The THEMIS reveal morphology of Pc4 pulsations excited after substorm onset and Auroral streamer

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Outline

- Introduction
- Background
- Purpose of study
- Research techniques
- Aurora structure and data
- Summary
- Future work

Introduction

・Substorm

-Tail reconnection triggering substorm onset

-Substorm is categorized into three stage, Growth phase, Expansion phase, Recoveryphase.

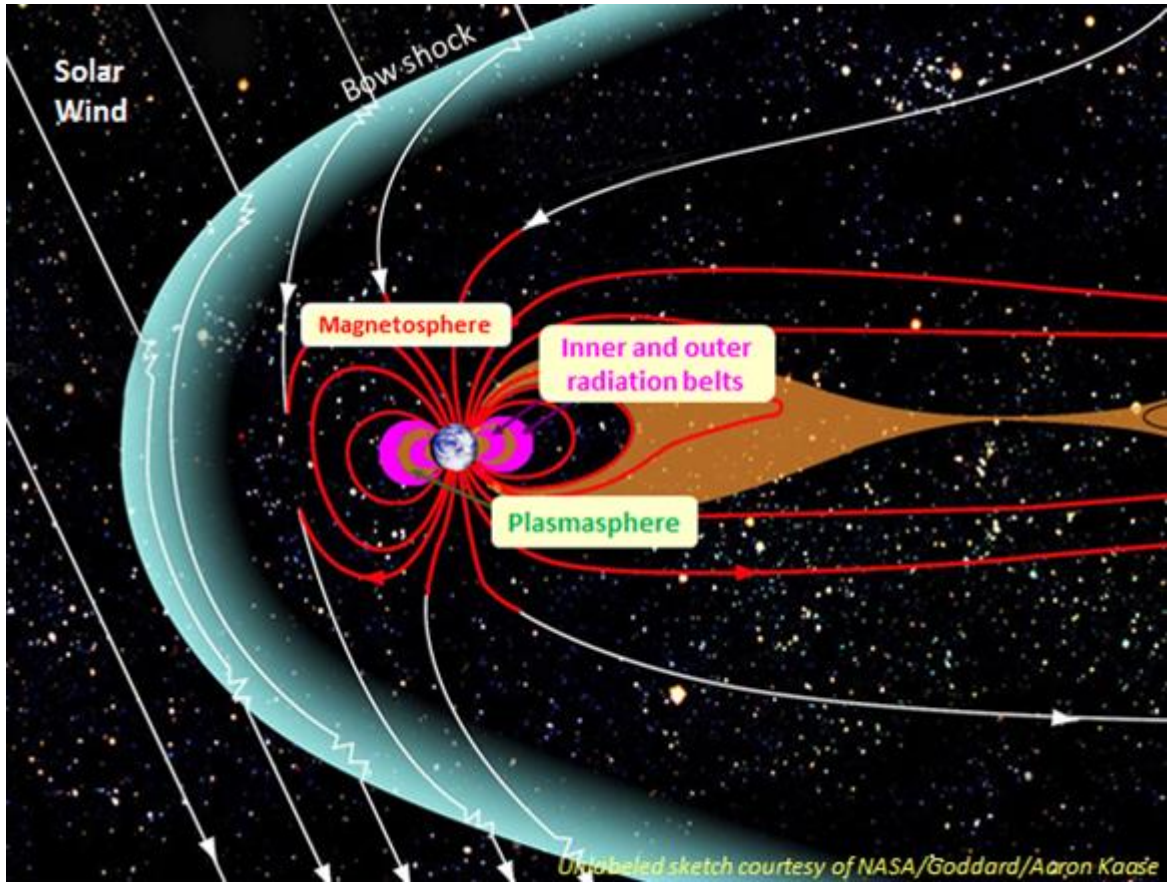
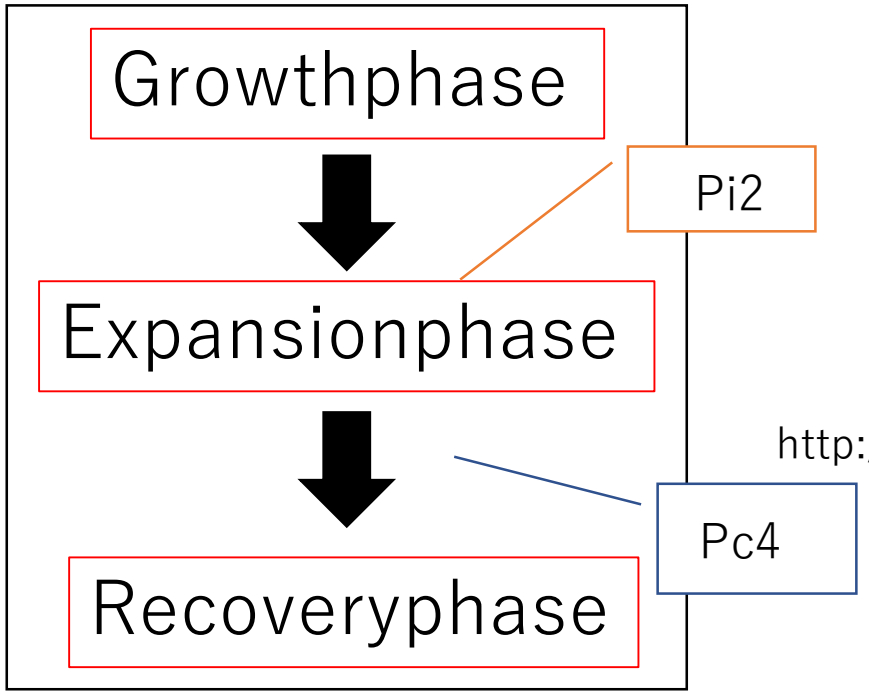


Fig.1　earth'magnetosphere

http://www.aeronomie.be/en/news-press/2013-09-18-vanallen-plasmasphere.htm



Introduction

・magnetic pulsation

-many magnetic pulsations in the magnetosphere

-In particular, Pi2 and Pc4 are related to the substorm

Type	Period Range[sec]	Frequency range[mHz]	Waveform・Features
Pc1	0.2-5	200-5000	Continuous regular
Pc2	5-10	100-200	
Pc3	10-45	22.2-100	
Pc4	45-150	6.67-22.2	
Pc5	150-600	1.67-6.67	
Pc6	＞600	＜1.67	
Pi1	1-40	25-1000	Irregular
Pi2	40-150	6.67-25	
Pi3	＞150	＜6.67	

Table1 Hydromagnetic pulsation are classified into waveform and period Range

Background

・Shishime(2013)

・Observating on high latitude station and synchronous orbit that nightside Pc4 pulsations excited by substorm events.

・Pi2 occurs on substorm onset,and then Pc4 occurs from expansion phase to recovery phase of substorm.

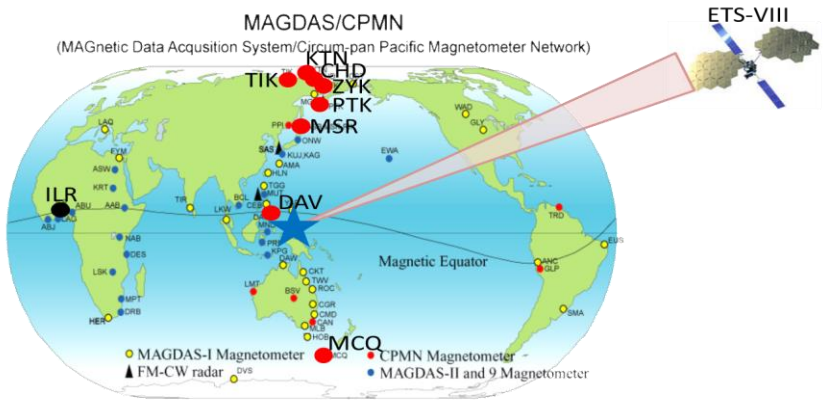


Fig.2 MAGDAS/CPMN station
Red point：210 degree meridianchainstation
black point：Africa magnetic equator
star：ETS-VIII projected ground point

Pi2

Pc4

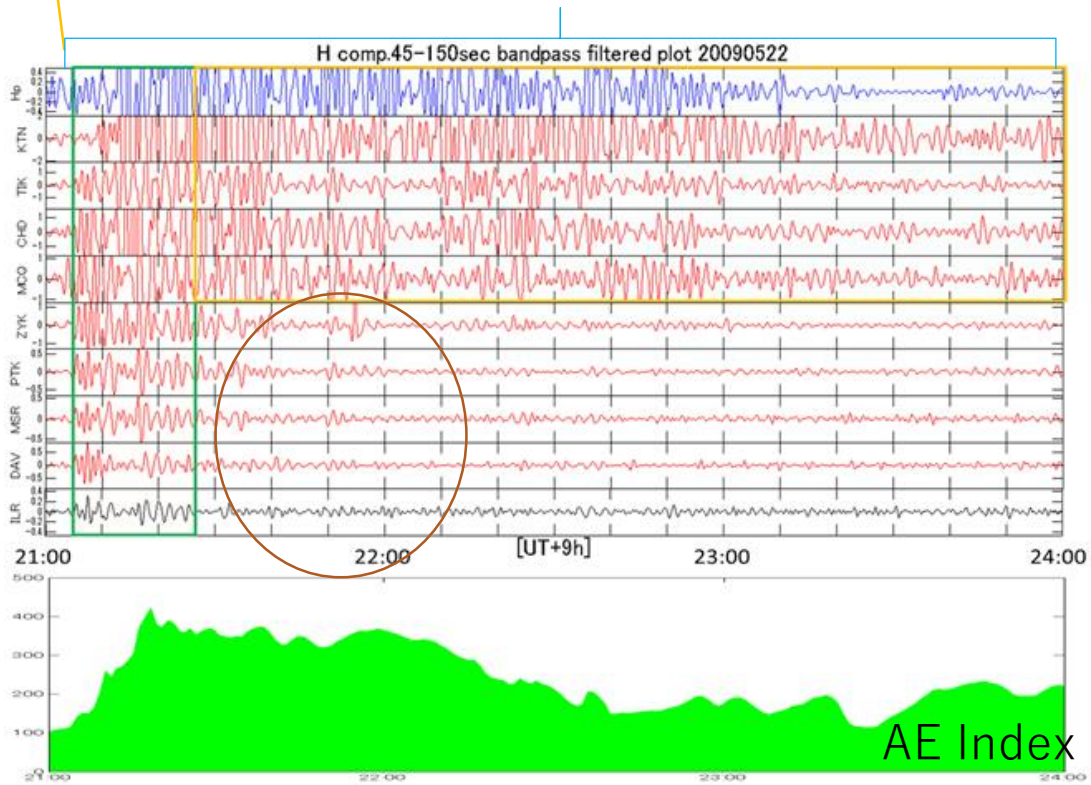


Fig.3 the upper 2009/05/22 21:00～24:00LT BPF plot
the lower AE Index

http://magdas.serc.kyushuu.ac.jp/station/index.html

Background

○Wave classification

・Pc4

→Alfven wave

・Pi2

→Magnetic sound wave

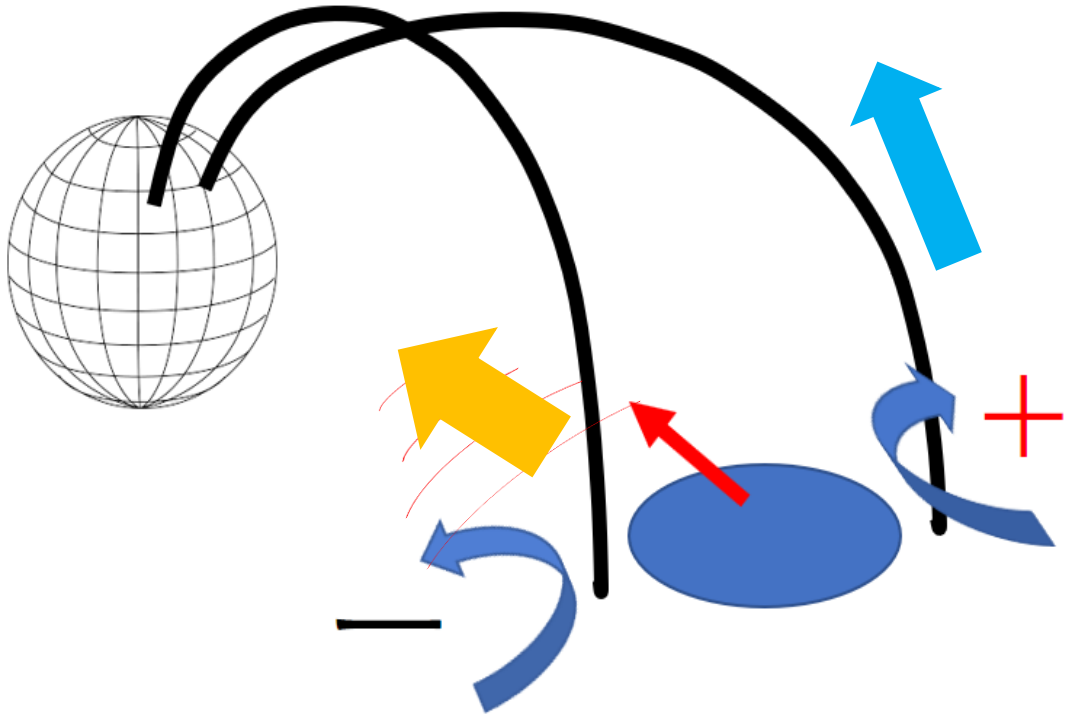


Fig.4 Conceptual diagram

Purpose of study

・They results suggest that Pi2 occurs on substorm onset, and then Pc4 occurs from expansion phase to recovery phase of substorm.

・substorm and Pc4 pulsations are related.

↓

・The THEMIS reveal morphology of **Pc4** pulsations excited after substorm onset and Auroral streamer

Research techniques

・THEMIS mission

-5 satellite which was launched by NASA in 2/2007 in cooperation with all-sky cameras on the ground and field observation, launched aim to elucidate the mechanism of the substorm. Learn more about each satellite to magnetic particles, temperature and global head e-flow, etc.

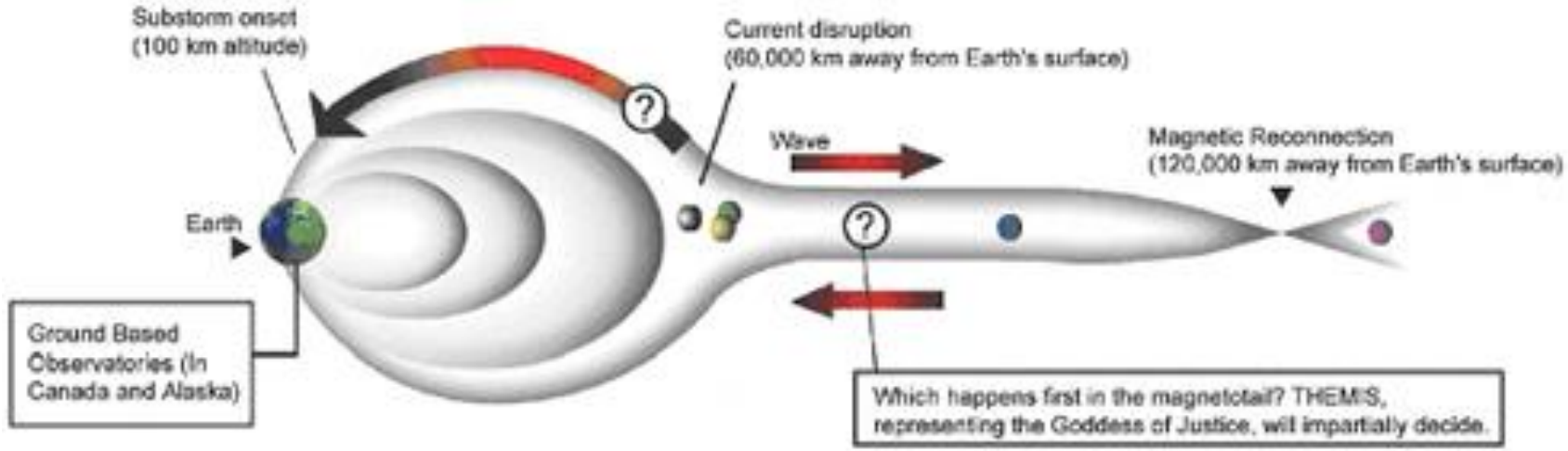
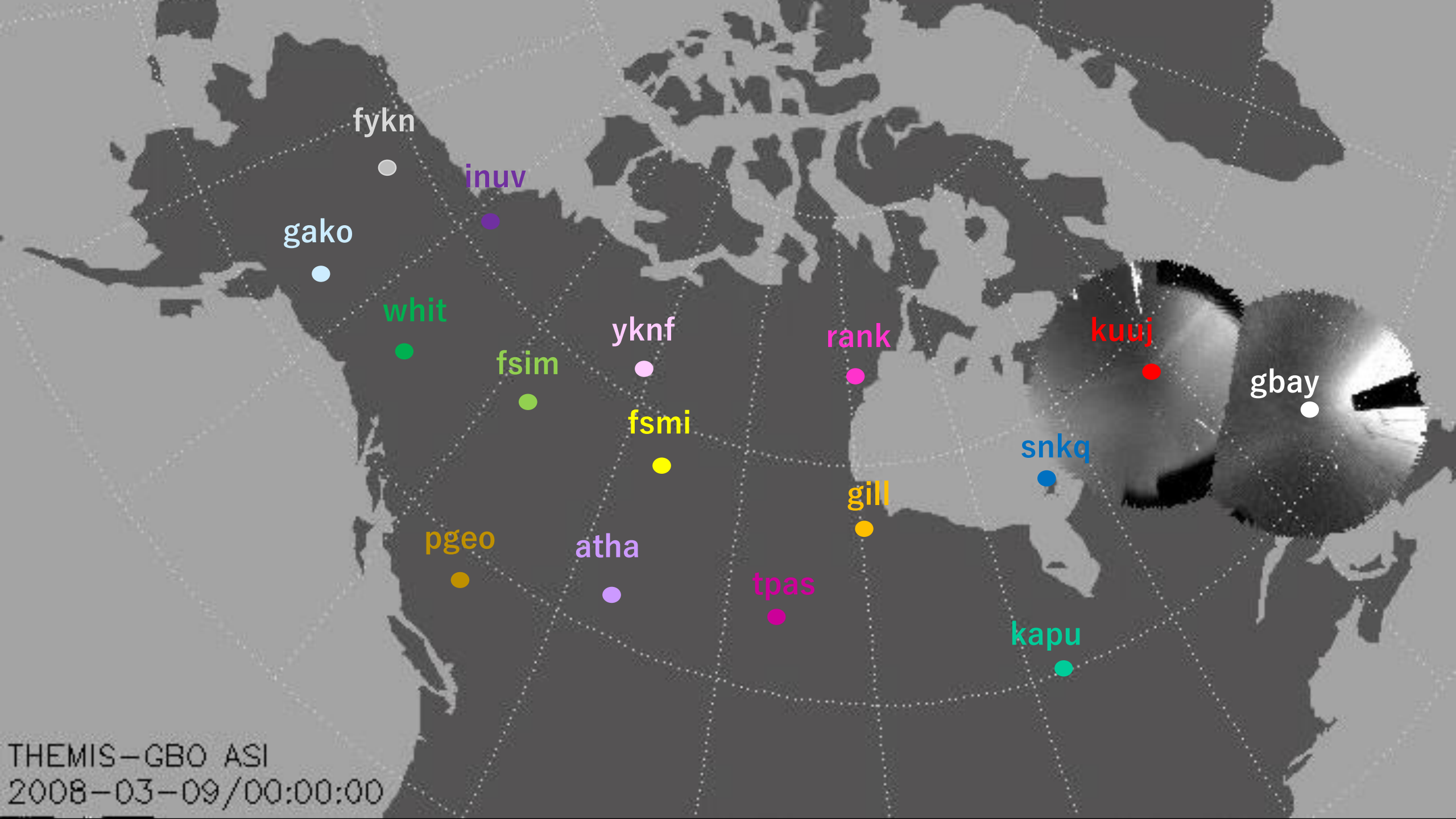


Fig.6 THEMIS speace crafts in magnetsphere

http://themis.ssl.berkeley.edu/overview.shtml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Aurora structure

(Westward travelling surge/S-fractal aurora)

-westward front of expansion auroral

-going westward with S-fractal aurora

-Dots indicate upward FAC, and crosses are downward FAC

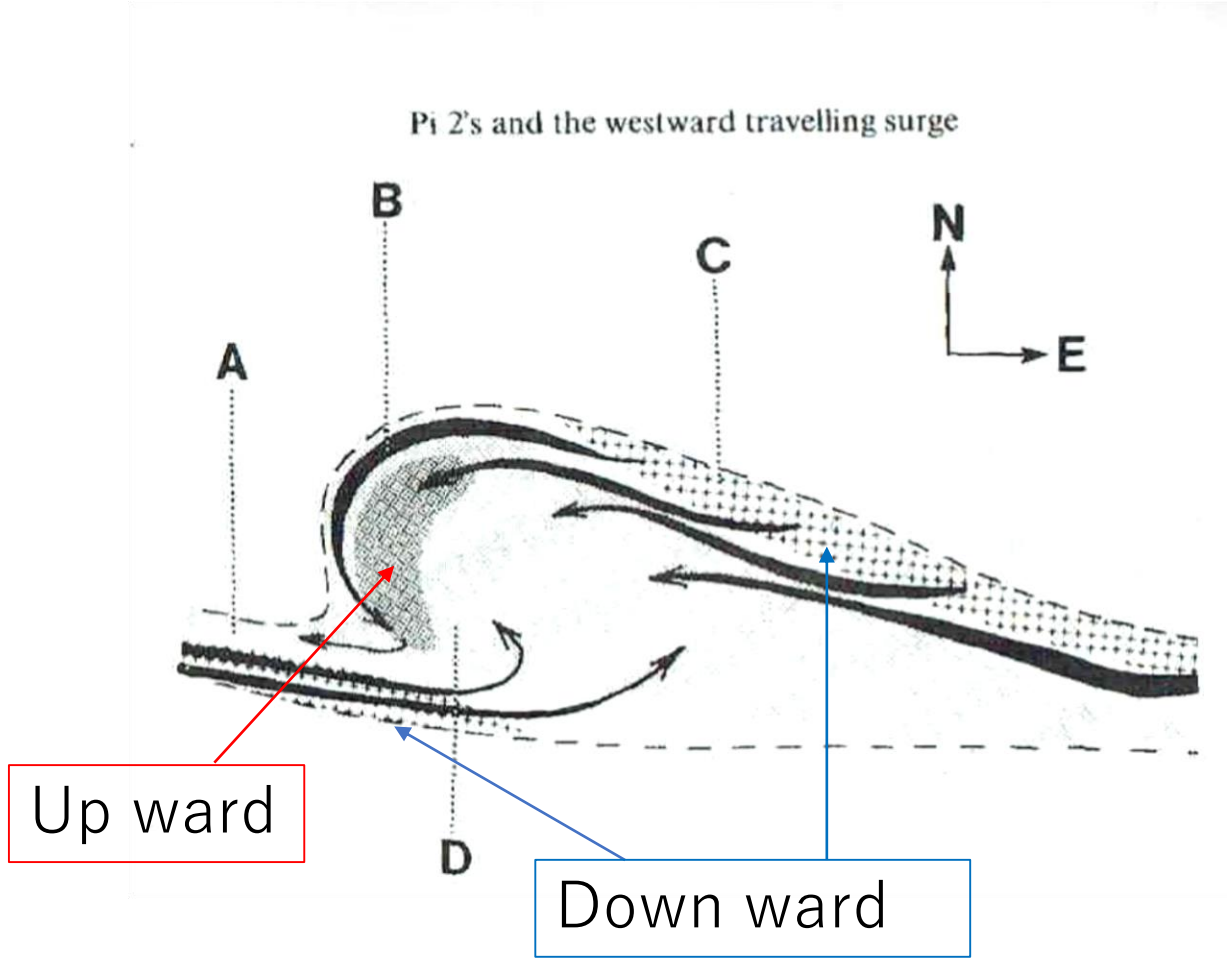


Fig.6 J.C. SAMSON and G.ROSTOKER(1982)

Aurora structure

(N-S Auroral/N-S aligned arc)

-elimination from center of Westward travelling surge

-propagation to low latitude

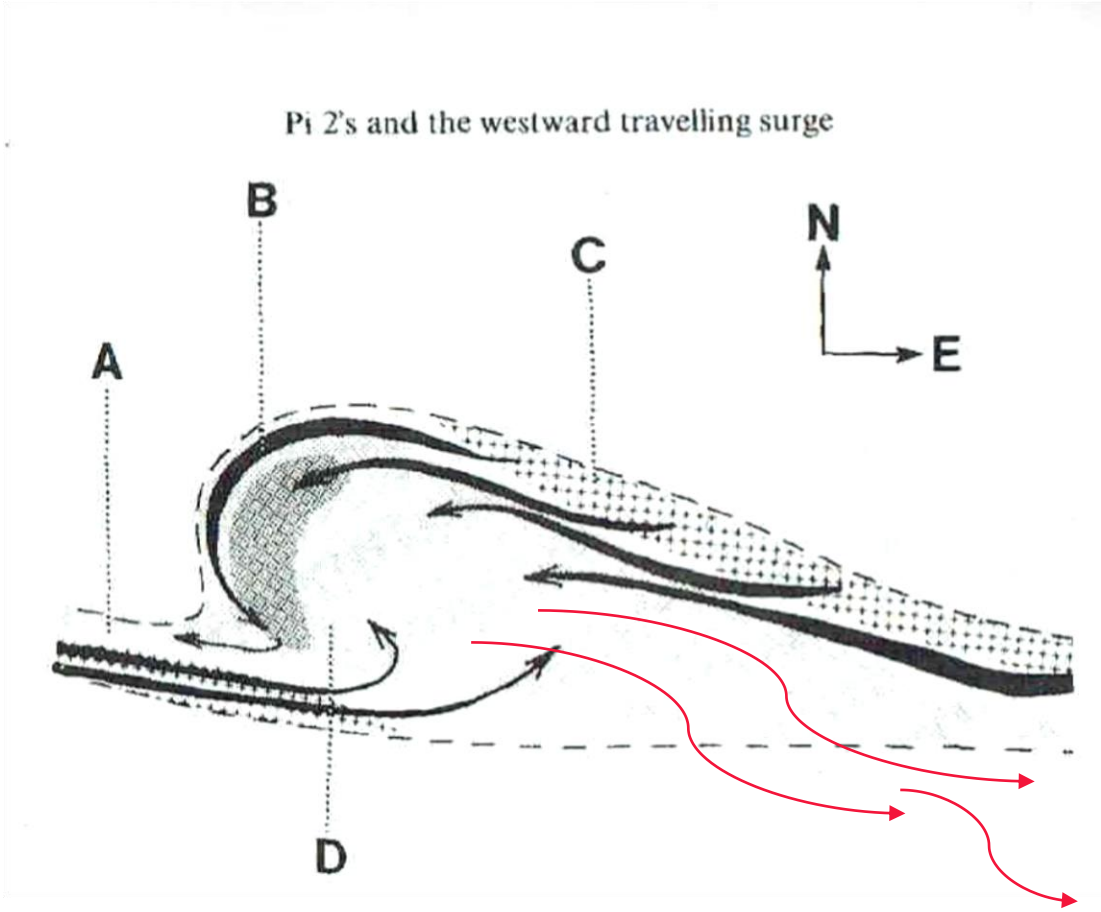


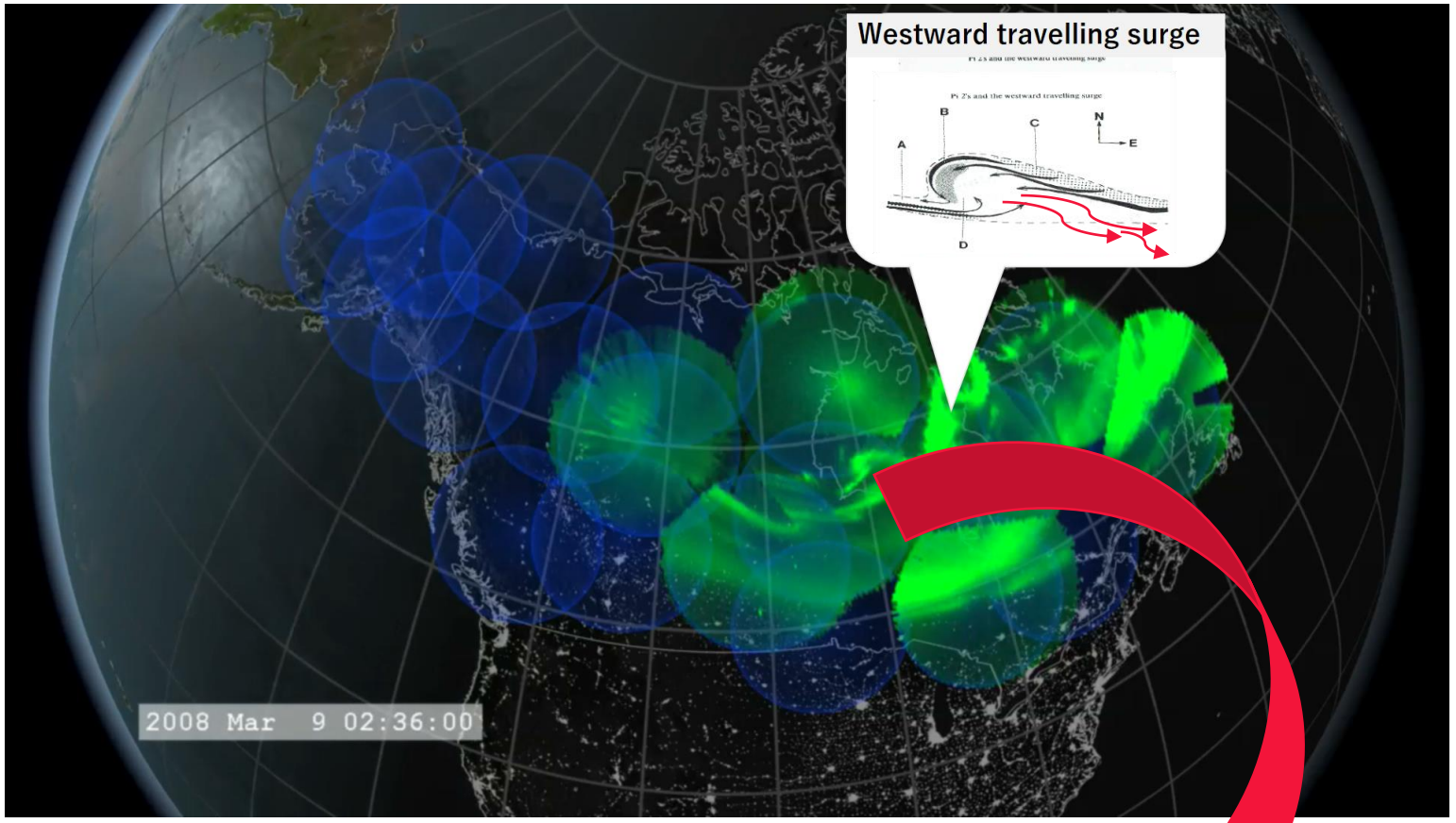
Fig.7 J.C. SAMSON and G.ROSTOKER(1982)

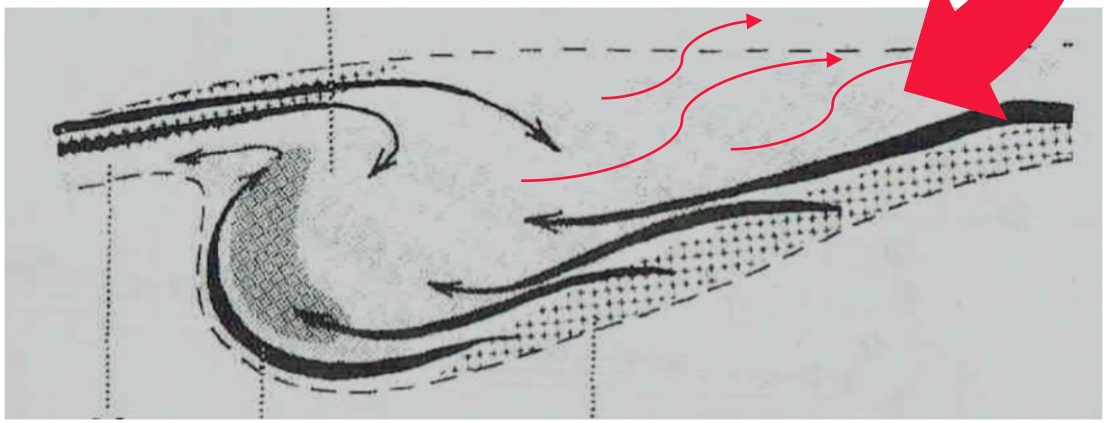
Research techniques

-current structure reveal from Magnetic field data of the station surge shows

-the structure in the earth project on magnetosphere

-reveal auroral streamer in magnetosphere





Aurora structure
(WTS)

○Magnetic field data and Band-pass filter
＊2008/3/2
○FSMI
○INUV

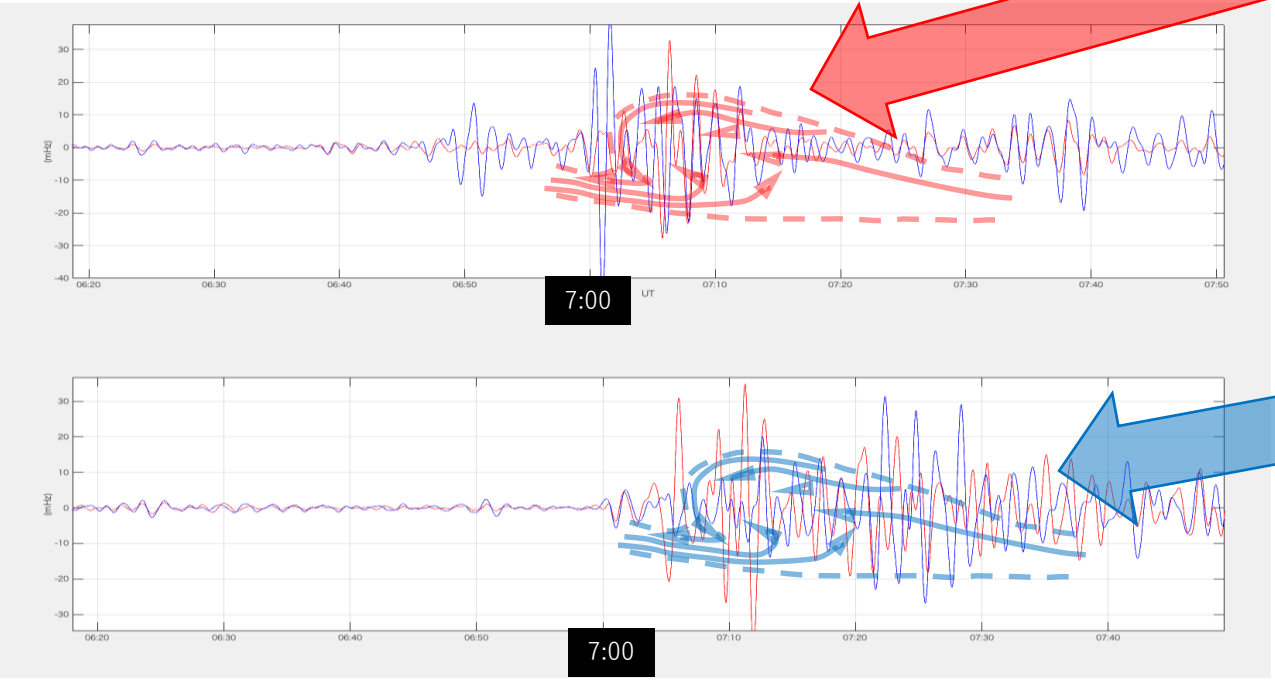


Fig.8 2008/3/2 Pc4 data

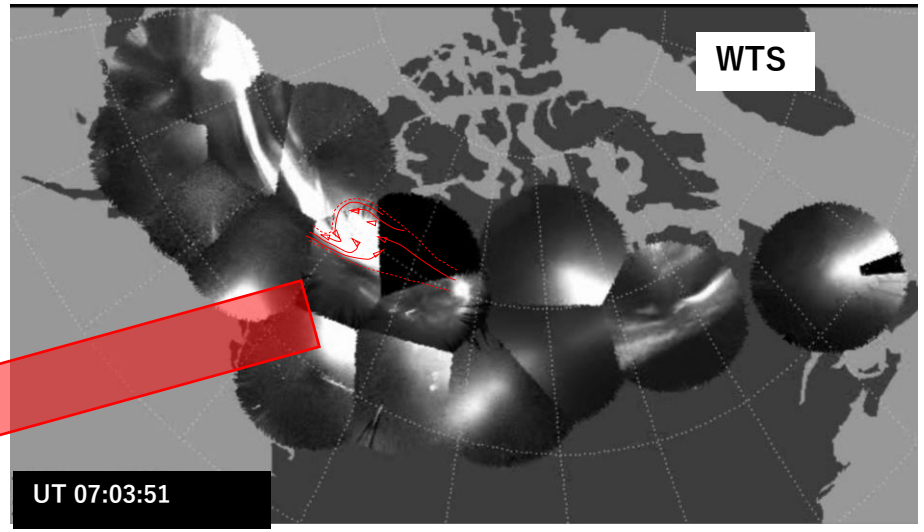


Fig.6 2008/3/2 UT07:03:51

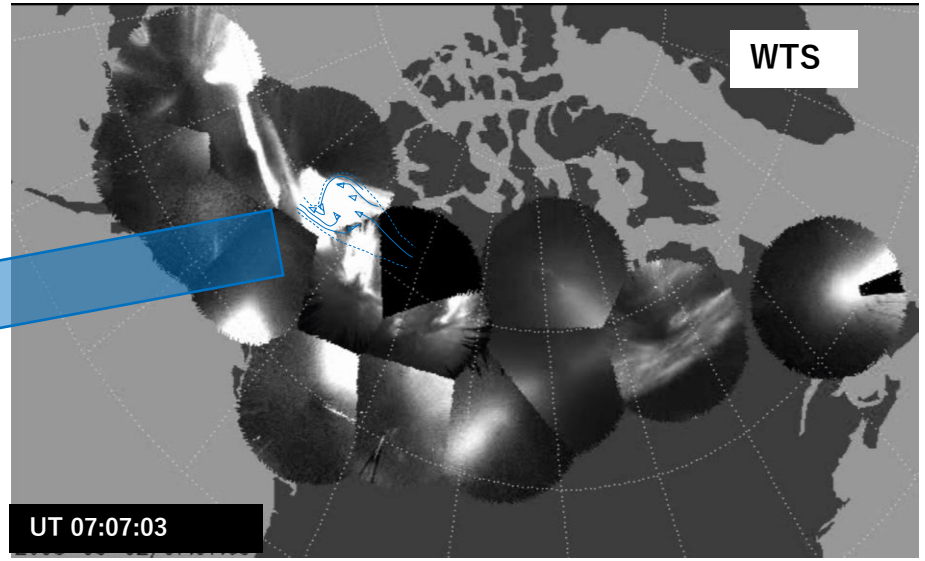


Fig.9 2008/3/2 UT07:07:03

Aurora structure

(Pulsating aurora)

-Brighness is uniform , shape is Arc

-Brighness of Aurora patch fluctuates quasi-periodically from a few seconds to a few tens of seconds

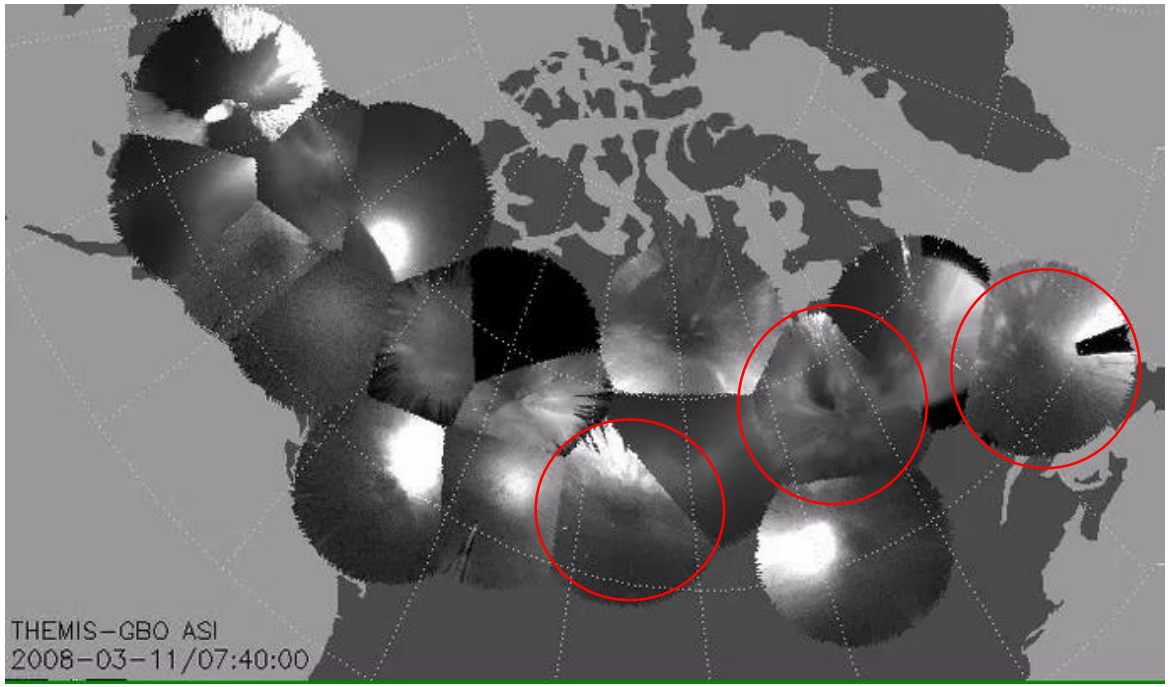
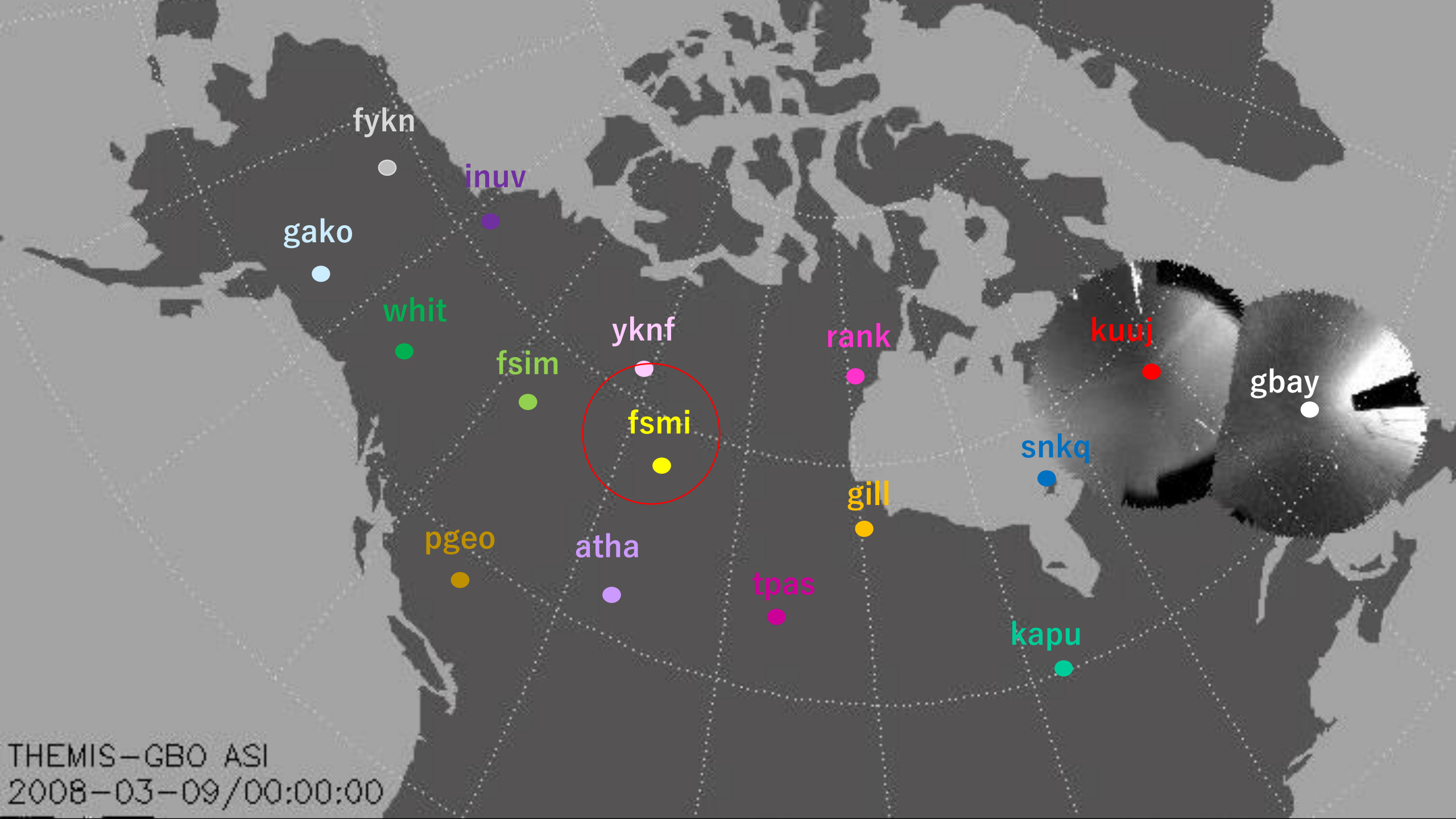


Fig.10 2008/3/11　movie　snkq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Aurora structure(Pulsating aurora)

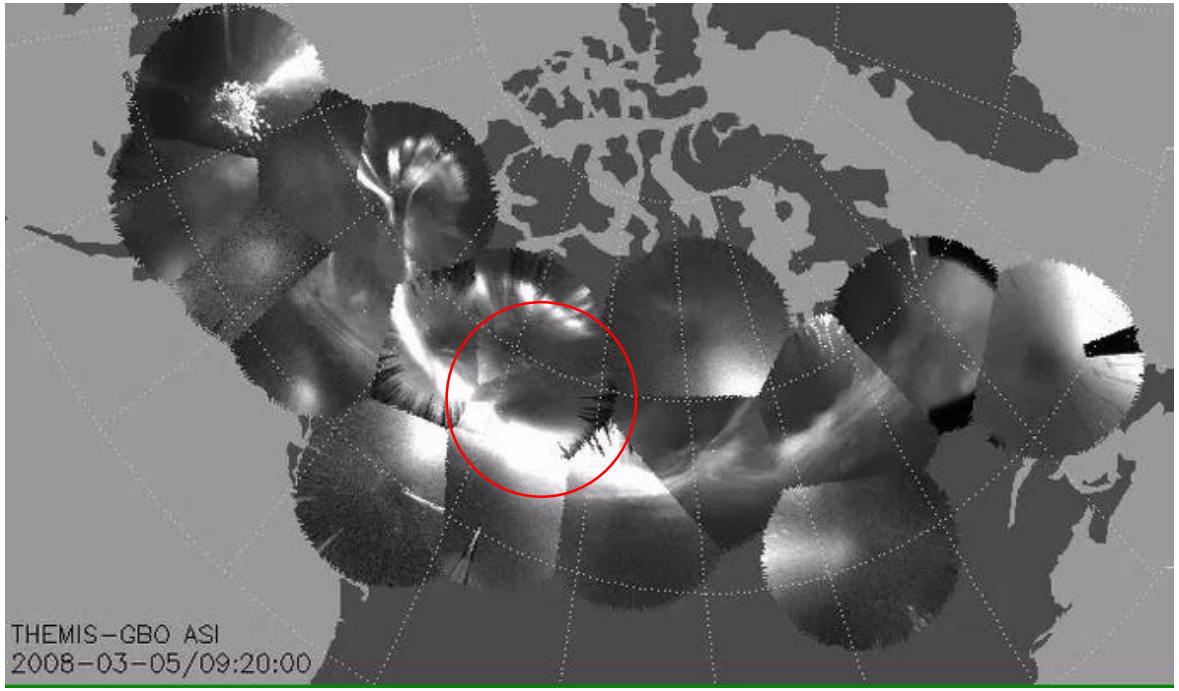


Fig.11 2008/3/5 movie fsmi

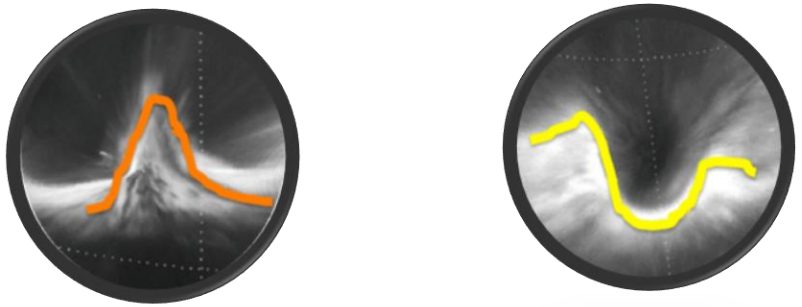


Fig.12 current structure torch and omega band

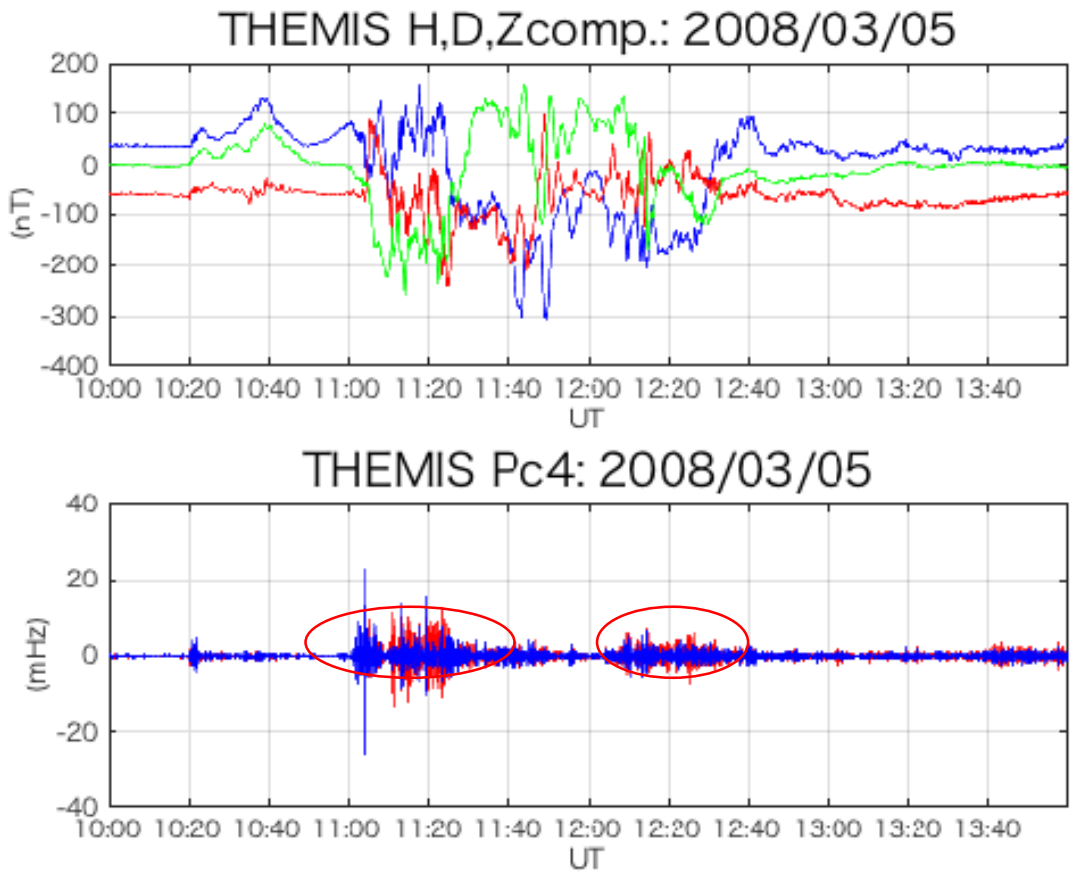
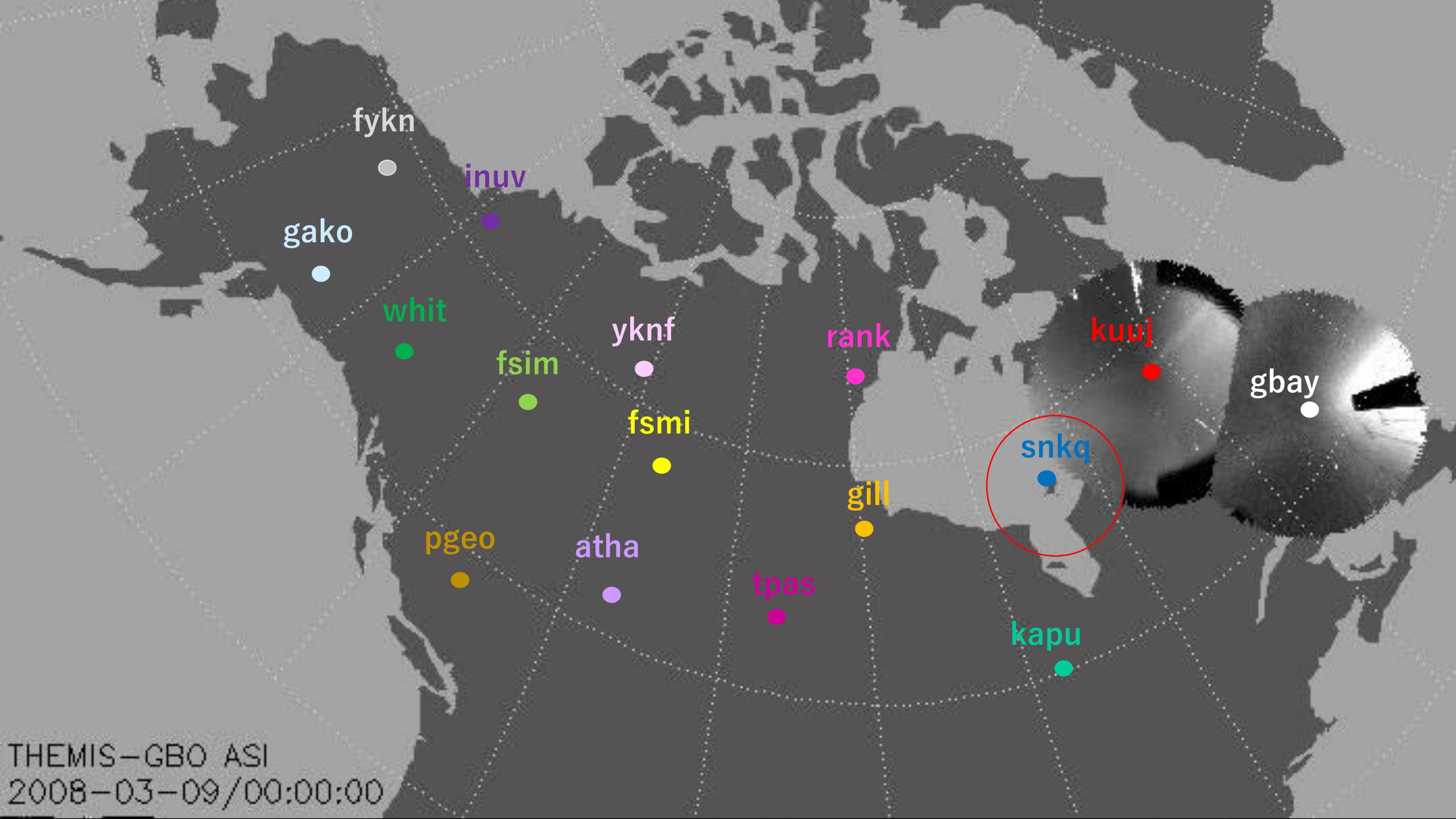


Fig.13 2008/3/11 fsmi data

http://polaris.nipr.ac.jp/~SD/sdjapan/workshop/2016NIPR/15-SATO_Omega.pdf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Aurora structure
(Pulsating aurora)

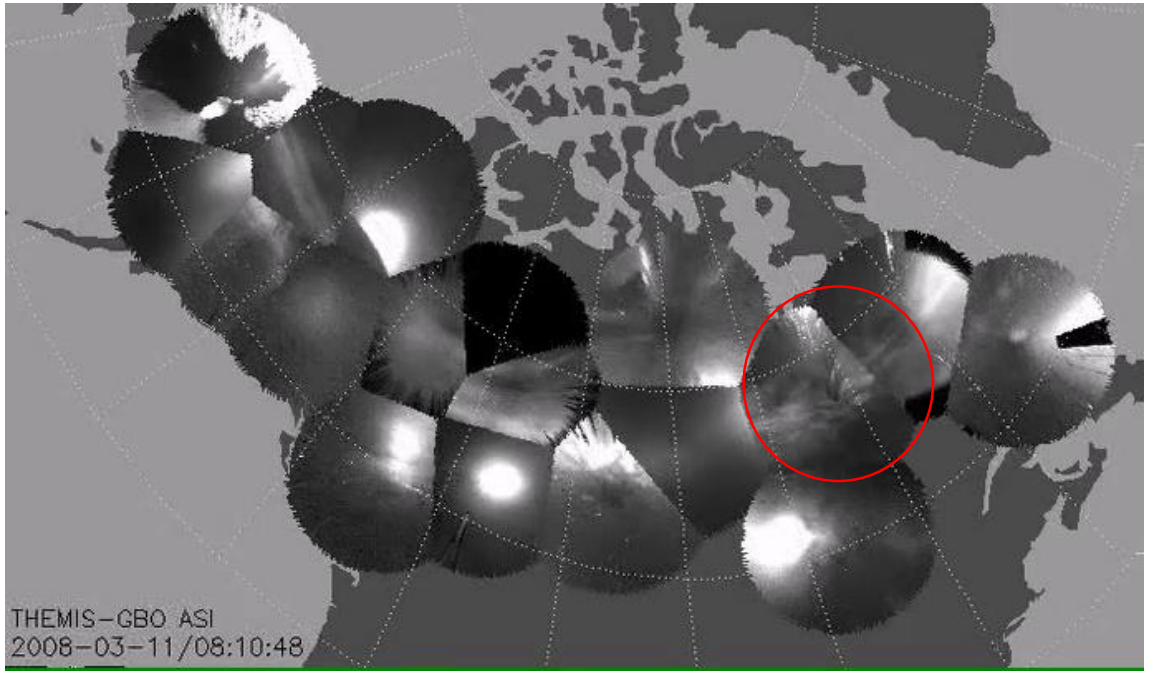

Fig.14 2008/3/11 movie snkq

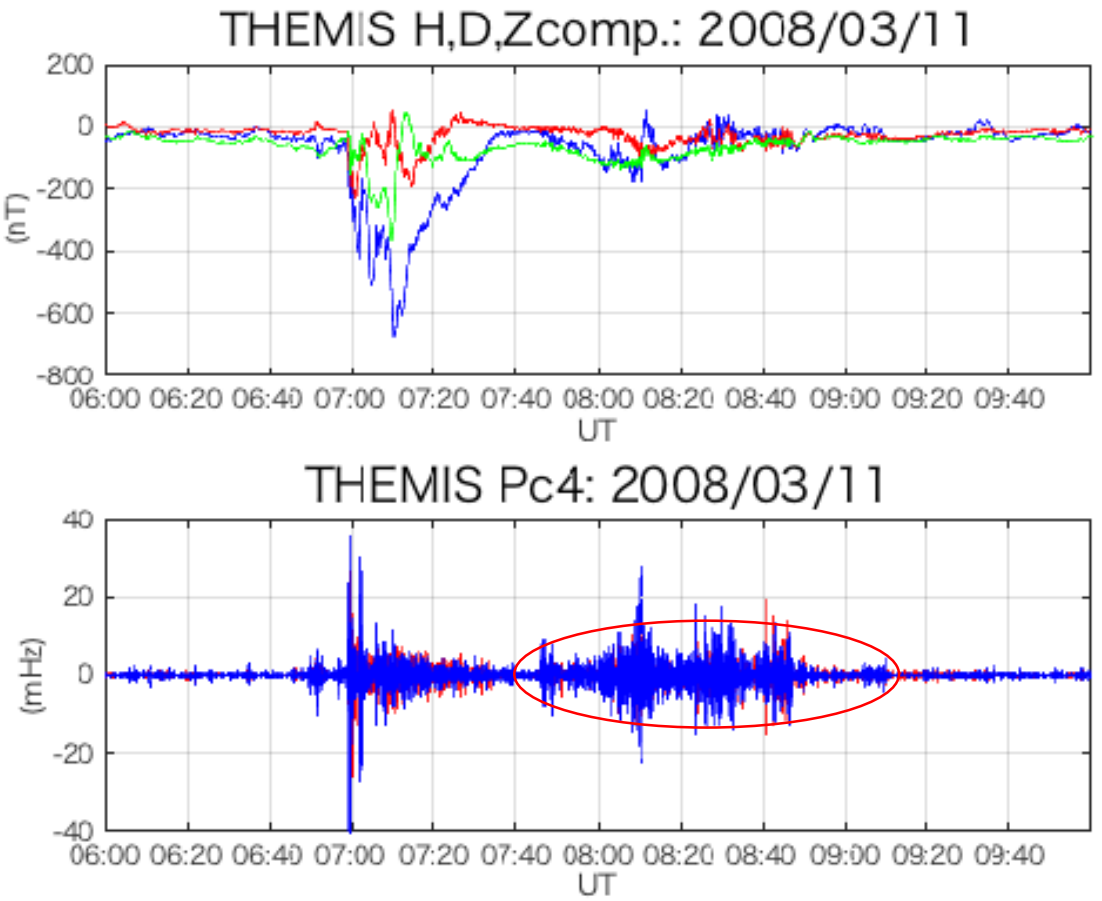

Fig.15 2008/3/11 snkq data

Summary

〇サージのアクティビティの伝播
・サージの伝播によってPi2like(transient Pc4)の現れる
　アクティビティの移動を確認することができた
→オーロラストリーマーが夕方側にフローを
　起こしているのではないか？

〇Pc4likeな波の伝播
・サージ以外のオーロラの構造でもPc4likeな波が見えた
→現在パルセーティングオーロラとPc4の波が起こるという
　ことは言われていないので他のイベントも確認し
　統計解析を行っていく

Future work

・磁気データからメソスケールでの大規模な等価電流系の
　推定を行っていく。
→M-Iカップリングの電流系を明らかにしていく

・オーロラ画像において、オーロラの流線の可視化を行い、
　オーロラ画像からオーロラの自動検出を行う。
→プラズマフローを明らかにしていく