Investigating the Transferability of Landslide Hazard Assessments

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https://scholarworks.umt.edu/gsrc/2021/stem_poster/3

Investigating the Transferability of Landslide Hazard Assessments

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Introduction

One of the major difficulties in landslide research is the proliferation of methods available, both for landslide identification and for hazard assessment. Many hazard assessment methods depend on the location of past landslides, but many countries do not have a national database of events, and if they do they contain inconsistent and incomplete data.
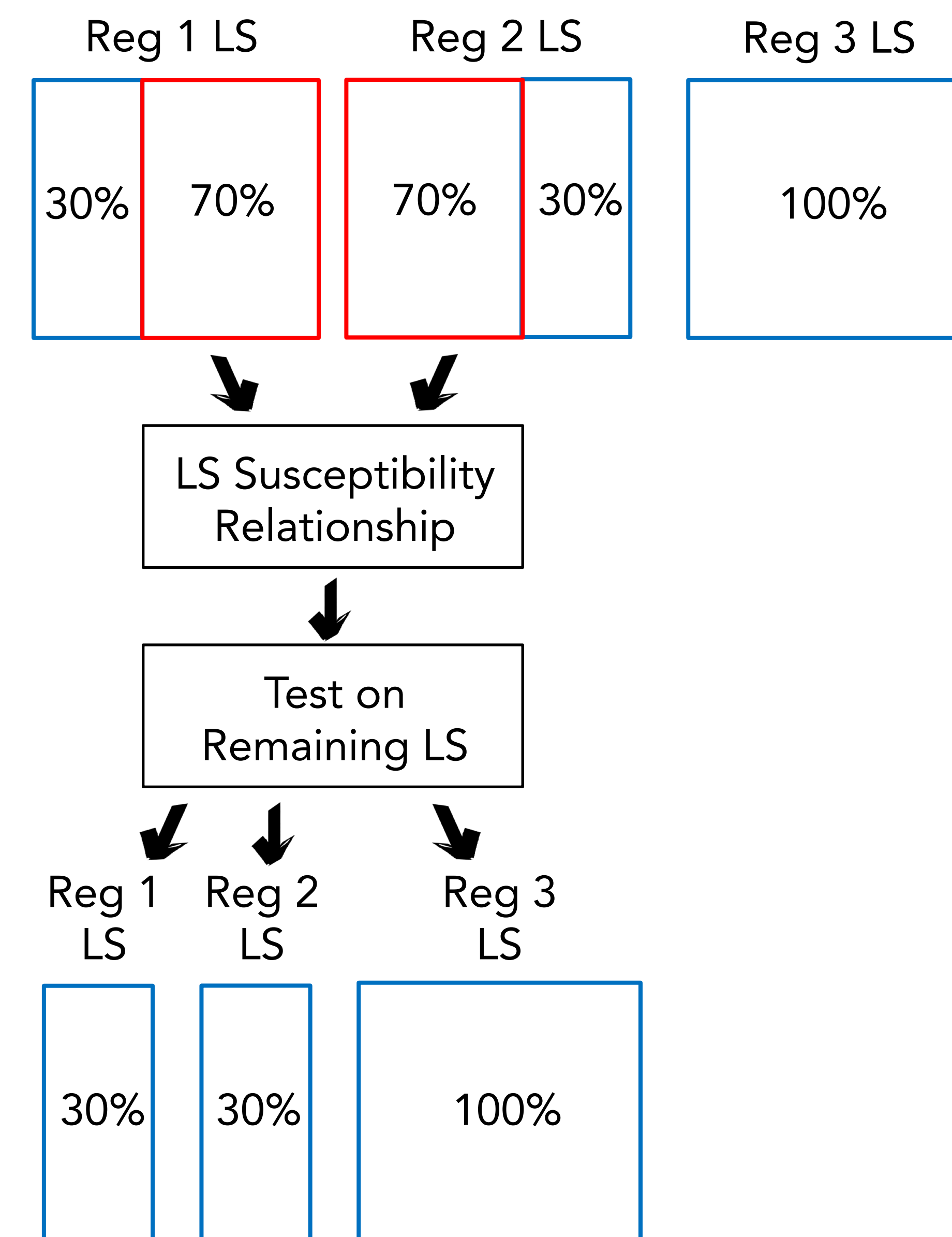
Implications

A thorough inventory of known methods will help hazard scientists decide which method to use in each situation.

The small number of explanatory variables and the simplicity of the statistical methods make this approach easy to implement and understand.

These results will allow scientists to use globally available data and the location of landslides in other regions, to conduct hazard assessments in unstudied regions.

Methods

Proposed Methodology:

Reg 1 LS | Reg 2 LS | Reg 3 LS

30% | 70% | 70% | 30% | 100%

↓ ↓

LS Susceptibility Relationship

↓

Test on Remaining LS

↓ ↓ ↓

Reg 1 LS | Reg 2 LS | Reg 3 LS

30% | 30% | 100%

Frequency Ratio:

$$FR = (LSD_{ij}/LSD_r)$$
$$LSI = FR_1 + FR_2 + \cdots + FR_n$$
$$P(true) = \frac{LSI - \min(LSI)}{\max(LSI) - \min(LSI)}$$

LSD_{ij} : LS density in jth class of ith response variable (eg. LS density in the 2000-2500 m class of elevation variable)
LSD_r : LS density of total region
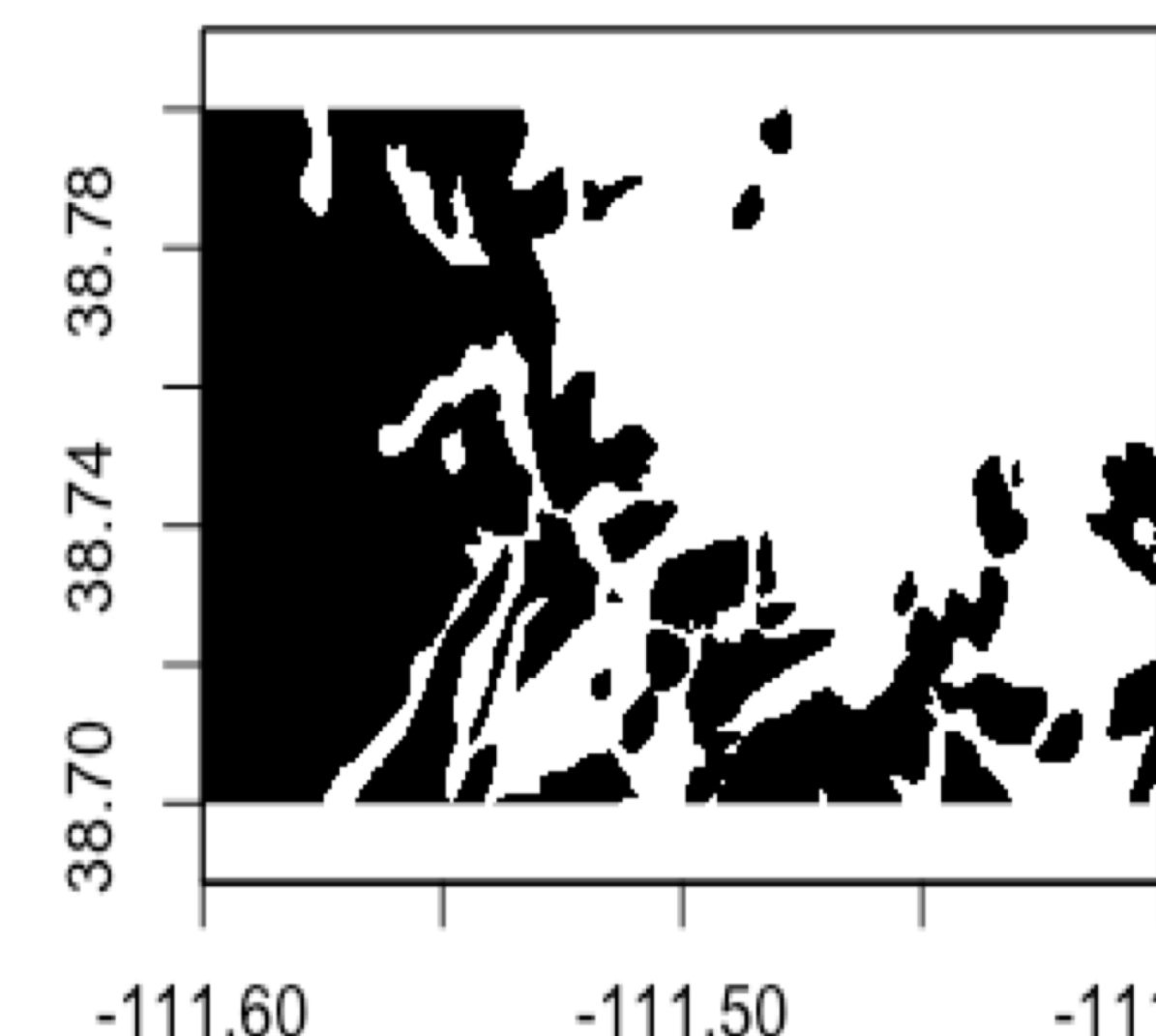LSI : LS Susceptibility Index of each pixel

Logistic Regression:

$$P(true) = \frac{\exp(a_0 + a_1 x_1 + \cdots + a_n x_n)}{1 + \exp(a_0 + a_1 x_1 + \cdots + a_n x_n)}$$

a_n : weighting coefficient of nth explanatory variable
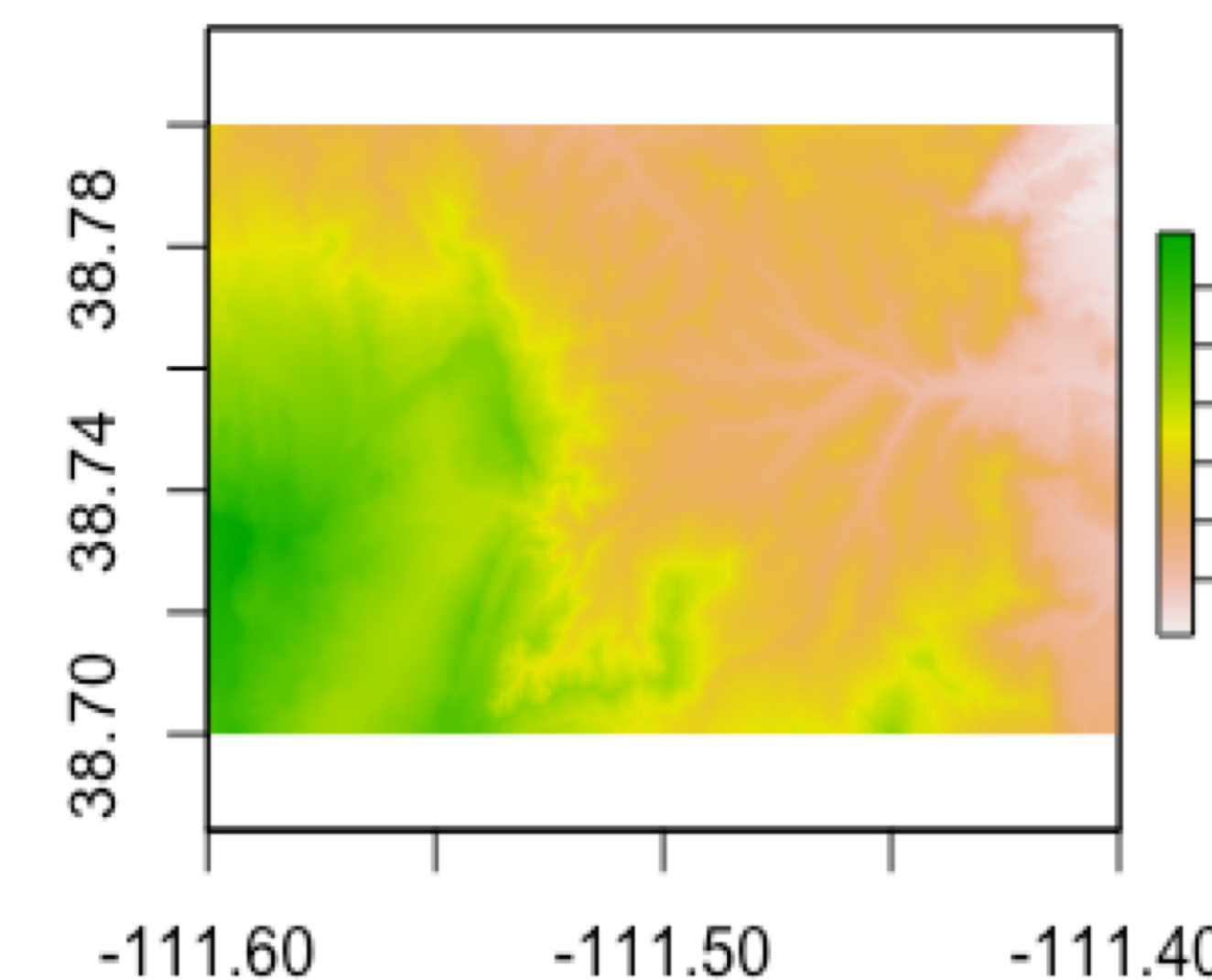x_n : nth response variable value

Inputs:

Landslides

Elevation

Output:

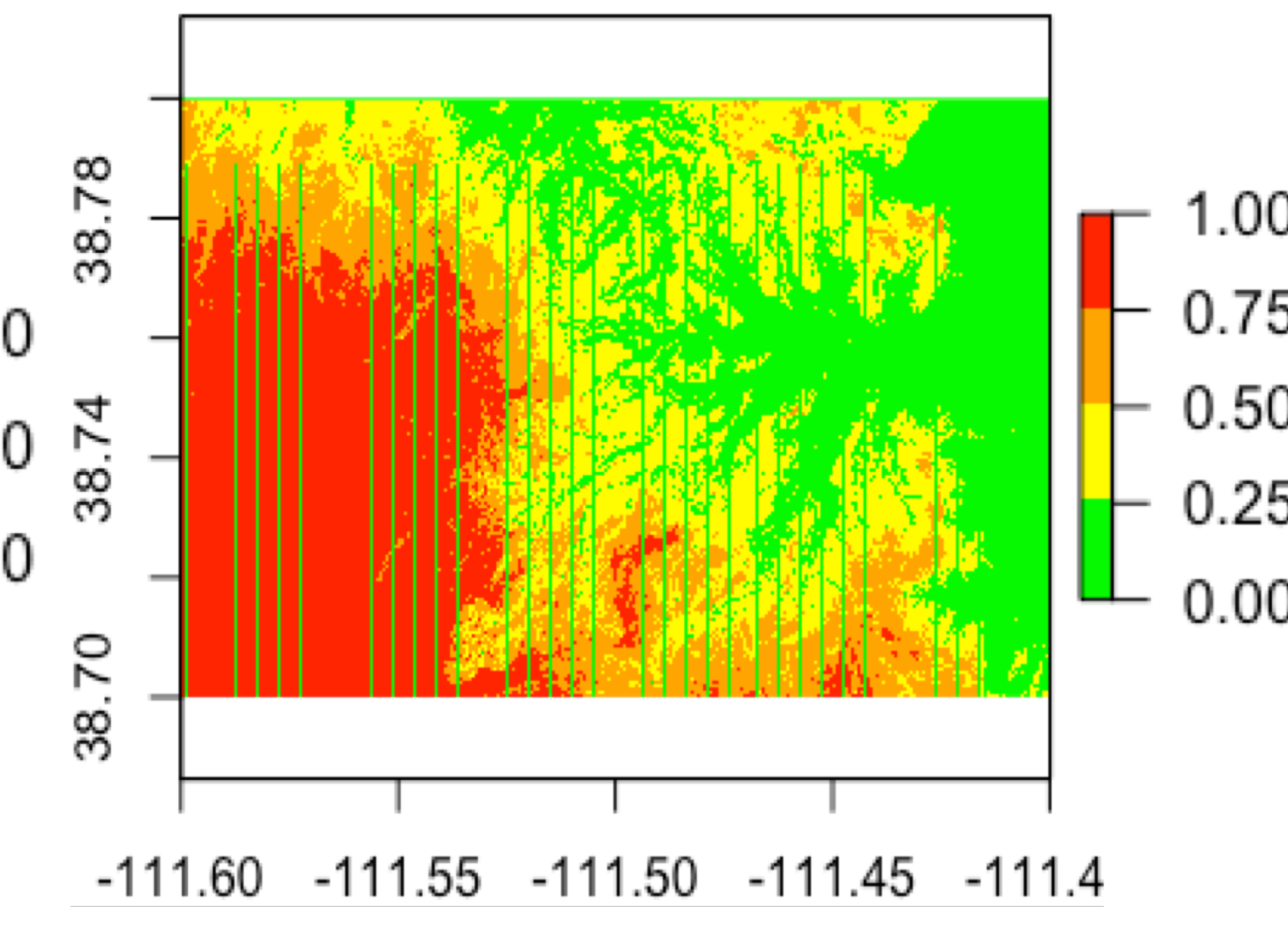**LS Hazard**

Response Variable: past landslide occurrence (binary: "true" or "false")

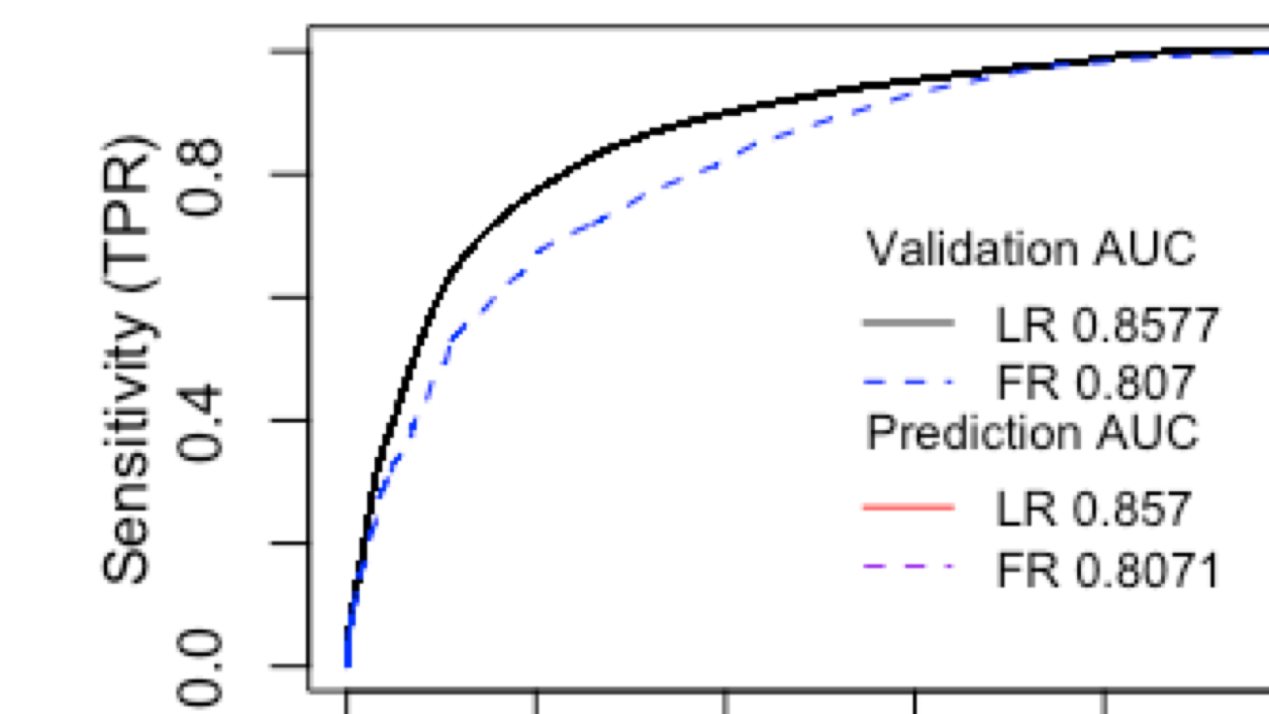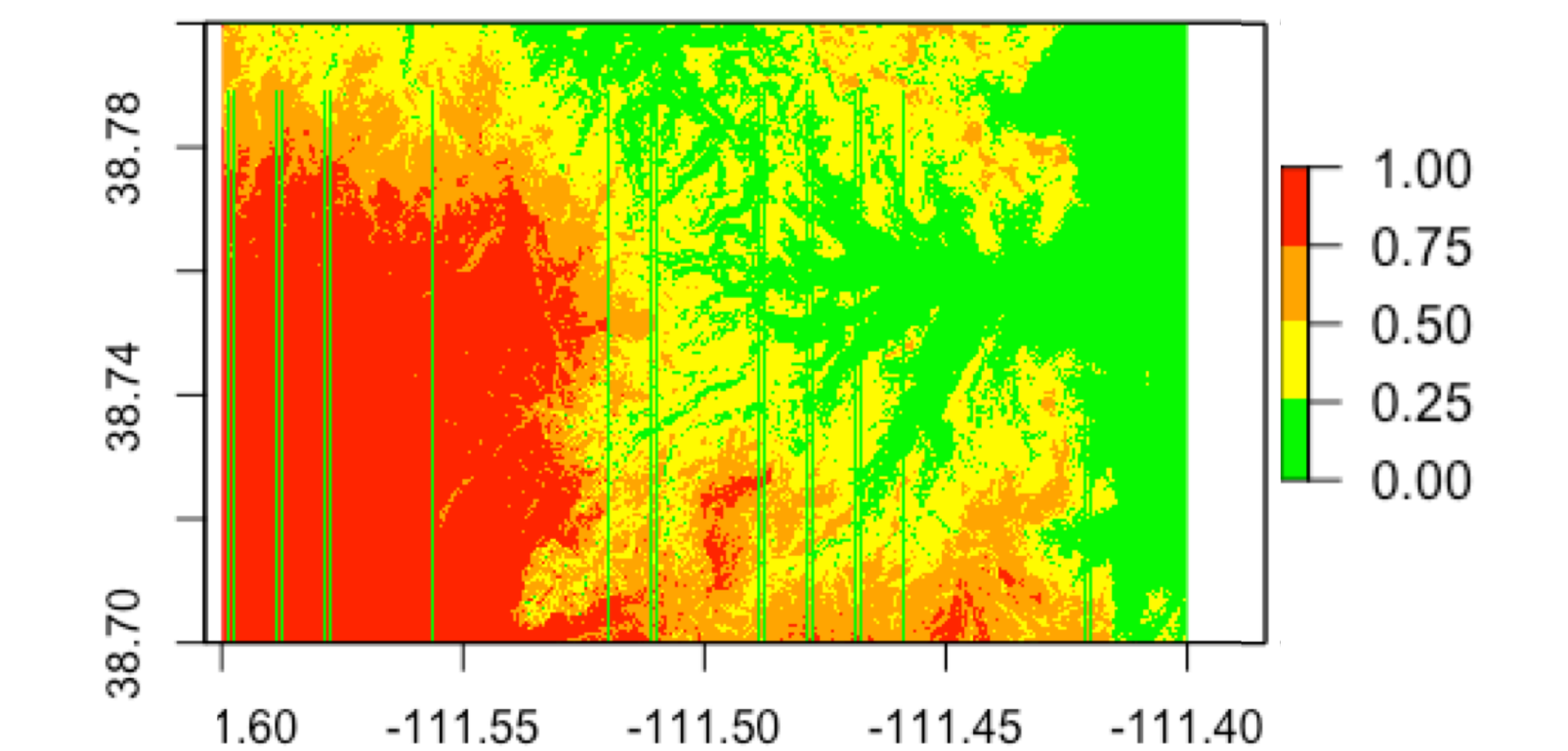*Explanatory Variables:* elevation, slope, aspect, curvature, topographical positon index (tpi)

Landslide Susceptibility: Probability of landslide occurrence

Results

UT ROC Curves
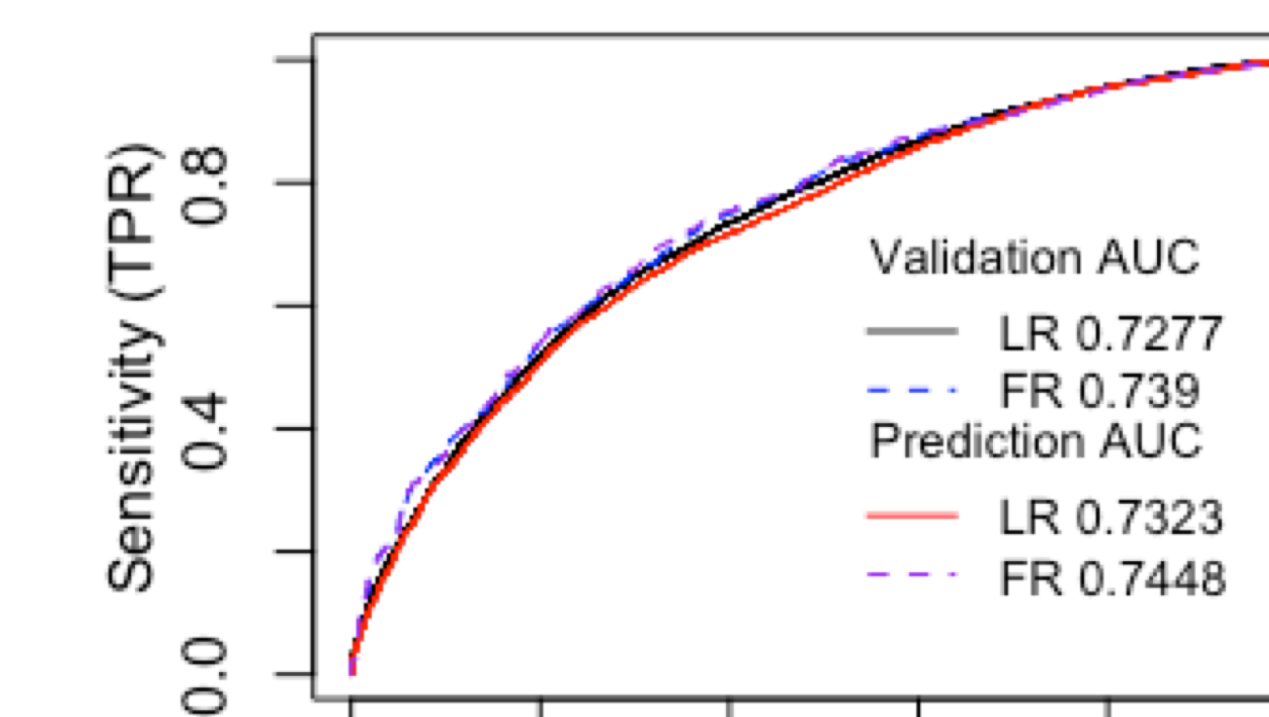
Validation AUC
LR 0.8577
FR 0.807
Prediction AUC
LR 0.857
FR 0.8071

UT Landslide Hazard

WA ROC Curves

Validation AUC
LR 0.7277
FR 0.739
Prediction AUC
LR 0.7323
FR 0.7448

WA Landslide Hazard

IT ROC Curves

Validation AUC
LR 0.776
FR 0.7451
Prediction AUC
LR 0.7785
FR 0.7472
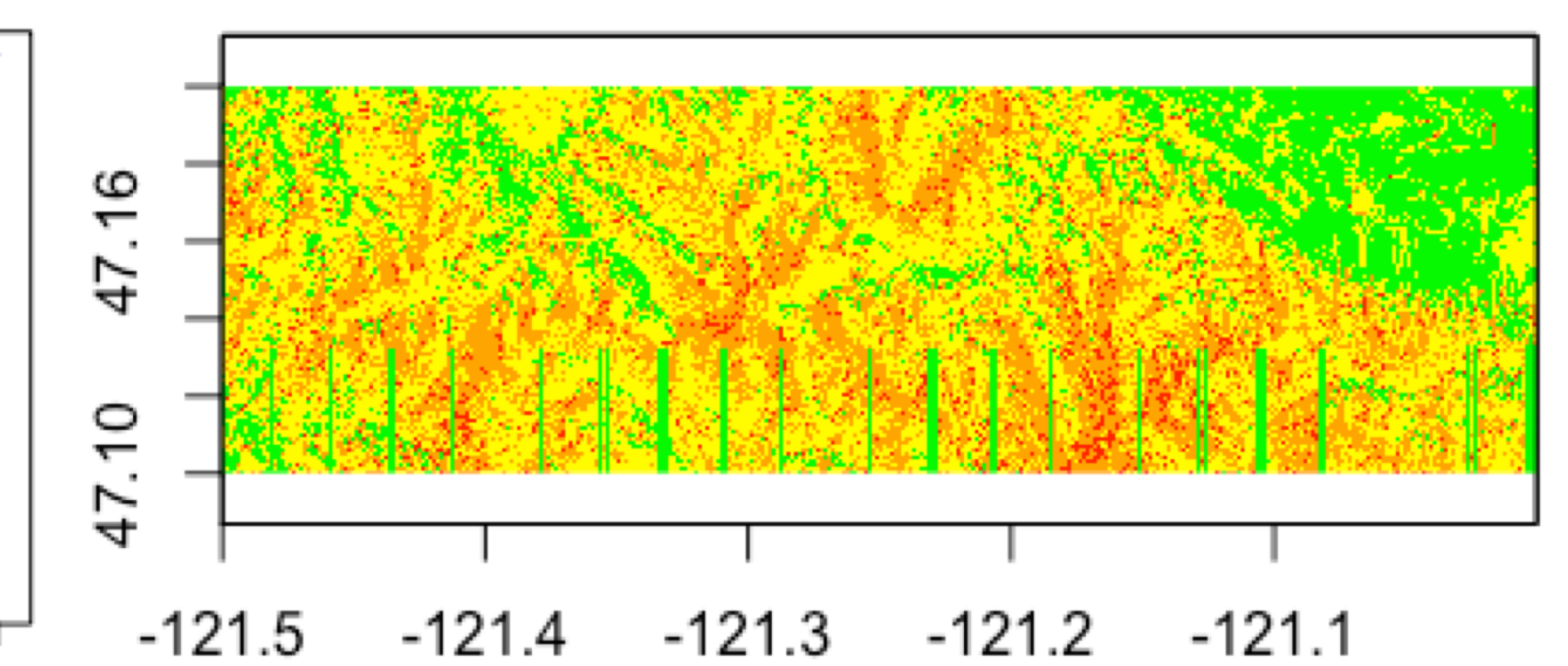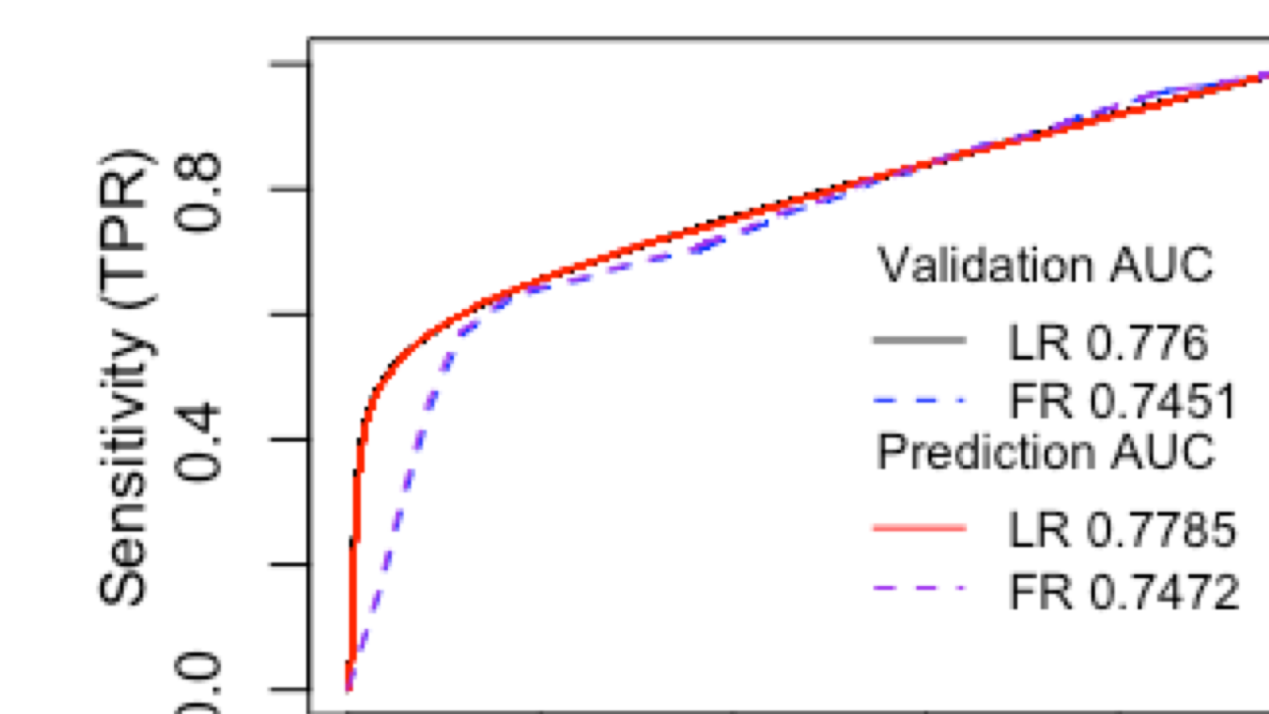
IT Landslide Hazard

UT-WA ROC Curves

Validation AUC
LR 0.8456
FR 0.8009
Prediction AUC
LR 0.8454
FR 0.8011
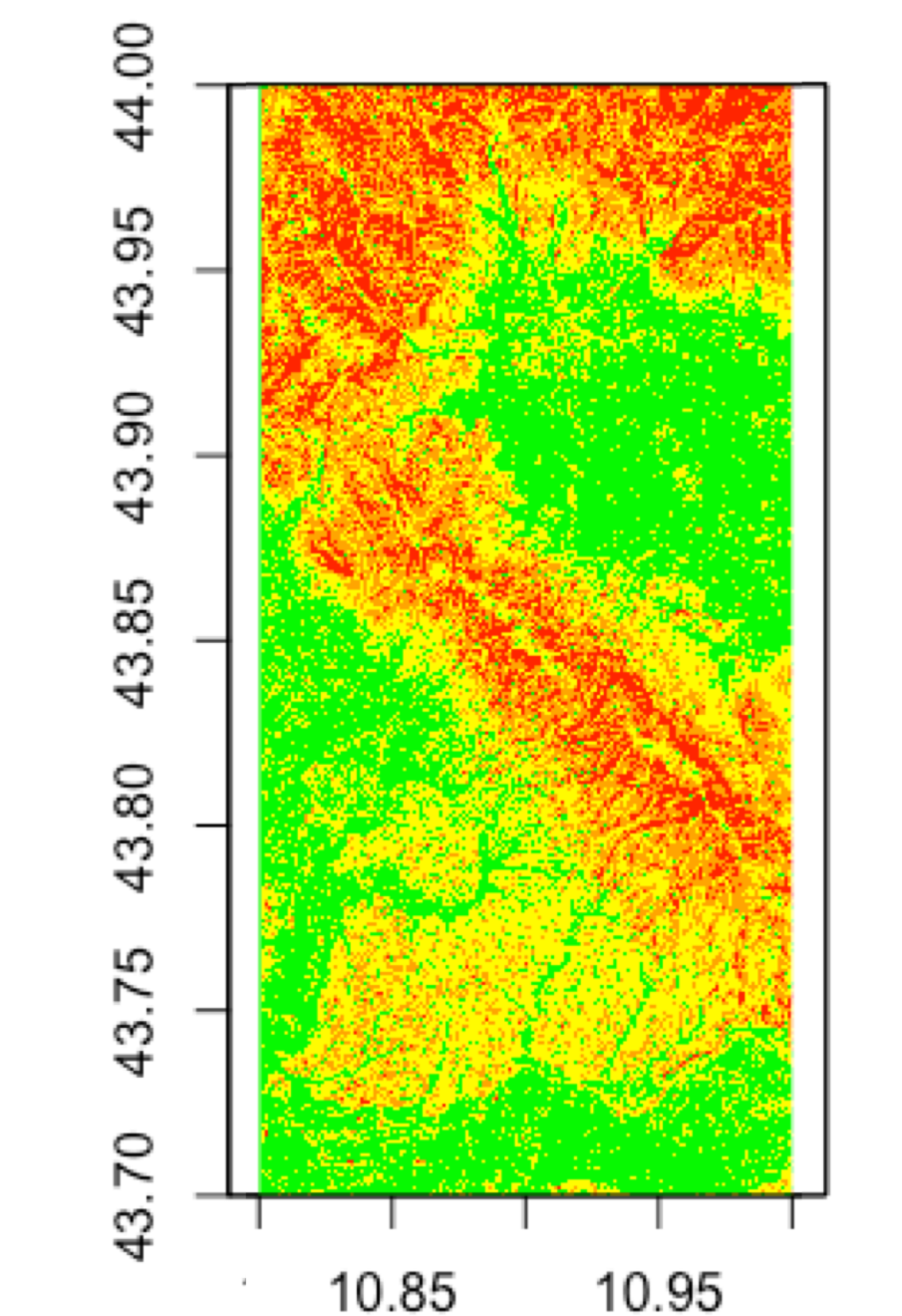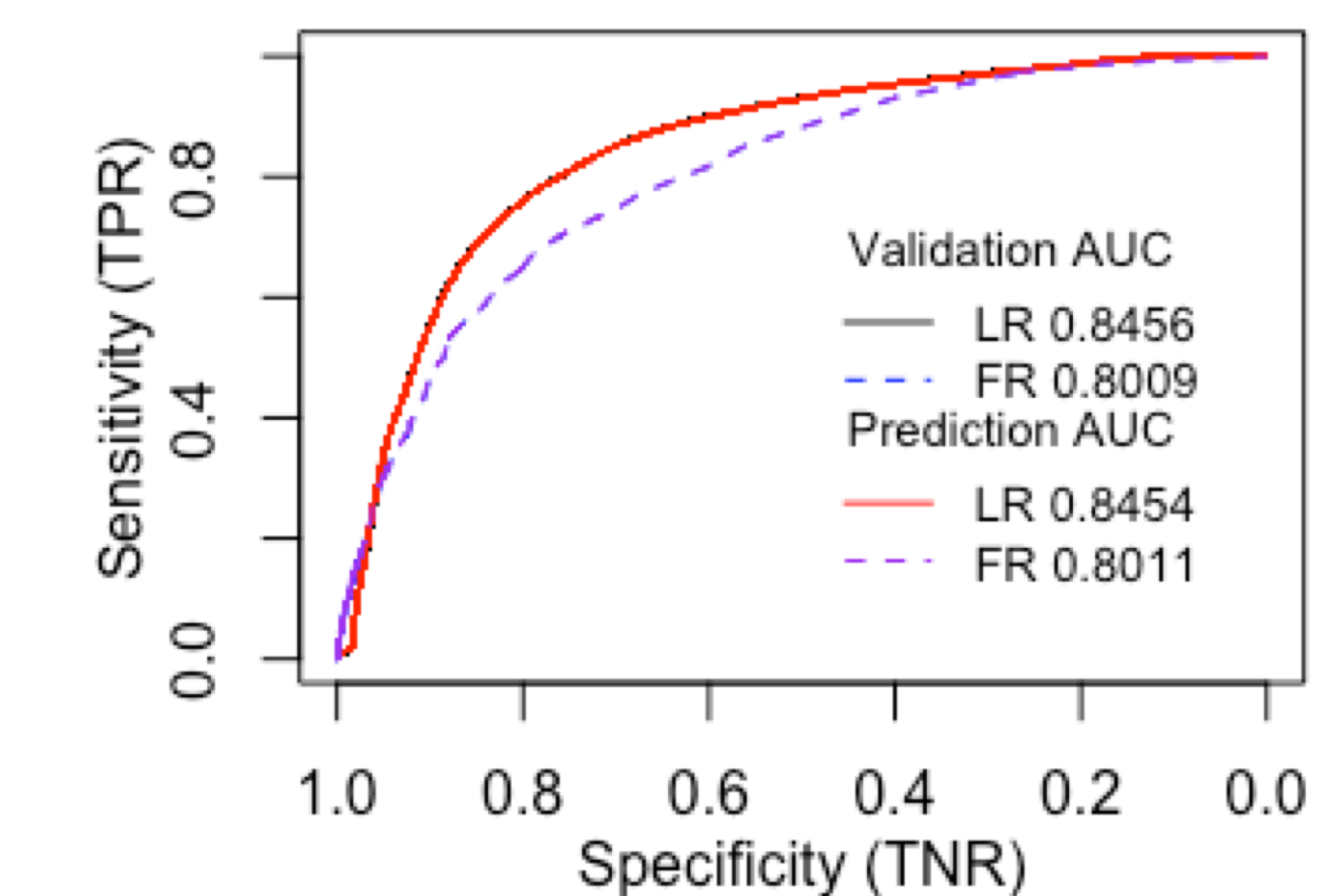
Products:
- Inventory of known Landslide Hazard Assessment Methods
- R code package
- Standard method or workflow

Sources:

Aleotti, P., & Chowdhury, R. (1999). Landslide hazard assessment: Summary review and new perspectives. *Bulletin of Engineering Geology and the Environment, 58*(1), 21–44. https://doi.org/10.1007/s100640050066

Kritikos, T., Robinson, T. R., & Davie, T. R. H. (2015). Regional coseismic landslide hazard assessment without historical landslide inventories: A new approach. *Journal of Geophysical Research: Earth Surface, 120*, 711–729. https://doi.org/10.1002/2014JF003224

USGS. (2019). How many deaths result from landslides each year? Retrieved from https://www.usgs.gov/faqs/how-many-deaths-result-landslides-each-year?qt-news_science_products=0#qt-news_science_products