"Comparitive Fading Behaviour of Horizontally and Vertically Polarized VHF Waves Over a Long Ocean Path"

by W.P. Lonc Principal Investigator

Saint Mary's University Jan.2/85

Rec'd from Dr. Whittaker Jan '85

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by

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Work performed under Contract Serial #0ST84-00044
and DSS File #27ST.36001-4-2037

Final Report for the period
April 1, 1984 to September 30, 1984.

Work performed under this contract

1. Replaced the antenna for 224.9 MHz, which had been damaged by wind and corrosion.
2. Reworked the analyzing antennas and associated pedestals at the receiving end (Saint Mary's).
3. Obtained additional data on most of the frequencies mentioned in this Report, and reviewed all pertinent earlier data.
4. Added a power-amplifier to the transmitter on 147.995 MHz.
5. Reworked the receivers assigned to this particular project.

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Introduction

The objective in this contract was to obtain some information pertaining to possible differential attenuation between the horizontal and vertical components of linearly polarized radiation in the VHF and UHF parts of the spectrum propagating from Sable Island to Halifax, in Nova Scotia. The surface path-length is approximately 300 km, and is almost entirely over salt-water (see map on page 3).

The procedure in this study consisted of exciting linearly polarized antennas which were slanted at 45 degrees to the horizontal (see page 4) such that the radiated power, due to symmetry, would exactly divide into equal horizontal and vertical components. The slant of the received linearly polarized radiation was then measured. Any differential attenuation would appear at the receiving end as a shift in the slant-angle.

The equipment and calibrating procedures were such that the maximum estimated uncertainty in the observed slant-angle is some 5 degrees either side of the nominal or average value. This uncertainty takes into account the uncertainty associated with orienting the transmitting antenna at 45 degrees using a spirit-level, as well as the uncertainty associated with orienting the analyzing antenna. Assuming a simple model for purposes of analysis (see page 5), an uncertainty of 5 degrees is equivalent to an uncertainty of approximately 0.8 db in the relative power levels in the two components. That is, any differential attenuation that is less than approximately 1 db would not be discernable in the data.

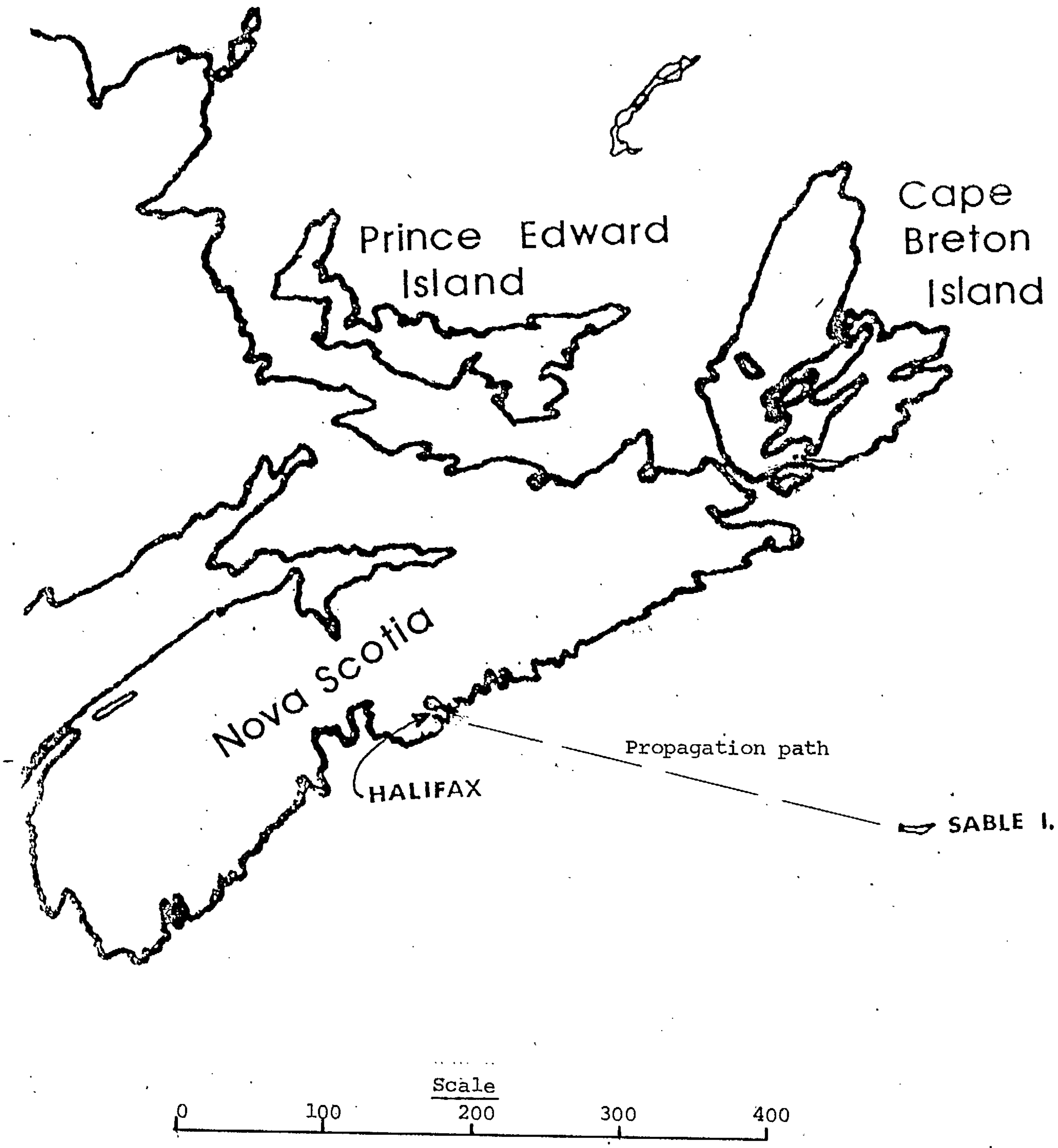
The results given in this Report pertain to observations on the following frequencies: 147.93 (formerly 147.9), 224.9 , 431.9, and 1296 MHz, and represent average values of several observations made during the period from February, 1983 to the end of December, 1984.

This Report supersedes previous reports on this topic (see our Final Report for 1983) and is considered to be a more accurate appraisal of all the data obtained by this laboratory for the Sable Island to Halifax path.

Results

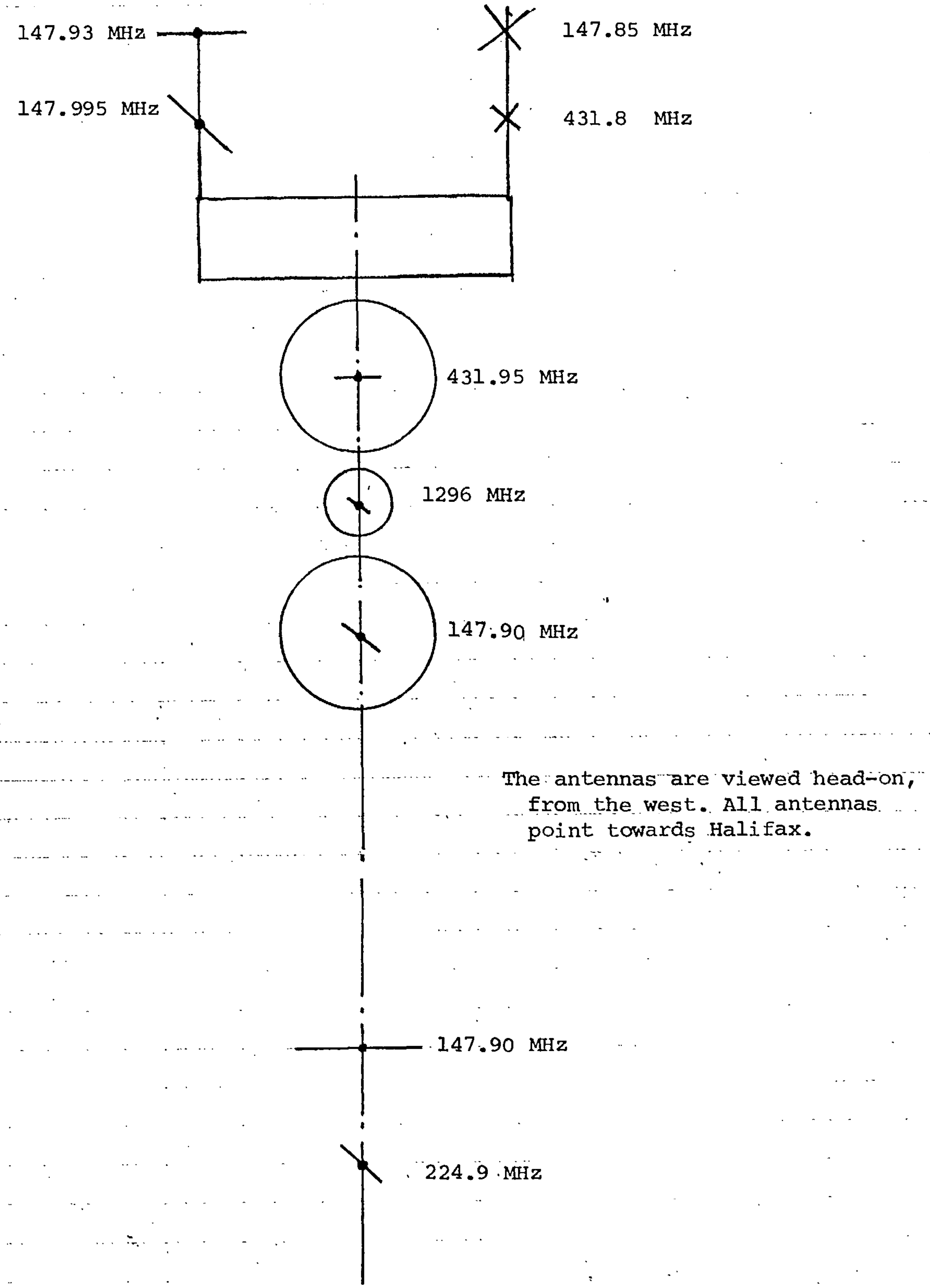
In general, it appears that the averaged values for each of the four frequencies (see page 6) could be interpreted as indicating that there is no differential attenuation at these frequencies over this particualar path; or, at most, that any such attenuation is less than approximately 1 db. It should be noted, however, that the results represent measurements requiring several minutes to complete, and therefore pertain to a time-scale in the order of several minutes. Hence, any differential attenuation on a shorter time-scale would have been smoothed out by the equivalent time-constant of the observational procedure, or would have been interpreted as noise. In fact, occasionally, while making observations, the shift in the tilt-angle would be rather definitely larger than the uncertainty over a time-interval of a few seconds; however, given the manual (rather than machine-controlled) method used to determine this angle, these fluctuations would be smoothed out in the process of manually positioning the antenna to what was considered to be the equilibrium position.

Figure 1: General view of the Nova Scotia coast-line, showing the propagation path in relation to Sable Island and Halifax.



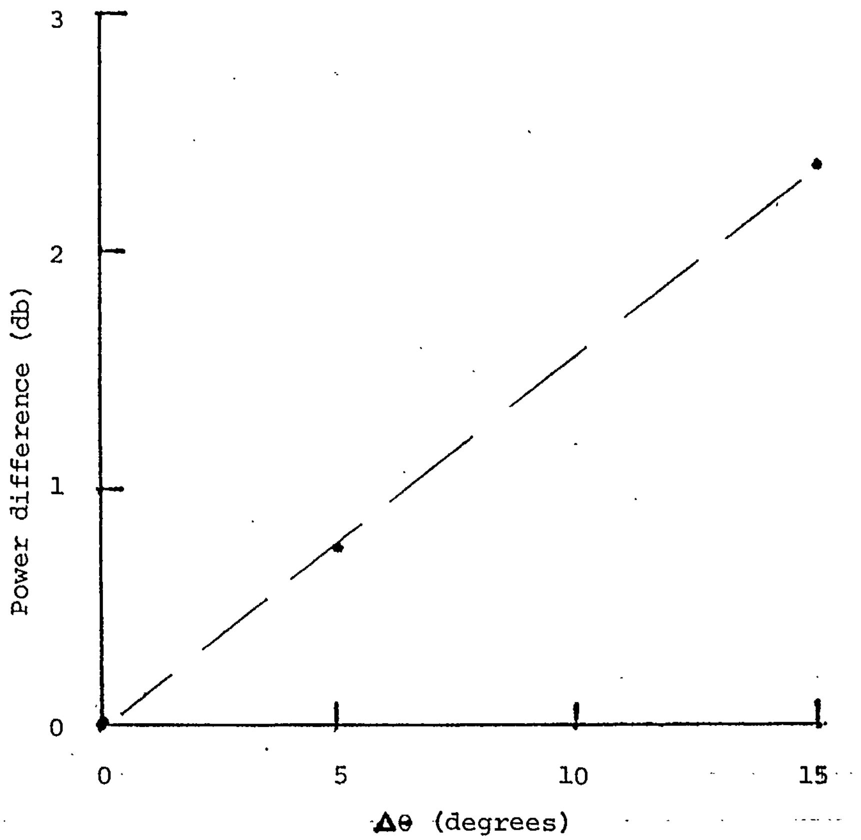
Schematic view of antennas on tower on Sable Island as of December 18, 1984, showing orientation of tilts.

(not to scale)



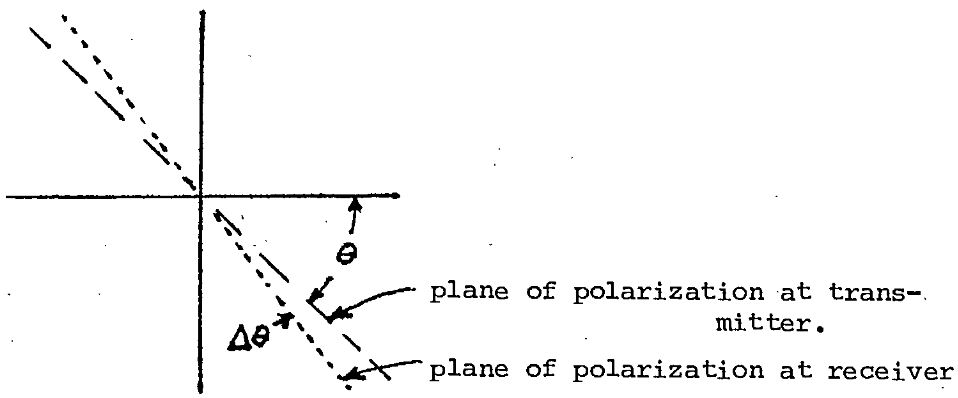
Conversion graph: $\pm\Delta\theta$ to $\pm$db

$\Delta\theta$ = change in the plane of polarization



Sample calculation: $\Delta\theta = \pm 5^\circ$ ($\theta = 40^\circ$ or $\theta = 50^\circ$)

$\tan 40^\circ = 0.839$; corresponds to a difference of 0.76 db between components.
(same result for $\theta = 50^\circ$)



Averaged values of observed differential attenuation, disregarding possible significance associated with fluctuations.

Frequency (MHz)	Average change in the slant (degrees)	Component under-going additional attenuation	Differential attenuation (db)	Uncer-tainty (db)
147.93	5	vertical	0.8	1
224.9	2	horizontal	0.3	1
431.9	2	vertical	0.3	1
1296	1	horizontal	0.1	1