台灣氣膠研究學會 Newsletter
Taiwan Association for Aerosol Research
NO.81 December 2020

Announcement

- **The 2nd board meeting of the 15th Committee of Directors and Supervisors has been held at National Pingtung University of Science and Technology on Dec. 19th, 2020.**
- New member for Corporate Membership.

  Huimin environmental tech corporation
- We have 9 new Full-members in TAAR. Welcome!
  1. **Hsu, Yi-Chun,** Director of the Center, Sustainable Environment and Remote Sensing Research Center, Kun Shan University
  2. **Lin, Kun-Yi,** Full Professor, Dept. of Environmental Engineering, National Chung Hsing University
  3. **Lu, Chien-Ho,** Researcher, General Research Service Center, National Pingtung University of Science and Technology
  4. **Chiu, Yi-Cheng,** Chairman, ExcelTek Engineering Consultants Corp.
  5. **Chang, Kuang-Chih,** Deputy Chief Engineering, Water Resources Agency, MOEA
  6. **Hsu, Wen-Li,** Researcher, Kaohsiung Municipal Ta-Tung Hospital, Kaohsiung Medical University
  7. **Tsai, Ming-Hsien,** Assistant Professor, Dept. of Child Care, National Pingtung University of Science and Technology
  8. **Wang, Ying-Fang,** Assistant Professor, Dept. of Occupational Safety and Health, Chung Shan Medical University
  9. **You, Sheng-Jie,** Dept. of Environmental Engineering, Chung Yuan Christian University
- AAQR is an SCIE indexed journal.

Contents

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◎ Editors：Sheng-Hsiang Wang, Yu-Chih Lin, Pei-Shih Chen, Yen-Ping Peng, Hsiao-Chi Chuang, Yu-Chieh Ting, Liang-Yi Lin, Kai-Chun Nien

◎ Date：9 FEB 2021

◎ Website http://www.taar.org.tw/

◎ E-mail：taarasst@gmail.com

The 2nd board meeting of the 15th Committee of Directors and Supervisors

Research Profile：Fang-Yi Cheng

2020 Chiu-sen Award

Name：Fang-Yi Cheng

Affiliation：Professor, Department of Atmospheric Sciences, National Central University

Education：

Ph.D of Department of Geosciences, University of Houston, TX, USA
Master of Department of Earth and Atmospheric Sciences, University of Houston, TX, USA
Bachelor of Department of Atmospheric Sciences, National Central University

E-mail：bonniecheng18@gmail.com

Webpage：
https://in.ncu.edu.tw/~fcheng/index.html

Personal History and Research Interests

Dr. Cheng graduated from Department of Atmospheric Sciences, National Central University for her bachelor degree. She obtained her Ph.D degree in Department of Earth and Atmospheric Sciences, University of Houston, TX, USA, in 2006. She joined the Department of Atmospheric Sciences, National Central University in August, 2009. The air pollution problems and atmospheric processes are tightly linked together. Dr. Cheng and her team developed a regional to local scale atmospheric physical and chemical modeling system to study the air pollution problems.

The major research conducted during the past five years include: (1) study the impact of the short-term weather and long-term climate on the air pollutants dispersions, (2) characterize the effect of the urbanization and complex terrain on the planetary boundary layer evolution, (3) source-apportionment of air pollutants, (4) development of the air quality modeling system and emission control strategy. Details are listed below.

A. Impacts of short-term weather and long-term climate on the air quality conditions in Taiwan

Hsu and Cheng (2016, 2019) applied the cluster analysis to classify the synoptic weather pattern and study its impact on local air pollutant concentrations in Taiwan. When the synoptic weather is influenced by a weak synoptic weather, due to the stagnant wind condition and enhanced stability, the high PM2.5 concentrations are observed, particularly over the central to southwestern Taiwan. When the prevailing wind are affected by the strong northeasterly monsoonal flow, the long-range transported air pollutants from China affect the local air quality in northern Taiwan. Summer related weather types are associated with low air pollutant concentrations. The results of the weather classification clearly indicate distinct synoptic weather patterns in Taiwan, that is associated with different air pollutant behaviors.

Cheng and Hsu (2019) indicated that the current emissions control strategy is able to improve the general PM2.5 problem in Taiwan and reduce the ambient PM2.5 concentration. Under regional climate change, a decreasing trend of wind speed and an increasing trend of stagnant wind conditions have occurred over the past 39 years, and a trend of enhanced stably stratified atmospheric structures have been observed in the past decade in Taiwan. Worsening meteorological conditions can limit air pollution dispersion and degrade air quality. Mitigation and reduction in the PM2.5 concentrations in the southwestern Taiwan can be difficult due to the worsening meteorological conditions. The long-term declining trend of PM2.5 in Taiwan is mainly associated with changes in local anthropogenic emissions and modulated by short-term yearly variations due to strong haze events in China. To successfully reduce the high PM2.5 concentrations, a stringent and effective emission reduction plan needs to be designed in a proper manner by decision-makers.

1. Cheng, F.-Y*. and C.-H. Hsu, 2019. Long-term variations in PM2.5 concentrations under changing meteorological conditions in Taiwan. Scientific Reports 9, 6635.
2. Hsu, C.-H. and F.-Y. Cheng*. 2019. Synoptic weather patterns and associated air pollution in Taiwan. Aerosol and Air Quality Research, 19, 1139-1151.
3. Hsu, C.-H. and F.-Y. Cheng*. 2016. Classification of weather patterns to study the influence of meteorological characteristics on PM2.5 concentrations in Yunlin County, Taiwan. Atmospheric Environment. V144, P397-408

B. Development of the air quality forecasting system in Taiwan

A real-time air quality forecasting (AQF) system using Weather Research and Forecasting (WRF) meteorological model and Community Multiscale Air Quality (CMAQ) model version 5.2 was developed in Taiwan. Cheng et al. (2021) investigated the performance of the AQF system and developed a bias-correction technique to improve the accuracy of the PM2.5 forecasts at each surface monitoring stations. The bias-correction method, which combines a cluster-analysis-based synoptic weather classifications, and considers the systematic PM2.5 biases associated with each weather type. There is common variability of the bias patterns within the same weather types and distinct variability between different weather types. The assessment of the CMAQ forecast output and the result after the application of the bias-correction method shows that the new bias-correction method is able to reduce the raw model forecast PM2.5 concentrations.

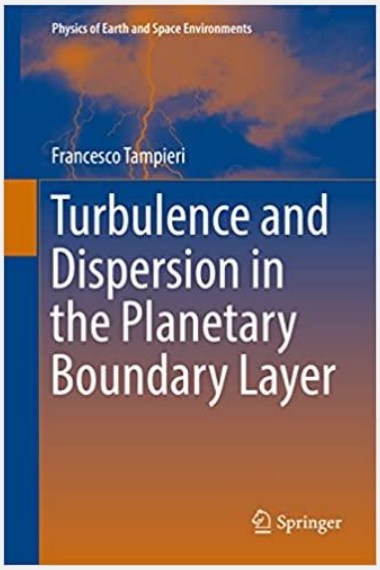
Hsu et al. (2019) developed a dynamical ammonia (NH3) emissions parameterization to improve the representation of the temporal variation in the major NH3 emissions sources for air quality model simulations in Taiwan. The CMAQ simulation with the application of the dynamical NH3 emissions approach improved the diurnal and seasonal variations in the NH3 and nitrate concentrations and reduced the simulated biases of NH3, nitrate and ammonium, particularly in the winter months. Given the significant uncertainty in processing NH3 emissions, a comprehensive process-based method or inverse modeling techniques should be used to optimize the estimation of NH3 emissions in Taiwan.

1. Cheng, F.-Y*, C.-Y. Feng, Z.-M. Yang, C.-H. Hsu, K.-W. Chan, C.-Y. Lee, S.-C. Chang, 2021. Evaluation of real-time PM2.5 forecasts with the WRF-CMAQ modeling system and weather-pattern dependent bias-adjusted PM2.5 forecasts in Taiwan. Atmospheric Environment, 244, 117909.
2. Hsu, C.-H., F.-Y. Cheng*, H.-Y. Chang, N.-H. Lin, 2019. Implementation of a dynamical NH3 emissions parameterization in CMAQ for improving PM2.5 simulation in Taiwan, Atmospheric Environment, 218, 116923.

C. Development of the high-resolution land surface conditions and its applications

Over the past few decades, land use (LU) and land cover (LC) characteristics in Taiwan have changed substantially. Major cities such as Taipei, Taichung, and Kaohsiung have evolved into megacities, accompanied by the removal of croplands and trees on the outskirts and further urbanization in different parts of the metropolitan area. A new LU dataset, obtained using 2009 MODIS satellite imagery with resolution 500 m, accurately shows the major metropolitan cities as well as other land types Cheng et al. (2013). Cheng et al. (2019) estimated the effective roughness lengths to better represent the roughness elements in Taiwan. An effective aerodynamic roughness length was estimated for the Taiwan area by considering the individual roughness lengths of underlying land coverages that make up the modeling grid box. Moreover, Lin and Cheng (2016) and Cheng and Chen (2018) developed a soil texture database to improve the soil conditions for numerical weather simulation. The update of the LU data, surface roughness length, soil texture and terrain height data enhances the simulation of the surface energy budget, surface meteorological fields, and land-sea breeze circulations in Taiwan. The application of the correct land surface datasets improves numerical weather simulations and enhance weather forecasting capability in Taiwan.

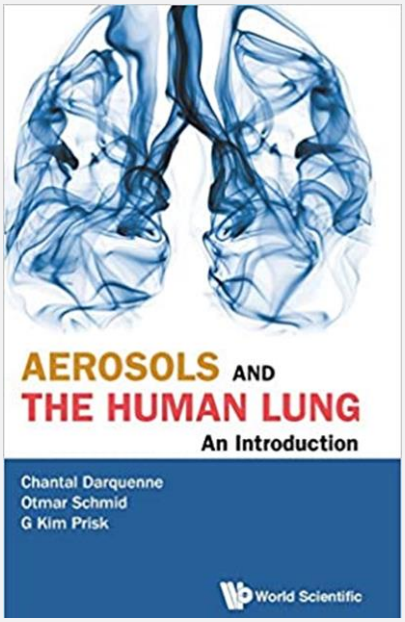
1. Cheng, F. Y.*, Lin, C. F., Wang, Y. T., Tsai, J. L., Tsuang, B. J., and Lin, C. H., 2019. Impact of Effective Roughness Length on Mesoscale Meteorological Simulations over Heterogeneous Land Surfaces in Taiwan. Atmosphere, 10 (12), 805.
2. Cheng, F.-Y.*, Hsu, Y.-C., Lin, P.-L., Lin, T.-H., 2013. Investigation of the effects of different land use and land cover patterns on mesoscale meteorological simulations in the Taiwan area, Journal of Applied Meteorology and Climatology, V52, NO.3, P.570-587.
3. Cheng, F.-Y.*, Yi Chen, 2018. Variations in soil moisture and their impact on land–air interactions during a 6-month drought period in Taiwan, Geoscience Letters, 5:26 1-14.
4. Lin, T.-S., F.-Y. Cheng*, 2016, Impact of soil moisture initialization and soil texture on simulated land–atmosphere interaction in Taiwan, Journal of Hydrometeorology, 17, 1337-1355.



Title: **Turbulence and Dispersion in the Planetary Boundary Layer**
Author: Francesco Tampieri
Publisher: Springer (2016)
Language: English
ISBN-13: 978-3319436029

Description:

In *Turbulence and Dispersion in the Planetary Boundary Layer* , Francesco Tampieri provides a comprehensive review of our current understanding of the planetary boundary layer, particularly the turbulent exchanges of momentum, heat and passive scalars between the surface of the Earth and the atmosphere. It presents and discusses the observations and the theory of the turbulent boundary layer, both for homogeneous and more realistic heterogeneous surface conditions, as well as the dispersion of tracers. Lastly it addresses the main problems arising due to turbulence in weather, climate and atmospheric composition numerical models. Written for postgraduate and advanced undergraduate-level students and atmospheric researchers, it is also of interest to anyone wanting to understand the findings and obtain an update on problems that have yet to be solved.



Title: Aerosols and the Human Lung: An Introduction

Authors: Chantal Darquenne, Otmar Schmid, G Kim Prisk

Publisher: WSPC (2020)

Language: English

ISBN-13: 978-9811212178

Description:

This book provides a comprehensive overview of the field of aerosol science related to particle inhalation and its effect on the lung, predominately in humans. It covers the basics of aerosol behavior, transport, deposition, clearance, and effects of aerosols, both environmental and therapeutic. Aimed at the researcher entering the field of aerosol inhalation it provides a valuable introductory resource in an accessible format.

Calendar of Events

Dates	Conferences	Location
Postponed to 2022 (T.B.D)	**Asian Aerosol Conference 2021** https://conference.gigvvy.com/aac2021	Taipei, Taiwan
26 MAR	**2021 Theory and Technique Taiwan Forum on Sustainable Environment** http://www.taar.org.tw/conference/20210326	Taipei, Taiwan
21 – 24 JUN 2021	**24th ETH-Conference on Combustion Generated Nanoparticles** http://www.nanoparticles.ch/index.html	Zürich, Switzerland
30 AUG – 3 SEP 2021	**European Aerosol Conference 2021 (EAC 2021)**	Birmingham, UK
24 – 25 SEP 2021	**The 28th International Conference on Aerosol Science and Technology (ICAST 2021)** (Coming soon…)	Pingtung, Taiwan
18 – 22 OCT 2021	**AAAR 39th Annual Conference**	Albuquerque Convention Center, Albuquerque, NM
4-9 SEP 2022	**11th International Aerosol Conference (IAC 2022)** https://pcoconvin.eventsair.com/iac2022/	Athens, Greece

Glossary

Atmospheric boundary layer

Atmospheric boundary layer (ABL) is also called planetary boundary layer or boundary layer. It is the bottom layer of the troposphere, which is directly affected by its contact with surface of the earth. The boundary layer height (BLH) ranges from 100 meters to 3000 meters. Due to the influence of surface heating, the BLH has a diurnal cycle, and the structure can be described by time. During daytime, a mixed layer grows in depth because of the heat transfer from the warm ground or wind shear, and it is capped by a stable entrainment zone. Near sunset, turbulence decays, becoming neutrally stratified, and leave a residual layer in place of the mixed layer.

During nighttime, due to the radiative cooling, the inversion occurs at the bottom of residual layer, and the top of inversion is considered as nocturnal stable boundary layer height.

In the study of air pollution, the boundary layer height would influence the vertical dispersion condition of pollutants, and the boundary layer height is closely related to the inversion layer above. Additionally, the inversion layer is related to phenomena, such as subsidence, radiative cooling, sloping front, downslope wind, and so on. Therefore, it is useful to understand the vertical distribution of pollutants by analyzing the inversion layer.