DEM quality assessment and improvement in noise quantification for geomorphic application in steep mountainous terrain

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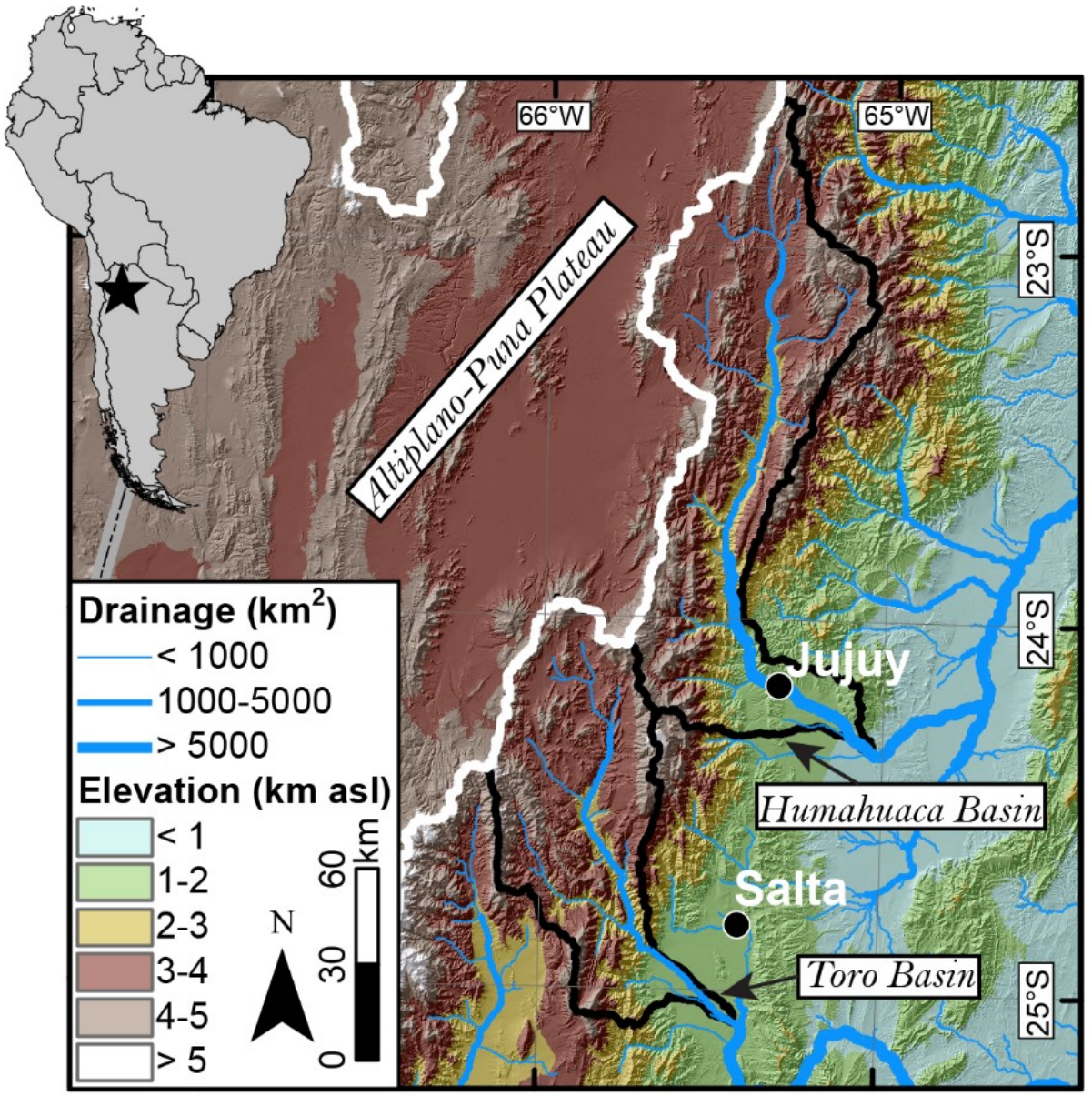

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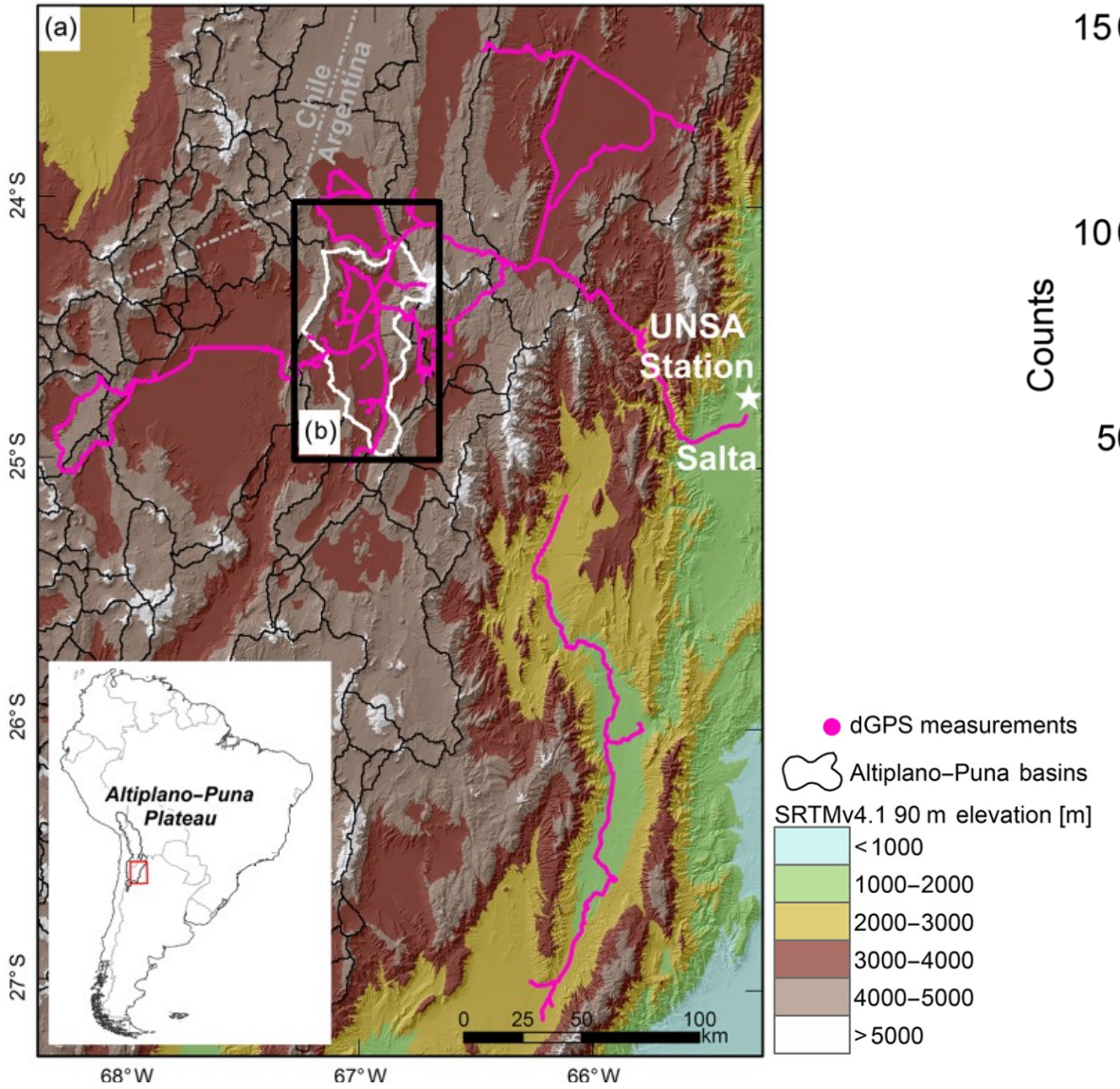

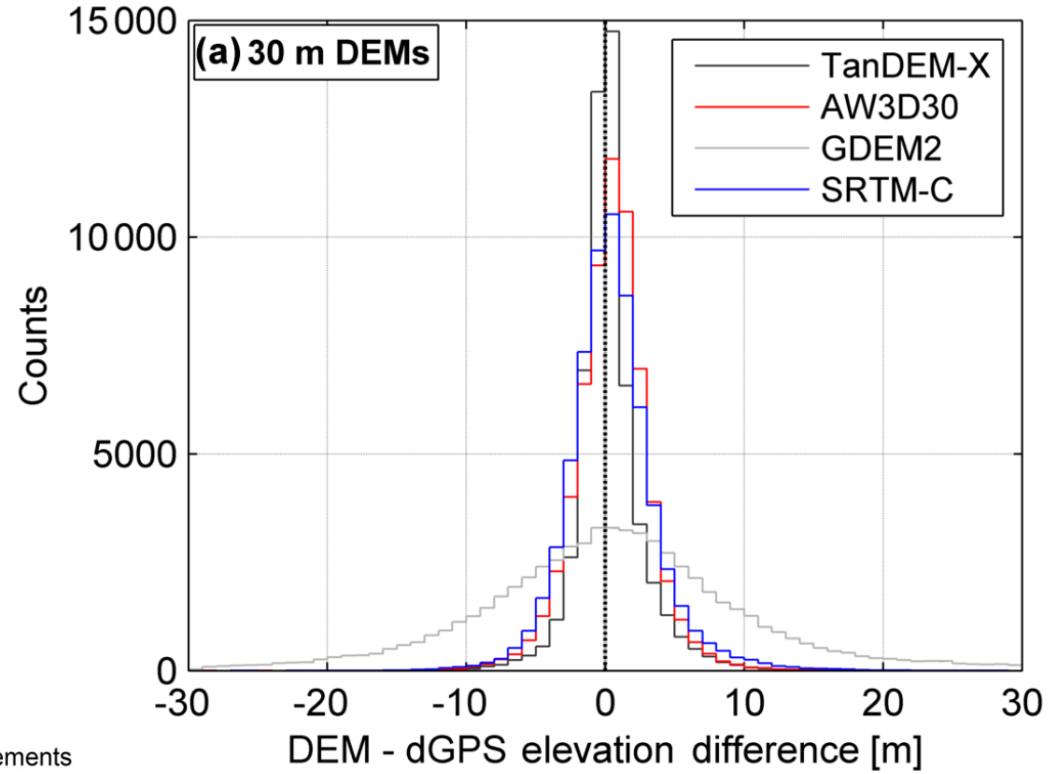

Point-based (e.g., GPS) measurements of DEM quality ignore the *spatial relationship* between adjacent pixels.

We rely on neighborhood (e.g., 3x3 window) calculations affected by these relationships.

Purinton B and Bookhagen B (2017) https://doi.org/10.5194/esurf-5-211-2017

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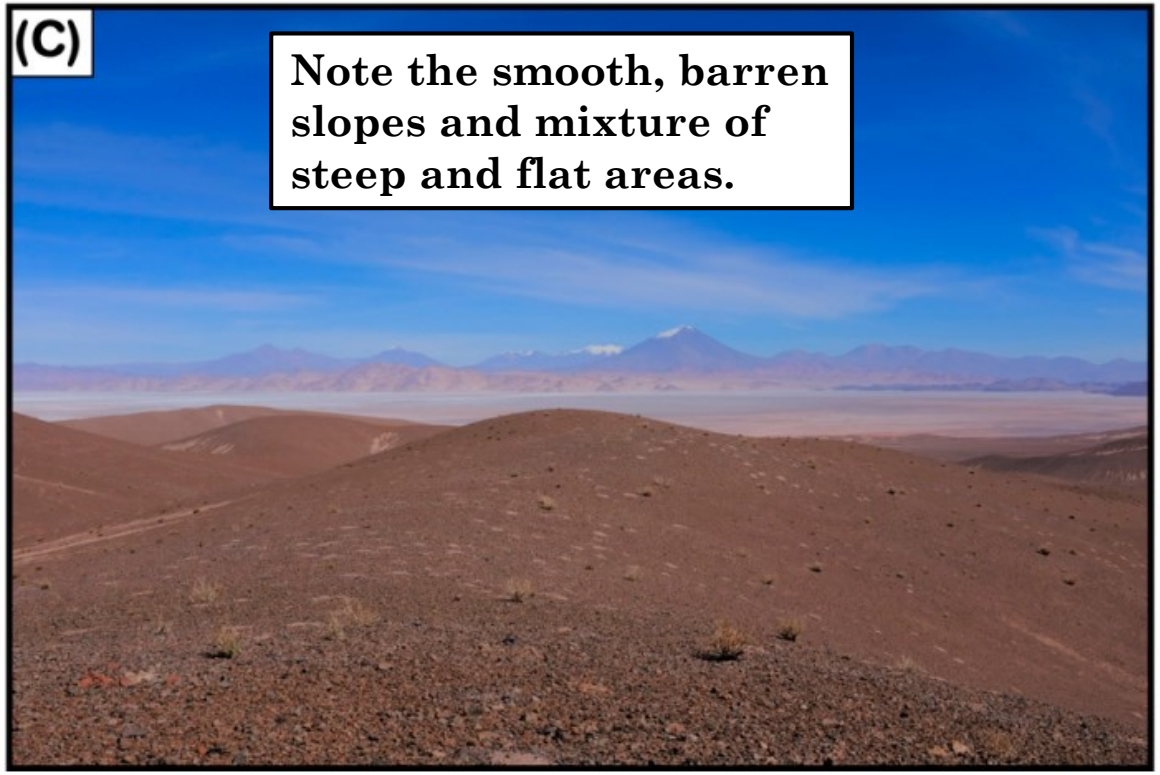
Our study area is: vegetation free, steep, and contains huge perfectly flat salt pans.

Perfect for bare-Earth remote sensing and quantifying sensor, orbital, and/or processing biases in DEMs.



Purinton B and Bookhagen B (2021) https://doi.org/10.3389/feart.2021.758606

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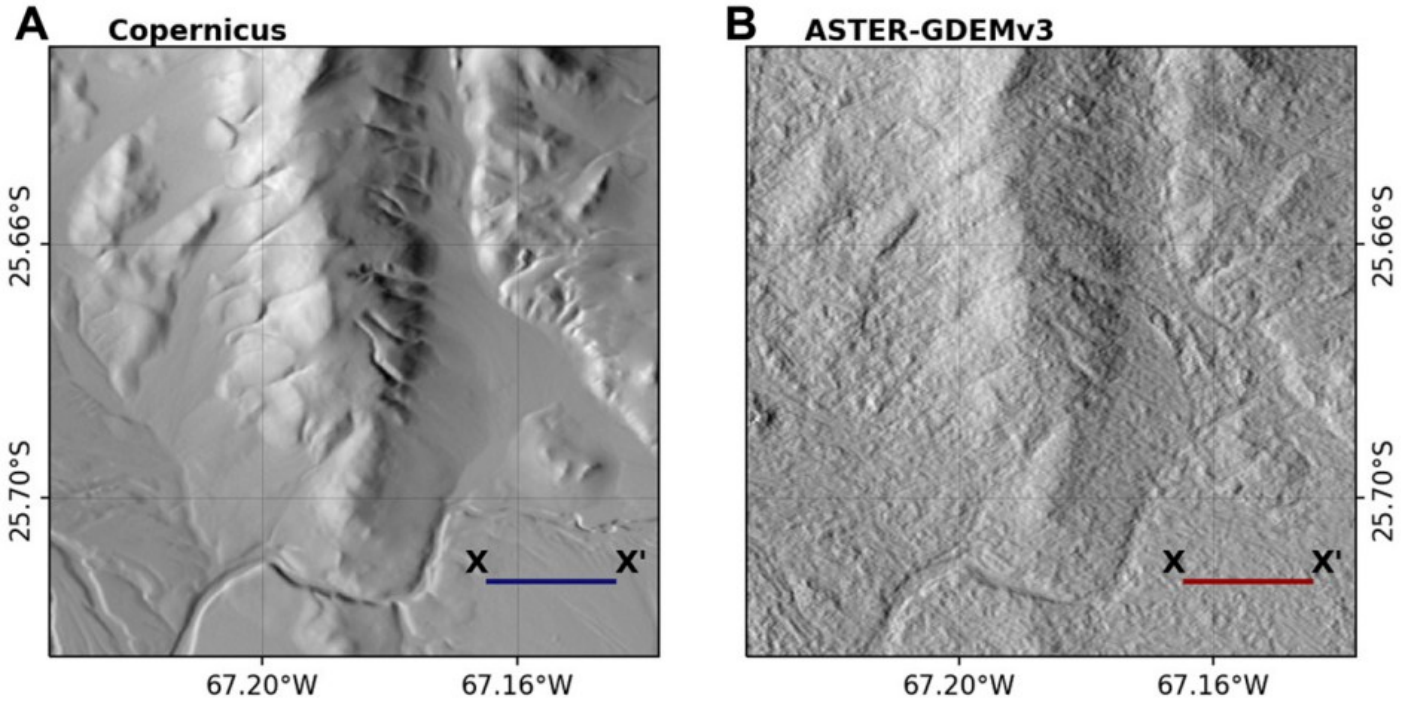
We intuitively assess the quality of a DEM given our knowledge of the area and hillshade images.

It looks like the ASTER-GDEMv3 is lower quality compared to Copernicus.



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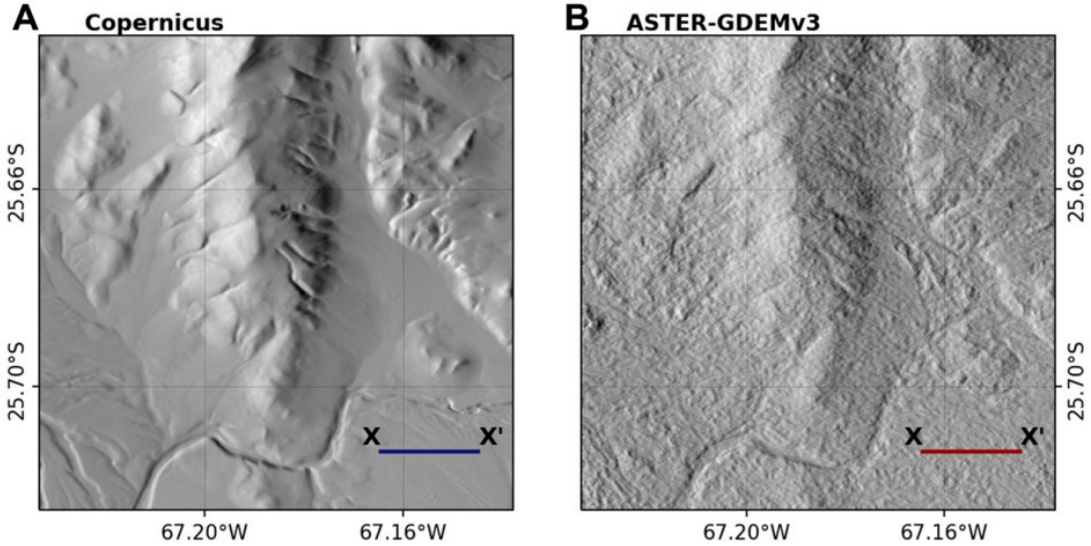
How do we turn our intuitive assessment into a quantitative analysis of the quality of a DEM based on the spatial relationship between pixels?



We term this the *inter-pixel consistency*, where *low* inter-pixel consistency refers to *high* variability in adjacent pixels.

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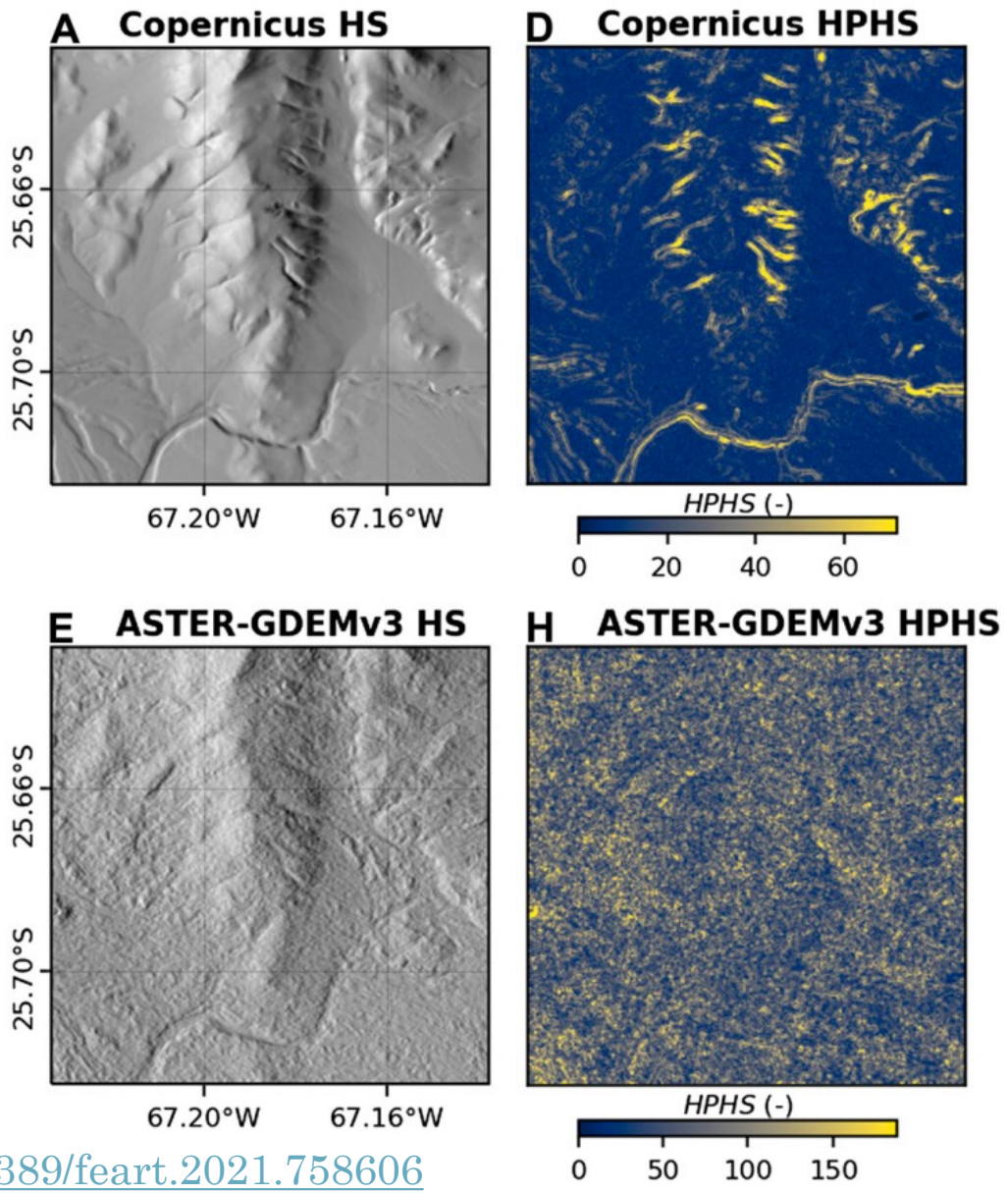
We developed a new metric called the *High-Pass Hillshade* (*HPHS*).

1. **Calculate HS with sun shining from four cardinal directions**
2. **Take a high-pass filter over each resulting HS**
3. **Return the maximum high-pass value at each pixel**

https://github.com/UP-RS-ESP/DEM-Consistency-Metrics

This metric is quick to calculate, follows from our intuition, and includes information on the slope and aspect of the DEM.



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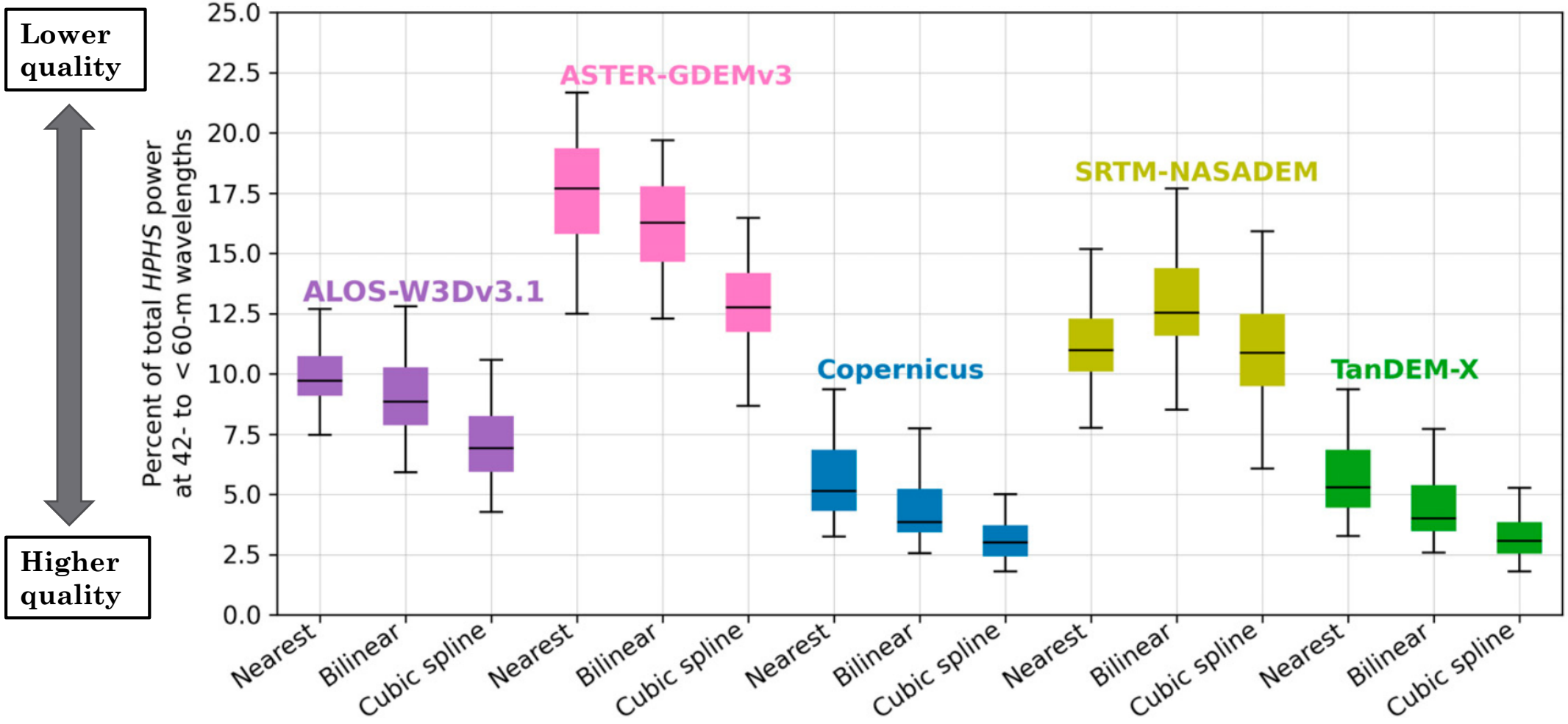
Using Fourier frequency analysis, we can quantify the variance of HPHS in adjacent pixels, and thus compare DEMs based on their *inter-pixel consistency*.



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