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REVIEW ARTICLE - SPECIAL ISSUE

Introduction to the special issue on "hydro-meteorological time series analysis and their relation to climate change"

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Observed changes in the climate system are unequivocal: atmosphere and ocean warming, sea level rising, amounts of snow and ice diminution and extreme weather events increasing are some examples (IPCC 2014). The impact of these phenomena on eco-hydrological processes is being studied all over the world (Tahir et al. 2011; Willems and Vrac 2011; Ficklin et al. 2016; Wu et al. 2016). Under this context, the study of hydro-meteorological time series is crucial to understand and characterize the behaviour of important variables such as rainfall and its related patterns and consequences (droughts and floods episodes), river flow, temperature, etc. Recent works show that small changes in temperature, precipitation and snow can have a large impact at the basin scale, being these variables the most affected by climate change (Wang et al. 2014; Zarenistanak et al. 2014; Faiz et al. 2017).

Considering the need to deeply know the evolution of hydrological series, it is important to note that water scarcity is one of the most significant challenges that society has to face today and in the coming years, being the key resource for socio-economic development and the natural ecosystems sustainability (Machiwal and Jha 2012). Due to unbridled urbanization and industrialization and the global growth of the population, the water demand is progressively growing in different locations around the world (UNESCO 2009; Grafton and Hussey 2011).

With the idea of modelling climate behaviour and forecasting more accurately certain meteorological variables, the use of different techniques can be found in the scientific literature. In this sense, many methods can be applied to detect trends and break points, to obtain scale properties and other characterization parameters. From the identification of significant cyclical components of solar irradiance and temperature (Boland 1995) using Fourier transform (spectral analysis) to the detection of long-range correlations in nonstationary hydro-meteorological time series using multifractal approach (Kalamaras et al. 2017; Krzyszczak et al. 2017), numerous techniques have been used to describe in detail the relevant natural processes. They range from the classical deterministic models such as Box–Jenkins approach or ARIMA to the most current ones using Artificial Neural Networks, Wavelet analysis, Support Vector Machine or Genetic Algorithms (Bărbulescu 2016).

To guarantee the reliability of the results obtained from time series analysis, it is necessary to work with validated data sets. Thus, different quality control procedures should be previously applied to hydro-meteorological series, identifying incorrect values, gaps or inconsistent records (Estévez et al. 2011; Fiebrich et al. 2010; López-Lineros et al. 2014).

Since hydro-meteorological variables exhibit a widely different behaviour in time and space, a detailed analysis of historical data series in different places of the world is needed. It is then a challenge for scientists to be able to understand how climate change is affecting hydro-meteorological datasets or vice versa, how the different behaviour of these variables can impact on the actual and future climate. This special issue aims at contributing to the understanding of such relationship, providing the most recent results in the analysis of time series of temperature, rainfall, drought, river flow, recorded worldwide and investigated with various statistical methods to disclose deep dynamical climate-linked properties and patterns.

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References

Bărbulescu A (2016) Mathematical methods applied for hydro-meteorological time series modeling. In: Studies on time series applications in environmental sciences. Intelligent systems reference library, vol 103. Springer, Cham

Boland J (1995) Time-series analysis of climatic variables. Sol Energy 55(5):377–388

Estévez J, Gavilán P, Giráldez JV (2011) Guidelines on validation procedures for meteorological data from automatic weather stations. J Hydrol 402:144–154

Faiz MA, Liu D, Fu Q, Qamar MU, Dong S, Khan MI, Li T (2017) Complexity and trends analysis of hydrometeorological time series for a river streamflow: a case study of Songhua River Basin, China. River Res Appl 34:101–111

Ficklin DL, Robeson SM, Knouft JH (2016) Impacts of recent climate change on trends in baseflow and stormflow in United States watersheds. Geophys Res Lett 43:5079–5088

Fiebrich CA, Morgan CR, McCmbs AG, Hall-Jr PK, McPherson RA (2010) Quality assurance procedures for mesoscale meteorological data. J Atmos Ocean Technol 27:1565–1582

Grafton RQ, Hussey K (eds) (2011) Water resources planning and management. Cambridge University Press, Cambridge, p 777

IPCC (2014) Climate Change 2014: Synthesis Report. In: Core Writing Team, Pachauri RK, Meyer LA (eds) Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC, Geneva, Switzerland

Kalamaras N, Philippopoulos K, Deligiorgi D, Tzanis CG, Karvounis G (2017) Multifractal scaling properties of daily air temperature time series. Chaos Solitons Fractals 98:38–43

Krzyszczak J, Baranowski P, Zubik M, Hoffmann H (2017) Temporal scale influence on multifractal properties of agro-meteorological time series. Agric For Meteorol 239:223–235

López-Lineros M, Estévez J, Giráldez JV, Madueño A (2014) A new quality control procedure based on non-linear autoregressive neural network for validating raw river stage data. J Hydrol 510:103–109

Machiwal D, Jha MK (2012) Introduction. Hydrologic time series analysis: theory and practice. Springer, Dordrecht

Tahir AA, Chevallier P, Arnaud Y, Neppel L, Ahmad B (2011) Modeling snowmelt-runoff under climate scenarios in the Hunza River basin, Karakoram Range, Northern Pakistan. J Hydrol 409(1):104–117

UNESCO (2009) The 3rd United Nations World Water Development Report: Water in a Changing World. World Water Assessment Program. UNESCO, Paris

Wang X, Yang X, Liu T, Li F, Gao R, Duan L, Luo Y (2014) Trend and extreme occurrence of precipitation in a mid-latitude Eurasian steppe watershed at various time scales. Hydrol Process 28:5547–5560

Willems P, Vrac M (2011) Statistical precipitation downscaling for small-scale hydrological impact investigations of climate change. J Hydrol 402(3):193–205

Wu F, Wang X, Cai Y, Li C (2016) Spatiotemporal analysis of precipitation trends under climate change in the upper reach of Mekong River basin. Quat Int 392:137–146

Zarenistanak M, Dhorde AG, Kripalani RH, Dhorde AA (2014) Trends and projections of temperature, precipitation, and snow cover during snow cover-observed period over southwestern Iran. Theor Appl Climatol 122:421–440

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