A Climatology of Atmospheric Unstable Layers Revisited

Marvin A. Geller
Stony Brook University
Stony Brook, New York USA

Ling Wang
GATS., Inc
Boulder, Colorado USA

Geller et al. (2021, *Mon. Wea. Rev.*) presented some early results on unstable layers in the atmosphere using as its data source US raw HVRRD (High Vertical-Resolution Radiosonde Data). Some of their major conclusions were the following.

- There is a greater preponderance of thick unstable layers in the troposphere relative to the stratosphere.

- There are more frequent occurrences of unstable layers of thickness 10-400 m in the stratosphere in the 12 UT soundings than in the 00 UT soundings over the eastern US, whereas those unstable stratospheric layers occur more frequently at 00 UT over the western US.

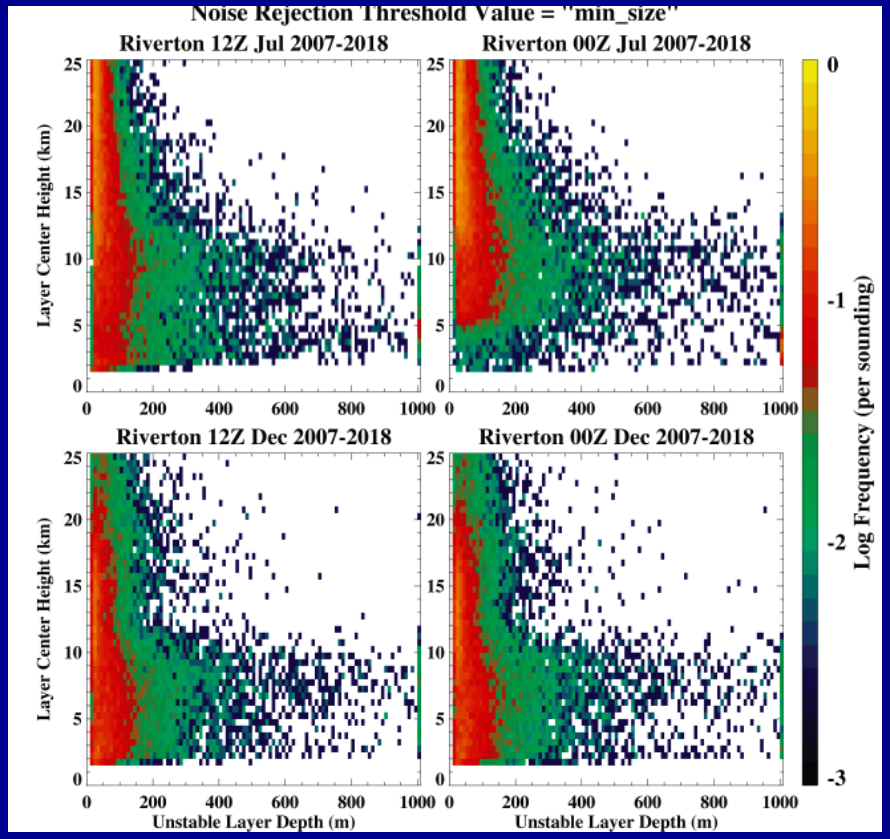
- At Koror, a radiosonde station in the deep tropics, a “notch” was seen at altitudes near 12 km in which there were fewer thin unstable layers at those altitudes and more thick unstable layers at those altitudes.

- An example was shown in Geller et al. (2021) of a discontinuity in the occurrence of unstable layers that accompanied a change in radiosonde instrumentation.

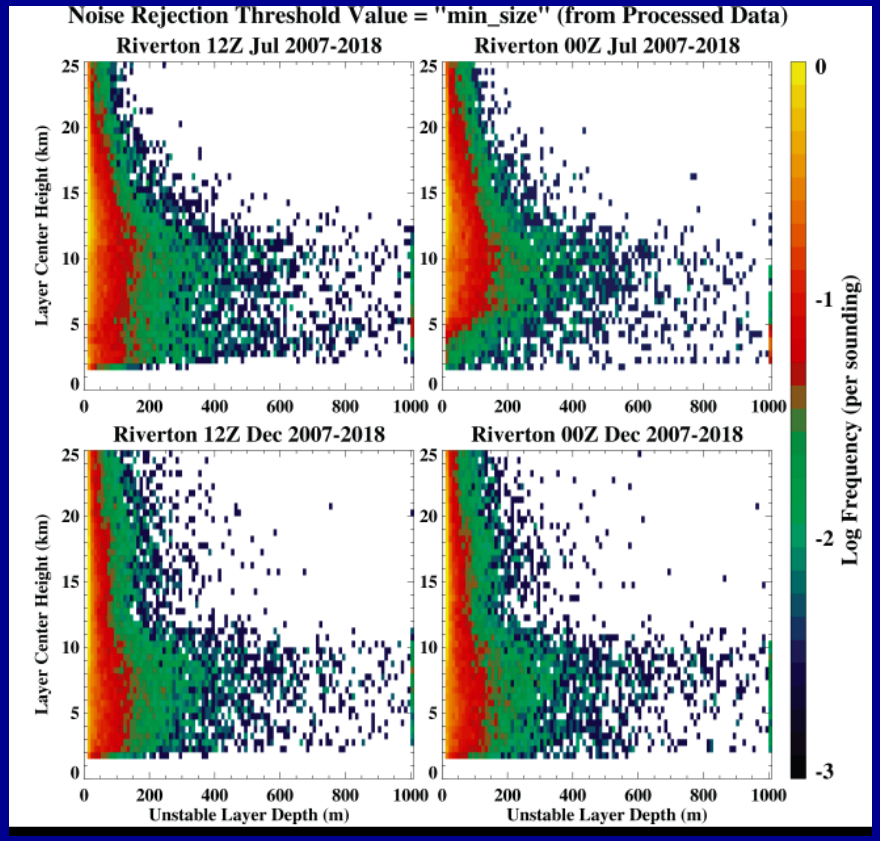
In the following, we will show changes in these conclusions, if any, when processed US HVRRD are used in comparison to our conclusions using the raw data.

There is a greater preponderance of thick unstable layers in the troposphere relative to the stratosphere.

RAW



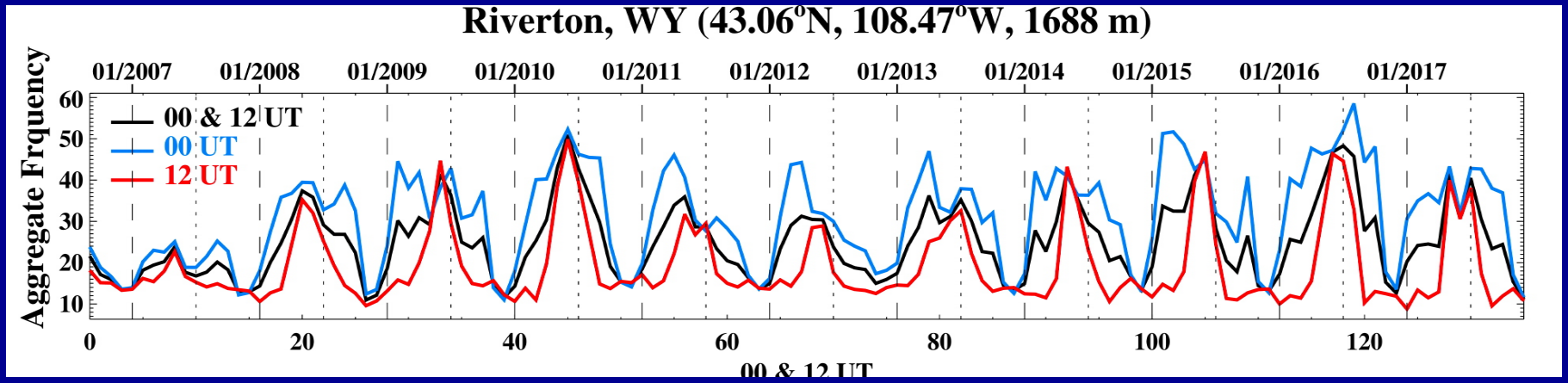
PROCESSED

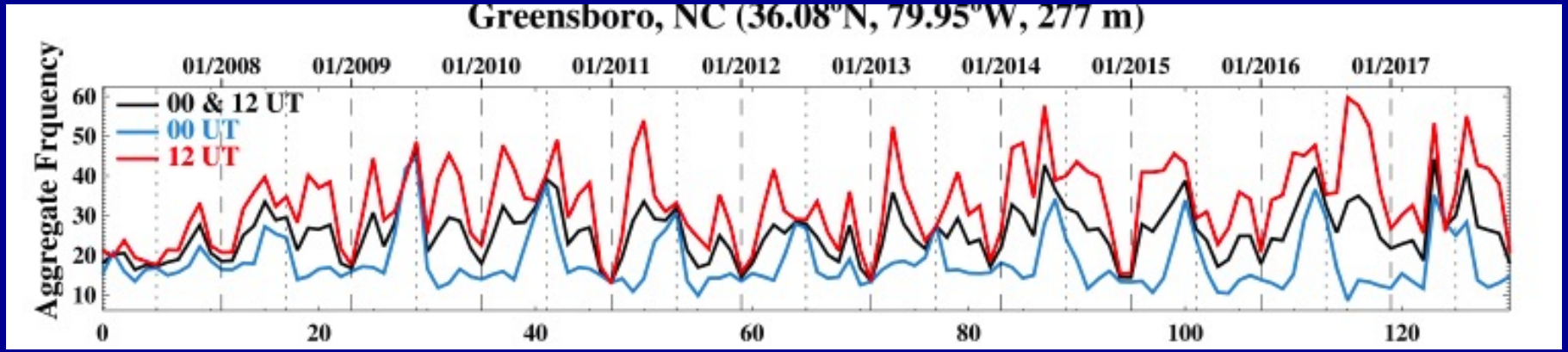


Some small differences are seen, but this conclusion remains the same.

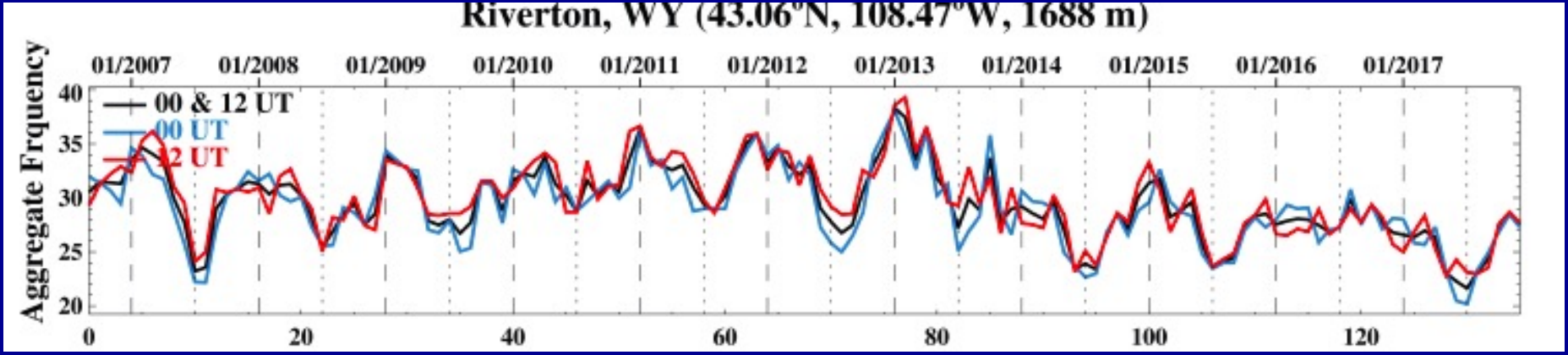
There are more frequent occurrences of unstable layers of thickness 10-400 m in the stratosphere in the 12 UT soundings than in the 00 UT soundings over the eastern US, whereas those unstable stratospheric layers occur more frequently at 00 UT over the western US.

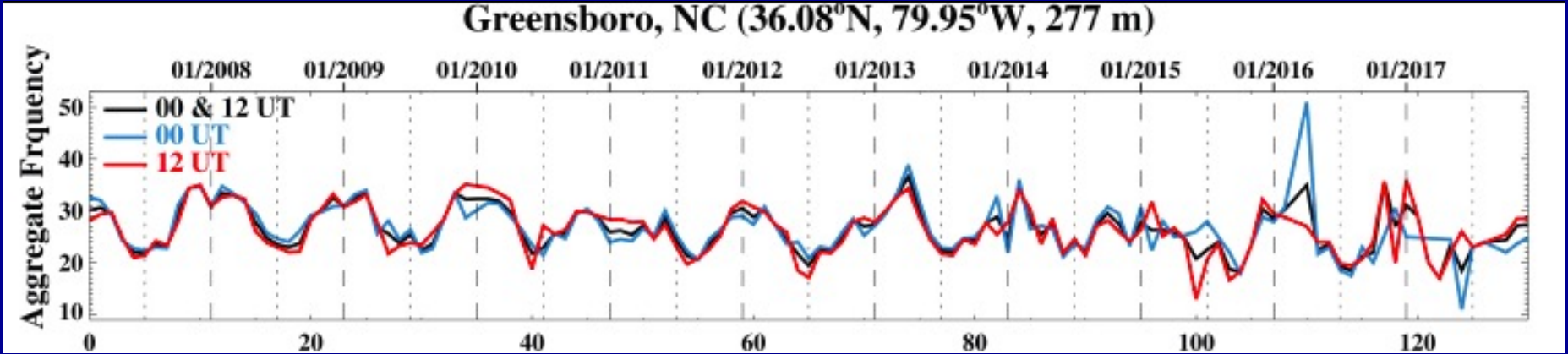
RAW


Riverton, WY (43.06°N, 108.47°W, 1688 m)
Aggregate Frquency
01/2007
01/2008
01/2009
01/2010
01/2011
01/2012
01/2013
01/2014
01/2015
01/2016
01/2017
00 & 12 UT
00 UT
12 UT
0
20
40
60
80
100
120
00 & 12 UT


Greensboro, NC (36.08°N, 79.95°W, 277 m)
Aggregate Frquency
01/2008
01/2009
01/2010
01/2011
01/2012
01/2013
01/2014
01/2015
01/2016
01/2017
00 & 12 UT
00 UT
12 UT
0
20
40
60
80
100
120

PROCESSED



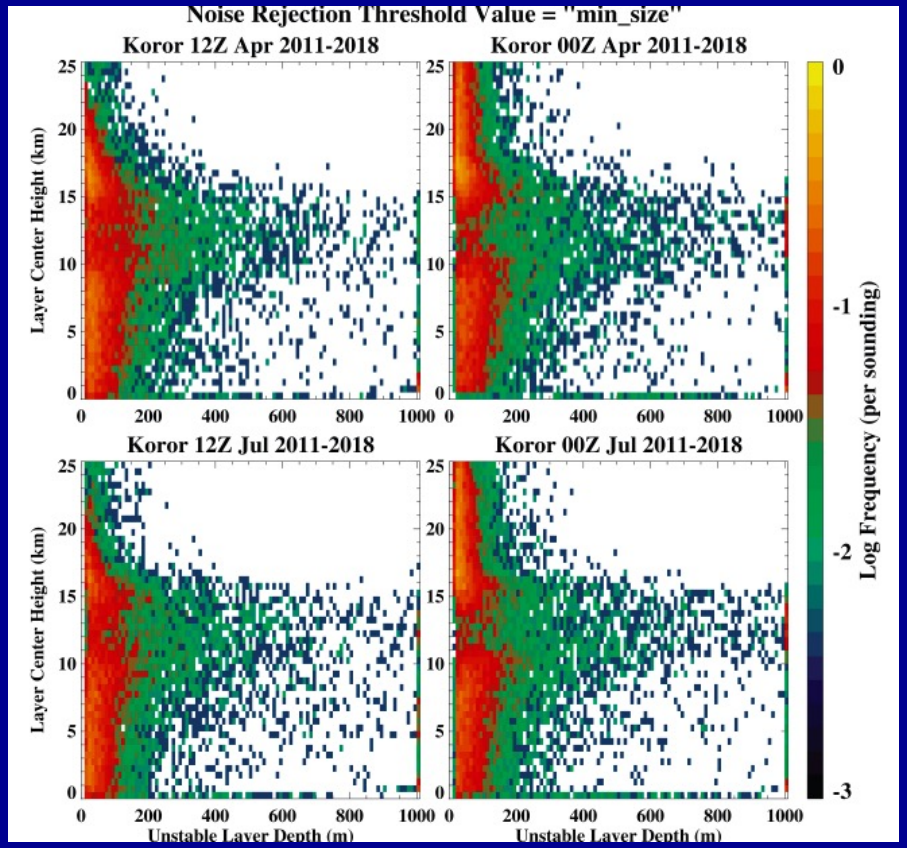


The 00Z/12Z differences seen in the raw data are almost completely gone.

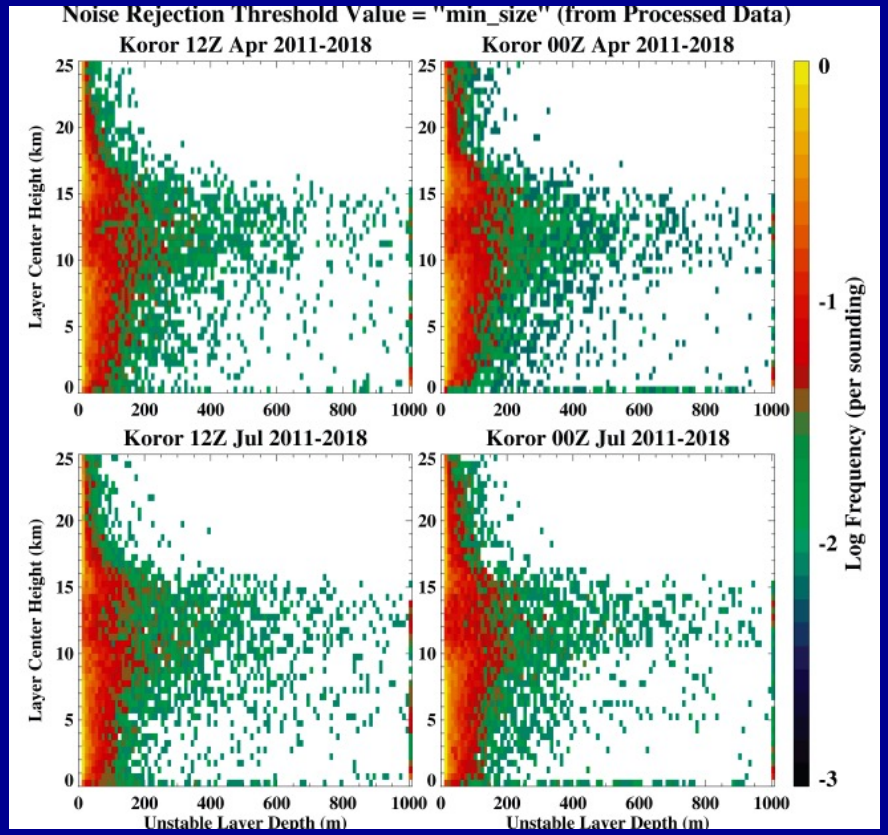
At Koror, a radiosonde station in the deep tropics, a “notch” was seen at altitudes near 12 km in which there were fewer thin unstable layers at those altitudes and more thick unstable layers at those altitudes.

At Koror, a radiosonde station in the deep tropics, a “notch” was seen at altitudes near 12 km in which there were fewer thin unstable layers at those altitudes and more thick unstable layers at those altitudes.

RAW

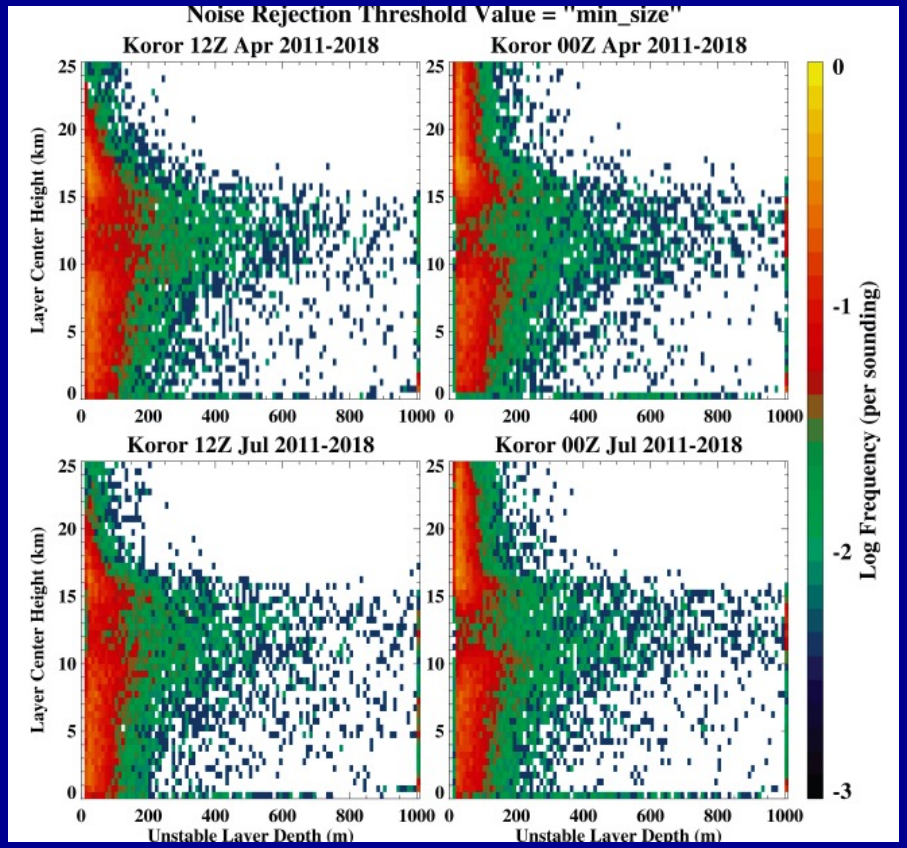


PROCESSED



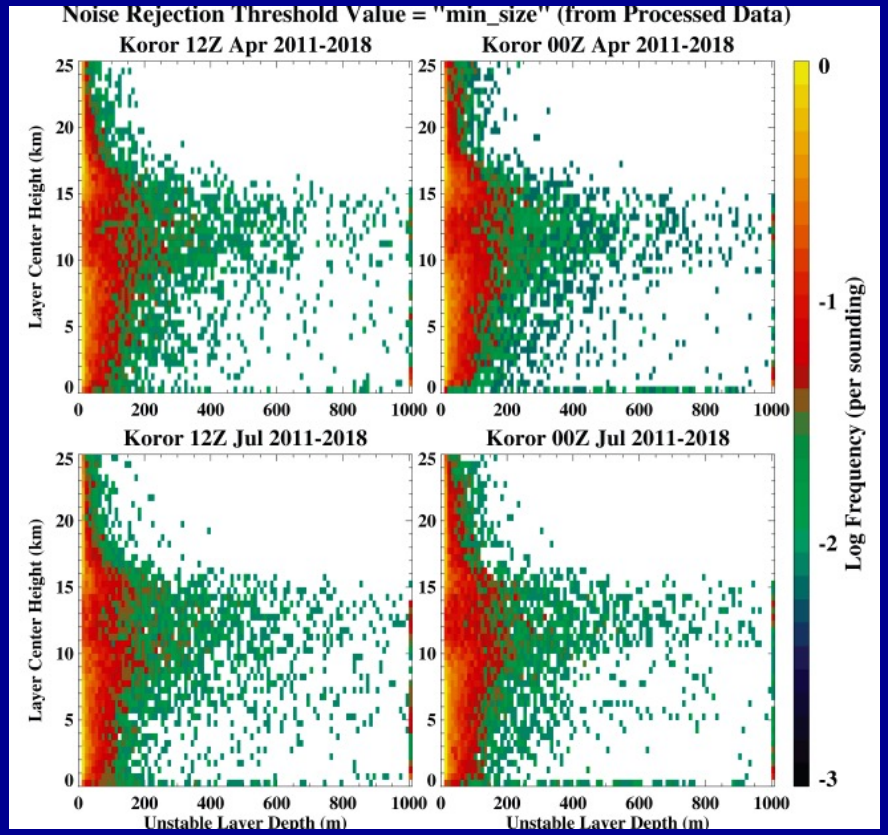
At Koror, a radiosonde station in the deep tropics, a “notch” was seen at altitudes near 12 km in which there were fewer thin unstable layers at those altitudes and more thick unstable layers at those altitudes.

RAW



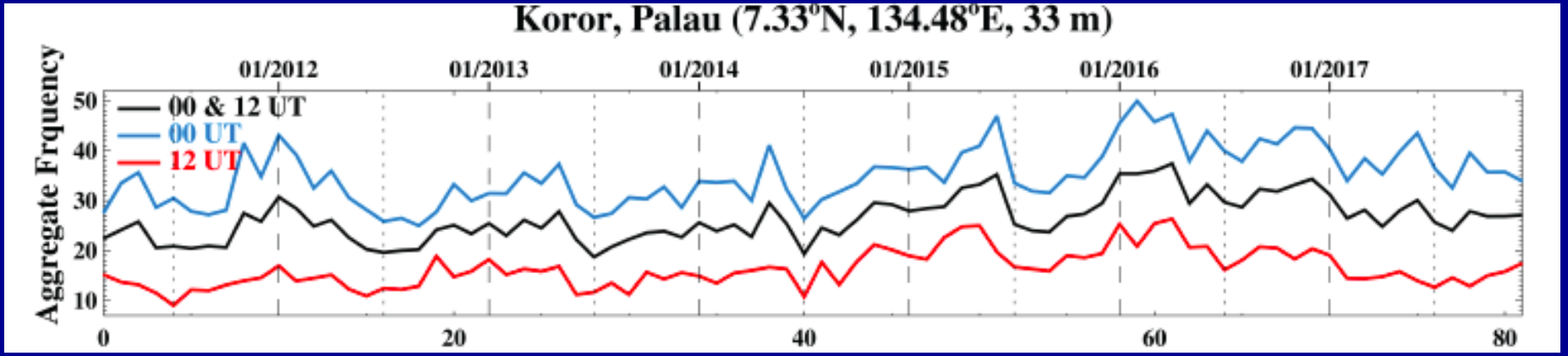
NIGHT DAY

PROCESSED

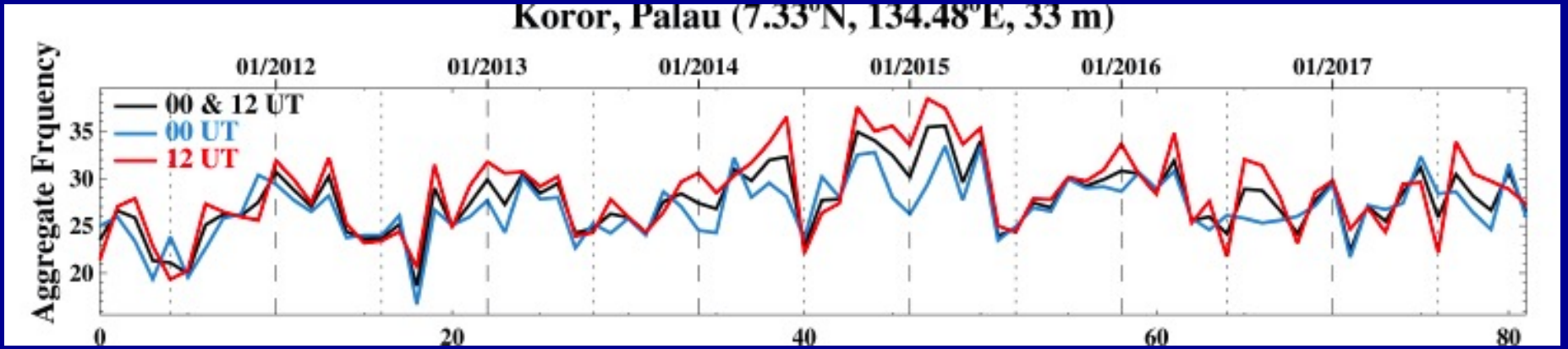


NIGHT DAY

RAW

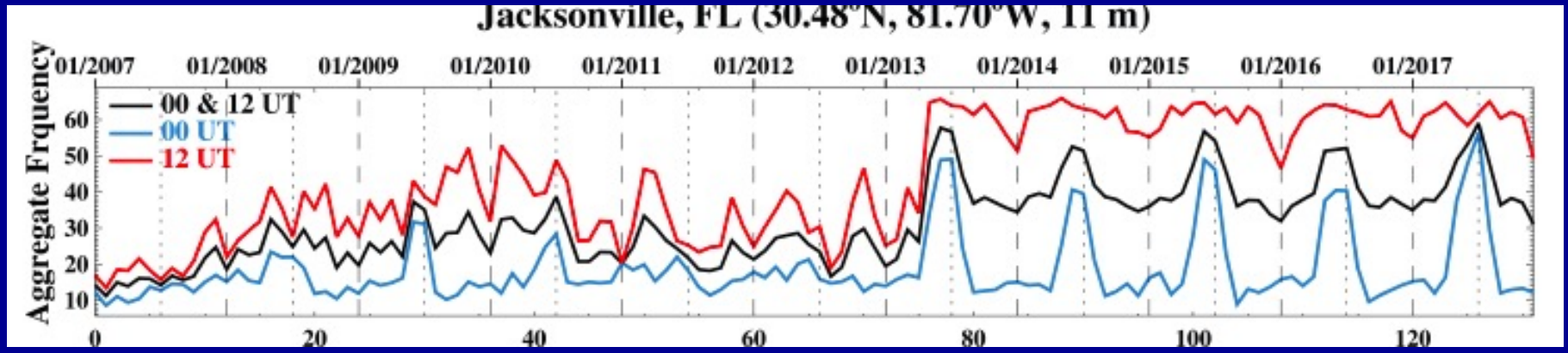


PROCESSED



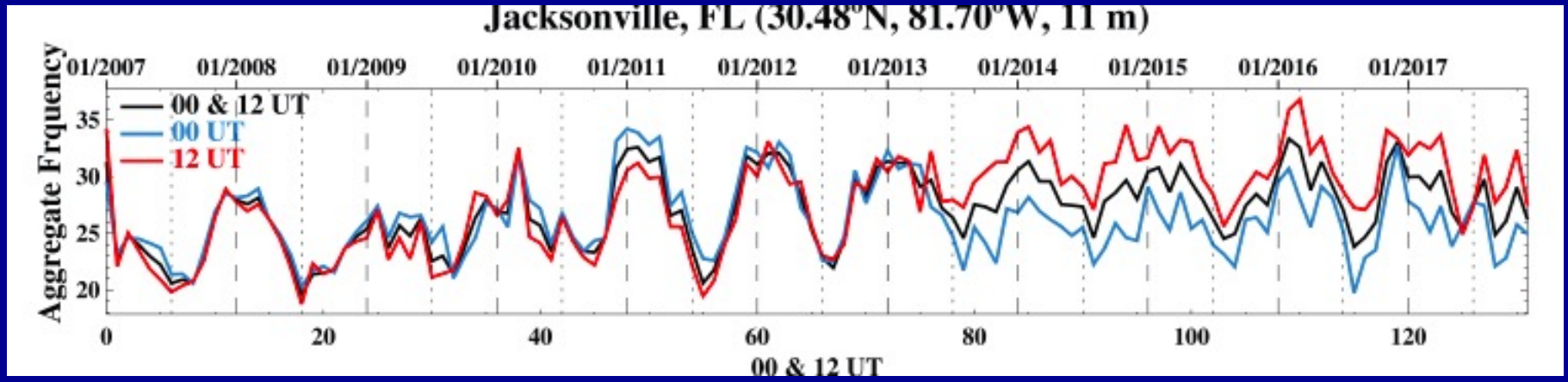
An example was shown in Geller et al. (2021) of a discontinuity in the occurrence of unstable layers that accompanied a change in radiosonde instrumentation.

RAW



LMS-MkIIa RS92-NGP

PROCESSED



Some Conclusions

- The general picture of the distribution of unstable layers in the troposphere and lower stratosphere is unchanged when processed HVRRD are used instead of raw HVRRD.
- The large differences between 00Z/12Z differences in unstable layer occurrences between the eastern and western contiguous US is largely eliminated when processed HVRRD are used versus raw HVRRD.

- The “notch” at Koror, where there are less thinner unstable layers and more thicker layers at about 12 km altitude is seen both when raw and processed data are analyzed. One difference is that when processed HVRRD are used the differences between the “notch” in daytime and nighttime soundings largely disappears.
- The large differences between the 00Z and 12Z occurrences of unstable layers at Koror and the secular increase in these layers largely disappears when processed HVRRD are used.

- Using processed HVRRD diminishes, but doesn’t eliminate, the noted discontinuities in unstable layer occurrences at some stations when radiosonde instrumentation was changed.