

# Utilization of SAR Data for Baseline Environmental Studies of Central Cebu Island, Philippines – Phase 1

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**Abstract:** The Remote Sensing Group of the Mines and Geosciences Bureau (MGB) has acquired SAR data of the Central Cebu Island for its research study area. The MGB is one of the proponent of DOST-NASA PACRIM II Project, which is composed of eleven (11) agencies and institutions in the Philippines, that focuses on the scientific application of radar data with the theme on hazard and natural resources management. The PACRIM II Project, being done on three-year term, is slated for completion in the year 2004. The main thrust of the project study of the MGB is the baseline environmental monitoring studies, on which the data are to be fused with some other available data from LandSAT and photogrammetry. The generated data is part of the information for the update of thematic mapping being done. The 12 x 60 km swath AirSAR data covers the Central Cebu Island. The highlights of conducting this research project are: Extent of Watershed Basin boundaries – identification of the tributaries that drain water supply to the metropolitan area; Monitoring of the mountain highways – identification of landslide risk prone sites as part of natural hazard monitoring on a national highway that cuts along the mountainous areas; and Coastline change assessment – monitoring the coastline activities relative to the rapid urbanization and exposure as part of coastal management. The Phase 1 of this report discusses the fusion with the ArcView generated data as baseline studies on the monitoring activities.

**Keywords:** AirSAR, radar, environment

## 1.0 DESCRIPTION OF THE STUDY

The theme of Phase 1 study is to extract information on the physical environment features of central Cebu Island for monitor using the remote sensing satellite data. One of the objectives is generation of data as a result of data fusion from the ArcView archive and the 1996 Cebu AirSAR data (center lat: 10.13, center lon:123.64 ) and to clarify the benefits of satellite data for monitoring the area. The generated data would then be used as an initial set-up together with the coming 2000 AirSAR data to analyze and track changes in the physical environments.

**TABLE 1 – RADAR**

Bands	L-band (25 cm), and P-band (68 cm)
Radar Altitude & Velocity	9258.6 m at 250 meters/sec.
Slant range / Azimuth resolution	5.5 m / 9.2 m
TOPSAR mode	L and P-band topographic (HH, VV and HV) + full total power; 10 bands
Incidence angle	45 – 55 degrees along site center line
Typical dimension / Platform	60 km x 10 km / Airborne

## 2.0 DESCRIPTION OF THE AREA

Central Cebu is a moderate geo-anticline in the midst of Visayan Sea Basin. The main physiographic features are due to crustal uplift and deformation. Main tectonic axis coincides with the NNE elongation of the island. Two normal structures run in NE direction, dips SE, as contact points of differing rock types/formations. The trend of most fold axes coincides with faults.

**TABLE 2 - DESCRIPTION**

Rock Type	Description	Occurrence	% Area
Carcar Formation	coralline limestone	Peaks, hills, dales	39.87%
Barili Formation	Marl, massive limestone	Peaks, hills, dales, karst	35.40%
Quaternary Alluvium	Stream deposits	Alluvial plains, riverbeds, coastline	13.63%
Mananga Group	Metasediments, metavolcanics	Basement, surface valley	4.57%
Toledo Formation	Sandstone, shale	Mountain flanks, caps	1.67%
Cebu Formation	Limestone, sandstone, shale conglomerate	Mountain flanks, caps	1.25%
Malubog Formation	Mudstone, coal seam, shale sandstone	Mountain & plain flanks, caps	1.18%
Maingit Formation	sandstone, shale	plain flanks	0.78%
Lutopan Diorite	intrusive	rugged mountains	0.64%
Pandan Formation	Metasediments, metavolcanics	Mountain flanks	0.47%
Baye Andesite	volcanics	rugged mountains	0.30%
Linut-od Formation	limestone	hills, mounds, karst	0.17%
Serpentinite Peridotite	Serpentinite, peridotite	Basement, lens bodies	0.03%
Lutak Hill Formation	limestone	hills, mounds, karst	0.03%

**TABLE 3 - SLOPE and EROSION**

Gradient	Elevation	Characteristic	% Area	Erosion Type	% Area
0-18%	0-100 m	Level to undulating	13.38%	No apparent erosion	9.06%
8-18%	100 – 200 m	Undulating to rolling	8.97%	Slightly eroded	0.56%
18-30%	200 – 500 m	Rolling to hilly	61.36%	Moderately eroded	19.33%
30-50%	500 – 700 m	Hilly to mountainous	16.22%	Severely eroded	65.69%
50%>	700 – 1000 m	Very steep	0.13%	Very severely eroded	5.36%

### 3.0 IDENTIFICATION OF SUBJECTS

1. Watershed Boundaries – The only identified watershed is the Cebu National Park sited at the valley low rolling hills (center lat: 10.133, center lon: 123.6). The approach is to enhance the data by discriminating the pixels with sets of hierarchial classifiers. The vegetated boundary is to be separated from the clear cut areas (1<sup>st</sup> level) and primary vegetation is to be separated from the secondary vegetation (2<sup>nd</sup> level). Further studies are to be made on the drainage system on their water bearing capacity. The study is to come up a matrix system that would be applicable in illustrating the subject over time.

2. Mountain highways – The NE of swath data wherein Cebu Transcentral road cuts the mountainous area and considered as risk zones prone to landslides (center lat: 10.283; center lon:123.816 ). The study is to generate DEM, identify risk portions of mass movements as based on geologic database system and create classification of risk vulnerability.

3. Coastline change assessment – Monitoring the thriving fishport Alcantara coastline area, an inlet south of swath data (center lat: 9.966, center lon: 123.283) for its coastal activities relative to the rapid urbanization and exposure as part of coastal management. The Alcantara river drains its water and other

stream loads. The site is very good to study alluvial deposit dispersion that builds up on the estuary over time. The study is to adopt methods of classifying, filtering and discriminating the different materials, and analysis of change in shoreline using the updated radar data by overlay. A series of thematic maps will be done coupled with the already existing database.

#### **4.0 ACKNOWLEDGMENT**

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#### **5.0 REFERENCES**

Socio-economic Profiling and Environmental Study of the Four Protected Areas in Cebu Island. Vol. 1 General topics and Vol. 2 Water resources profile. University of San Carlos – Water Resources Center (USC-WRC).

Mines and Geosciences Bureau (MGB), 1997. Geology of the Philippines, Unedited version.

Bureau of Mines and Geosciences (BMG), Ministry of Natural Resources, 1986. Geology and Mineral Resources of the Philippines, 2<sup>nd</sup> Edition, Volume 1, Geology.

ENVI Version 3.0 User's Guide, December 1997.

1996 Cebu Map Data. ArcView GIS Version 3.2, 1999. Environmental System's Research, Inc.