城市气象科技信息监测简报

（文献类）

2022 年 8 月（总第 14 期）

北京气象学会
北京城市气象研究院

2022 年 9 月 5 日

前 言

2021年7月，依托北京城市气象研究院行业信息监测与分析系统，北京气象学会与支撑单位北京城市气象研究院联合制作了《城市气象科技信息监测简报》，定期为会员提供科技信息服务。简报每月一期，每期分为文献和咨询两类。

目前，学会主要依据城市气象领域的关键词搜索信息，并形成每月简报。欢迎各位会员向我们提供相关科技领域信息及其搜索关键词，不断扩充简报的专业领域范围，丰富简报的内容，以更好地满足广大会员朋友们对快速更新科技信息的需求。

同时，热诚欢迎广大会员对简报的科技信息内容、展现形式、阅读体验和收获感悟等提出建议和点评。编辑团队将遴选出优秀建议和点评内容刊载在简报上。

2020年12月，学会换届成立了第21届理事会，现拥有52 家理事单位和 947 名会员。我们希望借助此简报，为广大会员朋友们提供高质高效的科技信息服务，同时在大家的支持和帮助下，我们共同将简报建设成为会员交流的友好平台。

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✧监测周期

2022 年 08 月 01 日 - 2022 年 08 月 31 日

✧监测主题

专题研究——城市边界层、城市气象精细预报、城市气候与生态、人工智能气象；

❖专题研究

✧城市边界层

本监测周期内，文献信息共更新 2 条：

1. OpenIFS/AC: atmospheric chemistry and aerosol in OpenIFS 43r3

摘要：In this paper, we report on the first implementation of atmospheric chemistry and aerosol as part of the European Centre for Medium-Range Weather Forecasts (ECMWF) OpenIFS model. OpenIFS is a portable version of ECMWF's global numerical weather prediction model. Modules and input data for model cycle CY43R3, which have been developed as part of the Copernicus Atmosphere Monitoring Service (CAMS), have been ported to OpenIFS with the modified CB05 tropospheric chemistry scheme, the bulk bin tropospheric aerosol module, and the option to use Belgian Assimilation System for Chemical ObsErvations (BASCOE)-based stratospheric ozone chemistry. We give an overview of the model, and describe the datasets used for emissions and dry deposition, which are similar to those used in the model configuration applied to create the CAMS reanalysis. We evaluate two reference model configurations with and without the stratospheric chemistry extension against standard observational datasets for tropospheric ozone, surface carbon monoxide (CO), tropospheric nitrogen dioxide (NO2), and aerosol optical depth. The results give basic confidence in the model implementation and configuration. This OpenIFS version with atmospheric composition components is open to the scientific user community under a standard OpenIFS license.

来源：GMD

发布时间：2022-08-11

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https://gmd.copernicus.org/articles/15/6221/2022/

2. Observing system simulation experiments reveal that subsurface temperature observations improve estimates of circulation and heat content in a dynamic western boundary current

摘 要：Western boundary currents (WBCs) form the narrow, fast-flowing poleward return flows of the great subtropical ocean gyres and are sources of rapidly varying mesoscale eddies. Accurate simulation of the vertical structure, separation latitude, and ocean heat content of WBCs is important for understanding the poleward transport of heat in the global ocean. However, state estimation and forecasting in WBC regions, such as the East Australian Current (EAC), the WBC of the South Pacific subtropical gyre, is challenging due to their dynamic nature and lack of observations at depth. Here we use observing system simulation experiments to show that subsurface temperature observations in a high eddy kinetic energy region yield large improvement in representation of key EAC circulation features, both downstream and ～600 km upstream of the observing location. These subsurface temperature observations (in concert with sea surface temperature and height measurements) are also critical for correctly representing ocean heat content along the length of the EAC. Furthermore, we find that a more poleward separation latitude leads to an EAC and eddy field that is represented with far reduced error, compared to when the EAC separates closer to the Equator. Our results demonstrate the importance of subsurface observations for accurate state estimation of the EAC and ocean heat content that can lead to marine heatwaves. These results provide useful suggestions for observing system design under different oceanographic regimes, for example, adaptive sampling to target high energy states with more observations and low energy states with fewer observations.

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https://gmd.copernicus.org/articles/15/6541/2022/

✧城市气象精细预报

本监测周期内，文献信息共更新 4 条：

1. Comparison and evaluation of updates to WRF-Chem (v3.9) biogenic emissions using MEGAN

摘要：Biogenic volatile organic compounds (BVOCs) emitted from the natural ecosystem are highly reactive and can thus impact air quality and aerosol radiative forcing. BVOC emission models (e.g., Model of Emissions of Gases and Aerosols from Nature – MEGAN) in global and regional chemical transport models still have large uncertainties in estimating biogenic trace gases because of uncertainties in emission activity factors, specification of vegetation type, and plant emission factors. This study evaluates a set of updates made to MEGAN v2.04 in the Weather Research and Forecasting model coupled with chemistry (WRF-Chem version 3.9). Our study considers four simulations for each update made to MEGAN v2.04: (i) a control run with no changes to MEGAN, (ii) a simulation with the emission activity factors modified following MEGAN v2.10, (iii) a simulation considering the changes to the plant functional type (PFT) emission factor, and (iv) a simulation with the isoprene emission factor calculated within the MEGAN module instead of being prescribed by the input database. We evaluate two regions, Europe and the southeastern United States, by comparing WRF-Chem results to ground-based monitoring observations in Europe (i.e., AirBase database) and aircraft observations obtained during the NOMADSS field campaign. We find that the updates to MEGAN v2.04 in WRF-Chem caused overpredictions in ground-based ozone concentrations in Europe and in isoprene mixing ratios compared to aircraft observations in the southeastern US. The update in emission activity factors caused the largest biases. These results suggest that further experimental and modeling studies should be conducted to address potential shortcomings in BVOC emission models.

来源：GMD

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https://gmd.copernicus.org/articles/15/6311/2022/

2. OpenIFS/AC: atmospheric chemistry and aerosol in OpenIFS 43r3

摘要：In this paper, we report on the first implementation of atmospheric chemistry and aerosol as part of the European Centre for Medium-Range Weather Forecasts (ECMWF) OpenIFS model. OpenIFS is a portable version of ECMWF's global numerical weather prediction model. Modules and input data for model cycle CY43R3, which have been developed as part of the Copernicus Atmosphere Monitoring Service (CAMS), have been ported to OpenIFS with the modified CB05 tropospheric chemistry scheme, the bulk bin tropospheric aerosol module, and the option to use

Belgian Assimilation System for Chemical ObsErvations (BASCOE)-based stratospheric ozone chemistry. We give an overview of the model, and describe the datasets used for emissions and dry deposition, which are similar to those used in the model configuration applied to create the CAMS reanalysis. We evaluate two reference model configurations with and without the stratospheric chemistry extension against standard observational datasets for tropospheric ozone, surface carbon monoxide (CO), tropospheric nitrogen dioxide (NO2), and aerosol optical depth. The results give basic confidence in the model implementation and configuration. This OpenIFS version with atmospheric composition components is open to the scientific user community under a standard OpenIFS license.

来源：GMD

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https://gmd.copernicus.org/articles/15/6221/2022/

3. Simulations of aerosol pH in China using WRF-Chem (v4.0): sensitivities of aerosol pH and its temporal variations during haze episodes

摘要：Aerosol pH is a fundamental property of aerosols in terms of atmospheric chemistry and its impact on air quality, climate, and health. Precise estimation of aerosol pH in chemical transport models (CTMs) is critical for aerosol modeling and thus influences policy development that partially relies on results from model simulations. We report the Weather Research and Forecasting Model coupled with Chemistry (WRF-Chem) simulated PM2.5 pH over China during a period with heavy haze episodes in Beijing, and explore the sensitivity of the modeled aerosol pH to factors including emissions of nonvolatile cations (NVCs) and NH3, aerosol phase state assumption, and heterogeneous production of sulfate. We find that default WRF-Chem could predict spatial patterns of PM2.5 pH over China similar to other CTMs, but with generally lower pH values, largely due to the underestimation of alkaline species (NVCs and NH3) and the difference in thermodynamic treatments between different models. Increasing NH3 emissions in the model would improve the modeled pH in comparison with offline thermodynamic model calculations of pH constrained by observations. In addition, we find that the aerosol phase state assumption and heterogeneous sulfate production are important in aerosol pH predictions for regions with low relative humidity (RH) and high anthropogenic SO2 emissions, respectively. These factors should be better constrained in model simulations of aerosol pH in the

future. Analysis of the modeled temporal trend of PM2.5 pH in Beijing over a haze episode reveals a clear decrease in pH from 5.2 ± 0.9 in a clean period to 3.6 ± 0.5 in a heavily polluted period. The increased acidity under more polluted conditions is largely due to the formation and accumulation of secondary species including sulfuric acid and nitric acid, even though being modified by alkaline species (NVCs, NH3). Our result suggests that NO2 oxidation is unlikely to be important for heterogeneous sulfate production during the Beijing haze as the effective pH for NO2 oxidation of S(IV) is at a higher pH of ~ 6.

来源：GMD

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https://gmd.copernicus.org/articles/15/6143/2022/

4. Rad-cGAN v1.0: Radar-based precipitation nowcasting model with conditional generative adversarial networks for multiple dam domains

摘要：Numerical weather prediction models and probabilistic extrapolation methods using radar images have been widely used for precipitation nowcasting. Recently, machine-learning-based precipitation nowcasting models have also been actively developed for relatively short-term precipitation predictions. This study was aimed at developing a radar-based precipitation nowcasting model using an advanced machine-learning technique, conditional generative adversarial network (cGAN), which shows high performance in image generation tasks. The cGAN-based precipitation nowcasting model, named Rad-cGAN, developed in this study was trained with the radar reflectivity data of the Soyang-gang Dam basin in South Korea with a spatial domain of 128 × 128 pixels, spatial resolution of 1 km, and temporal resolution of 10 min. The model performance was evaluated using previously developed machine-learning-based precipitation nowcasting models, namely convolutional long short-term memory (ConvLSTM) and U-Net. In addition, Eulerian persistence model and pySTEPS, a radar-based deterministic nowcasting system, are used as baseline models.We demonstrated that Rad-cGAN outperformed reference models at 10 min lead time prediction for the Soyang-gang Dam basin based on verification metrics: Pearson correlation coefficient (R), root mean square error (RMSE), Nash–Sutcliffe efficiency (NSE), critical success index (CSI), and fraction skill scores (FSS) at an intensity threshold of 0.1, 1.0, and 5.0 mm h−1. However, unlike low rainfall intensity, the CSI at high rainfall intensity in Rad-cGAN deteriorated

rapidly beyond the lead time of 10 min; however, ConvLSTM and baseline models maintained better performances. This observation was consistent with the FSS calculated at high rainfall intensity. These results were qualitatively evaluated using typhoon Soulik as an example, and through this, ConvLSTM maintained relatively higher precipitation than the other models. However, for the prediction of precipitation area, Rad-cGAN showed the best results, and the advantage of the cGAN method to reduce the blurring effect was confirmed through radially averaged power spectral density (PSD). We also demonstrated the successful implementation of the transfer learning technique to efficiently train the model with the data from other dam basins in South Korea, such as the Andong Dam and Chungju Dam basins. We used the pre-trained model, which was completely trained in the Soyang-gang Dam basin. Furthermore, we analyzed the amount of data to effectively develop the model for the new domain through the transfer learning strategies applying the pre-trained model using data for additional dam basins. This study confirmed that Rad-cGAN can be successfully applied to precipitation nowcasting with longer lead times and using the transfer learning approach showed good performance in dam basins other than the originally trained basin.

来源：GMD

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https://gmd.copernicus.org/articles/15/5967/2022/

✧城市气候与生态

本监测周期内，文献信息共更新 5 条：

1. Climate and parameter sensitivity and induced uncertainties in carbon stock projections for European forests (using LPJ-GUESS 4.0)

摘要：Understanding uncertainties and sensitivities of projected ecosystem dynamics under environmental change is of immense value for research and climate change policy. Here, we analyze sensitivities (change in model outputs per unit change in inputs) and uncertainties (changes in model outputs scaled to uncertainty in inputs) of vegetation dynamics under climate change, projected by a state-of-the-art dynamic vegetation model (LPJ-GUESS v4.0) across European forests (the species Picea abies, Fagus sylvatica and Pinus sylvestris), considering uncertainties of both model parameters and environmental drivers. We find that projected forest carbon fluxes are

most sensitive to photosynthesis-, water-, and mortality-related parameters, while predictive uncertainties are dominantly induced by environmental drivers and parameters related to water and mortality. The importance of environmental drivers for predictive uncertainty increases with increasing temperature. Moreover, most of the interactions of model inputs (environmental drivers and parameters) are between environmental drivers themselves or between parameters and environmental drivers. In conclusion, our study highlights the importance of environmental drivers not only as contributors to predictive uncertainty in their own right but also as modifiers of sensitivities and thus uncertainties in other ecosystem processes. Reducing uncertainty in mortality-related processes and accounting for environmental influence on processes should therefore be a focus in further model development.

来源：GMD

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https://gmd.copernicus.org/articles/15/6495/2022/

2. Representing surface heterogeneity in land–atmosphere coupling in E3SMv1 single-column model over ARM SGP during summertime

摘要：The Earth's land surface features spatial and temporal heterogeneity over a wide range of scales below those resolved by current Earth system models (ESMs). State-of-the-art land and atmosphere models employ parameterizations to represent their subgrid heterogeneity, but the land–atmosphere coupling in ESMs typically operates on the grid scale. Communicating the information on the land surface heterogeneity with the overlying atmospheric boundary layer (ABL) remains a challenge in modeling land–atmosphere interactions. In order to account for the subgrid-scale heterogeneity in land–atmosphere coupling, we implement a new coupling scheme in the Energy Exascale Earth system model version 1 (E3SMv1) that uses adjusted surface variances and covariance of potential temperature and specific water content as the lower boundary condition for the atmosphere model. The new lower boundary condition accounts for both the variability of individual subgrid land surface patches and the inter-patch variability. The E3SMv1 single-column model (SCM) simulations over the Atmospheric Radiation Measurement (ARM) Southern Great Plain (SGP) site were performed to assess the impacts. We find that the new coupling parameterization increases the magnitude and diurnal cycle of the temperature variance and humidity variance in the lower ABL on non-precipitating days. The

impacts are primarily attributed to subgrid inter-patch variability rather than the variability of individual patches. These effects extend vertically from the surface to several levels in the lower ABL on clear days. We also find that accounting for surface heterogeneity increases low cloud cover and liquid water path (LWP). These cloud changes are associated with the change in cloud regime indicated by the skewness of the probability density function (PDF) of the subgrid vertical velocity. In precipitating days, the inter-patch variability reduces significantly so that the impact of accounting for surface heterogeneity vanishes. These results highlight the importance of accounting for subgrid heterogeneity in land–atmosphere coupling in next-generation ESMs.

来源：GMD

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https://gmd.copernicus.org/articles/15/6371/2022/

3. AWI-CM3 coupled climate model: description and evaluation experiments for a prototype post-CMIP6 model

摘要：We developed a new version of the Alfred Wegener Institute Climate Model (AWI-CM3), which has higher skills in representing the observed climatology and better computational efficiency than its predecessors. Its ocean component FESOM2 (Finite-volumE Sea ice–Ocean Model) has the multi-resolution functionality typical of unstructured-mesh models while still featuring a scalability and efficiency similar to regular-grid models. The atmospheric component OpenIFS (CY43R3) enables the use of the latest developments in the numerical-weather-prediction community in climate sciences. In this paper we describe the coupling of the model components and evaluate the model performance on a variable-resolution (25–125 km) ocean mesh and a 61 km atmosphere grid, which serves as a reference and starting point for other ongoing research activities with AWI-CM3. This includes the exploration of high and variable resolution and the development of a full Earth system model as well as the creation of a new sea ice prediction system. At this early development stage and with the given coarse to medium resolutions, the model already features above-CMIP6-average skills (where CMIP6 denotes Coupled Model Intercomparison Project phase 6) in representing the climatology and competitive model throughput. Finally we identify remaining biases and suggest further improvements to be made to the model.

来源：GMD

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数据类型：期刊

https://gmd.copernicus.org/articles/15/6399/2022/

4. Climate Services Toolbox (CSTools) v4.0: from climate forecasts to climate forecast information

摘要：Despite the wealth of existing climate forecast data, only a small part is effectively exploited for sectoral applications. A major cause of this is the lack of integrated tools that allow the translation of data into useful and skillful climate information. This barrier is addressed through the development of an R package. Climate Services Toolbox (CSTools) is an easy-to-use toolbox designed and built to assess and improve the quality of climate forecasts for seasonal to multi-annual scales. The package contains process-based, state-of-the-art methods for forecast calibration, bias correction, statistical and stochastic downscaling, optimal forecast combination, and multivariate verification, as well as basic and advanced tools to obtain tailored products. Due to the modular design of the toolbox in individual functions, the users can develop their own post-processing chain of functions, as shown in the use cases presented in this paper, including the analysis of an extreme wind speed event, the generation of seasonal forecasts of snow depth based on the SNOWPACK model, and the post-processing of temperature and precipitation data to be used as input in impact models.

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https://gmd.copernicus.org/articles/15/6115/2022/

5. A daily highest air temperature estimation method and spatial–temporal changes analysis of high temperature in China from 1979 to 2018

摘要：The daily highest air temperature (Tmax) is a key parameter for global and regional high temperature analysis which is very difficult to obtain in areas where there are no meteorological observation stations. This study proposes an estimation framework for obtaining high-precision Tmax. Firstly, we build a near-surface air temperature diurnal variation model to estimate Tmax with a spatial resolution of 0.1◦ for China from 1979 to 2018 based on multi-source data. Then, in order to further improve the estimation accuracy, we divided China into six regions according to climate

conditions and topography and established calibration models for different regions. The analysis shows that the mean absolute error (MAE) of the dataset (https://doi.org/10.5281/zenodo.6322881, Wang et al., 2021) after correction with the calibration models is about 1.07 ◦C and the root mean square error (RMSE) is about 1.52 ◦C, which is higher than that before correction to nearly 1 ◦C. The spatial‐temporal variations analysis of Tmax in China indicated that the annual and seasonal mean Tmax in most areas of China showed an increasing trend. In summer and autumn, the Tmax in northeast China increased the fastest among the six regions, which was 0.4 ◦C per 10 years and 0.39◦C per 10 years, respectively. The number of summer days and warm days showed an increasing trend in all regions while the number of icing days and cold days showed a decreasing trend. The abnormal temperature changes mainly occurred in El Niño years or La Niña years. We found that the influence of the Indian Ocean basin warming (IOBW) on air temperature in China was generally greater than those of the North Atlantic Oscillation and the NINO3.4 area sea surface temperature after making analysis of ocean climate modal indices with air temperature. In general, this Tmax dataset and analysis are of great significance to the study of climate change in China, especially for environmental protection.

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