European Commission

Science for Environment Policy

Environmental hazards due to climate change set to increase in Europe — with regional differences

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Researchers have modelled the exposure to multiple hazards across different regions of Europe in relation to heat, cold, drought, wildfire, flooding and wind. The study indicated that, over the next century, environmental hazards are likely to increase, particularly along coastlines and on floodplains, and that south-western Europe is likely to be the worst-hit region.

Europe is expected to face extreme climatic events over the coming decades, which will lead to increased hazards to the environment and society. Extreme climatic events are unexpected or unusual weather- or climate-related hazards, such as major heat waves, flooding, droughts or wildfires.

A changing climate is likely to affect different regions in Europe to varying extents. Furthermore, assessing multiple hazards is difficult as they work in different ways and can also interact to produce combined effects. This study attempted to identify areas in Europe with the highest level of exposure to a range of climate hazards in order to inform adaptation and land planning efforts.

The researchers modelled hazards in Europe, accounting for regional variation in the intensity and frequency of climatic extremes. Climate hazards indicators were derived for the baseline (1981–2010) and over three periods to the end of the century (2011–2040, 2041–2070 and 2071–2100). Specifically, they predicted the threat posed by heat- and cold-waves, river and coastal floods, droughts, wildfires and windstorms. Climate simulations were based on 'business-as-usual' greenhouse-gas emissions under the A1B emissions scenario of the IPCC.

Heatwave data for the analysis were based on the Heat Wave Magnitude Index daily, which is based on the duration and intensity of heat-wave events using daily maximum temperatures. Cold waves were calculated from minimum air temperatures. The risk of wildfires, windstorms, sea level rises, inland flooding and drought were calculated from data provided in previous studies.

The analysis produced an assessment of multiple hazards, based on the definition of a common metric, namely the Expected Annual Fraction Exposed (EAFE), which is based on the predicted changes in frequency of extreme events.

Overall, the results indicate that an increase in extreme events is likely across Europe. The south-western region is the region that is likely to suffer the most, however, and is expected to experience an increase in extreme events including heatwaves, droughts and wildfires. Potential hotspots for multiple hazards are mainly located along coastlines and floodplains in Europe, where flooding can combine with temperature-related climate changes. These hotspots include the British Isles, the North Sea area, north-western parts of the Iberian Peninsula, as well as parts of France, the Alps, Northern Italy and Balkan countries along the Danube River.

Looking at individual types of extreme event, the modelling indicated that the frequency of heatwaves is likely to increase significantly, especially in southern Europe where, by the end of the century, up to 60% of the region could be annually exposed to heatwaves considered so severe that they are, currently, only expected to occur once every 100 years. In contrast, current cold extremes may disappear in Europe by the end of the century.

Continued on next page.

Source: Forzieri, G., Feyen, L., Russo, S., Vousdoukas, M., Alfieri, L., Outten, S., Migliavacca, M., Bianchi, A., Rojas, R. & Cid, A. (2016). Multi-hazard assessment in Europe under climate change. *Climatic Change*, 137(1): 105-119 DOI:10.1007/s10584-016-1661-x. This study is free to view at: http://link.springer.com/article/10.1007/s10584-016-1661-x

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Reduced river levels are likely to become more common in western and southern Europe and, by 2100, over 25% of the region could be exposed to annual droughts currently only experienced once every 100 years. Droughts are expected to become much less intense in northern, eastern and central Europe, due to higher rainfall levels, the results suggest. Most of Europe, especially western, eastern and central regions, could experience extreme wildfires more frequently.

River flooding across Europe shows larger variability induced by climate model realisations compared to the other hazards, and future flood hazard due to increases in rainfall could rise consistently in western Europe. Coastal floods also show a major increase along Europe's coastline, mainly due to sea-level rise, for example, the Danube Delta in eastern Europe may be subject to major inundations of seawater.

There was less evidence of major changes in windstorms, although western, eastern and northern Europe are likely to experience minor increases in windstorm hazard.

The researchers highlight some uncertainties in their results. For instance, greenhouse gas emissions and other related factors cannot be predicted precisely. They also applied a conservative approach to assessing hazards, which may have led to an underestimation of the overall impacts of combined hazards.

However, they say this study is valuable in that it is the first multi-hazard assessment for Europe and provides useful information regarding how climate-related extreme events are likely to evolve under a changing climate, which could be used for adaptation strategies. They note that a strong overall increase in climate hazards is particularly likely in regions which are highly populated and of high economic importance. In addition, the EAFE score described in this study acts as a common reference unit on the probability of environmental events occurring, allowing comparison of changes in hazard frequency across a number of hazards.