

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

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Background

- Synoptic Climatology
 - The study of atmospheric behavior and characteristics
 - Local or regional climate in specific area
 - Visual Representations
 - Global Climate Models: Coupled Model Intercomparison Project “Phase 5” (CMIP5) ensemble
 - GCMs have biases, inaccuracies that differ from reality
- Question
 - How can we obtain more accurate models?

Objectives

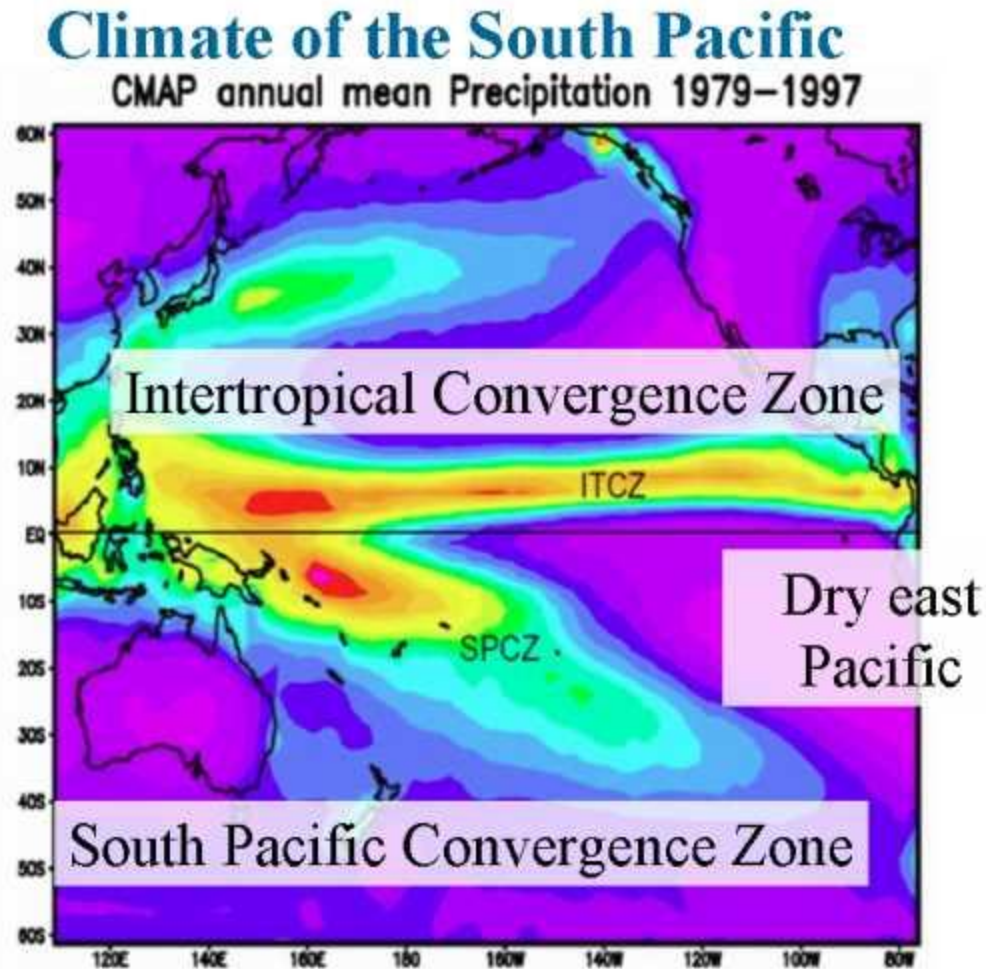
Broad Objectives

- Improve our understanding of climate: how and why it works the way that it does
 - Precipitation
- Test efficiency of SOMs
 - Ability to organize large climate data sets

Specific Objectives

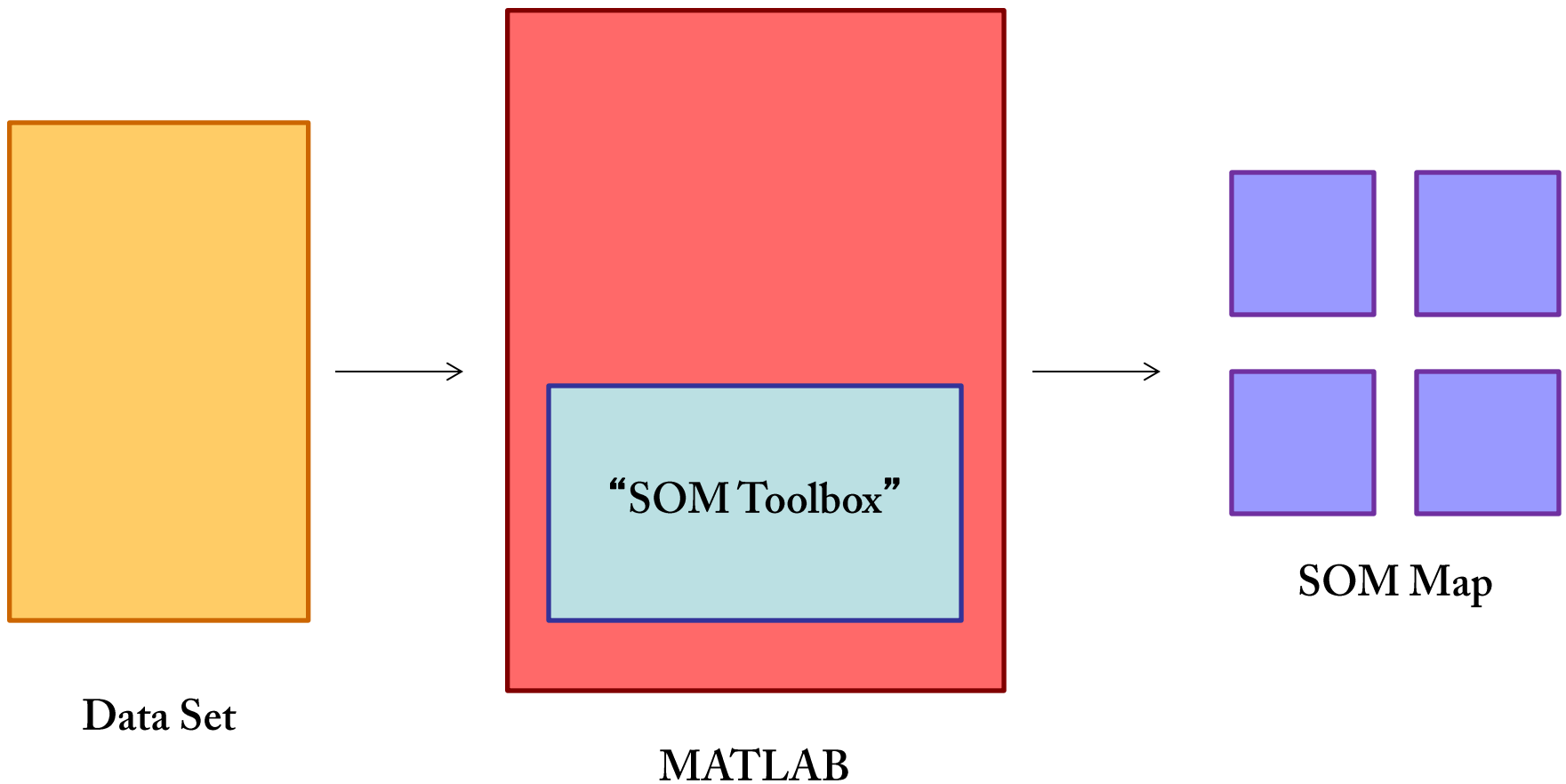
- To identify the causes of biases in global climate models
- To learn more about SPCZ and ITCZ precipitation patterns
 - Possible relations the two large rainbands may have

Where are they located?



<http://www.psyberspace.com.au/meteorology/soi.htm>

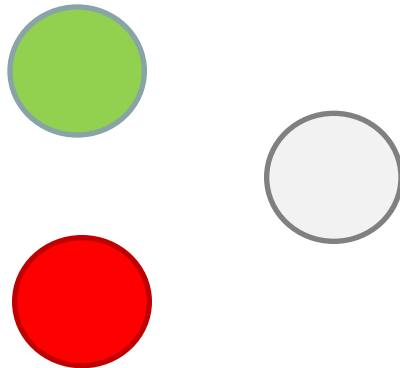
How SOM Analysis Works



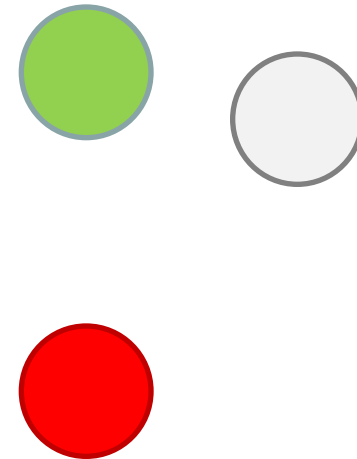
Self-Organizing Maps

- “Train” SOM neurons to match data points
 - How neurons learn data
- Colors have 3 parameter values: (Red, Blue, Green)
 - Red = (6,0,0)
 - Green = (0,0,6)
 - Neuron = (1,1,6)

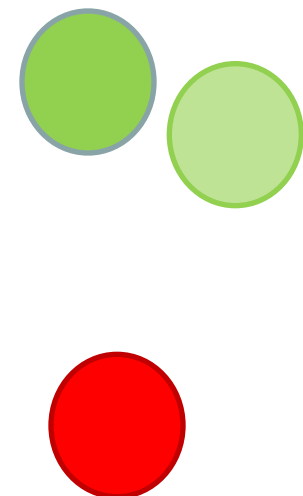
1)



2)



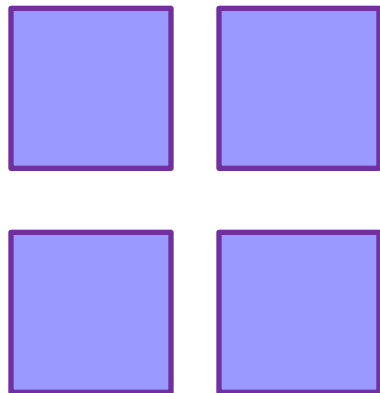
3)



SOM Analysis Methodology

TRMM Data Set

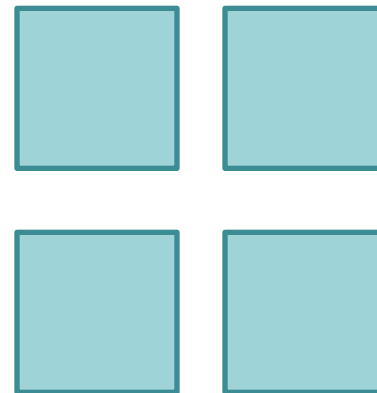
- NASA's Tropical Rainfall Measurement Mission (TRMM)
- Observational Data
 - Observational benchmark
 - Help identify the biases



SOM Map

CMCC Data Set

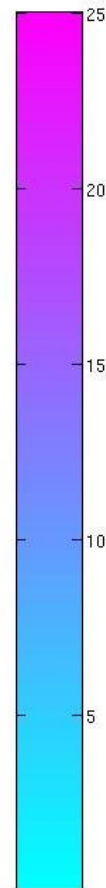
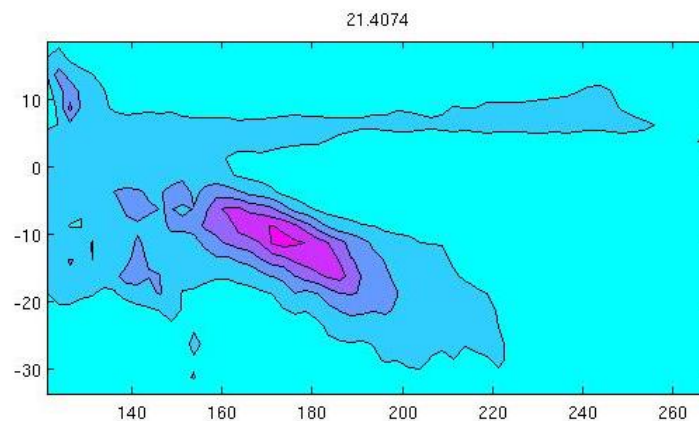
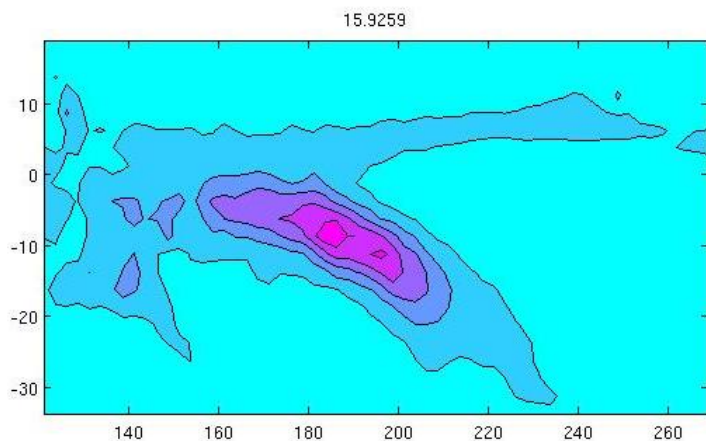
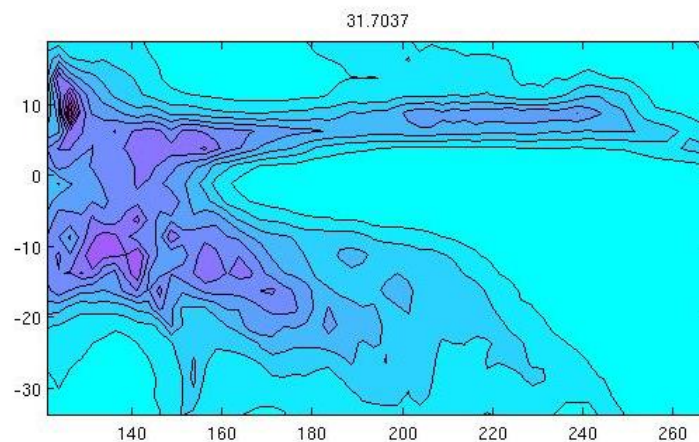
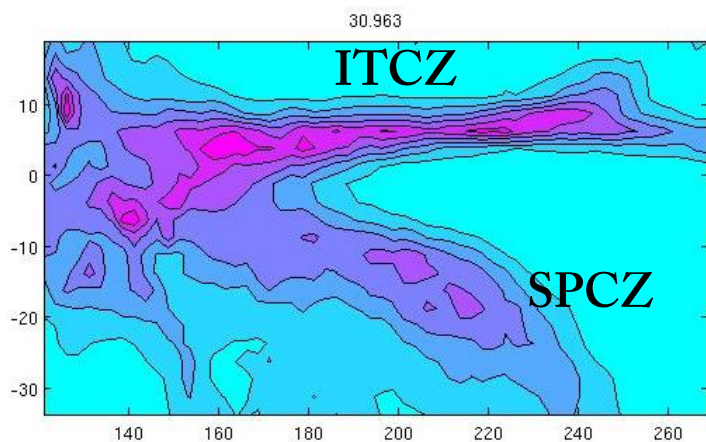
- CMIP5 ensemble model
- Known to have biases, expect to see such
- Will be compared to TRMM SOM analysis



SOM Map

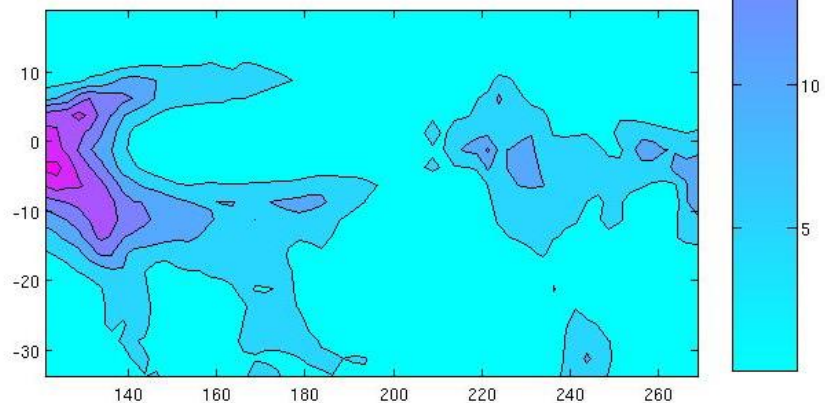
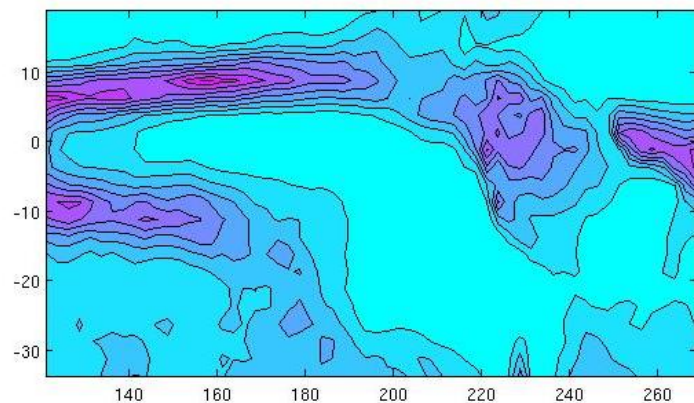
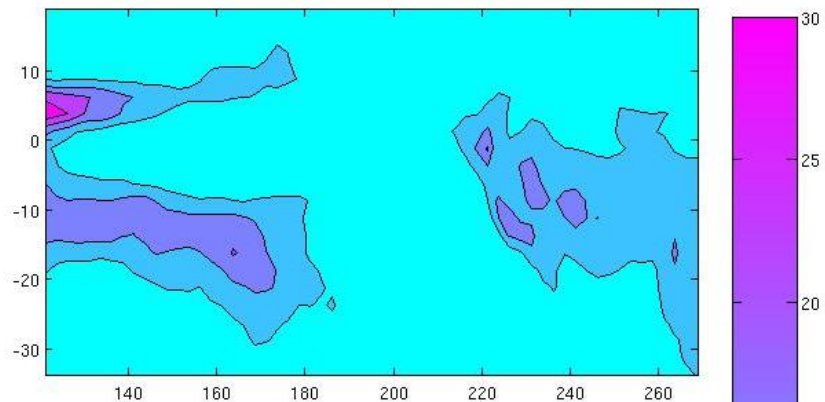
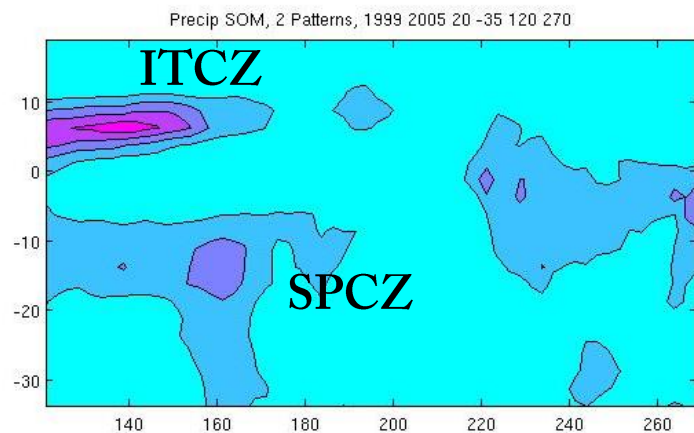
VS

TRMM SOM Analysis



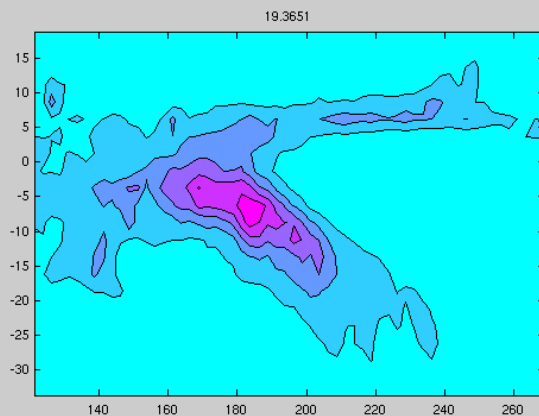
Precip in mm

CMIP5/CMCC SOM Analysis

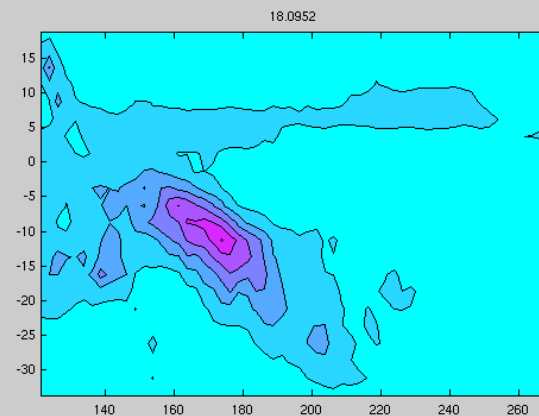


TRMM SOM Map Node Differences

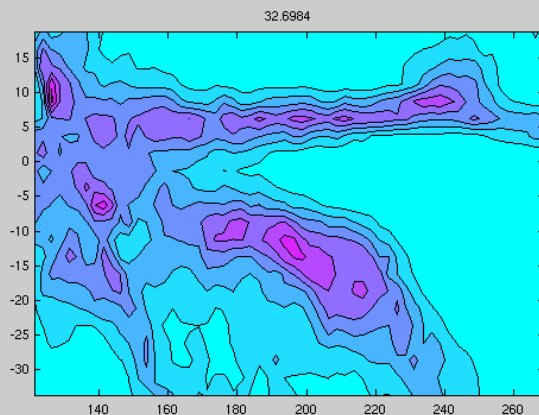
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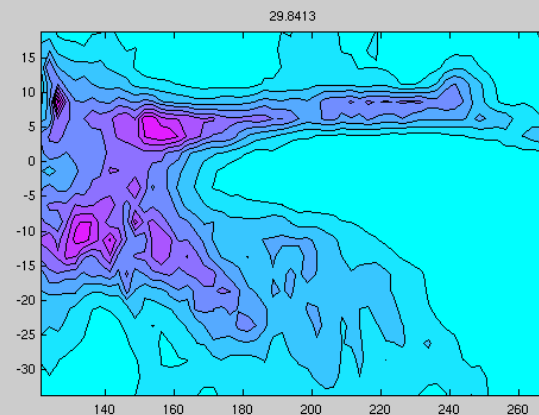
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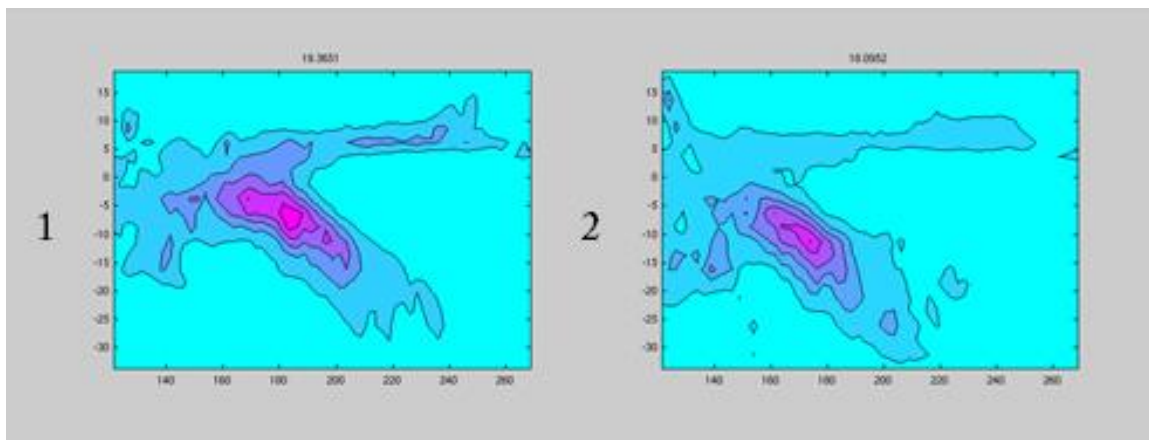
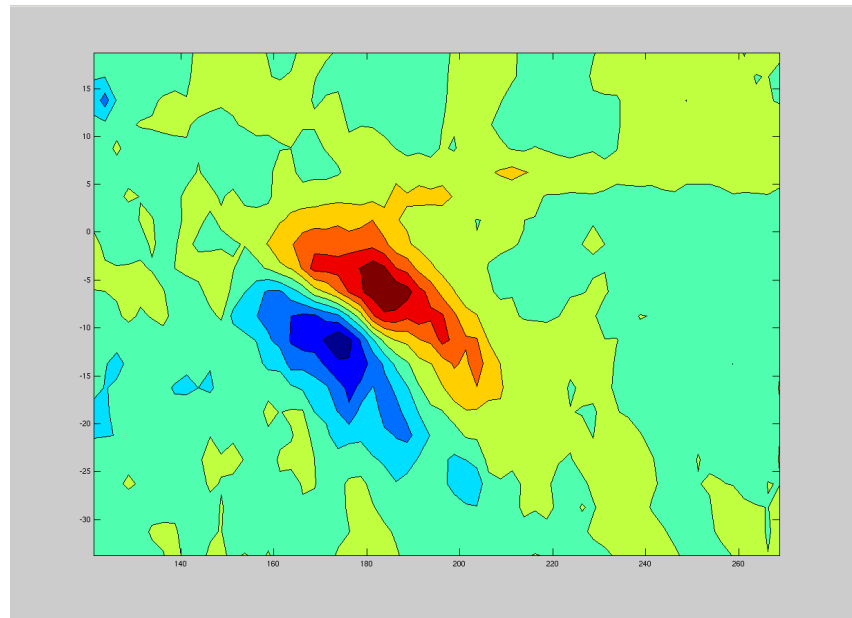
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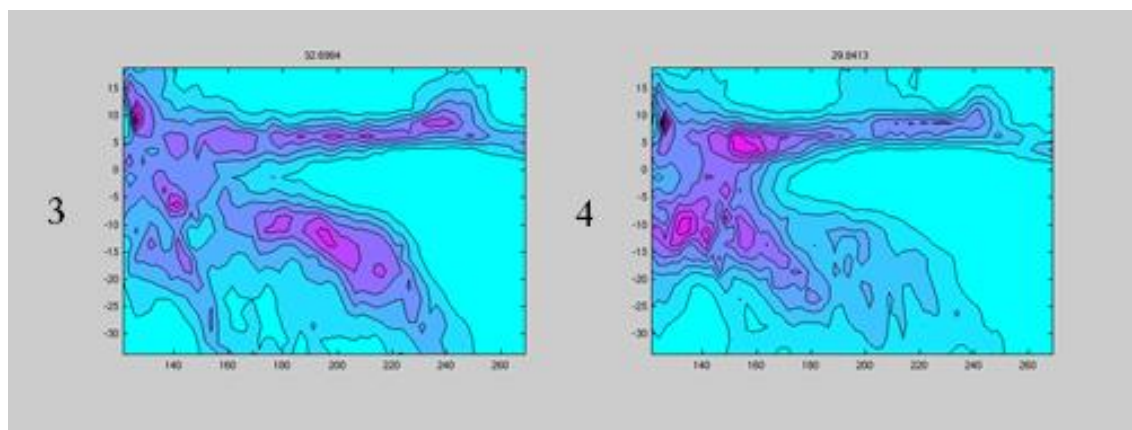
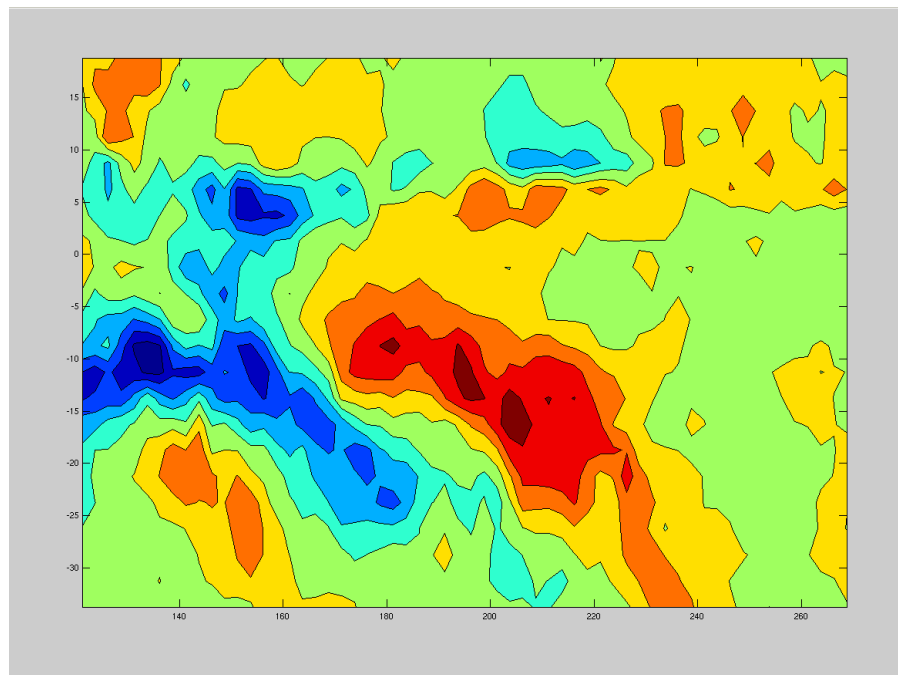
4



TRMM SOM Map Nodes 1 vs. 2



TRMM SOM Map Nodes 3 vs. 4



Conclusion/Future Work

- Research strongly suggests SOMs to be an efficient data analysis tool
 - Reduces high-res data to lower, visible dimensions
 - Ability to “learn” the data set that is being used
- Results suggest anomalies are not produced by SOM analysis
 - Most likely due to CMIP5 model parameterization
- Future Work
 - Conducting SOM analysis on:
 - Other CMIP5 models
 - Plotting difference between TRMM and CMIP5 SOM nodes

Acknowledgements

- Department of Environmental Science
 - Dr. Benjamin Lintner
 - Mr. Maxwell Pike
- RiSE REU
 - Dr. Evelyn Erenrich
 - Ms. Ana Rodriguez
- DIMACS REU
 - Dr. Eugene Fiorini
- Texas Southern University
 - Dr. Lila Ghemri
- CCICADA

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Thank you for
your time!

Questions?