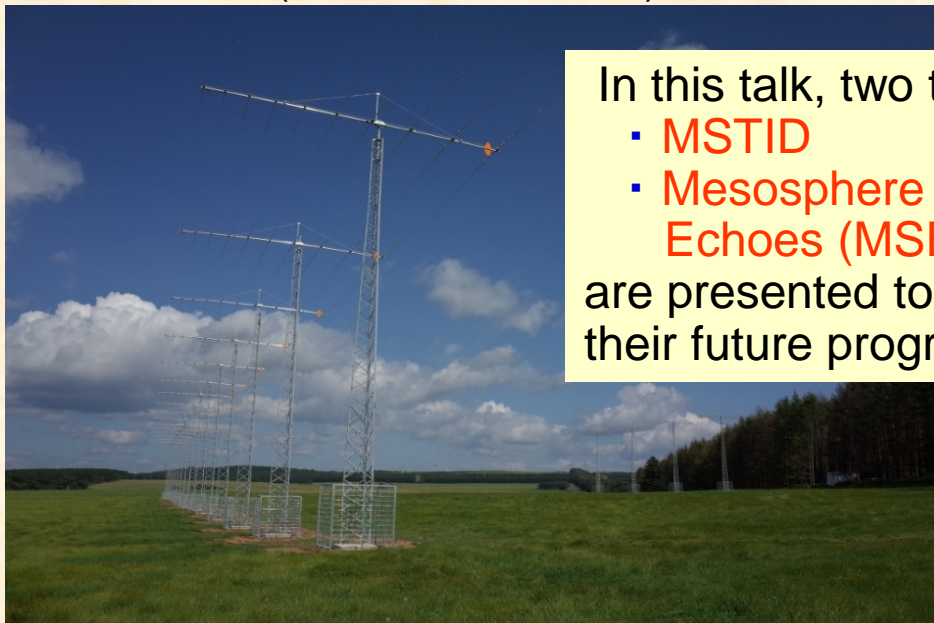


北海道ツイン短波レーダーによる電離圏・上部中間圏 観測の進展 *Progress of Ionosphere and Upper Mesosphere Observations With the Hokkaido Twin HF Radars*

小川 忠彦 T. Ogawa (NICT)

SuperDARN Hokkaido West
(since 24 Oct. 2014)

SuperDARN Hokkaido East
(since Dec. 2006)



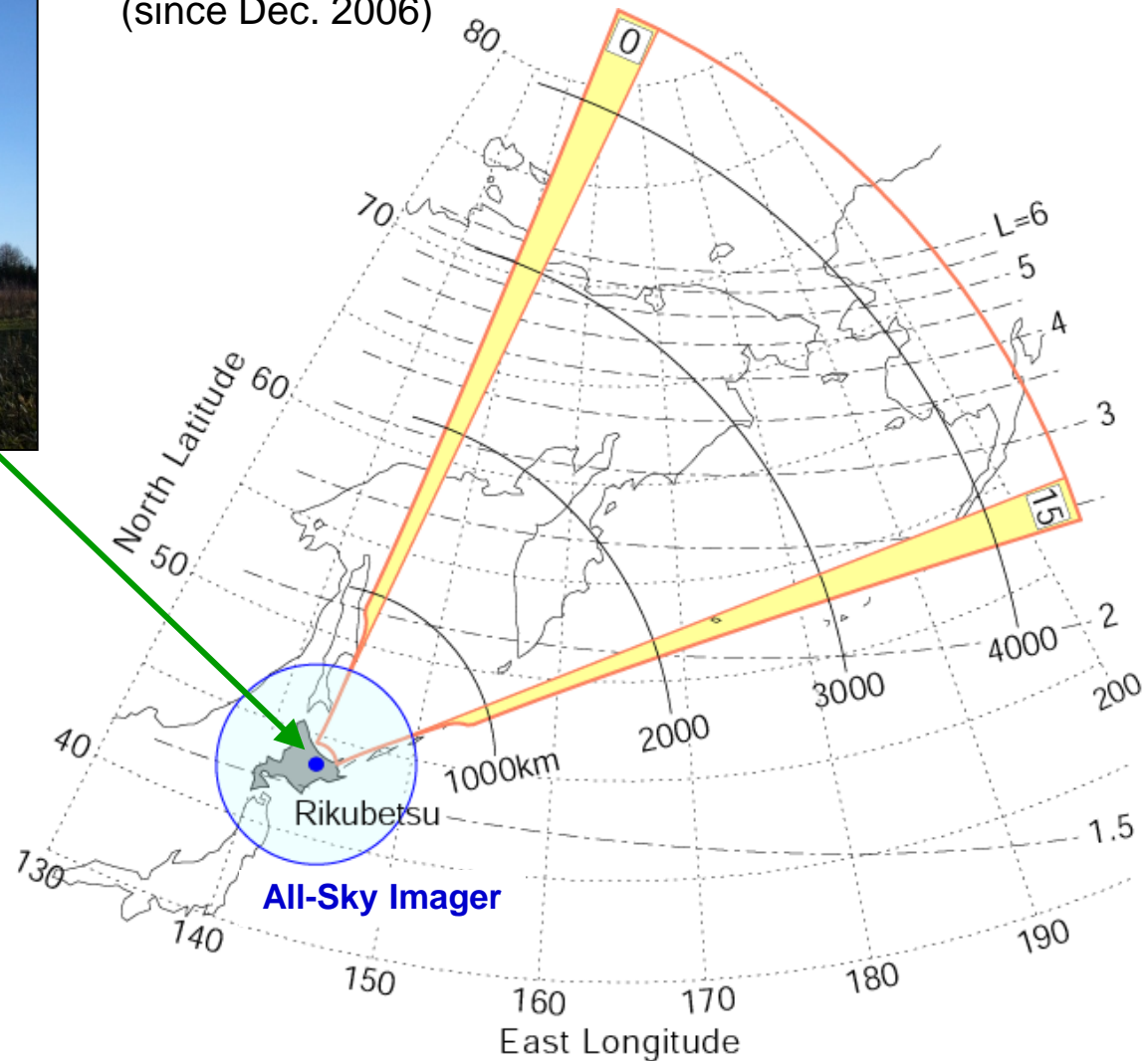
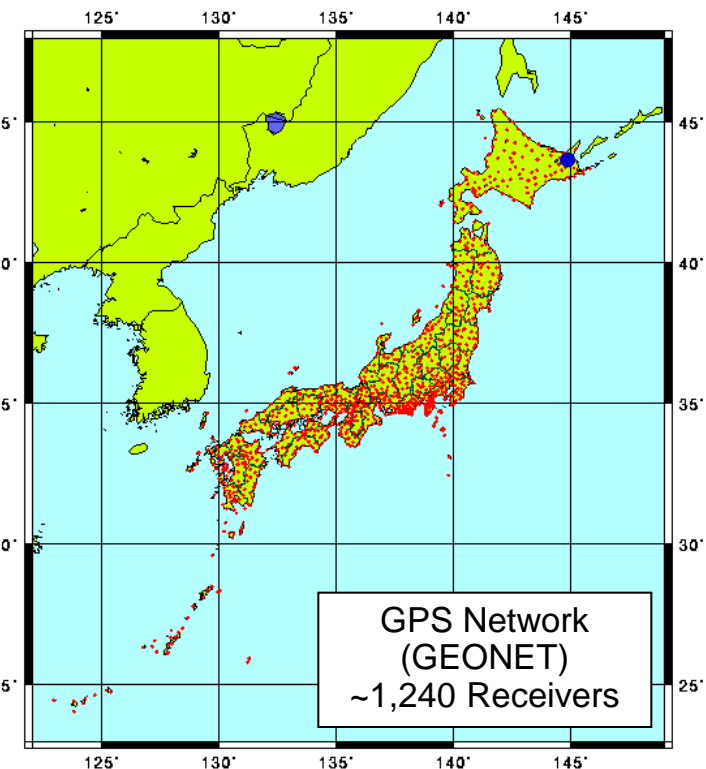
In this talk, two topics

- **MSTID**
- **Mesosphere Summer Echoes (MSE)**

are presented to discuss their future progress.



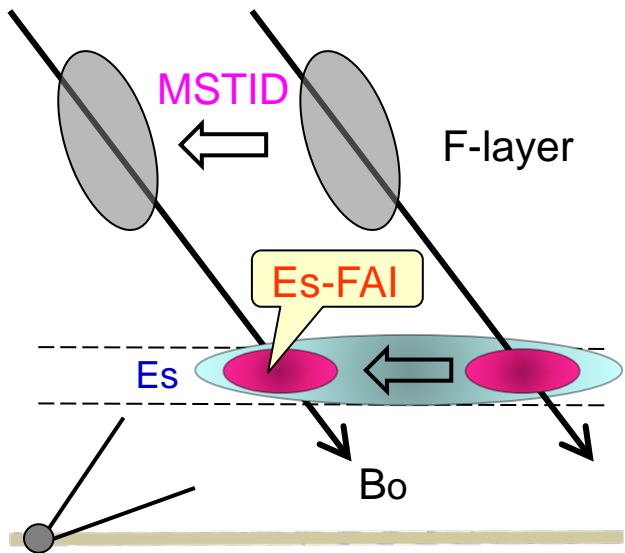
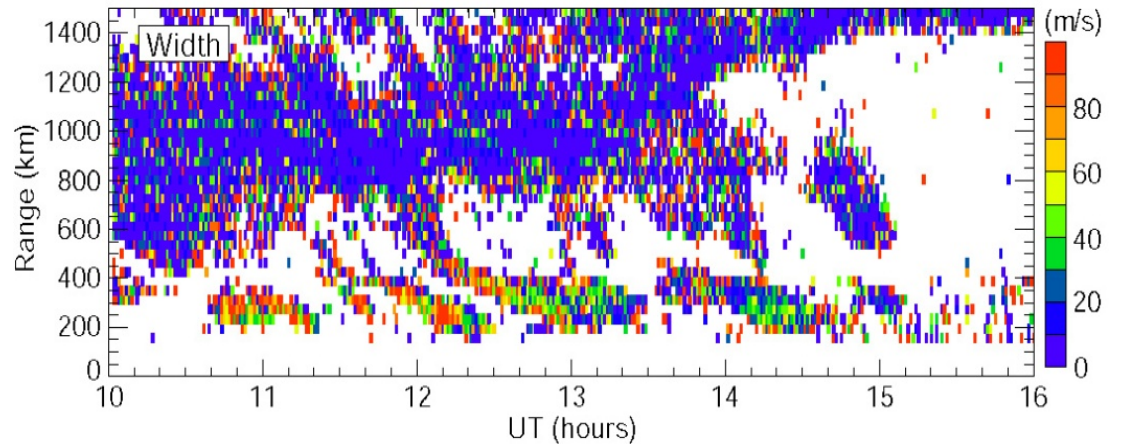
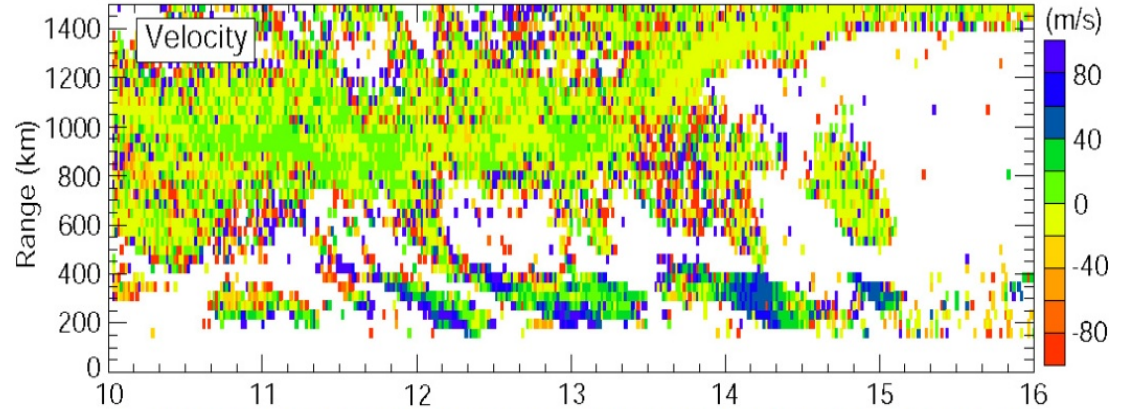
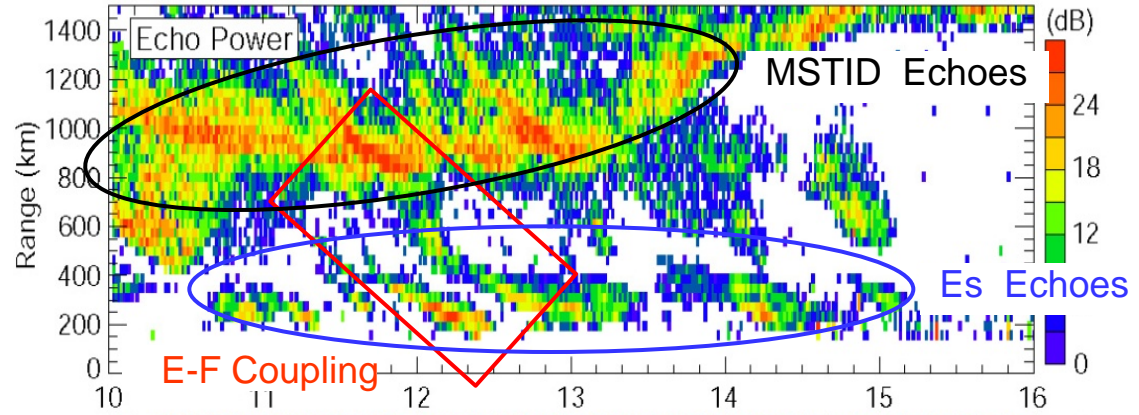
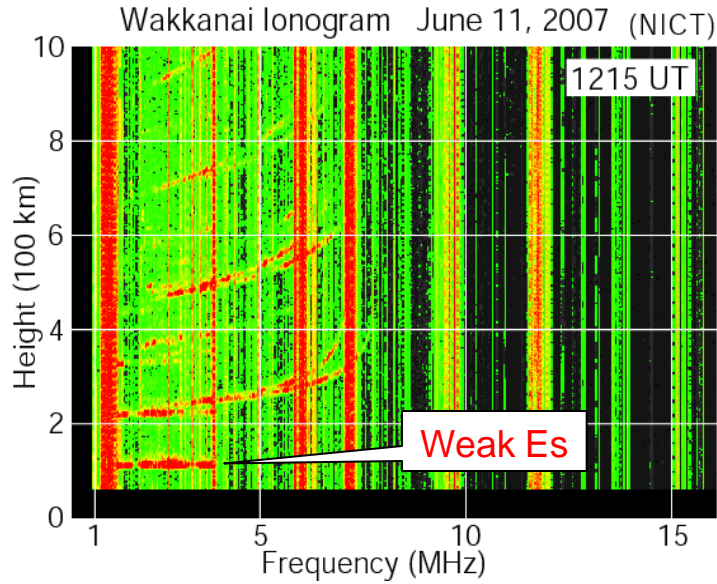
SuperDARN Hokkaido
East Radar at Rikubetsu
(since Dec. 2006)



Rikubetsu (43.53°N , 143.61°E ; geomag. 36.46°N)

Simultaneous MSTID and Es Echoes

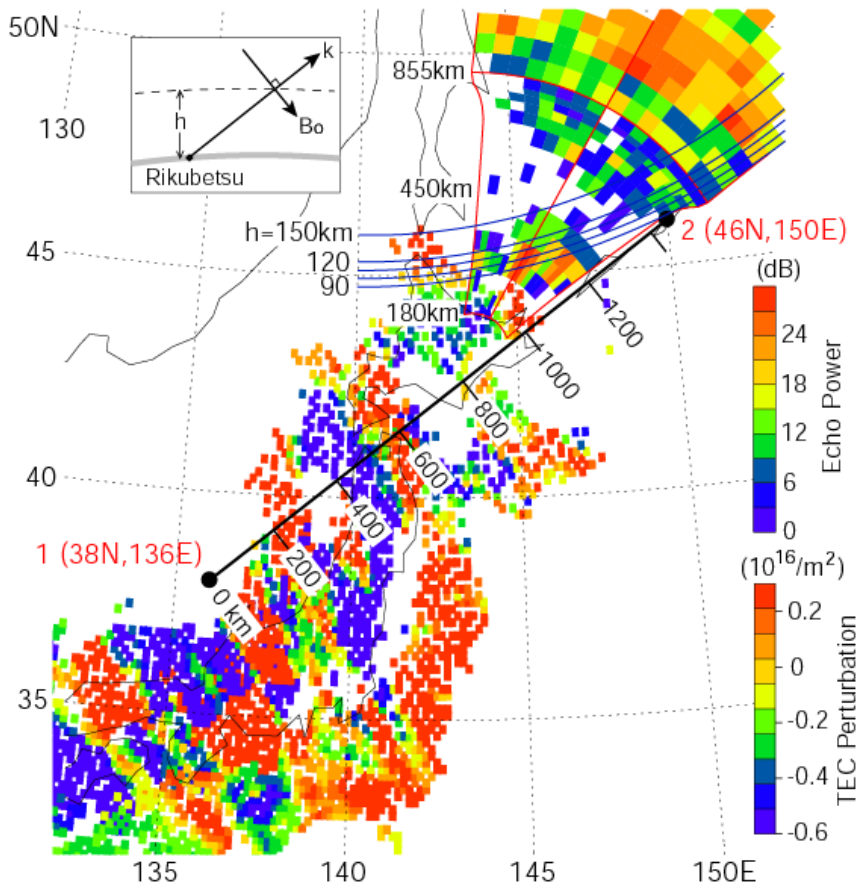
Hokkaido 9.1 MHz Beam 14 June 11, 2007



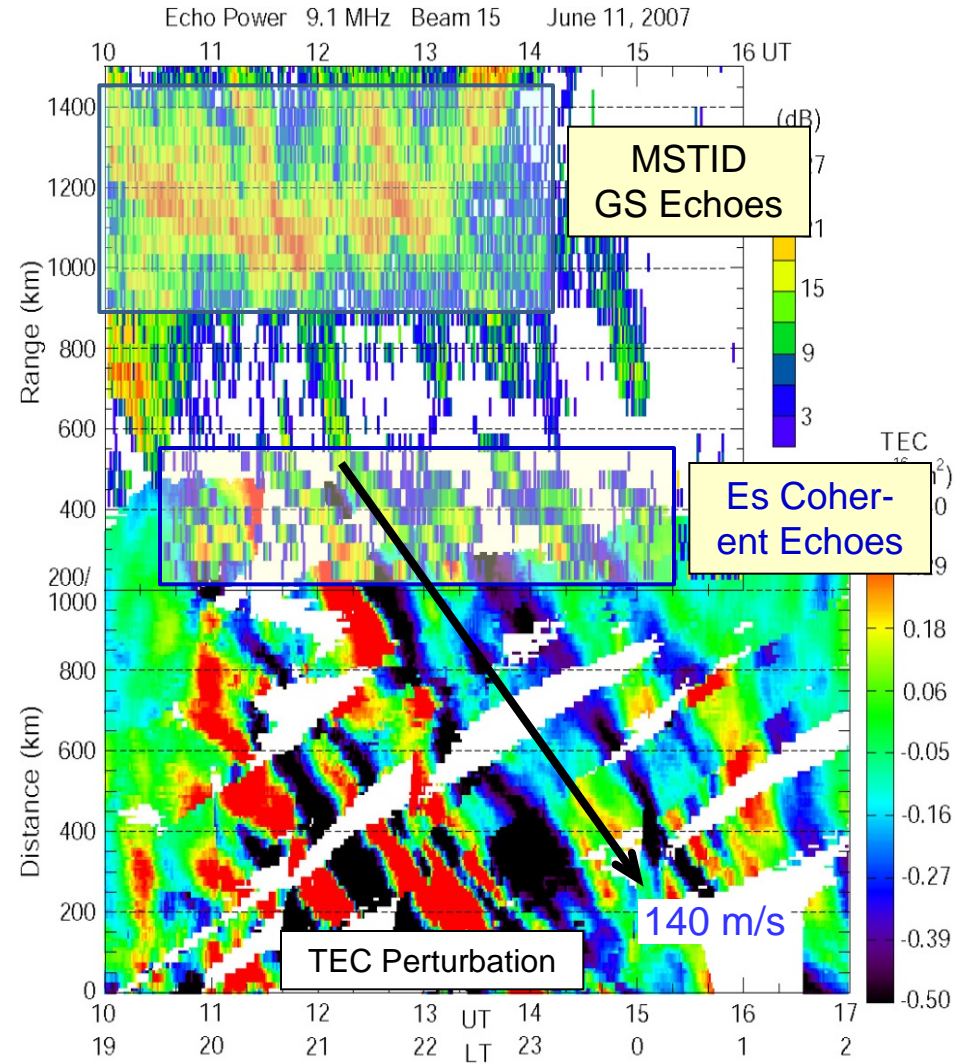
SW Propagation of Nighttime MSTIDs and Es Echo Region

Summer Night

1201 UT June 11, 2007



Echo power on beam 5 and TEC keogram along the oblique solid line



- Movement (~ 140 m/s) of Es coherent echo regions coincides well with that of TEC perturbations.
- E-region echo occurrence depends on the phase of TEC perturbations.

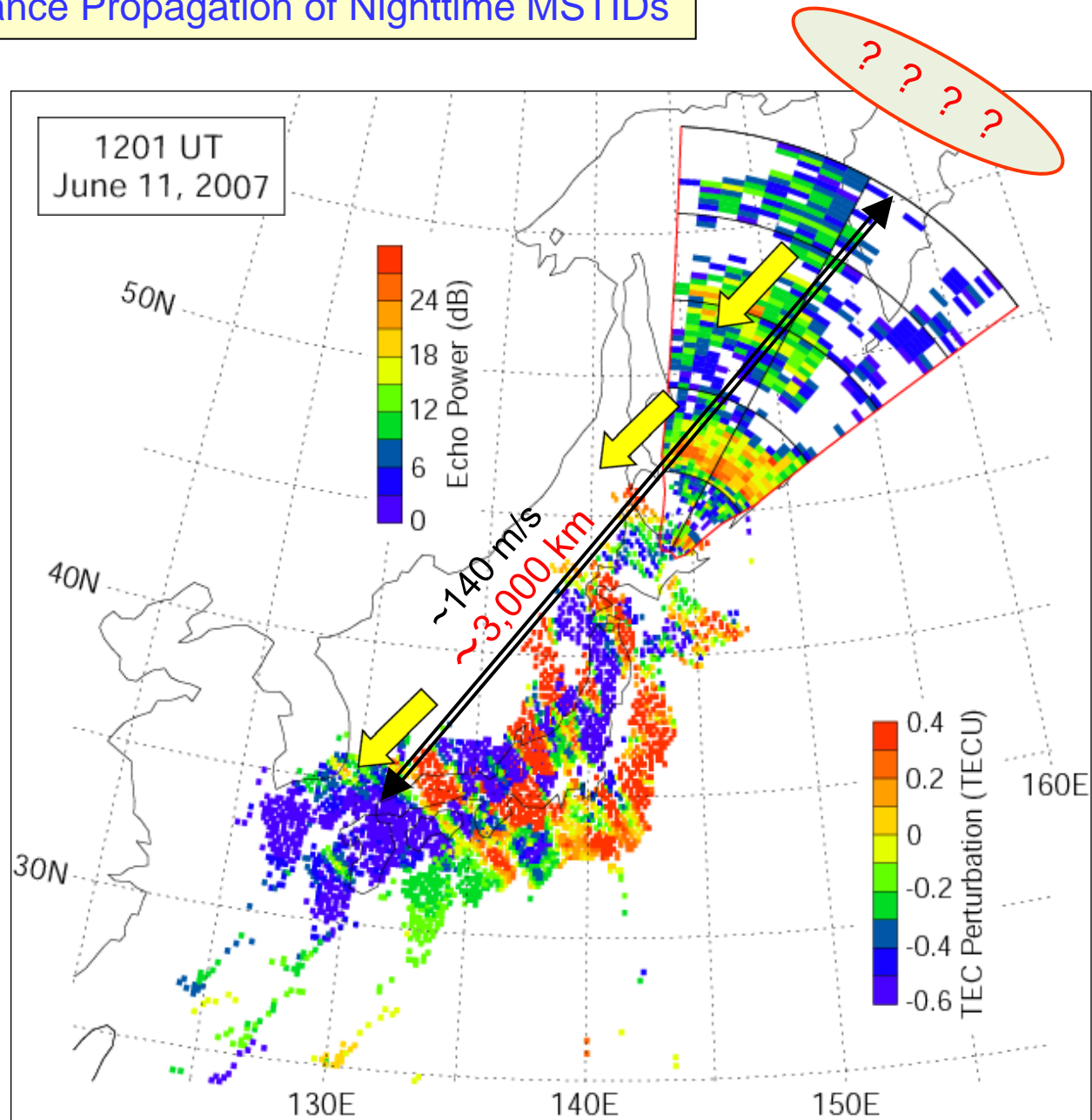
Long-Distance Propagation of Nighttime MSTIDs

11 June 2007

Geomagnetic Kp indices
(Kp: 1 0 0+ 0+ 0+ 1 1- 1)

Nighttime MSTIDs, probably generated at high-latitudes during geomagnetically quiet period, propagated southwestward at about 140 m/s from Kamchatka to the western part of the Japanese Islands over 3,000 km, taking about 6 hrs.

Question is where and how they were generated.



Long-Distance Propagation of Nighttime MSTIDs

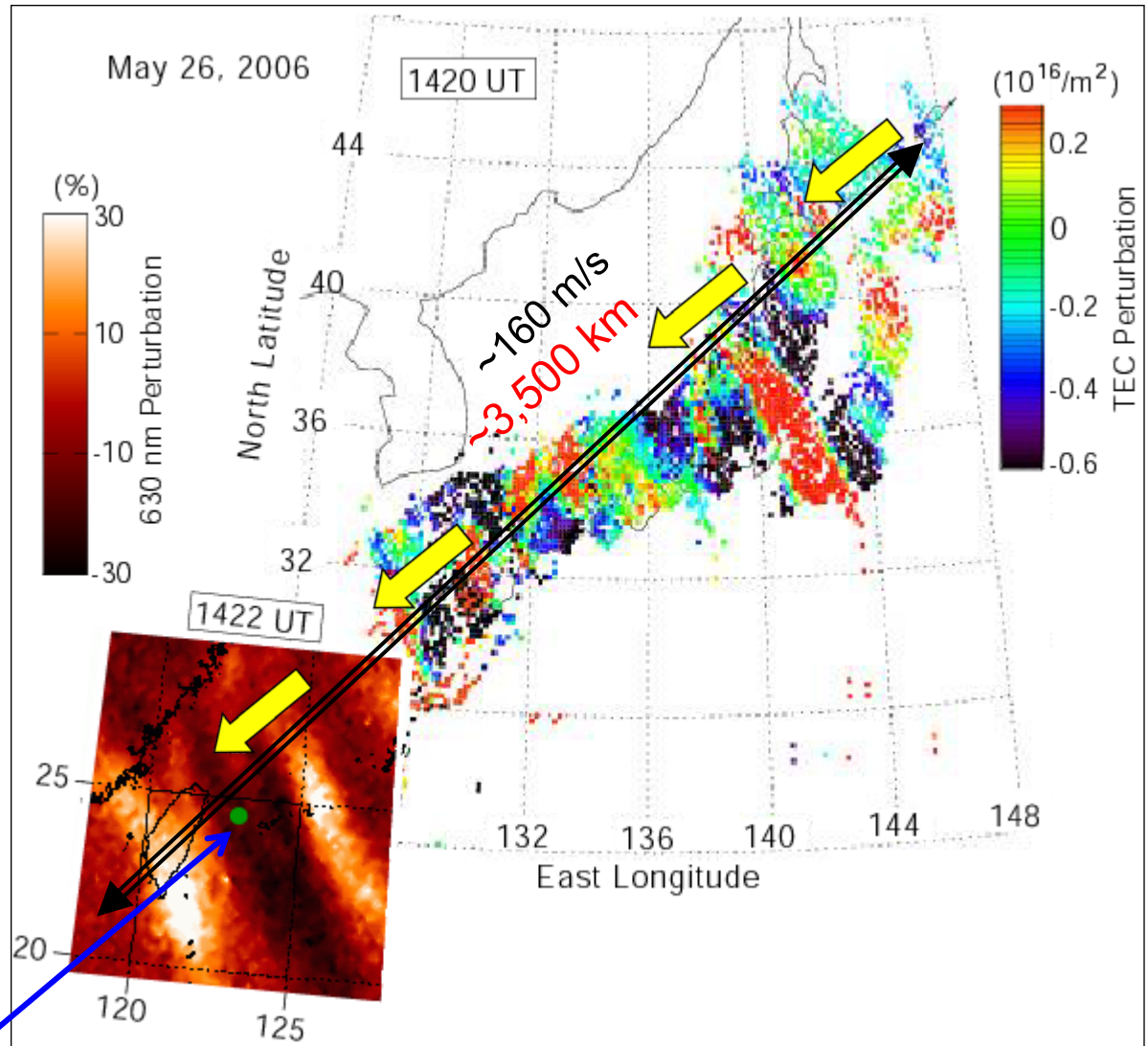
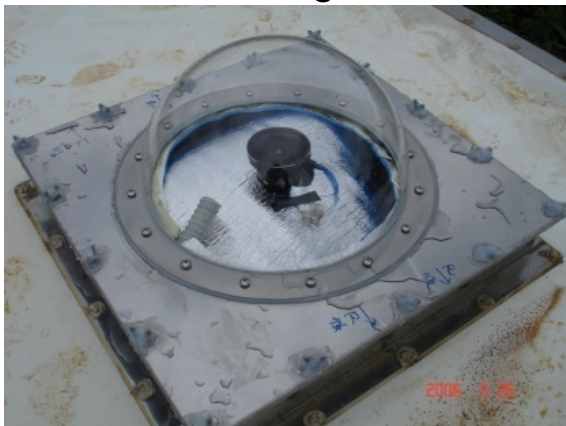
(Ogawa et al., 2009b)

26 May 2007

Geomagnetic Kp indices
(Kp: 1+ 1- 1- 0+ 1 1 1- 1-)

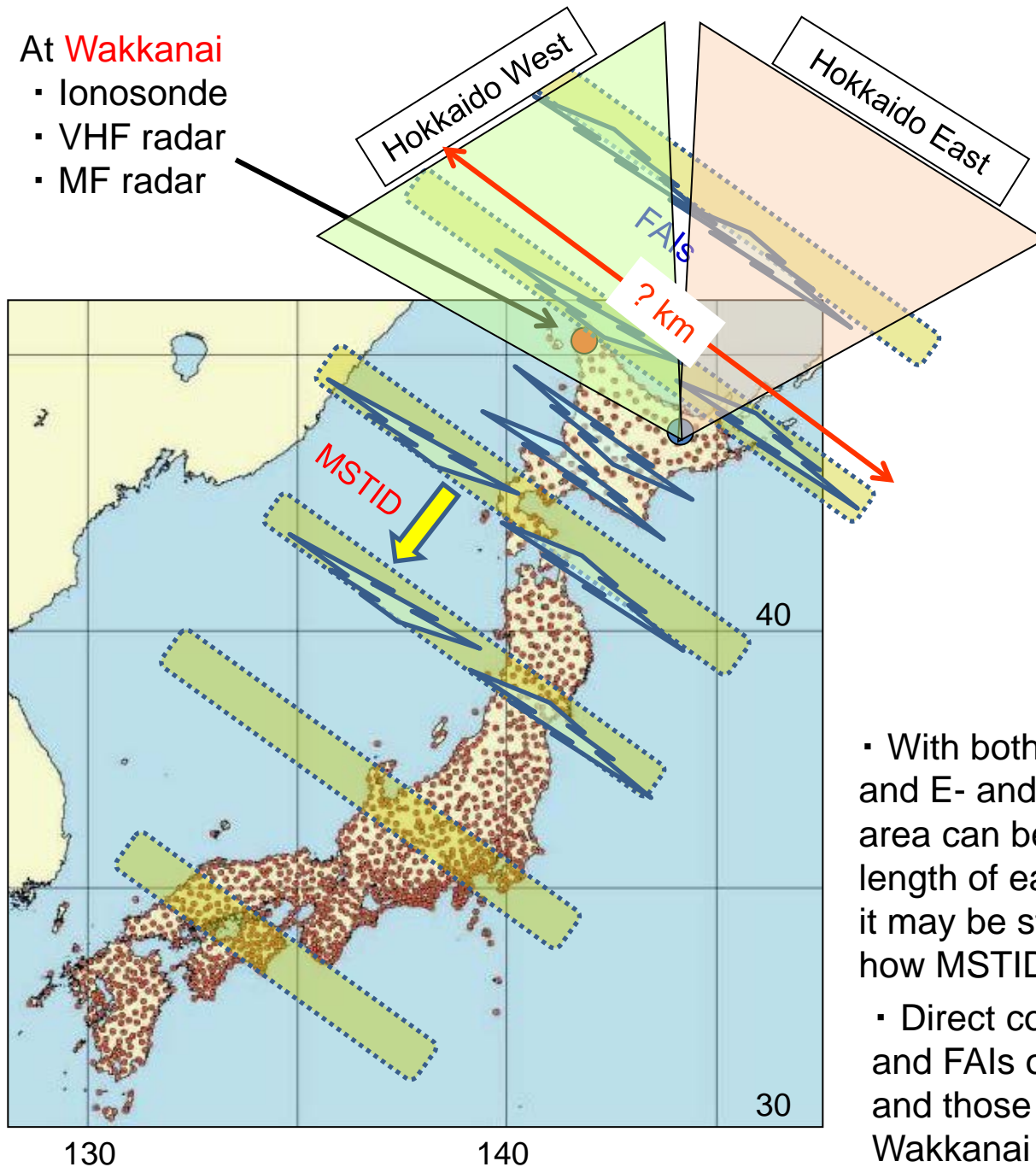
Nighttime MSTID propagated southwestward at about 160 m/s from Hokkaido to Taiwan over 3,500 km, taking about 6 hrs.

630-nm all-sky imager at Yonaguni



At **Wakkanai**

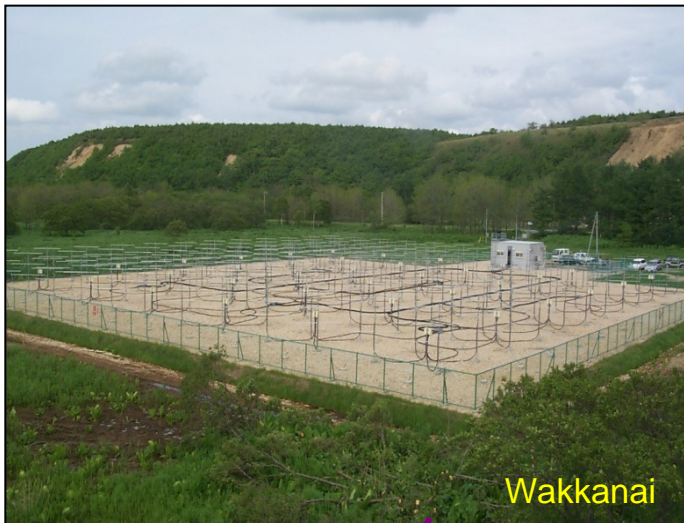
- Ionosonde
- VHF radar
- MF radar



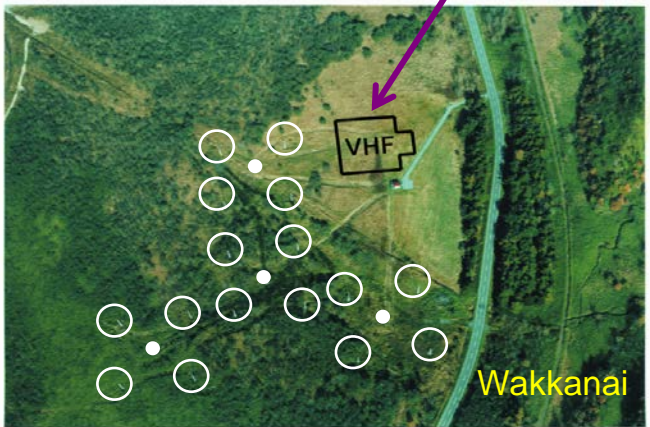
- With both radars, MSTID characteristics and E- and F-region FAIs within a wide area can be clarified; in particular, E-W length of each MSTID wave front. However, it may be still difficult to identify where and how MSTIDs are generated.
- Direct comparison between MSTIDs and FAIs observed with the West radar and those observed with the ionosonde at Wakkanai can be made.

Mesosphere Summer Echoes (MSE)

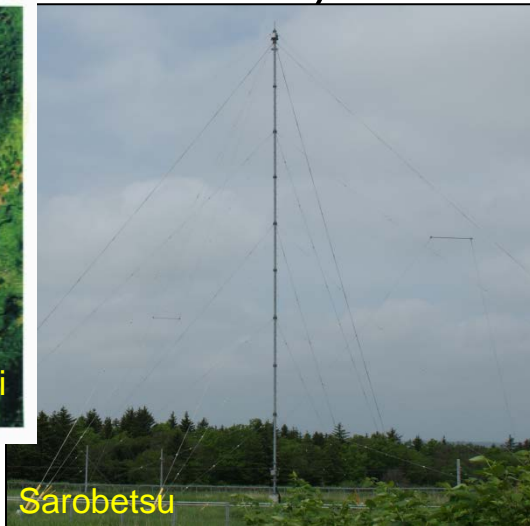
46.5-MHz VHF Radar (80 kW)



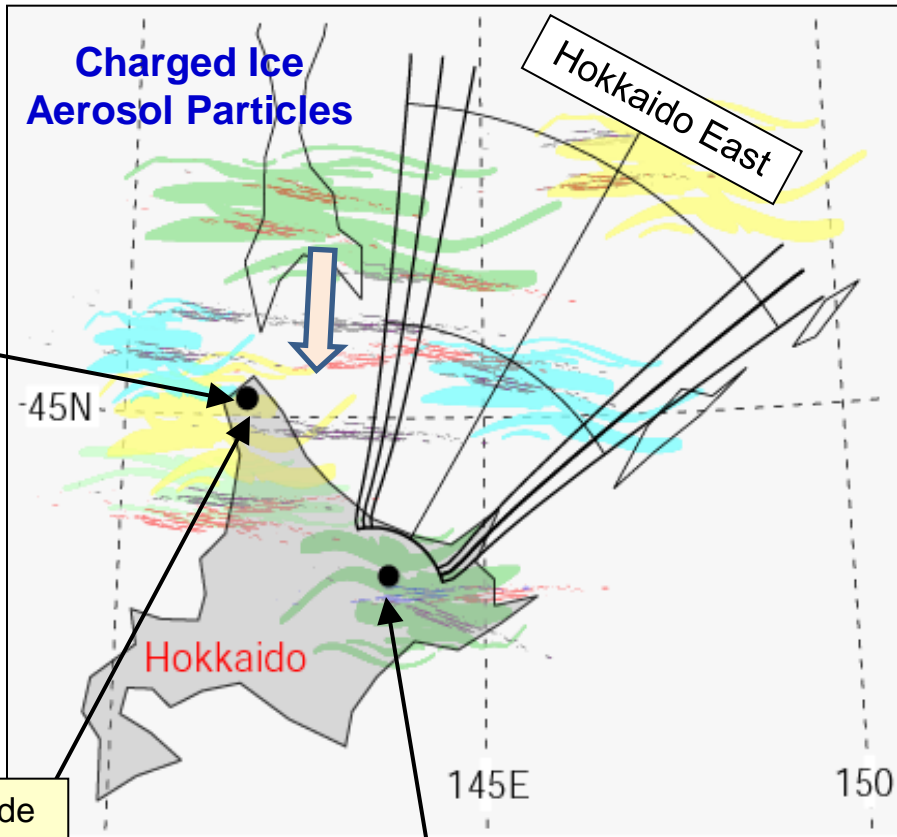
1.96-MHz MF Radar (50 kW)



Ionosonde



Charged Ice
Aerosol Particles



Hokkaido East

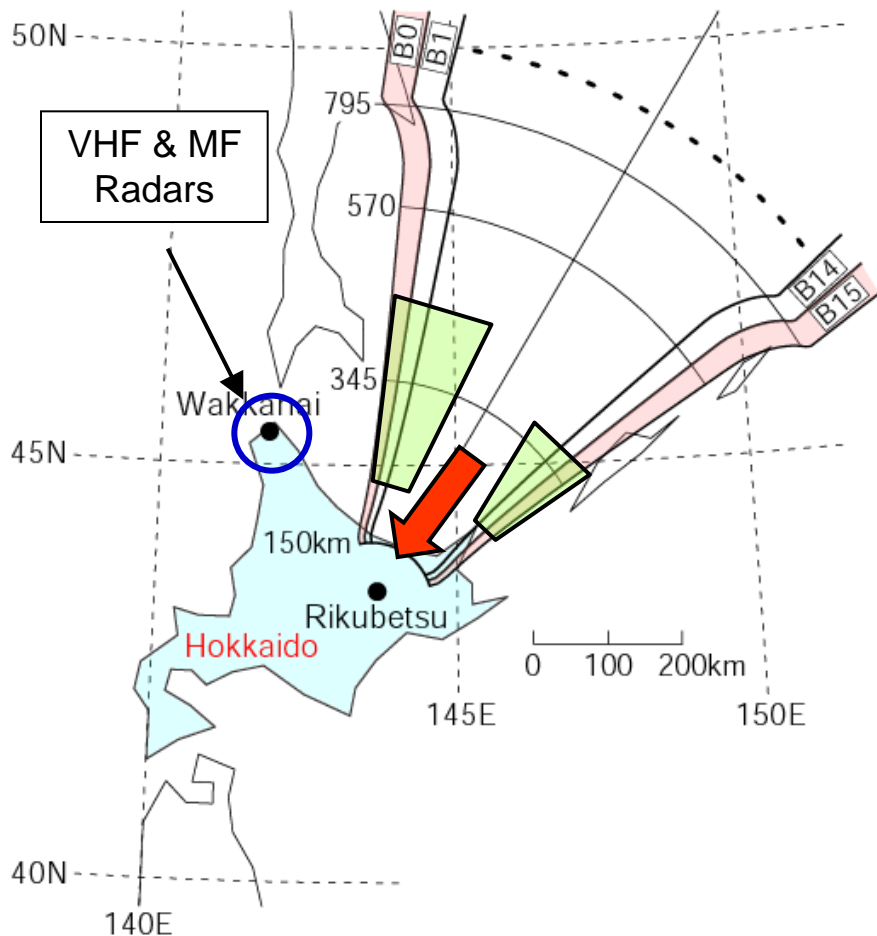
Rikubetsu

Sarobetsu

!! First SuperDARN Observations of MSE !!

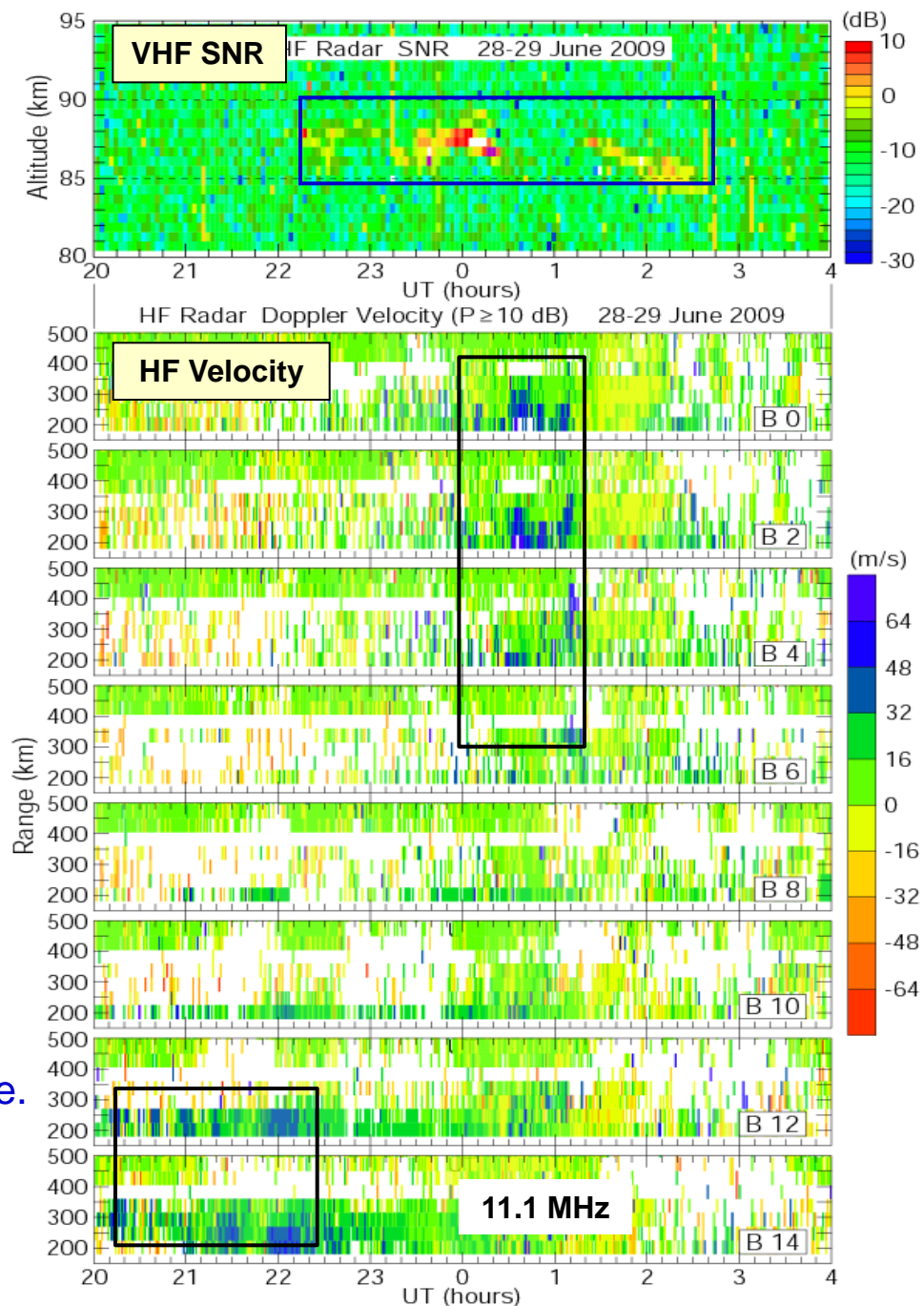
28-29 June 2009

(Ogawa et al., 2013)



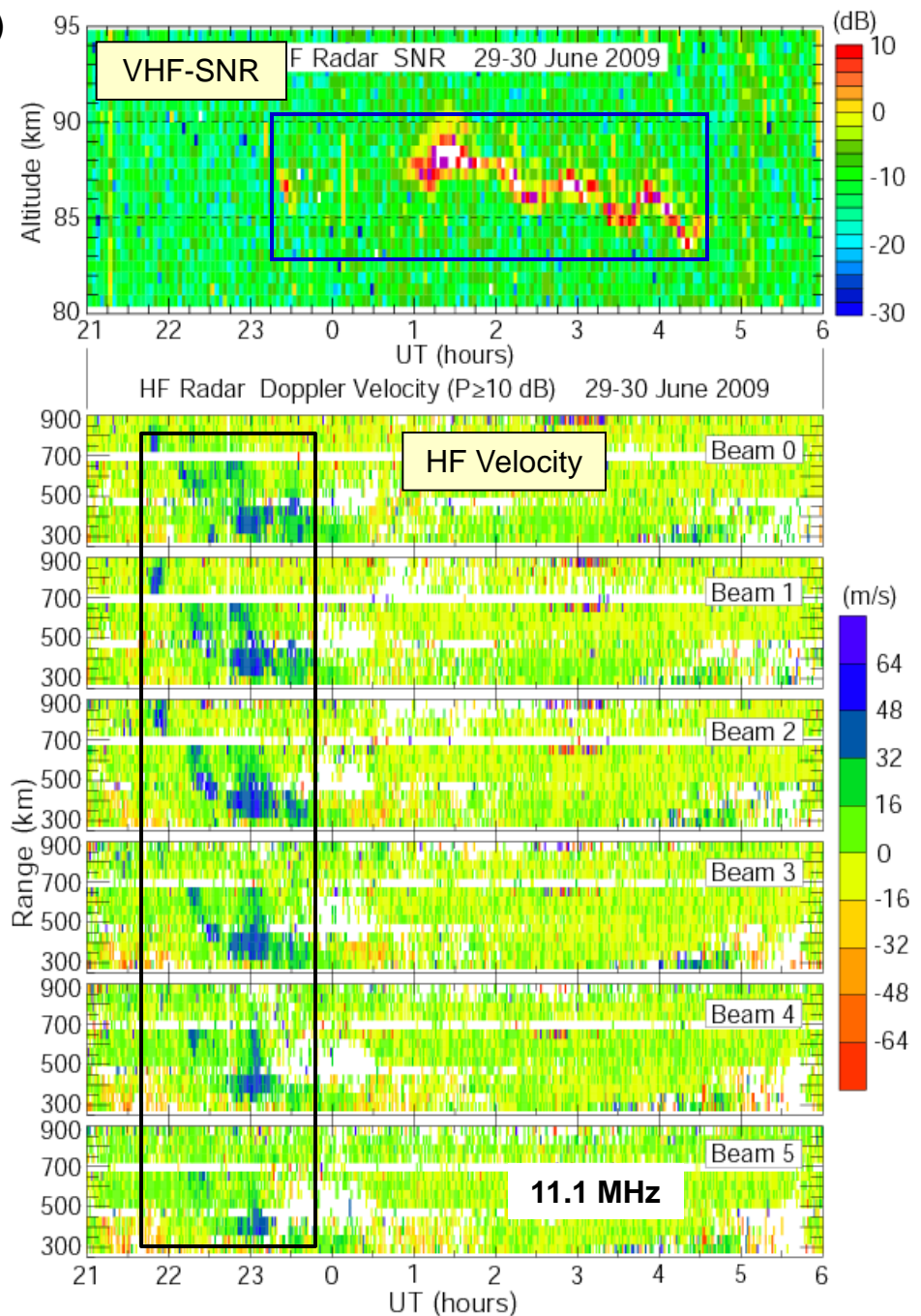
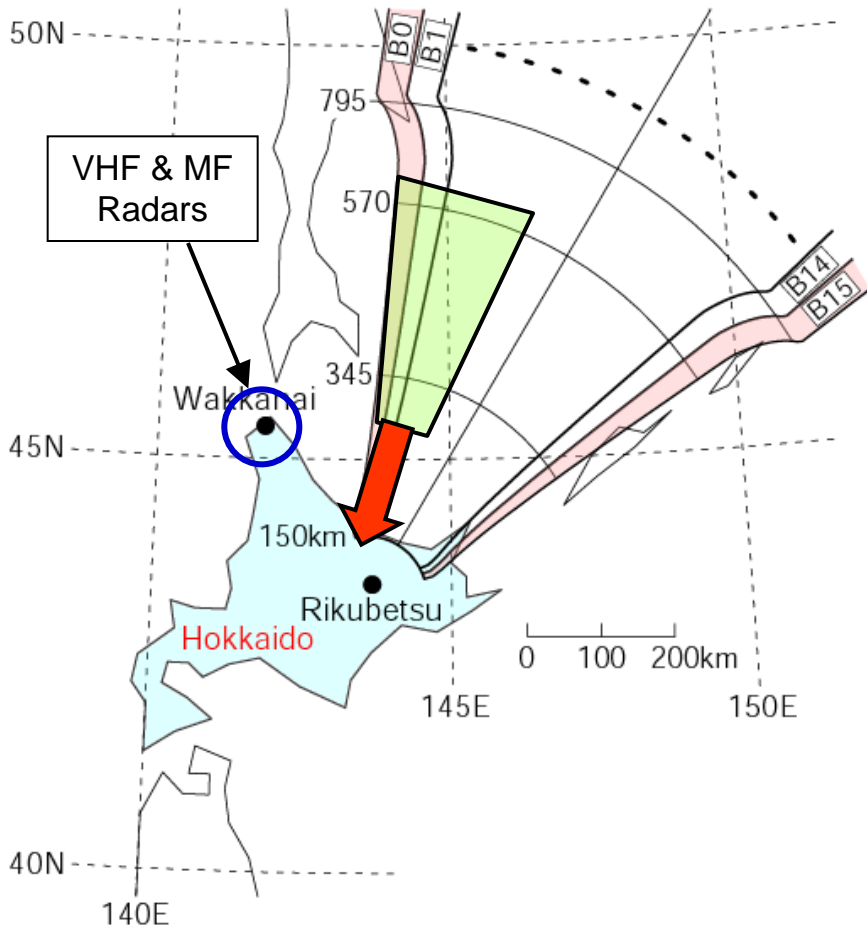
MSE occurrence is sporadic in time and space.

Fast positive Doppler velocities with a maximum of +60 m/s indicate southward-moving echo targets (charged ice particles).



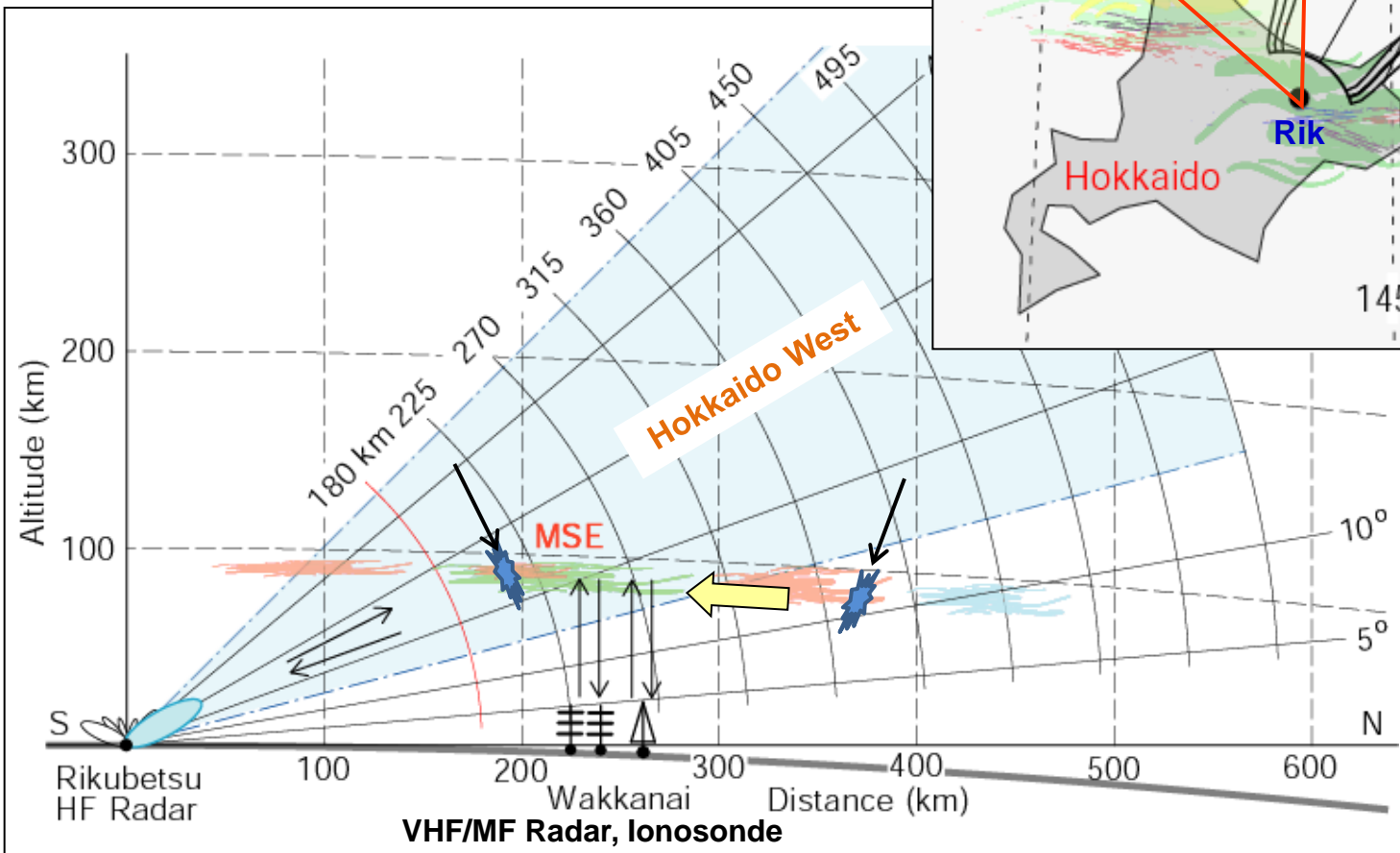
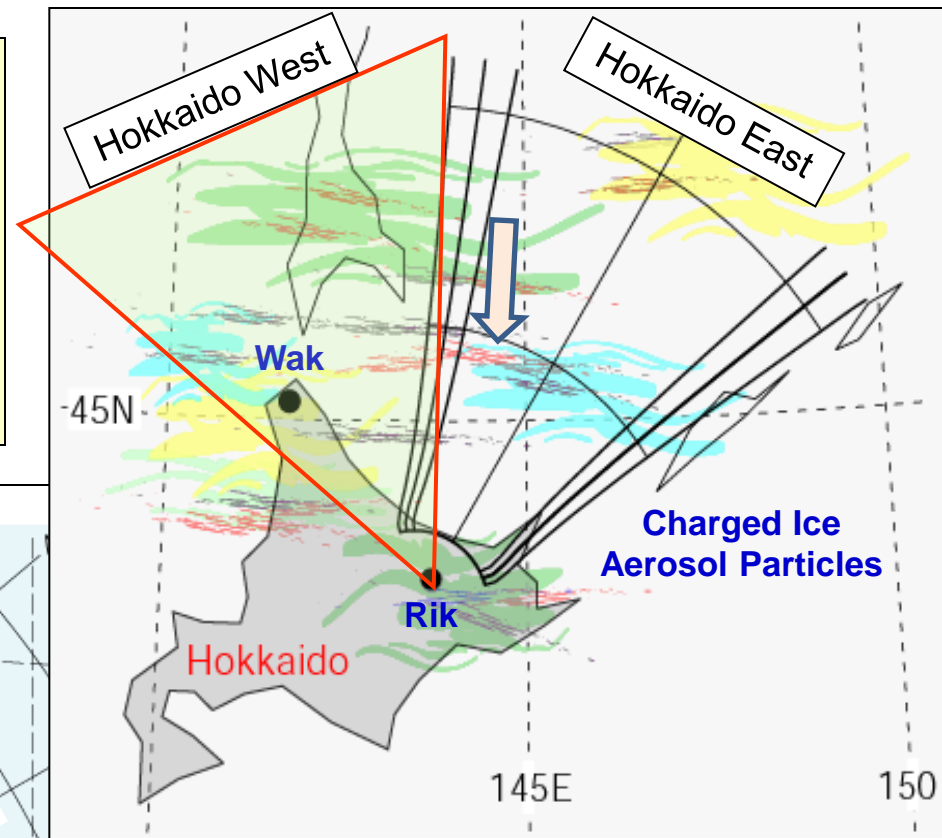
(Ogawa et al., 2013)

29-30 June 2009



Fast positive Doppler velocities with a maximum of +60 m/s indicate southward-moving echo targets (charged ice particles).

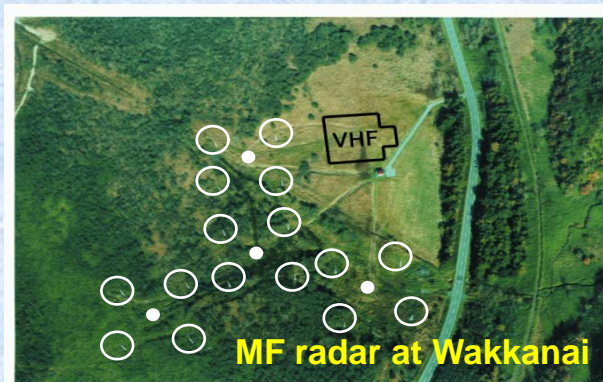
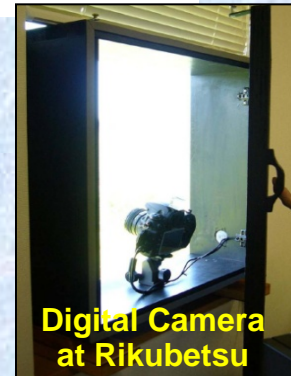
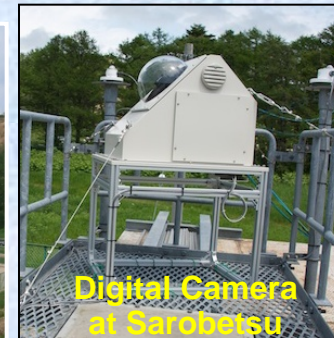
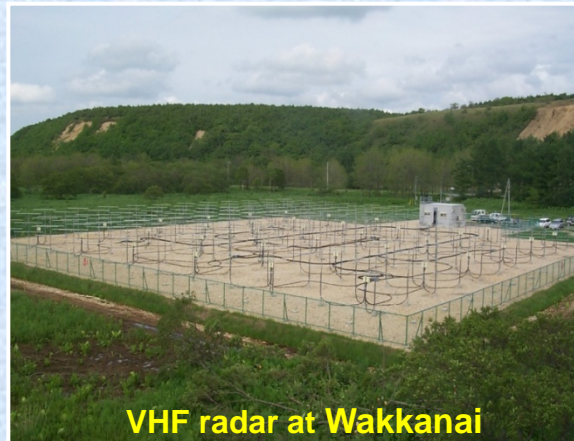
- With both HF radars, spatial and temporal variations of MSE in a wide area are clarified.
- Simultaneous **common volume observations** of MSE with Hokkaido-West, VHF and MF radars and ionosonde are essential to explore detailed MSE physics.
- Comparison between neutral winds observed with Hokkaido-West and MF radar is important.



- Very low mesopause temperature
- Charged ice/aerosol particles
- Plasma/neutral turbulence
- Tides + atmospheric gravity waves +

Summary

- We can obtain many fruitful and new scientific results from observations with the Hokkaido twin HF radars in collaboration with other instruments such as VHF and MF radars and ionosonde, etc.
- Further progress of the studies of TID (MSTID and LSTID) and mid-latitude MSE is highly expected.



稚内 (NICT)



Nikon D-700
(since 2012.6.13)

サロベツ (NICT)



Nikon D-700
(resumed 2012.6.11)

初山別天文台 (明治大)



Panasonic DMC-FZ150
(since 2012.7.4)

母子里 (駒澤大)



カラービデオ
WATEC

パンクロ
ビデオ
WATEC

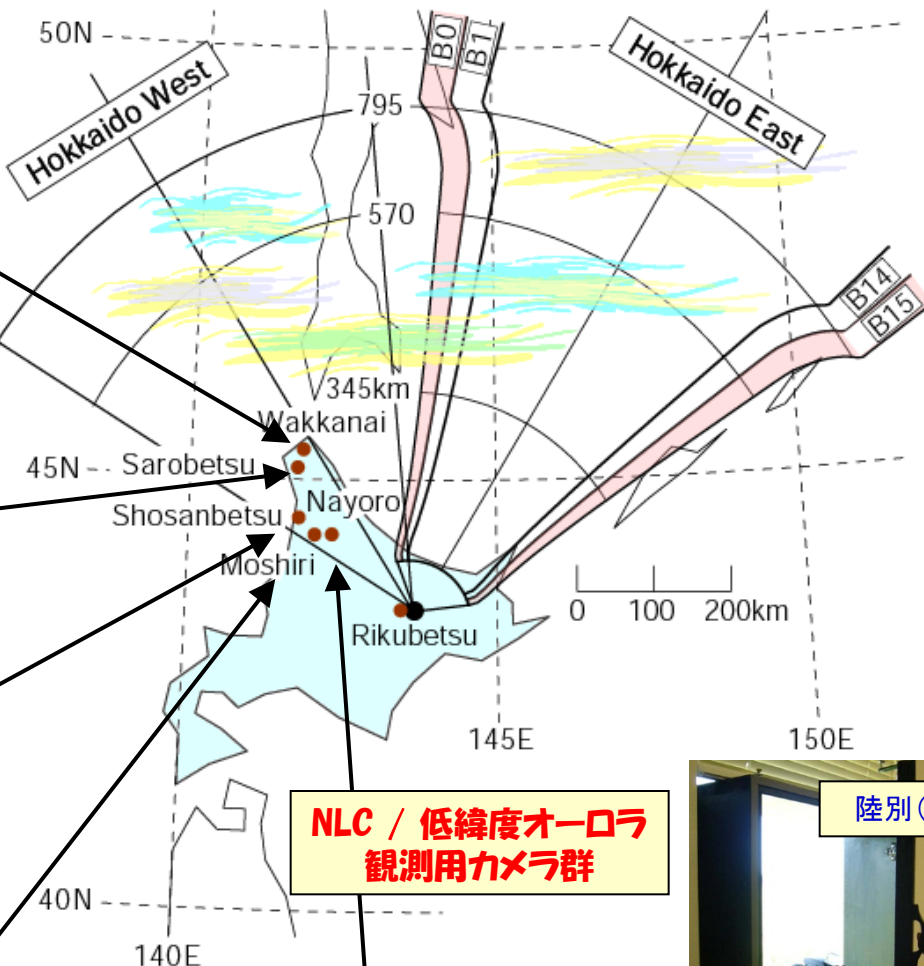
Nikon D-90

(since 2013.7.24)

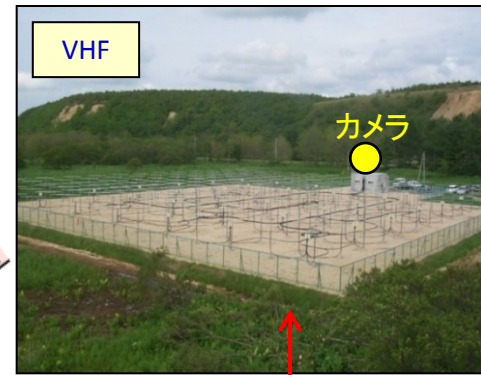
名寄天文台 (明治大/NIPR)



Nikon D-90
(since 2012.6.2).

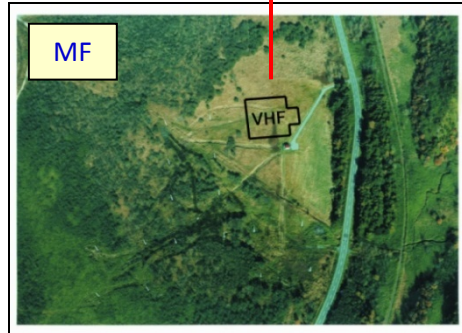


稚内 (NICT)



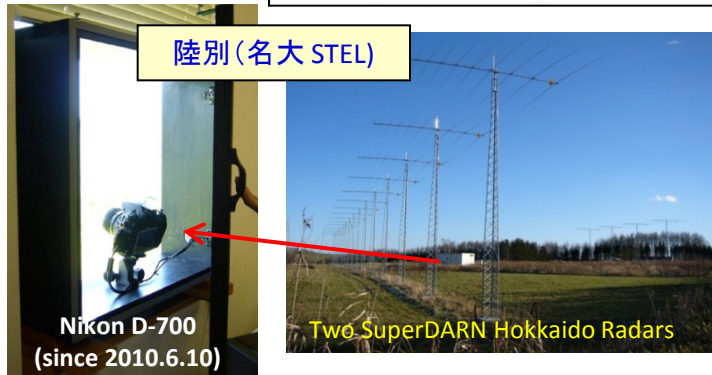
VHF

カメラ



MF

陸別 (名大 STEL)



Nikon D-700
(since 2010.6.10)



Two SuperDARN Hokkaido Radars

- Wakkanai (45.36°N, 141.81°E),
- Sarobetsu (45.16°N, 141.75°E)
- Shosanbetsu (44.56°N, 141.77°E)
- Moshiri (44.37°N, 142.27°E)
- Nayoro (44.37°N, 142.48°E)
- Rikubetsu (43.53°N, 143.61°E)

**2014.11.4
現在**