

Four Years of ACTS Propagation Measurements in Vancouver

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ACTS Propagation Measurements in Vancouver

- **Climatic characteristics at Vancouver**
- **Statistics of Attenuation for the Period 1994-1997
using reprocessed data**
- **Comparison of Measured Statistics with
Prediction Models**
- **Summary**

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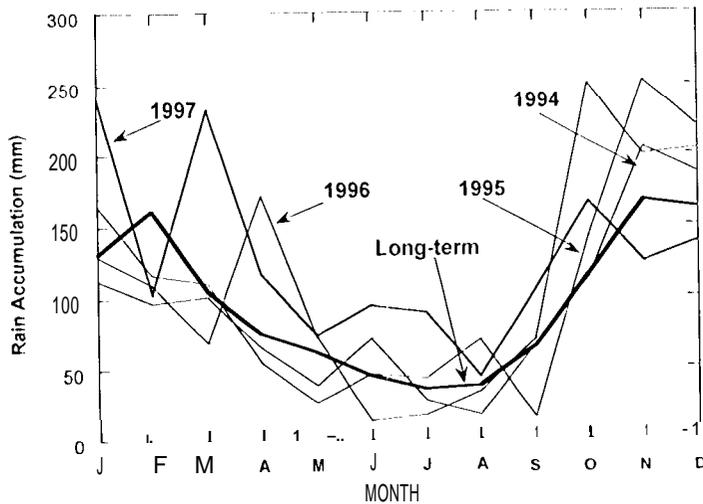
Climatic characteristics at Vancouver

Climatic Characteristics at Vancouver

- Pacific maritime climate. Little heavy rain but a great deal of widespread drizzle and lower-rate rainfall
- Long-term annual average rainfall at the Vancouver Int. Airport: about 1020 mm. Average annual snowfall: 60 cm
- Average daily temperature : from 0° to 24° C over the year
- Vancouver falls in rain zone D in the ITU-R classification and in rain zone BI in the Crane's Global classification
- Measured rain rate level for 0.01% of time :13 mm/hr (measurements over a ten-year period at the Vancouver International Airport*)

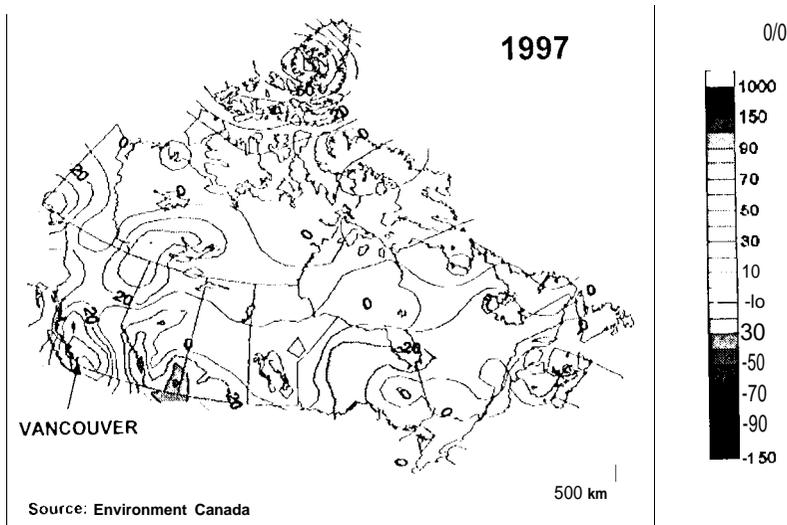
* The Vancouver International Airport is located some 8 km south of the UBC site

Rain Accumulation at Vancouver 1994-1997



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Precipitation Departures from Normal (above/below the average of last 50 Years)



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- Average precipitation and temperature were above normal in 1997 along much of the Pacific Coast
- 1997 averaged about 17% wetter than normal along the Pacific Coast, representing the 2nd wettest year in the last half century
- Temperature was close to two degrees warmer than normal over the course of the year
- 1997 was drier than normal in eastern Canada

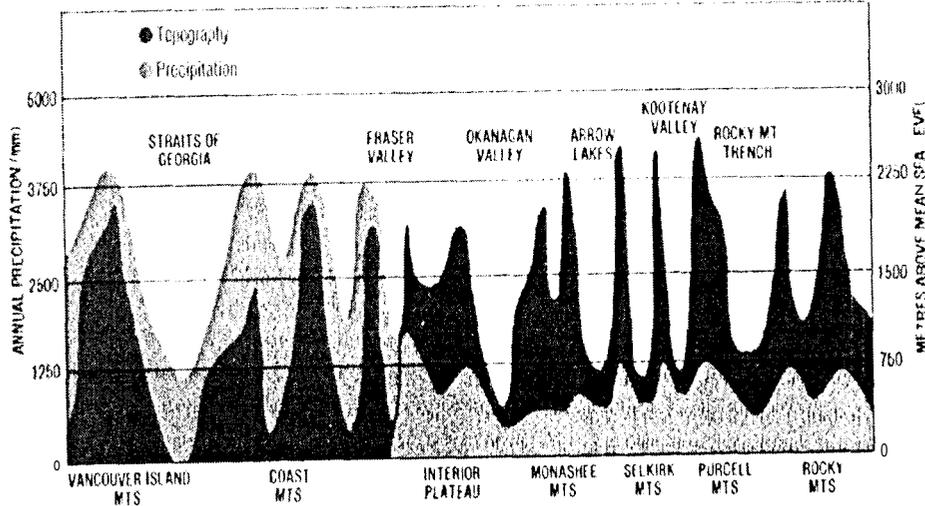
Seasonal and Annual Average Freezing Level Heights (km above ground level)

Station	Lat N (deg)	long W (deg)	Height (m a.s.l.)		Spring	Summer	Fall	Annual average	ITU-R formula
Vernon B.C.	5014	11917	555	0.89	142	2.71	178	1.70	2.96
Port Hardy B.C.	5041	12722	22	1.25	143	2.83	218	1.92	2.92
Vancouver B.C.	4915	12315	164						3.0

Freezing level heights obtained from radiosonde data for the period 1979-1990

. The values obtained utilizing the ITU-R formula agree fairly well with the observed summer heights, otherwise the heights tend to be overestimated

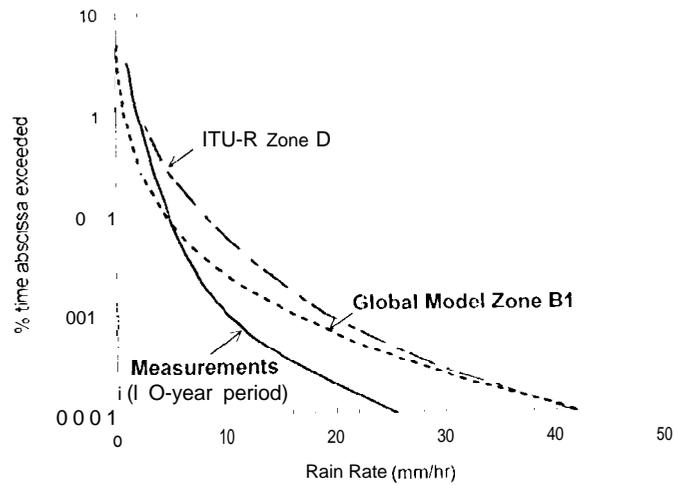
Effect of Topography on Precipitation Across Southern British Columbia



(Adapted from B C Atlas of Resources)

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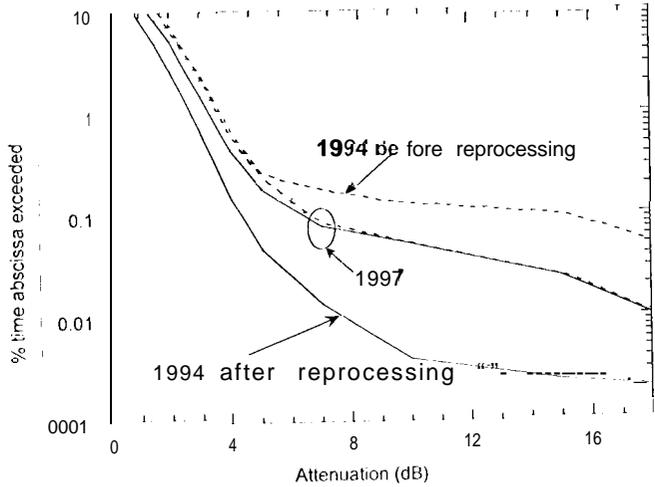
Rain Rate Statistics at Vancouver

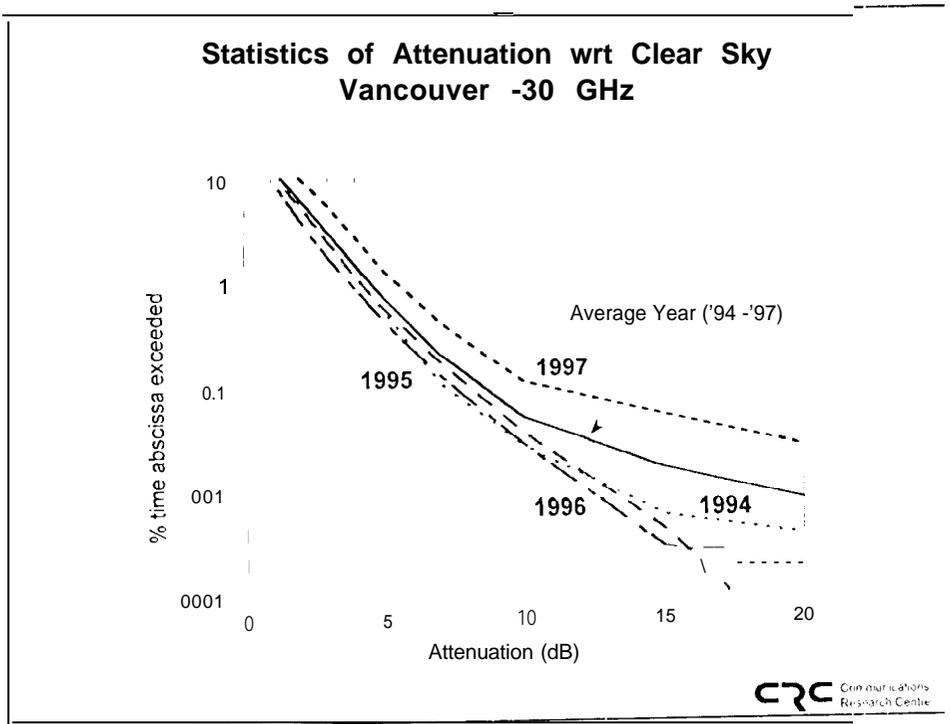
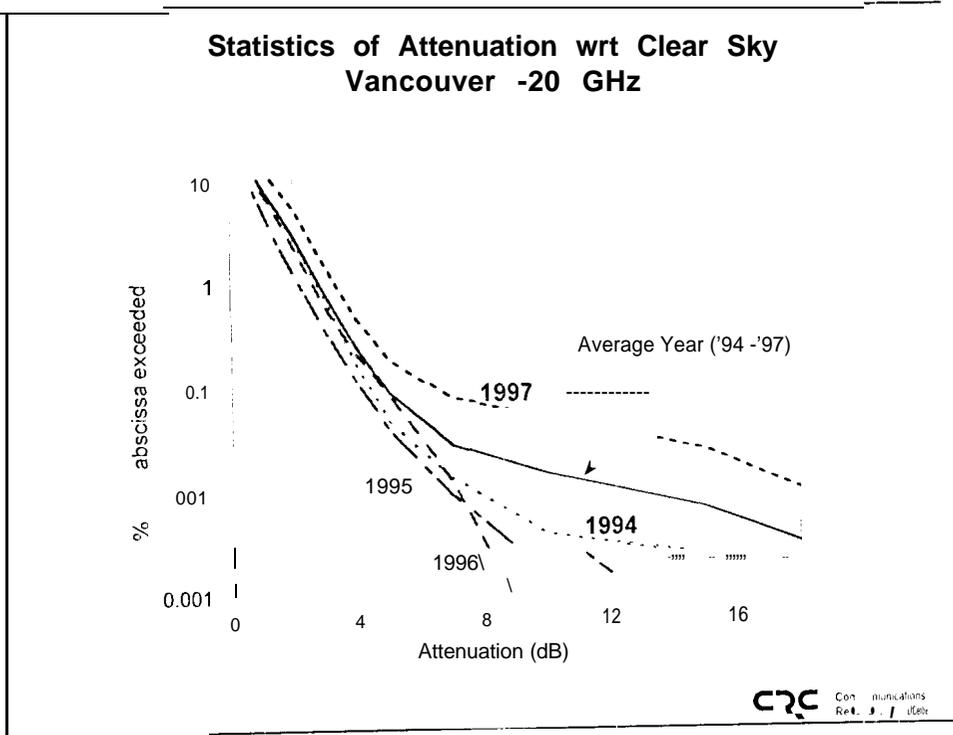


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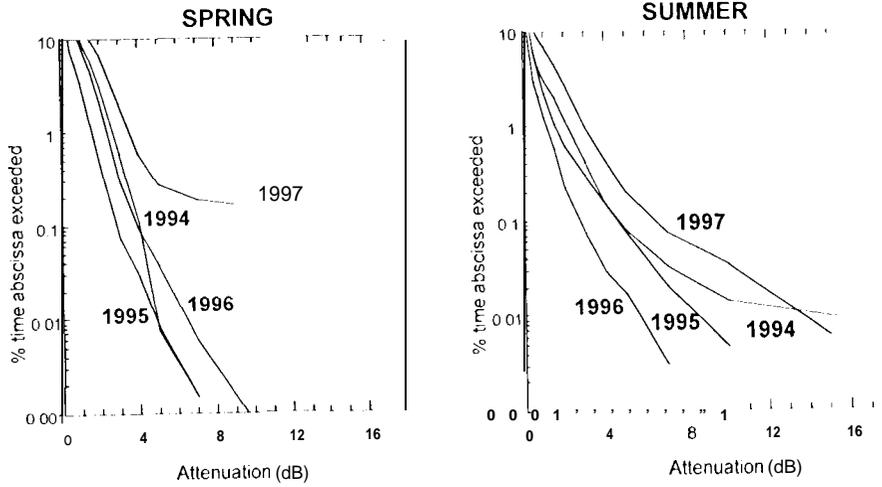
Statistics of Attenuation Using Reprocessed Data 1994-1997

Reprocessed Data Attenuation wrt Clear Sky -20 GHz



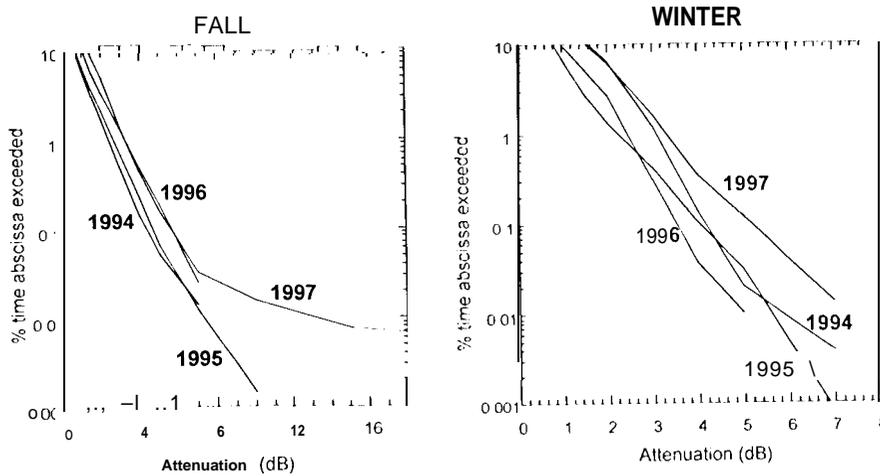


Seasonal Statistics
Attenuation wrt Clear Sky -20 GHz



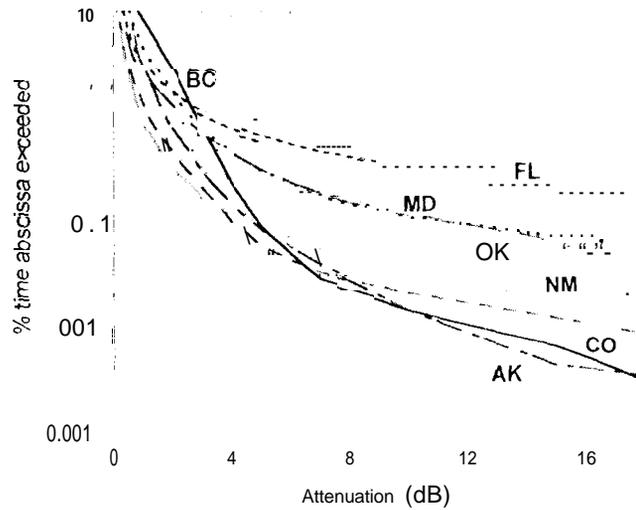
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Seasonal Statistics
Attenuation wrt Clear Sky -20 GHz



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Attenuation wrt Clear Sky at 7 Sites 20 GHz



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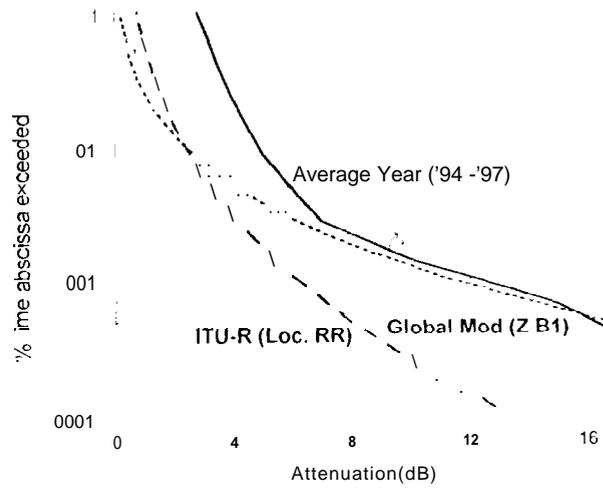
Statistics of Attenuation

- 1997 clearly dominates the annual and seasonal statistics of attenuation for the period 1994-1997
- Attenuation distributions for 1994, 1995 and 1996 show little interannual variability
- Winter season (December-February) statistics show many small attenuation events of long duration, especially below 5 dB
- The effect of antenna wetting can have an important influence on the measured statistics, especially on statistics for the Winter season

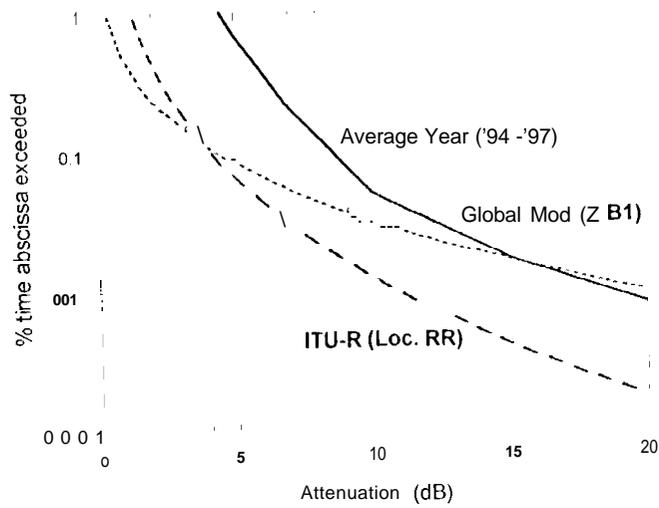
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Comparison of Measured Statistics with Prediction Models

Comparison of Models and Measurements Vancouver -20 GHz

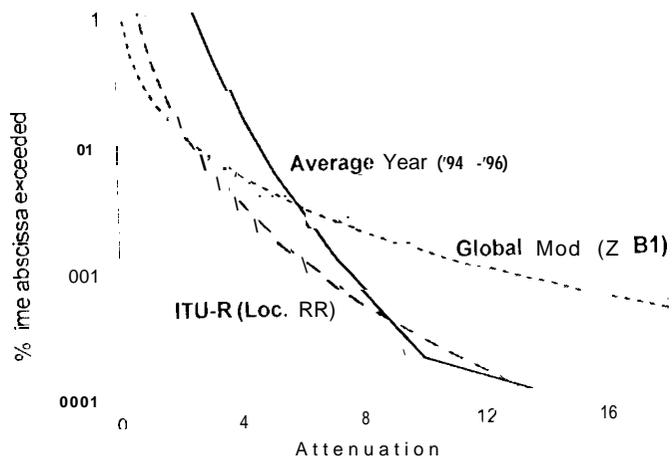


Comparison of Models with Measurements Vancouver -30 GHz

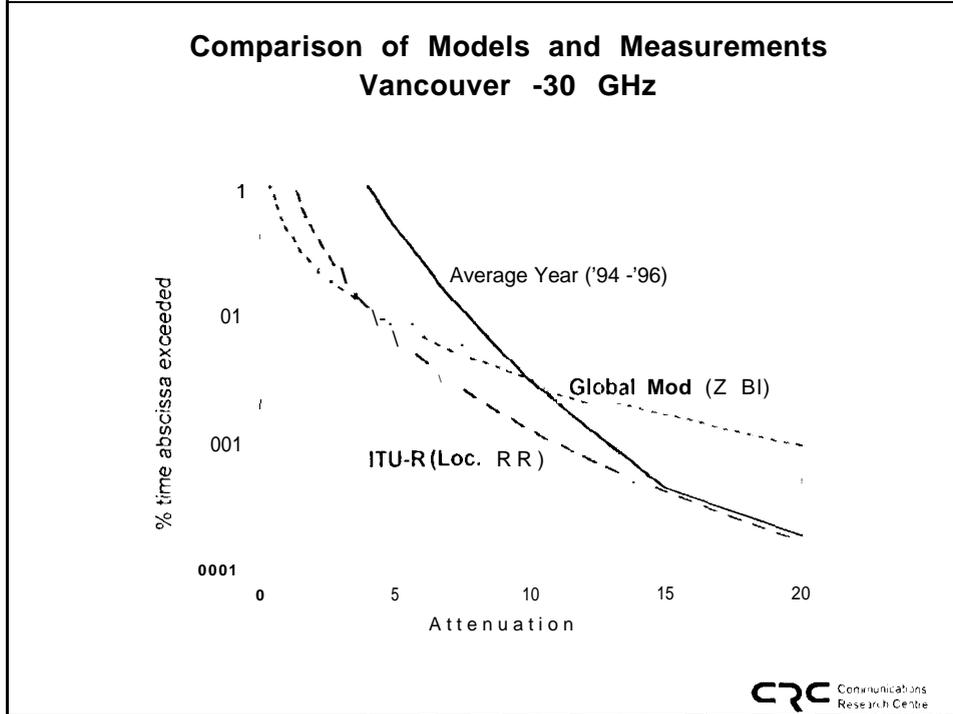


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Comparison of Models and Measurements Vancouver -20 GHz



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Comparison of models with measurements

- Comparison of models with data measured for an average year (period 1994-1997):
 - The ITU-R model clearly underpredicts the attenuation measured at both frequencies
 - The Global model underpredicts the measured data in the region of small attenuation values but measured and model curves agree rather well above about 7 dB (at 20 GHz) and 12 dB (at 30 GHz)
- When models are compared with statistics of an average year for the period 1994-1996, the ITU-R model gives better results than the Global model
- In the region of low attenuation values the measured statistics can be affected by the combined effects of antenna wetting and moisture penetration into the receive antenna feed

Summary

- Four years of data (1994-1997) recorded at the ACTS-Vancouver site were re-processed by the U. of Oklahoma, improving their quality
- Annual and seasonal attenuation statistics measured at Vancouver during the period 1994-1997 are strongly dominated by the year 1997 when rainfall reached record levels along the South-Pacific coast of Canada
- Comparisons of measured statistics with the ITU-R and the Global rain attenuation prediction models indicates mixed results, with the Global model giving better results when compared with statistics of an average year (period 1994-1997)
- Correction for antenna wetting effects was not yet implemented