GIMMS Phenology: A 1/12-Degree Product of Vegetation phenology for the Northern Hemisphere

Metadata:

Spatial resolution: 1/12 degree
Temporal resolution: annual
File format: GeoTIFF
Scale factor: 1
Fill values: -9999
Spatial extent: Northern hemisphere(>30deg)
Temporal extent: 1982 -2014
Map projection: Geographic
Units: Day of year
Method: the phenology retrieval method is indicated by the number following "Method_" in the file name. See the Description for details on the methods.

Citation:

Wang, X., Xiao, J., Li, X., Cheng, G., Ma, M., Zhu, G., Arain, M.A., Black, T.A., Jassal, R.S. (2019) No trends in spring and autumn phenology during the global warming hiatus. *Nature Communications*, 10, 2389. https://doi.org/10.1038/s41467-019-10235-8.

Fair Data Use Policy:

We make this data product available to the research community as we believe that the dissemination of this data set will lead to advancement in science. If you plan to use our data in a manuscript or presentation, we request that you inform us at an early stage of your work. You should ensure that your research does not significantly overlap with what we are currently working on with this product. In addition, if this data set is essential to your work, or if an important result or finding depends on the GIMMS-Phenology data, co-authorship may be appropriate. You must inform us of your analysis and publication plans well in advance of submission of a paper, give us an opportunity to read and intellectually contribute to the manuscript, and, if appropriate, offer co-authorship.

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Download:

Global Ecology Group Data Repository: http://data.globalecology.unh.edu/data/GIMMS_NDVI3g_Phenology/. ***Please visit our webpage (http://globalecology.unh.edu) for any update.***

Description:

Based on the latest GIMMS NDVI3g dataset, one of the most widely used NDVI datasets to monitor global vegetation, north hemisphere vegetation phenology was estimated using five widely used phenology retrieval methods. To ensure the quality of phenology results, some pre-processes were performed. The pixels with annual mean NDVI less than 0.1 were considered as non-vegetated areas and were excluded in phenology estimation. The Savizky-Golay filter was applied to the GIMMS NDVI3g dataset to minimize the noise before phenology estimation.

The five phenology retrieval methods are explained as follows:

Method 1: First, a double logistic function (EQ 1) was fitted with the time series NDVI, and then the second-order derivative of the fitted curve was calculated. The two dates corresponding to the two local maxima points in the first half year are the SOS and the onset of maturity. The two

dates corresponding to the two local maxima points in the second half year are the onset of senescence and the EOS.

$$y(t)= a+b(1/(1+e^{(c(t-d))}) + 1/(1+e^{(e(t-f))})) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where c, d, e and b are parameters of this function, a is the initial background NDVI value, a + b is the maximum NDVI value, t is time in days and y(t) is the NDVI value at time t.

Method 2: First, a double logistic function (EQ 1) was fitted with the time series NDVI, then the date when NDVI increasing (or decreasing) fastest was used as SOS (or EOS). Specifically, the date corresponding to the maxima (or minima) value in first-order derivative of the fitted curve was determined as SOS (or EOS).

Method 3 and 4: The dynamic threshold NDVI was used to extract phenology. The NDVI was fitted with a double logistic function. Then, the fitted NDVI was normalized using the following function: Ratio_day = (NDVI_day-NDVI_min)/(NDVI_max-NDVI_min), where NDVI_day is fitted NDVI at given day, NDVI_max and NDVI_min are maximum and minimum NDVI each year. A threshold ratio was used to determine SOS and EOS in spring and autumn. Here, we used the threshold 0.2 in method 3 and 0.5 in method 4.

Method 5: A fixed threshold NDVI value was used to determine the phenology. The NDVI season dynamic was calculated from the multiyear averaged NDVI, then the NDVI change rate (NDVI_RC) was estimated from the multi-year averaged NDVI seasonal dynamics using the following function: NDVI_RC=(NDVI(t+1)-NDVI(t))/(NDVI(t)) where NDVI(t+1) and NDVI(t) are NDVI value at time t+1 and t, respectively; The NDVI values correspond to maximum and minimum NDVI change rate are used as the thresholds for SOS and EOS, respectively. The first and second half year NDVI was fitted with a polynomial function: $NDVI=a+a1\times t+a2\times t^2+\cdots+an\times t^n$ n=6, where t is Julian day in a year, and a, a1, a2, … a6 are fitting parameters. SOS and EOS were determined by comparing the fitted daily NDVI with the thresholds.

Citation for this data product:

Wang, X., Xiao, J., Li, X., Cheng, G., Ma, M., Zhu, G., Arain, M.A., Black, T.A., Jassal, R.S. (2019) No trends in spring and autumn phenology during the global warming hiatus. *Nature Communications*, 10, 2389. https://doi.org/10.1038/s41467-019-10235-8.

Relevant publication:

Wang, X., Xiao, J., Li, X., Cheng, G., Ma, M., Che, T., Dai, L., Wang, S., Wu, J. (2017) No consistent evidence for advancing or delaying trends in spring phenology on the Tibetan Plateau. *Journal of Geophysical Research: Biogeosciences*, 122, 3288–3305, DOI: 10.1002/2017JG003949.

Know issues:

During EOS estimation, we found that the GIMMS3g Version1 NDVI data has an abrupt change in autumn. This problem widely existed in pixels with latitude greater than 60°. This has impacted the EOS estimation. User should use caution for using EOS in the high latitude areas.