Sharpening Landsat 7 Canopy Reflectance Using a Multi Soil Sensor Platform

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1. Introduction

Plant-soil relationships can be monitored using canopy reflectance.
The spatial resolution of freely available remote sensing data is often too coarse to fully understand spatial dynamics of crop status.

In this study, Landsat 7 (L7) canopy reflectance is downscaled from the native resolution of 30×30 m to that typical of yield maps (ca. 5×5 m) employing geospatial soil-sensor data.

2. Materials and Methods

Site

Two winter wheat (*Triticum aestivum* L.) fields (F5, 24 ha; F8, 33 ha) in Colorado in the 2002-2003 growing season.

GEOGRAPHICALLY WEIGHTED REGRESSION (GWR)

Individual regression coefficients are associated to each pixel, based on a local multiple linear regression with *n* (i.e.,22) contiguous neighbors

Dependent variable:

L7 canopy reflectance at **30×30 m**

blue (450-520 nm), green (520-600 nm), red (630-690 nm), near-infrared (770-900 nm), shortwave infrared 1 (1550-1750 nm), and shortwave infrared 2 (2090-2350 nm).
(Example for seasonal average reflectance)

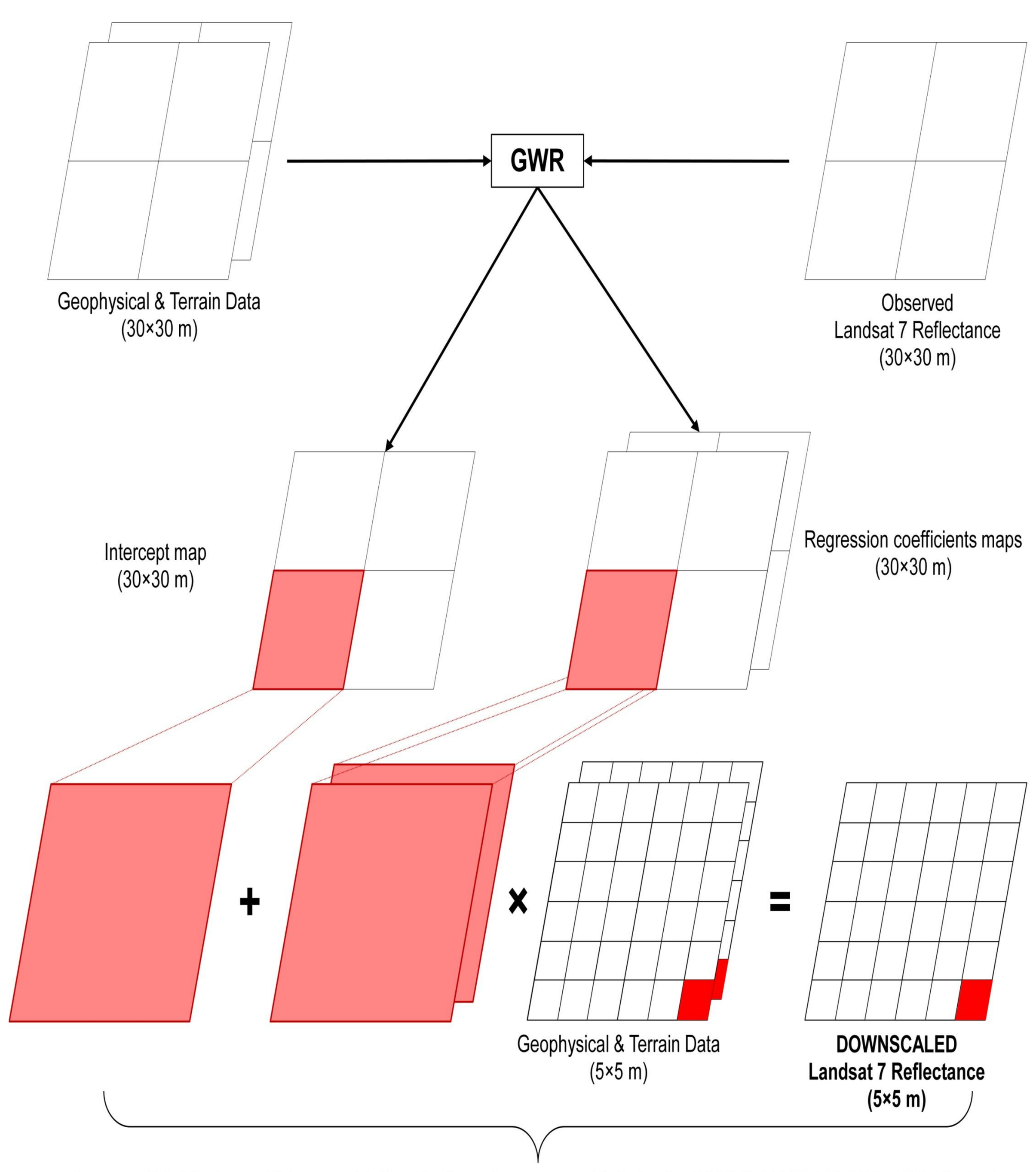
Explanatory variables:

Very high-resolution ancillary data
(Significant proxies for the soil properties influencing yield)

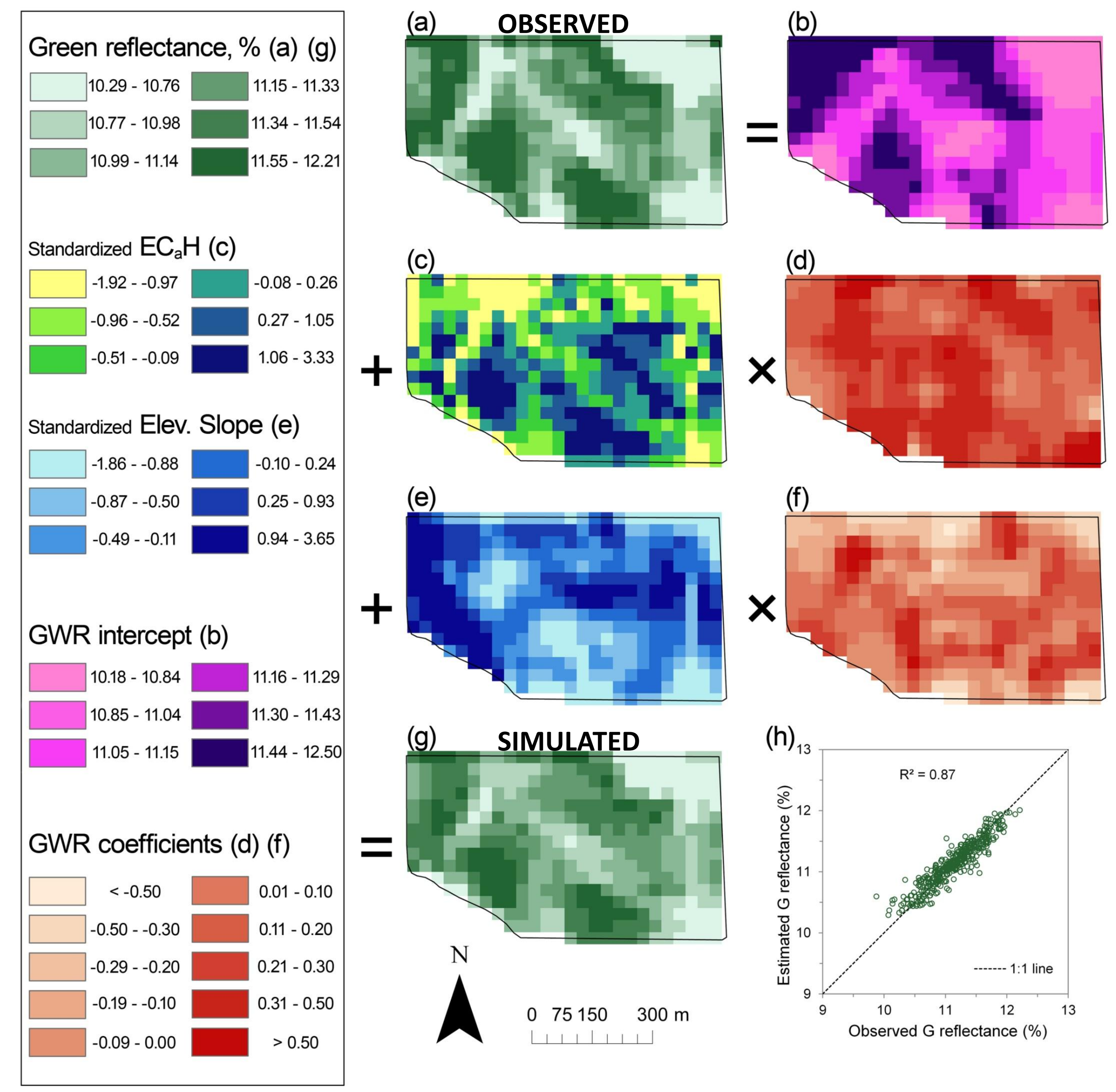
- Soil apparent electrical conductivity
- NAIP (from USDA-FSA) bare-soil imagery
- Micro-elevation slope (RTK)

Downscaling

1. The GWR is described at 30×30 m
2. The 30×30 m GWR coefficient maps are applied to the 5×5 m ancillary data
3. The sharpened L7 canopy reflectance is estimated



3. Results



GWR L7 sharpening

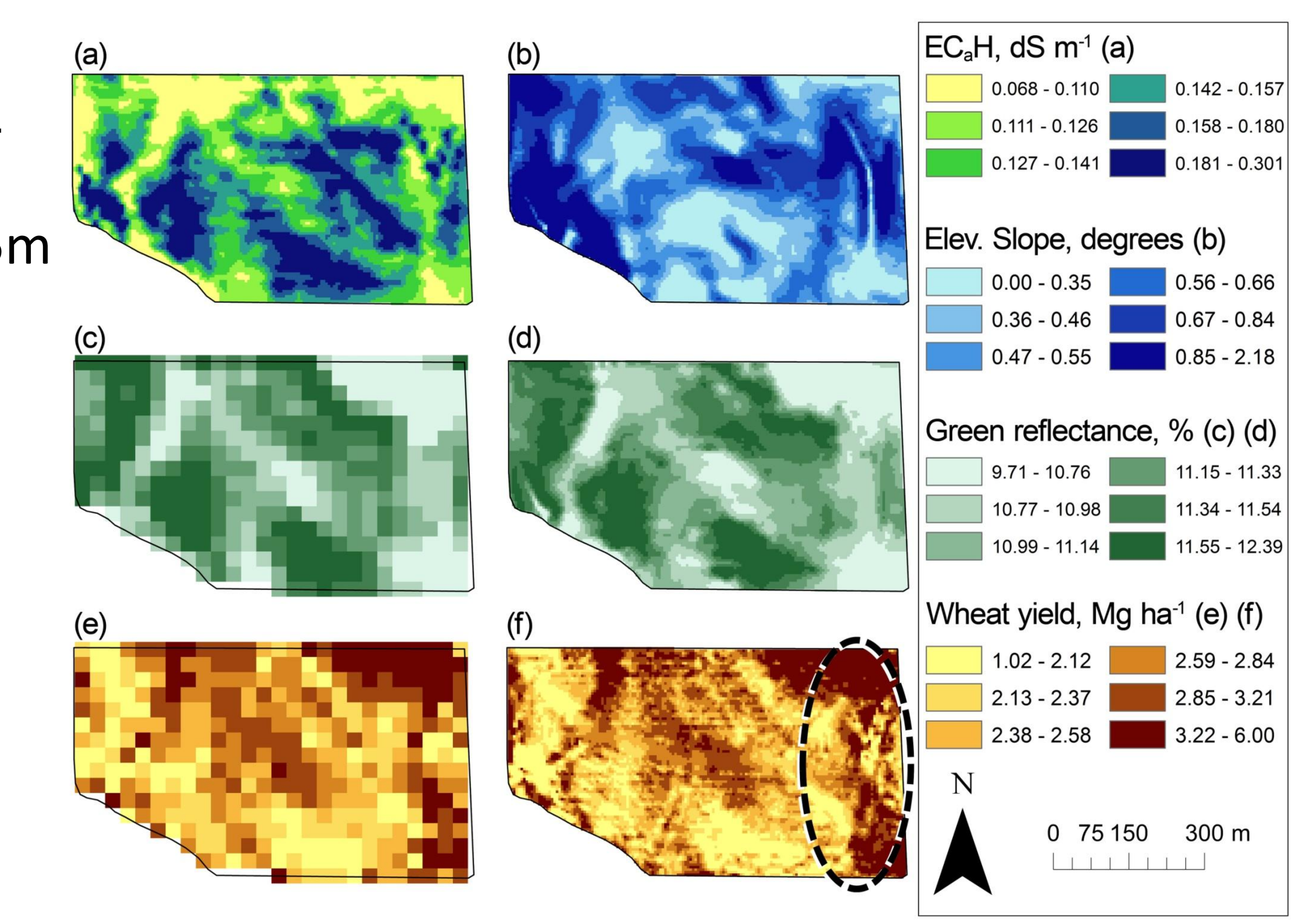
- Edaphic factors (those measured by apparent electrical conductivity and micro-elevation slope) are accountable for most of the crop spatial variability.

For all L7 bands, at both fields
$0.83 < R^2 < 0.94$

- The localized regression coefficients allow understanding where the soil properties associated with each sensor influence crop performance the most

INDEPENDENT VALIDATION with YIELD DATA

- The L7-yield relationships at 5×5m are equivalent (or slightly improved) to those at 30×30m
- Small scale variation was NOT captured by the 30×30m reflectance map, but was well described by the downscaled maps.



4. Remarks

The proposed methodology can be used to study soil-induced crop-status spatial variability, at high resolutions, throughout the growing season, facing costs remarkably lower than buying and pre-processing high resolution imagery.

Read more about this: Scudiero et al. (2015) ."Downscaling Landsat 7 canopy reflectance employing a multi-soil sensor platform". *Precision Agriculture*. DOI: http://dx.doi.org/10.1007/s11119-015-9406-9

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