論 文 の 内 容 の 要 旨

論文題目　Modeling emission inventories for key sectors in Ho Chi Minh city, Vietnam
(ベトナム国ホーチミン市を対象とした主要部門からの排出インベントリのモデリング)

氏　名　グエン ティ クイン チャン

In developing countries, air pollution is worsening and not improving (in some cases getting even worse). The WHO said 98 percent of urban areas in “low- and middle-income countries” with populations of more than 100,000 fall shy of the group’s air quality standards. However, to combat with the degradation of air quality, a reliable and official information system about air pollution is crucial and vital. It becomes necessary to make use of all the scientific tools available for the management of the atmospheric environment. One of these tools is emission inventory. It can answer for the questions: What quantities of air pollutants are emitted and where do they come from? Emission inventories are now regarded as required tools for a wide range of environmental measures such as management of chemicals as well as the prevention of air pollution. In light of this fact it is important to update and compile the local emission inventories using available data so that the scientific background of effective policies and the input data for atmospheric transport and deposition models can be designed.

In this research I focused on compiling local emission inventory for one of two biggest cities in Vietnam – Ho Chi Minh city. I chose Ho Chi Minh city because Hanoi is influenced by the northeast monsoon and strong northeast wind currents in winter, that are believed to carry pollutants and dust from the vicinity in the northeast to Hanoi. Meanwhile, the relative independence of situation in HCMC on other adjacent sources facilitates the compiling local emission inventory. Deriving from these facts, my research question is to use different data sources, like statistics, remote sensing, air dispersion model, to answer: which emission sectors are the dominated ones influencing air quality in Ho Chi Minh city? How those sectors evolve along time? At this moment, how much pollutants they emit into the atmosphere in Ho Chi Minh city? When and where is the pollution the most severe?

To answer these research questions, I set three objectives: i) estimate the impact of

long-range transport biomass burning emission on local air quality in HCMC in pre monsoon season using air quality numerical simulations and remote sensing data, ii) model the evolution of main anthropogenic emission sectors in HCMC using remote sensing data and statistical data, iii) compile high temporal and spatial resolution vehicle EI in HCMC by modelled traffic flow data.

To achieve above objectives, local statistical data, several remote sensing datasets, global emission inventories, air dispersion model were used in this research. Firstly, the impact of biomass burning (BB) emission in the vicinity on air quality in Ho Chi Minh city was assessed using the Weather Research and Forecasting model coupled with Chemistry – WRF Chem and remote sensing data as complementary approach. The simulations showed little influence of BB on local air quality in HCMC. However, when comparing with in situ data and AOD product from MODIS, the uncertainties of WRF Chem output was revealed. So we supported our finding by satellite images analysis, including FRP data, burn area product, AOD and simulations of HYSPLIT Trajectory Model. The conclusion of this part is BB is not key emission sector that can strongly impact on air pollution in HCMC.

In chapter 3, basing on the outputs of previous part and literature review, the dominant anthropogenic emission sectors in HCMC were defined: vehicle emission, residential buildings and manufacturing industrial sector. I modeled the annual evolution of these sectors and update the top down emission inventories using statistics and remote sensing data, to prepare annual grid maps of emission from those three key sectors. On road emission was considered as a function of emission factors and annual vehicle kilometer travelled, which in influenced by economic factors, demographics and urban factors. The change in residential buildings emission was based on the change in population and urban morphologies. Meanwhile, the evolution of manufacturing industrial sector is mainly derived from production data. Transportation is the most dominated and the fastest growing emission sector with 80% increase from 2009 to 2016, mainly because of the sharp rise in vehicle population.

In chapter 4, high detailed vehicle emission inventory was compiled based on modelled traffic flow data. The vehicle EI was calculated basing emission factors, vehicle mixing data, road network and traffic flow. This part take advantages of Google traffic condition maps combining with other traffic parameters provided by previous studies in HCMC to derive hourly traffic flows. The diurnal traffic flow demonstrates clearly the peak hours in study area – 17.00 with traffic densities estimated for Secondary, Primary road and Tertiary road are over 4000 PCUs and 2600 PCUs respectively. Equivalent to temporal variation of traffic density, the total vehicle emission get peak in 17.00 with

over 80 Tons of CO, 1.5 Tons of NOx and 0.043 Tons of PM2.5 per hour. The spatial distribution of emission varies along time, also. In the morning, high emission level is seen mainly in ring road. Afterward, the emission hot spot shifts to central area, making the remarkable change in spatial allocation. The output of this chapter provide the closer insight of Transportation - the biggest contributor of total emission in HCMC and the fastest growing emission sector. This hourly emission inventory will be an useful scientific basis for personal exposure studies and effective policy-making in future.