

# Light Aircraft Observational Capabilities

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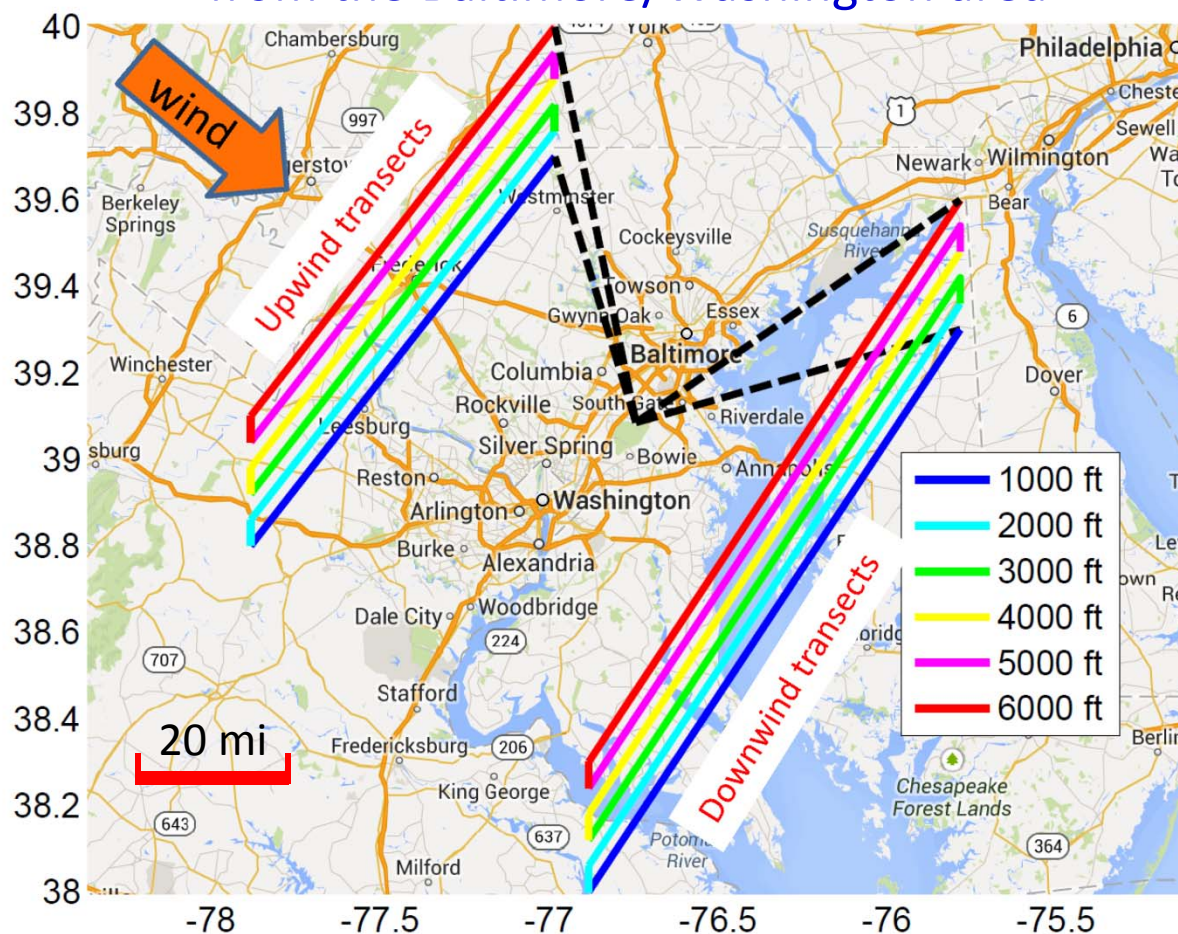
# FLAGG-MD

## Fluxes of Greenhouse Gases in Maryland



# FLAGG-MD

Mass Balance Experiments to characterize GHG emissions from the Baltimore/Washington area



$$E.R. = \int_0^{z_i + x} \int_{-x}^{+x} ([C] - [C]_b) \times U_{\perp} dx dz$$

E. R. : emission rate

[C] : concentrations (downwind)

[C]<sub>b</sub> : concentration in background

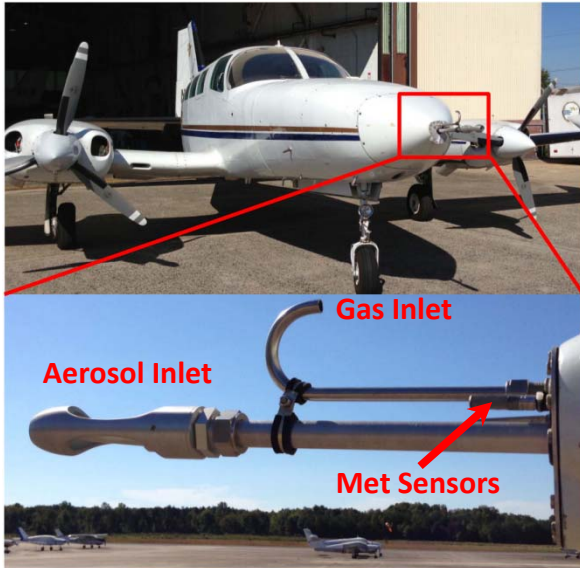
U<sub>⊥</sub> : perpendicular wind speed

# UMD Cessna 402B Specifications

- **Twin Engine: 300 Horsepower**
- **Top Speed: 229 kts**
- **Cruise Speed: 210 kts**
- **Stall Speed (dirty): 70 kts**
- **Rate of Climb: 1,610 fpm**
- **Fuel Capacity: 102 gal**
- **Range: 1,180 nm**



# UMD Cessna 402B Research Aircraft



**GPS Position** (Lat, Long, Altitude)

**Met** (T, RH, P, wind speed/direction)

**Trace gases:**

$O_3$ : UV Absorption, modified TECO

$SO_2$ : Pulsed Fluorescence, modified TECO

$CH_4/CO_2/CO$ : Cavity Ring Down, Picarro

$NO_2$ : Cavity Ring Down, Los Gatos

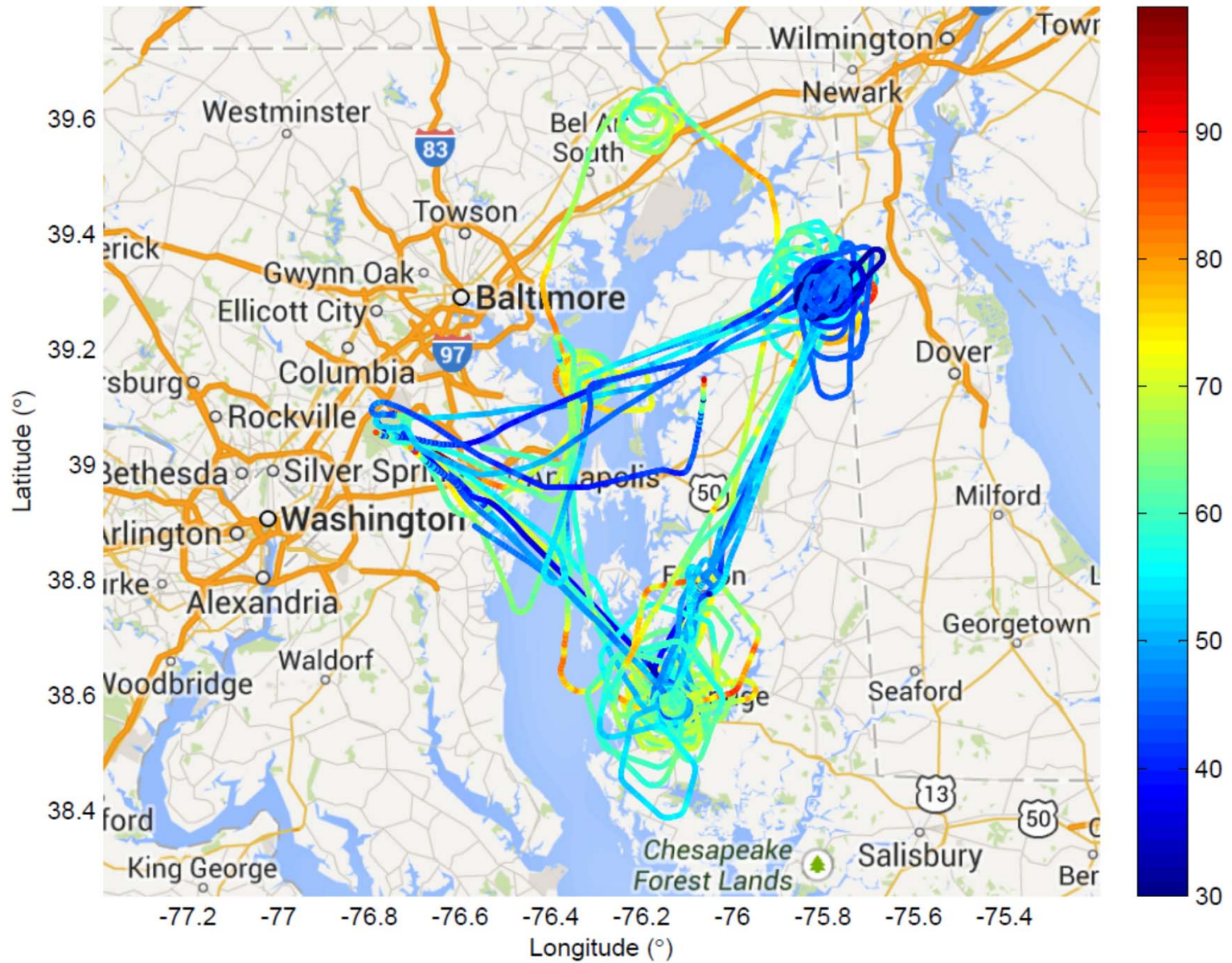
**Aerosol Optical Properties:**

Scattering:  $b_{scat}$  (@450, 550, 700 nm),  
Nephelometer

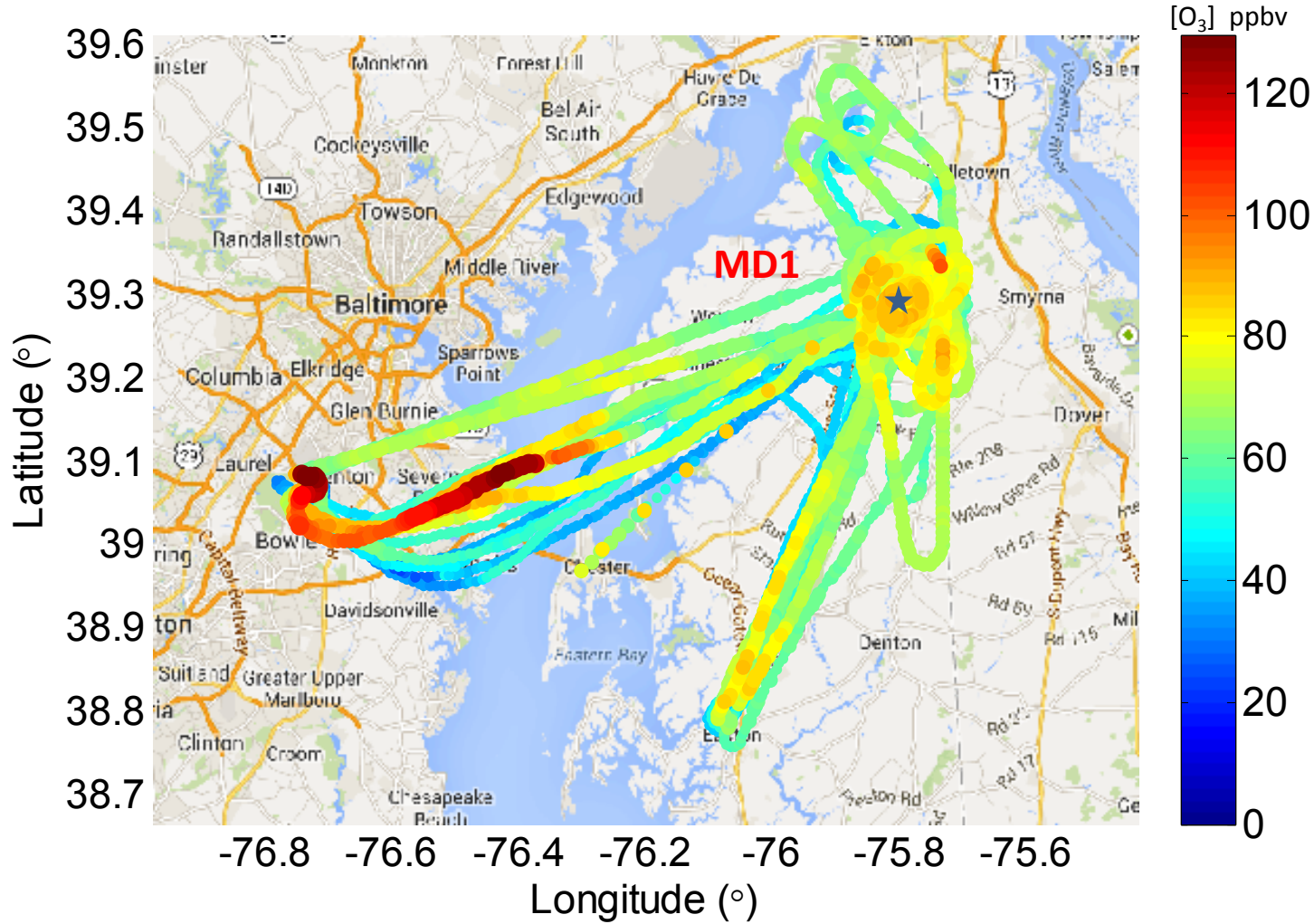
Absorption:  $b_{ap}$  (565 nm), PSAP

Black Carbon: Aethalometer

# Ozone during Summer 2014 Flights

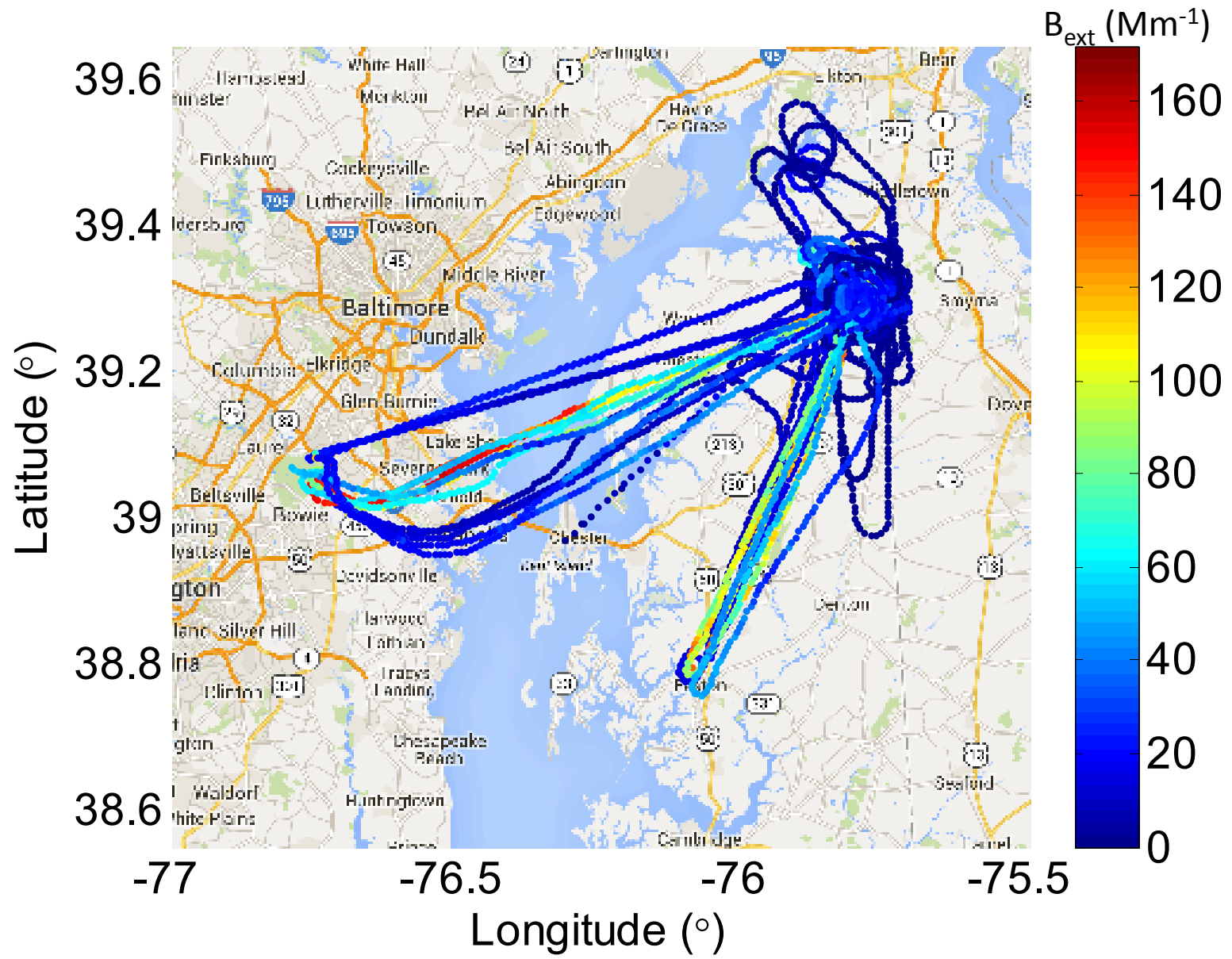


# Ozone during Summer 2013 Flights



- Single spiral location: MD1 in Willington, MD (39.299°N, 75.799°W)
- Totally 17 flights
- Morning flights: ~09:00 – 11:00; Afternoon Flights: ~13:00 – 15:00 (LT)

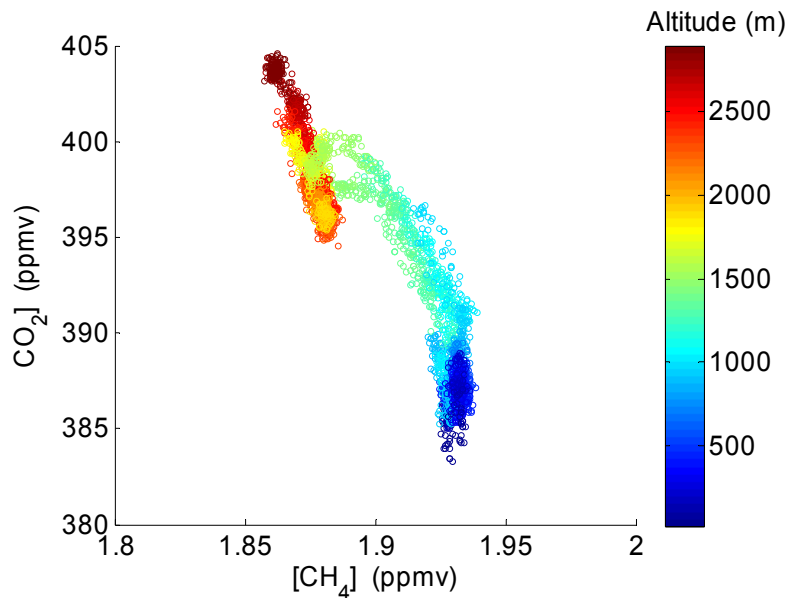
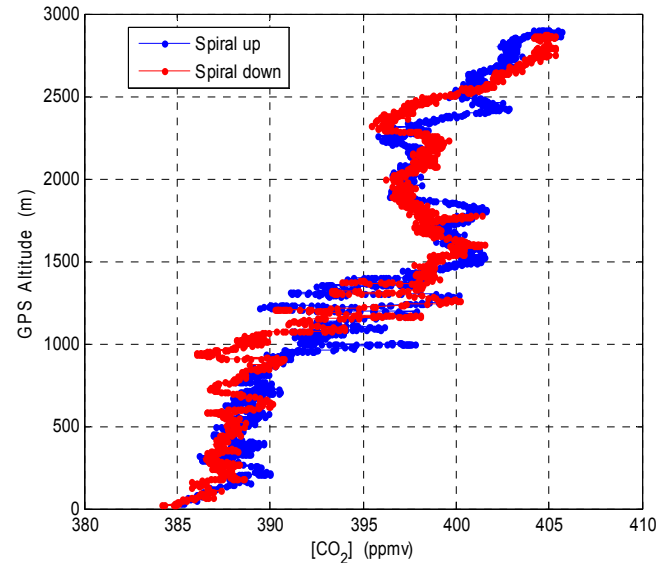
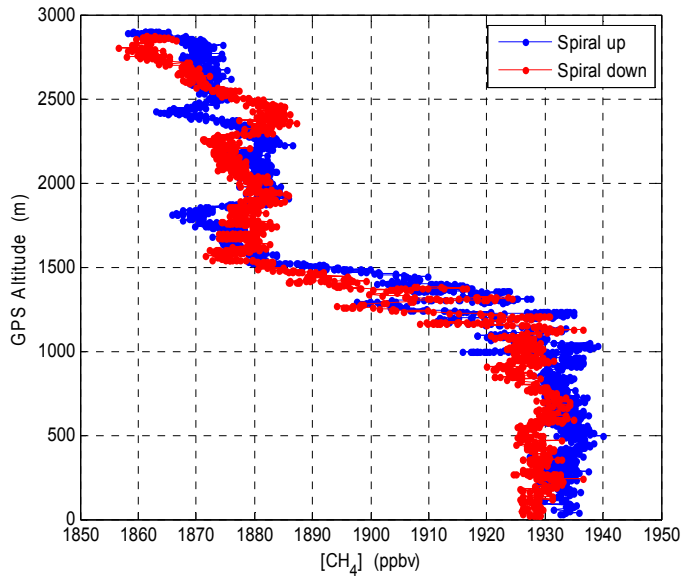
# Aerosol Extinction during Summer 2013 Flights





# Methane (CH<sub>4</sub>)/CO<sub>2</sub> Observations

RF3\_07/07/2014 Afternoon spirals over MD1 in Millington, MD



- CH<sub>4</sub>: higher in the mixing layer  
lower in the free troposphere
- CO<sub>2</sub>: lower in the mixing layer—bio uptake  
Higher in the free troposphere
- Anti-correlation between CO<sub>2</sub> and CH<sub>4</sub>:  
altitude dependence

# Purdue Beechcraft Duchess Specifications

- **Twin Engine: 180 Horsepower**
- **Top Speed: 171 kts**
- **Cruise Speed: 158 kts**
- **Stall Speed (dirty): 60 kts**
- **Rate of Climb: 1,248 fpm**
- **Fuel Capacity: 100 gal**
- **Range: 843 nm**



**Purdue ALAR  
(Airborne  
Laboratory for  
Atmospheric  
Research)**



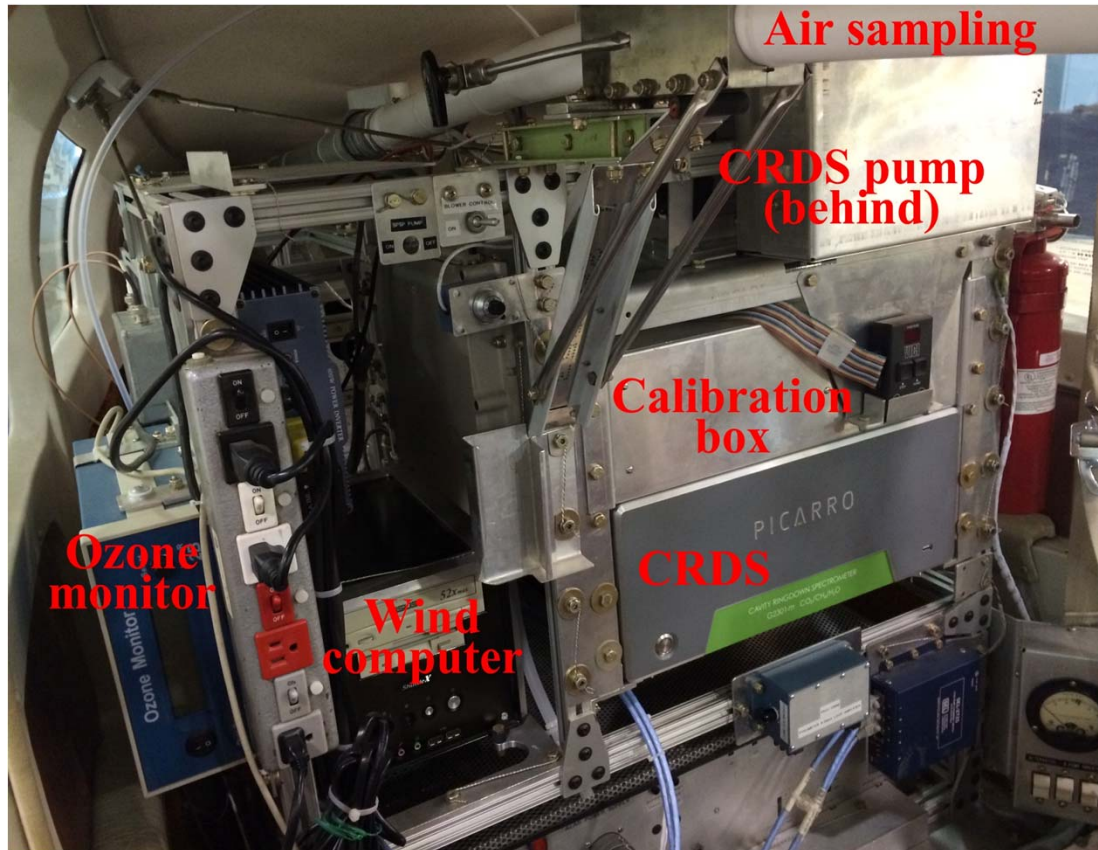
Beechcraft Duchess  
Light twin engine



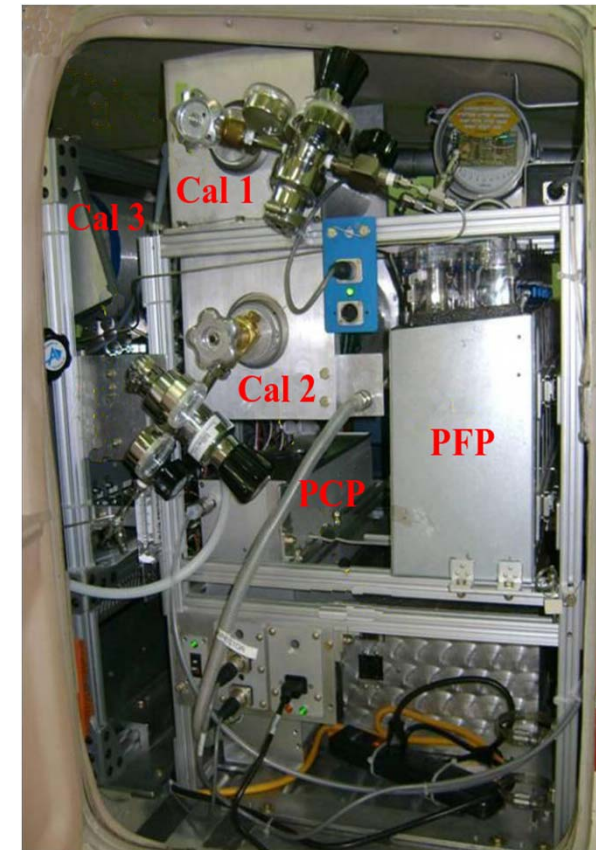
BAT: Best Air Turbulence probe  
up to 50 Hz turbulence wind

# Purdue Duchess Research Aircraft

## Front View



## Back View



**GPS Position** (Lat, Long, Altitude)

**Met** (T, RH, P, 3-D wind by BAT)

## Trace gases:

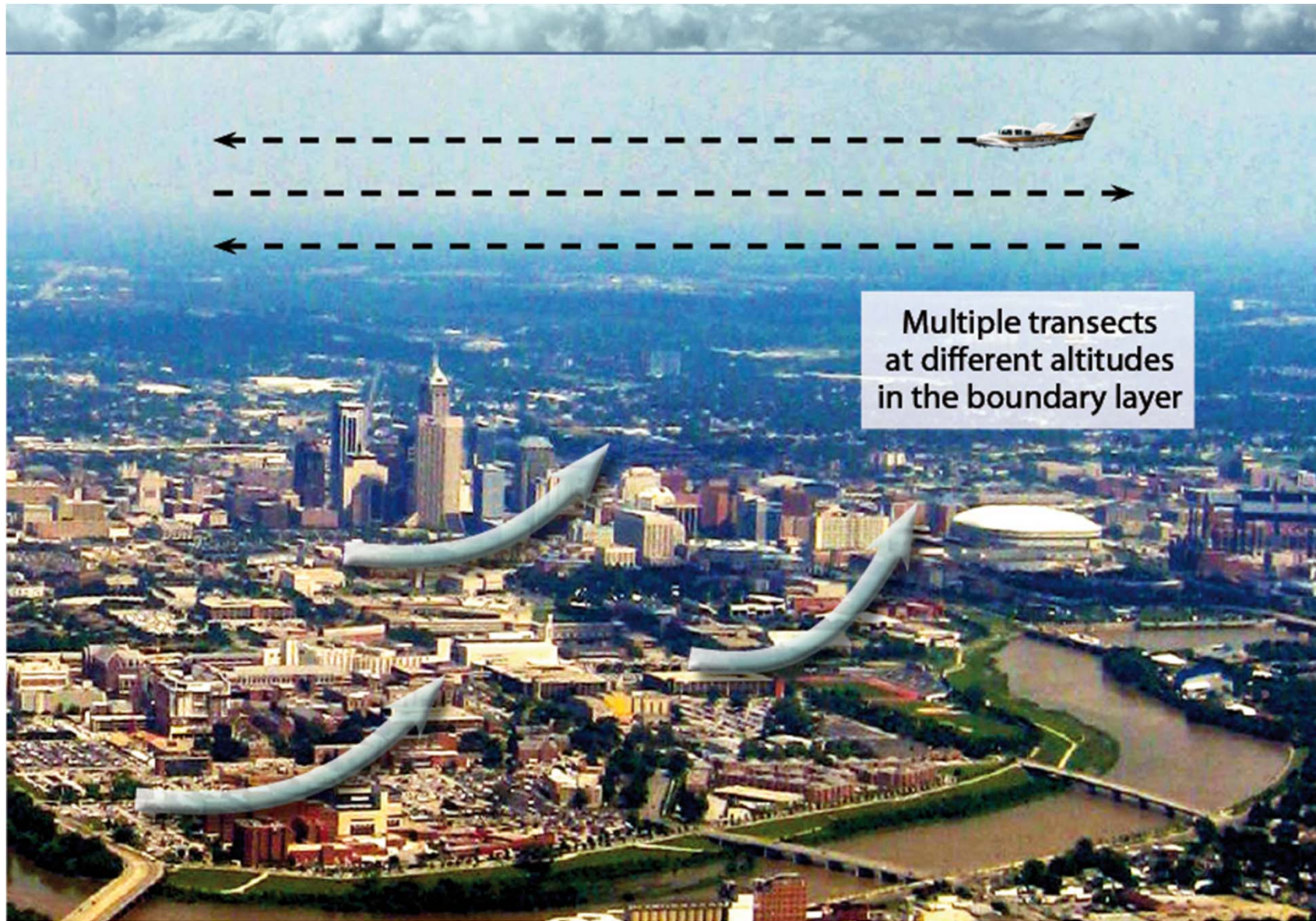
**O<sub>3</sub>**: UV Absorption, 2B Technology

**CH<sub>4</sub>/CO<sub>2</sub>**: Cavity Ring Down, Picarro

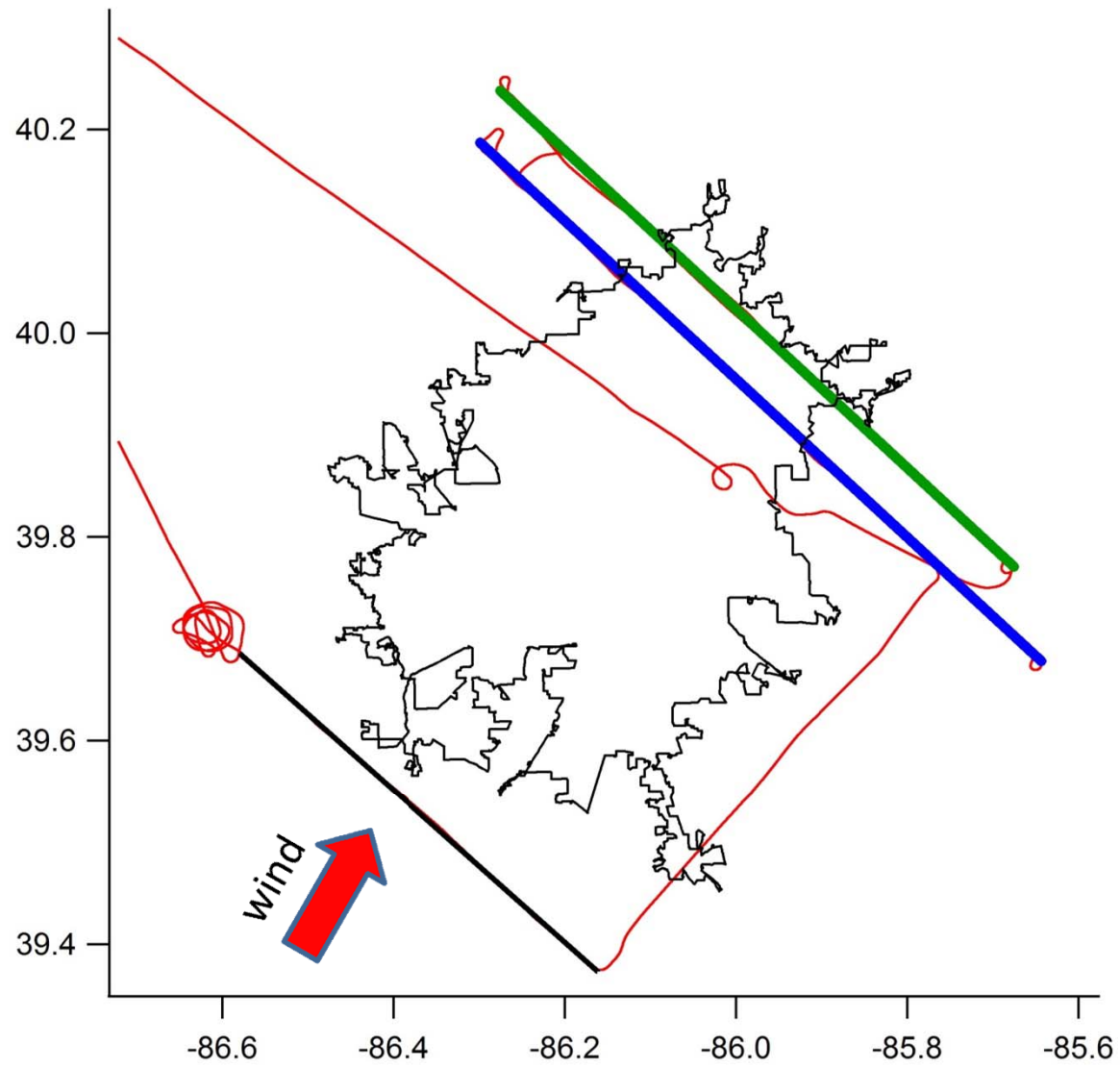
**Flask package**: CO<sub>2</sub>/CH<sub>4</sub>/CO and VOCs

**NO<sub>2</sub>**: Cavity Ring Down, Los Gatos (to be added)

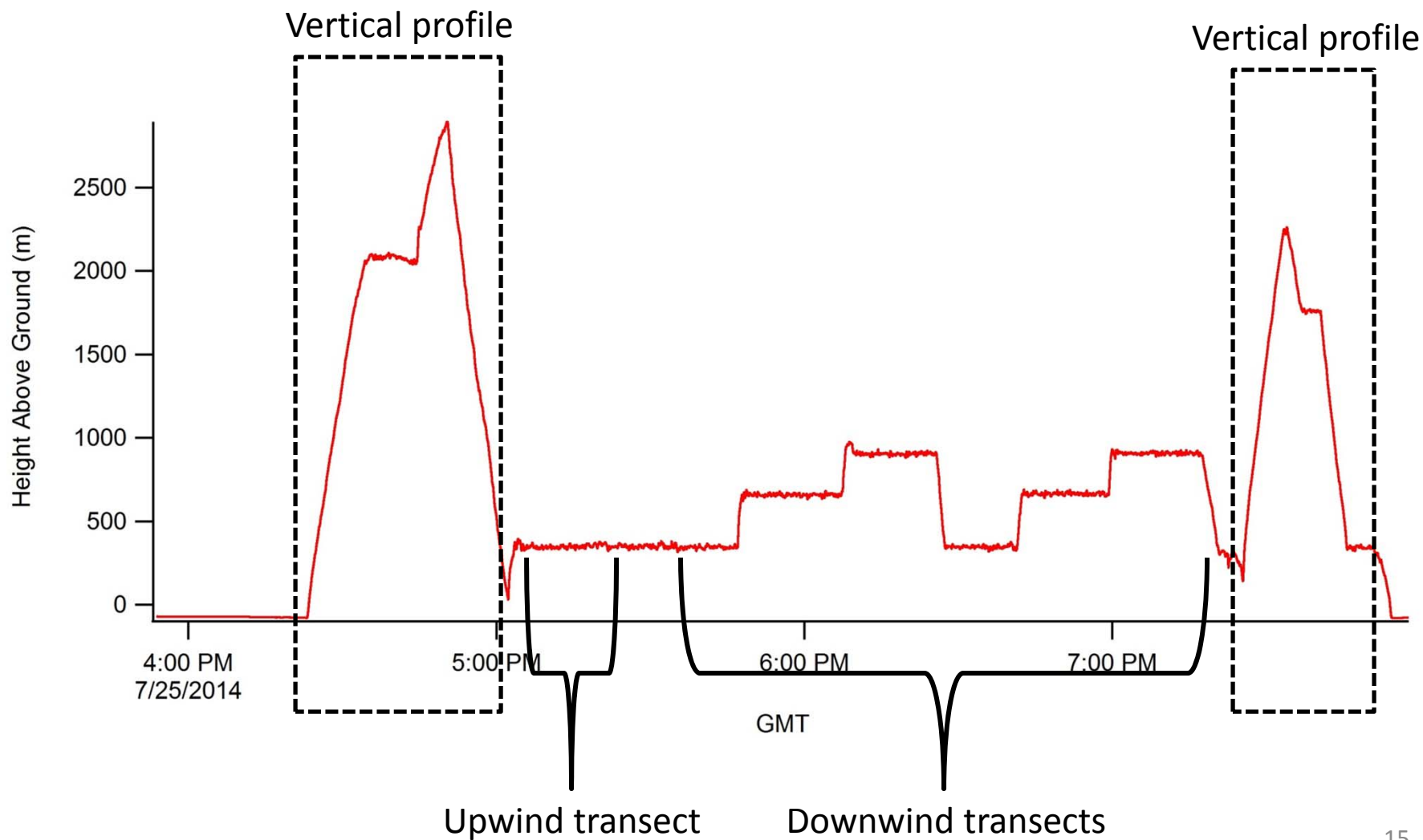
# INFLUX Project: GHG fluxes in Indianapolis



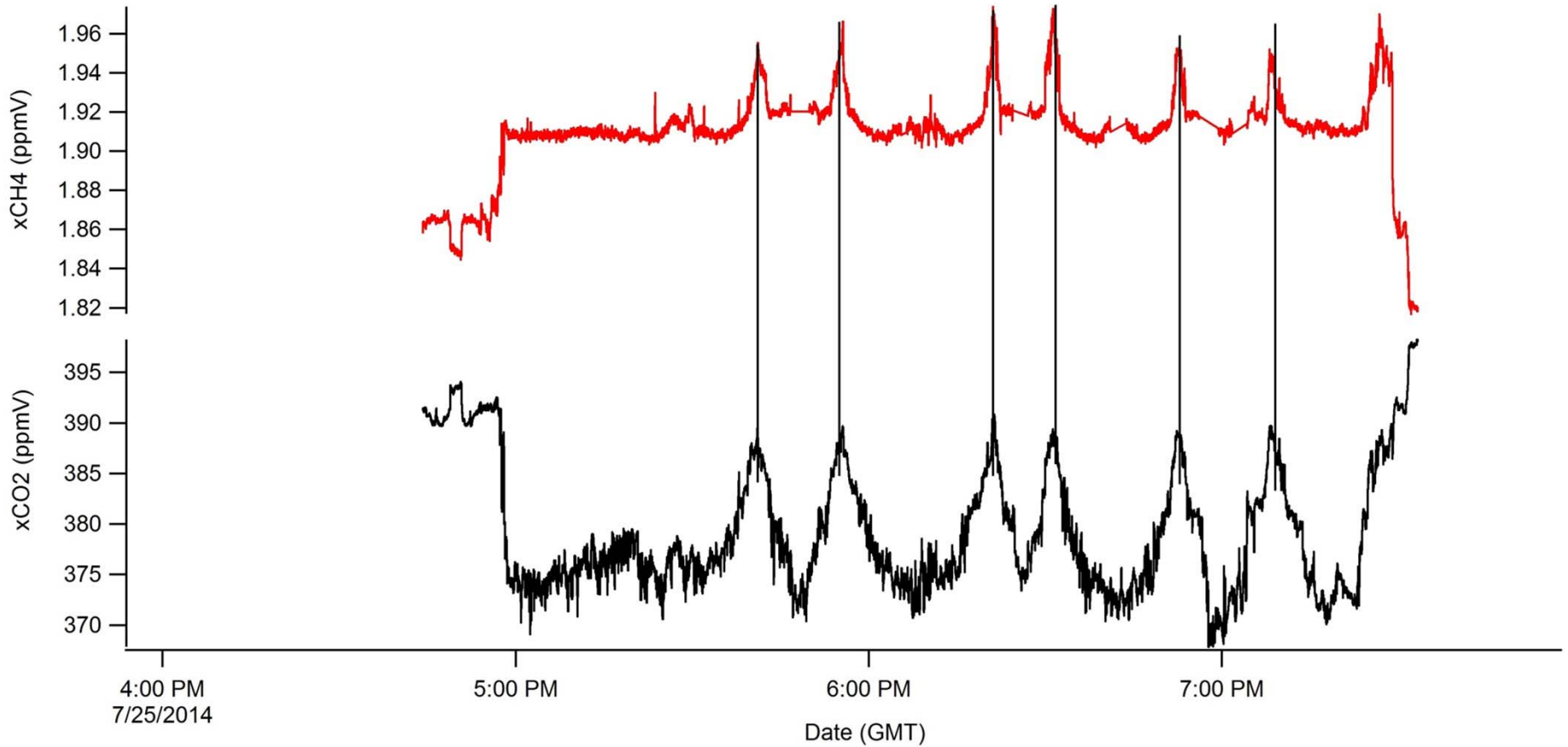
# Transects: 7/25/2014



# Transect: 7/25/2014



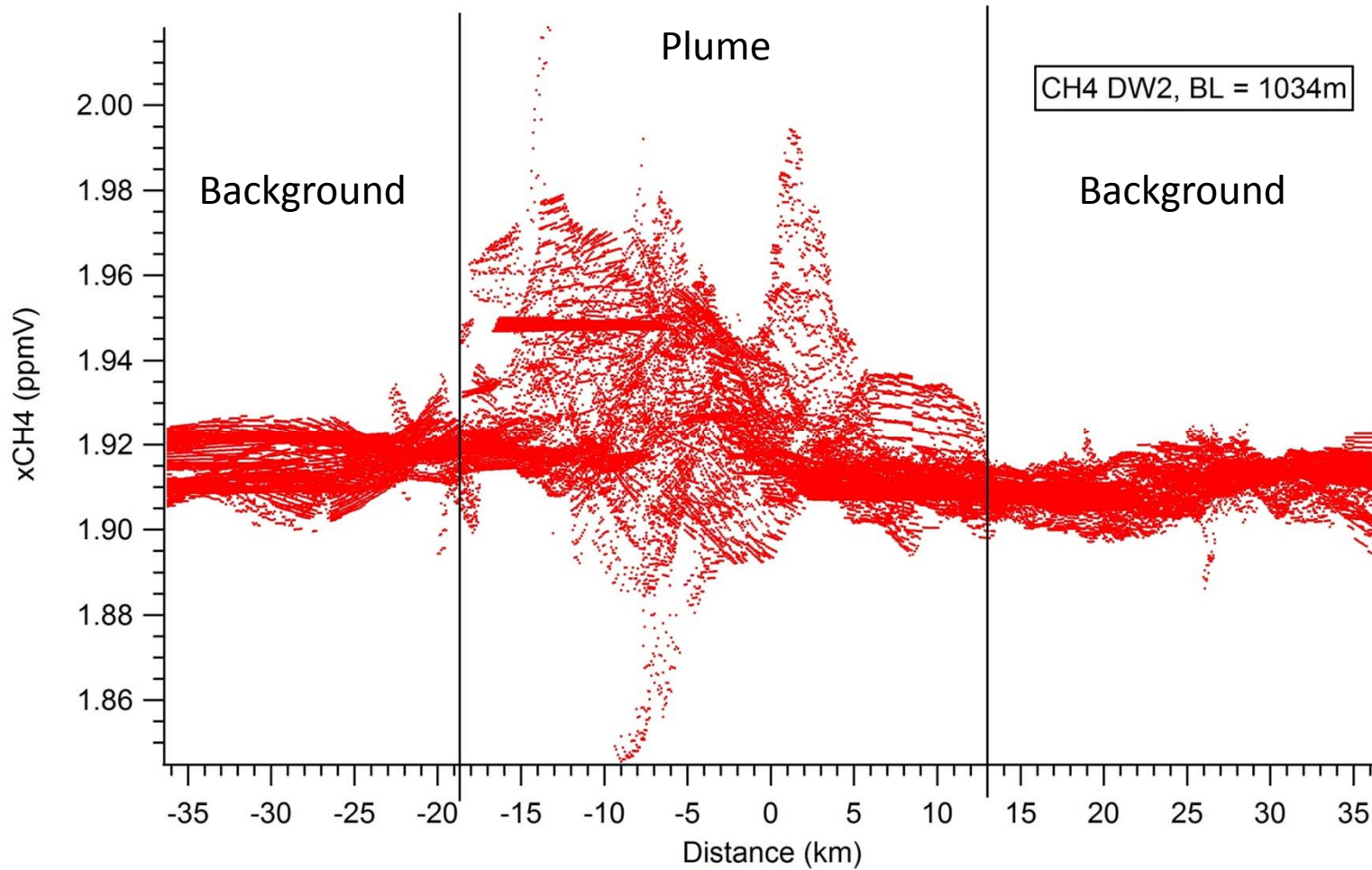
# Concentration profiles: July, 25th



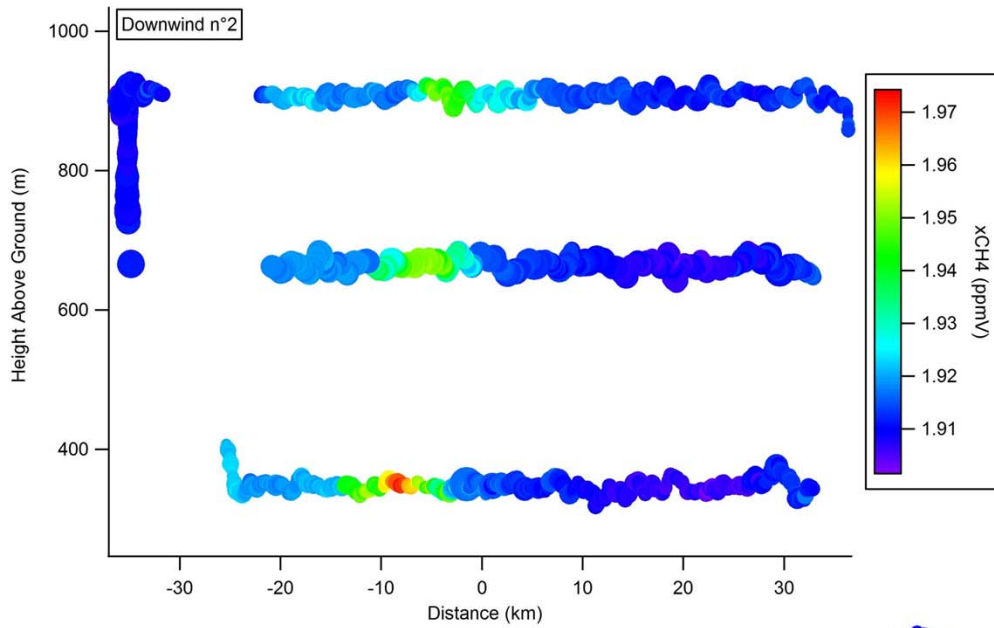
- Lines: plume from the city,
- CH<sub>4</sub> and CO<sub>2</sub> are well correlated



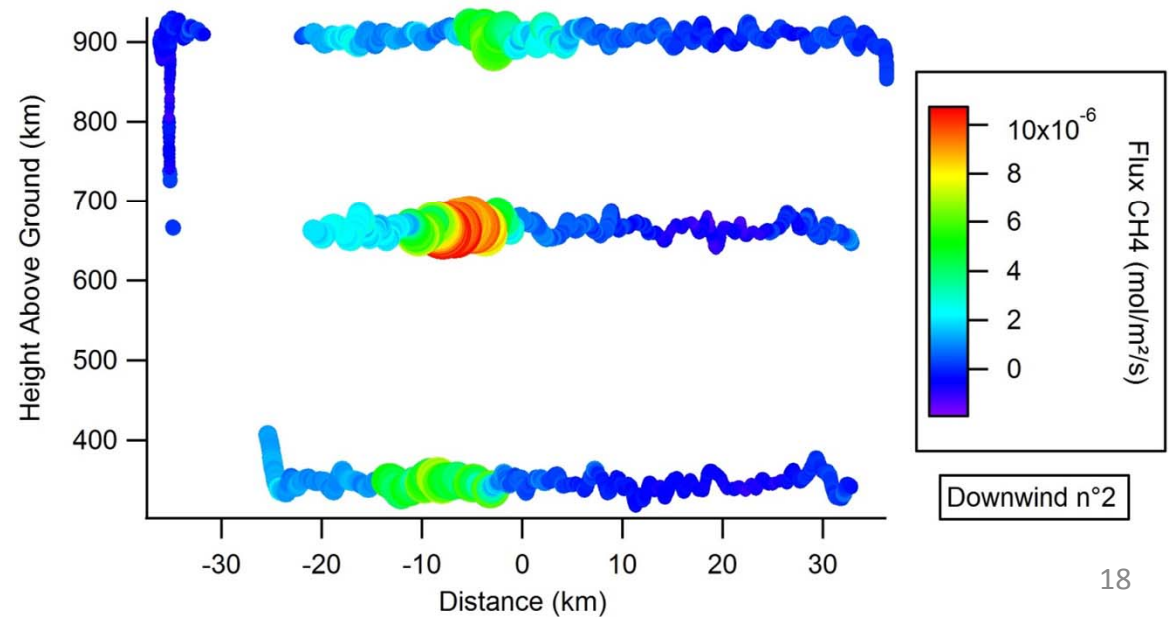
# CH<sub>4</sub> concentration: July, 25th



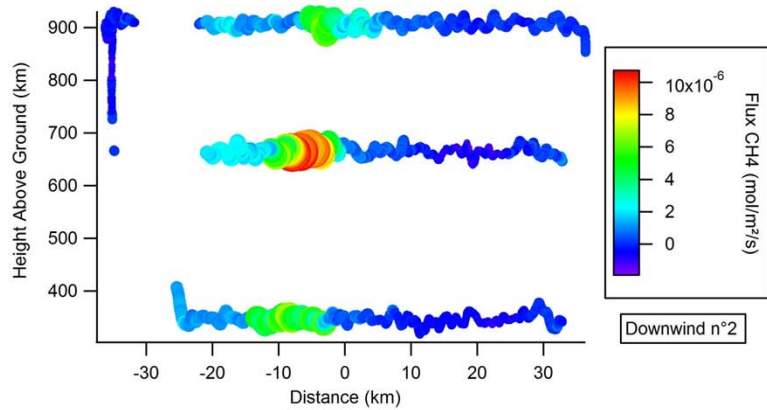
# Downwind transects: CH<sub>4</sub> (July, 25th)



Concentrations



# Downwind transects: CH<sub>4</sub> (July, 25th)

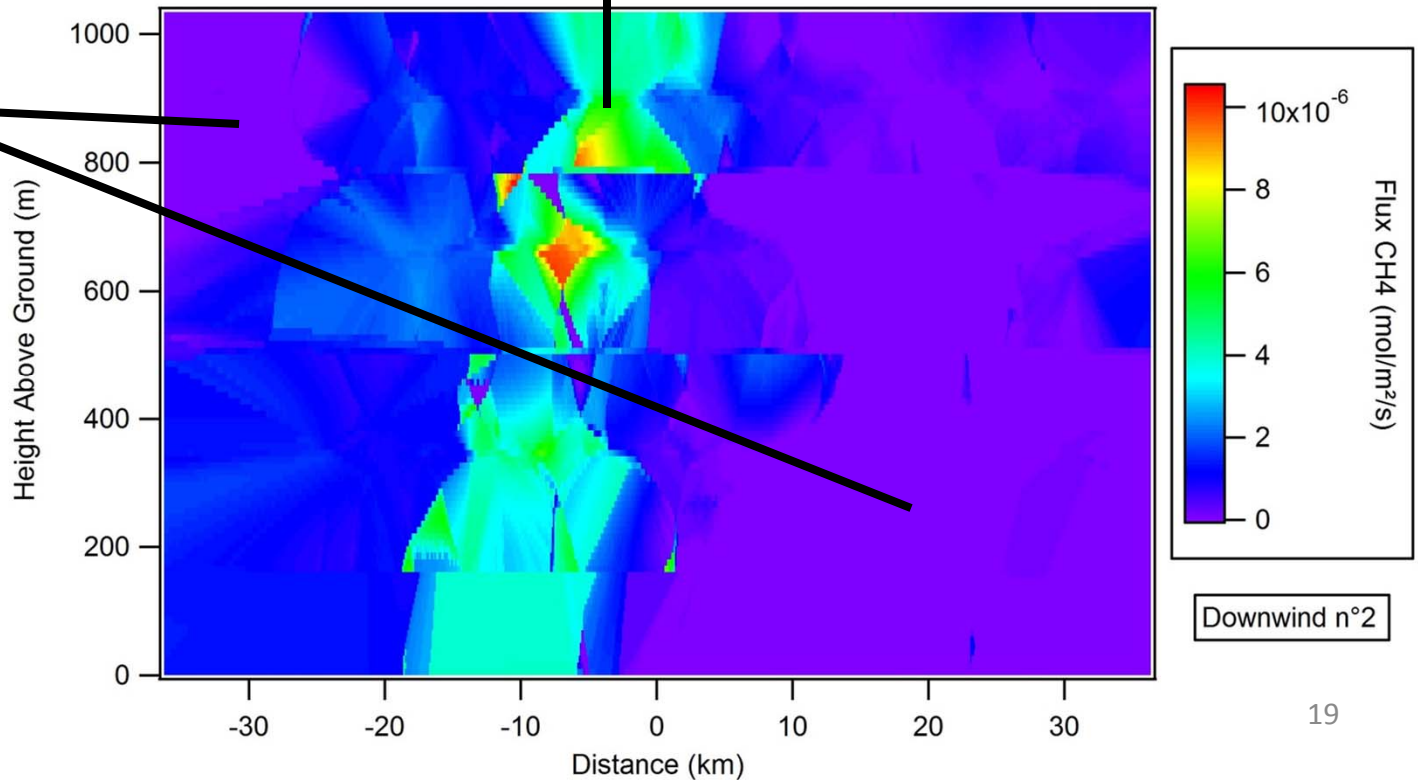


Integrated flux:  
**72 mol/s**

Plume

Background

kriged  
flux



# Formation Flights: C-130, Cessna, and Duchess

## **Objective:**

- To compare observations of met, trace gases, and aerosols

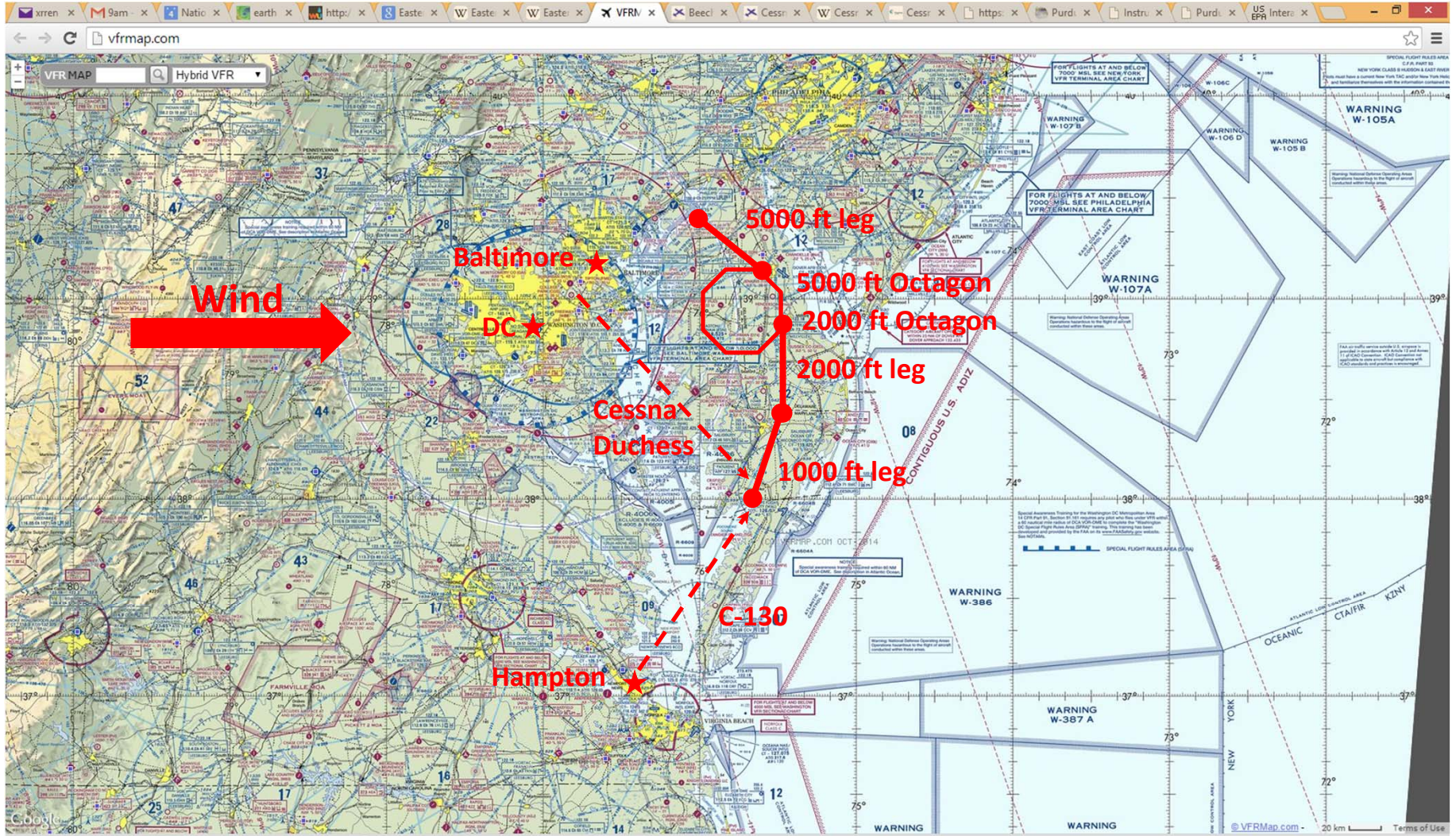
## **Tentative Plan:**

- To fly a few constant altitude legs in and above the PBL (e.g., 1000, 2000, and 5000 ft above ground)
  - Parallel racetrack patterns
  - octagons to test sensitivity to heading.
- Missed approaches

## **A Possible Location:**

- Over the Eastern Shore, where ATC is much easy to deal with.

# Example for a Formation Flight: C-130, Cessna, and Duchess

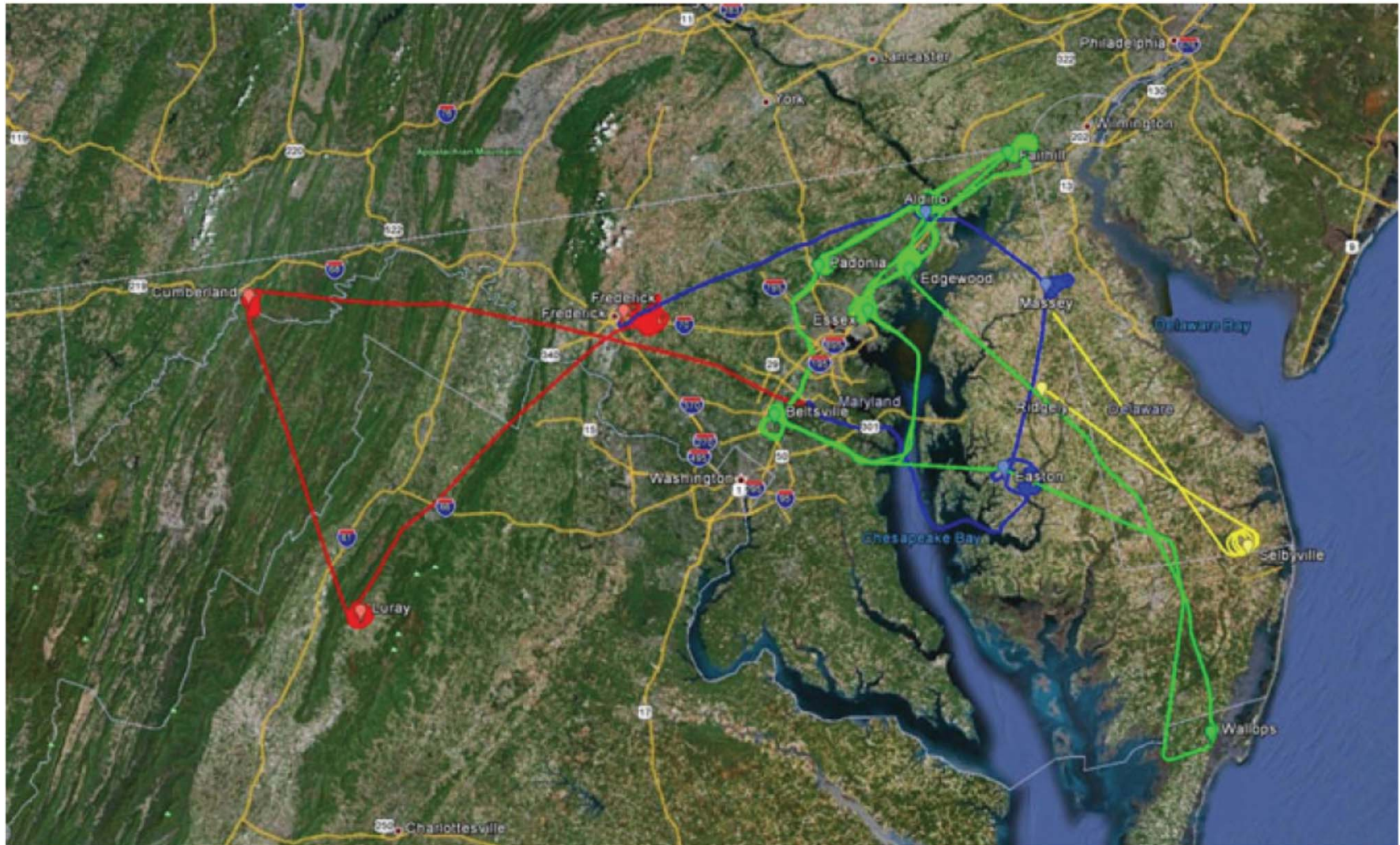


# Cessna and NASA P-3B during DISCOVER-AQ 2011

Yellow: Intercomparison

Green: P-3B

Red and Blue: Cessna



**Questions/Suggestions?**

**Look forward to flying together with C-130!**