

CALIBRATION OF STOCHASTIC ICE NUCLEATION SCHEME

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INTRODUCTION

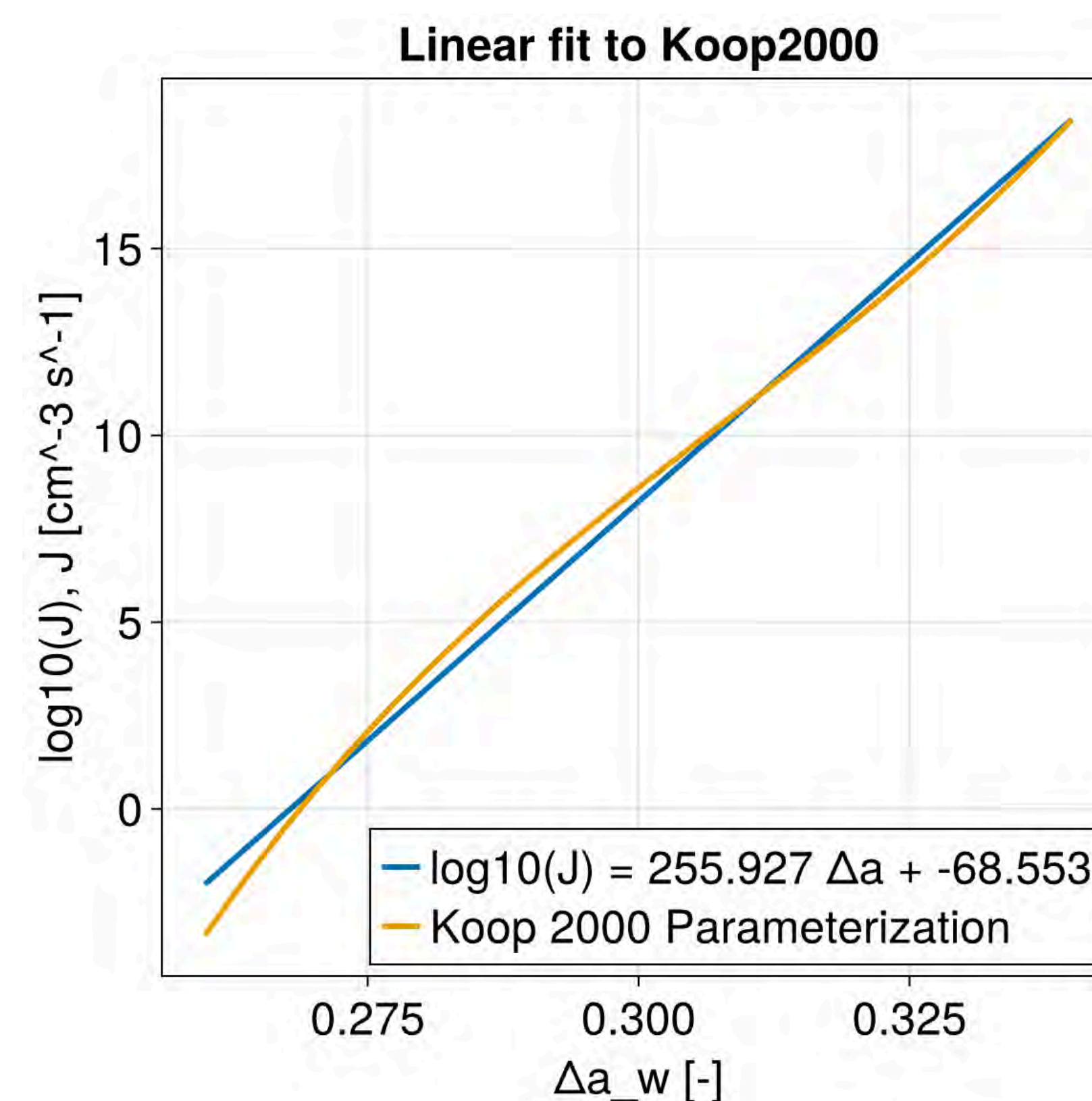
Ice nucleation is parameterized differently across global models. Some models use deterministic over the more physically accurate stochastic parameterizations because of their computational efficiency. While it is preferable to use a consistent set of parameterizations that would account for key aerosol types and all relevant conditions, many parameterizations are restricted to select conditions.¹

GOAL:

Calibrate a **consistent** and **computationally efficient** set of **time-** & **aerosol-** dependent parameterizations for homogeneous, immersion, and deposition ice nucleation.

PARAMETERIZATION

$$\log_{10}(J) = m\Delta a_w + c$$

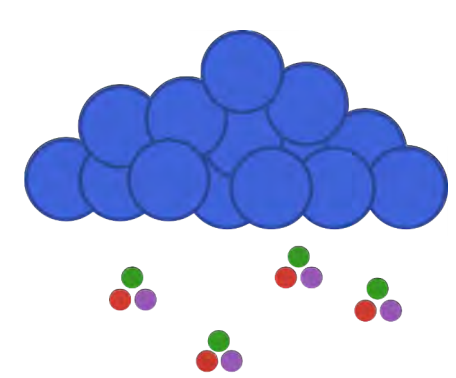


Parameterization for aerosol-dependent **heterogeneous** nucleation rate coefficient, J, is linear in water activity criterion.^{2,3}

A linear regression is performed for a similar cubic parameterization for **homogeneous** freezing.⁴

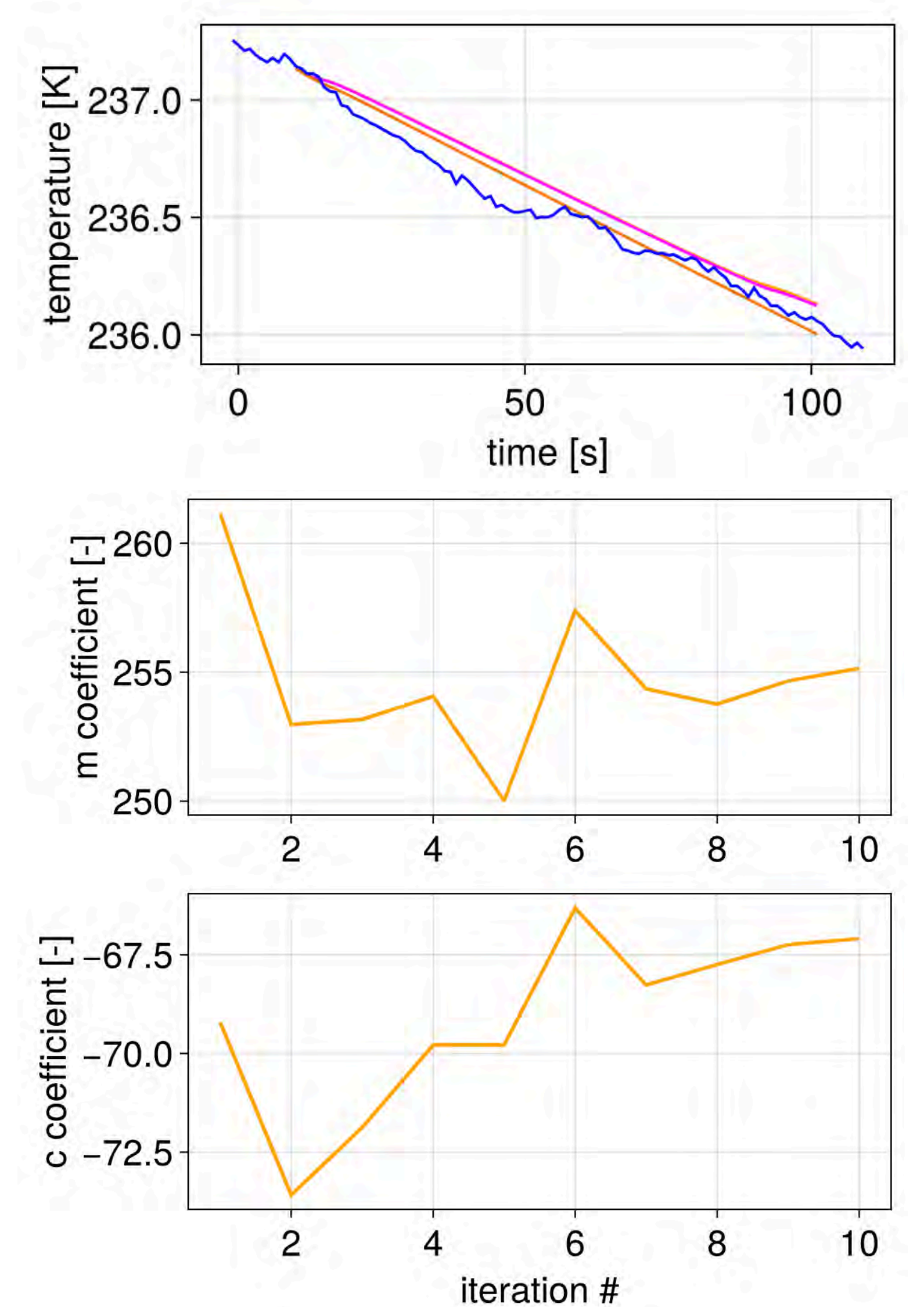
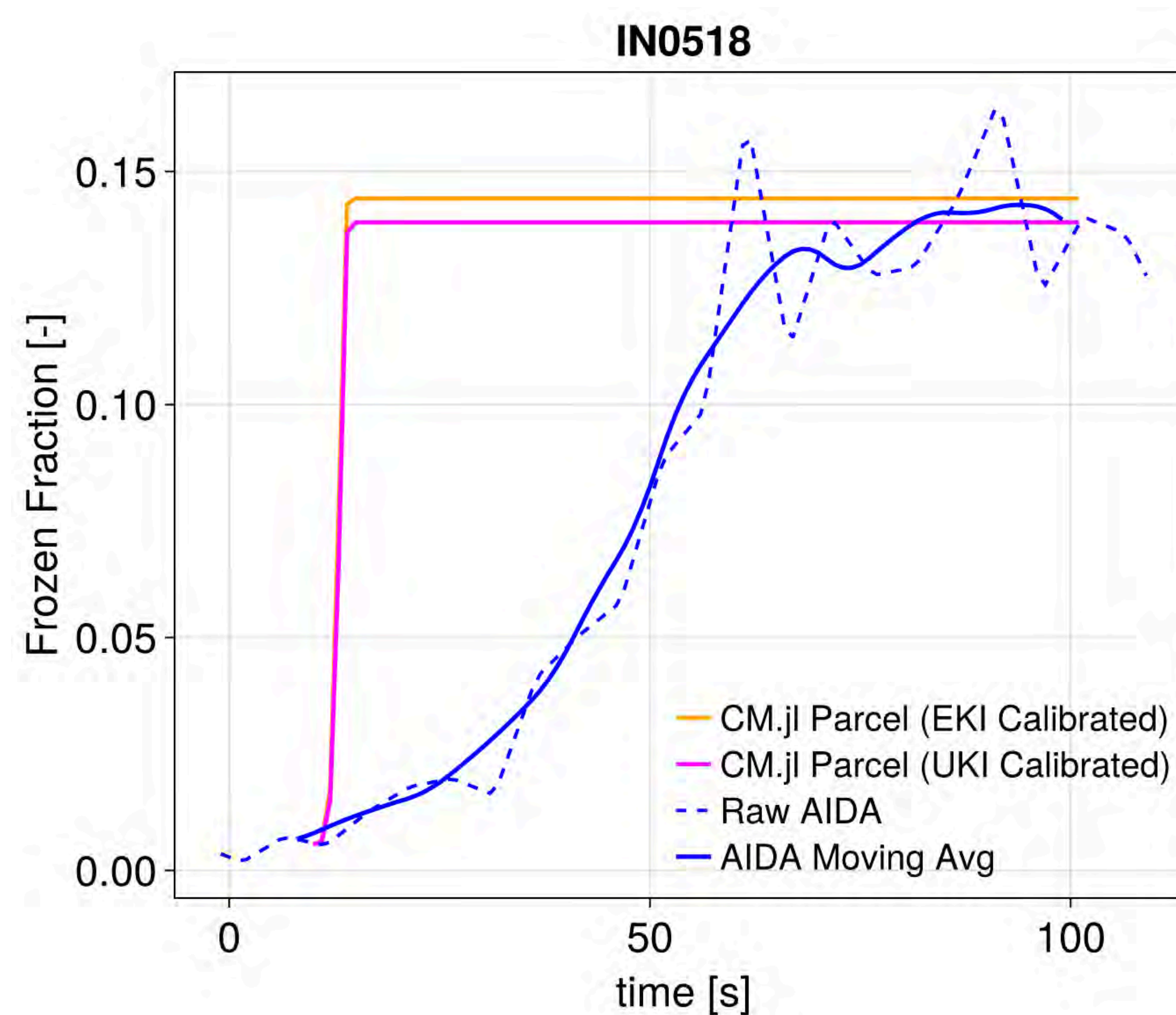
CALIBRATION

- Priors used are derived from literature (see pre-calib curve)
- Parameterizations implemented in an adiabatic parcel model
- Free parameters calibrated against AIDA chamber (from KIT)
- Calibrations performed with EnsembleKalmanProcesses.jl



Check out the CloudMicrophysics.jl GitHub repo for details, other work, and tools.

Calibration to a homogeneous ice nucleation experiment.



CONCLUSION

Further Investigation

- Calibration for heterogeneous freezing modes
- Error analysis
- Compare to atmospheric observations
- Compare to a size-resolved scheme

Scaling Up

- What are key aerosol types that should be accounted for regionally and temporally?
- What data should be used to validate ice crystal number concentrations across the globe?

REFERENCES

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3. Alpert, P. et al. (2022). Ice nucleation imaged with X-ray spectro-microscopy. *Environ. Sci.: Atmos.*
4. Koop, T. et al. (2000) Water activity as the determinant for homogeneous ice nucleation in aqueous solutions. *Nature*.

This project is supported by Schmidt Sciences, LLC.