

Finding the Optimum Resolution, and Microphysics and Cumulus Parameterization Scheme Combinations for Numerical Weather Prediction Models in Northern Thailand: A First Step towards Aerosol and Chemical Weather Forecasting for Northern Thailand

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Weather forecasts dictate our daily activities and allow us to respond properly during extreme weather events. However, weather forecasts are never perfect, but differences with model output and with observations can be minimized. Discrepancies between meteorological observations and weather model outputs are often caused by resolution differences (point vs. grid comparisons) and by the parameterizations used in the model. Atmospheric model parameterization refers to substituting small-scale and complicated atmospheric processes by simplified ones. In order to make weather forecasts more accurate, one can either increase the model resolution or improve the parameterizations used. Increasing model resolution can simulate small-scale atmospheric processes better, but takes a longer simulation time. On the other hand, improving model parameterization schemes involve in-depth measurements, analysis and research on numerous atmospheric processes. However, one can find a combination of existing parameterization schemes that would minimize observation-model differences. It is therefore essential to ask the question, "What model resolution and parameterization scheme combinations at a particular location and at particular seasons produce model output that has the smallest difference with observations simulated at a reasonable amount of time?"

Northern Thailand is a meteorologically active and unstable region especially during the summer and monsoon months (e.g. intense thunderstorms, hail storms, etc). It is also where high concentrations of air pollutants occur during the dry months (e.g. haze). It is therefore essential to have model forecasts close to observations for this region to reduce the risk from weather and from air quality degradation. This study aims to find the optimum model resolution and parameterization scheme combinations at particular provinces in northern Thailand with available data during the wet and dry seasons that produces minimum differences with observations.

Nested model simulations are performed using the Weather Research and Forecasting (WRF) model (v. 3.6) ran in the High-Performance Computer (HPC) cluster of the National Astronomical Research Institute of Thailand (NARIT) for northern Thailand (2 km spatial resolution and hourly output), for the whole of Thailand (10 km spatial resolution and hourly output), and for the entire Southeast Asia (50 km spatial resolution and 3-hourly output). Combinations of the Lin et al., the WRF Single-Moment 5-class, the WRF Single-Moment 6-class and the WRF Double-Moment 6-class microphysics parameterization schemes, as well as the Kain-Fritsch, the Grell-Devenyi (GD) ensemble and the Grell 3D cumulus parameterization schemes would also be utilized to determine the optimum resolution and parameterization of the model when compared to observations. Meteorological data would come from selected weather stations in Chiang Mai, Chiang Rai and Lampang in northern Thailand from December 1-15, 2014 (cool dry season), from April 1-15, 2015 (warm dry season) and from August 1-15, 2015 (wet season).

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