

# DEVELOPING A REAL-TIME AGRICULTURAL DROUGHT MONITORING SYSTEM FOR DELAWARE USING A GEOSPATIAL FRAMEWORK



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## MOTIVATION

There are three main motivations for this research:

### 1) Agriculture is an important part of Delaware:

- 2400 farms covering 560,000 acres (45% of the state)
- 480,000 acres of crops (216,000 acres of soybeans and 168,000 acres of corn)

### 2) Recent growing-season moisture variability in Delaware (Figure 1 and Figure 2):

- Severe drought during 2002 reduced yields by ~30%
- Ranked as the third driest growing-season since 1895
- 2003 was the wettest growing-season recorded since 1895

### 3) Current drought monitoring products are too coarse both spatially and temporally for many applications (Figure 3):

- Finest spatial resolution = climate division or county
- Finest temporal resolution = weekly (or monthly)
- Therefore, they are not appropriate for making operational decisions or monitoring moisture conditions at a finer spatial resolution

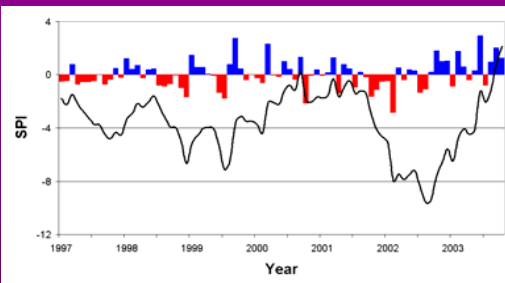


Figure 1. Recent precipitation variability in Delaware: monthly Standardized Precipitation Index (SPI) values in northern Delaware (1997-2003)



Figure 2. Examples of drought impacts: a) Corn crop near Elkton, MD (August 6, 2002), and b) Lums Pond State Park, New Castle County, DE (July 20, 2002)

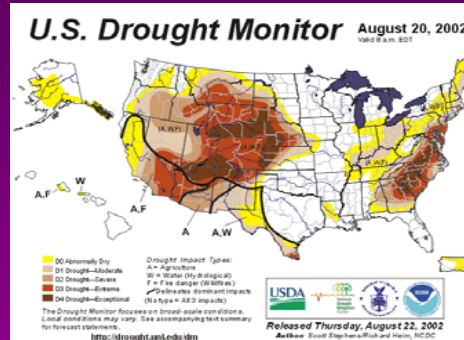


Figure 3. An example of the spatial resolution of current drought monitoring products: US Drought Monitor (August 20, 2002)

## DATA & METHODS

The real-time Agricultural Drought Monitoring System (ADMS) incorporates National Weather Service (WSR-88D) radar-derived precipitation estimates and meteorological data provided by the Delaware Environmental Observing System (DEOS) to run the crop growth/water balance models (Figure 4). ArcGIS will be utilized to organize, store, and manipulate the various input data layers. In addition, much of the analysis, such as determining the location of agricultural land in Delaware and interpolating the meteorological data, will be carried out within ArcGIS.

### Model inputs:

- Meteorological data (daily max and min temperatures; precipitation; solar radiation)
- Soils data (such as: drainage, runoff & evaporation coefficients; soil water-holding capacity & rooting coefficients at several depths)
- Crop & Management data (crop coefficients related to: type, photoperiod sensitivity, duration of grain filling; plant density, plant depth & date of planting)
- LULC data (Delaware LULC series was developed in 1997 by Earth Data)

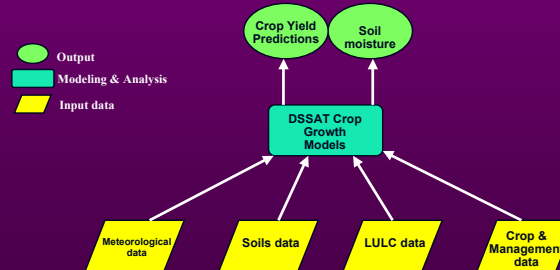


Figure 4. Schematic diagram of the real-time Agricultural Drought Monitoring System

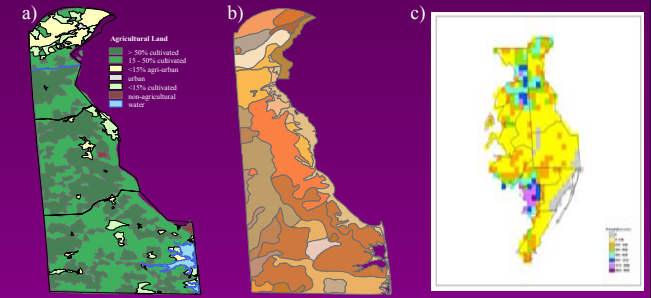


Figure 5. Selected model input data: a) LULC data, b) soils data, c) radar-derived precipitation estimates

### Model Output:

- Maps of soil moisture (and other water balance variables) (Figure 6)
- Probabilistic predictions of crop yield using historical data

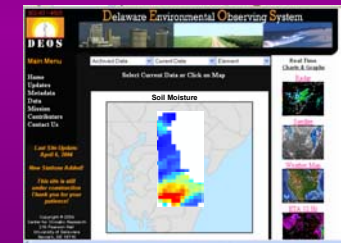


Figure 6. An example of model output: Delaware soil moisture map

## RESULTS & CONCLUSIONS

Agricultural producers require timely, crop specific information to assist in making operational decisions. Moisture conditions exhibit a high degree of spatial variability because of the importance of convective precipitation. As a result, the drought monitoring products that are currently available in the United States (e.g., US Drought Monitor) are too coarse (both spatially and temporally) for most agricultural applications.

The ADMS provides high resolution (4X4 km), real-time (updated daily), drought monitoring and crop yield estimates. This system will facilitate irrigation scheduling, pesticide management, and commodity futures trading. It will also allow federal and state agencies to monitor, on a real-time basis, the severity and spatial extent of severe flood/drought events to determine if federal drought assistance is required. The model output will be used to create maps of soil moisture, evapotranspiration and crop yield predictions that will be updated on daily basis during the growing season and will be made available at <http://www.udel.edu/DEOS/>.