Virtual Institute

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Using WRF with the TAU bin microphysics to test new parameterization of ice nucleation; Preliminary results

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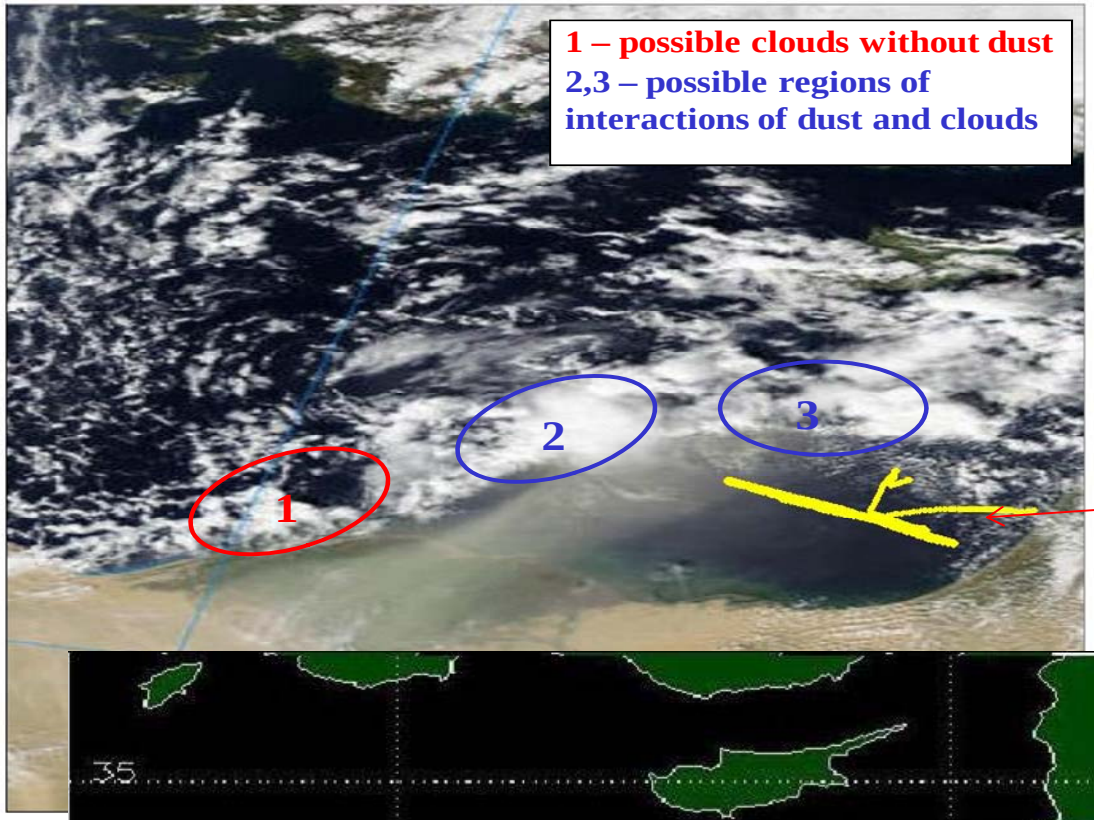
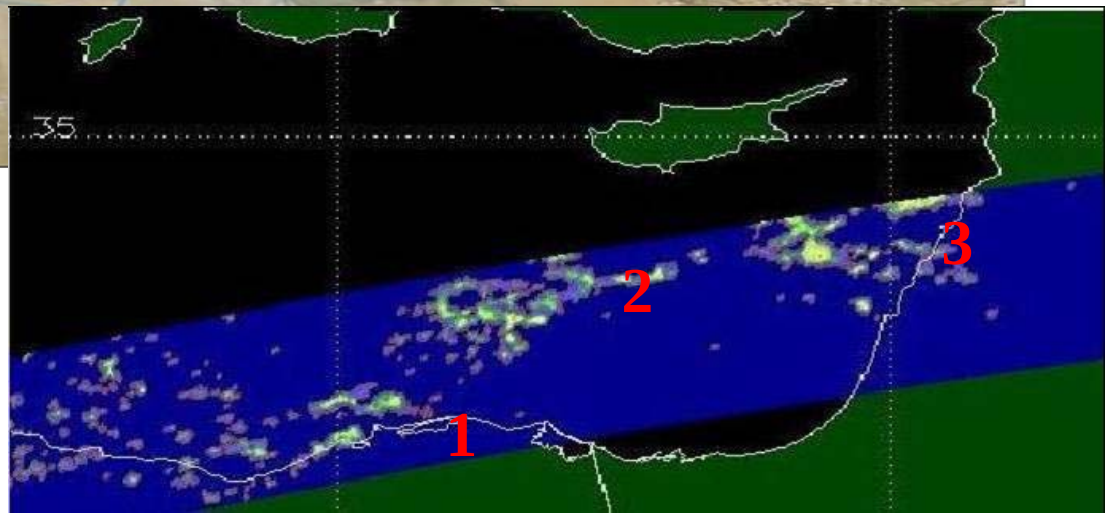
(WRF: Weather Research and Forecast http://wrf-model.org/)

Dust storm during MEIDEX – 28 January, 2003



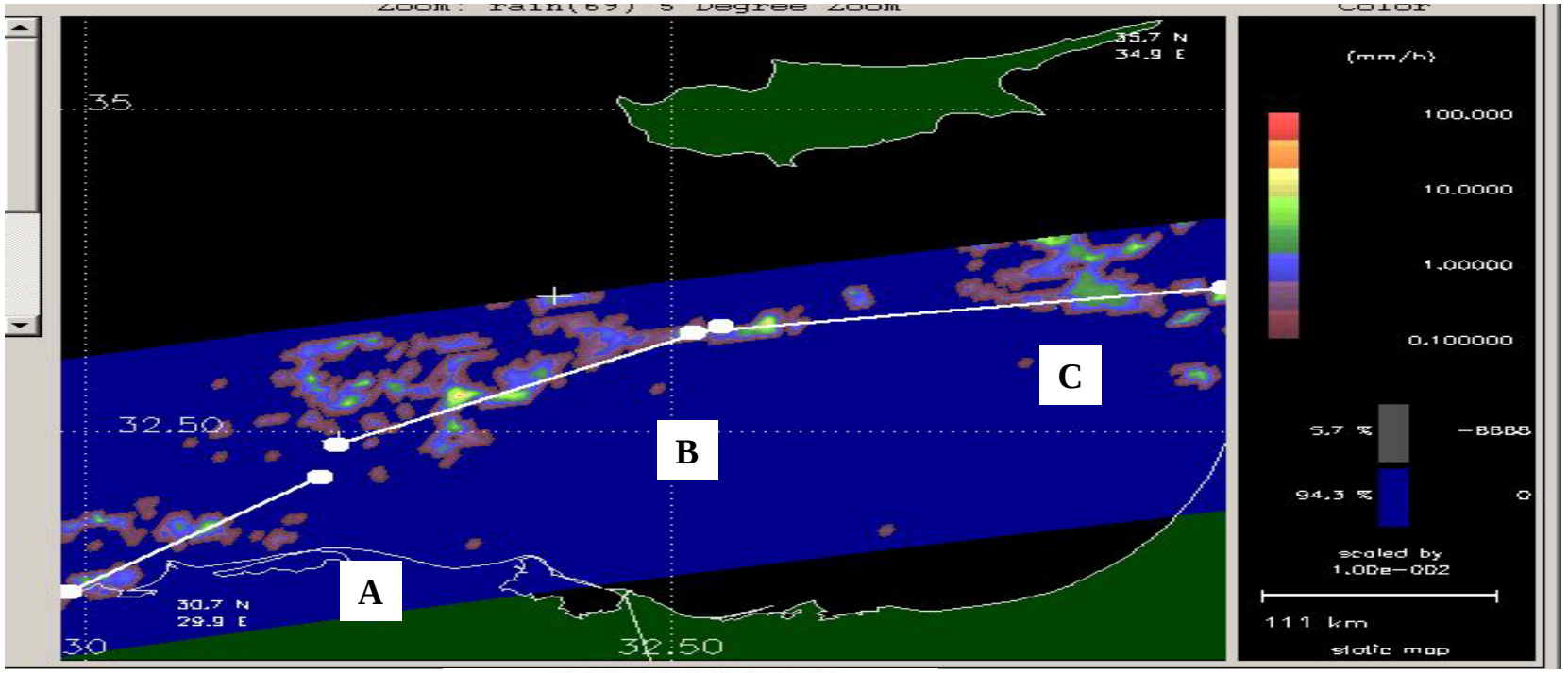
MODIS image

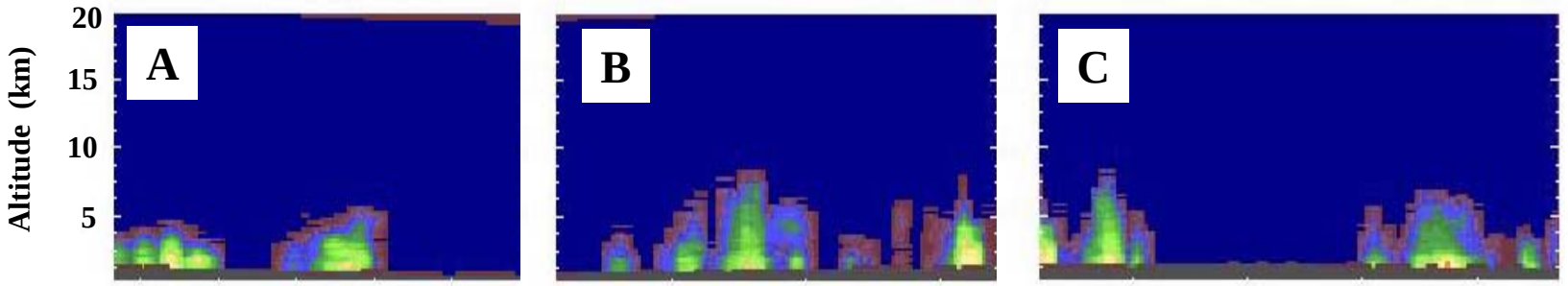
Flight path



Precipitation Based on TRMM

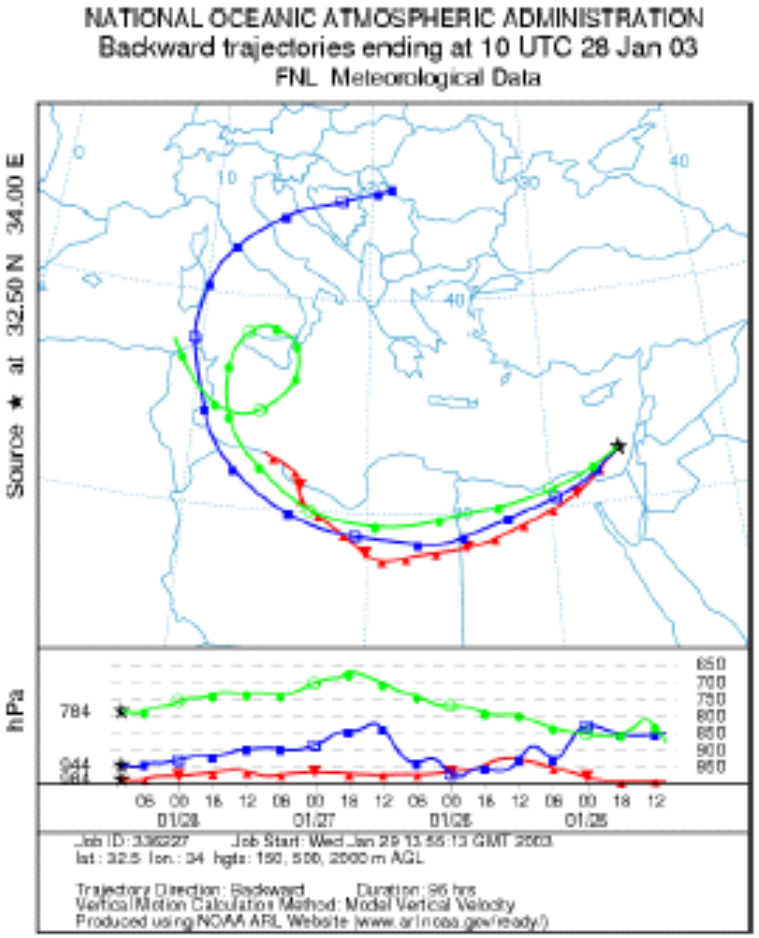
See Levin et al 2005 for detail



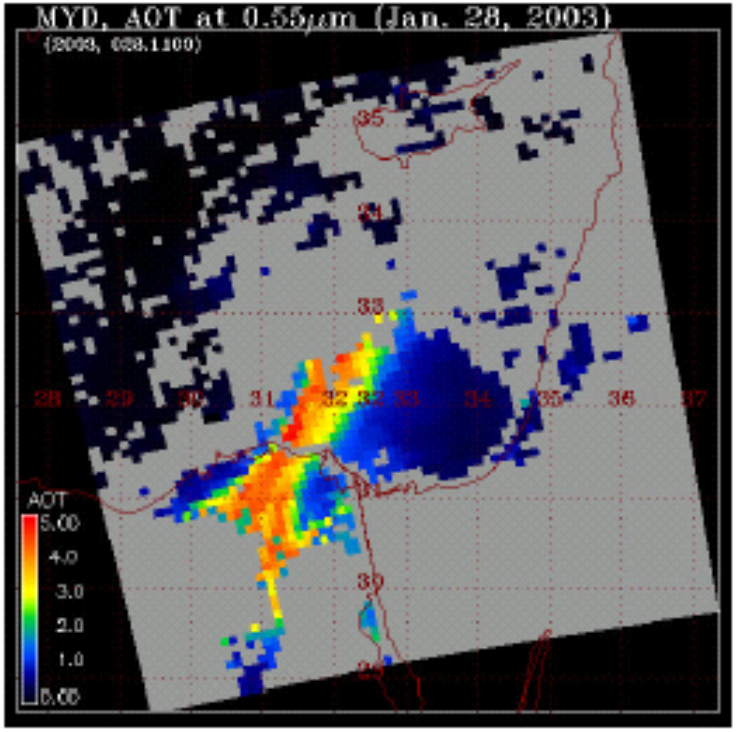


This storm is interesting because it interacted with dust in B and C, while in A the interaction is less obvious. This storm produced flooding when it crossed the coast of Israel.

Question: What is the effect of the dust and the pollution we observed at high altitudes on the precipitation.

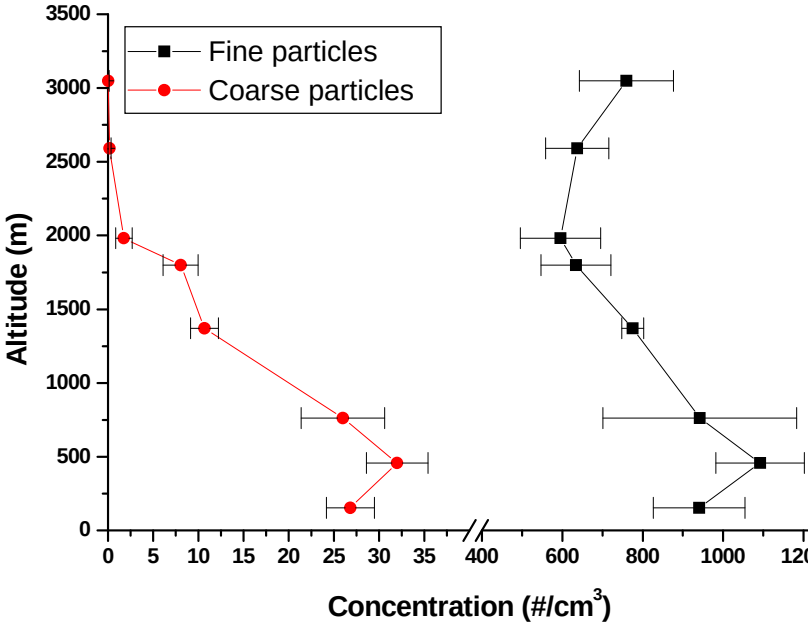


AOD of the MEIDEX dust storm

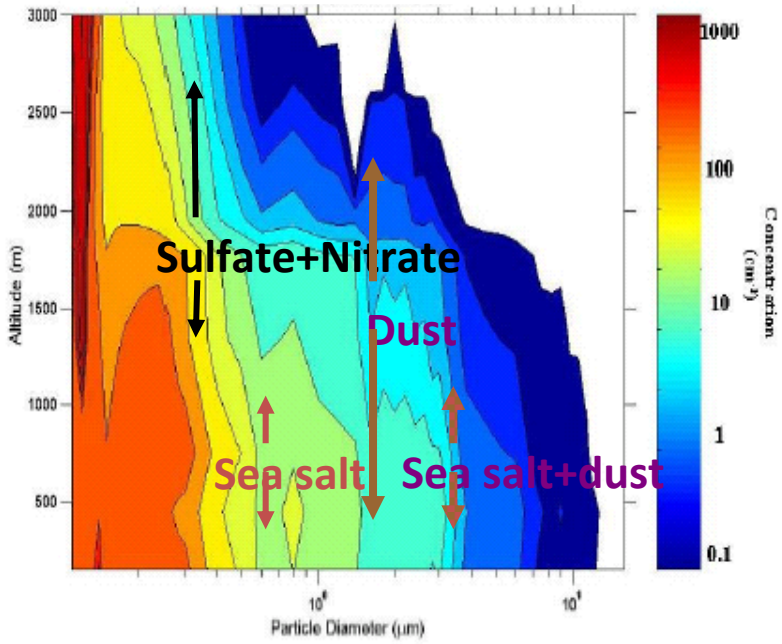


Results from airborne measurements

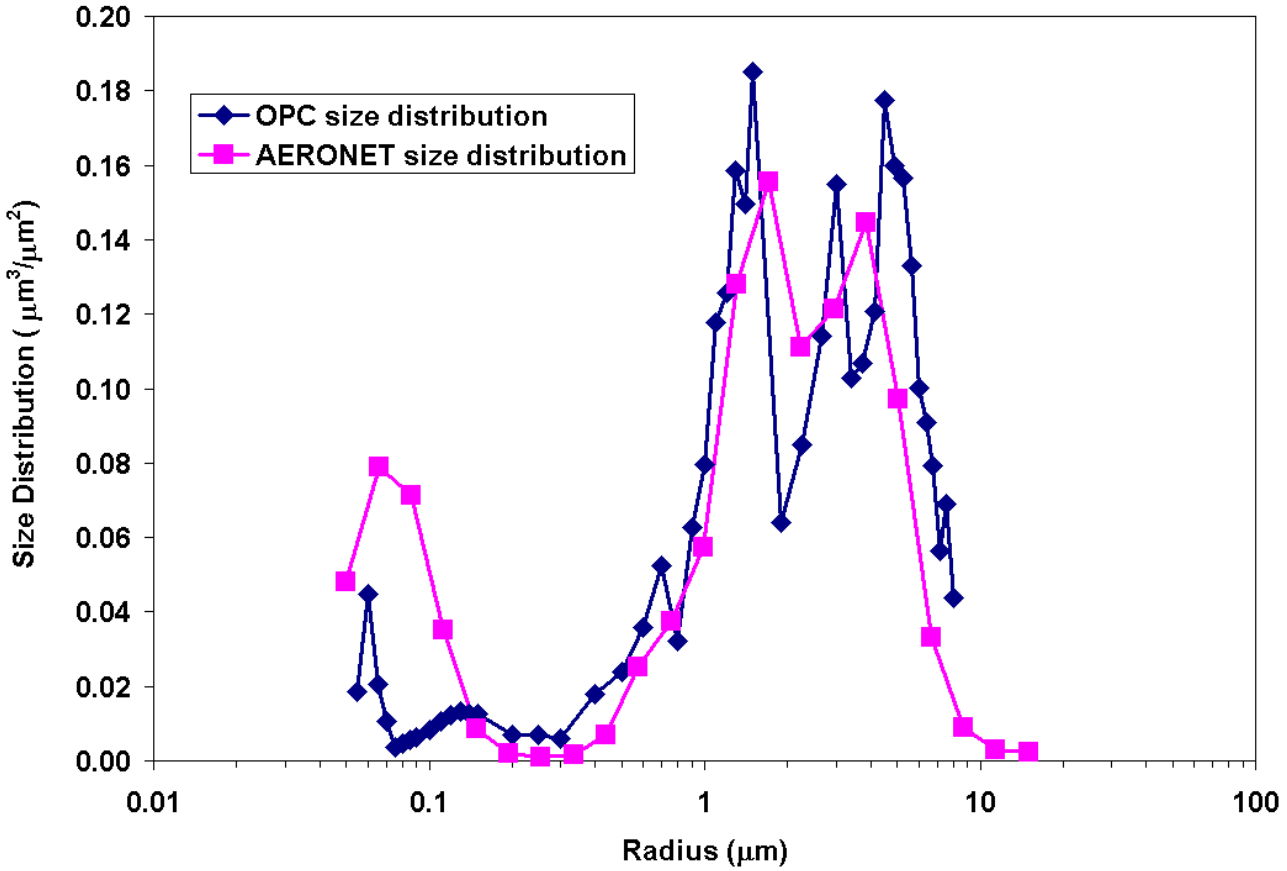
Average as a function of height



Size distribution and composition of individual Particles as a function of height (28 /1/03)

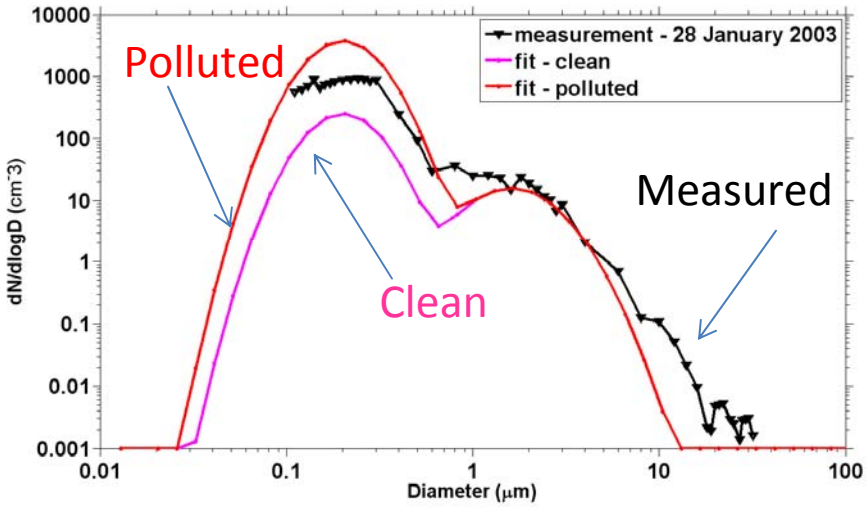


Integrated size distribution from the airborne measurements and from AERONET at Nes Ziona, Israel (28.01.2003)

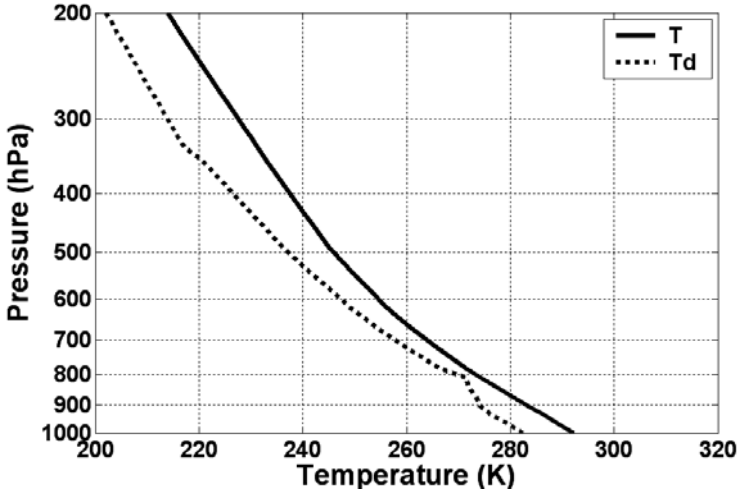


Initial conditions for model simulations

Aerosol size spectra



Average winter profiles for the Eastern Med.



Average measured spectrum of aerosols (28 Jan 2003) ----------

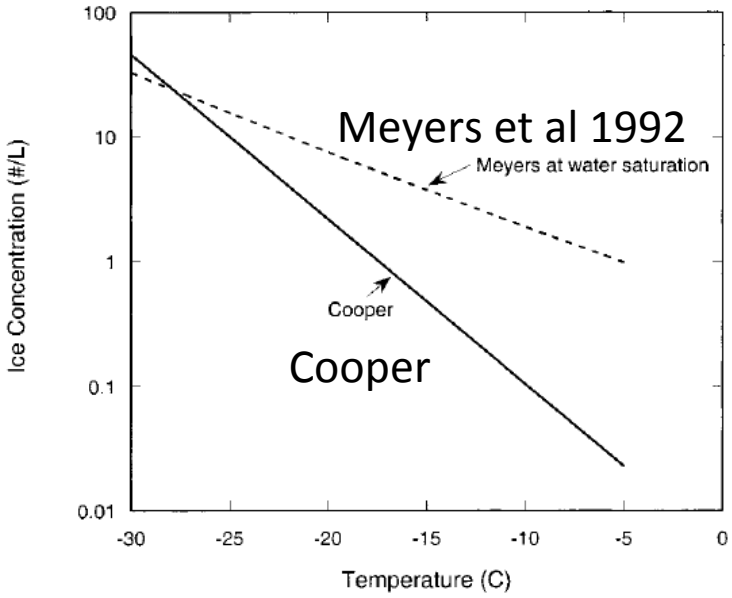
Hypothesized Clean atmosphere (100 CCN) with Giant CCN --------

Hypothesized dusty (polluted) atmosphere with Giant CCN ---------

New Ice nuclei formation scheme

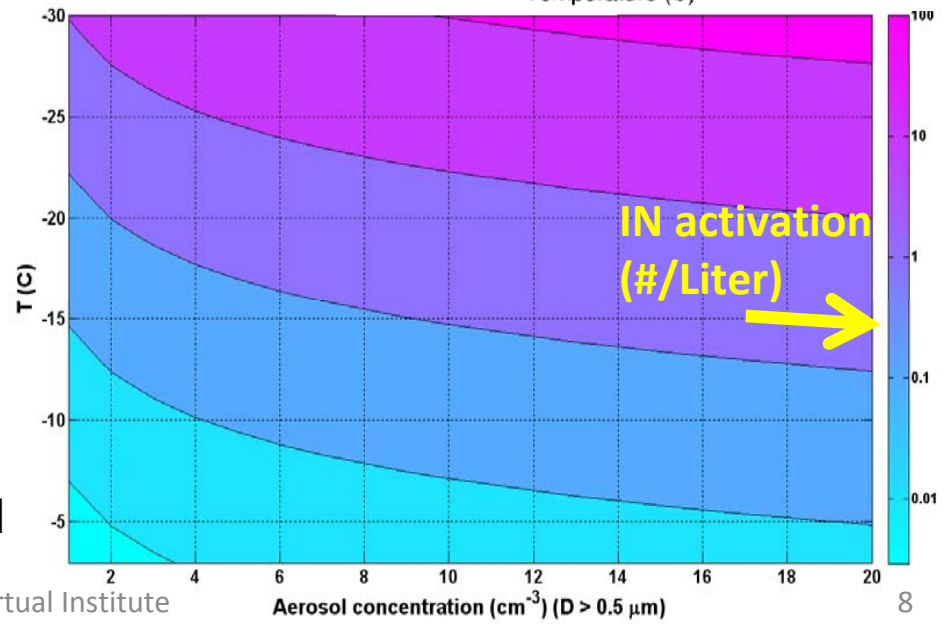
Old parameterizations:

- **Depends on T and on supersaturation above ice. No dependence on aerosol physical or chemical properties**



New parameterization:

- **Depends on T and on concentration of aerosols > 0.5 µm.**

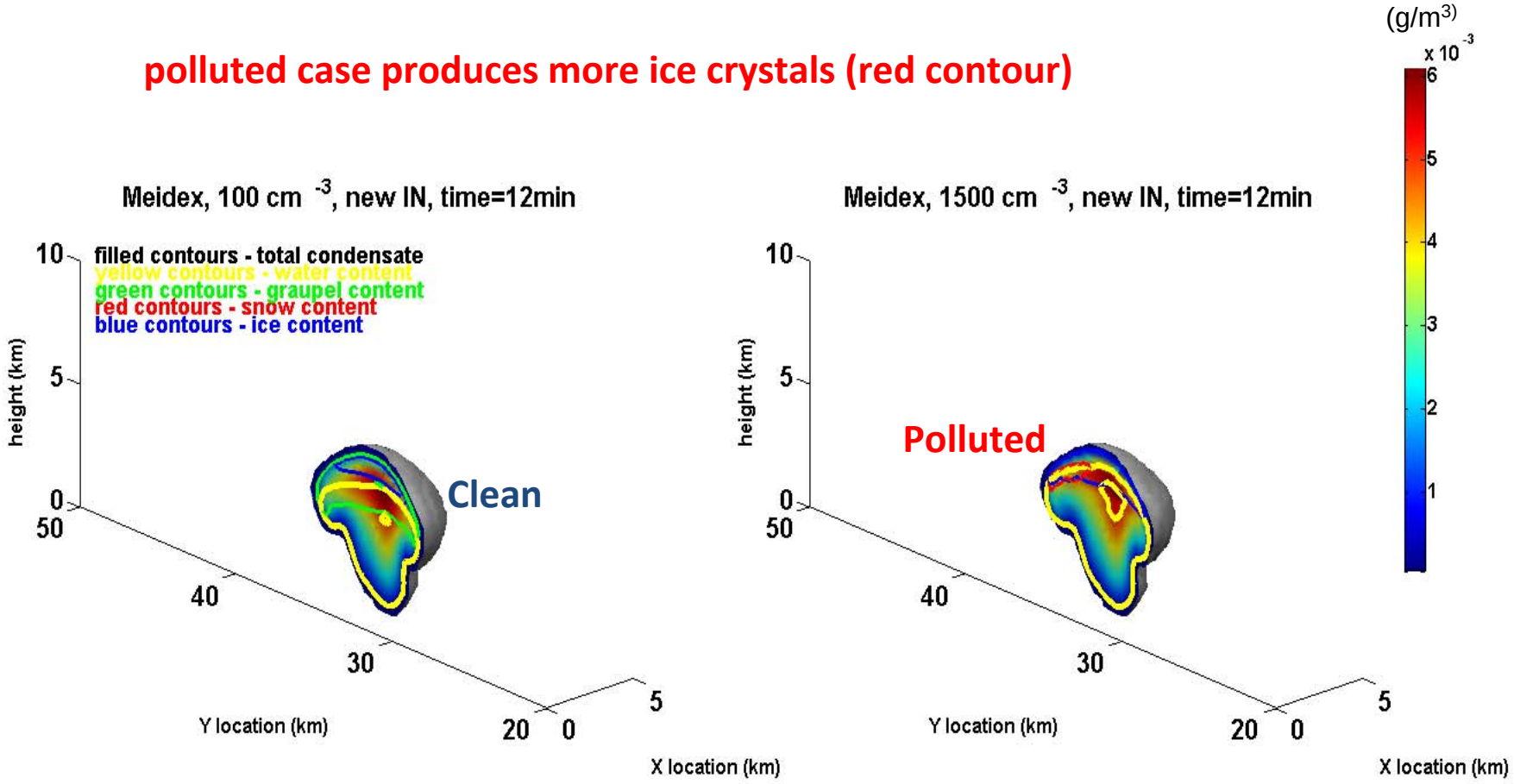


Note: No contact nucleation is included

Comparison between clean (100 cm^{-3}) and polluted (1500 cm^{-3}) conditions

clean case produces more graupel mass (green contour)

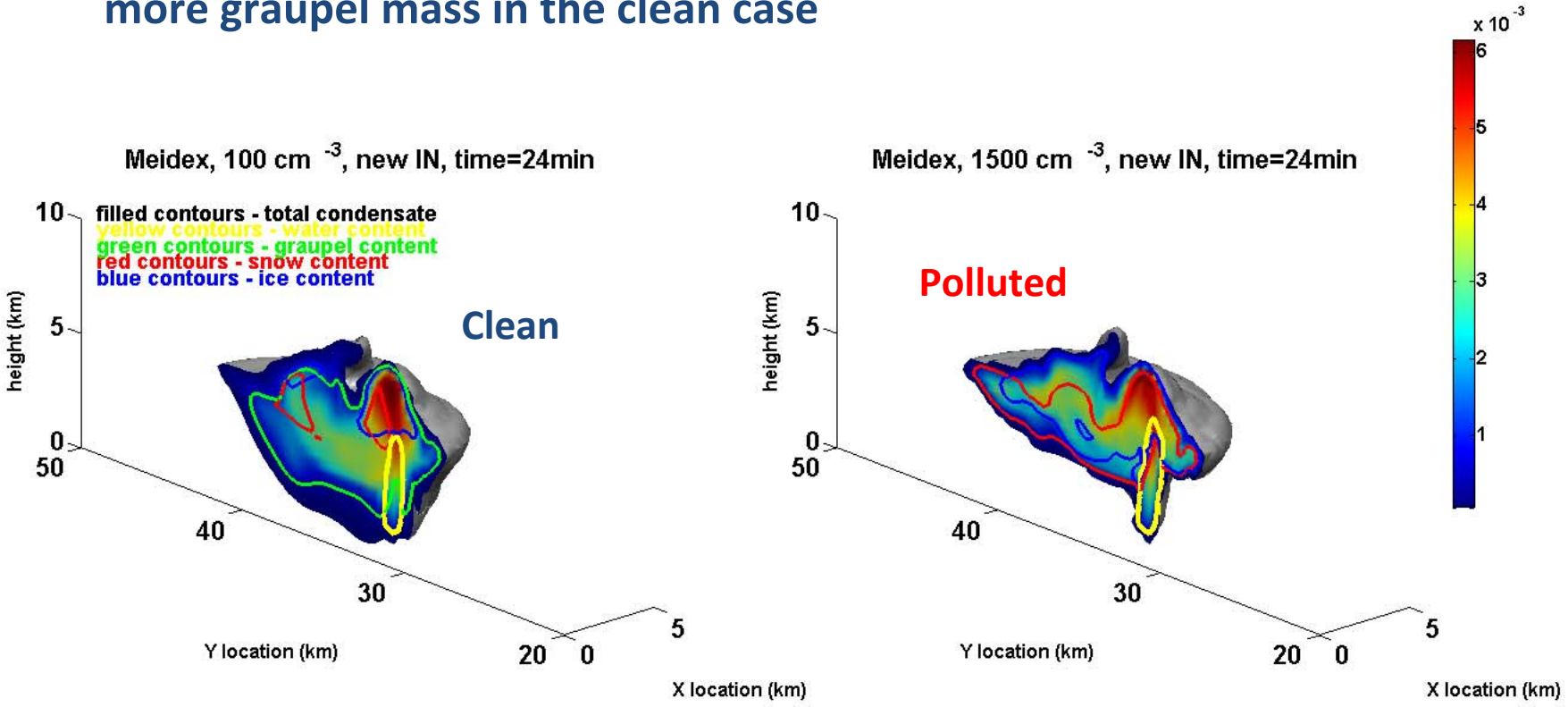
polluted case produces more ice crystals (red contour)



Comparison between clean (100 cm^{-3})and polluted (1500 cm^{-3}) conditions

Larger rainfall area for the clean case

more graupel mass in the clean case

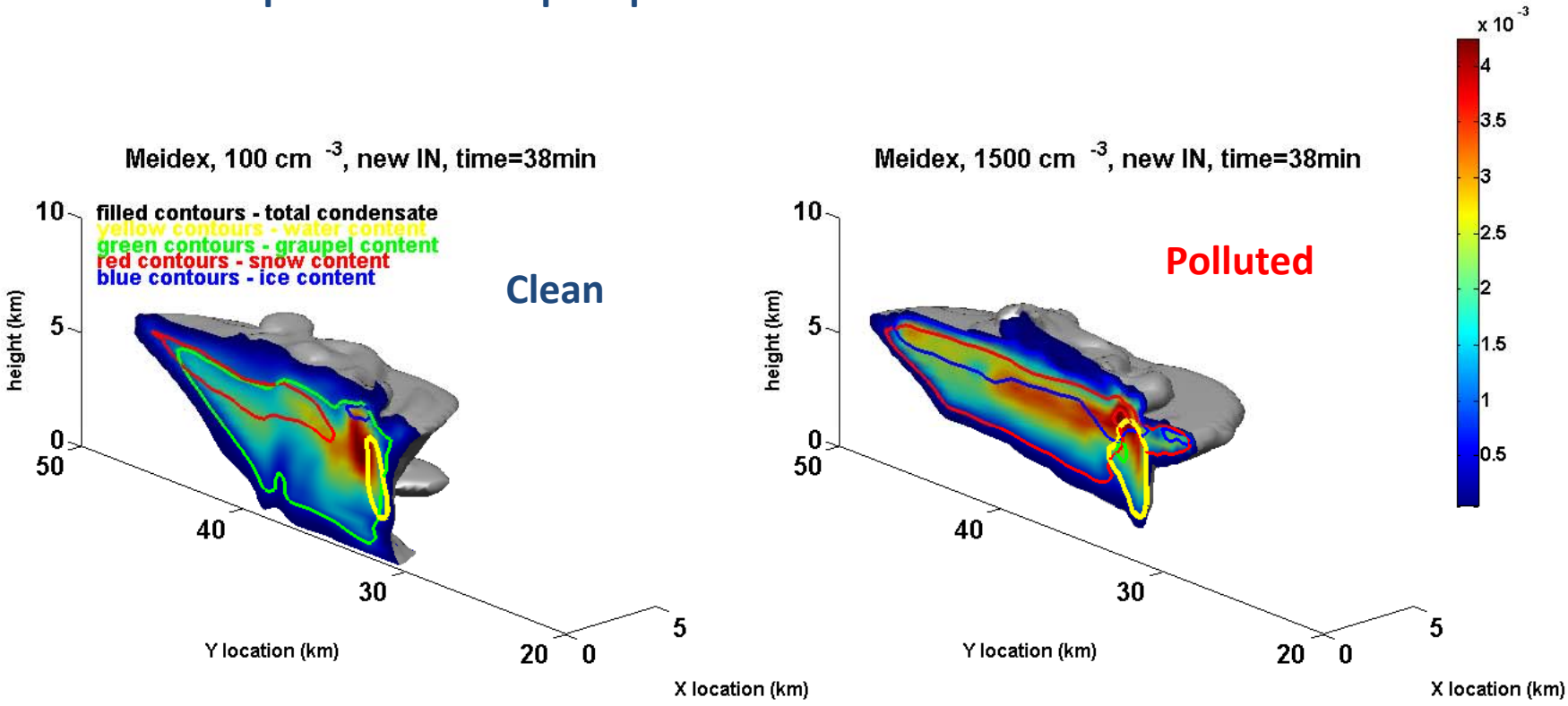


After 24 min

Comparison between clean (100 cm^{-3}) and polluted (1500 cm^{-3}) conditions

The polluted cloud spreads aloft over a wider area (notice the dark color of total condensate)

Clean cloud produces more precipitation

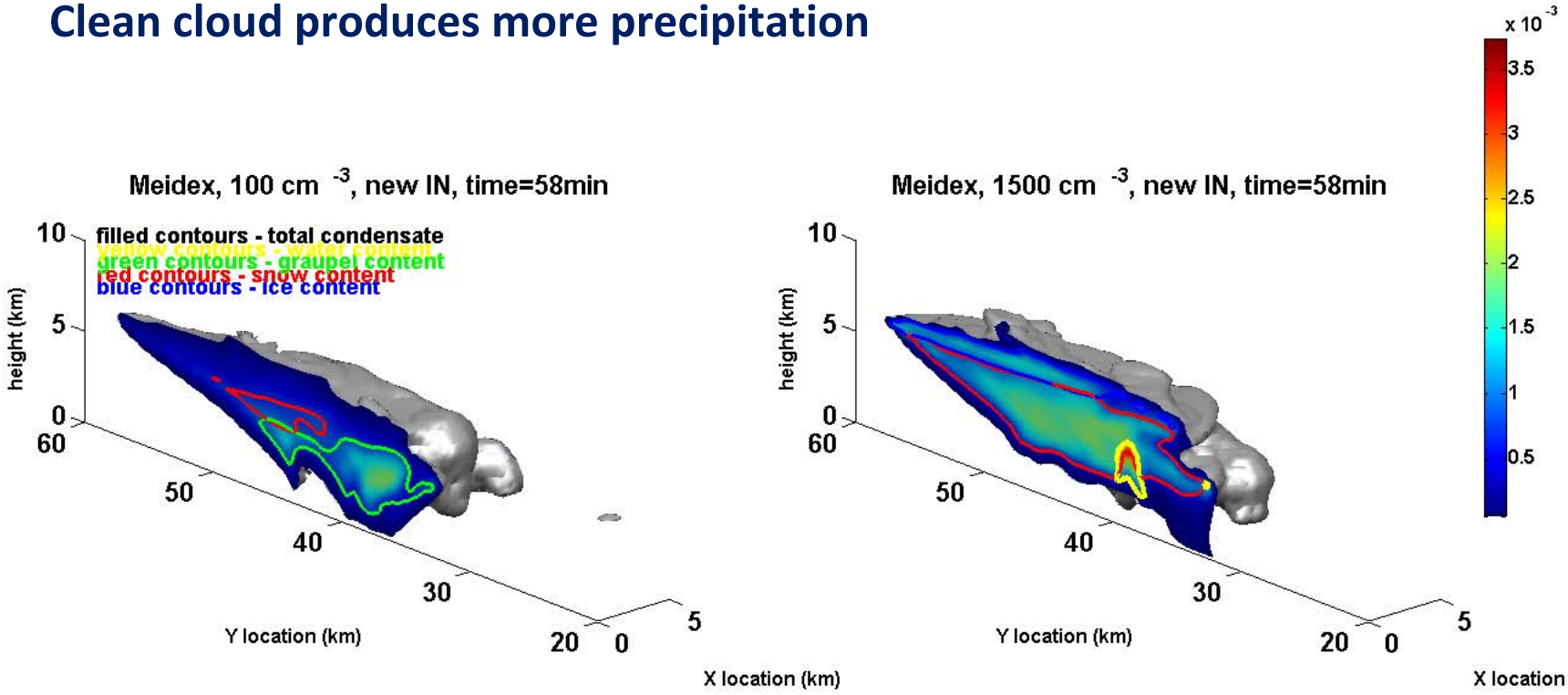


After 38 min

Comparison between clean (100 cm^{-3}) and polluted (1500 cm^{-3}) conditions

The polluted cloud spreads aloft over a wider area (notice the dark color of total condensate)

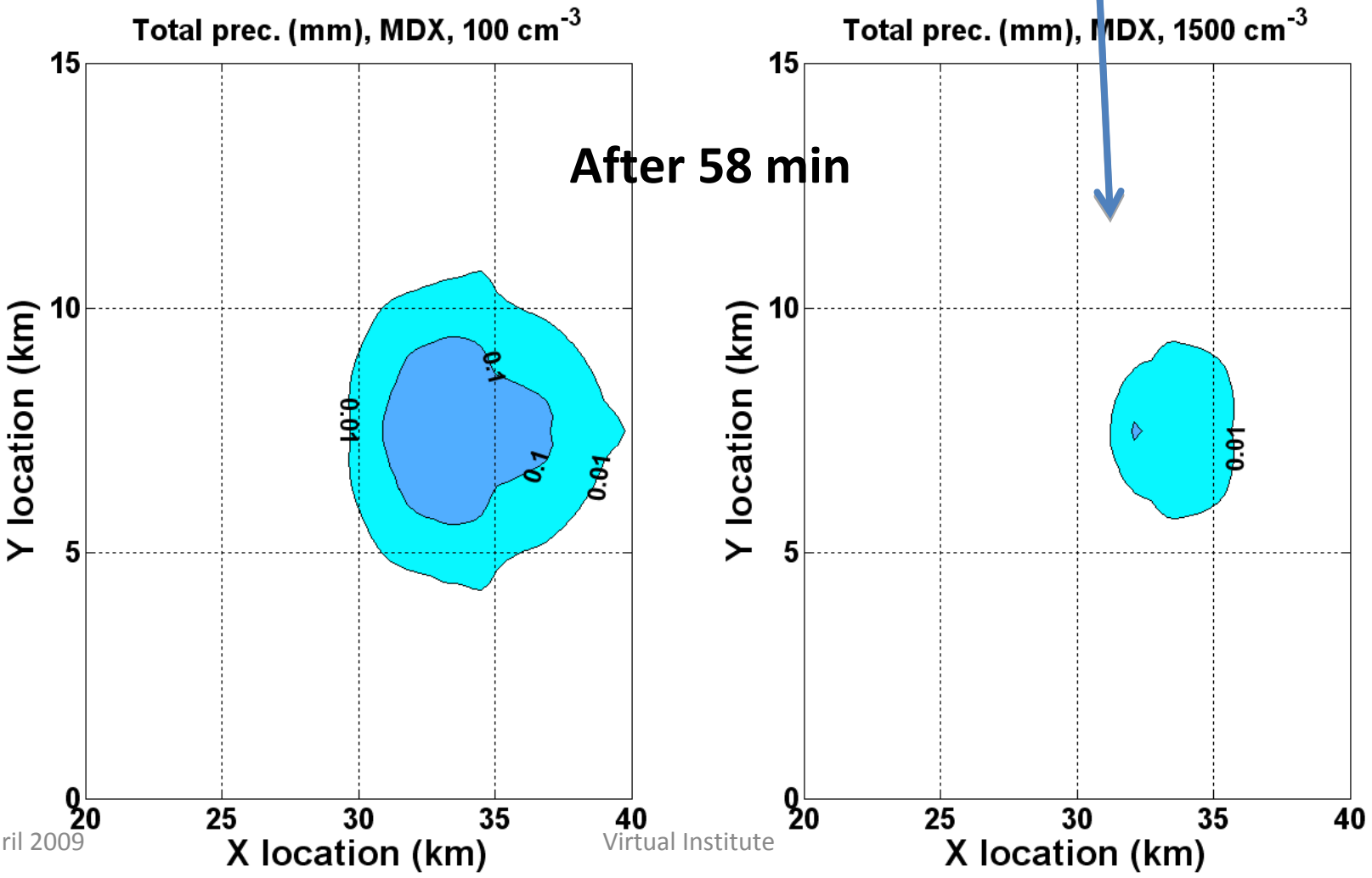
Clean cloud produces more precipitation



After 58 min

Total ground precipitation (mm)

The polluted cloud produces less precipitation and spreads over smaller area

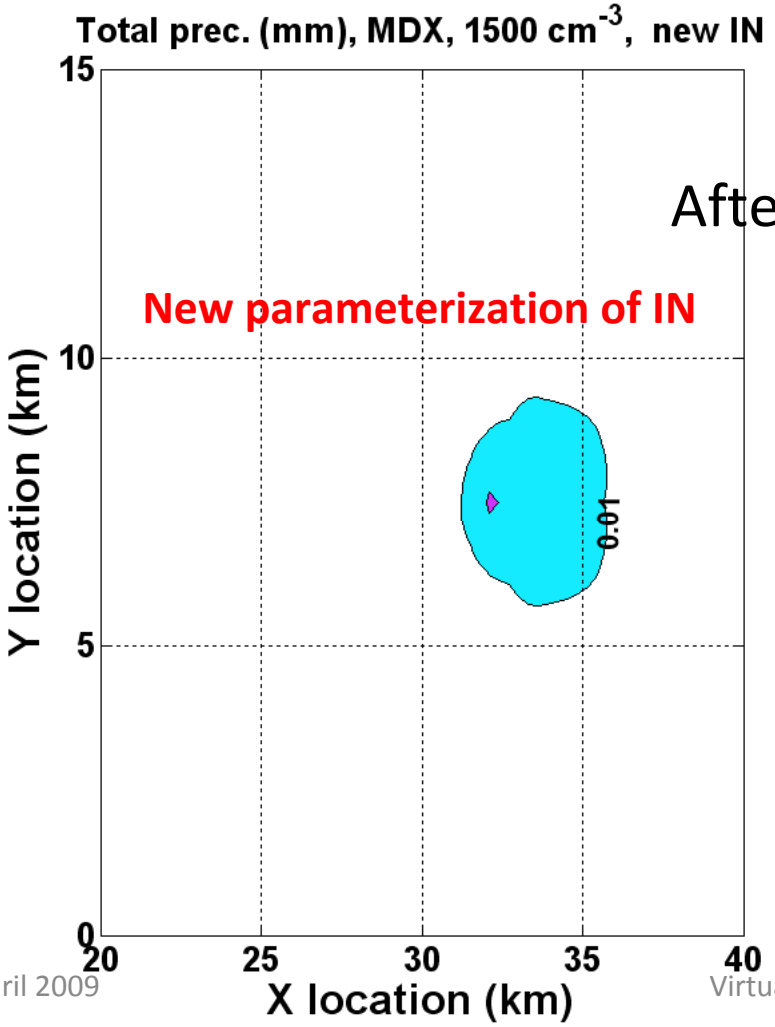


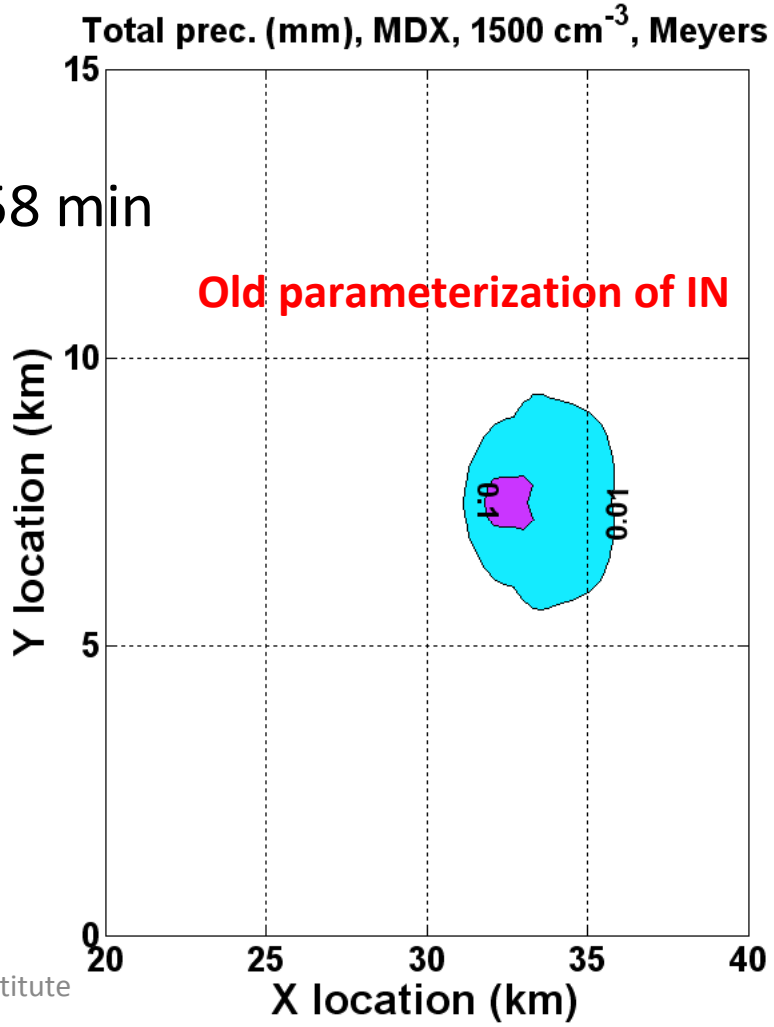
Total ground precipitation (mm)

After 58 min

The new IN formation scheme produces less precipitation than Meyers. This is because the new scheme produces fewer ice crystals and thus less graupel particles are produced leading to lower precipitation amounts.

After 58 min





summary

The results in the 3D runs resemble those we obtained from the 2D TAU cloud model (see *Teller and Levin , ACP 2006*).

The new ice parameterization (no contact is included) produces lower concentrations of ice crystals as compared to the *Meyers et al* formula and leads to smaller amounts of precipitation.

Comparing clean to polluted cases:

- **Clean clouds produce more rain amounts on the ground.**
- **They produce rainfall over a larger area with a larger contribution from graupel particles.**
- **The polluted clouds grow taller only slightly and most of the ice aloft is spread horizontally.**

Plans for the future

We plan to continue testing the WRF with the new ice nucleation parameterization using dust as GCCN and various types of anthropogenic particles.

The results of our measurements of ice nuclei with the FRIDGE in the Eastern Mediterranean will eventually be used as input for the WRF runs.