Study on development of citra satellite remote sensing for map updating studies

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Abstract. During the past 10 years, the city of Surabaya has experienced many changes in land use, especially land in East and West Surabaya where open land (rice fields, fields, ponds) has undergone a change to built up land, especially housing. The purpose of this study is to determine changes in land cover that occurred as a whole in the city of Surabaya from 2002 to 2014, to get the largest land cover changes that occurred in the East and West of the city of Surabaya. Multi-temporal satellite imagery method to determine changes in land cover that occurred as a whole in the city of Surabaya from 2002 to 2009. Results from the satellite classification of Landsat imagery data were analyzed using comparative analysis to obtain changes in built land cover, Green Open Space (GOS) and waters in the city of Surabaya. The classification method used is guided classification with object oriented. Study of Development of Remote Sensing Satellite Imagery for Updating Map Studies (Case Study: Surabaya City) requires the ability to apply and develop the results of research to be carried out for the benefit of society in general and the advancement of education in particular.

1. Introduction
Economic growth (economic growth) of the city of Surabaya has increased every year. Economic growth is one indicator to evaluate the development / progress of economic development in a region in a certain period. Gross Regional Domestic Product (GRDP) both at current prices and at constant prices reflects the output produced by people in a particular region, is one indicator that is often used to measure economic conditions and the level of economic growth of a region [1].

Road developments will facilitate accessibility between locations. So that locations that have new roads and have easier accessibility to reach other locations will increase the market value of land in the area [2]. Surabaya City's GRDP in 2006-2010 based on current prices and at constant prices can be seen in Table 1.

The results obtained, the change in urban type land cover with the results of the classification obtained from land cover [3]. The division of sub-districts in the city of Surabaya was 19 sub-districts in 1992 and became 28 sub-districts in 2001 and in 2008 increased to 31 sub-districts to date. This condition causes morphological changes in the shape of the East coast (Surabaya City RTRW 2007) [4,5]. This is evident from the occurrence of Surabaya City region expansion (Figure 1).

The results obtained, the change in urban type land cover with the results of the classification obtained from land cover Surabaya City Region is also growing, this is evident from the occurrence of Surabaya City region expansion.
Table 1. Surabaya city's GRDP in 2006-2010 at current price (in billions of rupiah).

| No | SECTOR                        | 2006   | 2007   | 2008   | 2009   | 2010   |
|----|-------------------------------|--------|--------|--------|--------|--------|
| 1  | Primer Sector                 |        |        |        |        |        |
|    | Agriculture                   | 145.01 | 145.57 | 135.78 | 165.89 | 178.30 |
|    | Mining and excavation         | 9.24   | 8.08   | 13.98  | 10.31  | 11.32  |
| 2  | Secondary Sector              |        |        |        |        |        |
|    | Processing industry           | 34,538.94 | 37,749.89 | 42,099.82 | 41,277.02 | 45,508.52 |
|    | Electricity, Gas and Clean Water Construction | 3,529.00 | 4,061.70 | 6,019.88 |
| 3  | Tertiary Sector               |        |        |        |        |        |
|    | Trade, Hotel, and Rest Area   | 41,754.61 | 46,608.32 | 54,734.88 | 76,354.51 | 88,851.24 |
|    | Transportation and communication | 10,187.85 | 11,430.33 | 11,997.22 | 17,099.70 | 20,230.54 |
|    | Finance, Rentals and Company Services | 6,733.65 | 7,231.42 | 7,975.34 | 10,879.17 | 12,388.90 |
|    | Services                      | 7,771.74 | 8,274.58 | 9,082.77 | 13,860.96 | 16,452.65 |
|    | Total GRDP                    | 112,926.94 | 124,347.23 | 141,490.68 | 178,558.96 | 205,161.46 |

Source: Surabaya in 2011 and KUA Surabaya in 2010

Figure 1. Surabaya city map.

2. Methods
This research was conducted with several stages of data processing. The initial stage of the data processing flow is carried out starting from data. The data used in this study are Landsat-7 Citra Satellite in 2002, 2008 and Landsat-8 in 2014. Citra composite, this process aims to do a combination of bands to identify certain appearance / true appearance in the field (true color).

Geometric correction. this process aims to change the position of the image in accordance with the actual coordinates on the surface of the earth [6]. In processing this geometric correction, Landsat-7 satellite imagery of 2002 uses 14 ground control points (GCP); Landsat-7 satellite imagery in 2008 using 12 Ground Control Points (GCP); and Landsat-8 satellite imagery in 2014 using 8 Ground Control Points
(GCP) with reference to the Rupa Bumi Indonesia (RBI) map [7]. Calculation of Root Mean Square Error resulting from this process on Landsat-7 satellite imagery in 2002 was 0.353, Landsat-7 satellite imagery in 2002 was 0.365, and Landsat-8 satellite imagery in 2014 was 0.225. This indicates that the geometric correction meets the requirement that the RMSerror must be less than equal to one [8] as shown in Figure 2.

![Figure 2](image)

Figure 2. Distribution of Ground Control Points (GCP), (a) Landsat-7 satellite imagery in 2002, (b) Landsat-7 satellite image in 2008, (c) Landsat-8 satellite image in 2014.

Landsat-7 satellite imagery in 2008 using 12 Ground Control Points (GCP); and Landsat-8 satellite imagery in 2014 using 8 Ground Control Points (GCP) with reference to the Rupa Bumi Indonesia (RBI) map.

3. Results and discussion

At this stage direct observation is used using GPS measurements obtained with UTM coordinates at each test point and their relationship to in situ land cover with high-resolution satellite imagery from 2014 [9]. Then obtained the table listed below, which compares the results of land cover classification from in situ with the results of Citra Satellite at the same object point [10].

The results obtained from the table almost 90% get the value according to in situ data, there is an error in the industrial area which is classified as an empty building, and the residential area is stated as the building area [11].

| No | X(m) UTM | Y(m) UTM | Land cover (in-situ) | Land cover (citra satelit) | Information                     |
|----|----------|----------|----------------------|-----------------------------|--------------------------------|
| 1  | 678770.102 | 9201853.605 | Pond                 | Pond                        | LPA Benowo Area                |
| 2  | 683579.453 | 9202709.829 | Pond                 | Pond                        | Teluk Lamong                   |
| 3  | 680591.341 | 9198781.236 | Open Field           | Open Field                  | Raya Sememi                    |
| 4  | 684495.745 | 9200668.248 | Industrial Area      | Building                    | Greges Area                    |
| 5  | 683959.456 | 9196248.090 | Settlement           | Building                    | Candi lontar                   |
| 6  | 687190.368 | 9200948.705 | Industrial Area      | Empty Land                  | Kalianak Area                  |
| 7  | 686887.087 | 9196721.702 | Settlement           | Building                    | Darmo Satelit Area             |
| 8  | 690145.243 | 9200614.714 | Settlement           | Building                    | Tanjung Sadari                 |
| 9  | 689147.145 | 9197425.730 | Dense Settlement     | Building                    | Simo Margorejo Area           |
| 10 | 678144.028 | 9199000.239 | Settlement and vegetation | Building                | Pakal Area                    |
| 11 | 687852.619 | 9191113.174 | Settlement and vegetation | Building                | Raya Menganti                 |
Table 2. Cont

| No | X(m) UTM | Y(m) UTM | Land cover (*in-situ*) | Land cover (citra satelit) | Information               |
|----|----------|----------|------------------------|----------------------------|--------------------------|
| 12 | 680395.785 | 9197064.887 | Settlement and vegetation | Building                | Raya Kanoman Kedung      |
| 13 | 683535.315 | 9193771.393 | Settlement and vegetation | Green Open Field | Lontarbaru/Pakuwon         |
| 14 | 688264.176 | 9194001.577 | Vegetation              | Green Open Field        | Satelit Toll Gate         |
| 15 | 686134.583 | 9194638.263 | Settlement              | Building                | HR Muhamad Area           |
| 16 | 682448.718 | 9192474.206 | Settlement              | Building                | Lidah Kulon Area          |
| 17 | 680450.670 | 9191346.411 | Open Field              | Empty Land              | Lakarsantri Area          |
| 18 | 684793.326 | 9191722.394 | Settlement              | Building                | Randengsari Area          |
| 19 | 683378.294 | 9189842.376 | Settlement              | Building                | Bangkingan Area           |
| 20 | 682352.557 | 9191114.074 | Settlement and Green Open Field | Building | Lidah Kulon Homestead |
| 21 | 685336.210 | 9189599.235 | Green Open Field        | Building                | Raya Klumprik Area        |
| 22 | 686801.865 | 9187899.483 | Green Open Field        | Building                | Mastrip raya Area         |
| 23 | 684093.145 | 9187201.172 | Settlement              | Building                | Mastrip Area              |

Source: researchers’ processed data.

The area is obtained from the estimation of the area calculation from the results of the classification of remote sensing satellite imagery, where the total pixels of each land cover class are multiplied by the resolution of the satellite imagery used. In this case Landsat satellite imagery is used, so the resolution of satellite imagery used in the area calculation process is 30 m x 30 m [12]. From figure 3 we can see changes in land cover for three years in a row (2002, 2008 and 2014).

Figure 3. Graph of changes in multitemporal land cover area.

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4. Conclusion
From the classification results obtained the extent of each type of land cover in 2002, 2008 and 2014. The area of land cover class in the city of Surabaya from 2002 to 2014 changed functions significantly. The change in function is caused by the dynamics and activities of the city which is very high, spurring the development of a very fast city and increasingly dense population growth.

References
[1] Danoedoro P 1996 Digital image processing, theory and application in remote sensing Yogyakarta Fac. Geogr. Gadjah Mada Univ.
[2] Luo P, Shen D, Mi H, Kong X and Wang J 2009 Stiffness Reduction Factor of Reinforced Concrete Bridge Pier Considering Characters of Nonlinear ICCTP 2009: Critical Issues In Transportation Systems Planning, Development, and Management pp 1–8
[3] Lillesand T, Kiefer R W and Chipman J 2015 Remote sensing and image interpretation (John Wiley & Sons)
[4] Lukitasari 2009 Evaluation of Changes in Land Cover of East Surabaya Coastal Area Using SPOT-4 Multi Spectral Image and LPI Map (Indonesian Coastal Environment) 1983 (Surabaya: Sepuluh November Institute of Technology)
[5] Surabaya City's GRDP in 2006-2010 in economic conditions and economic growth rates
[6] Regulation M P W 2011 No. 20 of 2011 regarding Guidelines for the Preparation of Detailed Spatial Planning and District Zoning Regulations
[7] Prahasta E 2005 Geographic Information System: Basic Concepts (Geodesy & Geomatical Perspectives) Publ. Informatics, Bandung
[8] Purwadhi S H 2001 Interpretation of Digital Imagery Jakarta: Grasindo
[9] Sutanto 1987 Remote sensing volume I Yogyakarta: Gadjah Mada University Press
[10] Hariyanto T 2011 Use of High Resolution Citra Satellite for Classification Land Cover Institut Teknologi Sepuluh Nopember Surabaya.
[11] Indonesia L R 2007 Number 23 of 2007 concerning Railways
[12] Indonesia L R 2007 Number 26 of 2007 concerning Spatial Planning