

## Weather and Climate Science for Service Partnership Programme

### Highlighting new CSSP Brazil research in high-resolution climate modelling

**Title:** Future precipitation projections for Brazil and tropical South America from a convection-permitting climate simulation

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**Authors:** Ron Kahana<sup>1</sup>, Kate Halladay<sup>1</sup>, Lincoln Muniz Alves<sup>2</sup>, Robin Chadwick<sup>1,3</sup> and Andrew J. Hartley<sup>1</sup>

<sup>1</sup>Met Office Hadley Centre, Exeter, UK; <sup>2</sup>INPE, São José Dos Campos, Brazil, <sup>3</sup>Global Systems Institute, University of Exeter, UK

#### Summary

South America is particularly vulnerable to climate change, with changes and impacts already seen in natural and human systems. Global climate simulations disagree on how rainfall may change in the future, hampering efforts to plan effective adaptation action. This study addresses this using a high-resolution, convection-permitting Regional Climate Model (CPRCM), which can provide a better understanding of rainfall and extreme events. The team found varying changes in different areas by the end of the century under a high-emissions scenario. Rainfall decreases in the Eastern Amazon with longer dry spells, while the Western Amazon develops a more distinct dry season. These could both adversely affect tropical forest biomes through droughts. Southeastern Brazil is set to see more frequent and intense rainfall. All areas see more intense extreme events, increasing the risk of floods and landslides that already cause major impacts. These results demonstrate the usefulness of high-resolution modelling over South America and give policymakers more confident projections of the future conditions the region will need to adapt to. This helps inform more effective adaptation measures aimed at reducing the impact of a changing climate.

#### Background

South America is among the most vulnerable areas of the world to climate change. The Amazon basin is seeing changes in temperature and seasonality, while highly populated areas suffer from natural disasters, with fires, flash floods and landslides being the most impactful. Projecting future changes in these events is important for understanding how to reduce their impact and save lives, however global climate models disagree on future rainfall changes. This study addresses this using a high-resolution, convection-permitting Regional Climate Model (CPRCM), which improves simulations of extreme weather events. At their highest resolutions they are capable of simulating atmospheric convection, a key process in many extreme events, rather than using pre-determined convection values. This paper reports the results of the South America Convection-Permitting Regional Climate Model (SA-CPRCM) experiment, the first use of a high-resolution RCM at a near-continental scale for South America and for climate (10-yr) timescale. The study aims to provide detailed and relevant future climate information for use by decision-makers in South America.

#### Results

The team found that different areas had varying patterns of rainfall change in their future simulations. Under a high-emissions scenario, rainfall decreases and becomes less frequent and more seasonal in the Eastern Amazon, along with longer dry spells, increasing the risk of drought. The Western Amazon sees more rainfall in April – June, but less from July – October, producing a more distinct dry season. This risks compounding impacts from land-use change and worsening the contraction of tropical forest, which is ill-adapted to such a seasonal pattern. Southeastern Brazil will face greater rainfall volume, frequency and intensity, further elevating the already high risk of floods and landslides. The future projections indicate intensified rainfall extremes across this highly populated region, with potentially strong impacts to both natural and human systems, particularly in densely populated areas prone to landslides and flash floods.

#### Methods

This paper used the Met Office's HadREM3 model, based on a configuration used for the UK Climate Projections, run at 4.5 km resolution. This model configuration shows clear improvements in sub-daily rainfall characteristics and extremes over Brazil and tropical South America compared to coarser resolution modelling systems, demonstrated in prior research by [Halladay et al.](#) Three 10-year simulations were carried out here, a present-day (1998-2007) hindcast to evaluate the model against observations, another present-day simulation nested within a global model simulation to compare future projections against, and a future simulation of a period around 2100 using a high-emissions scenario (RCP8.5). This ensures a recognisable signal of future climate change.

#### Policy relevance

These results provide an insight into future climate change in South America, as well as showcasing the benefits of high-resolution climate modelling. Based on more confident simulations of rainfall and how it is set to be affected by climate change, policymakers can formulate more useful and better targeted adaptation measures, helping reduce the impacts of a changing climate on the people and natural world of South America and the Amazon.