

# NEWSLETTER

## HEADLINE NEWS:

### SEPRESS Seamless Prediction System Officially Launched, Ushering in a New Era of Climate-Intelligent Services

On January 21, 2026, the Seamless Prediction and Services (SEPRESS) system was officially launched and made available to the public at the first anniversary carnival of the "101 Creation Camp" at the HKUST Shanghai Center. **Prof. GUO Yike**, Provost of the Hong Kong University of Science and Technology and Foreign Member of the Chinese Academy of Engineering, **Mr. FENG Lei**, Party Secretary and Director-General of the Shanghai Meteorological Service, along with members of the SEPRESS program team, attended the launch ceremony. As an integral component of the UNESCO International Decade of Sciences for Sustainable Development (IDSSD, 2024–2033), the project leverages next-generation climate-intelligent services to provide critical support for global sustainable development, risk management, and green transition.



Attendees at the SEPRESS system launch ceremony: Prof. GUO Yike, Provost of HKUST and Foreign Member of the Chinese Academy of Engineering (center); Mr. FENG Lei, Party Secretary and Director-General of the Shanghai Meteorological Service (3rd from right); and SEPRESS team members — Prof. LU Mengqian, Director of CCRS (3rd from left), Prof. YANG Jing, Beijing Normal University (2nd from left), Prof. BAO Qing, Institute of Atmospheric Physics, Chinese Academy of Sciences (1st from left), Dr. LIANG Ping, Chief Forecaster at the Shanghai Meteorological Service (2nd from right), and Prof. JIAN Jun, Dalian Maritime University (1st from right).



The SEPRESS system launch ceremony.

The SEPRESS initiative is built around six core missions: advancing global climate dynamical model development, upgrading weather and climate prediction services, establishing transparent Research-to-Operations (R2O) processes, promoting sustainable economic growth, empowering decision-makers, and improving the resilience of vulnerable populations including women, children, and minority groups. The launch of the SEPRESS system marks a significant step toward bridging the "last-mile" in delivering Sub-seasonal to Seasonal (S2S) prediction services to end users.

The SEPRESS platform is now live and open to the public. Users can access dozens of forecast products spanning multiple sectors and domains, including agriculture, energy, shipping, and disaster risk, with continuous updates and expansions planned. Concurrently, the official SEPRESS website will publish monthly outlook reports based on the seamless prediction system, for which a regular update mechanism has already been established. Looking ahead, SEPRESS will continue to advance seamless prediction technologies, deepen collaboration with industry, regional, and international partners, and ensure that cutting-edge climate-intelligent services deliver critical value across broader segments of society.

## HKUST Team Uncovers Performance-Limiting Intragrain Impurity Nanoclusters in Metal Halide Perovskites

Researchers at the Hong Kong University of Science and Technology (HKUST) reported a major advance in understanding intragrain microstructural defects in mixed-cation perovskites. The team, led by **CCRS member Prof. ZHOU Yuanyuan**, identified widespread metastable intragrain impurity nanoclusters (IGINs) in perovskite grains, which critically limit device efficiency and operational stability.



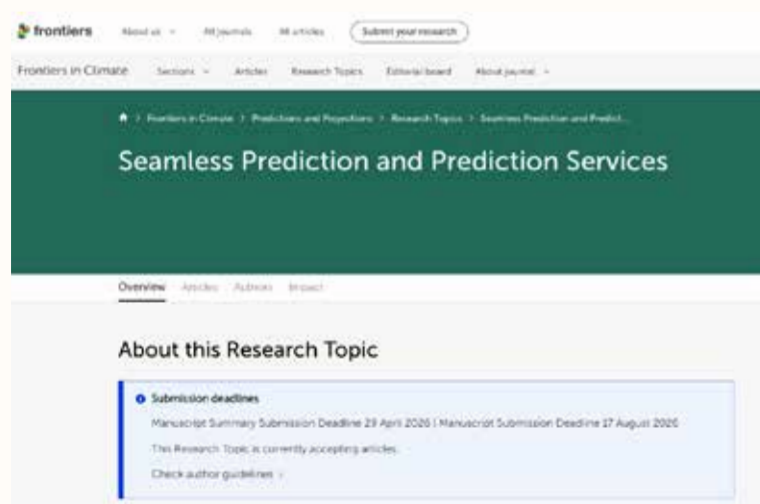
Prof. ZHOU Yuanyuan

Using low-dose scanning transmission electron microscopy (STEM), imaging simulations, and geometric phase analysis, the team directly resolved the atomic structure of these nanoclusters and confirmed them as a metastable non-perovskite  $A_2BX_4$  phase with edge-sharing octahedral chain motifs. The formation of IGINs was traced to nanoscale Cs compositional inhomogeneity within grains. Quasi-operando characterization and first-principles calculations further showed that these nanoclusters introduce defect states, enhance carrier recombination, and act as degradation seeds by decomposing into  $PbI_2$  under stress, thereby accelerating crystal deterioration.

To mitigate this intrinsic performance bottleneck, the team introduced an inner-salt additive (NDPS) into the precursor solution to regulate crystallization kinetics and homogenize Cs distribution. This strategy suppresses IGIN formation, relieves intragrain lattice strain, and reduces nonradiative recombination, leading to simultaneous gains in efficiency and stability. Devices based on this approach achieved 26.03% power conversion efficiency and maintained over 1000 hours of T95 operational stability under ISOS protocols, establishing an intragrain defect-engineering paradigm for high-performance and durable perovskite optoelectronics.

Their technology advances have paved the way for collaboration with CCRS Director Prof. LU to translate the intragrain defect-regulation strategy into practical device applications. By integrating NDPS-enabled cation homogenization and suppression of metastable intragrain impurity nanoclusters with scalable device fabrication and system-level integration, this collaboration aims to enable high-efficiency, high-stability perovskite photovoltaics for real-world deployment in sustainable energy systems.

## SEPRESS Team Launches Research Topic in Frontiers in Climate



The SEPRESS Research Topic page on *Frontiers in Climate*.

The SEPRESS team has launched a new Research Topic — "**Seamless Prediction and Prediction Services**" — in the SCI-indexed journal *Frontiers in Climate* (JCR Q2, IF 4.1), under its Predictions and Projections section. The Research Topic is now open for submissions from researchers and industry experts worldwide. Centering on multiscale climate predictions spanning subseasonal-to-seasonal (S2S), seasonal-to-annual (S2A), and annual-to-decadal (A2D) timeframes, the Research Topic seeks to dismantle the traditional silos of time-scale segmented prediction and address cross-scale interactions that conventional approaches overlook. Its core mission is to bridge cutting-edge scientific progress and real-world societal demands through an equitable, transparent, and two-way Research-to-Operation (R2O) framework.

Contributions are welcomed across **five key themes**: development of seamless prediction systems, verification and comparison with observations, examples of use of seamless predictions, equitable and transparent R2O for science-society alignment, and two-way interactive R2O for prediction system optimization.

The abstract submission deadline is **April 29, 2026**, and full manuscripts are due by **August 17, 2026**. Interested researchers are encouraged to visit the [Frontiers Research Topic](#) page for further details and submission guidelines.

## HKUST Researchers Project Intensified Meiyu Rainfall with Atmospheric River Impacts Across East Asia Under Global Warming



Dr. DAI Lun



Oscar ZHANG

Extreme Meiyu rainfall across East Asia poses escalating risks under global warming, with atmospheric rivers (ARs) playing a critical role in amplifying precipitation extremes. In this work, **Dr. DAI Lun** and **Oscar ZHANG** from the group of **CCRS Director Prof. LU Mengqian** analyzed future changes in Meiyu rainfall and its coupling with ARs using Coupled Model Intercomparison Project phase 6 (CMIP6) simulations under two scenarios: SSP245 (mitigation) and SSP585 (high emissions).

The study focused on four key regions with substantial Meiyu rainfall: the Korean Peninsula (KR), South Japan (JP), the lower Yangtze River basin (LYRB), and the South China coast with Taiwan Island (SCTW). Results show the projected intensification of both mean and extreme Meiyu precipitation, with SCTW experiencing the largest increase of more than 40% under SSP585, while JP exhibits the weakest amplification. Hazardous rainfall events are projected to rise sharply, particularly over KR and SCTW.

AR landfalls are expected to intensify by ~70% over KR and LYRB and nearly double over SCTW, leading to more frequent AR-related wet days and extremes, though AR precipitation efficiency may decline. Attribution analyses reveal that thermodynamic moistening broadly dominates precipitation increases, with circulation effects either offsetting (LYRB, JP) or strengthening (KR, SCTW) the changes.

These findings highlight the urgent need for climate risk management in East Asia. Importantly, the SSP245 mitigation pathway substantially reduces rainfall intensification and associated risks, underscoring the value of proactive climate protection measures.

## HKUST Researchers Develop Neural Field Framework to Fuse Multi-Source Wind Data for High-Fidelity Urban Wind Profiles

Accurate urban wind data is essential for building design, pedestrian comfort, pollutant dispersion, and emerging low-altitude economies such as urban drone delivery. However, meteorological observations are typically sparse and fragmented across heterogeneous instruments (such as Doppler LiDAR and wind profiler radar) each with distinct resolutions, coverage, and blind zones, leaving an incomplete picture of the urban wind field.



Prof. ZHANG Jize



Dr. JIANG Wenjun

In this work, **Dr. JIANG Wenjun** from the group of **CCRS member Prof. ZHANG Jize**, in collaboration with the Guangzhou Meteorological Bureau and Harbin Institute of Technology (Shenzhen), developed NF-MW (Neural Field for Multi-source Winds), a deep learning framework that fuses sparse multi-source observations into a continuous high-resolution wind field. NF-MW maps from spatio-temporal coordinates to wind values, enabling reconstruction at any arbitrary height and time. The framework addresses three domain-specific challenges: an orthogonal decomposition with multi-task learning handles the periodicity of wind direction; Fourier feature mapping overcomes the spectral bias of standard neural networks to capture high-frequency gusts; and a temporally segmented training strategy reduces complexity while enabling parallel computation.

Validated in Guangzhou, NF-MW achieved a Mean Absolute Error of 0.55 m/s for wind speed and 8.95° for direction, substantially outperforming classical interpolation and XGBoost baselines. NF-MW remains virtually unbiased for high wind speeds, whereas baselines dangerously underestimate extremes. This work provides a scalable method to generate high-fidelity wind datasets for urban planning, low altitude economy, wind engineering and air quality modeling.