Steve Mann/ILRI

G-range

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

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AGRICULTURE AND FOOD
www.csiro.au

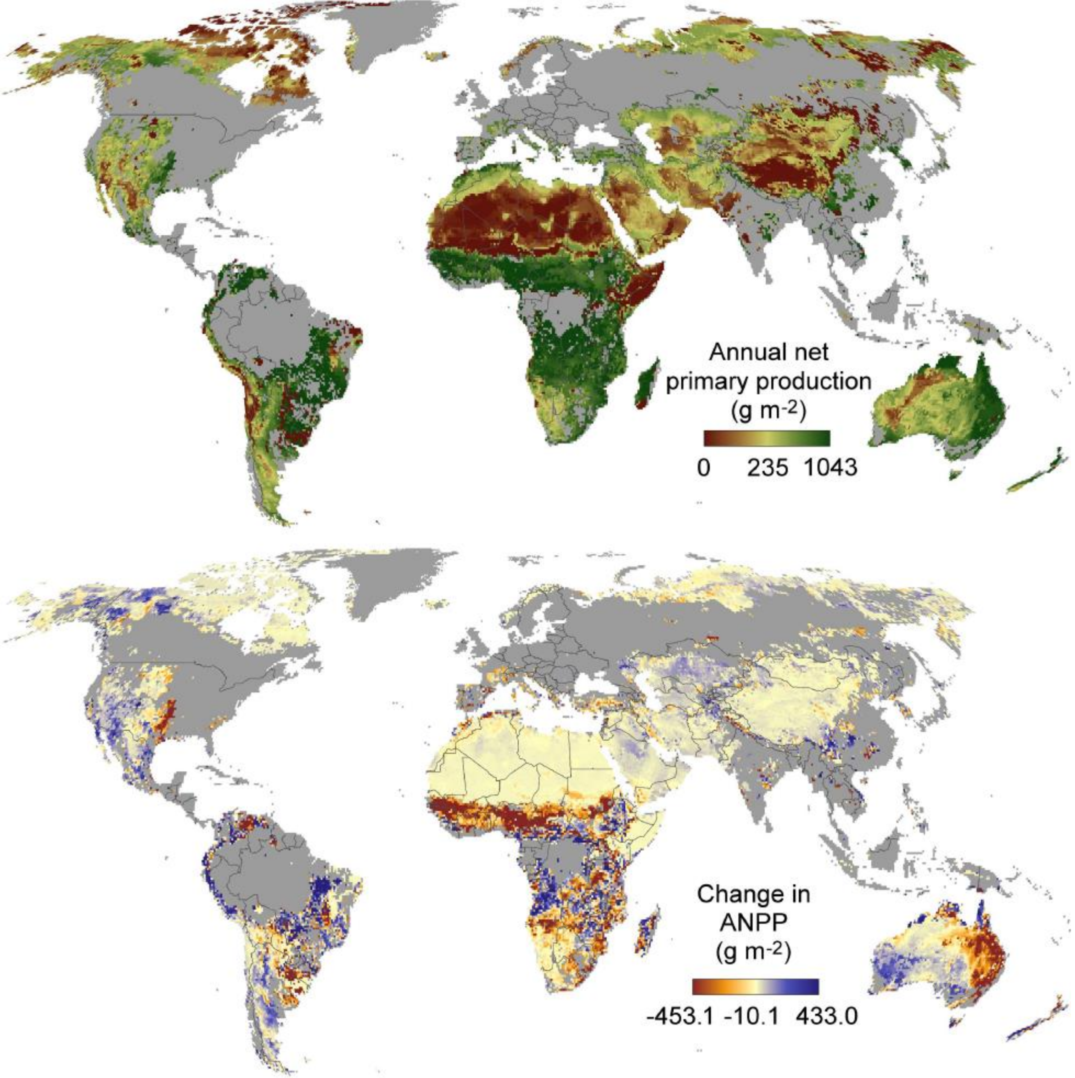
The University of Queensland Australia | QAAFI Queensland Alliance for Agriculture and Food Innovation
Colorado State University
GEOGLAM RAPP Rangeland and Pasture Productivity
CSIRO

Part 1:
Presentation of the model

Steve Mann/ILRI

G-range - A global ecosystem model for rangelands

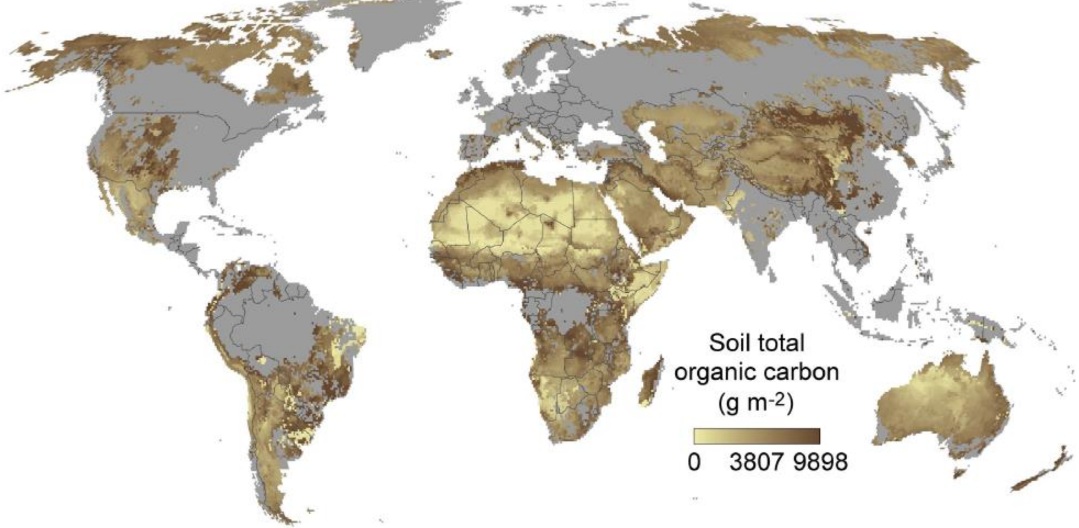
- **A joint effort between CSU, CSIRO, ILRI and CCAFS**
- **Ecosystem model** for grasslands, savannas, drylands, and other grazing lands
- **Moderate complexity**
- Simulate and forecast ecosystem dynamics in response to **climatic and management scenarios**
- From **global to local** scales
- Built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

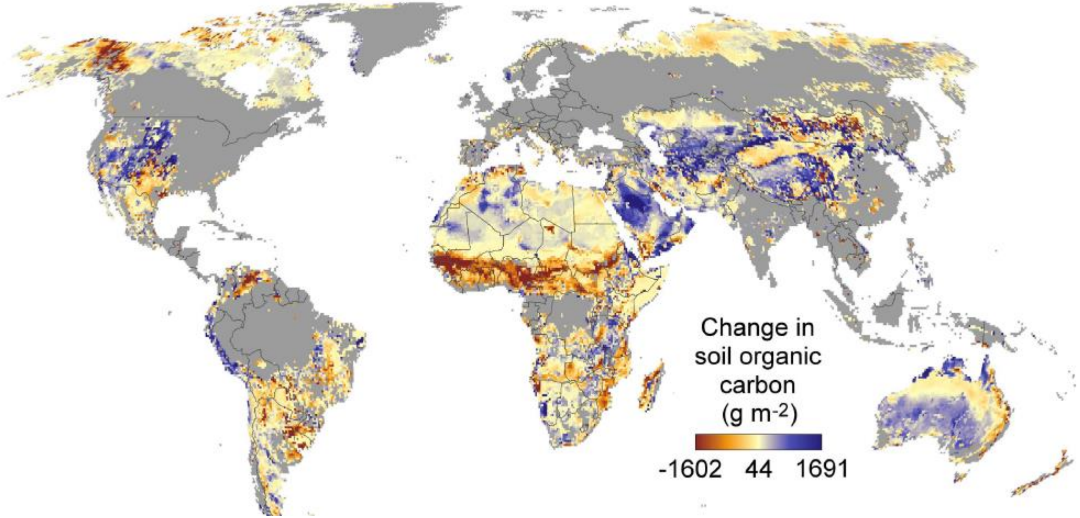


Some results from G-range runs

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)

Steve Mann/ILRI

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

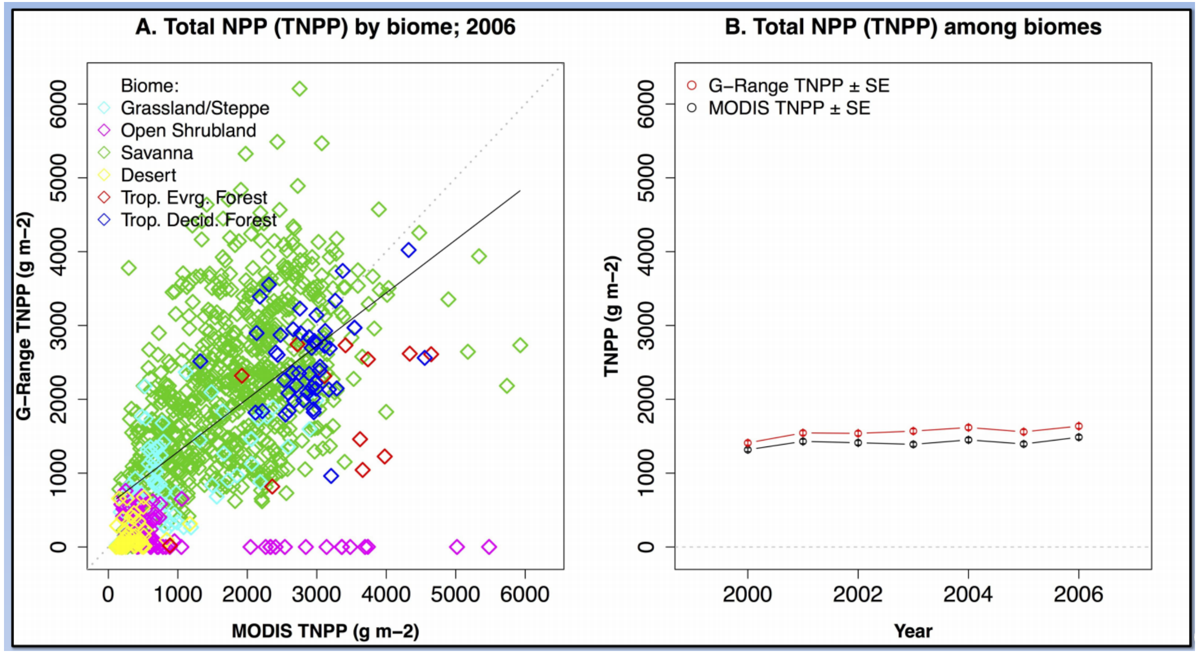


Figure 3. G-range regional **validation** using MODIS total NPP for **East Africa** and the **Greater Horn of Africa**.

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

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

Advantages:

- Predictive capability (forecasting or scenario testing)
- Richness and depth to the results
- Data on plant functional groups

Drawbacks:

- Volume of data
- Time

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Advantages:

- Same as approach 2
- Limit error around the estimates over time

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G-range used to calibrate the RS-based model

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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


Niger (Steve Mann/ILRI)

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

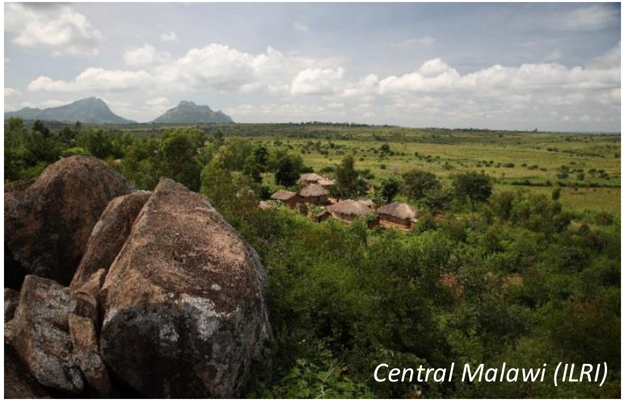
- **RS models, ecosystems models and field observations can benefit each other** in many ways (for models parametrisation, validation, etc.).

- 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


Central Malawi (ILRI)

Other references mentioned during this presentation

Century: NREL (Natural Resource Ecology Laboratory). 2000. Century 4 Homepage. Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, Colorado, USA. Online: http://www.nrel.colostate.edu/projects/century/reference2.htm

SAVANNA: NREL (Natural Resource Ecology Laboratory). 2007. SAVANNA – Readme: Publications and reports using the SAVANNA model. Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, Colorado, USA. Online: http://www.nrel.colostate.edu/projects/savanna/

Global Land Cover Characterization: Global Land Cover Characterization, Version 2. Available from the online source: Global Land Cover Characterization, US Department of the Interior, US Geological Survey, http://edc2.usgs.gov/glcc/glcc.php

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

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.

finer scales

Biomes for which parameters were provided that control ecosystem dynamics.