Exploiting AI methods to get the most out of multiscale observations.

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Satellite instruments have observed clouds for several decades, and we now have a rich dataset that can contribute to our understanding of cloud dynamics and feedback, which is crucial for improving climate predictions. However, these large datasets still need to be fully employed in improving our understanding of cloud and precipitation processes, partially because computing power has only recently approached the necessary scale. Moreover, in recent years, the development of visual recognition AI methods opened new perspectives in the field of image classification, to the point that ML algorithms scored better than humans.

During the EUREC4A campaign, various platforms collected many observations, enriching the satellite dataset records over the region. In our research group, we harnessed our collective expertise in ground-based and satellite remote sensing and machine learning to pioneer a unique self-supervised cloud classification approach. This approach extracted information on cloud physical processes from the visual structures in the images learned by the network. We then correlated the cloud evolution across different ML-identified patterns with the signatures observed at smaller scales, unveiling new insights into cloud dynamics and local signals.

Given the potential of the tested approach in the tropics, we extended its application to complex orography regions to characterize extremes using developments of our embedding approach. In this contribution, we discuss our preliminary results and the potential of machine learning approaches to enable representations across different scales.