Aalto University
School of Arts, Design
and Architecture

MAR-E1004 Basics of GIS: Visibility

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Slides adopted from Kirsi Virrantaus, Paula Ahonen-Rainio & Salla Multimäki

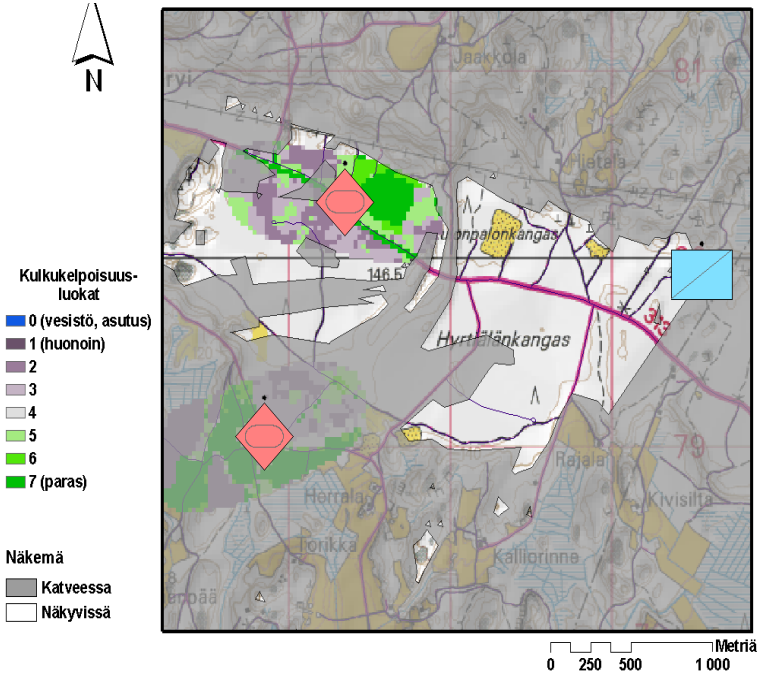
Learning goals

In this session you will learn

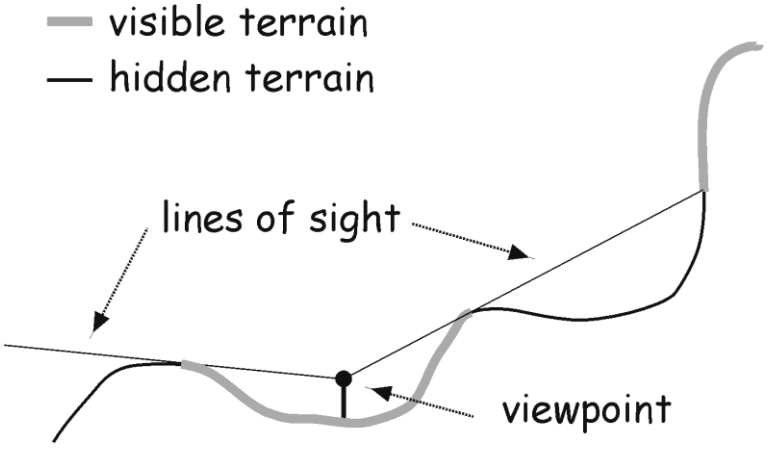
- **To explain what a viewshed is**
- **To calculate viewshed in ArcMap**
- **To apply visibility analysis in landscape characterization**

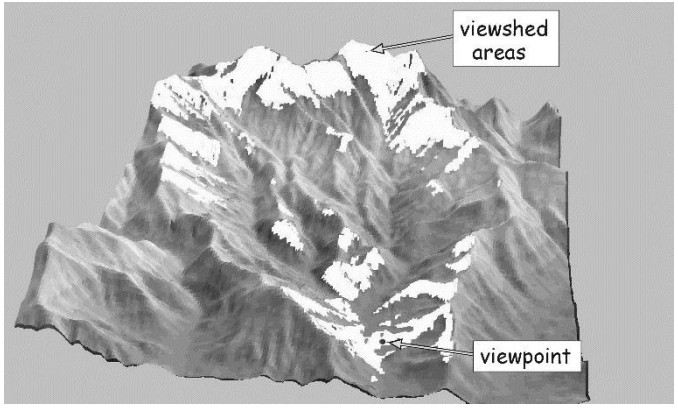
Viewshed

- **“A viewshed is an area of land, water, or other environmental element that is visible to the human eye from a fixed vantage point. The term is used widely in such areas as urban planning, archaeology, and military science.”**
- **Scale-dependent: Elevation model, or even buildings and trees?**
  - DEM does not include buildings or trees
- **Results can be merged with overlay analysis**



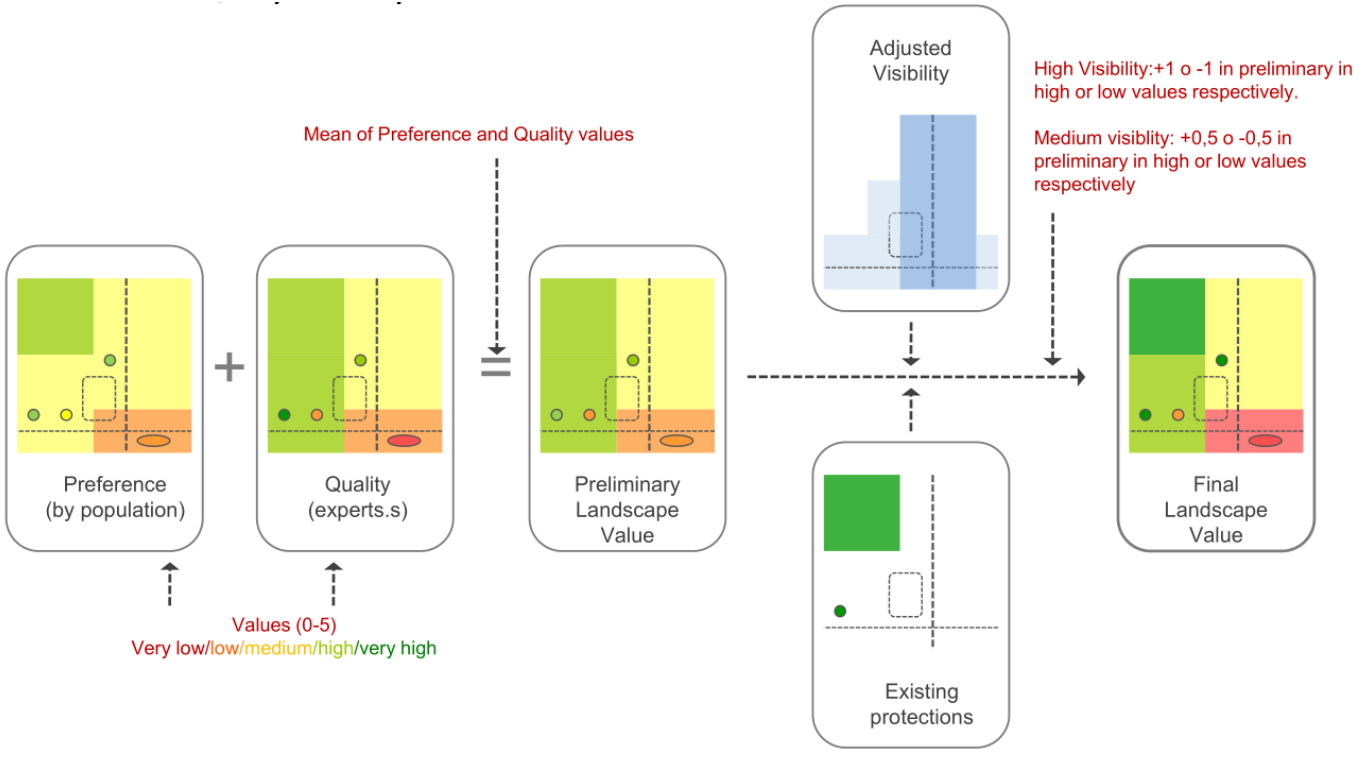
Example: Viewshed





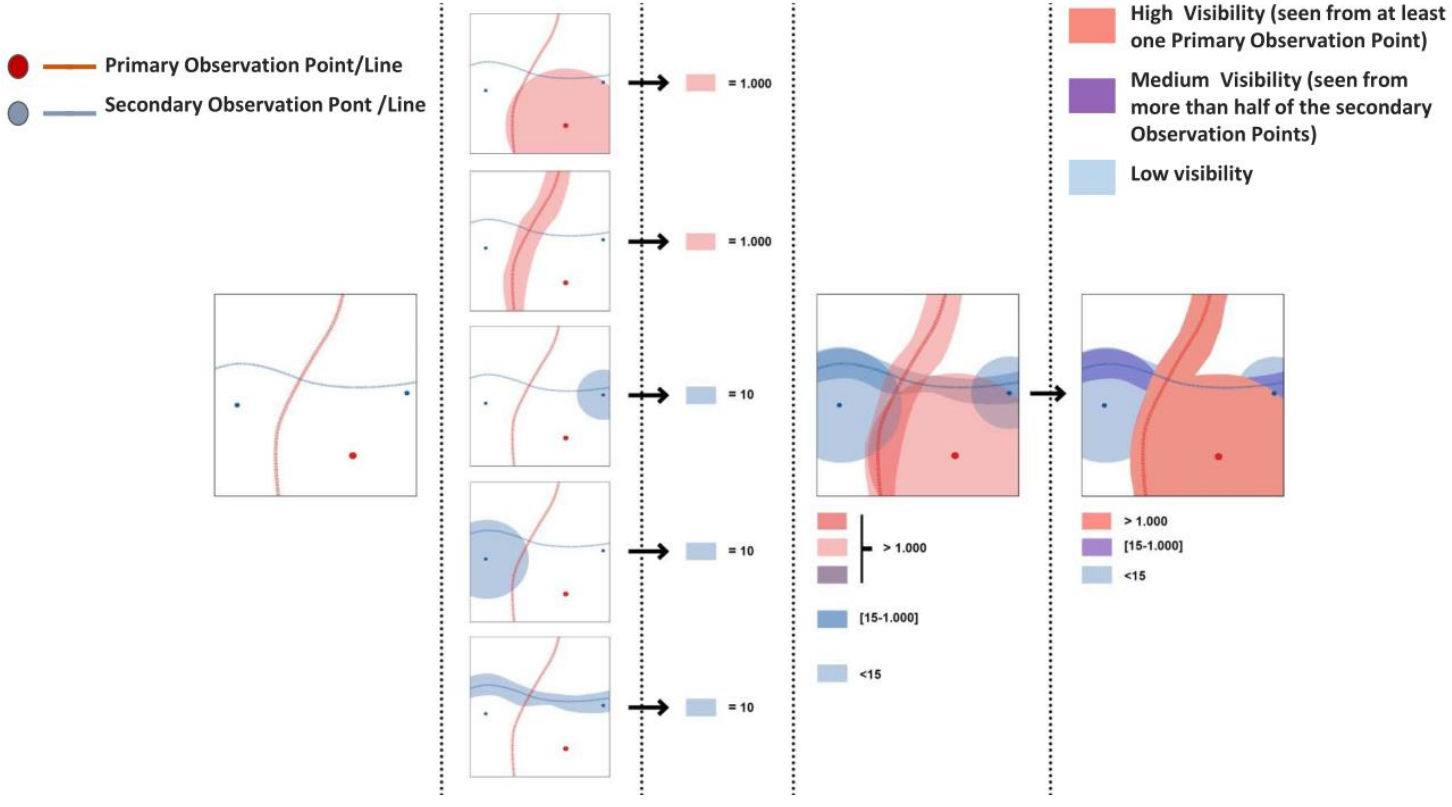
Bolstad: GIS Fundamentals

Visibility in landscape characterization



(Landscape Value as a combination of Landscape preference, landscape quality, landscape designations and landscape visibility according to the Valencian Landscape Regulation. A methodological approach by Juanjo Galan 2011)

Visibility in landscape characterization



Tools in ArcMap

- **Download and clip DEM for the same area where you focused in the previous homework**

- **Open ArcMap and the 3D Analyst toolbar from Customize -> Toolbars -> 3D Analyst**
  - Set the DEM to the toolbar
  - Try the Create Contour tool
  - Try the Create Line of Sight tool; you need to set observer and target height, and click these two points; also try the Profile Graph once you have a line of sight selected

Tools in ArcMap

- **Next create a couple of points and line(s): these represent the primary and secondary observation locations**
  - Give these the attributes OFFSETA and OFFSETB
    - *"The OFFSETA item indicates a vertical distance in surface units to be added to the z-value of the observation point." Default 1.*
    - *"The OFFSETB item indicates a vertical distance in surface units to be added to the z-value of each cell as it is considered for visibility." Default 0.*

- **Use Viewshed-tool from Spatial Analyst –toolbox (Spatial Analyst -> Surface -> Viewshed)**

- **Study the resulting layers; if you had more than one input location, the attribute VALUE gives you the amount of input locations that can see a particular pixel**

Task

Take a pair and think how would you consider the fact that humans have a limited distance they can see. Which analysis tools would you use and how?

Combine visibility with preferences

- **First reclassify / otherwise process the layers to create areas for high visibility (e.g. visible to at least one primary observation point), medium visibility (e.g. visible to more than half of the secondary observation points), and low visibility (other areas)**
  - This might require multiple uses of reclassify and raster calculator –tools; see next page for an example

- **Update the preferences from last week's Homework 1 with visibility (e.g. high = +1, medium = 0, low = -1)**

An example: from viewsheds to visibility areas

- **I have three Viewshed-layers: Viewshed from primary points (V_pri_points), from primary lines (V_pri_lines) and from secondary points (V_sec_points)**
- **To get final visibility layer with values -1, 0 and +1 as defined earlier, the following steps will work:**
  - Reclassify V_pri_points: 0 -> 0, 1-n -> 1
  - Reclassify V_pri_lines: 0 -> 0, 1-n -> 1
  - Sum the previous layers together with Raster Calculator and reclassify 0 -> 0, 2 -> 1 to get layer for high visibility (high_vis)
  - Reclassify V_sec_points (assuming I have 5 secondary points): 0-2 -> 0, 3-5 -> 1 to get layer for medium visibility (medium_vis)
  - Calculate 2 * high_vis + medium_vis with Raster Calculator; possible values are 0 (both inputs were 0), 1 (high_vis 0 and medium_vis 1), 2 (high_vis 1 and medium_vis 0) and 3 (both inputs were 1)
  - Reclassify the previous layer: 0 -> -1, 1 -> 0, 2-3 -> 1 to get a layer where high = 1, medium = 0 and low = -1

Additional information

More information about viewshed can be found from https://desktop.arcgis.com/en/arcmap/latest/tools/spatial-analyst-toolbox/using-viewshed-and-observer-points-for-visibility.htm

Homework

Answer the following questions and provide necessary maps

How does your previous analysis change when you add buildings to the DEM?

Step 1: Add buildings to the elevation model

- Buildings can be found from for example Topographic Database (Maastotietokanta) provided by National Land Survey of Finland (Maanmittauslaitos) in the file r_XXXXXX_p.shp where XXXXXX is the map sheet.
- Buildings don't have their height stored anywhere in that database (that KORARV is the elevation of the land beneath the building; don't use it!): you will have to use some sort of estimate
- Convert buildings to raster and add their height to the DEM

Step 2: Repeat the analysis you just did

- Until you get the layer that describes high (+1), medium (0) and low visibility (-1); no need to add it to the preferences-layer

Step 3: Compare the results (visually or analytically)

Is this visibility analysis now realistic, or are there some aspects missing? Which data sets would you include to the analysis to make the analysis more accurate?