



Molly E Brown, PhD

SCARCE NATURAL RESOURCES: THREATS TO AGRICULTURE



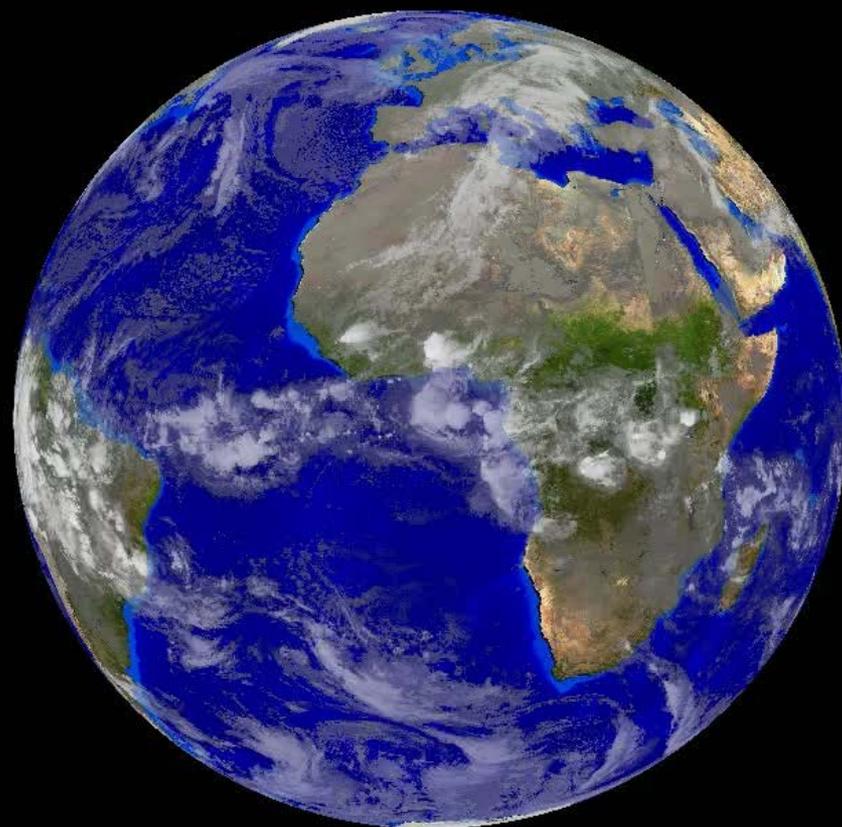
The Environment matters...

- Global food system is transforming
 - Links between food and fuel
 - Fiscal uncertainty adds complexity
- A changing climate reduces predictability and increases the likelihood of extreme events
 - Risk of weather-related agricultural impacts growing
 - The need for information that is comparable, timely and global is increasing
- Satellite remote sensing is a starting point for such information systems
- Allows detection of trends in observational networks which are far more certain than those seen in climate models



What can we see with remote sensing?

Rainfall
Clouds
Humidity
Soil Moisture
Floods
Biomass
Photosynthetic Activity
Land use
... and many others



Earth Observing Constellations

Morning Constellation

Afternoon Constellation





Information on..

- Land use and land cover – where are the farms and what is being cultivated?
- Clouds, rainfall and moisture availability monitoring for agriculture
- Health of the plants and the consequence for crop yield



Global Analysis of Land Cover change

- Land transformation to increase agricultural production
- Impacts on biotic diversity worldwide, soil degradation, and the ability of biological systems to support human needs.
- Land-use/cover changes also determine, in part, the vulnerability of places and people to climatic, economic, or sociopolitical perturbations

	Forest/woodland (10⁶ ha)	Steppe/savanna/grassland (10⁶ ha)	Cropland (10⁶ ha)	Pasture (10⁶ ha)
1700	5000 to 6200	3200	300 to 400	400 to 500
1990	4300 to 5300	1800 to 2700	1500 to 1800	3100 to 3300

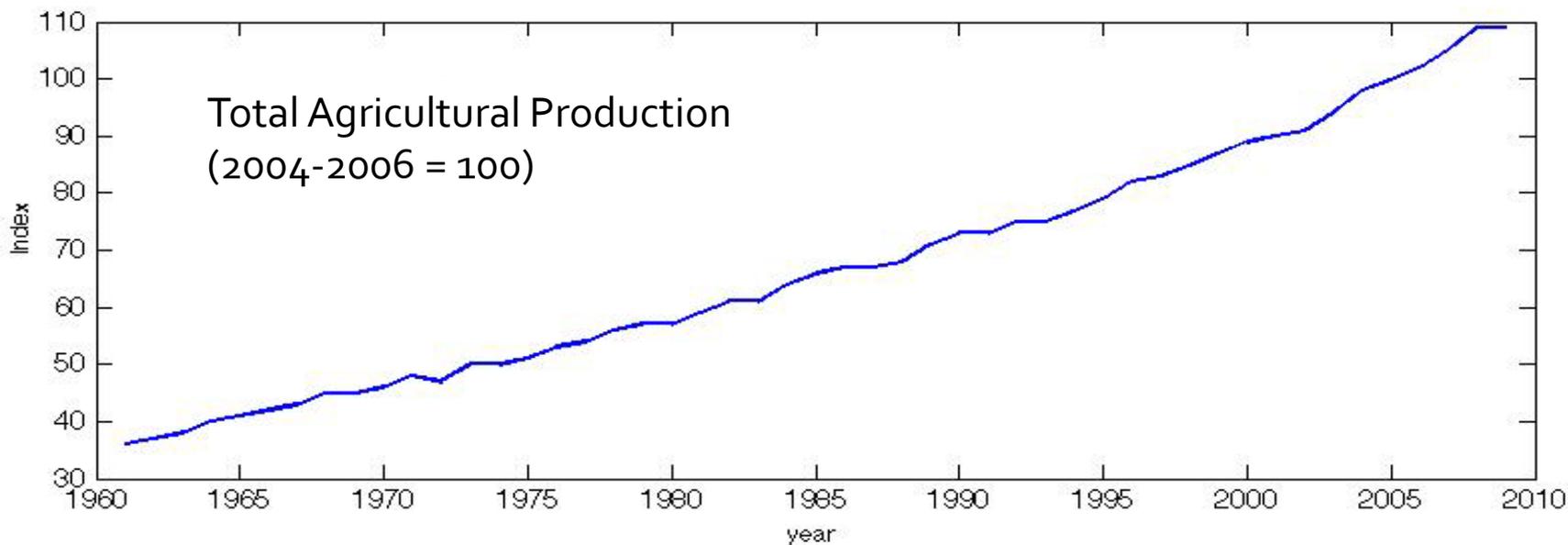


Increases in Agricultural Production

Increase in world food production and agricultural inputs from 1961 to 1996 based on FAO data

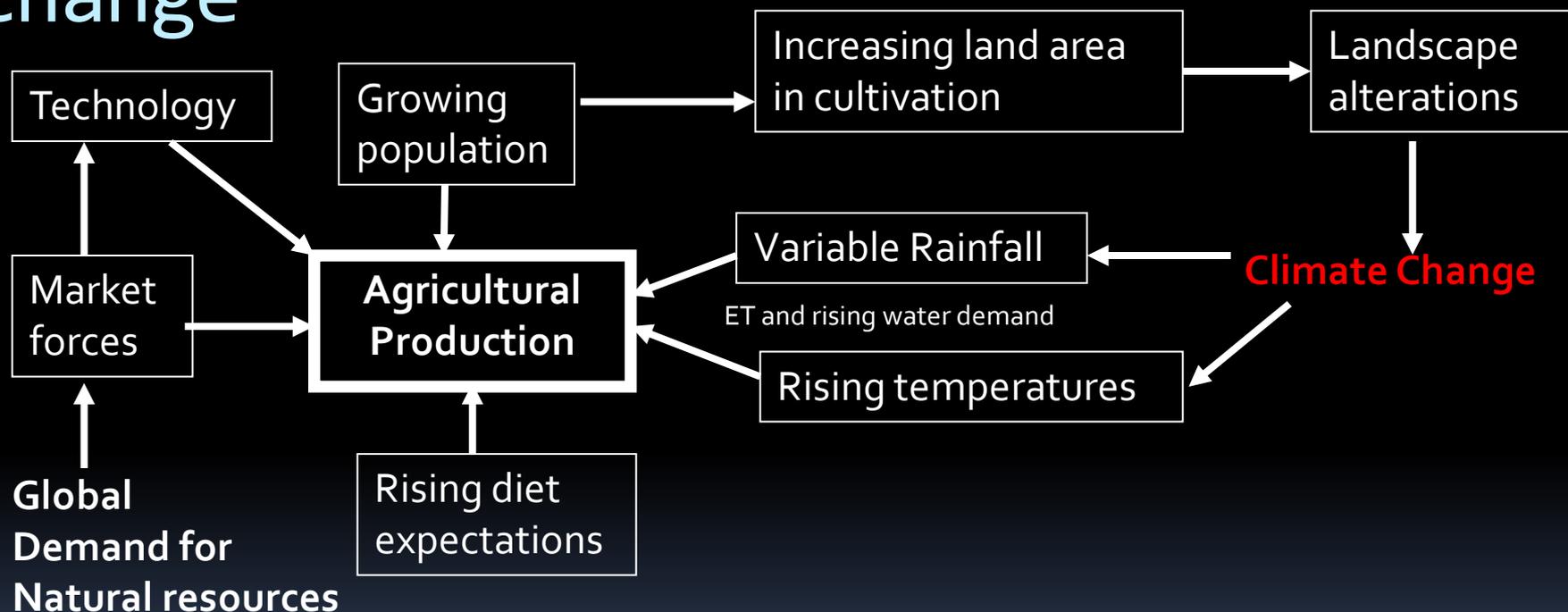
	Number-fold increase in 135 years (1861-1996)
World food production	1.97
Land under cultivation	1.098
Proportion of irrigated land	1.68
Nitrogen Fertilization	6.87
Phosphorus Fertilization	3.48

Lambin et al (2003) Annual Rev. Environ. Resour.





Food Demand, Markets and Ecosystems: influence of Climate Change



As populations and incomes rise, the global demand for food will also grow – probably roughly doubling by 2050 and shifting towards more water-demanding diets.



Global Agricultural System



Crop Intensity



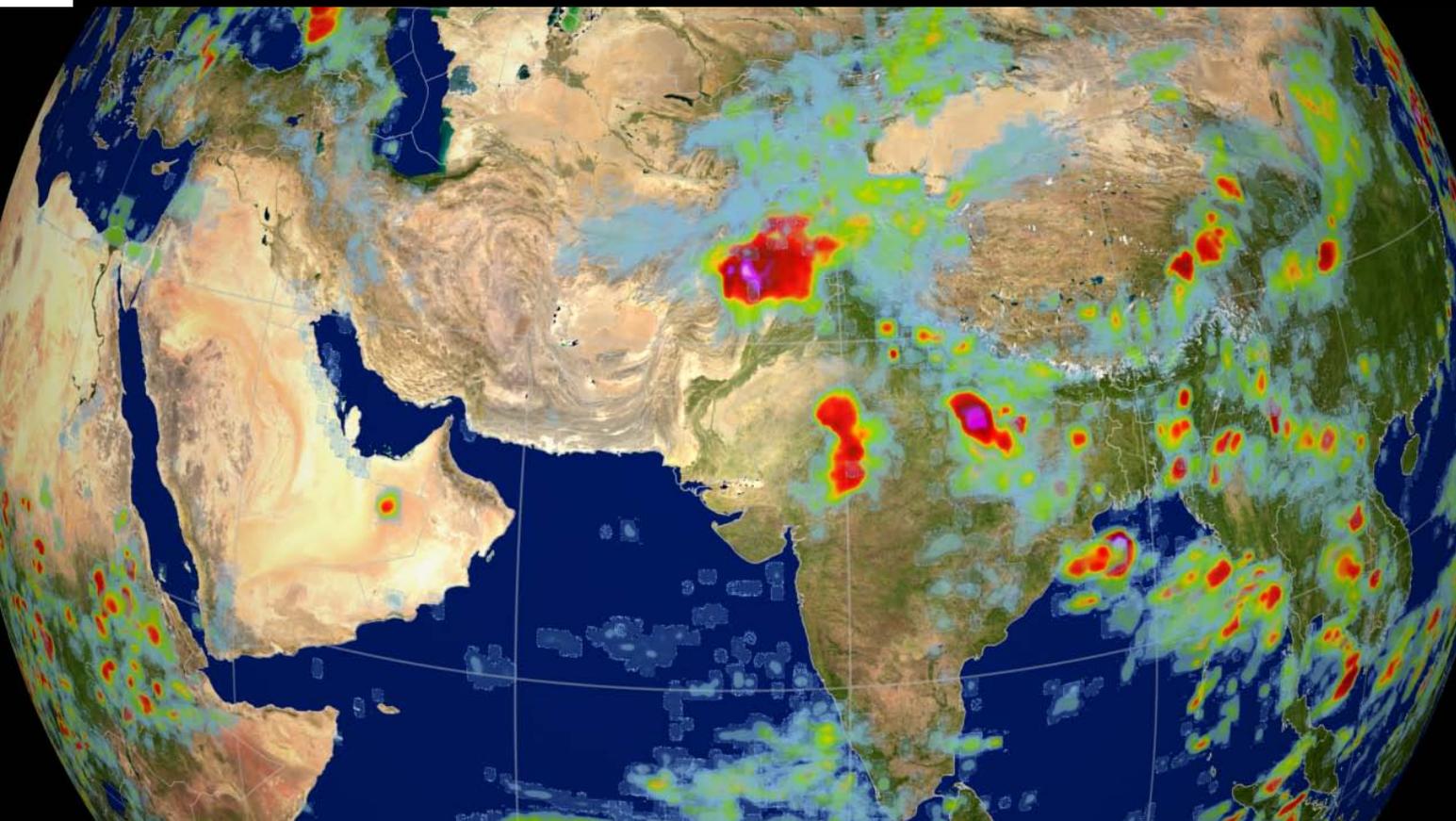
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Rainfall data from satellites

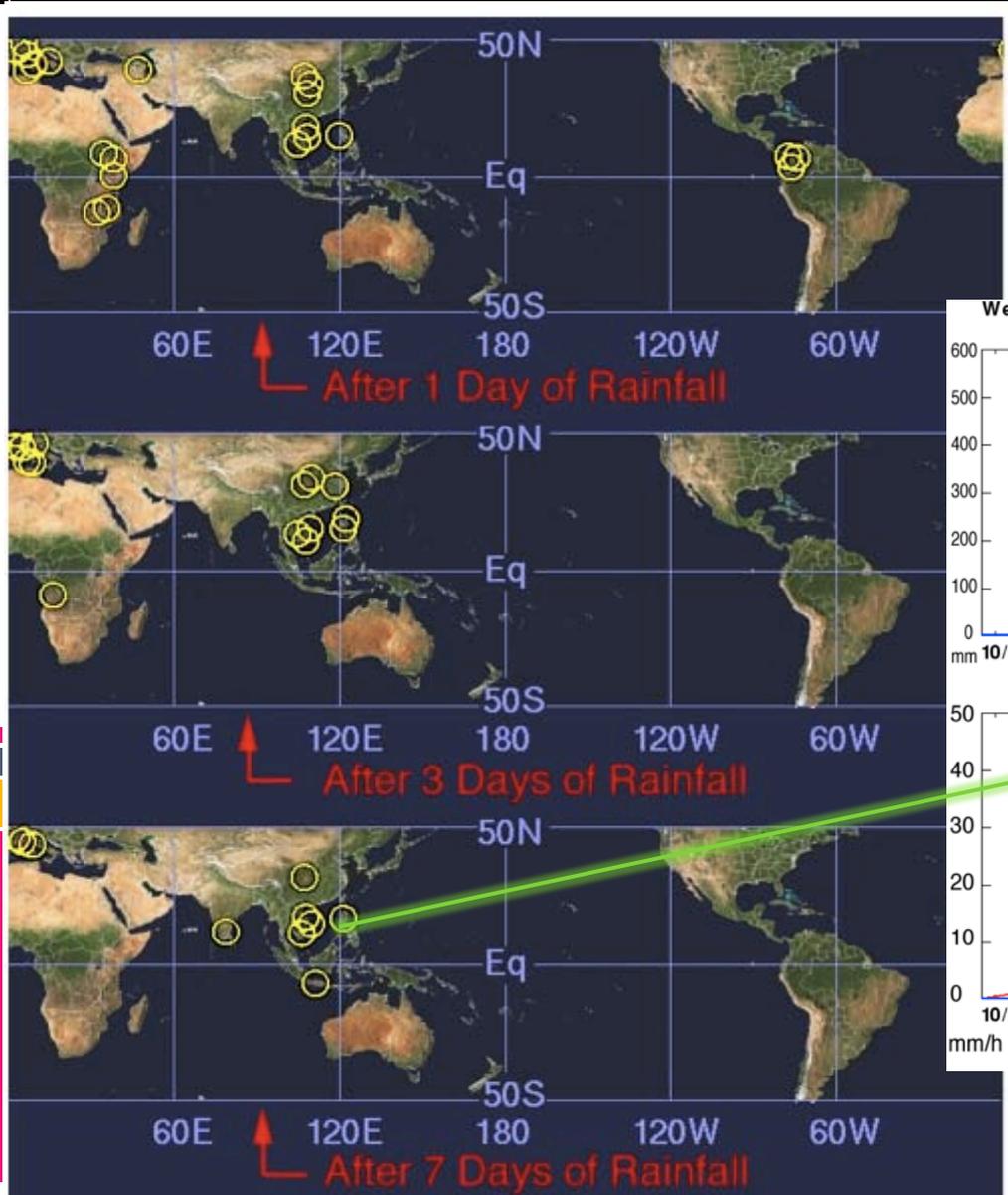
Real-time rainfall data are being used for flood forecasting, but in many developing countries rain gauging stations are either not available or are too sparsely available to develop representative aerial samples. Satellite-derived rainfall products are useful for flood forecasting.



Flooding event in Pakistan, India, and Thailand 2004

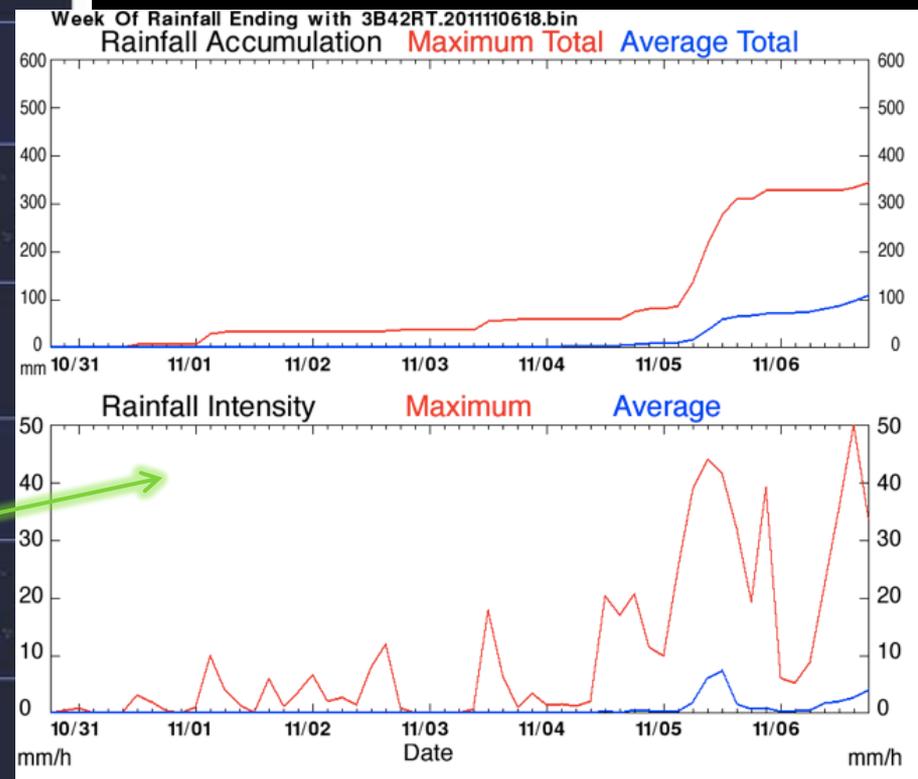


Potential Landslide areas



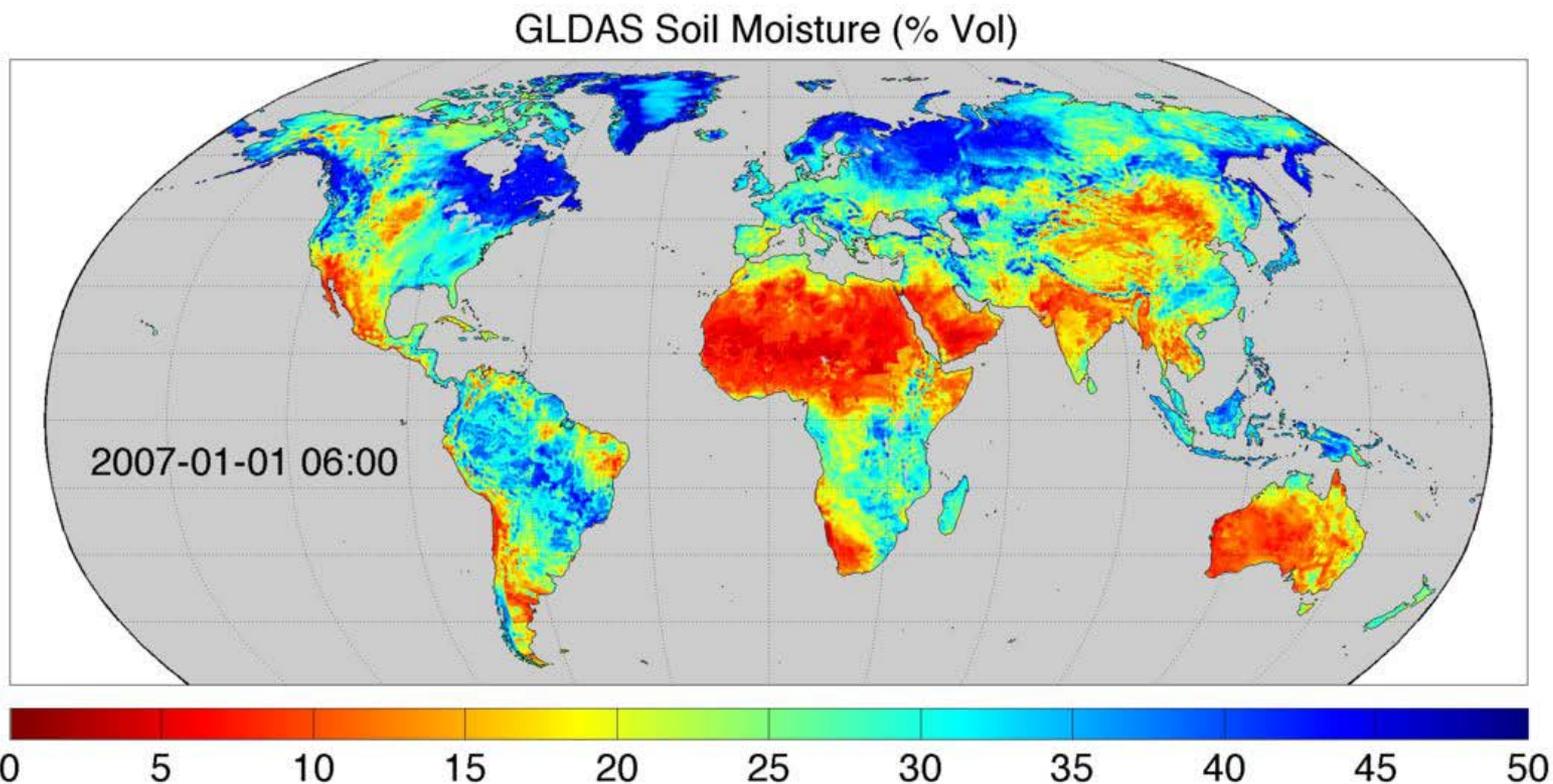
Rainfall data from
TRMM

November 6, 2011





Soil Moisture products



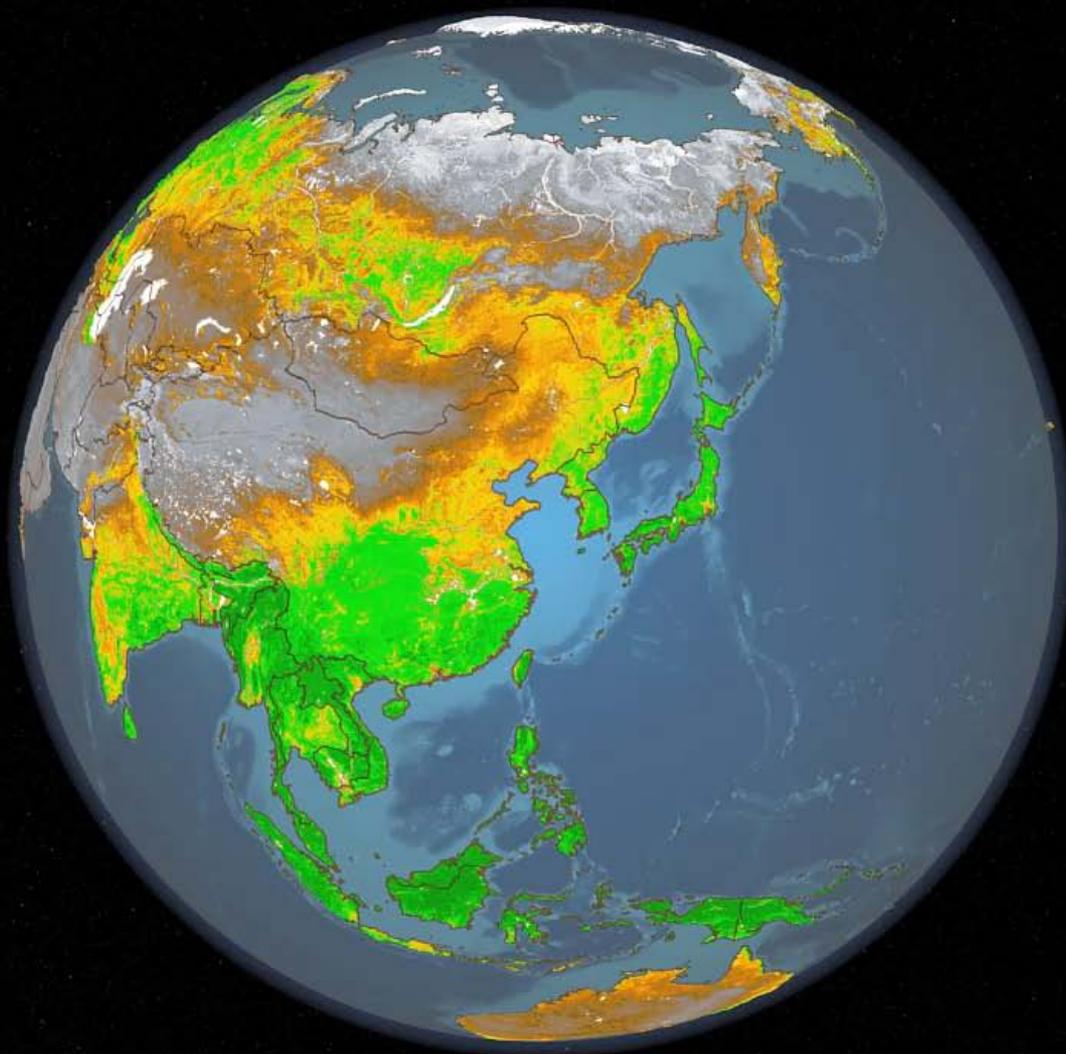


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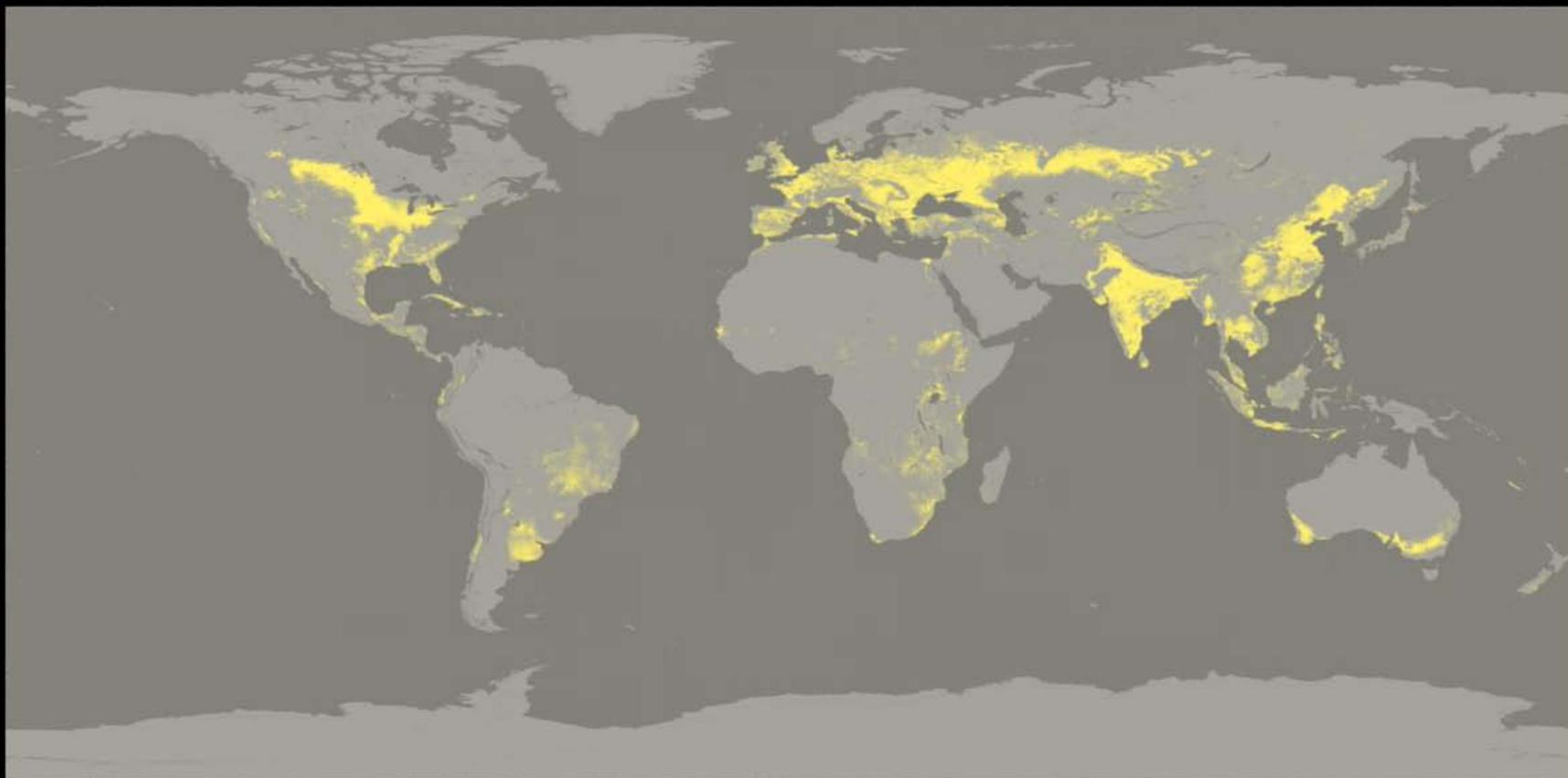


Vegetation Index Seasonality





Monitoring production- wheat





Increasing the usefulness of these data products...

- Integrated management systems that bring economics and supply concerns together with weather
- Two examples described here:
 1. Early warning systems for famine early warning
 2. National Integrated Drought Information System (NIDIS) in the Colorado River basin
- Detecting and responding to trends

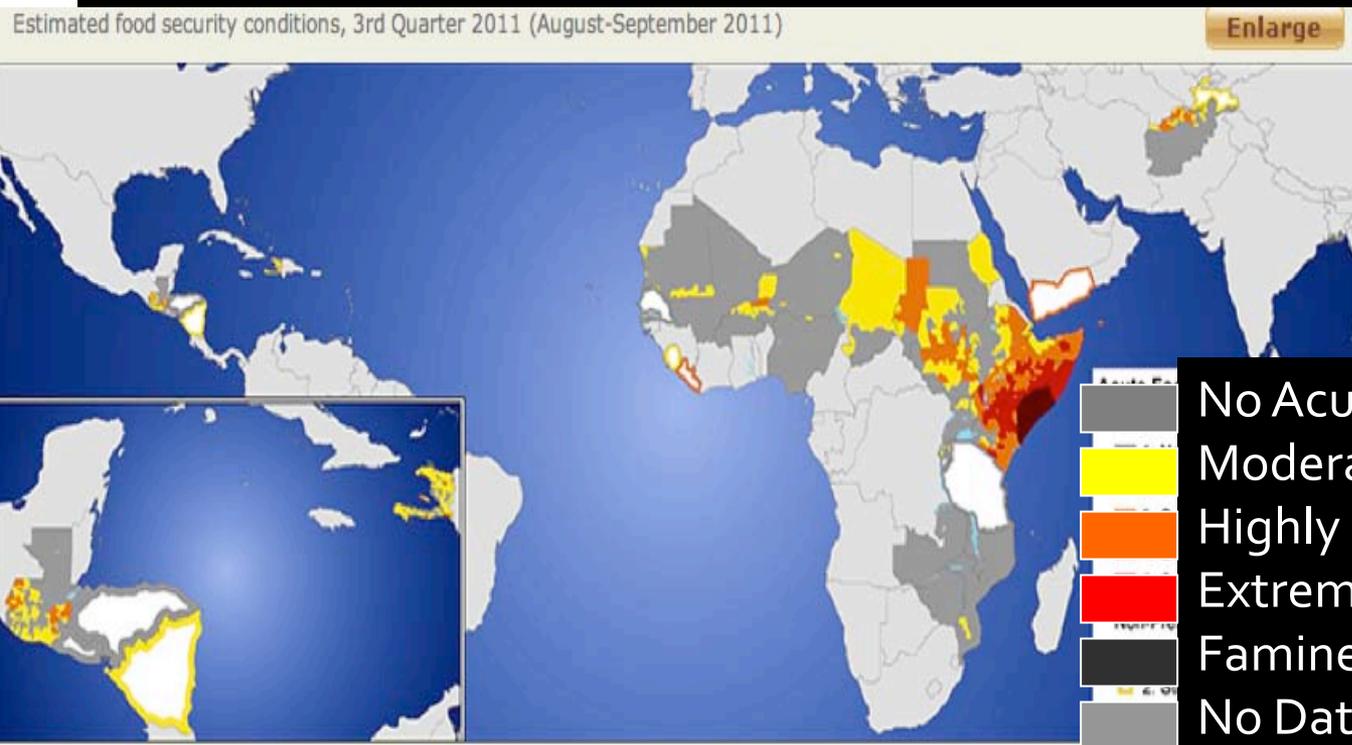


1. Famine Early Warning Systems

Network

FEWS NET is a USAID-funded activity that works to strengthen the abilities of countries and regional organizations to manage risk of food insecurity through the provision of timely and analytical early warning and vulnerability information.

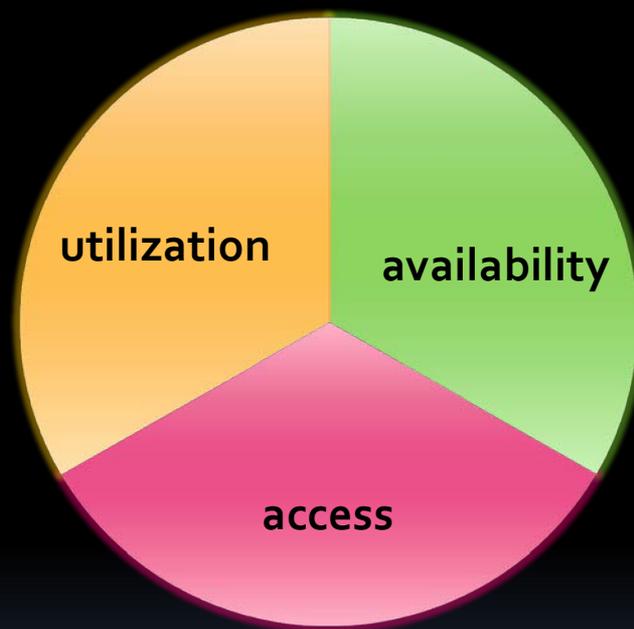
August-Sept 2011



Geographic Extent of FEWS NET's 23 countries with offices and those with extended remote monitoring

Food Security is achieved with three elements:

Individual: *Prevalent diseases, malnutrition, care of infants, feeding and food preparation practices, presence of health & sanitation facilities, water supply characteristics, etc...*



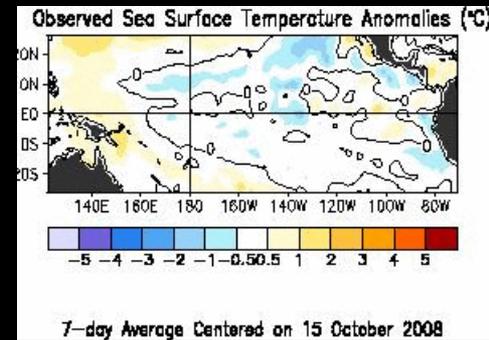
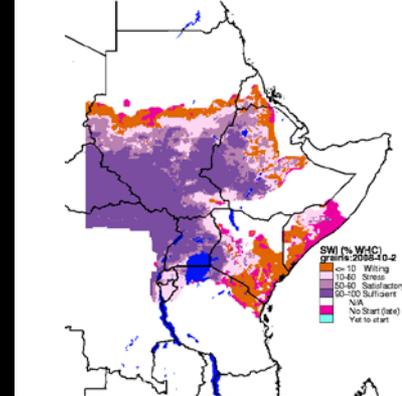
An area: *Crop planting date, vegetation or crop condition, amount & timing of rain, drought, market availability of food, food prices, imports, exports, public stocks, household stocks, wild food availability, etc...*

Household/community: *Local household food crop & animal production, household sales of goods & services, conditions of other income sources, labor wage rates, food aid, assets, etc...*

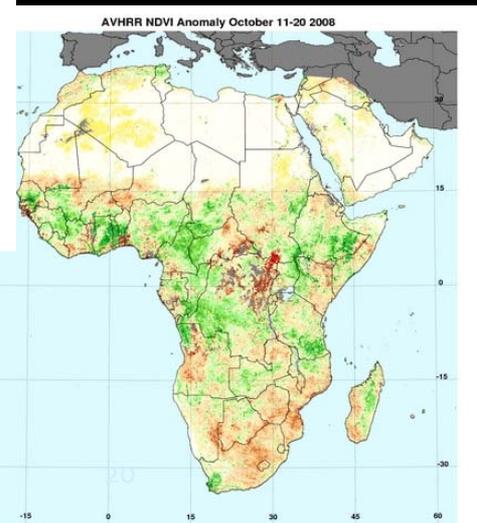
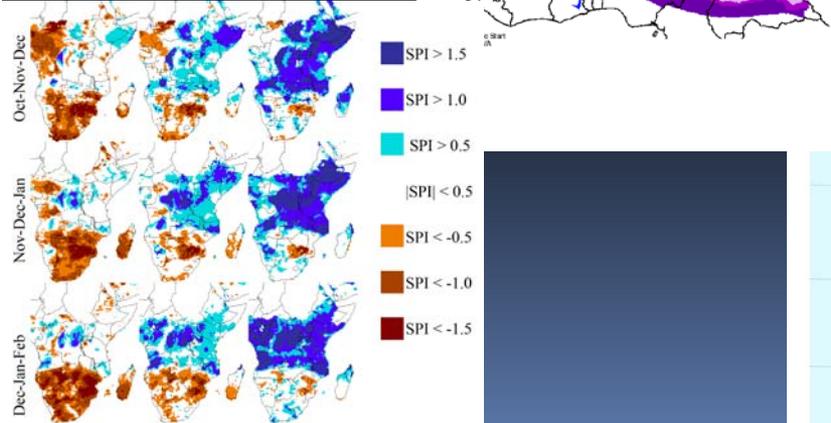
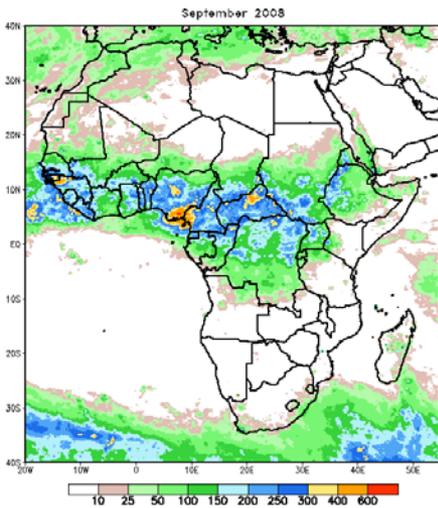


Satellite Products

- Vegetation, rainfall and humidity for flood and drought detection
- Satellite data used together with Earth Science Models to link weather to food security impacts for quantitative assessments



NOAA CPC FEWS-NET Rainfall Estimate (mm):
based on Satellite and Rain Gauge Data





Diversified and targeted information products And an integrated early warning information system....



Climate Prediction Center's Africa Hazards Outlook
For USAID / FEWS-NET
August 25– August 31, 2011

- Much of West Africa has received an above-average rainfall, while eastern Sudan has observed below-average rains during the past seven days.

- 1) An erratic rainfall distribution during the past two months has resulted in rainfall deficits throughout eastern Sudan into Eritrea and the lowlands of western Ethiopia. The insufficient rainfall has caused water shortages, which have prevented farmers from sowing seeds.
- 2) During June and July, coastal Hgaga rain showers have been below-average and erratic along the southern Somalia coast of the Shabelle and Jubba regions. The lack of coastal rains has negatively affected crops and cropping conditions in agro-pastoral areas, leading to the drying out of some crops.
- 3) Three consecutive weeks of above-average rainfall have caused flooding in the Lake Victoria region of western Kenya. The heavy rainfall had caused the overflowing of the Nyamasyara, Rae, and Kajulu Rivers, damaged infrastructure, displaced people, and destroyed crops. Additional rains could worsen ground conditions in the region.

Legend is very general, please see numbered descriptions for details.

Country Reports

Regional Reports

Executive Overview

Alert Statements

Market/Trade Information

ETHIOPIA Food Security Outlook Update
August 2011

Key Message: Ethiopia's agricultural production has improved significantly since August 2010, but the country remains at high risk of food insecurity due to erratic rainfall and low soil fertility. The 2011/12 crop season is expected to be a mixed one, with some areas experiencing above-average rainfall and others below-average rainfall. The 2011/12 crop season is expected to be a mixed one, with some areas experiencing above-average rainfall and others below-average rainfall.

FAO Early Warning System Network
SOUTH-WEST AFRICA FOOD SECURITY ALERT
March, 2004

SUMMARY: The 2003/04 season has been a dry one for southern Africa, with significant crop losses and food insecurity. The 2003/04 season has been a dry one for southern Africa, with significant crop losses and food insecurity. The 2003/04 season has been a dry one for southern Africa, with significant crop losses and food insecurity.

Executive Overview of Food Security Threats in Sub-Saharan Africa
April 21, 2004

FEWS NET Alert Status: Alerts: Food Insecurity in Africa

Alerts: Food Insecurity in Africa

SOMALIA Drought Food Security and Nutrition Monitoring
August 24, 2011

Key Messages: High levels of malnutrition and food insecurity in Somalia, particularly in the north and east. The 2011/12 crop season is expected to be a mixed one, with some areas experiencing above-average rainfall and others below-average rainfall.

IGAD Regional Food Security and Nutrition Monitoring
August 24, 2011

Key Messages: High levels of malnutrition and food insecurity in the IGAD region, particularly in the north and east. The 2011/12 crop season is expected to be a mixed one, with some areas experiencing above-average rainfall and others below-average rainfall.



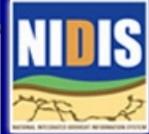
2. US National Integrated Drought Information System (NIDIS)

- Focuses on slow-onset droughts
- Absence of a universal definition leads to confusion and inaction on the part of national leaders
- Severity of droughts are described through multiple indicators and indices
- Impacts are non-structural and spread over large areas – mitigation is less obvious
- **Drought Preparedness** in the US has been slow



National Integrated Drought Information System (NIDIS)

- **Vision:** a dynamic and accessible drought information system that provides users with the ability to determine the potential impacts of drought and the associated risks they bring, and the decision support tools needed to better prepare for and mitigate the effects of drought
- **Requires:**
 - A national drought monitoring and forecasting system
 - A drought early warning system
 - An interactive information delivery system that links into response and decision making



U.S. Drought Portal

www.drought.gov

Search:

- HOME
- WHAT IS NIDIS?
- CURRENT DROUGHT
- FORECASTING
- IMPACTS
- PLANNING
- EDUCATION
- RESEARCH
- RECOVERY
- REPORTS

Area Drought Information

Select State...

Select Region...

Maps & Tools

- Map & Data Viewer - **new!**
- Geodata Portal
- Drought Monitor Graphics
- CRN Soil Data

Events & Announcements

- 36th Annual Climate Diagnostics and Prediction Workshop
- Navajo Drought Declaration Reaffirmation June 2011
- 2011 Southern US Drought Impacts and Assessment Workshop
- May 23, 2011 Southern Drought Briefing
- NIDIS Engaging Preparedness Workshop June 8-9, 2011
- NIDIS Engaging Preparedness Communities WG Survey
- Workshop on Drought Monitoring & Early Warning - May 10th, 2011
- NHWC Training Conference and Exposition - May 9-12, 2011

[View Archive](#) | [Portal Release Notes](#)

Regional Drought Webinars

- Colorado - weekly, 12PM EDT
- Southeast - Briefing Presentation, October 25th, 2011
- South Central Drought Briefing - Oct 27th, 11 AM CDT

Drought In The News

- Hay Shortage Compounds Woe in Drought-Stricken Texas - NYTimes.com
- Texas winter vegetable outlook wilts in drought - chron.com
- Drought plan amendment to preserve lake levels needs approval from Ga., S.C. | The Augusta Chronicle

Featured Products

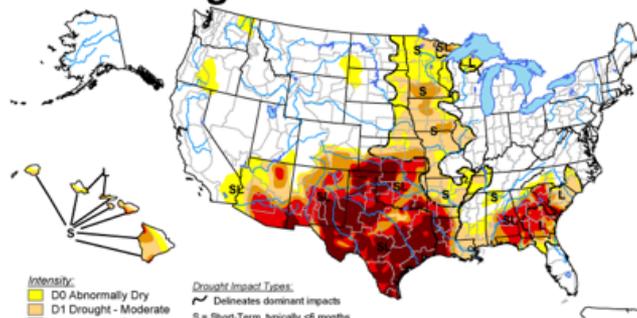
[Where are Drought Conditions Now?](#)

[How is the Drought Affecting Me?](#)

[Will the Drought Continue?](#)

U.S. Drought Monitor

November 8, 2011
Valid 7 a.m. EST



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

Drought Impact Types:
 S - Short-Term, typically <6 months (e.g. agriculture, grasslands)
 L - Long-Term, typically >6 months (e.g. hydrology, ecology)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

<http://droughtmonitor.unl.edu/>

Released Thursday, November 10, 2011
Author: Brian Fuchs, National Drought Mitigation Center



Regional Drought Early Warning Systems (DEWS)



(Click on an area to view the Drought Early Warning System - DEWS)

NIDIS Feature

MANAGING DROUGHT IN THE SOUTHERN PLAINS

You are invited to join us in a biweekly webinar (web-based seminar) series to discuss drought conditions, impacts and resources available to help manage drought in the Southern Plains. The first webinar will be held on Thursday, September 29 at 10:00 a.m. Central Time. Thursday webinars will be held on the 2nd and 4th Thursdays, also at 10:00 a.m. Central Time. The content is geared toward a general audience - anyone who has responsibility to manage or assist others in managing drought and related impacts.

If you would like to join in these webinars, you need to register via the SCEPP website: <http://www.southernclimate.org> or e-mail scepp@southernclimate.org. Registration is free but limited to 100 participants, so please register early. Each webinar will last about 30 minutes, plus additional time for questions. You will be provided with a link to the webinar and a toll-free phone line to call in.

Each webinar will include an overview of the current drought assessment and outlook, necessary of impacts across the region, and a topic or resource, such as La Niña or wildfire conditions. You will have an opportunity to suggest topics for following webinars. The primary focus is in the states most heavily impacted from the current drought - Texas, Oklahoma and New Mexico - but participation from surrounding states is encouraged.

The webinar series is sponsored by a partnership of the National Integrated Drought Information System (NIDIS), National Oceanic and Atmospheric Administration (NOAA), National Drought Mitigation Center, Southern Climate Impacts Planning Program, Climate Assessment for the Southwest, and the region's State Climatologists. Advancing Thursdays will feature a companion media-oriented briefing, sponsored by the National Weather Service, NOAA and NIDIS.

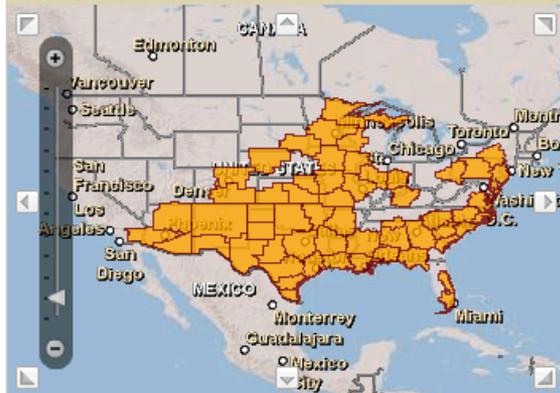
Information from the webinars will be posted on a website linked through <http://www.southernclimate.org> and summarized in an online newsletter, Drought Tracker. Please pass on this announcement to relatives or organizations or groups that are involved in managing or monitoring drought and related impacts.

To register or for more information, contact:
 Southern Climate Impacts Planning Program
<http://www.southernclimate.org>
 801-325-2391 or scepp@southernclimate.org

Webinar Topics:

- La Niña
- Cattle & Livestock
- U.S. Drought Monitor
- Ecological Impacts
- Assistance Programs
- Water Supply
- Ranch Drought Planning
- Wildfire
- Drought Ready Communities
- Agricultural Impacts

Drought Information Statements



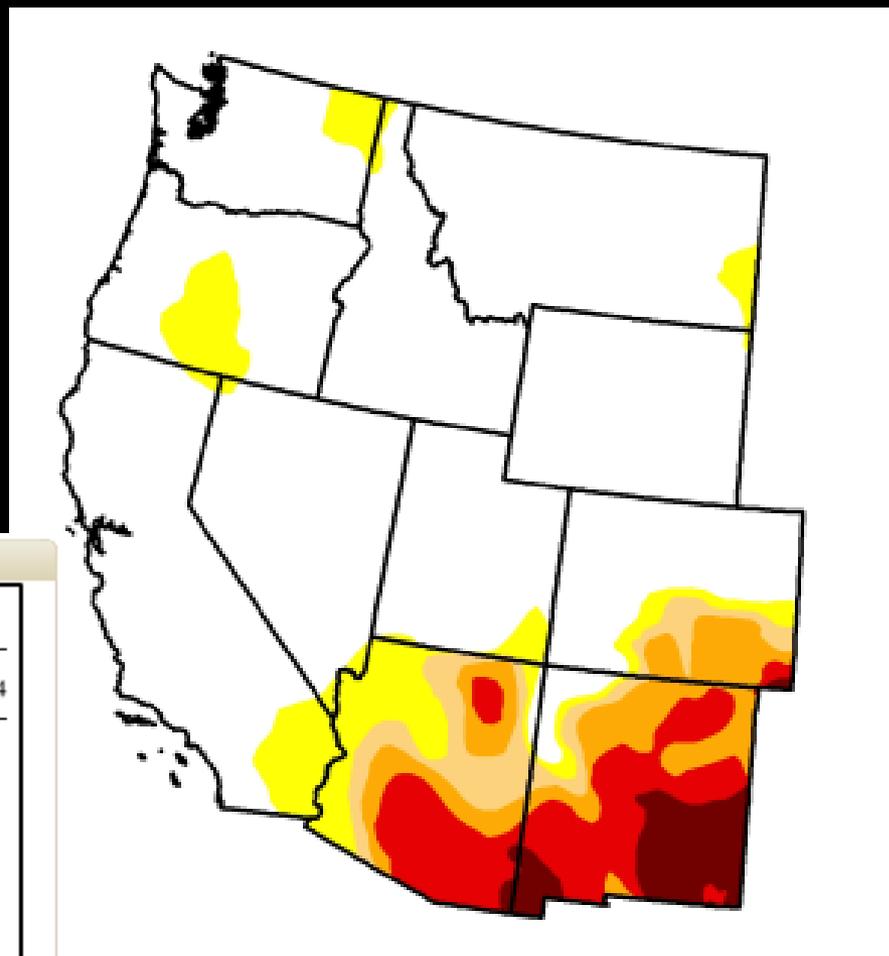
Click on a highlighted area to view the current NWS Drought Information Statement or [Click Here](#) to select from a list

[View larger map](#)

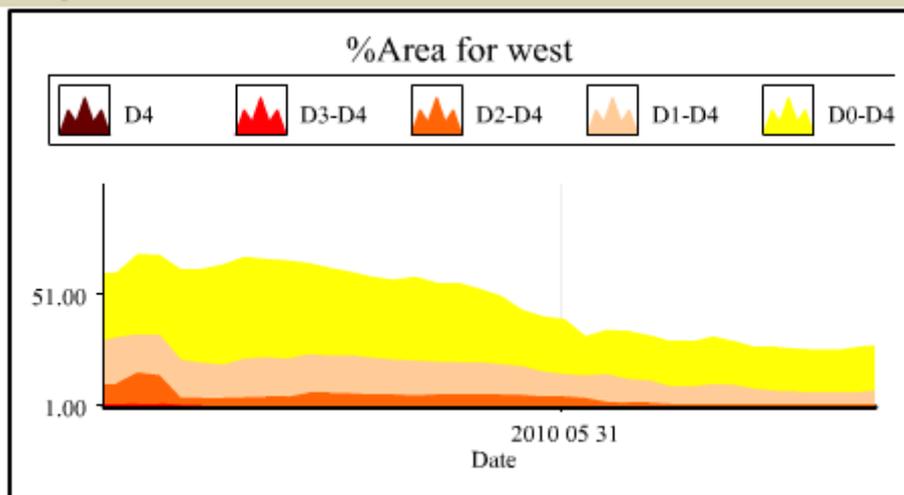


Drought conditions for November 8, 2011

- No drought
- Do Abnormally Dry
- D2 Drought - Moderate
- D3 Drought - Severe
- D4 Drought - Extreme
- D5 Drought - Exceptional



Drought Monitor Time Series - West





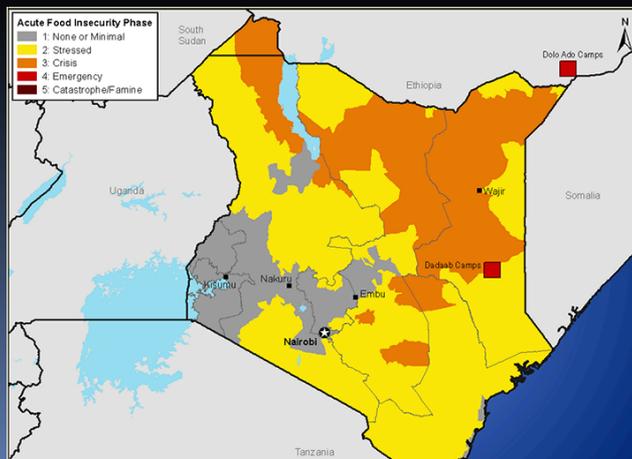
NIDIS seeks to understand climate risk for the Colorado River Basin

Climate data records

- Temperature and precipitation – using observations to better understand and attribute trends to climate processes
- Connecting trends in weather to socio-economic conditions
 - Demand for water in agriculture
 - Development policies for residential demand
- Understanding weather impact within a context

Trend Detection and Attribution

- Long rains in central **Kenya** have declined more than 100 millimeters since the mid-1970s.
- This decline is probably **linked to warming in the Indian Ocean**, and seems likely to continue.
- A warming of more than 1° Celsius may exacerbate drying impacts, especially in lowland areas.
- The drying trends could particularly impact densely populated areas to the east, north, and north-west of Nairobi.





Climate Change in regions sensitive to food production declines

Precipitation declines linked to increasing sea surface temps in the Indian Ocean

Knowing about these changes allows adaptation in region

Funk et al (2010)
USGS Report 3074

Productive crop areas shrinking

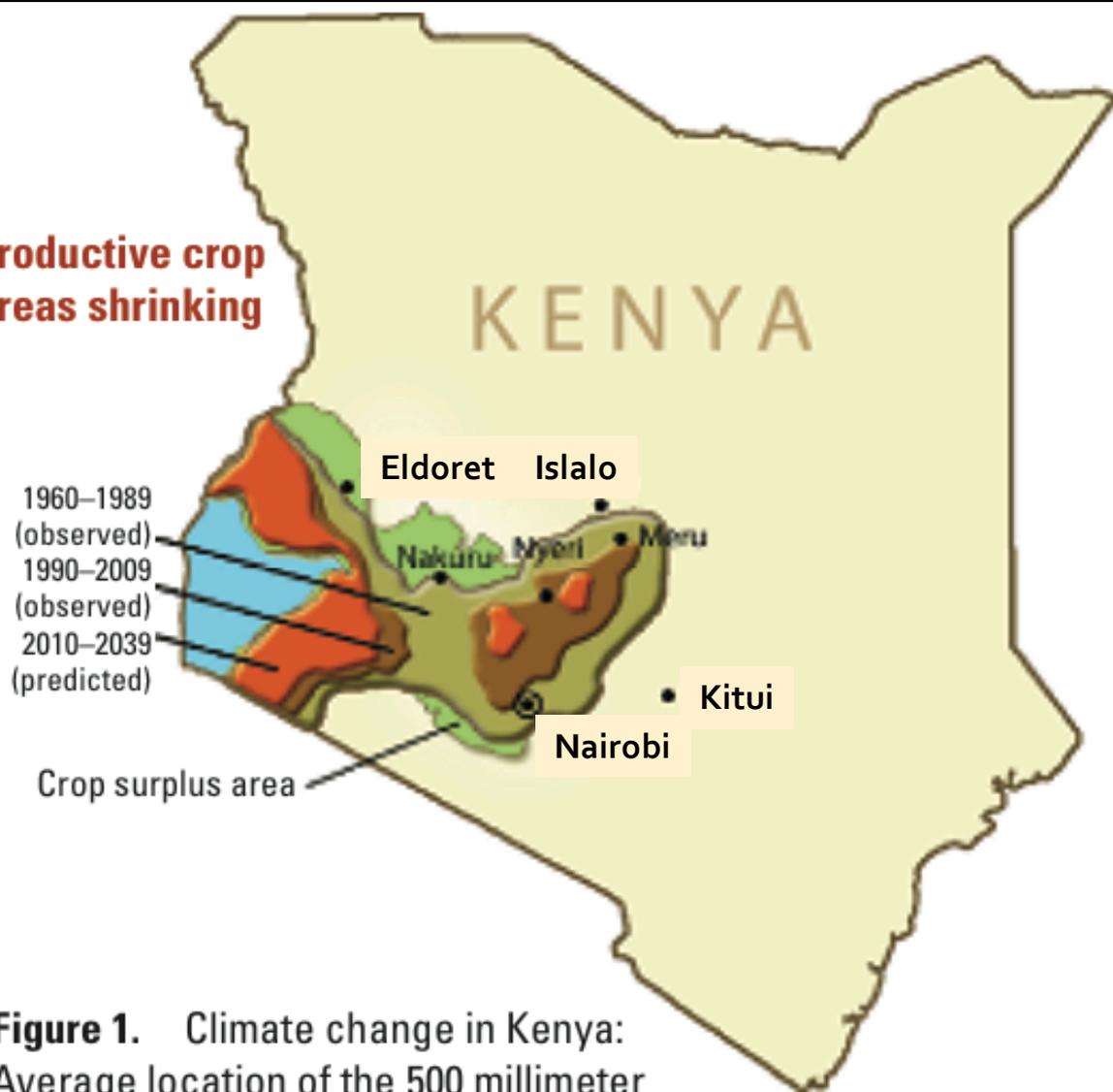


Figure 1. Climate change in Kenya: Average location of the 500 millimeter rainfall isohyets for the years 1975 (light brown), 1995 (dark brown), and 2025 (predicted, orange). The green polygon in the background shows the main crop surplus region of Kenya.



Summary

- Information on environment
 - Global satellite data provides information on land use, rainfall, soil moisture, vegetation vigor and crop yields
- Integrated analysis allows the transformation of these data into information that can be used to assess impact of weather on agriculture
- Trends in rainfall and temperature and their impacts on production can be mitigated with information
- Better understanding of weather impacts provides benefits to the entire food industry



Thank you!