Modeling and Measurements of Biogenic Isoprene in Southeast Texas

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Air Quality Division
Texas Commission on Environmental Quality
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- David Hitchcock, Houston Advanced Research Center

Recent history of TCEQ land cover data sets

- 1997-2001. Wiedinmyer et al. (2001). Land cover and land use data set, derived from Texas Parks and Wildlife data, USGS NLCD data for City of Houston, LCC and NASS data for agricultural areas. Used for SIP modeling from 2001-2006.
- 2001-2004. Texas Forest Service, USDA Forest Service, TCEQ, UH IMAQS, HARC, and others. Houston Green project for characterizing Houston's urban forest. See Byun et al. (2005), *J. Env. Mgmt* 75: 285-301, and www.HoustonRegionalForest.org
- 2003-2006. UT-Center for Space Research, Texas Forest Service, TCEQ, and HARC. Land cover data set(s) for photochemical grid modeling. Feldman et al., submitted.

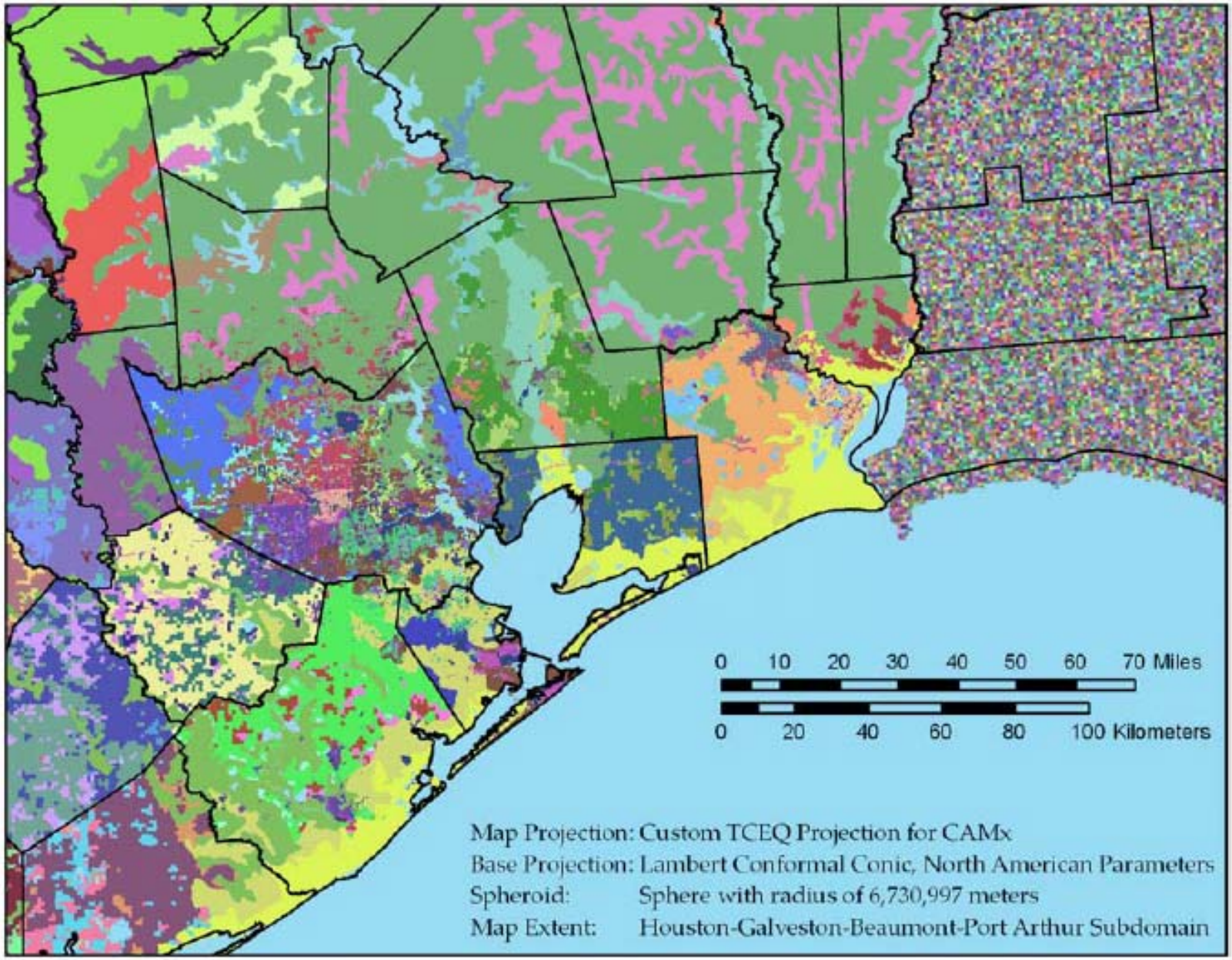
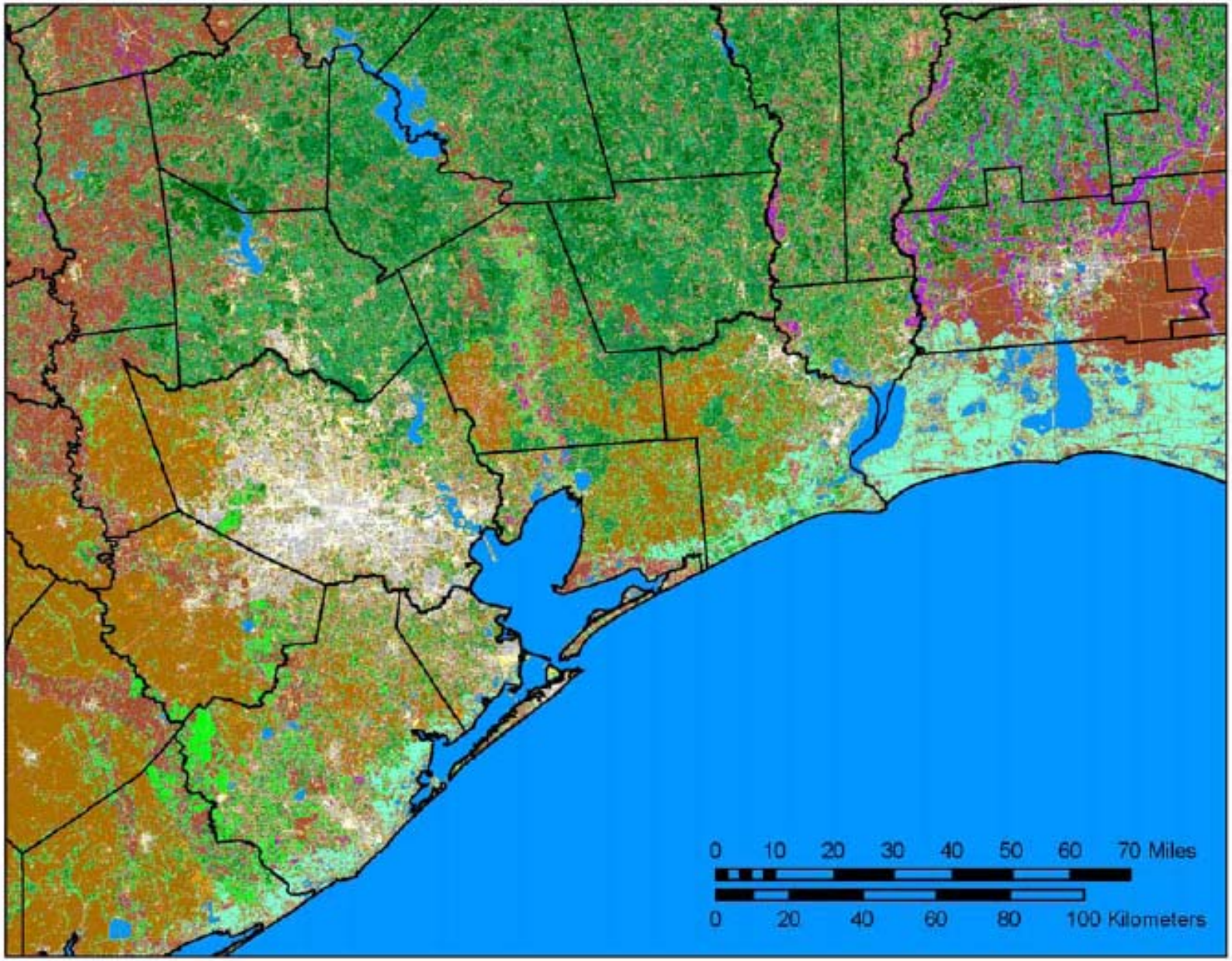


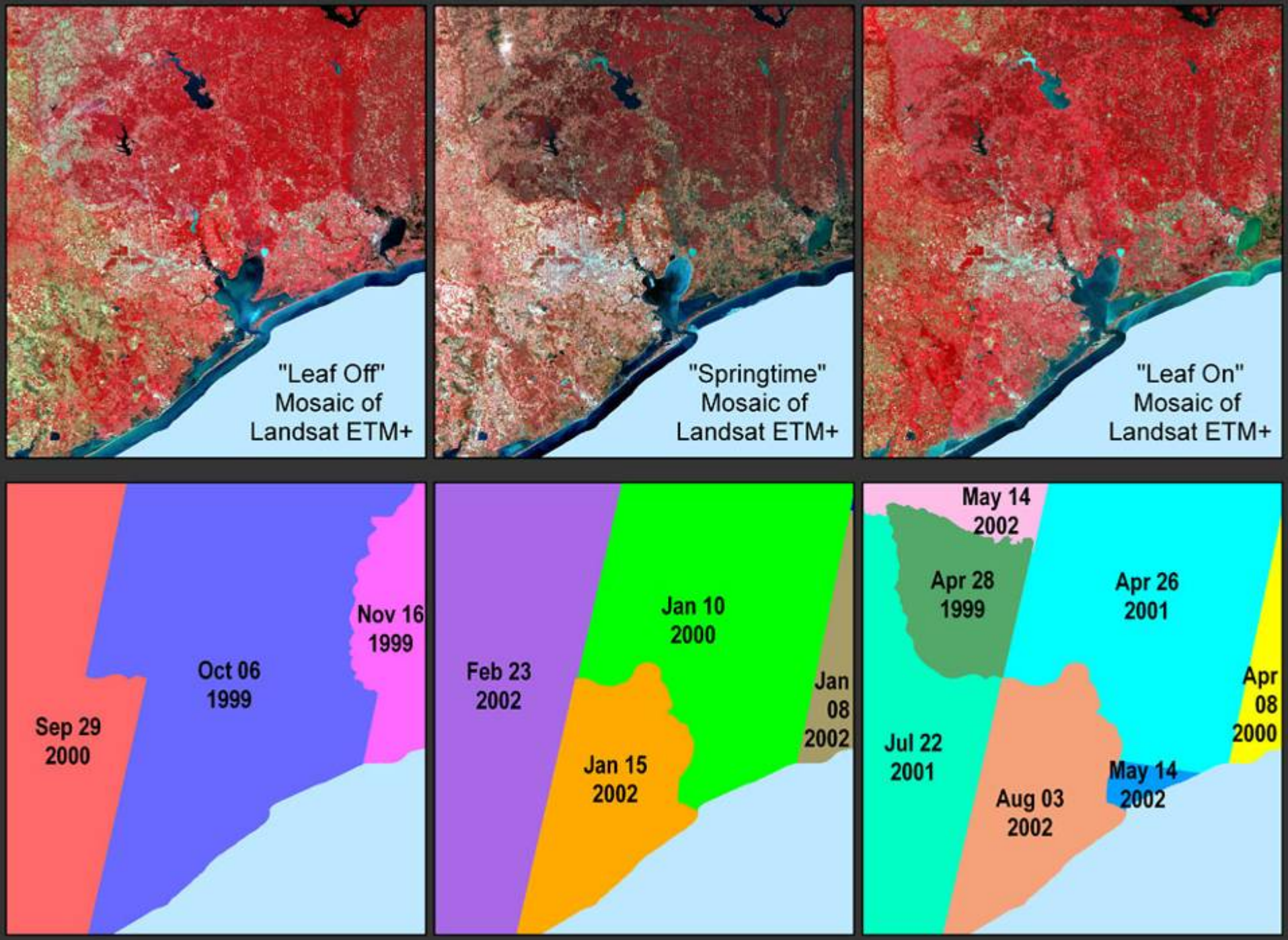
Figure 1.1. Example of Wiedenmeyer (Texas counties) and BELD 3.1 (Louisiana parishes) land cover types in the Houston metropolitan area.



Reclassified Land Cover for GloBEIS

Data used for developing the new land cover data set

- Classification of Landsat 7 data
- Shuttle Radar Topography Mission and National Elevation Dataset were used to help identify wetlands.
- USDA Common Land Unit data were used to help identify agricultural lands.
- Accuracy assessment and iterative refinements of the classifications were done with National Agricultural Imagery Program data, Digital Orthophoto Quarter Quads, and USGS National Land Cover Data 2001 data.
- Classification scheme is compatible with Texas Land Classification System, which was developed in 1999, in collaboration with other Texas state agencies.


"Leaf Off"
Mosaic of
Landsat ETM+
"Springtime"
Mosaic of
Landsat ETM+
"Leaf On"
Mosaic of
Landsat ETM+
Sep 29
2000
Oct 06
1999
Nov 16
1999
Feb 23
2002
Jan 15
2002
Jan 10
2000
Jan
08
2002
May 14
2002
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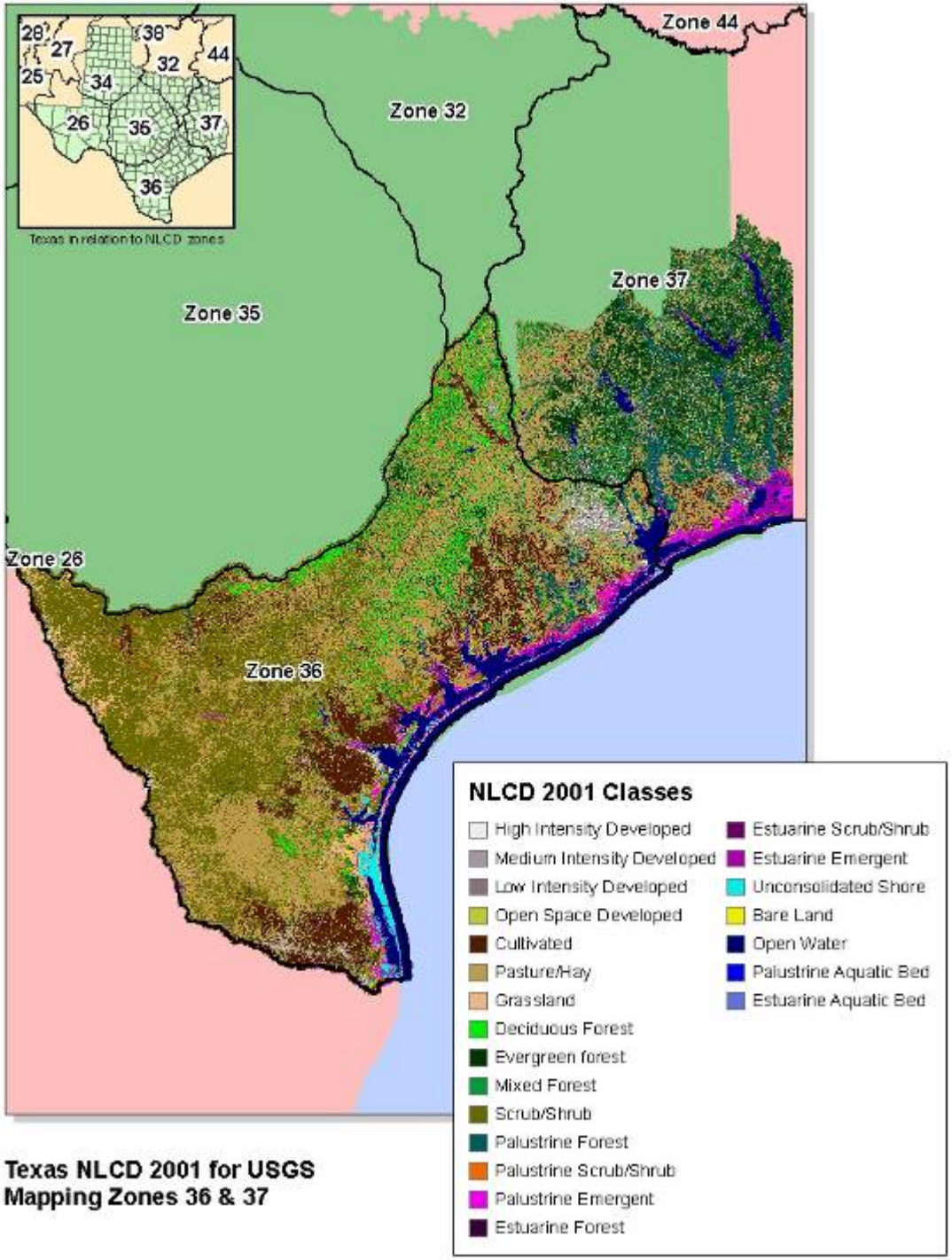
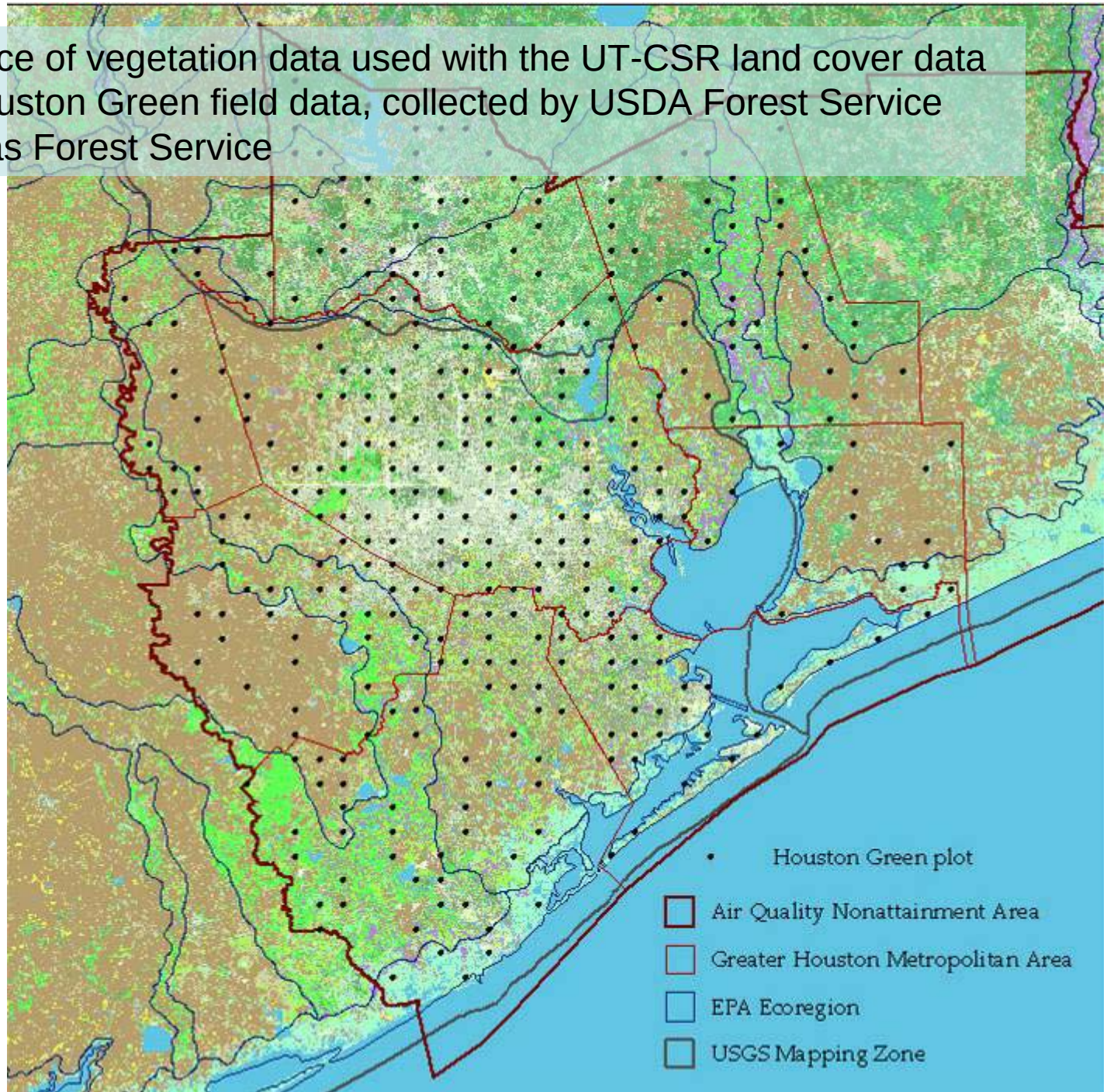
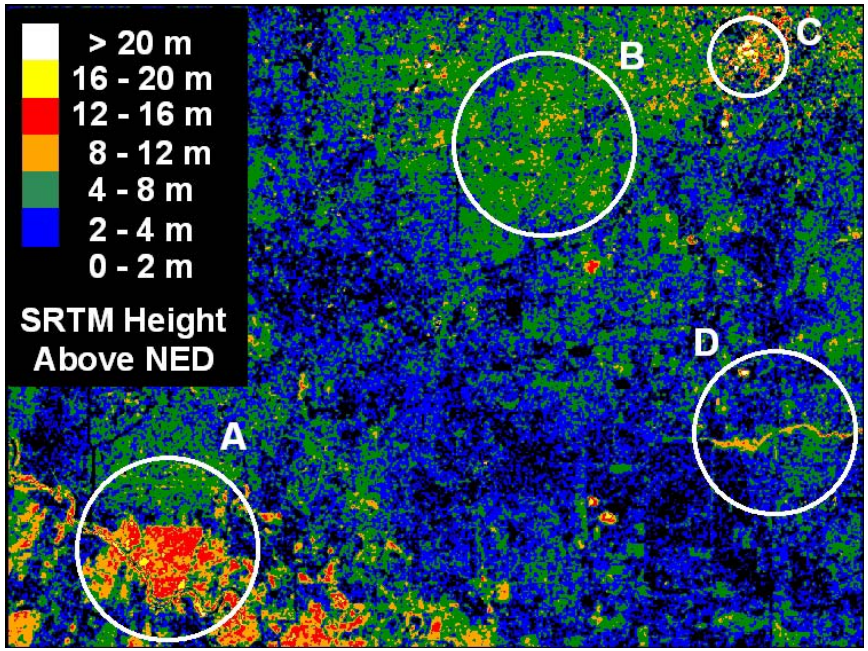


Texas NLCD 2001 for USGS Mapping Zones 36 & 37

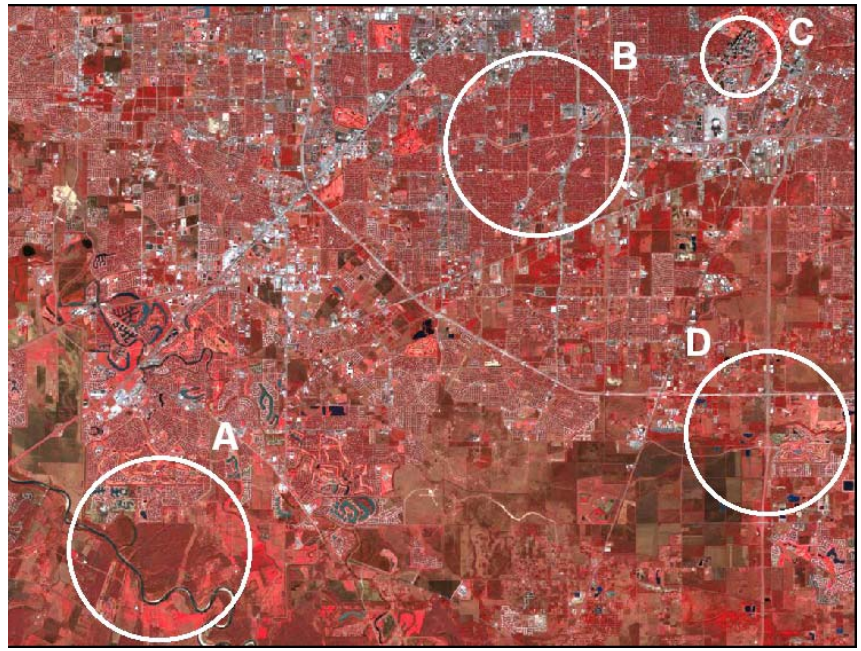
The source of vegetation data used with the UT-CSR land cover data is the Houston Green field data, collected by USDA Forest Service and Texas Forest Service



SRTM / NED: A Height Difference Grid, Statewide Coverage



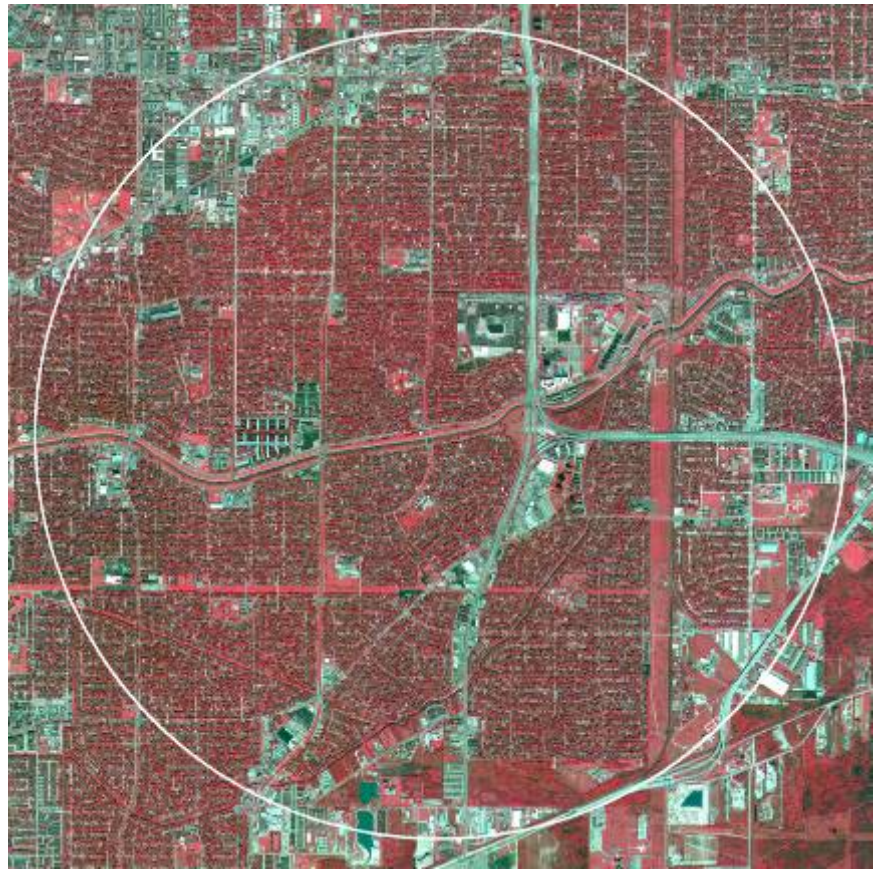
SRTM / NED difference data: February 2000



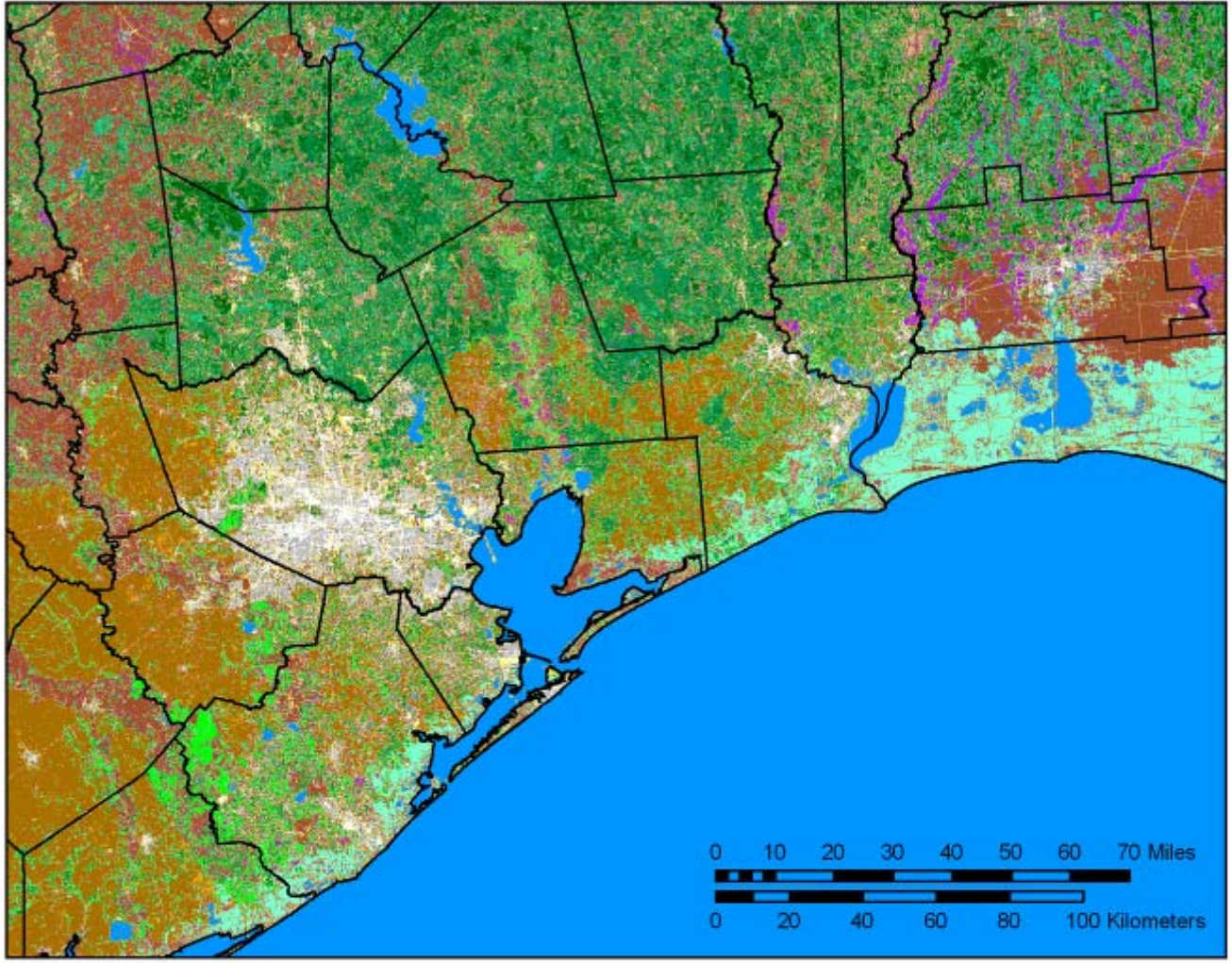
Landsat 7 ETM+: January 10, 2000

Texas NAIP
National Agricultural Imagery Program

1-meter resolution, acquired Summer/Fall 2004, color infrared



SCALE 1:35,000

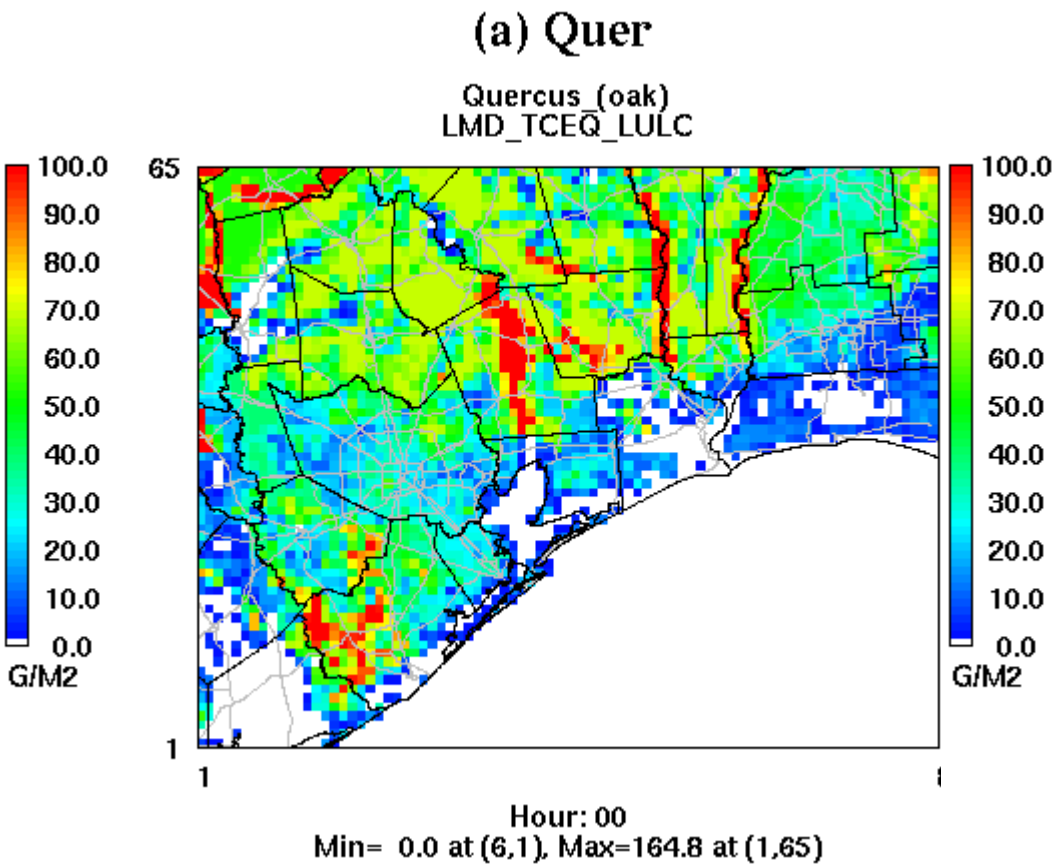


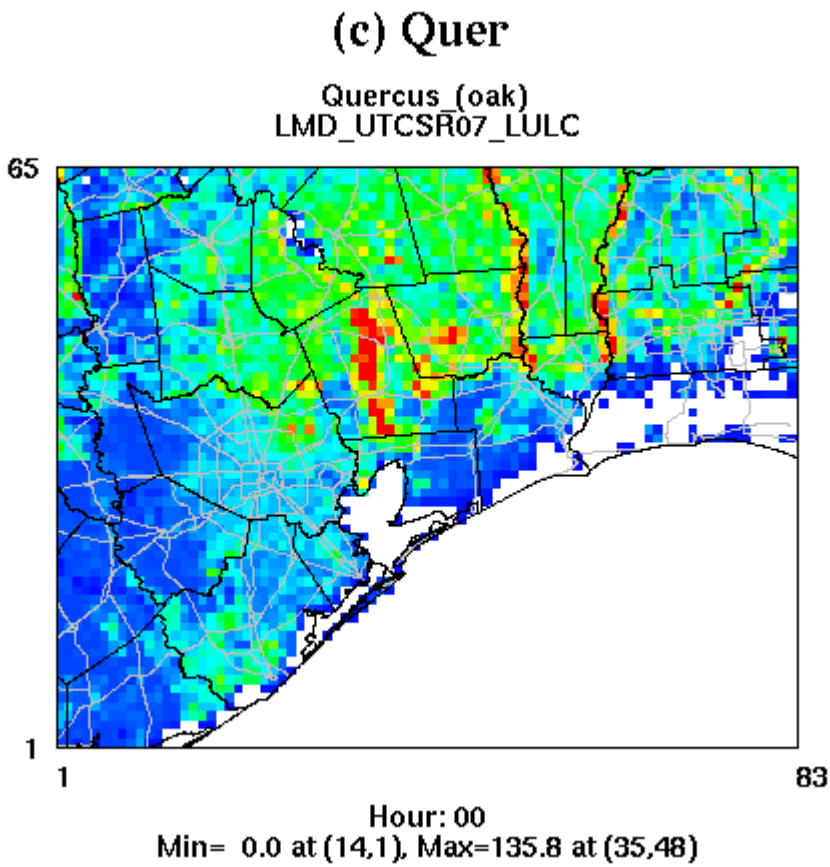
Reclassified Land Cover for GloBEIS

- Open Water
- Developed Open Space
- Developed Low Intensity
- Developed Medium Intensity
- Developed High Intensity
- Barren Land/Unconsolidated Shore
- Natural Herbaceous (excluding Ecoregion 34a)
- Cultivated Herbaceous (excluding Ecoregion 34a)
- Woody Wetland
- Natural Herbaceous (Ecoregion 34a, only)
- Cultivated Herbaceous (Ecoregion 34a, only)
- Herbaceous Wetland
- Cold-Deciduous Forest (Ecoregion 34)
- Cold-Deciduous Forest (Ecoregion 35)
- Needle-leafed Evergreen Forest
- Mixed Forest
- Woodland
- Shrubland

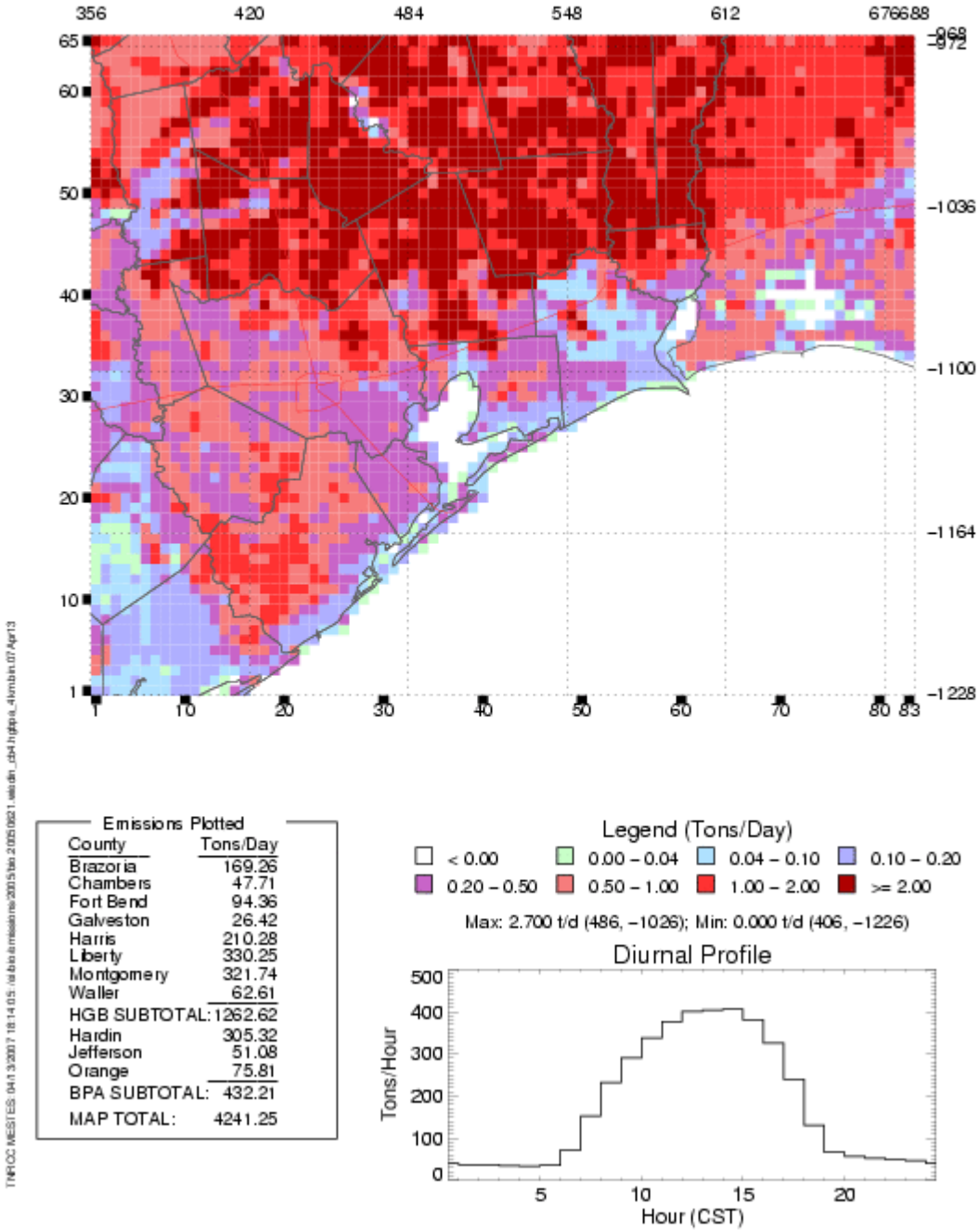
Oak leaf biomass distribution, from Wiedinmyer et al., 2001

Oak leaf biomass distribution, from UT-CSR LC + TFS vegetation



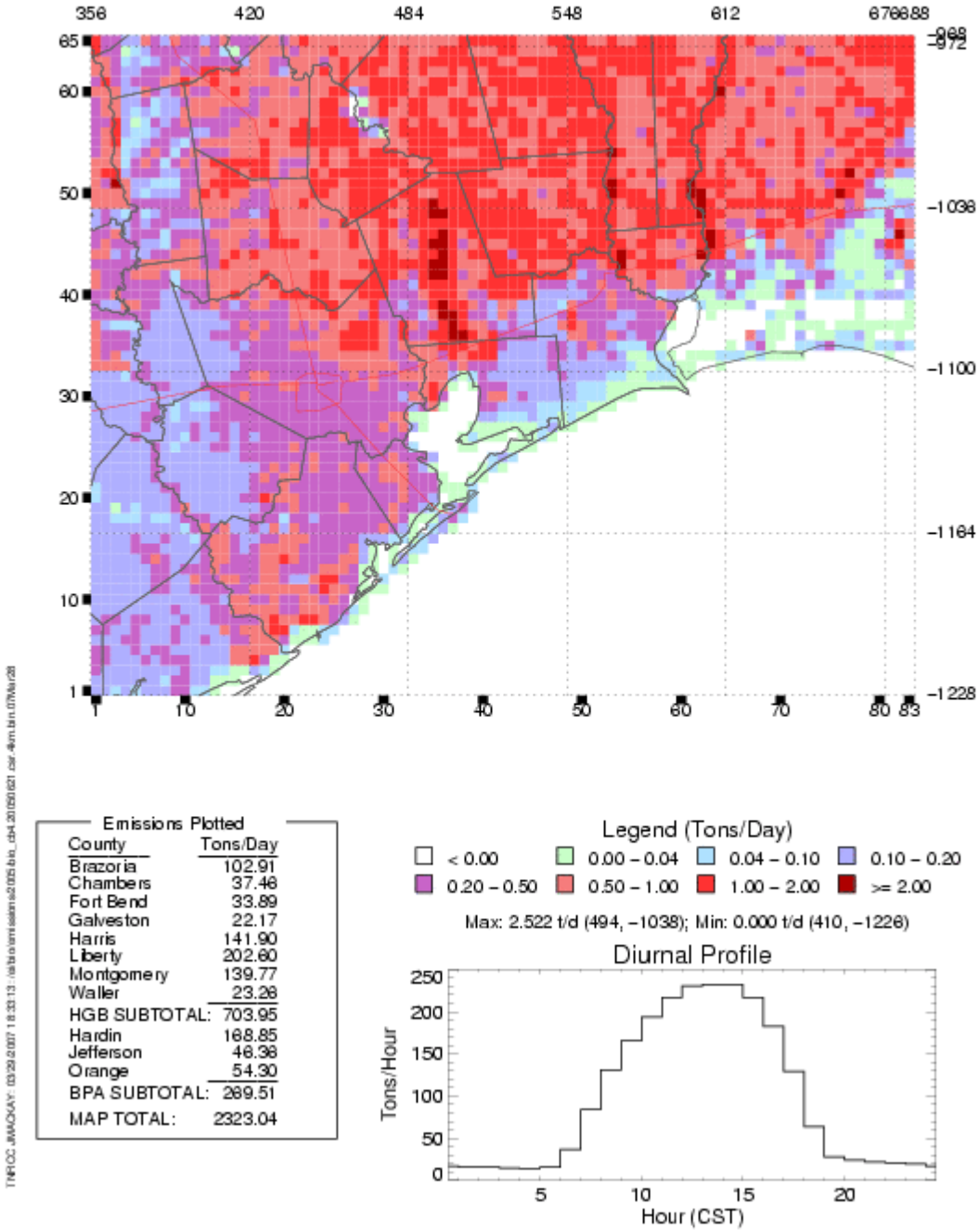


Figures by Soontae Kim, University of Houston



Biogenic emissions for June 21, 2005, based upon Wiedinmyer et al. (2001) land use/land cover data:

4241 tons VOC for the domain

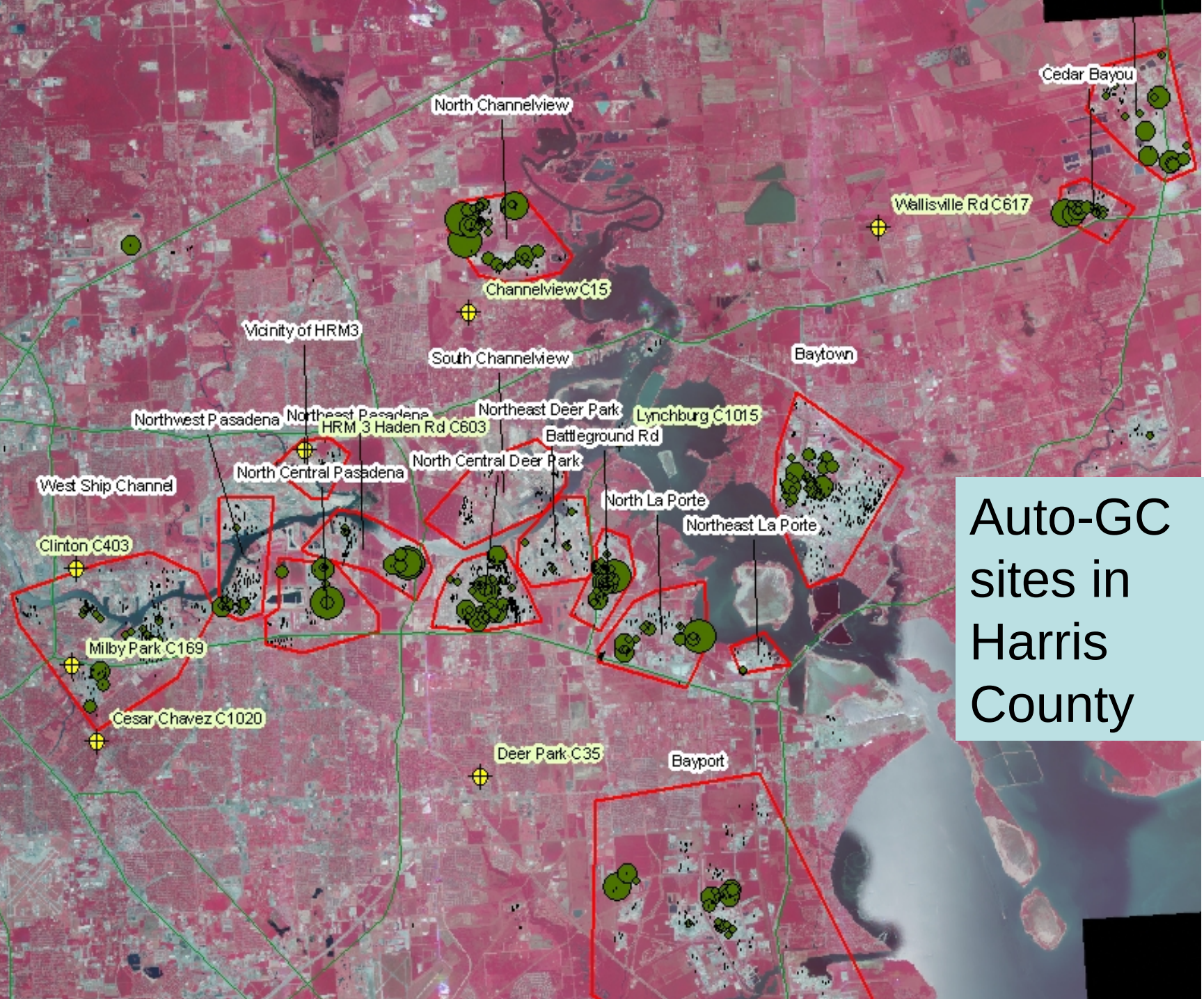


Biogenic emissions for June 21, 2005, based upon UT-CSR land cover data:

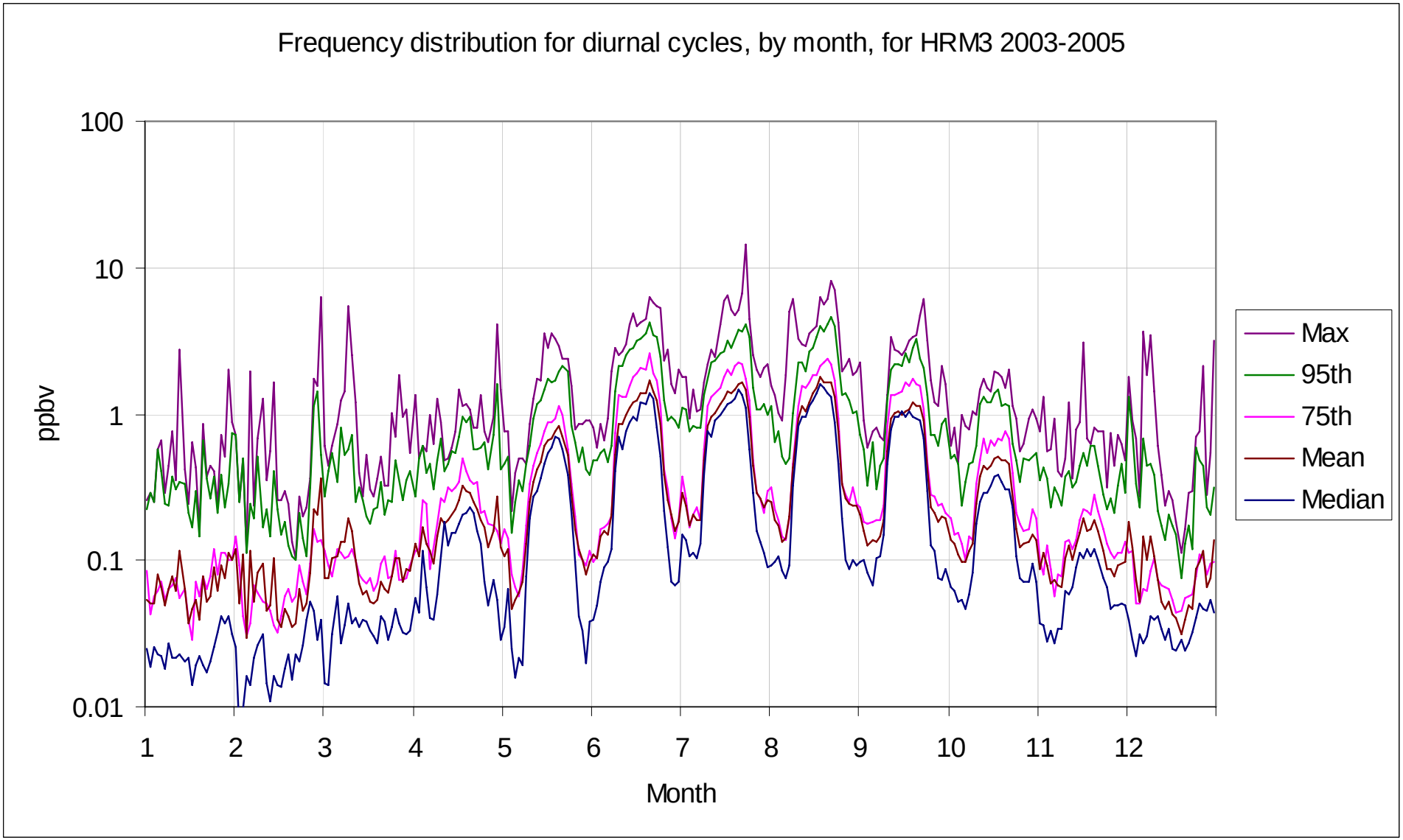
2323 tons VOC for the domain

Isoprene data in Houston

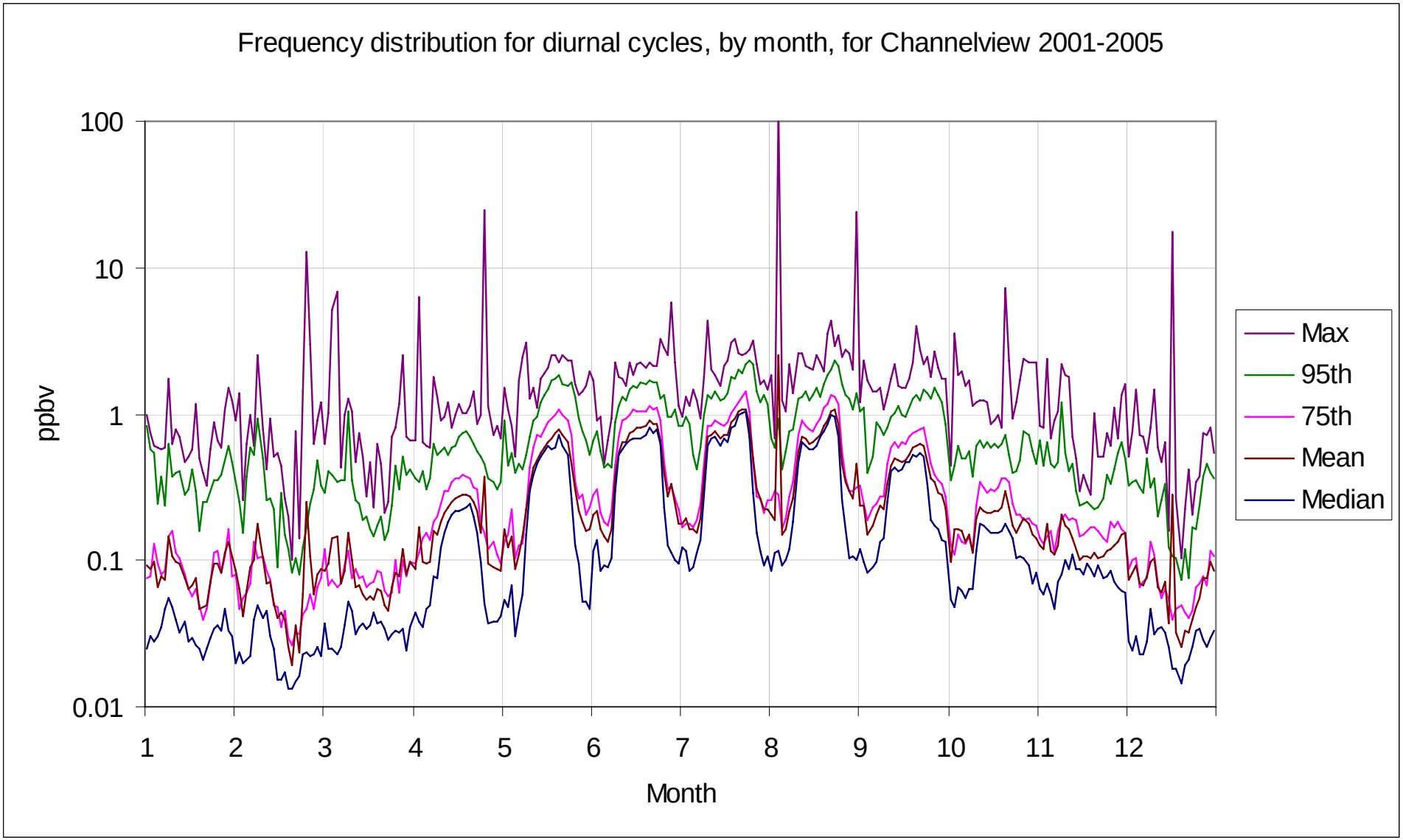
- How representative were biogenic emissions during 2006? Can't answer directly, but can look at isoprene concentrations to get rough guidance.
- Which auto-GC sites are appropriate for assessing biogenic emissions, given that there are some anthropogenic isoprene sources in Houston? Look at isoprene behavior at different sites.



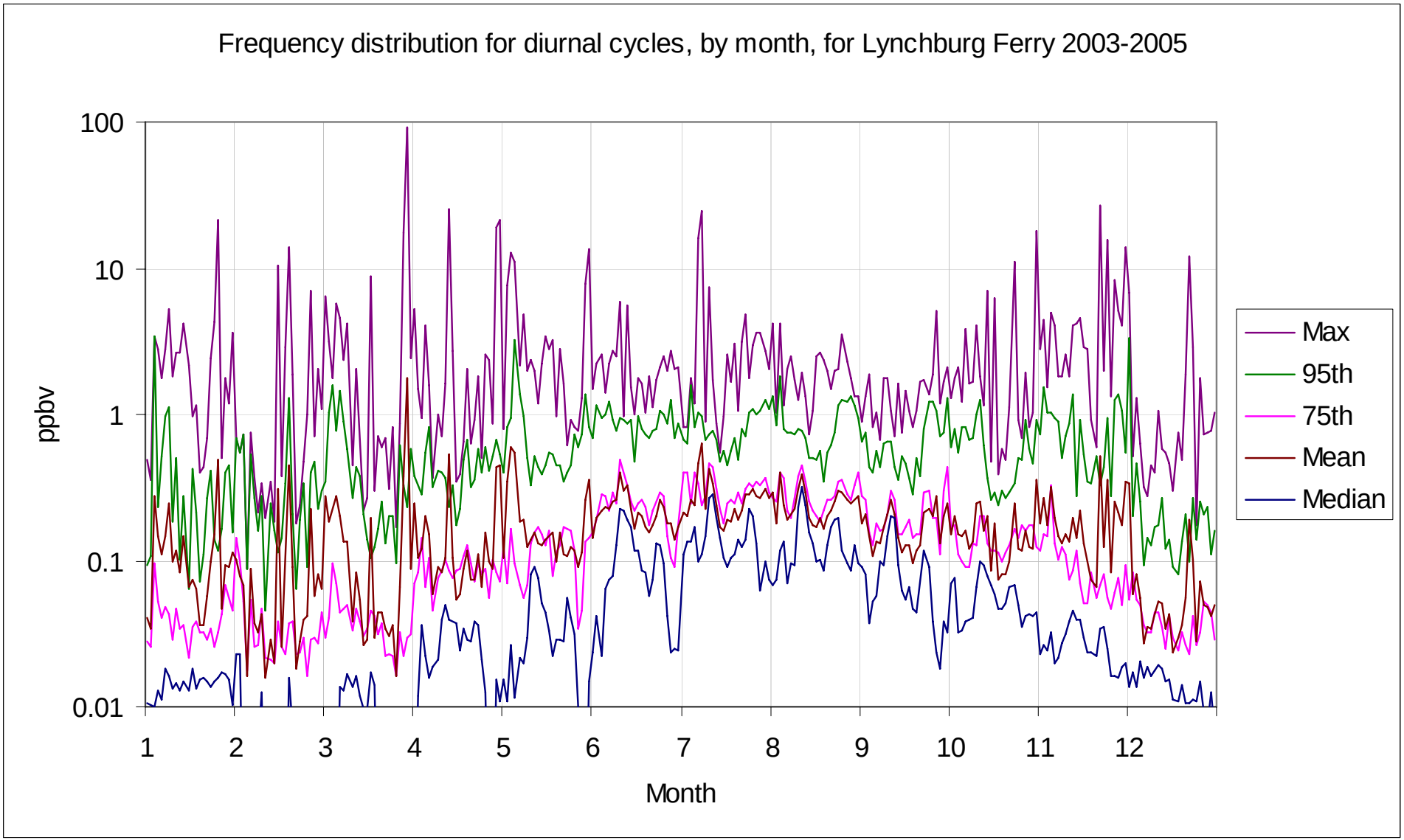
Auto-GC sites in Harris County



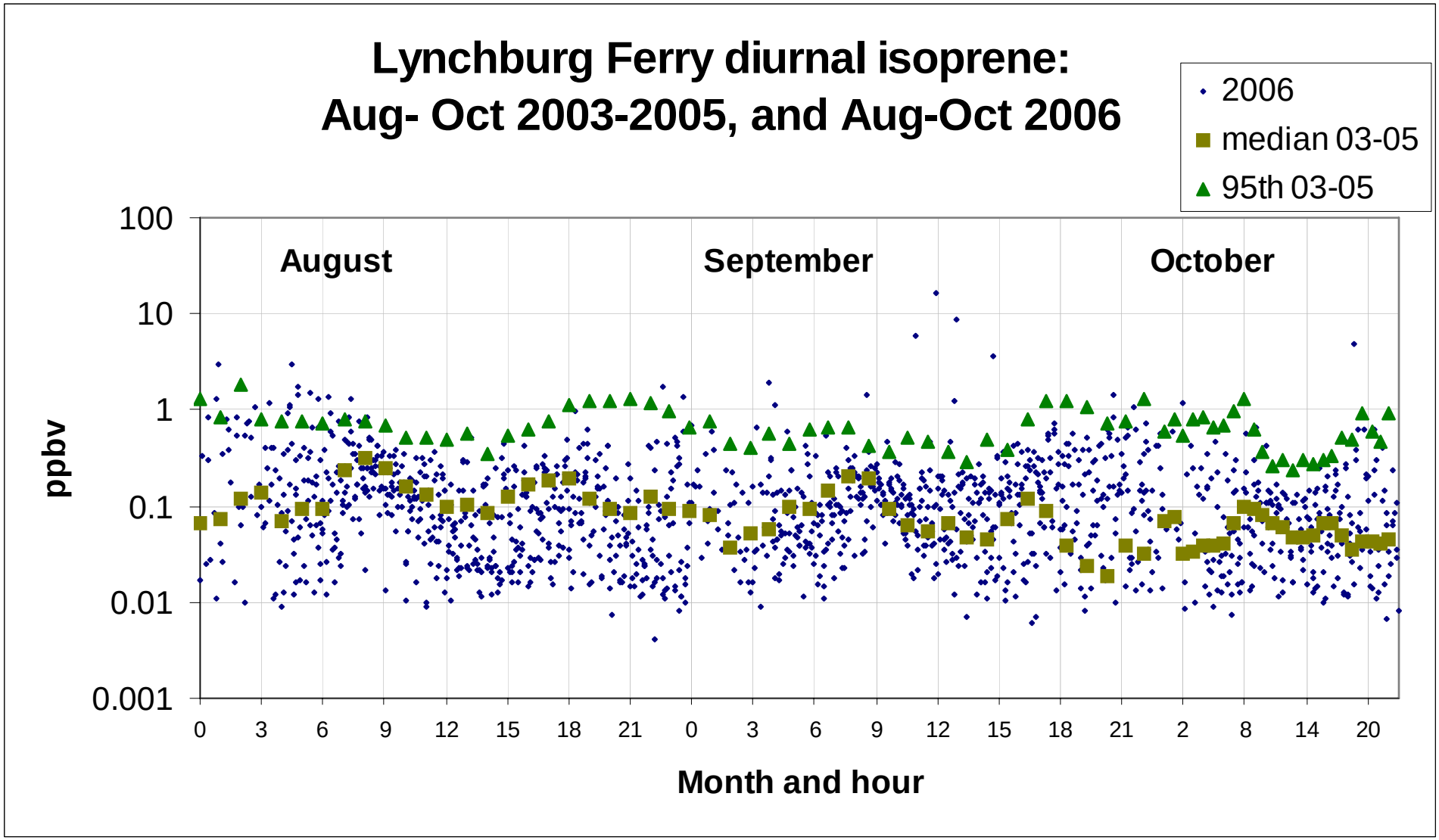
Seasonal and diurnal cycles are consistent with biogenic emissions.



Seasonal and diurnal cycles are consistent with biogenic emissions, but there are notable isoprene spikes during summer and winter.

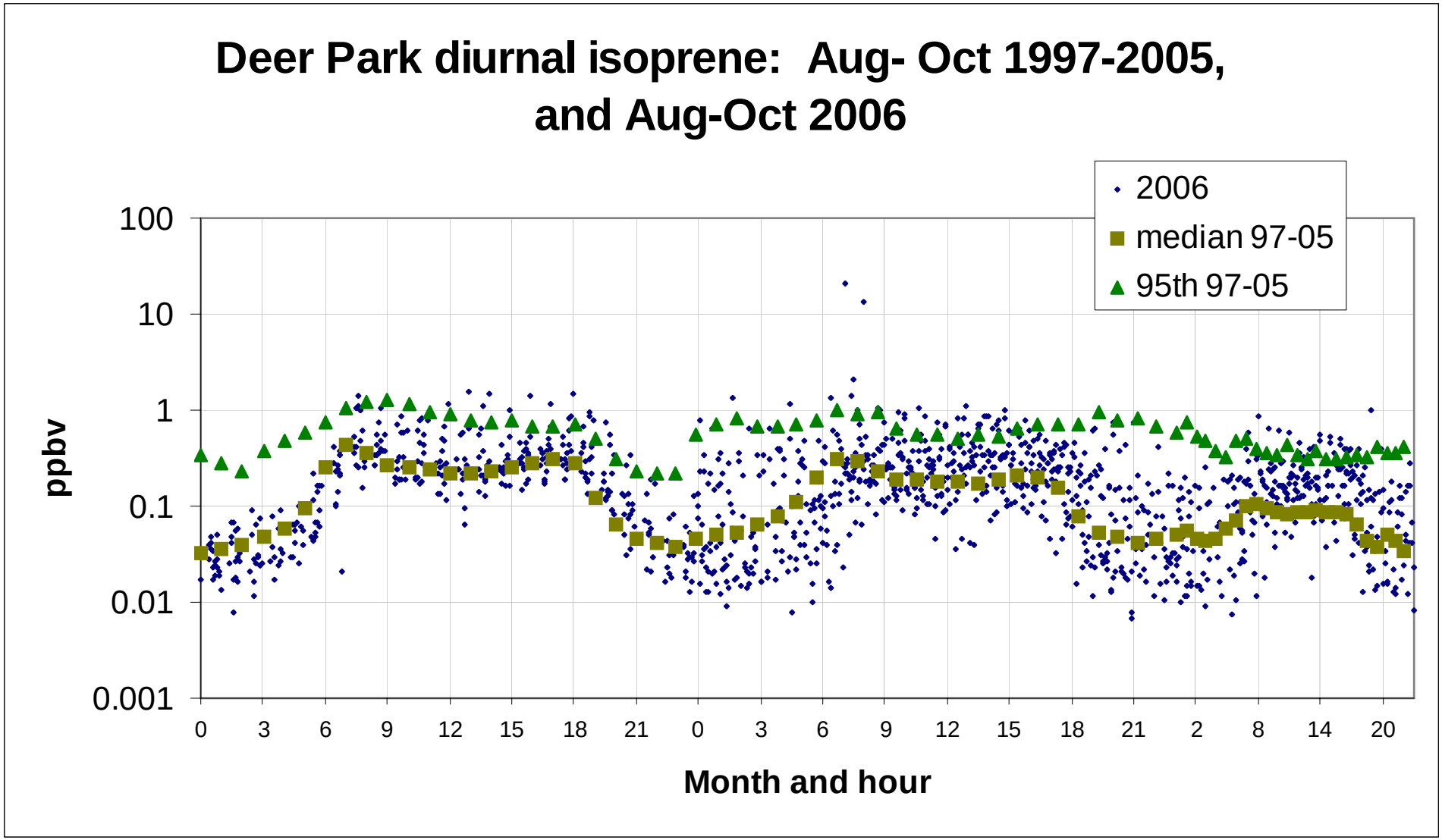


Seasonal cycle is consistent with biogenics (background?), but otherwise apparently dominated by plumes from anthropogenic source(s).

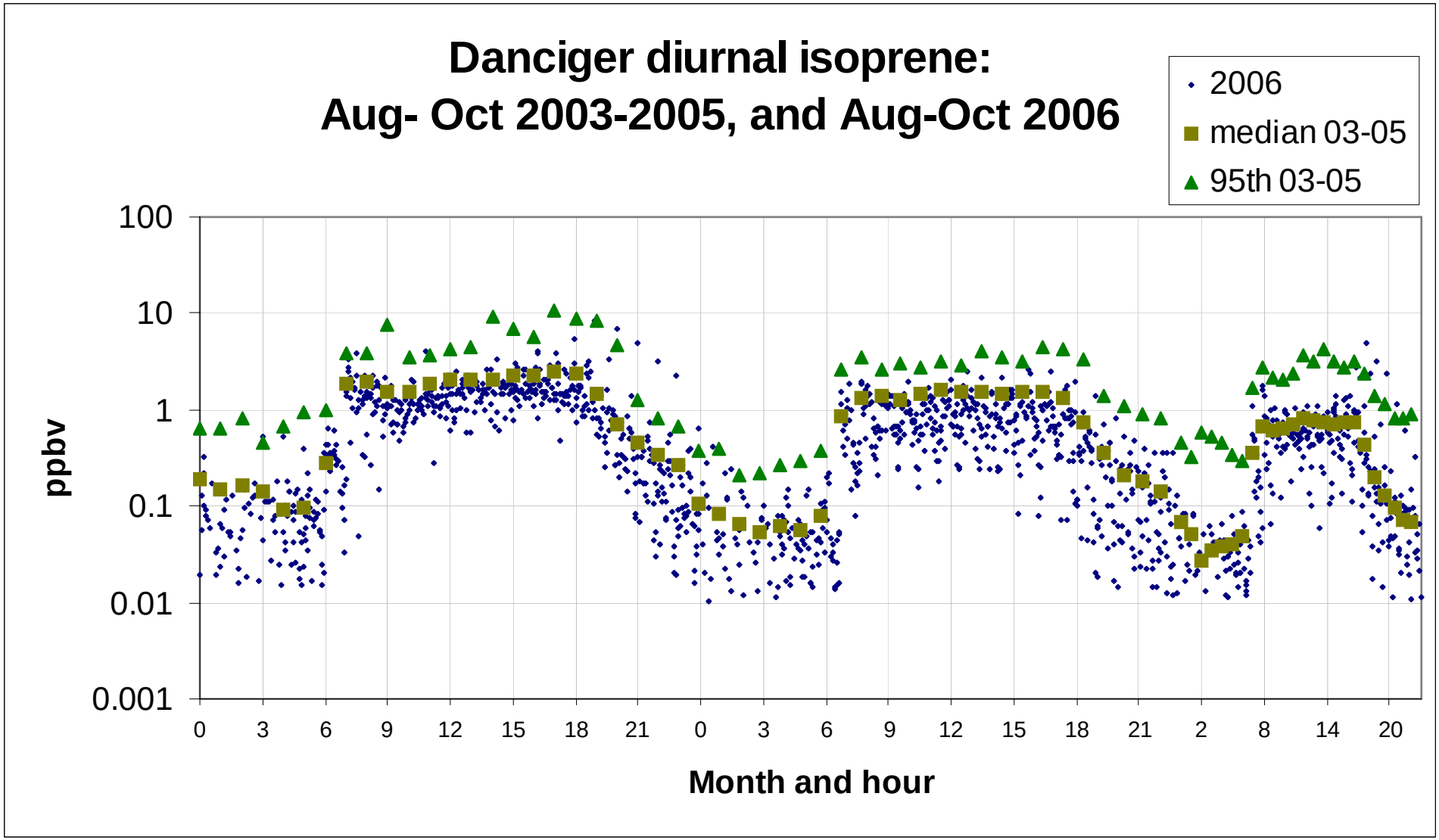


2006 isn't particularly unusual at Lynchburg Ferry site—mostly anthropogenic isoprene.

Eastern Harris County site shows biogenic signal with perhaps mobile influence during rush hours. 2006 appears to be representative of previous 9 years.



Two measurements >10 ppbv in September 2006 suggest anthropogenic isoprene plume.



Brazoria County site shows biogenic cycles, with concentrations often a bit lower than 3-yr median, and no apparent anthropogenic influence.

Summary

- New land cover data has improved spatial resolution and more quantifiable uncertainties.
- Biogenic emissions derived from new land cover and vegetation data are about 40% lower.
- Isoprene observations in 2006 are consistent with previous years.
- Several sites occasionally observe isoprene spikes, apparently associated with point sources.
- Lynchburg Ferry auto-GC is not appropriate for verifying biogenic emissions, but may be useful in identifying anthropogenic isoprene sources.