

DEVELOPMENT OF BANGKOK AIR QUALITY MANAGEMENT POLICY:
APPLICATION OF THE AIR POLLUTION MODEL (TAPM)

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การพัฒนานโยบายด้านการจัดการคุณภาพอากาศของกรุงเทพมหานคร
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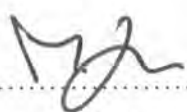
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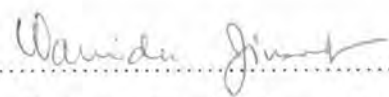
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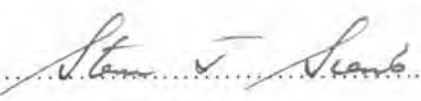
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ชุมพล ศรีประภากร : การพัฒนานโยบายด้านการจัดการคุณภาพอากาศกรุงเทพมหานคร โดยใช้ผลประยุกต์จากแบบจำลองคุณภาพอากาศ (ทีเอพีเอ็ม) (DEVELOPMENT OF BANGKOK AIR QUALITY MANAGEMENT POLICY: APPLICATION OF THE AIR POLLUTION MODEL (TAPM)) อ.ที่ปรึกษา: รศ.ดร. วนิดา จินสาตร์ อ.ที่ปรึกษาร่วม: ดร. STEVEN T.SIEMS และ ดร. สราวุธ เทพานนท์, 185 หน้า

ในการใช้แบบจำลองทีเอพีเอ็มพยากรณ์ตัวแปรทางอุตุนิยมวิทยา (อุณหภูมิผิวพื้น ความเร็วลม และทิศทางลม) เทียบกับค่าตรวจวัดจริงตลอดปี พ.ศ. 2542 พบว่า แบบจำลองฯพยากรณ์อุณหภูมิผิวพื้นได้ต่ำกว่าค่าตรวจวัดประมาณ 2 องศาเซลเซียส พบว่าค่า IOA อยู่ในช่วง 0.74-0.84 ทั้งนี้ค่าความจากผลของโคมความร้อนในตัวเมือง (Urban Heat Island) ที่แบบจำลองไม่ได้นำมาคำนวณด้วย สำหรับความเร็วลม แบบจำลองฯพยากรณ์ได้สูงกว่าค่าตรวจวัด พบค่า RMSE อยู่ในช่วง 1.49-2.21 ด้านการประเมินทิศทางลม แบบจำลองฯพยากรณ์ทิศทางลมหลักได้ดี แต่พบความคลาดเคลื่อนของการพยากรณ์ในช่วงลมมรสุมตะวันออกเฉียงเหนือ การพยากรณ์ความเข้มข้นก๊าซคาร์บอนมอนอกไซด์โดยตั้งค่าแบบจำลองชนิดใช้และไม่ใช้ข้อมูลตรวจวัดอุตุนิยม เทียบค่าตรวจวัดจริงตลอดปี พ.ศ. 2542 พบว่า แบบจำลองคำนวณค่าเฉลี่ยรายปีที่ 90 และ 95 เปอร์เซ็นไทล์ได้ใกล้เคียงกับค่าตรวจวัด

จากการใช้แบบจำลองการเติบโตของจراثกรุงฯ (บีวีจี) และแบบจำลองปริมาณจراثท้องถิ่นรายวัน (ดีทีแอล) ได้วิเคราะห์ข้อมูลเศรษฐกิจรายบุคคล ราคาน้ำมัน ราคารถยนต์ใหม่ จำนวนประชากรกรุงเทพฯ ย้อนหลังตั้งแต่ปี พ.ศ. 2532-2548 พบว่า มูลค่าผลิตภัณฑ์มวลรวมประชาชาติรายบุคคล ณ ราคาปี พ.ศ. 2531 และตัวแปรเวลา (จำนวนปี) มีนัยสำคัญทางสถิติสำหรับแบบจำลองบีวีจี 92.6% แบบจำลองดีทีแอลของถนนลาดพร้าวและดินแดง ที่ระดับความเชื่อมั่นที่ 79.5% และ 59.9% ตามลำดับ เมื่อใช้แบบจำลองคาดการณ์ค่าว่าจำนวนรถยนต์จดทะเบียนในกรุงเทพฯปี พ.ศ. 2558 มีประมาณ 6.09 ล้านคัน โดยปริมาณจراثรายวันที่ถนนลาดพร้าวและดินแดง มีจำนวนประมาณ 1.13 แสนคันต่อวัน และ 1.47 แสนคันต่อวัน ตามลำดับ

จากการคาดการณ์ปริมาณฝุ่นละอองขนาดเล็กกว่า 10 ไมครอน (ฝุ่นขนาดเล็ก) จากแบบจำลองบีวีจี และดีทีแอล ร่วมกับแบบจำลองคุณภาพอากาศทีเอพีเอ็ม พบว่า ปริมาณฝุ่นขนาดเล็กจะเพิ่มขึ้นเป็นลำดับตั้งแต่ปี พ.ศ. 2550-2558 ในช่วง $45.7-90.1 \mu\text{g}/\text{m}^3$ สำหรับถนนลาดพร้าว และ $72.3-143.0 \mu\text{g}/\text{m}^3$ สำหรับถนนดินแดง โดยมีปริมาณการปลดปล่อยฝุ่นขนาดเล็กต่อปีตั้งแต่ปี พ.ศ. 2550-2558 บริเวณถนนลาดพร้าวและดินแดง อยู่ในช่วง 251.4-552.4 ตันต่อปี และ 126-246.8 ตันต่อปี ตามลำดับ

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ลายมือชื่อนิสิต.....

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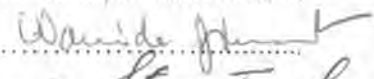
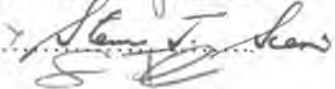
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MODEL / DAILY TRAFFIC LOCALIZATION (DTL) MODEL / FINE
PARTICULATE MATTER (PM10)

CHUMPOL SRIPRAPARKORN: DEVELOPMENT OF BANGKOK AIR
QUALITY MANAGEMENT POLICY: APPLICATION OF THE AIR
POLLUTION MODEL (TAPM). THESIS ADVISOR: ASSOC. PROF. WANIDA
JINSART, Ph.D., THESIS CO-ADVISOR: STEVEN T.SIEMS, Ph.D., AND
SARAWUT THEPANONDH, Ph.D., 185 pp.

This research aims to develop a framework on which to develop an air quality management policy for Bangkok. Future development scenarios are proposed, and the impacts of these scenarios are then assessed. This research has may be divided into four parts: the evaluation of the ability of The Air Pollution Model (TAPM, v3.0) to simulate the air quality in the semi-tropical environment of Bangkok, the development of future emission inventories of fine particulate matter (PM10) based upon various growth scenarios, the simulation of these various emissions inventories, and finally the analysis of these growth scenarios with respect to the air quality guidelines.

The evaluation of the TAPM model was undertaken on carbon monoxide for the year 1999. These simulations were observed to consistently under predict the surface temperature by 1.5-2°. This may simply be a reflection of the very strong urban heat island effect present in Bangkok. The next aim was to develop an emissions inventory for PM10 based upon vehicle usage. Records of vehicle registrations allowed for a Bangkok Vehicle Growth (BVG) model to be developed. The BVG was then combined with a model of the local emissions near two observations sites to estimate vehicle usage (and thus emissions) near the Ladphrao and Dindaeng pollution control sites. The base growth models predicts that the daily traffic on Ladphrao and Dindaeng to reach 113,000 and 147,000 vehicles per day, respectively. A local emissions inventory was then developed and used to initialise TAPM simulations of PM10. The model suggests that the PM10 concentration will increase at both sites, 45.7-90.1 µg m⁻³ for Ladphrao and 72.3-143.0 µg m⁻³ for Dindaeng, during 2007-2015. An analysis of a variety of potential air quality policies suggests that the installation of new air quality equipment would have the greatest impact on these levels.

Field of Study Environmental Management	Student's signature..... 
Academic year 2006	Advisor's signature..... 
	Co-Advisor's signature..... 
	Co-Advisor's signature.....

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ABBREVIATIONS

$\mu\text{g}/\text{m}^3$	Microgram per Cubic meter
ACM-KM	Accumulated Kilometer
AQMP	Air Quality Management Policy
AVG	Average
BAN	Ban Somdej station
BVG	The Bangkok Vehicle Growth model
BVRN	Bangkok Vehicle Registration Number
CO	Carbon Monoxide
CORR	Pearson Correlation
DET	Deterioration Rate
DET-EF	Deterioration-applied Emission Factor
DIN	Dindaeng road/station
DMA	Don Muang Airport station
DTL	The Daily Traffic Localization model
GNP pct_1988	Gross National Product per capita at 1988 price
GPP_bkk	Gross Provincial Product of Bangkok at current market price
HDDB	Heavy-duty Diesel Bus
HDDT	Heavy-duty Diesel Truck
IOA	Index of Agreement
IPIECA	International Petroleum Industry Environmental Conservation Association
LAD	Ladphrao road/station
LDDV	Light-duty Diesel Vehicle
LDGV	Light-duty Gasoline Vehicle
MAX	Maximum
MC	Motorcycle
MIN	Minimum
NI pct	National Income per capita
NON	Nontri Vidhaya School station
PCD	The Pollution Control Department

PM10	Particulate Matter diameter less than 10 μm
RAM	Ramkhamhaeng station
RHC	Robust Highest Concentration
RMSE	Root Mean Square Error
SING	Singharat station
SRK	Sirikit Convention Center meteorological observation site
TAPM	The Air Pollution Model configured without meteorological assimilation
TAPM#	The Air Pollution Model configured with meteorological assimilation
UHI	Urban Heat Island
ZKE	Zero Kilometer Emission Level