Degradation in Southern Central Africa

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http://www.inform.umd.edu/geog/LGRSS/Projects/degradation.html

Degradation in Southern Central Africa

Outline

1. DETECTION OF DEGRADATION
   - Potential land cover of S/C Africa
   - Actual conditions in S/C Africa
   - Inter-annual variability
   - Degradation
2. ASSESSMENT OF SEVERITY & CAUSES OF DEGRADATION
   - Biophysical conditions
   - Human impacts
3. CONCLUSIONS - BIOPHYSICAL & HUMAN DIMENSIONS
   - Southern Central Africa potential as a study region
   - Assess degradation in terms of resource supply to humans
   - Hierarchical structure to impacts
   - Dynamic relationships

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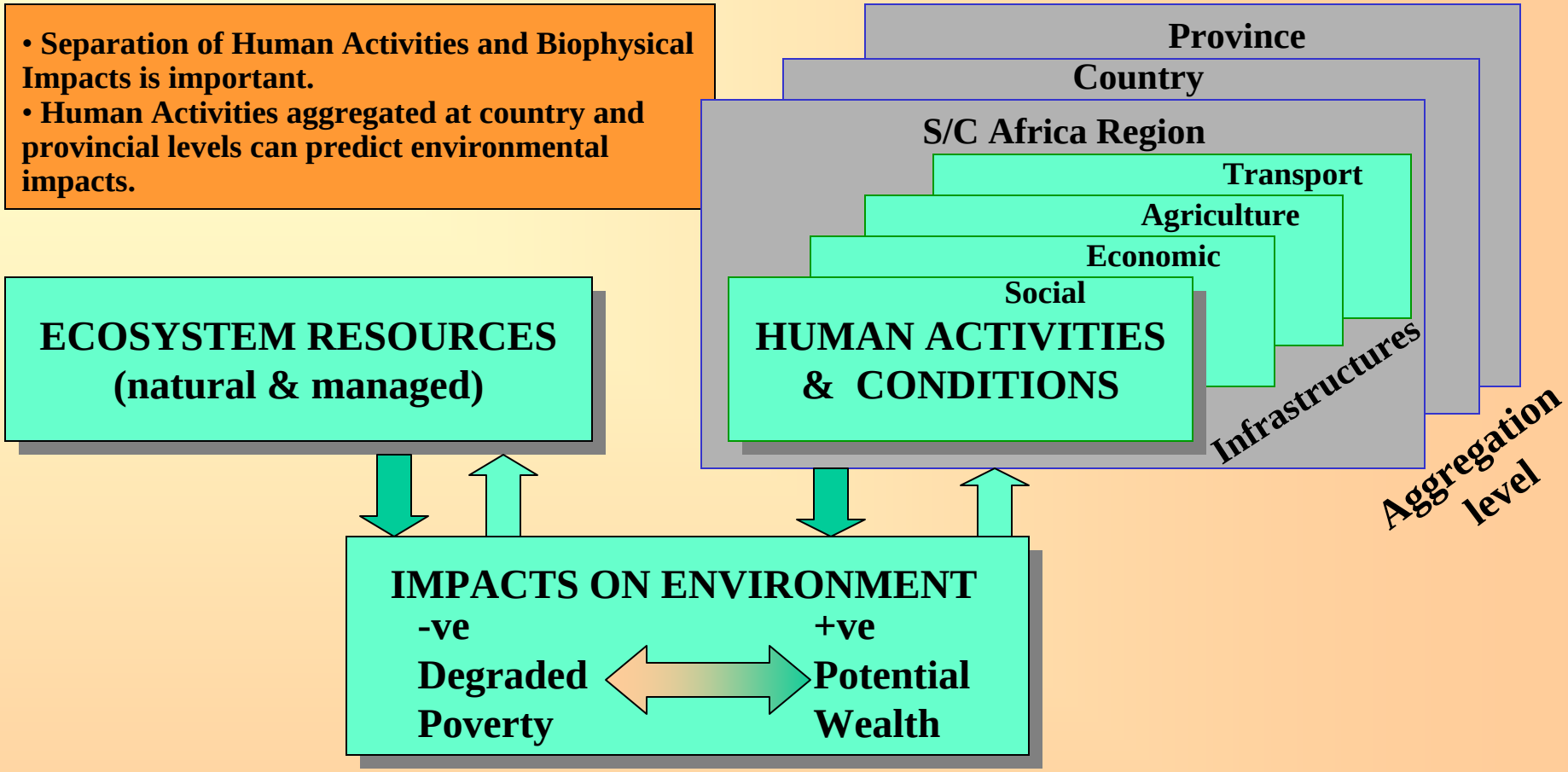
1. DETECTION OF DEGRADATION

Potential land cover of S/C Africa

– EOS DIS-Cover or White vegetation map

2. DEGRADATION AND DEFORESTATION IN SOUTHERN CENTRAL AFRICA

• **Separation of Human Activities and Biophysical Impacts is important.**
• **Human Activities aggregated at country and provincial levels can predict environmental impacts.**



• **S/C Africa region ideal for human/environment interaction study**
• **Map resources used by humans, not only biophysical variables**
• **Environmental impacts are well characterized by Human Activities & Conditions**
• **Resources, Impacts, and Human Activities monitored - noting aggregation level**
• **Integrated Assessment should be structured by aggregation level**

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1. DETECTION OF DEGRADATION

Actual conditions in S/C Africa

LAND COVER

- – EOS DIScover actual veg or Defries 1km land cover map
- – Earth Sat Geo-Cover TM mosaic for S/C Africa
- – Selected TM image(s)

BIOMASS

- –Prince & Goward biomass map or DeFries % tree cover map

PRODUCTIVITY

- –GLO-PEM NPP
  - –Average
  - –Time sequence

ENERGY BALANCE

- –SSiB transect through Zimbabwe

LAND COVER
EOS DIScover actual veg or Defries 1km land cover map

- **Actual veg cover map**

Land Cover - Earth-Satellite Corporation GeoCover Mosaic From Landsat Thematic Mapper Data

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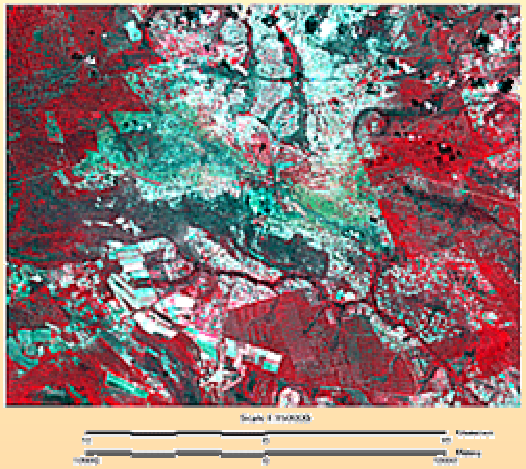
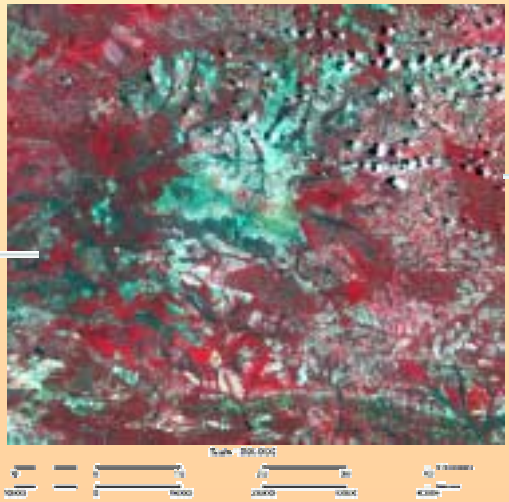
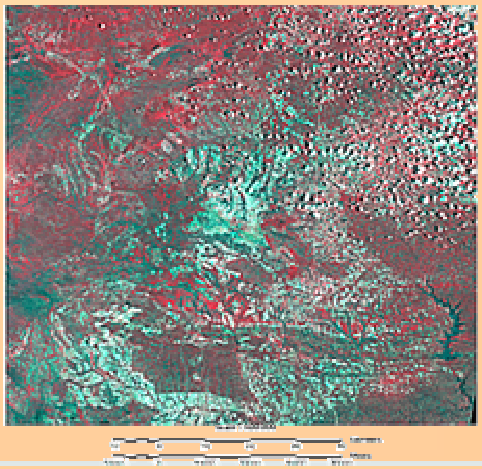
Degradation at Kabwe, Zambia

- **1986 17 Nov TM**







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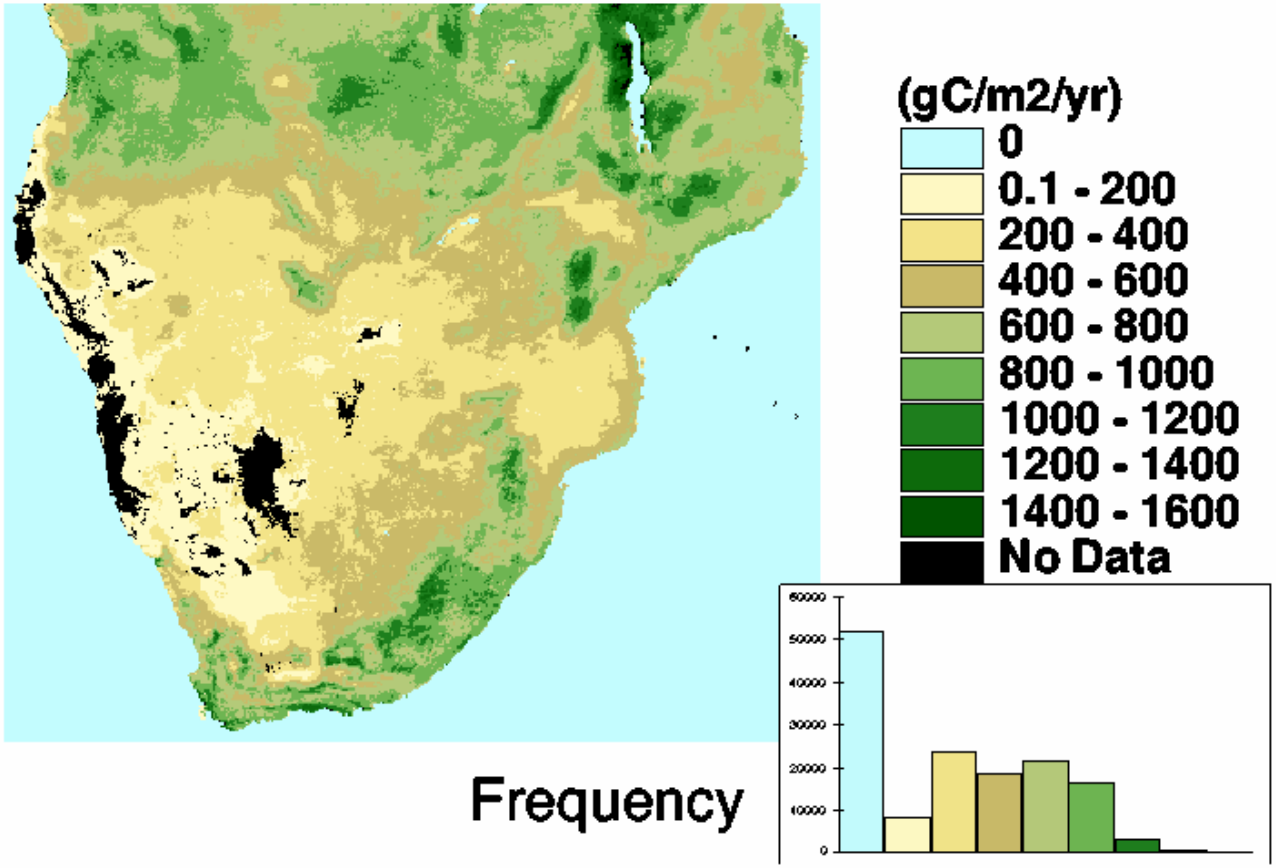
Actual Conditions - Biomass

–**Prince & Goward biomass map or DeFries % tree cover map**

Actual Conditions - Productivity

Actual NPP from GLO-PEM 1982-89



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1. DETECTION OF DEGRADATION

Actual conditions - Energy Balance

–Key Los AVHRR land surface condition images
–Results for Zimbabwe transect from SSiB simulations

1. DETECTION OF DEGRADATION

Inter-annual variability

–Coefficient of variation of inter-annual NPP

1. DETECTION OF DEGRADATION

Inter-annual variability

–Time sequences of NPP for selected polygons

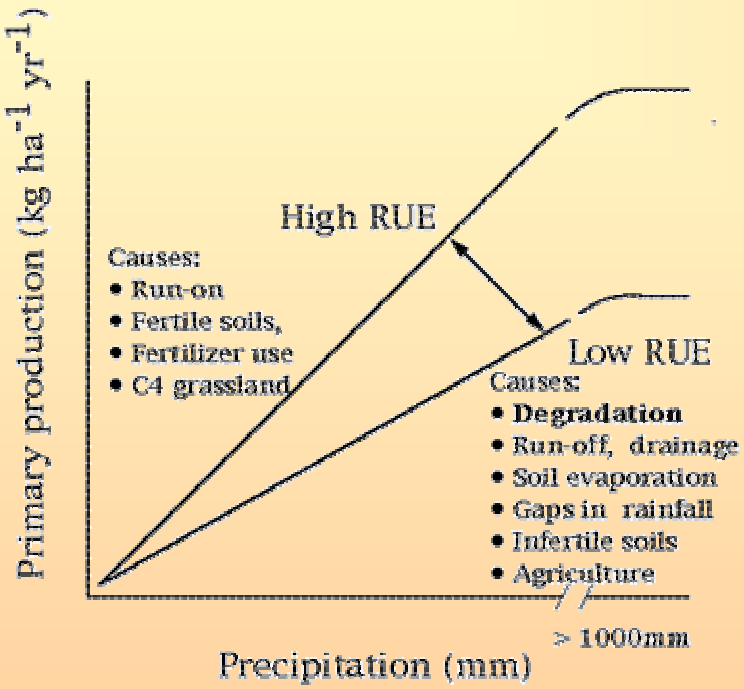
1. DETECTION OF DEGRADATION

Degradation

–RUE
- •Schematic (old)
- •Normalizing effect of rainfall (old)
- •S/C Africa RUE map (new)
- •Areas of agreement - 2 slides (old)
- •Global RUE (old)
- •Willmott Moisture index global map (old)

–Potential-Actual NPP
- •CEVSA schematic (new)
- •Veg cover/Veg condition schematic (new)
- •Comparison of Pot-Act and RUE for S/C Africa

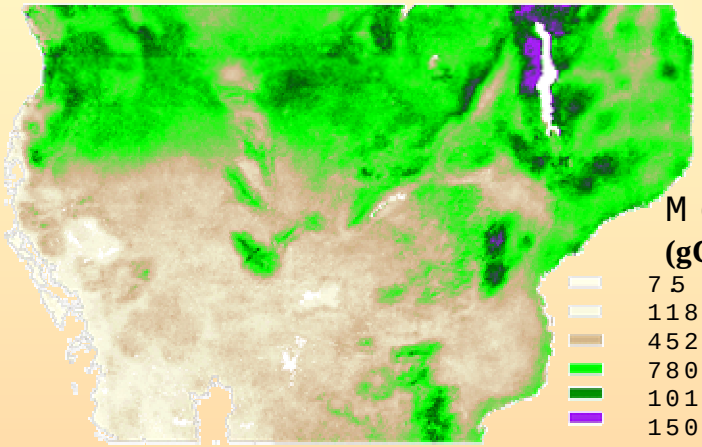
Outline of Rain Use Efficiency Theory



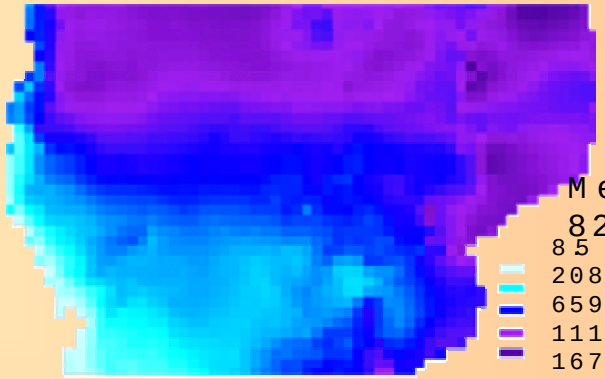
- **RUE = P_n / P_r = P_n / (T + E + I) + (D + R) + (ΔW + ΔWp)**
- **P_n= net primary production (NPP)**
- **P_r = precipitation** **All in volume water/time.**
- **T = transpiration**
- **E = soil evaporation**
- **I = evaporation from wet canopy**
- **D = drainage from the root zone**
- **R = run-off**
- **ΔW = change in water content of the soil**
- **ΔW_p = change in water content of the vegetation**

Normalizing effect of rainfall on regional NPP

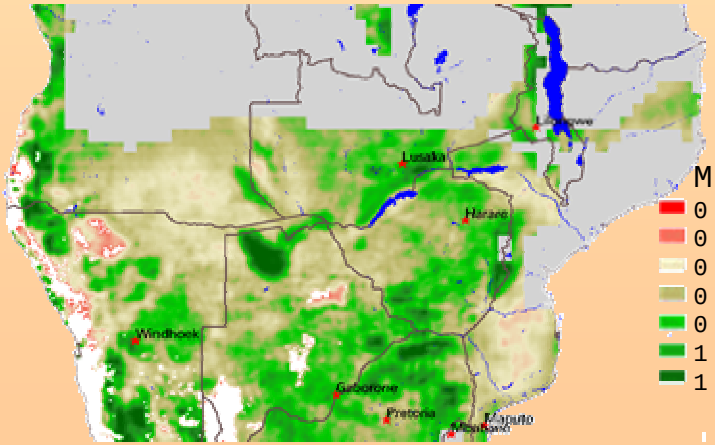
Mean NPP



Mean precipitation



Mean RUE



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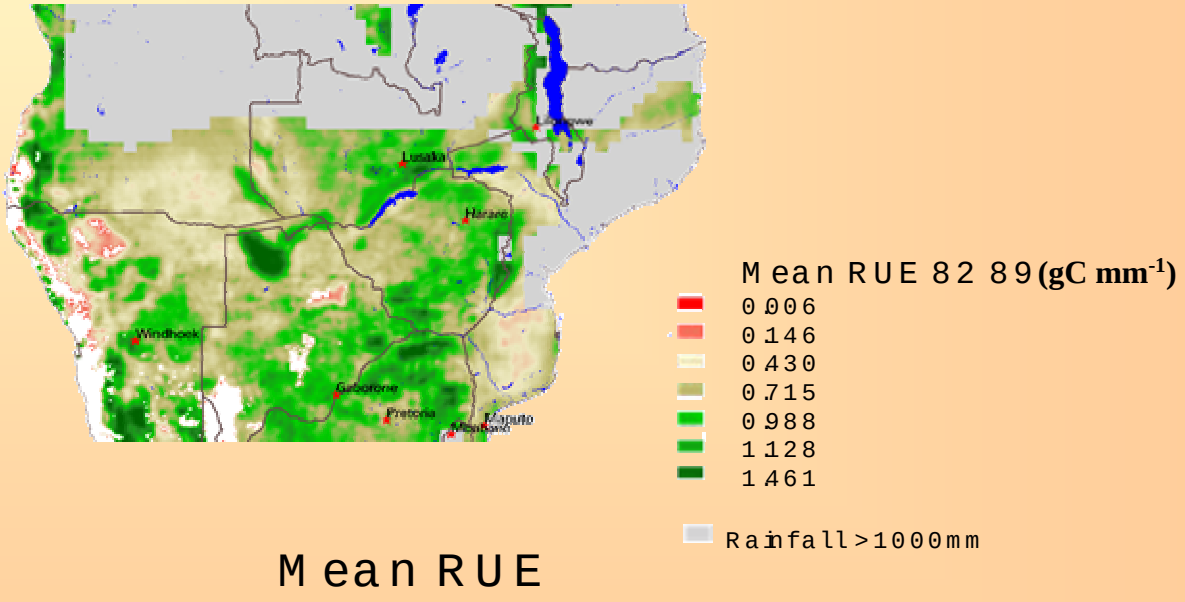
Mean Rain Use Efficiency



Mean RUE

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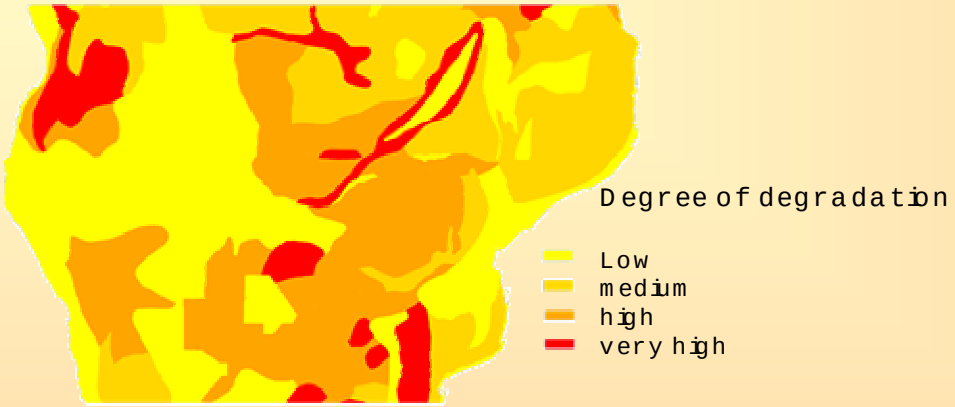
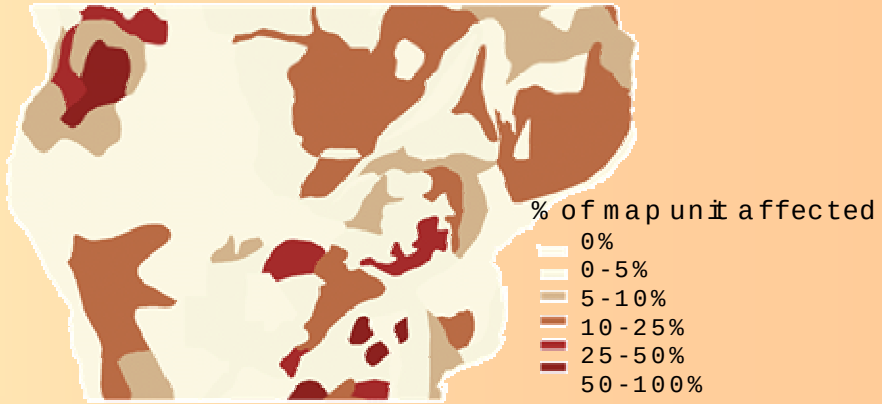
Areas of agreement, low RUE

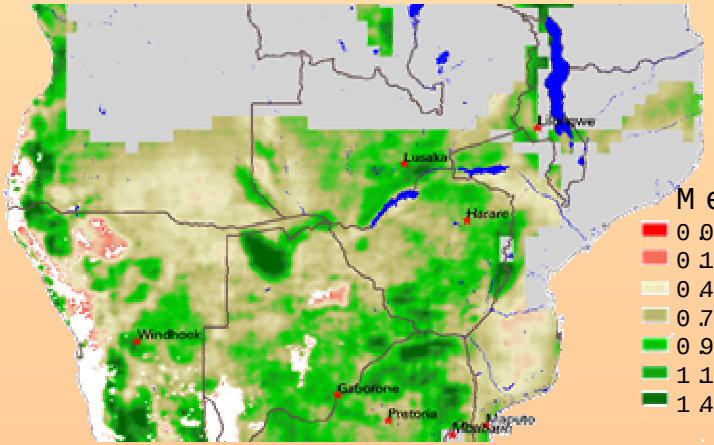
Degree of human induced soil degradation



Extent of human induced soil degradation



1. **Congo Shaba Province**
2. **Zambia Copperbelt**
3. **Botswana NE, Mkgadikgadi**
4. **Nambia N Windhoek**
5. **RSA N of Mbabane, Pretoria**
6. **Zimbabwe N & E borders**
7. **Angola Huambo**



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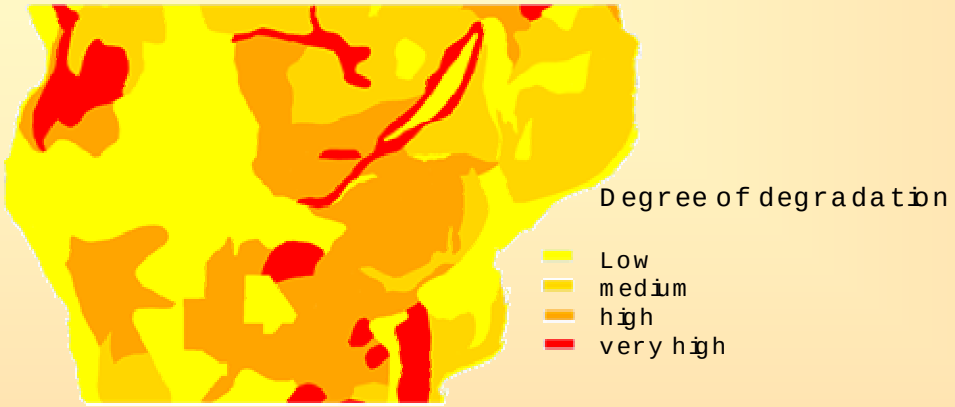
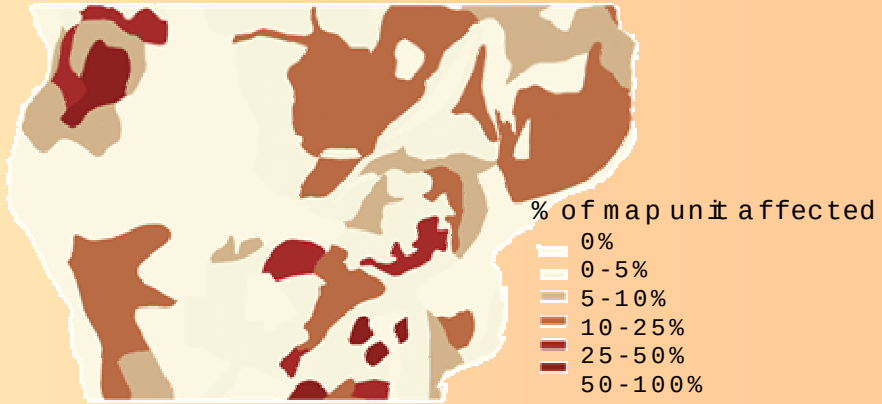
Areas of agreement, high RUE

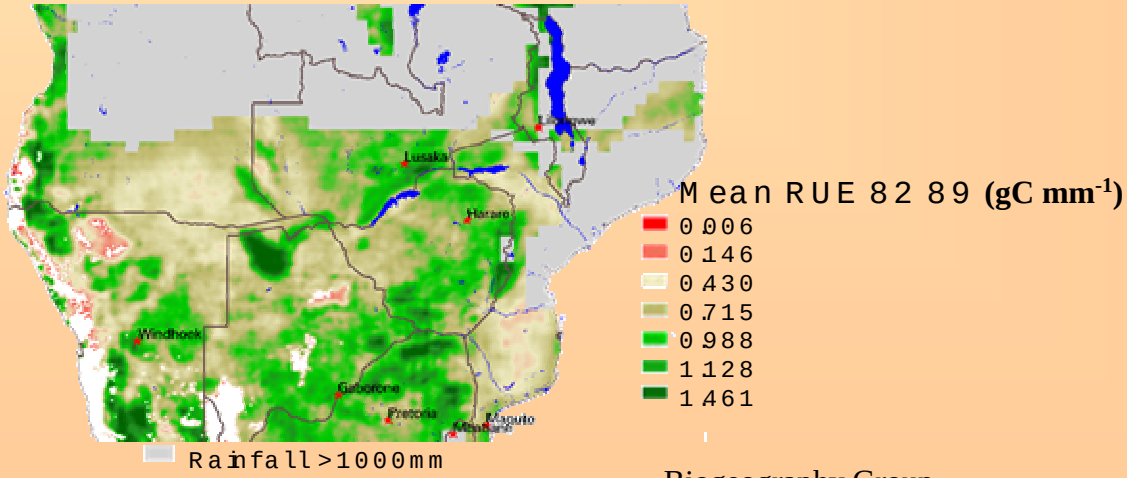
Degree of human induced soil degradation



Extent of human induced soil degradation



1. **Malawi N Province**
2. **RSA Nylsstroom Transvaal, N Drakensberg**
3. **Zimbabwe Metabeleland**
4. **Namimia E of Windhoek**



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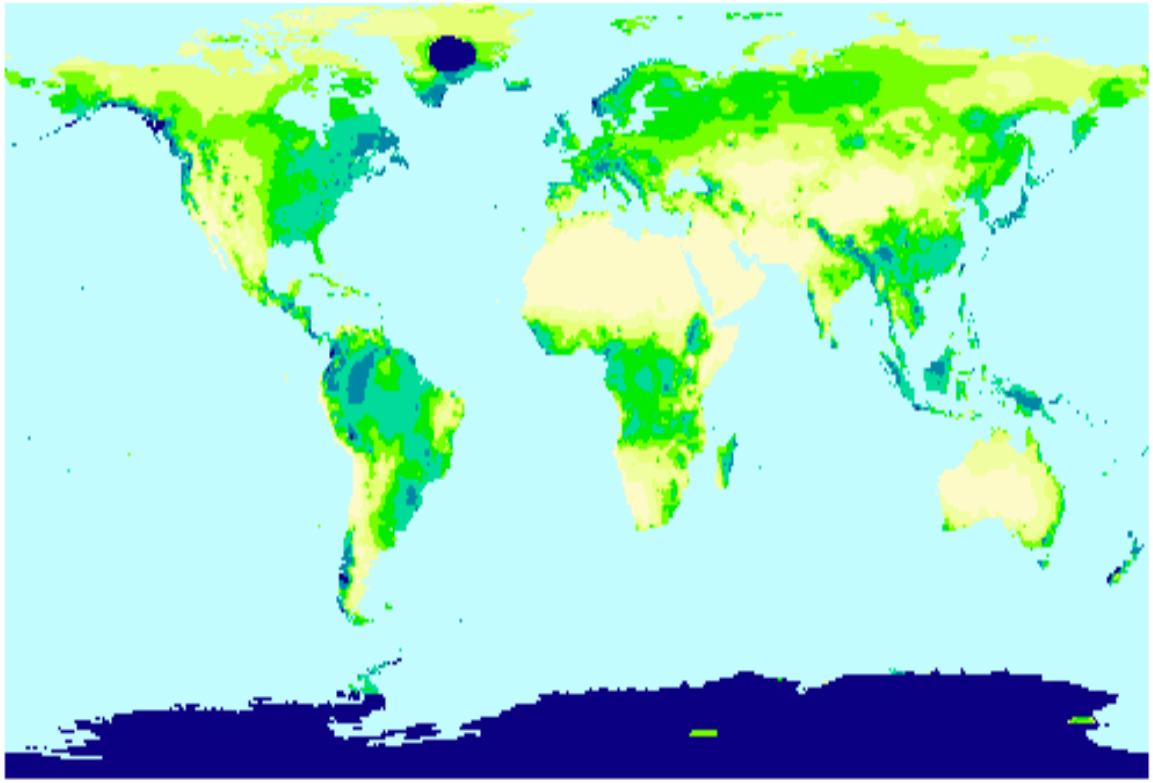
Willmott and Feddema's Moisture Index



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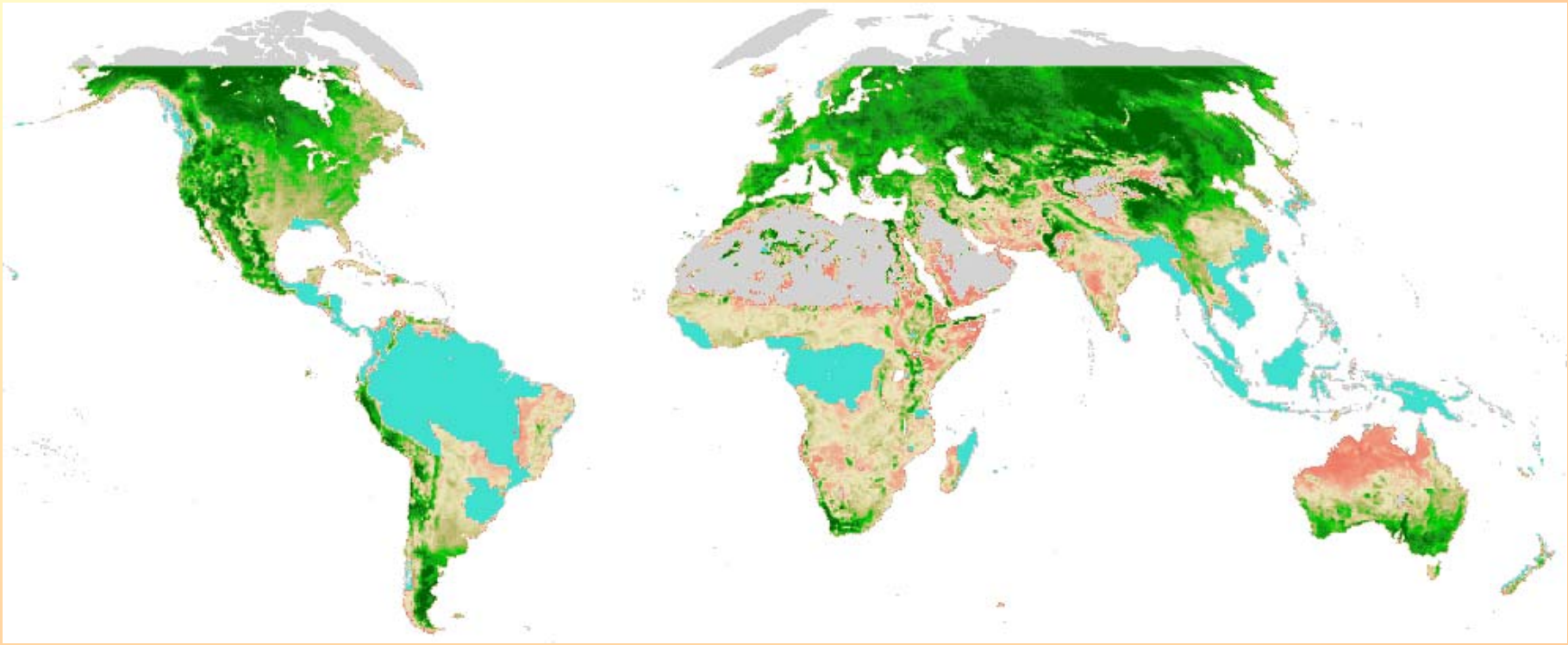
Global RUE Image ($gC\ mm^{-1}$)



No estimate from GLO-PEM

Rainfall > 1500mm

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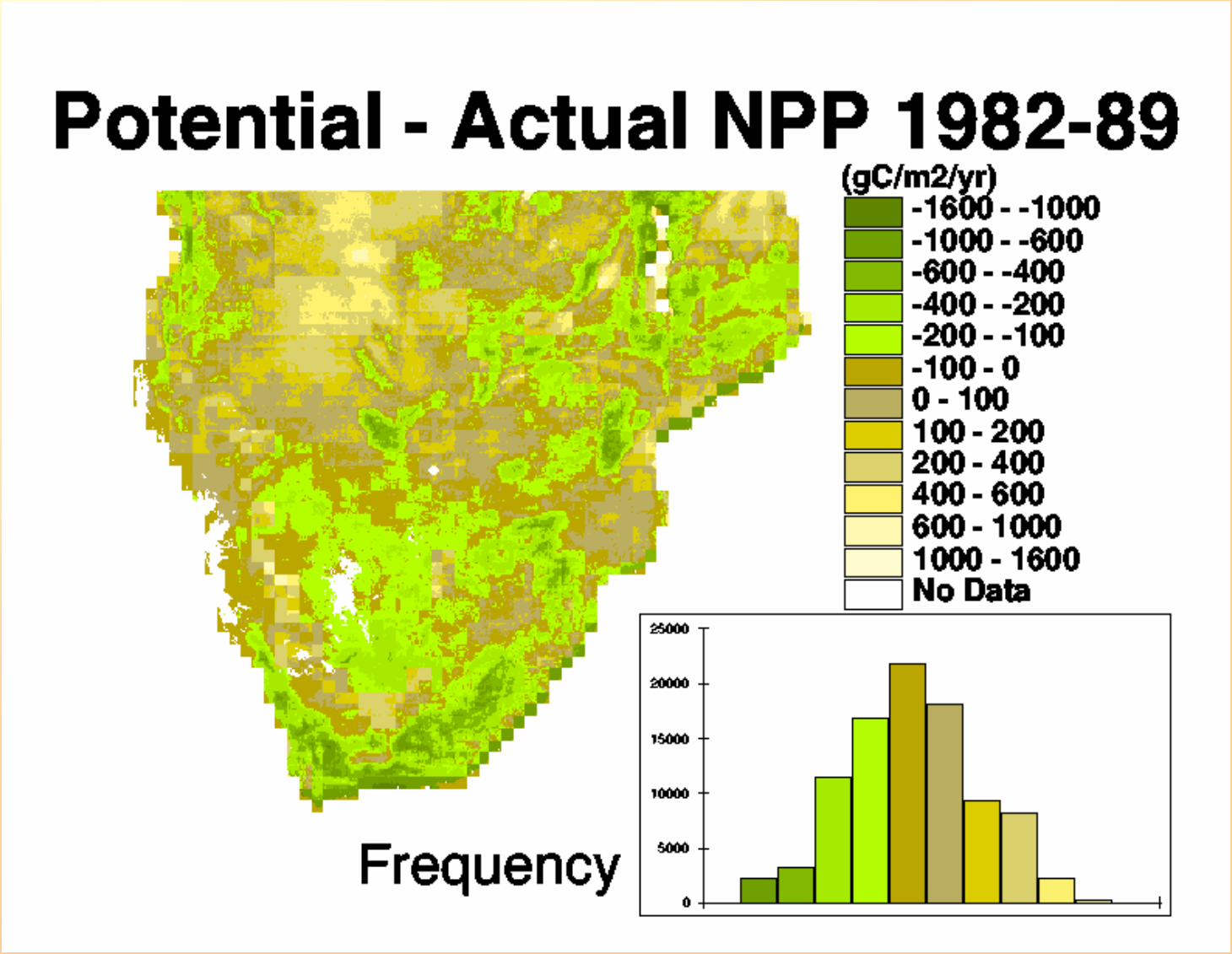
Comparison of Potential and Actual NPP, Difference

New CEVSA Schematic

Comparison of Potential and Actual NPP, Difference

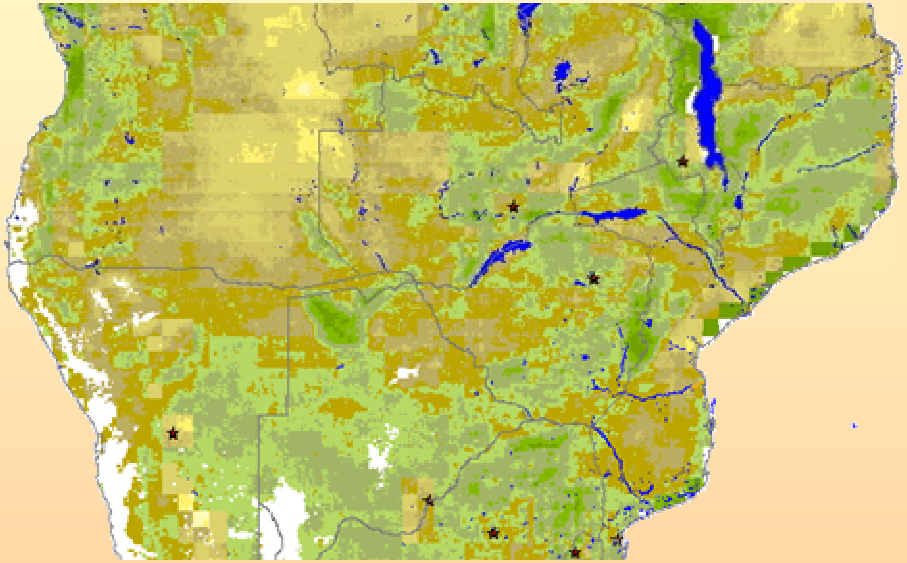
- **Veg cover/Veg condition schematic (new)**

Comparison of Potential and Actual NPP, Difference



Comparison of (Potential – Actual) NPP and RUE

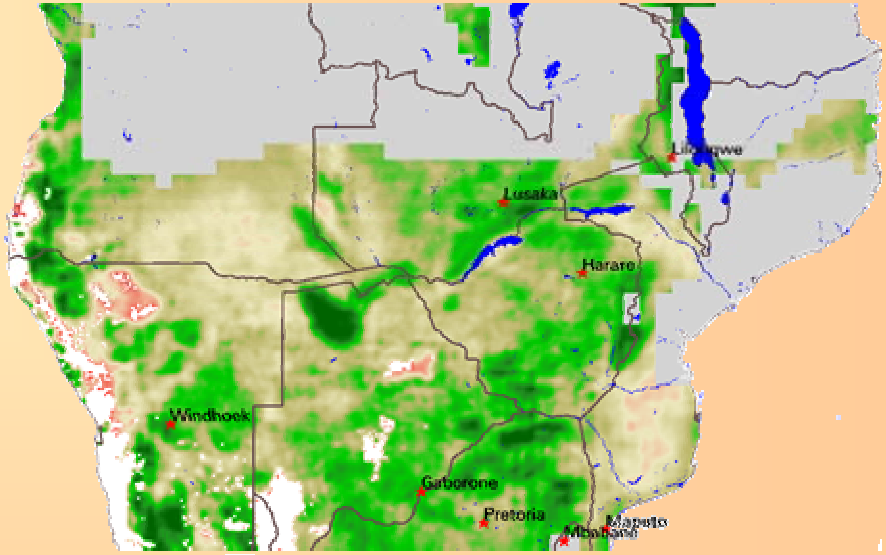
Potential – Actual NPP



(gC/m2/yr)
-1600 - -1000
-1000 - -600
-600 - -400
-400 - -200
-200 - -100
-100 - 0

0 - 100
100 - 200
200 - 400
400 - 600
600 - 1000
1000 - 1600
No Data

Rain Use Efficiency



Rainfall>1000mm

Mean RUE 82 89 (gC mm^{-1})
0.006
0.146
0.430
0.715
0.988
1.128
1.461

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2. ASSESSMENT OF SEVERITY & CAUSES OF DEGRADATION

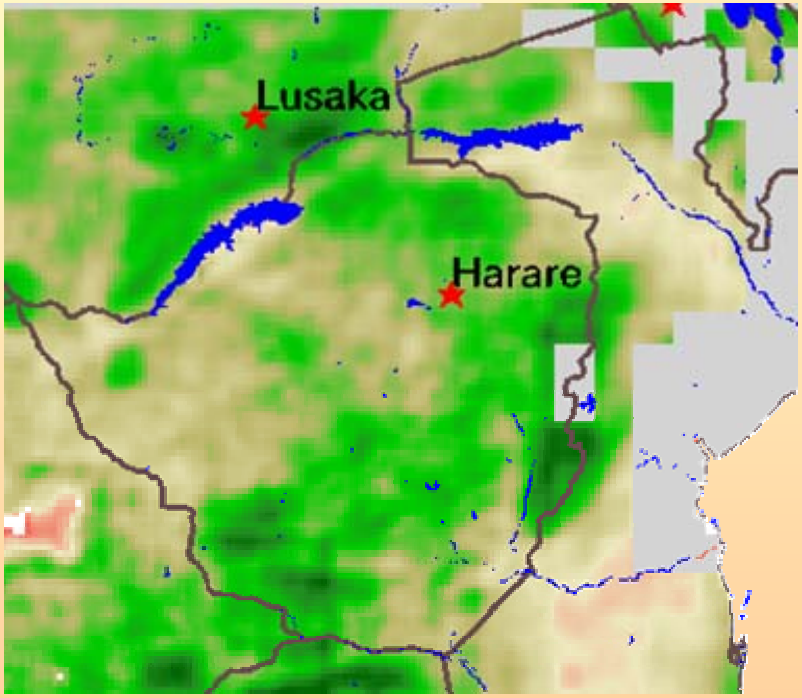
Biophysical conditions

Several maps of contrasts between different areas

- **Biomass? Possibly use GeoCover mosaic?**
- **NPP**
- **RUE and Pot-Act NPP**
- **Energy balance?**

Comparison of RUE and (Potential – Actual) NPP, Zimbabwe

Rain Use Efficiency

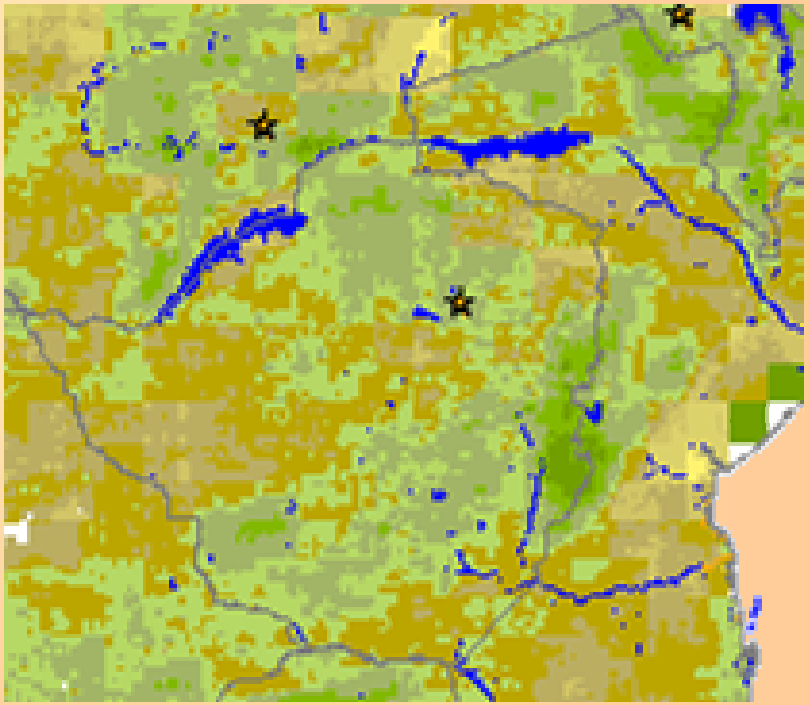


Rainfall > 1000mm

Mean RUE 82 89 (gC mm^{-1})

0.006	
0.146	
0.430	
0.715	
0.988	
1.128	
1.461	

Potential - Actual NPP



(gC/m2/yr)

-1600 - -1000	0 - 100
-1000 - -600	100 - 200
-600 - -400	200 - 400
-400 - -200	400 - 600
-200 - -100	600 - 1000
-100 - 0	1000 - 1600
	No Data

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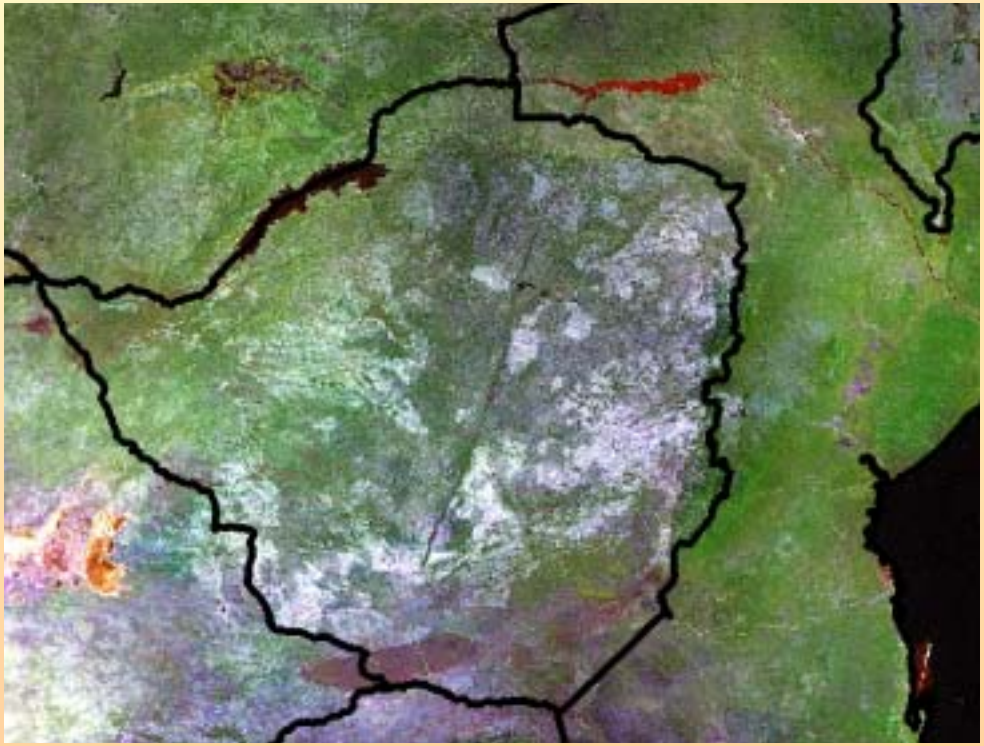
2. ASSESSMENT OF SEVERITY & CAUSES OF DEGRADATION
HUMAN IMPACTS

Several maps and appropriate stats of contrasts between different areas

- **Arrange in a spatial hierarchy**

Africa Mosaic with Country Boundaries and Land Use, Zimbabwe

EarthSat Africa Mosaic



Land Use

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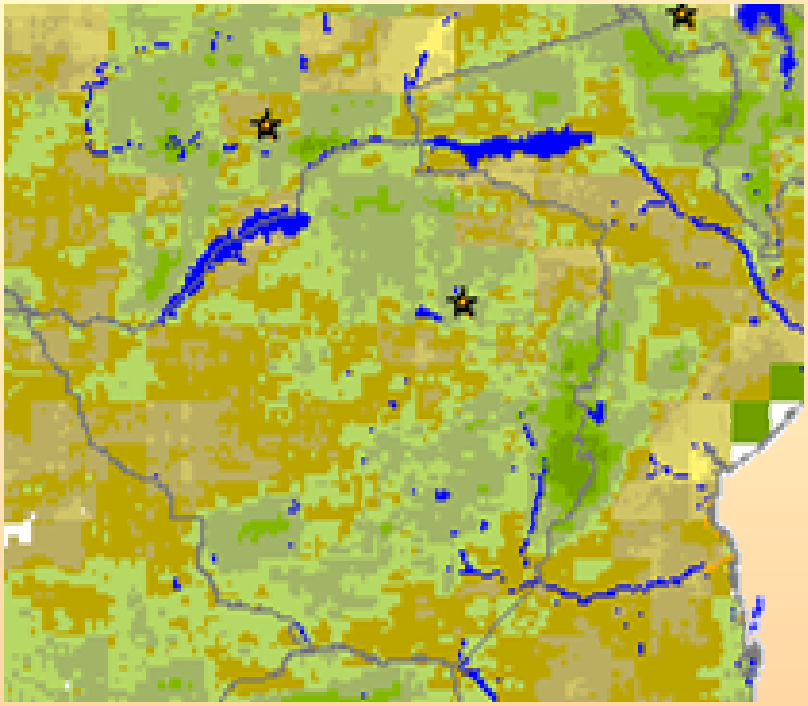
Comparison of Potential – Actual And Land Use in Zimbabwe



(gC/m2/yr)
-1600 - -1000
-1000 - -600
-600 - -400
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0 - 100
100 - 200
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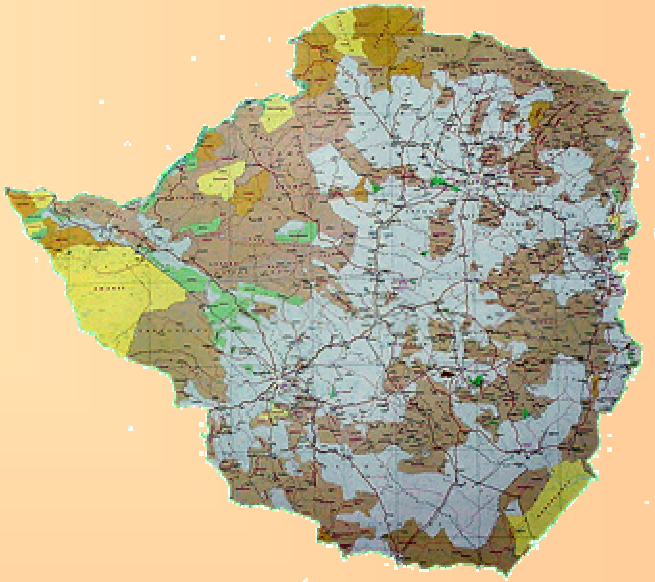
No Data



Commercial Lands
Communal Lands

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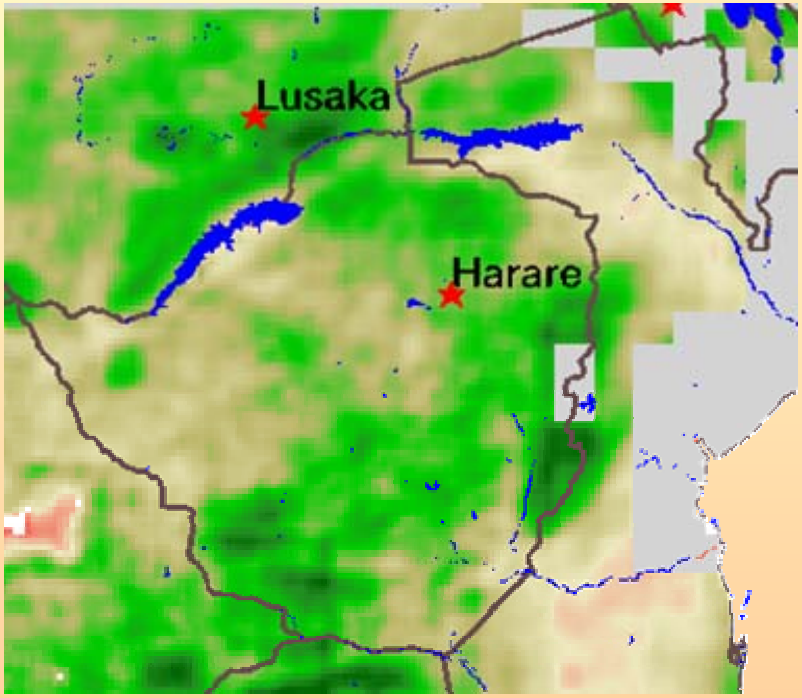
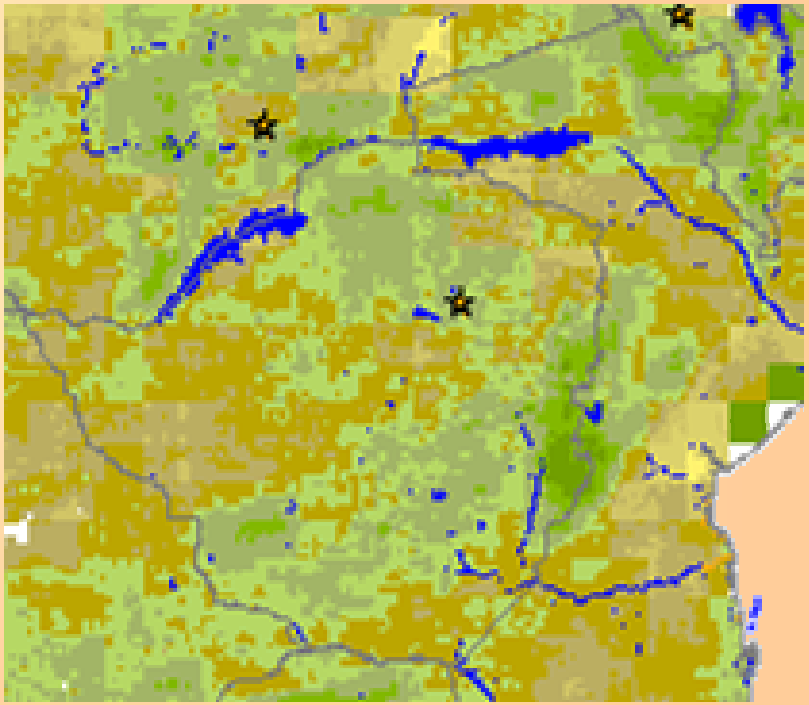
Comparison of Rue and Actual – Potential, Zimbabwe

Rain Use Efficiency



Potential - Actual NPP



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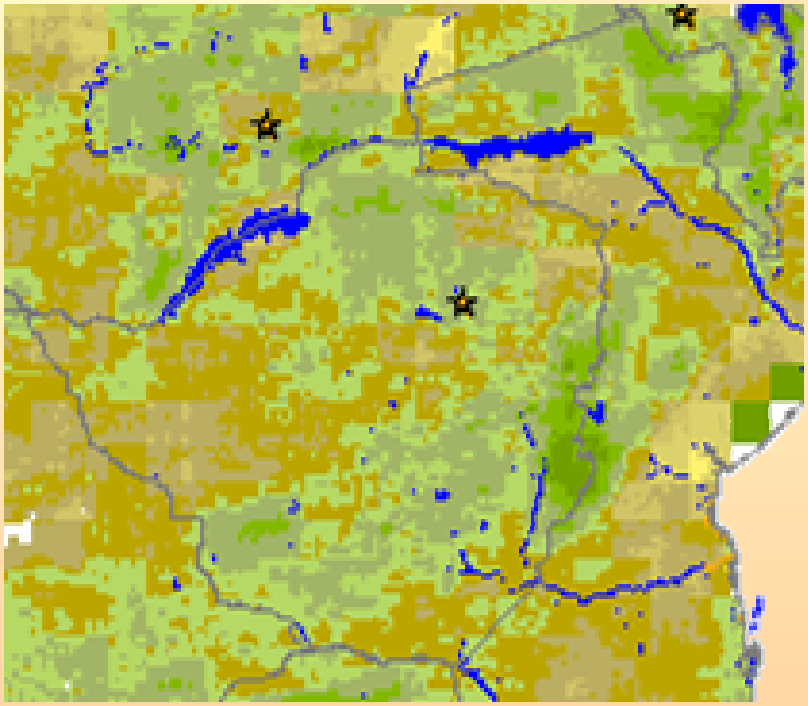
Comparison of Potential – Actual And Land Use in Zimbabwe



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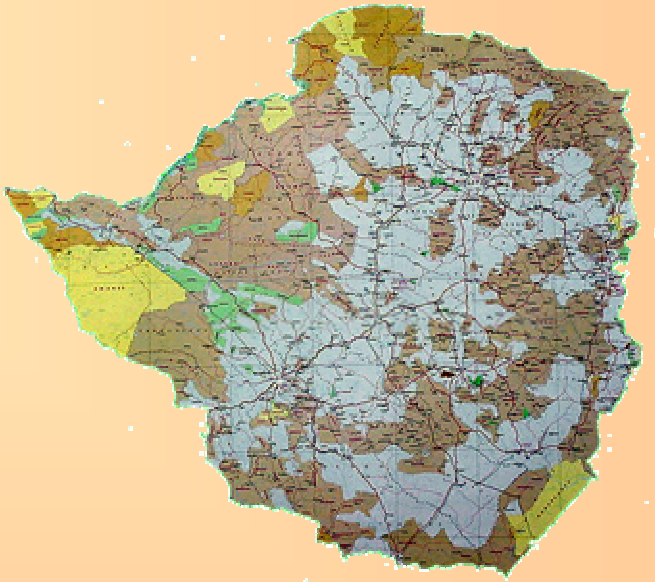

Commercial Lands
Communal Lands

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3. CONCLUSIONS - BIOPHYSICAL & HUMAN DIMENSIONS

- **Southern Central Africa - potential as a study region**
- **Assess degradation in terms of resource supply to humans**
- **Hierarchical structure to impacts**
- **Dynamic relationships**