

Introduction to Spatial Analysis

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Spatial Analysis

1. Perform integrated raster/vector analysis.

geostatistical and 3D analysis

2. Derive new information from existing geospatial data.

Terrain/morphological analysis, Spatial relationship, suitable location, point to point distance analysis

3. Query information across multiple data layer

Overlay, matching, query

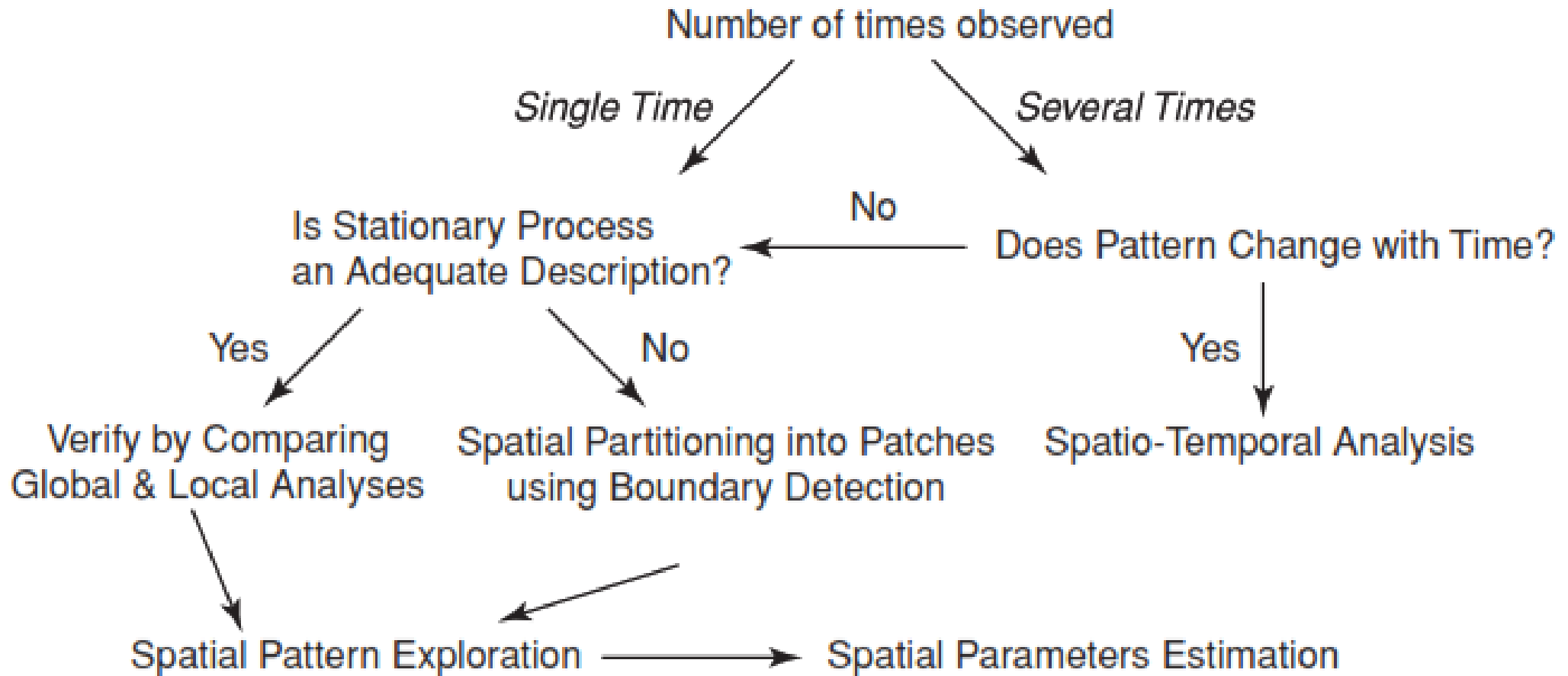
4. Fully integrate cell-based raster data

Multi Criteria Decision Analysis

Spatial Analysis

Fortin MJ. & Dale M.R.T., 2005, Spatial Analysis: A Guide for Ecologist, 2016

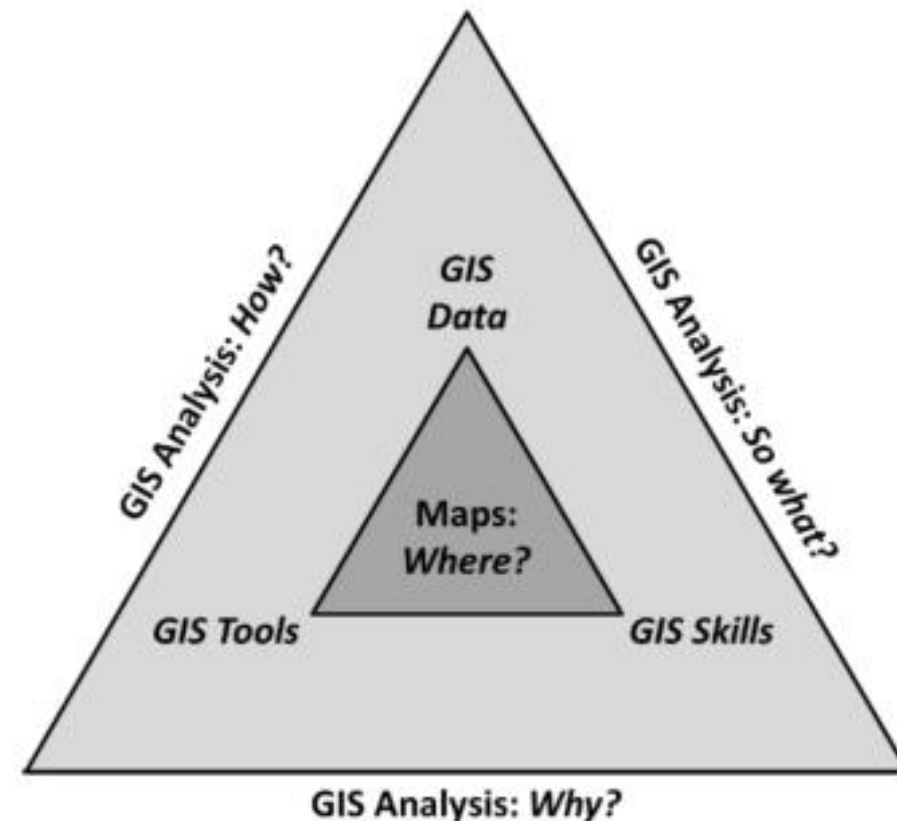
Decision-tree of Spatial Analysis



Spatial Analysis

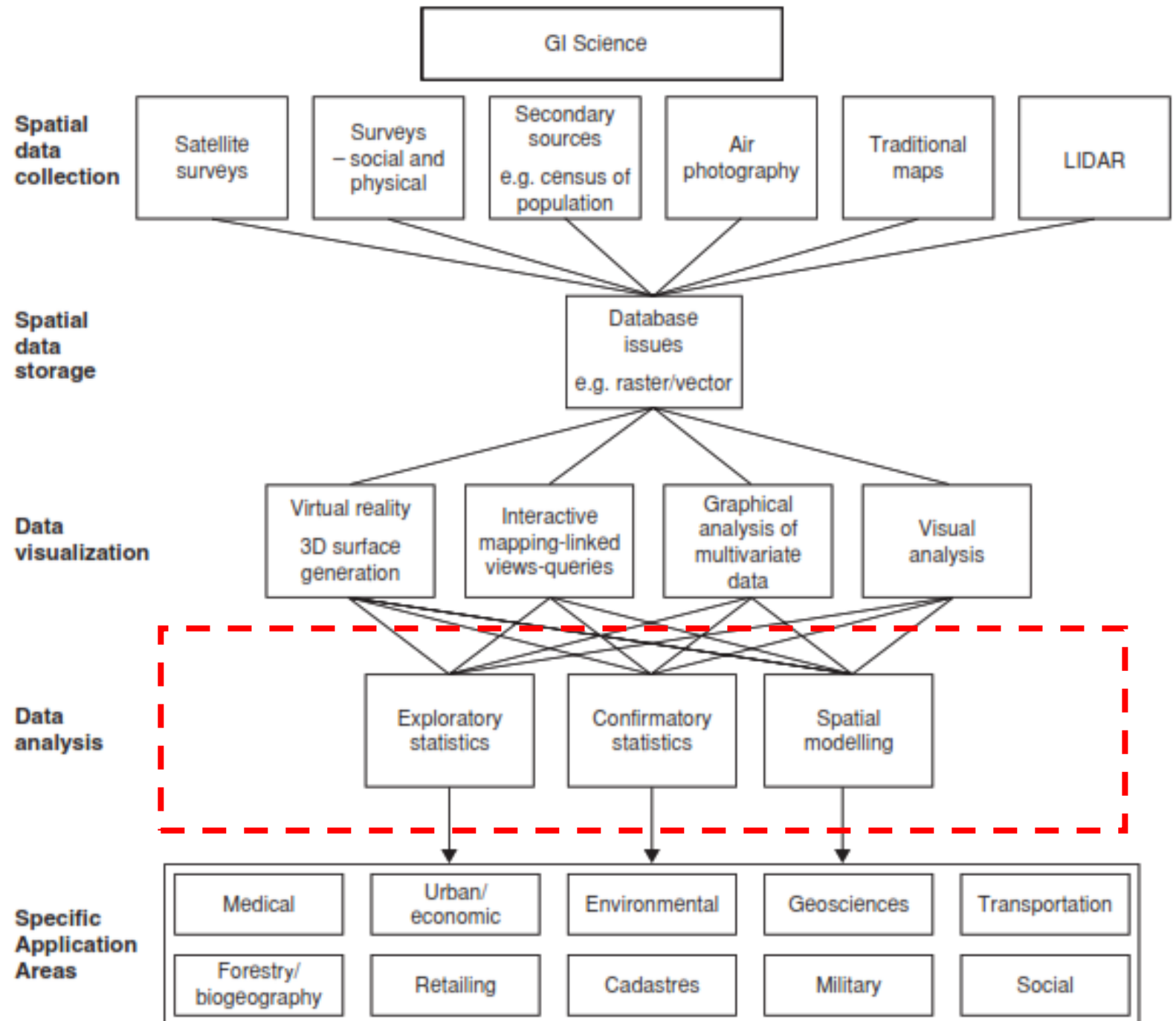
Carsten Braun, 2013, Advanced GIS, 2013

- **Data, Tools, and Skills based**
- **Answer What, Why, and How question**



Spatial Analysis

Fotheringham A.S. & Wilson J.P.,
2013, Geographic Information
Science: An Introduction, 2016



Spatial Analysis

Lloyd C D, 2011, Local Model for Spatial Analysis

- **Spatial Pattern**
- **Spatial Relation**
- **Spatial Prediction**

Spatial Pattern

1	5	10
5	35	50
10	25	50

- **Local Summary Statistics**

Low/High pass filtering, edge detector, texture

- **Geographically Weighted Statistics**

Inverse Distance Weighting (IDW), Moving window/kernel

- **Spatial Autocorrelation**

Moran's I , Geary C Contiguity Ratio

- **Spatial Association and Categorical Data**

Joint count approach, dissolve

$$\bar{z}_i = \sum_{j=1}^n z_j w_{ij}$$

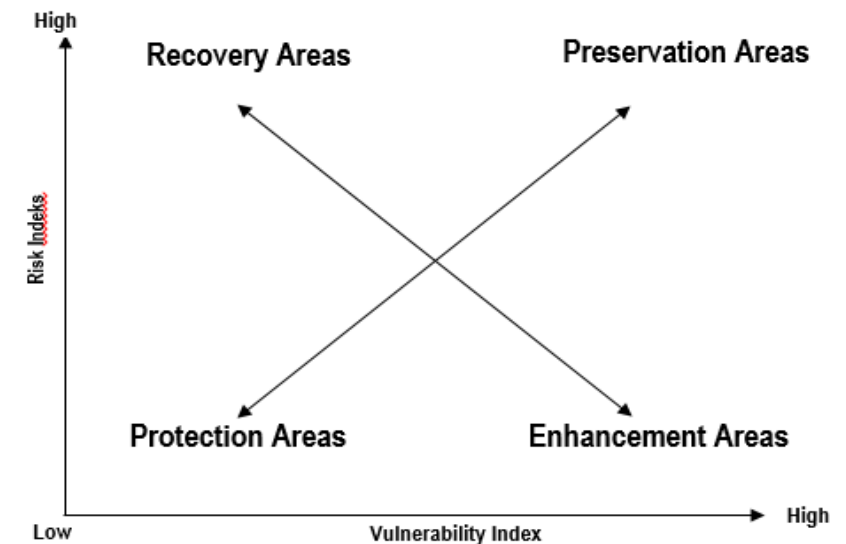
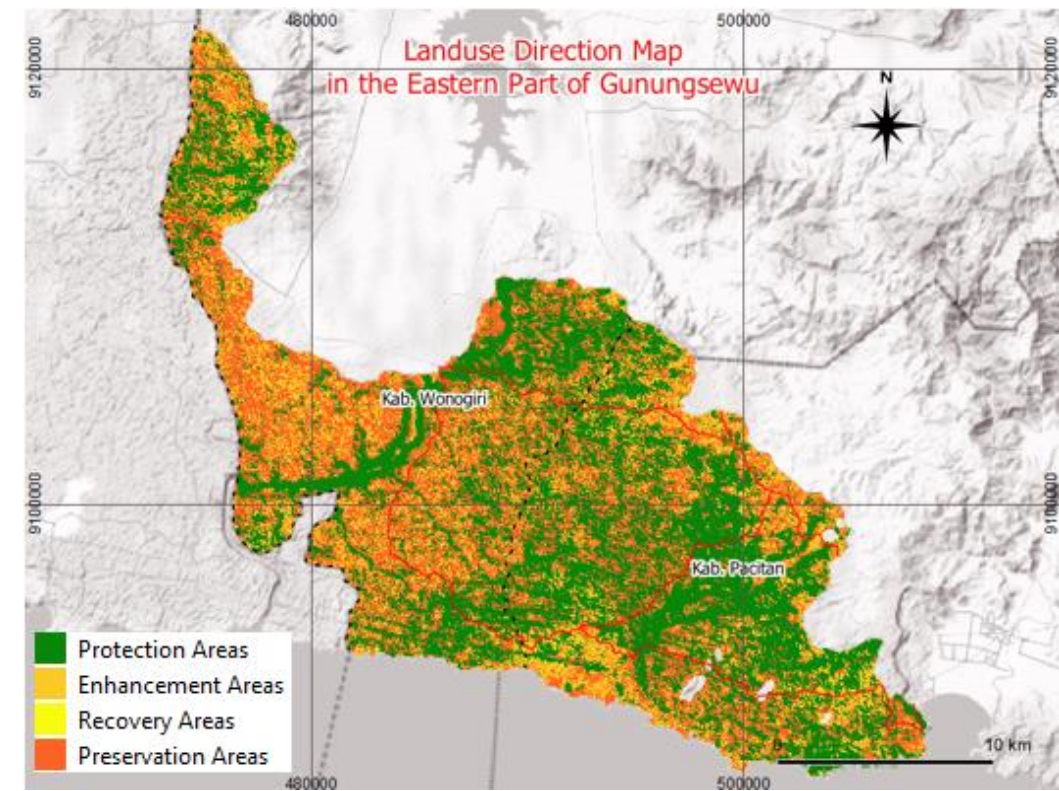
$$I = \frac{n \sum_{i=1}^n \sum_{j=1}^n w_{ij} (y_i - \bar{y})(y_j - \bar{y})}{(\sum_{i=1}^n (y_i - \bar{y})^2) \left(\sum_{i=1}^n \sum_{j=1}^n w_{ij} \right)}$$

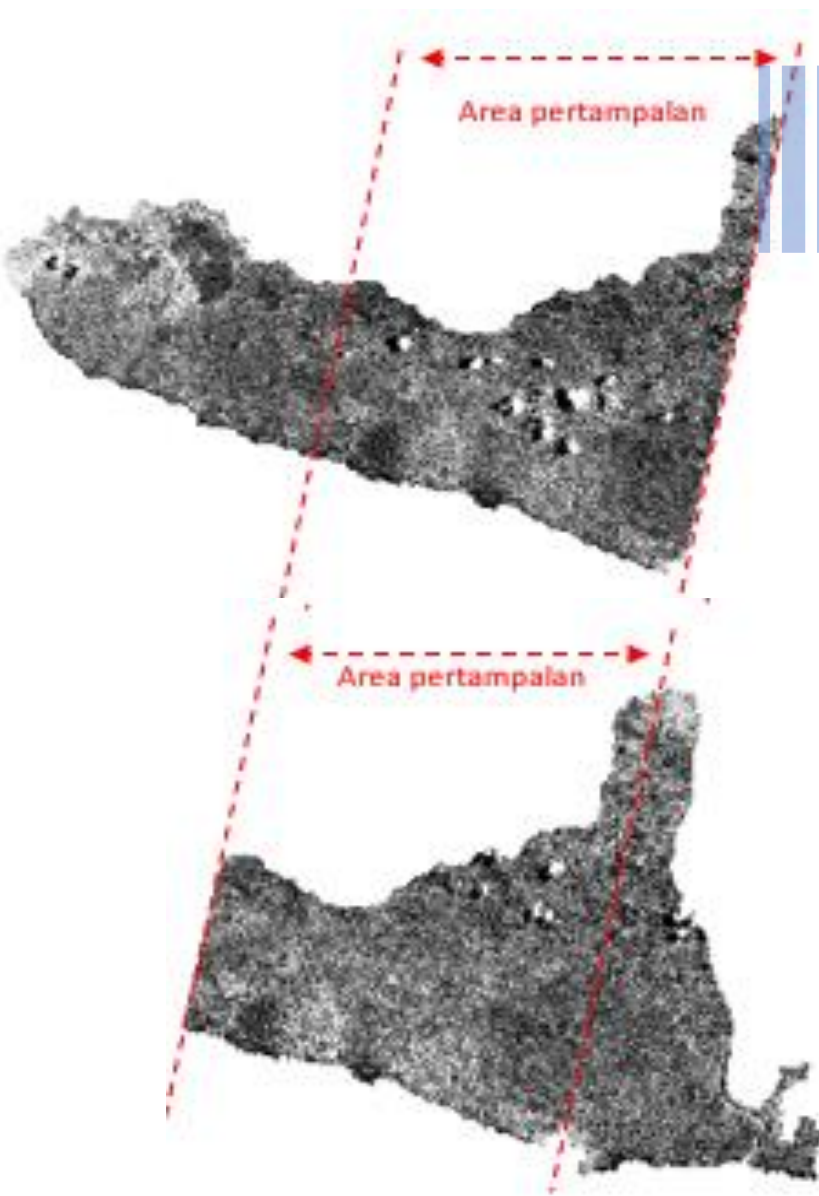
$$c = \frac{(n-1) \sum_{i=1}^n \sum_{j=1}^n w_{ij} (y_i - y_j)^2}{2 \left(\sum_{i=1}^n (y_i - \bar{y})^2 \right) \left(\sum_{i=1}^n \sum_{j=1}^n w_{ij} \right)}$$

Spatial Relation

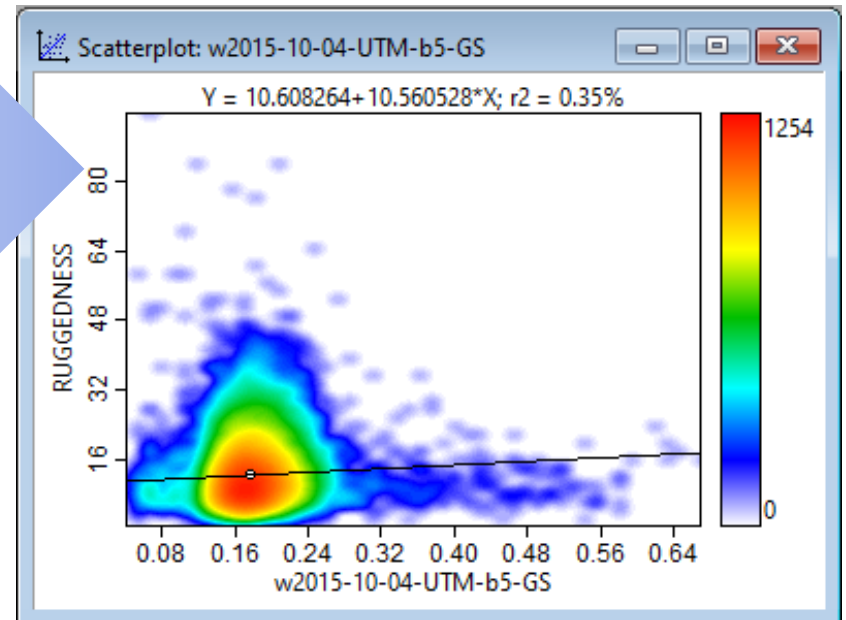
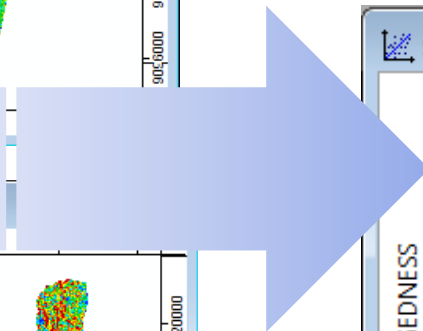
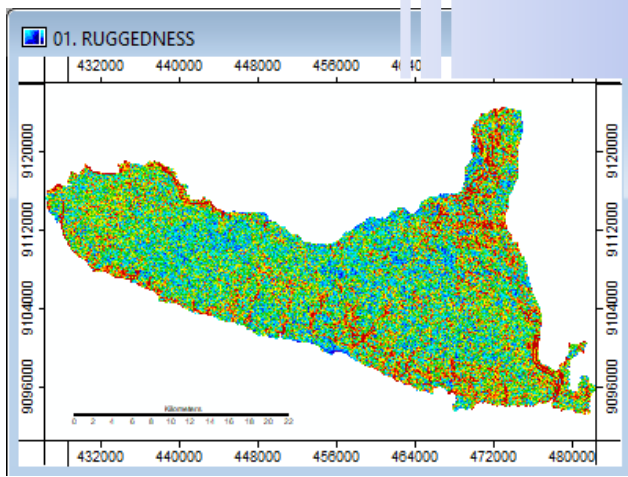
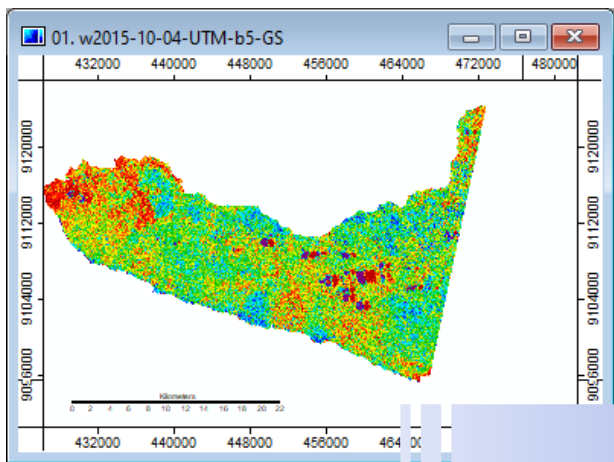
$$z_i = \beta_0 + \beta_1 x_{1i} + \dots + \beta_k x_{ki} + \varepsilon$$

- **Global Regression**
Ordinary Least Square (OLS)
- **Spatial and Local Regression**
Spatial Expansion Method (SEM)
- **Geographically Weighted Regression**
- **Spatially Weighted Classification**



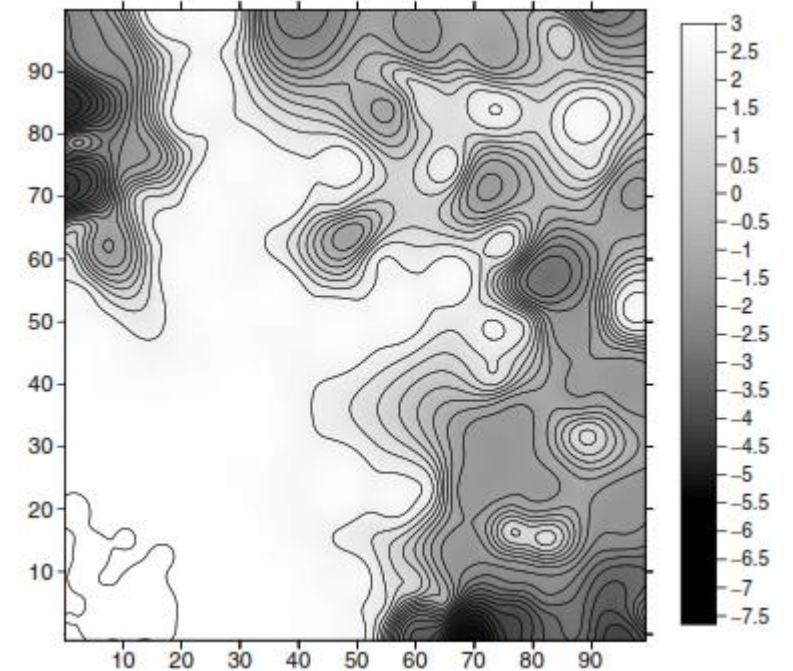


Band	Regression
Band 2	$Y = -0.014653 + 1.053567 X$
Band 3	$Y = 0.003241 + 1.056769 X$
Band 4	$Y = -0.0045632 + 1.183726 X$
Band 5	$Y = 0.054388 + 0.974324 X$
Band 6	$Y = 0.041282 + 0.962750 X$
Band 7	$Y = 0.019551 + 1.002011 X$



Spatial Prediction

- **Deterministic Method, Curve Fitting, Smoothing**
Point Interpolation
- **Geostatistic**
Kriging



$$\hat{z}_{SK}(\mathbf{s}_0) - m = \sum_{i=1}^n \lambda_i^{SK} [z(\mathbf{s}_i) - m]$$

Thank you....