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CENTER FOR BIODIVERSITY AND CONSERVATION

# Vector and raster data

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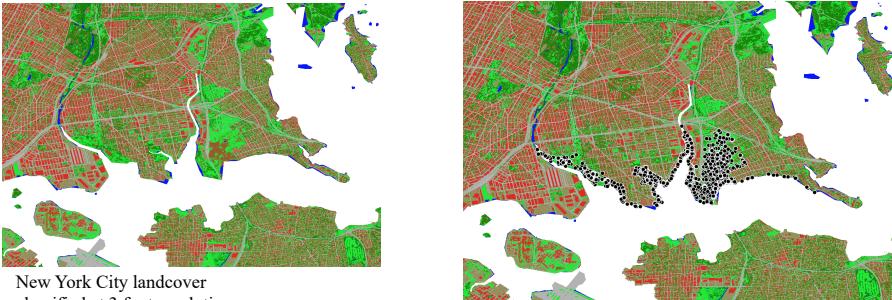
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## Two methods of GIS representation

- There are two main ways a GIS can create a logical data model of the world:
  - Raster = continuous fields
  - Vector = discrete features

New York City landcover classified at 3 foot resolution

Coyote occurrence records (as vector layer)



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# Vector

- Discrete objects
  - Represents the geographic world as objects with well-defined boundaries in otherwise empty space

Data from  
[naturalearthdata.com](http://naturalearthdata.com)

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# Vector Data

- Vector data represents features as *points*, *lines*, and *polygons*.
- It is best applied to discrete objects with defined shapes and boundaries.
- It is tied with tabular data

- Examples include:
  - GPS points
  - Roads
  - Protected areas

prefix	number	class	type	divided	country	state
1	Other	Unpaved			United States	California
2	Other	Other Paved			United States	Nevada
3	S2	Other	Other Paved		Mexico	
4	S1	Other	Other Paved		United States	California
5	S1	Other	Secondary	Undivided	United States	California
6	Other	Secondary	Undivided		United States	California
7	Other	Other Paved			Mexico	Puebla
8	Other	Other Paved			Mexico	Puebla

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# Vector data

- Classifying vector data by attributes
  - Attribute tables show categories of values (usually)
  - Some columns are necessary for making useful maps
- Attribute data can also be used for labeling
  - Many artistic options for adding labels

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# Vector data

- Vector data types:
  - 1. Whole number (integer)
  - 2. Whole number (64 bit integer)
  - 3. Decimal number (real)
  - 4. Text (string)
  - 5. Date
  - 6. Date & Time
  - Set the length (number of significant digits, etc.)

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name_id	name_it	name_ja	name_ko	name_nl	name_pl	name_pt	name_ru	name_sv	name_tr
1085									
1086									
1087	Cavite	Provincia d...	カヴィ テ州	카비테 주	Cavite	Prowincja ...	Provincia d...	Кавите	Provins Cav...
1088	Batangas	Provincia d...	バタンガス	바탕가스 주	Batangas	Batangas	Батангас	Batangas	Batangas
1089									
1090	Sorsogon	Provincia d...	ソルソゴン州	소르소곤 주	Sorsogon	Sorsogon	Сорсогон	Sorsogon	Sorsogon
1091	Albay	Provincia d...	アルバイ州	알바이 주	Albay	Albay	Албай	Albay	Albay
1092	Camarines ...	Provincia d...	南カマリネ...	남카마리네...	Camarines ...	Camarines ...	Южный Ка...	Camarines ...	Camarines ...
1093	Camarines ...	Provincia d...	北カマリネ...	북카마리네...	Camarines ...	Camarines ...	Северный ...	Camarines ...	Camarines ...
1094	Quezon	Provincia d...	ケソン州	케손 주	Quezon	Quezon	Кесон	Quezon	Quezon
1095	Aurora	Provincia d...	アーロラ州	아우로라 주	Aurora	Aurora	Аурора	Aurora	Aurora
1096	Departeme... dipartimen...	... dipartimen...	グラナダン...	그랑다스 주	Grand'Anse	Departame...	Гранд'Анс	Grand'Anse	Grand'Anse
1097	Colima	Colima	コリマ州	콜리마 주	Colima	Colima	Колима	Colima	Colima
1098	Departeme... dipartimen...	リトラル県	リトラル県	리토랄 주	Littoral	Departame...	Литораль	Littoral	Littoral De...
1099	Nayarit	Nayarit	ナヤリット州	나야리트 주	Nayarit	Nayarit	Наирит	Nayarit	Nayarit

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# Vector data

- Field calculator
  - Create/ edit fields using SQL (or the GUI)

The screenshot shows the ArcGIS Field Calculator window. It has two main sections: 'Create a new field' (selected) and 'Update existing field'. Under 'Create a new field', the output field name is set to 'USA', type is 'whole number (integer)', and length is 10. The expression editor contains the SQL code: `"admin" = 'United States of America'`. A tooltip for the 'group aggregates' function is visible on the right side of the interface.

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# Raster

- Continuous fields
  - Represents the real world as a finite number of variables, each one defined at every possible position.
- E.g. a Digital Elevation Model

The screenshot displays a grayscale digital elevation model (DEM) visualization. The terrain is rendered with varying shades of gray, where darker areas represent higher elevations and lighter areas represent lower elevations, illustrating the continuous nature of elevation data across a geographic area.

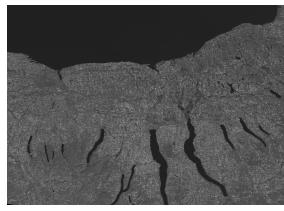
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## Raster Data

A raster model represents the world as a surface that is divided into a regular grid of cells, each of which are assigned a value.

Raster data includes images and grids. aerial photograph, a satellite image, or a scanned map, are often used for generating raster datasets.



Continuous, e.g., worldclim

Categorical


River

Trees

Lake

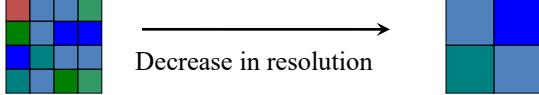
Grass

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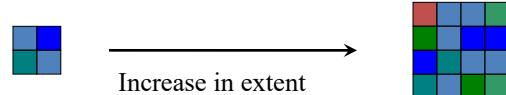
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### General data issues: spatial scale

Spatial scale has two elements: **resolution** and **extent**

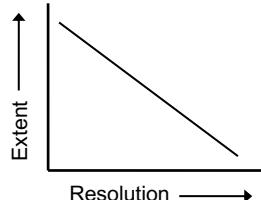


Decrease in resolution



Increase in extent

Resolution and extent tend to be inversely related

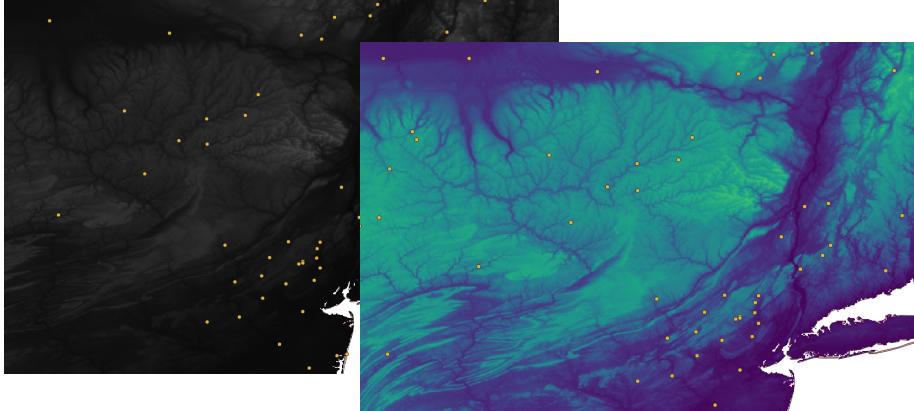


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## Raster data

- Rasters can be rendered to have custom colors
- No attribute table

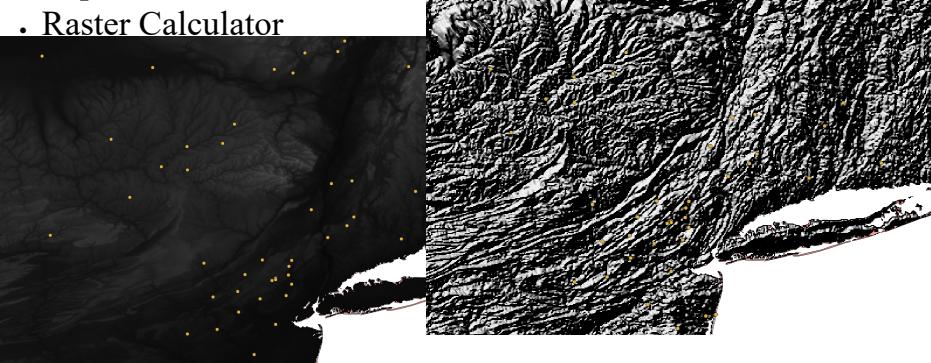


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## Raster data

- Elevation rasters can be used to create hillshade layers
- Viewshed analyses
- Slope
- Aspect
- Raster Calculator

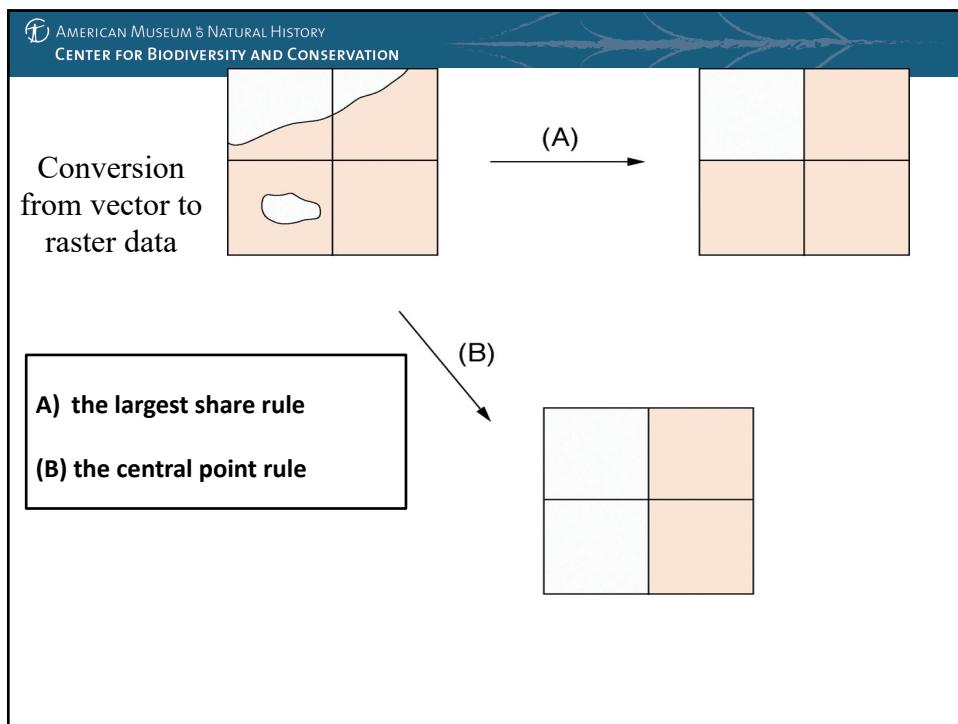


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RASTER	VECTOR
Resolution is explicit in the size of the grid cells / pixels	Resolution is difficult to define and therefore typically poorly defined (not rigorous)

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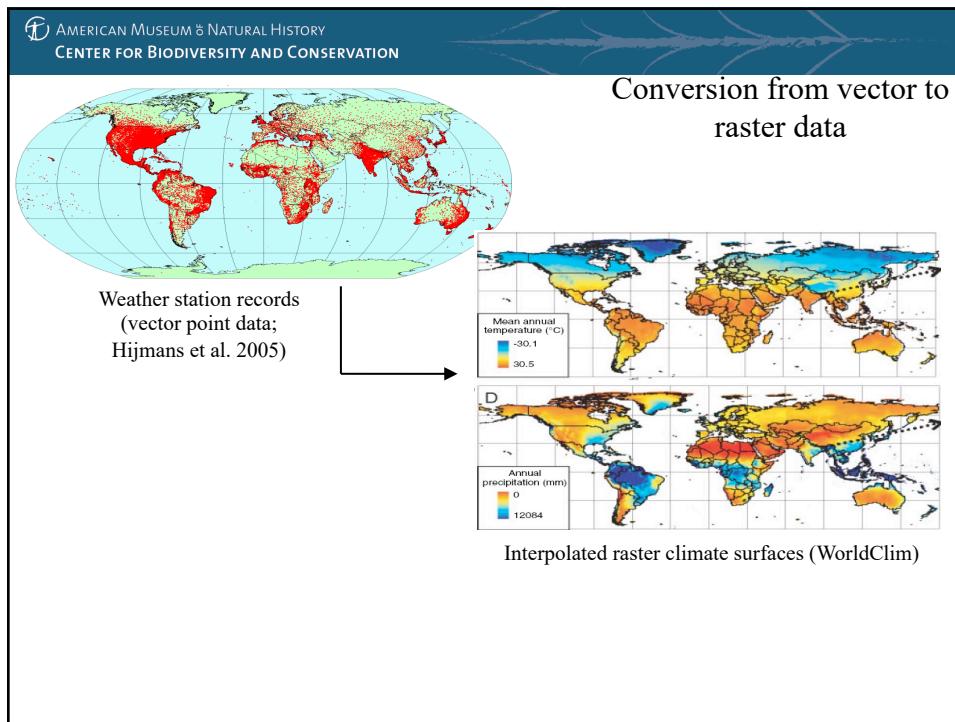
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## The nature of spatial data

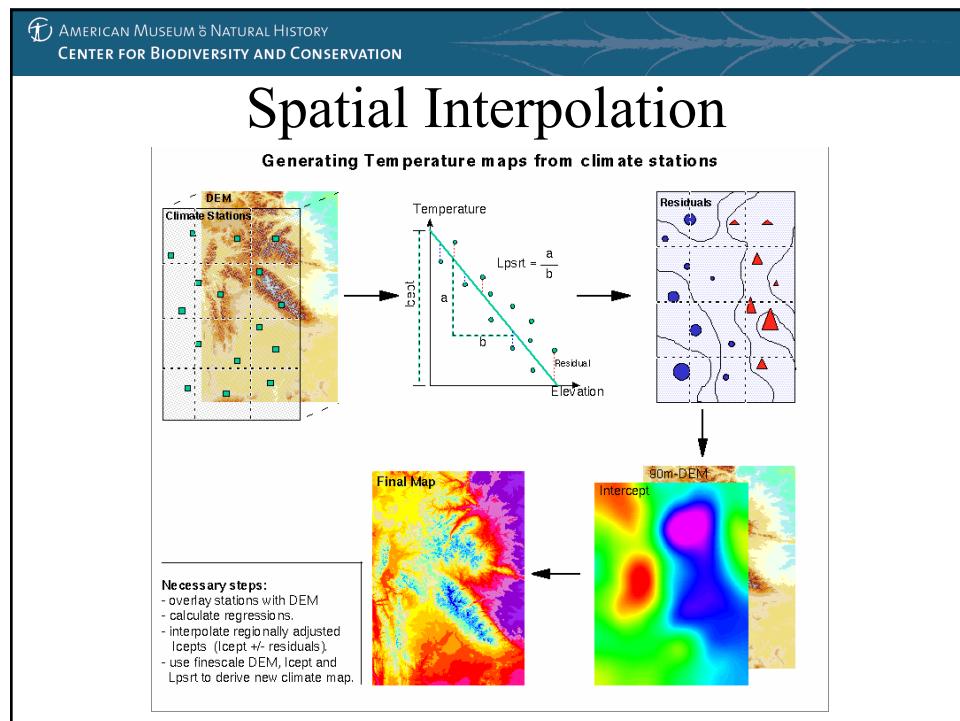
Tobler's First Law of Geography:  
*Everything is related to everything else, but near things are more related than distant things.*

Most of the things we are interested in are not randomly distributed in space.  
Con: Need to correct for spatial autocorrelation and bias in analyses  
Pro: Allows for interpolation

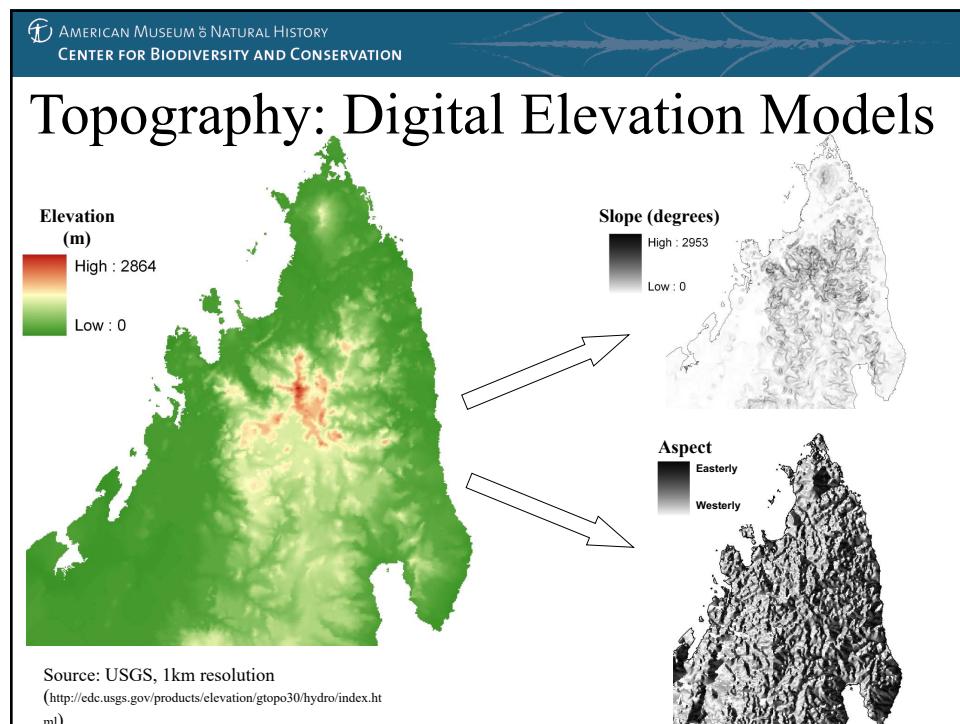
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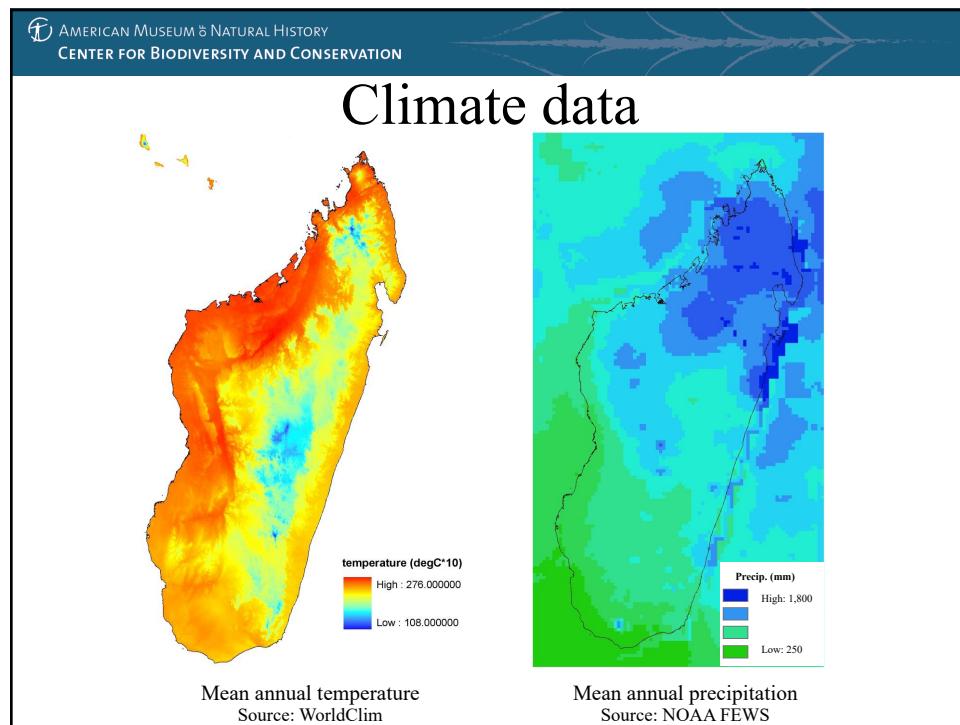
20



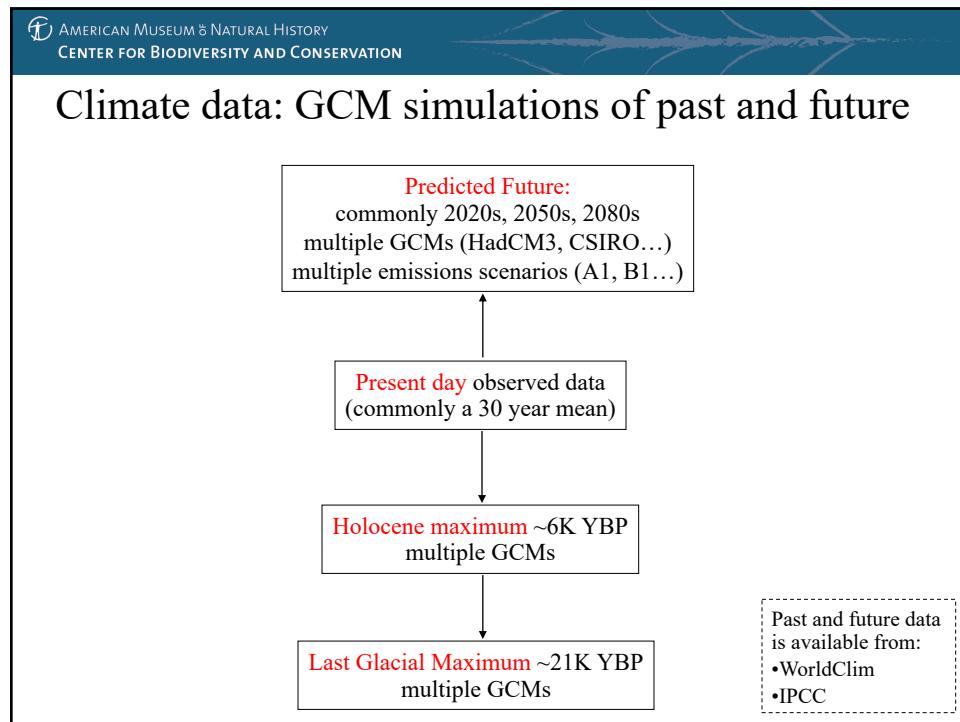
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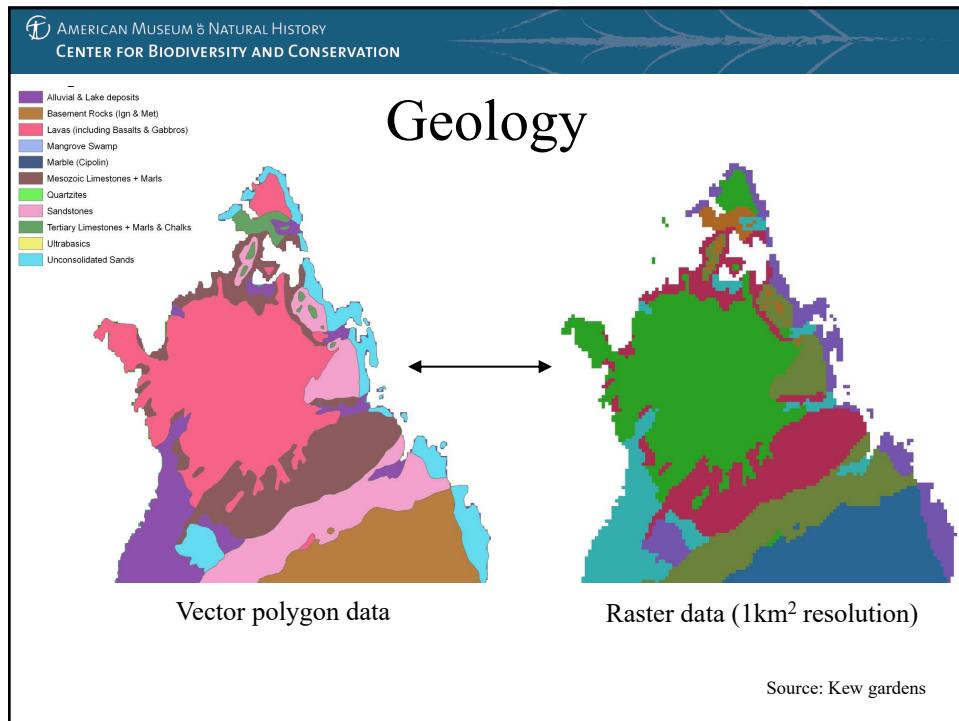
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