Multi-point ground-based observations of the thermosphere and ionosphere over Asia and Oceania by STEL, Nagoya University

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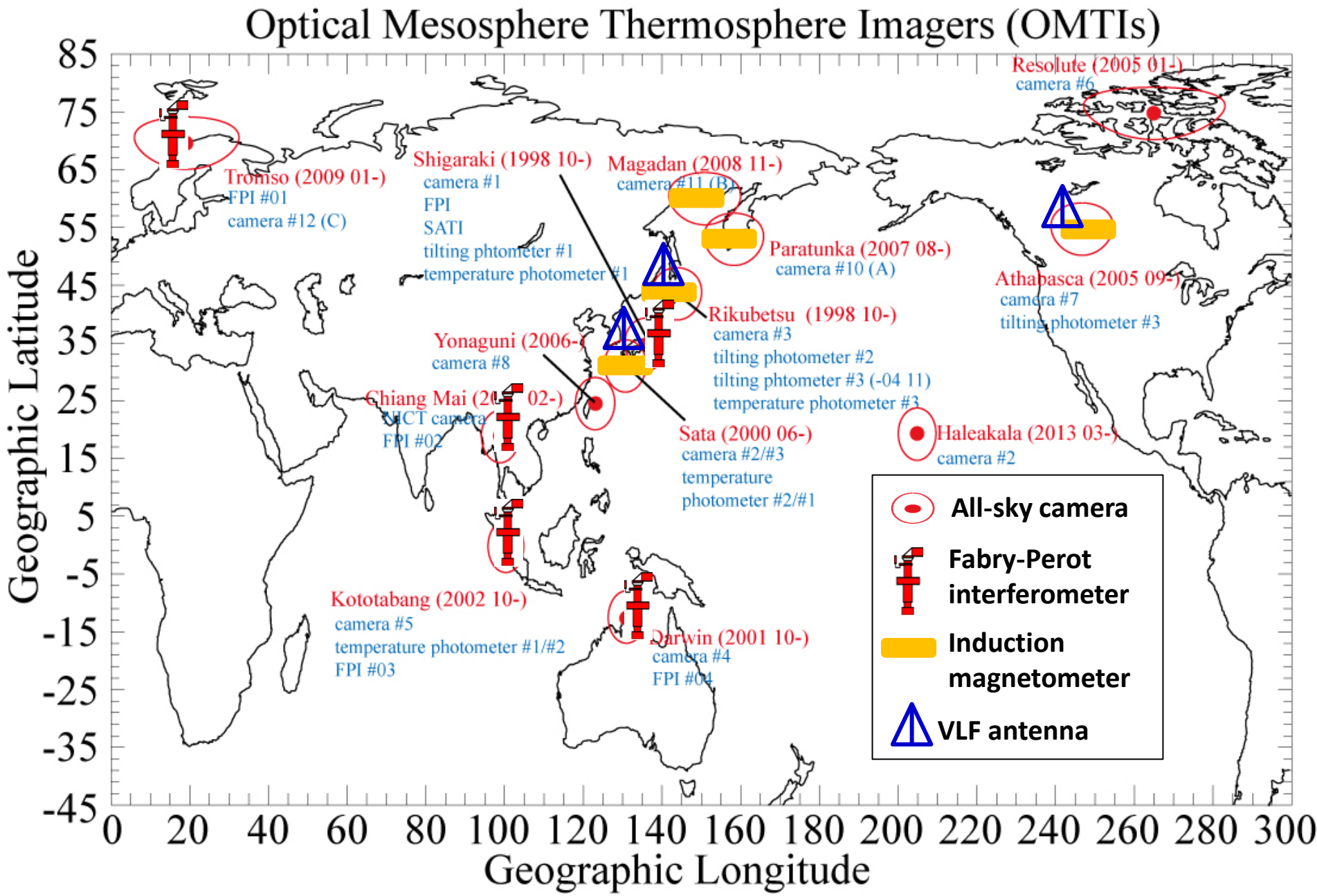
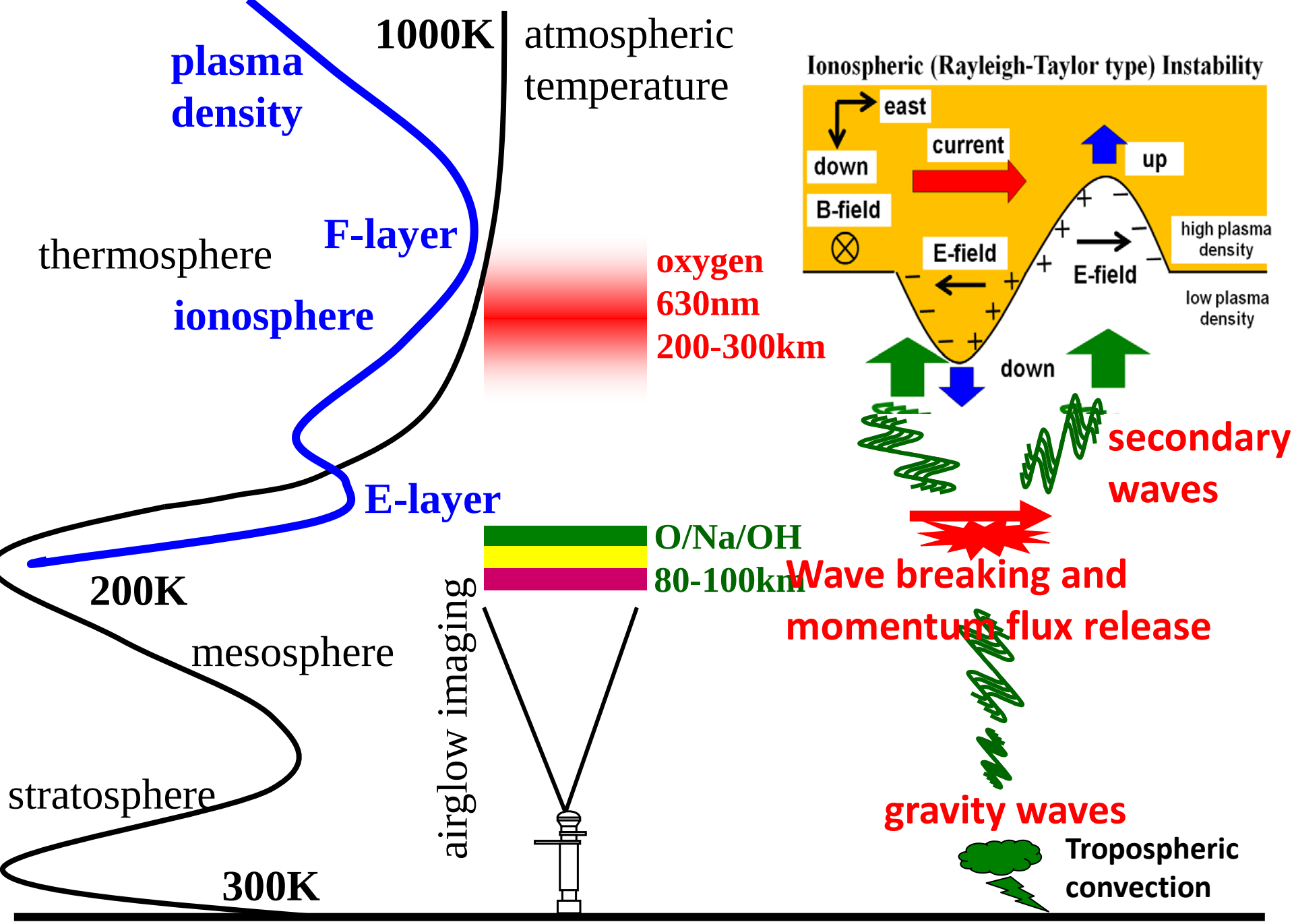
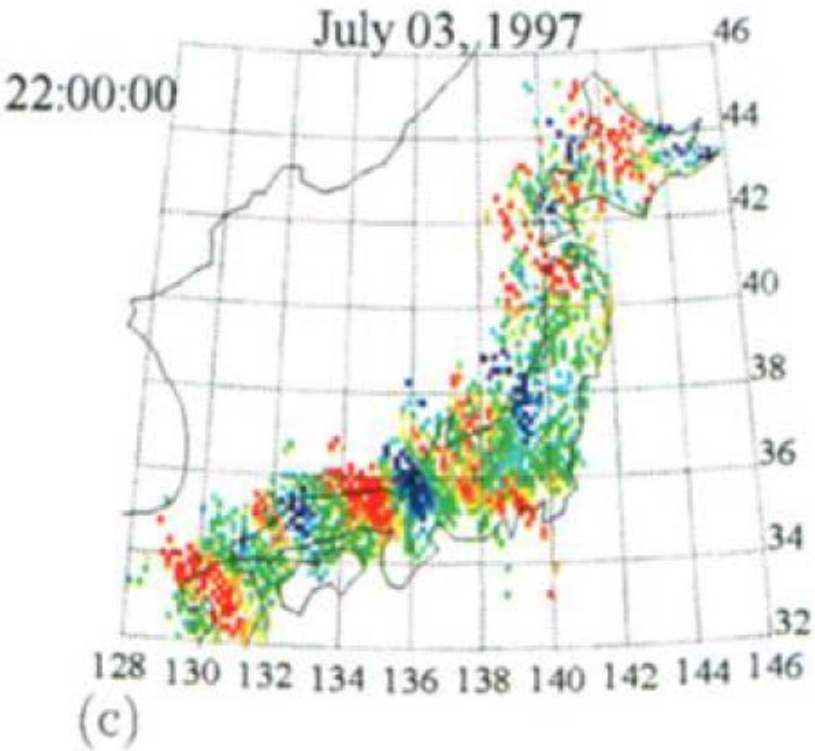
http://stdb2.stelab.nagoya-u.ac.jp/omti/



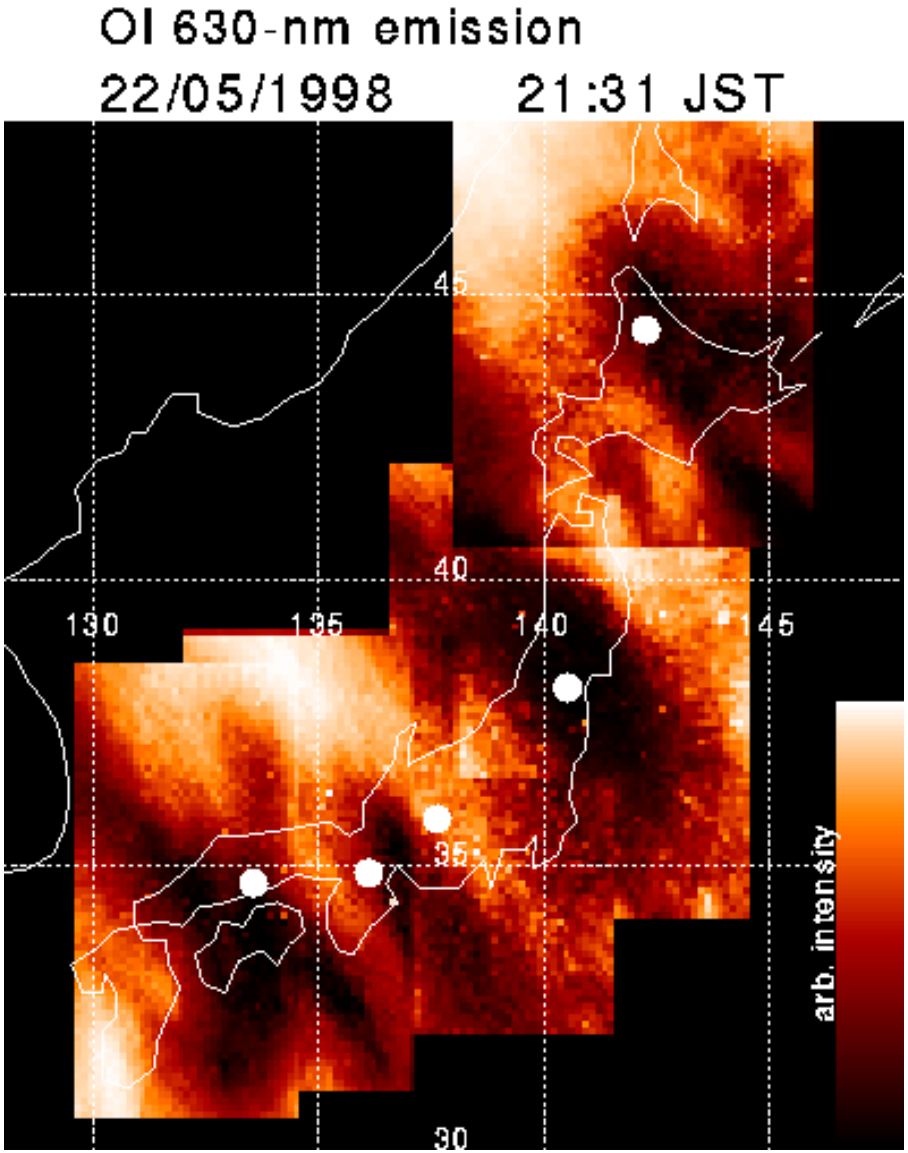
Station Name	MLAT	Collaborators
Resolute Bay, Canada	82.9	SRI International, U. Calgary, U. Electrocommunications
Tromsoe, Norway	67.1	EISCAT, NIPR
Athabasca, Canada	61.7	U.Athabasca, U.Calgary
Magadan, Russia	51.9	IKIR (FEB, RAS)
Paratunka, Russia	45.8	IKIR (FEB, RAS)
Rikubetsu, Japan	34.7	
Shigaraki, Japan	25.4	RISH (Kyoto U)
Sata, Japan	21.2	
Yonaguni/Ishigaki, Japan	14.6	ENRI, NICT
Haleakara, US	21.3	Kyoto U., Tohoku U.
Chiang Mai, Thailand	8.9	Chiang Mai U., NICT
Kototabang, Indonesia	−10.6	LAPAN, RISH
Darwin, Australia	−22.1	IPS Radio and Space Services


1000K
atmospheric temperature
plasma density
F-layer
thermosphere
ionosphere
oxygen
630nm
200-300km
E-layer
O/Na/OH
80-100km
200K
mesosphere
airglow imaging
stratosphere
300K
Ionospheric (Rayleigh-Taylor type) Instability
east
down
current
up
B-field
E-field
E-field
high plasma density
low plasma density
down
secondary waves
Wave breaking and momentum flux release
gravity waves
Tropospheric convection

Nighttime Medium-Scale Traveling Ionospheric Disturbances (MSTIDs)

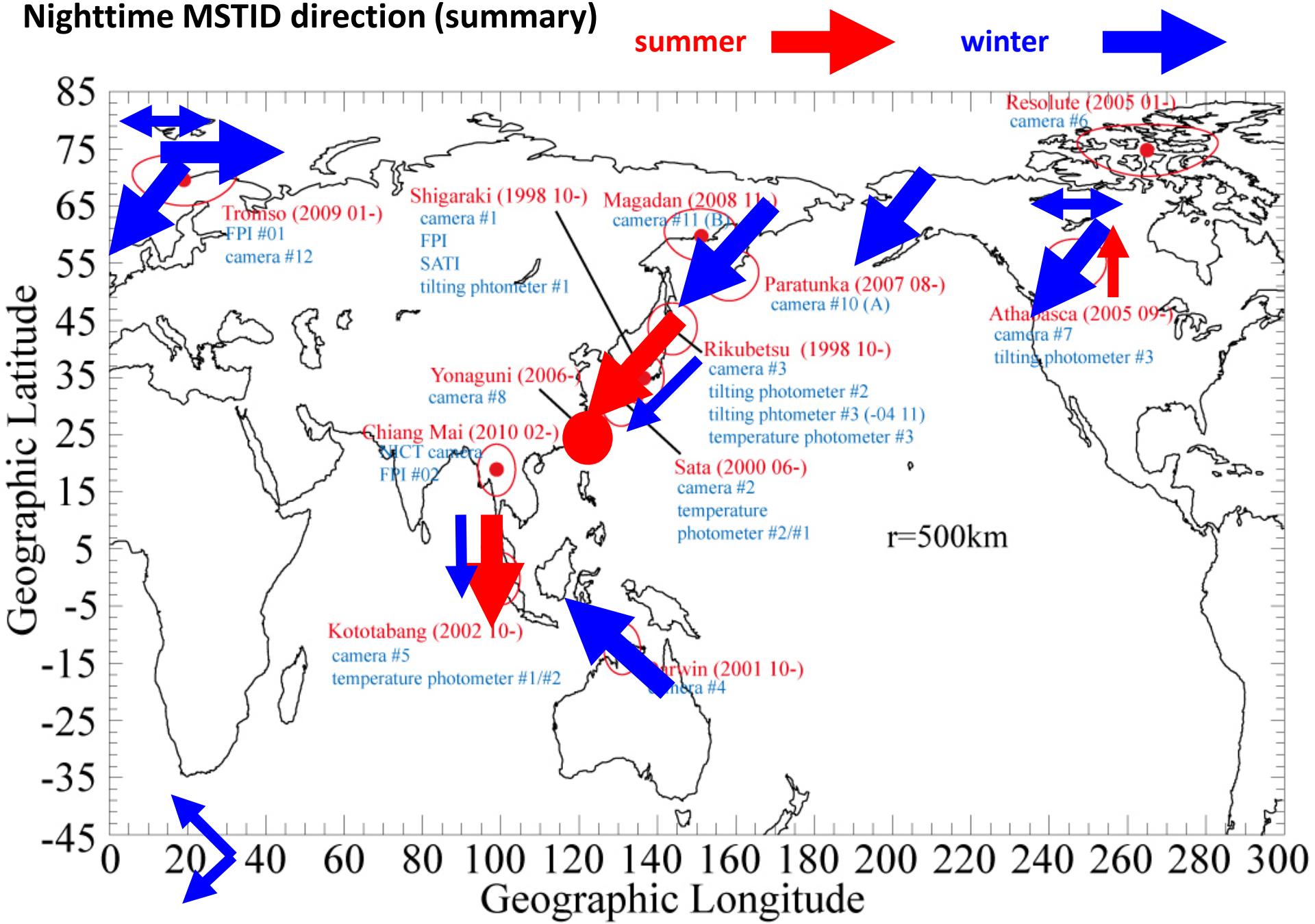


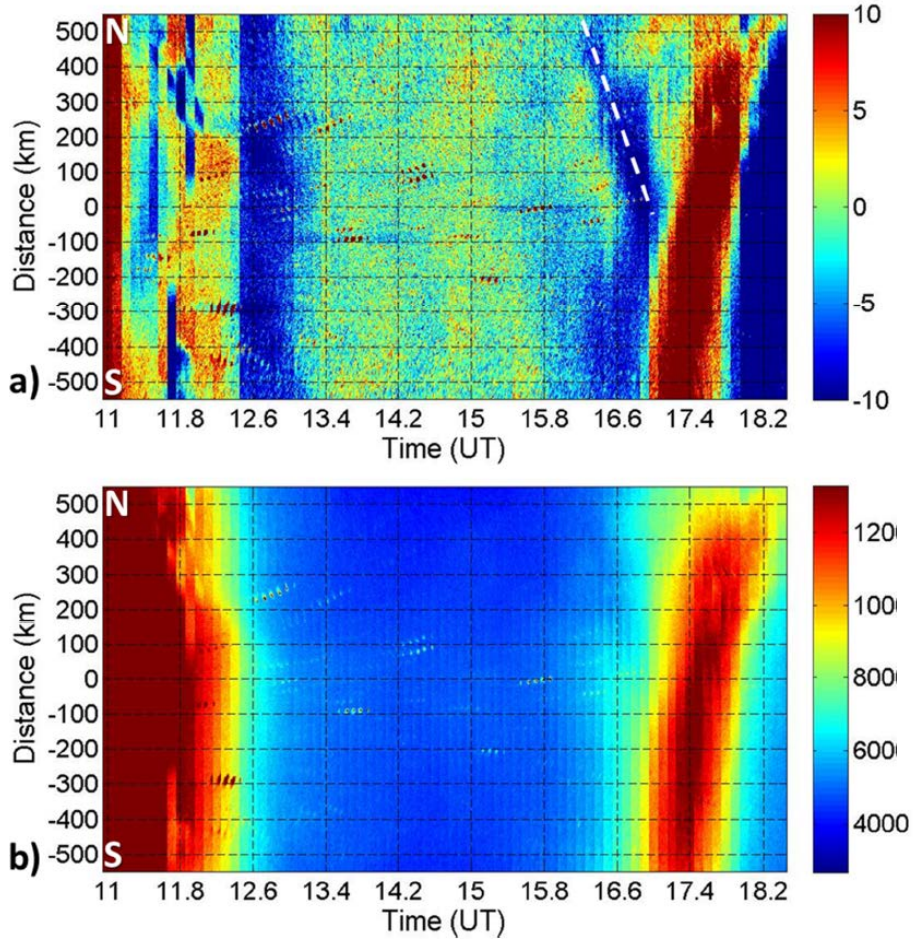
Saito et al. (GRL, 1998)

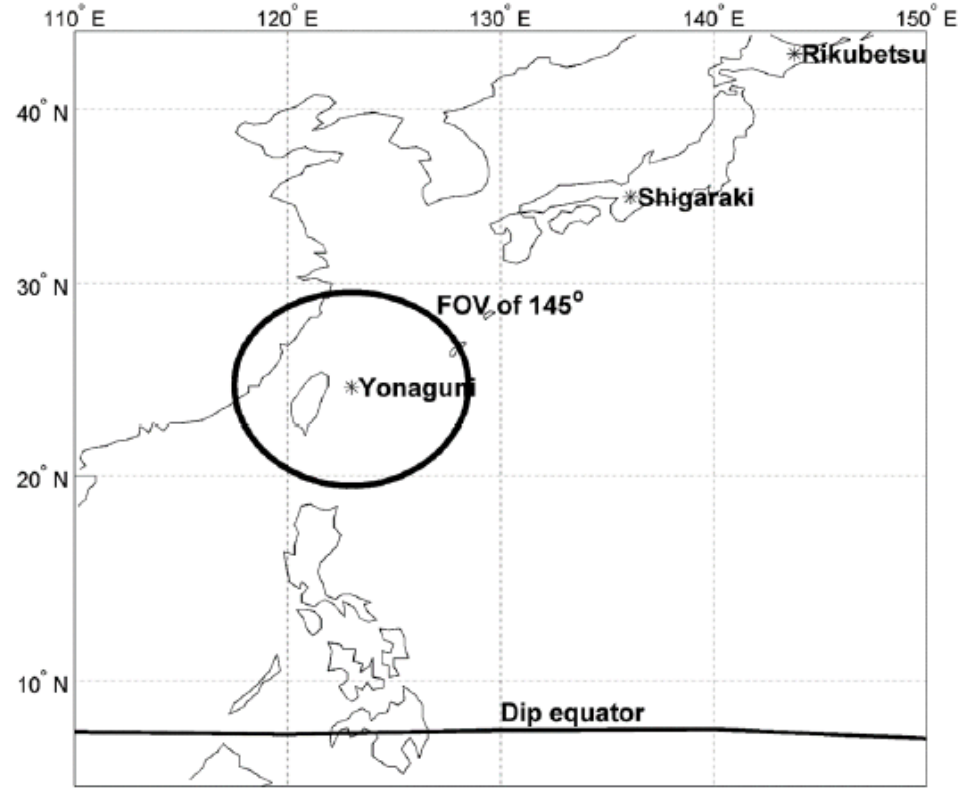


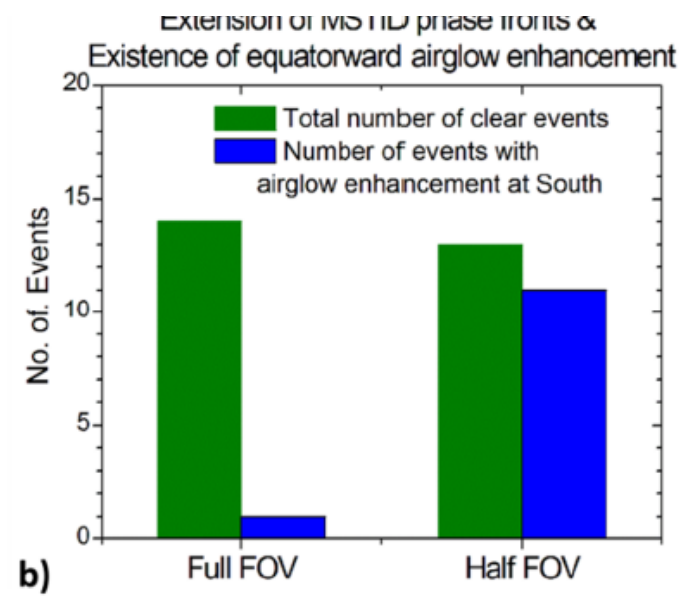
Kubota et al.(GRL, 2000);
Saito et al. (GRL, 2001)

Nighttime MSTID direction (summary)





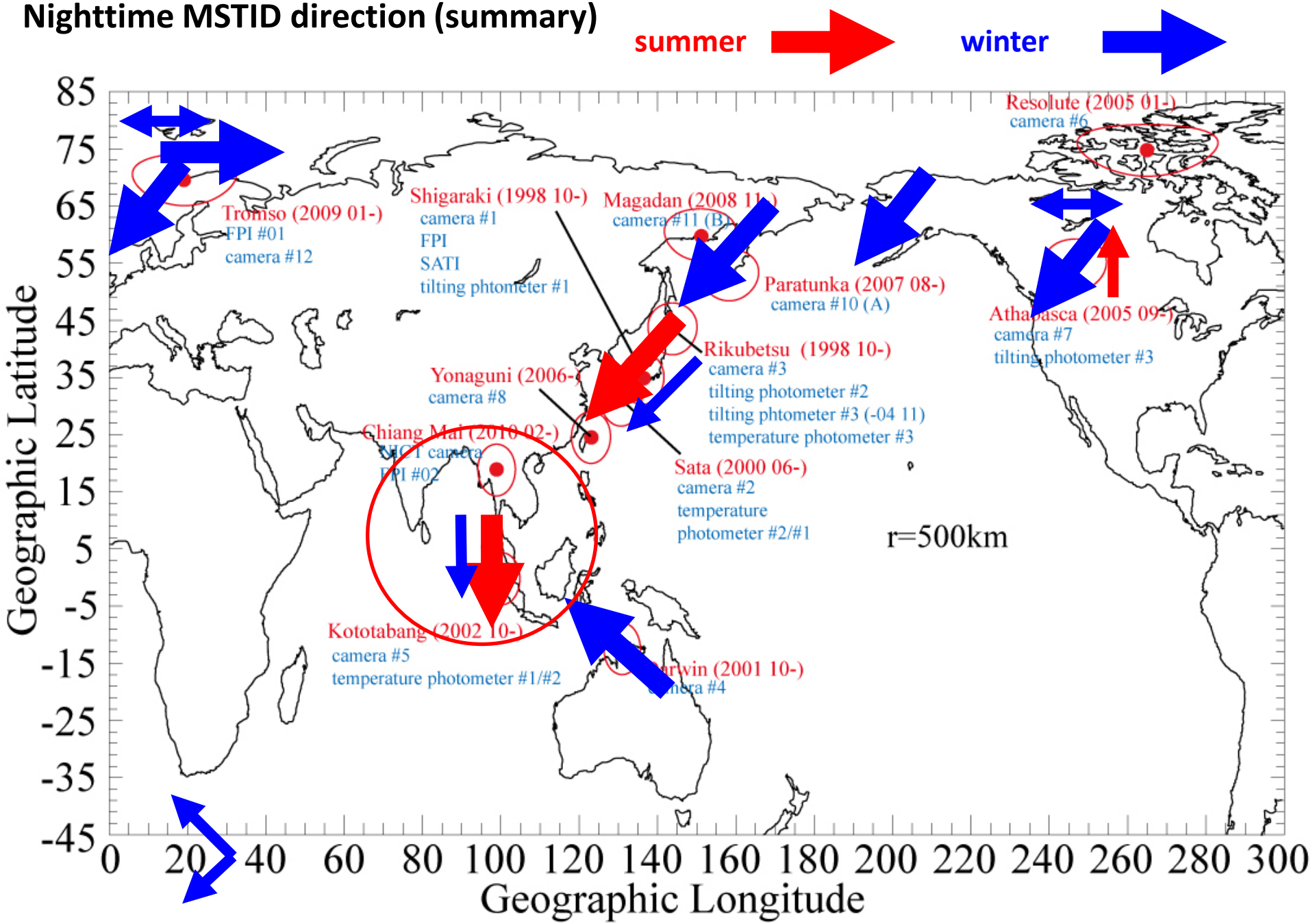


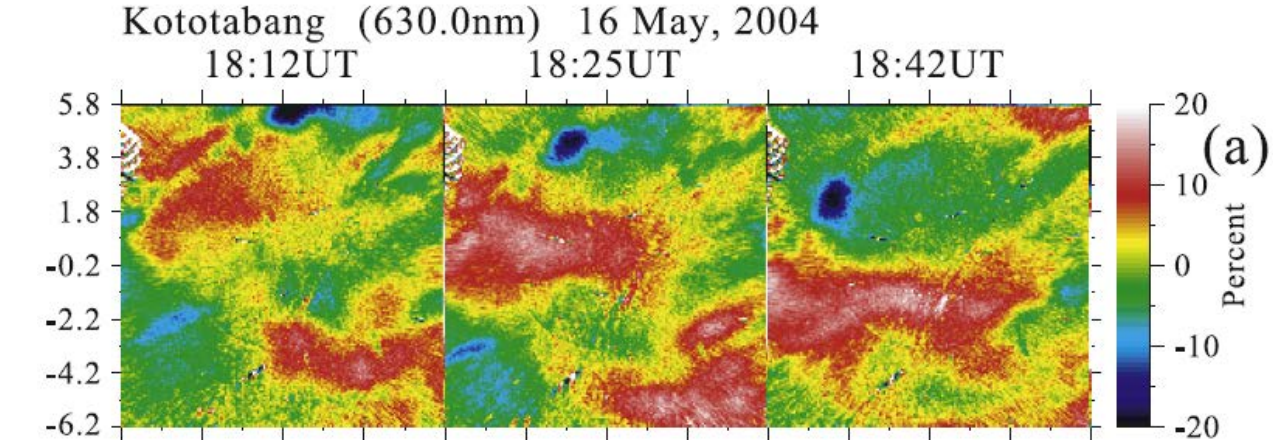


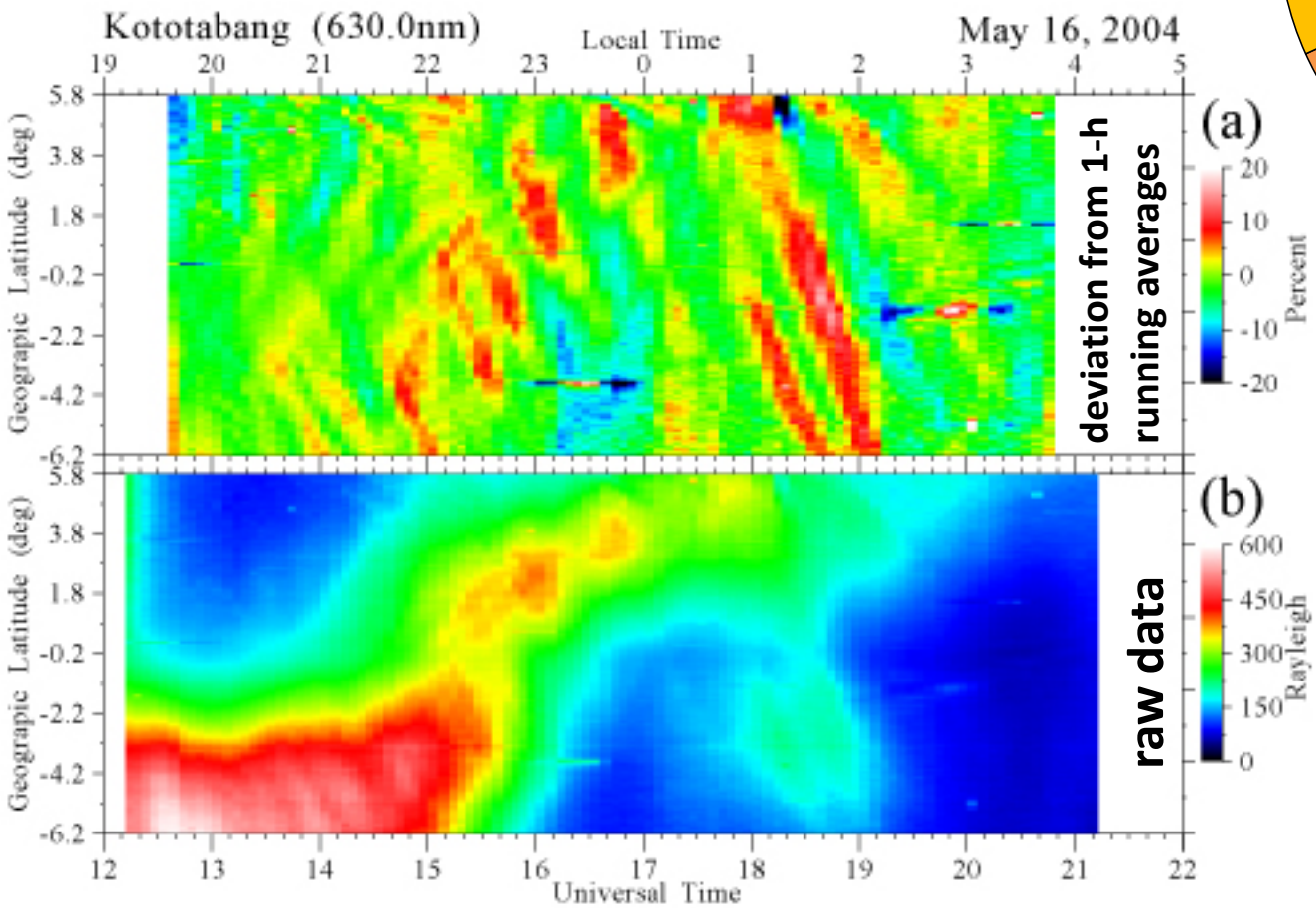
Equatorward boundary of nighttime middle-latitude MSTIDs by equatorial airglow enhancement.

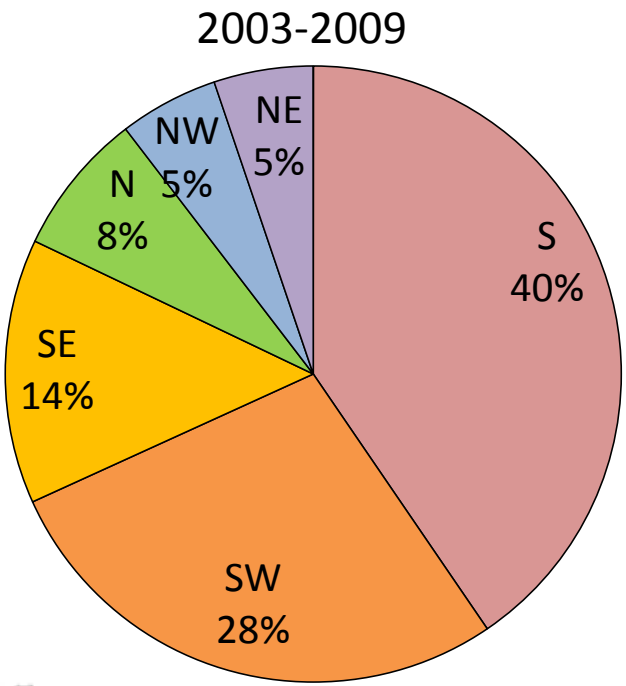
Narayanan et al. (JGR, 2014)

Nighttime MSTID direction (summary)







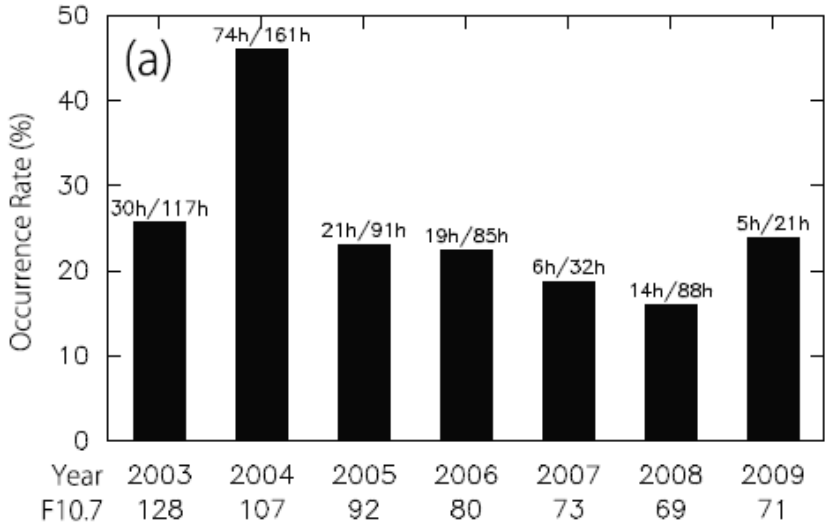


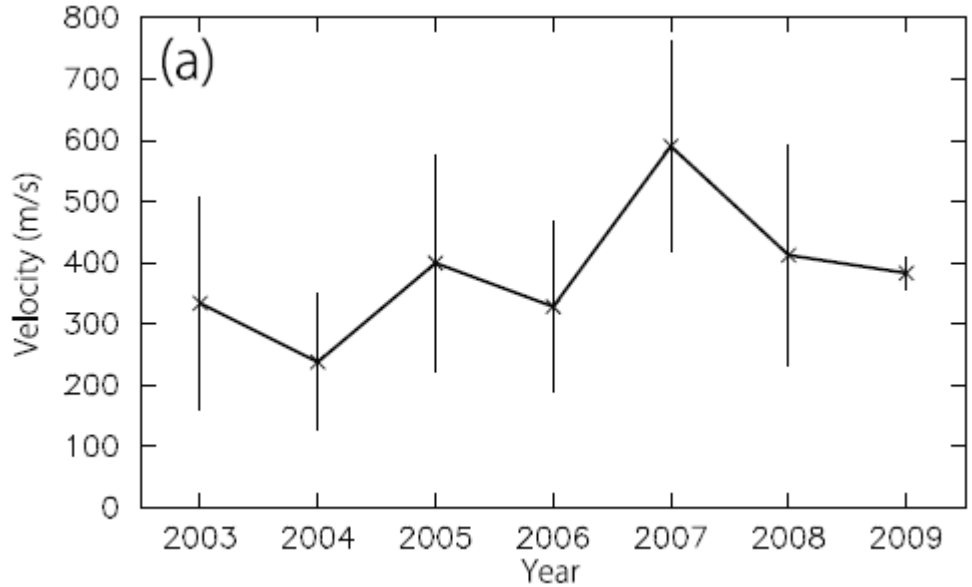
Fukushima et al. (JGR, 2012)

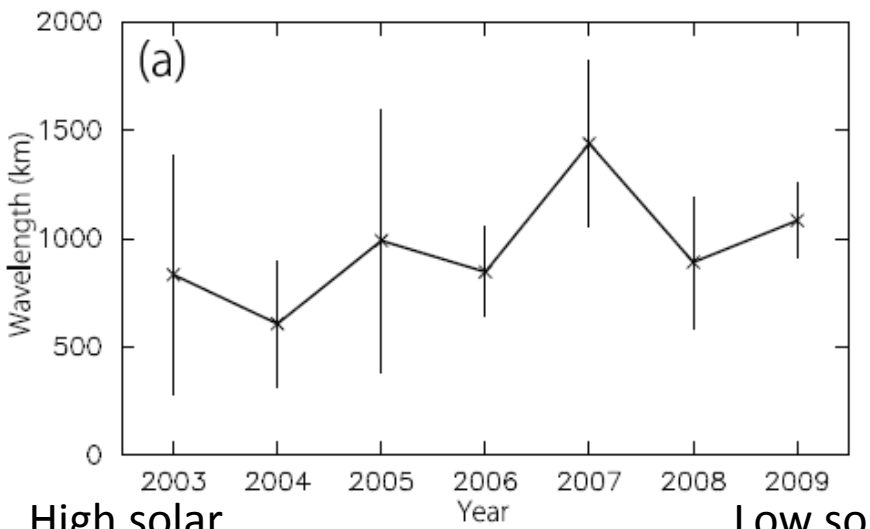
period: ~40min,
phase velocity: ~300m/s
→evanescent in the mesopause region
→ secondary gravity wave?

Shiokawa et al. (JGR, 2006)

Occurrence of southward-moving MSTIDs at Indonesia (MLAT=10S) → GW-like features

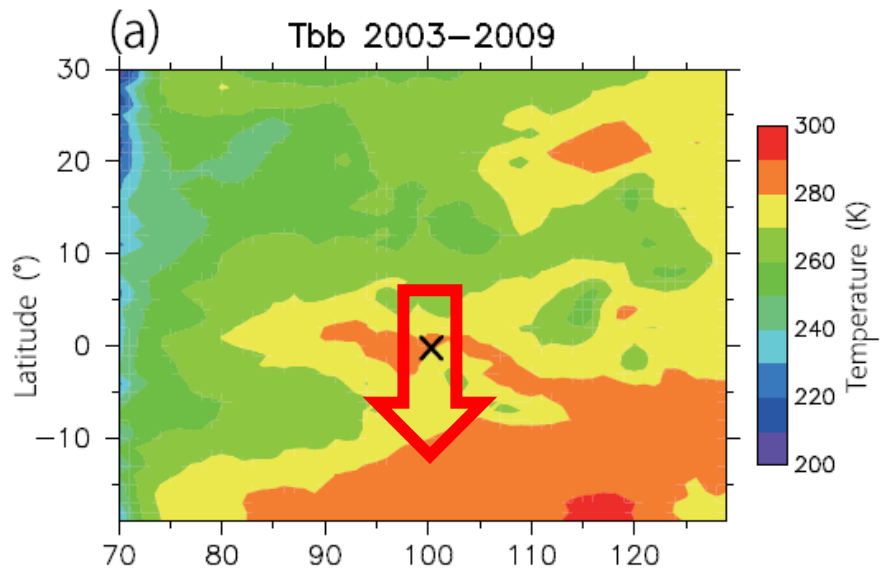




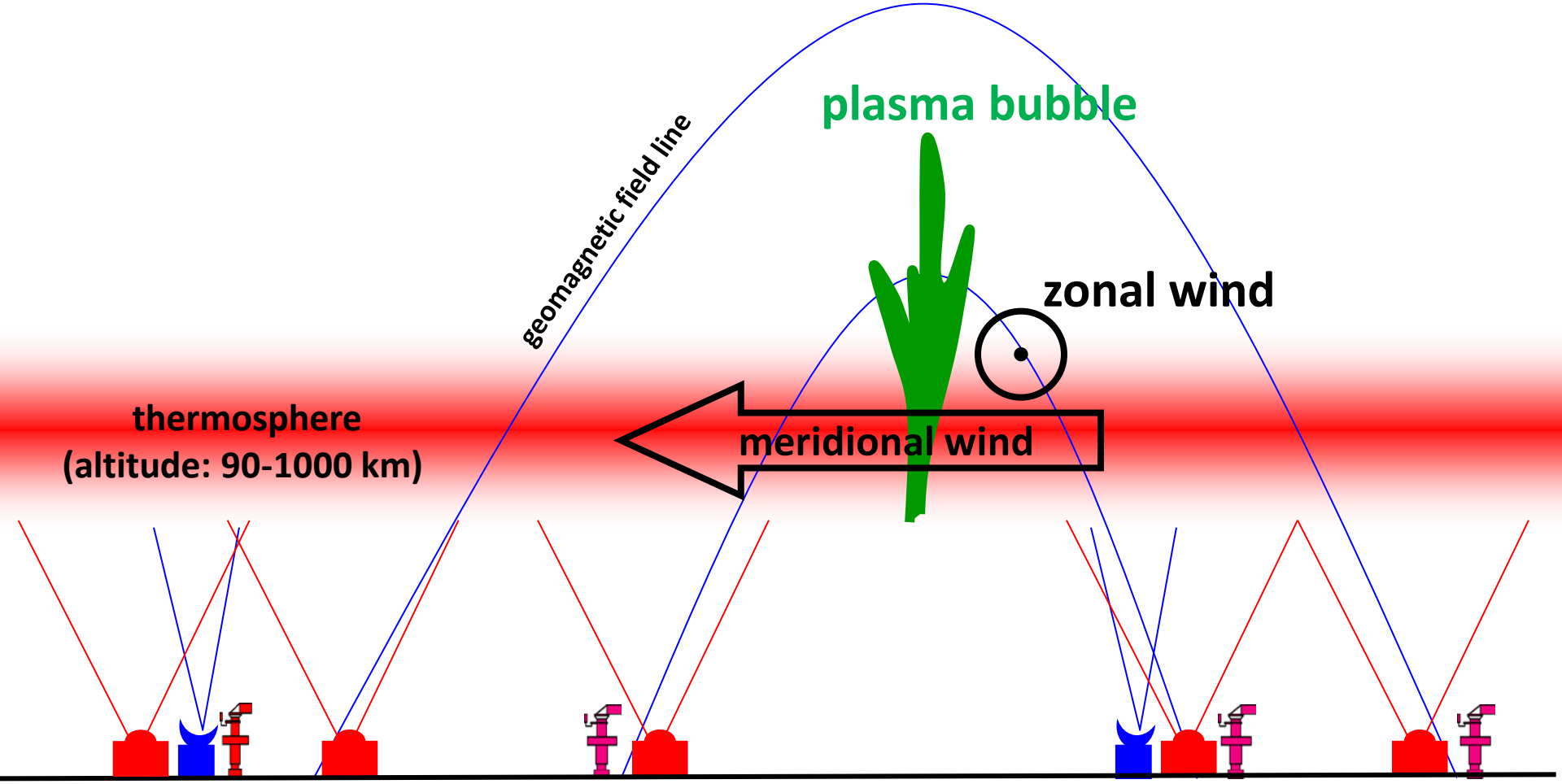


High solar activity

Low solar activity



Fukushima et al. (JGR, 2012)



Shigaraki
25MLAT
MU radar
FPI
Imager
GPS

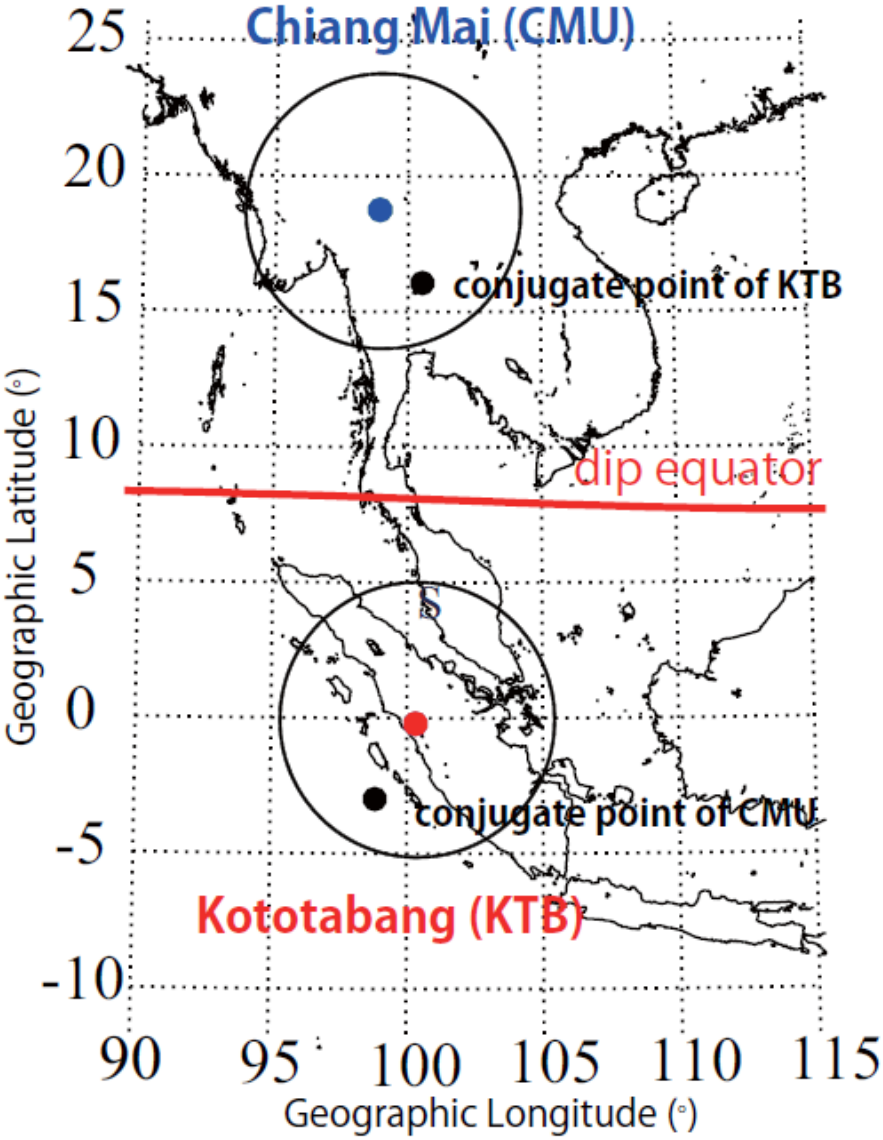
Sata
21MLAT
Imager
GPS

Tailand
+10MLAT
FPI
imager

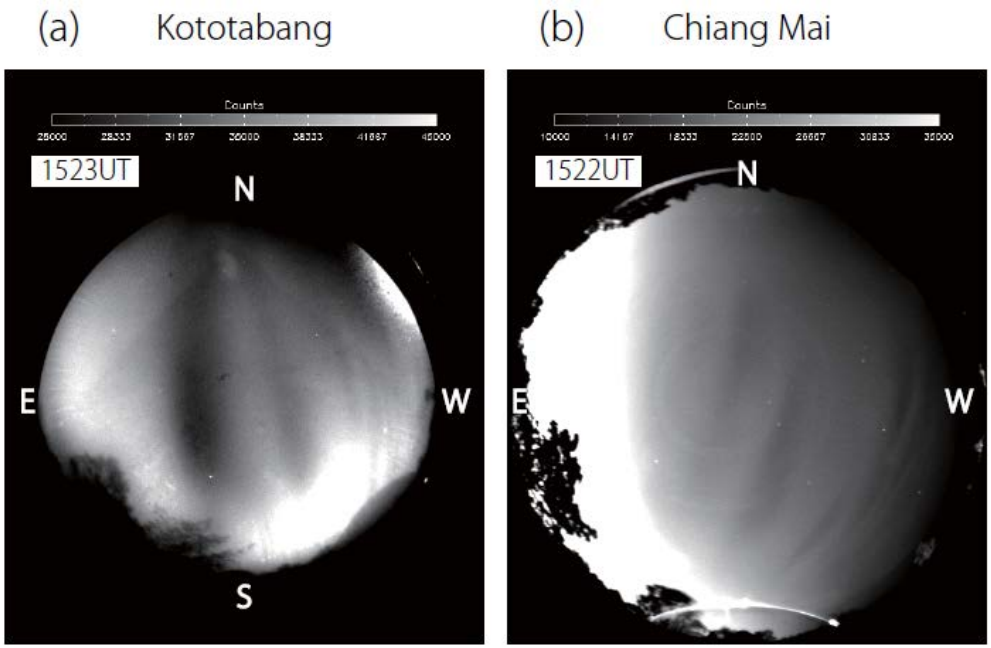
Indonesia
-10MLAT
EAR/VHF radar
FPI
Imager
GPS

Darwin
-22MLAT
FPI
imager

FPI: Fabry-Perot interferometer



April 5, 2011



Fukushima et al. (JGR, 2015)

$$v_{cal} = \frac{\sum_{PN} u_N + \sum_{PS} u_S}{\sum_{PN} + \sum_{PS}}$$

UT	1340	1510	1610	1730	1820	1920
v_{obs} (m/s)	124	124	120	116	112	103
u_{eN} (m/s)		78	82			56
u_{eS} (m/s)	121	126	100	84	85	84
Σ_{PN} (S)	3.28	1.92	1.89	2.35	2.47	1.99
Σ_{PS} (S)	4.38	3.16	2.33	1.45	1.13	0.87
v_{cal} (m/s)		108	92			65
v'_{cal} (m/s)		102	91			70

About 60-90% of the eastward bubble velocity can be explained by the F-region dynamo effect.

Fukushima et al. (JGR, 2015)

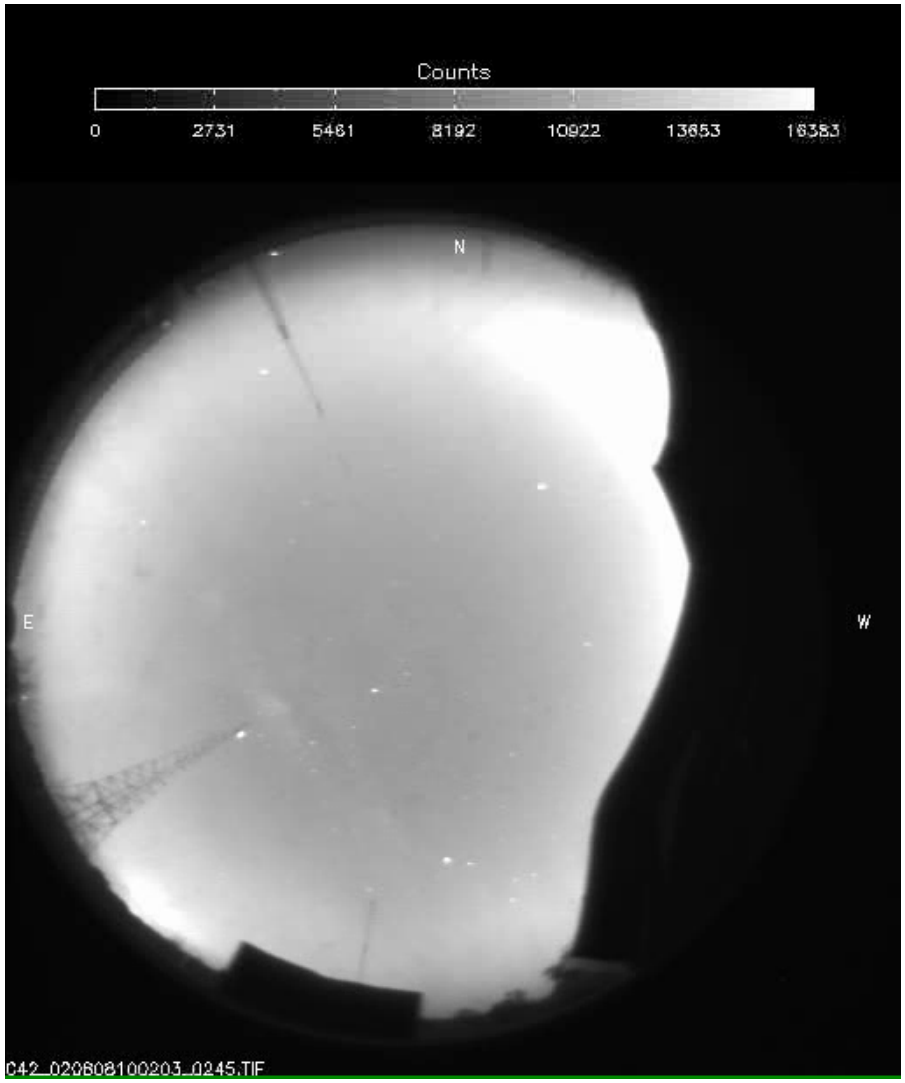
Plasma bubble disappearance by collision with an LSTID

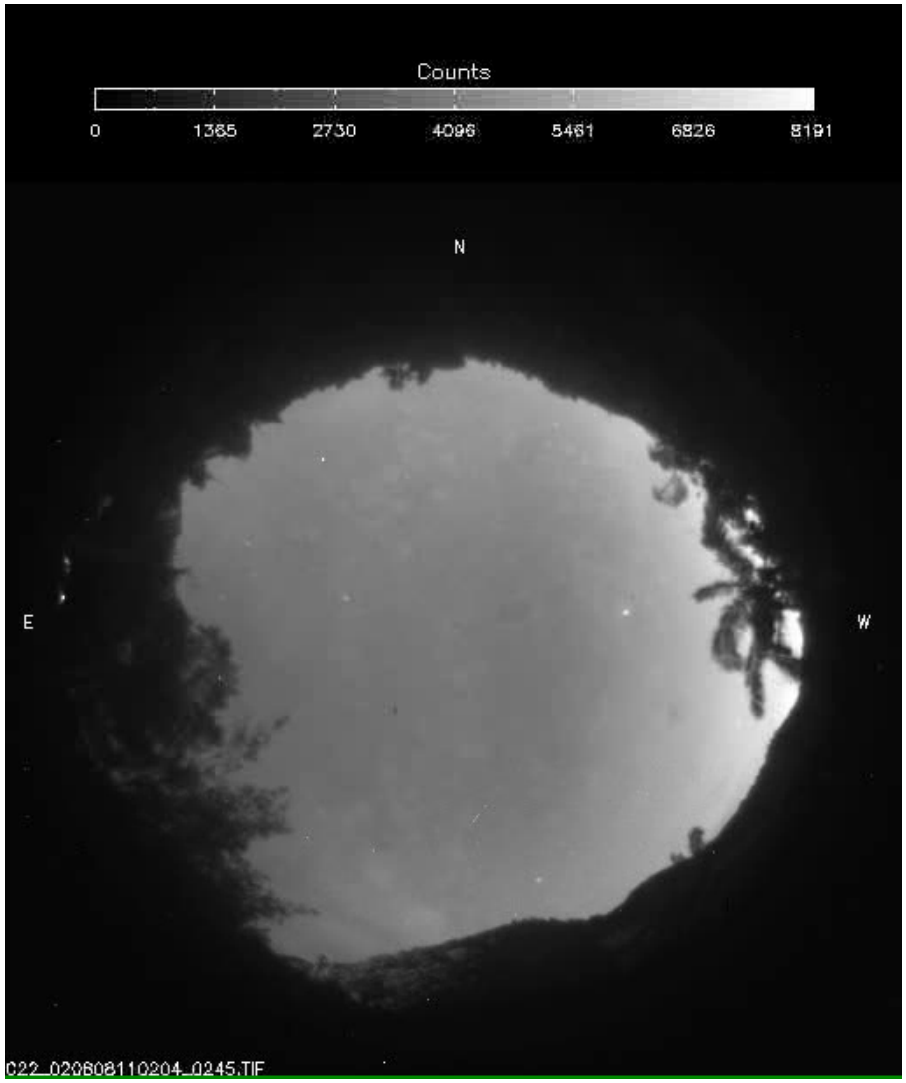
August 8, 2002 ~10:00-2:00 UT

Darwin, Australia (630 nm) **Sata, Japan (630 nm)**

N N

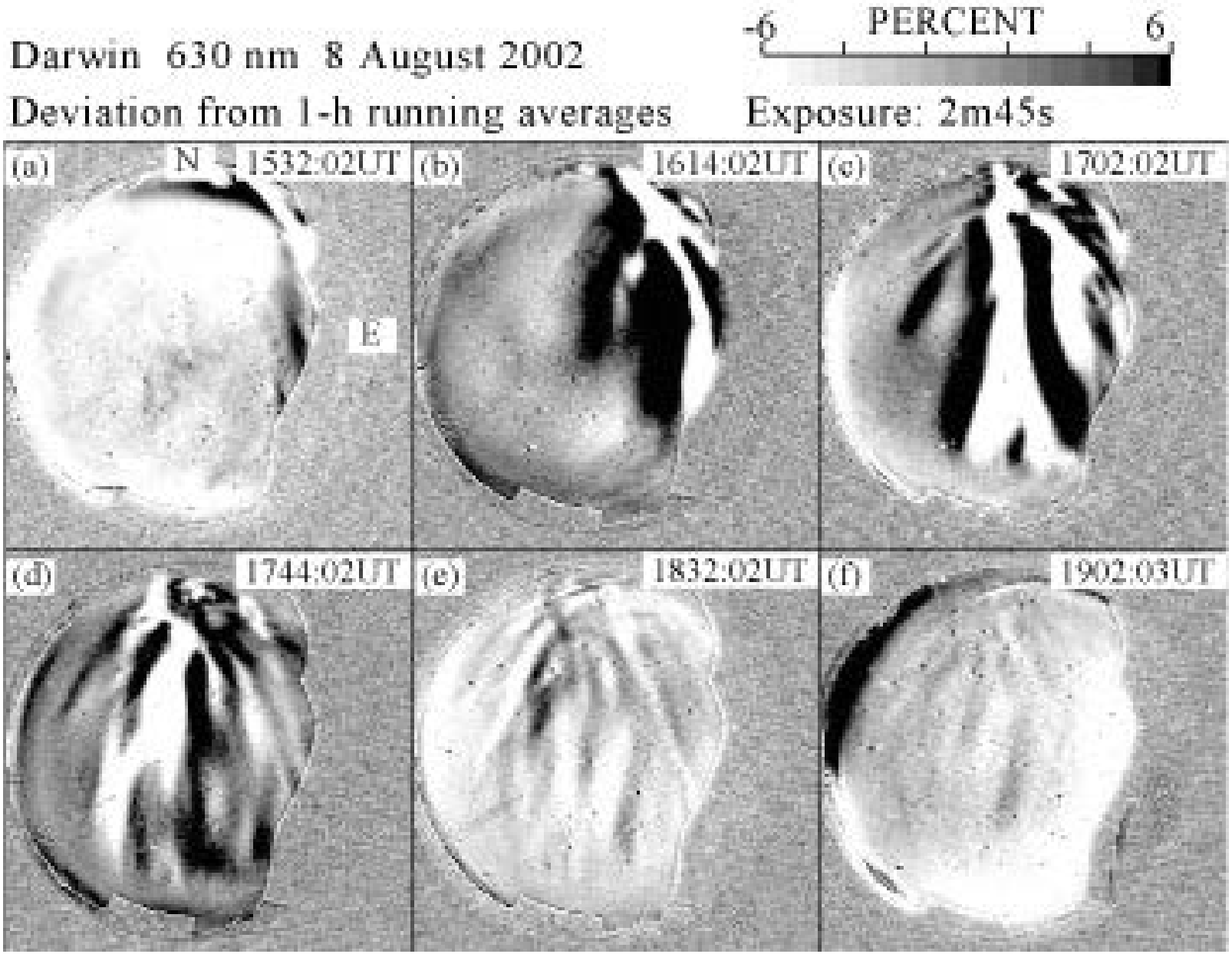
E W



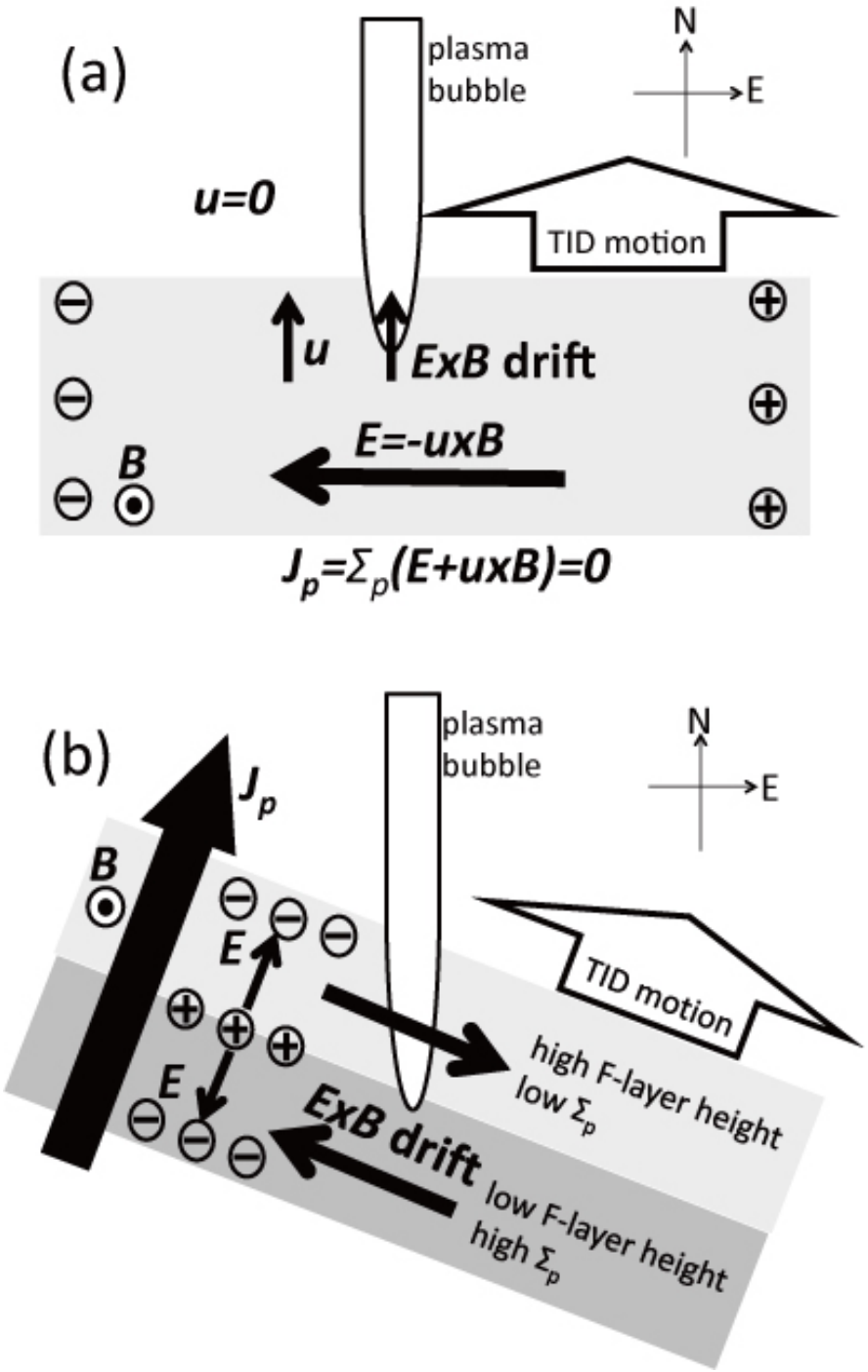


S S

Shiokawa et al. (EPS, 2015)



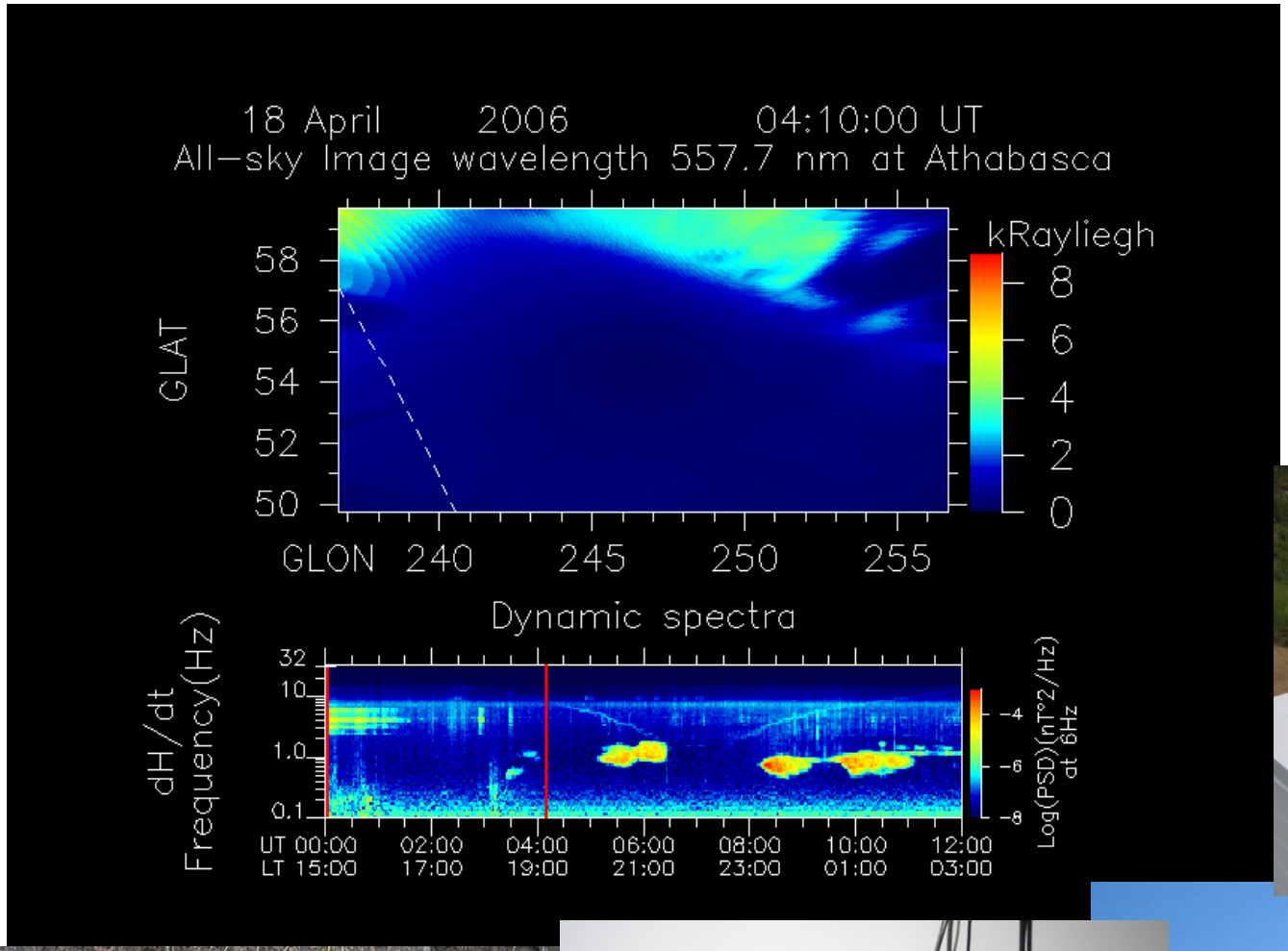
Shiokawa et al. (EPS, 2015)

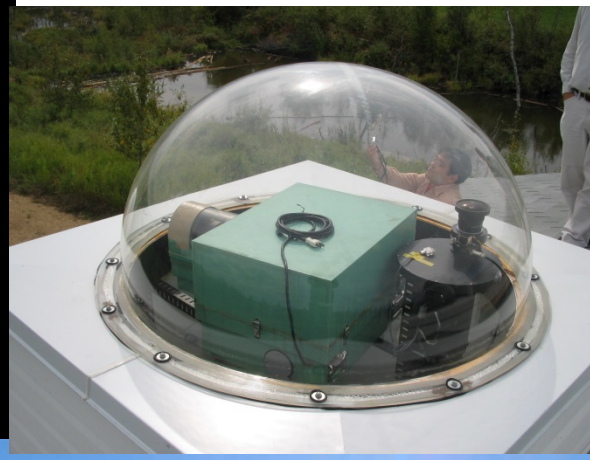


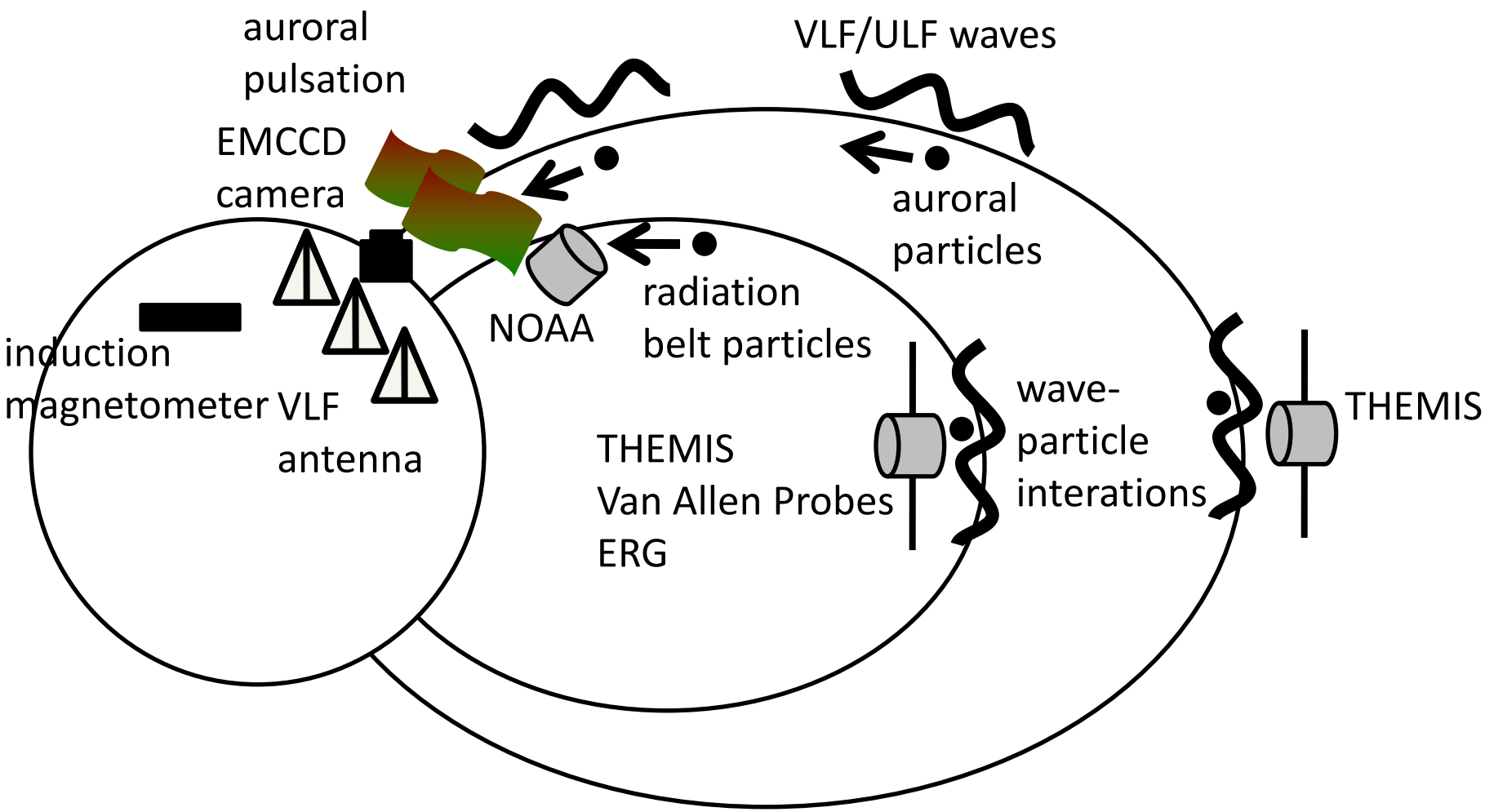
Shiokawa et al. (EPS, 2015)

induction magnetometer

Sakaguchi et al.
(JGR, 2008)

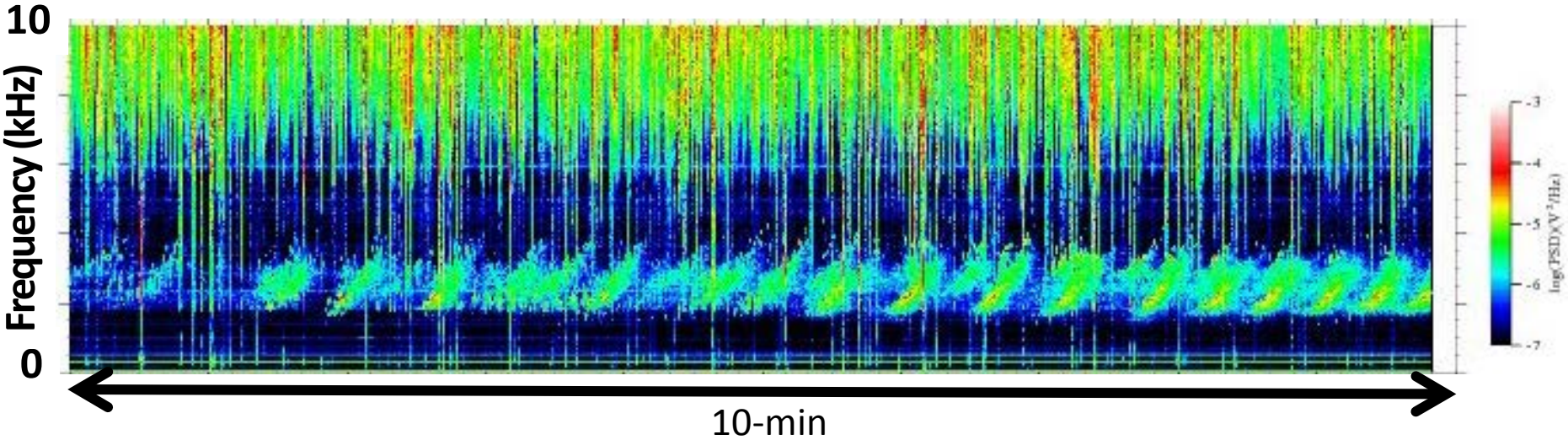


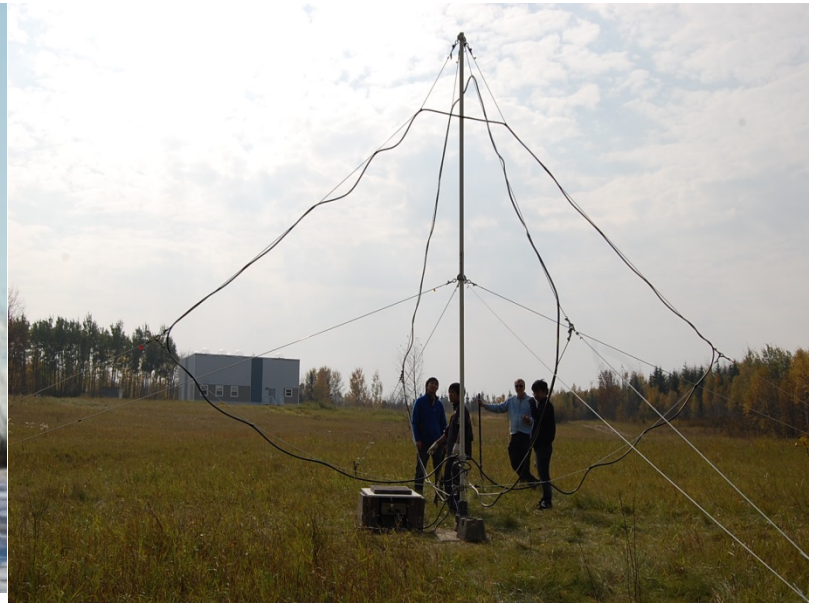



auroral
pulsation
EMCCD
camera
VLF/ULF waves
auroral
particles
radiation
belt particles
NOAA
induction
magnetometer
VLF
antenna
THEMIS
Van Allen Probes
ERG
wave-
particle
interations
THEMIS

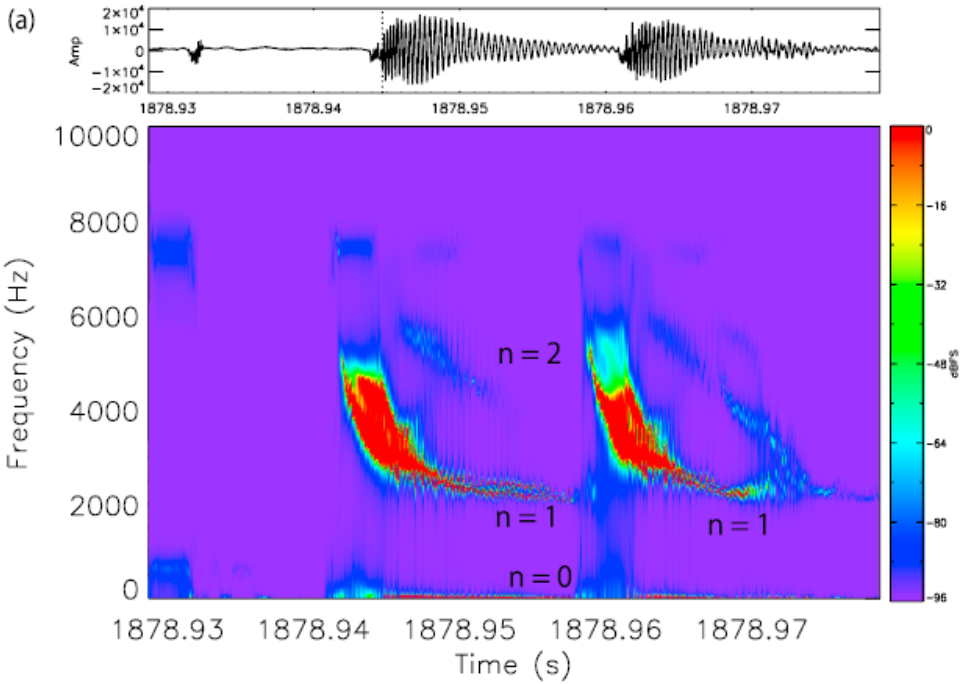
VLF/ELF loop antenna

Feb.12, 2012 10:30-10:40UT (02:30-02:40LT) Athabasca, Canada



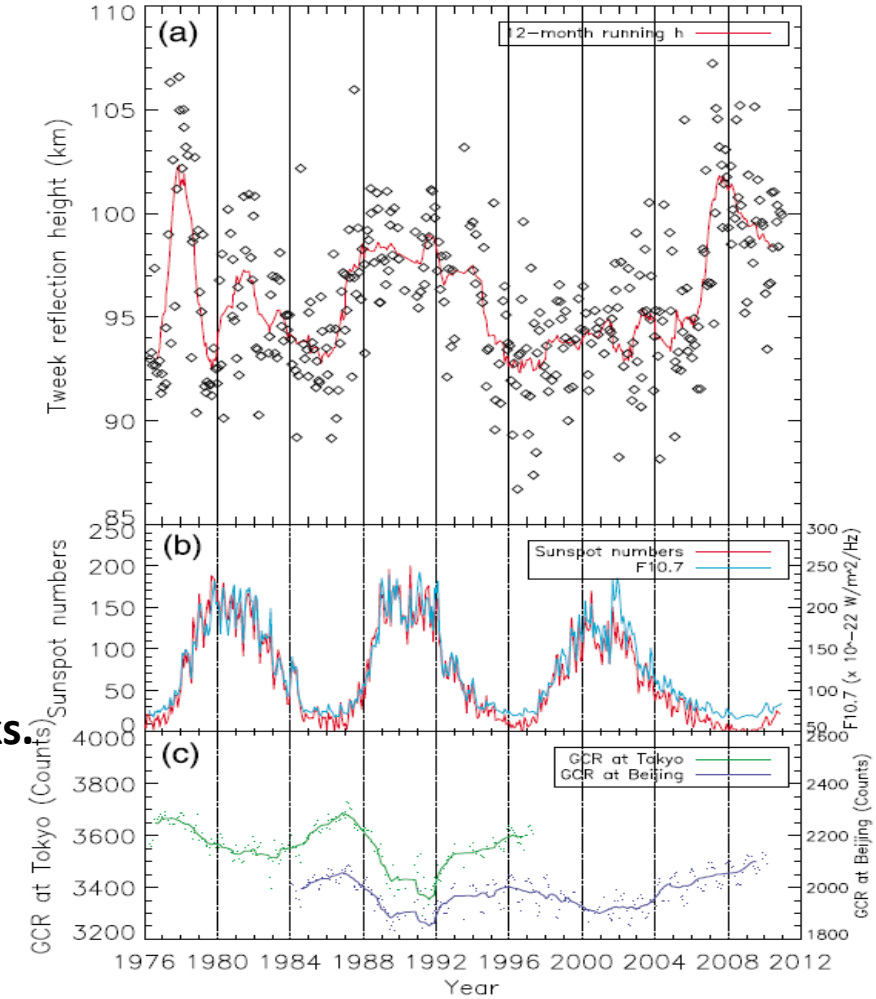


Shiokawa et al. (JGR, 2014)



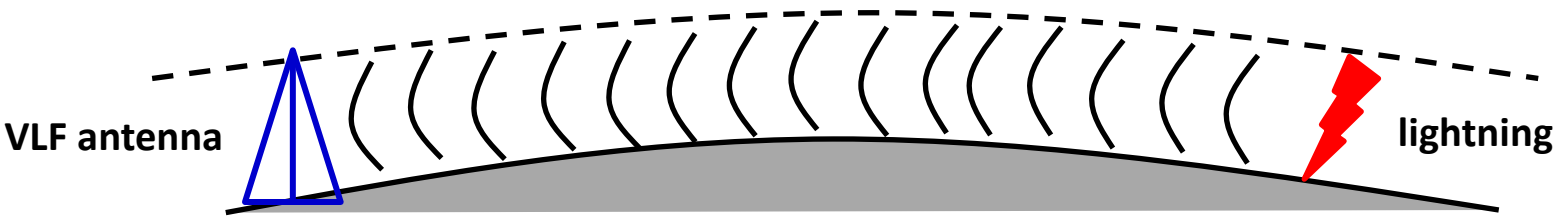
Ohya et al. (JGR, 2014) newly found daytime tweeks.

VLF/ELF antenna at Kagoshima, Japan



Ohya et al. (JGR, 2011): Long-term (36years) D-region height variation determined by tweek cut-off frequency.

D-region ionosphere



Summary

STEL, Nagoya University have been conducting multi-point observation of airglow (13 stations), geomagnetic pulsations (5 stations) and ELF/VLF radio waves (3 stations) in collaboration with Institutes in Asia and Oceania.

We show some recent results obtained by these network observations, i.e.,

- Nighttime MSTIDs features at middle and low latitudes caused by Perkins/E-F coupling instability and by gravity waves, respectively.
- Conjugate observation of plasma bubble propagation, their disappearance, and a midnight brightness wave, with thermospheric wind data obtained by FPI.
- High correlation of Pc1 pulsation with isolated proton aurora.
- VLF/ELF chorus waves at subauroral latitudes
- Tweek and related D-region height measurements.