Measurements of the Boundary Layer at Mauna Loa Observatory, Hawaii

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The NOAA Mauna Loa Atmospheric Baseline Observatory (MLO) is an atmospheric monitoring station on the North side of Mauna Loa Volcano (4169 m summit) located at an altitude of 3396 m. The bright sun, dark lava surface, and the seven percent grade of the mountain create a surface radiation wind that changes from upslope in the daytime to downslope after sunset. This radiation wind has a magnitude of 2.5-3.0 m/s. The off-island wind interacts with the mountain to create a barrier wind which is about 80% of the off-island windspeed. The radiation wind dominates when the off-island winds are low, and opposite is true when the off-island winds are strong. Temperature inversions form at sunset in the first 50 meters above the ground. Aerosol profiles, measured with a unique technique called CLidar, or camera lidar, often increase with altitude and show a peak between 60 and 160 meters. Nephelometer measurements on the tower verified a 40% increase between 10 and 38 meters. The aerosol generally decreases to upper tropospheric values with a distinct change in the rate of decrease at 600 m above the ground. At night the region between the aerosol peak and 600 m is often flowing upslope, counter to the downslope surface flow. The source of the air in this counter flow region is not well understood, but appears to come from levels below the station altitude at least occasionally. This possibly would impact the interpretation of some of the air samples taken during this period. A period in the winter of 2015-2016 was investigated to compare the different energy contributions to the diurnal cycle. For an average clear day the solar contribution was 6.6 kW*Hr/m^2 . The energy stored in the lava was estimated by burying temperature loggers and was 3.5 kW*Hr/m^2 and 0.06 kW*Hr/m^2 was stored in the air. The blackbody (greybody) radiation from the lava surface was 6.0 kW*Hr/m^2 over the 24 hour period.

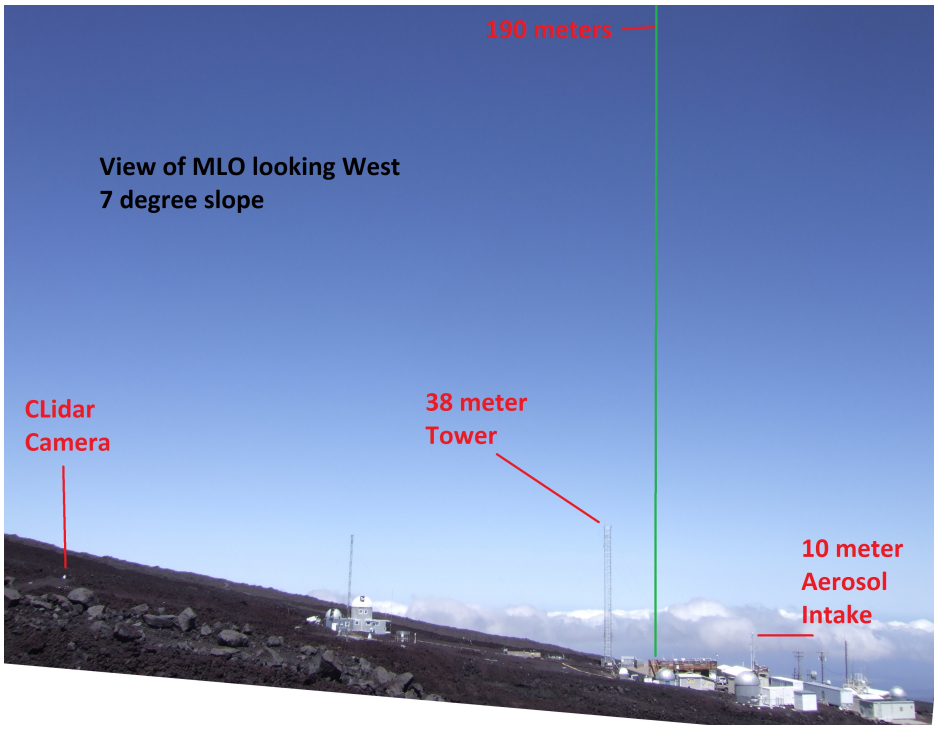

Figure 1. View of Mauna Loa Observatory showing the layout of the station on the dark lava, the position of the lidar laser (green beam) imaged by the CLidar camera, and the tower.