

Urban correction for the hydrological conditioning of the TanDEM-X DEM for the HydroSHEDS v2 database

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Motivation

The HydroSHEDS database provides global hydrographic data for hydrological applications. The second, refined version of the database is improved by using the high-resolution TanDEM-X digital elevation model (DEM). In order to derive hydrologic data from the terrain, during the so-called pre-conditioning, the DEM is edited and ancillary layers are calculated. Prior steps of the editing include, among others like void and outlier correction and the derivation of a coastline and water body mask, an urban correction.

When river networks are derived from a DEM, visible artificial structures can divert the streams as they intercept the natural course of the riverbed. Therefore, during the last step of the pre-conditioning, the urban correction aims to reduce such diversions caused by built-up structures.

Methods

- The World Settlement Footprint (WSF2015) is used to limit corrections only to urban areas
- Input: Unedited minimum TanDEM-X DEM (HYD_DEM)
- Calculation of a local mean, median and standard deviation for each pixel in a 3x3 pixel neighborhood
- Calculation of a local z-score
- Where the score exceeds the threshold of 0.5, the pixel value is replaced with the neighborhood median elevation.
 - ➔ 7 iterations to create a correction layer that can be subtracted from the original DEM
- Validation by visual comparison of the uncorrected and corrected DEMs and respectively derived stream networks with satellite imagery on 17 test sites around the world

Fig.2: Result of the urban correction

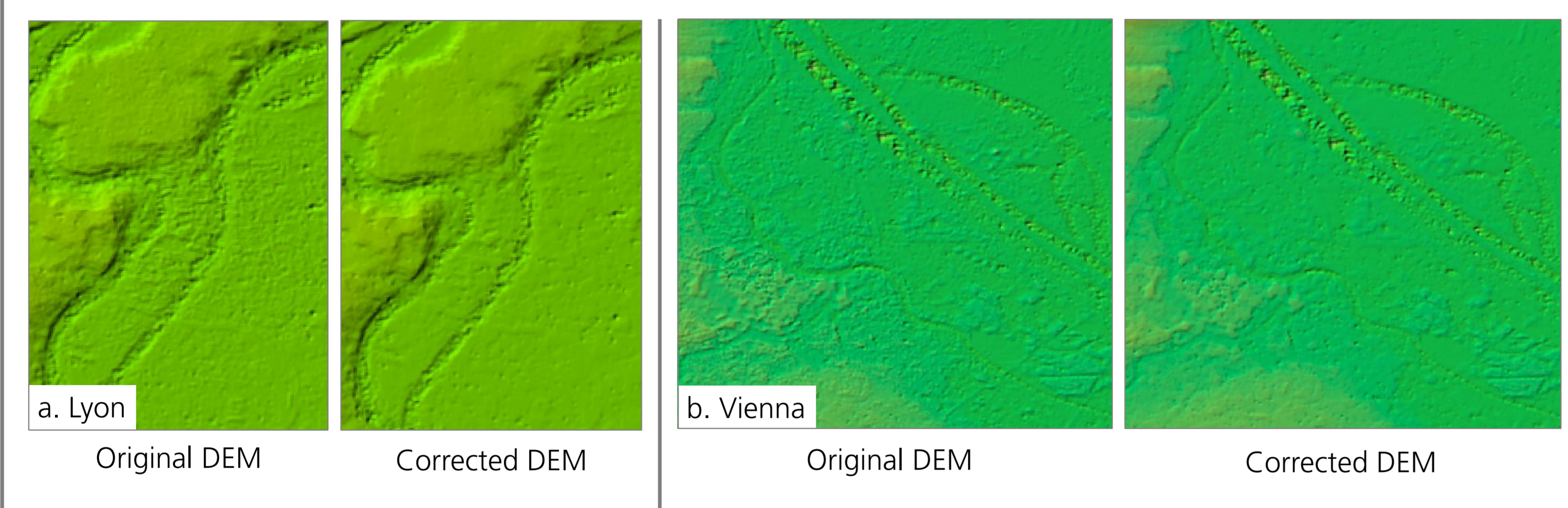
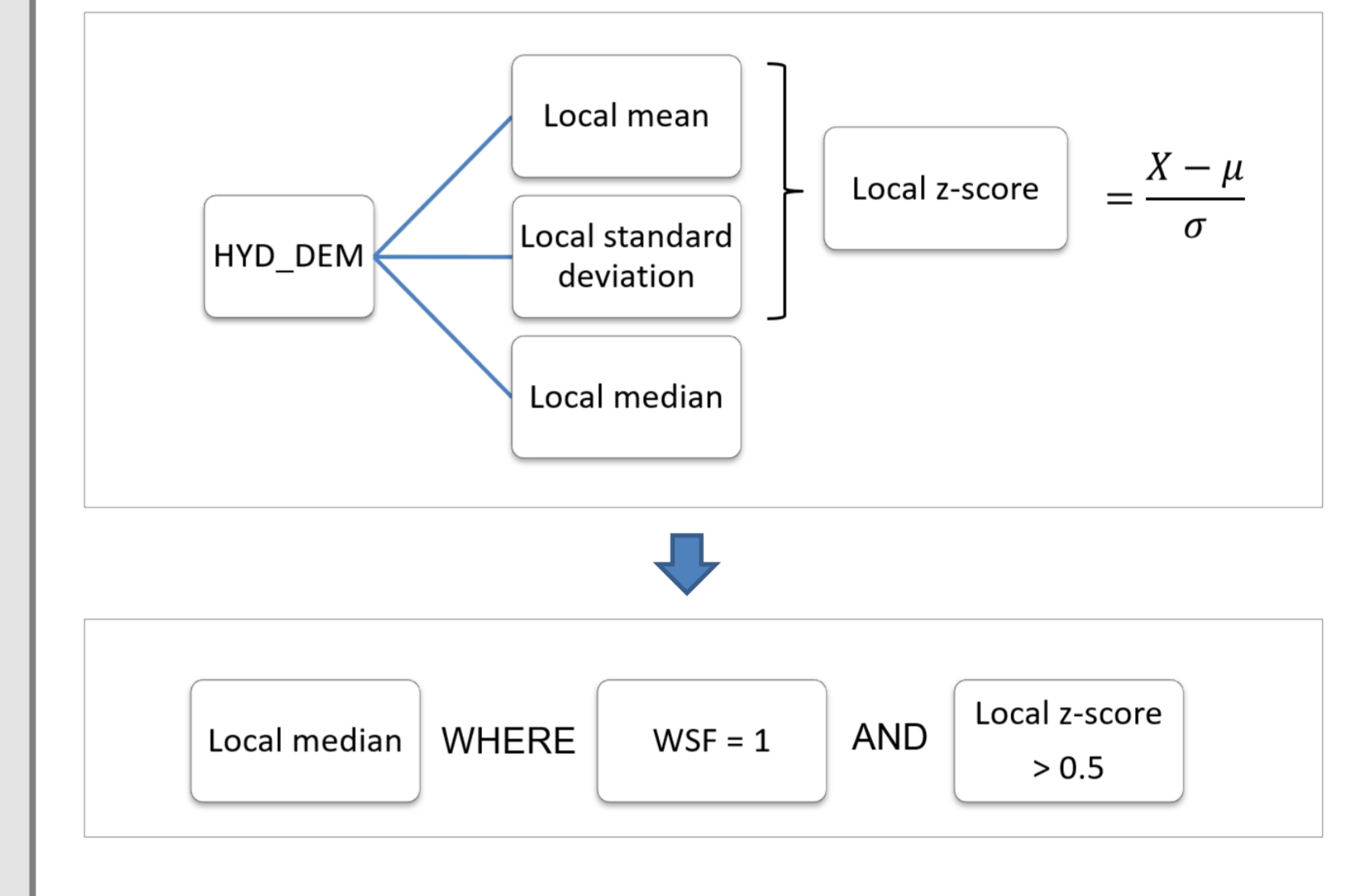


Fig.1: Urban correction workflow



Results and Discussion

- The correction successfully smoothes out urban structures previously visible in the DEM (Fig.2)
- In some cases, the urban correction clearly improves the derived streams (Fig.3)
- However, the validation also shows the need for additional editing
- For example, larger urban structures like highway bridges are not covered by the WSF and therefore not corrected (Fig.4)
- Other problems include the noisy water surface, which causes the jagged river courses, or vegetated areas which can have the same diverting effect on riverbeds as urban areas
- Nevertheless, the urban correction is an important pre-processing step for the following hydrological conditioning
- The corrected DEM could provide a valuable resource for other applications like e.g. flood mapping

Fig.3: Comparison of derived stream networks from the uncorrected and corrected DEM

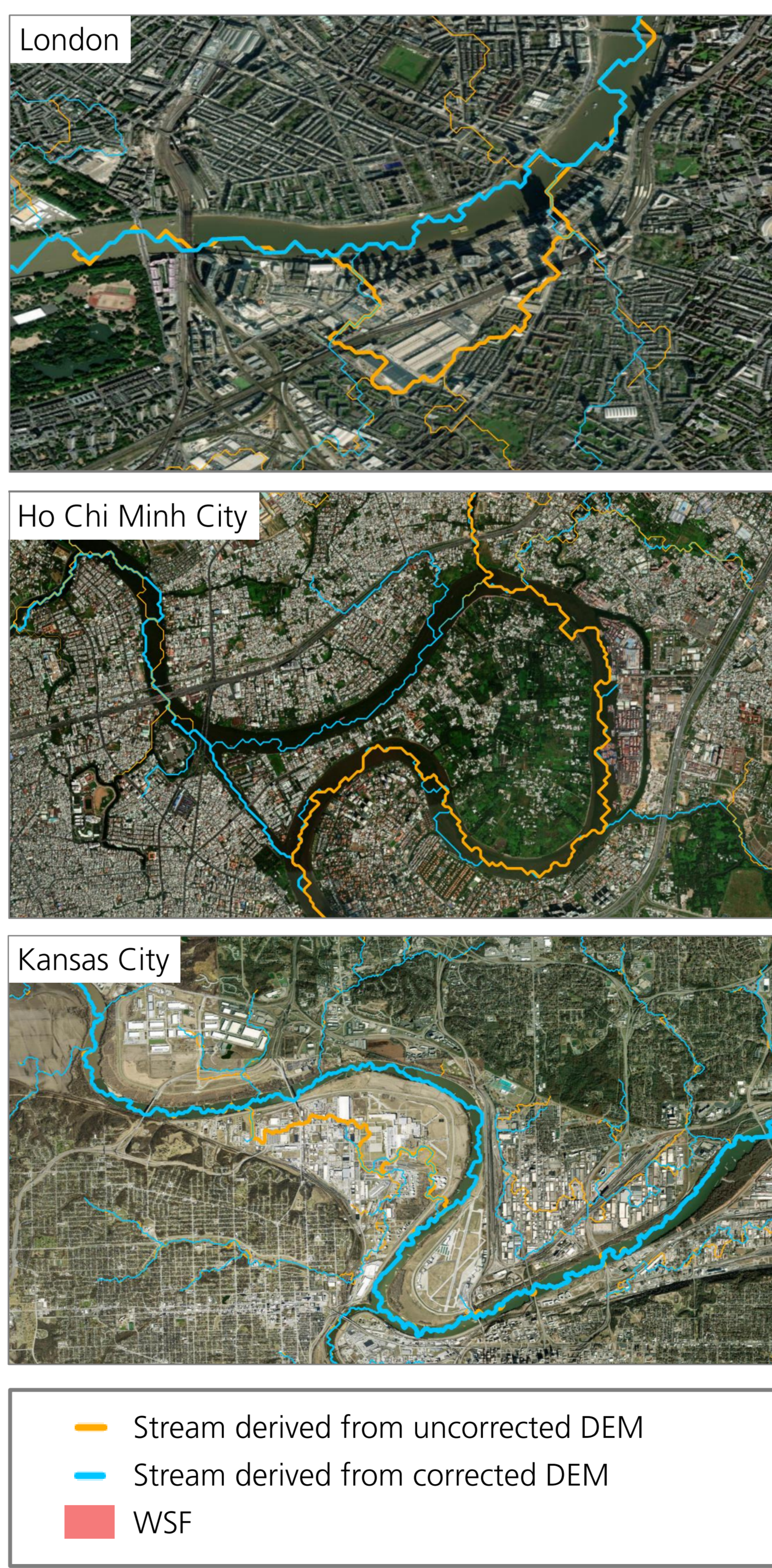
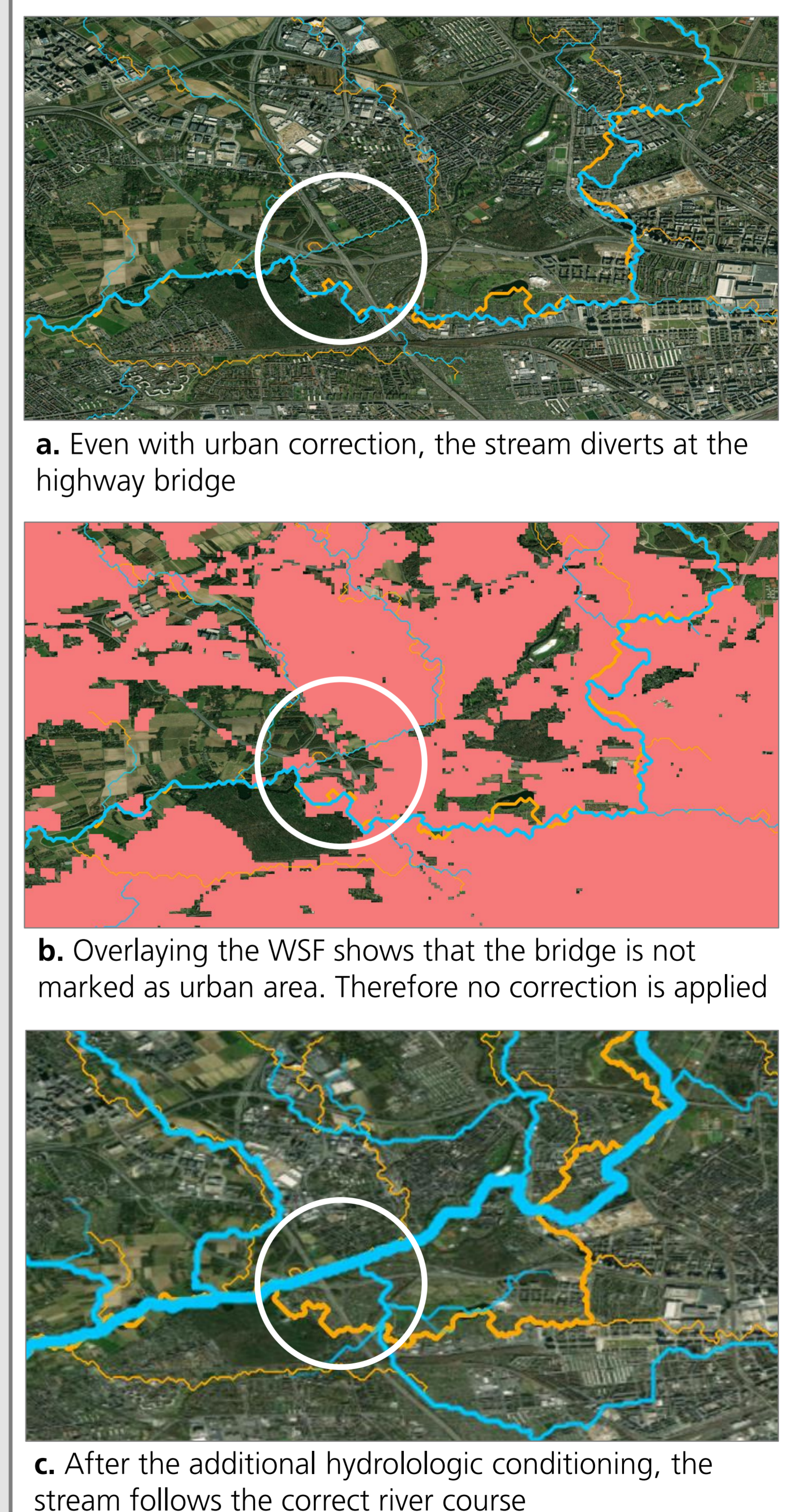


Fig.4: Example of necessary manual correction in Frankfurt am Main



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