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Wind drift effect on radar data through analysis of individual drop trajectories using 3D+1 innovative wind product

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Hydro-meteorologists and practitioners in charge of storm water management in complex areas such as cities or mountains are interested in high resolution space-time precipitation rainfall data, typically few hundreds of meters in space and few minutes in time. A crucial issue to get accurate data is the wind drift effect. Indeed, weather radars measure rainfall in altitude, and drops are advected by wind during their fall which affects the location of the measured field. This drift can be of few kilometres.

A recent study explored this issue through the simulation of individual drops trajectories in 3D space and time relying on: (i) an explicit numerical scheme to solve the non linear governing equations of rain drop's motion which relates the acceleration to the forces of gravity and buoyancy along with the drag force; (ii) a simplistic wind simulation approach relying on 100 Hz 3D sonic anemometer and scaling laws. Universal multifractals are used to quantify retrieved results. This physically based and mathematically robust framework has been extensively used to analyse and simulate geophysical fields extremely variable over wide range of space-time scales as wind and rainfall. Implementation of this model for drop trajectories enabled to show that multifractal features of input wind are retrieved also on drop velocities with an additional fractional integration. Large drops exhibit greater level of fractional integration. Simulating the fall of drops from an altitude of 1500 m, it was possible to show that for a strong wind event, drops located within a radar gate in altitude during 5 min are spread on the ground over an area of the size of a few kilometres which corresponds to numerous radar pixels. Furthermore drops of various sizes do not reach ground at same location.

In this study, the same numerical scheme is implemented using as space-time wind input a novel 3D product of Central Weather Agency, Taiwan. It provides vector wind over voxels of size approximately 1 km in horizontal direction, 500 meter in the vertical every 10 min. In a first step, trajectories of individual drops of various size and various initial locations are simulated. Multifractal features of simulated velocities are quantified and compared against expectations. Their spread over ground level is quantified as well as its evolution during the rainfall event. In a second step, these results are used to explore and interpret rainfall patterns observed on the 3D+1 available radar data. At last, consequences of these finds on the wind drift effect on radar rainfall data are discussed.

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Presenting Author

Auguste Gires

Email Address of Presenting Author

auguste.gires@enpc.fr

Affiliation of Presenting Author

Hydrologie Météorologie et Complexité, Ecole nationale des ponts et chaussées, Institut Polytechnique de Paris, Champs-sur-Marne, France

Address of Presenting Author

HM&Co École nationale des ponts et chaussées | Institut Polytechnique de Paris 6-8 avenue B. Pascal, Cité Descartes 77455 Marne-la-Vallée Cedex 02 France

Session

From Classical to Integrated Remote Sensing: New observation strategies for clouds and precipitation (multi-frequency, spectral polarimetry, multi-sensor)

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Authors: GIRES, Auguste (Hydrologie Météorologie et Complexité, Ecole nationale des ponts et chaussées, Institut Polytechnique de Paris, Champs-sur-Marne, France); WEI, Chi-Ling (Department of Civil Engineering, National Taiwan University, Taipei 10617, Taiwan); WANG, Li-Pen (Department of Civil Engineering, National Taiwan University, Taipei 10617, Taiwan); SCHERTZER, Daniel (Hydrologie Météorologie et Complexité, Ecole nationale des ponts et chaussées, Institut Polytechnique de Paris, Champs-sur-Marne, France); TCHIGUIRINSKAIA, Ioulia (Hydrologie Météorologie et Complexité, Ecole nationale des ponts et chaussées, Institut Polytechnique de Paris, Champs-sur-Marne, France)

Presenter: GIRES, Auguste (Hydrologie Météorologie et Complexité, Ecole nationale des ponts et chaussées, Institut Polytechnique de Paris, Champs-sur-Marne, France)