**Description for the general public**

Humidity is a key ingredient of the atmosphere which has strong control on the occurrence and strength of weather systems. Of main concern to the society are the extreme weather events such as storms, floods and landslides, heat waves and droughts… The impact of climate change on the frequency and intensity of extreme weather events is a crucial question addressed by the international scientific community. Because the precision of climate models is currently limited by insufficient knowledge on many processes in the Earth system (encompassing the atmosphere, oceans, and continental surfaces), measurements (observations) of humidity, temperature, and precipitation, among other atmospheric variables, are crucial. Monitoring the spatial distribution and temporal variations of these variables on the long term is challenging and of paramount importance to better understand the mechanisms controlling the weather and climate.

In this project we propose to assess the potential of the ground-based Global Navigation Satellites System (GNSS) networks as atmospheric integrated water vapor sensors for climate monitoring over Europe. GNSS data are currently used operationally for weather forecasting in Europe but not for climate applications. The reason is that the requirements on the quality of data for climate monitoring are much more demanding than for weather forecasting and necessitate hence special methodological developments.

We propose thus to conduct an end-to-end study including:

- The development of a methodology for optimal processing and post-processing of GNSS measurements for climate monitoring;
- The elaboration a high quality reprocessed and homogenized data set of GNSS integrated water vapor over Europe for the period 1997-2017;
- The study of the trends, extremes and variability of water vapor, temperature, and precipitation, and the validation of global and regional climate model simulations over Europe using the GNSS integrated water vapor in synergy with other observational and modelling data.

This research will address major scientific questions: (i) Are there significant trends in the mean, extremes and variability of water vapor over Europe during the past 20 years? (ii) How are these trends in water vapor linked with trends in atmospheric temperature and precipitation change over the same period? (iii) What is the realism of the representation of the mean, trends, extremes and variability of the water vapor in global and regional climate models over Europe?

This research will contribute to improve the methodology and optimal usage of GNSS data in the fields of geodesy, statistics, meteorology, and climate research. The project will foster a better understanding of atmospheric humidity and reduce uncertainties in climate predictions, enabling improved national and European policies mitigating negative effects of climate change. Direct and indirect societal benefits can be expected in the fields of disaster management, health, energy, water, agriculture and biodiversity.