Detecting Drought and Vegetation Health with Remote Sensing

Towards well-defined regional to global Risks and Impacts

Tobias Landmann*, Maximilian Schwarz*, Natalie Cornish*
*RSS - Remote Sensing Solutions, Munich, Germany, landmann@rssgmbh.de

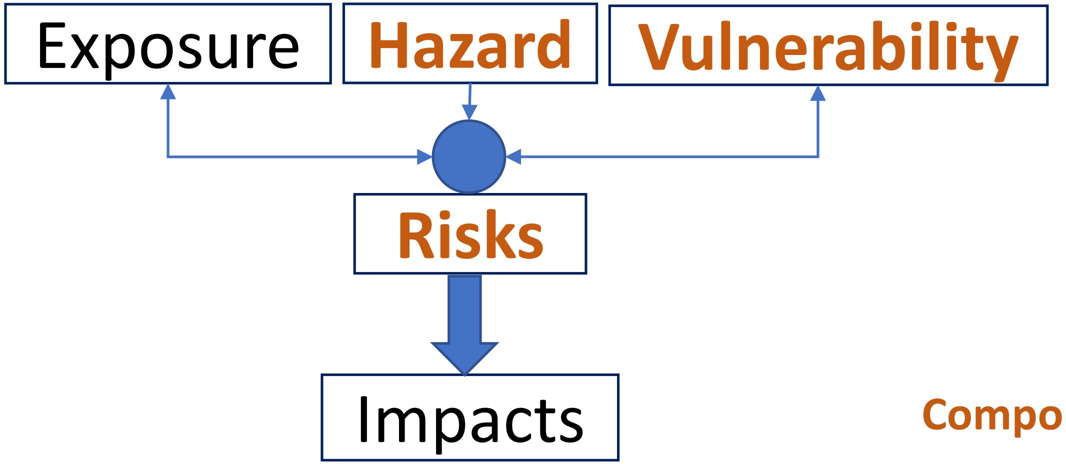
remote sensing SOLUTIONS

Bundesministerium für Bildung und Forschung

GRoW - GlobeDrought
Characterizing drought risk and impact

Background

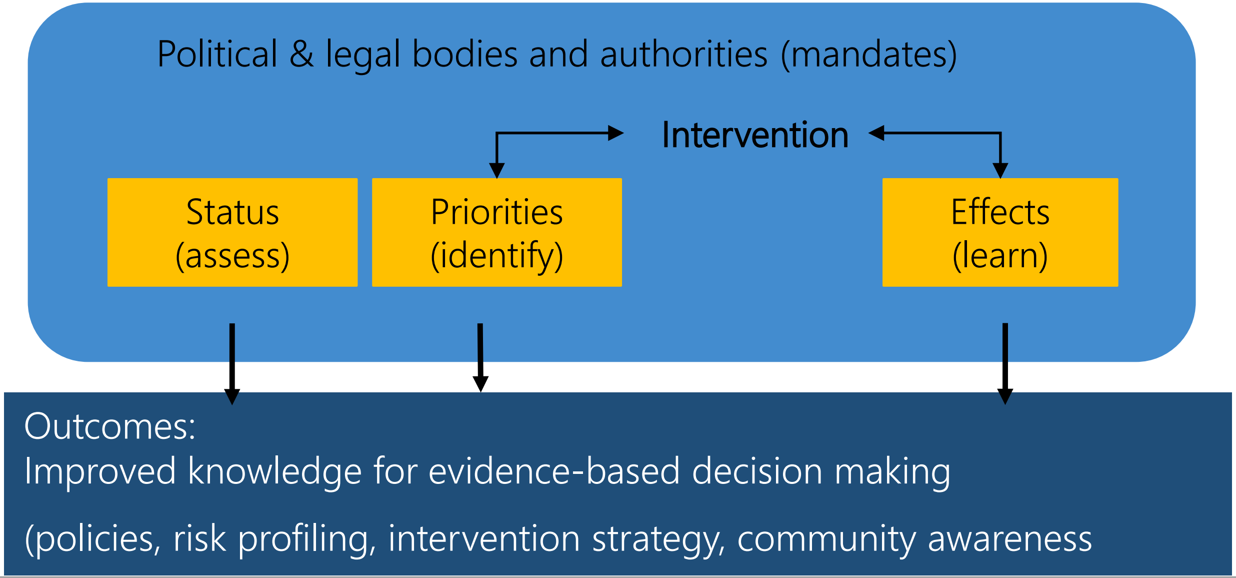
Drought risks and **follow on impacts** are **cumulative drought effects** based on vegetation stress and hazard conditions (usually measurable as deviations from normal) & socio-ecological settings.



Components that will be the focus herein

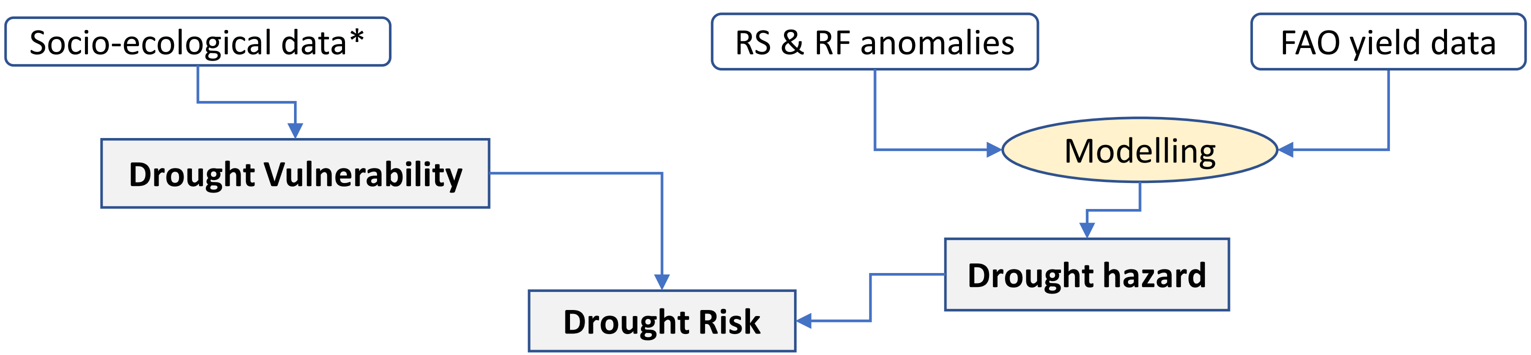
Background

- In the RS for development framework (below), RS-based risk and vulnerability monitoring routines are suitable for decision making
  - Risk and priority profiles (areas) can be effectively identified, used for EW or scenario assessments



Drought assessment framework introduced herein

- We will show the **possibilities** of using RS-based indicators for better 'Risk', 'hazard' and 'vulnerability'* assessments, re. **agriculture and rangelands**
  - Results can be integrated to **understand impact pathways, instigate better decisions**
  - **Novelty**: localized information that is **scalable,** while **various drought components are integrated**



* Social & economic susceptibility factors not used

Drought assessment framework introduced herein

- Multi data, multi scale approach & use of localized & spatial explicit (pixel-based) yet globally available data for robust upscaling

- E.g: (globally available[1]; spatially explicit[2]; localized[3])

Risk & vulnerability	Hazard
Livestock density[1] Irrigation versus rainfed[2,3] GDP[1] Population density[1]	FAO yield stats per country[1] = RS, RF anomalies[1, 2]

Specific Methodology – Hazard method, RS processing

- Global time-series RS-based variables used for logistic modelling- Hazard

		Definition of drought periods		
Crop yield	FAOSTAT	National statistics	2001–2016	Global
		Predictors for logistic regression model		
Precipitation	CHIRPS	0.05°	1981–2018	50°S–50°N
Surface reflectance	MOD09A1	500 m	2000–today	Global
LST	MOD11A2	1 km	2000–today	Global
Albedo	MOD43A3	500 m	2000–today	Global

Response variable

Predictor variables (RS-based)

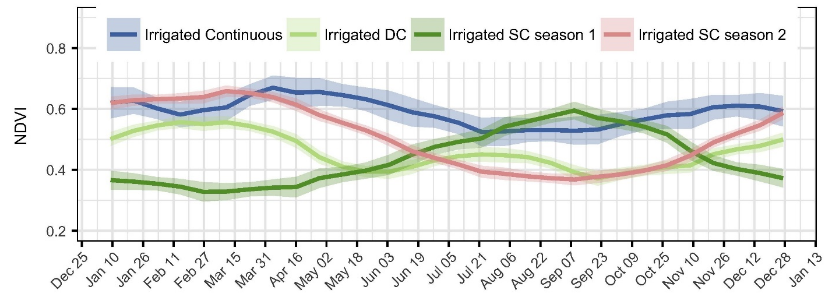
* Precipitation: SPI, Surface reflectance: NDII, NDVI

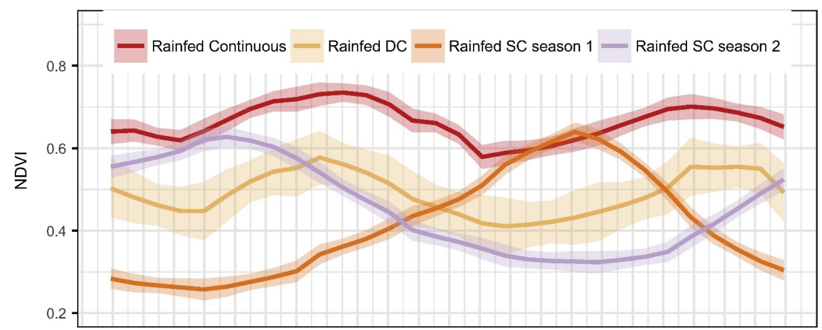
Specific Methodology – Hazard method, RS processing

- Global time-series RS-based variables processing -> index anomalies of precipitation, NDII, NDVI, LST and albedo
- Aggregation of land use classes (rangelands and croplands)
- Create Training data set based on drought years gained from yield anomalies (FAO data)
- Logistic regression model (RS-based variables as predictors) to predict drought probability (drought hazard)
- Cross-Verification: drought models, regional climate patterns, drought reports, food security classification data

Specific Methodology for vulnerability assessment– irrigation versus rainfed crops

- Need for better than just 'cropland extends' information to ascertain drought risk, vulnerability and impact
- Exploit wealth of explicit information from time-series data



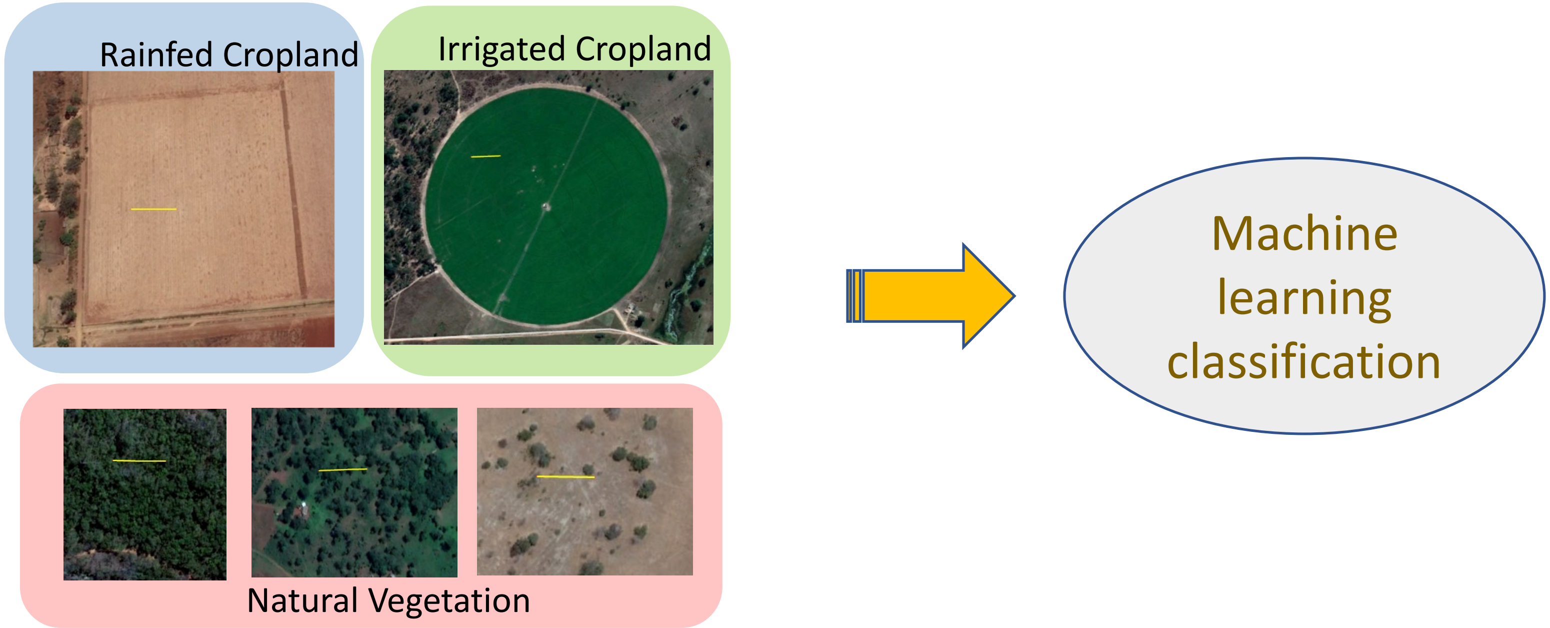


SC- Single crop (Africa)
DC- double crop (Africa)

Xiong et al., 2017

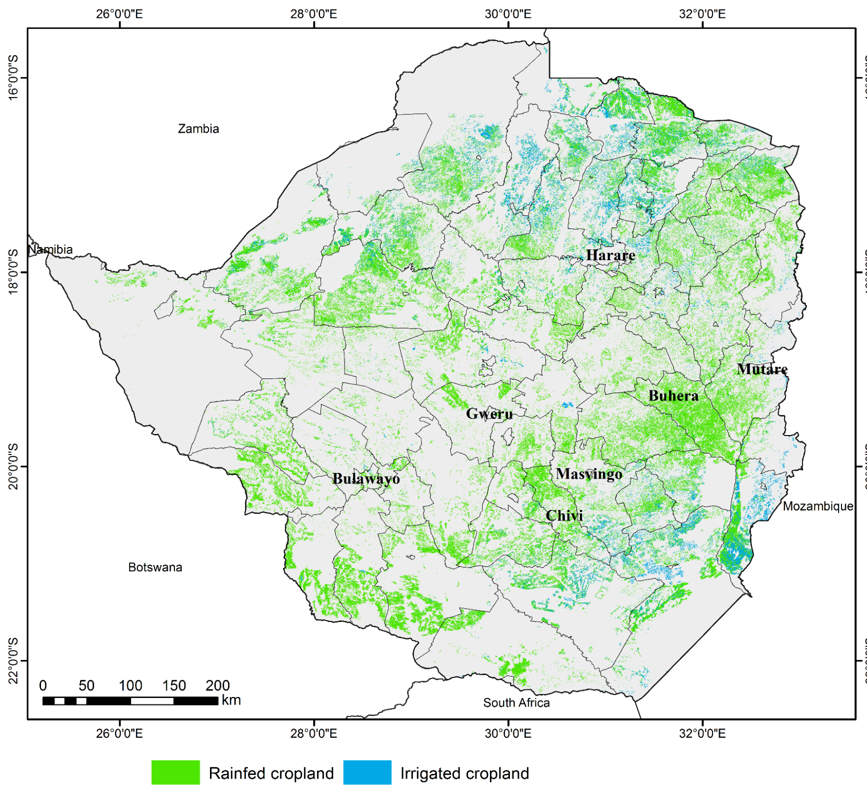
Specific Methodology for vulnerability assessment– irrigation versus rainfed crops

- Spatially explicit farming systems (irrigated vs. rainfed)
- Reference data using GE (left) for machine learning model



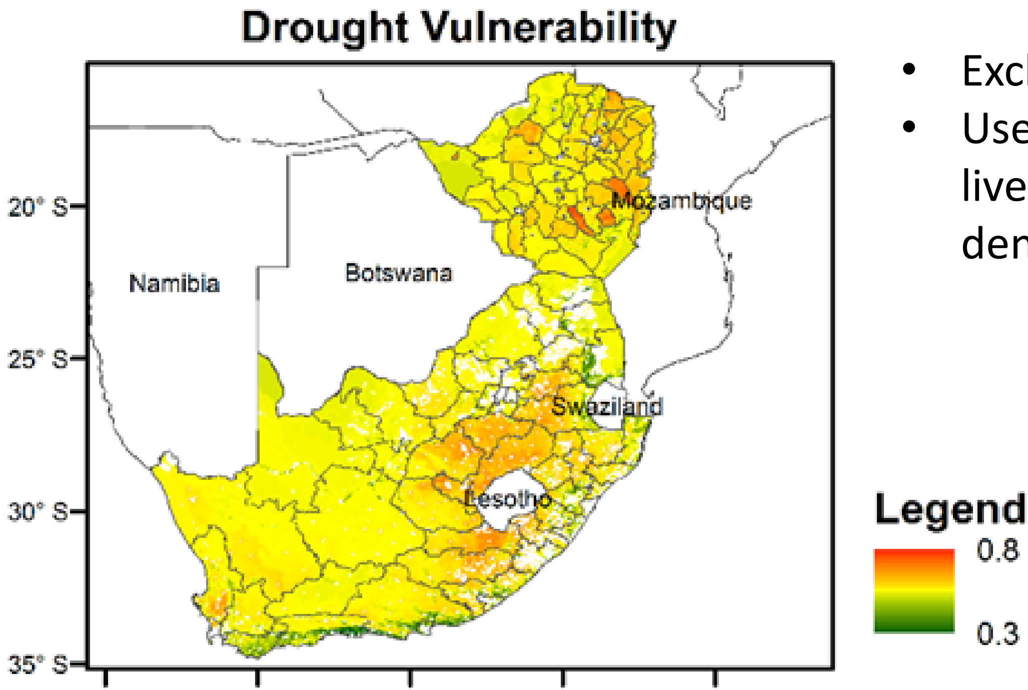
Specific Methodology for vulnerability assessment– irrigation versus rainfed crops

- Farming systems result for Zimbabwe (localized, spatially explicit)



Landmann et al., 2019

Vulnerability assessment– Result for S. Africa & Zim.

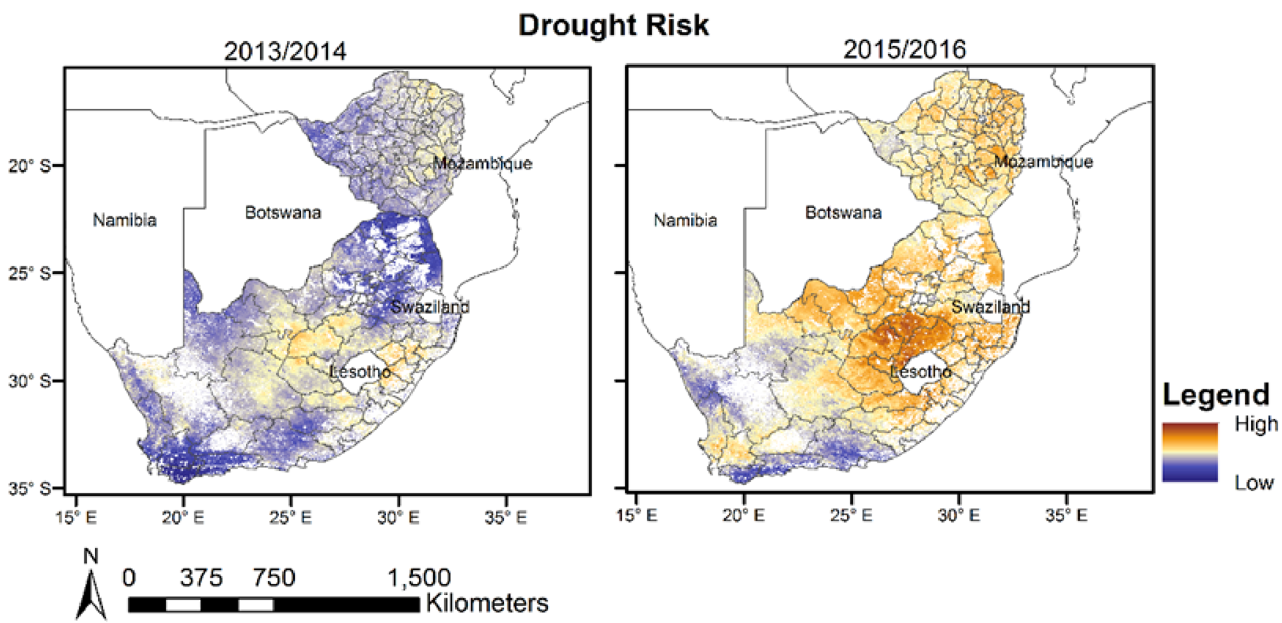


Schwarz et al., 2020

- Excludes urban areas
- Uses: farming systems, livestock & population density, etc

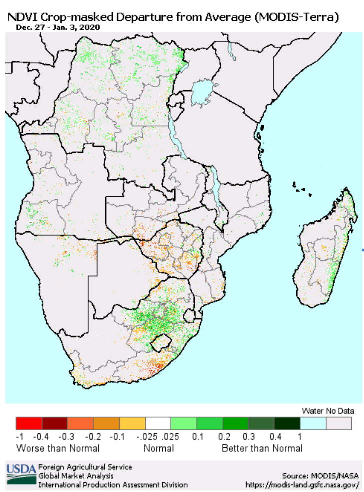
Specific Methodology for Risk mapping & results

- Risk: function of vulnerability and hazard
- Agricultural crops and grassland and scrubland, growing seasons December to March 2013/14 (left) and 2015/16 (drought year) (right)

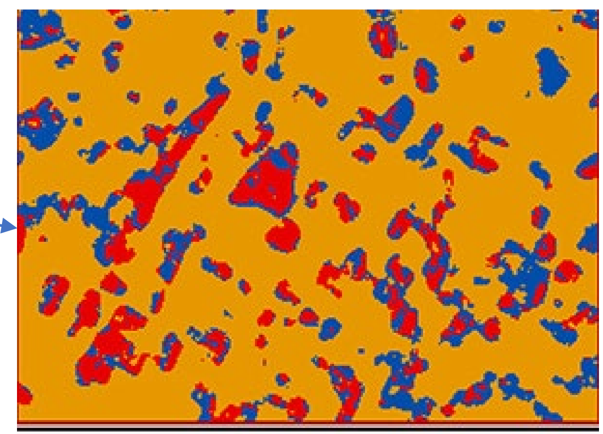


Integrative results for Zimbabwe in view of impact

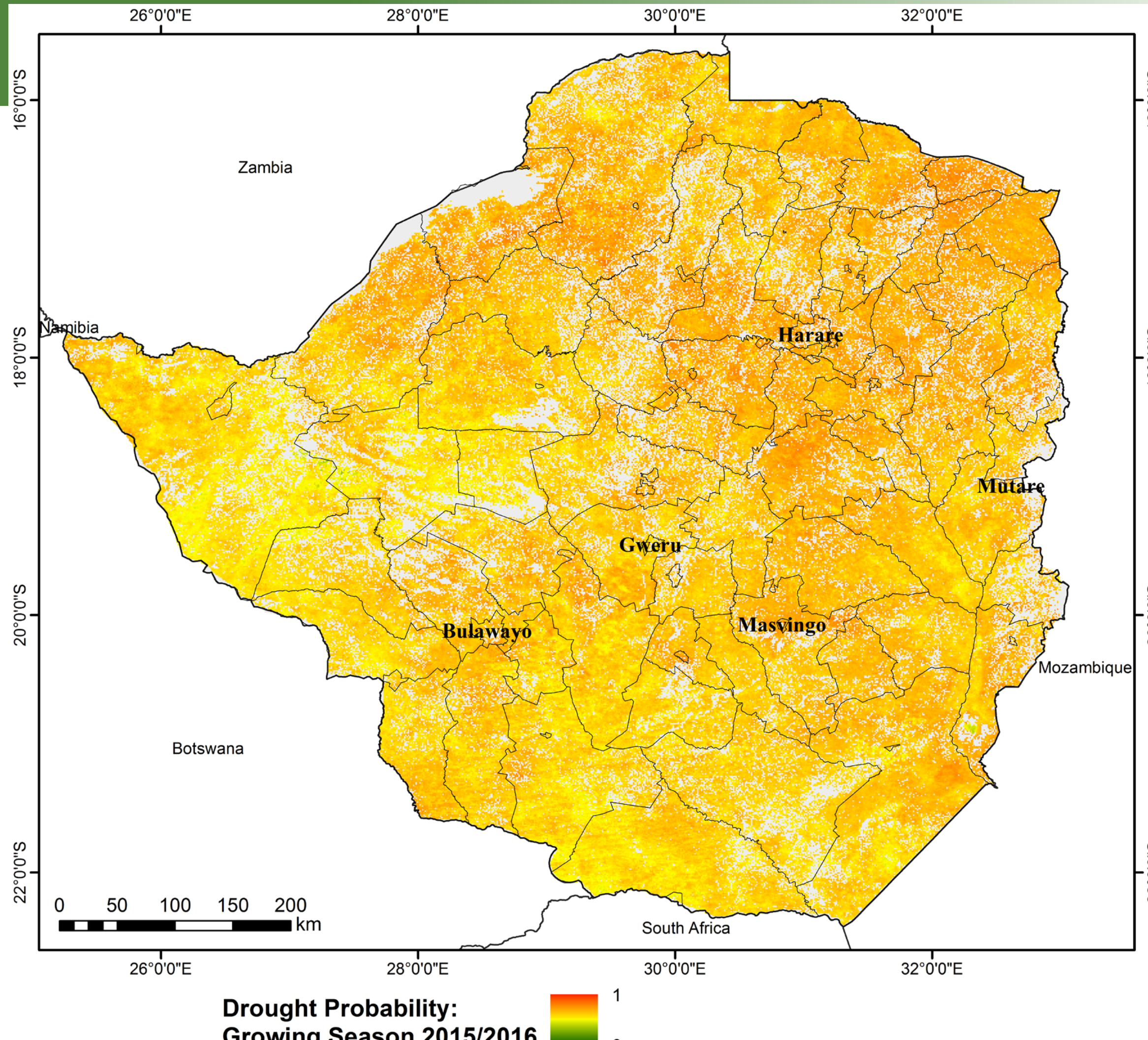
- Risk model is measurable impact indicator that renders effective information on where to prioritize (maximize effects)
- Integrative & localized results e.g. for Zimbabwe:
  - Hazard – farming systems - vulnerability – Risk



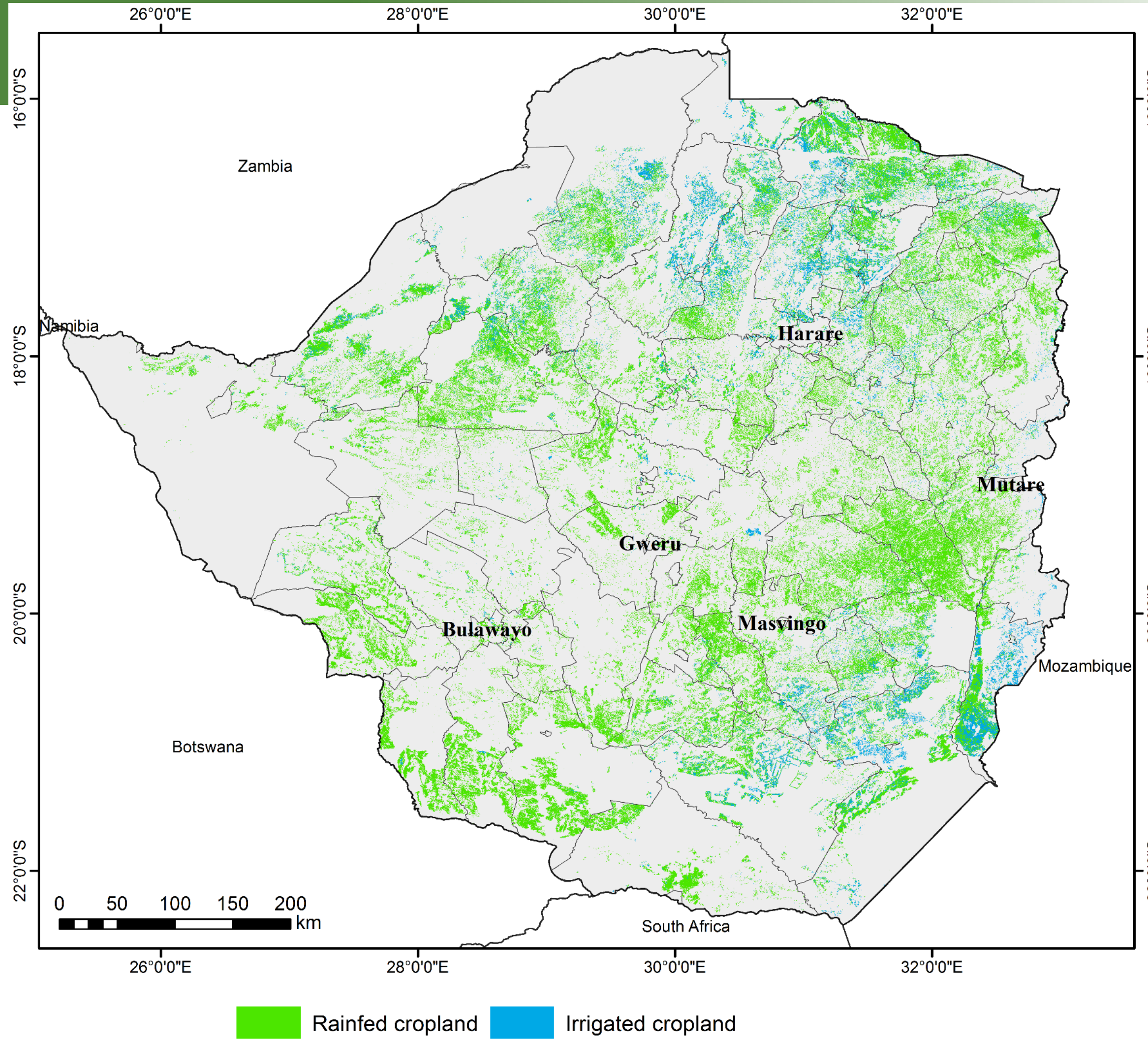
Crop Explorer



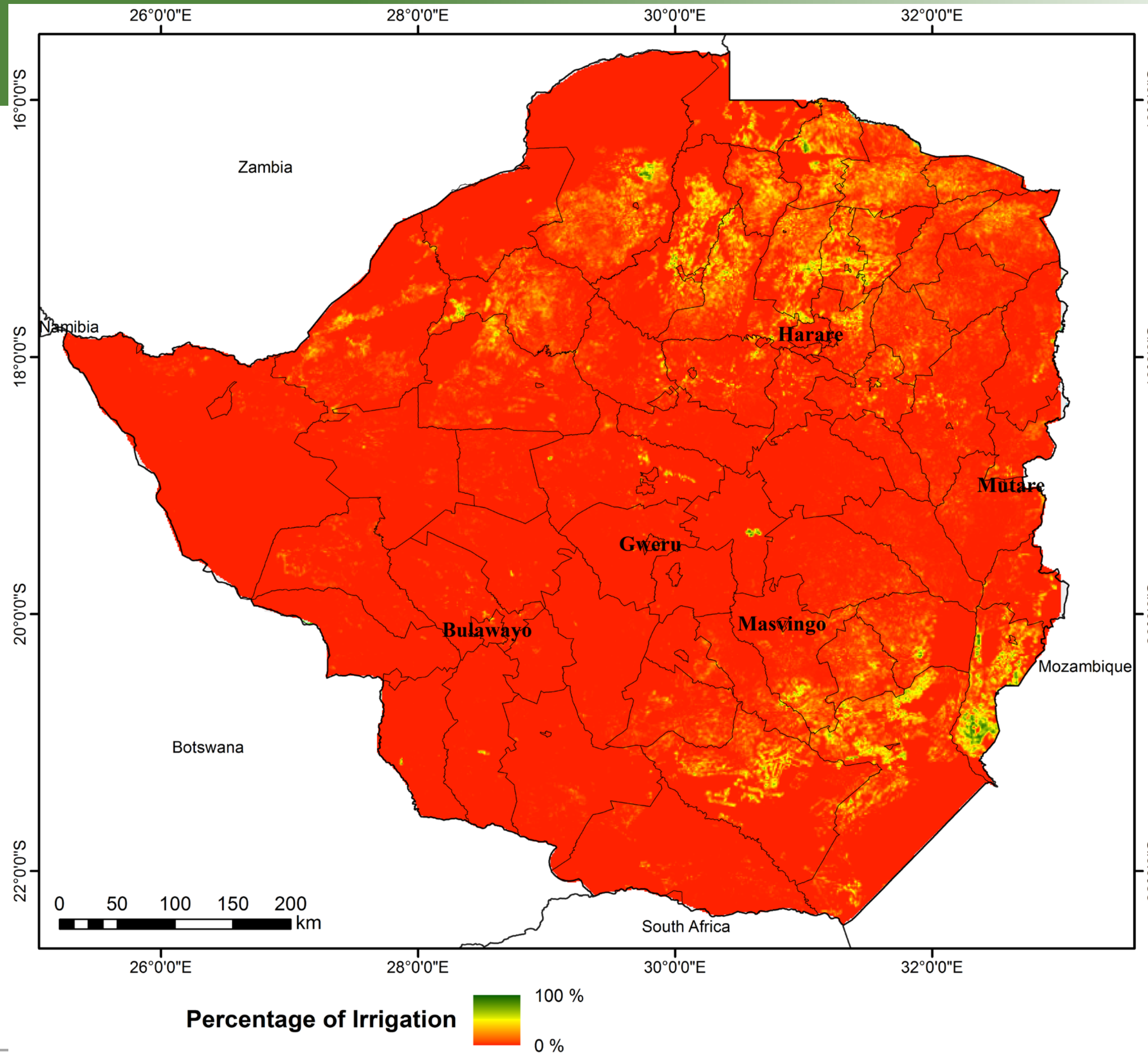
Drought hazard, prediction model using socio-economic and EO predictors, could be globally applicable (if fine tuned).



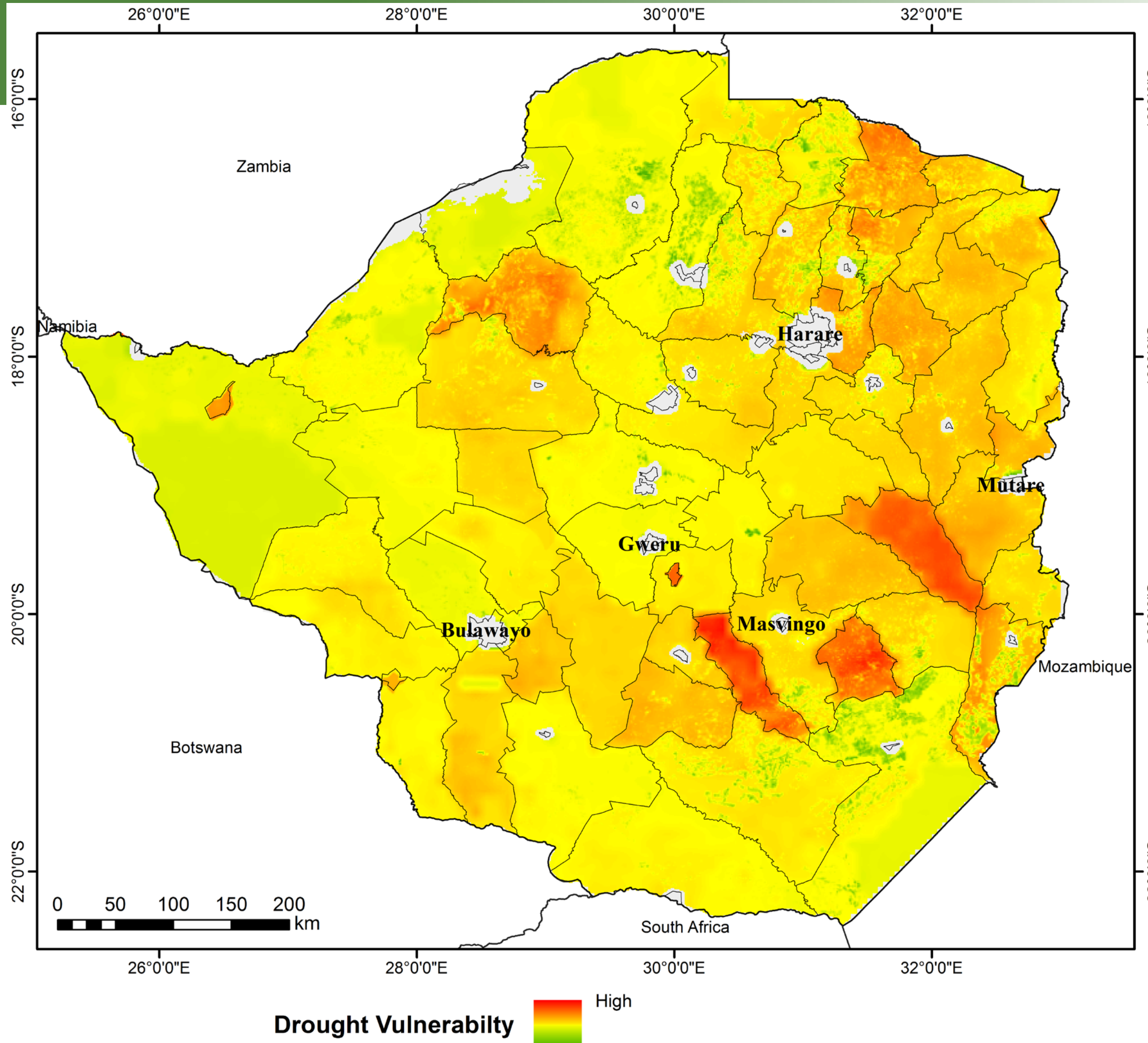
Rainfed and irrigated agriculture (as an important vulnerability aspect)



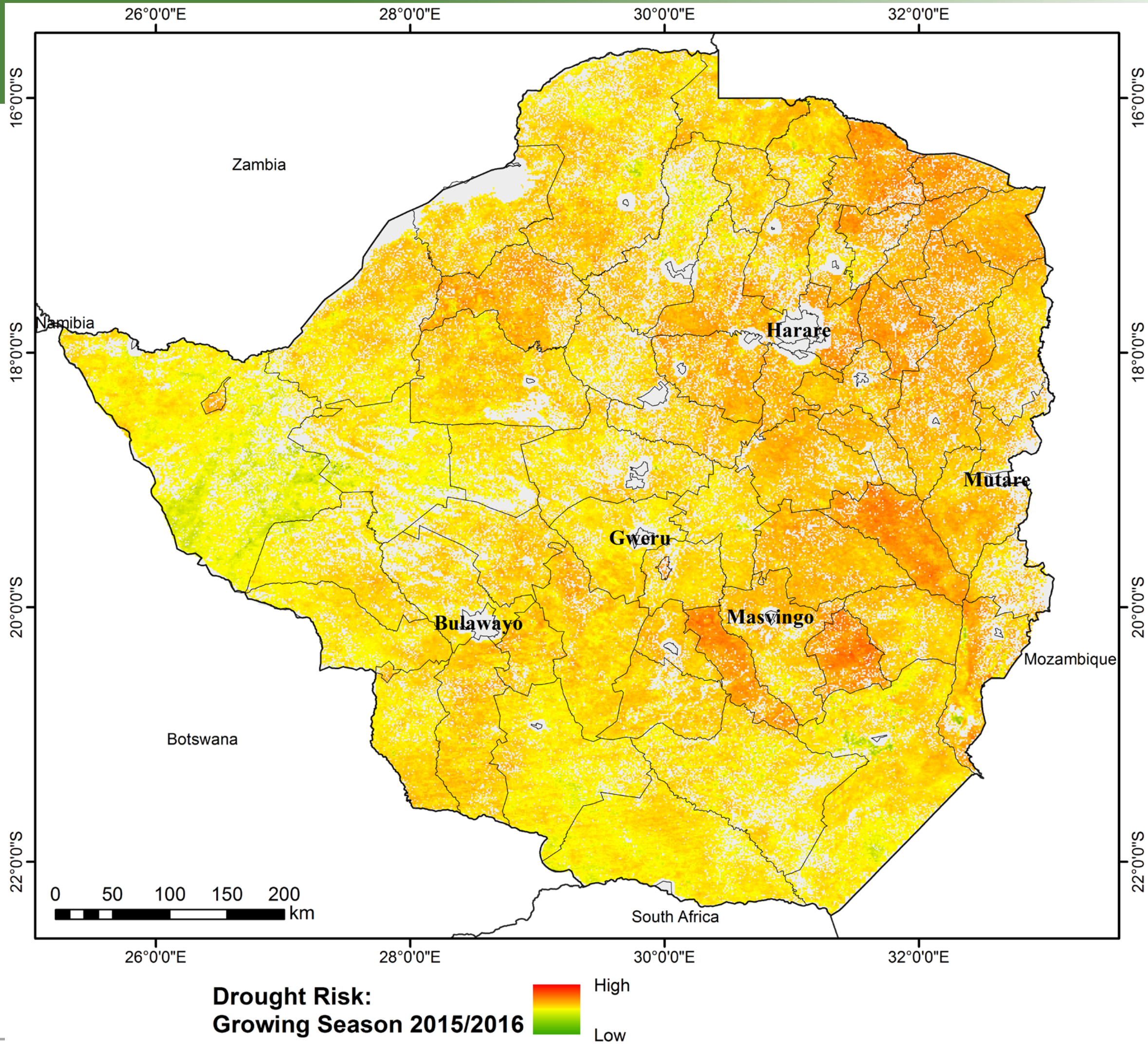
Rainfed and irrigated agriculture in percent (as an important vulnerability aspect)



Drought vulnerability using animal density, GDP, farming systems



Drought risk
using hazard and vulnerability



Thank you!

Bundesministerium
für Bildung
und Forschung

GRoW - GlobeDrought
Characterizing drought risk and impact

Globe Drought

rss remote sensing SOLUTIONS

Dingolfinger Str. 9
D-81673 München

franke@rssgmbh.de

www.rssgmbh.de