# APPLICATIONS OF OCCULTATION DATA IN CLIMATE MONITORING AND RESEARCH

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A careful analysis of radiosonde data and MSU soundings show a significant cooling of the lower stratosphere amounting in global average to some 0.8 K/decade over the last 25 years. High latitude changes in particular in the Antarctica are several times larger. This long term cooling trend has been interrupted by two significant warmings following the major volcanic interruptions by El Chichon in 1984 and Pinatubo in 1991 both warming effects lasting for a period of some two years. Numerical experiments suggest that the long term cooling is a combined effect of stratospheric ozone depletion and the increase of atmospheric greenhouse gases.

Model simulations with increasing greenhouse gases show that the main warming will occur in the upper troposphere and not at the surface, while observations show the largest warming at the surface and only a modest warming aloft. The quality of present observations are not good enough to settle this disparity.

Temperature changes caused by increased greenhouses are dominated by indirect feedback processes largely due to changes in atmospheric water vapour. Particularly crucial are moisture changes in the upper troposphere, a region where both radiosonde data and present satellite data are unreliable. There is an urgent need to monitor water vapour since models suggest a rapid increase with increasing temperature and an associated increase in intense precipitation. Present data are unable to detect any such changes as indicated by models. The lack of reliable humidity observations are also a contributing factor to the insufficient knowledge of the hydrological cycle, which presently is only known with an accuracy of ca. 10% in global, annual average.

Satellite occultation using GPS measurements as well as surface GPS measurements offer an important contribution to the present observing systems. A particular useful aspect is the expected small bias in this type of observations or at least a bias which is time-independent. An observational bias is acceptable while using observations in weather prediction but essential when using meteorological data for climate monitoring, when stable observations are needed for longer periods of time ( several decades or longer).

In my presentation I will outline a strategy towards a sustainable observational program for climate monitoring, a program of observation where occultation measurements would make an important contribution.