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EDUCATION

Ph.D., 2002.3, Biomedical Engineering and Environmental Sciences, National Tsing Hua University

M.Sc., 1997, Chemistry, National Central University

B.Sc., 1995, Chemistry, National Changhua University of Education

EMPLOYMENT

Adjunct Associate Professor, Department of Atmospheric Sciences, National Central University (2010~)

Associate Research Fellow, Research Center for Environmental Changes (RCEC), Academic Sinica (2010~)

Assistant Research Fellow, Research Center for Environmental Changes (RCEC), Academic Sinica (2006~2010)

Postdoctoral Fellow, Research Center for Environmental Changes (RCEC), Academic Sinica (2004~2005)

Postdoctoral Fellow, Institute of Earth Sciences, Academic Sinica (2002/10~2003/12)

Postdoctoral Fellow, Biomedical Engineering and Environmental Sciences, National Tsing Hua University (2002/3~2002/6)

HONORS & AWARDS

2018 Awarded Merit Bonus Program for Recruitment and Retention of Exceptional Talent, MOST

2017 Awarded Merit Bonus Program for Recruitment and Retention of Exceptional Talent, MOST

2016 Awarded Merit Bonus Program for Recruitment and Retention of Exceptional Talent, MOST

2013 Awarded Merit Bonus Program for Recruitment and Retention of Exceptional Talent, MOST

2010 Awarded Merit Bonus Program for Recruitment and Retention of Exceptional Talent, MOST

The 2004 Outstanding Paper Award of *Terrestrial, Atmospheric and Oceanic Sciences* (TAO) (SCI)

RESEARCH INTEREST

- (1) High performance VOC and greenhouse gas measurement techniques (on-line and in-lab)
- (2) Characterization of key precursors and their impact on secondary air pollutant formation (O₃,

- PM2.5) in urban, suburban, and rural environments
- (3) Hazardous/toxic VOCs in science parks and industrial complexes
 - (4) 3-D Multicopter UAV Sounding Technique (MUST) Platform
 - (5) Intelligent aerial monitoring for air pollution and meteorological variables

RESEARCH HIGHLIGHTS

Intelligent Aerial Monitoring for Air Pollution and Meteorological Variables:

Spatial information about chemical composition and meteorological variables is crucial for studying the chemical/physical processes of pollutants, especially in the near-surface atmosphere, where emissions and atmospheric processes of pollutants are most vigorous. We developed an novel multicopter UAV sounding technique (MUST) serving as an integrated platform to probe a comprehensive set of atmospheric variables, including meteorological parameters (temperature, relative humidity, pressure, wind direction and speed), the chemical composition (speciated VOCs, CO, CO₂, CH₄, CO₂ isotopologues, O₃, PM_{2.5}, and black carbon), and the radiation flux, as well as visible and thermal images. The versatile MUST has the potential to become an indispensable solution for parameters of high relevancy to the near-surface atmosphere, which could assist in atmospheric, meteorological, and interdisciplinary studies, e.g., spatial distribution and chemical/physical processes of smog and haze, pollution plume tracking, micrometeorology, determination of inversion layer heights, air-sea interactions, and investigation of industrial disasters, etc.

Environmental and Atmospheric Trace Gases:

Trace gases (VOCs, CO, CO₂, CH₄, N₂O, O₃, etc.) are recognized as the principal trace constituents in the atmosphere, which play a crucial role in many important environmental issues. These issues encompass tropospheric secondary oxidant formation (e.g., organic peroxy radicals (RO₂), ozone (O₃), and secondary organic aerosols (SOA)), stratospheric ozone depletion, regional and global climate, and toxicity concerns. My research interests focus on the development of high performance trace gas measurement techniques to investigate the environmental problems of trace gas relevance.

REPRESENTATIVE PUBLICATIONS (SCI Publication=72, h-Index=30)

1. **Chih-Chung Chang***, Chih-Yuan Chang, Jia-Lin Wang, Xiang-Xu Pan, Yen-Chen Chen, Yu-Jui Ho, 2020. An optimized multicopter UAV sounding technique (MUST) for probing comprehensive atmospheric variables. *Chemosphere* (in press). (SCI: 5.107)
2. **Chih-Chung Chang***, Chih-Yuan Chang, Jia-Lin Wang, Ming-Ren Lin, Chang-Feng Ou-Yang, Xiang-Xu Pan, Yen-Chen Chen, 2018. A study of atmospheric mixing of trace gases by aerial sampling with a multi-rotor drone. *Atmospheric Environment* 184, 254-261. <https://doi.org/10.1016/j.atmosenv.2018.04.032> (SCI: 4.012)

3. Chang-Feng Ou-Yang, Wei-Cheng Liao, **Chih-Chung Chang***, Hsin-Cheng Hsieh, Jia-Lin Wang*, 2018. Guided Episodic Sampling for Capturing and Characterizing Industrial Plumes. *Atmospheric Environment* 174, 188-193. (SCI: 4.012)
4. **Chih-Chung Chang***, Jia-Lin Wang, Chih-Yuan Chang, Mao-Chang Liang, Ming-Ren Lin, 2016. Development of a multicopter-carried whole air sampling apparatus and its applications in environmental studies. *Chemosphere* 144, 484-492. (SCI: 5.107)
5. Sheng-Po Chen, Yuan-Chang Su, Ching-Jui Chiu, Ching-Ho Lin, Julius Chang, **Chih-Chung Chang***, Jia-Lin Wang*, 2015. Inter-comparison of network measurements of non-methane organic compounds with model simulations. *Atmospheric Environment* 122, 94-102. doi:10.1016/j.atmosenv.2015.09.033
6. Chang-Feng Ou-Yang, **Chih-Chung Chang***, Shen-Po Chen, Clock Chew, Bo-Ru Lee, Chih-Yuan Chang, Geoffrey S. Dutton, Stephen A. Montzka, James H. Butler, James W. Elkins, Jia-Lin Wang*, 2015. Changes in the Levels and Variability of Halocarbons and the Compliance with the Montreal Protocol from an Urban View. *Chemosphere* 138, 438-446. (SCI: 5.107)
7. **Chih-Chung Chang***, Jia-Lin Wang, Shih-Chun Candice Lung, Chih-Yuan Chang, Po-Ju Lee, Clock Chew, Wei-Cheng Liao, Wei-Nai Chen, Chang-Feng Ou-Yang, 2014. Seasonal characteristics of biogenic and anthropogenic isoprene in tropical-subtropical urban environments. *Atmospheric Environment* 99, 298-308.
8. Wen-Tzu Liu, Sheng-Po Cheng, **Chih-Chung Chang***, Chang-Feng Ou-Yang, Wei-Cheng Liao, Yuan-Chang Su, Yue-Chuen Wu, Jia-Lin Wang*, 2014. Assessment of carbon monoxide (CO) adjusted non-methane hydrocarbon (NMHC) emissions of a motor fleet – A long tunnel study. *Atmospheric Environment* 89, 403-414.
9. F. Rohrer*, K. Lu, A. Hofzumahaus, B. Bohn, T. Brauers, **Chih-Chung Chang**, H. Fuchs, F. Holland, K. Kita, Y. Kondo, X. Li, S. Lou, Min Shao, Limin Zeng, Yuanhang Zhang, A. Wahner, 2014. Maximum efficiency in the hydroxyl-radical-based self-cleansing of the troposphere. *Nature Geoscience* 7, 559–563. doi:10.1038/ngeo2199.
10. Jia-Lin Wang, Clock Chew, Chih-Yuan Chang, Wei-Cheng Liao, Shih-Chun Candice Lung, Wei-Nai Chen, Po-Ju Lee, Po-Hsiung Lin, **Chih-Chung Chang***, 2013. Biogenic isoprene in subtropical urban settings and implications for air quality, *Atmospheric Environment* 79, 369-379.
11. Jia-Lin Wang, **Chih-Chung Chang***, Kun-Zhang Lee, 2012. In-line Sampling with Gas Chromatography-Mass Spectrometry to Monitor Ambient Volatile Organic Compounds. *Journal of Chromatography A* 1248, 161-168.
12. **Chih-Chung Chang**, Chang-Feng OuYang, Chieh-Heng Wang, Sen-Wei, Chiang, Jia-Lin Wang*, 2010. Validation of in-situ Measurements of Volatile Organic Compounds through Flask Sampling and Gas Chromatography/Mass Spectrometry Analysis. *Atmospheric Environment* 44, 1301-1307. doi:10.1016/j.atmosenv.2009.12.016.

13. **Chih-Chung Chang***, Jia-Lin Wang, Shih-Chun Candice Lung, Shaw-Chen Liu, Chein-Jung Shiu, 2009. Source characterization of ozone precursors by complementary approaches of vehicular indicator and principal component analysis. *Atmospheric Environment* 43, 1771-1778.
14. Hofzumahaus, A., F. Rohrer*, K. Lu, B. Bohn, T. Brauers, **Chih-Chung Chang**, H. Fuchs, F. Holland, K. Kita, Y. Kondo, X. Li, S. Lou, Min Shao, Limin Zeng, A. Wahner, Yuanhang Zhang, 2009. Amplified trace Gas Removal in the Troposphere. *Science* 324, 1702-1704. (SCI: 29.781)
15. **Chih-Chung Chang**, Cheng-Hsun Lai, Chieh-Heng Wang, Ying Liu, Min Shao, Yuanhang Zhang, Jia-Lin Wang*, 2008. Variability of ozone depleting substances as an indication of emissions in the Pearl River Delta, China. *Atmospheric Environment* 42, 6973-6981.
16. **Chih-Chung Chang***, Jia-Lin Wang, Shaw-Chen Liu, Shih-Chun Candice Lung, 2006 “Assessment of vehicular and non-vehicular contributions to hydrocarbons using exclusive vehicular indicators” *Atmospheric Environment* 40, 6349-6361.
17. **Chih-Chung Chang***, Tai-Yih Chen, Chuan-Yao Lin, Chung-Shin Yuan, Shaw-Chen Liu, 2005. “Effects of reactive hydrocarbons on ozone formation in southern Taiwan” *Atmospheric Environment* 39, 2867-2878.
18. **Chih-Chung Chang**, Shun-Jin Lo, Jiunn-Guang Lo, and Jia-Lin Wang*, 2003. Analysis of Methyl *tert*-butyl ether (MTBE) in the atmosphere and implications as an exclusive indicator of automobile exhaust. *Atmospheric Environment* 37, 4747-4755.
19. **Chih-Chung Chang**, Jiunn-Guang Lo, Cheng-Hsiung Tasi and Jia-Lin Wang, 2001. Concentration variation of halocarbons over an electrical industrial park and its implication in compliance with the Montreal Protocol. *Environmental Science & Technology*, Vol. 35, No 16, pp.3273-3279.
20. **Chih-Chung Chang**, Jiunn-Guang Lo and Jia-Lin Wang, 2001. Assessment of reducing ozone forming potential for vehicles using liquefied petroleum gas as an alternate fuel. *Atmospheric Environment* 35, 6201-6211.