Real-Time Identification of Radar Auroral Clutter Using SSUSI Data

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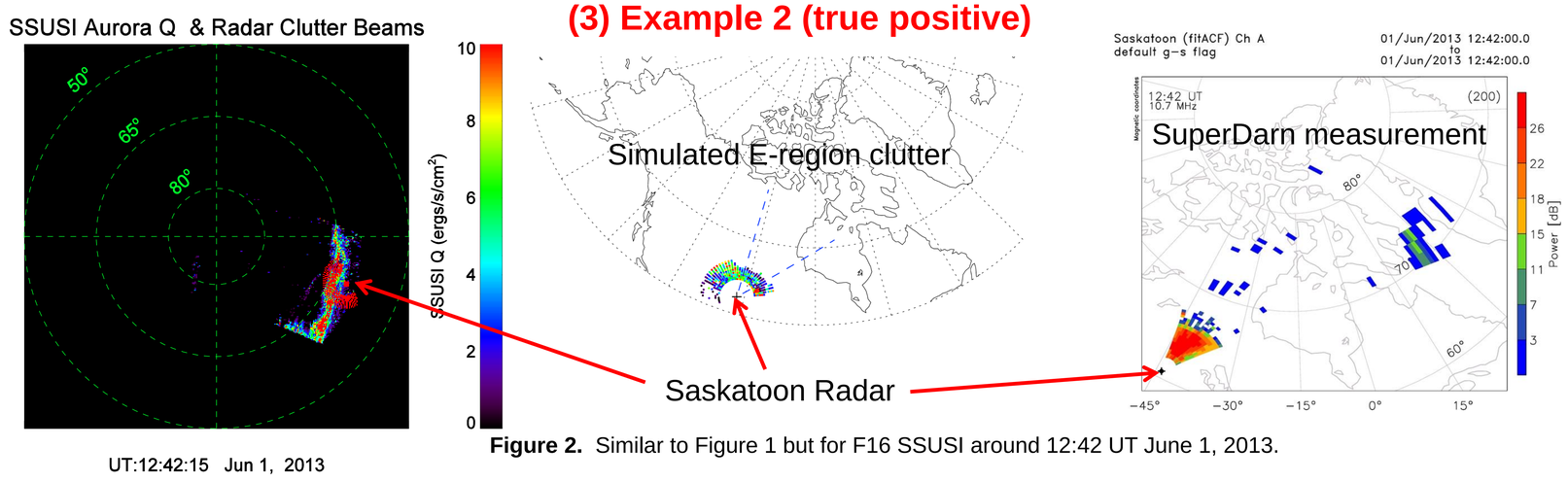
Abstract An algorithm has been developed to determine radar auroral clutter using auroral images from SSUSIs (FUV imagers on DMSP F16-19) in near real-time. Energetic particle precipitations in auroral region create high ionospheric E-region electron densities that scatter radio waves and cause "auroral clutter". We demonstrated the performance of the algorithm by comparing simulated radar clutter using SSUSI images and SuperDarn HF research radar data. By combining SSUSI auroral data and an auroral forecast model, we can predict auroral clutter a few hours ahead of time.

(1) Introduction

Radar auroral clutter is a noise source for radar operation. The source (enhanced electron density) moves with background plasma so it is not easy to eliminate it by examining its Doppler shift. Therefore it is important to identify the clutter. Auroral images from multiple SSUSIs allow us to determine the clutter in near-real time.

The newly developed algorithm allows estimates the relative auroral clutter intensities for any radar operated in the polar regions. The algorithm is validated by comparing coincident Saskatoon SuperDarn radar scatters from auroral E regions and the simulated auroral clutters using SSUSI auroral product (electron energy flux Q).



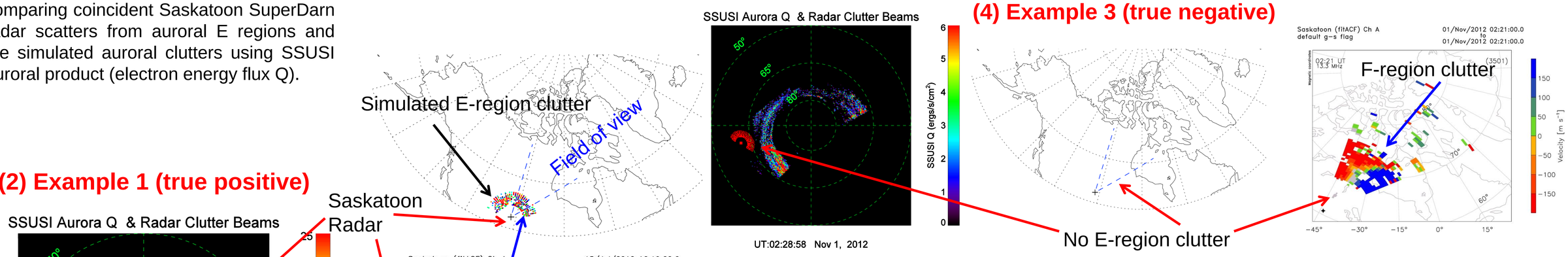


Figure 1. Left: DMSP F18 SSUSI Q map in magnetic latitude and local time coordinates (top/bottom: sunward/tailward, left/right:dusk/dawn, center: magnetic pole, auroral image time: ~16:19 UT, July 15, 2012, red dots: potential source region of auroral clutter). Top-right: Simulated E-region clutter. Bottom-right: coincident Saskatoon SuperDarn E-region radar clutter.

Figure 2. Similar to Figure 1 but for F16 SSUSI around 12:42 UT June 1, 2013.

Figure 3. Similar to Figure 1 but for F18 SSUSI around 02:21 UT, November 1, 2012.

4. Limited statistical results

SSUSI	Radar	Events
Positive	Positive	62
Positive	Negative	1
Negative	Positive	3
Negative	Negative	6

(5) Summary

(1) The algorithm & SSUSI data provide reliable auroral radar clutter estimation in near real-time.
(1) The true positive detection rate: ~98% [62/(62+1)].
(2) The true negative detection rate: ~67% [6/(6+3)].
(3) Heidke Skill Score: 0.72
(4) The algorithm is ready to be used for operation.