USDOT-Office of the Assistant Secretary for Research and Technology,
Commercial Remote Sensing & Spatial Information Technologies – Phase VI

Predicting Post-wildfire Debris Flow Occurrence in Western USA

Priscilla Addison, peaddiso@mtu.edu
Thomas Oommen, toommen@mtu.edu
Ashley Kern, ankern@mtu.edu

Michigan Tech
Create the Future

Data

- United States Geological Survey (USGS)
  - Open-File Report 2005-1218

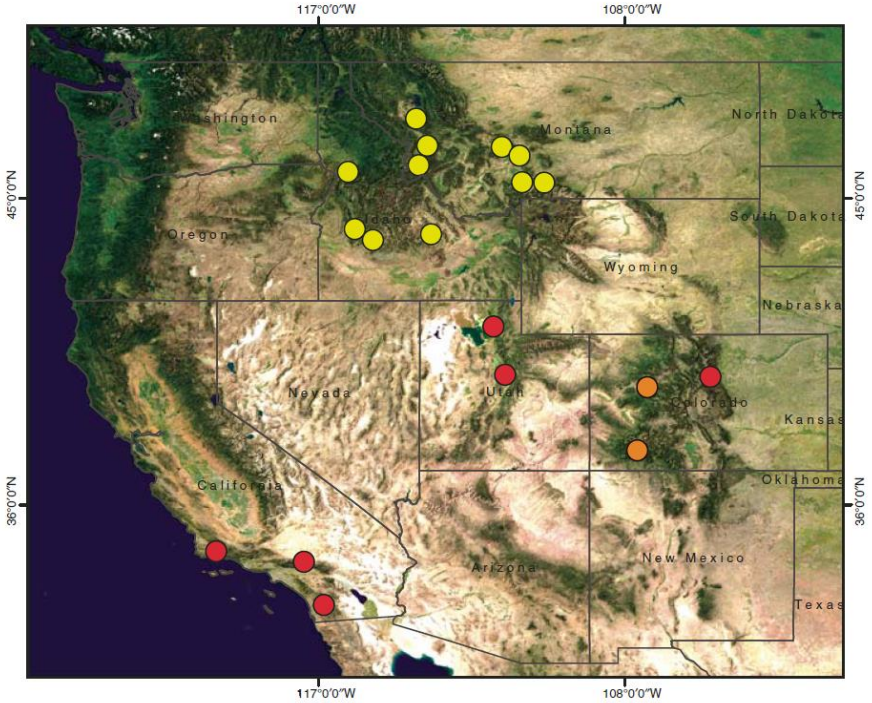
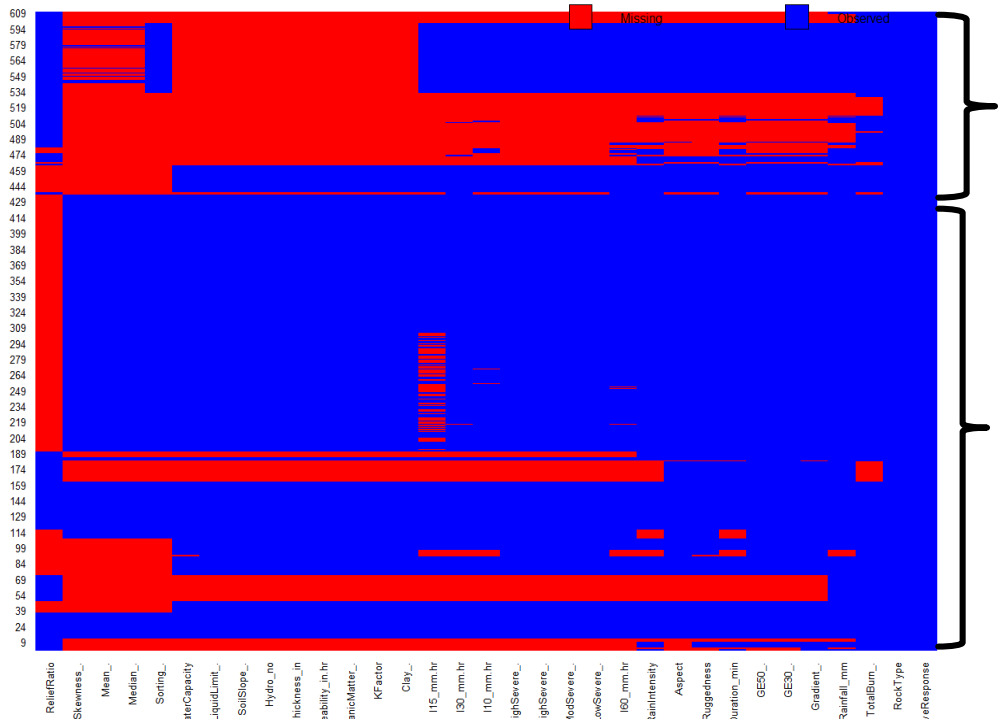


Figure 1. Map showing locations of basins used to develop models for the probability of debris-flow generation (yellow dots), for estimates of debris-flow volume (red dots), or both models (orange dots).

Michigan Tech

Data



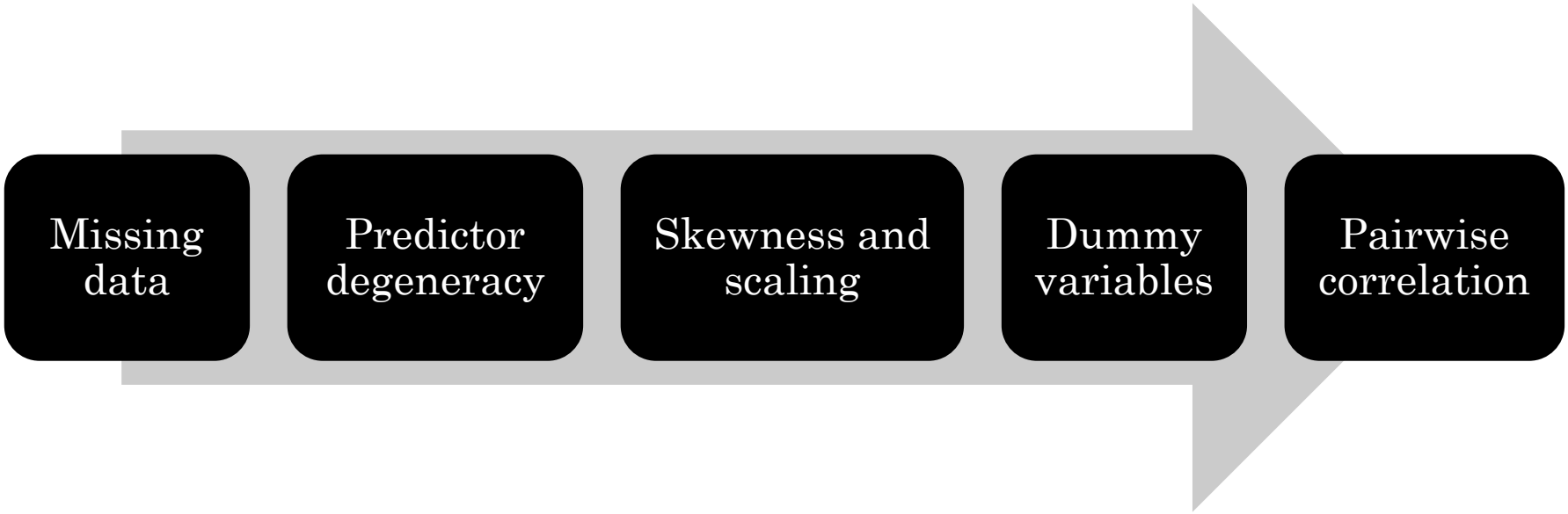
California *(144 samples)*

Intermountain West *(465 samples)*

- **33 predictors**
- **609 sample points**

MichiganTech

Pre-processing Steps



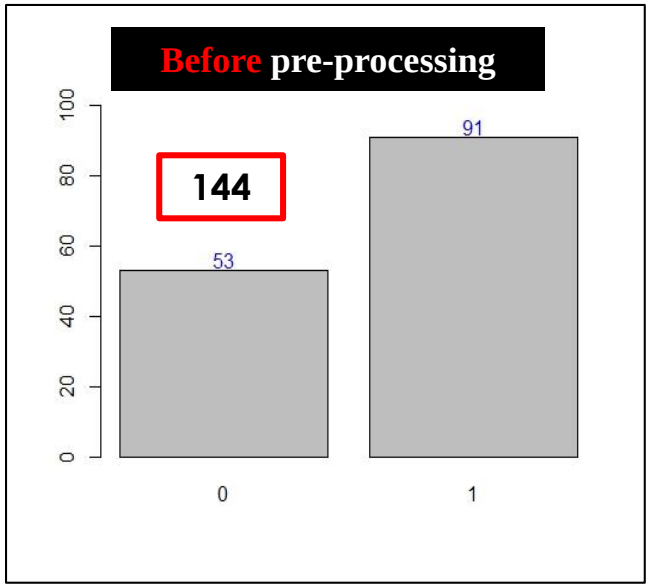
Different data explorations

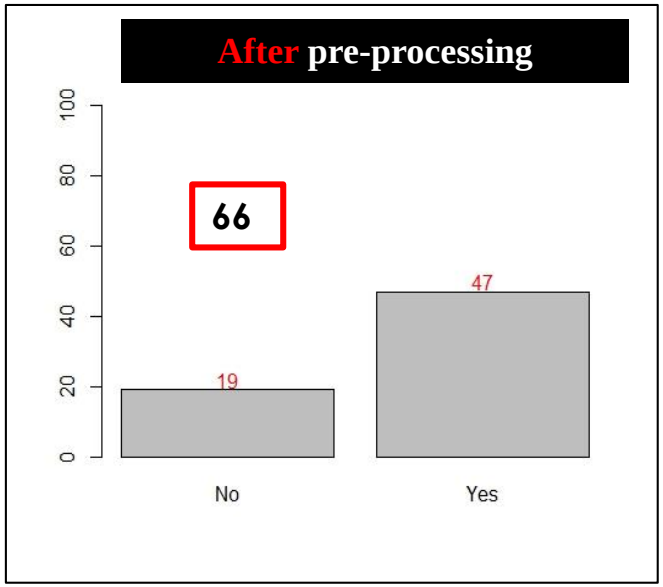
- Southern California (SC)
- Intermountain (Im)

Southern California

Data

Southern California





10 fold cross validation repeated 10 times

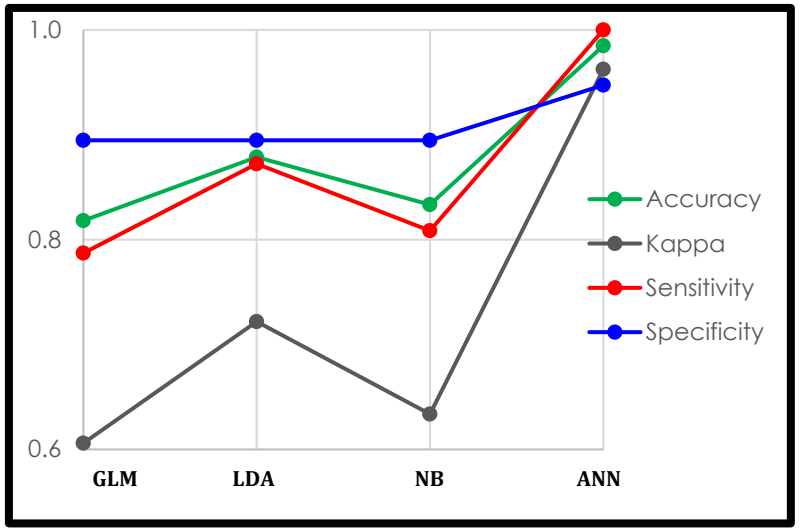
Michigan Tech

Results

Southern California

Training Metrics

MODEL	ACC.	KAPPA	SENS.	SPEC.
Logistic Regression **(GLM)**	0.818	0.606	0.787	0.895
Linear Discriminant Analysis **(LDA)**	0.879	0.722	0.872	0.895
Naïve Bayes **(NB)**	0.833	0.634	0.809	0.895
Averaged Neural Network **(ANN)**	0.985	0.962	1.000	0.947

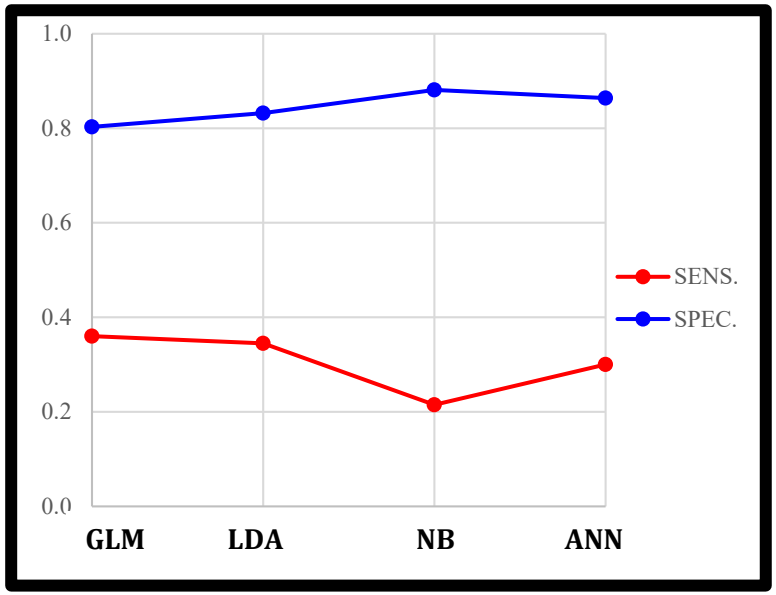


Michigan Tech

Results

Resampled Metrics – 10 fold CV

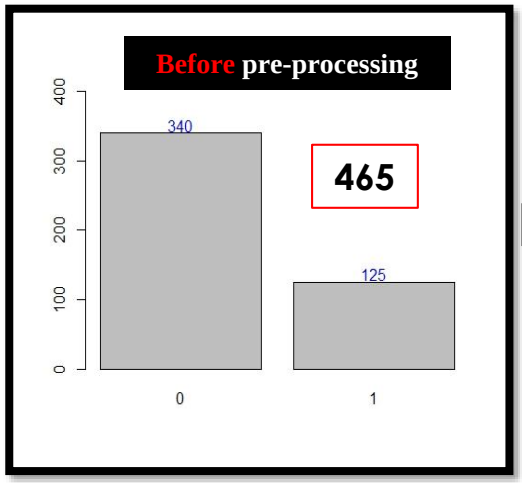
MODEL	SENS.	SPEC.
Logistic Regression **(GLM)**	0.360	0.803
Linear Discriminant Analysis **(LDA)**	0.345	0.832
Naïve Bayes **(NB)**	0.215	0.881
Averaged Neural Network **(ANN)**	0.300	0.864

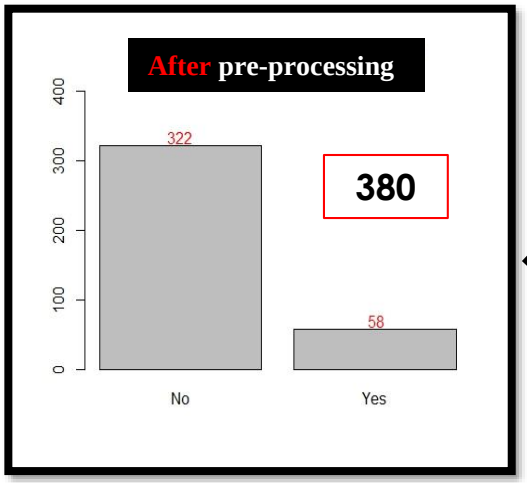


Intermountain

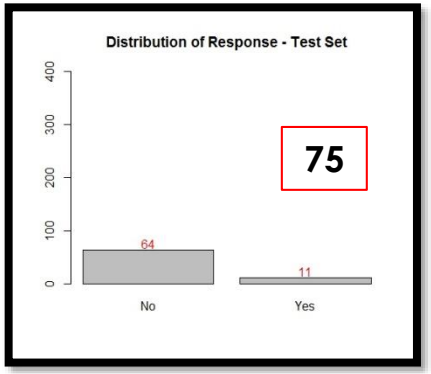
Data

Intermountain





80%



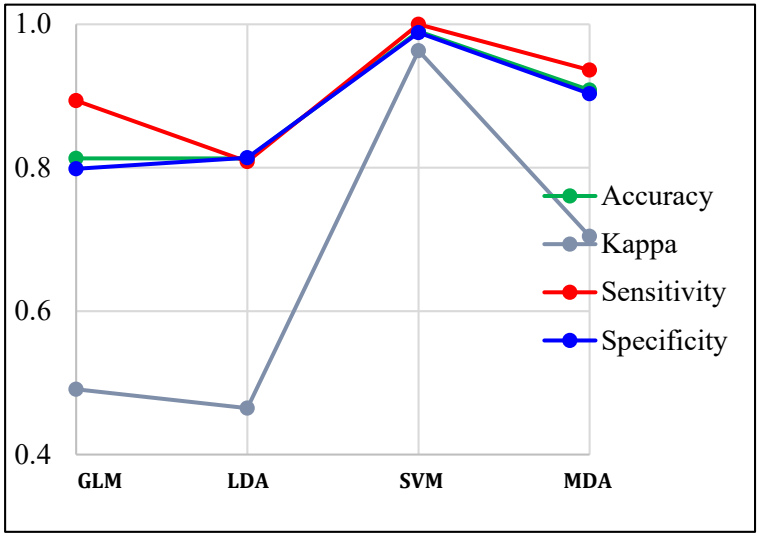
20%

Results

Intermountain

Training Metrics

MODEL	ACC.	KAPPA	SENS.	SPEC.
Logistic Regression **(GLM)**	0.813	0.491	0.894	0.798
Linear Discriminant Analysis **(LDA)**	0.813	0.465	0.809	0.814
Support Vector Machine **(SVM)**	0.990	0.963	1.000	0.988
Mixture Discriminant Analysis **(MDA)**	0.908	0.704	0.936	0.903



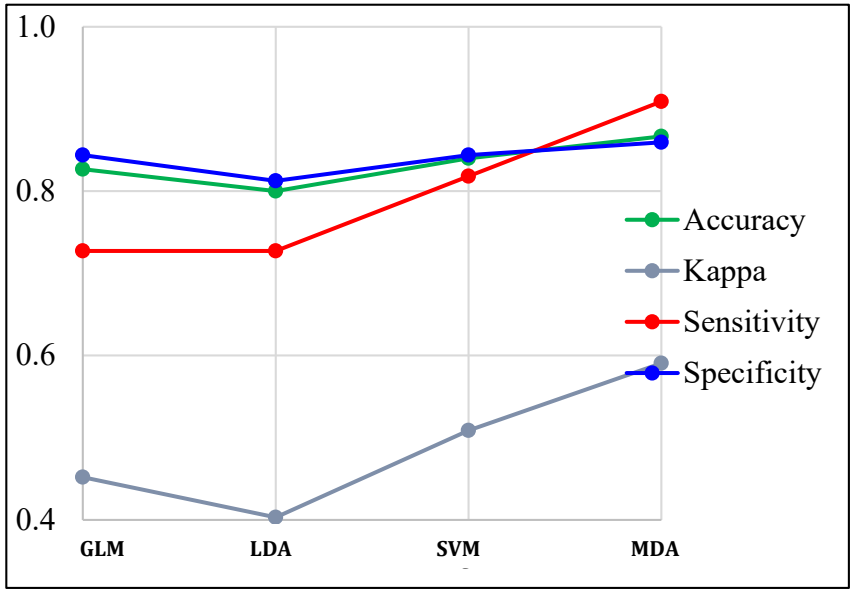
Michigan Tech

Results

Intermountain

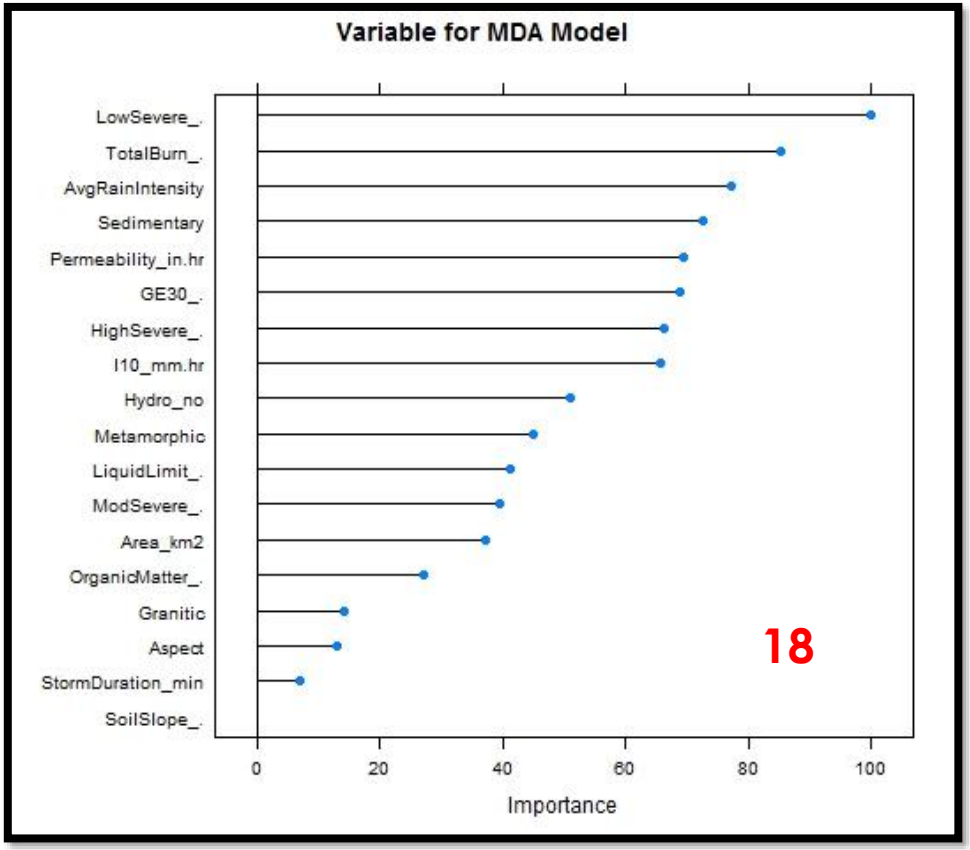
Validation Metrics

MODEL	ACC.	KAPPA	SENS.	SPEC.
Logistic Regression **(GLM)**	0.827	0.452	0.727	0.844
Linear Discriminant Analysis **(LDA)**	0.800	0.403	0.727	0.813
Support Vector Machine **(SVM)**	0.840	0.509	0.818	0.844
Mixture Discriminant Analysis **(MDA)**	0.867	0.591	0.909	0.859



Michigan Tech

Results


Variable for MDA Model
LowSevere_.
TotalBurn_.
AvgRainIntensity
Sedimentary
Permeability_in.hr
GE30_.
HighSevere_.
I10_mm.hr
Hydro_no
Metamorphic
LiquidLimit_.
ModSevere_.
Area_km2
OrganicMatter_.
Granitic
Aspect
StormDuration_min
SoilSlope_.
0
20
40
60
80
100
Importance
18

Conclusions and Future Work

- Nonlinear models performing better than linear models suggest an underlying nonlinear relationship between predictors and response variable.
- California data too scanty to glean a trend from it. Further data collection and model development required to improve predictions.
- Intermountain data performs better with a sensitivity of 91% for nonlinear MDA model in comparison with 44% of existing linear model (Cannon et al, 2010).
- Future work aims at:
  - ✓ Testing model validity with independent data obtained from Nevada BLM.
  - ✓ Developing linear and nonlinear volumetric models.