Time variability of GRACE data using JPL mascons

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Introduction

The Gravity Recovery And Climate Experiment (GRACE) satellites have been measuring gravity since 2002. JPL inverts these data using a mascon approach to generate monthly timeseries of mass everywhere on Earth's surface.

Viewing all these timeseries is impractical, so many GRACE maps display a single parameter (RMS, annual amplitude, etc.) for each timeseries, which only reveals a fraction of the data. For example, an RMS map shows no frequency information, like a black and white photograph. Annual amplitudes show information at only one frequency, like looking through a blue filter.

Luckily, timeseries are fully described by their power spectra. Hughes and Williams 2010 treated sea level power spectra as visible light spectra, displaying colors as humans see light. Their methodology is applied to timeseries from GRACE and the Noah land hydrology model in the Global Land Data Assimilation System (GLDAS).

Future work

1. Why does Paraguay have a $\sim$ 1.5 year "seasonal" cycle?
2. Compare GRACE to the ECCO and RACMO models.
3. Examine spatial variability of autocorrelation.
4. Apply this method to GRACE accelerations, mapping semi-diurnal (and longer) tidal periods to the visual spectrum.

Source code will be available at

`http://emmykillett.com`

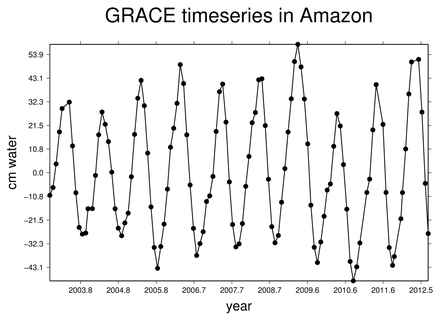
References

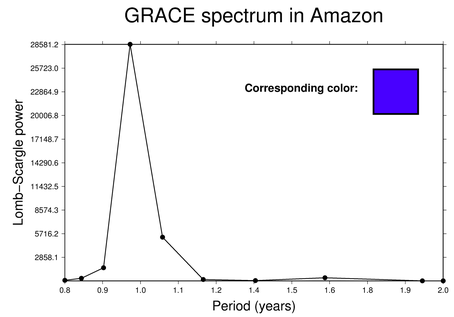
1. Hughes, C. W., and S. D. P. Williams (2010), The color of sea level: Importance of spatial variations in spectral shape for assessing the significance of trends, J. Geophys. Res., 115, C10048, doi:10.1029/2010JC006102.

Methodology

Trends and accelerations are removed from GRACE timeseries before calculating power spectra as a function of period. The shortest period is mapped to light with a 380 nm wavelength, and the longest period is mapped to 760 nm. These light spectra are converted to RGB values that humans would see, using the CIE 1931 color matching functions. Spectra with more power are brighter, but maximum brightness is the same in each GRACE/GLDAS pair so comparisons are meaningful.

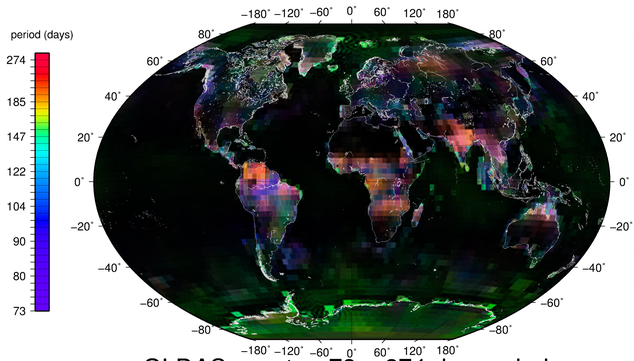
The color scales below show the corresponding colors for gaussian power spectra with the stated central periods. Wider power spectra correspond to less saturated (whiter, more pastel) colors than more narrow spectra which correspond to more vivid, saturated colors.



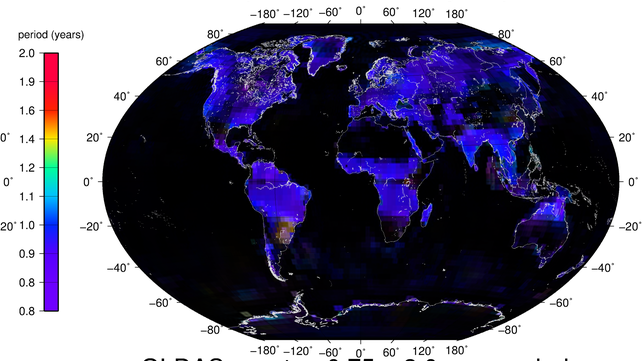


Results

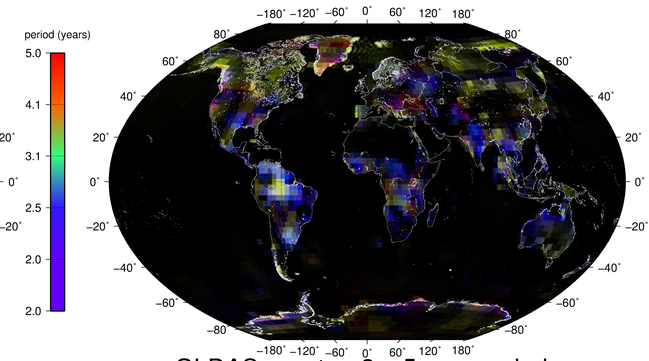
GRACE spectra, 73 – 274 day periods



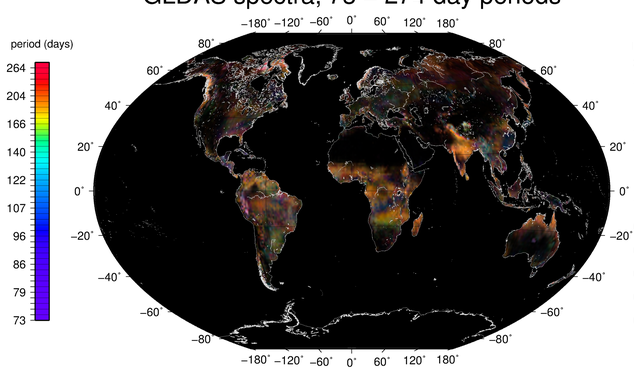
GRACE spectra, 0.75 – 2.0 year periods



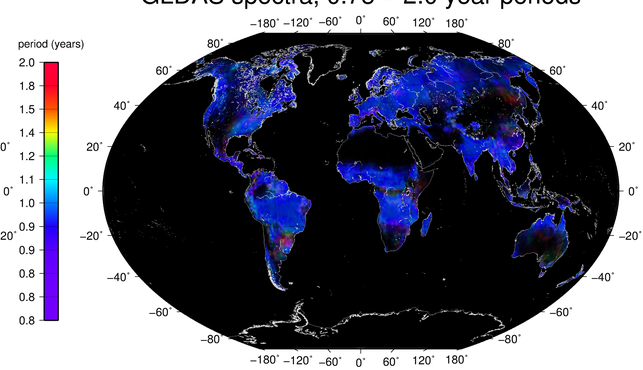
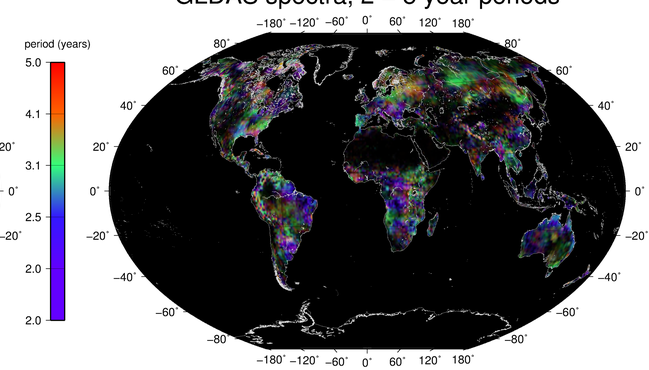
GRACE spectra, 2 – 5 year periods



GLDAS spectra, 73 – 274 day periods



GLDAS spectra, 0.75 – 2.0 year periods



GLDAS spectra, 2 – 5 year periods