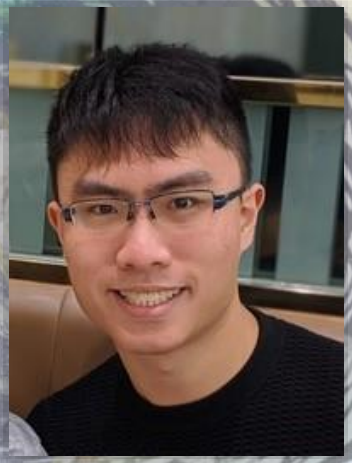
Improving the Representation of Desert Dust Emission in Earth System Models Using Process-Based and Empirical Approaches



Dr. Danny M. LEUNG (梁冕博士)

National Center for Atmospheric Research (NCAR)

Current Earth system models (ESMs) struggle to accurately simulate the spatiotemporal variability of the desert dust cycle and the impact of dust aerosols on Earth's climate and ecosystems. This is in part because these models lack multiple essential land-surface processes that couple dust with climate and land-surface changes. We address these fundamental problems and improve the representation of dust emission in ESMs using both a process-based approach and a data-driven approach. First, we develop a new process-based dust emission scheme that couples dust emission better with simulated land-surface processes in ESMs, with improved descriptions of (1) the effect of soil texture on the dust emission threshold, (2) the effects of rocks and vegetation on dissipating the surface wind stress, and (3) the effects of boundary-layer turbulence on driving intermittent dust emissions. We implement the revised dust emission scheme into the Community Earth System Model version 2 (CESM2) for dust cycle simulation. The results show that our scheme improves the CESM dust correlations against observations of key dust variables such as dust aerosol optical depth (DAOD) and surface particulate matter (PM) concentration. We also use a data-driven approach to construct a globally gridded, decadally varying 1841–2000 dust emissions; the derived emissions were then to force a long-term (1851–2000) dust simulation in CESM2. Results are in reasonable agreement with the long-term variability in most dust deposition records and long-term dust concentration trends. This contrasts with dust simulations from the Coupled Model Intercomparison Project (CMIP6), which show little to no secular trends.

21 Dec 2023

2:00 p.m.

Room 331, Science Centre

Zoom Link (Mixed-mode)

ID: 992 4969 9833 Passcode: 983837

EARTH AND ENVIRONMENTAL SCIENCES PROGRAMME

Enquires: 3943 5494 eesc@cuhk.edu.hk