

# Water vapour anomaly during the 2003 and 2007 heatwaves in Switzerland and Bulgaria

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## 2003 and 2007 heatwaves in Europe: water vapour anomaly

According to Bono et al. (2004), the 2003 European heatwave was the deadliest natural disaster in the last 50 years in Europe. The 2003 mean summer temperature in Switzerland was on average 3°C higher than the 1961 - 90 mean, corresponding to an excess of up to 5 standard deviations (Schar et al., 2004).

The Integrated Water Vapour (IWV) at GPS station Payerne (figure 1a), show: 1) a large positive anomaly in June (17%), 2) a small negative anomaly in July (-3%) and 3) a small positive anomaly in August 2003 (5%) (bottom panel in figure 1a). In 2003, both the radiosonde (figure 1b) and the GPS derived annual mean IWV show a small decrease in the range -3 and -1% when compared to the 13 and 6 year mean.

Globally, the column-integrated water vapor is expected to increase by about 7% for every 1° increase of temperature in agreement with the Clausius-Clapeyron (C-C) equation.

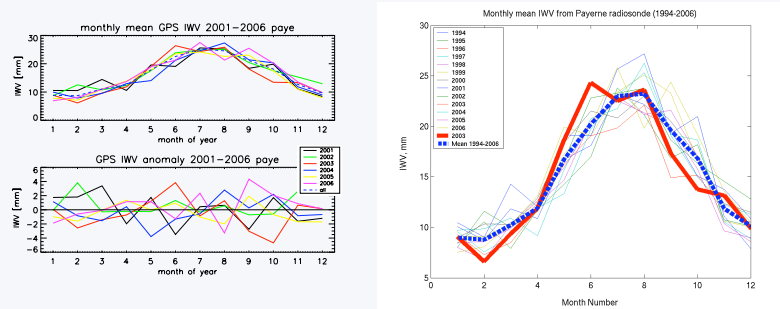


Figure 1: Monthly mean IWV: a) from GPS 2001-06 (left) and b) radiosonde 1994-2006.

In June and July 2007 a large part of the eastern Mediterranean and the Balkan Peninsula experienced heatwaves. In Romania, the estimated agricultural losses due to the heatwaves are about \$ 2 billion. The 2007 mean temperature in Bulgaria was on average 1.6°C higher than the 1961 - 90 mean.

## 2003 heatwave summer in Europe: temperature and rainfall anomaly

Positive temperature anomaly of 4°C was observed at Payerne in June and August 2003 (bottom right panel in figure 2a). The rainfall observations at 5 locations were examined and consistent decrease in rainfall were found during the first half of the year. In particular, during 2003 spring (MAM), the rainfall decreased by 50%. The 2003 summer (JJA) rainfall was 14% below the 2001-2006 mean.

The lack of rainfall during the 2003 spring and summer (bottom right panel of figure 2b) is a possible explanation for the factor of 2 difference between the observed increase of water vapour during the 2003 summer heat wave and the theoretical prediction based on the Clausius-Clapeyron equation.

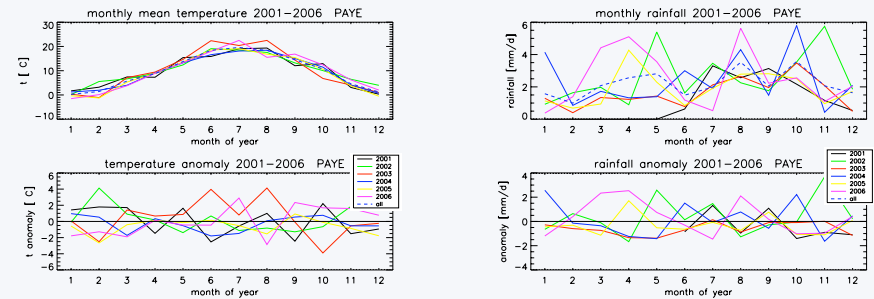


Figure 2: Monthly mean a) temperature (left) b) rainfall (right) at Payerne 2001-06.

Black et al. (2004) report an enhanced latent and sensible heat fluxes in June 2003. The increase in evapotranspiration in June 2003 facilitated the soil moisture depletion and further heating went into raising temperature, hence the heat wave in August 2003.

## Acknowledgment & References

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 Black et al., Factors contributing to the summer 2003 European heatwave. *Weather*, 59, 217-223, 2004.  
 Bono et al, Impacts of summer 2003 heat wave in Europe, *UNEP Environment Alert Bulletin*, vol. 2, 2004.  
 Schaer, C., and G. Jendritzky, Climate change: Hot news from summer 2003, *Nature*, 432, 559560, 2004.