GlobeDrought

A global-scale tool for characterizing droughts and quantifying their impact on water resources

Activities in Southern Africa

Summary

The aim of the 3-year GlobeDrought project (2017-2020) is to develop a web-based information system for comprehensively characterizing drought events and associated risks. The project will produce a spatially explicit description of drought risks by considering three components: (i) drought hazard, (ii) exposure, and (iii) vulnerability. It will investigate how droughts impact agricultural systems and public water supply. In terms of methodology, the project aims to link satellite-based remote sensing of vegetation conditions and analyses of precipitation data with hydrological modeling and crop modeling. This will produce indicators for characterizing meteorological, hydrological and agricultural droughts, which will make it possible to quantify drought hazards as an important driver of risk. Analyses of socioeconomic, governance-related and environmental data will provide the basis for quantifying exposure and vulnerability of social-ecological systems. Within the framework of a co-design process, potential users and stakeholders will help to shape the content and technical design of the drought risk information system. The global-scale analyses planned for the project which focuses on drought impacts on agricultural systems and water supply will be supplemented by detailed analyses for regions heavily affected by droughts such as Southern Africa (incl. South Africa and Zimbabwe), Eastern Brazil, Western India, and the Missouri River Basin of the United States.

GlobeDrought

Impact

In times of drought, water resources are insufficient. These water shortages often have negative effects on agricultural productivity and on associated socioeconomic factors. They can cause reduced income, food shortages and even famines. Operational early warning systems for droughts try to address the problem. However, they are mostly only capable of characterizing the status quo, or offer limited forecasts for droughts in the near future – e.g., the next three to six months. These early warning systems generally do not sufficiently integrate variables and drought indicators. In particular, they do not adequately describe causal links in the formation and development of droughts, connections between the various types of droughts (meteorological, hydrological and agricultural), and socioeconomic factors. The project intends to fill this gap by developing an **integrated drought (risk) information system**. With its planned experimental early warning system, the project aims to reduce the time between satellite-based data collection, identification of a drought risk and the implementation of countermeasures by political decision-makers and those involved in international humanitarian aid.
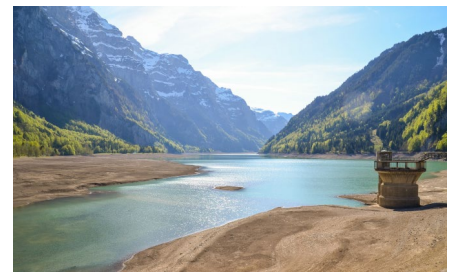
Partners in Southern Africa

SOUTH AFRICA
Prof. em. Andries Jordaan, University of the Free State (UFS), Faculty of Natural and Agricultural Sciences

National Disaster Management Centre (NDMC)

South African Weather Service

ZIMBABWE
Prof. Sara Feresu, University of Zimbabwe, Institute for Environmental Studies (IES)

Welthungerhilfe regional staff & collaborators

Expected outcome

The **Drought Risk Information System** will comprise of a global component and components providing more specific regional analyses for the Republic of South Africa and Zimbabwe. The experimental early warning system will provide data, maps and tools for near real time drought monitoring. In addition, a projection of the development of droughts within the next year will be provided, based on ensembles of historical climate data as replacement of climatic data for the future. Probabilities will be calculated to quantify how likely it is that a drought becomes more severe, remains similar, becomes less severe or disappears within the projected time period.

The **regional drought assessments** will be adapted in a co-design process to the requirements of partners and stakeholders in the region. Specific details will be defined at the 2nd GlobeDrought stakeholder meeting and in the period before this workshop.
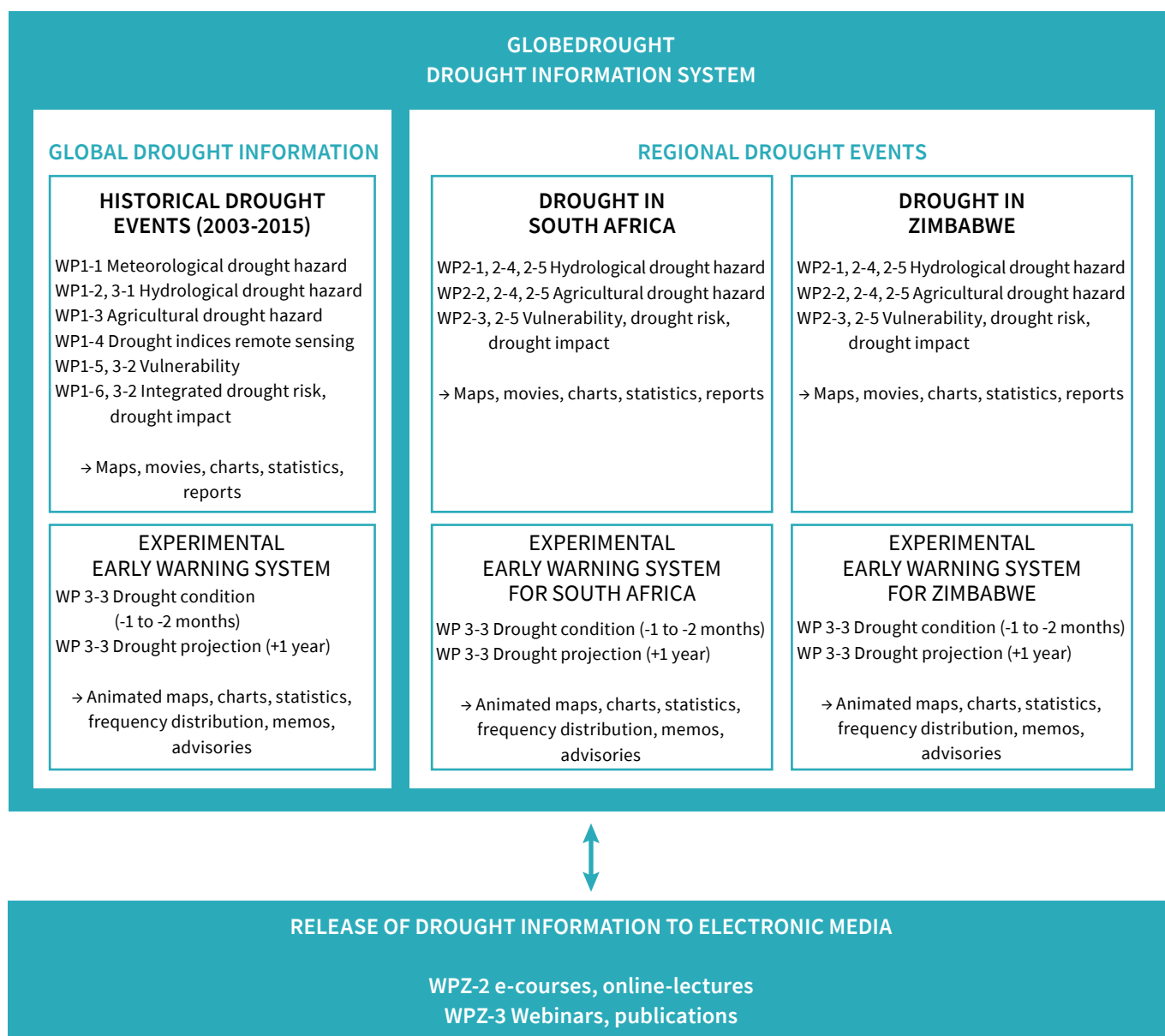

**GLOBEDROUGHT
DROUGHT INFORMATION SYSTEM**

GLOBAL DROUGHT INFORMATION

**HISTORICAL DROUGHT
EVENTS (2003-2015)**

WP1-1 Meteorological drought hazard
WP1-2, 3-1 Hydrological drought hazard
WP1-3 Agricultural drought hazard
WP1-4 Drought indices remote sensing
WP1-5, 3-2 Vulnerability
WP1-6, 3-2 Integrated drought risk, drought impact

→ Maps, movies, charts, statistics, reports

**EXPERIMENTAL
EARLY WARNING SYSTEM**

WP 3-3 Drought condition (-1 to -2 months)
WP 3-3 Drought projection (+1 year)

→ Animated maps, charts, statistics, frequency distribution, memos, advisories

REGIONAL DROUGHT EVENTS

**DROUGHT IN
SOUTH AFRICA**

WP2-1, 2-4, 2-5 Hydrological drought hazard
WP2-2, 2-4, 2-5 Agricultural drought hazard
WP2-3, 2-5 Vulnerability, drought risk, drought impact

→ Maps, movies, charts, statistics, reports

**EXPERIMENTAL
EARLY WARNING SYSTEM
FOR SOUTH AFRICA**

WP 3-3 Drought condition (-1 to -2 months)
WP 3-3 Drought projection (+1 year)

→ Animated maps, charts, statistics, frequency distribution, memos, advisories

**DROUGHT IN
ZIMBABWE**

WP2-1, 2-4, 2-5 Hydrological drought hazard
WP2-2, 2-4, 2-5 Agricultural drought hazard
WP2-3, 2-5 Vulnerability, drought risk, drought impact

→ Maps, movies, charts, statistics, reports

**EXPERIMENTAL
EARLY WARNING SYSTEM
FOR ZIMBABWE**

WP 3-3 Drought condition (-1 to -2 months)
WP 3-3 Drought projection (+1 year)

→ Animated maps, charts, statistics, frequency distribution, memos, advisories

RELEASE OF DROUGHT INFORMATION TO ELECTRONIC MEDIA

**WPZ-2 e-courses, online-lectures
WPZ-3 Webinars, publications**

Fig. 1: Products to be developed in specific work packages contributing to the Drought Information System
Source: project proposal

First Results

HIGH DROUGHT RISK CALCULATED FOR SOUTHERN AFRICA BY THE GLOBAL COMPONENT OF THE INFORMATION SYSTEM
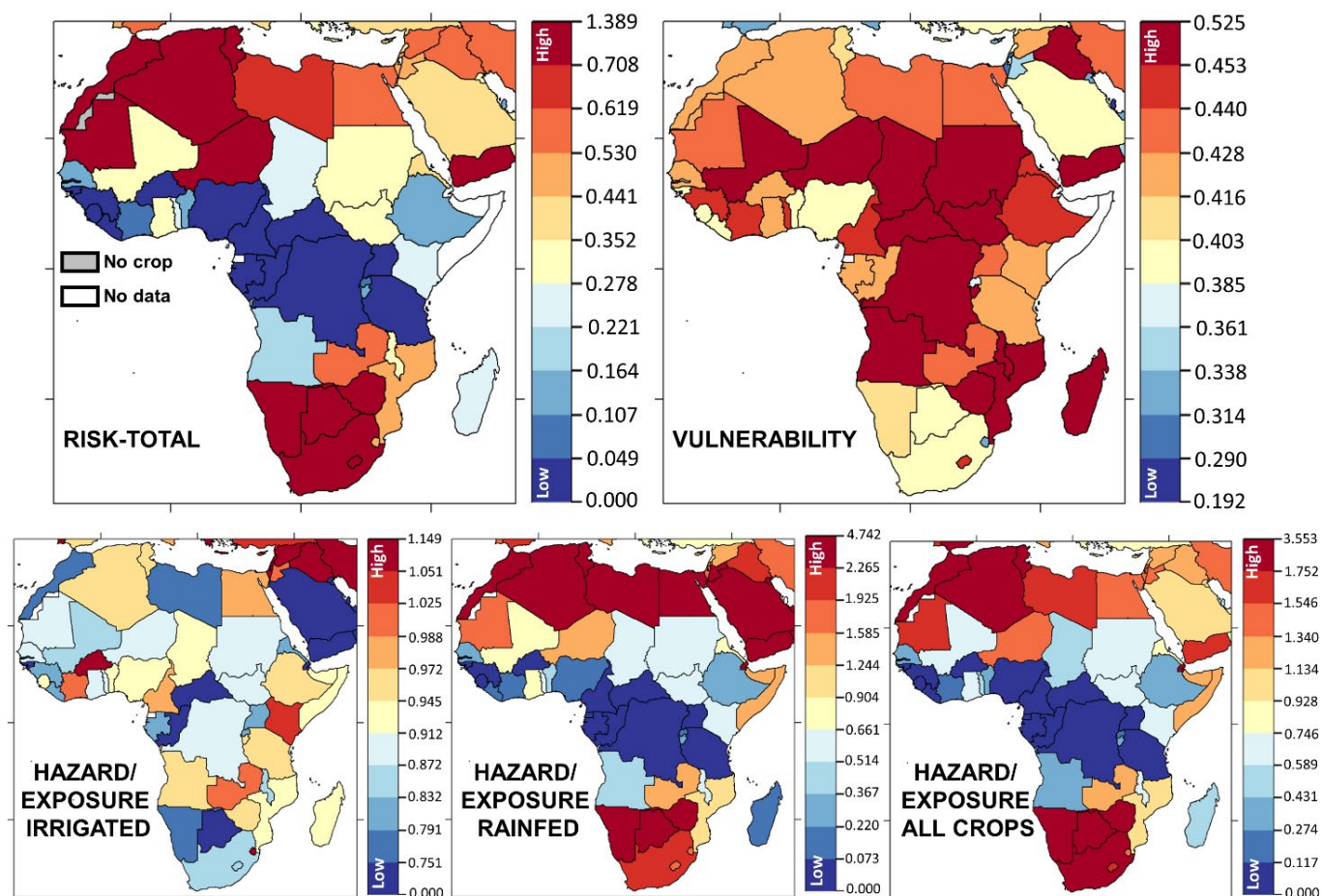

Fig. 2: Drought risk, vulnerability, hazard/exposure of irrigated, rainfed, and the whole crop production sector. The legends were defined by assigning the median of the value distribution to the yellow color in the center, the 90th percentile to the deepest red color, the 10th percentile to the deepest blue color and by determining the class ranges of the other colors by linear interpolation. Risk was calculated by multiplying hazard/exposure with vulnerability.

MAIZE YIELD SIMULATED FOR FOUR PROVINCES IN SOUTH AFRICA BY A CROP MODEL ASSIMILATING SOWING DATES FROM REMOTE SENSING
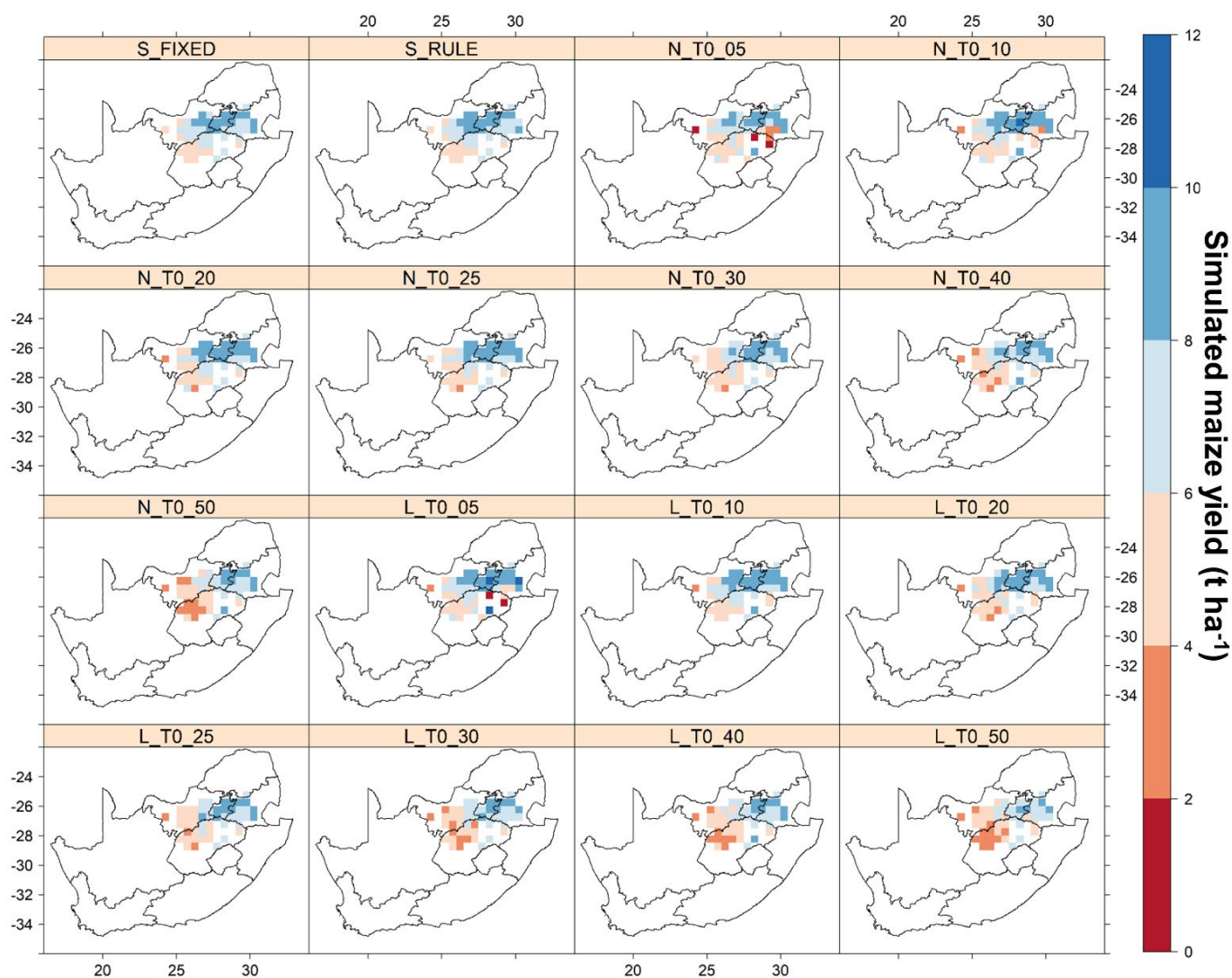

Fig. 3: Spatial pattern of mean yield of maize simulated using different RS products (LAI and NDVI), thresholds (0.05 to 0.5) and methodologies (fixed sowing and precipitation rule base) in the period 2002-2016 across maize growing grids at Free State, Gauteng, Mpumalanga and North West provinces of South Africa.

(S_FIXED: fixed sowing date, S_RULE: precipitation base sowing rule, L: LAI, N: NDVI, T0_05: threshold 0.05, T0_1: threshold 0.1, T0_2: threshold 0.2, T0_25: threshold 0.25, T0_3: threshold 0.3, T0_4: threshold 0.4 and T0_5: threshold 0.5)

Source: Rezaei et al., under review

MAPPING IRRIGATED AND RAINFED CROP AREAS IN ZIMBABWE BY USING REMOTE SENSING
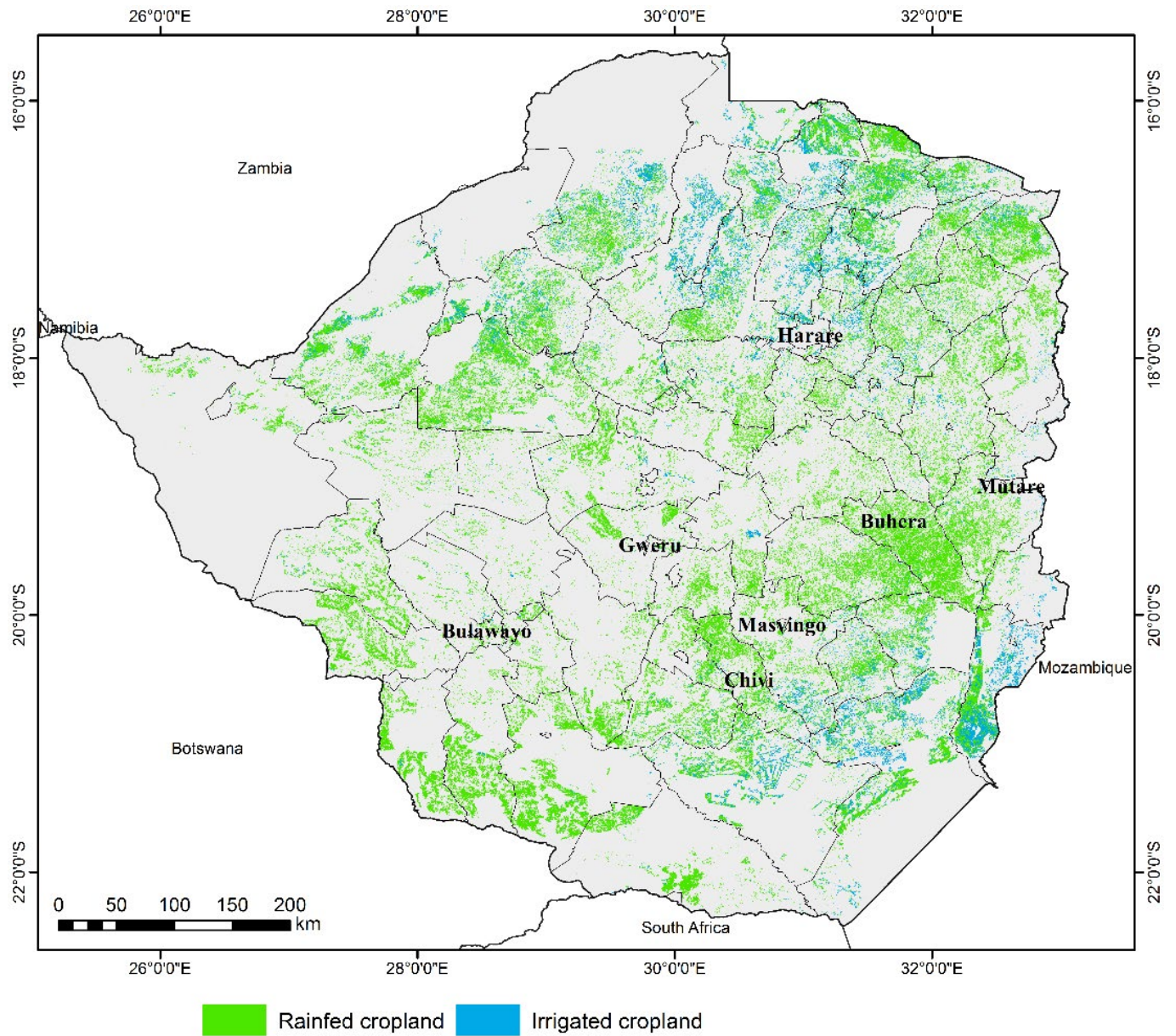
Source: Landmann et al., in press

E-Learning Activities

The GlobeDrought e-Learning activities are arranged into 12 learning blocks that are delivered sequentially. Each learning block covers the learning objectives of one topic with a webinar, an online lecture, and an online forum discussion.

The series includes two types of learning blocks:

1. **Technical**
   Covering different topics related to drought risk reduction and management, such as indicators, remote sensing, and risk assessment

2. **Thematic**
   Covering different topics related to drought impacts, such as migration, women empowerment, and food security

The webinars and lectures are targeted towards practitioners of all levels, including people involved in NGOs or international organisations working on disaster risk reduction and the the world of academia.

They are designed as a platform for information exchange where external stakeholders and relevant organisations provide insights into the role that innovative approaches can play in addressing drought impacts at all scales.

The story so far...

5 WEBINARS
International expert contributions
1 introductory | 2 thematic | 2 technical

UK   GERMANY   COLUMBIA   SOMALIA

80 PARTICIPANTS REGISTERED PER LEARNING BLOCK

35% RESEARCHERS
22% PRACTITIONERS
17% STUDENTS
11% POLICY MAKERS
15% Other

35% ACADEMIC INSTITUTIONS
20% GOVERNMENT AGENCIES
13% RESEARCH INSTITUTIONS
13% NGOs
19% Other

Upcoming: Eight more learning blocks on drought impacts, innovative methods to monitor and characterise drought, the GlobeDrought Information System and more.

More information is provided **on our website at**:
http://grow-globedrought.net/

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https://www.uni-goettingen.de/agronomy

Project partners and tools to be used

Prof. Dr. Stefan Siebert
Department of Crop Sciences
mail: stefan.siebert@uni-goettingen.de
https://www.uni-goettingen.de/
*Coordination; Drought impact on crop production
and agricultural water demand
Global: GCWM (Siebert and Döll, 2010)
Regional: SIMPLACE <LINTUL5, DRUNIR, CanopyT> (Zhao et al., 2015)*

Prof. Dr. Jürgen Kusche
Institute of Geodesy and Geoinformation
mail: kusche@geod.uni-bonn.de
https://www.igg.uni-bonn.de/en
*Drought impact on total water storage change;
Analysis of GRACE - gravity data, assimilation of total water storage changes
from GRACE into WGHM (Kusche et al., 2016; Schumacher et al., 2016)*

Dr. Olena Dubovyk
Center for Remote Sensing of Land Surfaces
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*Drought impact on vegetation health;
Remote sensing of vegetation condition, assimilation of remotely sensed
crop parameters into crop models (Dubovyk et al., 2015; Parplies et al., 2016)*

Prof. Dr. Petra Döll
Institute of Physical Geography
mail: p.doell@em.uni-frankfurt.de
http://www.goethe-university-frankfurt.de
*Drought impact on terrestrial hydrology;
Hydrological modeling using WaterGAP and WGHM (Döll et al., 2018; Döll
et al., 2012), coupling of WGHM with the crop model SIMPLACE <LINTUL5,
DRUNIR, CanopyT>*

Dr. Michael Hagenlocher
Institute for Environment and Human Security (UNU-EHS)
mail: hagenlocher@ehs.unu.edu
https://ehs.unu.edu/
*Indicator-based approaches for spatial vulnerability assessment
(agricultural systems, water supply) and integration of drought hazards,
exposure and vulnerability into drought risk (Hagenlocher et al., 2018;
BEH & UNU-EHS, 2016) at global level and within the case study regions.*

Dr. Jonas Franke
Remote Sensing Solutions GmbH
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http://www.rssgmbh.de/
*Development, hosting and marketing of the web-based drought information
system, remote sensing-based analysis of land use and vegetation
anomalies*

Daniel Rupp
Welthungerhilfe
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*Vulnerability and risk assessment Zimbabwe and other regions; analysis
of trade flows and emergency food aid; assessment of information from
own project network*

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