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The Green Ocean:
Lessons from the Amazon

"Inevitably, oceans dominate the planetary energy balance, as they intercept about four-fifths of all incoming radiation." – Smil (2002, p109)

Recent research has revealed that evapotranspiration accounts for a much larger role in the global water cycle than previously understood. Smil (2002) seems to find that "long run oceanic evaporation" dictates the "intensity of the global water cycle" (128). Furthermore, Smil emphasizes that if the Amazonian tropical rain forest were to be replaced by grasslands and crops, that the global impact would not be severe in even the most extreme case (246). The goal here will be to amend Smil's outdated assumptions that evapotranspiration has little influence on the global water cycle.

In a TED lecture, Antonio Donato Nobre (2010) describes the Amazonian forest as a heart, pumping and circulating the life blood of the planet (3:20). An amazing amount of water is pumped into the atmosphere by the trees of the Amazon, with a single large tree being capable of releasing 1,000 liters of water in a single day (5:35). Nobre estimates that 20 billion metric tons of water is released into the atmosphere daily by the Amazonian forest, a number that dwarfs the total volume of the Amazonian river itself at 17 billion metric tons (5:50). It would take 50 Itaipu's, the world's largest hydroelectric power plant, to generate enough power to mimic what the Amazonian forest achieves every day (6:39).

This "river floating above" gives life to the Amazon, as few clouds form over the ocean and thus, produce little rain (10:00). Nobre's statement seems to juxtapose Smil's (2002) claim that one third of terrestrial precipitation is supplied by ocean evaporation (128). For the Amazon at least, this rule-of-thumb does not seem to be accurate. Nevertheless, how does ocean evaporation reach the forest, anyway?

Nobre describes the Amazonian forest as a "biotic moisture pump," importing humidity from the ocean by "sucking" it in like a pair of lungs (13:07)[1]. Figure 1, a slide from his presentation, demonstrates how the ocean pulls dry continental air out of the desert and how the forest draws-in oceanic evaporation. Wang et al. (2008) has found that Amazonian deforestation has affected hydrometeorological processes at the local, region and global scales (3670). The forest was found to be necessary for the formation of deep clouds and to influence mesoscale air circulation (3674).

Smil states that ocean evaporation is responsible for the formation of seasonal cyclones and the Asian monsoon (128). Indeed true, Nobre expands to show that forests dictate their geographic pattern of formation. They do not form around the equatorial region

[1] Nobre also describes the forest as the liver or kidneys, with the capacity to filter the air (10:40).

(Figure 2) because the continental forest pump speeds the air above the sea, preventing hurricane formation (13:30).

Clearly, forests play a central role in the intensity of their regional water cycle and help dictate global climatology. It can be imagined that if we remove the forest from Figure 1, that we may invert the relationship between land and ocean, thereby reversing mesoscale circulation and the water cycle. As Nobre states, the Amazonian forest is a lesson for those outside (14:08). It can only be speculated how deforestation has impacted regional and global water cycles in the United States as these cycles have been previously unknown to us. However, we can infer that reforestation can function to restore degraded water cycles in addition to creating habitat and biodiversity.

As noted in Lecture 13 for this week, the sixth extinction is anthropogenically exacerbated by technology, habitat destruction, invasive species and the inability for native organisms to respond to climate change due to human activity. I assert that extensive reforestation efforts can help address each of these problems.

We can utilize our technology and new found knowledge to restore landscapes, rather than destroy them. Reforestation not only creates habitat, it can help unify a fragmented landscape to allow for species migration. In fact, human induced reforestation might be the only solution to species migration as natural "seed-dispersal may not keep up with rates of climate change" (Turner Lecture 13). Furthermore, reforestation can amplify rainfall, lightning (Sanford Week 5), cloud albedo, sequester carbon (Sanford Week 6), and help thwart soil erosion and degradation (Smil 241).

Rainfall supports terrestrial and freshwater life. The Yanomami have taught us that if you destroy the forest, the rains will end (Nobre 15:26). We may be "depriving nature of its technology" (19:51), but our new found self-awareness now provides us the opportunity and the duty to restore it.

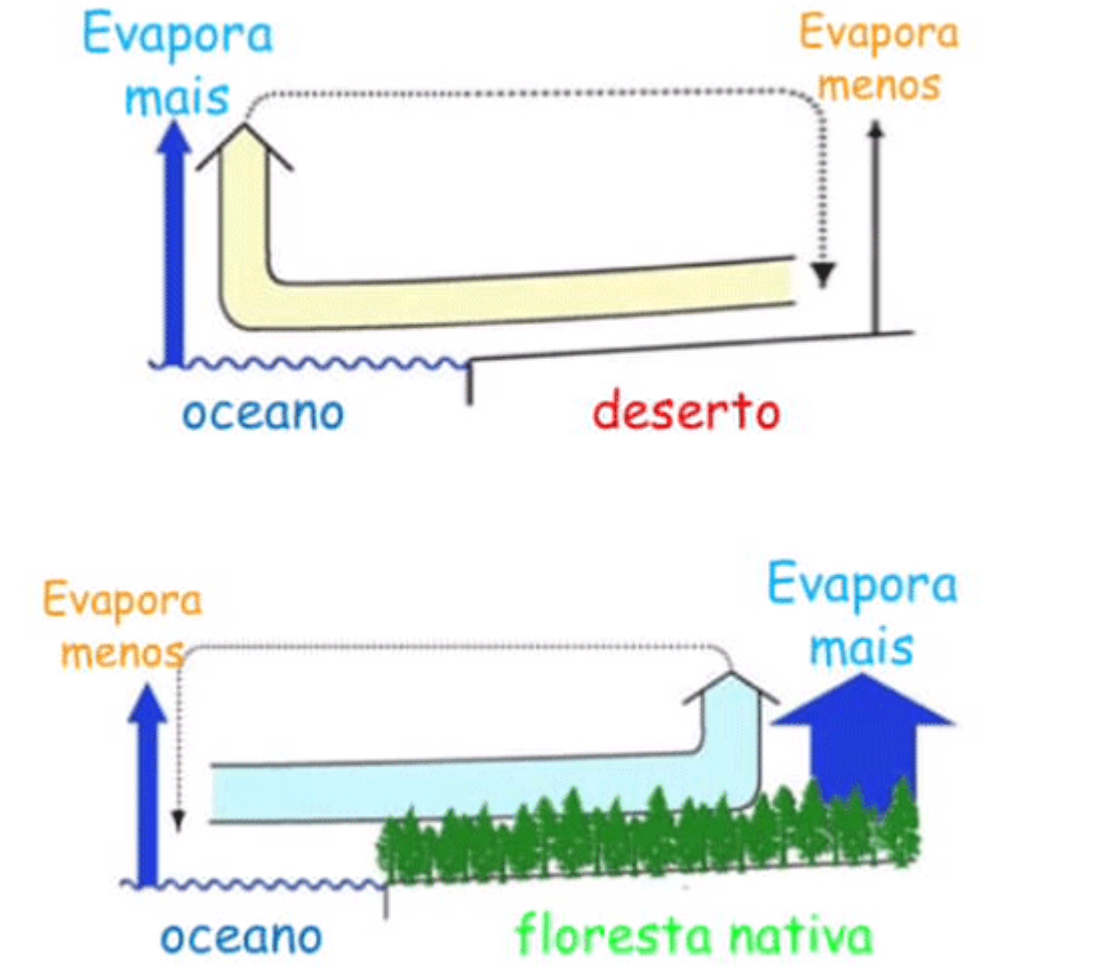

Figure 1 – Respective oceanic water cycles of desert and forested lands (Nobre 13:07).

Figure 2 – The absence of cyclone formation in the equatorial region is dictated by the affects of forests on mesoscale air circulation (Nobre 13:30).

References

Smil, Vaclav; "The Earth's Biosphere: Evolution, Dynamics, and Change" *MIT Press*, 2002

TEDxAmazônia - Antonio Donato Nobre mostra que tem um rio em cima de nós [video]. (2010). Retrieved 2/2012 from http://www.youtube.com/watch?feature=player_embedded&v=HYcY5erxTYs

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