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DEPARTMENT OF THE ENVIRONMENT

NASA air quality monitoring project: DISCOVER-AQ

12 July 2011

MWAQC Technical Advisory Committee meeting

Jennifer Hains

Maryland Department of the Environment

DISCOVER-PIs

James Crawford – NASA Langley

Kenneth Pickering – NASA Goddard

MDE

http://www-air.larc.nasa.gov/missions/discover-aq/discover-aq.html

DISCOVER-AQ

Deriving Information on Surface Conditions from COlumn and VERtically Resolved Observations Relevant to Air Quality

- Data Archive: DISCOVER-AQ
- Interactive Flight Tracks & Profile Data Plotter NEW!
- Satellite Overpass Tracks
- Flight / Daily / QuickLook Reports
- Data Access & Other Data Sources
- Flight Times (Take Offs / Landings)
- Mission Calendar
- ICARTT Data Format Document
- Data Management Plan
- Related Links & Websites

Tools

Recent Activities

- DISCOVER-AQ Science Team Meeting, October 5-7, 2010, National Institute of Aerospace, Hampton VA

NASA P3-B and King Air Flight Tracks

http://delphi.aero.und.edu/DiscoverAQFlightTracker.html

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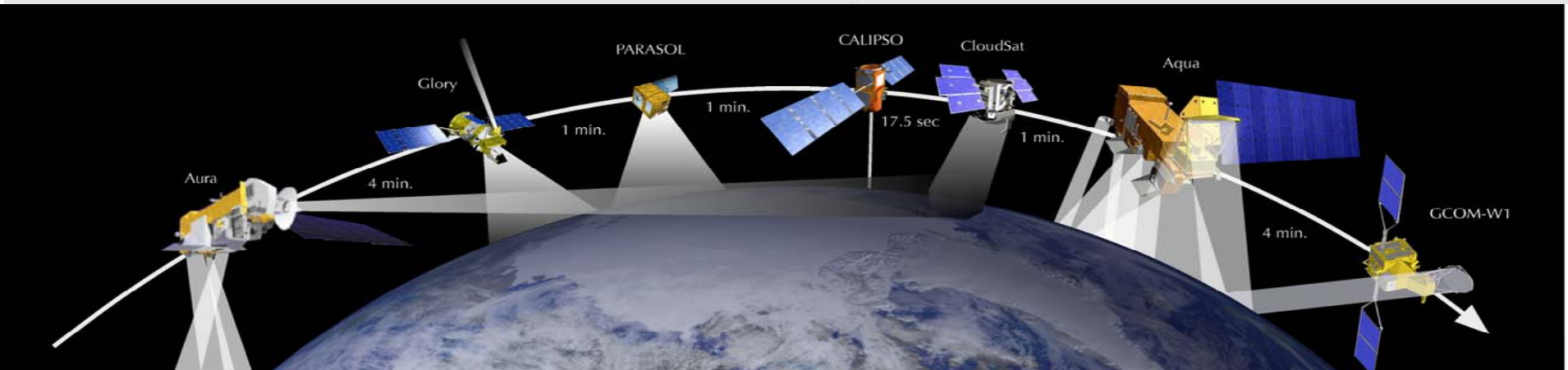
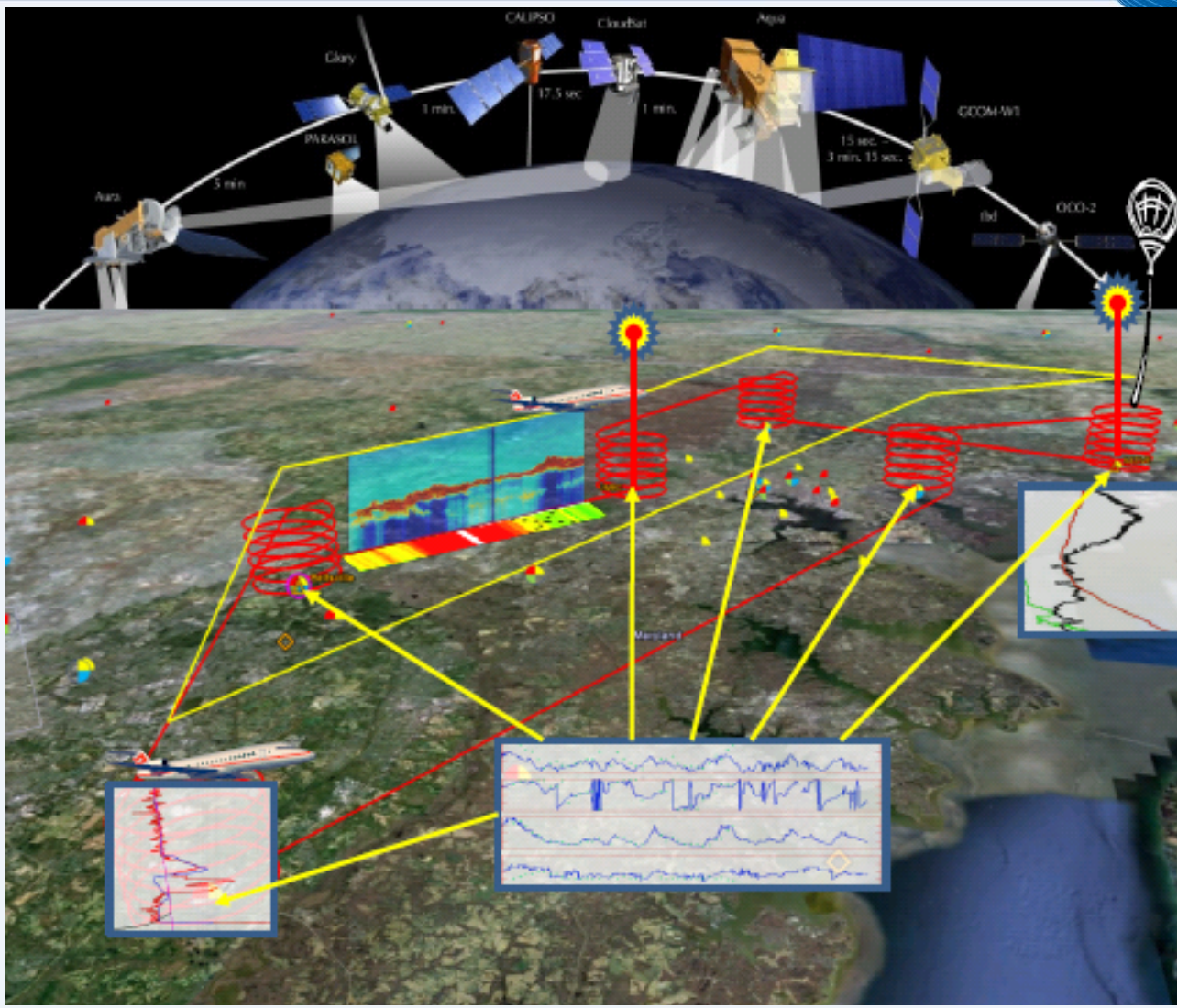
DISCOVER-AQ Objectives

- **Relate column and surface observations for O_3, NO_2, CH_2O and aerosols.**
  - **Improve understanding of use of satellite obs. to diagnose surface conditions.**
- **Examine diurnal variation of surface and column observations**
  - **Improve understanding of diurnal variability influences on satellite interpretation**
  - **Improve knowledge of factors controlling diurnal variability for testing and improving model**
- **Examine horizontal scales of variability affecting satellites and models.**
  - **Improve satellite interpretation for areas with steep gradients.**
  - **Improve representation of urban plumes in models.**
  - **More effective assimilation of satellite data by models.**



Measurements

- UC-12
  - HSRL aerosol lidar mapping
  - ACAM trace gas columns
- P3
  - In-situ profiles
- Surface
  - In-situ trace gas and aerosols
  - Columns from Pandora, Aeronet and Native



DISCOVER-AQ Trace Gas and Aerosol Observations

Trace Gas Observations	O_3	NO_2	CH_2O	NO	NO_y	CO	CO_2	CH_4	H_2O	VOC
Pandora, total column (12 sites)	X	X	X						X	
ACAM, nadir column (UC-12)	X	X	X							
In situ airborne profiles (P-3B)	X	X	X	X	X	X	X	X	X	X
In situ surface observations (AQS)	X	X			X	X			X	X
NATIVE in situ surface observations	X			X	X	X			X	
NATIVE sondes	X								X	
Aeronet									X	

Aerosol Observations (X) = dry aerosol measurement	AOD	PM2.5	Scattering	Absorption	Extinction	Non-Sphericity	f(RH)	Black Carbon	Soluble Ions	Size Distribution	PBL Height
HSRL, nadir aerosol profiles (UC-12)	X		X		X	X					X
In situ airborne profiles (P-3B)	(X)		(X)	(X)	(X)		X	X	X	(X)	X
In situ surface observations (AQS)		(X)									
NATIVE lidar			X								X
UMBC UMAP site with AERI	X	X	X		X		X			X	X
Aeronet	X			X						X	
MPLnet			X		X						X
Pandora	X										

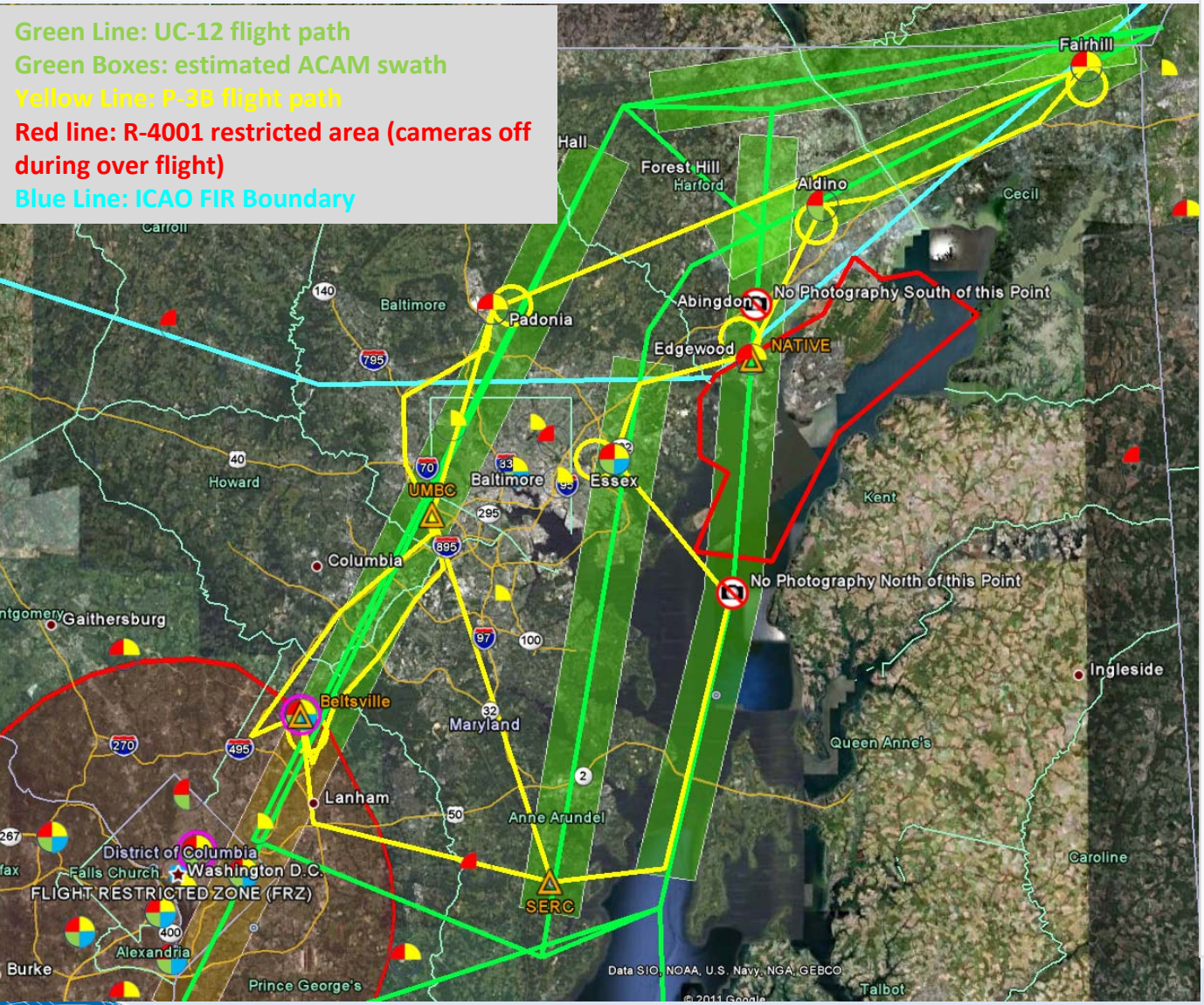
DISCOVER-AQ Science Team

Leadership	
Jim Crawford, NASA LaRC	Principal Investigator
Mary Kleb, NASA LaRC	Project Manager
Ken Pickering, NASA GSFC	Project Scientist
Gao Chen, NASA LaRC	Science Data Manager
P-3B In Situ Airborne Measurements	
Ronald Cohen, UC Berkeley	NO_2, ANs, PNs, HNO_3
Andrew Weinheimer, NCAR	O_3, NO_2, NO, NO_y
Alan Fried, NCAR	CH_2O
Armin Wisthaler, Innsbruck	Non-methane hydrocarbons
Glenn Diskin, NASA LaRC	H_2O, CO, CH_4
Stephanie Vay, NASA LaRC	CO_2
Bruce Anderson, NASA LaRC	aerosol optical, microphysical, and chemical properties
B-200 Remote Sensing Airborne Measurements	
Chris Hostetler, NASA LaRC	High Spectral Resolution Lidar (HSRL) aerosol profiles
Scott Janz, NASA GSFC	Airborne Compact Atmospheric Mapper (ACAM) nadir trace gas columns for O_3, NO_2, and CH_2O
Ground-based Measurements	
Jay Herman, UMBC	Pandora network for total trace gas columns of O_3, NO_2, and CH_2O
Anne Thompson, Penn State	Nittany Atmospheric Trailer and Integrated Validation Experiment (NATIVE) in situ O_3, CO, NO, NO_y; aerosol lidar; ozonesondes.
Ray Hoff, UMBC	Lidar aerosol profiles, AERI, Raman H_2O, ground data
Brent Holben, NASA GSFC	Aeronet
Data Analysis and Modeling (PI, Project Scientist, and Science Data Manager will also participate)	
P.K. Bhartia, NASA GSFC	trace gas retrievals and interpretation
Allen Chu, UMBC	aerosol retrievals and interpretation
Robert Chatfield, NASA ARC	statistical data analysis and interpretation
Rich Ferrare, NASA LaRC	aerosol analysis and interpretation of HSRL observations

Collaborations

- **EPA : Jim Szykman and David Williams**
  - Additional surface NO_2 (photolytic chemiluminescence)
  - Mobile NO_2 (quantum cascade laser)
  - Coordinated Cessna flights of ocean color radiometer package
- **NOAA: Rick Saylor and Shobha Kondragunta**
  - NOAA/NWS CMAQ O_3 and PM forecasts for flight planning.
  - GOES and GOME-2 near-real time trace gas and aerosols retrievals
- **MDE and UMD (Jennifer Hains and Russ Dickerson)**
  - Additional surface monitors.
  - Conducting coordinated flights with Cessna aircraft.

Flight Plan



- 12 flight days
- 6 spirals at surface stations.
- Tethered balloons and sondes to capture lower boundary layer.

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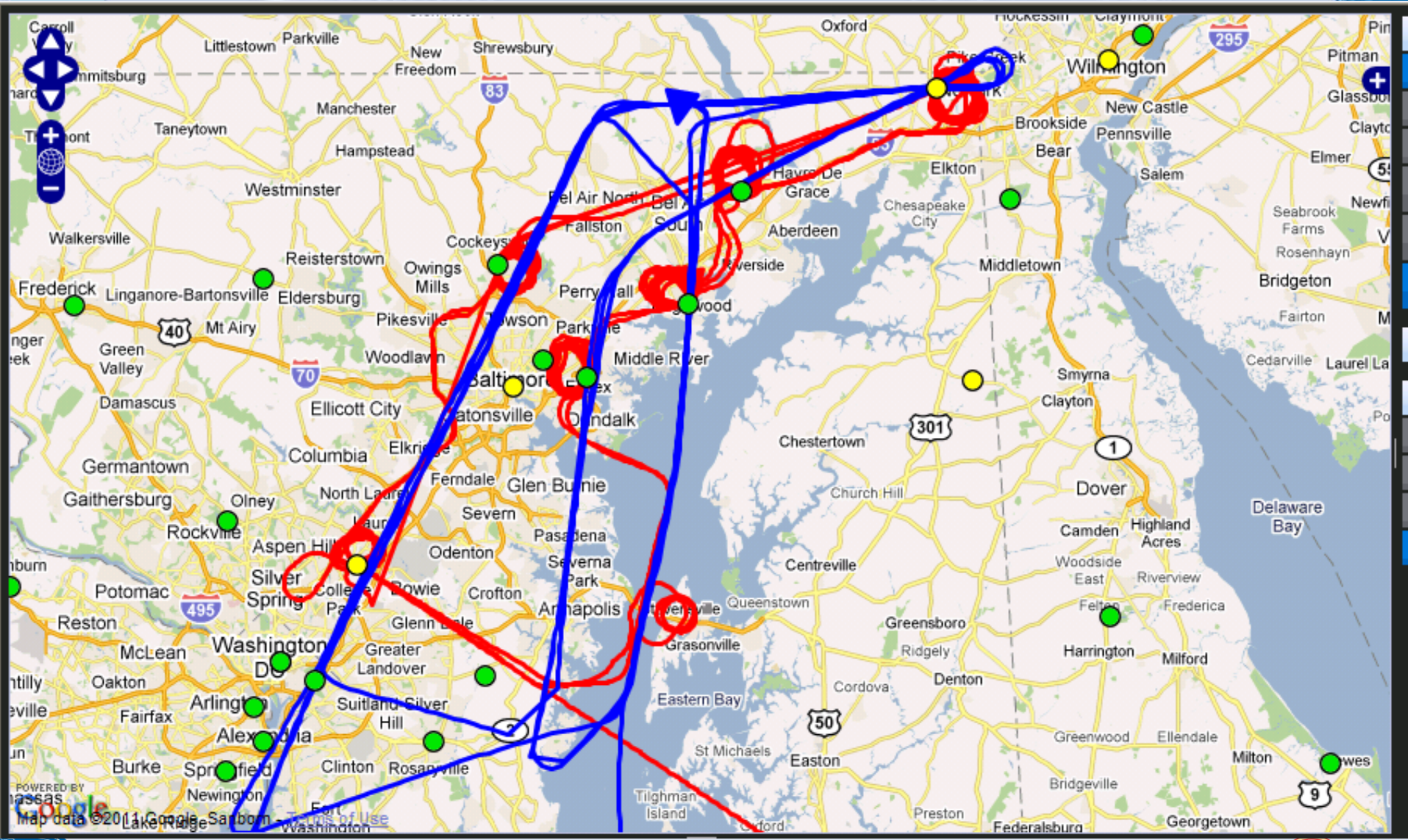
5 July 11 am


Littlestown
Parkville
New Freedom
Shrewsbury
Oxford
Manchester
Taneytown
Hampstead
Westminster
Walkersville
Frederick
Linganore-Bartonsville
Eldersburg
Reisterstown
Owings Mills
Pikesville
Mt Airy
Green Valley
Damascus
Woodlawn
Ellicott City
Columbia
Germantown
Gaithersburg
Olney
Rockville
Aspen Hill
Silver Spring
Potomac
Reston
McLean
Oakton
Fairfax
Burke
Springfield
Newington
Lake Ridge
Clinton
Rosaryville
Suitland-Silver Hill
Greater Landover
Glenn Dale
Bowie
Crofton
Odenton
Severn
Ferndale
Glen Burnie
Pasadena
Severna Park
Annapolis
Grasonville
Eastern Bay
St Michaels
Tilghman Island
Easton
Oxford
Queenstown
Centreville
Chesapeake City
Elkton
Havre De Grace
Aberdeen
Fallston
Perry Hall
Middle River
Essex
Dundalk
Chestertown
Church Hill
Smyrna
Clayton
Dover
Camden
Highland Acres
Woodside East
Riverview
Felton
Frederica
Greensboro
Ridgely
Harrington
Milford
Denton
Cordova
Greenwood
Ellendale
Milton
Bridgeville
Preston
Federalsburg
Georgetown
Delaware Bay
Middletown
Bridgeton
Seabrook Farms
Rosenhayn
Fairton
Cedarville
Laurel
Wilmington
New Castle
Brookside
Pennsville
Bear
Salem
Elmer
Pitman
Glassboro
Newfield
Clayton
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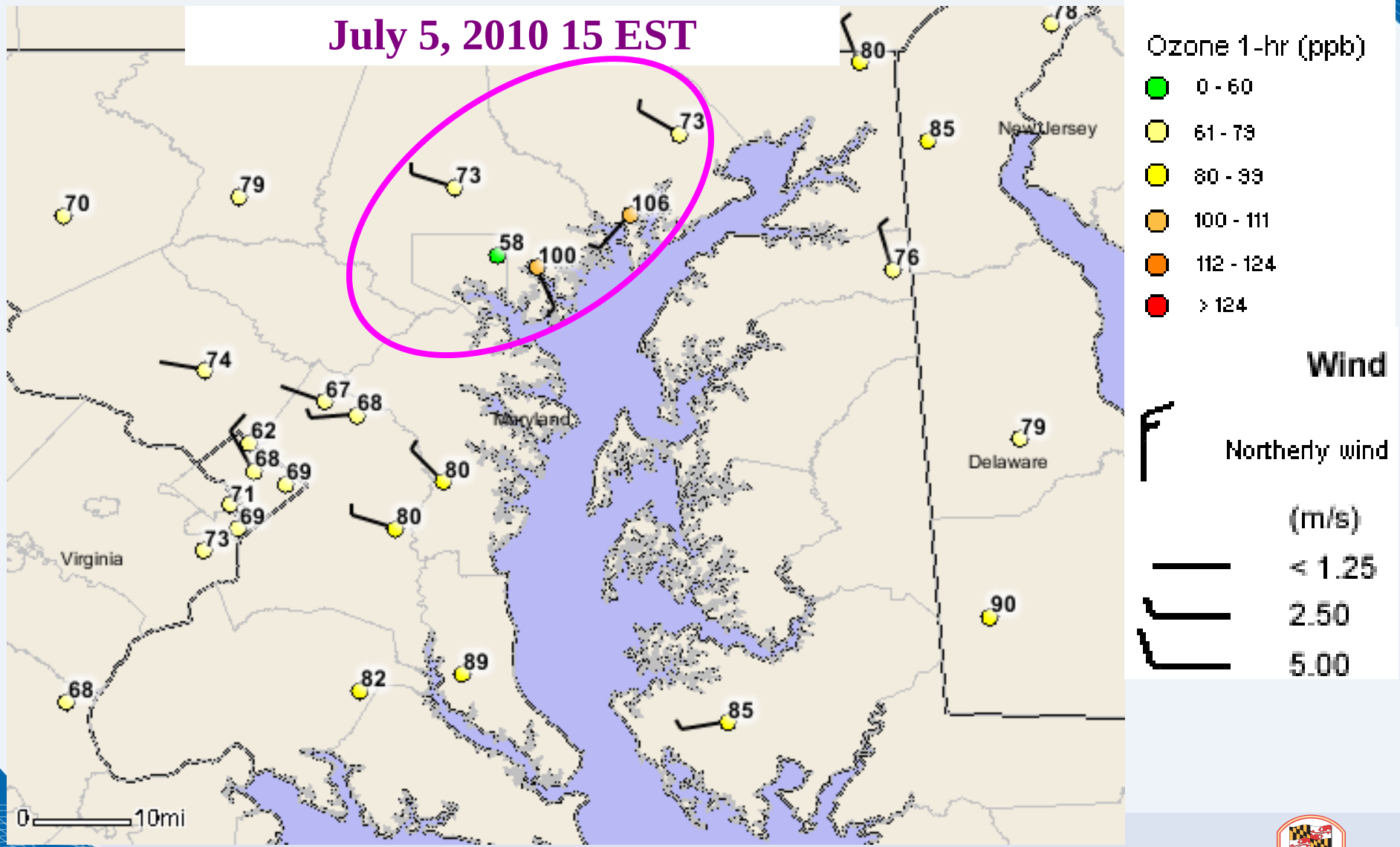
	Aldino	Davidsonville	Edgewood	Essex	Furley ES, Baltimore	Padonia	So. Carroll	Calvert Cnty.	PG County Equest. Ctr.	Frederick County	HU-Beltsville	Rockville	So. Maryland	Fair Hill	Millington	Hagerstown	Piney Run	Peak 8-hour O3 (ppb)
2010 DV	78	79	89	78	67	77	76	77	77	75	78	74	75	80	75	72	71	
5/26						76												76
5/30								76										76
5/31			80	79	77					77	83				76	76		83
6/1			79											92	81			92
6/7	79		89	83		76					76			89	77			89
6/8	80	88	114	101	87	83	79	87	95	82	82	81	77	94	91	76		114
6/9		87	106	83	76	82	77	93	86	76	80		86	96	100			106
6/10		94	87	81	77	86		92	92		91		98	76	78			98
6/18									76						76			76
6/28									76									76
7/1	80	80	81						80				79					81
7/2	98	78	107	87	83	92	85	78	81	85	88	88	79			84		107
7/3	84		78															84
7/5		78	98	91	82				85									98
7/6	90																76	90
7/7	85	79	87	85	84	88	79		83	76	94	82			78			94

DISCOVER flight

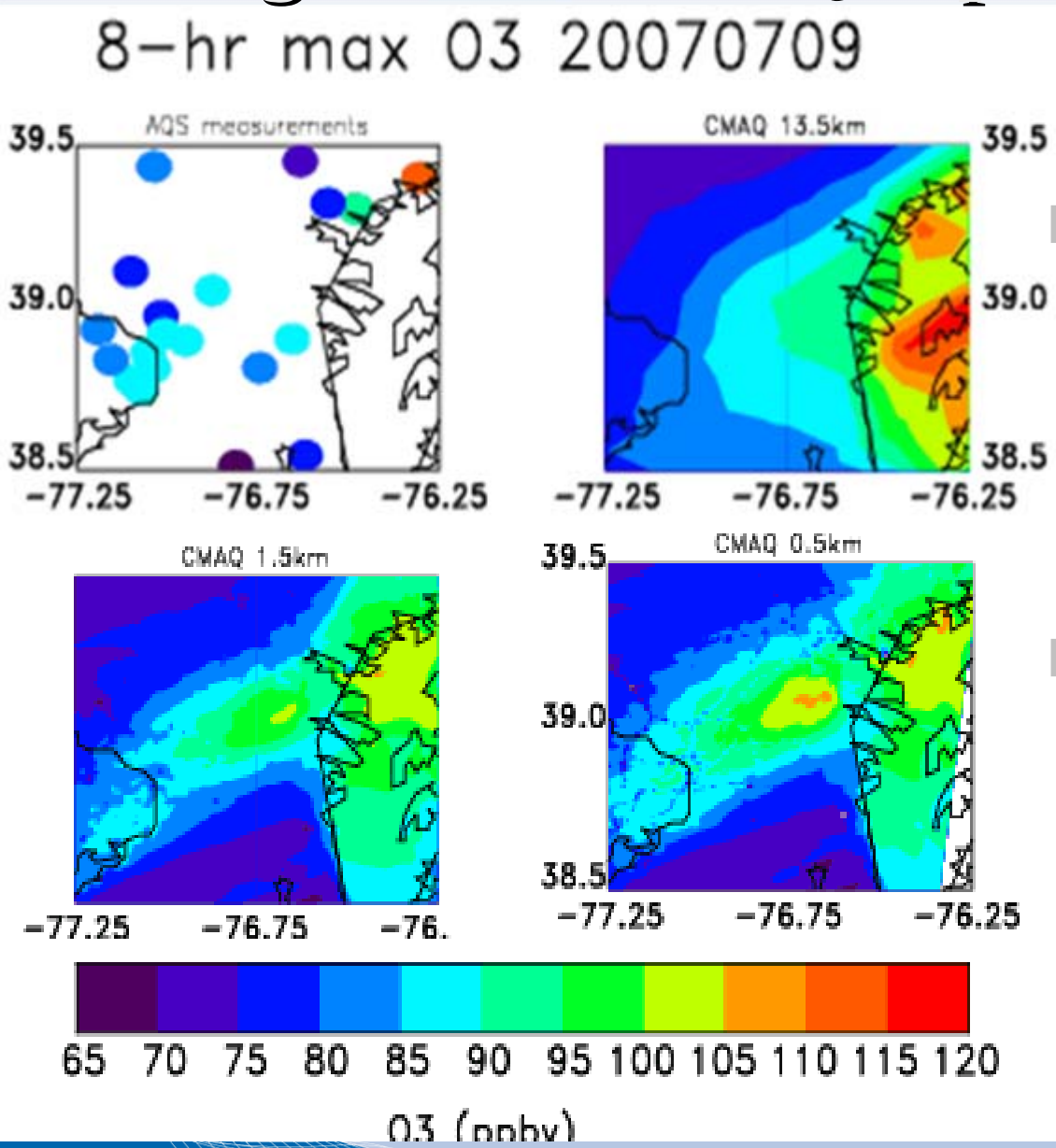
UMD flight

Bay Breeze Occurrence



http://www.airnowtech.org/gis/index.cfm

High res. CMAQ captures bay breeze



Low resolution

- O_3 in the bay.

High resolution

- captures bay breeze.

- O_3 closer to measurements.

Courtesy: Chris Loughner UMD

DISCOVER-AQ Status update

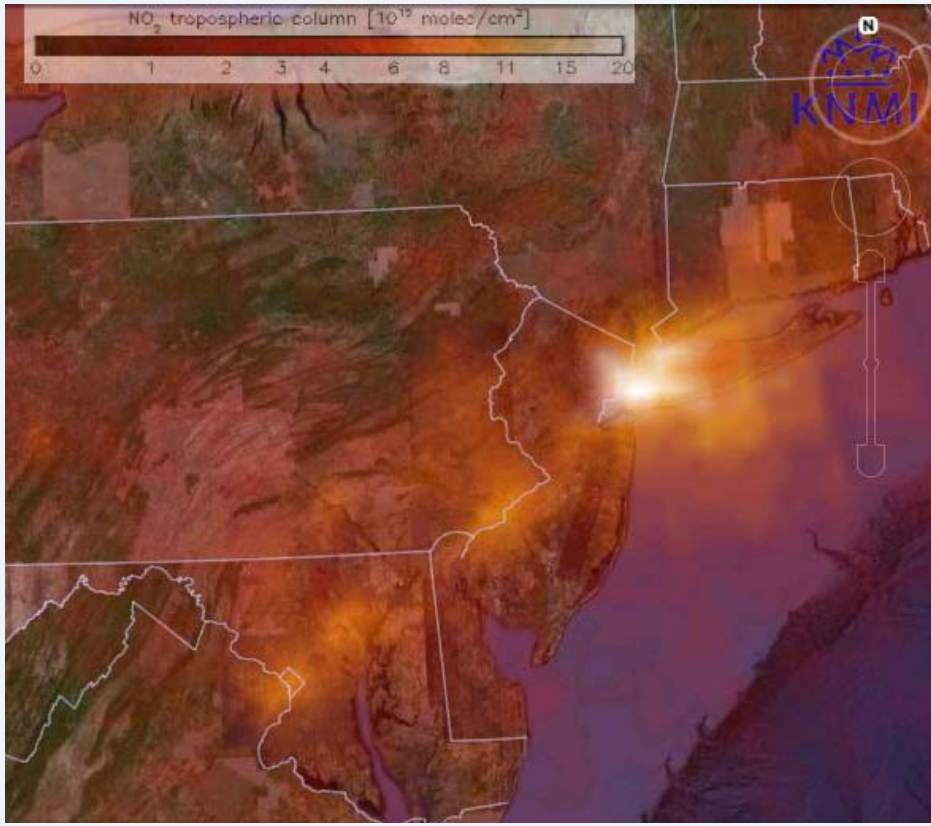
- 3 flights completed with 58 profiles completed.
  - Spirals from 1000 – 10,000 ft.
  - Transects at 1000 ft. between spirals.
- Remote sensing instruments operational at 6 ground sites.
- Expect 9-11 more flights with at least 230 profiles.

http://www-air.larc.nasa.gov/missions/discover-aq/discover-aq.html

Use of DISCOVER-AQ results

- Improve understanding
  - Boundary layer chemistry.
  - O_3 precursor transport.
  - Extent of O_3 and aerosol pollution.
- Provide measurements to test air quality models.
  - Clues on how to better regulate emissions.
- Increase usability of satellite data.

OMI tropospheric NO_2 July 2008



We acknowledge the free use of tropospheric NO_2 column data from the OMI sensor from www.temis.nl

Contact

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MDE

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