Integrated Emission Inventory and Modelling to Assess the Distribution of Major Pollutants from Rice Straw Open Burning in Hanoi, Vietnam

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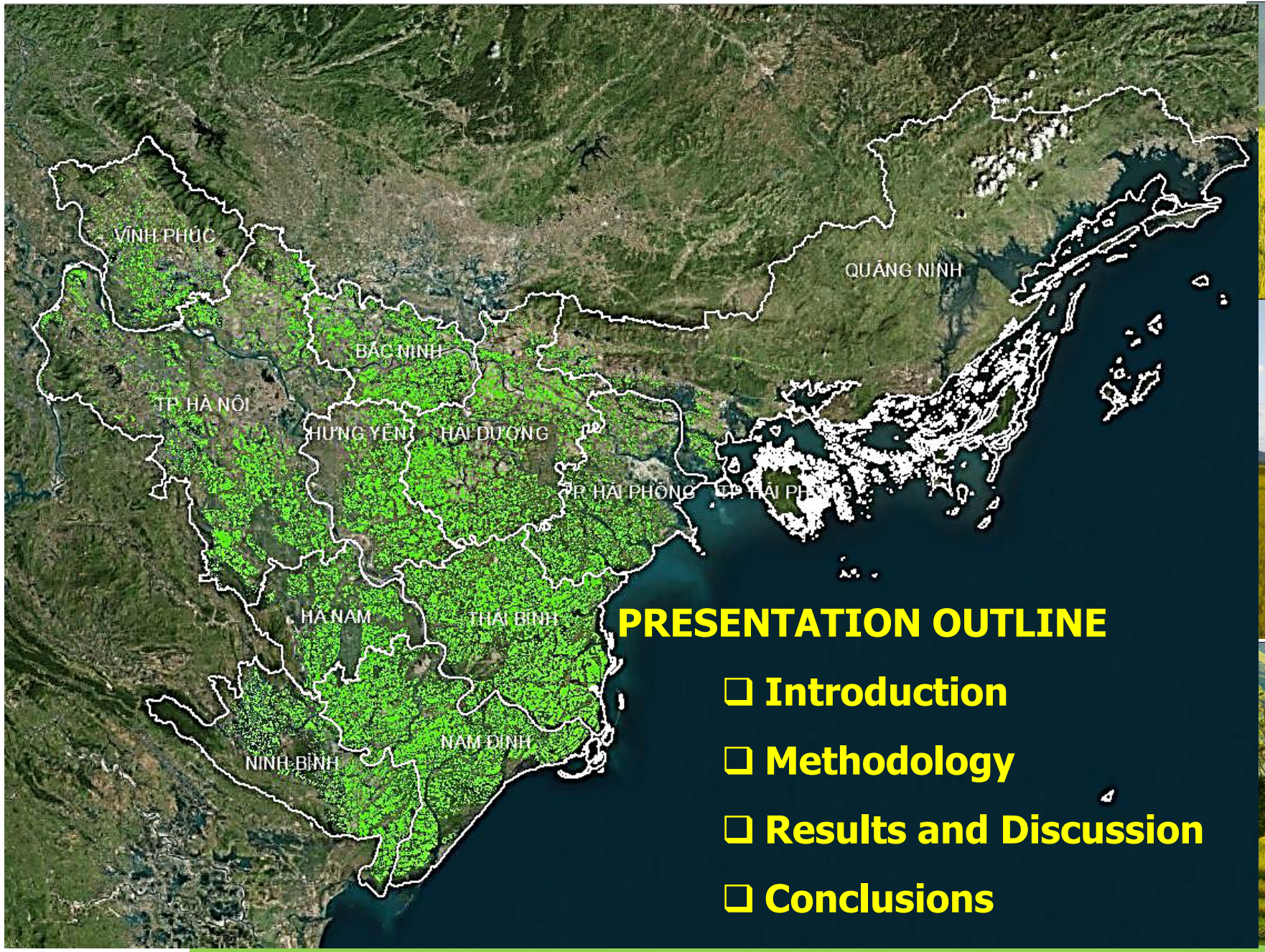
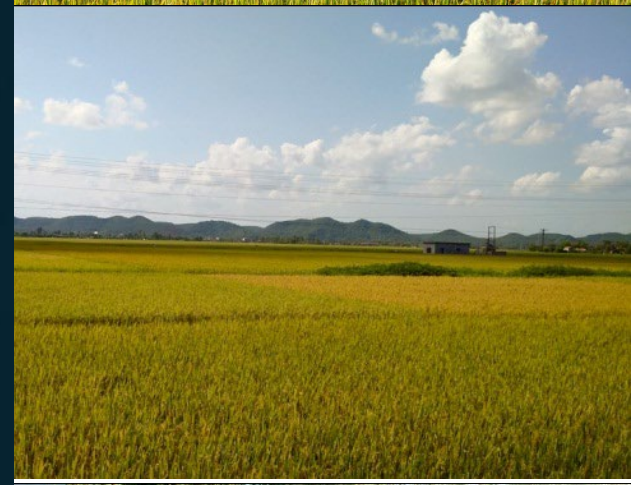




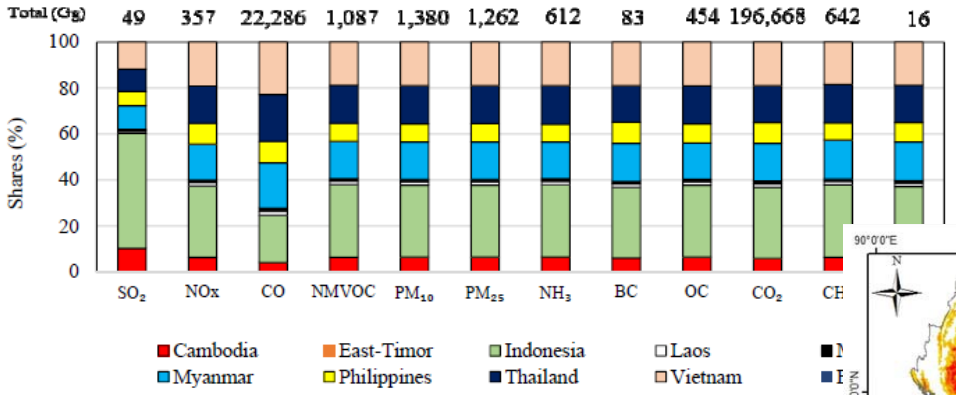
PRESENTATION OUTLINE

- ❑ Introduction
- ❑ Methodology
- ❑ Results and Discussion
- ❑ Conclusions

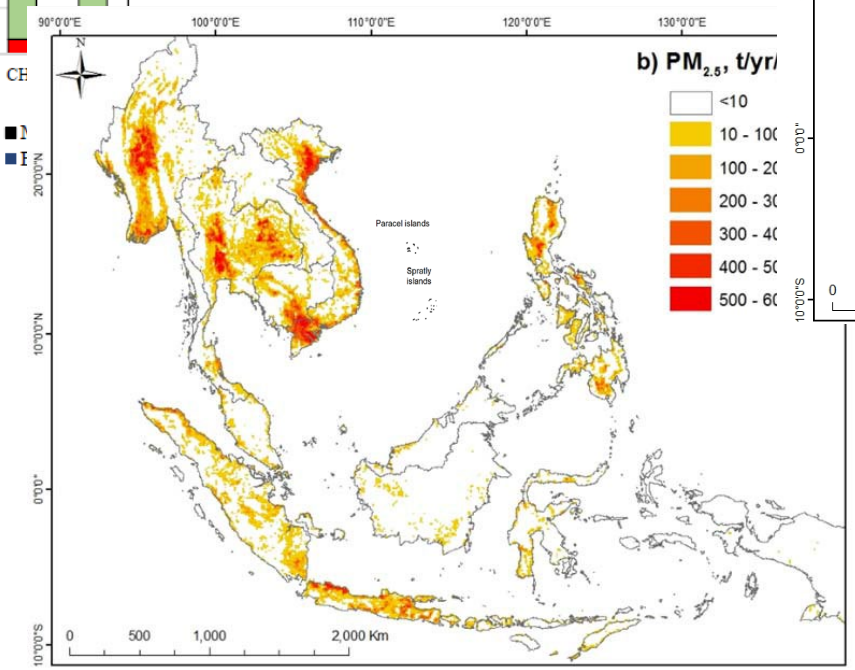
1. INTRODUCTION

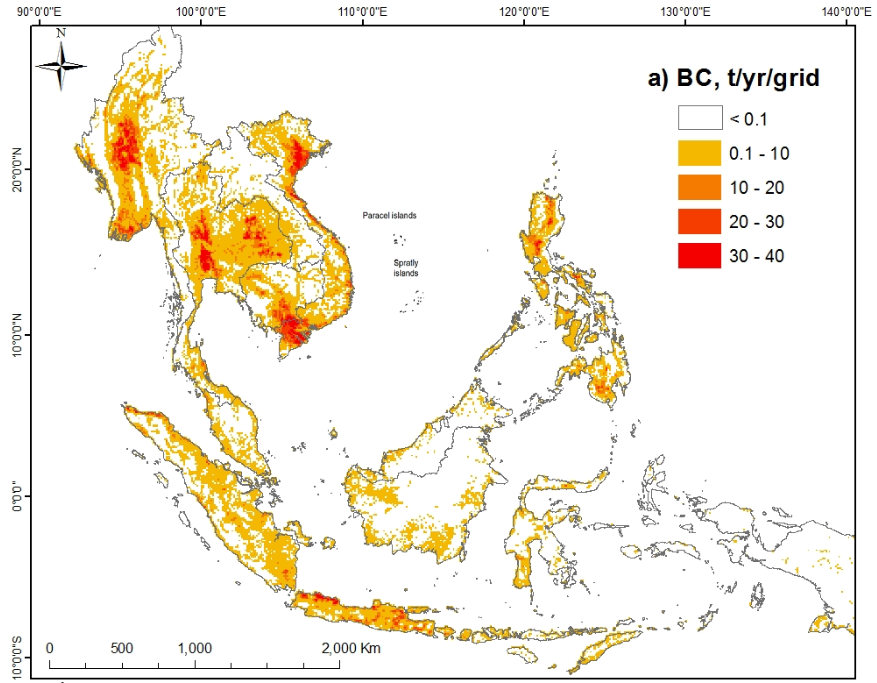
- **Rice** (*Oryza sativa* L.) is a globally cultivated species and is the most popular crop in many Asian countries.
- **Rice residue** was often used for various purposes such as cooking, cattle feeding, roof covering, etc.
- Since the living condition of farmers has been getting better, these ways of RS utilization are losing their necessity.
- **Rice straw burning (RSB)**, is a very popular behavior in Vietnam that has been perceived as an effective method to kill pests and weeds for the next cultivating seasons.
- **RSB**, is one of the sources of global air pollution:
  - ***pollutants:*** *PM (BC, OC) and gases (CO, NO_x, VOC, SO_2, etc.), semi-VOC (pesticides, PAHs, etc)*
  - ***major GHGs:*** *CO_2, N_2O, CH_4*
  - ***SLCPs:*** *BC, OC and O_3 precursors (NO_x, HC, CO)*
- **RSB** → *environmental effects / human effects*

❑ **Trend of RSB:** increasing in short- and medium terms → Large amount of emission but is still not well quantified → Need to EI and using models to evaluation effects of the RSB to air quality.



Kim Oanh et al. (2016)





Emissions Estimation

Step 1: Total annual crop production:

$$M_j = P_j \times N_j \times D_j \times B_j \times \eta_j$$

Bio_j

- P_j: Crop production *(kg)*
- N_j: Crop specific residue-to-production ratio *(%)*
- D_j: Dry matter-to-crop residue ratio *(%)*
- B_j: Fraction of dry matter residues that are burned in the field *(%)*
- η_j: Crop specific burn efficiency ratio *(%)*

Step 2: Emission rates from the residue burning:

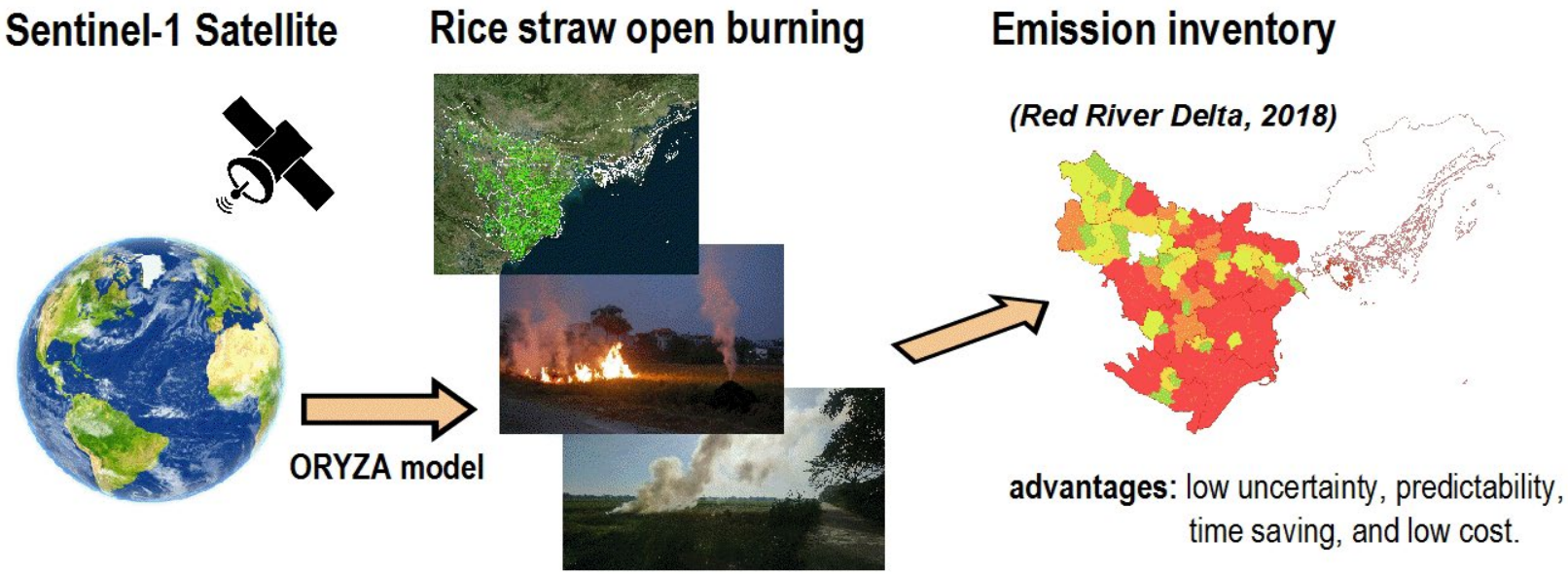
Amount of burned crop residues in a year
(kg- dry mass of residue)

$$EI_{ij} = \sum_{i}^{n} M_j * EF_{ij}$$

Emission factors of species i and crop type j
(g/kg dry mass of residue)

EF's air pollutants ***(g/kg)*****:** PM_{10}: 9.1; $PM_{2.5}$: 8.3; BC: 0.51; SO_2: 0.18; CO_2: 1177; CO: 93; NOx: 2.28; NH_3: 4.1; CH_4: 9.59; NMVOC: 7.0

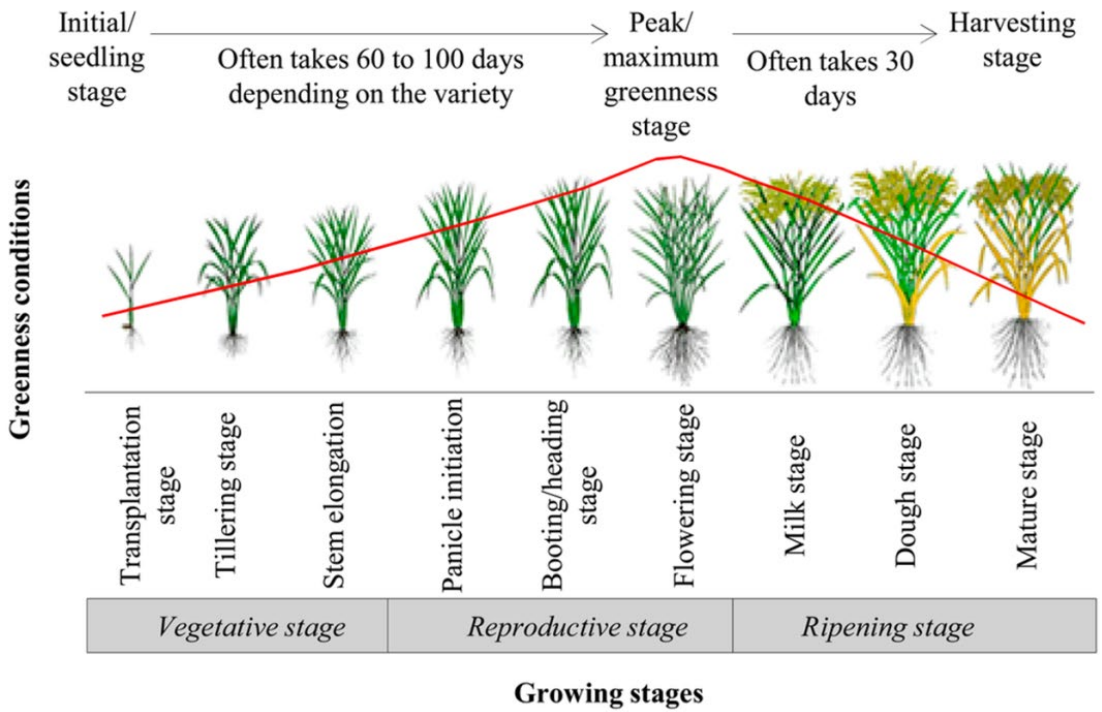
(Andreae and Merlet, 2001; Cao et al., 2008; Christian et al., 2003; Kim Oanh et al., 2011).

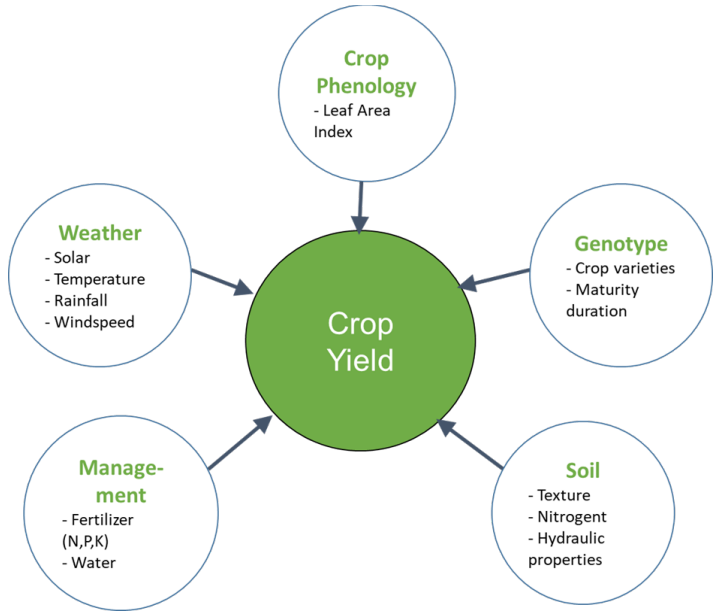


Advantages:

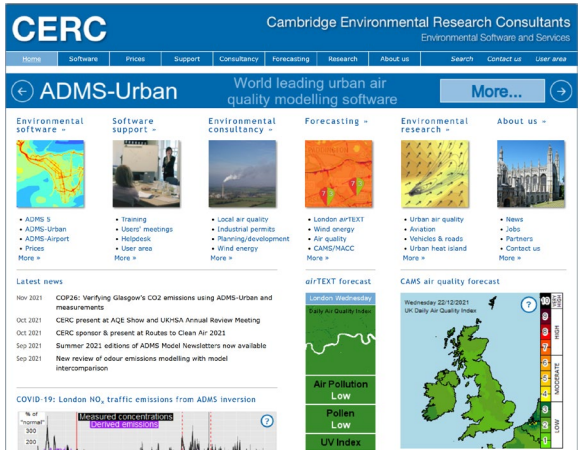
- ❑ low cost;
- ❑ time saving;
- ❑ provide suitable activity data → alter/ improve the traditional data collection;
- ❑ more realistic estimated emissions of the air pollutants.

- The Sentinel-1 satellite platforms (Sentinel-1A and Sentinel-1B) mounted with Synthetic Aperture Radar (SAR) which acquire backscattering signals from the earth surface into digital image data files.
- Using time-series data from land-preparation to harvesting periods, we could be able to apply our phenology-based classification algorithm to map rice of the study area.
- ORYZA 2000, a rice yield forecast model developed by the International Rice Research Institute, which acquires Leaf Area Index (LAI) from remote sensing data.





Atmospheric Dispersion Modelling System (ADMS)



meteorological data

emissions / activity data

source data

background concentrations

time-varying emission profiles

ADMS-Urban

- dispersion
- met. pre-processor
- regional model link
- chemistry
- deposition
- street canyons
- buildings
- complex terrain

high resolution pollution maps

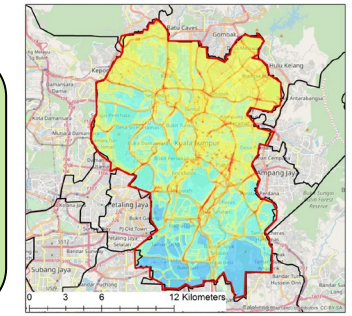
annual averages, exceedences, percentiles

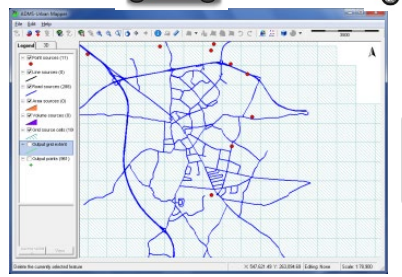
comparison with monitoring data

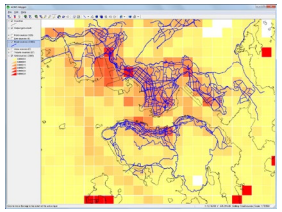
comparison with air quality standards

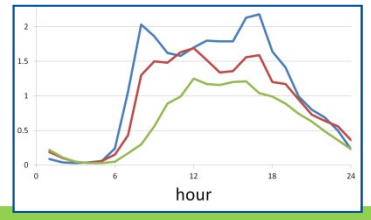
future predictions

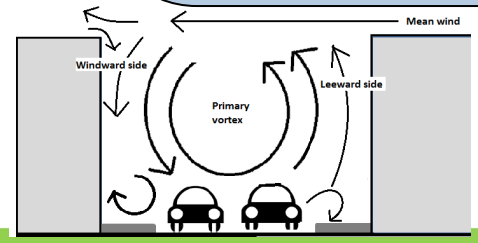
Policy / management, etc

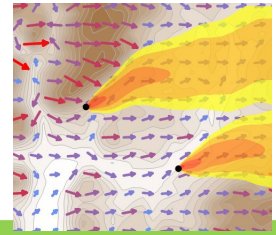






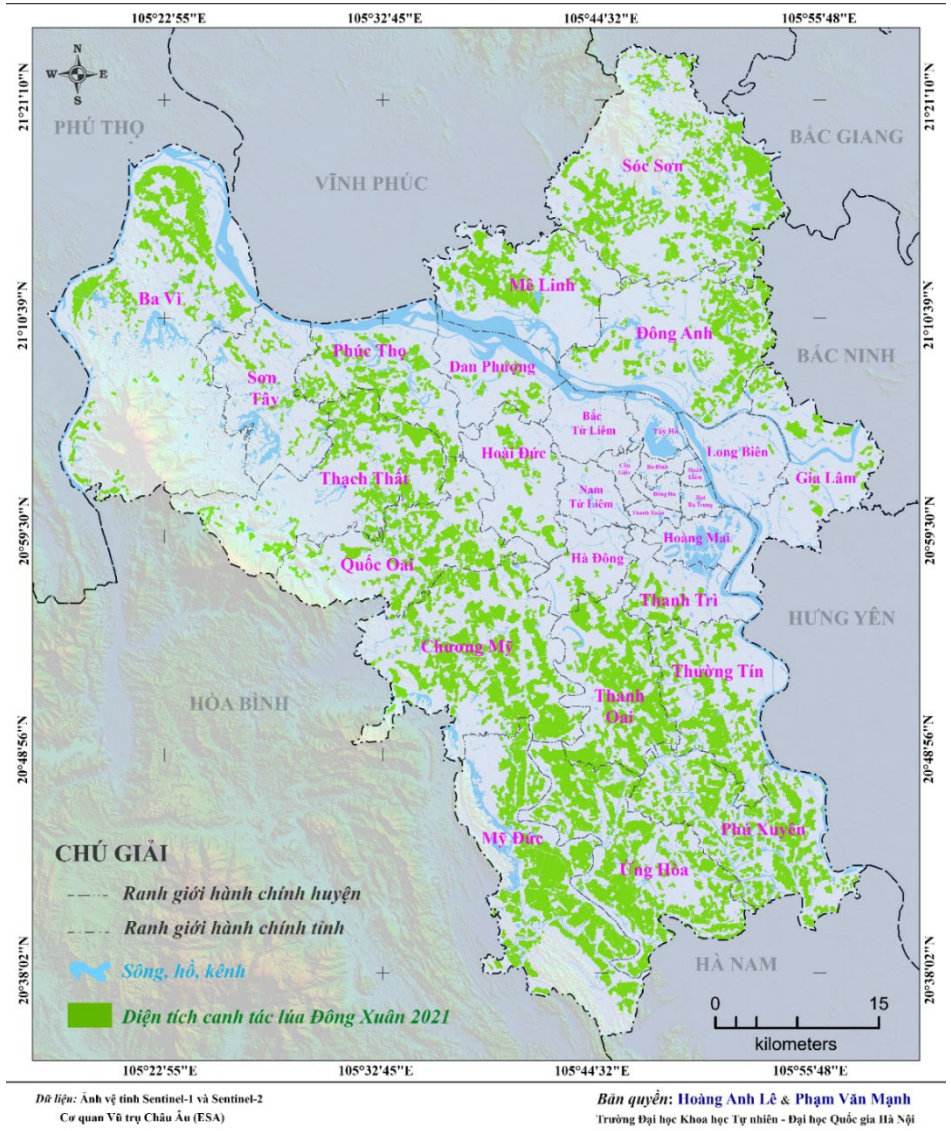






3. RESULTS

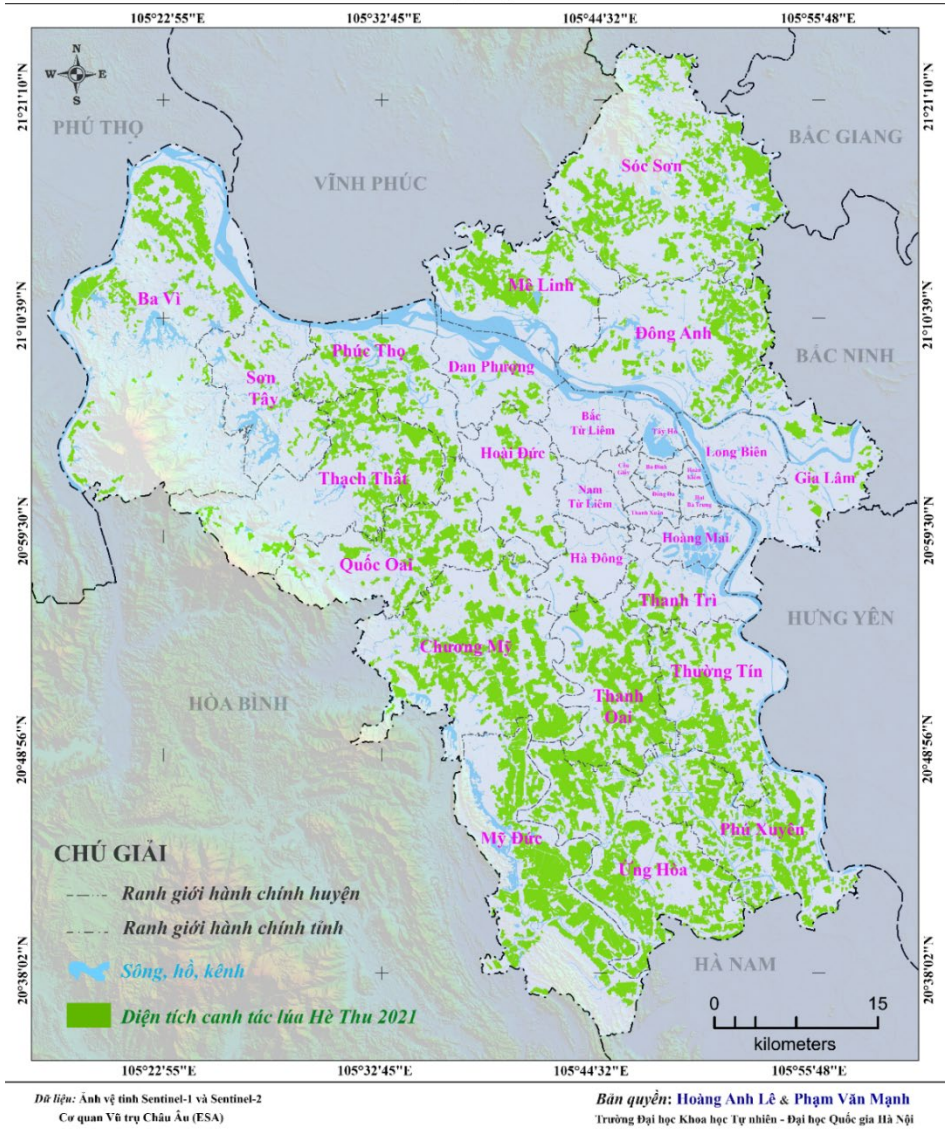
Rice area cultivated, SWS



Dữ liệu: Ảnh vệ tinh Sentinel-1 và Sentinel-2
Cơ quan Vũ trụ Châu Âu (ESA)

Bản quyền: Hoàng Anh Lê & Phạm Văn Mạnh
Trường Đại học Khoa học Tự nhiên - Đại học Quốc gia Hà Nội

Rice area cultivated, SAS



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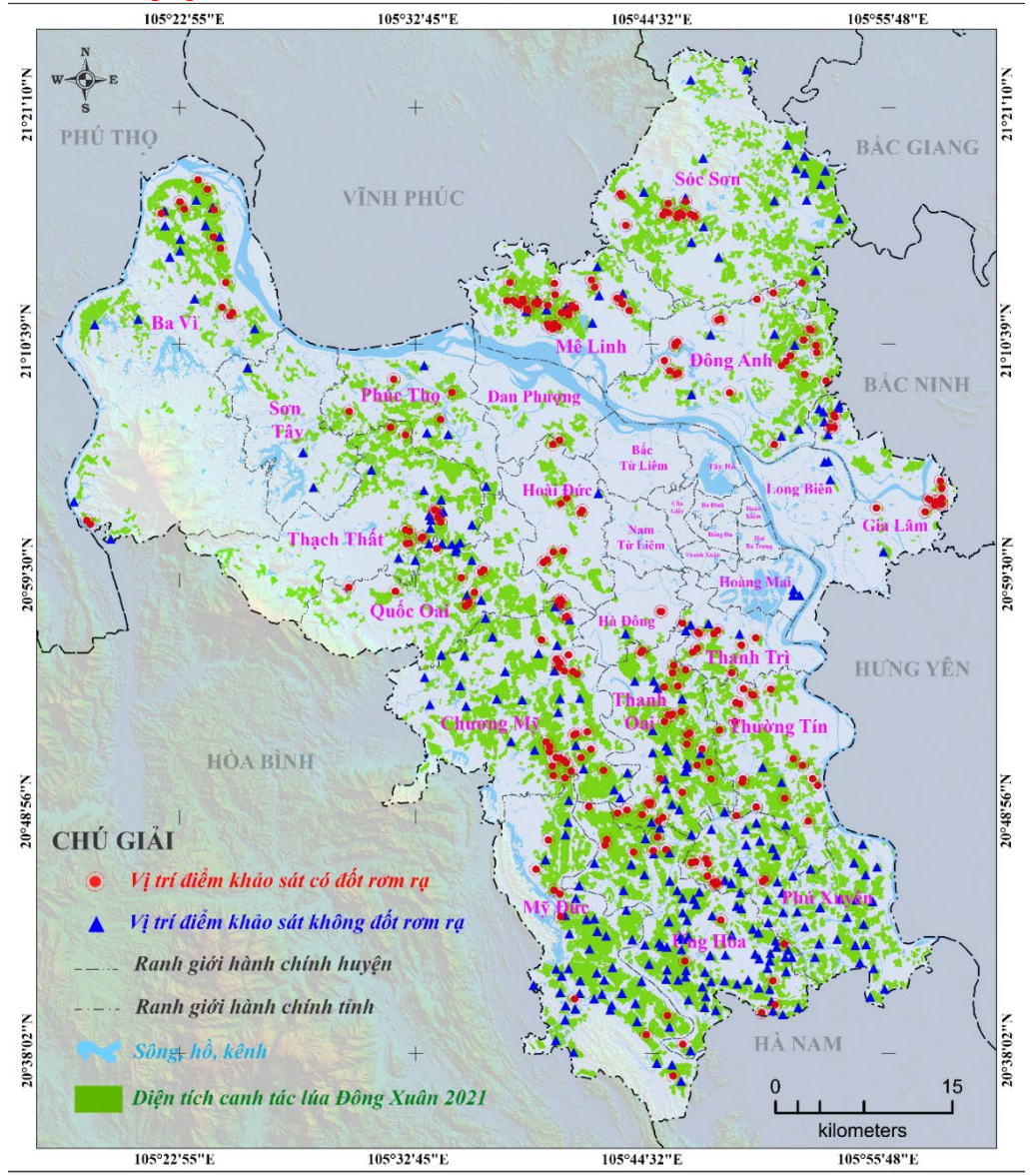
Survey points, SWS



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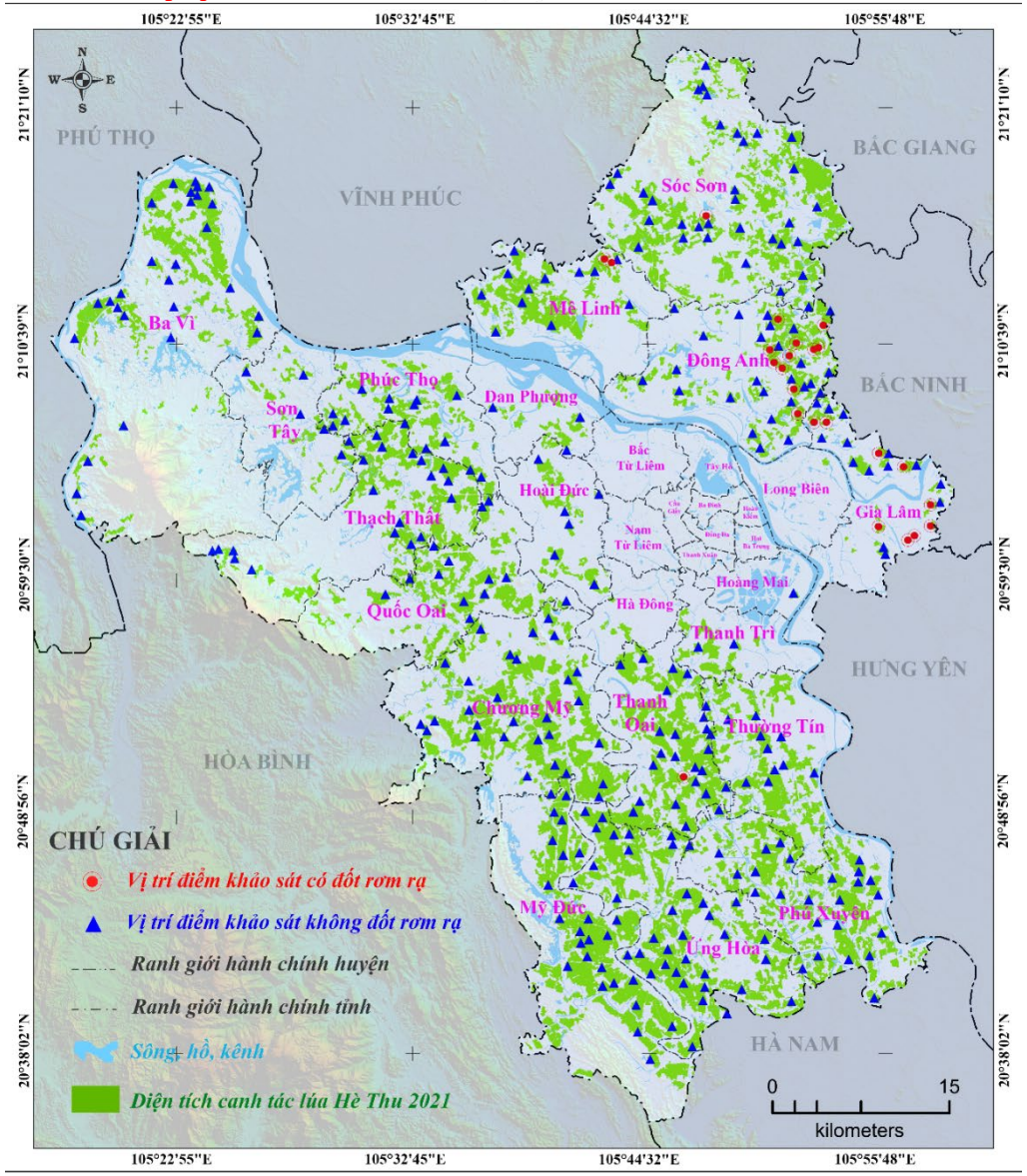
Survey points, SAS



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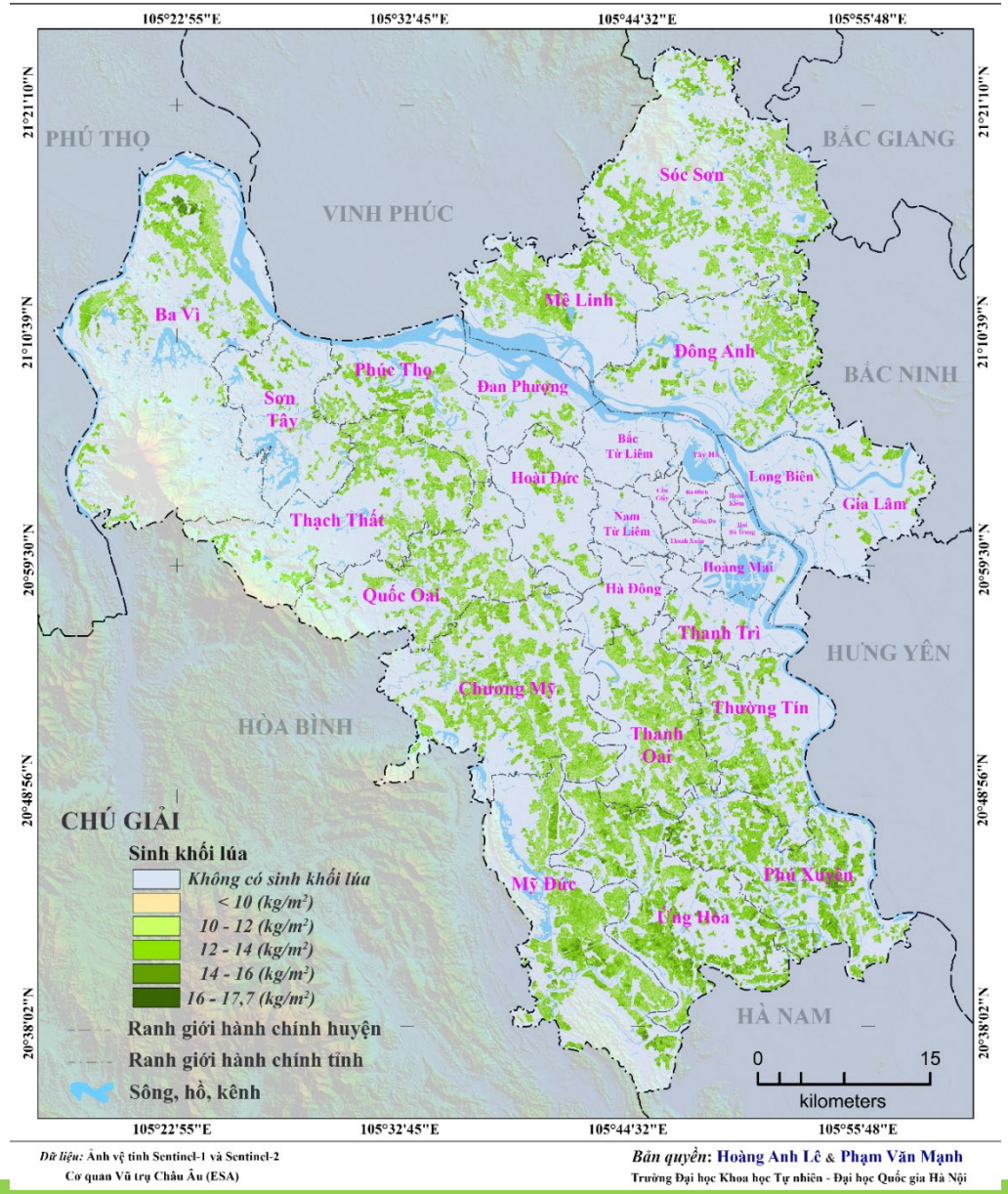
Biomass product, SWS



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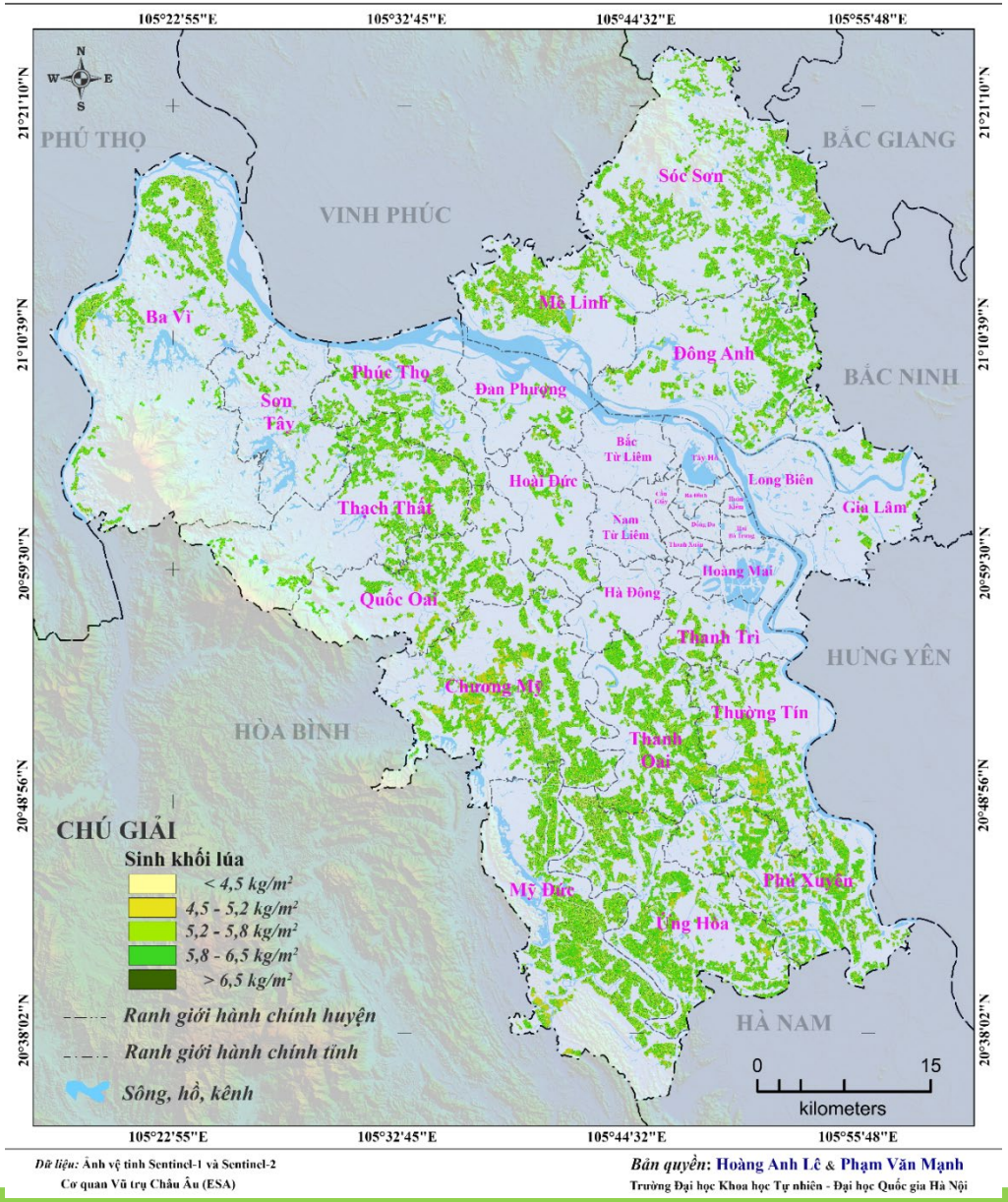
Biomass product, SAS



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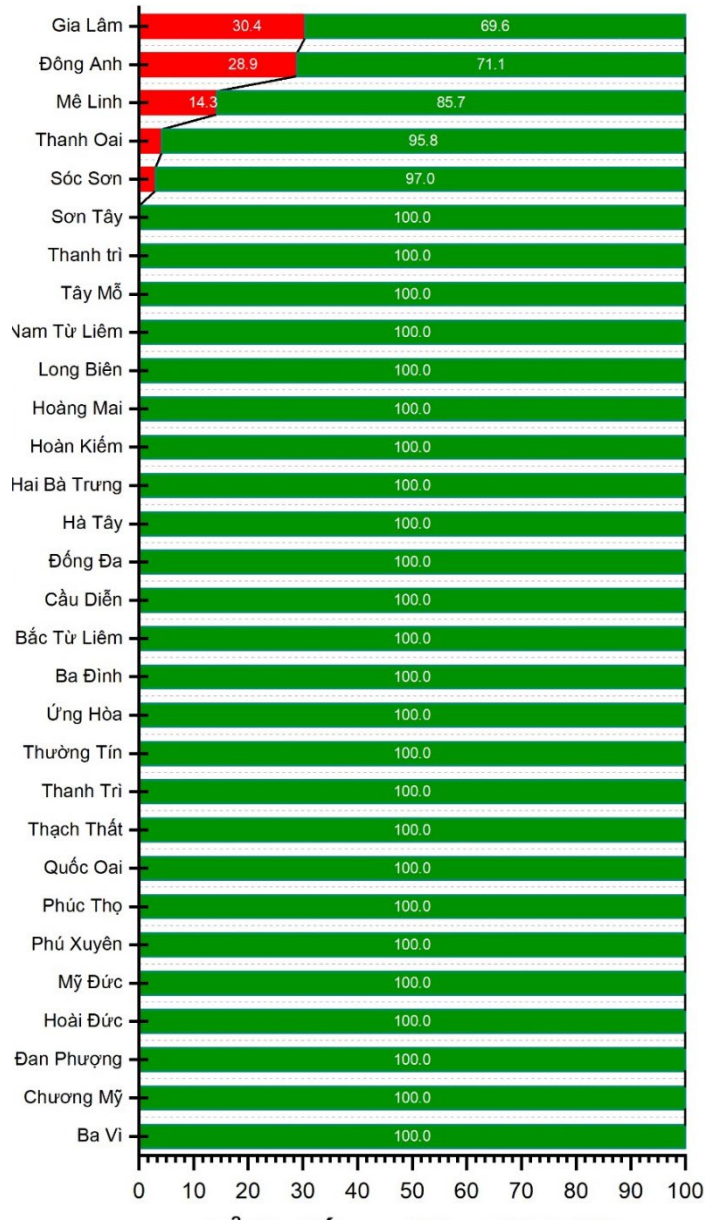
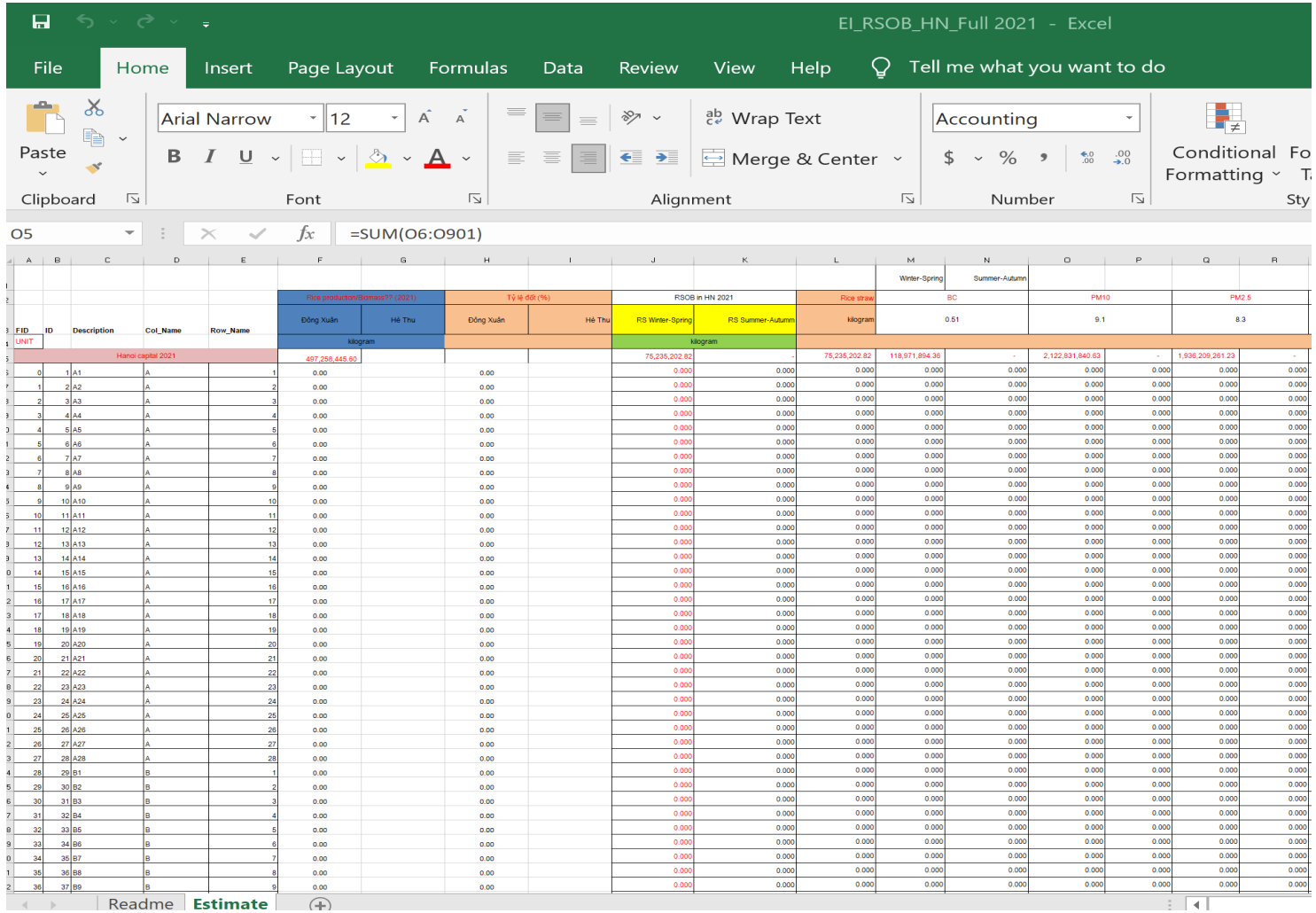
RS burned rate, SWS



RS burned rate, SAS


EI_RSOB_HN_Full 2021 - Excel
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Data
Review
View
Help
Tell me what you want to do
Paste
Clipboard
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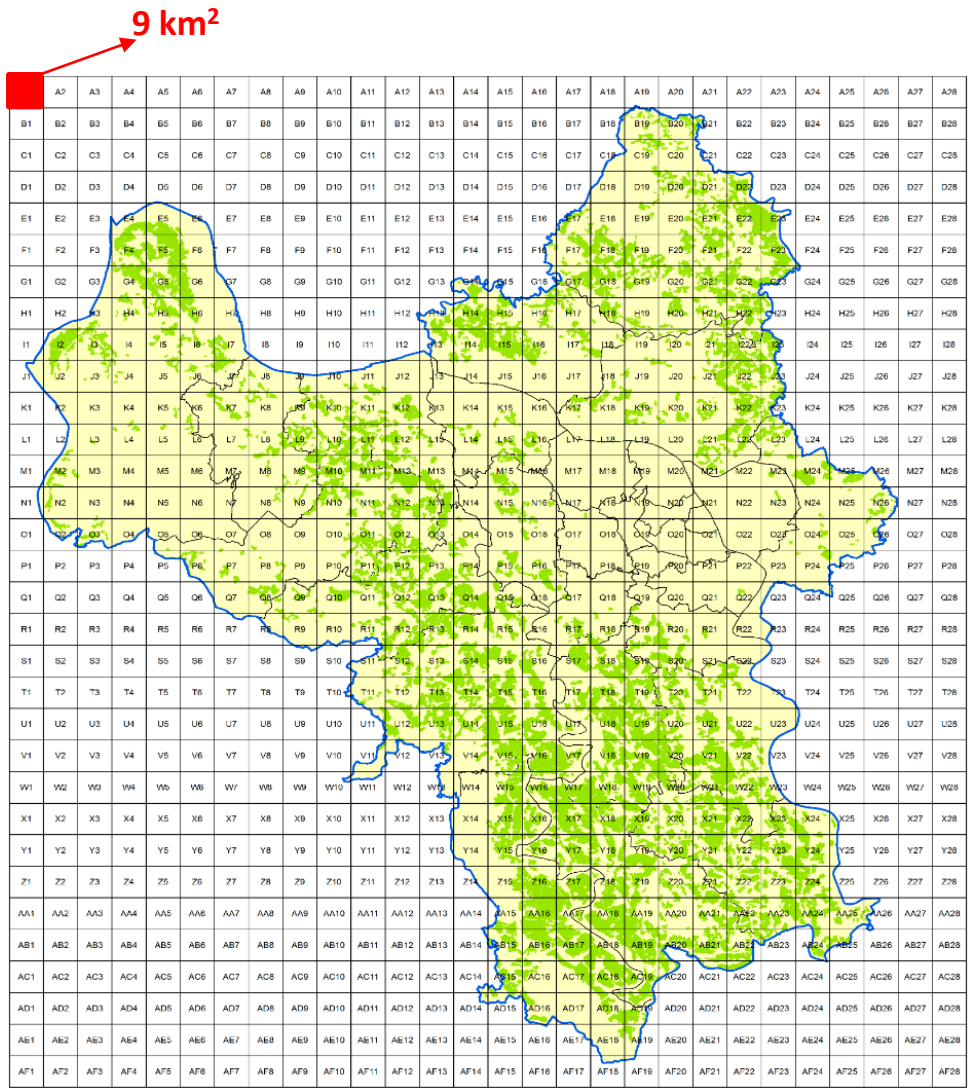
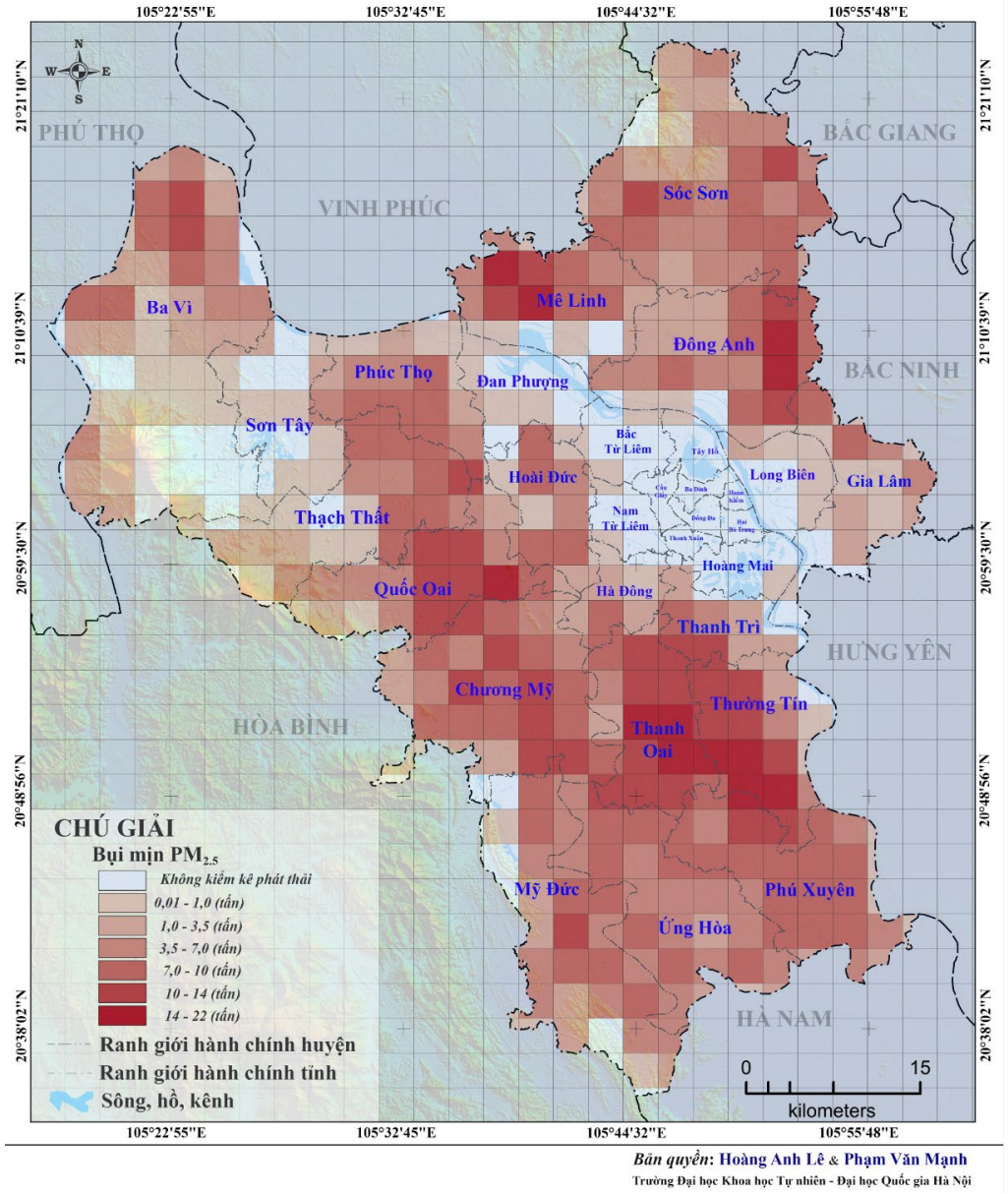
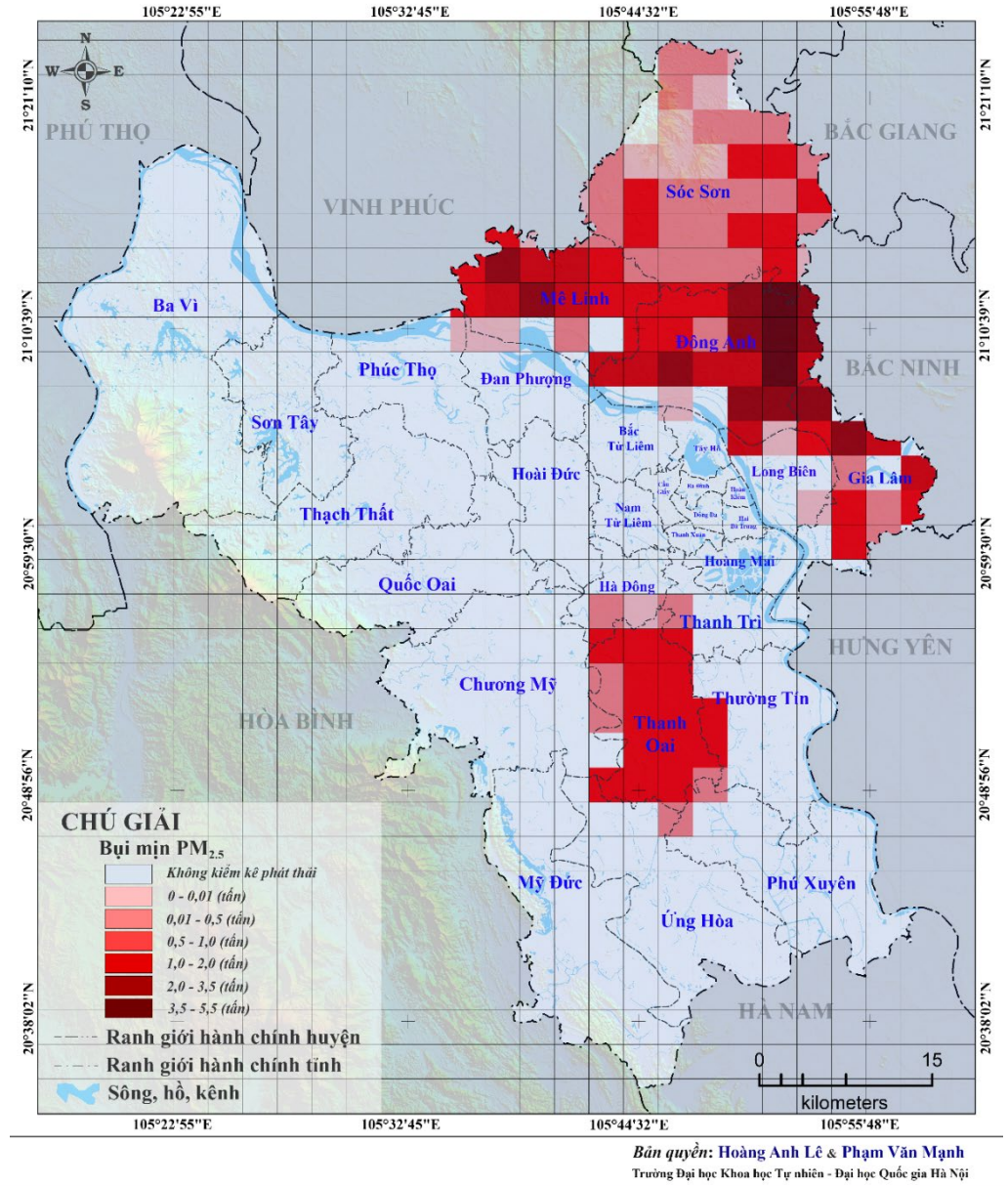
Number
Conditional Formatting
O5
=SUM(O6:O901)
Readme
Estimate


9 km²

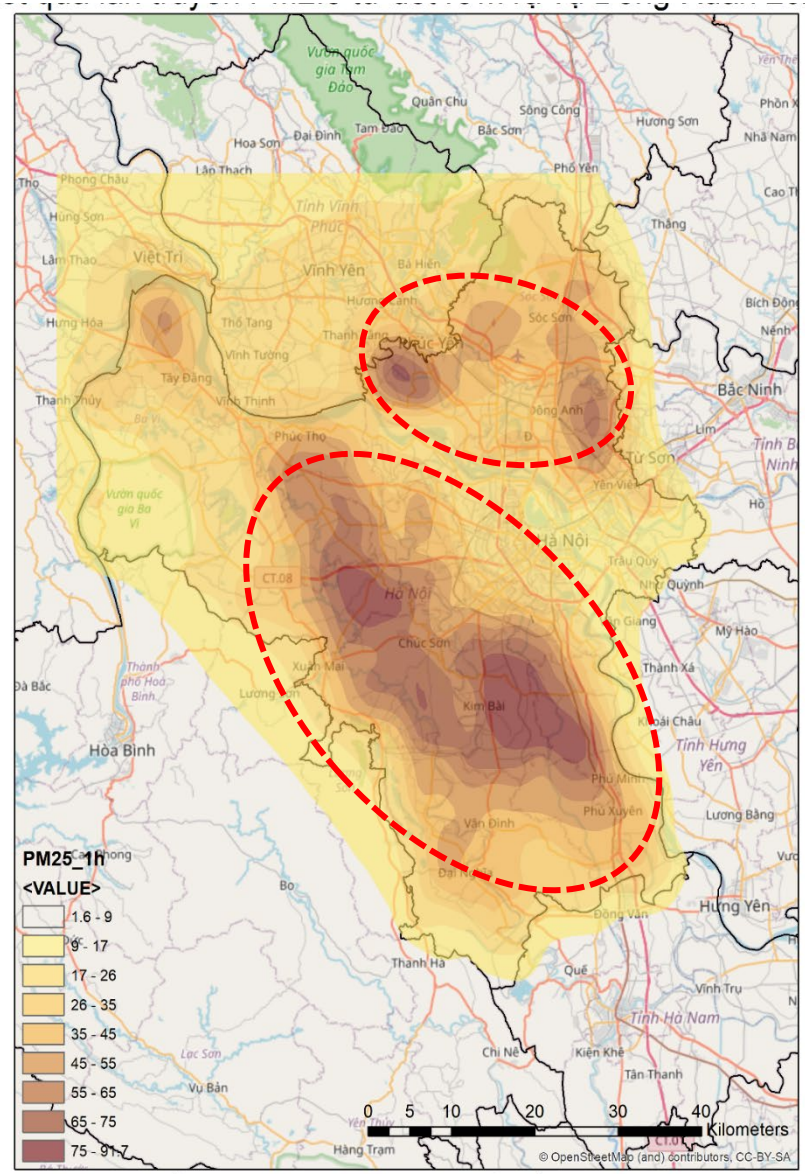
Emission, SWS



Emission, SAS



ADMS model for $PM_{2.5}$



Dữ liệu: Mô hình lan truyền ADMS

Bản quyền: Hoàng Anh Lê* & Ngô Quang Khôi**
* Trường Đại học Khoa học Tự Nhiên - Đại học Quốc gia Hà Nội
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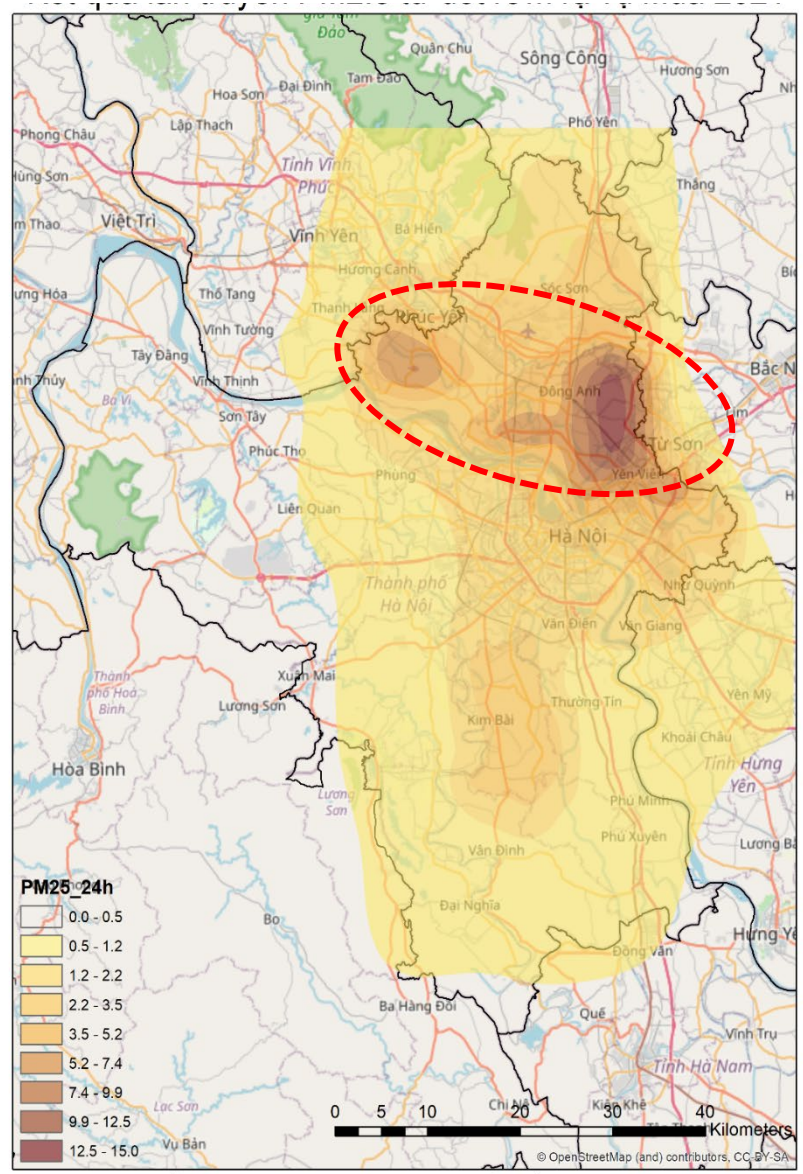

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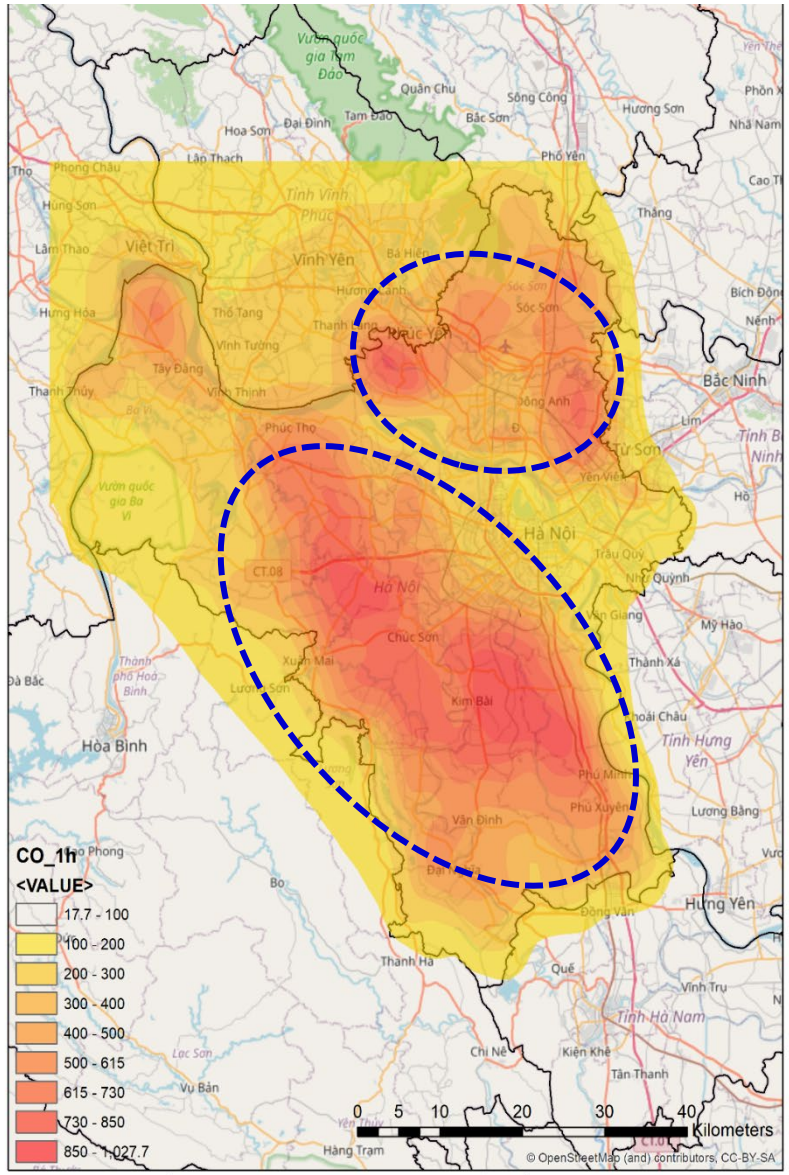
ADMS model for CO



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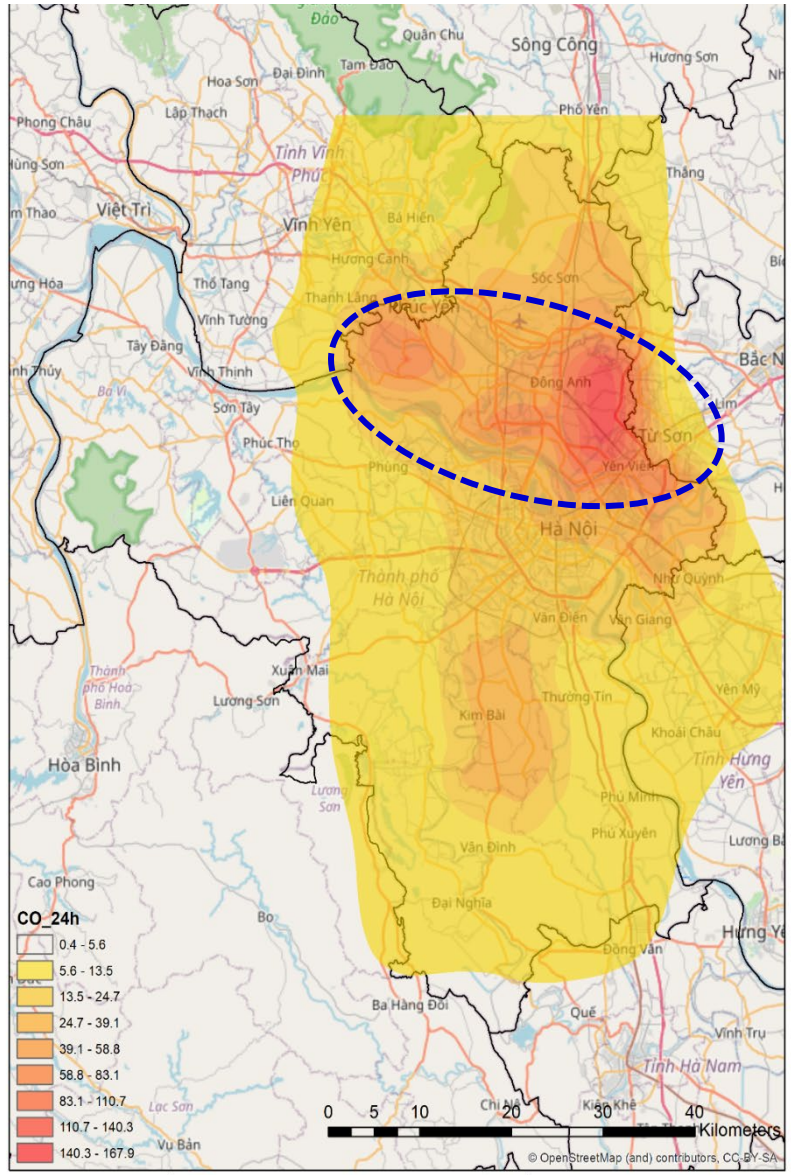

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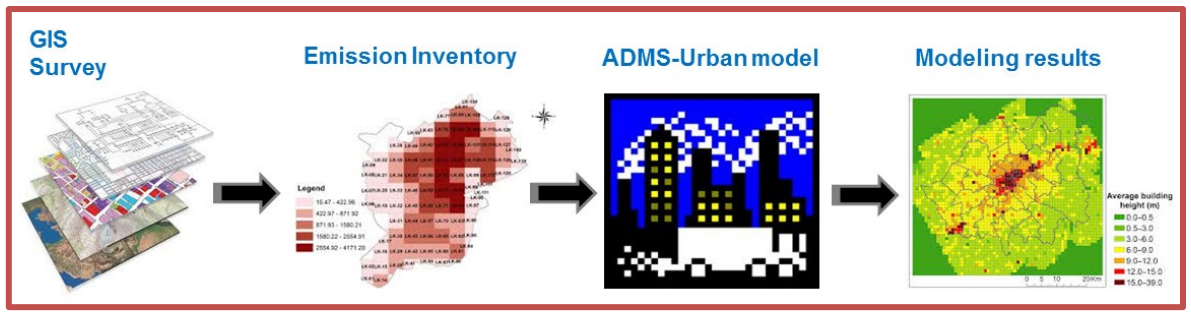
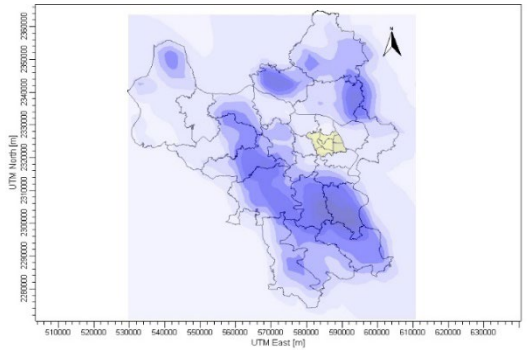
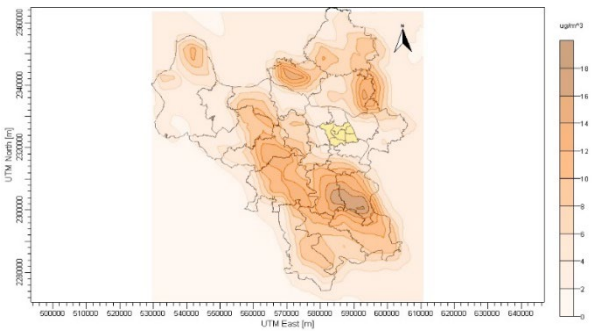
** Cranfield University

4. CONCLUSIONS

- **RSOB** has been acknowledged as one of the main sources of air pollution in Vietnam.
- **Remote sensing** can provide suitable activity data which can alter/ improve the traditional data collection.
- Integrated **EI and modelling** to assess the distribution of pollutants from RSOB.







Thank you!

Assoc. Prof. Dr. HOANG ANH LE
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