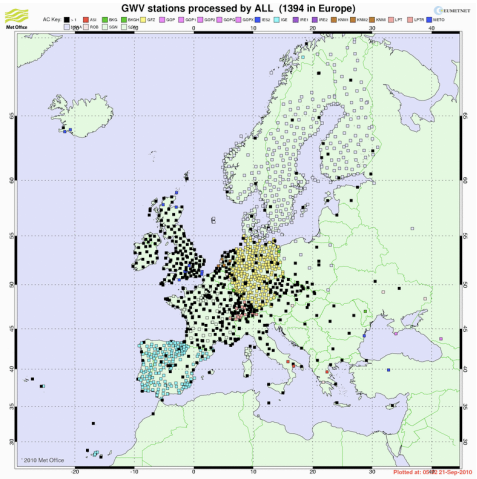
GMES workshop, March 17-18, 2011 @ Sofia Bulgaria

Exploitation of ground-based Global Navigation Satellite Systems (GNSS) for Meteorology and Climate studies in Bulgaria

Dr Guergana Guerova
Department of Meteorology and Geophysics, Sofia University
email: guerova@phys.uni-sofia.bg

Background & Motivation

The Global Navigation Satellite Systems (GNSS), a new technology that revolutionised the navigation, is becoming an indispensable part of our daily life with millions of chips installed in portable car navigation devices and mobile phones. Beside the numerous civilian and commercial applications, GNSS proved to be an accurate sensor of the most abundant greenhouse gas, namely atmospheric water vapour. Application of GNSS in Meteorology is a well established research field in Europe. GNSS data from 1,400 stations (as on the figure to the right) are available, within the EUMETNET - EGVAP project, for model validation and assimilation in state-of-the-art models used for operational weather prediction by the National Meteorologic Services. Advances in GNSS data processing is making possible to also use the GNSS data for climatic trend analysis, an emerging new area of research that is both attractive and important.

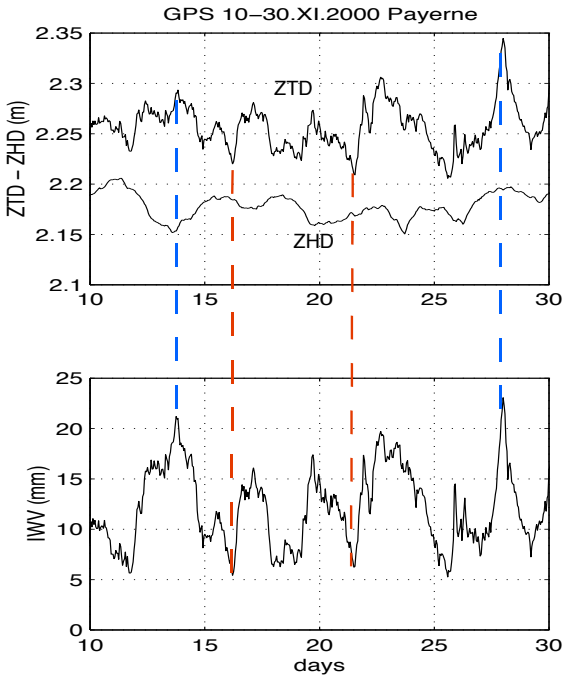


GNSS Meteorology concept

The concept of GNSS Meteorology was first suggested in 1992 by Bevis [1]. As the GNSS signal travels trough the atmosphere its propagation is affected by atmospheric gases and in particular water vapour, which has high temporal variation up to 20-30% within a day. Thus vertically integrated water vapour data with high temporal and spatial resolution can be derived from the GNSS signal time delay. Plotted on the panel to the right is the temporal variation for station Payerne, Switzerland of:

- the total delay in direction zenith: Zenith Total Delay (ZTD)
- the delay due to O_2 and N_2: Zenith Hydrostatic Delay (ZHD)
- the delay introduced by water vapour: Integrated Water Vapour (IWV)

[1] M. Bevis et. al., "GPS Meteorology: Remote Sensing of Atmospheric Water Vapor Using the Global Positioning System." JGR, 97, D14, 1992, 15,787-15,801.



GNSS Meteorology in Bulgaria and Southeast Europe

This project is a first step towards application of GNSS for Meteorology and Climatic studies in Bulgaria and Southeast Europe. The work will be conducted in close collaboration with the University of Bern, Switzerland and the Delft University of Technology, Netherlands. It is expected to foster national links that will lead to integration of the GNSS data from Bulgaria in the European data exchange within EUMETNET - EGVAP project. Note, the present station sparsity in Eastern Europe. A user friendly water vapour database will be developed and used for (1) cross-validation of ground-based and satellite observations and derivation of systematic biases, (2) validation of numerical models used for research and weather prediction, (3) study of water vapour distribution in Bulgaria and Southeast Europe, (4) detection of long term trends in water vapour and links to heat waves, droughts and changes in the pathway of the Atlantic Cyclones, and (5) studies of accuracy of state-of-the-art climate models for Bulgaria and Southeast Europe.

Acknowledgment

This research is supported by a Marie Curie International Reintegration Grant (FP7-PEOPLE-2010-RG) within the 7^{th} European Community Framework Programme.