A new method to compare global vegetation greening phase dynamics

The fraction of Absorbed Photosynthetically Active Radiation (fAPAR) is an essential diagnostic variable to investigate the temporal and spatial dynamics of the terrestrial biosphere. We introduce a new algorithm that allows for the robust identification of seasonal signals from multi-annual time series with a special focus on the difference in the seasonal phases of the characteristic signal.

Robust greening phase analysis

By vector normalisation and integral calculation [1], we isolate the seasonal signal from any amplitude aspects that are influenced by the inconsistencies of the various data sets, derived from fAPAR time series from remote sensing sensors, and from climate models.

Data

Sensor | Time series | Spatial resolution | Temporal resolution
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AVHRR Pathfinder | 1993 – 2000 | 0.5 degree | monthly
SeaWiFS | 1998 – 2005 | 4 km | daily
MODIS combined | 2003 - 2009 | 1998 – 2005 | 1.5 degree

Model

JSBACH | 1985 – 2006 | 1 degree | bimonthly
Global Analysis | 1990 – 2009 | 1 degree | daily
ORCHIDEE | 1986 – 2009 | 4 degree | monthly

References


The robust greening phase pattern algorithm is ideal for the assessment of seasonal processes simulated by the vegetation components of climate models. Regions and land cover types, where the seasonality of the models agree with the remote sensing data sets can be detected as well as regions, where models and observations disagree.

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Figure 1: Phasing calculation of a sample normalised annual fAPAR curve

Figure 2: fAPAR values from SeaWiFS time series (examples from 1998)

Figure 3: fAPAR values from MODIS combined products

Figure 4: (left) Fraction time-series per latitude diagram per sensor time series; (right) sample greening phase patterns for 10% location of 10% greening phase

Pattern comparison

1) Sensor results

The pattern comparison results show consistent global spatio-temporal patterns significant at the 95% confidence level. Based on the monthly resolved data sets that have been evaluated in this study, no remarkable shifts are visible. Shifts stay in the range of +/- 1 month, which is the expected minimum shift for monthly resolved data.

2) Model results

Figure 5: (left) Shifts in time between the greening phase results from seaWiFS products (left) and MODIS combined products (right)

Figure 6: Combination of the phase comparison of three sensors. White regions display a shift between the datasets, at very good agreement, colored regions show high agreement between two sensors and low agreement with the third one.

Greening Phase Analysis

- Robust and fast comparison of seasonality
- Applicable to multi-source time series from various vegetation indices
- Allows for the validation of climate models