MODELING OF TRANSPORT PROCESSES FOR AIR POLLUTANTS ENHANCED WITH GEOGRAPHIC INFORMATION SYSTEM

By

BONIFACE CHUKS EKECHUKWU

Thesis submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Doctor of Philosophy

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DEDICATION

To My Wife and Children

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

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Chairman: Prof. Dato. Muhamad Zohadie Bardaie, Ph.D., P.Eng.

Faculty: Engineering

The message of this research is that meteorological data should be resolved first to obtain their resultants. The resultants of the meteorological data, wind speed and direction are then used for the evaluation of Pasquill-Gifford plume dispersion model for better accuracy. Air pollutants dispersing in the atmosphere have another force acting on them. The force that is acting on the air pollutants is the wind velocity, which has both magnitude and direction. The wind finally succeeds in diverting and altering the normal speed and direction of the pollutant. Under still air, air pollutants can disperse normally in the atmosphere at their own speed and direction. The speed and force of the wind normally dominate the air pollutants. This is why resultant speed is absolutely necessary in tracing air pollutants dispersion. The resultant speed and direction are like the true speed and direction of the pollutant. The use of trigonometry in determination of resultant speed and direction gives more accuracy in locating the true position of the pollutant in the form of position vector. This research has used a geometric approach to trace air pollutants in the form of position vectors. When the equation is resolved the resultant speed and direction

usually come out. This resultant speed in turn is used to evaluate Pasquill-Gifford plume dispersion model to get the accurate concentration of the pollutants. Observed CO data from Kajang town of Malaysia has been used to validate the model. The research further enhances the model with Geographic Information Systems. Dots density is used to represent distribution of pollutant molecules, polygon to represent buildings and lines to represent roads or rails. This research, having used a new method of simulating the movement of air pollutants with respect to winds direction, applied geographical information systems (GIS) to display in a town map the movement of air pollution.

Abstrak tesis dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Doktor Falsafah

PEMBINAAN MODEL UNTUK MENGESAN ARAH DAN PENYEBARAN PENCEMAR-PENCEMAR UDARA DIENHANCE OLEH SISTEM INFOMASI GOEGRAFIK

Oleh

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Pengerusi : Prof. Dato. Muhamad Zohadie Bardaie, Ph.D., P.Eng.

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Mesej penyelidikan ini ralah data meteorologi patut diseresaikan sebelum memperoleni keputusanna. Keputusana data meteorologi, kelajuan dan aran angin akan digunakan seterusnya untuk penilain Pasquuill-Gifford 'plume' dispersi model bagi meninggikan ketepatan model ini pencemar udara di atmosfera mempunyai satu lagi daya yang bectindak ke atasnya. Daya yang dimaksudkan ini ralah kelajuan angin yang mempunyai aran dan magnitud. Aknirnya, anyin akan berjaya dalam menguban kelajuan dan aran tuju pencemar-pencemar udara. Pada kebiasaan, kelajuan dan daya angin mengatasi kelajuan dan daya pencemar udara. Oleh itu, kelajuan keputusan data meteorologi adalan perlu dalam mengesan dispersi pencemar udara. Kelajuan dan aran daripada keputusan data meteorologi adalan seperti kelajuan dan aran sebenar pencemar udara. Penggunaan trigonometri dalam penentuan kelajuan dan aran keputusan data meteorologi memberi lebin ketepatan dalam menentukan posisi sebenar bahan peneemar dalam bentuk posisi vektor. Bila persamaan diselesaikan, kelajuan dan aran keputusan data meteorologi diperoleni.

Kelajuan dari sini digunukan untuk menentukan, model Pasquill-Gifford plume-dispersi bagi mendapatkan konsenirasi tepat pencemar. Data pemerhatian dari Bandar Kajang (di Malaysia) telan digunakun untuk mengesahkan model tersebut. Kajian ini juga turut menjadikan model tersebut lebin menarik dengan sistem informasi geografik (GIS). ‘Dots density’ digunakan untuk mewakili penyebaran molekul pencemari poligon untuk mewakili bangunan dan garisan untuk mewakili jalan raya dan jalan keretapi. Kajian ini setelah menggunakan kaedan baru untuk stimulasi gerakan pencemar udara dengan mengambil kera aran angin, mengaplikasikan sistem informasi geografi (GIS) untuk mempamerkan pergerakan peneemaran udara dalam peta bandar.

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I certify that an Examination Committee met on 2nd of April, 2004 to conduct the final examination of Boniface Chuks Ekechukwu on his Doctor of Philosophy thesis entitled "Modelling of Transport Processes For Air Pollutants Enhanced With Geographic Information System" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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DELARATION

I hereby declare that the thesis is based on my original work except for quotations and citations, which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

BONIFACE CHUKS EKECHUKWU

Date

TABLE OF CONTENTS

			Page
DEDICATION			ii
ABSTRACT			iii
ABSTRAK			v
ACKNOWLEDGEMENT			vii
APPROVAL			viii
DECLARATION			x
LIST OF TABLES			xiii
LIST OF FIGURES			xiv
CHAPTER			
1	**INTRODUCTION**		1.1
	1.1	Statement of the Problems	1.4
	1.2	Aim and Objectives	1.5
	1.3	Scope and Limitations	1.7
	1.4	Outcome of the Research	1.8
2	**LITERATURE REVIEW**		2.1
	2.1	Origin of air pollution control	2.1
	2.2	History of Air Pollution Modeling	2.6
		2.2.1 Description Of Models	2.7
		2.2.2 Type of model	2.9
3	**METHODOLOGY**		3.1
	3.1	Model Structures	3.1
	3.2	Development of Model	3.2
	3.3	Wind-field	3.3
	3.4	Turbulence and Turbulent Motion	3.4
	3.5	Atmospheric Stability	3.4
	3.6	Directional Tracing	3.5
	3.7	Position of Air Pollutant Particle in the three dimensional plane	3.7
	3.8	Ideal Gas Mixtures	3.10
	3.9	Flow and Diffusion	3.11
	3.10	Gaussian Plume Equation	3.13
	3.11	Lateral Dispersion	3.14
	3.12	Vertical Dispersion	3.14

3.13 Model Applicability 3.15
3.14 Development of GIS 3.16
3.15 Constraints 3.18
3.16 Assumptions 3.18
3.17 Model predictions 3.19
3.18 Other Assumptions and Constraints 3.19
3.19 Input Requirements 3.20
3.20 Data Analysis 3.20
3.21 Output Analysis 3.20
3.22 Process Description 3.21
3.23 Diffusion 3.23
3.24 Derivation of the diffusion equation 3.25
3.25 Steady state solutions of the diffusion equation 3.27
3.26 Resistance of diffusion 3.29
3.27 Diffusion resistance plus environmental sink 3.30
3.28 Diffusion Facilitated by wind speed 3.32
3.29 Pollutants flow driven by pressure 3.44
3.30 Pollutants flow driven by gravity 3.45
3.31 Pollutants flow driven by temperature 3.46

4 **MODEL SIMULATION AND VALIDATION** 4.1
4.1
Resolution of Meteorological forces 4.1
4.2 New
Model Integration 4.4
4.3 Plume Model Construction 4.8
4.4 Puff Model Construction 4.9
4.5 Simulation of the new Method Using Puff 4.11
4.6 Assessment of accuracy 4.13
4.7 Simulation of the new Method Using Plume 4.16

5 **RESULTS AND DISCUSSIONS** 5.1
5.1 Chart discussions for Prediction with Kajang CO Data of 2000 5.4
5.2 Output Display with Geographical Information Systems(GIS) 5.16

6 **CONCLUSION** 6.1

BIBLIOGRAPHY R.1
APPENDICES A.1
BIODATA OF THE AUTHOR B.1