Passive Monitoring of Ambient Reactive Gaseous Mercury in the Four Corners Area, Eastern Oklahoma, and Central/East Texas: Important Method Evaluation and Baseline Work

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Introduction

- This presentation will summarize the first year of a two year monitoring project estimating reactive gaseous mercury (RGM, a.k.a. gaseous oxidized mercury, GOM) dry deposition in the Four Corners area and eastern Oklahoma, and preview a similar study to be done in Texas.

- RGM of interest because of its chemical reactivity/water solubility; RGM readily deposits to water, soils and vegetation by both dry and wet processes; atmospheric lifetime = 0.5-2 days versus 0.5-2 years for elemental mercury which is mildly reactive and sparingly soluble in water.

- Four Corners/Eastern Oklahoma project is a two year effort funded by U.S. EPA ORD Regional Applied Research Effort (RARE) program; the upcoming Texas study will also be funded by RARE.

- Project Collaborators: U.S. EPA Region 6, U.S. EPA ORD, Frontier Geosciences/Global Sciences, Alion, NMED, NPS, USFS/BLM, Jemez Pueblo/Valles Caldera Trust, Cherokee Nation.

- Ambient monitoring began in August, 2009, and will run through the first part of August, 2011.

Project Objectives

- To gather first-time RGM dry deposition estimates for 24 consecutive months at six sites in the Four Corners area to set a valuable ambient RGM dry deposition estimate baseline with proper assessment of: (a) the effectiveness of the Frontier Atmospheric Dry Deposition (FADD) surrogate surface devices in providing reliable RGM dry deposition estimates and (b) the inter-annual RGM dry deposition estimate variability.

- (a) to be accomplished by comparing FADD RGM data to Tekran RGM data at the Stilwell, OK site, and by assessing relative percent difference (RPD) statistics for field duplicate samples.

- Five of the seven total project sites are collocated with wet deposition mercury measurements so wet mercury + dry RGM data will be evaluated for the first time at those sites.

- The baseline data can be used to assess future success of new mercury emission reduction regulations for boilers and incinerators (February, 2011 final Air Toxics Standards for Major and Area Source Boilers and Certain Incinerators) and for the power sector (March, 2011 proposed national standard for mercury pollution from power plants).

Study Areas Background

- The Four Corners area of the southwest U.S. contains many protected National Parks and Monuments amidst growing oil/gas production and some of the largest coal-fired power plants in the U.S. Some of the fish tissue samples previously taken in the Four Corners Area have exceeded EPA's criterion concentration for human health consumption of fish (0.3 mg/kg methylmercury fish tissue). Texas also contains many large coal-fired power plants in its central and eastern sections.

- Ambient ozone and nitrogen oxides have been extensively monitored in the Four Corners area, but other pollutants of concern, such as ambient RGM, have not been monitored in the past because of cost and other considerations.

- To address cost concerns, and for ease of operations, this project is using passive sampling devices for RGM from Frontier Geosciences. A great benefit of passive sampling is that it enables more pollutant sites to be deployed for the same cost as a single continuous monitoring station.

- It was desired for confidence purposes to be able to compare the passive data to a recognized continuous method for RGM. Fortunately in Region 6, the Cherokee Nation hosts the operations of a Tekran continuous instrument in Eastern Oklahoma that monitors for elemental, particle bound, and reactive gaseous, mercury.

Study Sites

- A variety of site types was desired, including:

- **Regional Background** - Mesa Verde National Park for the Four Corners Area and Stilwell for Eastern Oklahoma.

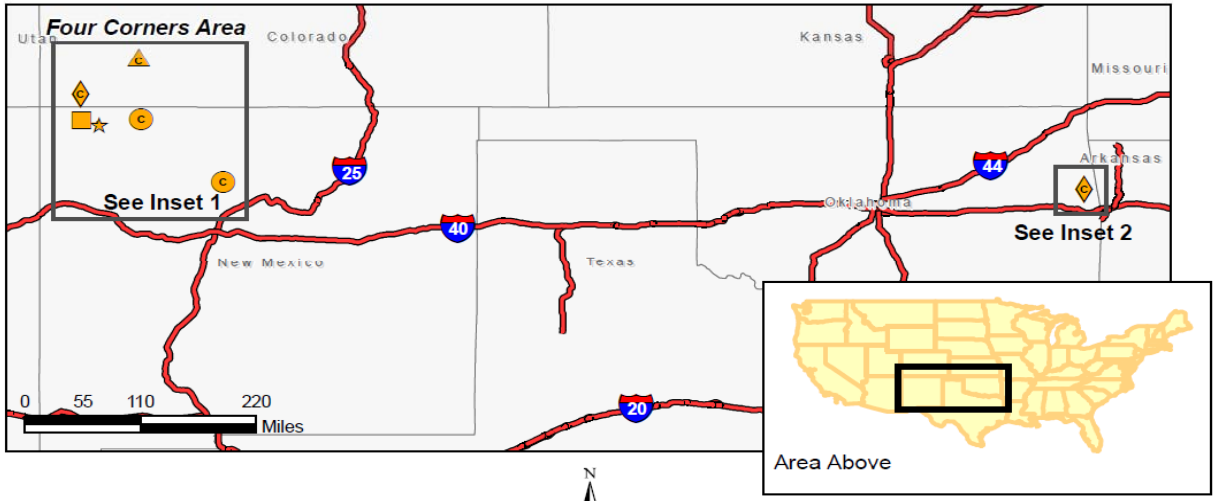
- **Power Plant Impacted** (i.e. in close proximity to the Plants) – Substation, located about 2.5 miles west of San Juan Power Plant and about 8 miles north of Four Corners Power Plant.

- **Rural** – Navajo Lake and Valles Caldera National Preserve.

- **Urban** – Farmington Airport.

- **Elevated Mountain** – Molas Pass.

Map of the 8/2009 - 8/2011 passive mercury dry deposition monitoring sites in the Four Corners Area and Eastern Oklahoma

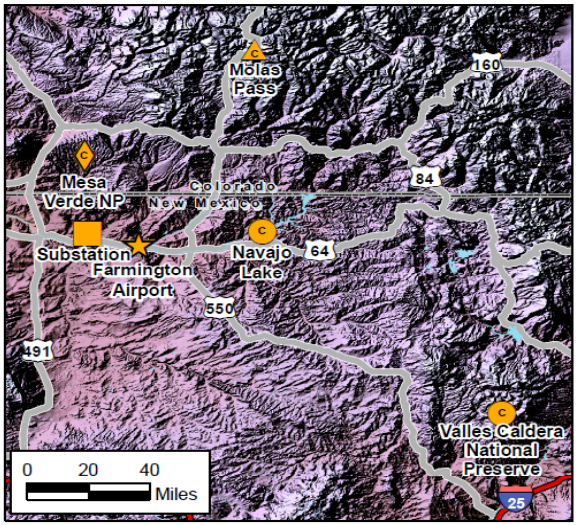


Monitoring Site Elevations:

Molas Pass – 10,659 ft asl
Valles Caldera – 8,717 ft asl
Mesa Verde NP – 7,126 ft asl
Navajo Lake – 6,470 ft asl
Substation – 5,505 ft asl
Farmington Airport – 5,492 ft asl

Stilwell, OK – 997 ft asl

Inset 1



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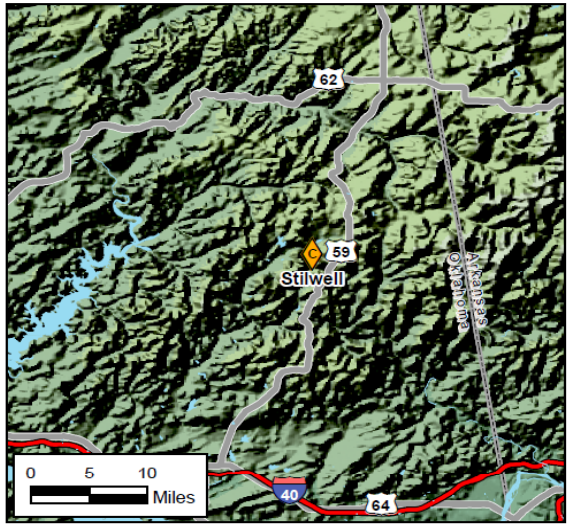


- Elevated Mountain Site
- Power Plant Impacted Site
- Regional Background Site
- Rural Site
- Urban Site

- Interstate
- US Highways
- State Boundary

C - collocated with mercury wet deposition monitoring equipment

Sources:
U.S. EPA AQS Database, NADP,
USGS NED Data, and U.S. EPA Region 6.

EPA Region 6
GIS Support Team
Dallas, TX
September 3, 2010

Important Thanks to Monitoring Site Hosts and Operators!

- **Cherokee Nation** – Collocated Tekran/Passive site at Stilwell, OK; Ryan Callison, Jacque Adam, April Hathcoat, Larry Scrapper, Philip Ketcher, Dani Keese

- **New Mexico Environment Department** – Substation, Farmington Airport and Navajo Lake sites; Joe Cotie, Terry Hertel

- **National Park Service** – Mesa Verde National Park site; George San Miguel, Paul Bohmann

- **USFS/BLM** – Molas Pass site; Kelly Palmer, Brian Parker

- **Jemez Pueblo and Valles Caldera Trust** – Valles Caldera National Preserve site; Tammy Belone, Bob Parmenter

Pictures of Substation Site passive reactive gaseous mercury stand (left), and San Juan (top right) and Four Corners (bottom right) Power Plants

Pictures of Valles Caldera (Left) and Navajo Lake (Right) Sites

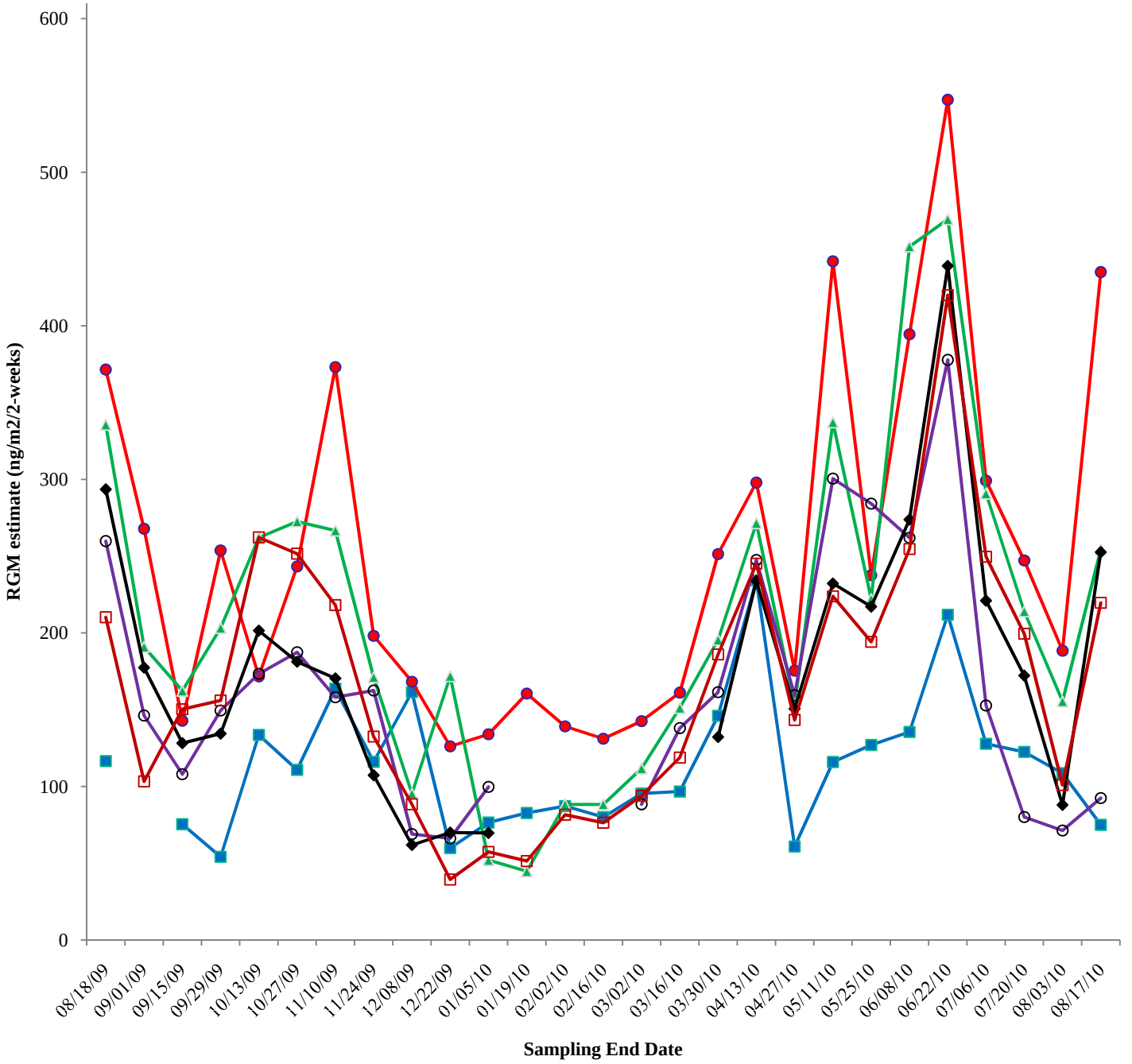
Pictures of Molas Pass site (upper left), Mesa Verde NP site (upper right), and Farmington Airport site (bottom two pictures)

Passive Sampling

- FADD surrogate surface (Ion Exchange Membrane) samples deployed for two-week integrated periods, every other Tuesday in conjunction with national weekly wet MDN efforts.

- Duplicate field samples deployed every other sampling period and duplicate field blanks taken every four sampling periods.

Four Corners Area Estimated RGM Dry Deposition Data Time Series

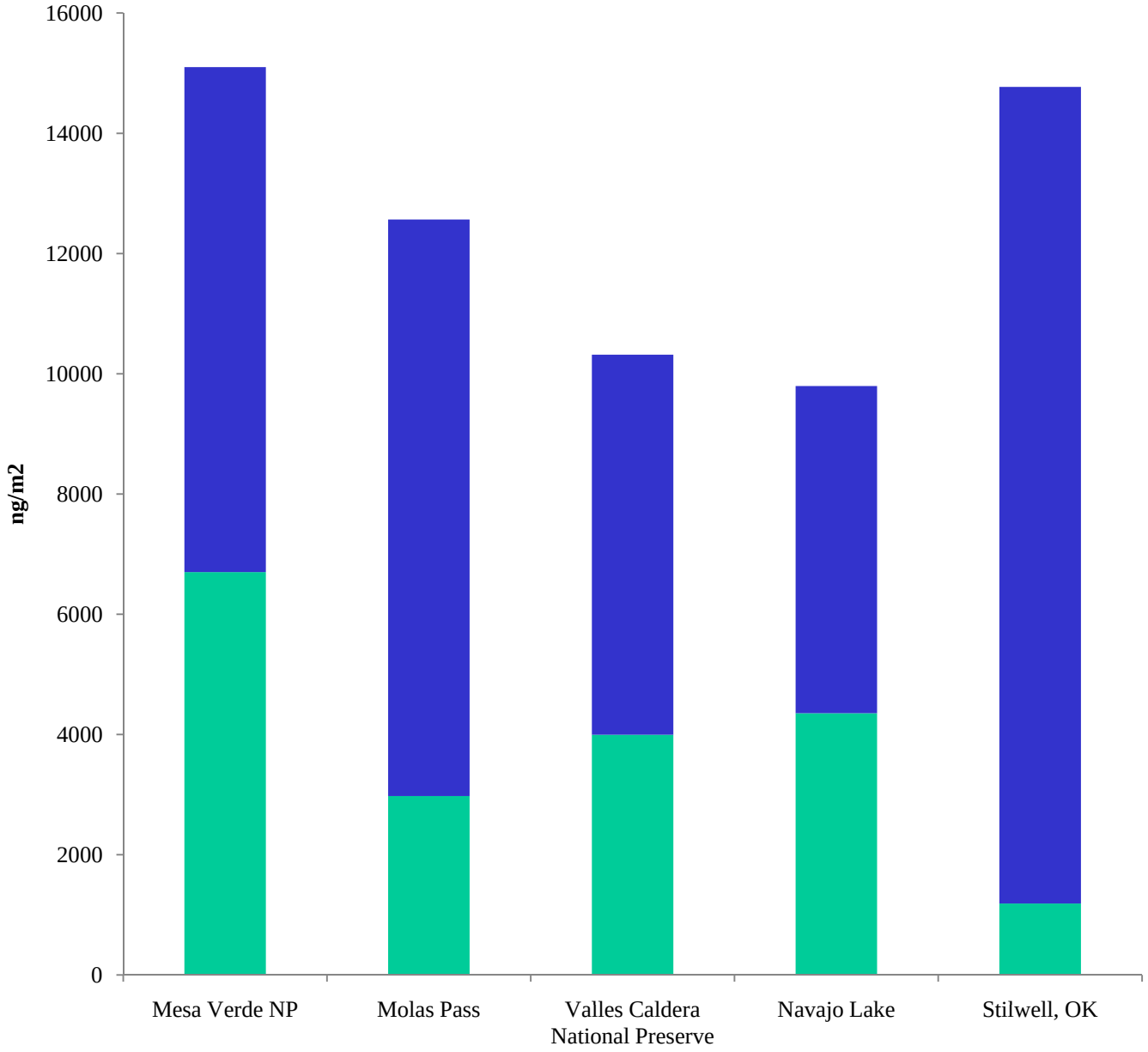


Mesa Verde NP generally the highest RGM deposition site (about 30 miles north of power plants).
Substation generally the second highest RGM deposition site (closest to power plants).
Molas Pass generally the lowest RGM deposition site.

Peak RGM deposition estimates for all sites in spring, summer, and fall;
Lowest RGM deposition estimates in winter.

Regional RGM deposition peaks and valleys will undergo detailed analyses.

Estimated Dry RGM + Wet Deposition Hg (8/09-8/10 total ng/m2)



-Stilwell, OK dominated by wet deposition (wet = 92%, dry=8%)

-Four Corners dry RGM a significant part of total deposition, ranging from:

-24% at Molas Pass

-39% at Valles Caldera National Preserve to 44% at Navajo Lake and Mesa Verde National Park.

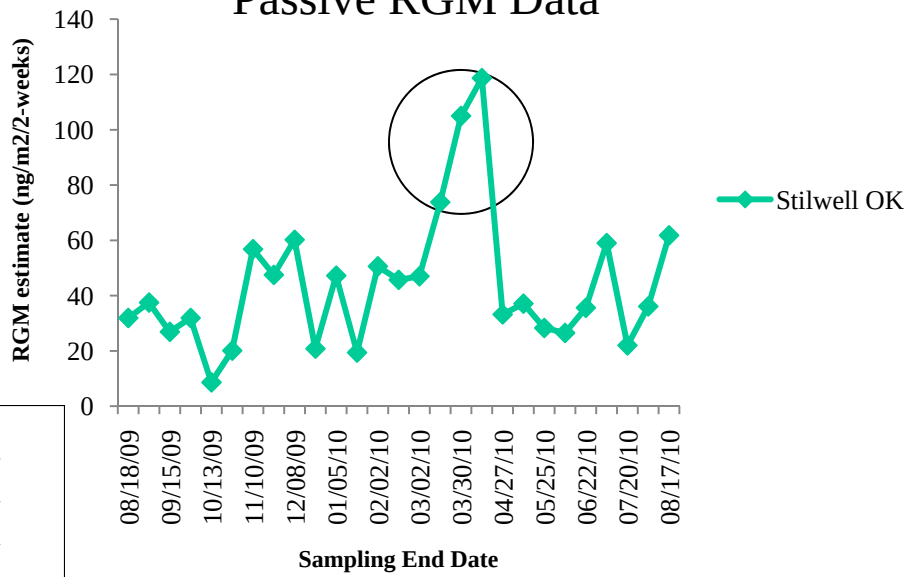
Tekran data very limited in western U.S. The only active Tekran site in EPA Region 6 is at the Stilwell site in Oklahoma.

Collocated Tekran/Passive RGM Monitoring Site at Stilwell, OK.

Stilwell, OK RGM Tekran and Estimated Passive RGM Data (8/2009 – 8/2010)

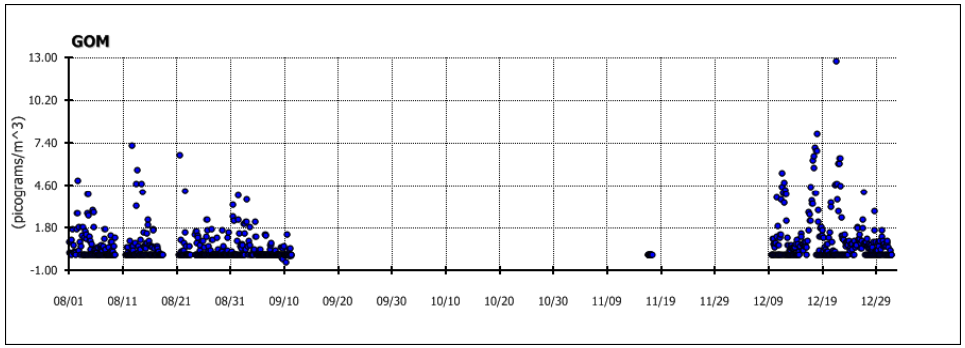
The higher Tekran values recorded from around 3/2/2010 to around 4/13/2010 correspond to the highest estimated passive RGM (a.k.a. GOM) data values seen so far at Stilwell.

Passive RGM Data

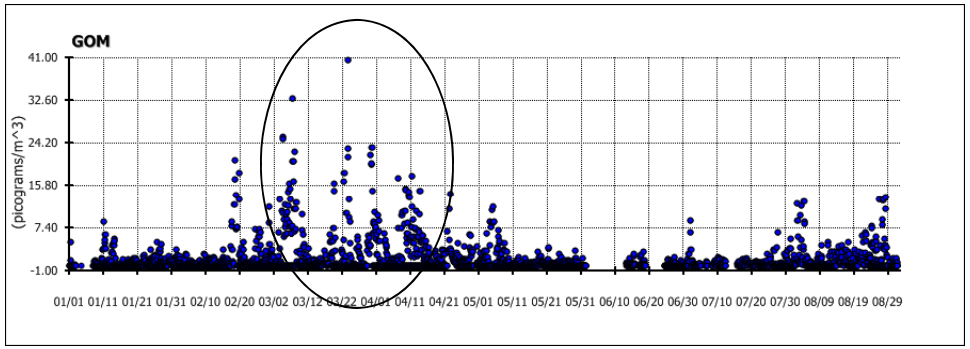


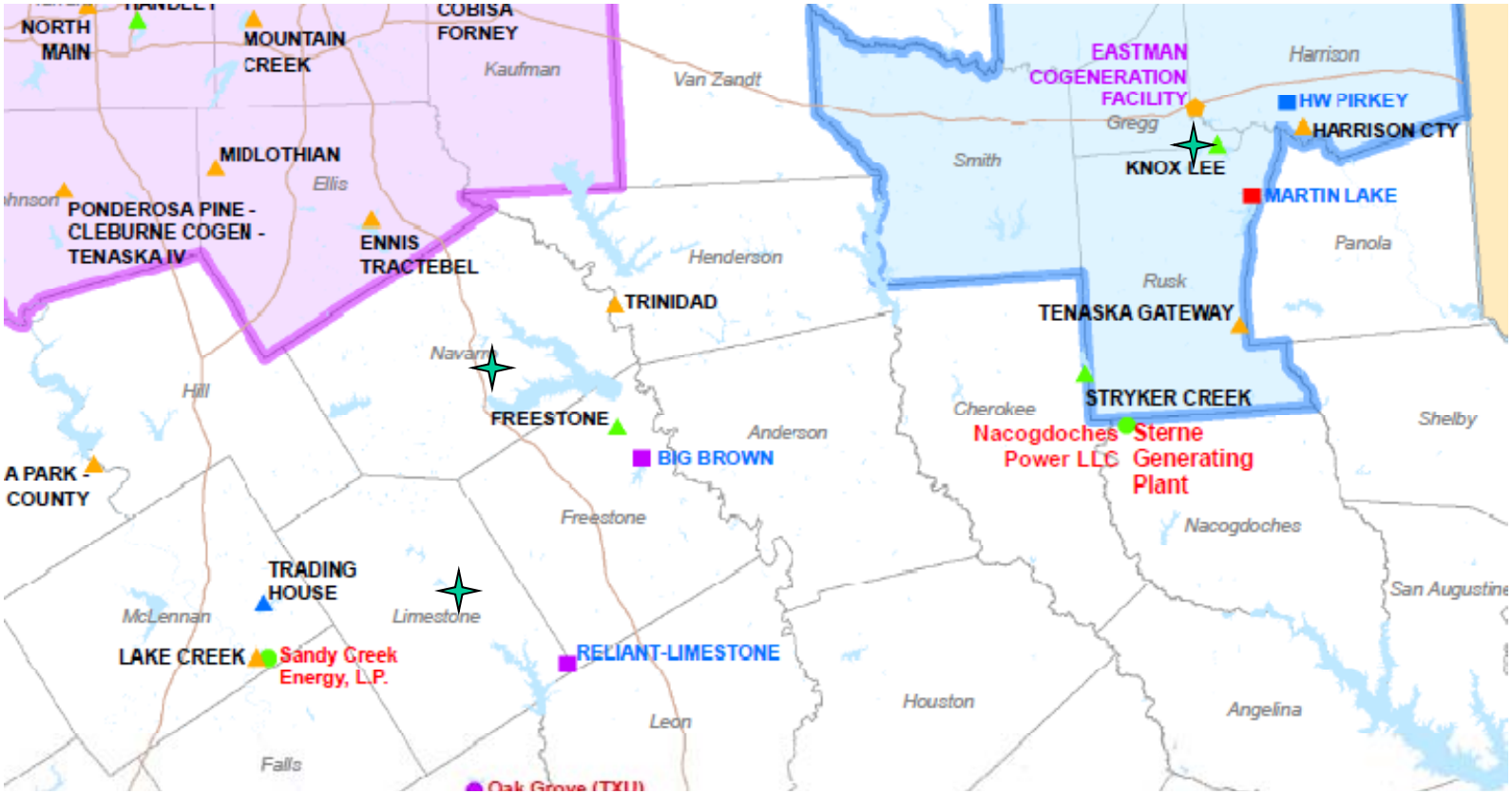
Tekran RGM Data

2009



2010





✦ Proposed passive RGM sites in central and east Texas

Upcoming Work

- Continue second year of sampling (through the first part of August, 2011) at all seven sites.

- Conduct analysis of collocated real-time RGM/passive estimated RGM data from Stilwell site.

- Conduct detailed analyses of the two year dataset, including merging site specific meteorological data (wind speed, wind direction, temperature) with the mercury data.

- After second year of data collection, will work with Alion on some spatial analyses of the complete two year dataset, and begin construction of journal article documenting results from the two year study.

- Begin Texas study in September, 2011 and sample for one year through September, 2012.