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Comparative Studies of the propagation characteristics of MSTIDs in auroral and mid-latitude regions

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Contents

Motivation

In order to clarify whether or not the source of MSTIDs appearing in the auroral and mid-latitude regions are common, we compared, for the first time, propagation parameters (e.g. propagation direction, horizontal phase velocity and dominant period) of the daytime MSTIDs observed with the SuperDARN radars in the auroral and mid-latitudes.

We employed 3 radars to detect MSTIDs. Figure shows the field-of-view of the northern hemispheric SuperDARN radars, where the radars employed in our analysis are shaded. Kodiak and King Salmon radars observe the auroral regions, while Hokkaido radar observes the mid-latitude region.

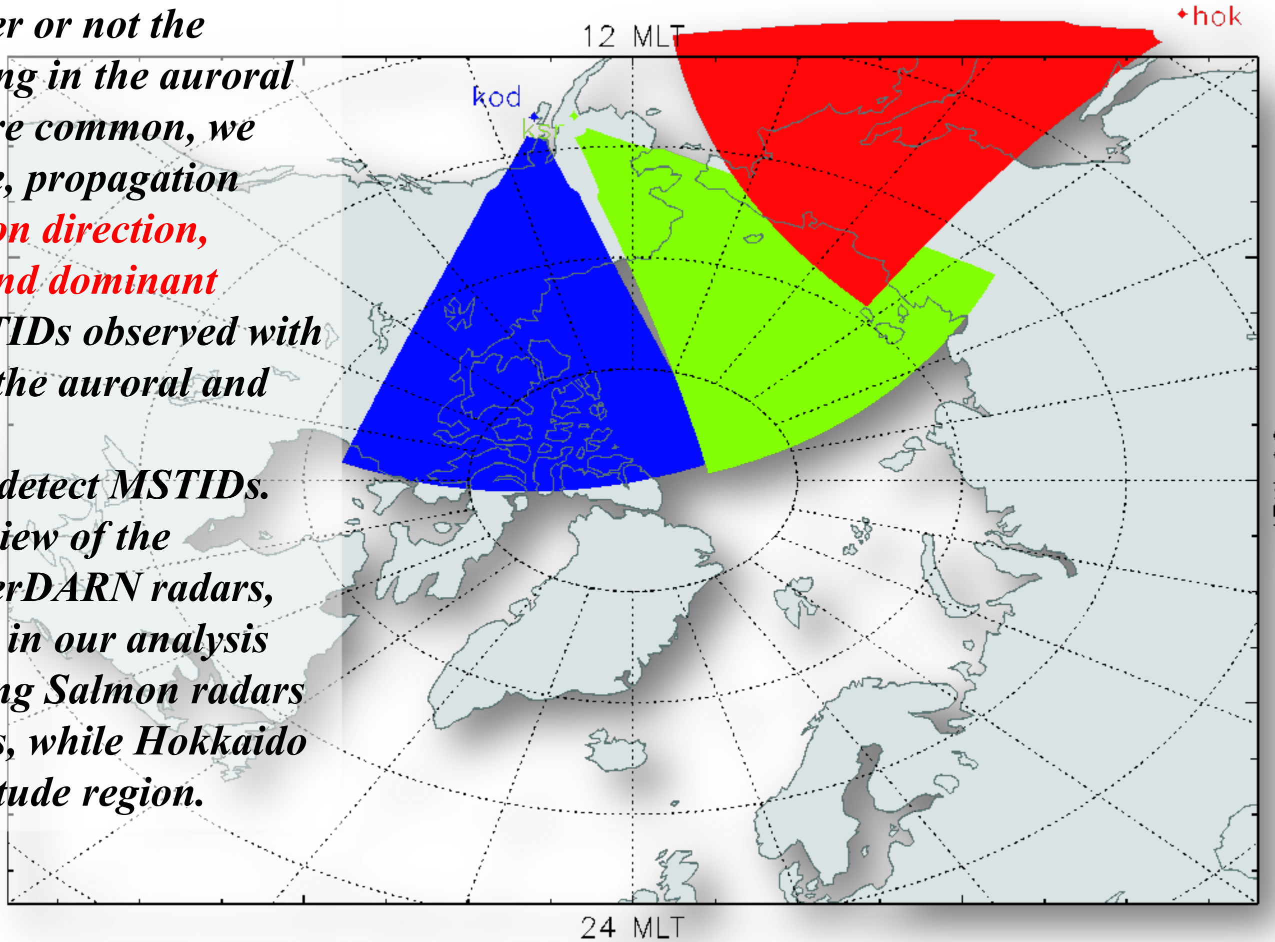
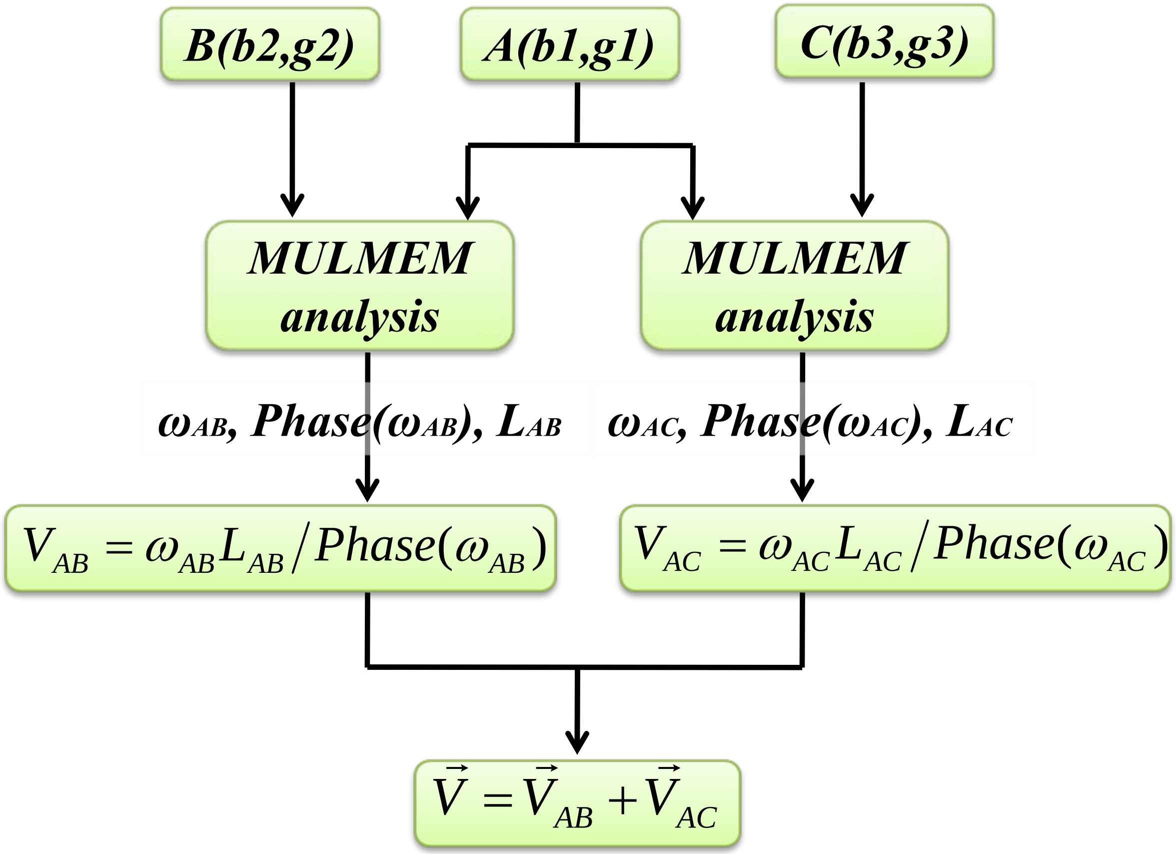
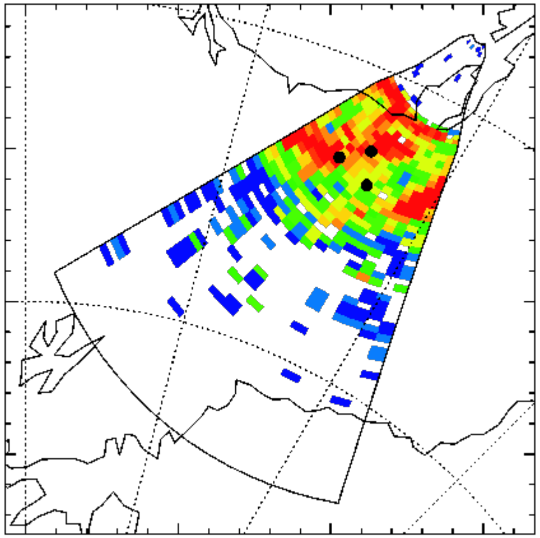


Figure Caption. The field-of-view of the northern hemispheric SuperDARN radars employed in our analysis.

Method of Analysis

This algorithm is based on a cross-spectral analysis with multi-channel maximum entropy method (MULMEM) [Strand, 1977; Shibata 1987]. This algorithm was applied in the present study to the time-series of ground-backscattered power obtained by three cells within the field-of-view of the radar.





In next slide, we introduce an example of the comparison of temporal variations in MSTID propagation parameters between the two latitudinal regions.

Case studies of MSTIDs in the auroral and mid-latitudes

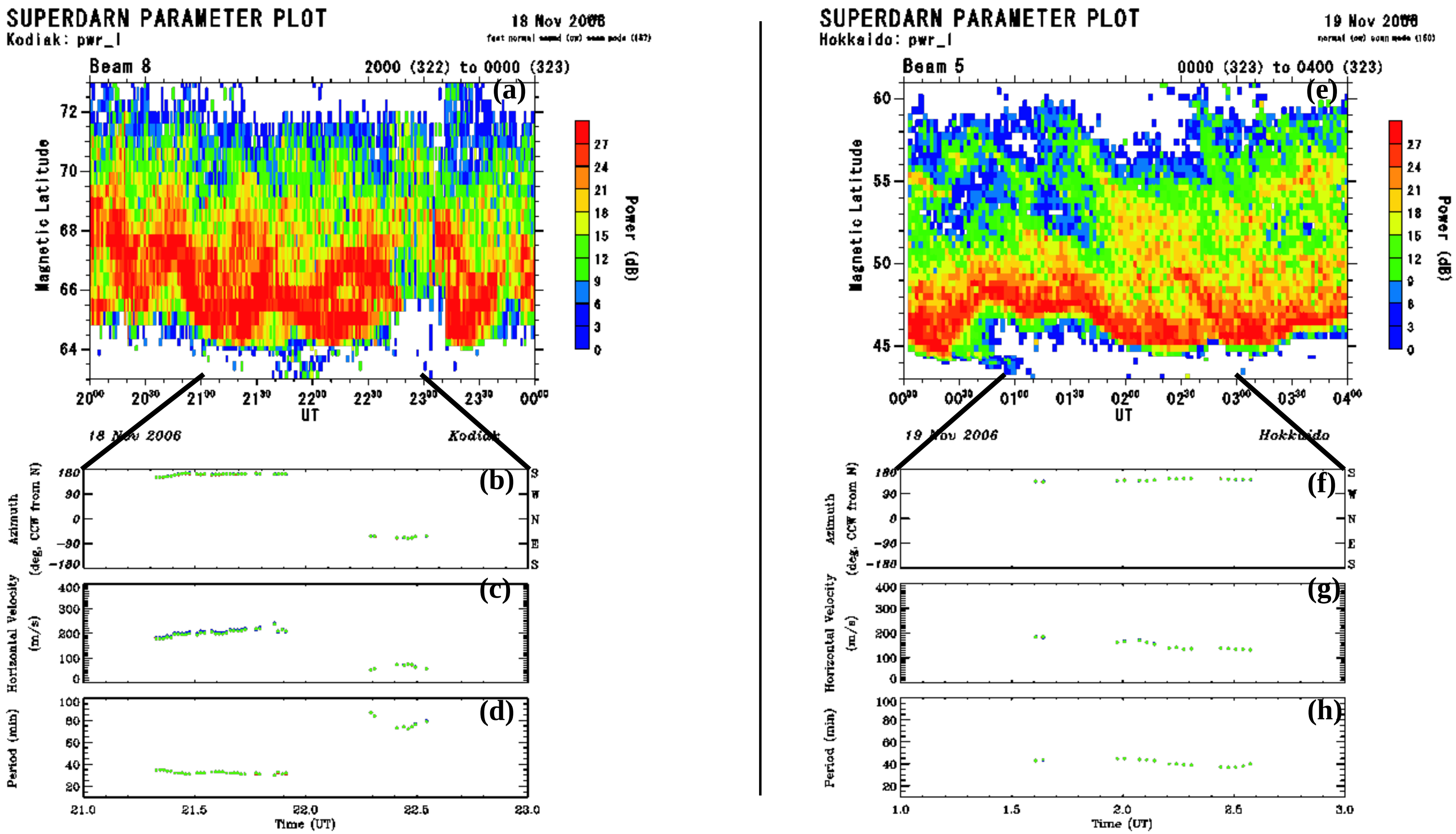


Figure Caption. Temporal variations of the MSTIDs' propagation parameters in the auroral and mid-latitude regions. (a-d) Auroral observations. (e-h) Mid-latitude observations. (a, e) RTI plots. (b-d, f-h) Parameters derived from cross-spectral analysis using SuperDARN data.

Statistical Comparison of MSTIDs in auroral and mid-latitudes

The data span 42 autumn and winter months from September 2000 to February 2007 for the auroral radars, 7 autumn, winter and spring months from November 2006 to May 2007 for the mid-latitude radar.

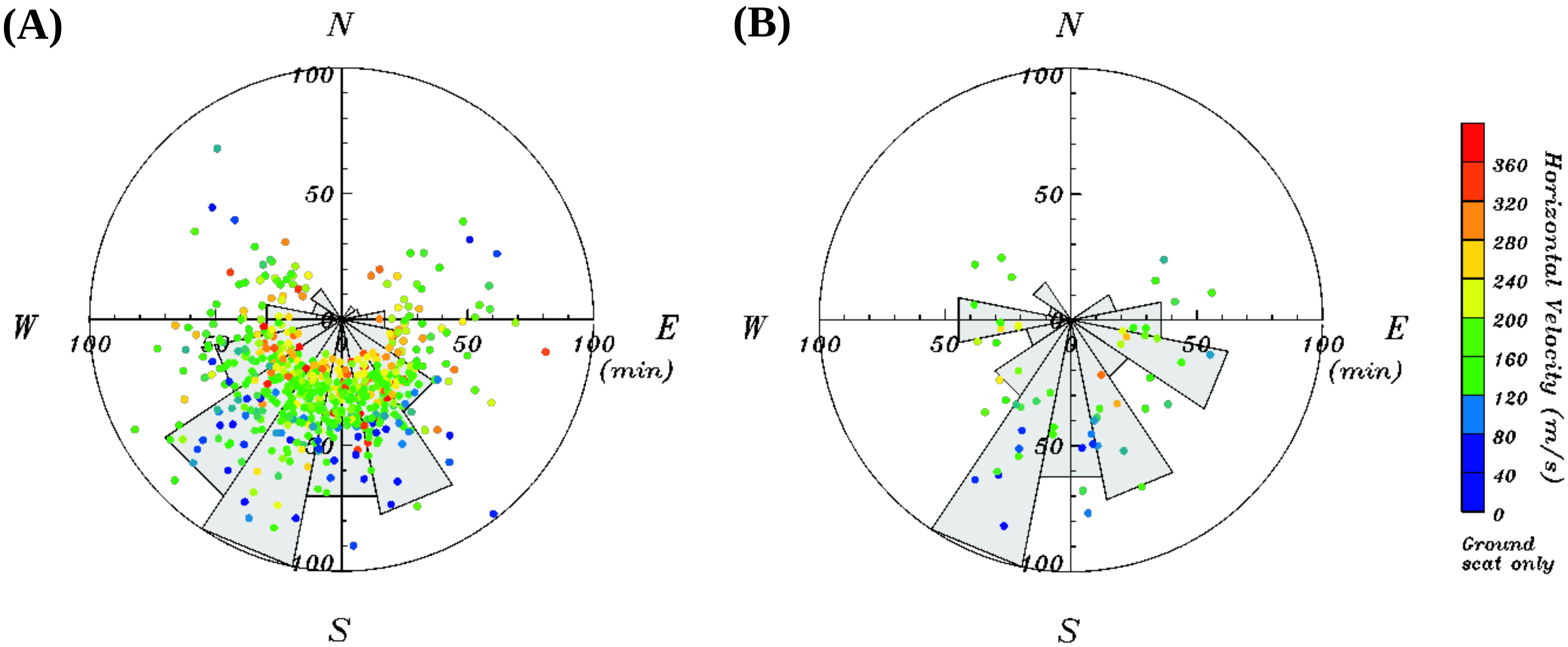
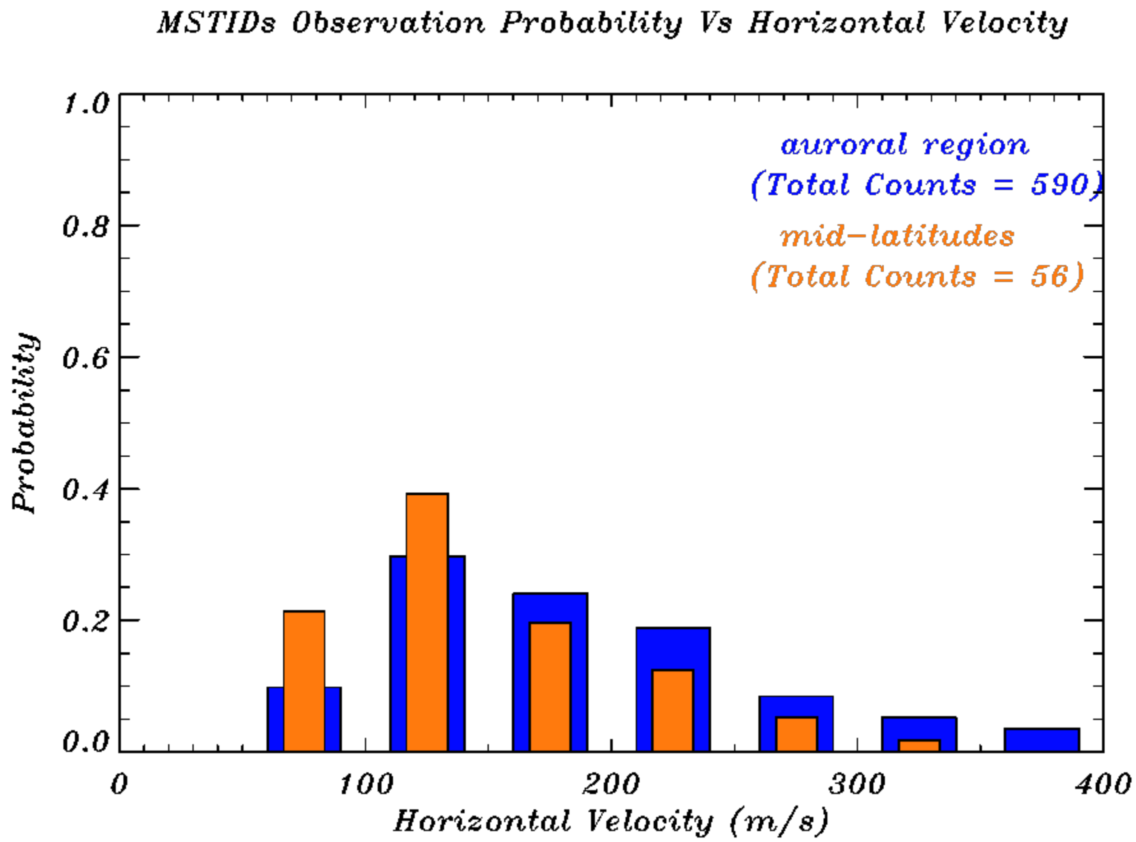


***Figure Caption.* Propagation characteristics observed at (A) auroral (Kodiak and King Salmon) and (B) mid(Hokkaido) latitudes. Radial distance from center denotes wave period. Horizontal phase velocities are color-coded according to the gradient shown. Shaded areas indicate the frequency distribution of propagation direction (southward is toward the bottom of the page).**

Statistical Comparison of MSTIDs in auroral and mid-latitudes



Although the peak occurs at approximately 100-150 m/s at both latitudes, MSTIDs with higher phase velocities occur less frequently than in the mid-latitude region. This suggests that some fraction of the MSTIDs with higher horizontal phase velocity are unable to reach the mid latitudes even if the propagation direction is predominantly equatorward.

Figure Caption. ***Histogram of MSTID occurrence as a function of horizontal phase velocity.***

Statistical Comparison of MSTIDs in auroral and mid-latitudes

The similarities

- ***Shorter-period MSTIDs have higher horizontal phase velocity (and vice versa), indicating that the horizontal phase velocity of MSTID varies as a decreasing function of the fluctuation period. This result is in agreement with HF Doppler observations by Shibata and Okuzawa [1983].***

- ***The propagation directions of the MSTIDs observed in the auroral and mid-latitude regions tend to be southward, with the directional maximum toward the SSW.***

The differences

- ***Average phase speed of the mid-latitude MSTIDs is lower than that for the auroral latitudes.***

Conclusions

In summary, through near-simultaneous SuperDARN observations at auroral and mid latitudes it was demonstrated that MSTIDs can propagate from auroral to mid latitude regions with persistent propagation parameters if the dominant propagation direction is approximately equatorward.

It was shown that a proportion of MSTIDs with higher horizontal velocity do not reach the mid-latitudes, which will be derived from the combined effects of

1) *the difference of the dissipation rate for AGW energy and*
2) *the tid-measurement theory of the SuperDARN radars.*