

**VIETNAM INSTITUTE OF METEOROLOGY,
HYDROLOGY AND CLIMATE CHANGE**

SOCIALIST REPUBLIC OF VIET NAM
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**DOCTORAL THESIS INFORMATION WITH NEW SCIENTIFIC
CONTRIBUTION, THEORETICAL STUDY**

- 1. Dissertation title:** Assimilation Research of Satellite Data for Community Multiscale Air Quality Model (CMAQ) in Hanoi Area

Code: 9850101

Major: Resource and environment management

- 2. PhD Candidate:** Nguyen Hai Dong

Advisors: Assoc.Prof.Dr. Doan Ha Phong

Dr. Le Ngoc Cau

Training Institution: Viet Nam Institute of Meteorology, Hydrology, and Climate Change.

- 3. Introduction to the Dissertation:**

Air pollution is a tremendous problem faced by all countries in the world, the rapid rate of urbanization and industrial development which mean that a large amount of potentially hazardous waste being released into the atmosphere. As a result, air pollution affects human health and well-being, causes widespread damage to vegetation, crops, wildlife and the climate; depletes necessary natural resources for sustainable economic development.

Community Multi-scale Air Quality (CMAQ) is a modeling system capable of simulating complex atmospheric processes affecting variability, propagation, and deposition. The input data factor of the model plays a very important role, deciding on the accuracy of the simulation results and the air quality forecast output. Model inputs include meteorological factors such as

humidity, wind, temperature; air quality factors, topographical and overlay factors. The dissertation researches technical solutions to integrate satellite data on the basis of data assimilation method in order to build a set of input data for the CMAQ model for simulating and assessing air quality.

The mathematical basis of the Kalman filter is the algorithm that provides estimates of some unknown variable based on observed measurements over time, the measurements do not necessary to be the variables state themselves, but only need to related to them through a function that can be linearized. In meteorology, Kalman filters are widely used to improve the prediction of variables of interest.

Satellite data with the advantage of being used to evaluate air quality on a large scale at the same time through Aerosol Optical Depth (AOD) has been researched, processed, marked by the thesis. Besides, it also classified by atmosphere class and convert to the format in accordance with the input format of the WRFDA assimilation module in order to providing quality-assured input data for the assimilation process in the WRF model system.

The thesis has researched and applied The Local Ensemble Transform Kalman Filter (LETKF) with the 4DVAR data assimilation technique in the WRF weather forecasting and research model system to assimilate the AOD data. Which is a product of MODIS satellite images to create the best quality input data set for the WRF-CMAQ model system for simulating air quality in Hanoi and other areas.

The results of the dissertation have provided a scientific basis, a new method using satellite data in building a set of input data for the WRF-CMAQ model system for simulation and assessment of air quality. At the same time, the research has also built a process of assimilating satellite data for the CMAQ to create a tool for air quality assessment in Hanoi in particular and Vietnam in general.

4. New contributions of Dissertation:

- The research has applied the Kalman filter with a combination of localized variations in the WRFDA data assimilation system of the WRF

weather forecasting and research model, providing a scientific basis and a new method using satellite data to build a set of input data, significantly improving the initial state for the WRF-CMAQ model system in simulating and evaluating air quality, improving estimation accuracy and air quality forecast results for Hanoi area.

- This dissertation has built a process of assimilating AOD satellite data, providing input data for the CMAQ to air quality forecasting and monitor air pollution, which suitable to the conditions of Vietnam, especially meaningful for areas where monitoring stations have not been installed.

- The dissertaion has established a new method in air quality assessment through the comprehensive WRF-CMAQ model system for monitoring air pollution in Hanoi city and expanding for all provinces across the country.

Representative of Advisors

PhD Candidate



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Dr. Le Ngoc Cau



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