城市气象科技信息监测简报

2023 年 8 月 （总第 26 期）

北京气象学会
北京城市气象研究院
中国气象局城市气象重点开放实验室

2023 年 9 月 6 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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目　录

❖报告概述 3

✧监测周期: 3

✧监测主题: 3

❖行业动态 3

✧新闻资讯 3

1. Early Warnings for All Initiative launched in Tajikistan 3
2. Early Warnings for All gains ground with national launches 4
3. Wind Simulation in Urban Microclimate 4
4. Extreme weather is the 'new norm' 5
5. Early Warnings for All helps to reduce the vulnerability of Maldives 5
6. WMO publishes global update of climate datasets 6
7. July 2023 confirmed as hottest month on record 7
8. Copernicus confirms July 2023 was the hottest month ever recorded 7
9. WMO Strengthens Global Cooperation to Protect All Lives from Flash Floods 8
10. Crucial Role of Soil Moisture in Urban Green Spaces 9
11. Exceptional heat and rain, wildfires and floods mark summer of extremes 9
12. Typhoons trigger destruction and record-breaking rainfall in China 10

❖专题研究 11

✧城市边界层 11

Understanding changes in heat waves, droughts, and compound events in Yangtze River Valley and the corresponding atmospheric circulation patterns 11

Sensitivity of northeastern US surface ozone predictions to the representation of atmospheric chemistry in the Community Regional Atmospheric Chemistry Multiphase Mechanism (CRACMMv1.0) 12

✧城市气象精细预报 13

How does tropospheric VOC chemistry affect climate? An investigation of preindustrial control simulations using the Community Earth System Model version 2 13

Comparison of methods to estimate aerosol effective radiative forcings in climate models 14

Identifying climate model structural inconsistencies allows for tight constraint of aerosol radiative forcing 15

The three-dimensional structure of fronts in mid-latitude weather systems in numerical weather prediction models 16

✧城市气候与生态 17

On the use of convolutional neural networks for downscaling daily temperatures over southern South America in a climate change scenario 17

✧人工智能气象 18

On the use of convolutional neural networks for downscaling daily temperatures over southern South America in a climate change scenario 18

Machine learning algorithms for merging satellite-based precipitation products and their application on meteorological drought monitoring over Kenya..... 19

❖报告概述

✧监测周期：

2023 年 08 月 01 日 - 2023 年 08 月 31 日

✧监测主题：

行业动态——新闻资讯、文献信息；

❖行业动态

✧新闻资讯

本监测周期内，城市气象资讯信息共更新 12 条

1. Early Warnings for All Initiative launched in Tajikistan

摘要：The UN Secretary-General's Early Warnings for All Initiative (EW4All) is rapidly gaining ground. Action plans are being rolled out around the world to ensure that people know when dangerous weather is headed their way.Tajikistan has held a two-day national consultation, co-chaired by the Deputy Prime Minister and the UN Resident Coordinator in Tajikistan, and bringing together key stakeholders from state and international organizations, media and civil society organizations. There was active involvement from the lead agencies of four pillars of the Early Warnings for All Initiative: the United Nations Office for Disaster Risk Reduction (UNDRR), the World Meteorological Organization (WMO), the International Telecommunication Union (ITU), and the International Federation of Red Cross and Red Crescent Societies (IFRC).The series of national consultations kicked off in July with a meeting in the Maldives in the Indian Ocean. An Early Warnings for All Action Plan will be launched at the Africa Climate Summit in Kenya on 4 September. Deputy Prime Minister of Tajikistan, Mr. Sulaimon Ziyozoda, highlighting his government's commitment to climate change adaptation, disaster risk reduction and the call of the United Nations Secretary-General to protect everyone with early warning systems. "Coordination of activities of different sectors and stakeholders, involvement of communities at risk, availability of favorable institutional and legislative environment, clear distribution of roles and responsibilities - all these are necessary to create effective and consistent early warning systems," he said. Tajikistan is faced with the frequent occurrence of natural hazards, such as avalanches, earthquakes, floods, mudflows, and landslides, with climate change further exacerbating their impacts.

来源：WMO

发布时间：2023-08-30

数据类型：资讯

https://public.wmo.int/en/media/news/early-warnings-all-initiative-launched-tajikistan

2. Early Warnings for All gains ground with national launches

摘要：The UN Secretary-General’s Early Warnings for All Initiative (EW4All) is rapidly gaining ground. Action plans are being rolled out around the world to ensure that people know when dangerous weather is headed their way.Tajikistan has held a two-day national consultation, co-chaired by the Deputy Prime Minister and the UN Resident Coordinator in Tajikistan, and bringing together key stakeholders from state and international organizations, media and civil society. Ethiopia also held an inception workshop.There was active involvement from the lead agencies of four pillars of the Early Warnings for All Initiative: the United Nations Office for Disaster Risk Reduction (UNDRR), the World Meteorological Organization (WMO), the International Telecommunication Union (ITU), and the International Federation of Red Cross and Red Crescent Societies (IFRC).The series of national consultations kicked off in July with a meeting in Maldives in the Indian Ocean. An Early Warnings for All Action Plan in Africa will be launched at the Africa Climate Summit in Kenya on 4 September. The Early Warnings for All initiative will be showcased at the Climate Ambition Summit in September in New York and at COP28 in Dubai in December 2023. Deputy Prime Minister of Tajikistan, Mr. Sulaimon Ziyozoda, highlighted his government’s commitment to climate change adaptation, disaster risk reduction and the call of the United Nations Secretary-General to protect everyone with early warning systems.

来源：WMO

发布时间：2023-08-30

数据类型：资讯

https://public.wmo.int/en/media/news/early-warnings-all-gains-ground-national-launches

3. Wind Simulation in Urban Microclimate

摘要：Urban microclimates are influenced by a myriad of factors, one of which is the three-dimensional wind field. This wind vector plays a role in processes like energy transport and pollutant dispersion, as well as in factors such as wind-related safety and comfort for humans and vegetation.Updates in ENVI-met V5.5The release of ENVI-met

V5.5 brought about updates beneficial for professionals in urban planning, architecture, and environmental modelling. Features regarding the Digital Elevation Model (DEM) usability have been added in this version.Refinement of Vertical Wind ProfilesOne of the updates in ENVI-met V5.5 includes improved vertical wind profiles. Earlier versions of the software encountered challenges when simulating wind patterns over diverse terrains. ENVI-met V5.

来源：ENVI

发布时间：2023-08-22

数据类型：资讯

https://www.envi-met.com/wind-simulation-in-urban-microclimate/

4. Extreme weather is the 'new norm'

摘要：The summer of extremes continues. July was the hottest month ever recorded. The high-impact weather is continuing through August.“This is the new normal and does not come as a surprise,” said Alvaro Silva, a climate expert with WMO. “The frequency and intensity of many extremes, such as heatwaves and heavy precipitation, have increased in recent decades. There is high confidence that human induced climate change from greenhouse emissions, is the main driver,' he told a regular media briefing in Geneva.Moderate and severe heat warnings for the third week of August have been issued by several national meteorological and hydrological services in Europe, including from France, Switzerland, Germany, Poland, Croatia, Italy, Greece, Hungary, Austria, Lithuania. WMO stresses the need to follow authoritative warnings from national meteorological and hydrological services to stay safe.During the weekend of 19-20 August, maximum temperatures may reach up to 40 °C in parts of southern France, according to Meteo-France. It said it would be the most intense heatwave of the summer of 2023.

来源：WMO

发布时间：2023-08-18

数据类型：资讯

https://public.wmo.int/en/media/news/extreme-weather-new-norm

5. Early Warnings for All helps to reduce the vulnerability of Maldives

摘要：Maldives is the first Asian country and first Small Island Developing State to initiate the UN Secretary-General’s Early Warnings For All program.A national consultation on the Early Warnings for All (EW4All) initiative in Maldives took place in July 2023 in order to boost political momentum for and achievement of the EW4All Action

Plan by 2027. It leveraged the decades of efforts in the disaster risk reduction and management space by the UN community.The consultation was presided by H.E. Ms. Aminath Shauna, Minister of Environment, Climate Change and Technology (MoECCT), and co-chaired by Ms. Khadeeja Naseem, State Minister and the UN Resident Coordinator, Catherine Haswell.It built on the existing regulation and operationalization of Early Warning Services in the Maldives, the Government of Maldives and embraced the technical expertise from the four pillar leads: the United Nations Office for Disaster Risk Reduction (UNDRR), the World Meteorological Organization (WMO), the International Telecommunication Union (ITU), and the International Federation of Red Cross and Red Crescent Societies (IFRC).'As one of the most vulnerable countries to the climate crisis, it is critical that we build our national capacity in early warning and preparedness, and this is a key piece of our adaptation strategy.

来源：WMO

发布时间：2023-08-15

数据类型：资讯

https://public.wmo.int/en/media/news/early-warnings-all-helps-reduce-vulnerability-of-maldives

6. WMO publishes global update of climate datasets

摘要：Comprehensive new climate datasets have just been published after a massive two-year effort by members of the World Meteorological Organization (WMO) and the US National Centers for Environmental Information (NCEI). The updated information from more than 140 countries and thousands of locations is the climate equivalent of a census and is vital for monitoring climate change and for climate sensitive sectors.In order to assess whether a given day, week, month or year is warmer or wetter than average, WMO uses 30-year-long baselines, known as Climatological Standard Normals or CLINO. These are averages of climatological data over a 30-year period. It’s important to use a long-term average because of the natural variability in our climate.The US National Centers for Environmental Information (NCEI) have just issued the new WMO Climatological Standard Normals 1991-2020 to replace the previous baseline of 1981-2010. Additional countries will still be submitting their updates in the coming months.WMO recommends that the 30-year standard reference periods be updated every decade to better reflect the changing climate and its influence on our day-to-day weather experience.“Rising atmospheric concentrations of greenhouse gases are changing the Earth’s climate much

faster than before. As a result, decision-makers in climate-sensitive sectors and industries such as water management, energy, health, agriculture and viticulture could be basing important decisions on information that may be out of date," says Dr.

来源：WMO

发布时间：2023-08-15

数据类型：资讯

https://public.wmo.int/en/media/news/wmo-publishes-global-update-of-climate-datasets

7. July 2023 confirmed as hottest month on record

摘要：Earth just had its hottest July on record. Sea ice was the lowest on record. For the fourth consecutive month, the global ocean surface temperature hit a record high.The monthly climate monitoring reports from the European Union's Copernicus Climate Change Service, the US National Oceanic and Atmospheric Administration and NASA confirm the extraordinary pace of climate change as a result of heat-trapping greenhouse gases in the atmosphere.WMO uses the datasets in its State of the Global Climate reports and to inform decision-makers around the world. The year to date has been the third warmest on record.Globally averaged surface air temperature for all months of July from 1940 to 2023. Shades of blue indicate cooler-than-average years, while shades of red show years that were warmer than average. Data: ERA5. Credit: C3S/ECMWFBased on the information from the WMO community, United Nations Secretary-General António Guterres warned that "the era of global warming has ended" and "the era of global boiling has arrived.

来源：WMO

发布时间：2023-08-15

数据类型：资讯

https://public.wmo.int/en/media/news/july-2023-confirmed-hottest-month-record

8. Copernicus confirms July 2023 was the hottest month ever recorded

摘要：The global average temperature for July 2023 is confirmed to be the highest on record for any month. The month was 0.72°C warmer than the 1991-2020 average for July, and 0.33°C warmer than the previous warmest month, July 2019.The Copernicus Climate Change Service (C3S), implemented by the European Centre for Medium-Range Weather Forecasts on behalf of the European Commission with funding from the EU, routinely publishes monthly climate bulletins reporting on the changes observed in global

surface air temperature, sea ice cover and hydrological variables. This month, highlights about sea surface temperature are also included in this press release. All the reported findings are based on computer-generated analyses using billions of measurements from satellites, ships, aircraft and weather stations around the world.Globally averaged surface air temperature for all months of July from 1940 to 2023. Shades of blue indicate cooler-than-average years, while shades of red show years that were warmer than average. Data: ERA5.

来源：WMO

发布时间：2023-08-08

数据类型：资讯

https://public.wmo.int/en/media/news/copernicus-confirms-july-2023-was-hottest-month-ever-recorded

9. WMO Strengthens Global Cooperation to Protect All Lives from Flash Floods

摘要：The Flash Flood Guidance System (FFGS) has been instrumental in saving lives and reducing losses from flash flooding in 72 countries, benefitting over 3 billion people.The FFGS played a crucial role recently during Cyclone Freddy, which hit Malawi hard from March 11 to 15, 2023. Using the FFGS, the Department of Climate Change was able to alert the public about the heavy rains and potential flood risks. From March 11, they started issuing these warnings daily, and later, even twice a day. The important updates were shared with the public through newspapers, radio, TV, emails, and WhatsApp groups.However, flash floods continue to significantly threaten lives, livelihoods, and property, especially with the added challenges of climate change and unplanned development in flood-prone areas. To tackle this global issue, concerted actions are required at the global, regional, and national levels to enhance existing systems and extend coverage to more countries, aligning with the Early Warnings for All initiative to ensure that early warning systems protect everyone on Earth within the next five years.The Second Global Workshop on the Flash Flood Guidance System took place in Skopje, North Macedonia, from 19th to 23rd June 2023 and saw active participation from 203 representatives representing 64 countries. The successful organization of this event was made possible through the support of the host nation and various organizations, notably the United States Agency for International Development (USAID) and the National Meteorological and Hydrological Service of North Macedonia. The workshop aimed to

foster greater collaboration among hydrometeorological forecasters and disaster managers, facilitating meaningful discussions and initiatives in the field of flash flood preparedness and response.

来源：WMO

发布时间：2023-08-07

数据类型：资讯

https://public.wmo.int/en/media/news/wmo-strengthens-global-cooperation-protect-all-lives-from-flash-floods

10. Crucial Role of Soil Moisture in Urban Green Spaces

摘要：Urban areas around the globe grapple with the multifaceted challenges of climate change. One aspect thats gaining prominence is the creation of resilient green spaces. The health and efficiency of these spaces are intricately linked with soil moisture levels, which in turn significantly influence tree leaf temperatures.Understanding Tree Physiology and Soil MoistureWhen soil retains ample moisture, trees can efficiently absorb water. This process facilitates transpiration, leading to effective leaf cooling and warding off heat stress. On the flip side, when soil lacks sufficient moisture, transpiration is hindered. This lack can elevate leaf temperatures, increase water loss, reduce photosynthesis, and even lead to tree damage.The Imperative of Soil Moisture ManagementMaintaining the right moisture levels in soil isnt just about nurturing healthy trees. Its an essential practice, especially in regions grappling with water scarcity. By ensuring proper moisture management, we bolster the resilience of trees, allowing them to effectively perform their ecosystem roles, even when faced with shifting environmental conditions.

来源：ENVI

发布时间：2023-08-07

数据类型：资讯

https://www.envi-met.com/the-significance-of-soil-moisture-for-resilient-urban-green-spaces/

11. Exceptional heat and rain, wildfires and floods mark summer of extremes

摘要：Dangerous weather - intense heat and devastating rainfall – has impacted large parts of the Northern hemisphere in this summer of extremes, causing major damage to the people’s health and the environment. Marine heatwaves are affecting large areas of the

ocean. July is expected to be the hottest ever month on record.China set a new national daily temperature record in July, and was hit by record-breaking rainfall at the start of August. Many new station temperature records around the world were broken in July. The start of August also saw a winter heatwave in parts of South America.Wildfires caused devastation and dozens of casualties and forced evacuations of thousands of people in Canada, parts of the Mediterranean, including Algeria, Greece, Italy and Spain.Canada has seen its worst wildfire season on record, harming air quality for millions of people in North America. Fires are now burning in the Canadian Arctic. The Copernicus Atmosphere Monitoring Service (CAMS) reported that as of the end of July, the total estimated wildfire carbon emissions for the year to date reached double the previous Canadian annual total.

来源：WMO

发布时间：2023-08-03

数据类型：资讯

https://public.wmo.int/en/media/news/exceptional-heat-and-rain-wildfires-and-floods-mark-summer-of-extremes

12. Typhoons trigger destruction and record-breaking rainfall in China

摘要：Record-breaking rainfall induced by tropical cyclones has caused devastation and casualties in the Chinese capital Beijing and the surrounding province of Hebei, prompting a major relief and rescue operation. Other Asian countries have also been hit.Beijing recorded its heaviest rainfall over the past few days since records began 140 years ago. It logged 744.8 millimeters of rain, the maximum amount of precipitation recorded during the rainstorm, between 8 p.m. on Saturday 29 July and 7 a.m. Wednesday 2 August at a city reservoir, according to the Beijing Meteorological Service in a report cited by the Xinhua News Agency.There were reports of more than a dozen casualties, with more than 125,000 people evacuated.

来源：WMO

发布时间：2023-08-02

数据类型：资讯

https://public.wmo.int/en/media/news/typhoons-trigger-destruction-and-record-breaking-rainfall-china

❖专题研究

✧城市边界层

本监测周期内，文献信息共更新 2 条：

Understanding changes in heat waves, droughts, and compound events in Yangtze River Valley and the corresponding atmospheric circulation patterns

摘要：Heat waves, droughts, and compound drought and heat waves (CDHWs) have received extensive attention because of their disastrous impacts on agriculture, ecosystems, human health, and society. Here, we computed the heat wave magnitude index (HWMI), drought magnitude index (DMI), and compound drought and heat wave magnitude index (CDHMI) for Yangtze River Valley (YRV) from July to August during 1961–2022. We compared the large-scale atmospheric circulation characteristics of different extreme events based on these indexes. The results show that the positive center with sink motion in East Asia provides a favorable circulation background for heat wave events. Drought events are mainly affected by the zonal wave train dominated by a significant negative anomaly in Siberia and a high-pressure anomaly upstream, and a anticyclonic water vapor with strong divergence over the Yangtze River basin. During CDHW events, both anomalous systems that affect heat waves and droughts appear and strengthen simultaneously. Specifically, in the middle and upper troposphere, the positive height anomaly center in YRV expands abnormally, and the “+–+” wave train over the northern 50° N region of East Asia becomes more obvious. Therefore, the positive anomaly and water vapor anomaly brought by the two circulation patterns at different latitudes are superimposed over the YRV, leading to severe CDHWs. At the same time, the warm positive eddy center and cold negative eddy center in high latitudes exhibit

来源：Springer

发布时间：2023-08-25

数据类型：期刊

https://link.springer.com/article/10.1007/s00382-023-06927-z

Sensitivity of northeastern US surface ozone predictions to the representation of atmospheric chemistry in the Community Regional Atmospheric Chemistry Multiphase Mechanism (CRACMMv1.0)

摘要：Chemical mechanisms describe how emissions of gases and particles evolve in the atmosphere and are used within chemical transport models to evaluate past, current, and future air quality. Thus, a chemical mechanism must provide robust and accurate predictions of air pollutants if it is to be considered for use by regulatory bodies. In this work, we provide an initial evaluation of the Community Regional Atmospheric Chemistry Multiphase Mechanism (CRACMMv1.0) by assessing CRACMMv1.0 predictions of surface ozone (O3) across the northeastern US during the summer of 2018 within the Community Multiscale Air Quality (CMAQ) modeling system. CRACMMv1.0 O3 predictions of hourly and maximum daily 8 h average (MDA8) ozone were lower than those estimated by the Regional Atmospheric Chemistry Mechanism with aerosol module 6 (RACM2_ae6), which better matched surface network observations in the northeastern US (RACM2_ae6 mean bias of +4.2 ppb for all hours and +4.3 ppb for MDA8; CRACMMv1.0 mean bias of +2.1 ppb for all hours and +2.7 ppb for MDA8). Box model calculations combined with results from CMAQ emission reduction simulations indicated a high sensitivity of O3 to compounds with biogenic sources. In addition, these calculations indicated the differences between CRACMMv1.0 and RACM2_ae6 O3 predictions were largely explained by updates to the inorganic rate constants (reflecting the latest assessment values) and by updates to the representation of monoterpene chemistry. Updates to other reactive organic carbon systems between RACM2_ae6 and CRACMMv1.0 also affected ozone predictions and their sensitivity to emissions. Specifically, CRACMMv1.0 benzene, toluene, and xylene chemistry led to efficient NOx cycling such that CRACMMv1.0 predicted controlling aromatics reduces ozone without rural O3 disbenefits. In contrast, semivolatile and intermediate-volatility alkanes introduced in CRACMMv1.0 acted to suppress O3 formation across the regional background through the sequestration of nitrogen oxides (NOx) in organic nitrates. Overall, these analyses showed that the CRACMMv1.0 mechanism within the CMAQ model was able to reasonably simulate ozone concentrations in the northeastern US during the summer of 2018 with similar magnitude and diurnal variation as the current operational Carbon Bond (CB6r3_ae7) mechanism and good model performance compared to recent modeling studies in the literature.

来源：ACP
发布时间：2023-08-21
数据类型：期刊
https://acp.copernicus.org/articles/23/9173/2023/

✧城市气象精细预报

本监测周期内，文献信息共更新 4 条：

How does tropospheric VOC chemistry affect climate? An investigation of preindustrial control simulations using the Community Earth System Model version 2

摘 要：Because of their computational expense, models with comprehensive tropospheric chemistry have typically been run with prescribed sea surface temperatures (SSTs), which greatly limits the model's ability to generate climate responses to atmospheric forcings. In the past few years, however, several fully coupled models with comprehensive tropospheric chemistry have been developed. For example, the Community Earth System Model version 2 with the Whole Atmosphere Community Climate Model version 6 as its atmospheric component (CESM2-WACCM6) has implemented fully interactive tropospheric chemistry with 231 chemical species as well as a fully coupled ocean. Earlier versions of this model used a “SOAG scheme” that prescribes bulk emission of a single gas-phase precursor to secondary organic aerosols (SOAs). In contrast, CESM2-WACCM6 simulates the chemistry of a comprehensive range of volatile organic compounds (VOCs) responsible for tropospheric aerosol formation. Such a model offers an opportunity to examine the full climate effects of comprehensive tropospheric chemistry. To examine these effects, 211-year preindustrial control simulations were performed using the following two configurations: (1) the standard CESM2-WACCM6 configuration with interactive chemistry over the whole atmosphere (WACtl) and (2) a simplified CESM2-WACCM6 configuration using a SOAG scheme in the troposphere and interactive chemistry in the middle atmosphere (MACtl). The middle-atmospheric chemistry is the same in both configurations, and only the tropospheric chemistry differs. Differences between WACtl and MACtl were analyzed for various fields. Regional differences in annual mean surface temperature range from −4 to 4 K. In the zonal average, there is widespread tropospheric cooling in the extratropics. Longwave forcers are shown to be unlikely drivers of this cooling, and possible shortwave forcers are explored. Evidence is

presented that the climate response is primarily due to increased sulfate aerosols in the extratropical stratosphere and cloud feedbacks. As found in earlier studies, enhanced internal mixing with SOAs in WACtl causes widespread reductions of black carbon (BC) and primary organic matter (POM), which are not directly influenced by VOC chemistry. These BC and POM reductions might further contribute to cooling in the Northern Hemisphere. The extratropical tropospheric cooling results in dynamical changes, such as equatorward shifts of the midlatitude jets, which in turn drive extratropical changes in clouds and precipitation. In the tropical upper troposphere, cloud-driven increases in shortwave heating appear to weaken and expand the Hadley circulation, which in turn drives changes in tropical and subtropical precipitation. Some of the climate responses are quantitatively large enough in some regions to motivate future investigations of VOC chemistry's possible influences on anthropogenic climate change.

来源：ACP

发布时间：2023-08-22

数据类型：期刊

https://acp.copernicus.org/articles/23/9191/2023/

Comparison of methods to estimate aerosol effective radiative forcings in climate models

摘要：Uncertainty in the effective radiative forcing (ERF) of climate primarily arises from the unknown contribution of aerosols, which impact radiative fluxes directly and through modifying cloud properties. Climate model simulations with fixed sea surface temperatures but perturbed atmospheric aerosol loadings allow for an estimate of how strongly the planet's radiative energy budget has been perturbed by the increase in aerosols since pre-industrial times. The approximate partial radiative perturbation (APRP) technique further decomposes the contributions to the direct forcing due to aerosol scattering and absorption and to the indirect forcing due to aerosol-induced changes in cloud scattering, amount, and absorption, as well as the effects of aerosols on surface albedo. Here we evaluate previously published APRP-derived estimates of aerosol effective radiative forcings from these simulations conducted in the sixth phase of the Coupled Model Intercomparison Project (CMIP6) and find that they are biased as a result of two large coding errors that – in most cases – fortuitously compensate. The most notable exception is the direct radiative forcing from absorbing aerosols, which is more than 40 % larger averaged across CMIP6 models in the present study. Correcting these biases

eliminates the residuals and leads to better agreement with benchmark estimates derived from double calls to the radiation code. The APRP method – when properly implemented – remains a highly accurate and efficient technique for diagnosing aerosol ERF in cases where double radiation calls are not available, and in all cases it provides quantification of the individual contributors to the ERF that are highly useful but not otherwise available.

来源：ACP

发布时间：2023-08-09

数据类型：期刊

https://acp.copernicus.org/articles/23/8879/2023/

Identifying climate model structural inconsistencies allows for tight constraint of aerosol radiative forcing

摘要：Aerosol radiative forcing uncertainty affects estimates of climate sensitivity and limits model skill in terms of making climate projections. Efforts to improve the representations of physical processes in climate models, including extensive comparisons with observations, have not significantly constrained the range of possible aerosol forcing values. A far stronger constraint, in particular for the lower (most-negative) bound, can be achieved using global mean energy balance arguments based on observed changes in historical temperature. Here, we show that structural deficiencies in a climate model, revealed as inconsistencies among observationally constrained cloud properties in the model, limit the effectiveness of observational constraint of the uncertain physical processes. We sample the uncertainty in 37 model parameters related to aerosols, clouds, and radiation in a perturbed parameter ensemble of the UK Earth System Model and evaluate 1 million model variants (different parameter settings from Gaussian process emulators) against satellite-derived observations over several cloudy regions. Our analysis of a very large set of model variants exposes model internal inconsistencies that would not be apparent in a small set of model simulations, of an order that may be evaluated during model-tuning efforts. Incorporating observations associated with these inconsistencies weakens any forcing constraint because they require a wider range of parameter values to accommodate conflicting information. We show that, by neglecting variables associated with these inconsistencies, it is possible to reduce the parametric uncertainty in global mean aerosol forcing by more than 50 %, constraining it to a range (around −1.3 to −0.1 W m−2) in close agreement with energy balance constraints. Our estimated aerosol forcing range is the maximum feasible constraint using our structurally imperfect model and the chosen

observations. Structural model developments targeted at the identified inconsistencies would enable a larger set of observations to be used for constraint, which would then very likely narrow the uncertainty further and possibly alter the central estimate. Such an approach provides a rigorous pathway to improved model realism and reduced uncertainty that has so far not been achieved through the normal model development approach.

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The three-dimensional structure of fronts in mid-latitude weather systems in numerical weather prediction models

摘要：Atmospheric fronts are a widely used conceptual model in meteorology, most encountered as two-dimensional (2-D) front lines on surface analysis charts. The three-dimensional (3-D) dynamical structure of fronts has been studied in the literature by means of “standard” 2-D maps and cross-sections and is commonly sketched in 3-D illustrations of idealized weather systems in atmospheric science textbooks. However, only recently has the feasibility of the objective detection and visual analysis of 3-D frontal structures and their dynamics within numerical weather prediction (NWP) data been proposed, and such approaches are not yet widely known in the atmospheric science community. In this article, we investigate the benefit of objective 3-D front detection for case studies of extra-tropical cyclones and for comparison of frontal structures between different NWP models. We build on a recent gradient-based detection approach, combined with modern 3-D interactive visual analysis techniques, and adapt it to handle data from state-of-the-art NWP models including those run at convection-permitting kilometre-scale resolution. The parameters of the detection method (including data smoothing and threshold parameters) are evaluated to yield physically meaningful structures. We illustrate the benefit of the method by presenting two case studies of frontal dynamics within mid-latitude cyclones. Examples include joint interactive visual analysis of 3-D fronts and warm conveyor belt (WCB) trajectories, as well as identification of the 3-D frontal structures characterizing the different stages of a Shapiro–Keyser cyclogenesis event. The 3-D frontal structures show agreement with 2-D fronts from surface analysis charts and augment the surface charts by providing additional pertinent information in the vertical dimension. A second application illustrates the relation between convection and 3-D cold-front structure by comparing data

from simulations with parameterized and explicit convection. Finally, we consider "secondary fronts" that commonly appear in UK Met Office surface analysis charts. Examination of a case study shows that for this event the secondary front is not a temperature-dominated but a humidity-dominated feature. We argue that the presented approach has great potential to be beneficial for more complex studies of atmospheric dynamics and for operational weather forecasting.

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✧城市气候与生态

本监测周期内，文献信息共更新 1 条：

On the use of convolutional neural networks for downscaling daily temperatures over southern South America in a climate change scenario

摘要：Global Climate Models (GCMs) depict a notable influence of climate change on southern South America (SSA). Future regional-to-local information for adaptation and mitigation policies can be obtained by downscaling over GCMs outputs, increasing the resolution of the climate projections. Current statistical downscaling approaches in the region [e.g., Generalised Linear Models (GLMs)] need to undergo "human-guided" feature selection, which is one of the main sources of uncertainty. Here, we explore the advantages and limitations of using Convolutional Neural Networks (CNNs) in SSA to downscale daily minimum and maximum temperatures. For this purpose, we elaborate three different experiments: a cross-validation (CV) in the present climate; downscaling the historical and RCP8.5 scenarios of the EC-Earth; a pseudo-reality experiment to measure the extrapolation skill. CV-experiment results show no remarkable differences between CNNs and GLMs, although the non-linearity of the CNNs improved the representation of the extreme aspects of temperatures. Additionally, we use eXplainable Artificial Intelligence to prove that co-linearities are better handled in CNNs. The pseudo-reality experiment shows a good extrapolation skill of CNNs, especially when the activation functions are linear. Overall, the automatic skill of CNNs to deal with co-linearities in predictor data—

against conventional approaches—together with the plausible climate change projections obtained—verified with the pseudo

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https://link.springer.com/article/10.1007/s00382-023-06912-6

✧人工智能气象

本监测周期内，文献信息共更新 2 条：

On the use of convolutional neural networks for downscaling daily temperatures over southern South America in a climate change scenario

摘要：Global Climate Models (GCMs) depict a notable influence of climate change on southern South America (SSA). Future regional-to-local information for adaptation and mitigation policies can be obtained by downscaling over GCMs outputs, increasing the resolution of the climate projections. Current statistical downscaling approaches in the region [e.g., Generalised Linear Models (GLMs)] need to undergo “human-guided” feature selection, which is one of the main sources of uncertainty. Here, we explore the advantages and limitations of using Convolutional Neural Networks (CNNs) in SSA to downscale daily minimum and maximum temperatures. For this purpose, we elaborate three different experiments: a cross-validation (CV) in the present climate; downscaling the historical and RCP8.5 scenarios of the EC-Earth; a pseudo-reality experiment to measure the extrapolation skill. CV-experiment results show no remarkable differences between CNNs and GLMs, although the non-linearity of the CNNs improved the representation of the extreme aspects of temperatures. Additionally, we use eXplainable Artificial Intelligence to prove that co-linearities are better handled in CNNs. The pseudo-reality experiment shows a good extrapolation skill of CNNs, especially when the activation functions are linear. Overall, the automatic skill of CNNs to deal with co-linearities in predictor data—against conventional approaches—together with the plausible climate change projections obtained—verified with the pseudo

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Machine learning algorithms for merging satellite-based precipitation products and their application on meteorological drought monitoring over Kenya

摘要：This study evaluates the reliability of merged satellite precipitation products based on single machine learning (SML) and double machine learning (DML) algorithms to estimate meteorological drought events over Kenya from 2000 to 2019. This study selected four SML algorithms, including Random Forest (RF), Support Vector Machine (SVM), K-nearest neighbors (KNN), and the gradient boosting machine (GBM) algorithm, to merge satellite precipitation products. In contrast, the DML algorithm is developed based on the classification RF approach and combined with these regression machine learning models (i.e., RF-RF, RF-SVM, RF-KNN, and RF-GBM). The four gridded precipitation products, including Climate Hazards Group Infra-Red Precipitation with Station (CHIRPS), Integrated Multi-Satellite Retrievals for GPM (IMERG-v06), Precipitation Estimation from Remotely Sensed Information using Artificial Neural Network-Climate Data Record (PERSIANN-CDR) and ERA-5 reanalysis datasets utilized in merging approaches. In total, we compared twelve precipitation products, including four gridded precipitation products (GPPs), four SML, and four DML, against Climate Research Unit (CRU) based rain-gauge (RG) observation. The Standardized precipitation indices (SPI) were estimated from these twelve precipitation datasets and compared their performance of CRU observation across Kenya. In addition, a total of seven statistical metrics were utilized for the performance assessment of all precipitation estimat

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