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# Aerosol dynamics and dispersion of radioactive particles


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T2.4-P1

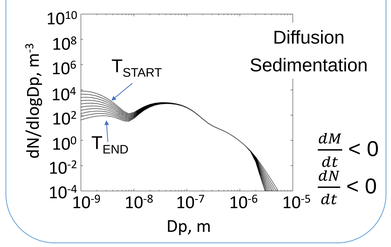
CTBTO uses measurements of radioactive particles to supervise the compliance of the test ban treaty. Dispersion models connects the assumed location of a nuclear source with a measurement station, that is, the dispersion model associates a detonation with a measurement.

Traditionally dispersion models have quite rudimentary descriptions of the processes that change the aerosol size distribution and composition throughout the transport. These processes, *aerosol dynamics*, include wet and dry deposition, coagulation, condensational growth, chemical interactions, nucleation of new aerosols and the interaction between the released aerosol and the ambient atmospheric aerosol.

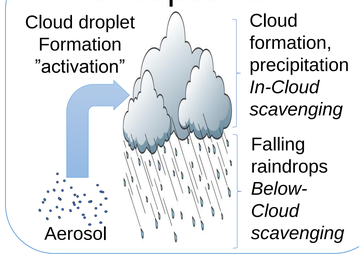
Using the trajectory box model CALM the importance of aerosol dynamics has been studied. The target of this study is to analyse the relevance of including more advanced aerosol dynamics into dispersion models that are used to track released radioactive particles.

## Aerosol Dynamic Processes

### Dry deposition




### Wet deposition

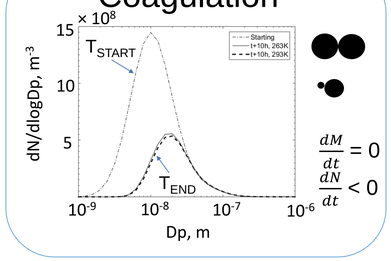



### Nucleation

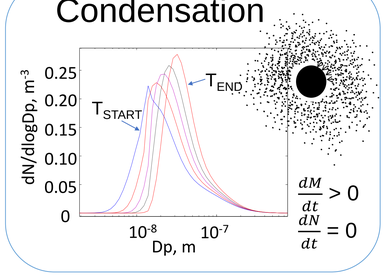
### Chemical transformation

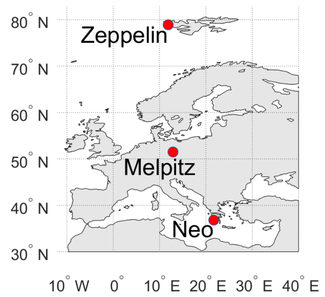
### Background sources

### Coagulation




### Condensation



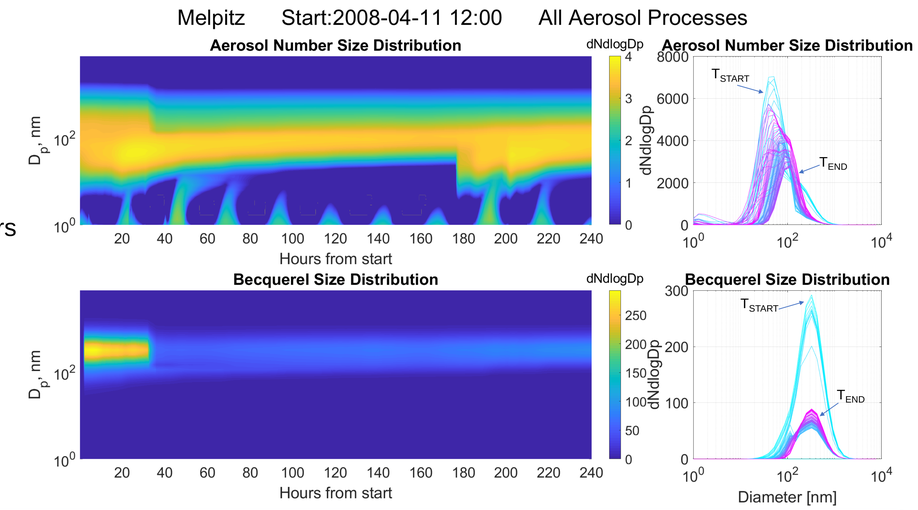




## Experimental setup

Measurement of aerosol size distribution for three different stations (Zeppelin - Arctic, Melpitz - Rural, Neo - Mediterranean) initiated 10-day-long trajectory calculations. Turning on and off aerosol dynamic processes show the importance of those. Caesium-137 was released in the beginning of each trajectory to track its change over time. For each hour (except for missing measurements) for each station a simulation was started. For a whole year of measurements this made in total 115455 simulations for the different experiments (five different experiments with different aerosol processes turned on and off).

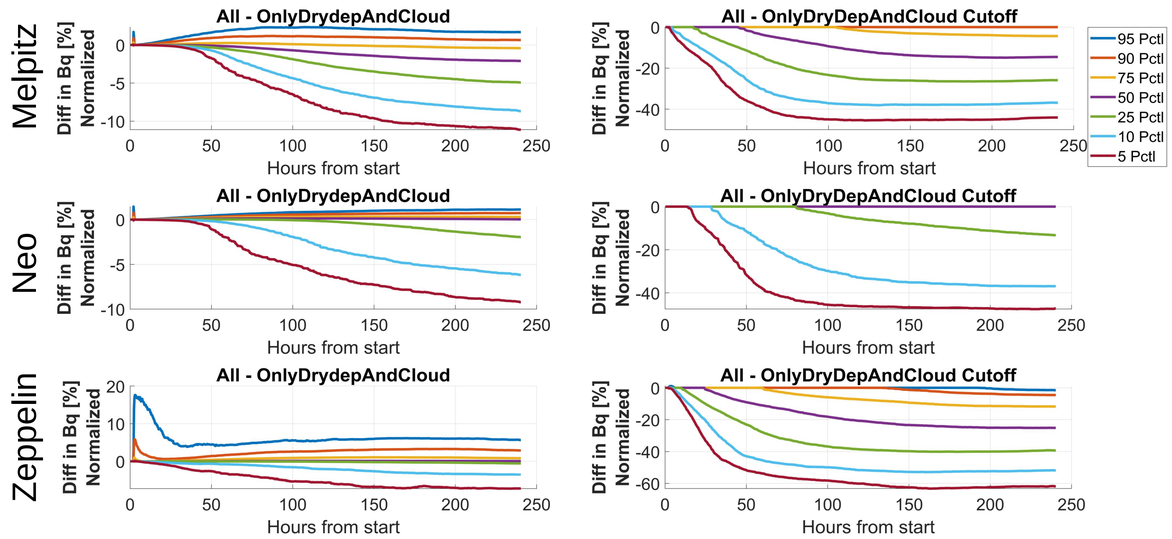
## One example trajectory:

Evolution of size distribution. Number distribution (top) Becquerel distribution (bottom). After 40 hours most radioactivity is rained out in this case.




## The impact of including advanced aerosol dynamic processes

Difference in air concentration of radioactivity throughout the simulation as percentile values.




Difference: *"all processes"* and *"only dry deposition and clouds"*

Difference: *"all processes"* and "only dry deposition and cloud, simplified wet deposition mimicking a dispersion model"

## Result and conclusions

- The size distribution of radioactive particles changes over the trajectory. There is a transfer of particles and radioactivity mainly into the accumulation mode
- Mean values over time work well without advanced aerosol dynamics
- When simulating individual events, the inclusion of advanced aerosol dynamics can make a difference
- In 5% of the cases there is roughly a factor of 2 difference in air concentration with the simplified wet deposition scheme
- Including this in a dispersion model increase the model confidence

**Disclaimer:** The views expressed on this poster are those of the author and do not necessarily reflect the view of the CTBTO