
Derivation of Crop Parameter Attributes for Cropping Systems Modeling

Jim Kiniry, Norman Meki, Lori Metz and Mari-Vaughn Johnson



Grassland, Soil and Water Research Laboratory



Needs

- Simulation models require field-based parameter development and field-validation of runs for each species of interest
- Cooperation is essential to:
 - help develop and improve plant parameters
 - validate the model at a wide range of sites, soils, and latitudes
 - make large area yield simulation runs
- Continued ongoing collaboration and development of new collaborations is paramount

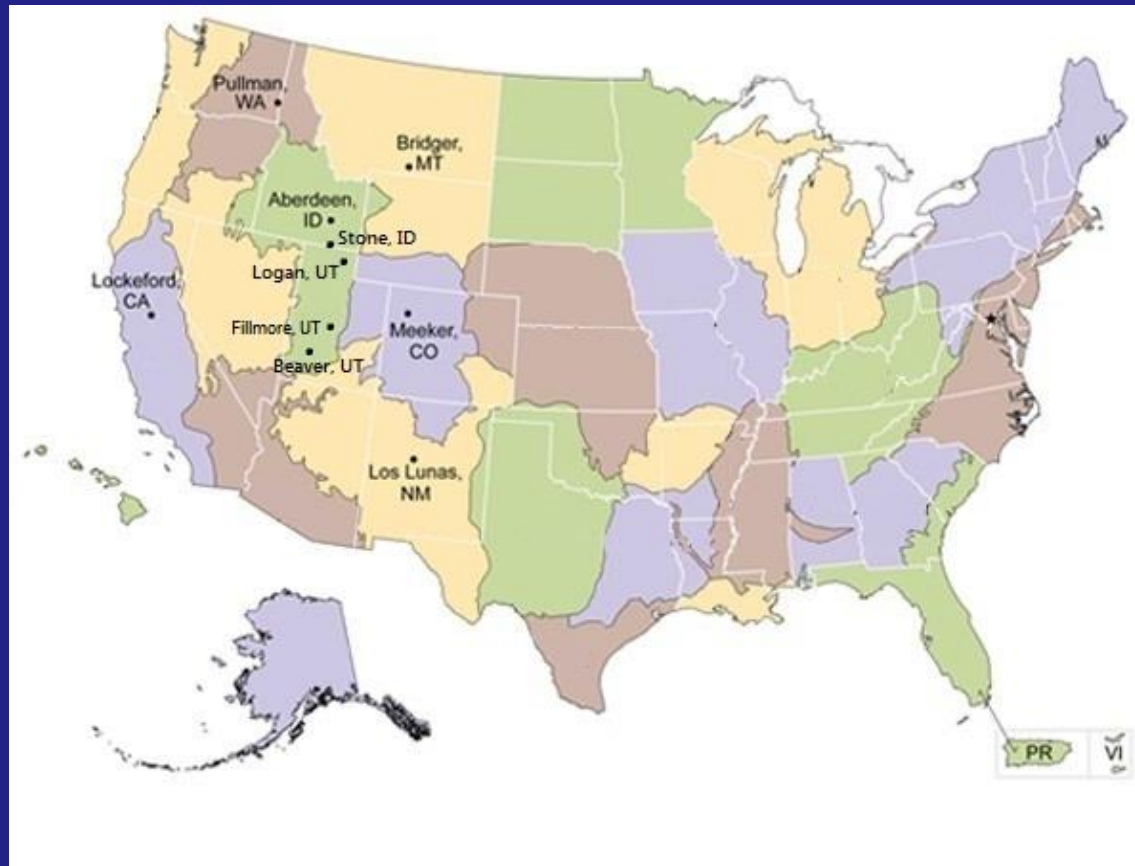
Model Outputs

- Plant productivity
- Plant species dominance
- Runoff and infiltration
- Soil erosion (water)
- Drought and nutrient stress impacts
- Nutrient demand and uptake by plants

Plant Parameters for Plant Functional Groups of Western Rangelands

- LAImax
- Values for k
- RUE
- For forbs, grasses, and shrubs

Locations where plant data was collected



Western Rangeland Study

- Results of this multiyear project were published both as individual species values and as functional groups
- Results were validated by simulating various range sites in the region and comparing to published NRCS yield values

Summary of Western Grass Parameters

Grass parameters ranged from:

- LAI_{max} 1.0 to 2.1
- k -0.50 to -0.85
- RUE 0.70 to 1.3g MJ⁻¹

Conclusions from Western Rangeland Study

- Results demonstrated that assessments with process-based models such as ALMANAC are feasible with realistic estimates of plant parameters for plant functional groups in a region.
- Our measurements of individual species within each functional group provide parameter estimates for these assessments.

Wetland CEAP

- Conservation Effects Assessment Project (CEAP)
- Wetlands are important sinks or filters for sediment, organic carbon, nitrogen and phosphorus
- Need for regional and national wetland assessment
- ALMANAC – Parameterize wetland plant species, simulate management and sustainability of wetland ecosystem
- SWAT – Model wetland hydrology and integrate with other watershed land uses and processes

Wetland Cooperators

- Amber Williams with USDA-ARS Temple
- Megan Lang and Greg McCarty, USDA-ARS, Beltsville, MD
- Loren Smith, Oklahoma St. University
- Dan Keesee and Kelly Attebury, USDA-NRCS, Temple and Lubbock, TX
- David Mushet USGS-Jamestown, ND

Planned Deliverables

- Plant parameters for some representative plant species in key wetland plant functional groups
- These plant parameters will be transferred to other, similar process based simulation models including APEX, SWAT, and EPIC

Field-Based Measurements

- Plant nutrient concentrations and physiological distribution at different phenological stages
- Light extinction coefficient (k) determined from FIPAR measurements and destructive LAI measurements
- Radiation use efficiency: dry matter produced per unit light intercepted over time

Field Data Requirements

- **FIPAR** using the ceptometer
- Area sampled
- Harvest and weigh plant
- **LAI** using the leaf area meter



Data Collected

- At least two to three harvests taken over the growing season
- Fraction photosynthetically active radiation (FIPAR) measured in the field using a ceptometer
- Leaf Area Index (LAI) recorded from harvested species
- K derived from the data to be used in Beer's Law
- Plant nutrient concentrations

Website links to field measurement protocol

Gathering Field Data

How to use ceptometer: [AccuPAR LP-80 Basics Standard](#)

Taking measurements for ALMANAC: [Sampling Protocol Standard with Photos](#)

Collecting Data: [Field Datasheets](#)

Data Entry Template: [FIPAR LAI K Example](#)

Video Explanations showing formulas, how and why we measure the way we do:

[Virtual Seminar: Standardized Methods for Measuring Intercepted PAR in Canopies Using Ceptometer](#)

[Video: Measuring PAR and LAI with Accupar LP-80 Ceptometer](#)

[Decagon Ceptometer: Accupar LP-80](#)

[LI-COR Leaf Area Meter: Li-3100C Area Meter](#)

Maryland

- **Cattail**
- **Smartweed**
- **Sedge**
- **Rush**



Playas

- Burr Ragweed
- Spike Rush
- **Smartweed**
- Cheeseweed
- Arrowhead (2014)
- Narrowleaf Goosefoot (2013)



North Dakota

- **Cattail**
- **Slough Sedge**
- **Bulrush**
- **Smartweed**
- **Whitetop**
- **Reed Canary Grass**



Ongoing Western Rangeland Research

- Arizona with Lori Metz and Steve Barker on triangle-bursage and creosote bush
- Miles City, Montana with Jennifer Muscha, Mark Petersen, and Robert Killian on threadleaf sedge, needle and thread, green needlegrass, prairie sandreed and winterfat

Ongoing Biofuel Plant Research

- Navy research on Maui with Norman Meki, Susan Crow, Richard Ogoshi, and Mae Nakahata
- Oilseed research with Kim Hunter, Kate Behrman, Dan Long, and many others
- Hybrid poplar work with Tian Guo, Gang Shao and Bernard Engel

Plan:

- Transfer plant functional group/species parameters to EPIC, APEX, and SWAT for various analyses