Abstract

~~F~~A phenomenon of frequent ~~SO_2~~ noontime SO_2 concentration peaks ~~phenomenon~~ was discovered in a detailed analysis ~~on~~ of the SO_2 concentrations in the North China Plain (NCP). The possible causes and their contributions are analysed. The impacts of such a phenomenon on the sulphur cycle were studied and the implications of the phenomenon for atmospheric chemistry, cloud physics and climate were discussed. Different from the more common SO_2 diurnal patterns with high nighttime concentrations, NCP witnessed high frequencies of ~~SO_2~~ noontime SO_2 peaks, with an occurrence frequency of 50 ~~–~~to 72% at ~~the~~ four stations. Down-mixing of elevated pollution layers, plume transport processes, mountain-valley-winds and fog/high RH haze events were the possible causes. The contribution of each process varies from ~~each other~~day to day and from station to station, however, ~~neither~~ none of those four processes can be neglected. SO_2 peaks occurring during noontime instead of nighttime will~~-~~ lead to a 13~~–~~ to 35% increase in sulphur dry deposition, 9~~–~~ to 23% increase in gas phase oxidation and 8~~–~~ to 33% increase in aqueous phase conversions, which will increase the hygroscopicity and the light scattering of aerosols, thus having important impacts on atmospheric chemistry, cloud physics and climate.

Change the format later in the manuscript, too. Separation of a range with ”to” eliminates any possible confusion with the mathematical “minus” sign and is more readable

Page 1

The diurnal variation of primary gas pollutants in polluted regions ~~are~~ is typically characterized

Page 3

Thus, the representativeness of such averaged profiles ~~is unsure~~ and how common such events ~~were~~are is uncertain~~,~~. Similarly ~~what might have caused them~~their cause or ~~what~~ the possible impacts such diurnal variation patterns might have is still not clear.

been proven to be highly representative of the polluted ~~background~~NCP region (Xu et al., 2011a).

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To analyse how the SO_2 diurnal variation pattern influences ~~upon~~ the sulphur cycle, the WQ

The dry deposition velocity of SO_2 is ~~under the~~ influenced ~~of~~ by the surface type and roughness.

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higher values during the night and lower ones during the day, ~~the~~ this NCP study has revealed ~~inversed~~a time reversal of SO_2 variation characteristics.

However, how frequently such events occur,

Some confusion with Figures 3 and . Fig 3 inserted in text in three places as well as at end of manuscript.

The averaged diurnal variation pattern of group 3 shows lower peak values than group 2

plume transport process is characterized by the ~~cohesive~~ coherent variation of SO_2 and CO.