Accurate detection of spatio-temporal variability of vegetation by remote-sensing observations

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Accurate detection of spatio-temporal variability such as plant phenology (seasonal changes) and land cover changes is important task to evaluate the spatio-temporal variability of ecosystem functions and services and biodiversity under climate changes. Towards this aim, near-surface and satellite remote-sensing observations are useful from plot to global scales with a high spatio-temporal resolution. However, from the ecological research viewpoint, remote-sensing observations have not yet been sufficiently validated by *in situ* observed data and collected sufficient ecological interpretations. Here, (1) we have conducted the "Phenological Eyes Network" (PEN; http://www.pheno-eye.org) [1], which mainly performs daily phenological observations by using time-lapse digital cameras and spectroradiometers, in various ecosystem sites from Pan-Arctic to tropical regions; (2) we validated the phenological observations by near-surface and satellite remote-sensing; and (3) based on the ground-truth, we developed the algorithm for detecting the timing of start and end of growing season and land cover changes by analyzing daily satellite-observed vegetation index data. In this presentation, we review and discuss the usability, uncertainty, problems, and outlook of remote-sensing observations through studies of PEN.

[1] Nasahara & Nagai (2015) *Eco Res* **30**(2), 211–223.