Atmospheric Rivers over the Arctic with the ICON model

Motivation
- The Arctic warms faster than other regions, but the relative role of the individual feedback mechanisms contributing to the Arctic Amplification is still unclear.
- Aim: Improving the understanding of specific regional atmospheric feedbacks starting with model evaluation of spatiotemporal patterns of selected key processes: moisture intrusions and their particular cases - atmospheric rivers, boundary layer vertical mixing, mixed-phase clouds.
- The high-resolution ICON modelling framework is used with a grid refinement over the Arctic (from 13 km down to 3 km) and first time model assessment of atmospheric river related processes in the Arctic.

Atmospheric Rivers (ARs): important moisture intrusions
- ARs represent river-like atmospheric moisture transport from lower latitudes. ARs explain 90% of poleward water vapor transport outside of the tropics, with important impacts in both polar regions, yet not well understood.
- How can ICON-LAM represent the spatiotemporal structure of ARs?
- What is the role of ARs for precipitation (both snowfall and rainfall), and what are related impacts on surface and tropospheric warming?

Analysis of an Arctic Atmospheric River: ICON-LAM, ICON-GLOBAL, ERA5 vs Observations
- ICON-GLOBAL: 13.15km res., 3-hourly output, 90 v. levels (top: 75km)
- ICON-LAM: 6.58km res., hourly output, 70 v. levels (top: 23km)
- ERA5: 31km res., hourly output, 137 v. levels (top: 80km)
- Obs: radiosonde & GPS at Ny-Alesund during ACLOUD campaign

- ICON-LAM humidity profile closer to observations: moisture intrusion in ca. 1500m well captured (lines: Ny-Alesund location, shadings: 4 closest points).
- ICON shows realistic temperature profile with 5K increase from 05/06 to 06/06/17.
- AR visible from Integrated Water Vapor (IWV) pattern from ICON-LAM.
- Shift of the AR location in ICON-LAM compared to ERA5 and ICON-GLOBAL.
- South of AR: latent HF dominates (evapo.) with low pressure & precipitation.
- Within AR: evapo. suppressed and sensible HF towards the surface (warm air over cold surface).

Outlook
- Continue ongoing AR analysis (IWV, precip, surface fluxes, 3D structure,...).
- Sensitivity of AR to boundary & initial conditions.
- AR case studies with campaign observations (ACLOUD/PASCAL, HALO, MOSAiC).

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