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ANtarctic Gravity Wave Instrument Network

THERMOSPHERIC NIGHTIME MSTIDS OBSERVED BY AN ALL-SKY IMAGER AT COMANDATE FERRAZ ANTACTICA STATION (62 S)

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Outline

- **Ferraz station at King George Island**
- **All-Sky airglow imager**
- **Wave Activity over Ferraz Station**
- **Summary**

4th International ANGWIN Workshop:

Exploration of High-latitude Upper Atmosphere Wave Dynamics

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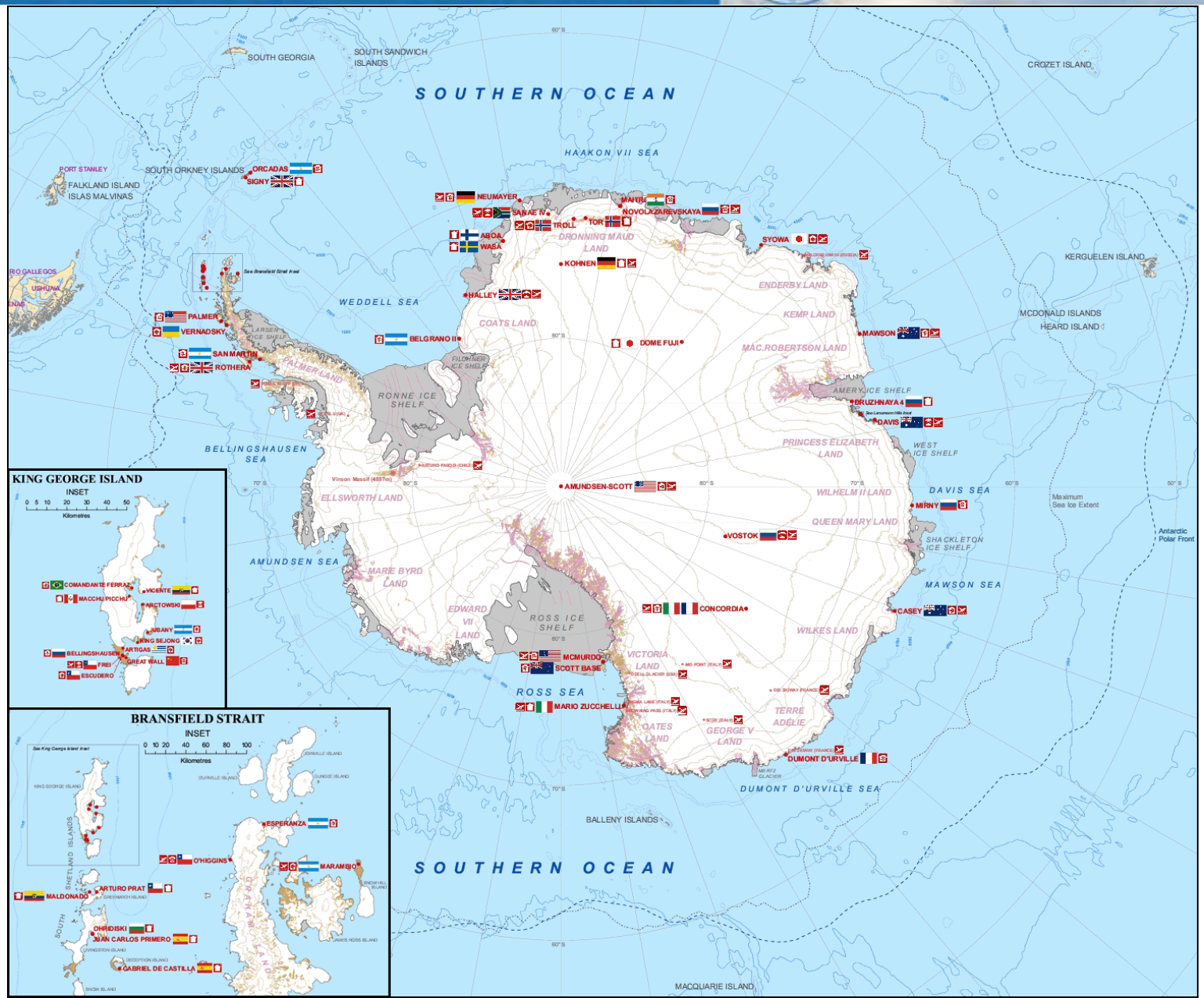
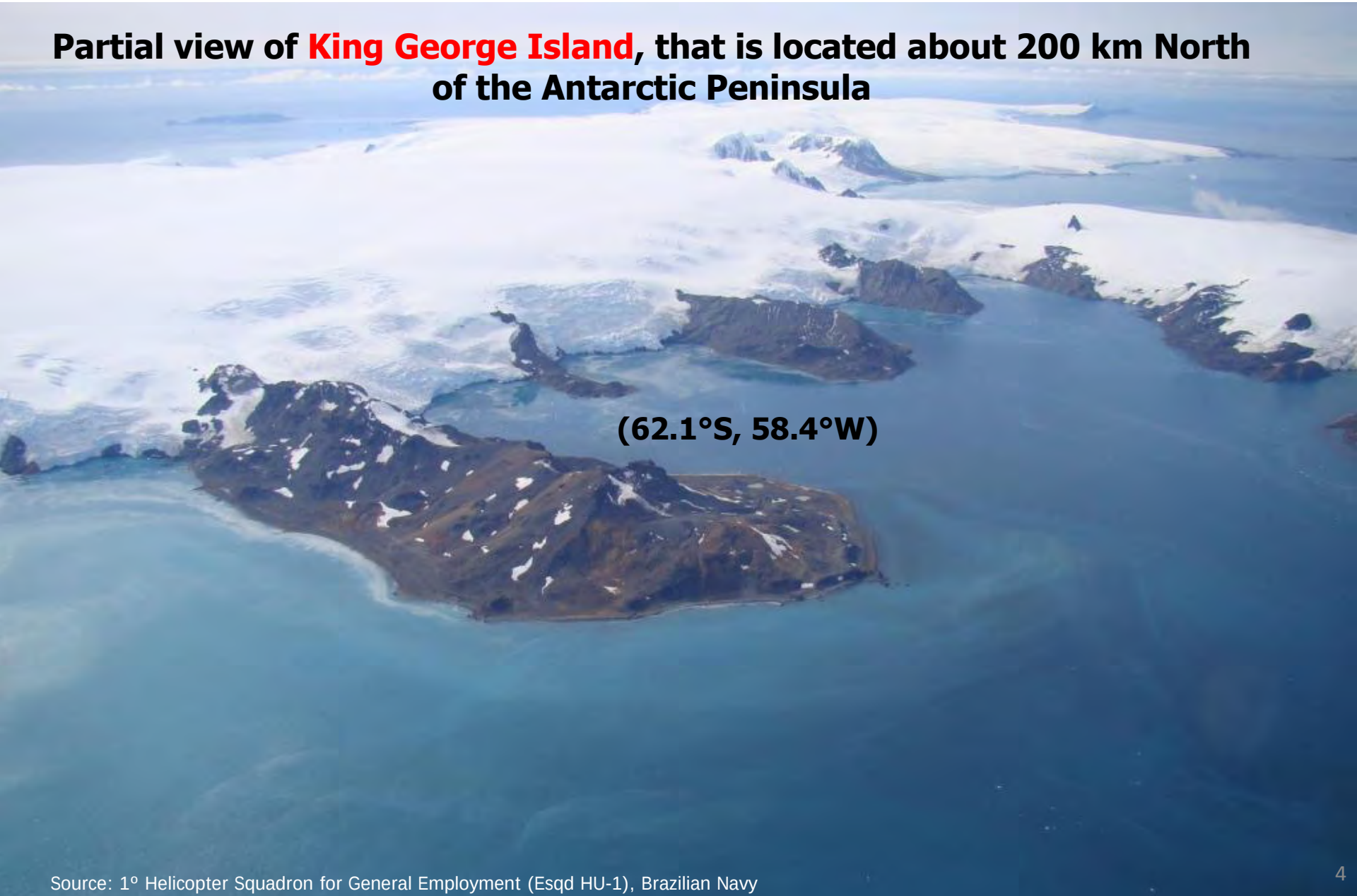
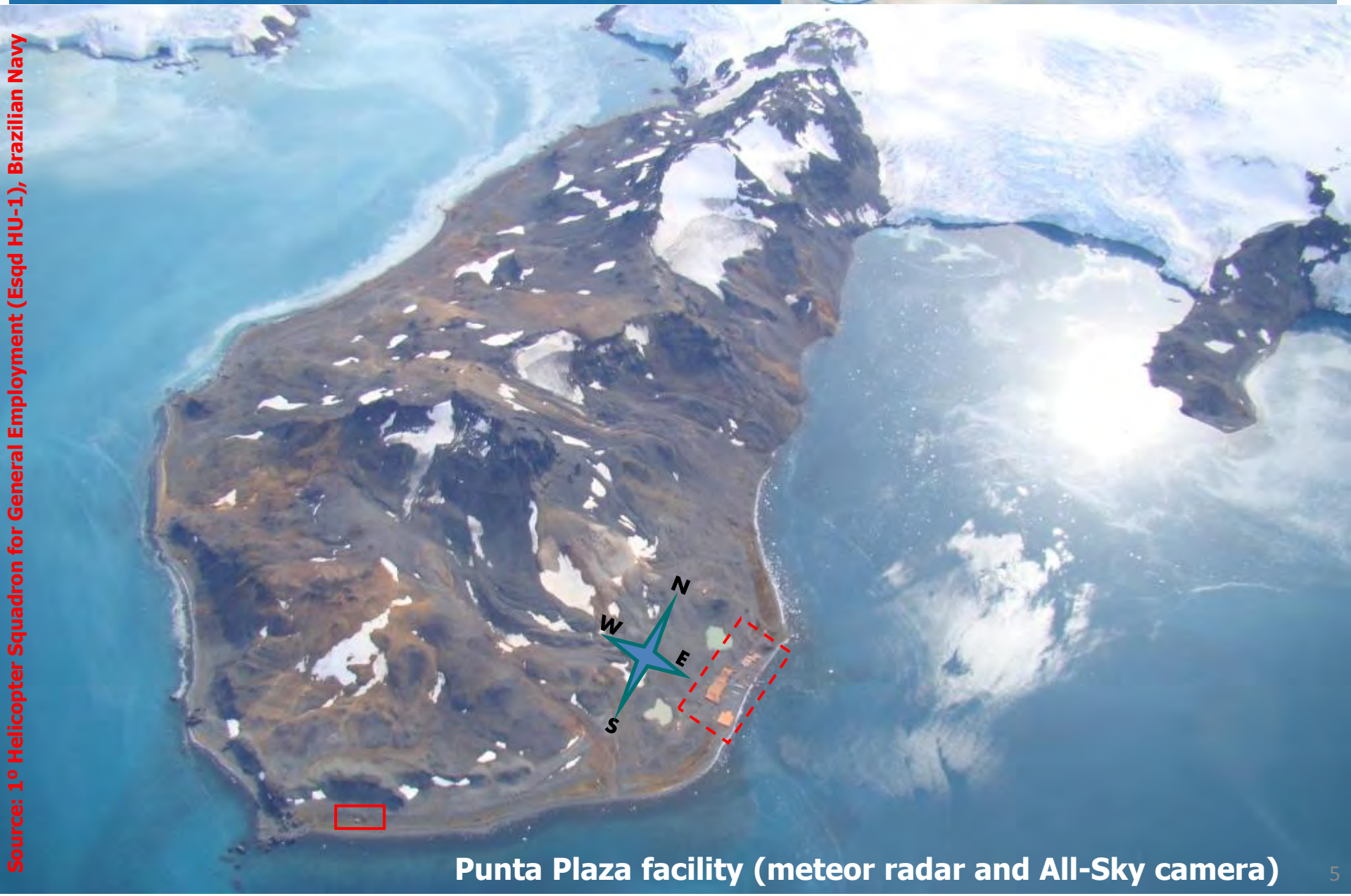


Partial view of King George Island, that is located about 200 km North of the Antarctic Peninsula



Source: 1º Helicopter Squadron for General Employment (Esqd HU-1), Brazilian Navy



Source: 1º Helicopter Squadron for General Employment (Esqd HU-1), Brazilian Navy

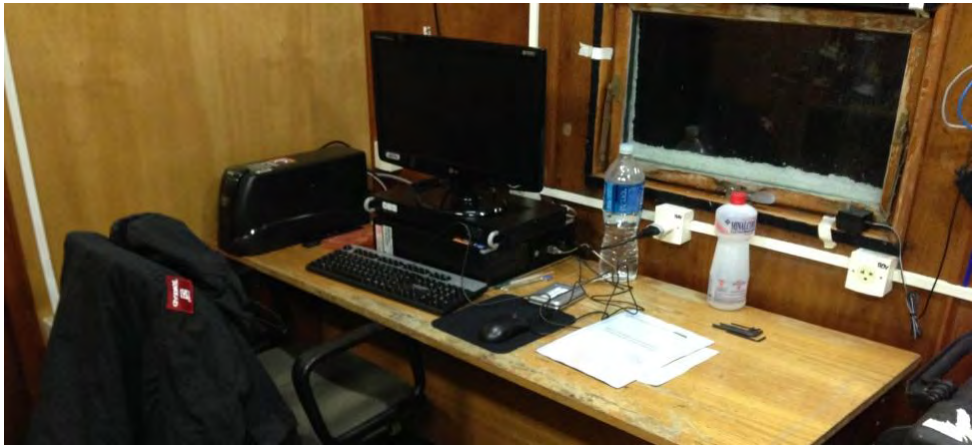
Punta Plaza facility (meteor radar and All-Sky camera)

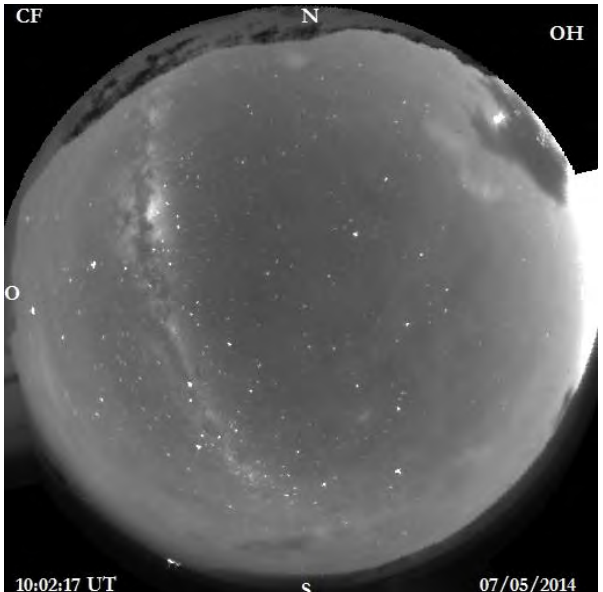
Ferraz Station - Punta Plaza Site

Source: J. V. Bageston

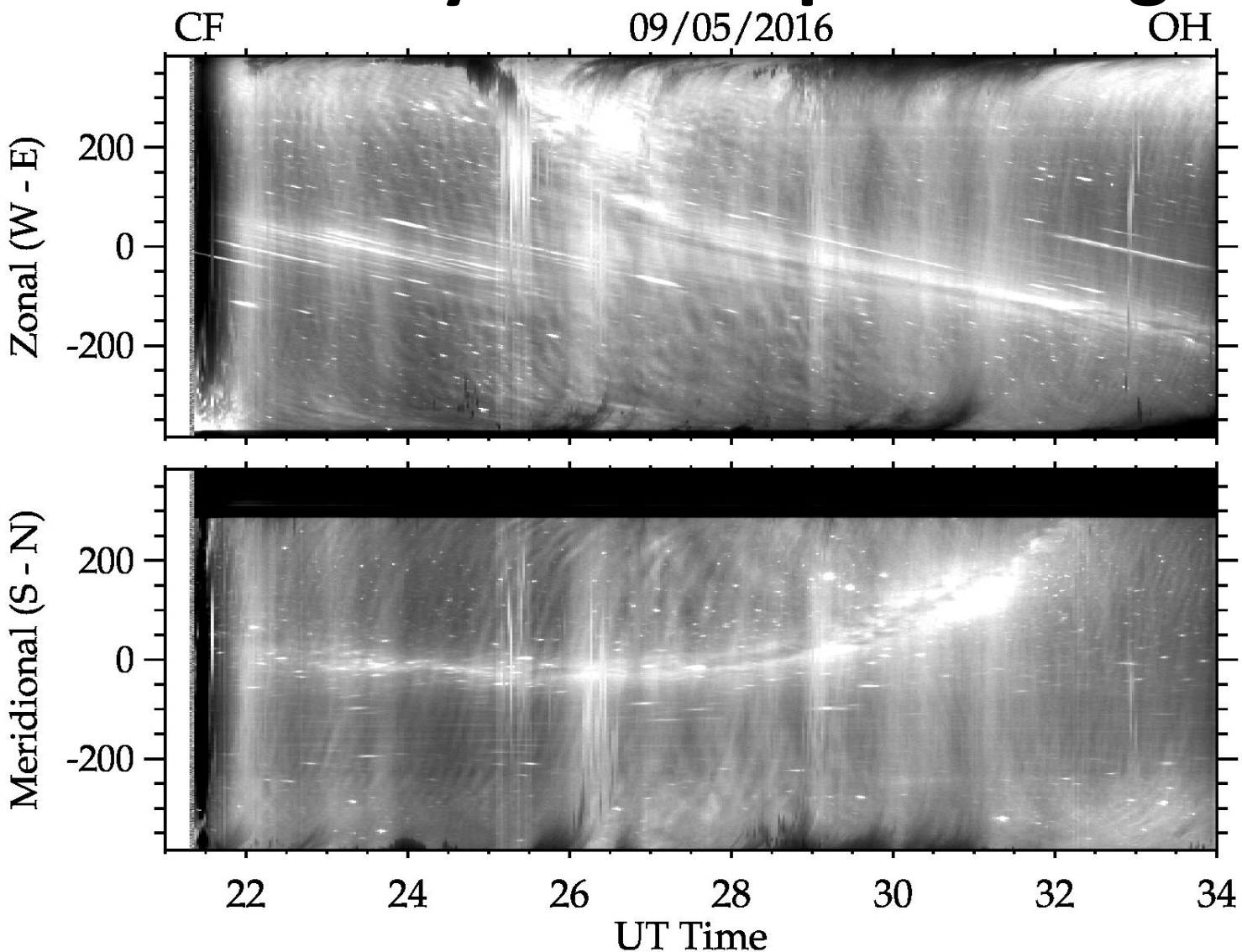
Observing Gravity Waves at Ferraz

A new all-sky airglow imager with three filters (OH NIR, OI 557.7 and 630.0 nm) was installed at Ferraz Antarctic Station in 2014.

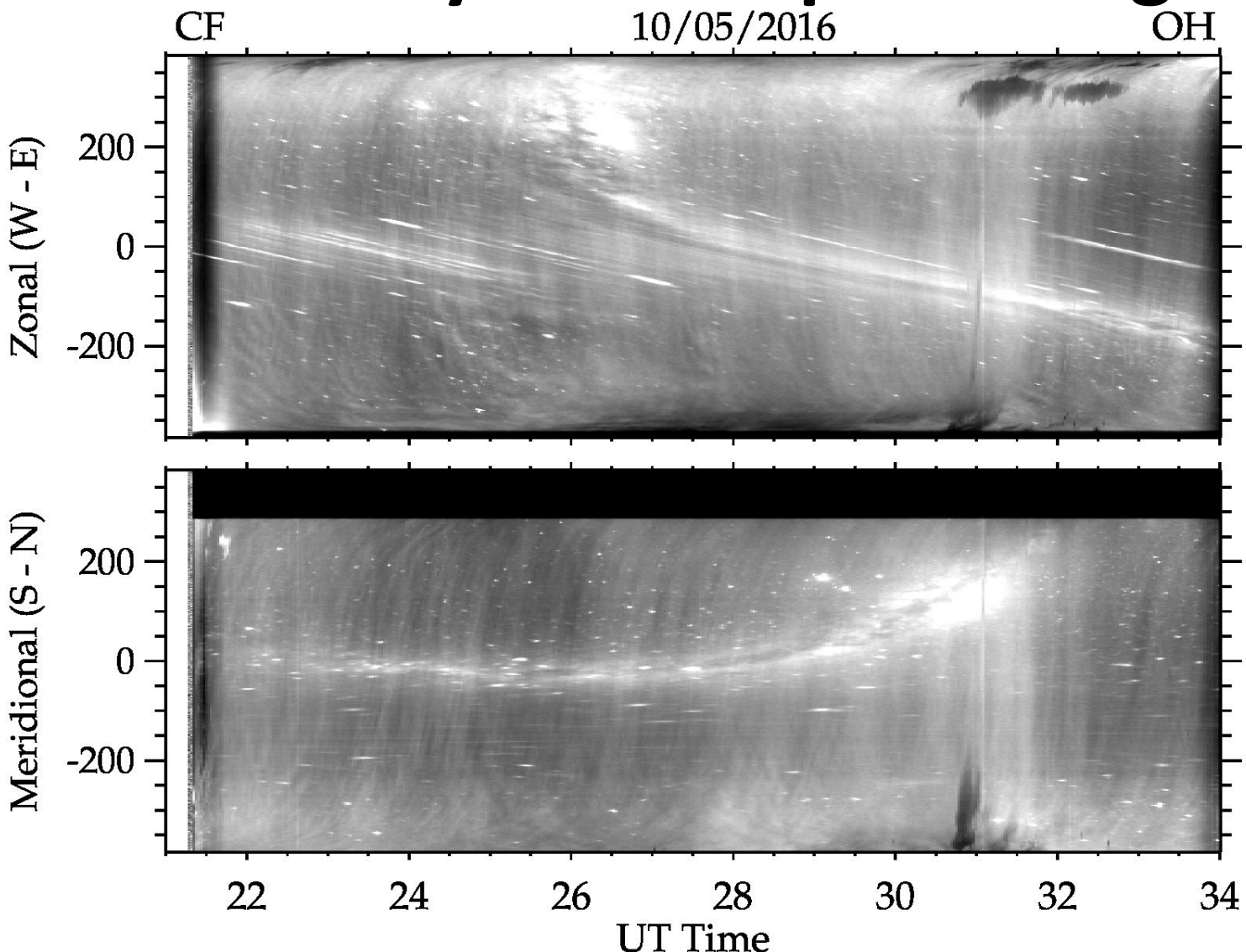




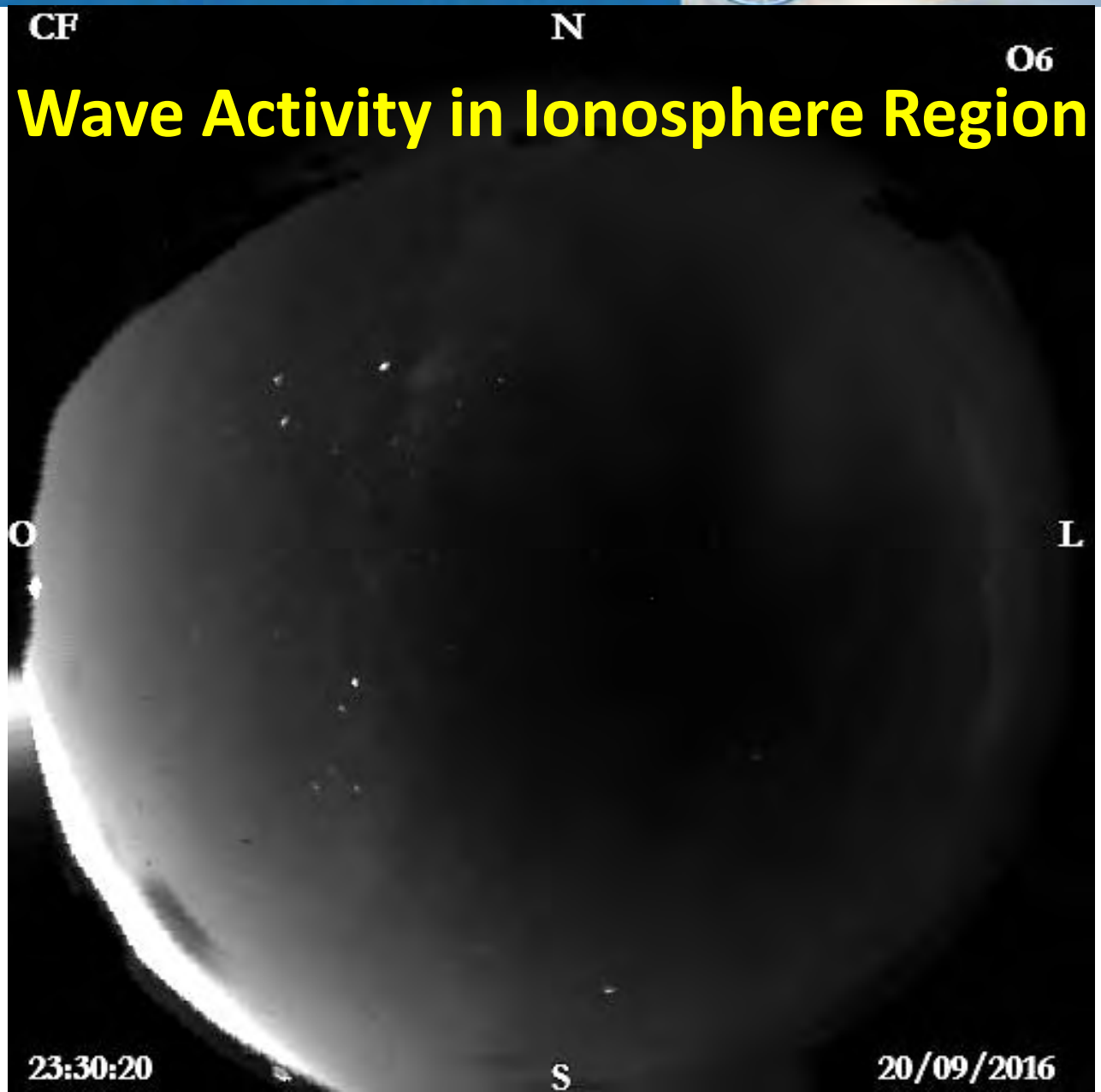
Wave Activity in Mesophere Region



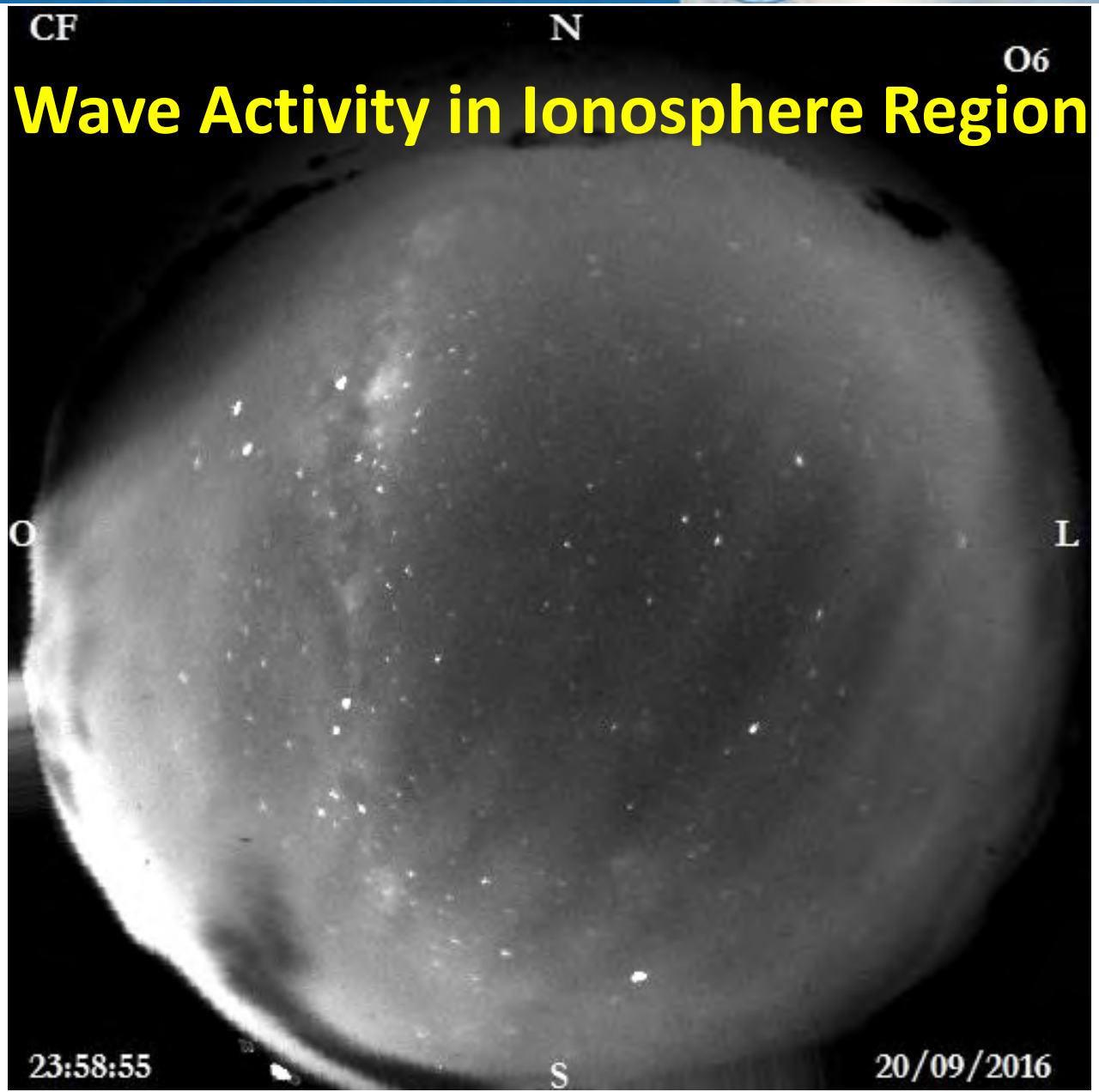
Wave Activity in Mesophere Region



Wave Activity in Ionosphere Region



Wave Activity in Ionosphere Region



Are these waves related to OH emission?

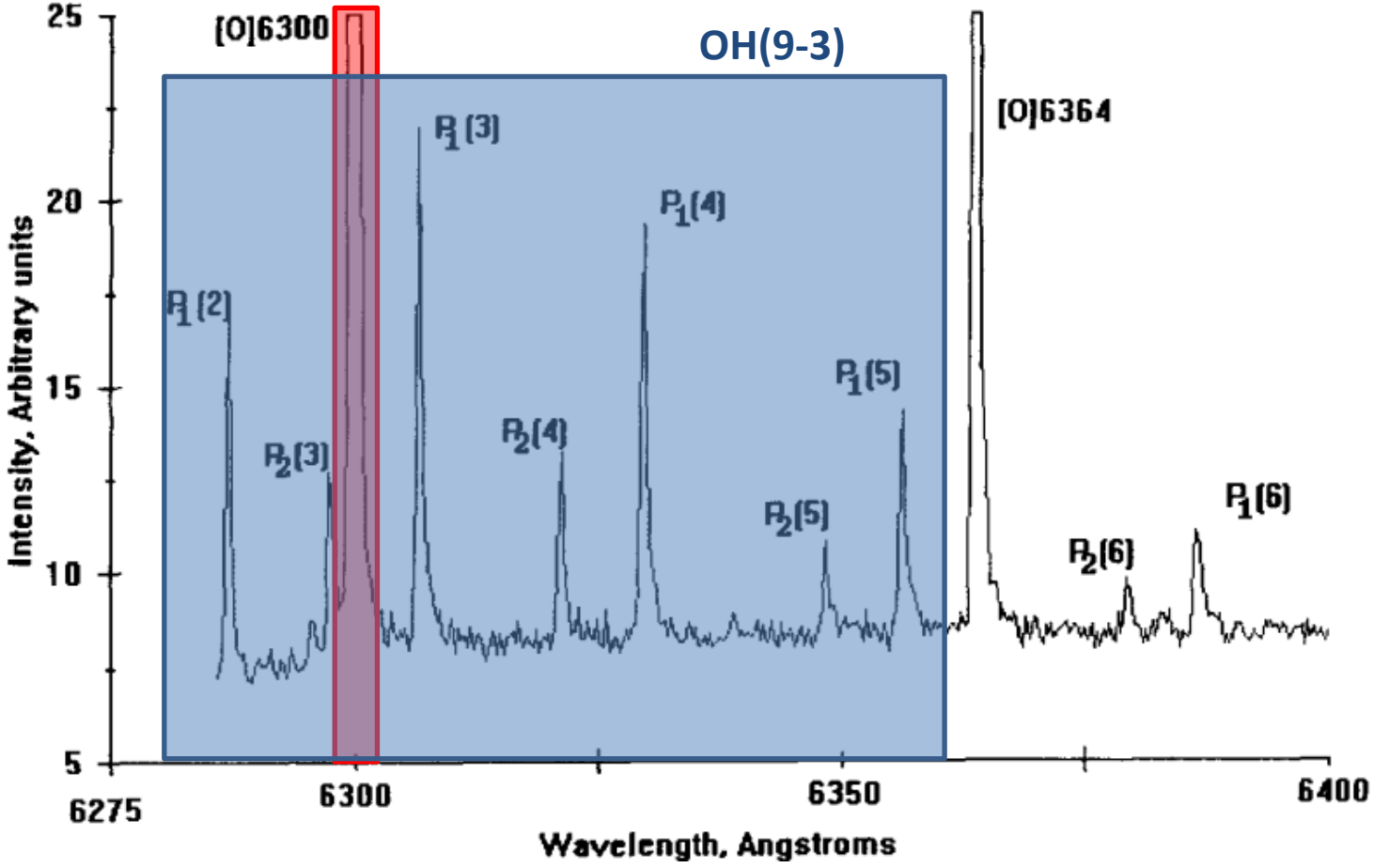
Journal of Atmospheric and Solar-Terrestrial Physics, Vol. 59, No. 1, pp. 117–124, 1997

1364-6826/97 $17.00+0.00
0021–9169(95)00196–4
Pergamon

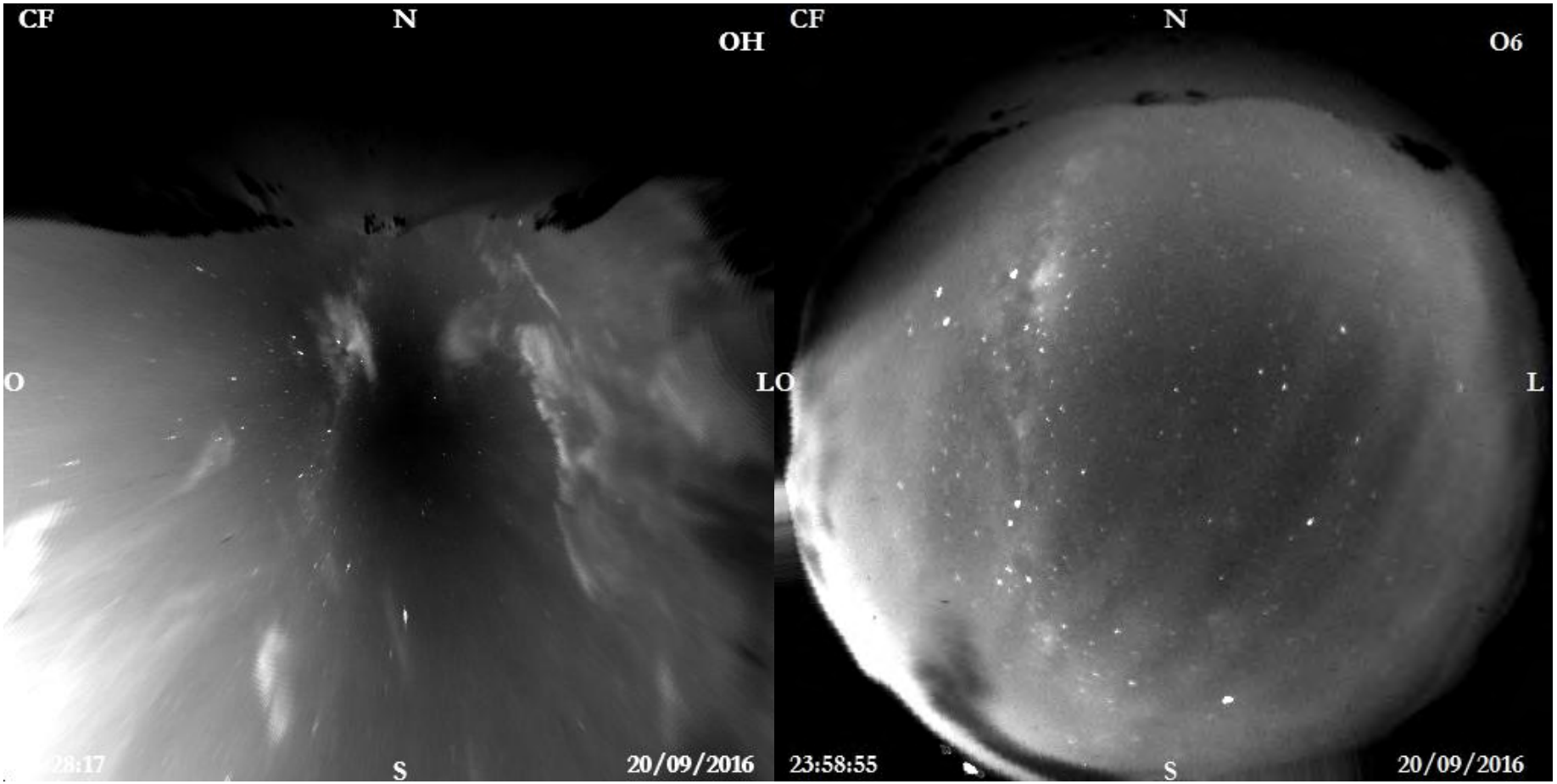
High resolution spectrography of hydroxyl in the night airglow

Yvonne Elsworth,[1] J. J. Lopez-Moreno[2] and J. F. James[3]*

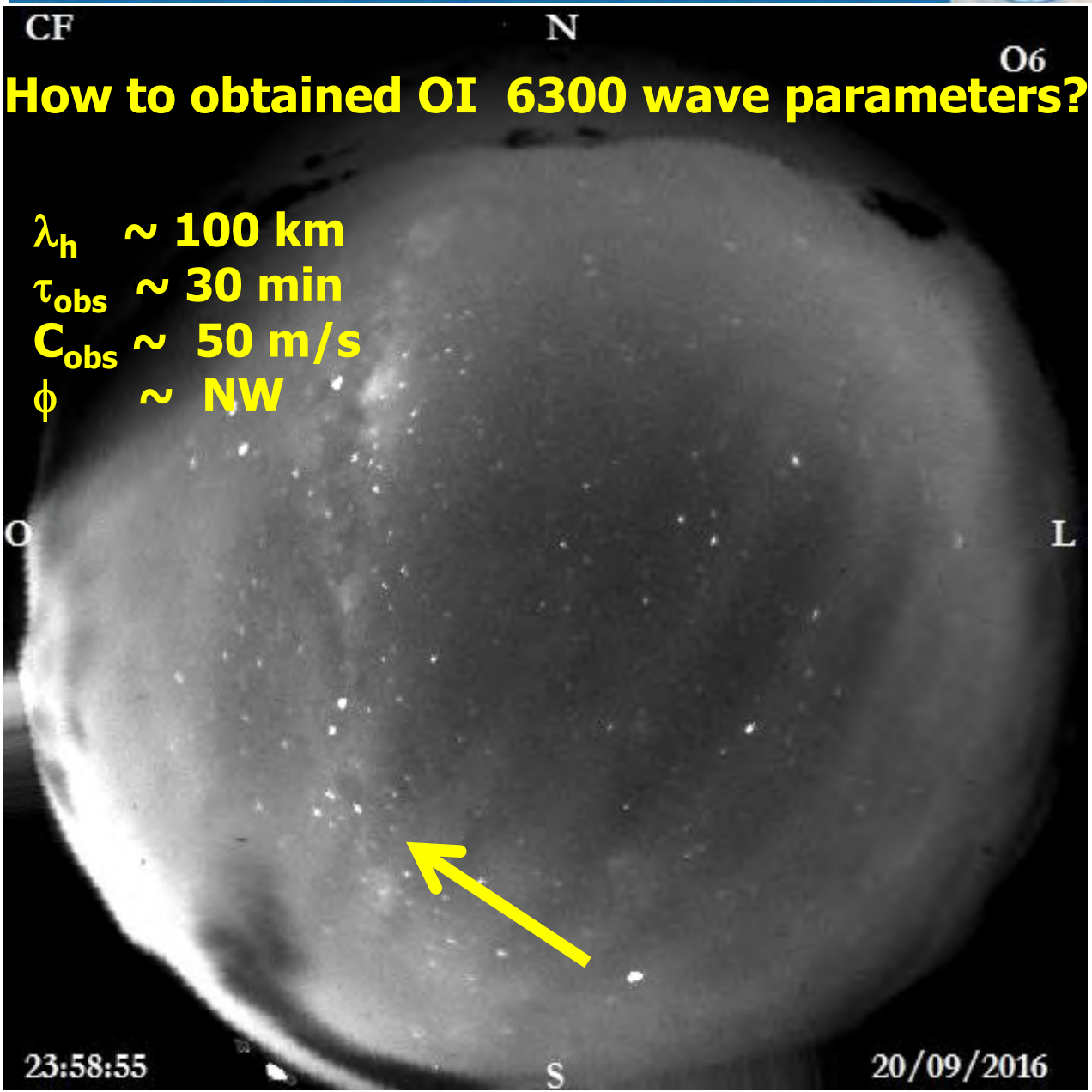
OI Filter used has a Band Wide of 20 Å



How to ruled out OH Contamination?



So, no wave was propagating at the mesosphere to NW direction!



How to obtained OI 6300 wave parameters?

λ_h ~ 100 km
τ_{obs} ~ 30 min
C_{obs} ~ 50 m/s
ϕ ~ NW

We used the well know Cross Spectrum Analysis

Horizontal Wavelength

$$\lambda_h = \frac{2\pi}{\sqrt{k^2 + l^2}}$$

Observed Phase Velocity

$$c_{obs} = \frac{2\pi}{\sqrt{k^2 + l^2}} \frac{\Delta\phi_{(k,l)}}{360°} \frac{1}{\Delta t}$$

Observed Period

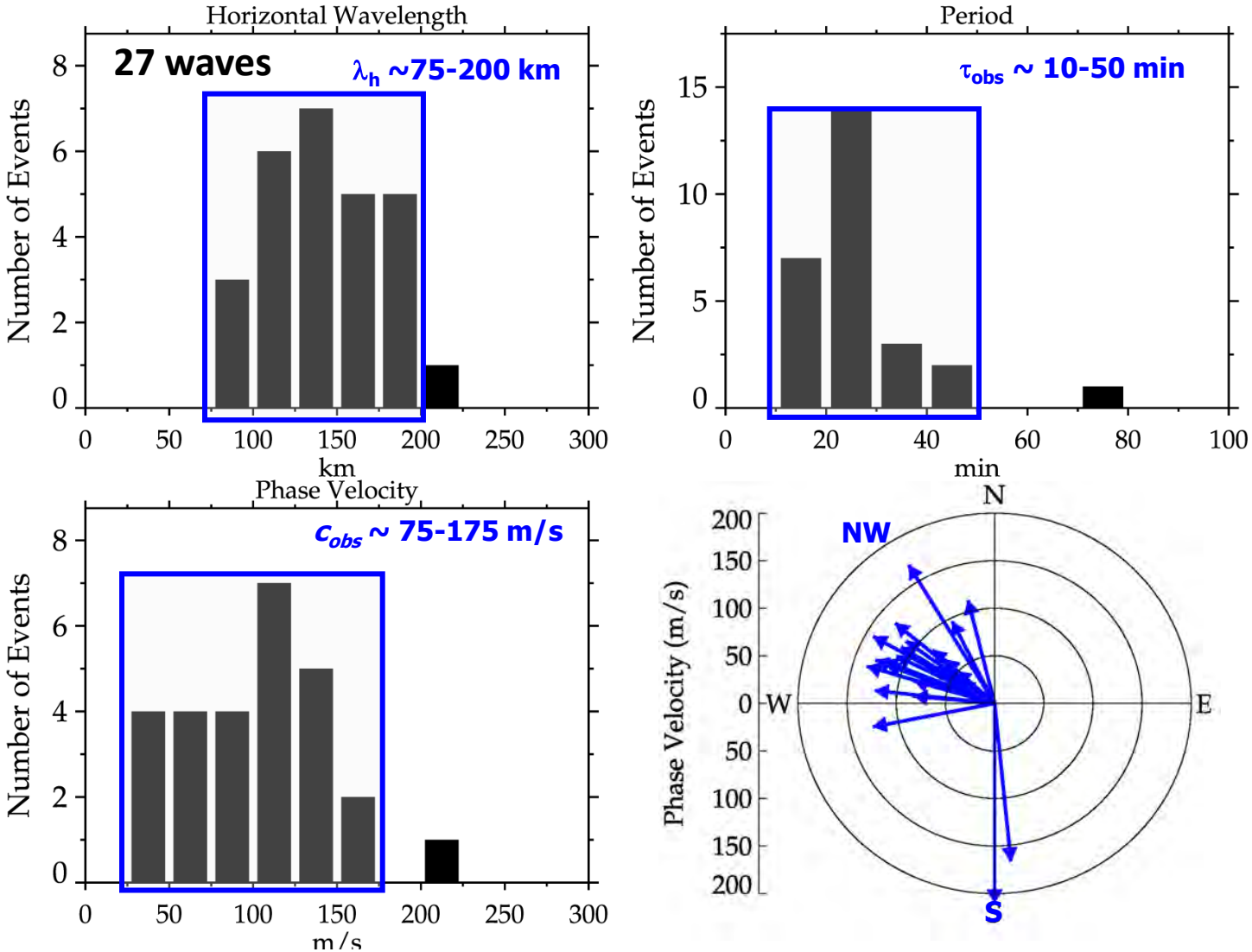
$$\tau_{obs} = \frac{\lambda_h}{c_{obs}}$$

Prop. Direction

$$\varphi_{(k,l)} = tg^{-1} \left\{\frac{Im\, C(k,l)}{Re\, C(k,l)}\right\}$$

Now we applied the method to all observed cases!

Over all Results



So, what kind of waves are they?

When wave structures are observed in the ionospheric parameters, they are called traveling ionospheric disturbances (TIDs).

Depending on the size of the TID, they can be called small scale (SSTID), medium scale (MSTID) or large scale (LSTID).

Type	Period (min)	Wavelength (km)	Phase Velocity (m/s)
SSTID	Few minutes	$\lambda \leq 100$ km	$c \leq 200$ m/s
MSTID	$5 \leq \tau \leq 60$ minutes	$\lambda \leq 1500$ km	$100 \leq c \leq 700$ m/s
LSTID	30 min $\leq \tau \leq$ ~hours	$\lambda > 1000$ km	$300 \leq c \leq 1200$ m/s

Comparison with other OI 630 nm observations

62ºS (27 waves)

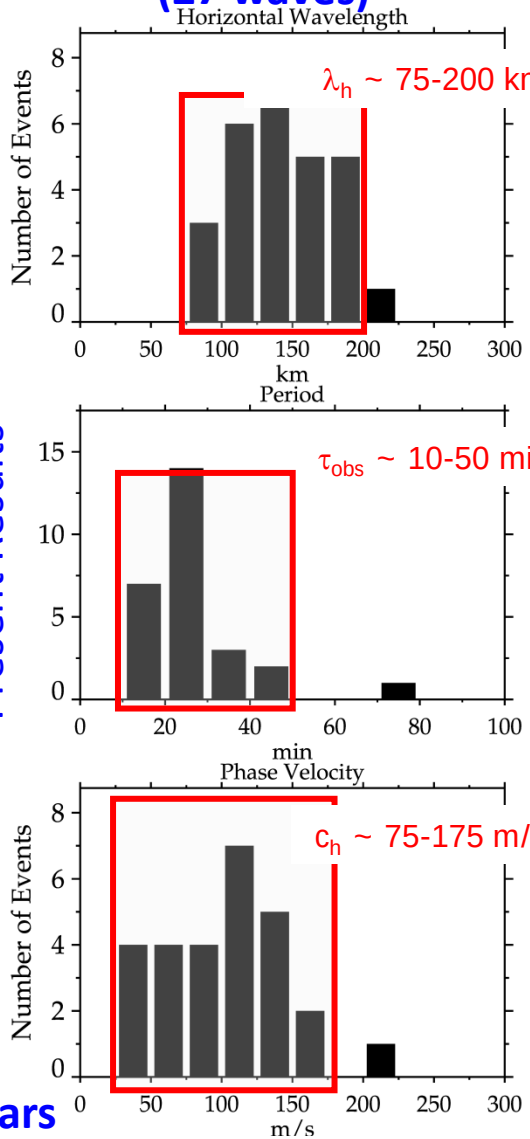
22ºS (48 waves)

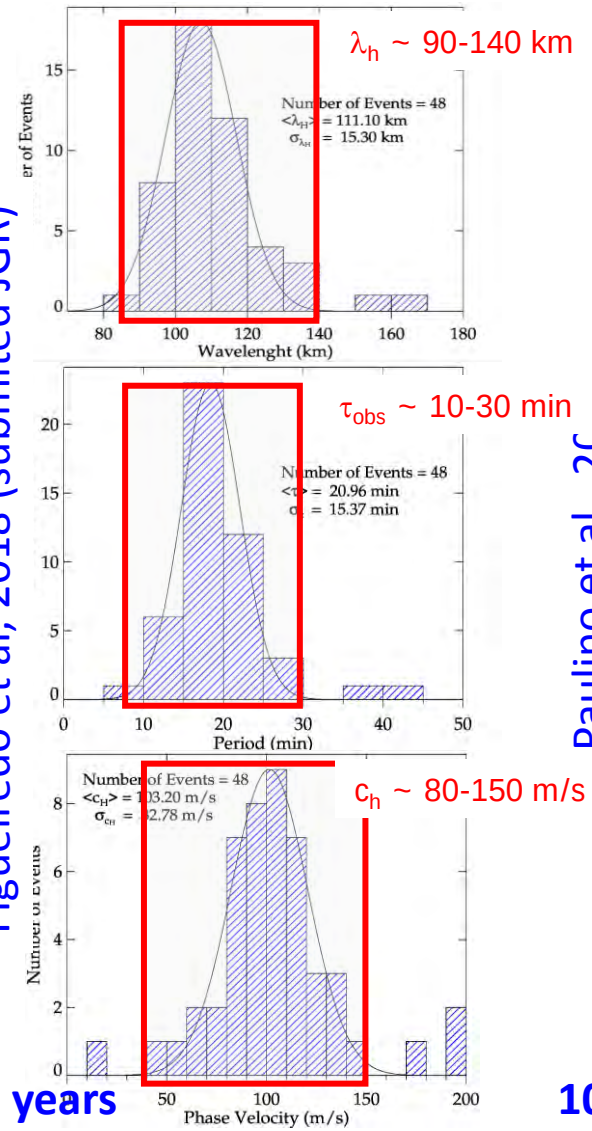
7ºS (98 waves)

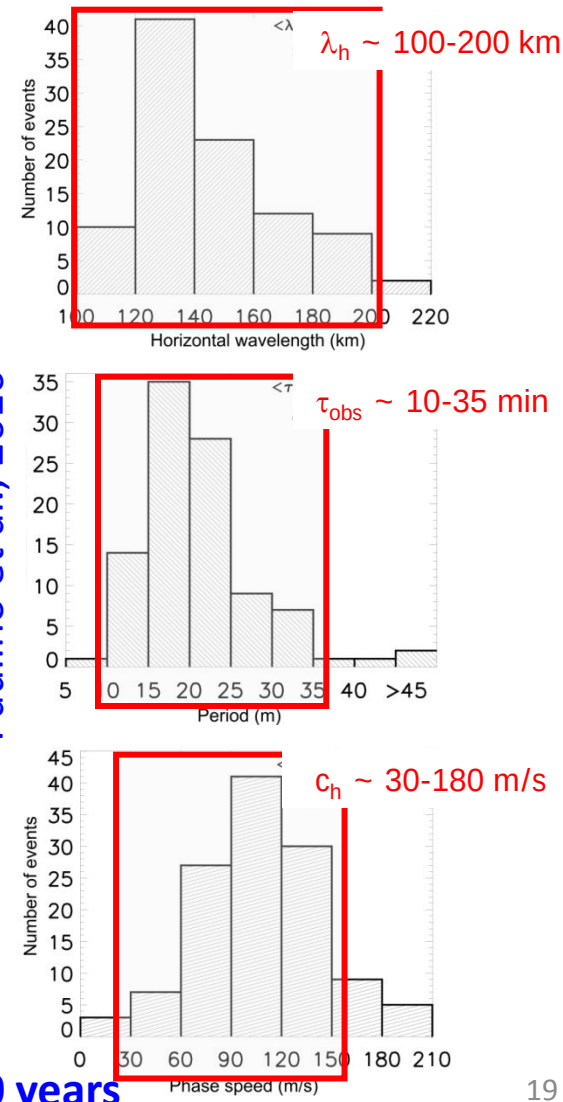
Present Results

Figueiredo et al, 2018 (submited JGR)

Paulino et al., 2C





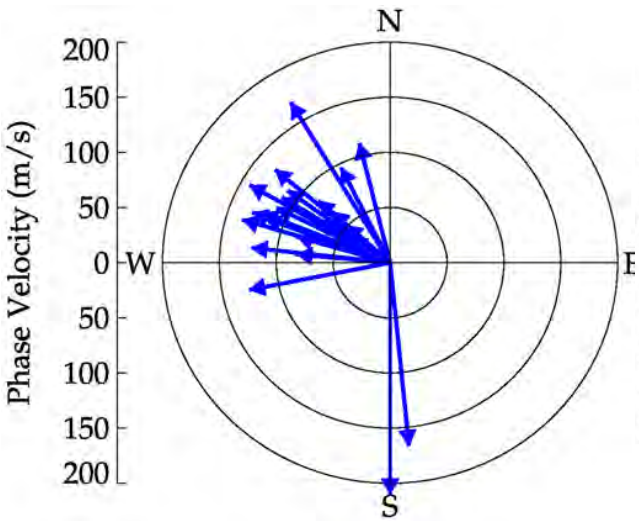


2 years **2.5 years** **10 years**

Propagation Direction

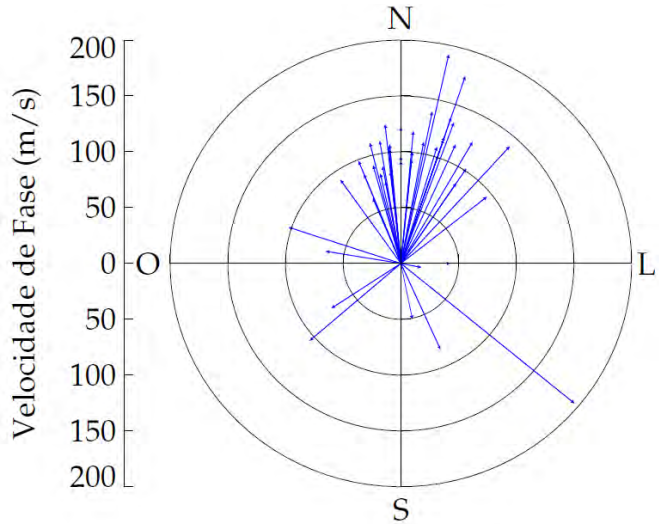
62ºS

(27 waves)



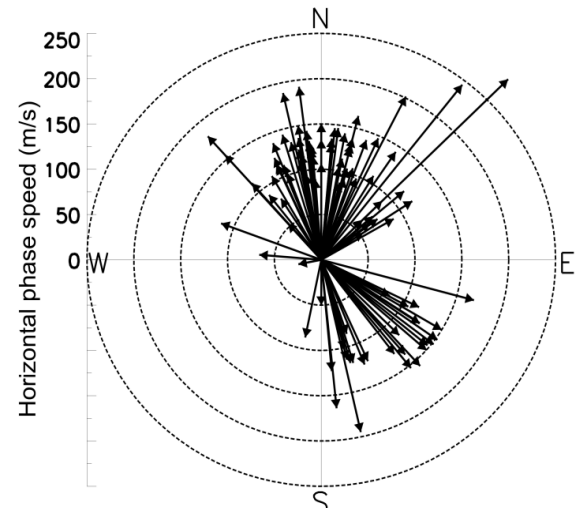
22ºS

(48 waves)



7ºS

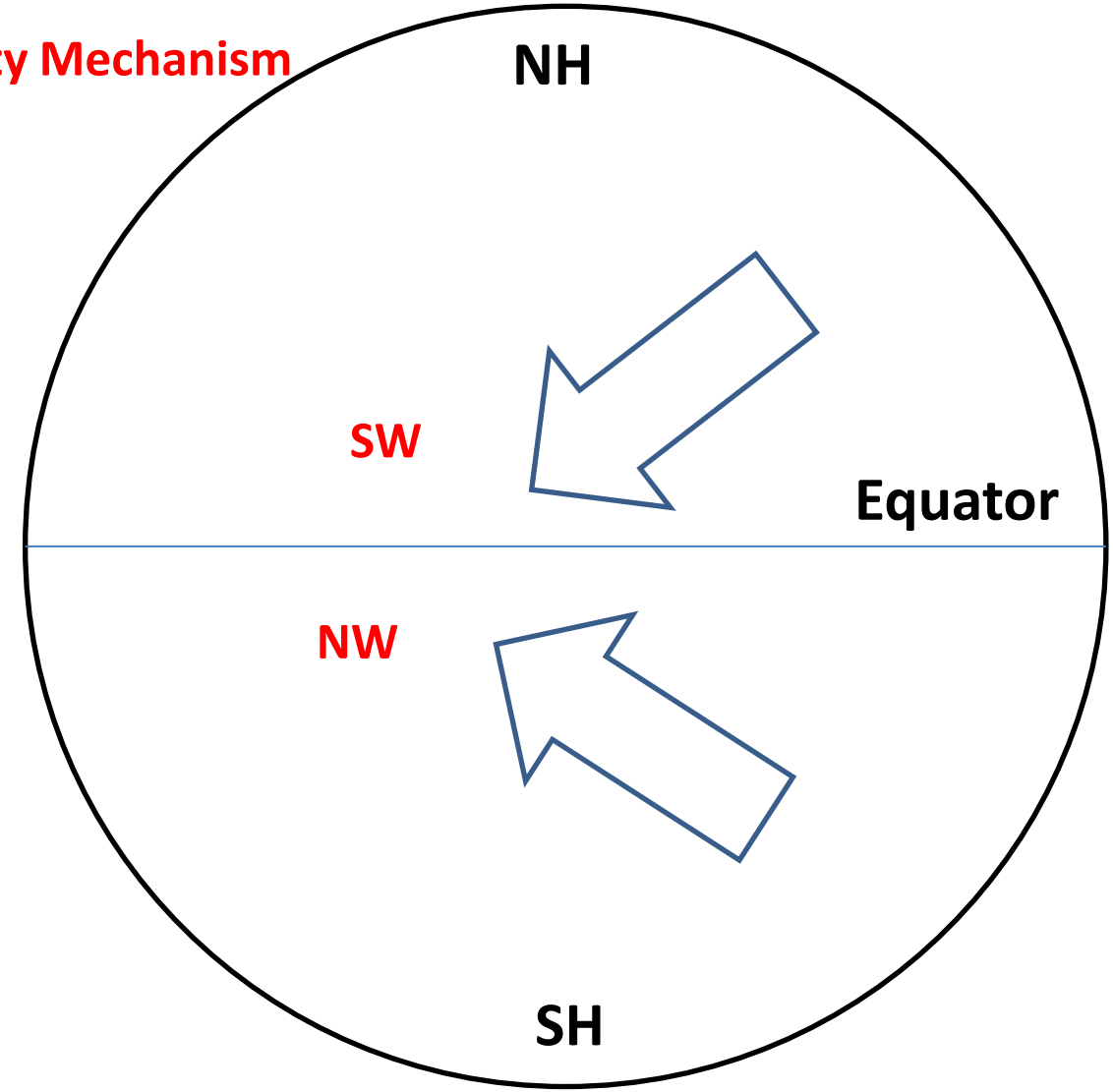
(98 waves)



One of the most important mechanisms that has been pointed out as being effective for generation of MSTIDs is the Perkins instability (Perkins, 1973).

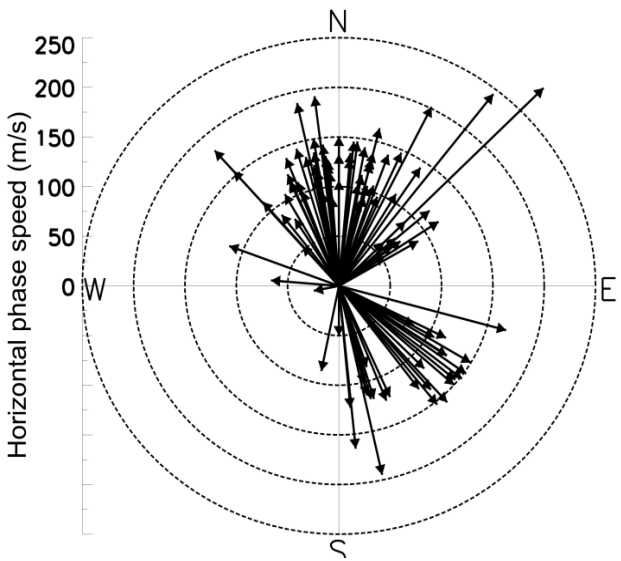
TID's Propagation Direction

Perkins instability Mechanism



Looking closely in the wave Propagation Directions

7ºS
(98 waves)

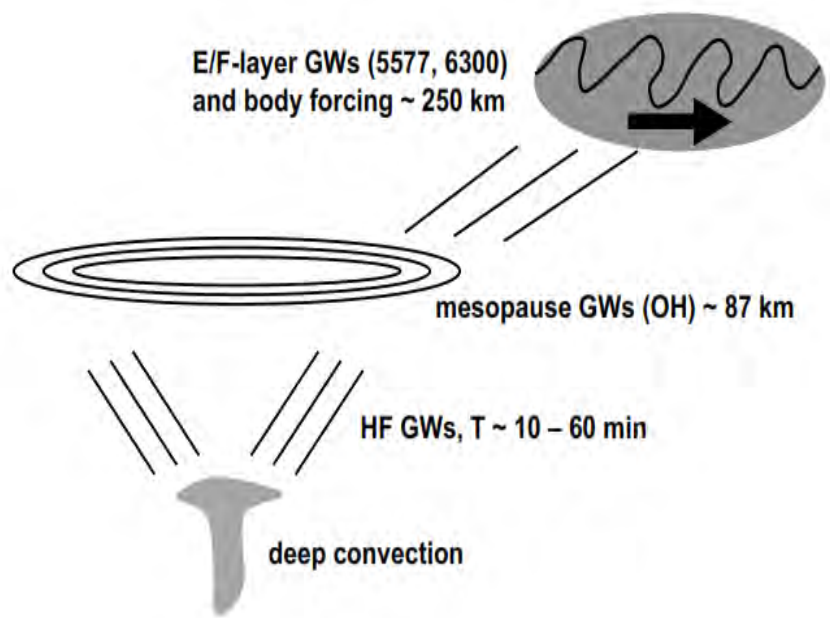


Paulino et al., 2016

-Not related with the Perkins instability process.

-Not directed linked by waves generated in the troposphere.

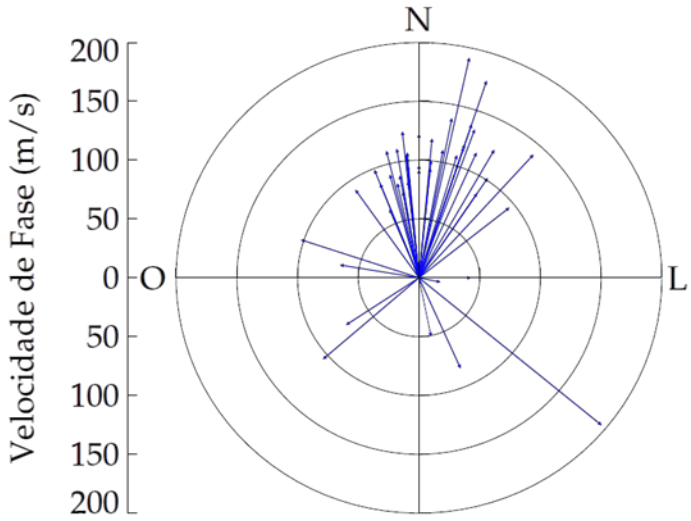
-Waves may be generated at the bottom site of the ionosphere region

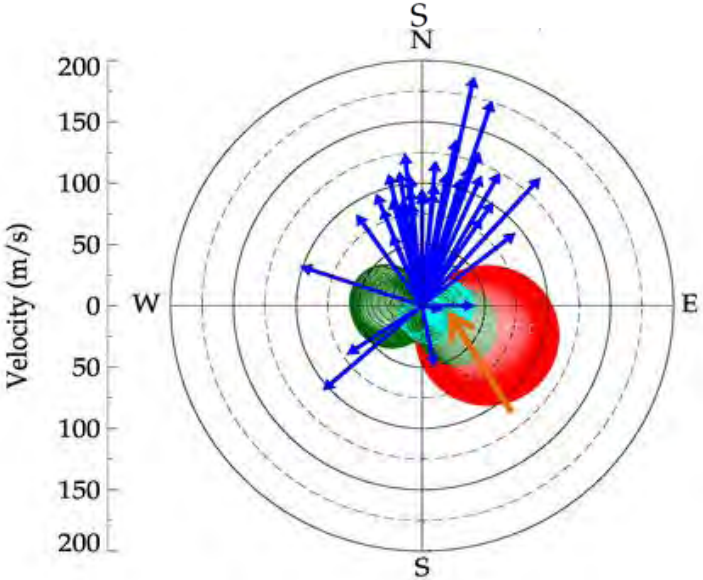


(FRITTS et al., 2009)

22ºS

(48 waves)

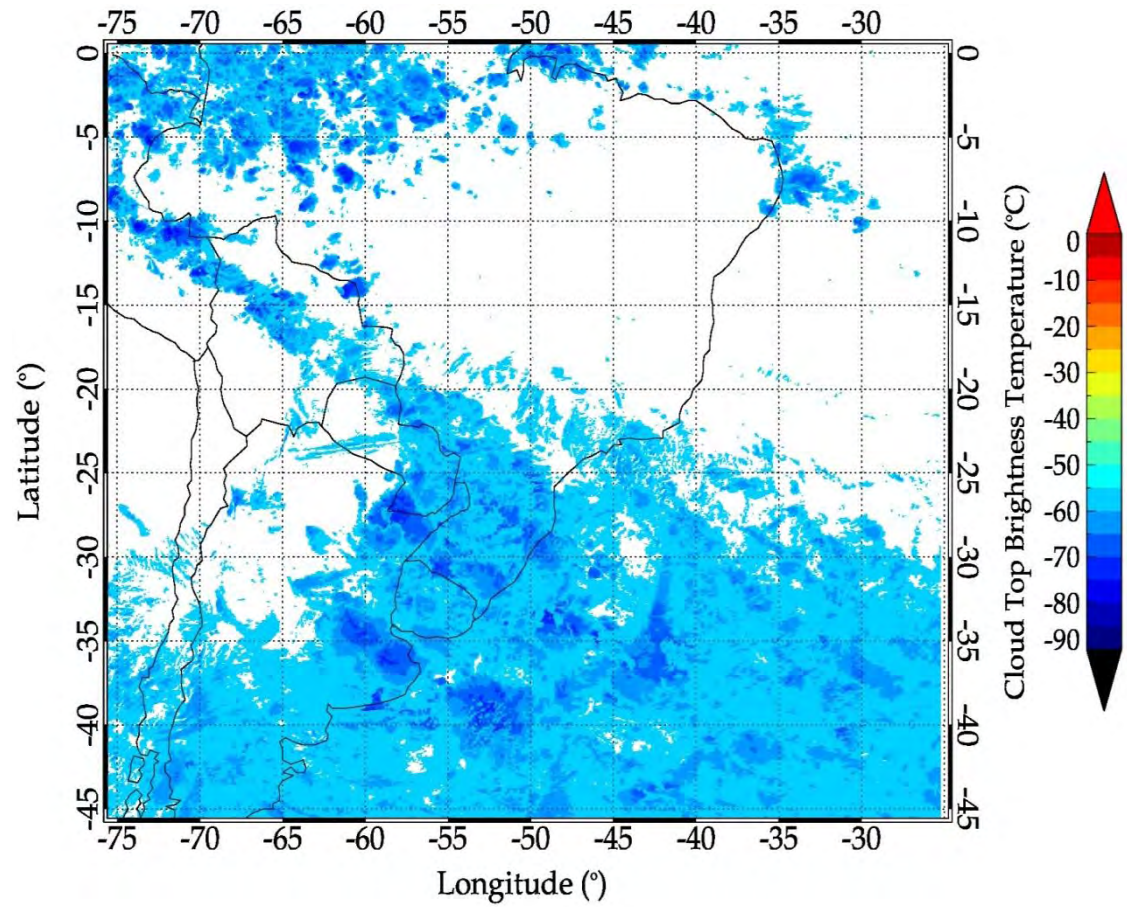




Figueiredo et al., 2018 (Submitted to JGR)

Cloud Top Brightness Temperature (CTBT) with temperatures below -45°C.

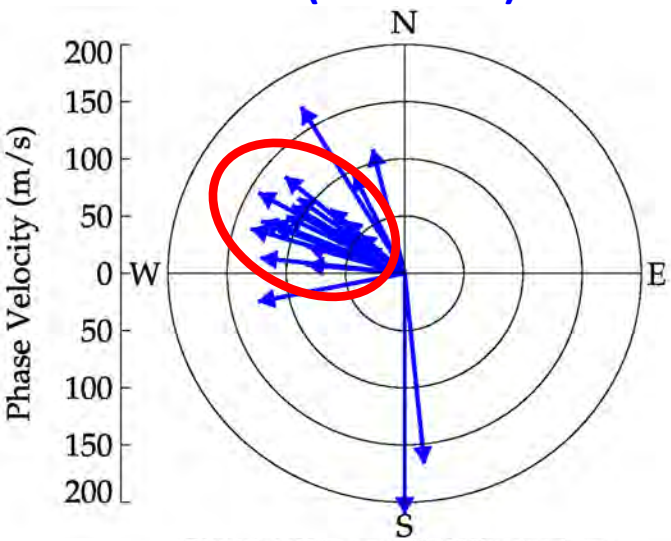
Winter

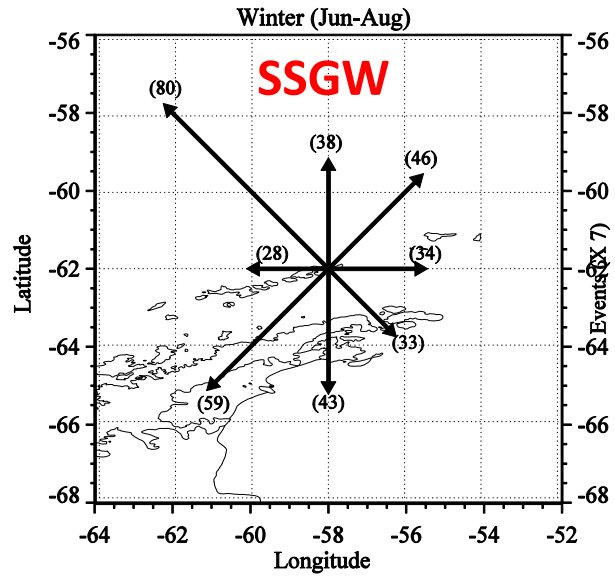


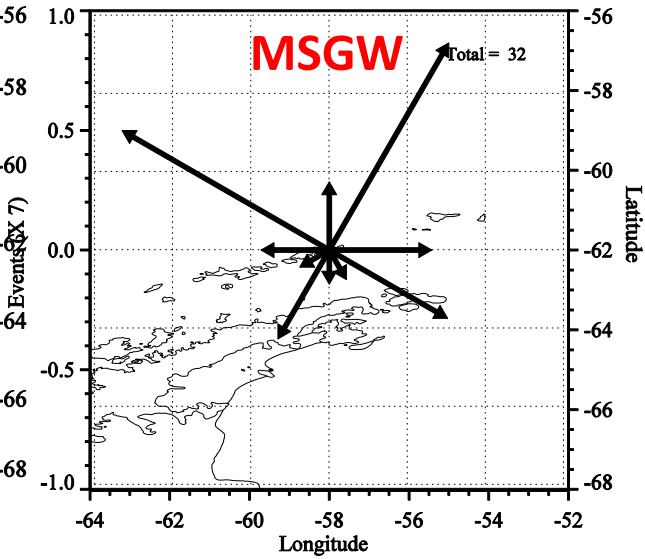
Cold front and tropospheric jet stream

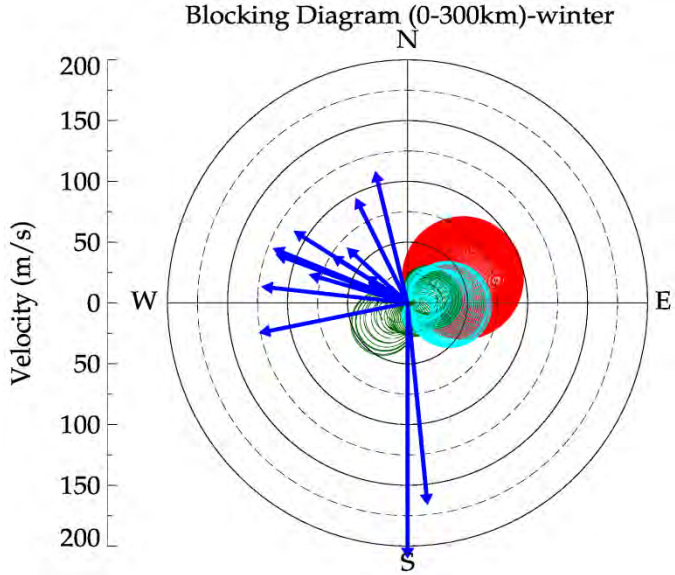
62ºS

(27 waves)

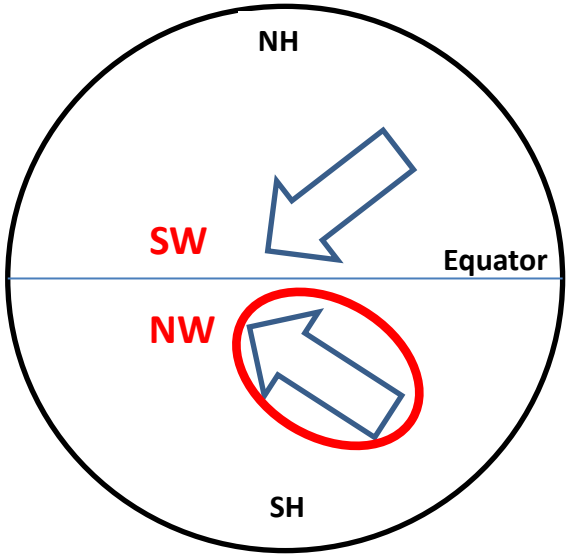








Perkins Instability Mechanism



Summary

- Around 27 MSTIDs were observed **in 2 years** (2015 e 2016) at the Brazilian Antarctic Station;
- The **main MSTID' s** characteristics:
  - λ_h ~ 75 - 200 km
  - τ_{obs} ~ 10 - 50 min
  - c_{obs} ~ 75 - 175 m/s
- Similar wave parameters were found at S.J. Cariri (7ºS) and Cachoeira Paulista (22ºS);
- According to MSTID's propagation direction they seem be generated by the **Perkins Instability Mechanism,** however more investigation should be done.

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Obrigado!

Perguntas?