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Abstract title	**Observations of the first aerosol indirect effect using ground based remote sensing at JOYCE**
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Abstract text	**The first aerosol indirect effect (1st AIE), according which increasing aerosol loading leads to increased cloud droplet number concentration and decreased effective radius, is investigated based on the ground-based remote sensing observations at Jülich ObservatorY for Cloud Evolution (JOYCE) in Germany. An aerosol cloud interaction (ACI) index based on measurements from cloud radar and ceilometer is proposed to measure the magnitude of ACI. The ACI index is the linear regression slope of cloud radar observation (reflectivity factor) at 35.5 GHz and ceilometer observation (backscatter coefficient) at 1064 nm, and it is separately calculated for 10 gm^{-2} liquid water path (LWP) bins. The radar observation is logarithm of the height averaged integration of reflectivity factors (Z) from cloud base to 90 m above cloud base, and the ceilometer observation is logarithm of height averaged integration of backscatter coefficients (β) from 200 to 290 m below cloud base. Based on the relationships $Z \approx n_{cloud} * D^6_{cloud}$, and $\beta \approx n_{aerosol} * D^2_{aerosol}$, a negative ACI index is expected when increasing aerosol number**

concentrations ($n_{aerosol}$) lead to an increase in cloud droplet number (n_{cloud}), but a decline in droplet size (D_{cloud}). Using the ACI index to detect 1st AIE is at first implemented for one stratus cloud case, and further applied to long-term observations of shallow stratus clouds in the atmospheric boundary layer over JOYCE. The proposed ACI index could serve as a simple tool to exploit long-term observations for improving understanding of aerosol-cloud coupling.

Keywords **ground-based remote sensing**
first aerosol indirect effect
ACI
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