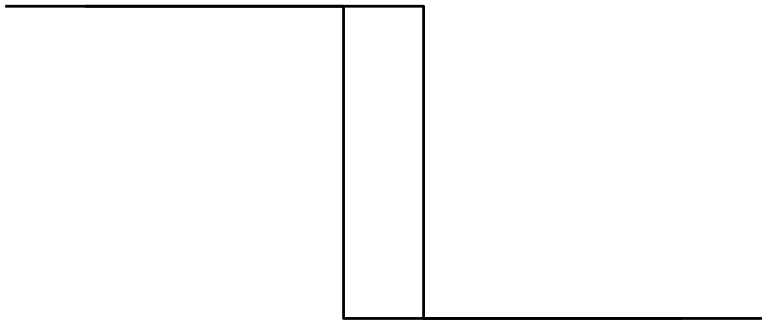
DEM quality control
some critical points

- Reference data, also called “ground truth” (GT) needed

  - GT should ideally be a order of magnitude (10 times) better. This often difficult, costly or impossible to achieve. Thus, GT should be 2-3 times better.
- GT should be dense enough and cover different cases of land cover, terrain relief (steepness, roughness) and texture (not only easy cases)
- Note that GT may include errors, even large ones, especially if not post-edited
- Differences of two DEMs may be due to differences in the definition of the 3D coordinate system of each one of them.

  - Ideally a 3D similarity transformation (3 shifts, 3 rotations, one scale) between the DEMs should be computed and measured DEM transformed to GT. Most dangerous are shifts. They cause big differences at surface discontinuities (e.g. buildings, see below same building (correct), shifted horizontally).



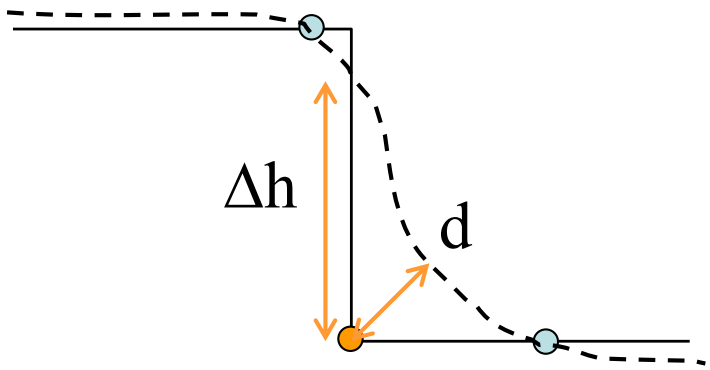
- A matching DEM usually compared:
  - to a more accurate matching DEM (e.g. satellite vs aerial images)
  - a Lidar (laser) DEM
  - much less often DEM from SAR interferometry
  - don’t use few points by GNSS (even if points very accurate)

- Never compare a DSM with a DTM. Or if yes, use only common terrain points.
- Caution with multitemporal differences

  - Trees (e.g. grow 30 cm/year, forests grow or decrease), difference in crops (e.g. corn field), technical structures (buildings demolished or new ones, roads, bridges etc.), quarries, open mines, snow cover (espec. thick one, as in this lab), moving objects (e.g. vehicles, which will anyways be matched wrongly is they move between the stereo images even with along-track stereo). Multitemporal differences more important when accuracy of DEM high (submeter and dm level)

Height differences may be due to modelling, not matching, errors

- Quantitative comparison to reference DEM
- Two comparisons:
  - **Surface height (2.5D)**: difference between the heights of reference DEM and the heights interpolated from generated DEM
  - **Euclidean distance (3D)**: normal distance between the surfaces (Geomatic Studio v4.1 by Raindrop). Unfortunately few programs allow this.
- Limit of DEM height comparison: even if the measurement is correct (blue circles), the surface modeling error may cause large height differences (example: step profile)



- Comparison involves interpolation of one DEM into the other (called target DEM here).
- Interpolation errors depend on:
  - the point density of target DEM
  - the single point accuracy of target DEM
  - the quality of interpolation algorithm (e.g. nearest neighbour versus bicubic interpolation)
  - terrain steepness and roughness and surface discontinuities
- If GT a TIN, avoid first interpolating a regular grid (less interpolation errors)
- How to select the target DEM? In this lab, 2m lidar DEM vs 5m matching DEM

  Considerations:
  - Use the denser DEM (less interpolation errors)
  - Use the more accurate DEM (less interpolation errors, you do not change the GT values)