The influence of groundwater depth on the moisture recycling system in the Amazon rainforest following agriculture land-use change

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Moisture Recycling
- Moisture recycling is the return of moisture to the atmosphere due to evapotranspiration which can then precipitate out locally or further downstream
- Up to 70% of the rainfall in the Amazon has been recycled
- The provision of rainfall outside the Amazon is a key ecosystem service for agriculture, hydropower generation and drinking water.

Fig. 1 Amazon moisture recycling system (blue arrows) representing both internal recycling of moisture and transport downstream. Grey arrows represent dominant wind direction driving moisture transport.

Research Objectives
To determine whether the inclusion of different agricultural land-use classification will improve moisture recycling models, focusing on the seasonality of evapotranspiration fluxes.

To determine the importance of groundwater depth on agricultural productivity and whether areas of shallow groundwater are less detrimental to the moisture recycling systems than agricultural areas over deep groundwater.

Agricultural Land-Cover
Moisture recycling models
- Do not use different agricultural land-cover;
- Simplify the situation to areas of forest cover and forest loss.
However, rangeland and crop systems differ greatly in seasonality especially in single cropping systems which are still common in the region.

Groundwater
Dry season:
Forest do not suffer from water stress;
- Due to access of groundwater storage by deep roots forest continues to transpire moisture to the atmosphere.

The interaction between agricultural vegetation and groundwater in this region is poorly understood.

Methods
Develop a moisture recycling model for agricultural regions using a combination of crop model and remote sensing observations.

Fig. 2 Moisture recycling
a) Primary forest with well functioning moisture recycling
b) Land-use change scenario with lower levels of evapotranspiration and atmospheric transport and increased runoff source - Aragão, 2012.

Fig. 3 Proposed relationship between groundwater depth, rainfall (blue; ERA-interim data), transpiration (red; theoretical range based on early observations) and dry season length.

A) Primary forest maintains high evapotranspiration throughout the dry season, due to the deep rooting depth of forest. This has also been shown in areas of deep groundwater.
B) Rangeland showing a delayed reduction in transpiration at the start of the dry season.
C) Rangeland over deeper groundwater, responding directly to lower rainfall levels resulting in a longer dry season.

Fig. 4 Amazon moisture recycling system (blue arrows) representing both internal recycling of moisture and transport downstream. Grey arrows represent dominant wind direction driving moisture transport.