Overview of IONS – Strategy, Accomplishments and Views from "The Summer that Wasn't"

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Presentation

IONS (INTEX Ozonesondes Network Study)

- ICARTT**/INTEX/NEAQS science from sondes
- Sequence
    * Overview of IONS approach to ICARTT goals
    * IONS Results in context of INTEX issues
    * Early analysis of mid-Atlantic-NE O_3 budgets, climatology in “Summer That Wasn’t” - ***2004***

Subtexts

➢ Ozonesondes – Strategic design of network raises traditional method to “state-of-art” for integrating models, in-situ, satellite data

➢ Rich dataset for primary analysis, other applications

**ICARTT = Intl Consortium for Atmospheric Research on Transport & Transformation

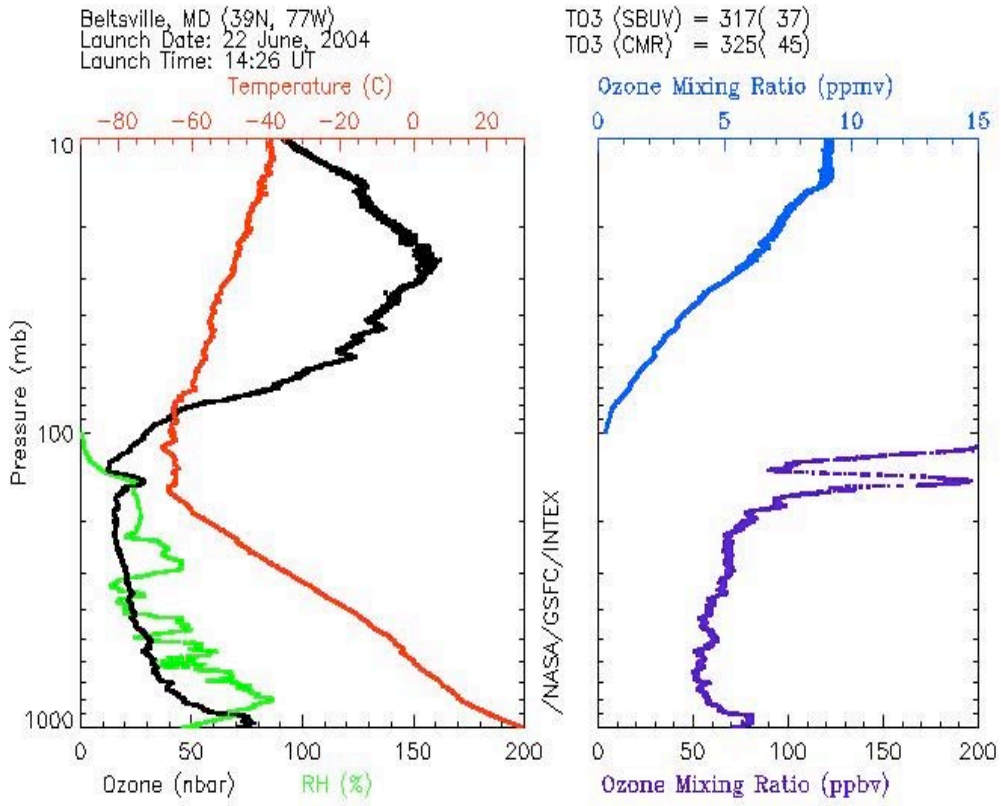
TROPOSPHERIC OZONE UNITS

Mixing ratio, ppbv; pollution > ~25 ppbv, 0 km

Column-integrated, DU; pollution > 25-30 DU

Ppmv – stratosphere; Total ozone w/ SBUV

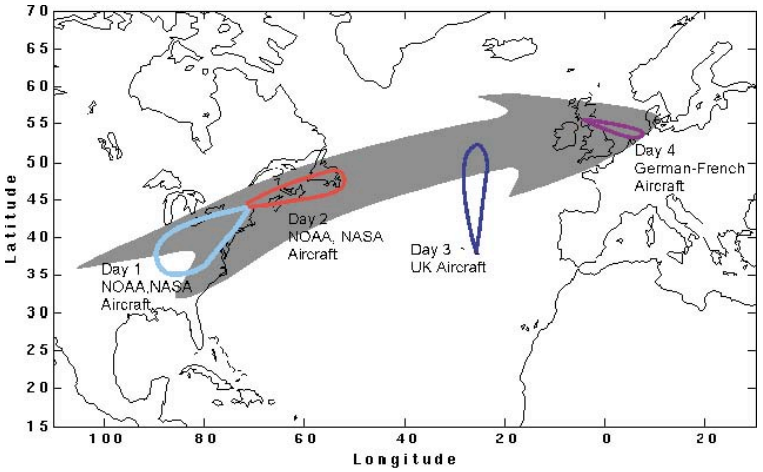
Free Trop = Climate, Long-range Impact BL = “Smog”

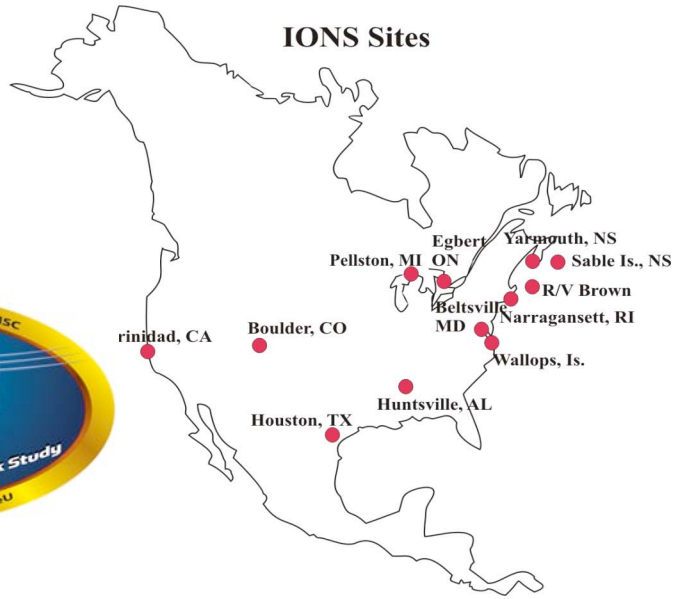


Define Ozone Network Requirements

Design No. American O_3 sonde network for INTEX (Intercontinental Transport Expt) to answer:

1. Can O_3 pollution be followed *during ICARTT?* √
2. What are O_3 transport patterns across NA? √
3. How much Asian O_3 reaches western NA? √
4. Can O_3 formation, transport in high pollution be: √
   Measured from satellite? Predicted?

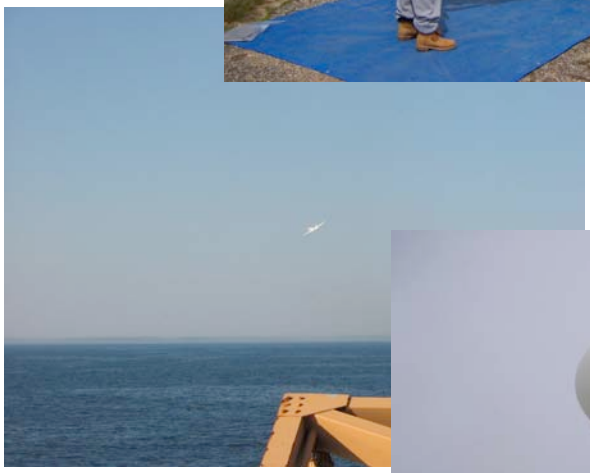




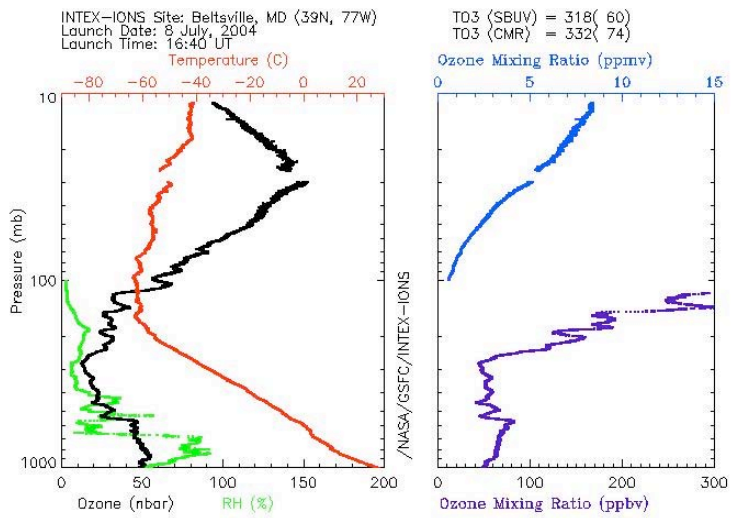
IONS – 2004: (INTEX Ozonesonde Network Study)

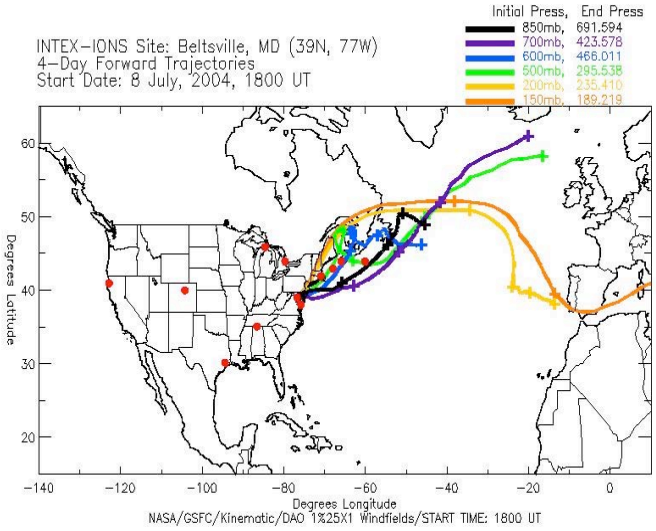
Design Responds to Scientific Require

- Design objectives met.
- Central US/Canada ➔ eastern outflow (MI, TO); SC to NE US/maritime flow
- Eight NE/NA sites, *R H Brown*
  - Lagrangian Flight Planning
  - Launch, aircraft coordination
- Operated 6 weeks, July-August, 6 sites daily: 290 sondes
- Images - http://croc.gsfc.nasa.gov/intex/ions.html. Data at ICARTT site – cloud1.arc.nasa.gov

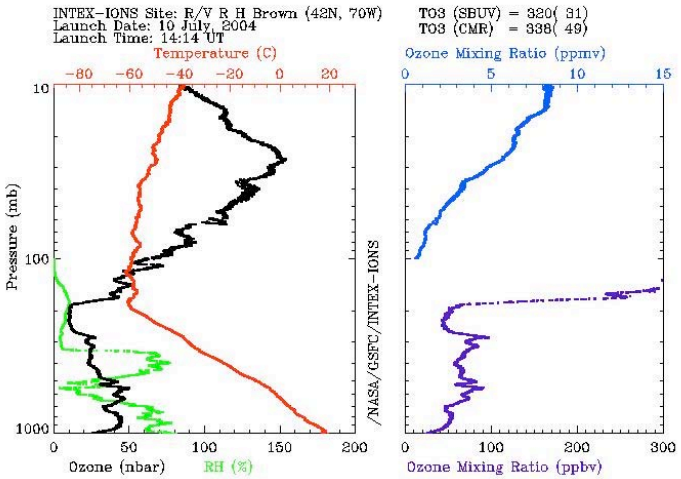


1. Can O_3 pollution be followed *during ICARTT?* √ Lagrangian Operational Design

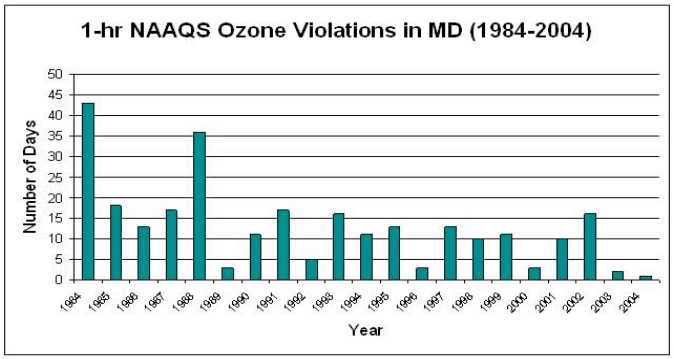


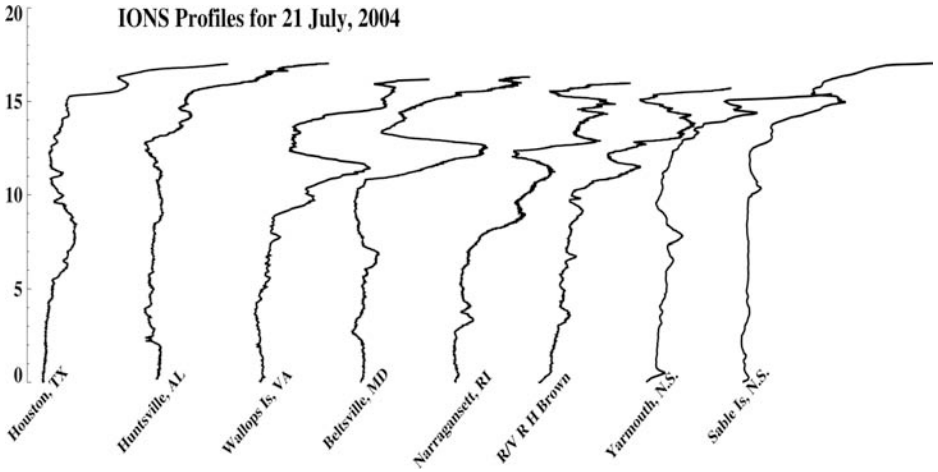


Ozone at 500 hPa from Beltsville predicted to arrive at *RH Brown* two days later, and did so.



2. What are O_3 transport patterns across NA? √ Lagrangian View – Surprise – less ozone than expected!

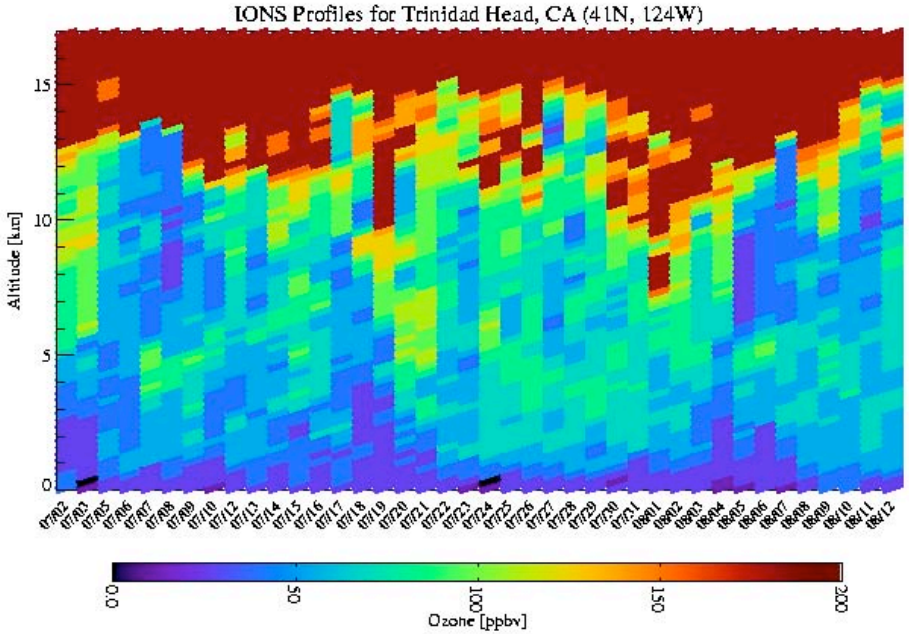


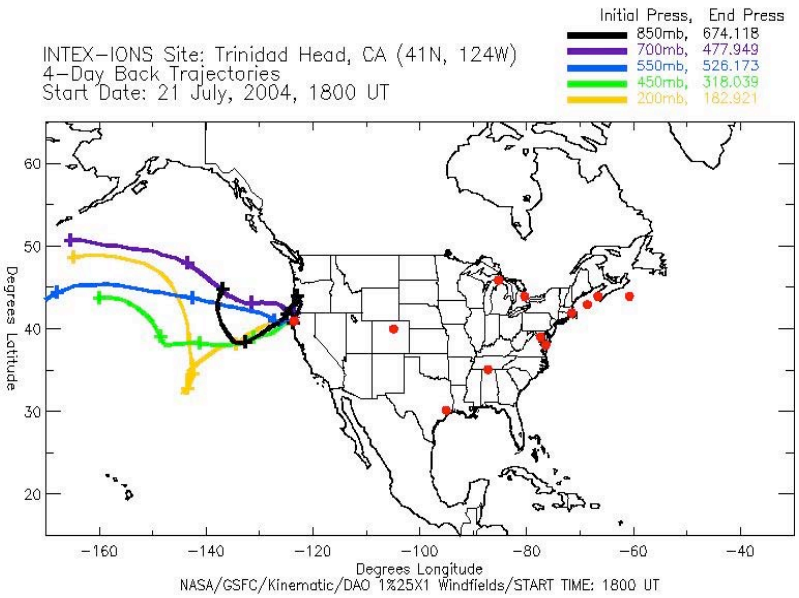


- Maryland 20-yr Air Quality "Best" typical for MA-NA region
- Note! Peaks on 21/7 WFF/Beltsville/RI/*R H* Brown/NS due to *stratospheric* ozone. Pollution (> 60 ppbv, 5-10 km) underneath
- Typical pattern with a few exceptions in early August

3. How much Asian O_3 reaches western NA?

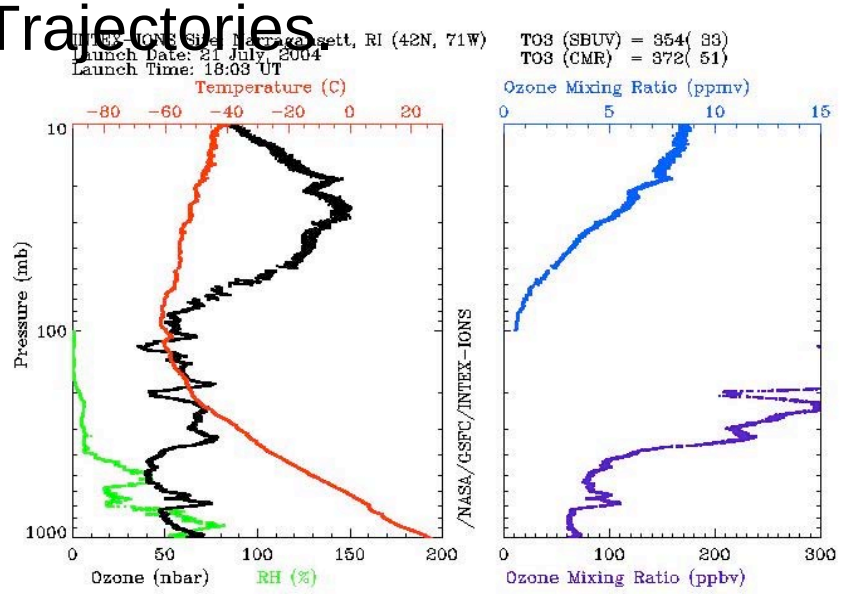
√

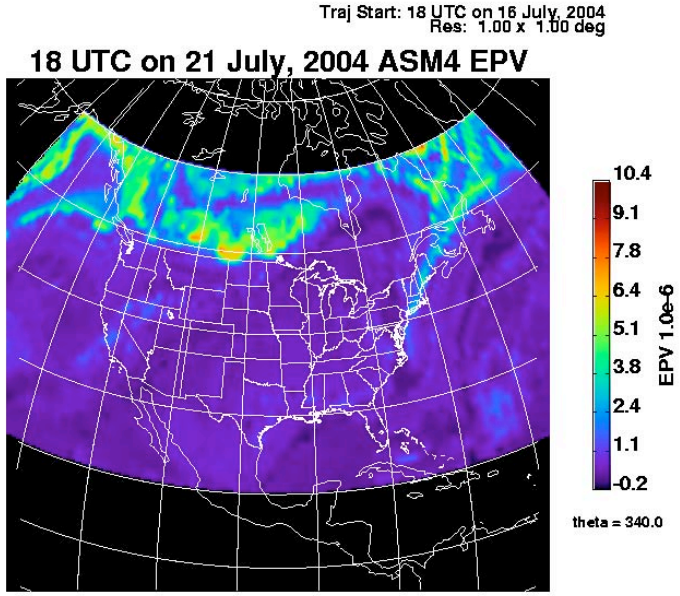


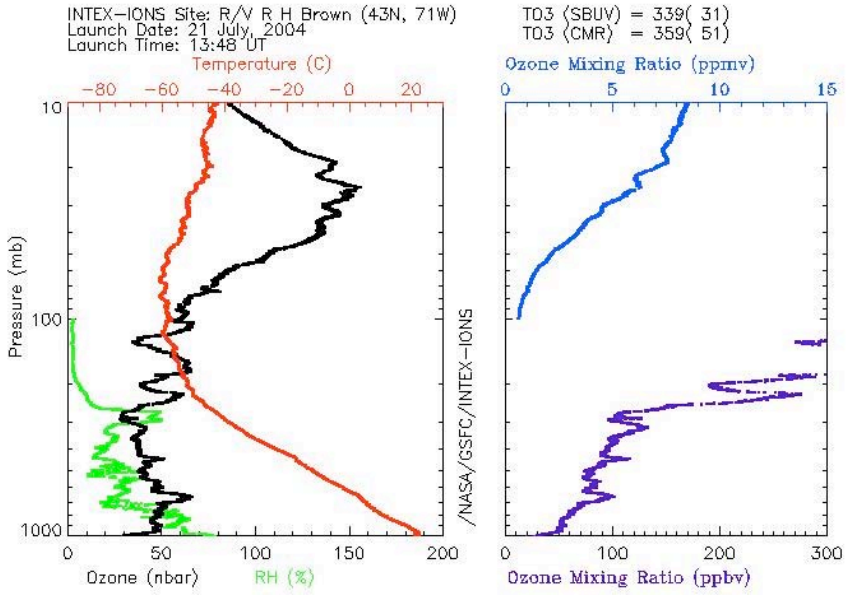


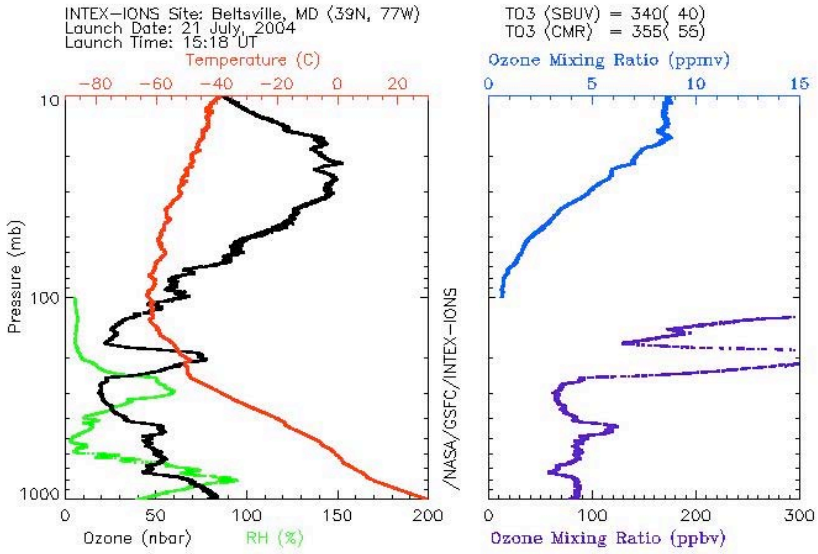
- 21/7 example shows *some* of O_3 pollution from Asia.
- Longer back-trajectories to be run, based on kinematic Schoeberl model & GMAO GEOS-4.
- Further analysis will use met. fields (RDF-pv, pot. Temp).

21 July 2004, "Summer That Wasn't:" RI, Beltsville **Profiles**; RDF (reverse-domain-fill) EPV. 1x1deg, 340K Back Air Parcel Trajectories









Analysis to Date: Upper Tropospheric Ozone Budgets

- **Budgets:** How much ozone from:
  - Local-regional photochemistry, interaction of pollutant sources with convection, lightning?
  - Long-range transport, advection of pollution?
  - Stratosphere? √

  Approaches:
  - Correlate O_3 with meteorological, chemical tracers √
  - Illustrate with UT/LS O_3 and pv, water vapor √

Resources – take advantage -- http://croc.gsfc.nasa.gov/intex
Images at ICARTT archive.
Date POC – tlk@croc.gsfc.nasa.gov

Evaluate Stratospheric Impact in UT Ozone

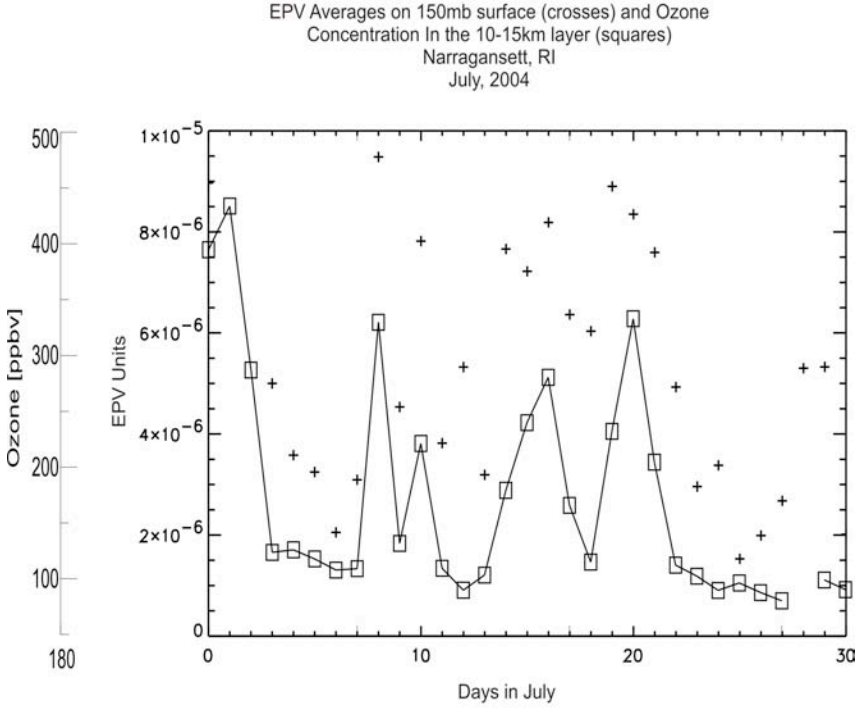
Select 10-15 km Ozone Layer (mean mixing ratio) for Analysis

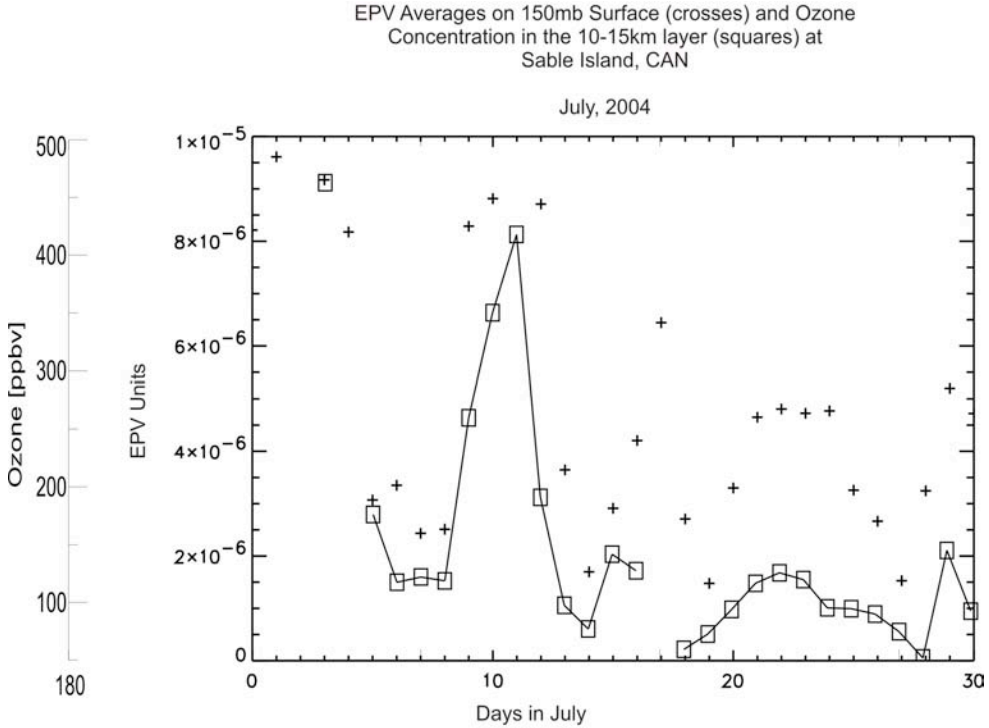
July 2004 – Compare daily EPV (GMAO, 150 hPa) & ozone.

Most stratospheric influence - Pellston, Narragansett (below).

Less influence - *R H Brown*, Sable Island (below)

- Site comparison consistent with overall meteorology

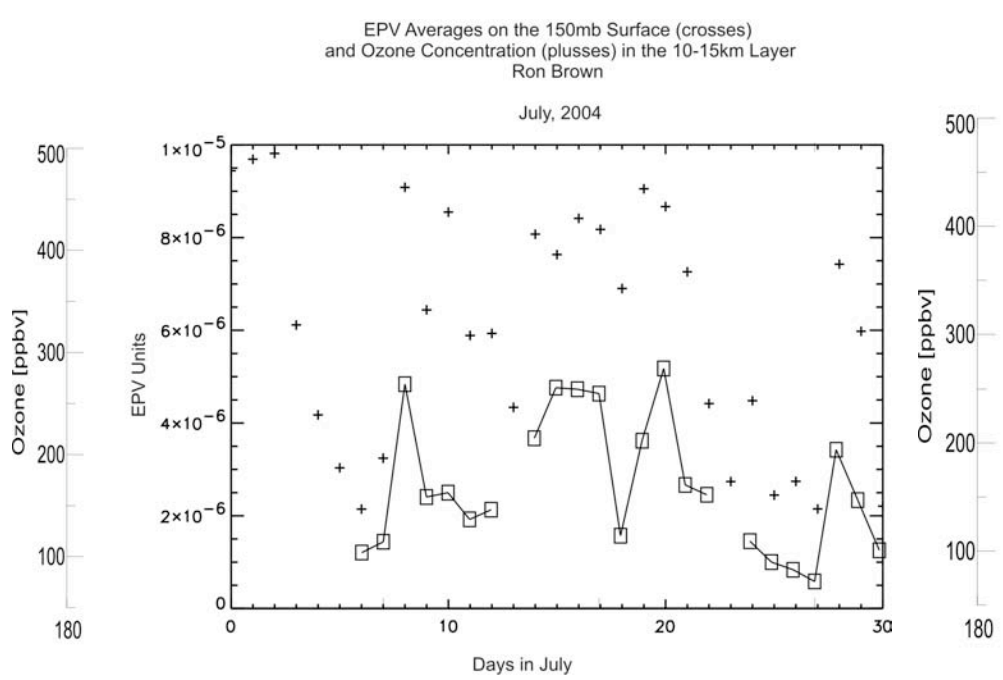


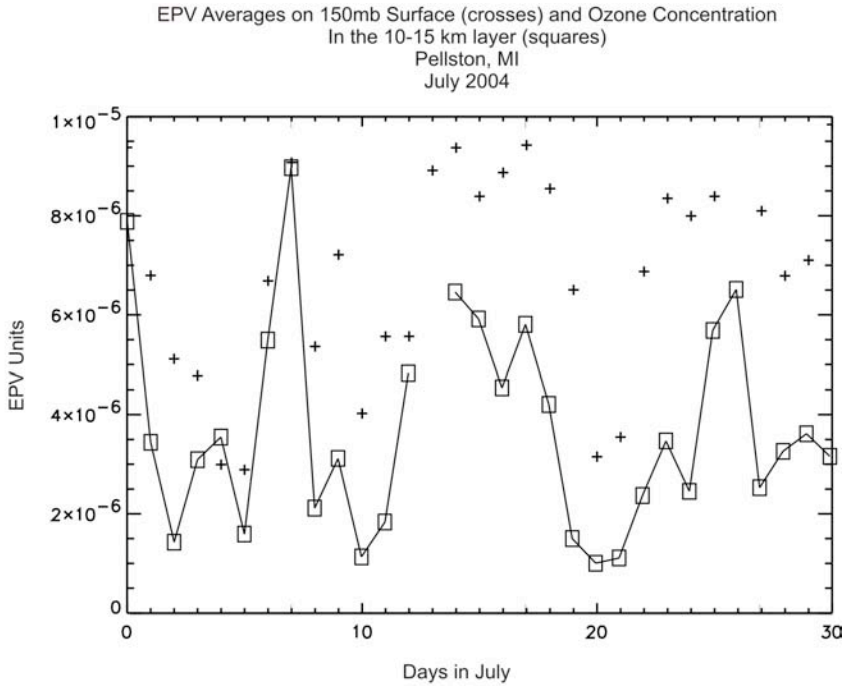


Ron Brown UT Ozone Intermediate in NE-NA

10-15 km Ozone Layer & July 2004 EPV

Left – *R H Brown.* Right – Pellston. Latter more consistently in low pressure area, lower tropopause, higher pv, ie strat. influence





STATUS – COLLABORATIONS – PUB PLANS

Ongoing Analysis: Mid-Tropospheric 2004 Ozone Budget

- Challenge: Separate pollution from aged UT/LS sonde O_3
- Approaches:
  - Statistics with sonde data (H_2O-O_3), trajectories
  - Interpret O_3 with tracers (eg CO, NO_x) from satellite, DC-8, P-3

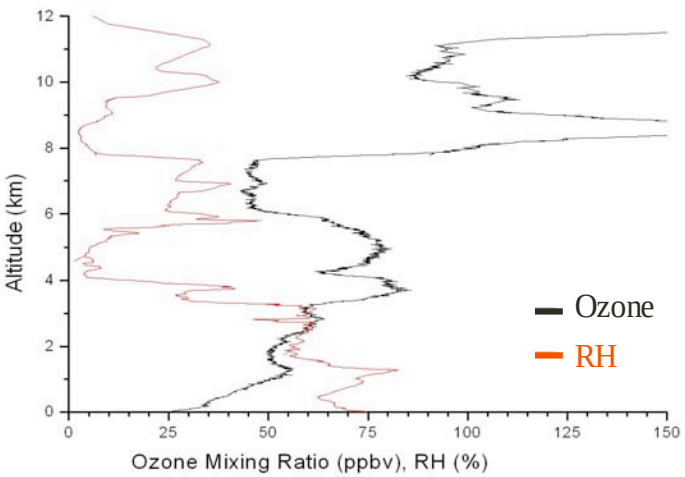
√ **RHB Data, Images** at cruise website**.** All **IONS images,** GSFC Met images: <croc.gsfc.nasa.gov/intex>. **All data, images** at ICARTT archive

IONS/Sondes Emphasis: Micro-Workshop on 10 Mar, c/o CMDL Sam Oltmans, Anne Thompson [tentative papers]

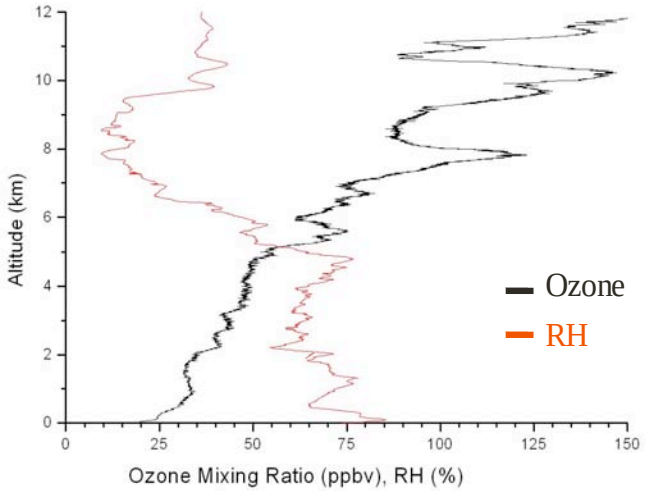
- IONS Overview – AMT
- Analyses to Date -
  - URI/Narragansett – episodic NOx titrating out surface ozone– J Merrill
  - Trans-continental flow – O Cooper, S Oltmans

Mid-trop. “Ozone Ambiguity” (4-12 km)

Ronald H. Brown: July 16, 2004

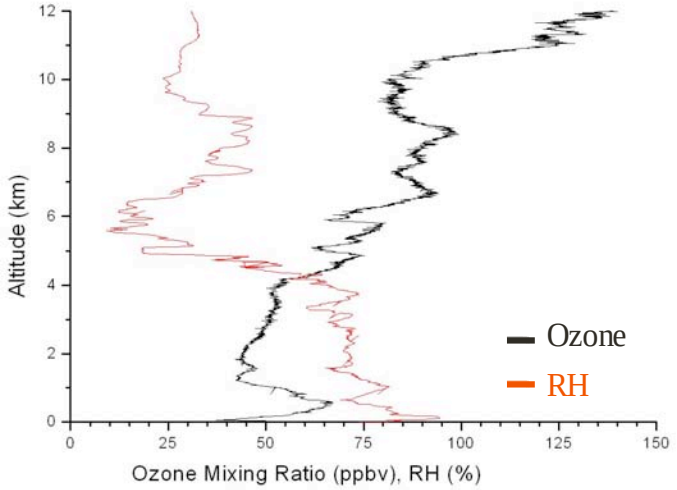


Ronald H. Brown: July 17, 2004

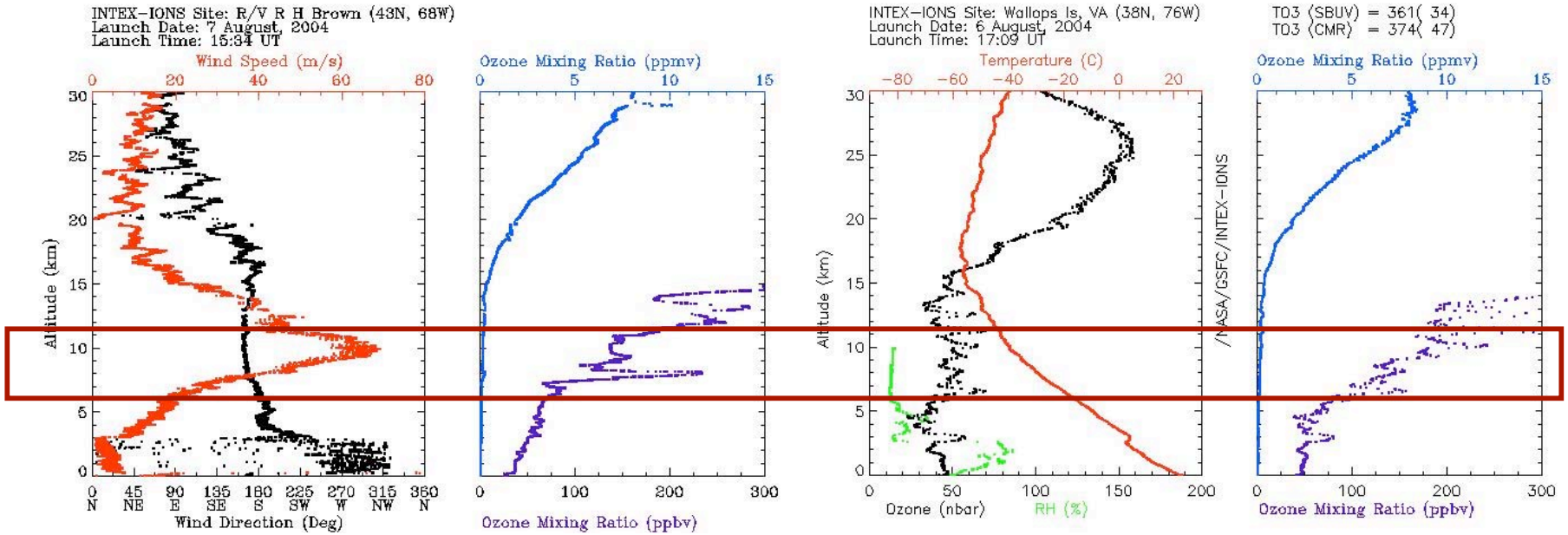


Plan O_3-RH correlations with high resolution data. Case studies & aircraft tracer comparisons when possible

Ronald H. Brown: July 18, 2004



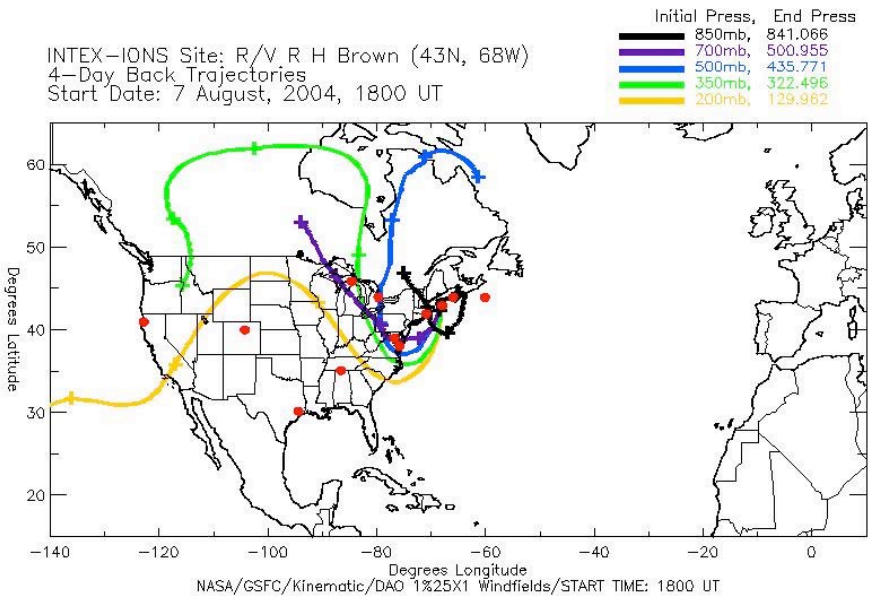
Example of Trajectories Available – *7-8 Aug*



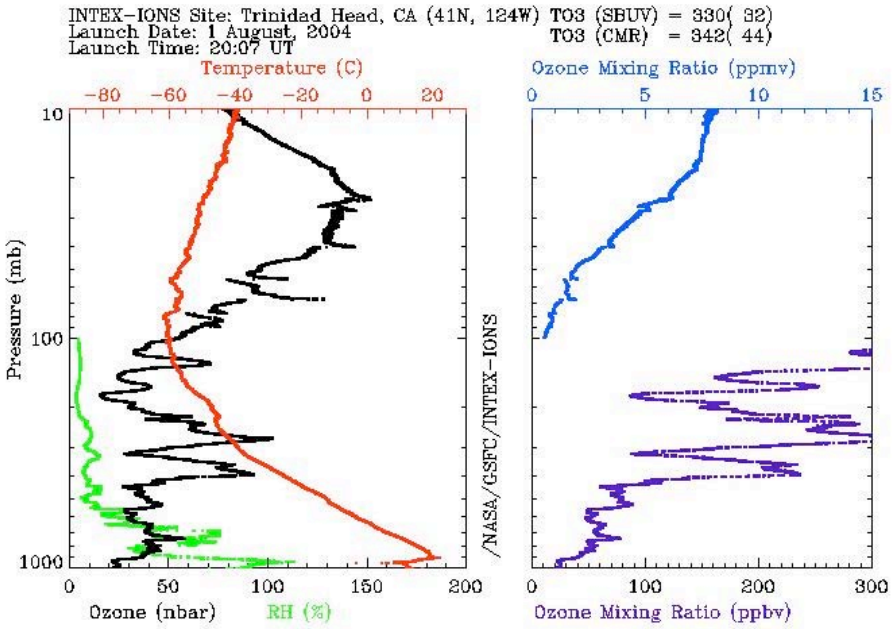
- 8 - 10 km peaks in O_3 > 150 ppbv

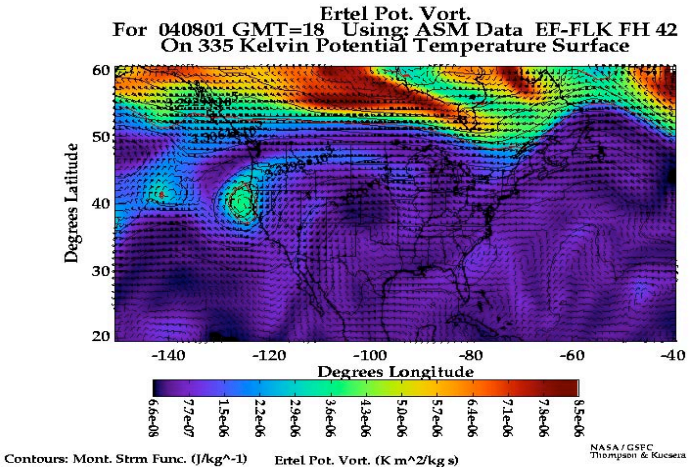
->> matching elevated aircraft measurements.

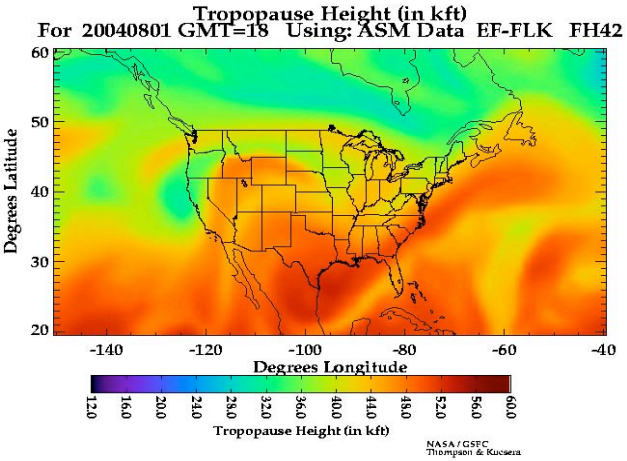
- GPS/trajectories show origins from South/West Region.
- Elevated upper level O_3 found previous day at Wallops Is.



Meteorological Fields from GMAO – EPV (335K), Trop. Height – 1 August STE – Cutoff Low – Trinidad Head







Analyze with INTEX GMAO fields:

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  - Trans-continental flow – O Cooper, S Oltmans
  - Alaskan fires double Houston pollution – G Morris

Workshop, Collaborations, Potential Papers:

- Ozone variability over entire cruise – (RHB & RI/Maritime)
- Episodes – Ozone lidar plumes (Senff) 22 July; 30/7-1/8 stability (Angevine); Others ? 16-19 July, 21 July, early August

Resource – Use ozone, trajectories, met data