

Impact of cloud microphysical schemes of global and regional models on the dynamic of Arctic cyclones: comparison with airborne and CloudSat-CALIPSO data

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Uncertainty on Arctic cyclone forecasts

Arctic cyclones:

large-scale cyclone (1000km), with long life (2 weeks), above 65°N and bringing humidity in Arctic region

Uncertainty on **Dynamics**:

- Two types of system observed: baroclinic / barotropic
- Duration due to Tropopause Polar Vortexes
- · Impact on sea ice melting in summer

Uncertainty on cloud microphysical parameterization:

- Unknown cloud microphysical processes
- Error on numerical representation of mixed-phase clouds
- Impact on dynamics through Potential Vorticity (PV) alteration due to heating (Mazoyer et al. 2022)



Schematic of Arctic cyclone dynamics and impact on sea ice

Comparison with satellite and aircraft data



 Delanoë, J., and R. J. Hogan, 2008: A variational scheme for retrieving ice cloud properties from combined radar, lidar, and infrared radiometer, Journal of Geophysical Research, 113, D07204, doi:10.1029/2007JD009000.
Delanoë, J., and R. J. Hogan, 2010: Combined CloudSat-CALIPSO-MODIS retrievals of the properties of ice clouds. Journal of Geophysical Research, 115, D00H29, doi:10.1029/2009JD012346
Mazoyer, M., et al., 2021: Microphysics Impacts on the Warm Conveyor Belt and Ridge Building of the NAWDEX IOP6 Cyclone, Monthly Weather Review, 149, 3961–3980, doi: 10.1175/MWR-D-21-0061.1

Problematic and Methodology

Two models:

 ARPEGE (global model)
Which liquid/ice partition function must be used for clouds

representation in Arctic cyclones ?

 AROME-Arctic (regional model) Which parameterization better

represent clouds in Arctic cyclones ?

Methodology:

Compare simulations with different microphysics representation to observations and study impacts of heating due to microphysics change on PV (dynamics)

Arctic cyclone on May 2019

Study case:

- Arctic cyclone born in Russia the 9th May 2019
- Northward trajectory of 7 days with end near Svalbard
- Minimum Pressure: 999hPa
- Crossed 15 times by CloudSat and CALIPSO



PV and wind alteration due to heating

Time along satellite cross-section and ARPEGE forecast (Init 11/05/19 OUTC) of Mean Sea Level Pressure and $\theta_a(850hPa)$ at OUTC 13/05/19



Conclusion and Perspectives

- A new partition function has been established from DARDAR with a bimodal shape (no linear as represented in models)
 In future:
- Incorporate the new partition function in ARPEGE
- Compare the initial and new partition function in ARPEGE on study cases
- Compare two cloud microphysical schemes of AROME-Arctic
- Other study case and use of airborne data from THINICE