Retrieval of vertically integrated water vapor from SEVIRI measurements

Laura DOBOR, Aniké KERN*, Zoltán BARCZA, Rita PONGRÁCZ, Sziánh PÁSZTÓR, Csaba FERENCZ*

*Department of Meteorology, Eötvös Loránd University, H-1117 Budapest, Pázmány P. st., 1/4, HUNGARY
Adaptation to Climate Change Research Group, Hungarian Academy of Sciences, H-1051 Budapest, Roosevelt, sp., 9, HUNGARY

E-mail: dobor.laurad@yahoo.com, anikek@itus.elte.hu, zoltanbar@itus.elte.hu, ritapongracz@itus.elte.hu, sziánh@itas.elte.hu, csaba.ferenc@elte.hu

Abstract

Satellite-based remote sensing in Earth sciences provides an efficient way to quantitatively estimate meteorological elements at the atmosphere in high spatial and temporal resolution. Satellite measurement broadcasted to ground-based receiving stations are widely used in environmental and atmospheric science for monitoring purposes. Remotely sensed data is also routinely utilized in numerical weather prediction (NWP). The second installation of the Meteosat Second Generation programme (MSG-2), or Meteosat-9, is a geostationary satellite operated by the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT). The Spinning Enhanced Visible and Infrared Imager (SEVIRI) is a radiometer installed on the MSG-2 satellite, which observes radiation in 12 spectral bands and provides data of minimal 3-h and 1-km horizontal resolution. The presented research activity is based on data acquired by the MSG receiving station located in Budapest, Hungary, at the Eötvös Loránd University (ELTE). In 2009, we adapted the SAF NWS software (Satellite Application Facility on support to Near-surface and Very Short Range Forecasting, developed by the German Meteorological Agency) at the Department of Meteorology at ELTE, and derived several products to support environmental research and weather forecast. We analyzed vertically integrated water vapor (IWV) products derived from SAF NWS. The software uses two different algorithms, which are based on (i) statistical and (ii) physical retrieval of the integrated water vapor content. Verticalized integrated water vapor and layer integrated water vapor at three levels (i.e. 1013-840 hPa, 840-437 hPa, and 437-0 hPa) are calculated in 15 minutes temporal and 3 km spatial resolution (in nadir). The target area covers the Carpathian Basin located in Central-Eastern Europe. Our investigation is mainly focusing on cloud-free conditions in the daytime. For the MSG-2 satellite, which observes radiation in 12 spectral bands and provides data of minimal 3-h and 1-km horizontal resolution, we compared them with the better method MODIS (MODerate resolution Imaging Spectroradiometer) based results. The main aim is to critically assess the applicability of the retrieval methods to calculate integrated water vapor. Our results can directly be used in data assimilation related data selection and contribute to the improvement of weather forecasts.

2/a: Validation of the SEVIRI based IWV estimates

2/b: Diurnal variability of integrated water vapor content

2/c: Comparison of the SEVIRI and MODIS based IWV estimates

Conclusions

- For the estimation of integrated water vapor, the physical retrieval method (PGE13) seems to be the preferred method for SEVIRI. This is demonstrated by the determined daily cycle of IWV (D/C) and validation with radiosonde data (D/R). The dry bias of radiosonde water vapor data has been taken into account during any validation procedure that uses those sounding data.
- Investigation of the daily cycle of IWV might provide invaluable information about the quality and physical attributes of the IWV product. Though MODIS WI-NIR method provides IWV data only for land area, a case study (C12) suggests that MODIS WI-NIR estimates are closer to PGE13 than the MODIS MOD07 based results.
- The temporal evolution of IWV can be utilized in a numerical weather prediction model (e.g., PGE13) and should be used.

References


Acknowledgements

The authors would like to thank the Hungarian Academy of Sciences for the financial support of the project. The MODIS products are distributed by the MODIS Land Products Data Distribution Center (MODIS LPG)(http://modis.gsfc.nasa.gov).