DIURNAL CHANGES OF RADIO REFRACTION

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ABSTRACT

Pathlength variations due to refraction changes in the troposphere may impose a severe limitation to VLB experiments (like random clock drifts). In connection with a VLB experiment Moran and Penfield (1976) analysed surface values of water vapor density, data of several hundred radiosonde launches and of measurements of sky brightness near the water vapor line at λ = 1.3 cm. They found that the surface values allow to estimate the pathlength to an accuracy of 5 cm in summer and 2 cm in winter. Sky brightness data give a prediction accuracy of 1.5 cm for all weather conditions, but for cloudfree conditions the accuracy was 0.3 cm.

Three different methods were used in radio astronomy to determine the water vapor content:

1) IR absorption measurements in the direction of the sun (Wesseling et al., 1974),

2) relative emission measurements near the water vapor line at λ = 1.3 cm (Moran et al., 1976),

3) absolute measurements of emission in the range of 100 to 1000 GHz (Hills et al., 1978).

The question, which line and which method is best, is still unanswered. In principle the absorption measurements may be preferred, since they give exactly the amount of water vapor in the line of sight, but this method depends on the sun. Method 2 may turn out to be most useful, since it allows to map the water vapor emission in any direction at any time; the exact calibration may give some problem. Method 3 seems to be too involved to be practical for routine pathlengths corrections.

E. Tengström and G. Teleki (eds.), Refractional Influences in Astrometry and Geodesy, 163–164.

REFERENCES

Hills, R.E. et al.: 1978, "Absolute Measurements of Atmospheric Emission and Absorption in the Range 100 to 1000 GHz", paper presented at the Third International Conference on Submillimeter Waves, Guildford, U.K.

Moran, J.M., Penfield, H.: 1976, "Test and Evaluation of Water Vapor Radiometers". Contract NAS5-20975, final report.

Wesseling, K.H. et al.: 1974, Radioscience, 9, 349.

DISCUSSION

P.V. Angus-Leppan: asked for a clarification of the use of the 1.3 cm wavelength measurements for water vapor content.

W.J. Altenhoff: repeated, that Moran and Penfield studied the radiation from the water vapor line of λ = 1.3 cm. Using aerosonde measurements of water vapor content, correlated to the radiation results, they conclude, that it is possible to predict wet pathlengths to within 0.3 cm. The speaker, however, regarded this accuracy as overestimated.

J.C. de Munck: asked if any attempts had been made to determine the humidity of the air by acoustical means. By combination of measurements of acoustical waves and radar waves, it should be possible to map the humidity distribution in the atmosphere.

W.J. Altenhoff: answered that it would be possible, but that he was not aware of any such attempt. In his opinion, the absorption measurements were the most reliable ones for VLBI.

J.A. Hughes: declared as his opinion, that acoustical means can map the water vapor distribution, but since in the case of radio interferometry one is interested in the instantaneous line of "sight" integrated effect, he doubted that acoustical methods could improve upon the direct radiation measurements. The acoustical methods do work however, so he agreed with de Munck, that they could be used if sufficient time and space resolution were available.