selected sites, as described by Longley and Rice (1968). Measurement attempts that failed because the signal was "in the noise" are indicated by a mark located at the level of the maximum measurable loss. In each figure the upper graph shows measured and predicted values with a receiver height of one meter, the lower graph presents the same information with a receiver height of 10 m. A definite improvement in propagation conditions with the increased receiver height is consistently shown, particularly at the lower frequencies.

These five figures all show a wide scatter of the data when plotted as a function of distance. Most of this scatter results from differences in individual path profiles. If low values of transmission loss are observed over a path at one frequency and receiver height, consistently low values are observed at the other frequencies and heights. For example, the low losses (plotted high in the figures) shown for paths at d = 27.5, 52.5, 79, and 119 km appear at all frequencies and receiver heights. An examination of the corresponding profiles shows that these are either clear line-of-sight or isolated knife-edge diffraction paths. On the other hand, the larger than average losses for paths at d = 5, 79.5, and 119 km are all for two-horizon paths with rather large elevation angles.

Such path-to-path differences, caused by differences in individual profiles, are taken into account in the point-to-point predictions for specific paths, as described in section 3 of this report. An area prediction calculates the median transmission loss expected at each distance, with an allowance for path-to-path or location variability.

In figures 1 through 5 with the receiver only one meter above ground, the medians of data lie between the two curves for random and carefully selected sites at the lower frequencies, but at the higher frequencies the prediction curve for selected sites describes the medians of data. With the receiver 10 m above ground the prediction for selected sites agrees with the medians of data at all distances and frequencies shown.

For several paths in this group the measurements were repeated on three or more different days. In some instances two or three measurements were made in the same month, but in others the elapsed time was six months to a year. For some paths the results of the repeated measurements agree closely with each other, but for other paths the results differ by 15 to 20 dB. Some of these differences represent commonly observed seasonal differences in propagation conditions; others may result from local atmospheric changes. In general the values measured during the period April through June show less attenuation than those measured in the period November through February. No detailed analysis of these changes has been made.

The measurements at seven "concealed" transmitter sites were compared with those at corresponding "open" sites. These paths range from 6 to 36 km in length. At all distances and receiver heights the paths with concealed transmitters show larger values of transmission loss than the corresponding open paths. These differences range from about 4 dB for the shortest path at 230 MHz to 35 or 40 dB for the longer paths at 4595 and 9190 MHz. Even a rather thin screen of deciduous trees increases the transmission loss 20 to 25 dB at 9190 MHz, while at the three lower frequencies over the same paths the increased losses are 6 to 10 dB. At present the area predictions make no allowance for such surface "clutter" in a quantitative way. More measurements of this type are needed as a basis for defining a "clutter factor" that would allow for the effects of natural and man-made objects.

2.2 Fritz Peak, Colorado, R-2

Measurements in the 230 to 9200 MHz range were continued with a common receiver site located in the mountains west of Boulder at the foot of Fritz Peak. The peak shields the site from the eastern plains, and 36 of the 44 transmitter sites are located in the mountains. These measurements are described in detail in part II of the report by McQuate, Harman, and Barsis (1968). The data represent conditions in rough mountainous terrain, where the ground cover is chiefly coniferous forest.

The immediate foreground at the receiver site is clear to a distance of more than 50 m but is rather heavily forested beyond that distance. The paths range in length from 2.5 to 120 km. The majority of the transmitting sites were selected to provide an unobstructed foreground in the direction of the receiver.

Path profiles were read from detailed topographic maps and the terrain parameter calculated for each path. The median value, Δh = 650 m, was used to characterize the terrain irregularity for these paths. Unfortunately, even though the common receiver is located in the mountains the paths in this group do not have similar characteristics. The 3 to 10 km paths would be better represented by a much smaller value of Δh, and several of the longer paths extend well out over the plains, with transmission over relatively smooth terrain for the major part of their lengths.

Figures 6 through 10 show the measured and predicted values of basic transmission loss plotted as a function of distance. The wide scatter of data, some 60 dB for the shorter paths, indicates that the characteristics of these short paths show marked differences from each other. An examination of the terrain profiles for the 3 to 10 km paths shows that the median value of Δh is less than 200 m, and that most of these are line-of-sight and knife-edge diffraction paths. In this group only two 3 km paths

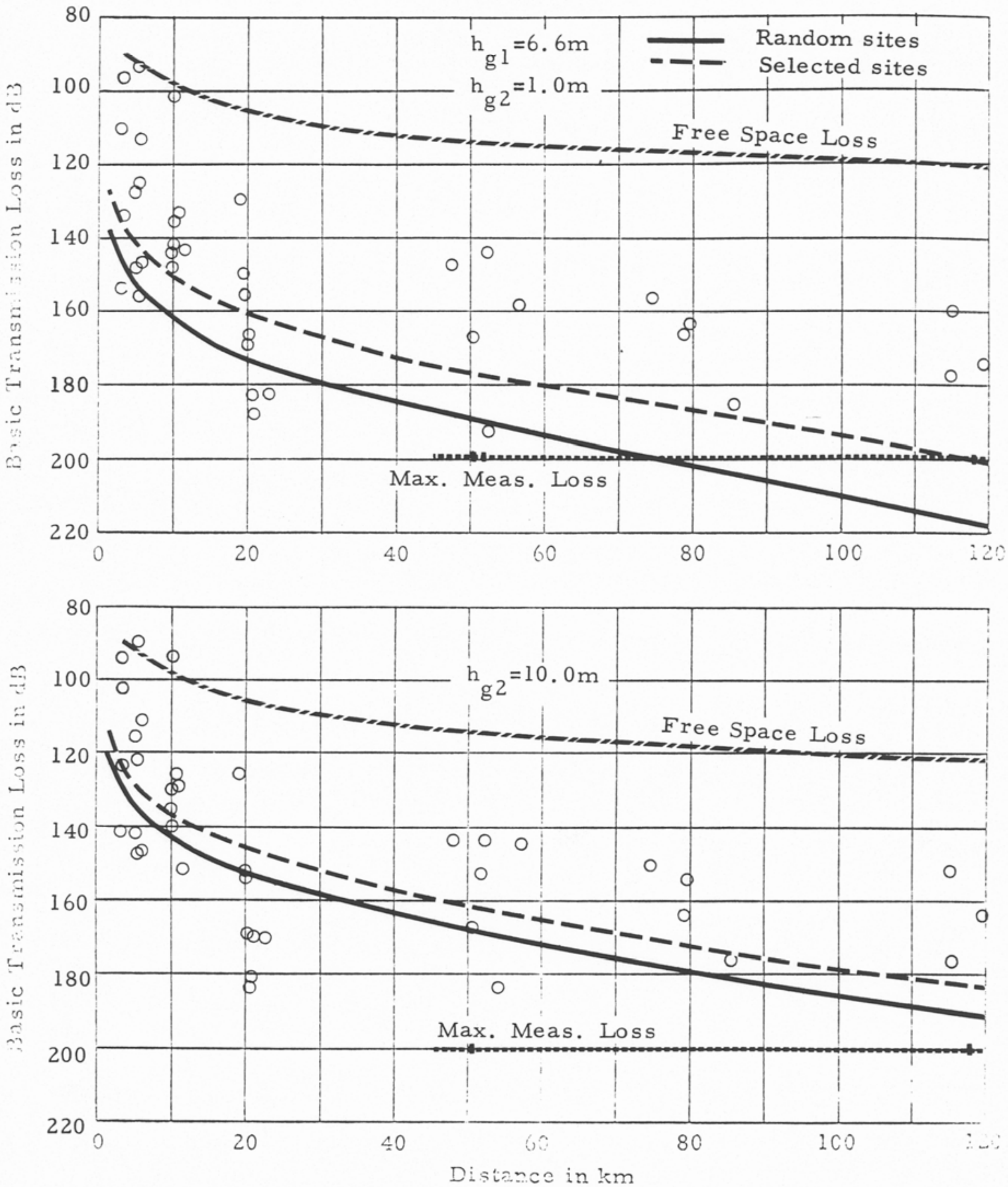

Figure 6. Basic transmission loss, measured and predicted, common receiver site R-2, Δh=650m, f=230MHz.

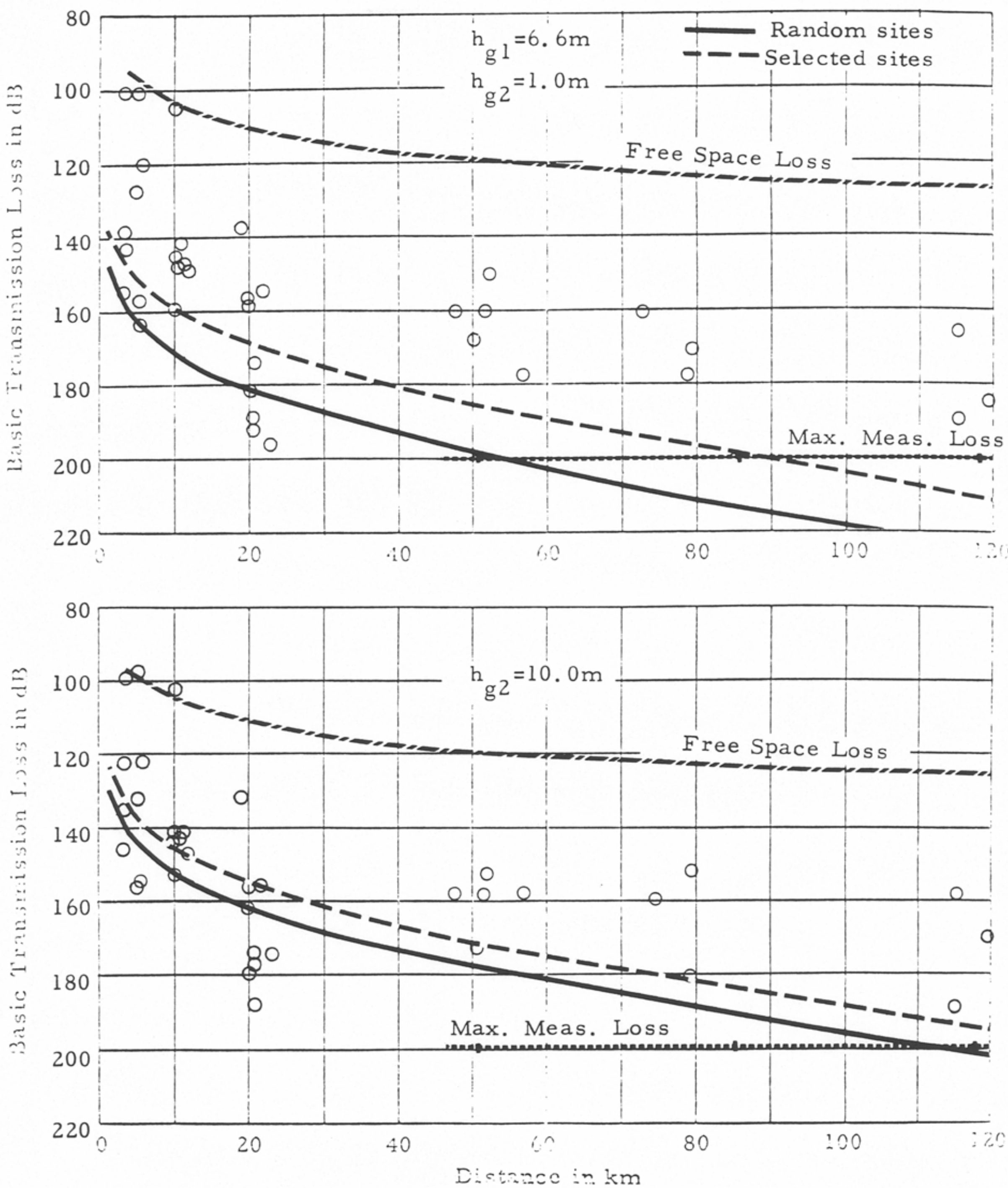

Figure 7. Basic transmission loss, measured and predicted, common receiver site R-2, Δh=650m, f=407MHz.

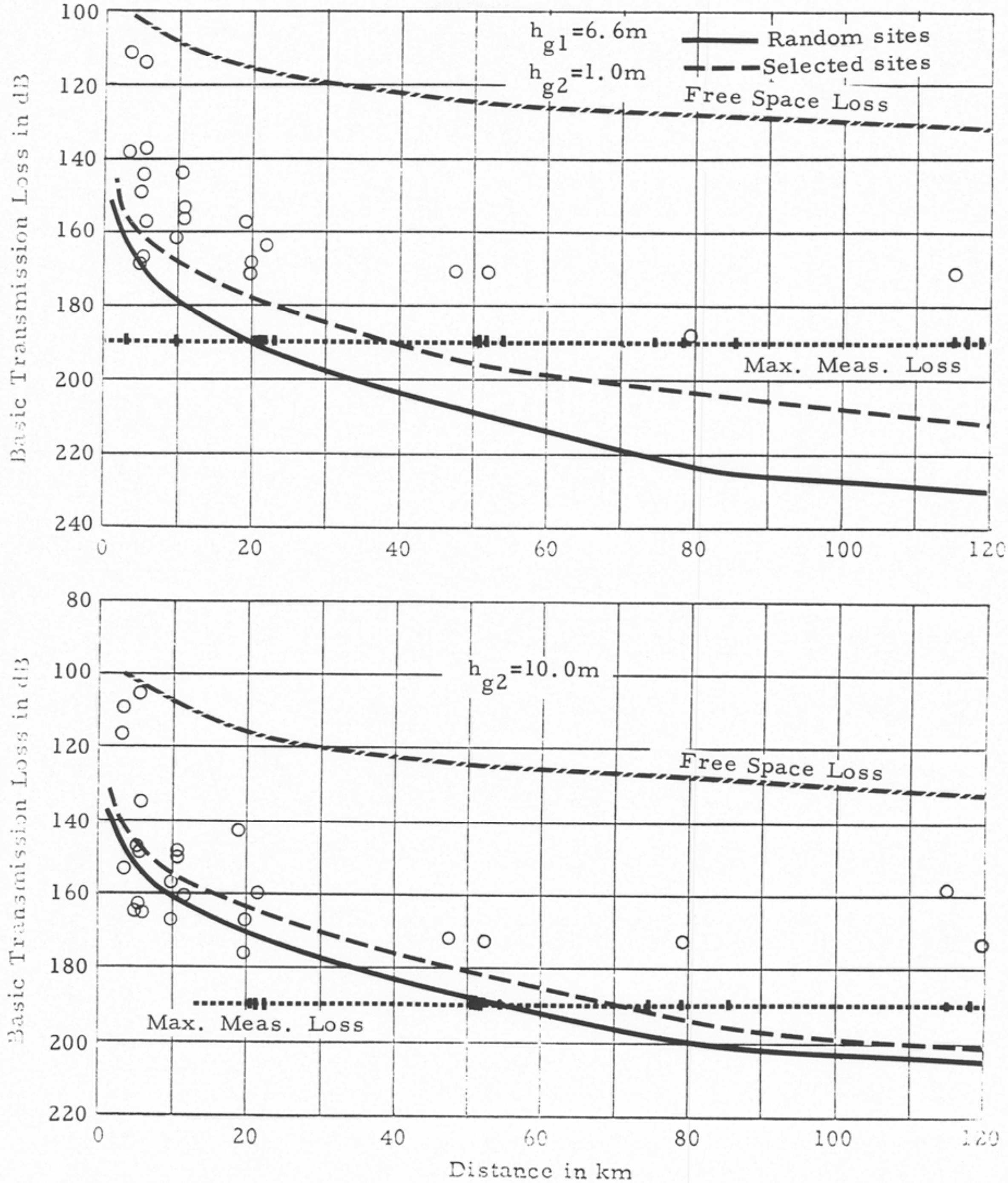

Figure 8. Basic transmission loss, measured and predicted, common receiver site R-2, Δh=650m, f=751MHz.

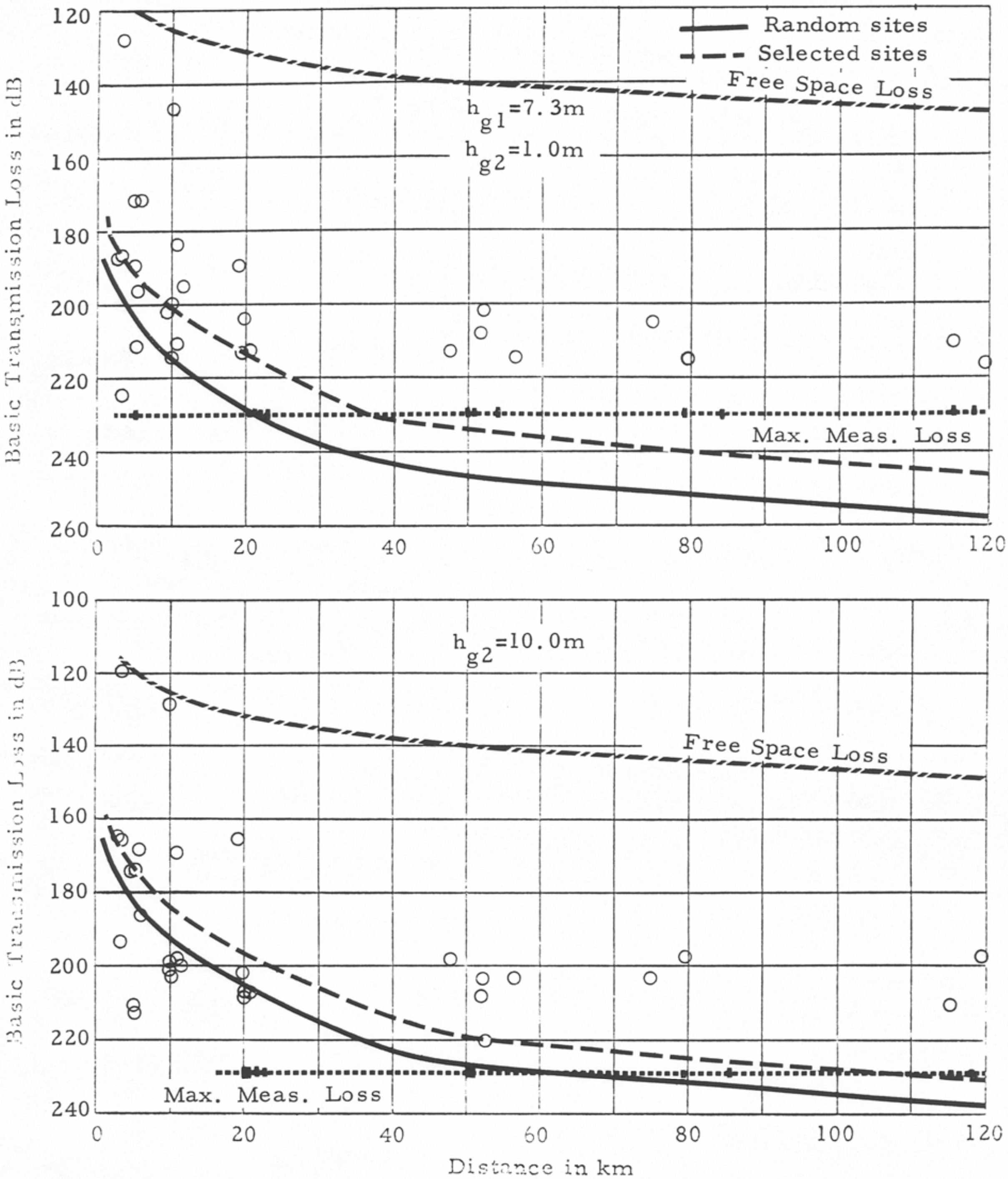

Figure 9. Basic transmission loss, measured and predicted, common receiver site R-2, Δh=650m, f=4595MHz.

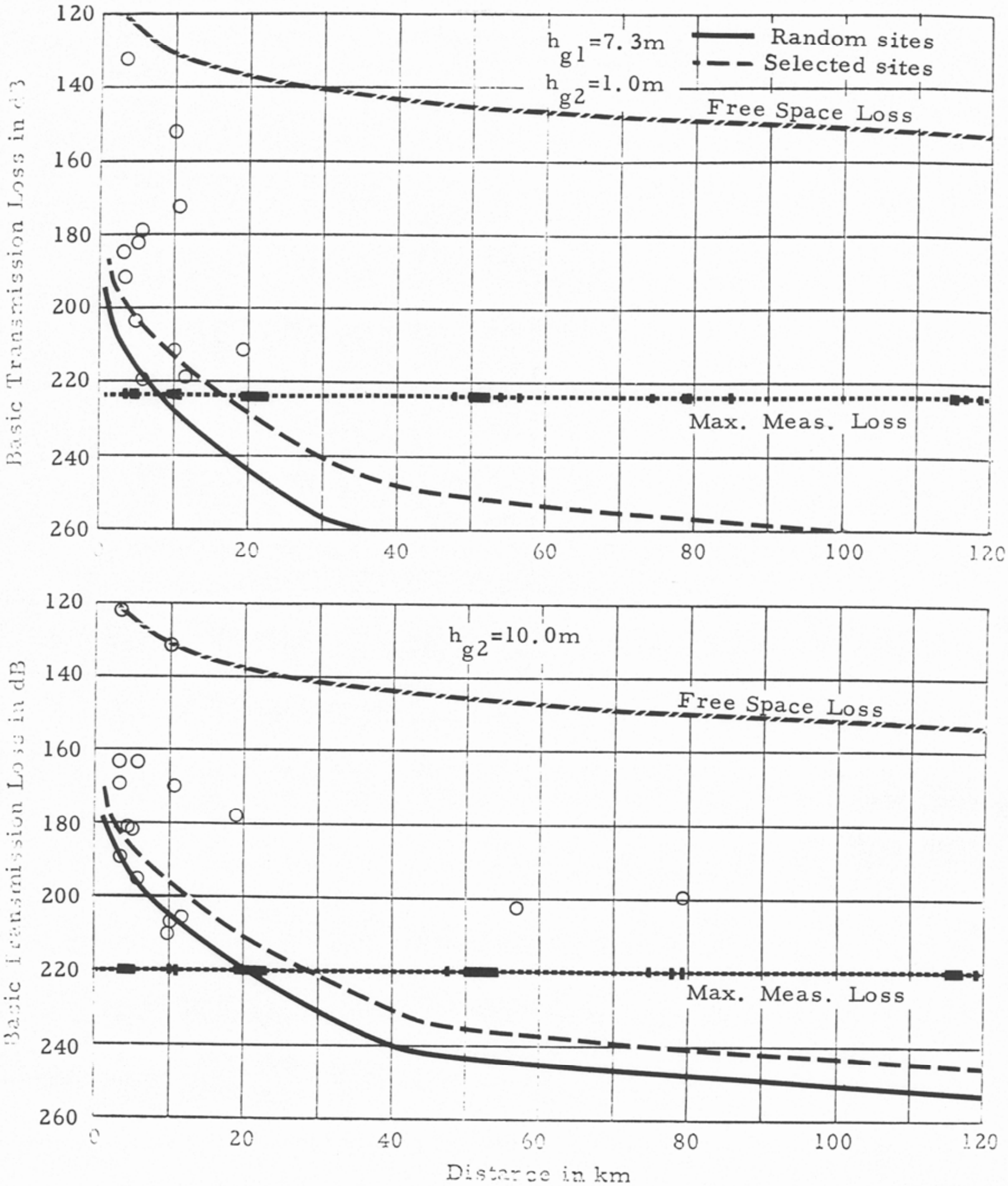

Figure 10. Basic transmission loss, measured and predicted, common receiver site R-2, Δh=650m, f=9190MHz.