Use of passive samplers and surrogate surfaces for measurement of atmospheric Hg at three sites in Florida

Mae Gustin, Christianna Peterson

University of Nevada

Peter Weiss-Penzias UC Santa Cruz

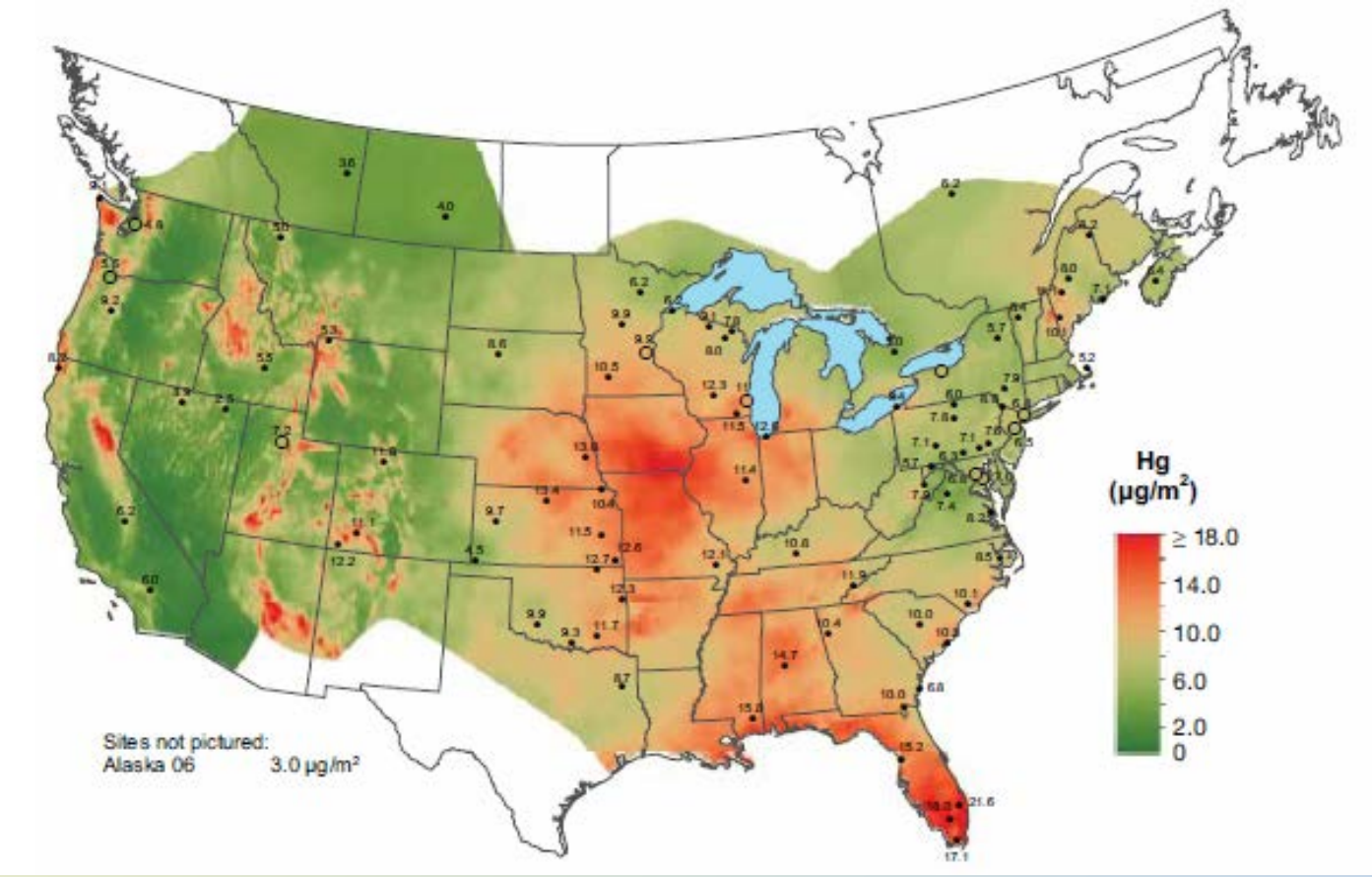
Acknowledgements

- EPRI- Arnout ter Shure and Leonard Levin
- State of Florida
- SEARCH Network
- Musheng Alishahi, Casandra Woodward, and Melissa Markee

Talk organization

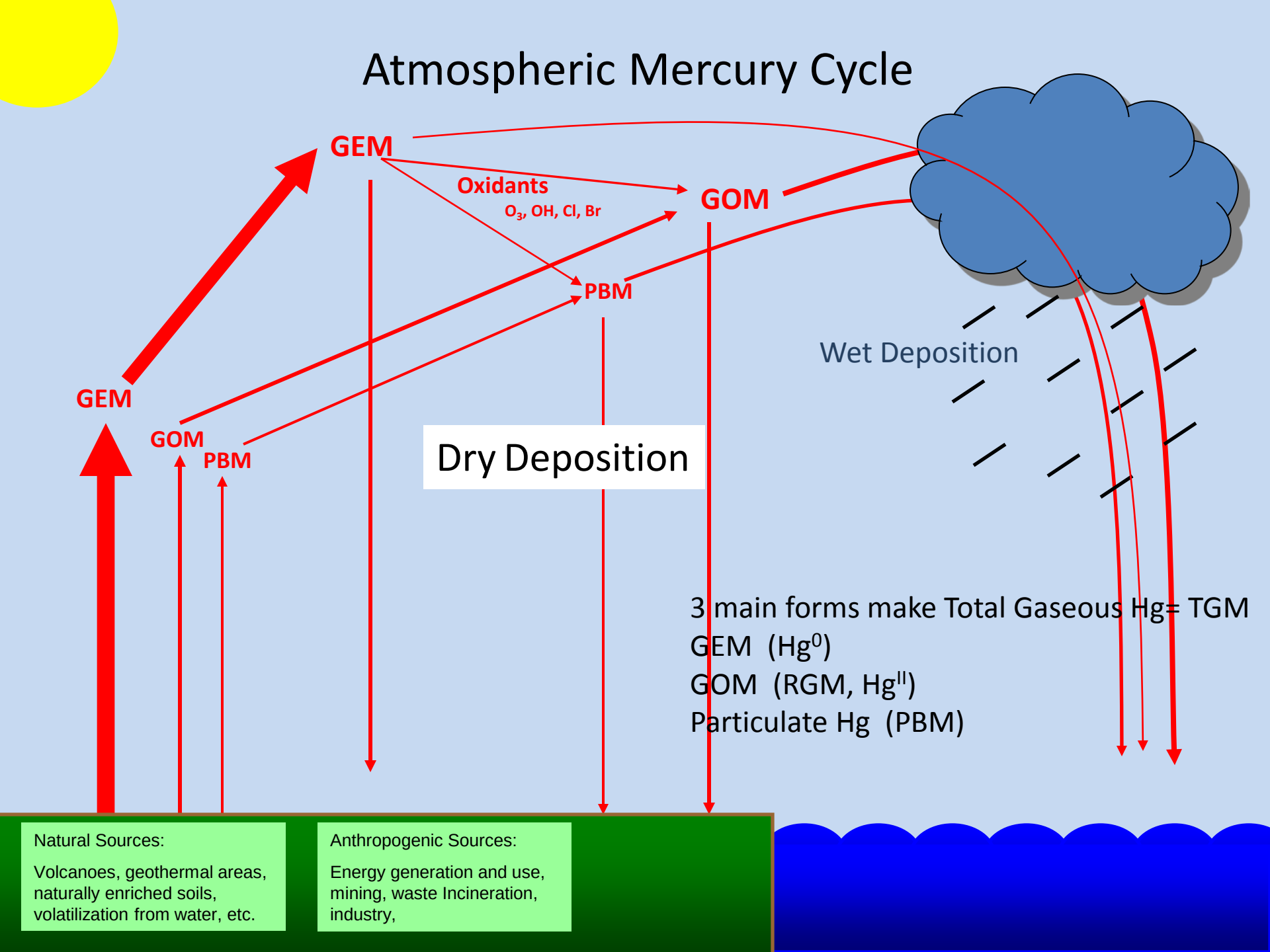
- Background information
- Overall objectives of this work
- Data collected and methods
- Results
- Conclusions

Why worry about Florida and Hg?



National Atmospheric Deposition Program/Mercury Deposition Network
http://nadp.sws.uiuc.edu/lib/data/2010as.pdf

Atmospheric Mercury Cycle



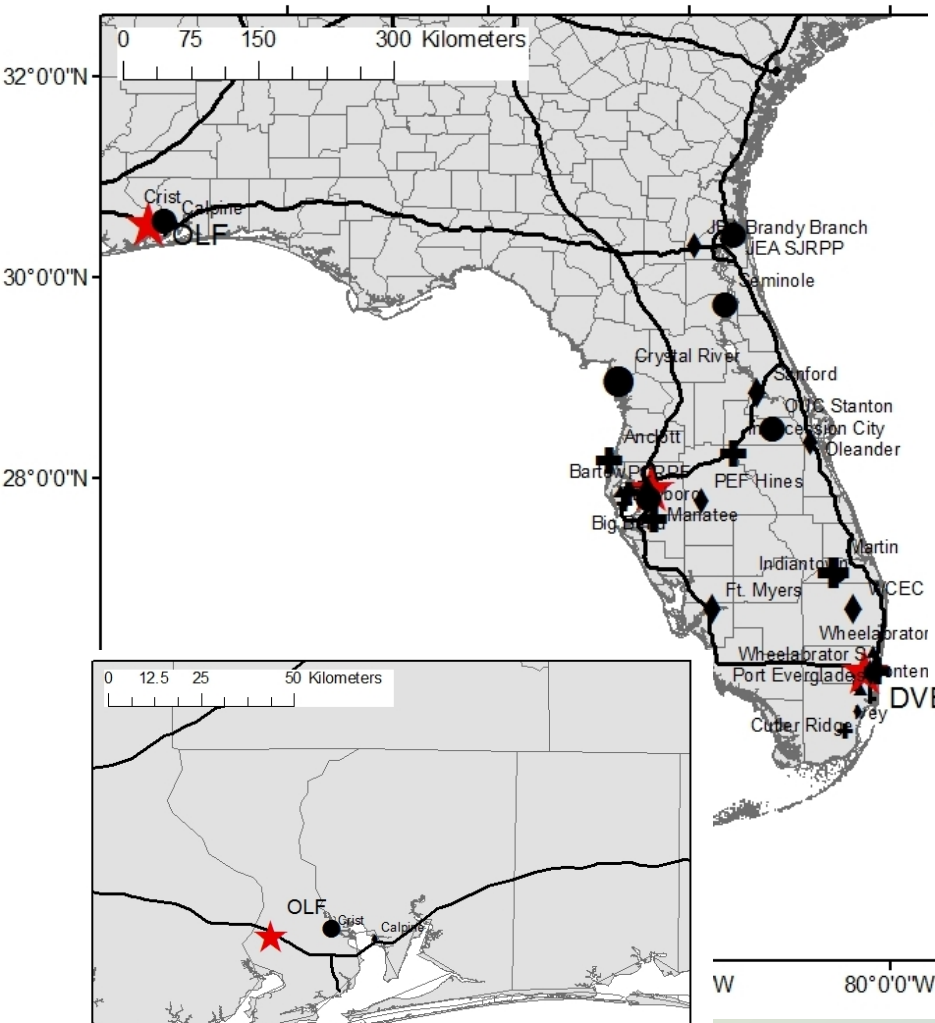
Objectives

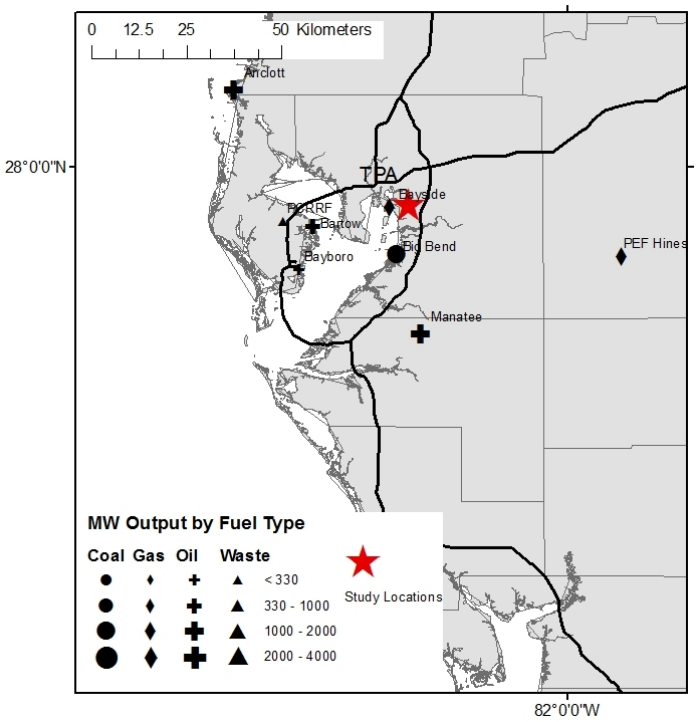
- Objective 1 -Investigate the utility of passive sampling systems to record spatial and temporal patterns of atmospheric Hg concentrations and dry deposition *(Peterson et al. 2012 Science of the Total Environment)*

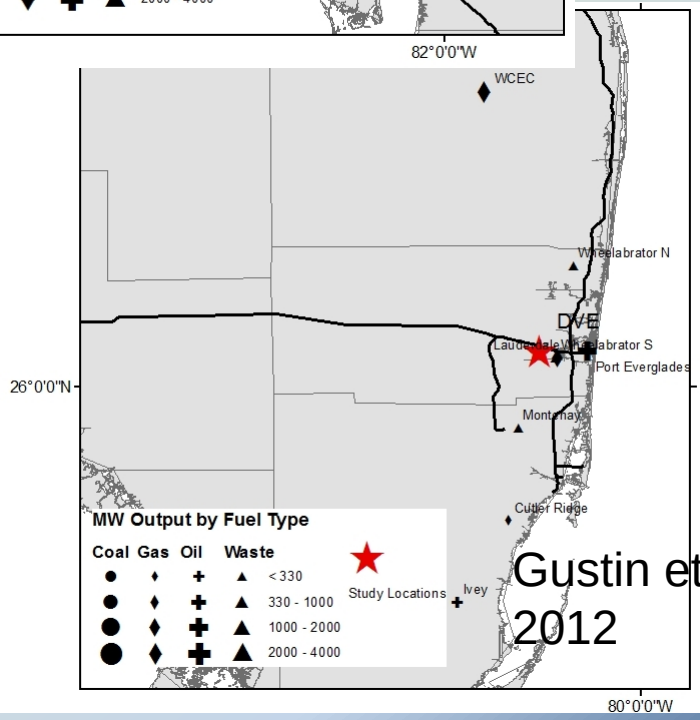
- Objective 2-Estimate dry deposition *(Peterson et al. Science of the Total Environment; Gustin et al. 2012 Atmospheric Chemistry and Physics)*

- Objective 3-Determine the sources of GOM to Florida

  Working hypothesis: *Source tracking easier during dry periods* *(Gustin et al. 2012 Atmospheric Chemistry and Physics)*







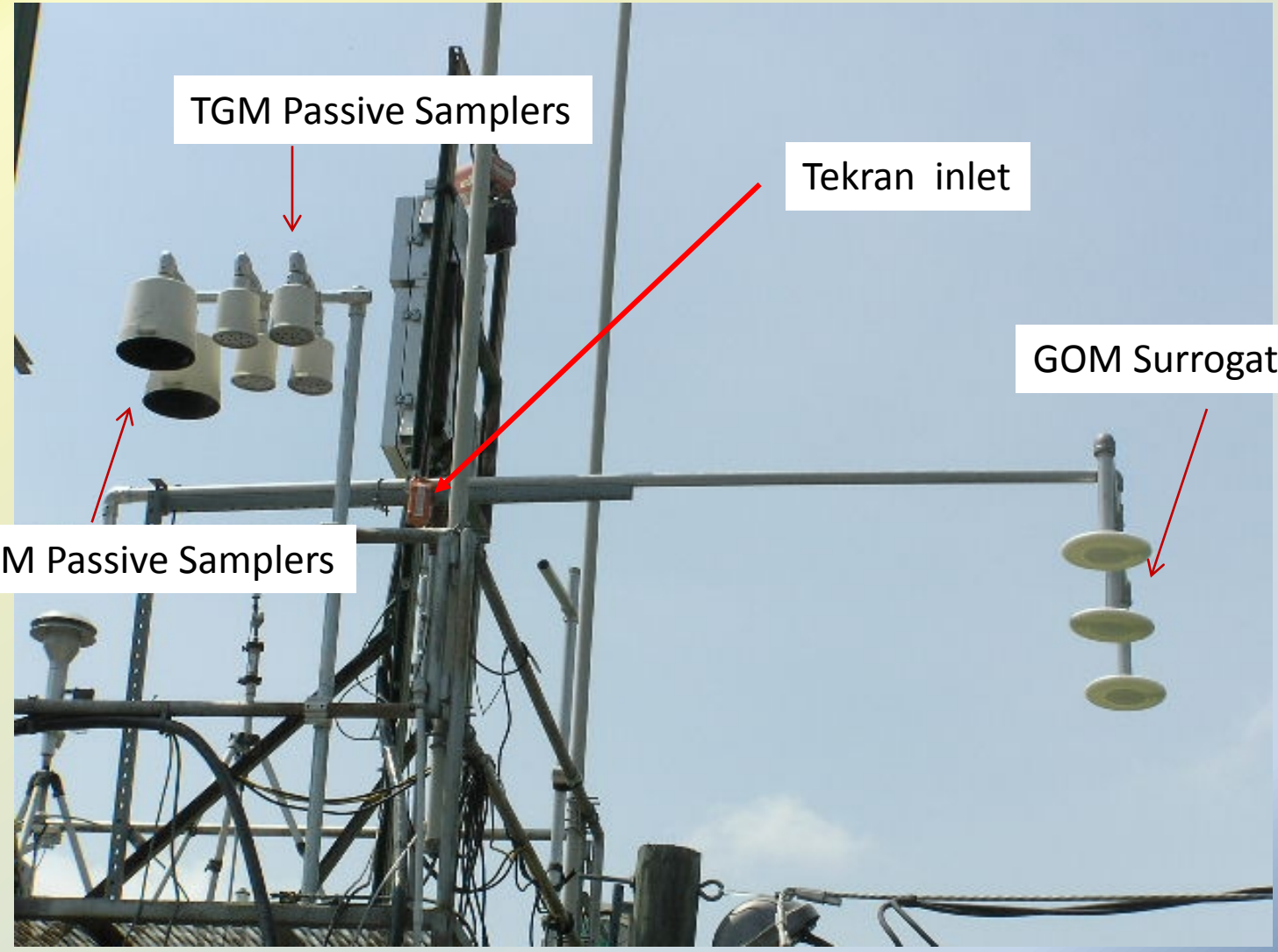
Gustin et al. 2012

Two types of passive systems

- Surrogate surfaces –potential deposition (ng/m^2 h)
  - System configured to measured GOM
    - Fine aerosols cannot be ruled out
  - Depends on turbulence
  - Form of GOM will influence uptake
    - Different deposition velocities

- Passive samplers- measure of concentration (pg/hr)
  - GOM and TGM
  - Sampling rate based on Fick's Law
    - Diffusion driven
  - Empirical sampling rate developed to compare with theoretical to see how well they are working

Hg Samplers at OLF, near Pensacola



Why passive systems?

- Broadly and easily deployed
- Capture trends in concentrations and deposition simultaneously
- Do not require electricity
- Can be deployed with minimal technical training
- Configured so that little inadvertent contamination occurs with deployment and shipment

Overview of Tekran measured concentrations

Mean annual GEM:
OLF: 1.2 ng m^{-3}
TPA: 1.3 ng m^{-3}
DVE: 1.4 ng m^{-3}

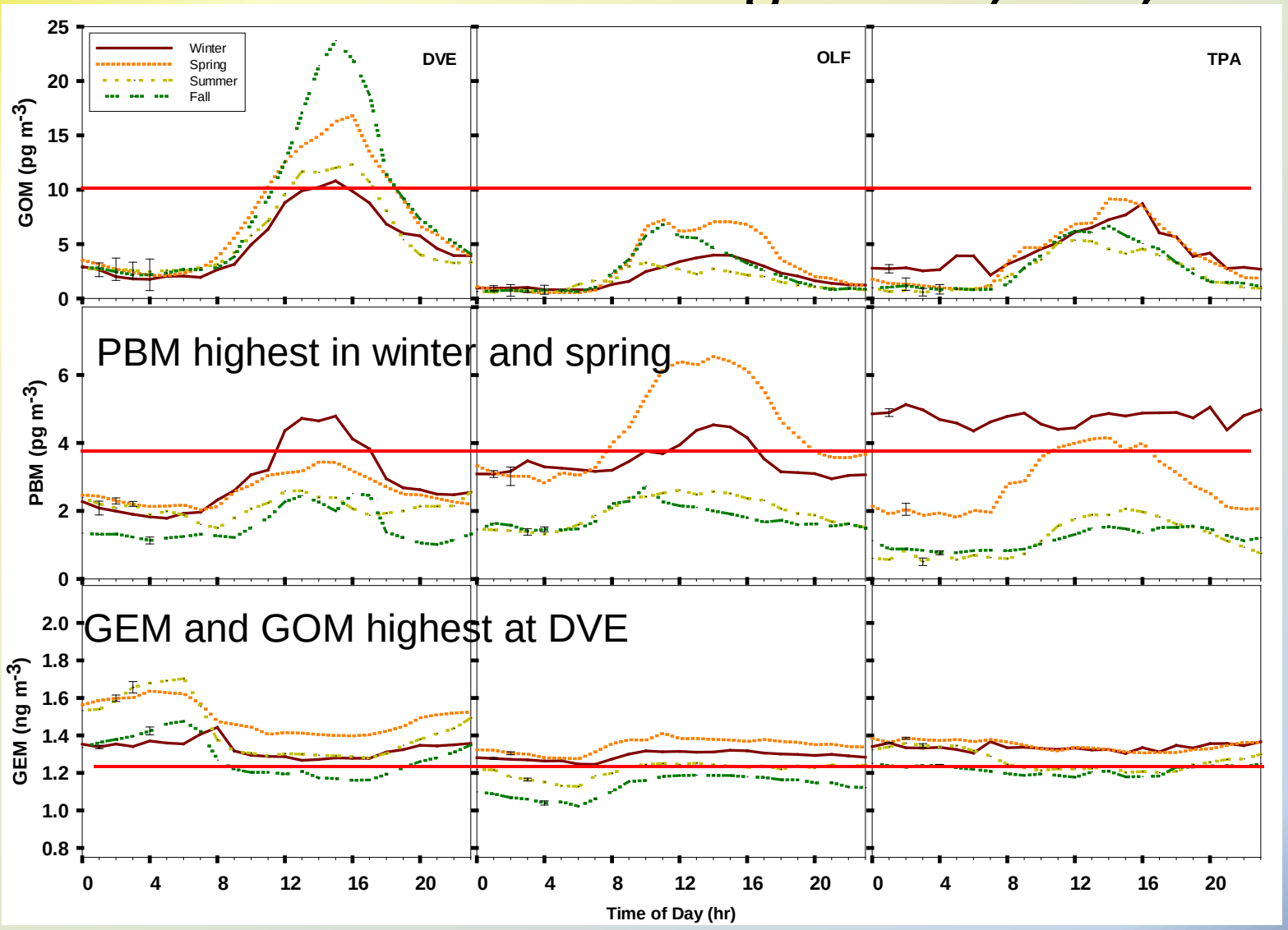
Mean annual GOM:
OLF: 2 pg m^{-3}
TPA: 3 pg m^{-3}
DVE: 6 pg m^{-3}

Mean annual PHg:
OLF: 3 pg m^{-3}
TPA: 2 pg m^{-3}
DVE: 2 pg m^{-3}

Objective 3: Assessing sources

- Tools used
  - Tekran data
  - Criteria air pollutant data
  - Analyses of meso- and synoptic- scale air movement
  - Chemistry and back trajectories for events
  - Passive sampler and surrogate surface data

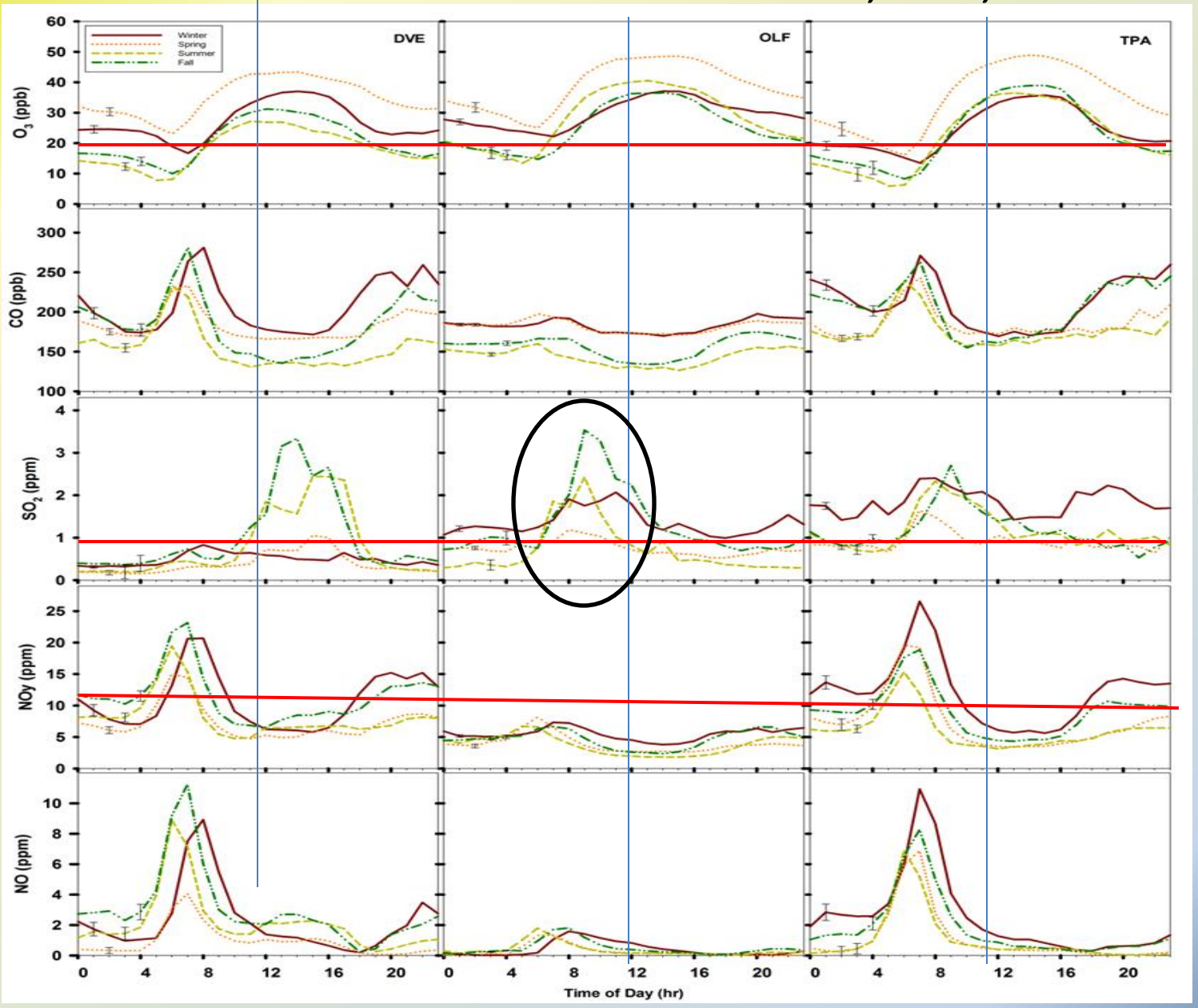
Seasonal Diel Tekran Hg – DVE, OLF, TPA



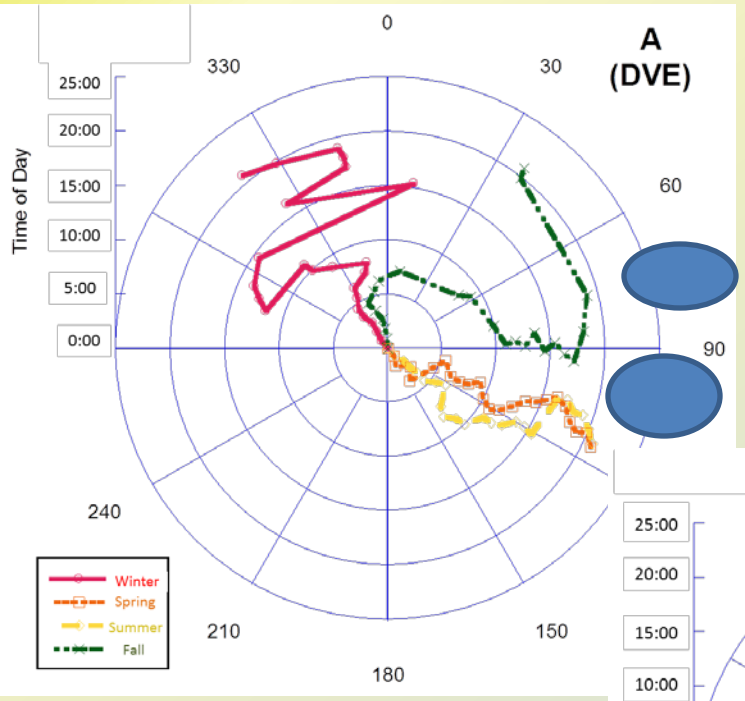
Gustin et al. submitted

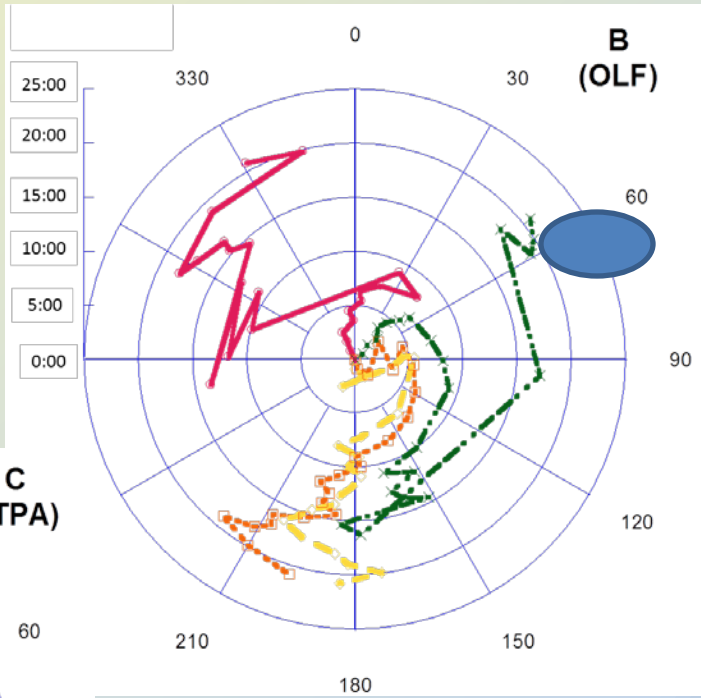
Objective 3.

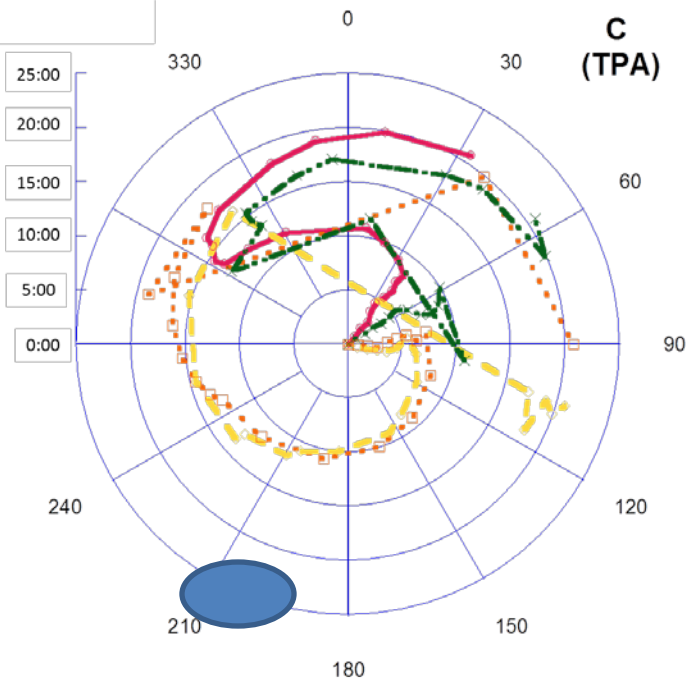
Criteria Air Pollutants– DVE, OLF, TPA



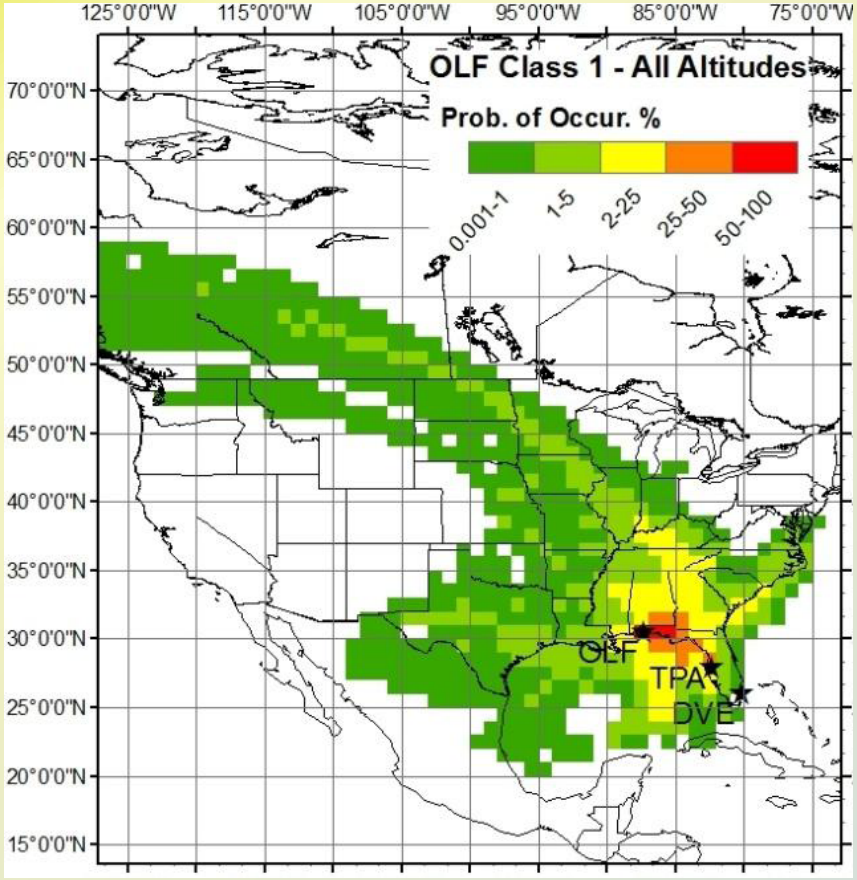
Seasonal wind direction information



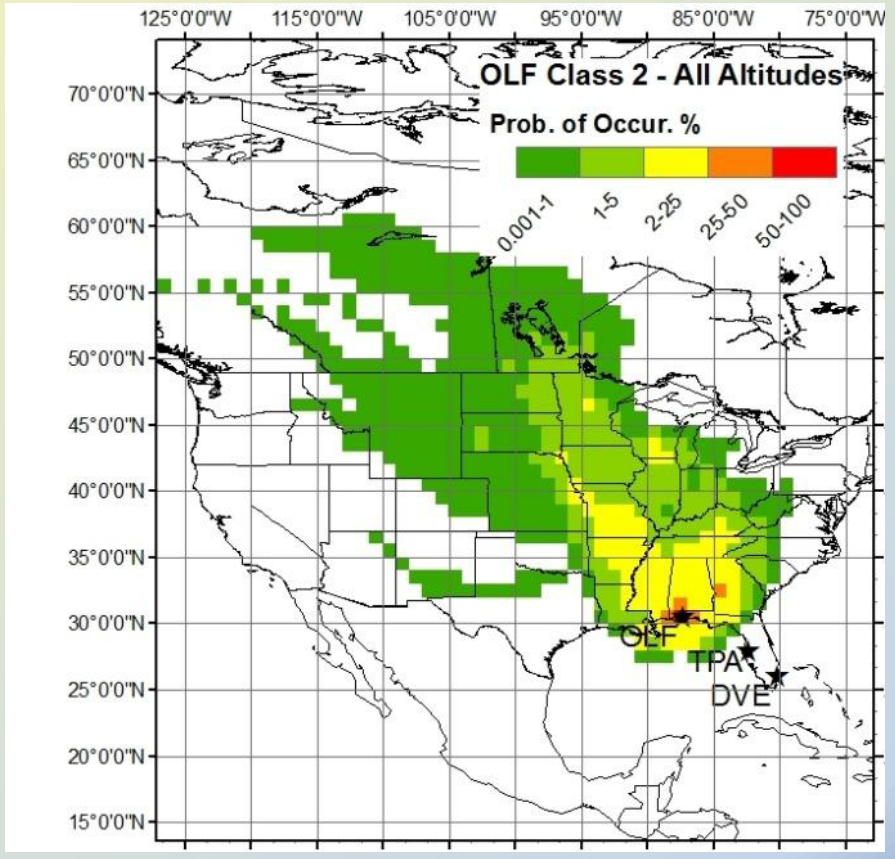




72 hour trajectory analyses

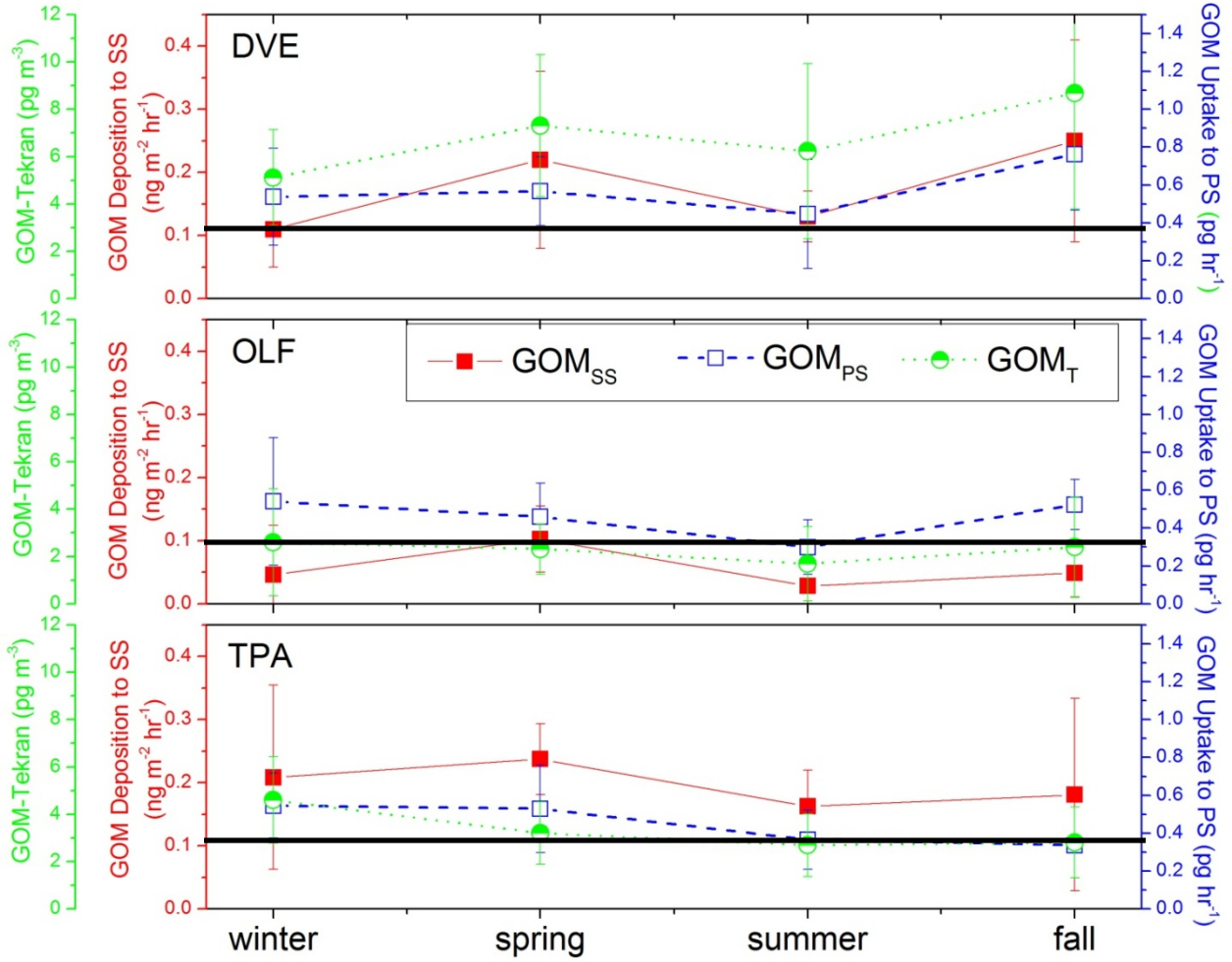


Class 1 > 97 percentile GOM
peak SO2> mean of peak
Wind direction from EGP power plant



Class 2 > 97% GOM
peak SO2 < mean
Wind direction NOT from power plant

Seasonal variation

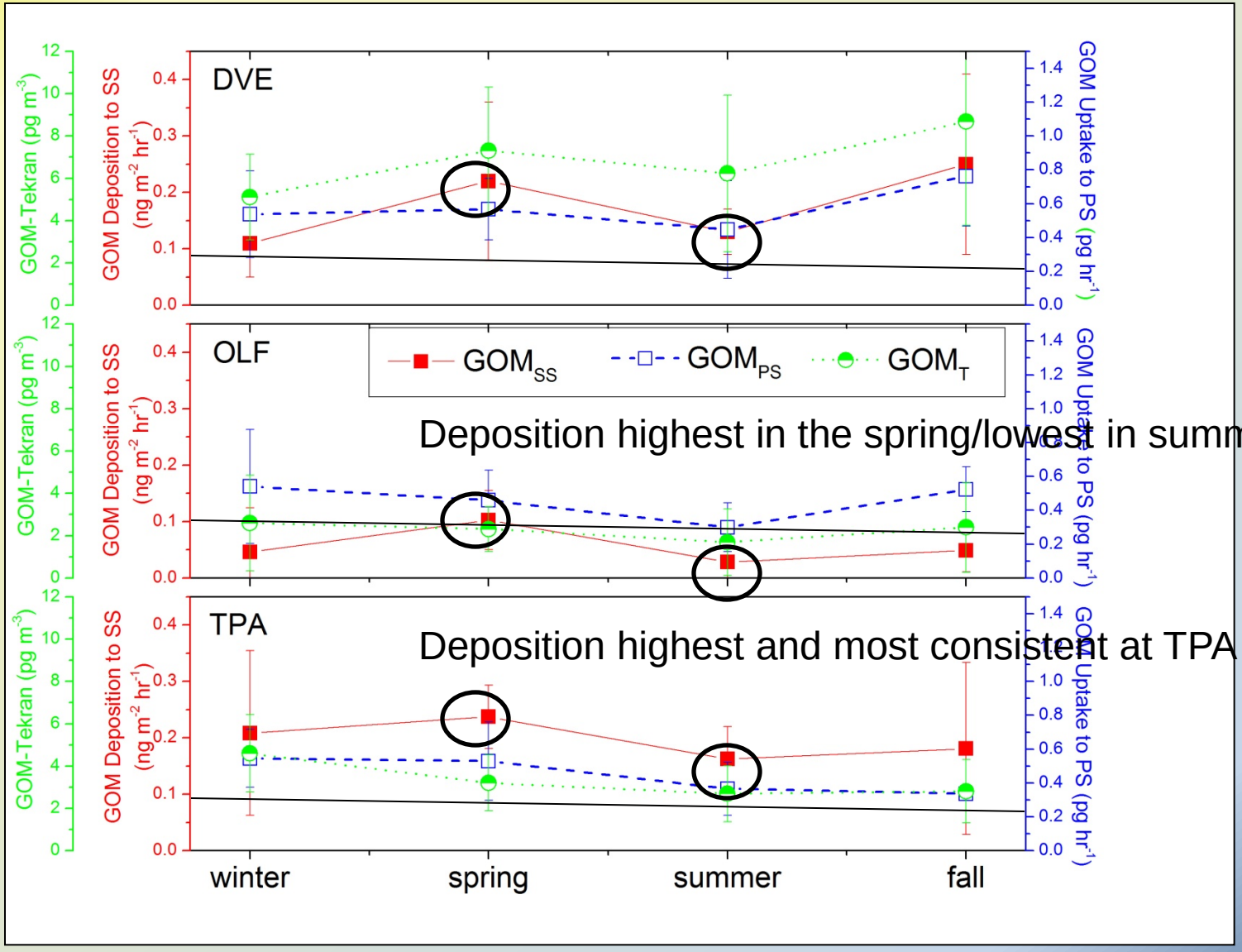


Highest concentrations Tekran and PS at DVE

Highest deposition measured at TPA

Objective 3.

Seasonal variation



Deposition highest in the spring/lowest in summer

Deposition highest and most consistent at TPA

Conclusions

- Objective 3-Determine the sources of GOM to Florida

  Working hypothesis: *Source tracking easier during dry periods*

  - Natural background dry deposition 0.03 ng m^{-2} h^{-1}
  - Higher values in winter and fall due to mobile sources
    - 0.10 ng m^{-2} h^{-1} at TPA and DVE
    - 0.03 ng m^{-2} h^{-1} at OLF
  - Long range transport spring at all sites
    - 0.8 ng m^{2} h^{-1}
  - Local electricity generating plants DVE
    - ~ 0.10 ng m^{2} h^{-1} directly or indirectly