DETERMINATION OF INFILTRATION RATE IN TROPICAL WATERSHED USING REMOTE SENSING AND HYDROLOGICAL MODEL

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ABSTRACT: The rate of infiltration is determined as the amount of water per surface area and time unit that penetrate the soil. Information about the rate of infiltration is important indication concerning: the efficiency of irrigation and drainage, optimizing the availability of water for plants, improving the yield of crops and minimizing erosion. The aim of this study is to analyse the capability of using ALOS/PALSAR remote sensing data to determine the rate of infiltration in a tropical watershed. For this purpose, the Green-Ampt hydrological model is used and backscatter coefficient ($\sigma°$) of ALOS/PALSAR data as a function of soil moisture is one of the main input parameter in this hydrological model. Other parameters such as hydraulic conductivity (Ks), soil porosity, and wetting front suction head (Ψf) are determined from field measurement in the study area.

1. INTRODUCTION

Malaysia is one of the tropical countries that receive very high intensity of rainfall each year with about 2000 mm to 2500 mm per year. High intensity of rainfall will increase infiltration rate and surplus water will either absorbed into the soil or become runoff that closely related to the flood occurrence (Taylor *et al.,* 2008). Floods are natural disasters that frequently hit Malaysia every year during monsoon season. As reported by Malaysian Drainage and Irrigation Department (DID Malaysia), year 2006 has create a history in Malaysia when the worst ever floods occur at Batu Pahat (Hua, 2008).

The study of infiltration can lead to the runoff element that causing flood event. Therefore, the main objective of this study is to determine the spatial variability of infiltration rate around the area of Bekok and Batu Pahat catchment. Other than infiltration, this study is also focusing on soil moisture since it was the main input parameter in the hydrology model which is Green-Ampt model. Soil moisture is very crucial and important to be known before the infiltration measurement can be done.

The Green-Ampt model is a theoretical infiltration capacity based on Darcy's law where the wetting front is assumed to decent with time (Sugimoto, 2008). Remote sensing technology can provide some input data in this model which is soil moisture data. The soil moisture data can be determined from PALSAR data which is an active remote sensing sensor from ALOS satellite. Since remote sensing dealing with large scene and area, the used of satellite sensors with complete coverage of the Earth's surface in this study is more applicable comparing with the conventional method which dealing with spatial variability, time consuming and costing (Paloscia *et al.,* 2005).

2. STUDY AREA

Study area that has been chosen in this study is the basin nearer the Bekok catchment that located in the mid-western part of the State of Johor (Figure 1). With latitudes 2.1132 N and longitudes 103.0867 E, the basin area is affected with seasonal northeast monsoon that coming from east cost of peninsular Malaysia with maximum rainfall amount between Novembers to January every year (MMD, 2009).
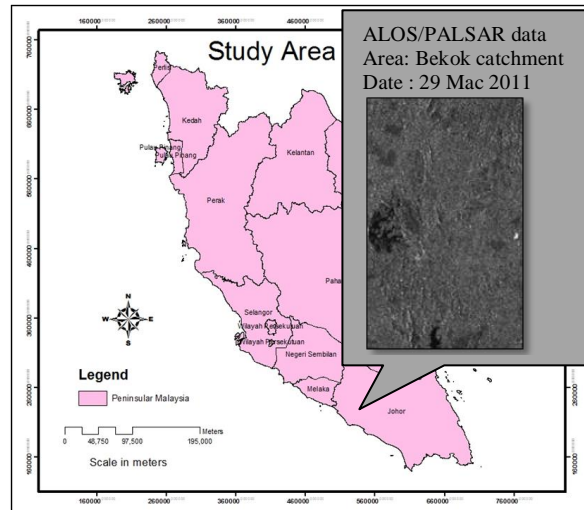
Figure 1: Location of the study area of Bekok catchment, Malaysia

3. DATA AND METHODOLOGY

Data and methodology applied in this study is remote sensing ALOS/PALSAR data, hydrological data and in-situ data. All the data is explained in details in the next section.

3.1 ALOS/PALSAR data

The ALOS data used in this study is Phased Array L-Band SAR (PALSAR) which is fully polarimetric instrument operates in L-band with 1270-Mhz (23.6 cm) center frequency and 14- and 28-MHz bandwidths. PALSAR is an active microwave with high spatial resolution and multi polarized sensor make it able to observe the earth surface even in cloud cover condition (ERSDAC, 2006 ; Tadono *et al.,* 2008).

Information accessible from SAR data such as PALSAR consist of backscattering coefficients, which shows the strength of microwave irradiation emitted from the antenna and returned after scattering on the surface of targeted bodies. Analysis of backscattering coefficient enables to estimate soil moisture, forest biomass, ocean wave and others (ERSDAC, 2006).

3.2 Soil Sampling and In-situ Infiltration Measurement

To validate the result of soil moisture obtained from ALOS/PALSAR data, some soil sampling is done to get the field value of soil moisture. The sampling method applied is a direct method which involves the soil sample collected and oven dried method.

To validate the infiltration rate from Green-Ampt model, in-situ infiltration measurement is done by using tension disk infiltrometer. All the field and in-situ measurement is done in the study site which is Bekok catchment.

3.3 Methodology

Flow chart of the methodology is illustrated in figure 1.2 below. The methodology consists of processing from satellite data, soil sampling from field work and in-situ infiltration measurement.
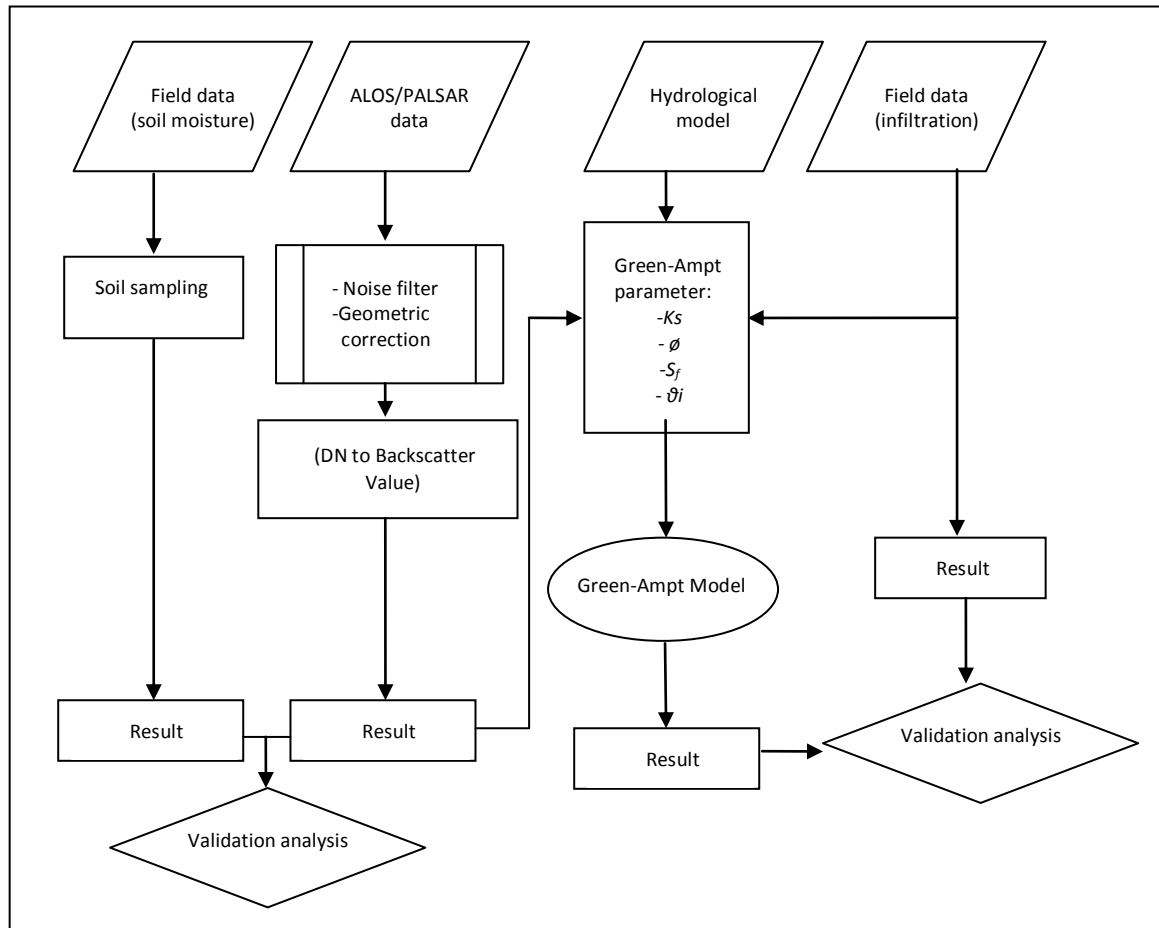
Figure 2: flow chart of Methodology

4. RESULT AND DISCUSSION

There are two result of this study which will be a map of soil moisture derived from ALOS/PALSAR data and a map of infiltration rate of study area which is in Bekok catchment. The soil moisture result from ALOS/PALSAR data is validating with field data and analysing with correlation analysis.

The second result is the variability of infiltration rate by using Green-Ampt model. The result in this study area is validating by doing some in-situ infiltration measurement. The correlation from both result which is from model and in-situ is analyse. All factors influence infiltration rate such as gravity, soil moisture, precipitation, soil particle, compaction surface, animals burrowing, vegetative cover, temperature and air entrapped in the soil (Singh, 1992) are discussed based on the result obtained.

Since this study is still in propose, no technical result and analysis produced to be discussed. The overall aim of this study is to analyse the capability of using ALOS/PALSAR remote sensing data to determine the rate of infiltration in a tropical watershed around Bekok catchment by using Green-Ampt hydrological model.

6. REFERENCES

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