QUANTITATIVE STUDY OF THE ECO-WATER INDICES BASED ON REMOTE SENSING

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ABSTRACT

Eco-water, as a new concept, has been proposed by our research group recently. It is a vegetation-centred phase formed by the transformation of atmospheric precipitation held in the vegetation phase, the vegetation humus phase and the root soil phase. As a challenging crucial issue in the hydrological cycle research field, the eco-water phase is similar to the groundwater phase capable of precipitation interception and rivers or groundwater supplementation. In this paper, an experimental investigation is conducted at Maoergai area in the upper Minjiang River. Grounding on ecology, botany, hydrogeology, forest hydrology and genesis mechanism of ground object remote sensing information, multi-temporal and multi-type remote sensing data, measured spectrum and the routine observation were applied to construct the indices for Eco-water and its inversion model. The four Eco-water indices, including Vegetation Canopy Interception Content, Vegetation Water Content Index, Soil Moisture Index and Eco-water Storage Index, were calculated. The results show that the RS information model can reflect the real soil moisture.The dissertation brings forward the Eco-water Remote Sensing quantitative study based on vegetation layer. The vegetation-based calculation model for Eco-water with quantitative remote rensing technology, which has been identified in the dissertation, possesses significant science affect and practical value; and it can not only advance the methods of Eco-environment study, but also promote the research on water-resources transformation and water-cycle, also enlarge the domains of remote sensing applications.

(1) The eco-water information index system mainly includes the Modulus of Eco-water Conservation (MEC), the Coefficient of Eco-water phase Rich Water Extremum (CEPRWE), the Modulus of Eco-water Runoff (MER), the Vegetation Moisture Content (VMC), the Soil Moisture Saturation(SMS), the Soil Moisture Content(SMC), the Environmental Moisture(EM) and the Environmental Temperature(ET), etc. The key parameters that reflect the eco-water phase resource quantity are the VMC, the SMS, the SMC, the MEC and the CELRWE. These parameters can be obtained by remote sensing image information extraction methods such as inversion means, also some of the parameters by spectrum testers or other instruments measuring at the scene or in the laboratory directly or indirectly.

（2）Ground parameters of the eco-water are closely related to its surrounding environmental

moisture, temperature and brightness, etc., and thus they are reflected to different degree information in remote sensing images. This makes it possible to build the models for the conversion between eco-water phase ground parameters and remote sensing information parameters.

(3) The Modulus of Eco-water Conservation (MEC) characterizes the volume of eco-water conserved in per unit area of the eco-water phase, corresponding to the factors including the VMC, the SMC, the vegetation canopy interception content and terrain conditions, etc. The total eco-water conservation of the eco-water phase in the study area will be measured by the established MEC remote sensing inversion model.

Given the M×N pixel matrix of remote sensing images in the study area, let $MEC\ (i,j)_t$ as the MEC of pixel（i,j）at time t, $I(i,j)_t$ as the vegetation canopy interception content, $S(i,j)_t$ as the SMC and $V(i,j)_t$ as the VMC, then the MEC remote sensing inversion model is defined as:

$$MEC\ (i,j)_t = A\ (k_1 I(i,j)_t + k_2 S(i,j)_t + k_3 V(i,j)_t + B \qquad i=1,2,3\cdots M;\ j=1,2,3\cdots N$$

Here, *k1*, *k2* and *k3* are individual weight coefficients respectively; A and B are undetermined coefficients.

Therefore, the MEC remote sensing quantitative measurement model ($MEC\ (g)_t$) of a specific category of terrain (g) in the study area at the time of t can be expressed as:

$$MEC\ (g)_t = \sum_{i=1}^{M}\sum_{j=1}^{N} \mathrm{MEC}(i,\ j)_t$$

Since the eco-water is to maintain the normal functions of the ecological environment, which is difficult to be quantified, it will take great effects to access its resource quantity by general methods. The proposed quantitative remote sensing study of the vegetation-centred eco-water will not only enrich ecological environment theoretical researches, but also promote researches in theories and technological methods of water resource evolution and hydrological cycle, and widen the application research fields of remote sensing technology, which is of scientific importance and potential significance of social and economic value for the Western Development and even the national ecological environment researches.

Keywords: eco-water , eco-water information index (system), modulus of eco-water conservation, remote sensing inversion model, quantitative remote sensing