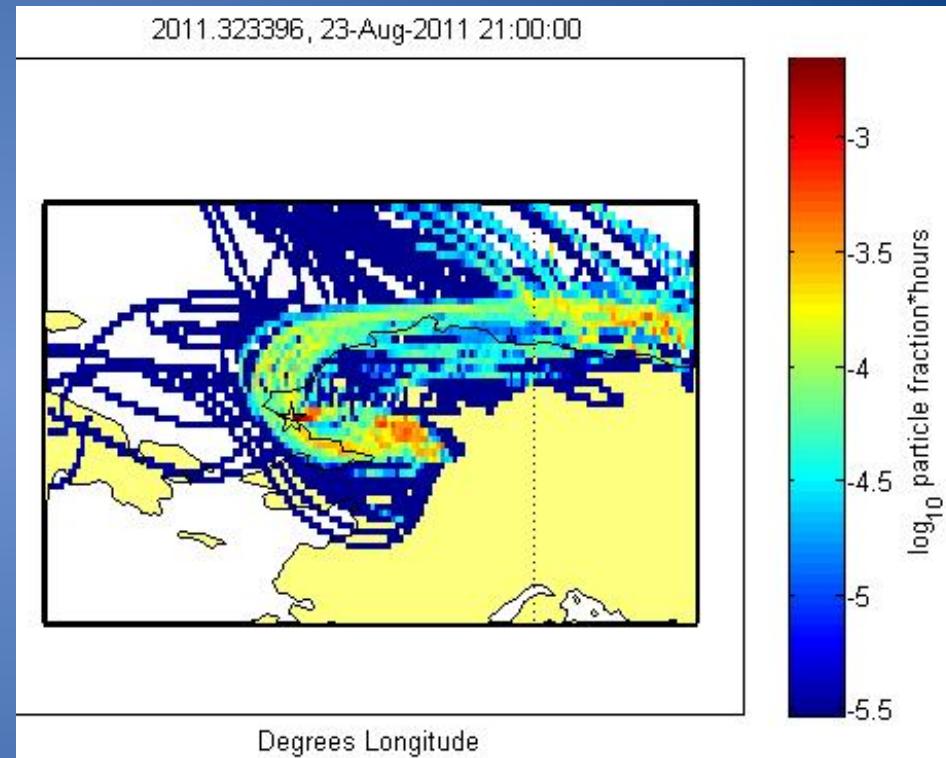


Lon:  $147^{\circ}\text{W}$

# 8/23/2011: Profile over Kivalina, AK



Enhanced CH<sub>4</sub> below 2000 m and below 500 m with no enhancement in CO



24-hr HYSPLIT Footprint from 300 m receptor

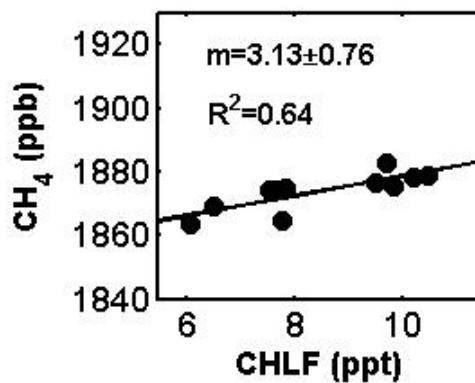
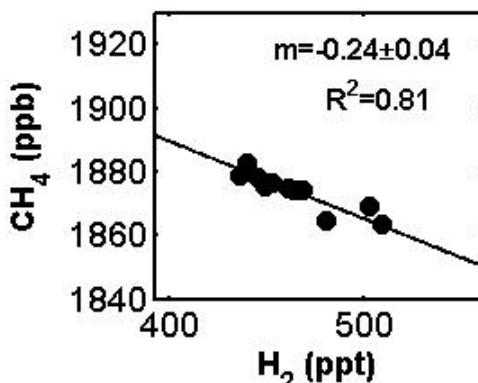
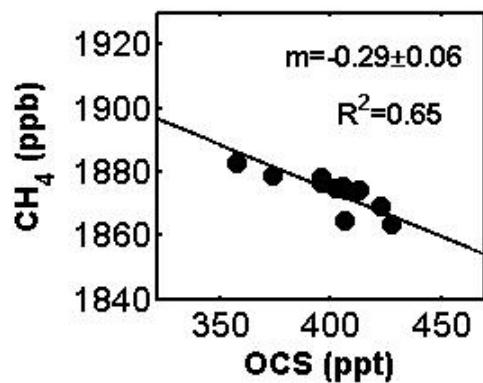
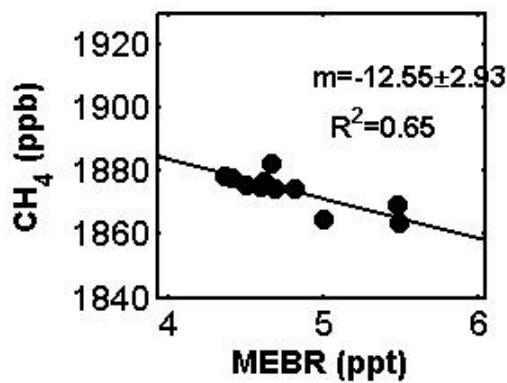
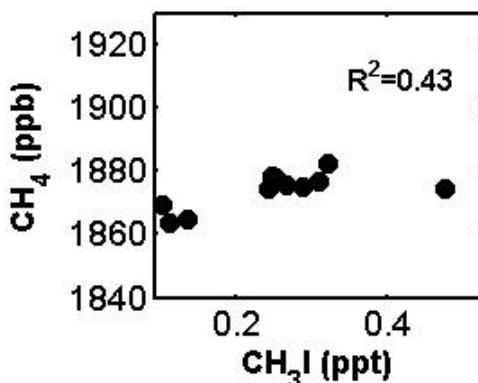
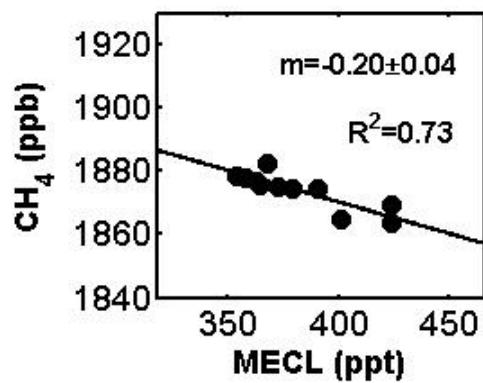
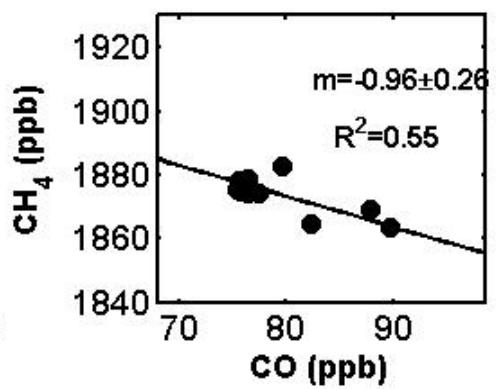
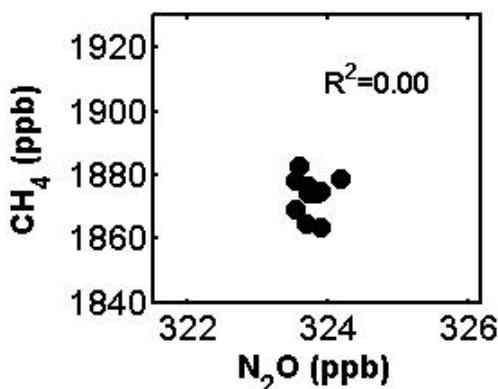
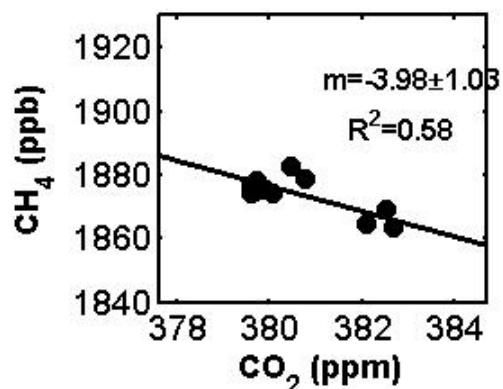
GCMS (HATS) gases may help resolve source of signal

# Summary

- Unique opportunity for science
  - regular flights throughout the season
  - over multiple years
- Variability in CO<sub>2</sub> and CH<sub>4</sub> largely transported from lower latitudes
- Addition of continuous CO valuable for pinpointing transported pollution / biomass burning
- Measurements can help develop a more sophisticated background condition for the interior of Alaska

# 8/23/2011: Ocean Profiles (2 locations)

PRELIMINARY



## PRELIMINARY

## 8/23/2011: Kivalina Profile

