Parsivel雨滴譜儀及雨量筒風場模擬暨雨滴軌跡追蹤
A study of Parsivel and rain gauge flow simulations and raindrop trajectories

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摘　　要

當風通過障礙物時，氣流有一部分會受障礙物阻擋產生下切的氣流，也有一部分會向障礙物迎風面前緣上方及兩側繞流，並在障礙物迎風面邊緣產生角隅強風。實際上觀測儀器同樣會受到氣流的影響，使得量測的數值可能產生偏差，這情況也會出現在 Parsivel 雨滴譜儀及雨量筒等儀器上，在迎風面前緣上方會產生上升氣流，而這個上升氣流可能會使雨滴掉落的軌跡產生偏差，致使觀測數值受到影響。對 Parsivel 雨滴譜儀及雨量筒而言，風向不同時，影響的程度也會有所改變，因此風通過觀測儀器時產生的氣流使數據產生偏差，進而導致對降雨的量測是一項重要的課題。

本研究先透過 SketchUp 建立 parsivel 及雨量筒之 3D 模型，並使用計算流體力學(Computational Fluid Dynamics，CFD)之數值模擬，模擬不同風向及風速的風場在通過 Parsivel 及雨量筒後產生的擾流，接著透過模擬出的三維風場，並找出儀器感應面周圍的網格點，再使用 4 階的龍格-庫塔法進行雨滴掉落軌跡之追蹤，向上追蹤之該層高度並計算出其降雨面積，並探討不同風向、風速及雨滴粒徑大小對其降雨面積之差異性，再推算出 Parsivel 及雨量筒對於觀測數值產生的影響程度。其中模擬範圍的 XYZ 為 10m×10m×5m 網格解析度為 0.1m×0.1cm×0.1cm。

關鍵字：Parsivel、雨量筒、計算流體力學、scSTREAM、角隅流

Abstract

When the wind passes through an obstacle, part of the airflow will be blocked by the obstacle to produce upstream vortex, and part of the airflow will flow over and on both sides at the windward front edge of the obstacle, and generate a corner flow at the edge of the windward side of the obstacle. In reality, the airflow will be affected by the instrument which may cause deviations in the measurement. For Parsivel and rain gauge, this effect will change when the wind direction is different. This may lead to rainfall measurement bias.

In this study, we first established 3D models of Parsivel and rain gauge through SketchUp, and used computational fluid dynamics (Computational Fluid Dynamics, CFD) software to simulate the wind fields passing through Parsivel and rain gauge at different wind directions and speeds. In addition, we use the simulated wind field to compute the raindrop falling trajectories using the fourth-order Runge-Kutta method. Here we use the backward tracing to find the area where the raindrop was falling from to discuss the rainfall amount in term of the area. The XYZ of the simulation domain is 10m×10m×5m and the grid resolution is 0.1m×0.1cm×0.1cm.

Keywords: Parsivel、rain gauge、Computational Fluid Dynamics、scSTREAM、Corner flow