GlobeDrought – Global assessment of drought risk for agricultural systems

Hamdeh Nouri1, Ehsan Eyshi Rezaei1, Isabel Meza2, Petra Döll3, Olena Dubovyk4, Helena Gerdener4, Gohar Ghaazarany5, Michael Hagenlocher6, Claudia Herbert7, Jürgen Kusche7, Tobias Landmann8, Eklavya Popat9, Daniel Rupp10, Stefan Siebert11, Yannick Urs1

1Department of Crop Sciences, University of Göttingen, Von-Seebold-Strasse 8, 37075 Göttingen, Germany
2Institute for Environment and Human Security (UNU-EHS), United Nations University, UN Campus, Platz der Vereinten Nationen 1, 53113 Bonn, Germany
3Institute of Physical Geography, Goethe University Frankfurt, Akerstraße 1, 60386 Frankfurt am Main, Germany
4Center for Remote Sensing of Land Surfaces, University of Bonn, Gerhard-Dunkel-Str. 1, 53113 Bonn, Germany
5Institute of Geography and Geoinformation, University of Bonn, Nussallee 17, 53115 Bonn, Germany
6Remote Sensing Solutions GmbH, Dingolfinger Str. 3, 81737 Munich, Germany
7Deutsche Wetterdienst e.V., Friedrich-Ebert-Anlage 1, 37179 Göttingen, Germany

Summary

Improved understanding of drought and proactive plans and policies to mitigate drought effects are priorities of many national and global institutions. Responding to their needs, we present for the first time, an integrated assessment of drought risk and impact for both irrigated and rainfed agricultural systems at the global scale.

We linked meteorological data, satellite-based vegetation, land cover and total water storage anomaly data with hydrological and crop water models and vulnerability indicators to assess drought risk.

Our findings can support the identification of tailored measures to reduce drought risk and increase the resilience of agricultural systems.

Data and methods

**Drought risk index**: hazard-exposure-vulnerability

**HAZARD**: a deviation of the situation in a specific year or month from long-term mean (1986–2016).

Two models simulated the terrestrial hydrology on daily steps:

- WaterGAP with climate forcing WFDEI-GPC3 (30 arcmin).
- Global Crop Water Model (GCWM) with climate forcing CRU-TS 3.25 (5 arcmin).

**EXPOSURE**: the elements located in areas that could be adversely affected by drought hazard.

- Weighting grid-cell-specific hazards with the harvested area of irrigated and rainfed crops MIRCA2000, national scale.

**VULNERABILITY**: the predisposition to be adversely affected as a result of the sensitivity or susceptibility of a system and its elements to harm, coupled with a lack of coping and adaptive capacity.

- Selection and classification of 46 vulnerability indicators by socioecological susceptibility (SOC_SUS_ENV, SUS) levels of lack of coping capacity (COP) and lack of adaptive capacity (AC) following the risk framework of the IPCC.

Drought risk: multiplying hazard and exposure by vulnerability at pixel level

Results

**Conclusion and outlook**

- Our findings affirm the disparity in drought effect through space and crop type.
- Aggregating drought effects on different crops misrepresent the drought impacts on specific crops, and notable information gets lost by aggregation.
- The spatial variability in drought risk on global and regional scales might help to identify leverage points for reducing impacts and properly anticipate, adapt and move towards resilient agricultural systems.

References

- Nouri, H., Eysli Rezaei, E., Siebert, S., Drought impact assessments for crop production need to be crop specific (in preparation).

Contact

Prof. Stefan Siebert (project leader)
Division of Agronomy, University of Göttingen, Von-Seebold-Strasse 8, 37075, Göttingen, Germany
E-mail: stefan.siebert@uni-goettingen.de
Phone: 0551-39-24359
https://www.uni-goettingen.de/en/22092.html