Horizon 2020 Societal challenge
5: Climate action, environment,
resource efficiency and raw materials

CONSTRAIN
Constraining uncertainty of multi-decadal climate projections
GA number 820829
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1.Changes with respect to the DoA

The task 2.2.2.1 is: "*to characterize the mesoscale organisation of shallow convection and to host a workshop on this topic"*. As a result of the corona pandemic an on-site workshop was not possible but instead we have had regular on-line meetings with the involved institutes that were working on this task with discussions and presentations on the progress of this theme. This has resulted in 2 publications in the peer reviewed literature (see below) that provides a firm basis for the subsequent modelling work on the influence of these organisation modes on climate change. We plan to have a one-day on-line meeting in April 2021 with external partners aiming to discuss how to further coordinate modelling efforts around EUREC4A to further facilitate task 2.2.2.2 and to have a larger and more general on-site workshop on low clouds mesoscale organisation in 2022.

2.Dissemination and uptake

The general dissemination of this work is already taking place via publication in the peer reviewed literature and through presentation at international conferences such as the AGU and the EGU but also at smaller scale conferences. Within CONSTRAIN, the mesoscale characterization as proposed and further detailed in Schultz et al. (2021) and Janssens et al. (2021) will be used in task 2.2.2.2 where we will use a hierarchy of models to evaluate their capability to reproduce the observed modes of mesoscale organization and to further explore how the relative frequencies of occurrence for these modes will change under warming conditions and how this will affect climate change.

3.Short Summary of results (< 250 words)

In (Schultz et al. 2021) four previous identified patterns of meso-scale cloud organization in the trades – called Sugar, Gravel, Flowers and Fish – as observed satellite imagery are linked to long-term records of ground-based measurements Barbados Cloud Observatory and model reanalyses. This way the local thermodynamical and cloud structure (wind, temperature, humidity, rain and cloud fraction profiles) and the large scale forcings associated with each of the four cloud patterns are now identified. The results suggest that due to the tight bound of the patterns to wind and air-mass origin, the patterns with the higher cloud fraction, Flowers and Fish, will be disfavoured in a warming climate with more equable sea-surface temperatures and fewer mid-latitudinal disturbances.

Instead of building further on subjective, but interpretable classes of patterns Janssens et al. (2021) used a large set of 21 commonly used metrics for 5,000 cloud fields observed by satellite over the Atlantic Ocean east of Barbados. These 21 metrics contain a large amount of redundant information: To effectively describe and interpret the cloud patters, only four derived metrics are required: typical cloud size, the size of connected clear sky patches, the clouds' degree of directional alignment and spatial variance in cloud top height. These four metrics form a new, effective and interpretable pattern description, which can be used to better understand how cloud patterns develop and how this impacts the wider climate system. The specific cloud types, Sugar, Gravel, Flowers and Fish used in (Schultz et al. 2021) can be easily integrated into this framework.

4.Evidence of accomplishment

Schulz, H., Eastman R. & Stevens B. (2021) "Characterization and Evolution of Organized Shallow Convection in the Trades" Submitted to J. of Geophysical Research (Atmosphere), under review. Preprint freely available at : https://www.essoar.org/doi/abs/10.1002/essoar.10505836.1

Janssens, M., Vilà-Guerau de Arellano, J., Scheffer, M., Antonissen, C., Siebesma, A. P. & Glassmeier, F. (2021), "Cloud Patterns in the Trades Have Four Interpretable Dimension. Geophys Res Lett, 48, e2020GL091001. https://doi.org/10.1029/2020GL091001