Aerosol - cloud droplet concentration closure for marine stratocumulus clouds: Comparison of two parameterisations using an inverse modelling framework

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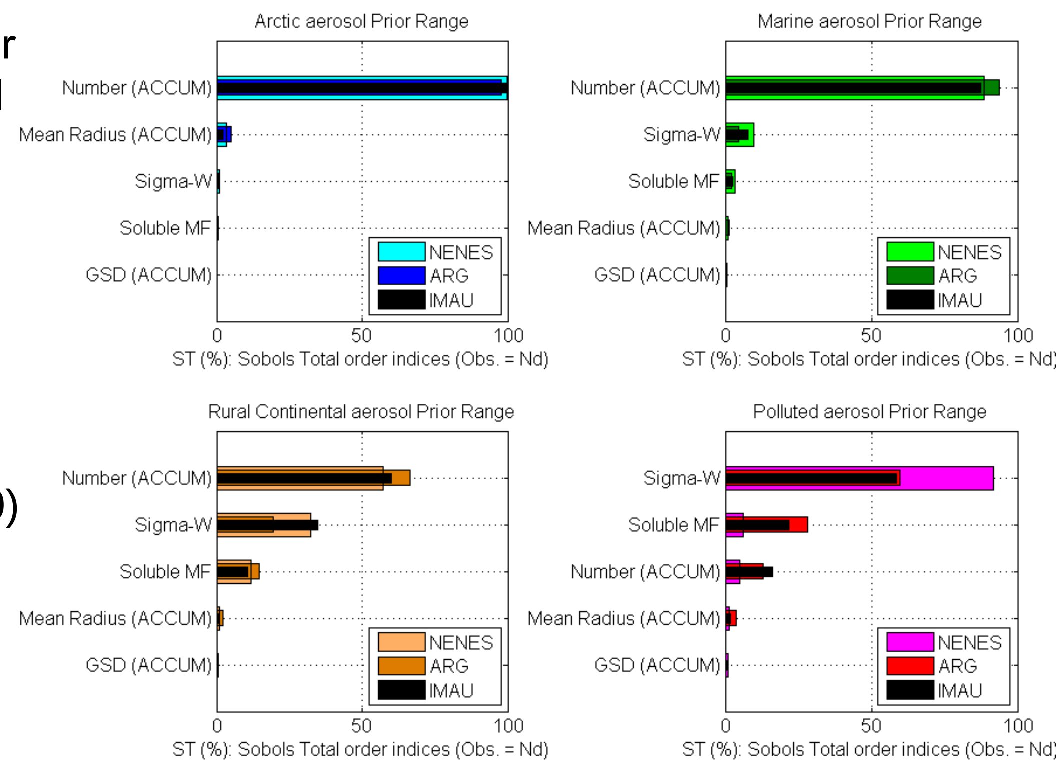
Sobol' Indices: Global parameter sensitivity

By investigating how the ranking changes as the aerosol environment becomes more polluted we can guide future in-situ campaigns towards certain parameters. Results also provide insight into performance of parameterisations compared to more detailed cloud models.

- Sobol's indices (Total effect) for three models over four aerosol environments using the prior ranges documented in Partridge et al., 2012.
- Except for strongly polluted regions sensitivity of droplet number to key parameters in NENES (Barahona et al., 2010) droplet activation scheme are closer to cloud parcel model (Roelofs and Jongen, 2004) than ARG (Abdul-Razzak and Ghan, 2000) parameterisation.



Abdul-Razzak, H. and Ghan, S. J.: A parameterization of aerosol activation 2. multiple aerosol types. JGR, 2000.

Barahona, D. et al,.: Comprehensively accounting for the effect of giant CCN in cloud activation parameterizations, ACP., 2010.

Partridge, D. G., et al.: Inverse modeling of cloud-aerosol interactions – Part 2: Sensitivity tests on liquid phase clouds using a Markov Chain Monte Carlo based simulation approach, ACP, 2012.

Roelofs, G. J. and Jongen, S.: A model study of the influence of aerosol size and chemical properties on precipitation formation in warm clouds, JGR, 2004.

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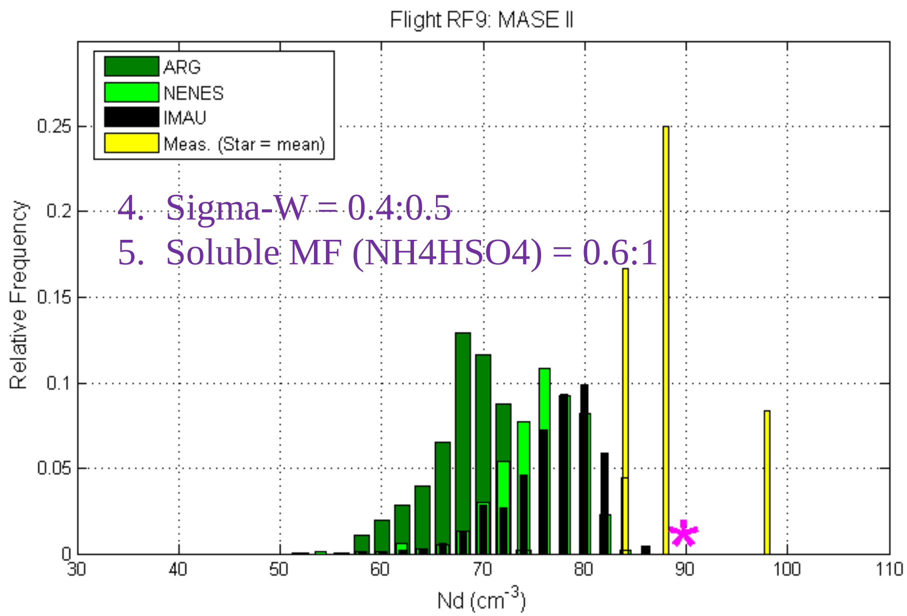
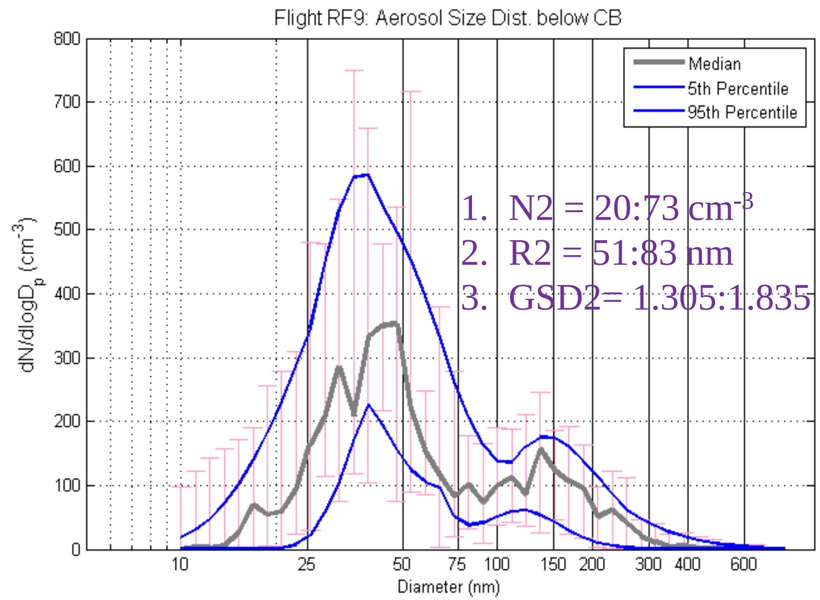
Inverse Modelling: MCMC

- Couple two droplet activation parameterisations and a cloud parcel model to the DREAM Markov Chain Monte Carlo (MCMC) algorithm (Vrugt et al., 2009) and observations from MASE II.
- After convergence to the parameter values that provide the best fit to the observations we plot the corresponding posterior distributions of the simulated droplet concentrations for two flights.





- Irrespective of parameter values from observed prior range over 5 dimensional parameter space we cannot match the observations for the cleanest marine Sc cloud (Flight RF9).
- Indicates parameteric uncertainty (for a parmaeter held constant, i.e. the mass accomodation coefficient), or structural error present.
- Discrepancy for cleanest flight significantly larger for ARG parameterisation.

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