Nature's heartbeat

By Benjamin Hennig and Yadvinder Malhi

Oceanic and terrestrial ecosystems are highly productive. This can be demonstrated by their gross primary productivity (GPP) – the rate at which organic material is built through the process of photosynthesis. Measured according to the amount of carbon absorbed from the atmosphere and fixed in vegetation, the level of GPP gives us an idea of how well the biosphere is utilising the sun's energy.

Plants and phytoplankton are the real biomass factories, building ecosystems and supporting life higher up the food chain. In marine ecosystems productivity is therefore largely concentrated in shallow coastal areas as well as ocean areas with upwellings, both places that are rich in nutrients and feature abundant plankton. On land, productivity is highest in regions with good moisture supply and a year-round growing season.

This gridded cartogram uses satellite observations from NASA's Moderate Resolution Imaging Spectroradiometer (MOD17). By measuring greenness, it is able to estimate the cumulative GPP of the biosphere on land at a one kilometre resolution.

The main map shows the annual picture that emerges when adding up nature's productivity throughout the year on a regularly distributed high-resolution grid and then resizing the grid cells according to these values. The resulting cartogram is a proportional representation of the global GPP patterns over land. To help interpret these values, the areas of low and high productivity are highlighted through an additional colour overlay - brown for the lowest, blue for the highest.

In terms of annual biological activity on land, the wet tropics dominate. GPP is lowest in areas that are either very dry, such as the Sahara and Australian outback, or very cold, such as the polar regions and mountain ranges including the Himalaya and the Rocky Mountains in North America.

There is a strong seasonal pattern to productivity. The series of monthly GPP cartograms below shows how the changing seasons determine the variability of energy production throughout the year. In January, the map has a fat tropical bulge: the warm and wet tropics dominate while the extensive land regions of the northern hemisphere are in deep winter, with short days and cold temperatures severely limiting production. By June, however, vast expanses of the northern hemisphere have greened up. Now experiencing long days, they are just as productive as the tropics and the map looks more familiar in shape.

Each cartogram provides a picture of the relative distribution of GPP each month (although keep in mind that the overall productivity differs between the different months), moving between the northern hemisphere and the tropics like nature's heartbeat. ●

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