Hydrology and Earth System Sciences Discussions

Interactive
Comment

Interactive comment on "Estimation of vegetation cover resilience from satellite time series" *by* T. Simoniello et al.

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We thank the reviewer for his/her detailed comments to improve the quality of the paper, which has been revised by taking into account the referee's suggestions.

General comments

Reviewer Comment (RC) - Sect. 4.2, page 520: on the use of the fuzzy K-mean unsupervised algorithm. Is there a particular motivation to choose the fuzzy K-means unsupervised algorithm instead of the k-mean algorithm or another unsupervised method? Please, a comment on this point.

We selected the fuzzy-k-means since what we expect in a phenological classification is not an abrupt variation between a cluster phenology and another; instead, especially for natural vegetation, we can expect that there are gradual differences among

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phenological patterns. In this context, the fuzziness concept can be more appropriate than an abrupt partition. In fact, if we consider very few clusters (e.g. 2-4), the use of fuzzy K-means or simple K-means unsupervised algorithm on monthly NDVI provides quite similar classification results. By increasing the number of clusters (e.g. 5-15), the simple K-means tends to generate clusters with a high lack of distribution homogeneity: it tends to highly fragment few clusters leaving practically unaltered the others. To obtain results similar to fuzzy K-means from the simple K-means algorithm, we need to search for a large number of clusters and, then, to proceed with an aggregation process. We also tested the Isodata clustering and we found that fuzzy K-means and Isodata algorithms provide similar cluster distribution; but considering the number of input parameters required to run the Isodata the first one is highly preferable. We added a sentence in text in order to explain the motivation of fuzzy K-means algorithm.

(RC) - Sect 5, Results: on the temporal interval used to estimate the mean life time _ (years). Reference period to compute the persistence map is 10 years, and the evaluation period, 12 years. Have the authors checked how the reference temporal interval could influence the estimation of _ ? For example, how much them could change if the reference time interval was shorter? A brief discussion on this point is welcome.

Two points have to be evaluated to exclude shorter reference period.

The first one is linked to a technical issue: the mean life cycle of NOAA satellite platforms is about 4-5 years, the selected interval is long enough to consider at least two platforms in order to minimize eventual intercalibration residuals that could introduce spurious effects in NDVI trend computation.

The second one concerns a statistical issue. NDVI time series are very noised and trends computed at any pixel on too short periods put into evidence short interannual instabilities rather than long range vegetation dynamics. Of course, the length of the reference period is 10 years (1982-1991) for all the pixels, but the "effective" length of

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the initial trend should be a random variable, since for each pixel it depends on the last passage time. As an example, if the period 1982-1987 appears to be stationary at a given site (there is no trend) then the sign of the initial trend will be determined by the fluctuations observed during the previous 4 years 1988-1991. Thus, as it is typical in problems concerning fluctuating fields, the initial conditions express a large variety of "old" and "young" fluctuations and trends. Pixel details depend on such initial conditions but general dynamical inferences concerning the stationary character of the series should not vary. In particular, vulnerable areas, identified by negative trends that persist along all the observational period continue to be vulnerable also if we extend the reference period.

(RC) - Sect 5, Results: on the pixel resolution. Given the experience of authors for processing 1.1x1.1 km2 AVHRR data, could the authors give a comment on how the pixel resolution could influence the estimation of _?

Larger pixels tend to smooth the NDVI response being composite by mixed targets at sub-pixel level, this is especially evident in very heterogeneous regions such as the investigated study area. Generally, the lower the resolution, the lower the NDVI variability, therefore trends estimated form 8km data are lower in magnitude compared to those estimated from 1km time series, but they are slightly more persistent.

(RC) - Sect. 5.4, Results: on the time-step used to get clusters. The time step used is of 10 years. In general, the use of more data permits a better estimation of the clusters (in this case, representative phenological responses). Have the authors checked if a shorter time step (e.g. 5 years) could give similar clusters? Moreover: was the selection of the number of clusters (7 clusters) guided from the nr of climate regions? Please, a comment on this point could clarify how much these choices could affect the results.

The optimal choice, obviously, is to adopt the whole time series. We selected a time-step to propose an approach allowing for a computational time reduction. The effects

of shorter intervals were evaluated and we found that the border of clusters change by considering different time-steps for the monthly average computation. Quantitatively, by shortening the time-step, up to consider all the available years, we found a pixel movement among the clusters of about 6% between 10 and 5 year intervals, about 5% between 5 year interval and the whole time series, and about 7% between 10 year interval and the whole time series. In particular, in this last comparison we found a maximum number of shifted pixels (87 on a cluster made of 754 pixel) corresponding to 11.5%. Therefore, for our analysis the influence is minimal.

We selected just 7 clusters since it is the number of vegetated land covers. We excluded the class of water bodies and included also the urbanized areas since at the considered spatial resolution such pixels are made of large vegetated portions. The rationale of such a choice considers that the principal trainer for sub-annual NDVI dynamics is the land cover type, deviations from the characteristic phenological pattern of each land cover are mainly due to climate regime and altitude.

We clarify such points also in the text.

Specific comments (RC) - Page 517, line 16: please, specify the acronym MVC.

The acronym MVC (Maximum Value Composite) was specified.

(RC) - Page 519, line 25: the sentence should be corrected in "... adding all the persistence maps from ti to T."

Actually, there was a misprint in the formula of the cumulative map. Such a map refers to a reference time ti and to an observational time T. It reports the number of years where the sign trend has been confirmed: summation starts form ti+1. As an example, a cumulative map equals to -1 means that the initial (negative) trend is survived for one other year only, that is we found a negative trend both in the period [0 ti] and [0 ti+1]. This misprint has been corrected.

(RC) - Page 520, line 5: to better define q(t), next part could be changed in: "...where

N(t) and N(ti) are the number of non cleared trends having the same sign in P(x,y,t) and P(x,y,ti), respectively."

In order to clarify the persistence probability, we changed the sentence as suggested.

(RC) - Page 522, line 24, and Page 523, line 2: the numbers maximum and minimum divergence (13 years, and -5.7 years) don't fit with values shown in fig. 7. Please, check them (them should be 15 and -5.8, respectively).

There was a typing error in the text. Since we tested different altitude segmentation levels, when we added the new selected figure we erroneously left the values of the old one.

(RC) - On tabs 1,2,3: a quantitative measure of the pixels that have a positive and a negative trends, could be easily obtained by showing the percentage of them. This evaluation could help to better understand the extension of the phenomenon, per class, climatic region or cluster. I suggest to add these percentages in the tables.

The percentage of positive and negative trends at initial stage was added in each table.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 5, 511, 2008.

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