IMPROVING METHODS FOR CROP YIELD FORECAST AND EARLY WARNING SYSTEMS

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Outline - Research Topics

- Crop simulation models (CSM) – types of models
- Remote Sensing (RS): Principles and Vegetation Indices
- Yield Gap Analysis
- Linking CSM with RS for yield forecast
- Early Warning Systems (EWS)
- Research needs for improving Ag Statistics in developing countries
Yield Forecasting Methods

- National Yield Statistics
- Crop Simulation Models/Yield Gap
- Weather Monitoring
- Remote Sensing
- Other Information

Yield Forecast

Software Tools
Rainfall alone cannot be used to predict yield.

Lobell et al., 2013 Nature Climate Change

Crop Simulation Models

• Types of models: **Deterministic and Stochastic**
  • Deterministic: Statistical, Mechanistic and Functional

Example of a functional model (SALUS)
Triangles (△): Data are still in the process of quality-check and thus not available yet.
The soil groups, according to FAO (1990) and included in WISE v. 1.1.

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<th>North America</th>
<th>Central &amp; South America</th>
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TOTAL: 1272 895 158 522 478 79

a Soil groups were summarized by continent. The value indicates the number of soil profiles in WISE 1.1 database.
Spatial and Temporal Variability of Crop Yield

Spatial Variability

Temporal Variability
Simulation and Predictions

Corn Grain Yields (Mg/ha)

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<th>Years</th>
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<th>MEASURED</th>
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<td>2012 low yielding zone (higher elevation)</td>
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<td>2013 till July 5, then wet year like 2011</td>
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<td>2013 till July 5, then dry year like 2012</td>
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<td>Wet yr with 10 days of 37°C and no rain for 1 mo</td>
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<td>Dry year with deficit irrigation</td>
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- Wet yr with 10 days of 37°C and no rain for 1 mo
- Dry year with deficit irrigation
AgMIP project

Rosenzweig et al., 2013, *Ag. For. Meteo*; Asseng et al., 2013 *Nature Climate Change*
Remote Sensing

RS can be used for yield estimation directly using VI or indirectly by incorporating data into simulation model for crop growth and development either as within season calibration checks of model output (LAI, biomass) or in a feedback loop used to adjust model starting conditions (Maas, 1988).

\[ \text{NDVI} = \frac{(\text{NIR} - \text{RED})}{(\text{NIR} + \text{RED})} \]
Early Warning System (EWS) is defined as an integrated system for monitoring, data collection, analysis, and communicating to people in order to make early decisions to protect peoples and the environment (Davies et al. 1991).

FAO Global Information & Early Warning System (GIEWS) on Food and Agriculture (ISDR, 2009)

Most of the EWS use RS for crop monitoring and early screening for signs of drought, flood, ENSO, climate change
• RS - Create a database with availability and usefulness of satellite to exploit its spatial, temporal and spectral resolutions and its cost
• Test functional CSM using observed weather and soil properties along different scenarios of management to reproduce what RS has indicated
• Run pilot projects where CSM are integrated with RS to test the capability of the procedure under stratified agriculture to improve Ag Stats in developing world
Thank you

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