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Recurrence Quantification Analysis of temperature time series from marine cumulus clouds during EUREC4A

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Clouds are the source of the biggest uncertainty in weather and climate models. One cannot fully understand clouds without understanding turbulence and microphysical processes in clouds. During EUREC4A experiment in 2020, data from cloud penetrations and ABL was collected using Twin-Otter aircraft. Data gathered using UFT2b thermometer, a device able to measure temperature with centimeter-scale resolution (temporal frequency of 2 kHz, assuming ~60 m/s aircraft speed), contains valuable information about turbulence and cloud dynamics during various cloud penetrations. Using Recurrence Quantification Analysis, a tool used to analyse time series in order to study linearity and chaos in the system, we extract information about regimes present in clouds in terms of mixing of cloud air with environmental air, and possible chaotic or deterministic behavior. The analysis also enables to divide and classify portions of cloud in terms of turbulence. Criteria for cloud division and classification will be discussed, which will be illustrated by selected examples of recurrence plots and characteristic quantities in various regimes.