

The Use of Satellite Imagery to Monitor Surface status in North Beijing, China

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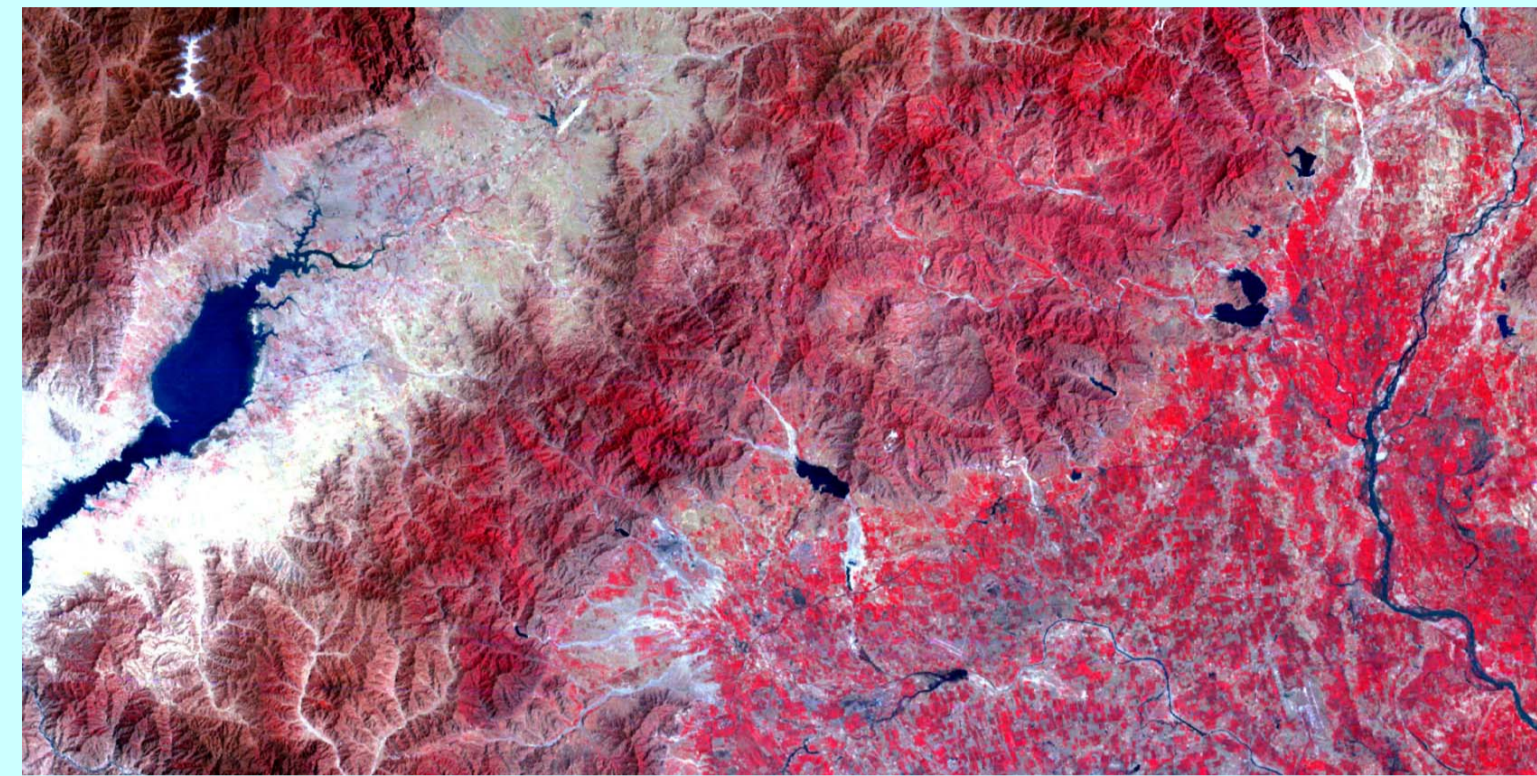
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Satellite imagery data can reflect surface status. We can find the change of surface status by classify land cover and calculate NDVI of the satellite imagery data in 1975 and 2001.

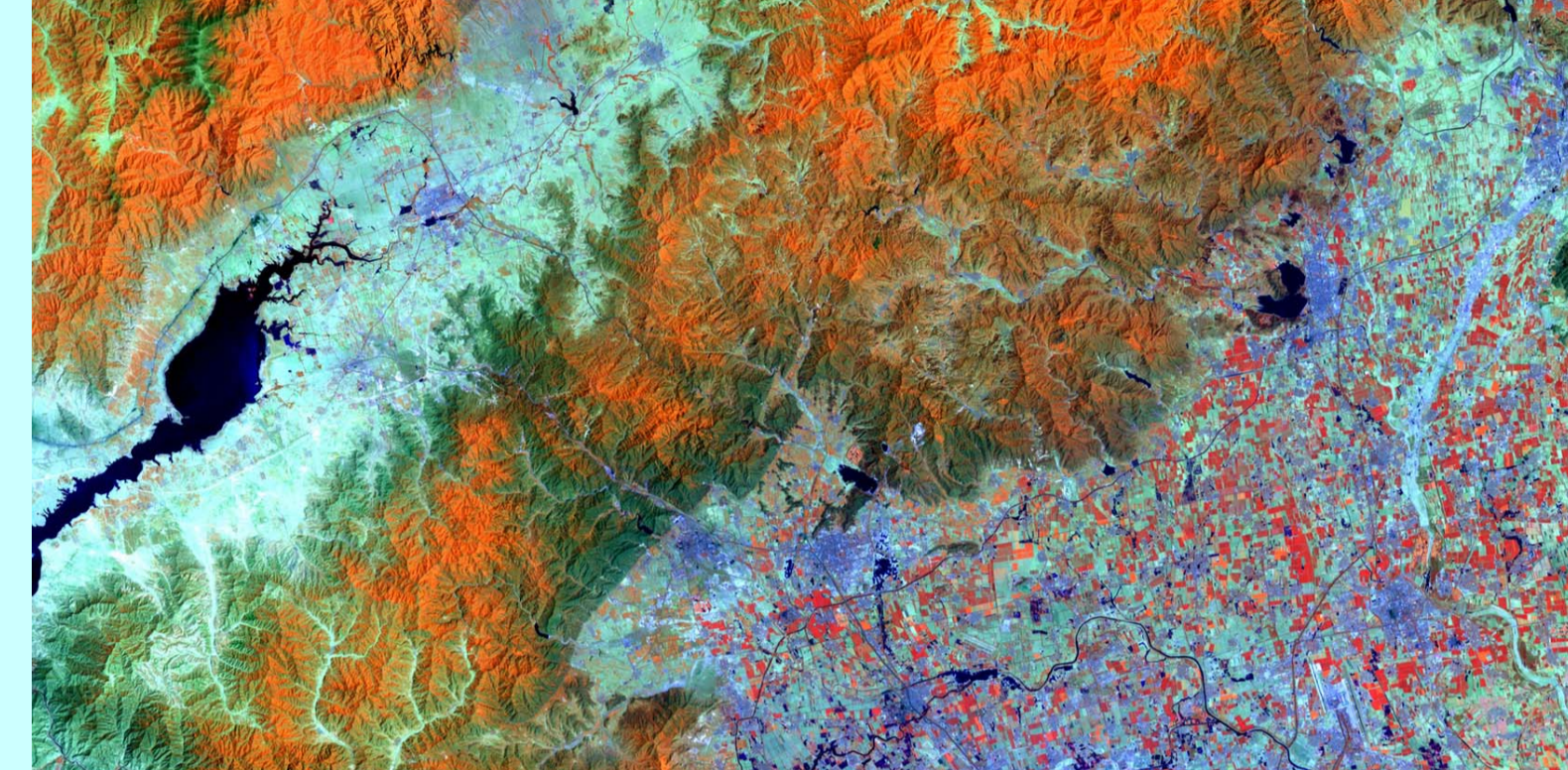
Research zone is located in the northwest of Beijing and it's central coordinates is longitude 116° 30' East, latitude 40° 15'. Material data is MSS 1975.5 and TM 2001.5.



Location of study area



Landsat MSS color composite of band 7,5 and 4 in RGB

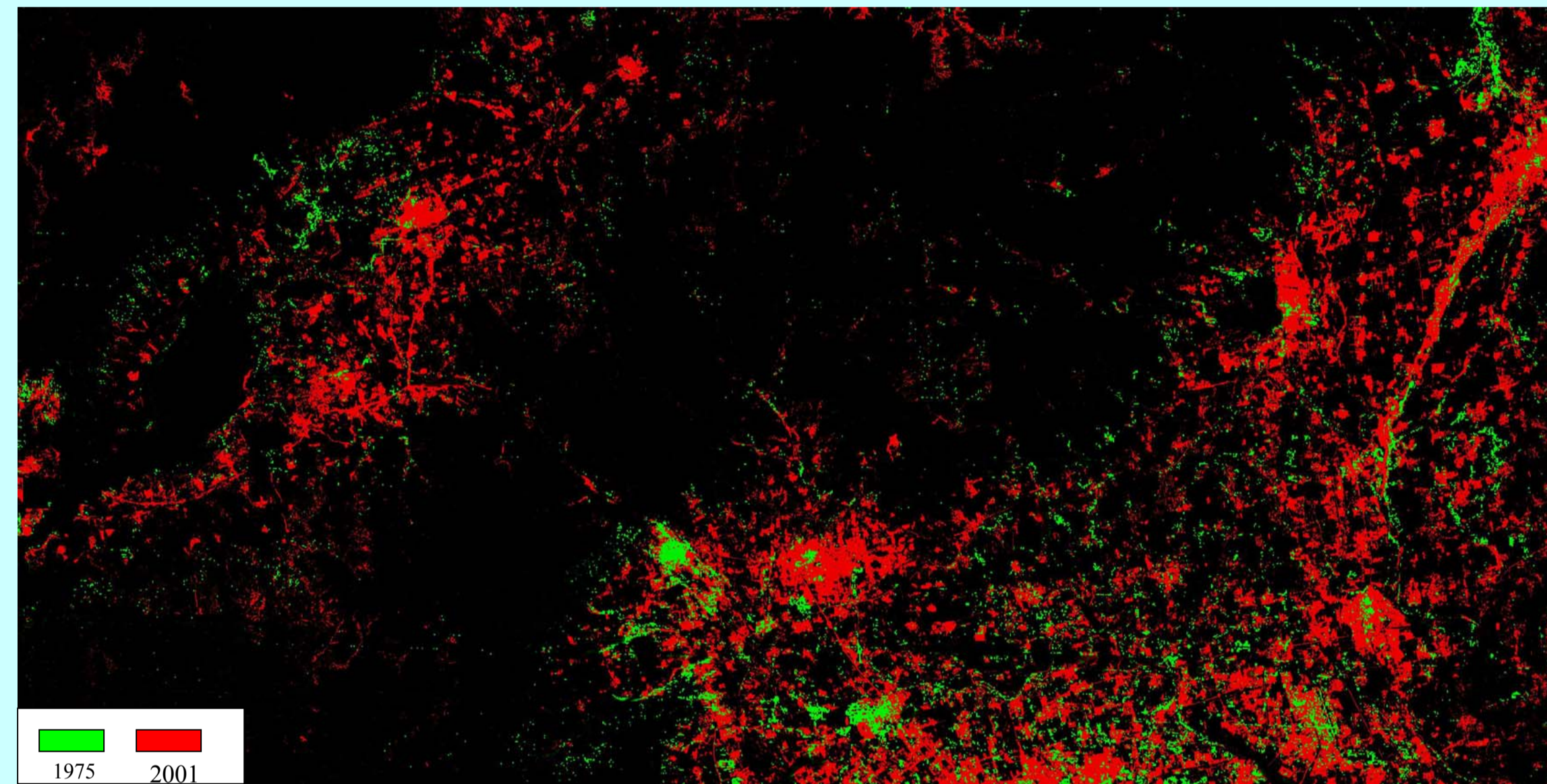


Landsat TM color composite of band 4,5 and 2 in RGB

Principle and processing procedure:

First, make the data of the two images have the same coordinate system by image to image register and form data set.

$$F(x, y) = \begin{bmatrix} G(x, y)_{1975} \\ G(x, y)_{2001} \end{bmatrix}$$



Result of man-made architecture change between 1975 and 2001

Second, Supervised classify the images by Maximum likelihood method.

Classification principle is:

$$L_k = P(k | x) = P(k) \times P(x | k) / \sum P(i) \times P(x | i)$$

There are seven types: forest, shrub, farm, sand area, bare area, water body

Outcome is as below table:

year/proportion	forest	shrub	farm	Man-made architecture area	sand area	bare area	Water body	unclassified area
1975	26.12%	21.07%	34.457%	3.120%	3.296%	6.172%	2.316%	3.5%
2001	32.05%	10.650%	32.9951%	11.487%	3.156%	3.538%	2.123%	4.01%

Through the table, we can find clearly the quantities variations of different land coverage types.

From this, we can see that land coverage has taken great place.

1. Man-made architecture area added to 22,300,000km² from original 60,000km²(202276x30m). The reasons are:
 - population expansion needs more and more residence space, so more and more farms are becoming residential area.
 - as the enhancement of living level, human's request to residence are enhanced.
 - floating population's increase also enhanced the residence request.

2. Forest area is increasing

The government has been paying much attention to the green project for many years. It enforces the measures such as sealing mountain, man-made forestation, to forest in recent years. Man-made forestation area was 218.6,000 km² just in Year 2000.

3. Area of Naked lands and sands is decreasing

Naked lands include wild hills, bottomland. In order to improve the environments in Beijing, the government has taken lots of measures such as naked hills' reclaim, explosion whole forestation, sands' alteration, to make wild hills become forestation.

VI can reflect vegetation types, vegetation growing status and the variations of vegetation types, which is an important parameter to the research of surface status. $NDVI = (NIR - RED) / (NIR + RED)$ in this, NIR: near infrared band, RED: red band. Calculate NDVI to The two images are as follows:

$$NDVI_{MSS} = (B7 - B5) / (B7 + B5)$$

$$NDVI_{TM} = (B4 - B3) / (B4 + B3)$$

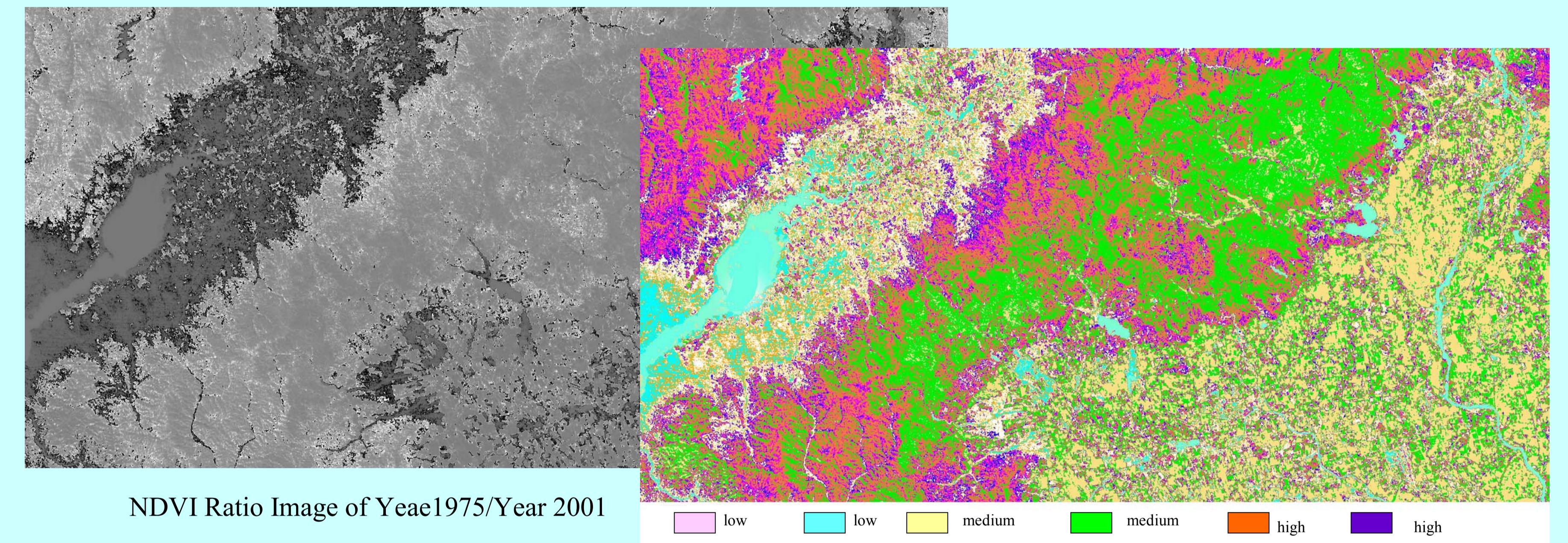
Influenced by climates, growing status of vegetation make NDVI different in the same period. Meanwhile, physical mechanism of remote sensors of MSS is different, which make their difference in spectra, space resolution and pixel's gray degree. In this case, the two NDVI images need to be amended. The method is:

Statistically compare the two NDVI images. Confirmed the stable area such as water body and select some of area as standard unchanged area, then calculate the average difference of the pixels.

$$\Delta d = \frac{\sum NDVI_{1975}(i)}{N} - \frac{\sum NDVI_{2001}(i)}{N}$$

We can produce two new NDVI images by Using Δd to amend the influence of VI. Then we divide the two images into a NDVI difference image.

$$DN(x, y) = \frac{NDVI_{2001}}{NDVI_{1975}}$$



NDVI Ratio Image of Year 1975/Year 2001

NDVI Ratio Graded Image

Outcome analysis:

- Density slice image of ratio is 6 grades, from low level to high level, that represent stable area to dramatic changed area. The edges of hill area belong to changed area, because they have the features of changed area, VI advanced and vegetation type transit to forest from shrub area.
- Green areas in middle hills represent the same forest areas of the two years. The change level belong medium, that represent forest cover density has little change.
- The ranges of farm in plains were not hardly changed in the ratio image, because some crops has different grow season. The level of farm can not represent vegetable status.

Conclusions:

We can get land's dynamical shift rules by surface status research using remote images of Year 1975 and Year 2001. We can also gain land covers' types of different years by Image division.

Comparing the two NDVI images, we can get the results of VI shift.

The two methods have the similar results.

For further research, we should consider the factors such as climates and social parameters.

Acknowledgment:

Thanks for the help to my research of my tutors Professor Liping Zhou and Professor Jing Li.