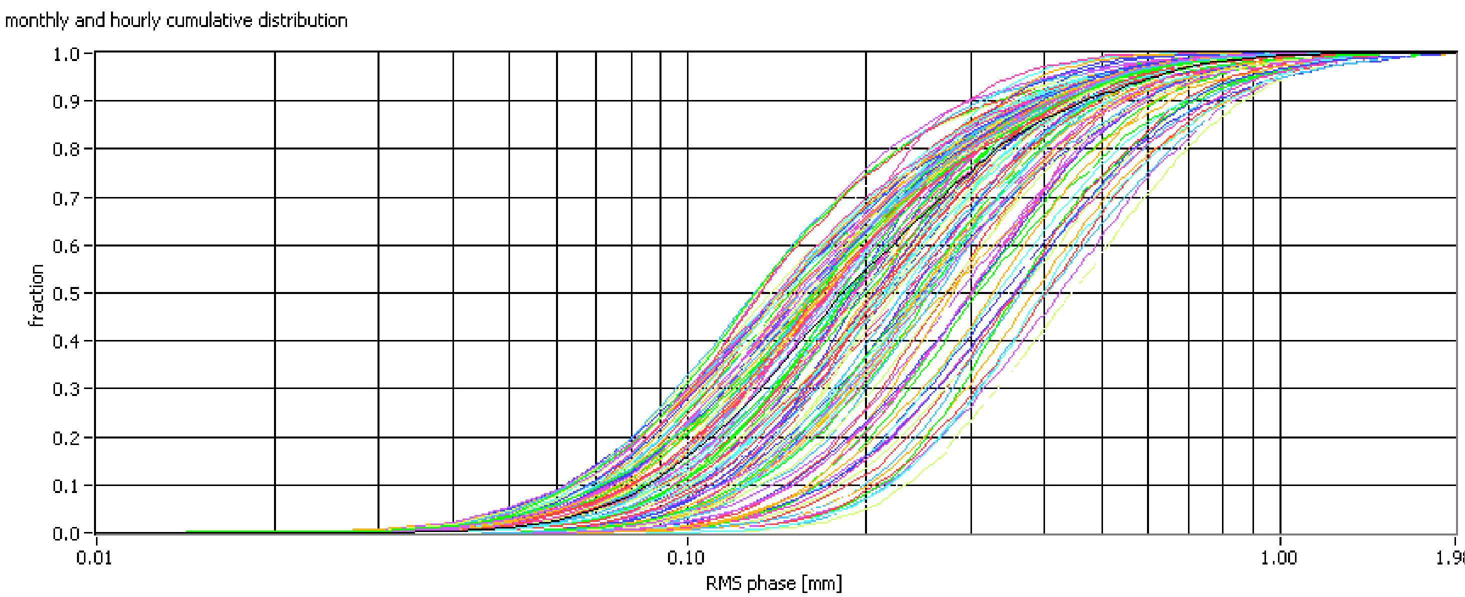
Summary of OVRO Phase Monitor Data

David Woody, November 14, 2003

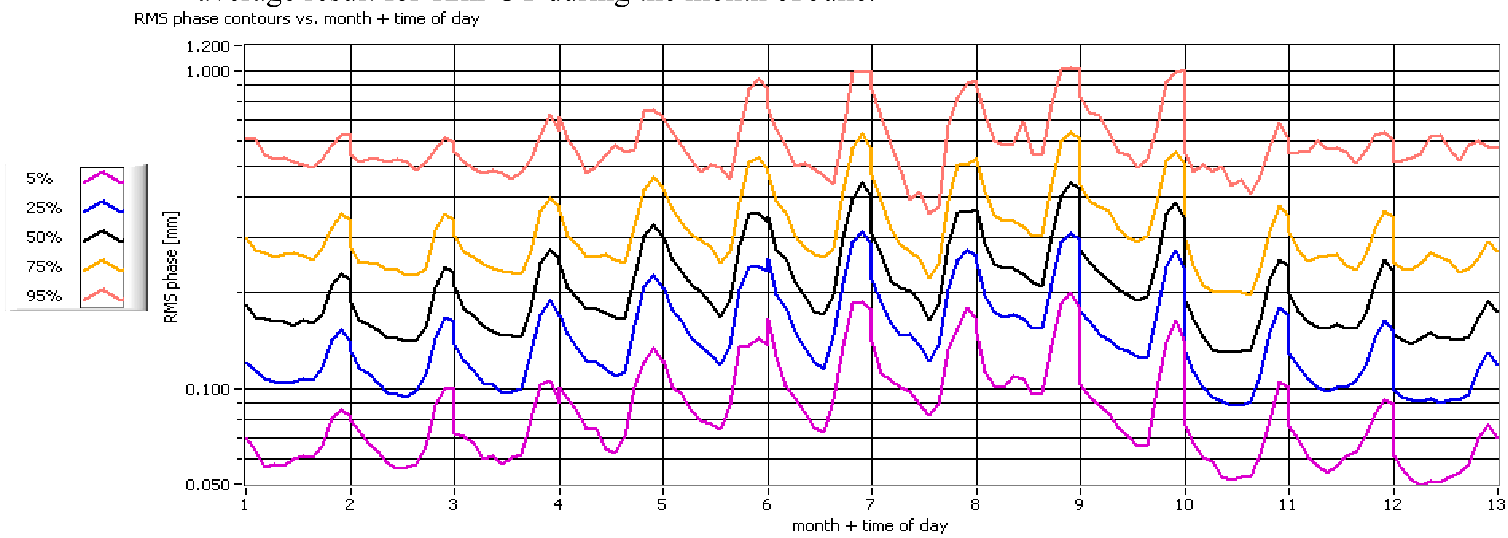
I have analyzed the data from the OVRO phase monitor system. This system is a copy of the one built by Colin Masson for Mauna Kea. It monitors the 12.5GHz carrier from a geostationary satellite DBS-1 using 100m baseline interferometer. The satellite is at an elevation of 43deg. The main output is the RMS phase from the interferometer over 5min intervals. We have archived data from Dec. 1994 to Oct. 2003. Some 15% of the data is missing due to equipment failures. The data was analyzed by accumulating the data in two hour bins for each month giving 144 data sets per year. The data sets from each year were then added together to produce the final eight year average result.

The 144 cumulative distributions, one for each UT two hour bin averaged over a month is shown below.



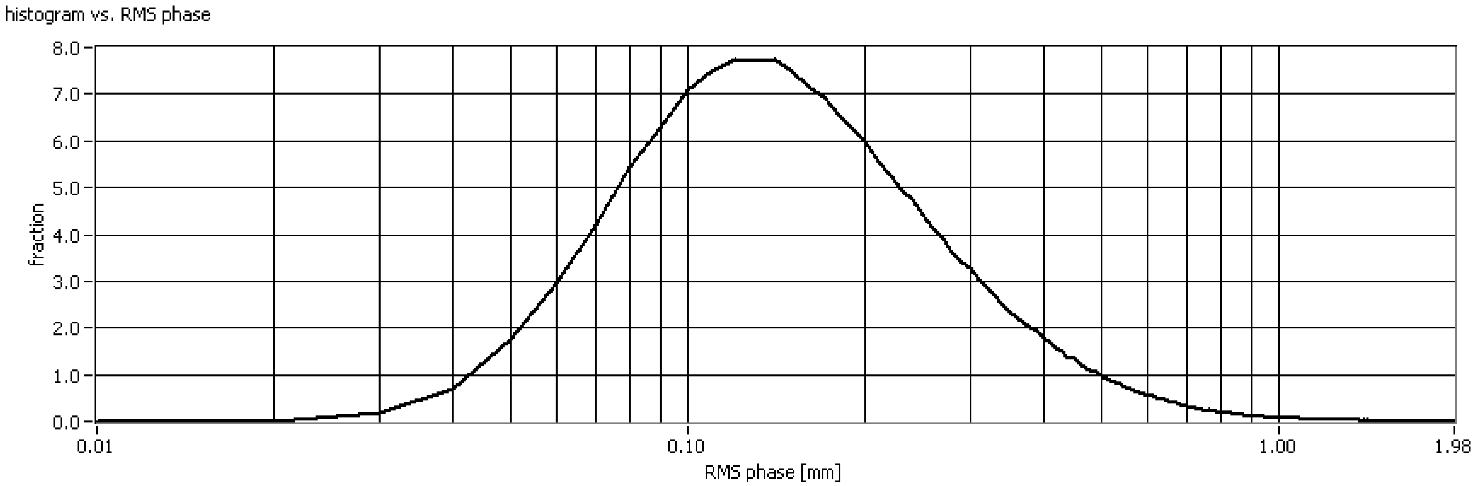
The data sets are all very similar with just a shift in the horizontal position as a function of month and time of day.

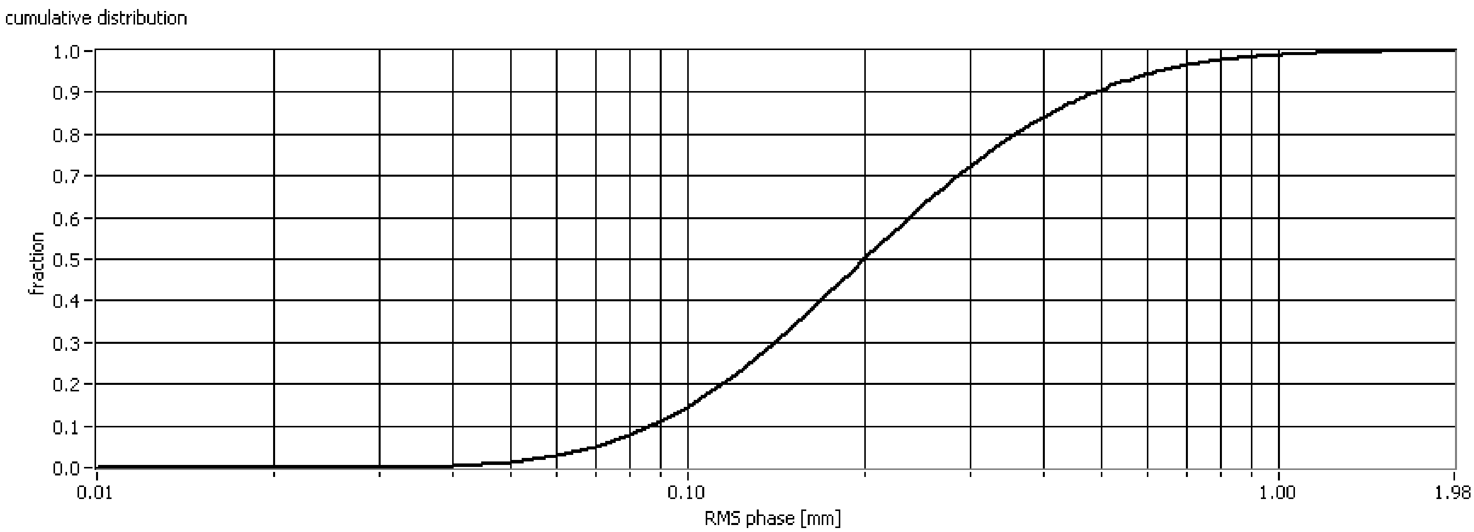
The plot below displays the average results for the 144 monthly + hourly results as plots of the RMS phase delay in mm at the five accumulation fractions of 5, 25, 50, 75 and 95 %. The horizontal axis is marked in months, but the fractional "month" corresponds to the UT time of day. Thus the data at 6.5 corresponds the month long average result for 12hr UT during the month of June.



The daily variations are actually larger than the annual variations with quite large daily variations during the summer months. Thus scheduling observations by time of day is as important as in picking the season, although the opacity effects will be dominated by the seasons.

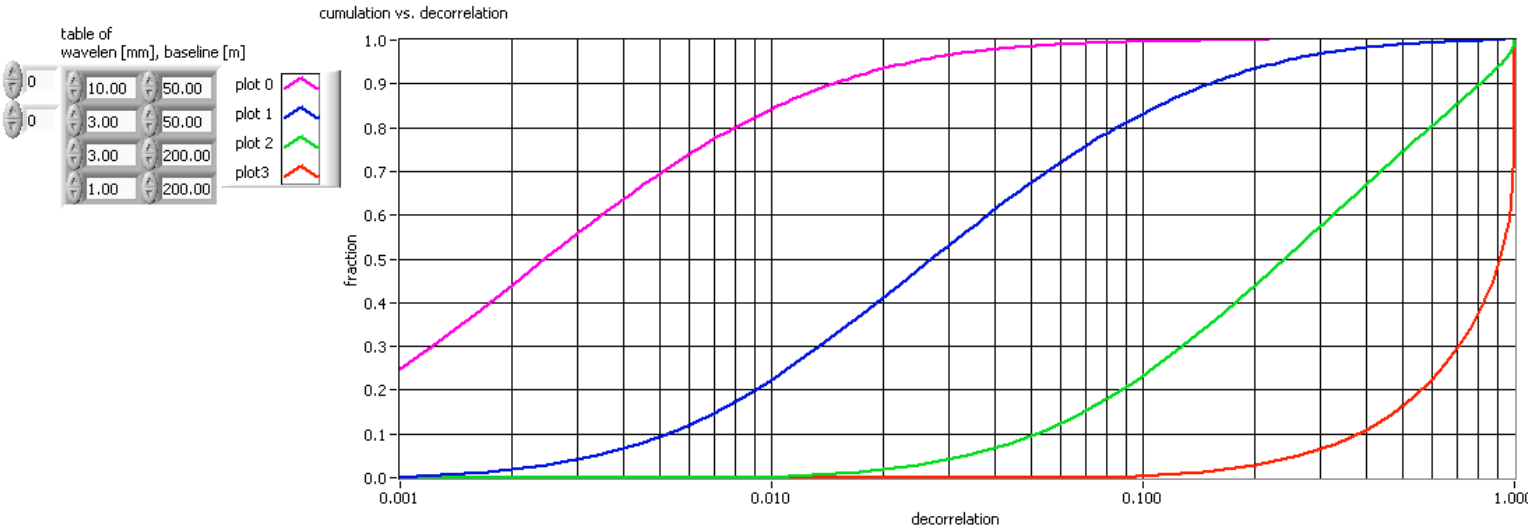
The grand average distribution and accumulative plots for the eight years of data are given below.





The data seems well behaved and the Gaussian distribution when plotted on a log scale is very intriguing. I will look at the data in more depth later and hope to produce a short memo for distribution in the next week or two.

The data can be scaled to different baseline lengths using the Kolmogorov spectrum as ~$BL^{5/6}$. The coherence or decorrelation is given by $\langle A \rangle = A\exp(-\frac{1}{2}\sigma^2)$, where by σ is the RMS phase error in radians. I have converted the RMS phase delay to decorrelation for several different wavelengths and baselines in the plot below. There was no correction for the elevation of the satellite since it is representative of the elevation for typical astronomical observations.



The difficulty of 1mm observations is clearly revealed by this plot.