地球科学輻合ゼミナール

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Ground and space based GPS atmosphere sounding: Recent results from GFZ

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During the last decade GPS techniques for ground and space based atmospheric/ionospheric sounding were established as an acknowledged tool for remote sensing. The atmospheric refraction, error source for the majority of geodetic applications, is used as measurement signal. Atmospheric properties, as, e.g., globally distributed vertical profiles of refractivity, temperature, water vapor and electron density can be derived from space based techniques. Ground based measure-ments, provided by global and regional networks, allow for the derivation of vertically or along the line-of-sight (slant) integrated water vapour (IWV) or electron density (Total Electron Content, TEC) content.

We review recent GPS atmosphere sounding results from GFZ. The status of the GPS radio occultation (RO) experiments aboard the satellites CHAMP, GRACE-A and TerraSAR-X is reviewed. Examples of scientific applications of the GPS RO data are given, e.g. clima-tological investigations of the vertical atmospheric temperature structure based on the long term data set from CHAMP (2001-2008) or ionospheric irregularities in E-region of the ionosphere. We also summarize activities related to new satellite missions with GNSS remote sensing applications.

We also introduce recent results of ground based monitoring. 5-min data of the global IGS network are used to derive a global long-term IWV data set. Observations of the regionally densified German network (about 300 stations) are processed in Near-Real-Time to provide IWV, data for assimilation by several European weather centers. In addition the slant data from these stations are used as a basis for 3D-tomographic reconstructions of water vapour. We also present initial results of atmospheric sounding using a small-scale network of single frequency GPS receivers within a meteorological measuring campaign of the World Meteorological Organization (WMO) at Lindenberg, Germany.

Complementary to the sounding techniques for remote sensing are promising GNSS reflecto-metry/scatterometry (GNSS-R) methods based on the detection and analysis of GNSS signals reflected from sea and ice surfaces. They allow for the calibration-free determination, e.g., of sea level changes and significant wave heights. Signatures of reflected components were detected, e.g., in GPS RO data from CHAMP. Current GFZ GNSS-R activities are reviewed, which are closely linked to initiatives related to GNSS receiver development.

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