Simulate Heavy Rainfall During 19th to 28th December 2014 Using WRF for Different Atmospheric Physics

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ABSTRACT

Quantitative Precipitation Estimation (QPE) plays an important role in predicting extreme rainfall events. Many scientific methods are using to estimate heavy rainfall event and common methods are using Doppler Weather Radar, Satellites and Numerical Weather Prediction. Different kind of numerical models are used for this purpose and Weather Research Forecasting (WRF ARW) is the commonly use numerical mode for the research community. Therefore many scientists are now engaging to investigate the possibility for estimating heavy rainfall events using WRF model.

Tuning up the model with various micro physics and cumulus parameters are the important parts of capturing the heavy rainfall. Different combinations of micro physics and cumulus parameters are now using and the Anthes-Kuo, Betts-Miller, Betts-Miller-Janjic (BMJ), Grell (GR) and the Kain-Fritsch scheme (KF) are better schemes according to many research.

This study was carried out to identify the suitable micro physics and cumulus parameters for Sri Lanka for the WRF model to estimate the heavy rainfall events. Heavy rainfall occurred during the period 18 to 27 December 2014, resulted in the worst flooding event in the island. To capture the event 6 experiments were carried out with the different combinations of micro physics and cumulus parameters for the WRF model.

Combinations of Kain–Fritsch, Betts–Miller–Janjic Cumulus parameters and Kessler, WSM5, WSM6 micro physics were used to identify the best combination to simulate the heavy rainfall event in December 2014. However, all the experiments underestimated the rainfall distribution on 25th December,which fairly widespread heavy rainfall occurred over most parts of the island except in the northern part of the island. During all 4 days (19, 20, 25, and 26 December 2014) EXP1 (Kessler and Kain–Fritsch), EXP3(WSM5 and Kain–Fritsch) and EXP6(WSM6 and Betts–Miller–Janjic) were able to capture the rainfall distribution occurred over northeast coastal areas and adjoining interior parts along the coastal belt, and north central and northwestern parts of the island, but those experiments were unable to capture rainfall distribution elsewhere. Part of the rainfall distribution, occurred outside the northeastern parts were able to capture by EXP2 (Kessler and Betts–Miller–Janjic) and EXP5 (MSM6 and Kain–Fritsch).

1 Introduction

The numerical prediction of extreme weather systems remains one of the most challenging problems in the field of meteorology. Most of the global models developed far generally underestimate the total rainfall produced in any heavy precipitation event, and also contain errors in terms of their prediction on the timing and location of the event. For a better prediction of flash floods, it is necessary to understand the dynamics and physics associated with isolated heavy precipitation and the dynamic features associated with thunderstorms and tornados etc. (Wang 2002; Lin et al. 2006; Lei et al 2008).