

Analysis of the Stationary Front Experiment

During TEXAQS II

Project T1

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Outline

- Justification for the study of stationary fronts – DFW episodes
- Review of the stationary front experiment conducted in 2006
- Summary and proposed further analysis

Why do Stationary Fronts Cause High Concentrations?

Potential Negative Contributions to High Concentrations

- They are often associated with cloudiness which would tend to decrease photochemical production.
- They are sometimes associated with deep moist convection which would enhance vertical mixing leading to increased dilution.

Potential Positive Contributions to High Concentrations

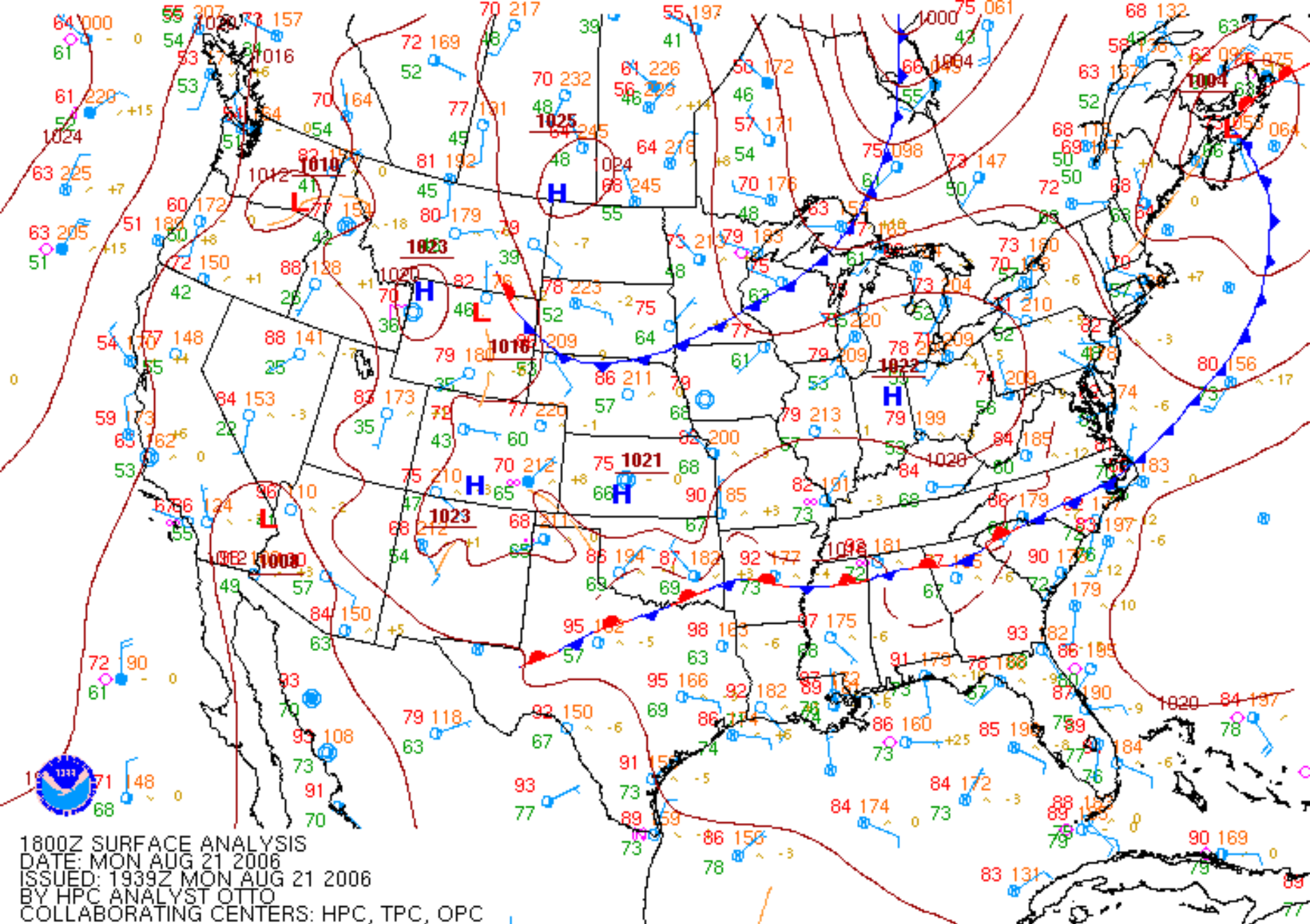
- Winds are light across the sheared frontal zone leading to a lack of dilution of surface precursor emissions.
- Lowered mixing heights on the north side of the front due to stability in the frontal surface could limit vertical mixing.
- Isentropic descent along the frontal surface could bring upper tropospheric air of stratospheric origin with high ozone to the surface.
- Light winds in the frontal zone could increase surface temperatures leading to higher chemical kinetic rates and anthropogenic and natural hydrocarbons.

Stationary Front Event 2006

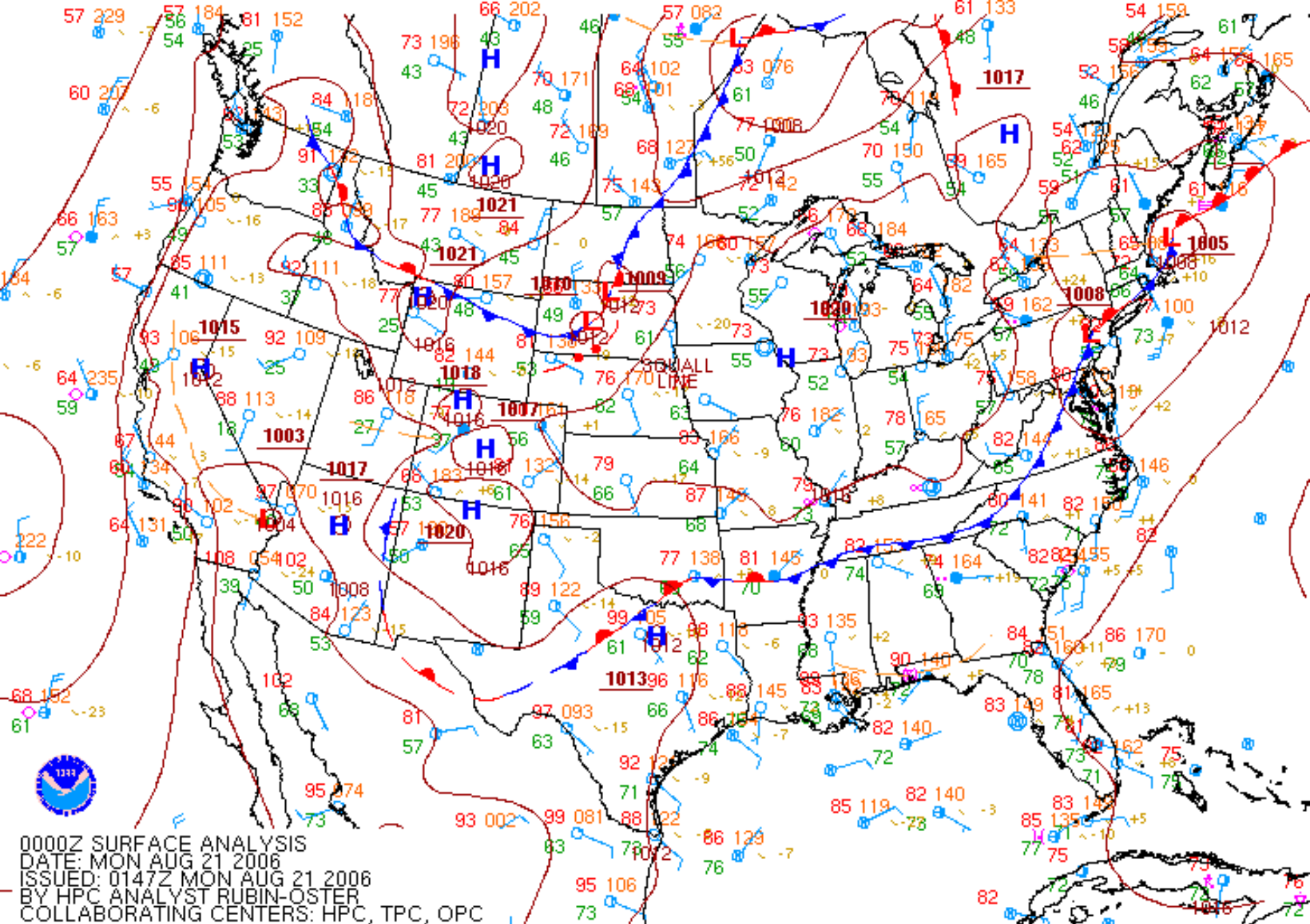
- HARC-funded project including UAH and Baylor University

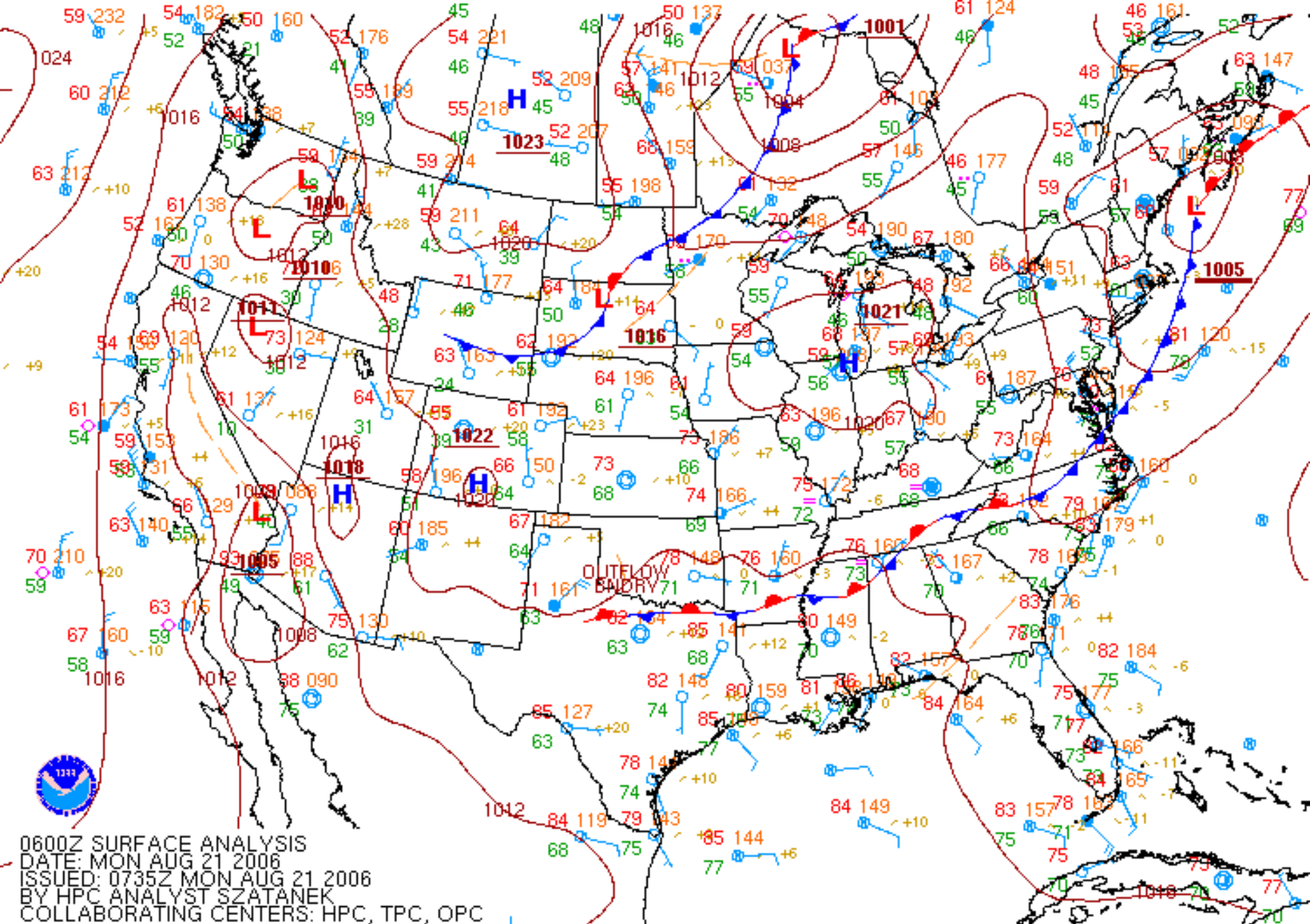


- Stationary front event occurred August 21-22, 2006

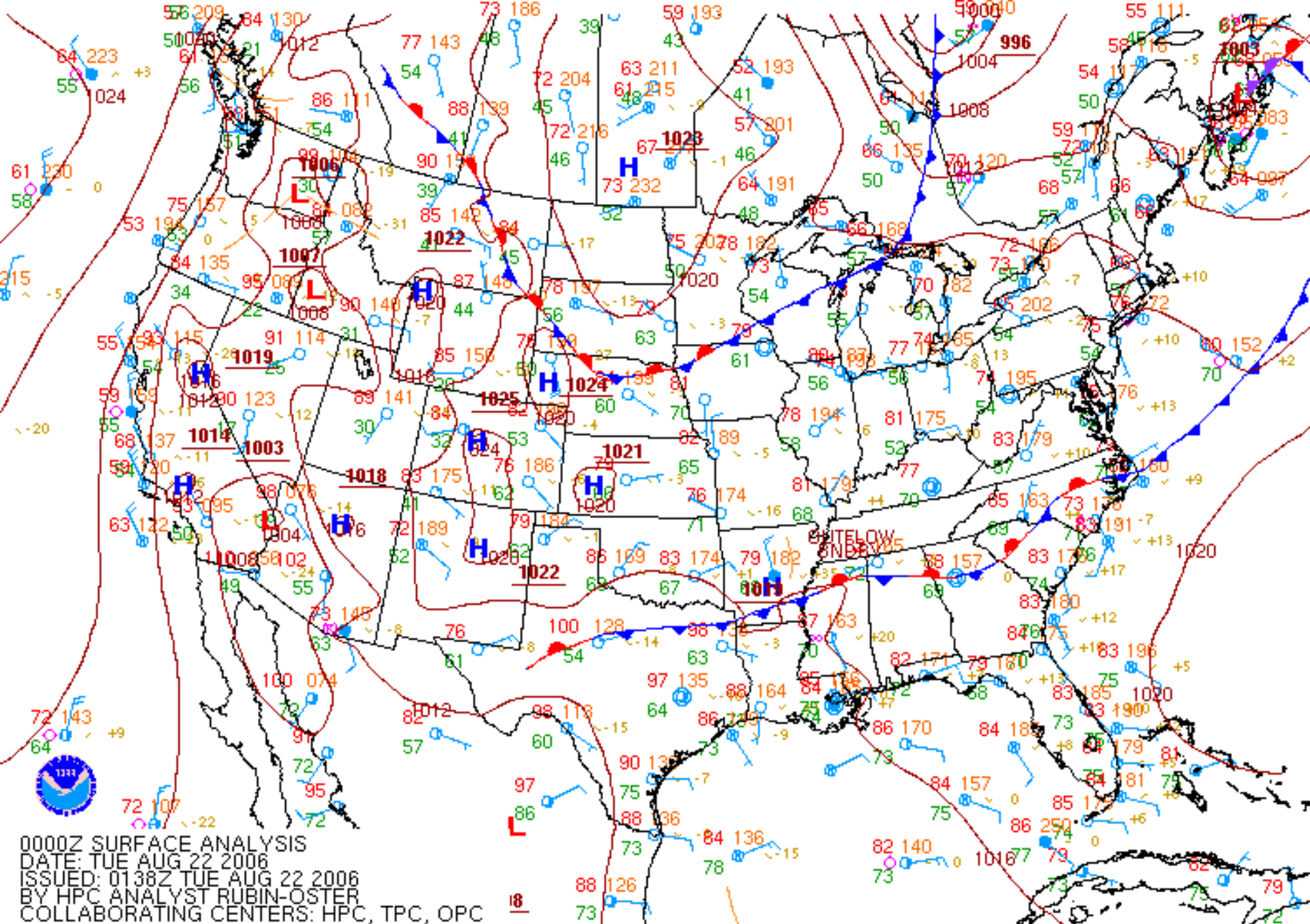


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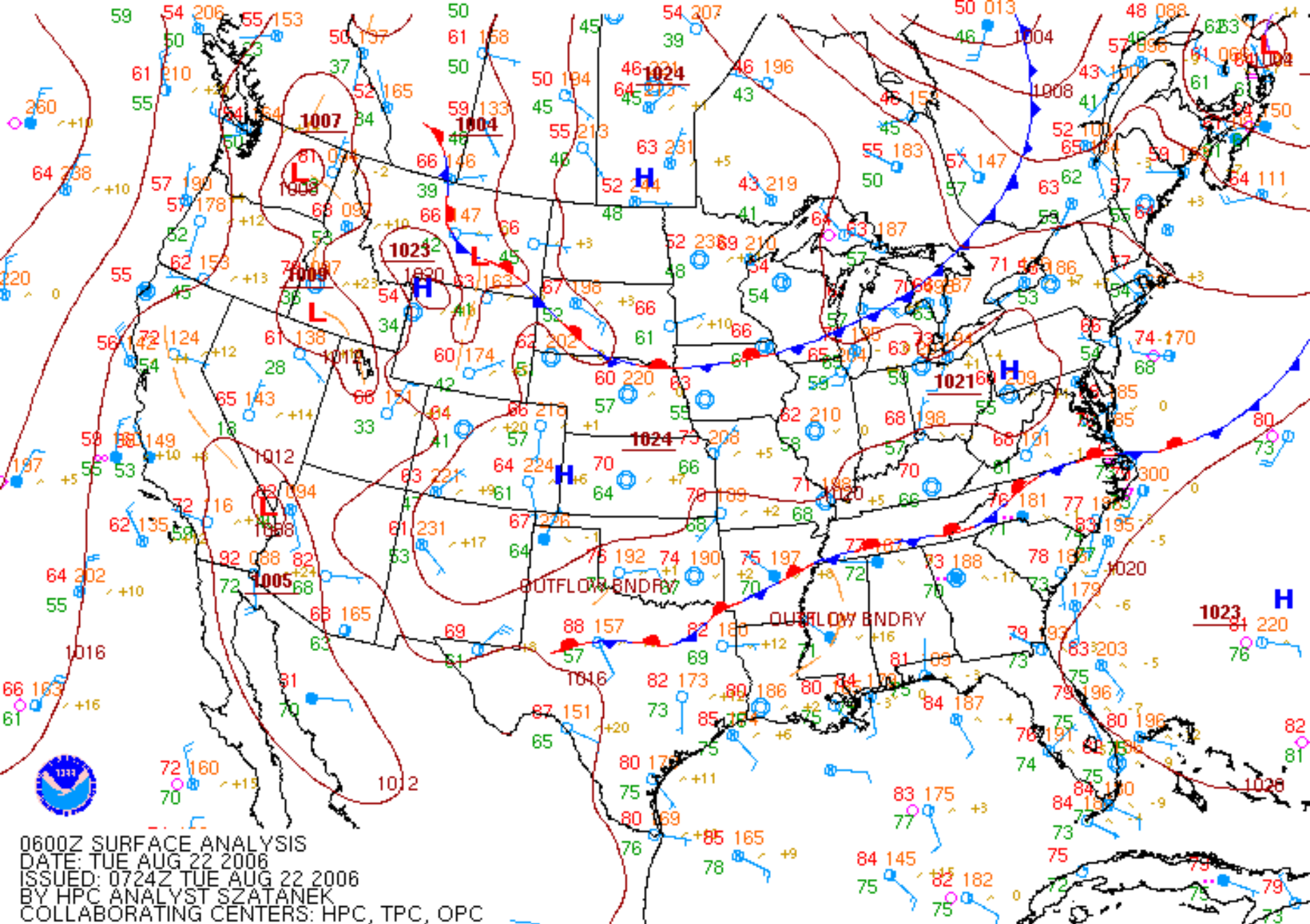




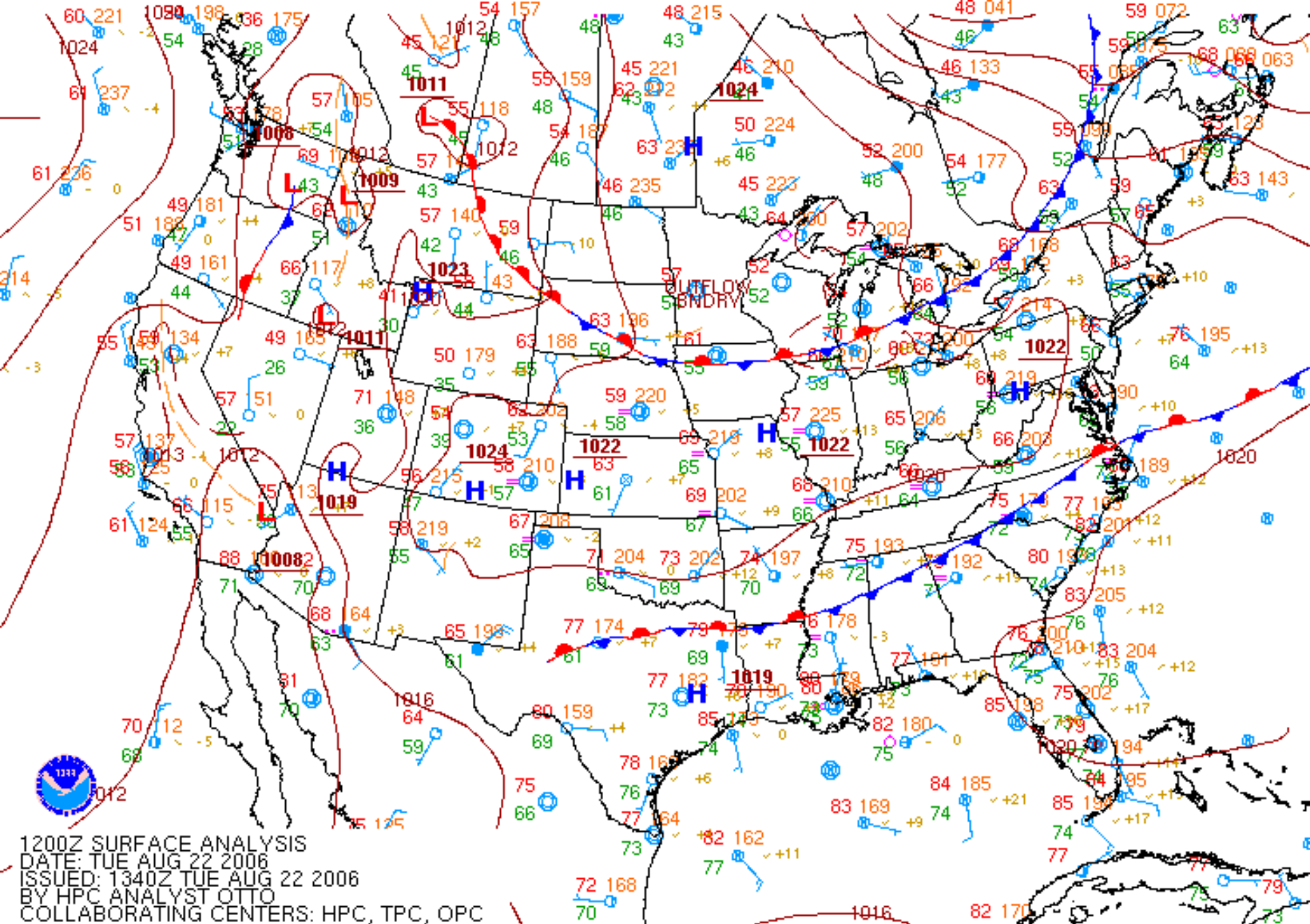
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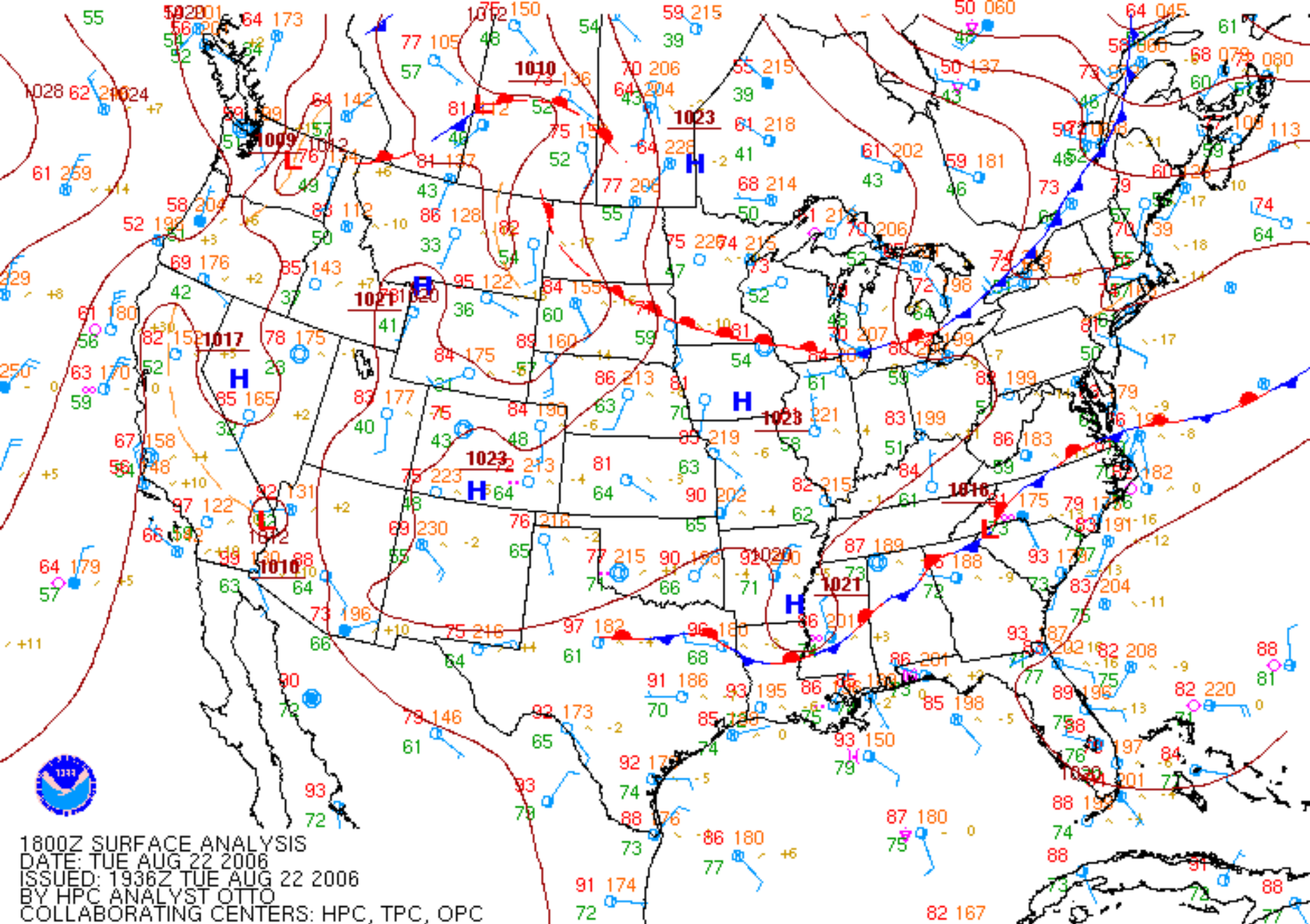
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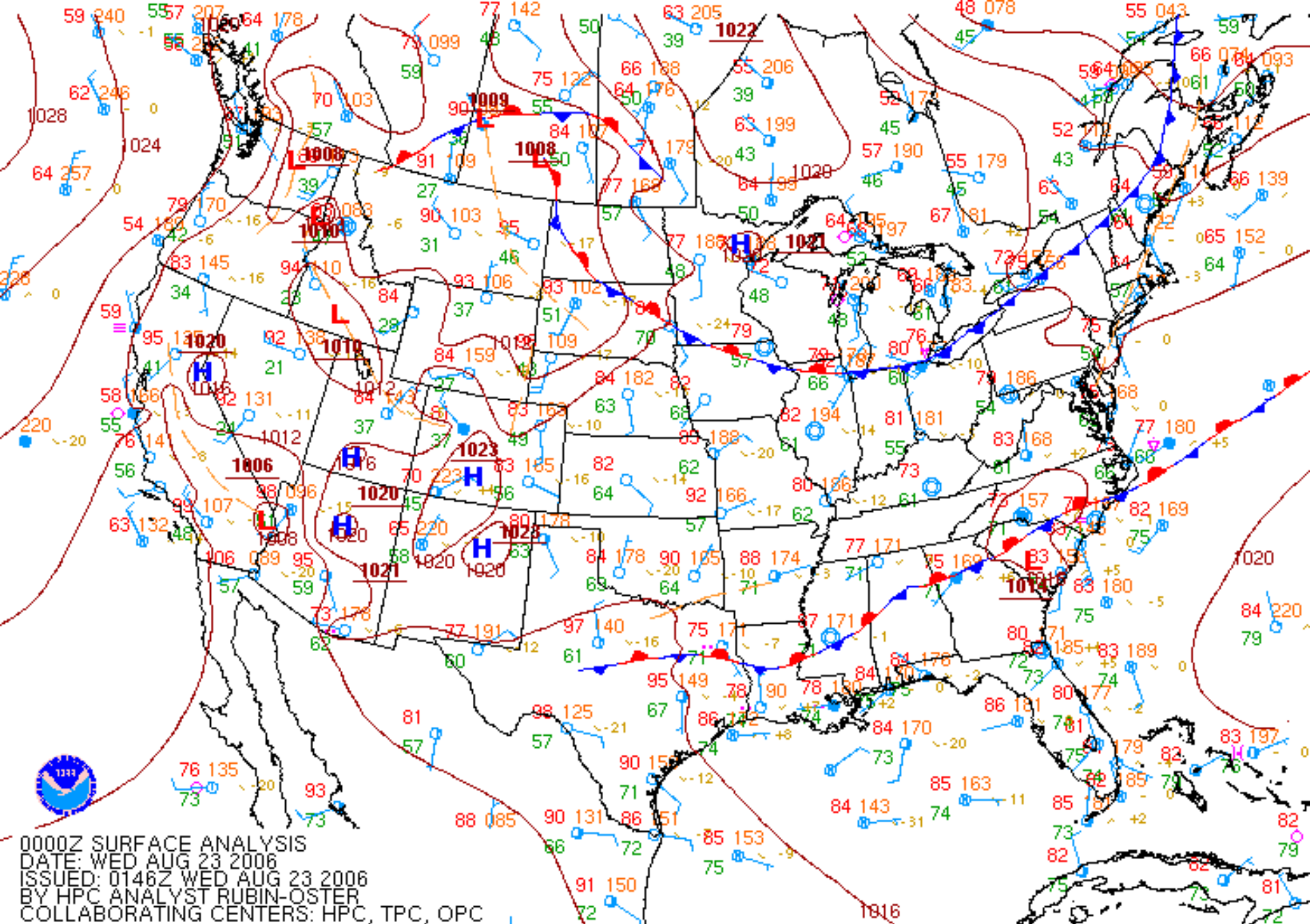
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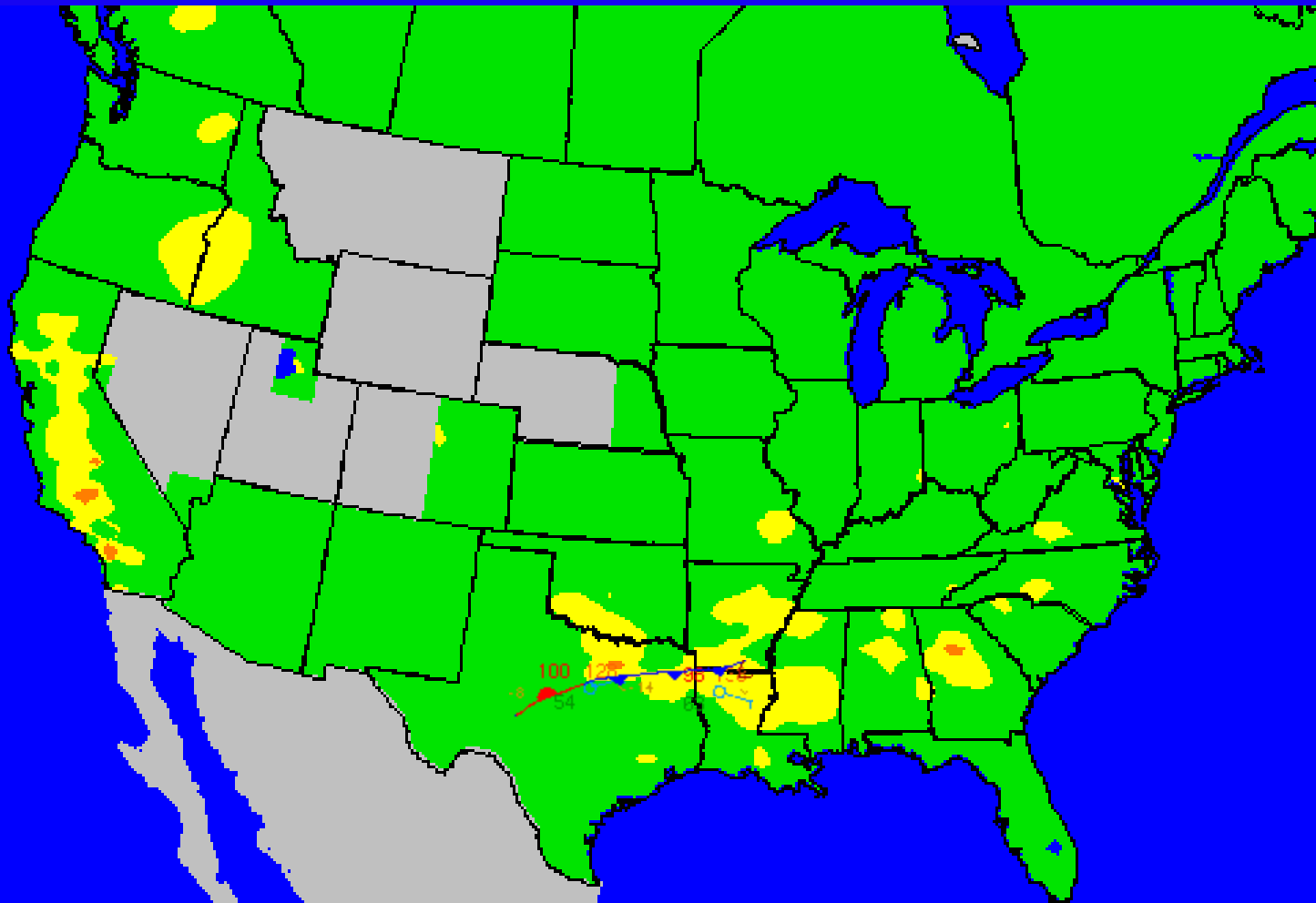


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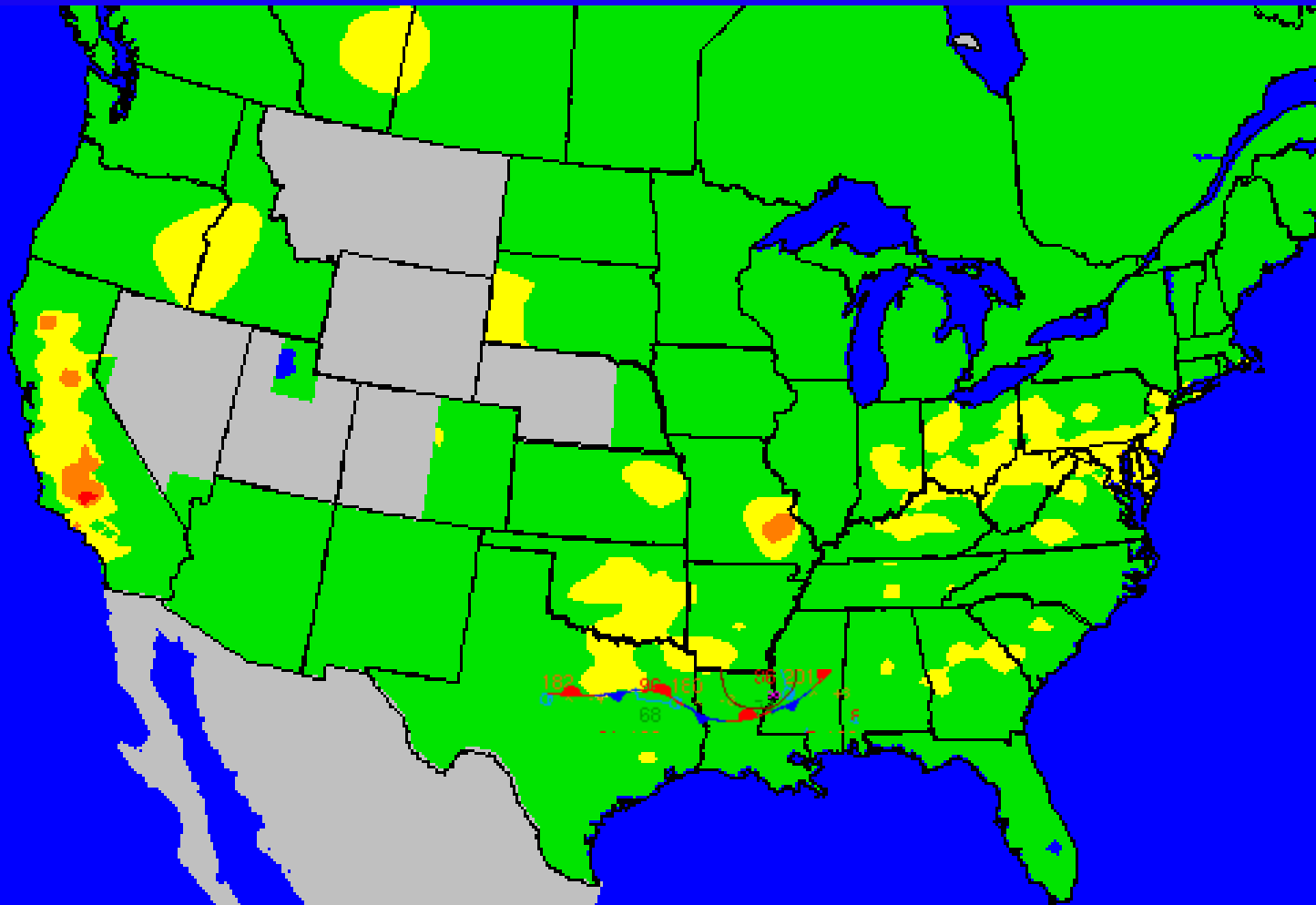
8-Hour Peak AQI for ozone for August 21, 2006 (from AIRNOW)



1 - 50 <u>Good</u>
51 - 100 <u>Moderate</u>
101 - 150 <u>Unhealthy for Sensitive Groups</u>
151 - 200 <u>Unhealthy</u>
201 - 250 <u>Very Unhealthy</u>
Data Not Availa

August 21, 2006

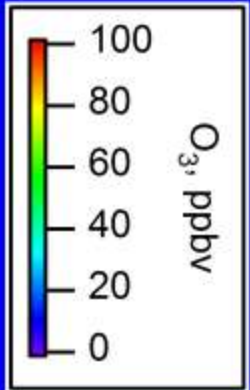
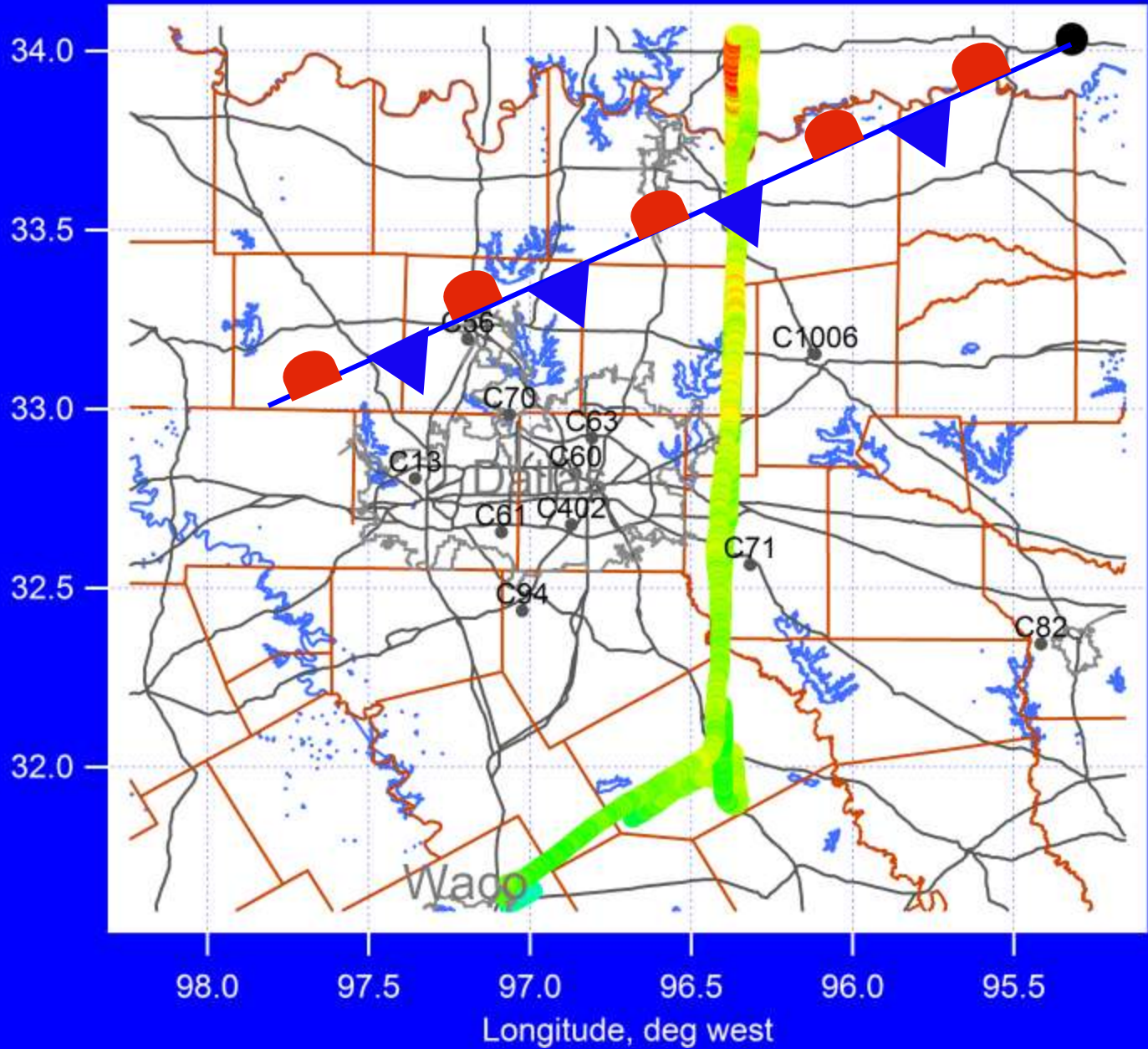
8-Hour Peak AQI for ozone for August 22, 2006 (from AIRNOW)

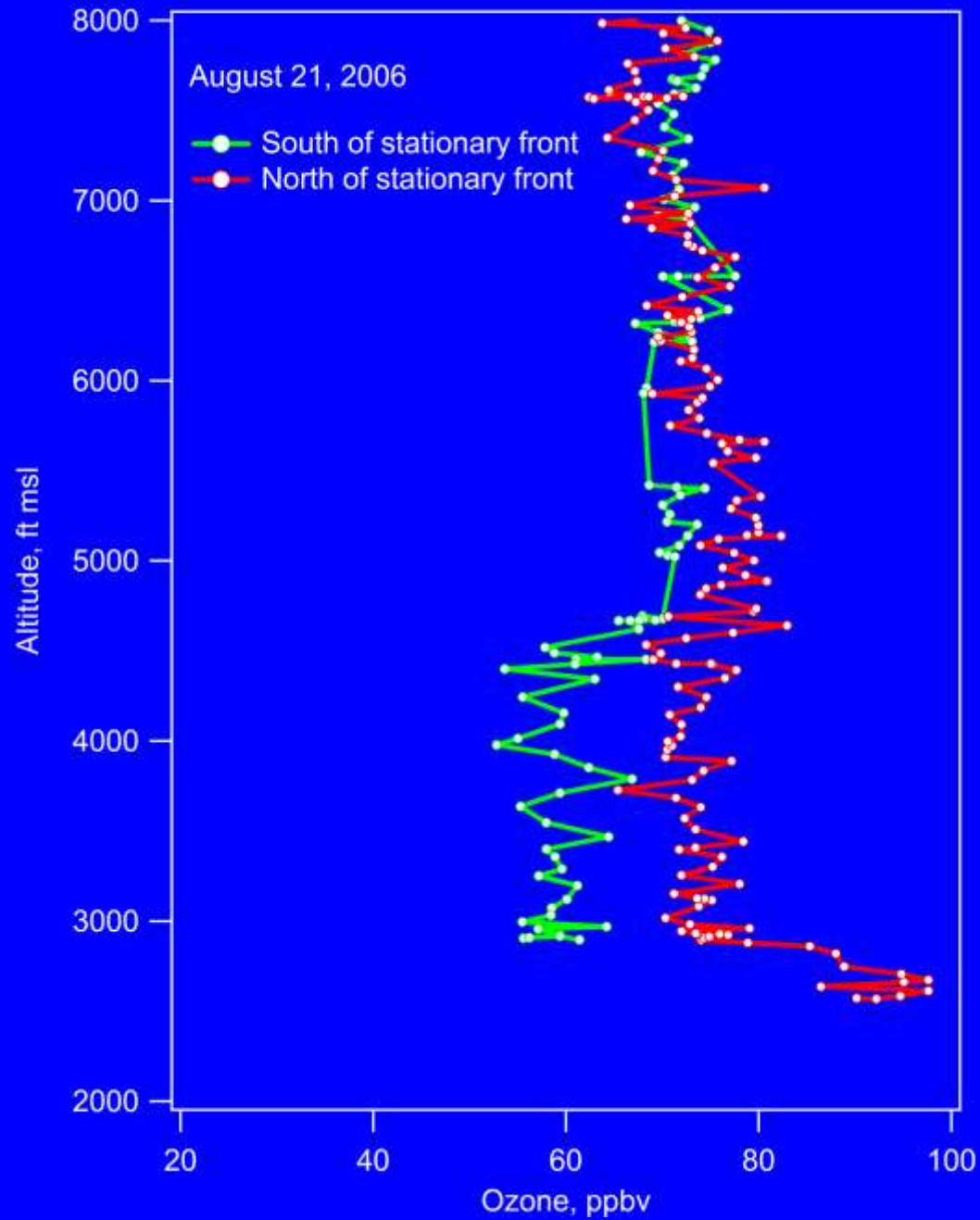


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Data Not Availa

August 22, 2006

Latitude, deg north

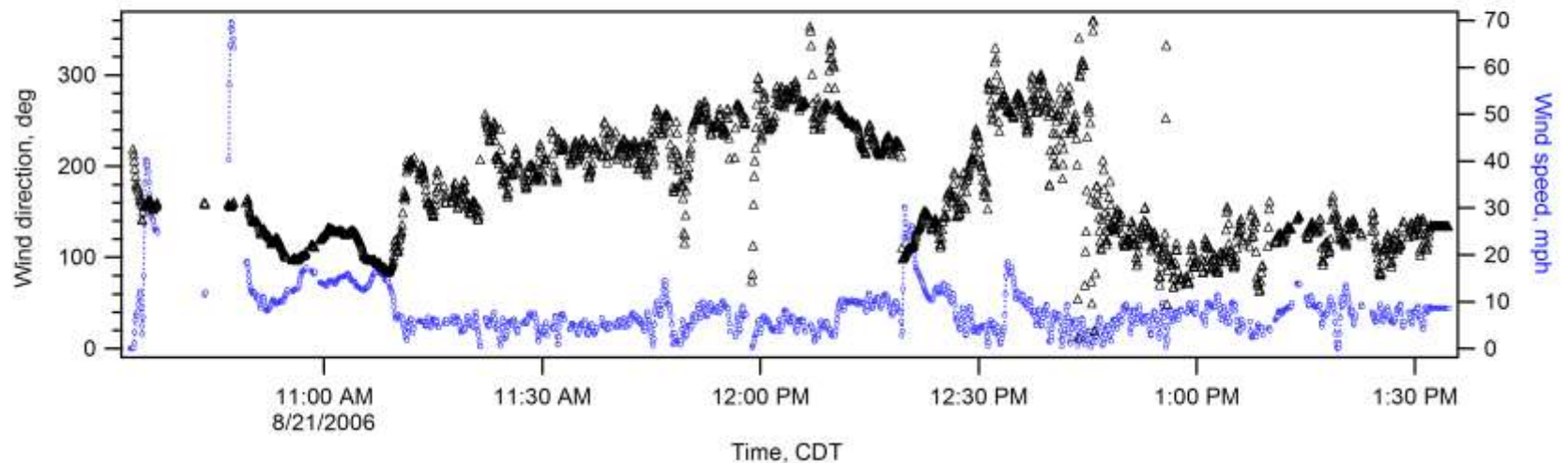
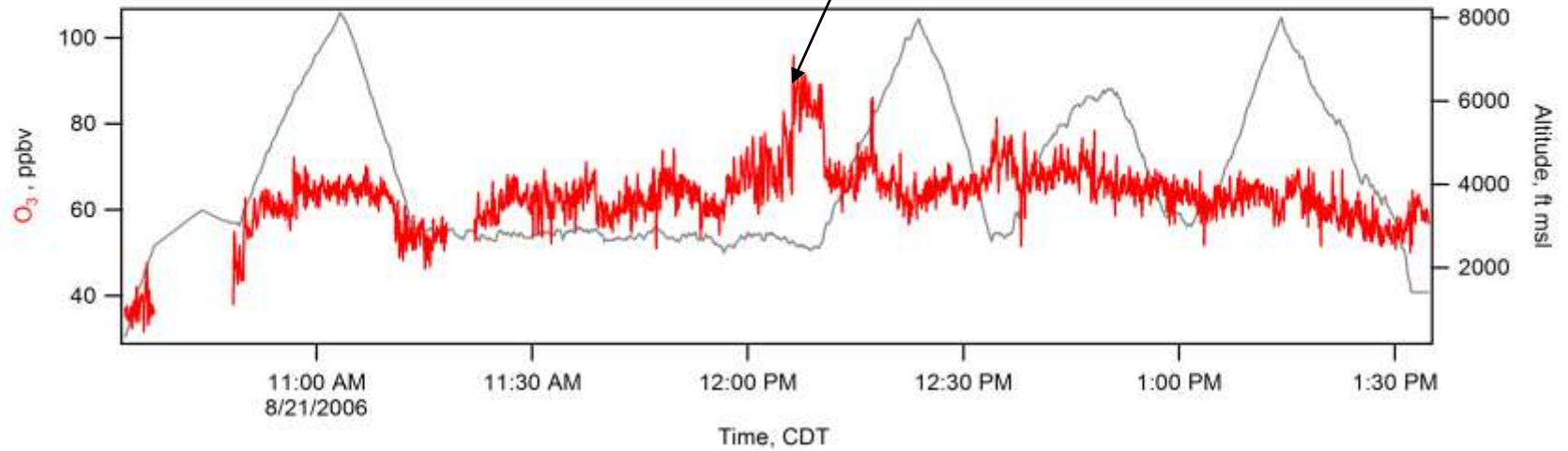




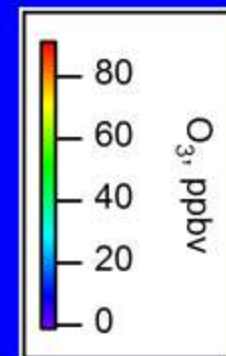
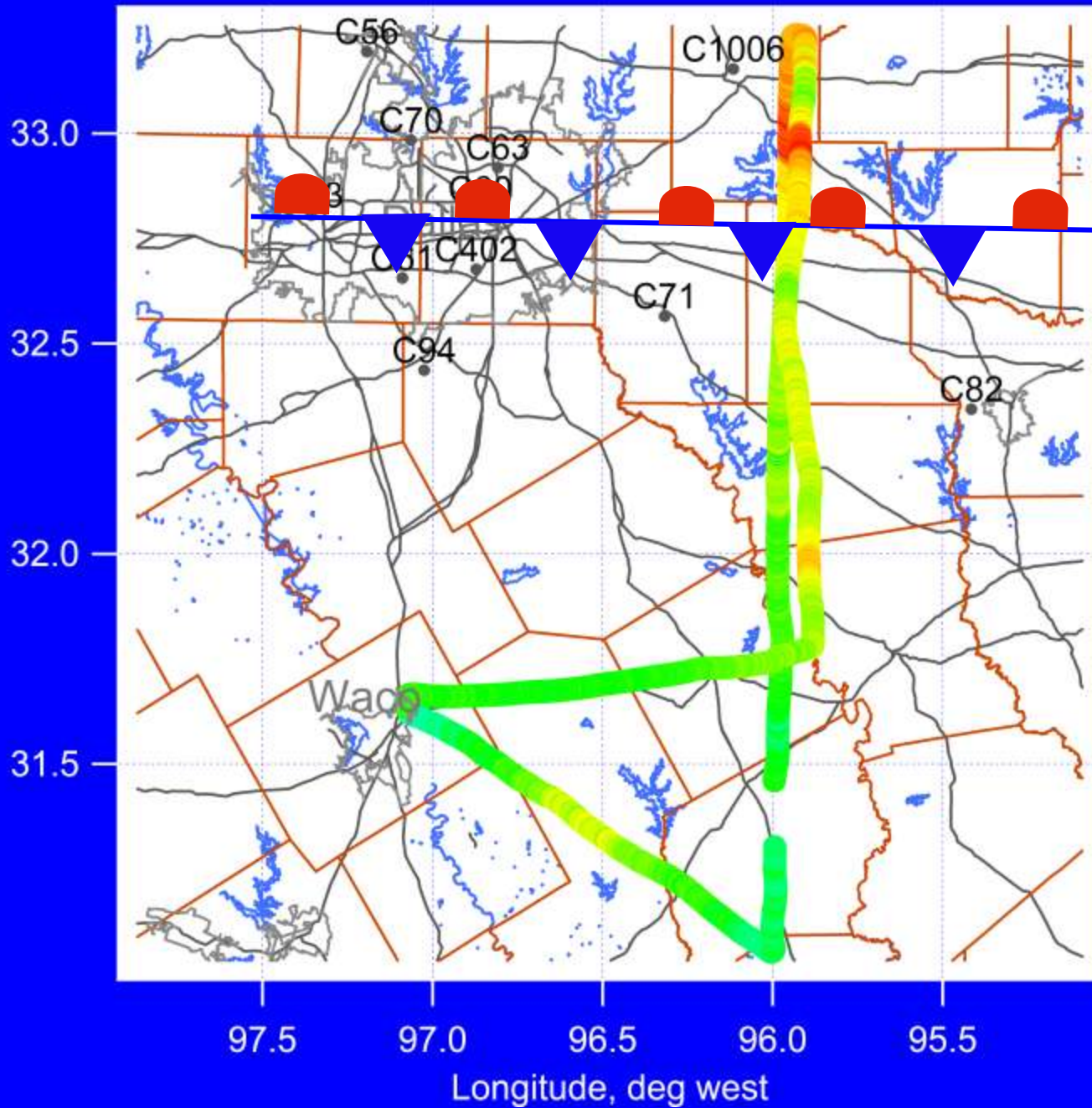
Baylor Institute for Air Science 2006 Data
Piper Aztec Flight Date: Mon, Aug 21, 2006
Flight start time = 10:33:23 AM CDT
Flight end time = 1:34:41 PM CDT

O3 peak near front

Date plotted: Mon, Aug 21, 2006



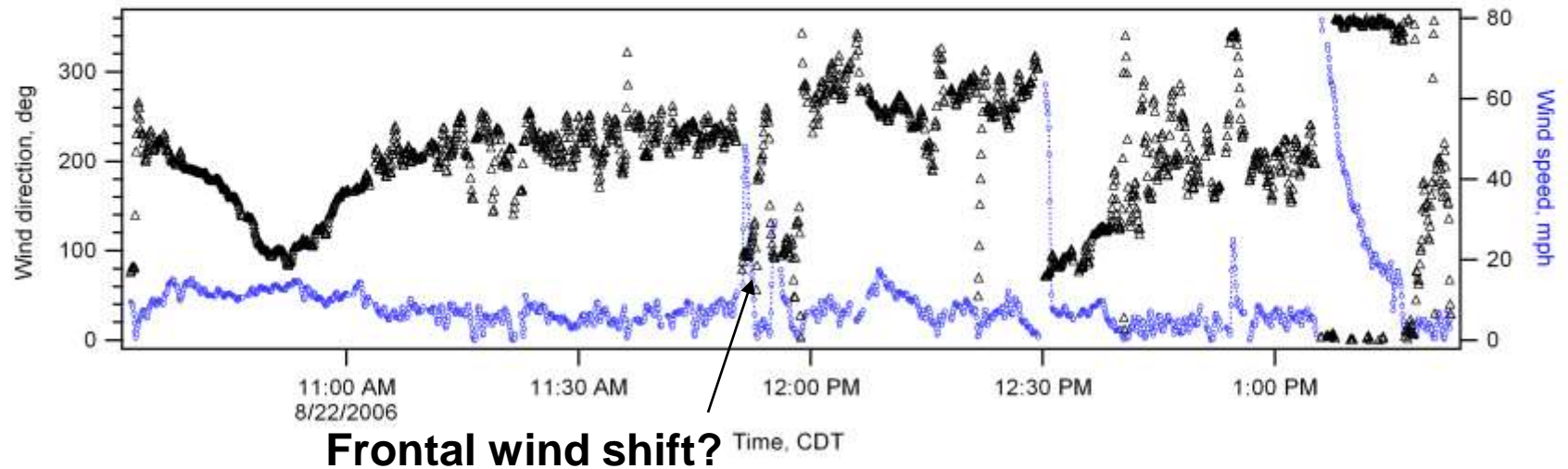
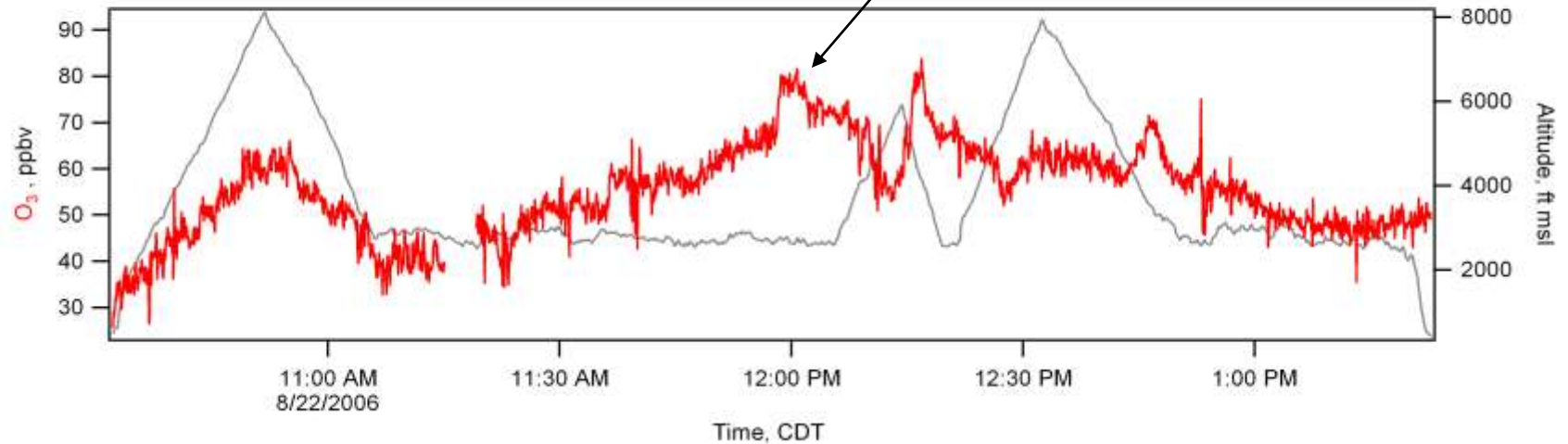
Latitude, deg north



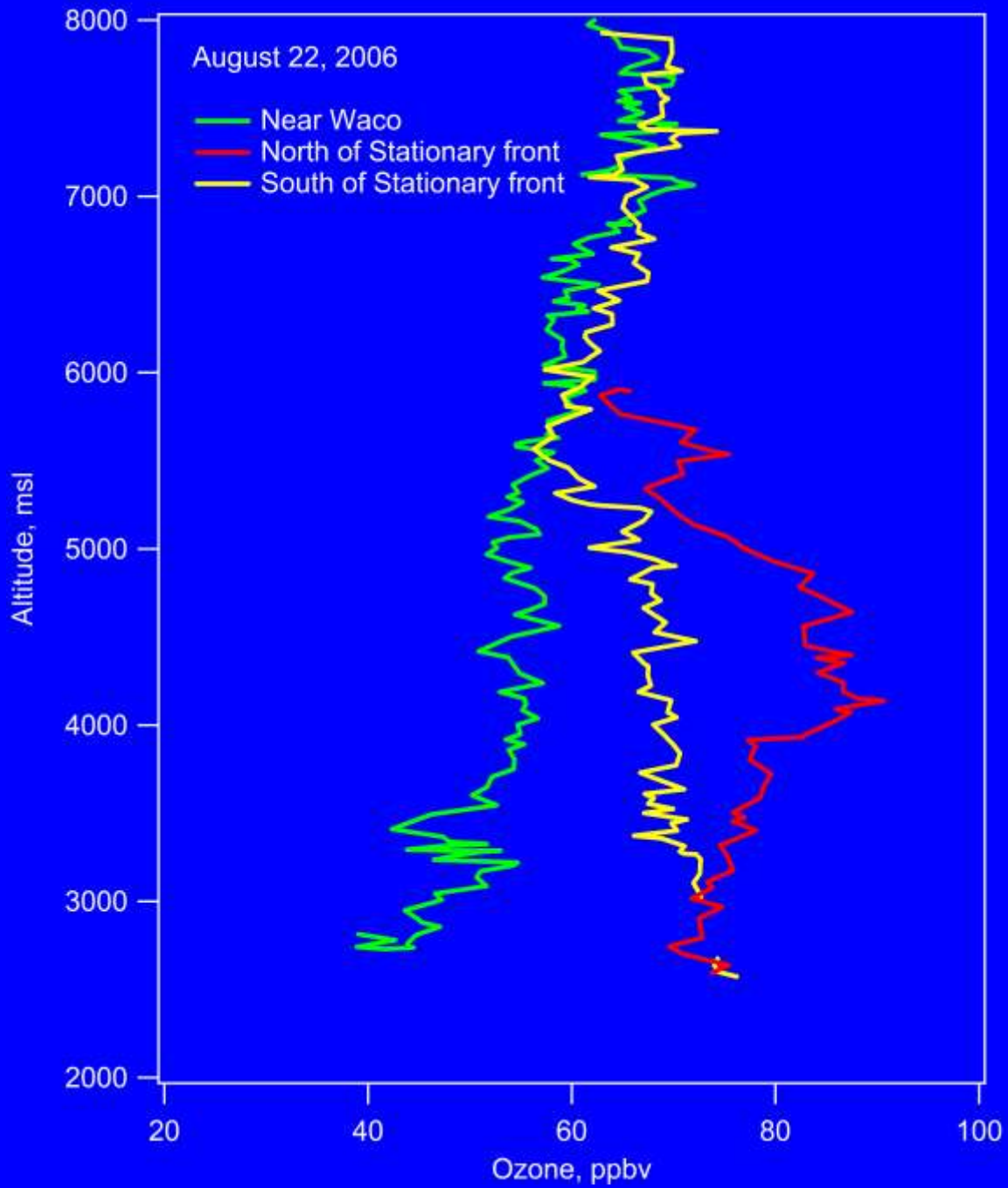
Baylor Institute for Air Science 2006 Data
Piper Aztec Flight Date: Tue, Aug 22, 2006
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Flight end time = 1:22:48 PM CDT

**Peak in concentrations
near or just north of front**

Date plotted: Tue, Aug 22, 2006

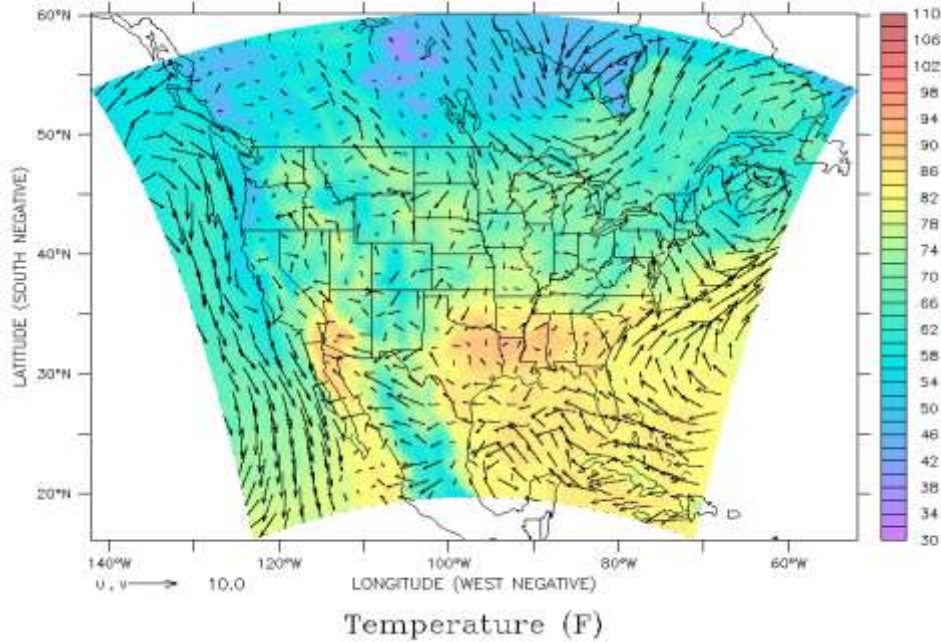


Frontal wind shift?



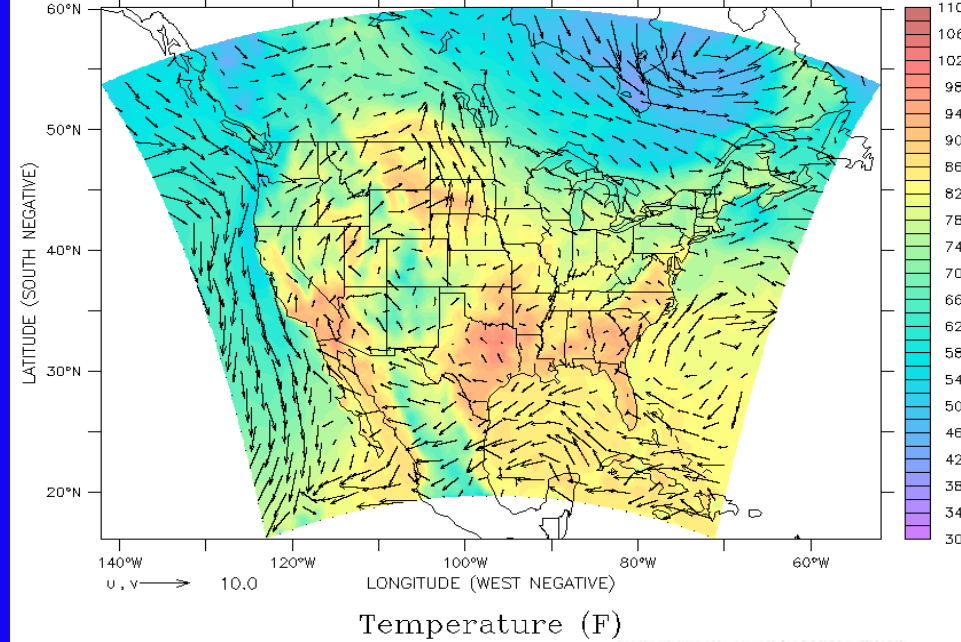
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MM5 version 3 format output on sigma levels

FERRET Ver. 6
NOAA/PIEL TRIP
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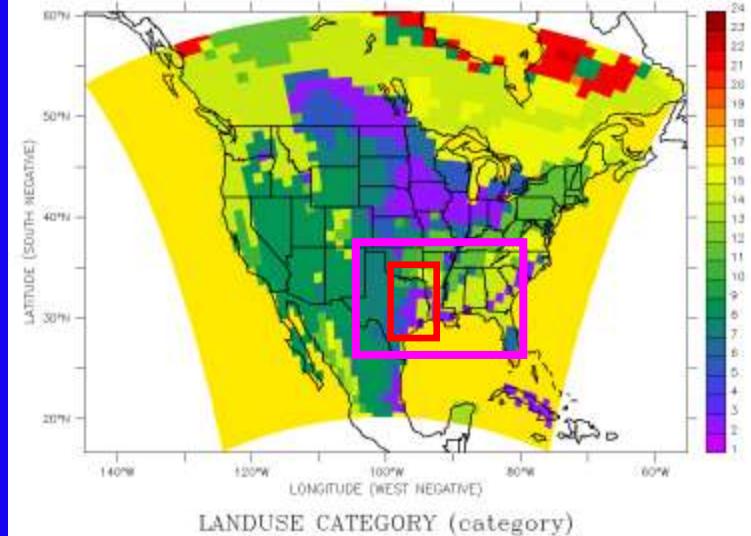
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Preliminary MM5 simulations showing the stationary front over Dallas during August 21-22 episode.

Additional modeling will nest down to 12 and 4-km grid spacing.

DATA SET: ifc.d1.asim:062313_090212
MM5 version 3 format output on sigma levels



Summary

- 1. The study was a success in that an excellent case was observed**
- 2. The aircraft results showed indeed that maximum ozone concentrations occurred near and north of the front.**
- 3. The high concentrations near the front are consistent with the hypothesis that a low dilution environment contributes to high concentrations. However, direct evidence based on aircraft winds were not conclusive.**
- 4. The role of lowered mixing heights also making a contribution to higher concentrations seems supported in that the highest concentrations were observed north of the front.**

Proposed further analysis as Project T1

Establish boundary conditions for modeling exercises

- Comparison and characterization of the air composition and physical conditions north and south of the stationary front using the airborne data.
- Compile and analyze the surface and aloft (radar and rawinsonde) meteorological observations for the target region.

Continue modeling and model comparison of the stationary front to support control strategy development for the DFW SIP

- Comparison of the UH and TAMU TEXAQS II modeling to the MM5 and CMAQ modeling performed at UAH.
- Comparison of the model results to the observations from all sources