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Discussions

Interactive comment on "Spring phenology and phenology-climate links inferred from two remotely sensed vegetation indices across regions and biomes" *by* Xiyan Xu et al.

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Summary

The manuscript compares the spring greenup date (SG) obtained using the method of Zhang et al. (2003) applied to the GIMMS dataset and the MODIS MOD13C1 dataset. It also compares the trend of the chronological regression on the same period, and the sensitivity of the SG to the climate before the SG. The results are completed by the analysis of the trend before the launch of MODIS.

General evaluation

The current manuscript has a nice first objective which is to explore the impact of the input remote sensing dataset to which the SG algorithm is applied. However it requires

more analysis to achieve this objective. If the objective is to evaluate the impact of the choice of the input dataset then the causes of the differences should be the target. This would allows to increase the confidence in the trend analysis based on the two datasets. The suggestion on the role of the transition from AVHRR2 to AVHRR3 should also be explored in depth as this is quite an interesting opening. In the following I suggest some changes and some previous articles that should be considered. The second objective on the sensitivity of SG to climate cannot be achieved without improvements on the work on the SG determination, as there is strong uncertainty on the SG.

Major comments

1/ The results report differences in the SG obtained with MODIS and with AVHRR and in the trend. The manuscript suggests possible explanations but does not attempt to determine the reasons clearly. In-depth exploration of the causes of these differences should be carried out as it is the aim of the manuscript. Possible sources of uncertainties, including spatial resolution changes with incidence angle, preprocessing, processing are explored in :

Helman, D. (2018) Land surface phenology: What do we really "see" from space? Science of The Total Environment, 618, 665 – 673.

Moreover, a key issue is the snowmelt. It is well-known that the detected SG is related to snowmelt and not to vegetation if the snow is not correctly treated (Moulin et al. 1997, Shabanov et al. 2002). Solutions have been proposed (Suzuki et al. 2003, Delbart et al. 2005, 2006, Thomson et al. 2015, Jin et al. 2017 for examples). In the current manuscript the snow issue is treated differently between the two dataset preprocessing, thus the results differ. It is necessary to assess the uncertainty of the two SG datasets through a comparison to ground observations of leaf expansion, in order to analyse the impact of the snow rejection methods.

Delbart, N., Kergoat, L., Le Toan, T., Lhermitte, J., & Picard, G. (2005) Determination of phenological dates in boreal regions using normalized difference water index. Remote

Sensing of Environment, 97, 26–38.

Delbart, N., Le Toan, T., Kergoat, L., & Fedotova, V. (2006) Remote sensing of spring phenology in boreal regions: A free of snow-effect method using NOAA-AVHRR and SPOT-VGT data (1982-2004). Remote Sensing of Environment, 101, 52–62.

Jin, H., Jönsson, A.M., Bolmgren, K., Langvall, O., & Eklundh, L. (2017) Disentangling remotely-sensed plant phenology and snow seasonality at northern Europe using MODIS and the plant phenology index. Remote Sensing of Environment, 198, 203–212.

Moulin, S., Kergoat, L., Viovy, N., & Dedieu, G. (1997) Global-scale assessment of vegetation phenology using NOAA/AVHRR satellite measurements. Journal of Climate, 10, 1154–1170.

Shabanov, N.V., Zhou, L., Knyazikhin, Y., Myneni, R.B., & Tucker, C.J. (2002) Analysis of interannual changes in northern vegetation activity observed in AVHRR data from 1981 to 1994. IEEE Transactions on Geoscience and Remote Sensing, 40, 115–130.

Suzuki, R., Nomaki, T., & Yasunari, T. (2003) West-east contrast of phenology and climate in northern Asia revealed using a remotely sensed vegetation index. International Journal of Biometeorology, 47, 126–138.

Thompson, B.G. (2015) Using phase-spaces to characterize land surface phenology in a seasonally snow-covered landscape. Remote Sensing of Environment, 166, 178–190.

2/ The pre-season length differs when so the variations of the climate variables differ. Thus the trend of the preseason climate from the two SG datasets should not be compared.

3/ The trends are reported if the p-value is less than 0.1. This is not a good value as it is too high. Maximum is generally 0.05, which is very high already.

5/ The GIMMS dataset and the MOD13C1 dataset are composite products with a compositing period of 15 and 16 days. This has a strong impact on SG uncertainty. This is why PAL product should be prefered (10 day composite) of 8-day MODIS dataset. The effect of the compositing period duration must be explored.

6/ Reported trends should be compared to those from :

Gonsamo, A. & Chen, J.M. (2016) Circumpolar vegetation dynamics product for global change study. Remote Sensing of Environment, 182, 13–26.

Park, T., Ganguly, S., Tømmervik, H., Euskirchen, E.S., Høgda, K.-A., Karlsen, S.R., Brovkin, V., Nemani, R.R., & Myneni, R.B. (2016) Changes in growing season duration and productivity of northern vegetation inferred from long-term remote sensing data. Environmental Research Letters, 11, 084001.

Minor comments

1/ Analysing the sensitivity of SG to temperature through linear correlation is not totally convincing. The phenology models are well known to be unlinear (non linear effects are mentionned in the discussion) and parameterized with thresholds. See for example :

Hänninen, H. (1990) Modelling bud dormancy release in trees from cool and temperate regions. Acta Forestalia Fennica, 213, 1-47.

The consequence is that, for example in an arctic ecosystem, a warming from -15°C to -5°C in March will have no impact on SG whereas a warming from 2°C to 3°C in may would have a strong impact. Thus changes in sensitivity of SG to temperature changes are expected.

2/ The style of the writing is often hard to read and the text should be clarified.

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