High Mercury Wet Deposition at a pristine site in Puerto Rico

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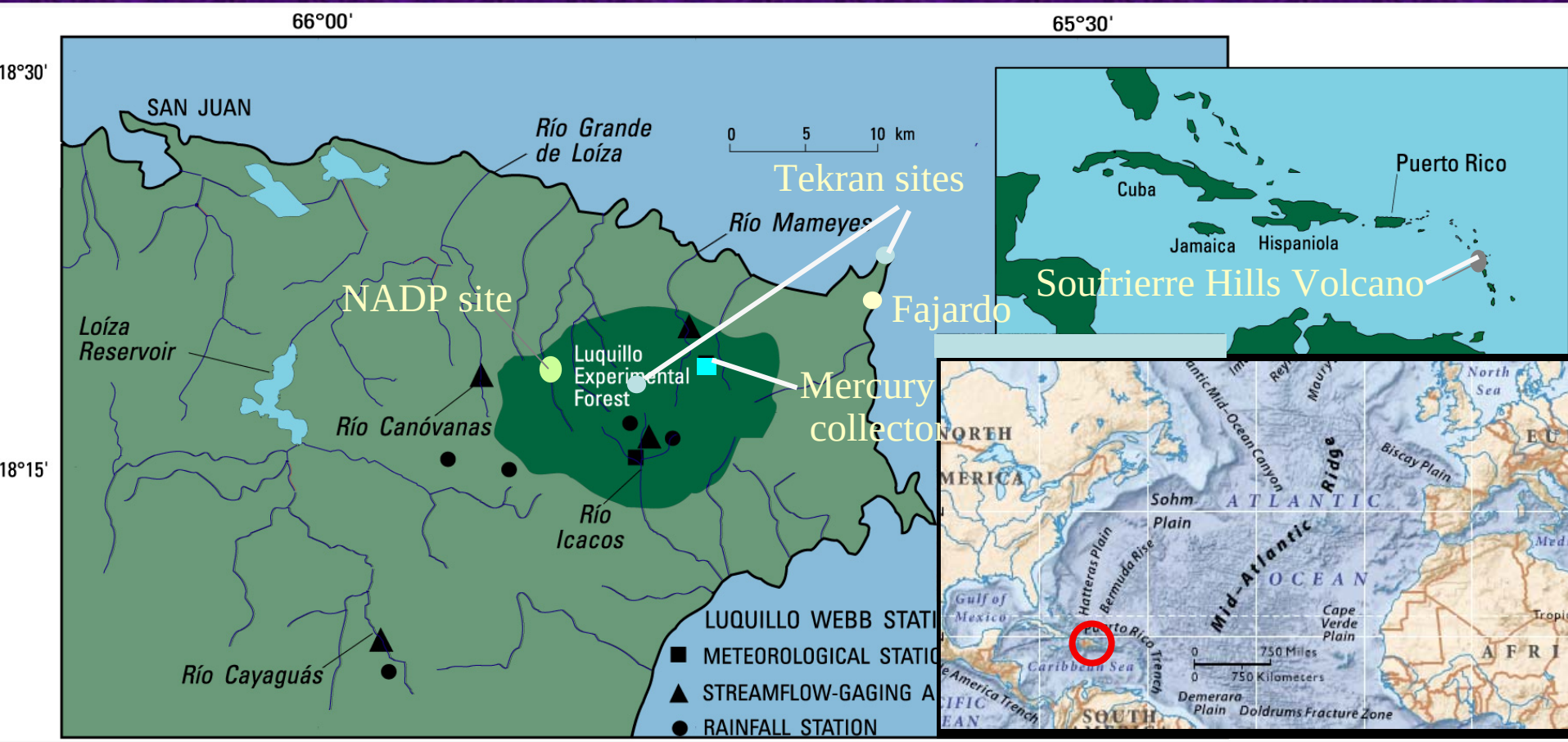
Puerto Rico Hg wet deposition site

An initiative of the USGS
Water, Energy and Biogeochemical Budgets (WEBB) program

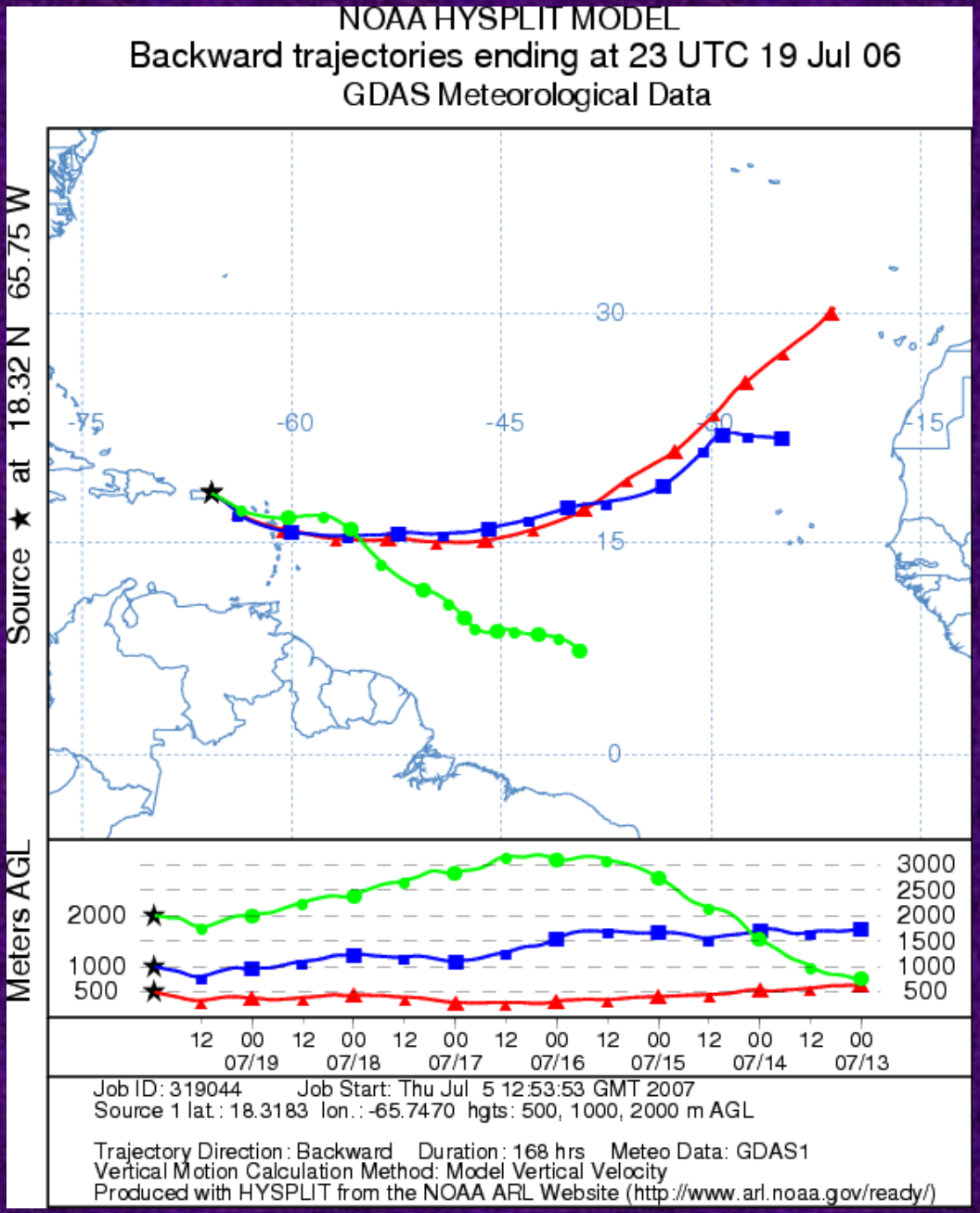


Hg wet deposition collector on top of 20-meter tower

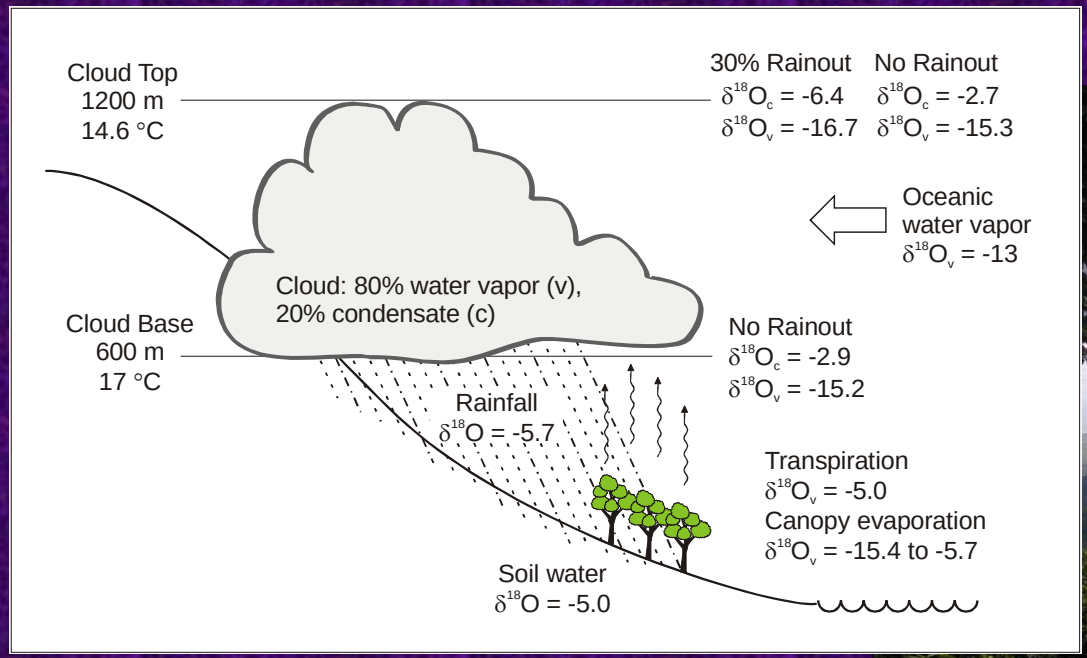
Site characteristics

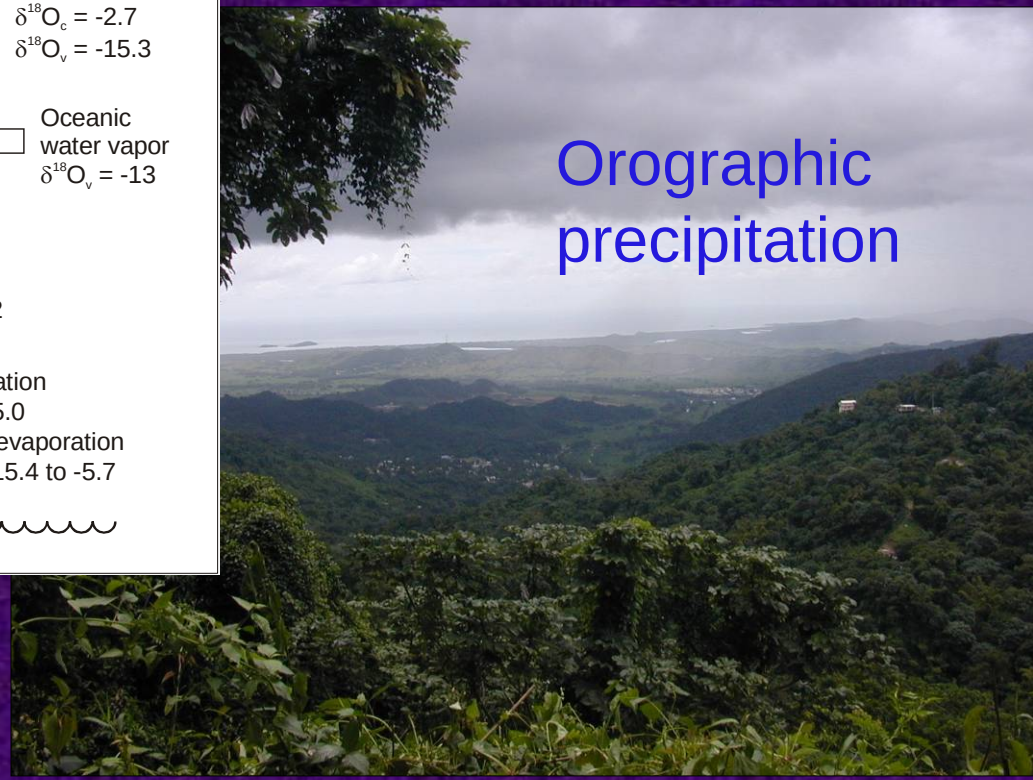
- 18 N, 66 W
- Elevation 485 m
- Annual precipitation 3000 mm
- Tropical wet forest (Tabonuco)
- Mean temperature 22 C
- Clean NE Trade Wind air masses
- Ridge top open to ocean, mountains behind

Hysplit

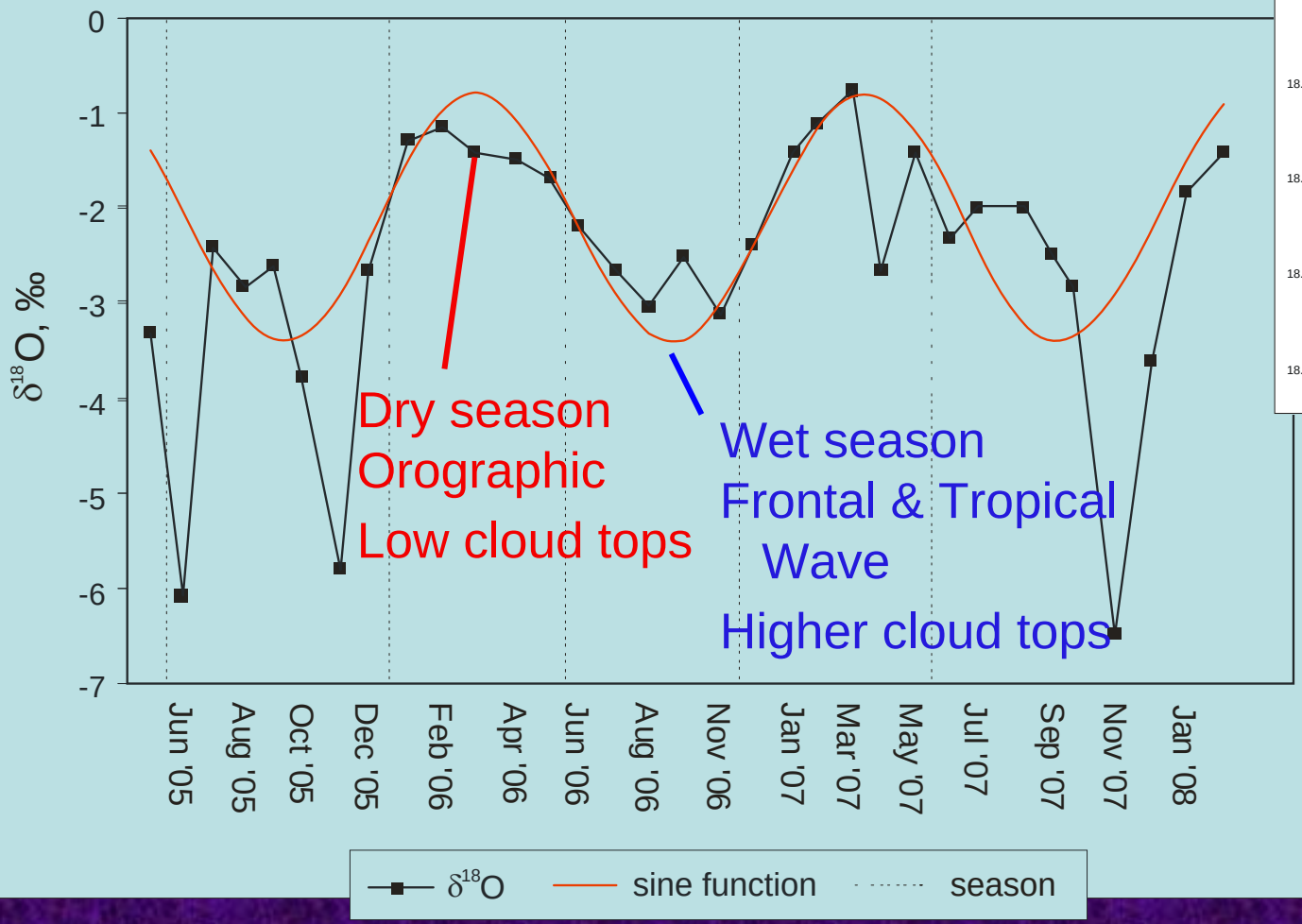

NOAA HYSPLIT MODEL
Backward trajectories ending at 23 UTC 19 Jul 06
GDAS Meteorological Data
Source ★ at 18.32 N 65.75 W
30
-75
-60
-45
-30
-15
15
0
Meters AGL
3000
2500
2000
1500
1000
500
2000
1000
500
12 00 12 00 12 00 12 00 12 00 12 00 12 00
07/19 07/18 07/17 07/16 07/15 07/14 07/13
Job ID: 319044 Job Start: Thu Jul 5 12:53:53 GMT 2007
Source 1 lat.: 18.3183 lon.: -65.7470 hgts: 500, 1000, 2000 m AGL
Trajectory Direction: Backward Duration: 168 hrs Meteo Data: GDAS1
Vertical Motion Calculation Method: Model Vertical Velocity
Produced with HYSPLIT from the NOAA ARL Website (http://www.arl.noaa.gov/ready/)

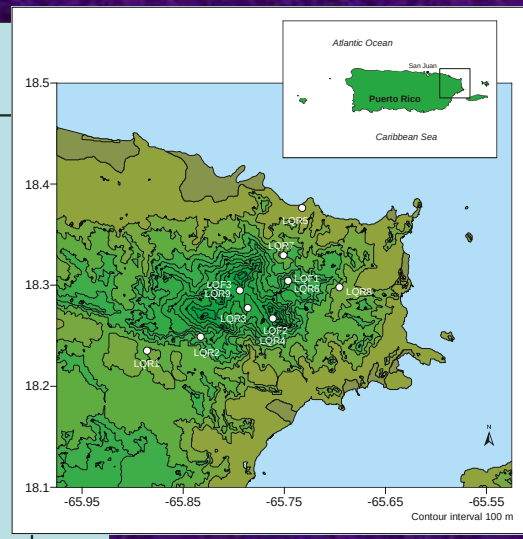
Isotopic fractionation in rainfall



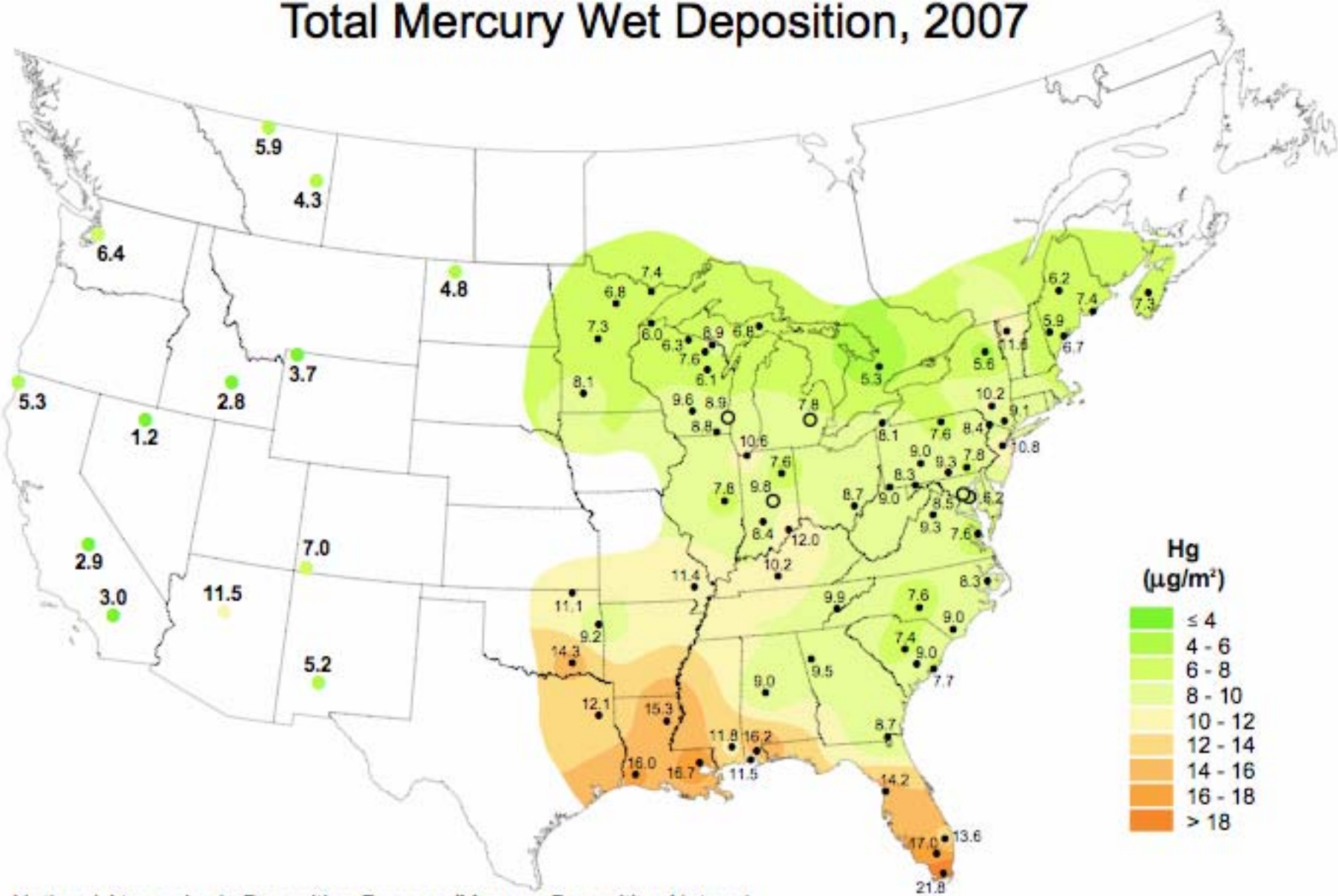


Seasonal patterns of rain isotopes



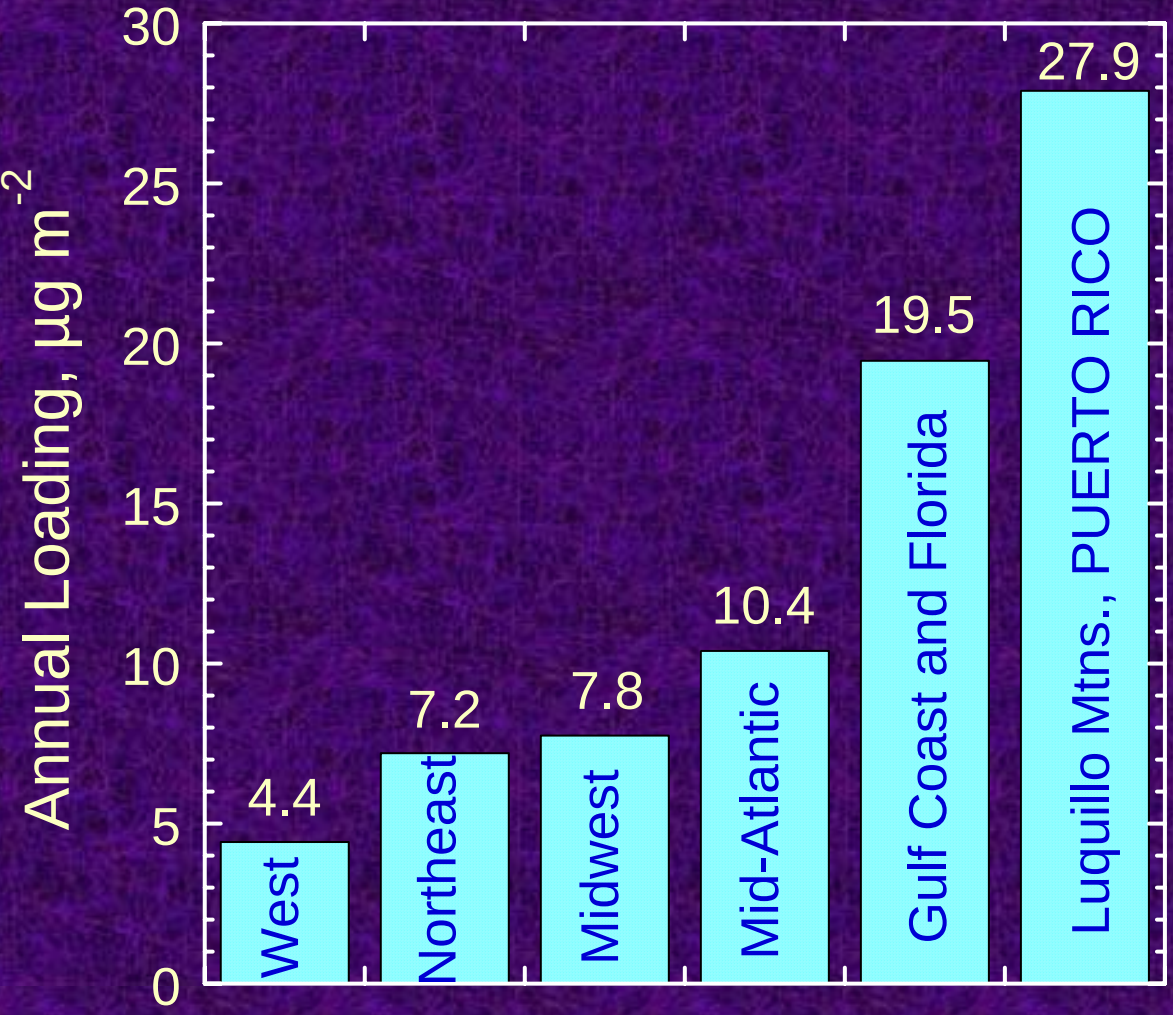


Total Mercury Wet Deposition, 2007

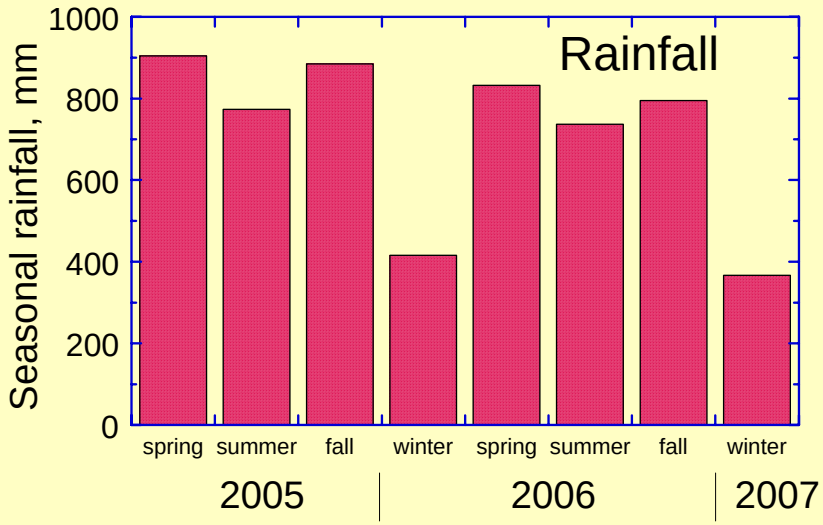


National Atmospheric Deposition Program/Mercury Deposition Network

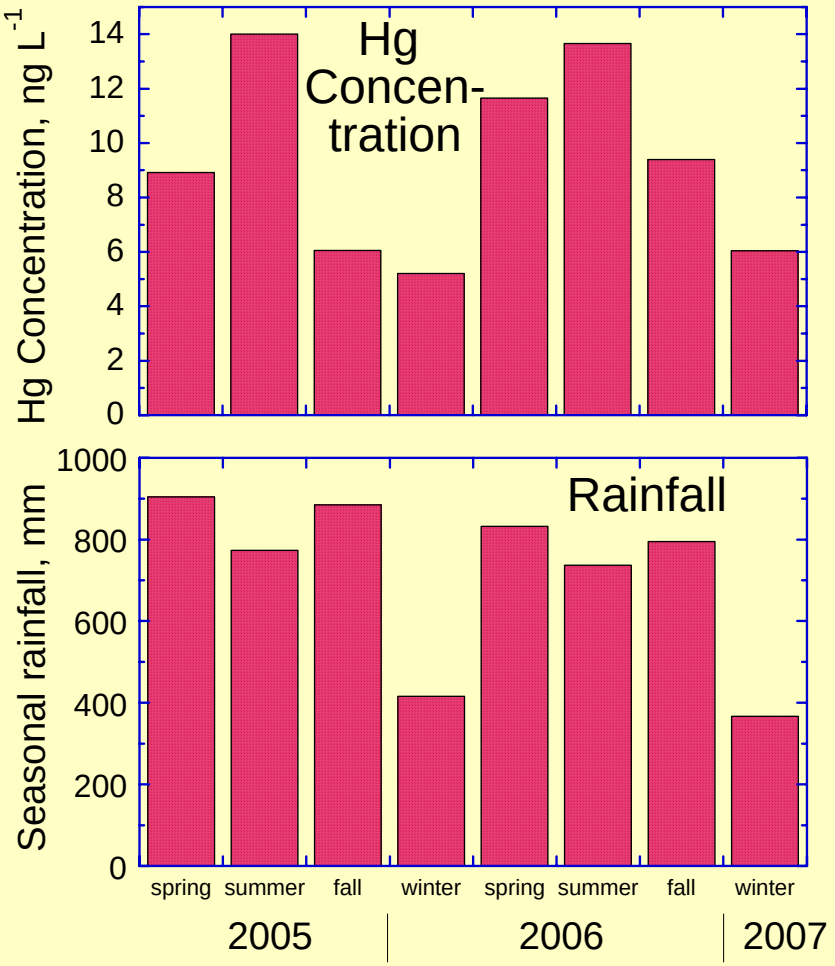
Puerto Rico -- Highest Wet Hg Deposition in the USA



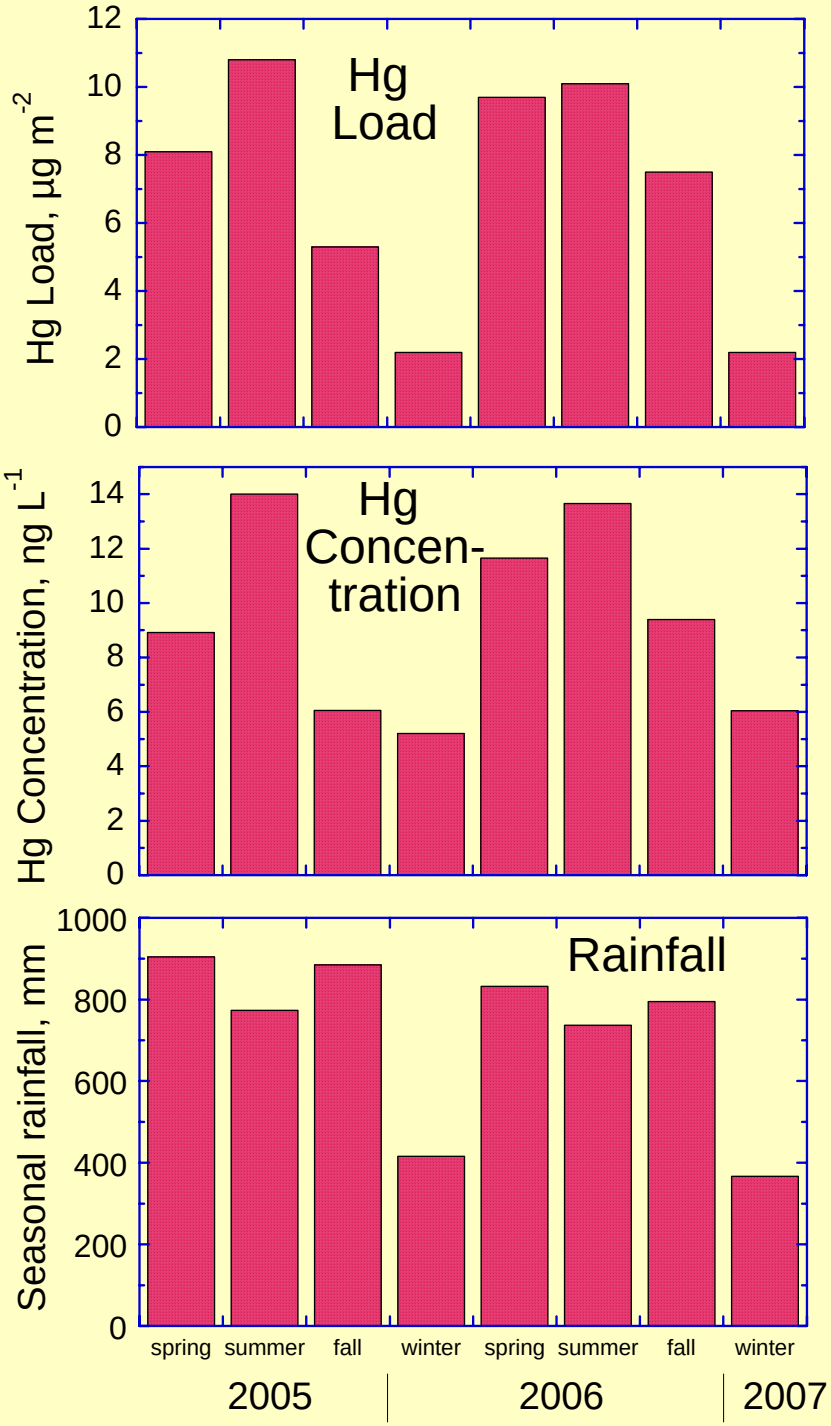
Seasonal patterns



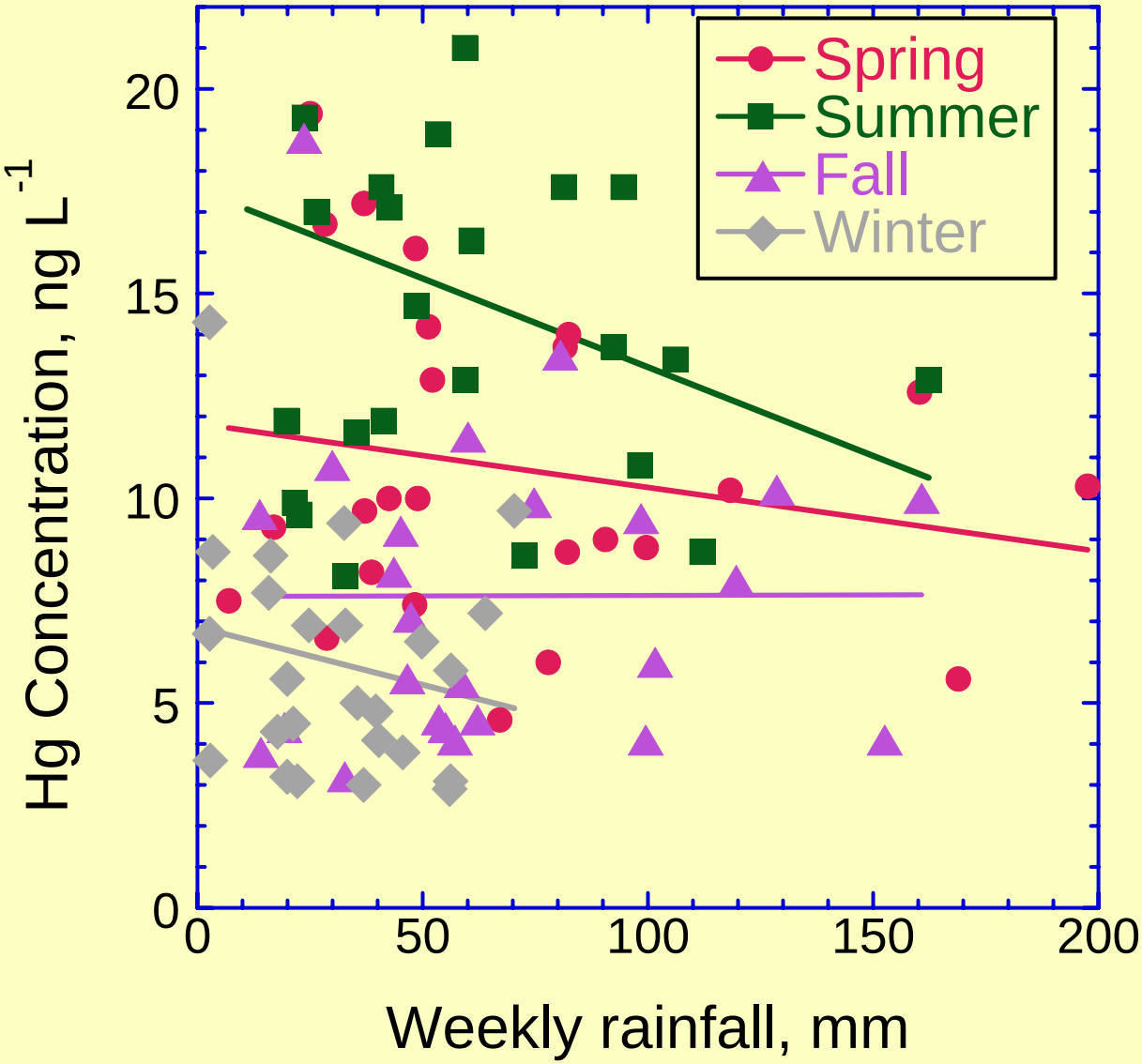
Seasonal patterns



Seasonal patterns

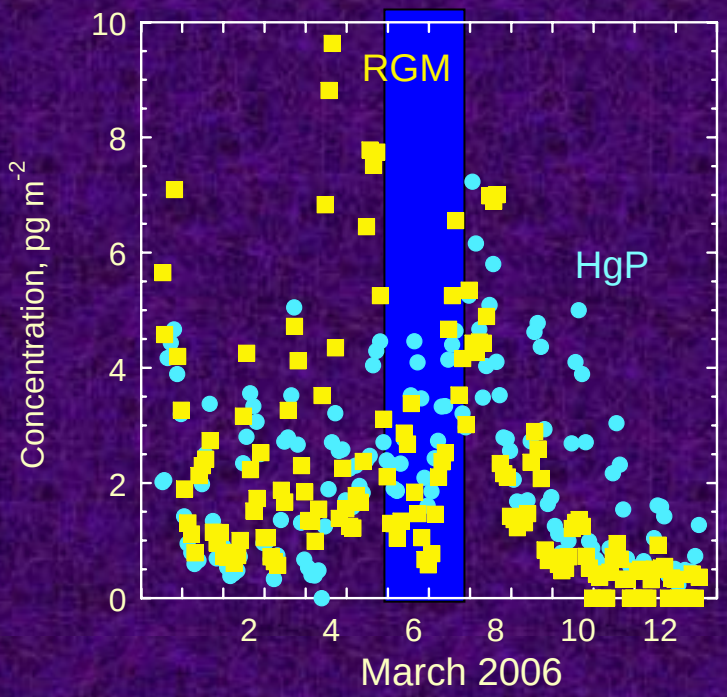


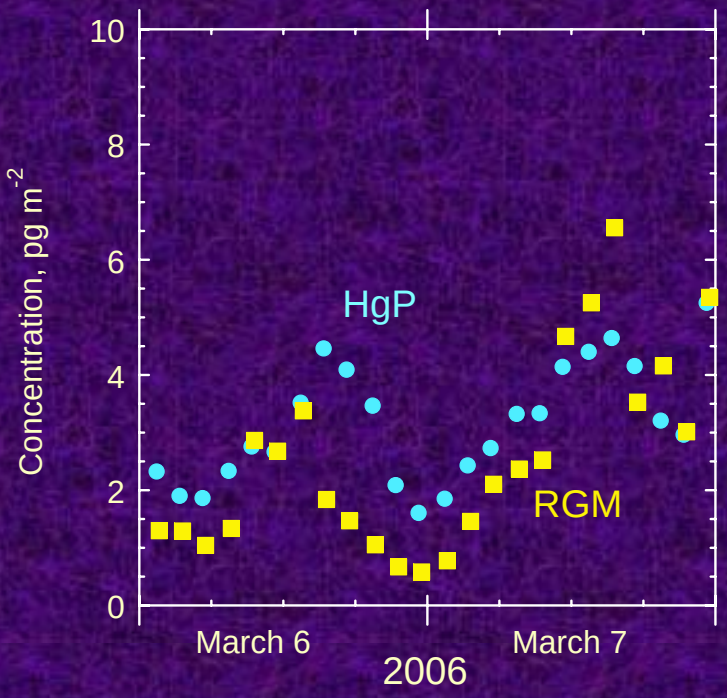
Seasonal Concentration - Volume Relations



Where is the mercury coming from??

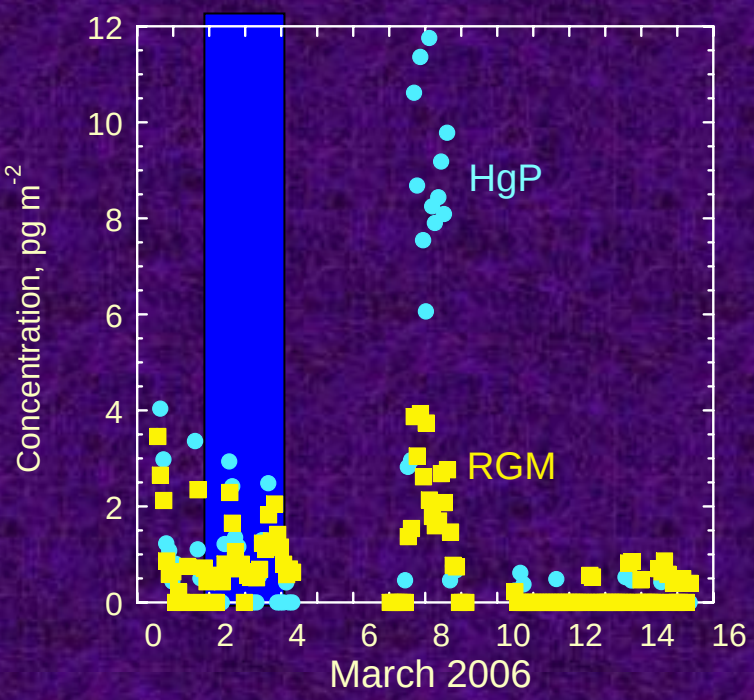
Atmospheric HgP and RGM -- Sea level site

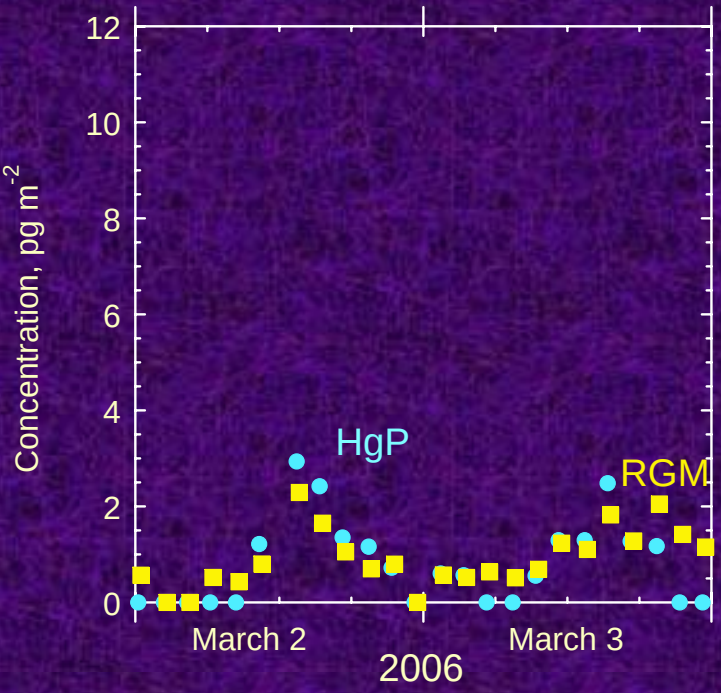




Atmospheric HgP and RGM -- Mountain site

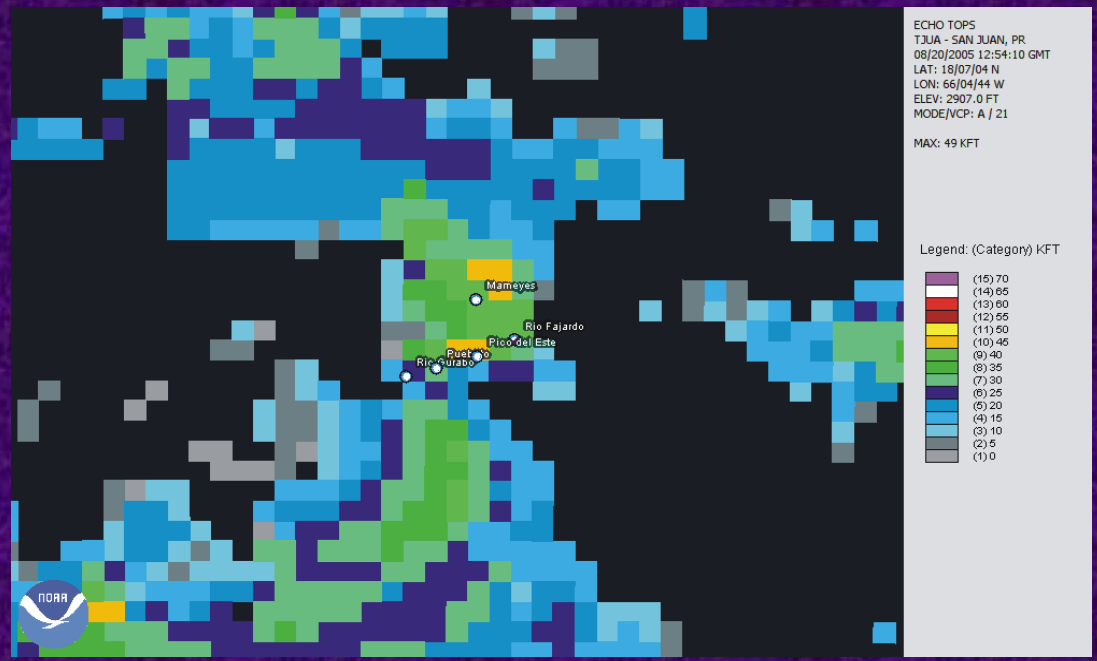
800 m



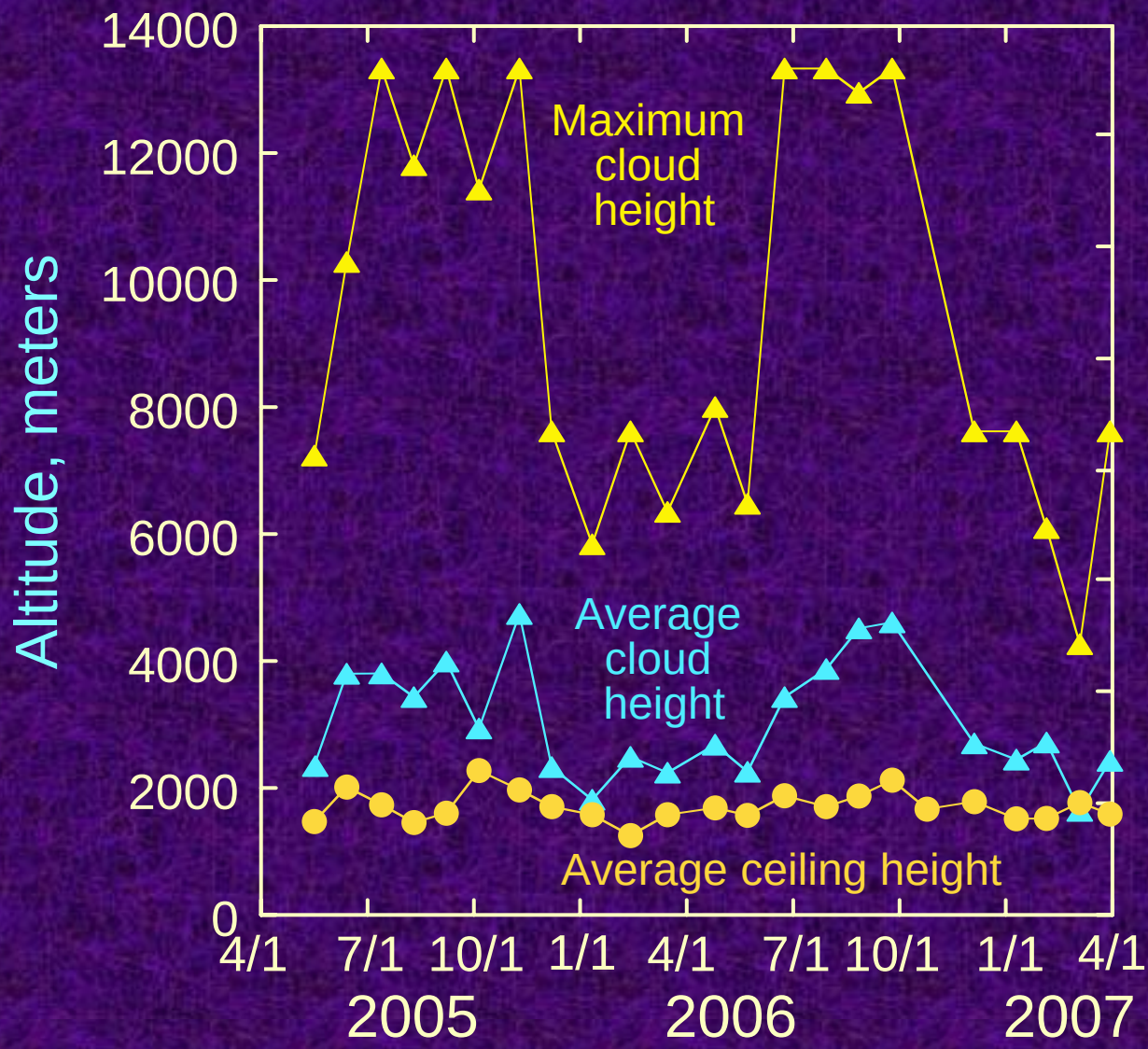


NEXRAD Echotops

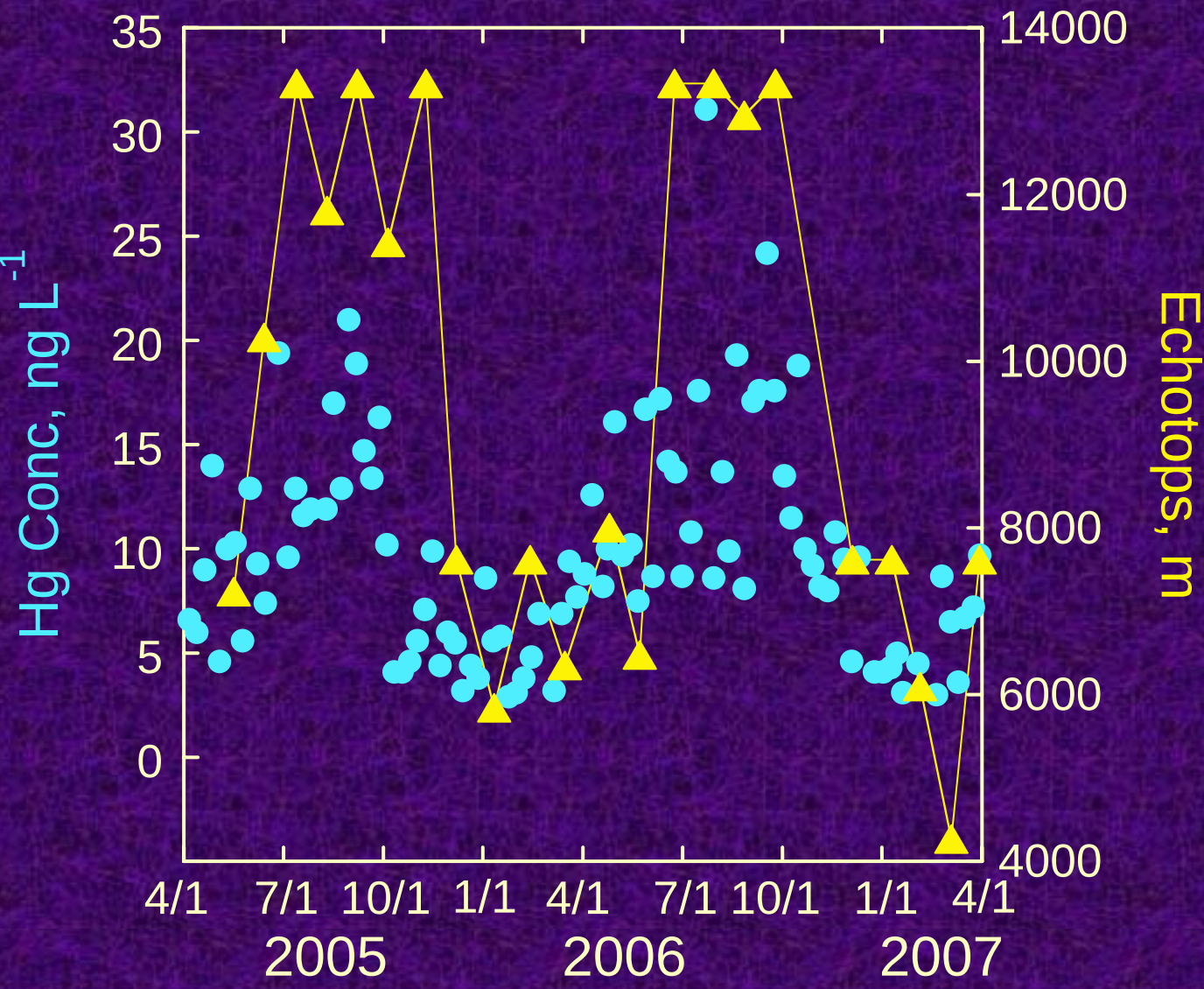
- Represent the top of the rain-producing layer in a cloud.
- Available every 10 minutes during a rain event.
- Ranged from 762 – 16,763 m in Puerto Rico.



Echotops analysis



Echotops and rainfall Hg



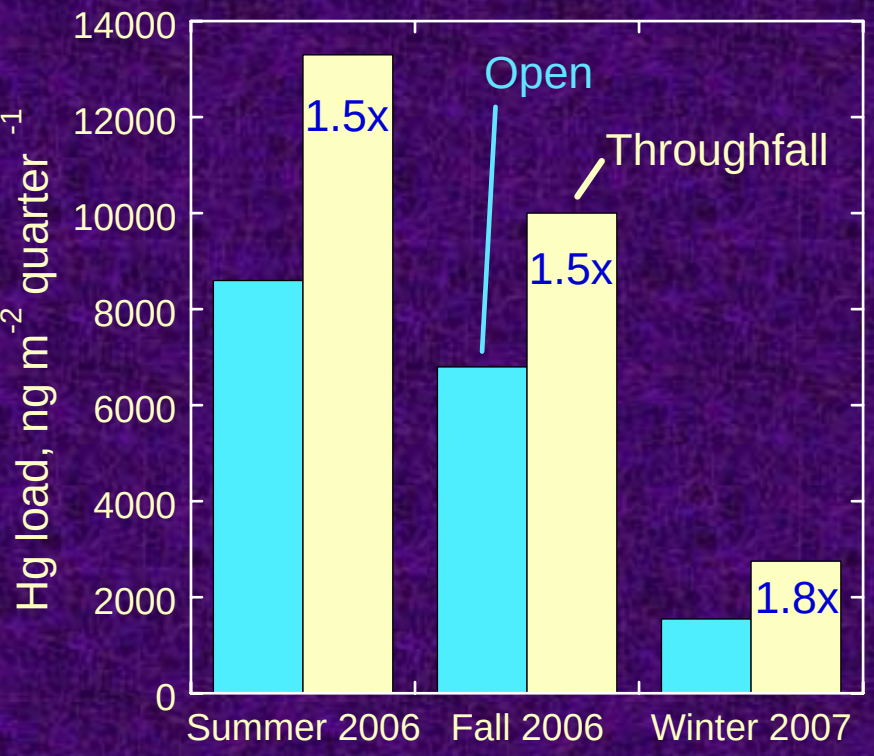
Hg in throughfall

Throughfall questions

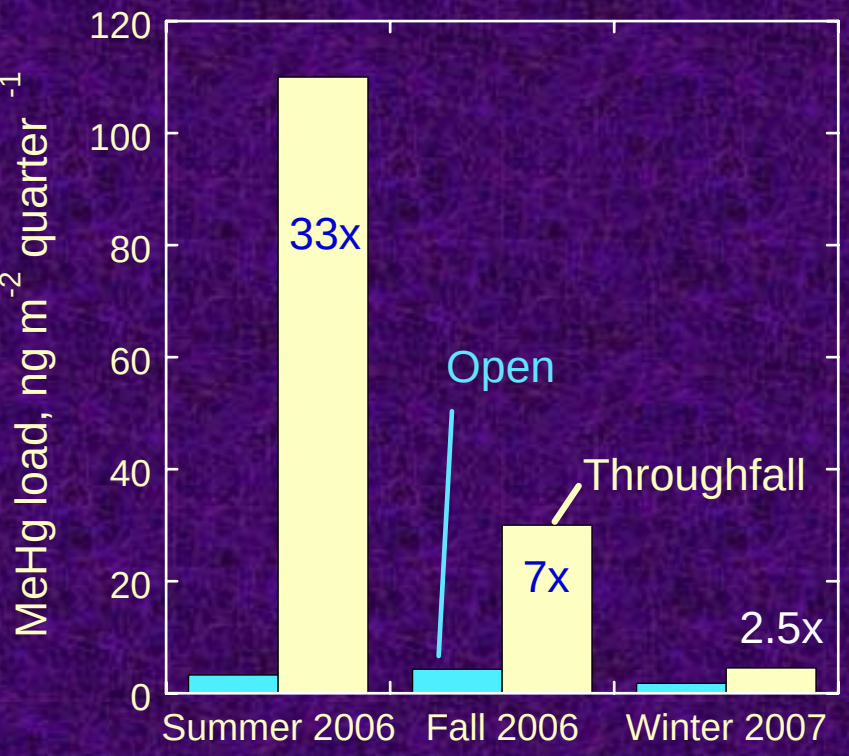
- Is the large canopy area a good surface for dry deposition?
- Given the high rainfall -- is Hg dry deposition important?
- Is there canopy enrichment of MeHg?

Wet Deposition: Throughfall

Total Hg



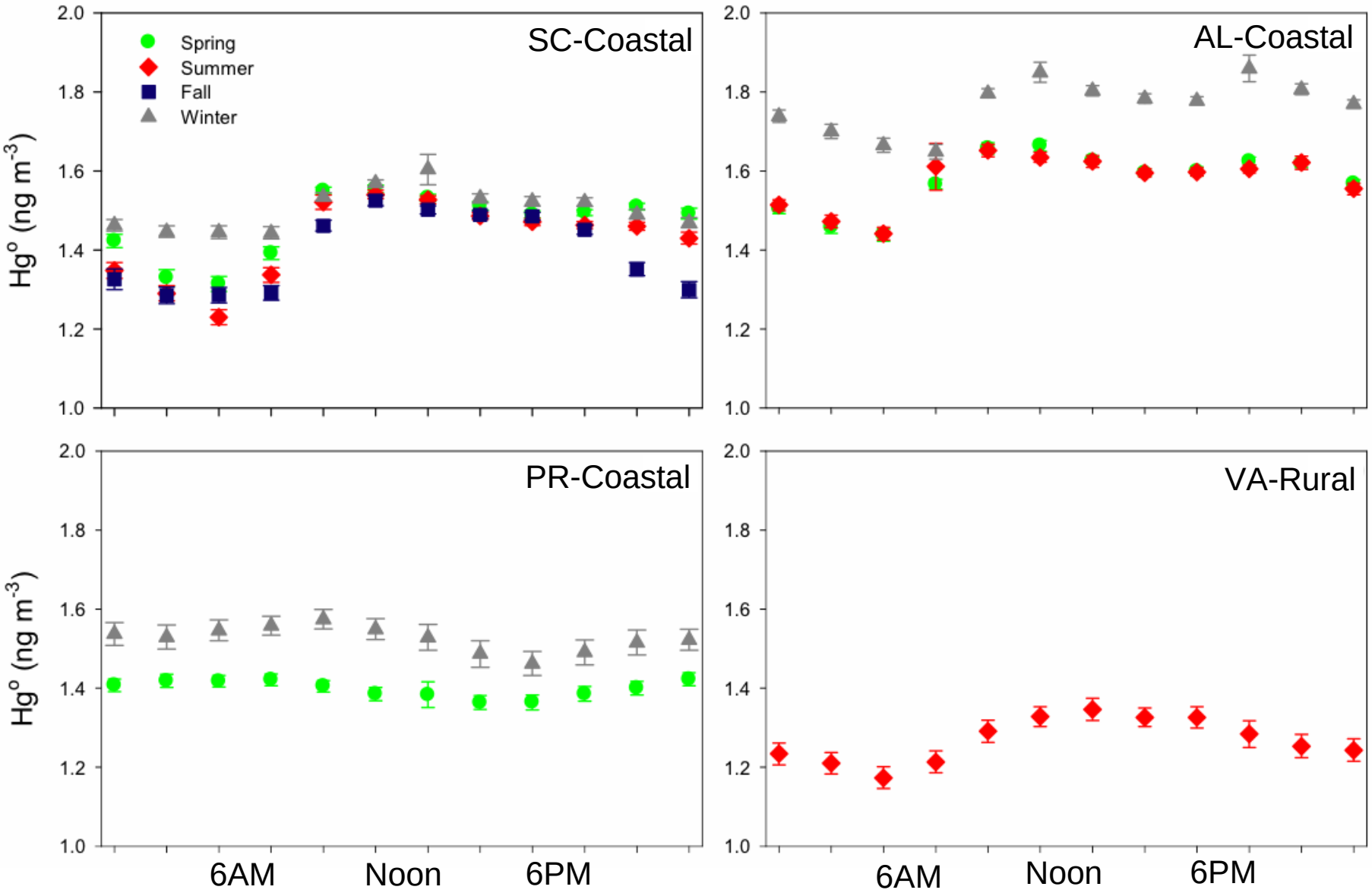
Methyl Hg



Conclusions

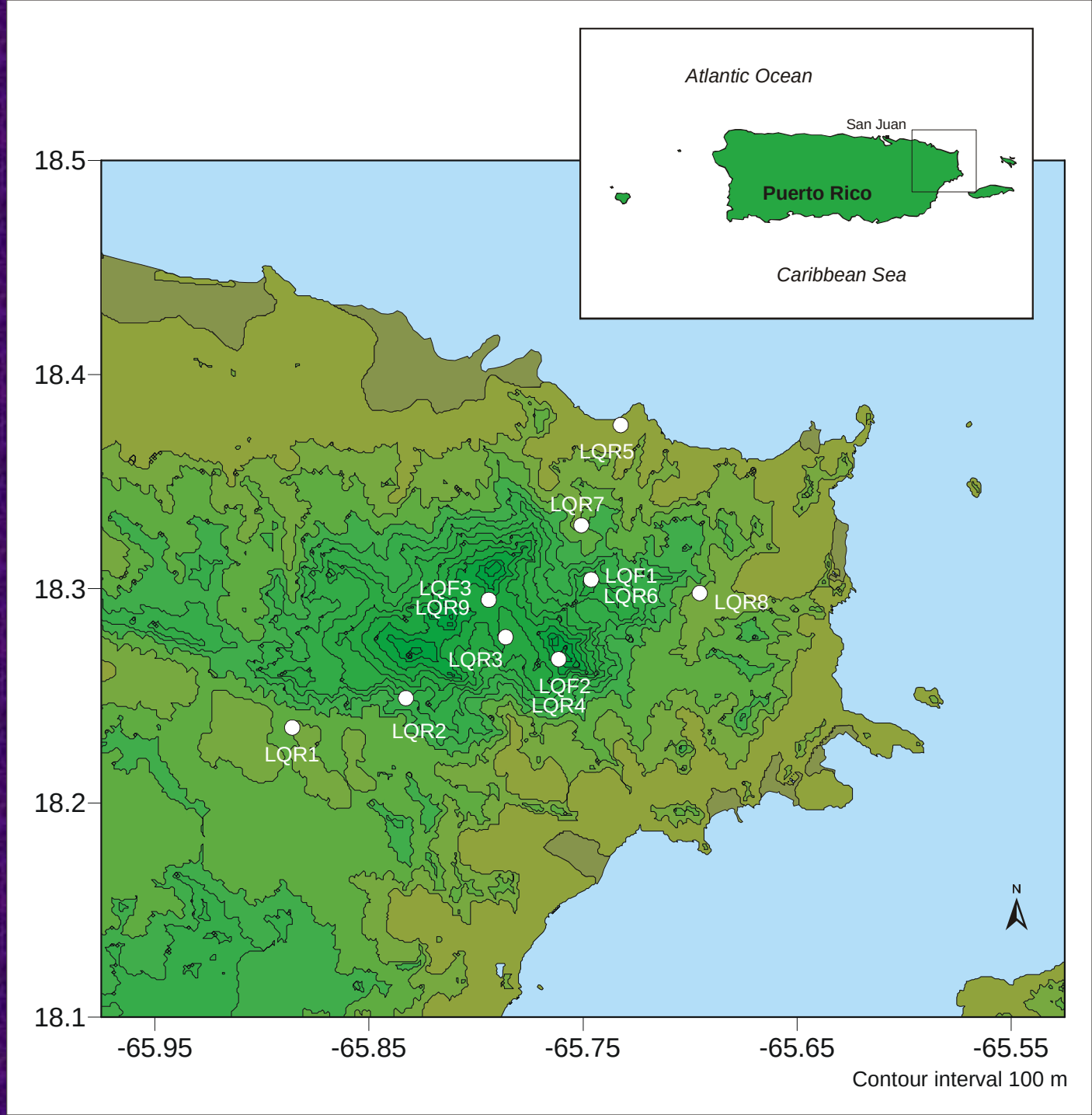
- Puerto Rico site has highest Hg wet deposition in USA
- Pristine site suggests source is global pool
- Very little RGM at ground level to support high rain loads
- Hg concentrations track cloud top altitudes
- Dry deposition also important
- Canopy appears to be source of MeHg
- High deposition results from RGM in free troposphere
- Need to measure other tropical sites

Hg^o 2-Hour Bin Plots I



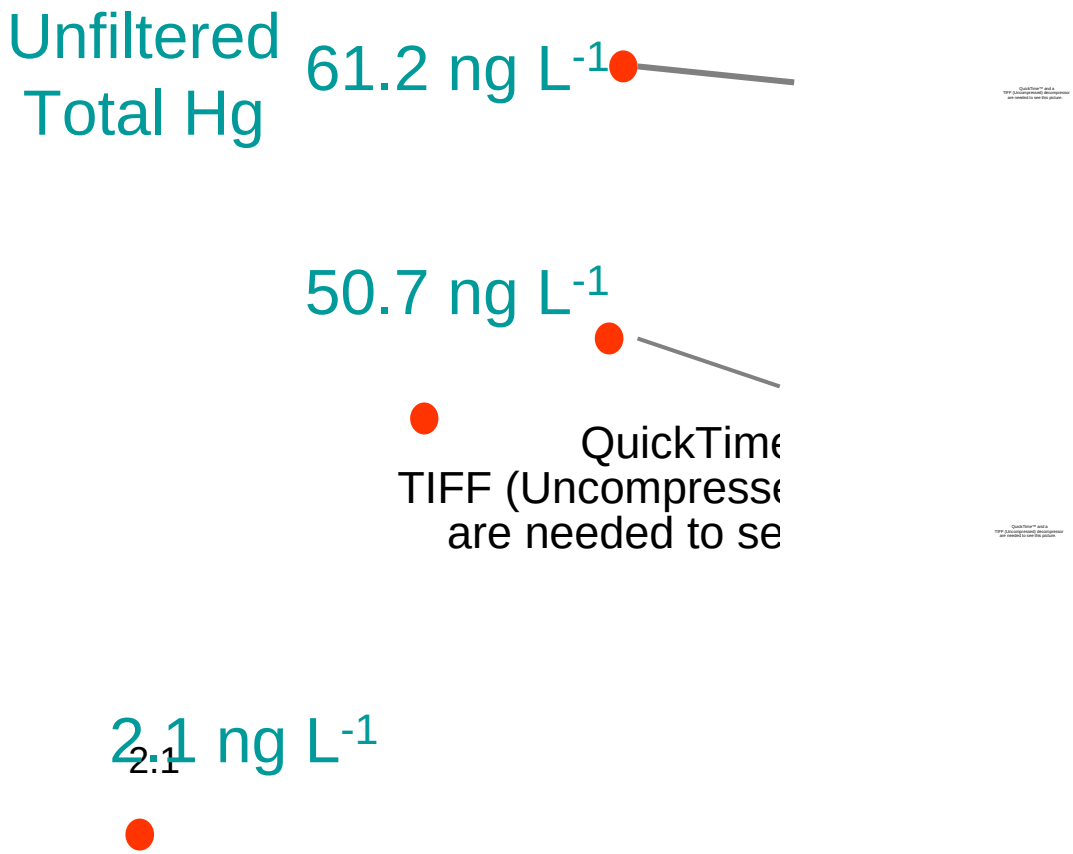
Study area

Rainfall: 2,500-4,500 mm y^{-1}
Altitude: 0 to 1100 m
Temperature: 24 - 27. 5 °C
Forest: montane cloud, wet and rain and lowland moist
Climate: easterly trade winds



Orographic rainfall

- Orographic = associated with mountains
- Lifting condensation level depends on T and humidity
- Higher T, deforestation can raise cloud base, decreasing cloud thickness and rainfall
- GCMs forecast a drier Caribbean with global temperature increases


Unfiltered
Total Hg
61.2 ng L-1
50.7 ng L-1
QuickTime
TIFF (Uncompresse
are needed to se
2.1 ng L-1
2.1

April 2006