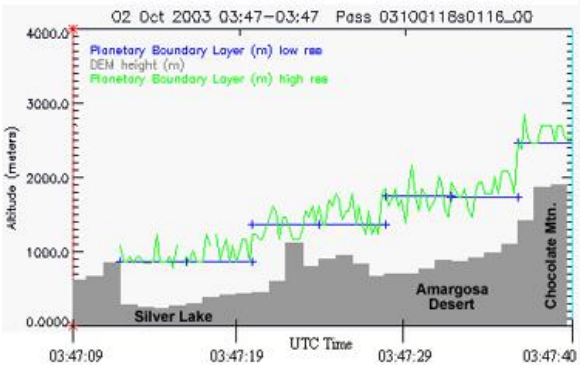
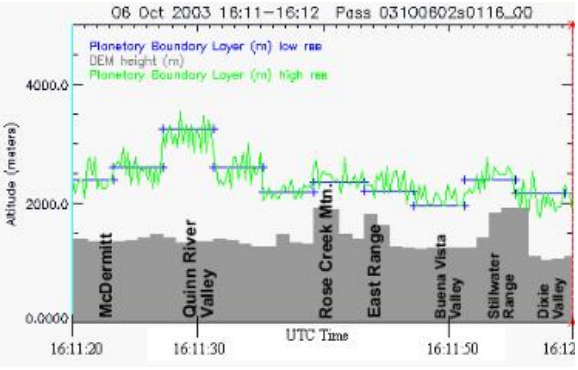
Planetary Boundary Layer (PBL) Heights over the Great Basin Desert, USA

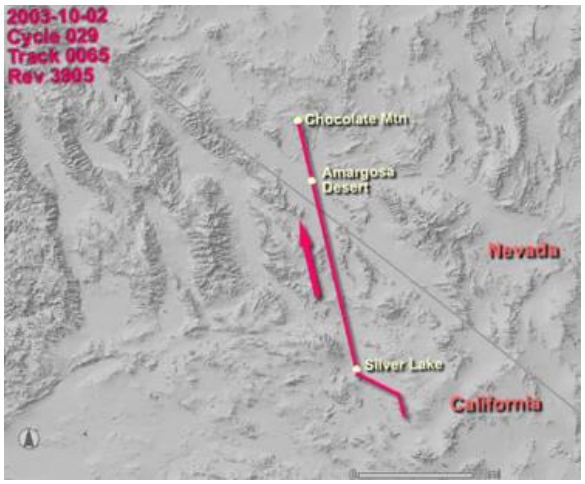


Nighttime PBL heights



Daytime PBL heights

ICESat track 0065



ICESat track 1129

The planetary boundary layer (PBL) is the portion of the Earth's lower atmosphere where turbulent transfers of heat, moisture, and momentum are the greatest. The PBL depth is generally greater in arid regions because of clear skies and low substrate water content, which allow higher surface temperatures, resulting in stronger sensible-heat fluxes to the atmosphere and deeper turbulent mixing.

In the Great Basin Desert, rising and subsiding air affects PBL height. Upward motion over heated, elevated terrain during the day causes the vertical temperature profile to become less stable, while subsidence that brings warm, dry air downward to lower elevations causes the vertical temperature profile to be more stable. Valleys typically have shallow boundary layers, while areas with higher terrain have deeper layers.

The ICESat/GLAS aerosol and PBL height product (GLAH08) provides the top and bottom heights of elevated atmospheric aerosol layers and PBL heights throughout the depth of the troposphere,

extending into the middle stratosphere to 41 km. The top left graph shows nighttime PBL heights (at 03:47 UTC) over a portion of the Great Basin, while the right graph shows daytime heights (at 16:11 UTC) over a different region in Nevada.

One possible cause of the sudden increase in PBL height over Quinn River Valley (top right image) may be localized, higher warming over the surface in the daytime, resulting in higher depths of turbulent transfer, and thus, PBL heights. Other factors that cause variation in PBL heights throughout the region include substrate thermal characteristics, subsidence, or small-scale cold fronts. Another factor common in the Great Basin Desert, with numerous valleys and mountains is nighttime temperature inversions.

Images and description courtesy of Jason Wolfe, NSIDC.