城市气象科技信息监测简报

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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 2 月 8 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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❖报告概述

✧监测周期：

2023 年 01 月 01 日 - 2023 年 01 月 31 日

✧监测主题：

行业动态——新闻资讯、文献信息、会议信息；

❖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 9 条，分别来自 WMO4 篇，中科院大气物理研究所 4 篇，南京大学 1 篇：

1. Global Greenhouse Gas Monitoring Infrastructure takes shape(全球温室气体监测基础设施初步形成)

摘 要：WMO is hosting an international symposium on a proposed Global Greenhouse Gas Monitoring Infrastructure to inform action to reduce levels of carbon dioxide and other heat-trapping gases in the atmosphere which are fuelling temperature increase. Sustained, coordinated global monitoring of greenhouse gas concentrations and fluxes is vital to help us understand and tackle the drivers of climate change and to support implementation of the Paris Agreement. Though WMO works in the area of greenhouse gases for several decades, multiple products and dataset that are critical for support of international climate policy are supported only by the research community. But at present, there is no comprehensive, timely international exchange of surface and space-based greenhouse gas observations. There is also a need for improved collaboartion on the model development and generation of the decision-support infromation on global scale. Some governments and international organizations undertake specific monitoring activities and maintain datasets but there is no steering mechanism and there is undue reliance on research funding. The three-day symposium aims to assemble the different pieces of the jigsaw puzzle into a single framework for a sustained, internationally coordinated monitoring infrastructure. More than 250 experts from research and operational communities, space agencies, meteorological services, the ocean and climate observing communities, academia, and UN partners are participating in the session at WMO's headquarters. "This initiative has a very important role to play," said Michel Jean, President

of WMO's Infrastructure Commission. "It's about the operationalization of the system into something which is much simpler and more coordinated than what we have now," he said.

来源：WMO

发布时间：2023-01-31

数据类型：资讯

https://public.wmo.int/en/media/news/global-greenhouse-gas-monitoring-infrastructure-takes-shape

2. FPH: 蓝天的变化及其健康效应

摘要：蓝天通常是在低云量、高能见度、低污染物浓度下，太阳光经瑞利散射之后形成的现象，受到天气和大气环境因素的共同影响，包含晴好天气和低大气污染两重特征。随着我国经济的飞速发展，蓝天的增加已经成为重要的民生需求，与人体健康息息相关。以京津冀地区为例，多次承办大型国际赛事，"奥运蓝"、"阅兵蓝"、"APEC 蓝"等特殊蓝天被国内外广泛报道。特别是 2015 年关于"北京蓝"的话题爆发性增长后，区别于霾，蓝天变化开始受到广泛关注。近年来，越来越多的流行病学证据表明，蓝绿空间（由河湖水系构成的蓝色空间和绿地系统构成的绿色空间）覆盖率不断提高有助于促进人类福祉和健康。同时，改善城镇空气质量对人类健康也大有裨益。而蓝天作为我们生活中最常见的蓝色空间，其蓝天覆盖率与人体健康间的联系依然未知。作为全球最大的发展中国家，新形势下双碳目标和"零碳中国"的倡导将通过减污降碳影响我国蓝天的分布，也对我国实现"美丽中国"、持续深入打好"蓝天保卫战"提出了更高的要求。然而，目前蓝天仍然缺乏认识一致的定义。气象部门认为，少云的晴天意味着蓝天，因此基于云量阈值对晴天进行了判定。

来源：大气物理所

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数据类型：资讯

http://www.iap.cas.cn/gb/xwdt/kyjz/202301/t20230131_6651651.html

3. AAS: 丝绸之路遥相关理论揭示 2021 年 9 月印度西北部和华北同时出现破纪录降水的原因

摘要：2021 年 9 月，在印度西北部和我国华北地区同时出现极端强降水，两地降水量均打破了有观测以来的历史记录，造成了严重的洪涝灾害和人员伤亡。通常情况下，印度西北部雨季和华北雨季发生在 7、8 月，两地雨季在 9 月基本结束，

而在欧亚陆地气温偏暖的背景下，2021 年 9 月亚洲降水异常和大气环流异常都具有类似于雨季（7、8 月）的特征。丝绸之路遥相关，红（蓝）色表示南（北）风异常。2021 年 9 月以绿色圆点所示位置的经向风定义的丝绸之路遥相关指数为历史最强。具体说来，该月西亚西风急流位置显著偏北，对应印度地区出现气旋式环流异常。异常的气旋式环流输送大量水汽至印度西北部，导致该地区出现极端降水。大量降水造成的潜热释放有利于加强高层大气遥相关波列，即丝绸之路遥相关，2021 年 9 月丝绸之路遥相关型为历史最强。加强的丝绸之路遥相关对应东亚地区出现东南风异常，有助于水汽进一步向北输送，导致华北地区出现极端降水。2021 年 9 月印度和华北降水异常由丝绸之路遥相关联系.发表在《大气科学进展》的此项研究的作者，中科院大气所陆日宇研究员指出：“季节转换期的气候异常应得到重视。此外，某一地区的极端气候事件可能通过激发大气遥相关波列，使得另一个遥远地区也出现气候异常。

来源：大气物理所

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http://www.iap.cas.cn/gb/xwdt/kyjz/202301/t20230130_6602879.html

4. STOTEN: 气溶胶-雾相互作用导致的二次有机气溶胶的爆发式增长

摘要：在我国秋冬季节，雾霾事件时有发生，然而二次有机气溶胶（SOA）与雾（或云）之间的基本相互作用还知之甚少，主要原因包括：（1）与无机盐不同，SOA 主要由半挥发或中等挥发的有机气体通过气-粒转化形成，这意味着 SOA 的吸湿性（或活化为云雾滴的能力）不仅取决于颗粒态有机分子，同时还受 SOA 气态前体物的影响；（2）SOA 组成和形成机理的复杂性，SOA 由成千上万种有机分子组成，其来源不仅包括各种气相反应，而且还包含了大量颗粒相反应；（3）外场观测中通常采用热力学模型（例如，ISORROPIA 或 E-AIM）估算颗粒水含量，但其往往忽视了有机气溶胶对颗粒水的贡献；（4）要揭示 SOA-雾相互作用，还需要精细化的气溶胶动力学模式与云雾微物理过程进行耦合，而在线耦合数千反应和数百个物种的大气化学动力学过程与云雾的微物理过程是一项挑战性任务。上述原因导致目前对亚饱和或过饱和条件下水汽在 SOA 形成中的作用知之甚少。中国科学院大气物理研究所贾龙副研究员及其合作者（徐永福和段民征研究员）通过高分辨质谱技术和精细化的气溶胶动力学模式（CSVA），在深入解析甲苯气态和颗粒态分子的基础上，从微物理角度解析了 SOA 与云雾之间的相互作用，并首次发现气溶胶-雾相互作用是导致的 SOA 爆发性增长的关键机制。其研究结果表明，水的相变

过程可以深刻影响 SOA 的形成，二次有机气溶胶的爆发式增长与云雾微物理密切相关。即，霾（haze）与雾（fog）紧密交织在一起，一方面，水溶性气态有机物的存在会降低 SOA 活化为云雾滴的临界过饱和比，导致 SOA 在湿度接近或低于100%时即可活化为云雾滴；同时，云雾的生成进一步促进水溶性气态有机物的气-粒转化，从而导致了 SOA 的爆发式增长。此外，还分析了温度和相对湿度在 SOA 生成中的耦合作用，发现低温可以显著放大有机气体对 SOA 爆发式增长和云凝结核活化的作用。上述结果表明云雾微物理过程是二次有机气溶胶爆发式增长的主要原因。相关论文：Jia, L., Xu, Y., Duan, M., 2023. Explosive formation of secondary organic aerosol due to aerosol-fog interactions. Sci. Total Environ. 866, 161338. https://doi.org/10.

来源：大气物理所

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数据类型：资讯

http://www.iap.cas.cn/gb/xwdt/kyjz/202301/t20230129_6602763.html

5. 袁慧玲教授课题组在华南暴雨个例研究方面取得进展

摘要：华南地区地处我国南端，常年雨水充沛、洪涝频发，华南灾害性暴雨事件长期受到广泛关注，是大气科学研究的重点问题之一。近期，我院袁慧玲教授课题组针对华南沿海地区暴雨个例进行模拟和预报方面研究，并发表了相关论文。华南夏季降水受到多种热带天气系统影响，其中西北太平洋一种重要的天气尺度扰动——东风波，是华南后汛期暴雨的重要诱因之一。袁慧玲教授课题组针对 2017 年 7 月华南沿海的一次伴有低层切变线和中层东风波的强降水事件进行了数值模拟和机理分析。结果表明，切变线与吕宋岛西北岸的低层扰动有关，而东风波对其在南海的维持和发展有重要影响。系统接近华南沿海时，东风波的准闭合环流有助于维持湿空气持续对流，其下方下沉气流诱导的辐散流在扰动中辐合促进了扰动发展，而形成的冷核促进了局地斜压性和对流的发展。该成果以“Onshore convection associated with the easterly wave over the South China Sea: A case study”为题发表于《Atmospheric Research》，第一作者为博士生陈文斌。另外，针对华南前汛期锋面降水和暖区降水共存的特性，课题组采用不同扰动方法对 2019 年 6 月一次双雨带事件开展对流尺度集合预报。结果表明，将初始和侧边界扰动与适当的物理方案相结合时，集合预报系统的预报效果最好。暖区降水的可预报性明显低于锋面降水，

较多成员未能触发对流而导致的整个暖区降水过程的漏报，其中物理方案在海岸对流触发过程中起着重要作用。

来源：南京大学

发布时间：2023-01-18

数据类型：资讯

https://as.nju.edu.cn/31/0e/c11323a602382/page.htm

6. ERL: 土壤温湿度变化表征了植被春秋季变化增强趋势的主要气候因素

摘要：近年来，中国陆地植被生态系统的演变得到广泛关注。卫星观测表明近几十年来我国陆地植被生态系统总体变好，呈“绿化”趋势。贡献因素除二氧化碳施肥效应和人为绿化及管理活动外，气候变化也扮演了重要的角色。然而植被响应气候变化受到植被生理、土壤和局地气候等过程调控，具有明显的时空差异。因此揭示生态系统响应气候变化的特征对我们理解气候变化影响生态系统的机理，评估影响和生态风险具有重要意义。本研究利用了近几十年来（1981-2018）的卫星观测叶面积指数（LAI）产品和再分析土壤温湿度产品（ERA5-Land）在 8 天的时间分辨率上开展了植被生态系统响应气候变化的特征，尤其关注了春季和秋季，即生长季开始和结束的两端。通过 LAI 的相对于自身的变化，即距平百分率，揭示了春秋季植被对气候变化的响应明显增强，多个生态类型形成了哑铃型的响应特征，虽然高原和西部草地生态系统显著的增强仍然发生在夏季，但仍呈提前趋势，而秋季响应延长。这一变化主要是气候暖化，引起春季升温的提前和秋季降温的滞后，即生长季延长。在水分条件允许的条件下，LAI 增加，形成显著的区域绿化的趋势。另外部分地区，主要是华北和西南干湿气候的过渡带区域，出现了植被棕化的趋势，即 LAI 下降的趋势，这主要是气候干旱事件频发和干旱化演变的结果，与几年来华北西南的强干旱事件频发有密切的联系。

来源：大气物理所

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数据类型：资讯

http://www.iap.cas.cn/gb/xwdt/kyjz/202301/t20230116_6599777.html

7. Past eight years confirmed to be the eight warmest on record

摘要：GENEVA, 12 January 2023 - The past eight years were the warmest on record globally, fueled by ever-rising greenhouse gas concentrations and accumulated heat, according to six leading international temperature datasets consolidated by the World Meteorological Organization.The average global temperature in 2022 was about 1.15 [1.02 to 1.27] °C above the pre-industrial (1850-1900) levels. 2022 is the 8th consecutive year (2015-2022) that annual global temperatures have reached at least 1°C above pre-industrial levels, according to all datasets compiled by WMO. 2015 to 2022 are the eight warmest years on record. The likelihood of – temporarily – breaching the 1.5°C limit of the Paris Agreement is increasing with time.The persistence of a cooling La Niña event, now in its third year, means that 2022 was not the warmest year on record, but is "only" the fifth or sixth warmest.

来源：WMO

发布时间：2023-01-12

数据类型：资讯

https://public.wmo.int/en/media/press-release/past-eight-years-confirmed-be-eight-warmest-record

8. Ozone layer recovery is on track, helping avoid global warming by 0.5°C（臭氧层的恢复有助于避免全球变暖 0.5°C）

摘要：DENVER/NAIROBI/GENEVA, 9 January 2023 – The ozone layer is on track to recover within four decades, with the global phaseout of ozone-depleting chemicals already benefitting efforts to mitigate climate change. This is the conclusion of a UN-backed panel of experts, presented today at the American Meteorological Society's 103rd annual meeting. Examining novel technologies such as geoengineering for the first time, the panel warns of unintended impacts on the ozone layer.The UN-backed Scientific Assessment Panel to the Montreal Protocol on Ozone Depleting Substances quadrennial assessment report, published every four years, confirms the phase out of nearly 99% of banned ozone-depleting substances has succeeded in safeguarding the ozone layer, leading to notable recovery of the ozone layer in the upper stratosphere and decreased human exposure to harmful ultraviolet (UV) rays from the sun.If current policies remain in place, the ozone layer is expected to recover to 1980 values (before the appearance of the ozone hole) by around 2066 over the Antarctic, by 2045 over the Arctic and by 2040 for the rest of the world. Variations in the size of the Antarctic ozone hole, particularly between 2019 and 2021, were driven largely by meteorological conditions. Nevertheless, the Antarctic

ozone hole has been slowly improving in area and depth since the year 2000.“That ozone recovery is on track according to the latest quadrennial report is fantastic news. The impact the Montreal Protocol has had on climate change mitigation cannot be overstressed. Over the last 35 years, the Protocol has become a true champion for the environment,” said Meg Seki, Executive Secretary of the United Nations Environment Programme’s Ozone Secretariat.

来源：WMO

发布时间：2023-01-09

数据类型：资讯

https://public.wmo.int/en/media/press-release/ozone-layer-recovery-track-helping-avoid-global-warming-05%C2%B0c

9. 2023 is Off to a Warm Start, Breaking Records Across Europe（2023 年是一个温暖的开始，打破了整个欧洲的记录）

摘要：A high-pressure zone over the Mediterranean region and an Atlantic low-pressure system induced a strong south-west flux that brought warm air from north-western Africa to middle latitudes. The air was further warmed when passing the North Atlantic due to a higher-than-normal sea surface temperature. In the eastern North Atlantic, sea surface temperature was 1–2 °C higher than normal, near the coasts of Iberia even more. All this caused record-breaking heat in several European countries on New Year's Eve and New Year's Day.Temperatures above 20 °C were observed in many European countries, even in Central Europe. Some national and many local temperature records for December and January were broken in several countries from Spain to eastern parts of Europe. Hundreds of weather stations across Europe had their all-time highest daily temperature for the months of December or January. Some relevant records are included next (previous records for all December and January months in brackets).On 31st December 2022:19.4 °C in Dresden-Hosterwitz, Germany (17.

来源：WMO

发布时间：2023-01-04

数据类型：资讯

https://public.wmo.int/en/media/news/2023-warm-start-breaking-records-across-europe

✧文献信息

本监测周期内，文献信息共更新 14 条，来自大气科学、应用气象学报、Geoscientific Model Development:

城市气象与灾害性天气研究

诱发四川冕宁“6.26”山洪灾害的突发性暴雨特征及其形成机制

摘要：基于多源观测、再分析和对流可分辨模式预报资料，运用物理量诊断、标准化异常、相似过程比较等方法，分析了 2020 年 6 月 26 日四川冕宁突发性暴雨过程的特征和形成机制。结果表明：（1）该过程是一次伴有多条带状 γ 中尺度对流系统、“列车效应”产生极端小时雨量的局地突发性暴雨过程，其对流回波质心较低，对流云团具有中尺度对流复合体云团特征；（2）冕宁北部的对流冷池出流与较强的谷地偏南气流相遇形成的辐合抬升构成了对流的触发机制；（3）川西南低空偏南气流具有阶段性增强特征并提供了持续的暖湿空气输送，其在过程初期与下山冷池的相互作用及后期与盆地西部南下冷空气的汇合，使对流反复在冕宁站西侧和南侧初生，并在下游形成“列车效应”；（4）对比历史相似过程，环境大气的对流有效位能等物理量具有更显著的异常和异常持续性；（5）川西南北部的高海拔地形对延缓冷空气进入安宁河谷和维持河谷内的不稳定层结有显著作用，并且该区域地形强迫抬升形成了河谷上游地区潜在的对流触发条件。最后给出了此次暴雨过程形成机制的概念模型。关键词:山洪/突发性暴雨/列车效应/冷池/水汽输送带/地形

来源：大气科学

发布时间：2023-01-18

数据类型：期刊

http://www.iapjournals.ac.cn/dqkx/cn/article/doi/10.3878/j.issn.1006-9895.2201.21186

中国西南部一次东移型暴雨中涡旋发展的多尺度地形影响研究

摘要：由观测和数值模拟结果分析发现，2019 年 8 月 5～6 日中国西南部的东移型致灾暴雨事件中存在三涡（南北双高原涡、西南涡）相继发展并导致暴雨加强和移动的现象。借助数值试验，研究了多尺度地形因子（青藏高原、横断山脉和四川盆地三大地形）各自对涡旋演变的作用。结果表明，横断山脉对西南涡的形成起

关键作用，四川盆地影响着西南涡的位置和强度。对于高原涡（南侧高原涡）的移动，四川盆地地形只影响涡旋强度演变，但不会改变高原涡的移动路径。一旦横断山脉被移除，高原涡的东移现象随之消失。进一步分析青藏高原和四川盆地交界处的陡峭地形坡度改变对涡旋发展的影响发现，发现坡度越陡，高原涡移动速度越快，且盆地内二涡合并后的西南涡强度越强。最后借助于倾斜涡度发展理论，解释了不同坡度对涡旋强度演变的影响：随着坡度变陡，倾斜涡度发展系数沿涡旋下滑路径快速减小，对垂直涡度局地倾向的强迫作用，加剧了涡旋的快速加强。关键词:暴雨/涡旋/地形/数值模拟

来源：大气科学

发布时间：2023-01-18

数据类型：期刊

http://www.iapjournals.ac.cn/dqkx/cn/article/doi/10.3878/j.issn.1006-9895.2106.21072

辽宁省温带气旋龙卷的环境参数特征

摘要：利用欧洲中期天气预报中心 ERA5 再分析数据，统计 1979—2020 年辽宁省 42 个温带气旋龙卷环境背景和物理量参数特征，结果表明：辽宁省温带气旋龙卷多发于温带气旋中心的西南、东南象限，与冷锋前暖区相对应，主要分布在辽河平原中西部及渤海湾沿岸，强龙卷（EF2 及以上级别）占比为 28.6%。风暴相对螺旋度和对流有效位能的大值区出现在气旋西南—东南象限，呈带状分布，龙卷风暴主要分布于风暴相对螺旋度大值区西北侧、对流有效位能大值区的顶端的强梯度区附近。强龙卷参数最大值达 0.7，其大值区与 EF2 及以上级别龙卷相对应。地面冷锋和干线是温带气旋龙卷的关键触发系统，对比近气旋中心和冷锋尾部湿度垂直分布，后者所表现的高层强干侵入导致风暴产生更强的冷池，过强的下沉气流可能是龙卷产生的不利因素。温带气旋龙卷多分布于高空急流左侧气流的分流区内，对应高空强辐散区。0～3 km 垂直温度递减率大值区与气旋中心附近的弱龙卷高发区有较好对应关系。关键词:龙卷;温带气旋;环境参数;辽宁省

来源：应用气象学报

发布时间：2023-01-01

数据类型：期刊

http://qikan.camscma.cn/cn/article/doi/10.11898/1001-7313.20230109

重庆市主城都市区热岛效应定量评估

摘要：结合夜间灯光数据、高程数据及地表分类数据，提出一种针对山地城市郊区背景划分的方法，并采用城乡二分法定量评估 2001—2020 年重庆市主城都市区热岛效应时空变化特征。结果显示传统缓冲区法和综合缓冲区法提取的郊区背景存在明显差异。利用传统缓冲区法提取郊区背景估算的热岛存在大量假热岛像元，导致传统缓冲区法估算的热岛面积明显大于综合缓冲区法。综合缓冲区法估算结果表明：主城都市区热岛主要分布在中心城区、长寿区、涪陵区以及各区县驻地附近，冷岛分布在东南部高海拔地区及中心城区部分山脉处。2001—2020 年主城都市区热岛面积占比随时间呈波动上升趋势，且具有明显的季节变化特征，夏季最强、冬季最弱。关键词:山地城市;城市热岛;城乡二分法;郊区背景划分

来源：应用气象学报

发布时间：2023-01-01

数据类型：期刊

http://qikan.camscma.cn/cn/article/doi/10.11898/1001-7313.20230108

气象综合指挥平台建设与应用

摘要：在重大活动、突发气象灾害以及汛期会商服务等特定时空气象保障过程中，采用各单位逐一汇报及展示专业产品或系统等传统方式，形成的产品及系统深度专业，但无法互动且运行协同不足，影响实时保障服务效益。气象综合指挥平台充分利用现有气象业务数字化成果，面向气象保障服务的时空及可视化需求，采用混合存储、接口服务以及图层组件发布等技术，实现多源数据的标准化处理、功能集约建设以及图层渲染等组件松耦合发布，首次在气象保障服务中接入空间天气、风云四号气象卫星高分辨率数据、秒级观测以及百米融合实况等数据及产品，实现气象产品全在线服务与中国气象局电视会商、云会商系统音视频信号的同步实时调度，为实时气象保障调度指挥提供服务支撑。该平台集成 113 种气象产品，发布 1106 个图层服务，成功完成 2022 年北京冬奥会和冬残奥会等国家重大气象保障工作，未来可为各类气象保障系统开发及专题气象保障服务提供支撑应用。关键词:指挥平台;服务中台;组件化;可视化

来源：应用气象学报

发布时间：2023-01-01

数据类型：期刊

http://qikan.camscma.cn/cn/article/doi/10.11898/1001-7313.20230110

复合翼无人机不同传感器探测大气温湿度对比

摘要：无人机为大气探测的重要平台，为克服固定翼起飞降落条件要求高和旋翼机飞行航时短的问题，中国科学院大气物理研究所中层大气和全球环境探测实验室自主研制了一款新型复合翼无人机。为检验其在近地面探测大气温湿度的能力，于 2020 年 7 月 28 日—8 月 6 日及 2021 年 8 月 1—6 日，在内蒙古自治区正镶白旗无人机综合验证基地开展了两期无人机搭载不同传感器探测温湿度的比对试验。结果显示：机载自动站与 GPS 探空仪所测温度绝对偏差为 2.00℃~2.35℃，系统偏差可订正；两者所测相对湿度绝对偏差为 4.28%；2021 年搭载维萨拉温湿探头，测量对比表明维萨拉温湿探头与 GPS 探空仪测量结果一致性较好，机载自动站与两者差异较大。飞行探测试验表明：长航时复合翼无人机在近地面大气层探空方面机动性强，与常规旋翼无人机相比，可获取更大垂直与水平范围的气象要素信息。关键词:复合翼无人机;机载自动站;GPS 探空仪;维萨拉温湿探头。

来源：应用气象学报

发布时间：2023-01-01

数据类型：期刊

http://qikan.camscma.cn/cn/article/doi/10.11898/1001-7313.20230107

X 波段相控阵偏振雷达观测墨脱地区云降水宏观特征的统计研究

摘要：第二次青藏高原综合科学考察研究项目在墨脱布设了一部X波段相控阵偏振雷达（X-PAR），实现了首次对河谷地区云降水的雷达连续观测。为了揭示高原东南河谷地区云降水的宏观特征，本文利用墨脱 X-PAR 2019 年 11 月至 2020 年 10 月的观测数据定量分析了墨脱地区云降水回波强度、回波顶高等参数的月变化、日变化和高度变化，并与那曲地区夏季季风时期多普勒雷达观测数据进行了比较。研究发现：（1）墨脱地区回波顶高、面积、强回波所占比例以及回波分布范围在 4～10 月大于 11～3 月，4～10 月降水频次高、对流性降水多，其中以 6 月最为显著。而进入 4 月后弱回波数量的大幅度增加导致了 4～10 月回波强度小于 11～3 月。降水回波月变化特征结合高原季风指数，将一年分为旱季（11～3 月）与雨季（4～10 月）。（2）雨季降水回波频次、顶高、面积均大于旱季，说明雨季降水频次更高、对流性活动更旺盛。降水回波频次、顶高、面积的日变化表明，旱季日降水主要发生在下午与上半夜，雨季主要发生在下半夜。（3）墨脱降水回波强度大部分小于 30 dBZ，旱季在海拔高度 3 km 以上回波发生频次高，雨季在 3 km 以下高。

（4）夏季季风期间墨脱回波顶高低于那曲，其顶高、面积日变化趋势与那曲不同。夏季季风期间那曲日降水主要集中在下午与上半夜，而墨脱则集中在下半夜。墨脱旱季云降水特征与那曲夏季季风时期特征较为相似。关键词:墨脱/相控阵双偏振雷达/云降水特征

来源：大气科学

发布时间：2023-01-18

数据类型：期刊

http://www.iapjournals.ac.cn/dqkx/cn/article/doi/10.3878/j.issn.1006-9895.2109.21050

一次高炮防雹的相控阵双偏振雷达观测特征

摘要：选取 2021 年 6 月 28 日山西省临汾市隰县一次高炮防雹作业过程，利用隰县 X 波段相控阵双偏振雷达数据分析作业前后强对流云变化的现象和机理。高炮防雹作业后冰雹云单体的宏观特征、动力和微物理的垂直结构均出现短时间明显变化。高炮防雹作业后 1 min 55 dBZ 顶高急剧下降约 2 km 至 0℃层以下，水平反射率因子 ZH 的强回波垂直结构在 0℃层断裂，径向速度散度显示单体前部和后部的辐合带减弱、消失，差分反射率 ZDR 在近地面增大，ZDR 柱消失，差分相移率 KDP 在中低层增大，共极化相关系数 ρhv 从 0℃层到近地面表现为 0.94~0.96 的柱状区，单体核心上部的过冷水小范围中心消失，0℃层以下由雨夹雹、霰、湿雪及各种雨的混合柱状分布转为低层大雨。这些短时间的明显变化现象支持爆炸防雹理论。关键词:相控阵双偏振雷达;高炮;防雹作业

来源：应用气象学报

发布时间：2023-01-01

数据类型：期刊

http://qikan.camscma.cn/cn/article/doi/10.11898/1001-7313.20230106

城市气候研究

stoPET v1.0: a stochastic potential evapotranspiration generator for simulation of climate change impacts

摘要：Potential evapotranspiration (PET) represents the evaporative demand in the atmosphere for the removal of water from the land and is an essential variable for

understanding and modelling land–atmosphere interactions. Weather generators are often used to generate stochastic rainfall time series; however, no such model exists for the generation of a stochastically plausible PET time series. Here we develop a stochastic PET generator, stoPET, by leveraging a recently published global dataset of hourly PET at 0.1∘ resolution (hPET). stoPET is designed to simulate realistic time series of PET that capture the diurnal and seasonal variability in hPET and to support the simulation of various scenarios of climate change. The parsimonious model is based on a sine function fitted to the monthly average diurnal cycle of hPET, producing parameters that are then used to generate any number of synthetic series of randomised hourly PET for a specific climate scenario at any point of the global land surface between 55∘ N and 55∘ S. In addition to supporting a stochastic analysis of historical PET, stoPET also incorporates three methods to account for potential future changes in atmospheric evaporative demand to rising global temperature. These include (1) a user-defined percentage increase in annual PET, (2) a step change in PET based on a unit increase in temperature, and (3) the extrapolation of the historical trend in hPET into the future. We evaluated stoPET at a regional scale and at 12 locations spanning arid and humid climatic regions around the globe. stoPET generates PET distributions that are statistically similar to hPET and an independent PET dataset from CRU, thereby capturing their diurnal/seasonal dynamics, indicating that stoPET produces physically plausible diurnal and seasonal PET variability. We provide examples of how stoPET can generate large ensembles of PET for future climate scenario analysis in sectors like agriculture and water resources with minimal computational demand.

来源：GMD

发布时间：2023-01-25

数据类型：期刊

https://gmd.copernicus.org/articles/16/557/2023/

数值天气预报

CMA-GFS 4DVar 边界层过程线性化的改进

摘要：持续发展和优化切线性模式的线性化物理过程，保持与非线性模式一致是改善四维变分同化（4DVar）分析和预报效果的有效方法之一。目前业务系统的 CMA-GFS 模式采用基于 Charney-Phillips （C-P）跳点的边界层参数化方案，而 CMA-GFS 4DVar 系统中采用基于 Lorenz 跳点的边界层线性化方案。为改善 CMA-GFS 4DVar 系统的边界层分析和预报效果，基于 C-P 跳点的边界层参数化方案研发

了新边界层线性化方案，并通过对方案中地表热量通量和水汽通量扰动、自由大气的理查逊系数扰动、边界层的热量和动量交换系数扰动等进行更加精细地规约化约束，在确保 CMA-GFS 切线性和伴随模式稳定运行的情况下，减少线性化过程对切线性模式预报精度的影响。切线性近似试验检验表明：相较于原方案，新边界层线性化方案可以减少边界层位温和比湿的相对误差，最大可减少 10%。批量 4DVar 循环同化试验表明：新边界层线性化方案可以有效改善切线性模式对低层位温、风场和比湿扰动的预报精度，减少 4DVar 内外循环目标泛函的相对差异，并提高 700 hPa 位势高度的可预报时效。关键词:边界层过程;线性化物理过程;CMA-GFS;四维变分同化。

来源：应用气象学报

发布时间：2023-01-01

数据类型：期刊

http://qikan.camscma.cn/cn/article/doi/10.11898/1001-7313.20230102

Customized deep learning for precipitation bias correction and downscaling(定制深度学习用于降水偏差校正和降尺度)

摘要：Systematic biases and coarse resolutions are major limitations of current precipitation datasets. Many deep learning (DL)-based studies have been conducted for precipitation bias correction and downscaling. However, it is still challenging for the current approaches to handle complex features of hourly precipitation, resulting in the incapability of reproducing small-scale features, such as extreme events. This study developed a customized DL model by incorporating customized loss functions, multitask learning and physically relevant covariates to bias correct and downscale hourly precipitation data. We designed six scenarios to systematically evaluate the added values of weighted loss functions, multitask learning, and atmospheric covariates compared to the regular DL and statistical approaches. The models were trained and tested using the Modern-era Retrospective Analysis for Research and Applications version 2 (MERRA2) reanalysis and the Stage IV radar observations over the northern coastal region of the Gulf of Mexico on an hourly time scale. We found that all the scenarios with weighted loss functions performed notably better than the other scenarios with conventional loss functions and a quantile mapping-based approach at hourly, daily, and monthly time scales as well as extremes. Multitask learning showed improved performance on capturing fine

features of extreme events and accounting for atmospheric covariates highly improved model performance at hourly and aggregated time scales, while the improvement is not as large as from weighted loss functions. We show that the customized DL model can better downscale and bias correct hourly precipitation datasets and provide improved precipitation estimates at fine spatial and temporal resolutions where regular DL and statistical methods experience challenges.

来源：GMD

发布时间：2023-01-25

数据类型：期刊

https://gmd.copernicus.org/articles/16/535/2023/

空气质量预报

The AirGAM 2022r1 air quality trend and prediction model（AirGAM 2022r1 空气质量趋势和预测模型）

摘要：This paper presents the AirGAM 2022r1 model – an air quality trend and prediction model developed at the Norwegian Institute for Air Research (NILU) in cooperation with the European Environment Agency (EEA) over 2017–2021. AirGAM is based on nonlinear regression GAMs – generalised additive models – capable of estimating trends in daily measured pollutant concentrations at air quality monitoring stations, discounting for the effects of trends and time variations in corresponding meteorological data. The model has been developed primarily for the compounds NO2, O3, PM10, and PM2.5. Meteorological input data consist of temperature, wind speed and direction, planetary boundary layer height, relative and absolute humidity, cloud cover, and precipitation over the period considered. The exact set of meteorological variables used in the model depends on the compound selected for analysis. In addition to meteorological variables introduced in the model as covariates, i.e. explanatory variables for the concentration levels, the model also incorporates time variables such as the day of the week, day of the year, and overall time, which is related to the model's trend term. The trend analysis is performed at each station separately. Thus, the model only considers the temporal features of concentrations and meteorology at a station, rather than any spatial correlations or dependencies between stations. AirGAM is implemented using the R language for statistical computing and, in particular, the GAM package mgcv. In the model,

meteorological and time covariates are represented and estimated as smooth nonlinear functions of the corresponding variables. Thus, the trend term is defined and estimated as a smooth nonlinear function of time over the period selected for analysis. Once fitted to training data, the model may be used as a prediction tool capable of predicting air pollutant concentrations for new sets of meteorological and time data which are not in the training set – e.g. for cross-validation or forecasting purposes. The model does not explicitly use emissions or background concentrations – these are sought to be implicitly represented through the estimated nonlinear relations between meteorology, time, and concentrations. In addition to meteorology-adjusted trends, the program also produces unadjusted trends – i.e. trends based on the same regression set-up but only including the time covariates. Both types of trends can be output in the same run, making it possible to compare them. Ideally, the meteorology-adjusted trend will show the trend in concentration mainly due to changes in emissions or physicochemical processes not induced by changes in meteorology. AirGAM has been developed and tested primarily in trend studies based on measurement data hosted by the EEA, including the AirBase data (before 2013) and the Air Quality e-Reporting (AQER) data from 2013 and onwards. Still, the model is general and could be applied in other regions with other input data. The EEA data provide daily or hourly surface measurements at individual monitoring stations in Europe. For input meteorological data, we extract time series from the gridded meteorological re-analysis (ERA5) provided by the European Centre for Medium-Range Weather Forecasts (ECMWF) for each monitoring station. The paper presents results with the model for all AirBase/AQER stations in Europe from the latest EEA trend study for 2005–2019.

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Comparing Sentinel-5P TROPOMI NO2 column observations with the CAMS regional air quality ensemble（Sentinel-5P TROPOMI NO2 柱观测结果与 CAMS 区域空气质量集合的比较）

摘 要：The Sentinel-5P TROPOspheric Monitoring Instrument (TROPOMI) instrument, launched in October 2017, provides unique observations of atmospheric trace gases at a high resolution of about 5 km, with near-daily global coverage, resolving individual sources like thermal powerplants, industrial complexes, fires, medium-scale

towns, roads, and shipping routes. Even though Sentinel-5P (S5P) is a global mission, these datasets are especially well suited to test high-resolution regional-scale air quality (AQ) models and provide valuable input for emission inversion systems.In Europe, the Copernicus Atmosphere Monitoring Service (CAMS) has implemented an operational regional AQ forecasting capability based on an ensemble of several European models, available at a resolution of $0.1^\circ \times 0.1^\circ$. In this paper, we present comparisons between TROPOMI observations of nitrogen dioxide (NO2) and the CAMS AQ forecasts and analyses of NO2. We discuss the different ways of making these comparisons and present quantitative results in the form of maps for individual days, summer and winter months, and a time series for European subregions and cities between May 2018 and March 2021.The CAMS regional products generally capture the fine-scale daily and averaged features observed by TROPOMI in much detail. In summer, the comparison shows a close agreement between TROPOMI and the CAMS ensemble NO2 tropospheric columns with a relative difference of up to 15 % for most European cities. In winter, however, we find a significant discrepancy in the column amounts over much of Europe, with relative differences up to 50 %. The possible causes for these differences are discussed, focusing on the possible impact of retrieval and modeling errors. Apart from comparisons with the CAMS ensemble, we also present results for comparisons with the individual CAMS models for selected months.Furthermore, we demonstrate the importance of the free tropospheric contribution to the estimation of the tropospheric column and thus include profile information from the CAMS configuration of the ECMWF's (European Centre for Medium-Range Weather Forecasts) global integrated model above 3 km altitude in the comparisons. We also show that replacing the global $1^\circ \times 1^\circ$ a priori information in the retrieval by the regional $0.1^\circ \times 0.1^\circ$ resolution profiles of CAMS leads to significant changes in the TROPOMI-retrieved tropospheric column, with typical increases at the emission hotspots up to 30 % and smaller increases or decreases elsewhere. As a spinoff, we present a new TROPOMI NO2 level 2 (L2) data product for Europe, based on the replacement of the original TM5-MP generated global a priori profile by the regional CAMS ensemble profile. This European NO2 product is compared with ground-based remote sensing measurements of six Pandora instruments of the Pandonia Global Network and nine Multi-AXis Differential Optical Absorption Spectroscopy (MAX-DOAS) instruments. As compared to the standard S5P tropospheric NO2 column data, the overall bias of the new product for all except two stations is 5 % to 12 % smaller, owing to a reduction in the multiplicative bias. Compared to the CAMS tropospheric NO2 columns,

dispersion and correlation parameters with respect to the standard data are, however, superior.

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Cross-evaluating WRF-Chem v4.1.2, TROPOMI, APEX, and in situ NO2 measurements over Antwerp, Belgium（交叉评估 WRF-Chem v4.1.2、TROPOMI、APEX 和比利时安特卫普的原位 NO2 测量）

摘要：The Weather Research and Forecasting model coupled with Chemistry (WRF-Chem) is employed as an intercomparison tool for validating TROPOspheric Monitoring Instrument (TROPOMI) satellite NO2 retrievals against high-resolution Airborne Prism EXperiment (APEX) remote sensing observations performed in June 2019 in the region of Antwerp, a major hotspot of NO2 pollution in Europe. The model is first evaluated using meteorological and chemical observations in this area. Sensitivity simulations varying the model planetary layer boundary (PBL) parameterization were conducted for a 3 d period in June 2019, indicating a generally good performance of most parameterizations against meteorological data (namely ceilometer, surface meteorology, and balloon measurements), except for a moderate overestimation (∼ 1 m s−1) of near-surface wind speed. On average, all but one of the PBL schemes reproduce the surface NO2 measurements at stations of the Belgian Interregional Environmental Agency fairly well, although surface NO2 is generally underestimated during the day (between −4.3 % and −25.1 % on average) and overestimated at night (8.2 %–77.3 %). This discrepancy in the diurnal evolution arises despite (1) implementing a detailed representation of the diurnal cycle of emissions (Crippa et al., 2020) and (2) correcting the modeled concentrations to account for measurement interferences due to NOy reservoir species, which increases NO2 concentrations by about 20 % during the day. The model is further evaluated by comparing a 15 d simulation with surface NO2, NO, CO, and O3 data in the Antwerp region. The modeled daytime NO2 concentrations are more negatively biased during weekdays than during weekends, indicating a misrepresentation of the weekly temporal profile applied to the emissions obtained from Crippa et al. (2020). Using a mass balance approach, we determined a new weekly profile of NOx emissions, leading to a homogenization of the relative bias among

the different weekdays. The ratio of weekend to weekday emissions is significantly lower in this updated profile (0.6) than in the profile based on Crippa et al. (2020; 0.84).Comparisons with remote sensing observations generally show a good reproduction of the spatial patterns of NO2 columns by the model. The model underestimated both APEX (by ca. −37 %) and TROPOMI columns (ca. −25 %) on 27 June, whereas no significant bias is found on 29 June. The two datasets are intercompared by using the model as an intermediate platform to account for differences in vertical sensitivity through the application of averaging kernels. The derived bias of TROPOMI v1.3.1 NO2 with respect to APEX is about −10 % for columns between (6–12) × 1015 molec. cm−2. The obtained bias for TROPOMI v1.3.1 increases with the NO2 column, following CAPEX=1.217Cv1.3-0.783 × 1015 molec. cm−2, in line with previous validation campaigns. The bias is slightly lower for the reprocessed TROPOMI v2.3.1, with CAPEX=1.055CPAL-0.437 × 1015 molec. cm−2 (PAL).Finally, a mass balance approach was used to perform a crude inversion of NOx emissions based on 15 d averaged TROPOMI columns. The emission correction is conducted only in regions with high columns and high sensitivity to emission changes in order to minimize the errors due to wind transport. The results suggest that emissions increase over Brussels–Antwerp (+20 %), the Ruhr Valley (13 %), and especially Paris (+39 %), and emissions decrease above a cluster of power plants in western Germany.

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✧会议信息

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