

INDONESIA CONTRIBUTIONS IN ALOS PROJECT

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ABSTRACT:

International Cooperation and Technology Transfer will be well done by Indonesia participation in ALOS Project through some research topics. Highlighted in this paper is preparation to research in topographic map production using ALOS data, which should contribute to the know-how of ALOS integrated mapping system. Three experiments will be taken to benchmark the ALOS data, so that some technological and financial effort of ALOS data-usage will be well known. The first experiment is topomap production of rural area of Bogor using PRISM and AVNIR. The second experiment should be topomap production and 3D-city model generation of the Jakarta metropolitan area using PRISM, AVNIR and PALSAR data. The third experiment should be topomap production in cloudy jungle and mountainous area in for East Kalimantan and Papua using AVNIR and PALSAR. A complete workflow and working schedule will be also presented.

1. INTRODUCTION TO ALOS PROJECT

The mapping satellite ALOS of Japan is launched on January 24, 2006. The ALOS mission has three sensors in single platform: Panchromatic Remote-sensing Instruments for Stereo Mapping (PRISM), to measure precise land elevation, Advanced Visible and Near Infrared Radiometer type 2 (AVNIR-2), which observes what covers land surfaces, and Phased Array type L-band Synthetic Aperture Radar (PALSAR), which enables day-and-night and all-weather land observation

Since two years before, JAXA has invited Indonesia to participate in the research using coming ALOS data. The National Institute of Aeronautics and Space of The Republic of Indonesia (LAPAN) is the liaison for JAXA and coordinator for the whole Indonesian partners. LAPAN is recently responsible for all remote sensing technology. Table 1 shows the participating institutes and their research topics:

The research topic carried out by BAKOSURTANAL is the most challenged one since it will be the comprehensive test for the main purposes of ALOS, i.e. mapping! Mapping or map updating, especially in rapid physical developed metropolitan with a lot of buildings or in ever-cloudy forest area, is always complicated, expensive, and the suitable technology is not always available. ALOS with combination of several sensors shall answer the challenges. In the other side, the capacity of integrated platform for several sensors in ALOS should be tested comprehensively, especially in topographic map production with more concerned in geometrical aspect.

1	Indonesian soil research Institute (ISORI), Soil and Agroclimate R&D, Ministry of Agriculture	Assessment of Land Degradation and Mass Movement using ALOS Satellite Data
2	Geology Development and Research Center, Ministry of Energy and Mineral Natural Resources	Modeling For Natural Resources Mapping
3	National Coordinating Agency for Surveying and Mapping (BAKOSURTANAL)	Topographic Map Production using ALOS Data; Benchmark test in urban area of Jakarta, rural area of Bogor and cloudy-forest area of Kalimantan/Papua
4	Center for Remote Sensing and Ocean Sciences (CreSos)	Development of Algorithms for Coastal Zone Management and Vessels Monitoring using ALOS Data
5	Regional Development Study Center, Bogor Agriculture University and GIS & RS Center of Aceh Syiah Kuala University	Land Use, Land Cover and Terrain Changes in Nanggroe Aceh Darussalam, Indonesia
6	Center for Forestry Mapping, Ministry of Forestry	Application of ALOS Satellite Imagery for Indonesian Forest Resources Monitoring

Table 1. Participating Institutes and their research topics

Participating Institutes	Research Topics
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2. TOPOGRAPHIC MAP PRODUCTION

Three experiments will be taken to benchmark the ALOS data, so that some technological and financial effort of ALOS data-usage will be well known.

Benchmark sites will be rural area of Bogor, urban area of Jakarta, and selected forest area of East Kalimantan or Papua. In these areas there are some data to compare: topographic map, GPS ground control point and some aerial photographs.

The first experiment should be taken for Bogor area. The big area of Bogor is in larger part rural and the water-catchment's area of the capital Jakarta with a midsize city in its center. PRISM and AVNIR data should give an up-to-date topographic map of scale 1:25.000, which accuracy could be comparable to one made at year 2000 based on 1:30.000 aerial photograph added with some SPOT-image and field survey. The area is a good representation of typical Indonesian mixture (mountainous area – plain area, midsize city and rural area). The test result will give the recommendation about the usage of ALOS for typical middle scale topographic map production.

2.1. Topomap of Typical Rural Area

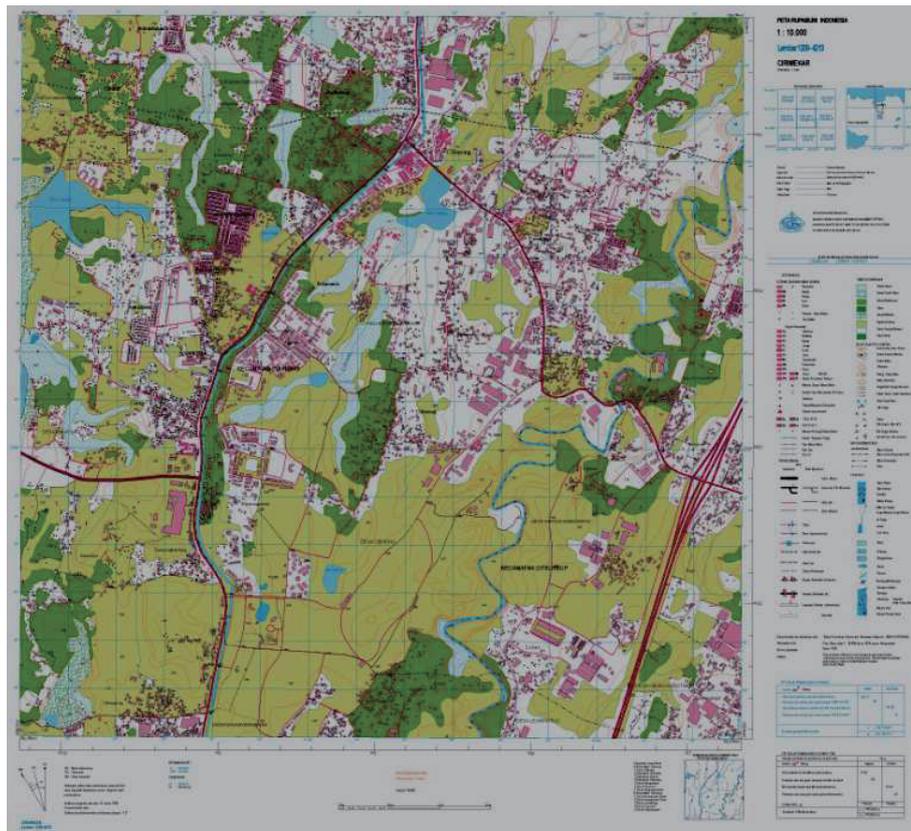


Fig. 1. Typical Indonesian topographic map made by photogrammetry
(© Bakosurtanal)

2.2. Topomap & 3D-City Model of Metropolitan Area

The second experiment should be taken for Jakarta area. This Indonesian capital has a lot of skyscrapers and dense settlement, which is growing rapidly. The city has also coastal area, which is in change. An up-to-date map of scale 1:25.000 should be made using PRISM and AVNIR. The new 3D-city model should be also made using PRISM and PALSAR data. We will compare these two sensors, and compare also with the old 3D-city model made by analytical photogrammetry. The capacity of AVNIR data to detect the material of the objects should be tested. The 3D-model has broadly application, e.g. cellular telecommunication planning, environmental study and fire-protection optimisation.

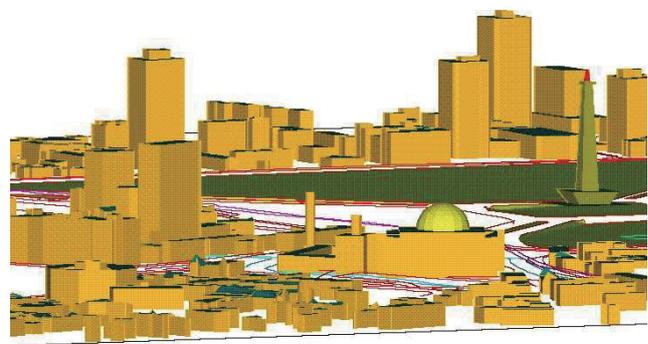


Fig. 2. Prototype of 3D city model made by photogrammetry
(© Bakosurtanal)

2.3. Topomap of Cloudy, Forest and Mountainous Area

The third experiment should be production of topographic map 1:50.000 for a selected area in East Kalimantan and/or Papua where the larger area are dominated by forest and the sky is oftener cloudy. In East Kalimantan, the benchmark could be the existing topographic maps made by photogrammetry and additional data from airborne interferometric SAR, SRTM, LANDSAT-TM and ASTER. In Papua, the benchmark could be only DEM of SRTM or older map produced by Indonesian Army (DITOP-AD). The area is a good representation of ever-cloudy area. East Kalimantan (Berau County) would be good representation of jungle in plain and marsh area, while Papua (Timika County) is good representation of jungle in mountainous area. In all test area, there are enough GPS Ground Control Points already. Definitive area should be selected after a complete path-row-index of ALOS received.

Topographic map will be made by using PRISM + AVNIR (for Bogor & Jakarta 1:25.000) and by using PALSAR + AVNIR (for Berau and Timika 1:50.000). A softcopy photogrammetry system will be used to processed PRISM and PALSAR data to generate the Digital Terrain Model (DTM). The DTM will be used further to generate the contour line. For 3D-city modeling, the DTM will be further modeled to generate the solid raster 3D-building model. This model is later compared with rasterized existing 3D-city model (in vector format)

The other part of topographic map (layer river, coastline, roads, settlement and vegetation) will be vectorized from AVNIR data. For land cover, a previous unsupervised classification could improve the process. The combination of this planimetric detail and contour line built the manuscript map. For the real map, addition information for administrative boundaries, building identifications, street classes and geographical names must be collected from field check or authoritative institution, but for this research unnecessary.

3. METHODS

The hypotheses of the research should be: (1) ALOS data can be used to the objective with certain requirements; (2) The accuracy is nearly closed the benchmark data.

The general approach is in the following flowchart:

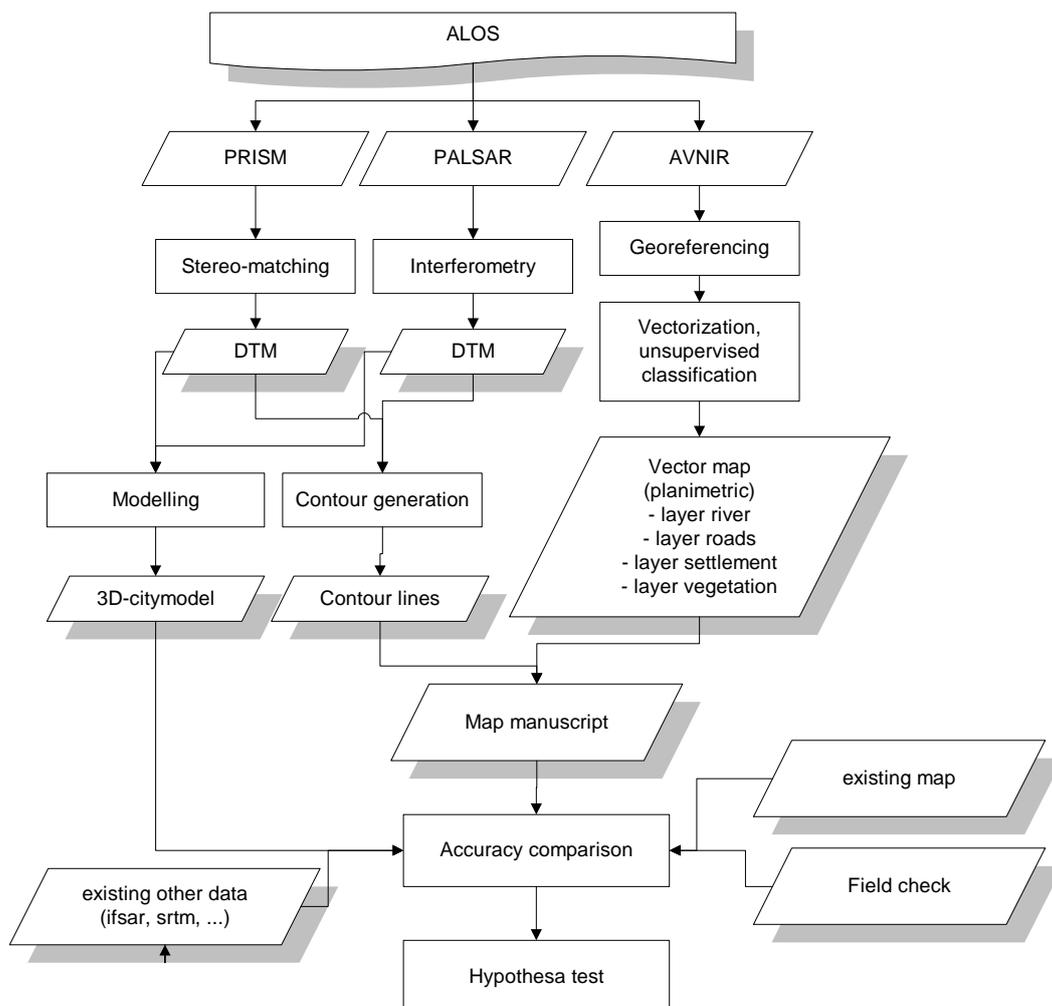


Fig. 3. Flowchart of the research method

4. DATA BENCHMARKING

Lastly, the result could be benchmarked with the existing map and with the reality (in case that there is change in nature). Twenty good distributed objects location would be selected and tested. The result would be classified as “good” if the 90% of the objects have the differences less than 0.2 mm to the map scale (horizontal) and 0.3 of the contour interval (vertical). For DEM, a comprehensive benchmarking will be done using DEM-subtraction. The figures-4 show a test done for benchmarking of DEM from Interferometric SAR data to DEM from photogrammetry.

Benchmark will be also done for the working efforts, manpower, time and costs. Production line with ALOS should be not only technologically possible but also economically feasible.

The research will contribute to the geospatial world about the benefit of ALOS data. For the area of research: In Bogor, planer (agriculture, environment and hydrology) will have an up-to-date map, which should support the function of Bogor as buffer area of Jakarta. In Jakarta, planer (urban planer, cellular telecom planer) will have an up-to-date map and 3D-city model which reduce the cost of all building-project. In East Kalimantan or Papua, planer (regional, forest, mining, environment) will have an up-to-date spatial data – partially for first time, especially in the area where cloudy will be “never” opened.

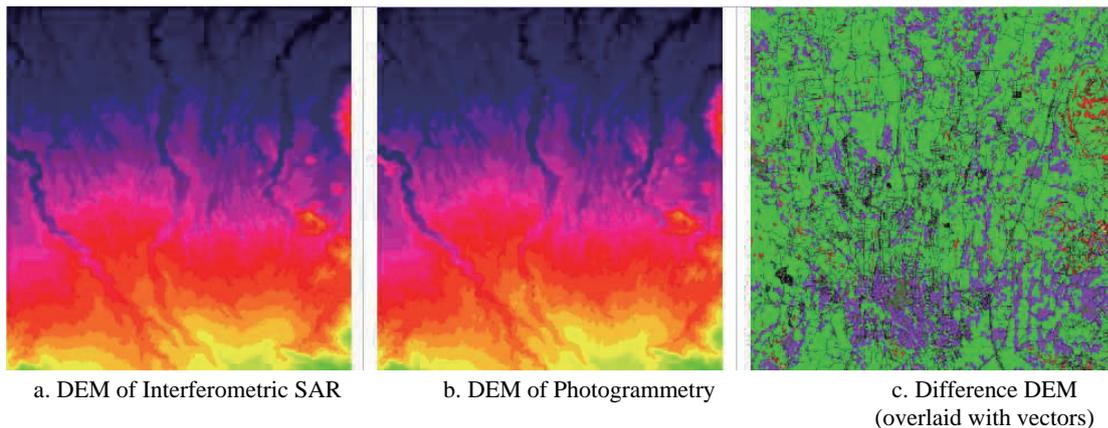


Fig. 4. Comparison of DEM (here in color coding)

The project is projected for three years with one-year preparation (2005), depend on the availability of the real ALOS data (after succeed with simulated data), the progress in data processing and the condition for field check. Part of work phases will be done sequentially, and part others will be done in parallel. Fig 5 is the tentative schedule up to 2008.

CONCLUSION

The research will give the geospatial world the real experience and know-how of using ALOS data in topographical map production and other usages. The project should be good example for International cooperation and technology transfer, which significantly contribute to the photogrammetry and remote sensing society.

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Workphase	
Preparation:	2005
Workshop / training	Early 2006
Data collecting & processing of simulated data	Early 2006
Data collecting (real ALOS data)	Late 2006
Data collecting (benchmark data)	Late 2006
DEM processing (stereo matching PRISM)	Early 2007
DEM processing (interferometry PALSAR)	Early 2007
DEM processing (DEM editing)	Mid 2007
DEM processing (contour generation)	Mid 2007
DEM procesing (3D City Modeling)	Late 2007
Georeferencing of AVNIR	Mid 2007
Unsupervised classification AVNIR	Mid 2007
Vectorization avnir	Mid 2007
Map manuscript production	Late 2007
Comparison with field data	Early 2008

Fig. 5. Tentative Schedule up to 2008