

洞庭湖区“冬陆夏水”区域变化研究

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摘要: 利用遥感与地理信息系统技术, 提取 1987, 1998, 2003 和 2008 年 4 个时段洞庭湖“冬陆夏水”区域。运用改进归一化差异水体指数 (MNDWI) 的方法, 提取丰水期和枯水期遥感图像的水体并相减, 获得“冬陆夏水”区域, 并对 20 年的“冬陆夏水”变化的面积进行监督分类。分析发现, 研究区的“冬陆夏水”面积, 从 1987 年到 2008 年的 20 年中, 增加区域的面积有 9.52 万 hm², 40.65% 为泥滩地, 38.94% 为苔草滩地, 20.41% 为芦苇滩地。为进一步研究钉螺孳生地生态环境因子做了前期工作。

关键词: “冬陆夏水”区域; 钉螺孳生地; 遥感信息处理; 地理信息系统

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日本血吸虫病是我国流行的一种重大传染病, 日本血吸虫的唯一中间宿主是钉螺^[1], 洞庭湖区是其主要分布区之一。洞庭湖区的钉螺分布属于湖沼型, 又称江湖洲滩型。研究表明, 钉螺是水陆两栖类动物, 最喜栖息的场所是时而有水时而无水的江滩洲滩^[2], 湖沼型区域钉螺孳生地水淹时间一般为 3-8 个月, 呈现“冬陆夏水”的生态环境^[2,3], 即夏季涨水时被淹没, 冬季水退后裸露出来。黄轶昕, 周晓龙等对江苏省江滩钉螺分布进行分析, 发现钉螺分布特点与冬陆夏水的生态条件有关^[4]。马巍等通过对洞庭湖钉螺扩散与水情变化规律的研究, 发现钉螺适宜在水淹天数 3-8 个月的水位变动区间生存, 其中水淹天数 5-6 个月的区间环境最适宜其孳生繁殖^[5]。本研究根据湖沼地区钉螺孳生地“冬陆夏水”的特性, 利用遥感和地理信息系统等技术自动提取 3 个时段“冬陆夏水”区域, 并对其面积变化进行监督, 为钉螺孳生地的确定奠定基础。

1 研究区域与数据源分析

本研究中的洞庭湖区, 包括岳阳、常德、益阳 3 个市辖区, 以及临湘、沅江、汨罗、津市 4 个县级市, 岳阳、华容、湘阴、南县、安乡、汉寿、澧县、临澧 8 个县, 共计 15 个县市; 介于北纬 28.25° ~ 29.95° N, 东经 110.20° ~ 113.75° E 之间 (见图 1); 土地面积 2.576 万 km², 占湖南省总面积的 12.2%; 研究区总人口 1171.86 万 (2008 年底), 占湖南省总人口的 17.12%^[6]。

根据研究区域范围及研究内容, 选用美国陆地卫星 LandsatTM/ETM+ 影像作为数据源。研究区跨越 4 个轨道, 分别为 123-39、123-40、124-39、124-40。洞庭

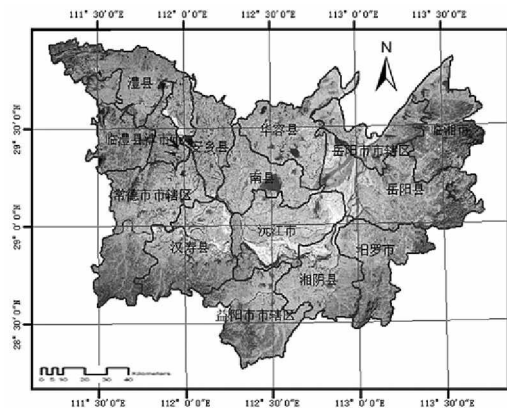


图 1 研究区域

湖的丰水期为 6-9 月, 枯水期为 12-3 月, 其中, 丰水期选用 1991 年 7 月, 1998 年 8 月, 2000 年 7 月和 2007 年 8 月; 枯水期选用 1987 年 12 月, 1998 年 12 月, 2003 年 1 月和 2008 年 3 月。

对遥感影像进行几何精校正与配准, 以及影像的镶嵌和裁切。应用 1: 50 000 精校正影像做基础图像几何静校正, 将校正后的遥感影像进行拼接, 应用 1: 25 000 湖南省行政区划图对拼接图像裁剪, 得到研究区范围。80 年代、1995 年、2000 年 1: 100 000 土地利用现状图用作对监督分类后的结果修改。

2 洞庭湖的“冬陆夏水”区域环境 GIS 分析

2.1 “冬陆夏水”区域的识别提取

洞庭湖区的钉螺分布属湖沼型, 钉螺孳生地水淹时间一般为 3-8 个月^[2], 呈现“冬陆夏水”的生态环境。“冬陆夏水”的范围即为丰水期和枯水期水域之差^[2,3]。

水体信息提取是获取“冬陆夏水”区域的关键。本研究选用徐涵秋^[7]的改进归一化差异水体指数 (MNDWI :

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Modified NDWI), 对水体信息提取。计算公式:

$$MNDWI = (Green - MIR) / (Green + MIR) \quad (1)$$

其中, MIR 为中红外波段, 即 TM/ETM+ 的第 5 波段; Green 为绿光波段, 即 TM/ETM+ 的第 2 波段。

应用改进水体指数 (MNDWI) 分别提取 4 个年份的丰水期和枯水期的 MNDWI。通过反复试验, 确定 MNDWI > 0 时的区域为水体。

对提取后的水体与原始影像进行人工对比判读, 发现结果中有夹杂大量阴影, 主要在山地森林一带。阴影分布处多有植被覆盖, 而水体一般无植被覆盖, 可采用差异性植被指数 (NDVI) [8] 得到由植被覆盖区域, 进一步区分水体和阴影。计算公式为:

$$NDVI = (NIR - R) / (NIR + R) \quad (2)$$

其中, NIR 为近红外波段, 即 TM/ETM+ 的第 4 波段; R 为红光波段, 即 TM/ETM+ 的第 3 波段。通过光谱亮度统计, 反复分析, 确定区分阴影和水体的条件为 NDVI < -0.09。

符合条件的为水体, 否则就是阴影。由此提取出枯水期和丰水期的水系, 图 2 为 1987 年 12 月 (枯水期) 和 1991 年 7 月 (丰水期) 的水体。

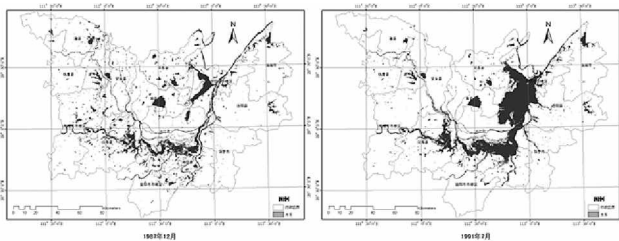


图 2 枯水期和丰水期水体提取

由式 (1) 和式 (2) 得出水体信息, 利用丰水期减去枯水期的水体, 得到该年“冬陆夏水”的区域 [9]。其计算公式为:

$$M = (MNDWI_{wet} > a \quad NDVI_{wet} < b) - (MNDWI_{arid} > a \quad NDVI_{arid} < b) > 0 \quad (3)$$

MNDWI_{wet} 表示根据式 (1) 计算的丰水期遥感影像的水体指数, MNDWI_{arid} 表示根据式 (1) 计算的枯水期的水体指数; NDVI_{wet} 和 NDVI_{arid} 分别表示根据式 (2) 计算的丰水期和枯水期的植被覆盖指数; a、b 为经验值。M 值大于零的区域即为该年“冬陆夏水”区域。上述过程均在 ENVI 软件中完成。

2.2 “冬陆夏水”区域环境变化 GIS 分析

将提取的“冬陆夏水”区域在 ArcGIS 软件的支持下, 转换为多边形, 将多边形图与枯水期影像叠加显示, 可发现其中夹杂一些小图斑, 主要分布在水田部分。这是由于在丰水期水田大多蓄水, 而在枯水期则多为旱地造成的影像。因此要对照遥感影像去除掉在

水田部分的细小图斑, 以免对结果造成影响。在 ArcGIS 中计算“冬陆夏水”区域的面积。

叠置分析是地理信息系统中用来提取空间隐含信息的方法之一, 叠置结果综合了原来两个或多个层面要素所具有的属性 [10]。在 ARCGIS 中对四个时段的“冬陆夏水”的面积做叠置分析, 分别得出某一时段内减少和增加的区域位置, 并统计出其面积。

为了区分增加的“冬陆夏水”区域的地物类型, 对其区域范围的遥感图像利用最大似然法 [8] 做监督分类。将分类结果导入到 ArcGIS 软件中, 统计得出从 1987 年到 2008 年增加的区域的每一类地物的面积。

2.3 结果分析

1) 分类精度评价。在图像精度评价中, 可混淆矩阵的方法来评价。混淆矩阵 (Confusion Matrix) 是通过将每个地表真实像元的位置和分类与分类图像中的相应位置和分类像比较计算的 [8]。结果表明, 从 1987-2008 年 3 个时间段中增加区域的总体分类精度均在 97% 以上。错分误差、漏分误差、发生器精度和用户精度见表 1, 2, 3。

表 1 1998 年 12 月遥感图像分类方法精度评价/%

	错分误差	漏分误差	发生器精度	用户精度
泥滩地	0.08	4.13	95.87	99.92
苔草滩地	0.49	0.05	99.95	99.51
芦苇滩地	44.51	1.12	98.88	55.49

表 2 2003 年 1 月遥感图像分类方法精度评价/%

	错分误差	漏分误差	发生器精度	用户精度
泥滩地	0.03	0.29	99.71	99.97
苔草滩地	0.13	0.00	100.00	99.87
芦苇滩地	2.05	0.42	99.58	97.95

表 3 2008 年 3 月遥感图像分类方法精度评价/%

	错分误差	漏分误差	发生器精度	用户精度
泥滩地	0.00	0.00	100.00	100.00
苔草滩地	0.53	3.25	96.75	99.47
芦苇滩地	3.99	0.65	99.35	96.01

可看出总体分类精度比较高, 相比之下, 芦苇滩地的错分误差较大。这是因为分类的遥感影像都是在冬季枯水期, 芦苇已经被收割, 在影像上与泥滩地色调相近, 容易引起错分。可参考土地利用图和夏季丰水期的影像进行修改。1987-2008 年增加区域分类结果如图 3 所示。

2) “冬陆夏水”区域的特点与规律。ArcGIS 中计算“冬陆夏水”区域面积, 得到 1987 年为 12.74 万 hm², 1998 年为 19.88 万 hm², 2003 年为 22.46 万 hm², 2008

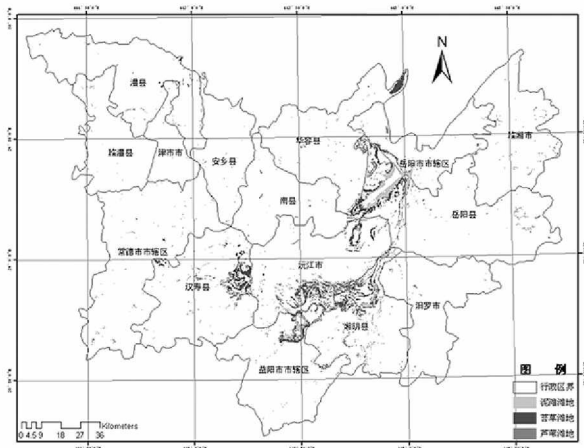


图 3 1987-2008 年分类图

年为 22.26 万 hm^2 ，且增加的区域逐渐向湖中心扩张 (见图 4)。1987 年到 1998 年近 10 年间“冬陆夏水”区域的面积净增加 7.64 万 hm^2 。其中，增加的部分 50.77% 为泥滩地，46.85% 为苔草滩地，2.38% 为芦苇滩地。1998 年到 2003 年净增加 2.59 万 hm^2 。其中，57.32% 为泥滩地，33.2% 为苔草滩地，9.48% 为芦苇滩地。2003 年到 2008 年，“冬陆夏水区域”有所减少，减少面积为 0.2 万 hm^2 ，且主要是泥滩地的变化。从 1987 年到 2008 年的 20 年中，增加区域的面积 9.52 万 hm^2 ，其中 40.65% 为泥滩地，38.94% 为苔草滩地，20.41% 为芦苇滩地 (见图 5)。

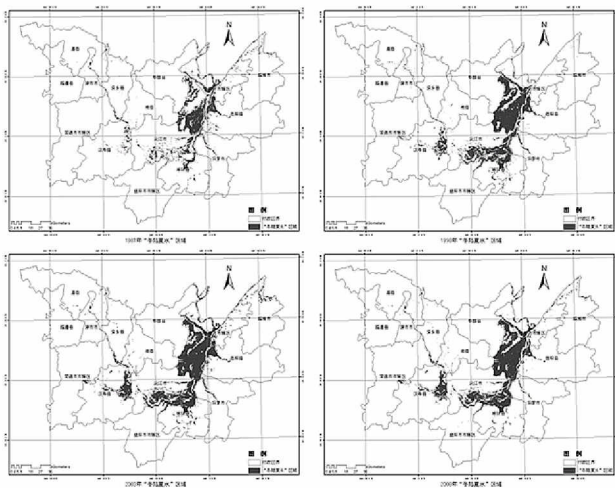


图 4 1987-2008 年“冬陆夏水”区域

3 结 语

洞庭湖的三(四)口四水携带的泥沙在洞庭湖区不断淤积，造成湖泊洲滩面积的增长。从 1987 年到 2008 年间，泥滩地、苔草滩地、芦苇滩地面积总体上增加了，但从 1998 年到 2003 年，增加速率有所放缓，且 2003 年到 2008 年，冬陆夏水区域面积有所减少。增

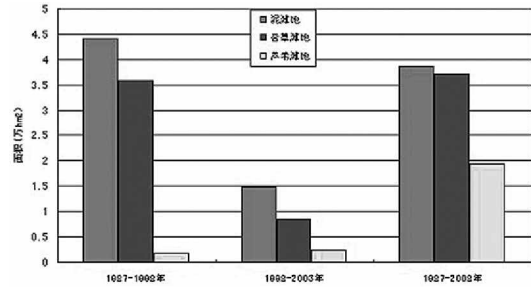


图 5 1987-2008 年增加部分湿地变化

加的区域的一部分随时间推移发展为植被洲滩。研究表明，在泥滩淤积 3-5 年后，泥滩地上开始生长植物，形成苔草滩地。而后随着“围湖造田”的禁止和造纸业的发展，洲滩被人为围垦而用于种植芦苇，使得芦苇滩地面积上升 [11]。已有研究发现，江滩型钉螺孳生地大多为苔草，芦苇等有植被区域 [12-14]。因此，增加的“冬陆夏水”区域是潜在的钉螺孳生地。本研究为进一步确定钉螺孳生地做前期工作。以后可搜集相关钉螺数据，对其植被环境、高程、土壤类型、温度、湿度等影响钉螺孳生的生态环境因子做进一步的研究。

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develop very quickly, and which including agent the departure of international and domestic air cargo, logistics distribution, air express, motor transport, rail transport, storage, inter-city distribution. In addition, the logistics company is also own inter-regional networking, information, intelligence, which also has supply chain management capabilities. Logistics company carries so many services, vehicle which plays an important role as a major tool in logistics company. The site was based on the Google Maps API to achieve the real-time monitoring of vehicle, using JSP + MySQL on page design and could also be queried the general information. Real-time vehicle monitoring and dispatching queries can greatly improve the efficiency of vehicles, thereby improving the company's efficiency.

Key words Logistics company , Google Maps API ,real-time vehicle monitoring (Page:126)

Precision Analysis of Coordinate Conversion Based on Geodetic Database and GPS Database of Hubei Province by JIANG Wei

Abstract By using several kinds of typical coordinate conversion models, this paper analyzed the problems of coordinate conversion based on geodetic coordinate database and GPS coordinate database of Hubei province. The result showed that if taking Hubei province as the whole to make coordinate conversion, its precision could meet the needs of the medium-small scale mapping and the general engineering surveying. But if the higher precision was required to be satisfied with, the divisional conversion should be made based on Hubei's topography.

Key words coordinate transformation ,coordinate system precision , GPS (Page:129)

Spatial-temporal Changes Study of Landscape Pattern in Shenzhen City Based on RS and GIS by CUI Shuang

Abstract Based on the means of the techniques of RS, GIS and landscape ecology, achieved the maps of patch types of Shenzhen after processing the TM images of 1995, 1999 and 2008 through ERDAS and ArcMap to study the landscape spatial changes in Shenzhen during the past thirteen years. Then calculated the indices of landscape patterns in Shenzhen City using Fragstats 3.3. After analysis, conclude that the human activity was the main driving factor for landscape change .

Key words Landscape pattern , Landscape indices , RS , GIS , Shenzhen (Page:133)

Changes of the Regions of "Water in Summer and Land in Winter" in Dongting Lake by LONG Fang

Abstract The regions of "water in summer and land in winter" of four periods in Dongting Lake were extracted by using remote sensing (RS) and geographic information system (GIS). The images of RS for abundant-water period and low-water period in Dongting Lake were extracted and Modified Normalized Difference Water Index (MNDWI) was computed and extracted. The region of "water in summer and land in winter" were determined by subtracting the MNDWI in the two images. The changes of the regions among 20 years were classified in ENVI 4.3 by using the supervised classification. During the 20 years from 1987 to 2008, the area have increased about 9.52×10^4 hm², and 40.65% of that is silt beach, 38.94% of that is lake marsh beach, 20.41% of that is reed beach. Previous studies have suggested that lake marsh beach and reed beach is the potential Snail habitats. The regions of "water in summer and land in winter" which was helpful for the distinguished and surveillance of snail habitat in marshland and for the prevention of schistosomiasis could be extracted from the satellite images.

Key words The regions of "water in summer and land in winter" , snail habitats , remote sensing image processing , GIS (Page:136)

Study of Experiment of Interferogram Denoising Filtering

by YU Jingbo

Abstract Based on introducing the basic principles of filtering denoising and interferogram denoising quality evaluation index, the qualitative and quantitative analysis of the results was carried out by the overall denoising and the decompositive denoising filter denoising interferogram. It was shown that the overall denoising had smoothness of better phase and the decomposition method could suppress speckle noise denoising effect and took a good edge retention.

Key words overall denoising ; decomposition denoising ; qualitative evaluation ,quantitative evaluation ,interferogram (Page:139)

Method for Creation DOM by Airborne LiDAR and Optical Images by HU Qi

Abstract A method for producing digital orthophoto was discussed in the paper using laser point cloud and optical image obtained from LiDAR system. Optical image was oriented by aerial triangulation according to exterior orientation elements provided by GPS and inertial navigation system and controled points collecting from laser point cloud data. DSM gained from LiDAR laser point cloud was filtered to get DEM. Orthophoto was produced through image rectification with the DEM, after image orientation.

Key words Lidar ,POS ,inertial navigation ,DOM (Page:142)

Status and Future Development of the Standard Structure of Celestial Navigation System by ZHU Xiaohong

Abstract Celestial Navigation System (CNS) is a location technology by measuring celestial bodies. According to the analysis on the status and application of CNS, the overseas and domestic standards and specifications of CNS were all described and compared by using classification and induction methods. The status of these specifications and standards were analyzed in detail. At last, the standard structure of CNS was proposed; meanwhile, some suggestions and opinions were given for CNS standards and specifications.

Key words Celestial Navigation ,standard and specification ,standard structure (Page:145)

Quality Inspection and Assessment of Specification GB/T 18316-2008 for Digital Surveying and Mapping by CHEN Yanli

Abstract The progresses for GB/T 18316-2008 in quality inspection methods and quality inspection contents and quality assessment had been discussed in the article. To strengthen discuss for 1:10 000 scale topographic maps key elements had been renewed. It indicated that the new specification had been improved in many aspects compared with old. At last the author put forward some individual suggestions to perfect the specification.

Key words digital line graph ,quality inspection ,quality assessment (Page:148)

Procedure of Great-Wall Thematic Map Symbols Library

by ZHANG Jiangxia

Abstract The paper introduced the key technology of making thematic map symbols library that servered for Ming Great Wall resource investigation of Gansu. A new procedure of making thematic map symbols was proposed based on Illustrator®, which formed integrated and standard symbols library. Not only did perform the work of making map of Great Wall thematic image, but also facilitated the study, management and protection of Ming Great Wall resource of Gansu.

Key words map of Great Wall thematic image, map factors, map symbols (Page:151)

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