SAVANNA Model - Basic Data Requirements

I. Weather

A. For a main base station in study area

A. Monthly precipitation, max and min temperature for as many years as possible for a main base station.

B.Relative humidity, wind speed over time. Otherwise the long-term mean relative humidities, windspeeds for each month can be used.

C. Solar radiation - for input (optional) or for comparison.

D. Potential evapotranspiration at main reference site - for calibrating PET model

B. For spatial runs

1. Monthly precipitation data for all weather/raingauge stations in or near study area.

2. Temperature lapse rate (rate of change with elevation)

II. Spatial (GIS) Data

A. The model is spatially explicit, ie.it can simulate landscapes and regions based on a grid-cell data structure (GIS), and where all of the grid-cells are simulated concurrently, with movement of animals or materials accross space during the simulation. The model does not have to be applied spatially, however. To predict distributions of tree-grass ratios over large areas, a spatial data set (GIS) is needed with the following information .

B. Soil map with attributes as in soil data, above.

C. Elevation, slope and aspect maps.

D. For runs with runoff/runon subareas - map of cover of each subarea type by grid-cell

E. Vegetation map - with attributes of:

1. Woody canopy cover - trees

2. Woody canopy cover - shrubs

3. Mean tree and shrub sizes and/or size class distributions. Size can be specified by height, crown diameter, or basal stem diameter.

4. Herbaceous total biomass (aboveground, root/shoot ratio can be used to calculate roots).

5. Species or functional group composition.

F. Herbivores

1. Maps of seasonal ranges (minimal)

2. Population density maps - for model testing

3. Maps of watering points (optional)

G. Fires - maps of fires that have occurred in the past. Can be mapped as a severity index.

H. For version 4L or above - hydrological flow accumulation map, for computing redistribution of precipitation among landscape units in relation to drainage pattern.

III. Plants

A. Biomass

1. Herbaceous plants - peak standing crops, mean at least, better for a number of years

2. Mean root biomass - can be estimated if unavailable.

3. Woody plants - current annual growth (leaf, twig), important for browse species, not as important for non-browse species

2. Optionally - finer time step (eg. monthly) data, separation of herb biomass into live and dead, separation into species or functional groups.

3. Phenological patterns

A. Green-up or leaf flush times - can estimate

B. Degree-days to flower, set seed, senesce - less important but useful

B. Plant ecophysiology

1. Maximal photosynthesis rate, if not available can use data from typical species

a. Optionally, how it responds to water, temperature, light, nitrogen..

2. Either stomatal conductance data, or data on how stomatal conductance varies in response to photosynthesis rate, under know humidity. Can use typical values if missing.

3. Specific leaf mass (g/m2) or leaf area (m2/g)

4. Nitrogen concentrations of live and dead leaves is important. Those of live roots, stems, fine and coarse branches are less critical, but useful.

C. Plant morphology, allometry

1. Woody plants

A. For 6 size classes - woody bole and stems weight, leaf weight, fine and coarse root weights, crown diameter, height, stem diameter

2. Herbaceous allocation

A. Fractions root, stem, leaf, reproductive.

B. Optionally, how root/shoot allocation responds to water and nitrogen stresses.

3. Rooting depths.

D. Woody plant population processes

1. Typical lifespan.

2. Typical establishment rate. Optionally, how it responds to precipitation , and . herbaceous biomass g/m2

IV. Soils and hydrology, nitrogen budget

A. Soil texture, optionally by depth.

B. Soil depth, ie. maximum plant rooting depth of woody plants

C. Herbaceous rooting depth

D. US Soil Conservation Service range site classification, or run-off curve number - can be estimated and calibrated to data on runoff as a fraction of precipitation..

E. Total carbon and nitrogen contents

F. Water table depth - if present. Typical monthly dynamics for relevant soil types.

G. Nitrogen deposition rate in precipitation, or concentration in precipitation

V. Herbivores (wild ungulates, and domestic livestock)

A. Note, herbivory can be simulated simply by specifying animal densities, intake rates, and diets. Optionally, animal energy balance, and animal population dynamics can be simulated.

B. Populations

1. Past numbers, for each population or herd.
2. Culling, offtake, or harvest rates for each population, over time, or expressed as a rule (to maintain a specified population size and composition).
3. Optionally, to simulate population dynamics - birth and death rates, gestation time, birth month, removal and restocking rates, by age class.
4. Optionally, how birth and death rate respond to body condition. This almost always has to be calibrated to match population dynamics.

C. Ecophysiology
1. Body sizes of adult male and female, immatures, newborns
2. Energy requirements - total, basal..
3. Fluctuations in body weight - at least a range between minimum (starving) and maximum (fat).
4. Optionally - energy costs of traveling, lactation, gestation
5. Optionally - lower critical temperature for thermoregulation.
6. Optionally - water requirements, amounts, types (saline vs. non)

D. Foraging, diets
1. Foraging functional response ie. how intake rate varies against forage biomass.
2. Diet composition - by plant groups simulated in plant model.
3. Dry matter digestibilities of forages.

E. Herbivory damage to plants
1. Additional damage to plants beyond eating them - eg. killing by trampling, debarking, felling.

VI. Predators
A. Abundance, densities
B. Dietary composition - amount and type of prey
C. Ranges, territories

VII. Fire
A. Fire history - incidence and severity of fires.
B. Plant responses to fire
1. Percent of tissue burned-off (can be by severity level)
2. Fraction of plants that die (can be by severity level).

C. Probablity of fire - only for projecting ahead. Can be specified vs. 3-month or 12-month moving average rainfall, or by green and dead herbaceous standing biomass.

VIII. Humans - pastoralists
A. Number in system.
B. Age/sex composition
C. Dietary requirements by age/sex, energy units
D. Energy content of diet items
E. Preferences of different food items in diet, can be expressed as diet composition in different seasons, including least and most stressful seasons. Including milk, meat from slaughtering, other food (chiefly grains)
F. Herd management

1. Desired livestock/human ratio, species composition, age/sex composition, in different seasons

G. Cash management

1. Target cash in account in different seasons