

Environmental Research, Technology Demonstration and Conference Projects

Project Completion

Project Number	07/2009																																				
Project Title	Study of photochemical air pollution in Hong Kong																																				
Principal Investigator (PI)	Prof Tao WANG, Department of Civil and Environmental Engineering, The Hong Kong Polytechnic University																																				
Project Summary	The main purpose of the project is to advance the knowledge of atmospheric science, provide scientific support to the governments of HKSAR and Guangdong in mitigating photochemical smog, and develop research tools and human resources for long-term management of air quality in the region																																				
Project Duration	48 months (From 2 July 2010 to 1 July 2014)																																				
Total Amount Approved	\$6,554,936																																				
Financial Status (as at project end date on 30 November 2013)	<p>Up to the present, eight disbursements totalling \$5,899,000 were issued to the recipient organization. According to the financial statement submitted by the PI at the end of the project, the total expenditure of the approved budget items amounted to \$6,340,952.15, as shown in the Budget & Expenditure Table below which has been examined and supported by the Research Projects Vetting Subcommittee (RPVSC):</p> <p style="text-align: center;"><u>Budget & Expenditure Table</u></p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;">Item</th> <th style="text-align: center;">Approved Budget (\$) (Revised in November 2011)</th> <th style="text-align: center;">Actual Expenditure (\$) (supported by RPVSC)</th> </tr> </thead> <tbody> <tr> <td>I. Manpower</td> <td></td> <td></td> </tr> <tr> <td>- Senior Research Assistant</td> <td style="text-align: right;">1,200,000</td> <td style="text-align: right;">999,033.65</td> </tr> <tr> <td>- Research Assistant</td> <td style="text-align: right;">2,799,936</td> <td style="text-align: right;">2,791,467.75</td> </tr> <tr> <td>II. Equipment</td> <td></td> <td></td> </tr> <tr> <td>- H₂O₂ Analyzer</td> <td style="text-align: right;">400,000</td> <td style="text-align: right;">399,538.40</td> </tr> <tr> <td>- JNO₂</td> <td style="text-align: right;">200,000</td> <td style="text-align: right;">199,998.46</td> </tr> <tr> <td>- Multi-gas Calibrator</td> <td style="text-align: right;">120,000</td> <td style="text-align: right;">119,984.50</td> </tr> <tr> <td>- Weather Station (Wind, Temp, TH, Solar, TUV)</td> <td style="text-align: right;">50,000</td> <td style="text-align: right;">49,775.65</td> </tr> <tr> <td>III. Station setup & Operation</td> <td></td> <td></td> </tr> <tr> <td>- Station premises PolyU</td> <td style="text-align: right;">215,000</td> <td style="text-align: right;">210,806.15</td> </tr> <tr> <td>- Transportation Travelling expenses to Tung Chung</td> <td style="text-align: right;">35,000</td> <td style="text-align: right;">38,893.50</td> </tr> </tbody> </table>	Item	Approved Budget (\$) (Revised in November 2011)	Actual Expenditure (\$) (supported by RPVSC)	I. Manpower			- Senior Research Assistant	1,200,000	999,033.65	- Research Assistant	2,799,936	2,791,467.75	II. Equipment			- H ₂ O ₂ Analyzer	400,000	399,538.40	- JNO ₂	200,000	199,998.46	- Multi-gas Calibrator	120,000	119,984.50	- Weather Station (Wind, Temp, TH, Solar, TUV)	50,000	49,775.65	III. Station setup & Operation			- Station premises PolyU	215,000	210,806.15	- Transportation Travelling expenses to Tung Chung	35,000	38,893.50
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	IV. General Expenses		
	- Replacement Parts & Consumables		
	- Standard Gases for Instrument Calibration	150,000	149,977.87
	- Operating gases	110,000	110,173.83
	- Filters & sample analyses	125,000	120,848.22
	- Instrument Replacement Parts / Consumables	362,000	362,289.90
	- Chemicals	80,000	78,515.89
	- Computer Accessories	35,000	34,366.74
	- Sampling Inlets, Accessories : tubing, Fittings, etc.	233,000	233,013.15
	- Instrumental Repair / Service by Suppliers	100,000	102,693.29
	- Shipment Charges	20,000	20,681.45
	V. Equipment & Operation Support		
	- Payment for Using Instruments & Support by the Mainland Partner	300,000	299,999.75
	VI. Dissemination of Study Results to the Public		
	- Setup & Maintenance of a Website	20,000	18,894
	Total :	6,554,936	6,340,952.15
Project Results and Achievements	<p>This project aims to answer some of the key scientific questions relating to persistent photochemical air pollution in Hong Kong and to develop research tools and human resources for the long-term management of 'green' environment in the Hong Kong-Pearl River Delta region (HK-PRD). The following project objectives have all been achieved:</p> <ul style="list-style-type: none"> ● With in-depth analysis of long-term air quality monitoring data and intensive supersite measurements data in the HK-PRD region, a comprehensive picture of oxidants pollution in Hong Kong is obtained. The ambient concentrations of O₃ show an increasing trend at most of the stations in the region, while the concentrations of ozone precursors (NO_x, CO and VOCs) have decreased. The overall situation of photochemical pollution in Hong Kong has not been improved. ● By combining the measurements and modelling studies, the project team has quantified the roles of synoptic and mesoscale meteorology in the trapping of air pollutants within Hong Kong, and in the transport of air pollutants to Hong Kong from other cities in the PRD (regional transport) and from other parts of Asia (super-regional transport). The results indicate that the regional impact has negated the local control 		

efforts of Hong Kong, and highlighted the significant contributions of regional/super-regional transport to the ozone pollution in Hong Kong.

- Based on supersite observations and data analysis, the project team gained comprehensive understanding of the sources and key chemical pathways involved in the formation of oxidants in a sub-tropical climate. The project team investigated in detail the O₃ production mechanism and established a conceptual model for O₃ pollution in Hong Kong. For the first time in Hong Kong, the project team has studied the heterogeneous chemistry of nitrous acid (HONO), dinitrogen pentoxide (N₂O₅) and hydrogen peroxides. These studies have yielded new insights into the atmospheric chemistry and suggested new research leads.
- The project team also developed integrated tools and the human resources needed for the further study of air pollution and climate in PRD and other rapidly developing regions of China. It developed some new capabilities for conducting high-level research on atmospheric chemistry, including improved models and measurement techniques for application in the high NO_x and oxidative subtropical environment such as HK and the PRD region. In addition, a well-trained multi-disciplinary and collaborative team has been developed, and many young researchers and students were trained.
- The results of the project have also provided scientific support to the governments in developing regional environmental policies/measures and mitigating photochemical smog, including findings on the need for local action and cross-boundary cooperation in the control of ozone pollution and recommendations for improvement of current air monitoring systems and future work to address the strong atmospheric oxidative capacity in Hong Kong. In conclusion, this 4-year collaborative project has significantly advanced knowledge of atmospheric science, provided timely support to air-quality management in HK and China, trained essential human resources, and promoted public awareness of regional air pollution and urgent need to solve the problem.

Major findings of the project are as follows:

- The ambient concentrations of NO_x and CO have been decreasing at most of the stations in Hong Kong. Meanwhile, the O₃ concentrations have still shown an increasing trend in most areas in HK-PRD region. The local ozone production in Hong Kong has been reduced through the strict VOC control by the government. However, the background ozone levels have increased more significantly, which were mainly attributed to the regional transport from the PRD and eastern China. This regional impact has negated the local control efforts of Hong Kong.
- HONO was found to be a dominant radical (OH) source at Tung Chung (TC), not only in the morning but also throughout the daytime. Some new insights about direct emission and heterogeneous production of HONO on aerosol and ground surfaces were obtained. ‘Missing’ daytime source of HONO was found at TC, and further analysis revealed the

	<p>possible contribution by aerosol surface. The emission factors of HONO were derived from the field measurement. Our results also suggested the important role of sea surface in the heterogeneous HONO formation and hence atmospheric photochemistry in the coastal areas like Hong Kong. These results have improved model simulations of ozone pollution in Hong Kong.</p> <p>The project team will present the project results and findings at the ECF Committee meeting scheduled for 17 December 2015.</p>
Action Required	<p>Members' views are invited on whether the project completion should be endorsed.</p> <p>Subject to Members' endorsement of the project completion, the total project expenditure will be \$6,340,952.15, and taking into account the amount already issued to the recipient organization as well as the interest income of \$9,498.70 generated, an amount of \$432,453.45 will be issued to the recipient organization to finalize the project account.</p>