Seasonality in the uplands of the Mekong river basin, mainland Southeast Asia

This poster describes research on environmental seasonality, land use, and population density in the uplands of Thailand, Laos, Cambodia, and Vietnam. Monthly variations in vegetation greenness and land surface temperature are measured using AVHRR and MODIS satellite data. Accompanying information on population density, land cover, and management status is used to examine seasonality.

The monsoon climate of mainland Southeast Asia brings a marked wet/dry annual cycle to the natural landscapes and agricultural economies of the lower Mekong River. In this region mountain ranges play a crucial hydrologic and environmental role. Extensive upland conservation zones shelter significant cultural and natural resources, but many areas in the mountains are subject to annual landscape degradation and soil erosion.

Understanding how land use and land management interacts with seasonal vegetation dynamics in the uplands will aid in environmental planning, particularly conservation management and agricultural development. This information will also help assess the significance of future land cover changes and landscape responses to climate variation.

Keywords: land use/land cover, population, seasonality

Objectives and Methods:

-- Evaluate ability of AVHRR and MODIS derived greenness and surface temperature data to show seasonal cycles with principal components analysis
-- Examine how land use, land cover, and population density influence seasonality
-- Compare isocluster classifications of principal components with existing land cover classifications

Uplands and lowlands:

Mainland Southeast Asia consists of several large river valleys and alluvial plains surrounded by mountainous areas trending in a north-south direction. The "uplands" of Southeast Asia is the most of the natural areas and are home to many of the minority groups of the region, while the lowlands hold the highest population densities and are dominated by rice agriculture. The 230 meter elevation contour roughly divides the region illustrated here into equal areas of "uplands" and "lowlands", but the issue of scale adds important nuances to the definition. For example, in "lowland" Northern Thailand, sloping, hill areas serve as uplands in terms of the resource extraction and agricultural use, while in many upland areas river and stream valleys are used for lowland-style rice cultivation.

Compared with lower elevations, the uplands show a significantly higher sensitivity to seasonality as measured by the second principal component of the isocluster of PCA components.

Seasonality in mainland Southeast Asia

Seasonality analysis of upland and lowland regions indicate that the Asian monsoon is particularly June and July. The eigenvectors of the third component contain 8.5% of the variability. The remaining components also significant, the low (EVI) component had about 0.5% of the variability, following significant elements to topography and seasonal as well.

Conclusions and future research:

Some of the data variability between the years 1992, 1995, and 2002 is due to change in sensors. Initial results indicate MODIS data is more sensitive to the nuances of season variation in vegetation greenness and surface temperature – particularly surface temperatures. Sensor differences aside, comparison of the 1992 and 1995 AVHRR data indicate significant year-to-year variation in seasonal environmental conditions.

The fluctuation of vegetation greenness and surface temperature closely follows the patterns of the measured precipitation and streamflow data, with the June-August period heavily influencing the values of the second principal component.

Analysis of the seasonal variations in vegetation and surface temperature hold promise for future investigations of land cover change. For example, in areas where change has occurred (as in the figure to the left, changing from forest to land in the Lao PDR example, and forest to clear in Thailand), examination of the component scores should allow for more detailed analysis of the changes as these can be usefully characterized using analysis of seasonal variation in vegetation and surface temperature.

Using surface temperature data to complement vegetation greenness measure greatly expands the ability to describe the seasonal fluctuations. The high temporal resolution of the data (potentially daily coverage) and the 250 meter and 500 meter spatial resolution for vegetation data should allow for even more detailed studies of environmental seasonality.