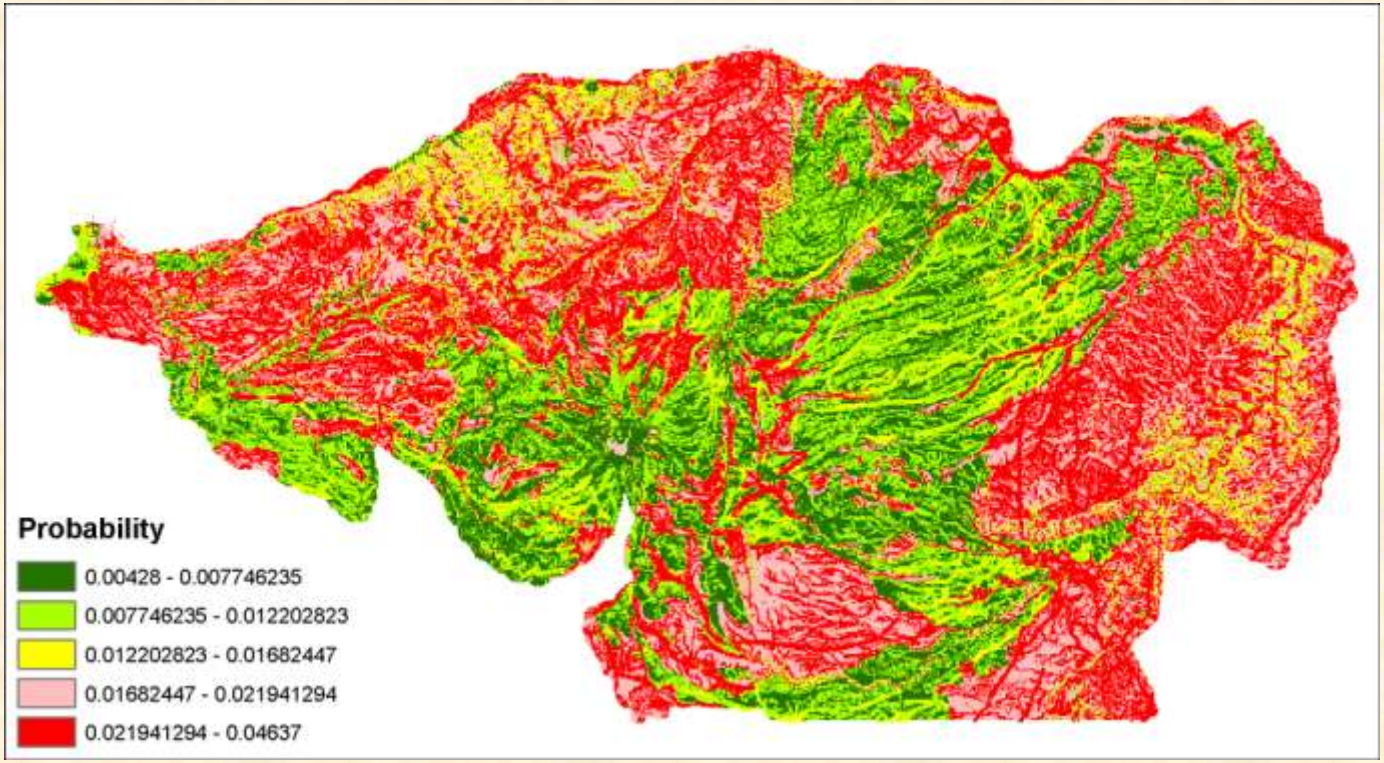
Predictive Modeling



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May 24, 2011

What is predictive modeling

- Settlement patterning
  - Interaction of environmental characteristics and culture
- Predicting occurrence of archaeological sites (dependent variable) in an unsampled location using one or more independent variables (environment/locational characteristics)
- Suitability Modeling
  - Locations that exhibit the best characteristics for people to live
- Resource management
  - Tools for agencies to reduce level of effort for surveys
  - Tools for predicting areas where development should be avoided

Steps for developing a model

- Define study area
- Collect archaeological information
  - Site locations
  - Previous research
  - Cultural information – How did humans use the landscape
- Determine and Collect environmental Data
  - Most methods want binary data (yes or no)
- Determine statistical method and apply to data

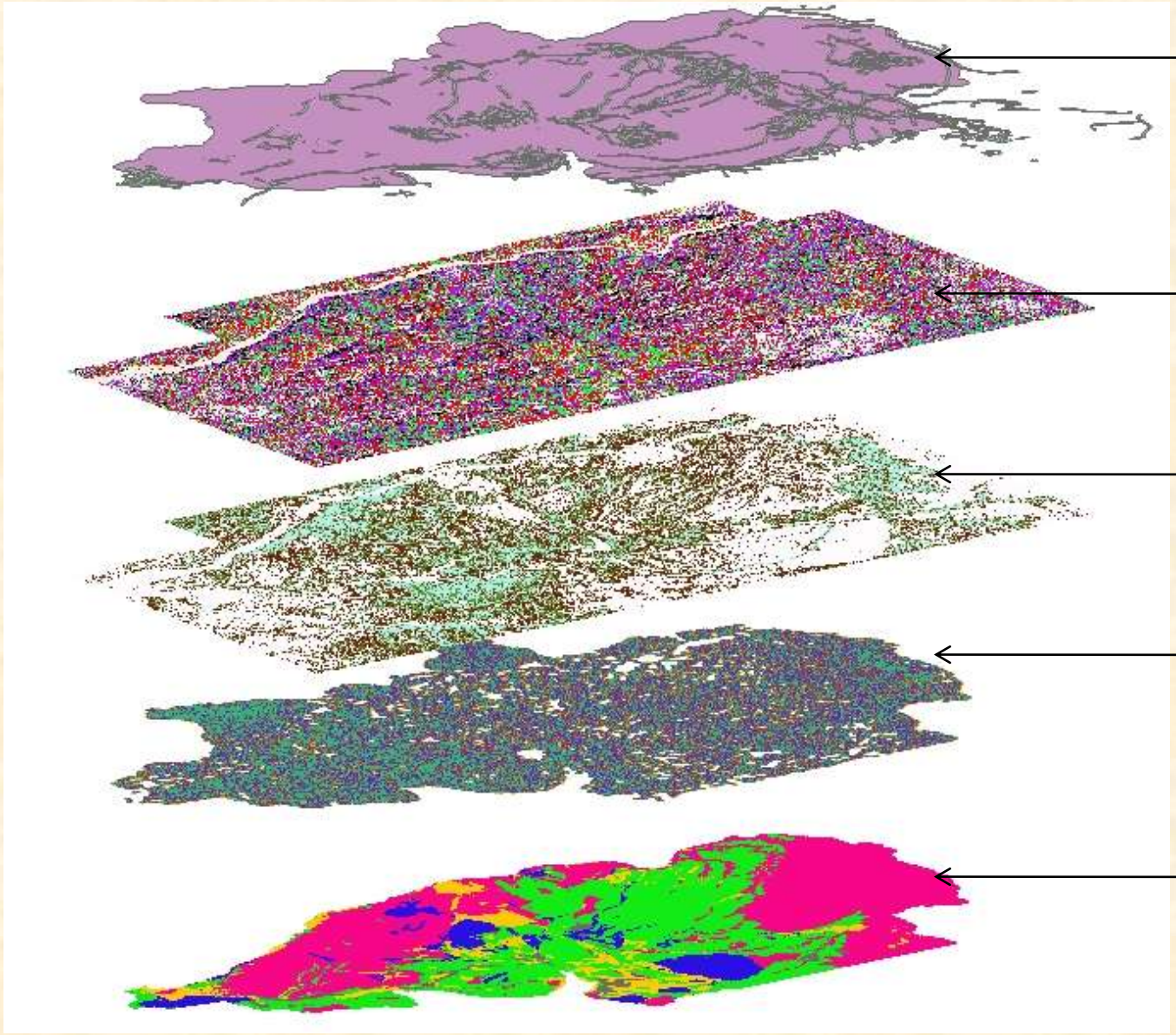
Predictive Models

- Vector/Raster Intersection
- Logistic Regression
- Bayesian methods (Weights of evidence)

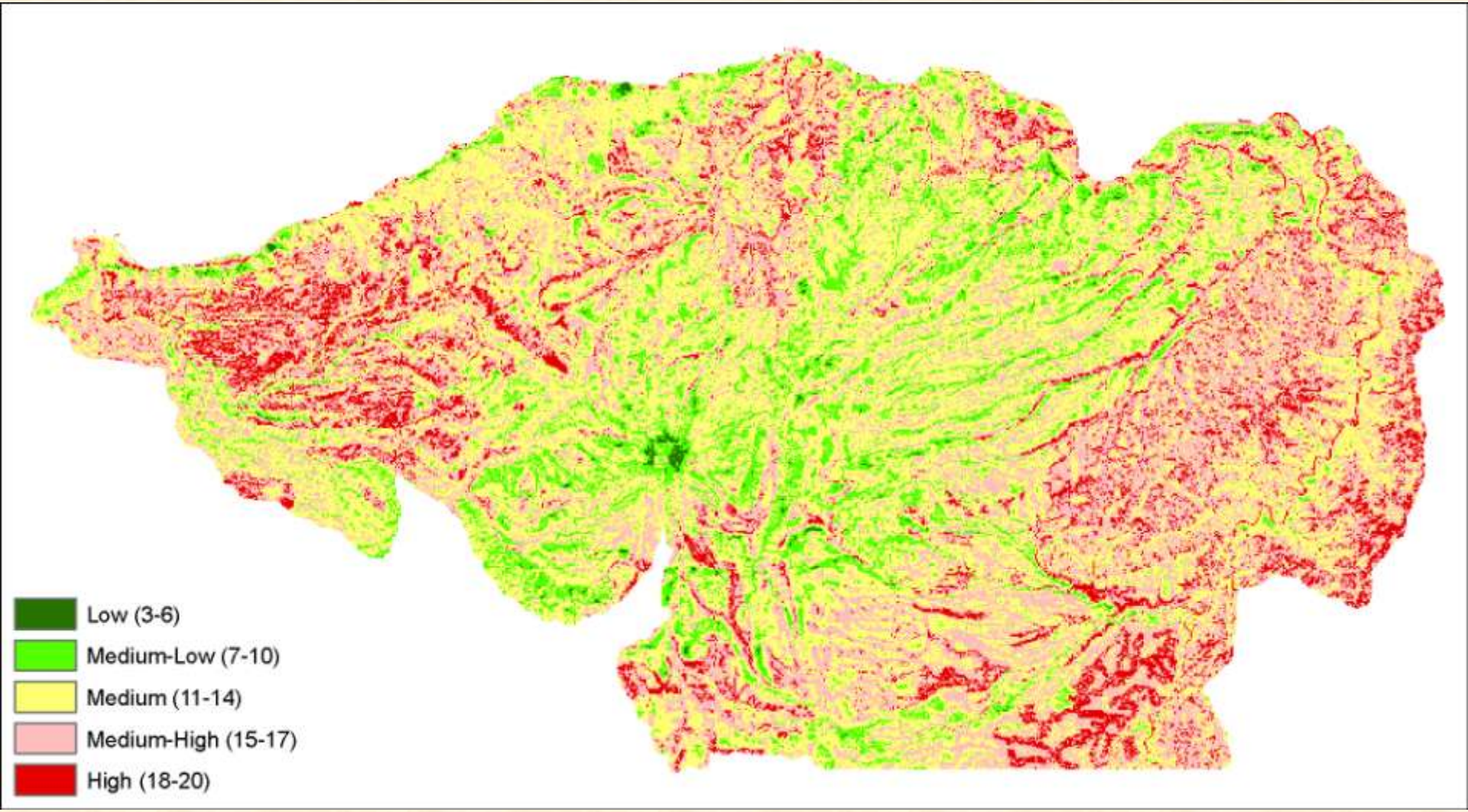
Vector/Raster Intersection

- Relies on previous research (or researcher's personal bias)
- Simple map algebra
- Score environmental variables based on previously know (imagined, believed) suitability for archaeological site occurrence
  - Importance of variable in predicting site locations
- Intersect maps and total up score
  - Map 1 + Map 2 + Map 3 . . . Map X = Prediction Map

Vector/Raster Intersection
Environment and Cultural Themes



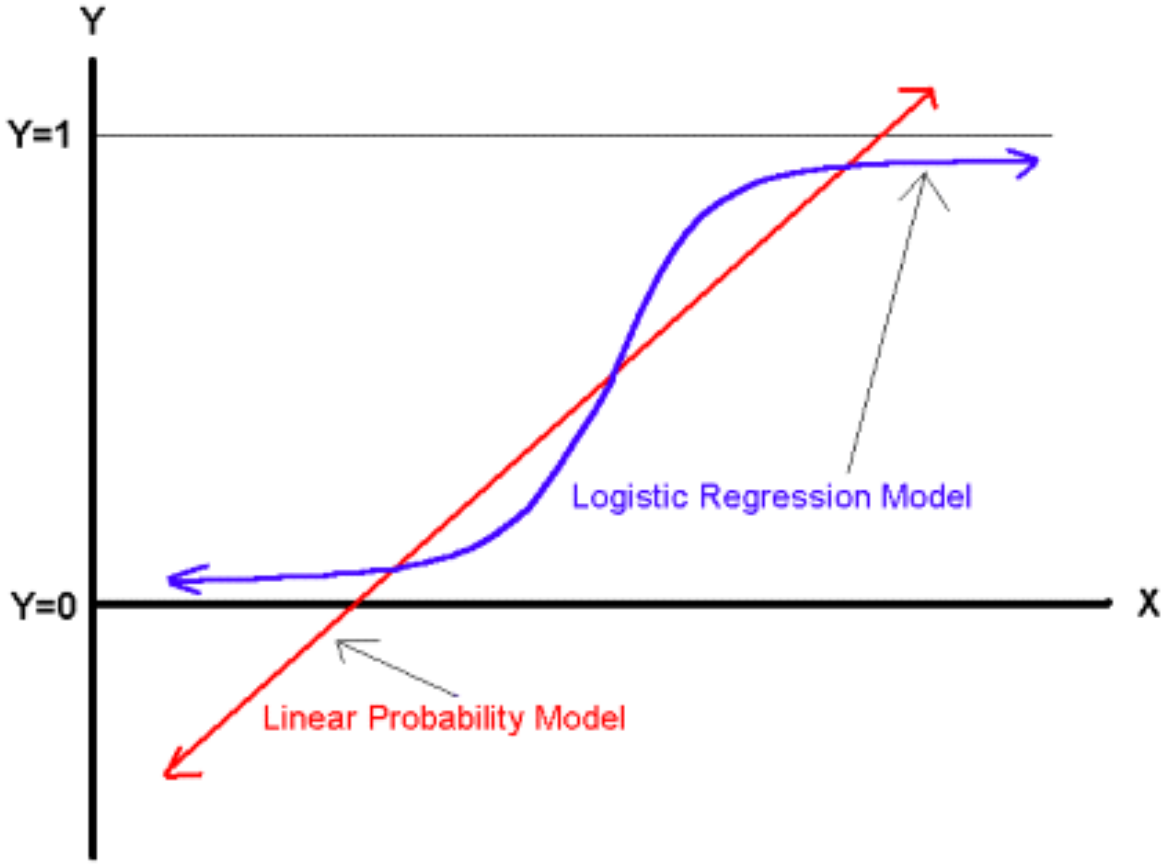
- GLO Features
- Aspect
- Slope
- Distance to Water
- Geologic Features


Low (3-6)
Medium-Low (7-10)
Medium (11-14)
Medium-High (15-17)
High (18-20)

Logistic Regression

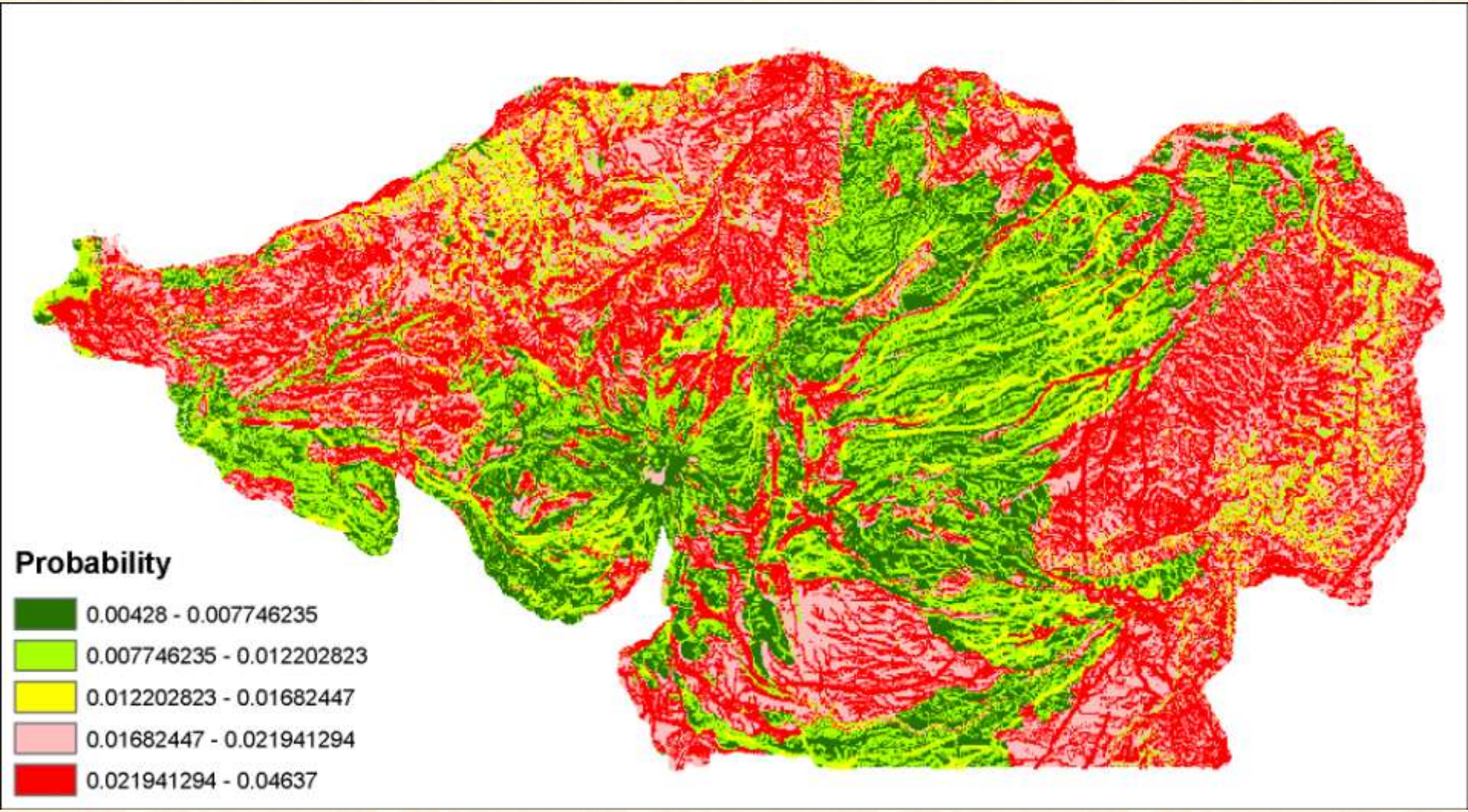
- Considered to be very powerful method
- Uses environmental variables to predict site and non-site locations
  - Presence or absence of sites with environmental variable combinations
- Interaction of environmental variables to determine site and non-site locations
  - Need non-site locations to associate environmental variables with negative information
- Creates S-shaped regression curve
- Does not require normal data

Comparing the LP and Logit Models



Logistic Regression

- First stage is data conversion
  - Converting data to raster
- Next stage is deriving environmental variables from the data
- Final stage is analyzing and evaluating the relationship between the archaeological database (the dependent variable) and the environmental (or independent) variables


Probability
0.00428 - 0.007746235
0.007746235 - 0.012202823
0.012202823 - 0.01682447
0.01682447 - 0.021941294
0.021941294 - 0.04637

Weights of Evidence

- Uses known archaeological site locations
  - Don’t need non-site locations
  - Environmental variables
- Bayes theorem
  - *event A* conditional on another event *B* is generally different from the probability of *B* conditional on *A*.

$$P(A|B) = \frac{P(B|A)\,P(A)}{P(B)}$$
$$\propto L(A|B)\,P(A)$$

- Calculates prior probability (a priori probability) or occurrence of sites across study area

$$\text{posterior} = \frac{\text{likelihood} \times \text{prior}}{\text{normalizing constant}}$$

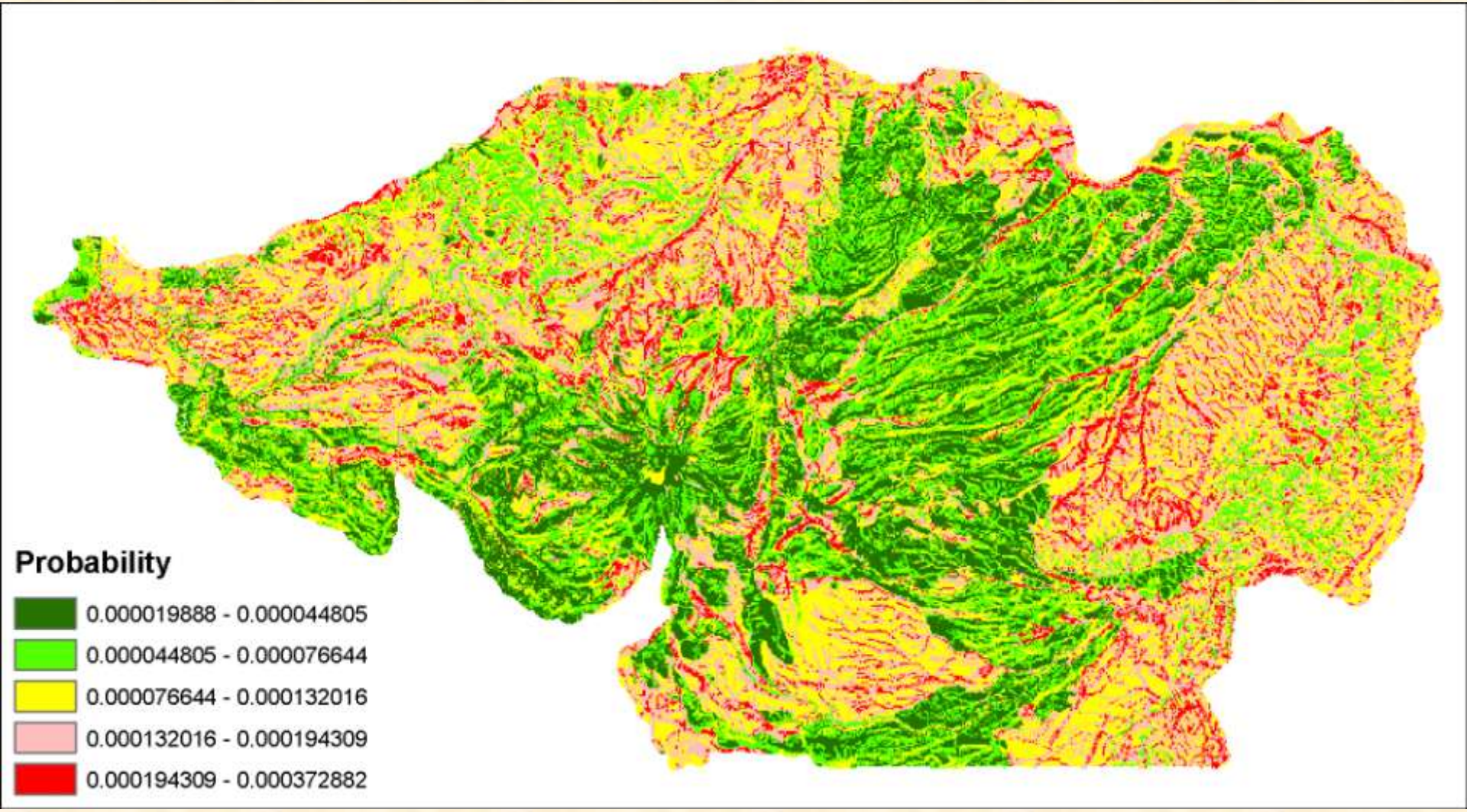
- Calculates posterior probability
  - Posterior probability is proportional to the product of the prior probability and the likelihood

Weights of Evidence

- Known sites
- Environmental variables
- Occurrence of sites at specific environmental variables
- Intersection of these variables across landscape means prediction for site

Weights of Evidence

- Posterior probability
  - Closer to 1, better prediction
  - Value greater than prior probability indicates some predictive power
  - Value lower than prior probability indicates little predictive power
- Can scale posterior probability into different levels of probability (high, medium, and low)


Probability
0.000019888 - 0.000044805
0.000044805 - 0.000076644
0.000076644 - 0.000132016
0.000132016 - 0.000194309
0.000194309 - 0.000372882