[1]严文莲,张国正,濮梅娟,等.南京一次强酸雾的化学特征和成因分析[J].自然灾害学报,2013,03:122-129.

YAN Wenlian,ZHANG Guozheng,PU Meijuan,et al.Chemical features and cause analysis of a strong acid fog event in Nanjing [J].,2013,03:122-129.

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南京一次强酸雾的化学特征和成因分析(PDF)

《自然灾害学报》[ISSN:/CN:23-1324/X] 期数: 2013年03期 页码: 122-129 栏目: 出版日期: 2013-07-30

Title: Chemical features and cause analysis of a strong acid fog event in Nanjing

作者: 严文莲[1]; 张国正[2]; 濮梅娟[1]; 刘端阳[3]; 李子华[4]

1. 江苏省气象台,江苏 南京 210008;
2. 南京农业大学,江苏 南京 210095;
3. 无锡市气象局,江苏 无锡 214101;
4. 南京信息工程大学,中国气象局 大气物理与大气环境重点开放实验室,江苏 南京 210044

Author(s): YAN Wenlian[1]; ZHANG Guozheng[2]; PU Meijuan[1]; LIU Duanyang[3]; LI Zihua[4]

1. Jiangsu Meteorological Observatory, Nanjing 210008, China;
2. Nanjing University of Agriculture, Nanjing 210095, China;
3. Wuxi Meteorological Observatory, Wuxi 214101, China;
4. CMA Key Laboratory for Atmospheric Physics and Environment, Nanjing University of Information Science and Technology, Nanjing 210044, China

关键词: 南京; 平流雾; 化学特征; 强酸雾

Keywords: Nanjing; advection fog; chemical characteristic; extremely acid fog

分类号: P426.4

DOI: -

文献标识码: -

摘要: 利用2009年12月1-2日一次平流雾过程中采集到的10个雾水样本资料,结合微物理结构、边界层结构和污染气体等资料,分析了其雾水化学特征,并与2006和2007年冬季观测分析的平流辐射雾和辐射雾雾水化学特征进行了比较.结果表明:平流雾过程中阴离子SO_4^{2-}浓度最高,其次为NO_3^-,阳离子中K^+最高;南京不同类型的雾水酸化类型均属于硫酸型,这次平流雾雾水酸性强,SO_4^{2-}和NO_3^-的浓度均高于平流辐射雾和辐射雾,尤其是NO_3^-浓度成倍增加;平流雾中雾滴平均直径、含水量与离子浓度呈反相关.对平流雾酸度来源进行了探讨发现,雾水酸度强的主要原因一是致酸物SO_4^{2-}和NO_3^-浓度高,其中NO_3^-成倍增加;二是缓冲物Ca^{2+}浓度特别低.局地排放和平流输送造成高浓度的SO_2和NO_2是导致强酸雾的重要原因,而平流和垂直输送使地面层的Ca^{2+}浓度减小,从而使得雾水中碱性物质减少,进而增强了雾水酸性.

Abstract: Using ten samples of the fog water collected in an advection fog process on December 1-2 ,2009 and the corresponding fog microphysical structure, boundary layer structure and air pollution data, the chemical characteristics of the advection fog waters and the cause of acid fog formation were analyzed and compared with that of the advection-radiation fog and the radiation fog

occurred in winters of 2006 and 2007. Results show that the principal negative ion in the advection fog waters is SO_4^{2-} whose concentration is higher then NO_3^- and other negative ions, while the main positive ion is K^+. All types of Nanjing fogs are sulfuric acid. Comparing with the advection-radiation fog and the radiation fog, all of the advection fog water samples are acidic and have stronger acidity. The concentrations of SO_4^{2-} and NO_3^- in the advection fog are higher than those of the other two fog types, especially the concentration of NO_3^-. The average diameter of fog droplets and fog water concentration are anti-correlated to ions concentration. The source of the acidity is mainly due to high concentration of acidic SO_4^{2-} and NO_3^- , in which NO_3^- doubled, while the concentration of the $Ca^{2+}$is particularly low. The high concentrations of SO_2 and NO_2 caused by local exhaustion and advection transport are the important causes of strong acid fog. Meanwhile advection and vertical transmission decrease the concentration of Ca^{2+}on the near-surface floor, which reduce the alkaline substances in fog water, and thus enhance the acidity of fog water.

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备注/Memo: 收稿日期:2012-9-11;改回日期:2012-12-4。
基金项目:国家自然科学基金资助项目(40975085);江苏省重大科技支撑与自主创新示范工程项目(BE2008618);江苏省科技支撑计划社会发展重大研究(BE2012771)
作者简介:严文莲 (1983-), 女, 工程师, 主要从事预报预测及大气污染研究. E-mail:yike-112@163.com
通讯作者:濮梅娟, 教授级高级工程师. E-mail:pumeijuan@126.com

更新日期/Last Update: 1900-01-01