Moisture source diagnostic for Hungary based on trajectory analysis and stable isotopic composition of precipitation

Emese Bottyán (1), György Czuppon (2), Krisztina Kármán (2), Tamás Weidinger (1), and László Haszpra (3)

(1) Eötvös Loránd University, Institute of Geography and Earth Sciences, Department of Meteorology, Budapest, Hungary (emese.bottyan@gmail.com), (2) Institute for Geological and Geochemical Research, Research Centre for Astronomy and Earth Sciences, Hungarian Academy of Sciences, (3) Hungarian Meteorological Service

The scope of our study was to determine the origin of precipitation, and to evaluate the relation between the stable isotopic composition (dD and d18O) of the precipitation and its source region as well as the isotopic effects that influenced the isotopic composition along the trajectories. For this purpose, event based precipitation samples were collected in seven meteorological stations in Hungary from April 2012 to November 2013 covering eighteen months. To reconstruct the path of the air moisture from the source region, we ran the NOAA HYSPLIT trajectory model based on GDAS database with 1° spatial and 6 hours temporal resolution, in backward mode for every day and every hour when precipitation took place at the given site, for heights of 500, 1500 and 3000 m. The evaluation of the right time interval of the precipitation event was carried out with applying a threshold for relative humidity of 80% for every height for the starting point. Only these trajectories were considered for further calculation.

The location where water vapour entered into the atmosphere was determined by calculation of the specific humidity along the trajectories. If the specific humidity of an air particle rose in a time interval at least 0.1 g/kg and its position was in the planetary boundary layer, we considered its geographical location as moisture source region. We also evaluated the ratios of the water originated above sea/ocean and continent, and the height at which the moisture was transported from the source to the sampling sites.

We determined five moisture source regions based on the trajectories, so we could give the first quantitative estimation for the precipitation supply of Hungary. We also examined the statistics of the stable isotopic data for every region and the relation between the source region and the stable isotopic composition of the precipitation samples. In addition, we determined the local meteoric water lines for each station.