



Scoping Meeting Agricultural Risk Assessment

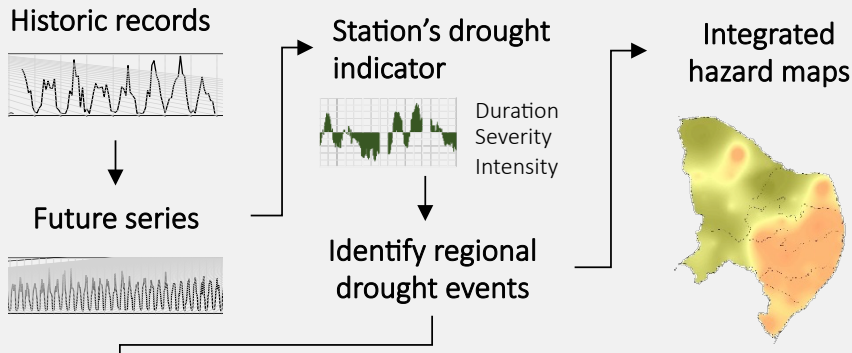
6 – 9 February 2017 – Boulder, Colorado

Data requirements



Hazard

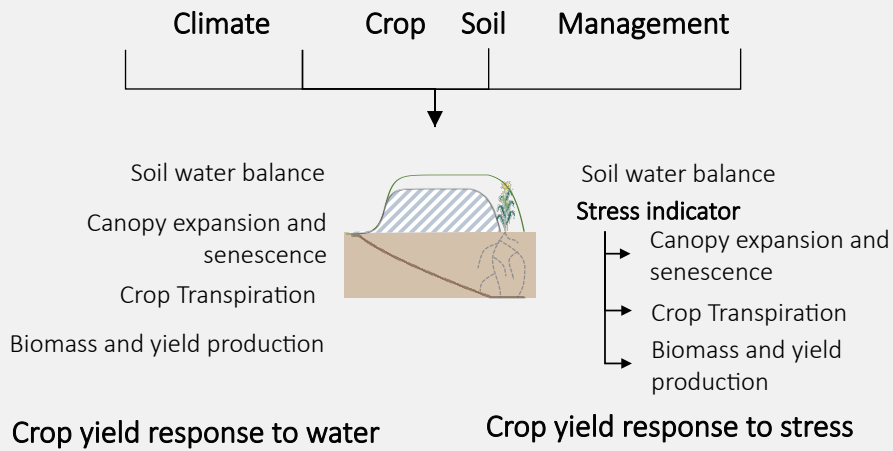
HAZARD



Inputs:
Precipitation and temperature series recorded in stations.

Outputs:
- Future climate series.
- Drought indicator parameters.
- Integrated hazard maps.

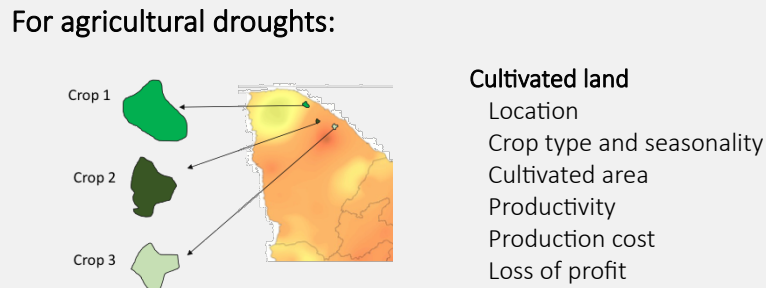
VULNERABILITY



Inputs:
- Climate series for drought events
- Crop type
- Soil type
- Modifiers (such as irrigation systems)

Outputs:
- Optimum yield production
- Yield production under water stress

EXPOSURE



Inputs:
- Coordinates, area
- Crop type, production cost per growing stage, yield per unit

Outputs:
- Exposed elements database

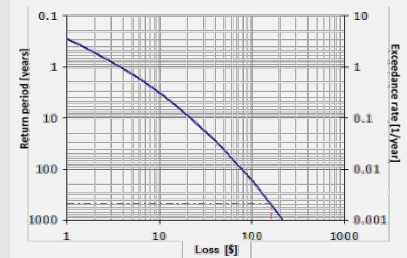
RISK

Inputs:
- Hazard (Intensity and frequency)
- Vulnerability (per cultivated land unit)
- Exposed elements database (per cultivated land unit)

Probabilistic risk assessment

$$v(p) = \sum_{i=1}^N Pr(P > p | E_i) F_{Ai}$$

Outputs:
Risk metrics
- Loss exceedance curve (LEC)

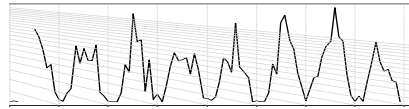


- Average annual loss (AAL)
- Probable maximum loss (PML)
- Risk maps

Hazard

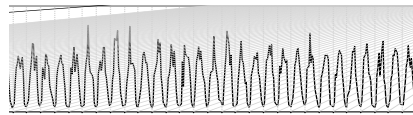
Inputs

Historic records



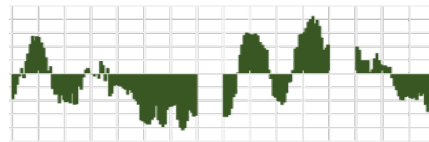
*Station or satellite data
Downscaling techniques for completion*

Future series



Probability distribution fitting

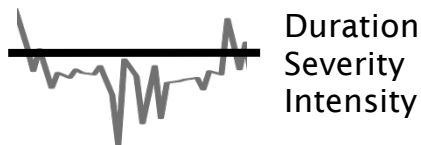
Drought indicator



*Reconnaissance Drought Index - RDI
Standardized Precipitation
Evapotranspiration Index - SPEI*

Outputs

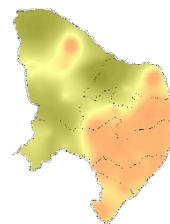
Drought events



Duration
Severity
Intensity

*Local and regional drought
event definition*

Integrated hazard maps

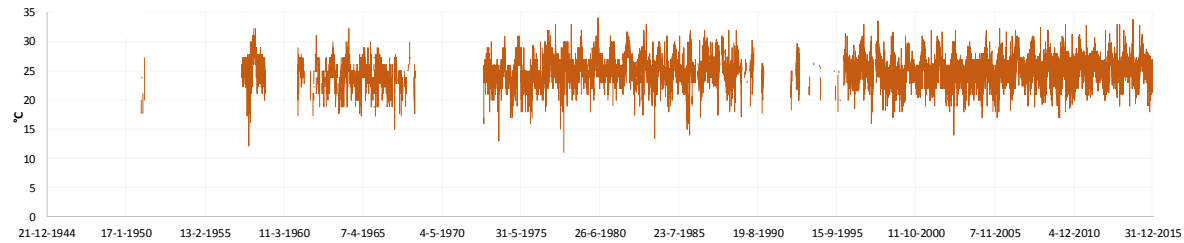


Spatial interpolation

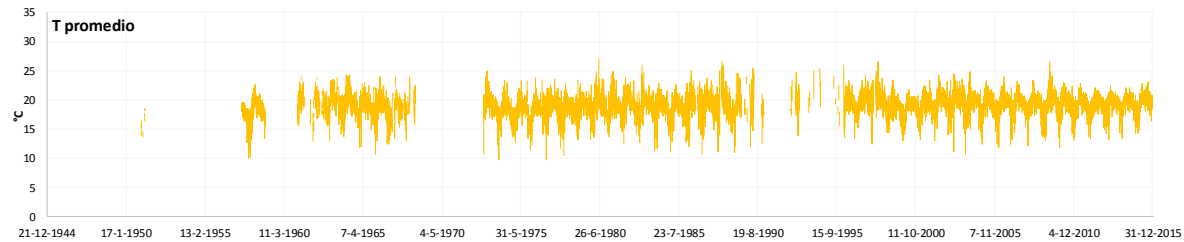
Hazard

Minimum parameters needed for hazard model

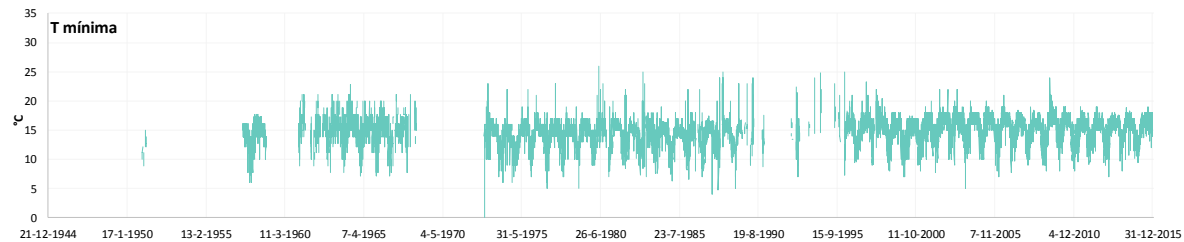
T max
[°C]



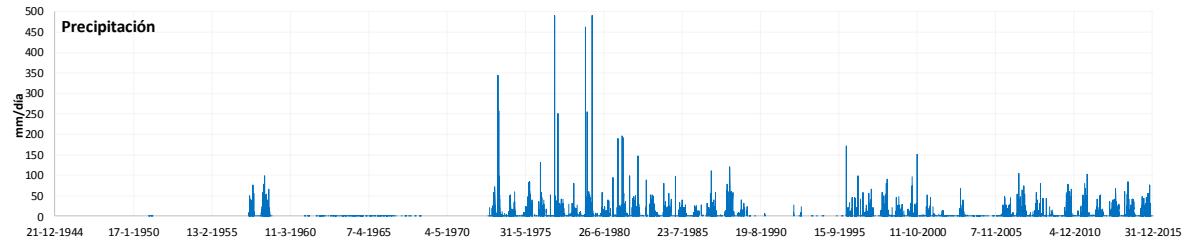
T mean
[°C]



T min
[°C]



Rainfall
[mm/day]



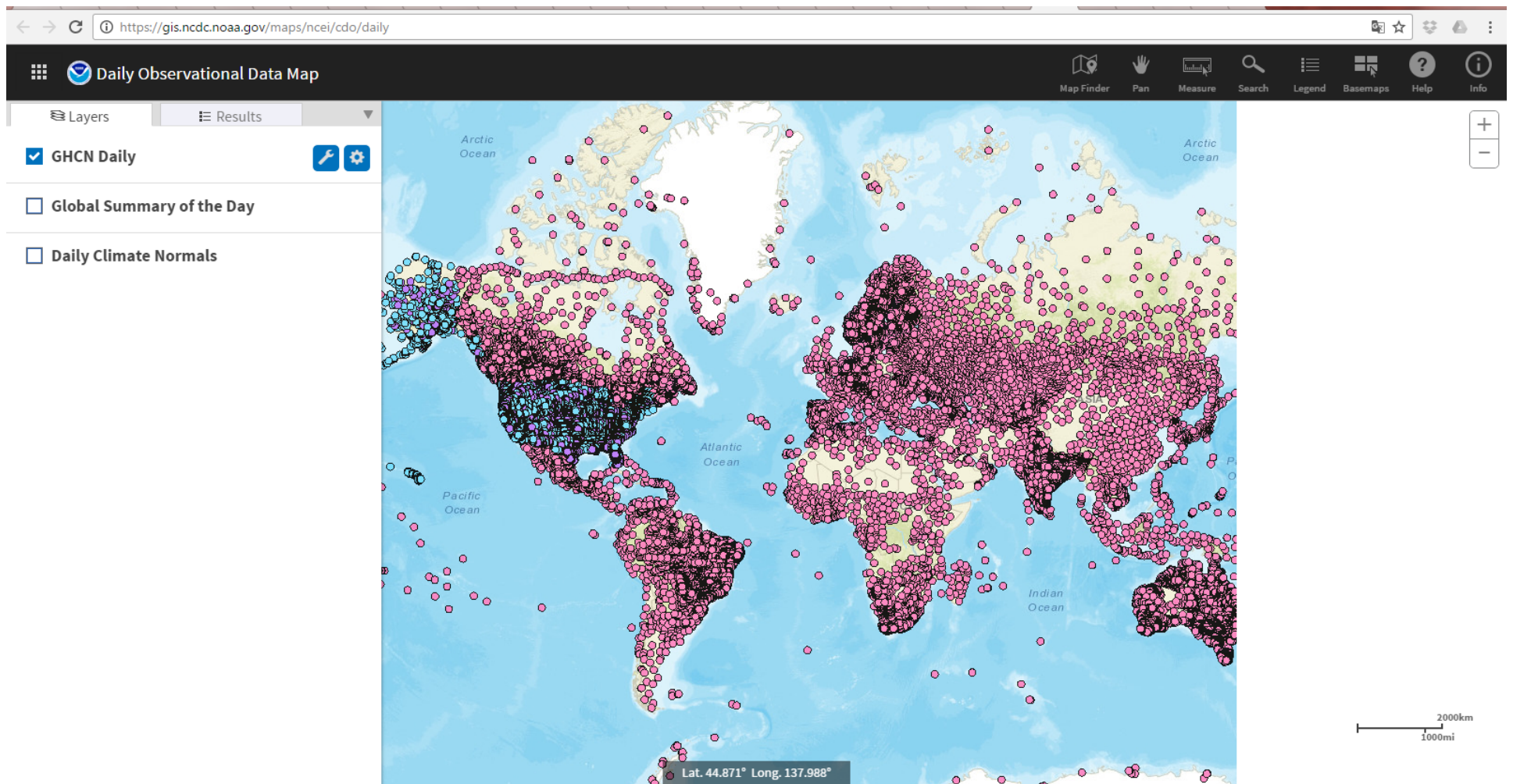
Hazard

Historic records

	<i>Rainfall</i>	<i>Temperature</i>
<i>Local</i>	National agencies data	
<i>Global</i>	GHCN-D: Global Historical Climatology Network Daily Temperatures NOAA	
	Global (Land) Precipitation And Temperature: University Of Delaware	
	CRU TS3.21 Gridded Precipitation And Other Meteorological Variables Since 1901	
	GPCP (DAILY): Global Precipitation Climatology Project NASA	
	TRMM: Tropical Rainfall Measuring Mission NASA and JAXA	
		NOAA Global Surface Temperature (NOAAGlobalTemp)

Hazard

GHCN-D: Global Historical Climatology Network Daily Temperatures NOAA




Hazard

Historic time series completion using statistical downscaling

Es seguro | <https://www.esrl.noaa.gov/psd/data/gridded/data.ncep.reanalysis.html>

U.S. Department of Commerce | National Oceanic & Atmospheric Administration | NOAA Research

 **Earth System Research Laboratory**
Physical Sciences Division

Search PSD: Search
Calendar | People | Publications

Physical Sciences Division About Contact Research Data Products News/Events Learn

Climate Datasets: By Category

- All
- Sub-daily
- Daily
- Monthly
- Surface
- Temperature
- SST
- Precipitation
- Land
- Ocean
- Multi-level
- Radiation
- Arctic
- Reanalysis
- Climate Indices

Search Datasets

20th Century Reanalysis

Popular Datasets

- ICOADS
- NCEP/NCAR Reanalysis
- N. American Regional Reanalysis

On this page: [Temporal Coverage](#) | [Spatial Coverage](#) | [Levels](#) | [Update Schedule](#) | [Download/Plot Data](#) | [Analysis Tools](#) | [Restrictions](#) | [Details](#) | [Caveats](#) | [File Naming](#) | [Citation](#) | [References](#) | [Original Source](#) | [Contact](#)

NCEP/NCAR Reanalysis 1: Summary

We have transitioned the data files from netCDF3 to netCDF4-classic format on Monday Oct 20th, 2014.

Brief Description:

- NCEP/NCAR Reanalysis 1

Temporal Coverage:

- 4-times daily, daily and monthly values for 1948/01/01 to present
- Long term monthly means, derived from data for years 1981 - 2010

Spatial Coverage:

- Global Grids

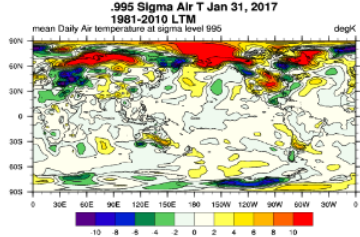
Levels:

- 17 Pressure level and 28 sigma levels. N/A

Update Schedule:

- Daily

.995 Sigma Air T Jan 31, 2017
1981-2010 LTM
mean Daily Air temperature at sigma level 995 degK



Pressure level

Surface

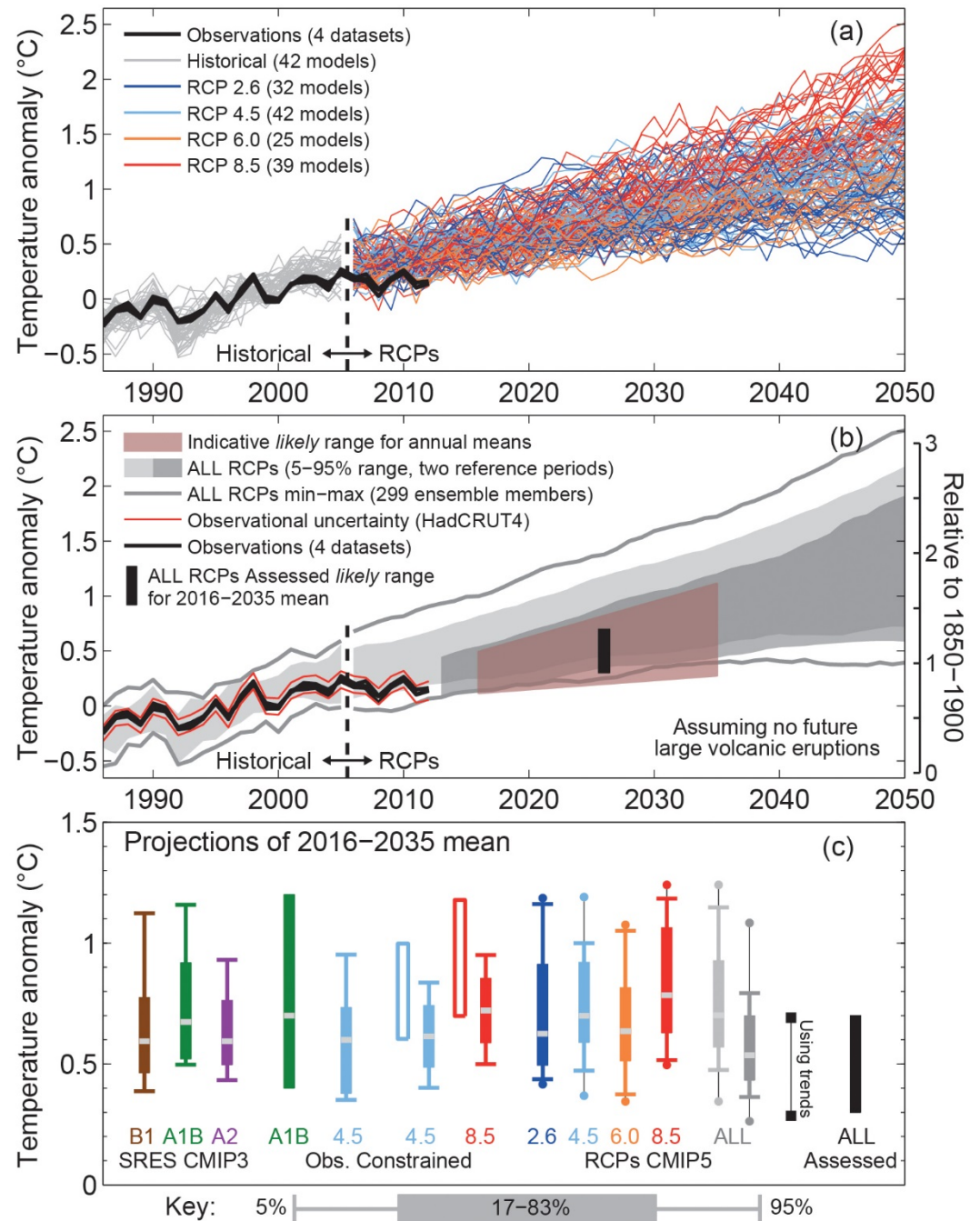
Hazard

Climate Change Models

IPCC AR5

Datasets Access:
climate.upei.ca

Global mean temperature near-term projections relative to 1850–1900



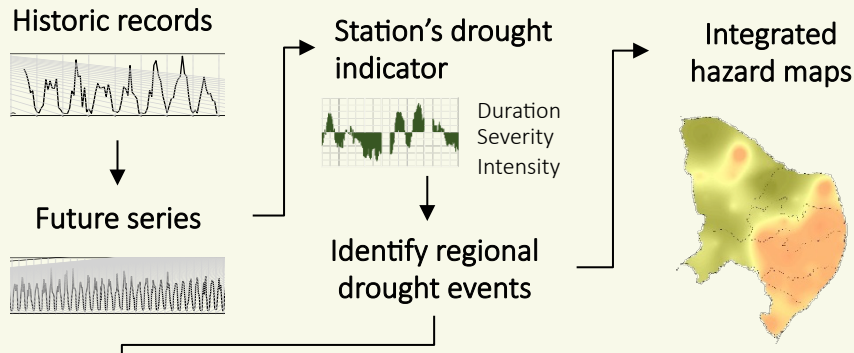
Hazard

Global Climate Models

ACCESS1	Australian Community Climate and Earth System Simulator	CNRM-CM5	Centre National de Recherches Météorologiques - Coupled Model 5	HadGEM2	Hadley Centre Global Environment Model version 2
BCC-CSM1.1	Beijing Climate Center Climate System Model versión 1.1	CSIRO-Mk3-6-0	Commonwealth Scientific and Industrial Research Organization	INMCM4	Institute for Numerical Mathematics Climate Model 4
BNU-ESM	Beijing Normal University Earth System Model	FGOALS-g2	Flexible Global Ocean-Atmosphere-Land System, Gridpoint version 2	IPSL-CM5	Institut Pierre Simon Laplace Climate Model
CanESM2	Second Generation Canadian Earth System Model	FGOALS-s2	Flexible Global Ocean-Atmosphere-Land System, Spectral version 2	MIROC4h	Model for Interdisciplinary Research on Climate 4
CCSM4	Community Climate System Model	FIO-ESM	First Institute of Oceanography-Earth System Model	MIROC5	Model for Interdisciplinary Research on Climate 5
CESM1-BGC	Community Earth System Model Versión 1 - BioGeoChemical model	GFDL-CM3	Geophysical Fluid Dynamics Laboratory - Climate Model 3	MIROC-ESM	Model for Interdisciplinary Research on Climate Earth System Model
CESM1-CAM5	Community Earth System Model Version 1 - Community Atmospheric Model Version 5	GFDL-ESM2G	Geophysical Fluid Dynamics Laboratory - Earth System Model 2G	MPI-ESM	Max Planck Institut für Meteorologie Earth System Model
CMCC-CESM	Centro Euro-Mediterráneo sui Cambiamenti Climatici - Carbon Earth System Model	GFDL-ESM2G	Geophysical Fluid Dynamics Laboratory - Earth System Model 2M	MRI-CGCM3	Meteorological Research Institute Global Climate Model 3
CMCC-CM	Centro Euro-Mediterráneo sui Cambiamenti Climatici - Climate Model	GISS-E2	Goddard Institute for Space Studies-E2	NorESM1-M	Norwegian Earth System Model
CMCC-CMS	Centro Euro-Mediterráneo sui Cambiamenti Climatici - Climate Model with a resolved Stratosphere	HadCM3	Hadley Centre Coupled Model Version 3		

Exposure

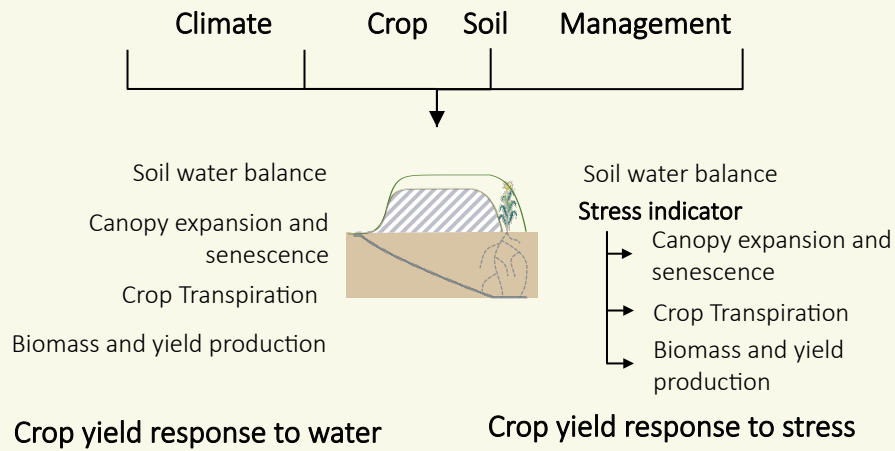
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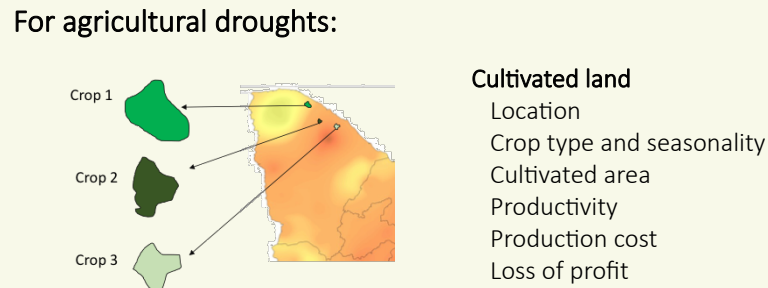
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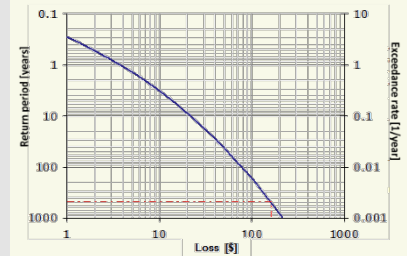
RISK

Inputs:
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Probabilistic risk assessment





$$v(p) = \sum_{i=1}^N Pr(P > p | E_i) F_{Ai}$$

Outputs:
Risk metrics
- Loss exceedance curve (LEC)



- Average annual loss (AAL)
- Probable maximum loss (PML)
- Risk maps

Exposure

Inputs	Location		<i>Georeferenced data, area</i>
	Crop characteristics		<i>Type and seasonality</i>
	Crop valuation		<i>Production cost, selling price</i>
Outputs	Exposed elements database		<ul style="list-style-type: none">- <i>Optimum yield production</i>- <i>Yield production under water stress</i>

Exposure

Location

Global Scale GAEZ - Land Resources/Land Cover/Cultivated Land



Organización de las Naciones Unidas para la Alimentación y la Agricultura - *por un mundo sin hambre*

GAEZ Zonas agroecológicas mundiales

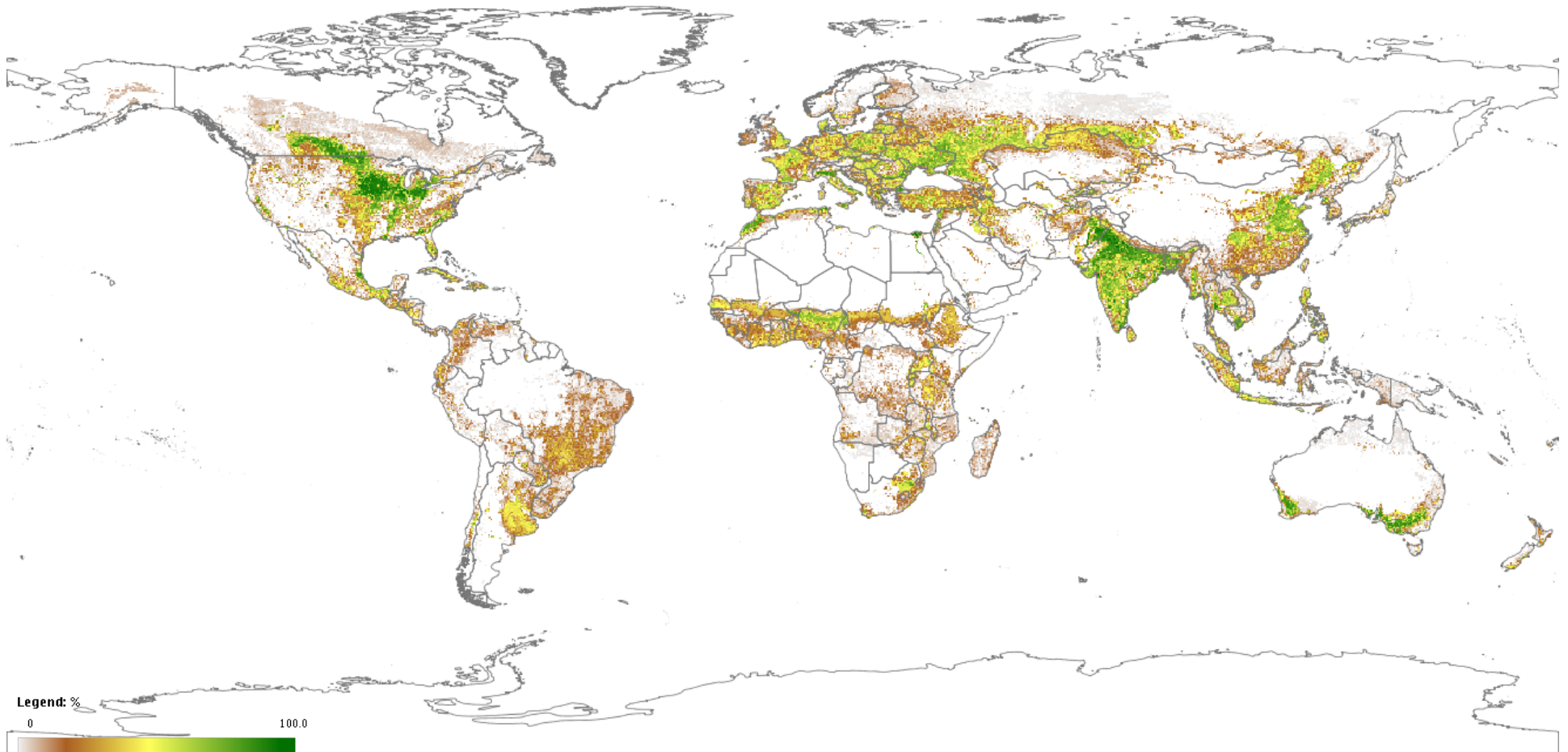
? Ayuda



International Institute for Applied Systems Analysis
www.iiasa.ac.at

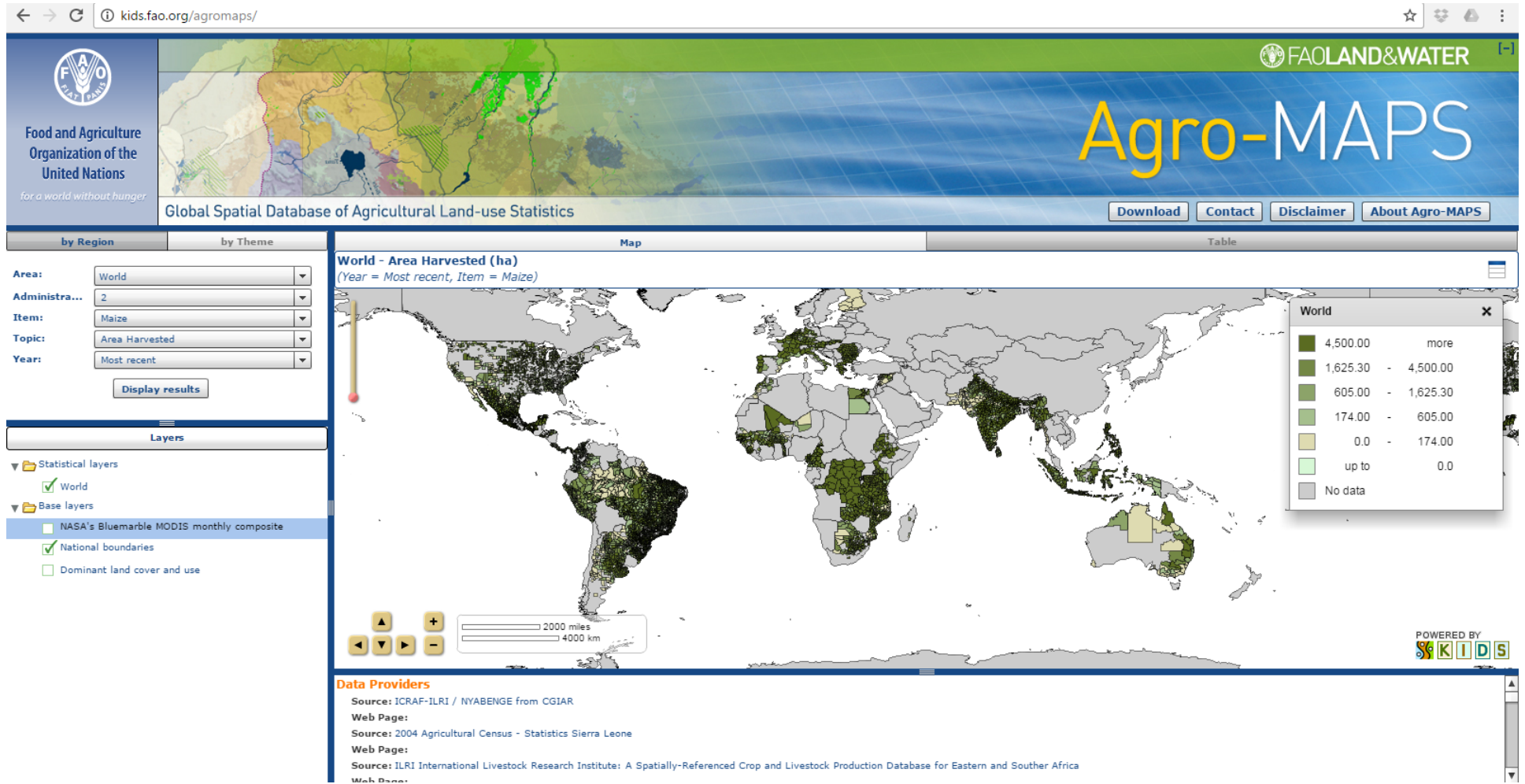
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Crop exposure

Location



Exposure

Crop Characteristics

*Global Scale
GAEZ – Suitability and Potential Yield/Crop Calendar/*



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GAEZ Zonas agroecológicas mundiales

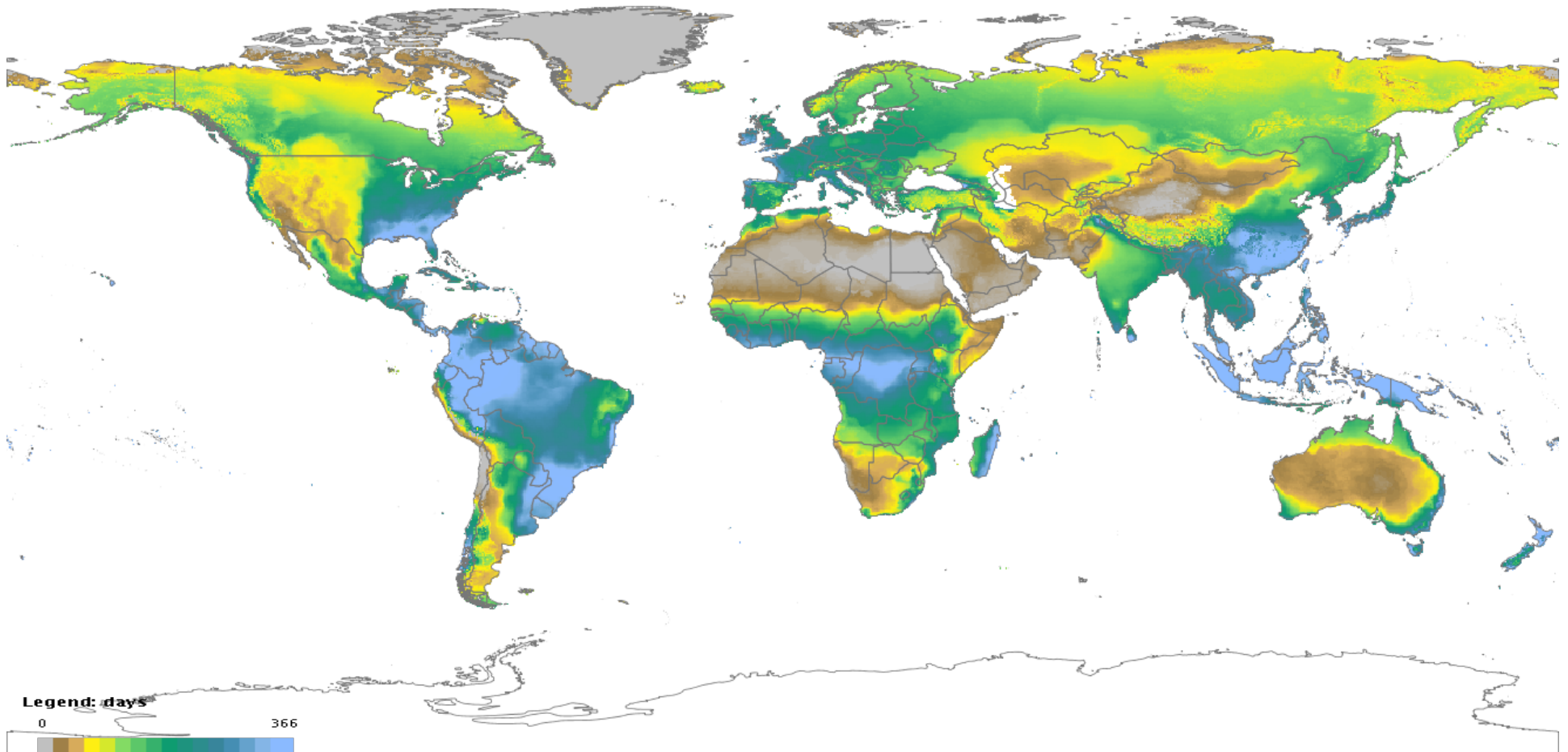
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Crop exposure

Crop characteristics



www.earthstat.org/data-download/

Home Data Download Examples and Collaborations

-  Cropland and Pasture Area in 2000
-  Harvested Area and Yield for 175 Crops
-  Greenhouse Gas Emissions From Croplands
-  Climate Variation Effects on Crop Yields for Maize, Soybean, Rice and Wheat
-  Yield Trends and Changes for Maize, Soybean, Rice and Wheat
-  Water Depletion and WaterGap3 Basins
-  Yield Gaps and Climate Bins for Major Crops
-  Fertilizer Application for Major Crops
-  Total Fertilizer Consumption for 140 Crops

Crop exposure

Crop valuation

Global Scale

FAO – Statistical data

- *Food Outlook*
- *AMIS Market Monitor*
- *Crop Prospects and Food Situation*
- *Food Price Monitoring and Analysis*
- *Crop and Food Supply Assessment Reports*
- *Oilcrops Monthly Price and Policy Update*
- *Global Food Price Monitor*
- *FAO Rice Market Monitor*

The screenshot displays the FAO Statistical data website. The main navigation bar includes 'Trade and markets' and 'Statistical data'. The left sidebar lists various sections: 'FAO Home', 'Economic and Social Development Department', 'Trade and Markets Home', 'Commodity markets', 'Trade', 'Emerging issues', 'Publications', 'Meetings and events', 'Projects', and 'Statistical data'. The main content area is titled 'Statistical data' and 'Price data and tools'. It features several key sections: 'Food Price Monitoring and Analysis Tool' (FPMA), 'FAO Food Price Index', 'FAOSTAT', and 'Short-term analyses and reports'. The 'Short-term analyses and reports' section includes: 'Food Outlook', 'Crop Prospects and Food Situation', 'Crop and Food Supply Assessment Reports', 'Global Food Price Monitor', 'AMIS Market Monitor', 'Food Price Monitoring and Analysis', 'Oilcrops Monthly Price and Policy Update', and 'FAO Rice Market Monitor'. A 'Related links' section on the right points to 'FAO statistics' and 'Agricultural Market Information System (AMIS)'. Below this is a 'World Food Situation' section with a line chart titled 'FAO Food Price Index' showing data from 2012 to 2016. A 'Tweets by @FAOstatistics' section is also visible, featuring a tweet from @FAOWHOCodex about Groundhog Day. The footer contains 'Contact us | Terms and Conditions | Scam Alert' and '© FAO, 2017'.

Exposure

Crop Valuation

Global Scale
GAEZ – Actual Yield and Production/Crop production value/



Organización de las Naciones Unidas para la Alimentación y la Agricultura - *por un mundo sin hambre*

GAEZ Zonas agroecológicas mundiales

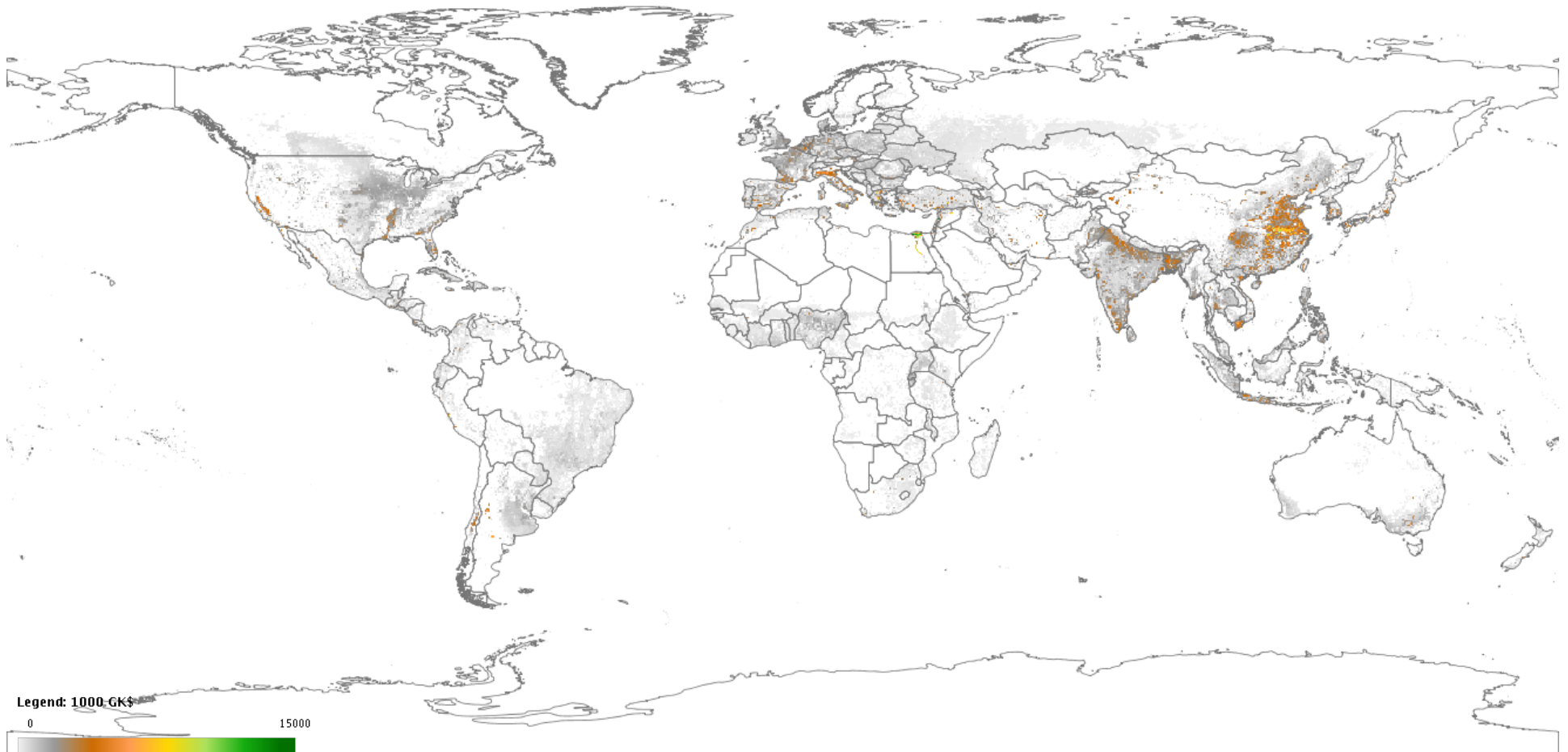
? Ayuda



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Crop exposed elements

Additional data sources



Provides geographic data sets with the purpose of solving the grand challenge of feeding a growing global population while reducing agriculture's impact on the environment.



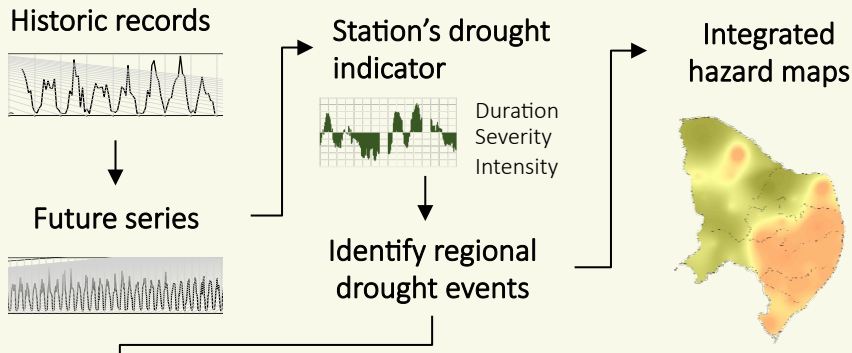
GEOGLAM is the Group on Earth Observations Global Agricultural Monitoring Initiative. Its objective is to provide AMIS with an international and transparent multi-source, consensus assessment of crop growing conditions and status, and agro-climatic conditions, likely to impact global production.



Statistics including production, supply, utilization, trade and closing stocks. Limited to AMIS countries (G20).

Vulnerability

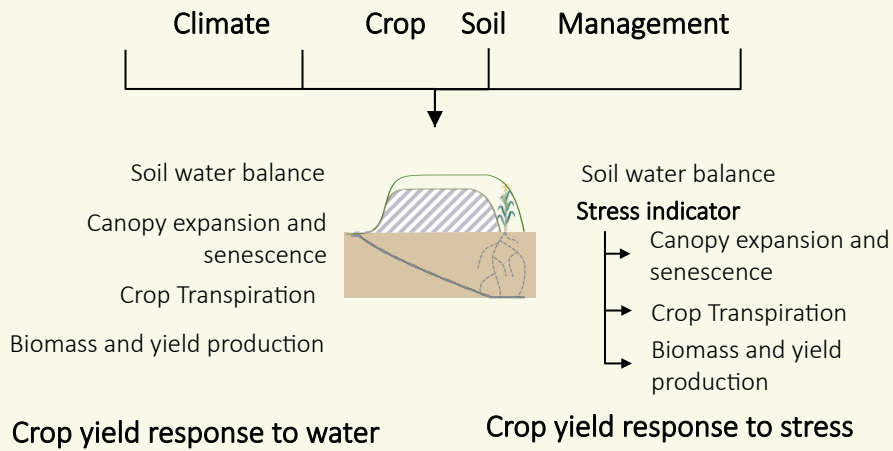
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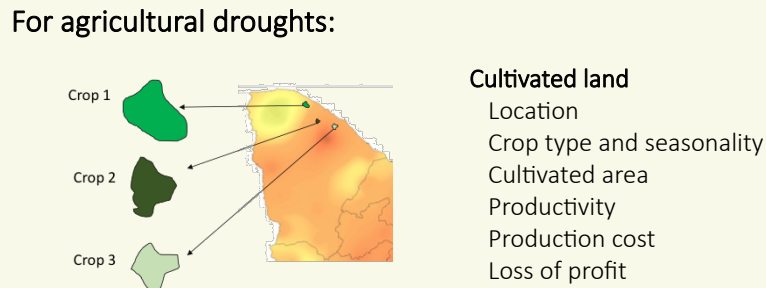
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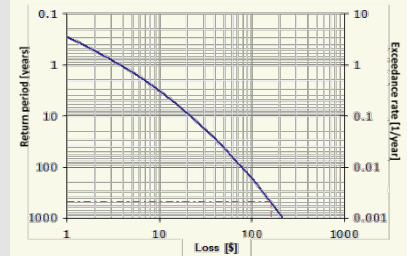
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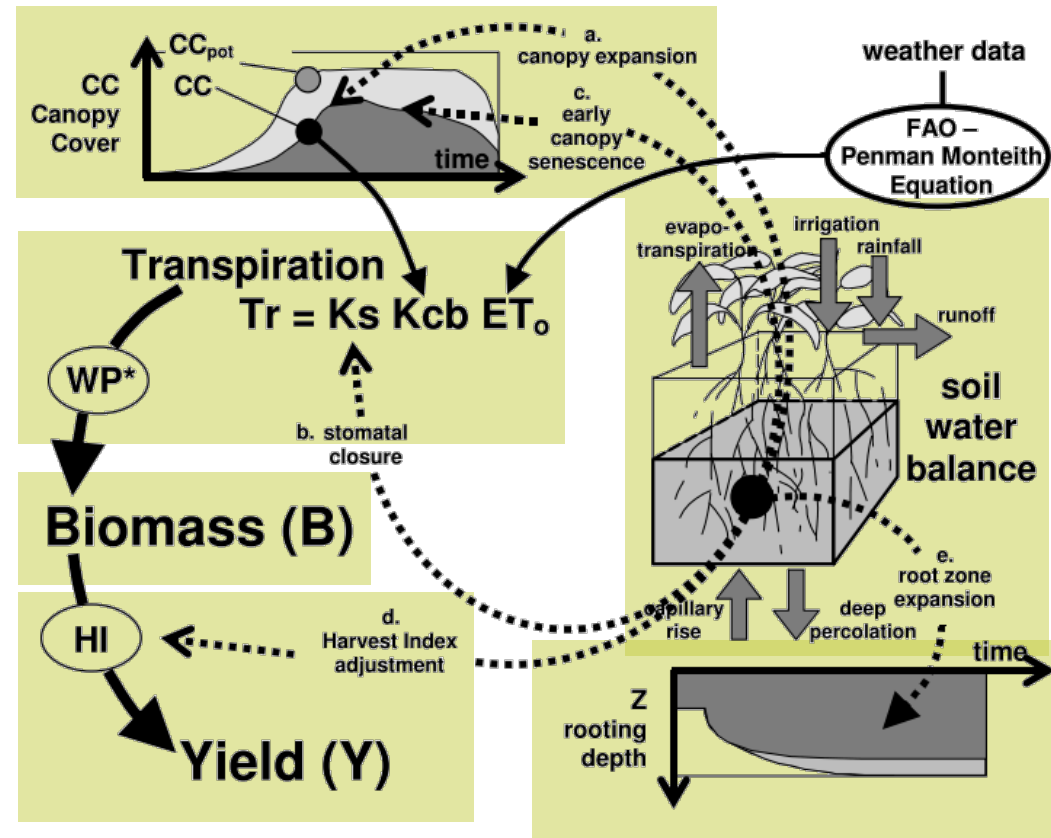
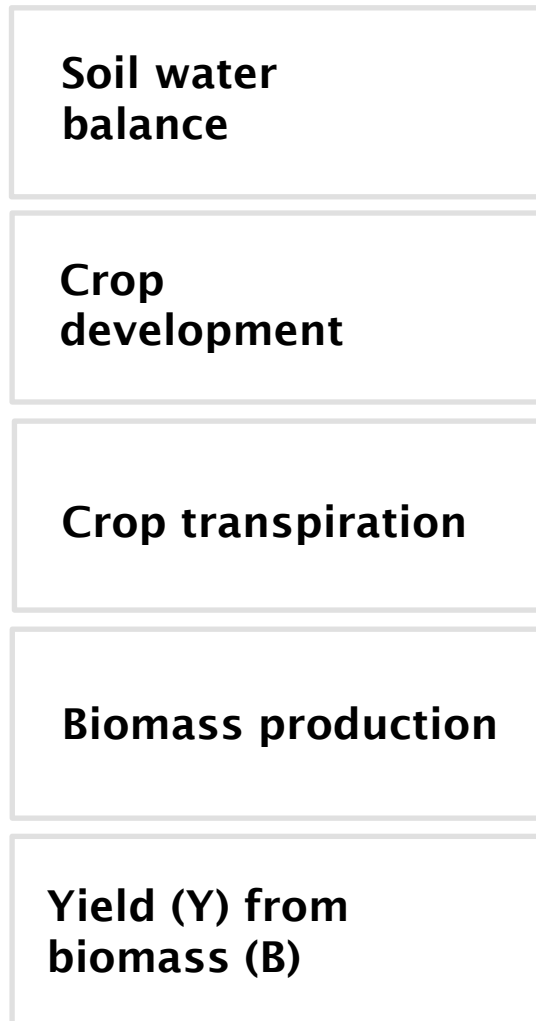
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- Loss exceedance curve (LEC)



- Average annual loss (AAL)
- Probable maximum loss (PML)
- Risk maps

Vulnerability

5-steps process



Crop Vulnerability

Inputs

Climate



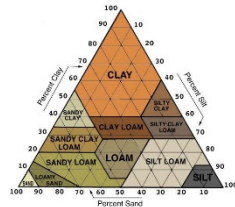
*Data from hazard modelling:
Air temperature, rainfall, ETo, CO₂*

Crop characteristics



*Phenology, canopy development,
root deepening, production,
seasonality*

Soil profile



*Soil horizons, soil surface,
restrictive layers, capillary rise*

Management



Modifiers: irrigation and fertilizers

Outputs

Yield



*- Optimum yield production
- Yield production under water stress*

Crop Vulnerability

Climate parameters

Climate



*Data from hazard modelling:
Air temperature, rainfall, ET_o , CO_2*

Parameters	Definition	Comments
T_x	Maximum air temperature	Influences crop phenology with effects on WP and HI.
T_n	Minimum air temperature	
P	Rainfall	Determinants of water balance of the soil root zone and water stress.
ET_o	Reference evapotranspiration	
$[CO_2]$	Carbon dioxide concentration	Affects WP, canopy expansion, stomatal conductance.

Crop Vulnerability

Crop characteristics

Crop characteristics



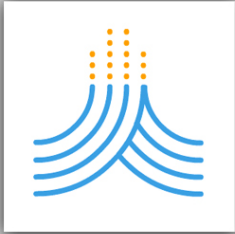
Phenology, canopy development, root deepening, production, seasonality

Parameters	Definition
Phenology	Growing Degree Days
Canopy development	Initial and maximum canopy cover, canopy growth and decline coefficients
Rooting Depth	Minimum and maximum rooting depth
Crop transpiration	Transpiration and ageing coefficient
Biomass production	Water productivity
Harvestable yield	Reference harvest index

AquaCrop

Crop Water Productivity Model

Version 5.0
October 2015
About



AquaCrop
Crop Water Productivity Model

Land and Water
Food and Agriculture Organization of the United Nations

Environment and Crop

Climate
Climate

Crop
Crop

Management
Irrigation
Field

Soil
Soil profile
Groundwater

Start growing cycle (D) 22 March

Select
Display/Update

Simulation

Simulation period: Simulation period: From: 22 March - To: 24 July

Initial conditions: (None) Soil water profile at Field C

Off-season: Simulation period linked to cropping period

Project: (None) No specific project

Field data: (None) No field observations

Run

Exit Program

SELECT file from Data Base

(double) Click a File in the list to select

File Name	Description
SorghumGDD.CRO	Bushland Texas 1993 Sorghum 27 May 1993
Soybean.CRO	Default Soybean, Calendar (Patancheru, 25Jun96)
SoybeanGDD.CRO	Default Soybean, GDD (Patancheru, 25Jun96)
SugarBeet.CRO	Default Sugar Beet, Calendar (Foggia, 22Mar00)
SugarBeetGDD.CRO	Default Sugar Beet, GDD (Foggia, 22Mar00)
SugarCane.CRO	as in Singels chpt

Selected File: DEFAULT.CRO

DEFAULT crop (a generic crop)

Delete selected file
Display/Update Crop characteristics

Cancel Main Menu

AquaCrop

Crop Water Productivity Model

Herbaceous Crops

Wheat

Rice

Maize

Soybean

Sorghum

Cotton

Sunflower

Sugarcane

Potato

Tomato

Sugar Beet

Alfalfa

Bambara Groundnut

Quinoa

Tef



Fruit Trees and Vines

Olive

Citrus

Apple

Plum

Almond

Pear

Peach

Walnut

Pistachio

Apricot

Avocado

Sweet cherry

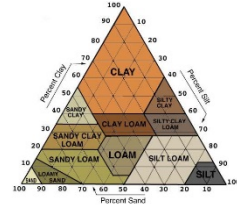
Grapevine

Kiwifruit

Crop Vulnerability

Soil type

Soil profile



*Soil horizons, soil surface,
restrictive layers, capillary rise*

Parameters	Definition	Comments
SAT	Soil water content at saturation	Related to the porosity of the type of soil
FC	Field capacity	Upper limit of water content under gravity
PWP	Permanent wilting point	Lower limit of water content
Ksat	Hydraulic conductivity at saturation	Is the capacity of the soil to transmit water under a hydraulic gradient.
GWT	Groundwater table	Depth below the surface.
ECGWT	Salinity of groundwater	

Crop Vulnerability

Soil type

Global Scale
GAEZ – Soil resources/



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GAEZ Zonas agroecológicas mundiales

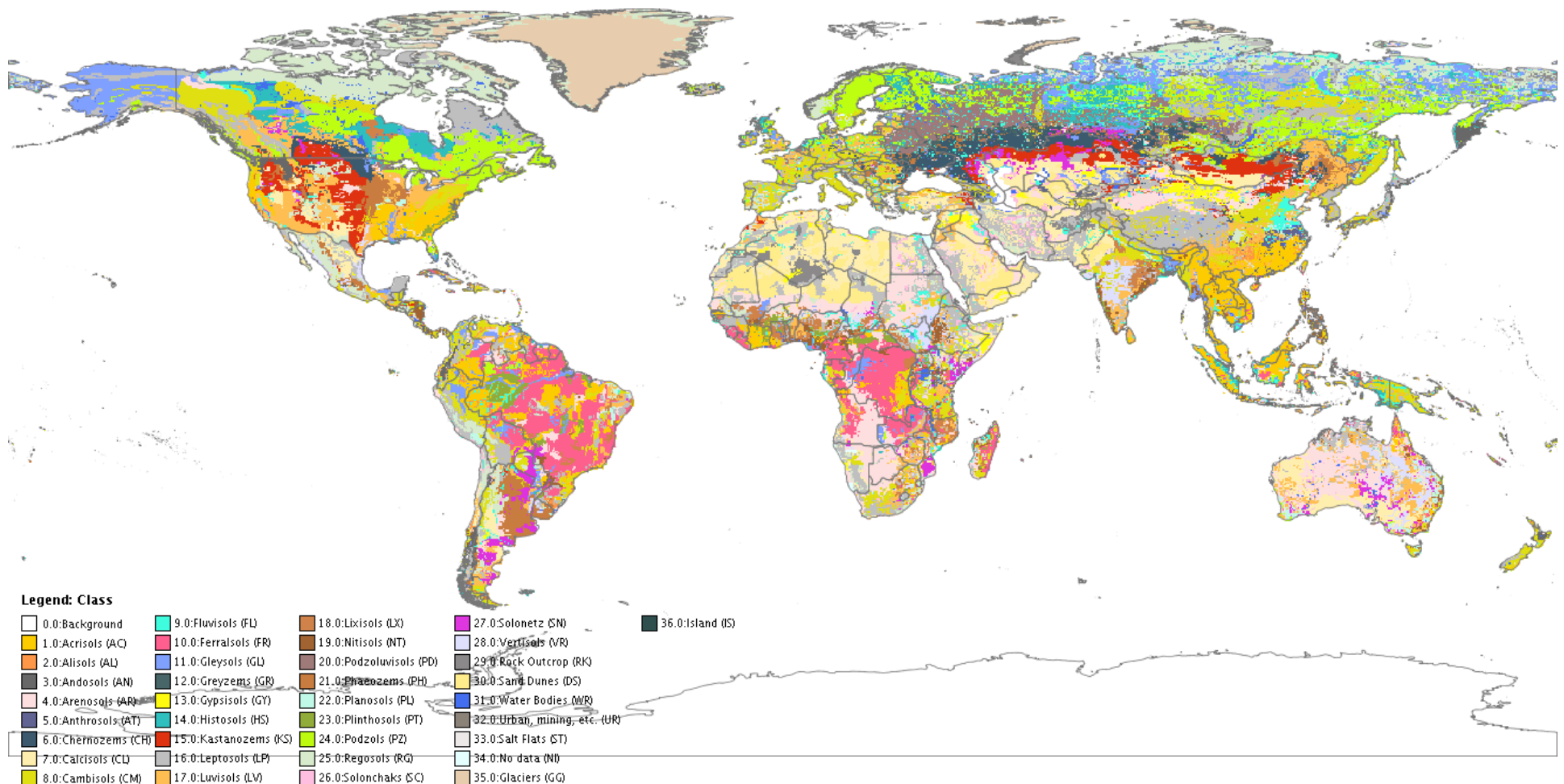
? Ayuda



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Crop Vulnerability

Soil type

Global Scale

GAEZ – Soil resources/

- *Dominant soil*
- *Nutrient availability*
- *Nutrient retention capacity*
- *Rooting conditions*
- *Oxygen availability*
- *Excess salts*
- *Toxicities*
- *Workability*

Crop Vulnerability

Management options

Management



Modifiers: irrigation and fertilizers

Parameters	Definition
Irrigation method	Water application methods include sprinkler, surface, or drip either surface or underground
Fertility	Native or fertilization
Mulching	Cover soil surface to reduce soil evaporation
Soil bunds	Small dykes to pond water or control surface runoff