K-Means Based Clustering to Find Local Climate Regions

Jason Veloz, Kunjben Patel, Hannah Aizenman, Michael Grossberg

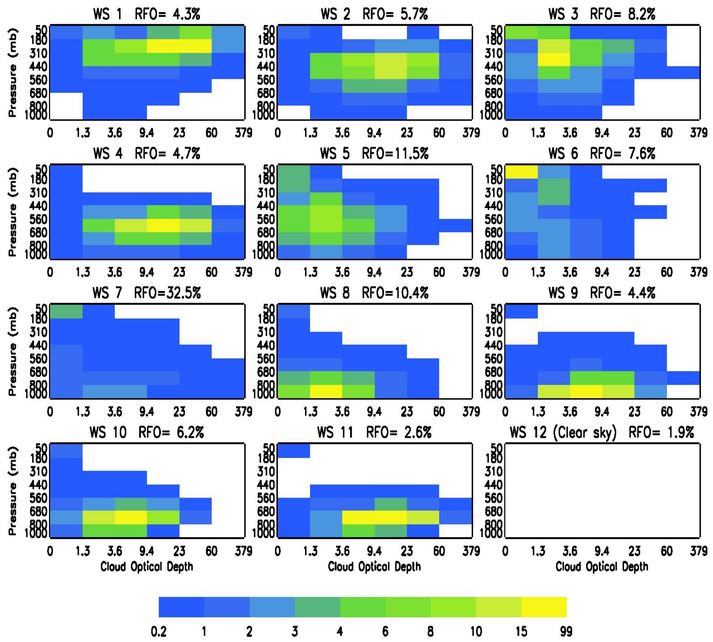
The City College of New York

NOAA CREST

Abstract

The ISCCP Cloud Project recorded cloud formations. Using this record they were able to detect eleven different weather states,each representing a different kind of weather condition. We analyzed the weather states from the years 1983 to 2009 on a 2.5X2.5 global resolution grid. The weather states are based on the joint 2D histogram of atmospheric optical thickness and cloud top pressure and therefore indicate weather phenomena such as fair weather, storms, and clear sky. We compute the relative frequency of occurrence (RFO) of each weather state (per grid cell). Then we use K-means to cluster the RFO to find which regions are similar to each other.

Weather States and Their Applications



George Tselioudis, William Rossow, Yuanchong Zhang, and Dimitra Konsta, 2013: Global Weather States and Their Properties from Passive and Active Satellite Cloud Retrievals. *J. Climate*, **26**, 7734–7746.
doi: http://dx.doi.org/10.1175/JCLI-D-13-00024.1

Weather states are classified based on the histogram of cloud top pressure (pc) and cloud optical depth (tau). PC-Tau is indicative of cloud types, which in turn is reflective of weather conditions. This means that if we find a certain cloud type over a certain region of the earth, we can usually predict what the weather conditions were for that area. These classifications are our weather states. Using these weather states, we were able to classify and compare the weather conditions of various regions on earth.

Acknowledgements

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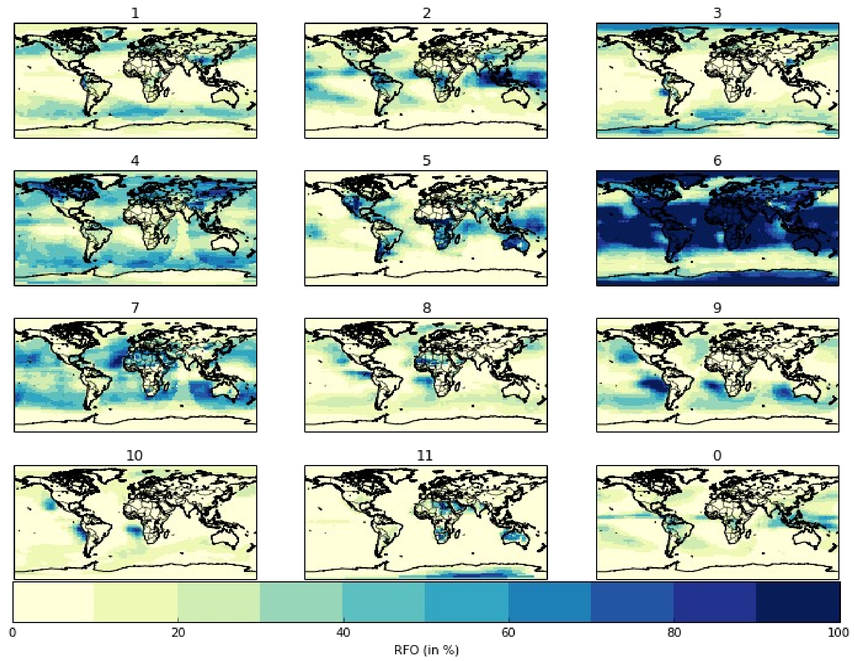
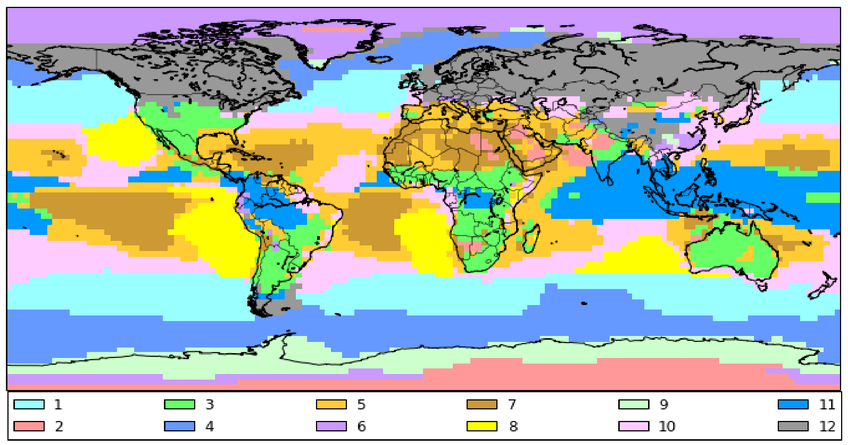
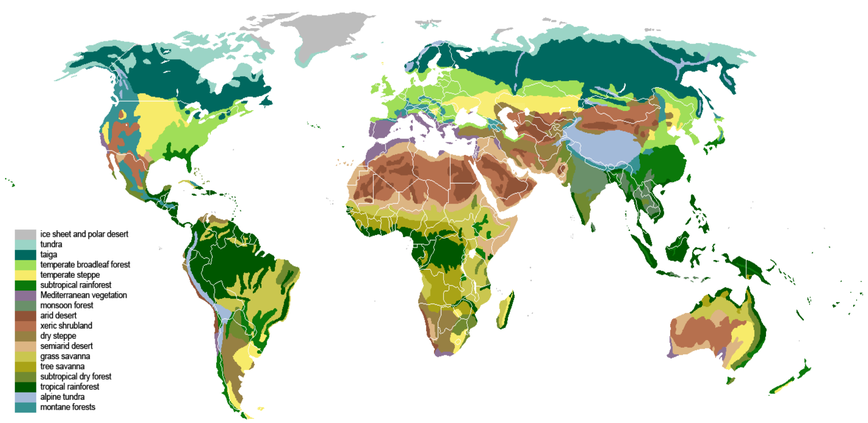
Weather State Relative Frequency of Occurrence



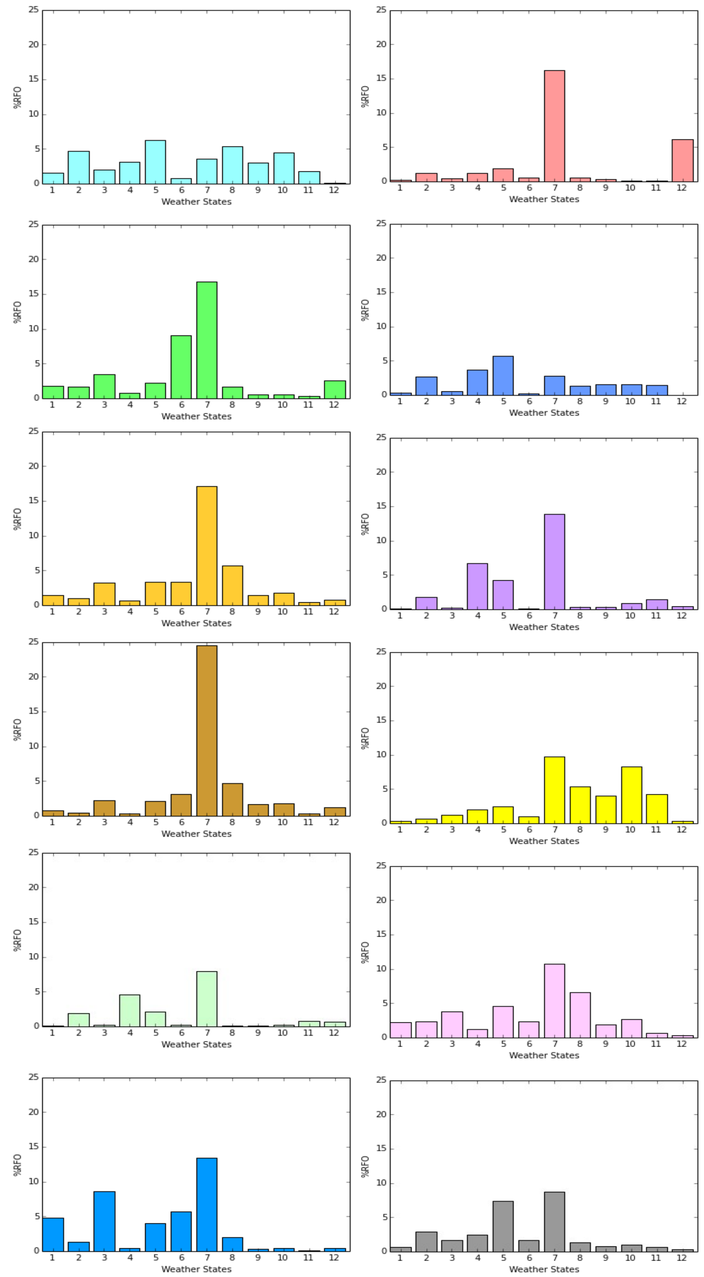
K-means Clustering of the RFO





https://upload.wikimedia.org/wikipedia/commons/e/e4/Vegetation.png

K-means Cluster Centroid



Discussion

We compared the results of our k-means cluster graph with a graph of different biomes throughout the world. There are various differences between our map and the map of biomes. For example, some clusters in Europe do not match up with our biome map. In our cluster map, Europe largely consistents of cluster twelve; however Europe contains more than five different biomes. This could be due to over clustering, but the results indicate that the data is fairly representative of the different types of weather conditions located around the world. The world's deserts are mostly classified as cluster 7, which has a high RFO of weather state 7, which is the fair weather state. Every other weather state within this cluster has a low RFO when compared to weather state 7. This is consistent with weather trends commonly found in desert regions, as fair weather usually dominates those regions.