# Task 4
# Haleakala Observatories
# Boundary Layer Height

Task 4 specifies analysis of CAPS relative humidity data for all 10 stations to derive a pseudo atmospheric profile, in order to define the maritime boundary layer height (BLH) for Haleakala. Here, the maritime boundary layer height is defined as that height in the atmosphere where the relatively high humidity near the ocean surface decreases significantly to a lower humidity level. Because the CAPS surface stations are deployed at various elevations at and around the summit of the mountain, they provide relative humidity measurements for a range of elevations. Their locations are described in Table 1.

| No. | Name | Elevation (ft) | Range to HO (mi) | Azimuth |
|---|---|---|---|---|
| 0 | Summit | 9970 | 0.1 | 135.0 |
| 1 | NE Ridge | 6200 | 5.0 | 31.5 |
| 2 | Koolau Gap | 6300 | 4.7 | 51.0 |
| 3 | Hanakauhi | 8450 | 5.5 | 67.0 |
| 5 | Haleakala | 7550 | 5.7 | 100.0 |
| 6 | South | 4400 | 3.3 | 159.5 |
| 7 | SW Ridge | 4440 | 7.0 | 242.0 |
| 8 | North | 2500 | 6.5 | 317.5 |
| 9 | North High | 8000 | 1.8 | 308.0 |
| 10 | SW High | 9100 | 2.8 | 238.0 |

Table 1
Site Data for CAPS REMS

To determine whether the CAPS humidity profile could be used to describe the free air profile, a comparison was made to the National Weather Service (NWS) radiosonde profiles. Since the NWS launches two radiosondes daily (at 00 UT and 12 UT) from Hilo (the nearest free air profile measurement), our analysis examined CAPS data at these same times. And because the current CAPS network of 10 remote stations (REMS) has only been in existence since late 2001, the study was limited to calendar year 2002.

For each day (of 2002) at the two times (00 UT and 12 UT), the relative humidity for the 10 REMS was plotted versus the elevation of the station. In most cases (but not all), the humidity is high at lower levels and falls to lower values at some higher elevation. Thus, a humidity profile was obtained for the atmosphere around Haleakala, Maui. There were many cases where the transition to a lower humidity did not occur within the range of REMS up to the summit at 10,000 feet ASL; in these cases, the BLH was above 10,000 feet. On other occasions, anomalies in the CAPS profile were explicable due to advection effects as the air mass was carried over the mountain; it is known that moist air flow over mountainous terrain generally produces cooling and rainfall on the windward side with upslope flow and warming and drying on the leeward side with downslope flow. In these cases, the leeward REMS were excluded from the profile in the determination of the BLH.

Archive data from the NWS was examined to determine this same level of transition from high to low humidity for the radiosondes launched at Hilo on Hawaii (the closest geographical set of data relative to Maui; the other radiosonde site in the Hawaiian Islands is Lihue, Kauai).

The CAPS data for 2002 consisted of 407 data sets. [There were a number of times throughout the year when data was not available for various reasons for all 10 REMS and thus these times/days were excluded from this study.]

The comparison of the definition of the BLH from CAPS data and from the Hilo radiosonde data showed good agreement (within one thousand feet) on 87% of the datasets (354 out of 407). The conclusion is that the CAPS network provides a very good approximation to the Hilo radiosonde BLH, and it is more specific to the site of Haleakala than Hilo, which is more than 100 miles away. And since CAPS has already demonstrated that the BLH is highly correlated with the occurrence of adverse weather at the summit of Haleakala, the CAPS BLH is presented as a measure of the threat of adverse weather there.

The variation of CAPS BLH for Haleakala is presented as a function of time throughout the year in Figure 1.

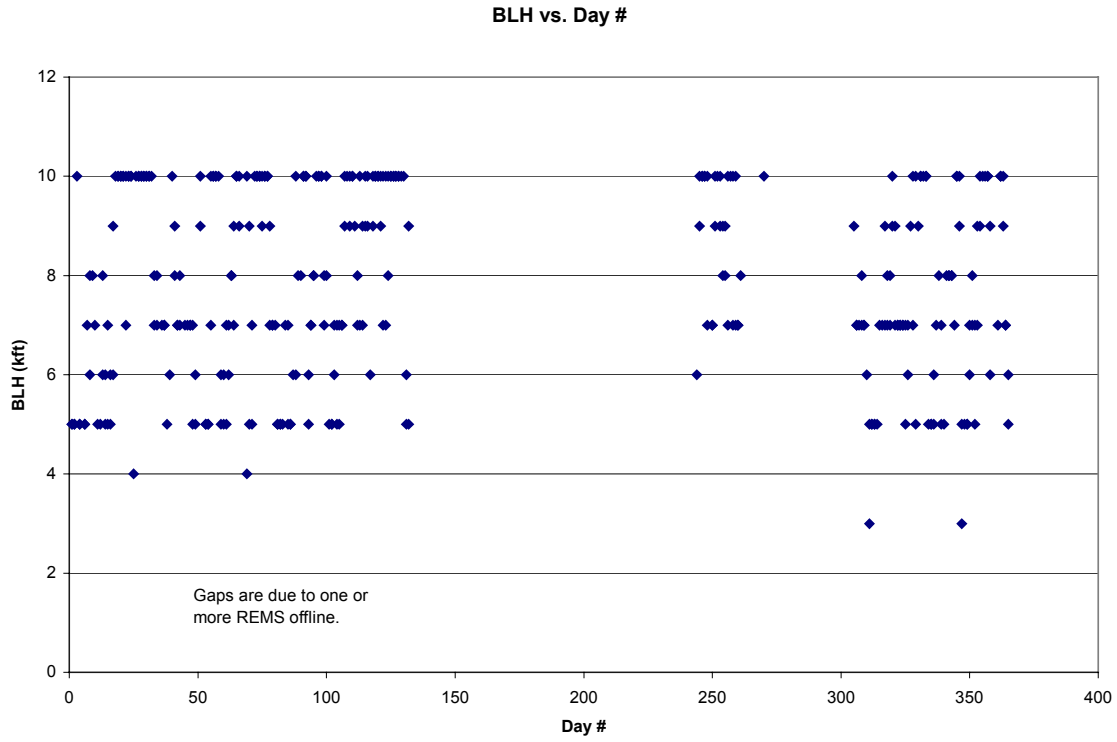


Figure 1—BLH (from CAPS) vs. Day # (2002)

The gaps in data from day number 133 to 243 and 262 to 303 are due to one or more REMS being offline. The first gap was due to a radio failure at REMS #5; since it serves as a relay for REMS #6, #6 also failed to report. Although data from the other stations exists, analysis for

these days was not done for this study. The second gap relates to computer problems at the base station.

The data presented here does not show any obvious intra-annual pattern. The same data is presented as a histogram in Figure 2.

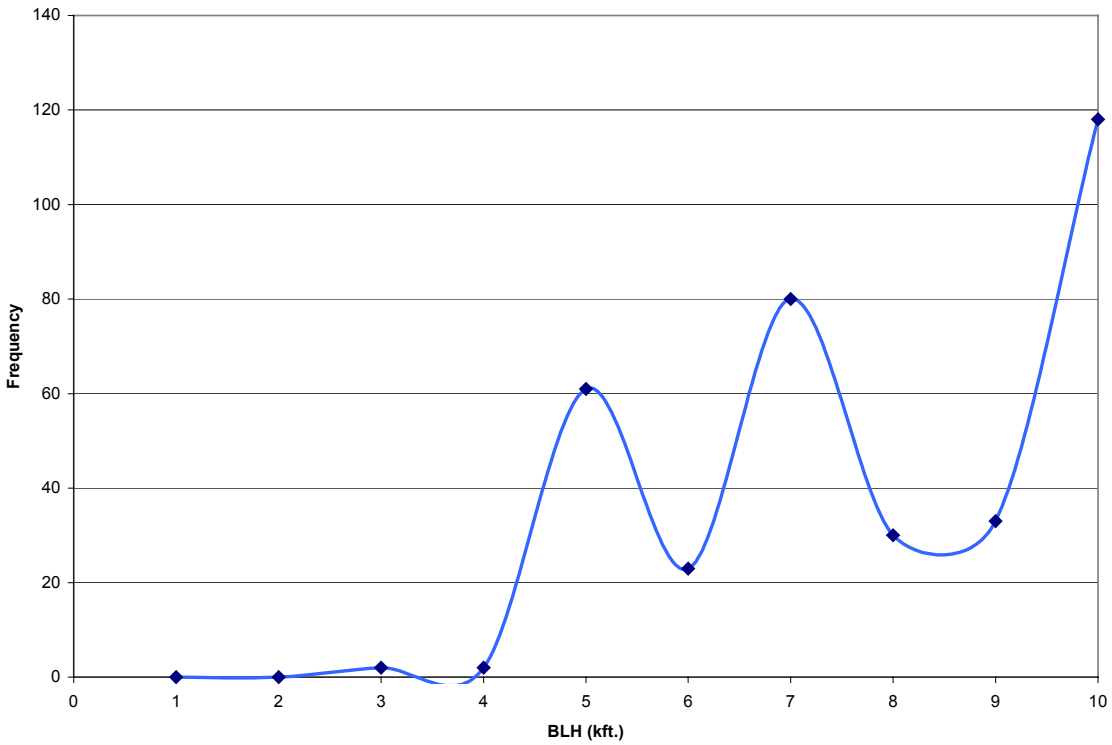


Figure 2
Histogram of BLH (CAPS)

During the year (2002) the boundary layer height was at or above 10,000 feet frequently (118 occurrences), Other peaks occur at 5,000 and 7,000 feet. For all occasions when the BLH was at or above 10,000 feet, adverse weather (fog and/or rain) occurred at the summit; such occurrences were simultaneous or within a few hours. Verification of adverse weather was determined from the CAPS video surveillance record.