Leveraging Satellite Technology to Advance Ecosystem Research & Applications

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Outline

- Remote Sensing Overview
- Current Tools
- New Directions
- Recent Results

Why consider remote sensing?

- Landscape classification
- Landscape change detection
- Identify resource properties
- …

What do land resource stewards and scientists need from remote sensing technology?

- Quantification
- Spatial resolution
- Knowledge of error

How do we advance ecosystem science and applications with remote-sensing technology?

- We must first determine variables that can be quantified remotely at an ecosystem scale and then determine measurement accuracy

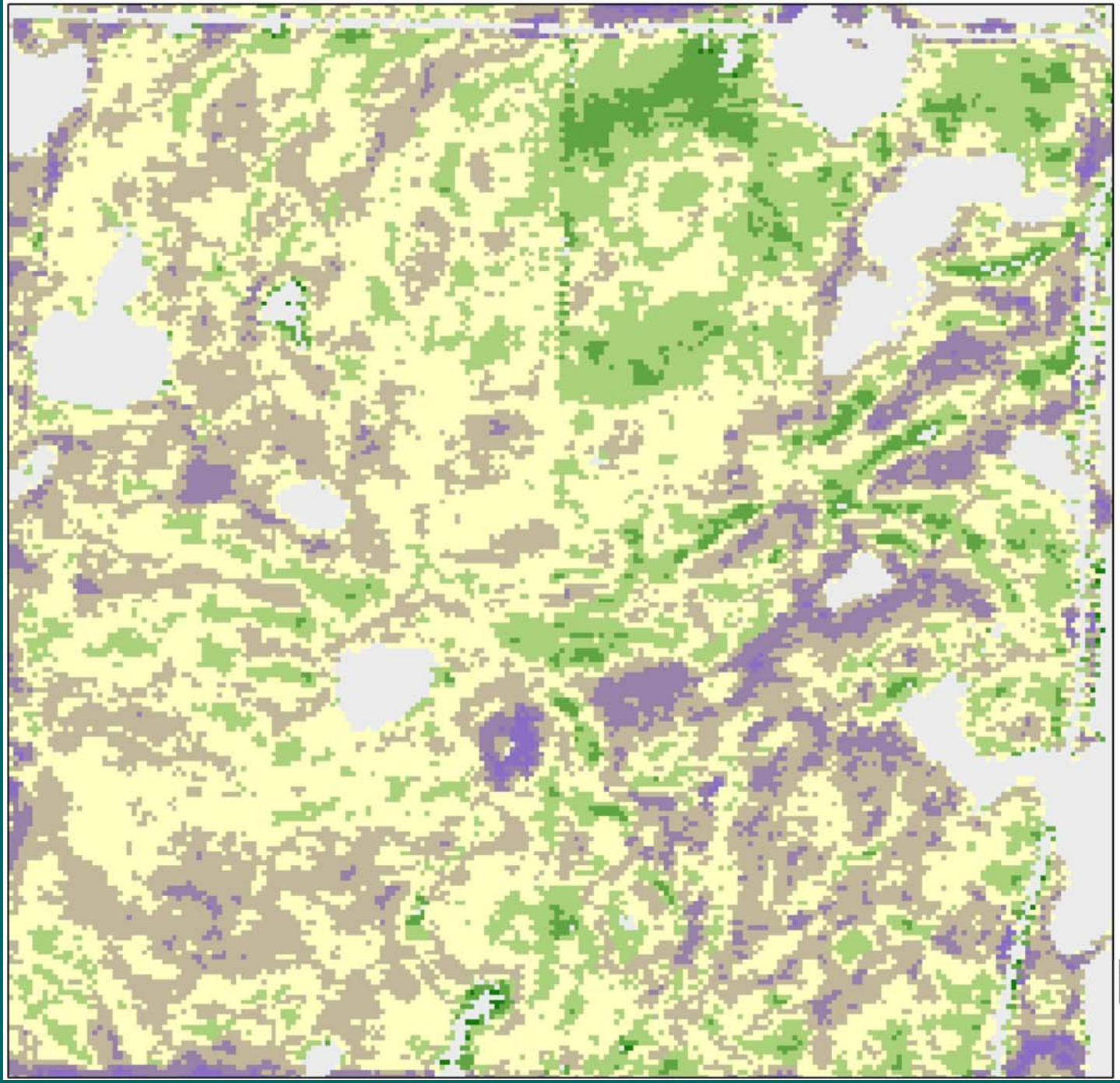
For Clarification….

- Geographically accurate, remote quantification of terrestrial properties is not trivial
- Ground survey data (using the human platform and eye as the sensor) will be more accurate than remote data available at meter-scale pixel sizes
  - Pixels sizes, swath widths, data constraints
- A popular satellite product commonly made available to the public through NASA is called NDVI, or Normalized Difference Vegetation Index
  - This does not quantify ecosystem properties—relative index

What does Normalized Difference Vegetation Index (NDVI) tell us?

(Asrar et al 1984; Hatfield et al. 1984; Todd and Hoffer 1998; Boelman et al, 2003; Schuerger et al, 2003 and others)

- Plant Production
- Plant Respiration
- Plant Greenness
- Plant Wetness
- Photosynthetically Active Radiation
- Leaf Area Index
- Plant Nitrogen
- Plant Biomass
- Plant Chlorophyll
- Plant Zinc Stress



Source: HyMap, Aug. 29, 2005

NDVI values

High

Low

Other

N

0 40 80 160 240 m

New directions-
Remote quantification

– Aboveground plant carbon: nitrogen ratio (C:N)

– Aboveground plant dry matter (kg ha^{-1} dry matter)

↓

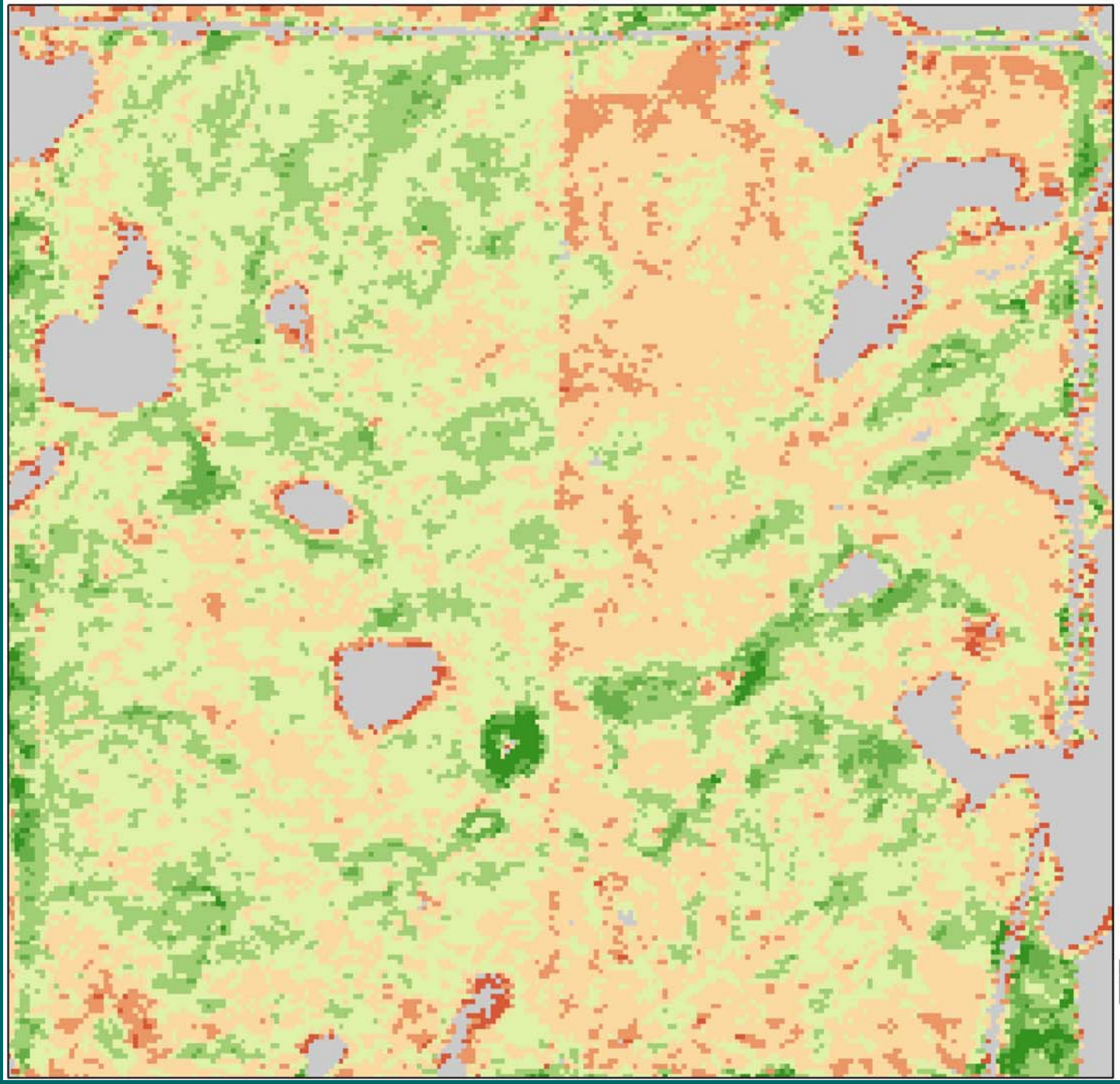
Aboveground plant carbon (kg C ha^{-1} dry matter)

Aboveground plant nitrogen (kg N ha^{-1} dry matter)

Methods Summary

- Experimentally manipulated range grasses to determine spectral response independent of plant water stress
- Performed field surveys
- Experiments involved integration of data at multiple scales- from plant to plot to pasture to landscape levels

(See Phillips et al. 2006 for details)



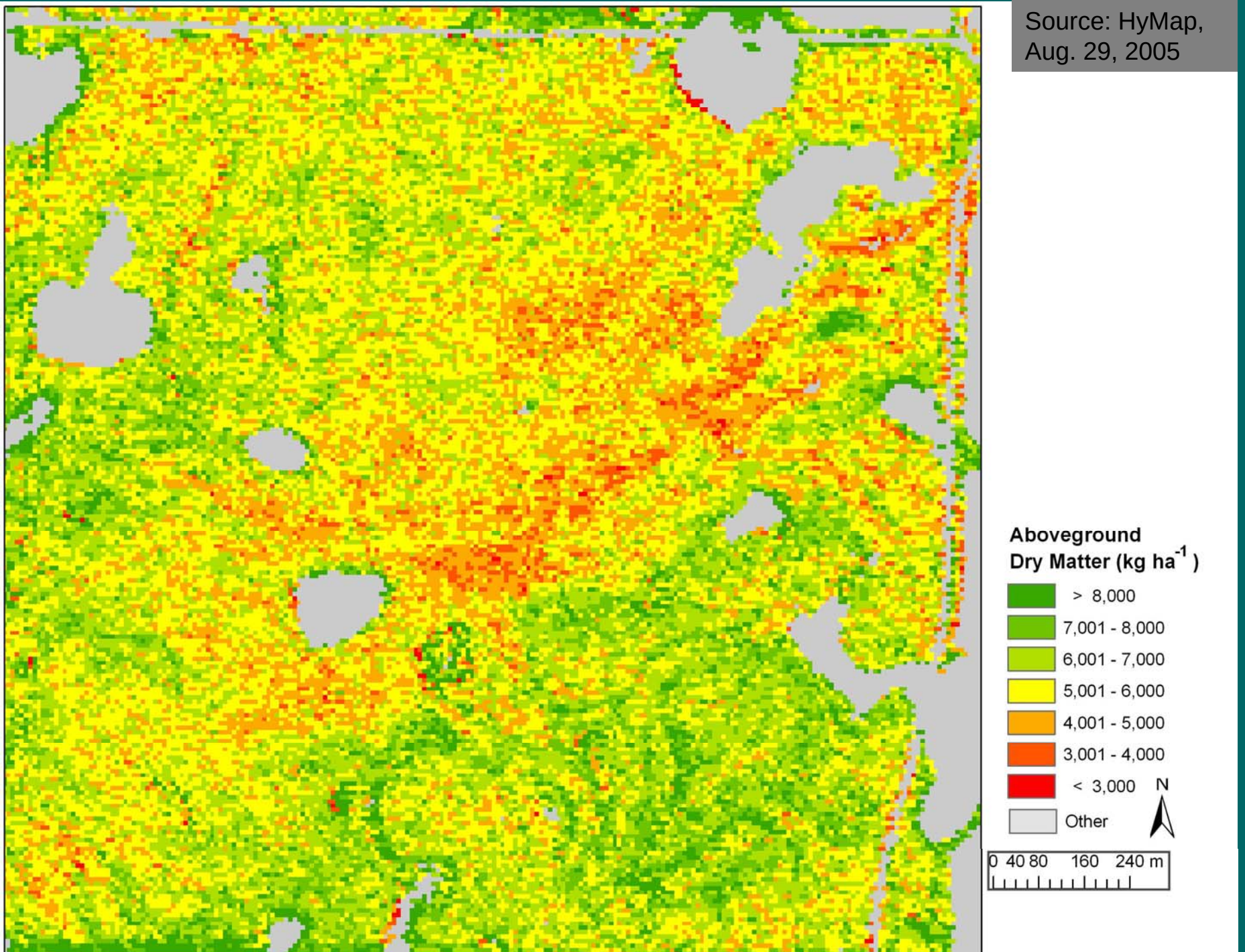
Source: HyMap, Aug. 29, 2005

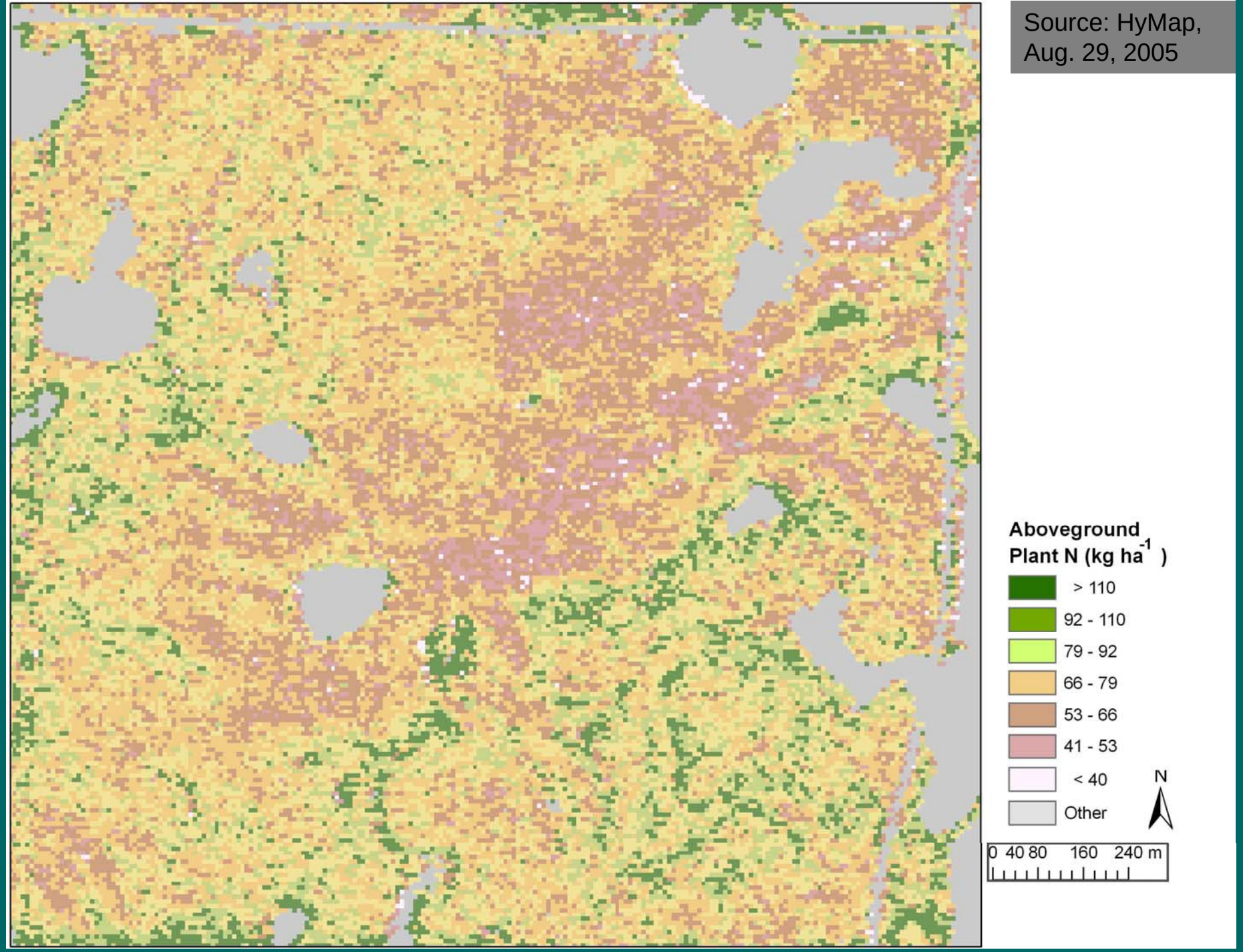
C:N Ratio

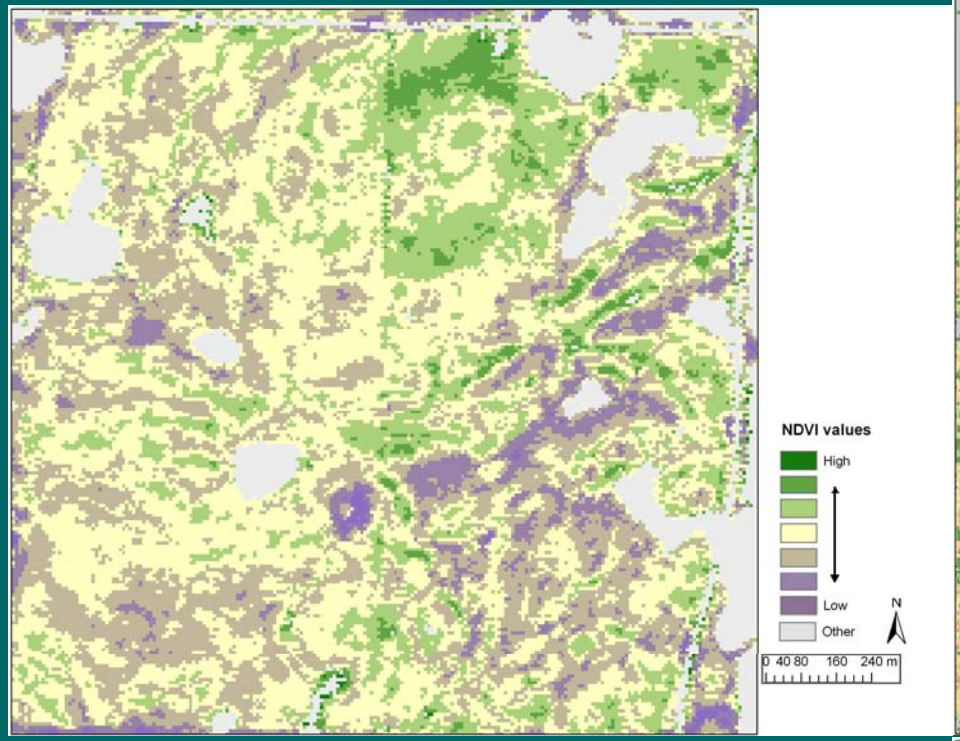
- < 25
- 25.1 - 27
- 27.1 - 29
- 29.1 - 31
- 31.1 - 33
- 33.1 - 35
- > 35
- Other

N

0 40 80 160 240 m


Source: HyMap, Aug. 29, 2005
Aboveground Dry Matter (kg ha-1)
> 8,000
7,001 - 8,000
6,001 - 7,000
5,001 - 6,000
4,001 - 5,000
3,001 - 4,000
< 3,000
Other
N
0 40 80 160 240 m


Source: HyMap, Aug. 29, 2005
Aboveground Plant N (kg ha-1)
> 110
92 - 110
79 - 92
66 - 79
53 - 66
41 - 53
< 40
Other
N
0 40 80 160 240 m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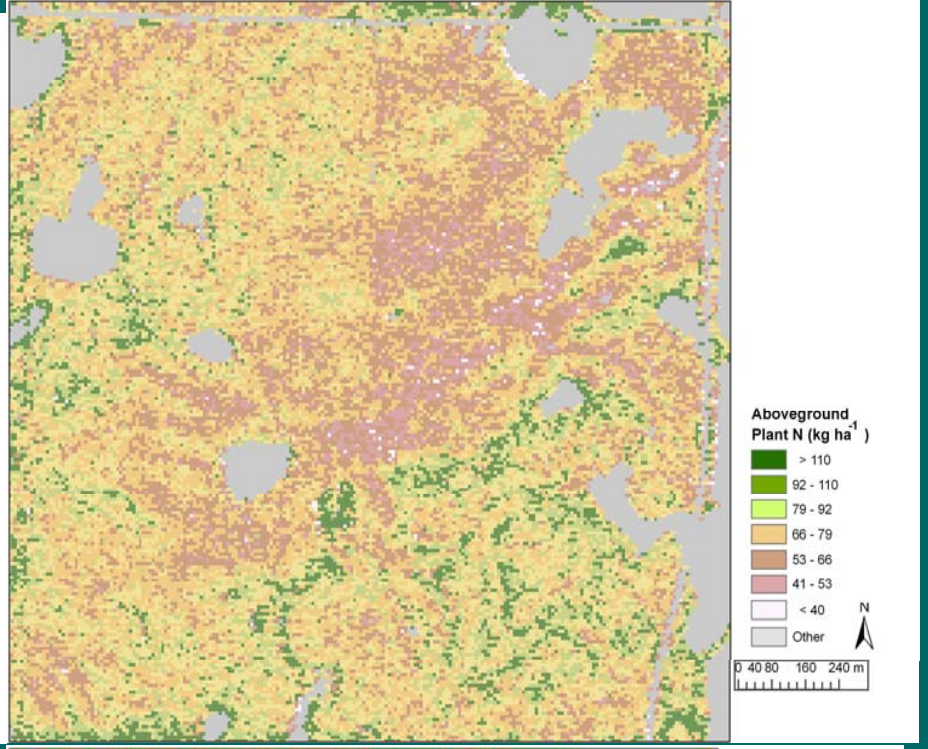
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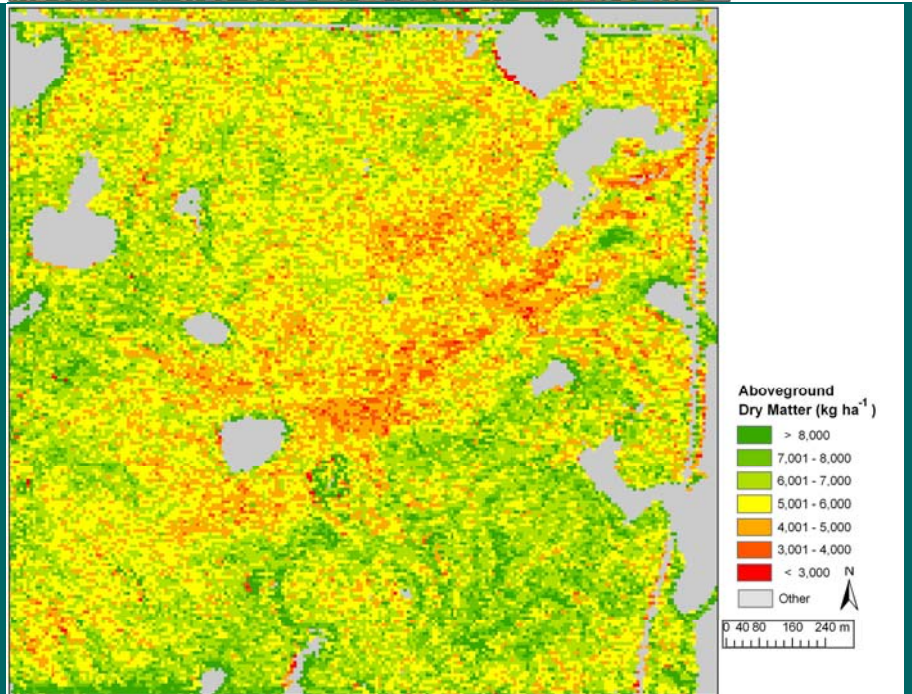
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Conclusions

- Rangeland vegetation mass (C and N) per unit area can be determined remotely
- Accuracy must be assessed with respect to sensor
- New directions in remote technology requires multi-disciplinary teams

Acknowledgements

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