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Analysis of aerosol hygroscopic growth by using combined lidar and radiosoundings at Barcelona coastal site

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Atmospheric aerosol particles may take up water from the environment under high relative humidity conditions, increasing their size (hygroscopic growth) and varying their optical and microphysical properties, thus altering their influence on climate. These variations can be measured under ambient unmodified conditions by means of remote sensors such as lidar systems. The lidar system in Barcelona provides vertically-resolved aerosol properties, which combined with radiosounding relative humidity profiles allow us to perform hygroscopic growth studies. The lidar system at Barcelona is part of the European Aerosol Lidar Network EARLINET since 2000, whereas radiosounding are launched twice daily close to the lidar site. An extensive database is thus available for the analysis of aerosol hygroscopicity. In this study, the period 2010-2018 is analyzed using a semiautomatic procedure for the identification of aerosol hygroscopic growth cases. Once identified, the conditions under which hygroscopic growth occurs are examined, paying special attention to wind regimes, aerosol typing and seasonal and daily relative humidity variations. Finally, the different cases when hygroscopic growth is detected are thoroughly analyzed in order to determine the enhancement of aerosol optical properties (namely the aerosol backscatter coefficient) with increasing relative humidity.