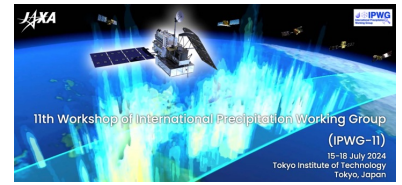


Temporal and Spatial precipitation downscaling in Brazil

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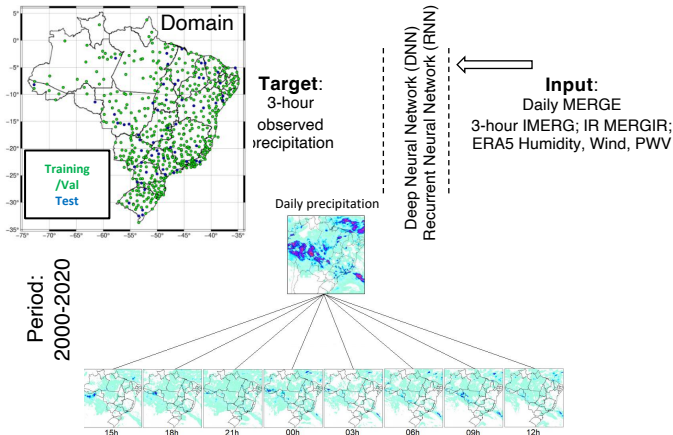
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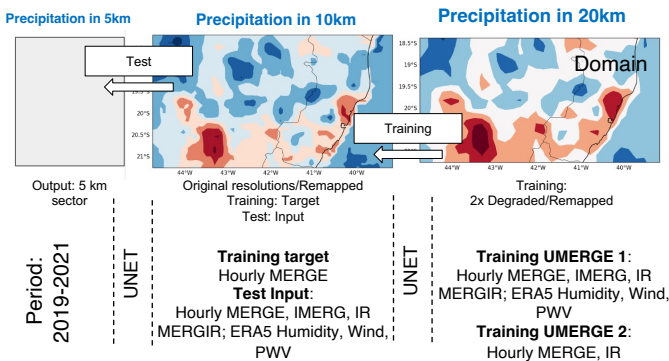
Abstract

In Brazil, where ground observational data for precipitation is limited, satellite rainfall estimation products play a crucial role despite inherent errors. Two studies aimed to enhance the spatial and temporal resolution of precipitation data using different approaches, focusing on downscaling techniques tailored for Brazilian conditions. The first study emphasizes the importance of satellite-estimated precipitation data for various sectors, particularly transportation, in regions with limited observational measurements. Brazil's sparse network of rain gauges presents challenges for effective planning and mitigation against precipitating events, especially for the transport sector. The study utilized machine learning techniques, specifically convolutional neural networks, to downscale precipitation data from 10 km to 5 km resolution along key railway routes. By incorporating data from numerical weather models, satellite images, and rain gauge observations, the study achieved improved resolution and accuracy in rain estimates. Performance evaluations highlighted the significant impact of precipitation on railway operations, emphasizing the need for accurate monitoring and mitigation strategies. In the second study, Artificial Neural Networks (ANN), including Deep Neural Networks (DNN) and Recurrent Neural Networks (RNN), were employed to downscale daily precipitation data to sub-daily scales. Utilizing satellite estimation corrected by rain gauges (MERGE), infrared brightness temperature, hourly precipitation estimation, and environmental data, the study aimed to represent the diurnal cycle and physical processes across different regions of Brazil. Results demonstrated the superiority of ANN over traditional estimation methods, with DNN exhibiting the best performance across regions and seasons. Sensitivity tests further confirmed the effectiveness of DNN, especially when additional meteorological variables were included, enhancing rain screening and overall accuracy. Both studies underscore the importance of downscaling techniques tailored to Brazilian conditions, addressing the challenges posed by sparse observational data. The integration of machine learning and satellite-based approaches offers promising solutions for improving the spatial and temporal resolution of precipitation data, enabling more effective planning and mitigation against climate impacts in Brazil.

Temporal Downscaling: daily precipitation data to 3-hour interval

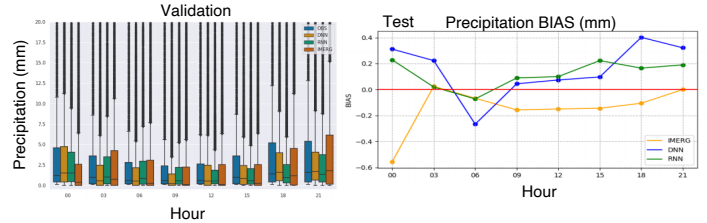


Spatial Downscaling: 10 km to 5 km



Results: Temporal downscaling

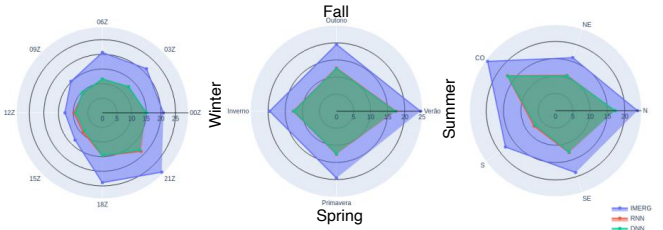
DNN is usually the best model



Test: MSE - 3-hour

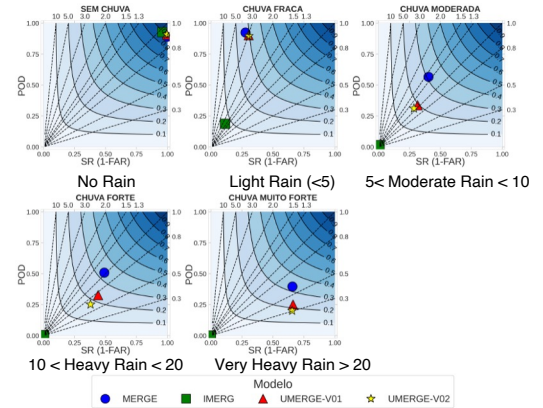
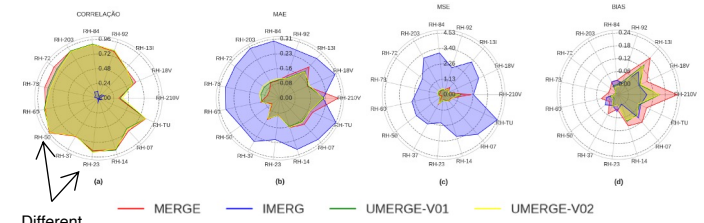
MSE - Season

MSE - Regions



Results: Spatial downscaling

Unet with only IR+MERGE (UMERGE-V02) is enough as the best model



Contact

The code and documentation will be release soon. Any collaboration, please, contact alan.calheiros@inpe.br

ACKNOWLEDGEMENTS

