



2013 Radio/Cell Phone Coverage Maps

Created by the NPS Pacific Island Inventory & Monitoring Program (I&M). Field data were collected in 2013 by the cooperative vegetation mapping team led by Meagan Selvig of the University of Hawaii at Hilo (UHH), including Kathy Akamine (UHH), Melissa Simon (I&M), Cory Nash (I&M), Elizabeth Urbanski (I&M), David Benitez (HAVO), Mark Wasser (HAVO), Colin Meston (HALE), and additional I&M staff. Data were spatially analyzed by I&M GIS Specialist Scott Kichman.

Methodology Used to Create Coverage Maps for Radio and Cellular Telephone Reception

Radio Coverage

1. Data were collected at 927 accuracy assessment plots from March-November 2013 to test radio receptivity. Crews used the HAVO-RPT-Mauna Loa, HAVO-RPT-South Point, and HAVO-RPT-Kulani Cone channels and received a verbal confirmation with staff located at HAVO Dispatch. This was recorded on the datasheet and notated in database as a “yes” for reception or a “no” for no reception. In some cases no data were collected so it was assumed no reception. This assumption was verified by comments in the data sheets.
2. Point values of -1 for “yes” and 0 for “no” were attributed to a GIS point feature class.
3. The point data were then weighted by using the inverse distance weighted (IDW) interpolation which explicitly implements the assumption that things that are close to one another are more alike than those that are farther apart. This model is appropriate for radio data because these data can be reliably verified. The “yes” and “no” values were physically verified.
4. The weighted point data were then used to create a classified raster image that showed a range of values from good reception to no reception.
5. A visual line of sight analysis was also done within the Park boundary using a 10 meter Digital Elevation Model. The viewpoint locations were the radio transmitters at HAVO-RPT-Mauna Loa (25 meters), HAVO-RPT-South Point (35 meters), HAVO-RPT-Kulani Cone (25 meters), and at HAVO-HQ (35 meters), and the view shed was an extent of 65 kilometers. VHF radio waves are high wattage, travel a shorter distance and are propagated concentrically. The view shed can be modeled for these waves. These data depict whether any point on the ground at a height of 2 meters can actually see the repeaters by line of sight. Four polygon datasets were created with values of yes (line of sight) and no (invisible to repeaters).

6. The classified raster and the view shed data were interpolated to filter out anomalies and to verify that good reception occurred in good line of sight and that no reception occurred in no line of sight. The interpolation takes into account the variable amplitude of radio transmissions over distance and terrain.
7. The final raster image was then clipped or cut to the Hawai'i Volcanoes actual survey park boundary and displayed in a map with terrain features and infrastructure.

Cell Phone Coverage

1. Data were collected at 927 accuracy assessment plots from March-November 2013 to test cell phone reception throughout the park. Cell phones using a Verizon service provider were checked. "Yes" was recorded if the cell phone received 1 or more bars. In some cases no data were collected so it was assumed no reception. This assumption was verified by comments in the data sheets.
2. Point values of 1 for "yes" and 0 for "no" were attributed to a GIS point feature class.
3. The point data were then weighted by using the ordinary kriging interpolation (hot spot) method which is the most general and widely used of the kriging methods. It assumes the constant mean is unknown. This is a reasonable assumption unless there is a scientific reason to reject it. Kriging assumes that there is an overriding trend in the data—for example, a prevailing wind—and it can be modeled by a deterministic function, a polynomial. This method was used for the cell data because the waves of cell transmissions are less powerful in wattage than radios and can easily be interfered with. This polynomial is subtracted from the original measured points, and the autocorrelation is modeled from the random errors. Once the model is fit to the random errors and before making a prediction, the polynomial is added back to the predictions to give meaningful results.
4. The weighted point data were then used to create a classified raster image that showed a range of values from good reception to no reception.
5. A visual line of sight analysis was also done within the park boundary using a 10 meter Digital Elevation Model. The viewpoint locations were cell towers located at the Ola'a Forest Reserve, Volcano Village, Na'ālehu, Pāhala, Kahuku area, South Point area, Kailua, and Captain Cook. These cell towers are all 30-35 meters in height. The view sheds were extended 65 kilometers. Cell transmissions as compared to radio waves are of a higher frequency, but less powerful, travel a longer distance and the wave is constant in amplitude. These data depict whether any point on the ground at a height of 2 meters can actually see the cell tower by line of sight. Eight polygon datasets were created with values of yes (line of sight) and no (invisible to cell towers). The classified raster and the view shed data were interpolated to filter out anomalies and to verify that good reception occurred in good line of sight and that no reception occurred in no line of sight.
6. The final raster image was then clipped or cut to the Hawai'i Volcanoes actual survey park boundary and displayed in a map with terrain features and infrastructure.