Regional Administrative Conference
for the Planning of VHF/UHF Television Broadcasting
in the African Broadcasting Area and
Neighbouring Countries
First Session, Nairobi, 1986

REPORT TO THE
SECOND SESSION OF THE CONFERENCE

(See Resolution 1)

General Secretariat
of the
International Telecommunication Union

Geneva, 1986

Regional Administrative Conference for the Planning of VHF/UHF Television Broadcasting in the African Broadcasting Area and Neighbouring Countries

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REPORT TO THE SECOND SESSION OF THE CONFERENCE

(See Resolution 1)

General Secretariat
of the
International Telecommunication Union

Geneva, 1986

FIRST SESSION OF THE REGIONAL ADMINISTRATIVE
CONFERENCE FOR THE PLANNING OF THE
VHF/UHF TELEVISION BROADCASTING IN THE
AFRICAN BROADCASTING AREA AND NEIGHBOURING
COUNTRIES, NAIROBI, 1986

Nairobi, 9 October 1986

The Chairman of the Second Session of the
Regional Administrative Conference
for the Planning of the VHF/UHF Television
Broadcasting in the African Broadcasting
Area and Neighbouring Countries

Dear Sir,

In accordance with Nos. 226 and 228 of the International Telecommunication Convention (Nairobi, 1982) and the provisions of Resolution No. 1 adopted by the First Session of the Regional Administrative Conference for the Planning of the VHF/UHF Television Broadcasting in the African Broadcasting Area and Neighbouring Countries (Nairobi, 1986), I have pleasure in enclosing the Report by the First Session to the Second Session of the Conference.

Yours faithfully,

S.K. CHEMAI
Chairman

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INTRODUCTION

The World Administrative Radio Conference (Geneva, 1979), in its Resolution No. 509, considering that the VHF/UHF frequency assignment Plan for television broadcasting was drawn up in Geneva in 1963 and noting the extension of the band allocated to the broadcasting service from 174 - 223 MHz to 174 - 230 MHz, invited the Administrative Council to take all necessary steps for convening a regional conference to review and revise the provisions of the existing VHF/UHF Plan for television broadcasting (Geneva, 1963) for the African Broadcasting Area, taking into account the assignments contained in the Stockholm Plan, 1961.

The Plenipotentiary Conference (Nairobi, 1982), in its Resolution No. 1, provided that this Conference should be held in two sessions. At its 40th session, the Administrative Council adopted Resolution No. 914 establishing an agenda for the First Session to be held in Nairobi, Kenya, from 22 September 1986 for three weeks. Furthermore, subject to consultations among the countries concerned, the Administrative Council agreed that the planning area should be extended with a view to enabling some neighbouring countries which had initiated preparations for coordinated planning of the VHF/UHF television broadcasting service to take part in the Conference.

The Administrative Council at its 41st session, considering the results of the foregoing consultations, amended Resolution No. 914 and decided that the First Session of the Regional Administrative Conference for the Planning of VHF/UHF Television Broadcasting in the African Broadcasting Area and Neighbouring Countries as defined, namely, Bahrain, Iraq, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates, and the Islamic Republic of Iran, would be held in Nairobi, Kenya, from 22 September 1986 for three weeks to prepare technical bases for the establishment of frequency assignment plans in bands I, III, IV and V for the television broadcasting service.

Consequently, the First Session was held in Nairobi from 22 September 1986 to 9 October 1986.

The technical criteria and planning methods were based on the contributions by administrations of the African Broadcasting Area and neighbouring countries as well as the work of the CCIR presented in its report to the First Session.

In addition to establishing the technical criteria for the television broadcasting service, the Conference at its First Session also examined compatibility problems relating to the other services sharing with the broadcasting service the frequency band 790 - 862 MHz in Region 1 and Bands I, III, IV and V in Region 3. The sharing criteria have been provisionally defined, subject to further consideration by the Second Session. The Second Session will have to establish regulatory procedures pertaining to the sharing of the bands allocated to broadcasting as well as to the other services.

The First Session of the Conference adopted its Report to the Second Session which provided instructions and guidelines for the preparatory work to be carried out by the permanent organs of the Union in the intersessional period, and also adopted Recommendations dealing with the draft agenda of the Second Session and with the abrogation of the Regional Agreement for the African Broadcasting Area (Geneva, 1963) to be submitted to the Administrative Council for consideration at its next session.

In the light of the tasks assigned to administrations and in particular to the IFRB, a detailed work programme and a schedule of the tasks to be performed were drawn up. Further technical studies to be undertaken by the CCIR, especially in the field of propagation, as well as other technical parameters, have been defined in various Recommendations.

CHAPTER 1 - DEFINITIONS

1.1 Coverage area

The area within which the field strength of a transmitter is equal to or greater than the usable field strength.

1.2 Service area

The part of the coverage area in which the administration has the right to demand that the agreed protection conditions be provided.

1.3 Minimum usable field strength*

Minimum value of the field strength necessary to guarantee satisfactory** service quality in the presence of natural and man-made noise but in the absence of interference from other transmitters.

1.4 Usable field strength

Minimum value of field strength necessary to guarantee satisfactory** service quality for at least 99% of the time and in at least 50% of locations, in the presence of natural and man-made noise and in the presence of interference from other transmitters.

1.5 Reference usable field strength

The agreed value of the usable field strength that should serve as a reference or basis for frequency planning.

1.6 Low power station

A station with an effective radiated power equal to or less than:

- 100 watts for band 47 - 68 MHz;
- 300 watts for band 174 - 230 MHz;
- 500 watts for band 470 - 862 MHz.

1.7 Planning area

African Broadcasting Area and neighbouring countries listed in Administrative Council Resolution No. 914 (as amended at the 41st session of the ITU Administrative Council), namely:

Saudi Arabia, Bahrain, United Arab Emirates, Iran (Islamic Republic of), Iraq, Kuwait, Oman, Qatar.

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* The term "minimum field strength to be protected" should not be used to refer to "minimum usable field strength".

** Approximately grade 3 under CCIR Recommendation 500-3.

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CHAPTER 2 - PROPAGATION IN THE VHF/UHF BANDS

2.1 Propagation data for the VHF/UHF television broadcasting service

2.1.1 General considerations

The propagation data contained in this chapter are based on the relevant CCIR Recommendations and Reports, on certain data already used for the African Broadcasting Conference, Geneva, 1963, and on the most recent work of Interim Working Party 5/5 of CCIR Study Group 5, of Interim Working Party 6/8 of CCIR Study Group 6 and on the studies carried out by the administrations of the Gulf region.

The propagation curves shown in Figures 2.1 to 2.34 are intended for the planning of the television broadcasting service. They give, on the basis of statistics of measurement results relying also on theoretical considerations, the value of field strength exceeded for 50% of locations for time percentages of 50, 10, 5 and 1%. Since propagation conditions are related to the refractive index of the medium in which radio waves propagate and that in the troposphere, this index depends on climatic and meteorological conditions, different curves are available corresponding to the geographical zones where they are to be applied.

The propagation characteristics above warm seas, hot seas and the coastal areas bordering them differ considerably from those prevailing elsewhere; above warm and hot seas and their coastal areas, the variation in refractive index versus altitude is responsible for superrefractive effects and for the occurrence of "ducts". These phenomena have been observed, for example, along the west coast of Africa between the Equator and the Tropic of Cancer, in the Straits of Gibraltar, in the Red Sea and in the maritime area extending from the Shatt-al-Arab up to and including the Gulf of Oman. Extensive studies have been carried out by Gulfvision in the area of extreme superrefractivity as defined in the area of the Shatt-al-Arab up to and including the Gulf of Oman.

The method used to forecast field strength values in the various propagation zones of the planning area is explained below.

It was also noted that abnormal long-distance (500 - 9,000 km) propagation by ionospheric layers could severely constrain frequency reuse in Band I. However, this factor will be disregarded for calculation purposes.

2.1.2 Geographical division of the planning area into propagation zones

Conclusions drawn from various sources are summarized in the map of Figure 2.35, which distinguishes:

- 4 continental zones numbered 1 to 4 (instead of 6 in 1963);
- 4 maritime zones: 3 being designated by the letters A, B, C and one non-designated zone having the same characteristics as continental zone 4;
- 1 coastal zone: C1.

The classification proposed is based mainly on radio characteristics, but although these characteristics are tied to meteorological factors, they do not correspond exactly to a meteorological classification. The various zones are characterized and shown on the map in Figure 2.35.

Zone 1: Temperate and subtropical (continental) regions, exhibiting propagation conditions found over land in Europe and North America;

Zone 2: Desert regions, exhibiting propagation conditions found in regions having low humidity and small annual variations in climate;

Zone 3: Equatorial regions, exhibiting propagation conditions found in hot and humid climates;

Zone 4: Maritime regions, representing warm seas and terrestrial zones of low altitude bordering warm seas, where superrefraction conditions occasionally obtain (all the seas around the African continent are Zone 4 except Zones A and B designated below);

Zone A: Maritime zones at low latitudes frequently displaying superrefractivity and where the mean annual value of ΔN is 70;

Zone B: Maritime zones at low latitudes frequently displaying superrefractivity and where the mean annual value of ΔN is 60;

Zone C: Maritime zone of the Gulf within the area extending from the Shatt-al-Arab up to and including the Gulf of Oman, which persistently displays extreme superrefractivity;

Zone C1: Coastal land area surrounding Zone C. The coastal land area of the Gulf, which frequently displays extreme superrefractivity and ducting, will be subject to the definition of the administrations concerned. The boundaries of the coastal land area of the Gulf within the territorial borders of each administration shall be defined with a maximum limit of 100 km and communicated to the IFRB by the administrations concerned at the latest by the end of 1987.

2.1.3 Areas subject to extreme superrefraction phenomena

Over the sea, ducts are more or less persistent and extensive depending on the climate and the prevailing winds. In the region from the Shatt-al-Arab up to and including the Gulf of Oman, they may persist all day and surface ducts have been observed in excess of 240 m in depth for 1% of the time and 120 m for

50% of the time. Over coastal areas, the altitude and depth of these ducts diminishes and their penetration inland depends not only on the coastal topography but also on the magnitude and direction of the wind.

2.1.4 Application of the curves

2.1.4.1 Propagation curves and their application

The propagation curves represented in Figures 2.1 to 2.34 establish a relation between the field strength and the path length; in the case of Figures 2.1 to 2.32 the effective height of the transmitting antenna is the characteristic parameter of each curve in the same figure; the values obtained correspond to a receiving antenna height of 10 m over local ground. The values are expressed in decibels relative to 1 µV/m (dB(µV/m)) for an e.r.p. of 1 kW in the direction of the receiver. The curves give the field strength exceeded at 50% of locations and each figure corresponds to time percentages of 50, 10, 5 and 1% for one of the geographical zones defined in section 2.1.2.

The curves for 50% of the time will be used to determine coverage areas and for calculations of continuous interference, and those for 1% of the time to calculate tropospheric interference.

The curves in Figures 2.1 to 2.32 correspond to the four zones (1 to 4) defined in section 2.1.2 above. In the case of a path passing above maritime Zone A or B, the curves applicable to Zone 4 will be used during the inter-sessional period with the addition of a correction of 10 dB or 5 dB respectively, to the values derived from these curves. Other values may be used following the measurement campaign(s). (See Recommendation 3). This correction is subject to the condition that the value obtained does not exceed the free-space value by more than 6 dB.

The propagation curves for bands IV and V for 1% of time in the area from the Shatt-al-Arab up to and including the Gulf of Oman are those given in Figure 2.33 for maritime Zone C and in curves (a) and (b) of Figure 2.34 for Zone C1, which is the coastal land area surrounding Zone C indicating different propagation characteristics of the northern and southern parts of the Gulf.

The method of calculation of interfering signal levels for any path shall be based upon linear interpolation between the values obtained from the curves for the zones traversed by that path (see section 2.1.4.5).

For each path, two calculations of interfering signal level will be made by the IFRB; one calculation using curve (a) in Figure 2.34 and the other using curve (b) in the same figure, as these two curves represent different propagation characteristics frequently observed within Zone C1 as defined above.

Either of the two results obtained from calculations may be used in bilateral negotiations between administrations as considered appropriate for the path concerned.

In the area from the Shatt-al-Arab up to and including the Gulf of Oman, the propagation curves to be used for Band III for 1% of the time shall be as follows:

For paths over the sea (Zone C), the VHF propagation curve for a transmitting antenna height of 150 m in Zone 4 (Figure 2.16) shall be used with the addition of a 15 dB correction factor appropriate for a region where the mean annual value of ΔN is 80. This correction is subject to the condition that the value obtained does not exceed the free-space value.

For paths over land (Zones 1 and 2) the VHF propagation curve for a transmitting antenna height of 150 m in the appropriate zone (Zone 1 or 2) shall be used. For paths crossing the coastal land area (Zone C1), calculations shall be made by considering, in turn, Zone C1 to be sea and land (Zones 1, 2), employing the appropriate propagation curves as defined above. The resultant field strength shall be the average of the two results obtained. For the case of mixed paths, linear interpolation shall be applied.

The propagation curves for 50% of the time for Bands III, IV and V shall be as follows:

For paths over the sea, the appropriate curves for Zone 4 shall be used with the addition of a 15 dB correction factor appropriate for a region where the mean annual value of ΔN is 80. This correction is subject to the condition that the value obtained does not exceed the free space value. For paths over land, the appropriate curves for Zone 1 or 2 shall be used. For the case of mixed paths, linear interpolation shall be applied (see section 2.1.4.5).

2.1.4.2 Correction for the effective transmitting antenna height

The curves in Figures 2.1 to 2.32 are given for effective transmitting antenna heights between 37.5 and 1,200 m, each value given of the effective height being twice that of the previous one. For different values of effective height, at distances where the field strength depends strongly on this height, one can interpolate; for the distance concerned, the most accurate procedure is to draw a curve giving the field strength as a function of effective height; nevertheless by referring directly to the figures which give the field strength as a function of distance, and performing a linear interpolation between the two curves corresponding to effective heights immediately above and below the true value, the corresponding error will not exceed 1.5 dB in the worst case.

For effective transmitting antenna heights less than 37.5 m, the values obtained for 37.5 m are used.

For effective transmitting antenna heights h_1 exceeding 1,200 m, the field strength at a distance x km from the transmitter is taken as the same as that given by the curve for an effective height of 300 m at a distance of $(x + 70 - 4.1\sqrt{h_1})$ km. Since this extrapolation is only applicable for transhorizon distances, its use is limited to distances greater than $x = (4.1\sqrt{h_1} + 70)$ km. For distances between 100 km and $x = (4.1\sqrt{h_1} + 70)$ km, it is assumed that the field strength exceeds the value corresponding to an effective transmitting antenna height of 1,200 m by the same amount as at $x = (4.1\sqrt{h_1} + 70)$ km, calculated in accordance with the above procedure. For smaller distances, this increment is determined by linear interpolation between 0 dB at 20 km and a value depending on the height h_1 at a distance of 100 km. The extrapolation is subject to the condition that the value obtained does not exceed the free-space value by more than 6 dB.

2.1.4.3 Correction for terrain irregularities

Data which would allow for terrain irregularities are generally not known with sufficient precision to be useful in the development of a plan. Correction for terrain irregularities will be disregarded for planning calculation and interference calculation purposes.

However, for bilateral or multilaterial coordination in Zones 1, 2, 3 and C1, it is possible, when the terrain relief on the propagation paths of concern is known with sufficient precision, to take account of the information given in Annex 2.A of this Chapter. These corrections do not however have to be made in type 4 zones, which have been delineated taking account of the fact that their relief is fairly flat and that the propagation conditions observed within them are close to those found over the adjacent seas.

2.1.4.4 Variations as a function of the percentage of locations

The curves referred to correspond to 50% of locations, the percentage used for the purposes of planning. Corrections for other percentages of locations are given in Figures 5 and 12 of CCIR Recommendation 370, according to the frequency band concerned, VHF or UHF (see also Annex 2.B of this Chapter).

2.1.4.5 Calculations for mixed paths (linear interpolation)

When propagation paths occur over zones of different propagation characteristics, as defined in section 2.1.2 above, the following method is used which takes account of the different characteristics of the various parts of the path.

$E_{i,t}$: field strength for path in Zone i equal in length to the mixed path for t% of time;

$E_{m,t}$: field strength for mixed path for t% of time;

d_i : length of path in Zone i;

d_T : length of total path.

To determine the field strength value for the mixed path ($E_{m,t}$), the following formula is used:

$$E_{m,t} = \sum_i \frac{d_i}{d_T} E_{i,t}$$

This method is also used for mixed paths between zones with different propagation characteristics in the VHF and the UHF bands.

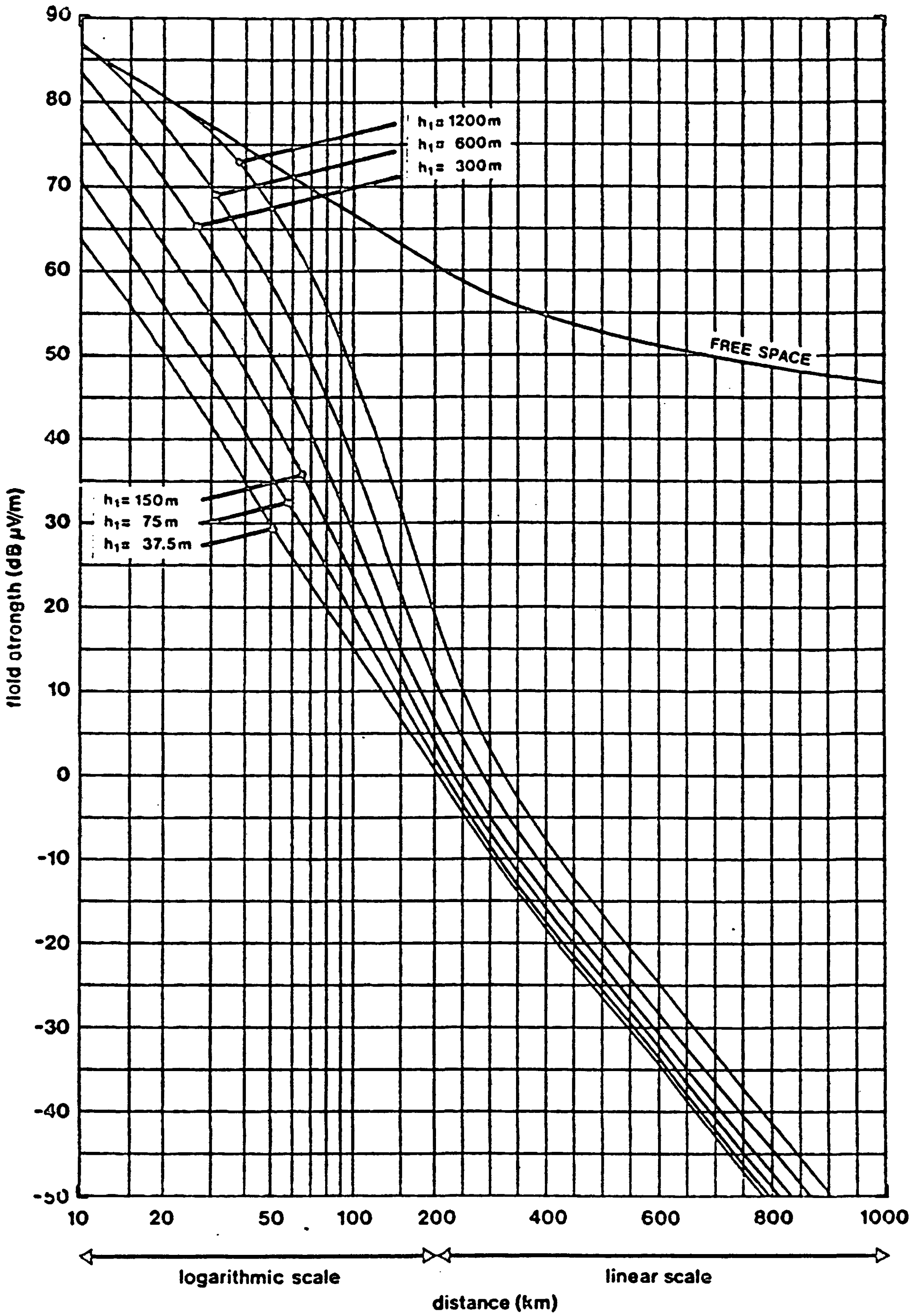


FIGURE 2.1

Propagation curves for the broadcasting service in Africa - Zone 1

Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz; temperate and subtropical (continental) regions 50% of the time; 50% of the locations; h_2 = 10 m

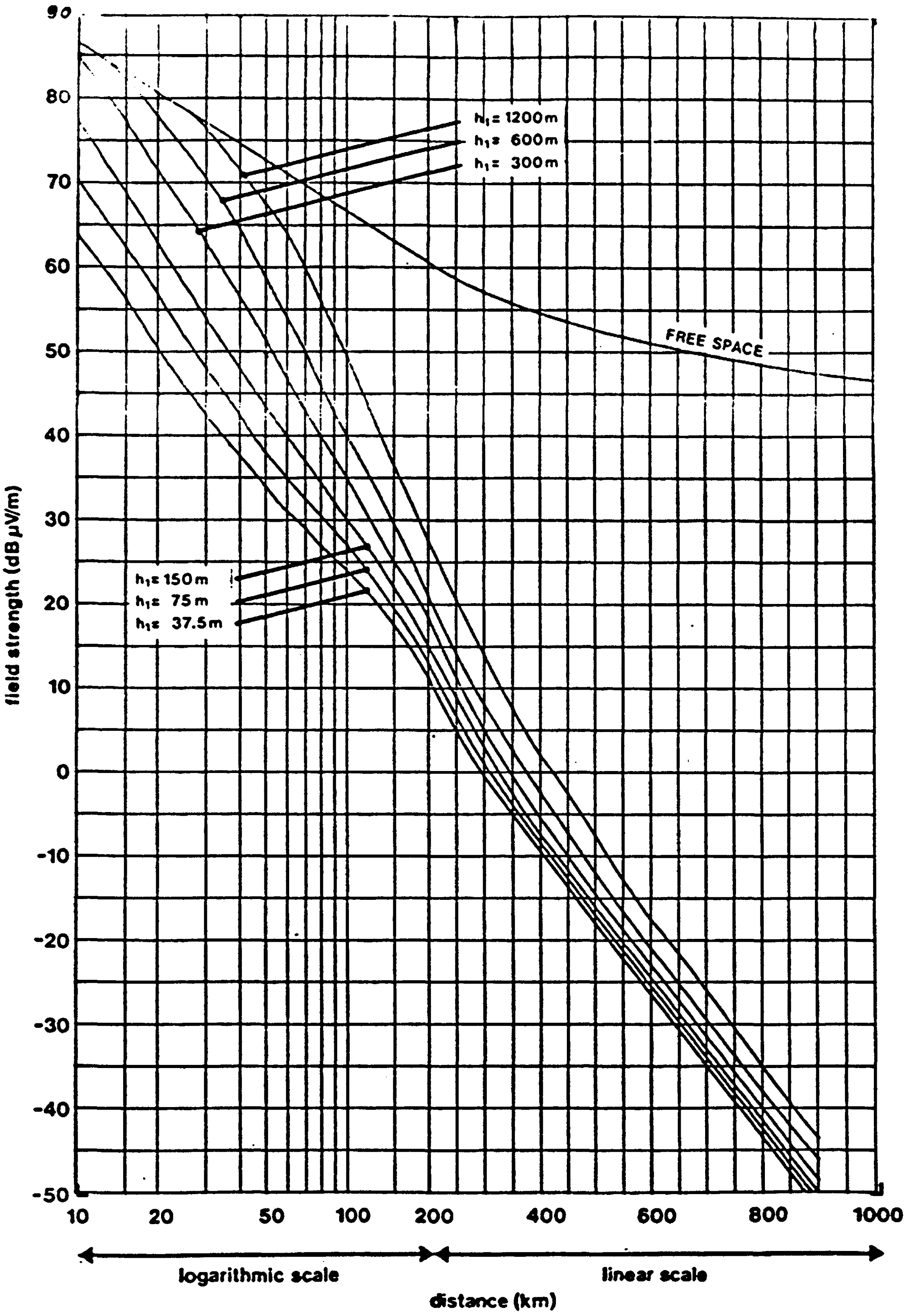


FIGURE 2.2

Propagation curves for the broadcasting service in Africa - Zone 1

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz; temperate and subtropical (continental) regions
10% of the time; 50% of the locations; h_2 = 10 m

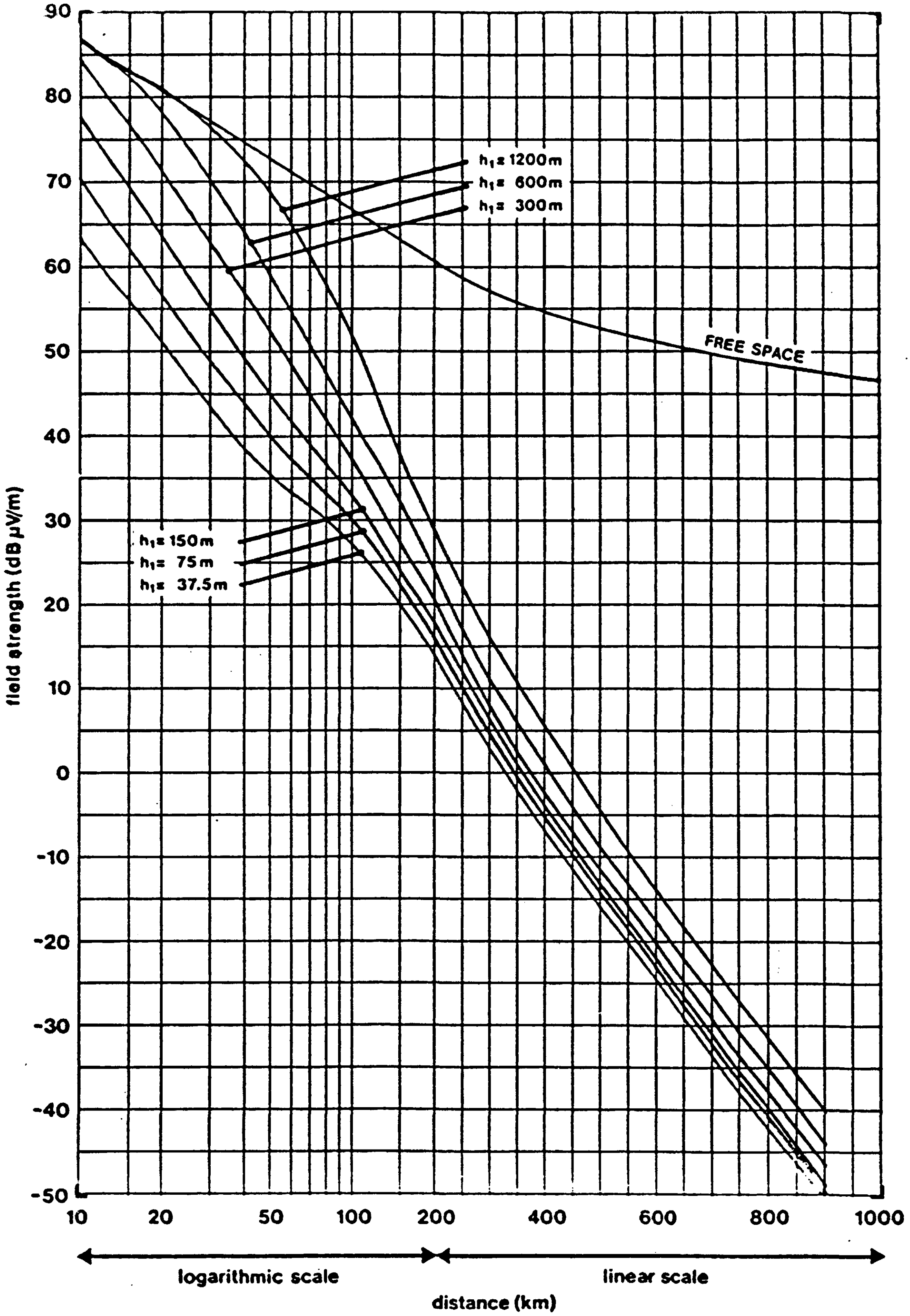


FIGURE 2.3

<u>Propagation curves for the broadcasting service in Africa - Zone 1</u>

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz; temperate and subtropical (continental) regions
5% of the time; 50% of the locations; h_2 = 10 m

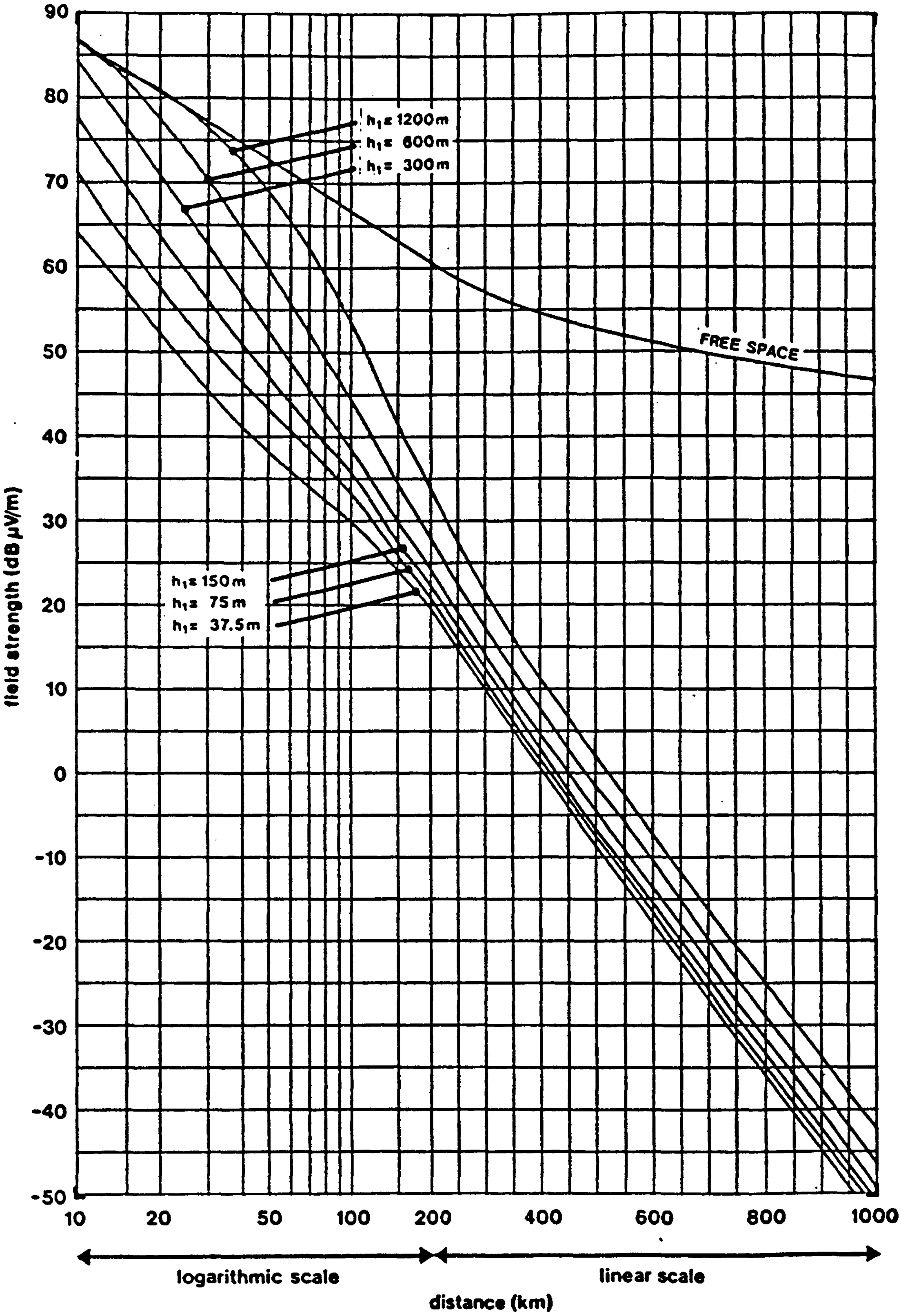


FIGURE 2.4

<u>Propagation curves for the broadcasting service in Africa - Zone 1</u>

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz; temperate and subtropical (continental) regions
1% of the time; 50% of the locations; h_2 = 10 m

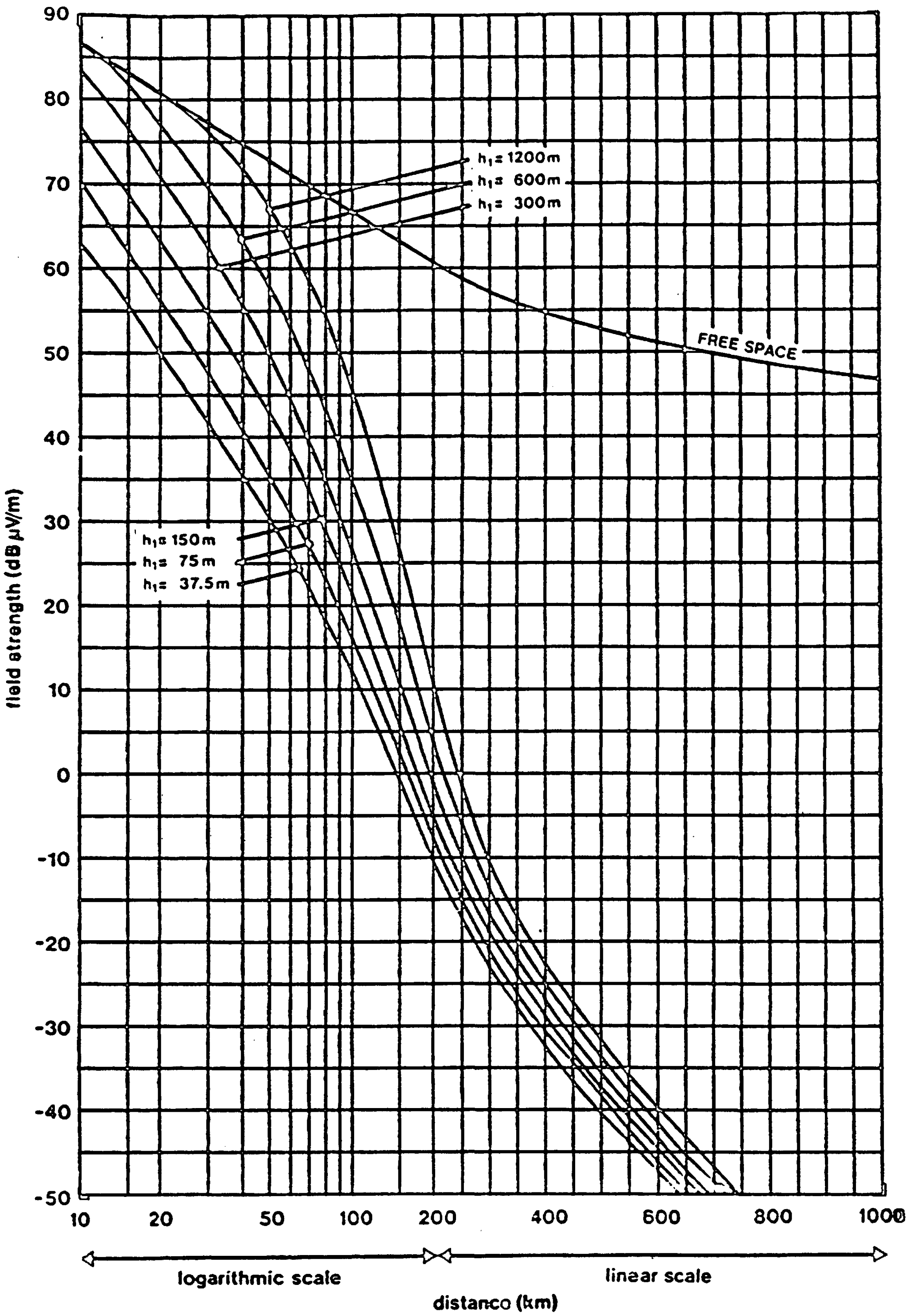


FIGURE 2.5

<u>Propagation curves for the broadcasting service in Africa - Zone 2</u>

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz; desert regions
50% of the time; 50% of the locations; h_2 = 10 m

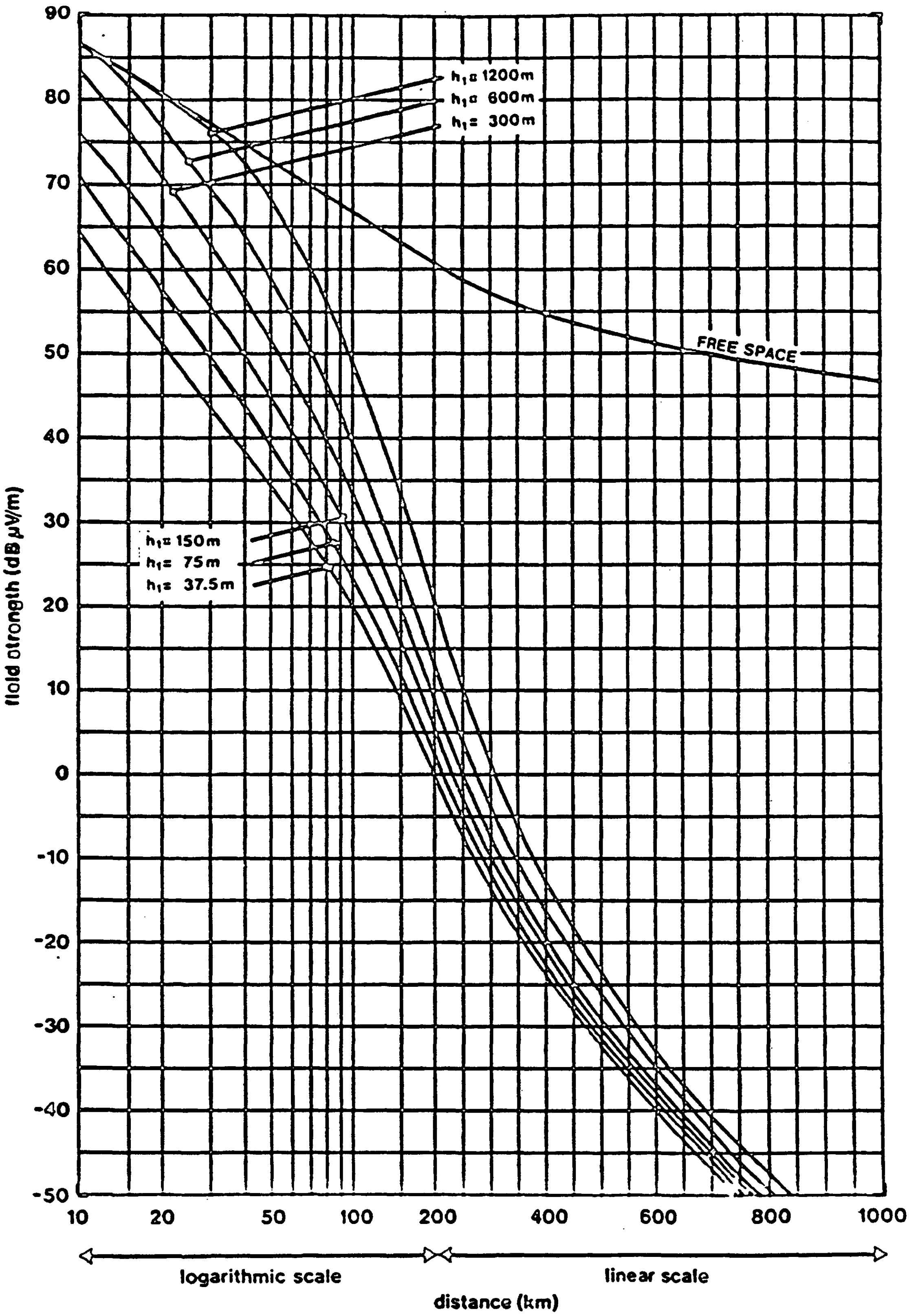


FIGURE 2.6

<u>Propagation curves for the broadcasting service in Africa - Zone 2</u>

Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz; desert regions
10% of the time; 50% of the locations; h_2 = 10 m

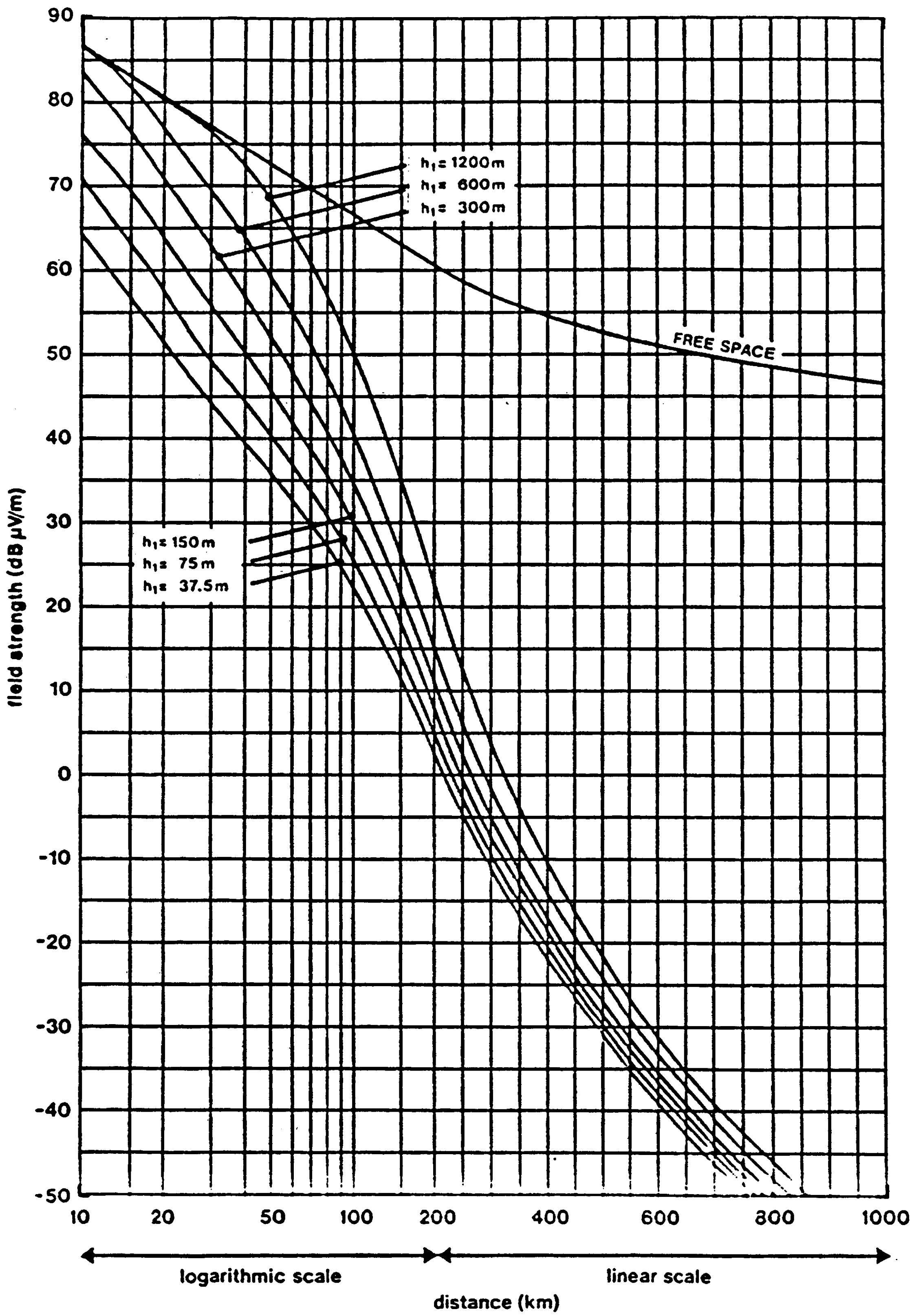


FIGURE 2.7

Propagation curves for the broadcasting service in Africa - Zone 2

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz; desert regions
5% of the time; 50% of the locations; h_2 = 10 m

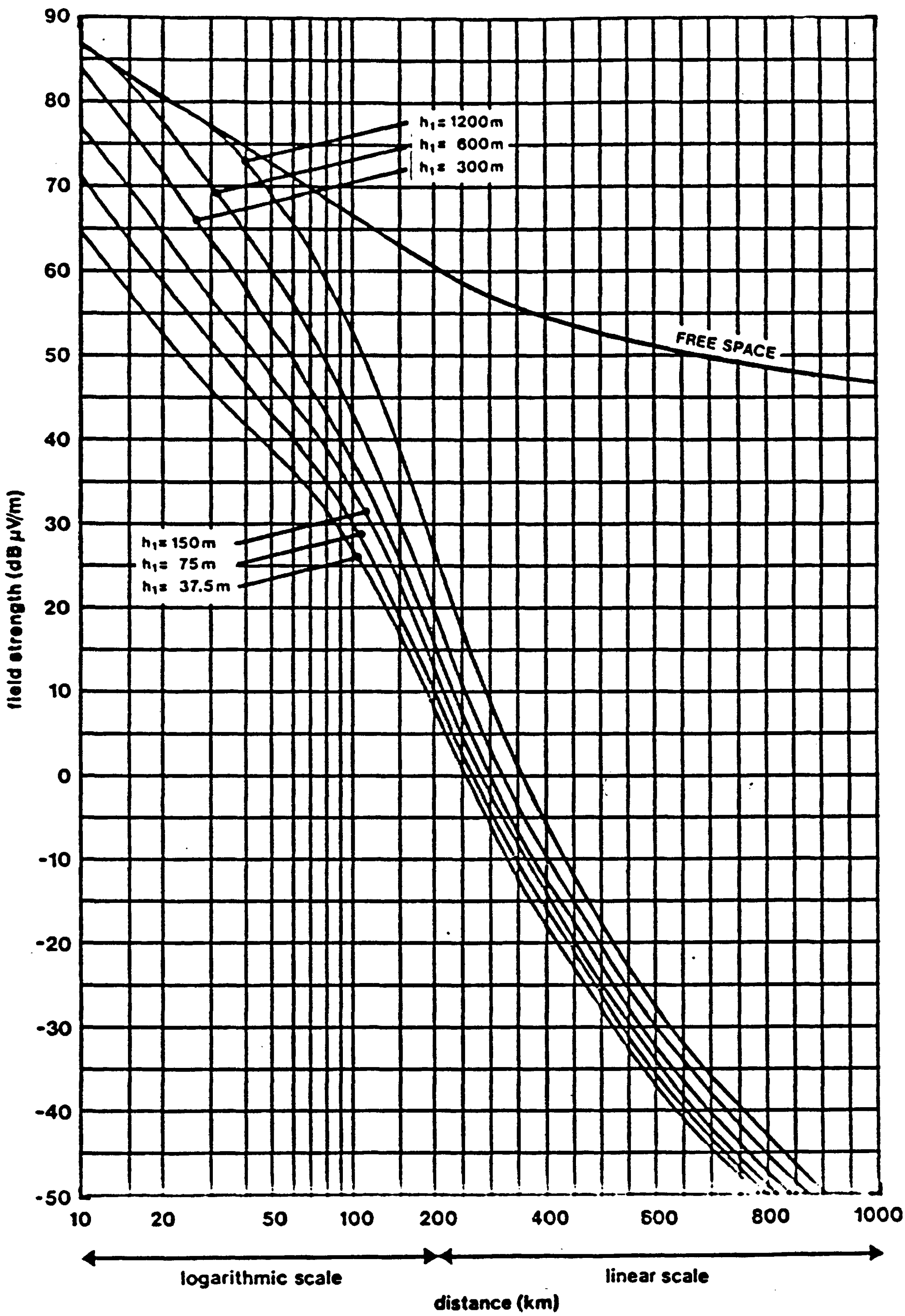


FIGURE 2.8

<u>Propagation curves for the broadcasting service in Africa - Zone 2</u>

Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz; desert regions
1% of the time; 50% of the locations; h_2 = 10 m

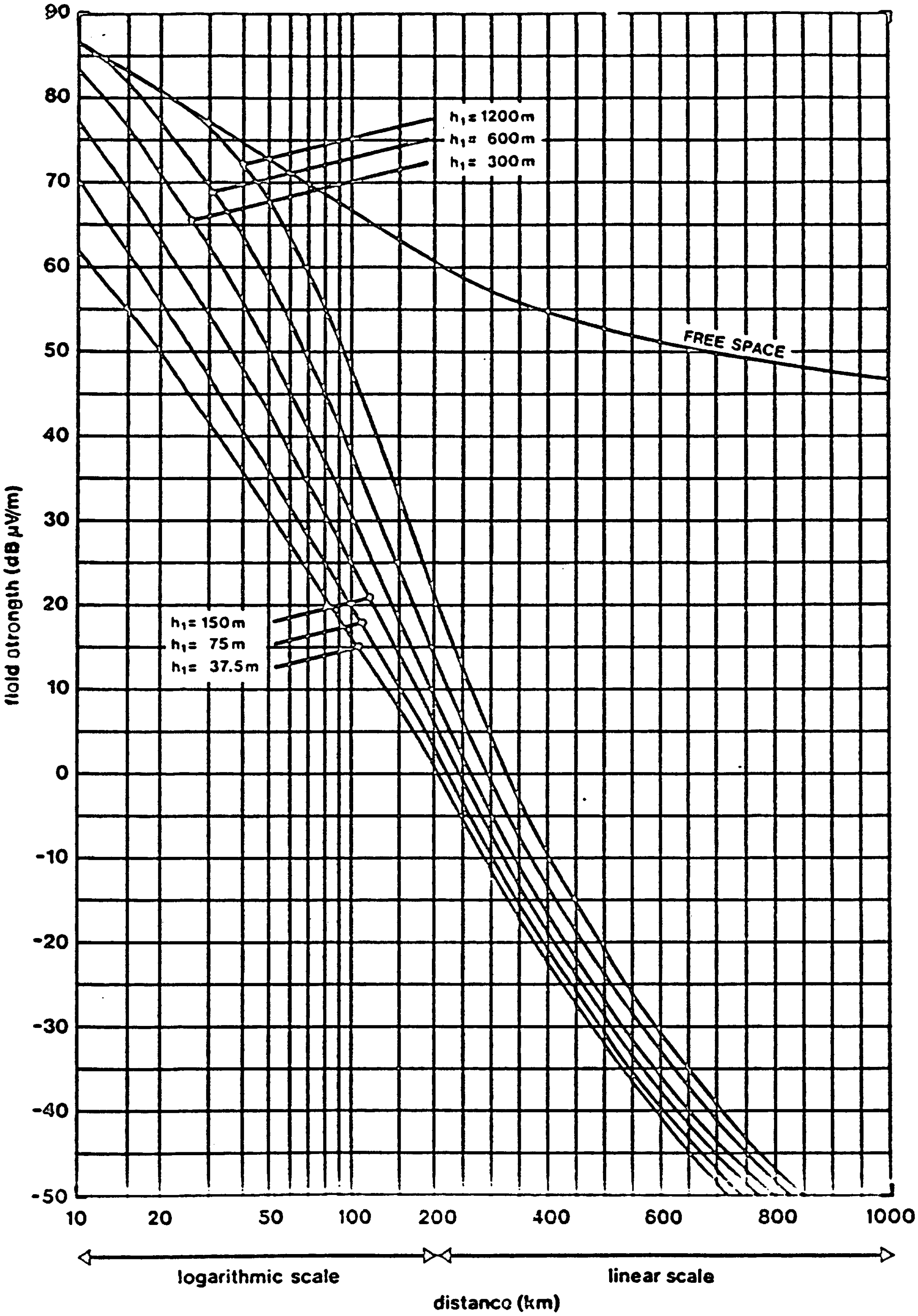


FIGURE 2.9

Propagation curves for the broadcasting service in Africa - Zone 3

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz; equatorial regions
50% of the time; 50% of the locations; h_2 = 10 m

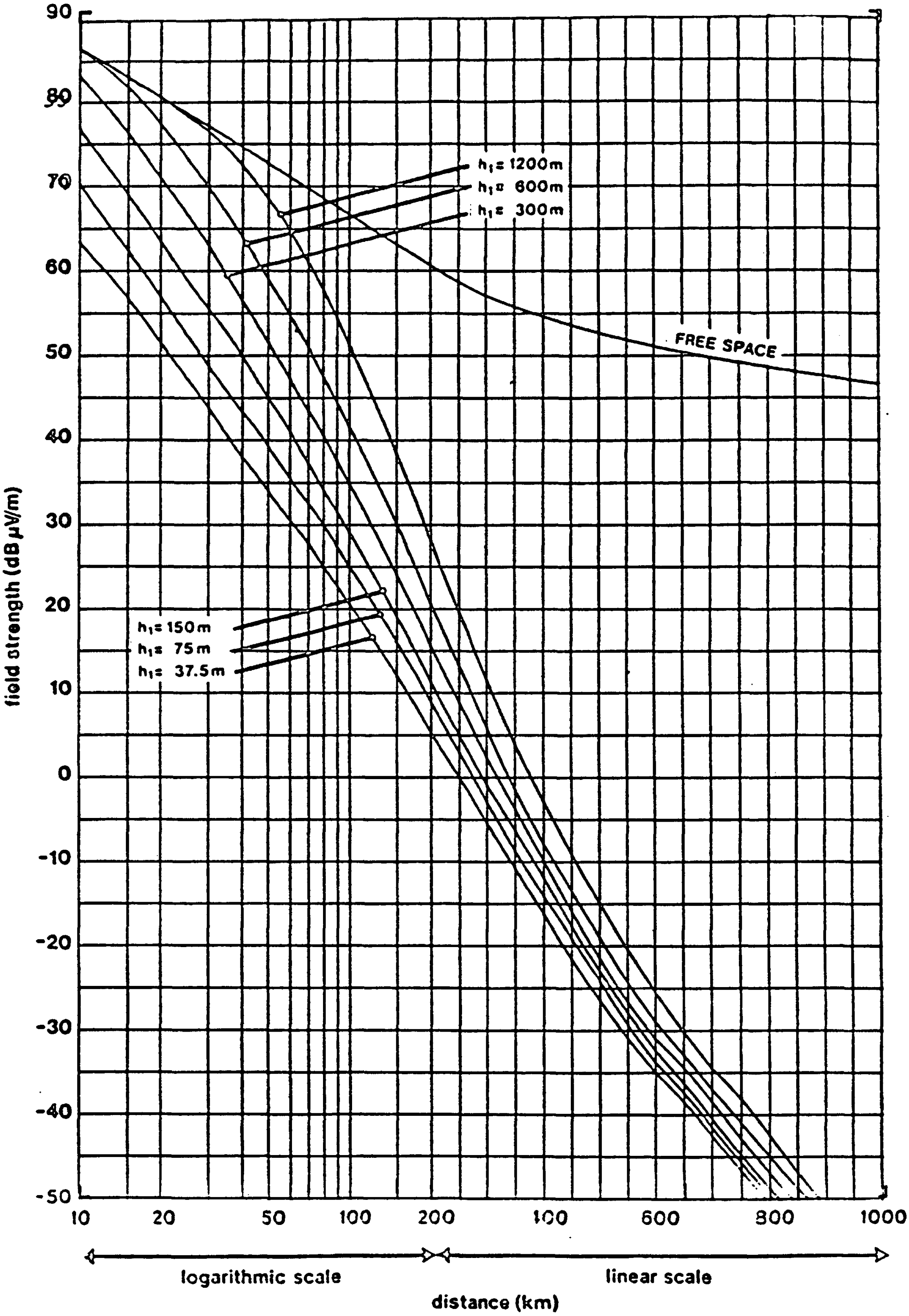


FIGURE 2.10

Propagation curves for the broadcasting service in Africa - Zone 3

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz; equatorial regions
10% of the time; 50% of the locations; h_2 = 10 m

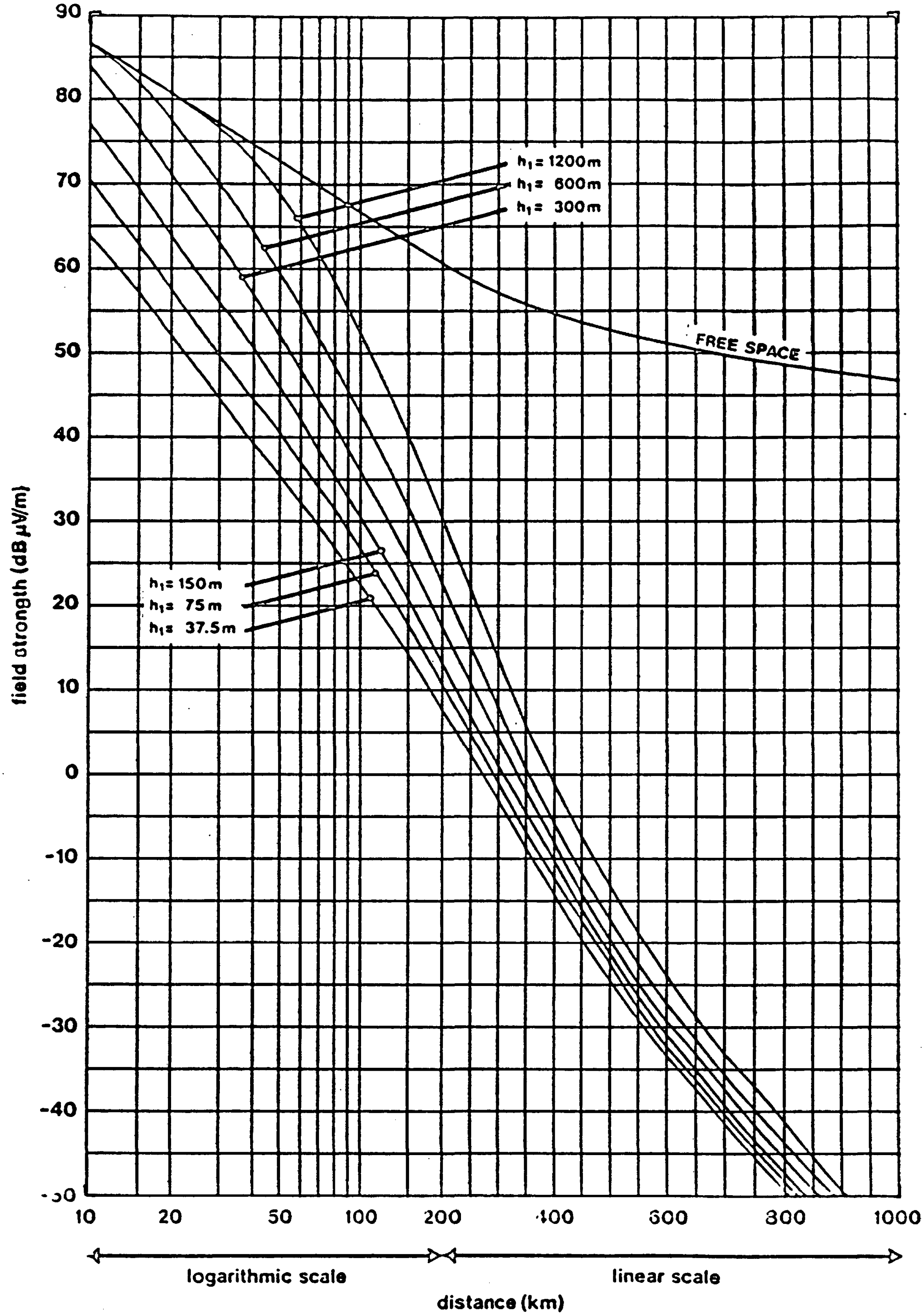


FIGURE 2.11

Propagation curves for the broadcasting service in Africa - Zone 3

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz; equatorial regions
5% of the time; 50% of the locations; h_2 = 10 m

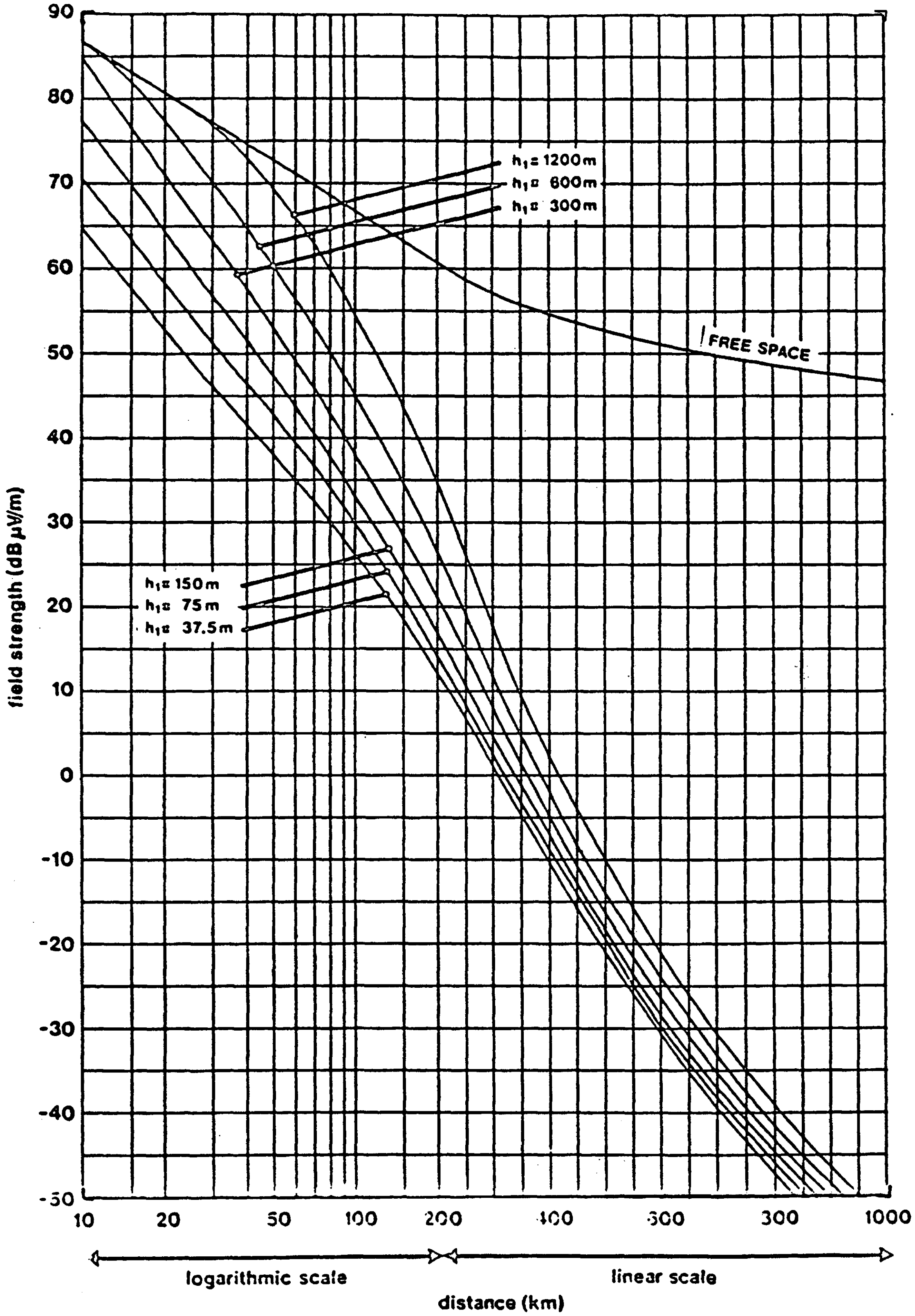


FIGURE 2.12

Propagation curves for the broadcasting service in Africa - Zone 3

Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz; equatorial regions
1% of the time; 50% of the locations; h_2 = 10 m

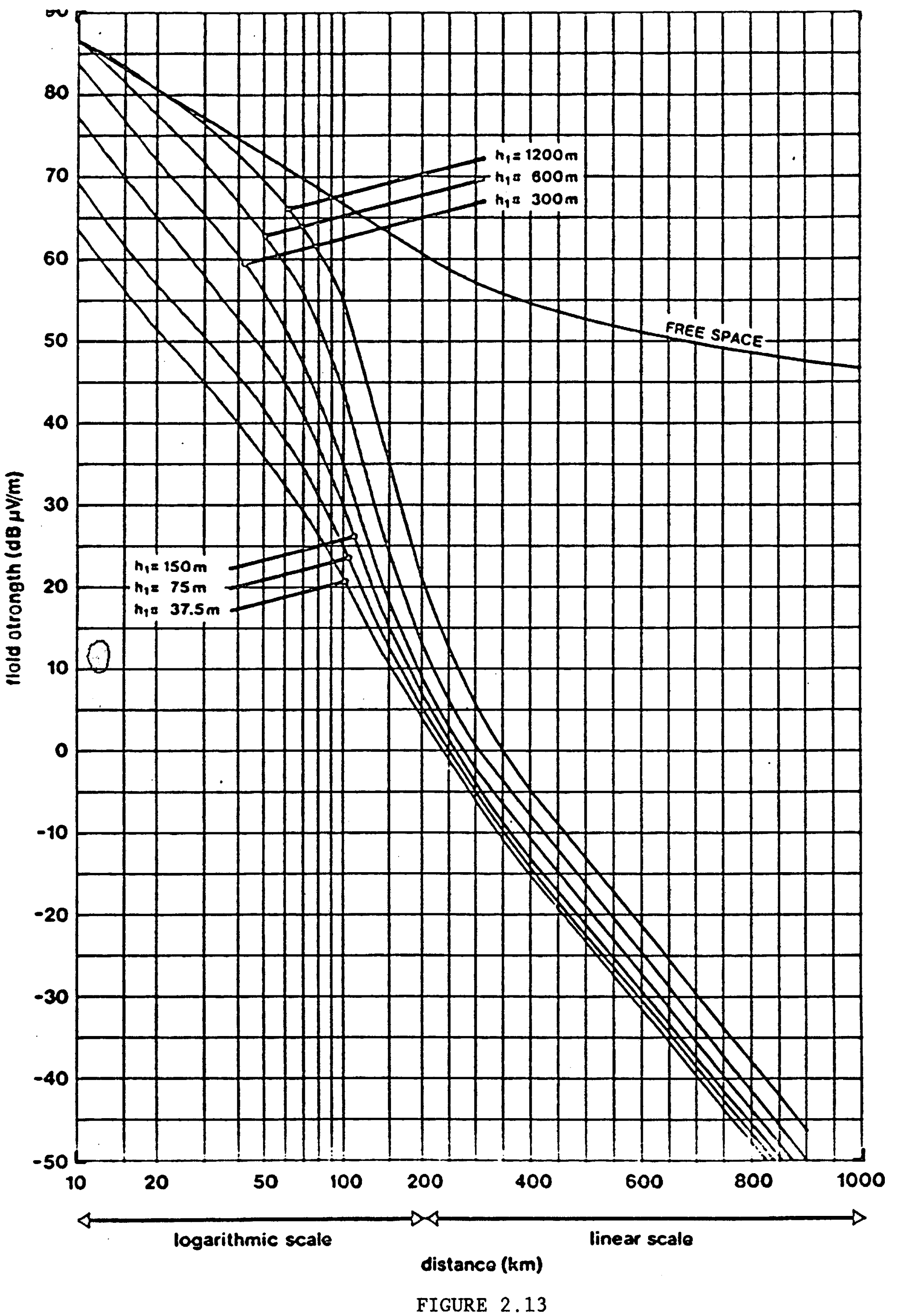


FIGURE 2.13

Propagation curves for the broadcasting service in Africa - Zone 4

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz; maritime regions
50% of the time; 50% of the locations; h_2 = 10 m

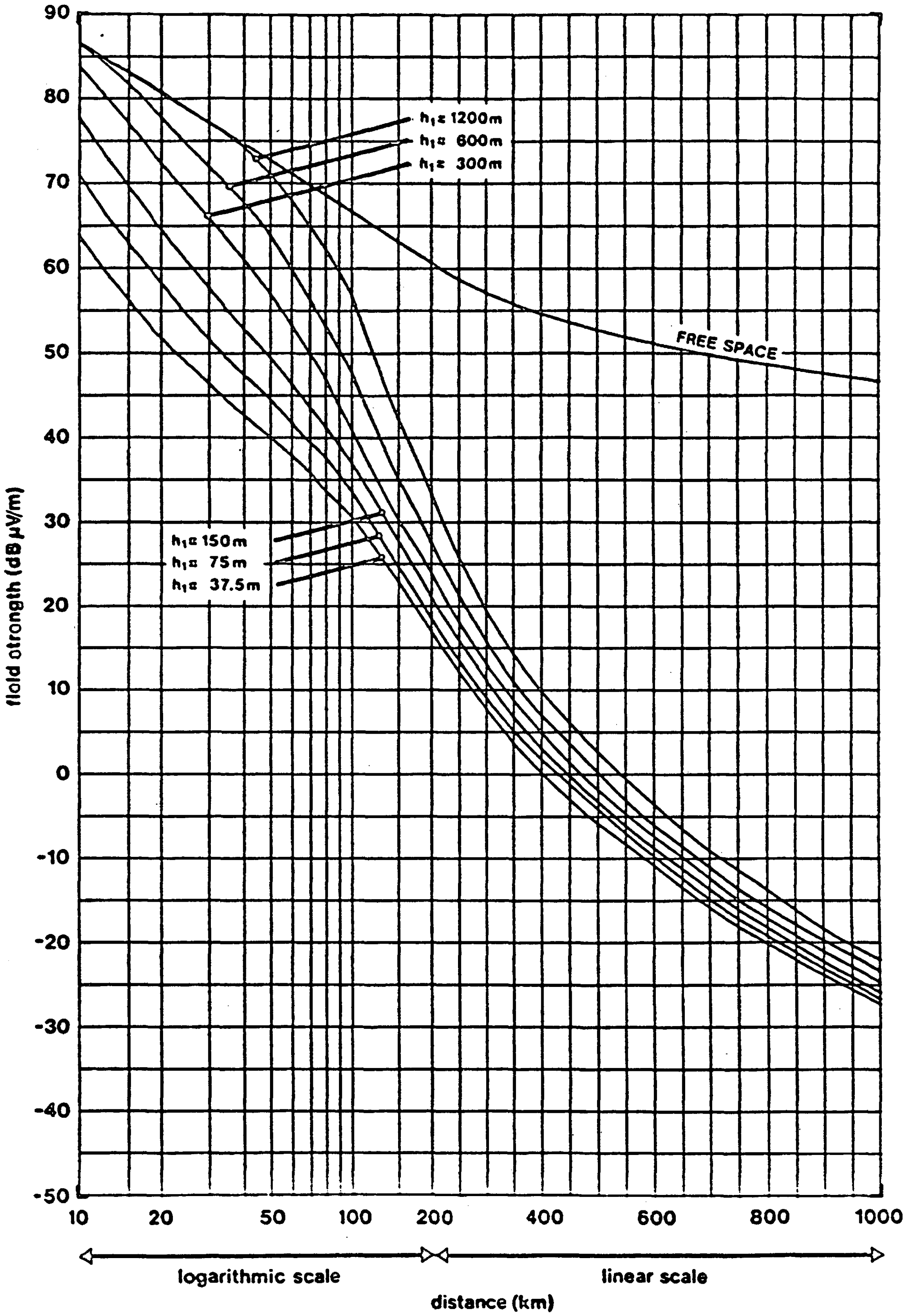


FIGURE 2.14

Propagation curves for the broadcasting service in Africa - Zone 4

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz; maritime regions
10% of the time; 50% of the locations; h_2 = 10 m

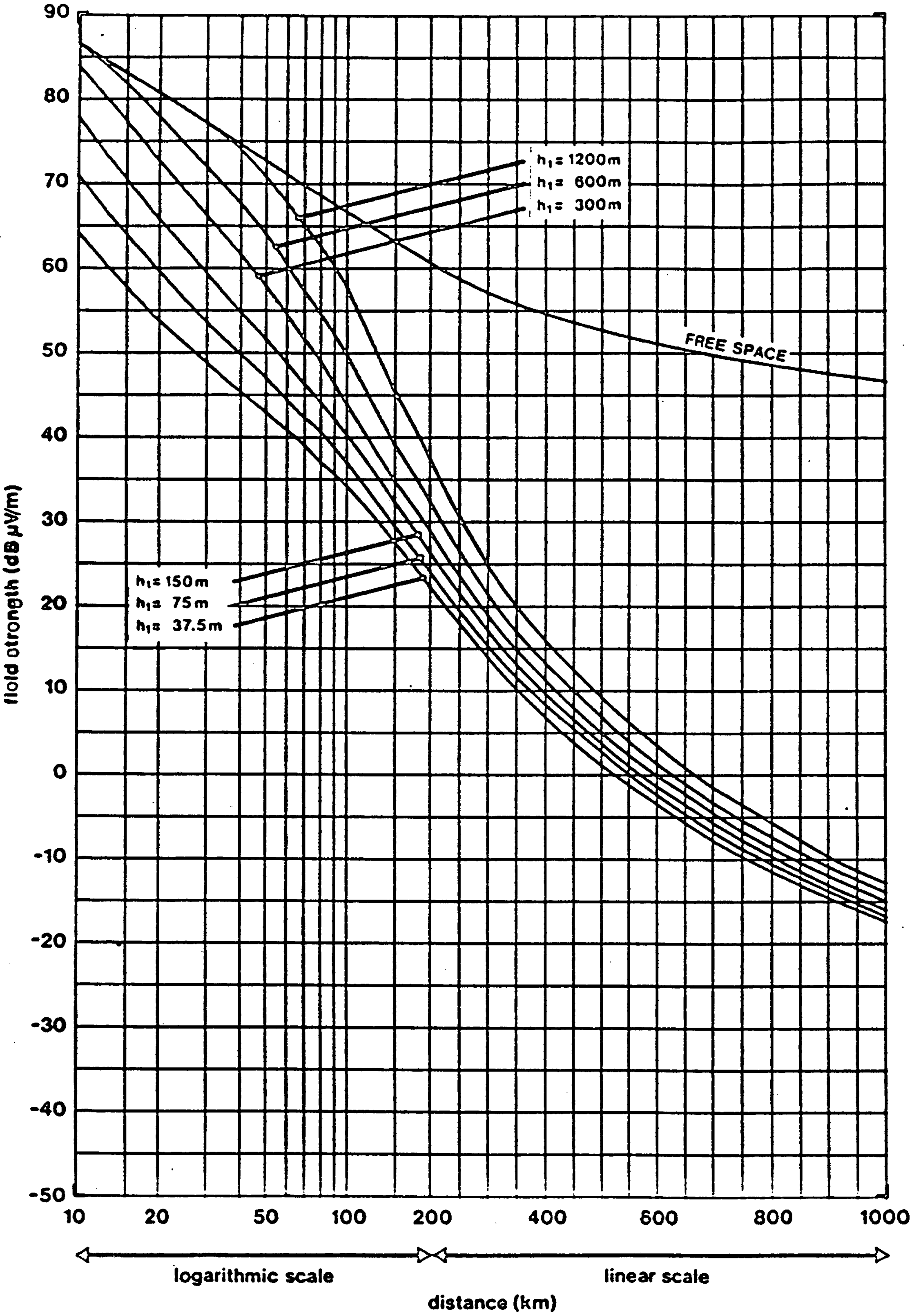


FIGURE 2.15

Propagation curves for the broadcasting service in Africa - Zone 4

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz; maritime regions
5% of the time; 50% of the locations; h_2 = 10 m

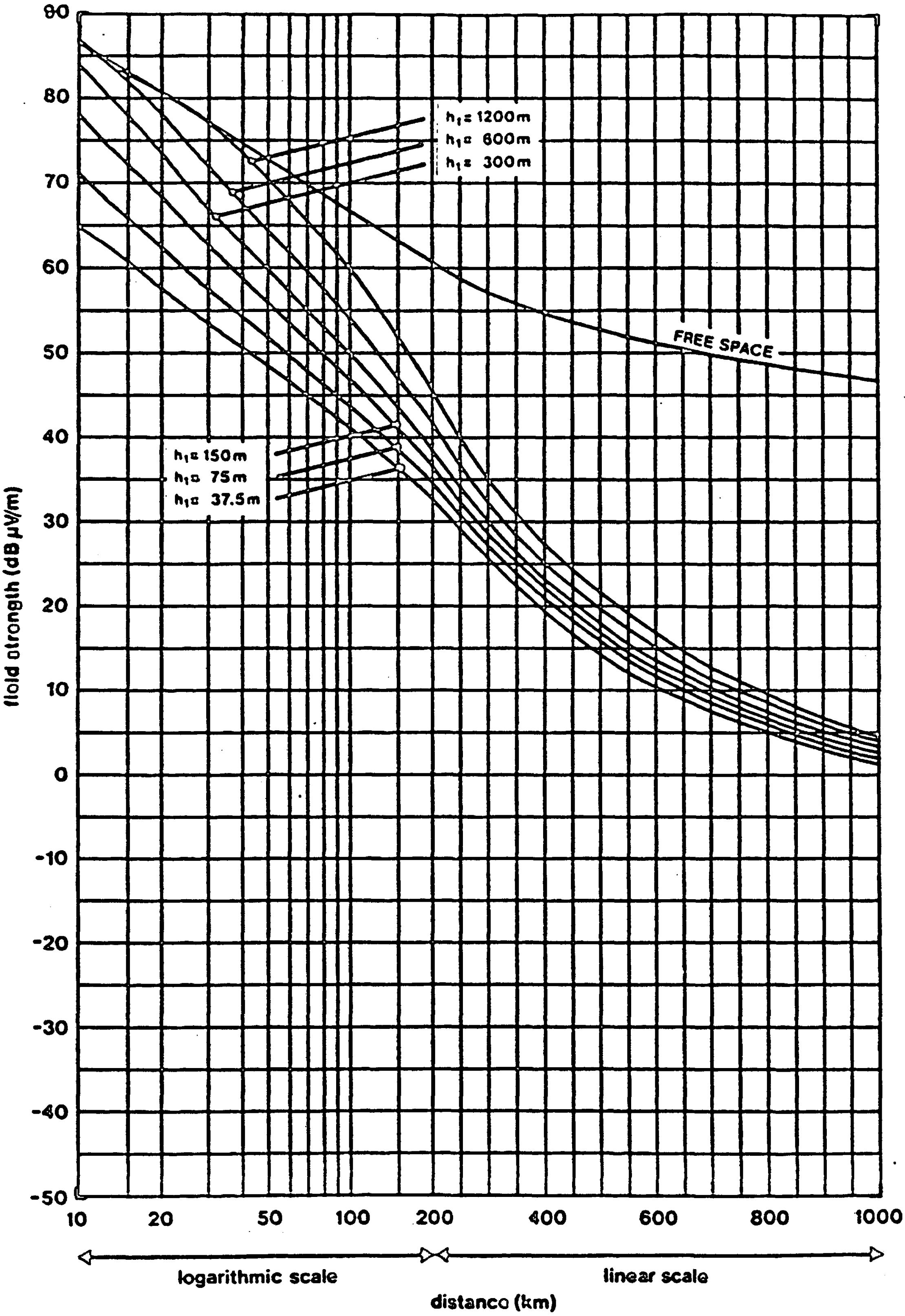


FIGURE 2.16

Propagation curves for the broadcasting service in Africa - Zone 4

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz; maritime regions
1% of the time; 50% of the locations; h_2 = 10 m

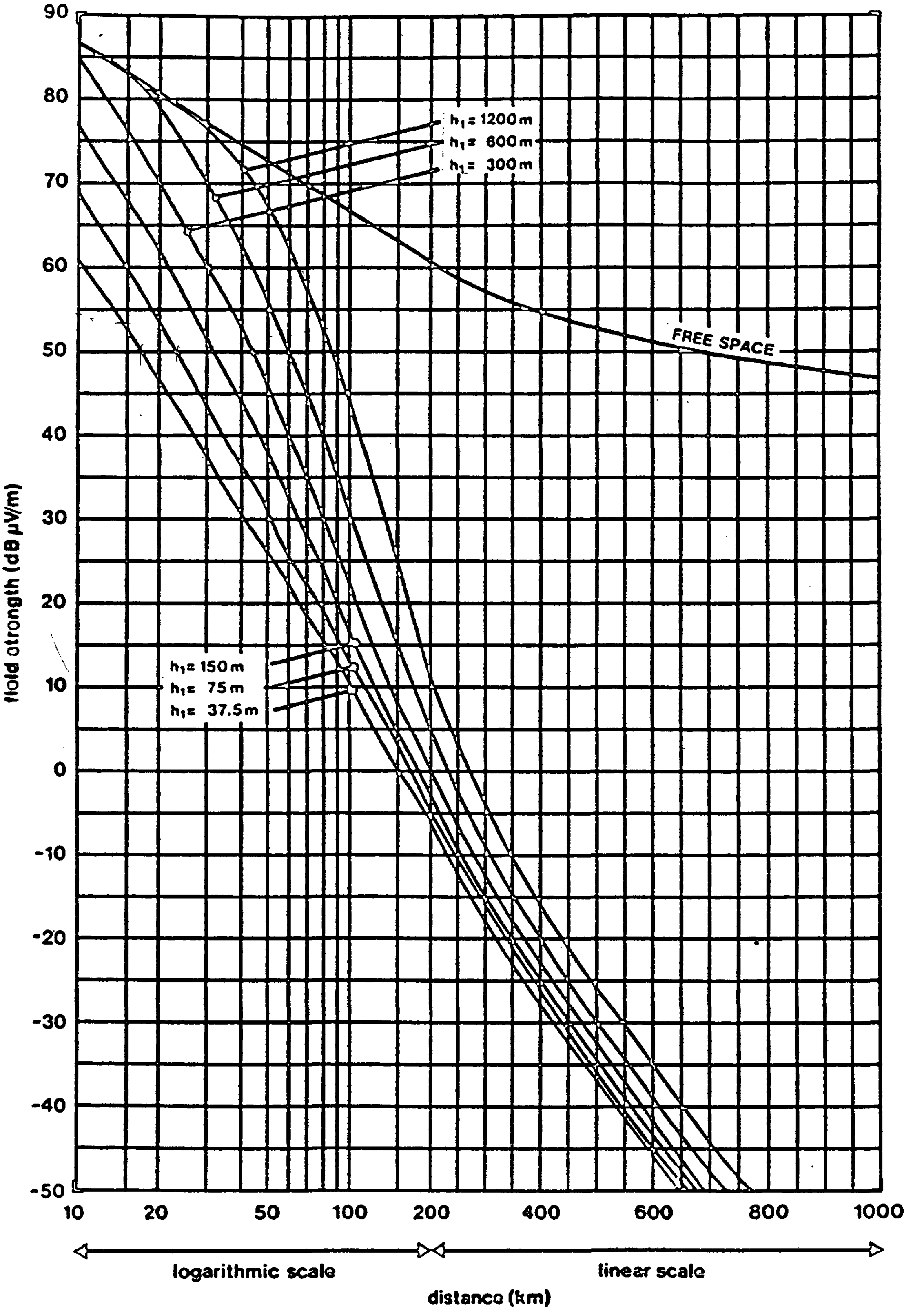


FIGURE 2.17

<u>Propagation curves for the broadcasting service in Africa - Zone 1</u>

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 450 to 1 000 MHz; temperate and subtropical (continental) regions
50% of the time; 50% of the locations; h_2 = 10 m

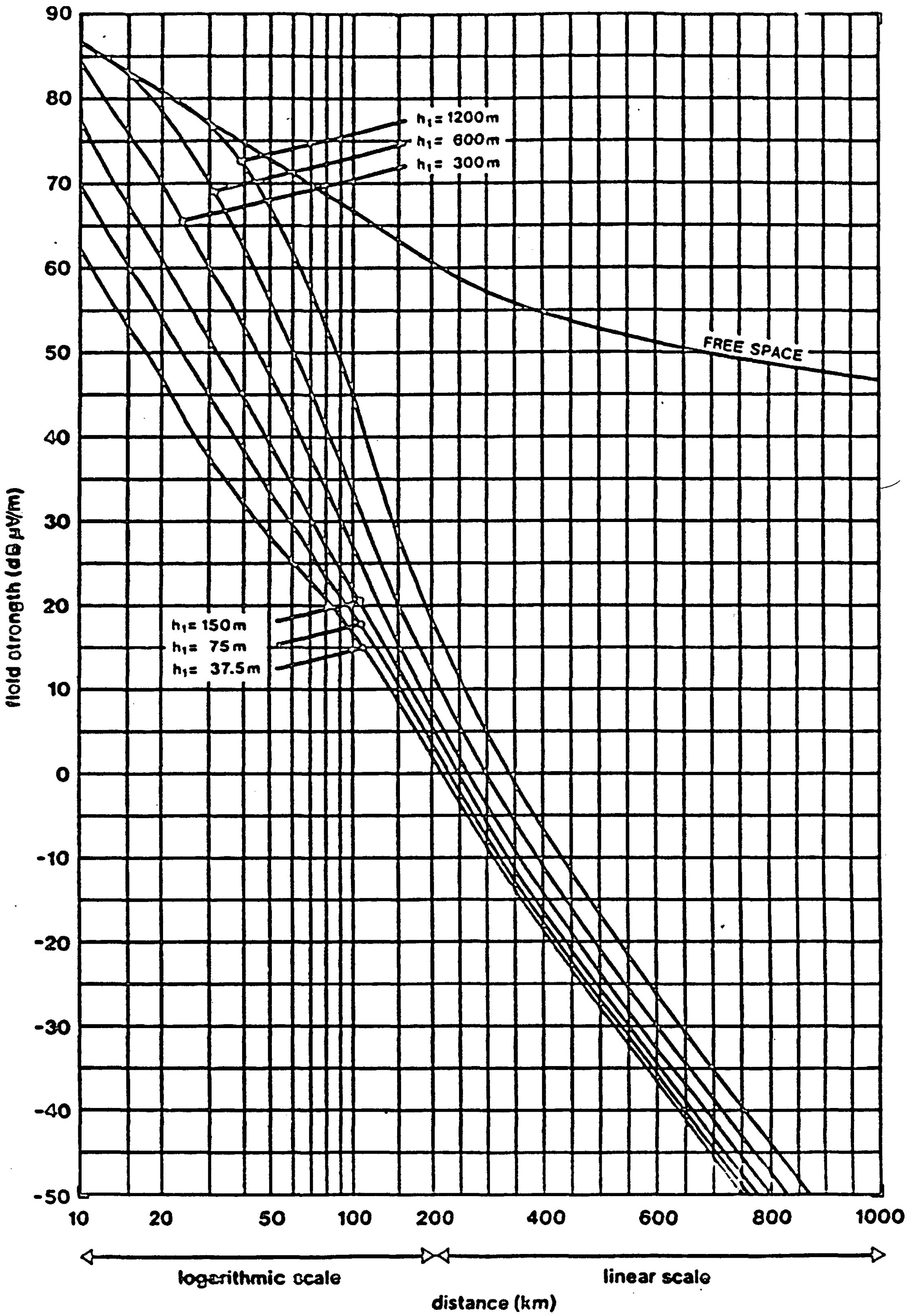


FIGURE 2.18

<u>Propagation curves for the broadcasting service in Africa - Zone 1</u>

Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 450 to 1 000 MHz; temperate and subtropical (continental) regions
10% of the time; 50% of the locations; h_2 = 10 m

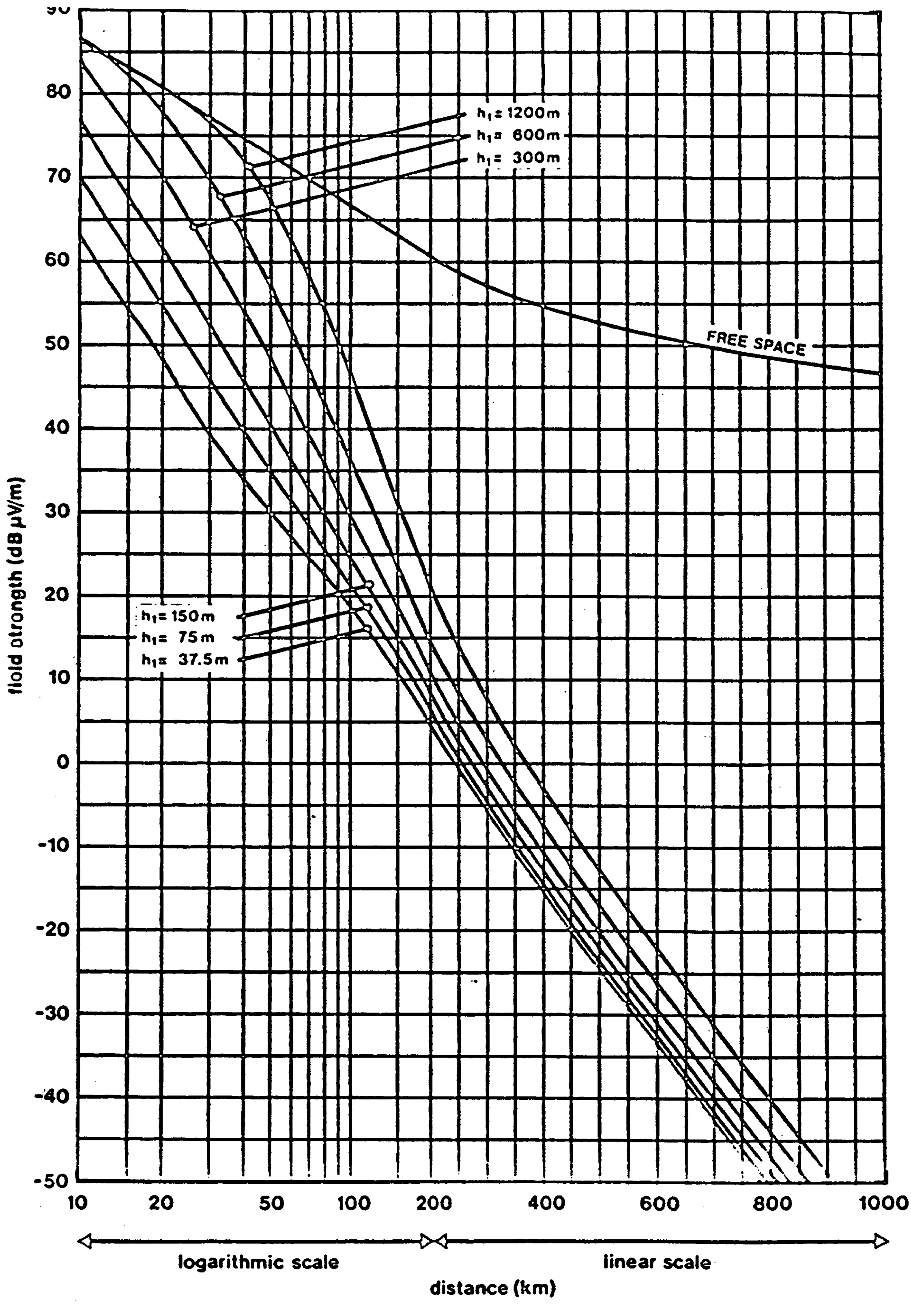


FIGURE 2.19

Propagation curves for the broadcasting service in Africa - Zone 1

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 450 to 1 000 MHz; temperate and subtropical (continental) regions
5% of the time; 50% of the locations; h_2 = 10 m

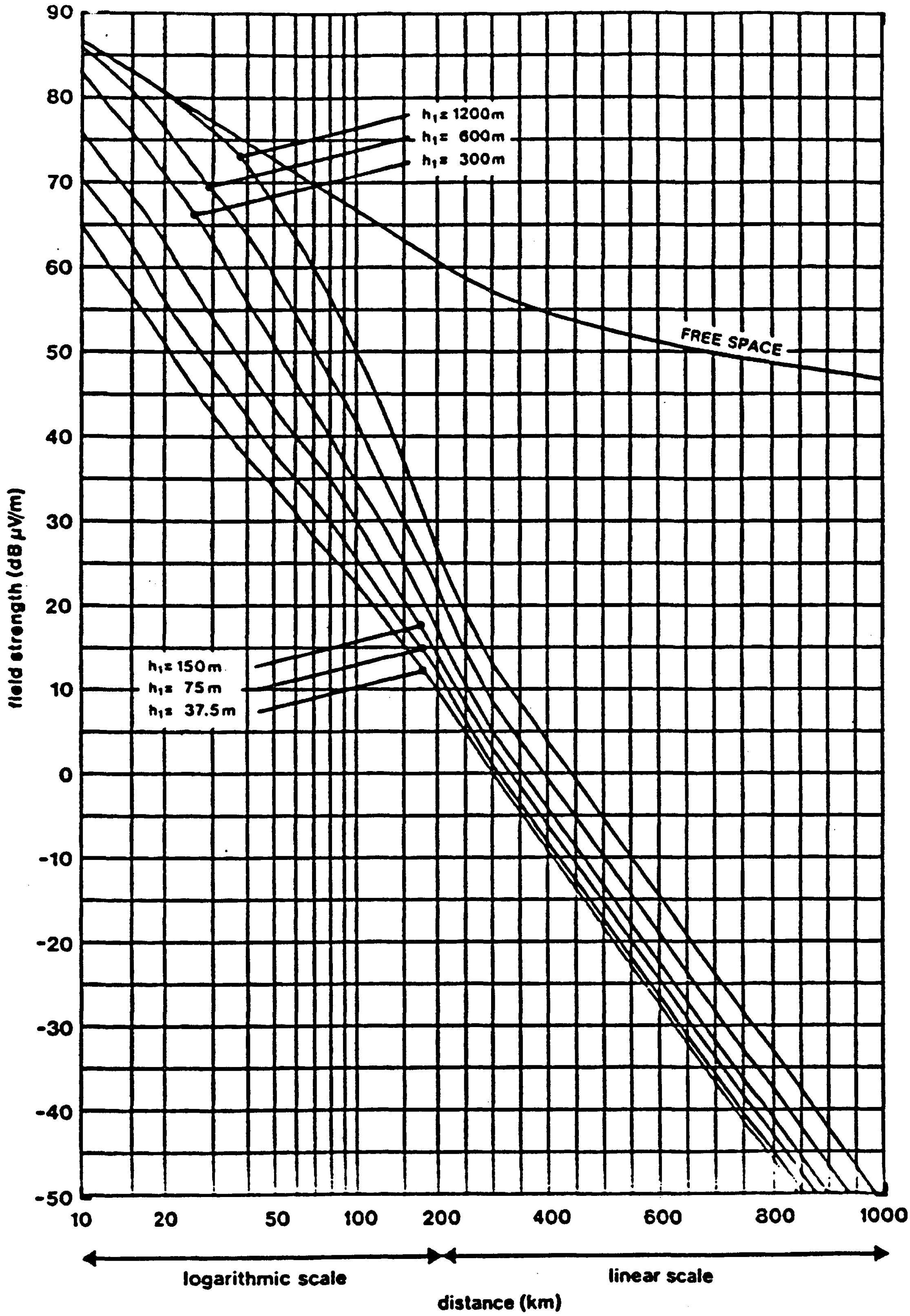


FIGURE 2.20

Propagation curves for the broadcasting service in Africa - Zone 1

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 450 to 1 000 MHz; temperate and subtropical (continental) regions
1% of the time; 50% of the locations; h_2 = 10 m

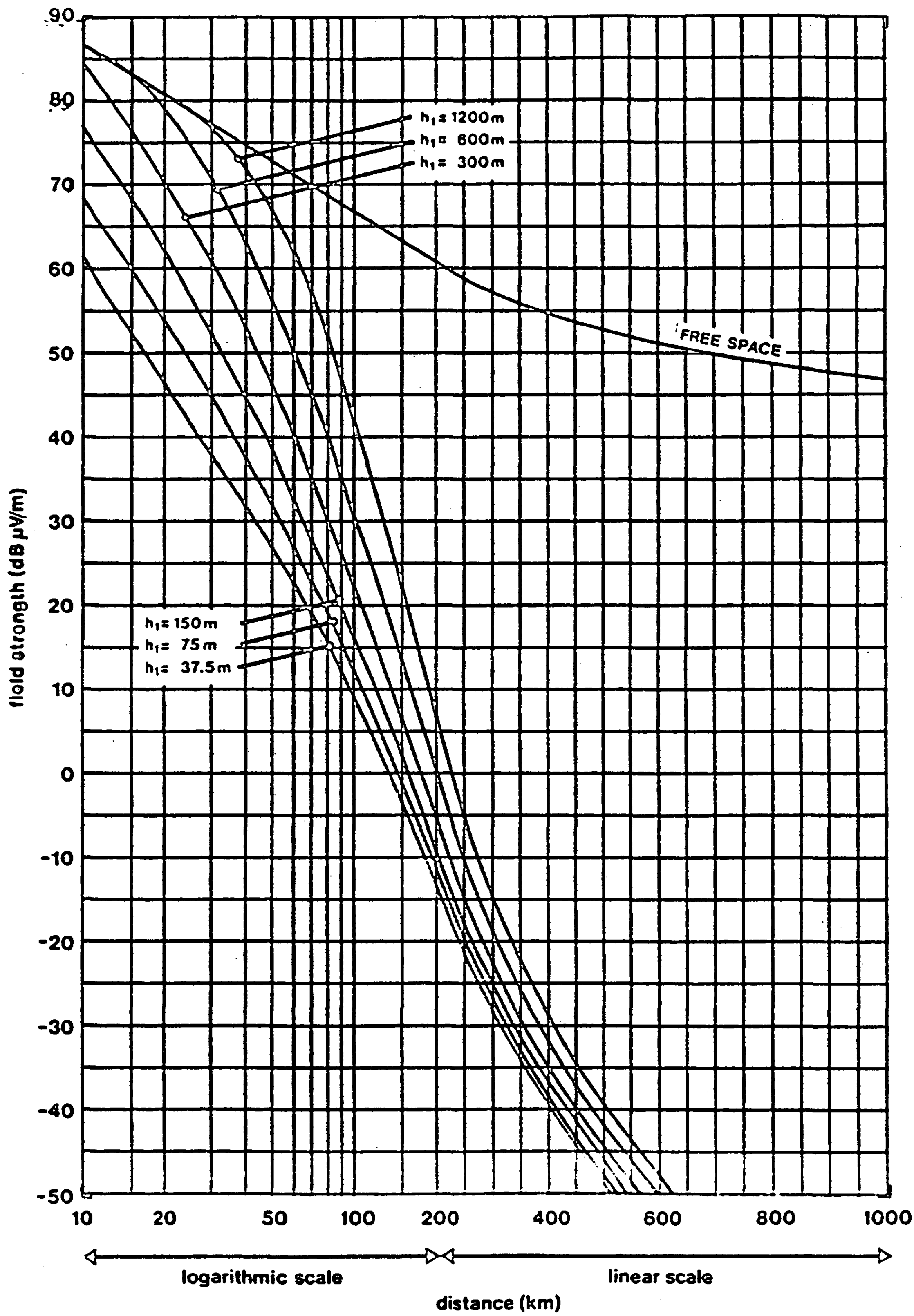


FIGURE 2.21

Propagation curves for the broadcasting service in Africa - Zone 2

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 450 to 1 000 MHz; desert regions
50% of the time; 50% of the locations; h_2 = 10 m

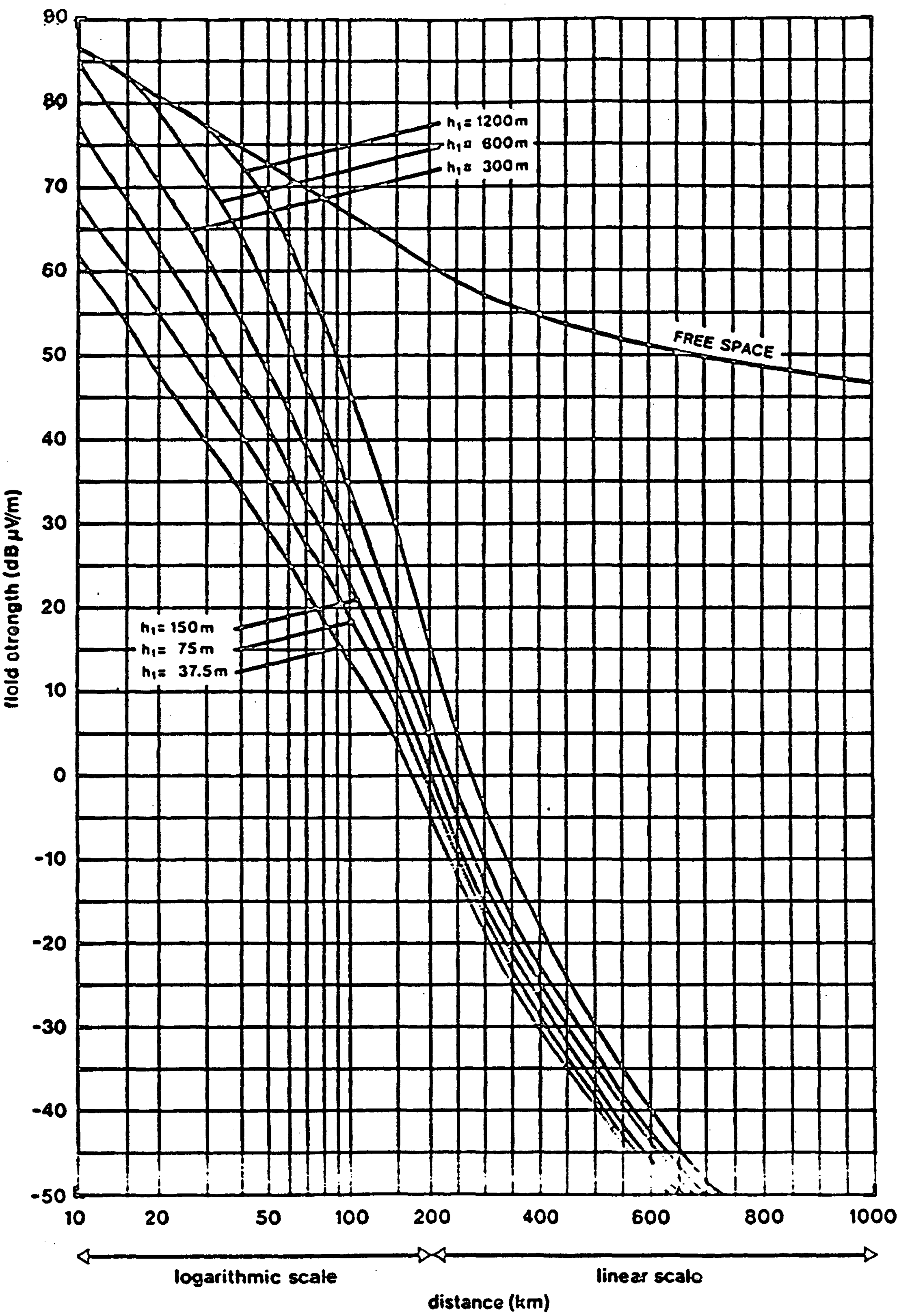


FIGURE 2.22

<u>Propagation curves for the broadcasting service in Africa - Zone 2</u>

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 450 to 1 000 MHz; desert regions
10% of the time; 50% of the locations; h_2 = 10 m

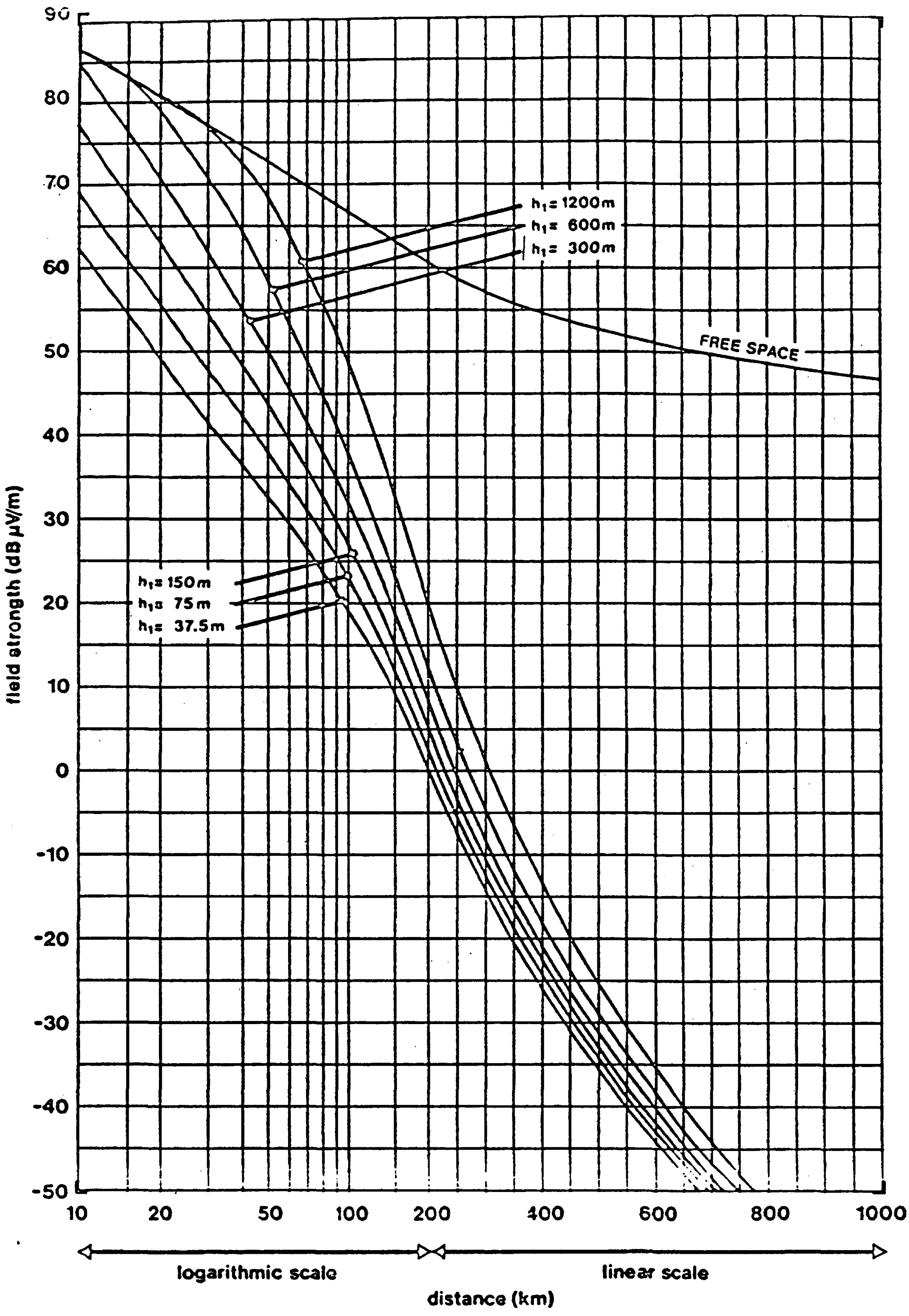


FIGURE 2.23

Propagation curves for the broadcasting service in Africa - Zone 2

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 450 to 1 000 MHz; desert regions
5% of the time; 50% of the locations; h_2 = 10 m

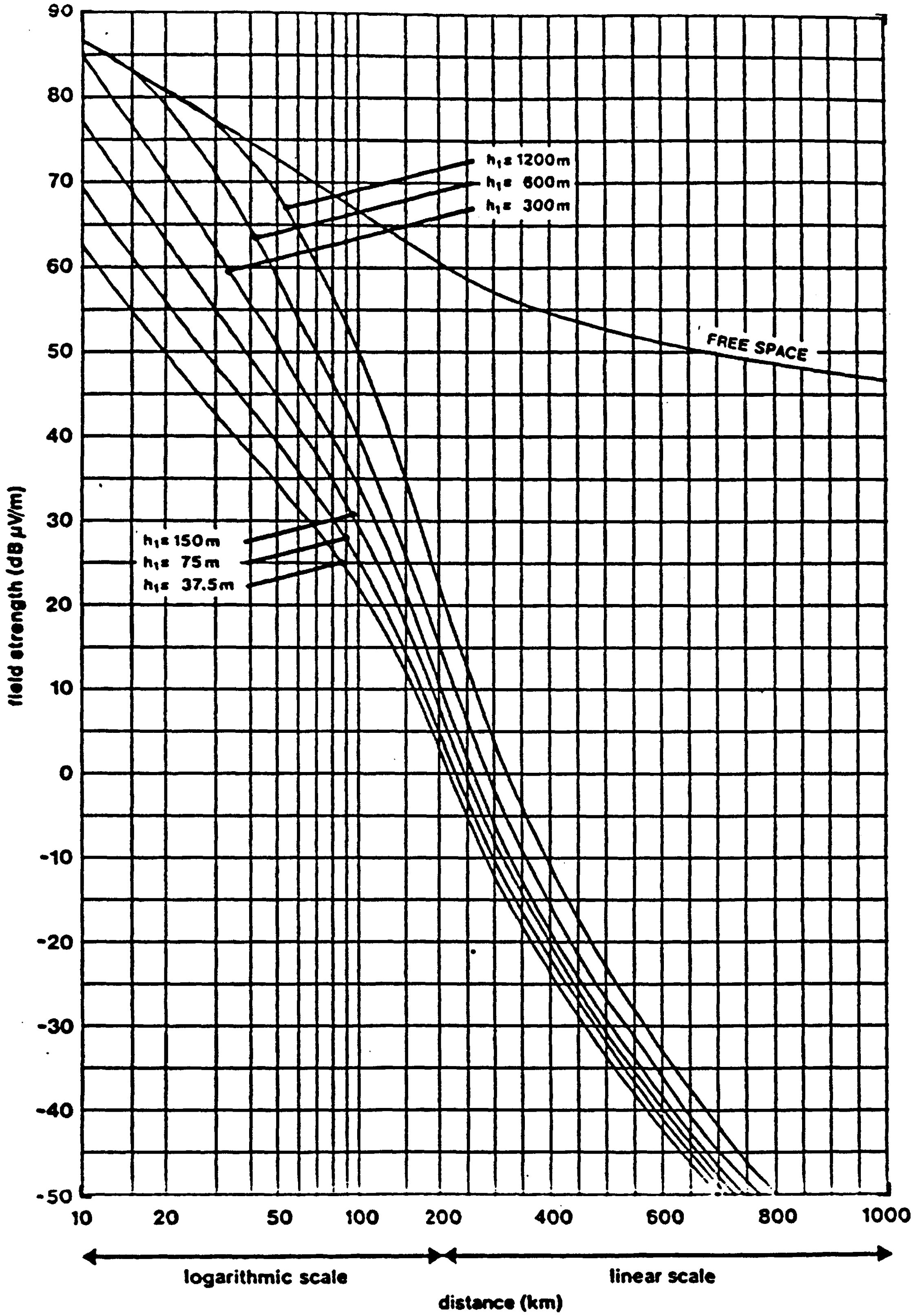


FIGURE 2.24

Propagation curves for the broadcasting service in Africa - Zone 2

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 450 to 1 000 MHz; desert regions
1% of the time; 50% of the locations; h_2 = 10 m

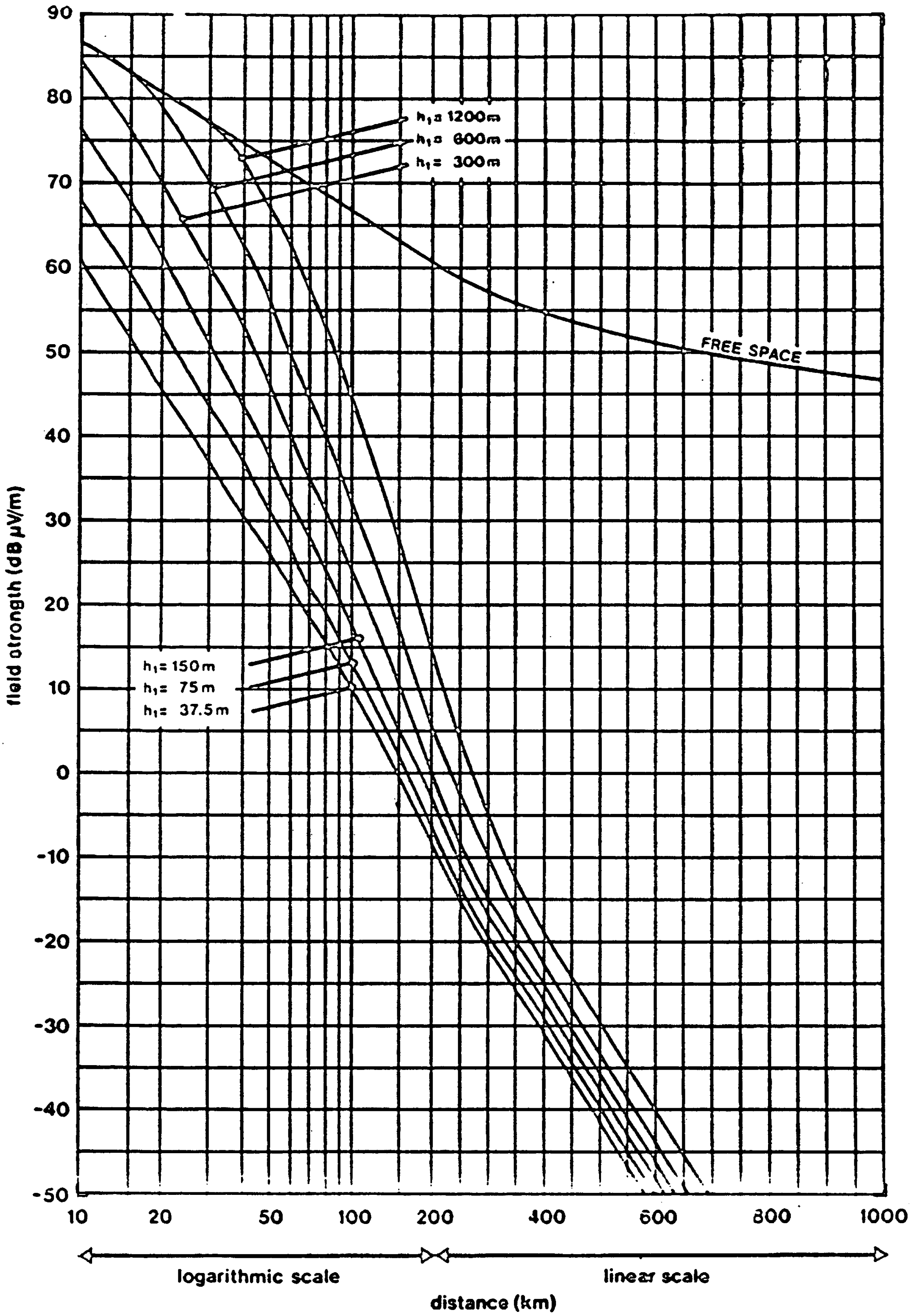


FIGURE 2.25

Propagation curves for the broadcasting service in Africa - Zone 3

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 450 to 1 000 MHz; equatorial regions
50% of the time; 50% of the locations; h_2 = 10 m

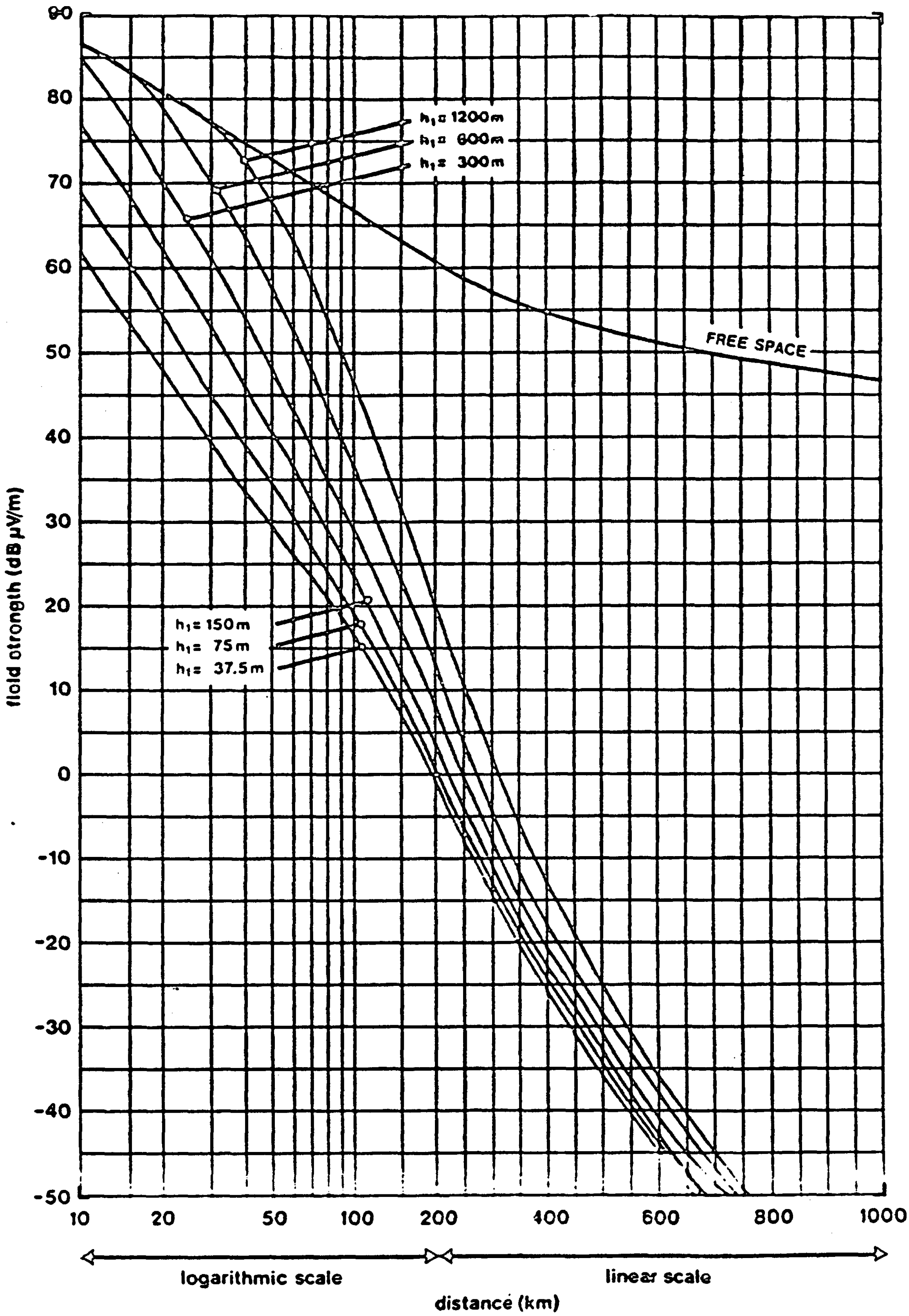


FIGURE 2.26

Propagation curves for the broadcasting service in Africa - Zone 3

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 450 to 1 000 MHz; equatorial regions
10% of the time; 50% of the locations; h_2 = 10 m

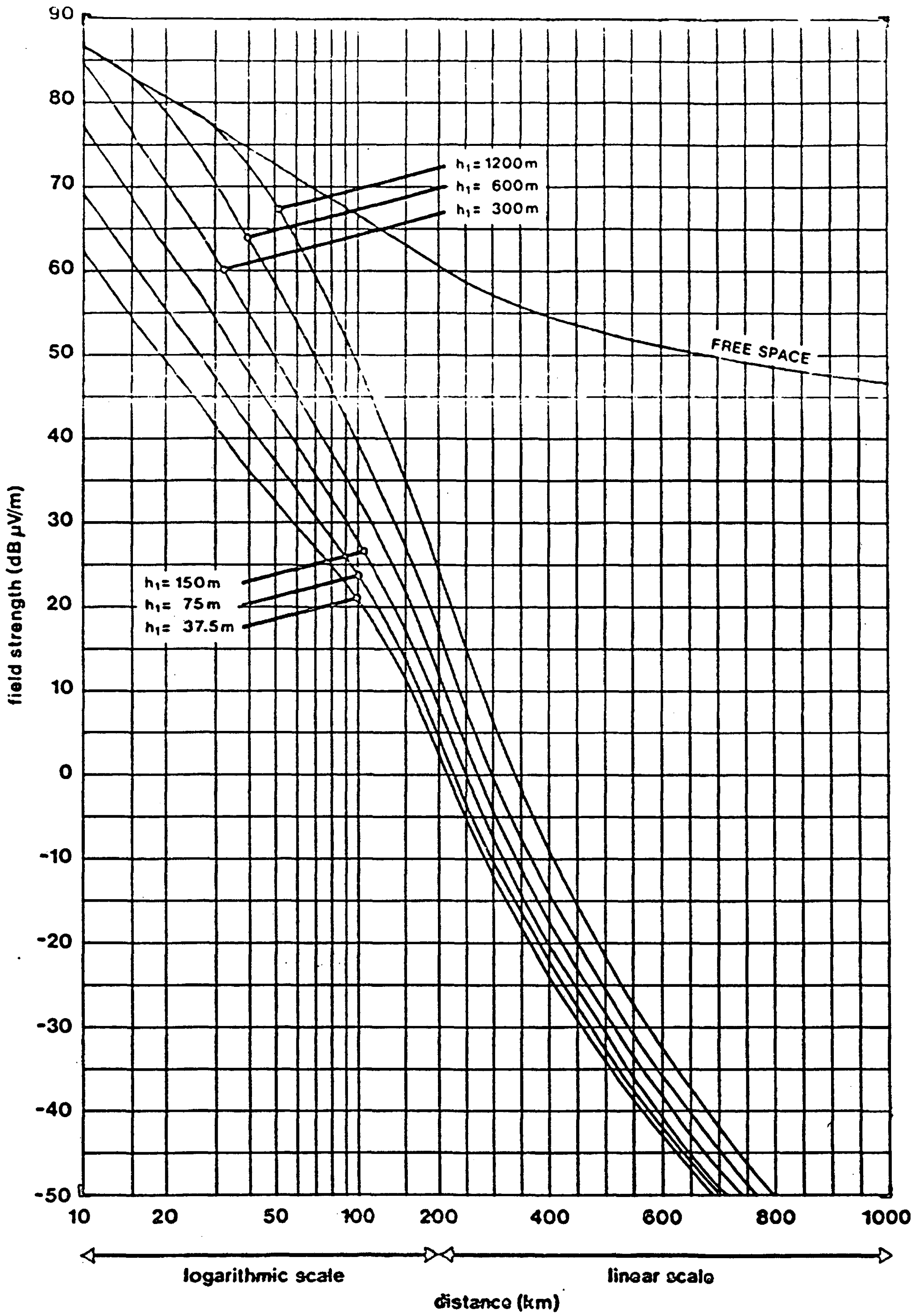


FIGURE 2.27

<u>Propagation curves for the broadcasting service in Africa - Zone 3</u>

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 450 to 1 000 MHz; equatorial regions
5% of the time; 50% of the locations; h_2 = 10 m

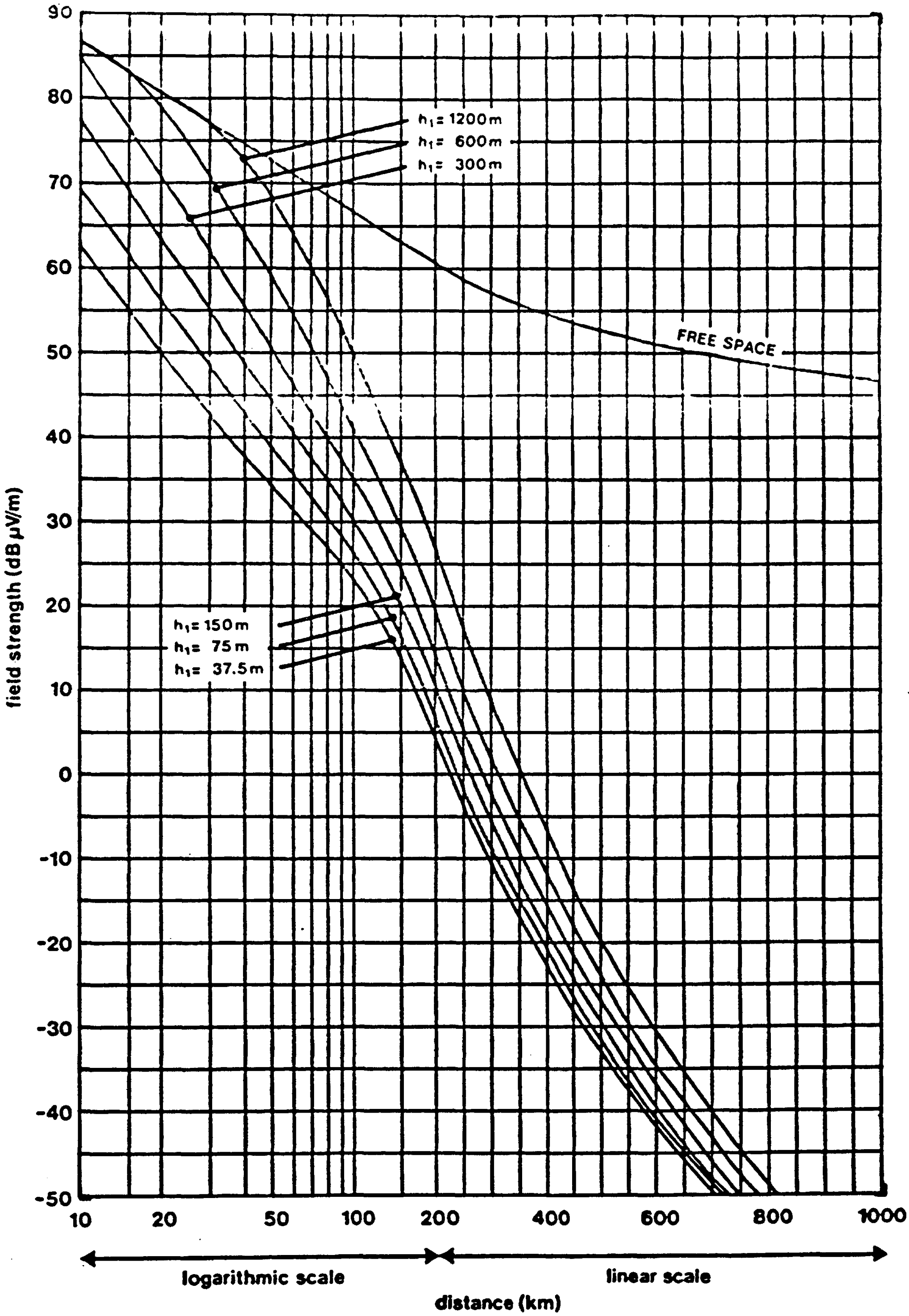


FIGURE 2.28

Propagation curves for the broadcasting service in Africa - Zone 3

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 450 to 1 000 MHz; equatorial regions
1% of the time; 50% of the locations; h_2 = 10 m

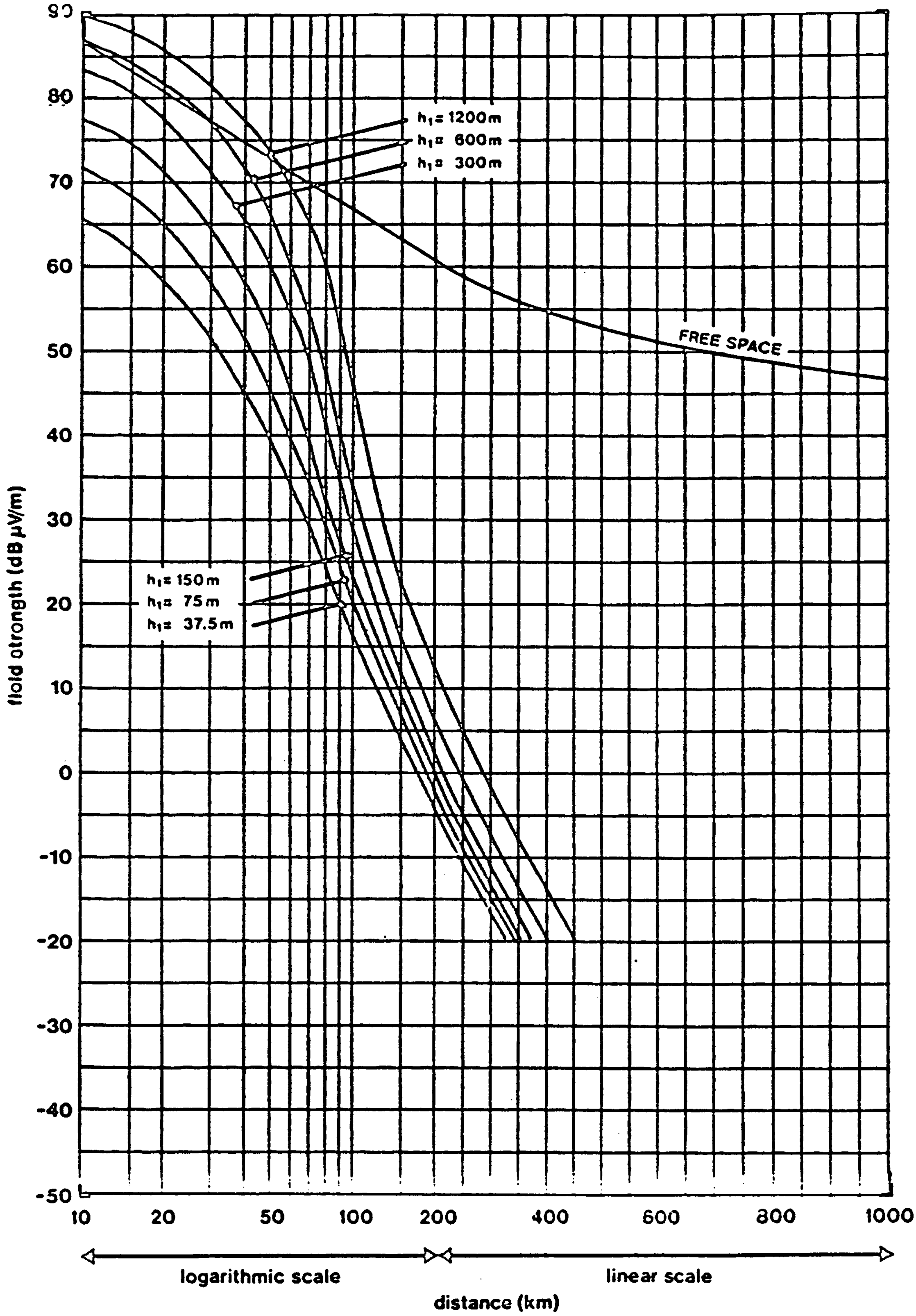


FIGURE 2.29

Propagation curves for the broadcasting service in Africa - Zone 4

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 450 to 1 000 MHz; maritime regions
50% of the time; 50% of the locations; h_2 = 10 m

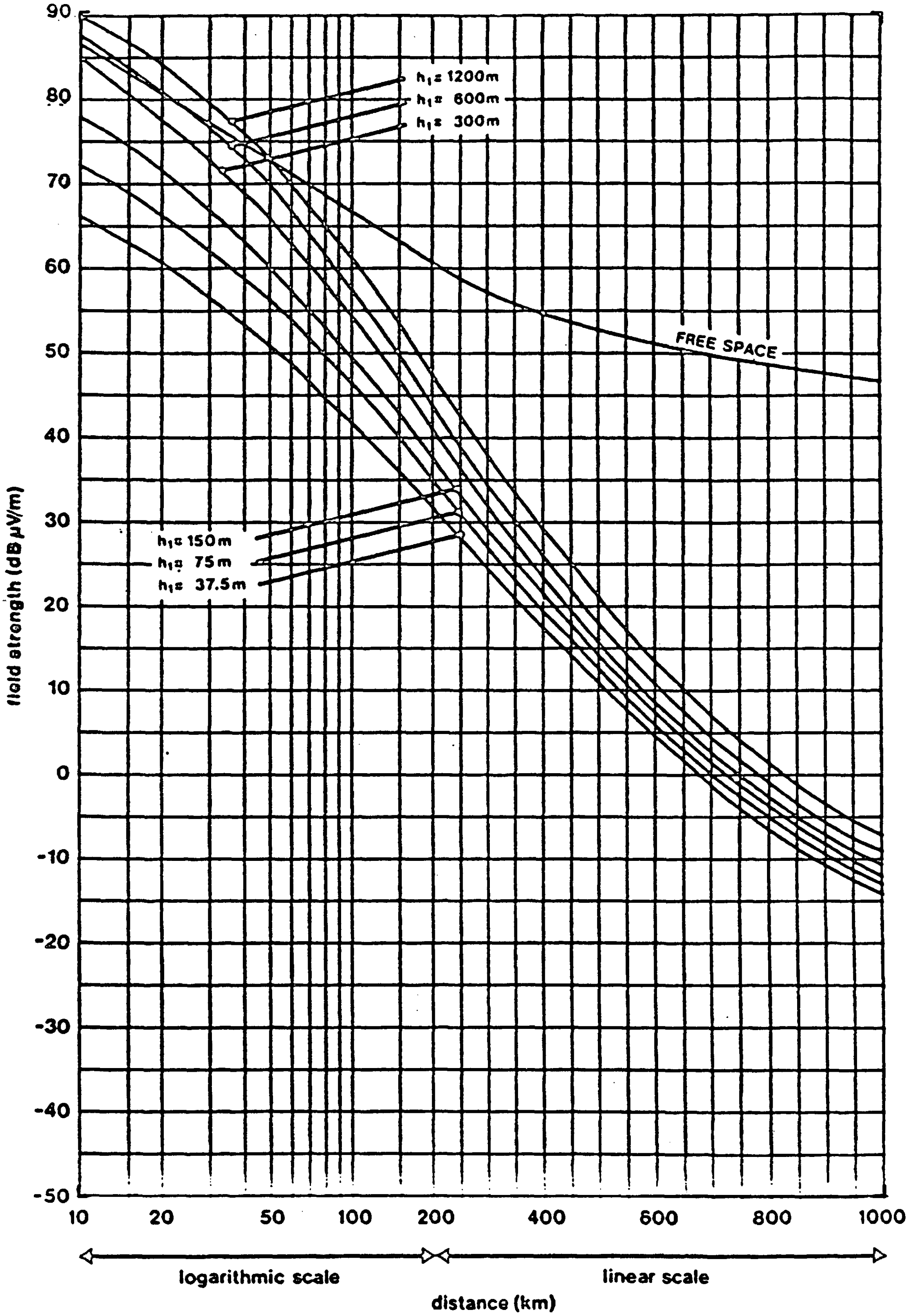


FIGURE 2.30

Propagation curves for the broadcasting service in Africa - Zone 4

Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 450 to 1 000 MHz; maritime regions
10% of the time; 50% of the locations; h_2 = 10 m

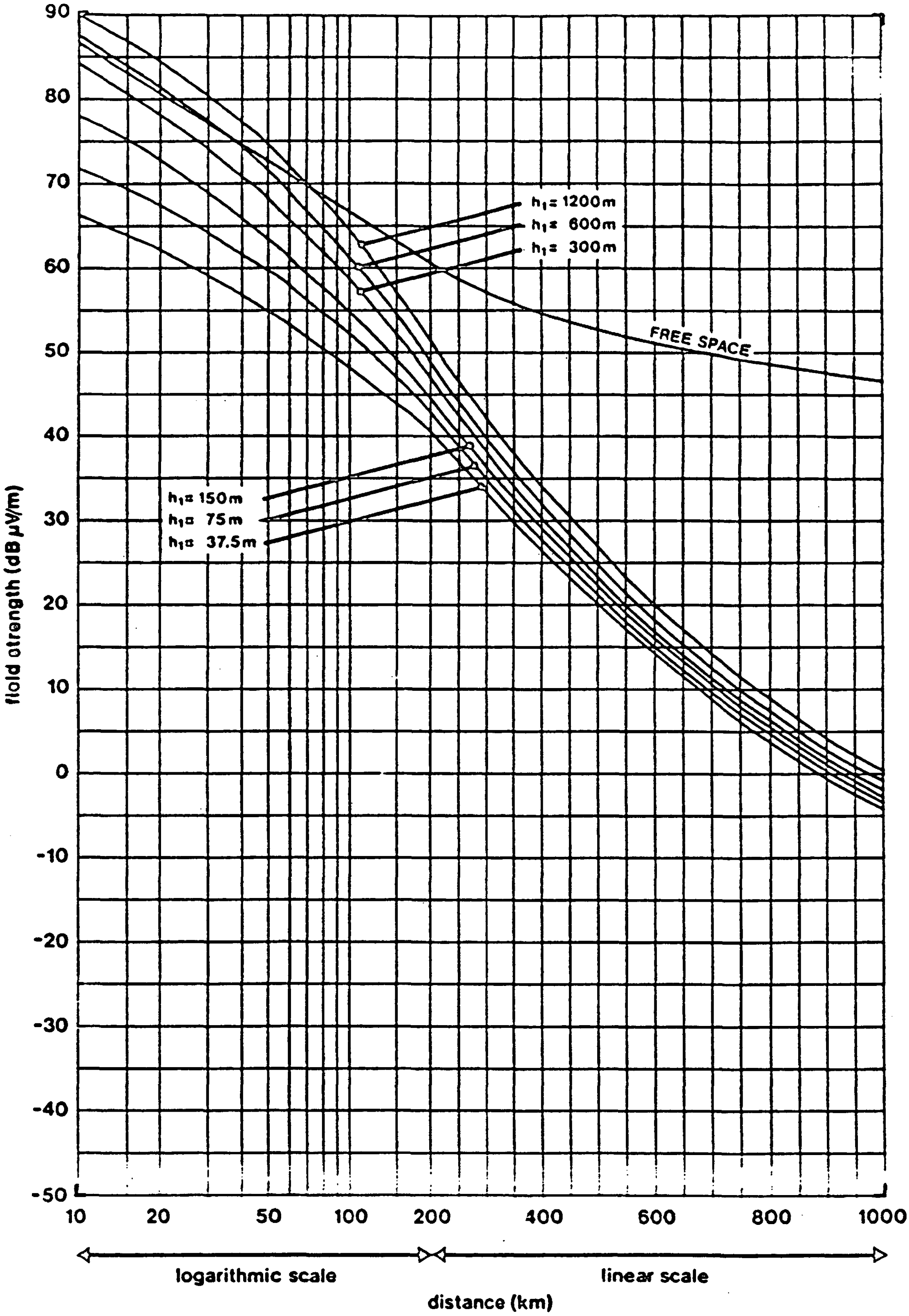


FIGURE 2.31

<u>Propagation curves for the broadcasting service in Africa - Zone 4</u>

Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 450 to 1 000 MHz; maritime regions
5% of the time; 50% of the locations; h_2 = 10 m

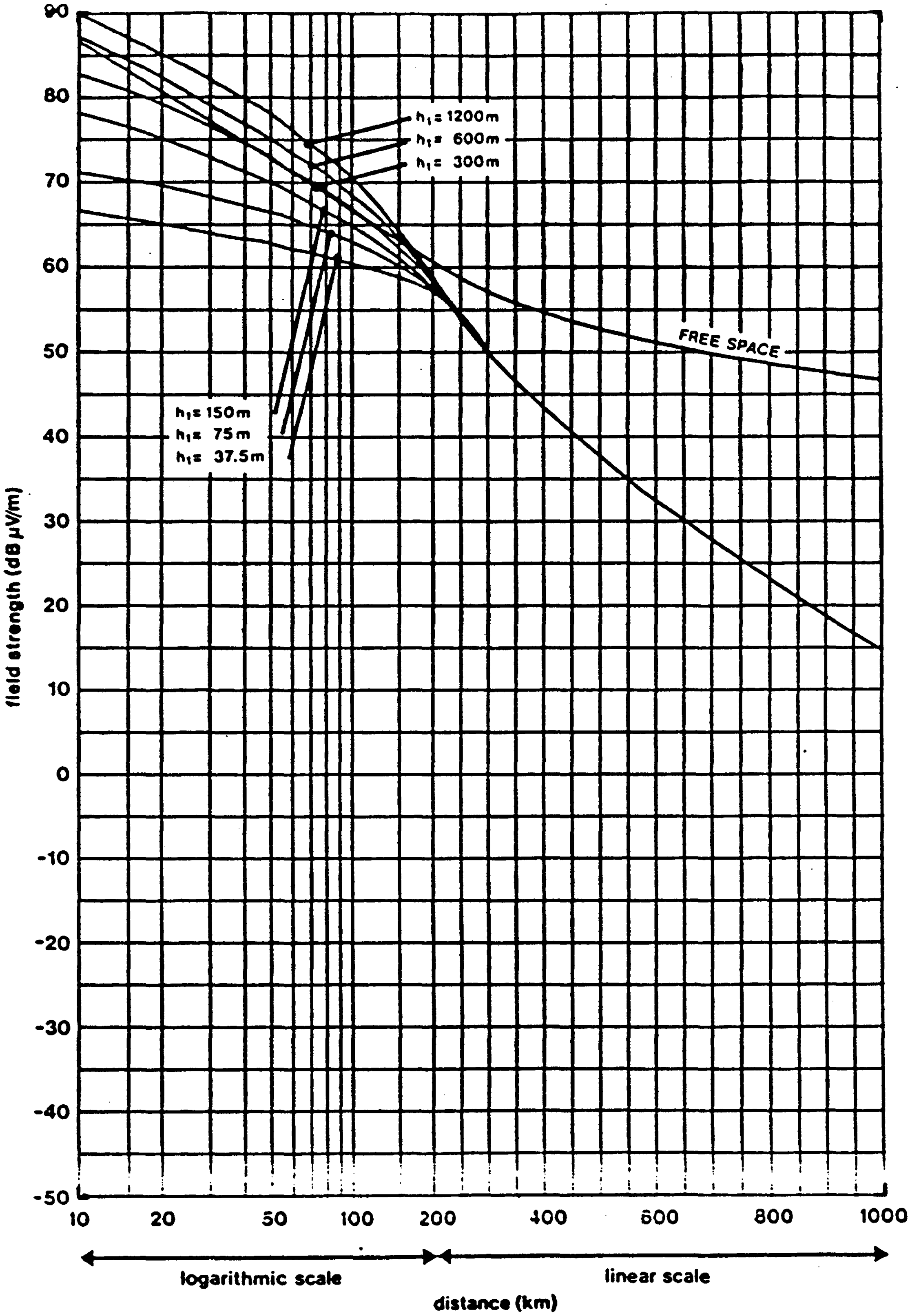


FIGURE 2.32

<u>Propagation curves for the broadcasting service in Africa - Zone 4</u>

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 450 to 1 000 MHz; maritime regions
1% of the time; 50% of the locations; h_2 = 10 m

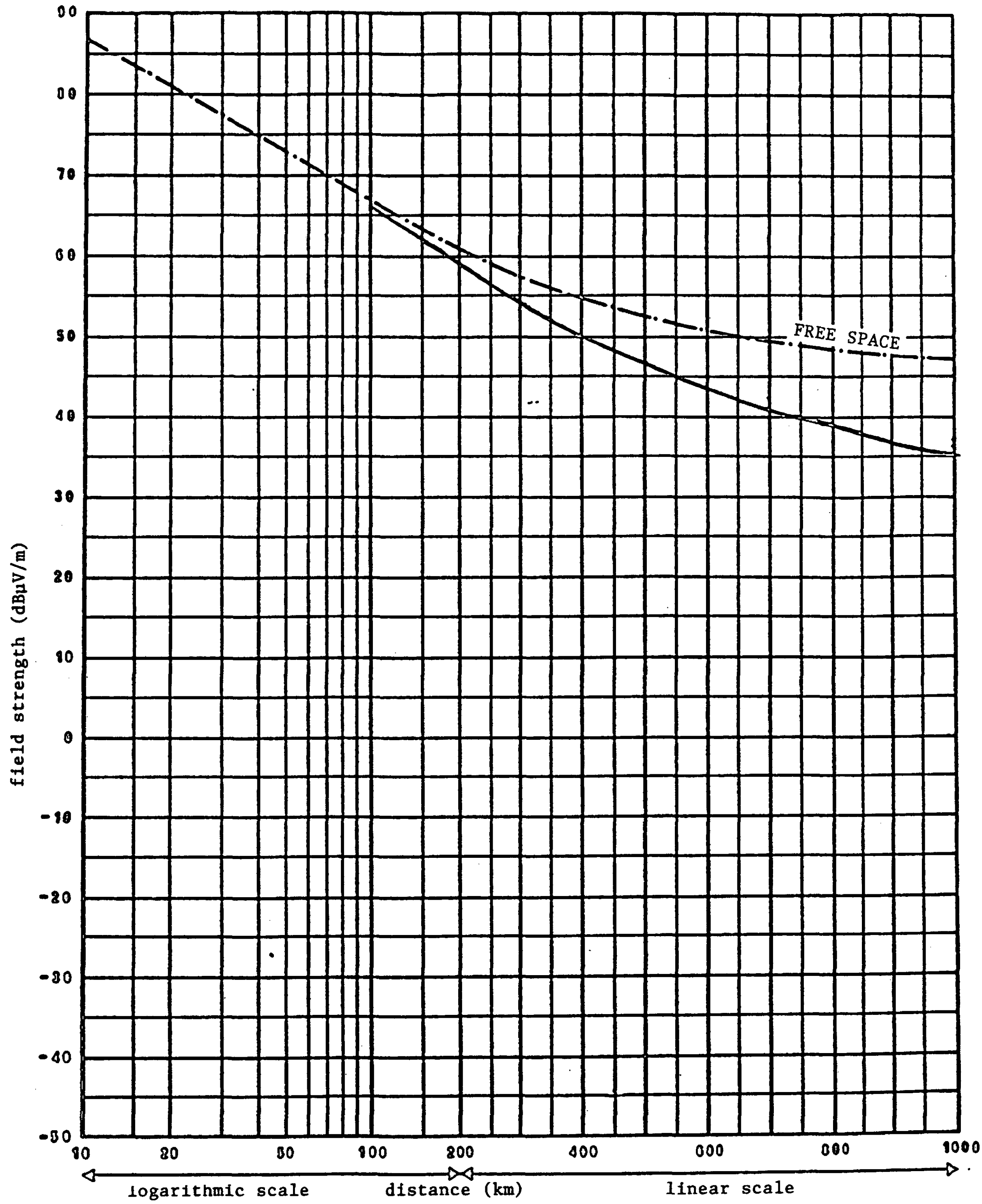


FIGURE 2.33

(E = 106.9 - 20 log d - 0.012d)

<u>Propagation curve for the broadcasting service for the Gulf within the area extending from the Shatt-al-Arab up to and including the Gulf of Oman (Zone: C)</u>

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 450 to 1 000 MHz;
1% of the time; 50% of the locations; h_2 = 10 m

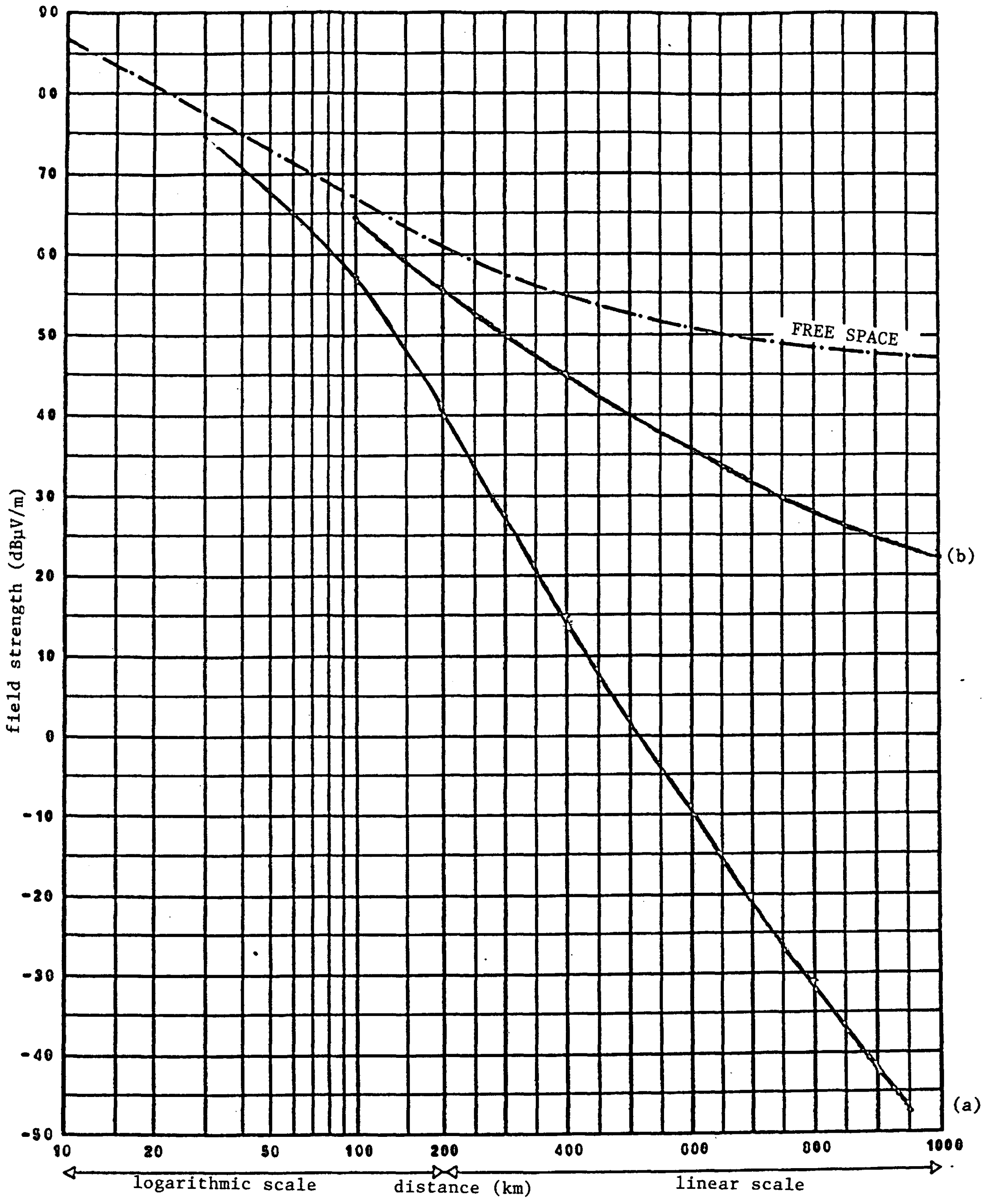


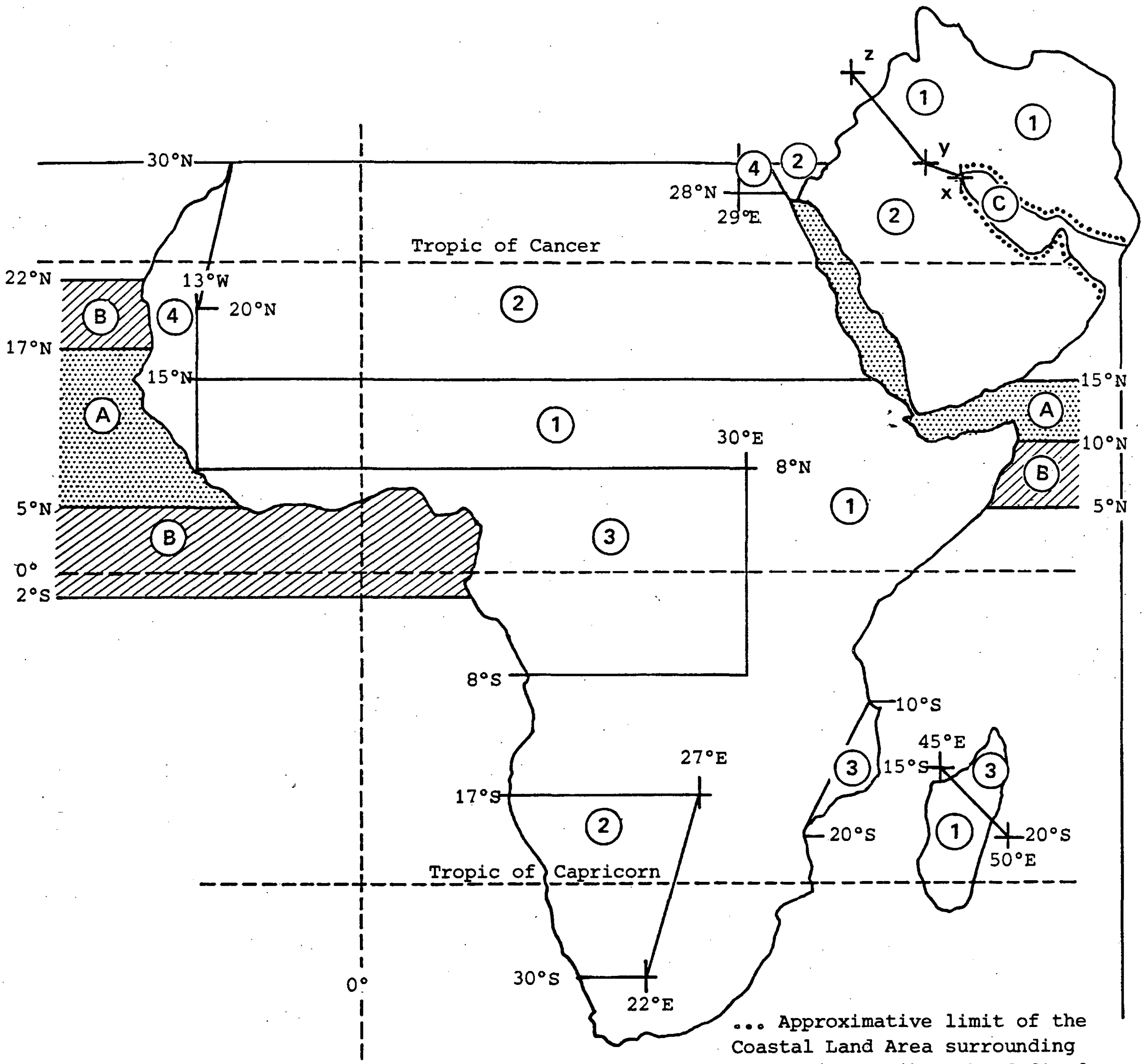
FIGURE 2.34

(a) (E_a = 106.9 - 20 log d - 0.100d)
(b) (E_b = 106.9 - 20 log d - 0.025d)

Propagation curves for the broadcasting service for the Gulf Coastal Land Area surrounding Zone C (Zone C1)

Field strength (dB(µV/m)) for 1 kW e.r.p.

Frequency: 450 to 1 000 MHz;
1% of the time; 50% of the locations; h_2 = 10 m



... Approximative limit of the Coastal Land Area surrounding Zone C (Zone C1) to be defined by the administrations concerned.

The geographical coordinates of the points x, y, z are as follows:
x : 48°E and ~~30~~°N 29
y : 45°E and ~~31~~°N 30
z : 40°E and 35°N

FIGURE 2.35

Geographical division of the planning area into propagation zones

2.2 Propagation curves for other services

In order to study the problems of compatibility between the broadcasting service and the mobile services and the fixed service in the bands shared by these services, field strengths are determined using the methods specified below.

To calculate unwanted broadcasting service signals, field strengths are derived from the curves described in section 2.1.4 taking account as appropriate of the height gain values given in section 1 of Annex 2.C and the variations as a function of percentages of locations given in Annex 2.B.

2.2.1 Mobile services

In the case of the land mobile service, the interfering field strength values are derived from Annex 2.C, using Figures 2.C.1 and 2.C.2 for urban areas, and Figures 2.C.3 to 2.C.5 for rural areas. The height gain values to be used are also given in the same annex.

The propagation curves for the aeronautical mobile service are given in Figures 2.C.6 and 2.C.7 of Annex 2.C.

The curves for the land mobile service should be completed by the CCIR in the intersessional period to allow for propagation conditions in urban areas for bands I and III and in rural areas for bands IV and V (see Recommendation 4) for all time percentages.

2.2.2 Fixed service

To predict the propagation of interfering signals from a station in the fixed service operating at frequencies above 500 MHz, use is made of the methods described in CCIR Report 569. For frequencies below 500 MHz, use is made of the appropriate curves for the broadcasting service described in section 2.1.4.

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ANNEX 2.A

Correction for terrain irregularities

When this correction is applied, it is a function of a parameter Δh defining the degree of terrain irregularity. It represents the difference between the altitudes exceeded by 10% and 90% of the terrain on the propagation path between 10 and 50 km from the transmitter (see Figure 2.A.1).

The curves relating to propagation above the ground for Zones 1, 2 and 3 correspond to a moderately rolling terrain for which a value of Δh equal to 50 m is regarded as appropriate. Figures 2.A.2 and 2.A.3 show the corrections (in dB) to be applied to propagation curves for other values of Δh in the case of VHF and UHF.

It should be noted that these corrections are not made for VHF Band I.

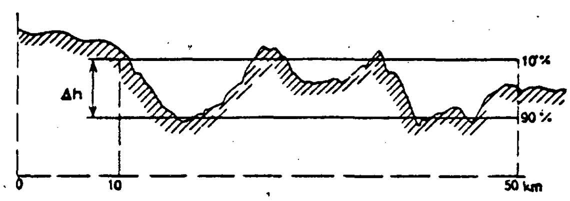

FIGURE 2.A.1

Definition of the parameter Δh

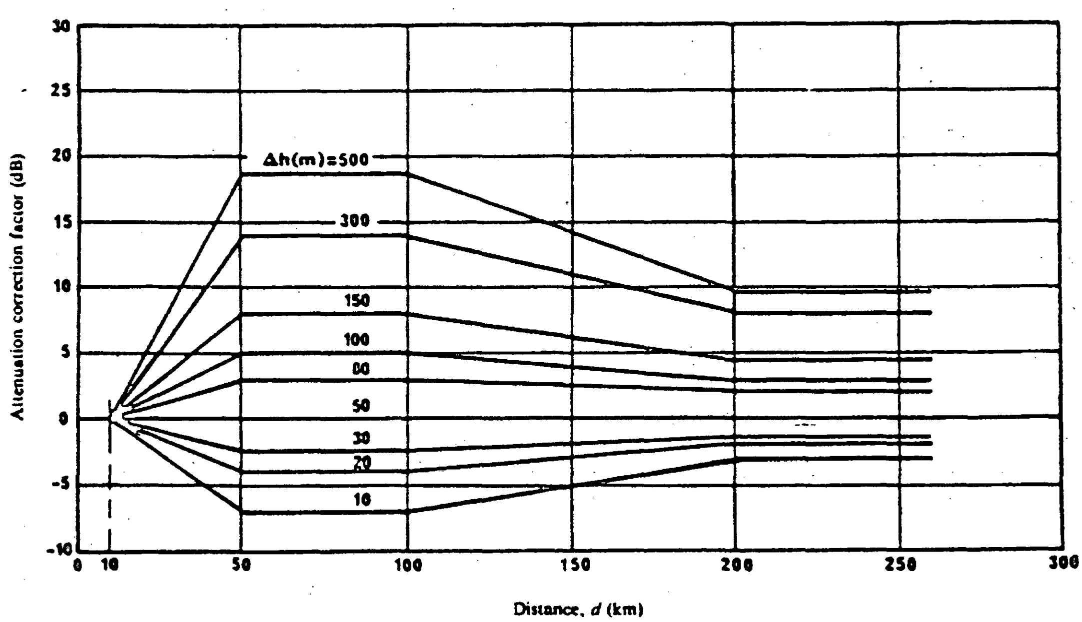

FIGURE 2.A.2

Attenuation correction factor as a function of the distance d(km) and Δh

VHF (Band III only)

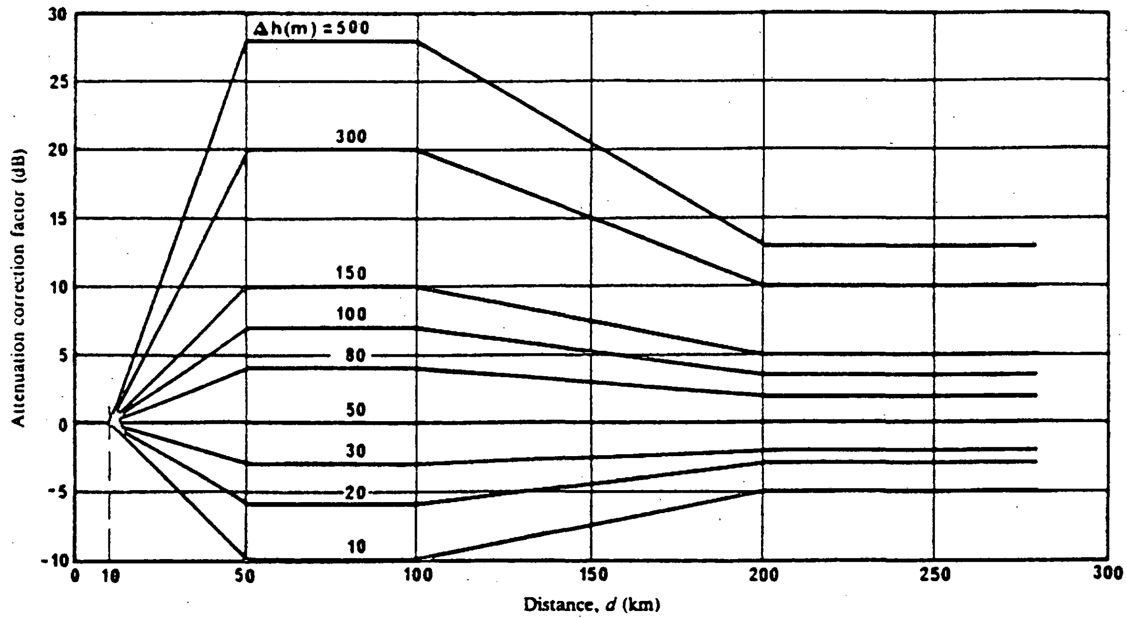

FIGURE 2.A.3

Attenuation correction factor as a function of the distance d(km) and Δh

UHF (Bands IV and V)

Receiver terrain correction (clearance angle)

The correction according to location referred to in Annex 2.B is applicable on a statistical basis only. If more precision is required for predicting field strengths in a small receiving area, a correction may be made on the basis of a "terrain clearance angle". This angle θ is measured at a point considered to be representative of the reception area; it is the angle between the horizontal at the receiving antenna and the line which clears all obstacles within 16 km in the direction of the transmitter. The example given in Figure 2.A.4 shows the sign convention which is negative if the line to the obstacles is above the horizontal. Figure 2.A.5 shows, in accordance with angle θ, the correction to be applied to the results obtained for 50% of locations. If this correction is applied, the correction according to location described in Annex 2.B (Figures 2.B.1 and 2.B.2) may no longer be applicable.

Corrections for terrain clearance angles outside the range -5° to 0.5° are not given in Figure 2.A.5. They may, however, be obtained tentatively by linear interpolation between the curves of Figure 2.A.5 and limiting values of 30 dB for VHF and 40 dB for UHF at 1.5° and -40 dB for both VHF and UHF at -15°, on condition that the free-space field strength is not exceeded.

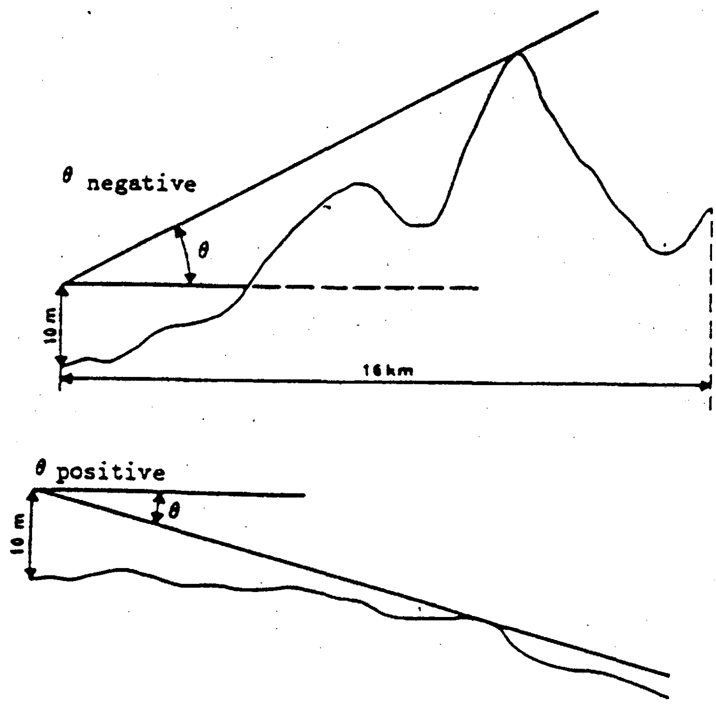

FIGURE 2.A.4

Terrain clearance angle

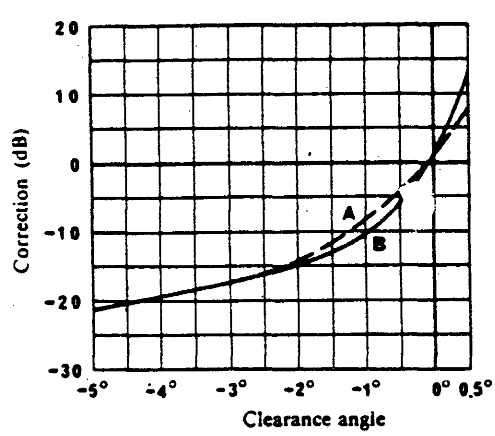

FIGURE 2.A.5

Receiving terrain clearance angle correction

Curve A: VHF (Bands I and III)
B: UHF (Bands IV and V)

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ANNEX 2.B

Correction for various percentages of locations

The curves described in Chapter 2 are representative of 50% of locations. Figures 2.B.1 and 2.B.2 give the correction (in dB) to be applied to other percentages of reception locations in the case of VHF and UHF.

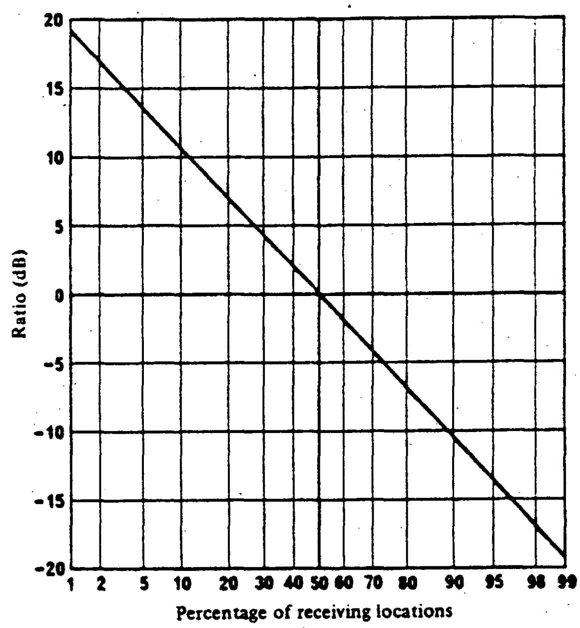


FIGURE 2.B.1

Ratio (dB) of the field strength for a given percentage of the receiving locations to the field strength for 50% of the receiving locations

VHF (Bands I and III)

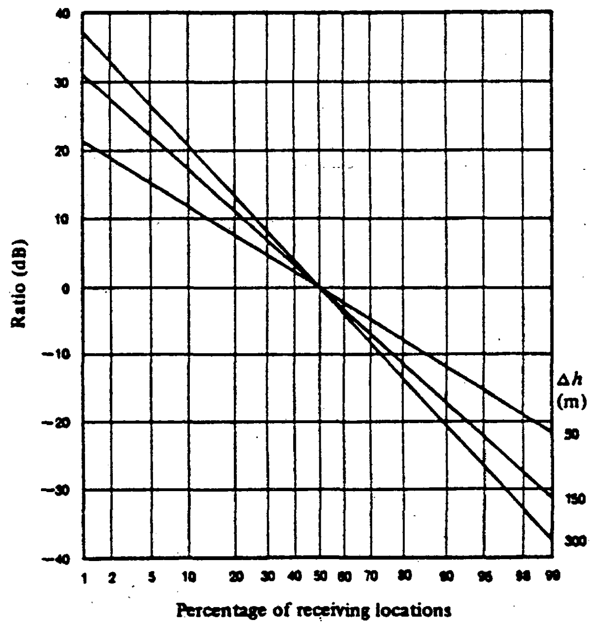


FIGURE 2.B.2

<u>Ratio (dB) of the field strength for a given percentage of the receiving locations to the field strength for 50% of the receiving locations</u>

The parameter Δh is described in Annex 2.A
UHF (Bands IV and V)

ANNEX 2.C

Additional data on propagation concerning compatibility with other services in the shared bands

1. Receiving antenna height gain data for the calculation of unwanted broadcasting service signals

a) VHF (Bands I and III)

The following reduction in the median field strength values may be expected by changing the receiving antenna height from 10 m to 3 m above ground: in Band I, 9 dB in hilly or flat terrain for both urban and rural areas; in Band III, 7 dB for flat terrain in rural areas and 11 dB for urban or hilly terrain. These values apply for distances up to 50 km. For distances in excess of 100 km the values should be halved, with linear interpolation of the values in decibels for intermediate distances.

b) UHF (Bands IV and V)

The following reduction in the median field strength values for bands IV and V may be expected by changing the receiving antenna height from 10 m to 3 m above ground. In rural areas, the median value of this reduction may be taken as 6 dB, in suburban areas as 7 dB, and in urban areas as 14 dB. These values apply for distances up to 50 km. For distances in excess of 100 km the values should be halved, with linear interpolation of the values in decibels for intermediate distances.

2. Receiving antenna height gain data for the calculation of unwanted land mobile service signals

Table I indicates the increase in median field strength that may be expected by raising the receiver antenna height from 3 m to 10 m.

TABLE I

Height gain factors, 3 m to 10 m

Zone	Band I	Band III	Bands IV, V
Rural (dB)	9	7	6
Urban (dB)	9	11	14

Figures 2.C.1 and 2.C.2 give propagation curves for UHF for a mobile receiving antenna height of 1.5 m in an urban environment. The increase in median field strength that may be expected by raising the antenna height from 1.5 m to 3 m may be taken as 3 dB in an urban environment.

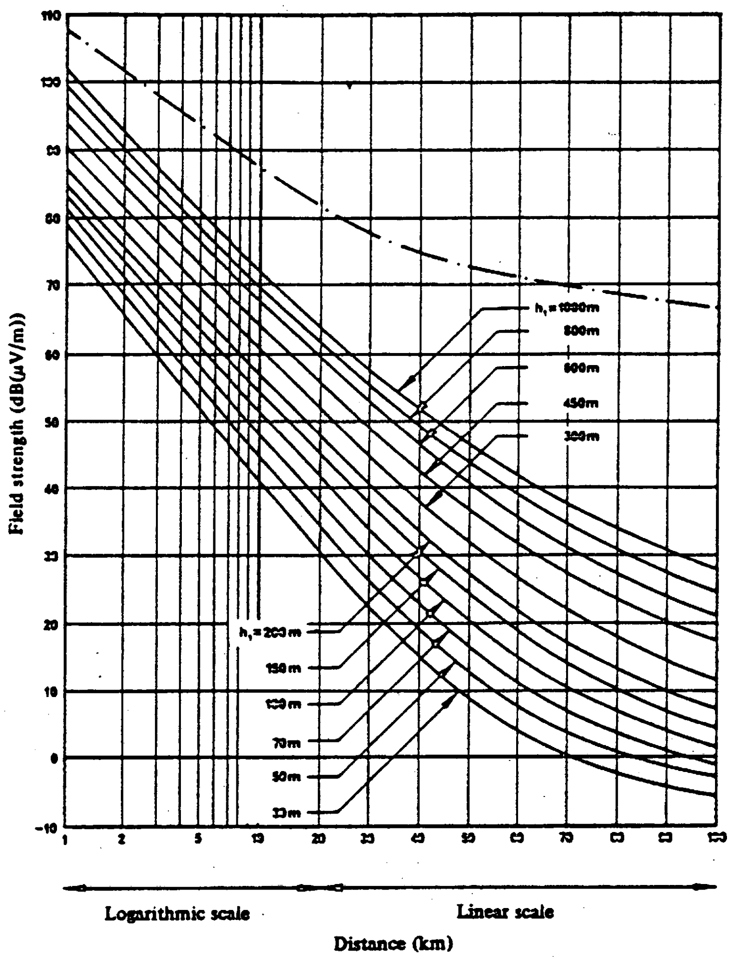


FIGURE 2.C.1

Field strength (dB(μV/m)) for 1 kW e.r.p.

Band IV, urban area, 50% of the time; 50% of the locations;
h_2 = 1.5 m

—— . —— . —— Free space

Propagation curves for the land mobile service

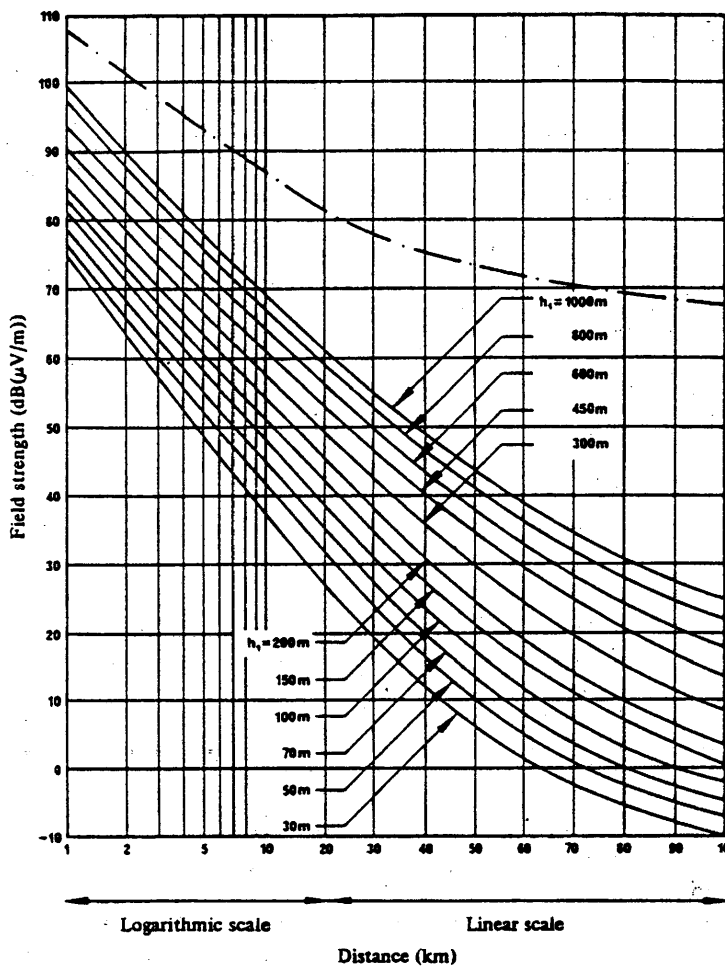


FIGURE 2.C.2

Field strength (dB(μV/m)) for 1 kW e.r.p.

Band V, urban area 50% of the time; 50% of the locations;
h_2 = 1.5 m

—— . —— . —— Free space

Propagation curves for the land mobile service

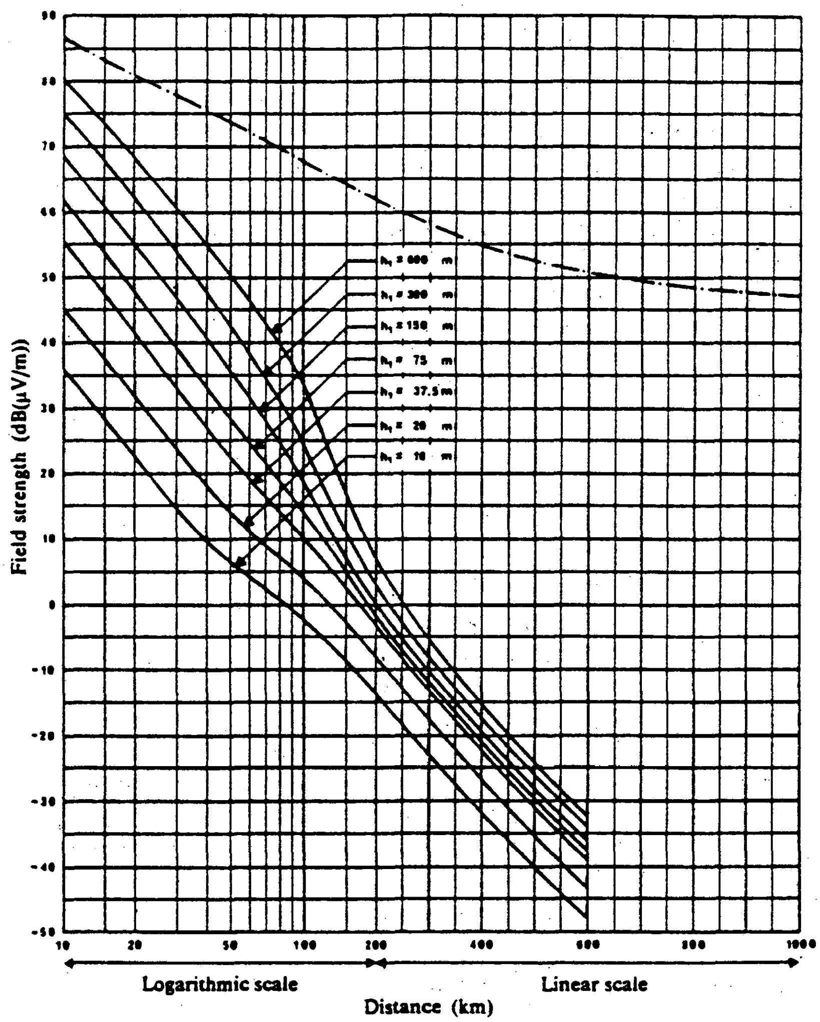


FIGURE 2.C.3

Field strength (dB(μV/m)) for 1 kW e.r.p.

Bands I and III, land, rural, 50% of the time; 50% of the locations; h_2 = 3 m

—— . —— . —— Free space

Propagation curves for the land mobile service

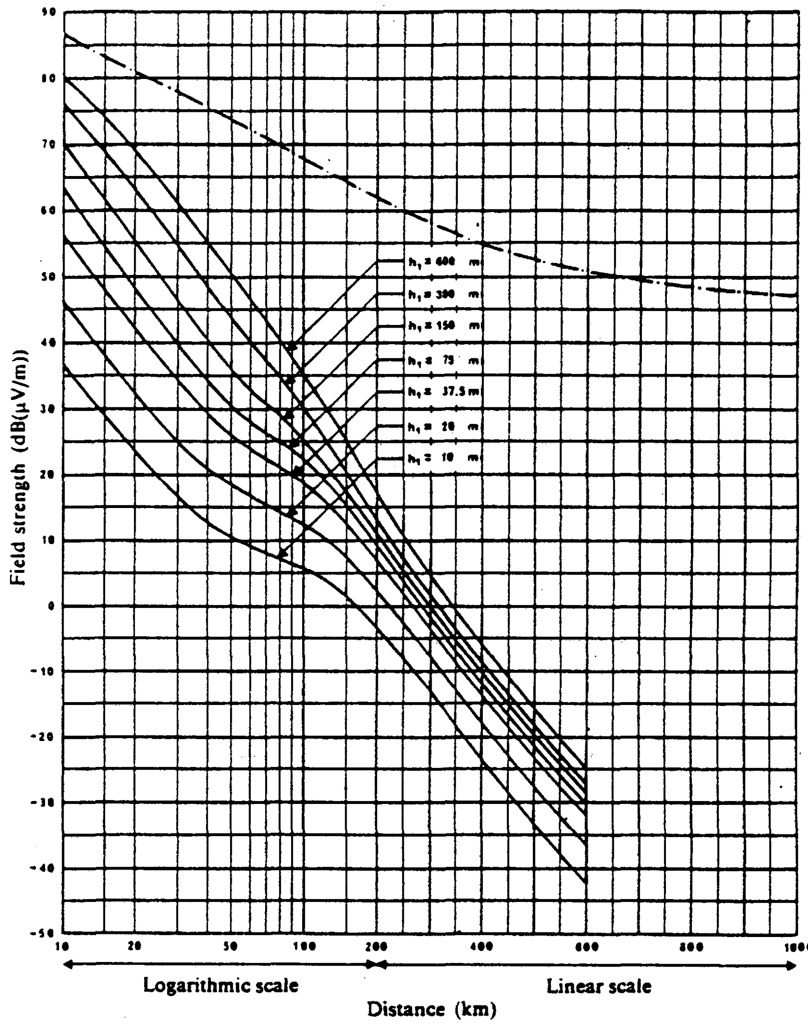


FIGURE 2.C.4

Field strength (dB(μV/m)) for 1 kW e.r.p.

Bands I and III, land, rural, 10% of the time; 50% of the locations; h_2 = 3 m

—— . —— . —— Free space

Propagation curves for the land mobile service

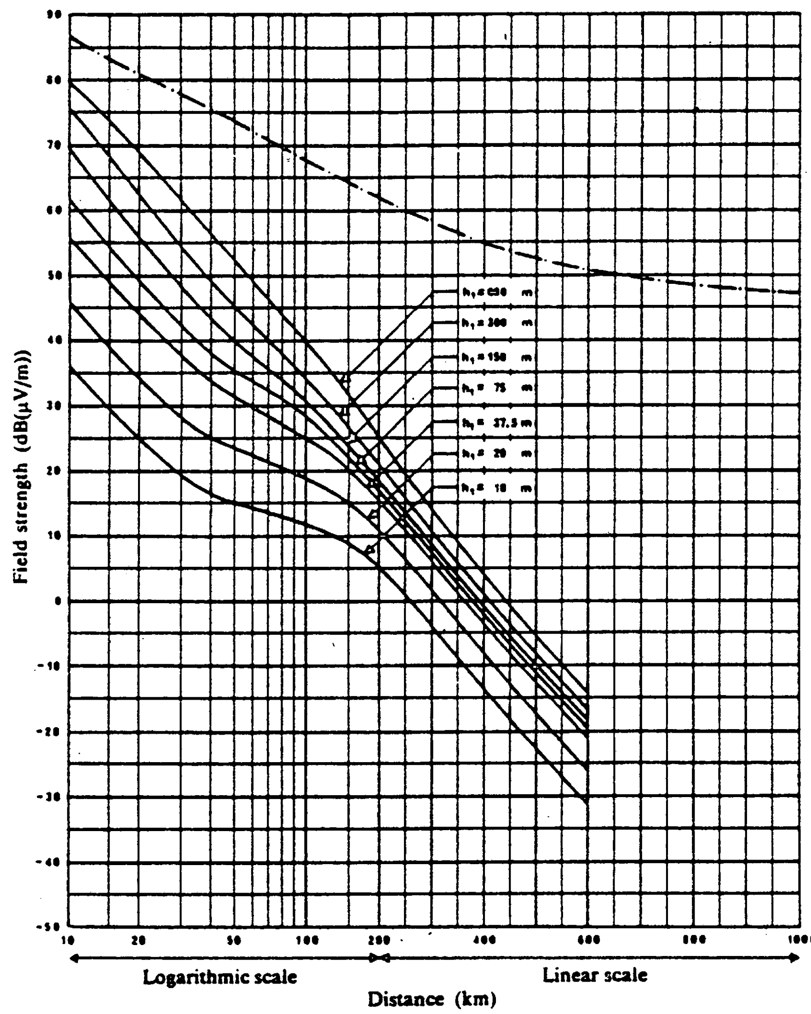


FIGURE 2.C.5

Field strength (dB(μV/m)) for 1 kW e.r.p.

Bands I and III, land, rural, 1% of the time; 50% of the locations; h_2 = 3 m

—— . —— . —— Free space

Propagation curves for the land mobile service

Code for antenna heights

Code	H_1 (m)	H_2 (m)
A	15	1000
B	1000	1000
C	15	10000
D	1000	10000
E	15	20000
F	1000	20000
G	10000	10000
H	10000	20000
I	20000	20000

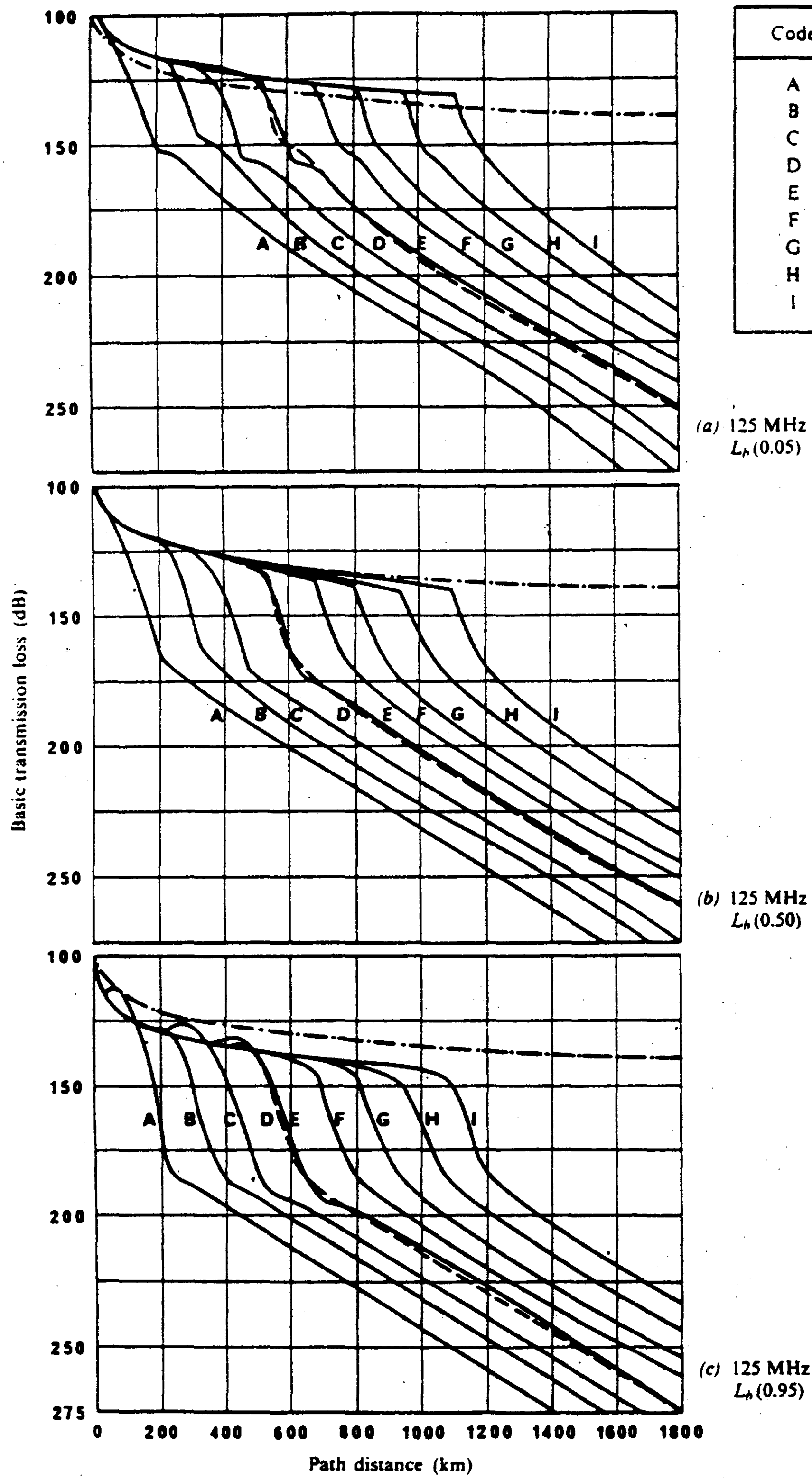


FIGURE 2.C.6

Basic transmission loss at 125 MHz for 5%, 50% and 95% of the time

— . — . — Free space

Propagation curves for the aeronautical services

Code for antenna heights

Code	H_1 (m)	H_2 (m)
A	15	1000
B	1000	1000
C	15	10000
D	1000	10000
E	15	20000
F	1000	20000
G	10000	10000
H	10000	20000
I	20000	20000

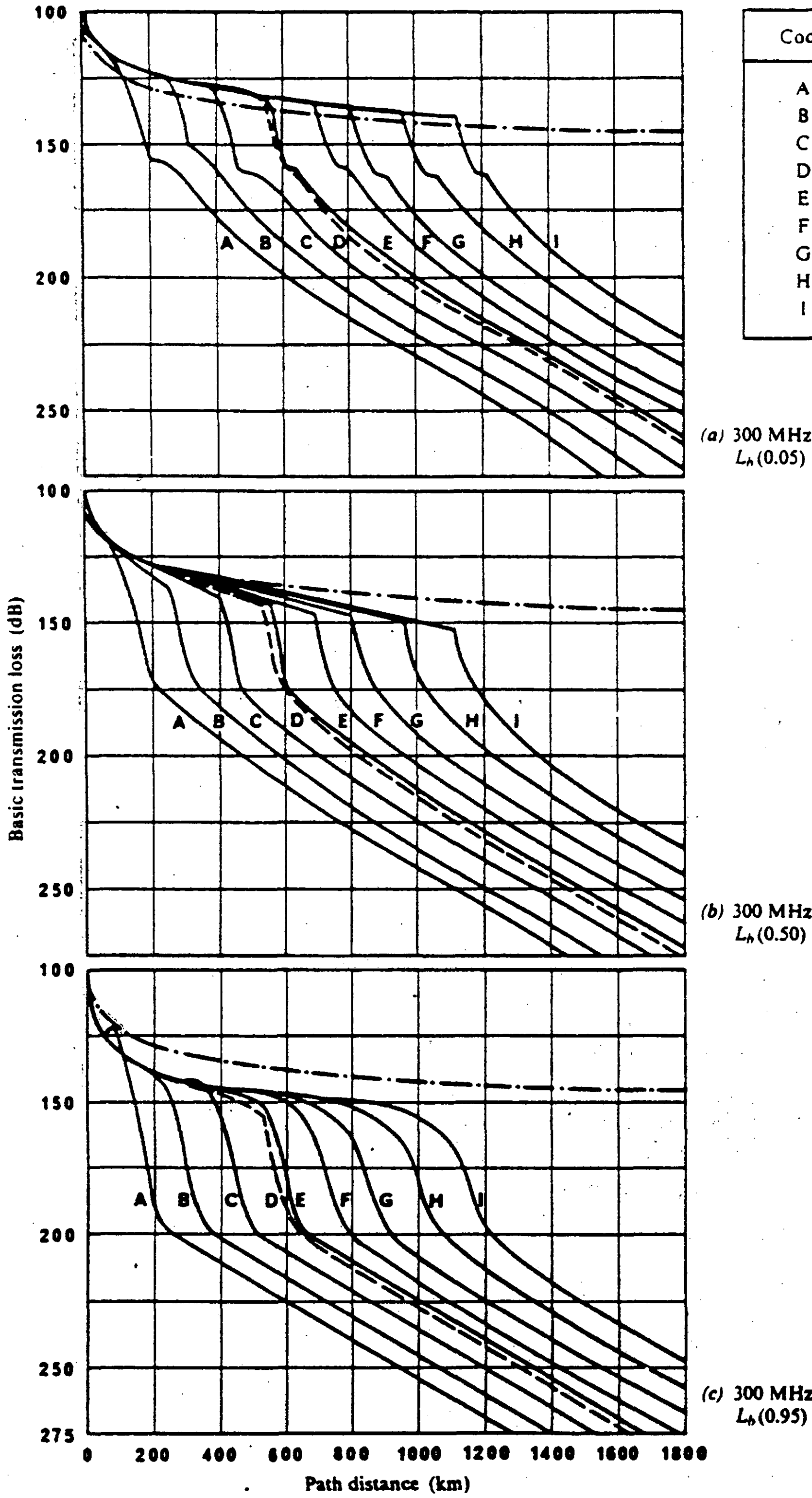


FIGURE 2.C.7

Basic transmission loss at 300 MHz for 5%, 50% and 95% of the time

—— . —— . —— Free space

Propagation curves for the aeronautical services

CHAPTER 3 - TECHNICAL STANDARDS AND TRANSMISSION CHARACTERISTICS

3.1 Optimum channel spacings, channel distribution

3.1.1 Channel spacing

A uniform channel spacing of 7 MHz or 8 MHz shall be used for Bands I and III. The 7 MHz channel spacing shall be applicable for systems using 7 MHz bandwidth; the 8 MHz channel spacing shall be applicable for systems using 8 MHz bandwidth.

A uniform channel spacing of 8 MHz shall be used for Bands IV/V.

3.1.2 Channel distribution

In each channel the nominal vision carrier frequency is situated at 1.25 MHz above the lower limit of the channel and the associated sound carrier frequency is higher than the vision carrier frequency.

3.1.2.1 Channel numbering in Band I (47 - 68 MHz)

In a plan using a 7 MHz channel spacing the frequency band 47 - 68 MHz is divided into three channels, each 7 MHz wide, numbered 2, 3 and 4 in accordance with the following table. In a plan using an 8 MHz channel spacing the frequency band 47 - 68 MHz is divided into two channels, each 8 MHz wide, numbered 2 and 3 in accordance with the following table:

Channel number	Channel limits (MHz)	Nominal vision carrier frequency (MHz)
	7 MHz channel spacing	
2	47 - 54	48.25
3	54 - 61	55.25
4	61 - 68	62.25
	8 MHz channel spacing	
2	47 - 55	48.25
3	55 - 63	56.25

3.1.2.2 Channel numbering in Band III (174 - 230 MHz)

In a plan using a 7 MHz channel spacing the frequency band 174 - 230 MHz is divided into eight channels, each 7 MHz wide, numbered from 5 to 12* in accordance with the following table. In a plan using an 8 MHz channel spacing the frequency band 174 - 230 MHz is divided into seven channels, each 8 MHz wide, numbered from 4 to 10 and from 5 to 11 in accordance with the following tables:

* For the Kingdom of Morocco the channel numbering used is M5 to M12.

Channel number	Channel limits (MHz)	Nominal vision carrier frequency (MHz)
	7 MHz channel spacing	
5	174 - 181	175.25
6	181 - 188	182.25
7	188 - 195	189.25
8	195 - 202	196.25
9	202 - 209	203.25
10	209 - 216	210.25
11	216 - 223	217.25
12	223 - 230	224.25
	8 MHz channel spacing	
4* 5*	174 - 182	175.25
5 6	182 - 190	183.25
6 7	190 - 198	191.25
7 8	198 - 206	199.25
8 9	206 - 214	207.25
9 10	214 - 222	215.25
10 11	222 - 230	223.25

3.1.2.3 Channel numbering in Band IV (channels 21-34) and in Band V (channels 35-69)

The frequency band 470 - 862 MHz is divided into 49 channels, each 8 MHz wide, numbered from 21 to 69 in accordance with the following table:

Channel number	Channel limits	Nominal vision carrier frequency	Channel number	Channel limits	Nominal vision carrier frequency
21	470–478	471.25	51	710–718	711.25
22	478–486	479.25	52	718–726	719.25
23	486–494	487.25	53	726–734	727.25
24	494–502	495.25	54	734–742	735.25
25	502–510	503.25	55	742–750	743.25
26	510–518	511.25	56	750–758	751.25
27	518–526	519.25	57	758–766	759.25
28	526–534	527.25	58	766–774	767.25
29	534–542	535.25	59	774–782	775.25
30	542–550	543.25	60	782–790	783.25
31	550–558	551.25	61	790–798	791.25
32	558–566	559.25	62	798–806	799.25
33	566–574	567.25	63	806–814	807.25
34	574–582	575.25	64	814–822	815.25
			65	822–830	823.25
35	582–590	583.25	66	830–838	831.25
36	590–598	591.25	67	838–846	839.25
37	598–606	599.25	68	846–854	847.25
38	606–614	607.25	69	854–862	855.25
39	614–622	615.25			
40	622–630	623.25			
41	630–638	631.25			
42	638–646	639.25			
43	646–654	647.25			
44	654–662	655.25			
45	662–670	663.25			
46	670–678	671.25			
47	678–686	679.25			
48	686–694	687.25			
49	694–702	695.25			
50	702–710	703.25			

* Numbering applicable for countries already using it.

3.2 Modulation standards, emission bandwidth

Planning shall be based on the transmission standards contained in Table 3.I.

TABLE 3.I

Characteristics of the radiated signals (monochrome and colour)

Item	Characteristics		B,G	H	I	K1
1	Frequency spacing (see Figure 3.1)	Nominal radio-frequency channel bandwidth (MHz)	B:7 G:8	8	8	8
2		Sound carrier relative to vision carrier (MHz)	+5.5 ± 0.001	+5.5	+5.9996 ± 0.0005	+6.5
3		Nearest edge of channel relative to vision carrier (MHz)	-1.25	-1.25	-1.25	-1.25
4		Nominal width of main sideband (MHz)	5	5	5.5	6
5		Nominal width of vestigial sideband (MHz)	0.75	1.25	1.25	1.25
6	Minimum attenuation of vestigial sideband (dB at MHz)		20(-1.25) 20(-3.0) 30(-4.43)	20(-1.75) 20(-3.0)	20(-3.0) 30(-4.43)	0(+0.8) 20(-2.7) 30(-4.3)
7	Type and polarity of vision modulations		C3F neg.	C3F neg.	C3F neg.	C3F neg.
8	Levels in the radiated signal (% of peak carrier)	Synchronizing level	100	100	100	100
		Blanking level	75 ± 2.5	72.5 to 77.5	76 ± 2	75 ± 2.5
		Difference between black level and blanking level	0 to 2 (nominal)	0 to 7	0 (nominal)	0 to 4.5
		Peak white-level	10 to 12.5	10 to 12.5	20 ± 2	10 to 12.5
9	Type of sound modulation		F3E	F3E	F3E	F3E
10	Frequency deviation (kHz)		± 50	± 50	± 50	± 50
11	Pre-emphasis for modulation (μS)		50	50	50	50
12	Ratio of effective radiated powers of vision and sound[1]		10/1	10/1	10/1	10/1
13	Line frequency f_H and tolerance when operated non-synchronously (Hz)		15 625 ± 0.02% (± 0.0001%)	15 625 ± 0.02% (± 0.0001%)	15 625 (± 0.0001%)	15 625 ± 0.02% (± 0.0001%)
13a)	Maximum variation rate of line frequency valid for monochrome transmission (%/S)		0.05	0.05	0.05	0.05

1 For existing stations which have a ratio other than 10/1, the existing ratio will be taken into account in planning.

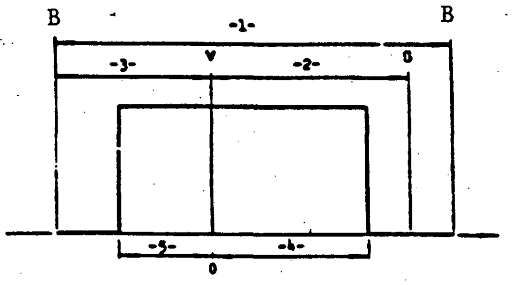


FIGURE 3.1

Significance of items 1 to 5 of Table 3.I

B: channel limit
V: vision carrier
S: sound carrier

Some administrations or broadcasting organizations might wish to consider the provision of a television service with two or more associated sound signals or other additional broadcasting services. Such systems should meet the following requirements:

- compatibility with single sound systems;
- no increase in the bandwidth of a television channel;
- at least the same coverage area for the additional sound channel as that of the picture channel;
- should not cause more interference to the standard systems operated by other neighbouring administrations than that resulting from the relevant protection ratios.

3.3 Protection ratios

Planning shall be based on non-precision offset conditions* (± 500 Hz carrier stability). Normally tropospheric interference values (1% of the time) will be used to calculate the nuisance field strength. In exceptional cases, values of continuous interference may be used; see section 3.3.8 for further details. Information concerning the relevant protection ratio values as well as additional information which may be of use for international negotiations is given in the following sections. Two (or more) sound channels and additional broadcasting services can be implemented as long as no constraints are thereby imposed on planning.

* See Annex 3.A.

3.3.1 Co-channel interference

In this section the protection ratios between two television signals apply only for interference due to the modulated vision carrier of the unwanted signal. Additional protection may be necessary if the wanted sound carrier is affected, or if the unwanted sound carrier lies within the wanted vision channel, e.g. the unwanted sound carrier of system G or H lies within the vision channel of system K1.

Table 3.II shows the protection ratios for carriers separated by multiples of twelfth the line frequency up to about ± 36/12 f_{line} (about ±50 kHz). These protection ratio values do not necessarily apply for greater carrier separations.

TABLE 3.II

Protection ratio between 625-line systems

Offset in $\frac{f_{line}}{12}$		0	1	2	3	4	5	6	7	8	9	10	11	12
Non-precision offset	Tropospheric interference	45	44	40	34	30	28	27	28	30	34	40	44	45
	Continuous interference	52	51	48	44	40	36	33	36	40	44	48	51	52
Transmitter stability ±500 Hz	Limit of perceptibility[1]	61	60	57	54	50	45	42	45	50	54	57	60	61
Precision offset	Tropospheric interference	32	34	30	26	22	22	24	22	22	26	30	34	38
	Continuous interference	36	38	34	30	27	27	30	27	27	30	34	38	42
Transmitter stability ±1 Hz	Limit of perceptibility[1]	42	44	40	36	36	39	42	39	36	36	40	44	48

[1] For information only.

(Value in the first column is only valid for the 0/12 case. All other values between 1/12 and 12/12 are the same by addition or subtraction of integer multiples of 12/12 up to ± 36/12.)

Figure 3.2 gives examples of protection ratio curves for the three most important offset positions (0/12, 4/12 and 6/12 f_{line}). The curves in each graph relate to tropospheric interference, continuous interference and the limit of perceptibility.

The white and black points indicate the positions for non-precision and precision offset respectively. The reference points for tropospheric and continuous interference are also indicated in Figure 3.2.

When operating TV transmitter networks with synchronized as well as phase-locked carriers, the protection ratio values are slightly reduced.

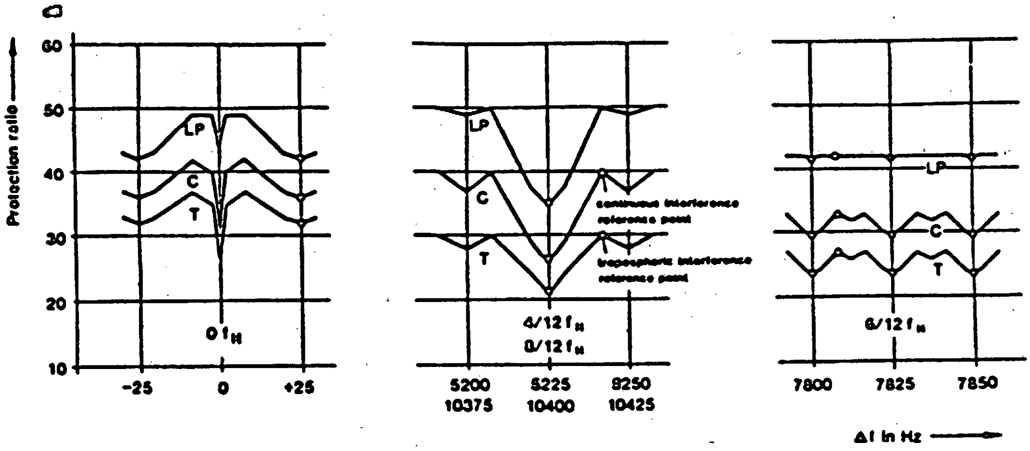


FIGURE 3.2

Precise structure of the protection ratio curves
for different offset positions

Δ f: frequency difference between the wanted and the unwanted carrier

o:	non-precision offset
o:	precision offset
Curves T:	tropospheric interference
C:	continuous interference
LP:	limit of perceptibility

3.3.2 Adjacent-channel interference

The given protection ratios apply to tropospheric interference and they are defined in terms of wanted and unwanted vision carrier levels. For continuous interference the values should be increased by 10 dB.

Adjacent-channel protection ratios cannot be determined directly from the overlapping channel protection ratio curves shown in Figures 3.3 and 3.4, because for certain systems the values may be affected by special measures in the receiver; e.g. sound traps.

3.3.2.1 Lower adjacent-channel interference

The worst interference on the picture signal from another signal using the same standard results from the sound signal in the lower adjacent channel. However, some improvement in protection is achieved if the unwanted sound carrier and the wanted vision carrier are separated by an effective offset in the vicinity of an odd multiple of 1/2 line frequency. This is particularly noticeable during periods without sound modulation when the improvement can be as much as 10 dB; with modulation the improvement is only 2-3 dB.

Linear correction should be made to take into account vision-to-sound power ratios different from those assumed in the following sub-sections.

VHF bands

The protection ratio below relates to the cases where the separation between the wanted vision carrier frequency and the unwanted sound carrier frequency is 1.5 MHz and the ratio between the unwanted vision and unwanted sound powers is 10 dB.

Protection ratio: all systems: -9 dB

UHF bands

For the various 625-line systems for use in 8 MHz channels in the UHF bands, Table 3.III gives the protection required by a signal of any system against a lower adjacent-channel signal of the same or any other standards, assuming a vision-to-sound power ratio of 10 dB for unwanted signals of all standards of systems used in the planning area. A correction must be made for different vision-to-sound power ratios.

TABLE 3.III

Protection ratio from lower adjacent-channel interference (UHF bands)

Unwanted signal / Wanted signal	Protection ratio (dB)			
	G	H	I	K1
G	-9	-9	-9	-9
H	-9	-9	-9	+13
I	-9	-9	-9	+13
K1	-9	-9	-9	-9

3.3.2.2 Upper adjacent-channel interference - VHF and UHF bands

Protection ratio: all systems: -12 dB

3.3.3 Image channel interference

The protection ratio required will depend on the intermediate frequency and image-channel rejection of the receiver, and on the type of unwanted signal falling in the image channel. It can be determined by subtracting the image rejection figure from the required protection ratio for overlapping channels. Table 3.IV shows this situation for the UHF bands. The wanted vision channel can be affected by the unwanted vision carrier, by the unwanted sound carrier or by both.

Image channel rejection: system I: 50 dB

all other systems: 40 dB.

TABLE 3.IV

Protection ratio for image channel interference in 625-line systems (UHF bands)

<table>
<tr><th rowspan="2">Unwanted signal / Wanted signal</th><th colspan="3">Protection ratio (dB)</th><th rowspan="2">Image channel</th><th rowspan="2">Remarks</th></tr>
<tr><th>G,H</th><th>I</th><th>K1</th></tr>
<tr><td>G</td><td>-1</td><td>-4</td><td>-11</td><td>n + 9</td><td rowspan="5">Interference from sound carrier</td></tr>
<tr><td>H</td><td>-1</td><td>-4</td><td>-9</td><td>n + 9</td></tr>
<tr><td>I</td><td>-13</td><td>-10</td><td>-10</td><td>n + 9</td></tr>
<tr><td rowspan="3">K1</td><td>0</td><td>0</td><td>-2</td><td>n - 9</td></tr>
<tr><td>-1</td><td>-4</td><td>-5</td><td>n + 9</td></tr>
<tr><td>+7</td><td>+7</td><td>+7</td><td>n + 10</td><td>Interference from vision carrier</td></tr>
</table>

The image-channel protection ratios in Table 3.IV apply to tropospheric interference, and are defined in terms of wanted and unwanted vision carrier levels assuming a vision-to-sound power ratio of 10 dB for unwanted signals of all standards of systems used in the planning area. A correction must be made for different vision-to-sound ratios. For continuous interference the values should be increased by 10 dB.

3.3.4 Overlapping channel interference

All figures and tables in this section give protection ratios to be applied when a CW signal lies within the vision channel of the wanted transmission, the wanted vision signal being negatively modulated.

Corrections to be made for other types of potentially interfering signals are as given in Table 3.V. When the interfering signal is a television signal, two calculations of protection ratio are necessary: one for the interfering vision carrier and one for the interfering TV sound carrier.

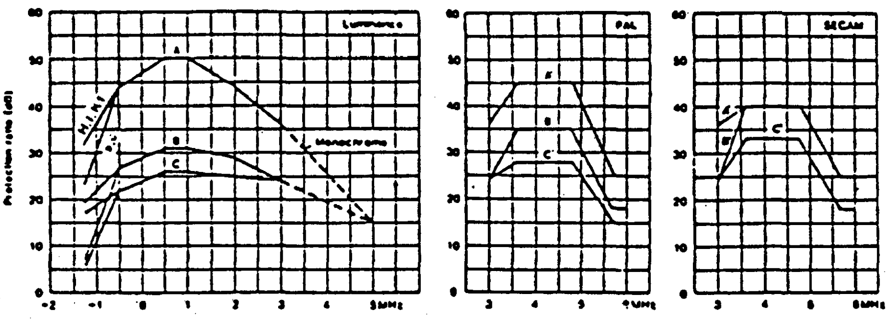
The protection ratios shown for unwanted frequency-modulated sound carrier do not apply to non-precision and precision offset conditions. Nevertheless, a reduction of 2 dB relative to the non-controlled condition is achieved for non-precision offsets between 3/12 and 9/12 of the line frequency.

TABLE 3.V

Correction values for different wanted and unwanted signals

Unwanted signal / Wanted signal	Correction factors (dB)			
	CW	TV-negative	FM-sound	AM-sound
Vision signal negative modulated	0	-2	0	+4

Figures 3.3 and 3.4 and Tables 3.VI and 3.VII give protection ratios applicable for tropospheric and for continuous interference. The values shown refer to the case of a wanted negatively modulated vision signal affected by an unwanted CW signal. The previously indicated corrections apply when considering other combinations of wanted and unwanted signals.



Offset (multiples of 1/12 line-frequency)		Curve	Luminance range								PAL ***		SECAM ***	
			-1.25*	-1.25**	-0.5	0.0	0.5	1.0	2.0	3.0	3.6-4.8	5.7-6.0	3.6-4.8	5.7-6.0
0	NO	A	32	23	44	47	50	50	44	36	35	18	40	25
	PO		23	11	32	34	40	40	37	31	28	15	33	18
1	NO		31	20	43	46	49	49	42	34	39	20	40	25
	PO		23	11	33	36	39	39	36	31	31	16	33	18
2	NO		28	17	39	42	45	45	39	32	42	22	40	25
	PO		21	9	29	32	35	35	33	29	34	17	33	18
3	NO		25	13	34	36	39	39	35	29	45	25	40	25
	PO		19	7	25	28	31	31	29	26	35	18	33	18
4	NO		22	10	30	32	35	35	32	27	42	22	40	25
	PO	C	17	5	22	24	26	26	25	24	34	17	33	18
5	NO		20	8	28	30	32	32	30	25	39	20	40	25
	PO	C	17	5	22	24	26	26	25	24	31	16	33	18
6	NO	B	19	7	27	29	31	31	29	24	35	18	40	25
	PO		17	5	24	26	28	28	26	24	28	15	33	18
7	NO		20	8	28	30	32	32	30	25	35	18	40	25
	PO	C	17	5	22	24	26	26	25	24	28	15	33	18
8	NO		22	10	30	32	35	35	32	27	39	20	40	25
	PO	C	17	5	22	24	26	26	25	24	31	16	33	18
9	NO		25	13	34	36	39	39	35	29	42	22	40	25
	PO		19	7	25	28	31	31	29	26	34	17	33	18
10	NO		28	17	39	42	45	45	39	32	39	20	40	25
	PO		21	9	29	32	35	35	33	29	31	16	33	18
11	NO		31	20	43	46	49	49	42	34	35	18	40	25
	PO		23	11	33	36	39	39	35	31	28	15	33	18
12	NO	A	32	23	44	47	50	50	44	36	35	18	40	25
	PO		23	11	32	40	40	40	37	31	28	15	33	18

Frequency difference (MHz) (separation between wanted and unwanted carriers)

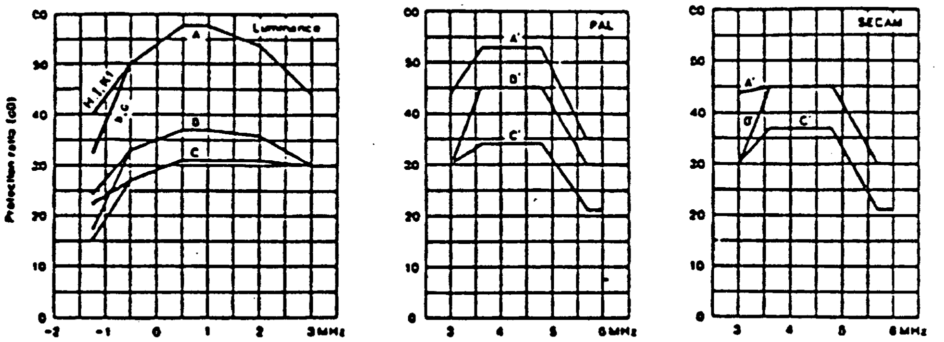
Protection ratio (dB)

FIGURE 3.3 and TABLE 3.VI

625-line systems - tropospheric interference

* H,I,K1 television systems
** B,G television systems
*** B,G television systems: the separation is 5.3 - 6.0 MHz

NO: non-precision offset
PO: precision offset



Offset (multiples of 1/12 line-frequency)		Curve	Frequency difference (MHz) (separation between wanted and unwanted carriers)											
			Luminance range								PAL ***		SECAM ***	
			-1.25*	-1.25**	-0.5	0.0	0.5	1.0	2.0	3.0	3.6-4.8	5.7-6.0	3.6-4.8	5.7-6.0
0	NO	A	40	32	50	54	58	58	54	44	45	30	45	30
	PO		30	22	37	38	44	44	42	36	34	21	37	21
1	NO		38	30	49	53	57	57	53	43	48	32	45	30
	PO		29	22	38	40	42	42	41	36	36	22	37	21
2	NO		34	27	46	50	55	55	51	41	51	33	45	30
	PO		27	20	34	36	38	38	37	34	39	24	37	21
3	NO		30	23	42	46	50	50	46	38	53	35	45	30
	PO		24	17	30	32	34	34	33	31	40	26	37	21
4	NO		28	21	38	42	45	45	42	35	51	33	45	30
	PO	C	22	15	27	29	31	31	31	30	39	24	37	21
5	NO		26	19	35	38	41	41	38	32	48	32	45	30
	PO	C	22	15	27	29	31	31	31	30	36	22	37	21
6	NO	B	24	17	33	35	37	37	36	30	45	30	45	30
	PO		23	16	29	32	33	33	32	30	34	21	37	21
7	NO		26	19	35	38	41	41	38	32	45	30	45	30
	PO	C	22	15	27	29	31	31	31	30	34	21	37	21
8	NO		28	21	38	42	45	45	42	35	48	32	45	30
	PO	C	22	15	27	29	31	31	31	30	36	22	37	21
9	NO		30	23	42	46	50	50	46	38	51	33	45	30
	PO		24	17	30	32	34	34	33	31	39	24	37	21
10	NO	-	34	27	46	50	55	55	51	41	48	32	45	30
	PO		27	20	34	36	38	38	37	34	36	22	37	21
11	NO		38	30	49	53	57	57	53	43	45	30	45	30
	PO		29	22	38	40	42	42	41	36	34	21	37	21
12	NO	A	40	32	50	54	58	58	54	44	45	30	45	30
	PO		30	22	37	44	44	44	42	36	34	21	37	21
Protection ratio (dB)														

FIGURE 3.4 and TABLE 3.VII

625-line systems - continuous interference

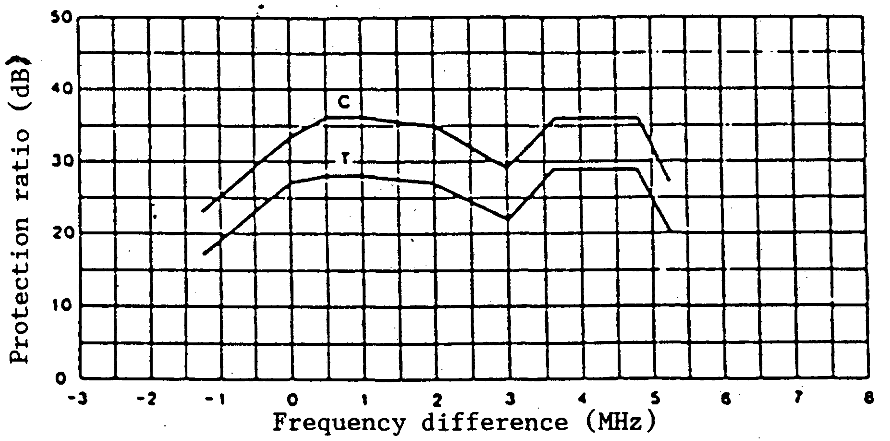
* H,I,K1 television systems
** B,G television systems
*** B,G television systems: the range is 5.3 - 6.0 MHz

NO: non-precision offset
PO: precision offset

The curves shown in Figures 3.3 and 3.4 are examples that can be derived directly from the associated tables. They illustrate the full range of protection ratio possibilities, from the worst case on non-controlled condition (curve A and A') to the best achievable using either non-precision offset (curve B and B') or precision offset (curve C and C'). The curves A, B and C are related to the luminance range, the curves A', B' and C' to the chrominance range for the PAL and SECAM systems. For frequency differences below -1.25 MHz or above 6 MHz the protection ratio may be derived by linear extrapolation to the channel limit.

3.3.5 Television signal affected by data signals

The inclusion of digital data such as teletext in the field blanking interval has no effect on required protection ratios. However, full improvement resulting from non-precision or precision offset operation is not achievable when the unwanted signal carries a full-field data signal. In this case, Figure 3.5 and Table 3.VIII show minimum values for all offset and non-offset conditions. The curves in Figure 3.5 apply to full-field data signals with pulse amplitude at 66% of the peak white-to-blanking level. The values should be increased linearly for higher modulation levels.



Frequency difference (MHz)	-1.25	0.0	0.5	1.0	2.0	3.0	3.6	4.8	5.25
(T) Tropospheric interference	17	27	28	28	27	22	29	29	20
(C) Continuous interference	23	33	36	36	35	29	36	36	27

FIGURE 3.5 and TABLE 3.VIII

625-line systems - B/PAL and G/PAL - protection from full-field data signals

3.3.6 Protection ratio for sound signals

Protection ratios for the wanted sound signal are given in Table 3.IX for tropospheric and continuous interference. The values quoted refer to the level of the wanted sound carrier. In the case of two-sound-carrier transmission each sound carrier must be separately considered. Multiplex modulated sound signals require higher protection.

TABLE 3.IX

Protection ratio for wanted sound carriers
Unwanted signal: CW or FM sound carrier

Difference between wanted sound carrier and unwanted carrier (kHz)	Wanted sound signal	
	Tropospheric interference	Continuous interference
	FM	FM
0	32	39
15	30	35
50	22	24
250	-6	-6

Note - For unwanted vision carrier subtract 2 dB.

The weighted signal-to-noise ratio will be improved by approximately 8 dB if 5/3 line offset is used instead of 2/3 line offset.

3.3.7 Calculation of frequencies for precision offset

Frequencies for precision offset

Table 3.X lists the possible frequencies for precision offset, in the vicinity of each twelfth of line frequency (f_{line}). For the luminance range, the frequencies shown in Table 3.X end with 25 Hz up to 6/12 f_{line} and with 100 Hz beyond this frequency. Two possibilities are shown for 6/12 f_{line} (7 800 and 7 825 Hz) because at this point the spectral lines are symmetrical and thus of the sample amplitude. The offset frequencies are expressed in twelfths of line frequency.

Alternative frequencies in the vicinity of each offset position, which differ by integer multiples of 50 Hz and by integer multiples of 15 625 Hz from the values given, are possible. The term "precision offset" always refers to a difference between the carrier frequencies of the wanted and unwanted transmitters, and not to an offset of a transmitter from its nominal carrier frequency.

If the frequency difference between wanted and unwanted carrier exceeds the normalized range specified in Table 3.X, one has to subtract integer multiples of 15 625 Hz. For computer calculations, formulae are given below for all precision offset frequency differences in the luminance and in the chrominance range, for 625-line systems.

TABLE 3.X

Normalized precision offset between 0/12 and 12/12 of line frequency for all 625-line systems

Offset in multiples of $\frac{f_{line}}{12}$	Precision offset frequency (Hz)		
	Luminance range	Chrominance range	
		PAL	SECAM
0	25	5	0
1	1325	1305	1302
2	2625	2605	2604
3	3925	3905	3906
4	5225	5205	5208
5	6525	6505	6510
6	7800 or 7825	7810	7812
7	9100	9120	9115
8	10400	10420	10417
9	11700	11720	11719
10	13000	13020	13021
11	14300	14320	14323
12	15600	15630	15625

Luminance range: $f_p = m \times 15\,625 \pm (2n + 1) \times 25$

$m \leq 192,\ n \leq 156$

Chrominance range: PAL systems: $f_p = m \times 15\,625 \pm (2n + 1) \times 25 + k$

$m \geq 216$ and
$k = -20$ for $0 \leq n \leq 143$
$k = -15$ for $143 \leq n \leq 169$
$k = -5$ for $169 \leq n \leq 299$
$k = +5$ for $299 \leq n \leq 312$

SECAM systems: $f_p = m \times 15\,625 + 2n \times (25 + \frac{25}{624})$

with m, n, k integers

Computation of operational precision offset frequencies in a network with transmitter triplets

Precision offset techniques are usually employed to provide solutions to particular interference problems between two co-channel transmitters. In operational television networks co-channel transmitters are situated at the corner of a triangle. A typical line offset (non-precision offset) situation for such a transmitter triplet is: nominal vision carrier frequency -2/3 f_{line}, ± 0 f_{line}, $\pm 2/3$ f_{line} of the line frequency, or in twelfth: 8M, 0, 8P. A transmitter triplet A-B-C consists of three transmitter pairs A-B, A-C and B-C. Introduction of precision offset for the above-mentioned example means a possible reduction of interference for all three pairs of the transmitter triplet. In practice only 35% of all theoretical possible transmitter triplets have full improvement for all three pairs, the residual 65% triplets have one or two pairs in non-precision offset.

Table 3.XI shows a complete and normalized list of these 35% possible cases within the range between 0 and 12P which secure improved interference situation for all three transmitter pairs within a triplet, when precision offset is used.

Precision offset frequencies for transmitter triplets can be determined using a simple rule. All transmitter triplets which cannot be translated to the normalized cases of Table 3.XI contain one pair at least without precision offset.

TABLE 3.XI

<u>Possible offset combinations allowing precision offset for all transmitter pairs in transmitter triplets</u>

CASE	OFFSET	FREQUENCY (Hz) (625-line systems)		
1	0 - 0P - 6P	0	25	7800
2	0 - 0P - 6P	0	25	7825
3	0 - 1P - 6P	0	1325	7800
4	0 - 1P - 7P	0	1325	9100
5	0 - 2P - 6P	0	2625	7800
6	0 - 2P - 7P	0	2625	9100
7	0 - 2P - 8P	0	2625	10400
8	0 - 3P - 6P	0	3925	7800
9	0 - 3P - 7P	0	3925	9100
10	0 - 3P - 8P	0	3925	10400
11	0 - 3P - 9P	0	3925	11700
12	0 - 4P - 6P	0	5225	7800
13	0 - 4P - 7P	0	5225	9100
14	0 - 4P - 8P	0	5225	10400
15	0 - 4P - 9P	0	5225	11700
16	0 - 4P - 10P	0	5225	13000
17	0 - 5P - 6P	0	6525	7800
18	0 - 5P - 7P	0	6525	9100
19	0 - 5P - 8P	0	6525	10400
20	0 - 5P - 9P	0	6525	11700
21	0 - 5P - 10P	0	6525	13000
22	0 - 5P - 11P	0	6525	14300
23	0 - 6P - 6P	0	7800	7825
24	0 - 6P - 7P	0	7825	9100
25	0 - 6P - 8P	0	7825	10400
26	0 - 6P - 9P	0	7825	11700
27	0 - 6P - 10P	0	7825	13000
28	0 - 6P - 11P	0	7825	14300
29	0 - 6P - 12P	0	7800	15600
30	0 - 6P - 12P	0	7825	15600

<u>Example</u>

The aim of this calculation is to transform all three offset positions into the range between 0P and 12P (see Table 3.XI). Each single transmitter carrier frequency can be moved by multiples of line frequency, i.e. by multiples of 12/12 (see Step 2). Moving of any twelfths is allowed, provided that all transmitter carrier frequencies are moved by the same number of twelfths (see Step 1).

Given: Transmitter triplet	A	B	C
Line offset position	18M	8P	2P

Step 1

Set one transmitter to zero by linear translation:	+18	+18	+18
Result:	0	26P	20P

Step 2

Translation of transmitter B and C into the range between 0 and 12P by subtracting or adding a multiple of the line frequency:		-24	-12
Result:	0	2P	8P

Step 3

Selection of precision offset frequencies from Table 3.XI:	0	2 625 Hz	10 400 Hz

Step 4

Step 2 has to be compensated		+31 250 Hz	+15 625 Hz
Result:	0	+33 875 Hz	+26 025 Hz

Step 5

Step 1 has to be compensated	-23 400 Hz	-23 400 Hz	-23 400 Hz
Result:	-23 400 Hz	+10 475 Hz	+2 625 Hz
equivalent to	18M	8P*	2P

3.3.8 Calculation of nuisance field

To apply the protection-ratio curves it is necessary to determine whether, in the particular circumstances, the interference is to be regarded as continuous or tropospheric**. A suitable criterion for this is provided by the concept of "nuisance field" which is the field strength of the interfering transmitter (at its pertinent e.r.p.) enlarged by the relevant protection ratio.

* To reduce the sound interference between transmitter B and C, an offset position of 20P = 26 100 Hz (enlarged by 12P = 15 625 Hz) would be preferable. In this case picture interference is unchanged.

** For further information see Recommendation 412-3 of the CCIR.

Thus, the nuisance field for continuous interference is given by the formula

$E_t = P + E(50,50) + A_c$

and the nuisance field for tropospheric interference is given by the formula

$E_t = P + E(50,T) + A_t$

where

P : e.r.p. (dB(1 kW)) of the interfering transmitter;
A : radio-frequency protection ratio (dB);
E(50,T) : field strength (dB(μV/m)) of the interfering transmitter, normalized to 1 kW, and exceeded during T% of the time,*

and where indices c and t indicate continuous and tropospheric interference respectively.

The protection-ratio curve for continuous interference is applicable when the resulting nuisance field is stronger than that resulting from tropospheric interference.

i.e. $E_c > E_t$
This means that A_c should be used in all cases when :
$E(50,50) + A_c \geqslant E(50,T) + A_t$.

3.3.9 Calculation of multiple interference

The simplified multiplication method shall be used to calculate the effects of multiple interference. See Annex 3.B for details of its application.

* For the calculation of tropospheric interference, 1% of the time is used.

3.4 Field strength values to be used in the planning process

Reference usable field strength

The median field strength values as given in CCIR Recommendation 417-3 should be used for the purpose of planning against interference in Bands I, III, IV and V. These values are:

Band	I	III	IV	V
dB(μV/m)	+48	+55	+65	+70

The values refer to the field strength at a height of 10 m above ground level. The percentage of time for which protection may be sought should lie between 90 and 99%.

The above values are identical to the values of the minimum field strength to be protected.

Note - In arriving at the figures shown above, it has been assumed that a satisfactory picture quality in the absence of interference from other television transmissions and man-made noise may be obtained with the following field-strength values:*

Band	I	III	IV	V
dB(μV/m)	+47	+53	+62	+67

In arriving at these figures, receiver noise, cosmic noise, antenna gain and feeder loss have been taken into consideration.

These values are based on noise limits, giving satisfactory** quality of the received picture on an average receiver and antenna installation. In countries with high density of interference, the usable field-strength values will depend on interference and not on noise.

It should be stated that the values from CCIR Recommendation 417-3 are based on old measurements and it is believed that the noise figures of receivers have improved. This seems to be the reason for which several countries have reported a good service with much lower field strengths in the absence of interference and man-made noise.

* See Note 1 of CCIR Recommendation 417-3.

** Approximately grade 3 under CCIR Recommendation 500-3.

3.5 Maximum radiated power

The planning shall be based on the following maximum power limits (e.r.p.):

BAND	I	III	IV/V
max power (kW)	100	200	500

At the moment, existing stations, in conformity with the Geneva 1963 Plan, are exempt from this limitation. Other exemptions can be granted with the agreement of the affected administrations.

It should be noted that in accordance with No. 2666 of the Radio Regulations, powers in excess of those necessary to provide the required quality of national service should not be used.

3.6 Basic characteristics of transmitting and receiving antennas - Polarization

3.6.1 Transmitting antennas

Administrations shall be free to choose which polarizations are to be used in their countries*. Linear polarization, i.e. horizontal or vertical, is the mode of polarization to be used, in general, in Bands I, III and IV/V. Studies on the use of circular polarization have been recommended (see Recommendation 6).

Insofar as polarization discrimination is concerned, it is considered to be a useful tool to reduce interference in individual cases, for example, in international coordination procedures.

Polarization discrimination shall not be taken into account in the planning procedure except in specific cases with the agreement of the administrations concerned. In such cases a value of 16 dB for orthogonal polarization discrimination may be used.

Although each administration is free to choose the mode of polarization it uses, in general the horizontal mode is preferable.

It is desirable that only one mode of polarization be used for all TV transmissions emanating from a given transmitter site for the same band.

* For further information see CCIR Report 464.

It is desirable that orthogonal polarizations be used for main and fill-in stations, e.g. if the mode of polarization is horizontal at the main transmitting site, then vertical polarization should be used at the associated fill-in stations.

The radiation pattern of transmitting antennas should be taken into account in planning.

The maximum e.r.p and, in the case of directional antennas, the attenuation (dB) with respect to the maximum value of the effective radiated power shall be specified at 10° intervals in a clockwise direction starting at true north.

In the case of mixed polarization the maximum effective radiated powers and radiation patterns of the horizontally and vertically polarized components are to be specified separately.

3.6.2 Receiving antennas

Planning calculations shall be based on the use of a non-directional receiving antenna.

For special interference problems to be treated on an individual basis (i.e. bi- or multilaterally), the discrimination that can be obtained by the use of directional receiving antennas is given in Figure 3.6.

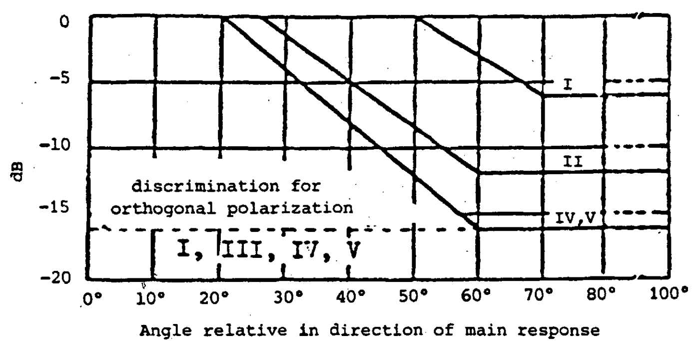


FIGURE 3.6

Discrimination obtained by the use of directional receiving antennas in broadcasting

(The number of the broadcasting band is shown on the curve)

Note 1 - It is considered that the discrimination shown will be available at the majority of antenna locations in built-up areas. At clear sites in open country, slightly higher values will be obtained.

Note 2 - The unbroken curves are valid when the wanted and the unwanted signals have the same linear polarization, whether horizontal or vertical.

3.7 Receiver characteristics

The values of the minimum usable field strength (see section 3.4) and the radio frequency protection ratios (see section 3.3) take into account receiver characteristics (sensitivity, selectivity, etc.).

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ANNEX 3.A

Non-precision offset

Figure 3.A.1 shows schematically the spectral lines of the television signal. The line structure of the picture signal is characterized by an accumulation of spectral lines around multiples of line frequency (f_{line}). An interfering signal will cause far more disturbance at these harmonic frequencies than at intermediate points where there are minima in the spectrum. Non-precision offset takes advantage of this line frequency structure of the video signal and, in particular, it is advantageous to offset the carriers by multiples of one-half or one-third of the line frequency.

The process of offsetting the unwanted transmitter frequency by one-half of line frequency (Figure 3.A.2), or by any odd multiple of this amount, allows its power to be increased by almost 20 dB without any increase in subjective impairment. In fact, half-line offset is only rarely used in practice because, in the rhombic structure of transmitter networks, any three transmitters form an almost equilateral triangle and only two of the three pairs of transmitters can work with a difference of one-half of line frequency; the third has to work in the non-controlled condition. It is therefore preferable, for planning purposes, to offset the frequencies by one-third of line frequency. A combination of offsets such as $0f_{line}$, $-1/3f_{line}$, $+1/3f_{line}$, will give the same protection ratio for all three pairs of transmitters and the protection ratio is only 2 to 3 dB worse than that obtained with half-line offset. The long-term stability of these favourable protection ratios can only be guaranteed, however, if the frequencies of the wanted and unwanted signals are kept constant within ±500 Hz.

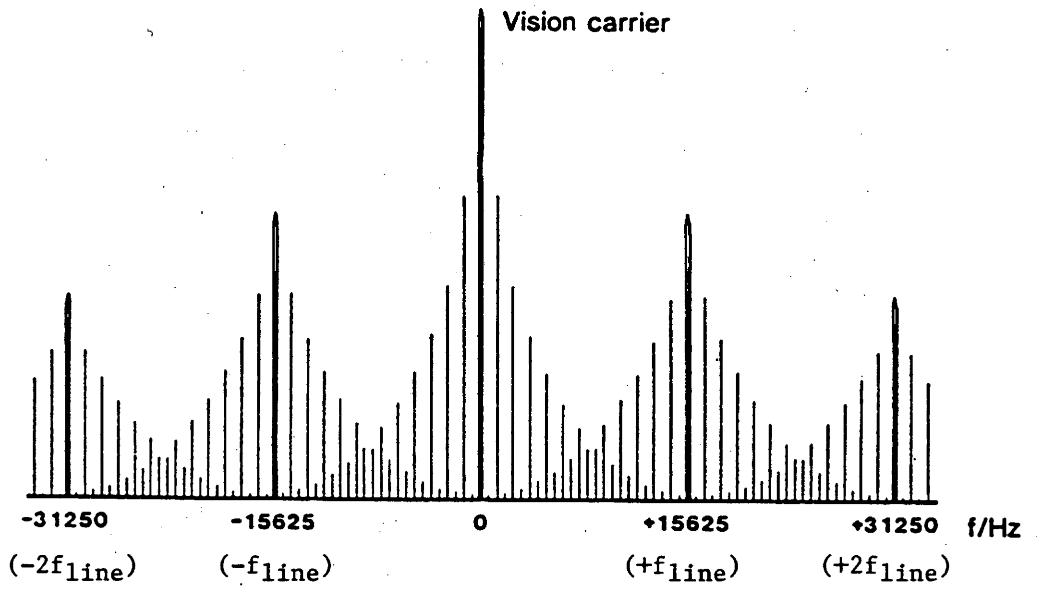

FIGURE 3.A.1

Television signal spectrum (625-line systems)

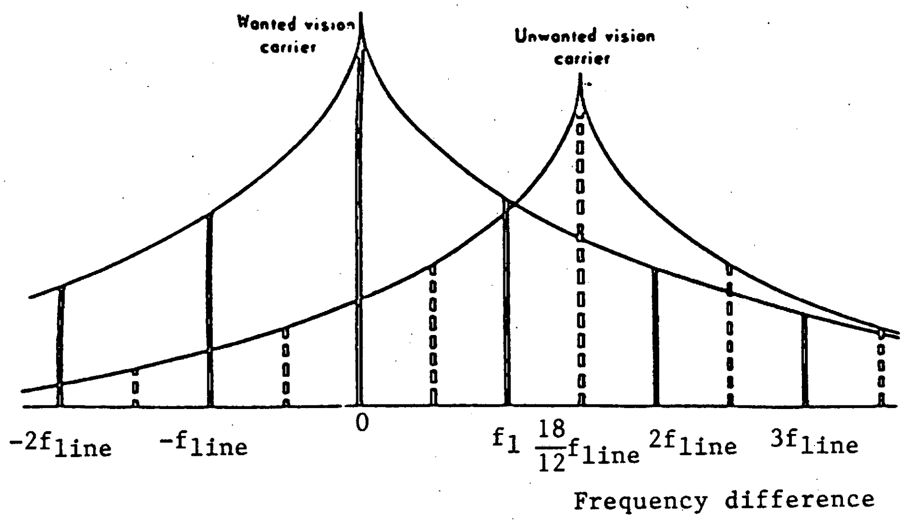

FIGURE 3.A.2

Optimum half-line offset

ANNEX 3.B

Simplified multiplication method for calculating usable field strengths

1. The concept of usable field strength

The usable field strength, E_u, is a quantity characterizing the coverage situation. To calculate the usable field strength, it is necessary to identify all the transmitters:

- which lie within a definite range of the wanted transmitter (according to experience: up to 800 km),
- which might cause interference in relation to the required protection ratio (A_i).

For the n interfering transmitters identified, the nuisance field, E_{si}, is:

$$E_{si} = P_i + E_{ni}(50,T) + A_i + B_i \qquad (1)$$

where

$E_{ni}(50,T)$: field strength in dB(μV/m) of the unwanted signal normalized to 1 kW effective radiated power (e.r.p.) at 50% locations for T% time (value derived from field strength curves of Recommendation 370);

P_i: e.r.p. in dB(kW) of the interfering transmitter;

A_i: protection ratio (dB);

B_i: receiving antenna discrimination (dB).

The usable field strength, E_u, is a function of the n nuisance fields, E_{si}, and is calculated by way of the formula:

$$P_C = \prod_{i=1}^{n} L(x_i) \text{ with } x_i = \frac{E_u - E_{si}}{\sigma_n \sqrt{2}} \qquad (2)$$

in which:

P_c: the coverage probability. To initiate the iterative calculation of E_u a predetermined value, P_{cp}, of the coverage probability is taken, e.g., $P_{cp} = 0.5$. With the value of E_u obtained at the end of the iterative process the coverage probability is $P_c = P_{cp} = 0.5$, i.e., 50% of locations.[1]

[1] P_c can be set to any other value of coverage probability (e.g. 45% $\rightarrow P_c = 0.45$).

L: the probability integral for a normal distribution:

$$L(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{x} [\exp(-t^2/2)]\, dt \qquad (3)$$

In this function x is the difference between the levels of the usable field-strength, E_u, and the nuisance field E_{si}, referred to σ, the standard deviation (with location) of the resulting difference in level.

Identical values are assumed for the standard deviations (with location) of the wanted and interfering field-strength levels: $\sigma_n = \sigma_s$. Thus, the standard deviation of the resulting level difference is:

$$\sigma = \sqrt{\sigma_n^2 + \sigma_s^2} = \sigma_n \sqrt{2}$$

The value σ_n = 8.3 dB is assumed for the frequency Bands I to III. For Band IV/V this value is dependent on the terrain attenuation, g. σ is then calculated using the formula σ_n = 9.5 + 0.405 g. The attenuation correction factor g (in dB) can be derived from Δn (see CCIR Recommendation 370).

2. Calculation of the probability integral

2.1 Tabular evaluation

The values of the probability integral in the form:

$$\varphi(x) = \frac{2}{\sqrt{2\pi}} \int_{0}^{x} [\exp(-t^2/2)]\, dt \qquad (4)$$

are given in Table I.

Since $$\frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\infty} [\exp(-t^2/2)]\, dt = 1$$

and $$\frac{1}{\sqrt{2\pi}} \int_{-\infty}^{0} [\exp(-t^2/2)]\, dt = 1/2$$

it follows that:

$$L(x) = \frac{\varphi(x)}{2} + 1/2$$

2.2 Evaluation using the Hastings approximation

If the calculations are to be done by computer (or programmable pocket or table calculator) the following rational approximation is very useful:

$$x \geq 0 : L(x) = 1. - \frac{1}{(2\pi)^{1/2}} e^{-x^2/2} H(y) \qquad (5)$$

$$x < 0 : L(x) = 1. - L(-x)$$

$$\text{with: } H(y) = C_5 y^5 + C_4 y^4 + C_3 y^3 + C_2 y^2 + C_1 y^1$$

$$\text{and: } y = \left[1. + 0.2316419|x|\right]^{-1}$$

$$C_5 = 1.330274429$$

$$C_4 = -1.821255978$$

$$C_3 = 1.781477937$$

$$C_2 = -0.356563782$$

$$C_1 = 0.319381530$$

By means of equation (5), one can avoid the integration in equation (3) and avoid using tables to evaluate the probability integral. The error involved by using this approximation is less than 10^{-7}.

3. Practical calculation procedures to determine the usable field strength

Since it is impossible to solve equation (2) explicitly for E_u for a predetermined value P_{cp} (e.g. P_{cp} = 0.5), it must be solved iteratively. We begin with an initial value for E_u, which, according to experience, should be some 6 dB greater than the largest of the E_{si}, and determine, successively, for each E_{si}:

$$z_i = E_u - E_{si} = \Delta_i$$

$$x_i = \frac{\Delta_i}{\sigma_n \sqrt{2}} \text{ (in Bands I to III: } x_i = \Delta_i/11.738)$$

$\varphi(x_i)$ from Table I

$$L(x_i) = \frac{\varphi(x_i)}{2} + \frac{1}{2}$$

Since for the standard deviation a value σ_n = 8.3 dB is assumed to apply for bands I to III, it seems appropriate to use Table II where $L(x_i)$ is presented as a function of Δ_i for σ_n = 8.3 dB. In Bands IV and V, where σ_n = 9.5 + 0.405 g, Table II may also be used once the Δ_i values have been corrected using:

$$\Delta_i' = \Delta_i \cdot \frac{8.3}{9.5 + 0.405\ g}$$

P_c is then determined by means of equation (2). If P_c is different from P_{cp} (e.g. P_{cp} = 0.5), the value obtained is used as a basis to correct, as a part of the iterative process, the initial E_u value. From experience, the correction may be assumed to correspond approximately to:

$$\Delta E_u \approx \frac{P_{cp} - P_c}{0.05} \text{ dB}$$

TABLE I

$$\varphi(x) = \frac{2}{\sqrt{2\pi}} \int_0^x [\exp(-t^2/2)]\, dt$$

x	$\varphi(x)$	x	$\varphi(x)$	x	$\varphi(x)$	x	$\varphi(x)$
0.00	0.0000	0.60	0.4515	1.20	0.7699	1.80	0.9281
01	0.0080	61	0.4581	21	0.7737	81	0.9297
02	0.0160	62	0.4647	22	0.7775	82	0.9312
03	0.0239	63	0.4713	23	0.7813	83	0.9328
04	0.0319	64	0.4778	24	0.7850	84	0.9342
0.05	0.0399	0.65	0.4843	1.25	0.7887	1.85	0.9357
06	0.0478	66	0.4907	26	0.7923	86	0.9371
07	0.0558	67	0.4971	27	0.7959	87	0.9385
08	0.0638	68	0.5035	28	0.7995	88	0.9399
09	0.0717	69	0.5098	29	0.8029	89	0.9412
0.10	0.0797	0.70	0.5161	1.30	0.8064	1.90	0.9426
11	0.0876	71	0.5223	31	0.8098	91	0.9439
12	0.0955	72	0.5285	32	0.8132	92	0.9451
13	0.1034	73	0.5346	33	0.8165	93	0.9464
14	0.1113	74	0.5407	34	0.8198	94	0.9476
0.15	0.1192	0.75	0.5467	1.35	0.8230	1.95	0.9488
16	0.1271	76	0.5527	36	0.8262	96	0.9500
17	0.1350	77	0.5587	37	0.8293	97	0.9512
18	0.1428	78	0.5646	38	0.8324	98	0.9523
19	0.1507	79	0.5705	39	0.8355	99	0.9534
0.20	0.1585	0.80	0.5763	1.40	0.8385	2.00	0.9545
21	0.1663	81	0.5821	41	0.8415	05	0.9596
22	0.1741	82	0.5878	42	0.8444	10	0.9643
23	0.1819	83	0.5935	43	0.8473	15	0.9684
24	0.1897	84	0.5991	44	0.8501	20	0.9722
0.25	0.1974	0.85	0.6047	1.45	0.8529	2.25	0.9756
26	0.2041	86	0.6102	46	0.8557	30	0.9786
27	0.2128	87	0.6157	47	0.8584	35	0.9812
28	0.2205	88	0.6211	48	0.8611	40	0.9836
29	0.2282	89	0.6265	49	0.8638	45	0.9857
0.30	0.2358	0.90	0.6319	1.50	0.8664	2.50	0.9876
31	0.2434	91	0.6372	51	0.8690	55	0.9892
32	0.2510	92	0.6424	52	0.8715	60	0.9907
33	0.2586	93	0.6476	53	0.8740	65	0.9920
34	0.2661	94	0.6528	54	0.8764	70	0.9931
0.35	0.2737	0.95	0.6579	1.55	0.8789	2.75	0.9940
36	0.2812	96	0.6629	56	0.8812	80	0.9949
37	0.2886	97	0.6680	57	0.8836	85	0.9956
38	0.2961	98	0.6729	58	0.8859	90	0.9963
39	0.3035	99	0.6778	59	0.8882	95	0.9968
0.40	0.3108	1.00	0.6827	1.60	0.8904	3.00	0.99730
41	0.3182	01	0.6875	61	0.8926	10	0.99806
42	0.3255	02	0.6923	62	0.8948	20	0.99863
43	0.3328	03	0.6970	63	0.8969	30	0.99903
44	0.3401	04	0.7017	64	0.8990	40	0.99933
0.45	0.3473	1.05	0.7063	1.65	0.9011	3.50	0.99953
46	0.3545	06	0.7109	66	0.9031	60	0.99968
47	0.3616	07	0.7154	67	0.9051	70	0.99978
48	0.3688	08	0.7199	68	0.9070	80	0.99986
49	0.3759	09	0.7243	69	0.9090	90	0.99990
0.50	0.3829	1.10	0.7287	1.70	0.9109	4.00	0.99994
51	0.3899	11	0.7330	71	0.9127		
52	0.3969	12	0.7373	72	0.9146	4.417	$1-10^{-5}$
53	0.4039	13	0.7415	73	0.9164		
54	0.4108	14	0.7457	74	0.9181	4.892	$1-10^{-6}$
0.55	0.4177	1.15	0.7499	1.75	0.9199	5.327	$1-10^{-7}$
56	0.4245	16	0.7540	76	0.9216		
57	0.4313	17	0.7580	77	0.9233		
58	0.4381	18	0.7620	78	0.9249		
59	0.4448	19	0.7660	79	0.9265		
0.60	0.4515	1.20	0.7699	1.80	0.9281		

TABLE II

Δ	L(x)	-logL(x)	Δ	L(x)	-logL(x)	Δ	L(x)	-logL(x)	Δ	L(x)	-logL(x)	Δ	L(x)	-logL(x)
.0	.50000	7.000	5.0	.66493	4.121	10.0	.80288	2.217	15.0	.89936	1.071	20.0	.95580	.457
.1	.50340	6.932	5.1	.66803	4.074	10.1	.80523	2.188	15.1	.90085	1.054	20.1	.95659	.448
.2	.50680	6.864	5.2	.67112	4.028	10.2	.80757	2.158	15.2	.90233	1.038	20.2	.95737	.440
.3	.51020	6.796	5.3	.67419	3.981	10.3	.80989	2.129	15.3	.90379	1.022	20.3	.95813	.432
.4	.51359	6.729	5.4	.67726	3.936	10.4	.81219	2.101	15.4	.90524	1.005	20.4	.95889	.424
.5	.51699	6.663	5.5	.68031	3.890	10.5	.81448	2.072	15.5	.90667	.989	20.5	.95964	.416
.6	.52038	6.596	5.6	.68335	3.845	10.6	.81675	2.044	15.6	.90808	.974	20.6	.96037	.408
.7	.52378	6.531	5.7	.68638	3.801	10.7	.81900	2.016	15.7	.90948	.958	20.7	.96109	.401
.8	.52717	6.466	5.8	.68939	3.756	10.8	.82124	1.989	15.8	.91086	.943	20.8	.96180	.393
.9	.53056	6.401	5.9	.69239	3.712	10.9	.82345	1.962	15.9	.91222	.928	20.9	.96251	.386
1.0	.53395	6.337	6.0	.69538	3.669	11.0	.82565	1.935	16.0	.91357	.913	21.0	.96320	.379
1.1	.53733	6.273	6.1	.69836	3.626	11.1	.82784	1.908	16.1	.91491	.898	21.1	.96388	.372
1.2	.54071	6.209	6.2	.70132	3.583	11.2	.83000	1.882	16.2	.91623	.884	21.2	.96455	.365
1.3	.54409	6.147	6.3	.70427	3.541	11.3	.83215	1.856	16.3	.91753	.869	21.3	.96521	.358
1.4	.54747	6.084	6.4	.70721	3.499	11.4	.83428	1.830	16.4	.91882	.855	21.4	.96586	.351
1.5	.55084	6.022	6.5	.71013	3.457	11.5	.83639	1.804	16.5	.92009	.841	21.5	.96650	.344
1.6	.55421	5.960	6.6	.71304	3.416	11.6	.83848	1.779	16.6	.92135	.827	21.6	.96713	.338
1.7	.55758	5.899	6.7	.71593	3.375	11.7	.84056	1.754	16.7	.92259	.814	21.7	.96775	.331
1.8	.56094	5.839	6.8	.71881	3.334	11.8	.84262	1.729	16.8	.92382	.800	21.8	.96836	.325
1.9	.56430	5.778	6.9	.72168	3.294	11.9	.84466	1.705	16.9	.92503	.787	21.9	.96896	.318
2.0	.56765	5.719	7.0	.72453	3.254	12.0	.84669	1.681	17.0	.92623	.774	22.0	.96955	.312
2.1	.57099	5.659	7.1	.72737	3.215	12.1	.84869	1.657	17.1	.92741	.761	22.1	.97013	.306
2.2	.57434	5.600	7.2	.73019	3.176	12.2	.85068	1.633	17.2	.92858	.748	22.2	.97071	.300
2.3	.57767	5.542	7.3	.73300	3.137	12.3	.85265	1.610	17.3	.92974	.736	22.3	.97127	.294
2.4	.58100	5.484	7.4	.73579	3.098	12.4	.85461	1.587	17.4	.93088	.723	22.4	.97183	.289
2.5	.58433	5.426	7.5	.73857	3.060	12.5	.85654	1.564	17.5	.93200	.711	22.5	.97237	.283
2.6	.58765	5.369	7.6	.74134	3.023	12.6	.85846	1.541	17.6	.93312	.699	22.6	.97291	.277
2.7	.59096	5.312	7.7	.74408	2.985	12.7	.86036	1.519	17.7	.93421	.687	22.7	.97344	.272
2.8	.59427	5.256	7.8	.74682	2.948	12.8	.86225	1.497	17.8	.93530	.676	22.8	.97396	.266
2.9	.59757	5.200	7.9	.74954	2.912	12.9	.86412	1.475	17.9	.93637	.664	22.9	.97447	.261
3.0	.60086	5.144	8.0	.75224	2.875	13.0	.86596	1.453	18.0	.93742	.653	23.0	.97497	.256
3.1	.60415	5.089	8.1	.75492	2.839	13.1	.86780	1.432	18.1	.93846	.641	23.1	.97546	.251
3.2	.60743	5.035	8.2	.75760	2.804	13.2	.86961	1.411	18.2	.93949	.630	23.2	.97595	.246
3.3	.61070	4.980	8.3	.76025	2.768	13.3	.87141	1.390	18.3	.94051	.619	23.3	.97643	.241
3.4	.61396	4.926	8.4	.76289	2.733	13.4	.87319	1.369	18.4	.94151	.609	23.4	.97690	.236
3.5	.61722	4.873	8.5	.76551	2.699	13.5	.87495	1.349	18.5	.94250	.598	23.5	.97736	.231
3.6	.62046	4.820	8.6	.76812	2.664	13.6	.87670	1.329	18.6	.94347	.588	23.6	.97781	.227
3.7	.62370	4.768	8.7	.77071	2.630	13.7	.87843	1.309	18.7	.94443	.577	23.7	.97826	.222
3.8	.62693	4.715	8.8	.77328	2.597	13.8	.88014	1.289	18.8	.94538	.567	23.8	.97870	.217
3.9	.63015	4.664	8.9	.77584	2.563	13.9	.88183	1.270	18.9	.94632	.557	23.9	.97913	.213
4.0	.63336	4.612	9.0	.77838	2.530	14.0	.88351	1.251	19.0	.94724	.547	24.0	.97956	.209
4.1	.63657	4.561	9.1	.78091	2.497	14.1	.88517	1.232	19.1	.94815	.538	24.1	.97997	.204
4.2	.63976	4.511	9.2	.78342	2.465	14.2	.88681	1.213	19.2	.94905	.528	24.2	.98038	.200
4.3	.64294	4.461	9.3	.78591	2.433	14.3	.88844	1.195	19.3	.94994	.519	24.3	.98078	.196
4.4	.64611	4.411	9.4	.78838	2.401	14.4	.89005	1.176	19.4	.95081	.509	24.4	.98118	.192
4.5	.64928	4.362	9.5	.79084	2.370	14.5	.89164	1.158	19.5	.95167	.500	24.5	.98157	.188
4.6	.65243	4.313	9.6	.79328	2.339	14.6	.89322	1.140	19.6	.95252	.491	24.6	.98195	.184
4.7	.65557	4.264	9.7	.79571	2.308	14.7	.89478	1.123	19.7	.95336	.482	24.7	.98232	.180
4.8	.65870	4.216	9.8	.79811	2.277	14.8	.89632	1.105	19.8	.95418	.474	24.8	.98269	.176
4.9	.66182	4.168	9.9	.80050	2.247	14.9	.89785	1.088	19.9	.95500	.465	24.9	.98305	.173

TABLE II (continued)

Δ	L(x)	-logL(x)	Δ	L(x)	-logL(x)	Δ	L(x)	-logL(x)	Δ	L(x)	-logL(x)	Δ	L(x)	-logL(x)
25.0	.98341	.169	30.0	.99470	.054	35.0	.99857	.014	40.0	.99967	.003	45.0	.99994	.001
25.1	.98376	.165	30.1	.99483	.052	35.1	.99861	.014	40.1	.99968	.003	45.1	.99994	.001
25.2	.98410	.162	30.2	.99496	.051	35.2	.99864	.014	40.2	.99969	.003	45.2	.99994	.001
25.3	.98443	.158	30.3	.99508	.050	35.3	.99868	.013	40.3	.99970	.003	45.3	.99994	.001
25.4	.98476	.155	30.4	.99520	.049	35.4	.99872	.013	40.4	.99971	.003	45.4	.99995	.001
25.5	.98509	.152	30.5	.99532	.047	35.5	.99875	.013	40.5	.99972	.003	45.5	.99995	.001
25.6	.98541	.148	30.6	.99543	.046	35.6	.99879	.012	40.6	.99973	.003	45.6	.99995	.001
25.7	.98572	.145	30.7	.99554	.045	35.7	.99882	.012	40.7	.99974	.003	45.7	.99995	.000
25.8	.98603	.142	30.8	.99565	.044	35.8	.99886	.012	40.8	.99975	.003	45.8	.99995	.000
25.9	.98633	.139	30.9	.99576	.043	35.9	.99889	.011	40.9	.99975	.002	45.9	.99995	.000
26.0	.98662	.136	31.0	.99587	.042	36.0	.99892	.011	41.0	.99976	.002	46.0	.99996	.000
26.1	.98691	.133	31.1	.99597	.041	36.1	.99895	.011	41.1	.99977	.002	46.1	.99996	.000
26.2	.98719	.130	31.2	.99607	.040	36.2	.99898	.010	41.2	.99978	.002	46.2	.99996	.000
26.3	.98747	.127	31.3	.99617	.039	36.3	.99901	.010	41.3	.99978	.002	46.3	.99996	.000
26.4	.98775	.125	31.4	.99626	.038	36.4	.99904	.010	41.4	.99979	.002	46.4	.99996	.000
26.5	.98802	.122	31.5	.99636	.037	36.5	.99906	.009	41.5	.99980	.002	46.5	.99996	.000
26.6	.98828	.119	31.6	.99645	.036	36.6	.99909	.009	41.6	.99980	.002	46.6	.99996	.000
26.7	.98854	.116	31.7	.99654	.035	36.7	.99912	.009	41.7	.99981	.002	46.7	.99997	.000
26.8	.98879	.114	31.8	.99663	.034	36.8	.99914	.009	41.8	.99982	.002	46.8	.99997	.000
26.9	.98904	.111	31.9	.99671	.033	36.9	.99917	.008	41.9	.99982	.002	46.9	.99997	.000
27.0	.98928	.109	32.0	.99680	.032	37.0	.99919	.008	42.0	.99983	.002	47.0	.99997	.000
27.1	.98952	.106	32.1	.99688	.032	37.1	.99921	.008	42.1	.99983	.002	47.1	.99997	.000
27.2	.98976	.104	32.2	.99696	.031	37.2	.99924	.008	42.2	.99984	.002	47.2	.99997	.000
27.3	.98999	.102	32.3	.99704	.030	37.3	.99926	.007	42.3	.99984	.002	47.3	.99997	.000
27.4	.99021	.099	32.4	.99711	.029	37.4	.99928	.007	42.4	.99985	.002	47.4	.99997	.000
27.5	.99043	.097	32.5	.99719	.028	37.5	.99930	.007	42.5	.99985	.001	47.5	.99997	.000
27.6	.99065	.095	32.6	.99726	.028	37.6	.99932	.007	42.6	.99986	.001	47.6	.99997	.000
27.7	.99086	.093	32.7	.99733	.027	37.7	.99934	.007	42.7	.99986	.001	47.7	.99998	.000
27.8	.99107	.091	32.8	.99740	.026	37.8	.99936	.006	42.8	.99987	.001	47.8	.99998	.000
27.9	.99127	.089	32.9	.99747	.026	37.9	.99938	.006	42.9	.99987	.001	47.9	.99998	.000
28.0	.99147	.087	33.0	.99753	.025	38.0	.99940	.006	43.0	.99988	.001	48.0	.99998	.000
28.1	.99167	.085	33.1	.99760	.024	38.1	.99941	.006	43.1	.99988	.001	48.1	.99998	.000
28.2	.99186	.083	33.2	.99766	.024	38.2	.99943	.006	32.2	.99988	.001	48.2	.99998	.000
28.3	.99205	.081	33.3	.99772	.023	38.3	.99945	.006	43.3	.99989	.001	48.3	.99998	.000
28.4	.99223	.079	33.4	.99778	.022	38.4	.99946	.005	43.4	.99989	.001	48.4	.99998	.000
28.5	.99241	.077	33.5	.99784	.022	38.5	.99948	.005	43.5	.99989	.001	48.5	.99998	.000
28.6	.99259	.075	33.6	.99790	.021	38.6	.99950	.005	43.6	.99990	.001	48.6	.99998	.000
28.7	.99276	.073	33.7	.99795	.021	38.7	.99951	.005	43.7	.99990	.001	48.7	.99998	.000
28.8	.99293	.072	33.8	.99801	.020	38.8	.99953	.005	43.8	.99990	.001	48.8	.99998	.000
28.9	.99309	.070	33.9	.99806	.020	38.9	.99954	.005	43.9	.99991	.001	48.9	.99998	.000
29.0	.99326	.068	34.0	.99811	.019	39.0	.99955	.005	44.0	.99991	.001	49.0	.99999	.000
29.1	.99341	.067	34.1	.99816	.019	39.1	.99957	.004	44.1	.99991	.001	49.1	.99999	.000
29.2	.99357	.065	34.2	.99821	.018	39.2	.99958	.004	44.2	.99992	.001	49.2	.99999	.000
29.3	.99372	.064	34.3	.99826	.018	39.3	.99959	.004	44.3	.99992	.001	49.3	.99999	.000
29.4	.99387	.062	34.4	.99831	.017	39.4	.99961	.004	44.4	.99992	.001	49.4	.99999	.000
29.5	.99402	.061	34.5	.99835	.017	39.5	.99962	.004	44.5	.99992	.001	49.5	.99999	.000
29.6	.99416	.059	34.6	.99840	.016	39.6	.99963	.004	44.6	.99993	.001	49.6	.99999	.000
29.7	.99430	.058	34.7	.99844	.016	39.7	.99964	.004	44.7	.99993	.001	49.7	.99999	.000
29.8	.99444	.056	34.8	.99849	.015	39.8	.99965	.004	44.8	.99993	.001	49.8	.99999	.000
29.9	.99457	.055	34.9	.99853	.015	39.9	.99966	.003	44.9	.99993	.001	49.9	.99999	.000

Then the determination of E_u has to be continued by repeating, with the corrected E_u, the calculation of new Δ_i and $L(x_i)$ for each E_{si} and of a new P_c. This procedure has to be carried out until the correction ΔE_u is falling below the accuracy limit. Table III gives an example for the iterative determination of E_u in the presence of five nuisance fields (σ_n = 8.3 dB). The values of $L(x_i)$ are taken from Table II.

TABLE III

Approximation:		1		2		3	
		E_u = 78 dB		E_u = 76.6 dB		E_u = 76.44 dB	
i	E_{si} (dB)	z_i(dB)	$L(x_i)$	z_i(dB)	$L(x_i)$	z_i(dB)	$L(x_i)$
1	64	14	0.8835	12.6	0.8585	12.44	0.8554
2	72	6	0.6954	4.6	0.6524	4.44	0.6474
3	60	18	0.9374	16.6	0.9214	16.44	0.9193
4	50	28	0.9915	26.6	0.9883	26.44	0.9878
5	45	33	0.9975	31.6	0.9964	31.44	0.9963
	P_c		0.5696		0.5082		0.5010
	ΔE_u(dB)		≈ -1.4		≈ -0.16		≈ -0.02

The result of the iterative computation is E_u = 76.42 dB.

The need to carry out numerous multiplications using at least four-digit numbers suggests a further simplification of the method consisting in substituting the $L(x_i)$ by the logarithms of their reciprocal value. This would reduce the computation work to a summation of the -log $L(x_i)$ values. To facilitate the computation of ΔE_u further it is appropriate to select a base for these logarithms such that ΔE_u is immediately apparent from a comparison of the sum with -log P_{cp} (logarithm to the same base), e.g. -log 0.5 (50%).

For convenience, the logarithms of $-L(x_i)$ are included in Table II. As an example these logarithms are used in Table IV. The underlying interference problem is identical in Tables III and IV and so are the results.

TABLE IV

Approximation:		1		2		3	
		E_u = 78 dB		E_u = 76.7 dB		E_u = 76.45 dB	
i	E_{si} (dB)	z_i(dB)	-log $L(x_i)$	z_i(dB)	-log $L(x_i)$	z_i(dB)	-log $L(x_i)$
1	64	14	1.251	12.7	1.519	12.45	1.575
2	72	6	3.669	4.7	4.264	4.45	4.386
3	60	18	0.653	16.7	0.814	16.45	0.848
4	50	28	0.087	26.7	0.116	26.45	0.123
5	45	33	0.025	31.7	0.035	31.45	0.037
-	-log P_c -log 0.5 [1]		5.685 -7.000		6.748 -7.000		6.969 -7.000
	Δ E_u(dB)		≈-1.3		≈-0.25		≈-0.03

1 for P_{cp} = 0.5; for other values of P_{cp}:
-log P_{cp} = (-7 $\log_{10}$ P_{cp})/$\log_{10}$ 2; e.g. for P_{cp} = 0.45: -log P_{cp} = 8.064

The result of the iterative computation is E_u = 76.42 dB.

CHAPTER 4 - COMPATIBILITY WITH OTHER SERVICES

4.1 Bands or services used on a shared basis

The First Session of the Conference found that in the shared band 790 - 862 MHz, the primary services to which it is allocated in the planning area enjoy equal rights.

4.2 Sharing possibilities

Studies on the possibilities for sharing between the different services having equal rights to the same band have been conducted by the CCIR. Three possible sharing methods were contemplated:

- time sharing: use of the same frequency band by different services at different times;
- band splitting: simultaneous use of different parts of the shared bands by different services;
- geographical sharing: simultaneous use of the same parts of the shared bands by different services, but in separate geographical areas.

The practical situation often consists in a combination of band splitting and geographical sharing.

In some countries, a number of TV channels are allocated to another service. For the countries concerned, sharing is effected by using band splitting; for the other countries by geographical sharing.

Although sharing might improve the spectrum utilization, it certainly reduces the flexibility for the further development of the broadcasting service. The addition of new broadcasting stations and the reassignment of channels to existing stations or the introduction of new systems will become more difficult or even impossible, the more extensively the band is shared.

4.3 Sharing criteria

For determining interference, the following sharing criteria have to be established:

- field strength to protect the television broadcasting service against fixed and mobile services;
- protection ratios;
- assessment of multiple interference;
- receiving antenna discrimination;
- propagation model.

4.3.1 Protection from fixed and mobile services

Assessments of interference to the vision and sound channels should be made for several reception locations within the service area of the television transmitter. These locations should be those which would seem to be most likely to suffer interference. These locations depend on the actual situation. In some cases, the reception locations of rebroadcast stations at relatively exposed sites may be the most critical. In other cases, areas with low field strength are more critical.

If the actual critical locations are unknown, then a higher standard of protection may be required.

The criteria depend on the service against which protection is required. Appropriate criteria are not yet available for all cases.

4.3.1.1 Field strength to protect the television broadcasting service against fixed and mobile services

Taking into account that in Region 1 the band 790 - 862 MHz and in Region 3 Bands I, III, IV and V are allocated on a shared basis, the First Session of the Conference adopted the following minimum figures of field strengths to protect the television broadcasting service from fixed and mobile services:

46 dB(μV/m)	Band I
49 dB(μV/m)	Band III
53 dB(μV/m)	Band IV
58 dB(μV/m)	Band V.

In practice, the minimum values of field strength adopted for TV/TV planning (see Chapter 3) are not always achieved. In many cases viewers are using improved antennas and pre-amplifiers to obtain an acceptable picture. In such instances, it would be desirable, or even essential, to seek protection for lower values, the level being determined by the available field strength of the wanted signal and the degree of protection against interference already afforded. With respect to these requirements for protection, the values as given above could be envisaged on a provisional basis. Studies to recommend final values are in progress (see Recommendation 4).

4.3.1.2 Protection ratios

Protection ratios appropriate to tropospheric and continuous propagation are given in Chapter 3.

The protection ratios against interference from a CW or frequency-modulated signal with non-controlled frequency, are valid in the case of sharing. If the fixed or mobile service is amplitude-modulated the protection ratio has to be increased by 4 dB.

4.3.1.3 Assessment of multiple interference

The simplified multiplication method described in Chapter 3 is used for the assessment of multiple interference. It is not known whether this method is appropriate for the calculation when large numbers of fixed or mobile stations capable of causing interference to a TV service are involved.

4.3.1.4 Receiving antenna discrimination

The antenna discrimination curves given in Chapter 3 apply to all types of unwanted signals, including transmissions by fixed, base and mobile stations. The protection shown to be obtained from orthogonal polarization discrimination can also be expected to apply to fixed and base stations. This advantage might be expected to be significantly reduced in the case of mobile stations and might be disregarded in the planning calculations.

4.3.1.5 Propagation model

Although Chapter 2 contains some information on propagation with respect to the fixed and mobile services, no complete propagation model for use in sharing studies has been established for the fixed or mobile services. Recommendation 4 addresses this problem to the CCIR with the request that studies be completed in time to provide the necessary sharing information to the Second Session.

4.3.2 Protection of the fixed and mobile services from broadcasting services

At the time of the First Session, no definite criteria had been established. Recommendation 4 addresses this problem to the CCIR with the request that studies be completed in time to provide the necessary sharing information to the Second Session. The relevant propagation model with respect to broadcast transmissions is contained in Chapter 2.

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CHAPTER 5 - PLANNING PRINCIPLES AND METHODS IN THE FREQUENCY BANDS TO BE PLANNED

5.1 Planning principles

5.1.1 The Plan to be established by the Second Session of the Conference is intended to replace the Plan annexed to the Agreement of Geneva 1963 insofar as the African Broadcasting Area is concerned. It shall contain existing assignments and planned assignments to stations in the African Broadcasting Area and in the following countries: ARS, BHR, IRN, IRQ, KWT, OMA, QAT, UAE.

Note 1 - The Administration of Saudi Arabia initiated the procedure for accession to the Stockholm Agreement, 1961, with respect to the part of its territory situated in the European Broadcasting Area. Should the procedure result in its accession to the above Agreement, the planning area for ARS will be limited to the part of its territory which is not situated in the European Broadcasting Area.

5.1.2 The planning process shall take account of existing assignments to stations in the planning area.

5.1.3 The existing assignments are:

- assignments in conformity with the Geneva 1963 Agreement notified to the IFRB by 31 October 1987*;
- assignments to stations in the planned area notified by 31 October 1987 to the IFRB by countries not parties to the Geneva 1963 Agreement;
- assignments of the fixed service in the band 790 - 862 MHz to stations in countries which have decided to use this band or part of it exclusively for the fixed service, and which are notified to the IFRB by 31 October 1987.

5.1.4 Assignments in conformity with the Geneva 1963 Agreement not notified to the IFRB by 31 October 1987, as well as any assignment to a broadcasting station notified after that date, shall be treated as new requirements.

* This date is intended to enable countries parties to the Geneva 1963 Agreement to apply the procedure of Article 3 of the Agreement with a view to bringing in to conformity with the Agreement their assignments in operation which do not conform (i.e., assignments operating with characteristics different from those appearing in the Plan or assignments not appearing in the Plan).

5.1.5 The planning shall guarantee to administrations equitable access to television broadcasting by securing the same number of national equivalent coverages for each country.

5.1.6 For planning purposes, a minimum number of channels should be used for each national coverage.

5.1.7 In planning their television stations, administrations shall, in application of No. 2666 of the Radio Regulations, endeavour to minimize the part of the coverage area overlapping territories of other countries.

5.1.8 In the planning process, account shall not be taken of low-power assignments. Existing low-power assignments shall be taken into account only if the stations are within a coordination distance and if they are modified in such a way as to be rendered compatible with the assignments already in the Plan and with No. 2666 of the Radio Regulations. Once the Plan is adopted, planned low-power stations may be entered in the Plan after appropriate coordination.

5.1.9 In accordance with Resolution No. 509 of WARC-1979, in the planning process, account shall be taken of assignments in conformity with the Stockholm Agreement, 1961, as of 31 October 1987.

Note 2 - See Note 1; should the Administration of Saudi Arabia accede to the Stockholm Agreement, its assignments to stations in the European Broadcasting Area shall be taken into account from the date of accession, if this date is after 31 October 1987.

5.2 Planning methods

5.2.1 Bands to be planned

a) The Plan to be established by the second session shall contain assignments to television broadcasting stations in the following bands:

- 47 - 68 MHz (in Botswana, Burundi, Lesotho, Malawi, Namibia, Rwanda, South Africa, Swaziland, Zaire, Zambia and Zimbabwe, the Plan shall be limited to 54 - 68 MHz) (see paragraphs c) and e) below);
- 174 - 230 MHz (see paragraph b) below);
- 470 - 790 MHz;
- 790 - 862 MHz (see planning principles 5.1.3 and 5.1.4 and paragraphs d) and e) below);

b) the Plan should also contain assignments to broadcasting stations in the bands indicated in No. 635 of the Radio Regulations for the countries listed therein under the conditions specified for the protection of the other services to which these bands are allocated. The planning of these bands assumes that the agenda of the second session will refer to them;*

* The Administration of Zimbabwe indicated its intention to request a competent administrative radio conference with a view to adding its name to No. 635 of the Radio Regulations.

c) in accordance with No. 561 of the Radio Regulations, the band 54 - 68 MHz is allocated in Zambia to the broadcasting, fixed and mobile services, except the aeronautical mobile service, on a primary basis. This Administration indicated its decision to use this band for the fixed service;

d) the band 790 - 862 MHz is allocated in Region 1 to the fixed and broadcasting services on a primary basis. The Administrations of Saudi Arabia, Bahrain and Oman indicated their decision to use this band exclusively for the fixed service. The Administration of Mozambique also indicated its decision to use part of this band for the fixed service*. In Spain, the band 830 - 862 MHz is used exclusively by the fixed and mobile services (except the aeronautical mobile service); for the latter service account will be taken of No. 697 of the Radio Regulations. Countries with broadcasting service assignments in the Plan in the band 790 - 862 MHz may use these assignments for the fixed service under conditions to be specified by the second session of the Conference;

e) when assigning frequencies to their stations in areas bordering the countries listed in paragraphs c) and d) above, administrations are requested to avoid making assignments that may be incompatible with these services.

* The Administration of Mozambique requires protection, in the planning process of Band V (790 - 862 MHz), of its frequency assignments indicated below. Additional particulars of these frequency assignments shall be submitted to the IFRB in time to be considered in the second session of this Conference.

Assigned Frequency (MHz)	Station (RX)	Geographical Coordinate	
811.46	Quelimane	36°E 54'	17°S 52'
826.46	Quelimane	36°E 54'	17°S 52'
834.22	Tete	33°E 40'	16°S 11'
838.34	Massinga	35°E 23'	23°S 19'
838.34	Quelimane	36°E 54'	17°S 52'
845.58	Tete	33°E 40'	16°S 11'
850.70	Massinga	35°E 23'	23°S 19'

Bandwidth: 1.35 MHz for each frequency carrier.

Administrations shall take into account the band 806 - 960 MHz used by the Administration of Mozambique for the primary fixed service, avoiding mutual interference.

5.2.2 Planning method for the band 470 - 862 MHz

5.2.2.1 Planning of the band 470 - 862 MHz shall be based on the use of the theoretical lattice method as described below.

5.2.2.2 The IFRB shall prepare an irregular lattice that takes account of the different propagation criteria adopted by the Conference. This lattice will be drawn starting from propagation Zones 1, 2 and 3 in Figure 2.35. The rhombics will be derived from the theoretical lattice used by the Regional Administrative Conference for the Planning of VHF Sound Broadcasting (Region 1 and part of Region 3), Geneva, 1984. The length of rhombic side will be 320 km (corresponding to two-thirds of lengths used by the Geneva 1984 Conference). The rhombics for the remaining parts of the planned area shall be derived for each zone from the propagation criteria adopted for it on the basis of a standard e.r.p. of 500 kW and an antenna height of 300 m (see note).

5.2.2.3 The IFRB shall develop for each rhombic the channel distribution to be used based on 8 MHz channel separation.

5.2.2.4 Using this lattice, administrations should select the appropriate frequencies to be assigned to their existing and planned stations.

5.2.2.5 The administrations shall then communicate to the IFRB their requirements so identified, together with the existing low-power stations within the coordination distance calculated in accordance with Annex 5.A.

5.2.2.6 The IFRB shall prepare a first draft Plan as follows:

a) as a first step, the channels will be assigned to stations without taking into account the existing low-power stations;

b) when the examination indicates an incompatibility between an existing and a planned station, the IFRB shall select an alternative compatible channel for the planned station and include it provisionally in the draft Plan pending acceptance by the administration concerned;

c) if such an alternative channel could not be found, the IFRB shall determine the appropriate changes to the technical characteristics of the planned stations, propose them to the administration concerned and enter them provisionally in the draft Plan;

d) only existing low-power stations which are within a coordination distance from the border of a neighbouring country will be considered;

e) the low-power stations will be examined to assess their compatibility with the assignments already in the draft Plan and shall be entered in the draft Plan if they are compatible;

f) if they are not compatible their frequency shall be modified with a view to obtaining compatibility;

g) if it is not possible to achieve this compatibility, they will be indicated as being subject to further coordination.

5.2.2.7 Administrations shall communicate to the IFRB the adjustments to the requirements already communicated in accordance with section 5.2.2.5 above, that they consider necessary in order to improve the Plan.

5.2.2.8 The IFRB shall prepare a new draft Plan to be communicated to administrations before the second session of the Conference, for consideration by the latter.

Note - The following table is given as an example for calculation of the rhombic size. It is based on an antenna height of 300 m.

ERP (kW) / Propagation zones	Rhombic sizes (km)		
	100	500	1000
1	320	350	385
2	235	295	320
3	260	305	340

5.2.3 Planning of band 174 - 230 MHz

5.2.3.1 The planning of the band 174 - 230 MHz shall be based on a channel spacing of 7 or 8 MHz, as selected by each country.

5.2.3.2 For planning purposes, the planning area will be subdivided into two sub-areas:

- sub-area A covering the countries of:

  South Africa, Angola, Botswana, Burundi, Congo, France, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Rwanda, Swaziland, Tanzania, Zambia and Zimbabwe,

- sub-area B covering the rest of the planning area.

5.2.3.3 Planning method for sub-area A

5.2.3.3.1 In the countries of sub-area A, the channel spacing will be 8 MHz. However, the Administrations of Zambia and Mauritius reserve their right to use a channel spacing of 7 MHz.

5.2.3.3.2 Administrations will define their requirements without using a theoretical lattice method.

5.2.3.3.3 Planning will consist in protecting the existing assignments and including the planned assignments in the Plan when they are compatible with these existing assignments. However, it may be necessary to evaluate the equitable use of this band in the border areas by indicating the approximate number of assignments possible for each; this can be done by means of a theoretical lattice that takes account of the different channel spacing used.

5.2.3.3.4 See 5.2.2.6.

5.2.3.3.5 See 5.2.2.7.

5.2.3.3.6 See 5.2.2.8.

5.2.3.4 Planning method for sub-area B

5.2.3.4.1 In the countries of sub-area B, the channel spacing will be 7 or 8 MHz, as selected by each administration.

5.2.3.4.2 Despite the extensive use of the band 174 - 230 MHz in the planned area and the fact that a standard channel separation in this band would compel a larger number of countries to modify the frequencies assigned to their stations, it is considered appropriate to use a theoretical lattice planning method in this band [1,2,3].

1 It should be noted that countries overlapping the two broadcasting areas and those having densely developed networks may encounter difficulties changing the frequencies of some of their existing stations.

2 Since Egypt is partly in the European and partly in the African Broadcasting Area, since it now has about 200 TV transmitters, nearly all of which are new, together with a standby system using the same coaxial equipment and the same antenna system and since many TV receivers use only Bands I and III, it may be difficult, if not impossible, to change the frequency.

3 Since the Administration of the Kingdom of Morocco uses a standard B which differs slightly from the standard B customarily employed in the part of the European Broadcasting Area concerned, it is obliged to keep the same standard for the part of its territory which is situated in the African Broadcasting Area.

Any difficulties arising from this situation shall be resolved by means of coordination with the countries concerned, as in the case of that part of the Moroccan territory which is situated in the European Broadcasting Area.

5.2.3.4.3 The IFRB shall prepare an irregular lattice that takes account of the different propagation criteria adopted by the Conference. This lattice for sub-area B will be drawn starting from propagation Zones 1, 2, and 3 in Figure 2.35 where the rhombuses will be those used by the Regional Administrative Conference for the Planning of VHF Sound Broadcasting (Region 1 and part of Region 3) Geneva, 1984. The rhombus side length will be 480 km. The rhombuses for the remaining parts of the planned area shall be derived for each Zone from the propagation criteria adopted for it on the basis of a standard e.r.p. of 500 kW and an antenna height of 300 m.

5.2.3.4.4 The IFRB shall develop for each rhombus two channel distributions; one based on an 8 MHz channel separation, and another based on 7 MHz.

5.2.3.4.5 Using these lattices, administrations should select the appropriate frequencies to be assigned to their existing and planned stations.

5.2.3.4.6 See 5.2.2.5.

5.2.3.4.7 See 5.2.2.6.

5.2.3.4.8 See 5.2.2.7.

5.2.3.4.9 See 5.2.2.8.

5.2.4 Planning method in the band 47 - 68 MHz

5.2.4.1 The planning of the band 47 - 68 MHz shall be based on a channel spacing of 7 or 8 MHz, as selected by each administration, without overlapping the adjacent bands not allocated to the broadcasting service.

5.2.4.2 In view of the small number of channels available, it is not considered appropriate to use a theoretical lattice planning method in this band.

5.2.4.3 The IFRB shall identify the incompatibilities between stations and propose for consideration by the second session any possible modification that can eliminate such incompatibilities.

5.3 Frequency planning constraints and measures for reducing them

5.3.1 Introduction

In order to ensure effective planning of terrestrial TV broadcasting services in the frequency ranges 47 - 68 MHz (Band I), 174 - 230 MHz (Band III) and 470 - 862 MHz (Band IV/V), it may be necessary to take into account certain constraints on the use of frequencies in order to avoid interference to other TV broadcast transmissions and to ensure compatibility with other broadcast services, e.g., the sound broadcasting service in the frequency range 87.5 - 108 MHz.

This section identifies the constraints that may result from the technical limitations of receiver design and also from the transmission of several TV and VHF/FM sound broadcast programmes from the same site or from non-co-sited transmissions with overlapping service areas. Co-channel, adjacent-channel and image channel transmissions are dealt with in Chapter 3.

No account is taken of interference resulting from radiation of harmonics or intermodulation products at transmitter sites, on the assumption that the broadcaster can take the necessary precautions to reduce such spurious radiation to acceptable levels.

It should be noted that these constraints refer to uniform channel spacing for the whole planning area. In the case of non-co-sited transmitters using different systems and/or different channel spacings with overlapping coverage areas, a detailed case-by-case investigation is necessary.

5.3.2 Constraints introduced by TV broadcast receivers

5.3.2.1 TV receiver local oscillator radiation

In view of the possibility of interference resulting from the use of superheterodyne receivers, the use of certain channel combinations is precluded. Receiver local oscillators operate at frequencies of 32.7 MHz below and between 38.9 and 40.2 MHz above the vision carrier of the wanted signal for systems used in Africa. Hence, if the channel separation is 7 and 8 MHz and channel N is used by one service, the choice of channel N+5 (N-4 for intermediate frequency of 32.7 MHz) for a neighbouring service would result in interference from local oscillators in receivers which are tuned to channel N.

Additionally, with such a difference in channel numbers, there is a risk of interference caused by an intermediate frequency beat.

In practice, these problems are gradually diminishing with improved receiver technology.

Radiation from TV receivers in the range 47 - 68 MHz may affect VHF/FM reception. This may occur when the TV local oscillator frequency lies near the carrier frequency of a VHF/FM transmission (see CCIR Report 946).

5.3.2.2. Image channel

Image channel interference occurs when transmissions are separated by about twice the intermediate frequency. The image channel affecting receivers tuned to channel N would be N+9 for systems G, H, I, and N-9, N+9 and N+10 for system K1.

Although the improved image channel rejection characteristics of modern receivers mitigate the problem, rejection is not complete and this situation should be avoided in preparing the frequency Plan. Image channel interference causes no problem in Bands I and III.

5.3.3 General considerations

The following constraints may be noted, although they cannot be generally taken into account when preparing frequency plans:

- harmonics from VHF/FM receiver local oscillators;
- harmonics and intermodulation products generated under overload conditions in receivers;
- transmitting antenna system limitations.

Note - For more details, see CCIR Report 1086.

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ANNEX 5.A

Coordination distance for the consideration of low-power stations

TABLE I*

Coordination distance (km) for the consideration of low-power stations

Band	Effective radiated power (W)	Effective antenna height (m)																	
		75						300						1200					
		Zones						Zones						Zones					
		1	2	3	4	A	B	1	2	3	4	A	B	1	2	3	4	A	B
	100	270	180	210	550	900	700	310	210	260	600	1000	770	380	270	330	680	>1000	830
	30	220	150	170	450	700	550	260	180	220	480	770	600	330	240	300	570	830	680
I	10	170	130	130	350	550	450	210	160	180	390	600	480	280	220	270	460	680	570
	3	130	110	110	270	450	350	160	140	150	320	480	380	240	190	240	380	570	460
	1	100	90	90	210	350	270	130	120	120	260	390	320	210	170	210	320	460	380
	300	260	170	190	510	840	650	290	200	250	560	900	710	360	270	320	640	970	780
	100	210	140	150	420	650	510	240	170	210	460	710	560	320	240	280	530	780	640
III	30	160	120	125	330	510	420	180	150	170	370	560	460	270	210	250	440	640	530
	10	120	100	100	260	420	330	150	130	140	300	460	370	230	190	225	360	530	440
	3	90	80	75	190	330	260	120	110	115	240	370	300	190	170	200	300	440	360
	1	60	60	60	130	260	190	90	90	90	180	300	240	160	150	175	250	360	300
	500	110	110	120	800	>1000	900	160	140	160	800	>1000	900	220	200	220	800	>1000	900
	300	100	100	110	750	1000	870	150	130	150	750	1000	870	200	190	210	750	1000	870
	100	80	80	80	650	870	750	125	110	125	650	870	750	180	170	180	650	870	750
IV/V	30	60	60	60	550	750	650	100	95	100	550	750	650	160	150	160	550	750	650
	10	45	45	45	450	650	550	80	80	80	450	650	550	140	130	140	450	650	550
	3	35	35	35	375	550	450	65	65	65	375	550	450	120	115	120	375	550	450
	1	25	25	25	300	450	375	50	50	50	300	450	375	100	100	100	300	450	375

* For geographical areas encompassing more than one propagation zone, linear interpolation shall be used to calculate the appropriate coordination distance.

TABLE IIa*

Band	Effective radiated power (W)	Zones			
		C**	C1		
			Effective antenna height (m)		
			75	300	1200
III	300	>1000	730	745	780
	100	890	550	565	600
	30	650	405	420	460
	10	540	330	345	385
	3	440	265	280	315
	1	360	210	225	260

TABLE IIb*

Band	Effective radiated power (W)	Zones		
		C**	C1**	
			a)	b)
IV/V	500	>1000	330	1000
	300	>1000	320	900
	100	>1000	280	750
	30	1000	240	620
	10	750	200	500
	3	550	170	400
	1	400	140	300

* For geographical areas encompassing more than one propagation zone, linear interpolation shall be used to calculate the appropriate coordination distance.

** Independent of effective antenna height.

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CHAPTER 6 - FREQUENCY REQUIREMENTS FROM ADMINISTRATIONS AND INTERSESSIONAL WORK

6.1 Frequency requirements

6.1.1 Method to be used by administrations in submitting their requirements to the IFRB in Bands I, III, IV and V

When submitting their frequency requirements, administrations shall provide the IFRB with the following essential characteristics:

1. Administration's serial number
2. Vision carrier frequency (MHz) (channel)
3. Vision carrier offset
4. Sound carrier offset
5. Symbol designating the administration submitting the requirements
6. Name of the transmitting station
7. Symbol designating the country or geographical area in which the station is located (see Table 1 of the Preface to the International Frequency List)
8. Geographical coordinates of the transmitting antenna site (degrees and minutes)
9. Height of the transmitting antenna site above sea level (m)
10. Height of the antenna above ground level (m)
11. Polarization
12. Maximum value of effective radiated power (dBW) of the horizontal polarization component of the vision carrier
13. Maximum value of effective radiated power (dBW) of the vertical polarization component of the vision carrier
14. Total vision/sound carrier power ratio
15. Maximum effective antenna height (m)
16. Effective antenna height (m) in different azimuths, every 30°
17. Attenuation (dB) with respect to the maximum value of effective radiated power of the horizontal component in different azimuths, every 10°
18. Attenuation (dB) with respect to the maximum value of effective radiated power of the vertical component in different azimuths, every 10°
19. Colour system
20. TV system
21. Channel spacing for Bands I and III

6.1.2 Requirements file and date of submission of requirements

Administrations shall be requested to indicate their relquirements in writing in response to a circular-letter which the IFRB shall send them before 1 June 1987. A requirements file will be established and will comprise:

a) The requirements submitted by administrations with the characteristics given in section 6.1.1.

b) For administrations which fail to submit their requirements by the deadline of 1 February 1988, the assignments contained in the Master International Frequency Register (MIFR) and in the Geneva Plan, 1963. These data shall be identified by the IFRB.

c) For administrations which fail to submit their requirements and have no assignments in the MIFR or in the Geneva Plan, 1963, the data resulting from the application of the planning methods by the IFRB for those administrations; the deadline fixed for the submission of requirements is 1 February 1988.

6.2 Intersessional work

6.2.1 Processing of requirements by the IFRB

After receipt, the requirements will be validated and entered in the requirements file used as a basis for the draft Plan.

When the requirements correspond to an assignment which has been notified to the IFRB in accordance with the Radio Regulations or in conformity with the Geneva Plan, 1963, the status of this assignment will be entered in the publication of the requirements file with different symbols (MIFR or GE63). The assignments in service in the Stockholm Plan (1961) of countries neighbouring the planning area or in conformity with that Plan will be taken into account up to 31 October 1987.

6.2.2 Dispatch of the requirements file

The IFRB shall send to each administration in duplicate, as soon as possible and not later than 1 May 1988, a printed list of its requirements.

Administrations shall check the characteristics of their stations and shall communicate to the IFRB not later than 1 August 1988 any material errors they may have detected.

The IFRB shall check these corrections and draw up the final requirements file.

The IFRB shall decide on the form in which to publish the requirements file (microfiche or printed lists) according to the volume of requirements submitted and shall send it to the administrations on 1 November 1988.

6.2.3 Development of the software for preparation of the draft Plan

This will be the most important and complex intersessional activity. It may be summarized in simplified form by the following stages:

6.2.3.1 Study and preparation of the architecture of the global system according to the characteristics of the requirements, the planning approach(es) adopted by the First Session and the planning constraints.

6.2.3.2 Software for input, validation and publication of the requirements file.

6.2.3.3 Development of the lattices for the planning methods with positioning of the theoretical networks on a sphere.

6.2.3.4 Development of the software for the nine propagation Zones.

6.2.3.5 Development of the software to find alternative frequencies for planned stations and low-power stations.

6.2.3.6 Study of the conditions for sharing with services other than television broadcasting.

6.2.3.7 Design, development and testing of the software for preparation of the draft Plan.

6.2.3.8 Software to take account of multiple interference.

6.2.3.9 Software to take account of the requirements of countries which have submitted no requirements.

6.2.3.10 Software to establish the reference situation.

6.2.3.11 Software for publication of the calculation results.

6.2.4 Calculation of results - draft Plan

On the basis of the requirements file, the IFRB shall prepare the first draft Plan and send the results to administrations by 1 February 1989 at the latest. The requirements file and first draft Plan may be supplied to administrations on magnetic tape on request.

After examining the results of the first draft Plan, administrations may modify their requirements with a view to reducing interference and shall send the IFRB any modifications made by 1 June 1989 at the latest.

On the basis of the modifications received, the IFRB shall prepare a second draft Plan, which shall be sent to administrations by 1 August 1989 at the latest.

6.3 Assistance to be provided by the IFRB

(See Resolution 2.)

6.4 Timetable of intersessional work

ACTIVITY	ACTION	DATE
1. End of First Session	-	October 1986
2. IFRB sends circular-letter requesting administrations to submit their requirements	IFRB	1 June 1987
3. Deadline for submission of requirements to IFRB by administrations	ADM.	1 February 1988
4. Input and validation of requirements by IFRB. Publication and dispatch of requirements file	IFRB	1 May 1988
5. Submission of corrections of material errors in the requirements file by administrations	ADM.	1 August 1988
6. Publication of requirements file and dispatch to administrations	IFRB	1 November 1988
7. First draft Plan prepared by IFRB and sent to administrations	IFRB	1 February 1989
8. Dispatch of modifications to requirements to improve the first draft Plan	ADM.	1 June 1989
9. Second draft Plan prepared by IFRB and sent to administrations	IFRB	1 August 1989
10. Second Session of the Conference	-	Oct./Nov. 1989

RESOLUTION No. 1

Report of the First Session

The Regional Administrative Conference for the Planning of VHF/UHF Television Broadcasting in the African Broadcasting Area and Neighbouring Countries (First Session, Nairobi, 1986),

considering

the terms of reference assigned to it by Administrative Council Resolution No. 914, as amended by the Council at its 41st session,

resolves

to approve the Report of this session of the Conference,

instructs

1. the Chairman of this session of the Conference to transmit under his signature the Report of the First Session to the Second Session of the Conference;

2. the Secretary-General to transmit this Report to all Members of the Union.

RESOLUTION No. 2

Assistance to be Provided by the IFRB to the Administrations of the Planning Area in the Intersessional Period

The Regional Administrative Conference for the Planning of VHF/UHF Television Broadcasting in the African Broadcasting Area and Neighbouring Countries (First Session, Nairobi, 1986),

considering

a) the Report of the First Session of the Conference to the Second Session;

b) in particular, the intersessional work programme of Chapter 6 of this Report;

c) that the administrations of the planning area might require special assistance;

d) No. 999, Article 10, of the Radio Regulations concerning assistance to be given by the IFRB to administrations with regard to the use of the frequency spectrum, and particularly to administrations requiring special assistance;

e) No. 1003, Article 10, of the Radio Regulations concerning the role of the IFRB in the preparation and organization of radio conferences;

f) that the Administrative Council, in its Resolution No. 914 (amended at its 41st session) containing the agenda of the First Session of the Conference, invited the IFRB to provide technical assistance in the preparation of this Conference,

resolves to invite the IFRB

to provide its assistance during the intersessional period to administrations requesting it,

recommends administrations

wishing to obtain the assistance of the IFRB to supply the necessary information relating to their request.

RECOMMENDATION No. 1

Draft Agenda of the Second Session of the Conference

The Regional Administrative Conference for the Planning of VHF/UHF Television Broadcasting in the African Broadcasting Area and Neighbouring Countries (First Session, Nairobi, 1986),

considering

a) Resolution No. 1 of the Plenipotentiary Conference (Nairobi, 1982) relating to future conferences of the Union;

b) Resolution No. 509 of WARC-1979 on the convening of a regional conference to review and revise the provisions of the existing VHF/UHF Television Broadcasting Plan (Geneva, 1963) for the African Broadcasting Area, taking into account the assignments contained in the Stockholm Plan, 1961;

c) that under the programme of conferences and meetings for 1988 and 1989, as revised and adopted by the Administrative Council at its 41st session, the Second Session should be held during the second half of 1989;

d) that the agenda for the First Session contained in Administrative Council Resolution No. 914, as amended at its 41st session, provides for the establishment by the First Session of a draft agenda for the Second Session of the Conference, to be submitted to the Administrative Council;

e) that the Second Session will need to consider:

1. the proposals from administrations;
2. the Report of the First Session to the Second Session;
3. the result of the preparatory work carried out by the permanent organs of the Union in the intersessional period on the basis of the decisions of the First Session;
4. the relevant reports from the IFRB and the CCIR resulting from their studies and planning exercises performed in accordance with the Report of the First Session to the Second Session;
5. the requirement for frequency assignments to be submitted by administrations;
6. the provisions relating to the other services sharing the same frequency band(s) with the broadcasting services in the planning area,

recognizing

a) that the planning of VHF/UHF Television Broadcasting in the planning area should take account of uses of already existing and planned assignments to stations in the bordering areas and should consider the relevant propagation data applicable in those areas;

b) that the planning processes should also take into account the frequency assignments which are in conformity with the Stockholm Agreement, 1961 (see Resolution No. 509 of WARC-1979),

recognizing further

a) that the VHF/UHF bands for planning television broadcasting are shared with other services by allocations shown in the Table of Frequency Allocation (Article 8 of the Radio Regulations);

b) that the rights of other primary and permitted services allocated in accordance with the above-mentioned table shall be taken into account,

noting

the wish expressed by the countries listed in No. 635 of the Radio Regulations to plan the frequency bands indicated therein,

recommends to the Administrative Council

1. to consider, by taking into account the foregoing considering, recognizing, recognizing further and noting paragraphs, the following draft agenda for the Second Session which shall:

1.1 to draw up an Agreement, according to the principles and methods established by the First Session, which shall include regulatory procedures, technical data and standards, together with an associated frequency assignment Plan for use by television broadcasting in the planning area for the following VHF/UHF frequency bands:

47 - 68 MHz

(54 - 68 MHz) for Botswana, Burundi, Lesotho, Malawi, Namibia, Rwanda, South Africa, Swaziland, Zaire, Zambia and Zimbabwe

174 - 230 MHz

470 - 790 MHz; 790 - 862 MHz (see paragraph 1.4 below)

1.2 to review and revise, as necessary, the relevant propagation data to be used in the planning areas, taking account of the CCIR report prepared in accordance with Recommendation No. 3 of the First Session;

1.3 to establish regulatory procedures pertaining to the sharing of the above bands between broadcasting and other services to which these bands are also allocated;

1.4 to establish the provisions which would define the conditions under which frequency assignments included in the Plan for the broadcasting service may be used by the administrations concerned for the fixed service in the band 790 - 862 MHz;

1.5 to include in the Plan the assignments to television stations in the bands 230 - 238 MHz and 246 - 254 MHz in the countries listed in No. 635 of the Radio Regulations, subject to the application of the procedure of Article 14 of the Radio Regulations for the other services to which the above-mentioned bands are allocated;

2. to envisage a duration of three weeks for the Second Session of the Conference.

RECOMMENDATION No. 2

Convening of a Regional Administrative Conference of the Members of the Union in the African Broadcasting Area to Abrogate the Regional Agreement for the African Broadcasting Area (Geneva, 1963)

The Regional Administrative Conference for the Planning of VHF/UHF Television Broadcasting in the African Broadcasting Area and Neighbouring Countries (First Session, Nairobi, 1986),

considering

a) that the Second Session of the Conference shall draw up an Agreement and associated frequency Plan for use by television broadcasting in the African Broadcasting Area and neighbouring countries in the VHF/UHF frequency bands;

b) that from the date of entry into force of the Agreement and associated frequency Plan referred to in a) above, there would be incompatibilities between the latter Agreement and Plan and the Regional Agreement (Geneva, 1963) and that it is accordingly intended to abrogate the Regional Agreement (Geneva, 1963) and to replace it by the Agreement and associated frequency Plan referred to in a) above;

c) that Article 7 of the Regional Agreement (Geneva, 1963) stipulates that no revision of the Agreement shall be undertaken except by an "administrative conference of the Members of the Union in the African Broadcasting Area convened in accordance with the procedure laid down in the International Telecommunication Convention";

d) that certain parts of the Regional Agreement (Geneva, 1963) relating to the VHF/FM sound broadcasting stations have already been abrogated in the Geneva 1985 Regional Agreement adopted by the Members of the Union in the African Broadcasting Area;

e) that, under the programme of conferences and meetings for 1988 and 1989 as revised and adopted by the Administrative Council at its 41st Session, the Second Session of this Conference should be held during the second half of 1989,

recommends to the Administrative Council

to take the necessary measures for convening during the third week of the Second Session of the Regional Administrative Conference for the Planning of VHF/UHF Television Broadcasting in the African Broadcasting Area and Neighbouring Countries, a regional administrative conference of the Members of the Union in the African Broadcasting Area, for an expected duration of two days with the following agenda:

> "to abrogate the parts of the Regional Agreement for the African Broadcasting Area (Geneva, 1963) which are still in force and relate to television broadcasting".

RECOMMENDATION No. 3

Need for Certain Propagation Studies Relevant to the Use of the VHF/UHF Bands in the Planning Area

The Regional Administrative Conference for the Planning of VHF/UHF Television Broadcasting in the African Broadcasting Area and Neighbouring Countries (First Session, Nairobi, 1986),

considering

a) that in Resolution No. 509 the World Administrative Radio Conference, Geneva, 1979, requested the CCIR to carry out the necessary technical studies for this Conference;

b) that the CCIR accordingly produced a report on the technical bases that included, inter alia, a chapter on propagation, and that this chapter has been adopted subject to the need to obtain further information on the subjects referred to below;

c) that the World Administrative Radio Conference, Geneva, 1979, likewise adopted Resolution No. 5 and Recommendation No. 68 dealing respectively with technical cooperation with the developing countries in the study of propagation in tropical areas, and with the study and prediction of radio propagation and radio noise;

d) that the XVIth CCIR Plenary Assembly, Dubrovnik, 1986, adopted Resolution 79-1 dealing, inter alia, with the need to encourage scientists and engineers from developing countries to carry out studies at first hand on propagation topics;

e) that further information is felt to be required on propagation in the planning area, relating in particular to ducting propagation in all areas thought to be specially prone to this phenomenon;

f) that for the whole planning area, the data indicating that radio propagation characteristics over land and over sea are identical under certain circumstances need to be verified,

invites the CCIR

1. to undertake, as a matter of urgency, further studies of propagation and radiometeorological conditions relevant to the planning area as defined by this Conference;

2. to continue studying propagation over land and over sea in the VHF and UHF bands, using data that become available;

3. to submit, at least six months before the Second Session of the Conference, a further report on the results of these studies for its consideration,

instructs the Secretary-General

to take the necessary steps to expand the ongoing measurement campaigns in the parts of the planning area where insufficient data are available as well as to integrate them, particularly those pertaining to broadcasting, in collaboration with the administrations concerned as well as with regional organizations,

requests

the administrations of developed and developing countries as well as recognized private operating and scientific agencies and industrial organizations to take an active part in and assist the measurement campaign(s) on propagation being undertaken by the Union,

recommends that the administrations of countries in the planning area

collaborate within the framework of the CCIR as a matter of urgency and within the limits of their capabilities, by sending the CCIR contributions relating to the aforementioned activities,

requests the Second Session of the Conference

to review the relevant paragraphs and figures in the Report to the Second Session in the light of this further CCIR report and also to consider the advisability, for planning purposes, of establishing separate curves for propagation conditions in the planning area.

RECOMMENDATION NO. 4

Continuation of Studies on Sharing Criteria for Services Using the Band 790 - 862 MHz in the Planning Area

The Regional Administrative Conference for the Planning of VHF/UHF Television Broadcasting in the African Broadcasting Area and Neighbouring Countries (First Session, Nairobi, 1986),

considering

a) that in the planning area the band 790 - 862 MHz is allocated on primary basis:

- to the broadcasting and fixed services in Region 1;
- to the broadcasting, fixed and mobile services in Region 3;

b) that more accurate data are required in order to confirm the values provisionally proposed in Chapter 4 of this Report;

c) that the World Administrative Radio Conference (Geneva, 1979), in its Resolution No. 509, invited the CCIR to carry out the necessary technical studies related to the present Conference;

d) that the Administrative Council, in its Resolution No. 914 (amended) establishing the agenda for this Conference, invited the CCIR to prepare a report on the necessary technical bases;

e) that the CCIR, in response to those requests, has drawn up a report on the technical bases, which includes a chapter on compatibility with other services, and has recognized that the studies to determine definitive values of sharing criteria between the broadcasting service and the other services are being undertaken,

recommends that administrations

cooperate urgently within the framework of the CCIR, and to the fullest extent possible, by submitting contributions on the above-mentioned subject, taking account of the CCIR working schedule,

invites the CCIR

1. to continue its studies on sharing criteria for services using the band 790 - 862 MHz in the planning area;

2. to submit a new report on this subject on the basis of those studies at least six months before the Second Session of the Conference;

3. to carry out these studies as part of the regular work of its Study Groups,

<u>and requests the Second Session of the Conference</u>

to reconsider the relevant parts of Chapter 4 of the Report to the Second Session in the light of data provided by administrations and the new CCIR Report and, if necessary, to contemplate modifying the values proposed in that Chapter.

RECOMMENDATION No. 5

Geographical Division of the Planning Area into Propagation Zones

The Regional Administrative Conference for the Planning of VHF/UHF Television Broadcasting in the African Broadcasting Area and Neighbouring Countries (First Session, Nairobi, 1986),

considering

a) that, in its Resolution No. 509, the World Administrative Radio Conference, Geneva, 1979, requested the CCIR to carry out the necessary technical studies for the present Conference;

b) that, in its Resolution No. 914 (amended) setting out the agenda of the present Conference, the Administrative Council invited the CCIR to prepare a report on the necessary technical bases;

c) that, in response to those requests, the CCIR drew up a report on the technical bases including, *inter alia*, a chapter on propagation containing a map showing a geographical division of Africa and the surrounding seas into propagation zones;

d) that the XVIth CCIR Plenary Assembly, Dubrovnik, 1986, adopted Resolution 95 dealing with the participation by the developing countries in the work of the CCIR;

e) that this Conference decided to extend this map to cover the whole planning area,

noting

that the division of the planning area into propagation zones might be improved on the basis of new data,

recommends that the administrations

collaborate urgently within the framework of the CCIR, and to the fullest extent possible, by submitting contributions on the above subject, taking account of the CCIR working schedule,

invites the CCIR

1. to pursue its studies for the geographical division of the planning area into propagation zones in close collaboration with the administrations concerned;

2. to prepare, on the basis of those studies, a new report on the subject for the Second Session of the Conference;

3. to carry out those studies as part of the regular work of its Study Groups, and complete its work at least six months before the start of the Second Session,

<u>requests the Second Session of the Conference</u>

to re-examine Figure 2.35 of Chapter 2 of the Report to the Second Session in the light of the data supplied by the administrations and the new CCIR report and to consider modifying the separations proposed in that Figure, wherever necessary.

RECOMMENDATION No. 6

Use of Circular Polarization for Television Broadcasting

The Regional Administrative Conference for the Planning of VHF/UHF Television Broadcasting in the African Broadcasting Area and Neighbouring Countries (First Session, Nairobi, 1986),

considering

a) that transmissions using circular polarization are already in use and are being implemented to an increasing extent in some countries as a means of improving television reception, particularly for portable television receivers and in areas subject to multipath propagation;

b) that the technique is well established in some countries for VHF sound broadcasting as a means of improving reception on portable receivers, including those housed in vehicles, by reducing multipath effects (see CCIR Report 464);

c) that, for the same effective radiated power of the horizontal and vertical components, the interference potential of circularly polarized transmissions is expected to be no greater than that of linearly polarized transmissions, either vertical or horizontal;

d) that further technical information is needed on the advantages and disadvantages of using circular polarization for television broadcasting,

noting

that the Plan to be prepared by the Second Session of the Conference based on the emission and propagation of linearly polarized waves need take no special account of the use of circular polarization,

recognizing

that in implementing an assignment in the Plan, administrations may use circular polarization at their own discretion, provided that there is no increase of interference to assignments of other countries included in the Plan,

invites the CCIR

1. to study, particularly from the standpoint of protection against interference, the technical characteristics and effectiveness of circularly polarized emissions in various conditions of use for television broadcasting, to determine the advantages and disadvantages and to deduce the relevant discrimination factors. So far as possible, these studies should be carried out as part of the regular work programme of the CCIR, without incurring additional expenses for the ITU;

2. to report the results of these studies to the Second Session of the Conference.

RECOMMENDATION No. 7

Place of the Second Session

The Regional Administrative Conference for the Planning of VHF/UHF Television Broadcasting in the African Broadcasting Area and Neighbouring Countries (First Session, Nairobi, 1986),

considering

a) Resolution No. 3 of the Plenipotentiary Conference (Nairobi, 1982) relating to invitations to hold conferences or meetings away from Geneva;

b) the substantial advantages to be derived from holding the Second Session in the planning area;

c) the importance of active participation by all countries of the Region;

d) that a draft Plan is to be established by the IFRB in the intersessional period, thus considerably facilitating the work of the Second Session;

recommends to administrations

that one of the administrations of the planning area should issue an invitation to hold the Second Session in its country;

requests the Secretary-General

to transmit this Recommendation to the administrations of the planning area as soon as possible so as to receive their reply before the 42nd session of the Administrative Council (1987), and to seek ways and means of enabling the Conference to be held in one of the planning area countries.

LIST OF ITU MEMBER COUNTRIES WHICH PARTICIPATED IN THE FIRST SESSION

(in the alphabetical order of the French version of the country names)

Algeria (People's Democratic Republic of)
Angola (People's Republic of)
Saudi Arabia (Kingdom of)
Bahrain (State of)
Benin (People's Republic of)
Botswana (Republic of)
Burkina Faso
Burundi (Republic of)
Cameroon (Republic of)
Comoros (Islamic Federal Republic of the)
Congo (People's Republic of the)
Djibouti (Republic of)
Côte d'Ivoire (Republic of)
Egypt (Arab Republic of)
United Arab Emirates
Spain
Ethiopia
France
Gabonese Republic
Ghana
Guinea (Republic of)
Equatorial Guinea (Republic of)
Iraq (Republic of)
Kenya (Republic of)
Kuwait (State of)
Lesotho (Kingdom of)
Liberia (Republic of)
Madagascar (Democratic Republic of)
Malawi
Mali (Republic of)
Morocco (Kingdom of)
Mauritius
Mauritania (Islamic Republic of)
Mozambique (People's Republic of)
Niger (Republic of the)
Nigeria (Federal Republic of)
Oman (Sultanate of)
Uganda (Republic of)
Qatar (State of)
Rwandese Republic
Senegal (Republic of)
Somali Democratic Republic
Swaziland (Kingdom of)
Tanzania (United Republic of)
Togolese Republic
Zaire (Republic of)
Zambia (Republic of)
Zimbabwe (Republic of)