Hydrol. Earth Syst. Sci. Discuss., 5, S1429–S1433, 2008
www.hydrol-earth-syst-sci-discuss.net/5/S1429/2008/

Hydrology and Earth System Sciences Discussions

Interactive comment on "A precipitation-based regionalization for Western Iran and regional drought variability" *by* T. Raziei et al.

T. Raziei et al.

Received and published: 7 October 2008

We thank both reviewers for their careful reading of the paper and useful suggestions. Below we quote each comment, provide our brief response to it, and indicate the changes made in the text.

Referee #1

General comments. We have appreciated very much the positive comments of Referee #1 on the scientific relevance of the topic addressed in the paper and the methodology used. In particular, the reviewer pointed out the shortcomings of the Precipitation Index (PI) with respect to the Standardized Precipitation Index (SPI) for drought studies. We totally agree about this, since the SPI has several properties that make the index a powerful tool for drought monitoring and related analyses. In the present paper our aim was just to show that using the seasonal precipitation amount we can identify five sub-regions in western Iran characterized by different variability, while considering a measure of hydrological drought as the basic variable for the analysis the sub-regions with independent variability reduce to two as shown in another paper (Raziei et al., 2008). This is a consequence of the different concept of 'precipitation regime' and 'drought regime'. The easiest way to illustrate this is to compute the standardized annual precipitation anomaly that is a rough measure of hydrological drought because it is standardized and involves a long time scale (the PI, due to its standardization, might be considered as a precursor of the SPI). Results suggest that the annual PI, despite its limitations, is able to capture the main features of drought variability in the region being in agreement with the analysis carried out using the SPI-12 (Raziei et al. 2008). However, for a quantitative and objective analysis of drought variability and related climate regionalization purposes, we strongly recommend the use of the SPI. The main difference, in fact, between SPI and PI is the mapping of the empirical probability distribution of cumulated precipitation into a normal distribution. This equal-probability transformation guarantees an objective comparison of the climatic conditions of different sites characterized by different hydrological regimes and allows monitoring both dry and wet periods. We have included these comments in the revised text.

Revised text, Section 4.5, at the end of the section: 'Finally, it is worth to notice that the PI has several shortcomings, among them the hypothesis that the basic variable at single station is Gaussian distributed (for details see Kats and Glantz, 1986). On the contrary, the SPI has several properties that make the index a powerful tool for drought monitoring and related analyses (see Bordi and Sutera, 2002 and references therein). Thus, for a quantitative and objective analysis of drought variability and related climate regionalization purposes, the use of the SPI is strongly recommended as also tested for Iran (Raziei et al., 2008). The main difference, in fact, between SPI and PI is the mapping of the empirical probability distribution of cumulated precipitation into a normal distribution. This equal-probability transformation guarantees an objective

HESSD

5, S1429–S1433, 2008

Interactive Comment

comparison of the climatic conditions of different sites/areas characterized by different hydrological regimes and allows monitoring both dry and wet periods. Thus, the aim of the present PI application is just to show that using the seasonal precipitation amount five sub-regions in western Iran can be identified that are characterized by different time variability, while considering a measure of hydrological drought as the basic variable for the analysis the sub-regions with independent variability reduce to two. This is a consequence of the different concept of 'precipitation regime' and 'drought regime'.'

Revised text, References: 'Bordi, I., and Sutera, A.: An analysis of drought in Italy in the last fifty years, Il Nuovo Cimento, 25C, 185-206, 2002.'

Specific comments:

1) The Mann-Kendall test is commonly used in Hydrology for trend detection and it is widely recognized that nonparametric procedures can have significantly higher power than parametric procedures in cases where there is a departure from normality. In our case the distributions of annual PI for the five sub-regions are positively skewed. Thus, for these reasons we decided to apply the Mann-Kendall test. However, for moderately skewed distributions, as in our case, the t-test is almost as powerful as the Mann-Kendall test.

2) According to the reviewer's suggestion we used the new variable y=p1(xyear-1966)+p2, with xyear from 1966 to 2000, for computing the coefficients of the linear fits.

The new legend of Table 4 is: 'Table 4. Values of angular coefficients (p1) and the intercepts (p2), with the corresponding error bands at 95% confidence level, Sum Square Error (SSE), the R-square statistics of the linear trend (i.e. y=p1(xyear-1966)+p2, with xyear from 1966 to 2000), and the Man-Kendall statistics of the regional annual PI time series. The critical values for the Man-Kendall statistics test at P-value= 0.1, 0.05 and 0.01 are 1.645, 1.96 and 2.576, respectively.'

HESSD

5, S1429–S1433, 2008

Interactive Comment

Technical corrections:

1) For table format we followed the recommendations of the HESS Journal. However, we agree with the reviewer and we have included in the new Table 1 a horizontal blank row below the investigated variables.

2) Yes, we agree and we changed the text accordingly. Section 3, after Eq. (1): '...where Pi is the mean rainfall of the ...'

3) We agree. Thus, in the revised text we denoted the un-weighted precipitation index with PIt hat .

4) At page 2151 and 2136 of the original text we refer to hydrological drought since the time scale under investigation is 12 months. Here the term 'hydrological' refers to the kind of drought analyzed and not to the basic variable.

Referee #2

The authors would like to thank Referee #2 for his positive and helpful comments that contributed to improve the presentation of the paper.

Minor modifications:

1) Since we are dealing with the variability of precipitation in time and space, relating our results with the seasonal mean sea level pressure maps appears less important, particularly for readers with less background in Atmospheric Physics. Moreover, in capturing the large-scale atmospheric conditions leading to precipitation, it should be interesting to analyze the sea level pressure anomaly in combination to other variables such as the geopotential height and temperature. However, for a comprehensive presentation in the manuscript only sample periods in the time series should be considered and displayed in a new additional section. This would defocus the main target of the paper that is the climate regionalization based on precipitation regimes within the region. For these reasons we decided to not include in the revised paper the suggested maps, though we recognize the relevance of an analysis of the large-scale atmospheric circu-

HESSD

5, S1429–S1433, 2008

lation patterns leading to precipitation events in Iran, especially hydrological extreme events. This can be the topic for future investigations.

2) We agree, we changed the revised text accordingly. Revised text, Section 3.1: '...the co-variability of precipitation time series at given stations across the study area'.

3) Figure 6 illustrates the eigenvalues corresponding to the un-rotated components, while Table 1 shows the eigenvalues associated to the Varimax rotated components. This is the reason for the differences in the eigenvalues shown in Fig. 6 and Table 1.

4) We agree; we have shown in the new Fig. 1a the rivers mentioned in the text.

5) 'Alborz' (from Persian language) is also written as 'Alburz' or 'Elburz' in the literature (mainly in old French textbooks). This is the origin of the different names in the map and text. To avoid any confusion we used the same word in the revised text, i.e. 'Alborz'.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 5, 2133, 2008.