4 不同土地管理方案对湖泊影响的预测模型

[Forecasting](http://cn.bing.com/dict/clientsearch?mkt=zh-CN&setLang=zh&form=BDVEHC&ClientVer=BDDTV3.5.0.4311&q=%E9%A2%84%E6%B5%8B%E6%A8%A1%E5%9E%8B" \t "_blank) [models](http://cn.bing.com/dict/clientsearch?mkt=zh-CN&setLang=zh&form=BDVEHC&ClientVer=BDDTV3.5.0.4311&q=%E9%A2%84%E6%B5%8B%E6%A8%A1%E5%9E%8B" \t "_blank) about effects of different management scenarios on lakes

不同的土地管理方案，会影响湖泊的TN负荷和TP负荷，从而影响水质。而且，当水中N、P含量超标时，加上合适的温度等其他条件，就会发生赤潮现象。湖泊水质会更加恶化。所以，我们首先建立对N、P含量的估算和预测模型。然后是是否发生赤潮的预测模型。

Different land use managements will have an impact on TN and TP load in lakes,

moreover, water containing elevated level of N,P with proper temperature and other factors precipitate potentially-toxic algal blooms reproduction, to some extent, making water quality severely worse. Firstly, we establish a model to estimate **nitrogen and phosphorus concentrations and** forecasting model for water quality which lay a firm foundation for evaluation model.

4.1 N、P量估算与预测的输出系数模型

Estimation of N,P concentrations and [Export](http://cn.bing.com/dict/clientsearch?mkt=zh-CN&setLang=zh&form=BDVEHC&ClientVer=BDDTV3.5.0.4311&q=%E8%BE%93%E5%87%BA%E7%B3%BB%E6%95%B0) [Coefficient](http://cn.bing.com/dict/clientsearch?mkt=zh-CN&setLang=zh&form=BDVEHC&ClientVer=BDDTV3.5.0.4311&q=%E8%BE%93%E5%87%BA%E7%B3%BB%E6%95%B0" \t "_blank) Model

4.11 模型介绍Introduction to models

研究土地利用-营养物质-湖泊富营养化关系的过程中，提出并应用了输出系数模型（也称单位面积负荷法）。模型在考虑土地利用分类的基础上，结合居民非点源污染物的排放和处理、牲畜的数量和分布来确定不同污染源的输出系数。同时模型在对总氮进行估算时还考虑了植物的固氮、氮的空气沉降等因素。该模型能较为准确的对大尺度流域的非点源污染进行评价和预测。模型的一般表达式为：

Researchers put forward and apply export coefficient model in the process of studying the relationships between nutrient and [lake](http://cn.bing.com/dict/clientsentence?mkt=zh-CN&setLang=zh&form=BDVEHC&ClientVer=BDDTV3.5.0.4311&q=%E6%B9%96%E6%B3%8A%E5%AF%8C%E8%90%A5%E5%85%BB%E5%8C%96" \t "_blank) [eutrophication](http://cn.bing.com/dict/clientsentence?mkt=zh-CN&setLang=zh&form=BDVEHC&ClientVer=BDDTV3.5.0.4311&q=%E6%B9%96%E6%B3%8A%E5%AF%8C%E8%90%A5%E5%85%BB%E5%8C%96" \t "_blank).On the basis of considering land use management, we can determine export coefficients of different pollutants by combining the emission of no-point pollutants and the number and distribution of livestock. At the same time, the model also accounts for factors about [nitrogen](http://cn.bing.com/dict/clientsearch?mkt=zh-CN&setLang=zh&form=BDVEHC&ClientVer=BDDTV3.5.0.4311&q=%E6%A4%8D%E7%89%A9%E7%9A%84%E5%9B%BA%E6%B0%AE" \t "_blank) [fixation](http://cn.bing.com/dict/clientsearch?mkt=zh-CN&setLang=zh&form=BDVEHC&ClientVer=BDDTV3.5.0.4311&q=%E6%A4%8D%E7%89%A9%E7%9A%84%E5%9B%BA%E6%B0%AE" \t "_blank) in [plants](http://cn.bing.com/dict/clientsearch?mkt=zh-CN&setLang=zh&form=BDVEHC&ClientVer=BDDTV3.5.0.4311&q=%E6%A4%8D%E7%89%A9%E7%9A%84%E5%9B%BA%E6%B0%AE" \t "_blank) and air [precipitation](http://cn.bing.com/dict/clientsearch?mkt=zh-CN&setLang=zh&form=BDVEHC&ClientVer=BDDTV3.5.0.4311&q=%E7%A9%BA%E6%B0%94%E6%B2%89%E9%99%8D) of [nitrogen](http://cn.bing.com/dict/clientsearch?mkt=zh-CN&setLang=zh&form=BDVEHC&ClientVer=BDDTV3.5.0.4311&q=%E6%A4%8D%E7%89%A9%E7%9A%84%E5%9B%BA%E6%B0%AE). The model is applicable in

forecasting and evaluating no-point polluted catchment with big scale. The general expression of model is that:

公式1；

其中，i为污染物类型。j为流域中营养源的种类，共n种。为污染物i在流域的总负荷量。为污染物i在流域第j种营养源的输出系数。为第j种营养源的数量。p为由降雨输入的营养物数量。

In the equation, I refers to the type of pollutant,j refers to the kind of nutrient source. refers to the total loads of pollutant i. refers to the export coefficient of i pollutant exporting j nutrient source. refers to the number of j

nutrient source, p refers to the number of nutrient source due to raining

输出系数模型利用黑箱原理，避开了非点源污染发生的复杂过程，所需参数少，操作简单，且具有一定的精度，在国内外得到了广泛的应用。

Export coefficient models exploit principles of black box, avoiding the complicated progress which no-point pollution may happen, and it has a certain accuracy.

4.12 模型参数的确定方法

The methods of determining model’s parameters

在应用输出系数模型时，关键问题是确定合理的输出系数值。在明确的土地利用情况的基础上，获取输出系数的常用途径是现场监测和查阅文献值。两种方法的比较如下表：

The key to solve problem is to determine a reasonable output coefficient when applying export coefficient model, on the basis of land use condition, the way to acquire export coefficient is **field inspection and** consulting literature. We will proceed comparisons as follows:

|  |  |  |
| --- | --- | --- |
| Method | **Field inspection** | Consult literature |
| Operation | Monitor water quality and calculate nutrient loads | Use previous research to get coefficient by consulting literature |
| Strength | [High](http://cn.bing.com/dict/clientsearch?mkt=zh-CN&setLang=zh&form=BDVEHC&ClientVer=BDDTV3.5.0.4311&q=%E8%BE%83%E9%AB%98%E7%B2%BE%E5%BA%A6" \t "_blank) [precision](http://cn.bing.com/dict/clientsearch?mkt=zh-CN&setLang=zh&form=BDVEHC&ClientVer=BDDTV3.5.0.4311&q=%E8%BE%83%E9%AB%98%E7%B2%BE%E5%BA%A6" \t "_blank)[.](http://cn.bing.com/dict/clientsearch?mkt=zh-CN&setLang=zh&form=BDVEHC&ClientVer=BDDTV3.5.0.4311&q=%E8%BE%83%E9%AB%98%E7%B2%BE%E5%BA%A6" \t "_blank)  Reveal pollution’s properties excellently | **Simplicity**  Low costs |
| Weakness | Take long time  High costs | Distinct characteristics  Uncertainties |

4.13基于水文水质资料的输出系数确定法的模型建立

Determine export coefficients based on hydrological materials

在输出系数中，受地域影响最大的是土地利用的输出系数。本文尝试在污染物质量守恒的前提下，采用基于历史水文水质监测资料的确定各土地类型的输出系数的方法。该方法兼具了现场监测和查阅文献两种方法。它比较适合我国缺乏非点源污染监测资料的现状。具体建模过程如下：

Area has the greatest impacts on the land use coefficient. under the premise of the law conservation of mass, we determine the different land export coefficients taking advantage of monitoring data, which is applicable in present situation being shortage of no-point pollution data.

Step1土地利用的分类与小流域选取

Classifying land use and selecting small watershed

根据研究的精度需要，将土地利用分为n种类型。在研究区内选取m个小流域，根据污染物在流域内输入输出质量守恒原则，建立产污方程：

The land use is divided into n types according to research，then selecting m small watersheds，pollutants’ inputs and outputs obey the law conservation of mass, we get

公式2

Step2求解参数Li

[Solving parameter](javascript:showjdsw('jd_t','j_')) li

公式3

Ci为小流域出口第i种污染物的年平均监测浓

度。 Q为流域出口的年总流量。ki为第i种污染物在小流域的损失系数。

Ci refers to the average of i pollutant of monitoring concentrations a year .Q refers to[annual](http://cn.bing.com/dict/clientsearch?mkt=zh-CN&setLang=zh&form=BDVEHC&ClientVer=BDDTV3.5.0.4311&q=%E5%B9%B4%E6%80%BB%E6%B5%81%E9%87%8F" \t "_blank) [flow](http://cn.bing.com/dict/clientsearch?mkt=zh-CN&setLang=zh&form=BDVEHC&ClientVer=BDDTV3.5.0.4311&q=%E5%B9%B4%E6%80%BB%E6%B5%81%E9%87%8F" \t "_blank)

Step3求解参数Lps和Lio

[geting parameter](javascript:showjdsw('jd_t','j_')) about lps and lio

根据式（2）和式（3），可得：

According to () and (),we have

公式4

其中，Lps表示农村生活，Lio表示畜禽养殖；

LPS refers to country life, lio refers to the breeding of livestock

公式5

式中：为枯水期流域出口第i种污染物的平均监测

浓度。为枯水期流域出口的总流量。为枯水期的时间。

Ck refers to the average of i pollutant of monitoring concentrations. Qk refers to total flows during dry season

Dk refers to the time of dry season

公式6

i为污染物类型;j为人或畜禽类型;Li0为第i种污染物总负荷。 Eij为单位数量第j种污染源第i种污染物的输出数(该值来自文献);Mij为第j种污染源的第i种污染物的营养物输入量Aj为人口数或畜禽养殖量。

i refers to pollutant types，j refers to types of livestock，

Eij refers to the number of i th pollutant exporting to j th pollution source in units

Mij refers to the nutrient of I th pollutant exporting to j th pollution source

Step4联立方程组求解Eij

Getting solution by a set of simultaneous equations.

对于污染物i，m个小流域课得到m个产污方程。因此可得到方程组：

For pollutant i, then we have

公式7

4.2 基于BP神经网络的赤潮预测模型