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Application of GNSS for severe weather events in Bulgaria: case study 2012

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GNSS and severe weather events

One of the applications of the GNSS Meteorology is to study severe weather events. Development of this applications is one of the tasks of working group two of the COST Action ES1206 "Advanced Global Navigation Satellite Systems tropospheric products for monitoring severe weather events and climate (GNSS4SWEC)". This work is a contribution to the COST Action and targets the use of Integrated Water Vapour (IWV), derived with the GNSS Meteorology method, during severe weather events provoked by a heavy precipitation in Bulgaria. Two case studies for 2012 are presented.

2D IWV maps for Bulgaria

Morland and Matzler (2007) propose an altitude correction based on the exponential decrease of IWV observed by the Swiss GPS network (figure 1 right panel):

$$IWV(h) = a \times IWV(0.498) \times exp\left[\frac{0.498 - h}{H}\right] \quad (1)$$

where: IWV (0.498) is the IWV measured by the GPS at Payerne, h is the height in kilometres for which IWV is being estimated and IWV(h) is the estimated IWV at height h, a is empiricly derived coefficients and H is scale height and depends on the ratio of IWV measured at Jungfraujoch (3584 m) to that measured at Payerne (498 m).

The proposed by Morland and Matzler (2007) correction is applied to 11 stations of the Zenith-geo GNSS network in Bulgaria (zenith-geo web site here) located at altitude between 36 and 542 m. The altitude corrected IWV is used to produce 2D maps of IWV fieled for north Bulgaria.

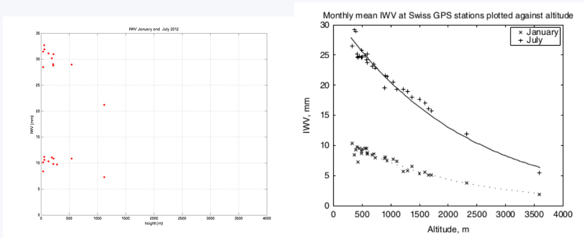


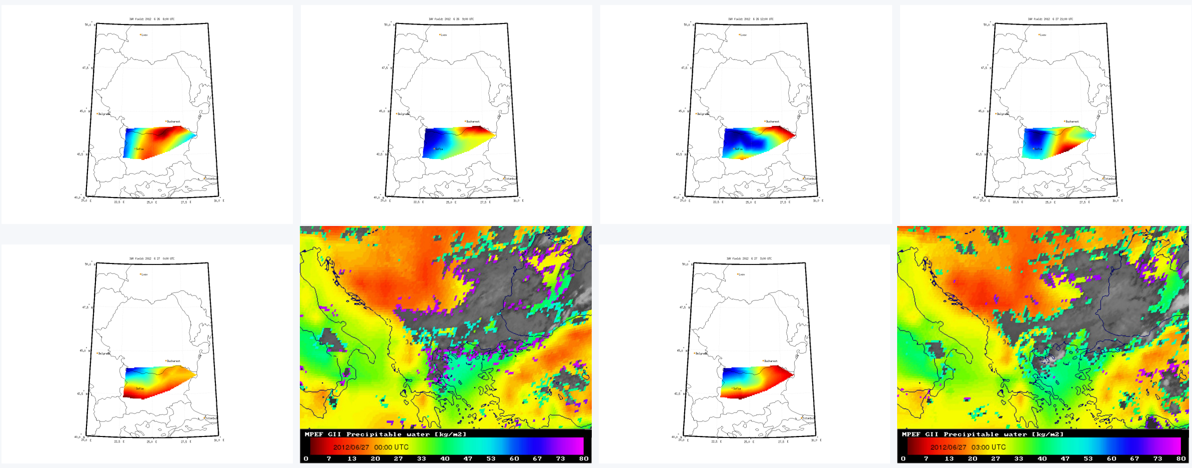
Figure 1: Monthly mean IWV from the Swiss GPS nework (right panel) and from Zenith-geo GNSS network in Bulgaria (left panel) for January (crosses) and July (stars).

Case studies: 25 May 2012 and 27 June 2012

- 25 May 2012

By using two-dimensional maps of the IWV distribution for the 25 May 2012 the maximum of the IWV (30 mm) for the region of Sofia between 06:00 UTC and 12:00 UTC is observed (not shown).This maximum precedes the passage of a cold front. The high amount of the IWV between 06:00 UTC and 12:00 UTC coinsides with the observed rainfall period.

- 27 June 2012



In the figure 2 are shown 2D maps of the IWV distribution obtained by GNSS meteorology method and from Meteosat for 27 June 2012. On the GNSS maps the maximum value for the IWV is displayed in red and the minimum in blue. On the Meteosat images the colors are reversed. The two methods display the strong south - north gradient of the IWV on the Balkan peninsula - its amount is almost double in south. For better understanding of the process the IWV distribution for the previous day is also shown. The intrusion of cold dry air can be easily noticed. The Balkan mountain plays the role of a barrier and the clod air first spread alonf the flatland region of the Denube river. This case study also demonstrates the synergy between GNSS meteorology and the Meteosat products.

Acknowledgment & References

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June Morland and Christian Matzler, ”Spatial interpolation of GPS integrated water vapour measurements made in the Swiss Alps”, 2007.