The sensitivity of Amazonian droughts to dry-season droughts is still poorly understood, with reports of enhanced tree mortality and forest fires on one hand, and extensive forest greening following on the other. Here, we report that the previous results of large-scale greening of the Amazon, obtained from an earlier version of satellite-derived vegetation greenness data – Collection 4 (C4) Enhanced Vegetation Index data – are reproducible, with both this earlier version and C5, owing to inclusion of atmosphere-corrupted data in the previous results. We find no evidence of large-scale greening of intact Amazon forests during the 2005 drought approximately 11%-12% of these drought-stricken forests display greening, while 28%-29% show browning or no-change, and for the rest, the data are not of sufficient quality to characterize any changes. These changes are also not unique – approximately similar changes are observed in non-drought years as well. Changes in surface solar irradiance are contrary to the speculation in the previously published report of enhanced sunlit availability during the 2005 drought. There was no co-relation between drought severity and greenness changes, which is contrary to the idea of drought-induced greening. Thus, we conclude that Amazon forests did not green during the 2005 drought.

INTRODUCTION

This study attempts to reconcile contradictory reports of increased tree mortality [Phillips et al., 2009] and extensive forest burning [Kugaya et al., 2007] with simultaneous greening of Amazon forests [Saatchi et al., 2007; Herman et al., 2010] during the 2005 drought. Our analysis here is focused on the following five questions:

1. Are the results published in SDHI07 reproducible with both the current (C5) and previous (C4) versions of EVI data?
2. What fraction of the intact forest area impacted by the drought exhibited anomalous greening in year 2005?
3. Is there evidence of higher than normal amounts of sunlight during the 2005 drought, which may have somehow caused the forests to green-up in the first place?
4. If drought caused the forests to green-up, is there a relationship between the severity of the drought and the spatial extent or magnitude of greening?
5. Are greenness changes during the 2005 drought unique compared to changes in non-drought years?

We conclude that the results of SDHI07 cannot be reproduced either with C4 or C5 EVI data owing to inclusion of atmosphere-corrupted data in their analysis.

CHANGES IN SUNLIGHT AVAILABILITY

GREENNESS CHANGES VIS-À-VIS DUGHT

COMPARISON WITH NON-DROUGHT YEARS

Figure 4: Spatial patterns of July to September 2005 dissimilarity index for EVI and C4 EVI data (two separate cases). (a) Difference: Direct EVI data minus C4 EVI data. (b) Difference: Direct EVI data minus C4 EVI data. The examination period for anomaly calculations is 2000-2005. These data include only those grid cells with ≥ 75% data (Red: >25% greening, Green: <25% greening).

Table 1: Change in spatial extent and magnitude of EVI anomalies of forest cover in the Amazon region for 2000 to 2005 and 2006 to 2009 in the dry season (July to September) (Results with no change, i.e., < 1% greening (or < 1% browning), are not presented).

Table 3: Summary of EVI anomalies for the Amazon region for 2000 to 2005 and 2006 to 2009 in the dry season (July to September) (Results with no change, i.e., < 1% greening (or < 1% browning), are not presented).

Reference:


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Note: the images used were kindly provided by NASA Earth Science Enterprise.

Figure 2: Spatial patterns of atmospheric corrosion of EVI data (a) Change trend of EVI data for wet season (May to September) from 2000 to 2005, displayed by black (positive) to red (negative) squares, with percentage of EVI anomaly data colored according to the range of EVI anomalies for each grid cell. The examination period for anomaly calculations is 2006-2009. Note that the change trend in EVI data is not the same as the greenness change trend. (b) Difference of EVI anomalies from July to September period of the year 2000, 2003, and 2006, color bar is 35% change.

Figure 1: Spatial patterns of July to September 2005 standardized anomalies of EVI data for Amazon region (C4 EVI data). (a) Difference: Direct EVI data minus C4 EVI data. (b) Difference: Direct EVI data minus C4 EVI data. The examination period for anomaly calculations is 2000-2005. These data include only those grid cells with ≥ 75% data (Red: >25% greening, Green: <25% greening).