

Climatology and Cluster Analysis: Self-Organizing Maps (SOMs)

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Background

- Climatology
 - The study of climate
- Can be modeled visually:
 - Climate Models: CMIP5 ensemble
 - Downside:
 - Tend to have errors when modeling naturally-occurring processes, referred to as biases
- Question
 - How do we obtain more accurate models?

Objectives

- Broad
 - To understand climate: how and why it works the way that it does
 - Precipitation
 - To organize large data sets via SOMs
- Specific
 - To identify the causes of biases in global climate models
 - Learn more about precipitation patterns in the SPCZ and ITCZ
 - Possible relations that they may have

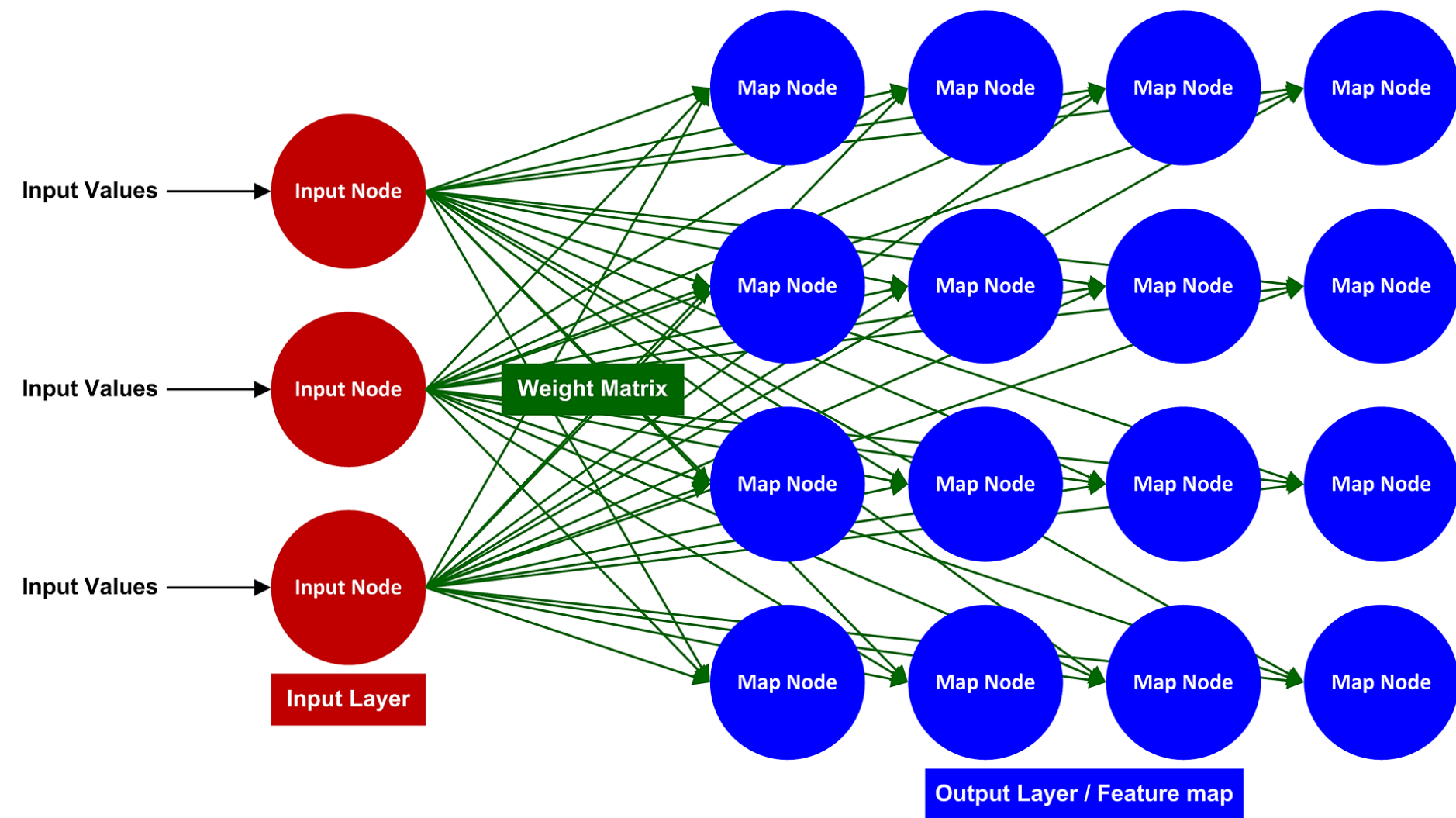
Self-Organizing Maps

- Novel tool in climatology
 - Requires intuition when considering input and parameters
 - Exploratory approach
- Concept
 - Data is represented as a weighted matrix that is later converted into mapped nodes
 - Weights determined via factors such as precipitation, day, year, etc.
 - Done via MATLAB

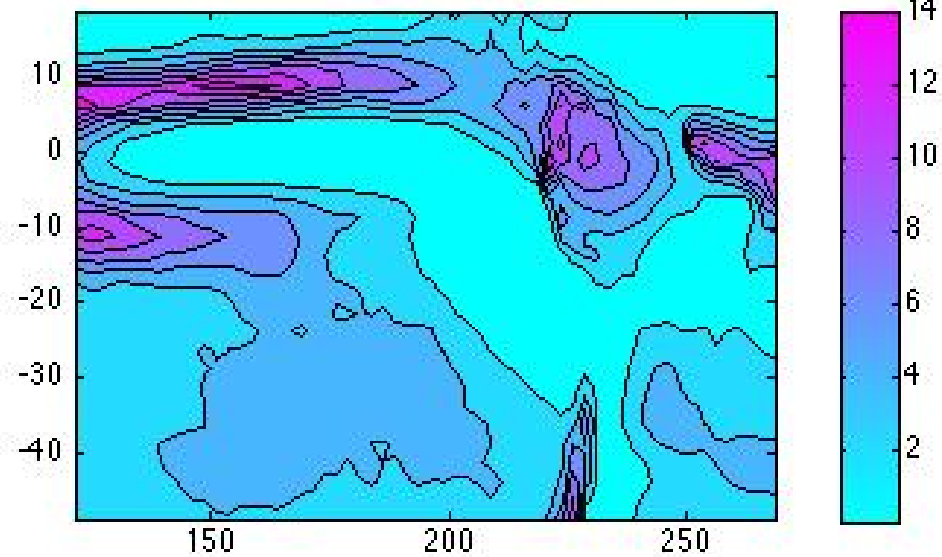
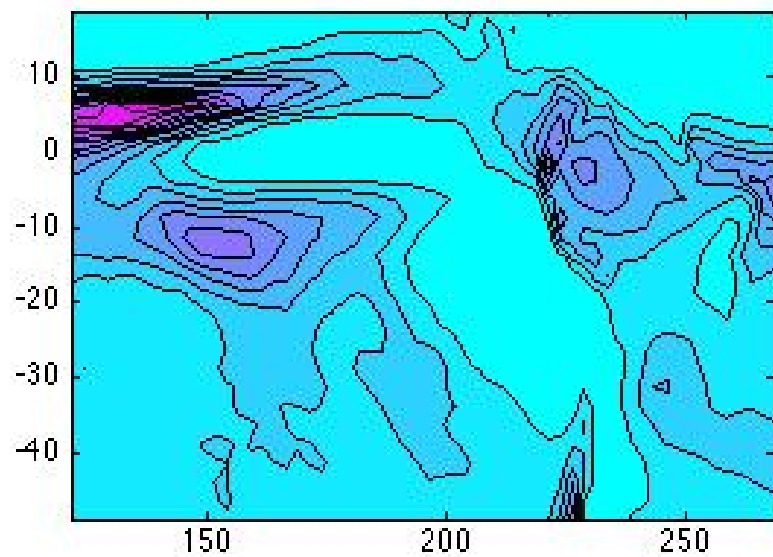
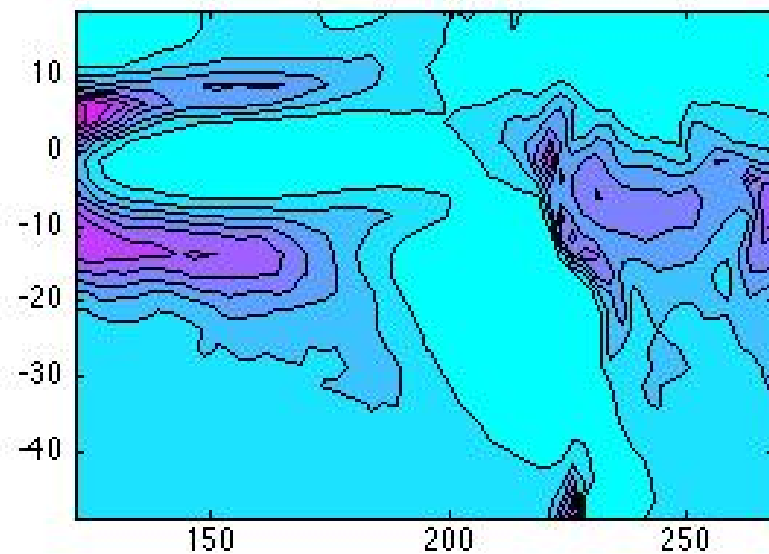
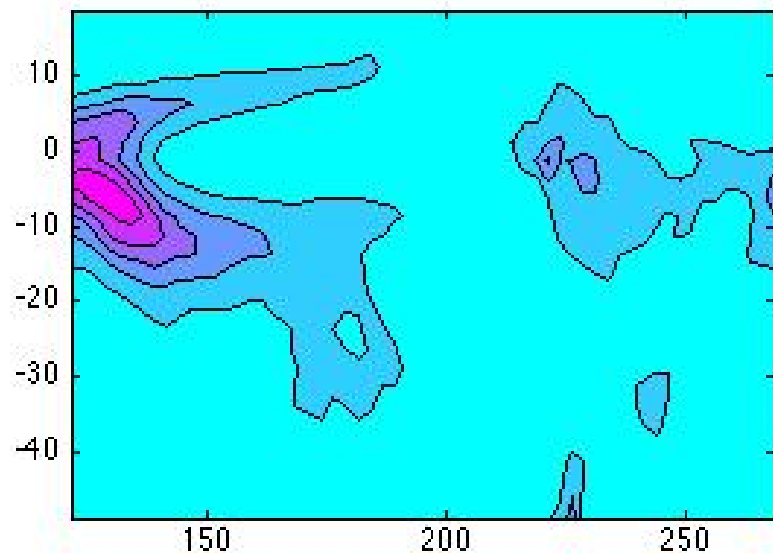
Self-Organizing Maps (cont'd)

- Color Example:
 - Colors consist of 3 parameter values: (Red, Blue, Green)
 - Two Nodes:
 - Red = (6,0,0)
 - Green = (0,0,6)
 - Is the color (1,1,6) closer to red or green?
 - Compute Euclidian distance
 - n – the number dimensions in a vector
 - i – the i^{th} component in the vector

$$\sqrt{\sum_{i=0}^n x_i^2}$$

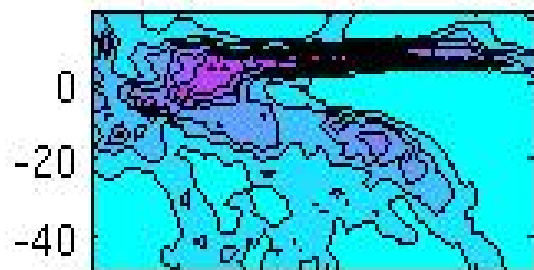


Precip SOM, 2 Patterns, 1960 2005 20-50 120 270



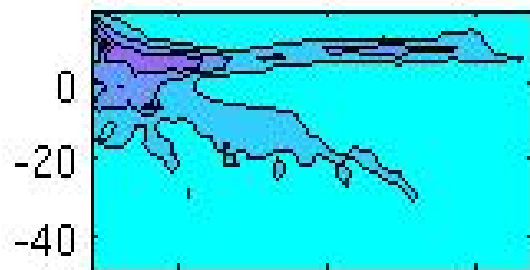


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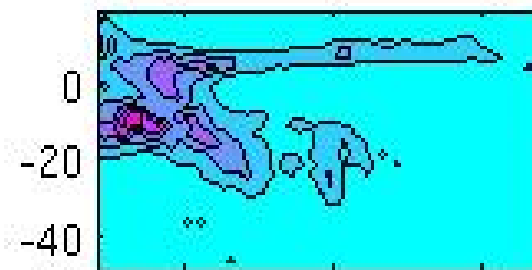
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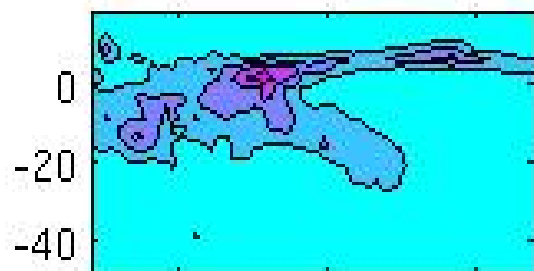
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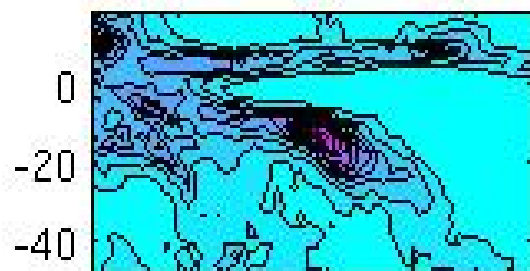
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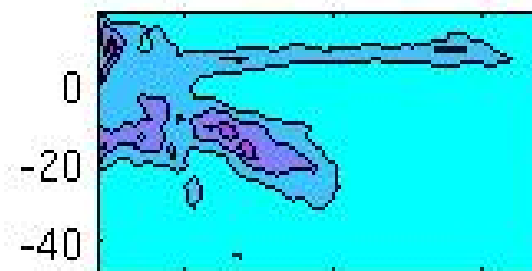
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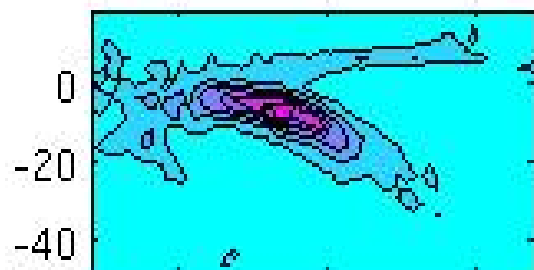
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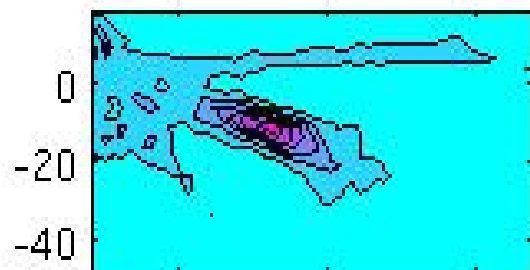
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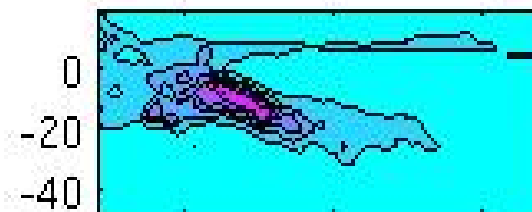
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10.1266

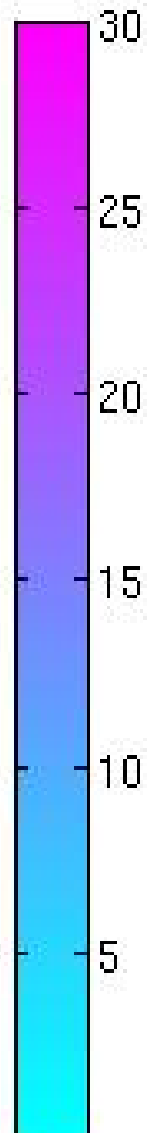


150 200 250

9.01899



150 200 250



References & Acknowledgements

- Department of Environmental Science
 - Dr. Ben Lintner (P.I.)
 - Max Pike (Graduate Student)
- SOMs and Climate
 - Hewitson, B. C., and R. G. Crane. "Self-organizing Maps: Applications to Synoptic Climatology." *Climate Research* 22 (2002): 13-26. Web.