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# The physics of rainclouds, what is behind rainfall trends?

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In several locations in the world rainfall was significantly declining during the last four decades since about 1970, despite during the same timespan the water vapor availability in the planetary boundary layer (PBL) was increasing by about five percent. Increasing water vapor levels in the PBL are a result of climate change and well in agreement with the observed ∼one degree increase of air temperature over the oceans. Increasing water vapor availability due to an increase in evaporation should lead to a higher turnover rate within the hydrological cycle, which should result either in more frequent or in more intense rainfall. Several regional observations especially along the Australian coastline show a contrary picture. Often rainfall is less frequent and the annual rainfall is declining. Also the number of rainy days goes down. This behavior could be caused by a number of different processes affecting both, the amount of liquid water in the atmosphere and the microphysical properties of clouds. Within the discussions are:
-A change in the large scale advection patterns due to global warming, shifting the trajectories of low pressure systems, a slow process that takes several decades.
-A change in land use by deforestation leading to lower roughness, higher albedo and lower convective energy. Such a land use change might happen within about one decade (e.g. Western Australia).
-A change in aerosol abundance. Addition of anthropogenic cloud condensation nuclei lead instantly to smaller cloud droplets and subsequently to a regional to continental scale redistribution of rainfall within the time scales of cloud lifetime (hours to days).

Airborne experiments show that indeed the number of aerosols in several of the respective areas investigated up to now was increasing roughly in time with the observed rainfall changes. However, only in few of the areas the availability of historical aerosol data is sufficient for a more detailed investigation. We show results from experiments in search for physical reasons for a regional scale rainfall decline observed along the Australian coastline. Here the historical database including an airborne survey in the early 70's allows to reconstruct a 'laboratory' notebook an aerosol trends. This makes the area a perfect 'natural laboratory' for such studies on the physical background for climate change trends and to disentangle different climate / hydrological cycle relevant physical processes.