Landsat-based Phenological Classification Mapping in Japan

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Land surface phenology (LSP) is associated with climate and terrestrial conditions over space and time, and the monitoring of LSP helps understandings of the terrestrial environments. The LSP is often inferred by satellite observations, and long-term and regularly-composited satellite imagery is now freely available. Due to its complex interactions with geographical and environmental factors, it is often difficult to characterise phenological cycles by LSP. In order to understand the baseline of the phenological cycle which would be expected as the principal vegetation seasonal activity, we aim at classifying LSP temporal patterns over the entire territory of Japan. Normalised Vegetation Difference Index (NDVI) time series during the period of 2014 to 2017 with the spatial resolution of 30m calculated from Landsat 8 surface reflectance were decomposed into three harmonic terms by harmonic analysis with removing of the temporal trend. Then amplitudes and phases of these three harmonic terms were classified into 36 classes according to their orders. Considering tall vegetation (e.g., tree covers) and short vegetation (e.g., agricultural lands), while excluding other land covers, two types of phenological classification maps with 36 classes for each were produced. The phenological classification proposed in this study is a new terrestrial map which provides new important information for land cover studies regarding climate change, environmental degradation, and human impact assessment. This simple unsupervised classification approach can have diverse advantages such as i) only one specific variable (in this case NDVI) was used, yielding a consistent result compared to models with multivariate analysis, ii) complex temporal profiles can be considered, suggesting better descriptions of LSP than using phenological parameters such as start-of-season, peak-of-season, end-of-season, and length of greening period (In particular, our approach can classify temporal profiles with multiple peaks in the seasonal cycle), iii) the unsupervised classification approach do not need reference samples, which would require reliable observations of phenological events for a supervised classification scheme (such datasets are often limited), and iv) the non-thematic way of classification can avoid mislabelling problems. Interpretation of the classification map can be done by the users, making it easy to utilise towards further climate / environmental studies.

Keywords: Phenology, Earth Observation, Landsat

