



Practical Applications of the Standardised Precipitation Index (SPI) as a Tool for Very Early Warning of Droughts and Floods in the Balkans Region

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Southern Europe is repeatedly identified in IPCC Reports as being particularly vulnerable to water resource impacts with risks being assessed as medium to high with current (low) levels of adaptation. Drought frequency will likely increase by the end of the 21st century under IPCC RCP8.5 (medium confidence).

The Balkans region has encountered some of its most significant ever floods and droughts since 2000, highly symptomatic of intense climate change. Foremost of these are the regional catastrophic floods in Albania (2009-10) (2010-11), Bosnia, Herzegovina and Serbia (2014), and the widespread droughts of 2007-08 and 2013-14. There is an urgent need to improve the awareness and implementation of drought and flood risk management tools in the national Ministries and National Hydrometeorological Services (NHMSs) of s.e. Europe generally.

This paper describes the development and application of a practical user-friendly tool to calculate SPI across a range of timescales as recommended by the WMO, using a conventional 'Year Book' format to enter monthly precipitation values, coupled with some automated and relatively simple VBA code. Since the tool is spreadsheet based, it is user-friendly and graphically intuitive. The conditional formatting capability introduces a visualisation element to the SPI which is extremely helpful to NHMSs and other non-expert decision makers in understanding SPI significance.

Recent practical application of the tool in relation to significant recent floods and droughts in Albania, Kosovo and Macedonia has demonstrated its value as a Very Early Warning tool. However, there are some implicit dangers in simply tracking the SPI 1, 2, n value per se without taking account of the actual accumulated deficits that may generate agricultural and ultimately hydrological droughts.

It is conventionally assumed that the sum of the SPI for all months within a drought event can be termed the drought's "magnitude". In fact this is not the case. In regions where rainfall is normally low during a month, large negative or positive SPIs may result even though the departure from the mean is relatively small, and the associated precipitation deficit will also be small. Conversely, a moderate SPI value in a high(er) precipitation month is likely to be much more significant with regard to precipitation 'hazard'.

The paper therefore illustrates within the SPI procedures the parallel use of a 'Precipitation Hazard Index' (PHI) which employs two key principles:

- The relative value of the SPI 1, 2, n is transformed to the PHI by simply by multiplying the SPI x the precipitation mean value for the same time period. The resultant score is more meaningful in precipitation deficit terms.
- The monthly PHI score is then accumulated continuously. The possibility for the SPI to fluctuate from negative to positive or vice-versa within a time period can disguise the continuing presence of a significant hydrological drought or flood hazard. Continuous accounting of the PHI arguably provides greater insight into the potential onset, severity and duration of a significant hydrological event.