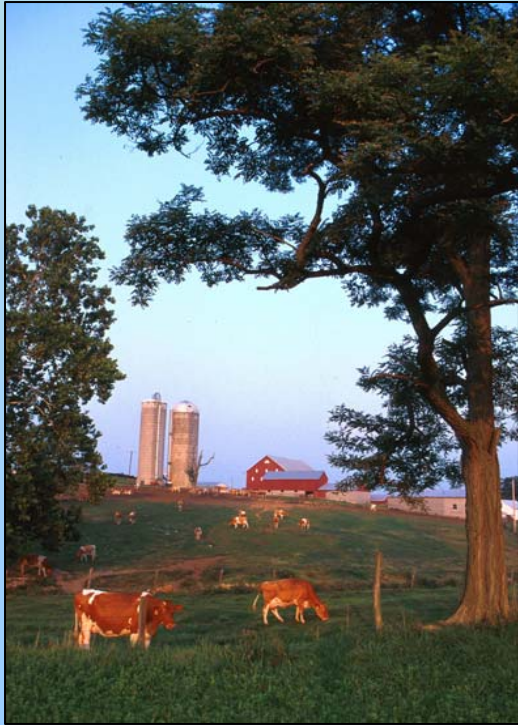


Modeling Rangeland Plant Growth: Future Directions To Meet Customer Needs.

Mark A. Weltz
*Rangeland Hydrologist
USDA-ARS
Exotic and Invasive Weeds
Reno, Nevada*



Agricultural Systems Modeling: Challenges and Opportunities



American Agriculture's Accomplishments:

- 16% of the \$9 trillion gross domestic product.
- 8% of U.S. exports in 2006.
- 17% of employment.
- < 2% U.S. workforce on farms/ranches.
- 100% of the citizens are users.

Natural Resources and Sustainable Agricultural Systems



Develop scientific knowledge and technology that ensure safe and affordable supplies of food, feed, fiber, and renewable energy while enhancing the environment and quality of life for producers, rural communities, the Nation, and the world.

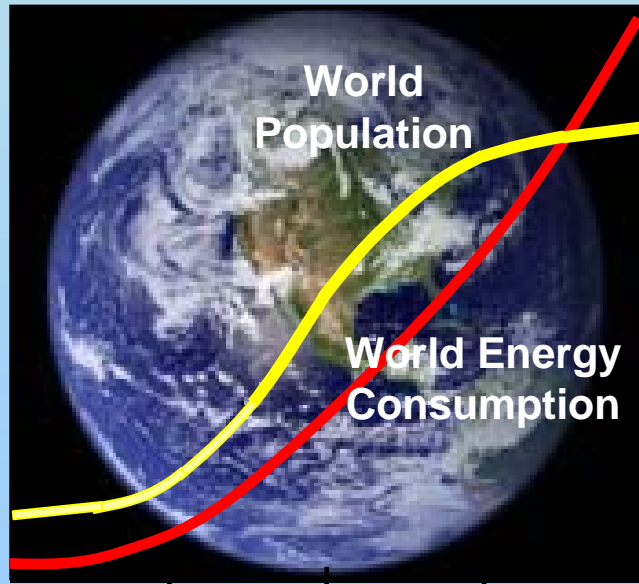
Agricultural Systems Modeling: Challenges and Opportunities



Research has helped producers address:

- Natural resource concerns.
- Changing market conditions.
- New technology introductions.
- New regulations.

Agricultural Systems Modeling: Challenges and Opportunities



Challenges Ahead:

- Food, feed, fiber production.
- Bio-based energy production.
- Water availability, drought, and water quality.
- Ecosystem requirements and regulations.
- Production in a changing climate, while addressing safety and security.

Agricultural Systems Modeling: Challenges and Opportunities

New challenges:

- Decision making is no longer limited to single-factor effects.
- Complex problems require holistic solutions.
- Need to look across disciplines and agency boundaries for partnerships.
- Problem-solving requires a systems approach.
- Partnerships are essential for success!



Challenges/Opportunities

Models are needed to address:

- What are the consequences of climate change on production and natural resources?,
- What would be the effect of regional drought on agricultural-based energy/food production?
- What production strategies have the least risk of economic loss?
- How can natural resource quality be best managed while achieving production goals?



Agricultural Systems Modeling: Challenges and Opportunities

Critical Role for Modeling:

- Full partner in outcome-based, problem-solving research.
- Leader in identifying critical challenges and opportunities.
- Contribute to holistic sustainable solutions that enhance agriculture competitiveness and profitability.



Challenges/Opportunities

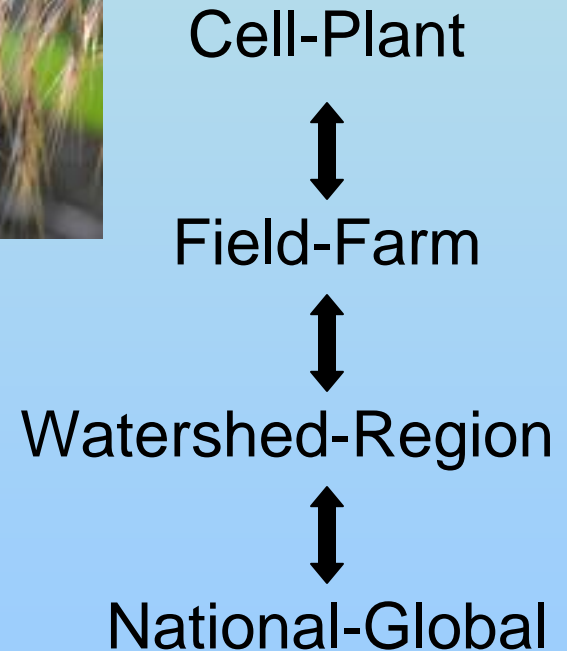
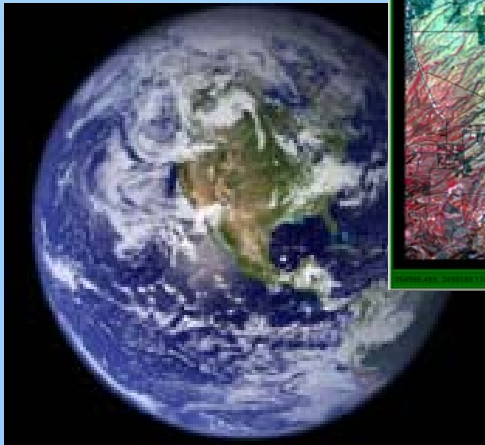
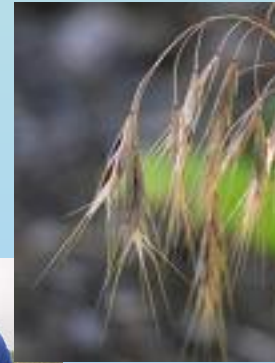


Models Must: Be able to operate using real-world observations that are not “research quality”, e.g.

- Standard weather data.
- Soil survey maps.
- GPS coordinates.
- Routine user-collected samples.
- Ranch and agency records.
- Observations collected by volunteers.

Challenges/Opportunities

Models Must: Be able to handle scales across space and time.



Challenges/Opportunities



Models Must: Realistically represent real world processes and complexity.

- Biological.
- Physical.
- Biochemical.
- Economic.
- Other constraints.

Challenges/Opportunities

Models Must: Produce results that can be applied to a variety of needs specified by the user community.



Research Community



**Government
Action
Agencies**



**Strategic Decision
Makers**



**Agricultural
Producers &
Consultants**

Challenges/Opportunities

Models Must: Be rigorously validated to ensure confidence in their results and maintain credibility.

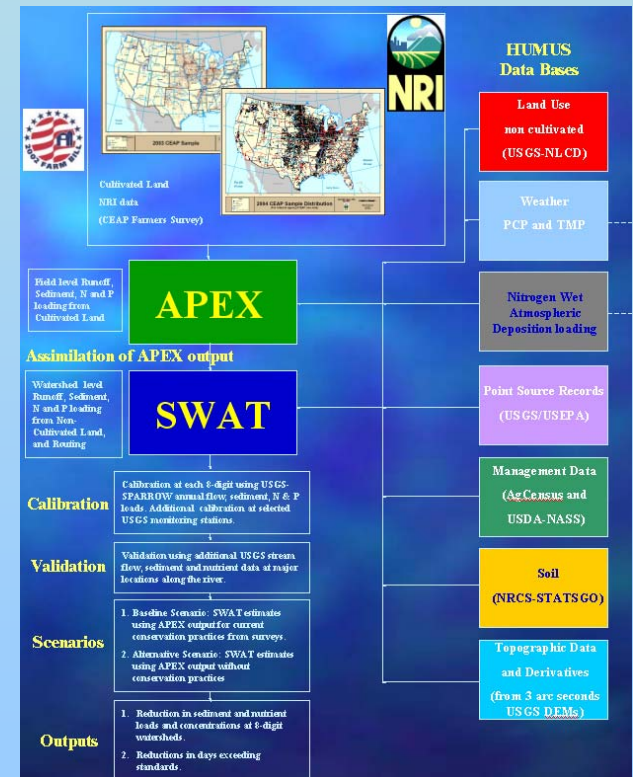
- Across ecological regions.
- Different management systems.
- Within-field to watersheds.
- Accommodate national observing networks.



Challenges/Opportunities

Models Must: Model databases must be complete and updateable.

- Use historical databases.
- Lockable databases.
- Exchange output with other models.
- GIS capable.

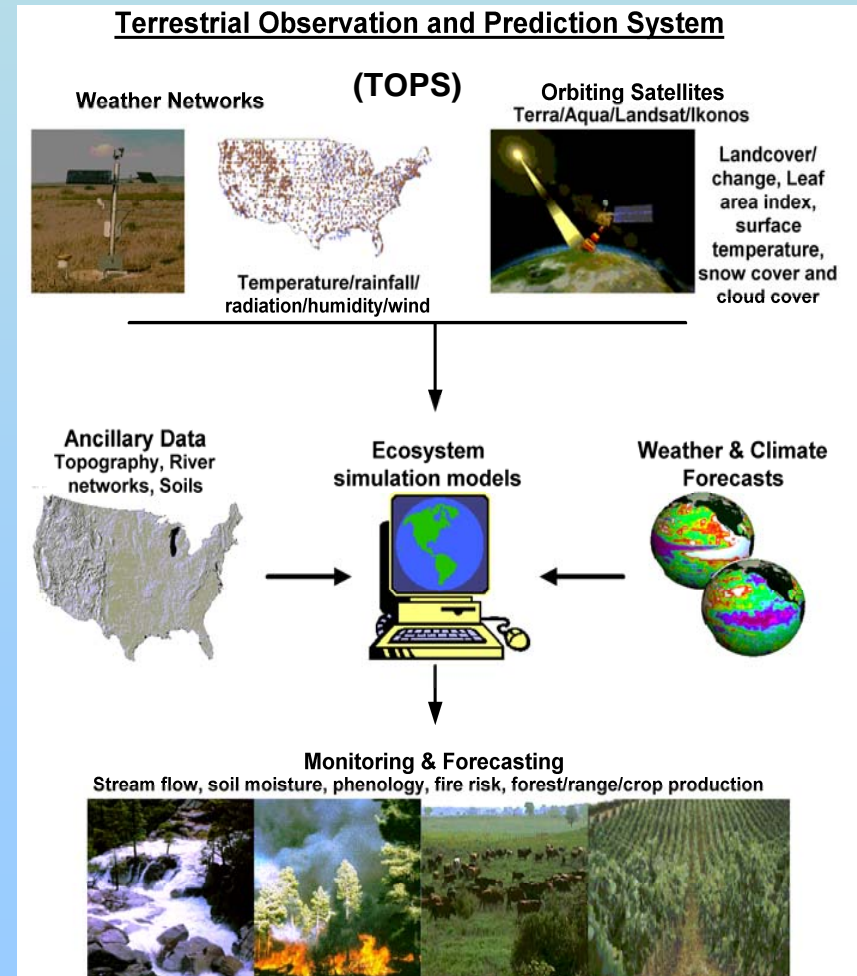


Challenges/Opportunities

Models need to update data in a simple manner for ecosystem forecasting:

Models need to be automated for on-demand data gathered from satellites and surface weather stations.

Pre-processing and integration of such data with simulation models allows for a variety of forecasts from local to global scales for use by operational agencies such as Forest Service, Bureau of Land Management, and Natural Resources Conservation Service.



Challenges/Opportunities

Models Must: Produce results that are easily understood by the user community.

- User guide and custom documentation.
- Model Interface (GUI) needs to be intuitive.
- Multiple output forms.
- Web data exchange protocols.



Challenges/Opportunities

Models Must: Be fully supported to be adopted.

- Customer support services.
- Training classes offered.
- Staff to upgrade and maintain the model.
- Model components need to be modular for easy maintenance and up grading.



Challenges/Opportunities

Models are needed to address:

- Impacts of land management practices: burning, brush control, grazing, invasive species control, and revegetation.
- Wildlife and livestock interactions.



Challenges/Opportunities

Models are needed to address:

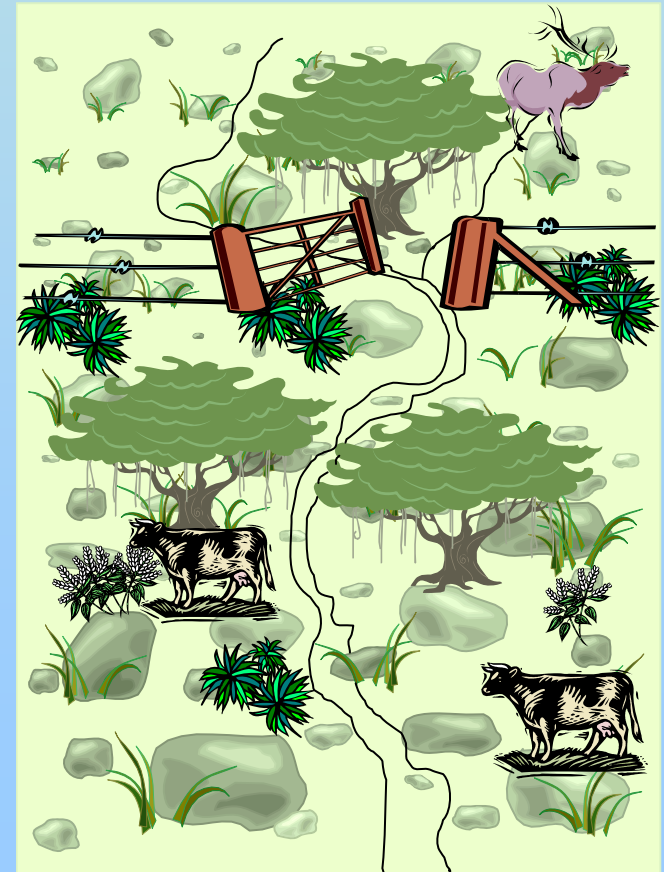
- Multiple species: trees, shrubs, grass, forbs, cacti, and cryptogams.
- Inter and Intra-species competition.



Challenges/Opportunities

Models are needed to address:

- Complex wildland hydrology.
- Complex slopes with different vegetation communities and management along the slope.



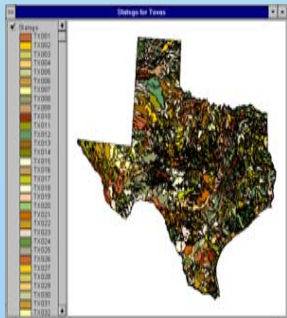
SWAT is used worldwide to assess environmental benefits

- SWAT stands for Soil and Water Assessment Tool.
- SWAT was chosen as the tool to quantify the environmental benefits of conservation practices at the national and watershed scales for the Conservation Effects Assessment Project (CEAP).
- ARS is committed to enhancing SWAT and making it available to its partners through collaborative efforts.



Increase partnerships to leverage resources and increase impact

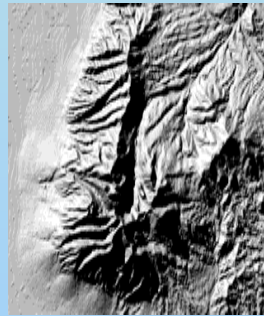
Soils



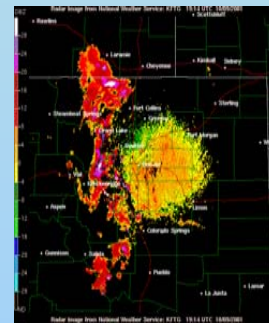
Hydrology



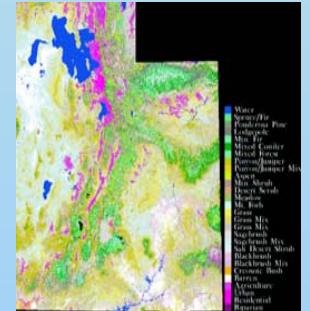
Topography



Climate



Land Use



**Partnerships are essential to improve:
Observational capabilities &
Modeling capabilities**