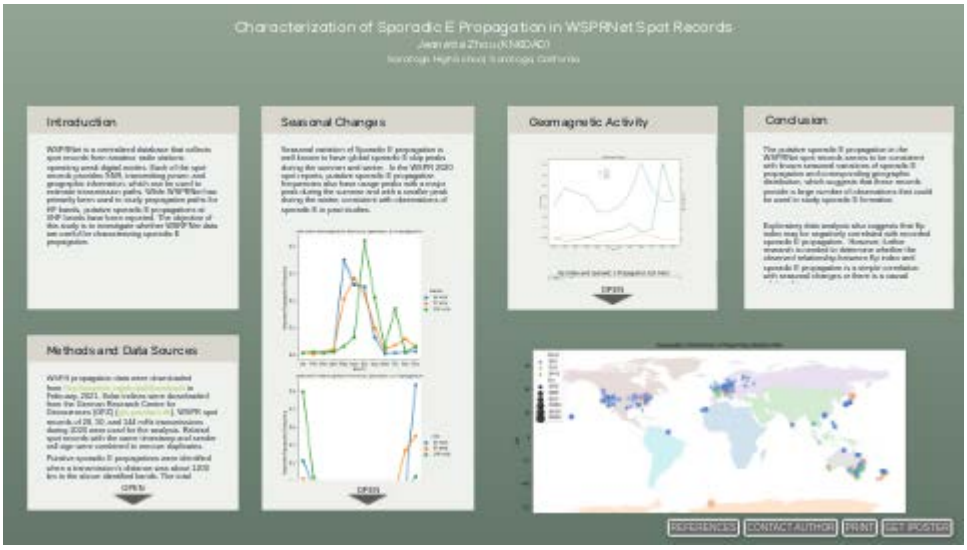
Characterization of Sporadic E Propagation in WSPRNet Spot Records



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PRESENTED AT:

INTRODUCTION

WSPRNet is a centralized database that collects spot records from amateur radio stations operating weak digital modes. Each of the spot records provides SNR, transmitting power, and geographic information, which can be used to estimate transmission paths. While WSPRNet has primarily been used to study propagation paths for HF bands, putative sporadic E propagations at VHF bands have been reported. The objective of this study is to investigate whether WSRPNet data are useful for characterizing sporadic E propagation.

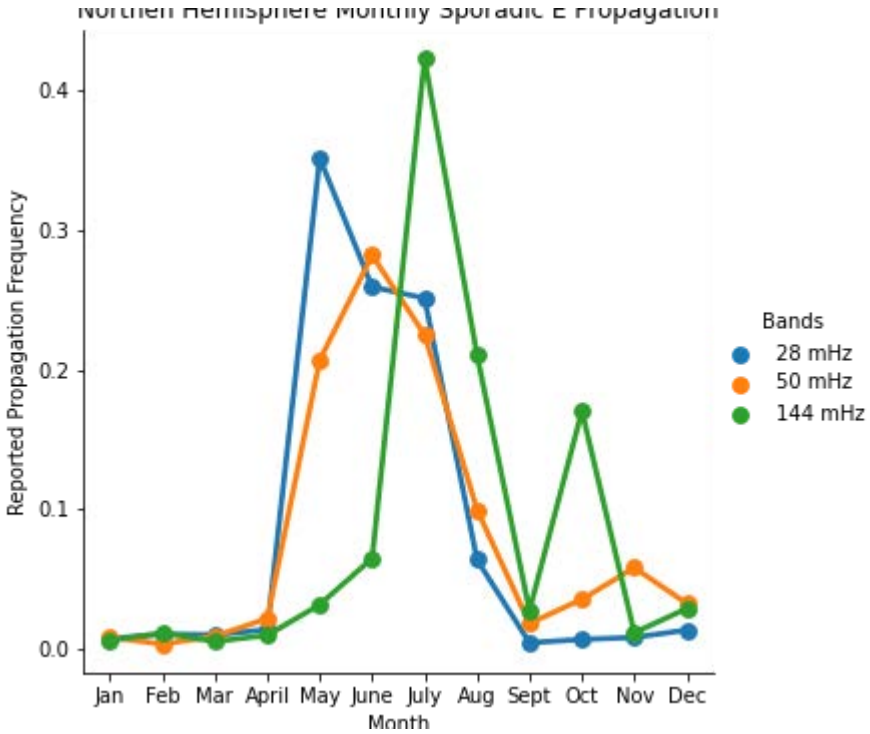
METHODS AND DATA SOURCES

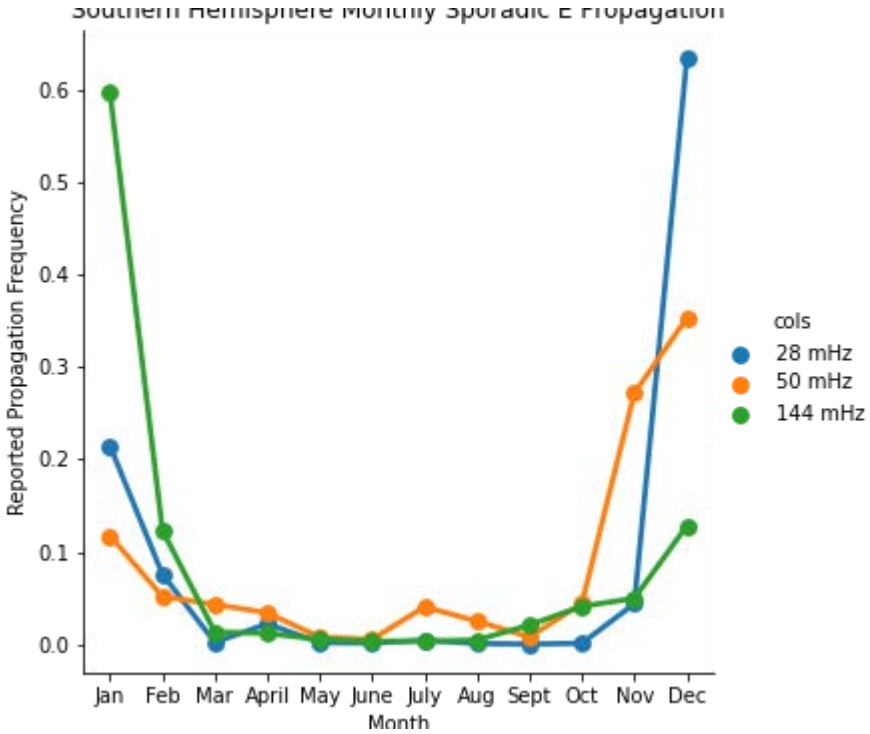
WSPR propagation data were downloaded from http://wsprnet.org/drupal/downloads (http://wsprnet.org/drupal/downloads) in February, 2021. Solar indices were downloaded from the German Research Centre for Geosciences (GFZ) (gfz-potsdam.de (http://gfz-potsdam.de)). WSPR spot records of 28, 50, and 144 mHz transmissions during 2020 were used for the analysis. Related spot records with the same timestamp and sender call sign were combined to remove duplicates.

Putative sporadic E propagations were identified when a transmission's distance was about 1200 km in the above identified bands. The total number of records used for the analysis was 1,118,989. Data analysis was performed using python 3 with pandas and maidenhead packages. Geopandas, matplotlib, and seaborn were used for plotting. Jupyter notebooks and intermediate data used for this analysis are available upon request from the author.

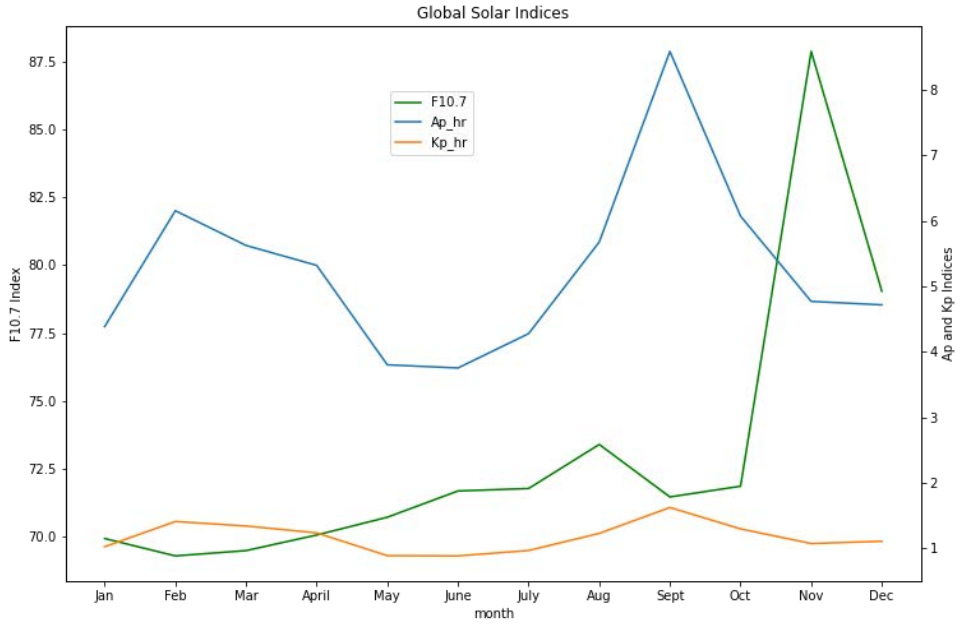
SEASONAL CHANGES

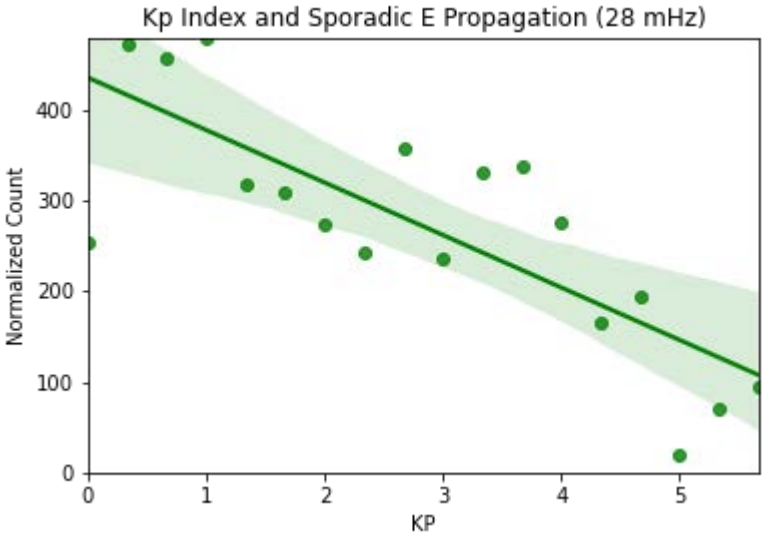
Seasonal variation of Sporadic E propagation is well known to have global sporadic E skip peaks during the summer and winter. In the WSPR 2020 spot reports, putative sporadic E propagation frequencies also have usage peaks with a major peak during the summer and with a smaller peak during the winter, consistent with observations of sporadic E in past studies.

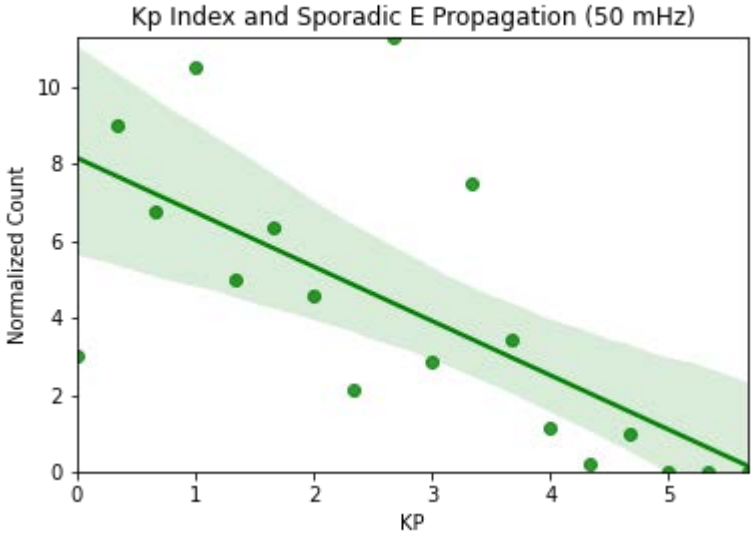


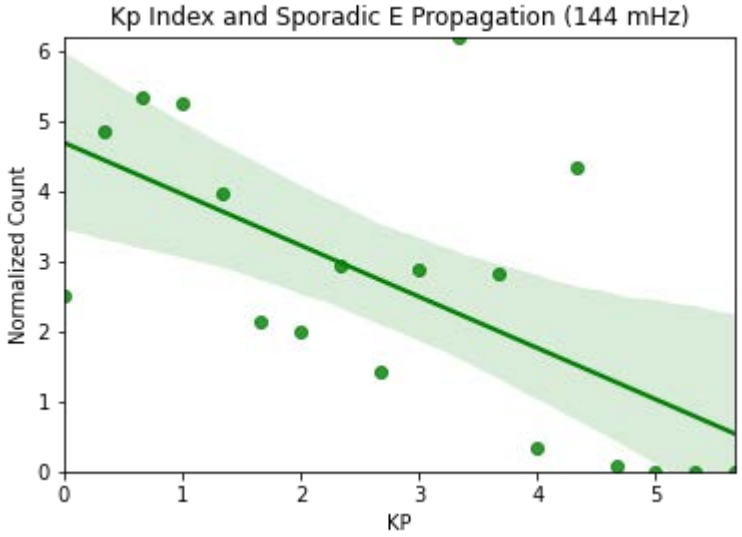


GEOMAGNETIC ACTIVITY









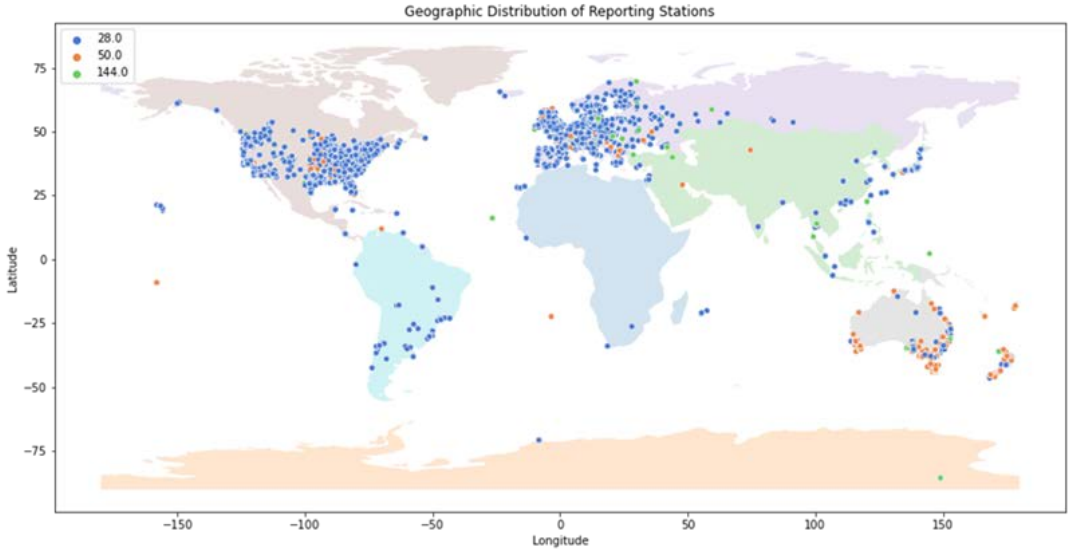
R-Squared Value for Kp effect on 28 mHz is 0.62, which indicates a relatively strong effect.

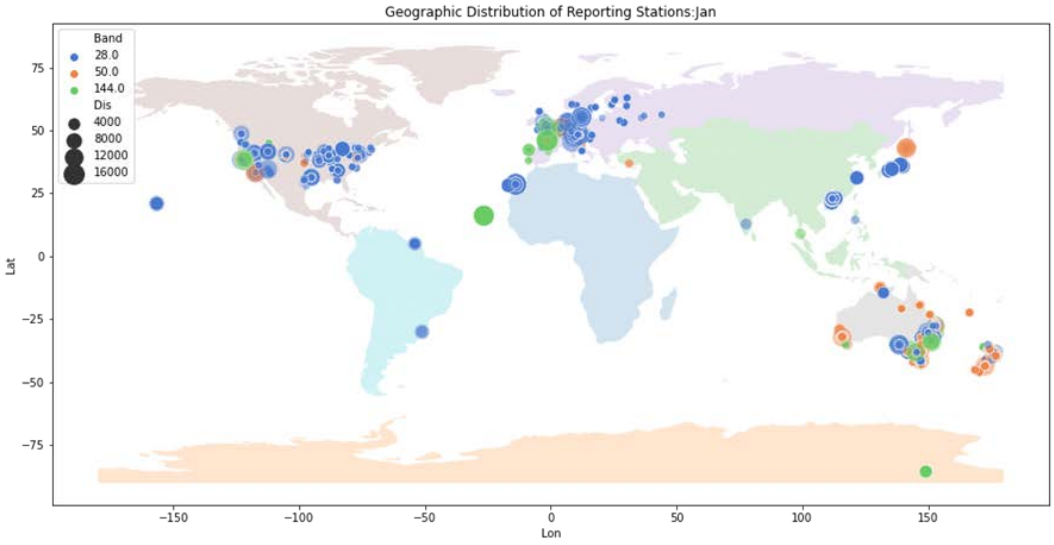
R-Squared Value for Kp effect on 50 mHz is 0.46 and for 144 mHz is 0.40, which suggests a modest effect.

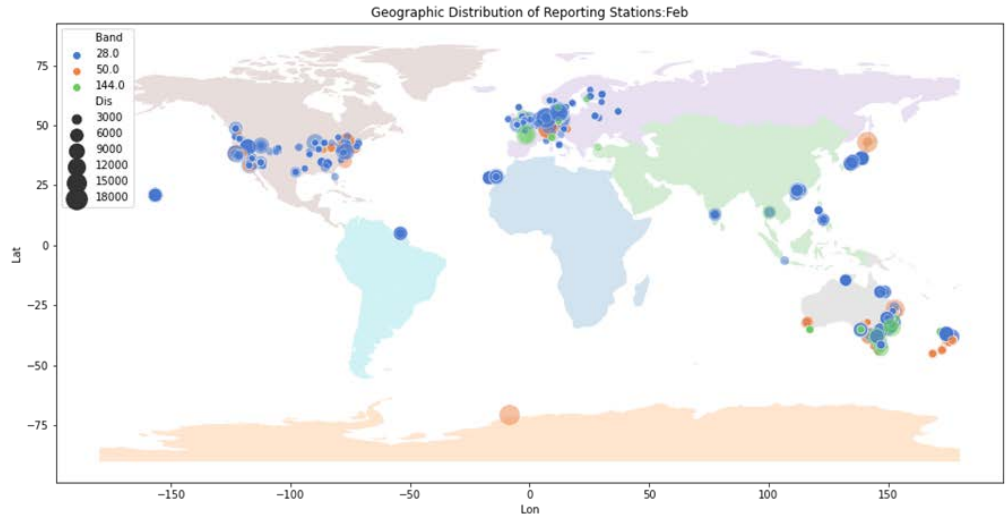
CONCLUSION

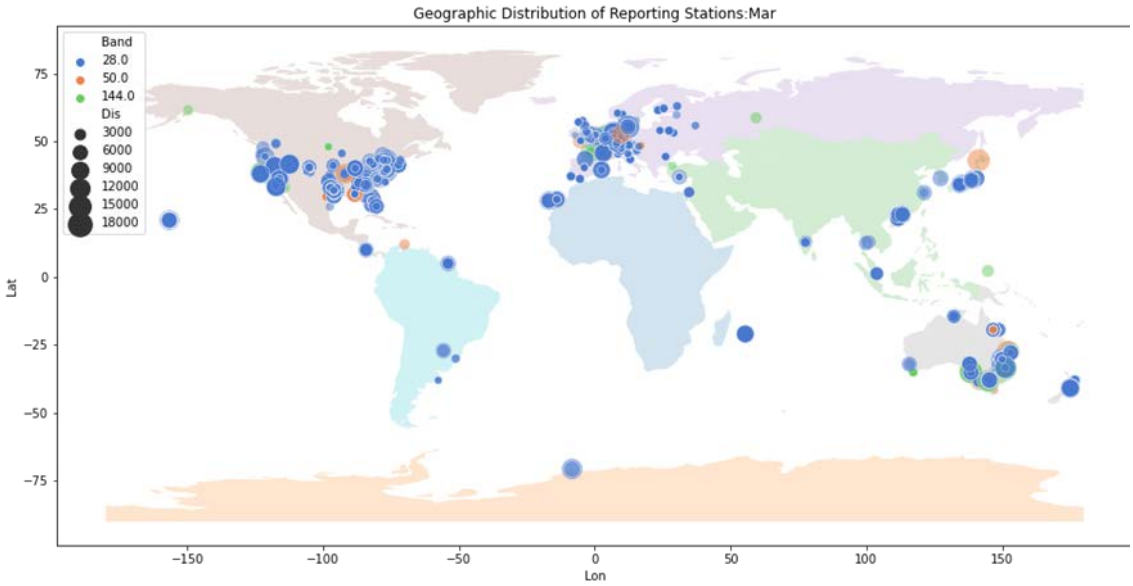
The putative sporadic E propagation in the WSPRNet spot records seems to be consistent with known seasonal variations of sporadic E propagation and corresponding geographic distribution, which suggests that these records provide a large number of observations that could be used to study sporadic E formation.

Exploratory data analysis also suggests that Kp index may be negatively correlated with recorded sporadic E propagation. However, further research is needed to determine whether the observed relationship between Kp index and sporadic E propagation is a simple correlation with seasonal changes or there is a causal relationship.






Geographic Distribution of Reporting Stations:Feb
Band
28.0
50.0
144.0
Dis
3000
6000
9000
12000
15000
18000
Lat
Lon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Band
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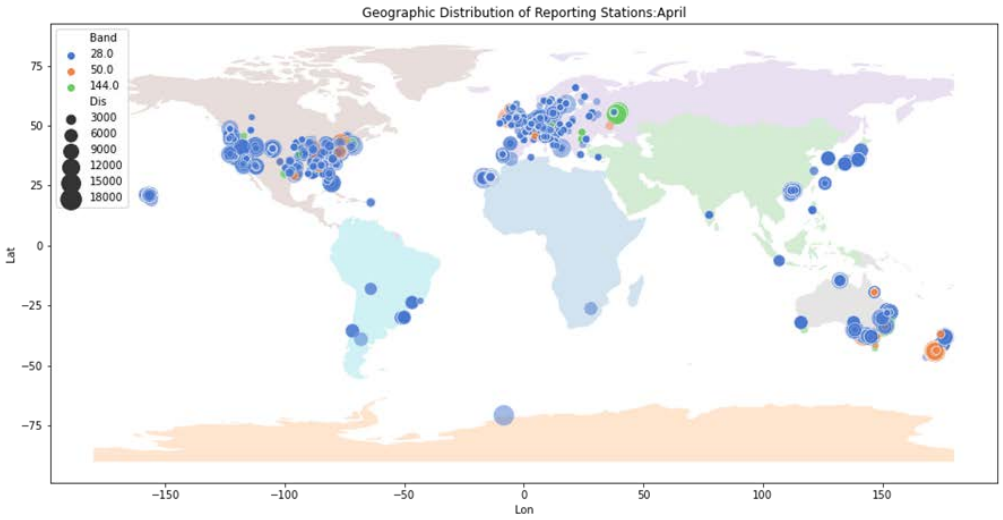
144.0
Dis
3000
6000
9000
12000
15000
18000
Lat
Lon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Band
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144.0
Dis
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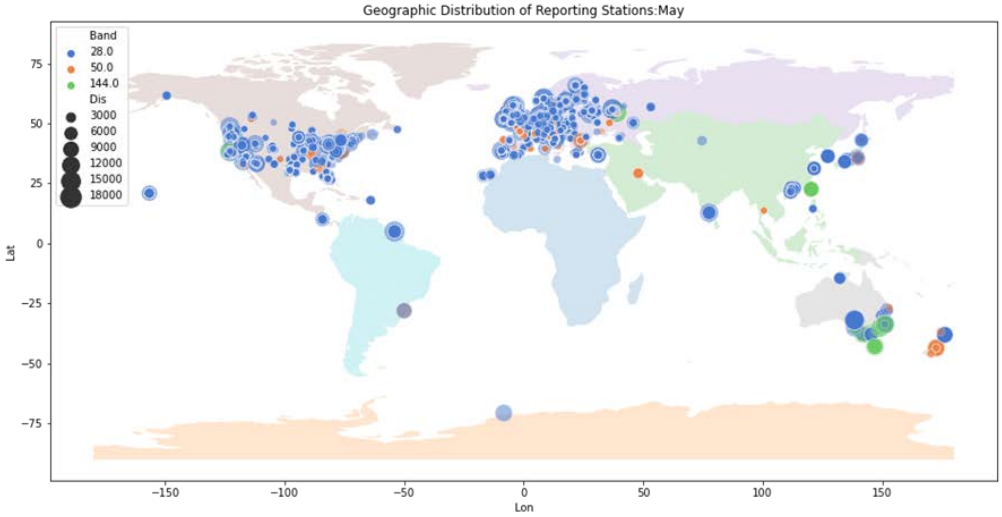
6000
9000
12000
15000
18000
Lat
Lon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Band
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Dis
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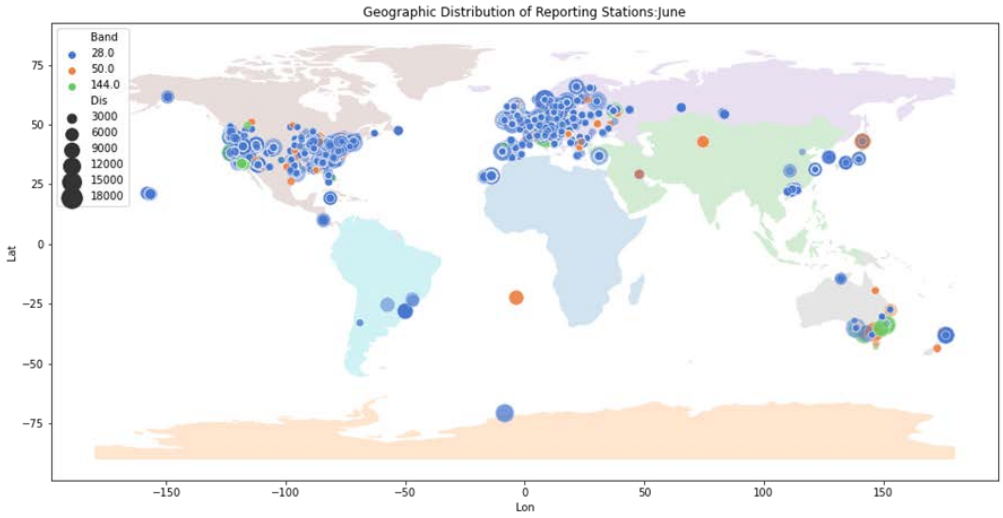
Lat
Lon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144.0
Dis
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6000
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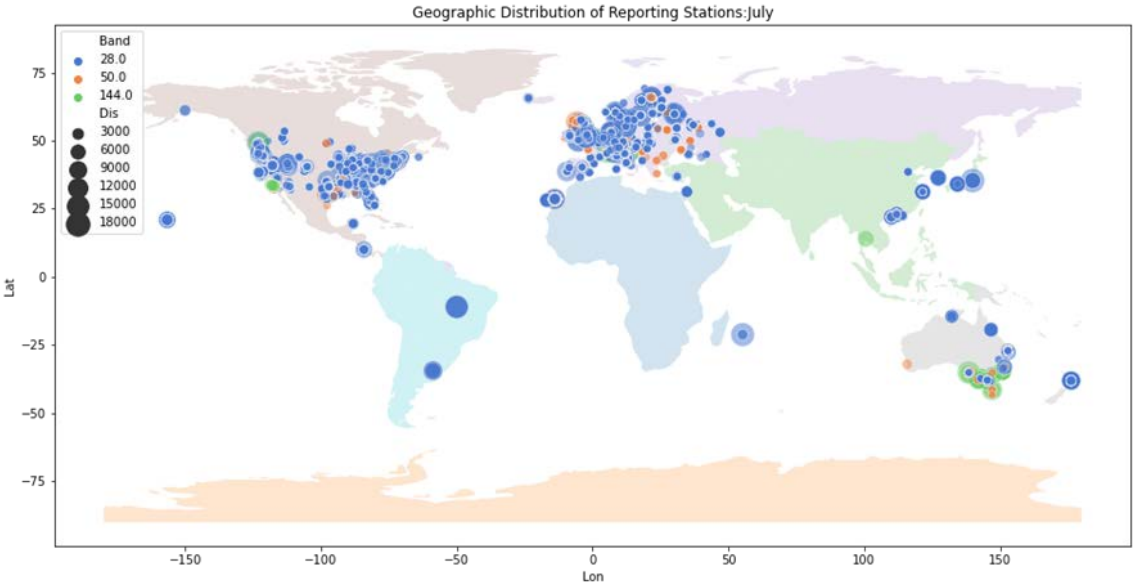
12000
15000
18000
Lat
Lon


Geographic Distribution of Reporting Stations:July
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144.0
Dis
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6000
9000
12000
15000
18000
Lat
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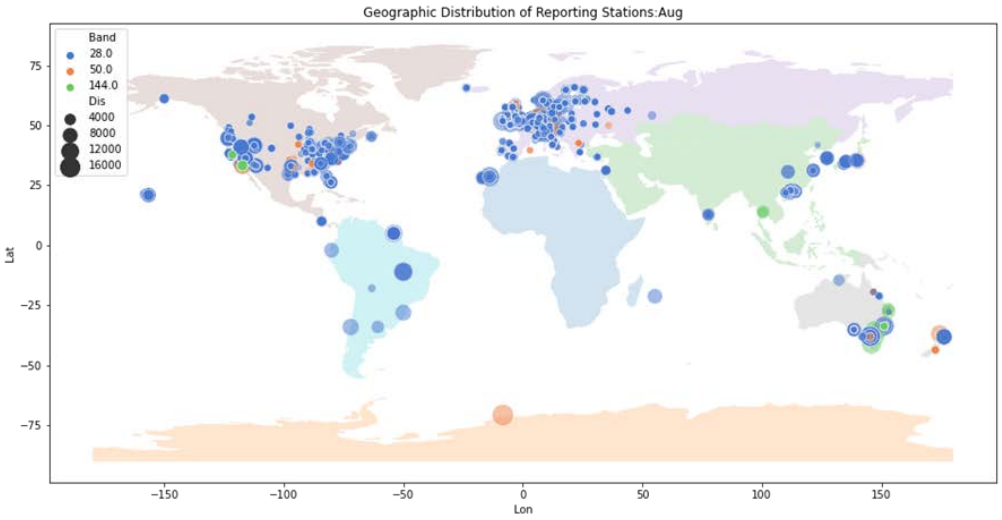
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50.0
144.0
Dis
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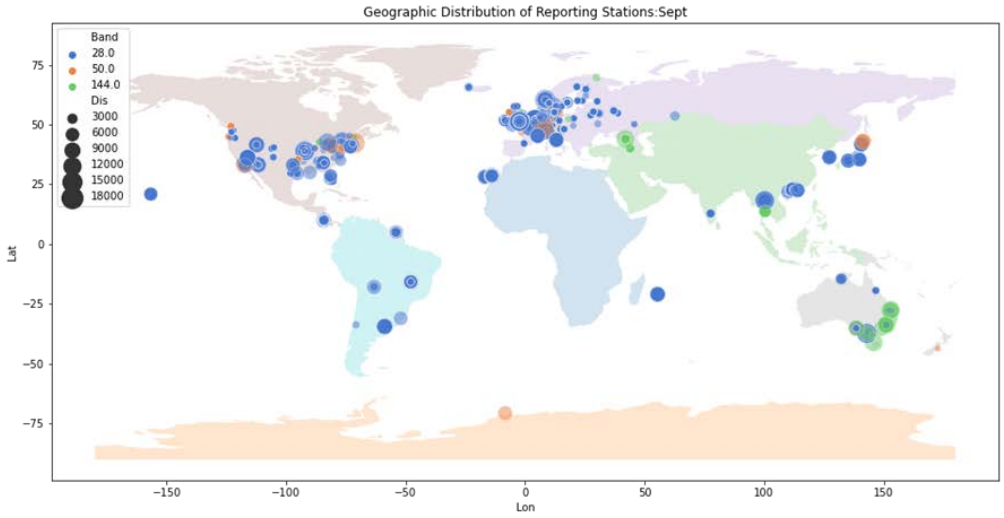
8000
12000
16000
Lat
Lon


Geographic Distribution of Reporting Stations:Sept
Band
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144.0
Dis
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6000
9000
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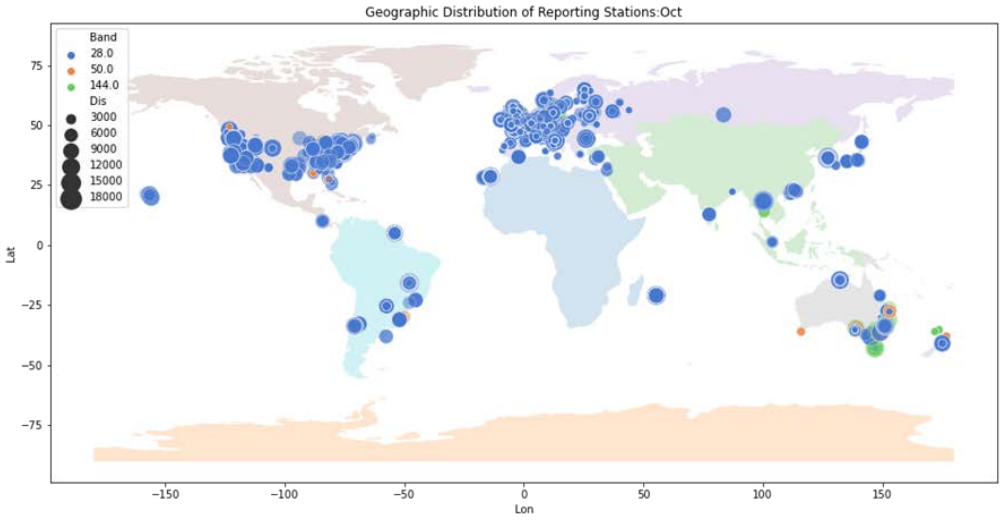
15000
18000
Lat
Lon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144.0
Dis
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18000
Lat
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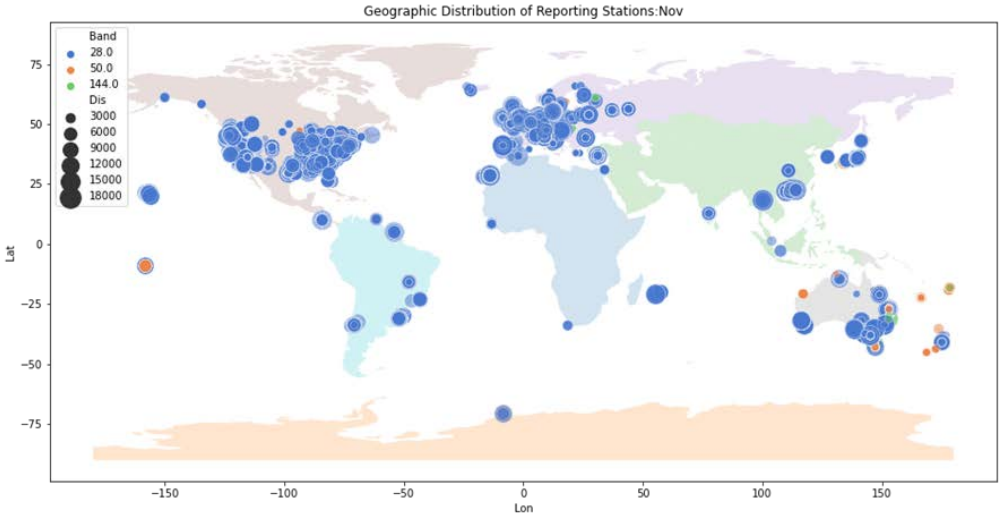
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Band
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144.0
Dis
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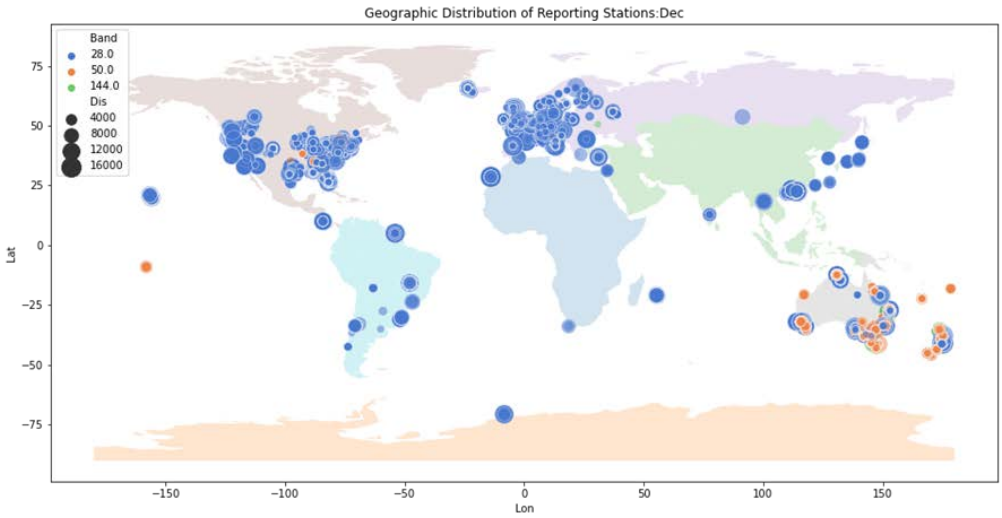
6000
9000
12000
15000
18000
Lat
Lon


Geographic Distribution of Reporting Stations:Dec
Band
28.0
50.0
144.0
Dis
4000
8000
12000
16000
Lat
Lon

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