# Question B

# How do the structure and dynamics of the planetary boundary layer and lower troposphere affect the ozone and aerosol concentrations in Houston, Dallas, and eastern Texas?

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June 1, 2007

B1(a): Boundary-layer structure and mixing near and over Galveston Bay and the eastern Houston ship channel area are spatially complex and variable from day to day.

*Update: Large spatial variability of mixing heights is caused by urban heat island (Ryerson), Galveston Bay and residual sea breezes (Nielsen-Gammon), and land use variations. Climatological mixing heights increase with distance from the coastline (Wilczak). Weak mixed layer growth may explain low PM2.5 concentrations in Galveston (Lambeth). Studies correlating local ozone concentrations with mixing height variations are not useful.*

B1(b) Vertical mixing profiles often do not fit simple models or conceptual profiles.

*Update: On the other hand, the Gulf of Mexico boundary layer seems to be remarkably constant, with positive heat fluxes and a mixed layer depth of 500-600 m.*

B1(c) High concentrations of ozone and aerosols are sometimes found above the planetary boundary layer in parts of the HGB ozone non-attainment area.

*Update: Ozonesondes show the evolution of lower-tropospheric ozone levels in response to cold front passages and shifts to continental transport, followed by stagnation (Rappenglueck).*

B2: Complex coastal winds are not necessary for accumulation of high concentrations of ozone in Houston.

*Update: Most, but not all, 8-h exceedances during the TexAQS-II field intensive (and other 2005-6 episodes) occurred when winds were light enough to allow stagnation/recirculation (Nielsen-Gammon). Processed airborne lidar measurements show plumes downwind of Houston with higher concentrations than were detected at surface monitors (Banta).*

B3: After sea breeze days, the Houston plume often is broadly dispersed at night through the formation of a low-level jet.

*Update: The sea-breeze low-level jet has been confirmed in profiler observations (Weissmann). The vertical wind shear is expected to lead to a spatially diffuse residual urban plume the following day. One day's emissions from Houston are sufficient to raise background levels 10 ppb in a 100 km x 100 km by 2 km volume (Senff). On occasion (e.g. Sept. 1), Houston emissions return to affect the following day.*

B4: The Dallas ozone plume can extend well beyond the existing ground-based ozone monitoring network.

*No update available.*

**Required Additional Analysis:**

The results reported here are preliminary. Most of the data discussed in this summary have yet to be subjected to comprehensive quality control procedures.

*Update: Most quality control has been completed or is in progress and will be completed by the end of August 2007.*

In addition to quality control, it will be useful to compare results from different platforms and observing systems in order to develop a comprehensive picture of the PBL during TexAQS-II.

*Update: Such synthesis will not be possible by August 2007.*

Observations from several valuable or unique instruments, such as the Doppler lidar on board the R/V Ronald Brown, have yet to be analyzed in any detail.

*Update: Such analysis is in progress. Mixed layer growth and low-level jet development have been studied.*

Numerical model simulations, with data assimilation, will provide a useful framework for integrating the various bits of observational information.

*Update: Such synthesis will not be possible by August 2007.*

Finally, it will be useful to investigate the extent to which the meteorology of the 2006 field intensive differed from that of the 2000 intensive and from typical conditions.

*Update: The 2006 high ozone events were unlike the 2000 events in Houston, but together the two field programs spanned the range of typical event types (Nielsen-Gammon). August and September 2006 were unusual for their frequent transport from the north (Sullivan). Ozone levels aloft were not much different in 2006 than in the previous two years (Morris). A statistical analysis of the roles of meteorology and emissions in causing ozone concentration differences between 2000 and 2006 needs to be performed (N-G).*