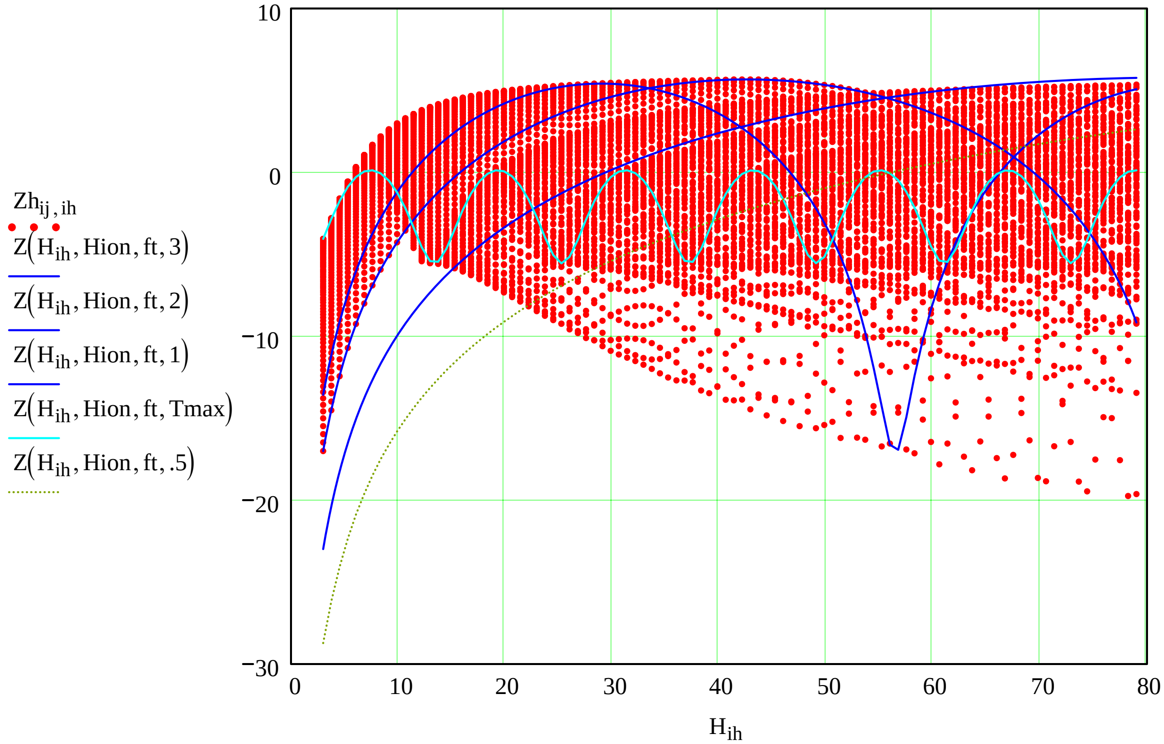
$IH := 100 \qquad ih := 0 .. IH - 1 \qquad ij := 0 .. IH - 1 \qquad Hmax := 79$

$$H_{ih} := hrms + \frac{ih}{IH - 1} \cdot (Hmax - hrms)$$

$Tmin := 2$

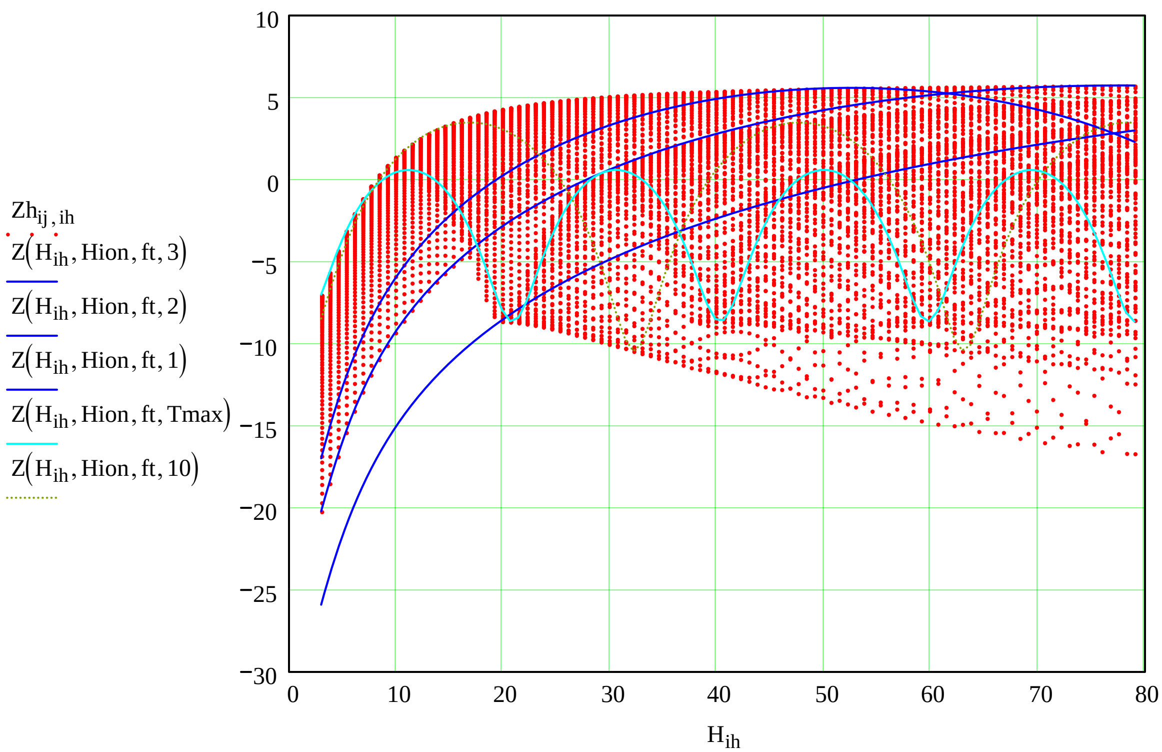
$ft := 52 \qquad Tmax := 14 \qquad to_{ij} := Tmin + \frac{ij}{IH - 1} \cdot (Tmax - 1)$

$$Zh_{ij,ih} := Z\left(H_{ih}, Hion, ft, to_{ij}\right)$$




6m band

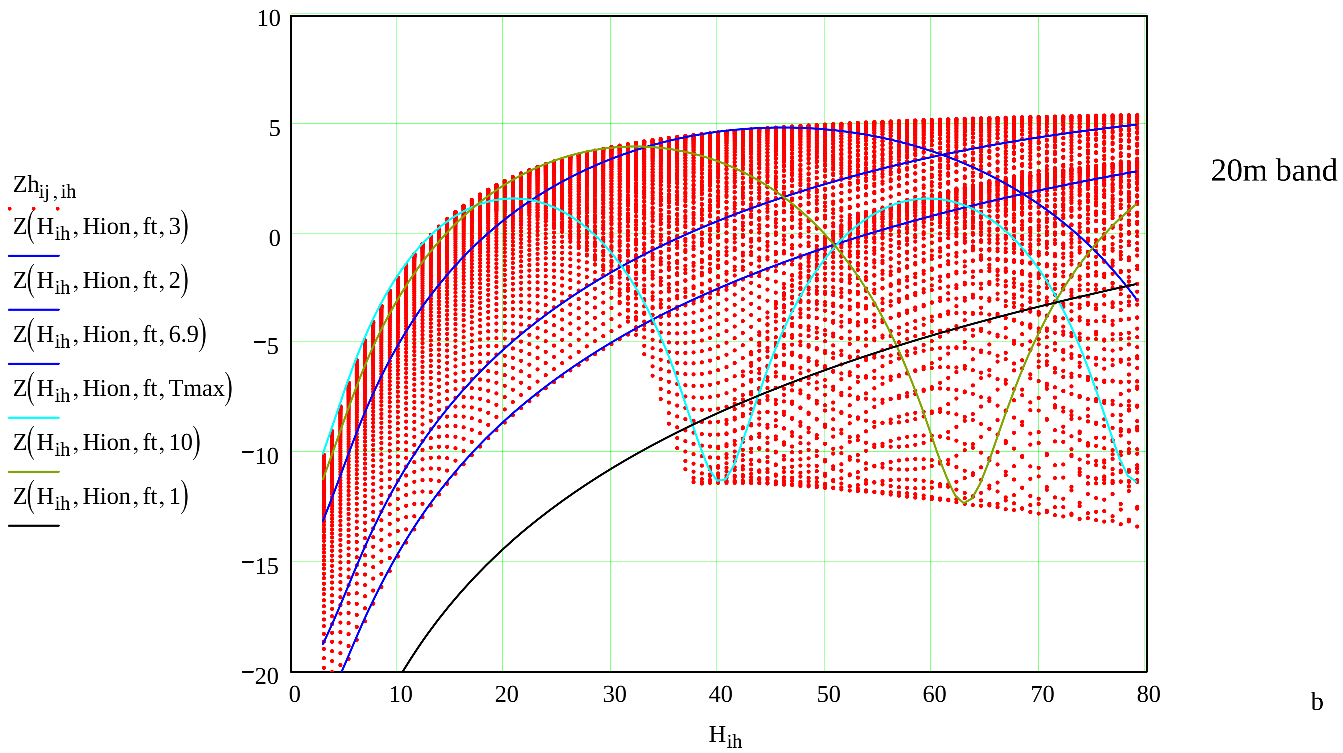
$ft := 28 \qquad Tmax := 16 \qquad Tmin := 2 \qquad to_{ij} := Tmin + \frac{ij}{IH - 1} \cdot (Tmax - 1) \qquad Zh_{ij,ih} := Z\left(H_{ih}, Hion, ft, to_{ij}\right)$




10m band

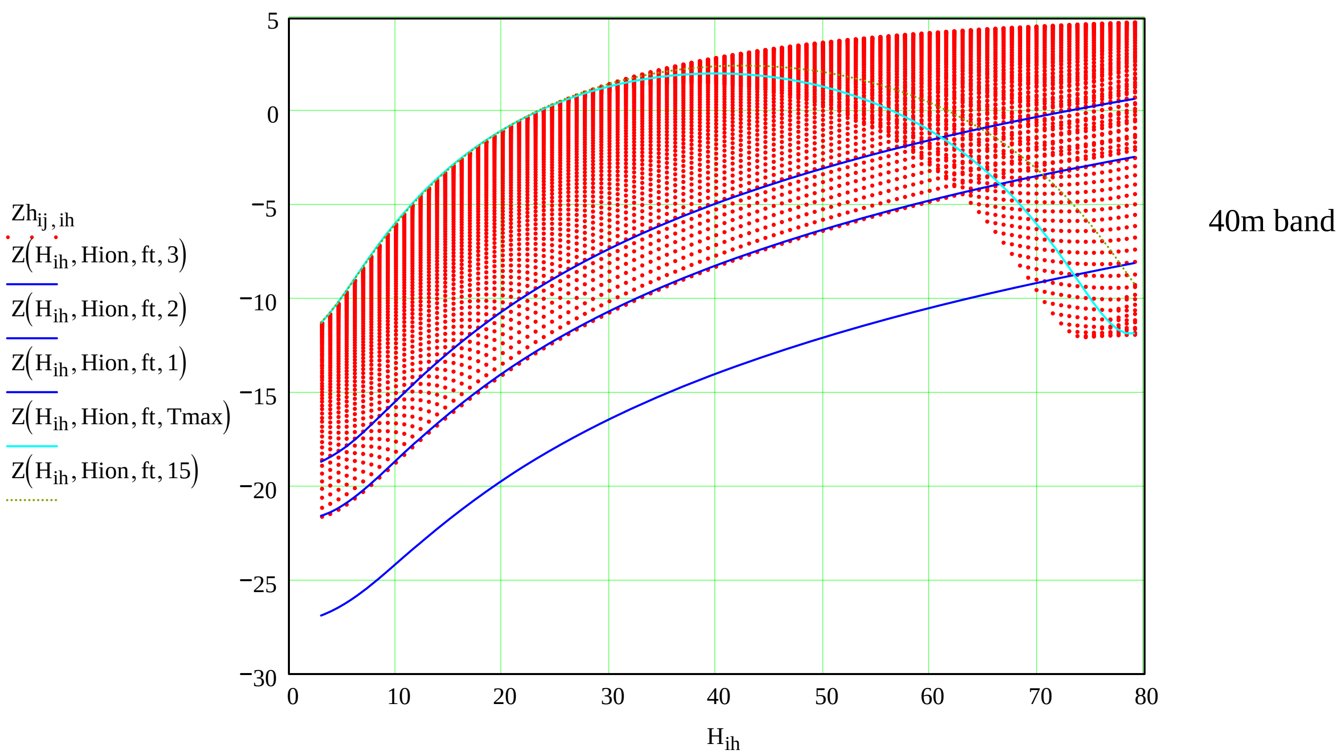
$Tmin := 2$

$ft := 14$ $\quad Tmax := 16$ $\quad to_{ij} := Tmin + \frac{ij}{IH - 1} \cdot (Tmax - 1)$ $\quad Zh_{ij, ih} := Z(H_{ih}, Hion, ft, to_{ij})$



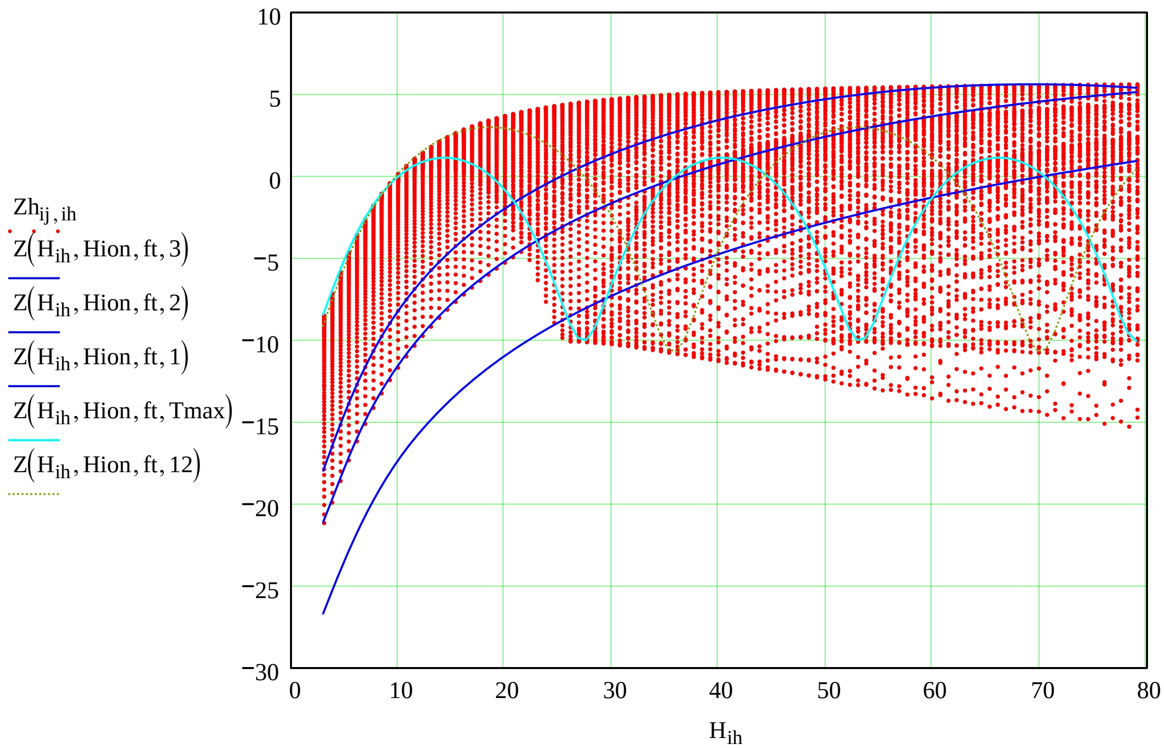

$Tmin := 2$

$ft := 7$ $\quad Tmax := 16$ $\quad to_{ij} := Tmin + \frac{ij}{IH - 1} \cdot (Tmax - 1)$ $\quad Zh_{ij, ih} := Z(H_{ih}, Hion, ft, to_{ij})$



$Tmin := 2$

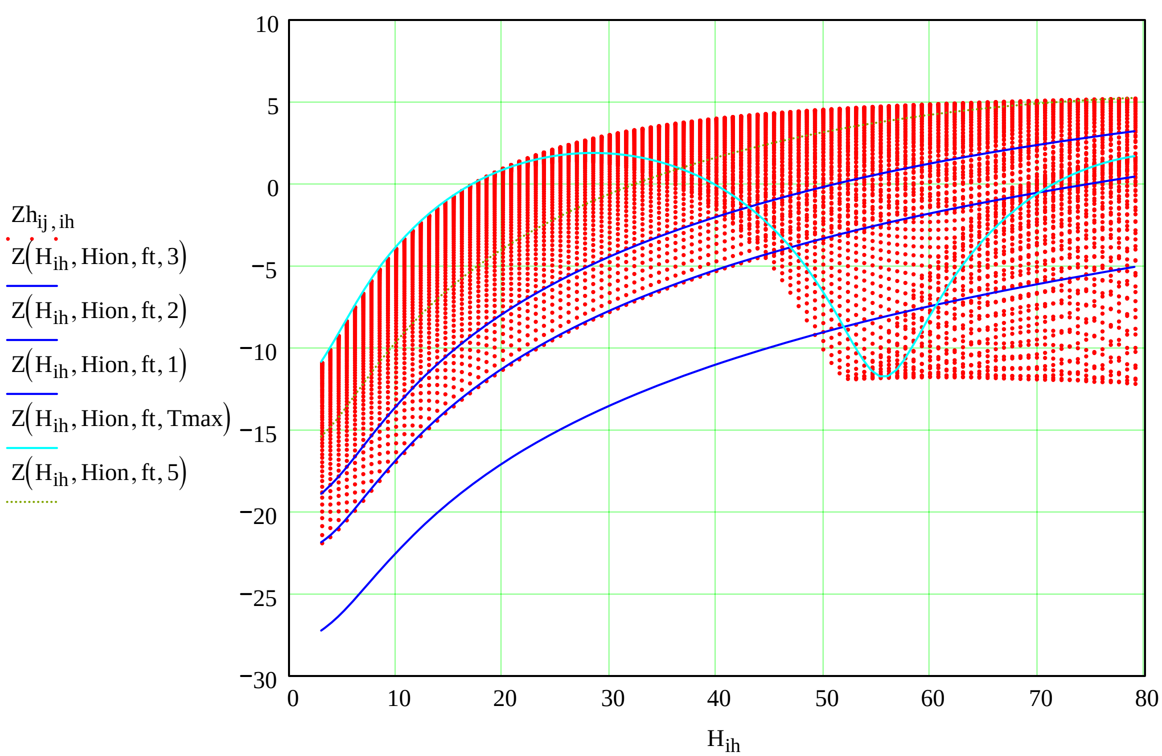
$ft := 21 \qquad Tmax := 16 \qquad to_{ij} := Tmin + \frac{ij}{IH - 1} \cdot (Tmax - 1) \qquad Zh_{ij,ih} := Z(H_{ih}, Hion, ft, to_{ij})$




15m band

$Tmin := 2$

$ft := 10 \qquad Tmax := 16 \qquad to_{ij} := Tmin + \frac{ij}{IH - 1} \cdot (Tmax - 1) \qquad Zh_{ij,ih} := Z(H_{ih}, Hion, ft, to_{ij})$




30m band

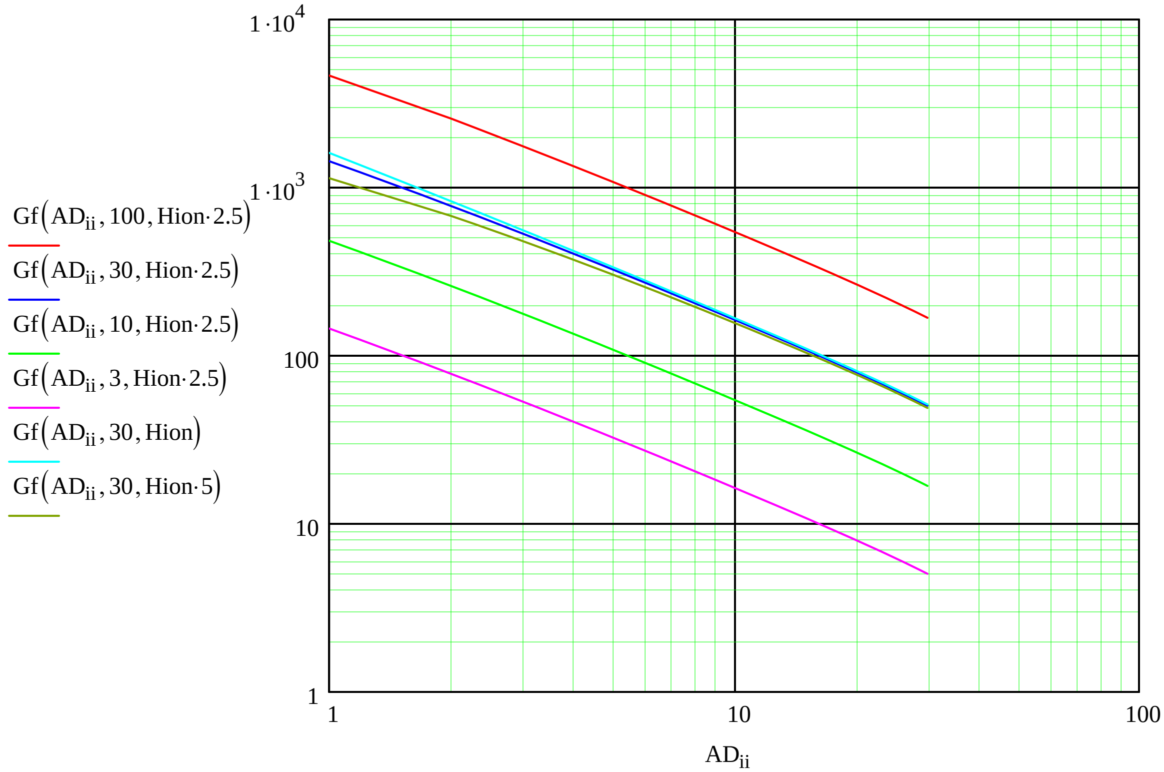
Distance, m, along the ground to the reflection point:

$$Gf(Tdeg, Hm, Hion) := Gb(Tdeg \cdot dtr, Hm, Hion)$$

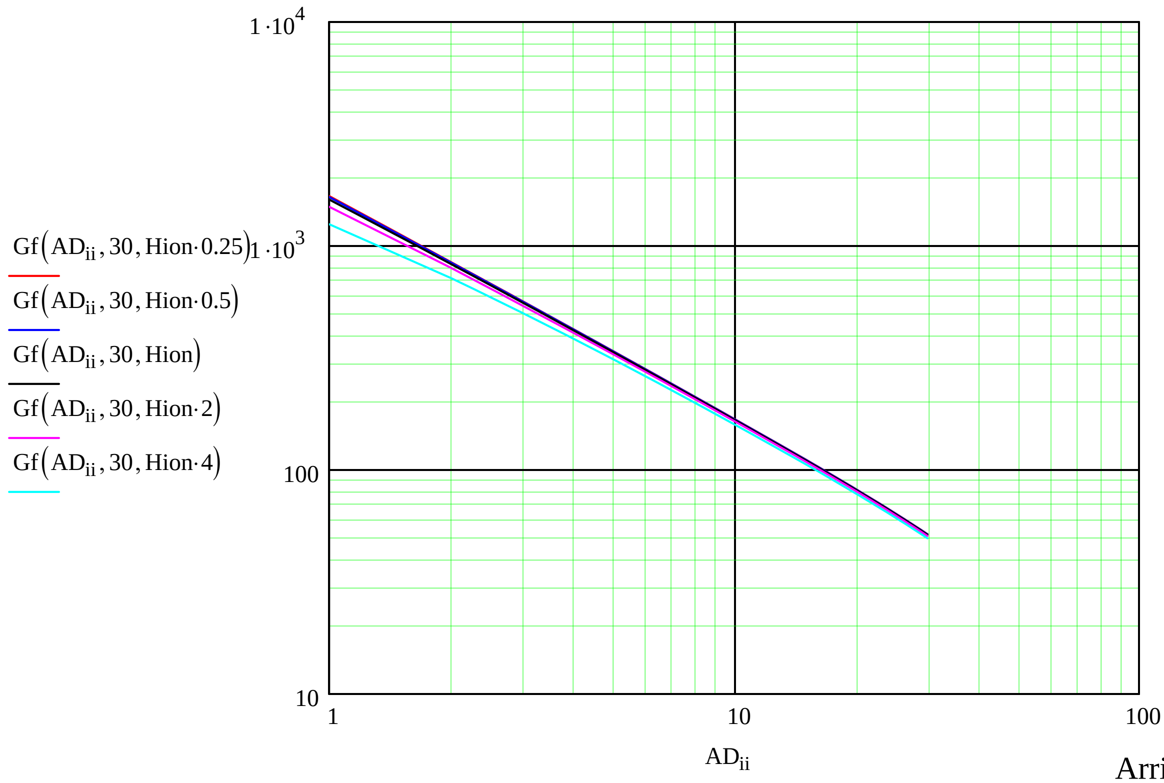
$ii := 0 .. 29$ $\quad AD_{ii} := (ii + 1)$ $\quad Hion = 1 \times 10^{5}$

$$Gapp(a, h) := 55 \cdot \frac{h}{a}$$

Meters to reflection point




Earth reflection point vs. ionosphere height



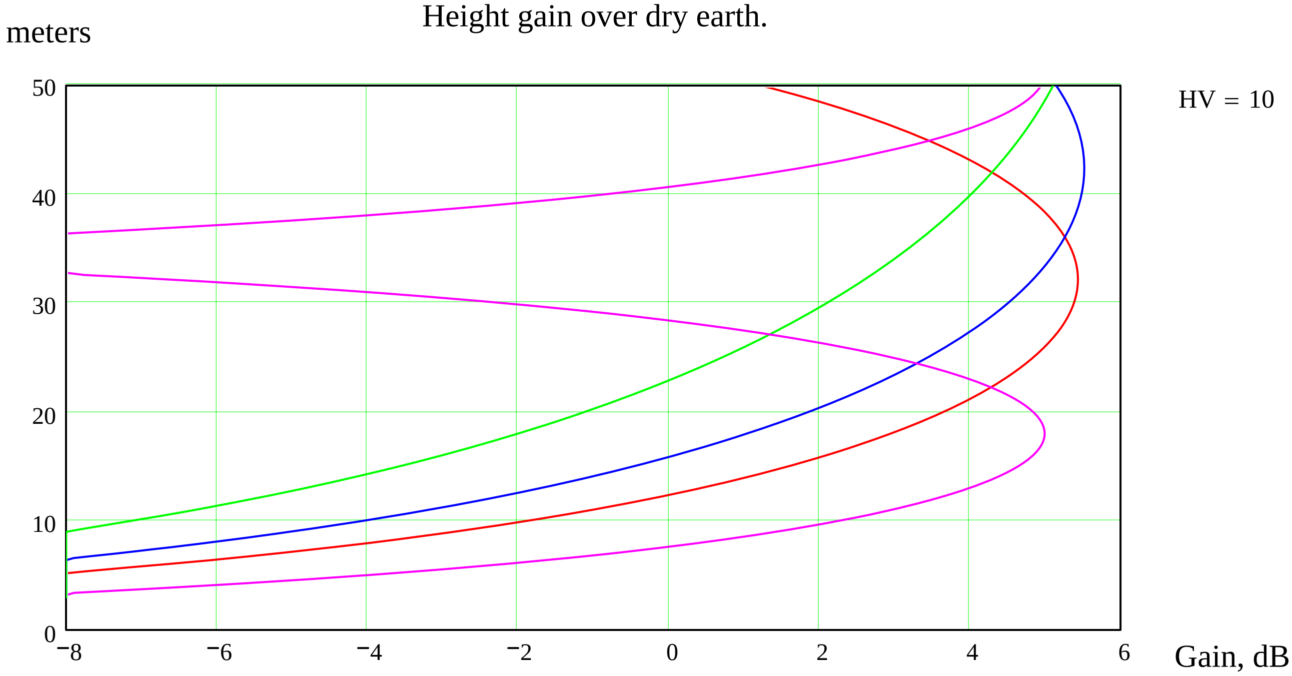

Arrival angle, deg

$bot := -8$

$t0 = 5$ t0 is arrival angle

$$G(h,H,fMHz,T) := \max\left(bot, 10\cdot\log\left(P\left(T\cdot dtr, h, H, \varepsilon(12, .0005, fMHz), hrms, fMHz, HV\right)\right)\right)$$

Height gain over dry earth.



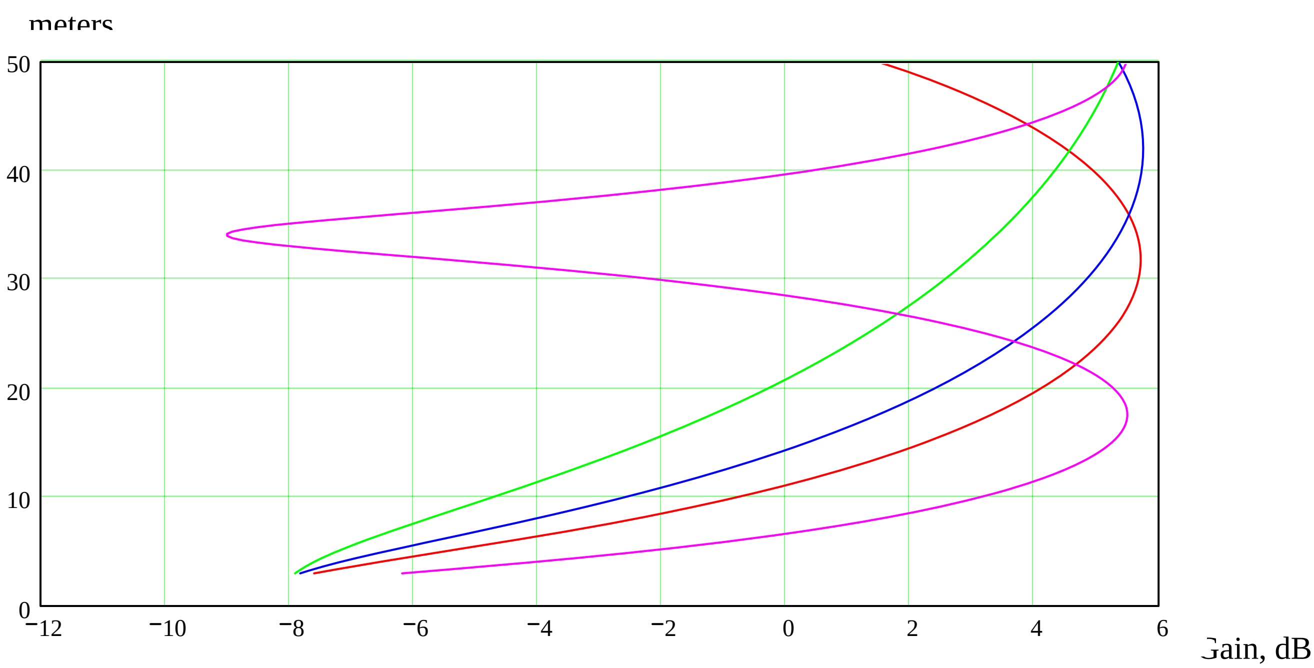

$HV = 10$

Almost entirely HORIZONTAL polarization over Sea: $HV := 20$ $hrms3 := 2$ $t0 := 5$

bottom of plot: $bot := -12$ t0 is arrival angle

$$W(h,H,fMHz,T) := \max\left(bot, 10\cdot\log\left(P\left(T\cdot dtr, h, H, \varepsilon(70.6, 4.54, fMHz), hrms3, fMHz, HV\right)\right)\right)$$

HF height gain over sea water, H polarization.



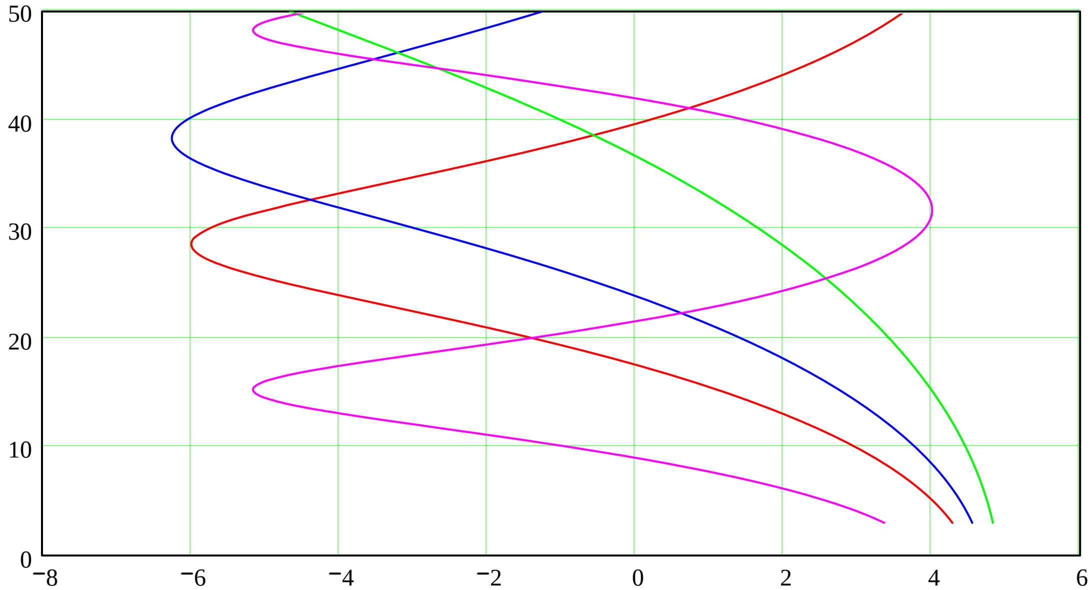
hrms3 = 2 HV := 0.05

## Sea water vertical pol

t0 is arrival angle

$f(h, H, fMHz, T) := 10 \cdot \log(P(T \cdot dtr, h, H, \varepsilon(70.6, 4.54, fMHz), hrms3, fMHz, HV))$

t0 := 5




IF height gain
over sea water;
Vertical
polarization.

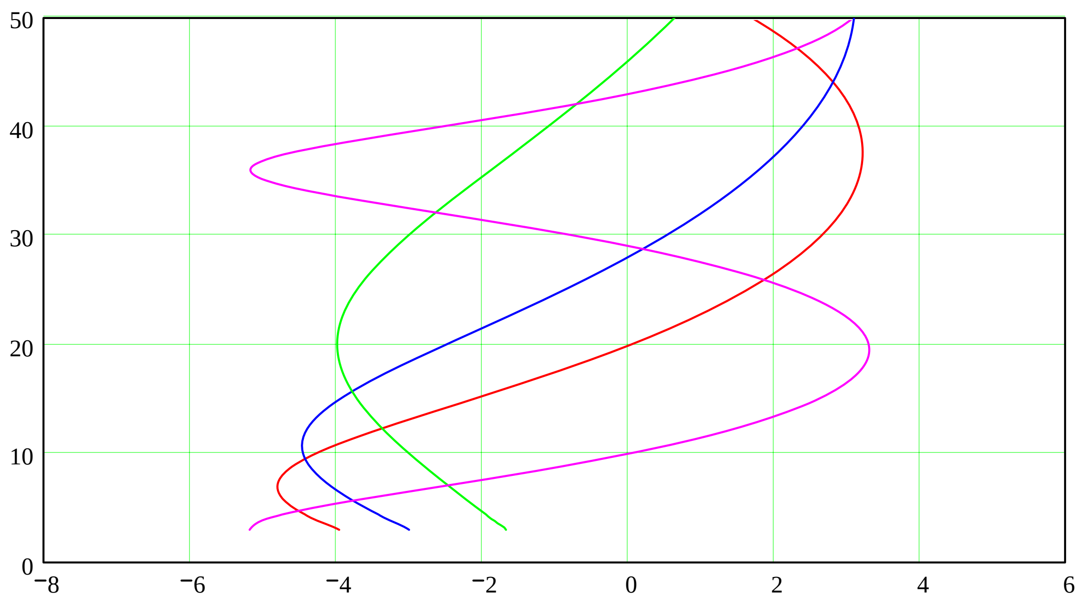
ain, dB

## Earth vertical pol

HVs := 0.05

$s(h, H, fMHz, T) := 10 \cdot \log(P(T \cdot dtr, h, H, \varepsilon(12, 0.05, fMHz), hrms3, fMHz, HVs))$

t0 = 5




F height gain
er earth; Vertical
larization.

For ground mounted vertical use 4-square array with 6 dBi gain. BW3 := 45

Yagi gain is omitted, but equals $fourSdB := 10 \cdot \log(Gain(2 \cdot BW3))$ fourSdB = 6.021

Cosine patterm equivalent: n := 1 $Npower := root\left(\cos(BW3 \cdot dtr)^{n} - 0.5, n\right)$ Npower = 2

$PLv(TO) := 10 \cdot Npower \cdot \log(\cos(TO \cdot dtr))$ PLv(BW3) = −3.01