Interannual response of global NDVI for precipitation, temperature, and radiation

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The vegetation over global terrestrial area is dominated by meteorological factors. Among the meteorological factors, precipitation, temperature, and radiation are the most dominant factor for the vegetation distribution and the interannual change. For obvious example, lack of precipitation precludes vegetation in desert in mid-latitude, while lack of temperature constrains the vegetation in high-latitude tundra zones. The cloud cover disturbs the potential photosynthetic activity of the vegetation by reducing the Photosynthetically Active Radiation (PAR; 0.4 - 0.7 micro-meter) from the sun.

How is the geographical distribution of precipitation-sensitive, temperature-sensitive, and PAR-sensitive vegetations? To answer this question, we derived the 10-year (1986 - 1995) time series of the mean precipitation, temperature, and PAR in the growing season (April to August in the Northern Hemisphere; October to February in the Southern Hemisphere), and the annual mean Normalized Difference Vegetation Index (NDVI) in 1 x 1 degree grid cells over the global terrestrial area. The NDVI was acquired from a global 20-year NOAA/AVHRR dataset with 4-minute resolution. Precipitation, temperature, and PAR values were provided from the ISLSCP Initiative II dataset. The 10-year interannual correlations between NDVI and precipitation (NDVI-P), NDVI and temperature (NDVI-T), and NDVI and PAR (NDVI-PAR) was calculated and compared. Those correlations were calculated base on 40 samples by aggregating 4 gird cells (i.e. 10 years x 4 grid cells; the horizontal resolution was reduced to 2 x 2 degrees). Those correlation coefficients (positive part only) were globally mapped.

In the region to the north of 60N in Eurasia and 50N in North America, the correlation of NDVI-T is the strongest, suggesting the vegetation in those areas interannually changes with temperature interannual change. In other regions, strong correlations in the NDVI-P prevail suggesting that most of vegetations in low and mid latitudes are sensitive to precipitation interannual change. Some grid cells over tropical area, western Siberia, Australia, and coastal areas indicate strong correlation in NDVI-PAR. Since the cloud amount in most of these areas is high, it is considered that the vegetation interannual is controlled by PAR interannual change. However, NDVI data may be contaminated by the cloud amount, which is also affect PAR value, therefore, further analyses will be required to derive a robust result.