Geophysical Research Abstracts
Vol. 16, EGU2014-1210, 2014
EGU General Assembly 2014

Trend analysis of river water temperatures in the Ebro River Basin (Spain)

Mª Angeles Lorenzo-Gonzalez, Dolores Quilez, and Daniel Isidoro
Centro de Investigación y Tecnología Agroalimentaria de Aragón (CITA), Zaragoza, Spain (malorenzog@aragon.es)

Water temperature is an important factor conditioning physical, biological and chemical processes in water courses. The huge changes along the last 50 years in land and water use (dam construction, urban development, nuclear power plants (NPP), riparian alteration, irrigation development, and return of agricultural lands to forests), along with climate change, call for the study of their influence on river water temperatures.

This work analyzed the trends (1973-2010) in water temperature (T_w) along the Ebro River (14 water quality stations) in North-East Spain and its main tributaries (6 water quality stations), as a first step to assess its possible relationships with land use changes, climate change, and other factors. Water temperature trends (ΔT_w) were estimated by two different methods: (1) multiple regression incorporating year seasonality and linear trend; and (2) non-parametric Mann-Kendall seasonal trend estimator. A cluster analysis based on principal components (performed upon the variables T_w, ΔT_w, annual T_w range, lag of the T_w annual cycle, coefficient of correlation between water and air temperature (T_a), and station altitude) allowed for grouping stations with similar behaviour in T_w (along the year, seasonality, and throughout the study period, trend).

Trend analysis by the regression and Mann-Kendall methods produced similar results. They showed significant ($P<0.05$) annual upward trends in T_w in all the stations but for the 2 headwater stations of the tributaries Aragón and Segre. However, there were significant differences in ΔT_w among stations and seasons. The lower reach of the Ebro River, downstream the Ascó NPP, showed the highest ΔT_w with an increase of 3.5^oC in 40 years ($\sim 0.09^oC$/year). In contrast, the stations located on dams or on the lower reaches of the tributaries showed the lowest trends: 1.3^oC in 40 years ($\sim 0.03^oC$/year). Generally, the ΔT_w were significant from April to June, but in the lower reach of the Ebro River (downstream from Ascó station), ΔT_w was significant from December to September.

The cluster analysis identified four kinds of stations: (i) headwaters with low T_w and generally low ΔT_w and close relationship between T_a and T_w; (ii) stations on dams, downstream the Garoña NPP, or downstream the main tributaries, with the weakest relationship between T_a and T_w; (iii) the stations in the mean reaches of the Ebro River and outlets of the main tributaries showing the closest relationship between T_a and T_w; and (iv) stations downstream from Ascó NPP that showed the highest ΔT_w and T_w (2^oC higher than contiguous stations).

Altogether, a noticeable increase in T_w was observed throughout the Ebro River Basin (up to 2^oC in 40 years) which may affect physic-chemical and biological in-stream processes. Although climate change should be contributing to this increase, the contribution of other anthropogenic factors (particularly related to land use, as irrigation development and reforestation) is likely to be important in this basin and its effect on T_w should be studied in detail.