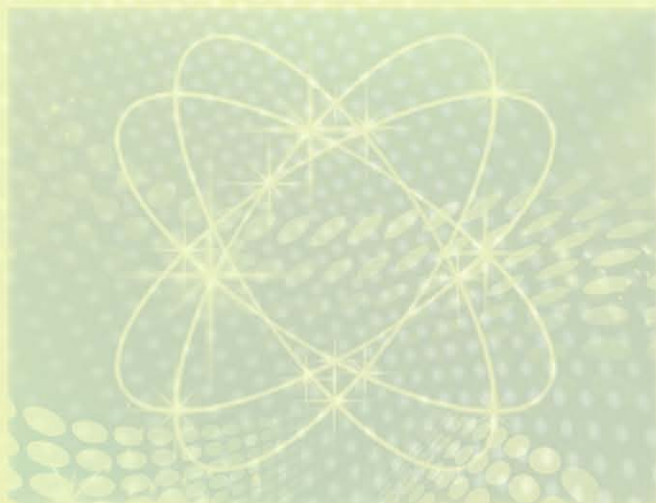


鄱阳湖湖泊水文
湿地生态与流域生态环境研究



《鄱阳湖地理与环境研究丛书》

编辑说明

鄱阳湖是中国最大的淡水湖泊。鄱阳湖承纳赣江、抚河、信江、饶河与修水五大江河来水,构成一个完整的鄱阳湖流域,其边界与江西省行政边界高度吻合,是开展多学科“人—地”关系研究不可多得理想场所。其水位的高动态性和季节性,以及与长江复杂的吞吐型水情关系形成了“洪水一片、枯水一线”的独特淡水湖泊湿地生态系统及其景观。鄱阳湖湿地是具有国际影响的重要湿地和候鸟栖息地。鄱阳湖对长江中下游的调蓄洪水、航运、城市供水、维护生物多样性等诸多方面具有不可替代的作用。鄱阳湖地区是长江三角洲经济区、珠江三角洲经济区、海峡西岸经济区等重要经济板块的直接腹地,是中部地区正在加速形成的增长极之一,具有发展生态经济、促进生态与经济协调发展的良好条件。2009年12月国务院正式批复《鄱阳湖生态经济区规划》,标志着鄱阳湖生态经济区建设上升为国家战略,成为国家区域协调发展战略的重要组成部分。

江西师范大学对鄱阳湖地理与环境的研究已经有长期的历史和科学积累。例如朱宏富先生等关于从自然地理特征探讨鄱阳湖的综合治理和利用;从构造因素讨论鄱阳湖的形成与演变;鄱阳湖区的发展战略和经济发展;三峡工程对鄱阳湖区农、牧、渔业的影响等方面的论著,为现代鄱阳湖研究提供了基础性工作。

鄱阳湖湿地与流域研究教育部重点实验室(江西师范大学)于2003年以江西省和教育部的省部共建的方式筹建,2007年通过教育部验收并更名为现有名称。重点实验室遵循“前沿科学研究与辅助政府决策并举”的宗旨,以“开放、流动、联合、竞争”为建设方针,以鄱阳湖复杂环境系统为研究对象,重点围绕鄱阳湖湿地与流域的关键科学问题,开展流域地表过程和水生态安全、湖泊湿地生态和环境健康、区域开发与资源可持续利用、空间信息模型方法与系统应用,以及时空动态监测网络系统与决策支持等方向的理论、方法和应用研究,取得了一系列科研成果。

2013年恰逢鄱阳湖湿地与流域研究教育部重点实验室成立10周年。在重点实验室

成立以来的十年历程中,在学术委员会的指导之下,在各级领导和全体同仁的共同努力之下,实验室正在逐步成为国内外具有重要影响的开放性、多学科、综合性鄱阳湖地理与环境及其湿地与流域科学的研究基地、理论与应用型人才培养基地、科技创新和成果转化基地和学术交流平台。

温故而知新。为了坚持对鄱阳湖研究的长期性和系统性,总结江西师范大学对鄱阳湖地理与环境科学研究的历史,并配合鄱阳湖湿地与流域研究教育部重点实验室成立 10 周年庆祝活动,我们组织出版《鄱阳湖地理与环境研究丛书》系列文集专著。本专著系列第一期丛书按时间段和科研专题编辑。第一辑由郑林教授主编,以“鄱阳湖人地关系与区域可持续发展”为主线,包括 1979~2003 年间发表的有代表性论文 46 篇。第二辑由舒晓波教授主编,以“鄱阳湖湿地与流域:资源环境与人类活动”为主线,包括 2004~2013 年间发表的论文 34 篇。第三辑由赖格英教授主编,以“鄱阳湖湿地与流域:湖泊水文、湿地生态与流域生态环境”为主线,包括 2004~2013 年间发表的有代表性的论文 34 篇。作为姊妹篇,本专著系列还包括刘影教授主编的《鄱湖缘,鄱湖情——鄱阳湖湿地与流域研究教育部重点实验室成立十周年纪念文集》。

该系列文集回顾和反映了我们关于鄱阳湖地理与环境研究的历史和发展进程,为我们今天所取得的成绩提供鼓励和借鉴,为我们今后的工作提供鞭策和参考。希望本系列文集能使我们关于鄱阳湖地理与环境科学研究的工作得到记载,方向得到继续,思想得到传承,精神得到发扬,并在今后出版的后续文集中得到体现。

王野乔 郑林

2013 年 9 月

Research on Geosystem and Environment of Poyang Lake

Poyang Lake is the largest fresh water lake in China. It is fed by the tributaries of the Gan, Fu, Xin, Rao and Xiu rivers and connected to the Yangtze River through the lake mouth in the north. The tributaries form a completed Poyang Lake watershed. As controlled by the water from the five rivers as well as the Yangtze River, the Lake's highly dynamic and seasonal variations in water level present a unique landscape of fresh water lake-wetland ecosystem. The variation of the size of the lake is illustrated as an ocean when flooded and as a line of river when withered. The Poyang Lake wetland is a key habitat site for wintering migratory birds with global importance. The lake plays an irreplaceable role for flood control, river shipping, city water supply and conservation of biological diversity of middle and lower reaches of Yangtze River. The boundary of the watershed matches almost perfectly with the administrative boundary of the Jiangxi Province which makes the Poyang Lake and the watershed an ideal test bed for studying the intertwined relationships between natural and anthropogenic factors within a coupled human-natural system. The Poyang Lake region is the hinterland of the Yangtze River delta economic zone, the Pearl River delta economic zone, the West-bank economic region of the Taiwan Strait, among other important economic plates. The Poyang Lake region is also one of the economic growth poles in China with appropriate conditions for advancements in eco-economy and promoting coordinated development with coexistence of ecosystem integrity and growing regional economy. In December 2009, the Plan for Poyang Lake Ecological Economic Zone was officially approved by the State Council of China. It symbolizes that the plan is upgraded to a national strategy, which is an important component of coordinated national and regional development.

Jiangxi Normal University has established tremendous amount of scholarship in the

long-term research on geosystem and environment of Poyang Lake. Studies by Professor ZHU Hongfu and his colleagues, such as on comprehensive management and utilization of Poyang Lake from perspective of physical geographical characteristics; formation and evolution of the lake from aspects of geological structure; regional development strategy and economic development; influence of Three Gorges Dam Project on agriculture, husbandry and fishery of Poyang Lake region, have laid a foundation for modern time research on Poyang Lake.

The Key Laboratory of Poyang Lake Wetland and Watershed Research was established in 2003 by the joint support from the Jiangxi Provincial government and the Ministry of Education of China. The Laboratory passed the credential assessment in 2007 and became an official key laboratory of the Ministry of Education. The mission of the Laboratory is to promote cutting-edge scientific research and support governmental decision-making. Adhering to principles of “Open, Exchange, Cooperation and Competition”, the Laboratory dedicates its efforts in study of the complex environmental system of the Poyang Lake with achievements. The Laboratory’s research directions include land surface process and water ecological security of the watershed, lake-wetland ecology and environmental health, regional development and sustainable utilization of resources, spatial information modeling and system applications, and spatial-temporal dynamic monitoring network systems and decision support.

As a Confucius saying pointed out that review of what has already been studied is the path to learn the new. In order to summarize research findings on geosystem and environment of Poyang Lake by the faculty of Jiangxi Normal University, as well as to celebrate the 10th anniversary of the Key Laboratory of Poyang Lake Wetland and Watershed Research, we edit and publish this book series. The series is compiled by research topics in a chronological order. Professor ZHENG Lin serves as the Editor for the Volume 1, which, under the theme of human-land relationship and regional sustainable development of Poyang Lake, includes 46 representative articles published between 1979 and 2003. Professor SHU Xiaobo serves as the Editor for the Volume 2, which, under the theme of Poyang Lake wetland and watershed: resources, environment and human activities, includes 32 articles published between 2004 and 2013. Professor LAI Geying serves as the Editor of the Volume 3, which, under the theme of Poyang Lake wetland and watershed: lake hydrology, wetland ecology and ecological environment, includes 34 articles pub-

lished between 2004 and 2013. As a companion volume of the above theme books, Professor LIU Ying serves as the Editor for a memorial collection under the title of “Deep Affinity and Love with Poyang Lake: the 10th Anniversary of the Key Laboratory of Poyang Lake Wetland and Watershed Research”.

This book series reflects the history and development of the studies on geosystem and environment of Poyang Lake by the faculty of geography and those with affiliation to the Key Lab within the Jiangxi Normal University. I hope that we can derive strength and inspiration and draw experience and reference from this series. I hope that this series will serve as a recorded history of the studies, extend our research directions, improve our knowledge and inspire our thoughts. I also hope that new developments and achievements along the line will be reflected in the future books of this series.

WANG, Yeqiao

October, 2013

前 言

鄱阳湖是我国最大的淡水湖,是长江水系中的两大通江湖泊之一,具有调蓄洪水和保护生物多样性等特殊生态功能,对维系区域和国家生态安全具有重要作用。鄱阳湖高动态的水位特征,形成了独特的湖泊湿地景观和生态格局。鄱阳湖流域不仅边界与江西省行政边界高度重叠,而且两者在面积上也相差无几,是自然单元和行政单元高度吻合的一个区域,是人地关系研究的一个典型区域和理想区域。鄱阳湖湿地与流域始终是鄱阳湖研究的焦点。长期以来,江西省就确立了“治湖必须治江,治江必须治山,治山必须治穷”的生态理念,并致力于“山江湖”的治理与开发。

江西师范大学地理学科自上世纪 80 年代以来,持续进行了鄱阳湖综合治理与开发的科学研究,涌现了朱宏富教授等一批在国内有影响的专家和学者。先后参与并承担了“鄱阳湖区围垦的综合评价”、“鄱阳湖区对长江洪水调蓄功能与综合防灾对策研究”,“鄱阳湖流域的经济开发与生态环境的历史考察”、“三峡工程对鄱阳湖区环境影响及对策研究”等一批国家级和省部级科研项目,为鄱阳湖及其流域的科学研究和区域发展做出了重要贡献。2003 年以来,随着鄱阳湖教育部重点实验室的建立和以“湿地与流域”为研究特色的确立,鄱阳湖及其流域的研究进一步深化,走向了平台化、专业化和国际化的道路。鄱阳湖教育部重点实验室成立 10 周年以来,先后有近 40 个项目获得国家自然科学基金、科技部科技计划支撑项目、国际合作项目、“863”和“973”等的资助,呈现出手段与方法先进、多学科交叉和空间信息技术综合应用的特征和趋势,是鄱阳湖湿地与流域研究的一个重要时期。

《鄱阳湖湖泊水文、湿地生态与流域生态环境研究》专辑就是在这样的背景下酝酿与成形的。本研究专辑收集了自 2003 年鄱阳湖教育部重点实验室成立以来在鄱阳湖湿地与流域研究方面的 34 篇主要研究论文,分“水文与湿地生态”、“生态要素与环境特征”和“空间信息技术应用”三个专题,其中“水文与湿地生态”专题 16 篇文章,包括鄱阳湖与长江的水沙交换、入湖河段的演变特征、湖泊水动力模拟、水利枢纽工程的影响分析、流域径

流变化特征、湖泊湿地空间分布格局与生态要素特征、候鸟栖息地与湿地生物多样性等内容。“生态要素与环境特征”10 篇文章,包括鄱阳湖及其流域“水、土、气、生”等不同圈层的生态要素及环境特征、重金属污染、流域植被变化与水文响应以及鄱阳湖流域重大生态安全问题监控措施等内容。“空间信息技术应用”8 篇文章,包括空间信息技术在鄱阳湖湿地植被生物量、湿地植被覆盖、鄱阳湖天然湿地边界确定及季节变化、湖泊水面覆盖信息提取、湖泊水体悬浮泥沙监测、水体悬浮颗粒物散射光谱分解方法以及流域优势植被冠层叶面积指数和消光系数等方面的综合应用内容。

赖格英

2013 年 9 月

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一、水文与湿地生态

鄱阳湖与长江水沙通量变化特征分析

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摘 要:利用 1956~2005 年湖口水文站水沙观测资料,分别分析了鄱阳湖和长江水沙通量的年代、年际、季节的变化规律以及水沙通量之间的关系。研究表明:(1)鄱阳湖入江水通量的年代变化明显,20 世纪 90 年代入江水通量具有明显的递增趋势,21 世纪初则呈递减趋势;而沙通量在 20 世纪 50 年代至 90 年代间有明显的递减趋势,2000 年以来呈明显的递增趋势。(2)水沙通量的年际变幅较大,但沙通量的年际变幅远大于水通量。(3)水沙通量的季节变化明显,鄱阳湖入江水通量主要集中在 4~9 月份汛期,其径流量占全年总径流量的 68% 以上。由于长江水倒灌,鄱阳湖入江的沙通量与水通量变化不一致,输沙量多集中于春夏两季,特别集中于鄱阳湖与长江汛期的间隔期 3~4 月份。(4)年输沙量和年径流量相关性较低,但是枯水期至汛期前期的水沙通量变化趋势一致性较好。

关键词:水、沙通量;特征分析;鄱阳湖;长江

鄱阳湖是我国第一大淡水湖,位于长江中下游交界处南岸,也是长江流域最大的通江湖泊^[1],承纳赣江、抚河、信江、饶河和修河 5 大河流及博阳河、漳河、潼河之来水,经调蓄后由湖口注入长江,是过水性、吞吐型、季节性的湖泊。鄱阳湖水系流域面积 16.22 万 km²,约占长江流域面积的 9%,多年平均径流量为 1494 亿 m³,占长江流域控制站大通水文站年径流量的 16.7%^[2]。湖口水文站为鄱阳湖水沙输入长江的控制站,位于长江与鄱阳湖的交接处。很多学者曾对鄱阳湖的水沙变化规律进行了大量研究,如闵骞利用都昌站长时间序列水位数据分析了鄱阳湖洪水的变化趋势,并结合防洪提出了相应的措施^[3];徐德龙等在大量实测水文资料的基础上分析了鄱阳湖流域的径流、洪水和输沙量等水文特征,探讨了年内年际变化和地区分布规律^[4];郭鹏等则对湖口、外洲和梅港 3 站多年的水沙数据进行了统计分析,分别利用滑动平均、Spearman 秩次相关和线性回归等方法对 3 站的水沙变化进行了趋势分析^[5]。但是从鄱阳湖与长江关系的角度来探讨其水沙变化还比较少,因此本文利用湖口水文站观测资料对鄱阳湖与长江水沙通量变化进行分析,以探

求鄱阳湖入江水沙变化的规律。

1 数据与方法

采用数据来自湖口水文站 1956~2005 年的水沙实测资料,包括年平均值、各月平均值和极值,利用数理统计的方法,分析鄱阳湖入江水沙通量的年代变化、年际变化、季节变化特征,并运用回归方法,分析水沙通量之间的关系。

2 鄱阳湖入江径流量变化

2.1 年代变化

由于大部分年份都存在长江江水倒灌入湖的现象,所以分别研究了入江和入湖水沙通量的特征值,但多年平均径流量和多年平均输沙量为净正通量,如表 1 所示。从表 1 可以发现,自 20 世纪 50 年代末至 90 年代,鄱阳湖入江多年平均径流量呈递增趋势,特别是在 90 年代更为明显,而 21 世纪初的几年径流量下降趋势明显。主要原因在于,鄱阳湖的来水受 5 河径流量控制,而 5 河径流主要来自降水。对江西省多年降水资料分析表明,20 世纪 50 年代至 90 年代江西的年降水总体略呈上升趋势,90 年代降水量异常偏多。

2.2 年际变化

鄱阳湖多年(1956~2005 年)平均入江径流量为 1473.6 亿 m^3 ,最小和最大年径流量分别为 1963 年的 573.6 亿 m^3 和 1998 年的 2670.9 亿 m^3 ,后者为前者的 4.66 倍,对应的模比系数 K 值分别为 0.39 和 1.81,其比值约为 4.64。从图 1 可以看出,各年径流量围绕着多年平均值上下波动,其中 1998 年的特大洪水和 1963 年的特大干旱偏离最明显,其他年份的变幅也较大,表明鄱阳湖入江径流量年际变化较大。年径流量离散程度分析表明:极差为 2097.3,标准差为 404.8,变异系数 C_v 为 27.4%;反映该序列偏态系数 C_s 为 56.4%,为正偏,与我国多数河流的水文序列相一致^[4],主要因为鄱阳湖为过水性、吞吐型湖泊;反映该序列数据在均值附近集中程度的峰度系数为 3.39,属于尖峰分布。