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Statistical characterisation of COSMO Sky-Med X-SAR retrieved precipitation fields by scale-invariance analysis

Roberto Deidda (1), Giuseppe Mascaro (1), Matteo Hellies (1), Luca Baldini (2), and Nicoletta Roberto (2)

(1) Universita di Cagliari, Dipartimento di Ingegneria Civile, Ambientale ed Architettura, Cagliari, Italy (rdeidda@unica.it, +39 070 675-5310), (2) CNR - Consiglio Nazionale delle Ricerche – Istituto di Scienze dell'Atmosfera e del Clima (ISAC), Via Fosso del Cavaliere 100, 00133 Roma

COSMO Sky-Med (CSK) is an important programme of the Italian Space Agency aiming at supporting environmental monitoring and management of exogenous, endogenous and anthropogenic risks through X-band Synthetic Aperture Radar (X-SAR) on board of 4 satellites forming a constellation. Most of typical SAR applications are focused on land or ocean observation. However, X-band SAR can be detect precipitation that results in a specific signature caused by the combination of attenuation of surface returns induced by precipitation and enhancement of backscattering determined by the hydrometeors in the SAR resolution volume. Within CSK programme, we conducted an intercomparison between the statistical properties of precipitation fields derived by CSK SARs and those derived by the CNR Polar 55C (C-band) ground based weather radar located in Rome (Italy).

This contribution presents main results of this research which was aimed at the robust characterisation of rainfall statistical properties across different scales by means of scale-invariance analysis and multifractal theory. The analysis was performed on a dataset of more two years of precipitation observations collected by the CNR Polar 55C radar and rainfall fields derived from available images collected by the CSK satellites during intense rainfall events.

Scale-invariance laws and multifractal properties were detected on the most intense rainfall events derived from the CNR Polar 55C radar for spatial scales from 4 km to 64 km.

The analysis on X-SAR retrieved rainfall fields, although based on few images, leaded to similar results and confirmed the existence of scale-invariance and multifractal properties for scales larger than 4 km. These outcomes encourage investigating SAR methodologies for future development of meteo-hydrological forecasting models based on multifractal theory.