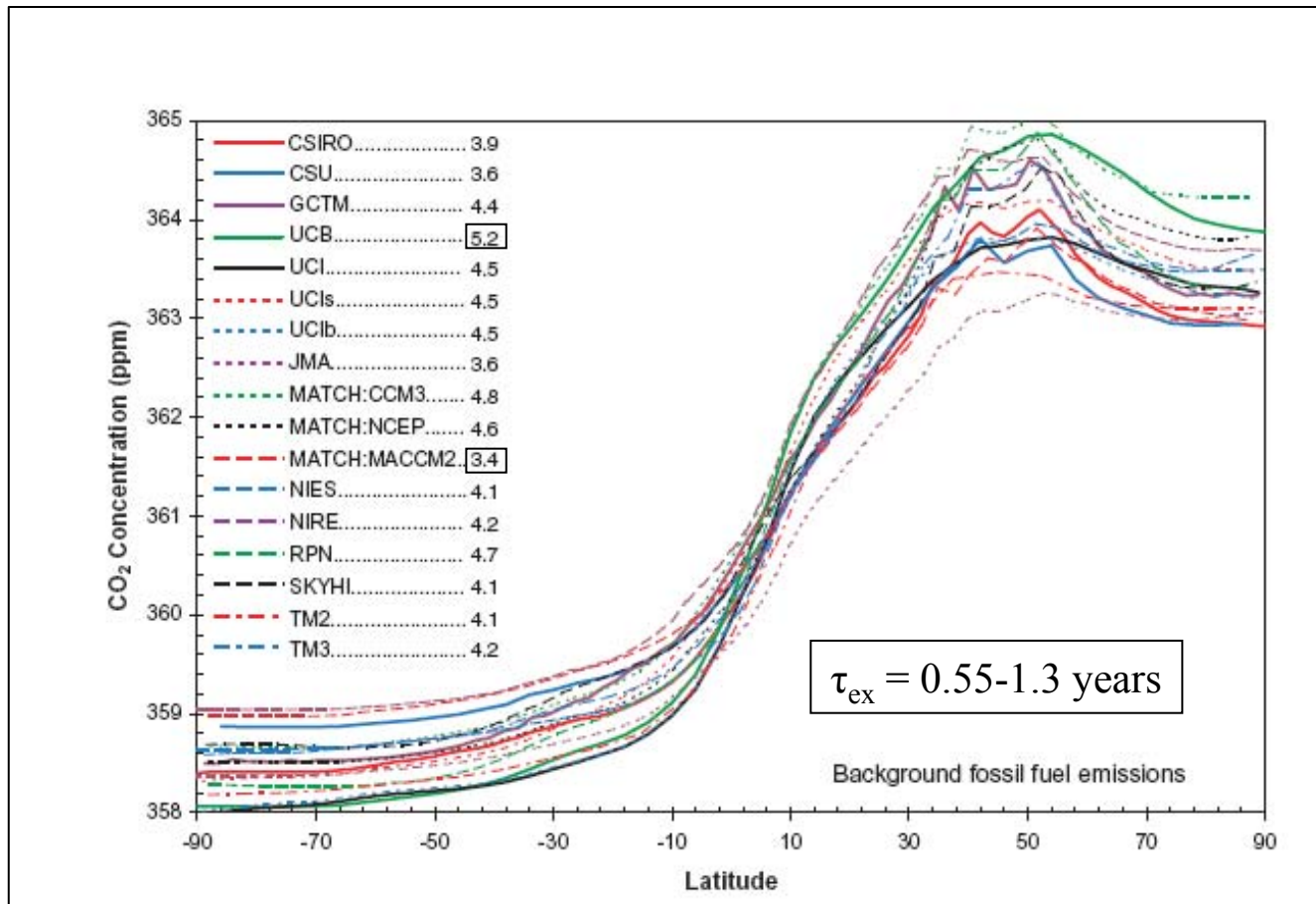# Why we want to collaborate with you

Or: The need for accessible, continuously-updated, accurate, multi-resolution, mass-conserving winds for carbon cycle inverse modeling analysis
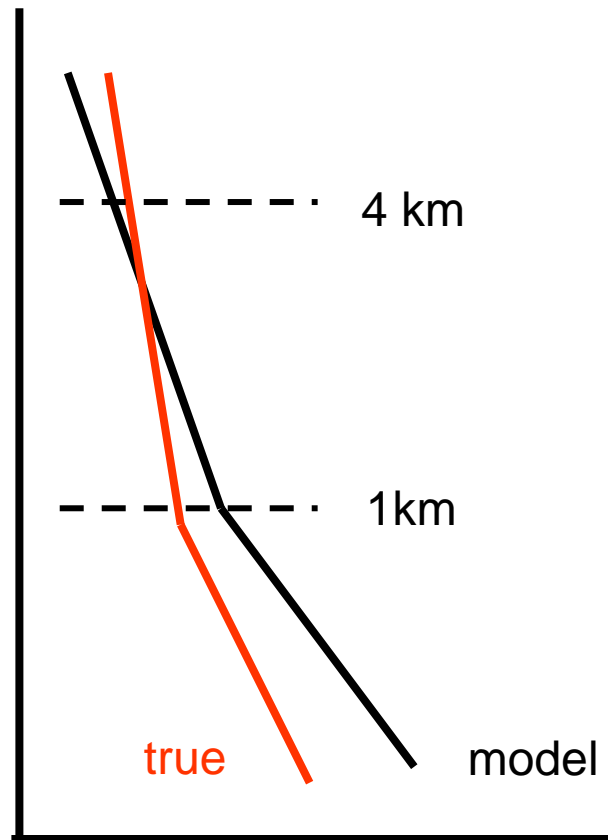
Adam Hirsch, GMD
July 10, 2008

Large scale transport differences

$\tau_{ex} = 0.55\text{-}1.3$ years

Gurney et al., Tellus B (2003)

# Northern Hemisphere vertical transport differences

- The vertical CO_2 gradient can test model transport

- Modeled vertical gradients are too large in the annual mean
  - And none get the seasonal pattern right

- Either summer ventilation is excessive or winter trapping is too great (or both)

Stephens et al., Science (2007)

Implications for CO$_2$ fluxes

- Vertical profile in NH correlated with carbon uptake by NH land (range from -0.5 to -4 GtC/yr)
- Corresponding range of Tropical Land release to maintain mass balance
- Additional uncertainty from large-scale transport differences
- *Using an ensemble average doesn't necessarily give the right answer*

1992-1996 average
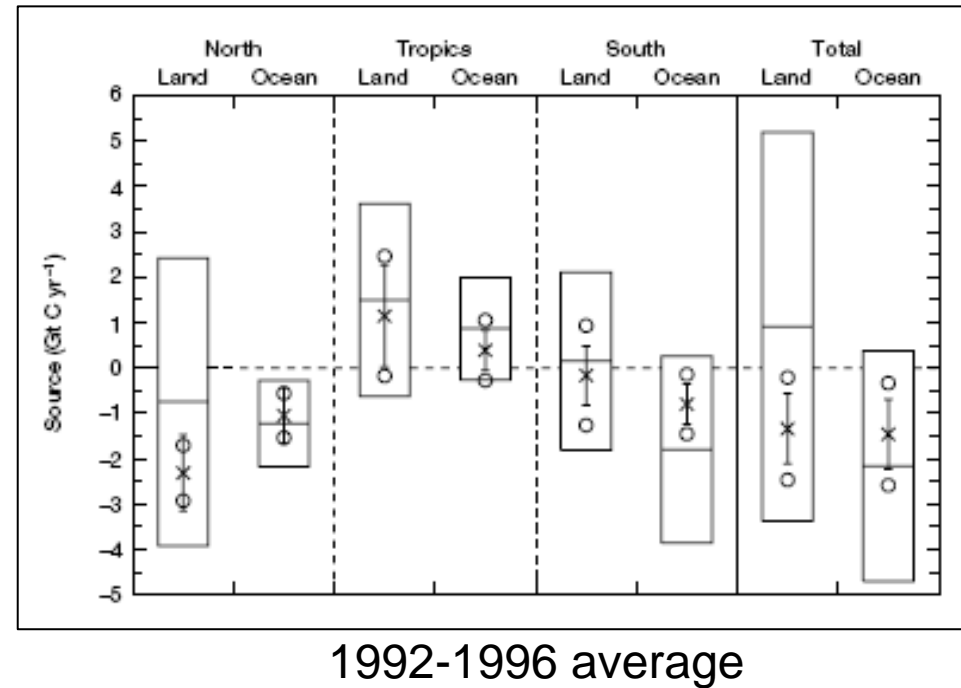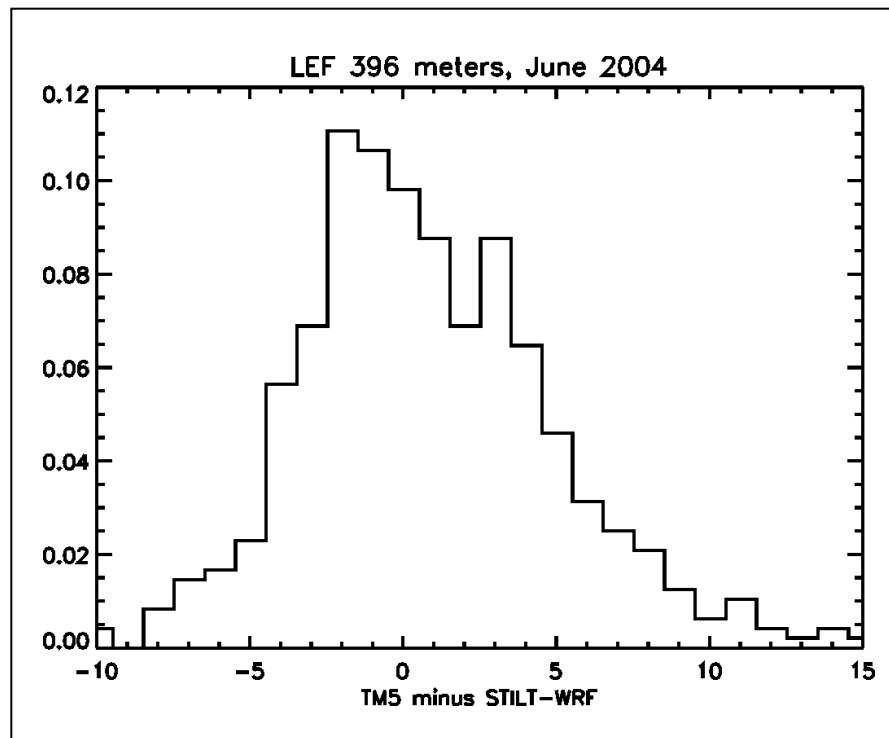
Continental Signals

LEF 396 meters June 2004

Same carbon fluxes
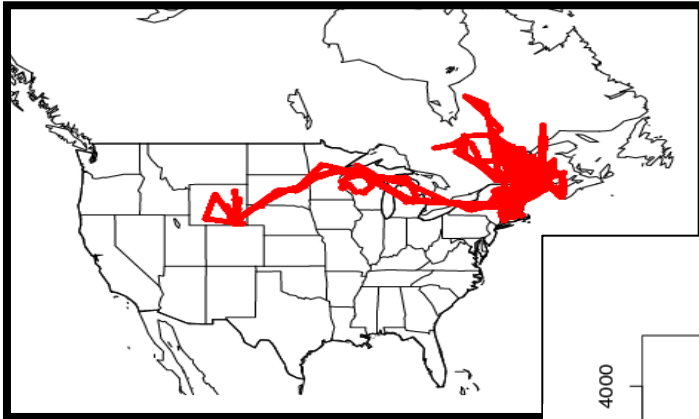(optimized
CarbonTracker)
transported by
TM5 and WRF-STILT
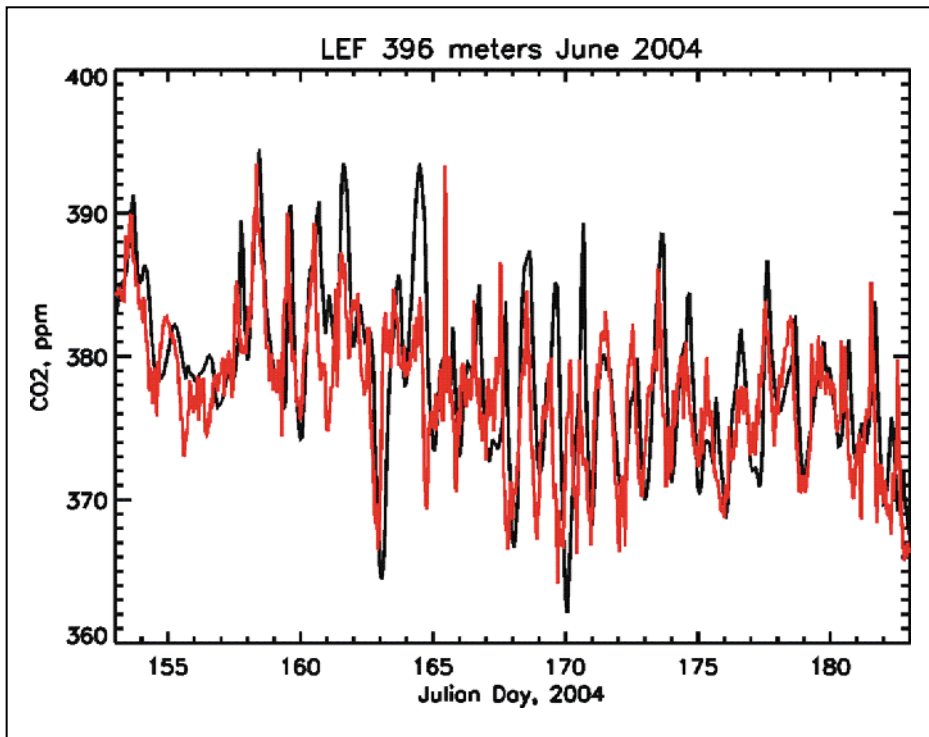
Mean difference = 1.2 ppm
Standard deviation = 4.5 ppm

Comparable to uncertainty
from using different carbon flux models
run with the same meterology

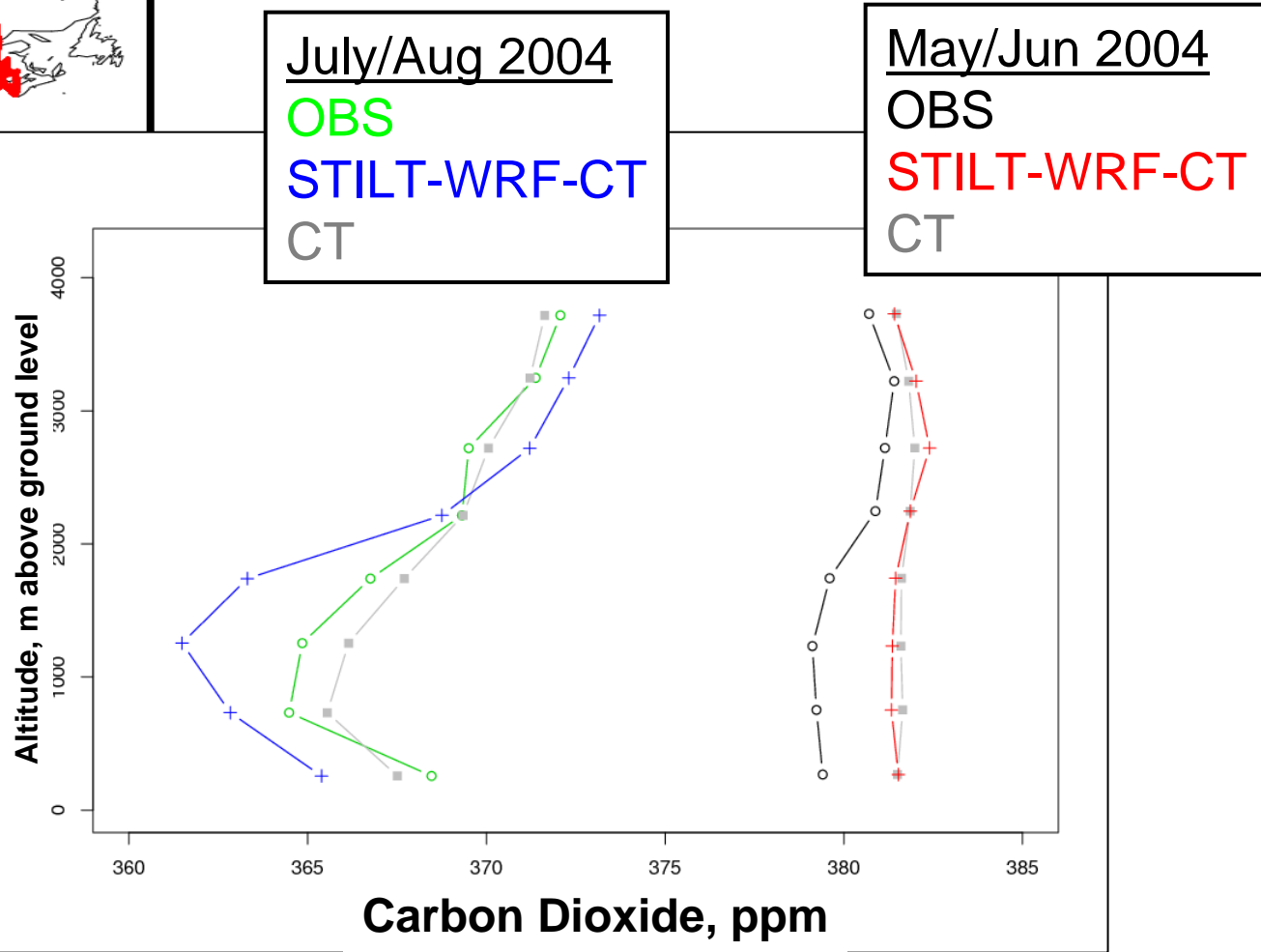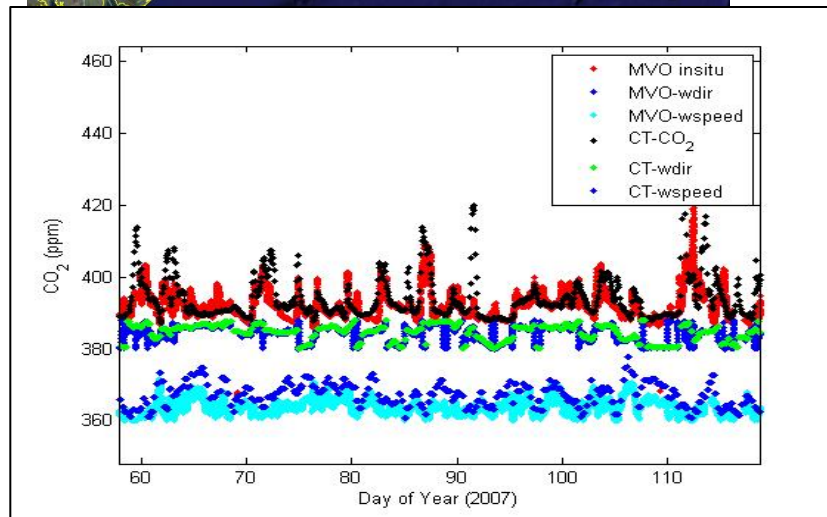LEF 396 meters, June 2004

TM5 minus STILT-WRF

Vertical Differences

**COBRA-MAINE:
HARVARD/NSF & NOAA
7 MAY – 16 AUGUST 2004
33 FLIGHTS**

Credit: Arlyn Andrews

July/Aug 2004
OBS
STILT-WRF-CT
CT

May/Jun 2004
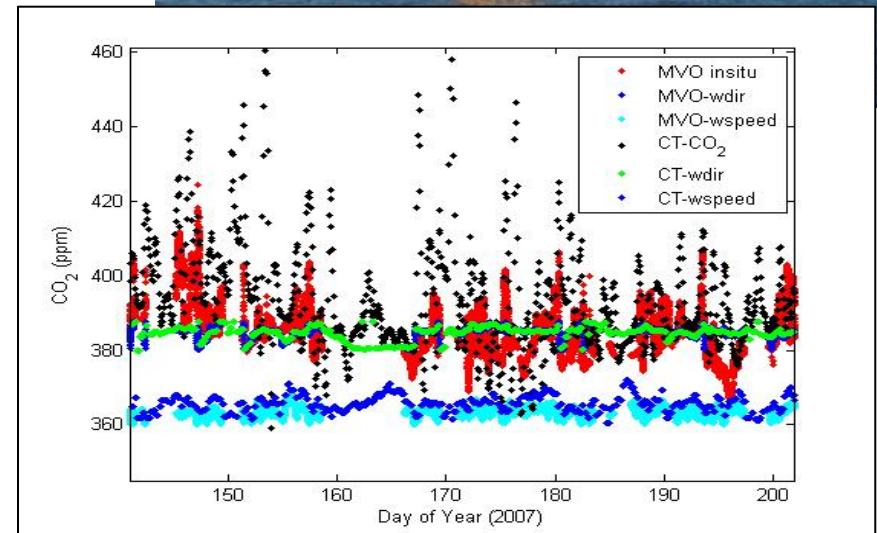OBS
STILT-WRF-CT
CT

Coastal Transport

Credit: Colm Sweeney
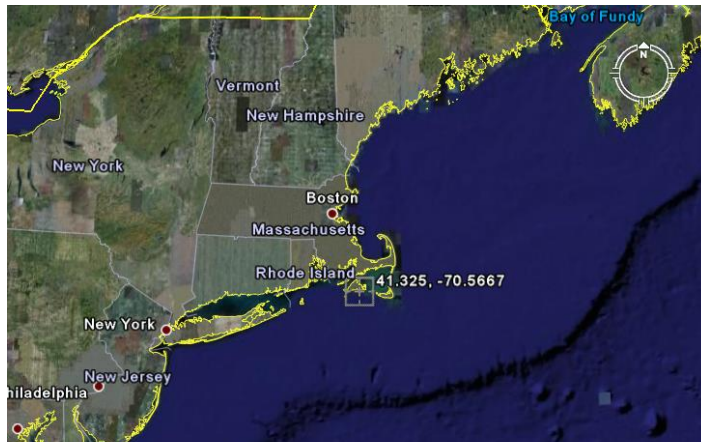
March 2007

June 2007

Conclusions

- We are in the process of evaluating different transport models for different carbon inverse modeling applications
- Need:
  - Accessible, accurate, multi-resolution, continuously updated met products which conserve mass and include vertical mass fluxes.
  - Continuously updated because we are doing multi-year runs.
  - Should be straightforward to tweak WRF or GFS output to make it more useful for greenhouse gas and air quality applications
- Can offer?
  - Improved 3-D CO_2 distributions (CarbonTracker) for increased accuracy of satellite-based temperature profile retrievals (Engelen et al., GRL 2001)
  - High-resolution boundary layer CO_2 (and meteorological) measurements to improve frontal passage timing (reanalysis?)
  - Vertical GHG profile data for long term improvement of boundary layer and vertical transport parameterizations in NWP models