Raster Analysis: An Example

Fires (1 or 4)

Slope (1-4)

+ Geology (1-4)
_____

Erosion Ranking (3-12)

Typical Raster Model Types:

❑ Suitability Modeling: Where is optimum location?

❑ Distance Modeling: What is the most efficient path from A to B?

❑ Volume and/or area calculations – strip mine remediation, dams and reservoirs, flooding

❑ Surface Modeling: What is concentration of x for area y?

❑ Spatial Density or Hot Spot: Where are highest occurrences of x for some normalized area?

❑ Hydrologic Modeling – where will water flow across a landscape?

Conceptual Modeling Process

1. State the problem or formulate a hypothesis

2. Break the problem down

3. Explore input data

4. Perform analysis

5. Verify results (if possible)

1. State the Problem

- What is your goal, *in one simple sentence*?
  - Single most important step – must be clearly articulated before beginning.

E.g. Where will problems with surface runoff and erosion be greatest in Yellowstone N.P. after the fires of 1988?

Goal: A "suitability" map of Yellowstone N.P. showing ranking, from 1 to 10, of potential for runoff and erosion problems at a resolution of 100 m^2.

2. Break the Problem Down

A. What are the objectives to reach goal?

B. What are the phenomena and interactions necessary to the model?

C. What datasets are needed (or are available)?

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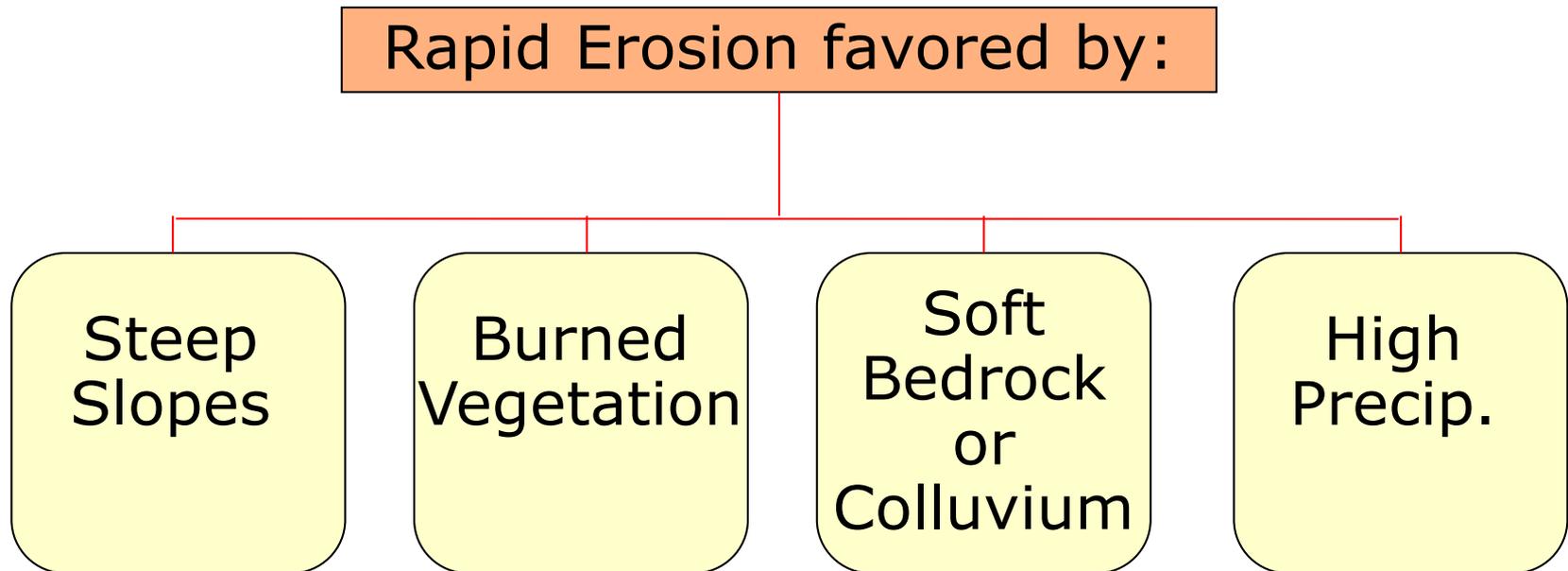
2. Break the Problem Down

A. What are the objectives to reach goal?

   i. Identify factors that control runoff and erosion, e.g.

> **Slope, Bedrock Geology, Vegetation vs. Burned areas, Precipitation**

   ii. What is relative importance of these factors, i.e. how will each be ranked and weighted?

2. Break the Problem Down

ii. What is relative importance of these factors?

Rapid Erosion favored by:

| Steep Slopes | Burned Vegetation | Soft Bedrock or Colluvium | High Precip. |

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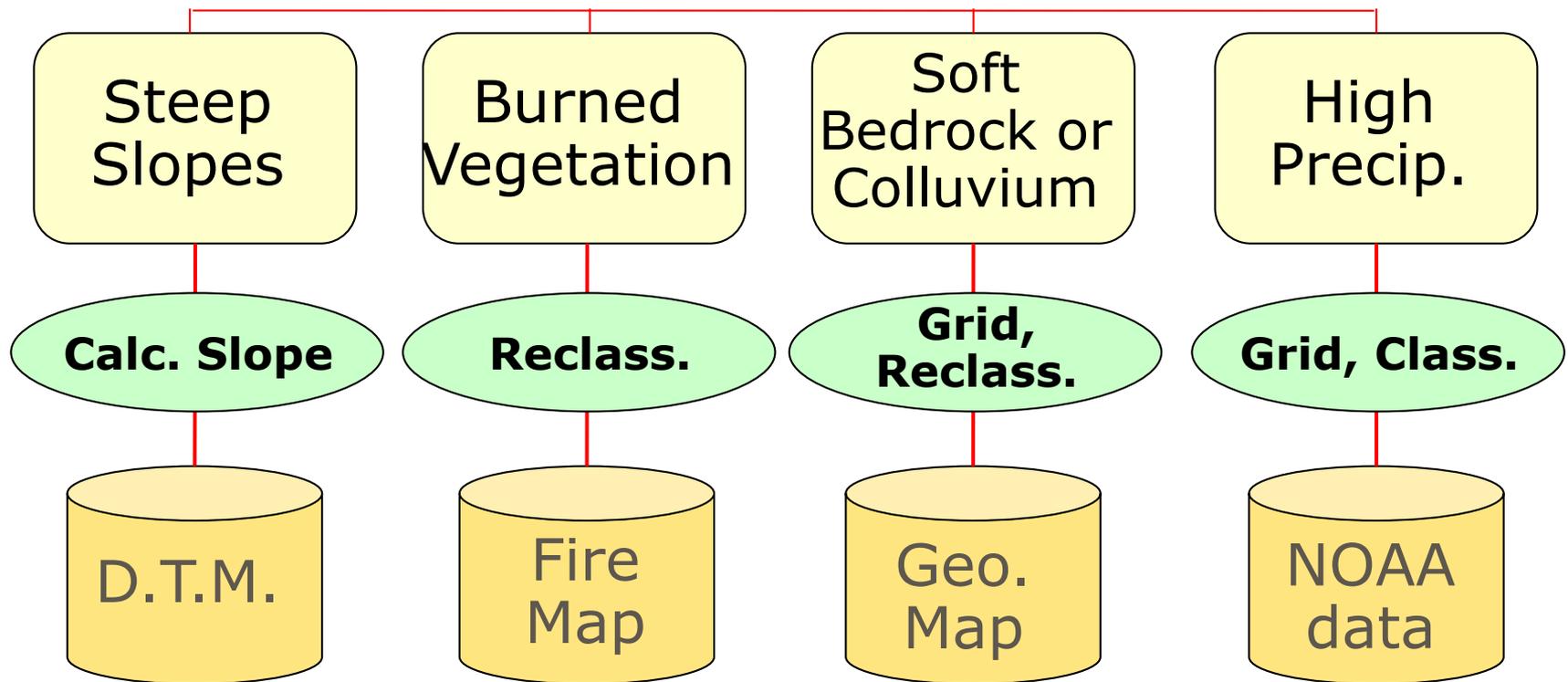Jackson School of Geosciences, University of Texas at Austin

2. Break the Problem Down

ii. What is relative importance of these factors, i.e. how will each be ranked (and weighted)? Example:

Rank	Geology	Slope	Burn	Precip.
1	Pre-Eocene rocks	$<10^o$	No	Low; W mm
2	lava flows and sediments	10°-20°	---	X mm
3	Ash flows, air fall tuffs	20°-30°	---	Y mm
4	Unconsolidated sediment	$>30^o$	Yes	High; Z mm

2. Break the Problem Down

C. What datasets are needed?

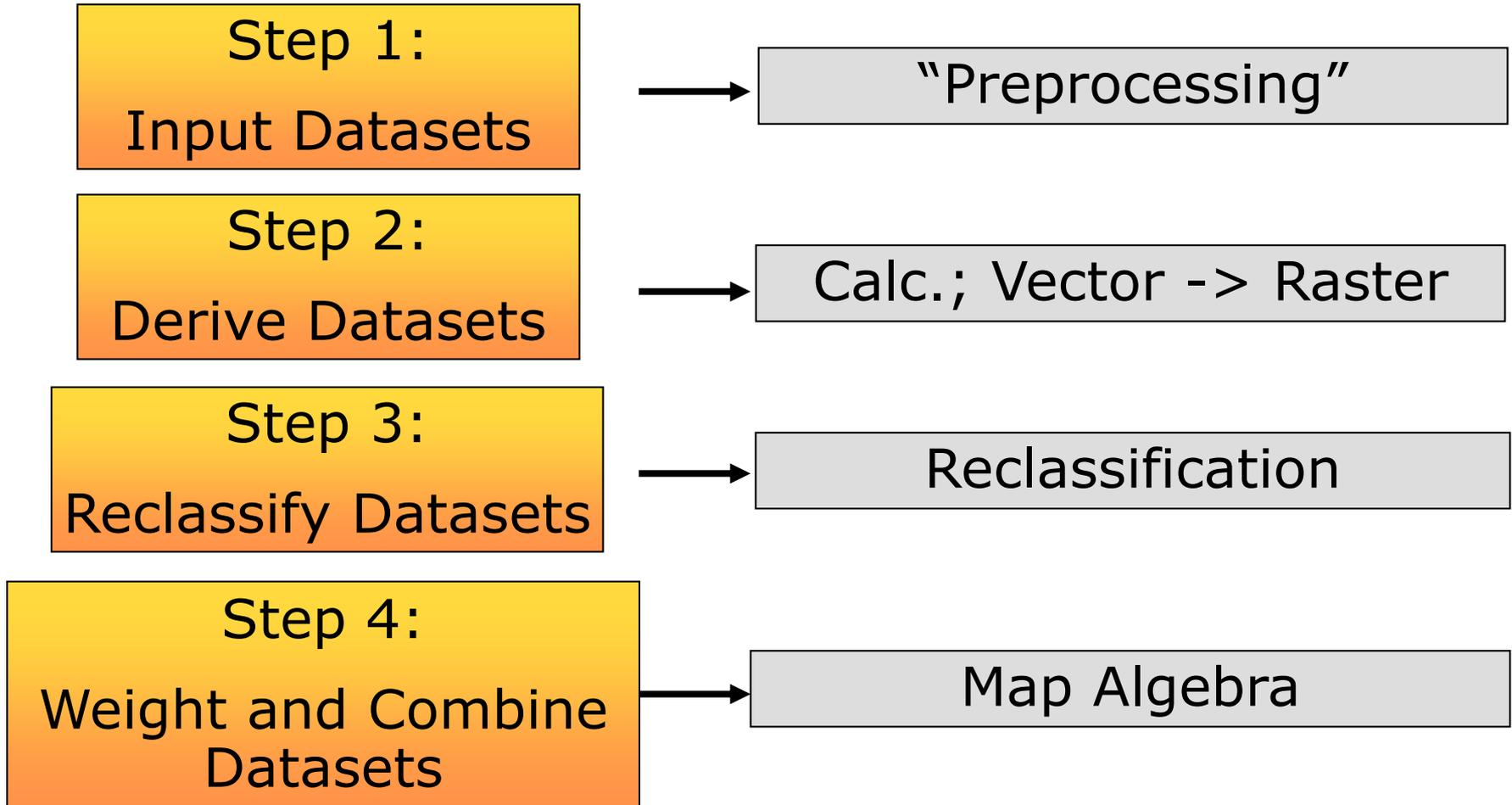| Steep Slopes	Burned Vegetation	Soft Bedrock or Colluvium	High Precip.
Calc. Slope	**Reclass.**	**Grid, Reclass.**	**Grid, Class.**
D.T.M.	Fire Map	Geo. Map	NOAA data

3. Explore Input Datasets

❑Rasters:

    ❑What are resolutions and extents?

    ❑If using extended rasters, what's in the VATs?
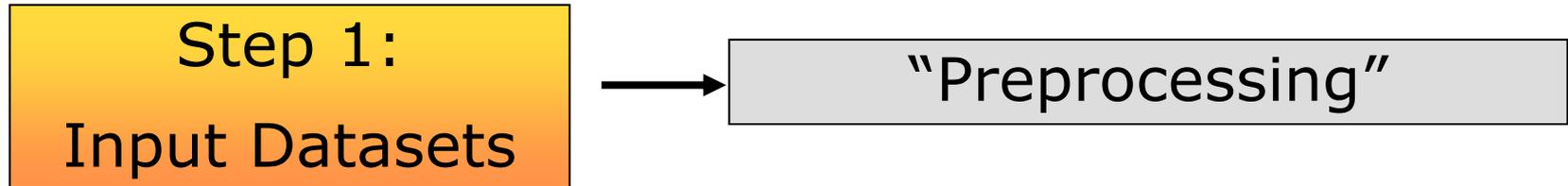
    ❑What are ranges for values?

❑Vector datasets:

    ❑Explore attribute table – what field will be used for ranking?

    ❑Can polygons be aggregated?

    ❑Can dataset be clipped to smaller size?
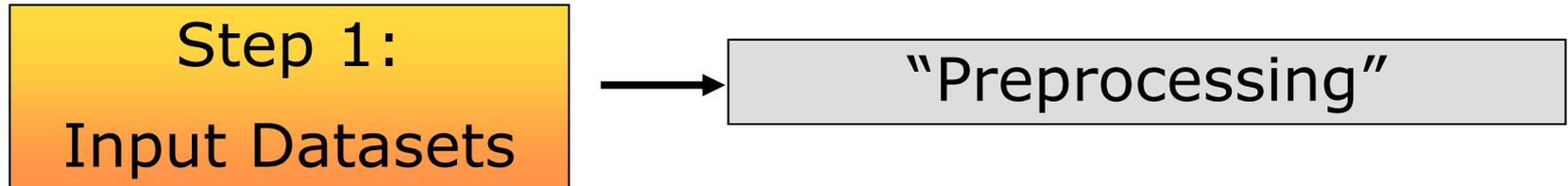
4. Perform Analysis

Step 1: Input Datasets	→ "Preprocessing"
Step 2: Derive Datasets	→ Calc.; Vector -> Raster
Step 3: Reclassify Datasets	→ Reclassification
Step 4: Weight and Combine Datasets	→ Map Algebra

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4. Perform Analysis: Step 1

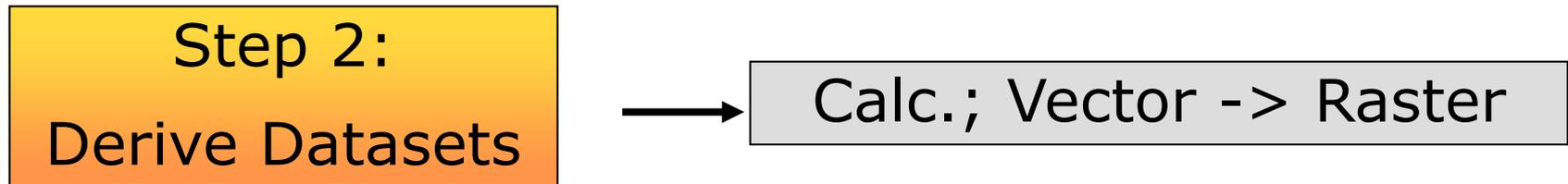| Step 1: Input Datasets | → | "Preprocessing" |

1. Projection: Choose a GCS or PCS and project files as needed.

2. Define grid properties, create and set mask

3. Table joins, symbolize, create layer files

4. Aggregate and/or clip vector data

5. Import and plot point data for gridding

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4. Step 1 – This example

| Step 1:
Input Datasets | → | "Preprocessing" |

1. Define/project all raster & vector files to a common spatial reference

2. Set grid properties, temp. directory, analysis mask (created from vector file of park boundary)

3. Join look-up tables to geology vector files, symbolize by multiple fields, save layer files for full and simplified geology polygons and arcs.

4. Dissolve geology polygons to simplify units; clip result to park boundary

5. Add field to geology attribute table for "erosivity" rank

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4. Perform Analysis; Step 2

| Step 2: Derive Datasets | ⟶ | Calc.; Vector -> Raster |

1. Calculate slope grid

2. Create geology raster from vector polygons

3. Create precipitation grid from point data

 - could also created buffers, find distances, calculate densities in this step, if needed

4. Step 2 – This example

Step 2: Derive Datasets	⟶	Calc.; Vector -> Raster
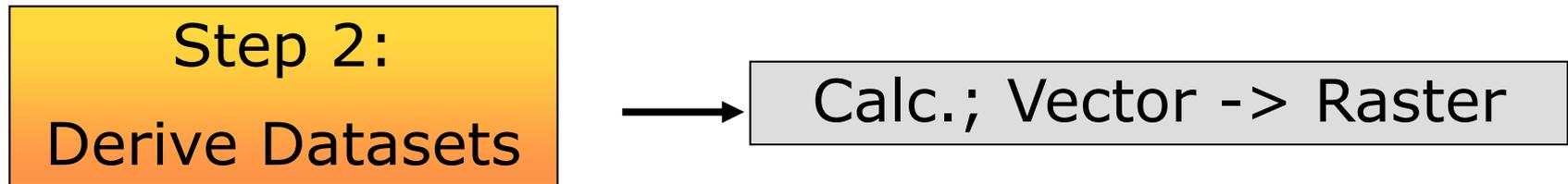
1. Create slope grid from DEM

2. Create geology grid from dissolved and clipped geology polygon shapefile; cell values are 1-17 codes for unit names

3. Perform IDW or Spline interpolation to generate 100 m^2 resolution grid of precipitation.

4. Perform Analysis: Step 3

Step 3:

Reclassify Datasets
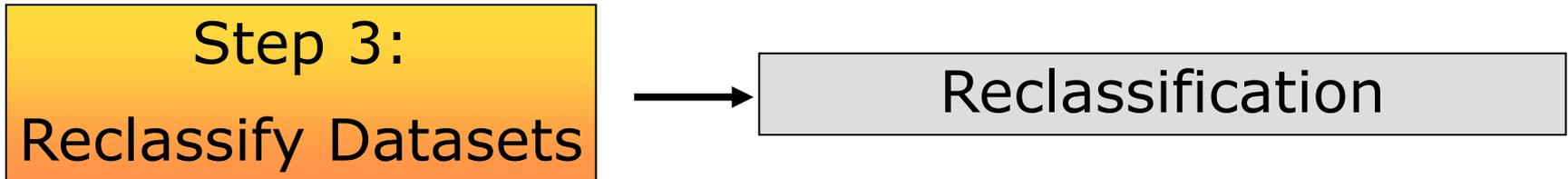
→ Reclassification

☐ Reclassify each grid by common scale, e.g. 1-4, giving higher values to more suitable attributes

4. Step 3 – This example

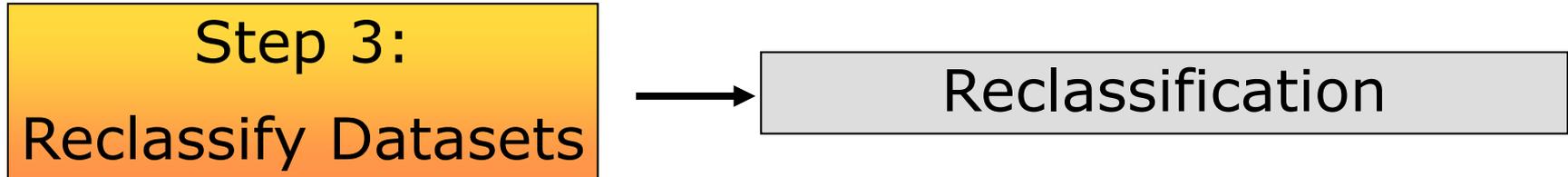**Step 3: Reclassify Datasets** → Reclassification

Rank	Geology	Slope	Burn	Precip.
1	Pre-Eocene rocks	$<10^o$	No	Low; W mm
2	lava flows and sediments	10°-20°	---	X mm
3	Ash flows	20°-30°	---	Y mm
4	Unconsolidated sediment	$>30^o$	Yes	High; Z mm

4. Step 3 – This example

Step 3:

Reclassify Datasets $\longrightarrow$ Reclassification

1. Reclassify slope grid into four slope categories

2. Reclassify geology grid codes to four "erosivity" values

3. Reclassify burn map into burn, no burn and no data; assign burn and no burn cells a 4 and 1, respectively.

4. Reclassify precip. values to four categories.

4. Perform Analysis: Step 4

| Step 4: Weight and Combine Datasets | → | Map Algebra |
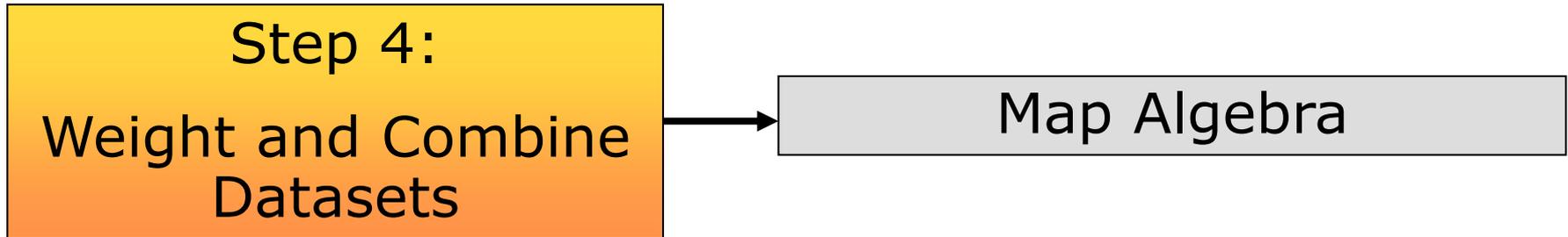
- ☐ Arrive at weights for each dataset

- ☐ Using the Raster Calculator, construct an expression that multiplies each grid by its weight and adds them all, creating a suitability raster.

- ☐ Examine, classify, and symbolize the new raster.

4. Step 4 – This example

Step 4: Weight and Combine Datasets	→ Map Algebra
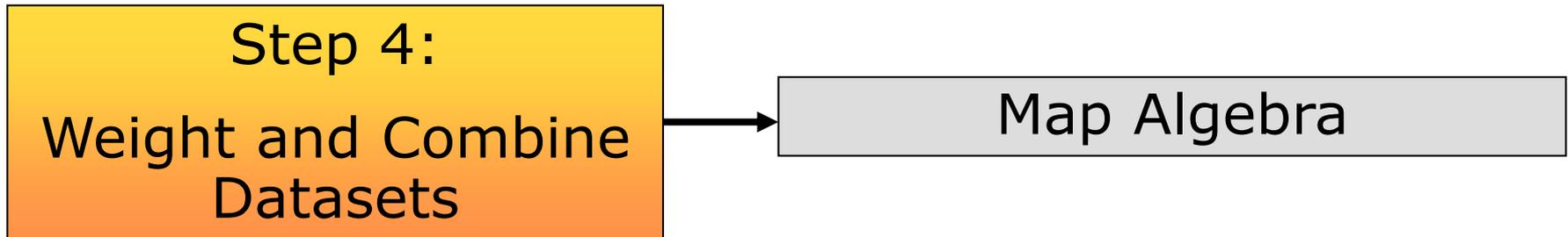
1. No weights assigned; no valid basis for doing so.

2. Grids added to produce raster of cells with values between 1-12.

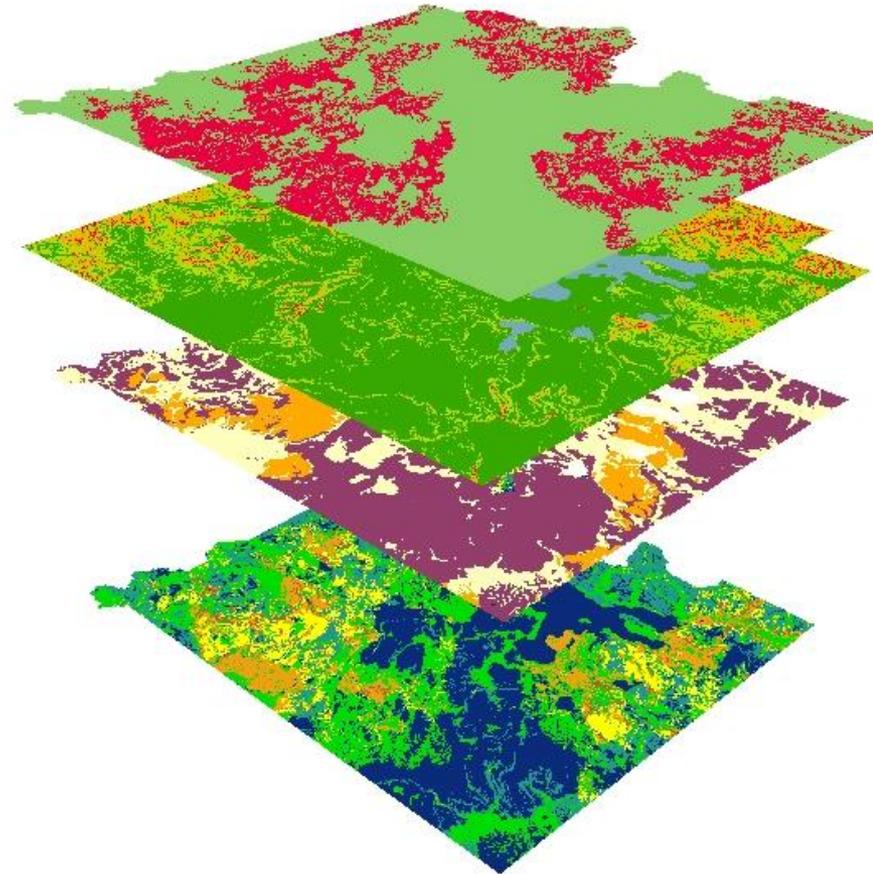3. New raster symbolized by classifying into six categories.

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Map Algebra

Fires (1 or 4)

Slope (1-4)

+ Geology (1-4)

_____

Erosion Ranking (3-12)

FIRES
VALUE
- 0: Unburnt
- 4: Burned

SLOPE
<VALUE>
- 1: 0 - 10 degrees
- 2: 11 - 20 degrees
- 3: 21 - 30 degrees
- 4: 31 - 62 degrees

GEOLOGY: Erosivity
VALUE
- 1: Refractory
- 2: Hardly erodable
- 3: Moderately erodable
- 4 Easily eroded

RESULT of Summation
Value
- 1 - 2: Erosion at a minimum
- 3 - 4
- 5 - 6
- 7 - 8
- 9
- 10 - 12: Erosion maximized

5. Verify Results

☐ Are empirical data available to test results?

☐ Are other modeling result available to compare?

☐ Can analysis be adjusted (e.g. rasters re-weighted) to fit measured results?

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