Implementation of the Revised SuperDARN MSTID MUSIC Algorithm in the DARNtids Analysis Toolkit

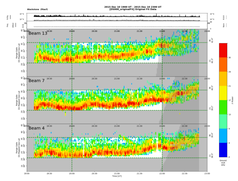
Nicholas J. Guerra[1], James P. Fox[1], Thomas Pisano[1], Michael Molzen[1], and Nathaniel A. Frissell[1]

[1]University of Scranton

Introduction

- DARNtids (https://github.com/w2naf/DARNtids) is a python-based software package that detects and characterizes MSTID activity in SuperDARN observations. It was originally developed to produce the results for *Frissell et al.* (2016). An architecture for the library has been mapped.
- DARNtids first detects the levels of MSTID activity in the SuperDARN data, and then runs the PyDARNMusic (https://github.com/hamSCI/pydarnmusic) analysis software on event periods with significant MSTID activity.
- The Multiple Signal Classification (MUSIC) algorithm in PyDARNMusic calculates MSTID period, wavelength, speed, and propagation direction.

Plotting in DARNtids



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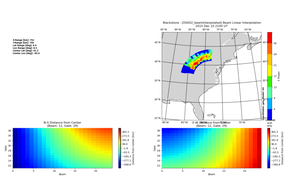

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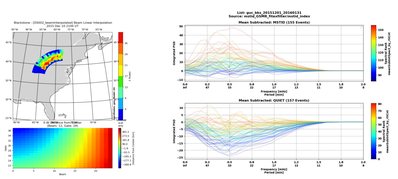

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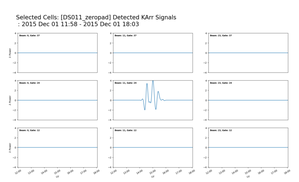

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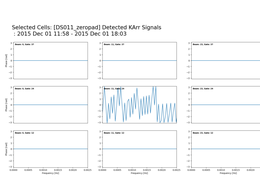

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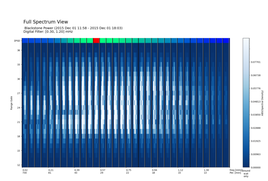

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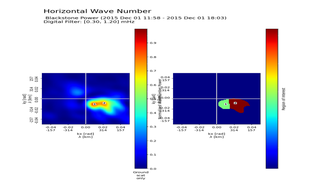

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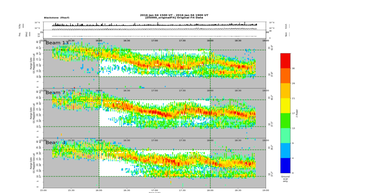

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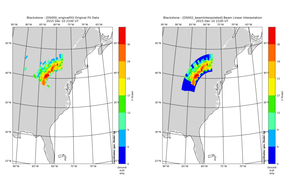

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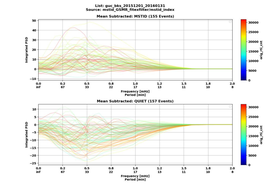

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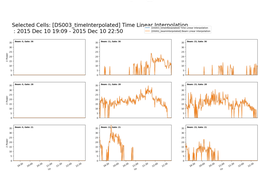

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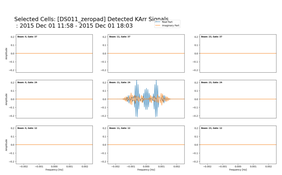

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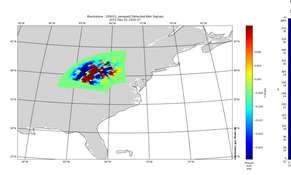

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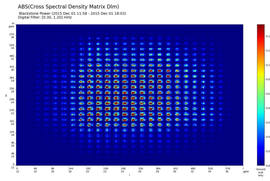

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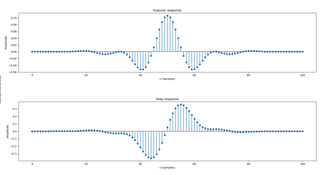

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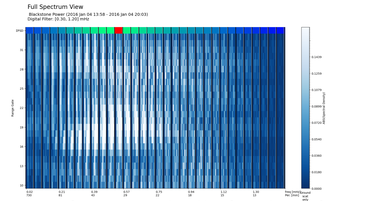

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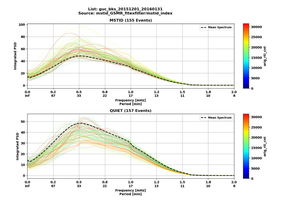

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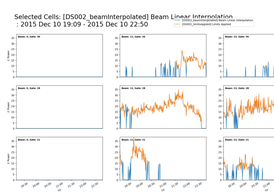

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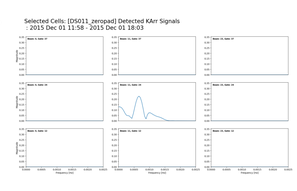

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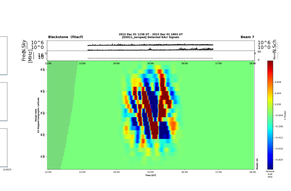

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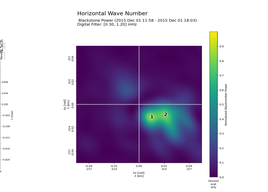

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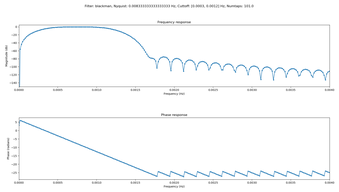

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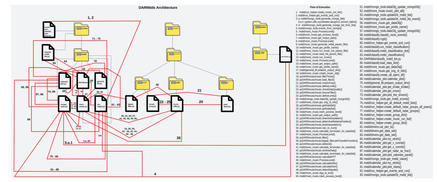
Classifying Data & MSTID Activity

- DARNtids has A.) a number of algorithms for determining what constitutes a good or bad period of data, and B.) an algorithm for calculating the MSTID index and determining if an MSTID period is active or quiet. It produces different plots for any given MSTID-active time period with good data.
- The `classify_none_events()` function is responsible for determining if an event period is good or bad based on 1.) whether or not data is available, 2.) the returned results of the `checkDataQuality()` function in pyDARNmusic, 3.) the fraction of radar scatter points present in the data window, and 4.) the percentage of daylight in the data window.
- The `checkDataQuality()` function is part of the pyDARNMusic library and marks a respective data set as bad if the specified radar was not operational during the chosen time period.
- The `get_mstid_scores()` function returns a score for how many radars saw MSTIDs in a given day. Each radar and analysis window contributes to the score, such that: mstid -> +1, quiet -> -1, None -> 0.

Summary & Future Work

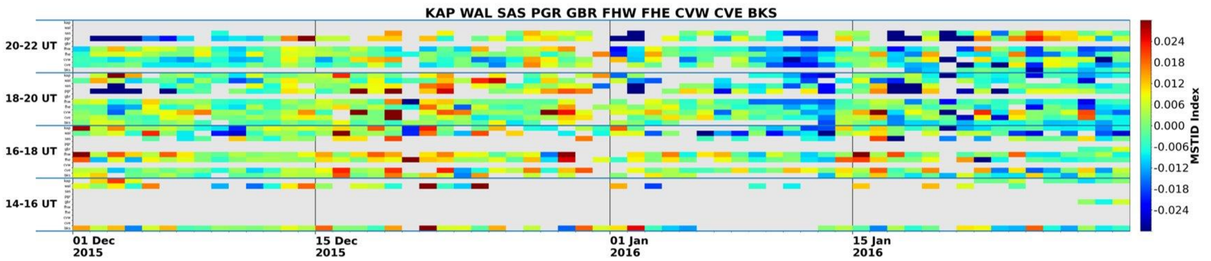
- The DARNtids Architecture and Flow of Control has been outlined.
- The algorithms responsible for determining good/bad periods of data, calculating MSTID index, and determining if a period is MSTID active or quiet have been identified and thoroughly investigated.
- As our team works on mitigating a bias in the MUSIC algorithm, I will be focusing on revamping the DARNtids library to incorporate the new MUSIC algorithm and eliminate existing redundancies, inefficiencies, and deprecations.

DARNtids Architecture



"Calendar" Plots

- "Calendar" plots are a time-series visualization summarizing the results of a DARNtids run.
- This calendar plot shows the MSTID index of North American SuperDARN radars from 1 December 2015 – 31 January 2016.



References

Frissell, N. A., J. B. H. Baker, J. M. Ruohoniemi, R. A. Greenwald, A. J. Gerrard, E. S. Miller, and M. L. West (2016), Sources and characteristics of medium-scale traveling ionospheric disturbances observed by high-frequency radars in the North American sector, J. Geophys. Res. Space Physics, 121, 3722–3739, doi:10.1002/2015JA022168.

Acknowledgments

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nicholas.guerra@scranton.edu

THE UNIVERSITY OF SCRANTON A JESUIT UNIVERSITY