Organización de las Naciones Unidas
para la Alimentación y la Agricultura

Utilización de los sensores remotos en el monitoreo de la sequía en agricultura

En colaboración con:

vito
vision on technology

ITC
UNIVERSITY OF TWENTE.

European Commission

ASIS

http://www.fao.org/climatechange/asis/en/

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Limitación en el uso de información pluviométrica:

- Las estaciones meteorológicas están dispersas y presentan series discontinuas.
- La precipitación estimada presenta un error de estimación y existe desvios en las diferentes regiones del planeta (Dinku et al. 2007, Lim and Ho 2000).

¿Qué es ASIS?

Es un sistema de detección de las áreas agrícola con alta probabilidad de sufrir sequía, para lo cual utiliza datos geoespaciales actualizados cada 10 días a un kilómetro cuadrado de resolución.

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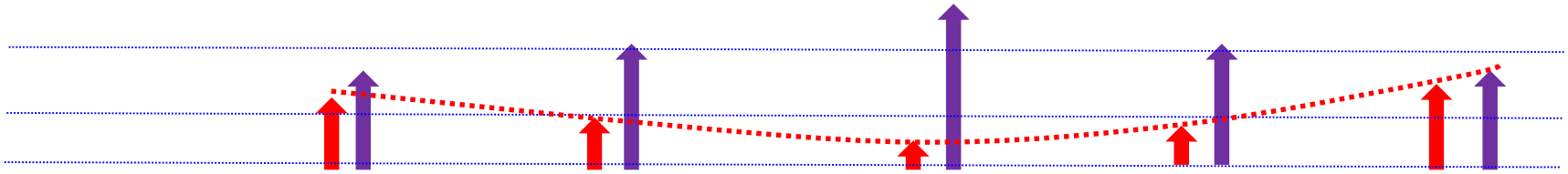
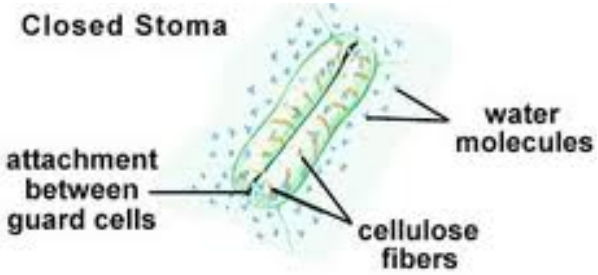
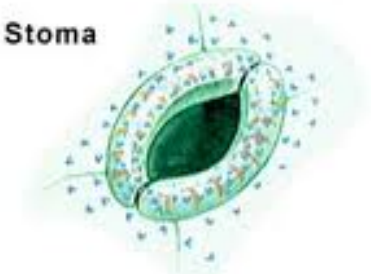
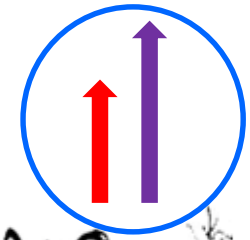
Energía electromagnética registrada por el sensor







Estrés hídrico



Emer-gence		Tassel	Silk		
Establishment (0)	Vegetative (1)	Flowering (2)		Yield Formation (3)	Ripening (4)
15-25 days	25-40 days	15-20 days		35-45 days	10-15 Days

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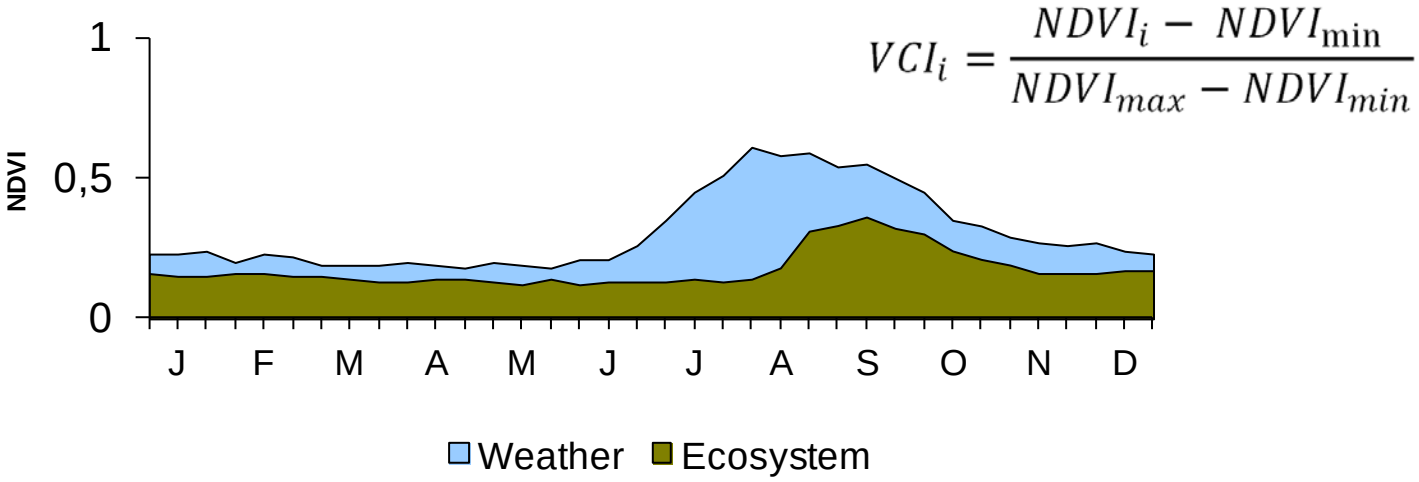
Hodh El Gharbi, Mauritania



***Source*:** Kogan, F. 1995. Droughts of the late 1980s in the United States as derived from NOAA polar-orbiting satellite data. Bulletin of the American Meteorological Society vol.76, No. 5 655-668 pp.

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El Sistema del Índice de Estrés Agrícola se basa en el Índice de Salud Vegetal (VHI, siglas del Inglés) (Kogan et al. 1995)

Vegetation condition index (VCI)

Temperature condition index (TCI)

$$VCI_i = \frac{NDVI_i - NDVI_{\min}}{NDVI_{max} - NDVI_{min}}$$

$$TCI_i = \frac{BT_{max} - BT_i}{BT_{max} - BT_{min}}$$

Vegetation Health Index (VHI)

VHI = a*VCI + (1-a)* TCI

low VHI

high VHI

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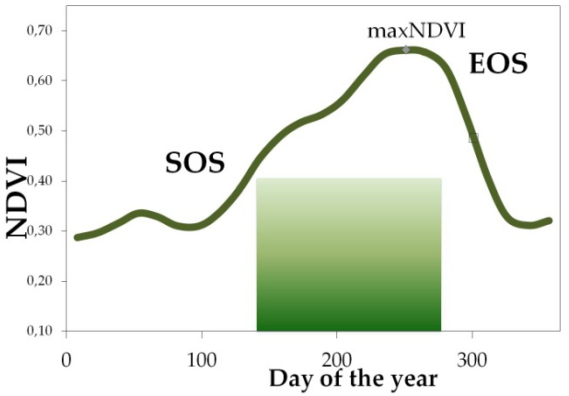
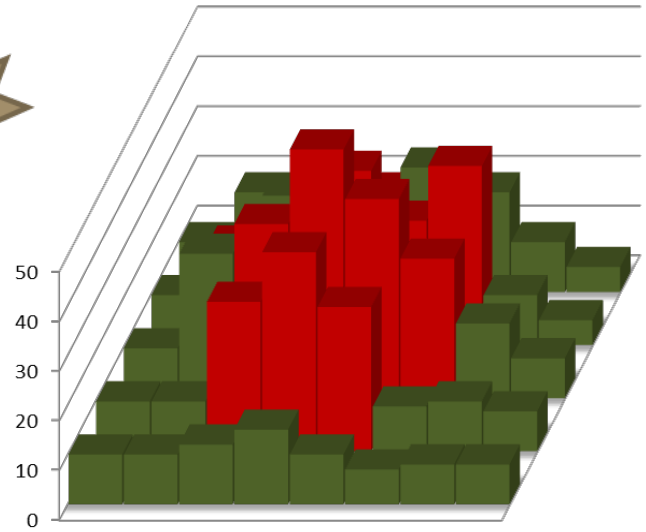
ASIS evalúa la severidad (intensidad, duración y extensión geográfica) de la sequía agrícola



Porcentaje de la área agrícola afectada por sequía (VHI<35)



VHI temporal average value

- 0- 10
- 10-20
- 20-25
- 25-35
- >35

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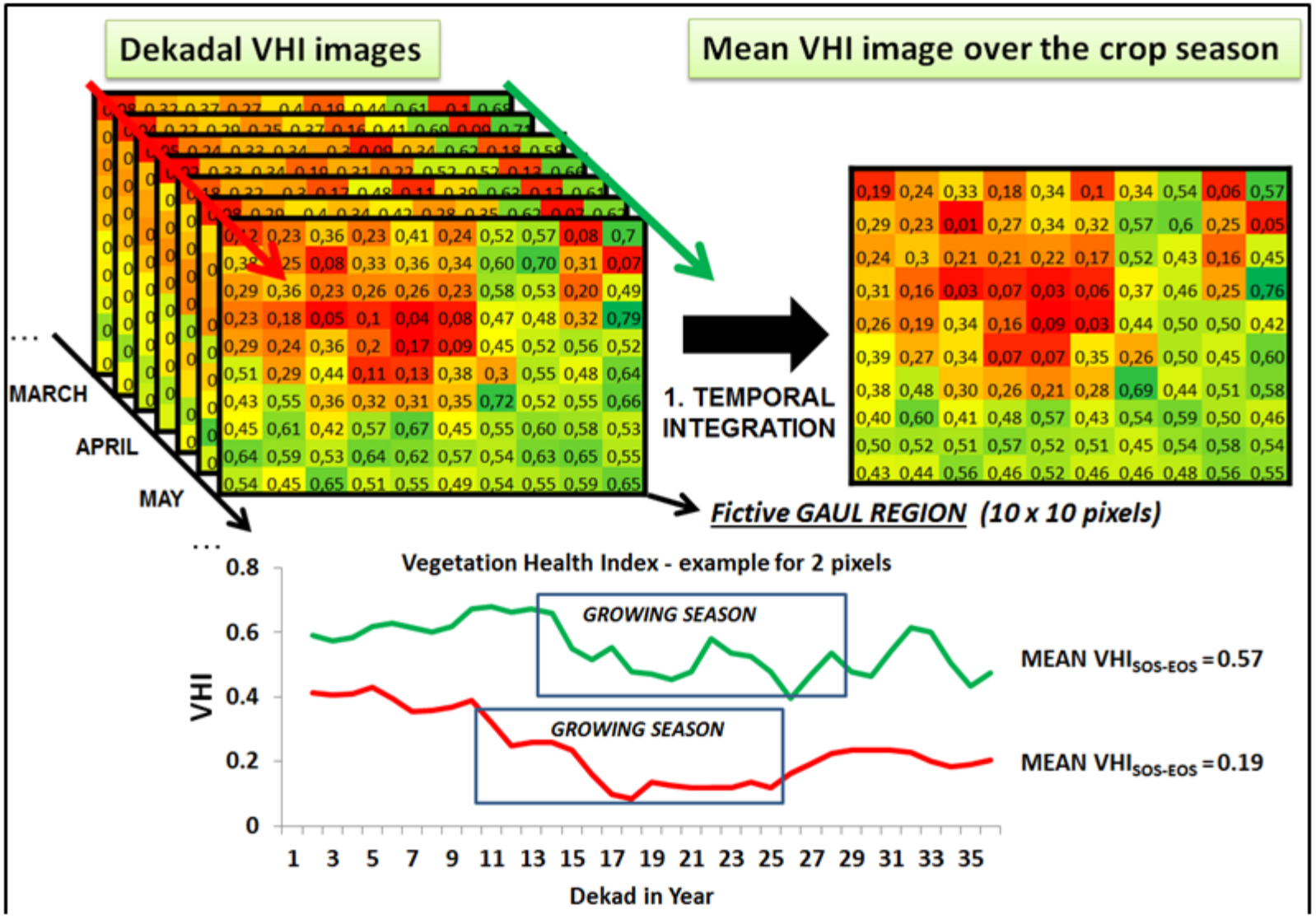
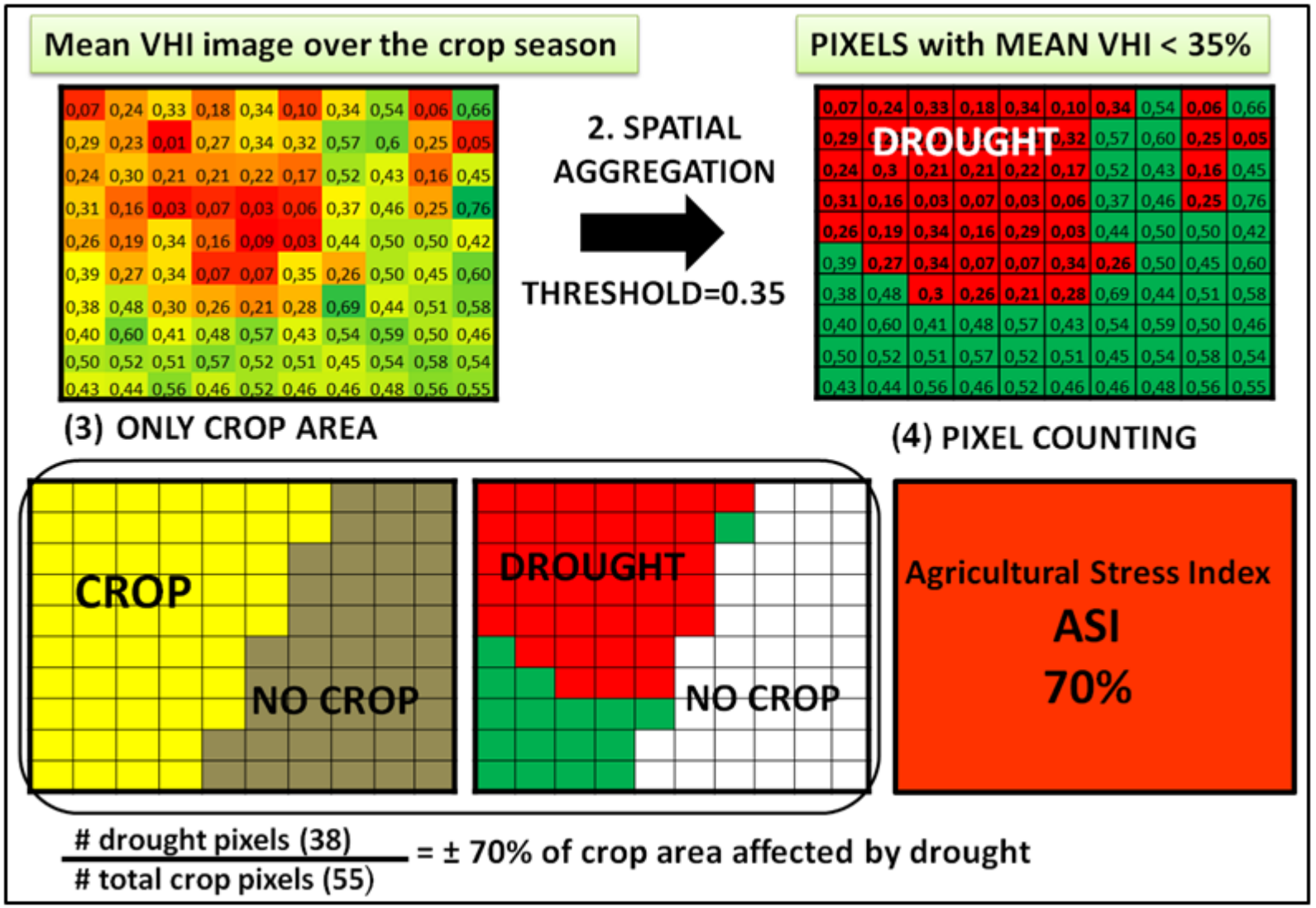
Integración Temporal en ASIS



Integración Espacial en ASIS



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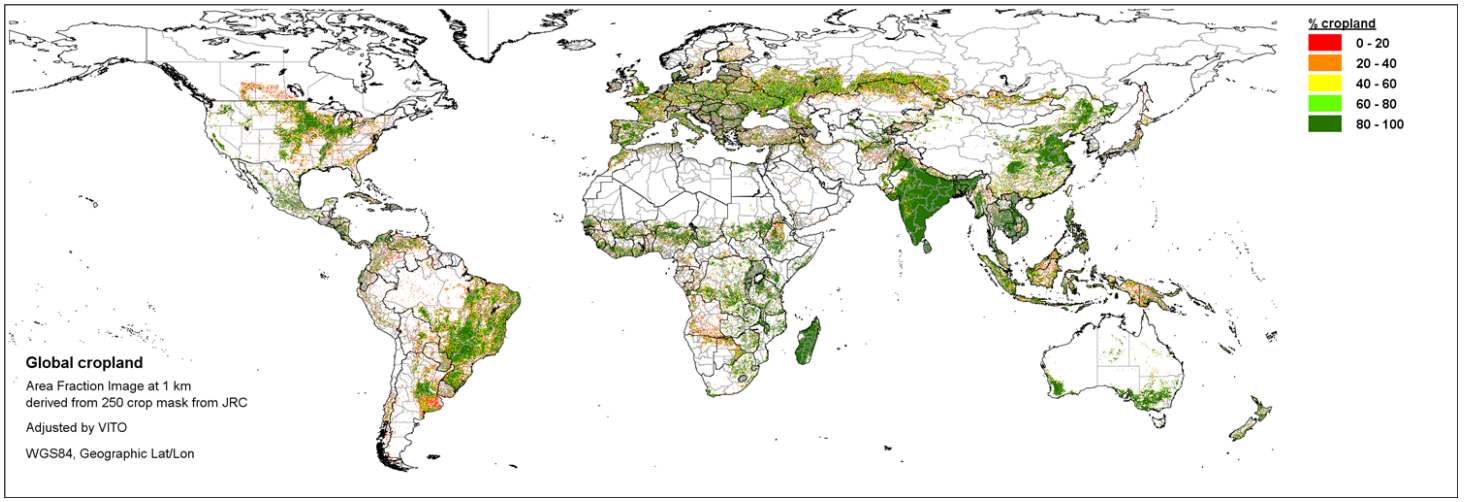
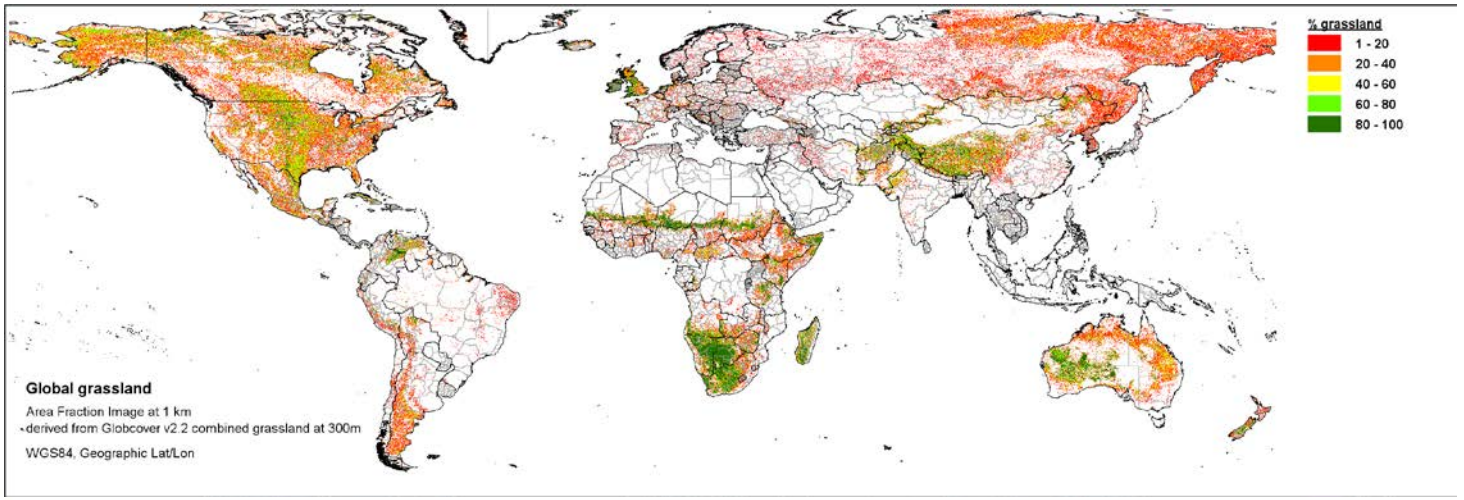
Máscara agrícola global





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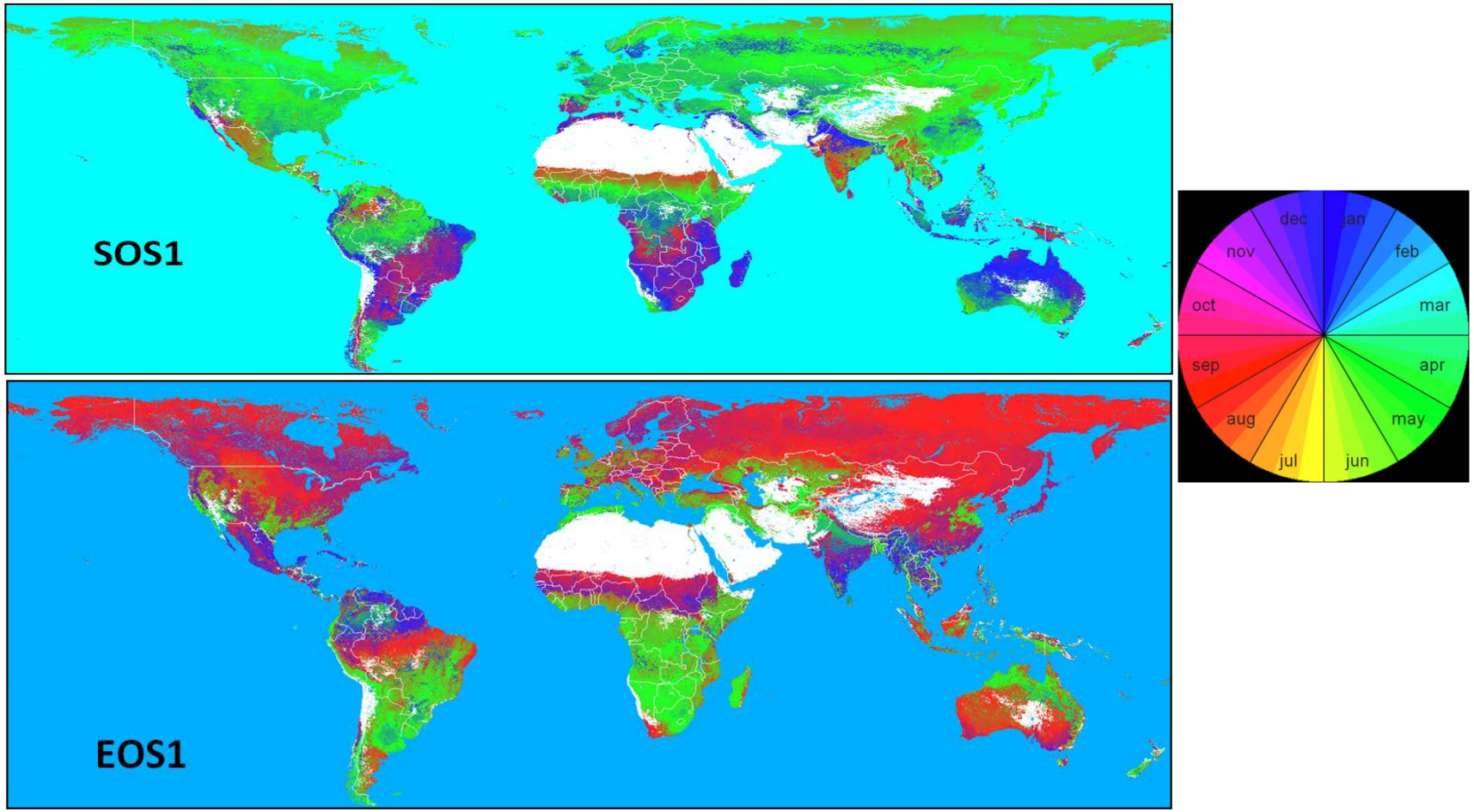
Agregación temporal – se define inicio de la temporada agrícola, SOS (start of growing season) y el final EOS (end of growing season)



SOS and EOS of the first season, as derived from the long term NDVI averages of SPOT-VGT (roi GLD, 21 km resolution).

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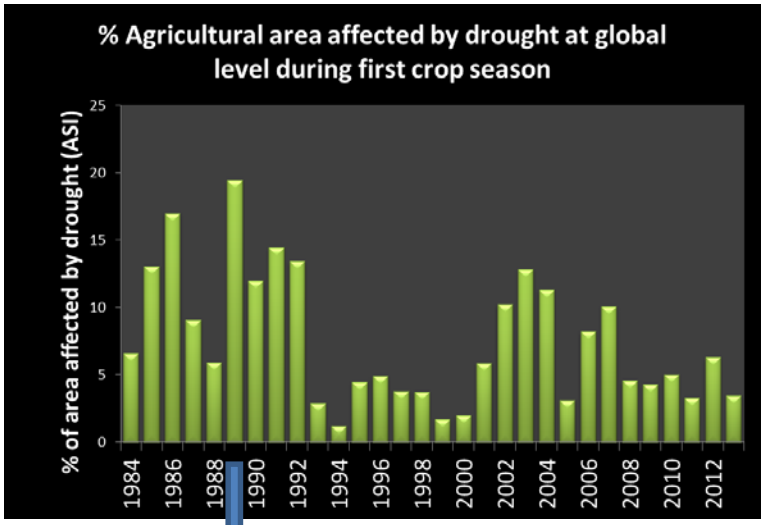

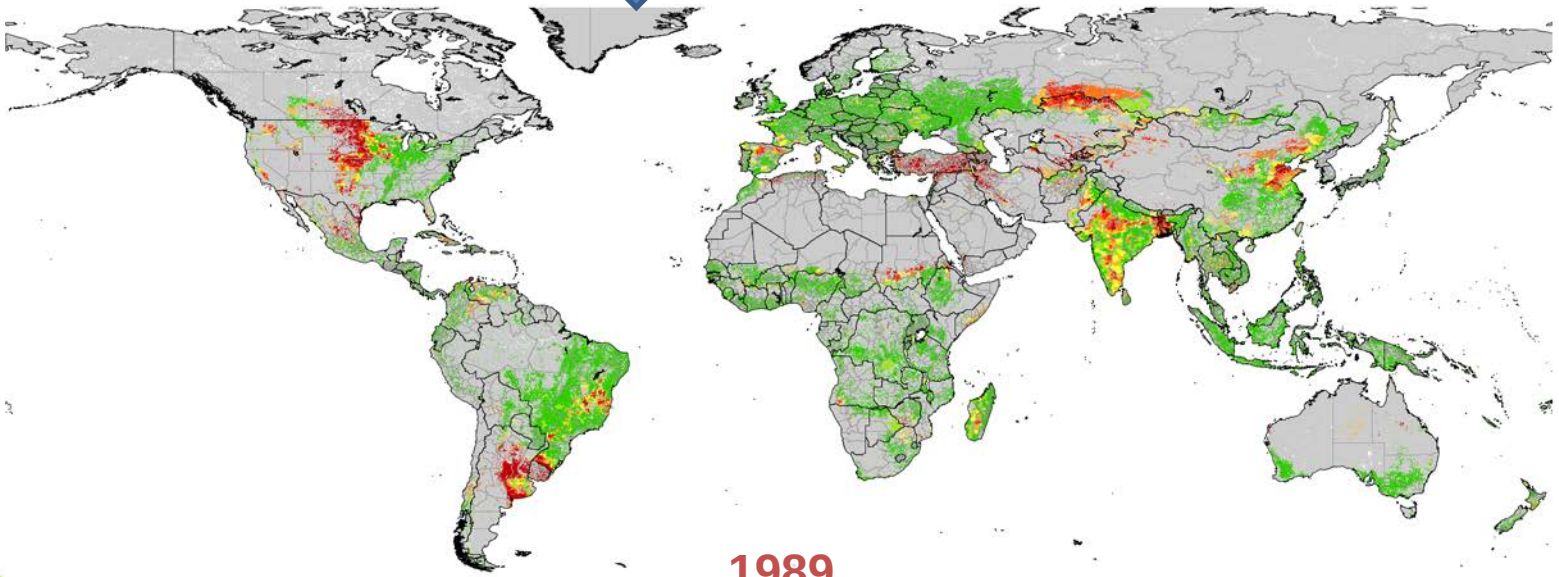

1989

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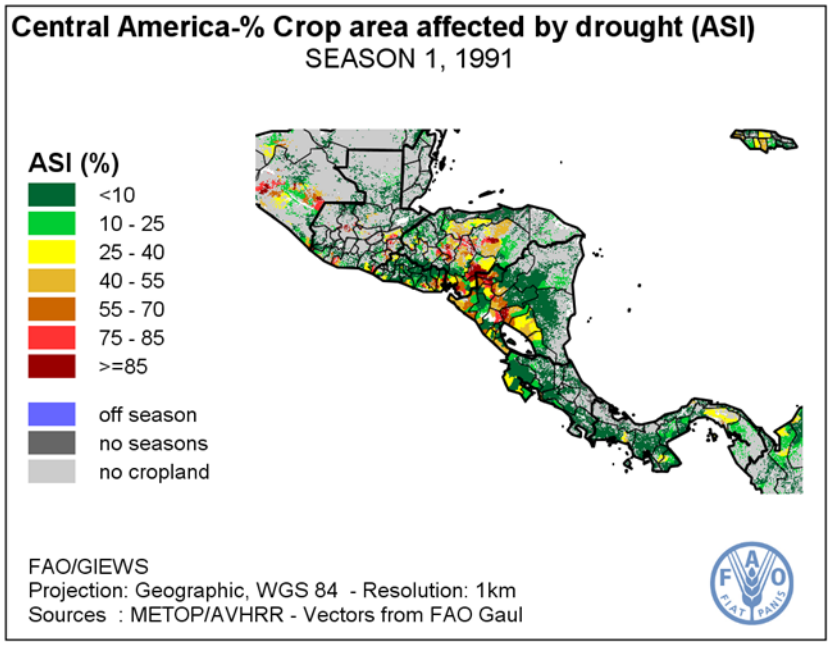

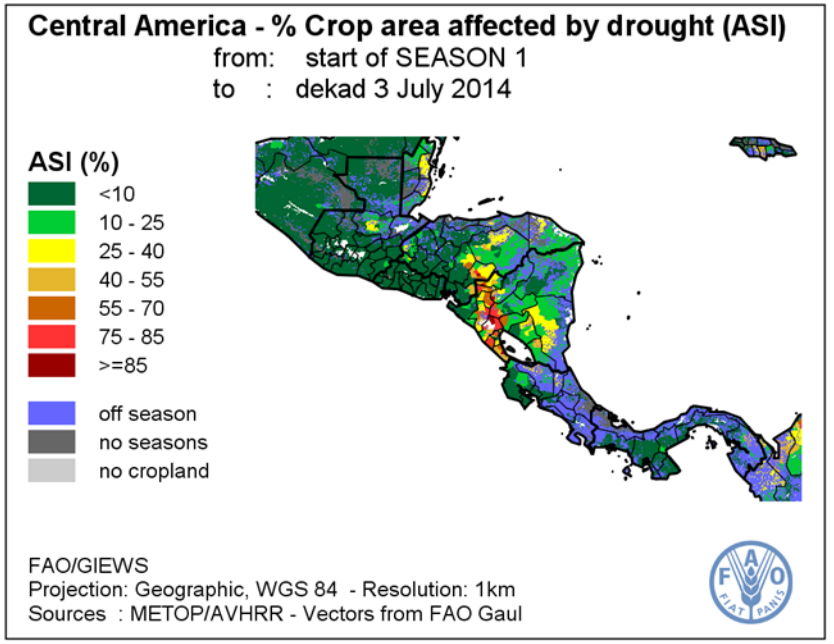

http://www.fao.org/giews/earthobservation

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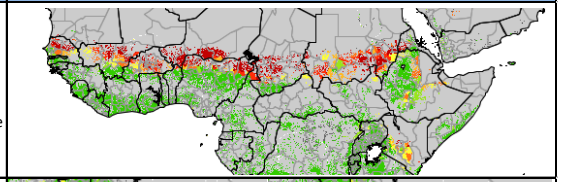
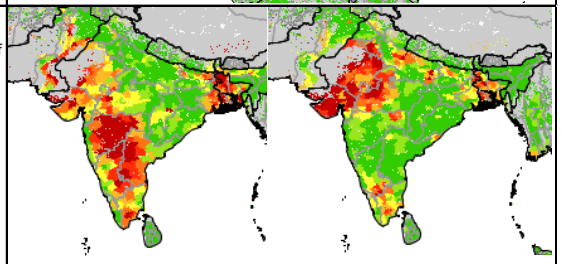
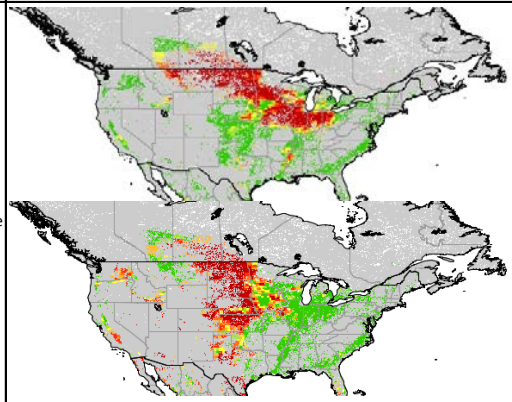
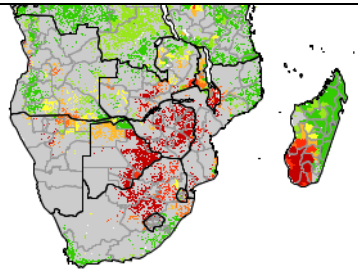
Year(s)	Country/region	Impact	ASI Map
1984	Sahel	During the crisis, an astounding 20 nations of Africa were under severe drought. Entire rivers and lakes completely dried up. Up to 20,000 people starved to death each month. Although the total number of people who perished is not completely known, it is estimated that over 1 million people died as a direct result of the drought. The worst drought in the Sahel during the early-mid 1980's occurred the year 1984 affecting most Sahel countries (Nicholson, 1985)	
1986 1987	India	In 1986 and 1987, India experienced severe drought (Nathan, 1994). During September and October 1986, the entire state of Haryana was hit by a drought. Crops like bajra, sugarcane, paddy, and pulses, worth a total of Rs. 100 crores, were damaged. In 1987, the drought situation was at its worst from June to August. Paddy sowing was done in only 40% of the area of Haryana. The 1987 drought affected 6,351 villages with a total population of more than 9 million, more than 1.4 million ha cropped area, and more than 5 million cattle. For drinking water alone, Rs. 3.70 crores assistance was given by the Indian government (Misra, 2003).	
1988 1989	United States	In the United States a severe droughts occurred during 1988 and 1989 (U.S. General Accounting Office, 1989). Following a milder drought in the Southeastern United States and California the year before, the 1988 drought spread from the Mid-Atlantic, Southeast, Midwest, Northern Great Plains and Western United States (U.S. Congress, 1988). This drought was widespread, unusually intense and accompanied by heat waves which killed around 4800 to 17000 people across the United States and also killed livestock across the United States. One particular reason that the Drought of 1988 became very damaging was farmers might have farmed on land which was marginally arable. Another reason was pumping groundwater near the depletion mark. The Drought of 1988 destroyed crops almost nationwide, residents' lawns went brown and water restrictions were declared many cities. This drought was very catastrophic for multiple reasons; it continued across the Upper Midwest States and North Plains States during 1989, not officially ending until 1990. The both droughts also affected Canada in certain divisions.	
1992	Southern Africa	The 1992 Southern African drought was the region's worst drought in living memory. Many wells and some perennial rivers dried. Well over a million cattle died: 1.03 million in Zimbabwe alone, more than 23% of the national herd (Tobaiwa, 1993). The drought affected around 86 million people in the 10 countries which then comprised SADC, of whom around 20 million people were estimated to be at 'serious risk' (SADC, 1993). Aggregate cereal production in the nine sverely affected countries (including South Africa) was 38% of the previous five-year mean, and only 22% in Zimbabwe, often an exporting country. Cereal imports into the 10 SADC countries and South Africa more than tripled during 1992/3, from 3.3 to 10.5 million tonnes (Clay, 1995).	

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GIEWS Earth Observation Website

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

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para la Alimentación y la Agricultura

Desarrollo de ASIS país

financiado por:

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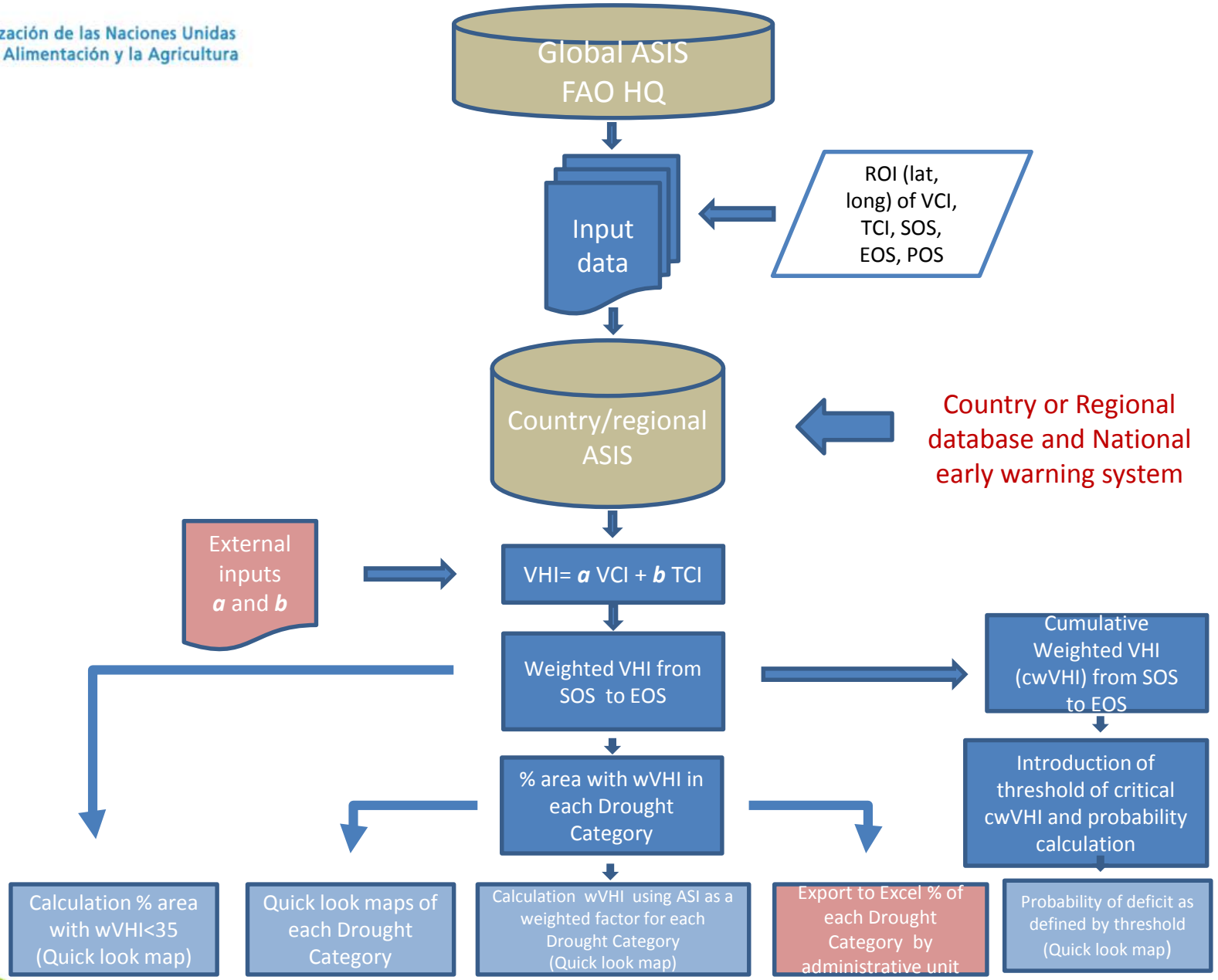

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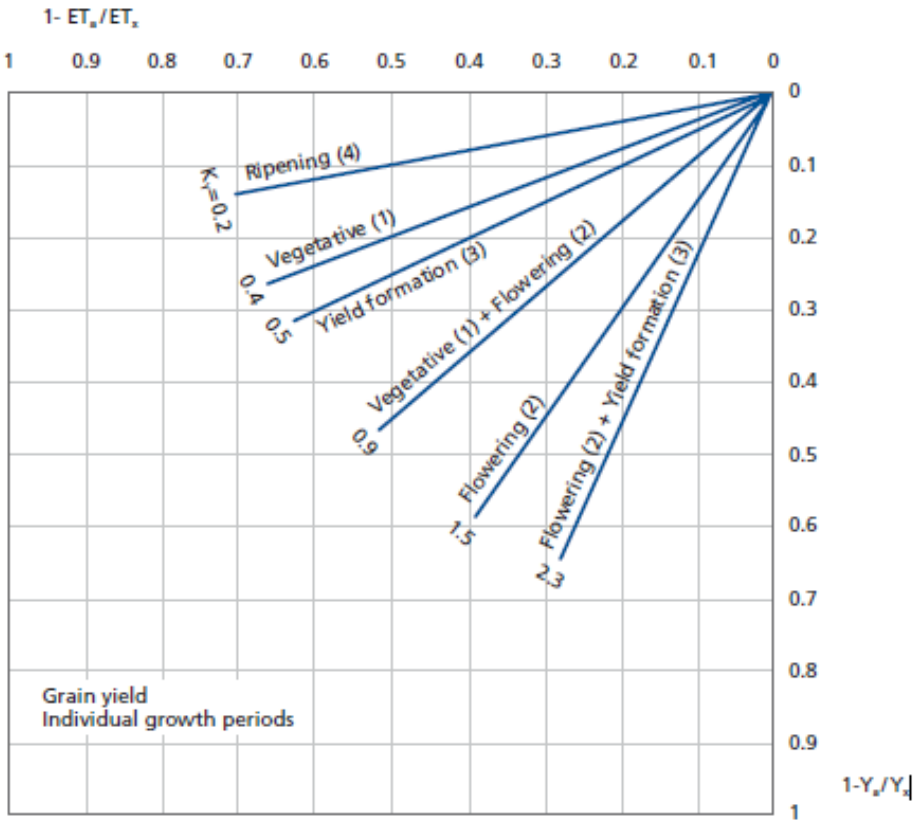
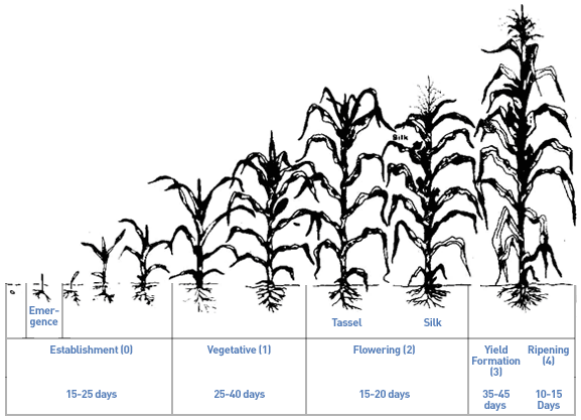
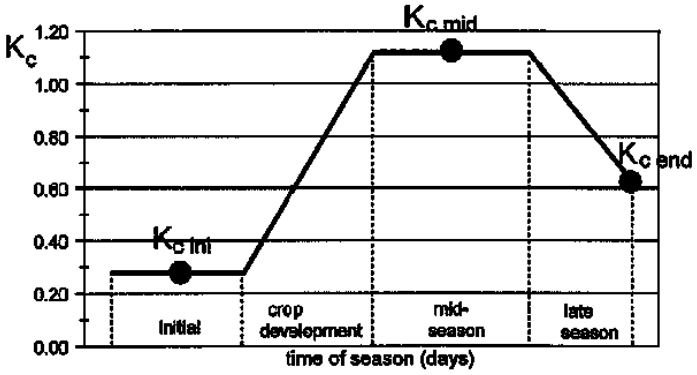
FIGURE 1 Linear water production functions for maize subjected to water deficits occurring during the vegetative, flowering, yield formation and ripening periods. The steeper the slope (i.e. the higher the K_y value), the greater the reduction of yield for a given reduction in ET because of water deficits in the specific period.







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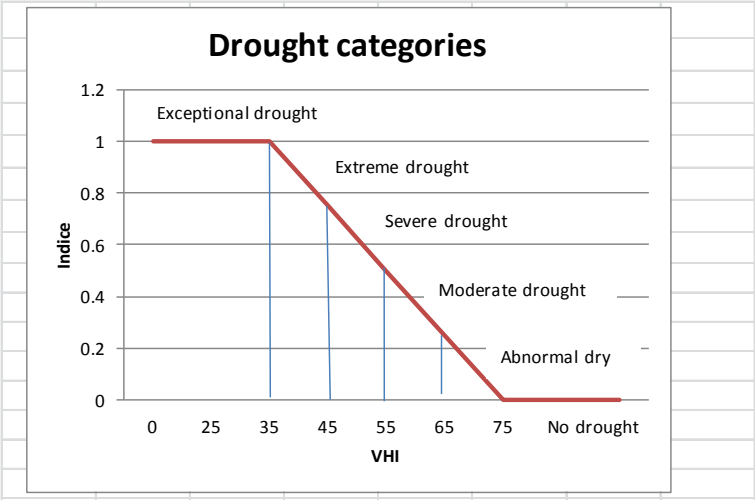
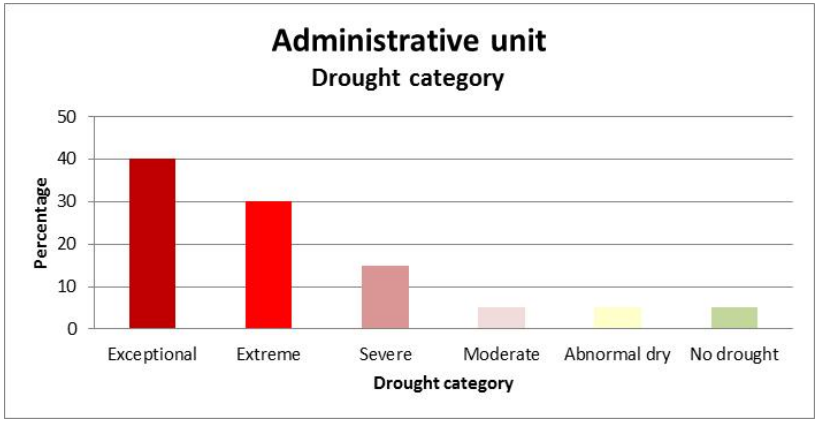
Categorías de sequía agrícola



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



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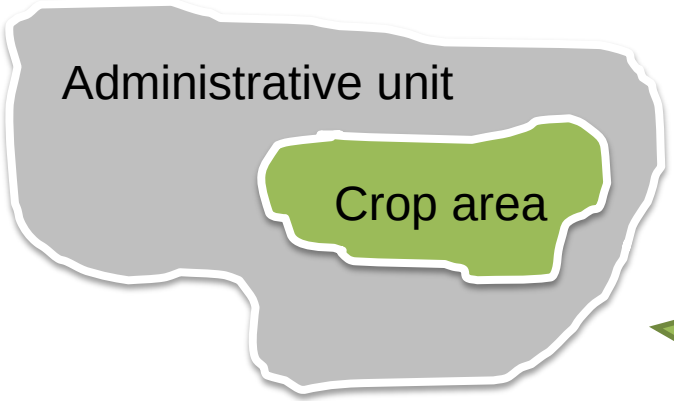
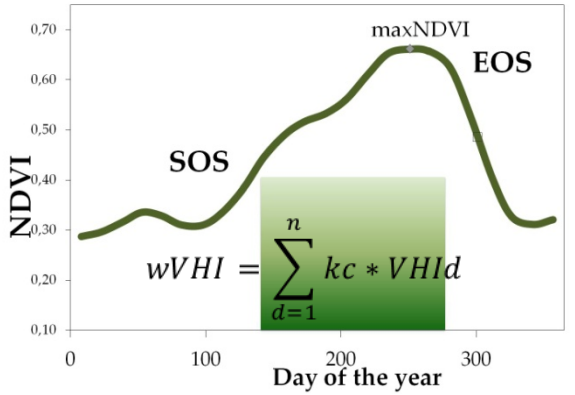
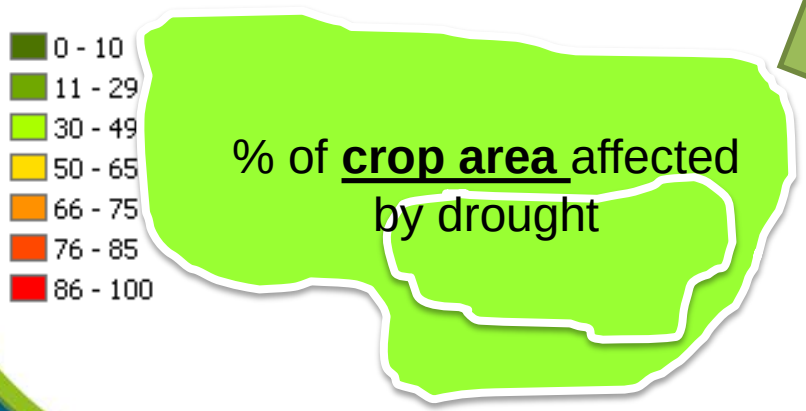
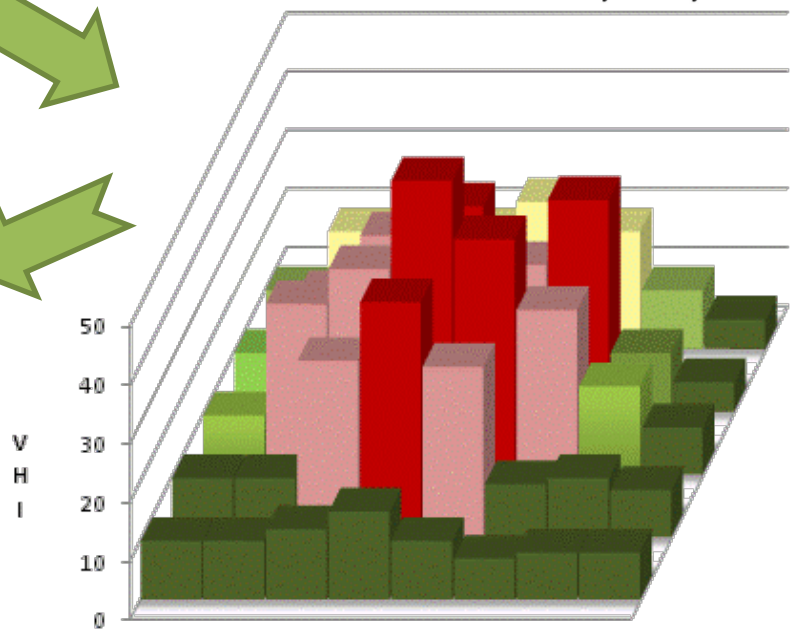




Percentage of the agriculture areas with VHI below 35





VHI temporal average value

- 0- 10
- 10-20
- 20-25
- 25-35
- >35

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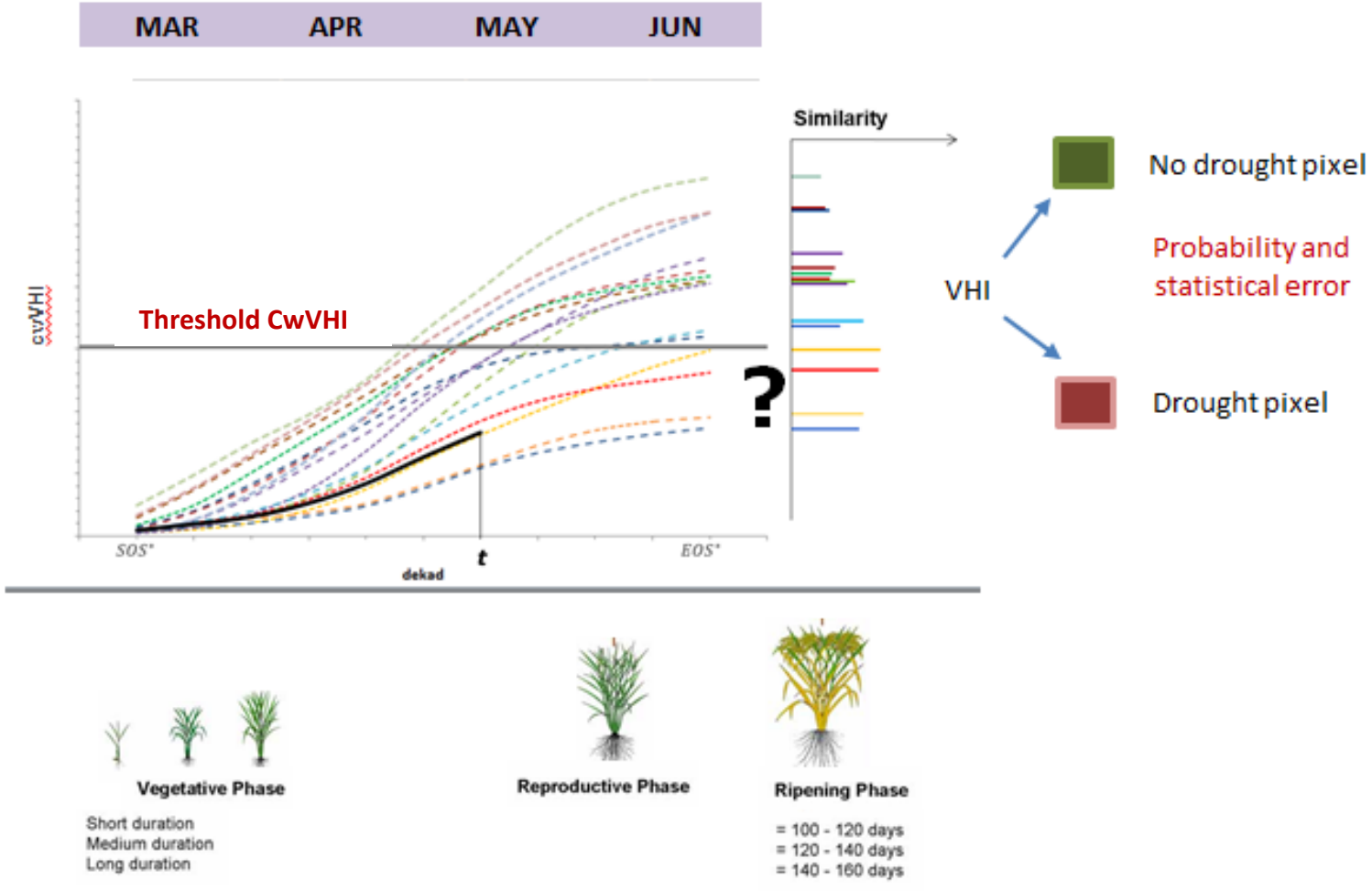
Previsión probabilística de la sequía agrícola



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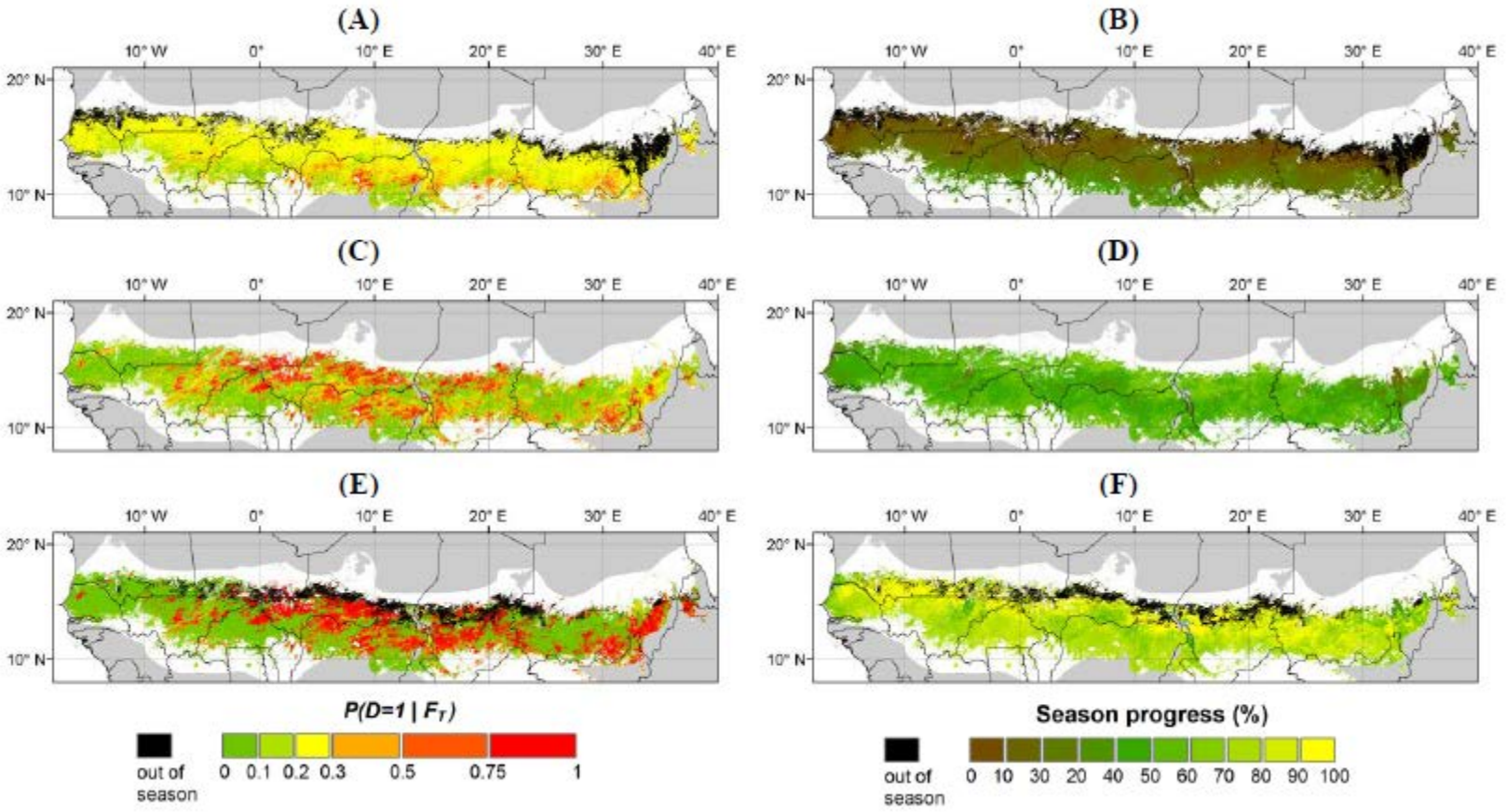

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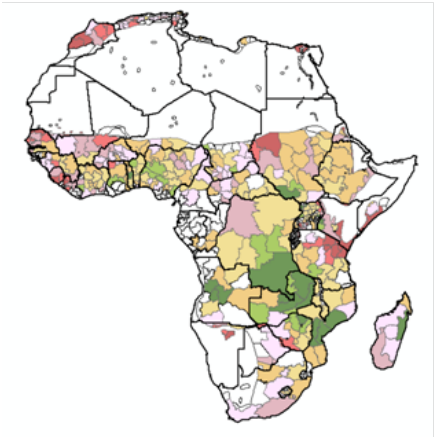
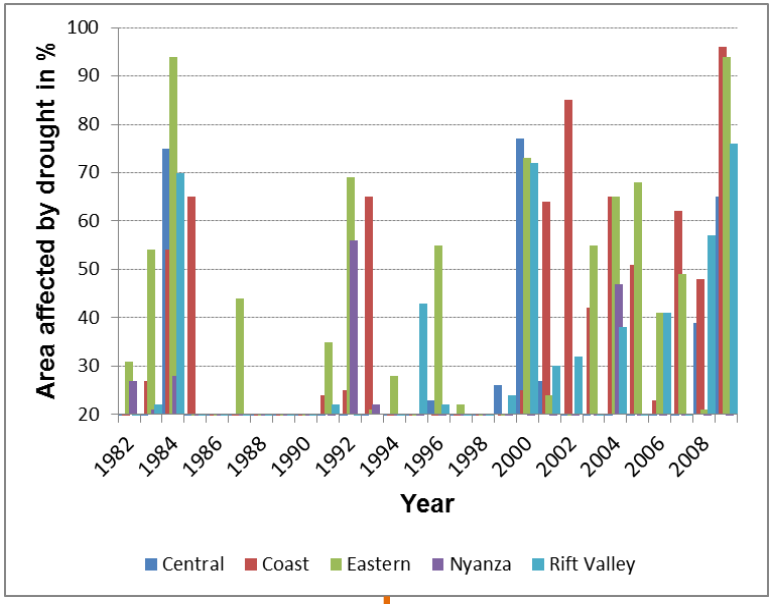
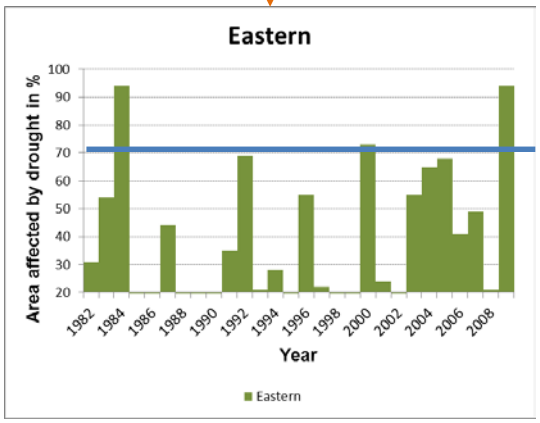
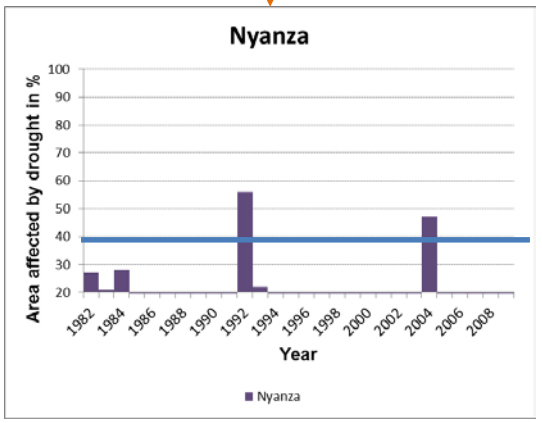
Seguro de sequía agrícola indexado en la información geoespacial



Probability by administrative unit of having more than 30% of the agricultural area affected by drought during the first crop season.







Hypothetical case of payoff at province level, using the line of 70 and 40% of agricultural area affected by drought in Kenya (1982-2010).

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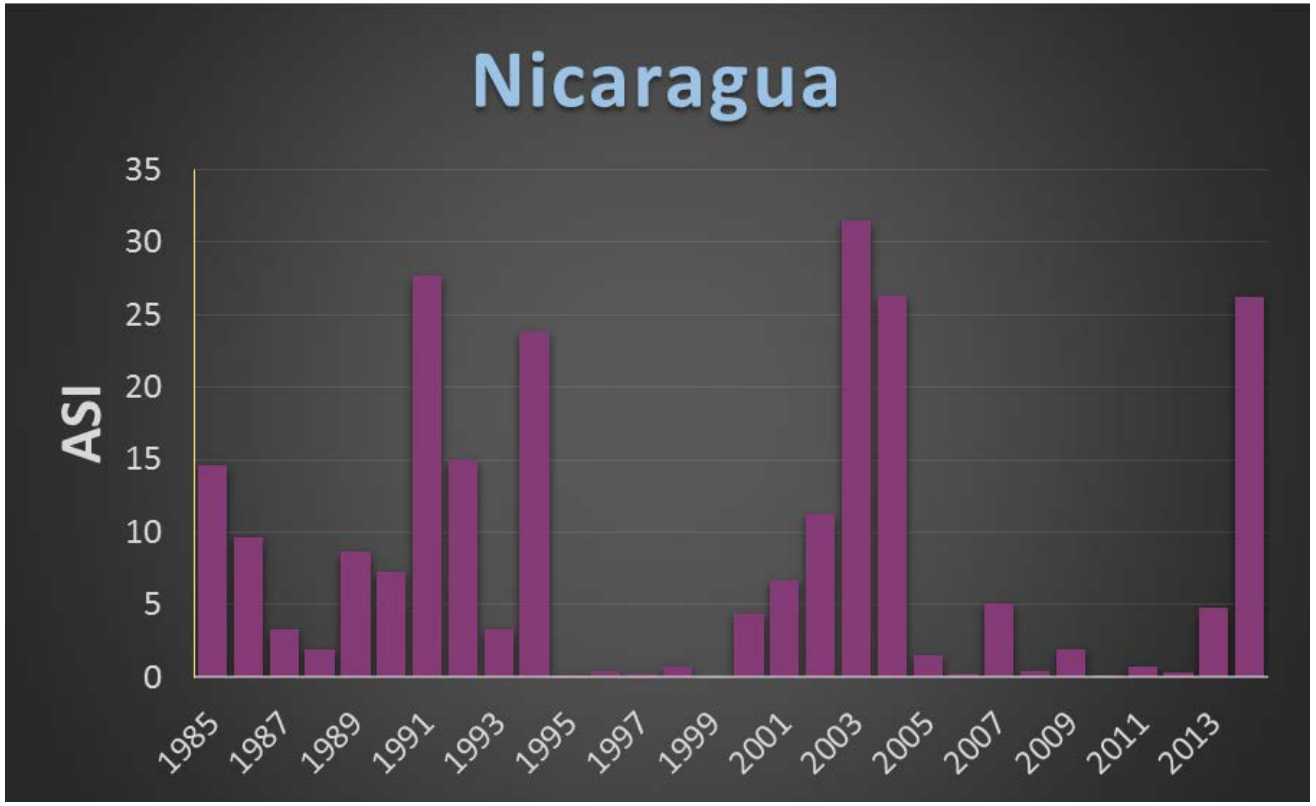
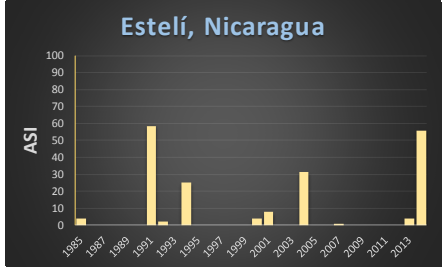
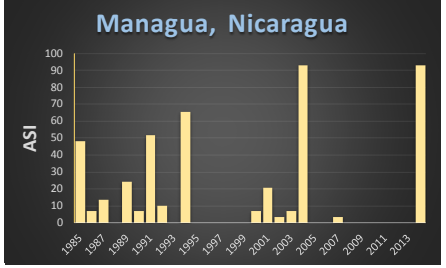
Percentage of area staple crops affected by drought at country level




Estelí, Nicaragua
ASI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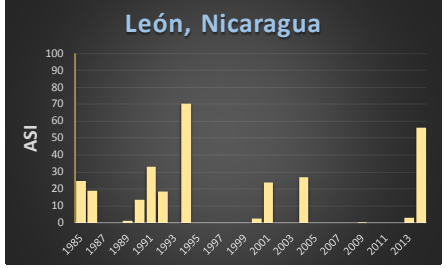
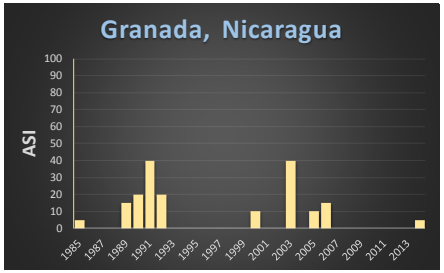
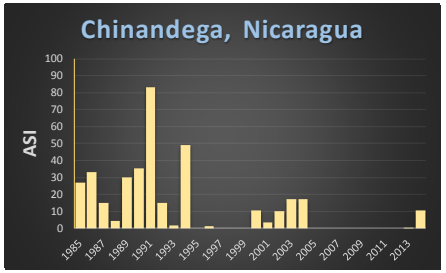
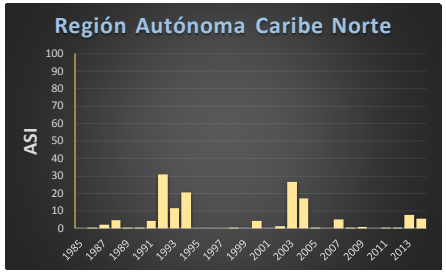
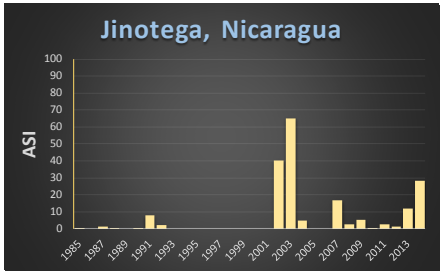
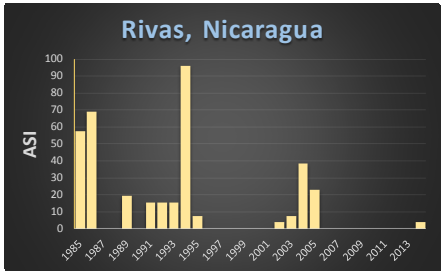

León, Nicaragua
ASI

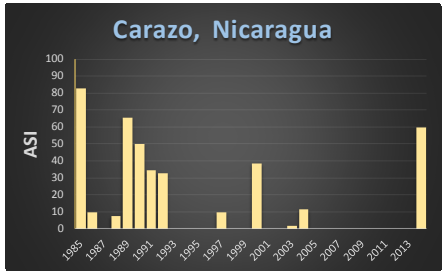

Granada, Nicaragua
ASI

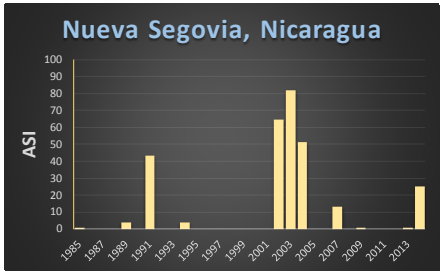

Chinandega, Nicaragua
ASI

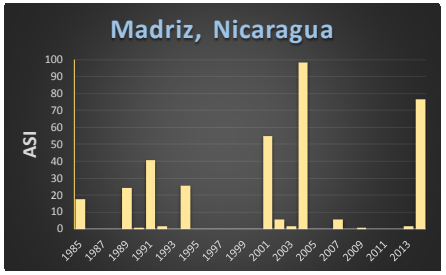

Región Autónoma Caribe Norte
ASI

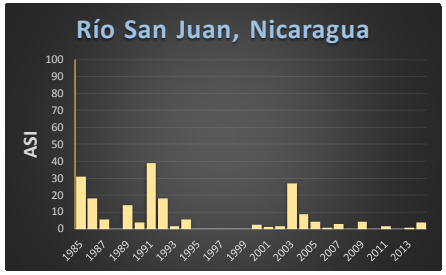

Jinotega, Nicaragua
ASI


Rivas, Nicaragua
ASI


Carazo, Nicaragua
ASI


Nueva Segovia, Nicaragua
ASI


Madriz, Nicaragua
ASI


Río San Juan, Nicaragua
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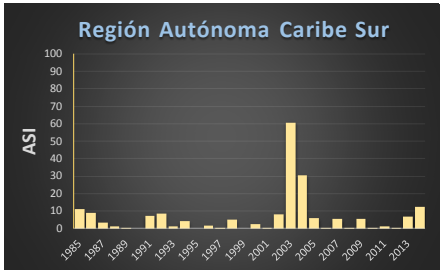
Región Autónoma Caribe Sur
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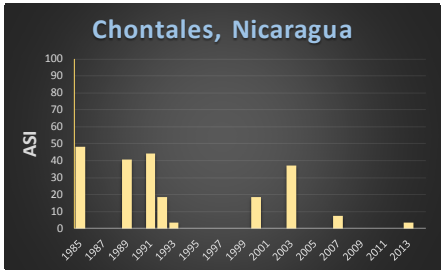
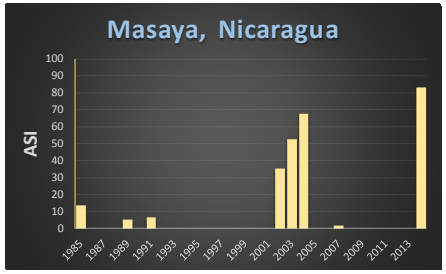
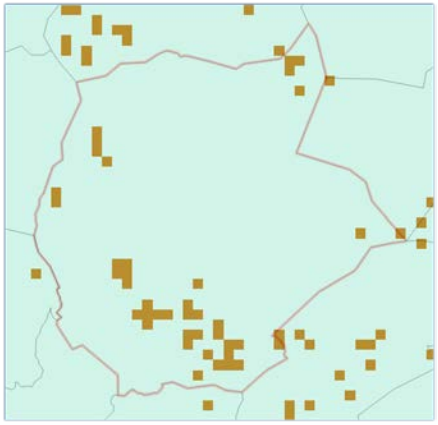
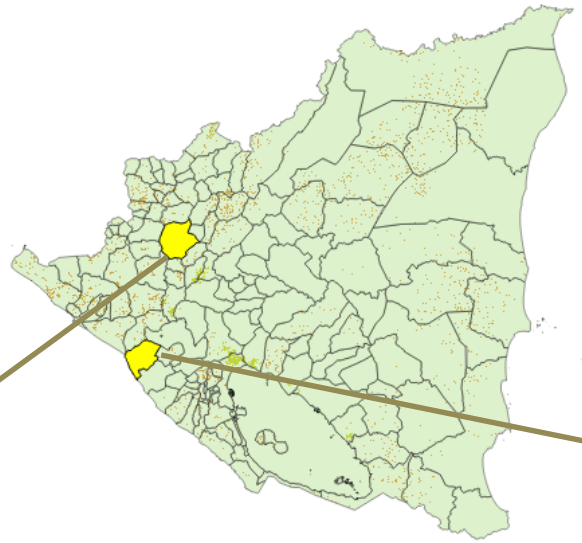
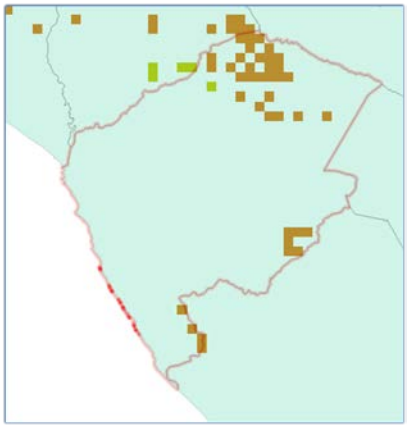

Chontales, Nicaragua
ASI


Masaya, Nicaragua
ASI

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

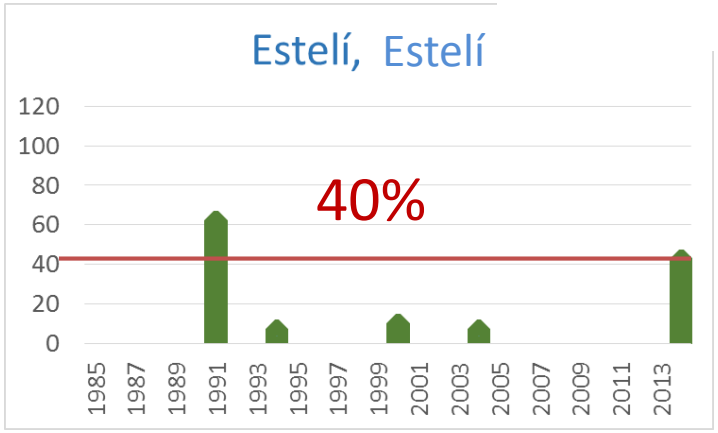


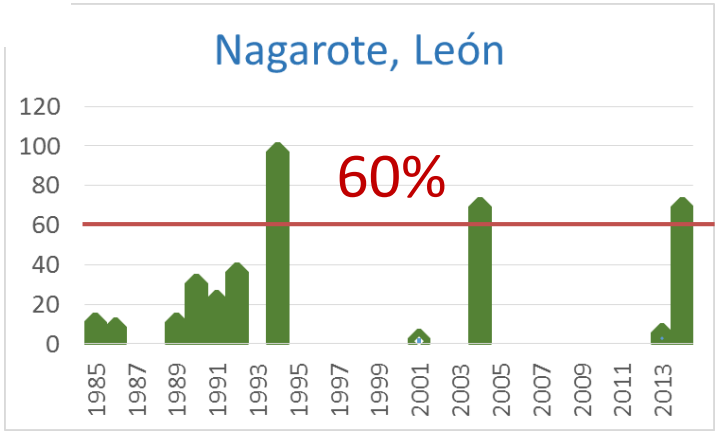




Fuente: INETER, 2017

Fuente: INETER, 2017





Organización de las Naciones Unidas para la Alimentación y la Agricultura

Syria

Crop yield model based on ASI

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

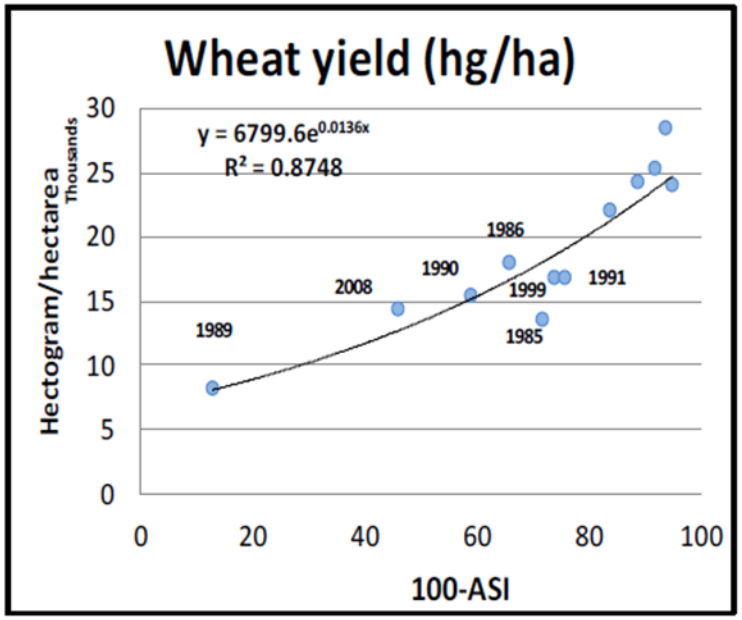
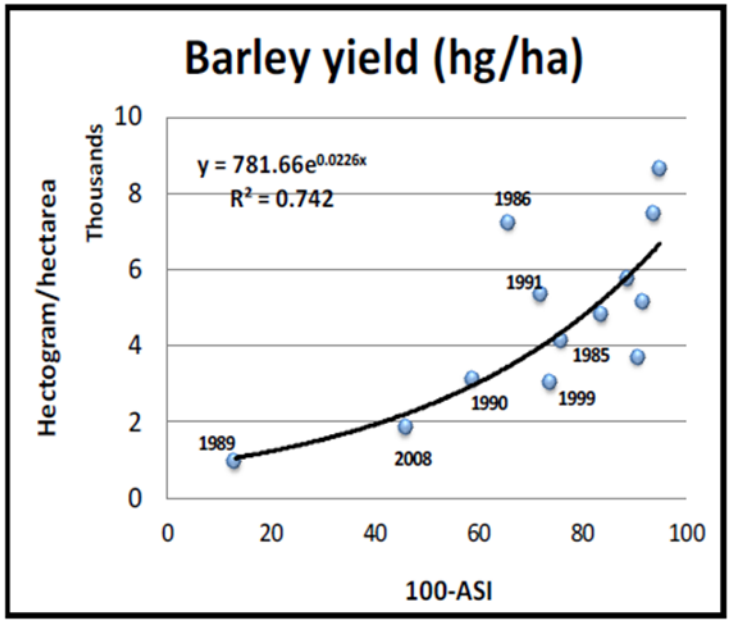
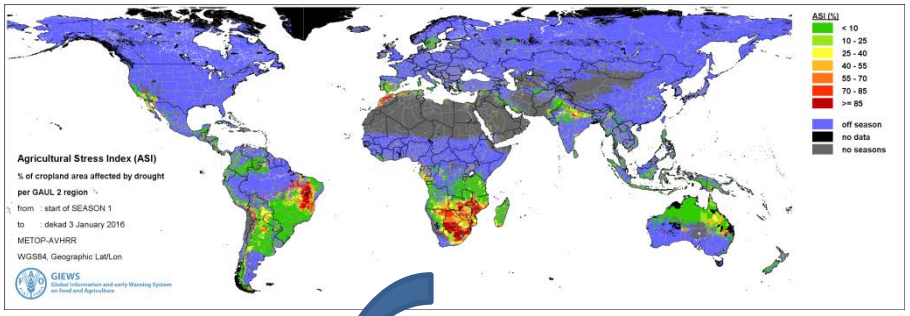


Figure 2: Barley yield model in which ASI explains 74% of the yield variation

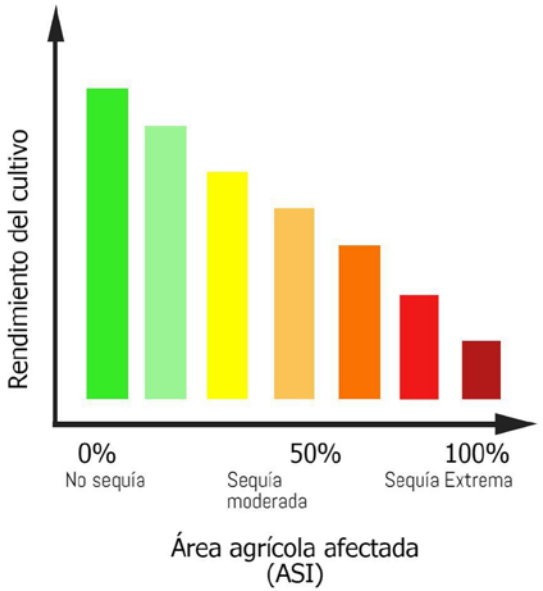


ASIS

Organización de las Naciones Unidas
para la Alimentación y la Agricultura



Sistema de Información Agroclimático para la toma de decisiones



Planificación

- Monitoreo
- Pronósticos
- Revisión de política pública
- Planificación de inversiones

Alerta temprana - prevención

- Divulgación
- Monitoreo y seguimiento de la amenaza

Activación del plan de contingencia

- Acciones de reducción del riesgo
- Recolección de agua
- Siembra de cultivos resistentes
- Cultivos de ciclo corto

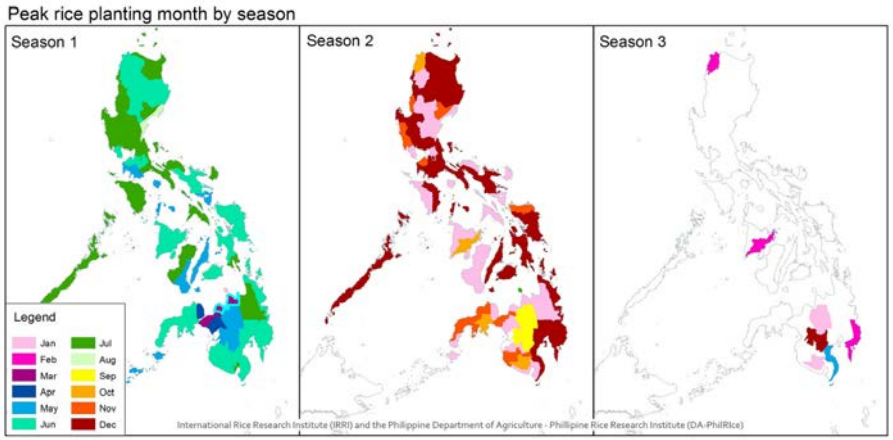
Atención a emergencias

- Implementación de fondos catastróficos
- Activación de líneas de crédito contingente
- Pagos de seguros
- Recuperación de medios de vida

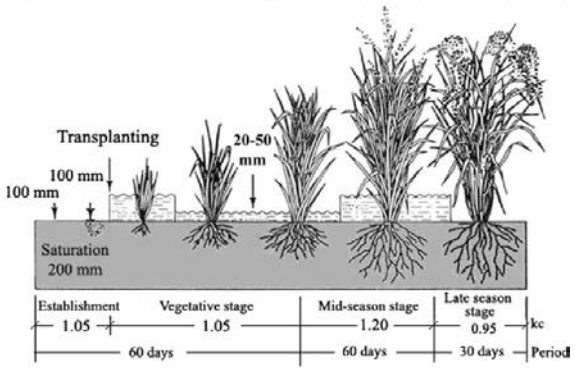
ASIS

Input data for calibration ASIS in Philippines (raster of the location of rice areas, plating dates and crop coefficient)

Rice Extent map of the Philippines 2000-2012 from MODIS imagery (Oct 2013 version) **Sources:** IRRI, DA-PhilRice, sarmap, GIZ

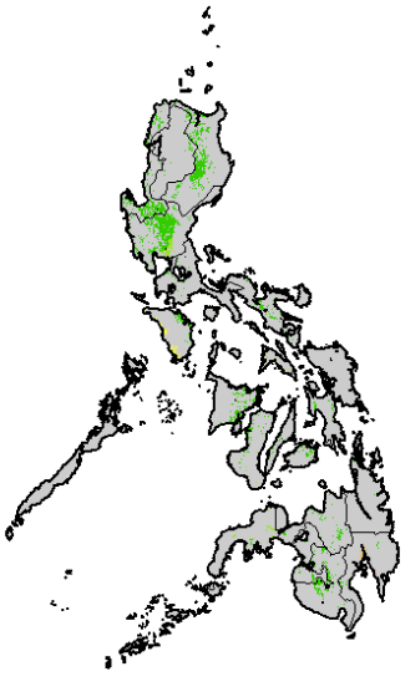


Aerobic rice (kc)
0.95 1.00 0.97

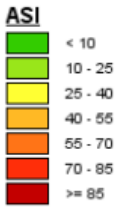


ASIS Outputs: Percentage of rice area affected by drought: a. at pixel level b. spatially averaged by province

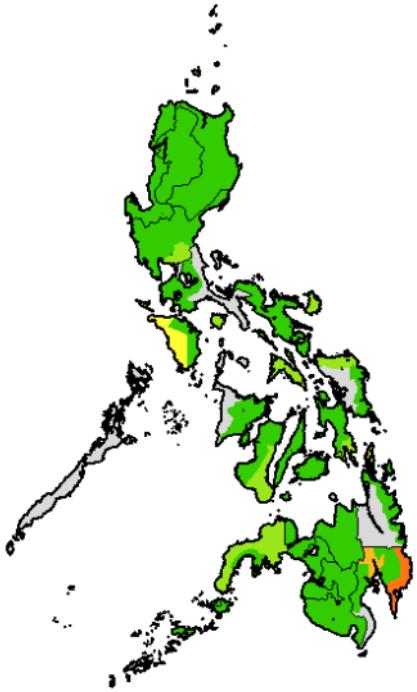
a. at pixel level



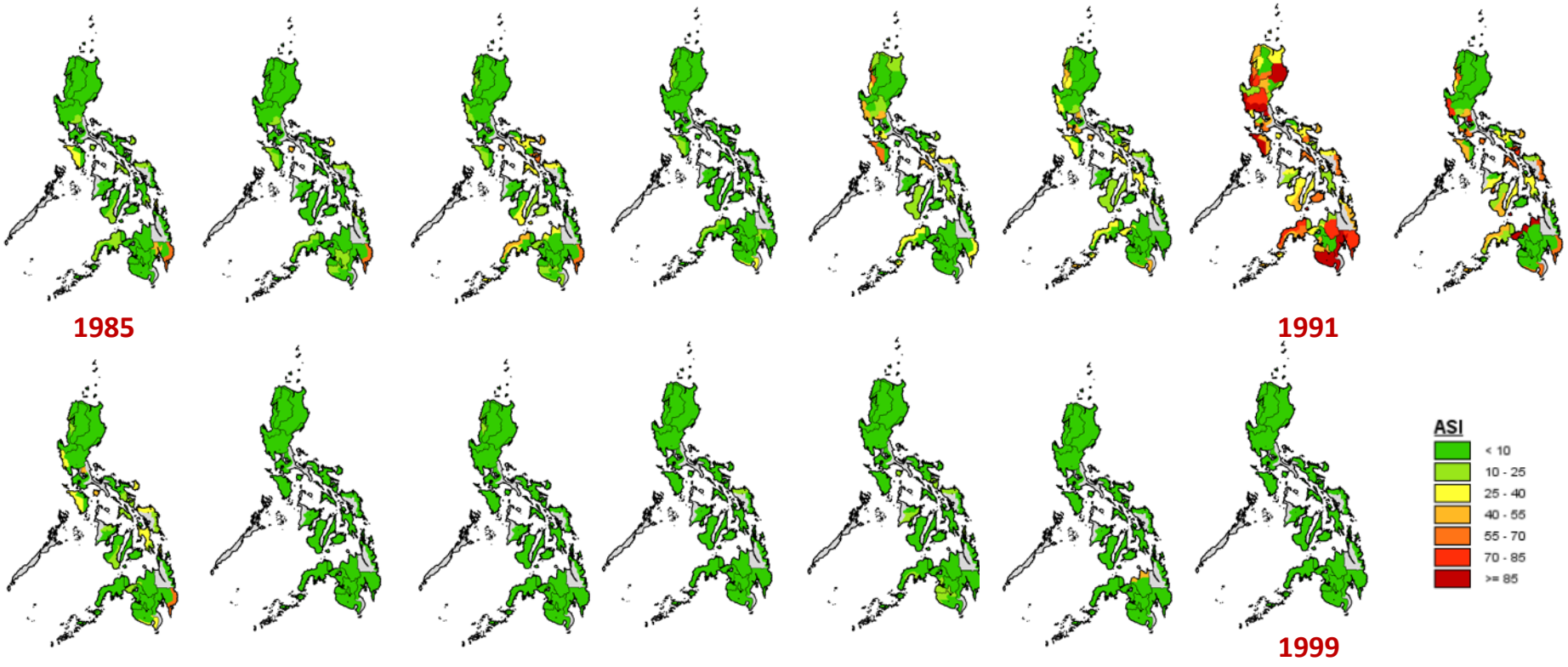
First crop season
1985



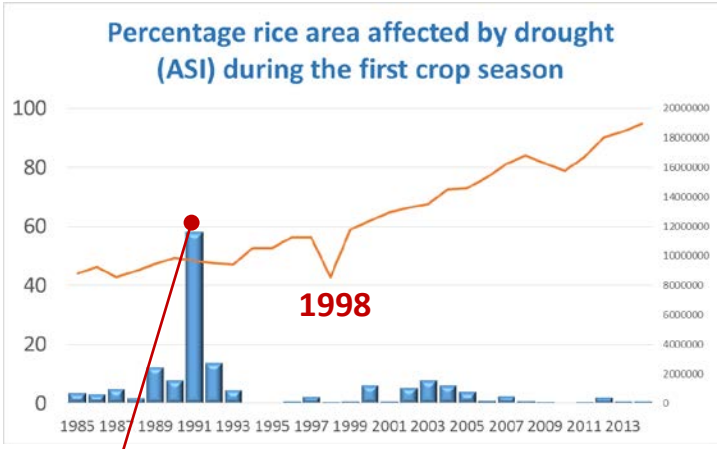
b. spatially averaged by province

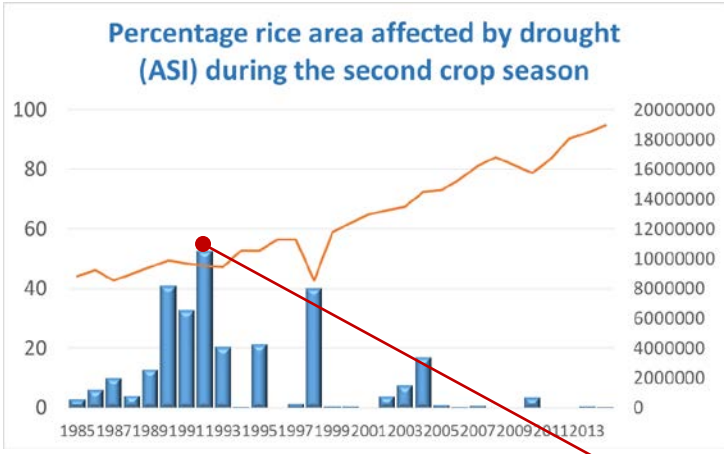


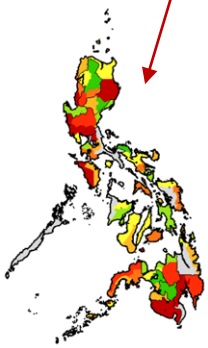
ASIS Outputs: Percentage of rice area affected by drought for the first crop season from 1985-1999



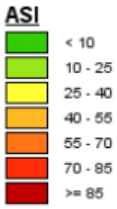
Percentage of rice area affected by drought in Philippines

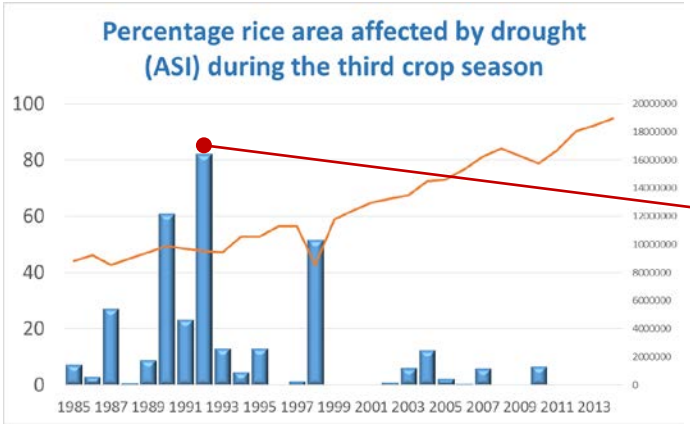


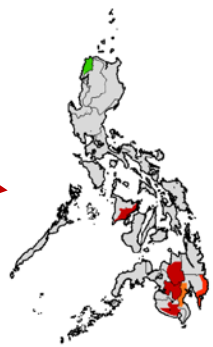




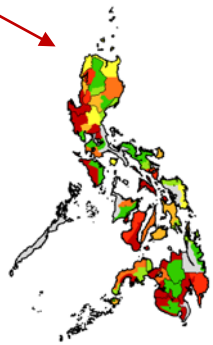
1991







1992



1992

Contribución de ASIS

1. Cuasi-Automático que se alimenta de imágenes preprocesadas por VITO lo garantiza la sostenibilidad del sistema

2. Integración espacio-temporal que no consideran la mayoría de los sistemas de monitoreo agrícola con base en información satelital

3. Serie única de >30 años a 1 km de resolución que permite recuperar la memoria histórica del pixel de haber sufrido un evento de sequía extremo