FAS/OGA/IPAD Introduction & Geospatial Data Applied to Global Agriculture Monitoring

USDA Foreign Agricultural Service (FAS)
Office of Global Analysis (OGA)
International Production Assessment Division (IPAD)
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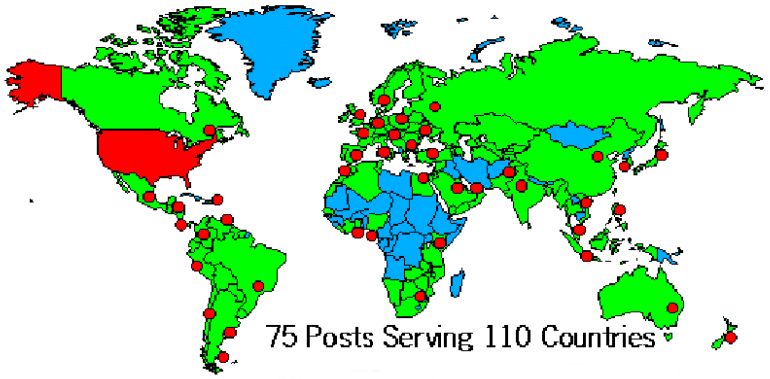
USDA/FAS/OGA/IPAD

Linking U.S. Agriculture FAS to the World

Foreign Agricultural Service (FAS) of USDA

Linking U.S. agriculture to the world to enhance export opportunities and global food security……

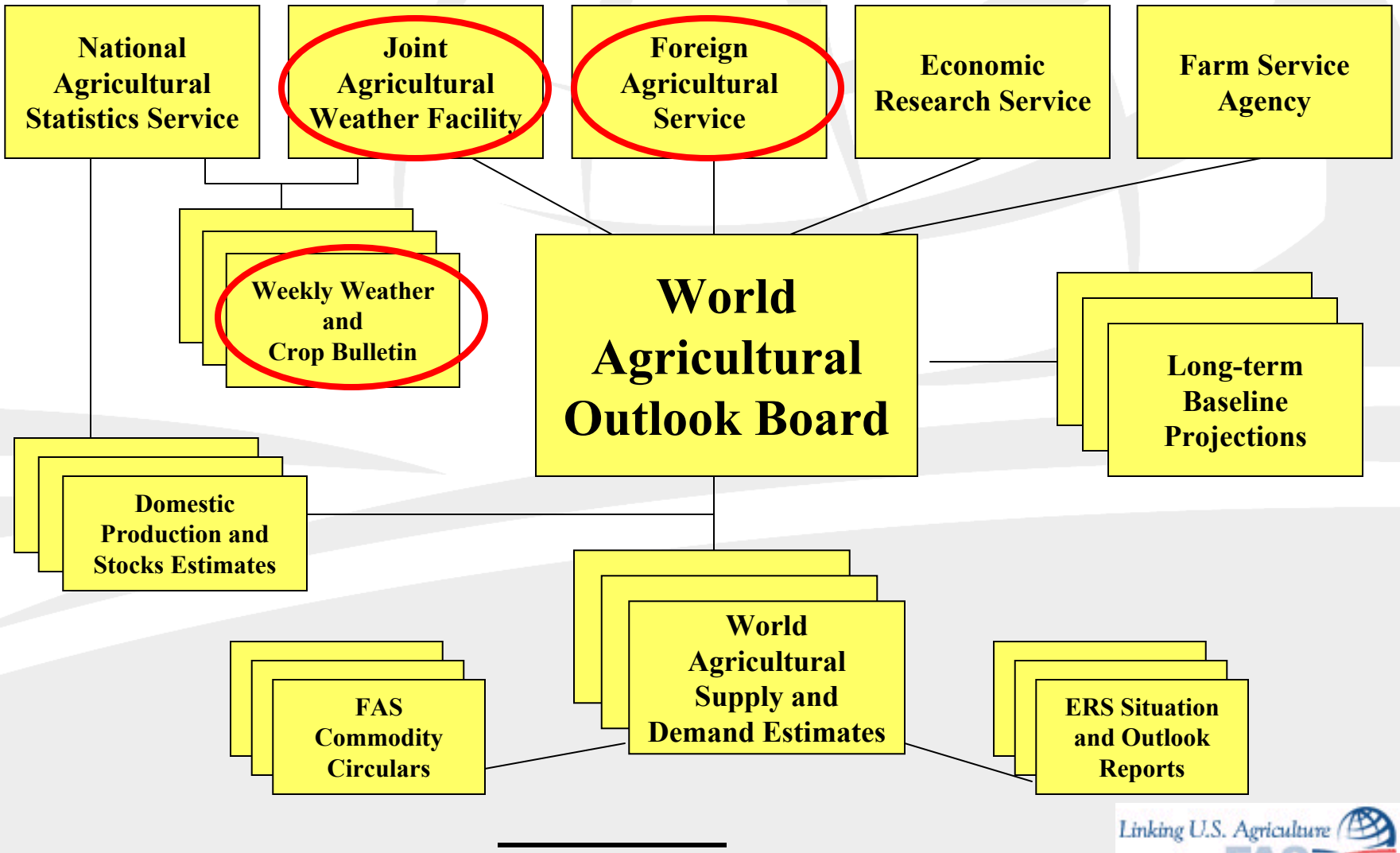
FAS Attachés Cover Over 70% of Global Land Area, and 85% of Foreign Global Population



- FAS is primarily responsible for USDA's:
  - Overseas activities with attachés located at 75 posts
  - Market development,
  - International trade agreements and negotiations,
  - Collection and analysis of statistics and market information.
- *http://www.fas.usda.gov/aboutfas.html*

Linking U.S. Agriculture FAS to the World

USDA's Economic Information System



Linking U.S. Agriculture FAS to the World

USDA's Economic Intelligence System

United States: Crop estimates (supply/demand) prepared every month by USDA's **NASS** *(National Agricultural Statistical Service).*

Foreign Countries: Crop estimates (supply/demand) audited & published every month by USDA's **ICEC** *(Interagency Commodity Estimates Committee):*

- ***WAOB*** (World Agricultural Outlook Board)
- ***FAS*** *(Foreign Agricultural Service)*
- ***ERS*** (Economic Research Service)

- **World Agricultural Supply & Demand Estimates (WASDE) estimates released to commodity markets on the *9-12th day of each month at 8:30AM*.**
- ***PSD Online* from FAS provides historical and current crop estimates.**

USDA/FAS Economic Analysis

- **Trade Policy**
- **Exporter Assistance & Export Programs**
- **Food Aid & Export Credit Programs**
- **UMR (Usual Marketing Requirements)**

Chicago Board of Trade (CBOT) & other commodity markets

USDA Publications

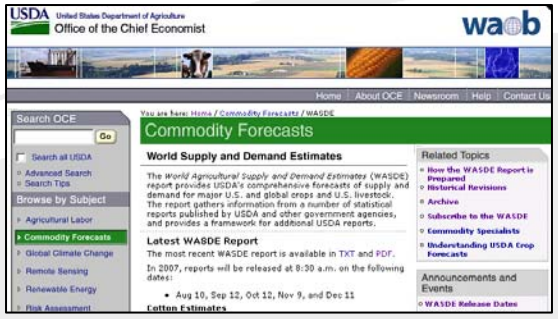
- **USDA decision-makers**
- **U.S. Ag Producers & Traders**
- **Commodity Price Discovery**
- **Commodity Price Adjustments**

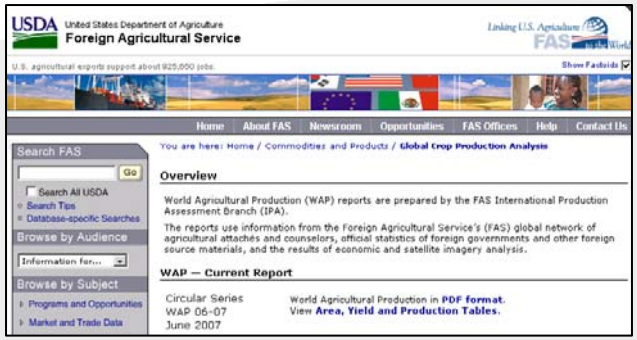
The Day of Lock-up

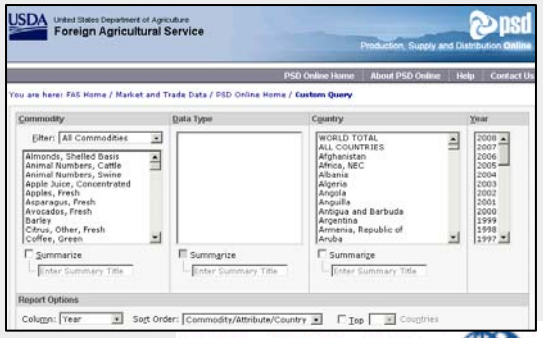
- **Why:** Maintain integrity with level playing field
- **How often:** Monthly, second week
- **When:** 2:00 a.m.
- **Where:** Secured wing in South Building
- **What:**
  - Incorporate NASS domestic estimates
  - Finalize PSDs and reports
  - Secretary Vilsack briefed and ***WASDE report is released at 8:30 a.m.***, before markets open
  - FAS reports and databases released at 9:00 a.m.

USDA's Economic Intelligence System

- **Lockup End Results: Monthly estimates for each country are available on the internet at:**
  - **WASDE Circular from WAOB released on the *9-12th day of each month at 8:30AM.*** (since Sept. 1973)
    http://www.usda.gov/oce/commodity/wasde/
  - **Monthly World Production, Market and Trade Reports**
    http://www.fas.usda.gov/currwmt.asp
  - **PSD Online from FAS**
    http://www.fas.usda.gov/psdonline/







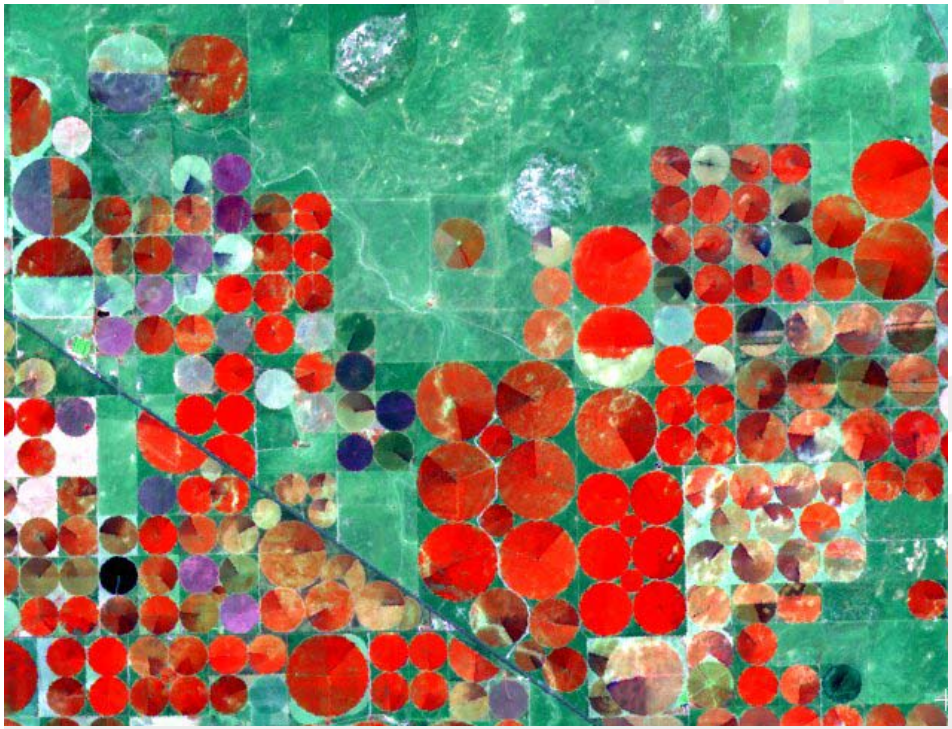
Goals of USDA's Economic Intelligence System

- Objective
  - Provide independent and unbiased information for commodity markets.
- Reliable
  - Best available information at current point in time.
  - Analysis based on sound data.
- Timely
  - Scheduled and immediate release for public, traders and commodity markets.

FAS Office of Global Analysis (OGA)
International Production Assessment (IPAD) Division

IPAD's Mission Statement:

Produce the most objective and accurate assessment of the global agriculture production outlook, and the conditions affecting global food security.



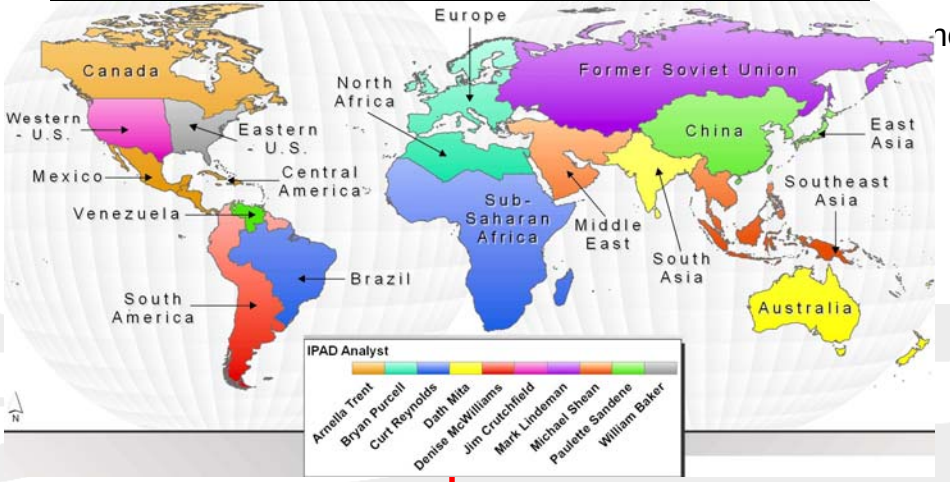
- **USDA's "Production and Supply Database"** (PSD Online) is used for market intelligence (http://www.fas.usda.gov/psd/)
- **IPAD's Heritage-** Joint **USDA/NASA/NOAA** remote sensing programs from 1975-1988.
  - **LACIE** (mid-1970's)**:** researched how to monitor agriculture with **Landsat & NOAA** satellite series.
  - **AGRISTARS** (1980's)**:** developed automated applications using Landsat, NOAA, and weather data from U.S. Air Force Weather Agency (AFWA).

IPAD Data Sources & Output Products

- FAS Field Travel
- Official Country Reports
- News Wire Services
- FAS Attaché Reports (http://www.fas.usda.gov/)

- *Weather Data (stations & satellites)*
- *Crop models (stations & satellites)*
- *Vegetation Data (satellites)*
  - Medium-resolution & temporal coverage
    - NOAA-AVHRR (1 & 8-km)
    - SPOT-IV (1-km)
    - MODIS (250-meters)
  - ne-resolution satellites
    - Landsat-7 (30-meters with 185-km swath width)
    - AWiFS on IRS satellite (70-m with 740-km swath width)

10 GIS Regional Analysts



Crop Production Estimates Released Each Month

- **World Agricultural Supply & Demand Estimates (WASDE)**
- **World Agricultural Production (WAP) Circular**
- **Production & Supply Database (PSD Online)**

Summary Satellites Used by IPAD

- *Geo-stationary satellites* monitor *weather (rainfall & temperature)* which is collected/processed by US Air Force Weather Agency (AFWA) at 25-km resolution
  - GOES (North & South America)
  - METEOSAT (Europe & Africa), and
  - GMS (Asia and Australia)

- *Polar-orbiting satellites* monitor *NDVI & generate false-color composites* for year-to-year comparisons (at 250-m resolution)
  - *Daily repeat cycle*
    - NOAA-AVHRR (1-km and 8-km resolution),
    - SPOT-VGT (1-km resolution),
    - Terra/Aqua Satellites (MODIS sensor with 250 meter resolution)
    - SSM/I (Special Sensor Microwave Imager (SSM/I, 25-km) to monitor surface wetness
  - *16-day and 24-day (5-day) repeat cycle*
    - Landsat-7 (30-m) and AWiFS (55-m) on IRS

- *Radar altimeter satellites* monitor lake water-level variations (with 10-day overpass)
  - ***70+ lakes:*** TOPEX/Poseidon (1992-2002), Jason-1 (2002-2009), OSTM Jason 2 (2009-present)
  - ***300+ lakes:*** ERS and ENVISAT from ESA

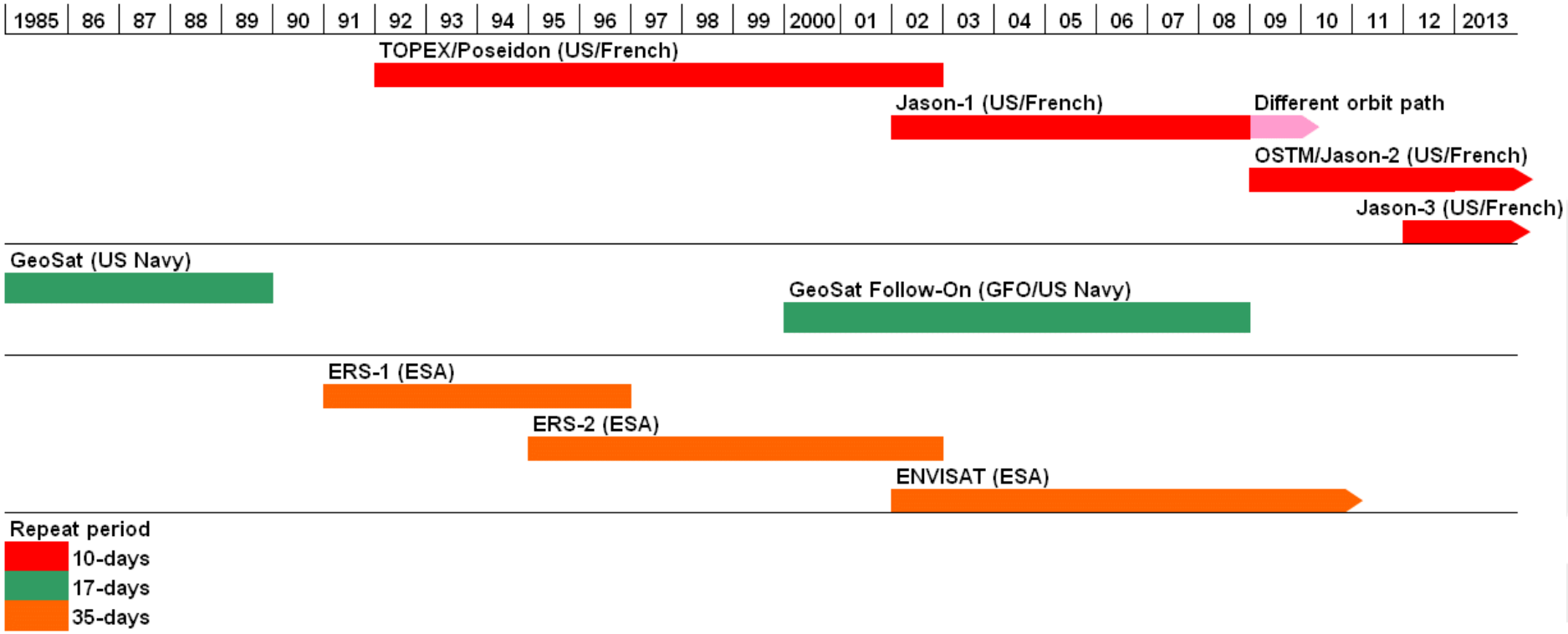
Global Reservoir and Lake Monitor (GRLM)

Source: http://www.pecad.fas.usda.gov/cropexplorer/global_reservoir/

GRLM measures reservoir/lake height variations from 1992-present for 70+ lakes worldwide by utilizing *satellite radar altimeters*.

Linking U.S. Agriculture FAS to the World

Timeline for Satellite Radar Altimetry



Recent Events:

- ***Sept. 17, 2008:*** End of Mission for GFO (Geosat Follow-On)
- ***June 20, 2008:*** Jason-2 or OSTM (Ocean Surface Topography Mission) was launched and follows Jason-1 orbit
- ***Feb. 14, 2009:*** Jason-2 continues along TOPEX/Poseidon/Jason-1 orbits and Jason-1 moved to new satellite orbit

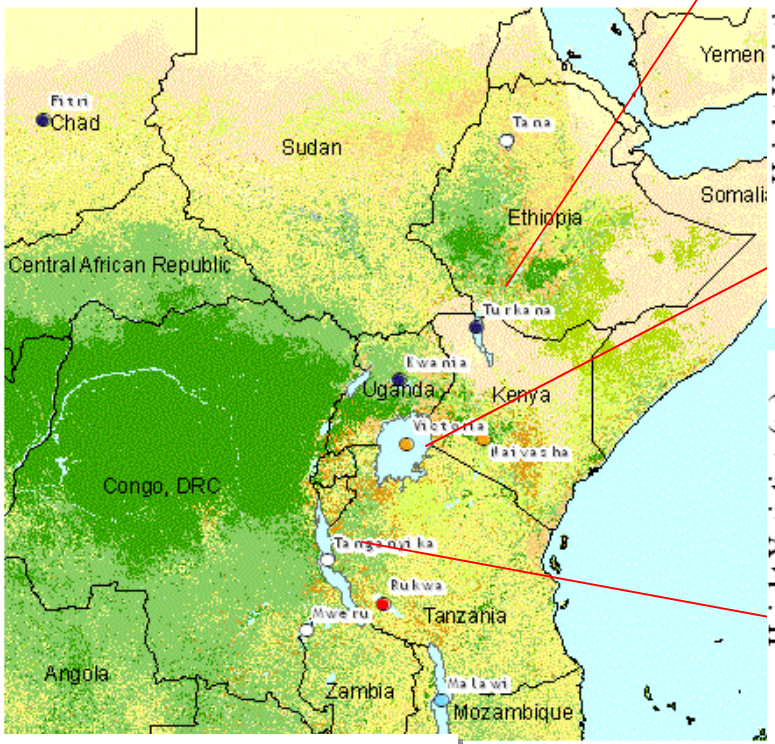
Linking U.S. Agriculture FAS to the World

1997/98 El Niño Effects on East Africa Lakes

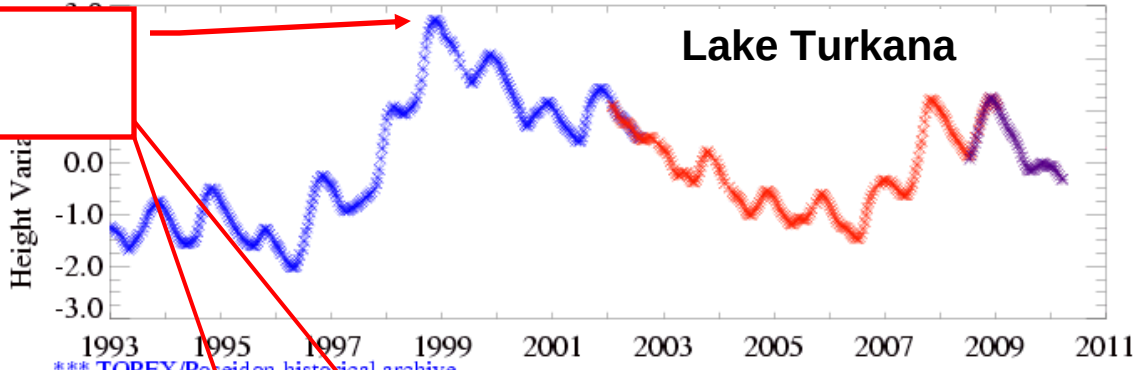
Decrease in regional lake water levels after 1997/98 El Nino.

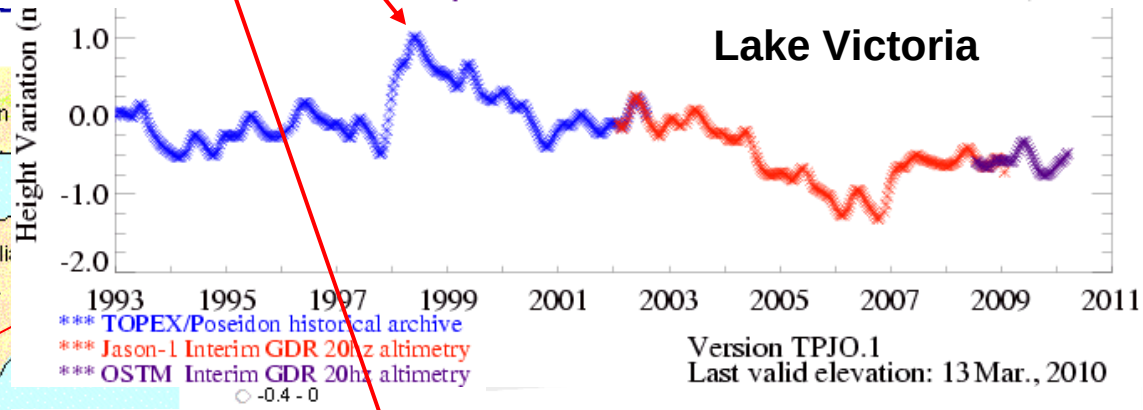
Global Reservoir and Lake Elevation Databas

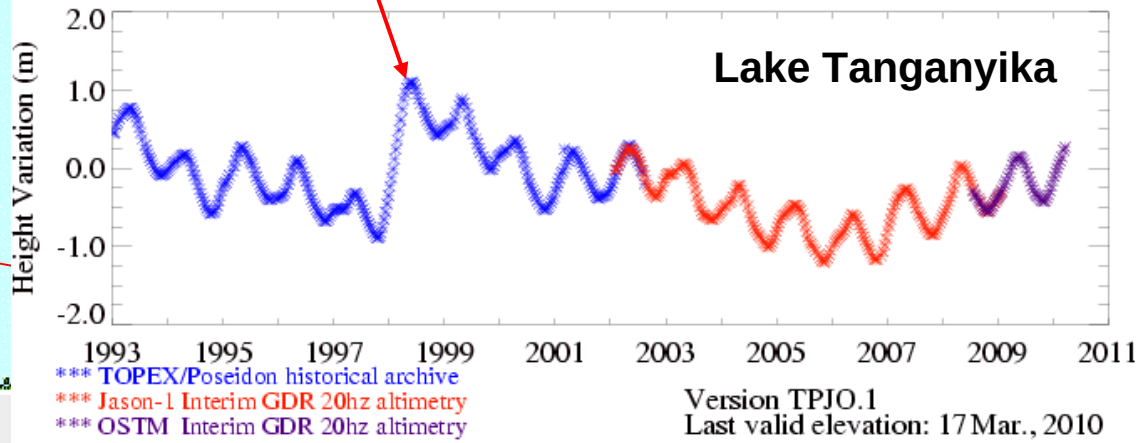
Click on a blue circle to see Lake Level Variations



http://www.pecad.fas.usda.gov/cropexplorer/global_reservoir/

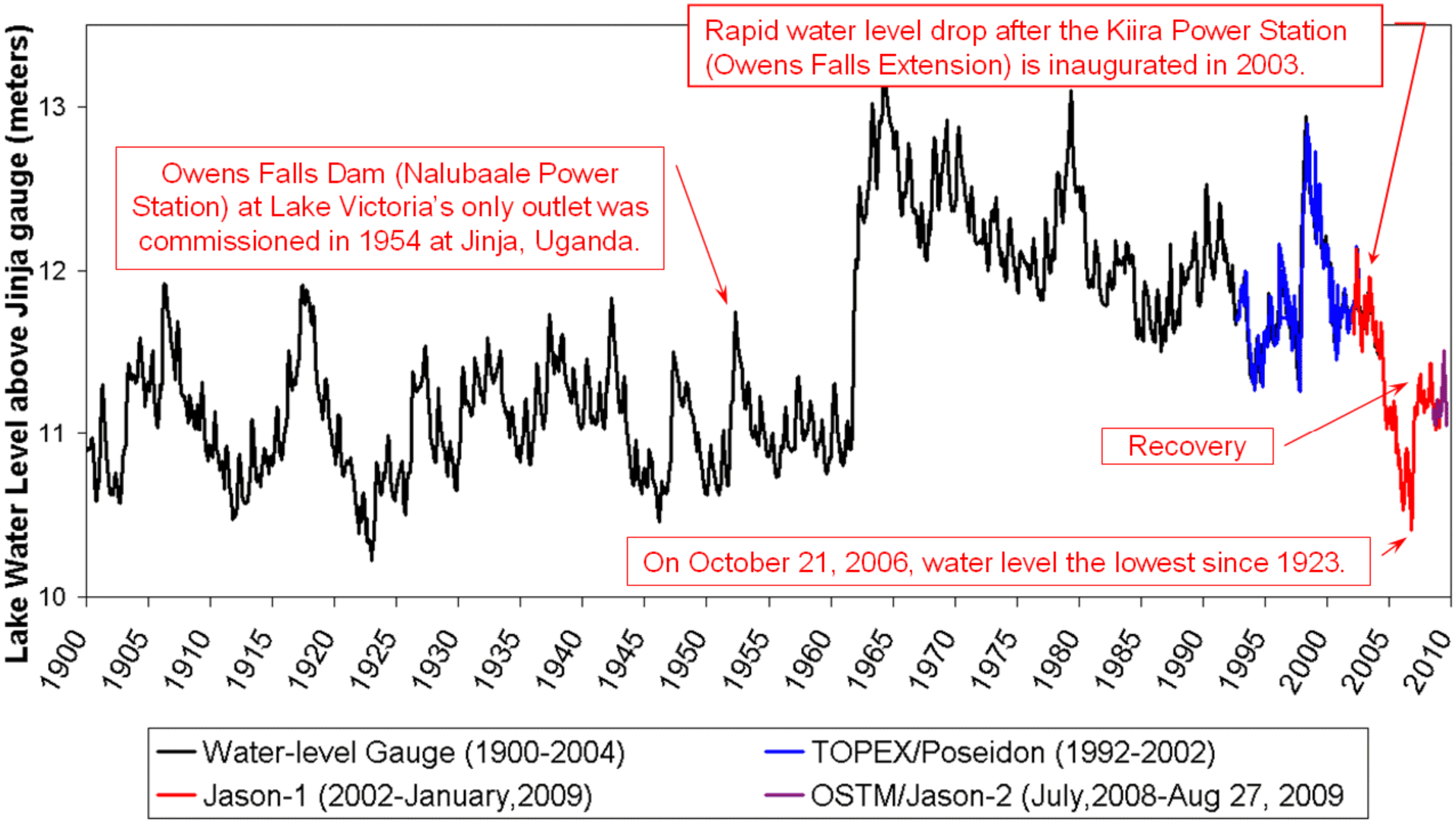






FAS to the World

Historical Water Level Elevations for Lake Victoria



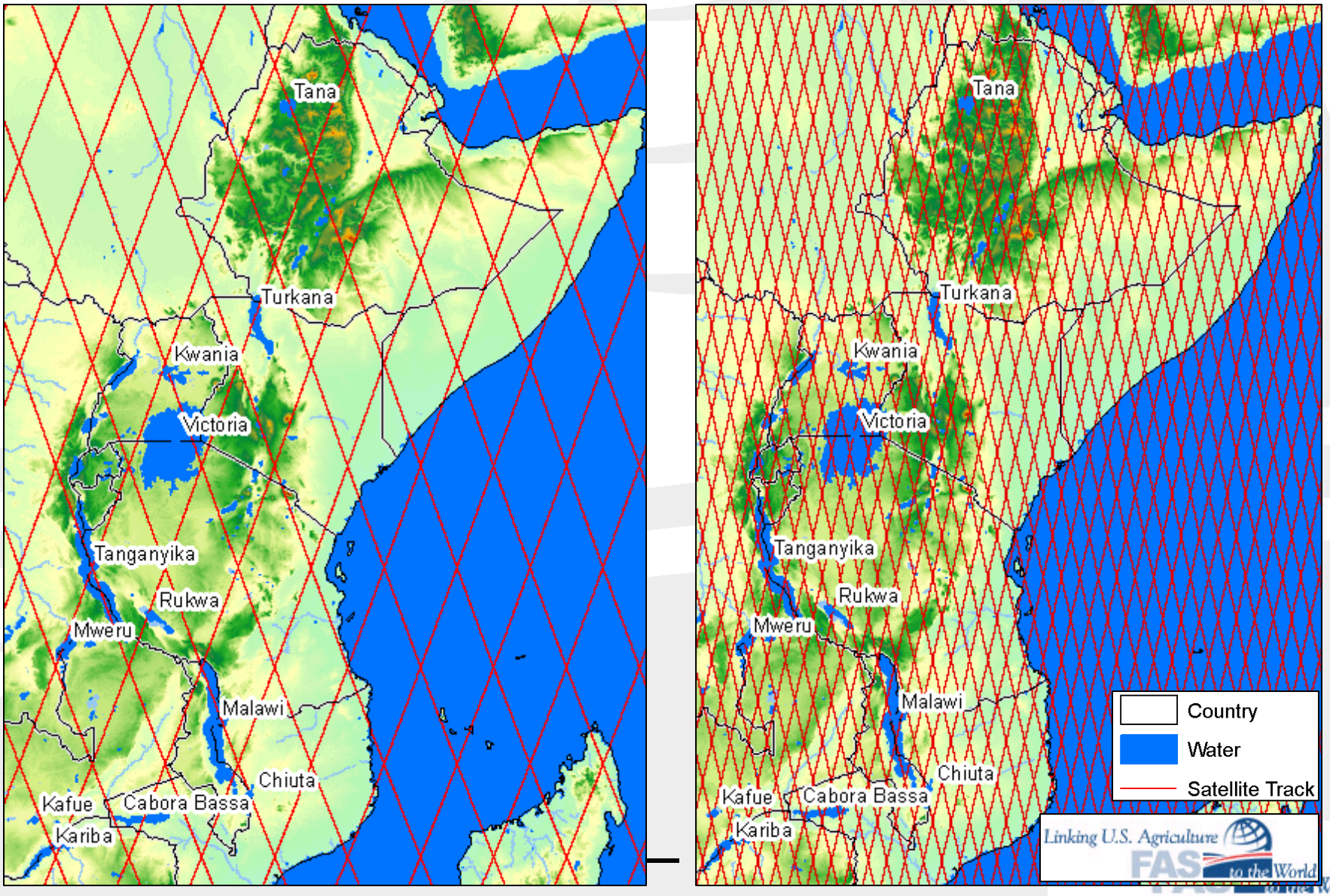
Data Source:
Water-level gauge data from Jinja, Uganda (near Lake Victoria's outlet)
Satellite radar altimeter data from USDS/NASA/UMD at:
http://www.pecad.fas.usda.gov/cropexplorer/global_reservoir/

U.S. Department of Agricultural (USDA)
Foreign Agricultural Service (FAS)
Office of Global Analysis (OGA)
International Production
Assessment Division (IPAD)

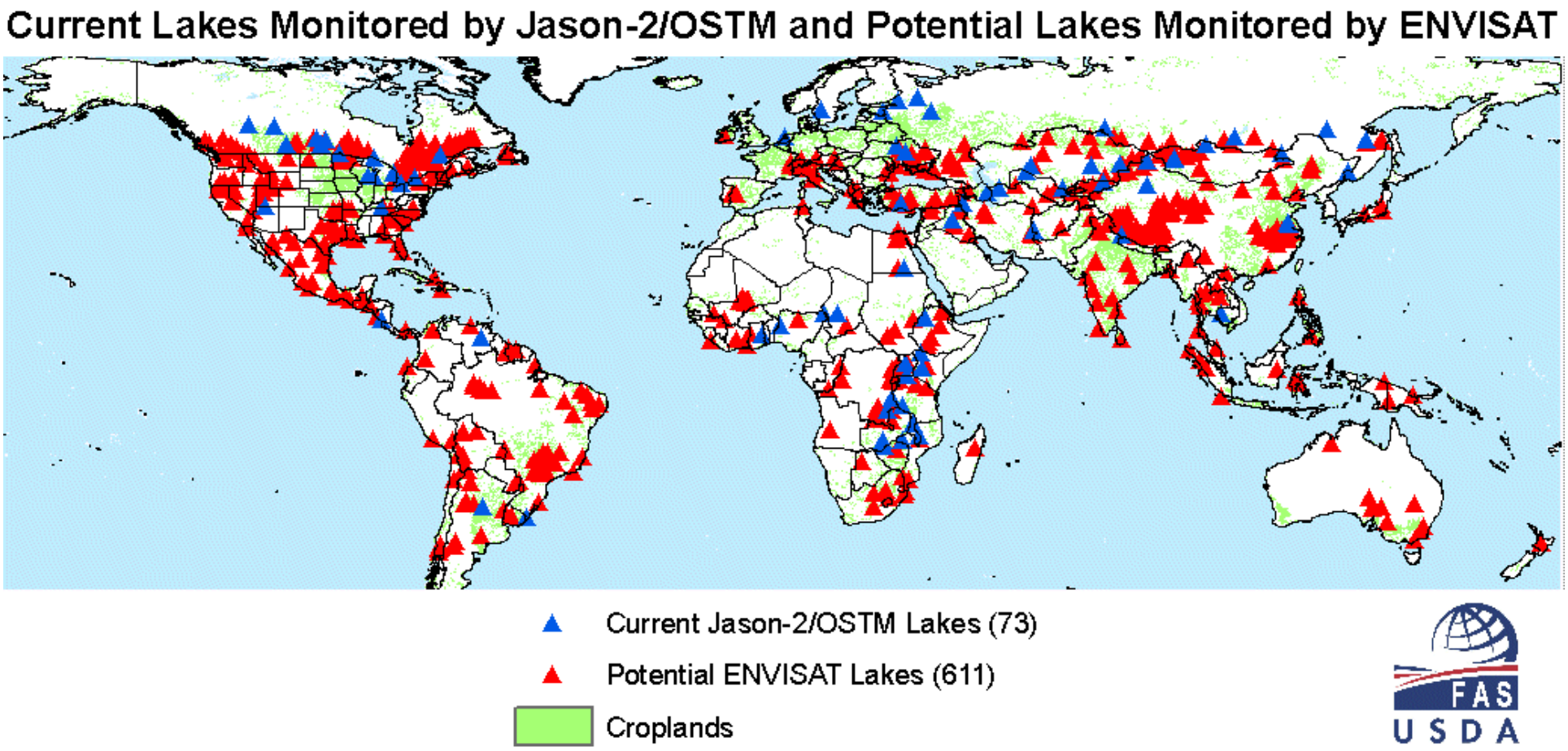
Different Satellite Orbits and Repeat Cycles

OSTM/Jason-2 Satellite Orbit with 10-day Repeat Cycle

ENVISAT Satellite Orbit with 35-day Repeat Cycle



Potential GRLM Improvement with ENVISAT



Data Source: Source: http://www.pecad.fas.usda.gov/cropexplorer/global_reservoir/

Linking U.S. Agriculture FAS to the World

Global Agricultural Monitoring (GLAM)

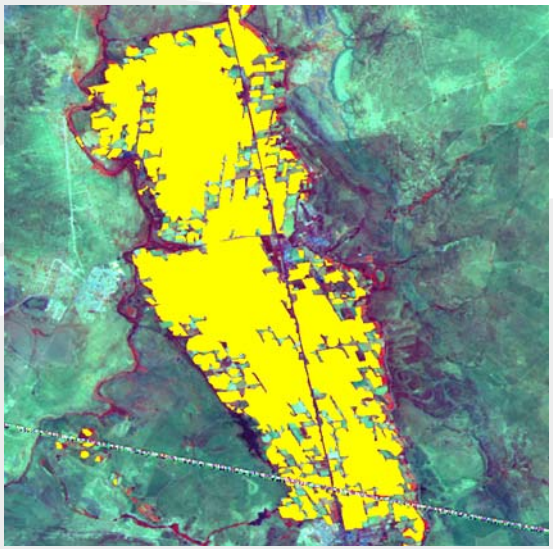
(Joint USDA/NASA funded project)

Area

AWiFS (56-m)
Landsat (30-m)

Semi-automated classification algorithms

Change in Area Estimates and Mid-season Dominate Crop Masks

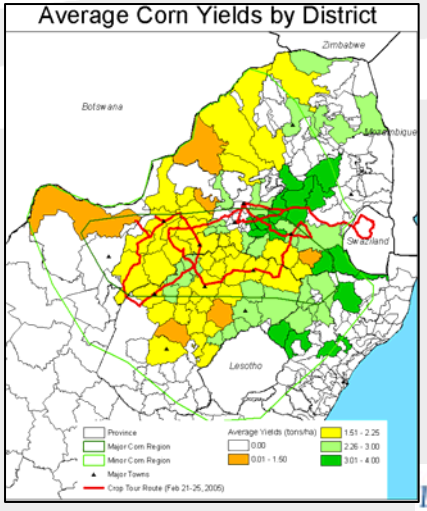


Yield

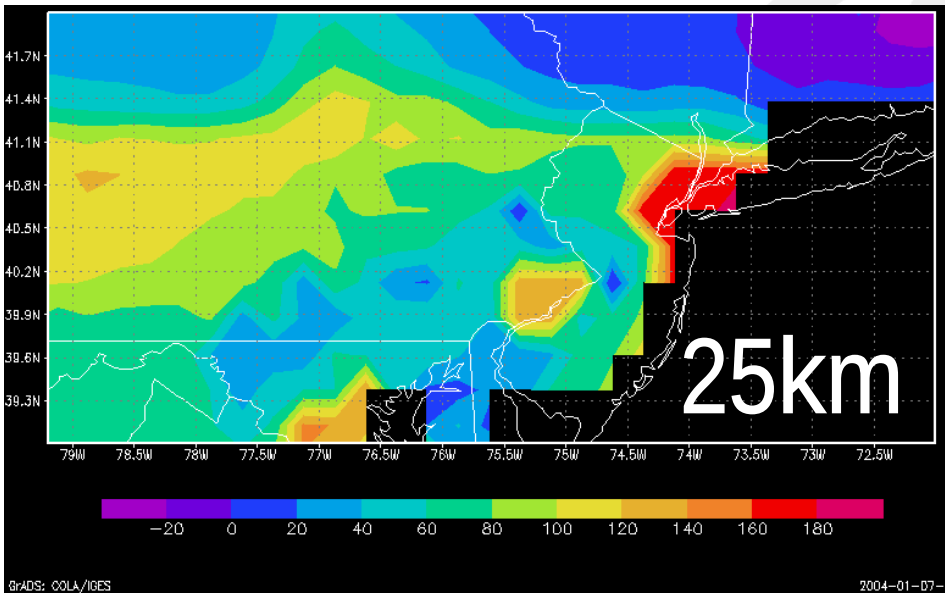
MODIS-CropNDVI (250-meter) Time Series Maps and Graphs

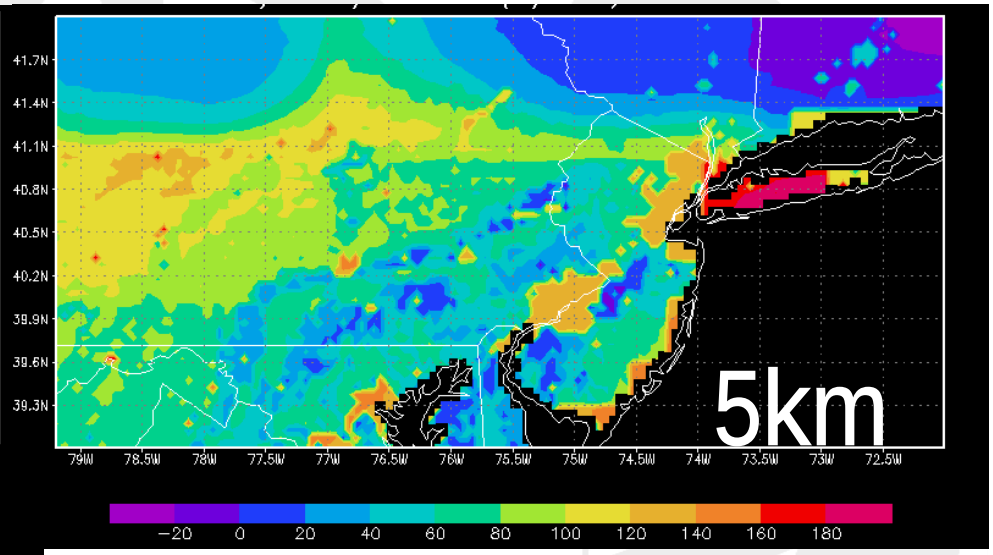
Regression and analog year algorithms

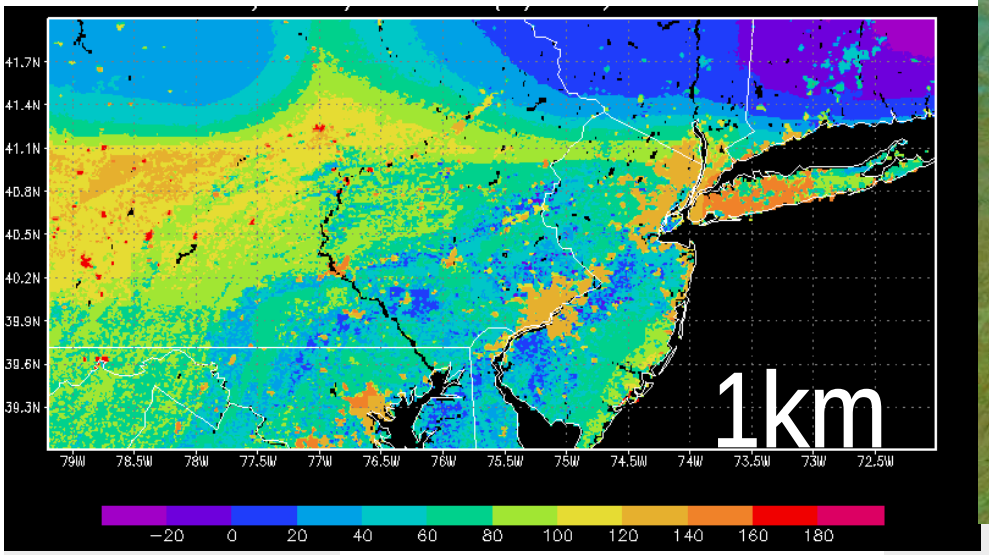
Mid-season to End-of-season Yield Estimates and Maps

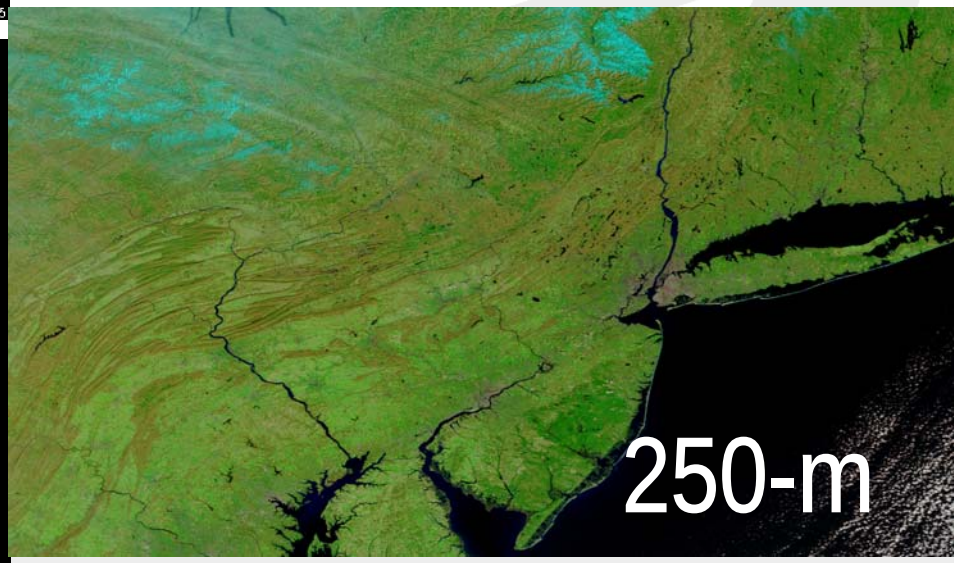


Precipitation (25-km) to MODIS-NDVI (250-m)









Linking U.S. Agriculture FAS to the World

World Meteorological Organization (WMO)

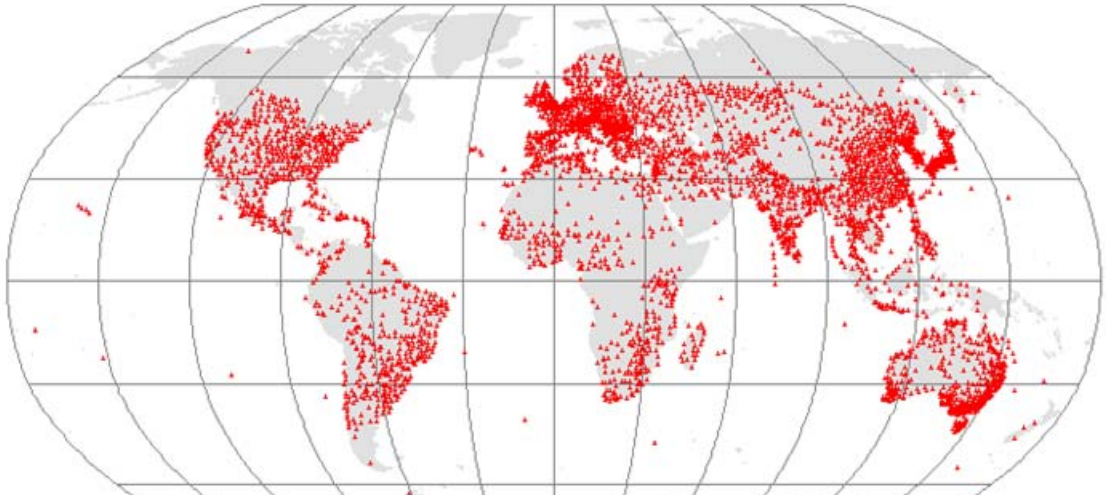
Daily Data Loaded Next Day:

- 24-hour precipitation
- Max Temp
- Min Temp
- Snow Coverage

PECAD Adds to CADRE:

- Average Daily Temperature
- Cumulative precipitation
- Potential ET
- Soil Moisture
- Crop Calendar
- Corn Hazard (Alarm)
- Winterkill Model

"Yesterday's Weather Delivered Today"



Daily weather data provided by approximately 7000 WMO ground stations

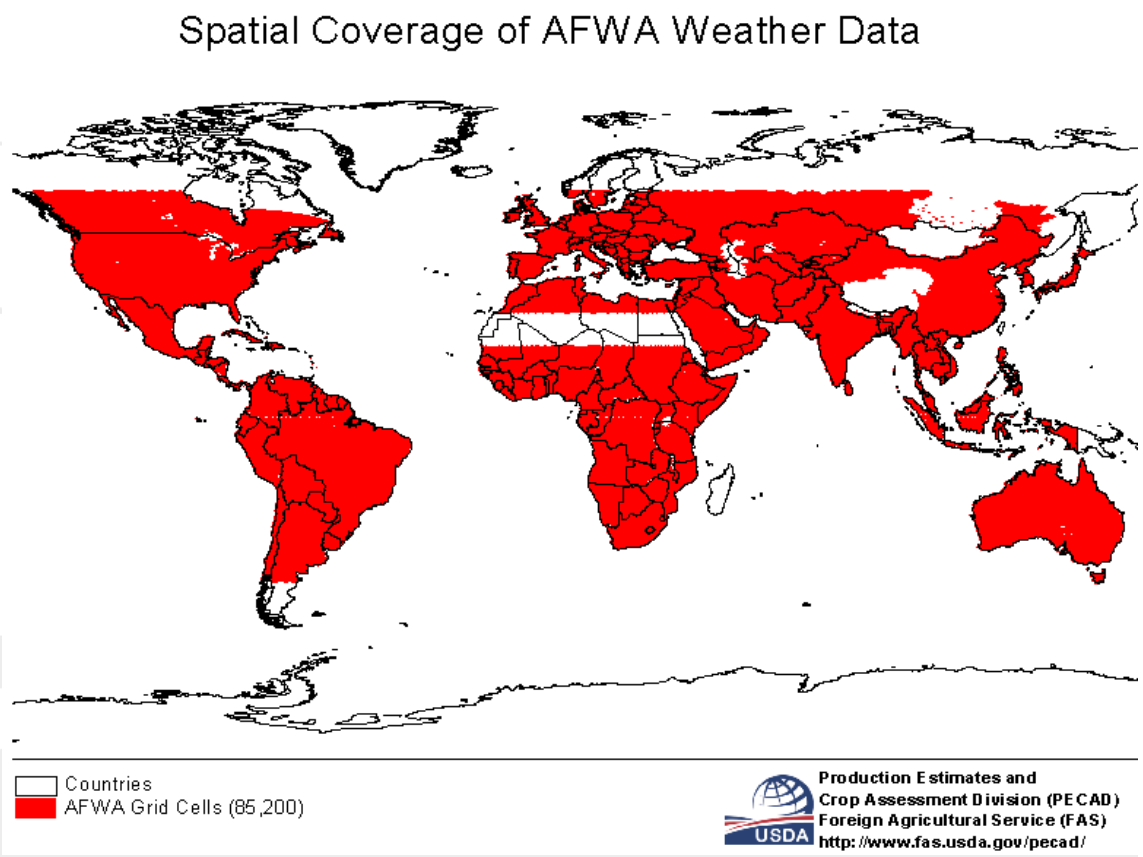
Air Force Weather Data (AFWA)

Daily AFWA Data Loaded Next Day:

- 24-hour precipitation
- Max Temp
- Min Temp
- Snow Coverage
- Actual and Potential ET
- Solar and IR Radiation

PECAD Adds to CADRE:

- Average Daily Temperature
- Cumulative precipitation
- Potential ET
- Soil Moisture
- Crop Calendar
- Corn Hazard (Alarm)
- Relative Yield Reduction
- Winterkill Model

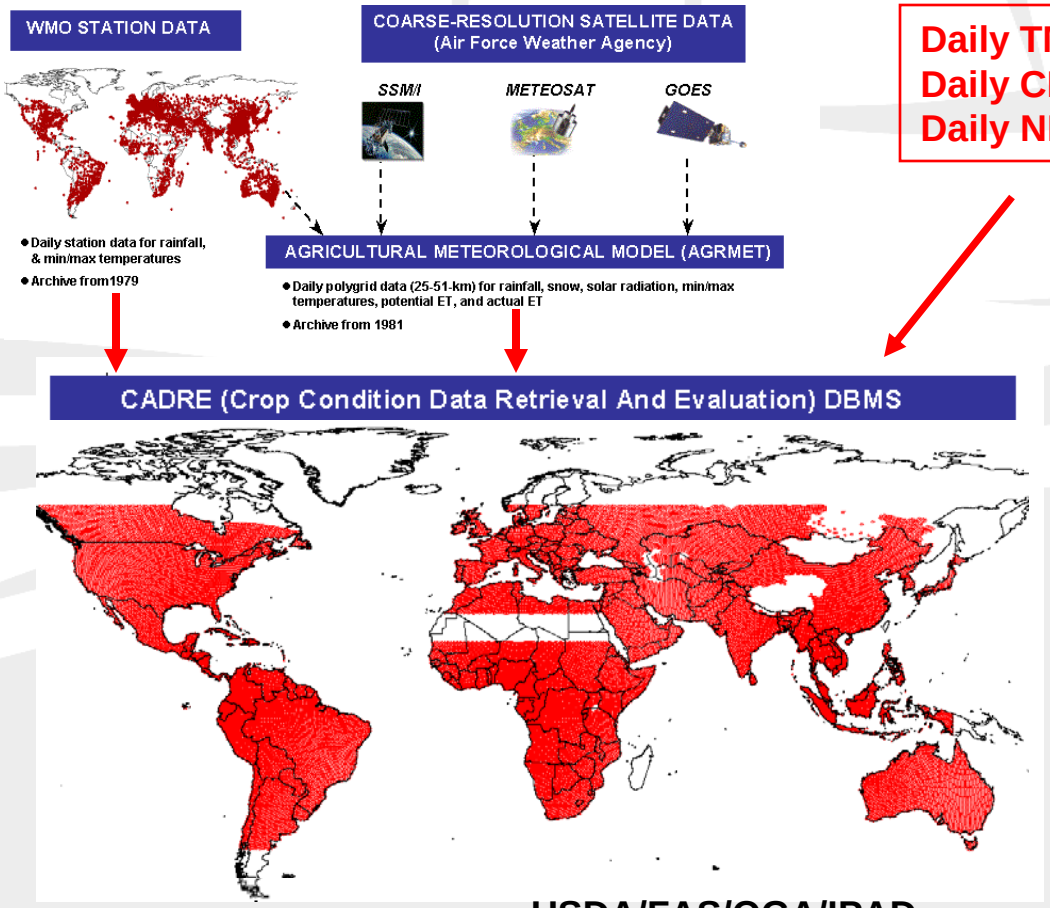


Linking U.S. Agriculture FAS to the World

CADRE
(Crop Assessment Data Retrieval & Evaluation)

CADRE is a *geospatial* database that stores (in Oracle):

- ***Daily weather station data*** (from WMO/GTS)
- ***Daily weather grid cell* data** (from AFWA)
  - Grid cell resolution (25km near equator & 51km near poles)
- **Daily TMPA** (from NASA), **Daily CMORPH** (from NOAA), and **Daily NEXRAD** (from NWS)



Daily TMPA (from NASA),
Daily CMORPH (from NOAA),
Daily NEXRAD (from NWS & US only)

Linking U.S. Agriculture FAS to the World

Summary Global Precipitation Data Sets Utilized by IPAD

Product/Source[1]	Spatial Resolution	Coverage	Infrared Geostationary Satellites (IR)	Passive Microwave (PMW)	Active Radar	Ground Station Gauge (SG)
GTS/WMO and NOAA/NWS (for USA)	approx. 7500 stations report daily	Global	No	No	No	Yes
AGRMET/ AFWA	47-km at 60° latitude (true) and 25-km at the equator	Global 60° N-S	Yes	SSM/I	No	Yes, GTS/WMO, NOAA/NWS, and others
CMORPH/ NOAA-CPC	8-km at equator	Global 60° N-S	Yes	SSM/I,TMI, AMSR-E, AMSU-B	No	No
TMPA-RT (3B42RT)/ NASA-DISC	0.25 degrees or approx. 28-km	Global/ 50° N-S	Yes	SSM/I,TMI, AMSR-E, AMSU-B	No	No[2]
NEXRAD/ NOAA-NWS	4-km	USA/ lower 48	Yes[3]	No	Ground Doppler	Yes, NOAA/NWS

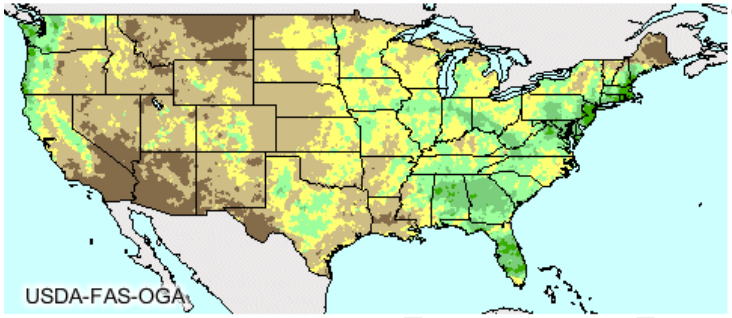
1. USDA/FAS' CADRE receives daily all precipitation products listed and Crop Explorer aggregates the daily products into 10-day time periods for agricultural monitoring.

2. Station gauges (SG) are added more than one month later to the 3B42RT product to produce an after real-time global precipitation product called 3B42 (V6).

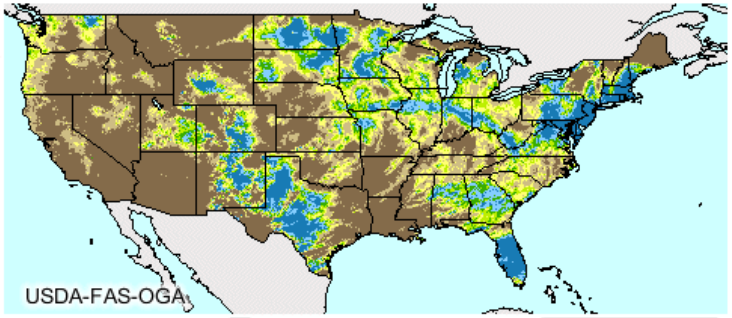
3. Satellite precipitation estimates (SPE) are incorporated in regions where there is limited or no radar coverage.

NEXRAD, Old-AFWA, WMO

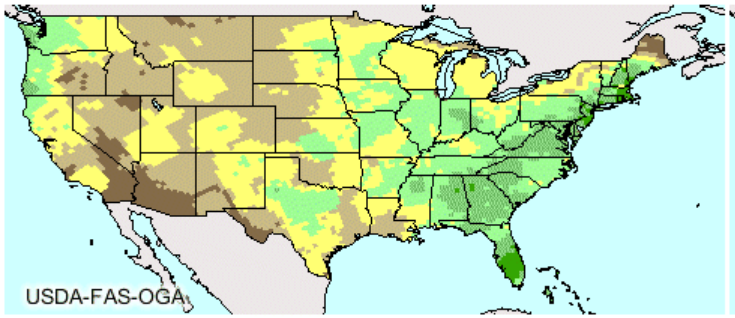
NexRad Precipitation
03/11/10 - 03/20/10 **Previous 10-day**
Click on a U.S. region to view its thematic map.



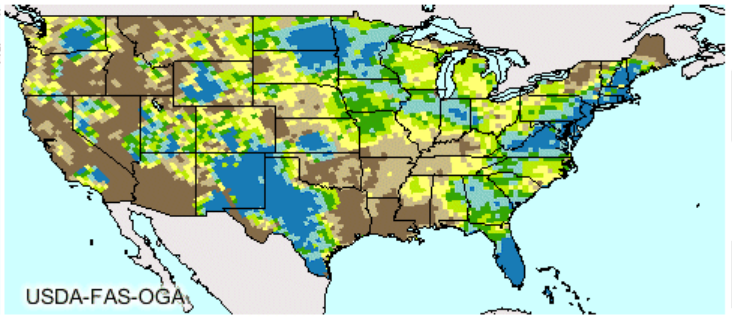
NexRad Decadal Percent Normal Precipitation
03/11/10 - 03/20/10



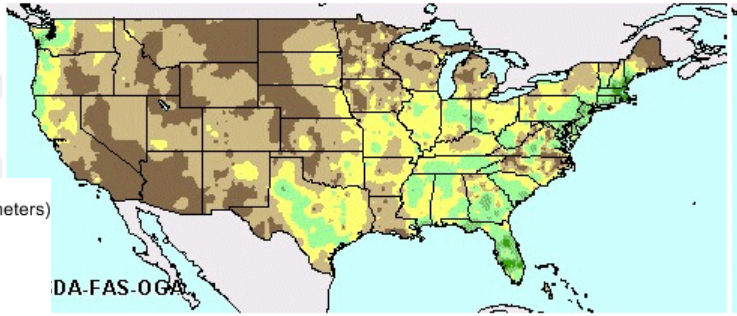
AFWA Precipitation View in Google Earth
03/11/10 - 03/20/10 **Previous 10-day**
Click on a U.S. region to view its thematic map.



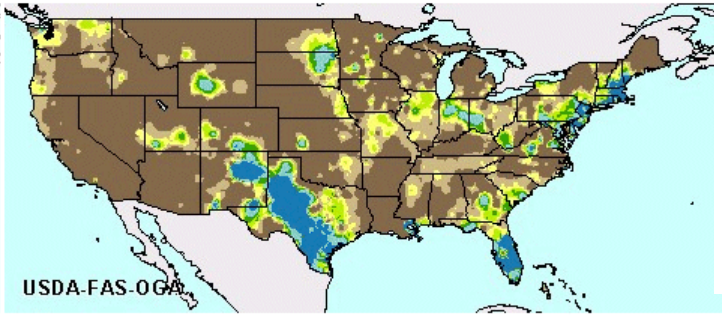
AFWA Decadal Percent Normal Precipitation View in Google Earth
03/11/10 - 03/20/10



WMO Precipitation View in Google Earth
03/11/10 - 03/20/10 **Previous 10-day**



WMO Decadal Percent Normal Precipitation View in Google Earth
03/11/10 - 03/20/10



Precipitation (Millimeters)
- > 400
- 200 - 400
- 100 - 200
- 50 - 100
- 25 - 50
- 10 - 25
- 1 - 1
- <= 1
- No Data

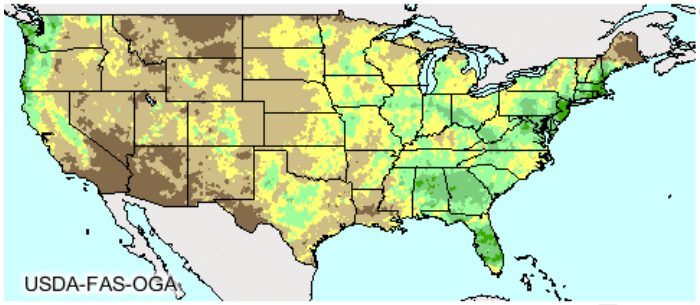
Decadal Percent of Normal (%)
- > 200
- 150 - 200
- 125 - 150
- 100 - 125
- 75 - 100
- 50 - 75
- <= 50
- No Data

USDA/FAS/OGA/IPAD

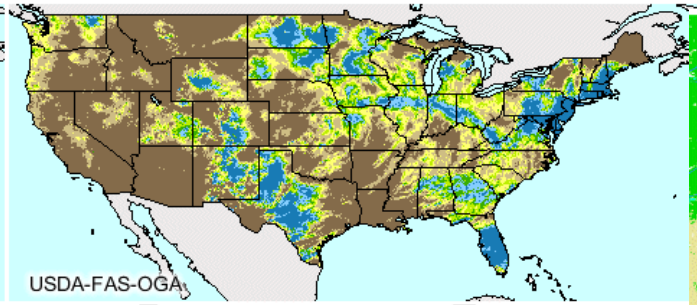
Linking U.S. Agriculture FAS to the World

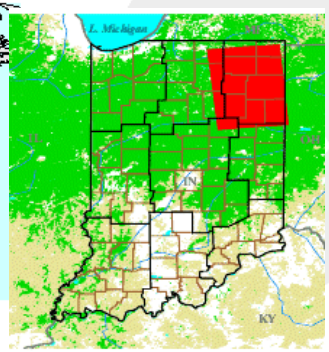
NEXRAD, NOAA-CMORPH, and TMPA-NASA

NexRad Precipitation
03/11/10 - 03/20/10 **Previous 10-day**
Click on a U.S. region to view its thematic map.



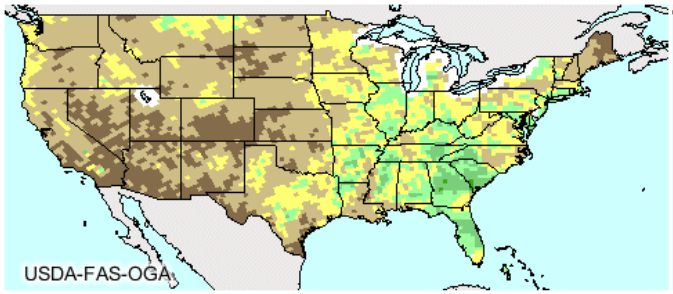
NexRad Decadal Percent Normal Precipitation
03/11/10 - 03/20/10



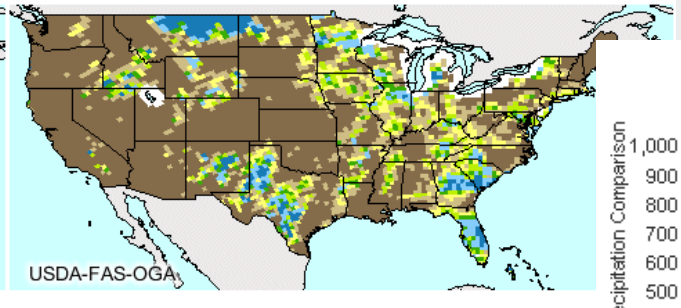


Indiana CRD 30
View Satellite Image

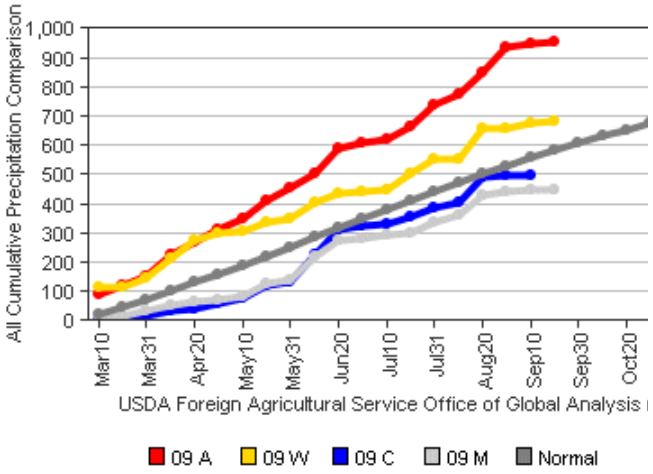
TMPA Precipitation View in Google Earth
03/11/10 - 03/20/10 **Previous 10-day**
Click on a U.S. region to view its thematic map.



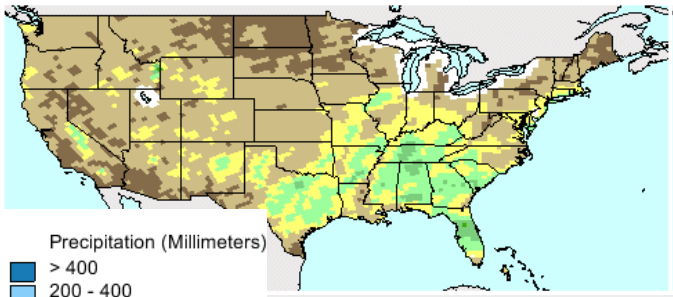
TMPA Decadal Percent Normal of Precipitation View in Google Earth
03/11/10 - 03/20/10



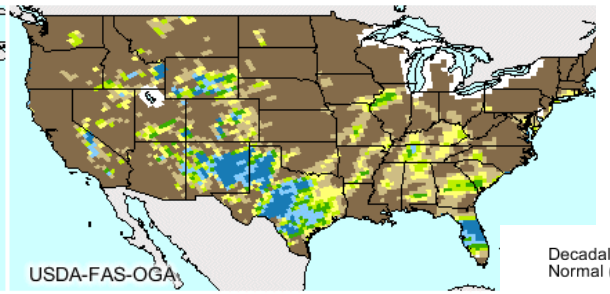
All Cumulative Precipitation Comparison in Indiana CRD 30



CMORPH Precipitation View in Google Earth
03/11/10 - 03/20/10 **Previous 10-day**



CMORPH Decadal Percent of Normal Precipitation View in G Earth
03/11/10 - 03/20/10



Precipitation (Millimeters)
- > 400
- 200 - 400
- 100 - 200
- 50 - 100
- 25 - 50
- 10 - 25
- 1 - 10
- <= 1
- No Data

Decadal Percent of Normal (%)
- > 200
- 150 - 200
- 125 - 150
- 100 - 125
- 75 - 100
- 50 - 75
- <= 50
- No Data

USDA/FAS/OGA/IPAD

Linking U.S. Agriculture FAS to the World

CADRE

CADRE stores ***baseline geospatial data sets:***

- ***Climate 30-year normals & NDVI multi-year averages***
- ***Soils water holding capacity***
- ***Average crop planting dates***

CADRE calculates and stores daily soil moisture, crop calendar and crop modeling data.

2-LAYER SOIL MOISTURE MODEL

- Estimates soil moisture daily for stations and grid cells.

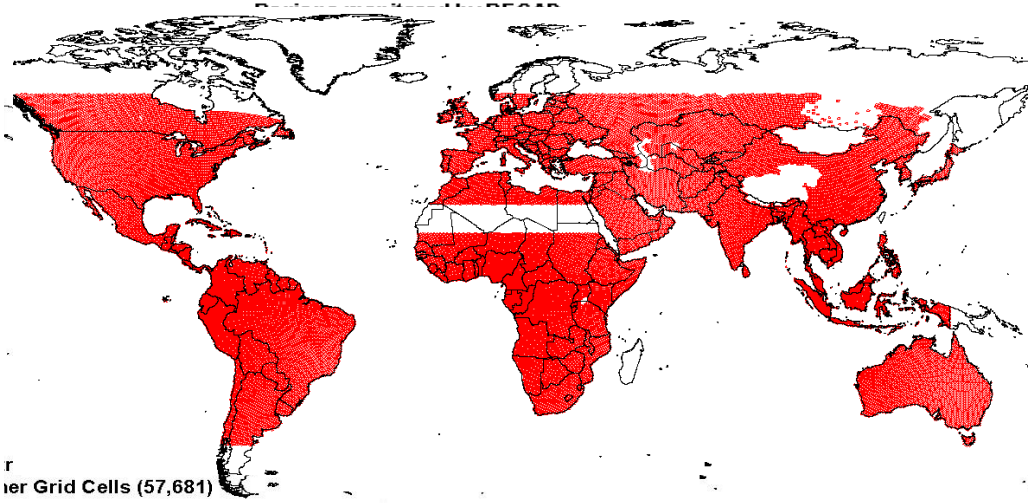
CROP STRESS (ALARM) MODELS

- Meteorological data filters that provide early warning to adverse weather conditions.
- Crop hazard algorithms monitor crop stress for corn, wheat, soybean, sorghum, and barley.
- Flag regional weather anomalies that exceed temperature and soil moisture thresholds for the particular crop.

CROP MODELS

- Crop calendar models crop stages for corn, wheat, and sorghum.
- Relative yield-reduction models based on crop water production functions.
- Models include wheat (CERES, AGRISTARS, Maas, & URCROP), corn (AGRISTARS & URCROP), soybean (Sinclair), sorghum (AGRISTARS) & barley (URCROP).

CADRE (Crop Condition Data Retrieval And Evaluation) DBMS



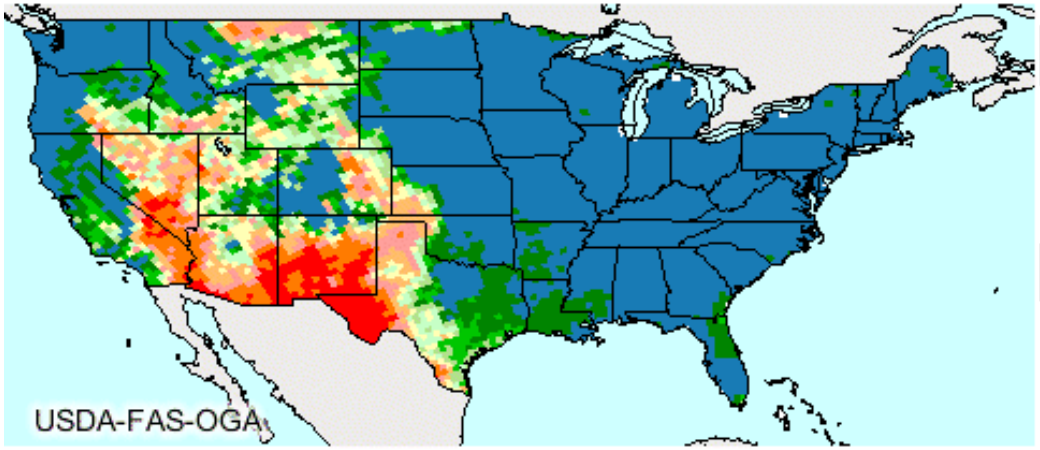
AFWA & WMO Soil Moisture

(modified 2-layer Palmer Model)

AFWA Percent Soil Moisture View in Google Earth

03/11/10 - 03/20/10 **Previous 10-day**

Click on a U.S. region to view its thematic map.

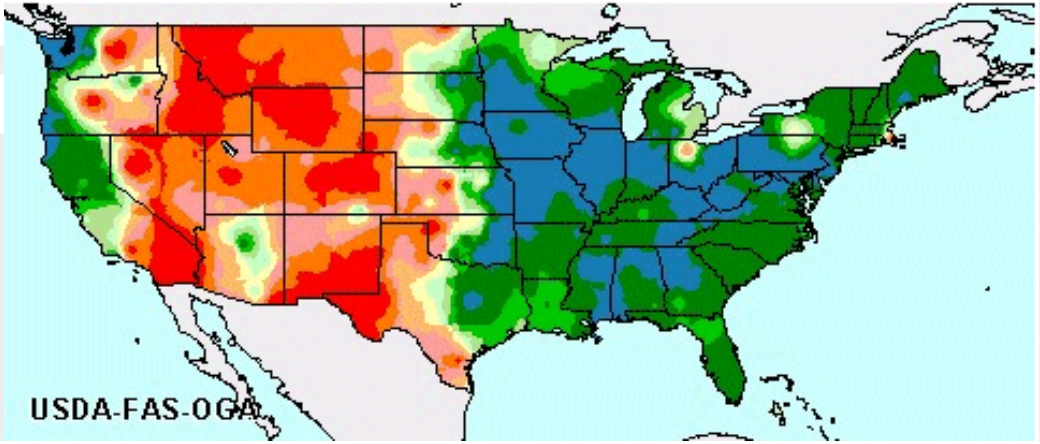


Percent Soil Moisture (%)

- 90 - 100
- 80 - 90
- 70 - 80
- 60 - 70
- 50 - 60
- 40 - 50
- 30 - 40
- 20 - 30
- 10 - 20
- 0 - 10
- No Data

WMO Percent Soil Moisture View in Google Earth

03/11/10 - 03/20/10 **Previous 10-day**



Linking U.S. Agriculture FAS to the World

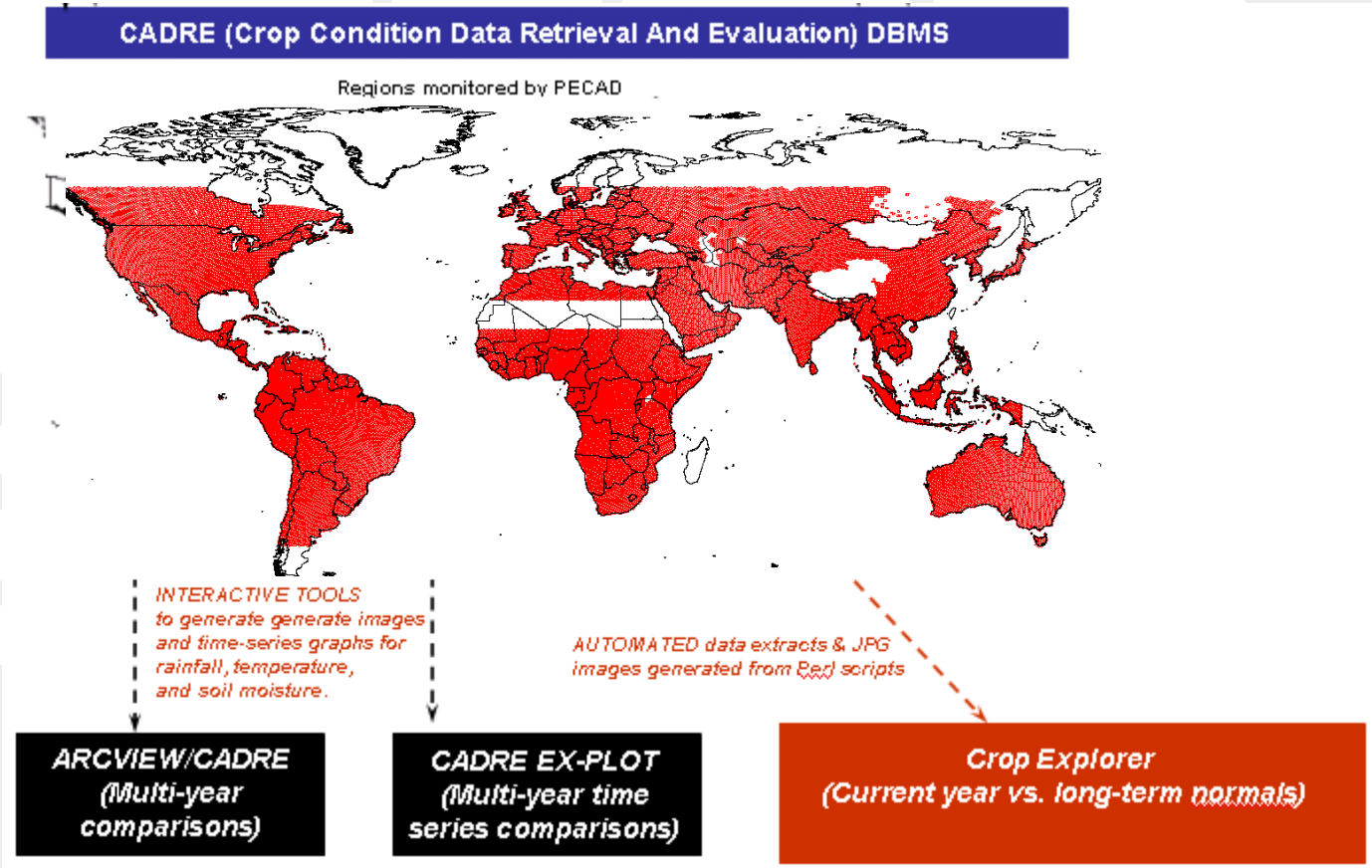
Summary Global Soil Moisture Data Sets Utilized by IPAD

Product	Data Source (process agency)	Spatial Resolution	Coverage	Input Data	Infrared Geosta-tionary Satellites	Passive Microwave	Ground Station with Gauge
"Station" 2-layer Soil Moisture Model (modified Palmer)	GTS/WMO and NOAA-NWS for USA (USDA/FAS)	16,000 total stations	Global	Daily rainfall and min/max temperatures for PET calculations	No	No	Yes, approx. 7500 stations report daily
"Grid cell" 2-layer Soil Moisture Model (modified Palmer)	AGRMET/ AFWA (USDA/FAS)	47-km at 60° latitude (true) and 25-km at the equator	Global 60° N-S	Daily rainfall and min/max temperatures for PET calculations	Yes	SSM/I	Yes, GTS/WMO, NOAA/NWS, and others
"Corrected" (AMSR-E) 2-layer Soil Moisture Model (modified Palmer)	AGRMET/ AFWA and MODIS/ AMSR-E (USDA/ARS/ HRSL)	47-km at 60° latitude (true) and 25-km at the equator	Global 60° N-S	"Grid cell" Soil Moisture "corrected" every 3-days with MODIS/ AMSR-E data	Yes	SSM/I and "corrected" with MODIS/ AMSR-E data	Yes, GTS/WMO, NOAA/NWS, and others
Surface Wetness	SSM/I (WeatherPre-dict Consult-ing-WPC)	1/3-degree or approx. 37-km	Global/ 80° N-S	Current week compared to 20-year climatology	No	SSM/I	No

CADRE

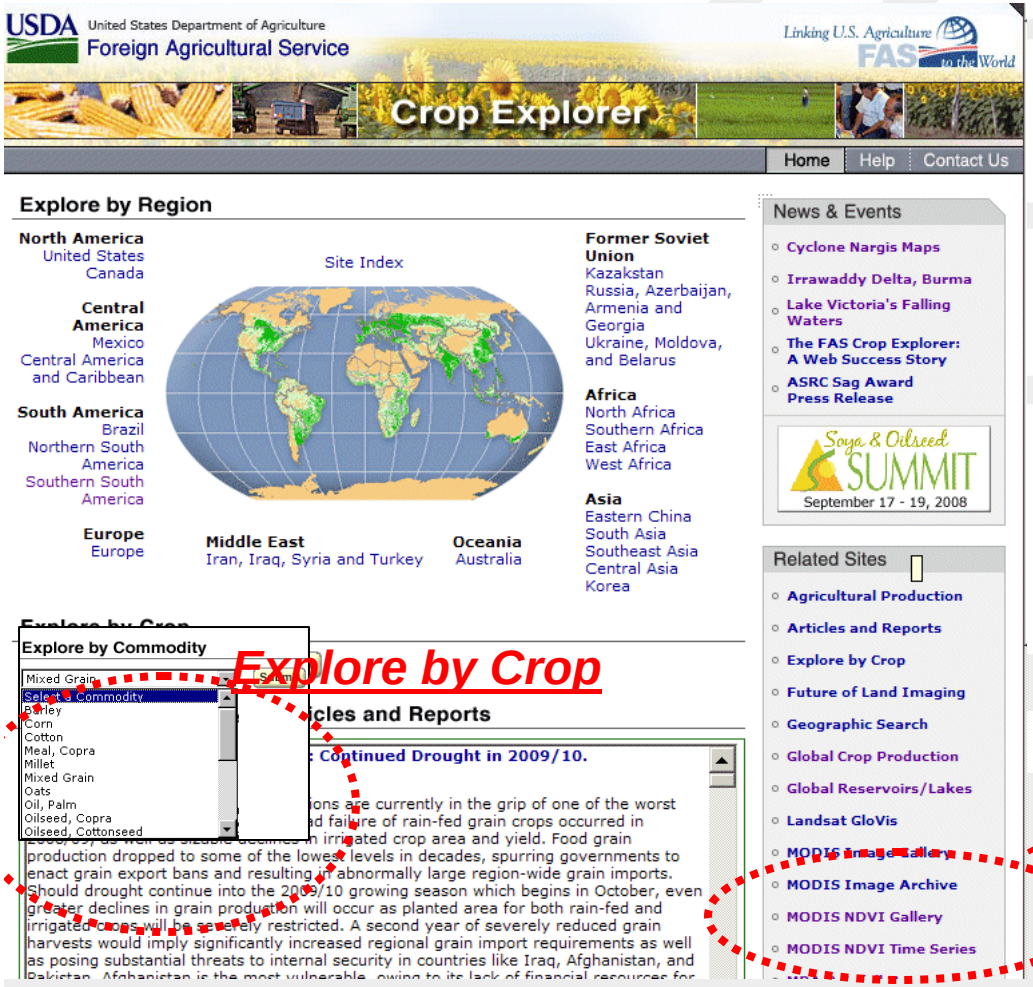
CADRE allows data to be displayed:

- *Automatic:* *"Crop Explorer"* products are displayed on the Internet every 10-days and for summer/winter growing seasons
- *Interactive:* Arcview GIS extractions for any region and time period.



Crop Explorer

(displays numerous weather and vegetation condition data sets over major crop regions every 10-days)



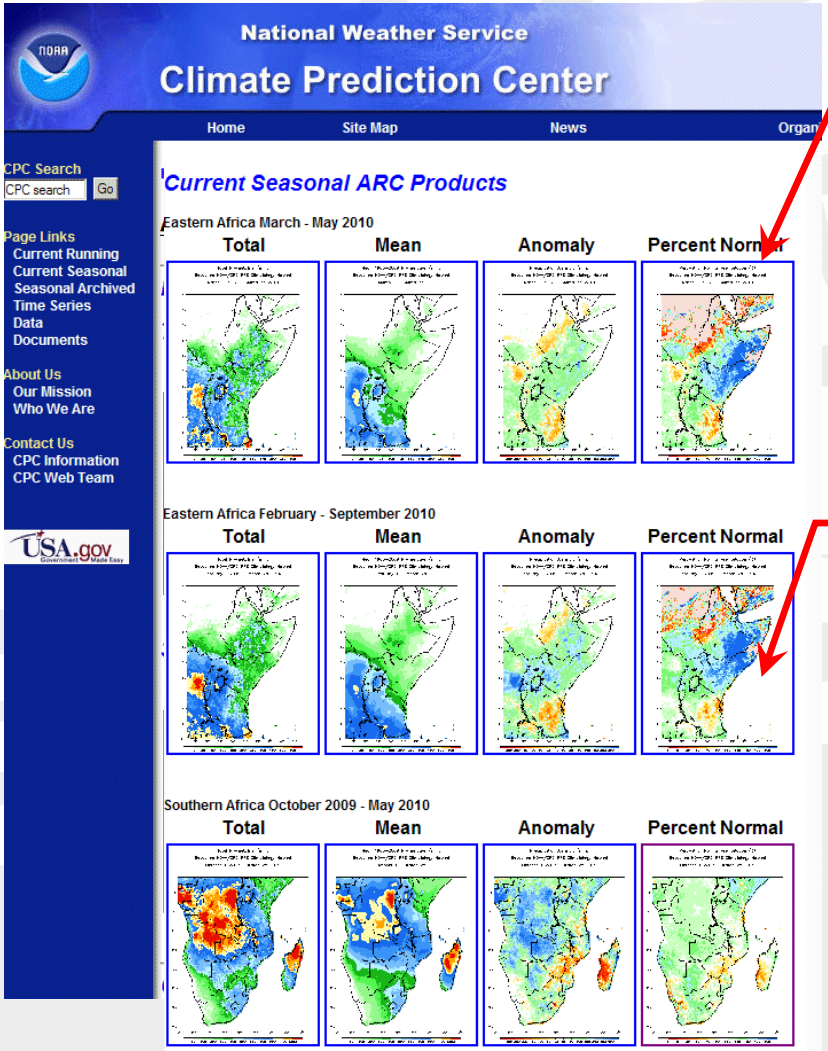
Maps and time-series charts for:

- ***Weather Data (AWFA, WMO, CMORPH, TMPA, and NEXRAD)***
  - Dekadal (10-day) precipitation & temperatures compared to climate normals
- ***Soil Moisture & Crop Models***
  - Modified Palmer two-layer soil moisture
  - *Behind firewall:* Crop calendars for wheat, corn, & sorghum and corn hazard/alarm model.
- ***Vegetation Indices (polar-orbiting satellites)***
  - GAC (8-km) (behind firewall)
  - SPOT-VEG (1-km)
  - MODIS (250-m)
- ***Daily MODIS***
  - Aqua and Terra (250-m)
- ***Lake/Reservoir Heights***
  - TOPOX/Poseidon,Jason-1, Jason-2
  - GFO
  - ERS, ENVISAT

Explore by Crop

Linking U.S. Agriculture FAS to the World

FAS/IPAD & NOAA/CPC Are Partners with USAID's FEWS-NET (Africa & beyond)

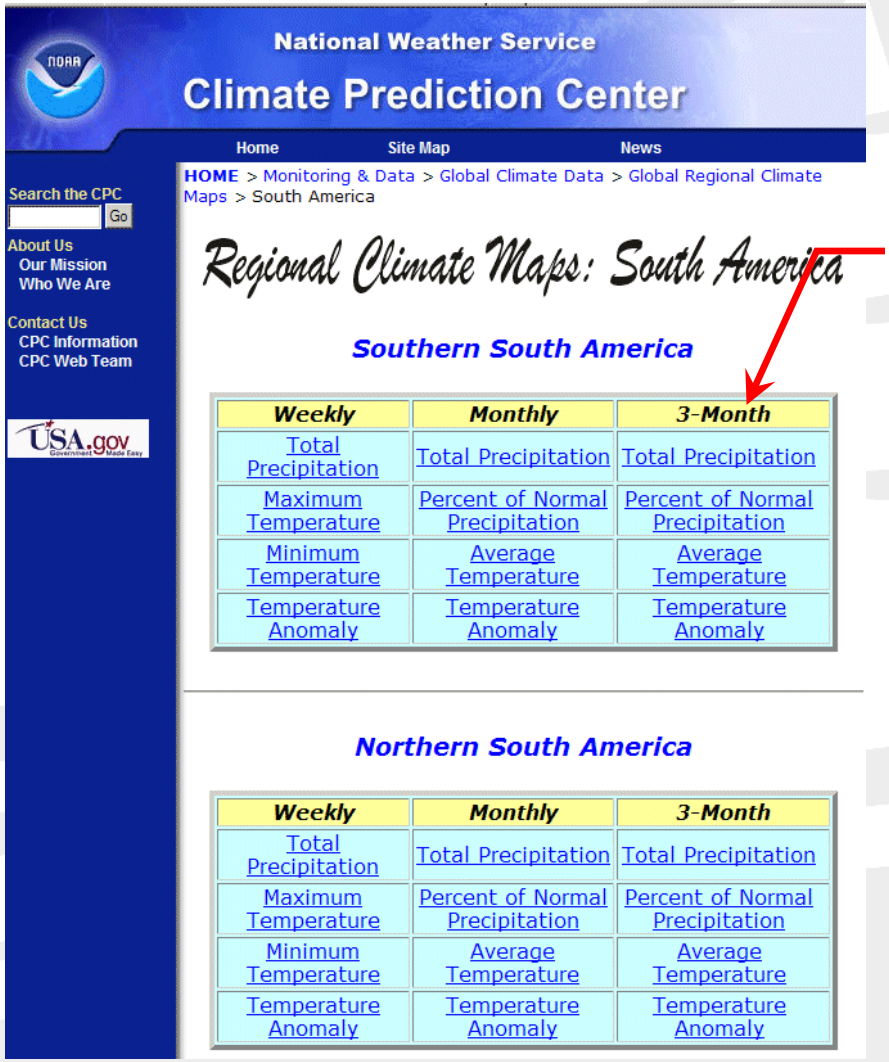


Growing Season Products for Africa

CPC Rainfall Estimate (RFE) product (8-km) with Meteosat, SSM/I, and ground stations merged

NOAA CPC Source: http://www.cpc.ncep.noaa.gov/products/fews/AFR_CLIM/afr_clim_season.shtml

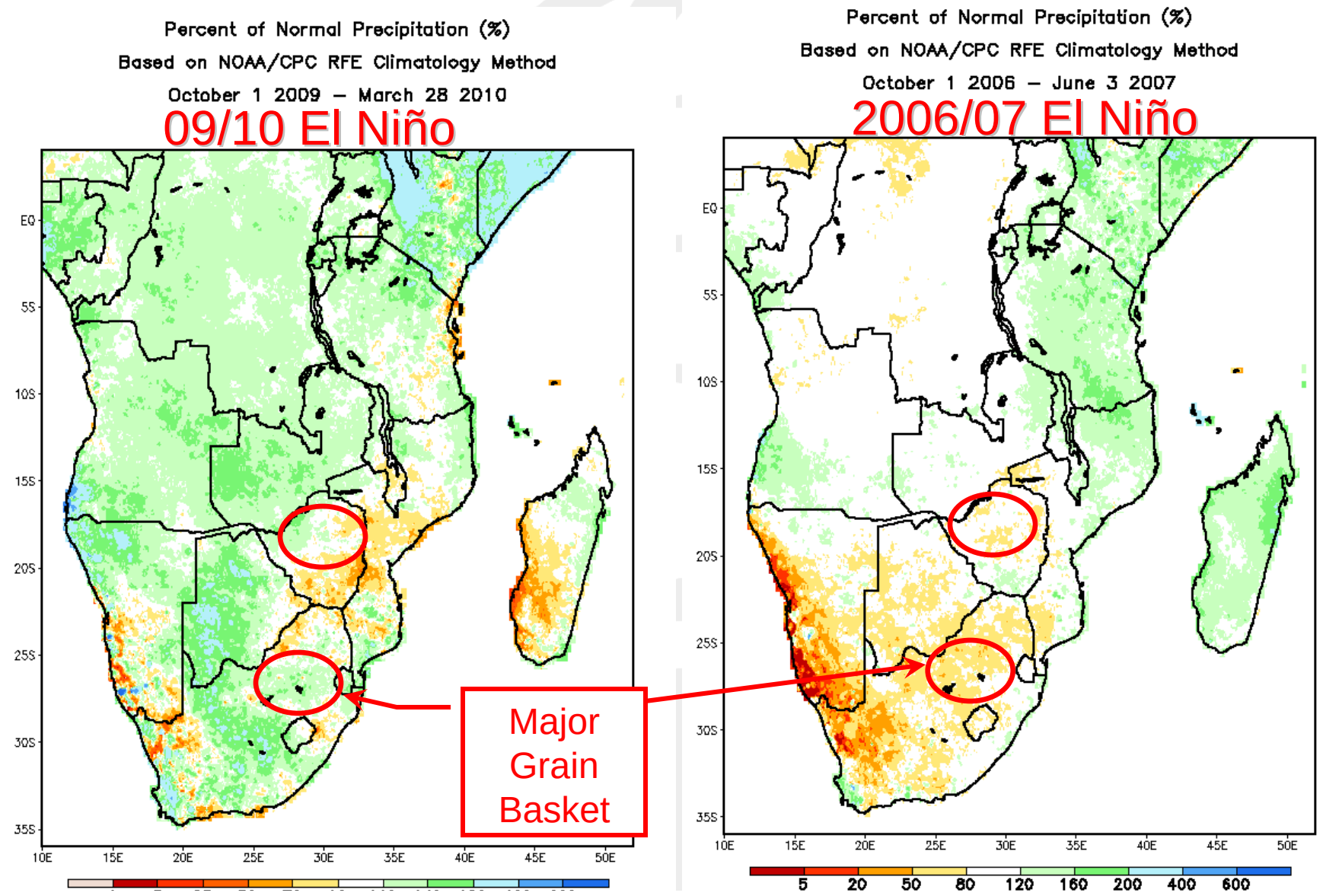
Growing Seasons for Other Continents?



Growing Season Products (4-6 months) for South America and other continents??

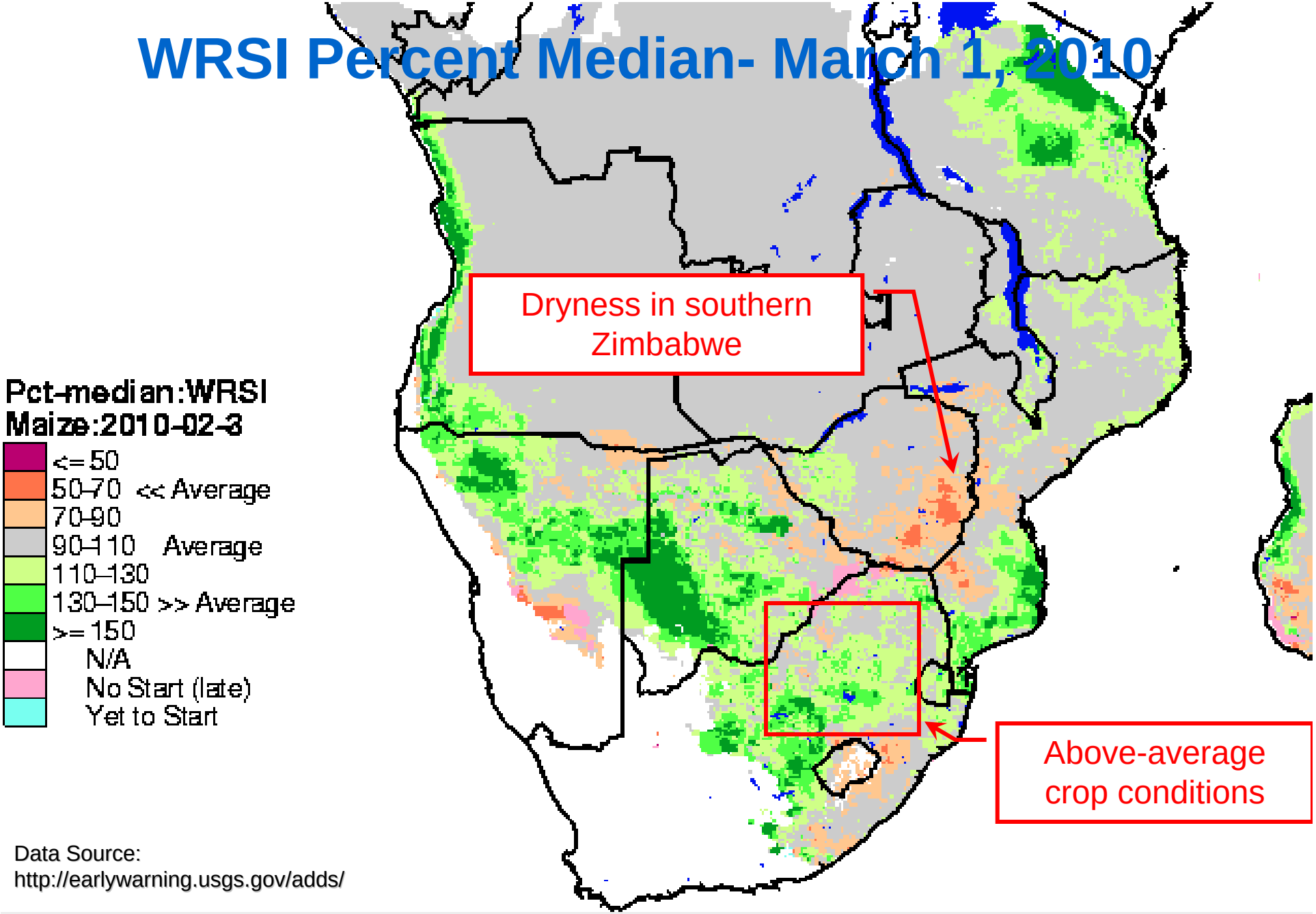
NOAA CPC Source: http://www.cpc.noaa.gov/products/analysis_monitoring/regional_monitoring/south_america.shtml

Southern Africa El Niño Comparison



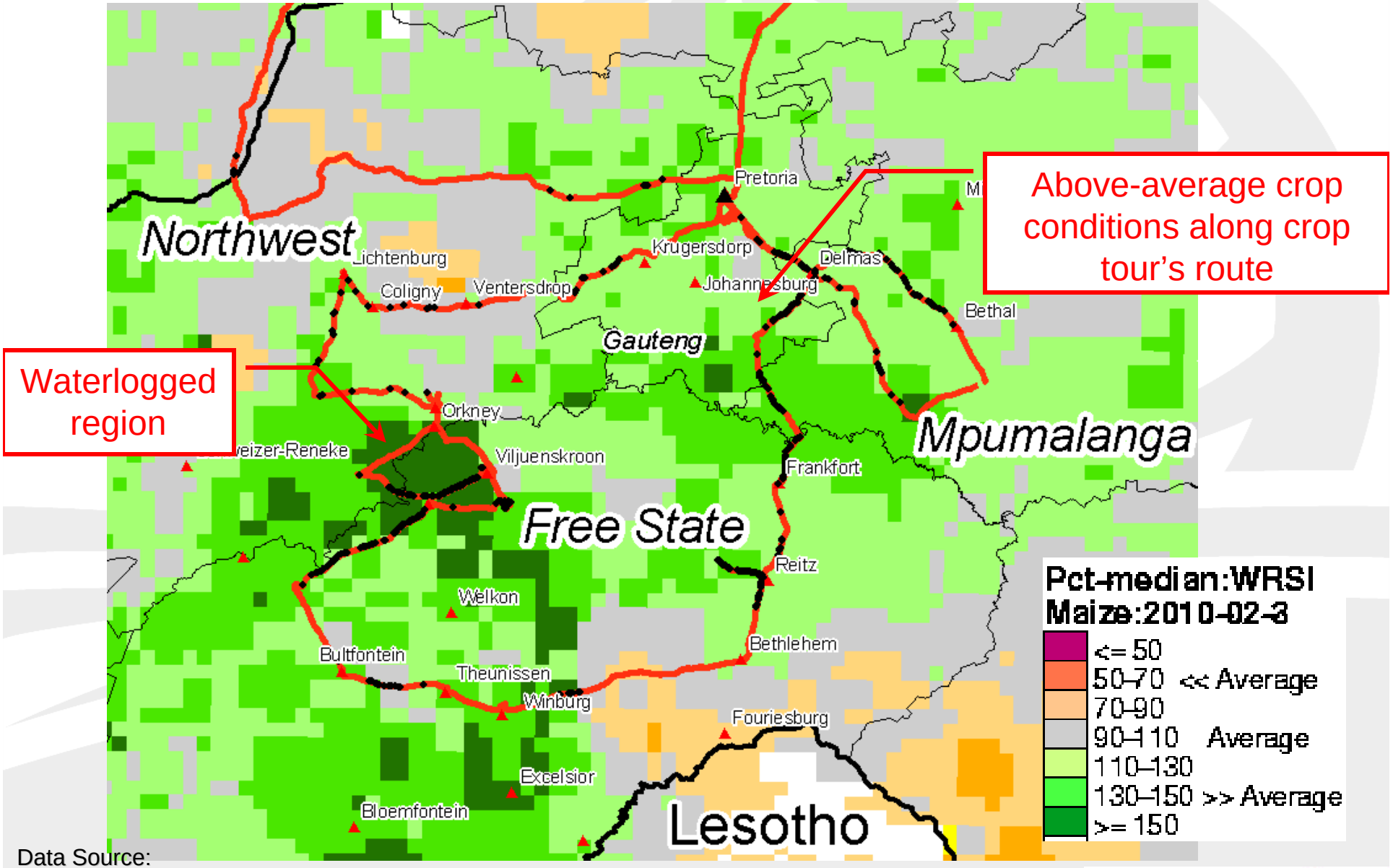
NOAA CPC Source: http://www.cpc.ncep.noaa.gov/products/fews/AFR_CLIM/afr_clim_season.shtml

WRSI Percent Median- March 1, 2010



Data Source:
http://earlywarning.usgs.gov/adds/

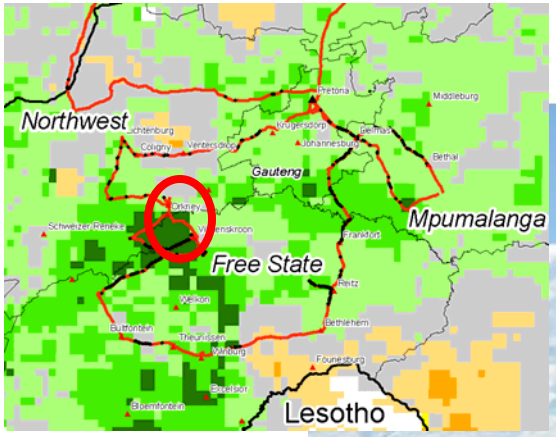
WRSI Percent Median (March 1, 2010)

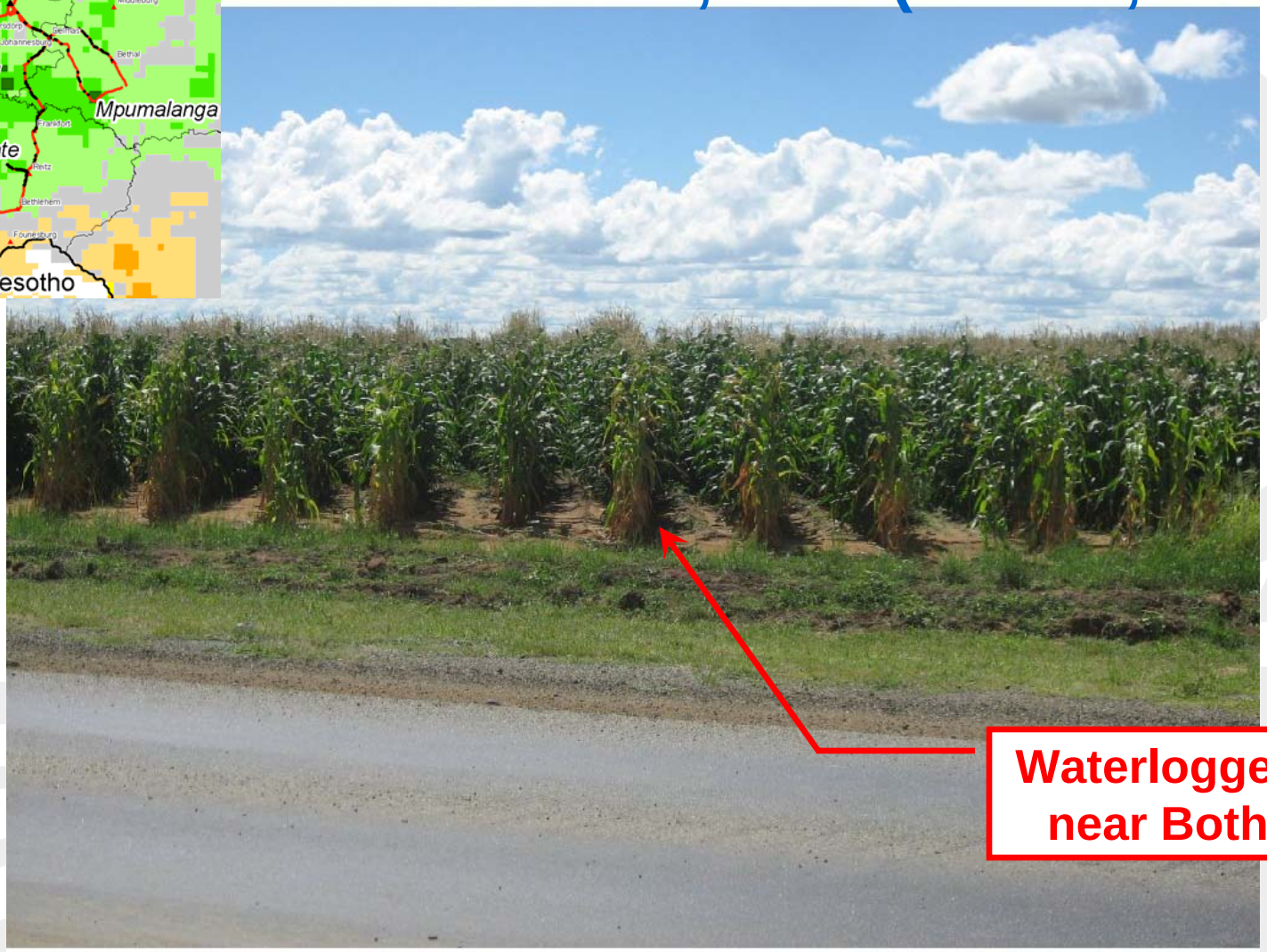


Data Source:
http://earlywarning.usgs.gov/adds/

Linking U.S. Agriculture FAS to the World

Bothaville, RSA (Feb 25, 2010)



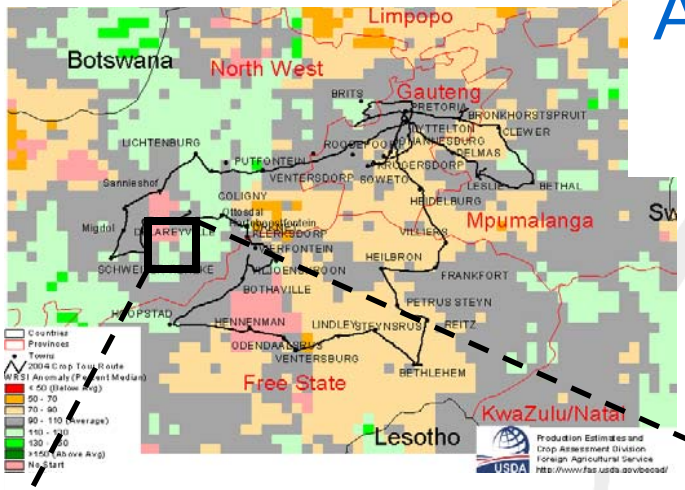


Linking U.S. Agriculture FAS to the World

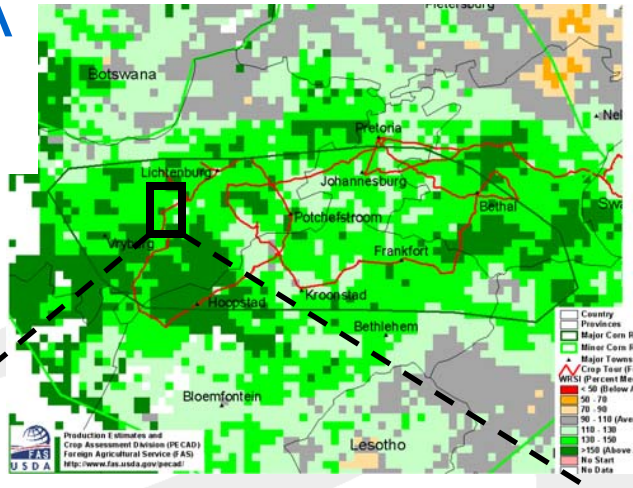
Albertshoek, RSA

(Crop failure May 2004, but bumper harvest May 2005)

WRSI Relative Yield (2003/04)

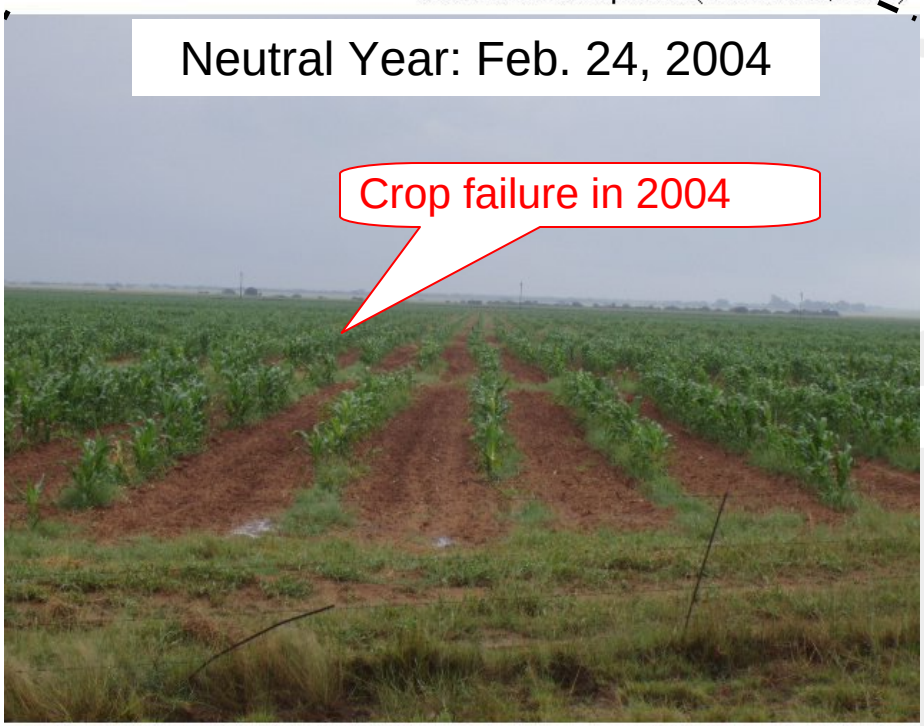


WRSI Relative Yield (2004/05)



South Africa Crop Tour (Feb. 19-26, 2004)

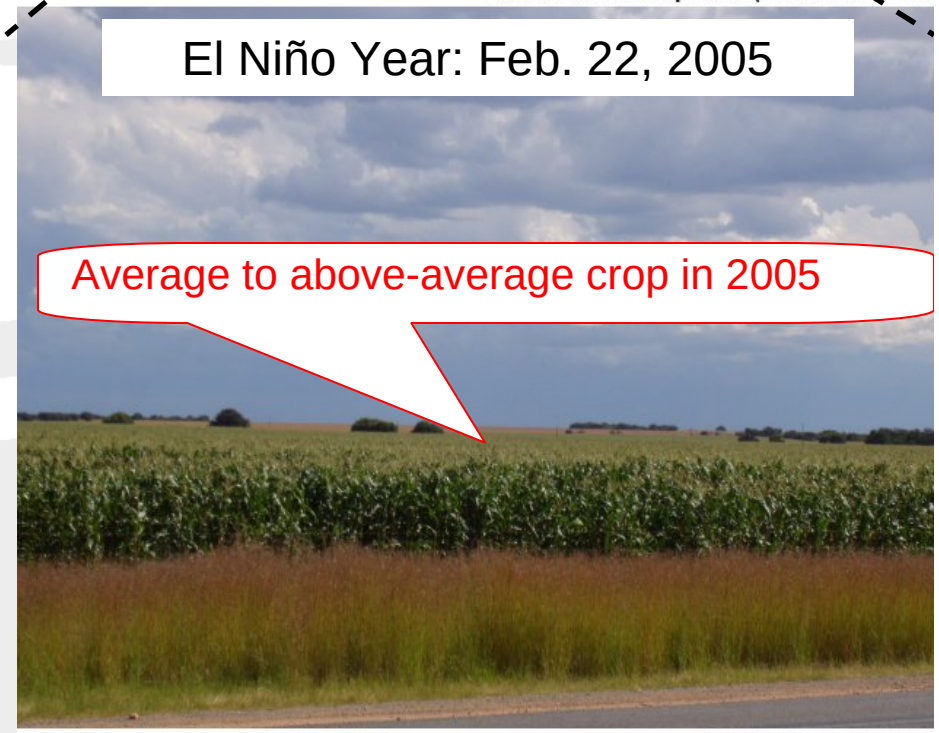
Neutral Year: Feb. 24, 2004



S 27° 03.034' E 025° 39.261' 1380 m 02/24/2004 02:20:26 PM

South Africa Crop Tour (Feb. 21-25, 2005

El Niño Year: Feb. 22, 2005



S 27° 07.244' E 025° 32.006' 1359 m 02/22/2005 3:06:27 PM

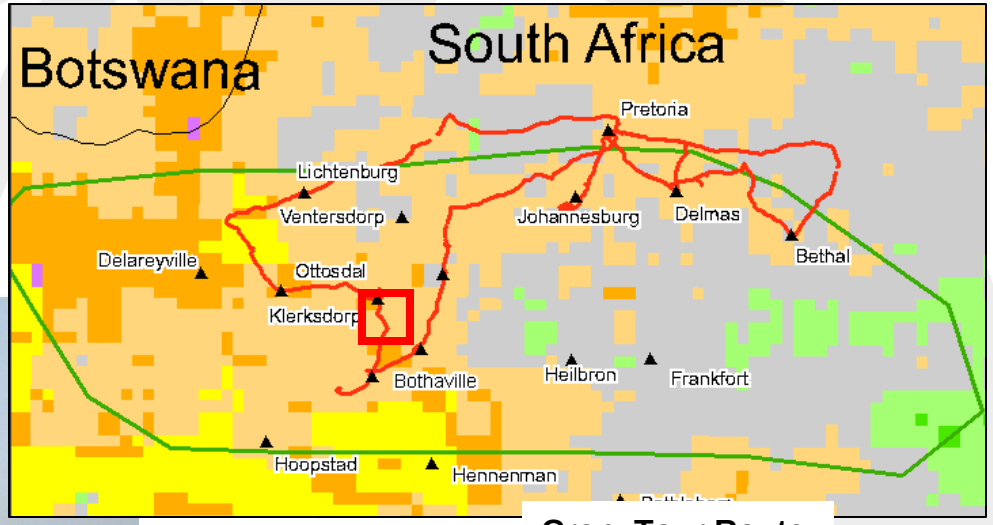
- GPS and digital camera data integrated with relative-yield model.

U.S. Agriculture FAS to the World

WRSI (March 20, 2007) – El Niño Year

Numerous late-planted fields died from water stress in March, 2007.

S 27° 17.184' E 026° 48.634' 4454 ft 02/21/2007 8:47:49 AM



Crop Tour Route (Feb 19-22, 2007)

Countries

Major Corn Region

Minor Corn Region

Towns

Percent Median (WRSI)

- <= 50
- 50 - 70 << Average
- 70 - 90
- 90 - 110 Average
- 110 - 130
- 130 - 150 >> Average
- 150 - 250
- Yet to Start
- No Start

Linking U.S. Agriculture FAS to the World

WRSI Data Source:
http://igskmncnwb015.cr.usgs.gov/adds/

Historical Pacific warm (red) and cold (blue) episodes based on a threshold of +/- 0.5 °C for the Oceanic Nino Index (ONI) [3 month running mean of ERSST.v3b SST anomalies in the Nino 3.4 region (5N-5S, 120-170W)], calculated with respect to the 1971-2000 base period. For historical purposes El Niño and La Niña episodes are defined when the threshold is met for a minimum of 5 consecutive over-lapping seasons.

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2002	-0.1	0.1	0.2	0.4	**0.7**	**0.8**	**0.9**	**1.0**	**1.1**	**1.3**	**1.5**	**1.4**
2003	**1.2**	**0.9**	**0.5**	0.1	-0.1	0.1	0.4	0.5	0.6	0.5	0.6	0.4
2004	0.4	0.3	0.2	0.2	0.3	**0.5**	**0.7**	**0.8**	**0.9**	**0.8**	**0.8**	**0.8**
2005	**0.7**	**0.5**	0.4	0.4	0.4	0.4	0.4	0.3	0.2	-0.1	-0.4	-0.7
2006	-0.7	-0.6	-0.4	-0.1	0.1	0.2	0.3	**0.5**	**0.6**	**0.9**	**1.1**	**1.1**
2007	**0.8**	0.4	0.1	-0.1	-0.1	-0.1	-0.1	-0.4	**-0.7**	**-1.0**	**-1.1**	**-1.3**
2008	**-1.4**	**-1.4**	**-1.1**	**-0.8**	**-0.6**	-0.4	-0.1	0.0	0.0	0.0	-0.3	-0.6
2009	-0.8	-0.7	-0.5	-0.1	0.2	**0.6**	**0.7**	**0.8**	**0.9**	**1.2**	**1.5**	**1.8**
2010	**1.7**											
2011												
2012												
2013												
2014												
2015												
2016												
2017												
2018												
2019												
2020												
2021												
2022												
2023												
2024												
2025												
2026												
2027												

NOAA/CPC Source: http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/index.shtml

Historical El Niño and La Niña Episodes

Based on the ONI computed using ERSST.v3b

NOTE:

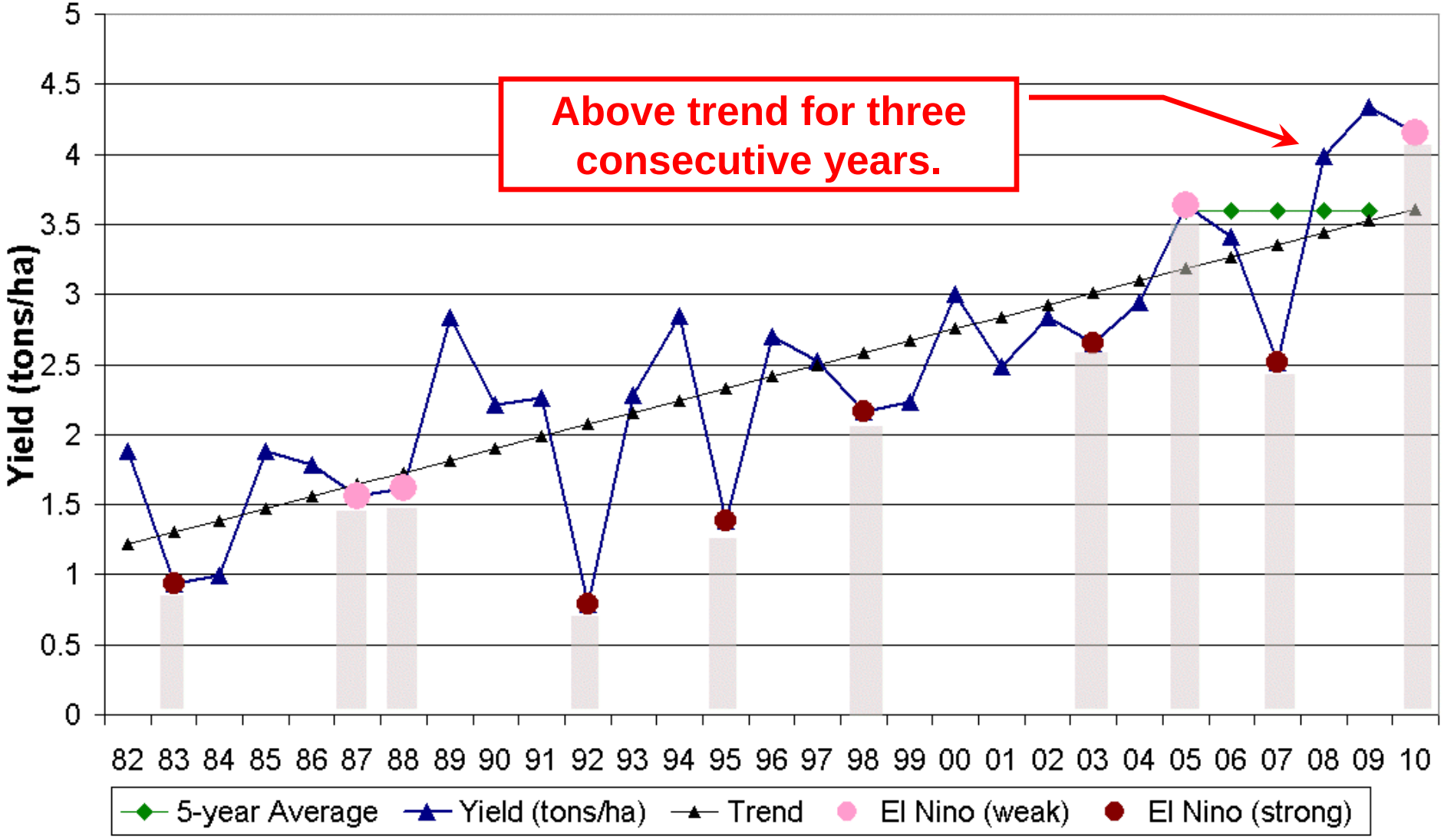
After updating the ocean analysis to ERSST.v3b, a new La Niña episode was classified (ASO 1962-DJF 1962/63) and two previous La Niña episodes were combined into one single episode (AMJ 1973- MAM 1976).

El Niño	Highest ONI Value
JAS 1951 - NDJ 1951/52	0.8
MAM 1957 – MJJ 1958	1.7
JJA 1963 – DJF 1963/64	1.0
MJJ 1965 – MAM 1966	1.6
OND 1968 – MJJ 1969	1.0
ASO 1969 – DJF 1969/70	0.8
AMJ 1972 – FMA 1973	2.1
ASO 1976 – JFM 1977	0.8
ASO 1977 - DJF 1977/78	0.8
AMJ 1982 – MJJ 1983	2.3
JAS 1986 – JFM 1988	1.6
AMJ 1991 – JJA 1992	1.8
AMJ 1994 – FMA 1995	1.3
AMJ 1997 – AMJ 1998	2.5
AMJ 2002 – FMA 2003	1.5
MJJ 2004 – JFM 2005	0.9
JAS 2006 - DJF 2006/07	1.1

La Nina	Lowest ONI Value
ASO 1949 – FMA 1951	-1.7
MAM 1954 – DJF 1956/57	-2.1
ASO 1962 – DJF 1962/63	-0.8
MAM 1964 – DJF 1964/65	-1.1
NDJ 1967/68 – MAM 1968	-0.9
JJA 1970 – DJF 1971/72	-1.3
AMJ 1973 – MAM 1976	-2.0
SON 1984 – ASO 1985	-1.0
AMJ 1988 – AMJ 1989	-1.9
ASO 1995 – FMA 1996	-0.7
JJA 1998 – MJJ 2000	-1.6
SON 2000 – JFM 2001	-0.7
ASO 2007 – AMJ 2008	-1.4

NOAA/CPC Source: http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/index.shtml

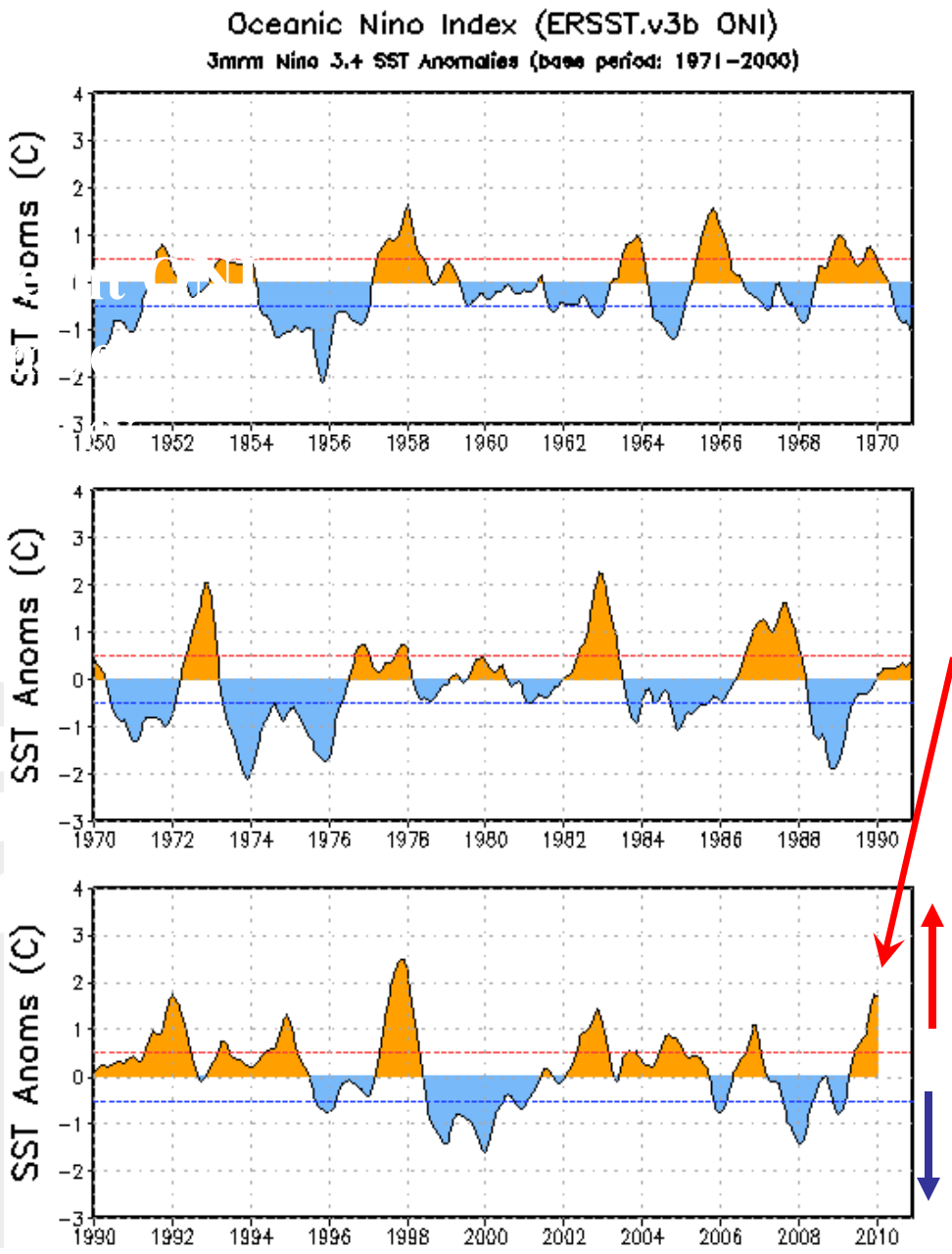
Historical Corn Yields in South Africa



Data Source: Historical yield data from USDA's PSD Online and
El Nino classification from NOAA's Climate Prediction Center (CPC)

Linking U.S. Agriculture FAS to the World

ONI (ºC): Evolution since 1950



NOAA/CPC Source: http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/index.shtml

Waterlogged corn fields in South Africa when should be drought.

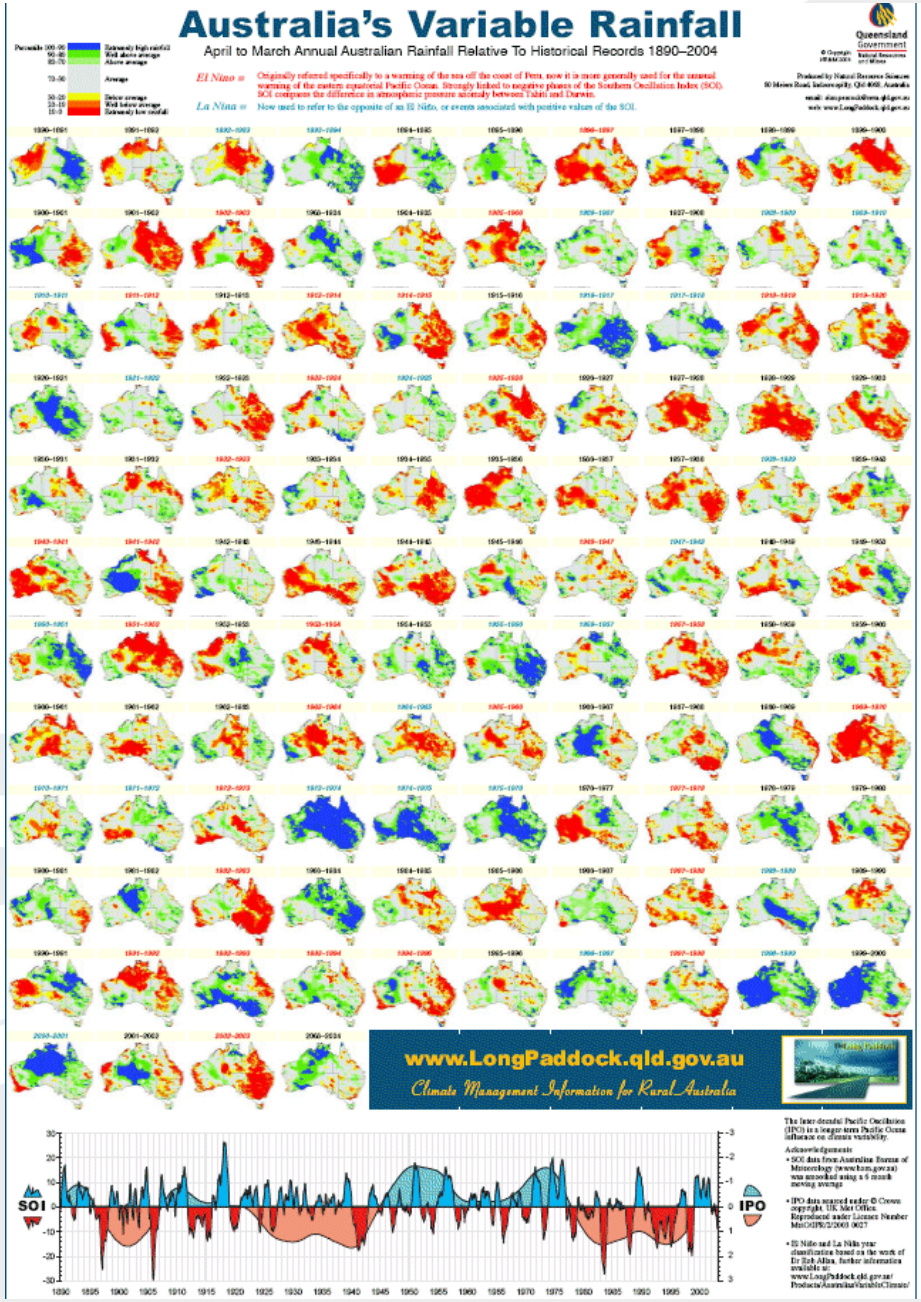
El Niño

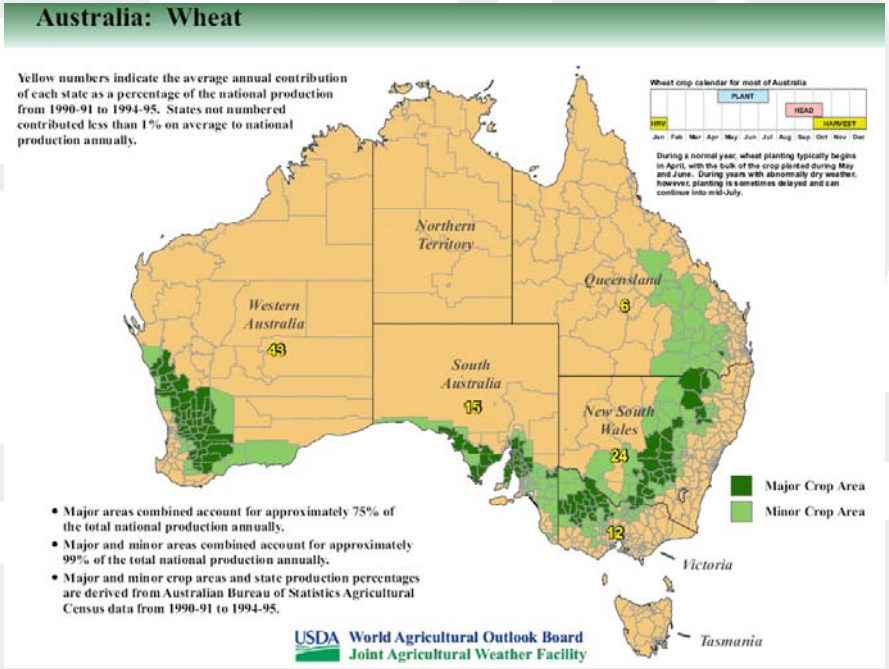
neutral

La Niña

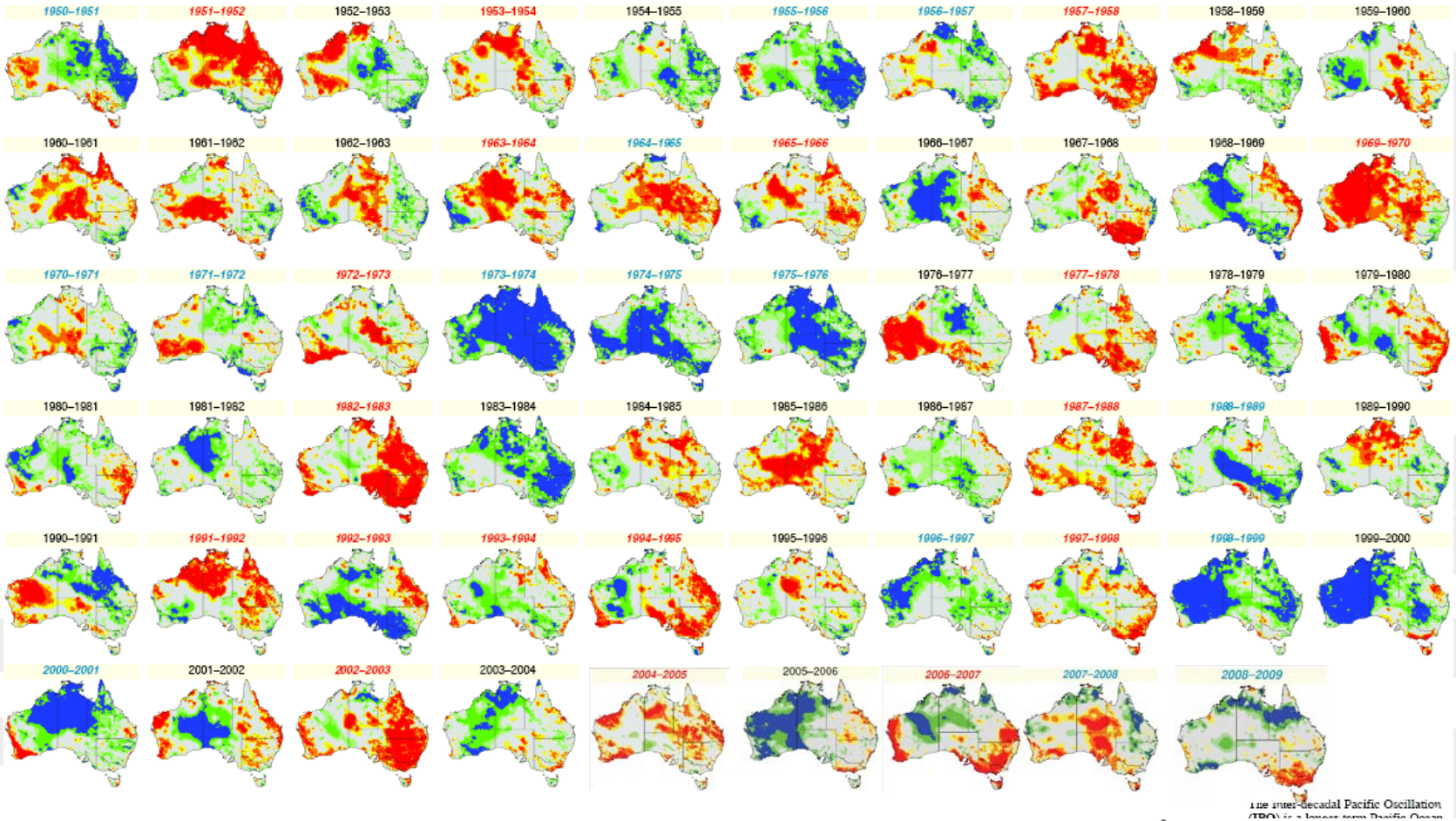
Linking U.S. Agriculture FAS to the World

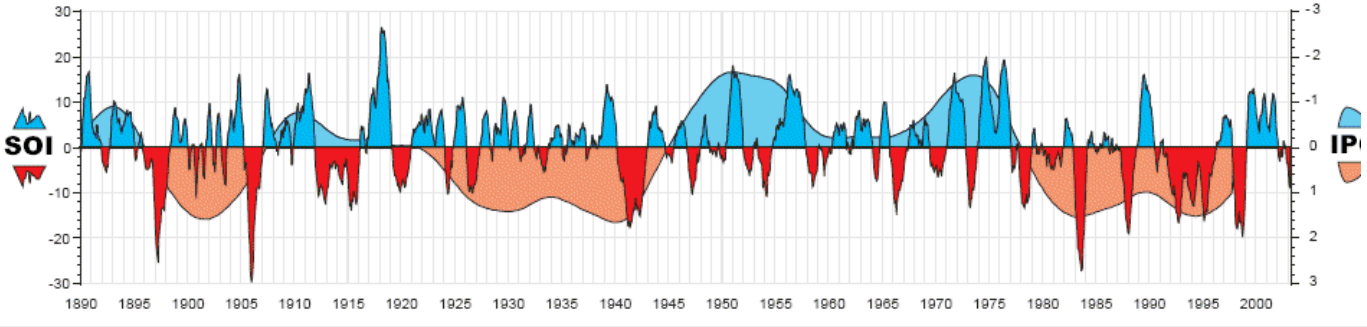
Historical Rainfall in Australia





Historical Rainfall in Australia





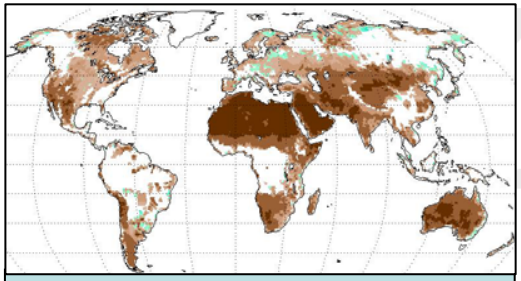
Percentile 100–90 Extremely high rainfall
90–80 Well above average
80–70 Above average
70–30 Average
30–20 Below average
20–10 Well below average
10–0 Extremely low rainfall

available at:
www.LongPaddock.qld.gov.au/
Products/AustraliasVariableClimate/

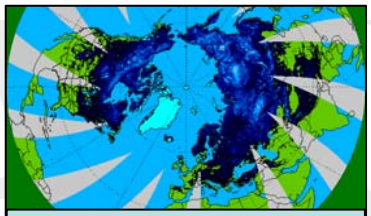
FAS to the World

Near Future Observations

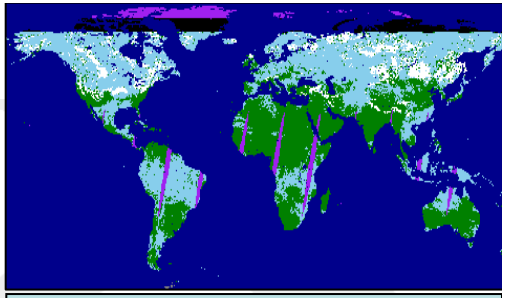
Vegetation/Carbon
(Landsat, AVHRR, MODIS, *VIIRS,* MetOp, *DESDynI, ICESat-II, HyspIRI, LIST, ASCENDS*)



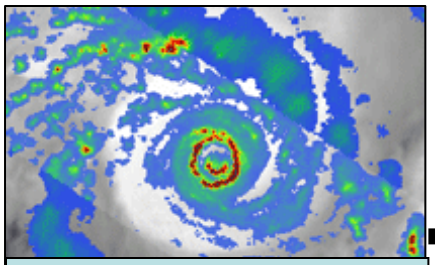
Surface soil moisture
(SMMR, TRMM, AMSR-E, *SMOS, Aquarius, SMAP*)



Snow water equivalent
(AMSR-E, SSM/I, *SCLP, GCOM-W, MIS*)



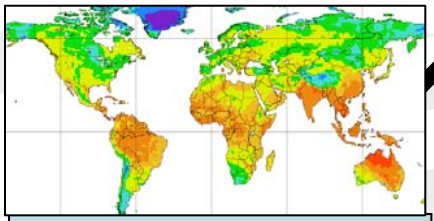
Snow cover fraction
(MODIS, *VIIRS, MIS*)



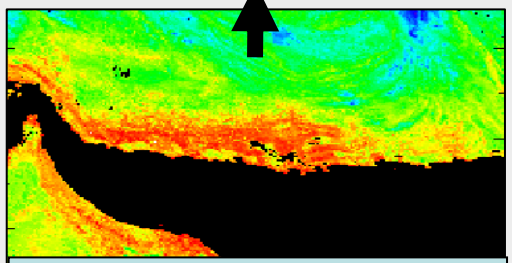
Precipitation
(TRMM, *GPM*)

New Inputs for Crop Explorer??

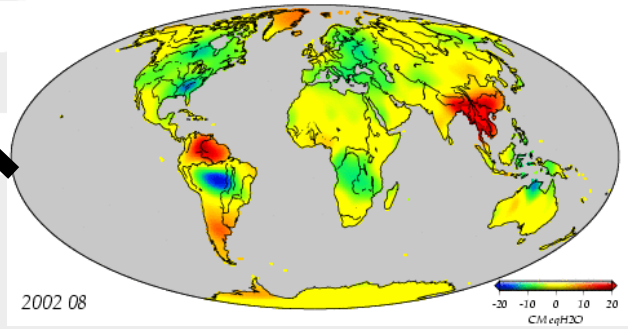
Water surface elevation
(Jason-2, *SWOT*)



Radiation
(CERES, *CLARREO*)



Land surface temperature
(MODIS, AVHRR,GOES,…)



Terrestrial water storage
(GRACE,*GRACEII*)

Modified from NASA- Peters-Lidard

Linking U.S. Agriculture FAS to the World

Possible CPC Assistance for Improving Global Agriculture Monitoring

- Improve ***daily*** global station gauge network from WMO/GTS, NWS & NOAAPORT/JAWF.
- Integrate daily global station network into daily CMORPH product (action: AFWA/NASA/NOAA)
- Set-up global growing season product for each continent
  - similar to RFE Africa/FEWSNET seasonal products at CPC.

Summary OGA/IPAD & FAS Web Outreach

- FAS PS&D On-line
  - http://www.fas.usda.gov/psd/psdselection.asp
- FAS (attache reports)
  - http://www.fas.usda.gov/scriptsw/attacherep/default.asp
- OGA/IPAD analyst updates
  - http://www.pecad.fas.usda.gov/search.cfm
- OGA/IPAD Crop Explorer (weather & NDVI)
  - http://www.pecad.fas.usda.gov/cropexplorer/index1.cfm
- OGA/IPAD Archive Explorer (AWiFS Landsat images)
  - http://www.pecad.fas.usda.gov/remote.cfm
- OGA/IPAD PSD Mapper
  - http://www.pecad.fas.usda.gov/ogamaps/
- OGA/IPAD Photo Gallery (geo-referenced)
  - http://www.pecad.fas.usda.gov/photo_gallery/pg_regions.cfm?CE_Region_ID=eafrica
- OGA/IPAD Tropical Cyclone Monitor
  - http://151.121.3.217/TropicalCycloneMonitor/
- GLAM-MODIS Web Products-NASA/USDA
  - MODIS (2002-present) time series data
    - http://pekko.geog.umd.edu/usda/test/
  - Daily MODIS data from Rapid Response System
    - http://www.pecad.fas.usda.gov/cropexplorer/modis_summary/index.cfm
  - Global Reservoir Monitor
    - http://www.pecad.fas.usda.gov/cropexplorer/global_reservoir/
  - NASA Earth Observatory's Agriculture Hazards
    - http://earthobservatory.nasa.gov/NaturalHazards/category.php?cat_id=6