Temperature Fluctuations of Different Vertical Scales in Raw and Processed US High Vertical-Resolution Radiosonde Data

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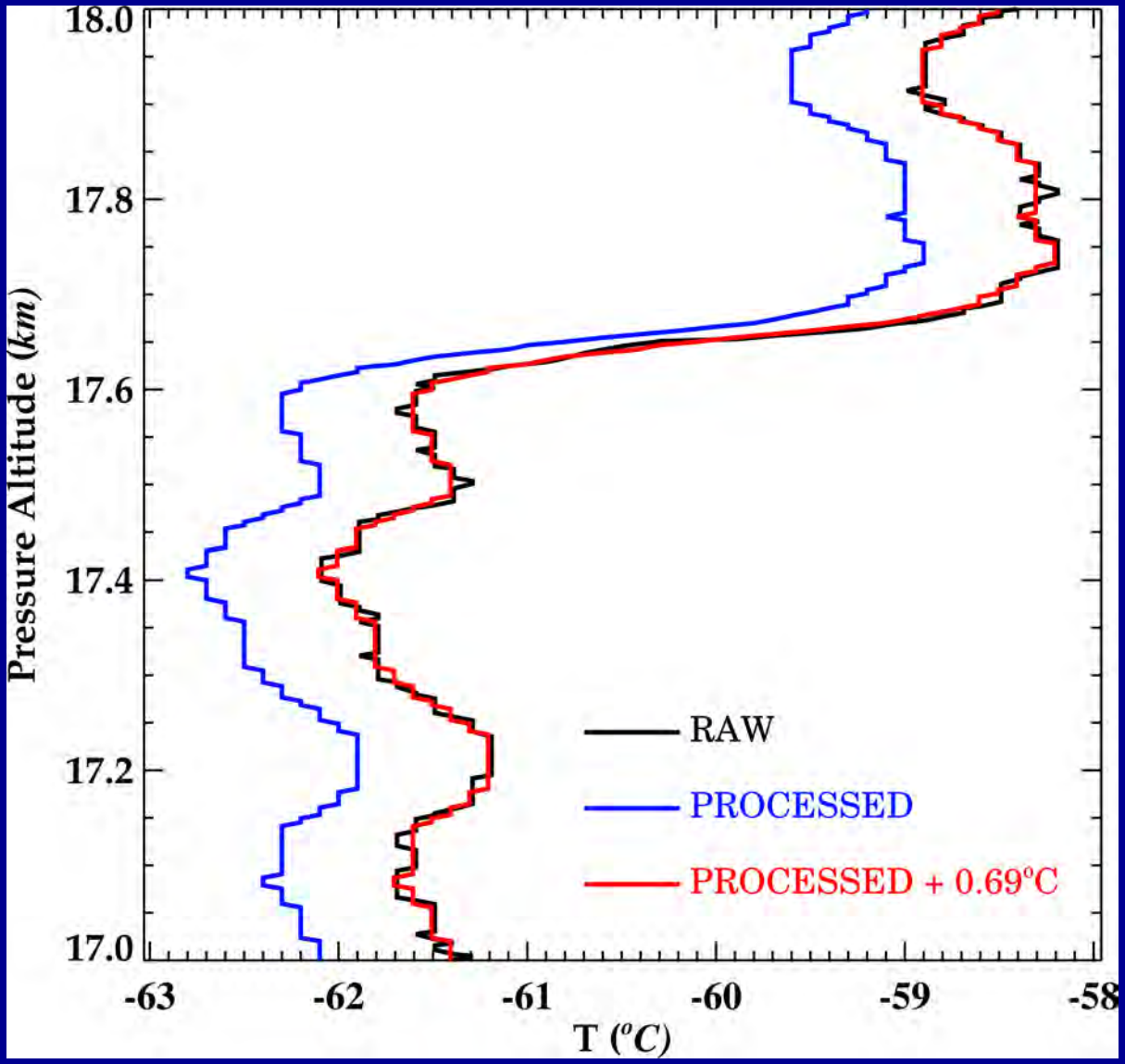
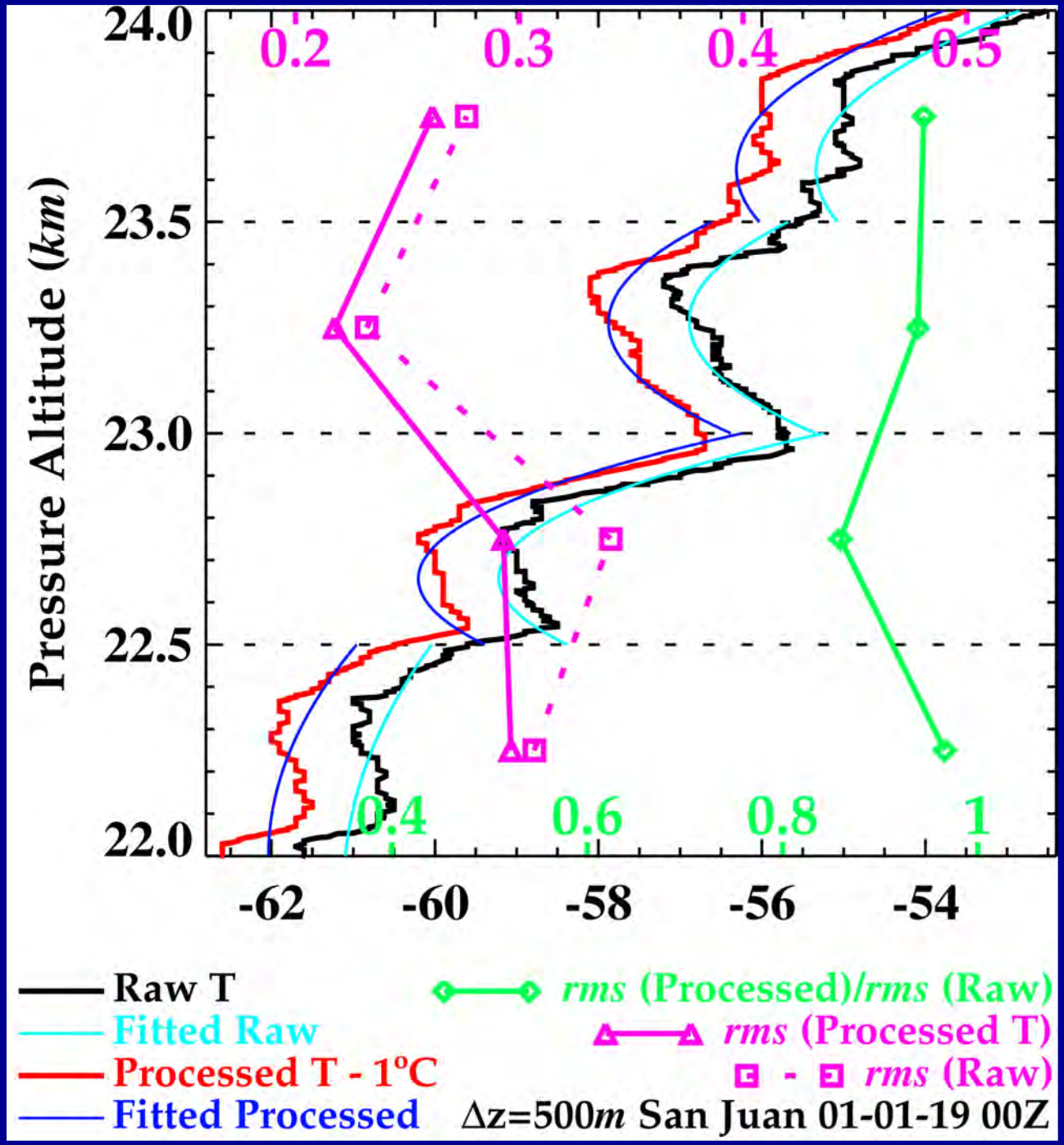
Two sets of HVRRD temperature profiles are available through NCEI. One is the raw profile, which represents the measured temperature by the radiosonde instrumentation. The other is the processed profile, which has been radiation corrected and smoothed. Radiosonde radiation corrections have been well documented, but the details of the smoothing in the processed temperature profile are considered to be proprietary to the instrument vendor, and are not available.

It is the purpose of this paper to see the nature of this smoothing that has been applied to the processed profiles



Raw (black curve) and processed (blue curve) temperature data in ^{0}C from HVRRD at Riverton, WY at 00Z on July 1, 2012. The red curve is the processed data offset by 0.69 ^{0}C. Sounding instrumentation was the Sippican Mark IIA.

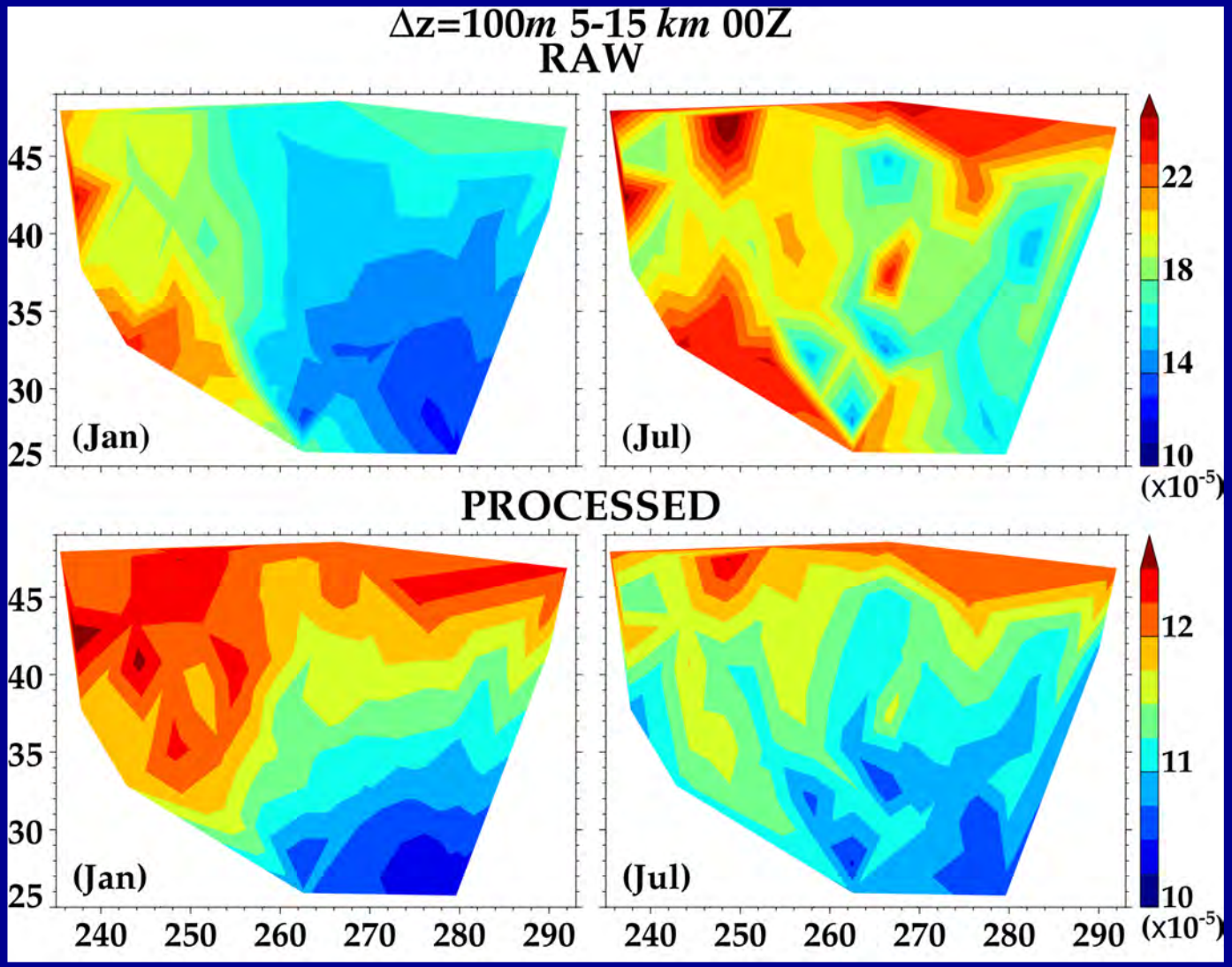
To quantify the smoothing at different vertical scales (Δz), we used the procedure pictured in the following figure (for Δz = 500 m).



$$rms = rms\left(T' / T_0\right)$$

2nd-Polinomial fit and Δz = 500 m are used in this example

We showed the procedure for Δz = 500 m for clarity. The *rms* values are greater for larger values of Δz, and the ratio of *rms* values for processed profiles to raw profiles becomes smaller with decreasing Δz. This will become apparent in later figures.

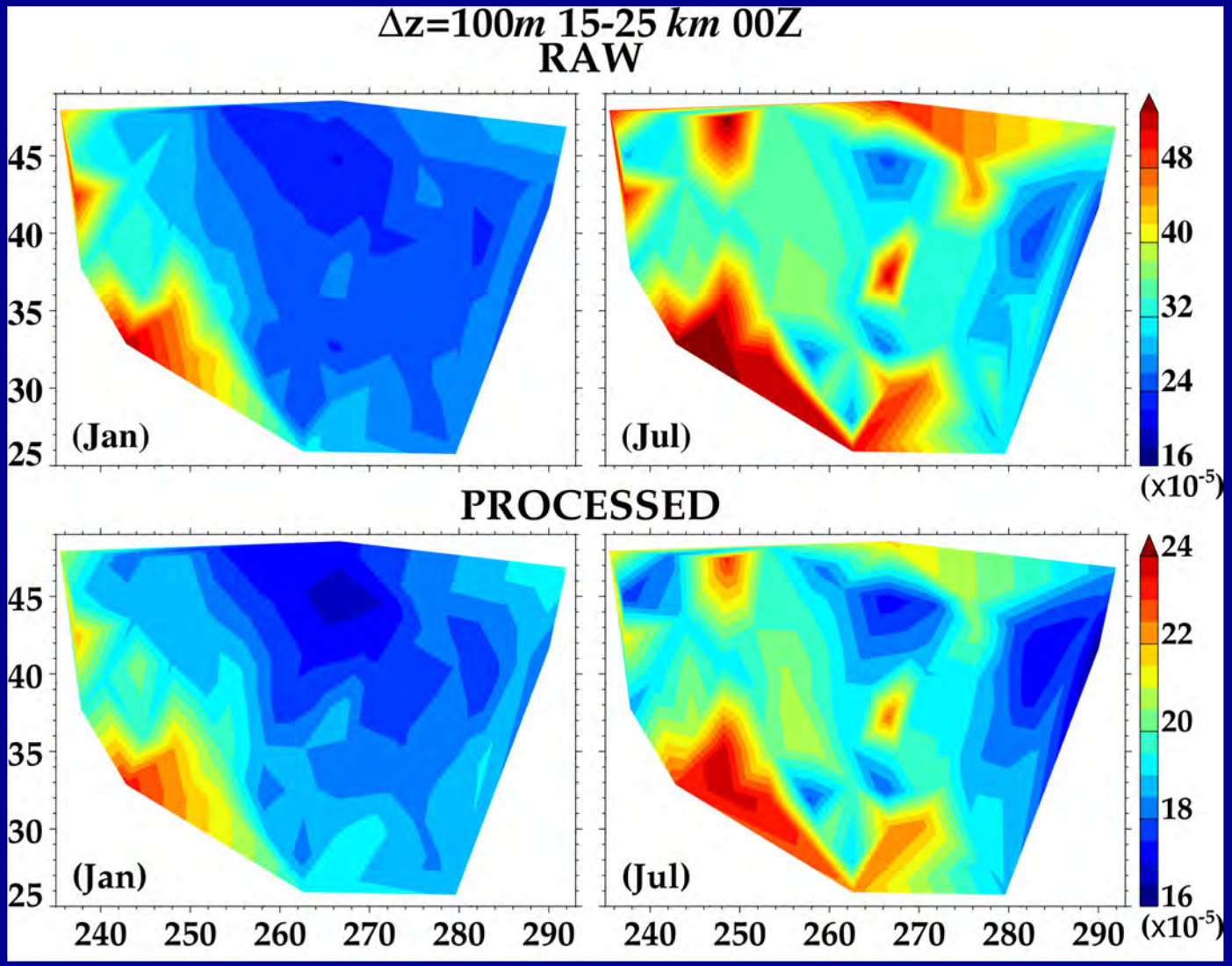


rms is larger in the RAW data

There are seasonal variations of *rms.*

The geographic variability of *rms* is largely retained in the PROCESSED data.

Maps of *rms* values for Δz = 100 m for the troposphere (5-15 km) for raw and processed data for January and July 00Z

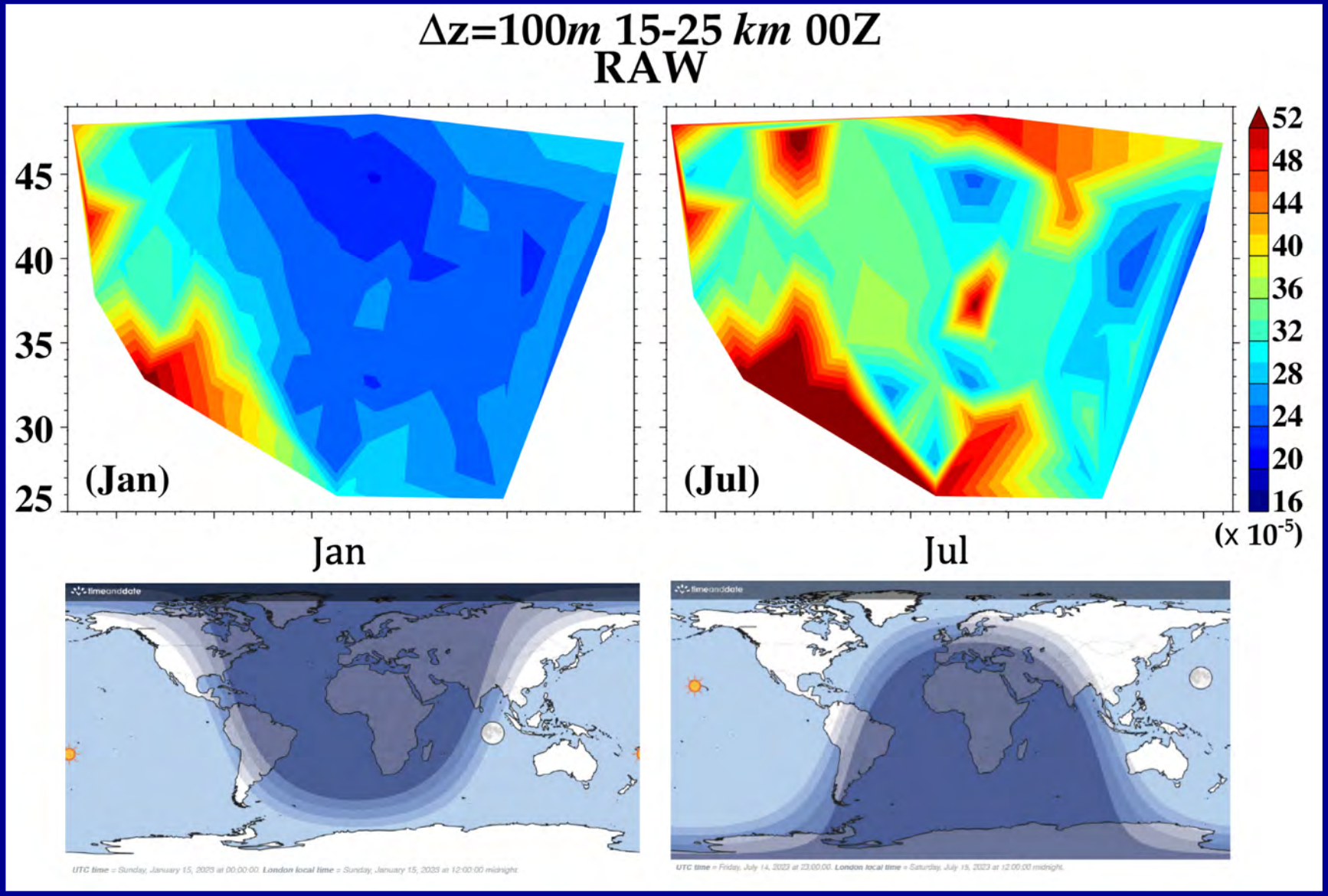


Again, *rms* is larger in the RAW data and there are seasonal variations of *rms.*

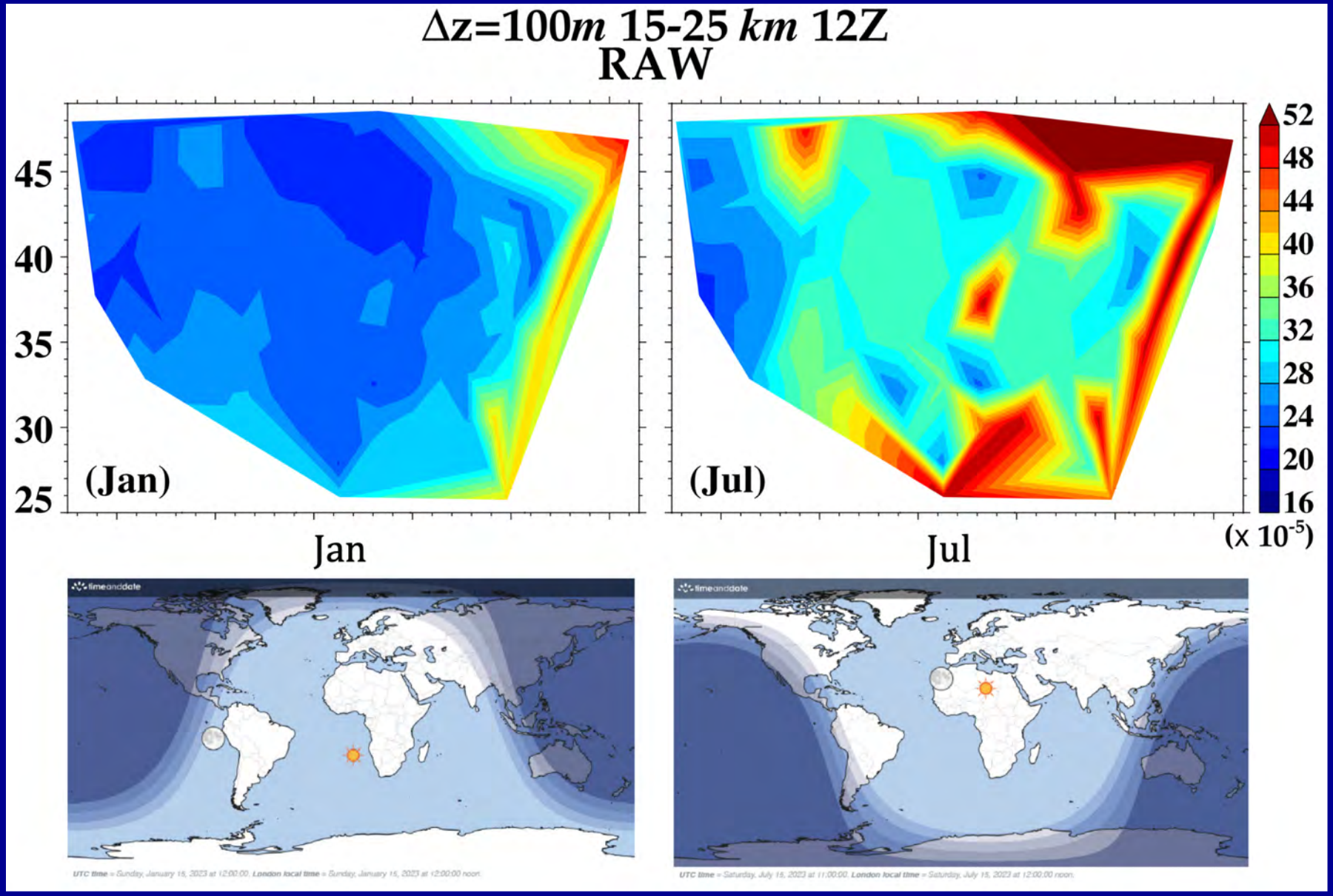
rms is larger in the lower stratosphere than troposphere.

And again, the geographic variability of *rms* is largely retained in the PROCESSED data.

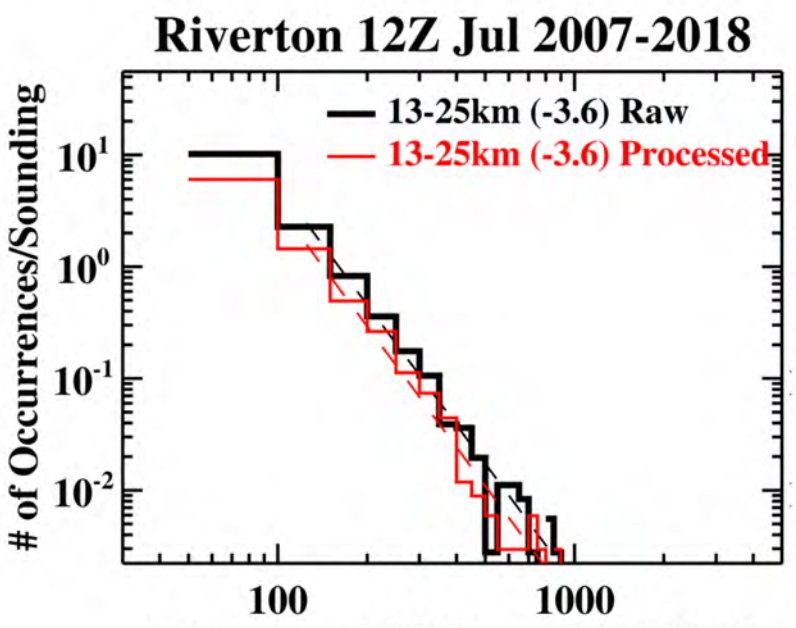
Maps of *rms* values for Δz = 100 m for the stratosphere (15-25 km) for raw and processed data for January and July 00Z

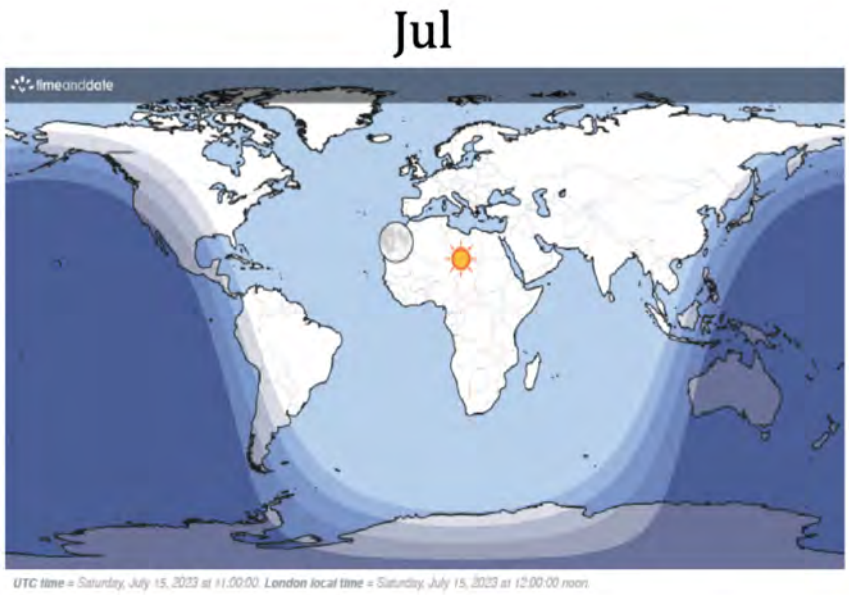


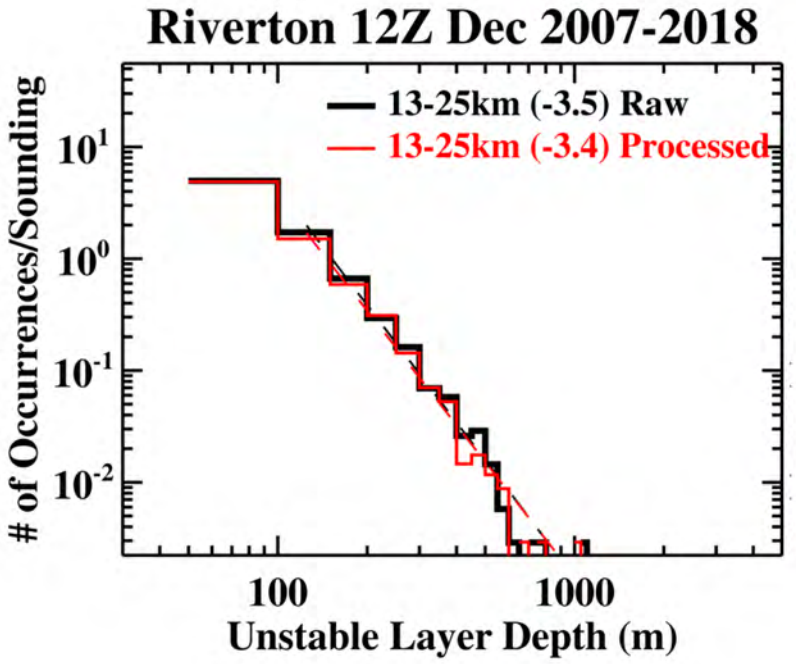
Top – January and July rms values for Δz = 100 m at 15-25 km for the raw data at 00Z. Bottom – Day/Night for 00Z

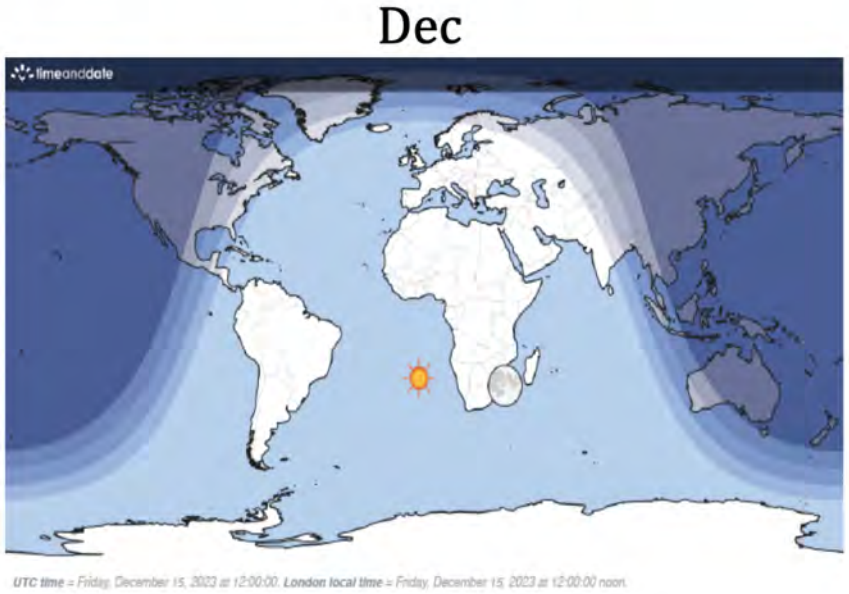


Top – January and July rms values for Δz = 100 m at 15-25 km for the raw data at 12Z. Bottom – Day/Night for 12Z.

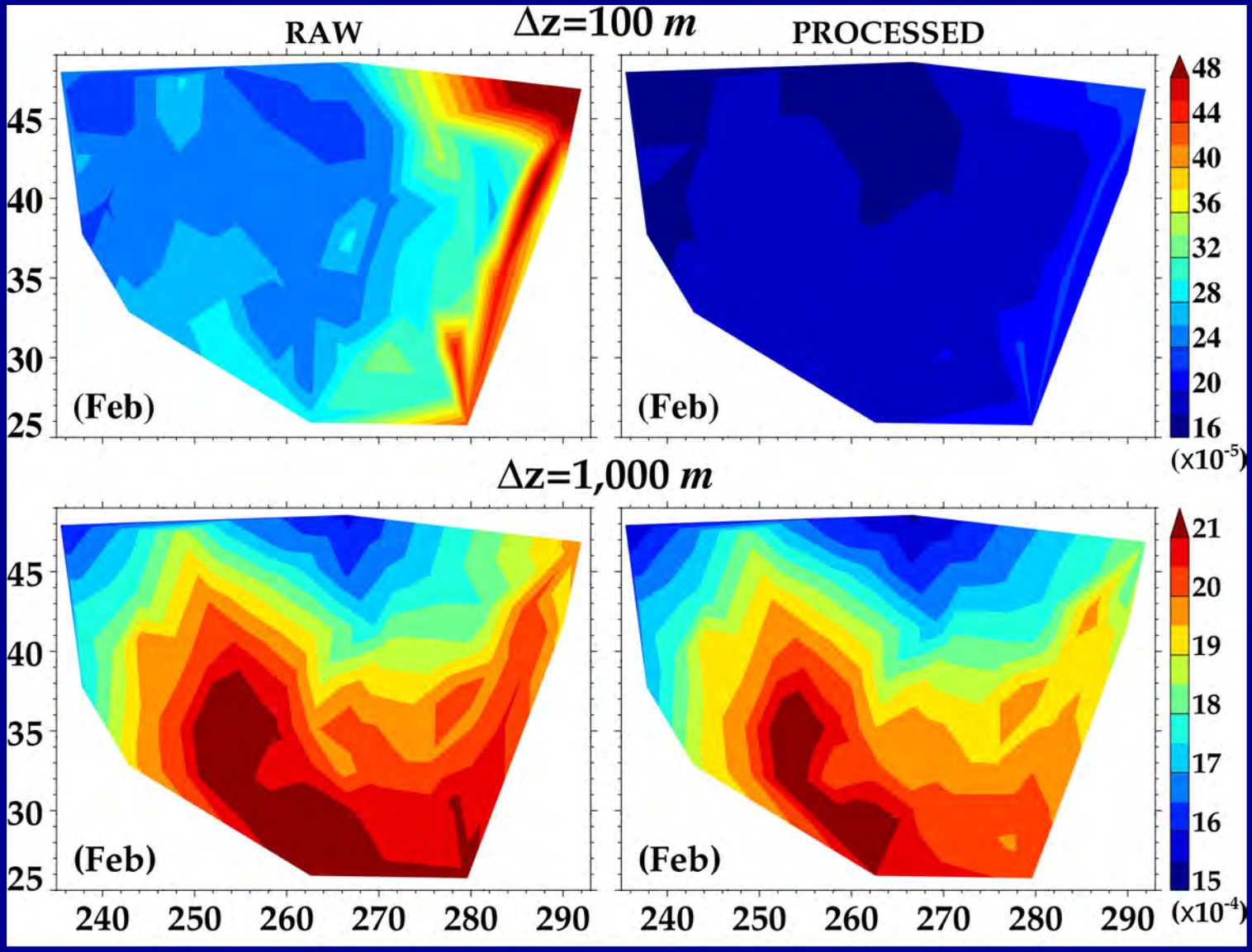




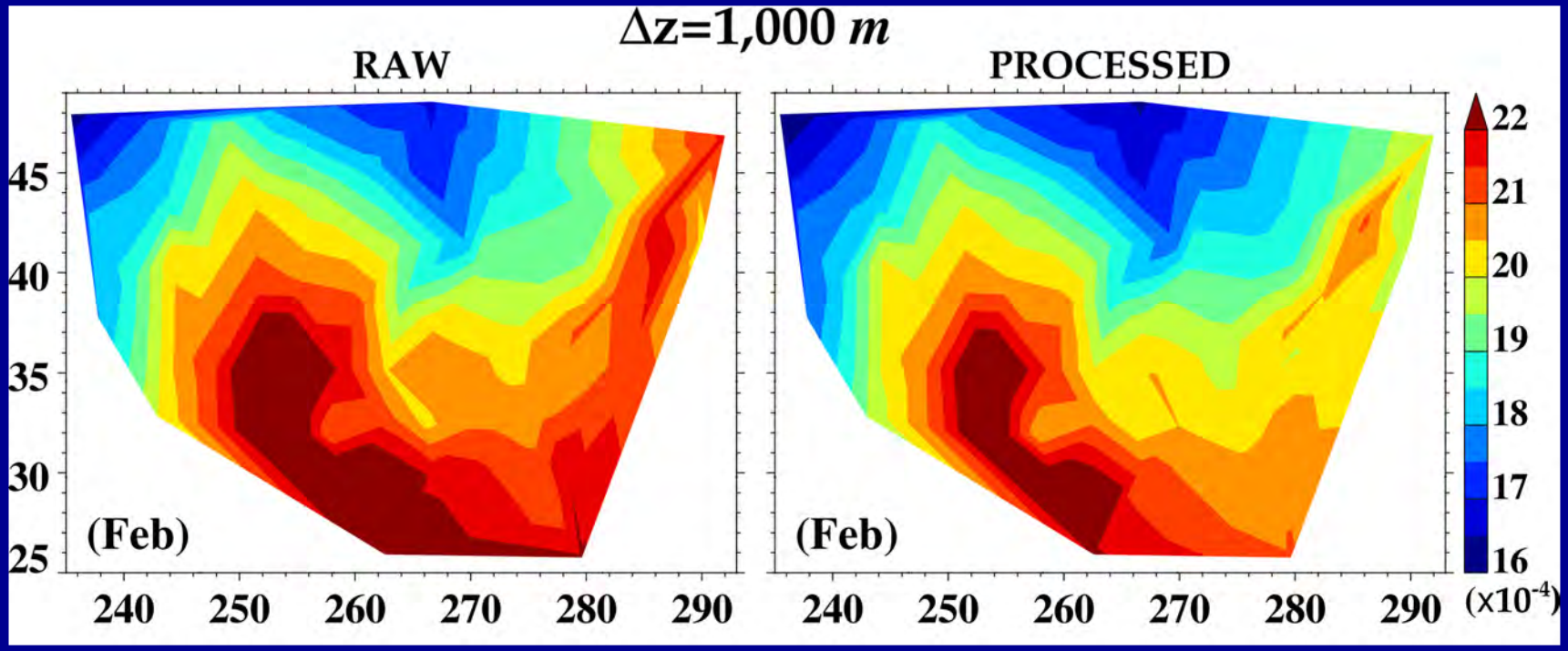




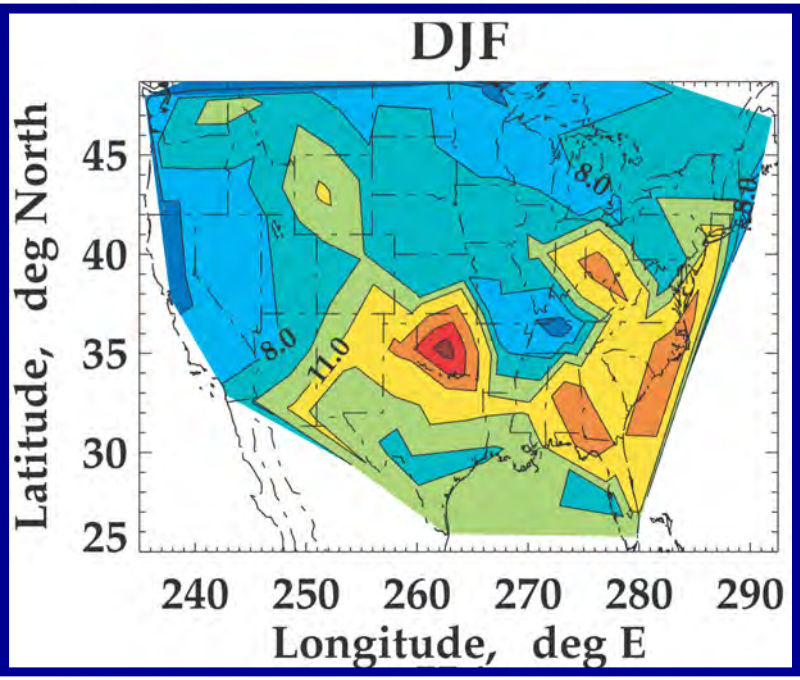
Normalized histograms for Riverton, WY



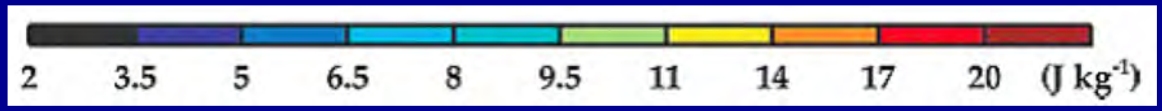
Note that the $\Delta z = 100$ m pattern is very different from the $\Delta z = 1{,}000$ m pattern. Also note, that for $\Delta z = 1{,}000$ m the raw and processed patterns are much more similar

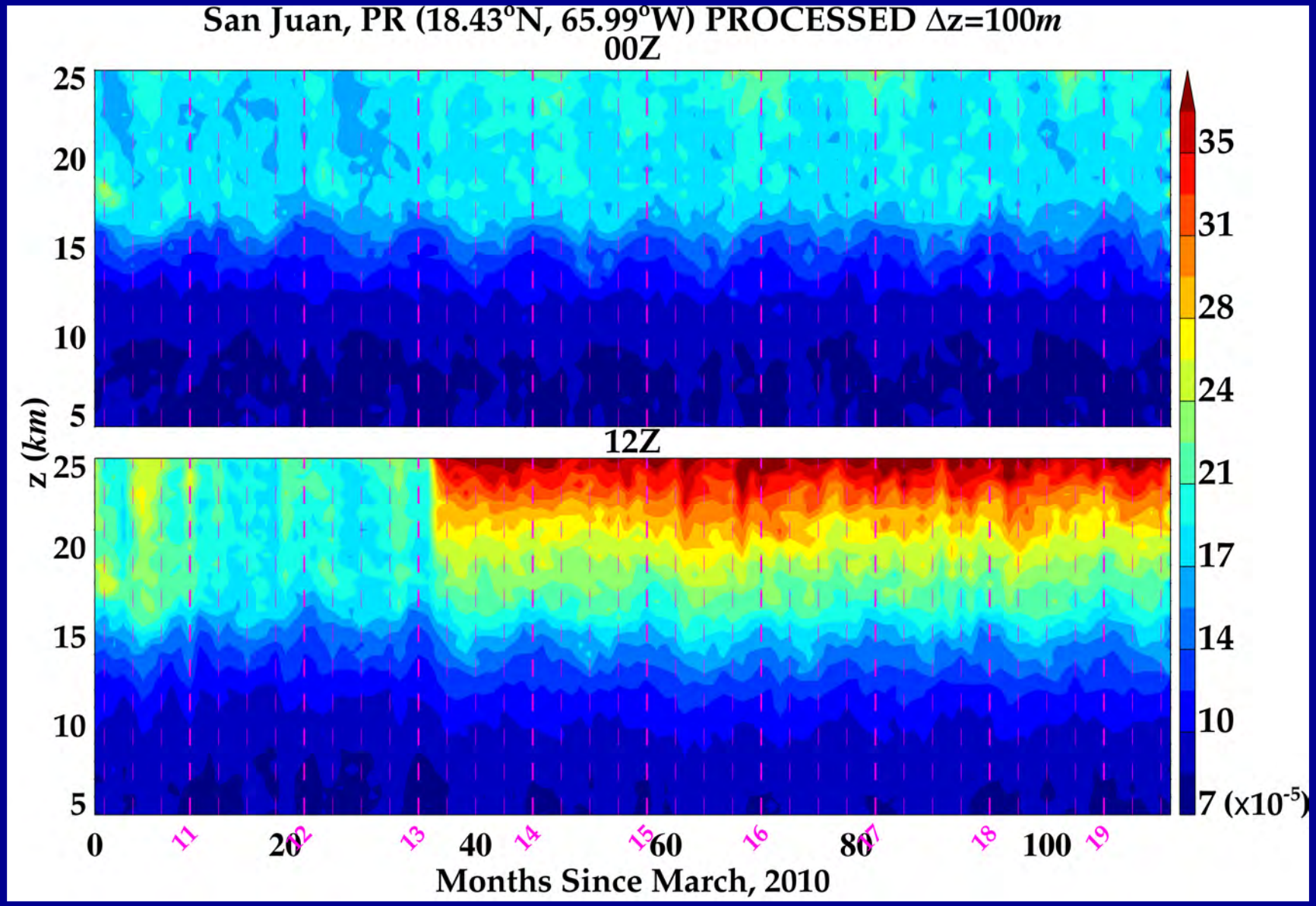


Upper: *rms* of small scale variability for Δz = 1,000m between 18 & 24.9 km



Left: Gravity wave energy in the stratosphere (Wang and Geller, 2003)





Discontinuity of *rms* at Δz = 100 m is found for PROCESSED data for some stations at 12Z. Remnants of spurious small-scale "noise."

Some Conclusions

- Processed US HVRRD are radiation corrected and smoothed.
- Raw HVRRD during daytime has spurious small-scale “noise.”
- Processed data improves upon the spurious daytime “noise,” but does not eliminate it.
- Larger scales are well represented in both raw and processed HVRRD.

Von Rohden et al. (*AMT*, 2022) have performed extensive laboratory characterization of the radiation corrections for the Väisälä RS41 instrument. This includes different pressures and sun angles. We believe that the small-scale “noise” in the raw data is a results of radiation effects resulting from pendulum and spinning of the radiosonde instrument. They indicate that there is enough information in radiosonde soundings to correct for these, but this has not been done.