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Science for Environment Policy

Revealing damages from droughts across Europe

Researchers have developed a new tool for assessing and predicting the damage caused by droughts to crop yields and hydroelectric energy production. The tool could provide useful information to policymakers, helping them develop drought management practices to improve food and energy security and adapt to climate change.

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Droughts can have wider reaching and longer lasting effects than other types of natural disasters, such as forest fires or floods, due to their cascading impacts on the complex hydrological cycle and related, sometimes continent-wide, dependencies. For example, a drought in one country can reduce river flows relied upon by a neighbouring country.

As such, better understanding of the complex effects of droughts on societies and countries can improve resilience to these events. This is especially important, since risk of drought is expected to increase over the coming years due to climate change.

In this research, funded by the European Commission as part of the GAP-PESETA project[1], the authors aimed to investigate and validate the relationship between drought severity and measurable damages throughout Europe, based on 'power-law functions'. A power-law is a mathematical technique describing the relationship between two quantities, where smaller changes in one factor (i.e. droughts) result in larger changes in another factor (i.e. damages). The researchers chose two measures, using extensive existing data, of drought damage: changes in crop yields and hydroelectric power generation.

Combining these data with three different types of standardised meteorological drought indicators allowed the researchers to identify which indicators and timescales (three or 12 months) were best associated with damages.

The authors used publicly available data, gathered between 1950 and 2012, on both damages and drought measures from across 21 European countries. This research is the first of its kind to apply this approach on a near continent-wide basis.

The 'Standardised Precipitation Evapotranspiration Index' (SPEI) indicator, over a three-month period, showed the best correlation for crop yields. The authors explain this was likely because this period of time best represents crop water requirements.

Many countries, especially Mediterranean countries such as Italy, Portugal and Spain, showed a strong relationship between droughts risks and crop yields. This reflects their vulnerability to water scarcity, the authors say.

Yet, the relationship was not as strong for all countries. For example, cereal production in Greece and Albania had only a weak or no relationship.

Continued on next page.

1.Assessment of drought damages and their uncertainties in Europe was supported by the Projection of Economic impacts of climate change in Sectors of the European Union based on bottom-up Analysis (PESETA) programme. See https://ec.europa.eu/jrc/en/peseta

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Revealing damages from droughts across Europe *(continued)*

Such differences in vulnerability could be due to a variety of factors. For example, whether irrigation is typically used, the availability and use of drought resistant crops and reservoir management practices.

The SPEI, again, showed the best correlation between drought and hydropower: this time over a 12-month period, which, the authors say, matches typical reservoir management time scales.

As with crop yields, a strong correlation was also found between drought and hydropower generation damages. Countries which rely heavily on hydropower, such as Albania, Portugal and Switzerland, were most vulnerable.

Countries such as Germany and the UK, with more diversified energy production, showed a smaller relationship between drought and hydropower damages. Effective drought mitigation practices in such countries could also explain the lower effects of droughts.

The authors highlighted that the results show how drought damages can be cumulative, and that the method can help reveal the true costs of droughts over time. Over the long term, more frequent but less severe droughts can lead to similar damages as one-off extreme drought.

Possibilities for improving the approach include the collection of spatially and temporally higher-resolved damage data and their careful filtering against non-drought-related economic effects such as the recent financial and economic crises. An example of such influences is shown for the case of inland water transport.

The approach could also be used in combination with climate projection data, the authors say, to aid planning of climate change mitigation or adaptation measures for future food and energy security.

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