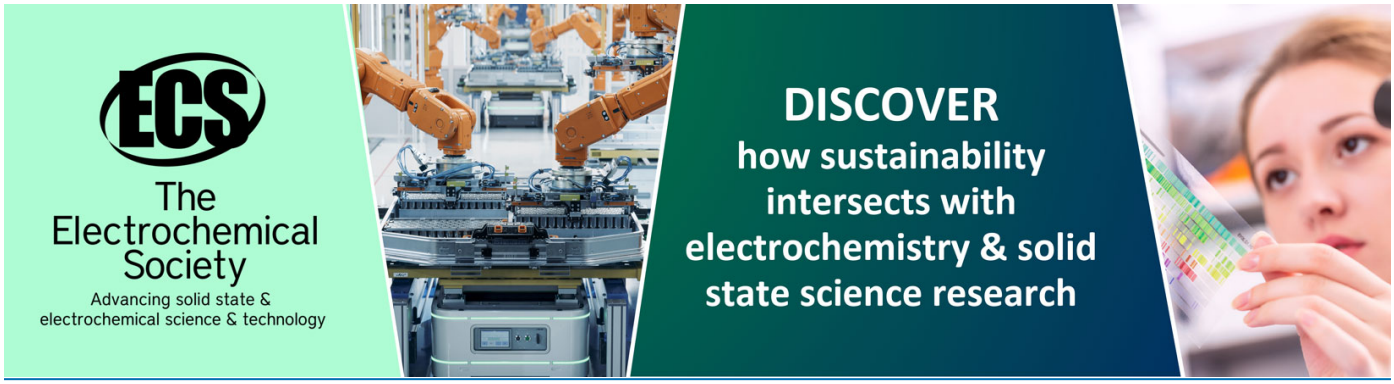
Detection and attribution since the production of the IPCC Fourth Assessment Report



S09.12

Detection and attribution since the production of the IPCC Fourth Assessment Report

Lucka Kajfez Bogataj
University of Ljubljana, Biotehnical Faculty, Slovenia

Since the production of the IPCC Fourth Assessment Report there have been remarkable advances in observations and analyses making the detection and attribution of climate change much more sound. The IPCC Working Group II Fourth Assessment Report found, with very high confidence, that observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases. Global assessment of data since 1970 shows that anthropogenic warming is likely to have had a discernible influence on many physical and biological systems. After the production of the AR4 report this assessment was expanded (Rosenzweig et al., 2008) with a larger database of observed changes and extend the attribution from the global to the continental scale using multiple statistical tests. The part that other driving forces, especially land-use change, might have played at the study locations, was also considered. Observed responses to climate change were found across a wide range of systems as well as regions, improving the geographic balance in data on observed changes. Changes related to regional warming have been documented in terrestrial biological systems, the cryosphere and hydrologic systems; significant changes related to warming have also been studied in coastal processes, marine and freshwater biological systems, and agriculture and forestry. Regarding changes in extreme events this paper discusses winter 2006-07, which was one of the warmest on record for much of the European continent. Records were broken as temperatures consistently hovered well above normal and snowfall was minimal. European averaged autumn and winter surface air temperature (SAT) timeseries indicate that the autumn 2006 and winter 2007 were extremely likely (>95%) the warmest for more than 500 years. In both seasons, SAT anomaly is widespread reaching up to three standard deviations from normal (Luterbacher et al., 2007). Separately, the temperatures experienced during autumn 2006 and winter 2007 are likely to have been the warmest in 500 years, but the sequential combination of two such warm seasons is a still rarer event. Also arctic sea ice has long been recognized as a sensitive climate indicator. Comparison of actual Arctic sea ice decline to IPCC AR4 projections show that observed ice loss is faster than any of the IPCC AR4 models have predicted (Stroeve et al. 2007), especially after 2007 and 2008 melt season, when Arctic sea ice plummeted to the lowest levels since satellite measurements began in 1979. Dynamical ice sheet processes are not included in current models but suggested by recent observations could increase future sea level rise. Understanding of these processes is still limited and there is no consensus on their magnitude. But in order to improve societal responses to climate change a further progress in 'climate change detection and attribution' studies is required. It must be focused on the following priority scientific issues: (1) better treatment of detection and attribution, in particular at the regional scale including studies of regional ocean changes, especially sea surface temperature trends. Although warming of the regional seas is similar to that observed over land, a separate study of the oceans would help provide convincing evidence of the cause of different regions warming. The causes of observed regional changes in sea level also need to be addressed, along with circulation changes and ocean chemistry. (2) A further development of detection and attribution studies using the concept of 'sequential attribution' whereby human activities can be attributed to changing surface air temperatures at a local or regional scale and then biological responses can be attributed to this human-induced temperature increase. Studies using joint attribution or 'end-to-end' method are welcome as well.. (3) Last but not least research should also focus on other uses of detection and attribution studies, like assessing the credibility of climate models or constraining climate projections by using detection and attribution studies to determine which models are most credible (Nicholls, 2007). Detection and attribution studies can also focus on past climate changes inferred from palaeo-climatic data. Past climate changes can inform studies of modern climate change by determining how strongly and rapidly climate can change without human interference.

References

•Luterbacher, J., M. A. Liniger, A. Menzel, N. Estrella, P. M. Della-Marta, C. Pfister, T. Rutishauser, and E. Xoplaki (2007), Exceptional European warmth of autumn 2006 and winter 2007: Historical context, the underlying dynamics, and its phenological impacts, Geophys. Res. Lett., 34, L12704, doi:10.1029/2007GL029951.

•Nicholls, N., 2007. Detecting, understanding and attributing climate change. Australian Greenhouse Office, Department of the Environment and Water Resources, Commonwealth of Australia, 2007

•Rosenzweig, C., D. Karoly, M. Vicarelli, P. Neofotis, Q. Wu, G. Casassa, A. Menzel, T.L. Root, N. Estrella, B. Seguin, P. Tryjanowski, C. Liu, S.Rawlins and A. Imeson, 2008. Attributing physical and biological impacts to anthropogenic climate

change. Nature 453, 353-357,| doi:10.1038/nature06937 •Stroeve, J., M.M. Holland, W. Meier, T. Scambos, and M. Serreze. 2007. Arctic sea ice decline: Faster than forecast. Geophys. Res. Lett. doi:10.1029/2007GL029703