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中国西北典型冰川区大气氮素沉降量的估算——以天山乌鲁木齐河源1号冰川为例

Atmospheric nitrogen deposition in the glacier regions of Northwest China: a case study of Glacier No.1 at the headwaters of Urumqi River, Tianshan Mountains

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中文摘要:

高寒冰川区氮素沉降量的变化会对区域生态系统产生显著影响,定量评估冰川区的氮沉降状况可以为修正相关模型提供重要的原始数据。通过2004年1月至2006年12月在天山乌鲁木齐河源1号冰川连续采样,分析了中国西北典型冰川区大气氮素的沉降特征,并估算了该区域的年均氮素沉降量。研究结果表明,1号冰川湿沉降中的硝态氮 (NO_3^--N)、铵态氮 (NH_4^+-N) 与总无机氮 (TIN) 存在着明显的季节变化特征:夏季沉降量最大,冬季最少,且与降水量表现出较好的对应关系。1号冰川氮素湿沉降的硝铵比 (NO_3^--N / NH_4^+-N) 月平均值在0.3-1间波动。1号冰川TIN湿沉降量年平均值为1.51 kg/hm^2 (其中NH_4^+-N沉降量占总量的69%,而NO_3^--N沉降量仅占31%),干湿沉降总量年均值为1.56 kg/hm^2,总氮 (TN) 的干湿沉降总量年均值为3.85 kg/hm^2。得到的冰川区氮素沉降量符合中国西部高寒区的一般水平,代表了该区域的本底值。

English Summary:

The atmospheric nitrogen deposition in the cold region (especially in the glacier region) of Northwest China, which takes a vital role during the nitrogen cycle, may influence the regional ecology and environment. And the long-term systemic observation on nitrogen deposition in the glacier region is helpful for quantitative modelling of typical drainage basins in the High Asia. According to the continues sampling of wet deposition (fresh snow) on the eastern branch of Glacier No.1 (43°06'N, 86°49'E, 4130 m above sea level) at the headwaters of Urumqi River in the eastern Tianshan Mountains from January 2004 to December 2006, the characteristics of atmospheric nitrogen wet deposition in the glacier region of Northwest China were discussed, and the annual nitrogen wet/dry deposition of both inorganic and organic types was estimated. The results indicated: (1) The nitrate nitrogen (NO_3^--N), ammonium nitrogen (NH_4^+-N) and total inorganic nitrogen (TIN) in the wet deposition varied seasonally. The nitrogen wet deposition from January to April was relatively low, and it increased significantly from April to May. With a little fluctuation, the nitrogen wet deposition was high from May to September, and the minimum of monthly deposition was 0.17 kg/hm^2, 0.04 kg/hm^2, 0.13 kg/hm^2, for TIN, NO_3^--N and NH_4^+-N, respectively. The nitrogen wet deposition decreased markedly after October, and kept at a low level from October to December. In the seasonal classification, the nitrogen wet deposition was highest in summer (June, July and August), and lowest in winter (November, December and January). The percentage of nitrogen wet deposition in summer was 54%, 52% and 55%, for TIN, NO_3^--N and NH_4^+-N, respectively. The nitrogen wet deposition correlated with precipitation amount significantly, and more than 93% of which occurred during the wet season (from April to October, with abundant precipitation in this period). (2) The NO_3^--N / NH_4^+-N ratio of wet deposition ranged from 0.3 to 1, which was influenced by both the regional emission and atmospheric transportation. The spatial transportation was calculated by the HYSPLIT (Hybrid Single-Particle Lagrangian Integrated Trajectory, which was developed by the Air Resources Laboratory, National Oceanic and Atmospheric Administration of USA) model 4.9 at 8:00 and 20:00 in Beijing Time (0:00 and 12:00 in Coordinated Universal Time) during all the precipitation days from 2004 to 2006 in different starting heights. (3) The inter-annual variation was not obvious during the study period of three years, so the mean annual deposition was representative at the sampling site. The mean annual wet deposition of TIN was 1.51 kg/hm^2 with 69% of NH_4^+-N and 31% of NO_3^--N. Considering the dry/wet deposition in total, the mean annual deposition of TIN was 1.56 kg/hm^2, with 1.07 kg/hm^2 of NH_4^+-N and 0.49 kg/hm^2 of NO_3^--N. In addition, the estimated annual dry/wet deposition of total nitrogen (TN), including TIN and TON (total organic nitrogen), was 3.85 kg/hm^2. The simulant value in this study corresponded well with the reported data of nitrogen deposition around the cold region in the West China.

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