'Tree-Grass': Proposal for a NASA Terrestrial Ecology Field Activity in Savannas and Mixed Tree-Grass Ecosystems

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INTRODUCTION

We describe a proposal for a NASA Terrestrial Ecology field activity that will enhance remote sensing and earth system modelling capabilities in ecosystems characterized by mixtures of woody and herbaceous species (‘tree-grass’ systems). The proposed “Tree-Grass” (TG) program will transform our ability to use satellite data and earth system models to assess the current and future role of tree-grass systems in the earth system, and their future in the face of changing climate, changing land use and human population growth. In doing so we will enhance our ability to manage tree-grass ecosystems for sustainability, food security and economic wellbeing.

Draft white paper and more information available at: http://www.nrel.colostate.edu/projects/srs/

(2) Tree-Grass Concepts

(3) Tree-Grass Science Framework

(4) Tree-Grass Strategies

(5) Tree-Grass Education & Outreach

Figure 1. Global distribution of tree-grass mixtures based on classification of MODIS VCF data

The MODIS VCF product (Hansen et al., 2003) provides relative cover estimates for ‘trees’, herbaceous’ & bare soil components. Tree-grass mixtures were assessed using fixed structural criteria (satisfying 1% < tree cover < 50% and grass cover > 25%). The sample area (1 km × 1 km) was selected to maximize areas with mid, high and low mountain regimes using a mean annual temperature threshold of -5°C (Woodward et al., 2004). The temperature threshold is necessary because, in these colder regions, under-story communities are dominated by general fulic and sub-shrub, not grasses, that TG resolves into woody and herbaceous mixtures. Delicate VCF data on bare soil and shrub, tree-grass mixtures are underestimated in some areas (e.g. large hectares in Central Australia).

Figure 2. Conceptual diagram for tree-grass and savanna systems, showing drivers of change, ecosystem processes and provision of goods and services (center), interactions between global change, showing drivers of change, ecosystem processes and provision of goods and services (center). The proposed "modelling capabilities in ecosystems characterized by tree-grass activity (right)."

Figure 3. Tree-Grass science framework showing key science questions, TG Science Themes, Earth Observation (EO)-Science Focal Areas and emergent Tree-Grass applications

Table 1. Global tree-grass areas estimated using structural criteria (tree and grass cover and bare soil)

<table>
<thead>
<tr>
<th>Continent</th>
<th>Total Land Area</th>
<th>Tree-Grass Area</th>
<th>% Tree-Grass</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>23.2 x 10⁶</td>
<td>07.6 x 10⁶</td>
<td>32.8</td>
</tr>
<tr>
<td>South America</td>
<td>28.7 x 10⁶</td>
<td>07.6 x 10⁶</td>
<td>32.8</td>
</tr>
<tr>
<td>Europe</td>
<td>17.5 x 10⁶</td>
<td>07.6 x 10⁶</td>
<td>32.8</td>
</tr>
<tr>
<td>Asia</td>
<td>33.7 x 10⁶</td>
<td>07.6 x 10⁶</td>
<td>32.8</td>
</tr>
<tr>
<td>Australia</td>
<td>39.7 x 10⁶</td>
<td>07.6 x 10⁶</td>
<td>32.8</td>
</tr>
</tbody>
</table>

(1) The Global Importance of Tree-Grass Mixtures

Conventional biome-based vegetation maps tend to under-emphasize tree-grass mixtures. Structurally-based analysis indicates that more than 35% of global land area can be considered “tree-grass”.

Figure 4: TG Intensive and Distributed field sites provide opportunities for detailed process-based studies with global sampling of diverse tree-grass systems

Figure 6. Tree-grass education and outreach programs

GGP = Graduate Research Fellowship Program
E4S = Earth System Science Summer Schools
TTAP = Technology Transfer & Adoption Program

Figure 7. Globally diverse tree-grass vegetation associations, with regions typically classified as savanna in the lower row

ACKNOWLEDGMENTS

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FIGURE LEGENDS

Figure 3: Tree-Grass science framework showing key science questions, TG Science Themes, Earth Observation (EO)-Science Focal Areas and emergent Tree-Grass applications

Figure 4: TG Intensive and Distributed field sites provide opportunities for detailed process-based studies with global sampling of diverse tree-grass systems

Figure 5: Proposed implementation strategy for the Tree-Grass research program

Figure 6. Tree-grass education and outreach programs

Figure 7. Globally diverse tree-grass vegetation associations, with regions typically classified as savanna in the lower row

TRE-GRASS KEY QUESTIONS

- How are climate change and land-use altering the structure, function and productivity of tree-grass systems at landscape, regional and global scales? (“Global Change Processes”)
- How will changes in tree-grass structure, function and sustainability into the future? Conversely, what is the potential for global change mitigation, and can human populations in tree-grass regions benefit from this potential? (“Goods and Services”)