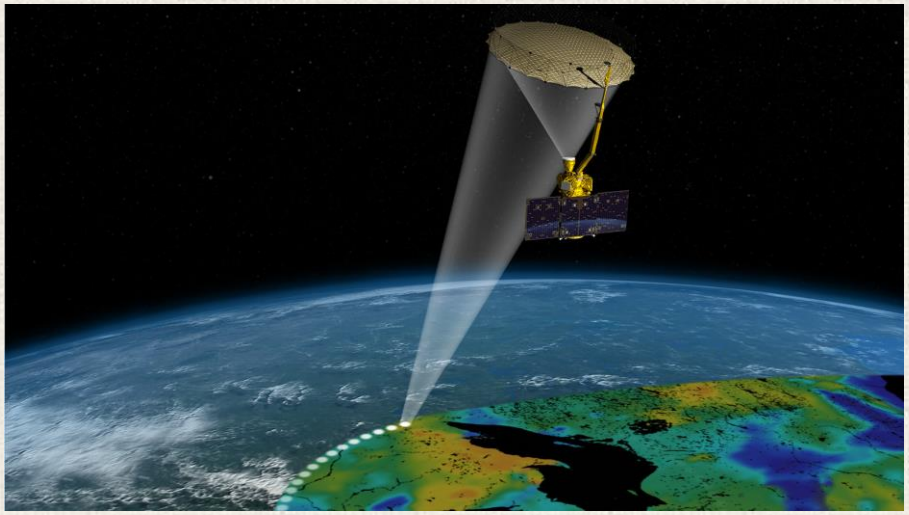
Geospatial Technology for emergencies and humanitarian aid: experience from FAO's work



Mobilise project workshop,
27-28 February 2018, Sri Lanka

Lorenzo De Simone, PhD (Information Technology Officer, CIO)
Credits to Shukri Ahmed, Oscar Rojas and Samuel Varas (FAO)

CONTENTS:

- Challenges faced in food and agriculture sector
- Intelligence required by various government organizations to make sound decisions
- Examples and Experiences from FAO Projects
- FAO current technology platform (current & future)

Some facts about FAO and Geospatial

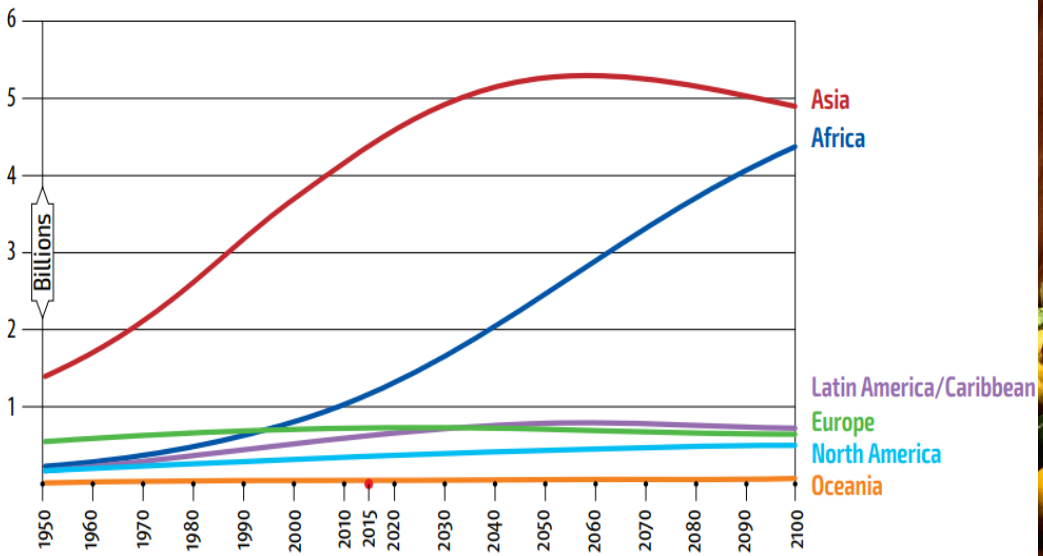
- More than 40years of experience in remote sensing and GIS
- Projects implemented in over 130 countries worldwide
- Applications in monitoring of Natural Resources, Agriculture and Emergency
- Member of preeminent geospatial international bodies: UN-GGIM, GEO
- Partnerships with Space Agencies such as NASA, ESA
- Partnership/collaborations with technology providers (e.g. Google, Amazon, Alibaba, Telefonica, ESRI, etc.)

Global trends are influencing food security, poverty and the overall sustainability of food and agricultural systems.

1 - Population growth, pressure on agriculture and changes in dietary demands:

- The world's population is expected to grow to almost 10 billion by 2050, boosting agricultural demand by some 50 percent compared to 2013.

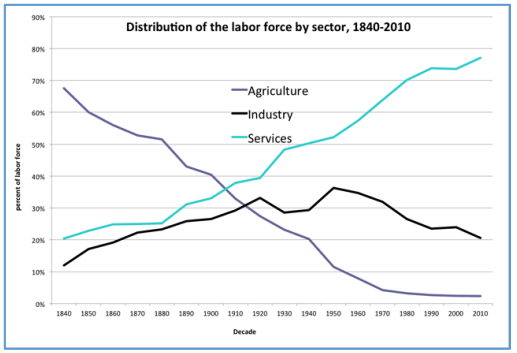
Figure 1.2 Population growth to 2100, by region (medium variant)



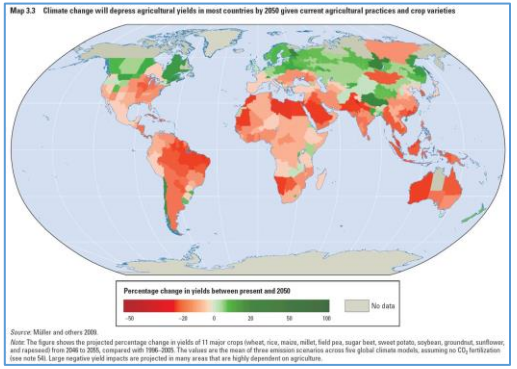
Source: UN, 2015.

Economic growth and population dynamics are driving the structural change of economies.

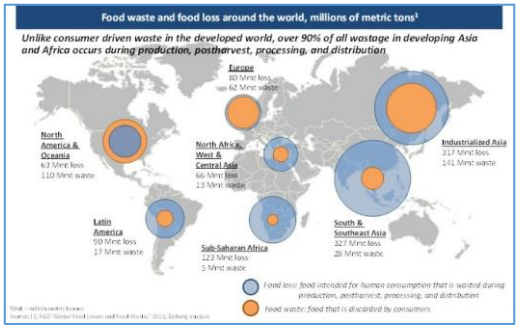
- The decline in the share of agriculture in total production and employment is taking place at different speeds and poses different challenges across regions.



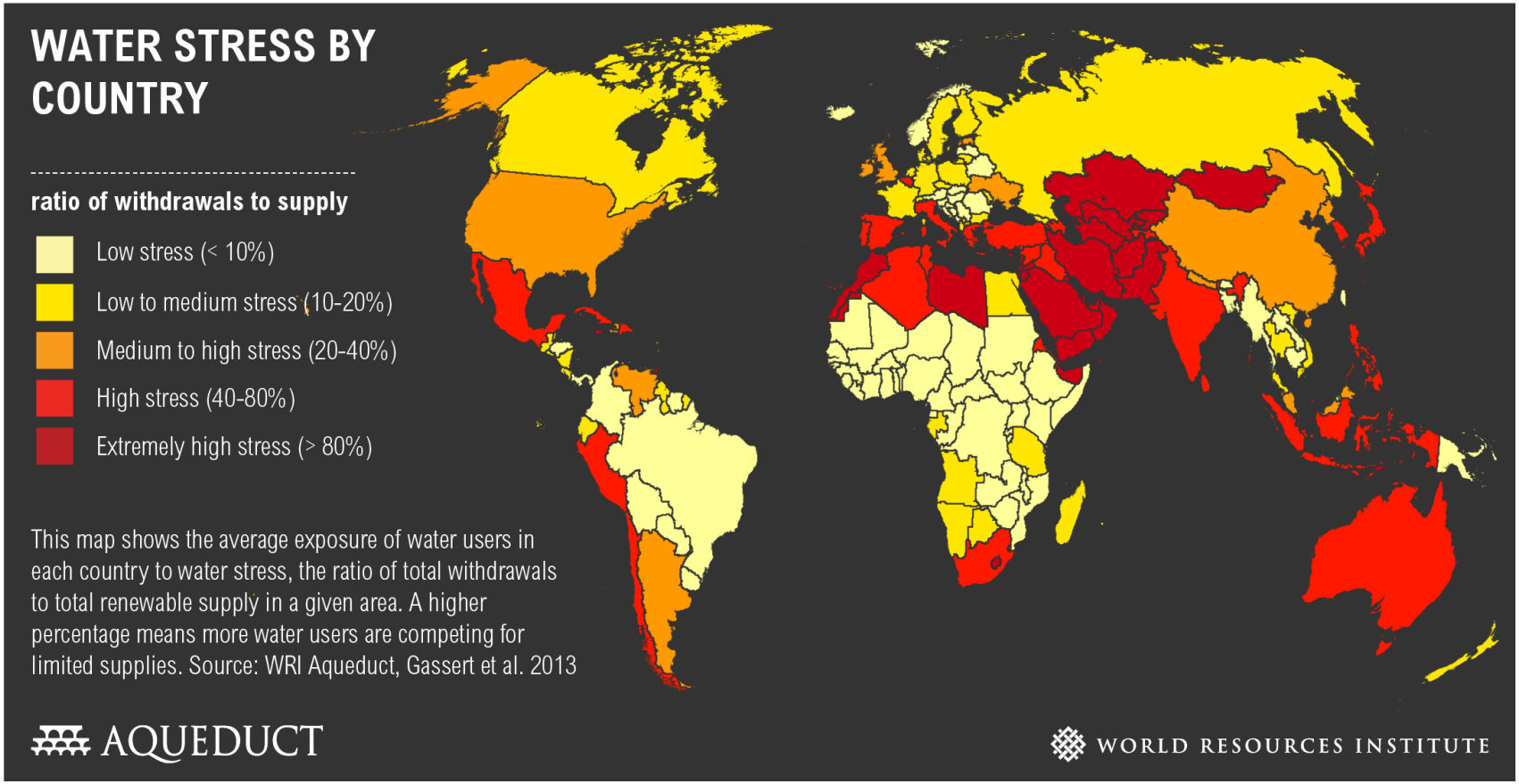
- Although agricultural investments and technological innovations are boosting productivity, growth of yields has slowed to rates that are too low for comfort and will further decrease as a result of CC impacts, with an increase on market prices



- Food losses and waste claim a significant proportion of agricultural output, and reducing them would lessen the need for production increases.



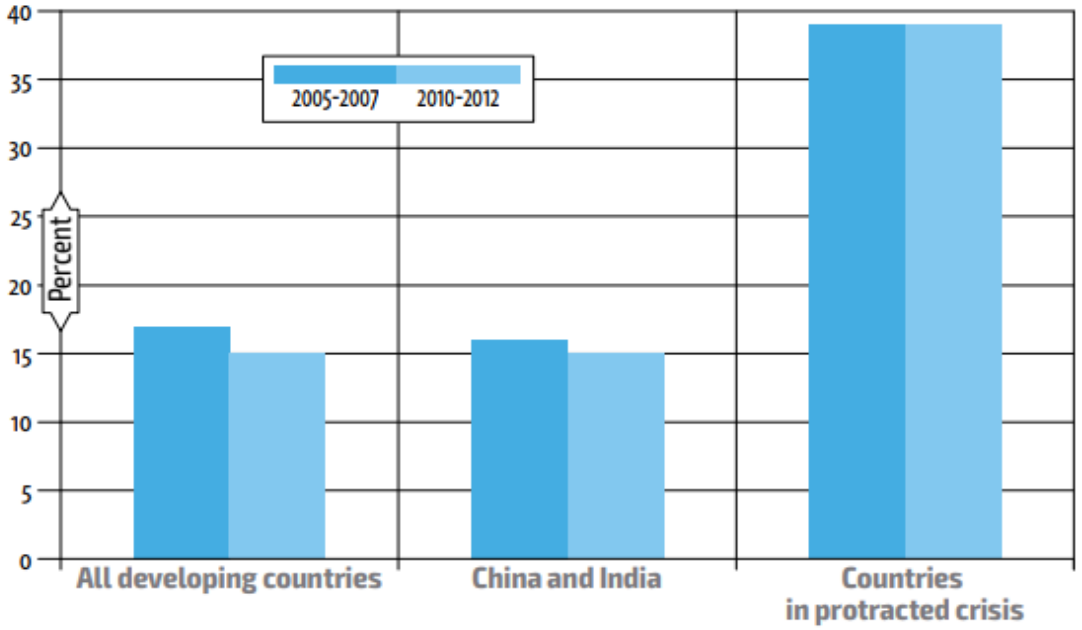
Climate change affects disproportionately food-insecure regions, jeopardizing crop and livestock production, fish stocks and fisheries.



- Competing demands from agriculture, industry and cities, major river basins now face water scarcity

Natural disasters, conflicts, and crises are increasing in number and intensity

Figure 7.1 Prevalence of undernourishment and protracted crises



Source: FAO, IFAD and WFP, 2015, p.37.

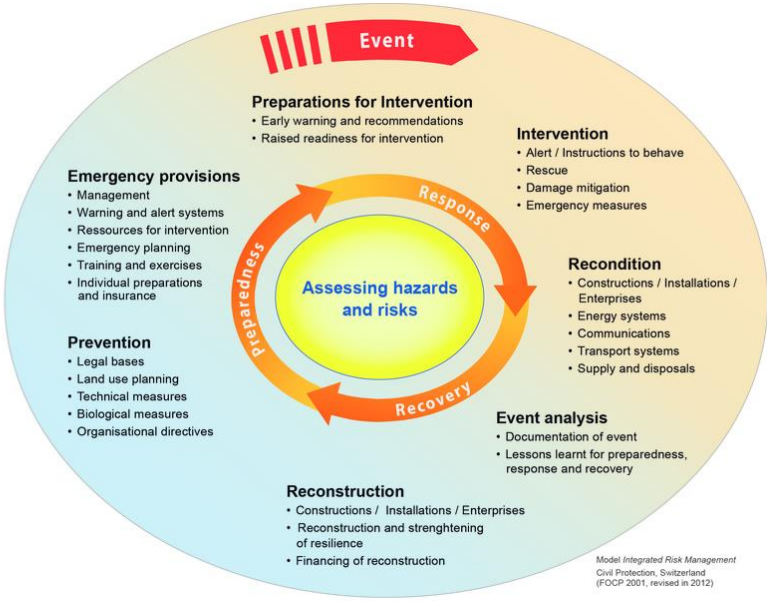
- Violent conflict also frequently characterizes protracted crises. On average, the proportion of undernourished people living in low-income countries with a protracted crisis is between 2.5 and 3 times higher than in other low-income countries.

Change in Components of Food Security:

- *Food availability*
- *Food accessibility*
- *Food utilization*
- *Food system stability*

Geospatial and DRR: Challenges and International context

- **integrated analysis of hazards, risks linked** with **land use, livelihoods planning, natural resource management**.
- **Baseline** risks/impacts/exposure; **monitor** progress over time and **forecast** scenarios
- **Data fusion** from different sources, and different time/space resolution.
- **Data Analytics** - automatic and robust
- **Real-time** risk status update



- International context:
  - The **World Humanitarian Summit** has underscored the need to shift from reactively managing crises to proactively reducing risks and that planning, financing and decision-making should be underpinned by data and common risk analysis.

  - The **Sendai Framework for Disaster Risk Reduction** has also recognized the need to increase the utilization of modern geospatial technologies and help promote better understanding of risks.

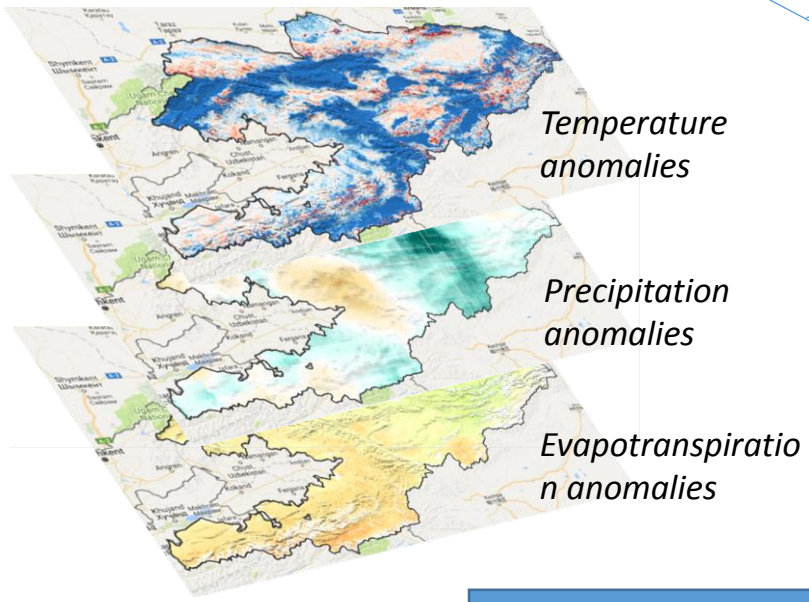
Examples of FAO's work in developing geospatial solutions for DRR and experiences from the field

- *Earth Map*
- *GIS Participatory assessment for conflict resolution support*
- *ASIS: Global and National implementation, drought monitoring and forecasting*
- *GAEZ: Global Agro Ecological Zoning – Land resources monitoring*
- *Myanmar Drones project*
- *Philippines Drones project*
- *Google Earth Engine partnership and applications: Locust watch and RVF watch*
- *Telefonica Partnership*

Climate Risk and Vulnerability Analysis and Mapping

- Availability of Google Technologies
- FAO data and technical knowledge
- Needs for support to formulation of project proposals with spatially explicit analysis
- Easy access to data and analysis for FAO users

Example Kyrgyzstan



\+

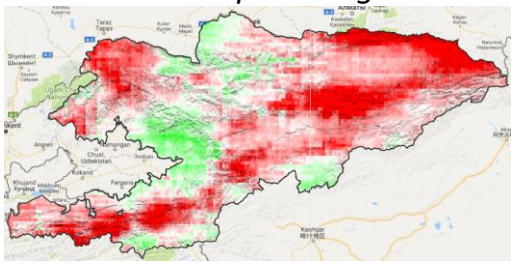
… other variables

Earth Map

Food and Agriculture Organization of the United Nations

Vulnerability Map

ex. to natural pasture growth



Red: high impact of climate

Green: low impact of climate

Climate Risk and Vulnerability Analysis and Mapping

- Availability of Google Technologies
- FAO data and technical knowledge
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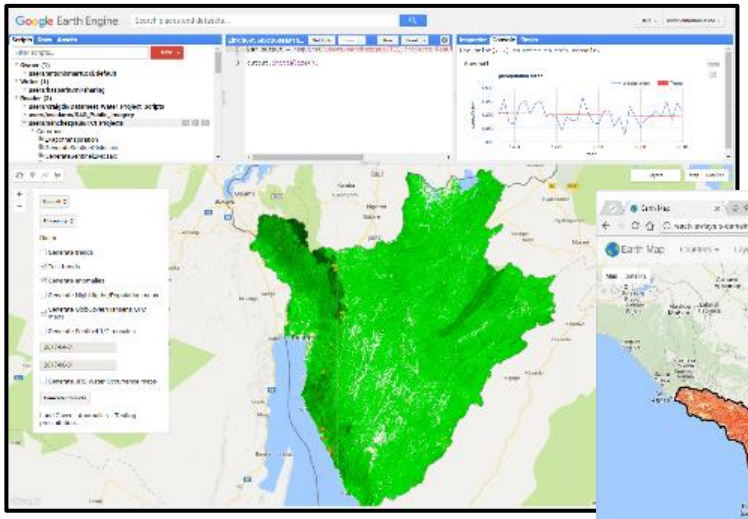
Data generation interface

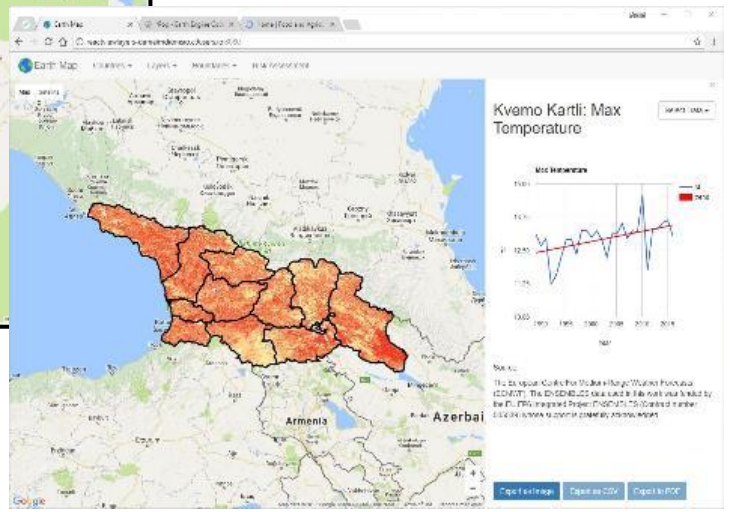


Google Earth Engine

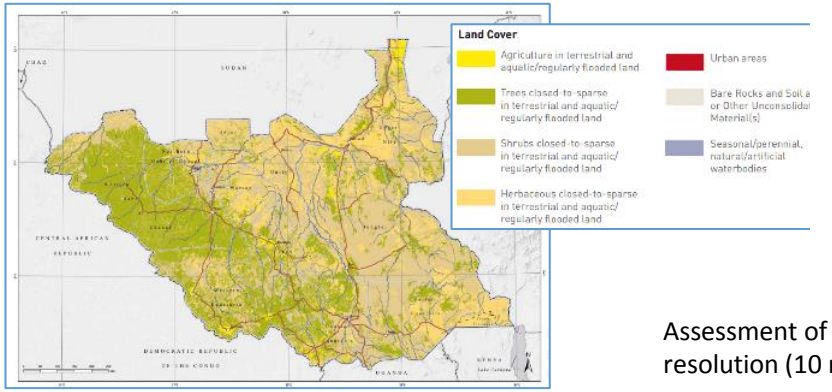
Earth Map

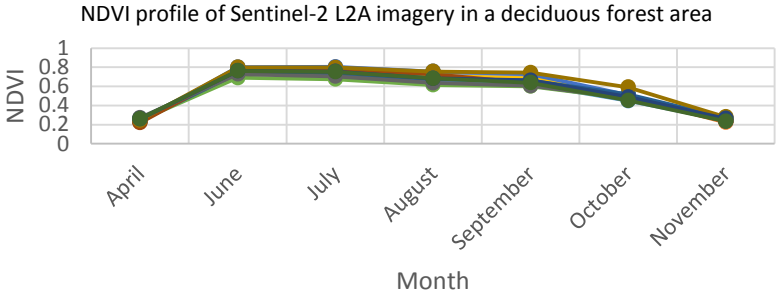
Food and Agriculture Organization of the United Nations

Data visualization console

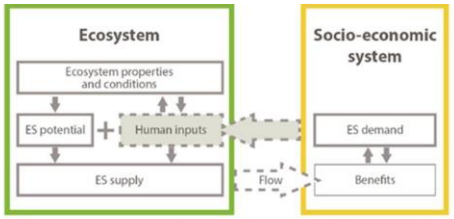


GIS Participatory assessment of natural resources to support conflict mitigation strategies – The case of South Sudan





Assessment of natural resources will be undertaken by multi-temporal high-resolution (10 m) satellite imagery.



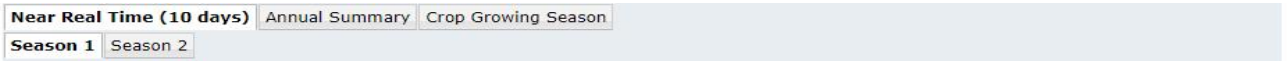
The territory is seen as a *social system* interacting with and depending on an *ecological substrate* whose survival depends on the connections and feedbacks linking both systems

Agricultural Stress Index ASIS: identification of areas of cropped land with a high likelihood of water stress (drought)

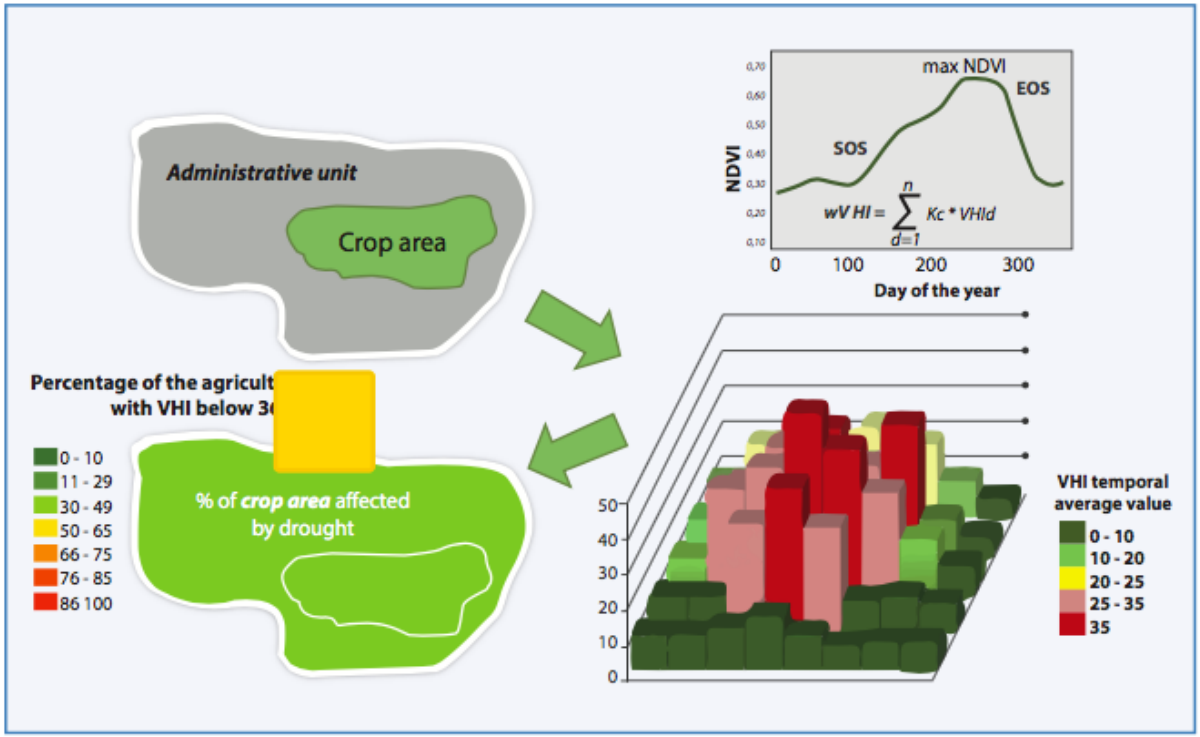
(Credits: Oscar Rojas FAO)

What ASIS is?

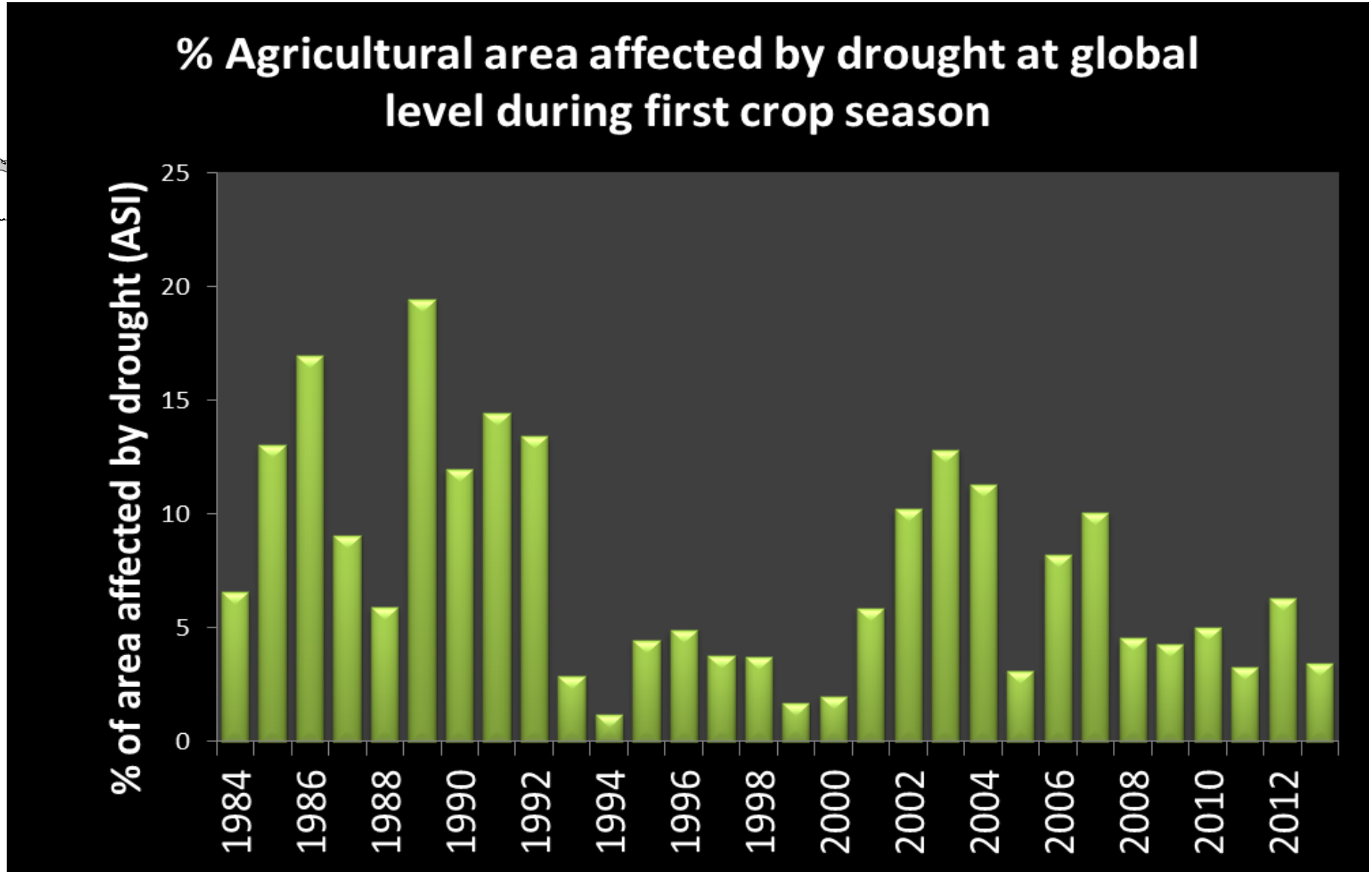
Is a expert system for agricultural drought monitoring based on 10-day satellite data of vegetation and land surface temperature from METOP-AVHRR sensor at 1 km.



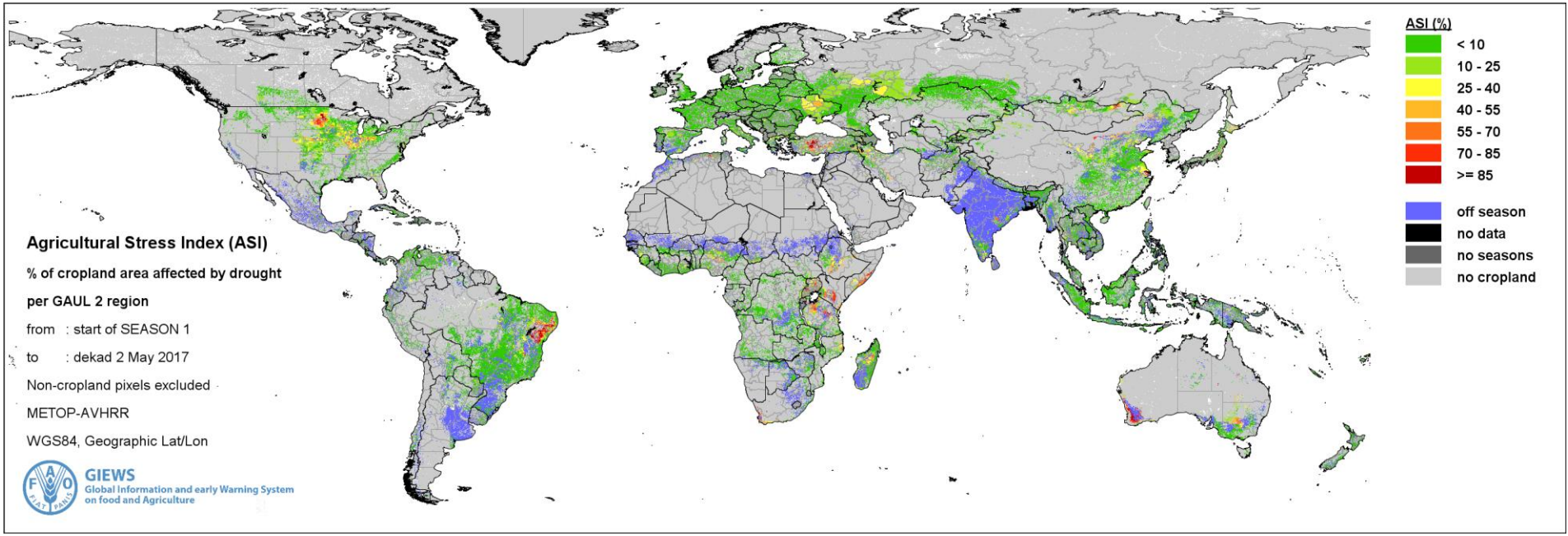
- Step2 **Calculation of the percentage of agricultural area affected by drought**
  - (pixels with VHI<35 – a value identified as critical in previous studies) to assess the spatial extent of the drought. Finally, the whole administrative area is classified according to the percentage of affected area.



ASIS Global monitoring



Near real time monitoring at global level (every 10 days)



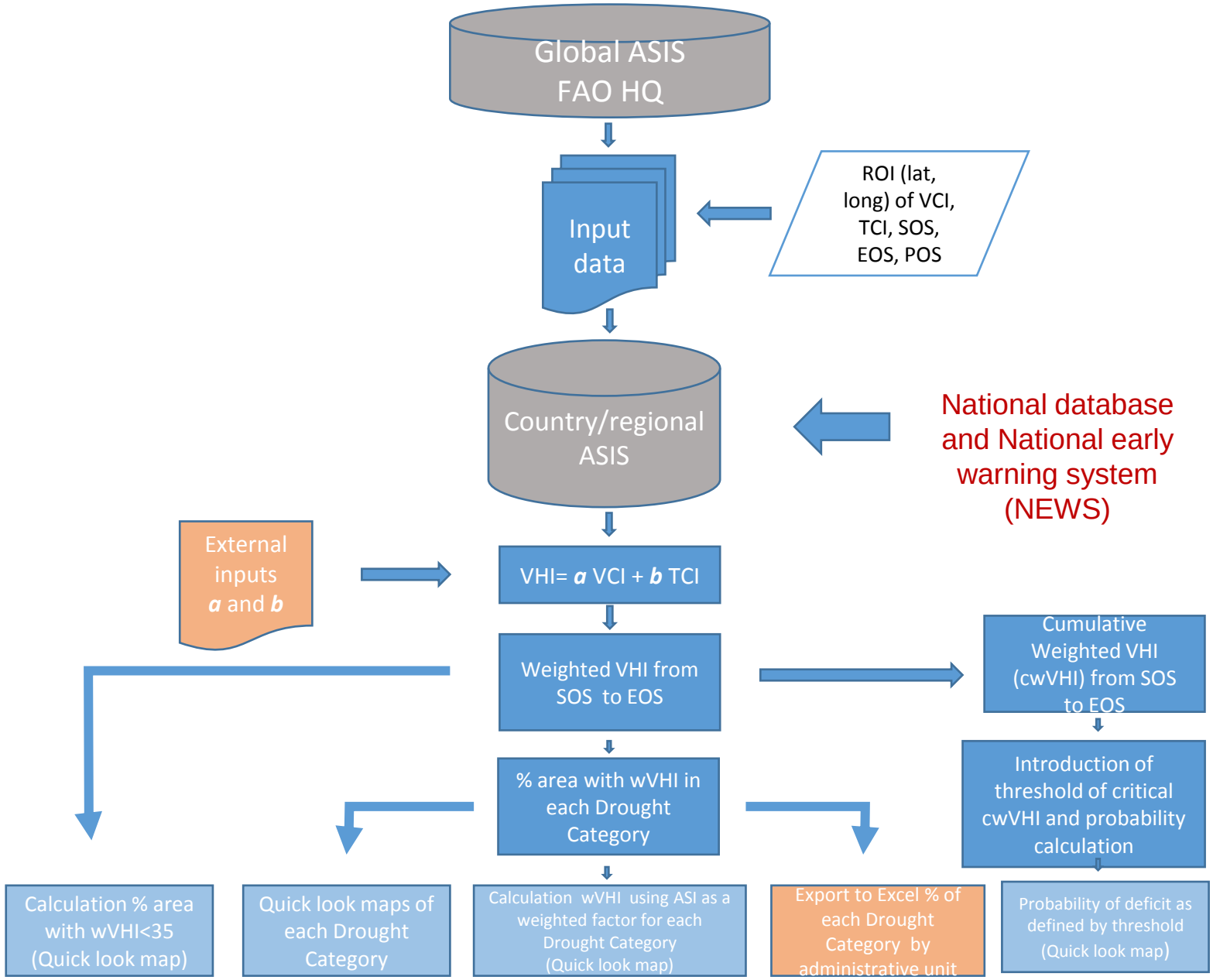
http://www.fao.org/giews/earthobservation

Country level ASIS

- Locally Implemented

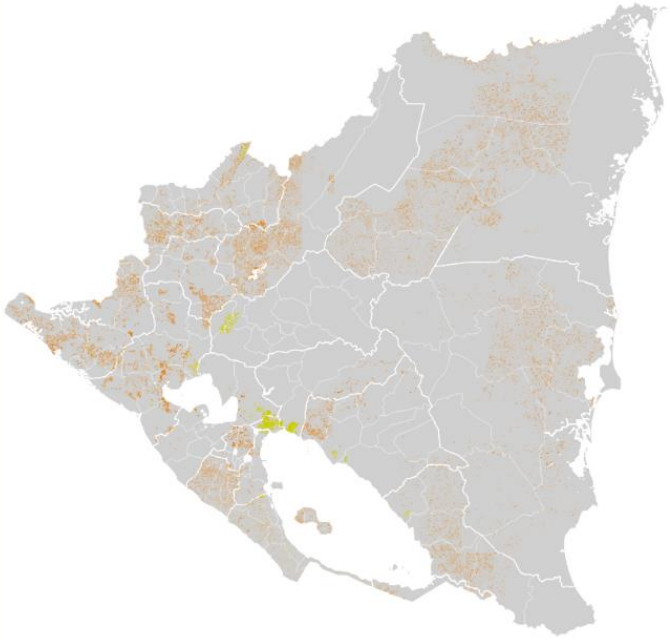
- Tool is calibrated with yield information (current land use maps, sowing dates, length of the crop cycle and crop coefficients)

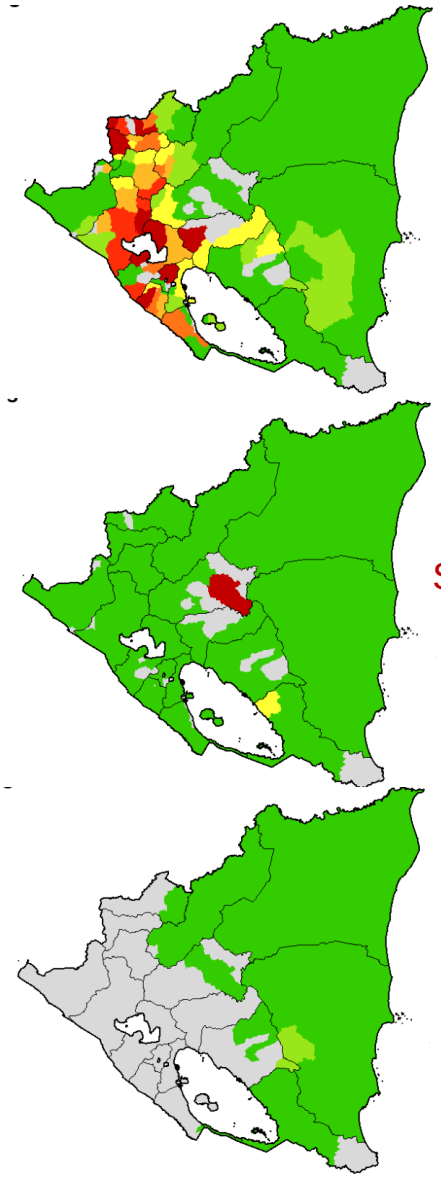
- More precise results regarding the water stress periods for different crops than the global tool.


Global ASIS
FAO HQ
Input data
ROI (lat, long) of VCI, TCI, SOS, EOS, POS
Country/regional ASIS
National database and National early warning system (NEWS)
External inputs *a* and *b*
VHI= *a* VCI + *b* TCI
Weighted VHI from SOS to EOS
Cumulative Weighted VHI (cwVHI) from SOS to EOS
Introduction of threshold of critical cwVHI and probability calculation
% area with wVHI in each Drought Category
Calculation % area with wVHI<35 (Quick look map)
Quick look maps of each Drought Category
Calculation wVHI using ASI as a weighted factor for each Drought Category (Quick look map)
Export to Excel % of each Drought Category by administrative unit
Probability of deficit as defined by threshold (Quick look map)

Calibrated ASIS for Nicaragua

Land used study
(rice, maize and beans)



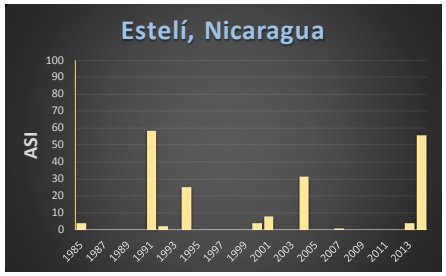


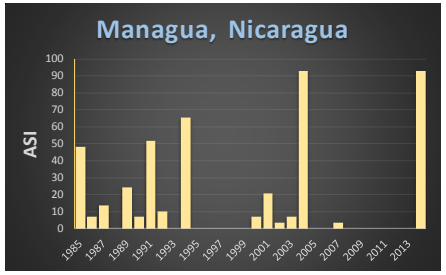
First crop season
(Primera)

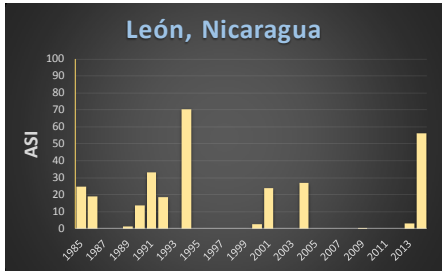
Second crop season
(Postrera)

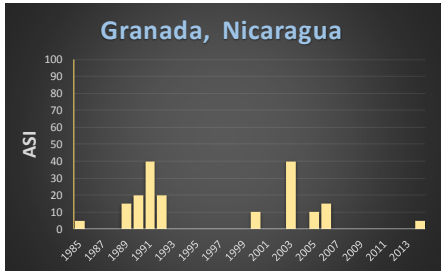
Third crop season
(Apante)

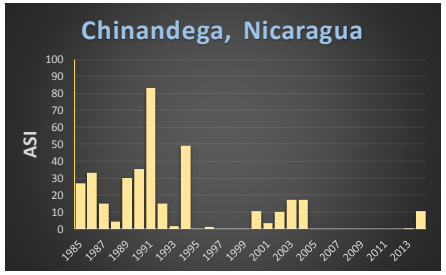
Credits Oscar Rojas)

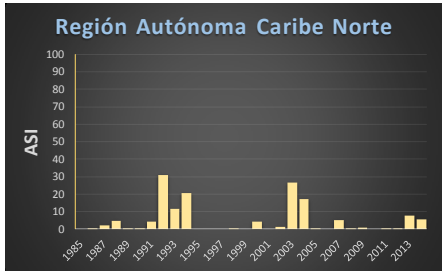

Estelí, Nicaragua
ASI

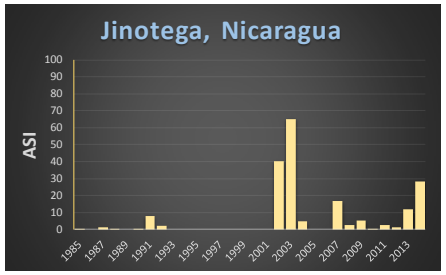

Managua, Nicaragua
ASI


León, Nicaragua
ASI


Granada, Nicaragua
ASI


Chinandega, Nicaragua
ASI


Región Autónoma Caribe Norte
ASI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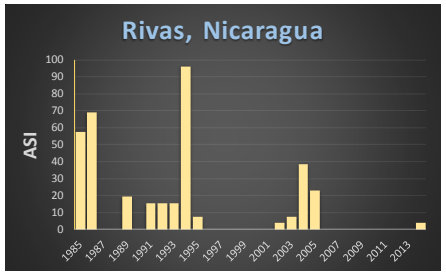
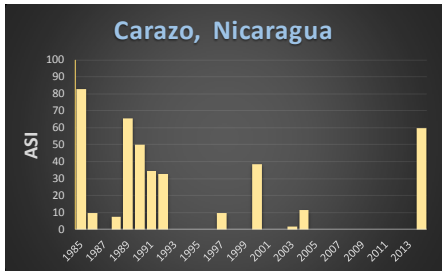
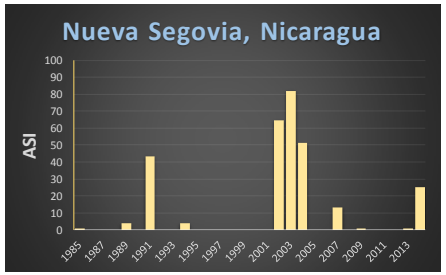
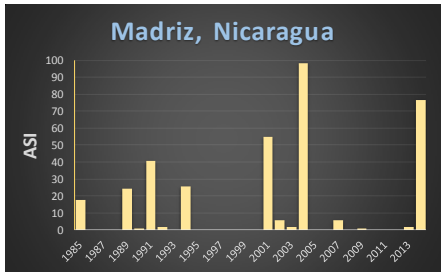
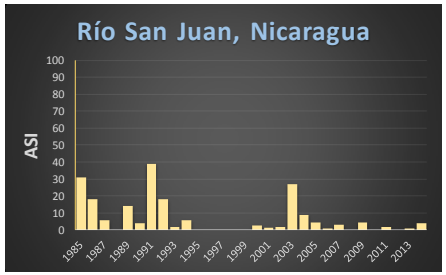
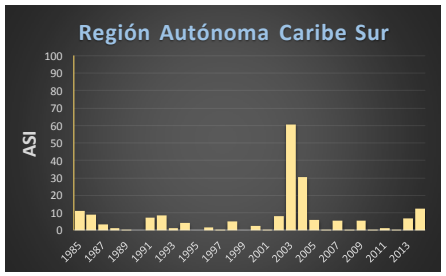

Rivas, Nicaragua
ASI

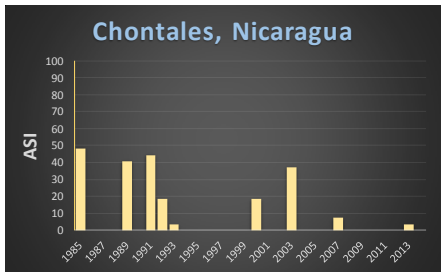

Carazo, Nicaragua
ASI

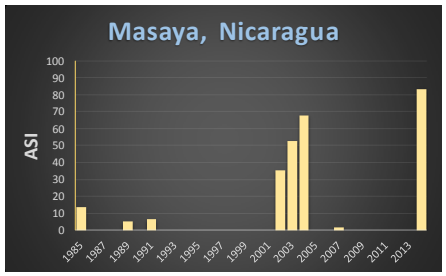

Nueva Segovia, Nicaragua
ASI


Madriz, Nicaragua
ASI

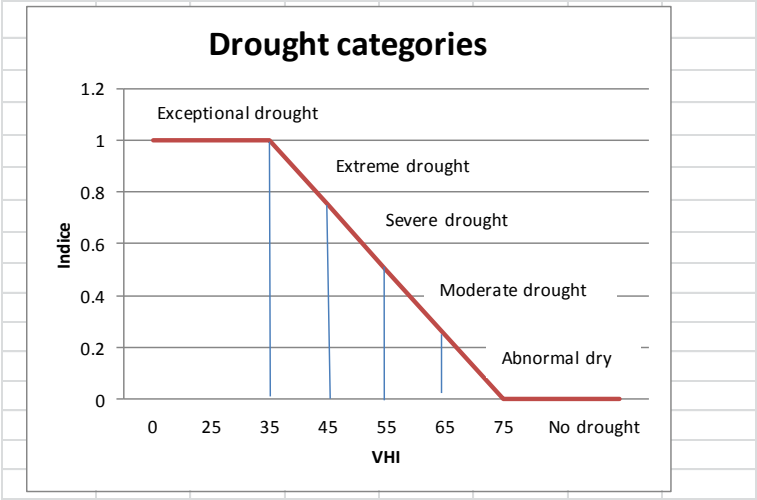

Río San Juan, Nicaragua
ASI


Región Autónoma Caribe Sur
ASI


Chontales, Nicaragua
ASI

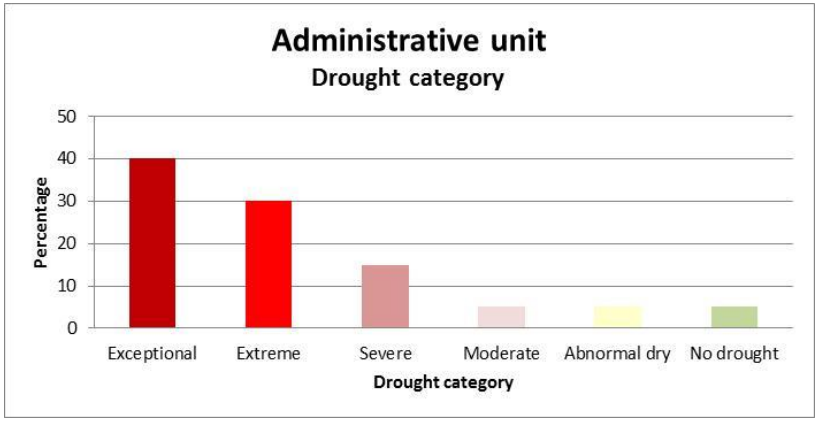

Masaya, Nicaragua
ASI

Drought categories used in ASIS

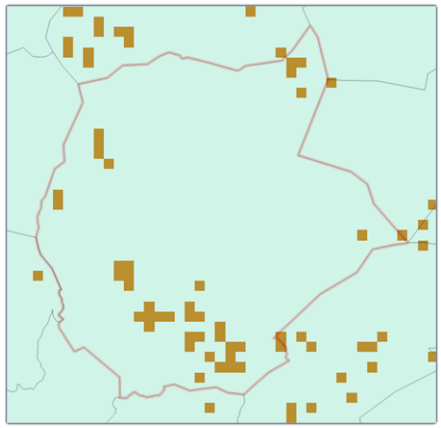


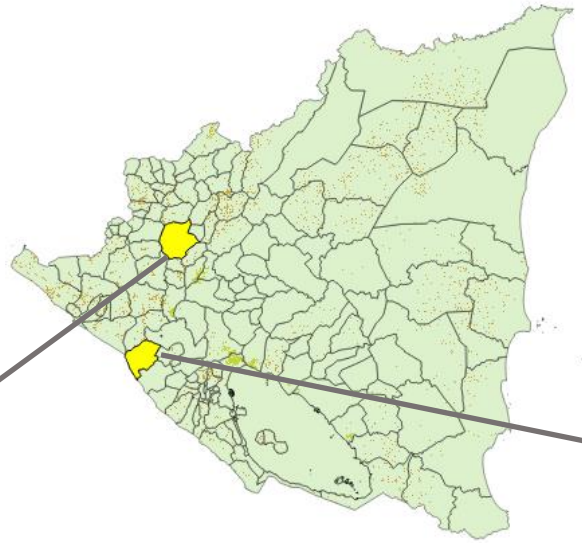
Indicator	Drought category	VHI pixel	ASI*
1	Exceptional Drought	<35	%
0.75-0.99	Extreme Drought	36-45	%
0.50-0.74	Severe Drought	46-55	%
0.25-0.49	Moderate Drought	56-65	%
0.01-0.24	Abnormal dry	66-75	%
0	No Drought	>75	%

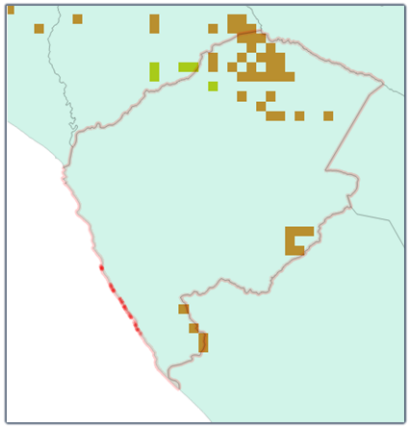
* Percentage of pixels in each drought categoy



Trigger for a indexed crop insurances based on geospatial data (1985-2014)

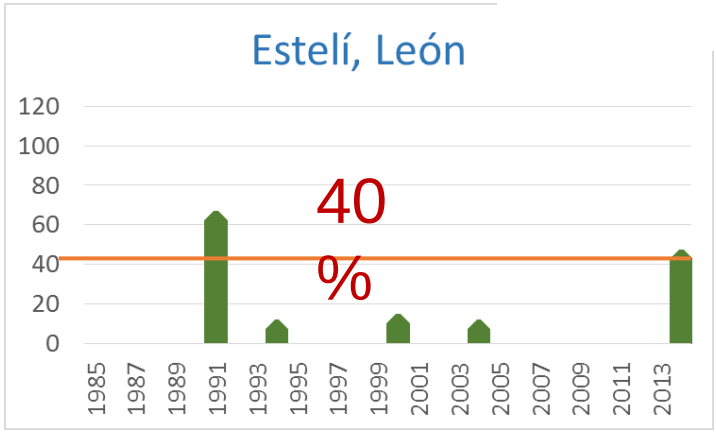


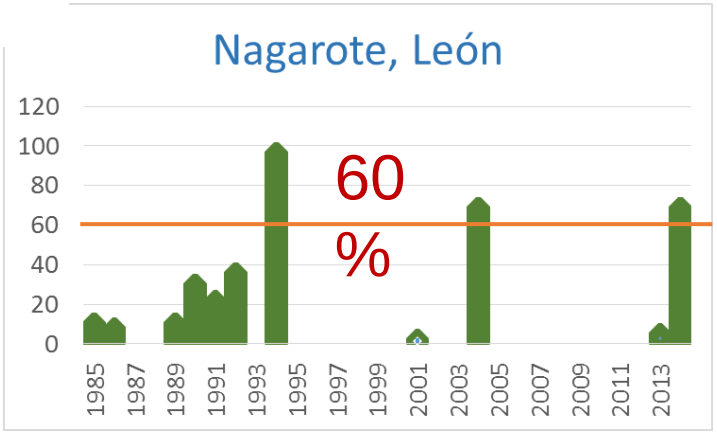




Fuente: INETER, 2017

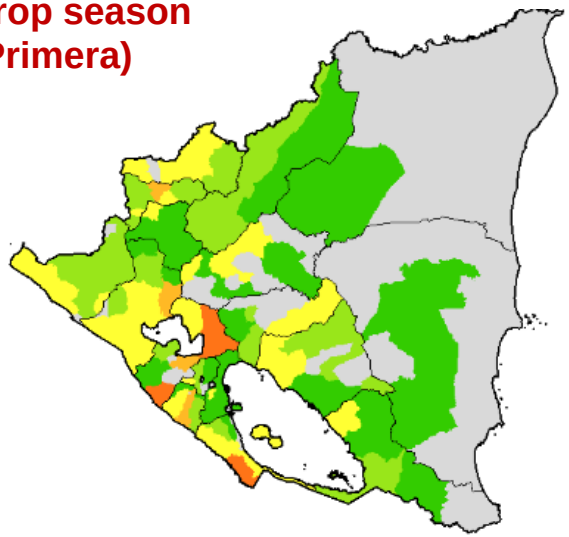
Fuente: INETER, 2017



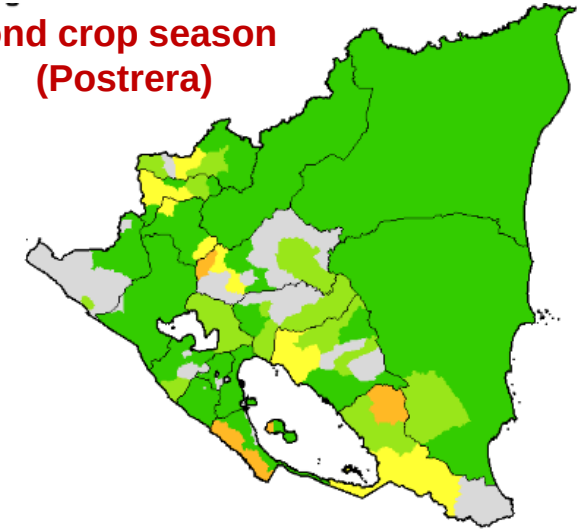


Historical probability of occurrence of >50% of grain area affected by drought during Primera, Postrera and Apante

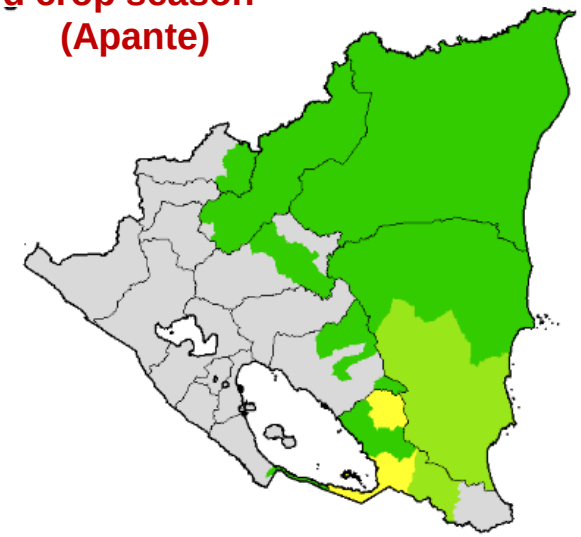
First crop season (Primera)



Second crop season (Postrera)



Third crop season (Apante)



Probability

- < 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 25
- 25 - 30
- >= 30

Syria

Crop yield model based on ASI

Figure 1: Wheat yield model in which ASI explains 87% of the yield variation

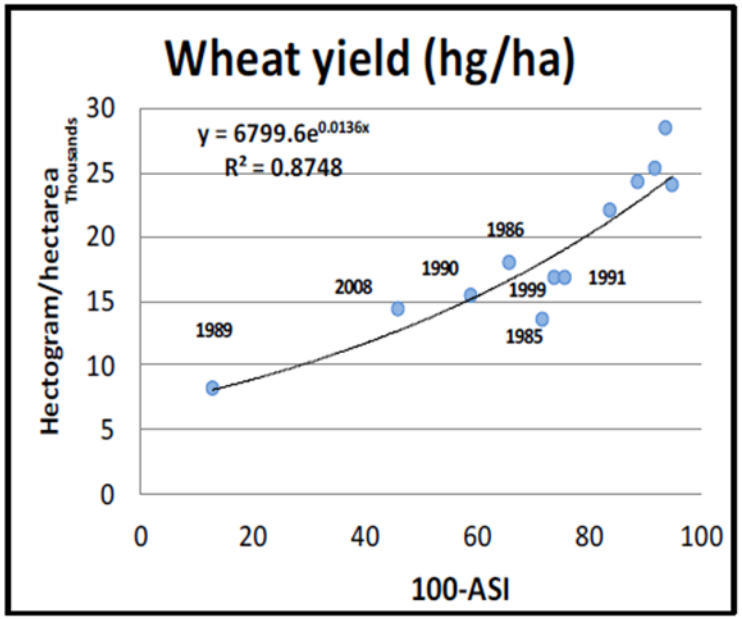
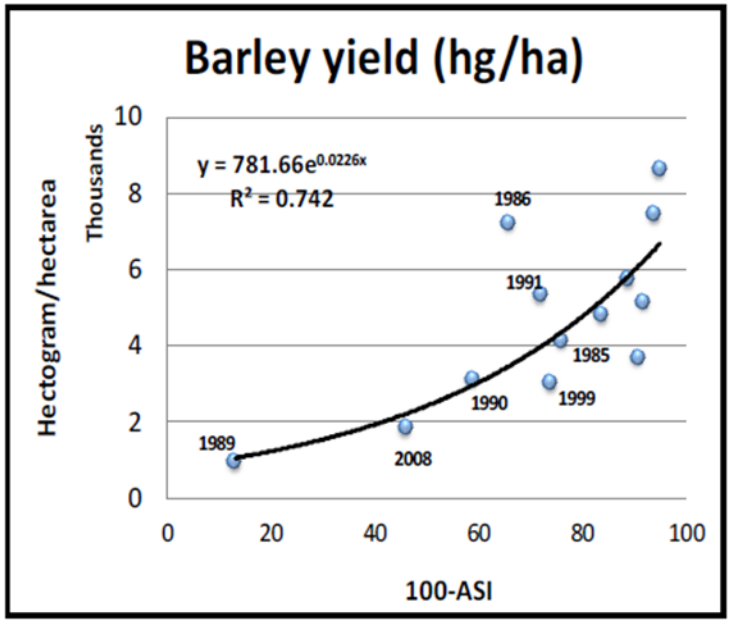
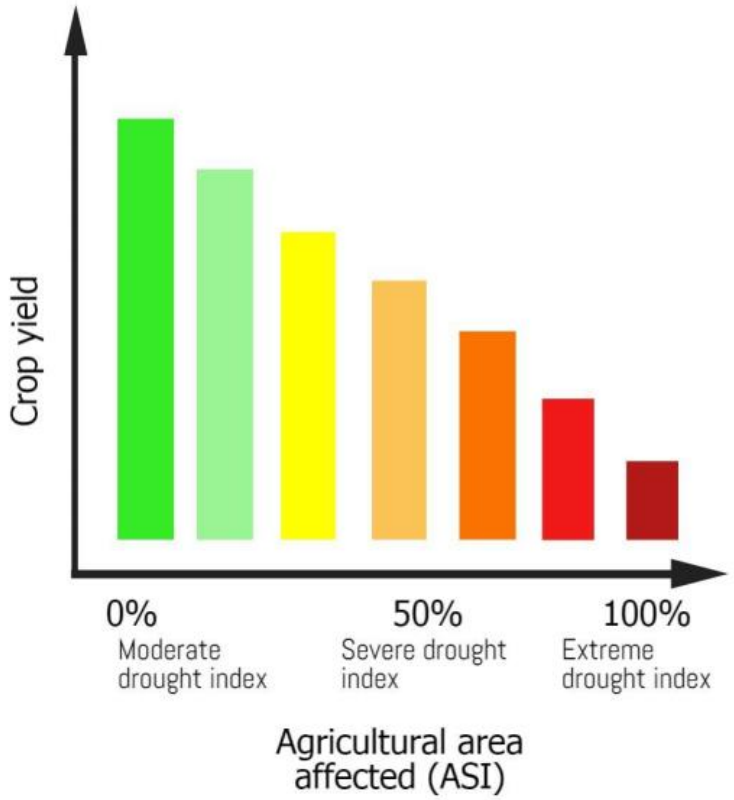


Figure 2: Barley yield model in which ASI explains 74% of the yield variation



Agroclimatic Information System for supporting decision making



Planning

- Monitoring
- Forecasting
- Public policy revision
- Investment planning

Early warning - prevention

- Dissemination
- Hazard monitoring and tracking

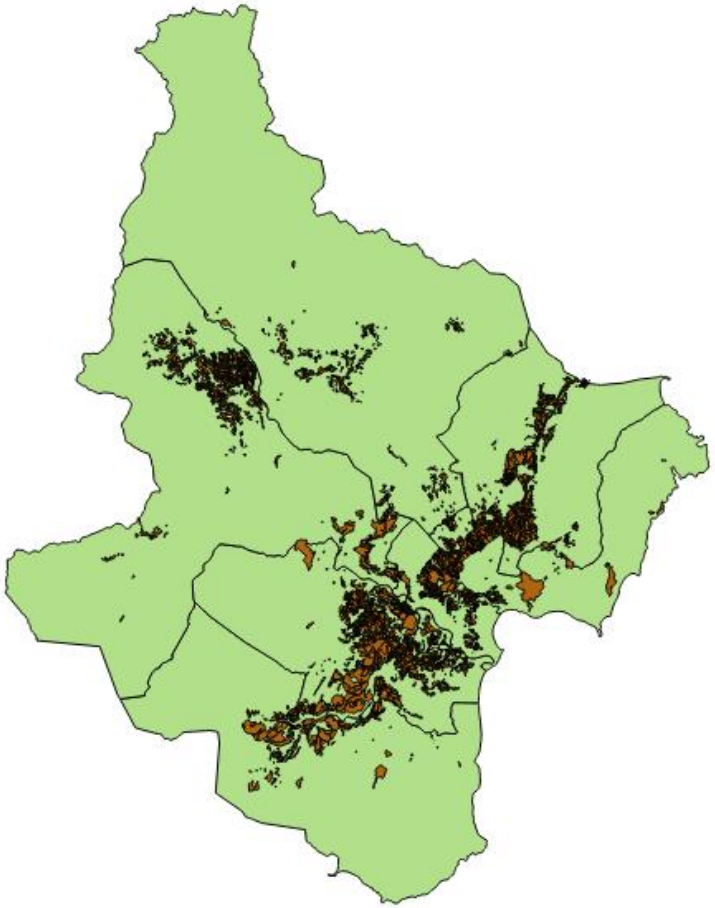
Contingency plan activation

- Risk reduction actions
- Water storage
- Drought resistent crops
- Short cycle crops

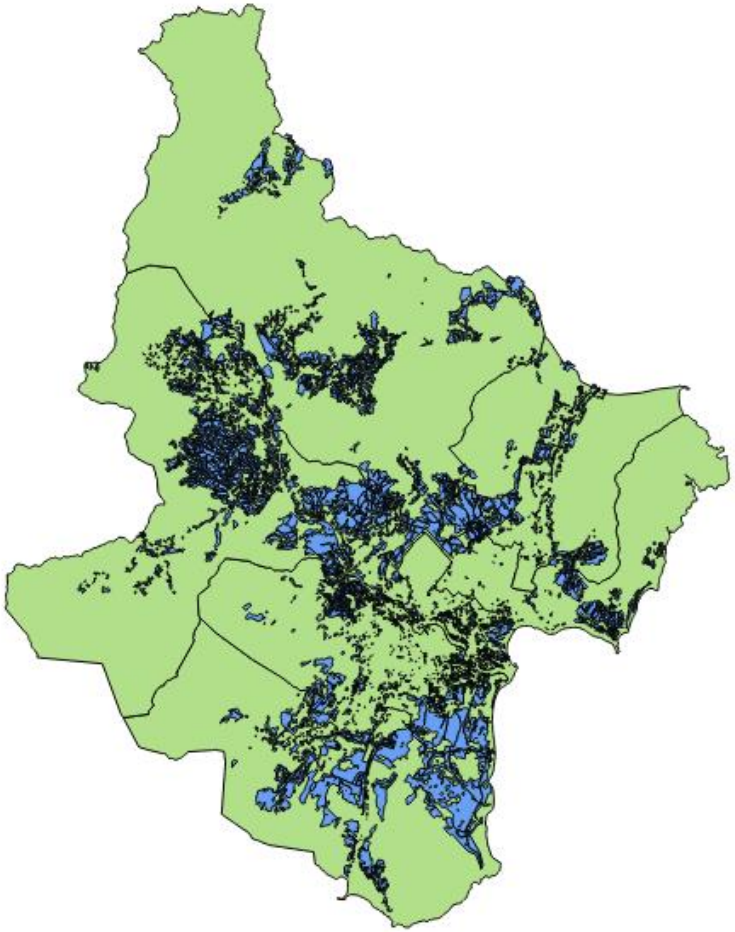
Emergency response

- Catastrophe fund implementation
- Access to contingent credit lines
- Insurance payments
- Livelihoods rehabilitation

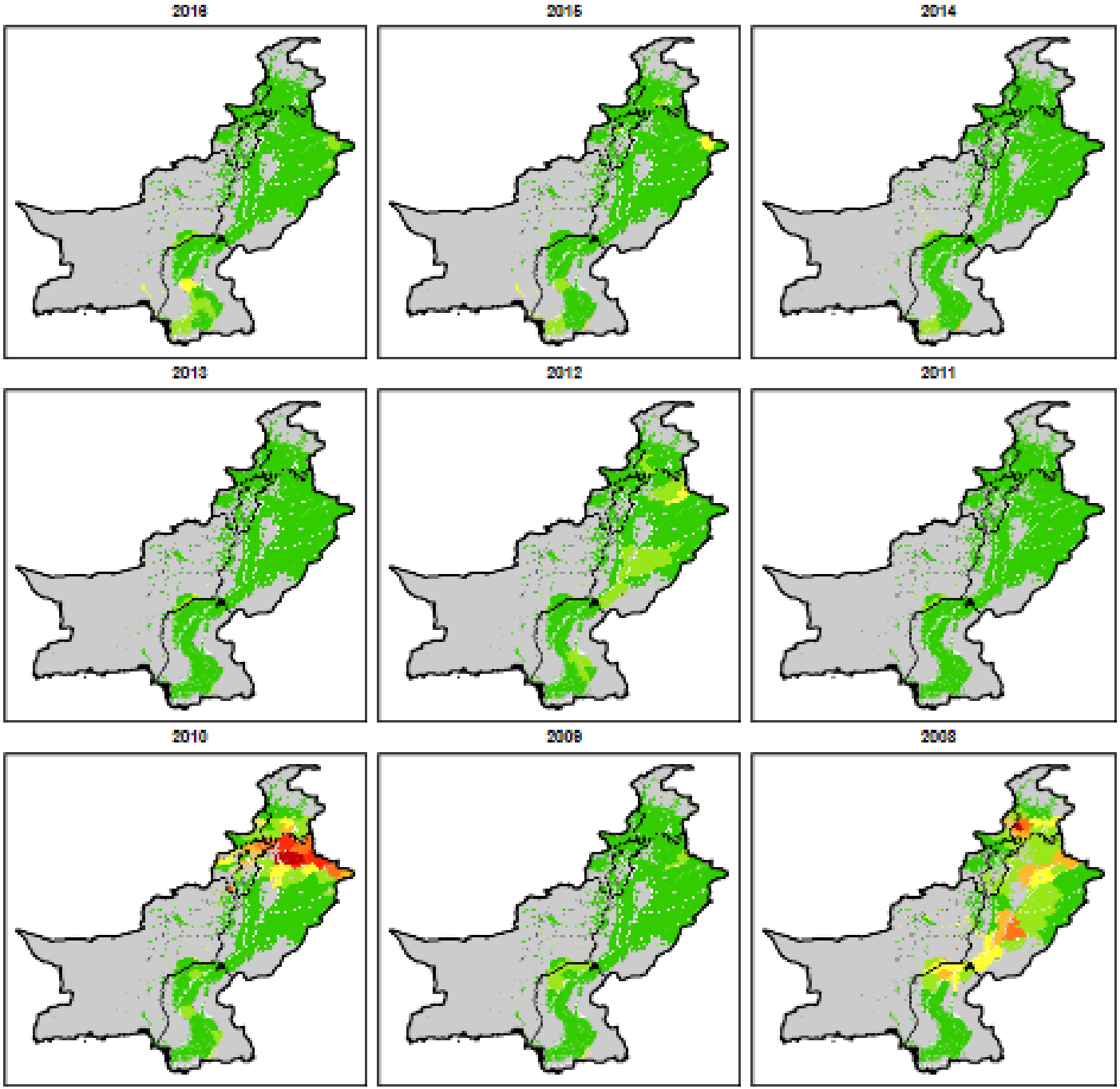
ASIS in Vietnam: Land use for Ninh Thuan province

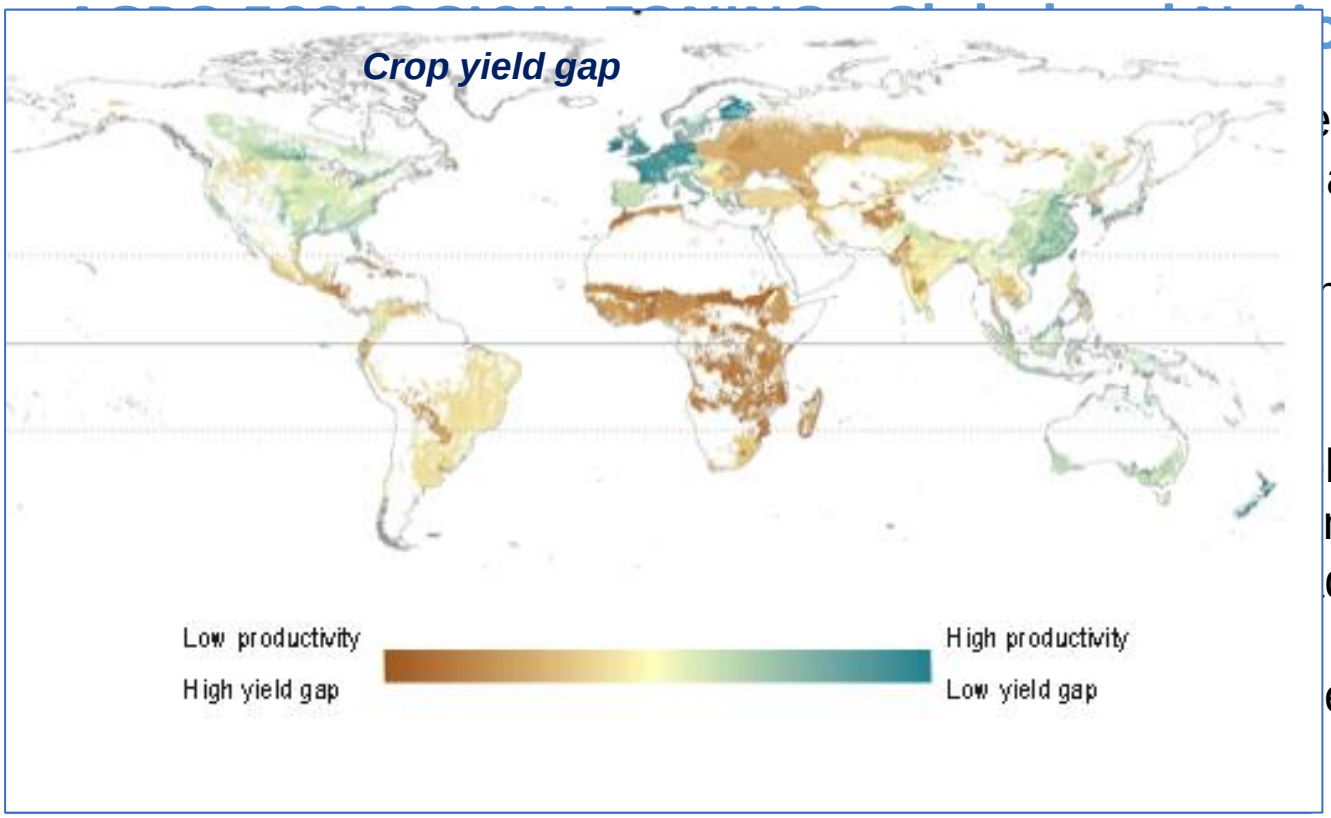


Rice



Secondary crops


2016
2015
2014
2013
2012
2011
2010
2009
2008



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Selected applications of GAEZ:

- Quantification of land productivity under current and future climate scenario, under low, medium and high inputs. 230 crops simulated
- Estimation of rain-fed or irrigated cultivation potential for food, feed, fiber, and bioenergy feedstock production
- Identification of environmental constraints to agriculture production
- Identification of potential hotspots of agricultural conversion and possible geographical shifts in agricultural land potentials due to changing climate
- Identification of areas for crop intensification
- 360.000 online spatial datasets

Myanmar and Drones Programme

- Since March 2016, FAO Myanmar has been enhancing its efforts towards strengthening government agricultural sector agencies in the areas of Disaster Risk Reduction (DRR) and Resilience, including the use of modern technologies to address existing data gaps and allow more timely and effective preparedness and response actions.

- On September 2016 and following an official request from the **Ministry of Agriculture, Livestock and Irrigation** (MOALI), **FAO** formally collaborated with the **Department of Technology Promotion and Coordination**, Ministry of Education through its **Myanmar Aerospace Engineering University (MAEU)** to explore the use of Unmanned Aerial Vehicles or Drones which, after a series of carefully structured activities, led to the institutionalization of the technology within MOALI.

- FAO is recognized as the first UN agency to utilize Drones for DRM in agriculture in Myanmar with preliminary mapping approaches and methodologies inspired from pioneering work of FAO and the Department of Agriculture in the Philippines

Key activities taken by FAO, MOALI and MAEU that resulted in the establishment of the MOALI Drone Mapping Team in 2017

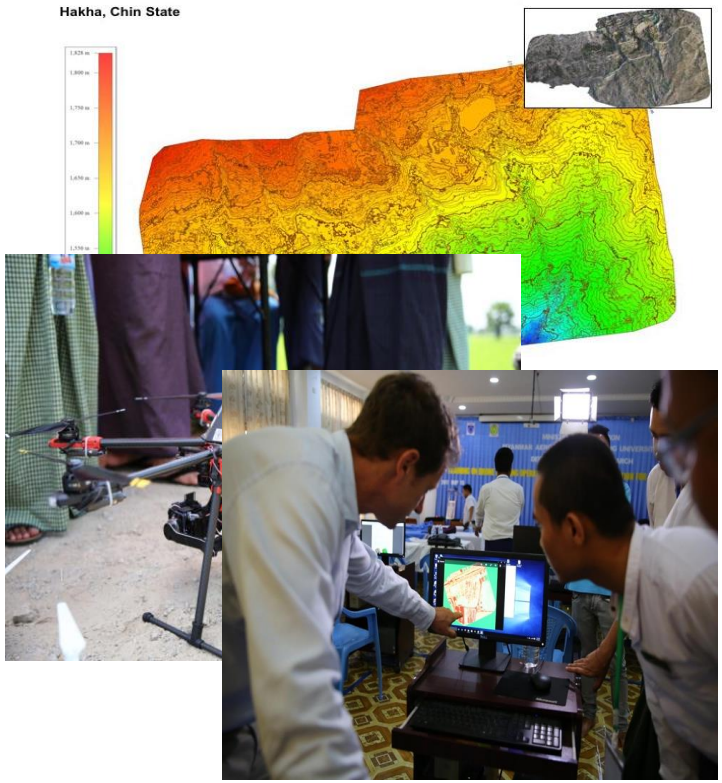
A Field-based trainings and test flights:
A comprehensive set of aerial mapping approaches and protocols for agriculture were tested FAO provided hands-on training to MAEU on rapid aerial assessment methodologies, DRR concepts and technical guidance on data processing.

B Application of Drone Mapping Technology after the 2016 floods in Magway region

C Drone Mapping Technology in Highly Remote Upland Agricultural Communities

D Institutionalizing Drone Mapping Technology and Capacities for Agriculture:

On 29 March 2017, with approval from the MOALI Minister's Office, the MoALI Drone Team, a subset of the bigger MoALI DRR Task Force, was established by the Government with FAO's technical assistance. The drone mapping consists of 30 inter-disciplinary experts from the different Departments and universities across MoALI (Agriculture, Livestock, Extension, Agriculture Research, Irrigation and Water Management, Land Records and Statistics, YAU, UVS, Mechanization, Cooperatives, Planning and others).



Philippines and Drones Programme

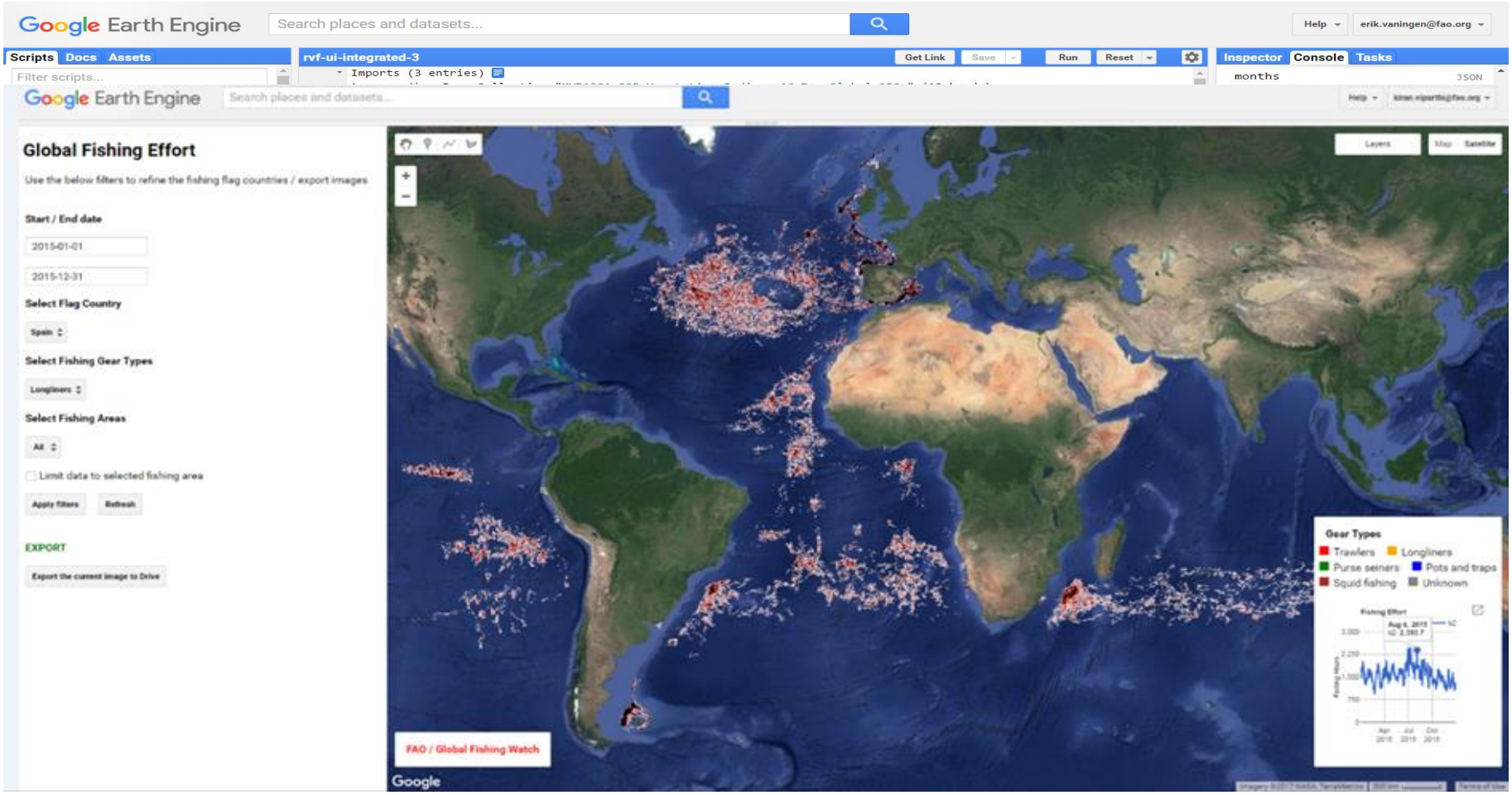
- In **2016 Philippine Government and FAO** take to the sky with **drones** in disaster risk reduction efforts for the agriculture sector
- It is an effort to stay ahead of the **negative impacts of climate change, floods and typhoons on its food security,** the **Philippine Department of Agriculture** (DA) and the UN's Food and Agriculture Organization (FAO) have launched drones to more accurately predict where agricultural damage will be worst and quickly assess damages when disasters strike.
- Some25 FAO and government technical experts have been deployed across the country to support drone missions whose first goal is to assess where farmlands are most at risk from natural disasters and quickly assess damages after they strike.

With the use of a drone, a team of technical specialists can assess up to **600 hectares in one day**, significantly accelerating the process of projecting the extent of damage that an incoming hazard may cause in agricultural areas, and quantifying actual damage after a disaster.

FAO and GOOGLE Partnership signed in Paris 2015

Several FAO *project developed using* GEE platform

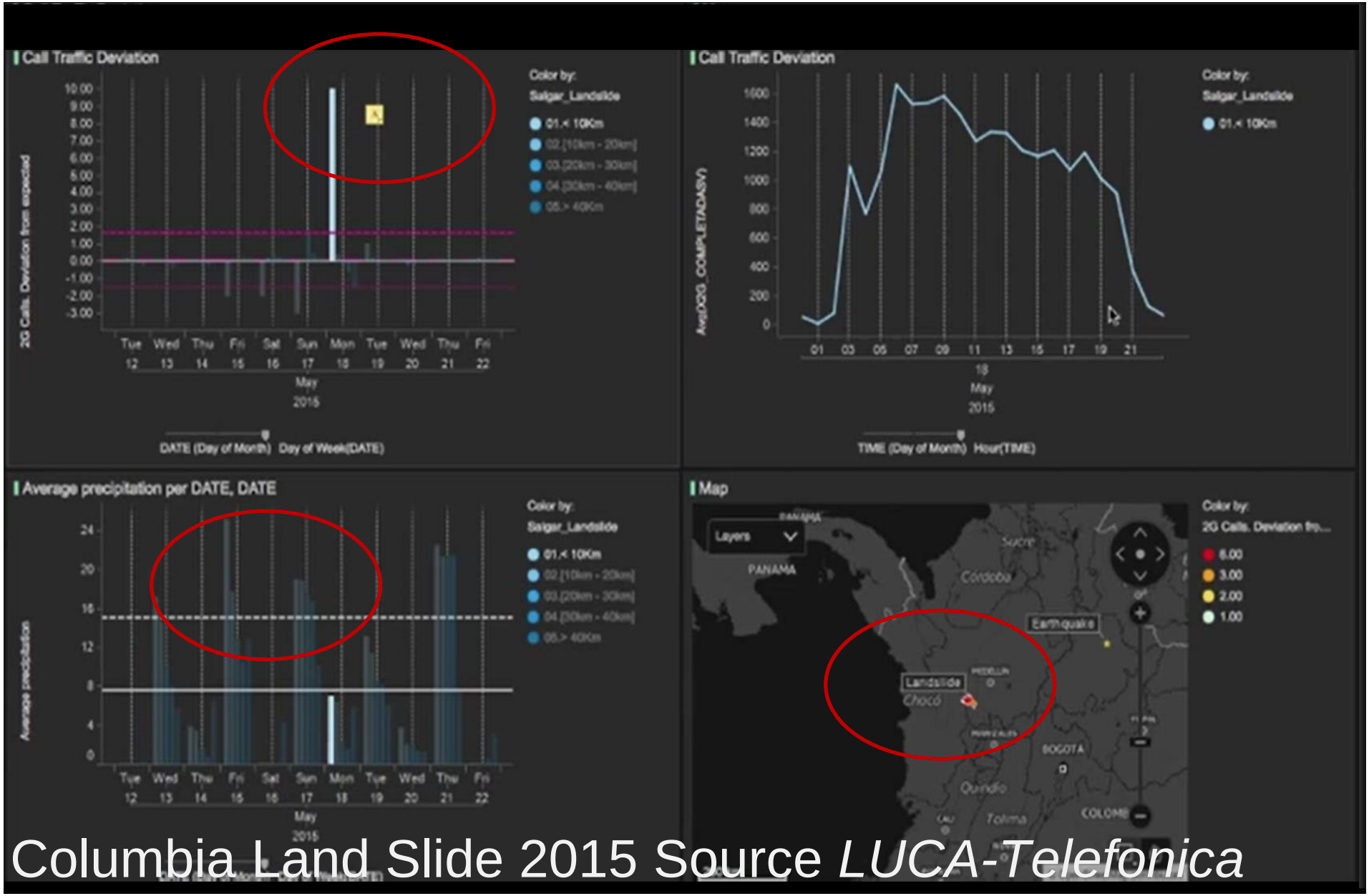
1) Desert Locust Mapper (locust presence monitoring and risk mapping tool) - SDG 12
2) Rift Valley Fever risk mapping tool under the Vmerge project* - SDG 2, 3
3) Fisheries
4) Water productivity
5) Vessel tracking
6) Harvest wastes



FAO and Telefonica Partnership signed in 2018

Telefónica Partners Program

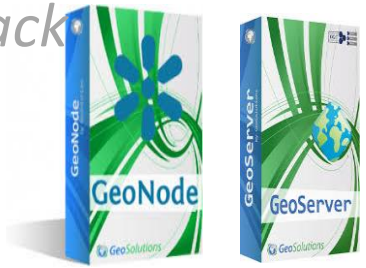
FAO *innovations*: partnership with mobile operators for humanitarian aid and Disaster Risk Reduction



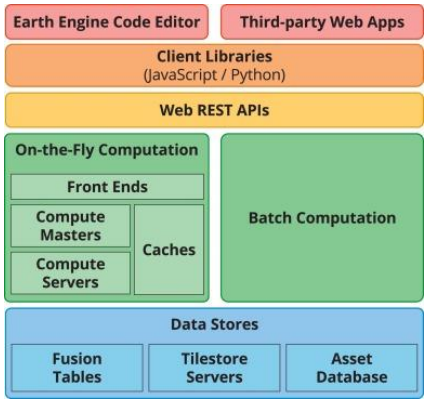
Columbia Land Slide 2015 Source *LUCA-Telefonica*

Architecture

Open source Geo-Solution stack

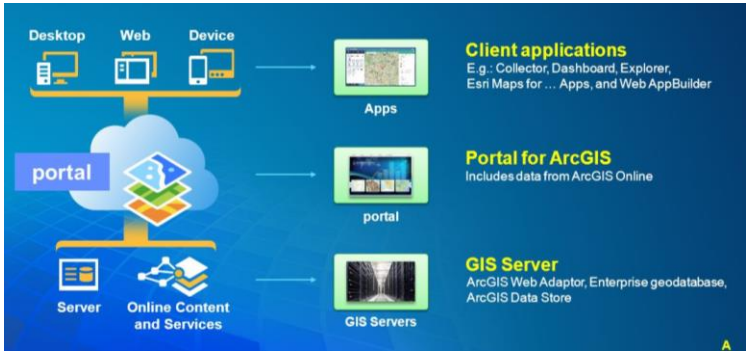


Google Earth Engine



The Earth Engine Code Editor and third-party applications use client libraries to send interactive or batch queries to the system through a REST API. On-the-fly requests are handled by Front End servers that forward complex sub-queries to Compute Masters, which manage computation distribution among a pool of Compute Servers

ESRI Arcgis Server/Arcgis Online

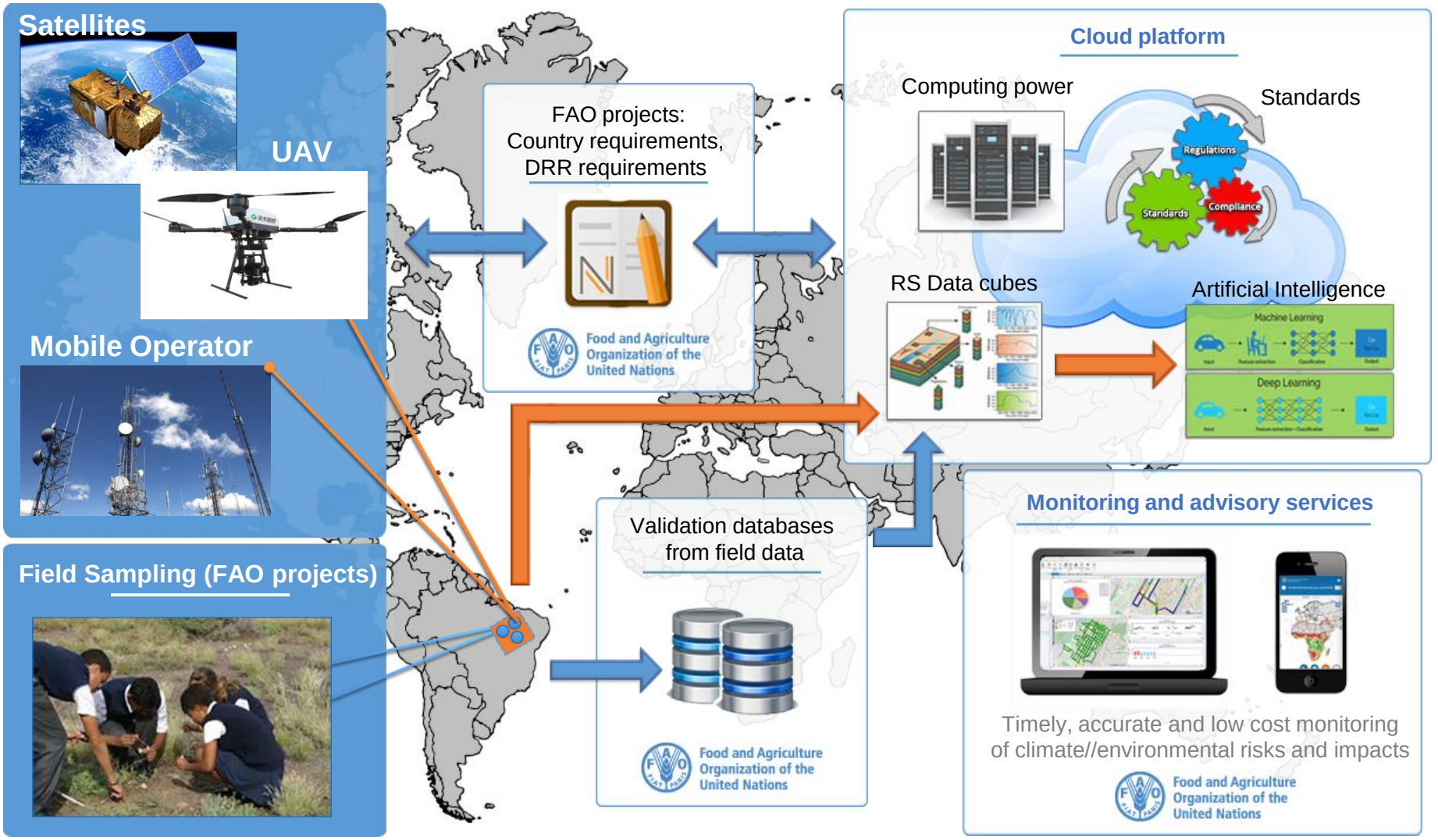


FAO Data Center in the Cloud

amazon web services™

Google Cloud Platform

Remote Sensing trends and SDGs: more sources of data, higher accuracy, real time big data, cloud computing , and open access



THANK YOU

For more information about FAO's work in geospatial technology & innovation please contact:

Lorenzo.DeSimone@fao.org