Scoping Meeting Agricultural Risk Assessment

6 – 9 February 2017 – Boulder, Colorado

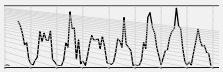
Data requirements

INGENIAR

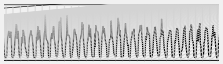
Hazard

HAZARD

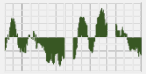
Historic records



Future series



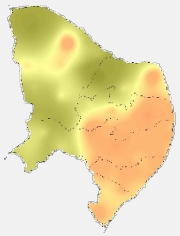
Station's drought indicator



Duration
Severity
Intensity

Identify regional drought events

Integrated hazard maps



Inputs:
Precipitation and temperature series recorded in stations.

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

VULNERABILITY

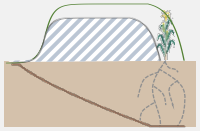
Climate | Crop | Soil | Management

Soil water balance

Canopy expansion and senescence

Crop Transpiration

Biomass and yield production



Crop yield response to water

Soil water balance

Stress indicator

- Canopy expansion and senescence
- Crop Transpiration
- Biomass and yield production

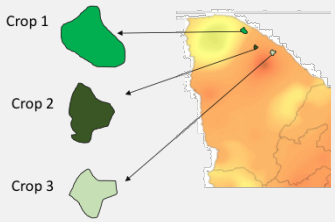
Crop yield response to stress

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

For agricultural droughts:



Cultivated land
- Location
- Crop type and seasonality
- Cultivated area
- Productivity
- Production cost
- Loss of profit

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

Outputs:
- Exposed elements database

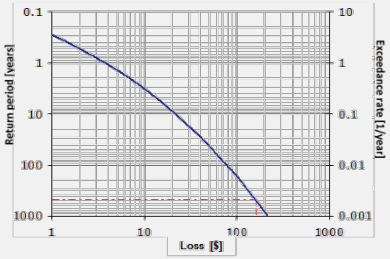
RISK

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)

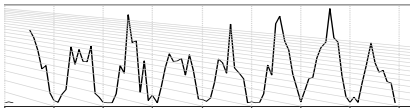


- Average annual loss (AAL)
- Probable maximum loss (PML)
- Risk maps

Hazard

Inputs

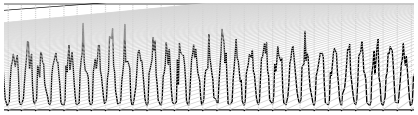
Historic records



Station or satellite data
Downscaling techniques for completion

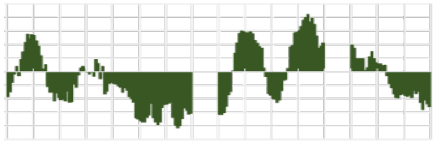
Outputs

Future series



Probability distribution fitting

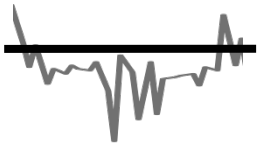
Drought indicator



Reconnaissance Drought Index – RDI

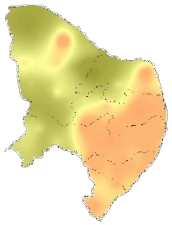
Standardized Precipitation Evapotranspiration Index - SPEI

Drought events



Local and regional drought event definition

Integrated hazard maps

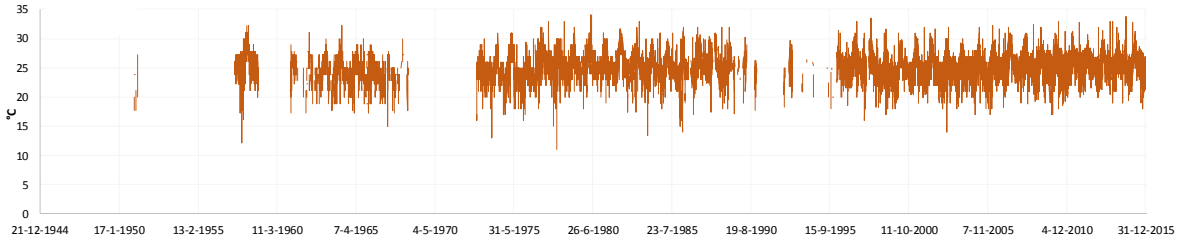


Spatial interpolation

Hazard

Minimum parameters needed for hazard model

T max [˚C]



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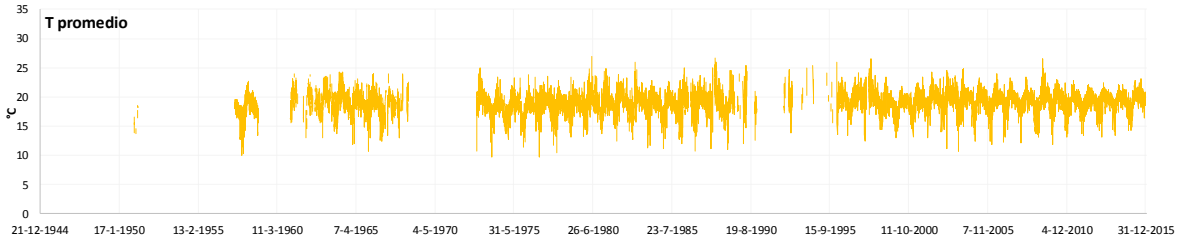

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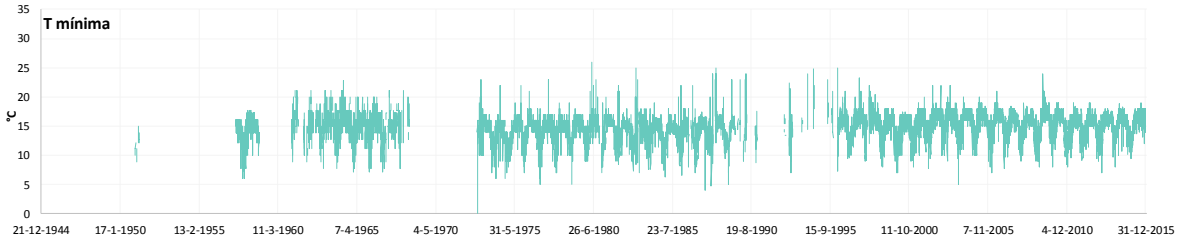
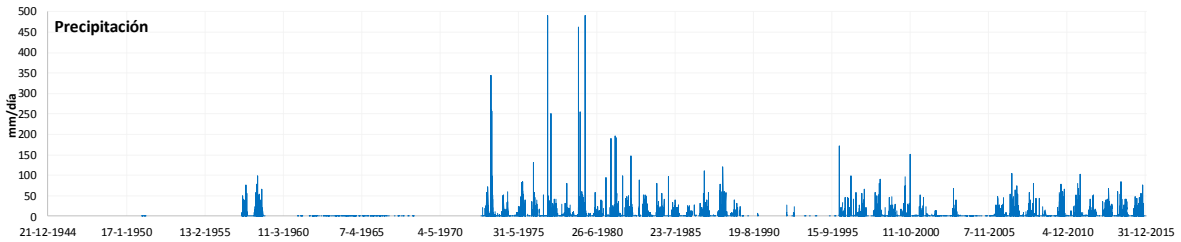


Rainfall [mm/day]



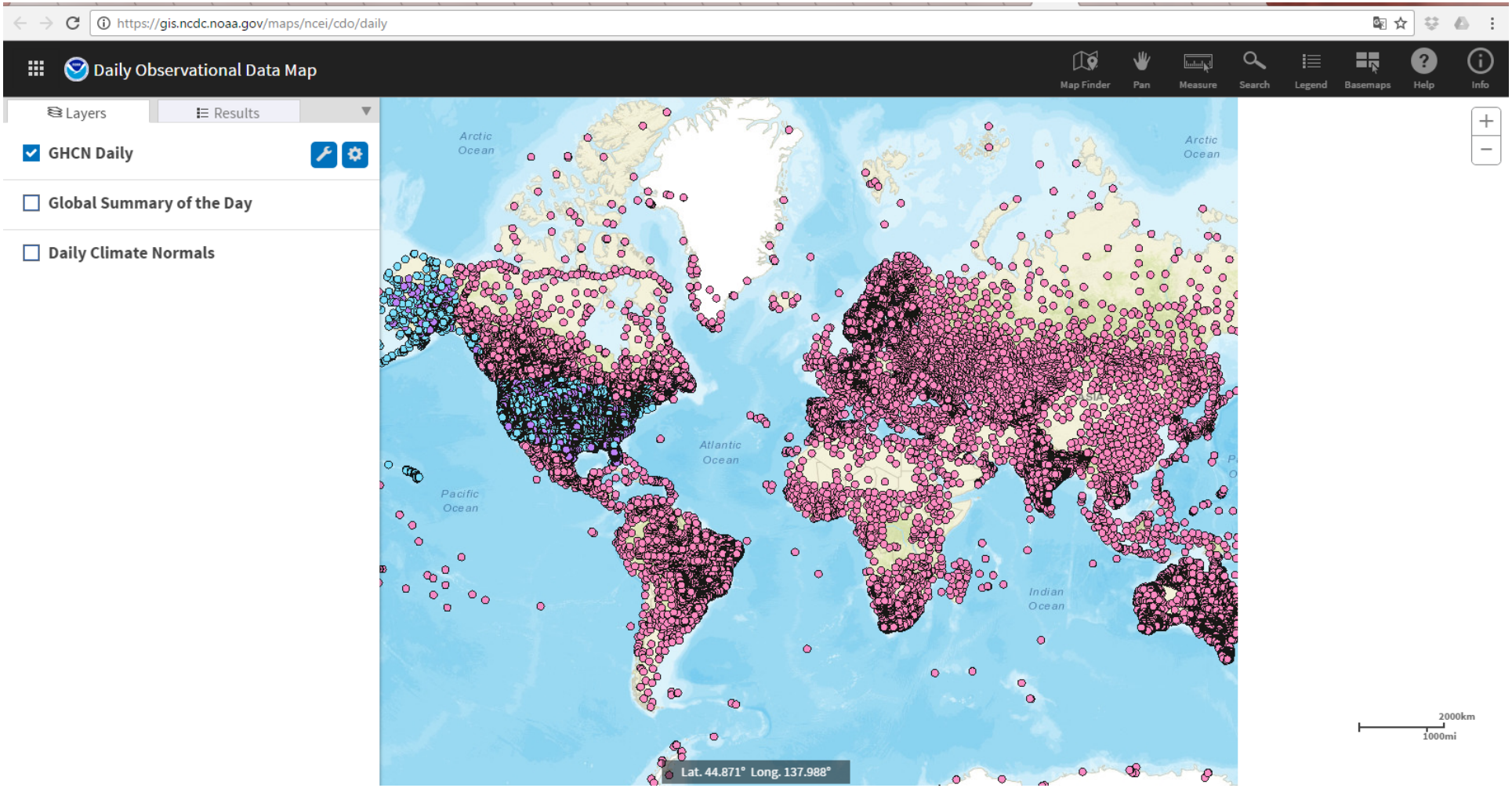
Hazard

Historic records

	Rainfall	*Temperature*
Local	**National agencies data**	
Global	**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

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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

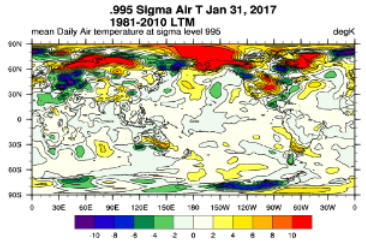
On this page: Temporal Coverage | Spatial Coverage | Levels | Update Schedule | Download/Plot Data | Analysis Tools
Restrictions | Details | Caveats | File Naming | Citation | References | Original Source | Contact

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

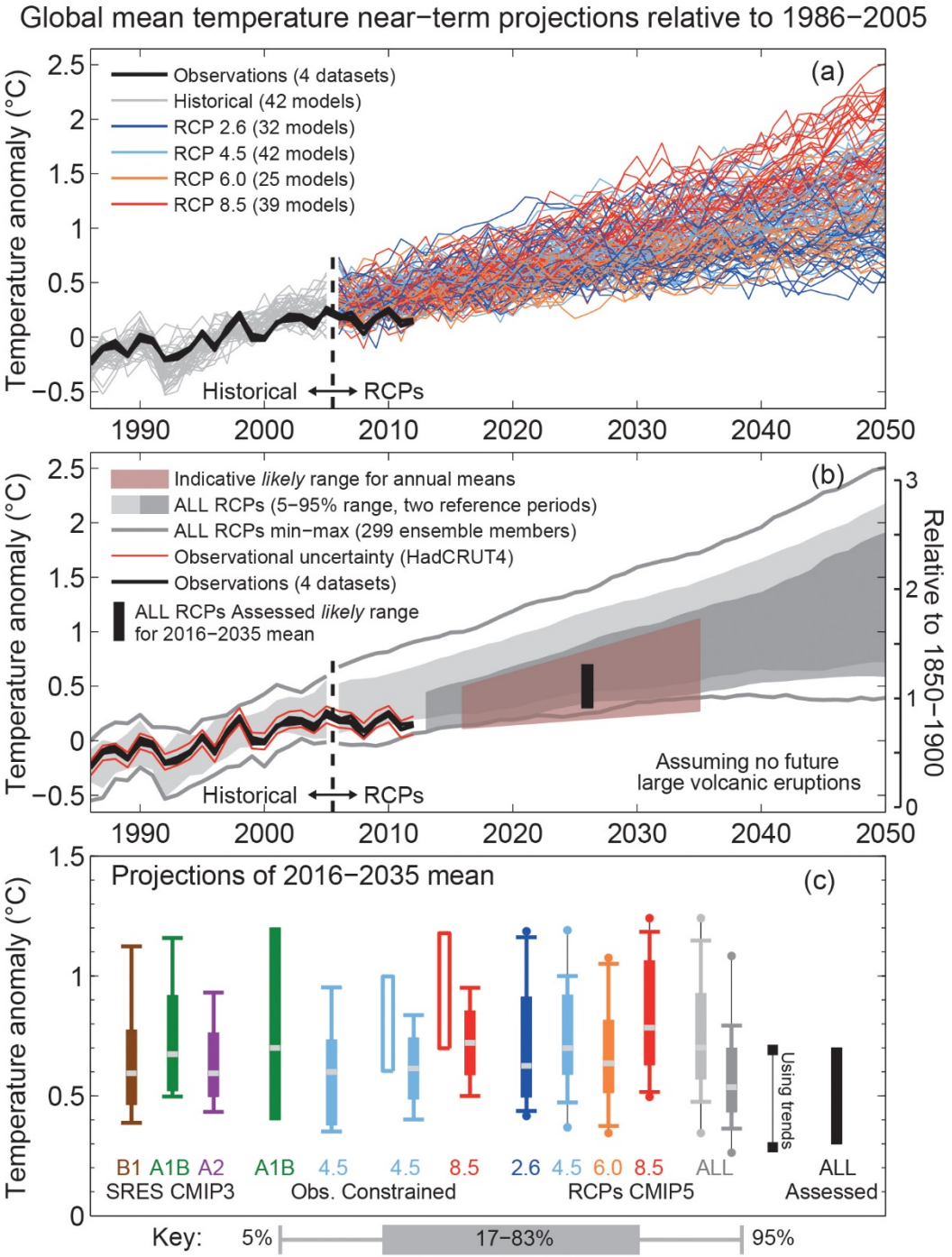
- Pressure level
- Surface

Hazard

Climate Change Models

IPCC AR5

Datasets Access:
climate.upei.ca



Hazard

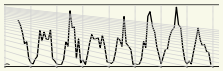
Global Climate Models

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 Cliamte 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 fur 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 Sustem Model
CMCC-CMS	Centro Euro-Mediterráneo sui Cambiamenti Climatici - Climate Model with a resolved Stratosphere	HadCM3	Hadley Centre Coupled Model Version 3		

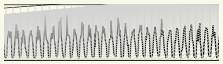
Exposure

HAZARD

Historic records



Future series

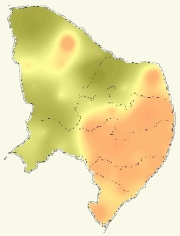


Station's drought indicator

Duration
Severity
Intensity

Identify regional drought events

Integrated hazard maps



Inputs:
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Outputs:
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VULNERABILITY

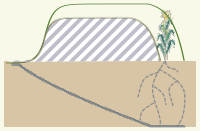
Climate | Crop | Soil | Management

Soil water balance

Canopy expansion and senescence

Crop Transpiration

Biomass and yield production



Crop yield response to water

Soil water balance

Stress indicator

- Canopy expansion and senescence
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Crop yield response to stress

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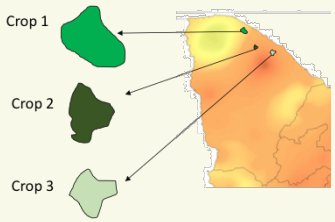
Outputs:
- Optimum yield production
- Yield production under water stress

EXPOSURE

For agricultural droughts:



Cultivated land
- Location
- Crop type and seasonality
- Cultivated area
- Productivity
- Production cost
- Loss of profit

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

Outputs:
- Exposed elements database

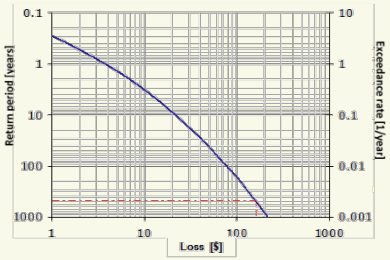
RISK

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

Exposure

Inputs

Location		*Georeferenced data, area*
Crop characteristics		*Type and seasonality*
Crop valuation		*Production cost, selling price*

Outputs

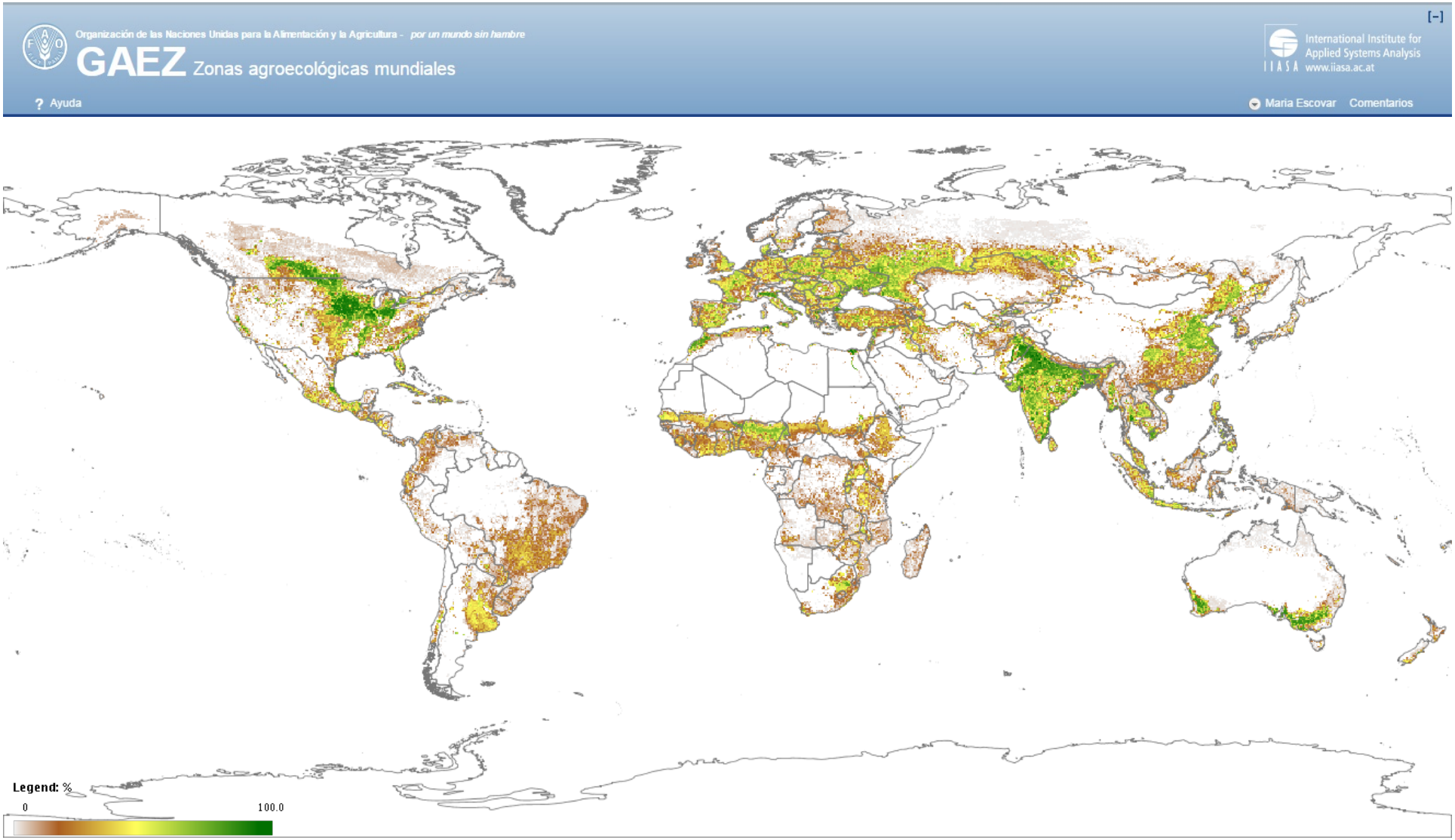
Exposed elements database		*- Optimum yield production* *- Yield production under water stress*

Exposure

Location

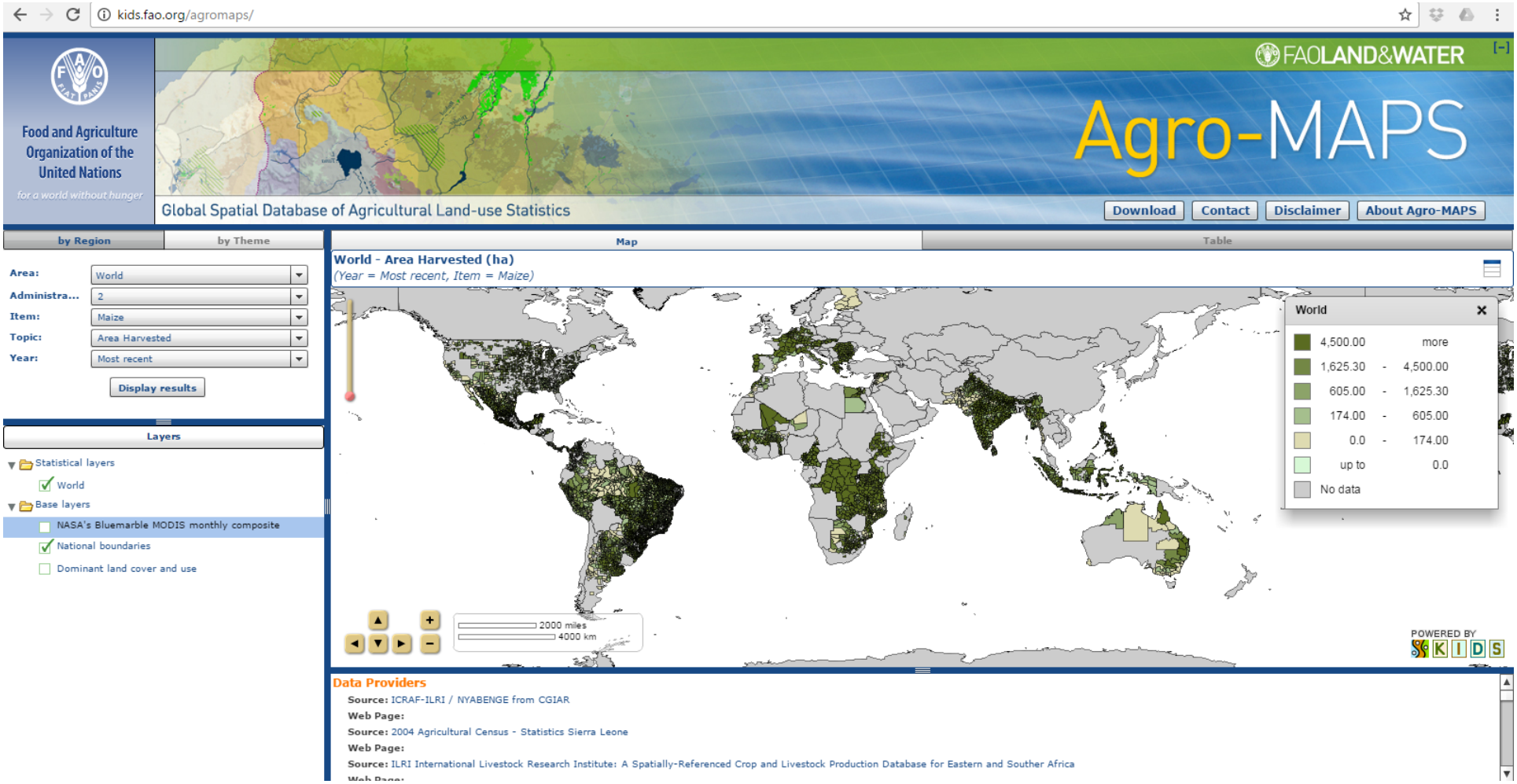
Global Scale

GAEZ – Land Resources/Land Cover/Cultivated Land



Crop exposure

Location

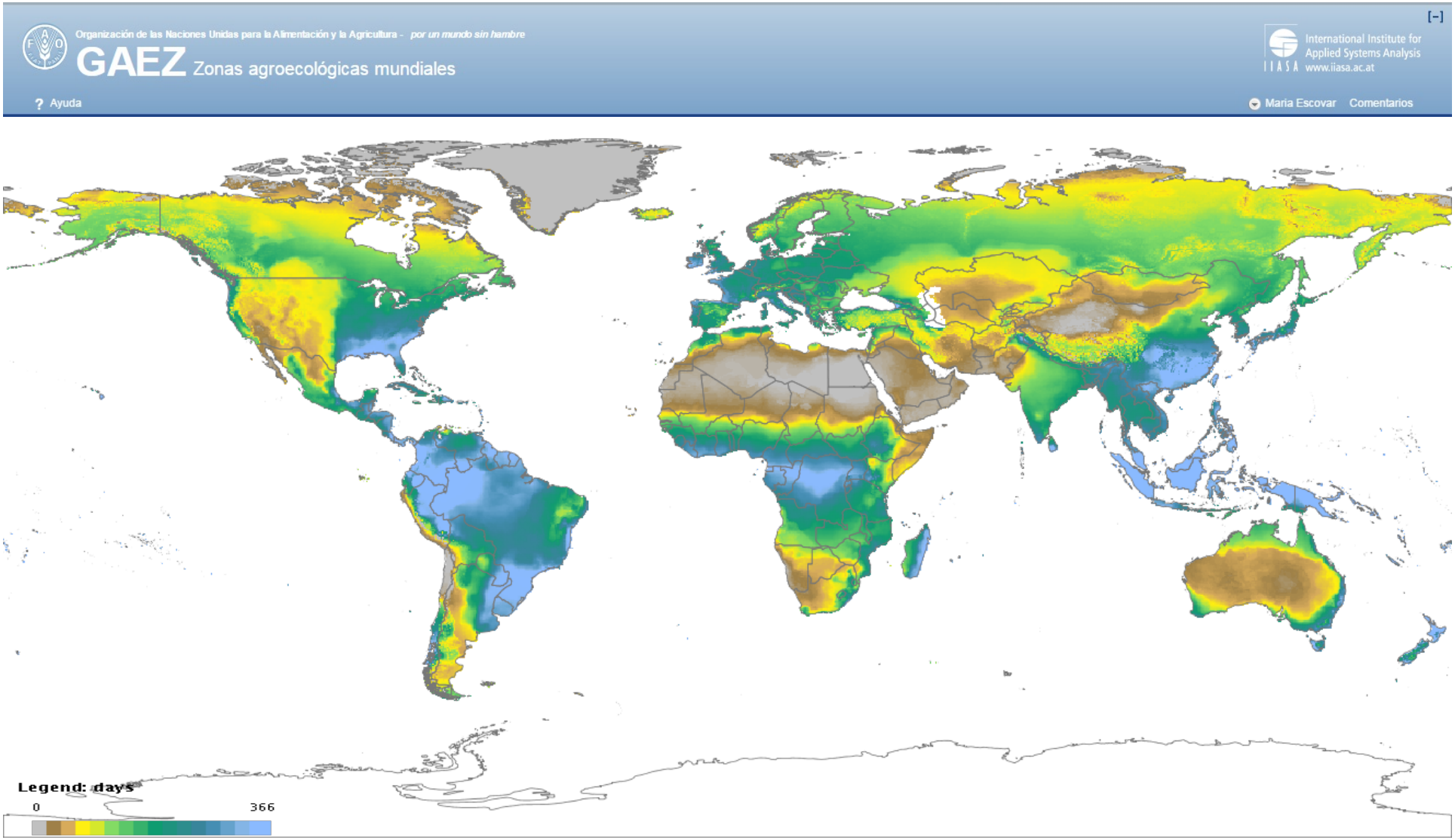


Exposure

Crop Characteristics

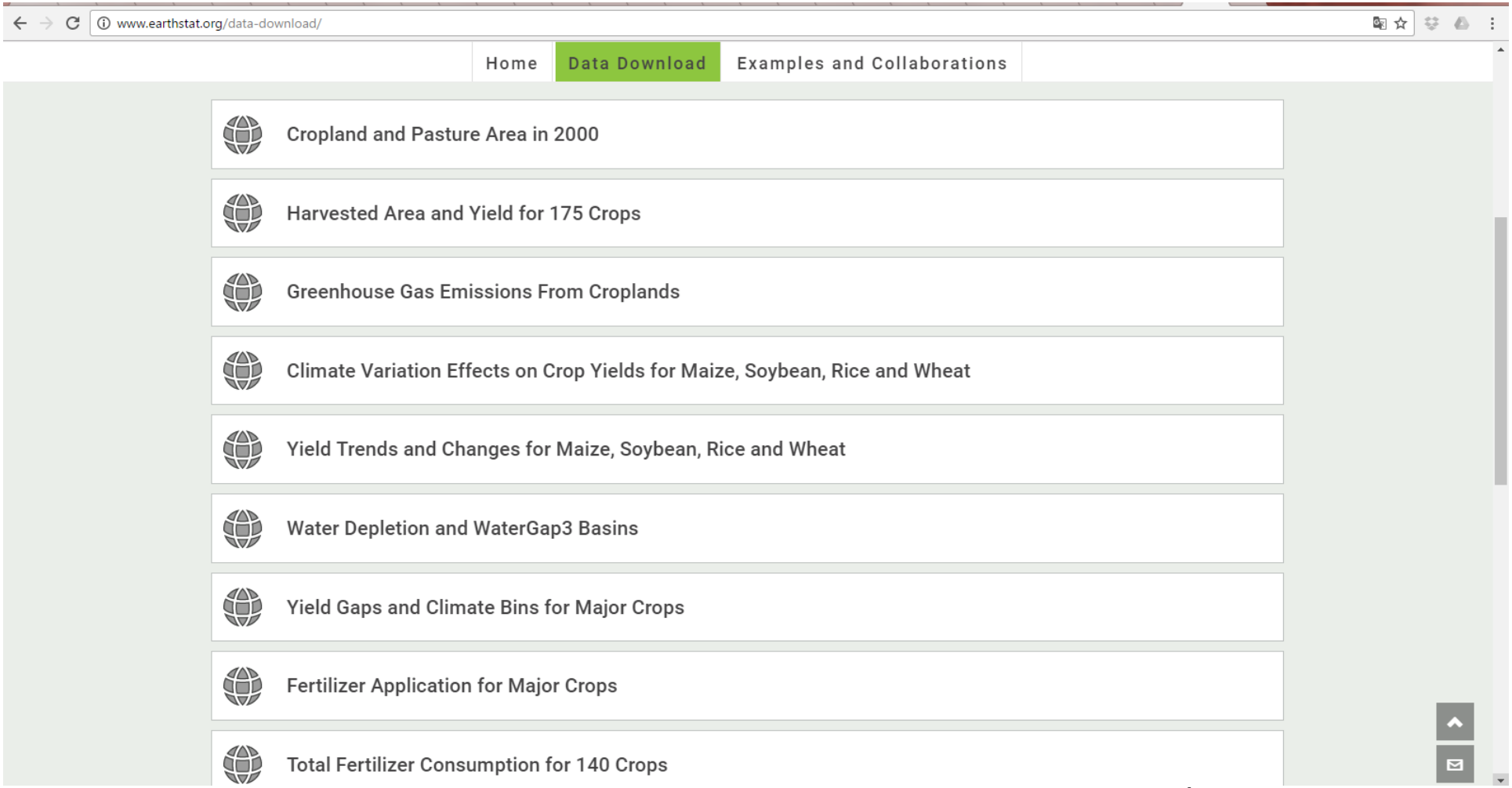
Global Scale

GAEZ – Siutability and Potential Yield/Crop Calendar/



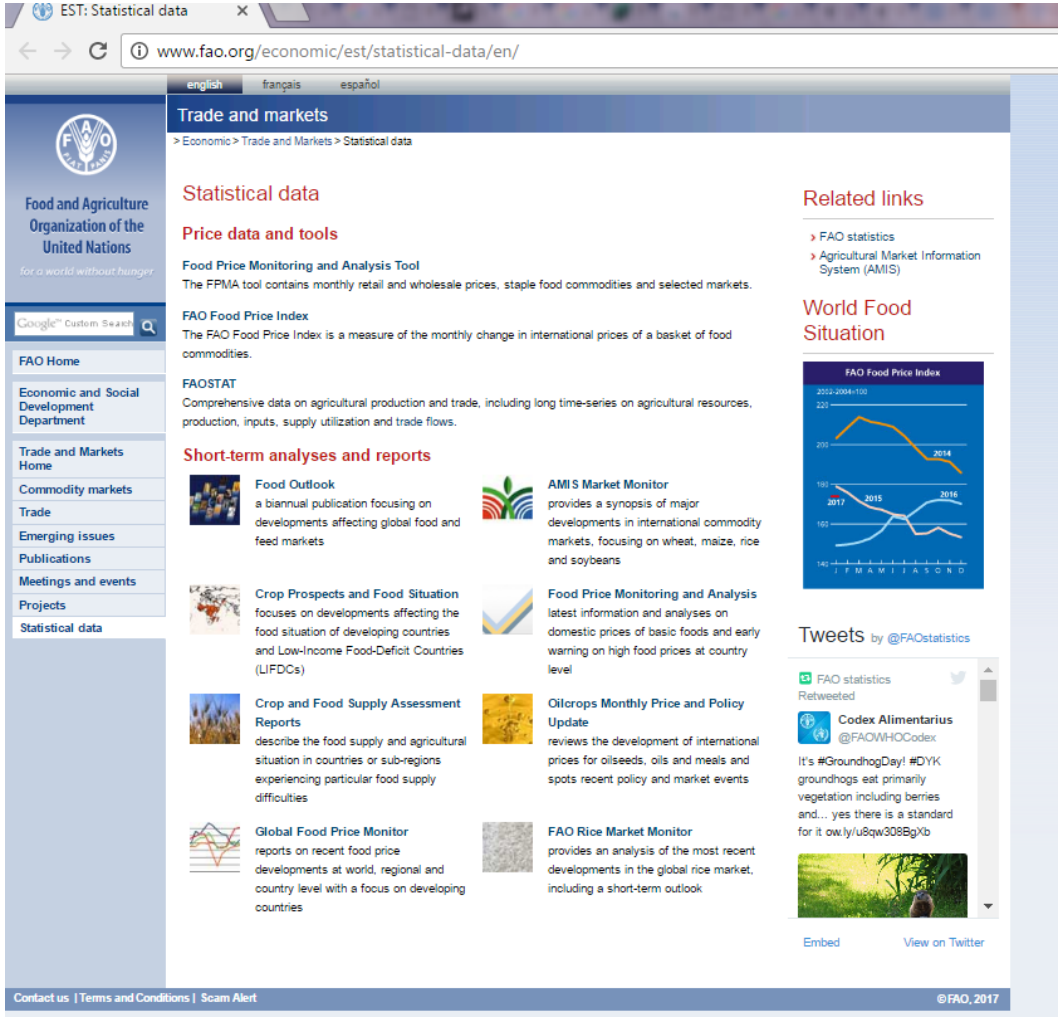
Crop exposure

Crop characteristics



Crop exposure

Crop valuation



Global Scale

FAO – Statistical data

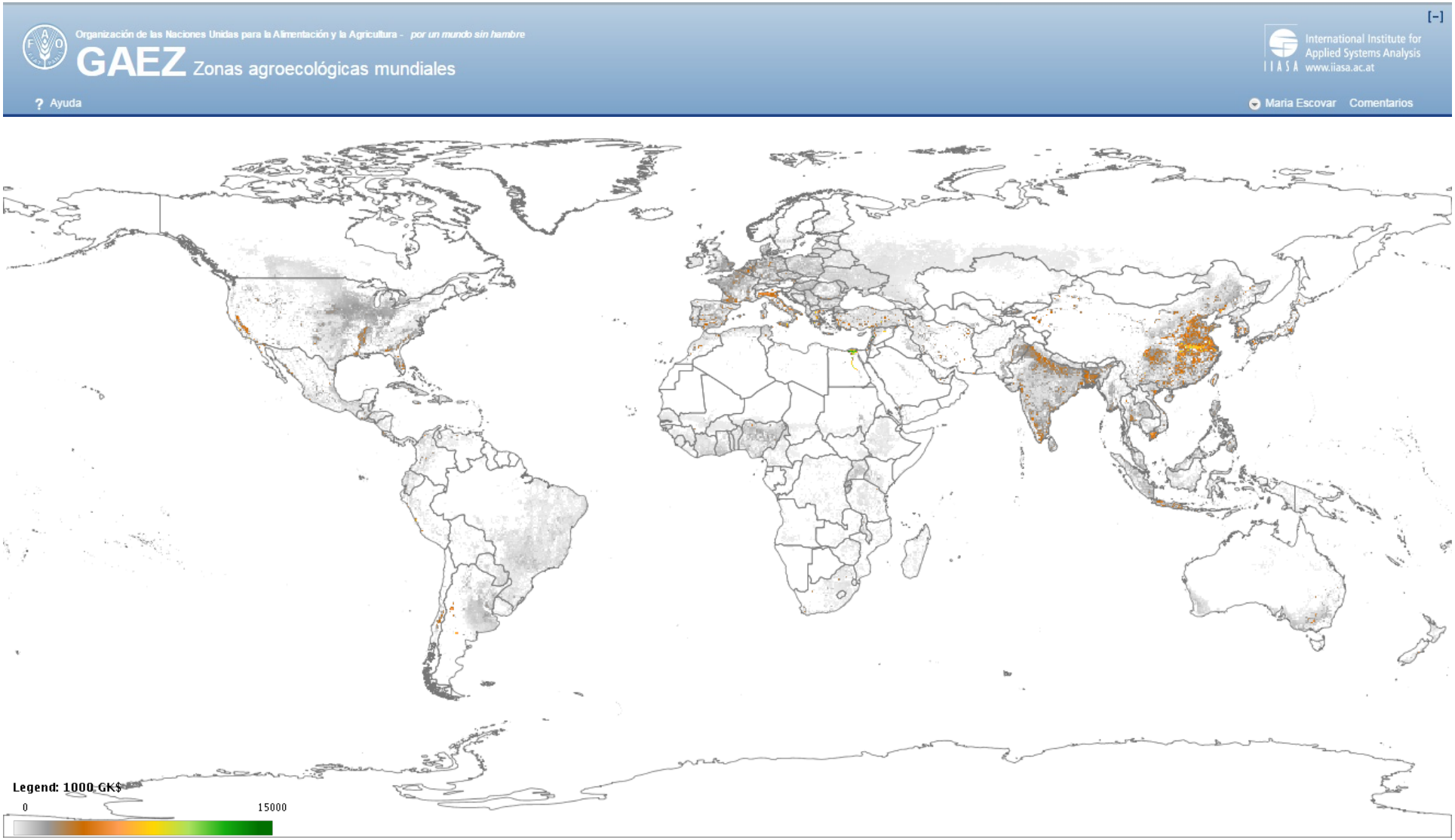
- *Food Outlook*
- *AMIS Market Monitor*
- *Crop Prospects and Food Situation*
- *Food Price Monitoring and Analysis*
- *Crop and Food Supply Assessment Reports*
- *Oilcrops Monthly Price and Policy Update*
- *Global Food Price Monitor*
- *FAO Rice Market Monitor*

Exposure

Crop Valuation

Global Scale

GAEZ – Actual Yield and Production/Crop production value/



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.

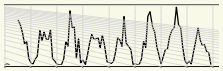
GEOGLAM is the Group on Earth Observations Global Agricultural Monitoring Initiative. Its objective is to provide AMIS with an international and transparent multi-source, consensus assessment of crop growing conditions and status, and agro-climatic conditions, likely to impact global production.

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

Vulnerability

HAZARD

Historic records



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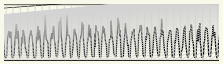
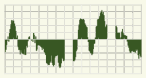


Station's drought indicator



Duration
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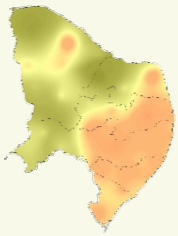
Identify regional drought events

Integrated hazard maps



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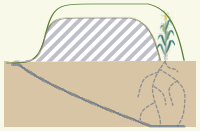

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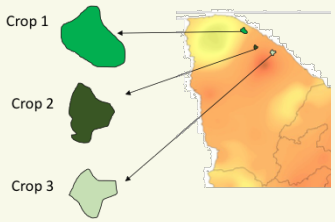

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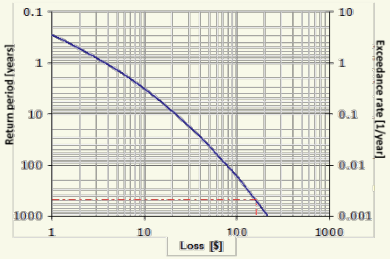
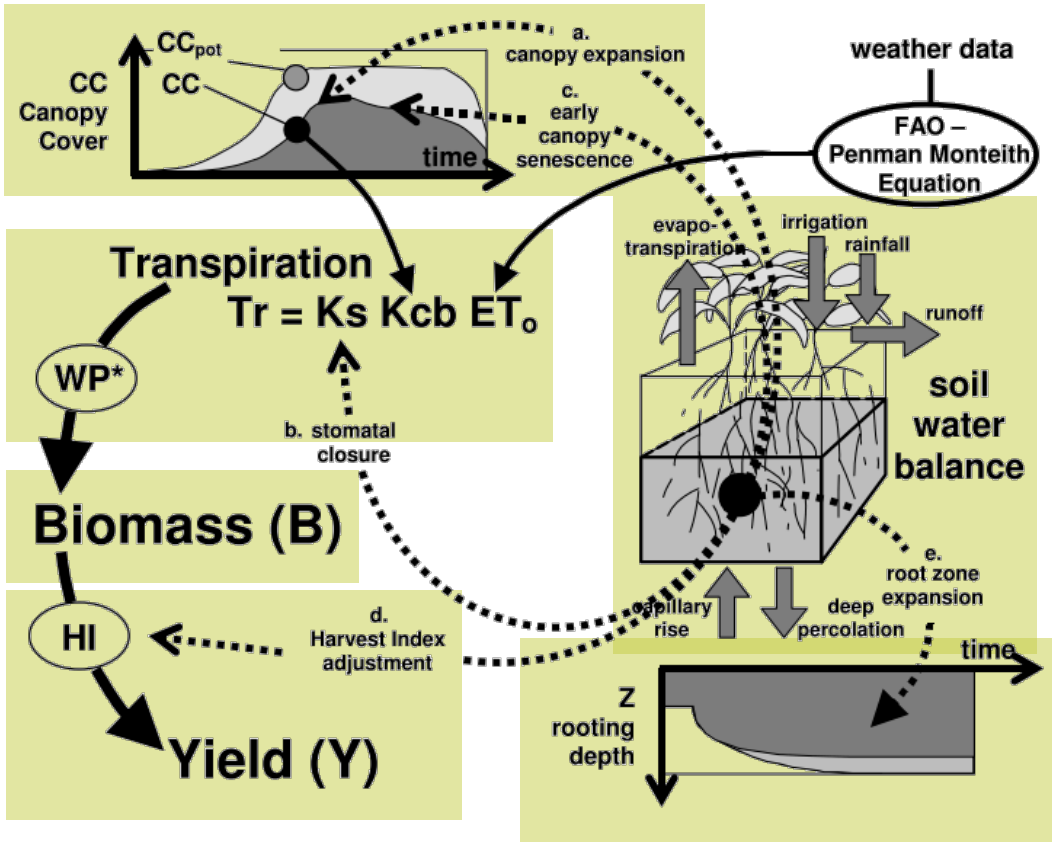


- Average annual loss (AAL)
- Probable maximum loss (PML)
- Risk maps

Vulnerability

5-steps process

- Soil water balance
- Crop development
- Crop transpiration
- Biomass production
- Yield (Y) from biomass (B)



Crop Vulnerability

Inputs

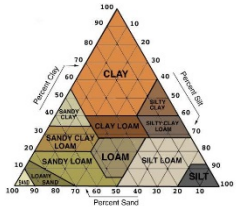
Climate

Data from hazard modelling:
Air temperature, rainfall, ETo, CO_2

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, ETo, 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

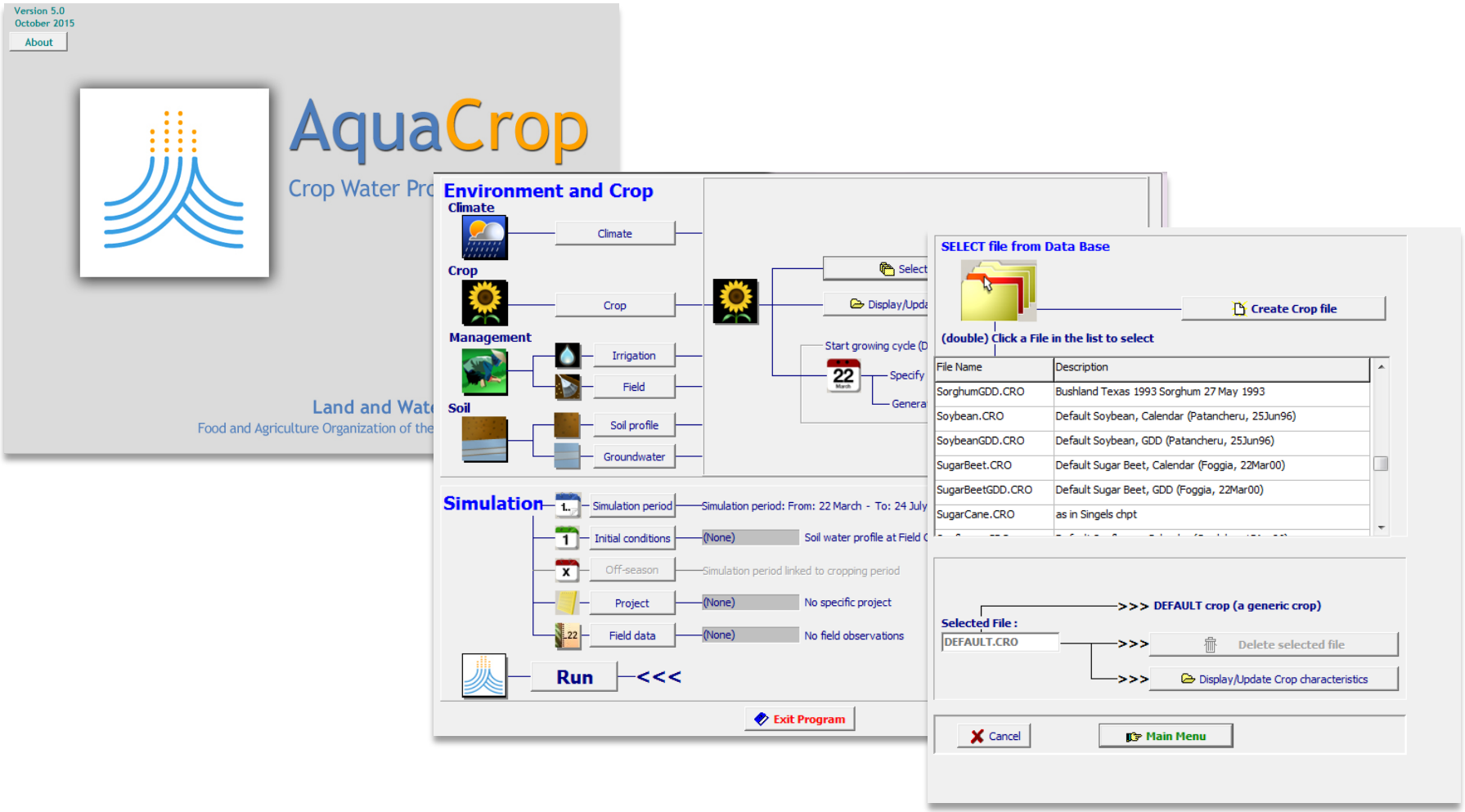
Crop characteristics

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



AquaCrop

Crop Water Productivity Model

Herbaceous Crops

Wheat
Rice
Maize
Soybean
Sorghum
Cotton
Sunflower
Sugarcane
Potato
Tomato
Sugar Beet
Alfalfa
Bambara Groundnut
Quinoa
Tef

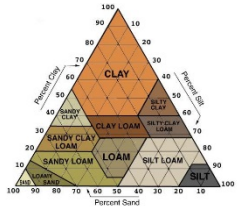
Fruit Trees and Vines

Olive
Citrus
Apple
Plum
Almond
Pear
Peach
Walnut
Pistachio
Apricot
Avocado
Sweet cherry
Grapevine
Kiwifruit

Crop Vulnerability

Soil type

Soil profile



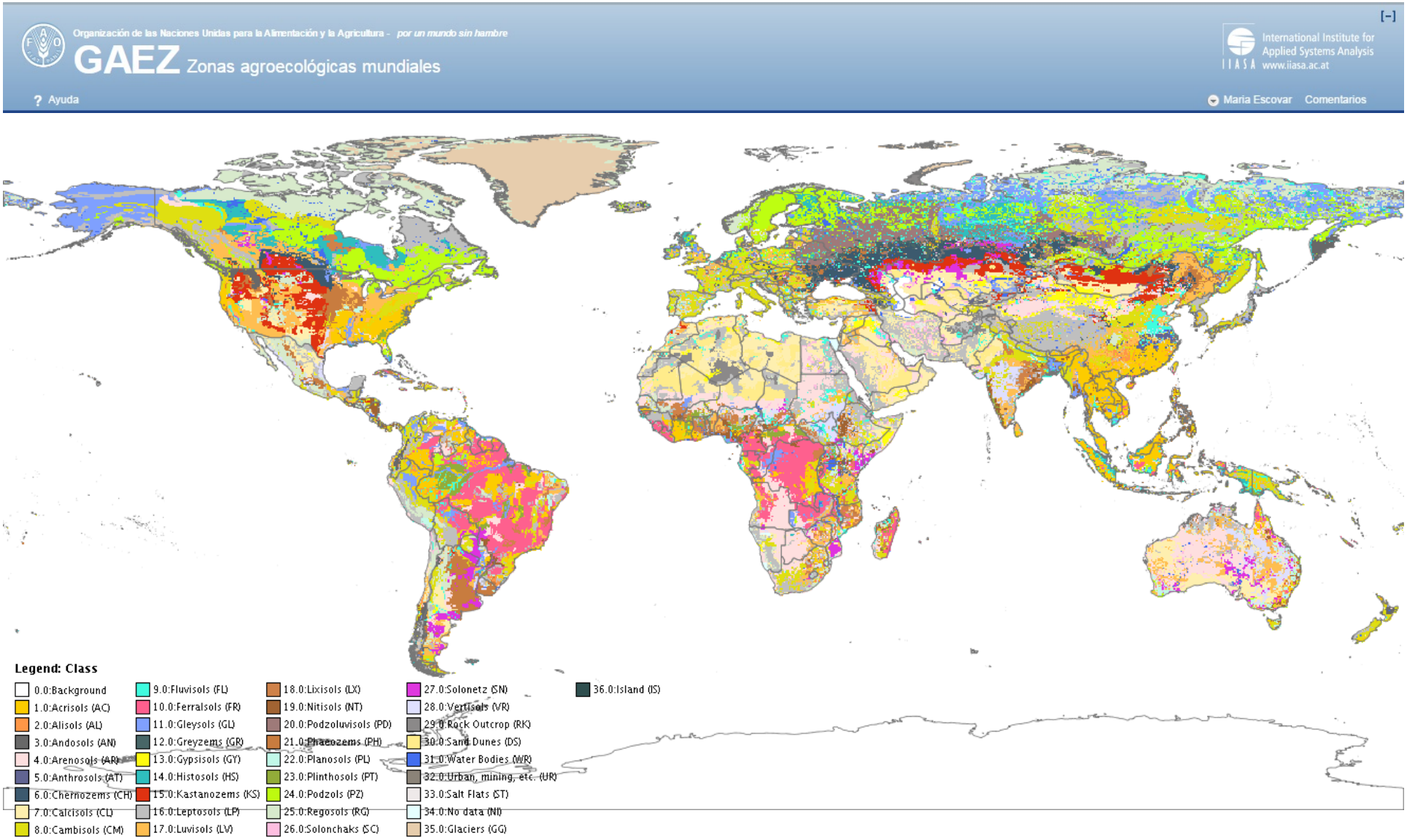
Soil horizons, soil surface, restrictive layers, capillary rise

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/



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