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Contour maps are frequently used to determine downslope direction, especially in tracing surface water flow, solifluction, or contamination movement. A much clearer view of downslope direction can be made using vectors proportional to the steepness of a slope.

Procedure:

Start with a CELL table, for example TOPO_GRID, covering the area of interest, with a field TOPO containing the elevation at the center of each cell. Use any of the 2D modeling programs such as KRIGE, INVERSE, TRIGRID, or MINQ to estimate this digital terrain model (DTM).

Use the DEFINE program to create fields DZDX and DZDY. Both of these should be ACTUAL fields. Use the Tables menu to add these new fields to the CELL table. These fields will be used to store the elevation differences between adjacent cells in the x and y directions of the model. Note that the TOPO, DZDX, and DZDY fields may be INTEGER or REAL fields, depending on the elevation data.

Use TBCALC to calculate the elevation difference between each pair of adjacent cells in the east/west (column) direction using the Equation:

$$\text{TEMP01 TOPO } \setminus - = \text{DZDX} \quad \text{TOPO} = \text{TEMP01} \quad \# \text{ equation 1}$$

Notice that the equation uses the register TEMP01 to pass the value of TOPO to the next record. Calculate with this equation, which stores the difference between the elevation of the cell and the cell to its left, then set up the next Equation:

$$\text{TOPO TEMP01 } \setminus - \text{DZDX} + = \text{DZDX} \quad \text{TOPO} = \text{TEMP01} \quad \# \text{ equation 2}$$

Before calculating with this equation, set the sOrt as follows: TOPO_GRID_row TOPO_GRID_col (-).

After calculating, the DZDX field contains the difference in elevation between the cell to the right and the cell to the left.

Now repeat the process for the row direction in the model. First calculate using the Equation:

$$\text{TEMP01 TOPO } \setminus - = \text{DZDY} \quad \text{TOPO} = \text{TEMP01} \quad \# \text{ equation 3}$$

And the sOrt: TOPO_GRID_col TOPO_GRID_row

DZDY now contains the elevation difference between the cell and the cell below it in the row direction. The final Equation:

$$\text{TOPO TEMP01 } \setminus - \text{DZDY} + = \text{DZDY} \quad \text{TOPO} = \text{TEMP01} \quad \# \text{ equation 4}$$

Should be performed with the sOrt: TOPO_GRID_col TOPO_GRID_row (-)

With these four calculations performed, each record contains the average change in elevation between its two neighbors in the column direction and in the row direction of the model. These two fields, DZDX and DZDY, can be plotted as vectors using the VECFIELD program. The order in which the calculation was performed ensures that the differences are positive in the downhill direction, and the resultant vectors will point downhill. Make sure to use filters to avoid plotting the spurious values in the first and last column and row of the model, as these cells do not have all four necessary neighbors.

The DZDX and DZDY fields can also be converted to slope direction and magnitude. The following CALCULATED FIELD Equations can be used. The divisions by column and row sizes are not necessary if the column and row size are equal in the CELL table.

Technote: Plotting Downslope Vectors

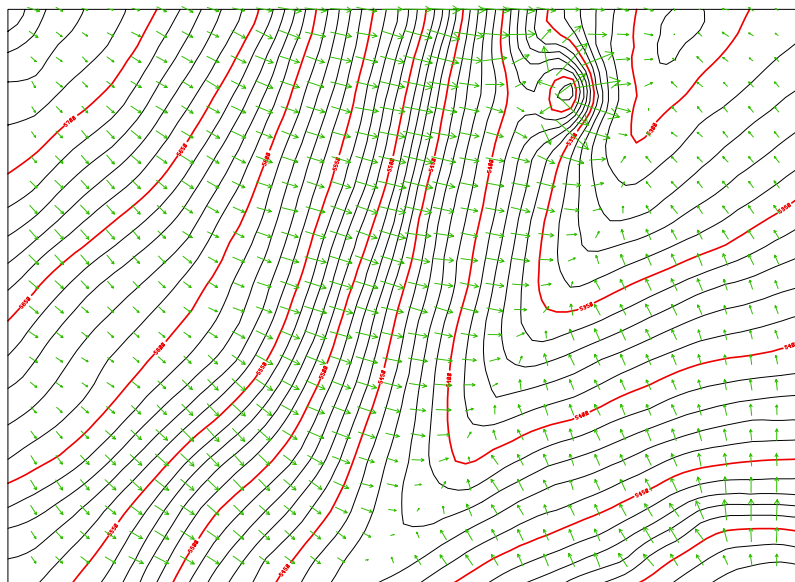
AZIMUTH: DZDX TOPO_GRID_col / DZDY TOPO_GRID_row / atan2
ANGLE: DZDX TOPO_GRID_col / DZDY TOPO_GRID_rsz / + 2 sort / Asian
SLOPE: ANGLE tan
NORMAL: ANGLE 90 \-

The following example is performed in the BOLAND database distributed with the TECHBASE tutorial data.

- a. With the *DEFINE* program, the following TABLE was added to the database:

```
Table TOPO_GRID is a CELL table with 11 fields and 4158 records
Table attributes:
  Lower-left X coord:      10000  Column size:  50  Number:  63
                        Y coord:      20000  Row size:  50  Number:  66
  Baseline azimuth:      90.00
FIELDS:
TOPO      ACTUAL   REAL      Minimum = 4000.0  Maximum = 6500.0
DZDX      ACTUAL   REAL      Minimum = -100.0  Maximum =  100.0
DZDY      ACTUAL   REAL      Minimum = -100.0  Maximum =  100.0
```

- b. Next, the TOPO field was estimated using the *KRIGE* program, using the east, north, and elev FIELDS from the topography TABLE as data points. A 250 foot circular search was used, with a maximum of 16 data points. The overgraze was specified as LINEAR, with a *Sill* of 500 and *Range* of 500.
- c. The *TBCALC* program was run with the equations one through four listed above.
- d. Separate metafiles were created using *GRIDCONT* and *VECFIELD*. When running *VECFIELD*, the vector *Style* was given as *Location CENTER* (vector centered on cell centroid). The proportion was given as *Size* 0. to.9 inch over a slope *Value* range of 0 to 80. The two metafiles plotted together yield the following graphic:



For additional information see [“Define - Create databases, tables, and fields” on page tb-3](#). [“Vecfield - Plot vectors” on page gr-187](#) and [“Krige - Kriging estimation” on page mo-27](#)