北海岸動力觀測與驗證實驗(NoCOVID21)暨臺灣區域豪雨觀測暨預報實驗(TAHOPE21)

Northern Coast Observation, Verification of Dynamics Experiment 2021 (NoCOVID21) & Taiwan-Area Heavy rain Observation and Prediction Experiment 2021 (TAHOPE21)

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摘　要

「臺灣區域豪雨觀測與預報實驗」(TAHOPE)為臺灣主導的大型國際觀測與預報實驗，預計執行三年(2019 年 8 月到 2022 年 7 月)，原本預定於 2020 年 5–8 月期間我方 TAHOPE 實驗團隊將與美國 PRECIP 實驗團隊、日本 T-PARCII 實驗團隊、及韓國 KPOP 實驗團隊等四國共同推動國際聯合觀測實驗，進行以臺灣區域為主體進行之國際聯合劇烈天氣(梅雨與颱風)的密集觀測實驗，所探討研究主題包含大尺度的環境影響、中尺度的對流系統與登陸颱風、乃至小尺度的雲微物理過程等，在臺灣海島與高山陡坡特殊地形下，透過大氣密集觀測導入先進大氣預報模式，同時進行即時或準即時之資料同化與數值預報。後來因為 2020 年 2 月後全球爆發的新冠肺炎(COVID-19)疫情影響，密集觀測延後至 2021 年 5–8 月間進行; 然而 2021 年全球新冠肺炎疫情依然嚴峻，所以國際聯合觀測實驗決定再延後至 2022 年 5–7 月間進行。

TAHOPE 實驗團隊與中央大學團隊決定於 2021 年 5–6 月梅雨季期間進行小型的密集觀測實驗(Intense Operational Period; IOP)，實驗正式名稱為「北海岸動力觀測與驗證實驗(NoCOVID21)」暨「臺灣區域豪雨觀測與預報實驗(TAHOPE21)」，此觀測實驗主要科學目的是要獲得梅雨鋒面位於台灣北海岸區域的動力、熱力及水氣場之中小尺度結構。在實驗操作方面，一方面要為 2022 年的大型國際實驗做暖身練習，另一方面測試如何在疫情三期警戒期間做遠距線上的每日天氣簡報(online weather briefing)與觀測實驗決策(IOP decision making)。第一次密集觀測任務(IOP1)期間為 5 月 29 日 12 UTC 時到 5 月 30 日 12 UTC 時，此為 2021 年第一道梅雨鋒面接近台灣，為北台灣帶來劇烈降雨。在觀測方面，中央大學剖風儀(wind profiler)觀測到梅雨鋒面前方的地形導致低層噴流(topographically-induced low-level jet)，而且氣象局雷達回波圖看到對流胞符合平行風切方向往上游後方累積成長(back-building)的過程。第二次密集觀測任務(IOP2)期間為 6 月 4 日 06 UTC 時到 6 月 6 日 00 UTC 時，此為 2021 年第二道梅雨鋒面，而且在台灣南方海面有彩雲颱風接近，為全台帶來劇烈降雨。在觀測方面，6 月 4 日在北台灣下起劇烈午後雷陣雨，許多雨量站紀錄時雨量超過 100 mm/h，其中最大時雨量甚至高達 209 mm/h，造成台北市區多處淹水。雷達回波圖也有看到對流胞符合平行風切方向往上游後方累積成長(back-building)的過程，對流區近地面回波極值高達 55 dBZ。

關鍵字：NoCOVID21、TAHOPE21、梅雨、中尺度對流系統、午後對流

Abstract

"Taiwan-Area Heavy rain Observation and Prediction Experiment" (TAHOPE) will be conducted from August 2019 to September 2022 to study Mei-Yu fronts, mesoscale convective systems (MCSs), landfalling typhoons, and afternoon thunderstorms near Taiwan. During May to August 2021, our TAHOPE team will join the PRECIP (Prediction of Rainfall Extremes Campaign In the Pacific) team from the US, the T-PARCII team from Japan, and the KPOP team from Korea to conduct the joint international field experiment for severe weather (Mei-yu fronts and typhoons) in the vicinity of Taiwan. The main themes of TAHOPE project range from large-scale environmental influence, mesoscale convective systems as well as microscale cloud physics processes, under the special topography of Taiwan Island with steep terrain. Through the joint network of intense observations, real-time or near real-time data assimilation and prediction will be conducted using advanced atmospheric models. Because of the outbreak of the COVID-19 pandemic, the intensive observation period (IOP) was first postponed to May to August 2021. However, the COVID-19 situation is still severe in 2021, so the international field campaign is delayed until May to July 2022.

For the Mei-Yu season in 2021, the TAHOPE team and the National Central University (NCU) radar team have decided to conduct a small-scale field experiment called "Northern Coast Observation, Verification of Dynamics Experiment 2021 (NoCOVID21) & Taiwan-Area Heavy rain Observation and Prediction Experiment 2021 (TAHOPE21)", in order to observe the mesoscale structure of dynamics, thermonamics, and moisture fields within the Mei-Yu fronts. The operational objectives of this experiments are two folds: the first one is to perform a pilot study before the large-scale international field campaign in 2022, and the second one is to test how to conduct an online weather briefing and make the IOP decision during the COVID-19 lockdown. Two IOPs have been conducted. The first IOP period is from 12 UTC 29 May to 12 UTC 30 May for the first Mei-Yu front event in Taiwan. The wind profiler data detected the topographically-induced low-level jet in northern Taiwan, and the radar data found the back-building features of convective cells persistently generated in the uptream of low-level shear vector in central Taiwan. The second IOP period is from 06 UTC 4 June to 00 UTC 6 June for the second Mei-Yu front with heavy rainfalls over the entrie Taiwan Island. In particular, severe afternoon thunderstorms occurred over northern Taiwan with intense rainfalls (several stations with rainrate > 100 mm/h and one station even with rainrate of 209 mm/h), which resulted in urban-scale flooding at Taipei City. Radar data also found back-building features of convective cells and the peak radar reflectivity can reach 55 dBZ near the surface.

Key words: NoCOVID21, TAHOPE21, Mei-Yu front, Meoscale Convective System, Afternoon Thunderstorms