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Two types of westerly tip jets near Greenland

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The westerly Greenland tip jet is a narrow and intense low-level jet in the lee of Cape Farewell. It mainly occurs during wintertime and has strong inter-annual variability. In the present study, we use airborne in-situ and remote-sensing observations and high-resolution numerical simulations with WRF to study two westerly Greenland tip jet cases.

The first case occurred 24 November 2003, where the airborne observations reveal new insights into the complex structure of the Greenland tip jet event, featuring two jet branches and a wake in between. One of the jets is located at the southeast of Cape Farewell, which is the Greenland tip jet. The other is located to the north and is connected to a downslope wind-storm. These jets are well reproduced by the model simulation, but their magnitude is slightly overestimated. The maximum wind of the Greenland tip jet of about 32 ms^{-1} occurs at around 850 hPa. The results show that the tip jet is associated with strong mountain gravity wave activity, where the wave energy radiates upwards into the stratosphere.

In contrast to the case observed in 2003, we also present another different tip jet case that occurred 18 February 1997. Here, the tip jet development is concurrent with strong frontogenesis which parallels to the tip jet and is situated along the northern boundary of tip jet. The baroclinic zone tilts southwards. In this case, the gravity waves are trapped with the energy channelled downstream and the tip jet is relatively long and intense. We compare the two different types of tip jets, which we refer to as the barotropic tip jet (case 2003) and the baroclinic tip jet (case 1997) and discuss the significantly differing dynamical mechanisms of these two types of tip jets.