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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; Journal of Geophysical Research: Atmospheres
- Grant reviewer: National Science and Technology Council (Taiwan);
- Co-organizer:
  - 6th Climate Hotpots in Action (CHiA) Forum, Academia Sinica, Taiwan, 2023/08/21-08/23
  - 7th Climate Hotpots in Action (CHiA) Forum, Academia Sinica, Taiwan, 2024/08/27-08/29
  - Climate Hotpots in Action (CHiA) Webinar series

GRANTS

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

RESEARCH INTEREST

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

My research focuses on understanding cloud and radiation processes and their roles in the Earth's climate system, particularly on parameterizing these processes in climate models. I have extensive experience with longwave radiation, planet boundary layer, and convection schemes in climate models. My work includes modifying existing schemes, implementing new schemes, and evaluating simulation results. Currently, I am investigating simulated marine stratocumulus characteristics in TaiESM1 by leveraging field observation data, reanalysis, and a hierarchy of TaiESM1 simulations including single-column model, nudge experiments, AMIP and fully coupled simulations.

RESEARCH HIGHLIGHTS

Characteristics of simulated marine stratocumulus in TaiESM1

TaiESM1 can reproduce realistic shortwave cloud radiative effects (SWCRE) over the marine stratocumulus regions, yet the underlying mechanisms remain unclear. Using observation data from the DYCOMS-II field campaign in the northeastern Pacific, along with TaiESM1 hindcast simulation for the same period, we find that TaiESM1 reproduces the observed SWCRE but underestimates the liquid water path and mixed layer height. To better understand TaiESM1's behaviors, we conduct a detailed tendency analysis for cloud liquid. Our analysis reveals that turbulence and macrophysics are the dominant processes, though they act in opposite ways. In the cloud layer, macrophysics generates cloud liquid while turbulence acts to remove it. In the subcloud layer, the cloud liquid diffused by turbulence is subsequently removed by macrophysics. This highlights the value of combining field campaign data, hindcast simulations, and tendency analysis to gain insights into model behavior and characteristics.

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

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. "Influences of Surface Spectral Emissivity and Cloud Longwave Scattering on Climate Simulations", National Central University, 2020/01/09.
2. "In the Journey of Physical Parameterizations in Climate Models", Academia Sinica, 2021/10/20.
3. "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), 2021/12/03.
4. "Implementation and Evaluation of the MYNN-EDMF scheme in GFDL AM4", National Taiwan University, 2023/04/18.
5. "Atmospheric Models: Introduction and Evolution", Taiwanese Earth System Model Tutorial, Academia Sinica, 2023/08/24.
6. "My Research Journey", National Cheng Kung University, 2023/12/29.
7. "History of Climate Modeling", Chinese Culture University, 2024/03/14

MENTORSHIP

- Undergraduate summer interns
    - Peng-Han Lin (National Central University), Project title: "Seasonal Variations of Cloud Radiative Effects over the South China Sea in Satellite Observation, ERA5 Reanalysis and TaiESM1" (poster; abstract), Academia Sinica, 2024/07-08
    - Yu-Hao Wang (National Taiwan Normal University), Project title: "從氣象觀測數據發掘都市發展軌跡：以臺中為例" (poster; abstract), Academia Sinica, 2024/07-08.
- Research assistants
    - Danielle Manalaysay, 2023/11-present.

OUTREACH

➢ **Scientific talks for the general public**

1. "Are the increasing extreme weather events related to climate change?", Academia Sinica Open House, 2023/10/12 (event webpage; event photos)

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

- Stories of Asian meteorologists, such as Tu-Cheng Yeh, Ching-Yen Tsay, etc. (6 articles)
- Stories of Japanese meteorologists, such as Akio Arakawa, Syukuro "Suki" Manabe, etc. (8 articles)
- Stories of American and European meteorologists, such as Carl-Gustaf Rossby, Joanne Simpson, John Mason, etc. (24 articles)
- Reflections on my research journey (5 articles)
- Reflections on my PhD journey (20 articles)
- 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, 2022/07/25.