Project: 1114

Project title: Development and evaluation of cloud glaciation processes in ECHAM-HAMMOZ

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Ice nucleating particles (INPs) can form ice in supercooled liquid clouds (between 0°C and 35°C). This can be triggered naturally or artificially by cloud seeding, but the fate of the ice virga (precipitation that does not reach the ground) produced is poorly understood.

Ice virga are formed when solid precipitation sublimates before reaching the ground, releasing moisture, consuming latent heat and affecting atmospheric stability. In a changing climate, changing INP concentrations may modify the impact of ice virga on their local environment.

Using the previous resource allocation, we looked for a relationship between the ice virga behaviour during cloud glaciation and INP concentration.

1) We used single column simulations with ECHAM-HAM to gain some insight when comparing the default two-moment microphysical scheme with the new tuned Predicted bulk Particle Properties (P3) scheme in ECHAM-HAM, especially considering the importance of time resolution for cloud glaciation (Fig. 1).

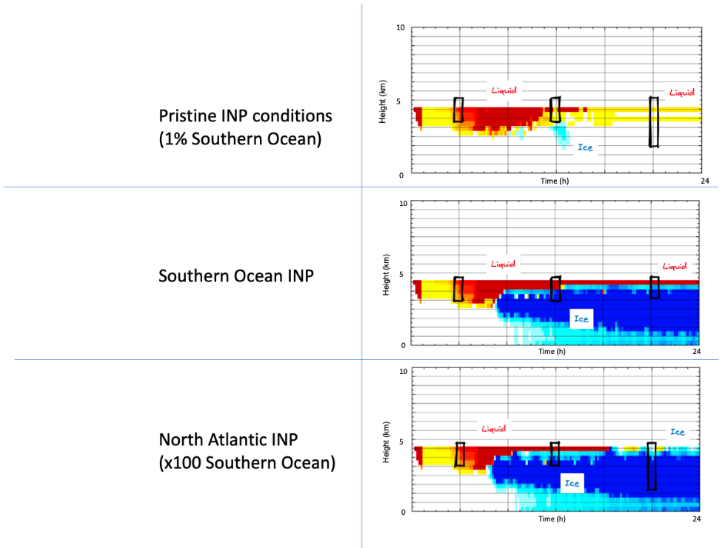

Figure 1. ECHAM-HAM single column simulations with varying INP concentrations. Liquid and ice-dominated regions are shown in red and blue, respectively.

2) We used the ICON model, configured to fit a mixed-phase cloud-favourable environment, to simulate the response of ice virga to different ice-nucleating particle concentrations (Fig. 2).

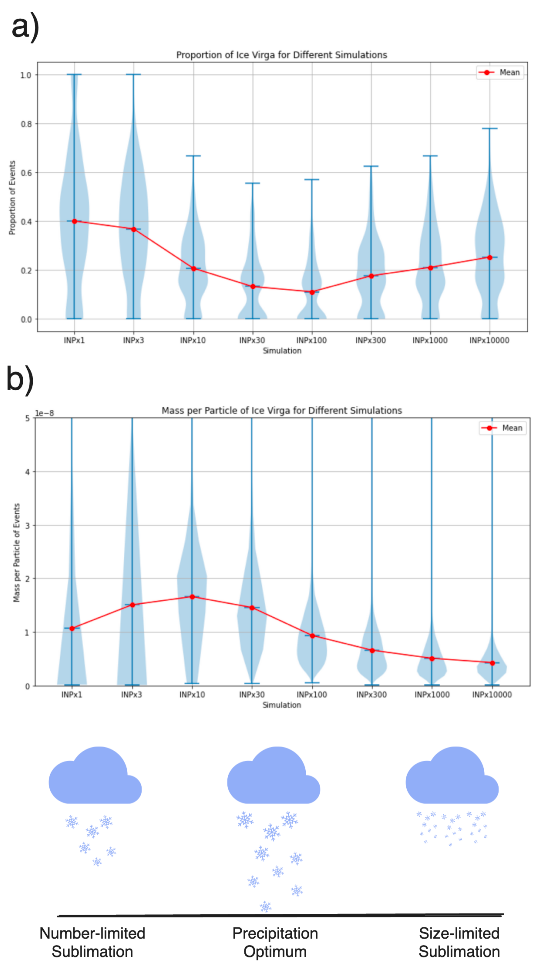

Figure 2. ICON-NWP 5km-torus simulations with varying INP concentrations. a) Ratio of ice virga events to total ice production events (precipitation and ice virga). b) Average mass per ice particle in kg within virga events.

These results are part of the first sensitivity studies to understand how cloud glaciation in stratiform clouds differs from the previous generation climate model ECHAM-HAM and the new generation weather-climate model ICON (Giorgetta et al., 2018; Crueger et al., 2018) and ICON-HAM (Salzmann et al., 2022). These findings will help the process of constraining the cloud phase in ICON-HAM in future projects.

References

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