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Partitioning of reactive nitrogen (NO_y) and dependence on meteorological conditions in the lower free troposphere

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Abstract. Results of continuous nitrogen oxide (NO), nitrogen dioxide (NO_2), peroxyacetyl nitrate (PAN) and total reactive nitrogen (NO_y) measurements along with seasonal field campaigns of nitric acid (HNO_3) and particulate nitrate (NO_3^-) measurements are presented for a two-year period at the high-alpine research station Jungfraujoch (JFJ), 3580 m asl. The NO_y mixing ratio and partitioning is shown to strongly depend on meteorological conditions. Knowledge of these meteorological transport processes allows discrimination between undisturbed (i.e. clean) and disturbed (i.e. influenced by regional pollution sources) free tropospheric (FT) conditions at the JFJ. Median NO_y concentrations during undisturbed FT periods ranged from 350 pptv (winter, December to February) to 581 pptv (spring, March to May). PAN was found to be the dominant NO_y species during spring and summer, whereas NO_2 was most abundant during autumn and winter. Particulate nitrate was found to contribute significantly to total NO_y during thermally induced vertical transport. Föhn events, synoptical lifting (e.g. fronts) and thermally induced vertical transport resulted in mixing ratios up to 10 times higher at the JFJ compared to undisturbed FT conditions. Furthermore this meteorological variability of the NO_y concentration and partitioning often dominated the seasonal variability. As a consequence the use of filters at the JFJ (and other mountainous sites) is crucial for the interpretation of data from such measurement sites. This study presents a further development of meteorological filters for the high-alpine site Jungfraujoch, which also could be modified and adapted to other mountainous measurement sites.

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