Comments to the paper "Determining spatial variability of dry spells; Markov based method, applied to the Makanya catchment, Tanzania"

General comments

The manuscript illustrates a methodology oriented to identify drought vulnerable areas, with special reference to sub-Saharan African regions, in order to develop strategies to reduce the risk of crop failure and increase agricultural yield through targeted irrigation and rainwater harvesting practices.
With respect to the proposed methodology, I totally agree with general comments by Dr. Bazrafshan. In addition, I believe that the authors should make an effort to better emphasize the main novelties in their study compared with previous published researches (De Groen, 2002 e Savenije, 2006).
Regarding the application, my impression is that results could be highly affected by uncertainty due to the lack of data, which, in my opinion, may lead to unreliable conclusions. More specifically, the maximum dry spell lengths of fixed occurrence probabilities have been derived with reference to rainfall data observed just in one season, namely Masika 2006. The authors have tried to compensate this fact by means of a scaling factor, based on the data set of Sane rain gauge, located outside the Makanya catchment. Since "Mul et al. (2009) show that precipitation can be very localised and highly variable" in this area (see lines 8-9, p. 11710), it's hard to believe that rainfall field in Sane could be the same as the one over the whole Makanya catchment. Similarly, another possible drawback may lie in assuming only one value of soil moisture for the whole catchment, when the critical drought spell length is derived.
Although the authors state that their methodological framework can applied to data scarce environment, anyway I think it requires a minimum amount of data to provide plausible, although qualitative, conclusions.

Specific comments

Abstract
Line 9-10: "In this paper a new Markov-based framework is presented to spatially map the probability of dry spell occurrence." As a matter of fact, the paper shows maps of dry spell lengths for fixed occurrence probabilities (see Fig. 4 B-D). This ambiguity is repeated several times in the text.

1. Introduction
Introduction should illustrate the main purposes of the study.

2.4 Probability of dry spell duration
Although Eq. (9) is a result of a previous study, I would suggest to briefly describe the analytical derivation of such equation, as well as the underlying simplifying hypothesis, if any.

3.1 Markov properties
Lines 16-18, p. 11715: The authors state that "the transition probabilities ... were calculated for the three individual month of the Masika season ... and for the season as a whole using Eqs. (2) and (3) (Table 1)". Following this sentence, I would expect to find transition probability values for each of the three months in the upper part of Table 1, but I can read only one couple of values for each station. Why? In addition, I believe that transition probabilities in Table 1 have been calculated based on Eqs. (5)-(7) rather than on Eqs. (2) and (3). Please clarify.

Line 10-13, p. 11716: "The scaling factor is derived by dividing the seasonal rainfall value of the Masika season in 2006 by the long term average amounts for the rain gauge located in Same (1940–2007) resulting in a factor of 0.55 [–]". The scaling factor is derived by using a data set from 1940

to 2007, while transition probabilities are previously derived by using data sets from 1940-1989. In my view, this is another weak point in the application.

Minor comments

1. Introduction
Line 26, p. 11708: replace "... shift to a more resource intensive diet is expected (Savenije, 1999; WWAP, 2009), requiring more use of the resources." with "... shift to a more water resources intensive diet is expected (Savenije, 1999; WWAP, 2009)."

2.2 Markov-based framework for critical dry spell analysis
Lines 20-23, p. 11711: Please provide a description of the flow chart in Fig.2

Line 23, p. 11711: " a short, but high spatial resolution, data set on rainfall exists". I understand that this is just a 1-year data set, namely 2006. Please specify.

Line 24, p. 11711 "... there are a number of stations which have up to 90 yr of daily rainfall ...". From Fig. 1 it seems that such stations have observations from 1940 to 1989, that is 50 years. Please clarify this point.

2.3 Spatially distributed Markov chain properties
Please define mathematical symbols which appear in eqs. (1), (2) and (3).

From Eq. (4) to Eq (7), P indicate the monthly rainfall value. P usually defines the occurrence probability, which is indicated as F in the paper. I would suggest to change symbols to avoid misunderstandings by the readers.

Line 23, p. 11713: reference to Fig. 2 is misleading, since maps of the spatial distribution of transition probabilities are expected to be represented in Fig. 2, which is not.

2.5 Critical dry spell
Line 10, p. 11715: reference to Fig. 4 is misleading.

Lines 10-13, p. 11715: "The critical dry spell length is then combined with the probability of a dry spell occurring ...". I would rather say that "The critical dry spell length is then compared with maximum dry spell length derived from Eq. (9) for different probability values".

3.1 Markov properties
Lines 18-20, p. 11715. "Single seasonal transition probability values scatter around a median value of a rainfall class (De 20 Groen, 2006)". I cannot get the link with previous statement.

Line 4, p. 11716: Please define the statistic F in Table 2.

Line 16-19, p. 11716: "The combination of the fixed coefficients ... provides the spatially distributed transition probabilities map of p_{01} and p_{11}". Fig. 4 B-D, does not illustrate the spatial distribution of transition probabilities. Please rephrase.

3.2 Dry spell maps
Lines 22-23, p. 11716:" These three graphs show the probability of non exceedance of dry spells of 80 %, 50% and 20% (based on Eq. 9)". Again, this sentence is misleading, as the figures show the spatial distribution of dry spell length for different occurrence probabilities.