

# **An improved approach for rainfall estimation over Indian summer monsoon region using Kalpana-1 data**

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## **Abstract**

In this paper, an improved Kalpana-1 infrared (IR) based rainfall estimation algorithm, specific to Indian summer monsoon region is presented. This algorithm comprises of two parts: (i) development of Kalpana-1 IR based rainfall estimation algorithm with improvement for orographic warm rain underestimation generally suffered by IR based rainfall estimation methods and (ii) cooling index to take care of the growth and decay of clouds and thereby improving the precipitation estimation.

In the first part, a power-law based regression relationship between cloud top temperature from Kalpana-1 IR channel and rainfall from Tropical Rainfall Measuring Mission (TRMM) – precipitation radar specific to the Indian region is developed. This algorithm tries to overcome the inherent orographic issues of the IR based rainfall estimation techniques. Over the windward sides of the Western Ghats, Himalayas and Arakan Yoma mountain chains, separate regression coefficients are generated to take care of the orographically produced warm rainfall. Generally global rainfall retrieval methods fail to detect the warm rainfall over these regions. Rain estimated over the orographic region is suitably blended with the rain retrieved over the entire domain comprising of the Indian monsoon region and parts of the Indian Ocean using another regression relationship. While blending, a smoothening function is applied to avoid rainfall artefacts and an elliptical weighting function is introduced for the purpose.

In the second part, a cooling index to distinguish rain/no-rain conditions is developed using Kalpana-1 IR data. The cooling index identifies the cloud growing/decaying regions using two consecutive half-hourly IR images of Kalpana-1 by assigning appropriate weights to growing and non-growing clouds. Intercomparison of estimated rainfall from the present algorithm with TRMM-3B42/3B43 precipitation products and Indian Meteorological Department (IMD) gridded rain gauge data are found to be encouraging. The advantages of the present algorithm are that it requires only two IR images as input without depending on other sources of information and simple to implement. The present algorithm performs better than the existing Kalpana-1 IR based rainfall estimation algorithm. Comparison with IMD rainfall data suggests that the underestimation of average rainfall has decreased by 30% for the present algorithm.