Remote Sensing and GIS to Predict the Regional Impacts of Drought

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Overview

- Climate and remote sensing products are improving capabilities for assessing drought impacts on rangelands.

- Remote sensing products can be used with simulation modeling to provide near real-time predictions of forage conditions.

- Integration of remote sensing products and model outputs within a GIS framework provides capabilities for identifying anomalies and trends on a near real-time basis.
Challenges for Rangelands

- Because of the large land areas occupied by rangelands, characterization of the extent and intensity of drought poses many challenges.

- Characterizing of forage biomass production over large landscapes is hard to do using conventional methods on a near real-time basis.

- Monitoring networks are generally sparse in rangeland areas:
  - Large distances between rain gauges
  - Data may not be appropriate for distant sites
Increased Availability of Climate and Remote Sensing Data

- **Climate**
  - Gauge/Station Interpolations
  - Radar Derived Rainfall
  - Satellite Derived Rainfall
  - Temperature Data

- **Vegetation Proxies**
  - Normalized Difference Vegetation Index (NDVI)
  - Enhanced Vegetation Index (EVI)
Interpolated Gauge Data

- Unified Precipitation Database
  - Optimal Interpolation of station data throughout continental US
  - 0.25° resolution
  - Produced daily
  - Data period: 1948 to present

Data available from:

ftp://ftp.cpc.ncep.noaa.gov/precip/CPC_UNI_PRCP/GAUGE_CONUS/V1.0/
Interpolated Gauge Data

Data Source: CPC Unified (gauge-based at 0.5x0.5 deg resolution) Precipitation Analysis

ftp://ftp.cpc.ncep.noaa.gov/precip/CPC_UNI_PRCP/GAUGE_CONUS/V1.0/
Radar Precipitation

- **NEXRAD** – Next Generation Weather Radar
  - Doppler radar
  - Produced every 24-hours
  - Multi-sensor version – gauge and satellite corrections
  - 4 x 4 km resolution
  - Continental US
  - Availability: 2003 to present
  - Download data from: [http://water.weather.gov/precip/](http://water.weather.gov/precip/)
NEXRAD Precipitation

http://water.weather.gov/precip/
Satellite Derived Rainfall

- CMORPH - Climate Prediction Center Morphing Product
  - Derived from passive microwave and thermal infrared imagery
  - 8 x 8 km resolution, 2003 to present

![CMORPH Precipitation Estimates](image)
Climate GIS Data Portal

http://www.cpc.ncep.noaa.gov/products/GIS/GIS_DATA/


CPC GIS DATA
(Shapefile & Raster)

NOTE: If you have any questions concerning any of the GIS data provided here, please contact the person responsible for the data.

Data in Support of the US Drought Monitoring
Contact: David.Miskus@noaa.gov

<table>
<thead>
<tr>
<th>Data Set</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Soil Moisture</td>
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<tr>
<td>Evaporation</td>
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<td>Precipitation</td>
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<td>Runoff</td>
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<tr>
<td>Temperature</td>
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</tbody>
</table>

NOTE: Information about the USDG products is found at:
http://www.cpc.ncep.noaa.gov/products/Solst_Monitoring/

Seasonal Drought Outlooks
Contact: David.Miskus@noaa.gov

Daily Gridded Precipitation Analysis
Contact: Wei.Shi@noaa.gov

CPC Unified Global Gauge Daily Precipitation Analysis

Precipitation Estimates
Contact: Nicholas.Novella@noaa.gov

Daily Gridded Temperature Analyses (C)
Contact: Wei.Shi@noaa.gov

Sea Surface Temperature
Contact: Nicholas.Novella@noaa.gov

Temperature and Precipitation Forecasts
Contact: Kenneth.Pelman@noaa.gov

- 1-10 day, 11-14 day, Monthly & Seasonal

Weather Hazard Assessments
- United States
  Contact: Kenneth.Pelman@noaa.gov
- Global
  Contact: Jon.Gotschlich@noaa.gov
- Africa, Afghanistan, Central
  Contact: Nicholas.Novella@noaa.gov
- America & Hispanics
  Contact: Jon.Gotschlich@noaa.gov
- Global Topics
  Contact: Jon.Gotschlich@noaa.gov
Vegetation Biomass Proxies

- **Vegetation Indices**
  - Normalized Difference Vegetation Index
    - AVHRR Data – 1 km resolution 1989 to present
    - MODIS Data – 250 m, 500 m, & 1 km resolution, 2001 to present
  - Enhanced Vegetation Index
    - Corrects for soil background and improves signal in heavily vegetated areas
    - 250 m, 500 m, & 1 km resolution, 2001 to present
Relative Greenness

Relative Greenness: Dec 18 - Dec 24 2012

LEGEND

WFAS-MAPS Graphics  National Interagency Fire Center
Short and Long Term Forecasts

- Improved forecasting provides capabilities for assessing risk in livestock decision making
- Available for precipitation and temperature
- Forecasts 7 days to more than a year
- Can be helpful in comparing with analogous years
Short and Long-Range Forecast Maps

Graphics: http://www.cpc.ncep.noaa.gov/products/predictions/30day/
Drought Early Warning for Livestock

- Integration of remote sensing, GIS, and simulation modeling for drought early warning
  - Simulation modeling provides means to translate RS data to livestock forage
  - GIS provides capabilities for mapping and anomaly detection
  - Integration provides framework for livestock early warning systems
Integrating GIS, Remote Sensing and Simulation Modeling for Early Warning

Near Real Time Climate Imagery (CMORPH precipitation and temperature)

Site Characterization

PHYGROW Model Servers

NDVI Imagery (greenness)

Geostatistical and Forecasting Analysis

Regional Maps

Individual Site Analysis
Map Products for Early Warning: Deviation from Long Term Average

September 1 to September 15, 2007

Severe Drought

Total Forage Available to Grazers
Deviation from Long Term Average

- **Very Good**
- **Scarcity**
- **Good**
- **Drought**
- **Medium**
- **Extreme Drought**
- **Poor**

 Disclaimer: This information is provided for decision support, but should not be the sole source of information for livestock and land management decisions. Mercy Corps, Texas A&M University, the Global Livestock GIS, and the US Agency for International Development are not responsible for any decisions made using the information provided here.
Map Products for Early Warning: 60-Day Forecast Deviation

Forecast for November 1 to November 15, 2007

Severe Drought Continues
Next Generation Livestock Early Warning Systems

- Integrated Networks and Sensors
- Improved forecasting
- Incorporation of other relevant data streams
  - Forage Quality
  - Livestock prices and futures
  - Feed and Hay prices
Conclusions

- Increased availability and higher resolution remote sensing data
  - Provides opportunities for near real-time assessment of drought
  - Accessible for risk management decision making

- Integrating remote sensing data with simulation modeling and GIS provides framework for assessing forage anomalies and trends
Conclusions

- Early warning system outputs, along with short and long-term forecasting information can improve risk management decision making.

- Next generation early warning systems could incorporate other data streams and sensor networks to provide more holistic decision support for livestock managers on rangelands.
Questions or Comments?