STILT modeling: Flight planning and analysis

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Atmospheric modeling component of ORCAS

- STILT: Stochastic Time-Inverted Lagrangian Transport model
- Use wind fields (forecast, reanalysis, modeled) to drive. Release air parcels (100s – 1000s) which stochastically sample turbulence and can move forwards or backwards in time.
- Been used extensively in regional aircraft campaigns & quantifying fluxes (over land)
- Key feature: links atmospheric observation with upwind sources/sinks

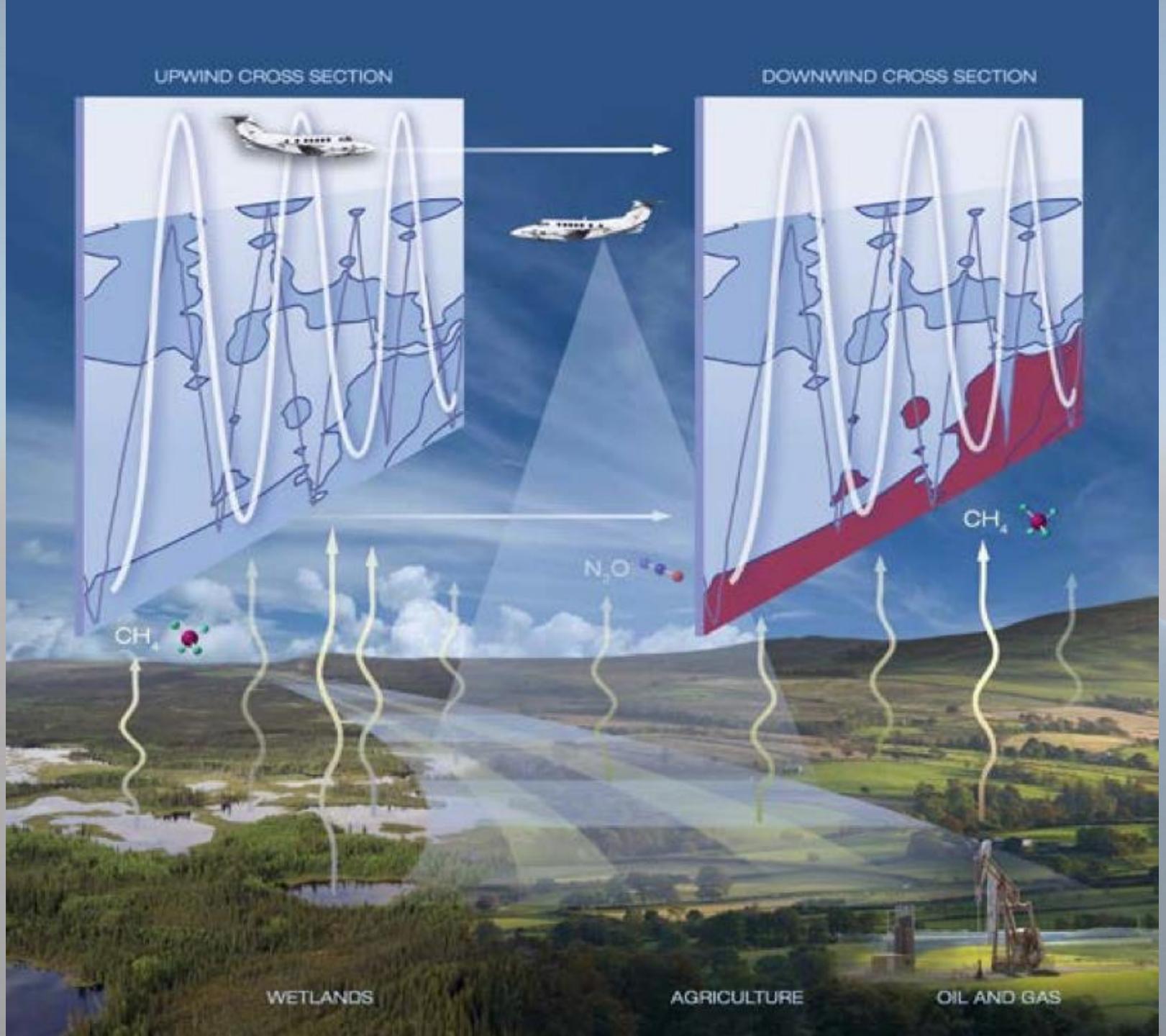
CARVE Polar-WRF/STILT
Receptor – Footprint Simulation
500 Particles, 10-day Back Trajectories

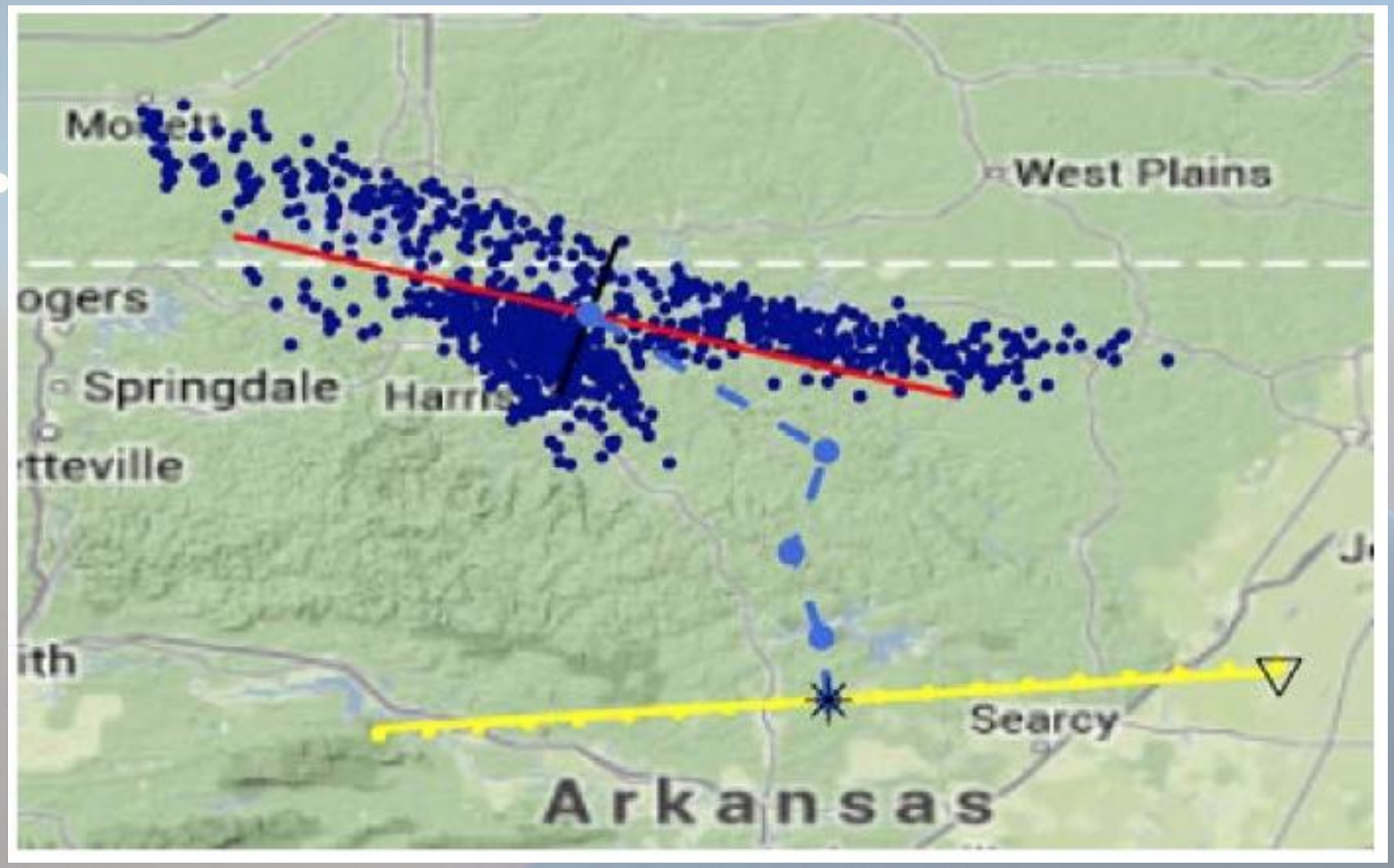
time : 11d 23h 00m

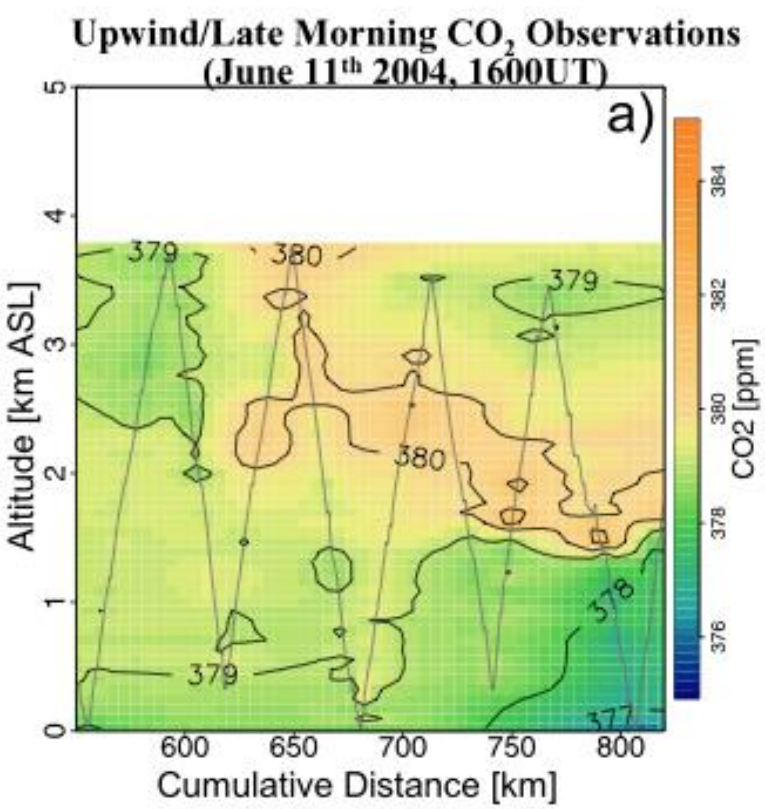
stilt2013x08x12x22x09x64.9860Nx147.6000Wx00301.nc

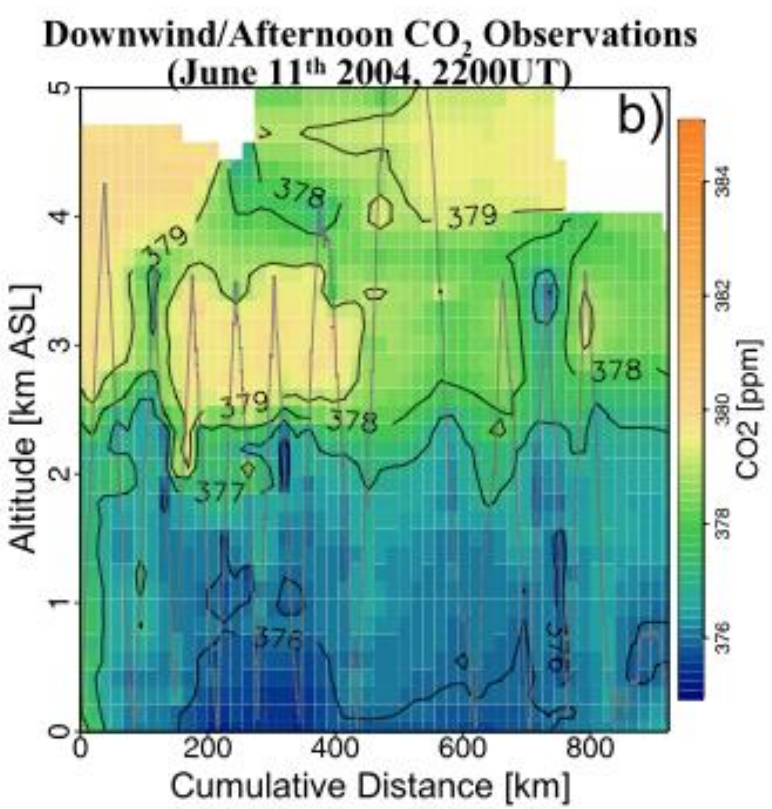
How will this be used for ORCAS

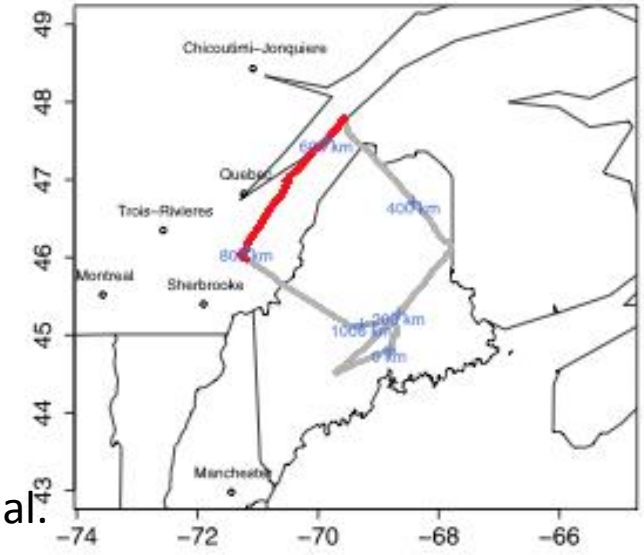
- 2 Modes
  - Flight Planning, possibilities
    - Lagrangian Flight strategies
    - Determine Air Origin/surface regions of influence
    - Predict Location of specific event plumes (say, upwelling?)
  - Post-mission analysis
    - Link observations with Fluxes (and Flux drivers)

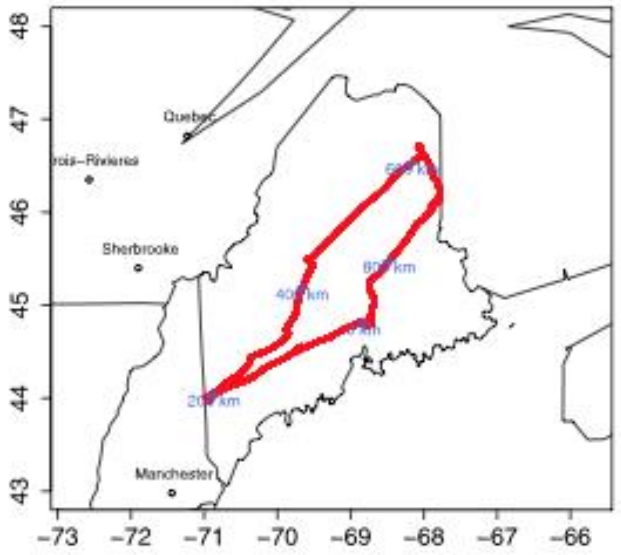

UPWIND CROSS SECTION
DOWNWIND CROSS SECTION
CH_4
N_2O
CH_4
WETLANDS
AGRICULTURE
OIL AND GAS


West Plains
Springdale
Searcy
Arkansas


Upwind/Late Morning CO2 Observations
(June 11th 2004, 1600UT)
a)
Altitude [km ASL]
Cumulative Distance [km]
CO2 [ppm]
379
380
378
377
376
384
382
600
650
700
750
800


Downwind/Afternoon CO2 Observations
(June 11th 2004, 2200UT)
b)
Altitude [km ASL]
Cumulative Distance [km]
CO2 [ppm]
379
378
377
376
384
382
380
0
200
400
600
800


Chicoutimi–Jonquiere
Quebec
Trois–Rivieres
Montreal
Sherbrooke
Manchester
−74
−72
−70
−68
−66


Quebec
Sherbrooke
Manchester
−73
−72
−71
−70
−69
−68
−67
−66

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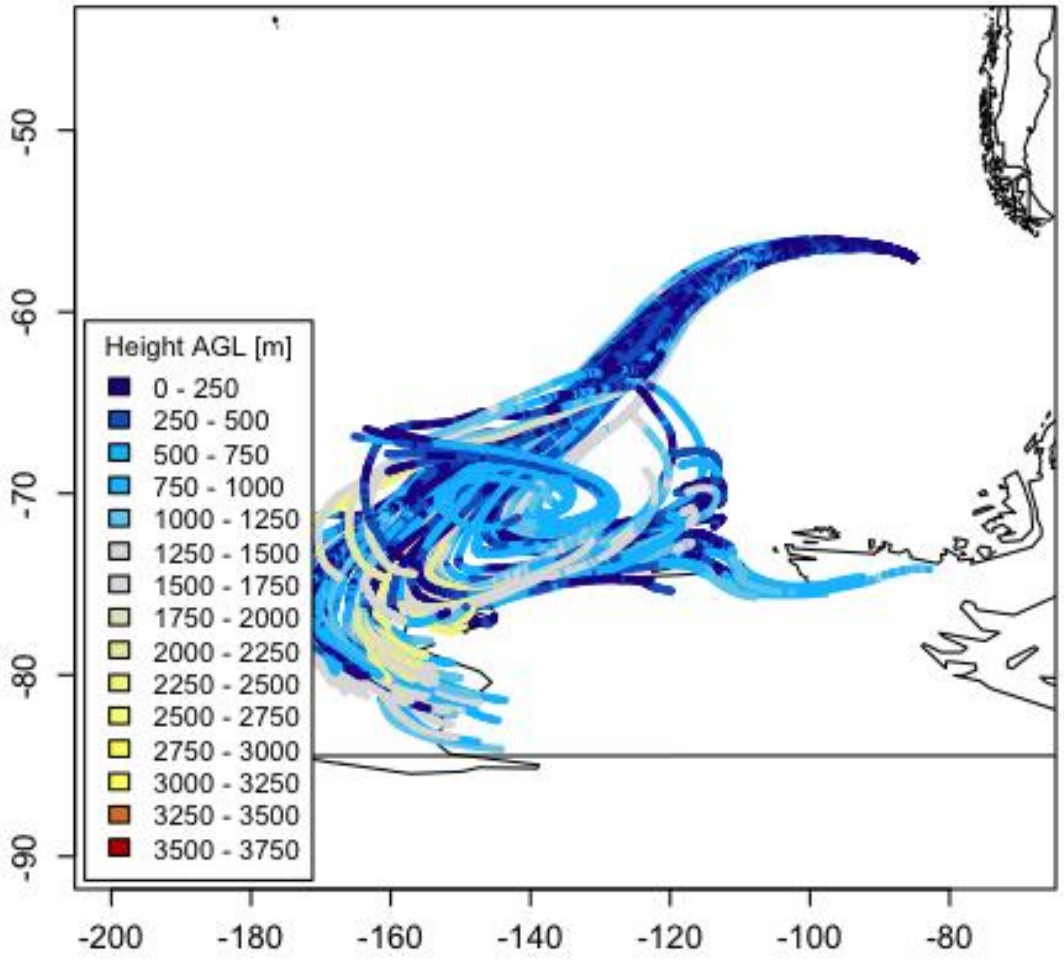
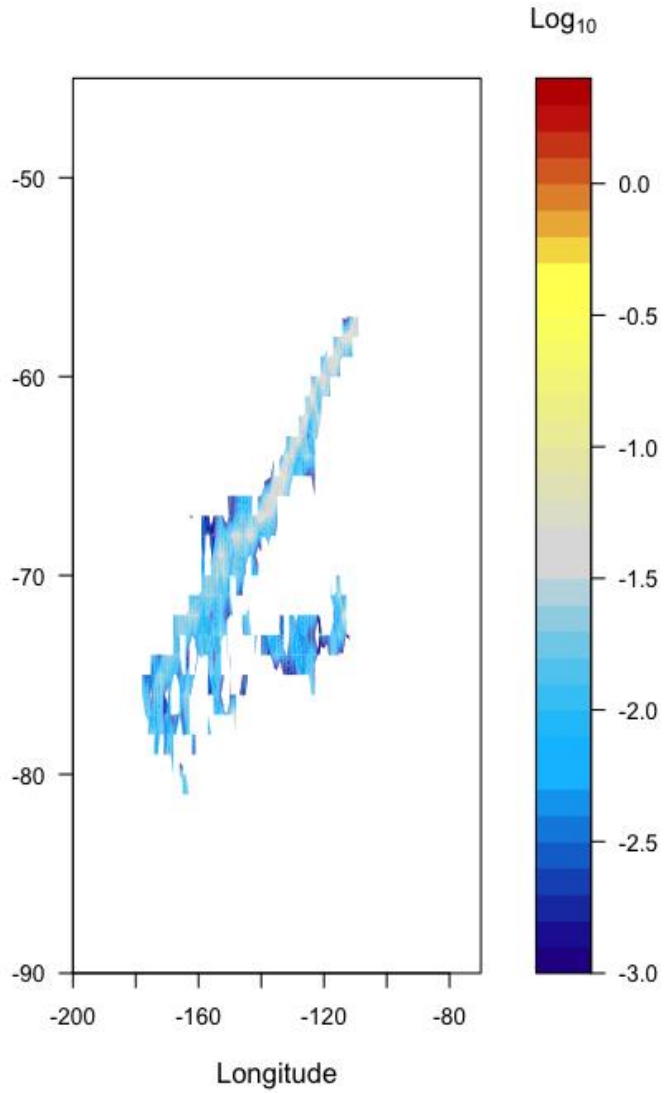
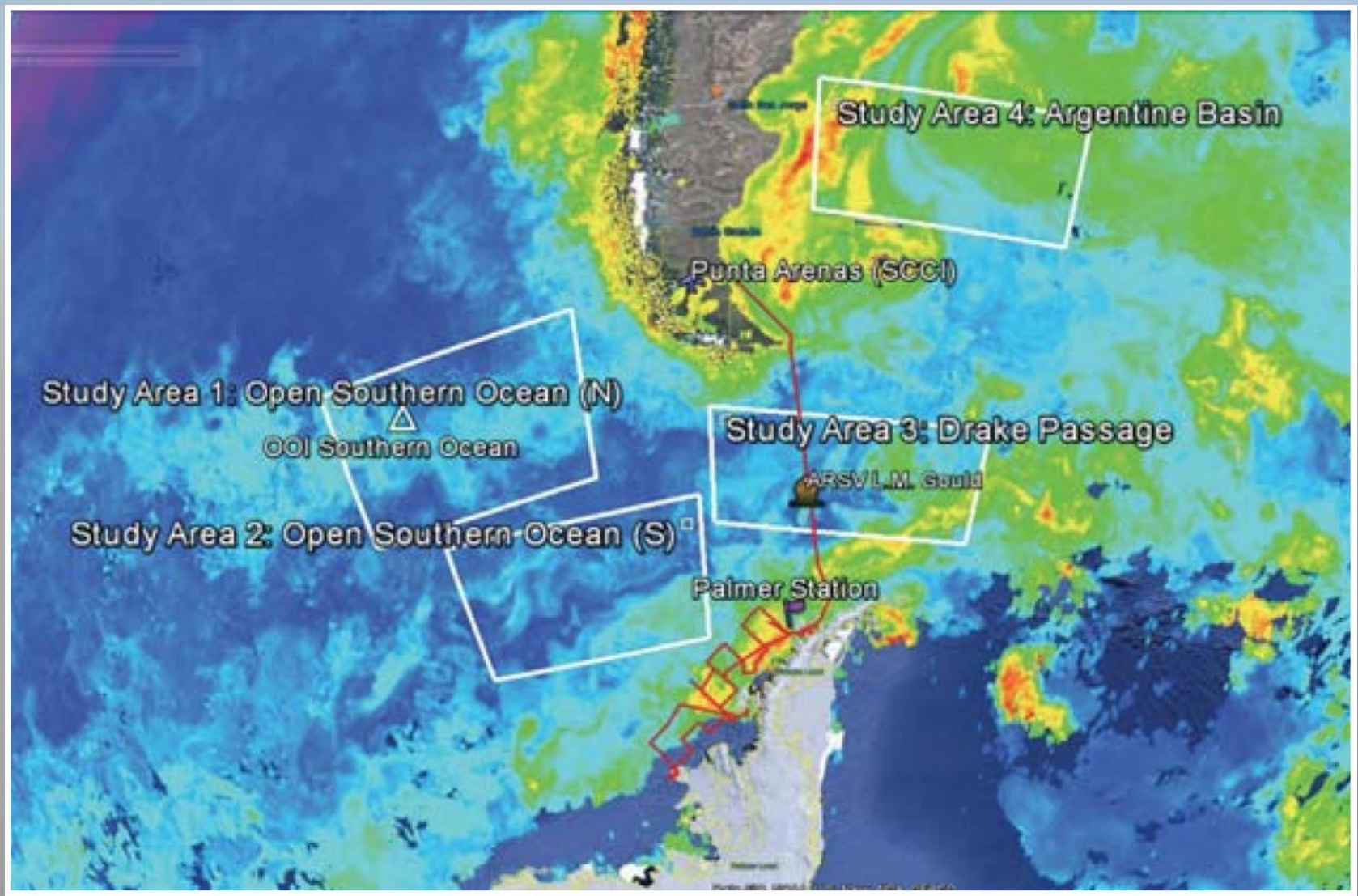
Determining air origin





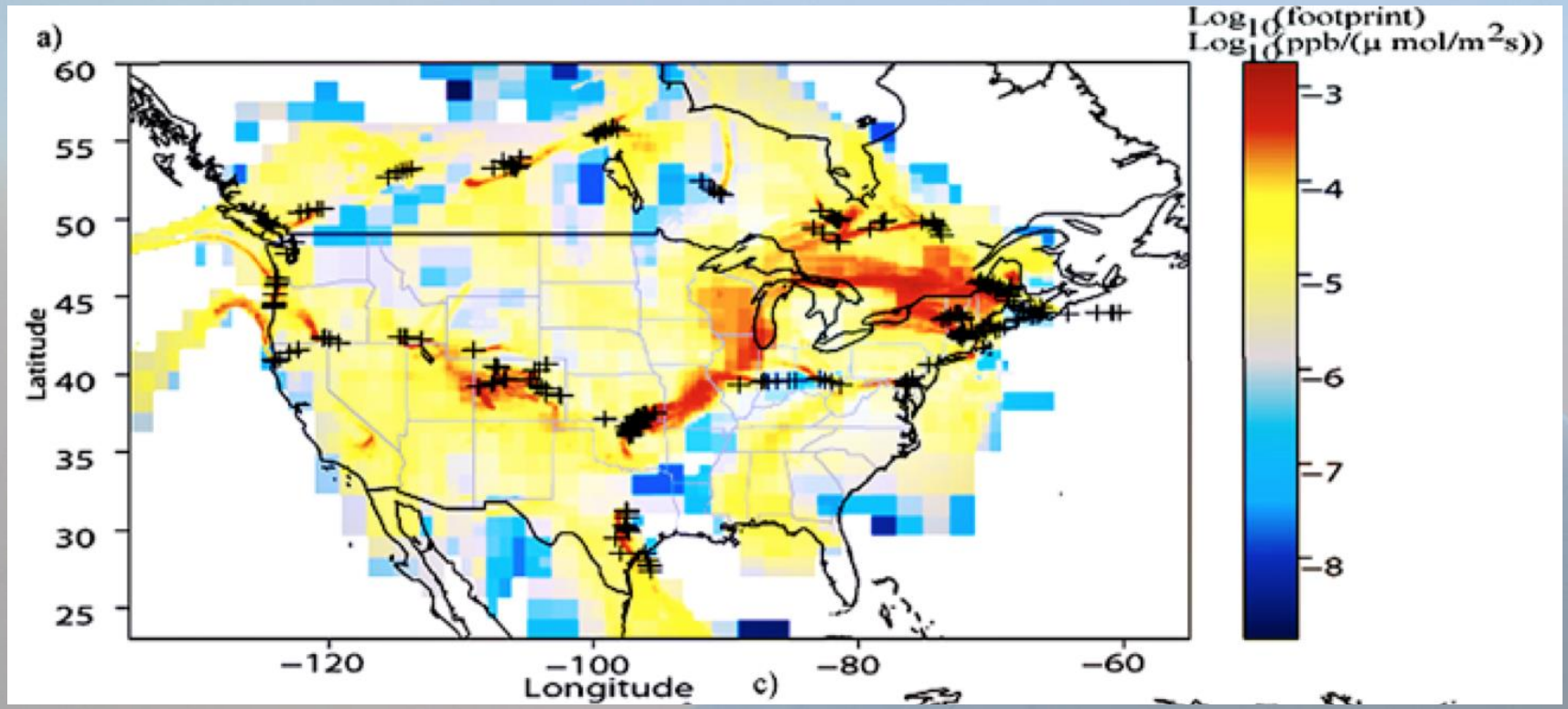
Forecasting location an event would appear (Forward modeling)



Post-mission analysis

- Quantifying fluxes & linking to drivers
  - Using all campaign data
  - Using lagrangian flight data
- Valuable for analysis
  - Upwind values
  - Modeled fluxes
  - Expected drivers for fluxes

All campaign footprint



Optimize fluxes (or important driving auxiliary variables) to match observations