The First Space-borne Precipitation Radar

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The goal of our research study was to evaluate the effect of soil moisture on rain intensity (i.e. precipitation rate), in order to more accurately estimate rain attenuation using precipitation radar.

At the end of 1997, a satellite called Tropical Rainfall Measuring Mission (TRMM) was launched with precipitation radar (PR). Generally, precipitation radar mounted on the ground emits a microwave pulse and observes the scattering of precipitation particles to quantitatively estimate rainfall intensity. Ground-based precipitation radars are widely used all over the world to forecast the weather. In spite of precipitation radar's long history, TRMM is the first case of precipitation radar in space. TRMM/PR can observe all the tropical area (within 35 degrees north/south of the equator) at least once per several days.

There are some technical differences between ground-based radars and TRMM/PR. TRMM/PR emits microwaves at higher frequency (13.8GHz) than general ground-based radars. By using a higher frequency, the spatial resolution is improved, but transmission interference by adsorption and scattering of raindrops weakens the signal; this interference is also known as *rainfall attenuation.* To correct estimation errors caused by rainfall attenuation, ground-based radar data is being collected. The basic strategy is as follows. Different from the precipitation, the land surface is stable in time. Therefore, the change in the scattering intensity between during rain period and during no-rain period can be attributed to the rainfall attenuation.

However, it is shown by our research that the scattering intensity on the land surface is sensitive to surface soil moisture content especially where the vegetation is sparse. The surface soil moisture estimation algorithm was developed out of the TRMM project, and helps to account for some of the variability when trying to predict rain attenuation. The above attenuation correction method does not explicitly consider the effects of soil moisture, even though the soil moisture content is probably greater during a rain period than during a no-rain period.

TRMM/PR will continue its observation over 7 years. Precipitation estimates are published and are available for various applications. As a successor of TRMM, Global Precipitation Measurement (GPM) project is now being prepared. Dual frequency Precipitation Radar (DPR) will be mounted on the core satellite for more accurate precipitation estimation.

Keywords:
Precipitation: Includes falling solid hydrometeors — hail, graupel (large hail with a diameter > 2 mm), and snow.

Rainfall attenuation: A phenomena that rain echoes in far ranges are often observed weakly because the microwave was attenuated by other rain echoes in near ranges. Rainfall attenuation is more severe in case of TRMM/PR which uses higher frequency of microwave compared with the case of ground-based radar.

Soil moisture: Water (content) in the soil. Soil moisture is provided by precipitation and will be evaporated into the atmosphere or run off to rivers. To know the soil moisture content quantitatively is very important in order to understand the water cycle over land.