Supplementary Material

From flood to turbidity current: combined models to simulate continent to ocean sediment transport in the Var system, France

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DEM processing

CAESAR-Lisflood has a run-time that is very dependent on the numerical size of the DEM. In order to have a reasonable model solution within a reasonable compute time we down sampled the 25 x 25 m DEM to a 50 x 50 m resolution. However, the down sampling is not straightforward. For example, within the Var catchment there are narrow ravines that while visible on a very high-resolution DEM will, when averaged into a lower resolution DEM, block the flow of water. The goal of the pre-processing is to remove artifacts from the averaging of elevation that might block the routing of water within the model.

To generate a DEM that allows for the continuity of the flow of water, the DEM in CAESAR-Lisflood has been morphologically processed, cropped, and resampled with a resolution of 50 m, with the following steps: The first step is to resample the high-resolution DEM using two methods, the mean elevation, and the minimum elevation. The second step is to apply a pit filling algorithm on the resampled DEM using the minimum. To fill pits, we apply the SinkFiller (Barnes et al., 2014) component of LandLab (Barnhart et al., 2020; Hobley et al., 2017) as it allows for D4 flow routing which is consistent with the Lisflood algorithm used within Caesar-Lisflood. We then run the Lisflood component of CAESAR-Lisflood on the pit filled minimum topography DEM to obtain the hydraulic network. The final step is to use the hydraulic network to replace regions in the resampled mean DEM with values from the pit filled minimum DEM. We use a cut-off of a water depth greater than 5 cm to define regions where the mean elevation is to be replaced by the minimum elevation. The workflow for this process can be accessed as a jupyter notebook that includes python scripts for the resampling using Qgis (Armitage, 2023).

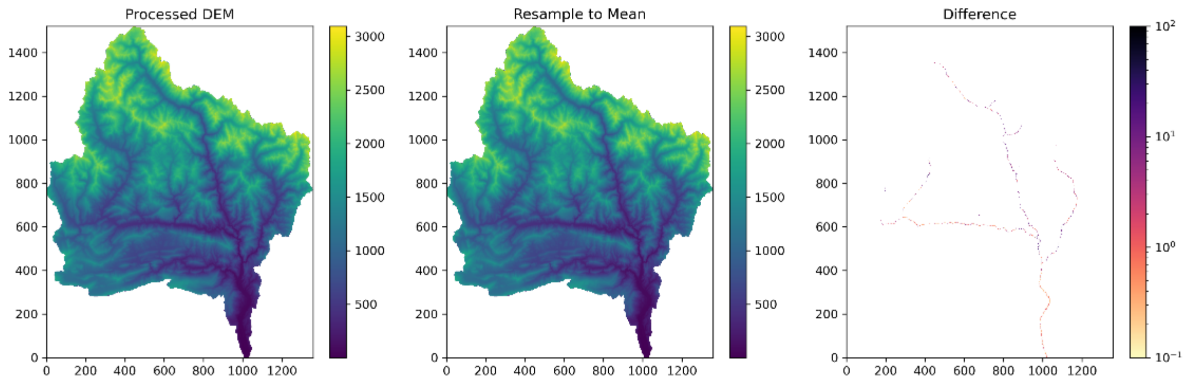

Figure 1: Comparison between the processed DEM and the input DEM resampled using the mean of the initial 25m resolution DEM. The difference between the two is plotted showing where the river network has been carved into the mean DEM.

When the processed DEM is compared to the mean we can see that the main channels have been carved out to maintain the flow (Figure 1). The distribution of elevation within the catchment is however modified by this pre-processing, with a shift to lower elevations due to the forcing of low topographies within the river channels (Figure 2). The low topography is however a real elevation from the minimum of points within the resampling, and as such is still representative of the landscape. We therefore would suggest that this pre-processing method is a reasonable compromise between a reasonable compute time and representing the landscape.

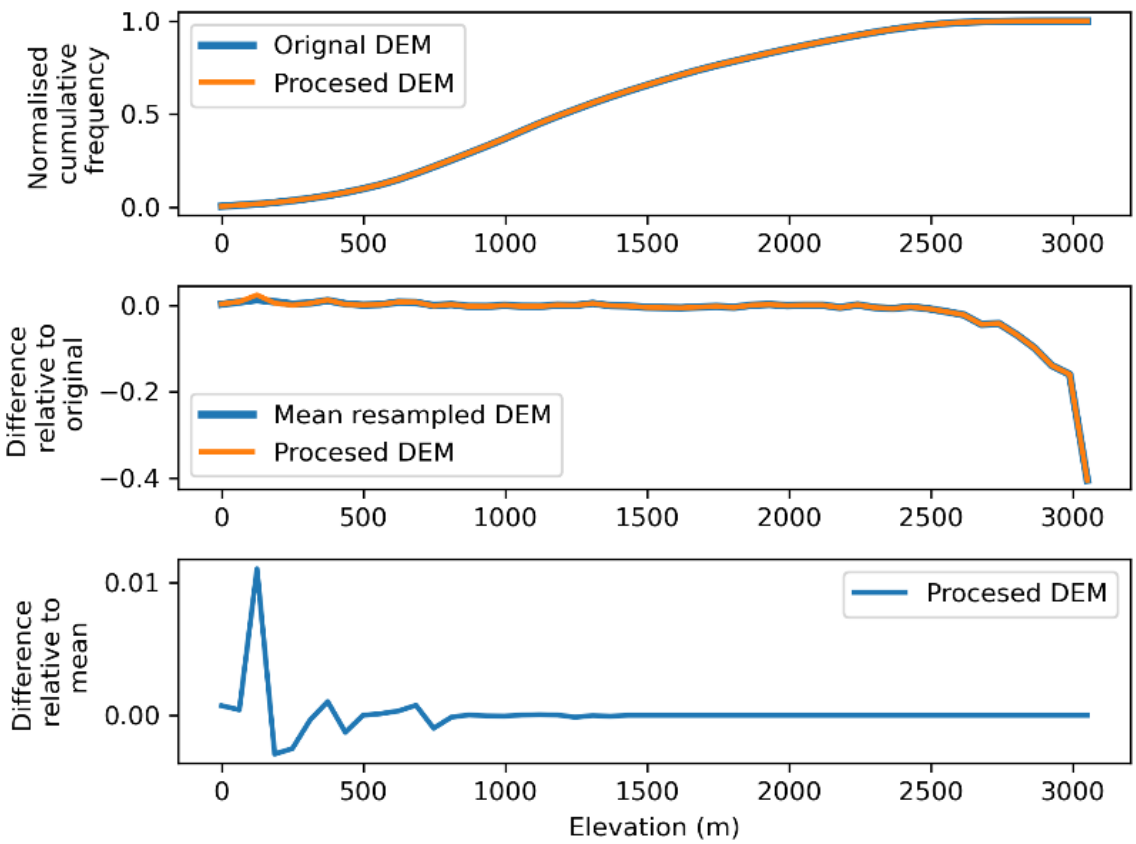

Figure 2: Cumulative distribution of elevation for the original 25 m DEM and the processed DEM. The difference in the distribution of the mean resampled DEM at 50 m resolution and the processed DEM is shown. It can be seen that both are similar, with an under-representation of high topography. The difference between the mean and processed DEM is shown. Here the impact of the carving can be seen, with an increase in low topographies for the processed DEM, where dams have been removed.

References

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