Total deposition of major inorganic ions at non-urban sites in China, 2001-2003 (part II)

Lei Jin[1], Min Shao[1*], Wenche Aas[2], Lei Duan[3], Rolf D. Vogt[4], Dawei Zhao[5], Renjun Xiang[6], Jinhong Zhang[7], Jinsong Xiao[8]

Introduction

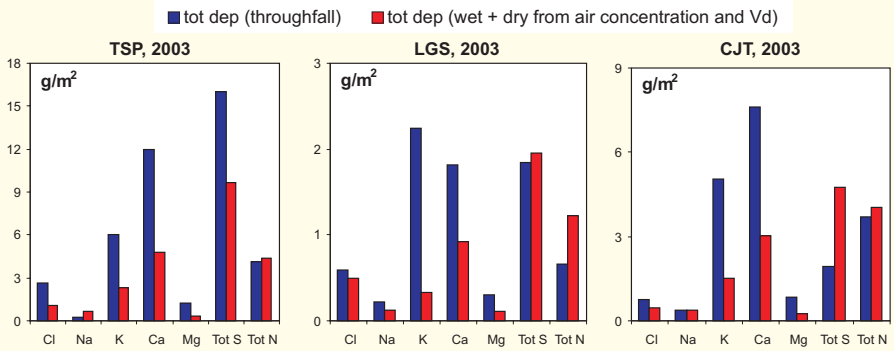
The IMPACTS sites are located in Tie Shan Ping (TSP) in Chongqing, Cai Jia Tang (CJT) in Hunan, Lei Gong Shan (LGS) and Liu Chong Guan (LCG) in Guizhou and Li Xi He (LXH) in Guangdong province, see poster Part I. The total deposition was estimated using the ground vegetation throughfall measurements. These results were in TSP, LGS and CJT compared with an inferential method, based on the measured air and aerosol concentration and deposition velocities taken from literature. A canopy budget model was used to analyse the influences of canopy exchange process at TSP.

Results

The sulphur deposition was considerable at all sites, and at TSP it was even much higher than observed at any sites in e.g Europe. In 2003 the total deposition of sulphur at these five sites ranged from 2-16 gSm^{-2} depending on the site characteristic and distance to emission sources. The total inorganic nitrogen depositions were comparable with the levels measured in other countries, it ranges from 0.6 to 4.4 gNm^{-2} in 2003. The calcium deposition is also very high and it shows similar site variations as sulphur with a total deposition in 2003 ranging from 2-12 gm^{-2}. The contribution of dry deposition to the total deposition was significant at all the sites. For sulphur the dry deposition was up to 3 times higher than the wet deposition. For calcium it was similar, while for nitrogen the contributions from wet and dry deposition were roughly equal. However, for nitrogen the total deposition might be somewhat underestimated using the throughfall method due to uptake of nitrogen in the crown. The canopy budget model indicates that the canopy is retaining nitrogen as well as it is leaching calcium. The comparison between the throughfall and inferential method show large variations, and it illustrates the difficulty in using deposition velocities calculated on European forest to estimate the deposition on Chinese forest. In addition, it is probably not correct to use the same deposition velocities at all the sites.

Conclusions

These results clearly show that it is important to include the contribution of alkaline dust as well as inorganic nitrogen in mitigating the effect of acid rain. It is not sufficient to only consider pH and sulphate as is commonly done in China. The contribution of dry deposition is of great importance to the total budget and it is necessary to get better estimates of the dry deposition processes, i.e. using flux methods. The particle size is critical when determining the deposition velocities, and measurements of size distribution of the different ions are needed.



aerosols (Vd in cm/s)								gases (Vd in cm/s)			
SO4-S	NO3-N	NH4-N	Cl	Na	K	Ca	Mg	SO2-S	NH3-N	NO2-N	HNO3-N
0.7	0.4	0.4	2	2	2	3	2	0.7	0.7	0.4	2

Figure 2. *Total deposition in 2003 estimated by two methods, and the deposition velocities used.*

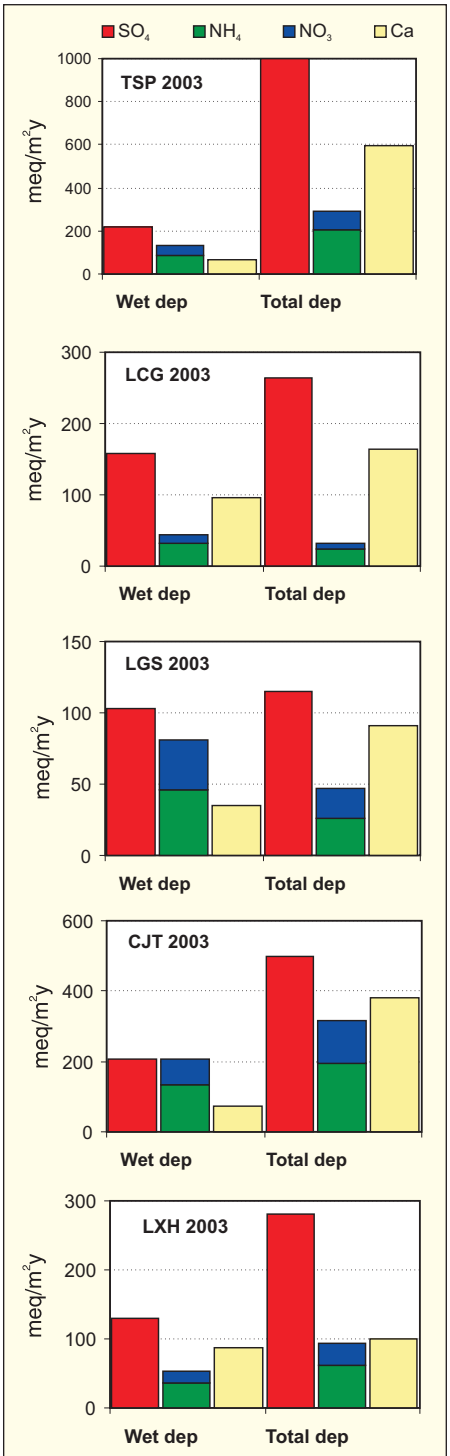


Figure 1 *Wet- and total deposition (throughfall) in 2003.*

1) College of Environmental Science, Peking University; mshao@ces.pku.edu.cn, goldbud@sohu.com
2) Norwegian Institute for Air Research; wenche.aas@nilu.no
3) Department of Environmental Science and Engineering, Tsinghua University, lduan@tsinghua.edu.cn
4) Department of Chemistry, University of Oslo, rolf.vogt@kjemi.uio.no
5) Chongqing Instiute of Environmental Science and Monitoring; zhaodawei@cta.cq.cn
6) Hunan Research Institute of Environmental Protection; hnkl@cs.hn.cn
7) Guangzhou Research Institute of Environmental Protection; jinhongzhang@hotmail.com
8) Guizhou Research Institute of Environmental Protection Science, xjs2003a@163.com

Acknowledgments

IMPACTS has been supported by The Norwegian Agency for Development Co-operation (NORAD), The Chinese State Environmental Protection Administration (SEPA) and the Chinese Ministry of Science and Technology (MOST).