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Drought Monitoring Activities in Mexico

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National Meteorological Service of Mexico (SMN)

U.S. Drought Monitor Forum

National Drought Mitigation Center

West Palm Beach, Florida. April 16-18 2013

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Outline

How is drought monitoring performed in Mexico

Input indices (SPI, PSDI, percent of normal, temperatura, vegetation and soil moisture)

Other inputs (agriculture reports, forest fires, telephone calls)

Monthly time-line for drought monitoring in Mexico

Formats in which drought monitor is delivered to users

An overview of users

Other efforts/approaches for DM in Mexico

Implementing a national strategy to cope with drought

Perspective of outstanding needs and further steps

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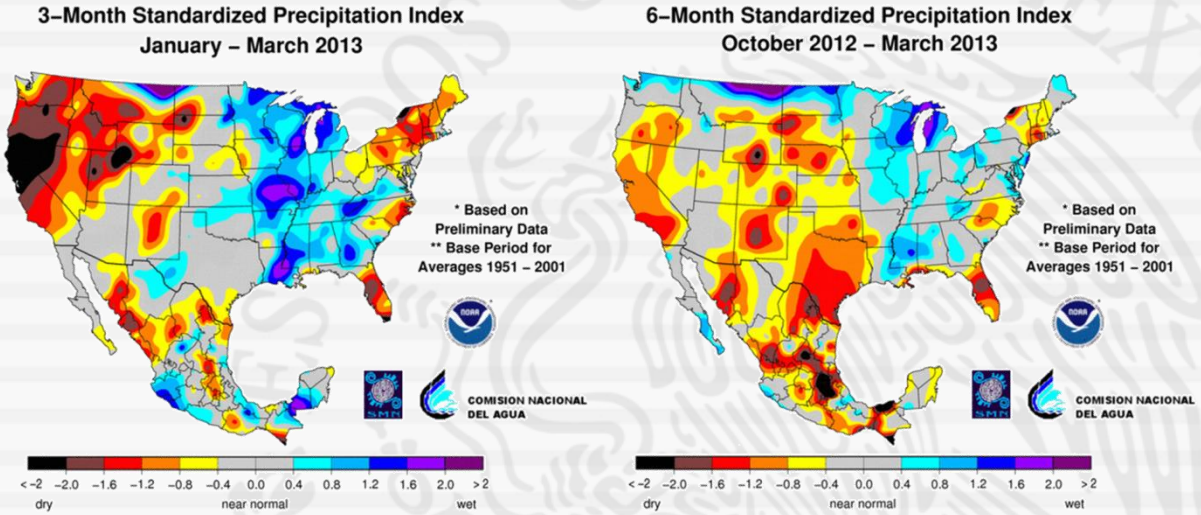
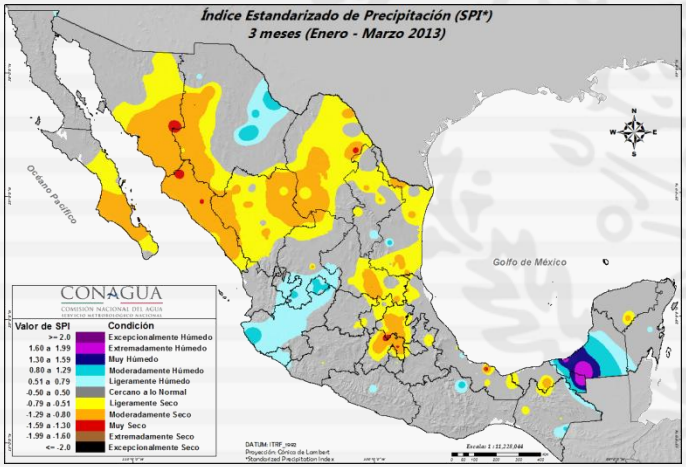
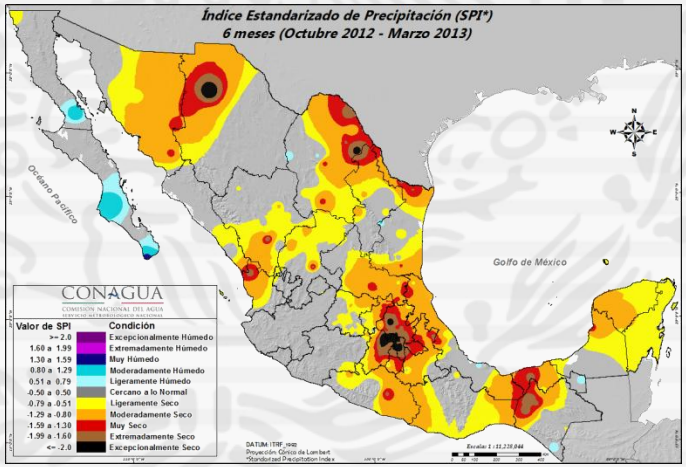
Input indices (Standardized Precipitation Index)

Standardized Precipitation Index (SPI)



Mode A:US-MX unified SPI; calculations made at US centers ***(132 long-term synoptic stations)***.





Mode B: MX-SPI; calculations made at SMN ***(324 long-term synoptic + climatological + hydrological stations)***

Mode A: these 132 stations are reported routinely to NOAA-NCDC, then used to compute indices
Mode B: these 324 stations might have shorter periods of record along with sporadic quality issues

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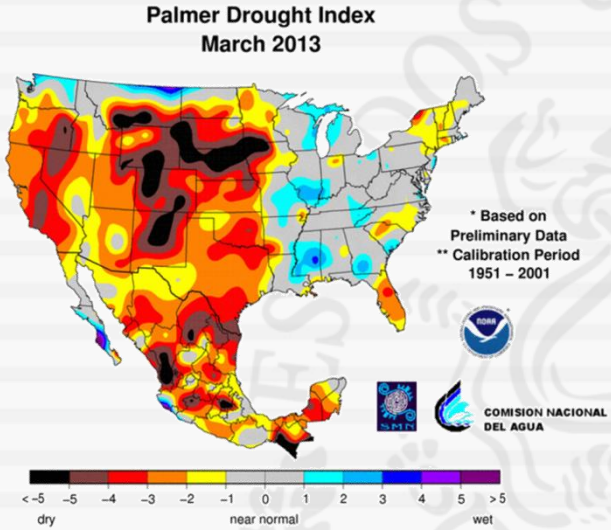
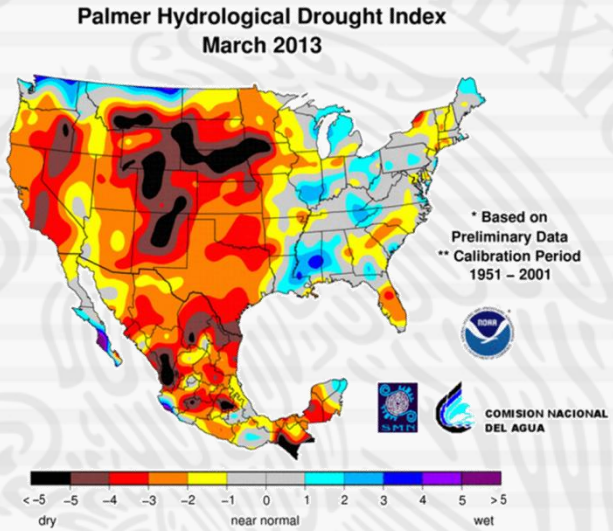
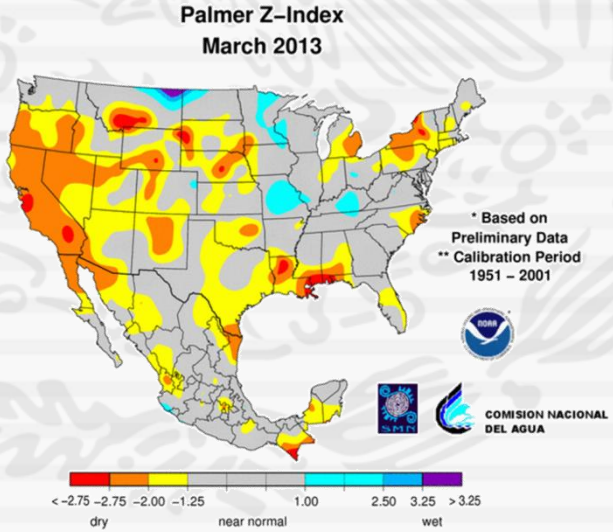
Input indices (Palmer Drought Index)

Palmer Drought Index





Long-term depiction



Short-term depiction

Useful for long-term analysis, but uncalibrated in Mexico though.
As of today the index is calculated in the US and SMN has not implemented yet a way for its calculation.

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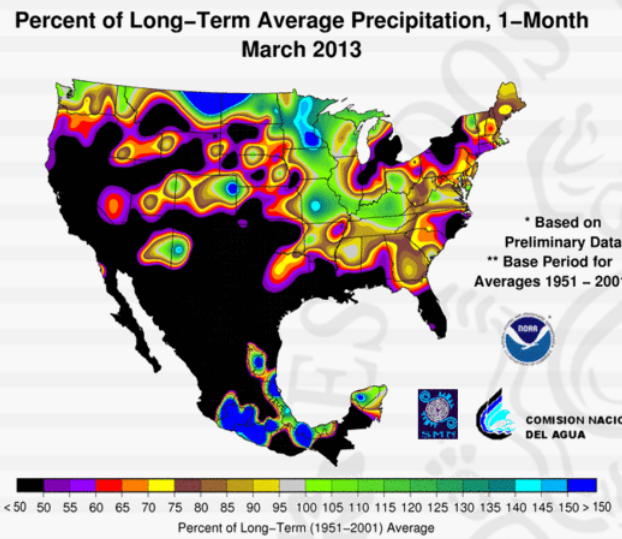
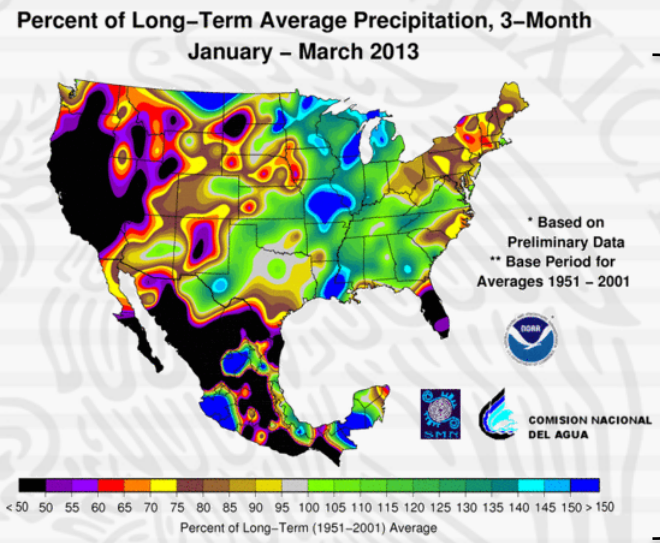
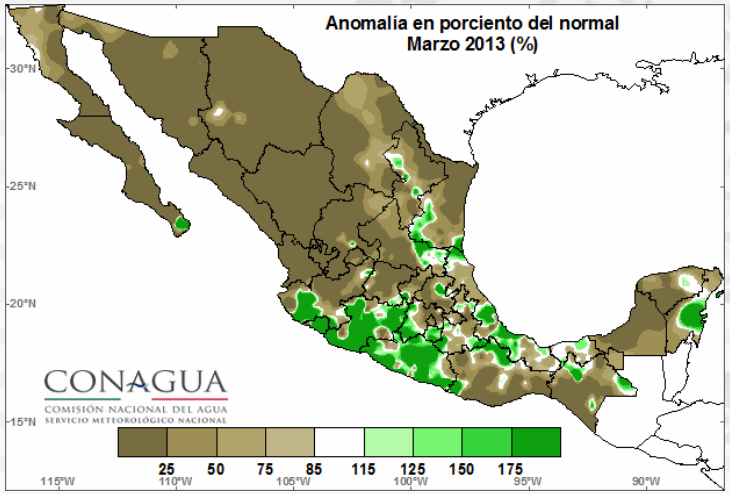
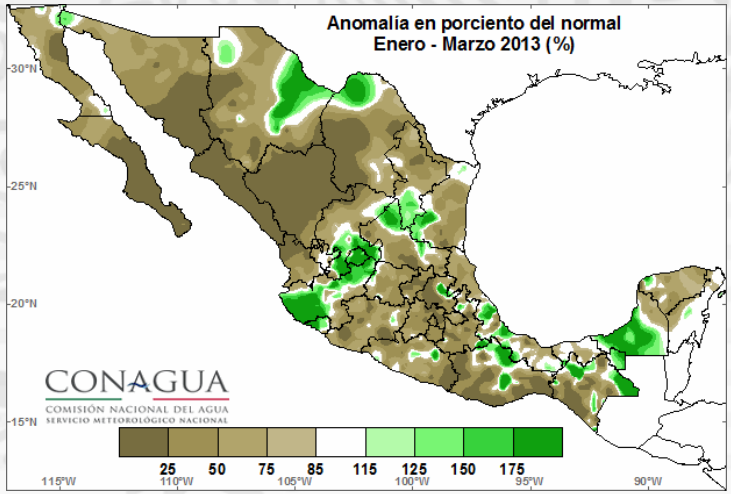
Input indices (percent of normal precipitation)





Mode A:US-MX calculations





Mode B: SMN calculations

Mode B: Interpolated data: observed vs Normal (1971 to 2000)

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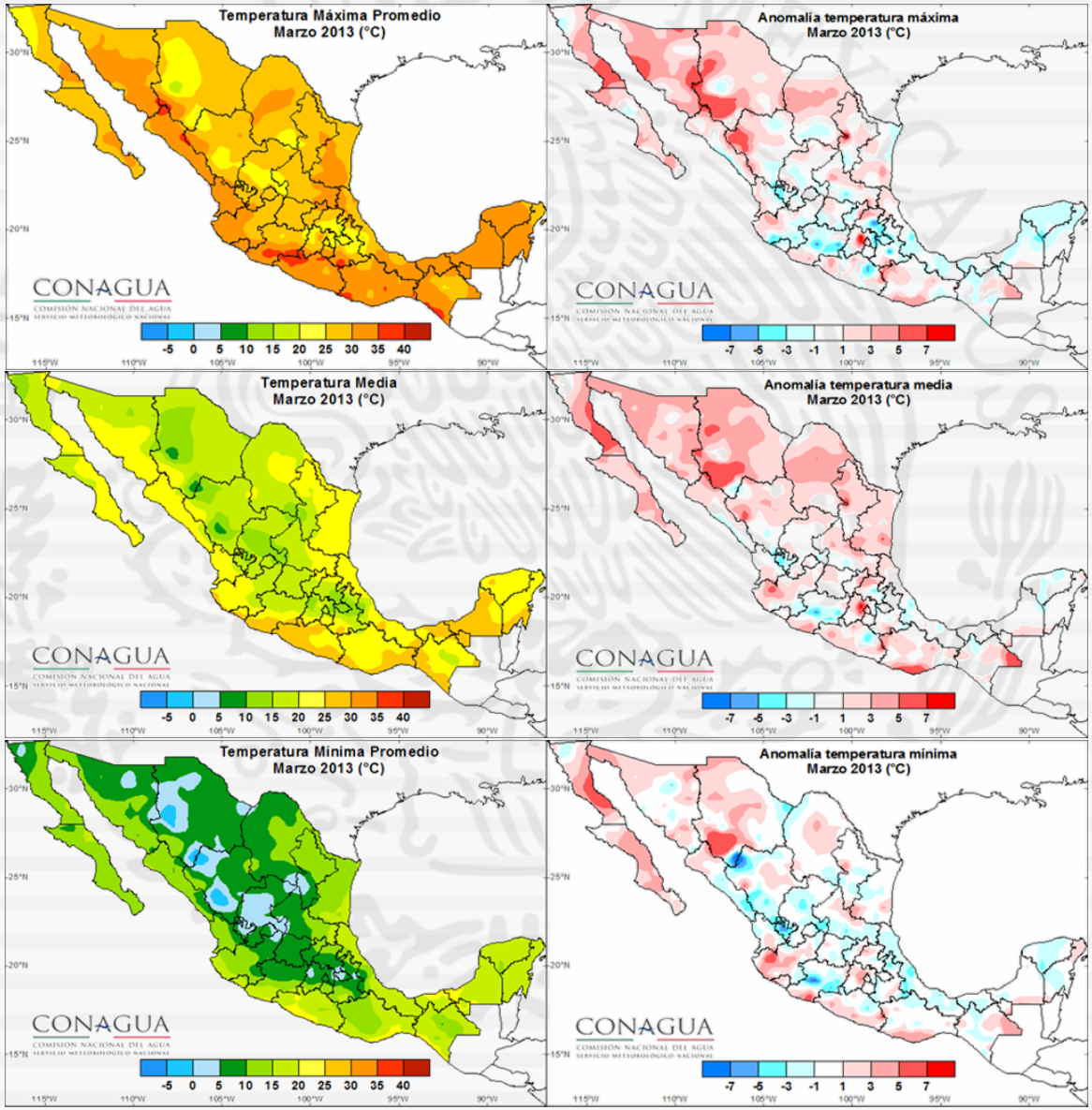
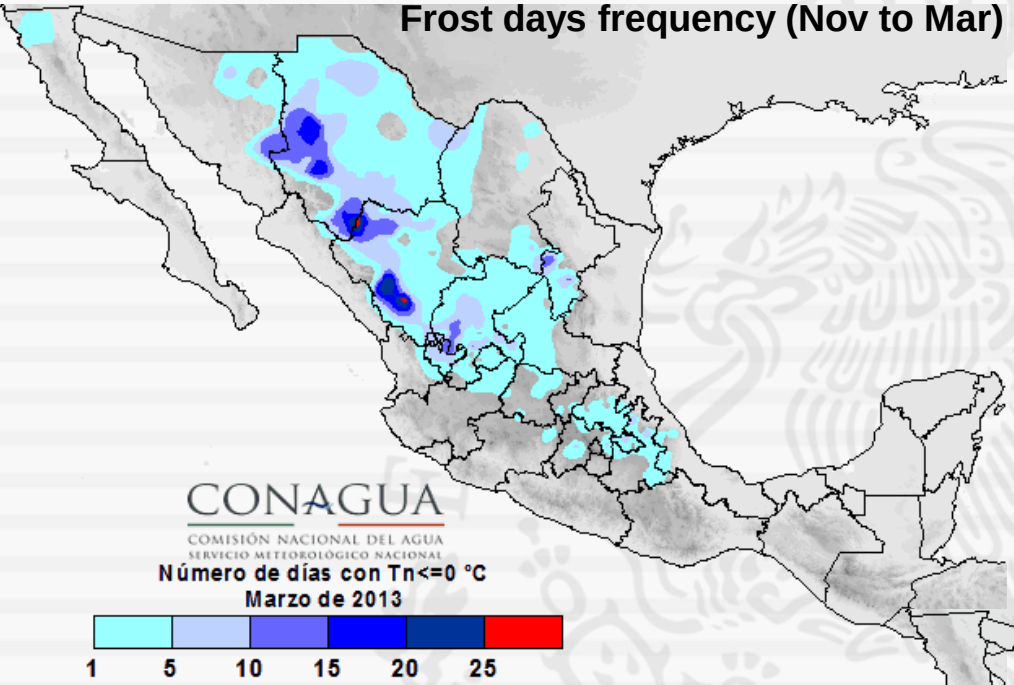
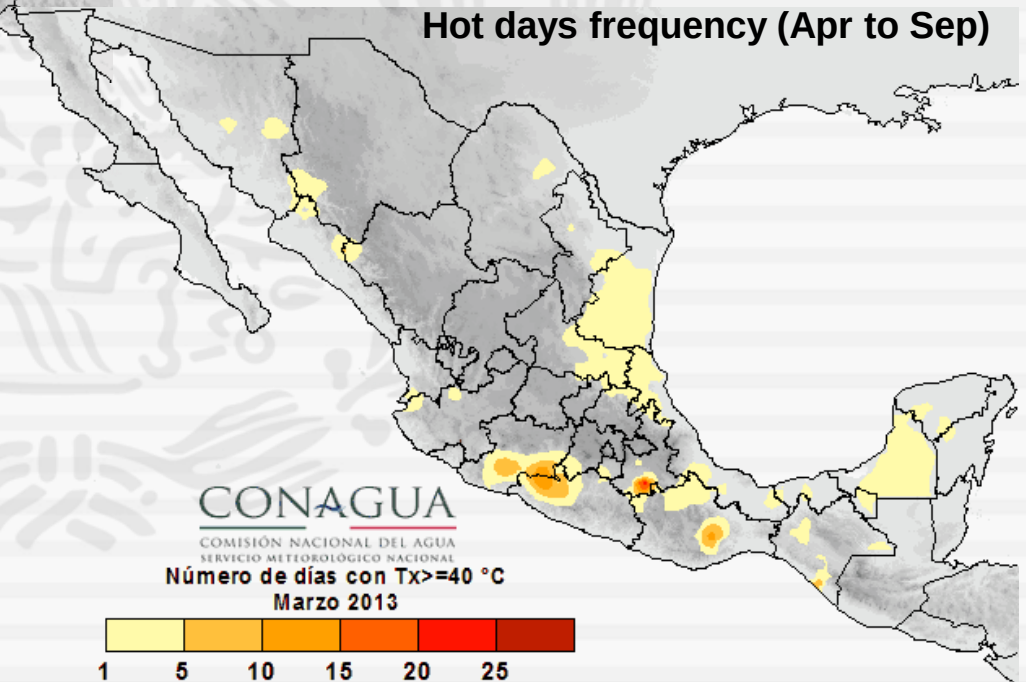
Input indices – Maximum temperature (mean + anomalies)



Input indices – temperature extremes frequency





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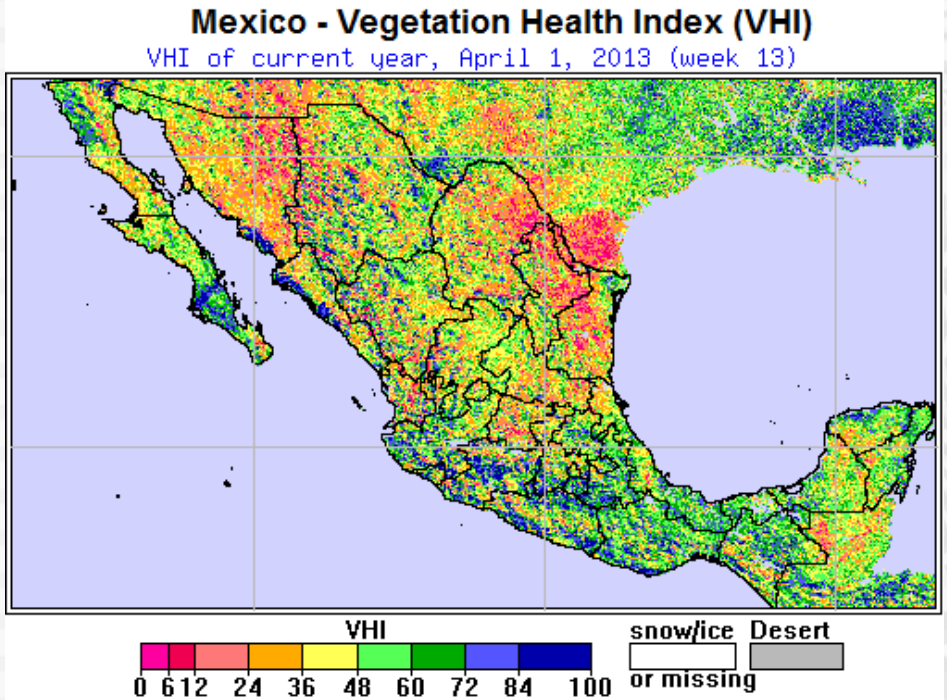
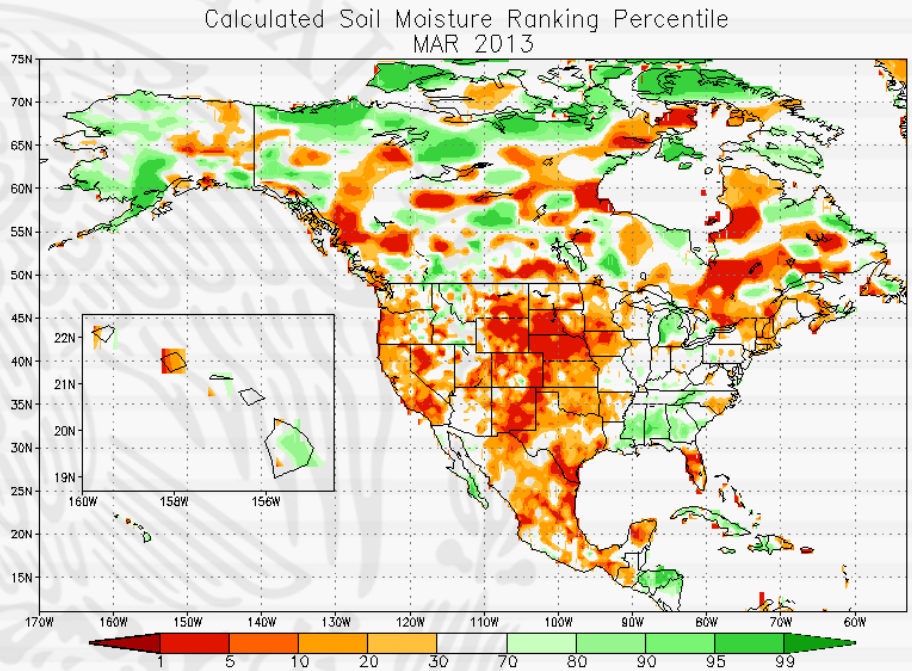
Input indices – vegetation health and soil moisture

By Remote Sensing o modelling





VHI is a proxy characterizing vegetation health or a combined estimation of available moisture and thermal conditions.

The CPC *Leacky Bucket* soil moisture estimated by a one-layer hydrological model. This model uses observed precipitation and temperature as inputs to calculate soil moisture, evaporation and runoff.

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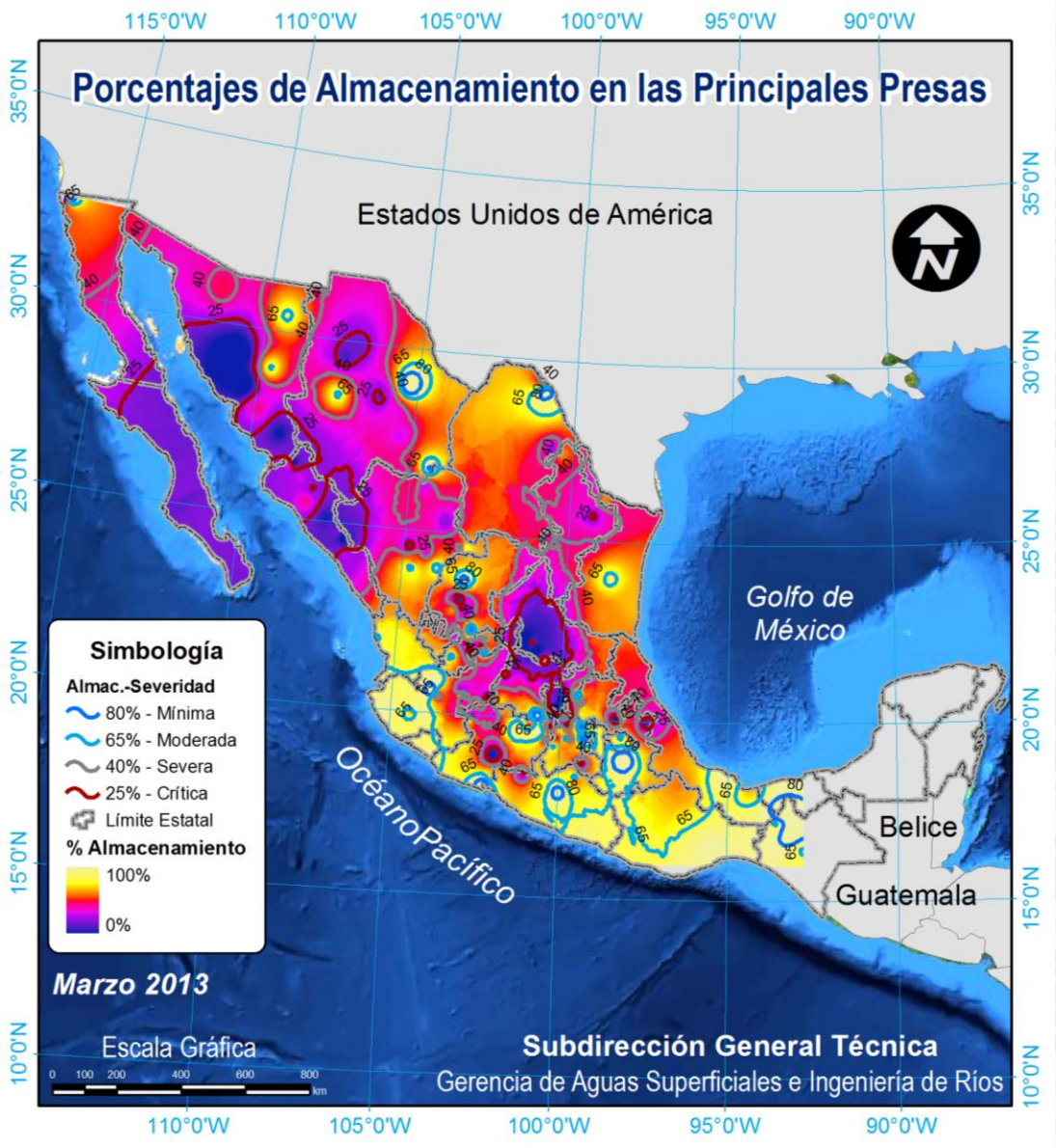
Other inputs – status of reservoir levels



A map depicting in March 2013. (Courtesy of CONAGUA's Hydrology Office)

Blue/red lines depict areas where reservoirs exhibit low storages (less than 25%), yellow/ blue shades depict areas where reservoir levels are good.

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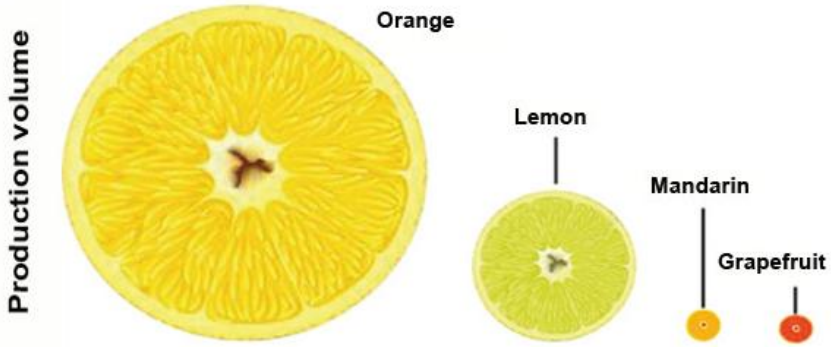
Other inputs – agriculture reports

Provided to SMN on a monthly basis by the National Information System for Agriculture, Food and Fisheries

The wealth generated by citrus exports between 2006 and 2011 amounted to 12 thousand 507 million pesos; the sales abroad are twice the amount generated by the tourism in the first long weekend over the year (February 5).

This great value is generated in few entities (only 1% of the national agricultural area) with outstanding participation of Veracruz, the main producer of the four citrus listed by the FAO as strategic (orange, lemon, tangerine and grapefruit) with 44% of the supply. It should be mentioned that while the area and production volume of the orange are more than two times higher than those of the lemon, the value of the last mentioned is greater.

Comparison: share of the citrus in the domestic production



Averages	Orange	Lemon	Mandarin and tangerine	Grapefruit
Volume (thousand ton)	4,190	1,972	419	392
Value (million tons)	4,309	4,515	464	506
Planted area (thousand ha)	339	150	34	18
Main producer stater	Veracruz (50%), Tamaulipas (13%) and San Luis Potosí (10%)	Veracruz, (23%) Michoacán, (23%) and Colima (20%)	Veracruz (50%) and Tamaulipas (14%)	Veracruz (60%) and Michoacán (14%)

Source: **SIAP** with figures from Delegations of SAGARPA.

By December 2011, the lemon production grew at an annual rate of 7.1% equivalent to 2.1 million tons, 138, thousand more than those obtained in 2010, while the orange rose 1.2% to 4.1 million tonnes, while grapefruit showed a surplus of 2.1%, ie 394 thousand tonnes.

SIAP *Disemina* reports and assesments are used to produce the agri-food lines inside our narratives

MEXICO: A beneficial rainy season was observed throughout July 2012 across most of northern and central Mexico, which helped to reduce the most severe drought categories over those regions. This was possible as some persistent troughs (low pressure regions)

The Information Service for Agri-Food and Fisheries (SIAP) stated that July rains triggered planting of a larger number of corn, beans and sorghum crops through spring and summer of 2012. The total area planted is 11% higher than that reported in the same period of last year, while the crop under irrigation is now 9% lower. For single crops, grain maize plantings grew favorably. Five states—State of Mexico, Jalisco, Oaxaca, Puebla and Chiapas—recorded more than 420 000 ha (more than 1 million acres) of land sown to grain maize. Four states (Zacatecas, Durango, Chihuahua and Chiapas) have about 700 000 ha (about 1.73 million acres) of bean crop. The grain sorghum crop totaled 350 000 ha (about 865 thousand acres) in Guanajuato, Michoacan, Sinaloa and Tamaulipas. For the autumn-winter 2012 season, the sorghum harvest has been virtually completed. Up to late July, harvested acreage for major crops was about 480 000 ha (about 1.2 million acres) higher than reported in the same period of 2011. For spring-summer 2012, crop acreage increased 73.5% for corn; 62% for beans; 58% for wheat, and 24% for rice. This was possible because large areas in the North, South and the Central parts of the country have had more cloudiness, which led to more moisture in the environment, and because of favorable

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Other inputs – forest fires

Provided by the National Forests Commission (CONAFOR), forest fires statistics report the number of hectares burned from the beginning of year to present vs similar periods in previous years.

SEMARNAT

REPORTE SEMANAL DE RESULTADOS DE INCENDIOS FORESTALES

2013 Del 01 enero al 28 de marzo de 2013

Coordinación General de Conservación y Restauración
Gerencia de Protección Contra Incendios Forestales

Datos de la semana del 22 al 28 de marzo de 2013.

Se presentaron 723 incendios forestales en 29 entidades federativas, afectando un total de 24,272 hectáreas. De esta superficie, el 93% correspondió a vegetación en los estratos herbáceo(1) y arbustivo(2) y el 7% al arbóreo(3). Las entidades federativas más afectadas fueron: San Luis Potosí, Guanajuato, Veracruz, Guerrero y Jalisco, que representan el 73% del total de la semana.

En el reporte semanal también se integraron datos de 24 incendios que se presentaron en fechas anteriores, con una afectación de 412 hectáreas, cuyos datos no habían sido reportados al Centro Nacional de Control de Incendios Forestales en su oportunidad. Las cifras de estos reportes extemporáneos de incendios están incluidos en los datos acumulados anuales y en la hoja número 3 de este informe.

Datos del año acumulados del 01 de enero al 28 de marzo de 2013.

En lo que va del año, se han registrado 3,742 incendios forestales en 32 entidades federativas, afectando una superficie de 72,188 hectáreas, de esta superficie, el 96% correspondió a vegetación en los estratos herbáceo y arbustivo y el 4% al arbóreo. Las entidades federativas con mayor número de INCENDIOS fueron: México, Distrito Federal, Puebla, Michoacán, Hidalgo, Chihuahua, Tlaxcala, Veracruz, Jalisco y Oaxaca, que representan el 85% del total nacional. Las entidades federativas con mayor SUPERFICIE afectada fueron: Baja California Sur, San Luis Potosí, Guerrero, Oaxaca, Puebla, Jalisco, México, Guanajuato, Michoacán y Durango, que representan el 78% del total nacional.

Días-hombre aplicados en los combate.

A la fecha los días-hombre han sido: CONAFOR 21,614 (22%), SEDENA 3,618 (4%), Gobiernos Estatales y Municipales 36,467 (38%), Otras Dependencias 1,874 (2%), Voluntarios y del Sector Social 33,446 (34%), para un total nacional de 97,019 días-hombre en el combate de incendios forestales.

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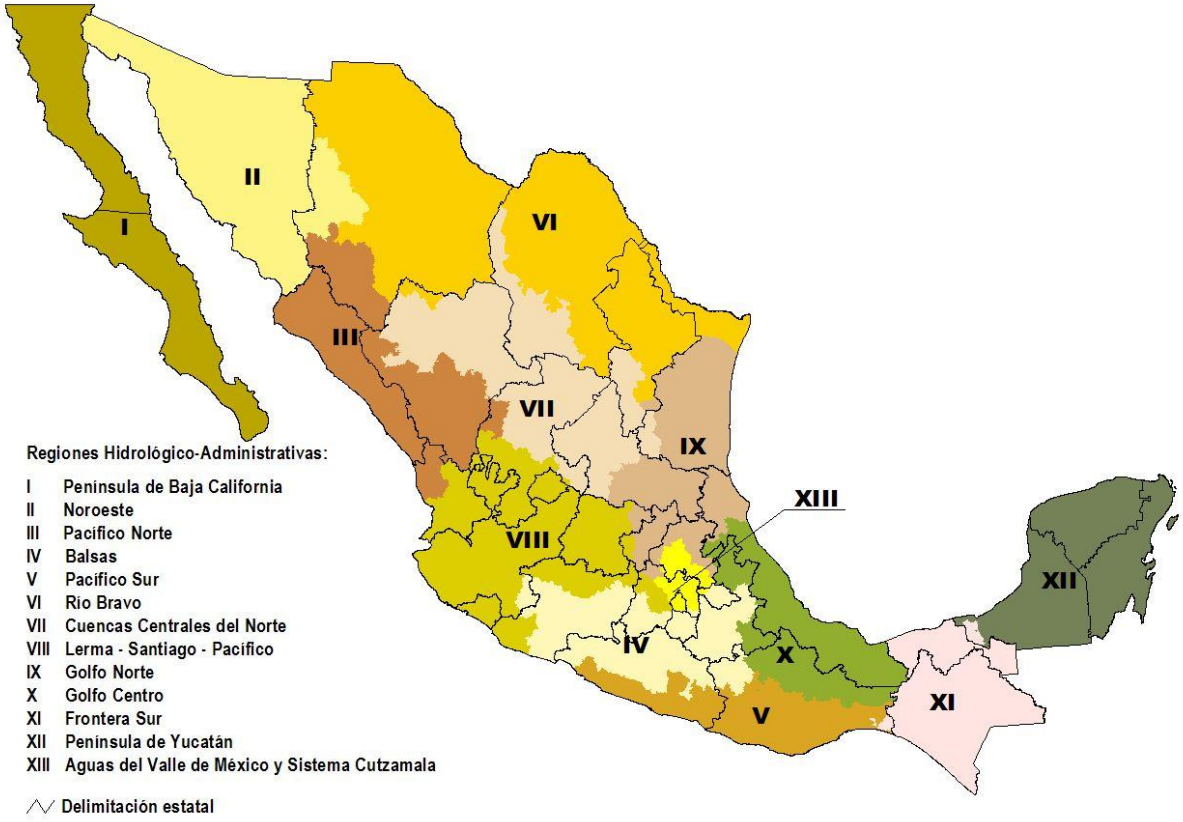
Other inputs – telephone calls and photos from regional offices

Telephone calls are made to each of the 13 regional offices of CONAGUA (the Agency SMN belongs to) in order to verify selected drought cases. They provide photos too.



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Monthly time-line for drought monitoring in Mexico

1. Begins the process for the new month, requesting for missing vaues if possible

2. Collecting rainfall and precipitation data and send to NOAA-NCDC.

2.a. SMN computes SPI (1,3,6,9,12,24 Months)

3. NOAA-NCDC computes drought indices:
*Palmer
*SPI
*Percent of Normal

4. SMN drought experts analyzes the information and creates the map

5. Final *shapefiles* are used to calculate drought statistics like area, municipality, regional and statate-level graphics

6. Gathering information from other agencies to draft the report (narrative) and publishes the final map on SMN portal

7. Translations for Mexican depiction to English languaje and the whole document into Spanish. Final report is available to public.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

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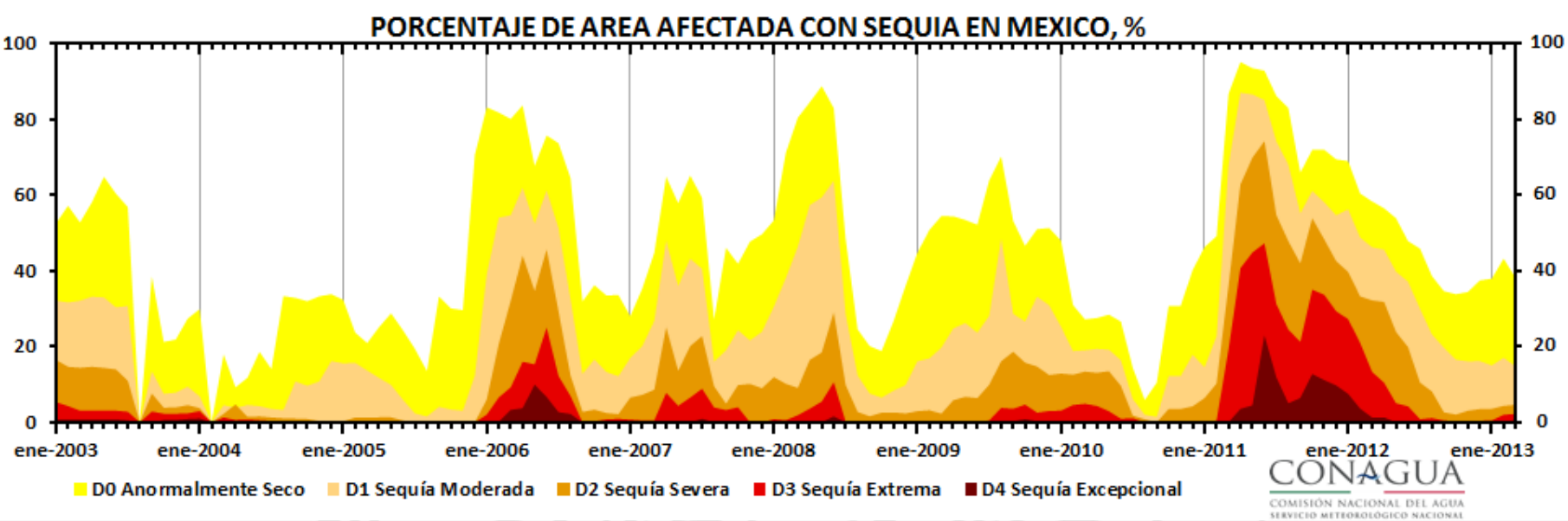
Formats in which DM is delivered to users

Country area in drought conditions (percentage).



Produced using GIS software, operationally since February 2012 (when a GIS expert joined the drought monitoring group at SMN).

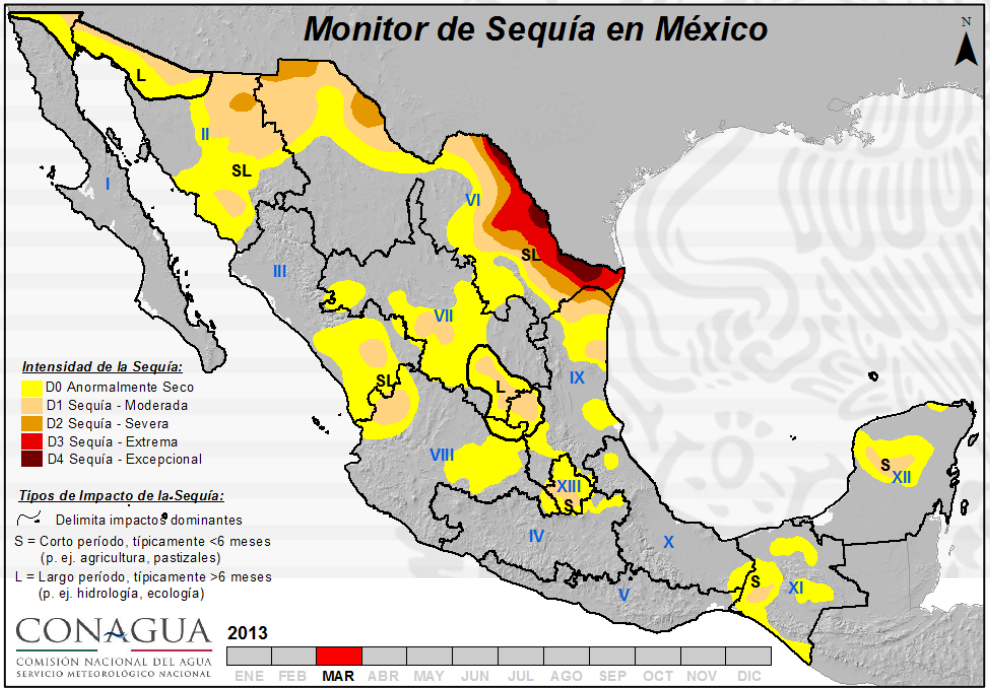
All *shapefiles* available since 2003.

Publicly available for the current month over the Internet. https://smn.conagua.gob.mx
Climatologia -> Sequia

	Porcentaje					
MES-AÑO	Sin afectación	D0 a D4	D1 a D4	D2 a D4	D3 a D4	D4
MAR-2013	61.95	38.05	14.75	4.62	2.24	0.66
FEB-2013	56.77	43.23	17.04	4.35	2.00	0.01
ENE-2013	62.08	37.93	15.02	3.58	0.53	0.01
DIC-2012	62.55	37.45	16.19	3.50	0.43	0.02
NOV-2012	65.62	34.38	16.12	3.05	0.32	0.00
OCT-2012	66.17	33.83	16.52	2.06	0.30	0.00
SEP-2012	65.37	34.63	19.69	2.64	0.52	0.00
AGO-2012	61.36	38.64	23.24	8.15	1.13	0.00
JUL-2012	54.15	45.85	29.99	10.50	0.84	0.00
JUN-2012	52.16	47.84	37.14	19.86	4.24	0.00
MAY-2012	46.12	53.88	39.78	23.87	5.02	0.00
ABR-2012	43.52	56.48	45.58	31.78	10.46	1.31
MAR-2012	41.69	58.31	46.20	32.18	13.31	1.26
FEB-2012	39.58	60.42	48.79	33.25	20.98	3.63

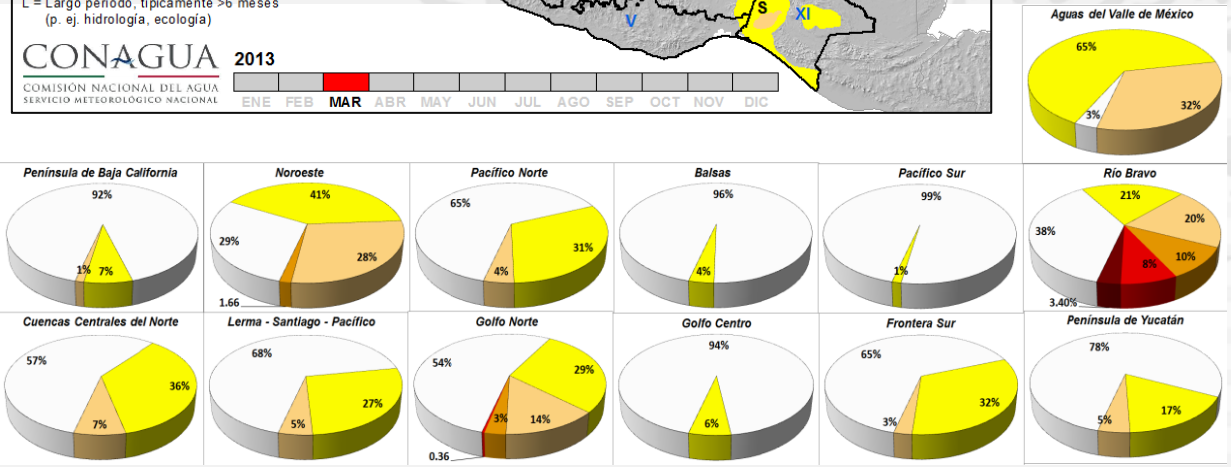
Formats in which DM is delivered to users

Areas in drought condition by CONAGUA's *Managing Units.*
This information has been reported as useful for CONAGUA's water management planning.



March 2013

		Porcentaje de área (%) Marzo 2013					
Clave	RHA	Sin afectación	D0	D1	D2	D3	D4
I	Península de Baja California	91.89	6.87	1.24	0.00	0.00	0.00
II	Noroeste	29.27	40.74	28.33	1.66	0.00	0.00
III	Pacífico Norte	64.57	31.14	4.29	0.00	0.00	0.00
IV	Balsas	96.43	3.57	0.00	0.00	0.00	0.00
V	Pacífico Sur	98.72	1.28	0.00	0.00	0.00	0.00
VI	Río Bravo	37.55	20.53	20.07	10.39	8.07	3.40
VII	Cuencas Centrales del Norte	56.89	35.73	7.38	0.00	0.00	0.00
VIII	Lerma - Santiago - Pacífico	68.34	26.80	4.86	0.00	0.00	0.00
IX	Golfo Norte	54.22	28.66	13.73	3.03	0.36	0.00
X	Golfo Centro	94.10	5.90	0.00	0.00	0.00	0.00
XI	Frontera Sur	65.18	32.23	2.59	0.00	0.00	0.00
XII	Península de Yucatán	78.35	17.11	4.54	0.00	0.00	0.00
XIII	Aguas del Valle de México	3.29	64.69	32.02	0.00	0.00	0.00



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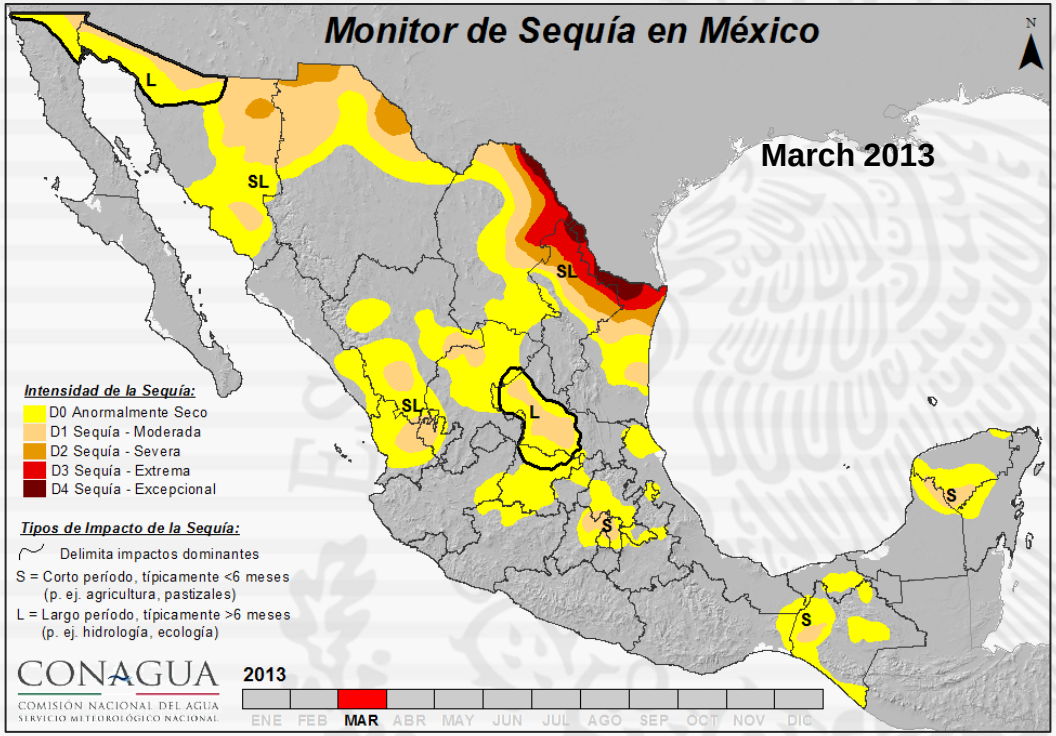
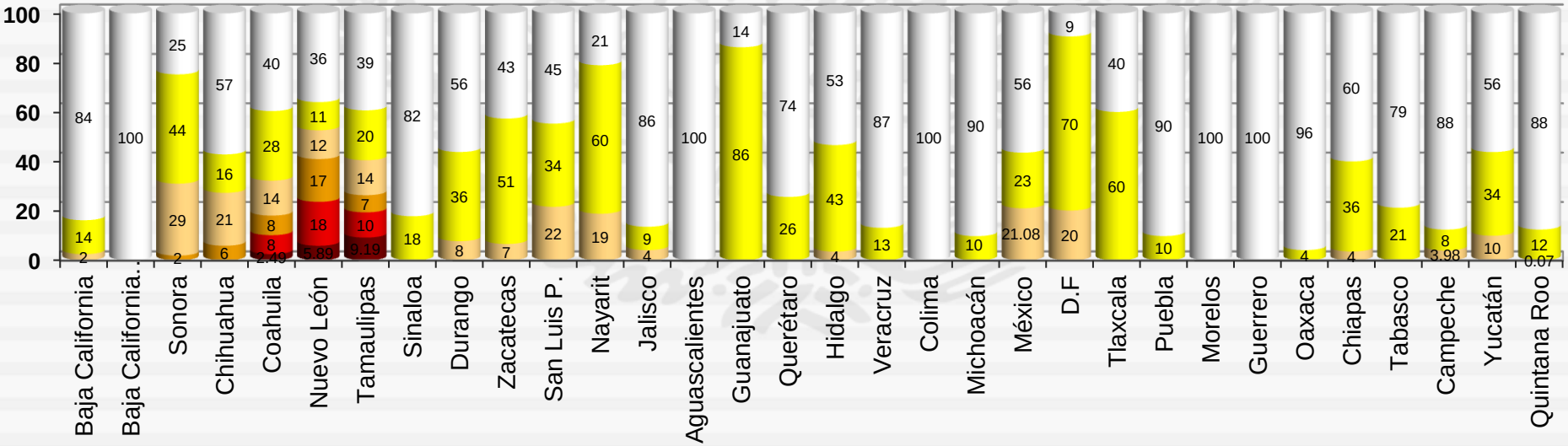
Areas in drought condition by Federal State



	Porcentaje de área (%) Marzo 2013					
Estados	Sin Afectación	D0	D1	D2	D3	D4
Baja California	83.76	13.76	2.48	0.00	0.00	0.00
Baja California Sur	100.00	0.00	0.00	0.00	0.00	0.00
Sonora	24.69	44.25	29.17	1.89	0.00	0.00
Chihuahua	57.10	15.59	21.41	5.90	0.00	0.00
Coahuila	39.55	28.16	14.18	7.94	7.68	2.49
Nuevo León	35.94	11.39	11.65	17.33	17.78	5.89
Tamaulipas	39.26	20.21	14.17	6.95	10.21	9.19
Sinaloa	82.16	17.84	0.00	0.00	0.00	0.00
Durango	56.14	36.11	7.76	0.00	0.00	0.00
Zacatecas	42.60	50.78	6.62	0.00	0.00	0.00
San Luis Potosí	44.64	33.68	21.68	0.00	0.00	0.00
Nayarit	20.99	60.14	18.87	0.00	0.00	0.00
Jalisco	86.42	9.43	4.15	0.00	0.00	0.00
Aguascalientes	100.00	0.00	0.00	0.00	0.00	0.00
Guanajuato	13.72	86.28	0.00	0.00	0.00	0.00
Querétaro	74.35	25.65	0.00	0.00	0.00	0.00
Hidalgo	53.32	43.16	3.52	0.00	0.00	0.00
Veracruz de Ignacio de la Llave	86.86	13.14	0.00	0.00	0.00	0.00
Colima	100.00	0.00	0.00	0.00	0.00	0.00
Michoacán de Ocampo	90.23	9.77	0.00	0.00	0.00	0.00
México	56.42	22.50	21.08	0.00	0.00	0.00
Distrito Federal	9.35	70.48	20.18	0.00	0.00	0.00
Tlaxcala	39.91	60.09	0.00	0.00	0.00	0.00
Puebla	90.18	9.82	0.00	0.00	0.00	0.00
Morelos	100.00	0.00	0.00	0.00	0.00	0.00
Guerrero	100.00	0.00	0.00	0.00	0.00	0.00
Oaxaca	95.85	4.15	0.00	0.00	0.00	0.00
Chiapas	59.96	36.46	3.58	0.00	0.00	0.00
Tabasco	78.72	21.28	0.00	0.00	0.00	0.00
Campeche	87.57	8.45	3.98	0.00	0.00	0.00
Yucatán	56.18	33.88	9.94	0.00	0.00	0.00
Quintana Roo	87.54	12.39	0.07	0.00	0.00	0.00



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An overview of main DM users

- Federal Government Advisors

- Government Agencies: mostly CONAGUA, SAGARPA and SEMARNAT.
  - CONAGUA - Water Management
  - SAGARPA - Agriculture, crops sowing and irrigation planning, but they would rather have drought outlooks/forecast.
  - SEMARNAT - Working in desertification and land degradation (soil use). United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification (UNCCD)

- Universities and Research Centers (locals and abroad). Researchs and students are using our shapefiles for integration into their researchs. Mexican students abroad are looking for our information, but their researches are in their first stages, no feedback yet.

- Local authorities (countys): Even to small scale, some local governments are looking for this product, and are aware of the complexity of this phenomenon.

- General public, including the media.

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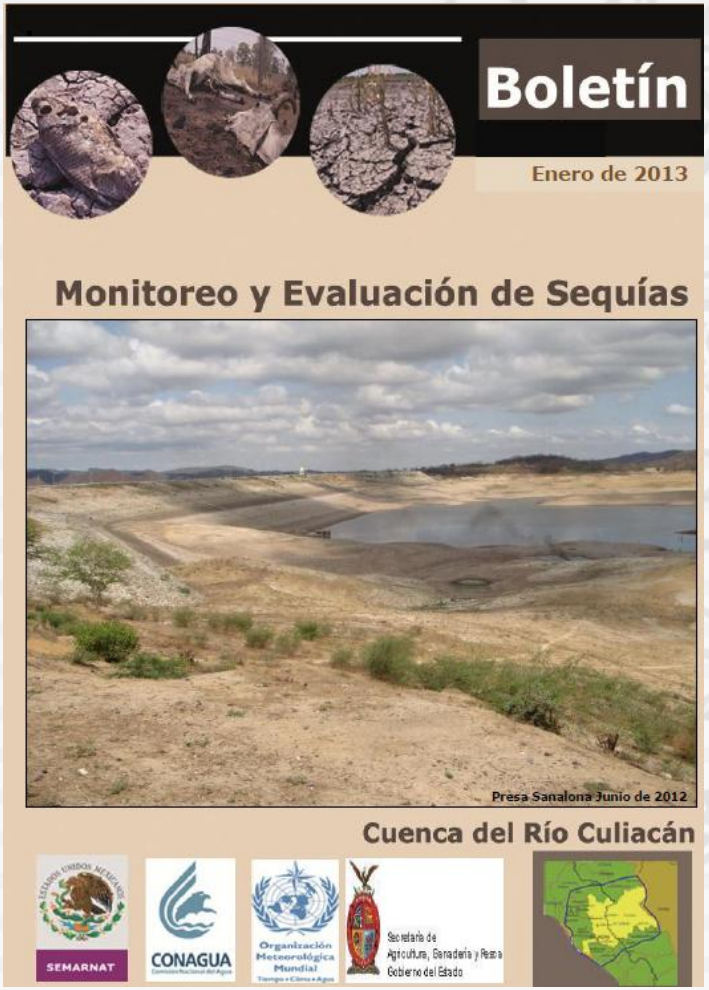
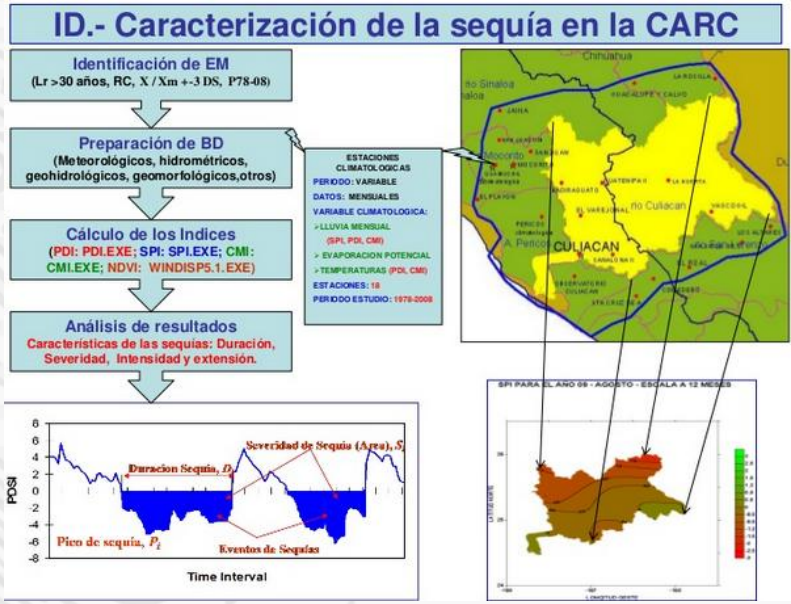
Other efforts for DM in Mexico

Some Local offices of CONAGUA perform regional drought assessments and bulletins (e.g. Culiacán, Sinaloa, Western Mexico)





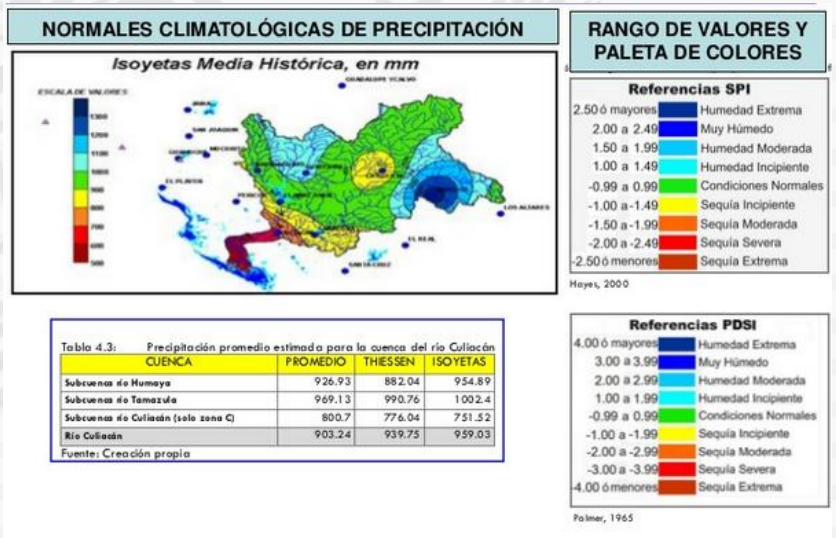


Tabla 4.3: Precipitación promedio estimada para la cuenca del río Culiacán

CUENCA	PROMEDIO	THIESSEN	ISOYETAS
Subcuenca río Humaya	926.93	882.04	954.89
Subcuenca río Tamazula	969.13	990.76	1002.4
Subcuenca río Culiacán (solo zona C)	800.7	776.04	751.52
Río Culiacán	903.24	939.75	959.03

Fuente: Creación propia

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Implementing a MX National Program to Cope with Drought

- **PRONACOSE.** PROgrama NAcional COntra la SEquia.
- It is a program launched officially by the new government of Mexico (February 2013), looking to prevent, manage and mitigate drought impacts across the coutnry.
- It is being coordinated by CONAGUA (with help from SMN). Its main goal is to guarantee water availability along with an efficient use of water at the watershed level.
- NADM is considered in PRONACOSE, but at the moment, official indices (for legal implications) are only SPI and SDI

Fisrt PRONACOSE meeting held in Durango, February 2013.

Expectations, outstanding needs and further steps

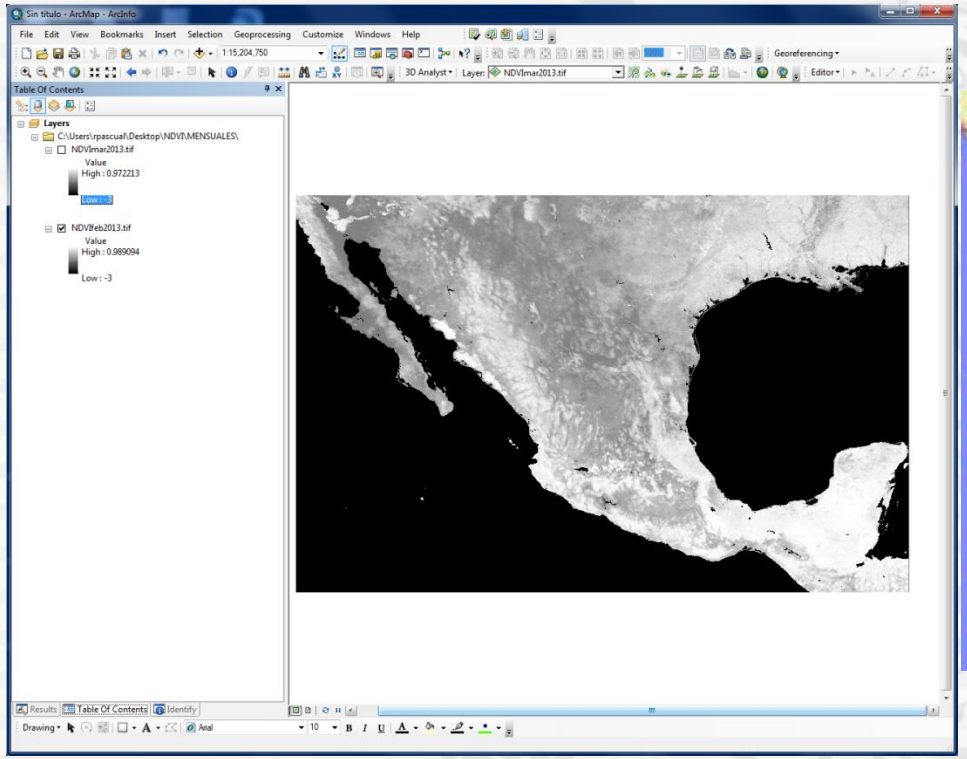
- **Deliver Drought Monitor twice a month.** Oftenly requested by government agencies, increasing temporal frequency of drought monitorin in Mexico to weekly or forthnightly products remains a challenge (development of this trhough cooperation with CPC is a possibility).

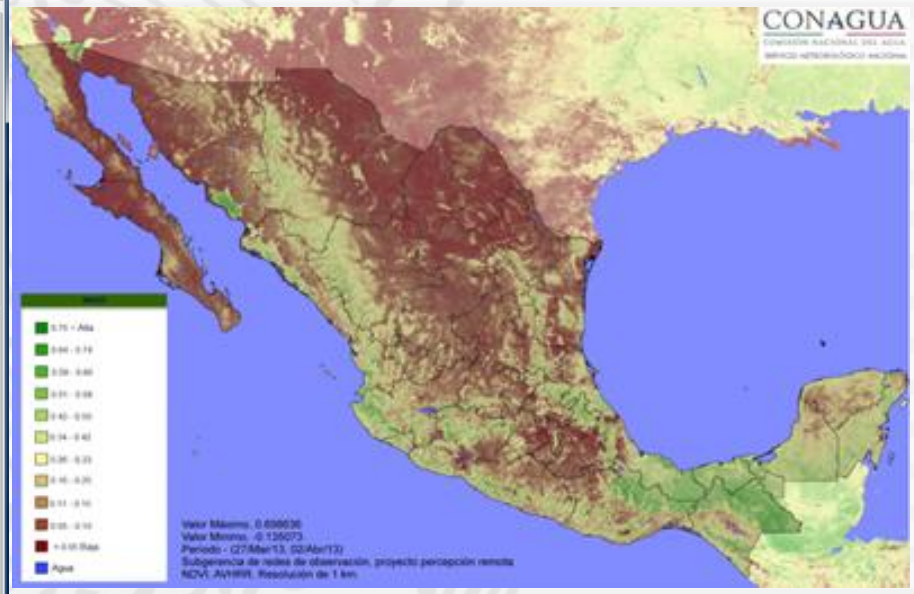
- **Increase from 132 stations** currently used in NADM to the whole **324** at NCDC in drought indices calculations and fill some gaps (need to do international coordination on the topic from SMN with US and Canada centers).

- **Drought prediction**. Apart from monthly and seasonal precipitation predictions, a multi-level, tailored product for specific sectors is needed. So far, using Lyon's et al., approach combining SPI and dynamical models seems like an option.

Expectations, outstanding needs and further steps

SMN-NDVI in-house developments (begun this year).





An initial attempt of producing NDVI locally at SMN.
Current experimental product is being evaluated.

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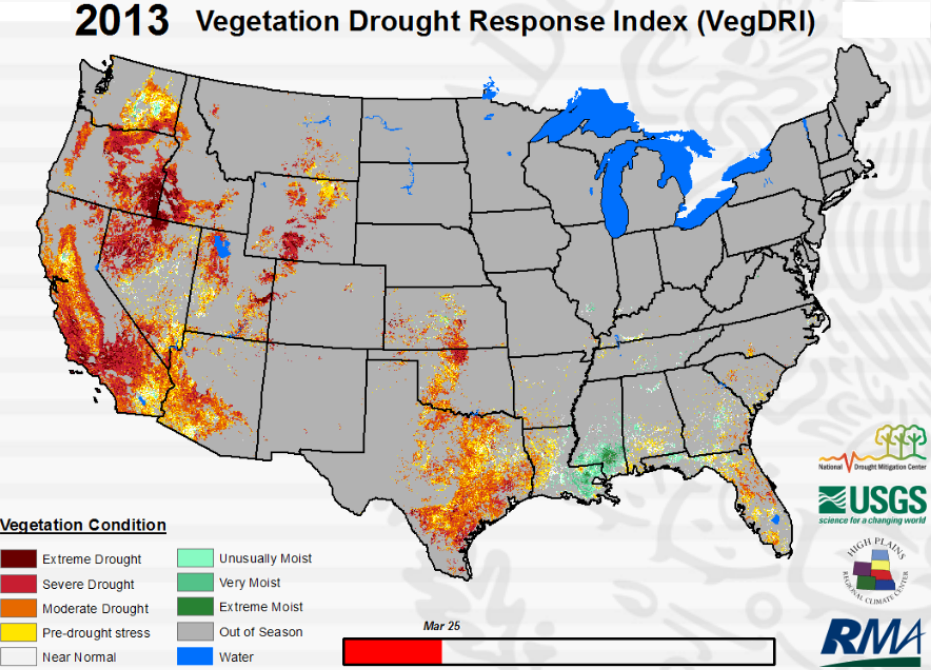
Expectations, outstanding needs and further steps

Expanding VegDRI index over Mexico?



A joint effort amongst UNL – SMN and SIAP.
Tadesse and Brown visited SIAP last week to see current progress and further steps.

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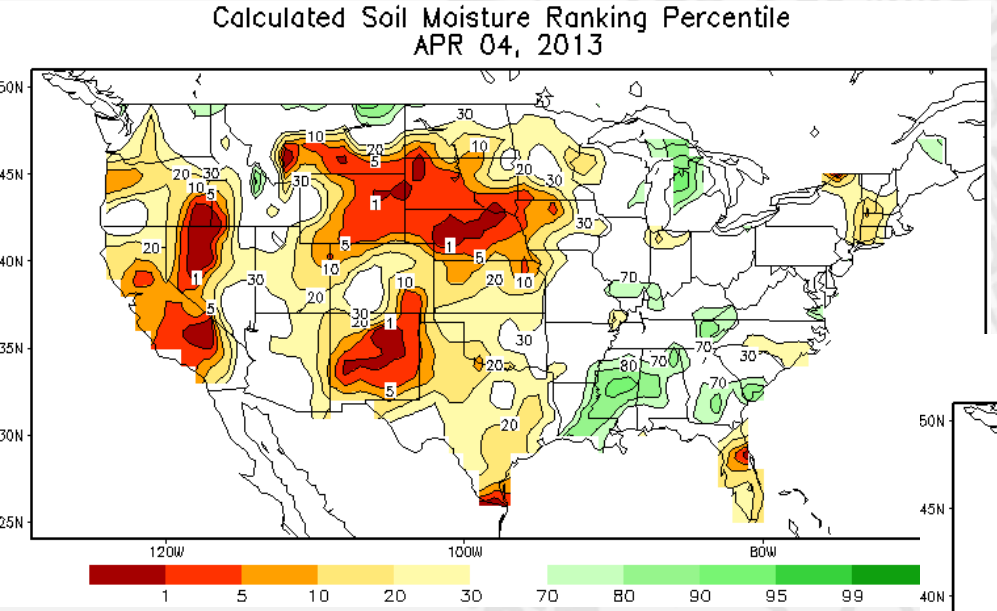
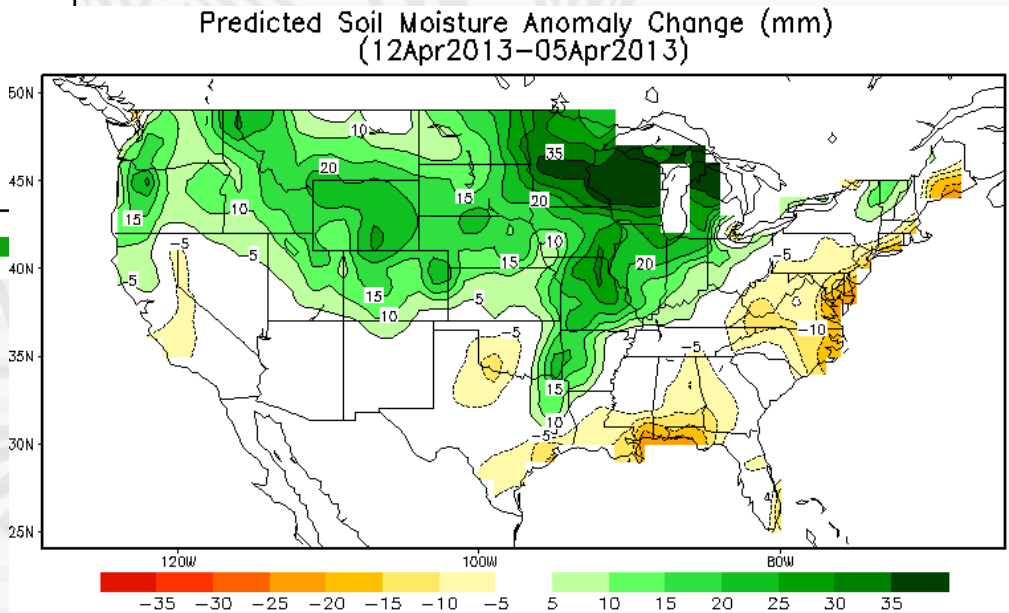
Expectations, outstanding needs and further steps

Is it possible to have data (modelled or observerd) for soil moisture over Mexico on a weekly basis?





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Thank you for your attention

Plase send your feedback, suggestions, comments or questions to any of SMN's drought monitoring technical team

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