

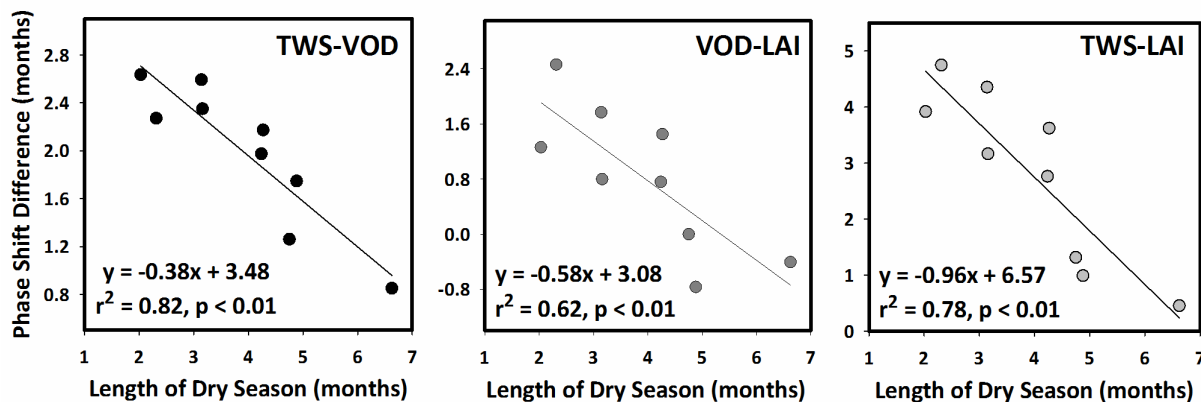
"Asynchronous Amazon forest canopy phenology indicates adaptation to both water and light availability" by Jones, Matthew; Kimball, John; Nemani, Ramakrishna

Article reference: ERL-100812

Appendix 1 – Pairwise Bispectral Analysis

As the sinusoidal model results in a generalized monthly climatology, we also conducted a more robust pairwise bispectral analysis between the three primary time series used in the analysis (TWS, VOD, and LAI) to confirm that the results did not significantly differ between these two methods. The pairwise bispectral analysis (see Shumway and Stoffer 2011; Bendat and Piersol 2012) provides the coherence, a linear correlation between two series indexed by frequency, and the phase lag, or the average delay between the two series as a function of Fourier frequency. In all cases the frequency of maximum coherence was equivalent to a 12 month cycle and the lag at the maximum coherence was similar to that derived from the sinusoidal model method. The bispectral analysis resulted in some improvement in the linear regressions of mean dry season length with the lag of the TWS-LAI time series (r^2 increase from 0.67 to 0.82) and the TWS-LAI time series (r^2 increase from 0.73 to 0.78), but a decrease with the VOD-LAI (r^2 decrease from 0.69 to 0.62). The results, plots and regressions from this analysis are shown below.

Ecoregion	GRACE-VOD		VOD-LAI		GRACE-LAI	
	Coherence	lag (months)	coherence	lag (months)	coherence	lag (months)
Ucayali	0.87	2.27	0.89	2.46	0.93	4.75
Southwest Amazon	0.97	2.59	0.96	1.77	0.99	4.36
Jurua-Purus	0.91	2.63	0.91	1.26	0.99	3.92
Purus-Madeira	0.94	2.35	0.93	0.80	0.98	3.17
Madeira-Tapajós	0.97	2.17	0.95	1.45	0.99	3.62
Tapajos-Xingu	0.95	1.97	0.94	0.76	0.99	2.76
Xingu-Tocantins-Araguaia	0.94	1.26	0.90	0.00	0.95	1.32
Tocantins/Pindare	0.98	1.75	0.97	-0.77	0.98	0.99
Maranhao Babacu	0.99	0.85	0.98	-0.41	0.97	0.45



References

Shumway R H and Stoffer D S 2011 *Time Series Analysis and Its Applications: With R Examples*, Third Edition, Springer New York. DOI 10.1007/978-1-4419-7865-3

Bendat J S and Piersol A G 2012 *Random Data: Analysis and Measurement Procedures*, Fourth Edition, Wiley Online Library. DOI: 10.1002/9781118032428