Atmos. Chem. Phys. Discuss., 9, C1566–C1568, 2009
www.atmos-chem-phys-discuss.net/9/C1566/2009/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Land use change suppresses precipitation" *by* W. Junkermann et al.

Anonymous Referee #1

Received and published: 6 June 2009

The study documents the thermodynamic and microphysical differences of air masses and clouds across an artificial line dividing between agricultural and natural areas in Western Australia during conditions of light winds with little exchange of air between the two zones. The paper has a remarkable finding of significantly greater aerosols amounts formed by primary nucleation over the agricultural area, with little or no similarly generated aerosols over the naturally vegetated area. The differences in the vegetation explain differences in the thermodynamic structure of the boundary layer.

The enhanced aerosols over the vegetated area increase also the CCN concentrations, leading to expected larger number concentrations and smaller sizes of droplets in the clouds there compared to the naturally vegetated area. This was also observed in a single cloudy day. The greater aerosol concentrations over the agricultural area dominated the weaker convectivity there and lead to clouds with larger number concentrations and smaller droplets.

The authors propose that the enhanced aerosols can explain part of the decreasing trend of precipitation in Western Australia.

I have the following comments on this interesting study:

Page 11483, lines 21-22: Please clarify the statement. It does not read logically.

Page 11484, line 2: The authors quote Ayers (2005) for stating that "current state of research indicated the difficulties to relate rainfall depletion to increased anthropogenic aerosol numbers". These difficulties do exist. However, compelling evidence for the role of aerosols suppressing precipitation in a case study of shallow clouds over Australia was presented by Rosenfeld et al., (2006) and the references therein. That paper also refutes the concerns of Ayers (2006) with respect to the previously published evidence of aerosols suppressing precipitation. Similar microphysical studies were conducted in California (Rosenfeld et al., 2008). The authors should quote and take into account these highly relevant papers to the background of their study and proposed conclusions.

Page 11484, line 20: Should the title of section 2 be "Experimental Design"?

Figure 2: The horizontal cross section shows particles > 10 nm at concentrations > 15,000 at the western area and <1,000 cm-3 in the eastern edge. But both vertical profiles (east and west) show similarly high concentrations of >15,000 cm-3 at heights lower than about 600 m. Please resolve this apparent contradiction.

Figure 5: a. Please explain better all the colors. b. Can the later time of the flight in the eastern area explain the higher cloud base there? Please show the difference between the ascending and descending profiles in the west area. Please specify the times in the day for the ascending and descending segments in the east and west vertical profiles. Please update the text respectively.

Page 11488, line 21: Do the authors refer here to drop size in radius or diameter? Droplets above a threshold radius of 15 micrometer are necessary to induce growth

of raindrops. According to Table 1 it appears that the authors counted drops with a diameter > 15 micrometer. The interpretation has to be changed respectively, or drops with diameter > 30 micrometer have to be counted and replace the provided factor of 2.4.

Table 1: The difference between cloud base temperatures is 4 degrees C. It is not likely to explain a 100 hPa difference in cloud base pressure. Please add to the table also the cloud base heights and re-check cloud base pressure in the naturally vegetated area. Furthermore, according to Figure 4d the cloud base heights are at about 1100 and 1500 m at the west and east areas, respectively. This is consistent with a 4 degree difference in their base temperature. But the height of 1500 m should be at around 850 and not 800 hPa.

References:

Rosenfeld D., I. M. Lensky, J. Peterson, A. Gingis. Potential impacts of air pollution aerosols on precipitation in Australia. Clean Air and Environmental Quality, 40, No.2. 43-49, May 2006.

Rosenfeld D., W.L. Woodley, D. Axisa, E. Freud, J.G. Hudson, A. Givati, 2008: Aircraft measurements of the impacts of pollution aerosols on clouds and precipitation over the Sierra Nevada. J. Geophys. Res., 113, D15203, doi:10.1029/2007JD009544.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 11481, 2009.