



## INVESTIGATING FUTURE RAINFALL CHANGES OVER BRAZIL

CSSP BRAZIL



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Rainfall affects all aspects of life on earth. For example, too much can cause flooding while too little can create drought, both of which impact the food we eat, our health and our quality of life. However current climate model projections do not provide a clear picture of how rainfall over Brazil will respond to climate change - some suggest less rainfall and others more. Research from the Climate Science for Service Partnership (CSSP) Brazil project is improving our understanding of how rainfall might change in order to provide robust, policy-relevant climate projections for Brazil.



## The “lungs” of the planet affect water too

The Amazon forest is a unique ecosystem representing the largest area of tropical forest in the world with more than 40,000 species of plants. This enormous ecosystem is often called “the lungs of the planet” due to its mass of trees which all absorb carbon dioxide (CO<sup>2</sup>) and breathe out oxygen.

In addition to this, the forest has a massive impact on the water cycle. So much rain falls over the Amazon basin that the Amazon river collects and discharges more than five times the volume of water of any other river in the world. This huge influx and flow of water has a knock-on impact on the weather of the Amazon region. In the hot, tropical climate, water is constantly evaporating back to the atmosphere where it can form as clouds and re-fall as rain again.

In fact, the behaviour of trees and plants can control the amount of water being evaporated and therefore the amount of rain which can subsequently fall. The reason lies in the tiny openings on the leaves of the plants called “stomata”. They control two things, both the amount of CO<sup>2</sup> which the tree needs to breathe-in to photosynthesise and build new wood, and also how much water is lost back to the atmosphere in return, known as transpiration. When it is particularly dry, plants can close stomata to protect themselves from too much water loss. Likewise, when it is wet they can open their stomata to allow more CO<sup>2</sup> in to aid growth.

Figure 1 shows this flow of water and CO<sup>2</sup> through a plant and how it can affect rainfall and the flow of water into rivers.

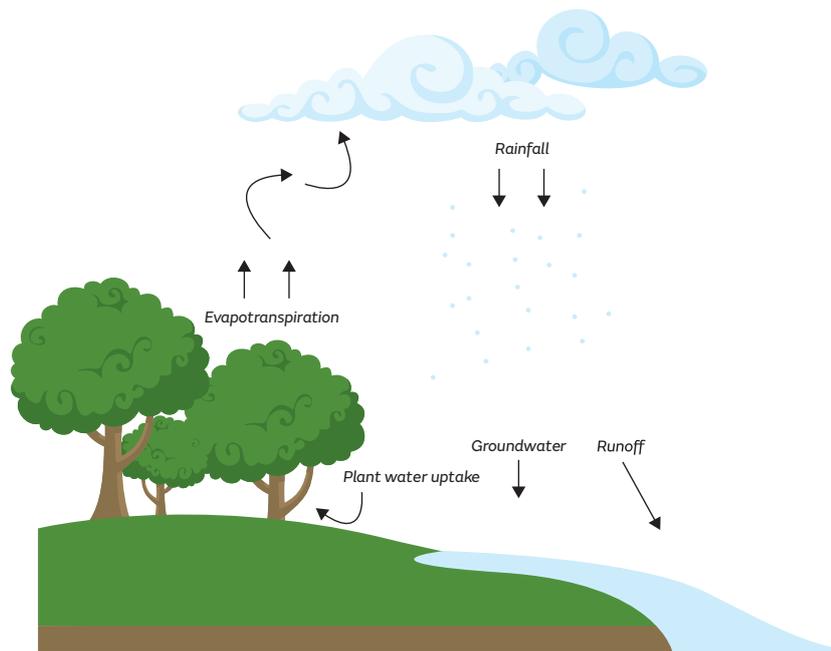


Figure 1. How plants and trees affect rainfall and water flows on a large scale.

As the amount of CO<sup>2</sup> in the atmosphere is currently increasing, plants can afford to close their stomata slightly in order to conserve more water but still absorb enough CO<sup>2</sup> to grow. This improved water use efficiency means that less water is transpired to the atmosphere resulting in reduced potential for subsequent rainfall.

## Brazil could be a hot spot for this drying effect

New work in CSSP Brazil suggests this could be the most important mechanism which drives future changes in rainfall over Brazil and in particular for the Amazon basin. The large red area over Brazil in figure 2 suggests this process could cause the region to become much drier by the end of the century.

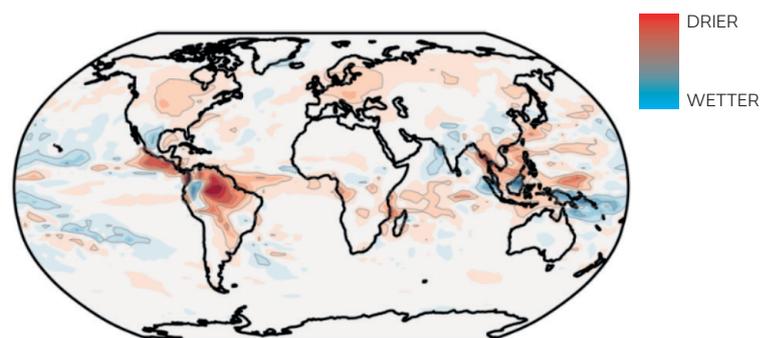


Figure 2. rainfall changes due to CO<sup>2</sup> affecting plant stomata.

Chris Jones, CSSP Brazil science lead at the Met Office, explained how important these new results are: “We’ve known for many years that the land surface can affect our weather, but these results show it is an increasingly important part of the puzzle to understand. These advances come when scientists from across the spectrum of research from atmospheric sciences to plant physiology come together to advance our ability to predict how climate change will affect our planet. CSSP Brazil continues to enable new collaborations between UK and Brazil scientists in order to tackle problems of importance for our future well-being”.

CSSP Brazil is also exploring rainfall changes in other regions of Brazil, not just the Amazon basin. One piece of collaborative work with the Brazilian National Institute for Space Research is investigating future changes in rainfall variability across regions, which could be crucially important when considering climate change impacts. This work suggests Brazil will experience more rainfall variability in future i.e. drier dry periods and wetter wet periods on daily, weekly, monthly and seasonal timescales, despite the future changes in mean rainfall being uncertain currently. This may provide useful information for climate change adaptation across, for example, the agriculture and water resource sectors in Brazil.

## **CSSP Brazil is building strong science partnerships**

CSSP Brazil is a research project that supports collaboration between the UK and Brazil. It aims to develop capability to inform decision makers in climate mitigation and adaptation strategy and to underpin services to support climate and weather resilient economic development and social welfare.

CSSP Brazil is building strong, sustainable partnerships between Brazil’s National Institute for Space Research (INPE), National Institute for Amazonian Research (INPA), National Centre for Monitoring and Early Warning of Natural Disasters (CEMADEN) and the Met Office, the UK’s national meteorological service, and other key UK and Brazilian scientific institutes.

The Weather and Climate Science for Service Partnership Programme – of which CSSP Brazil is a part - is funded by the UK Government’s Newton Fund.

For further information visit the Newton Fund website ([www.newtonfund.ac.uk](http://www.newtonfund.ac.uk)) and follow via Twitter: @NewtonFund

For more information on CSSP Brazil visit the Met Office website <https://www.metoffice.gov.uk/research/collaboration/newton/cssp-brazil/index>

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### **Met Office**

The Met Office is the UK’s national weather service working at the forefront of weather and climate science for protection, prosperity and well-being. The Met Office Hadley Centre, formed in 1990, is one of the UK’s foremost climate change research centres.

### **National Institute for Space Research (INPE)**

The National Institute for Space Research (INPE) is responsible for fostering Earth and space science and technology to offer products and services in benefit of the Brazilian nation.

### **National Institute for Amazonian Research (INPA)**

The National Institute of Amazonian Research (INPA) is a public research and educational institution and world reference in tropical biology, headquartered in Manaus, Brazil. INPA was founded in 1952, with the purpose of furthering scientific knowledge of the Brazilian Amazon Region through scientific studies of the physical environment and living conditions to promote human well-being and socio- economic development.

### **National Centre for Monitoring and Alerts of Natural Disasters (CEMADEN)**

The National Center for Monitoring and Alerts of Natural Disasters (Cemaden) is linked to the Brazilian Ministry of Science, Technology and Innovation (MCTI). Cemaden was formed in July 2011 with its main objective being to monitor and issue natural disaster alerts that help safeguard lives and reduce social, environmental and economic vulnerability resulting from these events.

