EDITORIAL OPEN

Climate and atmospheric science: raising the temperature

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Areas of research have a tendency to wax and wane. New discoveries, new techniques or enhanced perception of societal relevance can have a major stimulatory effect on research in specific fields leading them to be viewed as "fashionable". On the other hand, some fields decline as they are perceived as mature or lacking major new research challenges or societal relevance. The closely related areas of climate science and atmospheric science have the attributes of both massive societal relevance and a huge list of research challenges yet to be addressed adequately.

It may be helpful to give a few topical examples. The series of hurricanes which have devastated the Caribbean islands and parts of the USA have made the 2017 hurricane season probably one of the most severe in more than a century.[1] This raises many questions, such as whether the severe 2017 hurricane season was related to any predictable large-scale climatic drivers, such as Atlantic and Pacific sea surface temperatures. How predictable were the statistics of the 2017 hurricane season? What were the regional impacts of these extreme events? What are the physical mechanisms that control the development of hurricanes? There are also many questions relating to mid-latitude weather and the frequency and prediction of extreme weather events. To what extent are the extreme events attributable to a warming of global climate? Measurements of atmospheric carbon dioxide published in late 2017 showed the biggest rise for some years.[2] There remain many uncertainties around the atmospheric budget of carbon dioxide and the question must be posed as to whether the ability of the oceans to act as a sink for carbon dioxide is reducing as ocean acidification progresses.

The impacts from the El Niño event of 2015/2016, which was one of the strongest in over a century, have just passed and the tropical Pacific is turning towards a La Niña event predicted to peak in winter 2017/2018. Together these events are referred to as El Niño/Southern Oscillation (ENSO) events. ENSO events are climatically of global importance and teleconnections from such perturbations of tropical sea surface temperatures can cause weather fluctuations in many regions of the globe. For example, the 2015/2016 El Niño event was linked to droughts in the South Asian region, as well as stormy and wet conditions in western Europe,[3,4] but many other ENSO teleconnections have still to be explored and physically explained before any climate predictability may arise from them in future. For example, recently a stratospheric pathway of ENSO teleconnections to the extratropical regions and particularly to Europe has been discovered, but the details of the involved tropospheric–stratospheric interactions are still a matter of scientific debate.[5] Sea–ice interactions could also provide feedbacks at seasonal and subseasonal time scales that could lead to increased predictability of weather. In general, ENSO may be regarded as a *pacemaker* for global climate on interannual timescale, and its teleconnections are a major source of *seasonal predictability*. If the ENSO phenomenon can be considered as pacemaker at interannual time scales, the Atlantic Multidecadal Oscillation (AMO)[6] can be considered as pacemaker at decadal to multidecadal time scales, and also induces global teleconnections and climate impacts. Also the Interdecadal Pacific Oscillation (IPO)[7] is relevant at decadal to multidecadal time scales and can induce global climatic fluctuations, and could also be interconnected with the AMO. It is still controversial if there is substantial predictability at decadal time scales that goes beyond the global warming-related signals.[8] Studies in these research areas, as well as on regional climate assessments/modelling and subseasonal to seasonal prediction are also welcome in our journal.

Recent assessments have attributed 4.2 million deaths annually across the world to exposure to fine particle pollution and a further 250,000 deaths to pollution by tropospheric ozone.[9,10] The economic cost of crop losses due to tropospheric ozone is estimated in the billions of dollars annually, and liable to increase unless tropospheric ozone concentrations can be stabilised or preferably reduced. The determinants of concentrations of fine particulate matter and ozone are a complex function of atmospheric dynamics and atmospheric chemistry, and the scientific community still has much work to do to develop an adequate predictive capability for future concentrations as mitigation measures are developed. Cities such as Delhi[11] and Beijing have huge problems of air pollution, which are linked to both meteorology and atmospheric chemistry, and research is revealing new mechanisms of particle formation.[12] There are similar questions over stratospheric ozone and the recovery of the ozone layer, which requires an understanding of the complex coupling of ozone, atmospheric chemistry, transport and climate.[13] Also, the impact of industrial chemicals not controlled by the Montreal Protocol, which are not appreciably active in stratospheric ozone depletion, but are short-lived climate forcing agents needs to be understood. Further work is needed to quantify their releases into the atmosphere, their atmospheric distribution and processing, and their effects upon composition and climate.

These are only a few examples of the many issues of huge societal relevance facing the research community in climate and atmospheric science. The optimal solutions to climate change and air quality issues will avoid trade-offs between emissions of greenhouse gases and locally acting air quality pollutants, and require joined-up thinking between research communities which traditionally have remained rather separate. There are clearly many major research questions still to be addressed adequately in both climate science and atmospheric science including ones which bridge the two areas. For this reason, and bearing in mind the huge societal relevance of these issues, we believe that the future prospects for research in climate science and atmospheric science, despite intermittent short-term setbacks, are excellent and that there will be a clear need for authoritative journals in this area for the foreseeable future. Currently, the alternatives open to those wishing to publish in this field are limited and we therefore see the need for a new journal open to, and strongly encouraging, interdisciplinary work within the atmospheric sciences, as well as traditional single discipline studies. We plan to exercise very high editorial standards, publish a range of contributions, including regular articles, reviews, and perspectives, with flexible word limits, and are delighted to announce the formal launch of *npj Climate and Atmospheric Science*.

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Roy M. Harrison[1] and Fred Kucharski[2]
[1]University of Birmingham, Birmingham, UK and [2]The Abdus Salam International Centre for Theoretical Physics, Trieste, Italy
Correspondence: Roy M. Harrison (R.M.HARRISON@bham.ac.uk) or Fred Kucharski (kucharsk@ictp.it)

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