

Forest and savanna can switch quickly

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Acacia savanna south of Fada N'Gourma, Burkina Faso. Image: Wikipedia.

(PhysOrg.com) -- Two recent studies have found that environmental changes can bring previously stable forests and grasslands to tipping points that produce sudden large-scale and sometimes irreversible changes in which forest can become savanna and vice versa. These findings challenge previous assumptions that changes to natural systems occur continuously and smoothly.

In <u>one study</u> published in *Science*, scientists in The Netherlands, led by Marina Hirota of Wageningen University, studied NASA satellite data on forests (around 80% trees), savanna (around 20%) and treeless areas (about 5% tree cover). The group found that intermediate regions were rare, and that the <u>rainfall</u> was the primary factor determining which landscape would be found. The researchers also found that big shifts can



suddenly occur in the type of landscape, rather than the slow, smooth transition expected.

In a <u>US/South African study</u> also published in *Science*, researchers led by A. Carla Staver of Princeton University found that the degree of tree coverage generally depends on rainfall and seasonal changes, but in areas where the rainfall level is intermediate (1000-2500 mm annual) and <u>seasonal changes</u> are mild, fire becomes the most important factor in determining whether forest, grassland or treeless landscapes were likely to predominate. They found a tipping point at 40-45% tree coverage: below this fires spread rapidly, and above this the increased tree coverage slows down the spread of fires.

Both groups studied data collected by NASA's Aqua and Terra satellites, which use MODIS (Moderate Resolution Imaging Spectroradiometer) instruments to detect vegetation coverage and determine the type of vegetation prevailing. They both concentrated on areas thought to be least affected by human activity, including subtropical and tropical parts of Australia, South America, and Africa.

Prevailing theories of ecological development suggest that if the rainfall on a savanna gradually increases, the number of trees should also gradually increase until the region becomes a forest. The new studies suggest instead that the savannas remain grasslands as the rainfall increases until a tipping point is reached, at which time the <u>savanna</u> suddenly switches to a fully-forested area instead. Such sudden changes have been noted on a local scale but until now it had not been known that they occurred on a global scale.

The findings could have implications for people whose livelihoods depend on their landscape remaining the same, since it could change rapidly, which would require people to also adapt quickly to the changes. To assist them, Hirota's team has developed what they call *resilience*



maps identifying regions close to the tipping point.

The two studies could also help to refine climate change models, which currently assume the transition between <u>grassland</u> and <u>forest</u> is gradual and depends mainly on rainfall and temperatures.

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