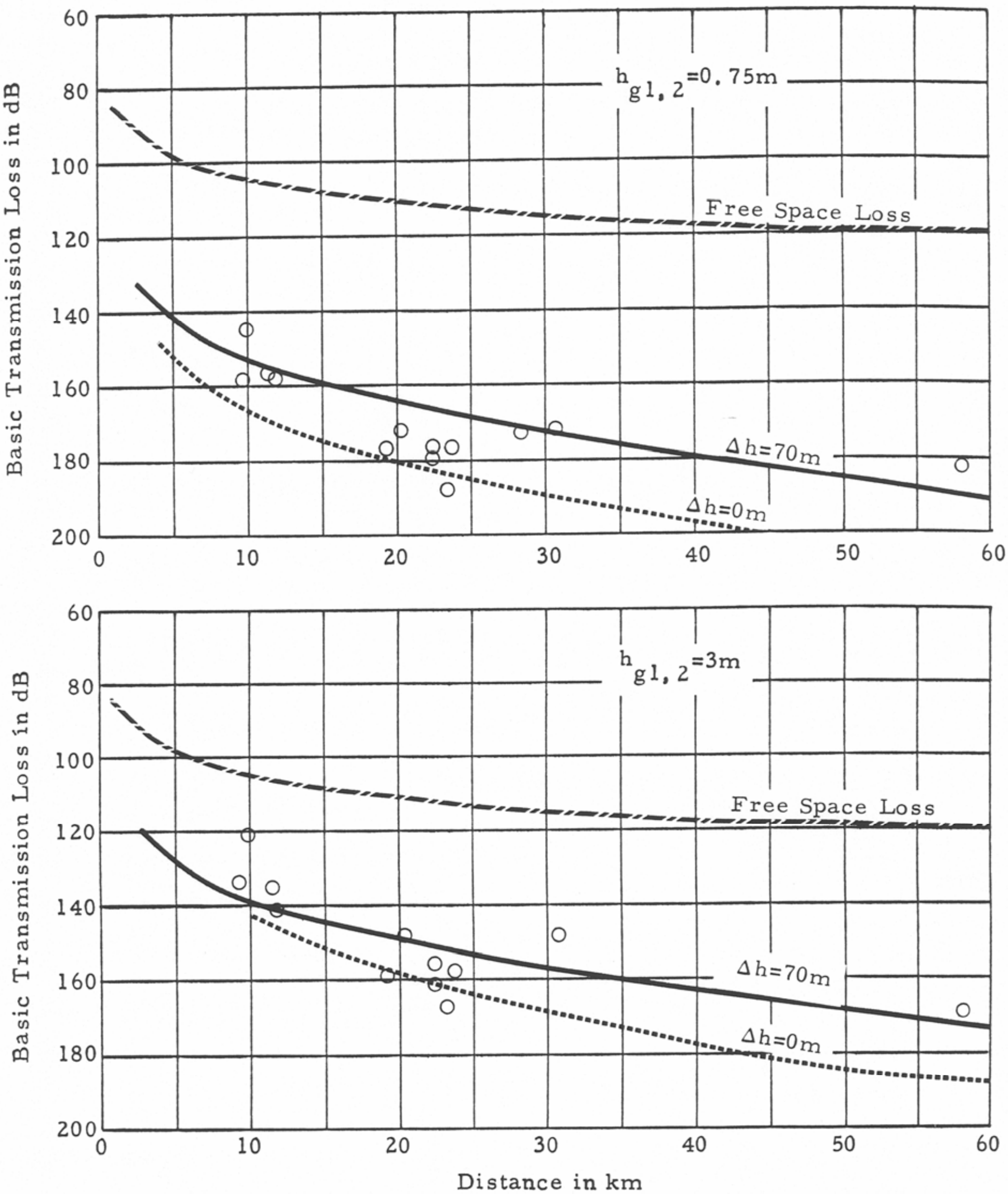

Figure 20. Basic transmission loss, measured and predicted, Ritzville area, Washington, Δh=70m, f=416MHz.

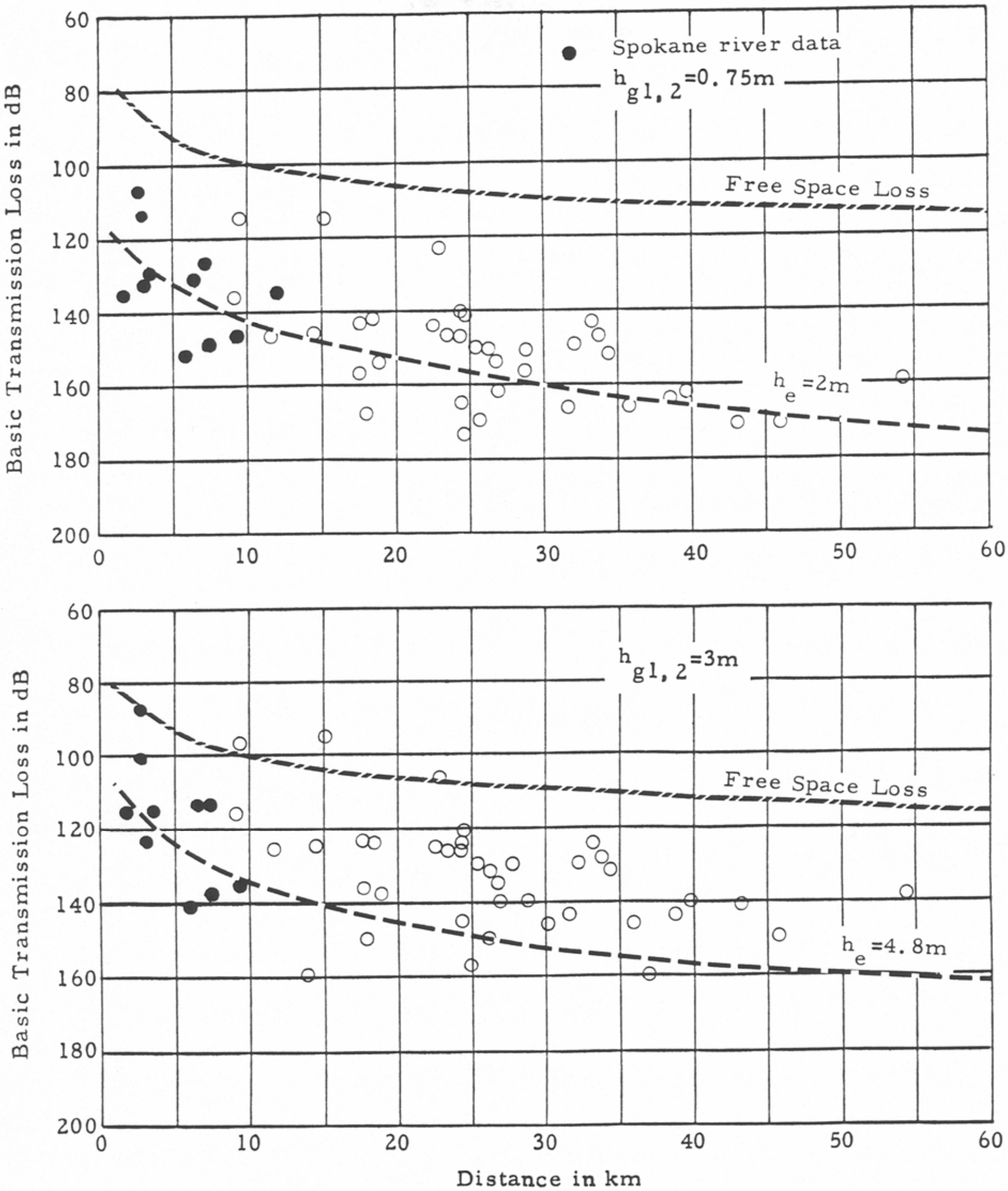

Figure 21. Basic transmission loss, measured and predicted, mountainous terrain, Washington, Δh=210 and 305m, f=230MHz.

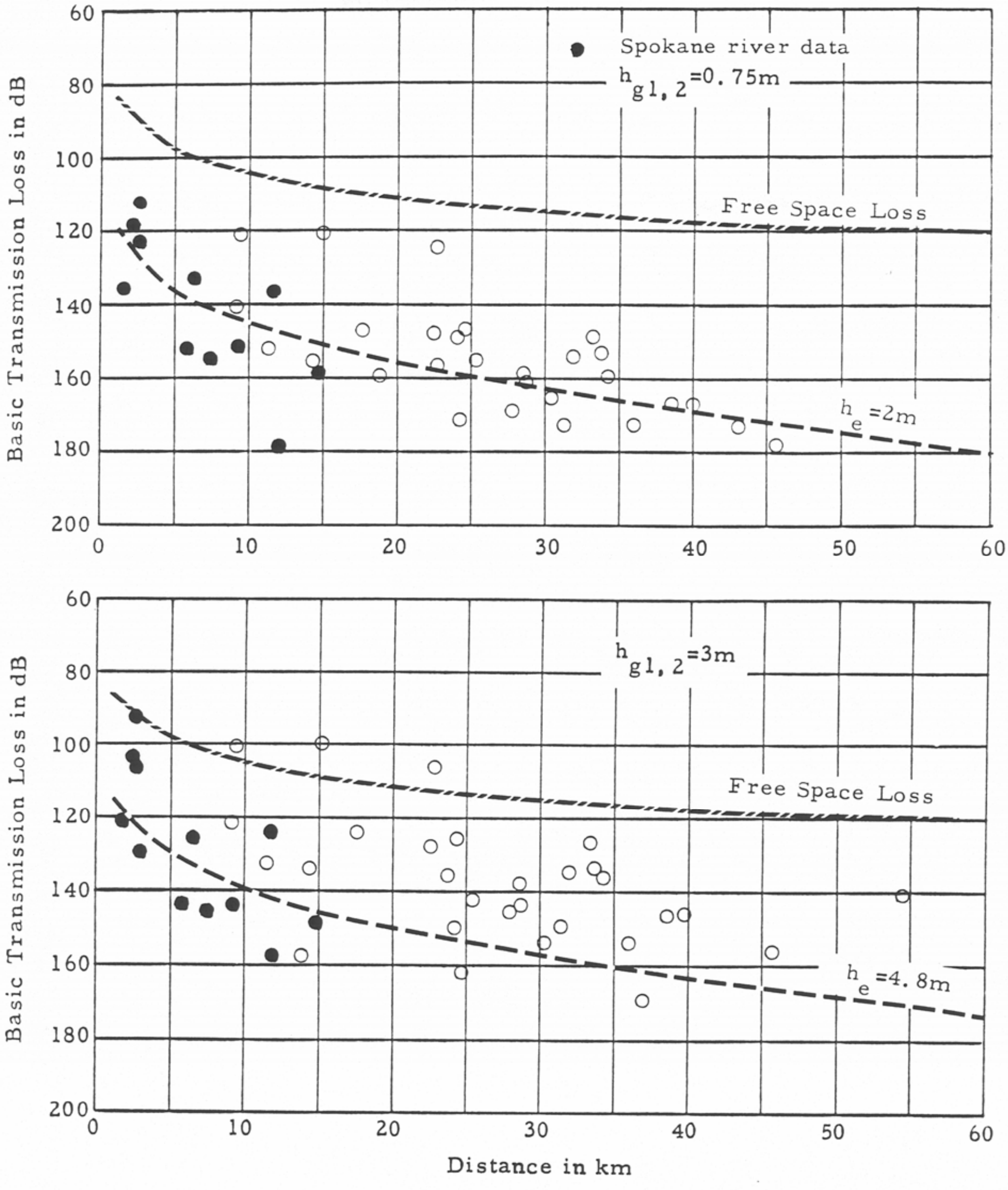

Figure 22. Basic transmission loss, measured and predicted, mountainous terrain, Washington, Δh=210 and 305m, f=416MHz.

416 MHz the predicted values overestimate the transmission loss especially for the higher antennas. Calculations based on very carefully selected sites would describe the medians of these data.

2.5 Measurements at VHF

A series of measurements with low antennas at frequencies of 20, 50, and 100 MHz was carried out in the Colorado plains and mountains and in an area in northeastern Ohio. This measurement program was sponsored by the U. S. Army Electronics Command to simulate net-type vehicular operations at frequencies up to 100 MHz and with antenna heights limited to less than 10 m above ground. The measurements in Colorado were made by personnel of the Institute for Telecommunication Sciences (formerly the Central Radio Propagation Laboratory of the National Bureau of Standards) and those in northeastern Ohio by Smith Electronics under contract to CRPL. Details of geographical locations, experimental procedures, and cumulative distributions of the data are reported by Barsis and Miles (1965), while path profiles and a complete tabulation of data are contained in a series of reports by Johnson et al. (1967).

All measurements in the Colorado plains and mountains were made from a common transmitter site northeast of Boulder. Receiving sites were selected from a map study at nominal distances of 5, 10, 20, 30, 50, and 80 km from the transmitter site, which is close to the plains-mountains boundary. All transmissions were continuous wave, using vertical polarization at 20.08 and 49.72 MHz, and both vertical and horizontal polarization at 101.5 MHz.

The measurement program in Ohio was conducted in an area surrounding Cleveland, using one central and five peripheral transmitters. Receiver sites were selected in concentric circles around the central transmitter at distances of 10, 20, 30, and 50 km. All paths were in hilly and partly wooded terrain, with none in urban areas. Transmission was at 19.97, 49.72, and 101.8 MHz with vertical polarization, and at 101.8 MHz with horizontal polarization.

In this report comparisons with predictions are shown for data taken using vertical polarization. Comparisons with data at 100 MHz using horizontal polarization are very similar to those using vertical polarization. Most of the comparisons are with data for the "principal" or randomly selected receiver site. An alternate site is the readily accessible site within a 100 m radius of the principal site at which a maximum value of field strength was recorded. An example of the resultant improvement in propagation conditions in Ohio is included.

The measurements in Colorado were chiefly in the plains but extended into the mountains. The paths were rather arbitrarily divided into two groups, those in the plains and those in the mountains. The separation is not clear-cut, as both groups include some measurements in the foothills, and neither group can be considered as representative of homogeneous terrain.

Point-to-point predictions for all paths in Colorado and Ohio have been compared with measurements and will be discussed in section 3.

2.5.1 Colorado Plains

For paths in the Colorado plains the transmitting antenna heights were 3.3 and 4 m for 20.08 and 49.72 MHz, respectively, with receiving antenna heights of 1.3 m at the lower frequency and 0.55 and 1.7 m at the higher one. At 101.5 MHz the transmitting antenna height was 3.15 m, with receiving antennas 3, 6, and 9 m above ground.

The common transmitting site is located in an open area with level terrain and clear foreground. Most of the receiving sites show clear foreground in the direction of the transmitter, but some paths are partially obstructed by buildings or trees. Procedures were planned to simulate completely random choices of sites by selecting readily accessible sites at nominal distances from the transmitter with a separation of at least 1 km between adjacent sites.

Measurements were made over about 190 paths in the plains at nominal distances of 3, 5, 10, 20, 30, 50, and 80 km from the common transmitter. At each of the shorter distances only 13 paths were used, with 18, 35, 43, and 52 measurements at nominal distances of 20, 30, 50, and 80 km, respectively. Values of the terrain parameter calculated from profiles read from topographic maps for all measurement paths have a median value $\Delta h = 90$ m that characterizes terrain for the area. Values of Δh, ranging from almost zero to 275 m, were obtained showing the wide diversity of terrain in this group of paths.

Figures 23 and 24 show the median and interdecile range of basic transmission loss derived from measurements at nominal distances of 3, 5, 10, 20, 30, and 50 km and a curve of predicted values as a function of distance assuming randomly selected sites. Figure 23 shows the results of measurements at 20 MHz with antenna heights of 3.3 and 1.3 m, and at 50 MHz with a transmitter height of 4 m and receiver heights of 0.55 and 1.7 m, and corresponding predictions of basic transmission loss as a function of distance. Figure 24 shows data at 101.5 MHz with a transmitting antenna height of 4 m and receiving antenna heights of 3, 6, and 9 m, with corresponding predictions. In both figures the interdecile range of data is rather large, often more than 20 dB, but in most cases the medians show good agreement with

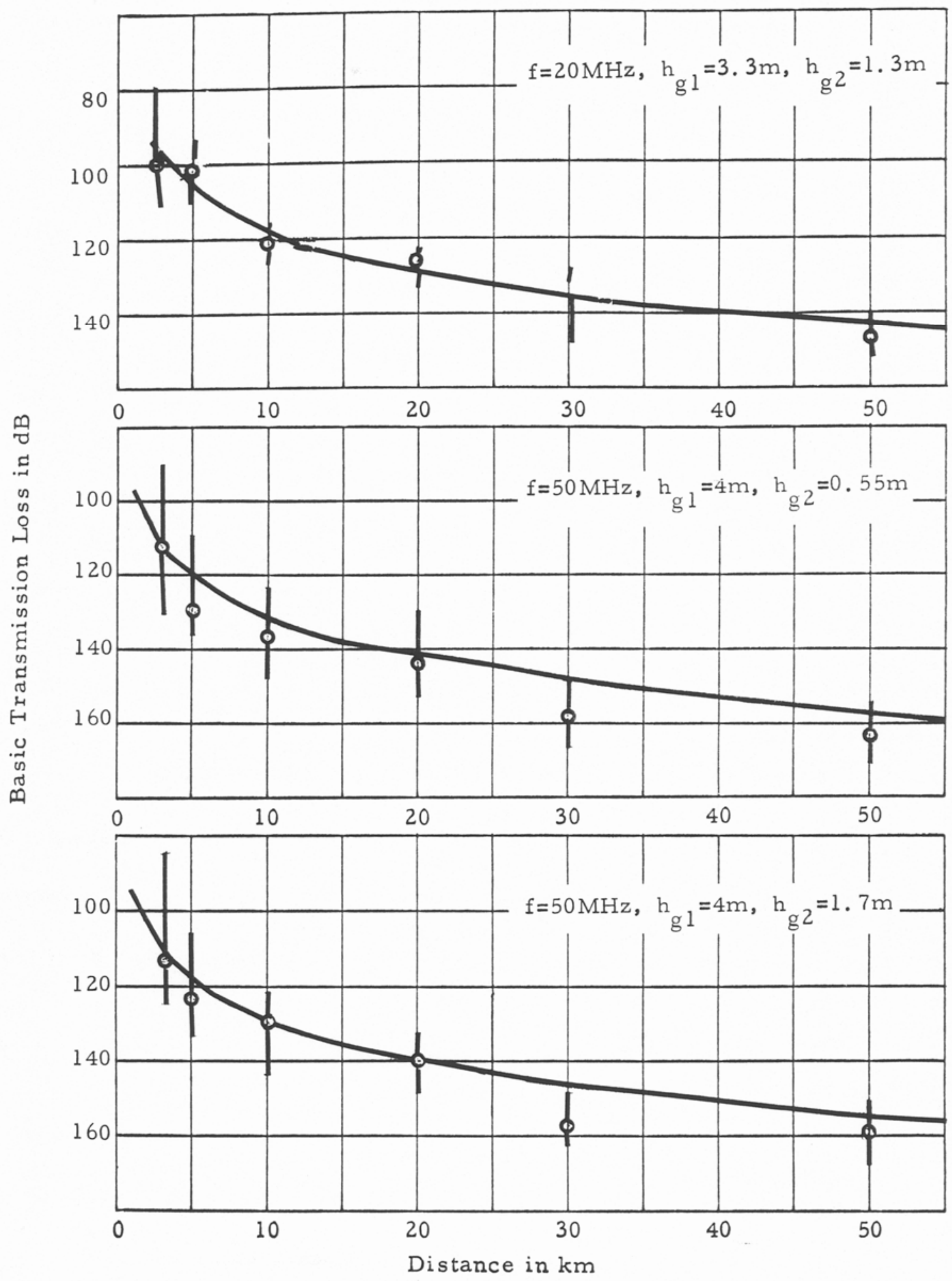

Figure 23. Basic transmission loss, Colorado plains, Δh=90m, f=20 and 50MHz, showing median and interdecile range of values at each nominal distance.

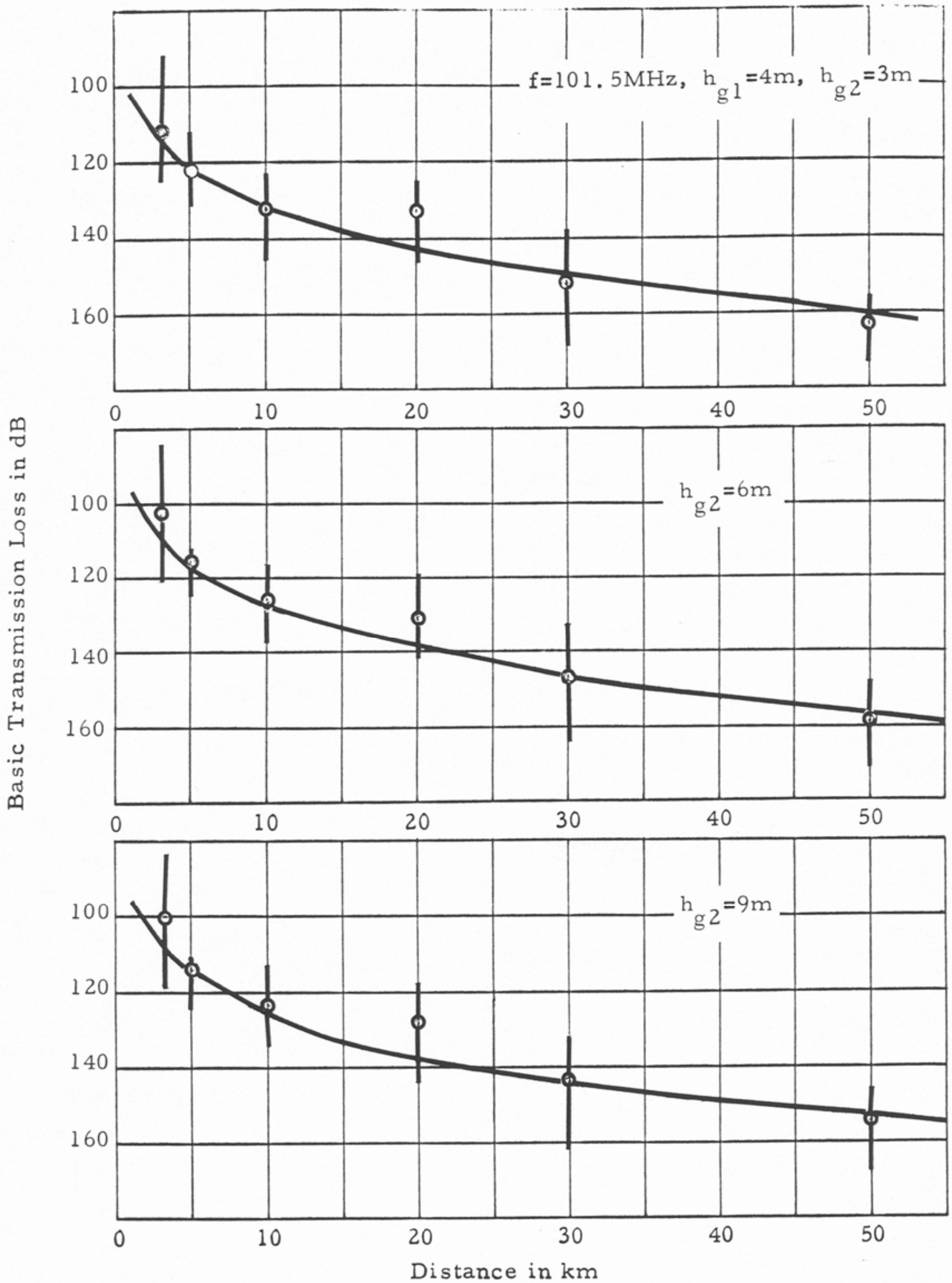

Figure 24. Basic transmission loss, Colorado plains, Δh=90m, f=101.5MHz, showing median and interdecile range of values at each nominal distance.