Transport of air pollutants to background sites in South China

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Introduction

Weekly air and precipitation measurements of main inorganic compounds were undertaken as part of the acid rain monitoring program IMPACTS (*Larssen et al. 2006*) at five sites in four different provinces of China from 2001 to 2003. The sites were located in TieShanPing (TSP) in Chongqing, CaiJiaTang (CJT) in Hunan, LeiGongShan (LGS) and LiuChongGuan (LCG) in Guizhou and LiXiHe (LXH) in Guangdong. Two of the sites (CJT and TSP) have performed intensive measurement periods with daily filterpack measurements in April - May 2002 and 2003, and October 2003. These measurements have been analysed with Lagrangian backward simulations (*Stohl et al., 2005*) to determine the main source areas and pathways of the air masses.

Results and Conclusion

The air concentrations of SO_2 reflect the different site characteristics with annual averages ranging from 0.5 to above 40 μSm^{-3}. The main components in the airborne particles are $(NH_4)_2SO_4$ and $CaSO_4$. (Fig 1) Reduced nitrogen has a considerably higher concentration level than oxidised nitrogen, reflecting the high ammonia emissions from agriculture. The concentration levels are significantly higher than seen in most other parts of the world (*Larssen et al. 2006*). Even though the relative concentration of nitrogen species is much less than of sulphate at the IMPACTS sites, the level is similar or even higher for reduced nitrogen compared with other parts of the world.

For both of the sites some of the highest pollution levels of sulphur compounds are seen when regional air masses are dominant, but also very high levels are seen when there is transport from the north, northwest and northeast (fig 2). From the SO_2 emission map (fig 3) it is clear that transport from northern sector may cause a high sulphur level in South China. No long-range episodes with air masses from outside China are observed.

The SO_2 emissions have been increasing rapidliy in recent years, and may be expected to continue to increase in the years to come. The current policy for acid-rain mitigation uses a flat emission reduction goal. A more cost-efficient, effects-based emission reduction policy should be developed by combining information on emissions, deposition, and environmental sensitivity.

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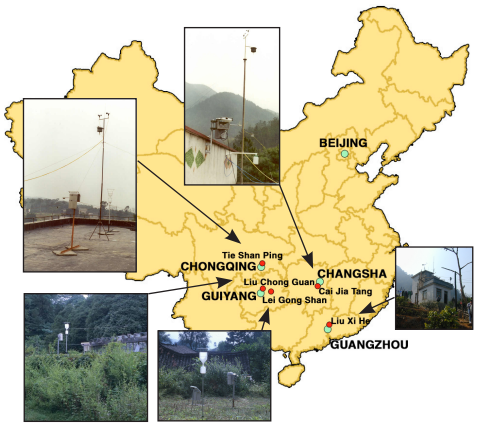
IMPACTS Monitoring Sites



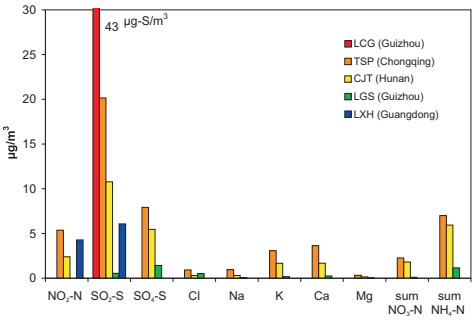


Figure 1. Annual average concetration in air and particles, 2003.

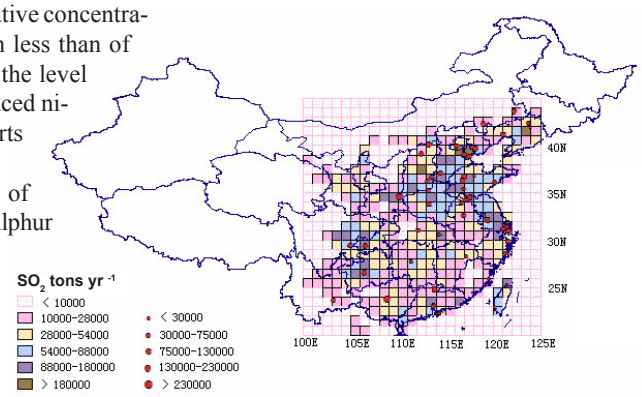


Figure 3. SO_2 Emission in China (Carmichael, 2002 and Meng Fan)

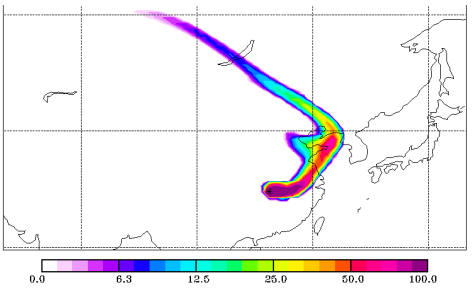
References

Carmichael, G.R., D.G. Streets, G. Calori, M. Amann, M.Z. Jacobson, J. Hansen, and H. Ueda (**2002**). Changing Trends in Sulfur Emissions in Asia: Implications for Acid Deposition, Air Pollution, and Climate. *Environ. Sci. Tech* 36, 4707-4713. The map shown is created by Meng Fan (CRAES)

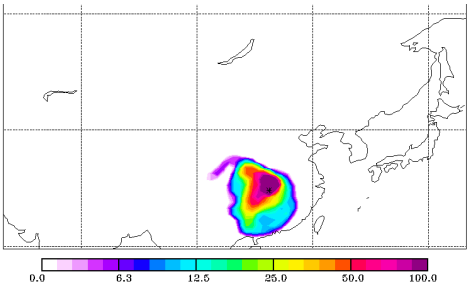
Larssen T., Lydersen E., Tang D., He Y., Gao J, Liu H., Duan L. Seip H.M., Vogt R.D, Mulder J, Shao M., Wang Y., Shang H., Zhang X., Solberg S., Aas W., Økland, T. Eilertsen O., Angell V.m Liu Q Zhao D., Xiang R., Xiao J., Luo J (**2006**). Acid rain in China. *Environmental Science and Technology*, January 15, 418-425

Stohl, A., C. Forster, A. Frank, P. Seibert, and C. Wotawa (**2005**) Technical Note: The Lagrangian Particle Dispersion Model FLEXPART Version 6.2, *Atmos. Chem. Phys.*, 5, 2461-2474.

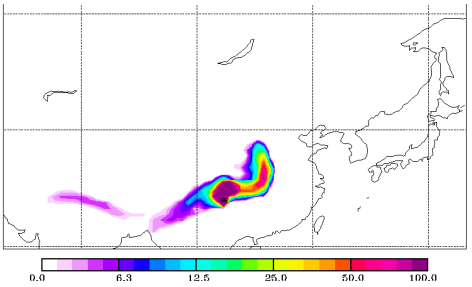
CJT, 2.06.2003: SO_2= 13.4 μgSm^{-3} and SO_4^{2-} = 20.3 μgSm^{-3}.



CJT, 12.11.2002: SO_2= 35.2 μgSm^{-3} and SO_4^{2-} = 2.5 μgSm^{-3}.



TSP, 20.04.2002: SO_2= 42.1 μgSm^{-3} and SO_4^{2-} = 9.7 μgSm^{-3}.



TSP, 9.11.2002: SO_2= 79.2 μgSm^{-3} and SO_4^{2-} = 18.4 μgSm^{-3}.

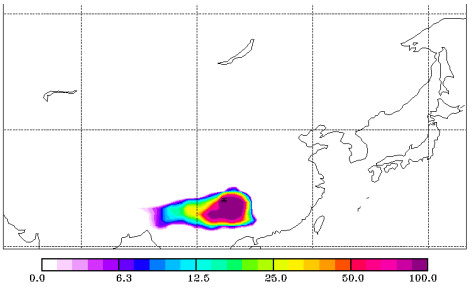


Figure 2. 5-day backward simulation for air masses arriving at CJT and TSP. Shown are the total column residence times. Values are given as precentages of the maximum residence time. The figure illustrates the pathways and source regions of the air masses. The simulations were performed using the particle dispersion model FLEXPART (Stohl et al., 2005).

Acknowledgments

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