G-range

Presentation of the model
Current and potential links with remote sensing products (RS)

Cecile Godde, Randall Boone, Ben Henderson, Philip Thornton, Mario Herrero
Part 1: Presentation of the model
G-range - A global ecosystem model for rangelands

- A joint effort between CSU, CSIRO, ILRI and CCAFS
- Ecosystem model for grasslands, savannas, drylands, and other grazing lands
- Moderate complexity
- Simulate and forecast ecosystem dynamics in response to climatic and management scenarios
- From global to local scales
- Built upon established models: Century & SAVANNA models
- Has been validated (site and regional scales, Africa) – encouraging results
Some results from G-range runs

Figure 1. Ensemble simulation results for annual net primary productivity of rangelands as simulated in 2000 and their change in 2050 under RCP 8.5 climatic pathway, with plant responses enhanced by CO2 fertilization.

(Boone, Conant, Sircely, Thornton and Herrero, submitted)
Some results from G-range runs

Figure 2. Ensemble simulation results for soil organic carbon in rangelands as simulated in 2000 and their change in 2050 under RCP 8.5 climatic pathway, with plant responses enhanced by CO2 fertilization.

(Boone, Conant, Sircely, Thornton and Herrero, submitted)
Part 2:
Link between G-range and Remote sensing products (RS)
RS for G-range parameterisations

• RS used as **fixed inputs**
• Example:
  
  Rangeland extent (Global Land Cover Characterization data)
  Herbaceous cover, shrub and tree cover (MODIS Land Products)
RS for ecosystem models control

RS used as a **correction** to control model uncertainty

- RS used as starting points for short-term ecosystem simulations
- RS as control of variability (e.g. SAVANNA)

**Trade-offs**

- Outcomes confined to smaller variations
- Volume of data
RS For G-range validation

Figure 3. G-range regional validation using MODIS total NPP for East Africa and the Greater Horn of Africa.

Sircely et al. (2014)
Links RS - Biophysical models - herd models

RS -> C-store model -> biomass

Advantages:
• Cost effective
• More empirical
• Based on observations “closely related” to the variable of interest (surface reflectance)
• Real-time estimates
• High resolution

Drawbacks:
• No predictive capability (forecasting or scenario testing)
• Unrefined data

->herd model->livestock production
Links RS - Biophysical models - herd models

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RS -> param. calibr. G-range -> biomass

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• Richness and depth to the results
• Data on plant functional groups

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## Links RS - Biophysical models - herd models

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**RS -> param. calibr. G-range and controlled over time -> biomass**

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**G-Range -> calibr. RS-model -> biomass**

G-range used to calibrate the RS-based model

->herd model->livestock production
## Links RS - Biophysical models - herd models

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- herd model -> livestock production
Next steps (1)

• A good way forward is possibly a **comparative analysis of the different methods**
Next steps (2)

- We use **two of the approaches** to estimate biomass, protein availability and GHG emissions in an Australian Case-study.

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Take home messages

• **G-range**: an intermediate complexity rangelands model, needed for assessing:
  – livestock production
  – impacts of climate change
  – adaptation and mitigation strategies

• **RS models, ecosystems models and field observations can benefit each other** in many ways (for models parametrisation, validation, etc.).

• **We need to combine RS models and ecosystems models more efficiently** to make use of the spatially dense RS observations.
For more information

- http://www.nrel.colostate.edu/projects/grange
  (downloads, report, sensitivity analyses, posters, contact details, etc.)

- Randall Boone – Colorado State University
- Mario Herrero – CSIRO
- Philip Thornton – CCAFS

Other references mentioned during this presentation


**MODIS:** MODIS Vegetation Continuous Fields (Hansen et al. 2006), e.g., http://glcf.umd.edu/data/vcf/
Thank you!

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Additional material
Data available for the baseline application (modifiable)

**Land type** (2): Land or ocean

**Land cover types** (97 in tot): Rangeland or not

**Ecosystem types** (15): have their own set of parameters

**Fire and fertilisation events**

**Soils** are simulated using four layers

**Kinds of vegetation** (3): herbaceous, shrubs, and trees

1) herbs within the herbaceous facet, 2) herbs under shrubs and 3) shrubs in the shrub facet, and 4) herbs under trees, 5) shrubs under trees, and 6) trees in the tree facet.

Herbaceous plants: leaves and shoots plus fine roots.
Woody plants: leaves (and shoots), fine branches, coarse branches, fine roots, and coarse roots.
Biomes for which parameters were provided that control ecosystem dynamics.