Relief inversion effect in terrain representations: Where should we place the light source?

Is ABC a valley or a ridge? Shaded relief maps can suffer from a visual illusion called relief inversion (Imhof, 1967). Cartographers conventionally use NW lighting (at 315°) to avoid this illusion. There is however no empirical evidence where exactly the best illumination position is.

We conducted a user study in which we systematically changed the light direction. We measured how many participants correctly identified valleys and ridges using a 5-point Likert scale (1 “clearly a valley” to 5 “clearly a ridge”). Ratings 2 and 4 express level of certainty (confidence).

In the example above, you see the same digital elevation model (DEM) hillshaded in a) under incident light from 337.5° and in b) from 157.5°. The marked landform (ABC) is a valley. Most observers perceive it correctly as a valley in a), but not in b), where they perceive a ridge.

Methods & Results
We have shown 128 stimuli (8 terrains with 16 light directions to naïve participants in a controlled lab-study (N=27). We measured participants’ accuracy in landform identification and their confidence. Accuracy results can be seen at the right. Confidence data suggested that participants were unaware of the illusion.