



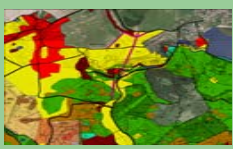
## THEME 3

# Stationary climatic data extrapolation using digital terrain model

Ing. Martin Klimánek, Ph.D.  
Doc. RNDr. Jaromír Kolejka, CSc.

[klimanek@mendelu.cz](mailto:klimanek@mendelu.cz)  
[kolejka@mendelu.cz](mailto:kolejka@mendelu.cz)  
<http://mapserver.mendelu.cz/>





## Compilation of map of potential average annual air temperatures on the territory of University Forest Enterprise „Křtiny“.

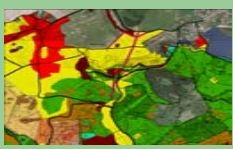
### Why to do it?

- Stationary time series represent points only, full area coverage is necessary for consequent data processing. The data extrapolation from points to the area can be done using defined physical relationships between temperature and area features (using map algebra).

### How to do it?

- We need DTM and climatologic data. Temperature time series collected on climatic stations create the data source for derivation of regression equation representing the dependence of temperature on elevation. Using this equation, the DTM data can be recalculated into temperature data covering the whole territory. Slope and aspect data can be derived from DTM as well. Using climatologic relationship equations, the temperature data layer can be specified respecting slope and aspect data.

## Stationary climatic data extrapolation using digital terrain model



$$T = T1 + T2 [^{\circ}\text{C}]$$

T1... temperature dependence on elevation

T2... temperature correction with regard to slope and aspect

$$T1 = 10.5935 - 0.0082 * [\text{DTM}]$$

$$T2 = A * K - A$$

$$A = 4.4 + T1 * 0.133$$

K = coefficient of proportional insolation  
(see table)

## Average annual air temperature

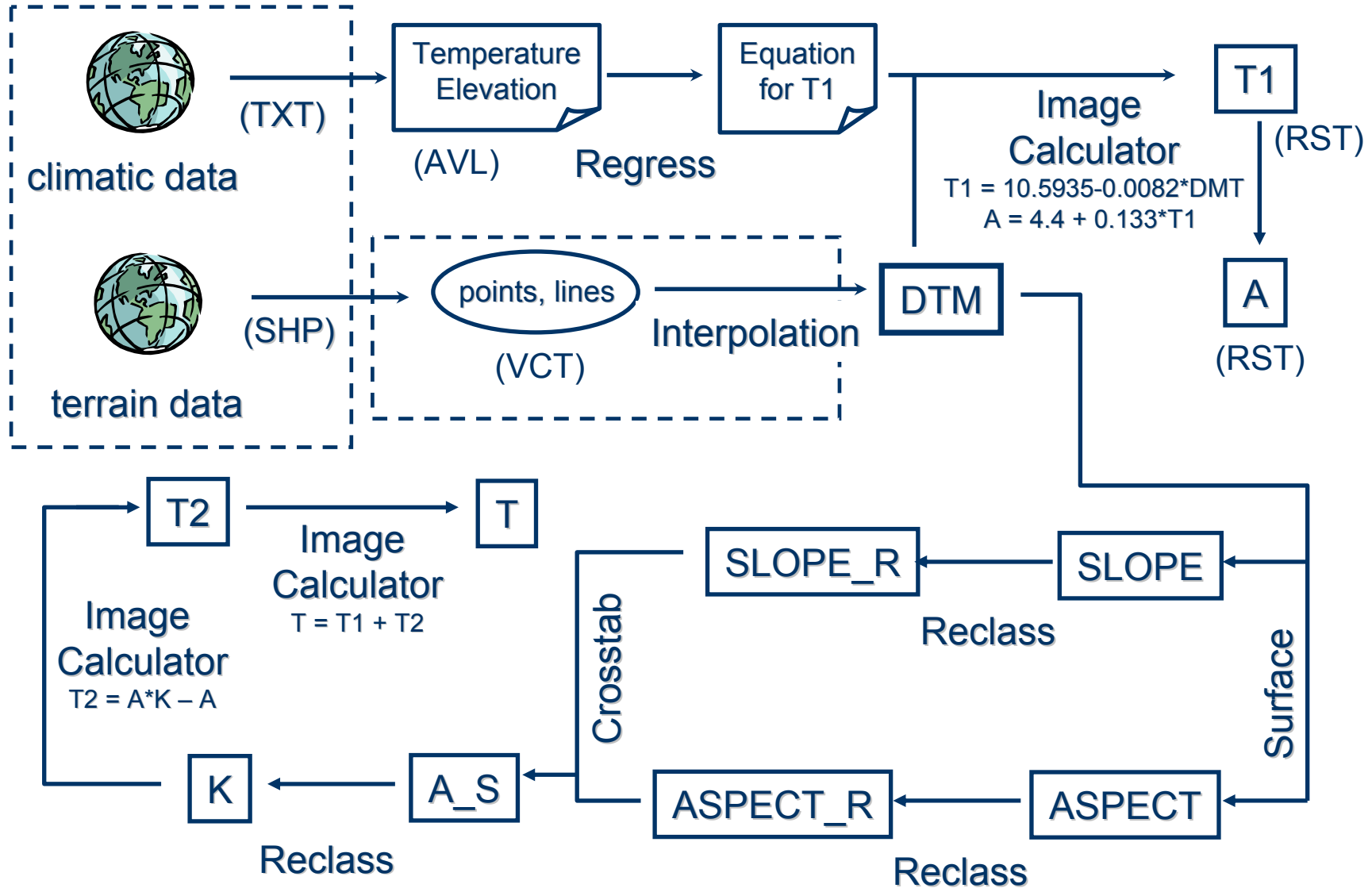
1. Tuřany	241 m a.s.l.	8.9 °C
2. Pisárky	223 m a.s.l.	8.5 °C
3. Babice	460 m a.s.l.	6.6 °C
4. Bukovinka	524 m a.s.l.	6.4 °C
5. Blansko	287 m a.s.l.	8.4 °C
6. Kuřim	291 m a.s.l.	8.0 °C
7. Olomuřany	360 m a.s.l.	7.6 °C
8. Hádý	420 m a.s.l.	7.5 °C
9. Soběřice	398 m a.s.l.	7.2 °C
10. Vranov	440 m a.s.l.	6.9 °C
11. Polanka	296 m a.s.l.	8.2 °C
12. Křtiny	430 m a.s.l.	7.1 °C
13. Proklest	540 m a.s.l.	6.1 °C

„K“	0°- 5°	5°-10°	10°-15°	15°-20°	20°-25°	25°-30°	30°-40°	40°-50°
S	1.05	1.11	1.17	1.22	1.26	1.31	1.34	1.37
SE, SW	1.04	1.10	1.16	1.20	1.24	1.26	1.28	1.30
E, W	1.02	1.06	1.09	1.11	1.12	1.12	1.10	1.07
NE, NW	1.00	1.02	1.01	1.00	0.99	0.97	0.92	0.84
N	0.99	1.00	0.98	0.96	0.93	0.87	0.81	0.75



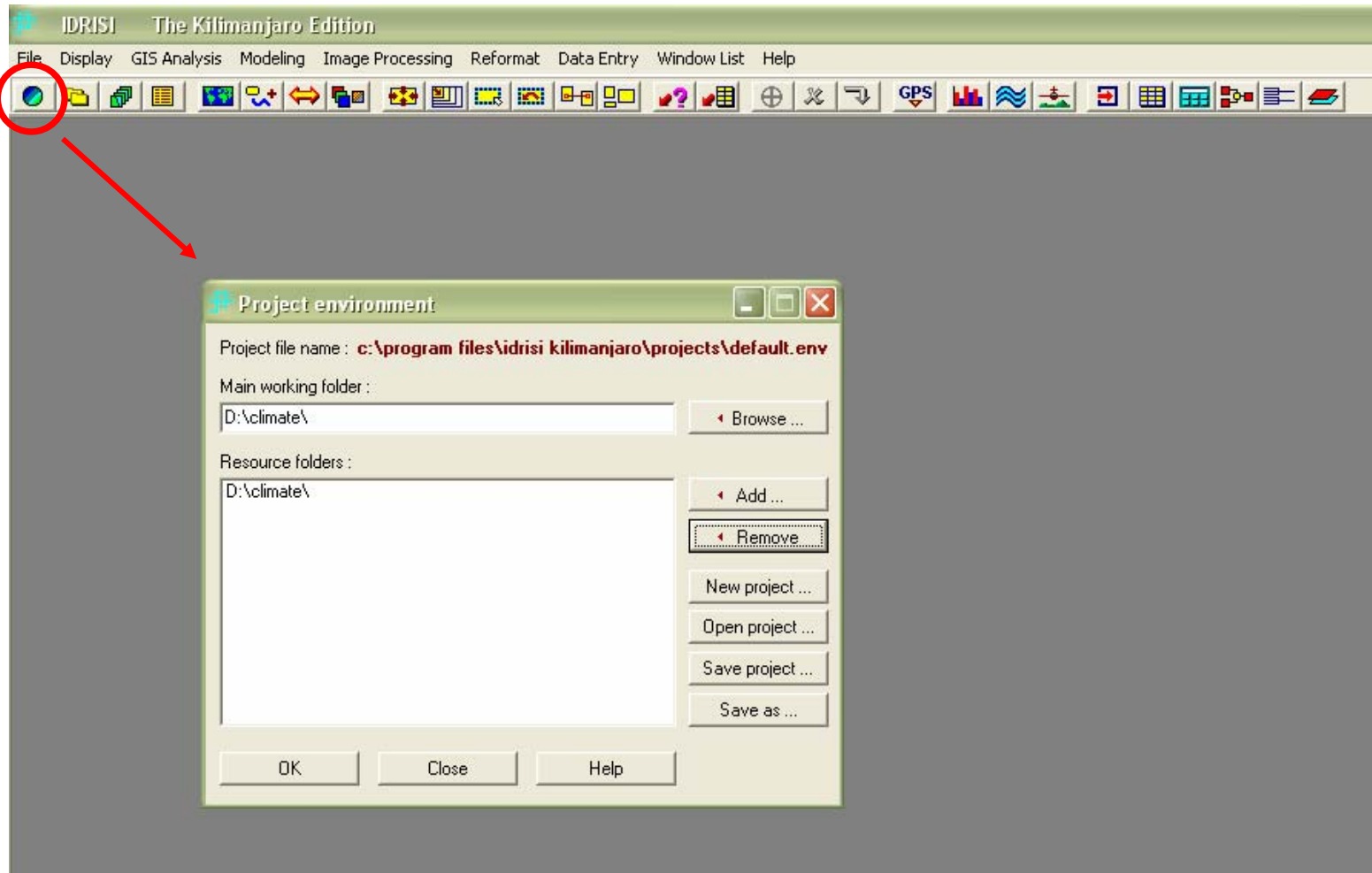
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## Stationary climatic data extrapolation using digital terrain model





### PROJECT ENVIRONMENT





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## Stationary climatic data extrapolation using digital terrain model

EDIT → elevation.avl, temperature.avl

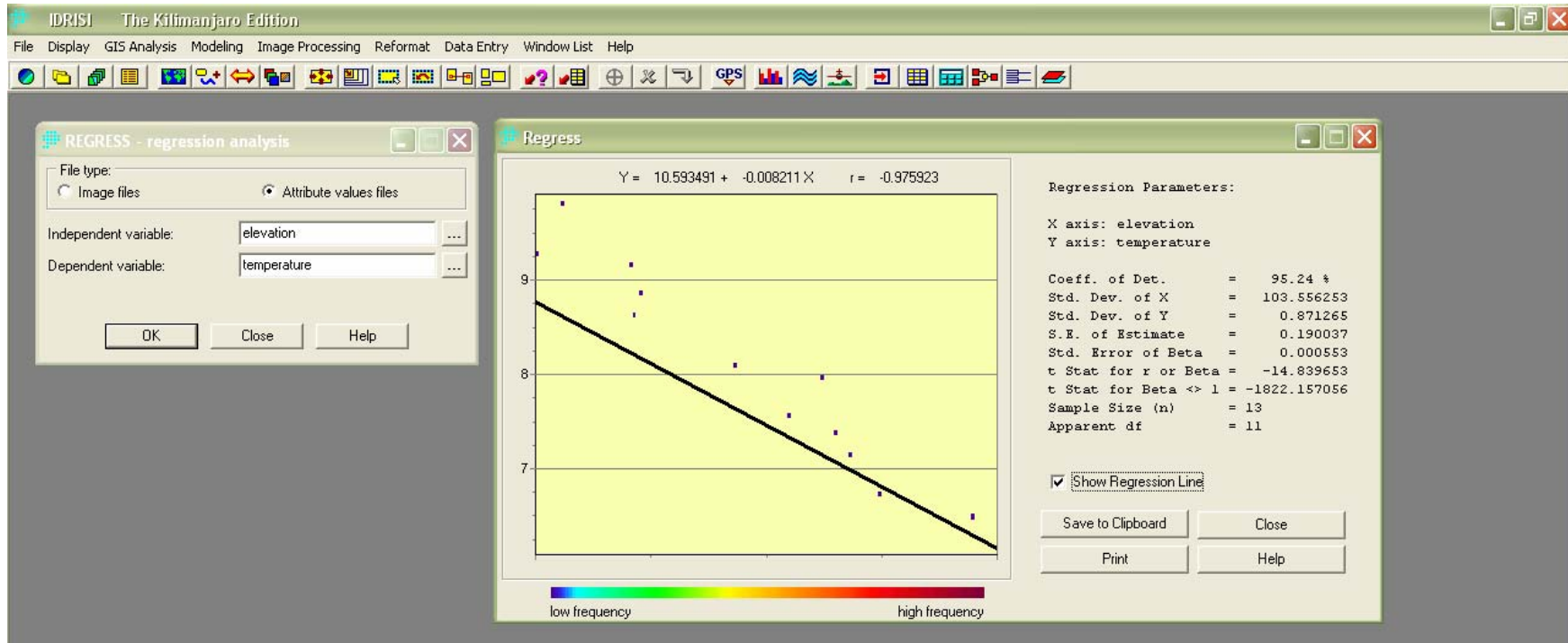
The screenshot displays the IDRISI 'The Kilimanjaro Edition' software interface. The main window shows a list of data values. Two 'Save file' dialog boxes are open, one for 'elevation.avl' and one for 'temperature.avl'. Both dialogs show the file being saved to the 'socrates' folder. The 'elevation.avl' dialog has the filename 'elevation' and the file type 'Attribute values file (\*.avl)'. The 'temperature.avl' dialog has the filename 'temperature' and the file type 'Attribute values file (\*.avl)'. The background window shows a list of values: 1 241, 2 223, 3 460, 4 524, 5 287, 6 291, 7 380, 8 420, 9 398, 10 440, 11 296, 12 430, 13 540. The 'temperature' dialog shows a list of values: 1 8.9, 2 8.5, 3 6.6, 4 6.4, 5 8.4, 6 8.0, 7 7.6, 8 7.5, 9 7.2, 10 6.9, 11 8.2, 12 7.1, 13 6.1.



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## Stationary climatic data extrapolation using digital terrain model

REGRESS → elevation.avl – temperature.avl





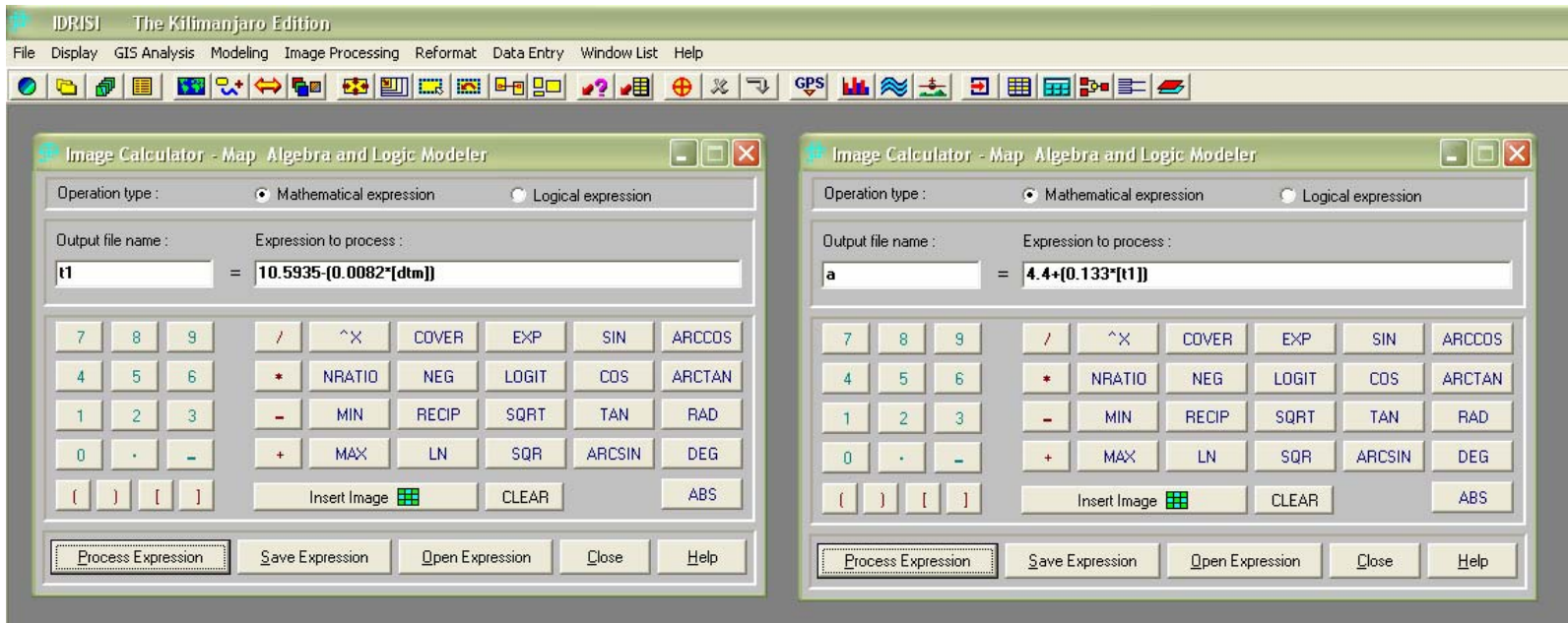


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## Stationary climatic data extrapolation using digital terrain model

DISPLAY → dtm.rst

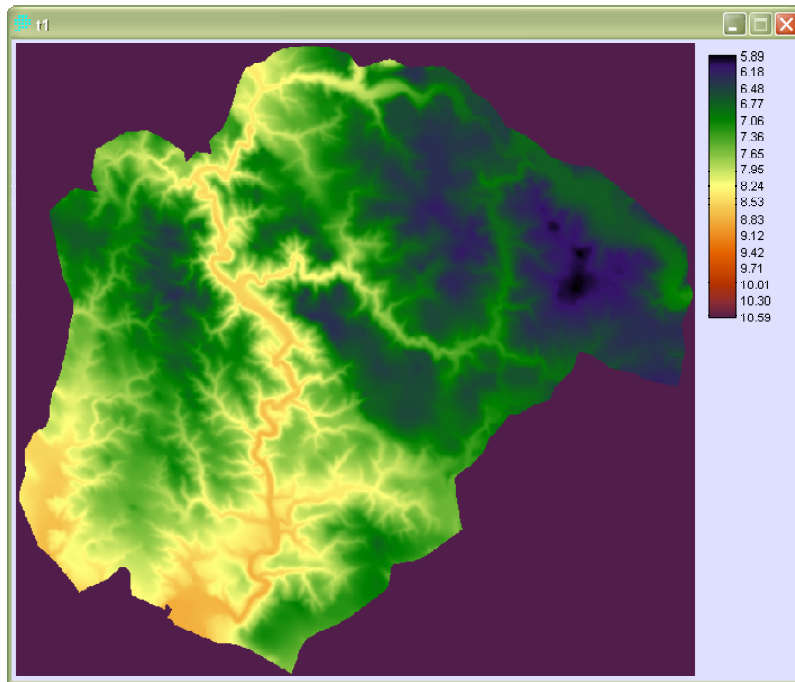
IMAGE CALCULATOR →  $t1 = 10.5935 - (0.0082*[dtm])$   
 $a = 4.4 + (0.133*[t1])$



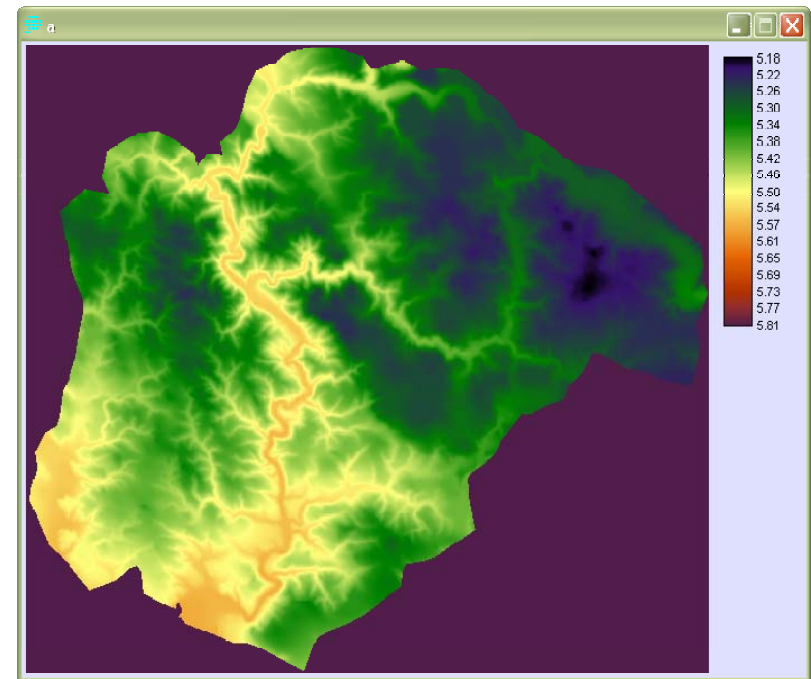




t1.rst, palette: Quant



a.rst, palette: Quant





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## Stationary climatic data extrapolation using digital terrain model

SURFACE → dtm.rst – slope.rst, aspect.rst

The screenshot displays the IDRISI 'The Kilimanjaro Edition' software interface. The main window shows a Digital Terrain Model (DTM) titled "Digital terrain model 'SLP Krtiny'". The DTM is a color-coded map of terrain elevation, with a legend on the right side showing a scale from <200.00 to 573.87. The legend values are: <200.00, 223.37, 246.73, 270.10, 293.47, 316.83, 340.20, 363.57, 386.93, 410.30, 433.67, 457.03, 480.40, 503.77, 527.13, 550.50, and 573.87. The DTM is displayed in a window titled "dtm".

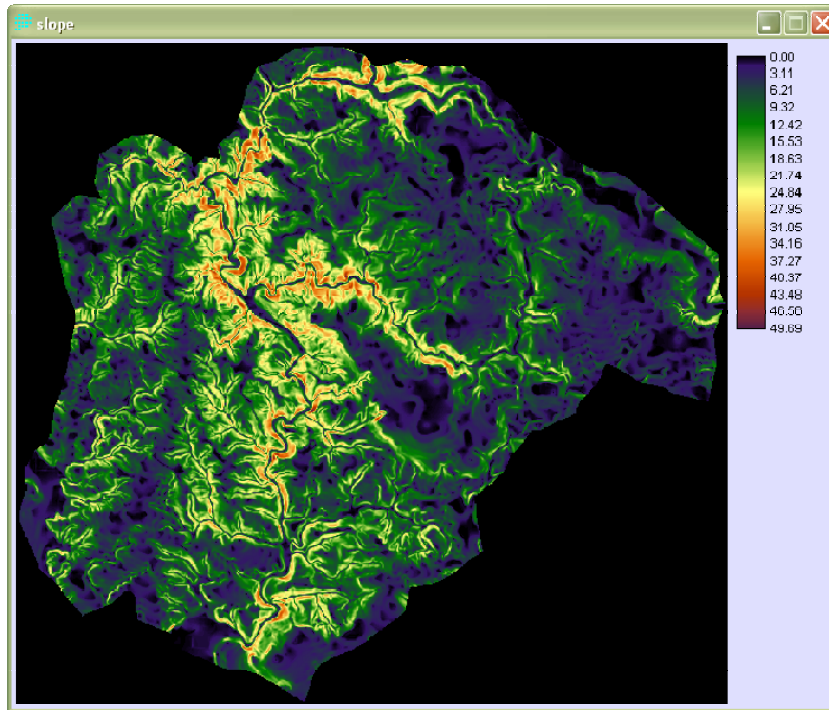
In the foreground, a dialog box titled "SURFACE - surface analysis" is open. The dialog box has the following settings:

- Calculate:  Slope,  Slope and aspect,  Aspect,  Analytical hillshading
- Input elevation model: dtm
- Output slope image: slope
- Output aspect image: aspect
- Calculate slopes in:  degrees,  percent
- Conversion from unspecified to m: 1
- Slope image title: (empty field)
- Aspect image title: (empty field)

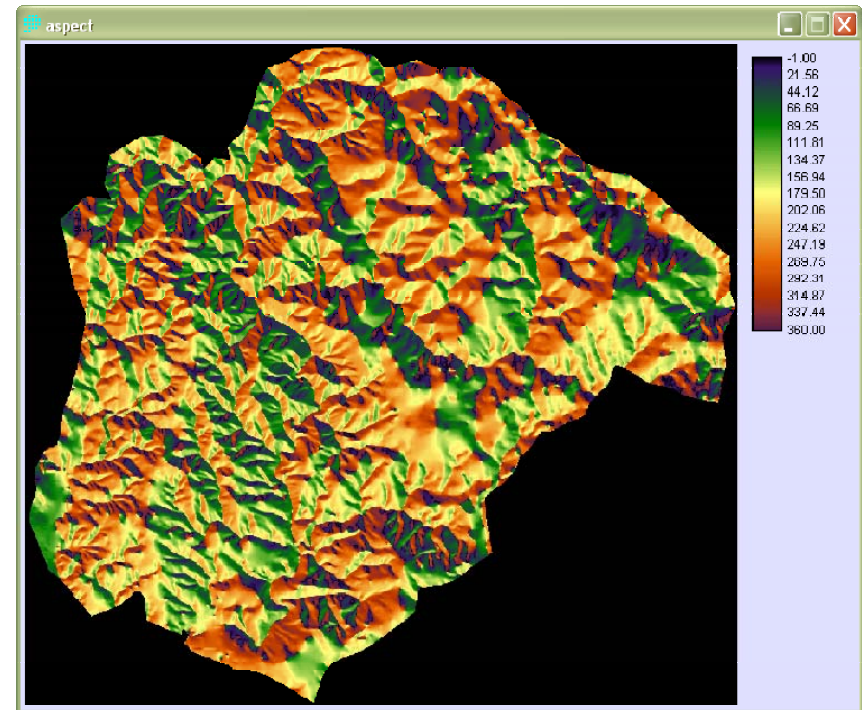
The dialog box has "OK", "Close", and "Help" buttons at the bottom.



slope.rst, palette: Quant



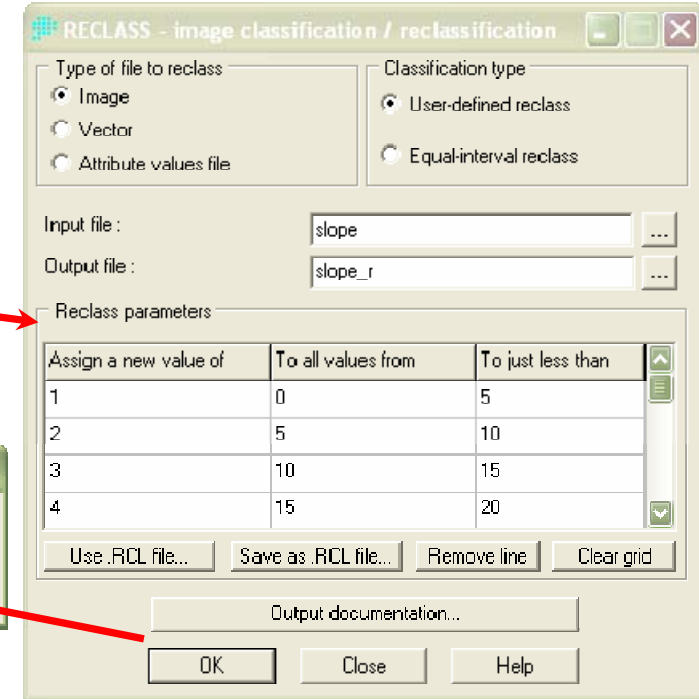
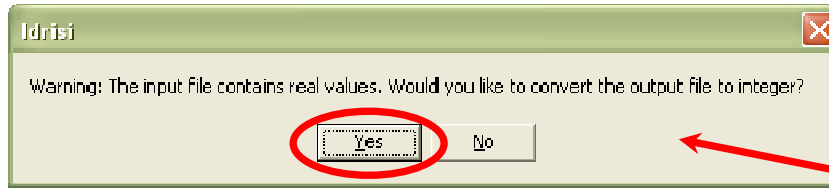
aspect.rst, palette: Quant





RECLASS → slope.rst – slope\_r  
 Save as .RCL File: slope.rcl

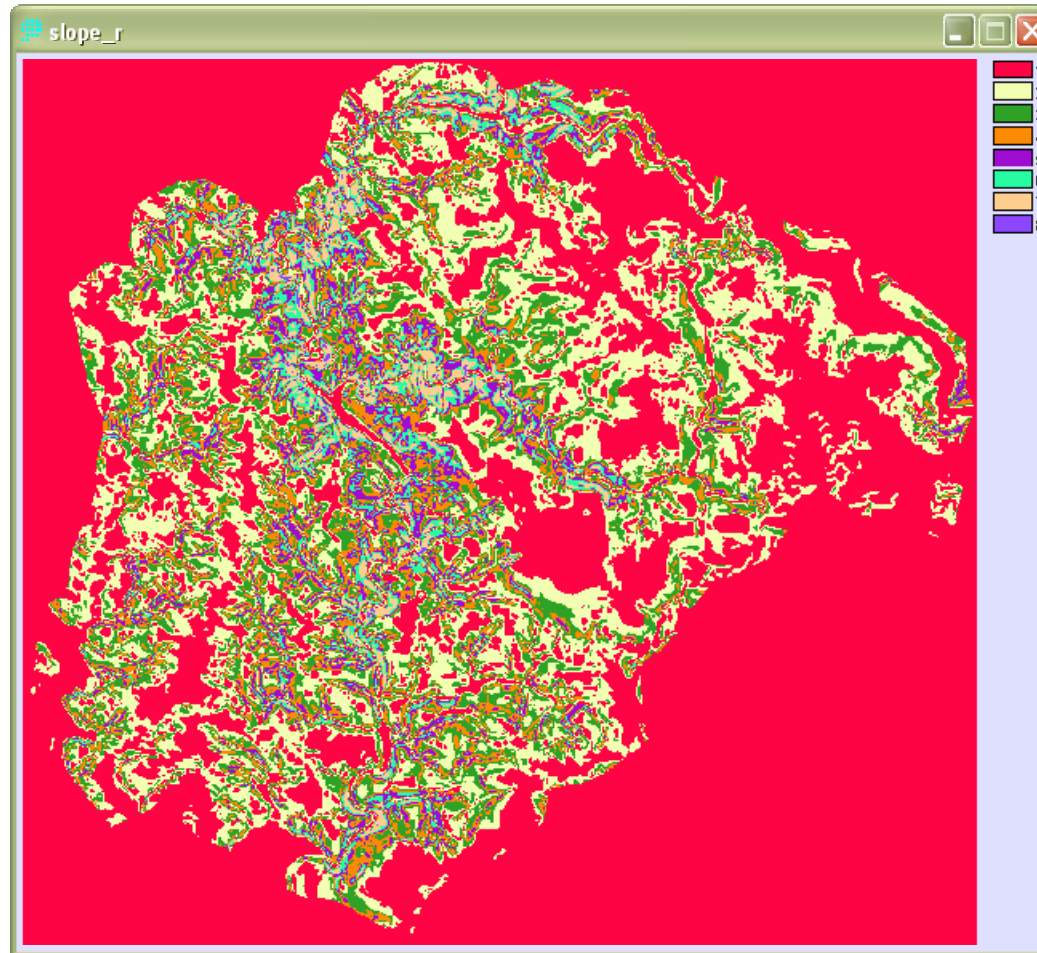
1 0 5  
 2 5 10  
 3 10 15  
 4 15 20  
 5 20 25  
 6 25 30  
 7 30 40  
 8 40 50



„K“	(1) 0°- 5°	(2) 5°-10°	(3) 10°-15°	(4) 15°-20°	(5) 20°-25°	(6) 25°-30°	(7) 30°-40°	(8) 40°-50°
S	1.05	1.11	1.17	1.22	1.26	1.31	1.34	1.37
SE, SW	1.04	1.10	1.16	1.20	1.24	1.26	1.28	1.30
E, W	1.02	1.06	1.09	1.11	1.12	1.12	1.10	1.07
NE, NW	1.00	1.02	1.01	1.00	0.99	0.97	0.92	0.84
N	0.99	1.00	0.98	0.96	0.93	0.87	0.81	0.75



slope\_r.rst, palette: Qual

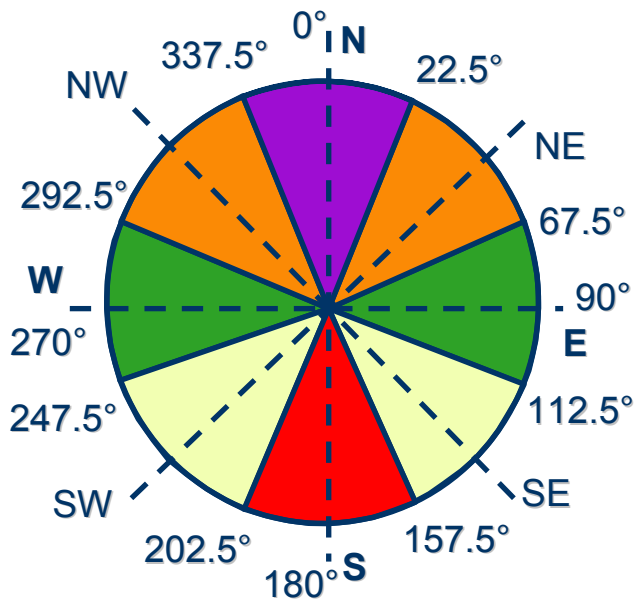


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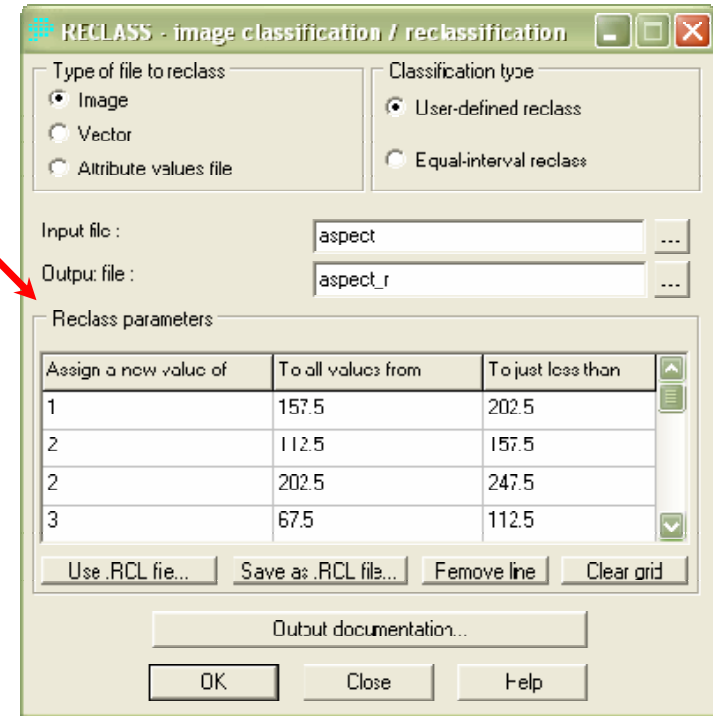
## Stationary climatic data extrapolation using digital terrain model



RECLASS → aspect.rst – aspect\_r.rst  
 Save as .RCL File: aspect.rcl

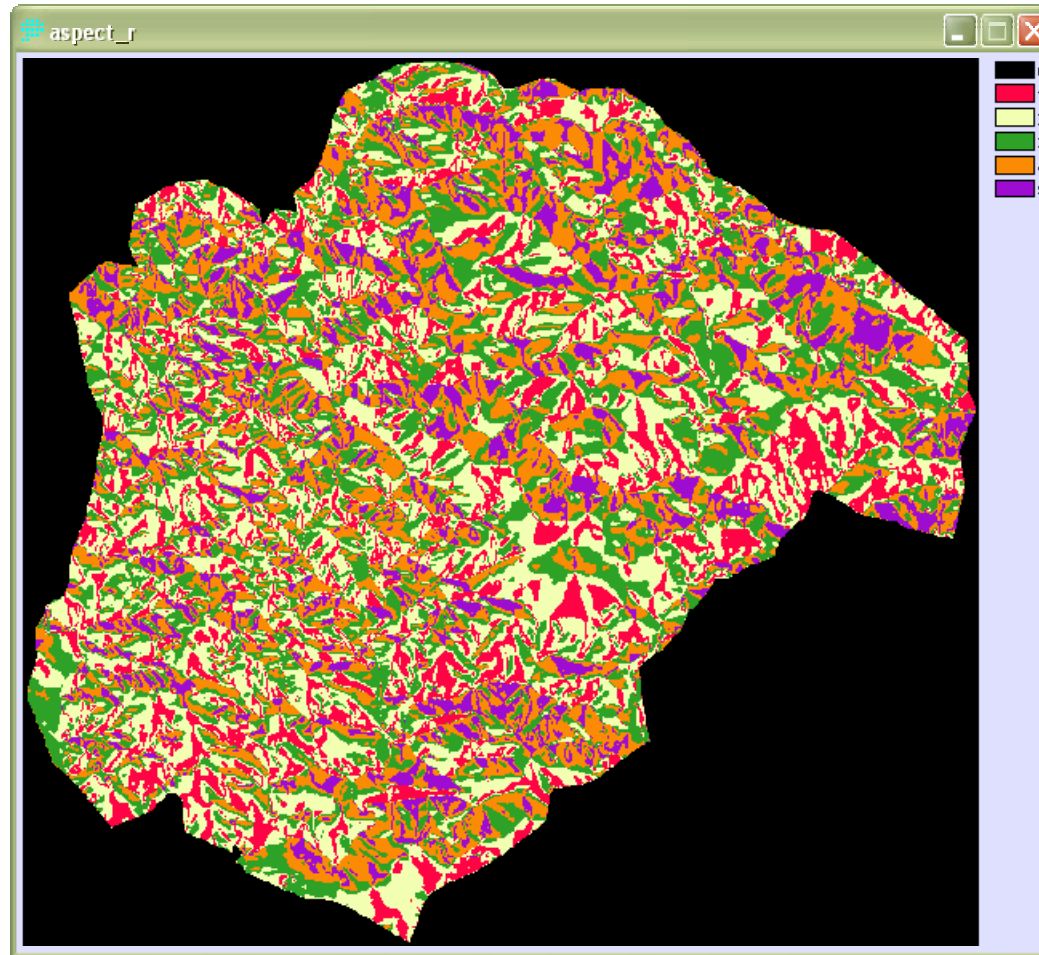


1	157.5	202.5
2	112.5	157.5
2	202.5	247.5
3	67.5	112.5
3	247.5	292.5
4	22.5	67.5
4	292.5	337.5
5	0	22.5
5	337.5	360
0	-1	0



„K“	0°- 5°	5°-10°	10°-15°	15°-20°	20°-25°	25°-30°	30°-40°	40°-50°
S (1)	1.05	1.11	1.17	1.22	1.26	1.31	1.34	1.37
SE, SW (2)	1.04	1.10	1.16	1.20	1.24	1.26	1.28	1.30
E, W (3)	1.02	1.06	1.09	1.11	1.12	1.12	1.10	1.07
NE, NW (4)	1.00	1.02	1.01	1.00	0.99	0.97	0.92	0.84
N (5)	0.99	1.00	0.98	0.96	0.93	0.87	0.81	0.75

aspect\_r.rst, palette: Qual

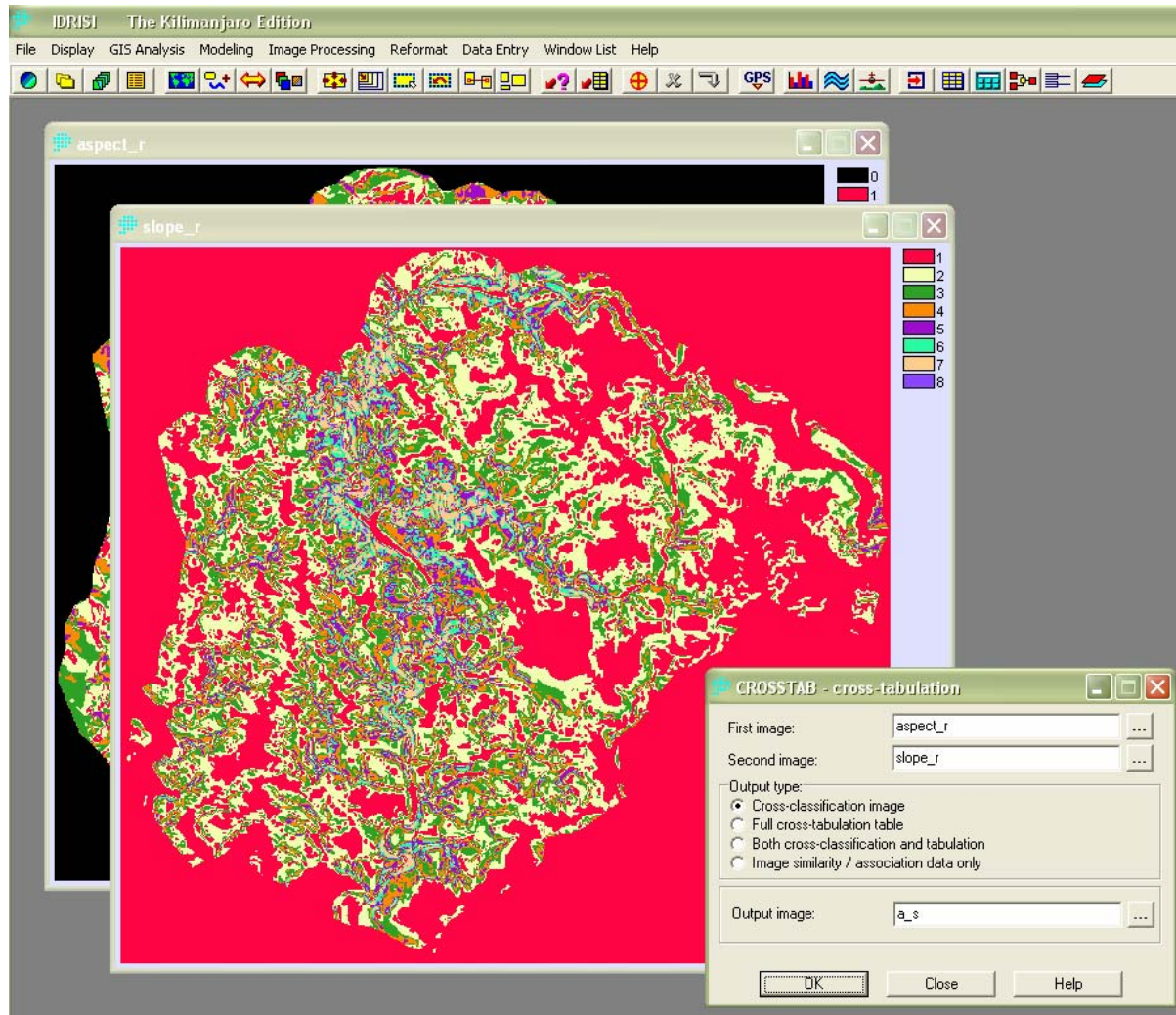




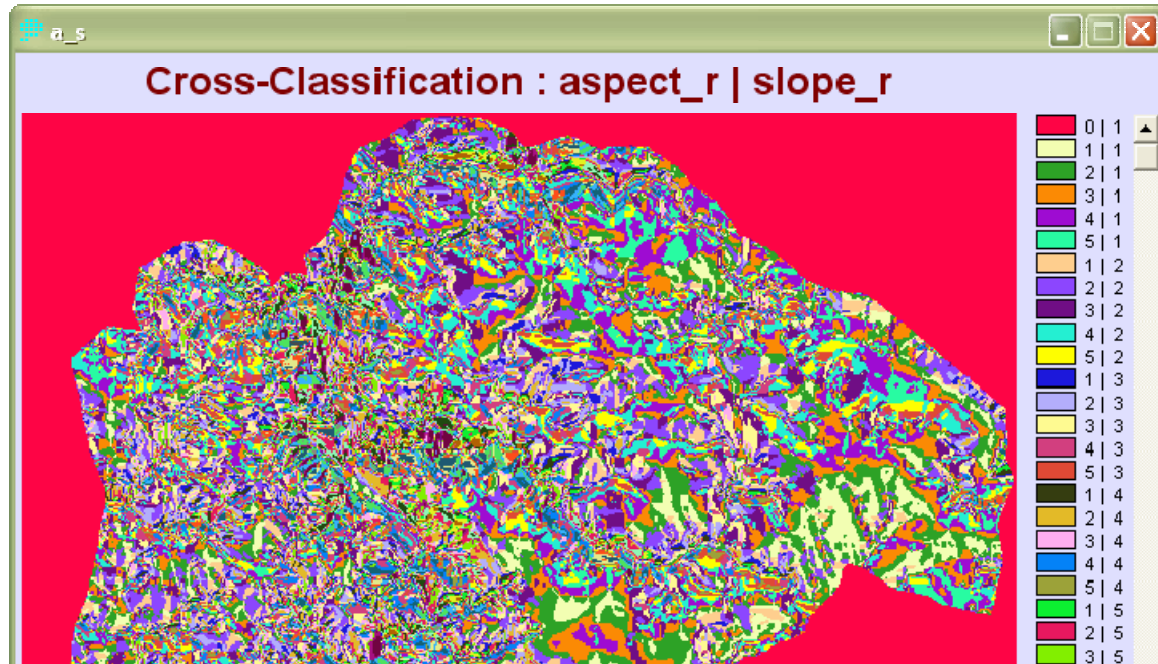
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## Stationary climatic data extrapolation using digital terrain model

CROSSTAB → aspect\_r.rst – slope\_r.rst → a\_s.rst



a\_s.rst, palette: Qual



„K“	0°- 5°	5°-10°	10°-15°	15°-20°	20°-25°	25°-30°	30°-40°	40°-50°
S	1.05 (1 1)	1.11 (1 2)	1.17 (1 3)	1.22 (1 4)	1.26 (1 5)	1.31 (1 6)	1.34 (1 7)	1.37 (1 8)
SE, SW	1.04 (2 1)	1.10 (2 2)	1.16 (2 3)	1.20 (2 4)	1.24 (2 5)	1.26 (2 6)	1.28 (2 7)	1.30 (2 8)
E, W	1.02 (3 1)	1.06 (3 2)	1.09 (3 3)	1.11 (3 4)	1.12 (3 5)	1.12 (3 6)	1.10 (3 7)	1.07 (3 8)
NE, NW	1.00 (4 1)	1.02 (4 2)	1.01 (4 3)	1.00 (4 4)	0.99 (4 5)	0.97 (4 6)	0.92 (4 7)	0.84 (4 8)
N	0.99 (5 1)	1.00 (5 2)	0.98 (5 3)	0.96 (5 4)	0.93 (5 5)	0.87 (5 6)	0.81 (5 7)	0.75 (5 8)

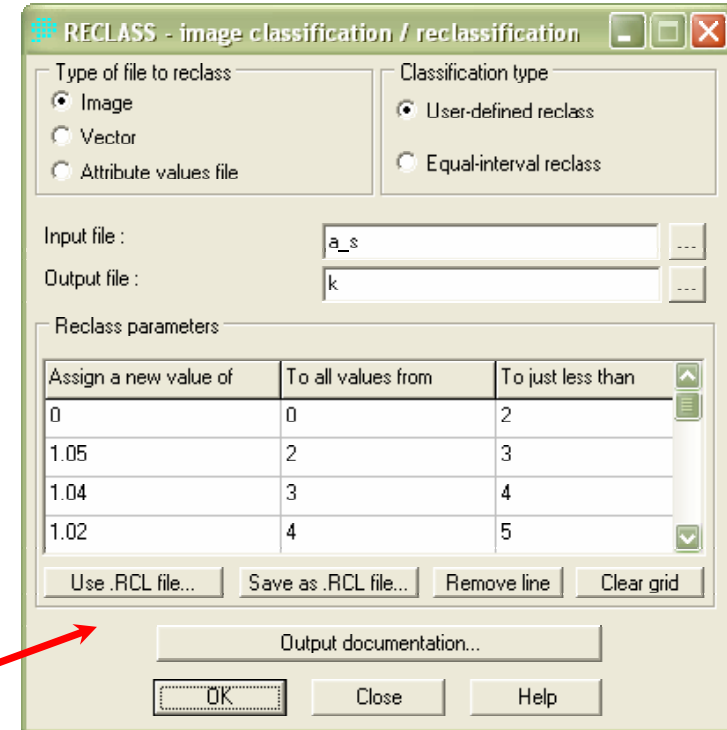


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## Stationary climatic data extrapolation using digital terrain model

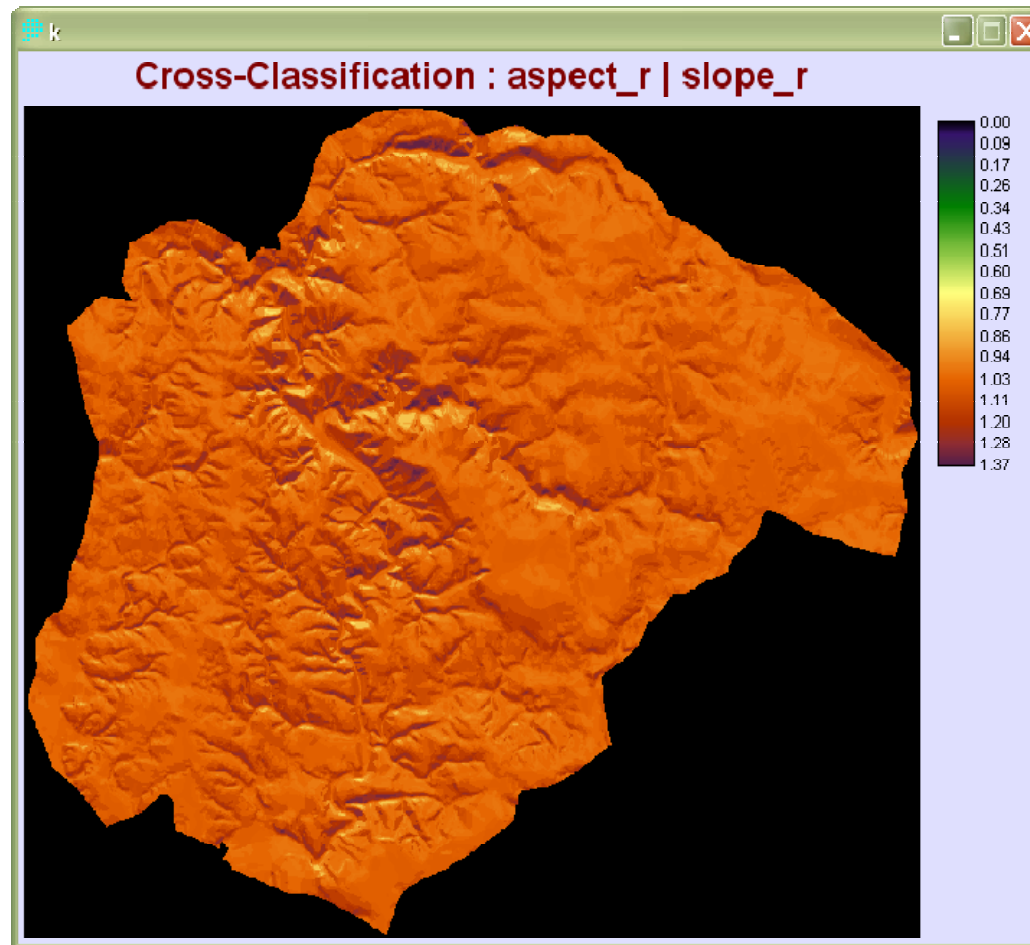
RECLASS → a\_s.rst – k.rst  
 Save as .RCL File: a\_s.rcl

0 0 2	1.17 12 13	1.24 23 24	1.10 34 35
1.05 2 3	1.16 13 14	1.12 24 25	0.92 35 36
1.04 3 4	1.09 14 15	0.99 25 26	0.81 36 37
1.02 4 5	1.01 15 16	0.93 26 27	1.37 37 38
1.00 5 6	0.98 16 17	1.31 27 28	1.30 38 39
0.99 6 7	1.22 17 18	1.26 28 29	1.07 39 40
1.11 7 8	1.20 18 19	1.12 29 30	0.84 40 41
1.10 8 9	1.11 19 20	0.97 30 31	0.75 41 42
1.06 9 10	1.00 20 21	0.87 31 32	
1.02 10 11	0.96 21 22	1.34 32 33	
1.00 11 12	1.26 22 23	1.28 33 34	



„K“	0°- 5°	5°-10°	10°-15°	15°-20°	20°-25°	25°-30°	30°-40°	40°-50°
S	1.05 (02)	1.11 (07)	1.17 (12)	1.22 (17)	1.26 (22)	1.31 (27)	1.34 (32)	1.37 (37)
SE, SW	1.04 (03)	1.10 (08)	1.16 (13)	1.20 (18)	1.24 (23)	1.26 (28)	1.28 (33)	1.30 (38)
E, W	1.02 (04)	1.06 (09)	1.09 (14)	1.11 (19)	1.12 (24)	1.12 (29)	1.10 (34)	1.07 (39)
NE, NW	1.00 (05)	1.02 (10)	1.01 (15)	1.00 (20)	0.99 (25)	0.97 (30)	0.92 (35)	0.84 (40)
N	0.99 (06)	1.00 (11)	0.98 (16)	0.96 (21)	0.93 (26)	0.87 (31)	0.81 (36)	0.75 (41)

k.rst, palette: Quant







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## Stationary climatic data extrapolation using digital terrain model

IMAGE CALCULATOR  $\rightarrow t2 = ([a]*[k]) - [a]$   
 $t = [t1] + [t2]$

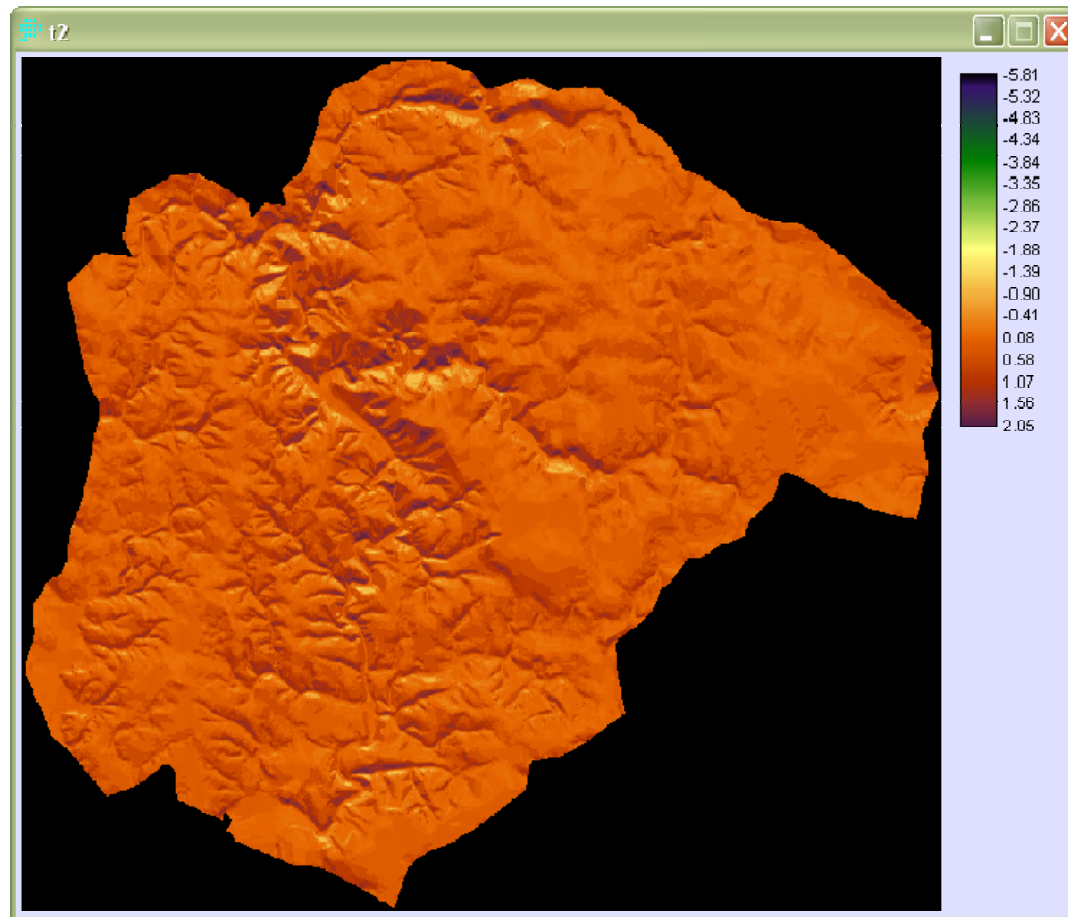




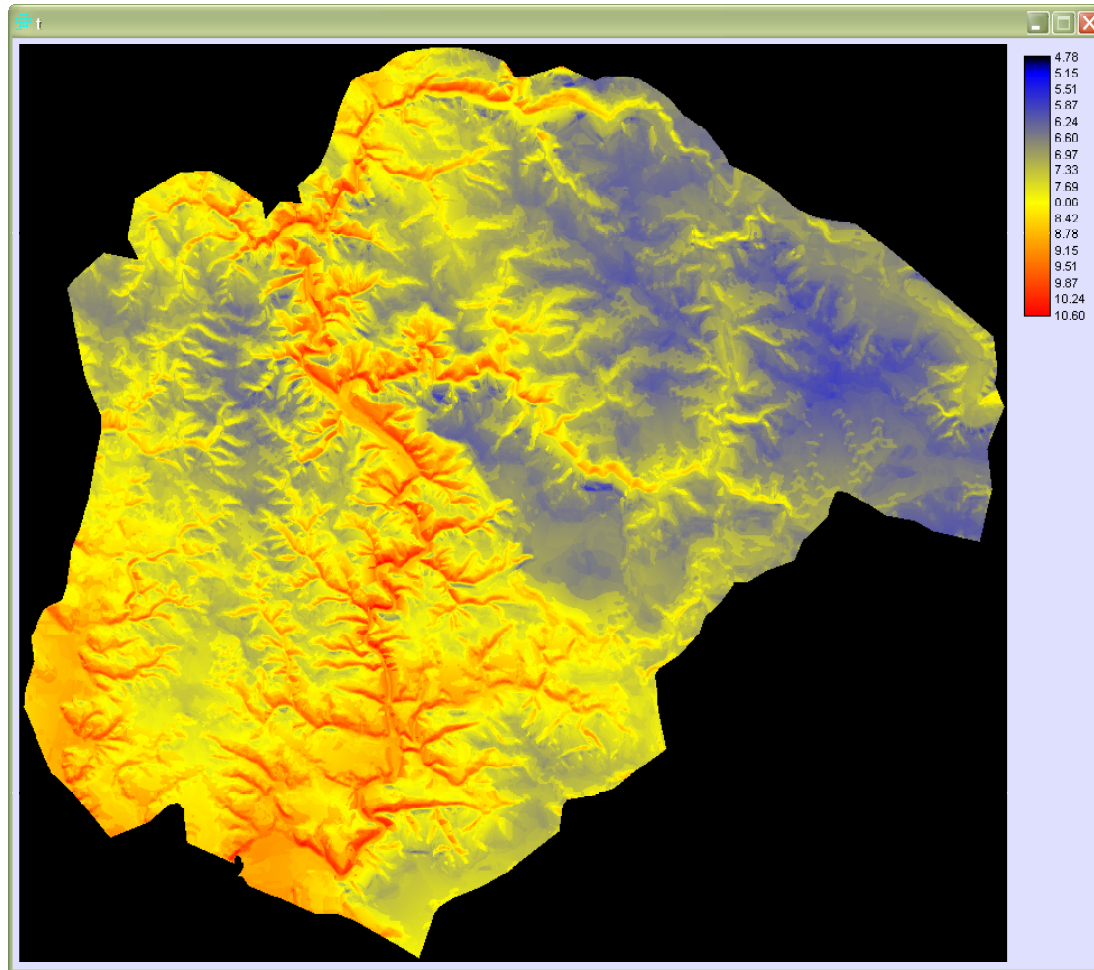
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## Stationary climatic data extrapolation using digital terrain model

t2.rst, palette: Quant



t.rst, palette: t.smp







## Result assessment:

- products depend on DTM and on DTM derived data
- accuracy of input climatic data and equations (correction equation with regard to slope and aspect, used coefficients)
- another factors, e.g. valley temperature inversion were not regarded



## Idrisi Macro Modeller

