On the evolution of precipitation in Central and South-Eastern Europe and its relationship with Lower Danube discharge

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Changes in temperature and precipitation regime are expected to lead to changes in the water regime of rivers. In this study we investigate the evolution of precipitation in the Upper and Middle Danube basin, for the 20th century, in connection to variations in the Lower Danube discharge. The average precipitation in the Upper and Middle Danube basin, as calculated from the records of 17 weather stations, and the discharge at Orsova display similar interannual and interdecadal variations. The variations in precipitation in the Lower Danube basin, recorded at 10 weather stations, show up in variations of the tributary rivers discharge and in the discharge of the upstream station Orsova and the downstream station Ceatal. To discuss interannual to centennial trends in precipitation, in the records of 17 weather stations, and in the discharge at Orsova, we applied spectral analysis applied to data using Multiple-Taper Method (MTM). The analysis reveals variations of short period (2-7 years), decadal variations with a period of ~11 years and variations with longer periods, 22 and/or 30 years and even longer. The time series were filtered by means of 11- (interdecadal trend, red) and 22-year (centennial trend, blue) running averages.

European climate data

- daily means of surface air temperature (SAT) from 24 European stations (red dots) during the period 1901-2011 (www.eca.knmi.nl/dailydata/); yearly means from 14 Romanian stations during the period 1850 - 2004 (brown dots); yearly means from Central Europe (1659-1999), De Bilt (1706-2011), Uppsala (1723-2011), Stockholm (1756-2011), Prague (1770-2002), Vienna (1775-2002) and Hohenpeissenberg (1781-2002) (green dots);
- daily means of precipitation (P) from 13 European stations (blue triangles) during the period 1901-2011 (www.eca.knmi.nl/dailydata/); yearly means from 14 Romanian stations during the period 1850 - 2004 (blue triangles);
- yearly means of lower Danube discharge (Q) from 4 gauges along the river, on the Romanian territory, namely Orşova (1840-2000) - upstream, Ceatal, Sulina, and SF Gheorghe (1921-2007) - downstream (light blue circles).

Anomaly relative to the mean over the time interval 1961-1990

- coherence of the variation - different linear trends

Precipitation and Lower Danube discharge

Interdecadal and centennial trends in precipitation, lower Danube discharge and surface air temperature

-11-year at Orsova (upstream) and met stations in the Upper and Middle Danube basin

-22-year at Orsova (upstream) and met stations in the Upper and Middle Danube basin

-22-year at Ceatal (downstream) and met stations in the Lower Danube basin

CONCLUSIONS

- the evolution of precipitation in the Upper and Middle Danube basin, for the 20th century, in connection to variations in the Lower Danube discharge was investigated;
- good correlation between the Danube discharge and precipitation recorded in the two studied catchments: Upper and Middle Danube basin and Lower Danube basin;
- delay of ~2 years in case of recorded data, and of ~4 years in case of interdecadal trends between precipitation and Danube discharge;
- discharge data and precipitation show similar variability at decadal, interdecadal and centennial timescales.

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References