

# Unusual Ionogram Disturbances seen at Eglin AFB Feb 2012



***Integrity ★ Service ★ Excellence***

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**GIRO Forum, Lowell MA, 20 May 2014**



# Overview



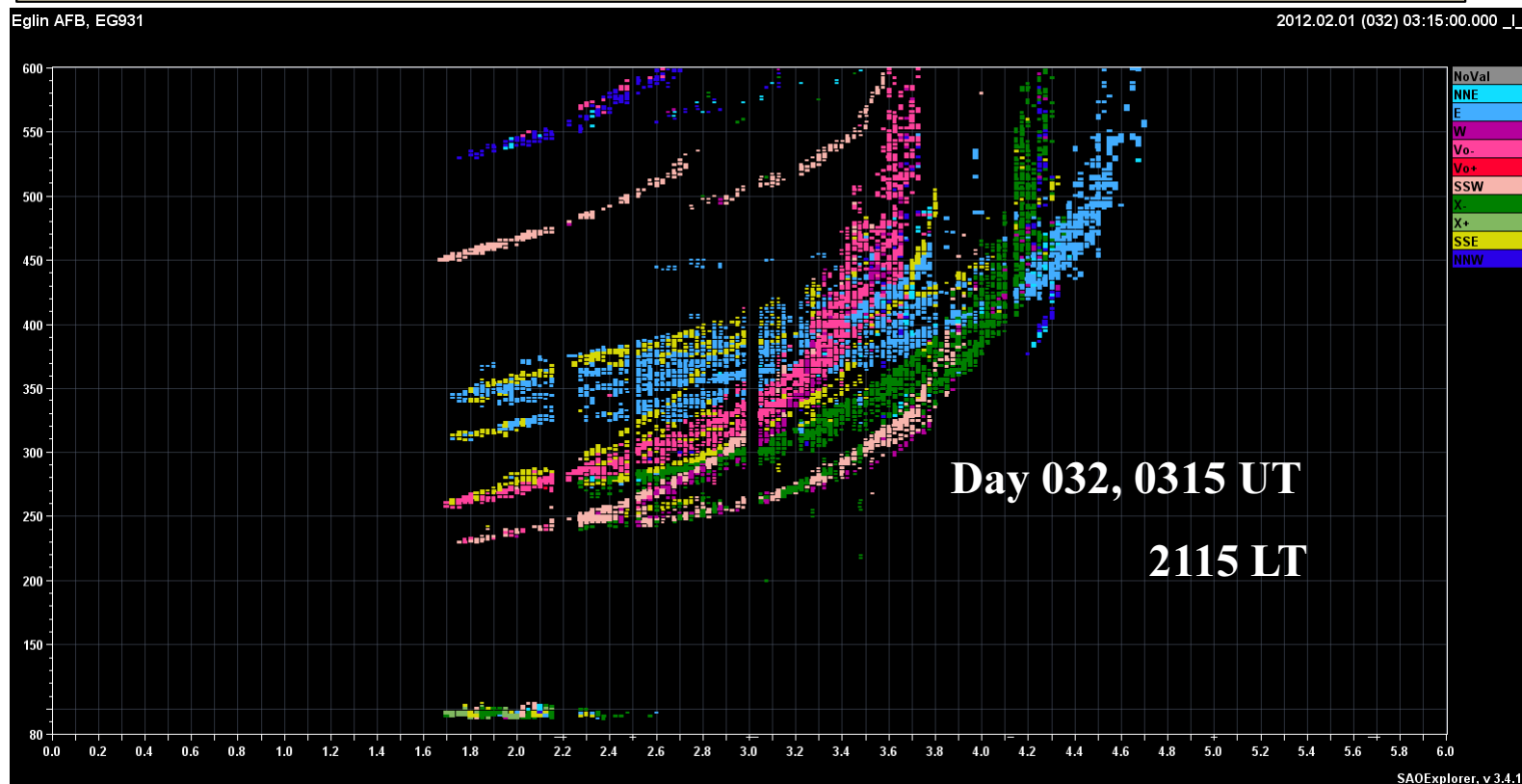
- A casual review of Digisonde DPS-4D ionograms from Eglin Air Force Base [EG931; Florida] for February 2012 showed unexpected multiple ionogram traces at ~0300 UT (21 LT) and later.
- Possible interpretations of the extra traces are solicited from the audience.
- Eglin AFB is at [30.50N, 273.50E; 40N magn], so its local time is 5.8 hours behind UT.
- For discussion purposes, we use  $LT = UT - 6$ .



# Eglin, Fully Developed Traces

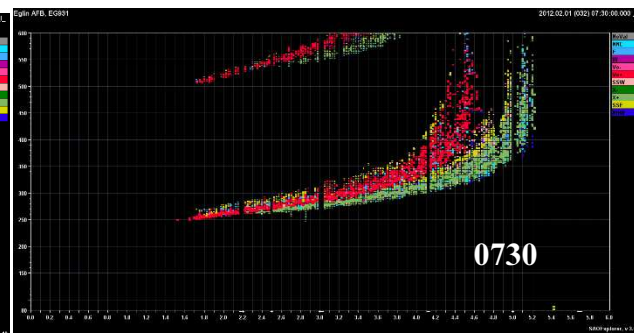
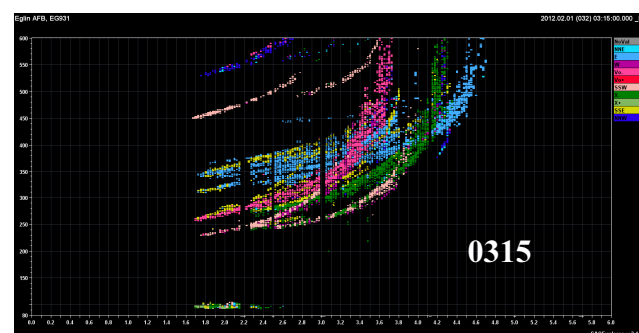
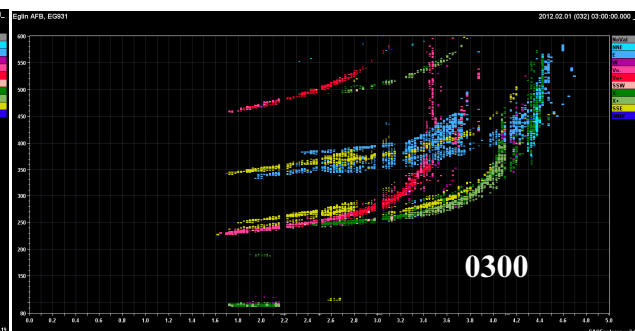
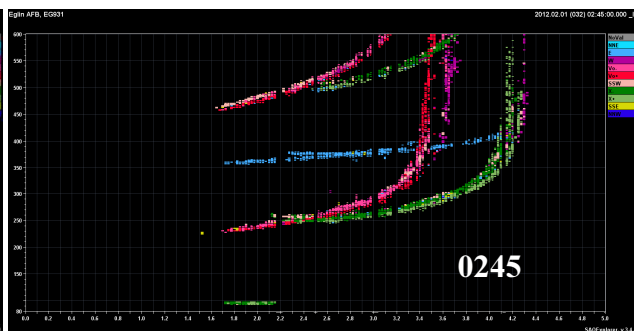
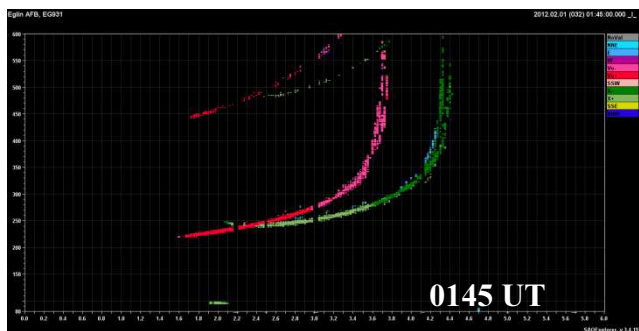


Very disturbed ionograms with multiple oblique traces were noticed for the Eglin AFB ionograms for early February 2012 at around 0300 UT (2100 LT). The first oblique trace was usually to the NNE (blue). More oblique traces appeared as time moved on. The oblique traces were seen on days 032-036 (only days analyzed). The ionogram below shows the mature stage of development. See also next slide.





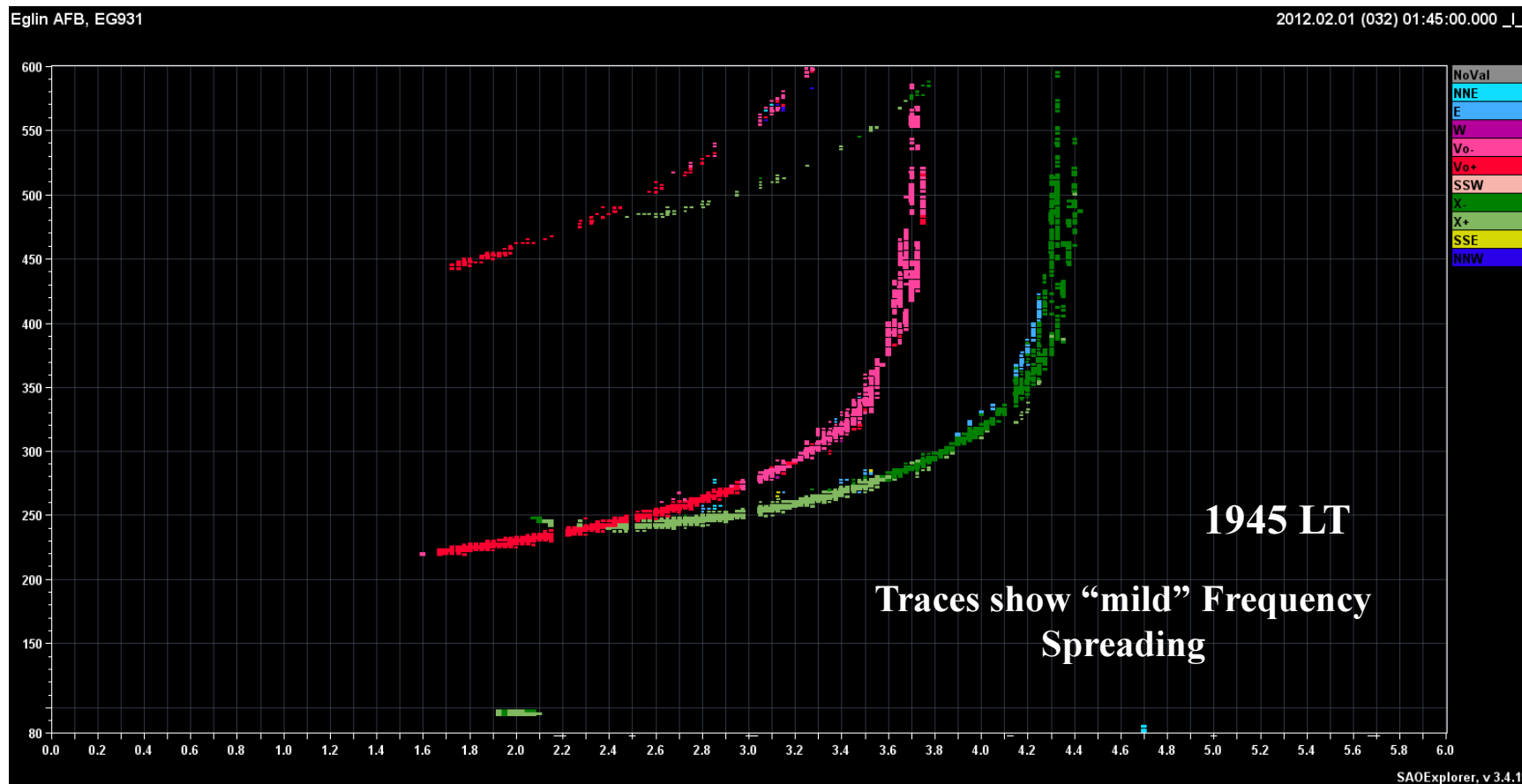
# Eglin Day 032, 2012



The multiple spread traces typically start with a single oblique trace that appears to the NNE of the Digisonde. See the 0245 UT ionogram.

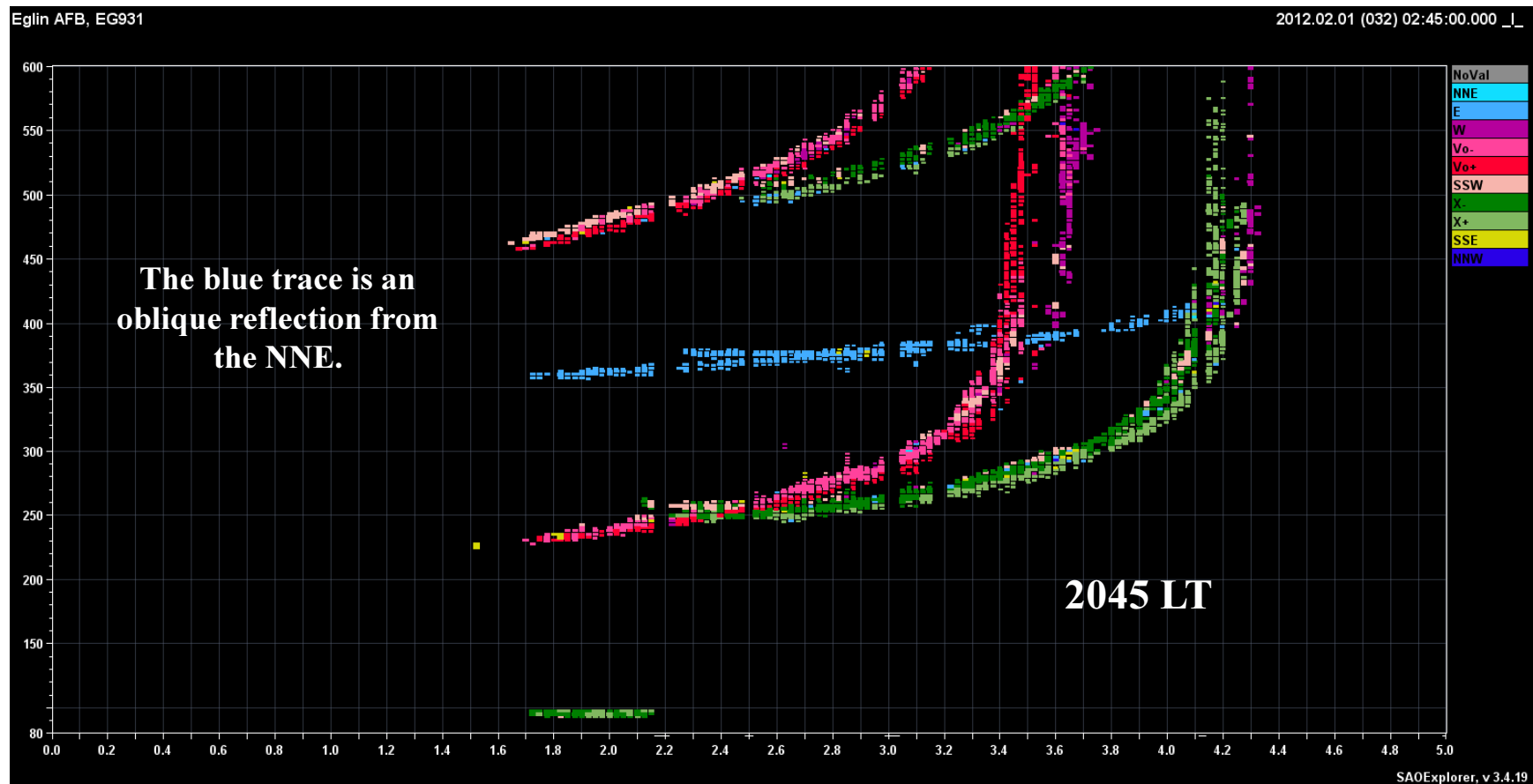


# Eglin, “Normal” Ionogram [0145 UT]



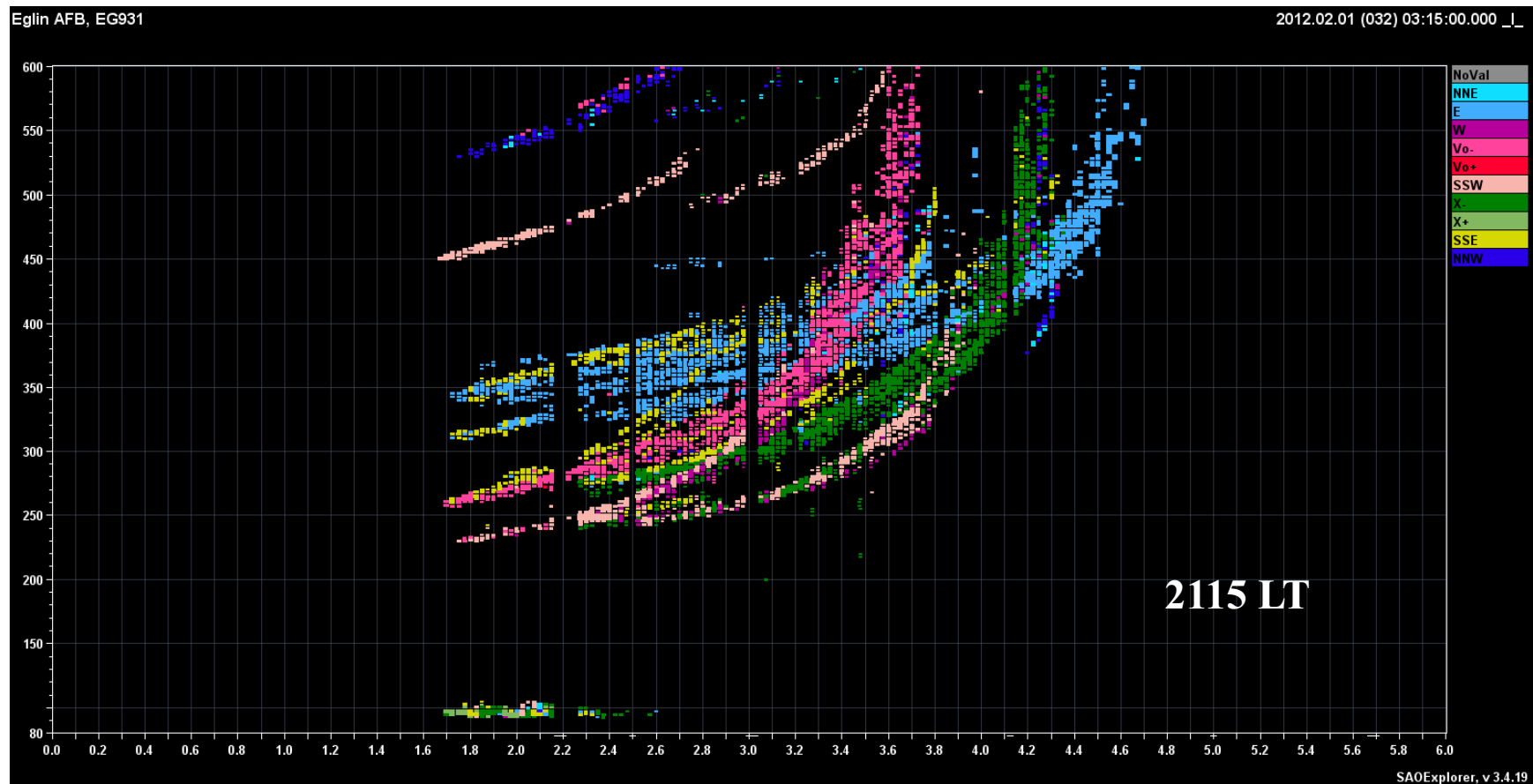


# First Ionogram in Sequence [Day 32, 0245 UT]



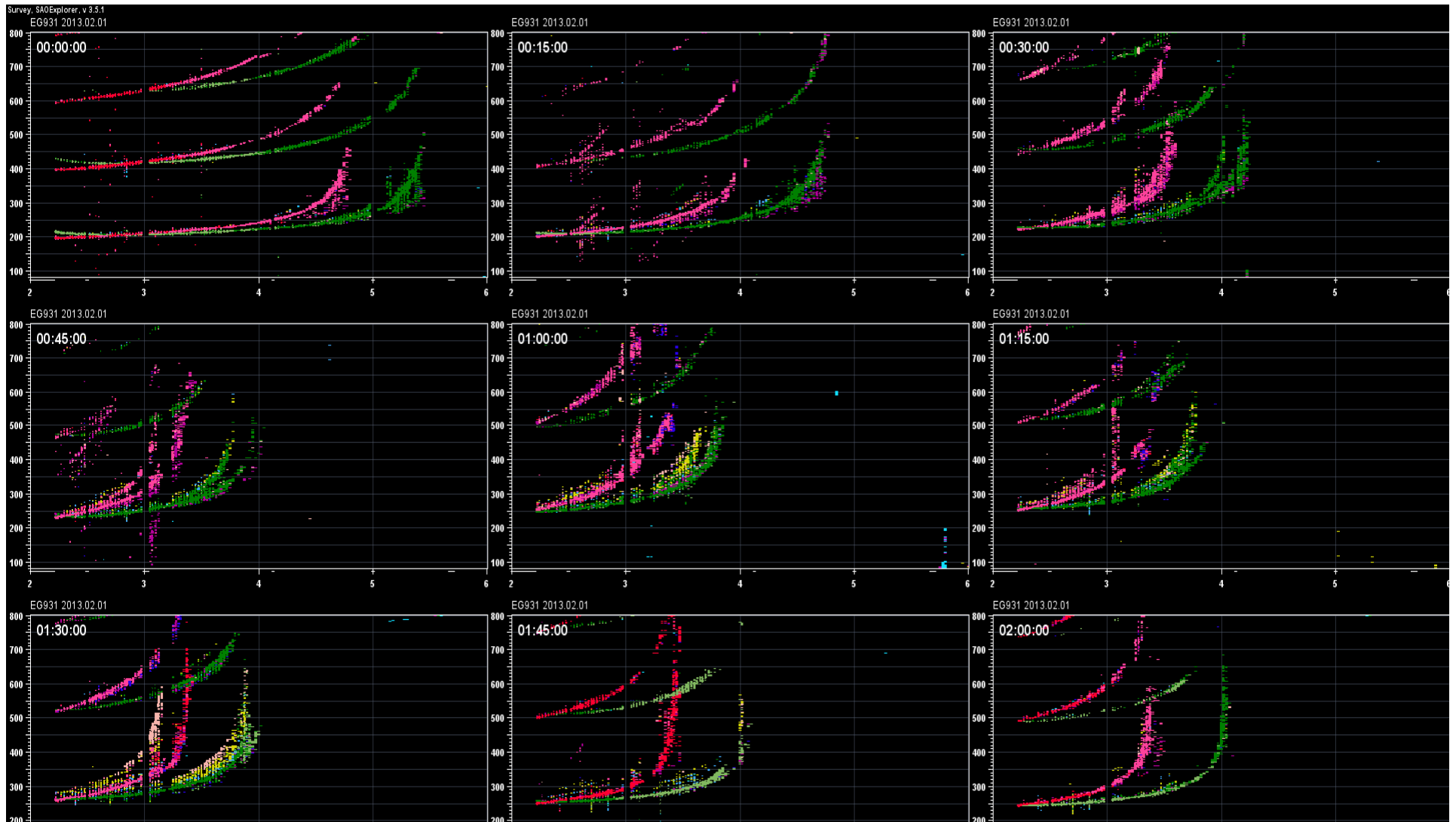


# Eglin, Day 32, 0315 UT Ionogram



# Ionogram Survey

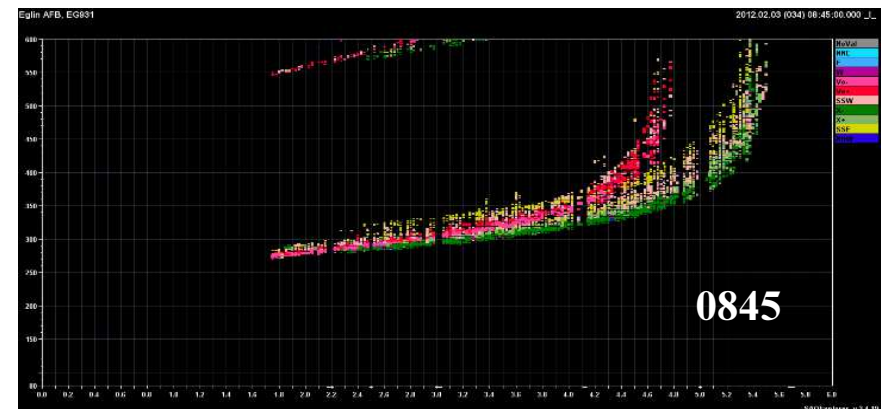
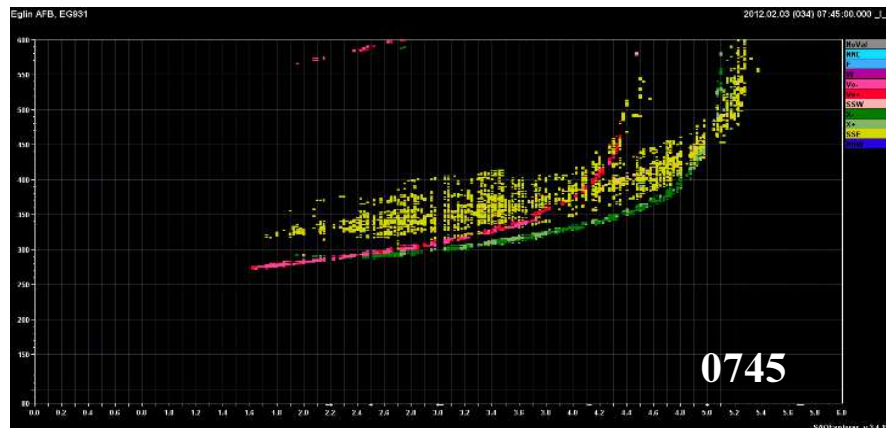
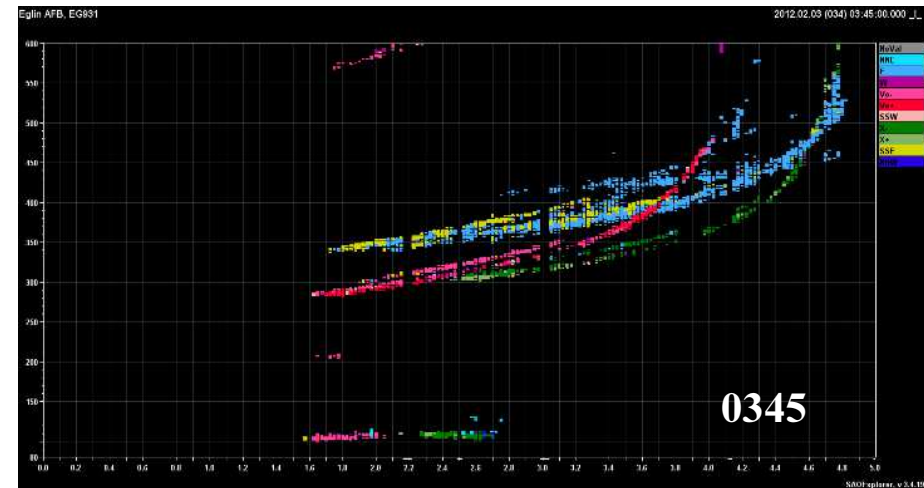
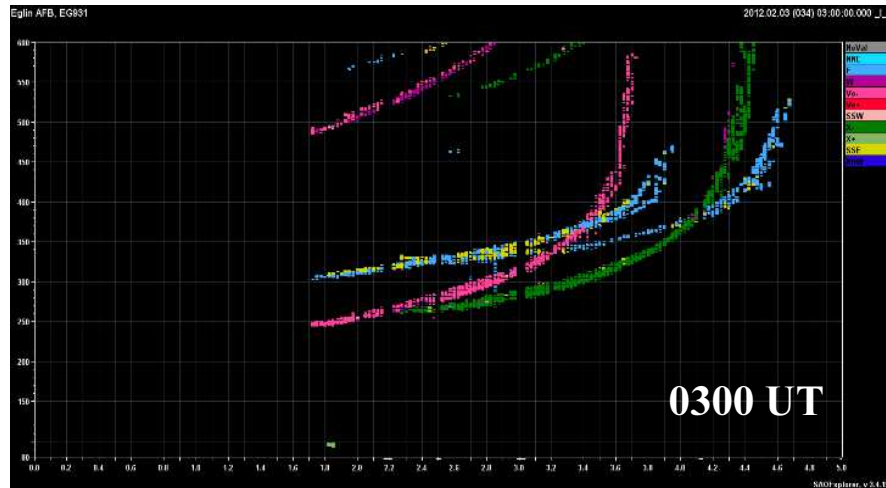
## Eglin, day 033, 2013





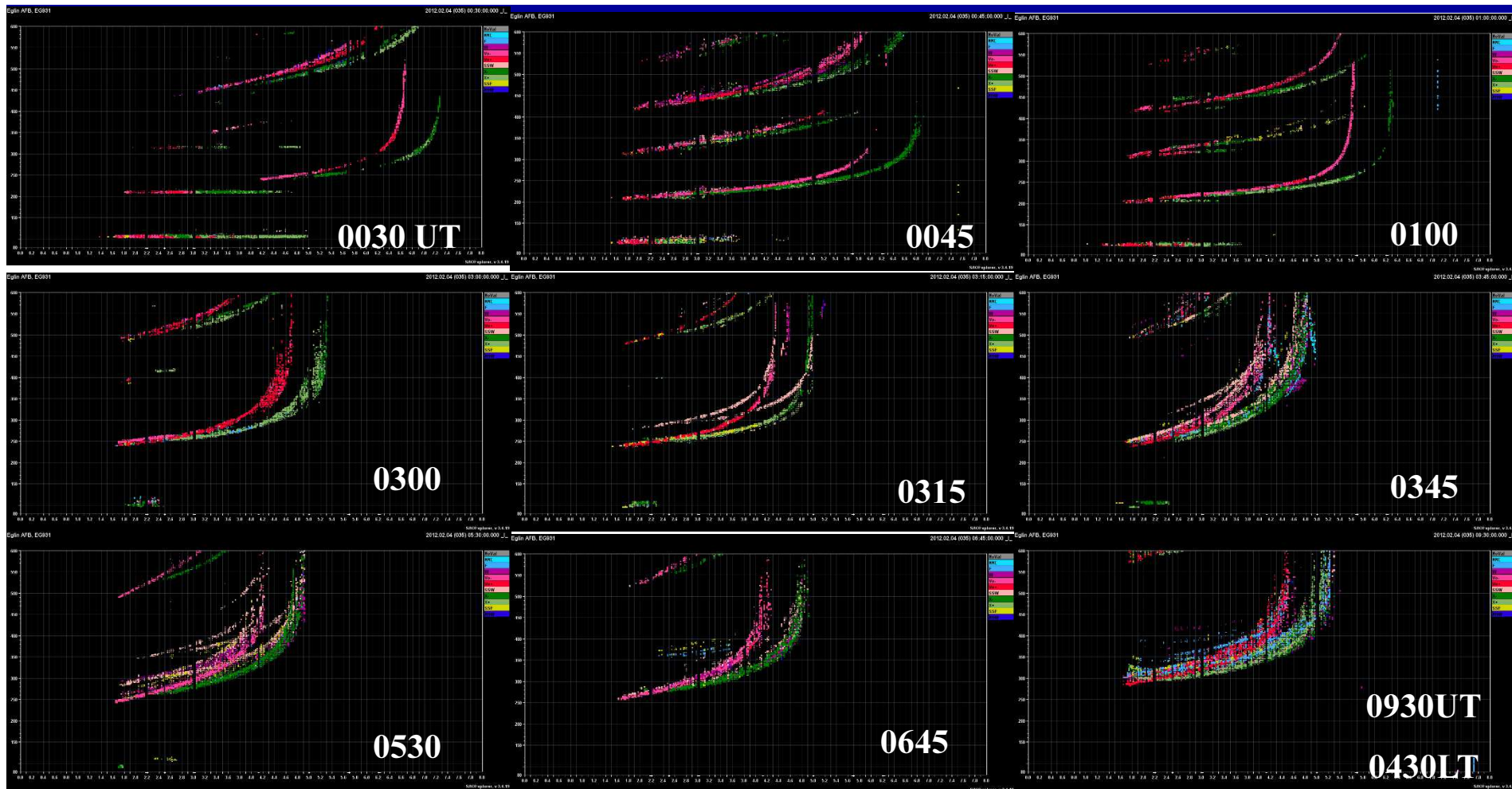


# Day 034, Eglin AFB



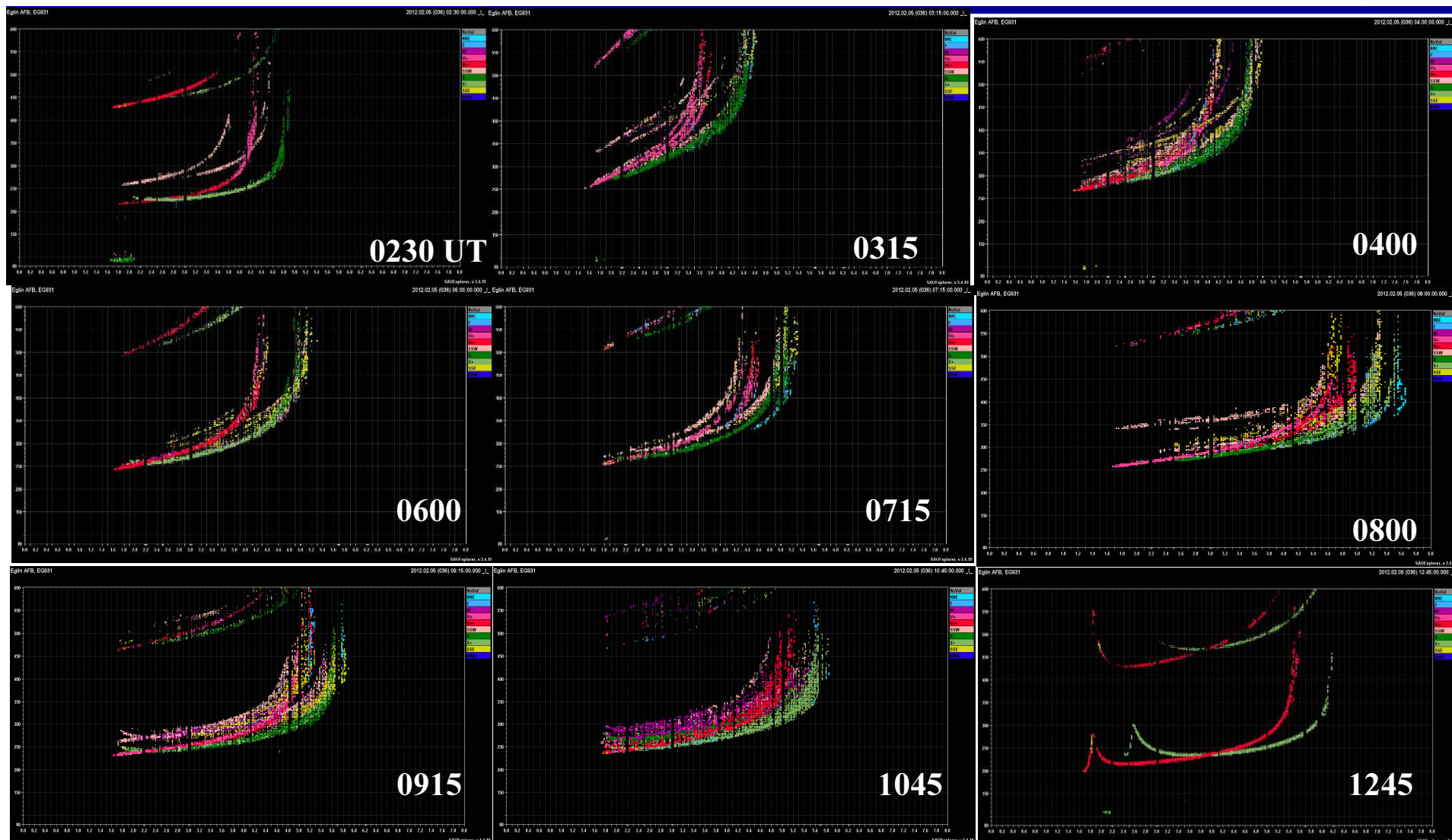


# Day 035, Eglin AFB





# Day 036, Eglin AFB

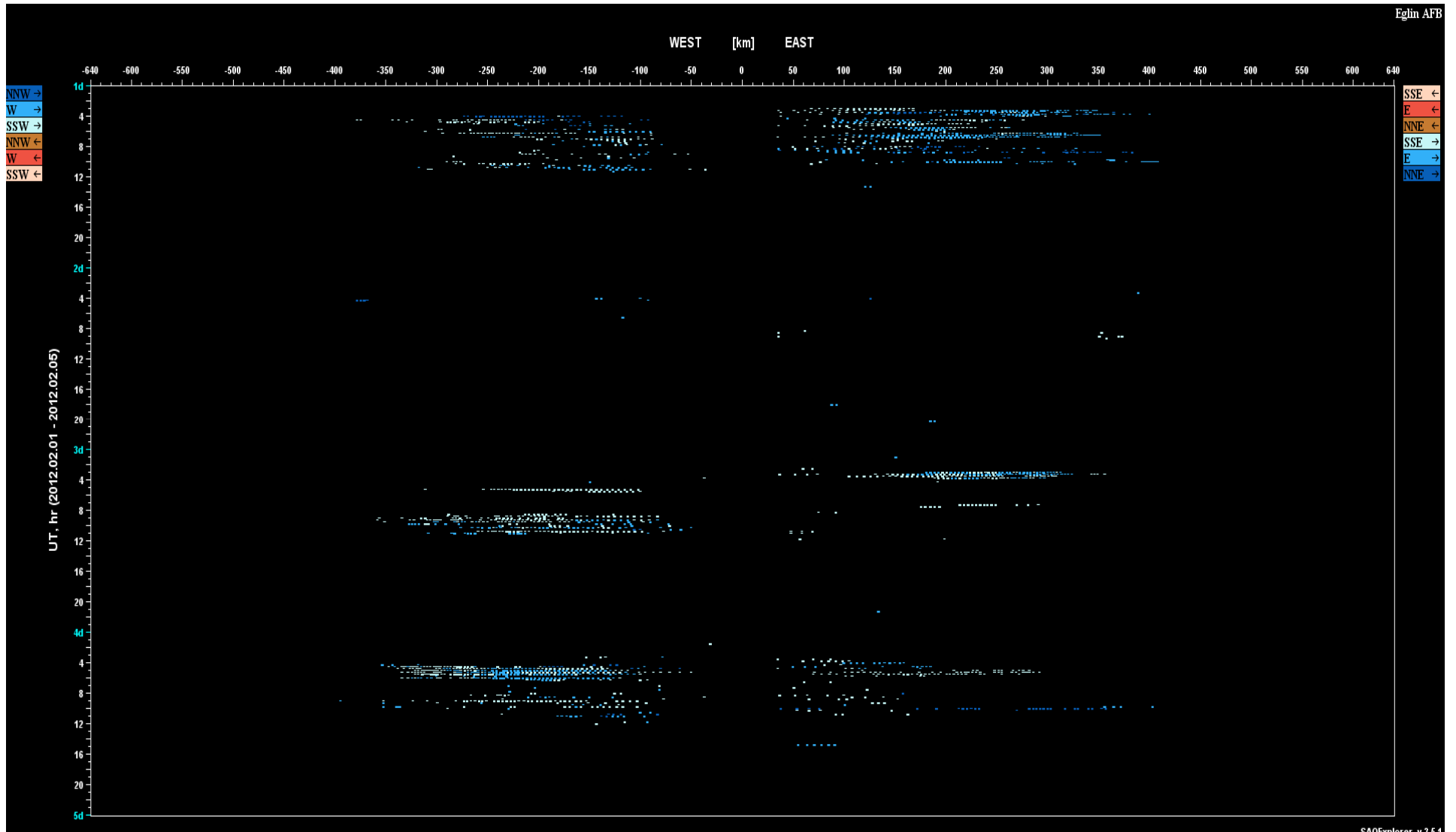


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# Directogram

## Eglin, days 032-034, 2012





## Other Mid-latitude Ionosondes



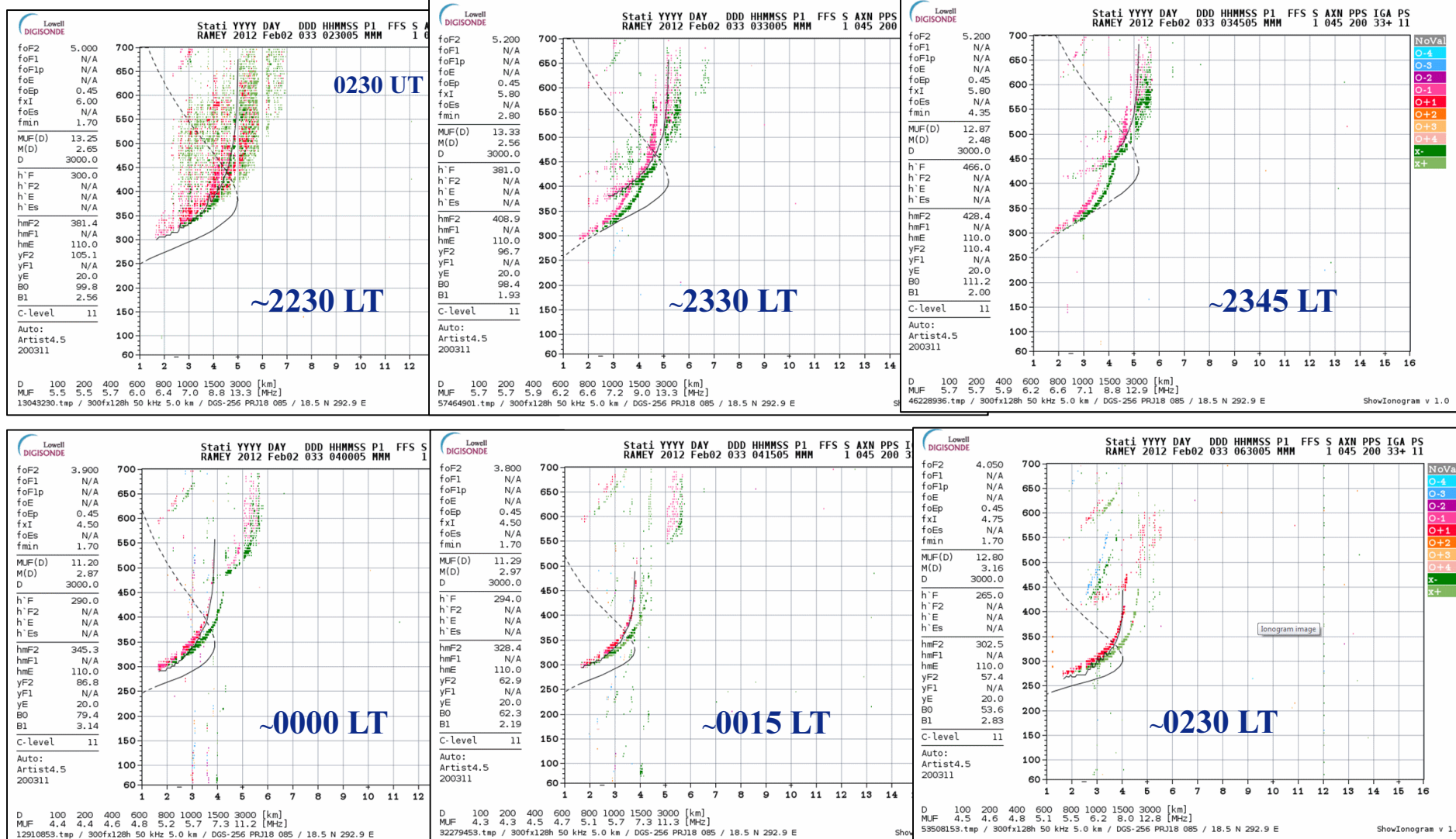
- February 2012 ionograms from Millstone Hill, Wallops Island, and other locations have been reviewed using <http://umicar.uml.edu/DIDBase/>
  - This is a very slow process from Kirtland AFB.
  - Extra traces similar to those seen at Eglin AFB were not seen [the search was not extensive]
- If there is a connection between the Eglin AFB ionograms and EPBs, we would expect the Ramey, Puerto Rico [PRJ18; 18.5N, 292.90E] ionograms to show similar extra off-vertical traces.
- Extra traces were seen on the nights of 033 and 035. The 032 ionograms showed RTB echoes.





# Ramey Ionograms Day 033, 2012

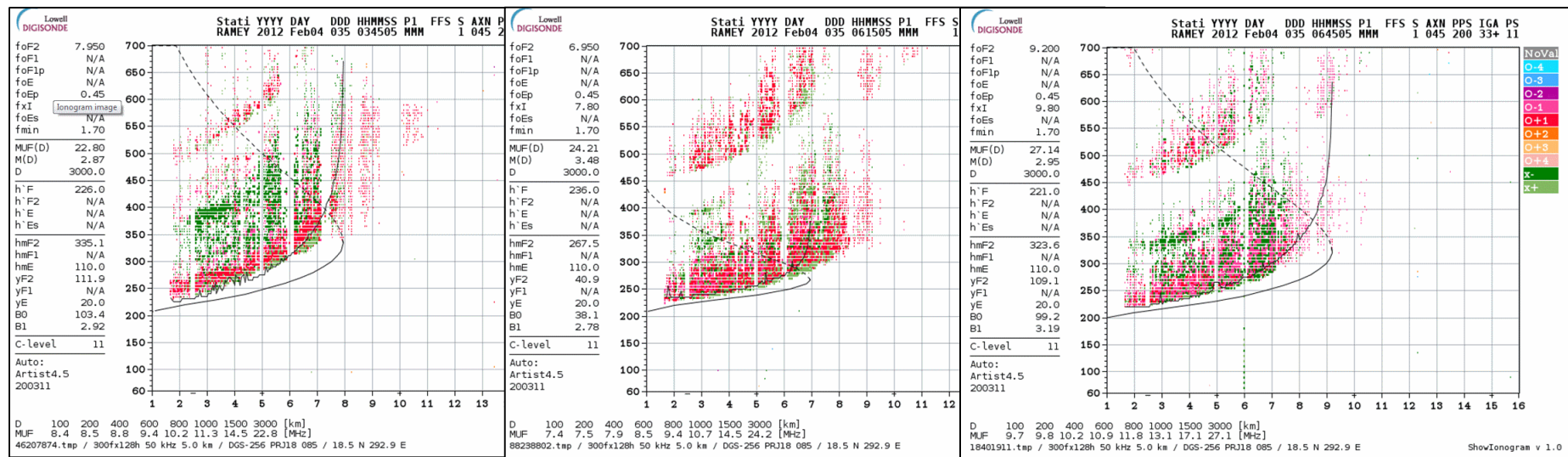
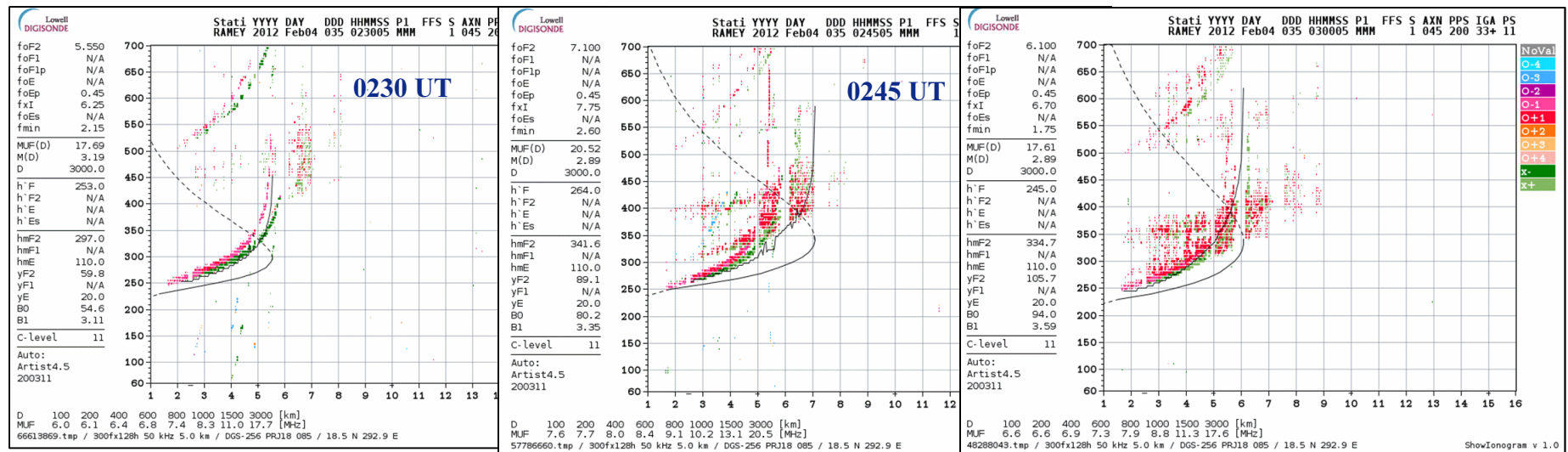
(no arrival-angle measurements)



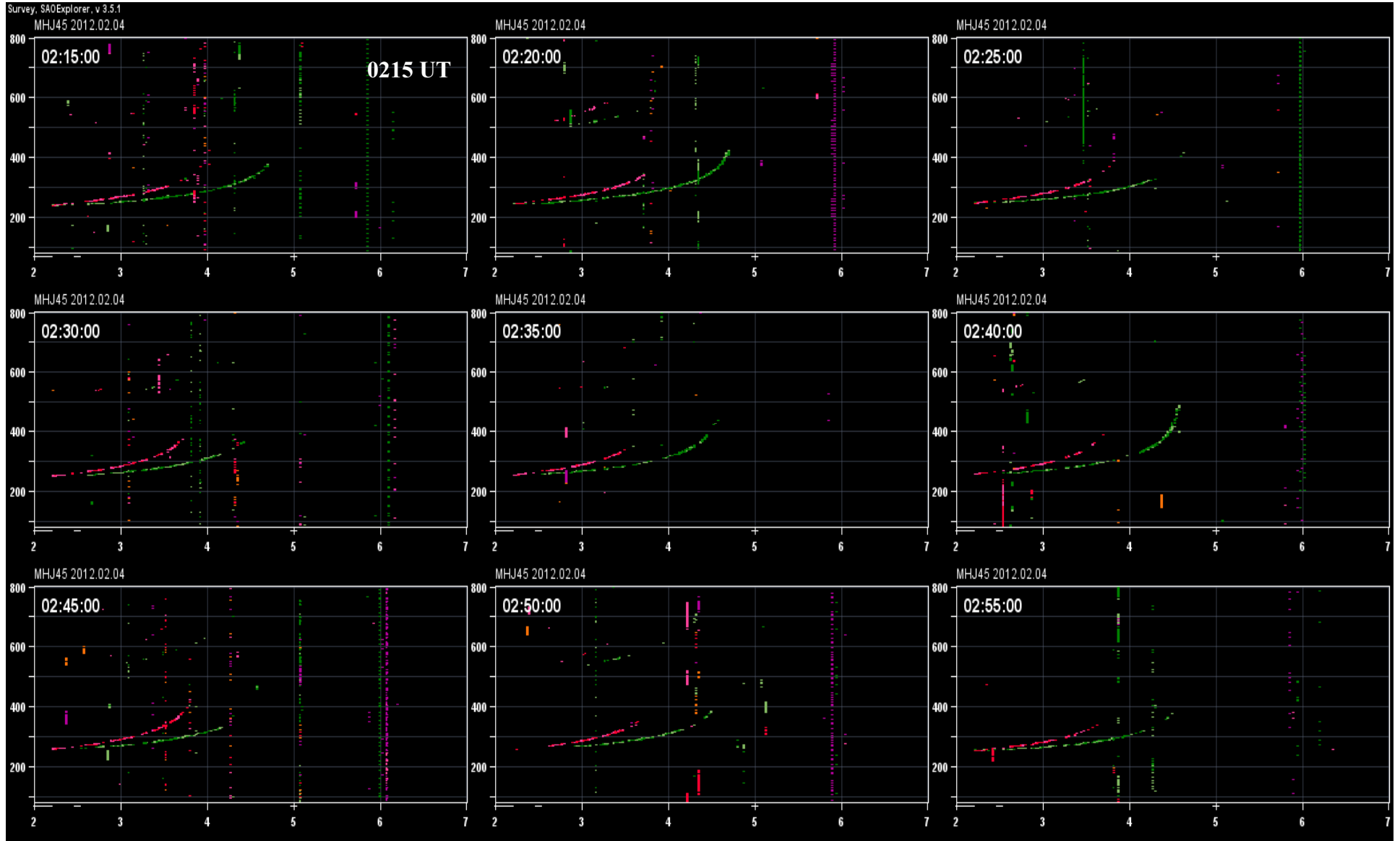


# Ramey Ionograms Day 035, 2012

(no arrival-angle measurements)



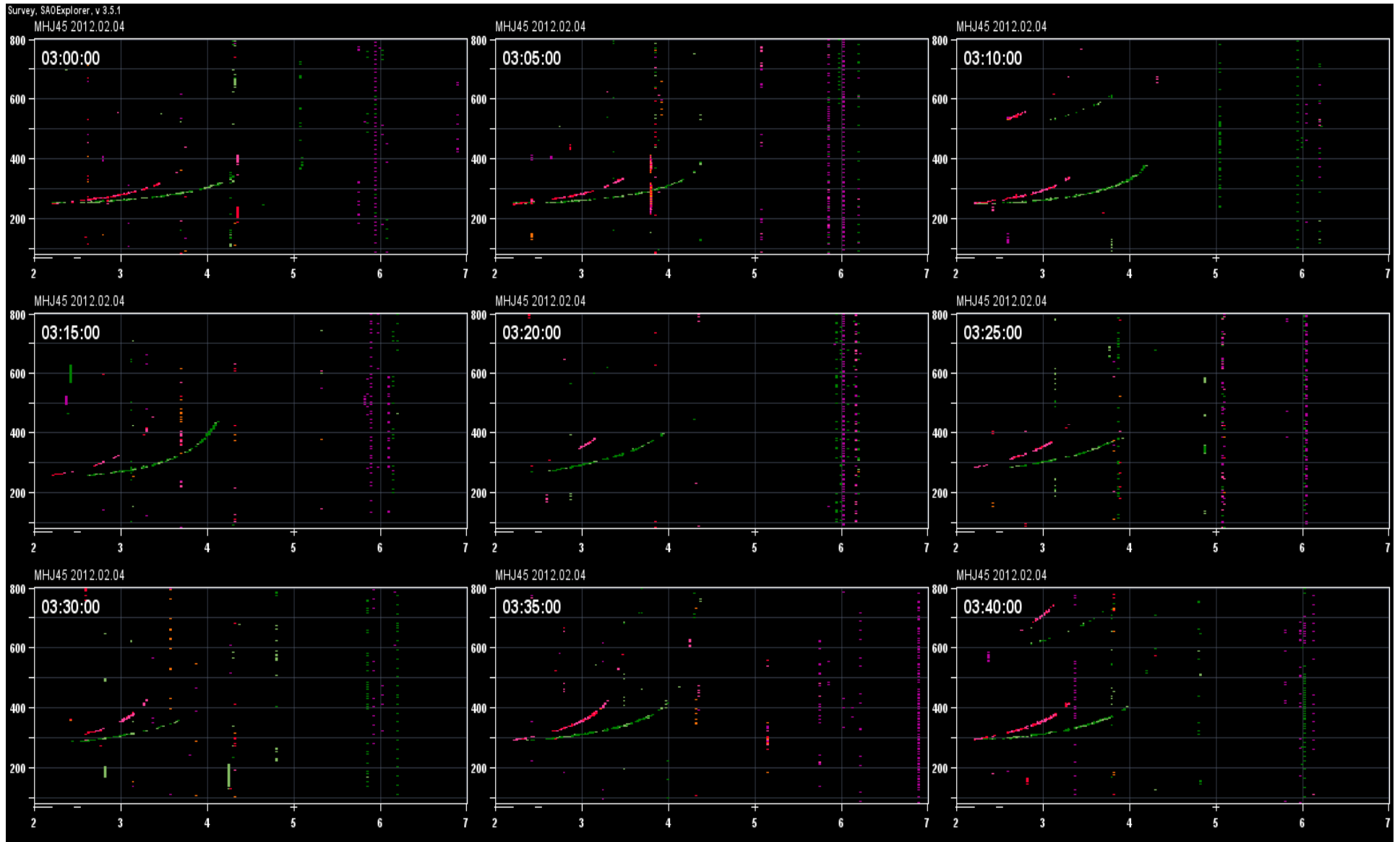
# Millstone Hill Ionograms Day 035, 2012





# Millstone Hill Ionograms Day 035, 2012

## Survey 0300





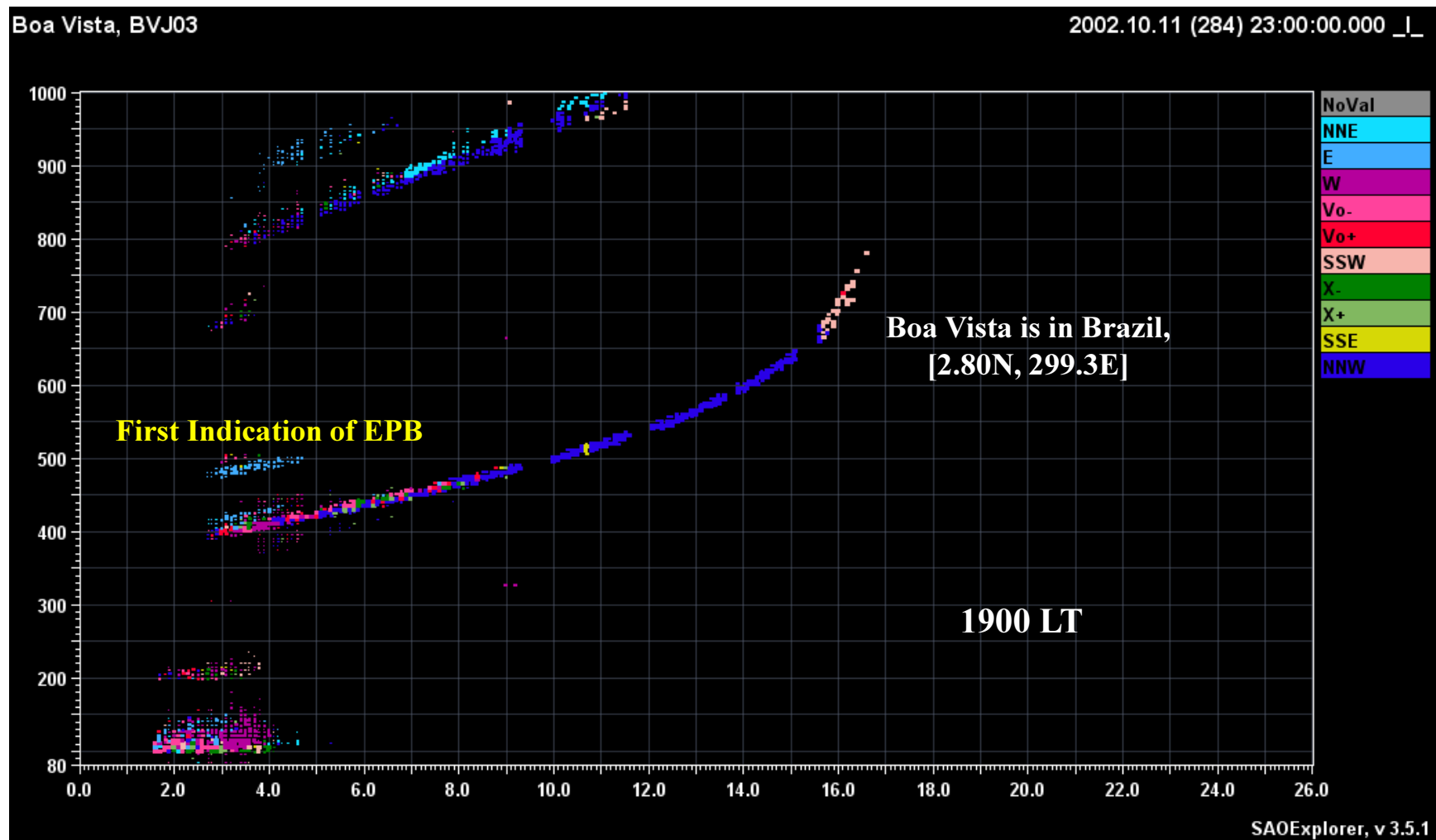
# Equatorial Plasma Bubbles



- The next three slides show early evening ionograms for the equatorial station Boa Vista [BVJ03; Brazil; 2.80N,299.30E]
- These ionograms are suggestive of the extra traces seen on the Eglin AFB ionograms.
- Are the extra traces at Eglin somehow related to Equatorial Plasma Bubbles, as seen at Boa Vista?
- Are the Equatorial Plasma Bubbles extending northwards to Eglin AFB [in the Florida panhandle]?

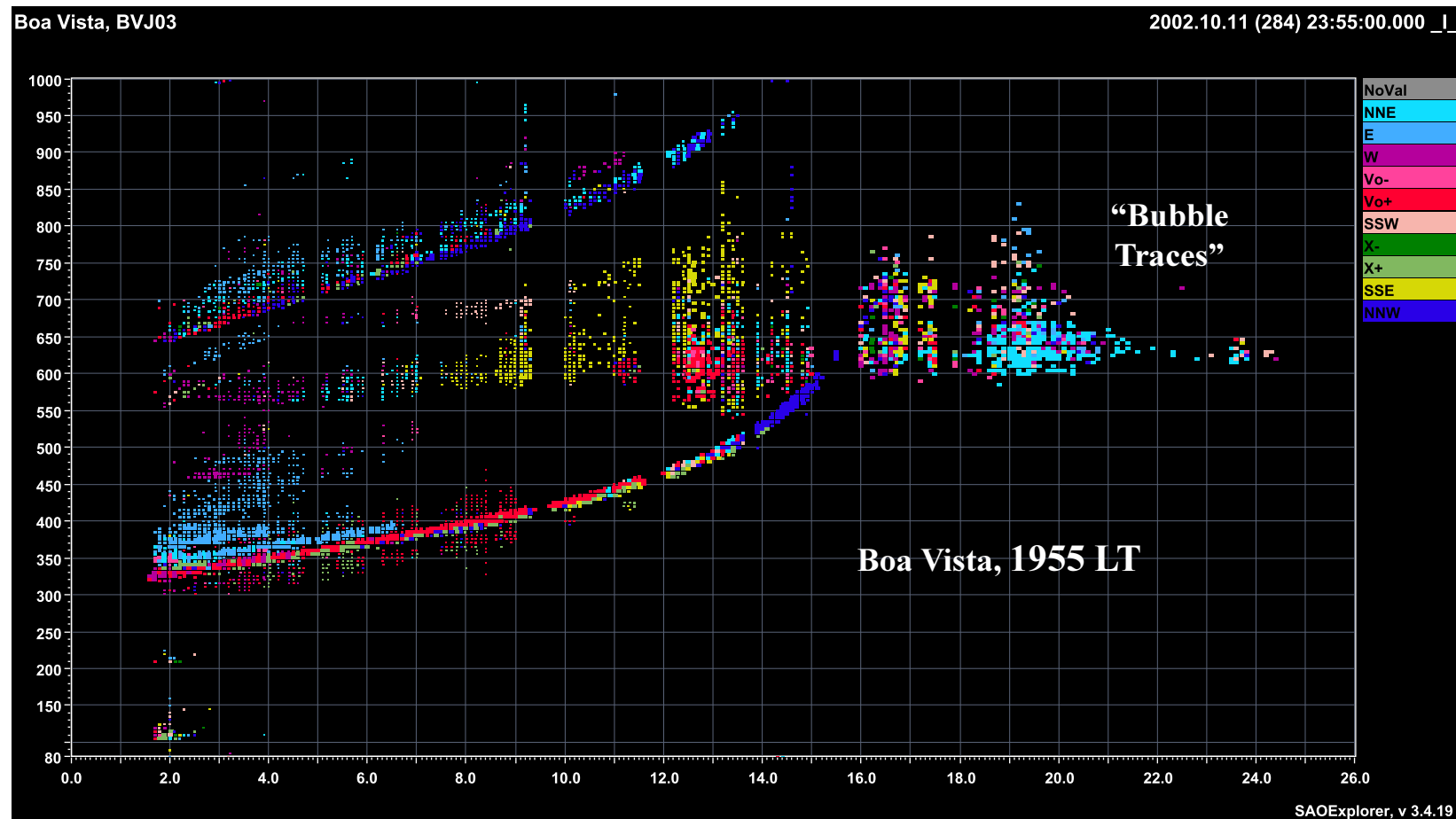


# Boa Vista Ionogram, ~1900 LT





# Boa Vista Ionogram, Day 284, 2002, 2355 UT



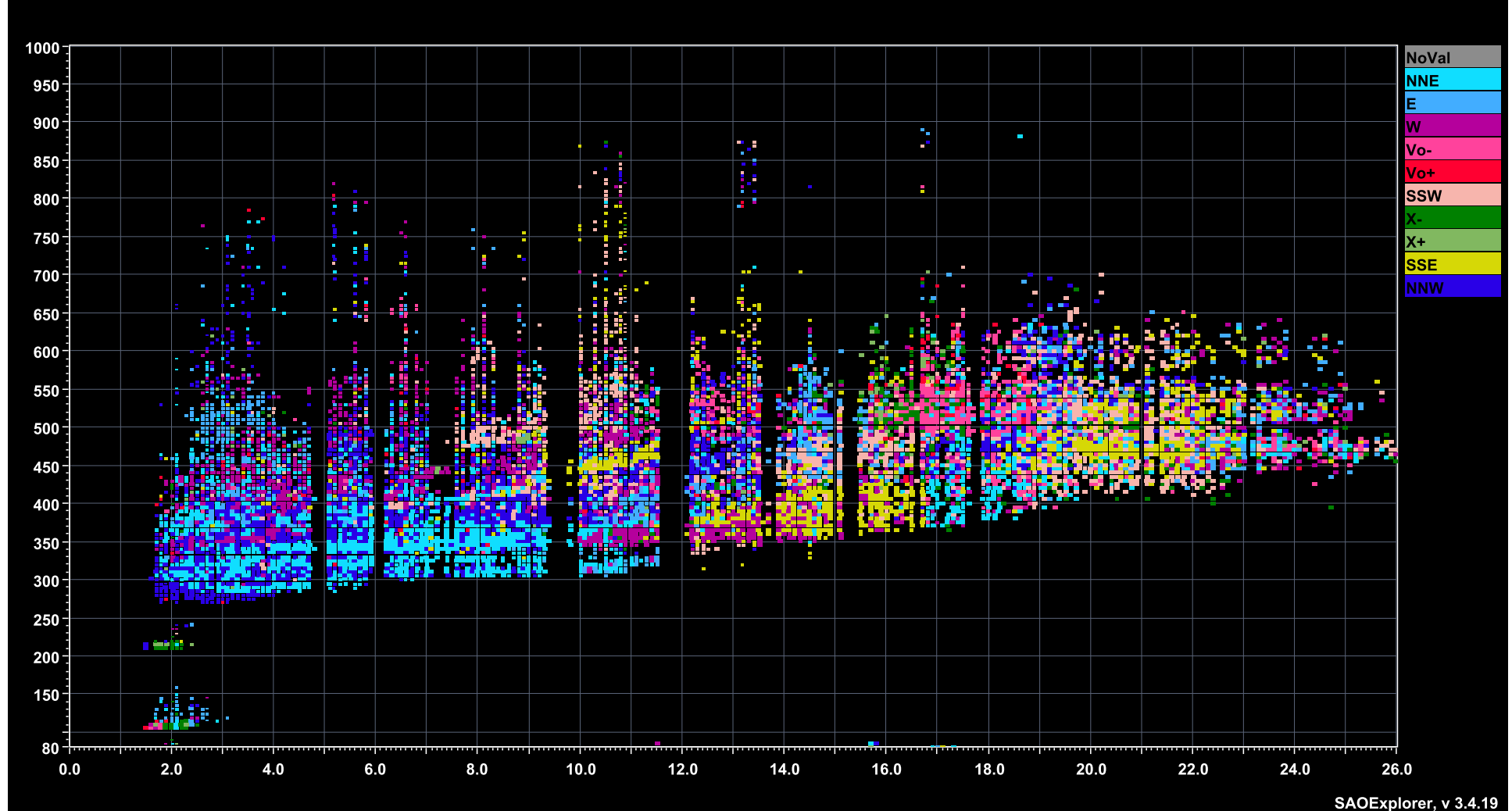


## 21. Overview



Boa Vista, BVJ03

2002.11.20 (324) 23:40:00.000 \_I\_



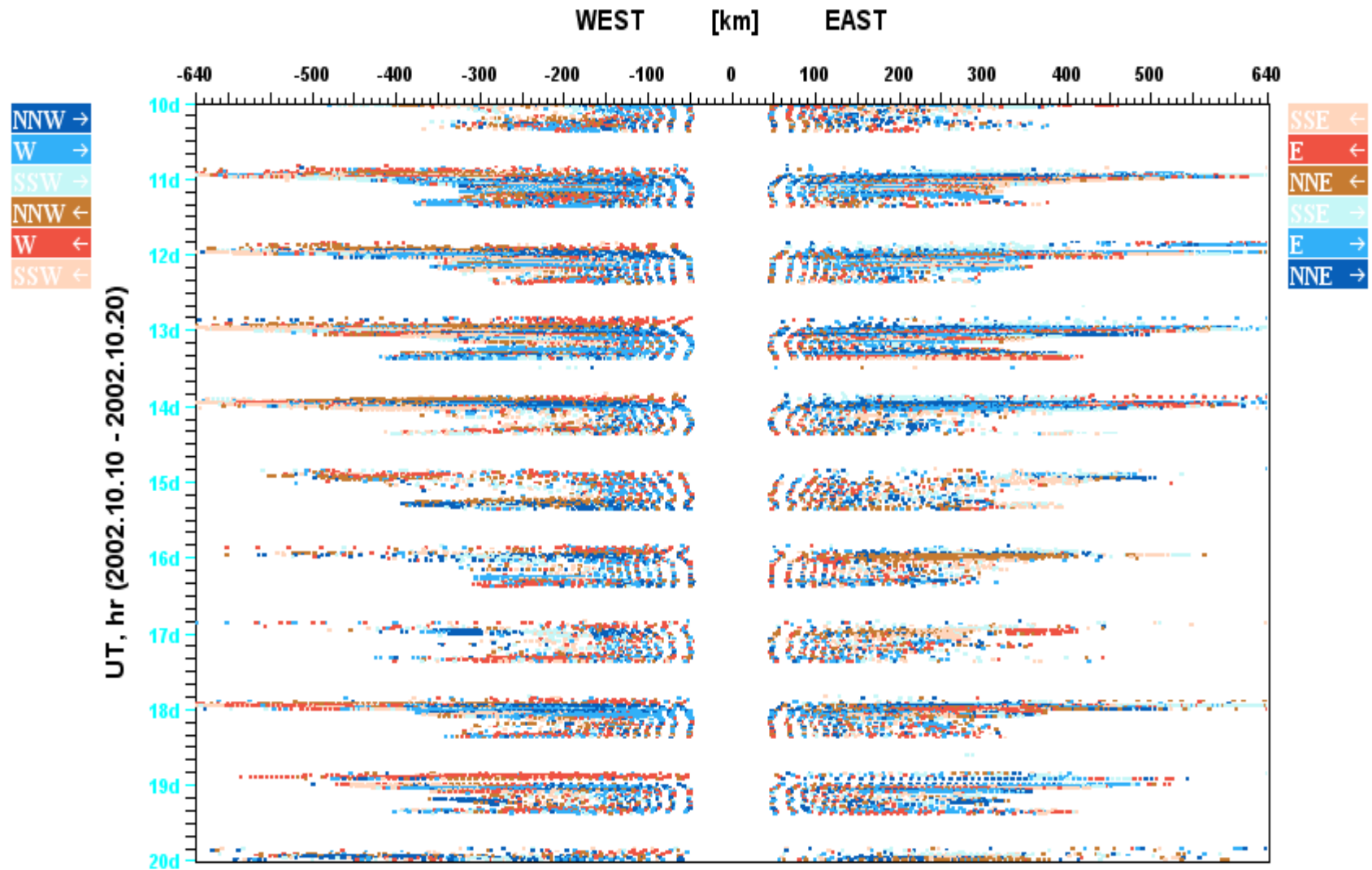
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# Boa Vista Directogram

October 2002, COPEX Campaign

BOA VISTA





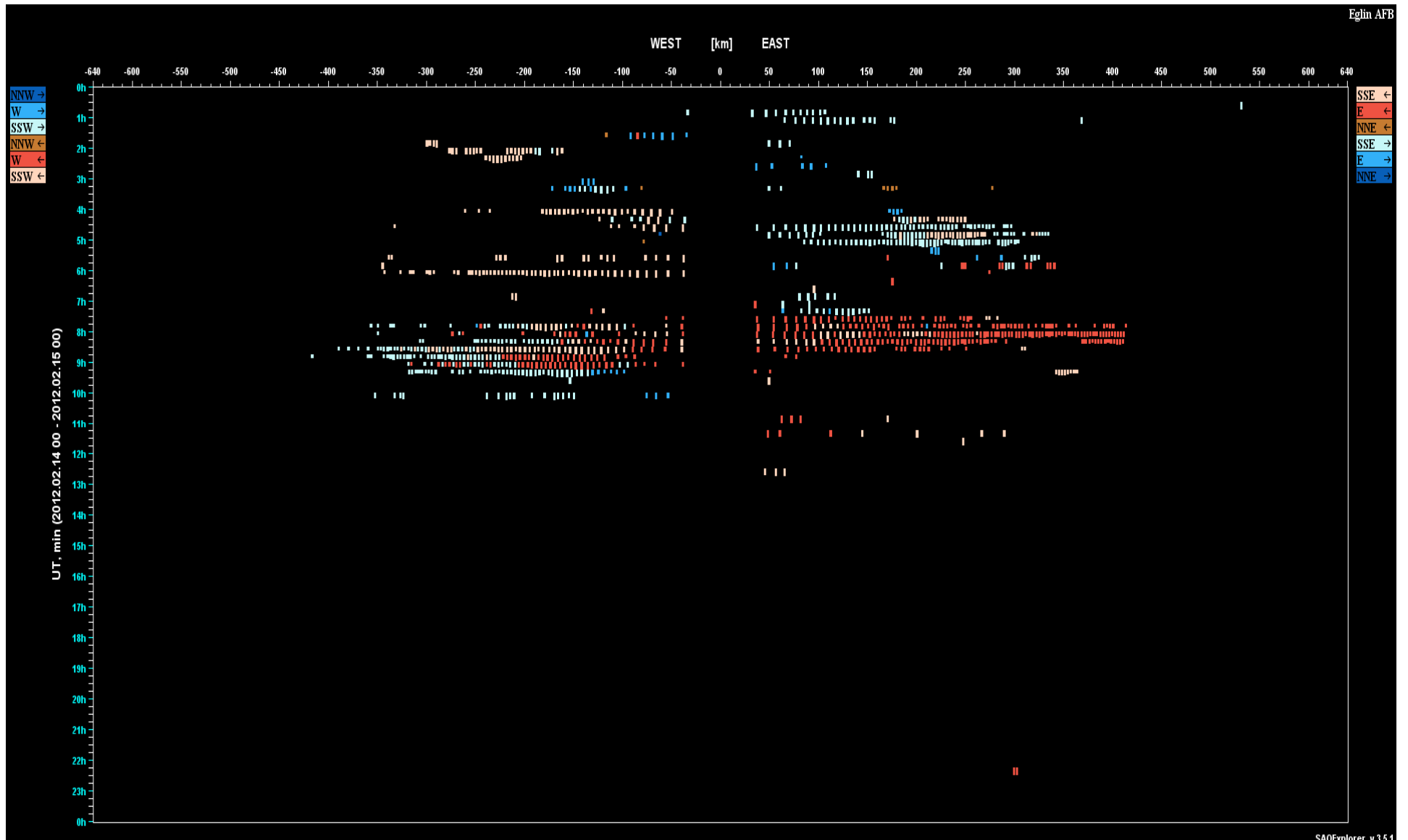
## Summary



- **The investigation into the extra traces seen on nighttime ionograms at Eglin AFB in February 2012 is incomplete.**
- **Since the Ramey (Puerto Rico) ionograms also seem to show extra traces, the extra traces might be an indication of Equatorial Plasma Bubbles extending into the mid-latitude ionosphere.**
- **More work is needed to confirm this interpretation.**

# Directogram

## Eglin, day 035, 2012





# Directogram

## Eglin, day 036-038, 2012

