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Source-receptor matrix calculation for deposited mass with a Lagrangian particle dispersion model in backward mode

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Lagrangian particle dispersion models (LPDM) are popular tools to simulate the dispersion of trace gases, aerosols or radionuclides in the atmosphere LPDMs typically consider only linear processes, i.e. processes that do not depend on the concentration of the simulated tracer such as non-linear chemical reactions. This linearity means that they are self-adjoint, i.e. they can be run forward and backward in time without changes to the source code. The only difference between such simulations is the sign of the wind components used for transporting the particles. In the case where the number of (potential) source elements is larger than the number of receptors, running the model backward from the receptors is computationally more efficient than running it forward from the sources (if the number of receptors is smaller than the number of sources).
To interpret the wet deposition of acidifying compounds or the contamination of snow by the albedo reducing BC, the s-r relationship of the deposited material would be very important to understand. To date, backward calculations for deposition quantities have not been possible. We present an extension of the LPDM FLEXPART that allows such calculations and test its performance for both dry and wet deposition.
We show a comparison between model results in forward and backward mode as well as modeled vs. measured concentration of black carbon at high latitudes. Both analysis prove that the model approach is working well in backward mode and also gives a very good agreement with deposition measurements.