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EDUCATION

2015/09 – 2019/12 Ph.D. in Climate Sciences, University of Michigan, United States
2009/09 – 2012/01 M.S. in Atmospheric Sciences, National Taiwan University, Taiwan
2005/09 – 2009/06 B.S. in Atmospheric Sciences, National Central University, Taiwan

EMPLOYMENT

2023/03 – present Assistant Research Fellow RCEC, Academia Sinica, Taiwan
2020/02 – 2023/02 Postdoctoral Research Associate, Program in Atmospheric and Oceanic Sciences, Princeton University, United States
2013/04 – 2015/06 Research Assistant RCEC, Academia Sinica, Taiwan

HONORS & AWARDS

2017 Government Scholarship to Study Abroad, Ministry of Education, Taiwan
2016 Rackham International Students Fellowship/Chia-Lun Lo Fellowship, Rackham Graduate School, University of Michigan
2015 Dean's Fellowship, College of Engineering, University of Michigan

PROFESSIONAL SERVICE

- Member: American Geophysical Union; American Meteorological Society
- Journal reviewer*: Terrestrial, Atmospheric and Oceanic Sciences*
- Co-organizer, 6th Climate Hotpots in Action (CHiA) Forum, Academia Sinica, Taiwan, 08/21/2023-08/23/2023
- Co-organizer, Climate Hotpots in Action (CHiA) Webinar series

GRANTS

1. Addressing Marine Stratocumulus Biases in Taiwanese Earth SystemModel version 1 (TaiESM1), National Science and Technology Council (NSTC), Taiwan, 08/2023-07/2026

RESEARCH INTEREST

- Planet boundary layer and convection, and their parameterizations
- Infrared radiation parameterization
- Climate modeling and diagnostics
- History of atmospheric sciences

My research interests are to understand cloud and radiation processes and their roles in the Earth's climate system, with a particular focus on parameterizing these processes in climate models. I have extensively worked on cloud and radiation parameterization schemes in climate models, including modifications of existing schemes, implementation of new schemes, and evaluation of simulation results. For instance, during my PhD study, I modified the longwave radiation scheme in NCAR CESM to include surface spectral emissivity and ice-cloud longwave scattering, and then investigated to what extent these modifications influence the simulated climate over the regions of interest, such as the Sahara and Sahel regions and the high latitudes. I also did similar implementations for the DoE E3SM model. During my postdoc, I explored two different coupling strategies for the boundary layer and convection schemes in GFDL AM4. In addition, I implemented a new boundary layer/convection scheme, Mellor-Yamada-Nakanishi-Niino Eddy-Diffusivity/Mass-Flux (MYNN-EDMF), into AM4 and evaluated its performance on marine stratocumulus regions.

RESEARCH HIGHLIGHTS

Influence of ice cloud longwave scattering on the polar climate

Most climate models neglect cloud longwave (LW) scattering because scattering is considered negligible compared to strong LW absorption by clouds and greenhouse gases. While this rationale is valid for simulating extrapolar regions, it is questionable for the polar regions, where the atmosphere is dry and hence has weak absorption, and ice clouds that have strong scattering capability frequently occur. Using the slab-ocean Community Earth System Model, we show that ice cloud LW scattering can warm winter surface air temperature by 0.8–1.8 K in the Arctic and 1.3–1.9 K in the Antarctic, while this warming becomes much weaker in polar summer. Such scattering effect cannot be correctly assessed when sea surface temperature and sea ice are prescribed as this effect is manifested through a surface-atmosphere coupling. For further details, please check out our 2020 GRL paper (https://doi.org/10.1029/2020GL090534).

Exploring two coupling strategies of the boundary layer and convection schemes

Planet boundary layer (PBL) and moist convection closely couple with each other. Here we explore two coupling strategies of PBL and convection schemes in GFDL AM4, namely, (1) PBL_then_Conv, in which the convection scheme sees the state updated by the PBL scheme, and (2) PBL_and_Conv,

in which both PBL and convection schemes see the same state. The AMIP results show that these coupling strategies have the strongest impact on marine shallow cumulus regime. PBL_and_Conv has weaker convection, stronger PBL activities, and more low cloud than those in the PBL_then_Conv. We hypothesize that these are because the convection scheme in PBL_and_Conv "sees" a less unstable state, leading to weaker convection.

Implementation and evaluation of the MYNN-EDMF scheme in GFDL AM4

GFDL AM4 underestimates marine stratocumulus amount on the west coasts of North and South America and of South Africa, leading to excessive shortwave absorption in these regions. To address this issue, we implement the Mellor-Yamada-Nakanishi-Niino Eddy-Diffusivity/Mass-Flux (MYNN-EDMF) scheme into the AM4. The major implementation challenges include (1) incompatibility of the MYNN-EDMF cloud scheme and AM4 cloud scheme, and (2) coupling the MYNN-EDMF with other schemes. The performance of the MYNN-EDMF in AM4 is evaluated using AMIP simulation. AM4 with MYNN ED shows moderate improvements in marine stratocumulus biases. However, AM4 with MYNN-EDMF worsens the already large marine stratocumulus biases, partly due to coupling with the AM4 stratiform cloud scheme.

REPRESENTATIVE PUBLICATIONS (*: corresponding author)

Peer-reviewed journal publication

1. Fan, C., **Chen, Y.-H.**, Chen, X. H., Lin, W., Yang, P., & Huang, X. L., 2023: A refined understanding of the ice cloud longwave scattering effects in climate model. Journal of Advances in Modeling Earth Systems, 15, e2023MS003810. https://doi.org/10.1029/2023MS003810.
2. **Chen, Y.-H.***, X. L. Huang, P. Yang, C.-P. Kuo, and X. H. Chen, 2020: Seasonal Dependent Impact of Ice-Cloud Longwave Scattering on the Polar Climate, Geophys. Res. Lett., 47, 1-10, https://doi.org/10.1029/2020GL090534.
3. Shiu, C.-J., Y.-C. Wang, H.-H. Hsu, W.-T. Chen, H.-L. Pan, R. Sun, **Y.-H. Chen**, and C.-A. Chen, 2021: GTS v1.0: A Macrophysics Scheme for Climate Models Based on a Probability Density Function, Geosci. Model Dev., 14, 177-204, https://doi.org/10.5194/gmd-14-177-2021.
4. Kuo, C.-P., P. Yang, X. L. Huang, **Y.-H. Chen**, and G. Liu, 2020: Assessing the accuracy and efficiency of longwave radiative transfer models involving scattering effect with cloud optical property parameterizations. J. Quant. Spectrosc. Radiat. Transf., 240, 106683, https://doi.org/doi:10.1016/j.jqsrt.2019.106683.

5. **Chen, Y.-H.**, X. L. Huang, X. H. Chen, and M. Flanner, 2019: The Effects of Surface Longwave Spectral Emissivity on Atmospheric Circulation and Convection over the Sahara and Sahel, J. Climate, 32, 4873-4890, https://doi.org/10.1175/JCLI-D-18-0615.1.

Non-peer-reviewed journal publication

1. **Chen, Y.-H.**, 2022: Evolution of Climate Models (In Chinese), Physics Bimonthly, 44, 25-32, https://pb.ps-taiwan.org/modules/news/article.php?storyid=648.
2. **Chen, Y.-H.**, 2022: A Short Biography of Syukoro Manabe (In Chinese), Physics Bimonthly, 44, 17-18, https://pb.ps-taiwan.org/modules/news/article.php?storyid=651.

SELECTED INVITED TALKS

1. **Chen, Y.-H.**, Influences of Surface Spectral Emissivity and Cloud Longwave Scattering on Climate Simulations, National Central University, January 9, 2020.
2. **Chen, Y.-H.**, In the Journey of Physical Parameterizations in Climate Models, Academia Sinica, October 20, 2021.
3. **Chen, Y.-H.**, The Michael Jordan in Climate Sciences: 2021 Nobel Prize in Physics laureate Syukuro Manabe, Meteorological Society of the Republic of China - Taiwan, virtual (Youtube link), December 3, 2021.
4. **Chen, Y.-H.**, Implementation and Evaluation of the MYNN-EDMF scheme in GFDL AM4, National Taiwan University, April 18, 2023.
5. **Chen, Y.-H.**, Atmospheric Models: Introduction and Evolution, Taiwanese Earth System Model Tutorial, Academia Sinica, August 24, 2023.
6. **Chen, Y.-H.**, My Research Journey, National Cheng Kung University, December 29, 2023.

OUTREACH

- **Scientific talks for the general public**

1. "Are the increasing extreme weather events related to climate change?", Academia Sinica Open House 2023, October 21, 2023 (event webpage; event photos)

- **Public Blog (in Chinese): Yi-Hsuan's journey of atmospheric sciences (陳毅軒的大氣遊記)**

1. Stories of Asian meteorologists, such as Tu-Cheng Yeh, Ching-Yen Tsay, etc
2. Stories of Japanese meteorologists, such as Akio Arakawa, Syukuro "Suki" Manabe, etc.
3. Stories of American and European meteorologists, such as Carl-Gustaf Rossby, Joanne Simpson, John Mason, etc.
4. Reflection on my research journey, 4 articles

5. Reflections on my PhD journey, 20 articles
6. Reflections on my postdoc journey, 10 articles

- **Miscellaneous articles**

1. 留學期間的文化體驗和反思，教育部 Taiwan GPS 海外人才經驗分享與國際連結計畫, https://twgps.moe.edu.tw/Post/1005.