Towards Improved Estimates of Global Cloud Fraction by Addressing Uncertainties Involved in Satellite Cloud Remote Sensing

Clouds are an integral part of the earth's atmosphere and play a crucial role in modulating earth's radiation budget and hydrological cycle. Currently, clouds contribute to the most considerable uncertainty in the estimated anthropogenic climate forcing. Accurate measurement of cloudiness or cloud fraction (CF) is the first and foremost requirement to minimize this significant uncertainty in the climate models. Since ground-based measurements cannot provide estimates of "true" CF, satellite remote sensing is the only tool to estimate the global distribution of CF. However, enormous disagreements in satellite-derived CF estimates for various reasons make it difficult to evaluate and improve climate models. While all sensors suffer from the resolution effect, particularly in the trade cumulus regions, those with a larger swath have an additional error due to the large view-angle. Different equator crossing times for sensors onboard the polar-orbiting satellites lead to differences in cloud climatology as they sample different phases of the diurnal cloud cycle. The sensors onboard geostationary satellites do not have this problem, but they suffer from the "resolution" and "view angle" effects. Some sensors are highly sensitive to thin cirrus, while others detect low clouds much better. Major causes for discrepancies among satellite derived CFs are summarized as (a) finite scale of cloud detection ('resolution effect'), (b) viewing geometry of sensors ('view angle effect'), (c) 'diurnal cycle' effect, and (d) 'instrument sensitivity and cloud detection methodology' effect. The only way to have a more realistic estimate of global CF is to minimize the uncertainties mentioned in satellite cloud remote sensing. In this thesis, the causes mentioned above for discrepancies in satellite cloud remote sensing have been addressed toward improved estimates of global cloud coverage.