



GATNDOR Topic 1: Collocation of Observations

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Payerne, Switzerland

2-4 March 2010



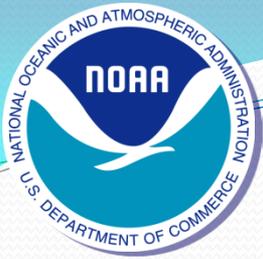
Basic question

- *What is the spatial representiveness of GRUAN's balloon-borne observations?*



Goal: Optimizing GRUAN for...

- **Error Characterization with Co-located Instruments:** How far apart can measurement systems be and yet be considered effectively to sample the same atmospheric column?
- **Enhanced Observations via Distributed Network Sites:** How far apart can GRUAN sub-sites be and still be considered a single GRUAN site?
- **Anchoring Satellite Observations:** How close must a satellite overpass be to a GRUAN site for the GRUAN observation to be useful for calibrating a satellite observation?
- **Reference Radiosonde Retrieval:** How far from the GRUAN station is a reference radiosonde likely to drift before falling back to ground?



Approach

- Balloon drift (horizontal displacement) from operational radiosonde stations
- Expect patterns based on climatological wind fields
- Climatology for 2007-2009
- $\text{Drift} = f(\text{height, season, station location, latitude})$
- Local (single station) results:
 - Balloon position map plots
 - Histograms of drift distance
- Global or regional results:
 - Contour plot maps of drift distance
 - Zonal averages of station drift distance statistics



Example of Local Results

- Balloon Position
- Sterling, Virginia
- Summer (JJA)

Radiosonde Balloon Locations at 925 mb

GRUAN site: Beltsville, Maryland, USA

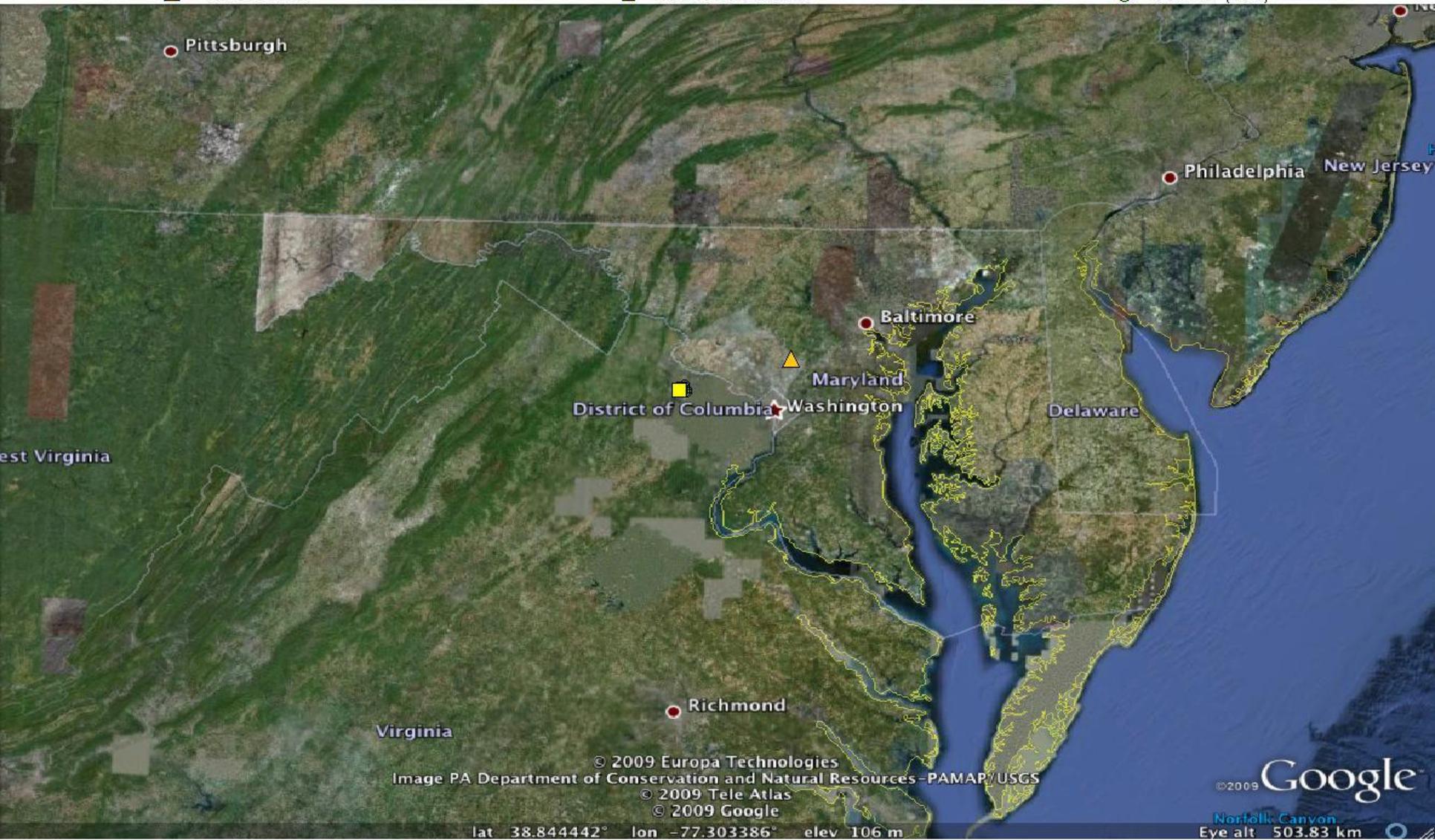
Radiosonde 72403

26 June 2007 to 13 June 2009

▲ = GRUAN Site

■ = Radiosonde Station

● = Summer (JJA)



925 mb

Radiosonde Balloon Locations at 850 mb

GRUAN site: Beltsville, Maryland, USA

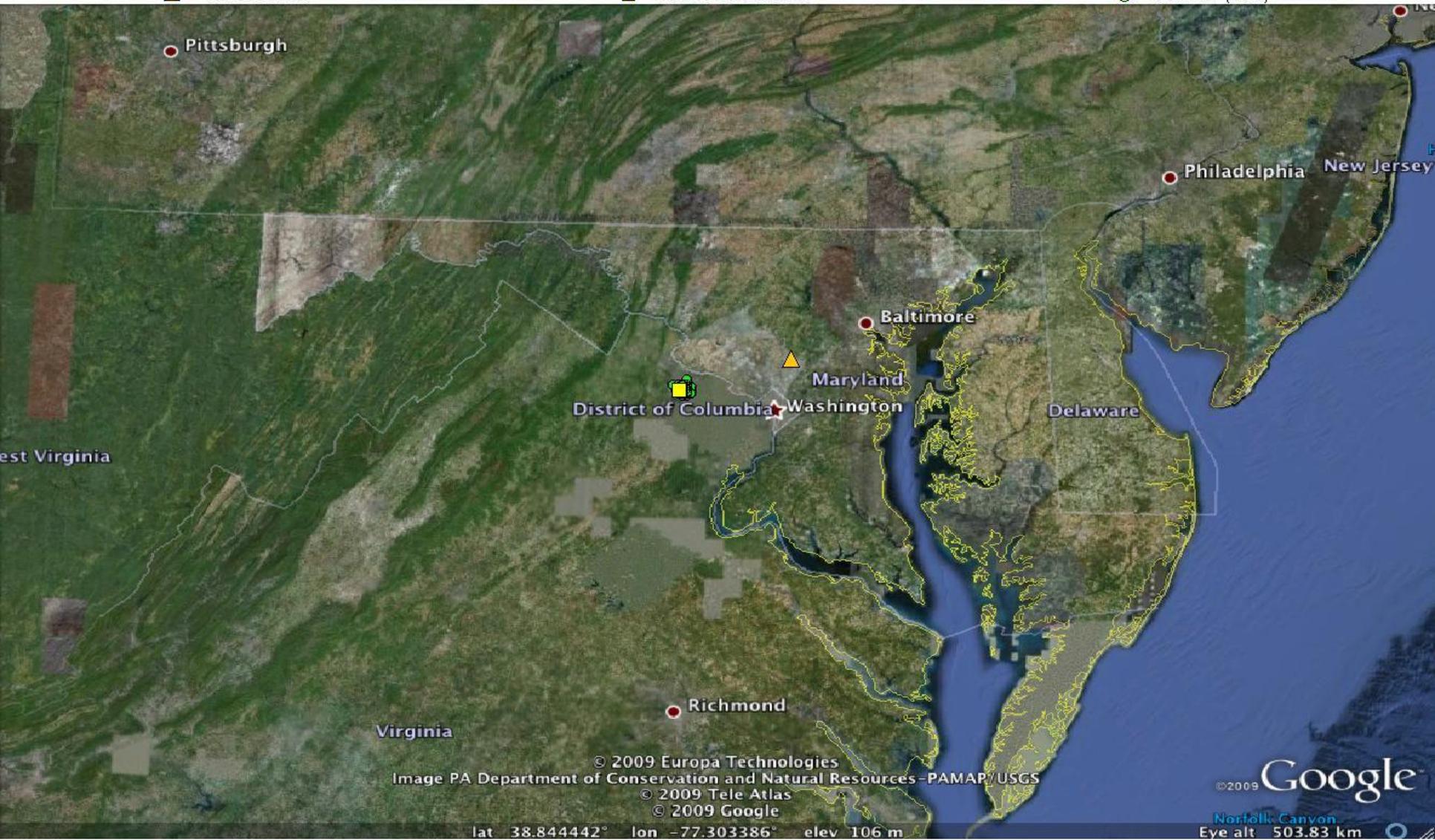
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850 mb

Radiosonde Balloon Locations at 700 mb

GRUAN site: Beltsville, Maryland, USA

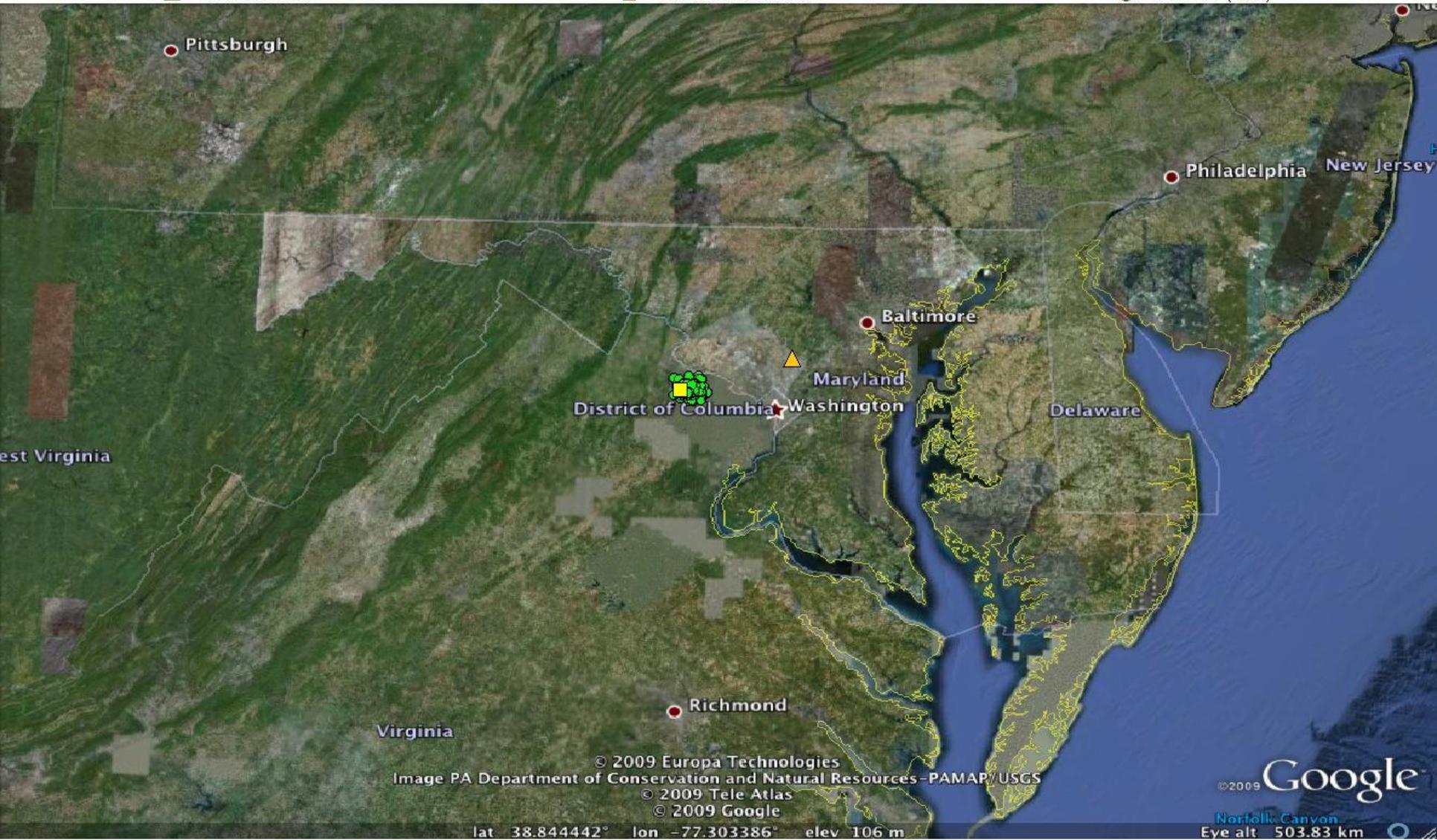
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700 mb

Radiosonde Balloon Locations at 500 mb

GRUAN site: Beltsville, Maryland, USA

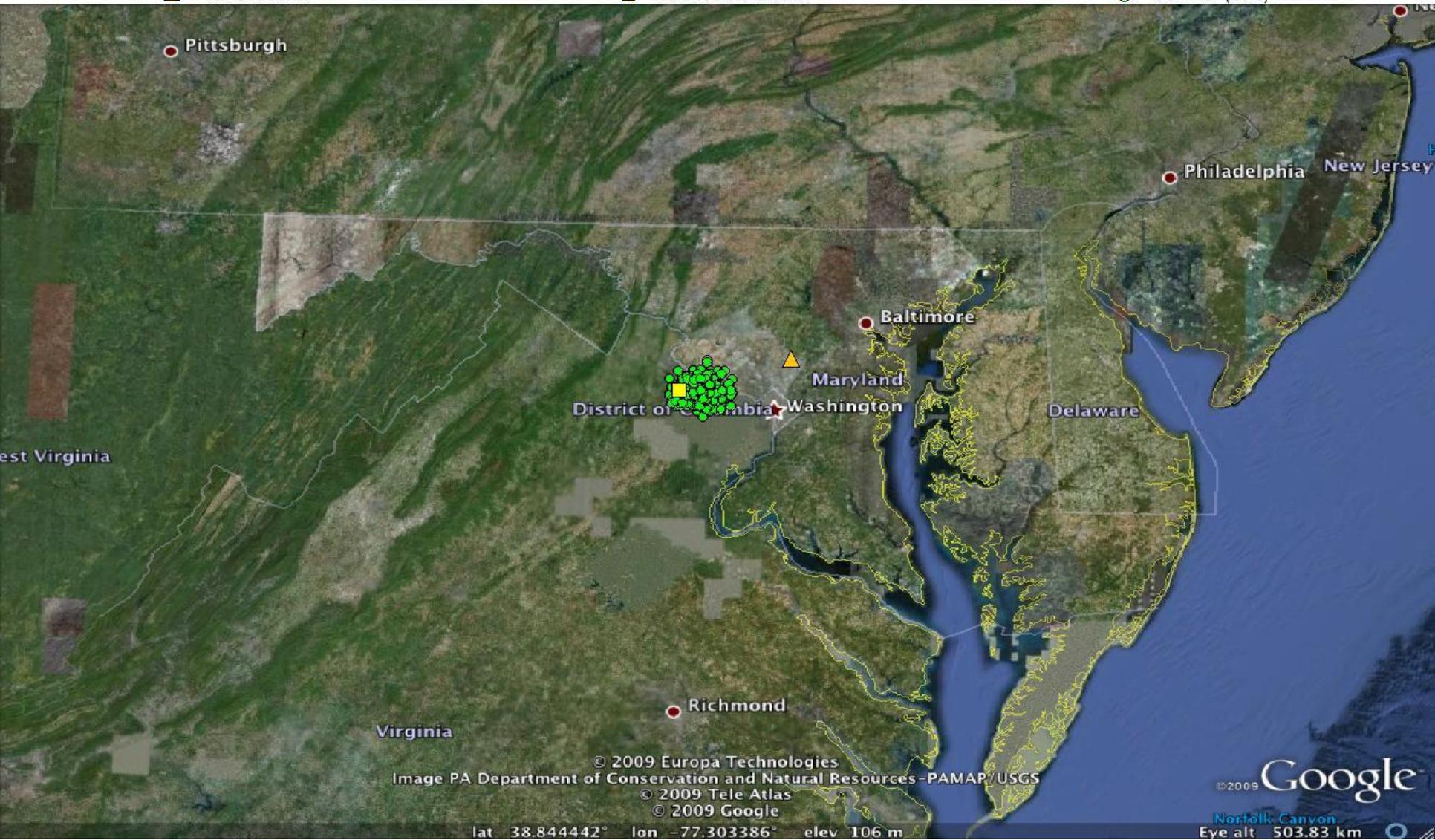
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500 mb

Radiosonde Balloon Locations at 300 mb

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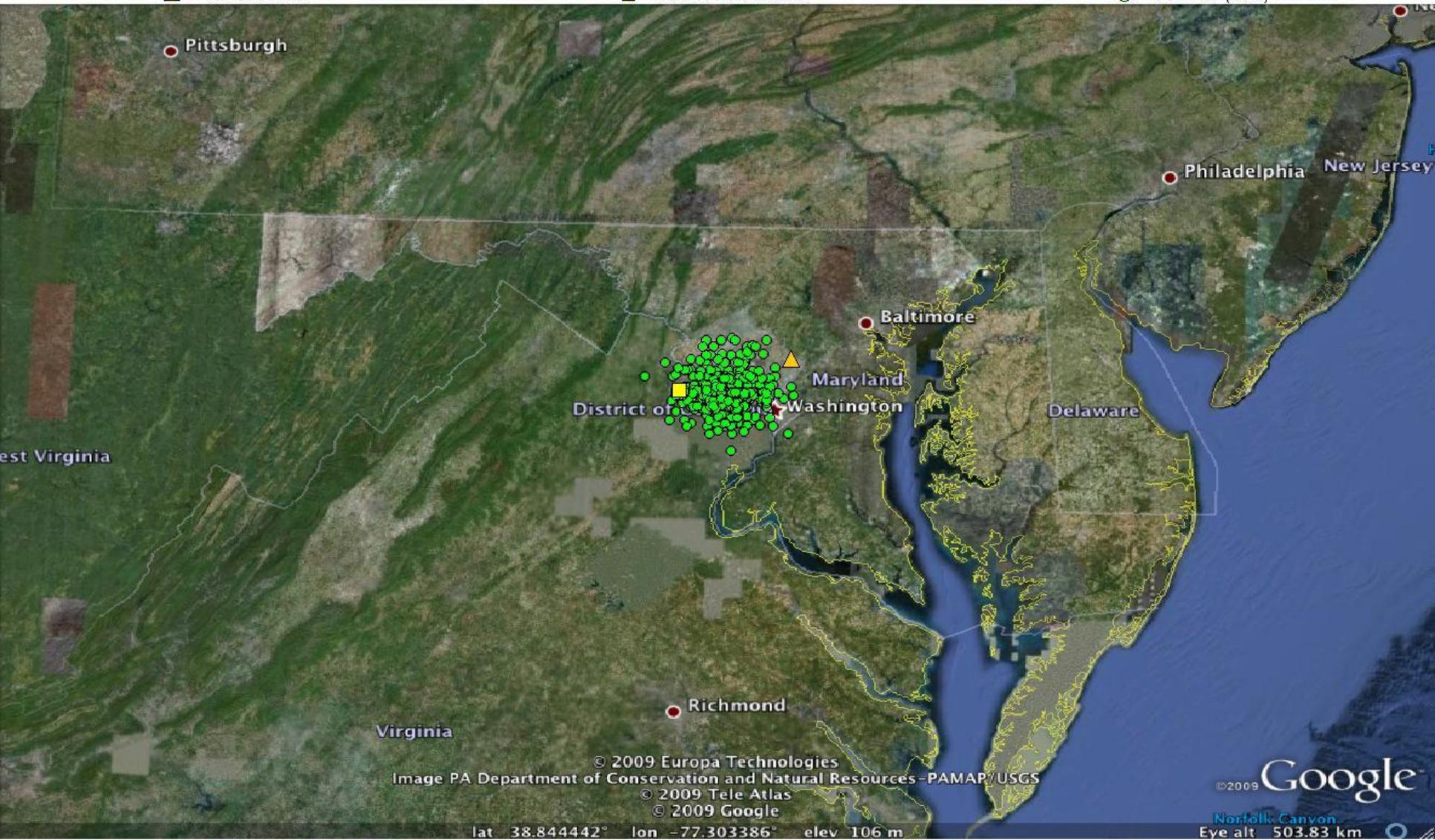
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300 mb

Radiosonde Balloon Locations at 200 mb

GRUAN site: Beltsville, Maryland, USA

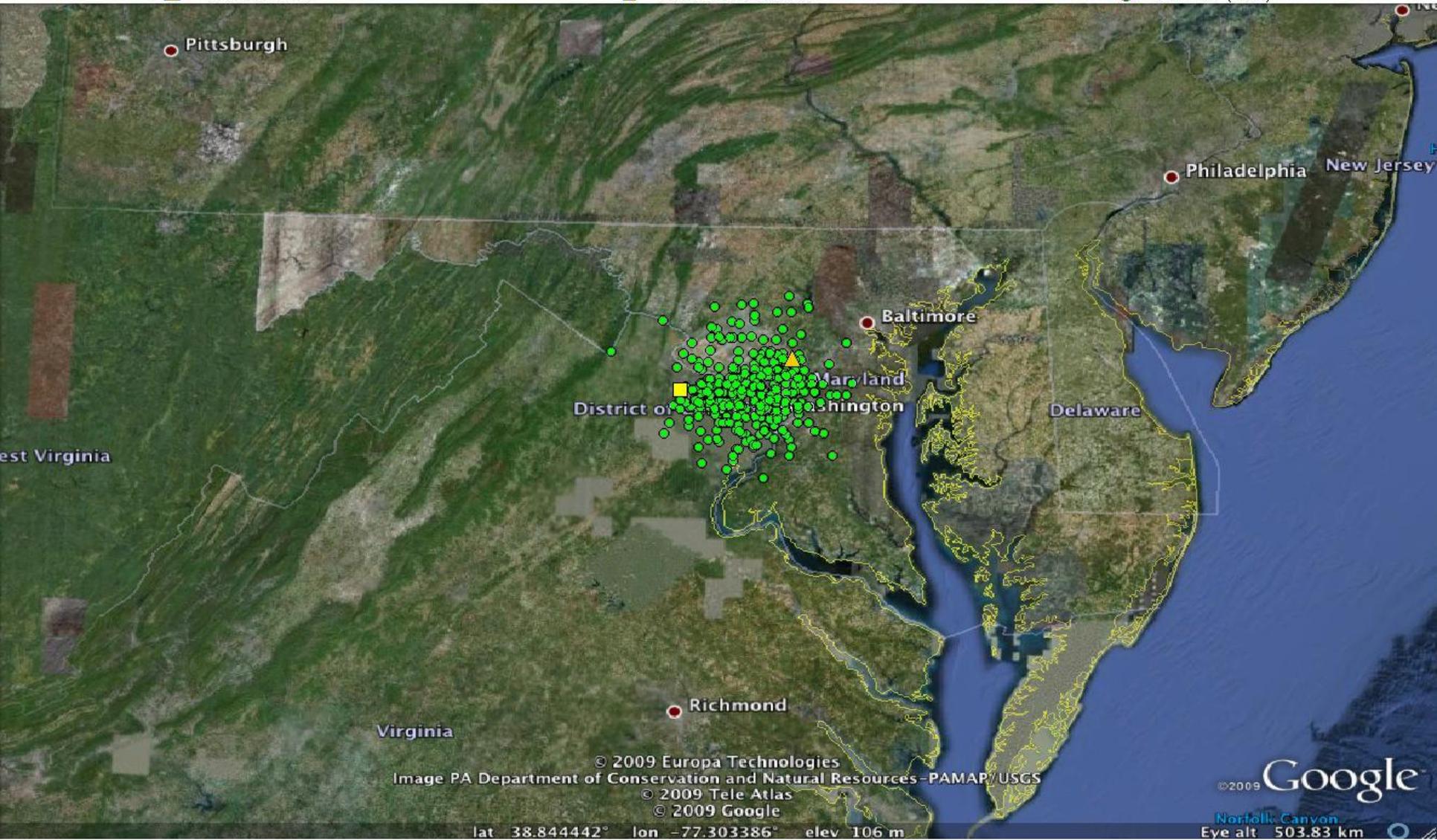
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26 June 2007 to 13 June 2009

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200 mb

Radiosonde Balloon Locations at 100 mb

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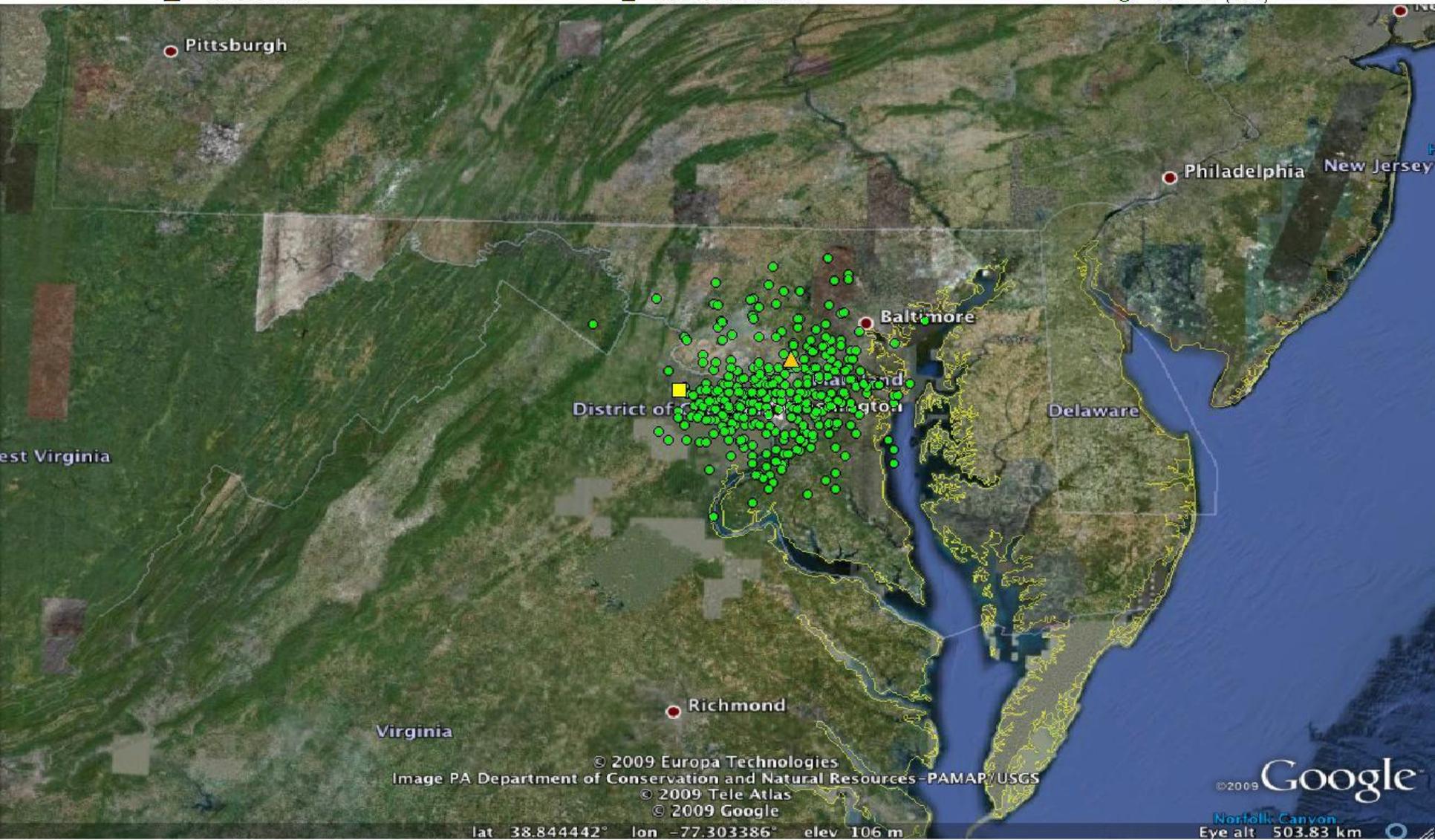
Radiosonde 72403

26 June 2007 to 13 June 2009

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■ = Radiosonde Station

● = Summer (JJA)



100 mb

Radiosonde Balloon Locations at 50 mb

GRUAN site: Beltsville, Maryland, USA

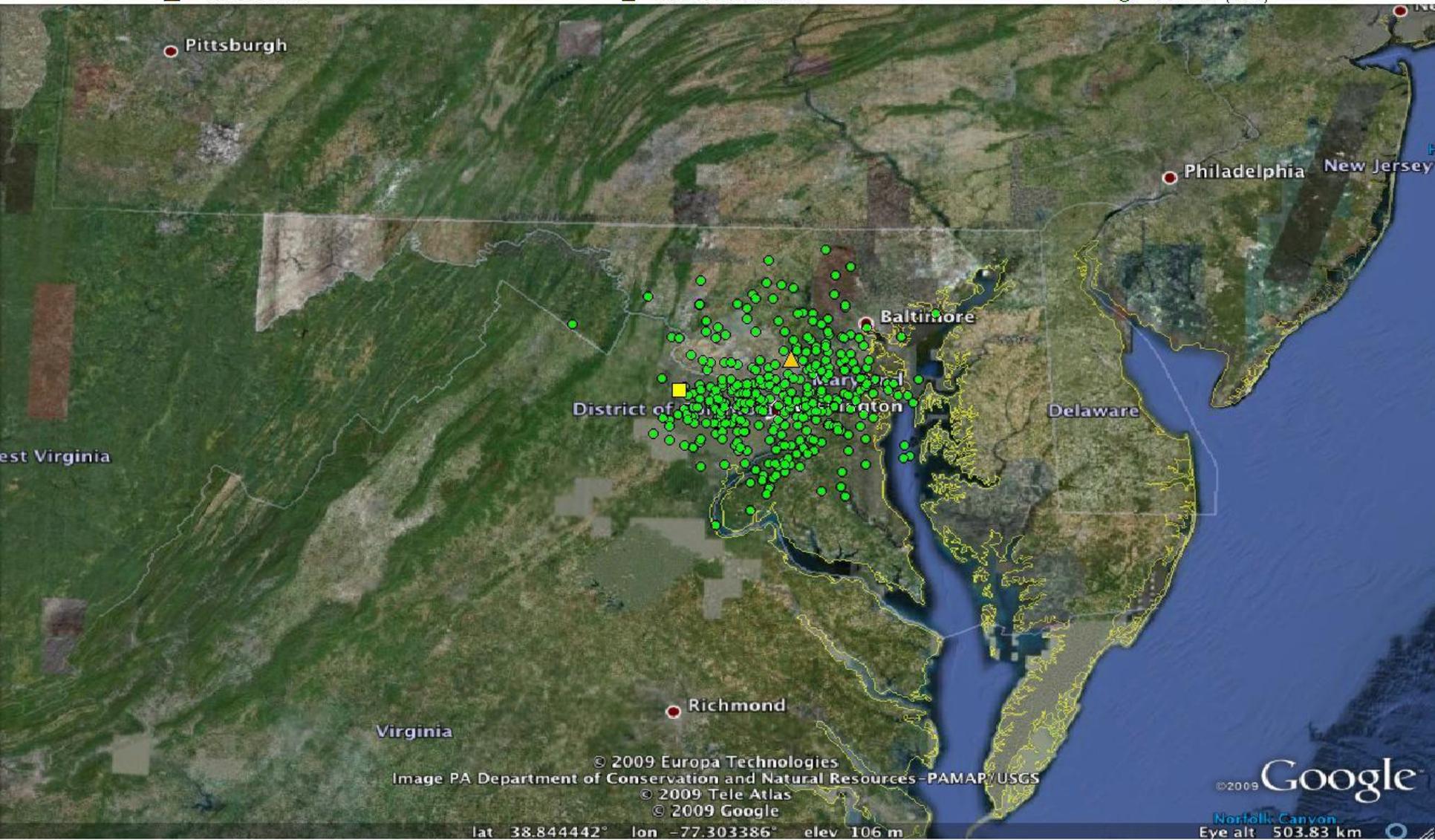
Radiosonde 72403

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■ = Radiosonde Station

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50 mb

Radiosonde Balloon Locations at 30 mb

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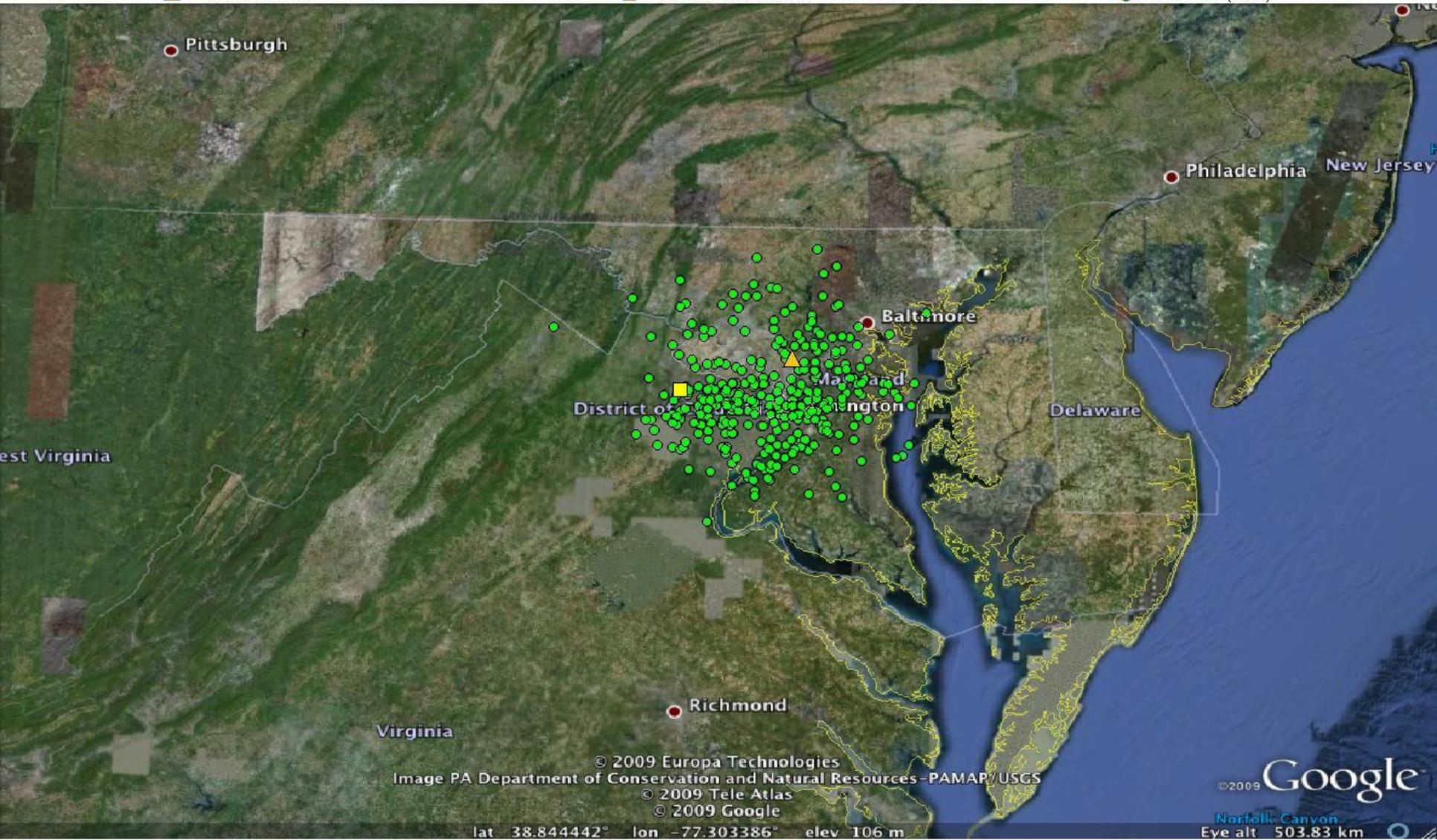
Radiosonde 72403

26 June 2007 to 13 June 2009

▲ = GRUAN Site

■ = Radiosonde Station

● = Summer (JJA)



30 mb

Radiosonde Balloon Locations at 20 mb

GRUAN site: Beltsville, Maryland, USA

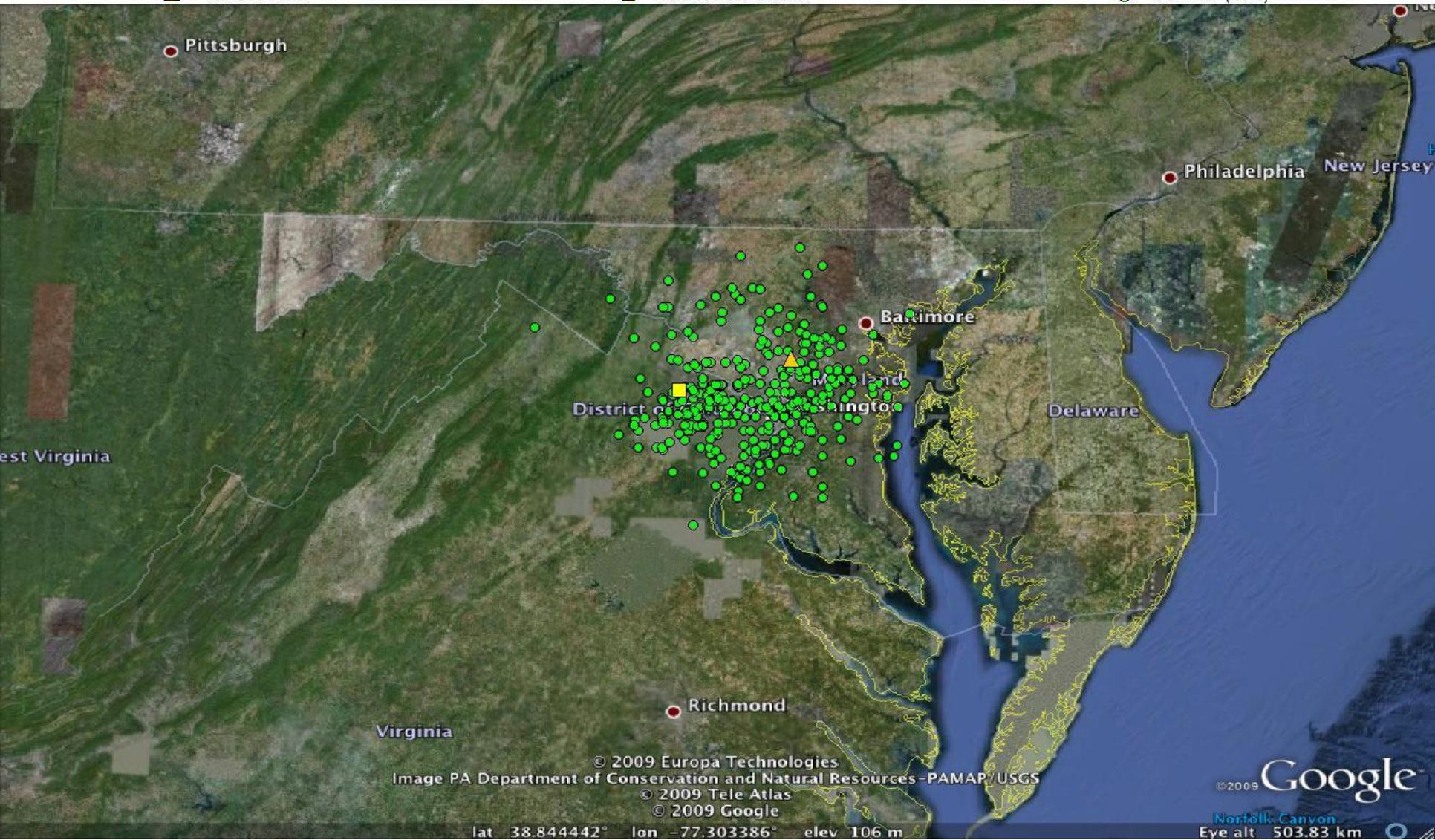
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26 June 2007 to 13 June 2009

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20 mb



Example of Local Results

- Balloon Position
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- Winter (DJF)

Radiosonde Balloon Locations at 925 mb

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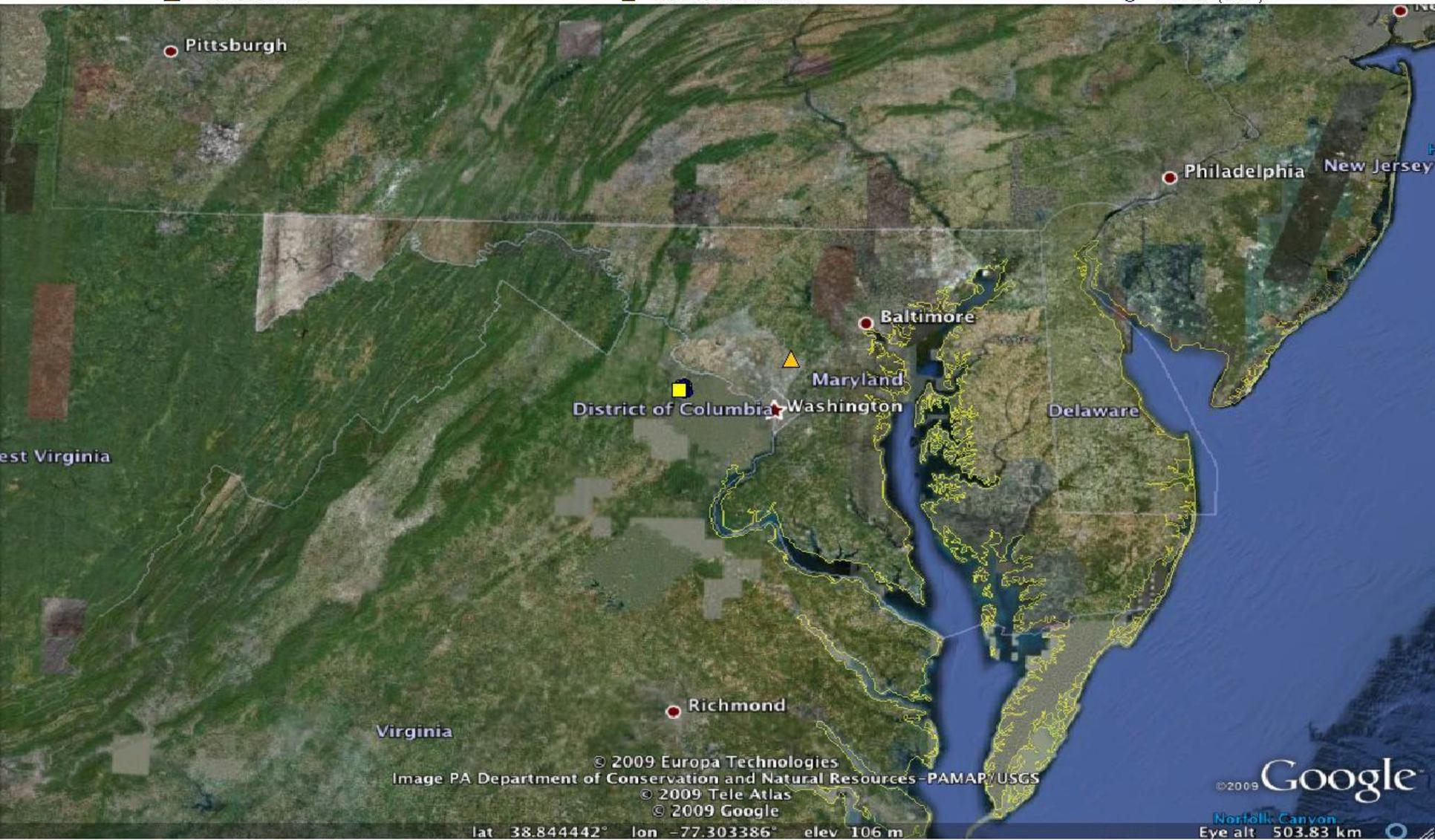
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925 mb

Radiosonde Balloon Locations at 850 mb

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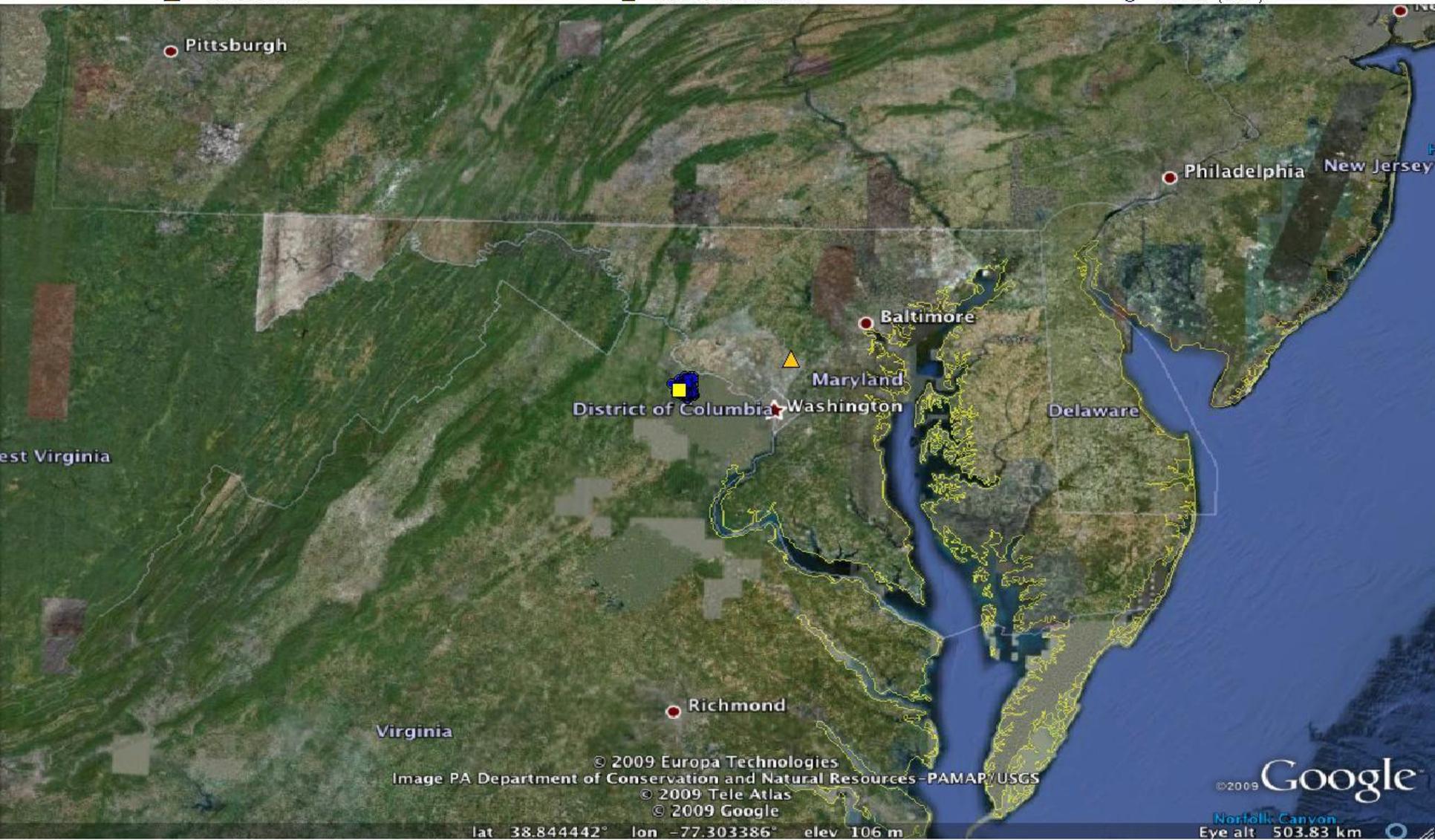
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26 June 2007 to 13 June 2009

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■ = Radiosonde Station

● = Winter (DJF)



850 mb

Radiosonde Balloon Locations at 700 mb

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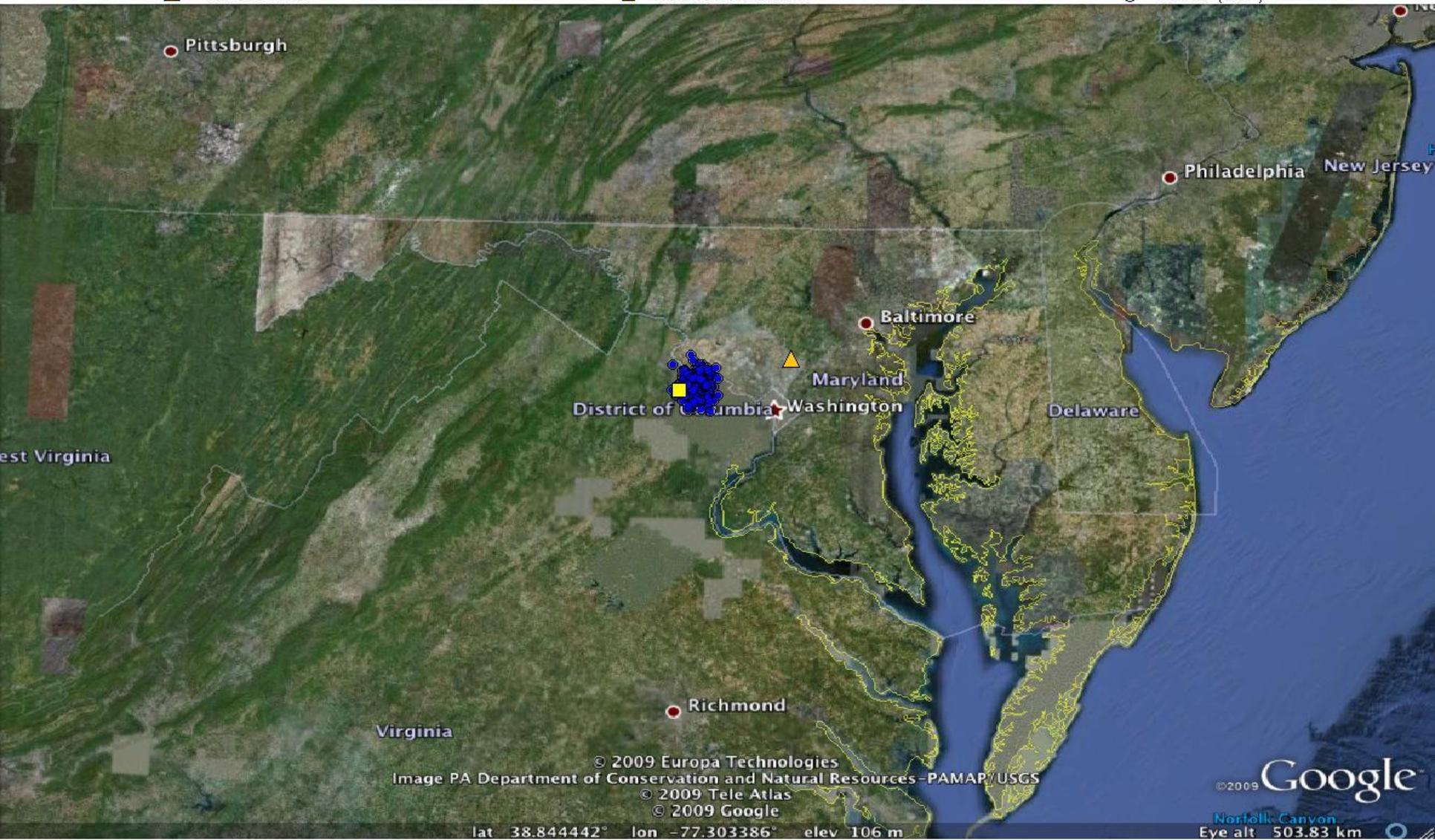
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26 June 2007 to 13 June 2009

▲ = GRUAN Site

■ = Radiosonde Station

● = Winter (DJF)



700 mb

Radiosonde Balloon Locations at 500 mb

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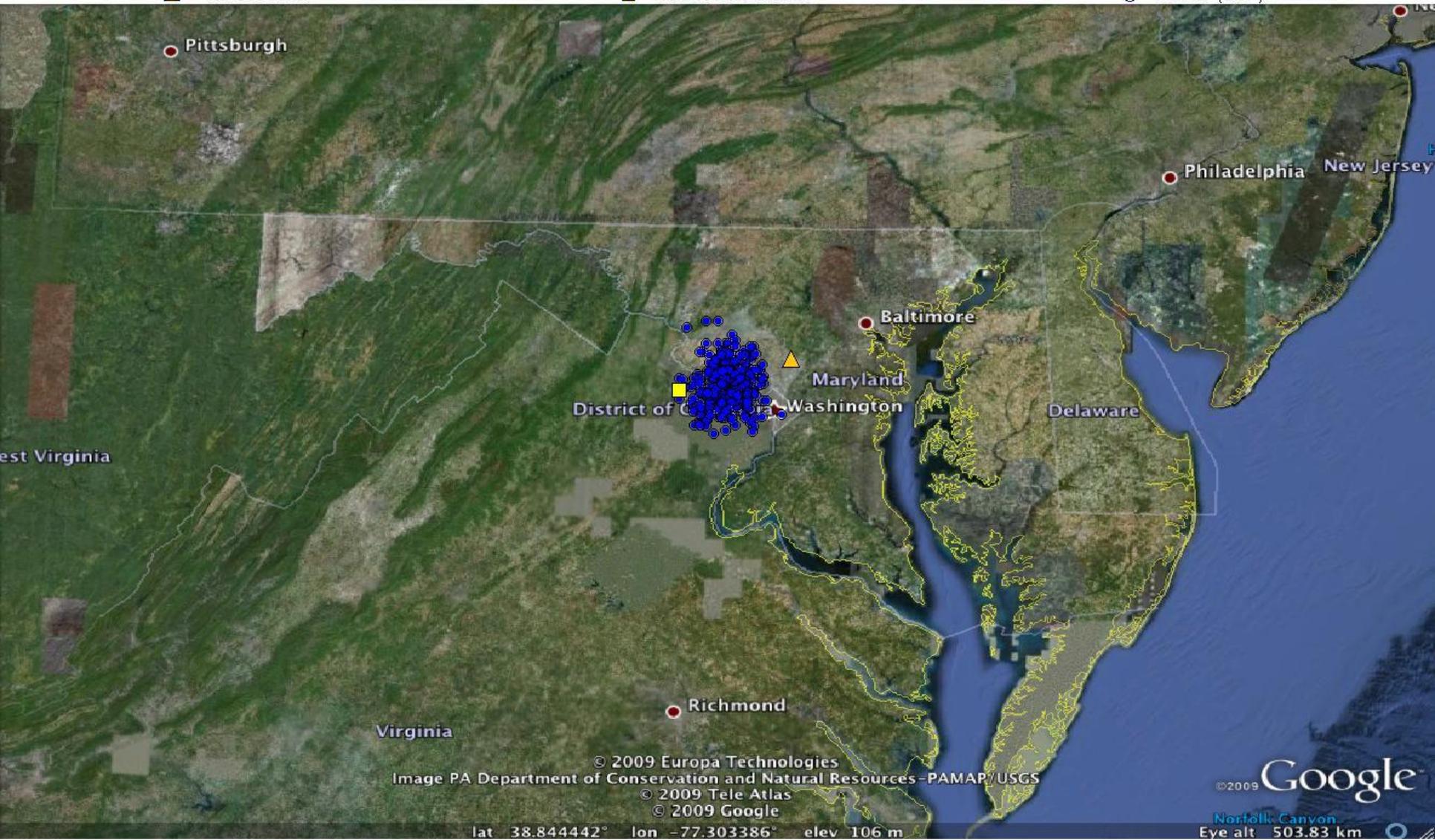
Radiosonde 72403

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500 mb

Radiosonde Balloon Locations at 300 mb

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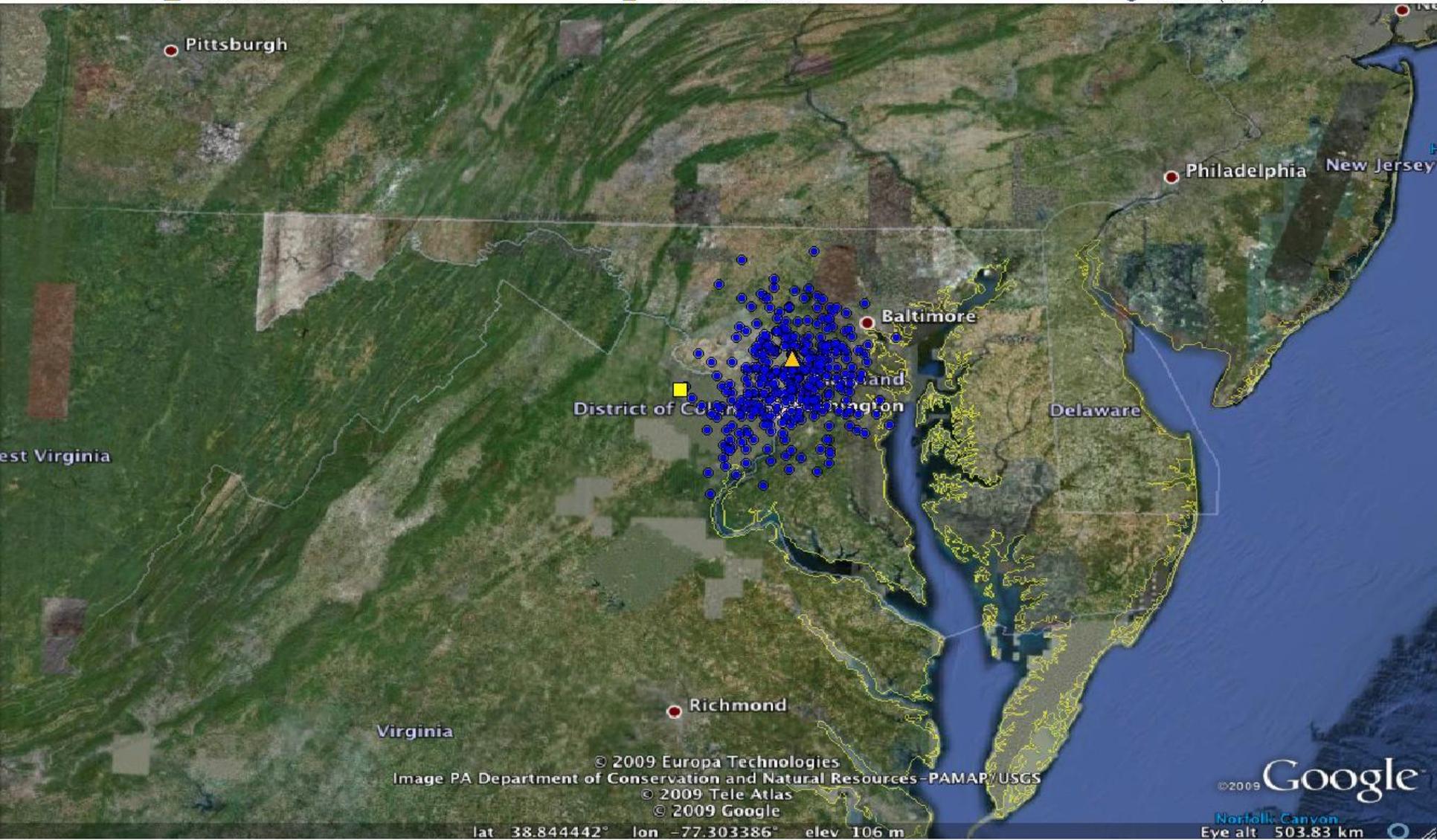
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300 mb

Radiosonde Balloon Locations at 200 mb

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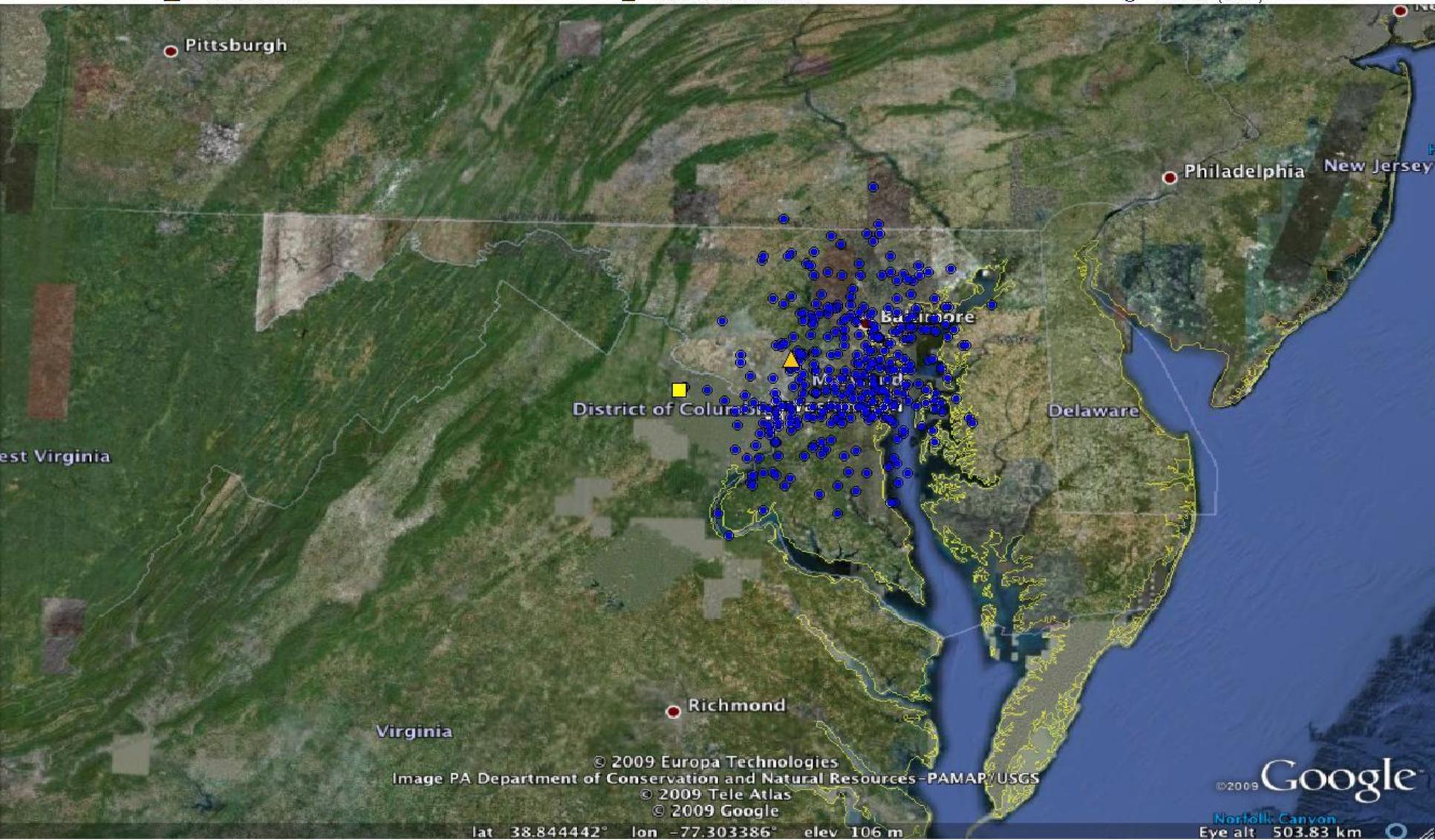
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200 mb

Radiosonde Balloon Locations at 100 mb

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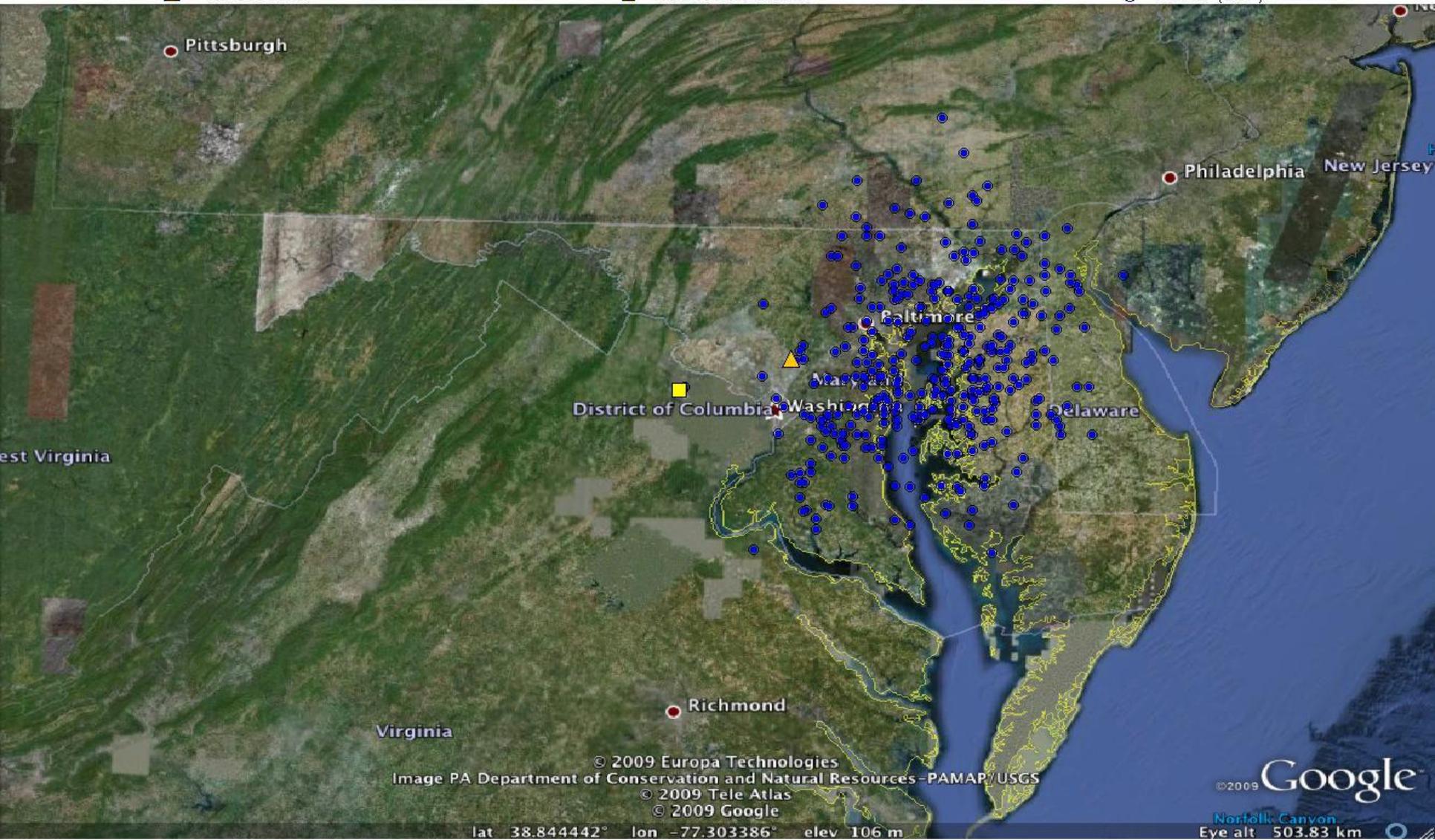
Radiosonde 72403

26 June 2007 to 13 June 2009

▲ = GRUAN Site

■ = Radiosonde Station

● = Winter (DJF)



100 mb

Radiosonde Balloon Locations at 50 mb

GRUAN site: Beltsville, Maryland, USA

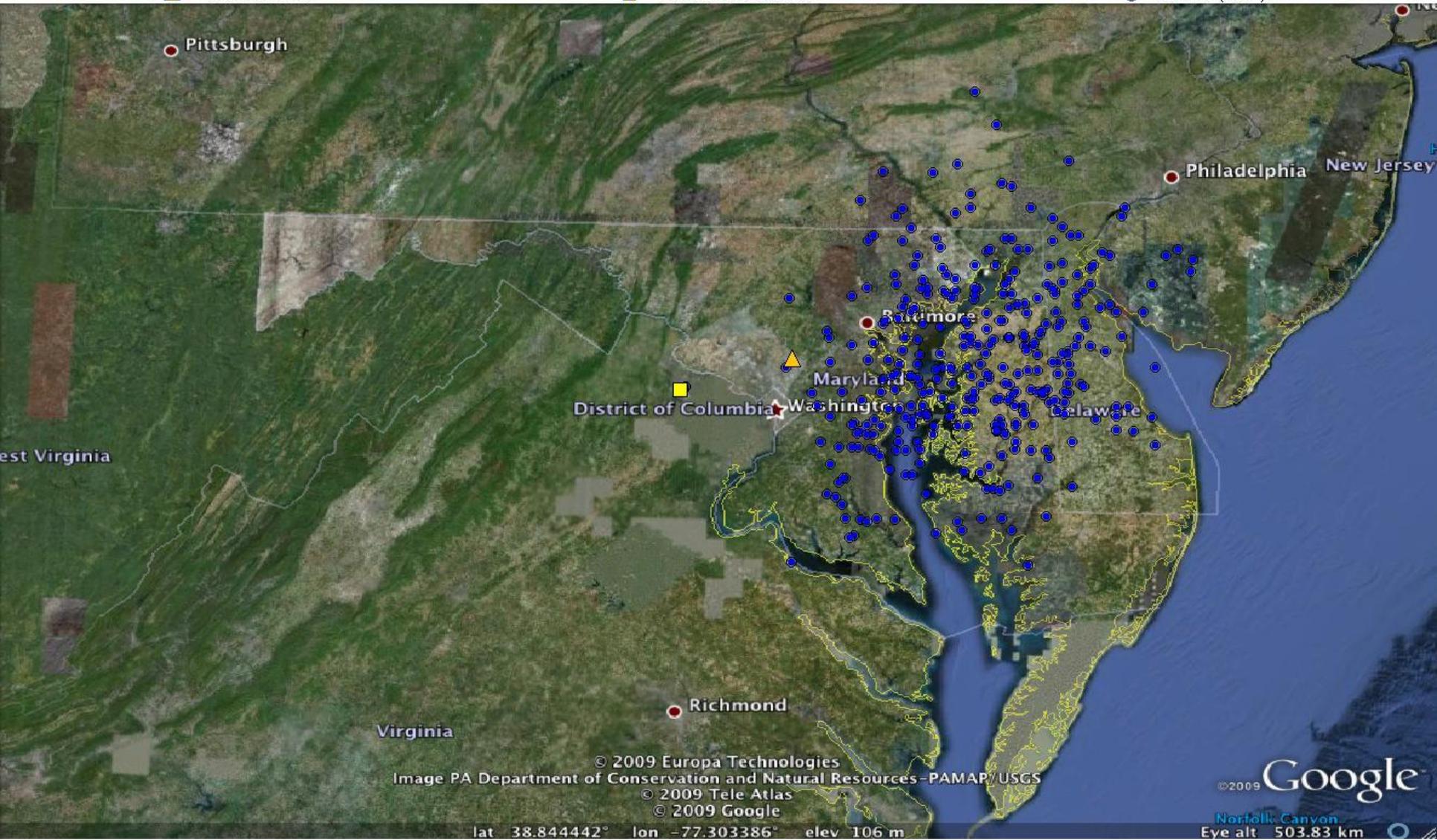
Radiosonde 72403

26 June 2007 to 13 June 2009

▲ = GRUAN Site

■ = Radiosonde Station

● = Winter (DJF)



50 mb

Radiosonde Balloon Locations at 30 mb

GRUAN site: Beltsville, Maryland, USA

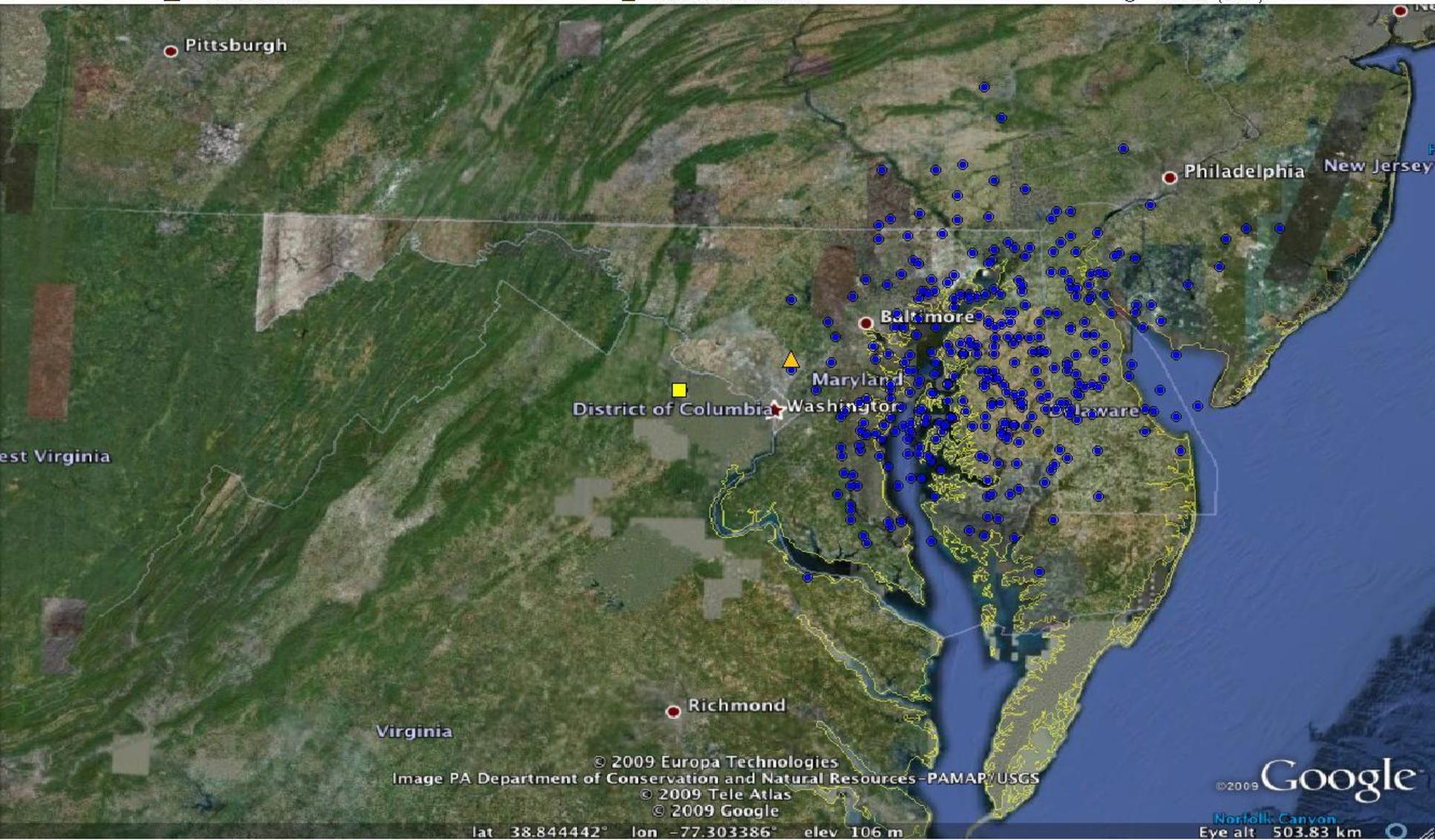
Radiosonde 72403

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30 mb

Radiosonde Balloon Locations at 20 mb

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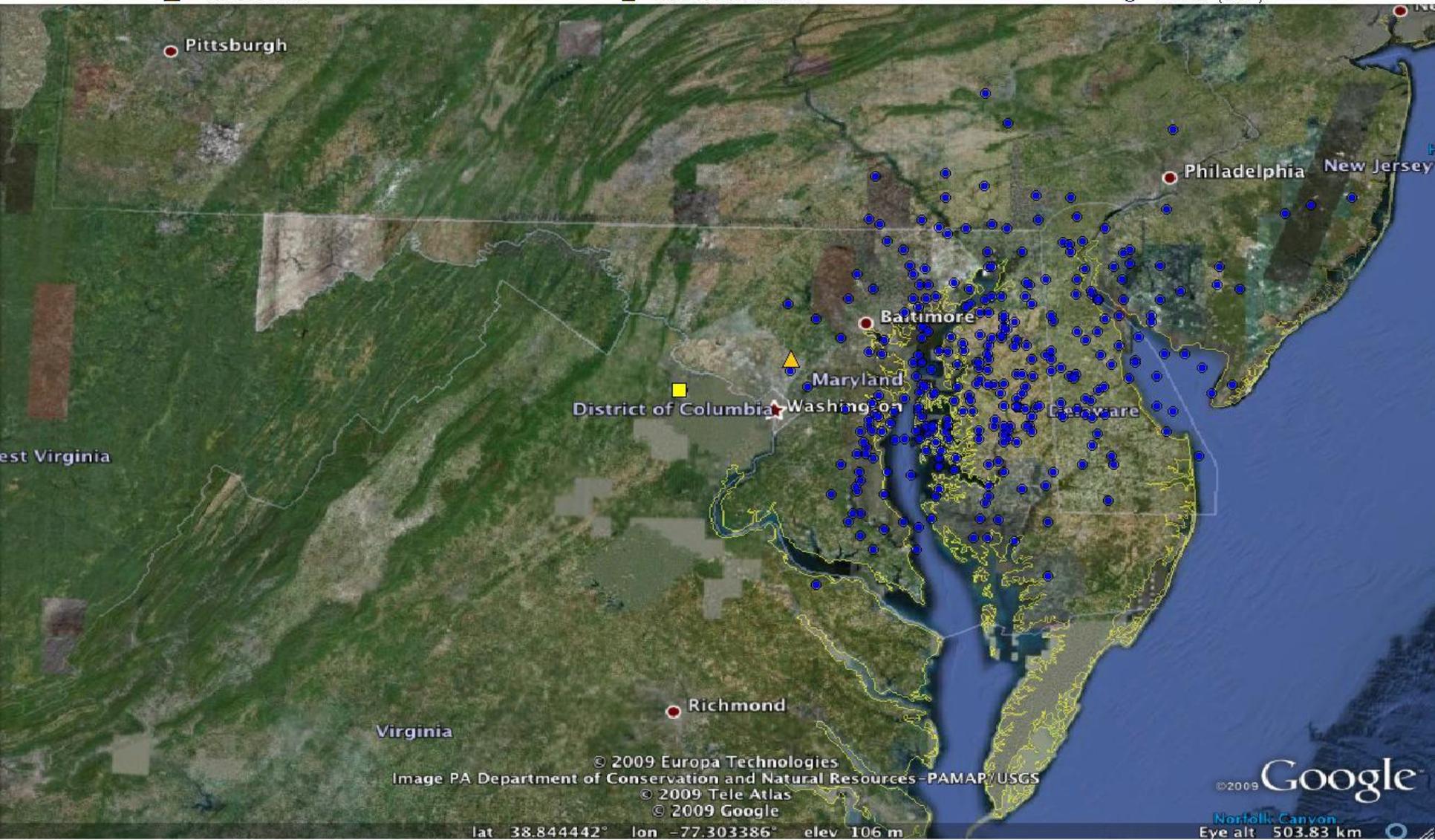
Radiosonde 72403

26 June 2007 to 13 June 2009

▲ = GRUAN Site

■ = Radiosonde Station

● = Winter (DJF)



20 mb



Example of Local Results

- Sterling, Virginia
- Summer/Winter Comparison

Radiosonde Balloon Locations at 500 mb

GRUAN site: Beltsville, Maryland, USA

Radiosonde 72403

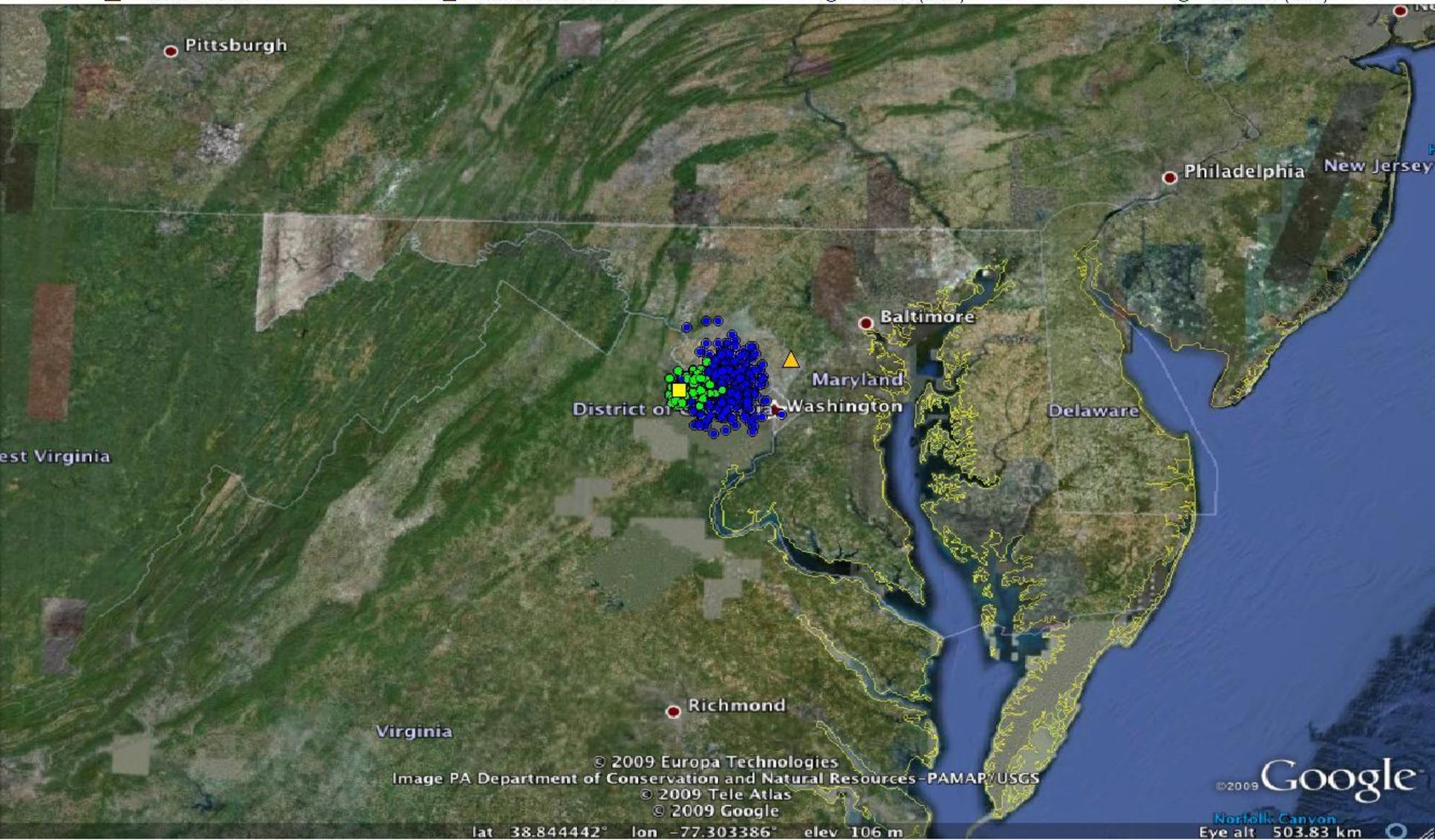
26 June 2007 to 13 June 2009

▲ = GRUAN Site

■ = Radiosonde Station

● = Winter (DJF)

● = Summer (JJA)



500 mb -- Summer vs Winter

Radiosonde Balloon Locations at 100 mb

GRUAN site: Beltsville, Maryland, USA

Radiosonde 72403

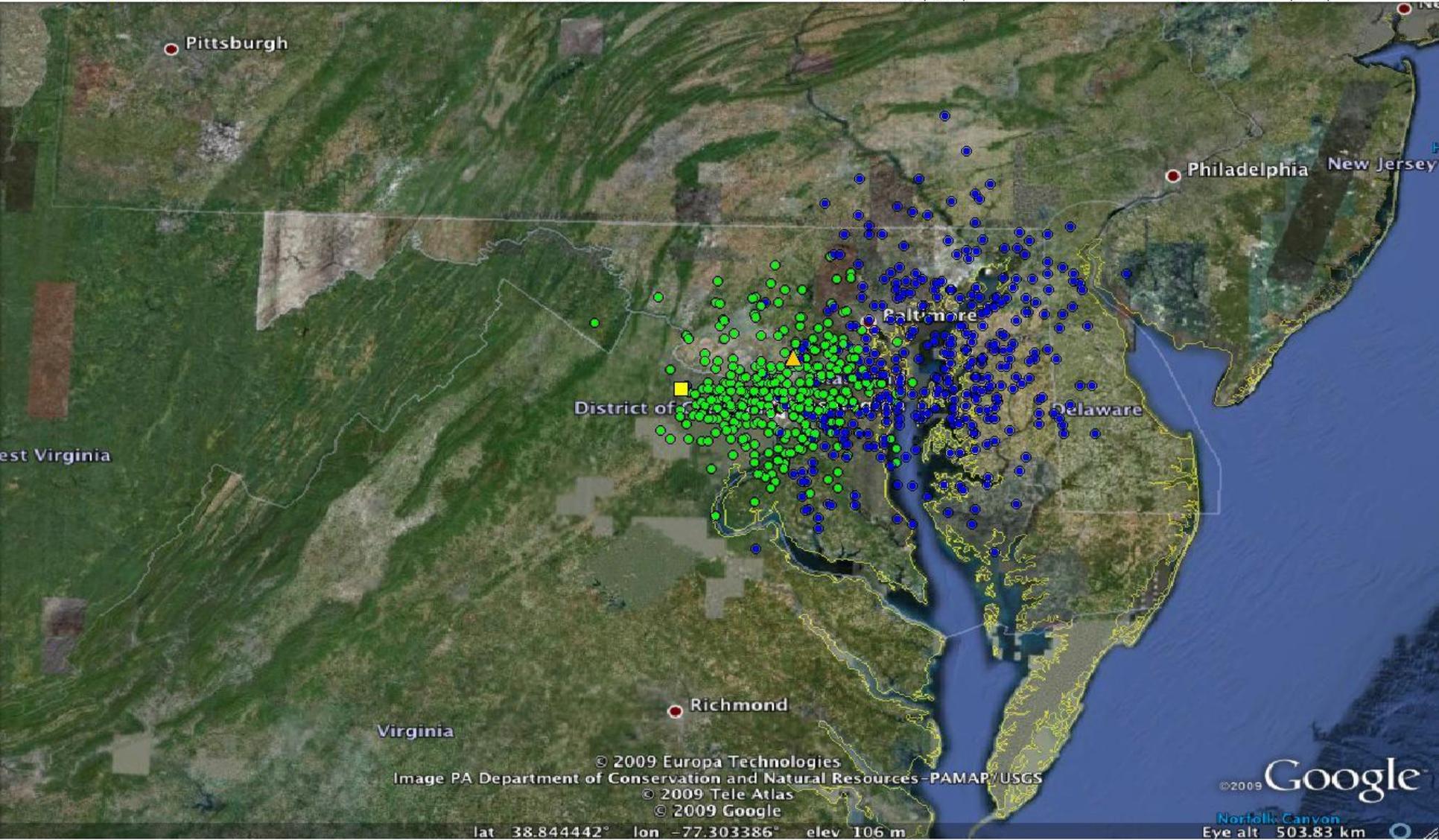
26 June 2007 to 13 June 2009

▲ = GRUAN Site

■ = Radiosonde Station

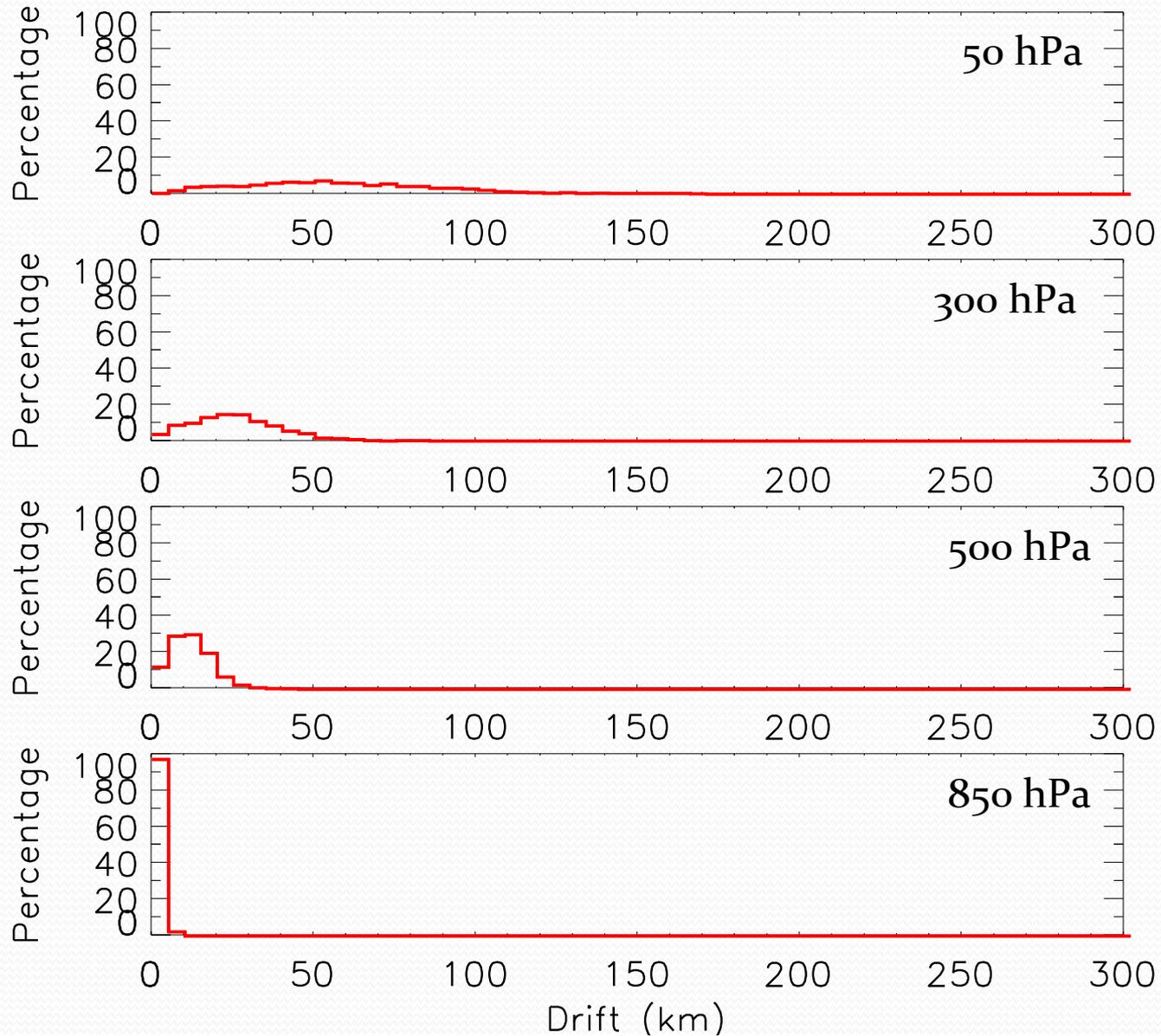
● = Winter (DJF)

● = Summer (JJA)

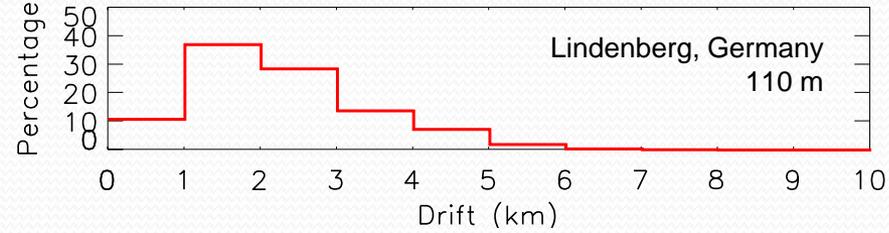
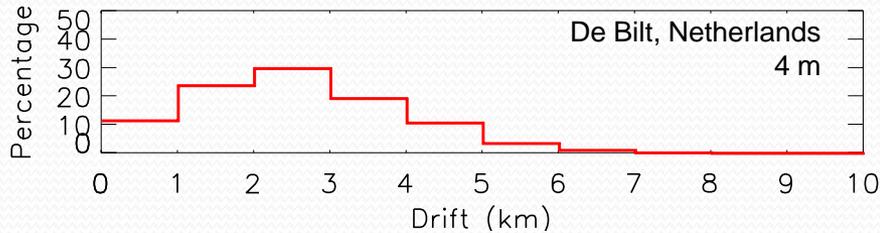
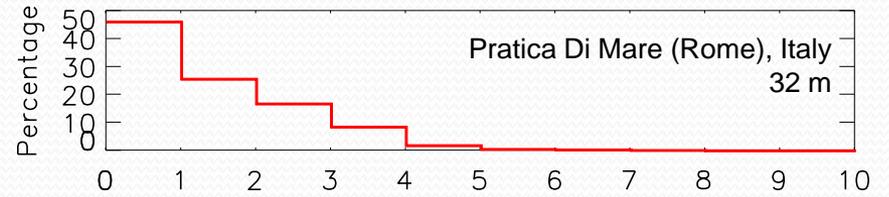
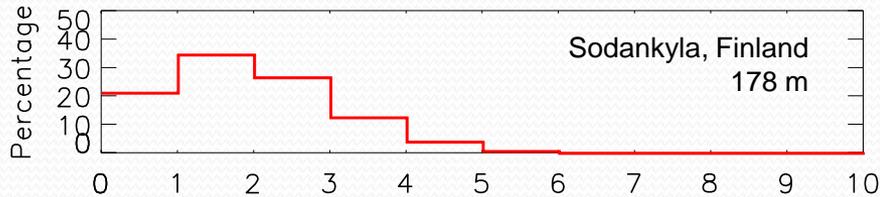
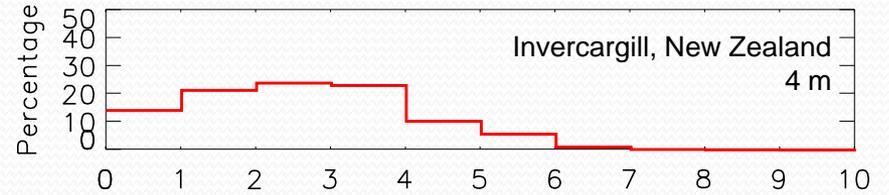
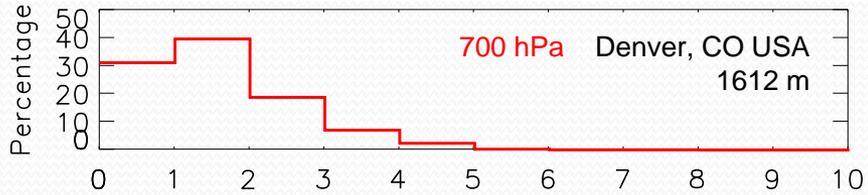
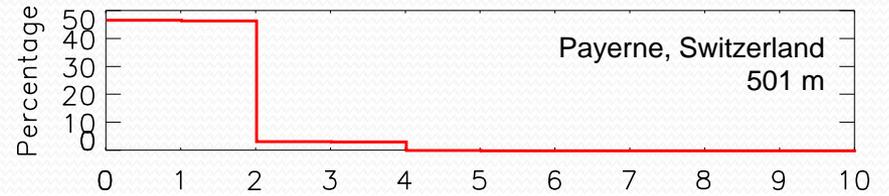
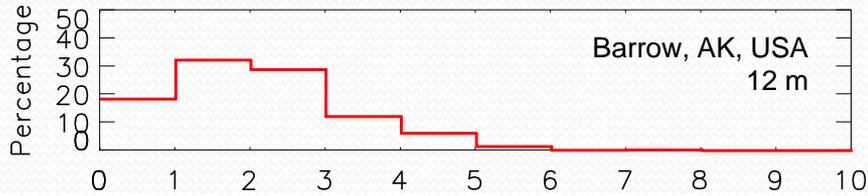


100 mb -- Summer vs Winter

pdfs of Drift from GRUAN Lead Center - Lindenberg



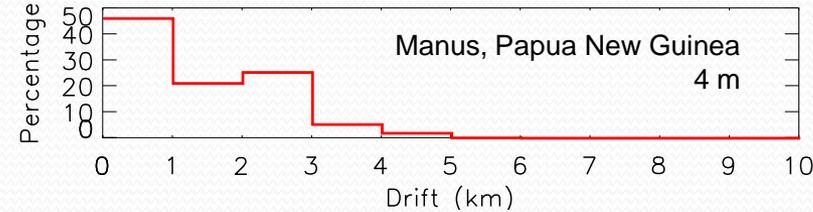
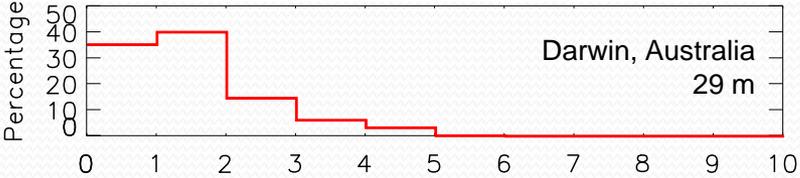
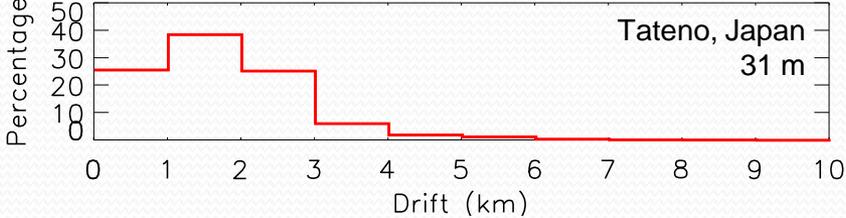
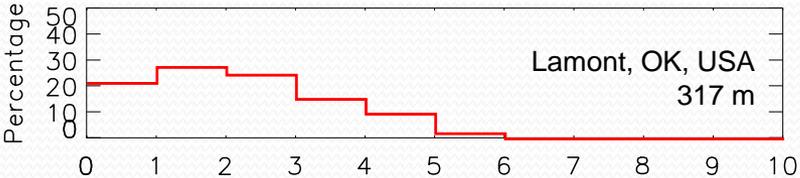
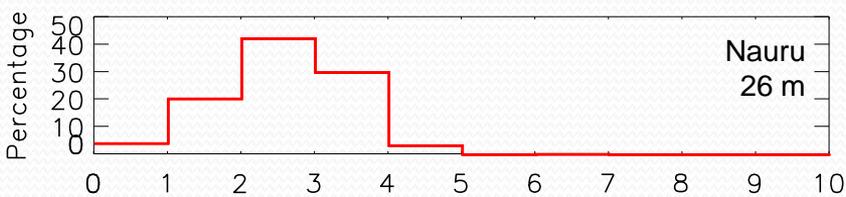
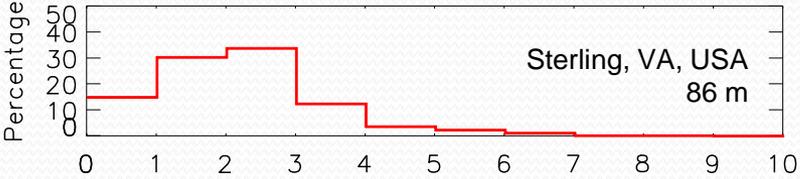
850 hPa Drift at GRUAN Candidate Stations



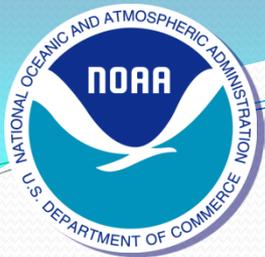
~40 km Boulder to Denver
~50 km Cabauw to De Bilt

~200 km Lauder to Invercargill
~350 km Potenza to Rome

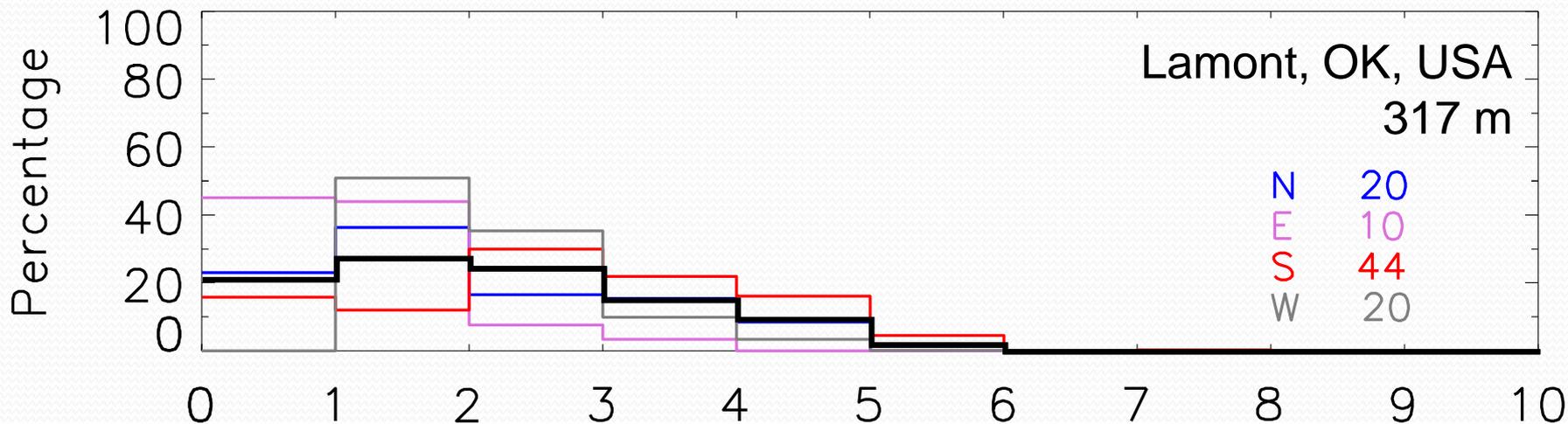
850 hPa Drift at GRUAN Candidate Stations



~50 km Beltsville MD to Sterling VA



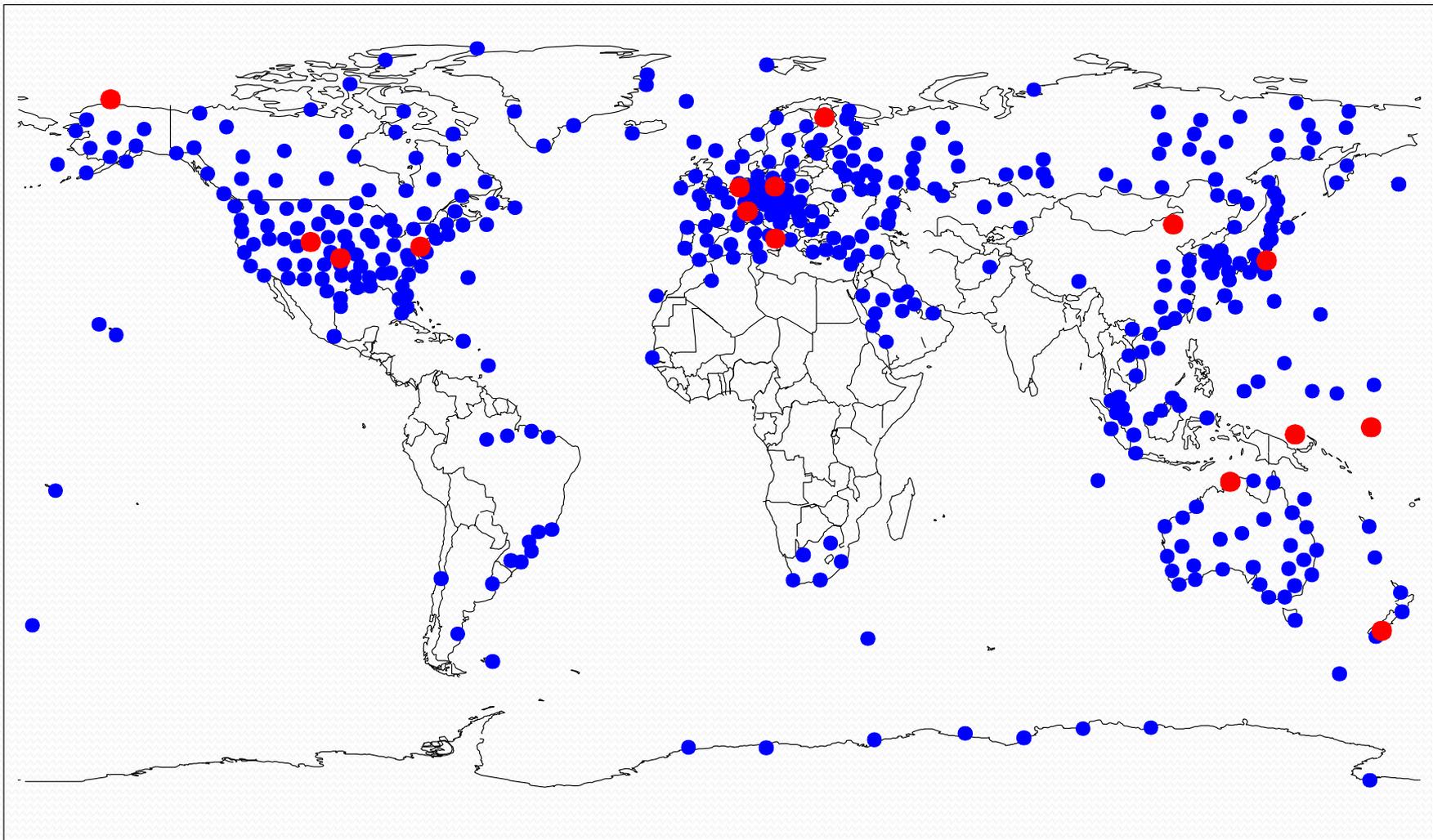
Wind direction effects





Radiosonde Station Network

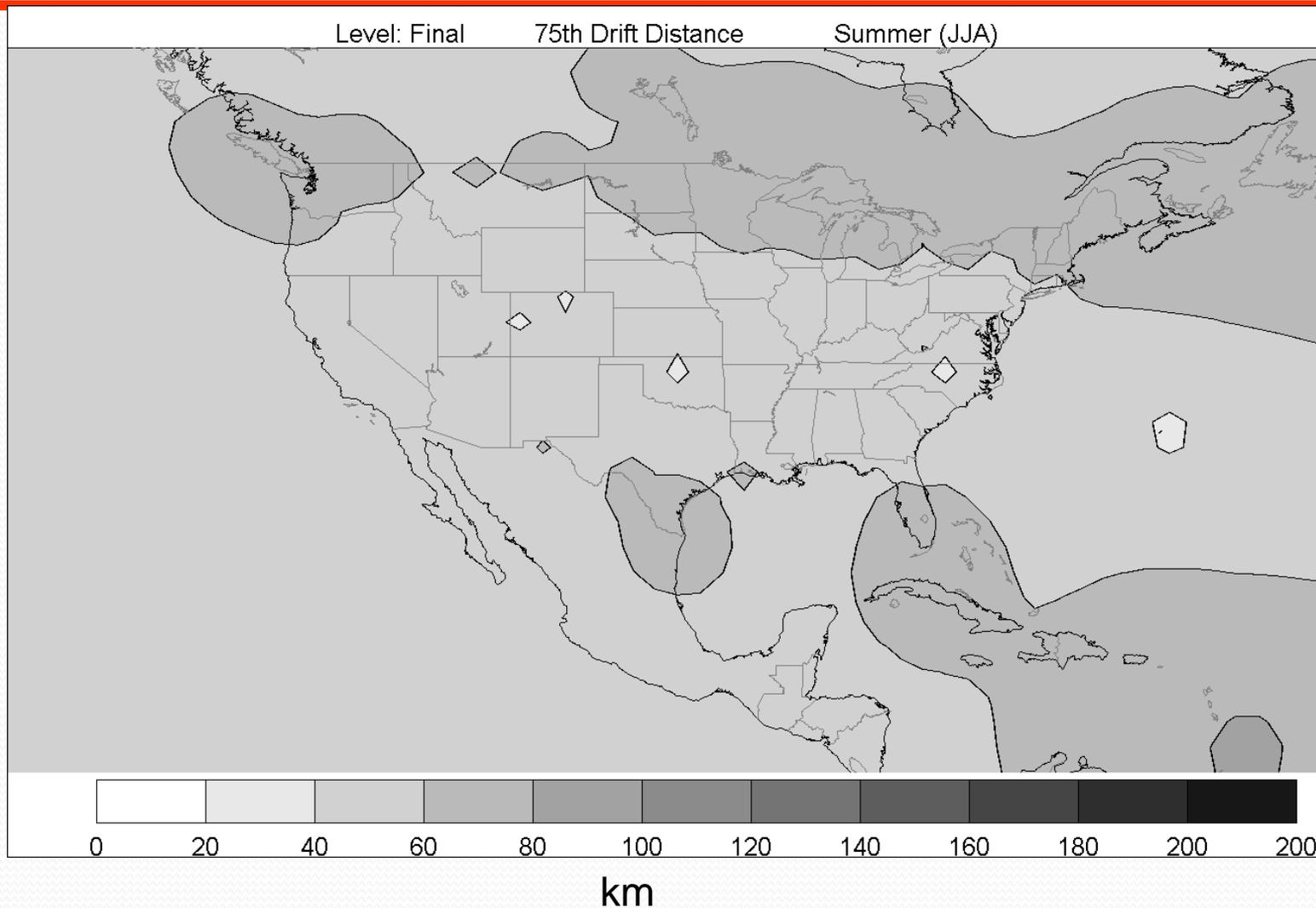
& GRUAN (candidate) sites





Example of Regional Results

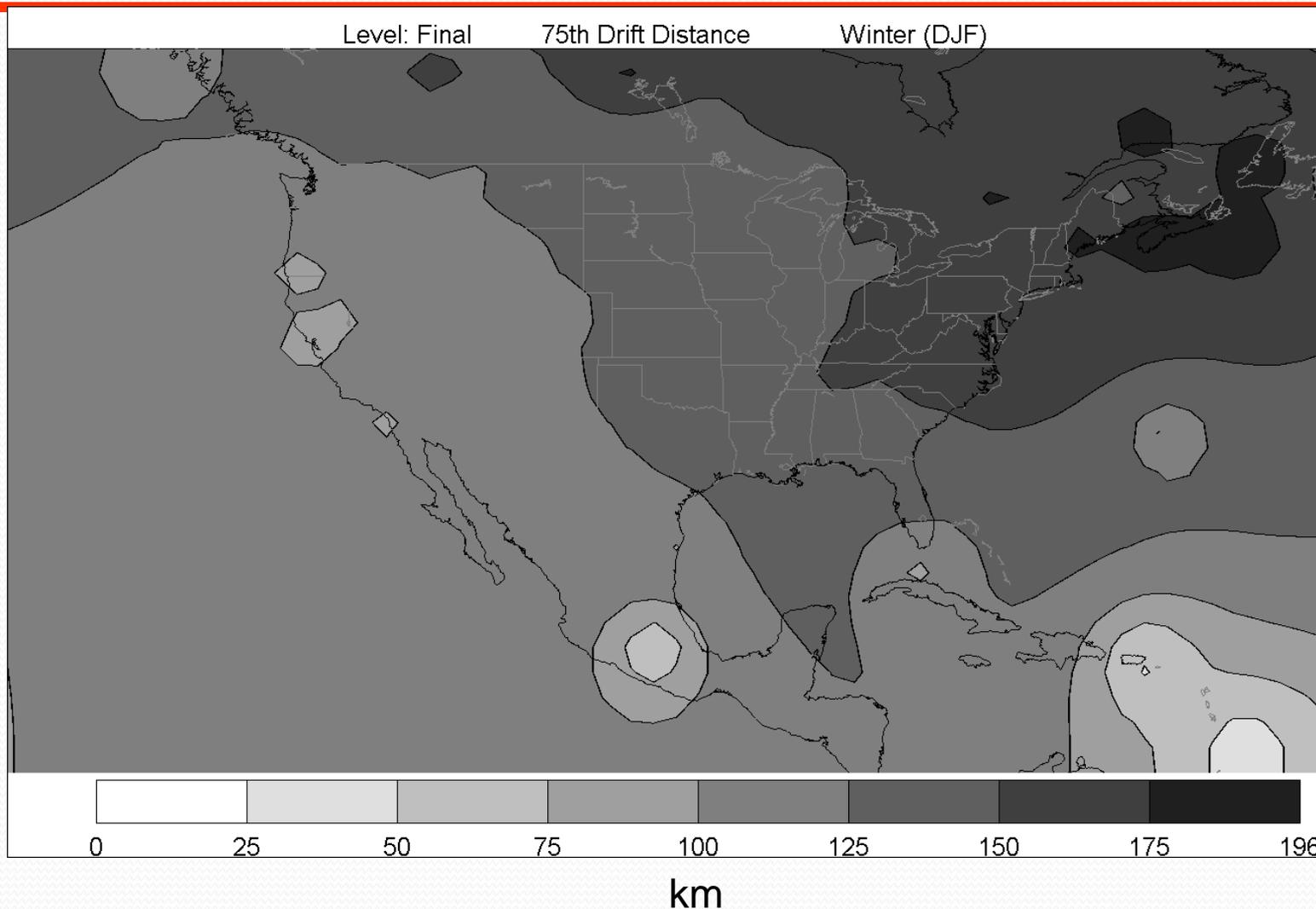
Summer Final Drift (75th %ile)





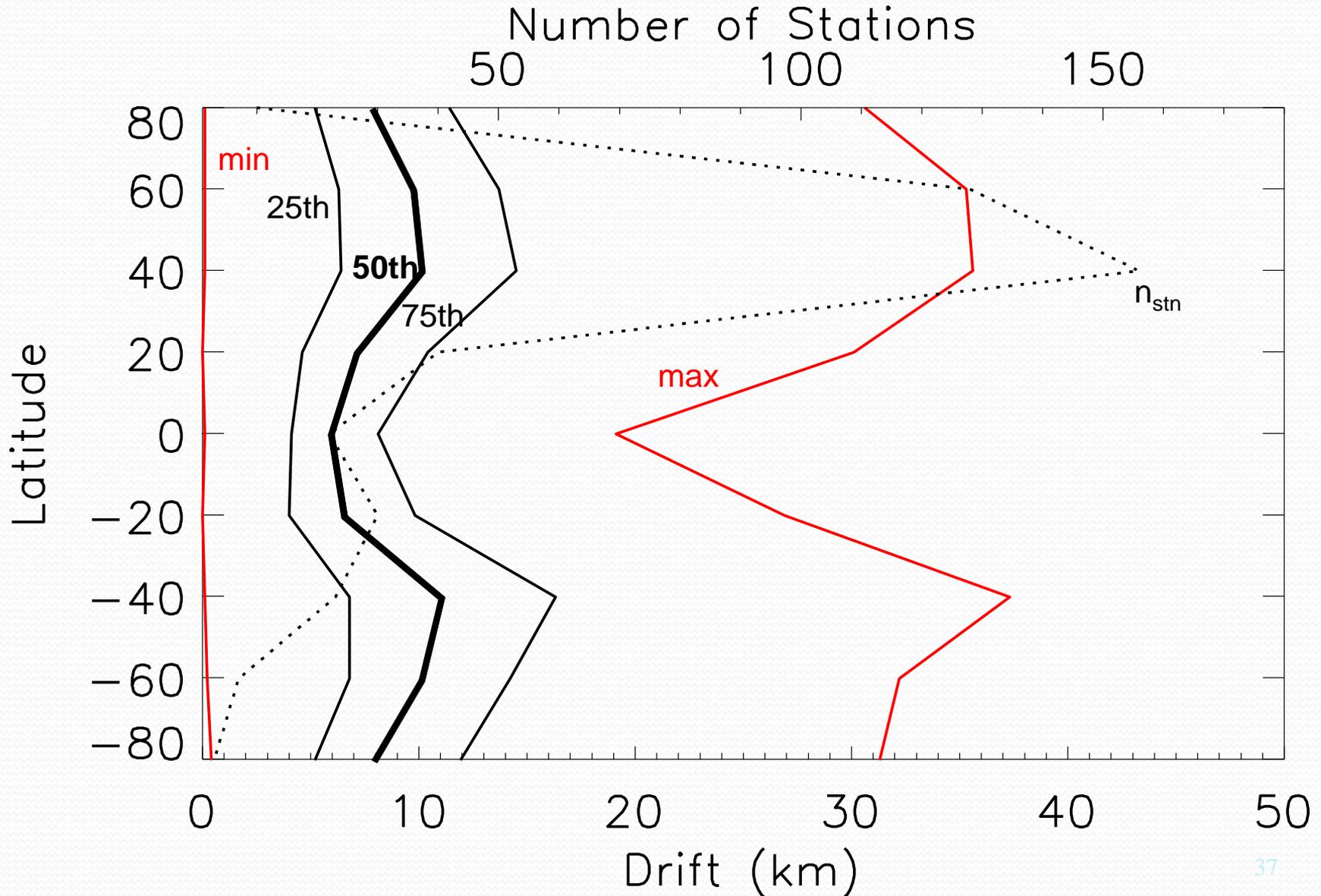
Example of Regional Results

Winter Final Drift (75th %ile)

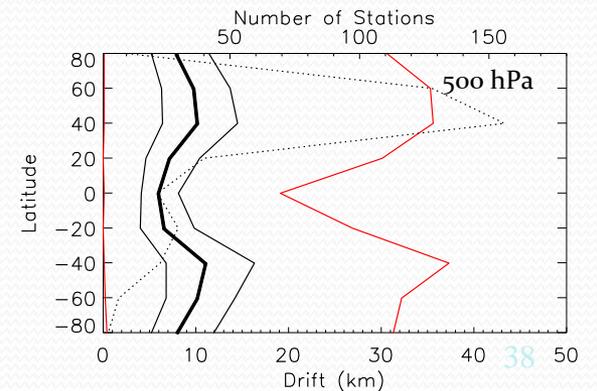
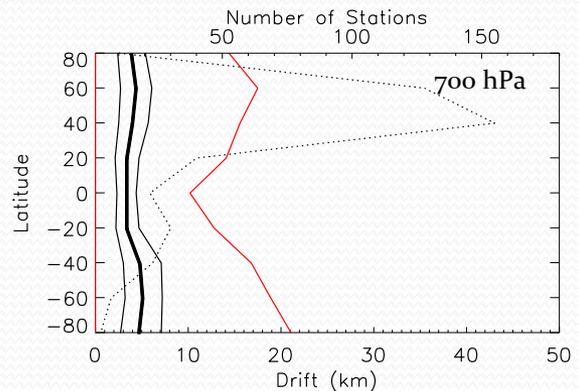
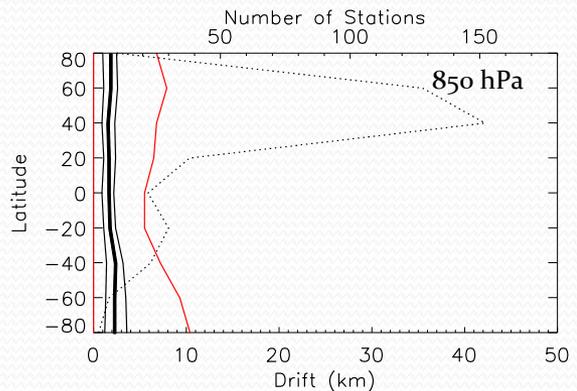
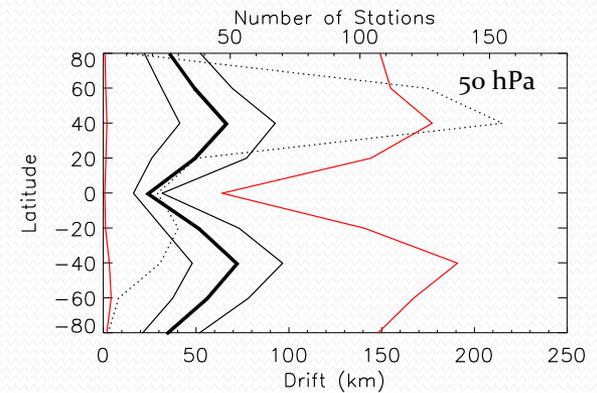
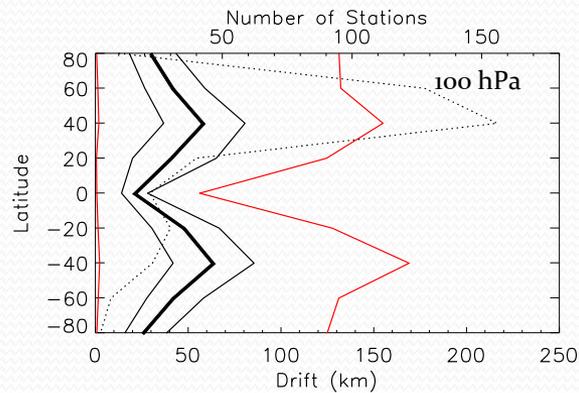
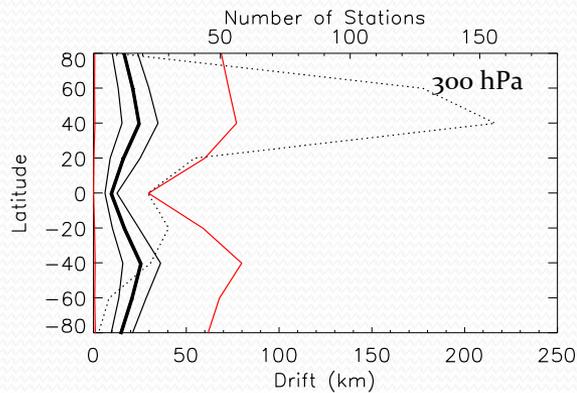
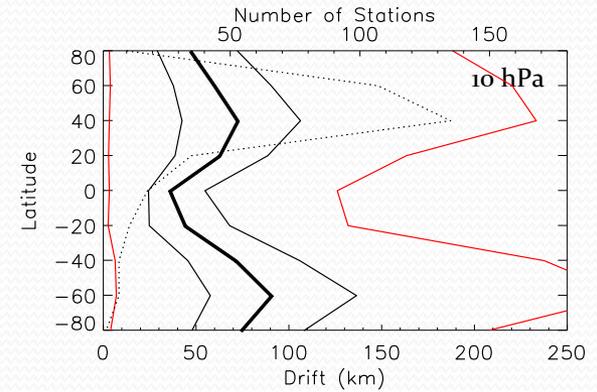
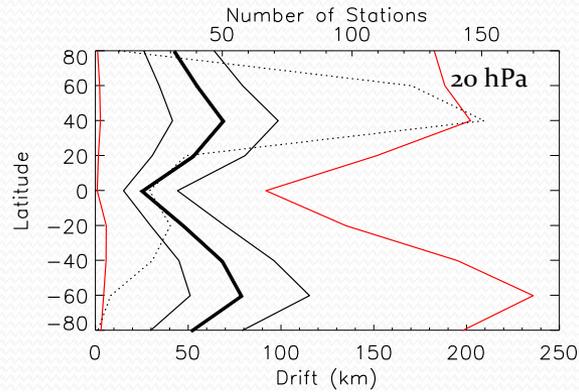
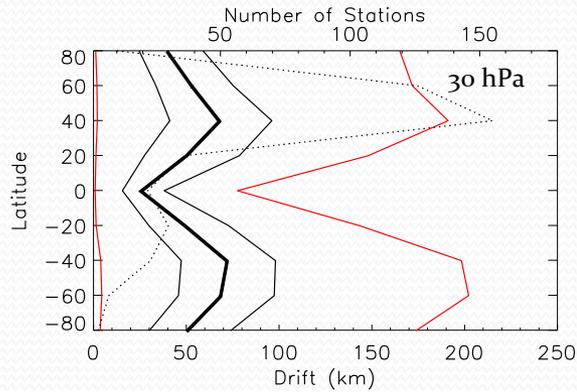


Global 500 hPa Drift Statistics

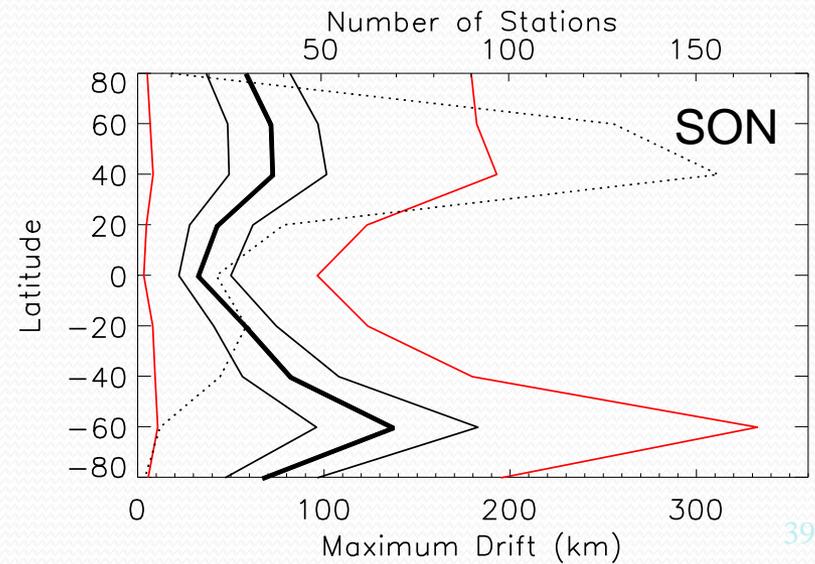
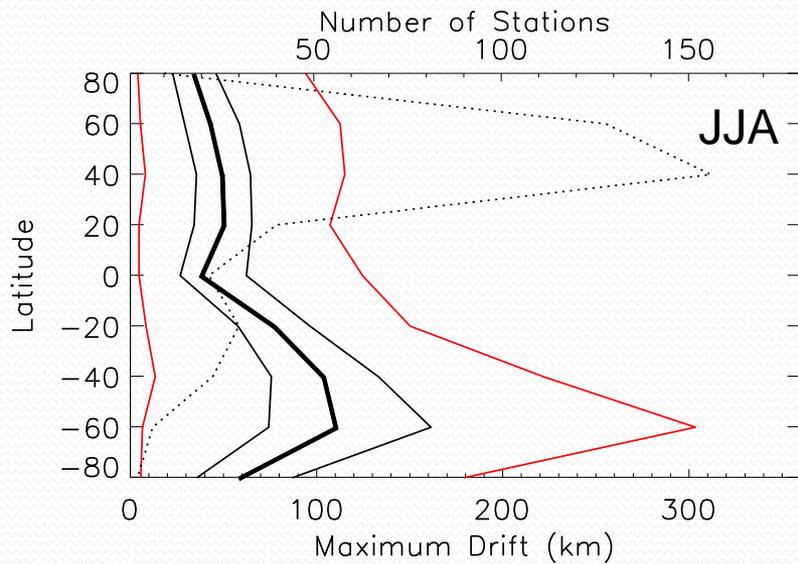
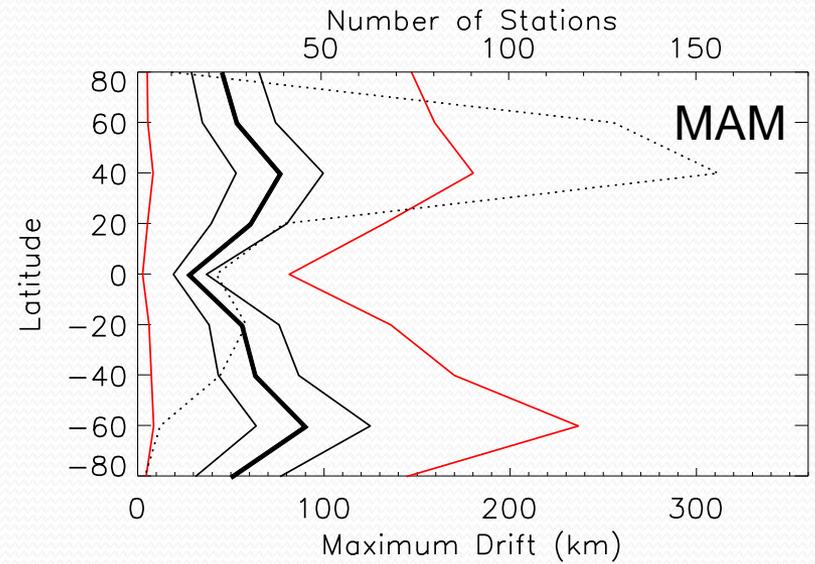
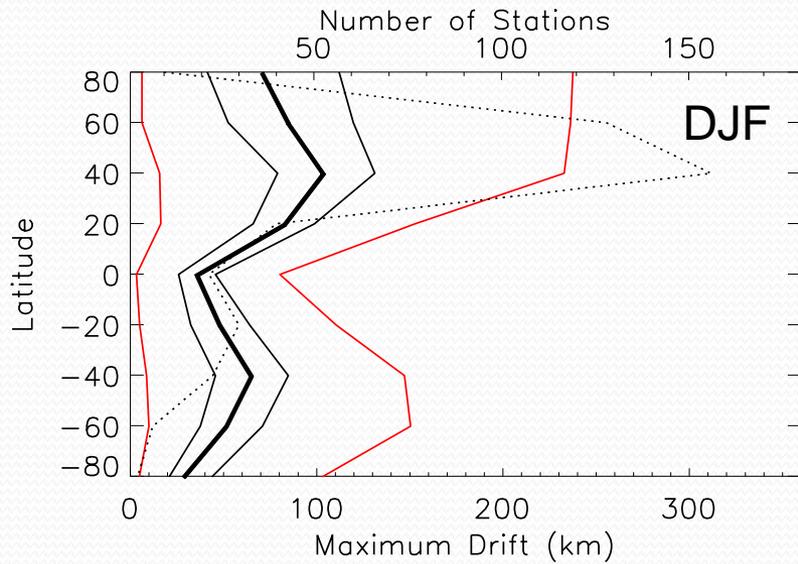
(avgs of station percentiles for 20° lat bands)



Pressure Level Drift Statistics



Seasonal Drift Statistics





Summary

- Balloon drift statistics quantify spatial sampling for in situ GRUAN observations
 - Probability distribution functions
 - Percentile values
- Data available for all GRUAN candidate sites, and for global radiosonde network
 - Seasonal patterns
 - Vertical variations
 - Wind-direction dependence
- Java-based “Drift Plotter” program available (see Tony Reale)
- Journal article in progress



Thank you!