CLIMATE SCIENCE FOR SERVICE PARTNERSHIP CHINA

Measuring climate risk in China

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ASSESSING THE ROLE OF CLIMATE CHANGE IN RECENT EXTREME WEATHER IN CHINA

A question often asked about climate change is whether the changes we are seeing in the Earth's climate are due to human influence, or if they can be explained by natural causes. The research that looks at this question is known as 'attribution' science.

CSSP China is carrying out attribution science to investigate the role of climate change in recent extreme weather and climate events in China.

Typically, people discuss climate and climate change in terms of long-term trends in temperature and rainfall. However, we most directly experience the effects of our climate, and changes to it, through extreme weather and climate events – whether over days, months, the coming year or longer term. Therefore, information on how extreme weather and climate events are changing is essential to help communities, industry and governments adapt to a changing climate.

How can attribution studies help support decision makers?

Attribution studies provide decision makers with guidance on the potential urgency and scale of measures needed to help them adapt to the impacts of a changing climate. Research showing that human activities increase the risk of a particular extreme weather or climate event supports policies to mitigate greenhouse gas emissions, for example. Combining attribution information with future climate projections can also support decision-making around adaptation to the impacts of climate change.

What CSSP China is doing

Scientists from the UK and China have analysed recent extreme weather and climate events in China and investigated whether they have become more likely with climate change. One such event, heavy rainfall in May 2015 in south-east China, resulted in severe flooding, loss of life and the displacement of 250,000 people into temporary shelters. A collaborative study between the Met Office Hadley Centre and the China Meteorological Administration found that such short-duration, heavy rainfall events in May in parts of this region are now about 60% more likely to occur, suggesting that climate change is increasing the risk of flooding in south-east China[1].

There is further evidence of an increasing risk of heavy, intense rainfall over China. A recent China-UK study looked at rainfall records over eastern China and found a significant shift from light to heavy rainfall in recent decades[2]. Using simulations from multiple climate models, CSSP China research shows that increases in greenhouse gas concentrations have made a significant contribution to the switch to heavier rainfall. This is because greenhouse gases create a warmer atmosphere that can hold more water vapour and thus produce more heavy rain. Further warming from greenhouse gases is predicted to lead to an increasing shift towards heavy precipitation over China in the future, leading to a potential increased risk of flooding.

Looking further into the future, CSSP China has shown that even if global temperature rise is limited to 1.5 °C above pre-industrial levels, as is the aim of the recent Paris COP21 agreement, China would still experience at least a 10% increase in the intensity of summer heavy downpours[3]. Chan Xiao of the Beijing Climate Centre led the research, spending 12 months at the Met Office Hadley Centre as a visiting scientist, strengthening UK-China collaboration.

CSSP China is also investigating the impact of climate change on larger meteorological systems responsible for extreme weather and climate, such as the East Asian summer monsoon, which brings much needed water for agriculture to most of eastern China. Recent UK-China research shows that climate change from human activity has led to an overall decrease in total monsoon rainfall over the past 65 years, and an increased number of dry days during the monsoon[4]. However, at the same time, climate change has caused the most extreme heavy rainfall events associated with the monsoon to become shorter but more intense. These changes suggest that climate change is increasing the likelihood of drought over the summer monsoon season as well as the chance of flash flooding during individual monsoon rainstorms.

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[1] Burke et al 2016, Attribution of extreme rainfall in southeast China during May 2015, Bulletin of the American Meteorological Society special report on attribution, **http://journals.ametsoc.org/doi/abs/10.1175/BAMS-D-16-0144.1**

[2] Ma et al 2017, Detectable anthropogenic shift toward heavy precipitation over eastern China, Journal of Climate, **http://journals.ametsoc.org/doi/10.1175/JCLI-D-16-0311.1**

[3] Xiao et al 2016, Robust increase in extreme summer rainfall intensity during the past four decades observed in China, Scientific Reports, **https://www.nature.com/articles/srep38506**

[4] Burke et al 2017, Impact of anthropogenic climate change on the East Asian summer monsoon, Journal of Climate, **http://journals.ametsoc.org/doi/abs/10.1175/JCLI-D-16-0892.1**

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What's next?

Future work will explore how climate change will affect different regions of China including investigating a wider range of extreme weather and climate events such as the changing risk of extreme cold events from human influence. Understanding how all these risks may change in future will help inform policies that support adaption to a changing climate.

UK-China Research Innovation Partnership Fund information

The Weather and Climate Science for Service Partnership Programme – of which CSSP China is a part - comprises projects to develop partnerships harnessing UK scientific expertise to build the basis for strengthening the resilience of vulnerable communities to weather and climate variability, supported by the UK government's Newton Fund.

For more information visit: **www.newtonfund.ac.uk** and follow via Twitter: @NewtonFund

For more information about CSSP China please visit the Met Office (www.metoffice.gov.uk/research/collaboration/cssp-china), IAP (www.lasg.ac.cn/cssp) or CMA (www.cma.gov.cn/en2014) or contact cssp-china@metoffice.gov.uk

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气候科学支持服务伙伴关系中国项目

衡量中国的气候风险

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评估气候变化对于中国近期极端天气的作用

关于气候变化，经常遇到的一个问题是我们所目睹的各种地球气候的变化究竟是由人类影响导致，还是可归因于自然因素。关注这一问题的研究被称为“归因”科学。

CSSP中国项目正在开展归因科学研究，旨在评估气候变化对于中国近期极端天气和气候事件的作用。

一般而言，人们会借助气温和降水的长期趋势来探讨气候和气候变化；但是，我们对于气候及其变化效应最直接的体验来自于极端天气和气候事件——无论是持续数日、数月、未来一年或更长期间。因此，有关极端天气和气候事件变化的信息对于帮助社区、各个行业和政府适应气候变化具有重要意义。

归因研究如何为决策者提供支持？

归因研究可就各种措施的潜在紧迫性和规模为决策者提供指引，以更好地适应气候变化所带来的影响。例如，研究表明人类活动可使特定极端天气或气候事件的风险升高，这为降低温室气体排放的政策提供了依据和支持。将归因信息与未来气候预估相结合，还能为有关适应气候变化影响的决策提供支持

CSSP中国项目正在进行的工作

中英两国的科学家分析了中国近期出现的极端天气和气候事件，并评估了它们发生的概率在气候变化的作用下是否已升高。此类事件的一个例子是2015年5月在中国东南部发生的强降水，该事件引发了严重洪灾，造成人员伤亡，迫使25万人转移到临时避难场所。英国气象局哈德利中心与中国气象局开展的一项协作性研究表明，5月在该区域多个地方出现这种短暂但强烈降水事件的可能性如今已升高约60%，这意味着气候变化正导致中国东南部的洪灾风险升高。[1]

还有更多证据表明中国境内发生强烈、集中降水的风险在升高。中英两国近期合作开展的一项研究评估了中国东部的降水记录，发现最近数十年发生了从轻度降水到强降水的明显转变。[2] 依托多个气候模型生成的模拟，CSSP中国项目的研究显示，温室气体浓度上升对降水加强的趋势具有重要的促进作用。这是因为温室气体会使大气温度升高，因而能蓄存更多的水蒸气，因此产生更强的降雨。根据预测，温室气体导致的进一步气候变暖可在将来导致中国降水不断增强，发生洪灾的潜在风险因此增加。

展望更长一段时间，CSSP中国项目已证明，即使按照近期巴黎COP21联合国气候变化大会商定的目标，较工业时代前的全球气温上升幅度控制在1.5 ° C的范围内，中国夏季强降水的强度仍将提高至少10%[3]。国家气候中心的肖潺是该项研究的负责人，其曾在英国气象局哈德利中心担任过12个月的访问科学家，促进了中英协作。

CSSP中国项目还在考察气候变化对更大规模气象系统所产生的影响，此类气象系统是引发极端天气和气候的根本原因，例如为中国东部大多数地区的农业带来急需雨水的东亚夏季季风。中英近期合作开展的研究表明，人类活动导致的气候变化在过去65年内已使季风带来的总降水量整体出现减少，且季风期间无雨天数也因此增加。[4]然而在同一时期，气候变化也使得与季风有关的大多数极端强降水事件持续时间变短，但强度增加了。这些变化意味着气候变化将使夏季季风季节出现干旱的可能性增加以及在个别季风暴雨期间出现暴洪的可能性增加。

[1] Burke等人，2016年，《2015年5月中国东南部极端降水的归因》，《美国气象学会公报》归因特别报告 http://journals.ametsoc.org/doi/abs/10.1175/BAMS-D-16-0144.1

[2] Ma等人，2017年，《造成中国东部强降水的显著人为因素》，《气候杂志》http://journals.ametsoc.org/doi/10.1175/JCLI-D-16-0311.1

[3] Xiao等人，2016年，《在中国观测到的过去四十年内夏季极端降水强度的显著增加》，**Scientific Reports**（《科学报告》）https://www.nature.com/articles/srep38506

[4] Burke等人，2017年，《人为气候变化对东亚夏季季风的影响》，《气候杂志》，http://journals.ametsoc.org/doi/abs/10.1175/JCLI-D-16-0892.1

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下一步？

接下来的工作将探索气候变化将如何影响中国的不同区域，包括考察更广范围的极端天气和气候事件，例如人类影响导致的极端寒冷事件风险变化。理解所有这些风险在将来可能如何变化，有助于为支持适应气候变化的政策提供参考。

中英研究与创新合作基金信息

天气气候科学支持服务伙伴关系计划（CSSP中国项目是其中之一）包含多个伙伴关系项目，旨在依托英国政府牛顿基金（Newton Fund）的支持，利用英国的科学专长，为加强易受天气和气候变率影响社区的复原力提供基础。

如需更多信息，请访问：www.newtonfund.ac.uk，并通过Twitter关注：@NewtonFund

如需有关CSSP中国项目的更多信息，请访问英国气象局 (www.metoffice.gov.uk/research/collaboration/cssp-china)、IAP (www.lasg.ac.cn/cssp) 或CMA (www.cma.gov.cn/en2014) 网站，或联系 cssp-china@metoffice.gov.uk

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