A paddy field effect seen on the KSP VLBI measurements

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Regular observations on the compact VLBI network around the Tokyo metropolitan area shows a good repeatability such as a 2-mm level in baseline length. However the repeatability tends to be degraded in summertime. A correlation analysis between measured baseline lengths and surface meteorological data revealed that an apparent position change of Kashima station occurred according to the change of temperature. By assuming that wet-rice-field (paddy field) located one-side of Kashima station is a major water vapor supply source, we evaluate the effect of atmospheric water-vapor pressure gradient on the apparent antenna position shift by using a ray-tracing method and by adopting the surface air temperature data. Results well coincide with the observations quantitatively.

Communications Research Laboratory established a compact VLBI network named KSP which monitors the crustal deformation around the Tokyo metropolitan area in Japan in order to utilize the data for the study of earthquake. In January, 1997 the KSP started regular 24-hour observations every other day. Recently, the total system performance in terms of measurement precision was evaluated and results showed that the precision in terms of repeatability defined as a standard deviation of five continuous samples of a measured baseline length was about 2 mm. However, this was about two times larger than that of the formal error of session analysis. This would suggest that the model applied in a 24-hour session baseline analysis is insufficient for a time scale longer than one day. In the KSP-VLBI baseline analysis, azimuthal asymmetries in the atmospheric refractive index are unmodeled. This might be cause of an error source in a baseline estimation and could account for a larger variation in day to day baseline estimation. Repeatability tends to be degraded in summertime. With this in mind, we have carried out further analysis to investigate causes of fluctuations seen in measured baseline length.

A correlation analysis between measured baseline lengths and surface meteorological data was made and it was suggested that an apparent position change of Kashima station occurred according to the change of temperature. Kashima station is located close to the Pacific Ocean and a wide "wet rice field (paddy field)" area is extended opposite direction to the ocean. We assume that both ocean and paddy field are major water vapor supply sources but temperature of water on paddy field is more influenced by ambient temperature than that of ocean. This will cause the water-vapor pressure gradient in the horizontal direction. We evaluate the effect of atmospheric water-vapor pressure gradient on the apparent antenna position shift by using a ray-tracing method and by adopting the surface air temperature data. Results well coincide with the observations quantitatively.