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Aerosol hygroscopic properties and chemical composition at the high alpine research station Jungfraujoch during the CLACE field campaigns

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Aerosol hygroscopic properties and chemical composition have been investigated during several field campaigns (three in winter; CLACE1, 3, and 4, and one in summer; CLACE 2) at the high alpine site Jungfraujoch (JFJ, 3580 m asl), which is mainly located in the free troposphere in winter but partially influenced by thermal convection of planetary boundary layer air in summer. A HTDMA has been used to measure hygroscopic growth factor distributions at 85% RH and size-resolved aerosol chemical composition has been investigated with various online and offline techniques.

The aerosol encountered at the JFJ is generally dominated by a readily hygroscopic mode with a small but still significant spread of growth factors, indicating an internal mixture with limited variability from particle to particle. Growth factors observed during the summer season are somewhat smaller and a small fraction of externally mixed less or non-hygroscopic particles are more often present compared to the winter season. However, the above findings are only valid when the JFJ is uninfluenced by Saharan dust events. Both absolute values and variability with time of measured hygroscopic growth factors are well reproduced by thermodynamic model predictions. This indicates that the ratio of readily hygroscopic inorganic salts to moderately or non-hygroscopic organic matter and black carbon determines the growth factor of these particles. Larger hygroscopic growth factors observed in winter compared to summer can be attributed to a larger relative fraction of inorganic salts present in the aerosol at the JFJ during the winter season.