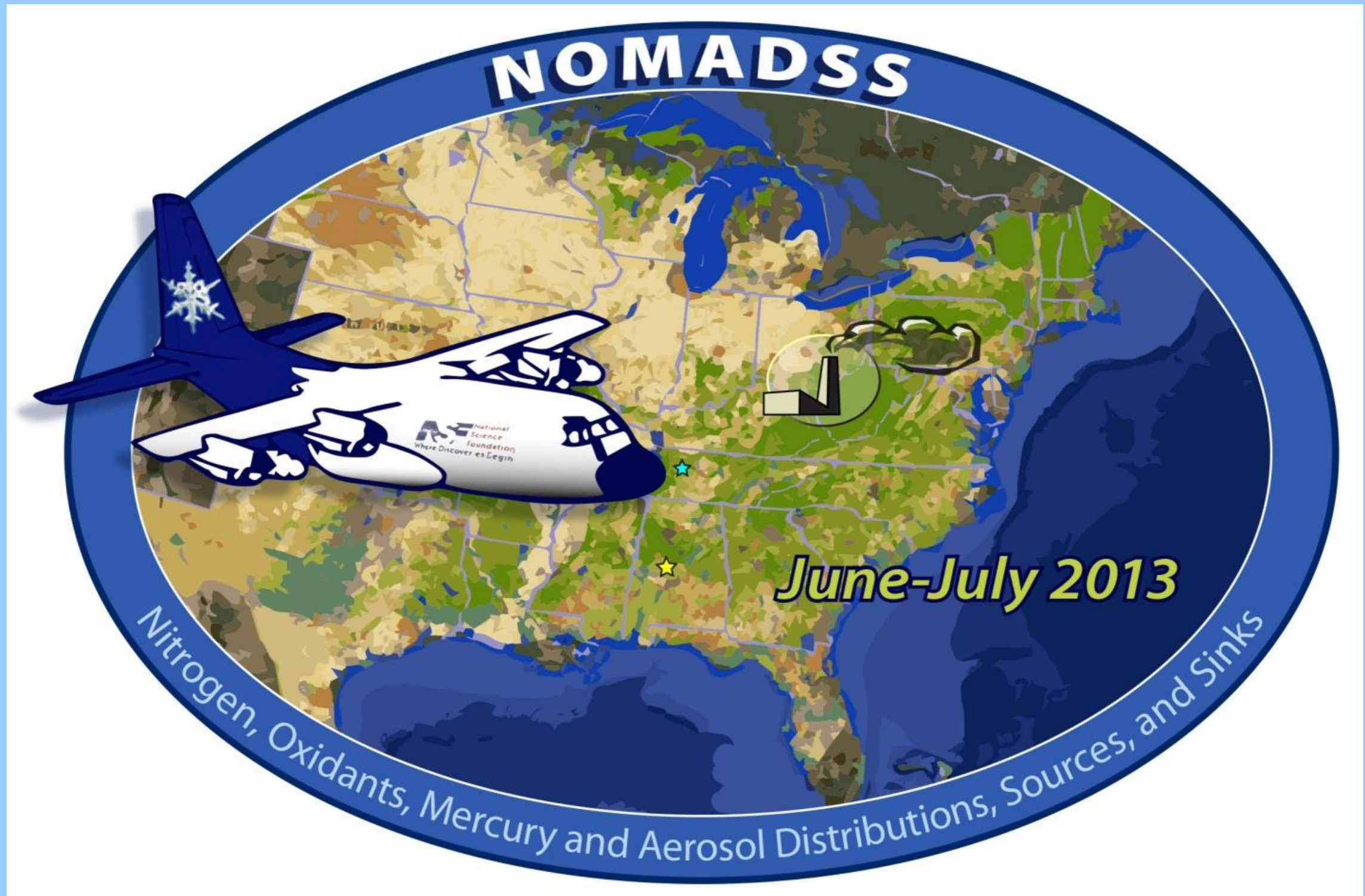


NOMADSS

Science goals, flight tracks and some prelim results

Dan Jaffe and the entire NOMADSS team



NOMADSS team

- SUNY-Albany/Wadsworth Ctr: Xianliang Zhou (Co-I)
- PNNL: Alex Guenther (Co-I)
- UW: D.Jaffe, L. Jaeglé, Viral Shah, Lynne Gratz, Crystal McClure and Jesse Ambrose;
- MIT: Noelle Selin, Shaojie Song, Amanda Giang, James Hunter;
- CU: Chris Cantrell, Lee Mauldin, Jordan Krechmer
- UCLA: Jochen Stutz, James Festa.
- UA-Huntsville: Geoffrey Heidelberger and Aaron Kaulfus.
- NCAR: Louisa Campos, Teresa Campos, Andrew Weinheimer, Frank Flocke, Eric Apel, Sam Hall, Christoph Knote, John Ortega, Rebecca Hornbrook, Jeong-Hoo Park, Geoff Tyndall, D. Knapp, D. Montzka, Steve Williams, Lisa Kaser, Bin Yuan (and many more in EOL)



Acknowledgments

- **Pilots: Scotty McClain and Ed Ringleman**
 - **Vidal**
- **Field mgrs: Allen Schanot and Pavel Romashkin**
 - **Everyone else at EOL**
- **All the cooperating scientists from NOAA, SAS, EPA, etc...**

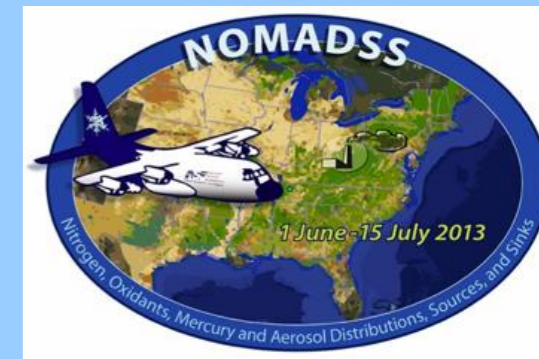


National Science Foundation
WHERE DISCOVERIES BEGIN



NOMADSS = NAAMEX + SOAS + TROPHONO

- NAAMEX: Constrain emissions of mercury from major source regions in the Eastern United States and quantify the distribution and chemical transformations of speciated mercury in the troposphere. Evaluate ground based Hg instrumentation for response to Hg⁺² compounds (Birmingham)
- SOAS: Quantify biogenic emissions and their interactions with anthropogenic pollutants and to understand the implications for atmospheric chemistry, air quality and climate.
- TROPHONO: Investigate the role of particulate nitrate photolysis in the cycling of reactive nitrogen species in the troposphere, focusing on HONO as an intermediate product.

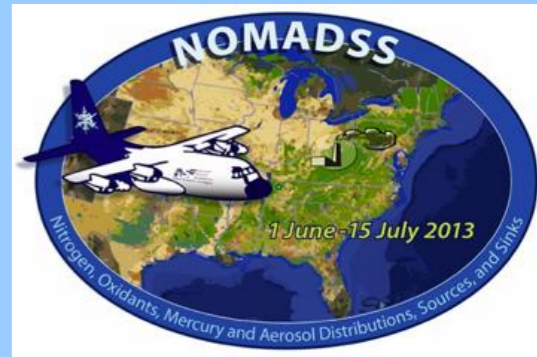


Observations on the C-130

- UW: Hg^0 , THg, Hg^{+2}
- CU: OH, HO_2 , RO_2 , SO_2
- SUNY-Albany: HONO, p- NO_3^-
- UCLA: Mini-DOAS (NO_2 , HONO, etc)
- NCAR: CO, CO_2 , CH_4 , O_3 , NO_x , TOGA, PTRM, SMPS, Actinic flux,

Models

- UW/MIT: GEOS-Chem Hg forecasts and post mission analyses.
- NCAR: MOZART and Flexpart forecasts and post mission analyses.



NOMADSS Aircraft operations



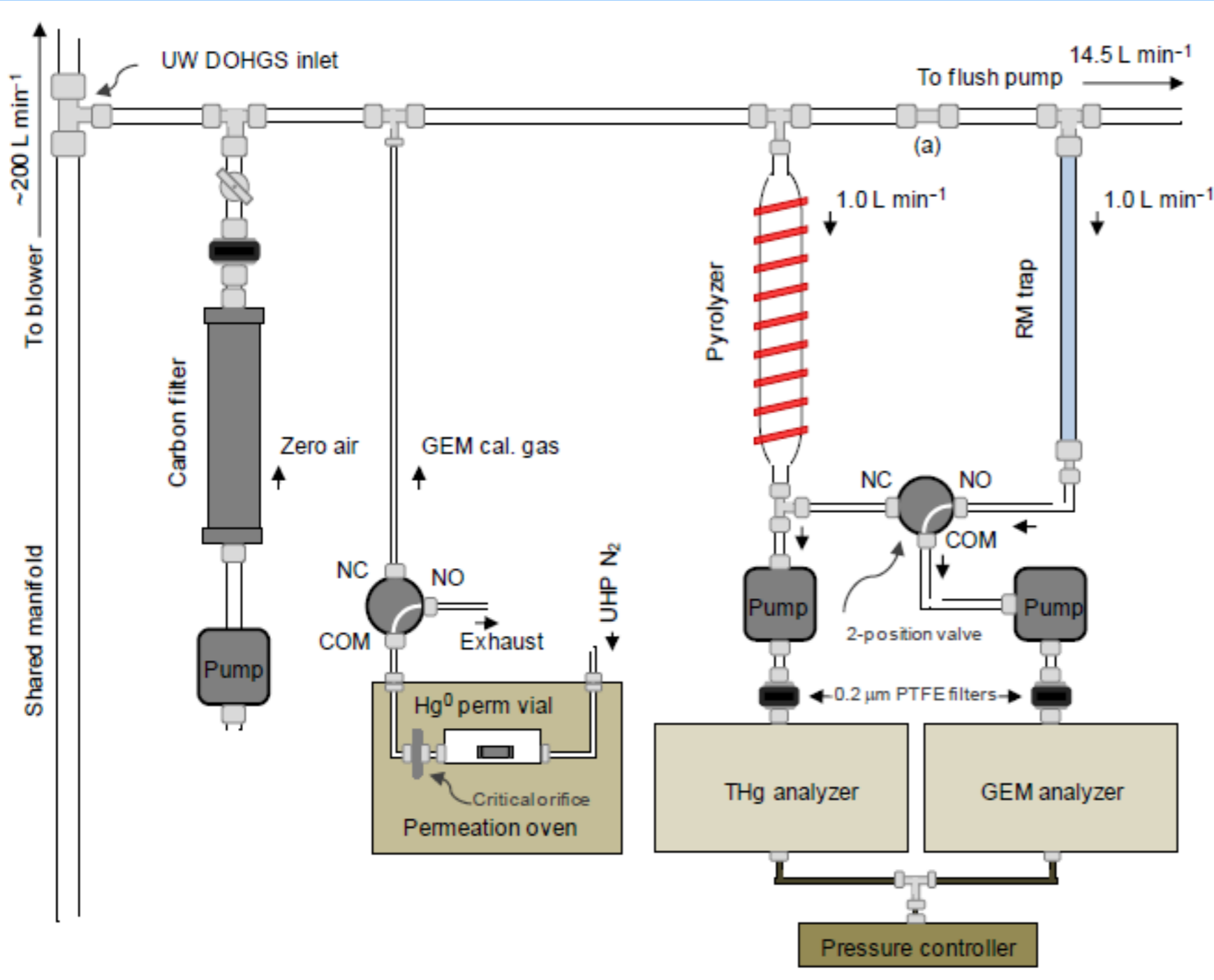
- Aircraft based out of Smyrna, TN (Nashville)
- 19 Research flights in June-July 2013
- Fully instrumented: CO, CO₂, NO_x, HO_x, SO₂, H₂SO₄, extensive VOCs, etc. and Hg.



Multiple goals for each flight

Flight	Date	Notes/goals
RF01	3-Jun-13	Smyrna to ROSE site in Central AL.
RF02	5-Jun-13	Flight to Texas/Louisiana border for stacked racetracks to examine VOC fluxes from vegetation.
RF03	8-Jun-13	Flight to Missouri/Arkansas for multiple stacked racetracks.
RF04	12-Jun-13	Flight to racetrack sites in Alabama and Mississippi
RF05	14-Jun-13	Flight to Alabama/Mississippi for stacked racetracks.
RF06	19-Jun-13	Sampling of high altitude/dry air power plant plumes in Texas
RF07	20-Jun-13	Sample power plant and other plumes in Ohio River Valley.
RF08	22-Jun-13	Sample Birmingham and NE Texas power plant plumes.
RF09	24-Jun-13	Vertical profile in very dry air over Texas.
RF10	27-Jun-13	High elevation over TX/OK with BB influence. BL sampling near Texarkana and Martin Lake pp.
RF11	29-Jun-13	Sample Birmingham, Gaston cfpps and Atlanta power plant plumes
RF12	1-Jul-13	Flight to Texas Gulf Coast to sample Houston outflow.
RF13	4-Jul-13	Sample Hg plume at high levels between Smyrna and El Dorado, Texas.
RF14	5-Jul-13	Sample clean marine air over the Atlantic Ocean.
RF15	7-Jul-13	Chicago and Indianapolis outflow and biogenic VOC flux enroute.
RF16	8-Jul-13	Clean marine air over the Atlantic Ocean and enroute.
RF17	11-Jul-13	Aged Canadian biomass burning plume and BVOC fluxes over MO.
RF18	12-Jul-13	Sample air in multiple stacked racetracks and nighttime evolution of HONO in the BL and free troposphere.
RF19	14-Jul-13	Flight to AR to examine vegetation emissions, RM distributon and emissions from munitions depot near AR/LA border.

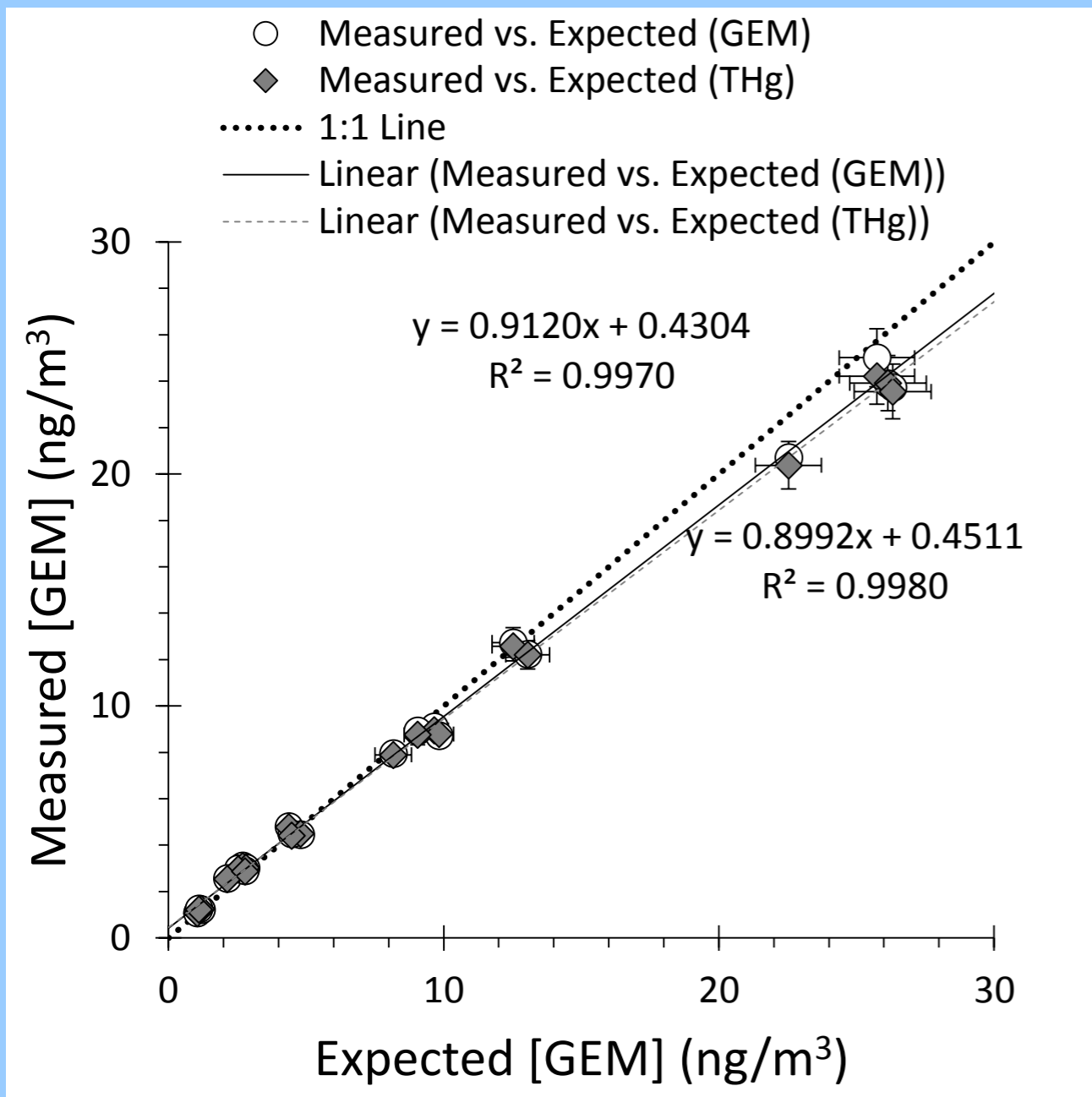
UW-Detector of Oxidized Hg Species (UW-DOHGS): THg, GEM and GOM (by difference)



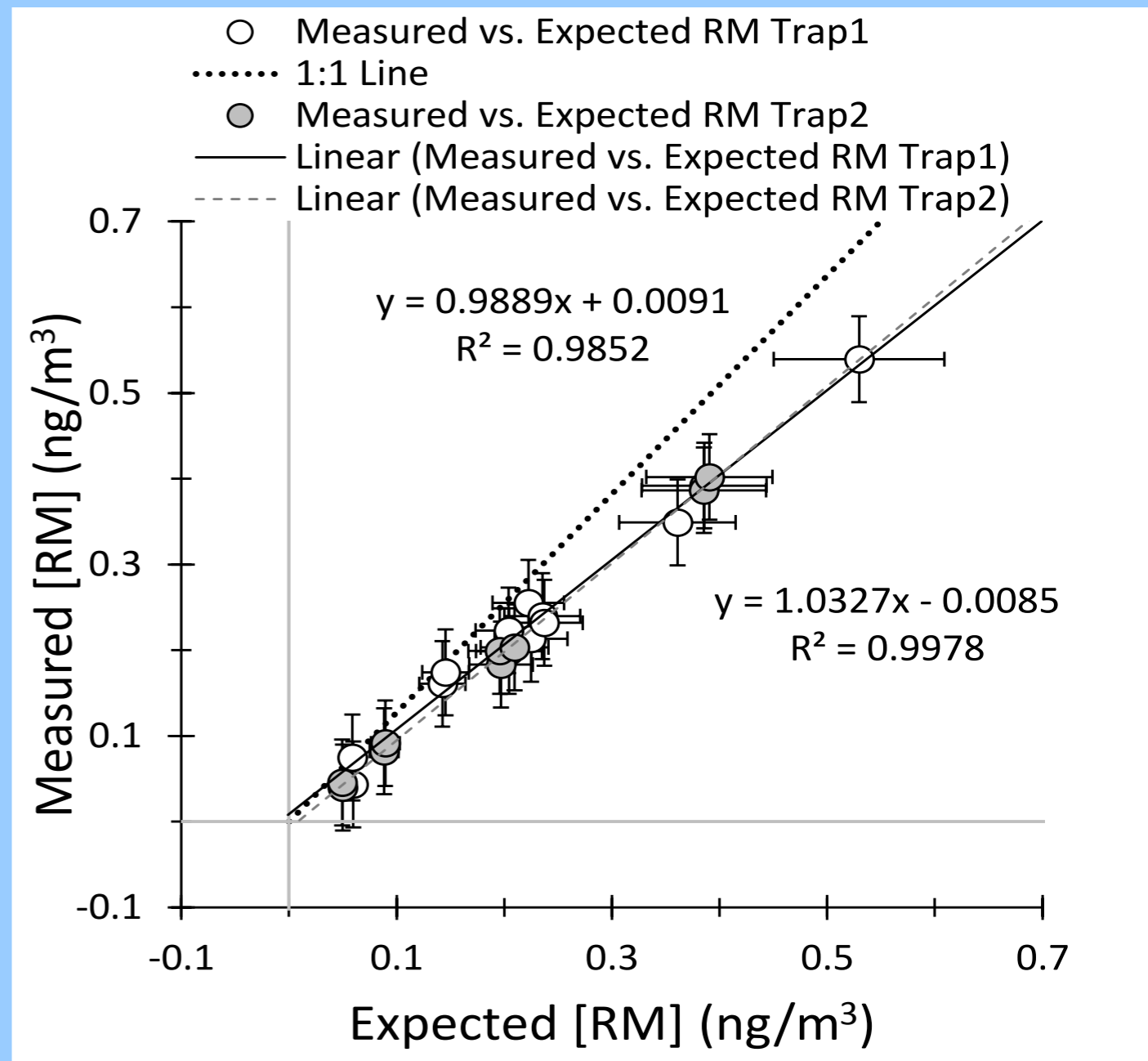
Swartzendruber et al 2009;
Lyman and Jaffe 2011;
Ambrose et al 2013.



GEM and HgBr₂ Calibration of the DOHGS



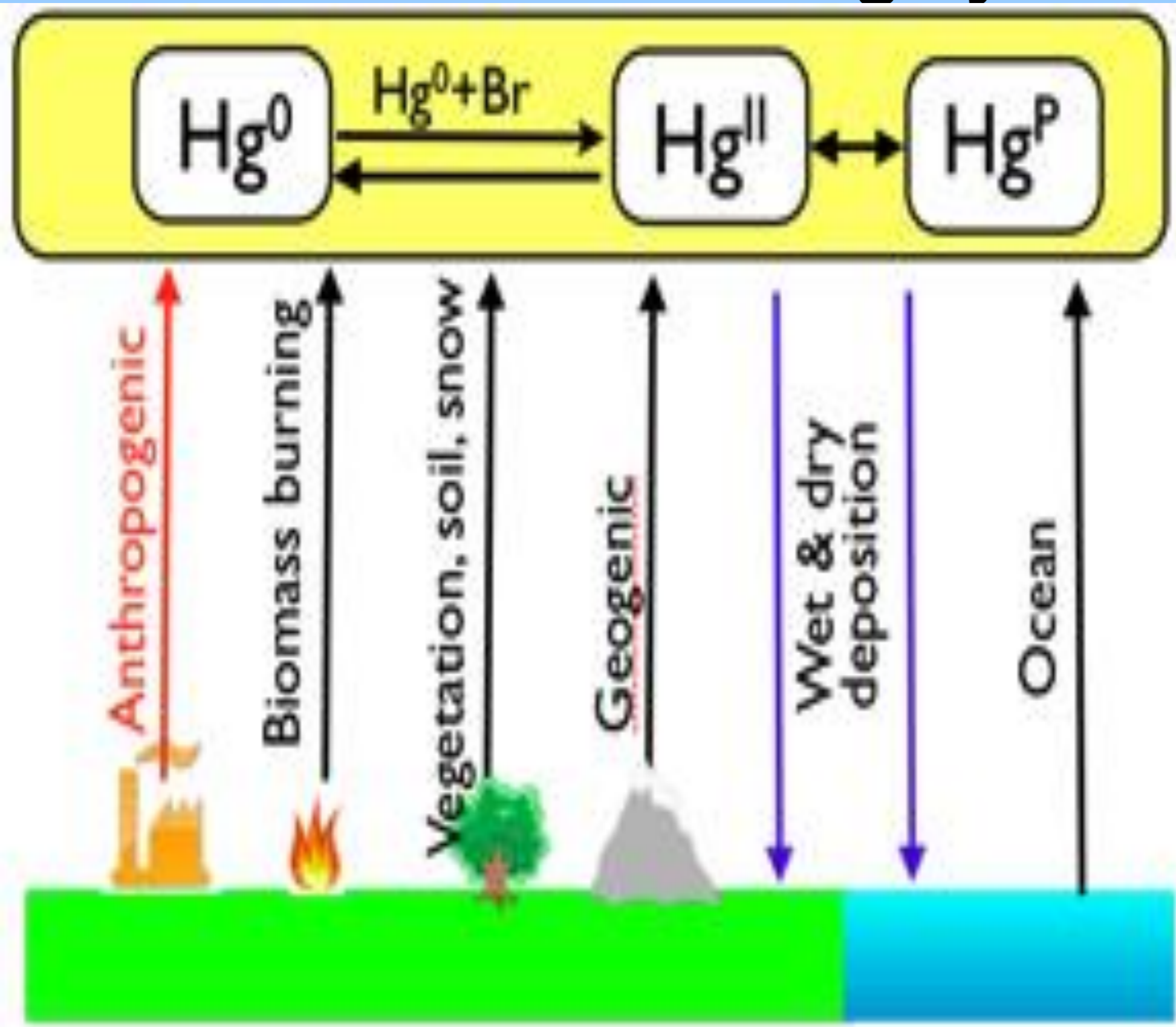
GEM



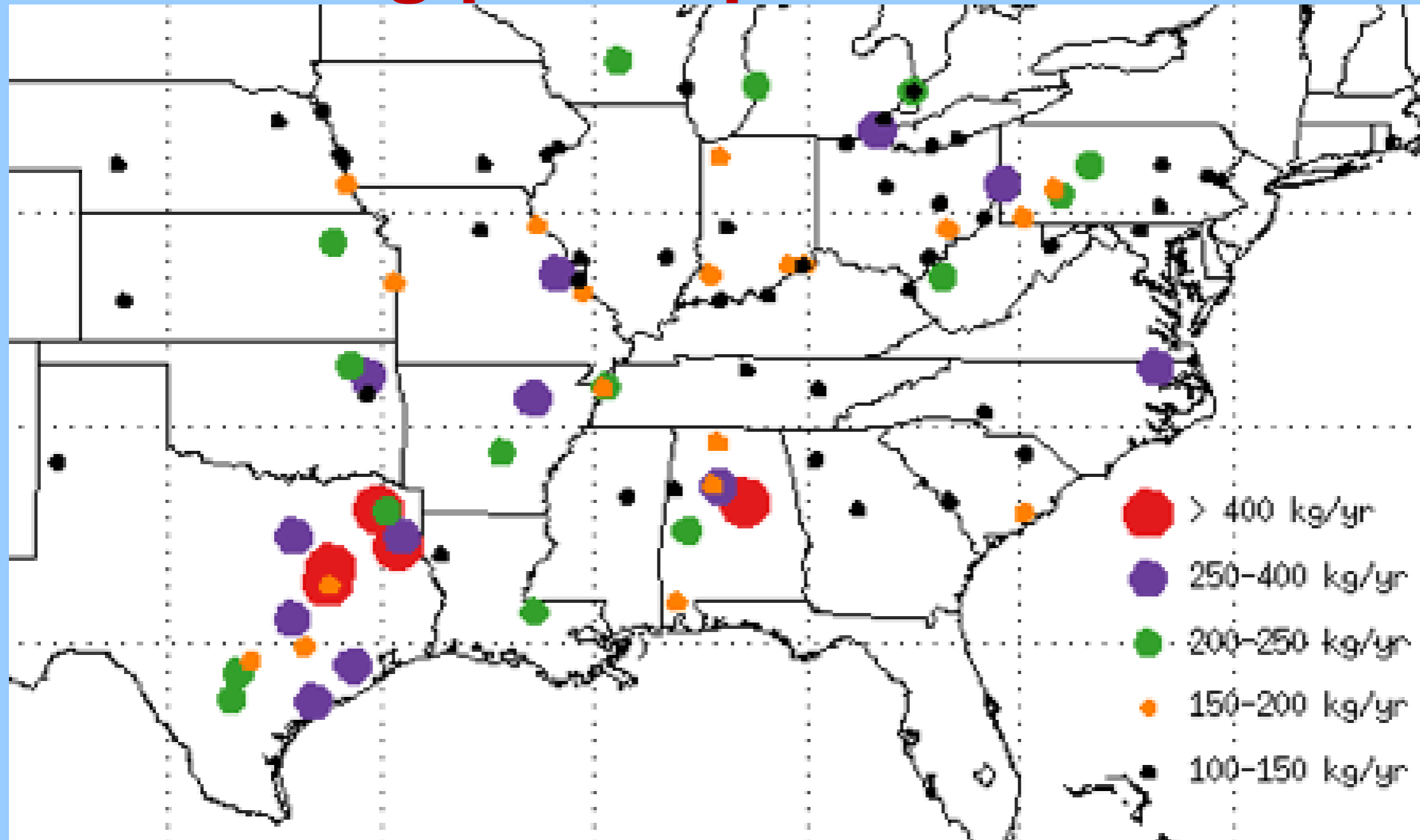
HgBr₂



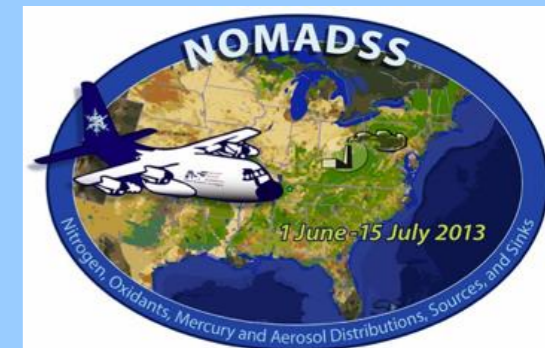
Global Hg cycle



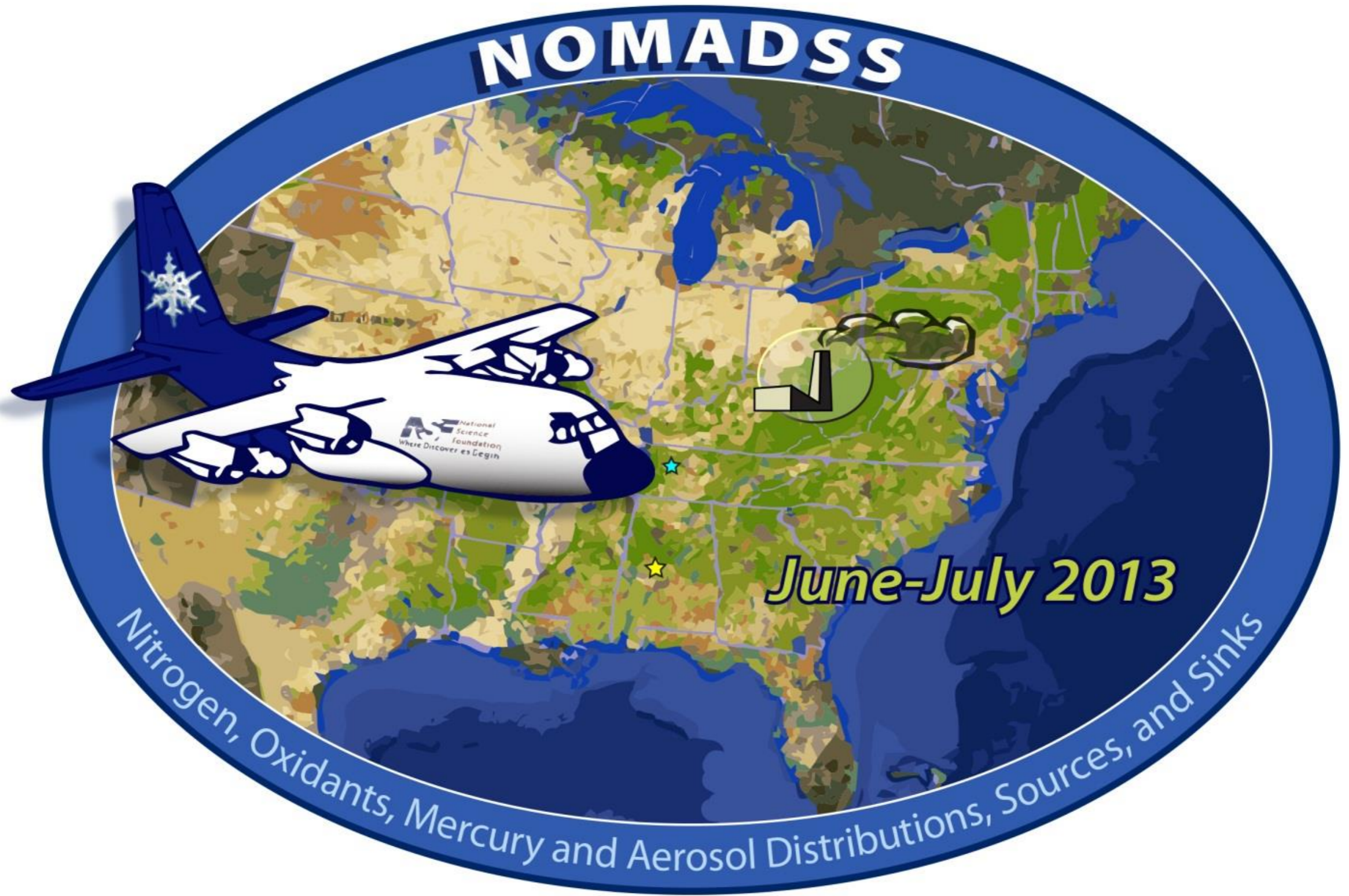
Constraining power plant emissions of Hg



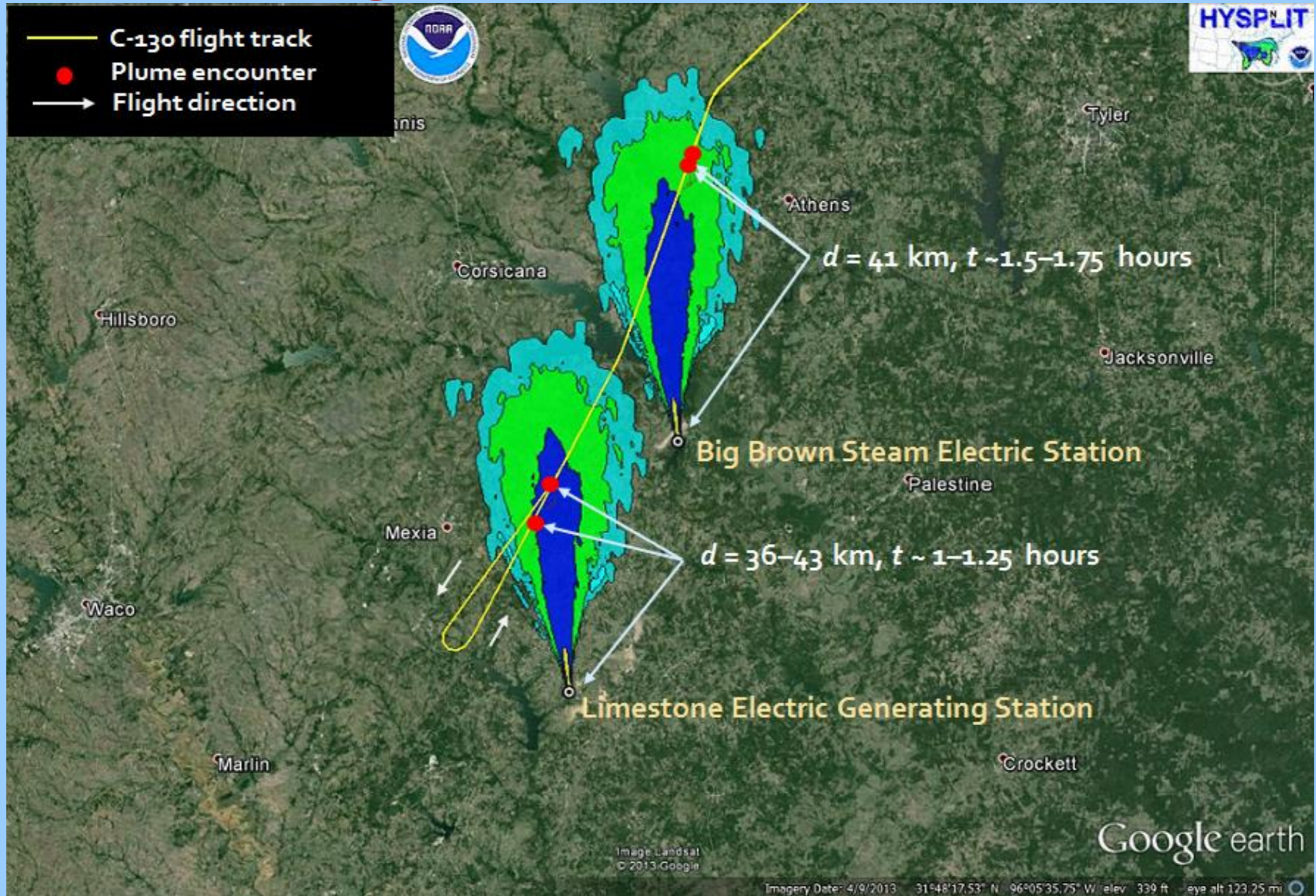
- 2011: Hg emissions from CFP = 25.4 tons (49% of US total)
- 2016: Hg emissions from CFP = 7 tons due to:
Mercury and Air Toxics Standard



NOMADSS previews



Evaluation of Hg emissions inventories (J.Ambrose)

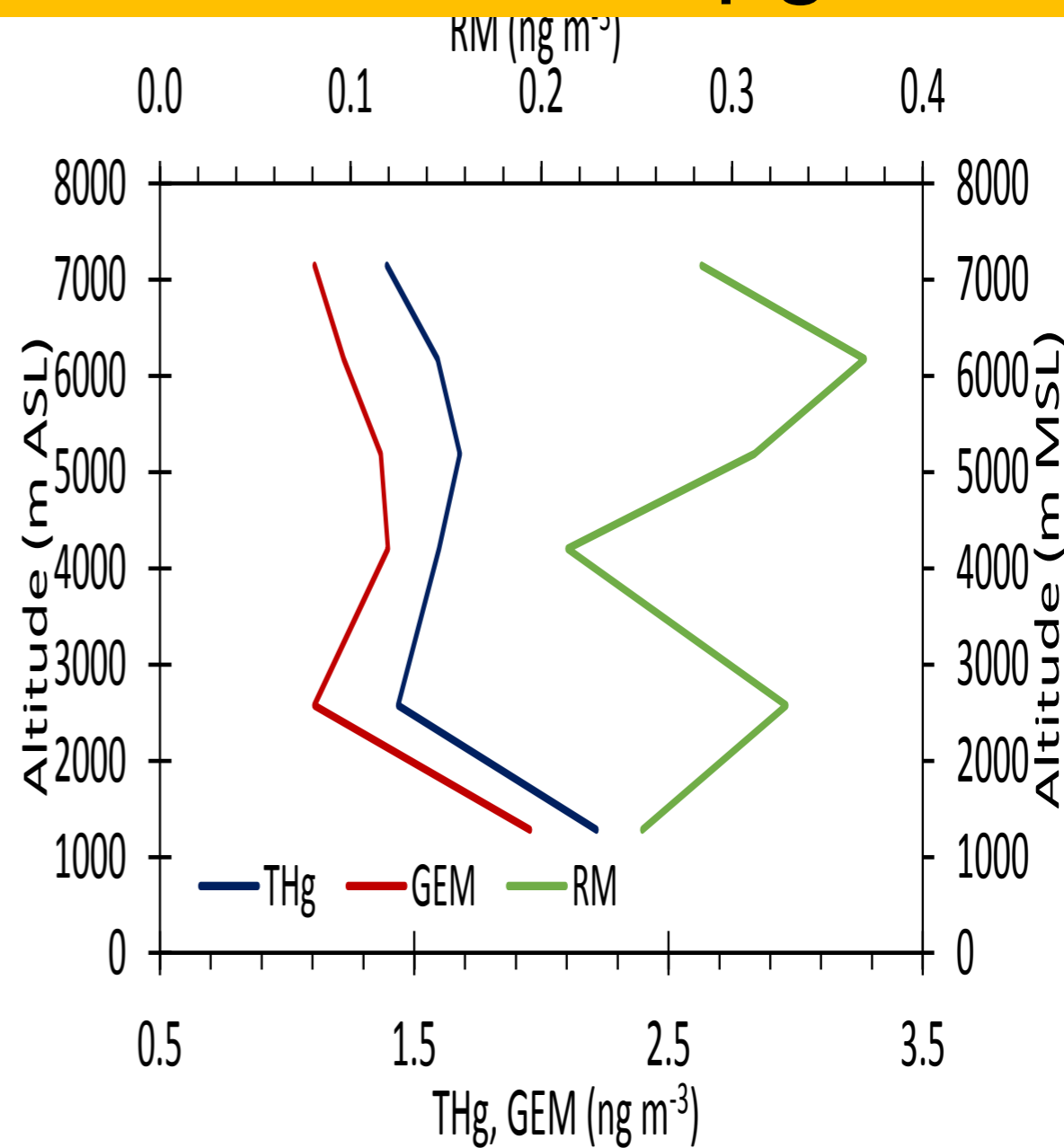
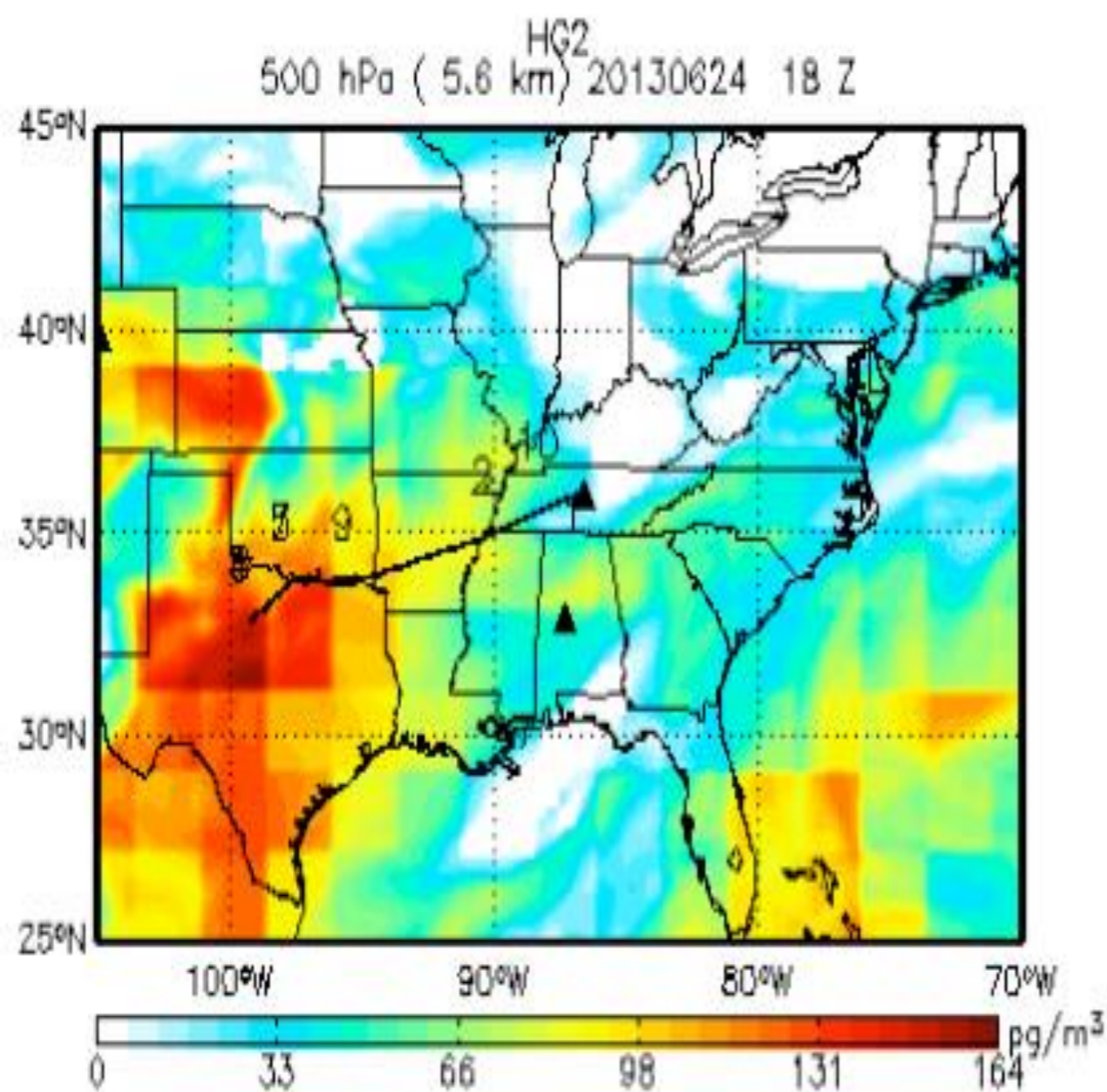


Hysplit dispersion model for Big Brown and Limestone plants at time of C-130 passage.

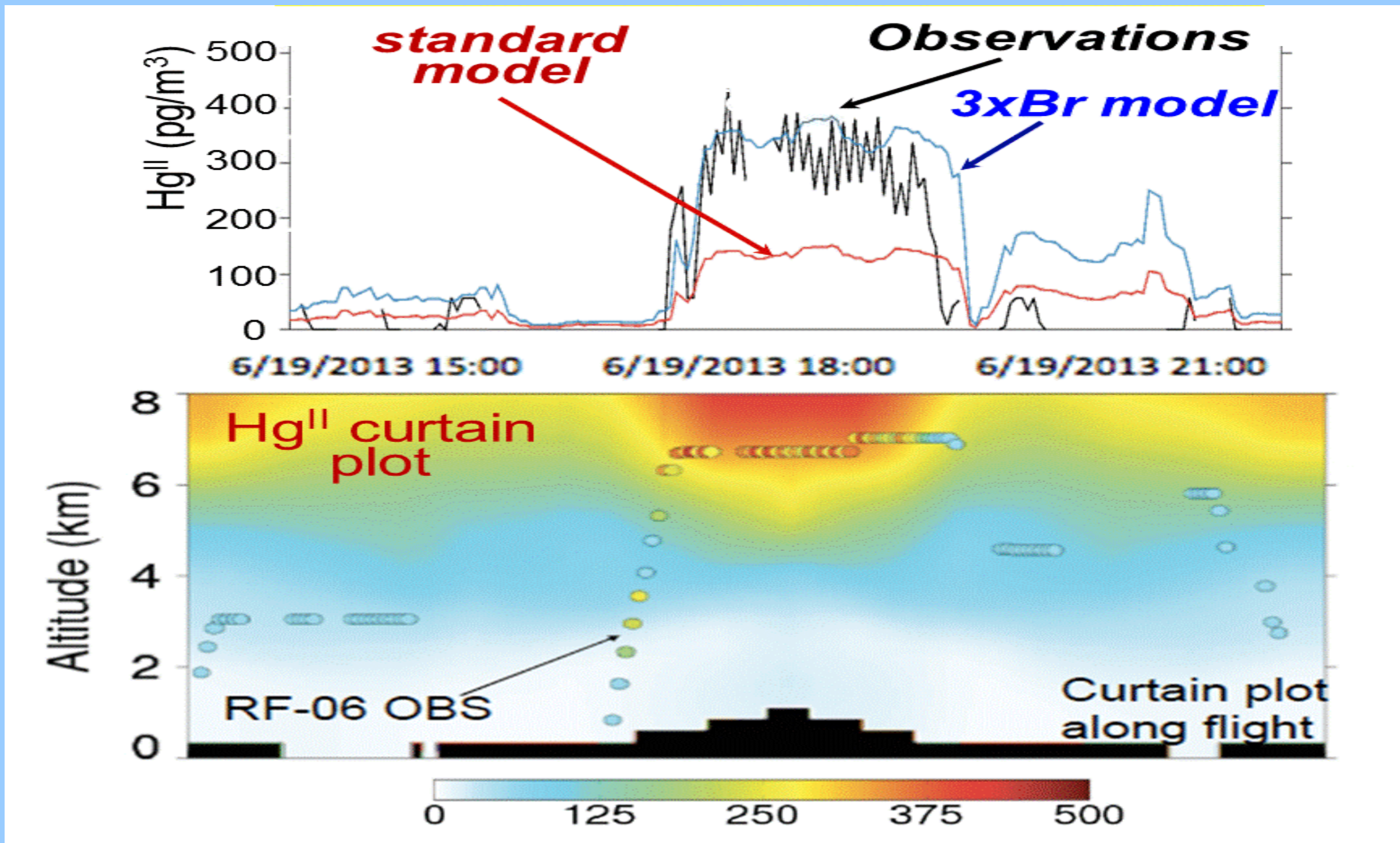
Hg²⁺ in the free troposphere: Much higher than in current models. (L.Gratz)

Forecast = 130 pg/m³

Obs = 350 pg/m³



How to explain high Hg^{+2} (V.Shah)



TROPHONO

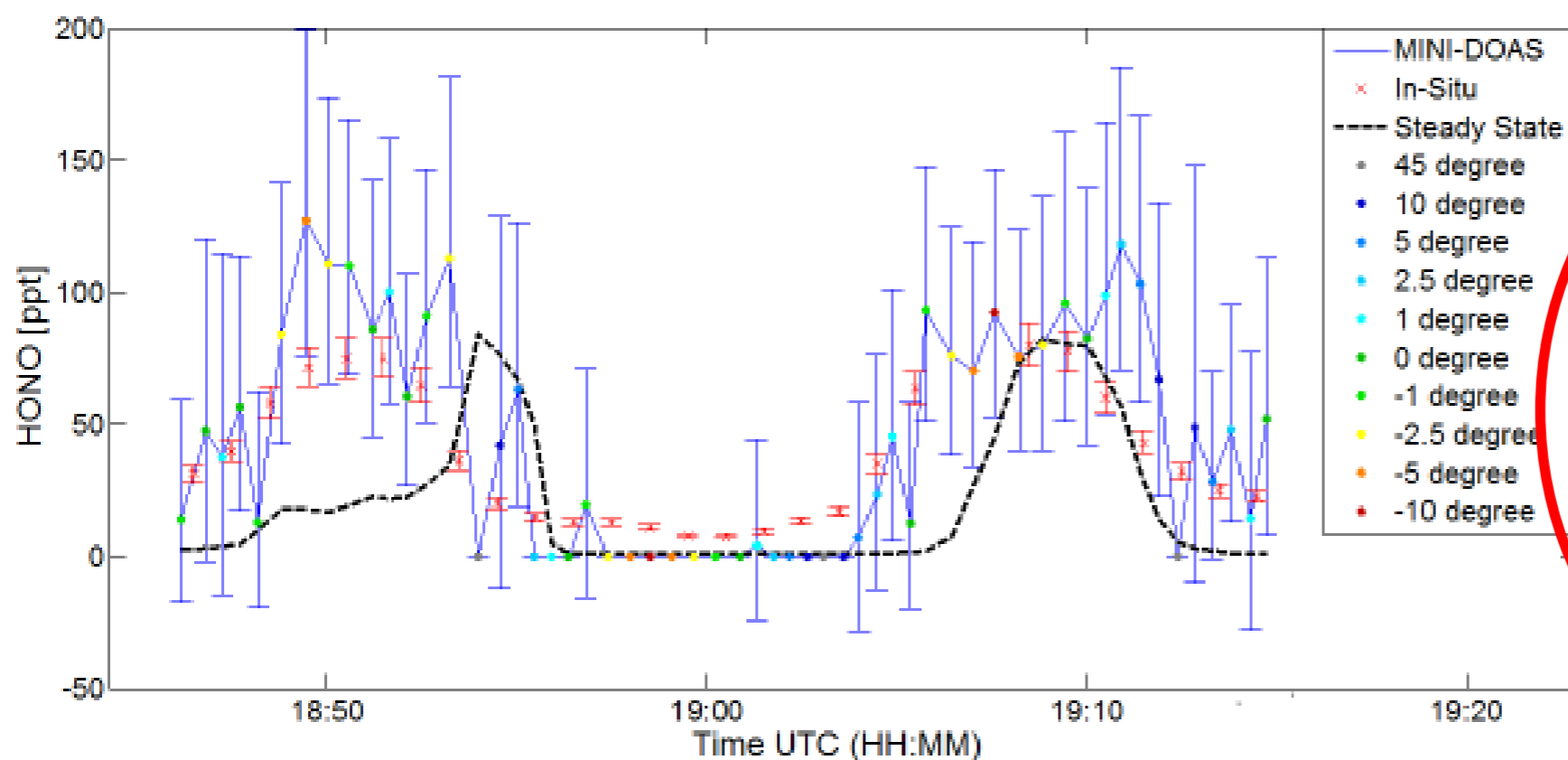
Xianliang Zhou, Chunxiang Ye, Dennis Pu, Wadsworth Center
James Festa, Max Spolaor, Jochen Stutz, UCLA

Goal: Study if the photolysis of aerosol nitrate or other aerosol processes are a source of HONO in the atmosphere.

Measurements:

HONO, HNO₃, aerosol nitrate by LPAP;

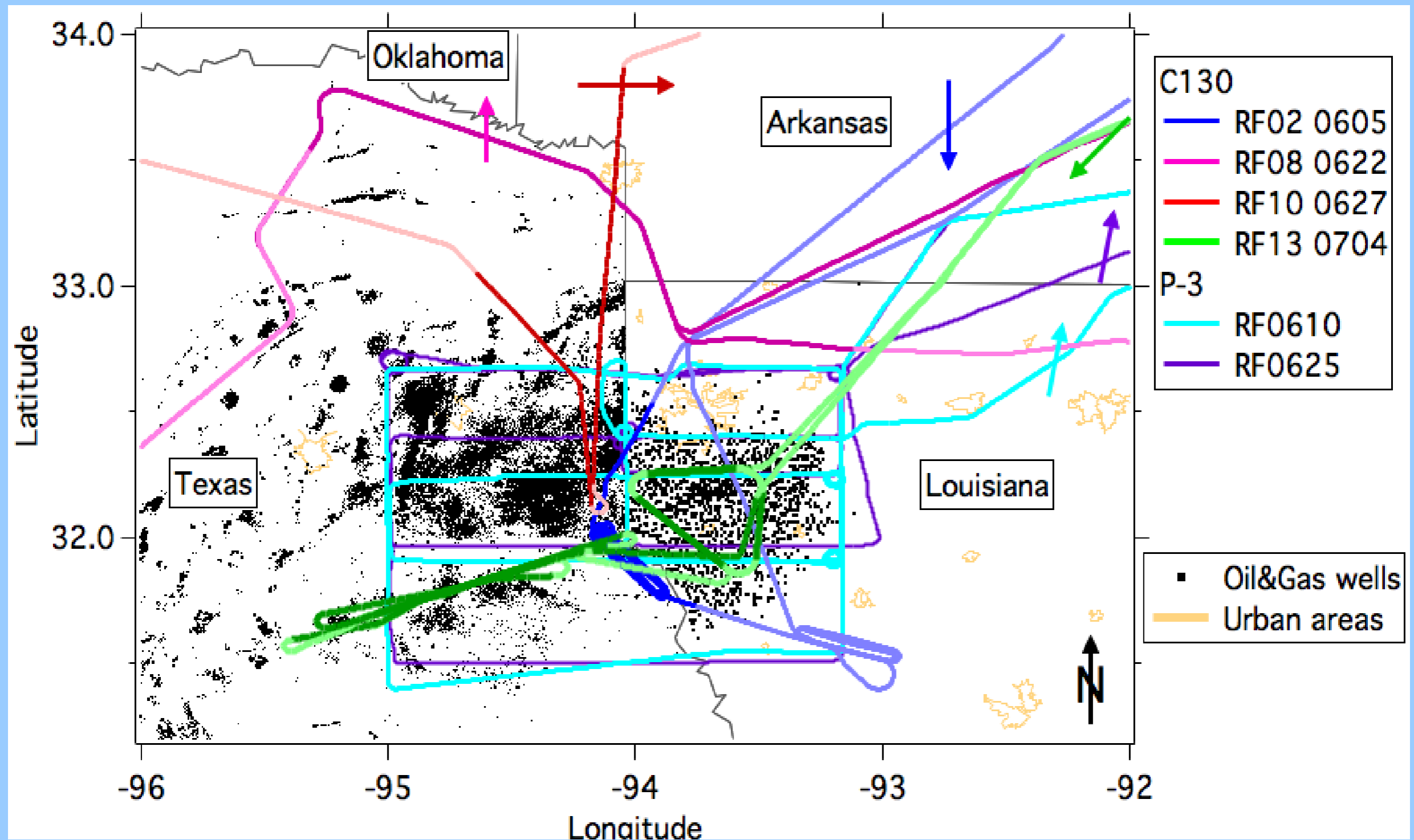
NO₂, HCHO, (Glyoxal, BrO in the future) by limb DOAS (see Poster by Festa et al.)



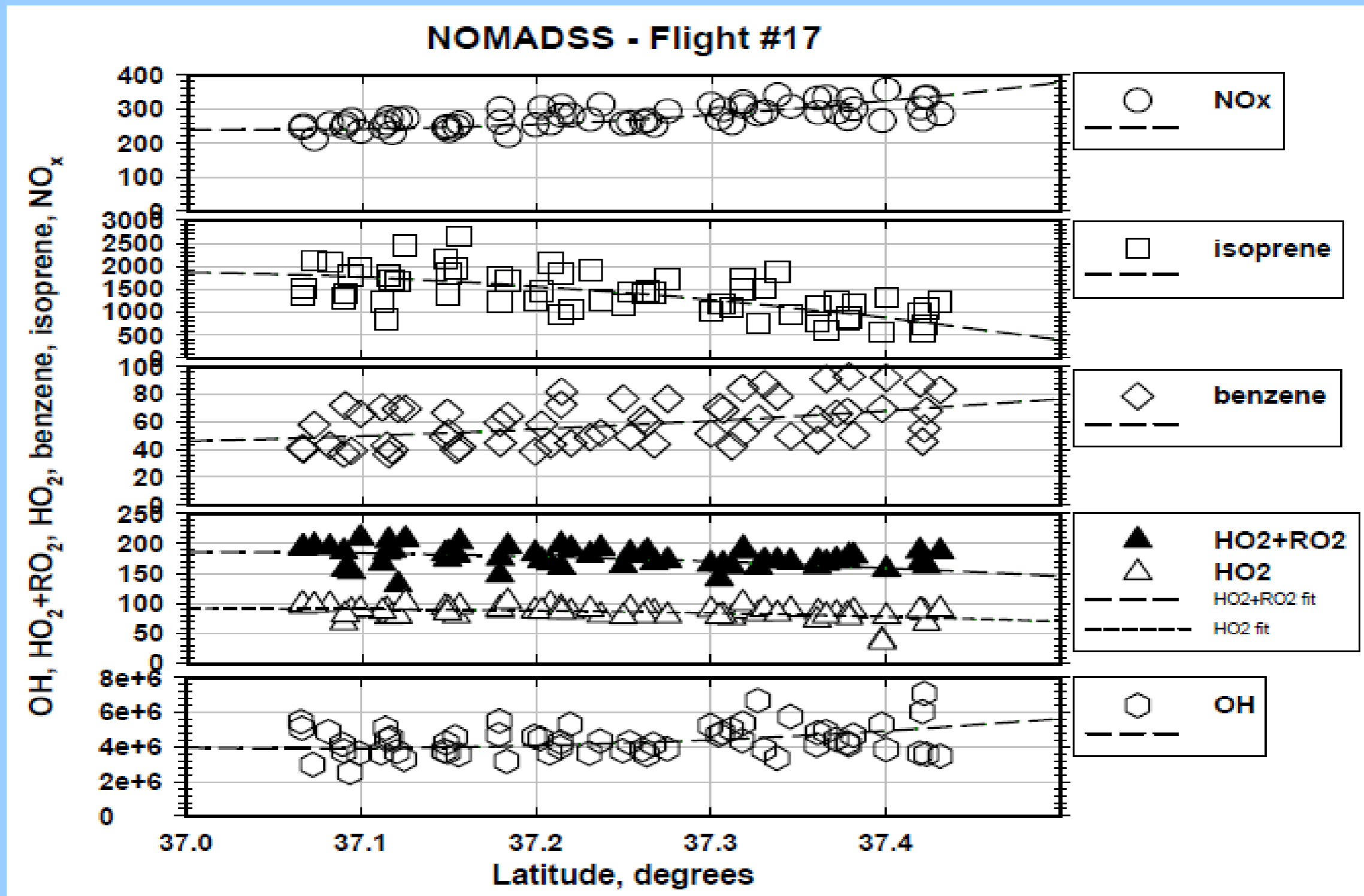
Observations of HONO by *in situ* LPAP and limb DOAS in power plant plumes show very good agreement.

A chemical source of HONO in these plumes is active.

VOCs Flux measurements over Haynesville Shale Gas Play (Bin Yuan- poster Monday evening)



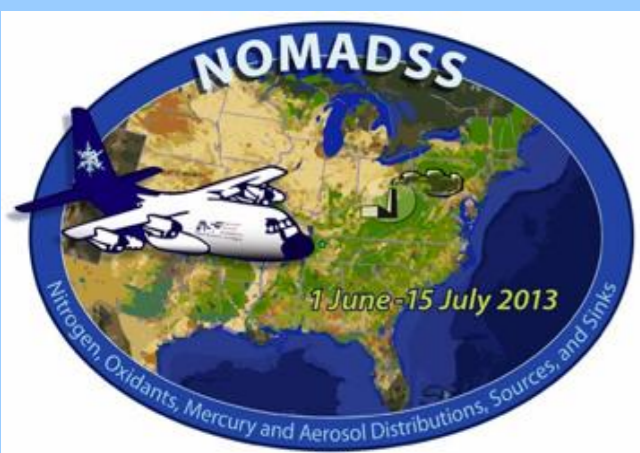
Changing oxidation environment during Flight 17 racetracks: Chris Cantrell



Higher OH, NO_x, lower isoprene →

NOMADSS Aircraft Summary

- The NOMADSS/SAS experiment provides a rich dataset which places new constraints on emissions from power plants, urban outflow, gas fields, etc.
- Very high levels of observed Hg^{+2} suggest stronger than expected oxidation of Hg^0 in air coming from the tropical/subtropical upper troposphere. This suggests a major rethinking of the global Hg cycle.
- Many other results.....



UNIVERSITY of WASHINGTON

Nashville: Home of the Recession Special

