

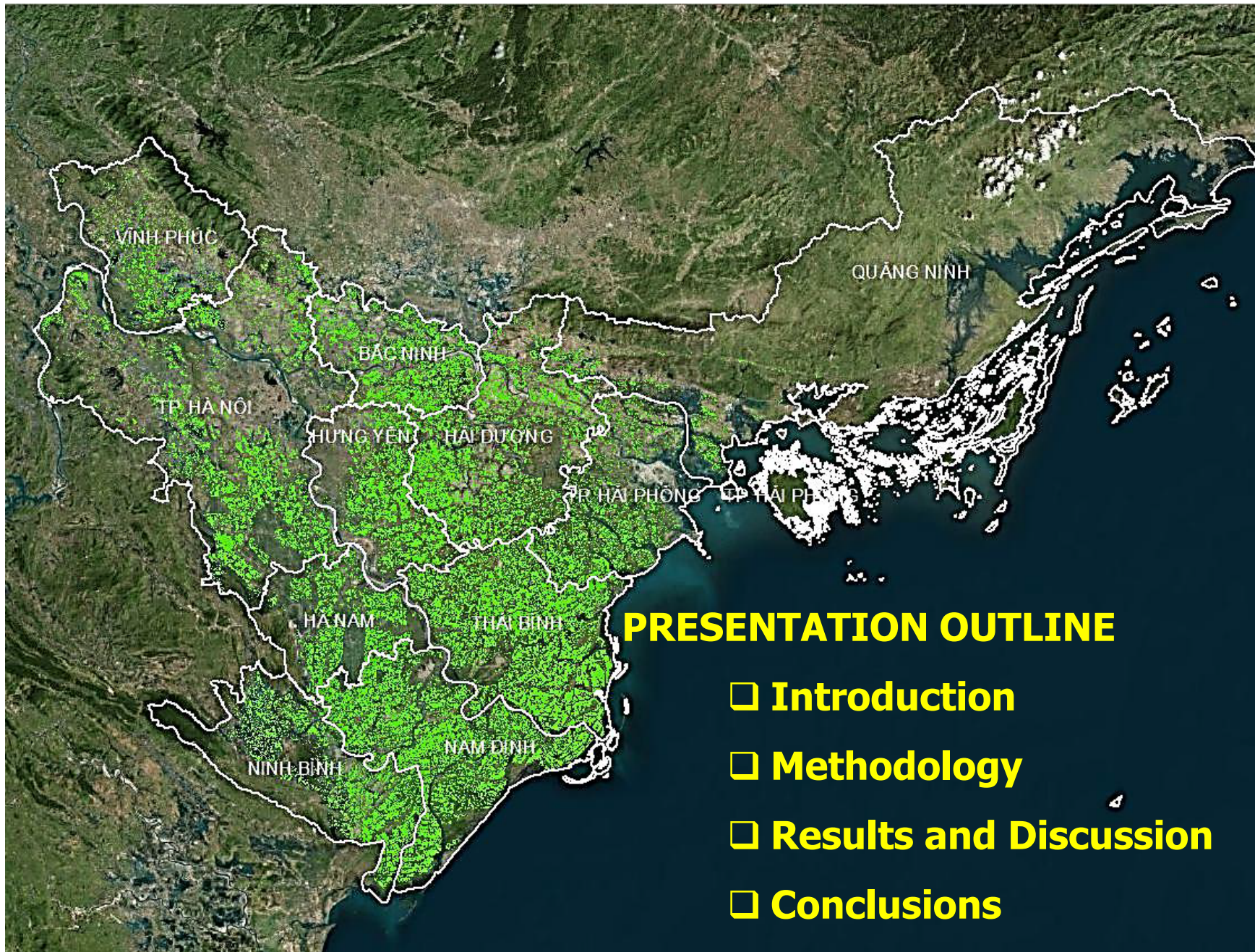
Integrated Emission Inventory and Modelling to Assess the Distribution of Major Pollutants from Rice Straw Open Burning in Hanoi, Vietnam

H.A. Le¹, N.Q. Khoi², P.T. Huyen¹, K.M. Thuy¹

¹Faculty of Environmental Sciences, VNU University of Science, Vietnam National University (VNU), Vietnam

²School of Water, Energy and Environment, Cranfield University, College Road, Cranfield, Bedfordshire, MK43 0AL, UK





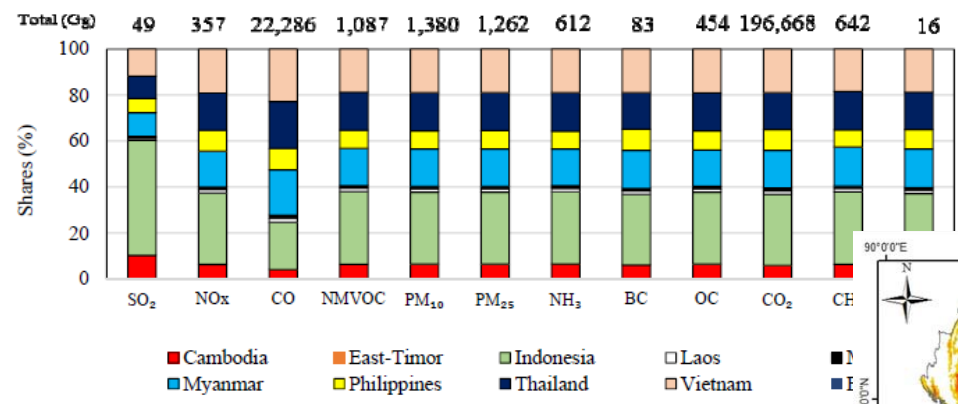
PRESENTATION OUTLINE

- Introduction
- Methodology
- Results and Discussion
- Conclusions

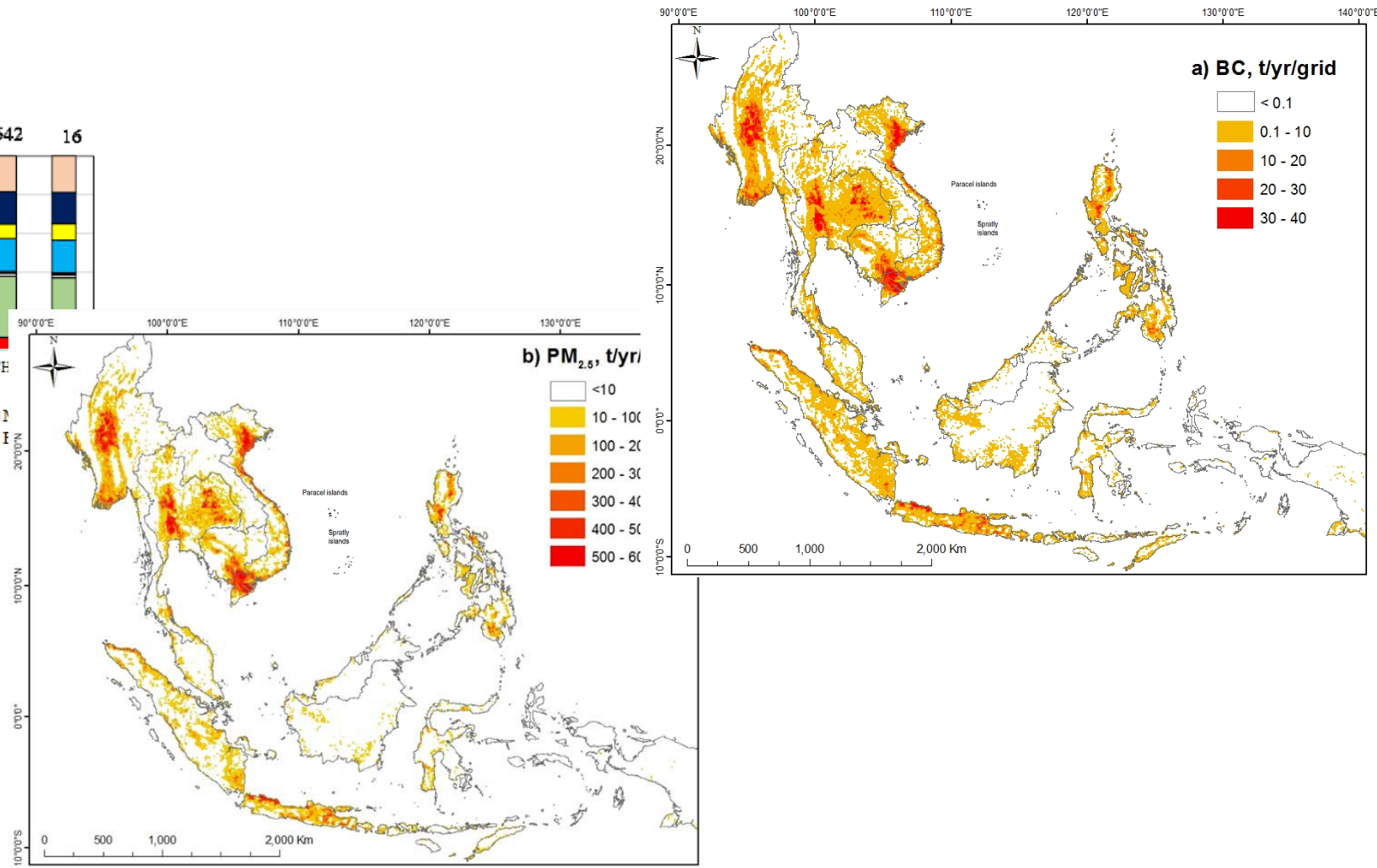
1. INTRODUCTION

- ❑ **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, SO₂, etc.), semi-VOC (pesticides, PAHs, etc)*
 - *major GHGs: CO₂, N₂O, CH₄*
 - *SLCPs: BC, OC and O₃ 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)



2. METHODOLOGY

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

- Crop production (kg)
- Crop specific residue-to-production ratio (%)
- Dry matter-to-crop residue ratio (%)
- Fraction of dry matter residues that are burned in the field (%)
- Crop specific burn efficiency ratio (%)





Step 2: Emission rates from the residue burning:

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

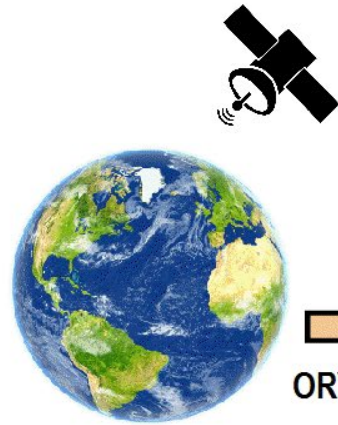
Amount of burned crop residues in a year
(kg- dry mass of residue)

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

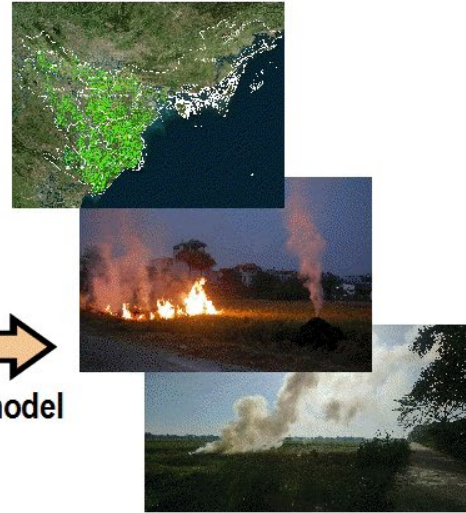
EF's air pollutants (g/kg): PM₁₀: 9.1; PM_{2.5}: 8.3; BC: 0.51; SO₂: 0.18; CO₂: 1177; CO: 93;
NO_x: 2.28; NH₃: 4.1; CH₄: 9.59; NMVOC: 7.0

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

Sentinel-1 Satellite



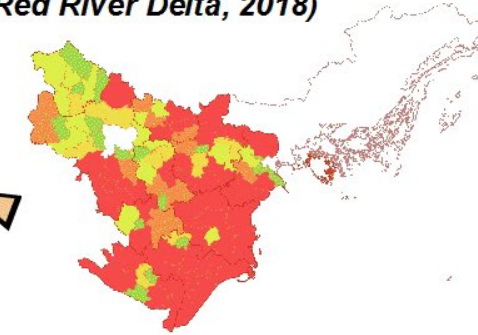
Rice straw open burning



ORYZA model

Emission inventory

(Red River Delta, 2018)

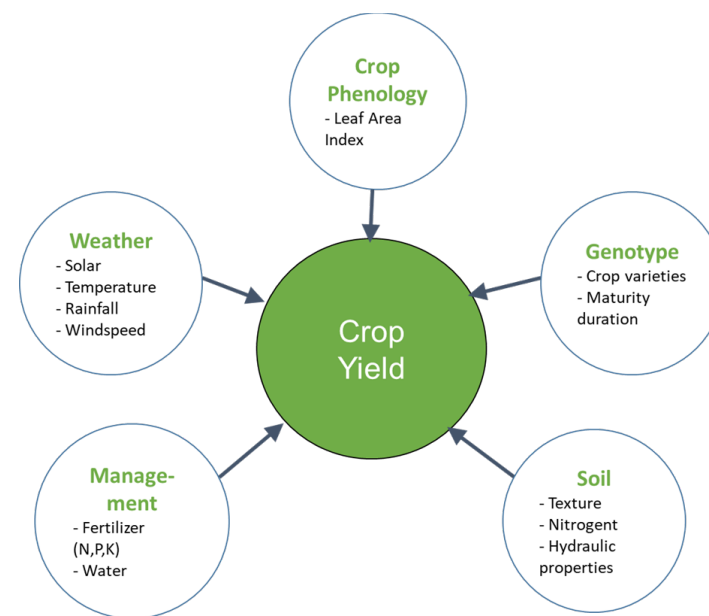
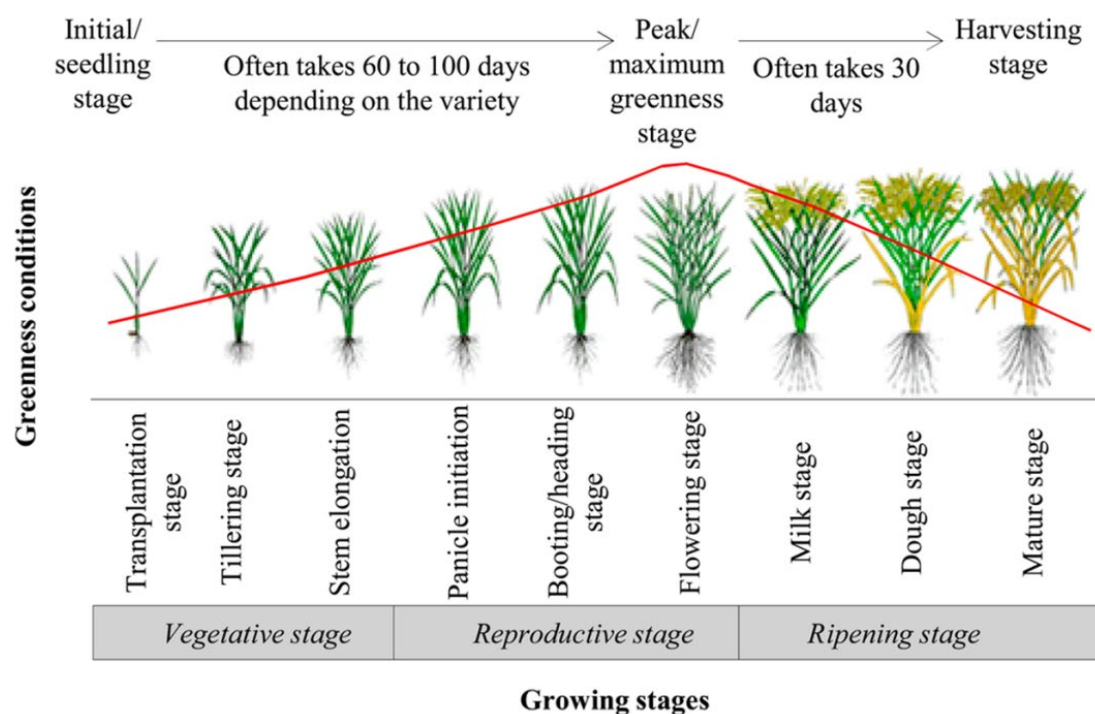


advantages: low uncertainty, predictability,
time saving, and low cost.

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)

CERC Cambridge Environmental Research Consultants
Environmental Software and Services

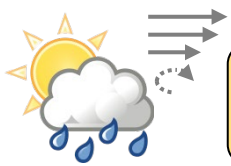
Home Software Prices Support Consultancy Forecasting Research About us Search Contact us User area

ADMS-Urban World leading urban air quality modelling software

Environmental software Software support Environmental consultancy Forecasting Environmental research About us

Latest news

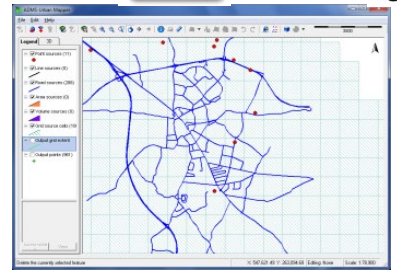
COVID-19: London NO_x traffic emissions from ADMS inversion



meteorological data

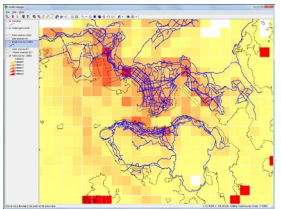


emissions / activity data

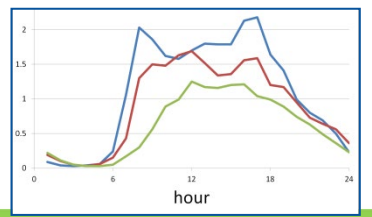


source data

background concentrations



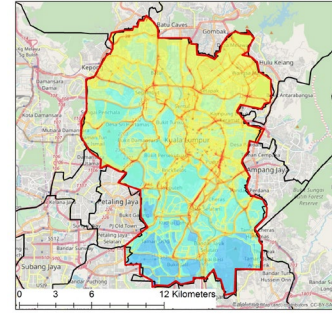
time-varying emission profiles



ADMS-Urban

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

high resolution pollution maps



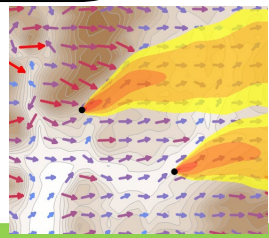
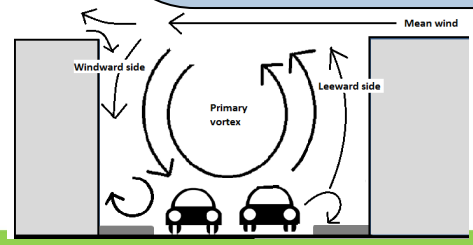
annual averages, exceedences, percentiles

comparison with monitoring data

comparison with air quality standards

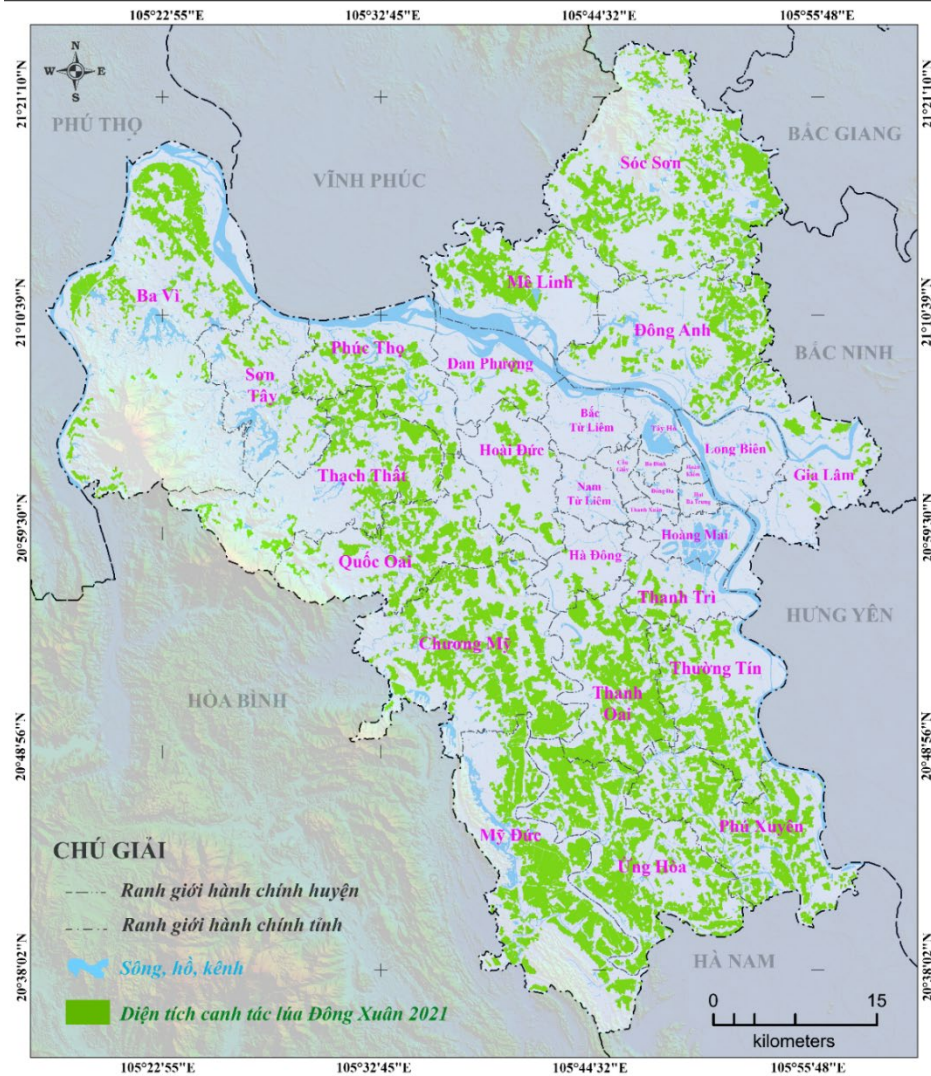
future predictions

Policy / management, etc



3. RESULTS

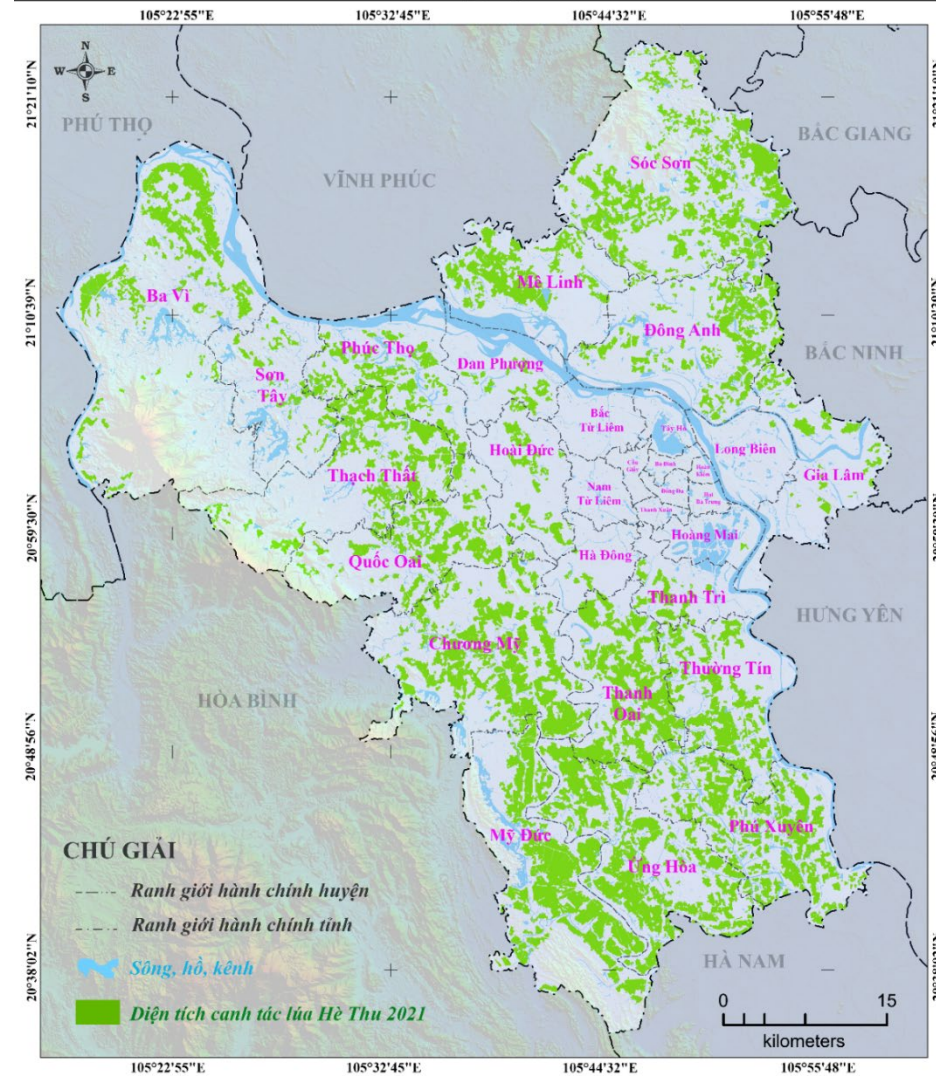
Rice area cultivated, SWS



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

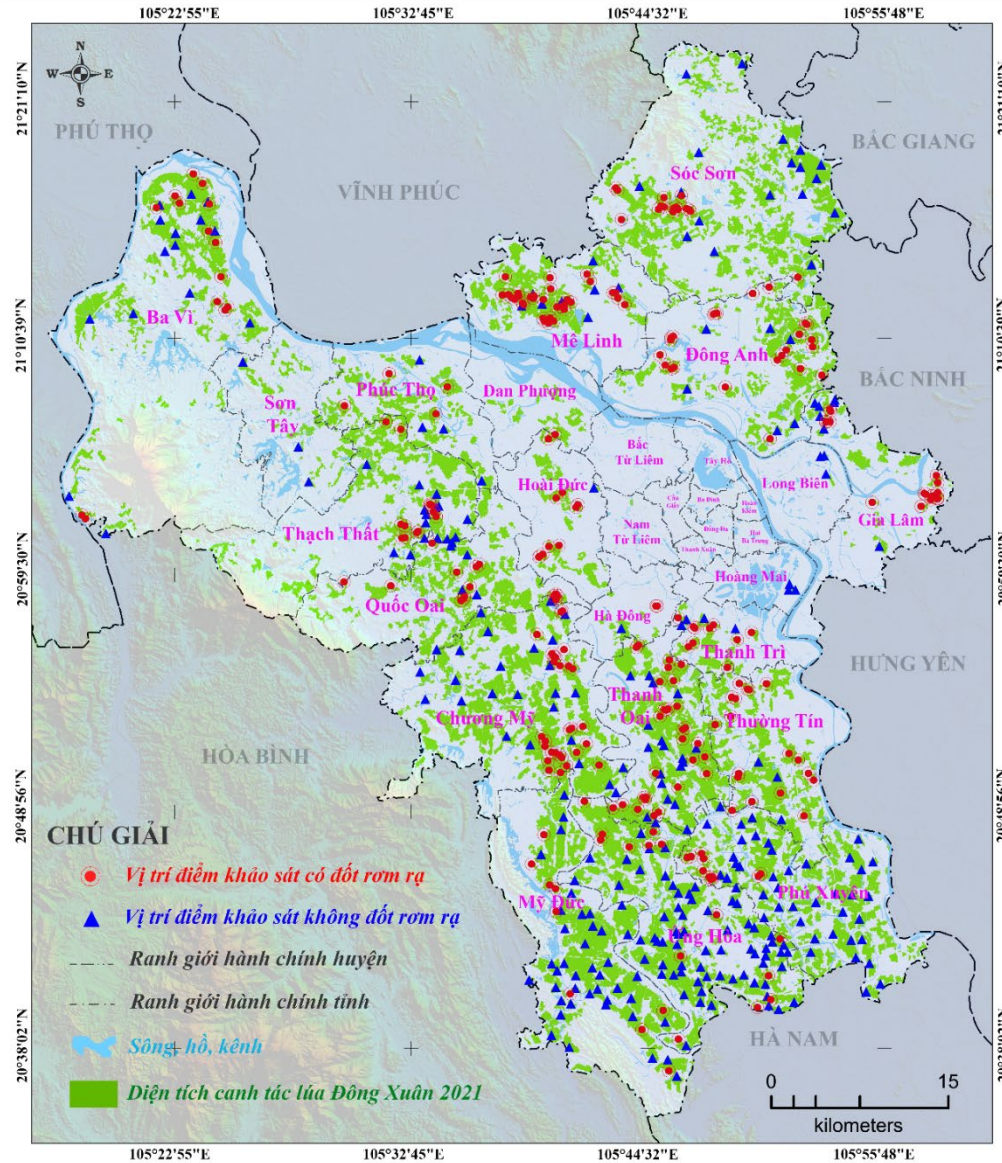
Rice area cultivated, SAS



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

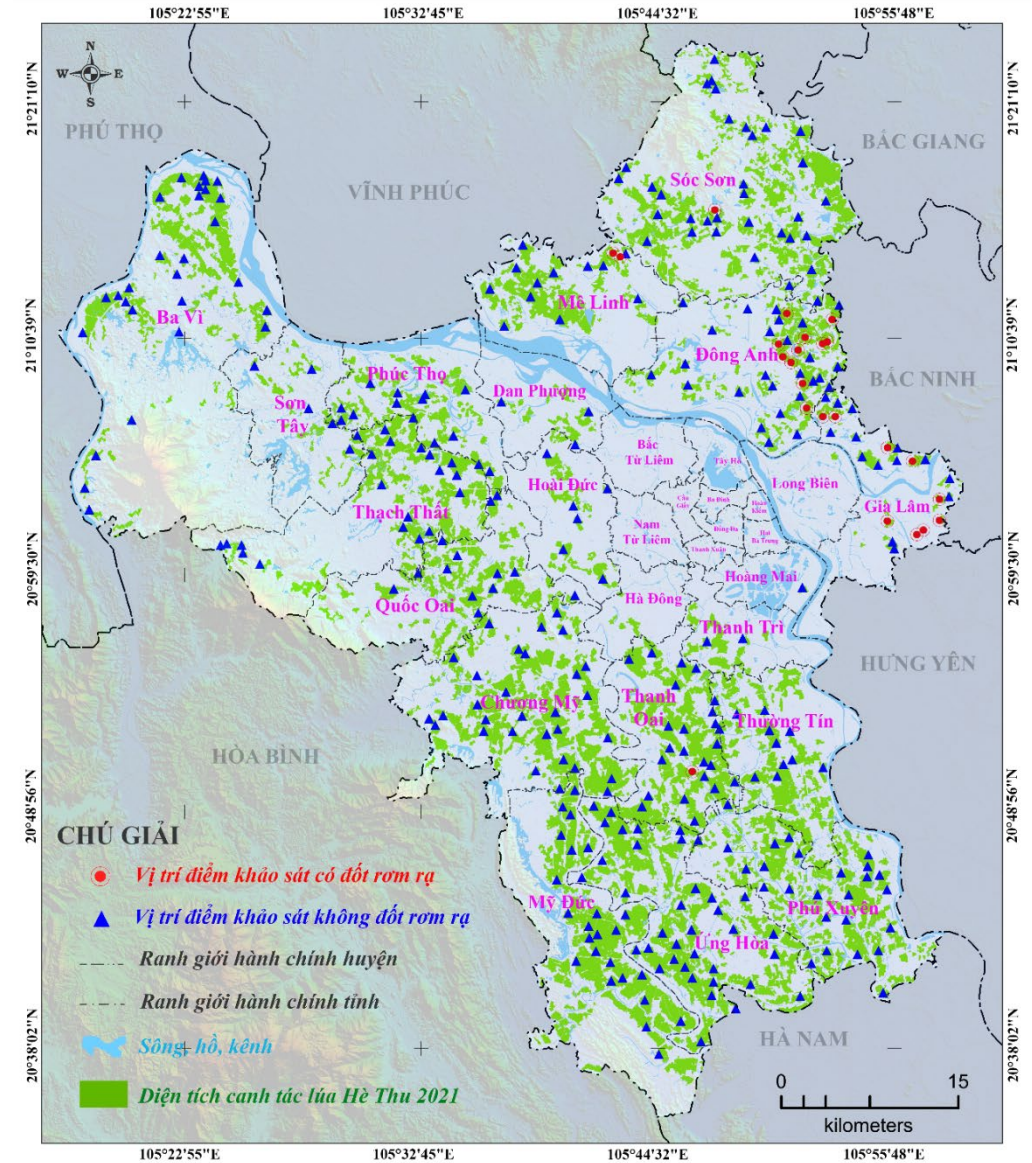
Survey points, SWS



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

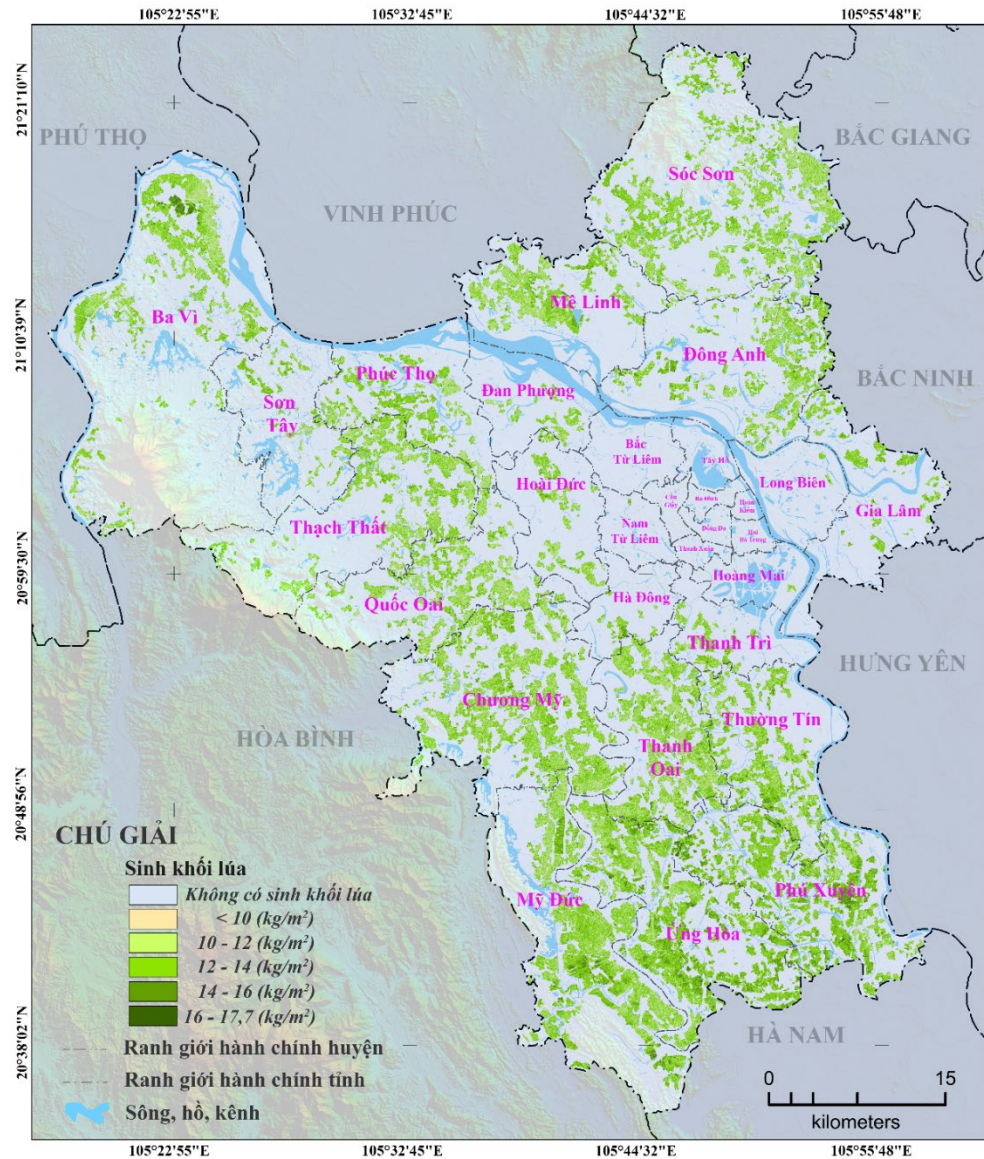
Survey points, SAS



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

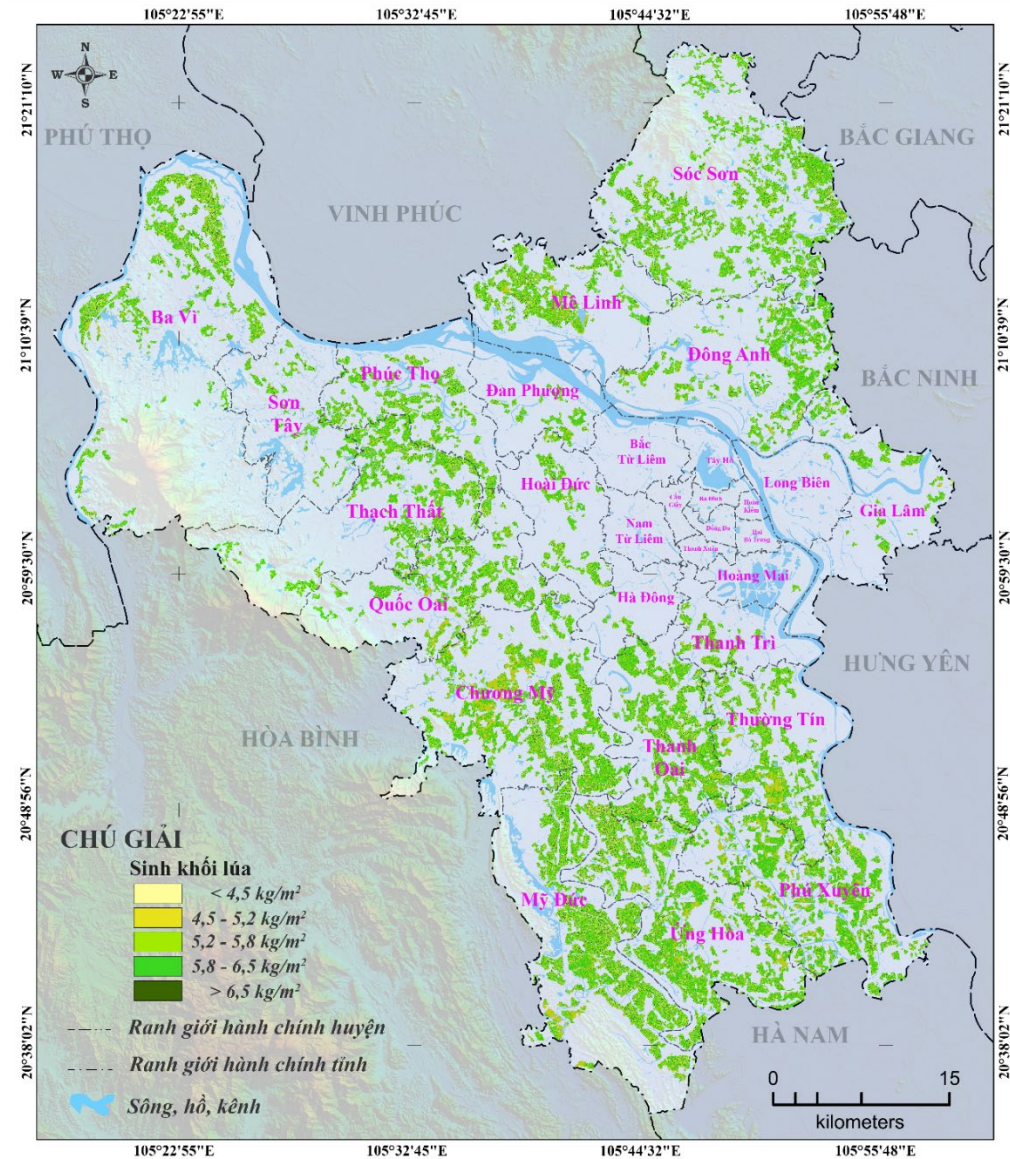
Biomass product, SWS



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
Trưởng Đại học Khoa học Tự nhiên - Đại học Quốc gia Hà Nội

Biomass product, SAS

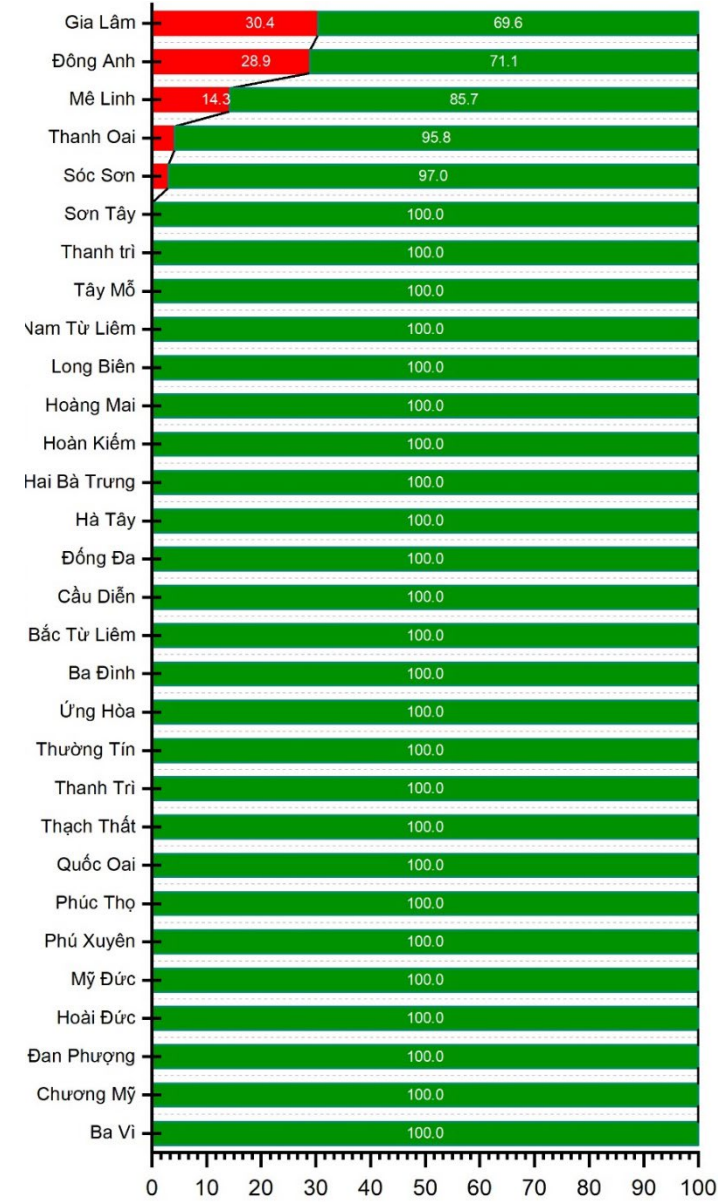


Dữ liệu: Ảnh vệ tinh Sentinel-1 và Sentinel-2
Cơ quan Vũ trụ Châu Âu (ESA)

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



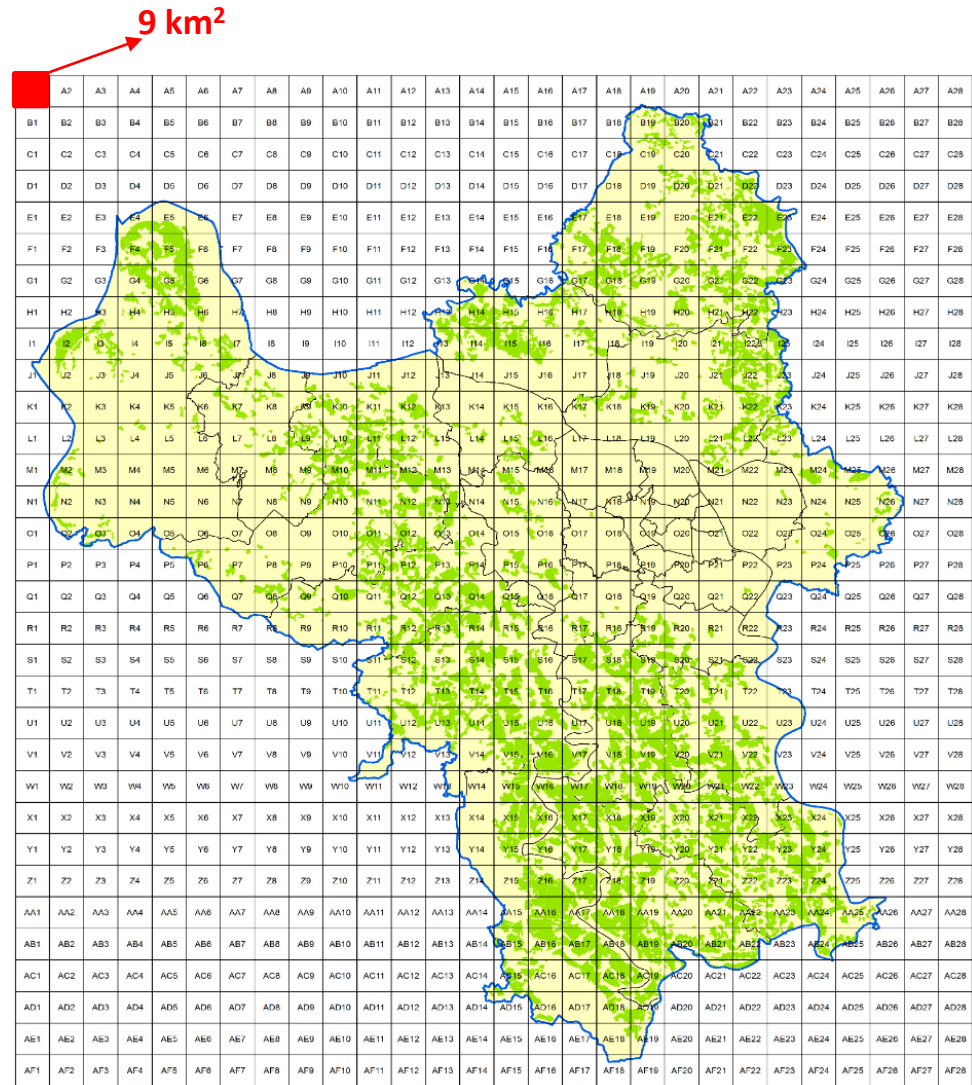
RS burned rate, SWS



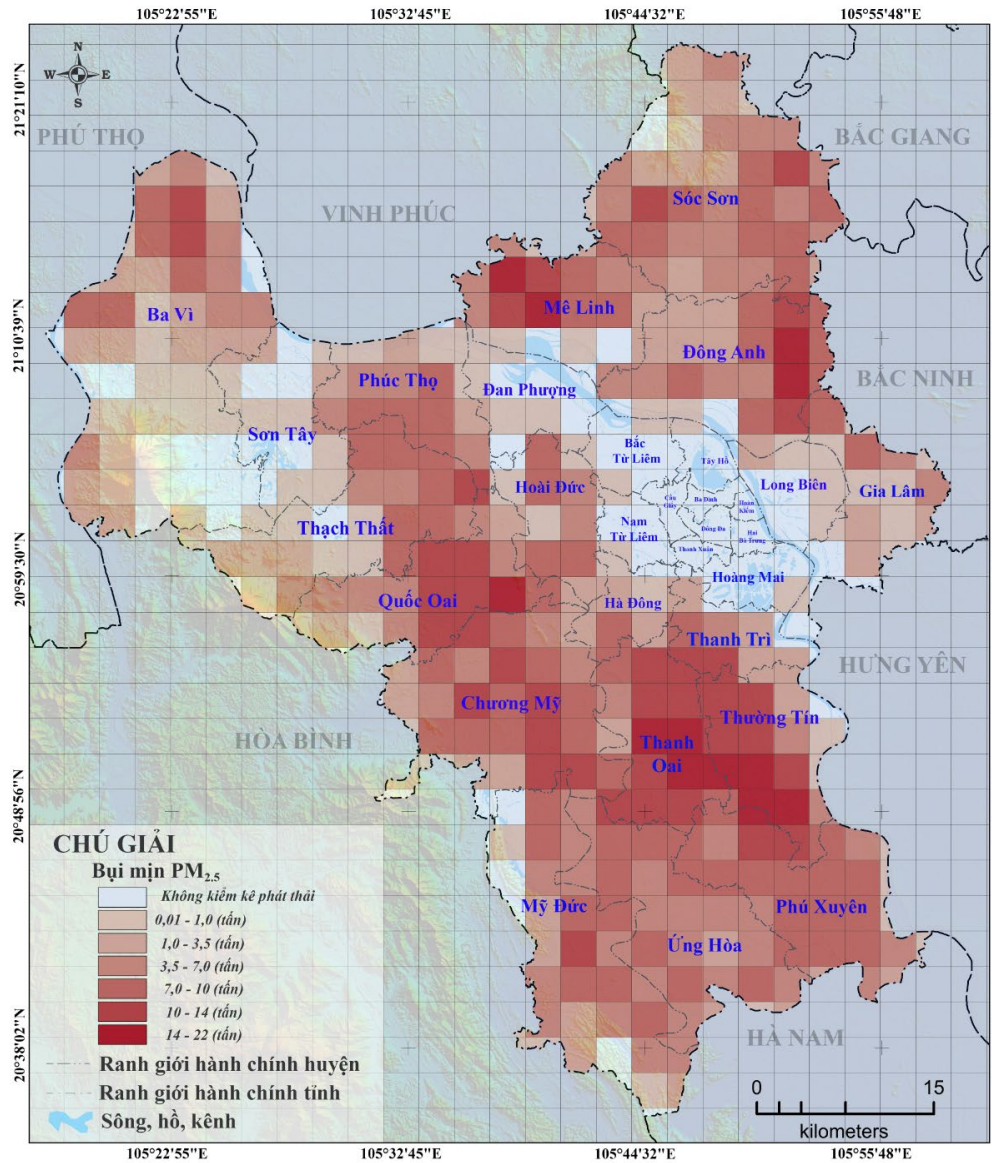
RS burned rate, SAS

Excel spreadsheet showing data for 'Hanoi capital 2021' and 'Rice production (tonnes)' (2021). The spreadsheet includes columns for 'Đồng Xuân', 'Hà Thủ', 'Rice straw', 'Winter-Spring', 'Summer-Autumn', and 'PM10'. A formula bar shows '=SUM(O6:O901)'. The data table below shows values for various rows (A1 to B9) and columns (F to R).

FID	ID	Description	CoL_Name	Row_Name	Rice production (tonnes) (2021)		Rice straw		RSOB in HN 2021		PM10		PM2.5	
					Đồng Xuân	Hà Thủ	Đồng Xuân	Hà Thủ	RS Winter-Spring	RS Summer-Autumn	kg/ha	0.51	9.1	8.3
Hanoi capital 2021					497,258,445.60				75,235,202.82	118,971,894.36	2,122,831,840.63	1,936,209,281.23		
0	1	A1	A	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
1	2	A2	A	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	3	A3	A	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
3	4	A4	A	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4	5	A5	A	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5	6	A6	A	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
6	7	A7	A	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
7	8	A8	A	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
8	9	A9	A	9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
9	10	A10	A	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
10	11	A11	A	11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
11	12	A12	A	12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
12	13	A13	A	13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
13	14	A14	A	14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
14	15	A15	A	15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
15	16	A16	A	16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
16	17	A17	A	17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
17	18	A18	A	18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
18	19	A19	A	19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
19	20	A20	A	20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
20	21	A21	A	21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
21	22	A22	A	22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
22	23	A23	A	23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
23	24	A24	A	24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
24	25	A25	A	25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
25	26	A26	A	26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
26	27	A27	A	27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
27	28	A28	A	28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
28	29	B1	B	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
29	30	B2	B	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
30	31	B3	B	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
31	32	B4	B	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
32	33	B5	B	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
33	34	B6	B	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
34	35	B7	B	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
35	36	B8	B	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
36	37	B9	B	9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

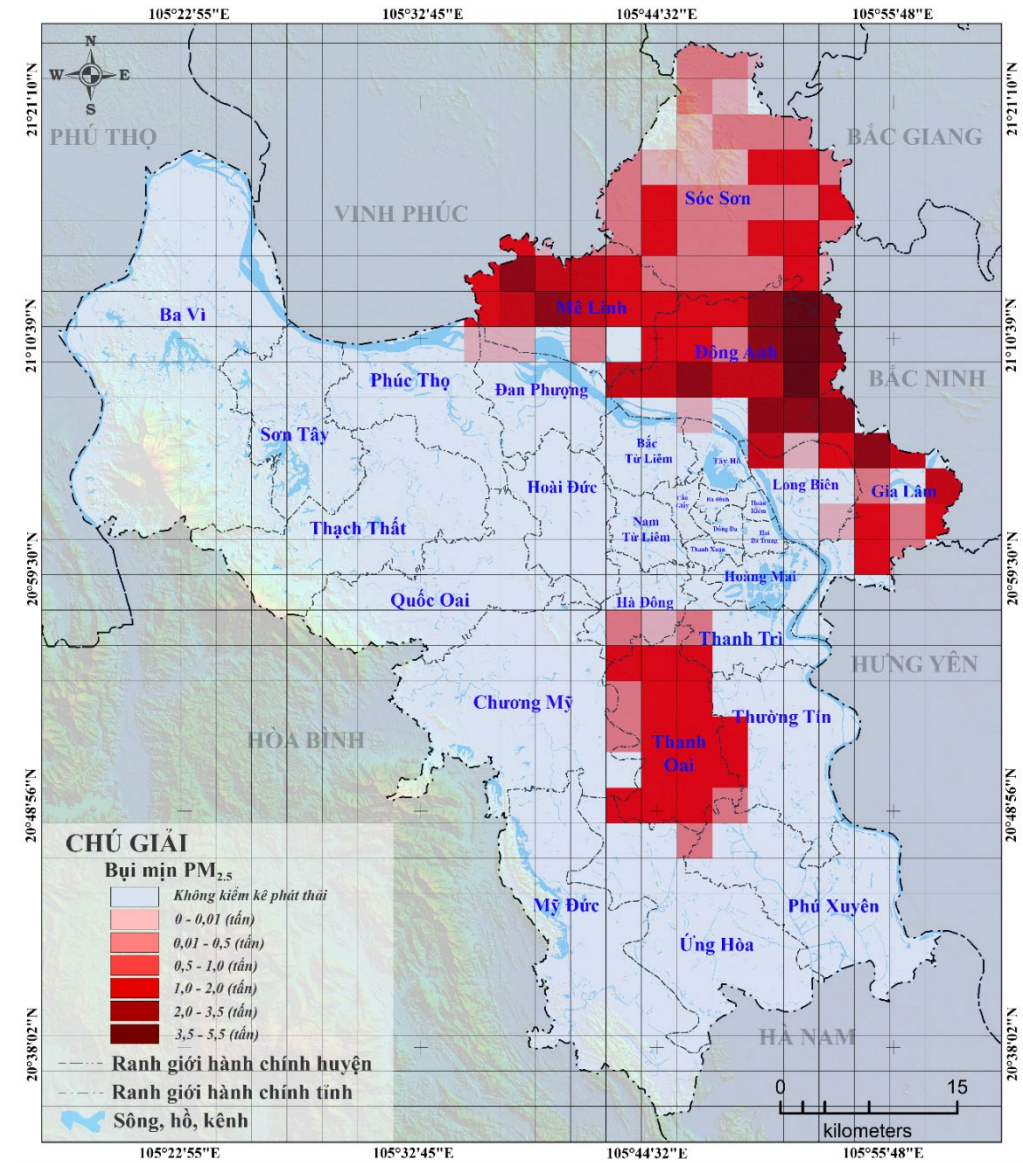


Emission, SWS



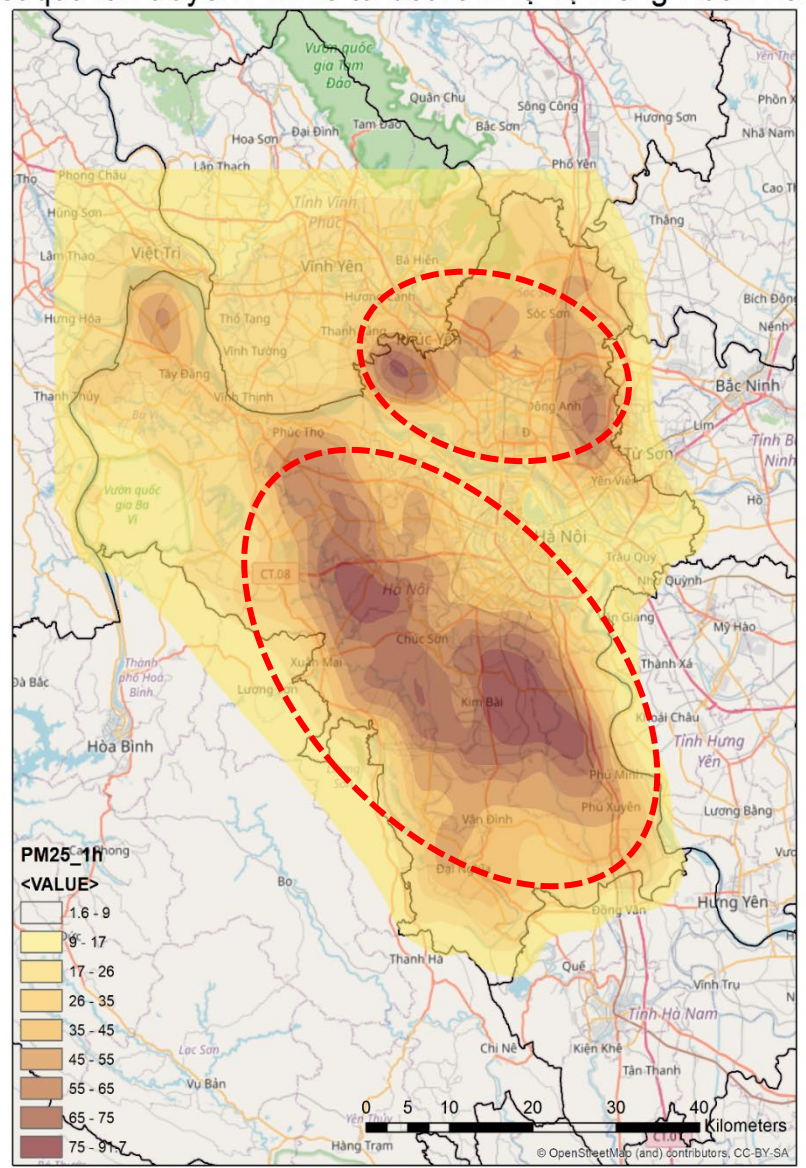
Bản quyền: Hoàng Anh Lê & Phạm Văn Mạnh
 Trường Đại học Khoa học Tự nhiên - Đại học Quốc gia Hà Nội

Emission, SAS

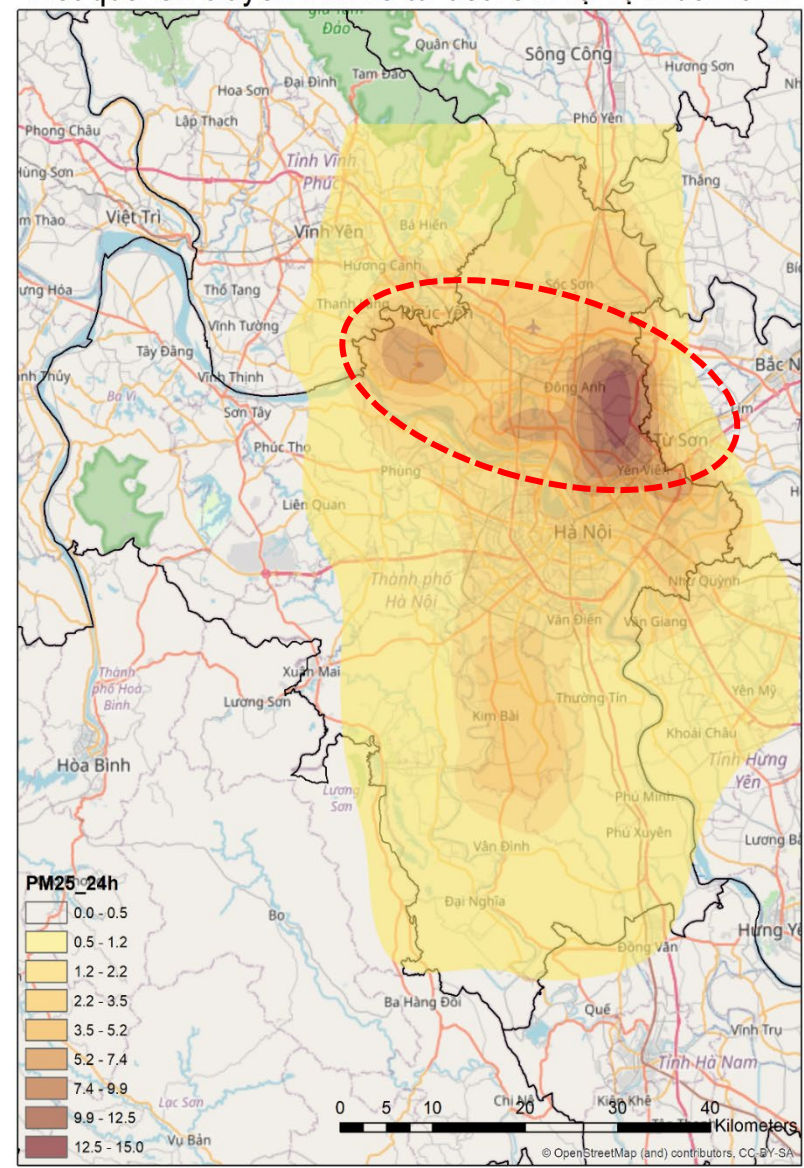


Bản quyền: Hoàng Anh Lê & Phạm Văn Mạnh
 Trường Đại học Khoa học Tự nhiên - Đại học Quốc gia Hà Nội

ADMS model for PM_{2.5}

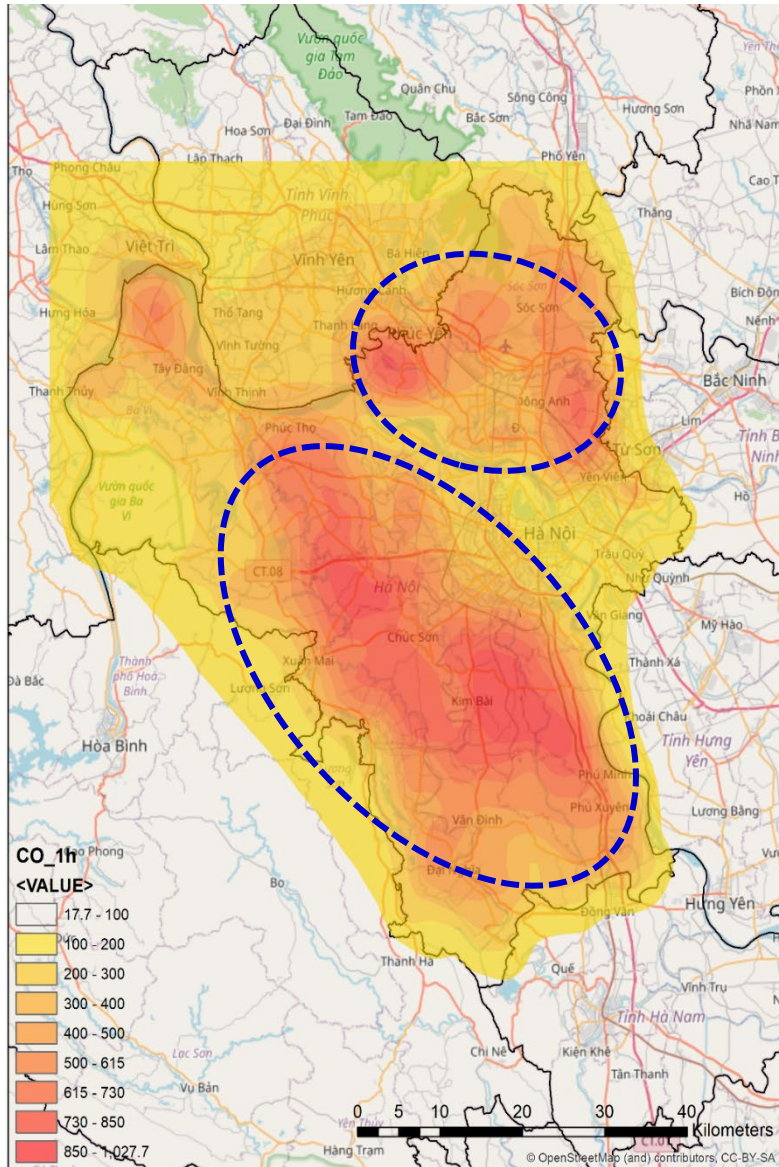


Dữ liệu: Mô hình lan truyền ADMS
 Bản quyền: Hoàng Anh Lê* & Ngô Quang Khôi**
 * Trường Đại học Khoa học Tự Nhiên - Đại học Quốc gia Hà Nội
 ** Cranfield University

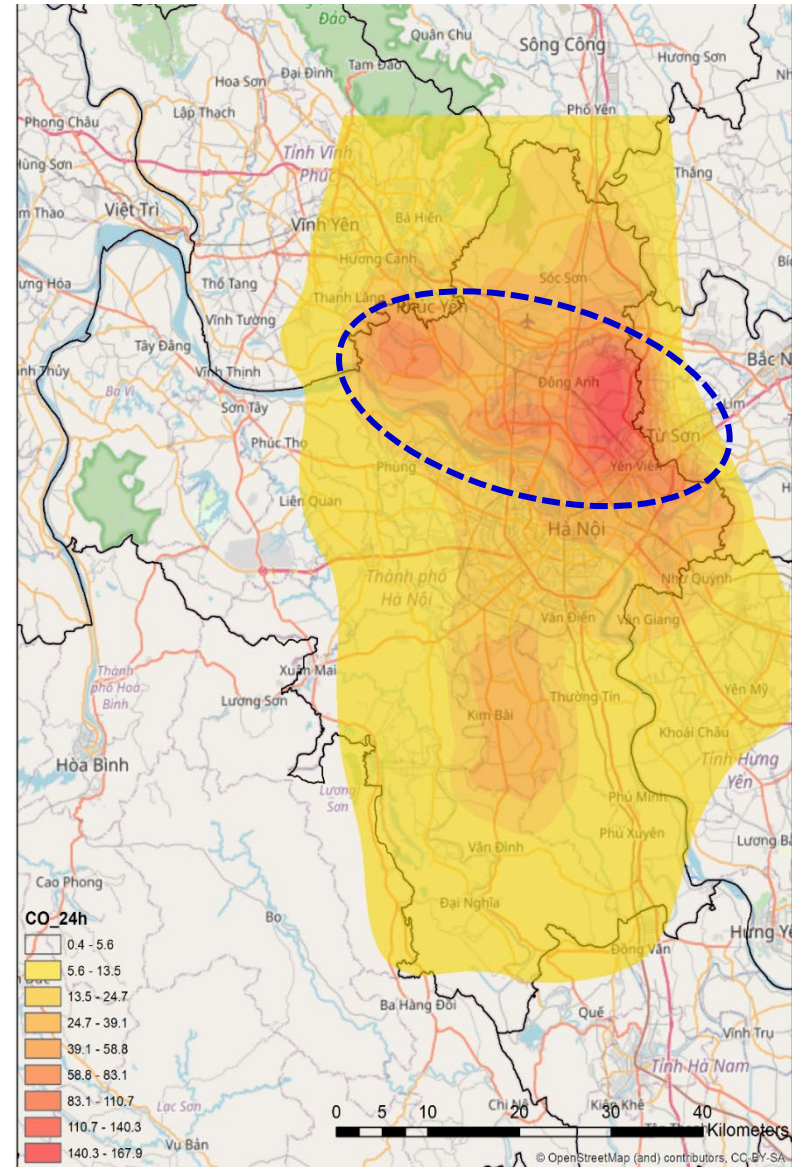


Dữ liệu: Mô hình lan truyền ADMS
 Bản quyền: Hoàng Anh Lê* & Ngô Quang Khôi**
 * Trường Đại học Khoa học Tự Nhiên - Đại học Quốc gia Hà Nội
 ** Cranfield University

ADMS model for CO



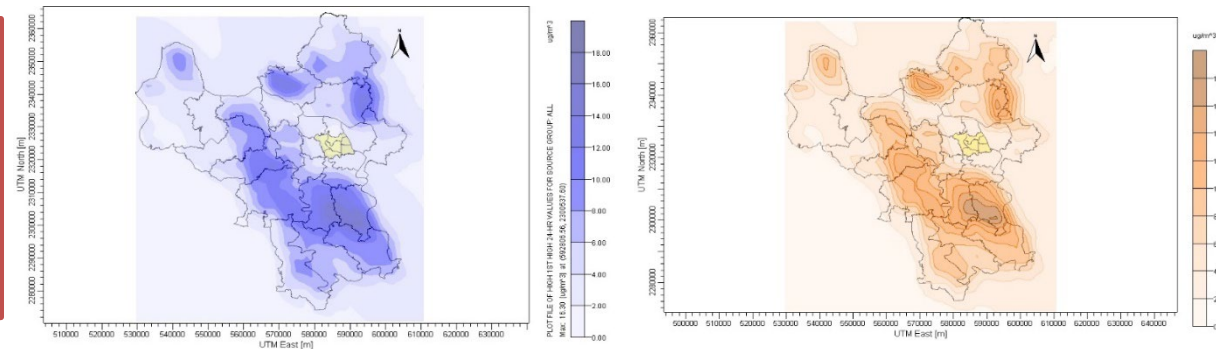
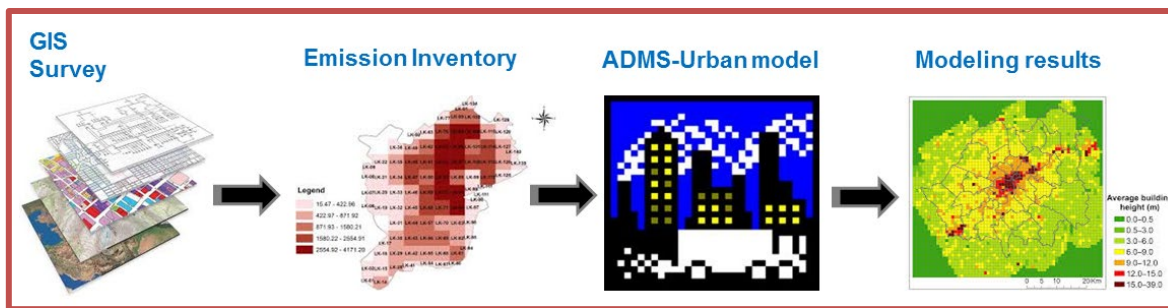
Dữ liệu: Mô hình lan truyền ADMS
 Bản quyền: Hoàng Anh Lê* & Ngô Quang Khôi**
 * Trường Đại học Khoa học Tự Nhiên - Đại học Quốc gia Hà Nội
 ** Cranfield University



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
 ** 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

Head of Department of Environmental Management
Faculty of Environmental Sciences (FES)
University of Science (VNU-HUS)
Vietnam National University (VNU)
334 Nguyen Trai Str., Thanh Xuan Dist., Hanoi, Vietnam
H.P: (+84) 913570406
Email: leha@hus.edu.vn; leha@vnu.edu.vn
Website: www.hus.vnu.edu.vn; www.vnu.edu.vn



Say no to open burning of rice straw



- Home
- Trending
- Subscriptions
- Library
- History
- Watch later
- Liked videos

SUBSCRIPTIONS

- Popular on YouT...
- Music
- Sports
- Gaming

MORE FROM YOUTUBE

- Gaming
- Live

FILTER



Say no to open burning of rice straw shortfilm

AQM Group • 3.3K views • 3 years ago



Say No to Open Burning of Rice Straw - updated May 2016

AQM Group • 456 views • 3 years ago



Say no to open burning of rice straw - Updated

AQM Group • 148 views • 3 years ago



Say no to open burning of rice straw shortfilm 1920x1080 30p update 3

AQM Group • 99 views • 3 years ago