

# Drought Monitoring Approaches for Parametric Agro-reinsurance in Mexico.

AGROASEMEX, S.A.

Prepared for the North American Drought Monitor Workshop. Mexico City.  
October 2006.



AGROASEMEX is a re-insurance company owned by the Federal Government of Mexico.

As a specialized Agency for Agriculture and Livestock, its mission is to provide producers with effective risk-transference schemes to deal with potential damages.

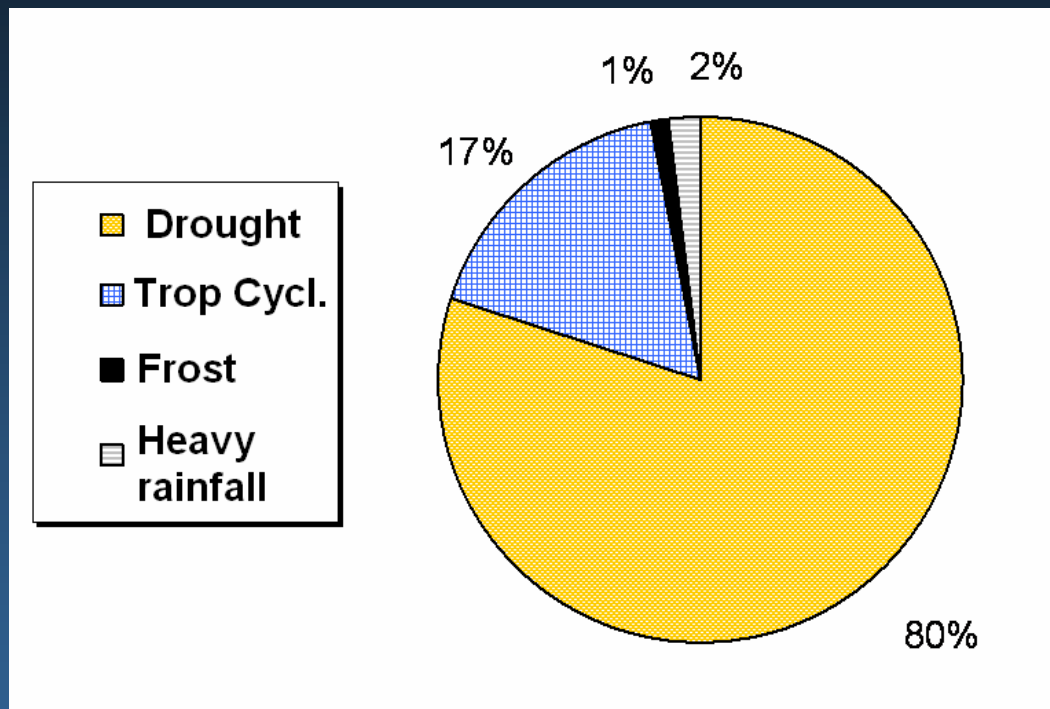
One such scheme is the Catastrophic Crop Insurance. This is a parametric risk-transference tool intended to spread risks and protect the economy in case of extreme lack of rainfall (drought).

The Cat scheme is designed to protect basic crops (maize, beans, sorghum) in non-irrigated areas (therefore is fully climate-variability dependent).

Based on the use of biophysical crop models and climate data, a series of thresholds are identified as parameters to detect drought. So, if the minimum amount of rainfall needed to have a successful development or production is not observed, indemnities take place immediately.

Monitoring indexes are a useful side-tool to assess spatial extension and severity of drought. In particular, the SPI in small timescales seems to be accurate enough for verification purposes.

In the agro-reinsurance sector of Mexico, the major risks to cope with are related to climate variability and extremes



Disasters in agriculture 1995-2003 related to climate extremes  
(based on info by SAGARPA).

Weather stations play an essential role in parametric crop insurance.  
Example: Weather station selected for parametric insurance.  
15076 “Presa Tepetitlán, Estado de México” (SMN/GASIR).



Required features:  
At least 25 years of data.

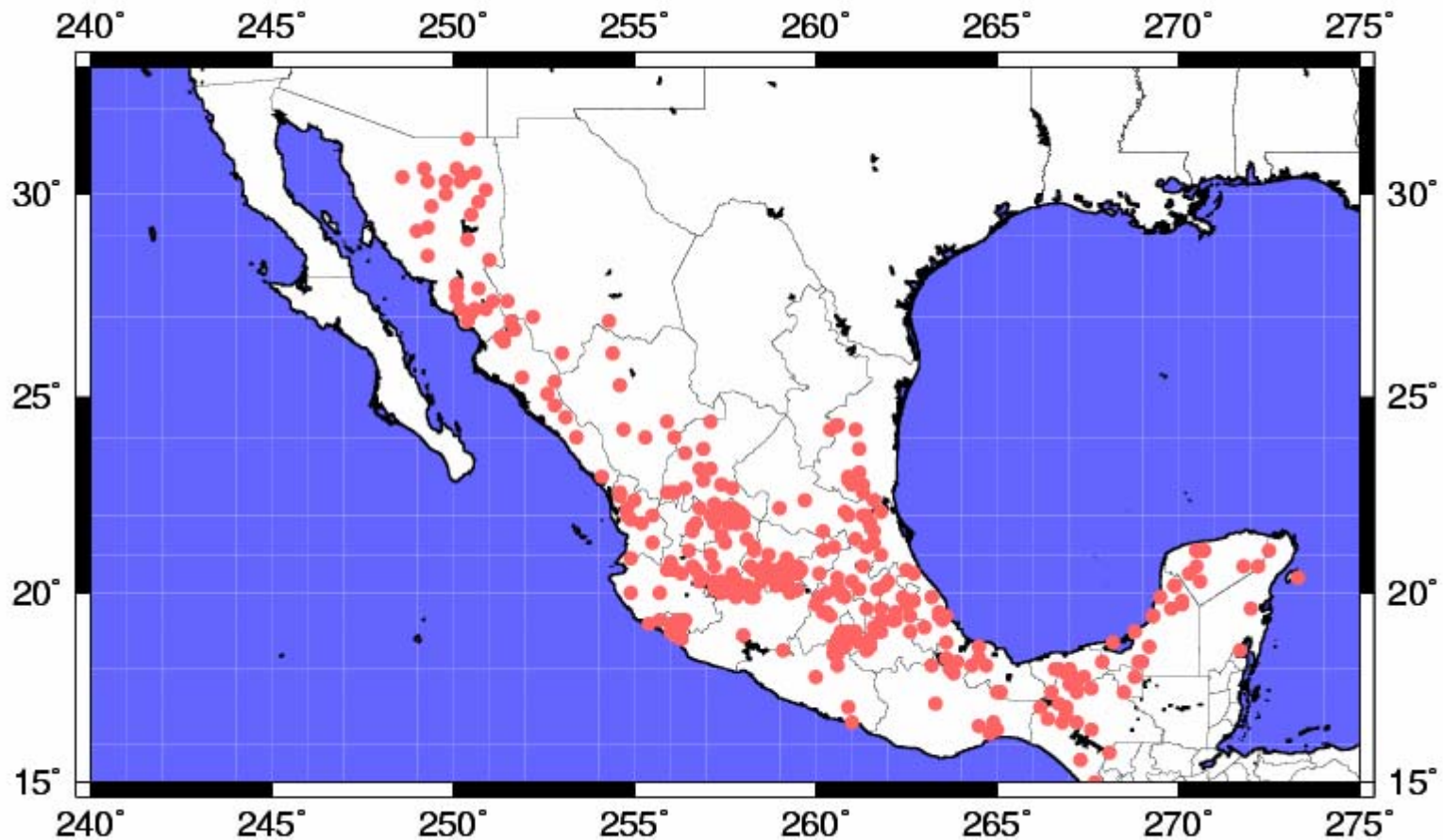
90% of records available in  
the data-series.

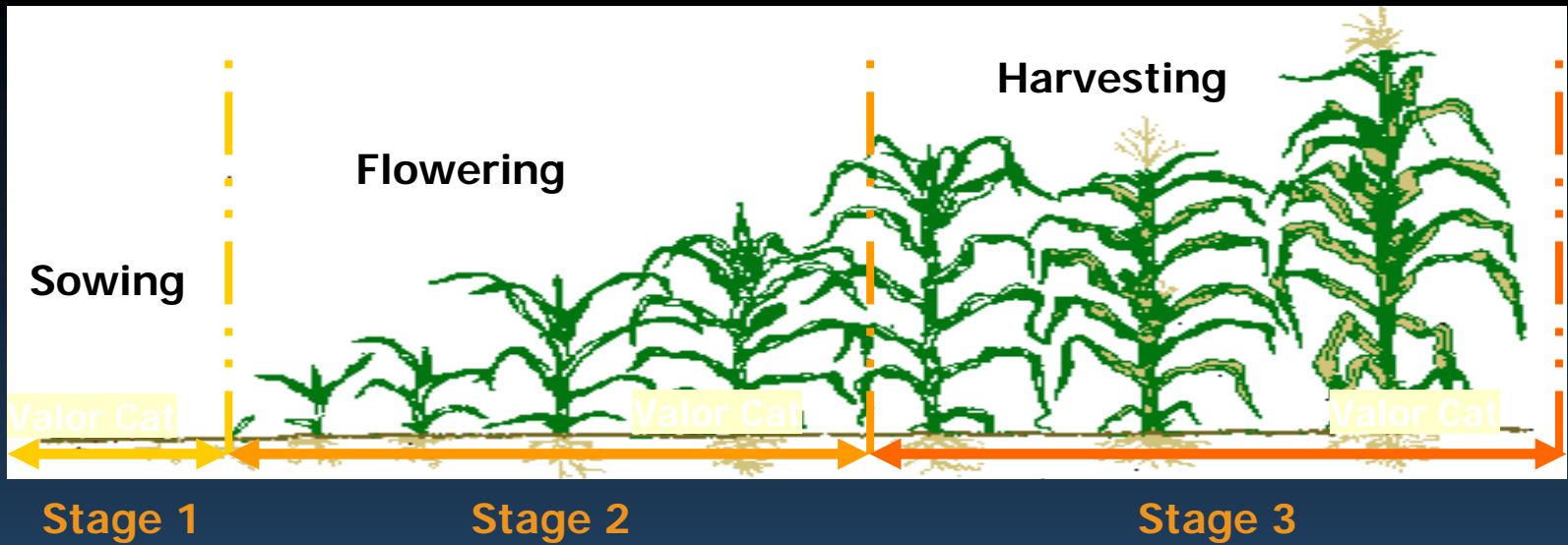
In the nearness of crop  
areas (no irrigated)

Updated metadata (GPS  
location and photo)

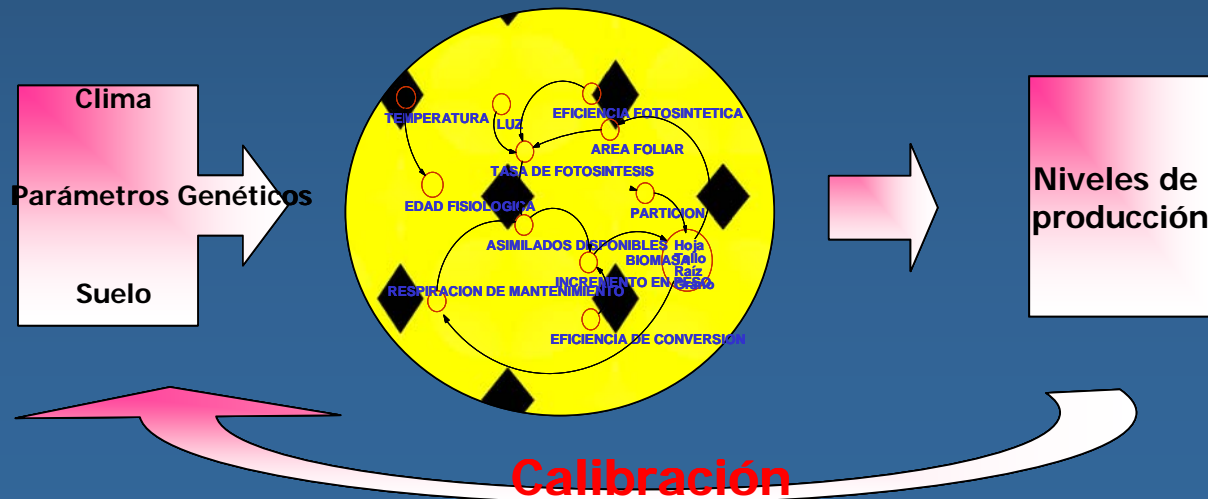
Real-time reports.

Considering the features needed in weather stations for insurance (international market), there is potential to include about 345 stations in the scheme.





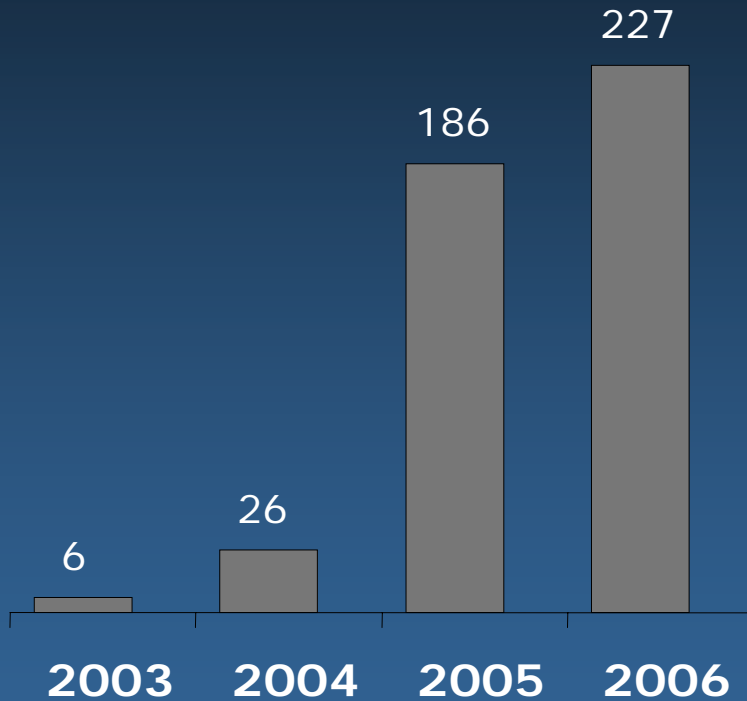
Climate indexes (rainfall thresholds) are determined for each region surrounding a selected weather station. To do so, simulations are made using biophysical growth models. The simulations consider the vegetal species, soil type and climate.



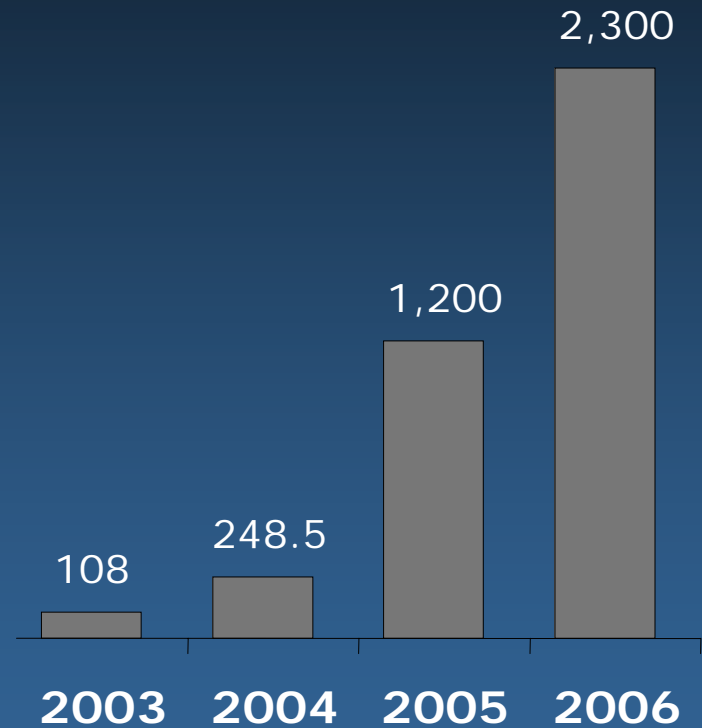
# CONTRACT SPECIFICATIONS

1. Insured parts are the Federal Government and the Governments of the Federal States.
2. Sum insured is at least the amount given by FAPRACC in case of climatic contingency (80 USD / ha).
3. Insured parts select the areas to protect (therefore the weather stations), crops and surface, based upon the portfolio available in AGROASEMEX.
4. Indemnities take place when the observed rainfall during a growing stage is lower than the threshold.
5. Indemnity is once and for all during a crop cycle.

## WEATHER STATIONS USED IN CAT CROP INSURANCE



## INSURED SURFACE (Millions of Has.)



The risk is transferred also to the international weather market.

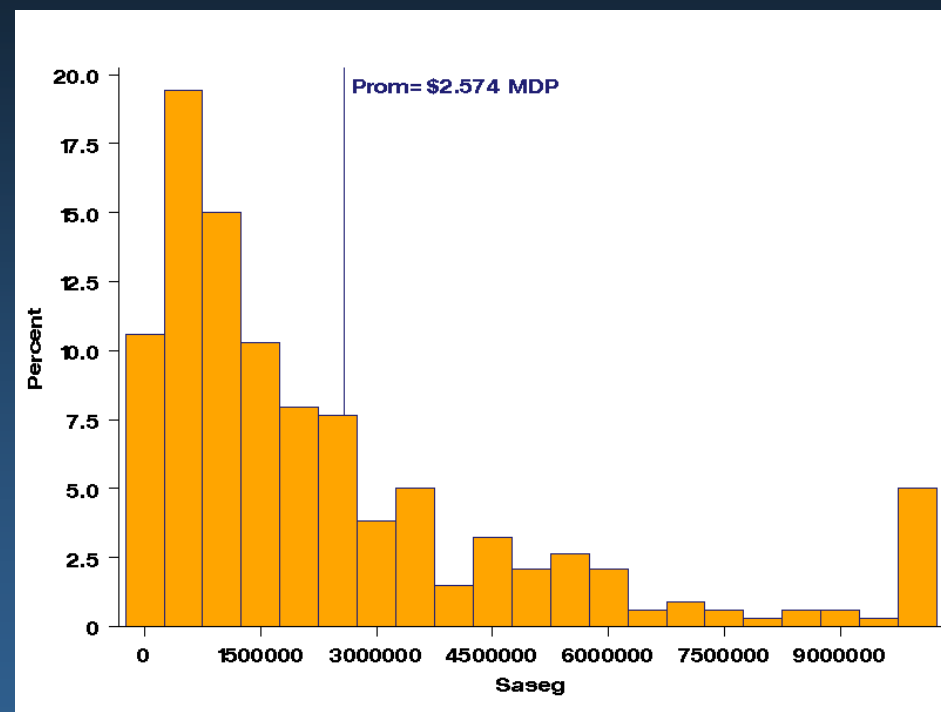
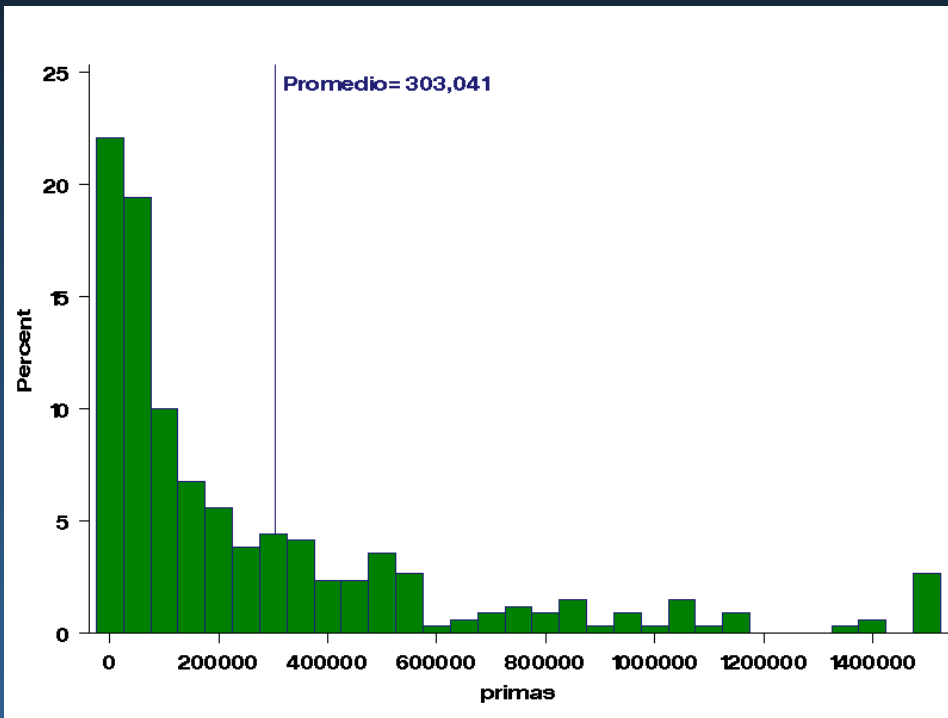


# What happens if a weather station is removed from operation?



- Cat Crop Insurance can not be offered.
- The maximum insurable surface by weather station is 24,250 Has (according to the regulatory maximum exposure of the company)
  - Insured sum of 1 Ha is between \$560 y \$800 mexican pesos (FAPRACC). Therefore, the insured sum in each weather station might be between \$13.5 y \$19.0 million pesos .
  - The average premium is 15%: \$2.0 million pesos

# What happens if a weather station is removed from operation?...



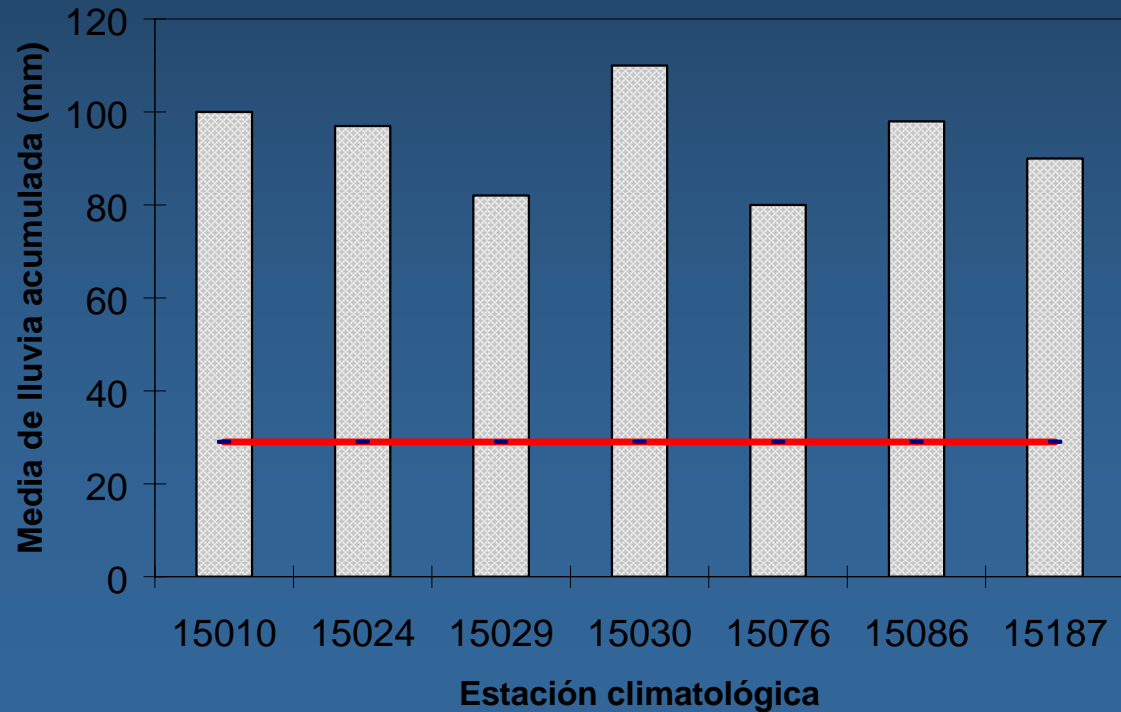
- Distribution of premiums and insured sum in 2005

Examples of tresholds for different crops in four states of Mexico (flowering and harvesting)

Estado	Cultivo	Triggers (mm acumulados de lluvia)	
		Floración	Cosecha
Zacatecas	Frijol	≤ 85 Del 11 de julio al 25 de agosto	≤ 46 Del 26 agosto al 10 de octubre
Oaxaca	Maíz	≤ 220 Del 11 de julio al 10 de septiembre	≤ 139 Del 11 de septiembre al 10 de noviembre
Tlaxcala	Cebada	≤ 140 Del 1 de julio al 31 de agosto	≤ 52 Del 1 de septiembre al 15 de octubre
Tamaulipas	Sorgo	≤ 111 Del 11 de agosto al 24 de septiembre	≤ 28 Del 25 de septiembre al 23 de noviembre

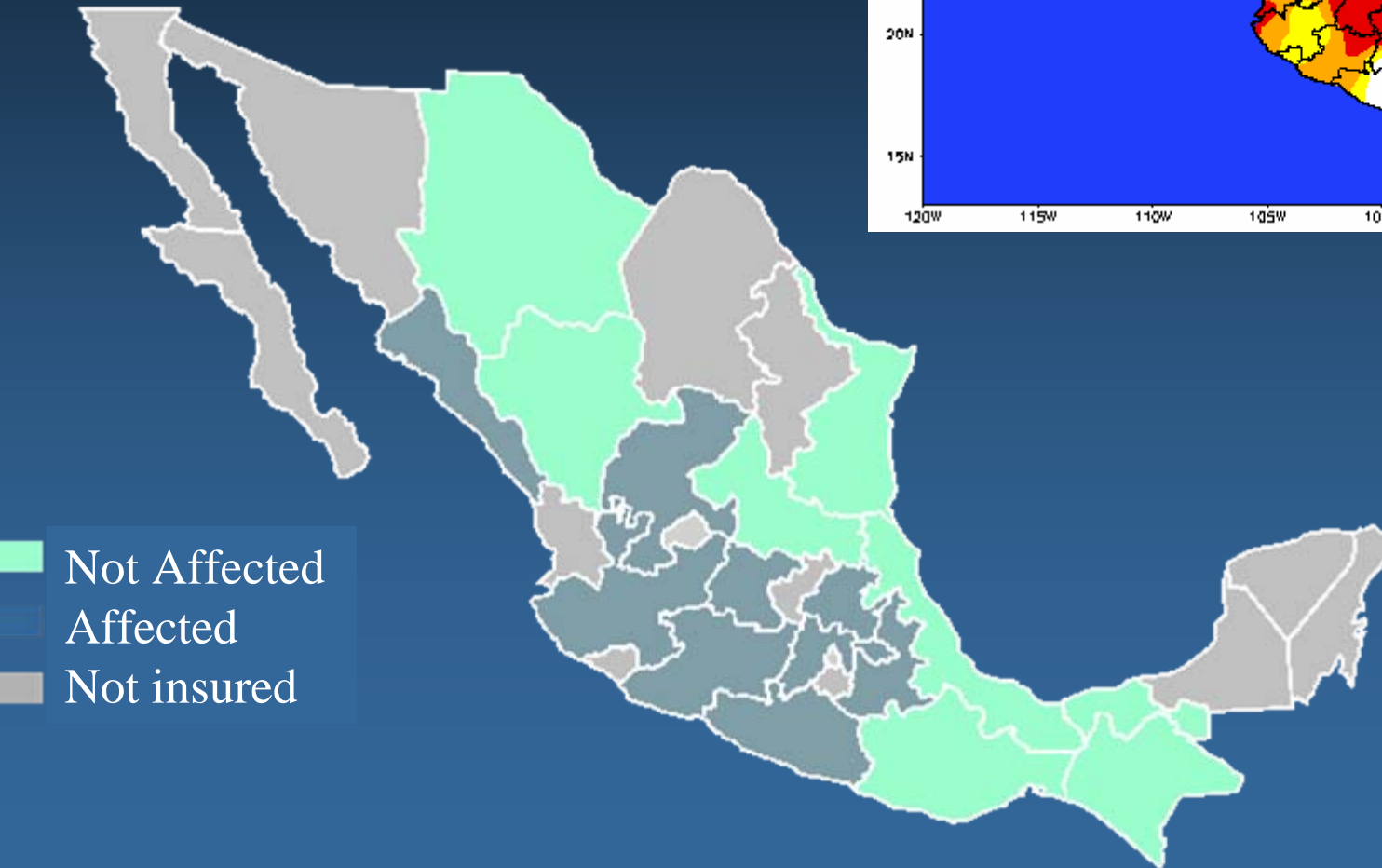
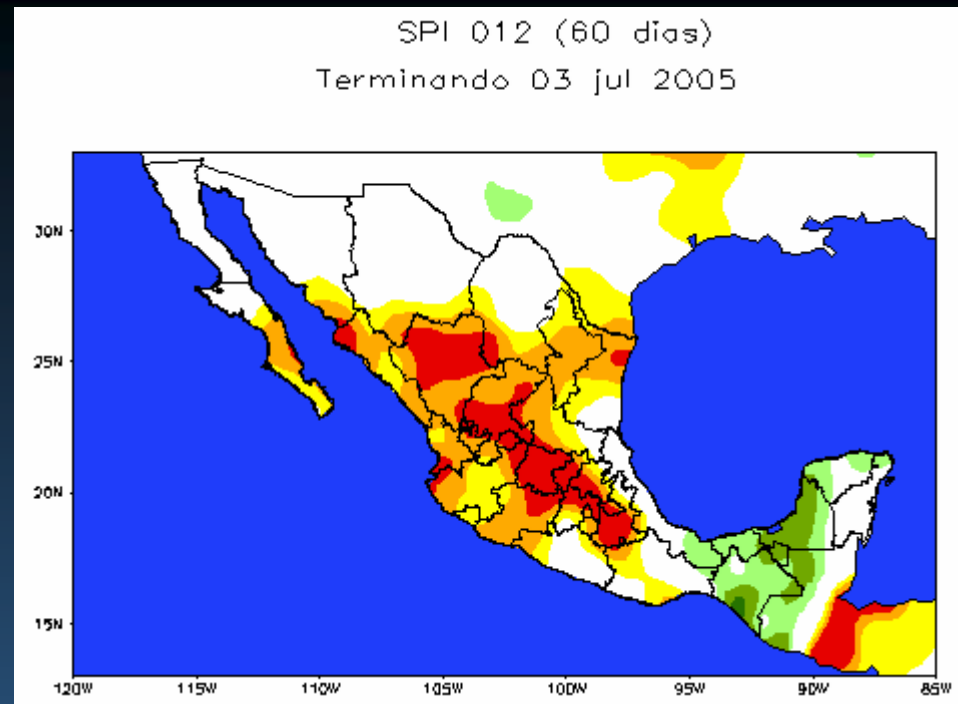
Lluvia promedio
  Valor umbral

The State of Mexico: Rainfall climatology and treshold for the sowing stage.



# Spring-Summer 2005

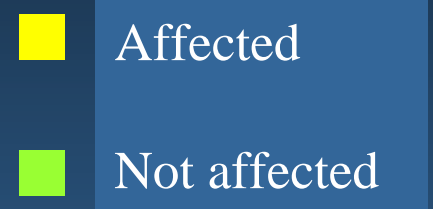
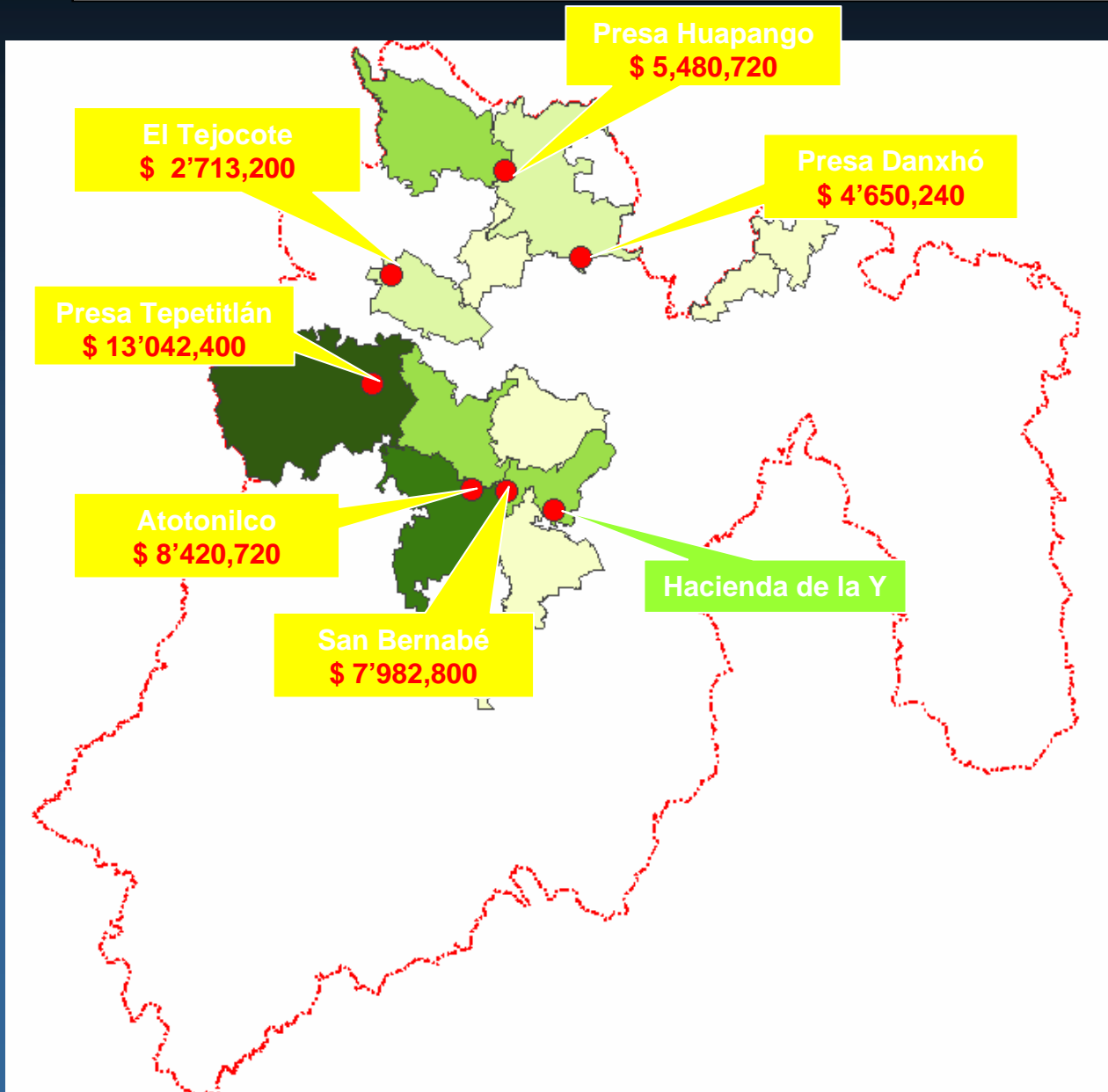
Federal States where surface was insured upon Cat Crop Insurance in 2005 (below) and SPI (right)



# Case of the State of Mexico 2005

- ✓ Onset of the rainy season is around May 14 (climatology)
- ✓ Severe drought was observed.
- ✓ There was not El Niño conditions.
- ✓ Treshold was not reached in 6 of 7 insured weather stations.
- ✓ Indemnities by 4.2 million dollars (88% insured sum)
- ✓ SPI seems to be useful for verifying purposes.

# Weather stations. The State of México 2005 (Maize)



# The State of Mexico: 2005

Crop	Stage 1	Stage 2	Stage 3
	<i>May 1 to Jun 9</i>	<i>Jun 10 to Aug 10</i>	<i>Aug 11 to Oct 10</i>
Maize	29 mm	163 mm	137 mm
	<i>May 15 to Jun 30</i>	<i>Jul 01 to Aug 15</i>	<i>Aug 16 to Sep 30</i>
Beans	29 mm	85 mm	52 mm

CLICOM ID	Name	Treshold Stage 1	Observed	Indemnity
15010	Atotonilco	29 mm	14	8.4
15030	Hacienda La Y	29 mm	48 -	
15086	San Bernabé	29 mm	16	8
15076	Presa Tepetitlán	29 mm	18	13
15024	Presa Danxho	29 mm	6	4.7
15187	Presa Huapango	29 mm	28	5.5
15029	El Tecojote	29 mm	23	2.7
			<b>Millions of pesos:</b>	<b>42.3</b>

# The State of Mexico: 2005

## Field status





# The State of Mexico: 2005

## Field status



Field status on June 10th 2005 surrounding the weather stations:

i) 15076 Presa Tepetitlán, & ii) 15086 San Bernabé.

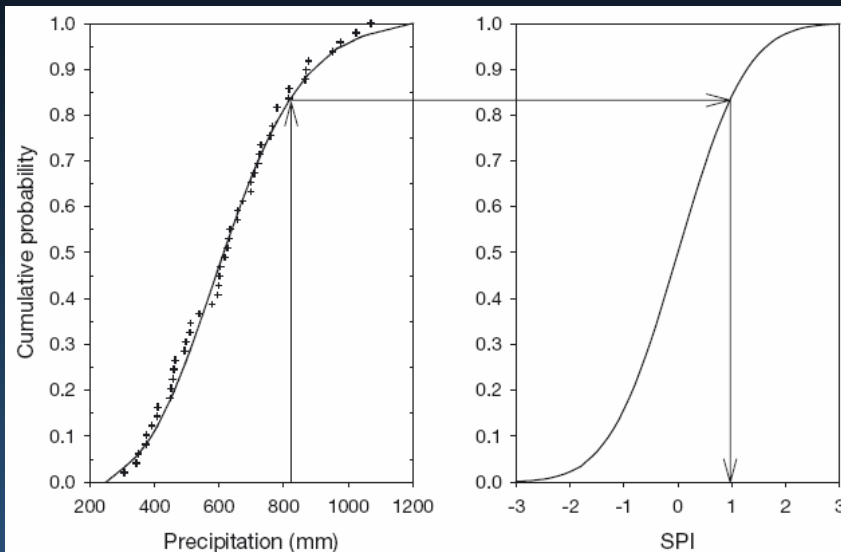
i)



ii)



# Advantages of using SPI



SPI	Categoría
> 2.0	Extremely wet
1.5 / 1.99	Very wet
1.0 - 1.49	Wet
0.99 / -0.99	Normal
-1.0 / -1.49	Moderated drought
-1.5 / -1.99	Severe drought
< -2.0	Extreme drought

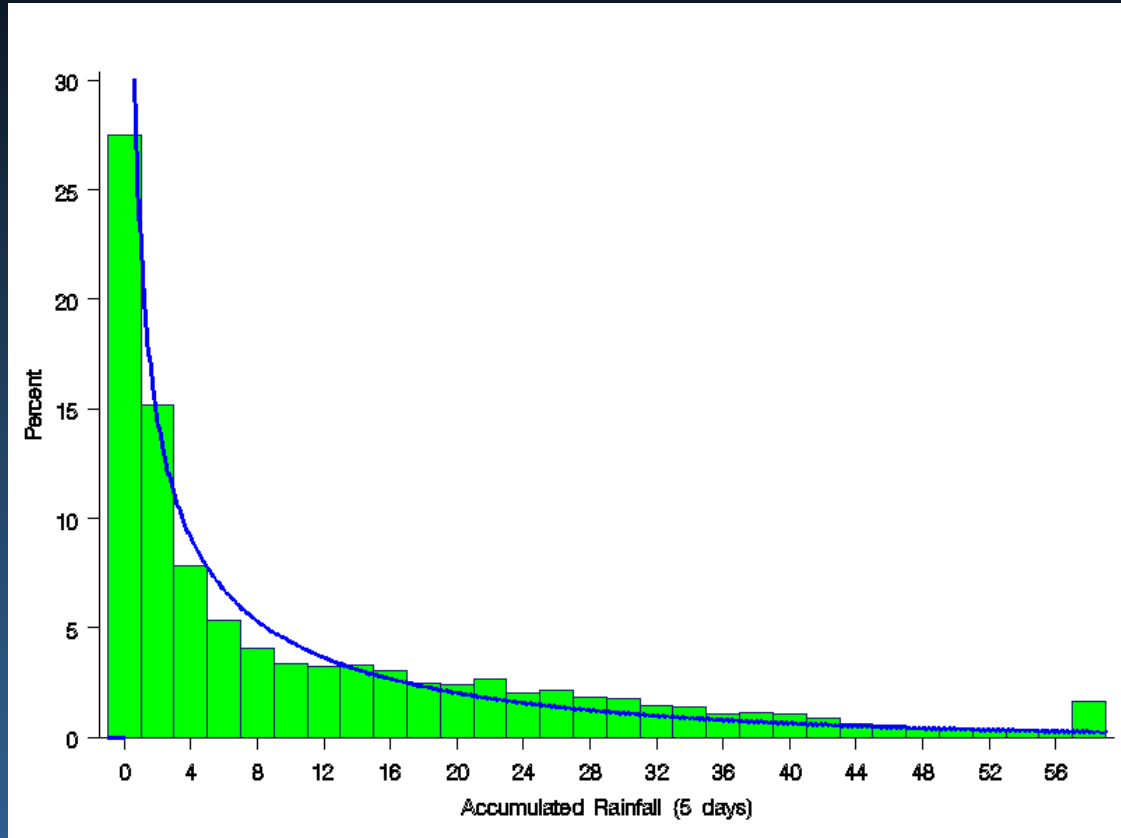
- ✓ Its calculation depends only on rainfall data availability.
- ✓ Provides an objective way to measure drought.
- ✓ Might be estimated for any time-scale.

*Disadvantage (for agriculture):*

- ✓ Soil moisture information is not considered.

The original SPI was adapted from monthly timescale to pentadal timescale (in order to see what's going on within growing stages).

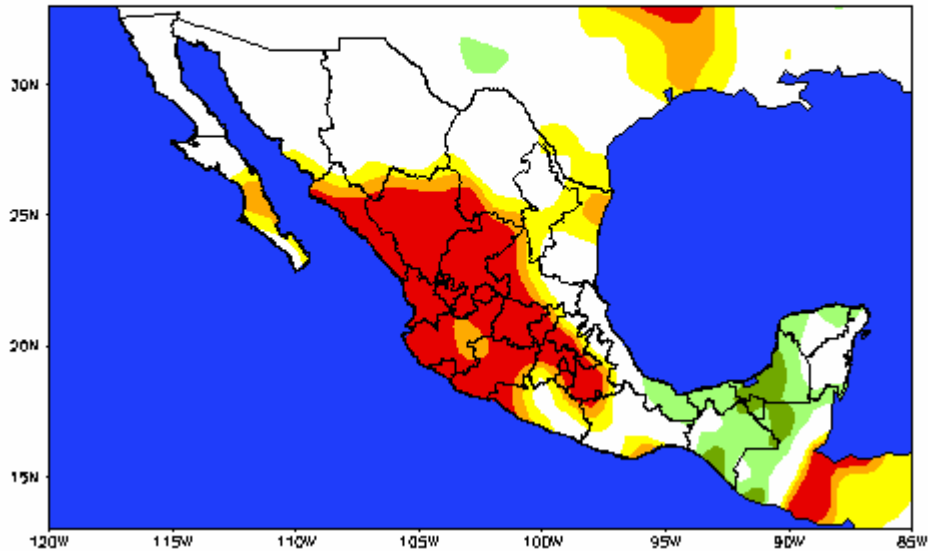
As in the original hypothesis, accumulated rainfall in the 5 day timescale fits into a gamma PDF.



The US National Agricultural Decision Support System uses the SPI in a weekly basis.

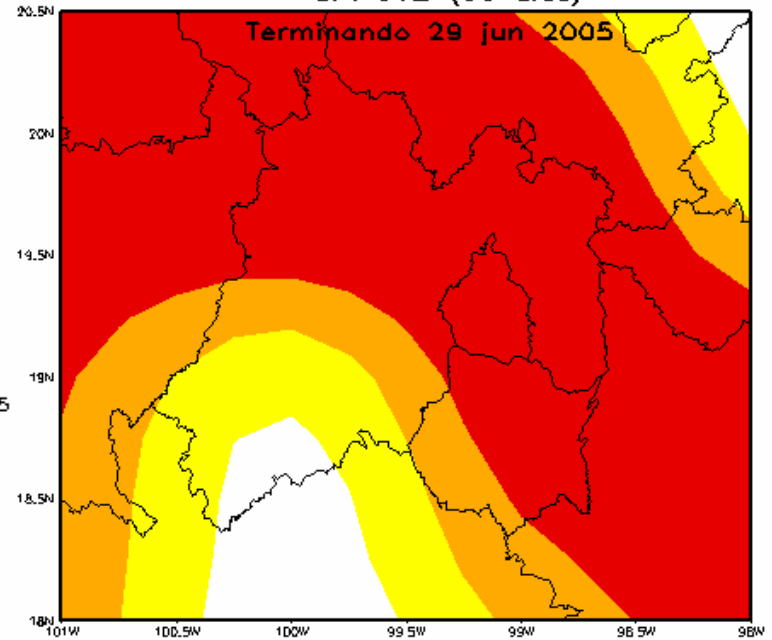
This work considered McKees' (1993) theoretical formulation and modifications to Edwards' source code (Mendez, 2006).

SPI 012 (60 días)  
Terminando 29 jun 2005

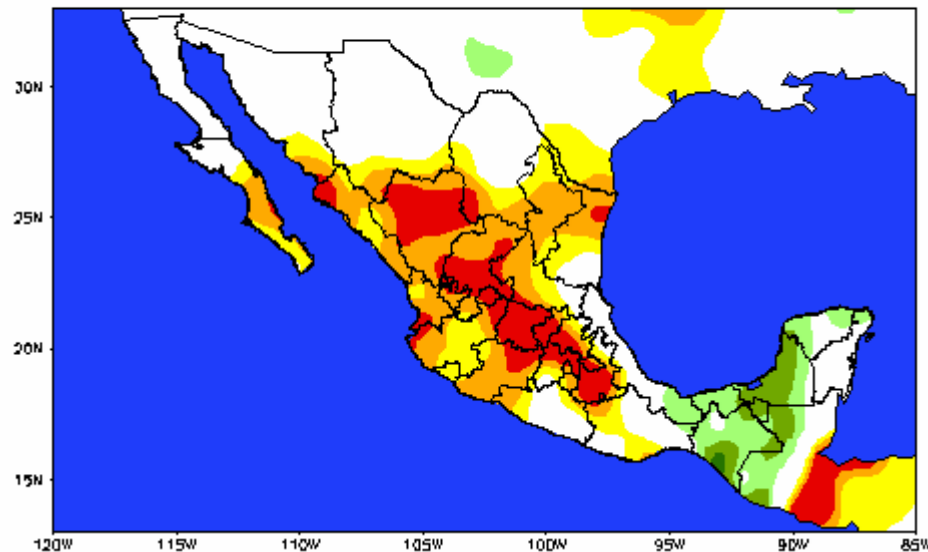


SPI 012 (60 días)

Terminando 29 jun 2005

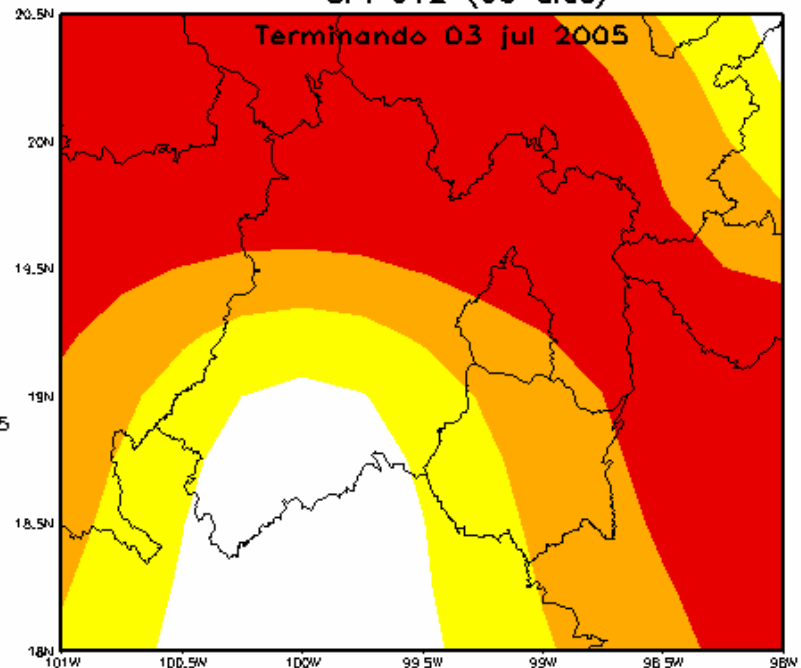


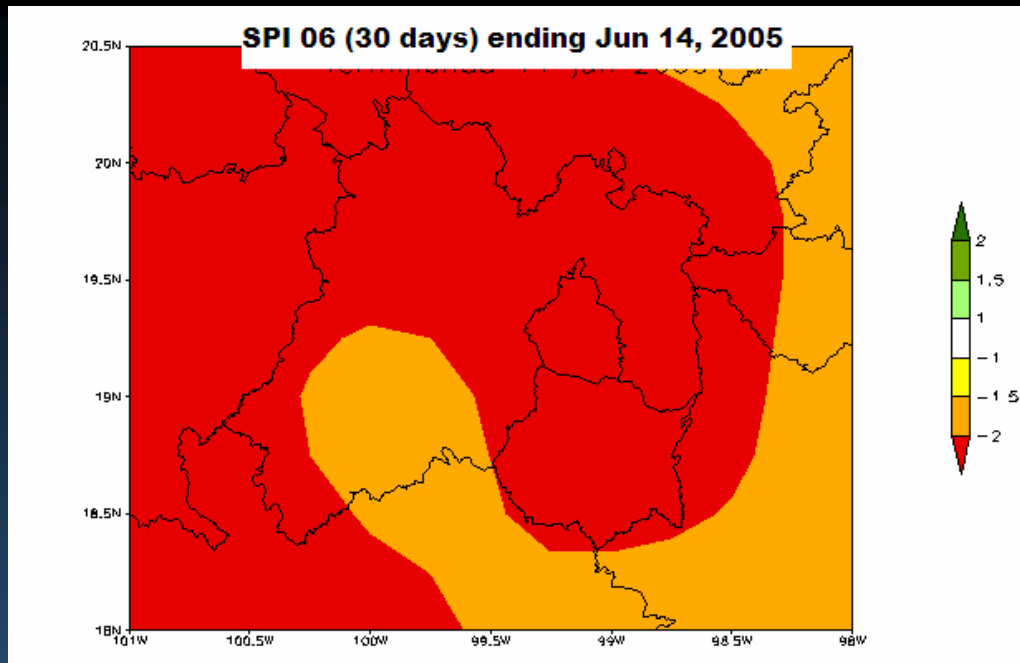
SPI 012 (60 días)  
Terminando 03 jul 2005



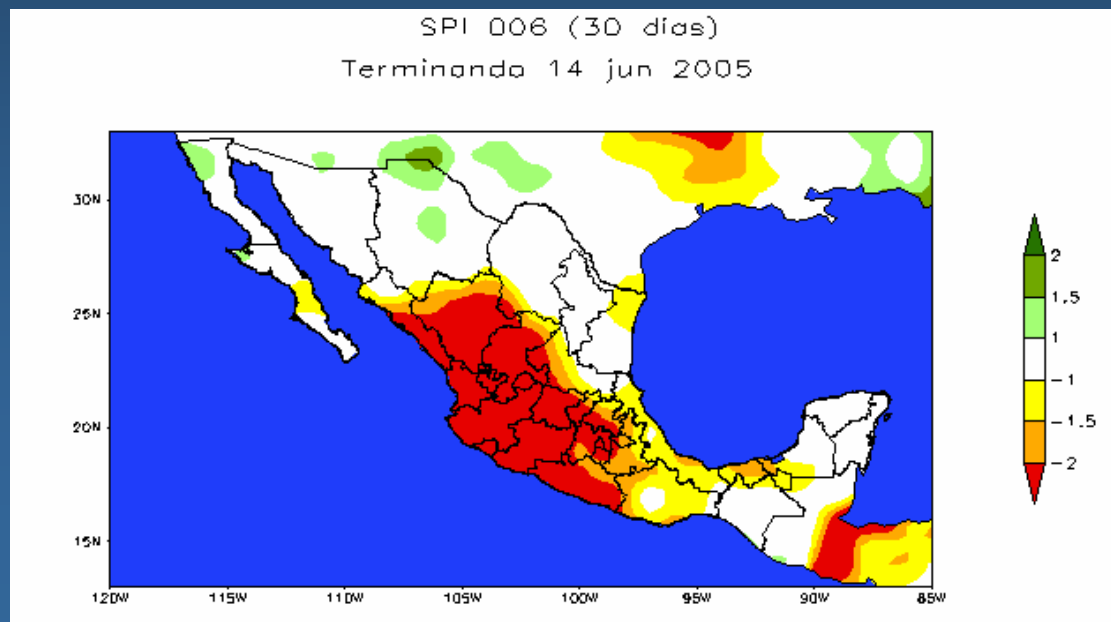
SPI 012 (60 días)

Terminando 03 jul 2005





The shorter the period of analysis the better the spatial pattern (valid for the sowing stage).



# North American Drought Monitor

June 2005

Released: Friday, July 15, 2005






<http://www.ncdc.noaa.gov/nadm.html>

## Analysts:


Canada - Ted O'Brien  
Dwayne Chobanik  
Mexico - Miguel Cortez  
Art Douglas  
U.S.A. - Douglas LeComte  
David Miskus\*  
Brad Rippey\*

(\* Responsible for collecting analysts input & assembling the NA-DM map)

## Intensity:

-  D0 Abnormally Dry
-  D1 Drought - Moderate
-  D2 Drought - Severe
-  D3 Drought - Extreme
-  D4 Drought - Exceptional

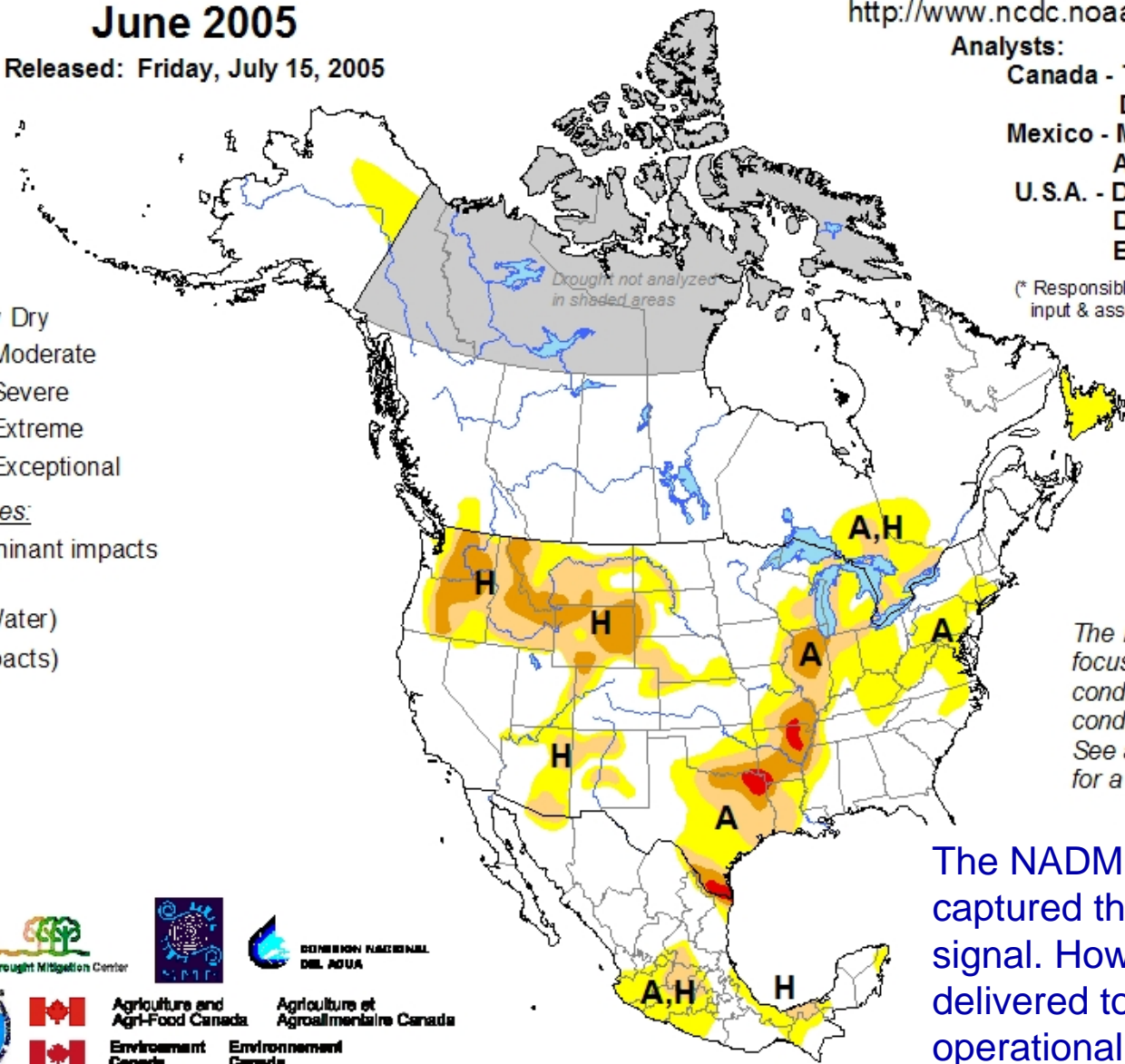
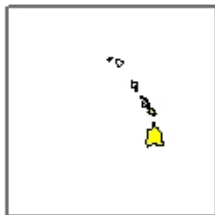
## Drought Impact Types:

 Delineates dominant impacts

A = Agriculture

H = Hydrological (Water)

(No type = Both impacts)



*The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text for a general summary.*

The NADM also captured this drought signal. However it is delivered too late for operational (indemnities) purposes.



Agriculture and  
Agr-Food Canada

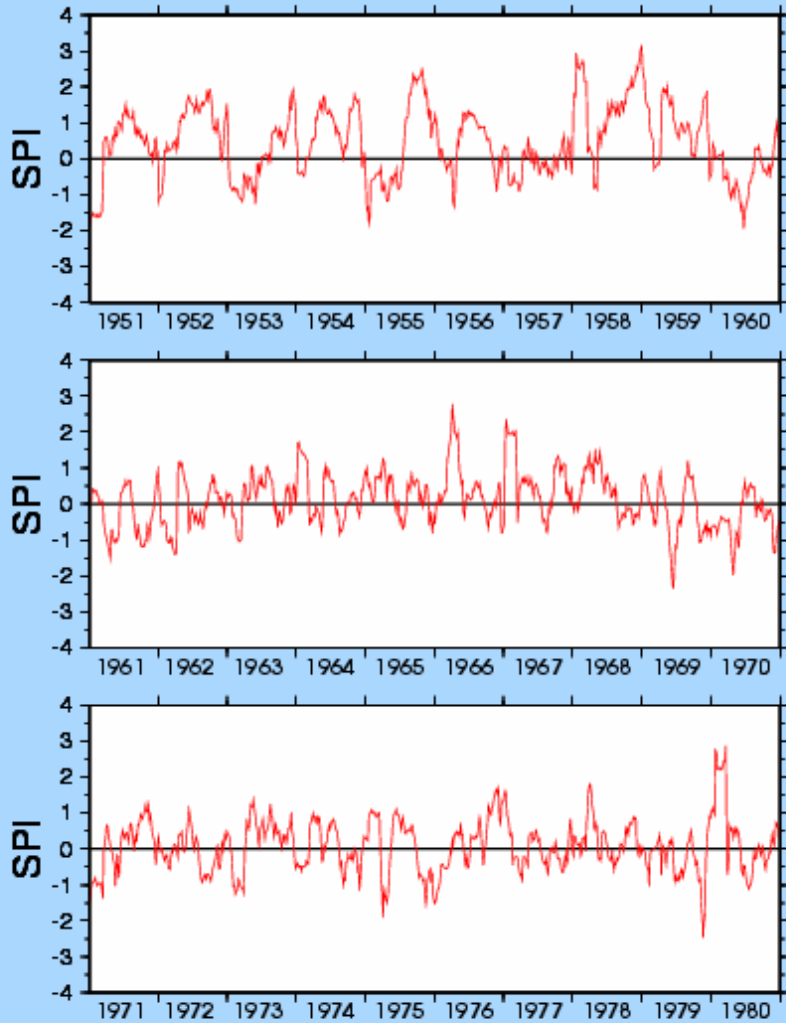


Environment  
Canada

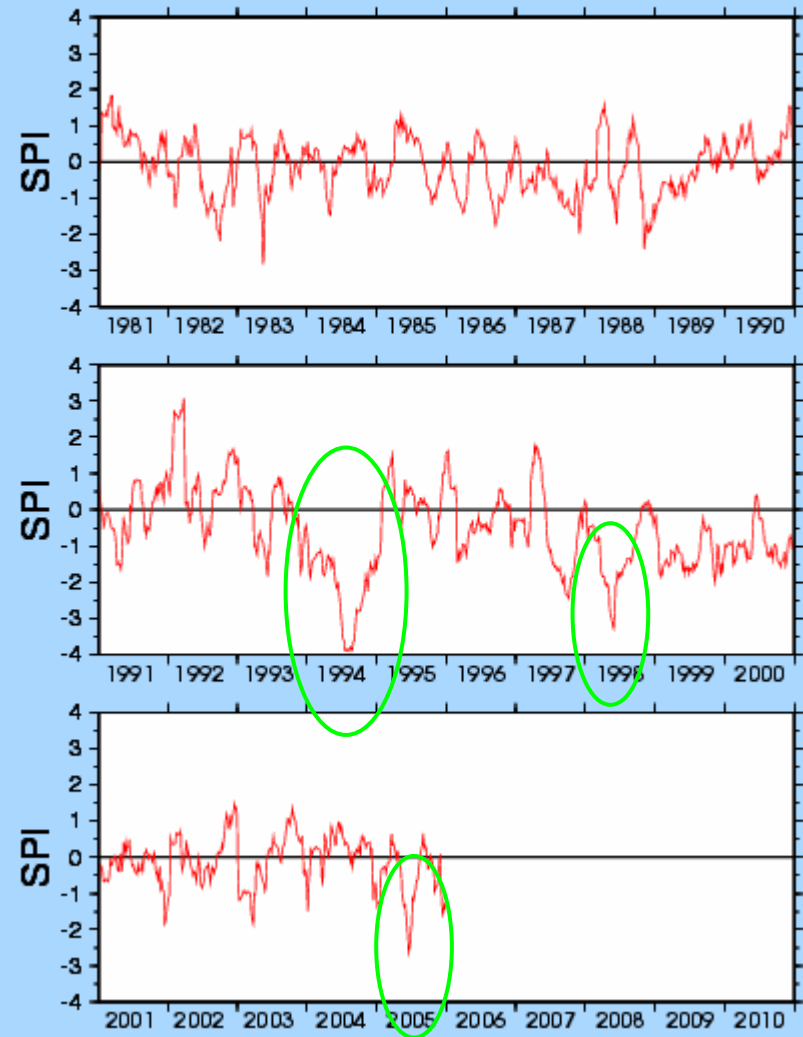


Environnement  
Canada

SPI 12 ( 60 dias)  
ESTACION 15010



SPI 12 ( 60 dias)  
ESTACION 15010



Drought in 2005 (neutral ENSO) was as strong as drought in 1998 (strong El Niño). Both of them were weaker than 1994's drought.



## Concluding remarks

- Implementation of Catastrophic Crop Insurance is possible when rainfall thresholds are determined based on climate-soil-vegetation relationships.
- Operation of this insurance is subjected to the availability of weather stations and continuity in the time-series.
- Extreme drought can occur even though ENSO conditions remain neutral.
- The SPI in small timescales (pentads, weeks) might be useful for regional verification purposes when a drought affects the growth of grains.

## What would be ideal in drought monitoring and research (in Mexico).

More strategic and less opportunistic

Looking forward as well as backward.

Capable of planning new services beside justifying decisions in the past.

Tailored products for different users/applications.

## Aknowledgements.

The following people contributed to this work.

### *AGROASEMEX, S.A.:*

Jesús Escamilla led the designing of parametric insurance for agriculture.

Mario Cuesta began the use of SPI with applications in parametric insurance.

Luisarturo Castellanos provided statistical analysis and graphics.

Jorge Luis Vazquez prepared this presentation.

Jorge Cuellar and Inés Zuñiga made the field-work and took the photos.

### *CNA (SMN and GASIR):*

Ricardo Villalobos is in charge of providing operational data.

Alejandro Gonzalez and Adolfo Portocarrero provided historical data.

Miguel Cortez provided guidance on seasonal prediction and diagnosis.

### *CCA-UNAM:*

Matías Mendez modified the original SPI source-code and adapted it to the 5-day timescale.

USMEX historical gridded data provided by the Climate Prediction Center, NOAA.

AGROASEMEX and CNA authorities established agreements which made possible the operational cat crop insurance.