ECOSYSTEM HEALTH ASSESSMENT BY USING REMOTE SENSING DERIVED DATA：A CASE STUDY OF TERRESTRIAL REGION ALONG THE COAST IN ZHEJIANG PROVINCE

Zhenghua CHEN[1], Qiu YIN[2], Li LI[1], Hua XU[1]

[1]State Environmental Protection Key Lab. of Satellite Remote Sensing, Ministry of Environmental Protection, Institute of Remote Sensing Applications, Chinese Academy of Sciences, Beijing, China, 100101

[2] Shanghai Center for Satellite Remote-sensing and Application, Shanghai, China, 201100

1. INTRODUCTION

Zhejiang province locates in the east of China, which is economically developed and densely-populated(seeing fig.1). The urban expansion and landuse/landcover changes with economic development quickly. In this paper, we try to assess its ecosystem health from aspects of vigor, organization and resilience by using remote sensing data as main indicators. The collected data include SPOT/VEGETATION from April 1st 1998 to 2009 December 21st, and some auxiliary data such as DEM, administrative map, meteorologic data and statistics.

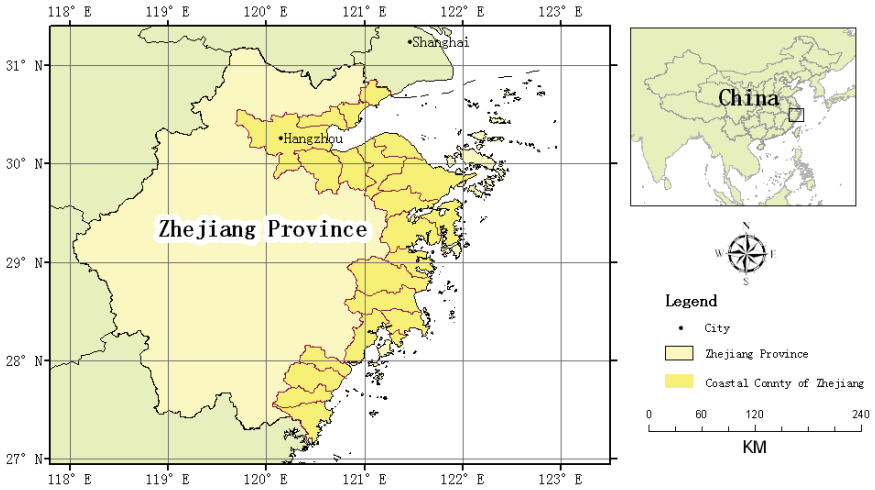

Fig.1 Location of study site

2. METHOD

Rapport[1] defined ecosystem health and have the viewpoint of that it can be assessed using measure of vigor, organization and resilience. Vigor is measured in terms of activity, metabolism or productivity; organization can be assessed as the diversity and number of interactions between system components; resilience is measured in terms of a system's capacity to maintain structure in the presence of stress[2, 3]. Costanza proposed an overall health index, HI=V×O×R, 0-1 index of vigor, organization and resilience[4]. In this paper, vigor, organization and resilience are calculated separately from indicators derived from remote sensing.

2.1. Vigor

Vigor represents cardinal measure of system activity, metabolism. NDVI is the indicator of vegetation active ability, the higher NDVI means more leaf density, chlorophyll concentration and photosynthesis. The gross primary productivity and net primary productivity of ecosystems are often calculated by using NDVI as main input parameters. So this demonstrates the feasibility of NDVI as vigor (seeing fig.2).

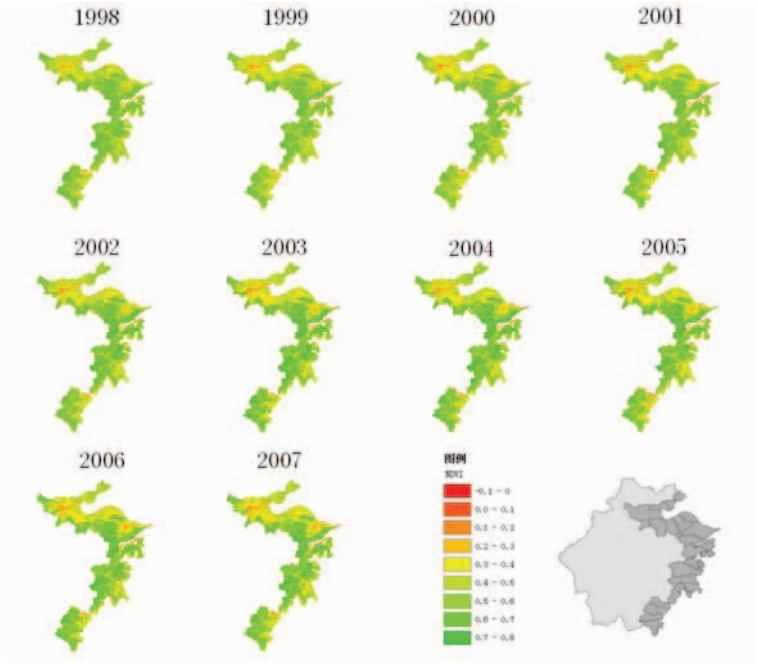

Fig.2 Average Annual NDVI (AANDVI) of Zhejiang coastal region from 1998 to 2007

2.2. Organization

The SPOT/VEGETATION has coarse resolution of 1km. Along with the urban expansion and factory construction, the vegetation area decrease. The fragmentation landscape become more common, some ecological services and functions will be blocked, for example after large displacement of vegetation by urban impermeable surface, leading to the loss of wild animal and plants habitat, water regulation and disturbance regulation. From the ecosystem services perspective, the city's ecological value is 0, farmland 92$\$hm^{-1}a^{-1}$, forest 969$\$hm^{-1}a^{-1}$, grass 232$\$hm^{-1}a^{-1}$, coastal zone 4052$\$hm^{-1}a^{-1}$[5]. Along with rapid urbanization, large-scale flat farmlands become cities, roads and factories. The movement of NDVI centriod can reflect the extent of the damage to the unbalanced development and organizational structure, affecting the energy flow and substance cycles. Therefore, vegetation percentage and vegetation centroid movement will embody the organization status. See fig.3 and fig.4.

Fig.3 Movement of NDVI centriod from 1998 to 2007

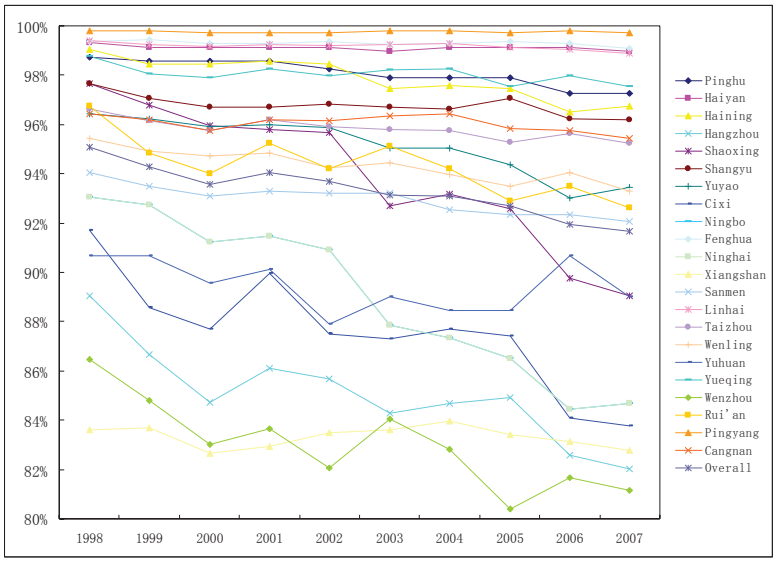

Fig.4 Vegetation percentage from 1998 to 2007

2.3. Resilience

The resilience refers to ability to recover from pressure, also known as ‘resistance’. Direct measurement of the ecosystem resilience is difficult, from the definition it should be measured according to growth range, recovery time. Decades of long time series vegetation index can be characterized as the ecological resistance to human activities and climatic pressure. If the NDVI maintains the same level or increased, it means strong resilience; if the NDVI decreases in recent years, it means weak resilience. In this paper we use SLOPE of each grid from 1998 to 2009 to represent resilience. See fig.5.

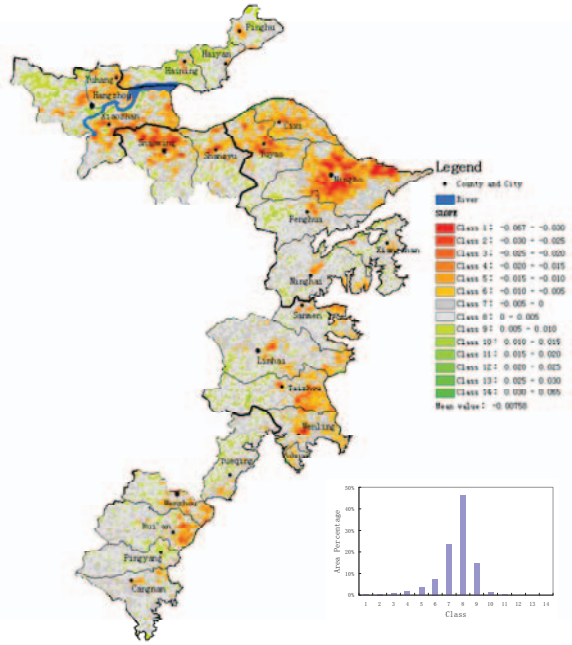

Fig.5 SLOPE of NDVI from 1998 to 2007

3. RESULTS AND CONCLUSION

The expected results include as follows: (1)vigor variation in recent 10 years; (2) the vegetation percentage decrease and DNVI regional centroid move to inland; (3)the lower SLOPE distributed around highly economic developed regions.

Key words: SPOT/VEGETATION; Vigor; Organization; Resilience; NDVI

[1] D. J. Rapport, "What constitutes ecosystem health?," *Perspective in Biology and Medicine,* vol. 33, pp. 120-132, 1989.

[2] D. J. Rapport, R. Costanza, and A. J. McMichael, "Assessing ecosystem health," *Trends in Ecology & Evolution,* vol. 13, pp. 397-402, 1998.

[3] M. T. Mageau, R. Costanza, and R. E. Ulanowicz, "The development and initial testing of a quantitative assessment of ecosystem health," *Ecosystem Health,* vol. 1, pp. 201-203, 1995.

[4] R. Costanza, "Toward an operational definition of health," in *Ecosystem Health-New Goals for Environmental Management*, R. Costanza, B. Norton, and B. D. Haskell, Eds. Washington,DC: Inland Press, 1992, pp. 239-256.

[5] R. Costanza, R. d'Arge, R. d. Groot, S. Farberk, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R. V. O'Neill, J. Paruelo, R. G. Raskin, P. Suttonkk, and M. v. d. Belt, "The value of the world's ecosystem services and natural capital," *Nature,* vol. 387, pp. 253-260, 1997.