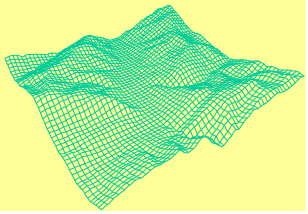
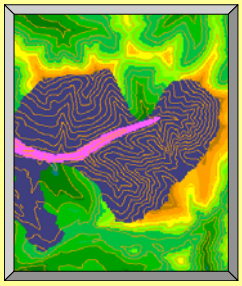
## Surface description





## Surface / terrain analysis



- **Generating DEMs**
- **Slope**
- **Azimut**
- **Landform**
- **Considering resolution / data model**



## Goals

- Generate a broad understanding for purpose and value of surface analysis
- Knowing the most important descriptive operators
- Gain an overview of analytical methods available for (terrain) surfaces

## Issues

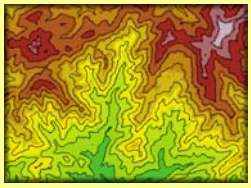
Since surfaces are spatially continuous phenomena other questions are asked, requiring different methods than spatially discrete observations :

- How can we describe *local* and *global* surface characteristics?
- What methods support the analysis of physical processes interacting with surfaces?



## Raster representation of surfaces

- *Point* Raster
- Generated by interpolating points
- Fixed resolution
- Simple algorithms





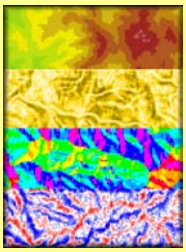
## Vector representation of surfaces (TIN)

- Irregular point measurements
- Tritriangulation
- Local adjustment of resolution
- Sophisticated Algorithms

## Local description of surfaces

Based on Surface::

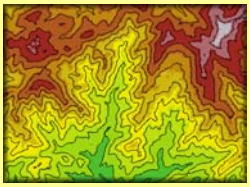
- Slope
- Azimut
- Curvature

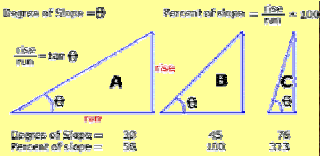


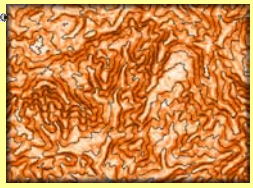


## Slope

- per-point estimation
- degree or percent







## Terrain classification: Slope (rise/run)

DEM

| | | | | |
|---|---|---|---|---|
| 32 | 32 | 34 | 39 | 43 |
| 33 | 35 | 34 | 43 | 44 |
| 34 | 35 | 44 | 45 | 46 |
| 42 | 43 | 53 | 52 | 55 |
| 47 | 47 | 52 | 54 | 56 |

Elevation in meters

resolution = 100 meters

| | | | | |
|---|---|---|---|---|
| 32 | 32 | 34 | 39 | 43 |
| 33 | 35 | 34 | 43 | 44 |
| 34 | 35 | 44 | 45 | 46 |
| 42 | 43 | 53 | 52 | 55 |
| 47 | 47 | 52 | 54 | 56 |

44 - 34 = 10 meters

10 / 100 = .1 or
10 % slope

Percent Slope

| | | | | |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | 10 | | |
| | | | | |
| | | | | |

## Terrain classification: Slope (rise/run)

The actual algorithm that is used to calculate slope is:

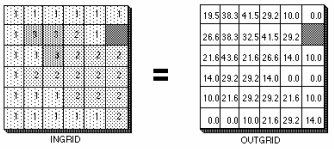
```
rise_run = SQRT(SQR(dz/dx)+SQR(dz/dy))
degree_slope = ATAN(rise_run) * 57.29578
```

where the deltas are calculated using a 3x3 roving window.
a through i represent the z_values in the window:

```
a b c
d e f
g h i

(dz/dx) = ((a + 2d + g) - (c + 2f + i)) / (8 * x_mesh_spacing)
(dz/dy) = ((a + 2b + c) - (g + 2h + i)) / (8 * y_mesh_spacing)
```

**Examples**




Value =NODATA

White Cells
Value = 0



## Terrain classification: Aspect (orientation)

DEM

| | | | | |
|---|---|---|---|---|
| 32 | 32 | 34 | 39 | 43 |
| 33 | 35 | 34 | 43 | 44 |
| 34 | 35 | 44 | 45 | 46 |
| 42 | 43 | 53 | 52 | 55 |
| 47 | 47 | 52 | 54 | 56 |

| | | | | |
|---|---|---|---|---|
| 32 | 32 | 34 | 39 | 43 |
| 33 | 35 | 34 | 43 | 44 |
| 34 | 35 | 44 | 45 | 46 |
| 42 | 43 | 53 | 52 | 55 |
| 47 | 47 | 52 | 54 | 56 |

Aspect

| | | | | |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | 0 | | |
| | | | | |
| | | | | |

Elevation in meters

resolution = 100 meters

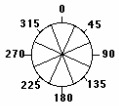
Min = 34, North (0 deg)
Max = 53, South (180 deg)

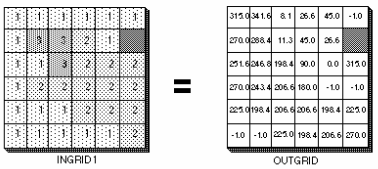
Aspect = 0 deg



## Terrain classification: Aspect (orientation)

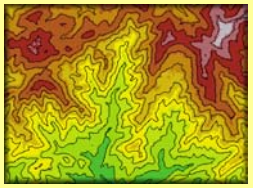
Aspect identifies the down-slope direction of the maximum rate of char
direction of the aspect.

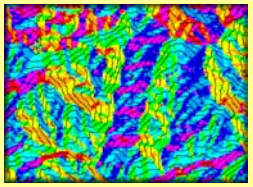


## Azimut

- Direction of steepest slope
- Cyclical scale!!

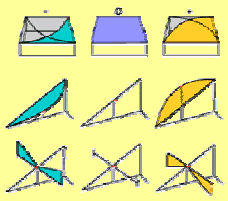


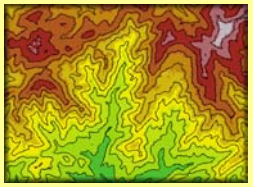


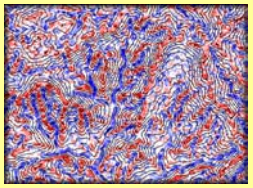


## Curvature

- concave vs. convex



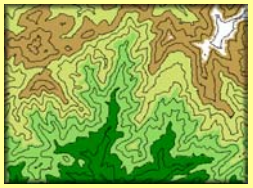






## ‚Global' description of surfaces

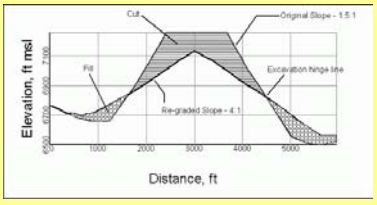
- Aggregation within zones
- Comparative description of sub-regions



## Cut-and-Fill

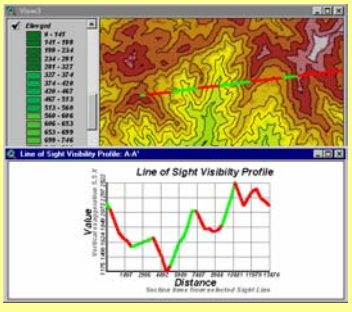
- Volumetric calculation for e.g. construction applications, incl optimization
- Applications in roadwork, excavation, mining, dump sites, …
- Either as full 3D or 2.5D calculations (difference between surfaces)





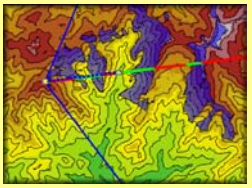


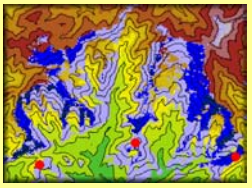

## Profiles



## Visibility

- Along one line of sight
- Sector from one point
- From multiple points, along a line







## Insolation – Irradiation

- Synthetic hillshade > cartography
- Aggregated solar illumination > hours of sunlight
- Irradiation (e.g. solar analyst)