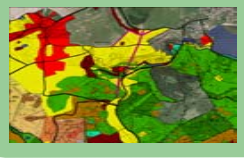

THEME 3

Stationary climatic data extrapolation using digital terrain model

Ing. Martin Klimánek, Ph.D.
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klimanek@mendelu.cz
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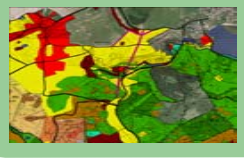
http://mapserver.mendelu.cz/



Compillation 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.

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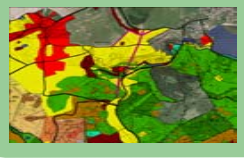

Stationary climatic data extrapolation using digital terrain model

T = T1 + T2 [°C]

T1... temperature dependence on elevation

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

T1 = 10.5935 – 0.0082*[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. Olomučany	360 m a.s.l.	7.6 °C
8. Hády	420 m a.s.l.	7.5 °C
9. Soběšice	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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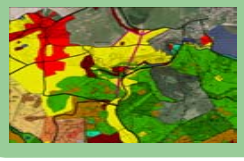
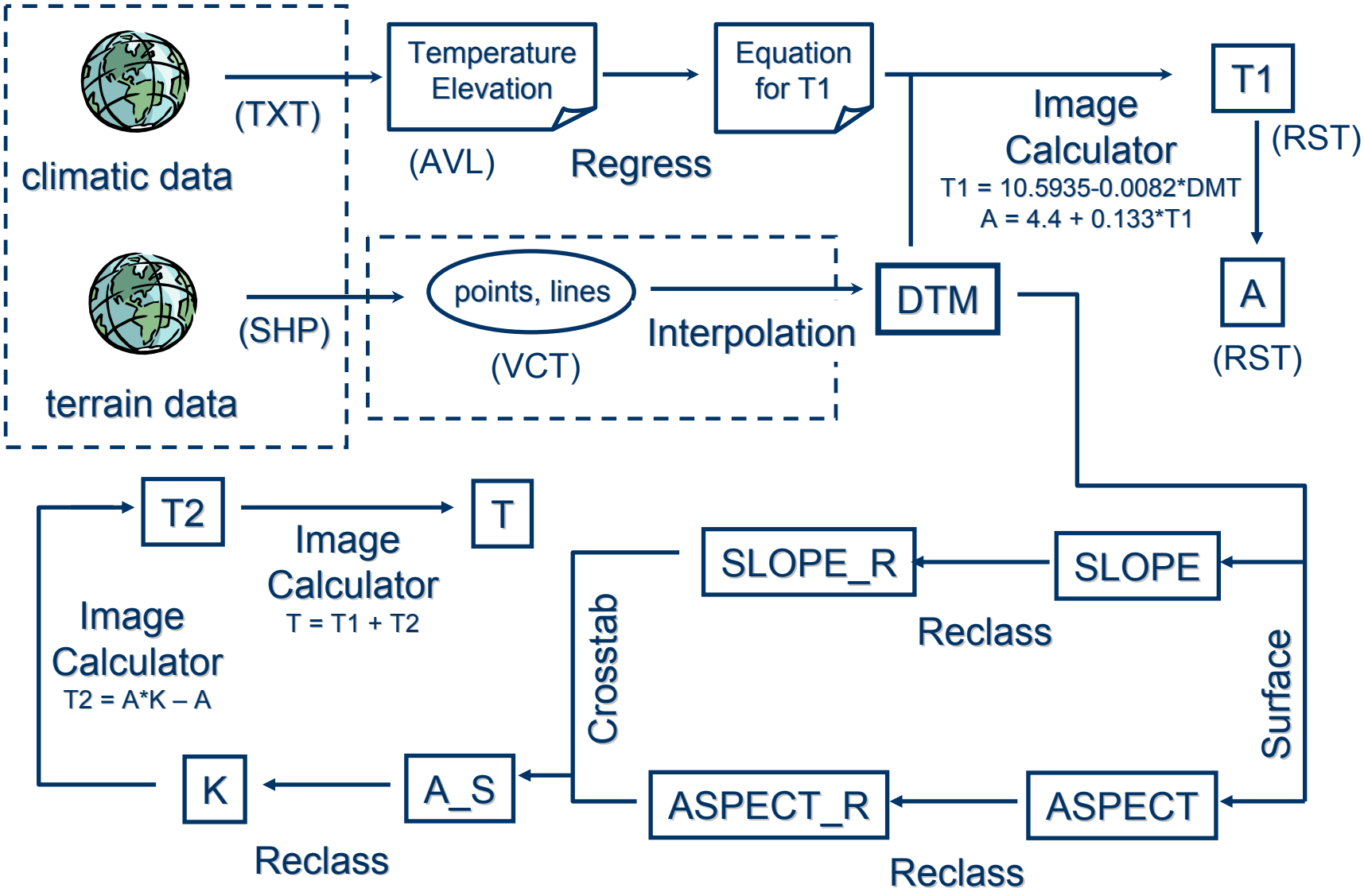


Stationary climatic data extrapolation using digital terrain model



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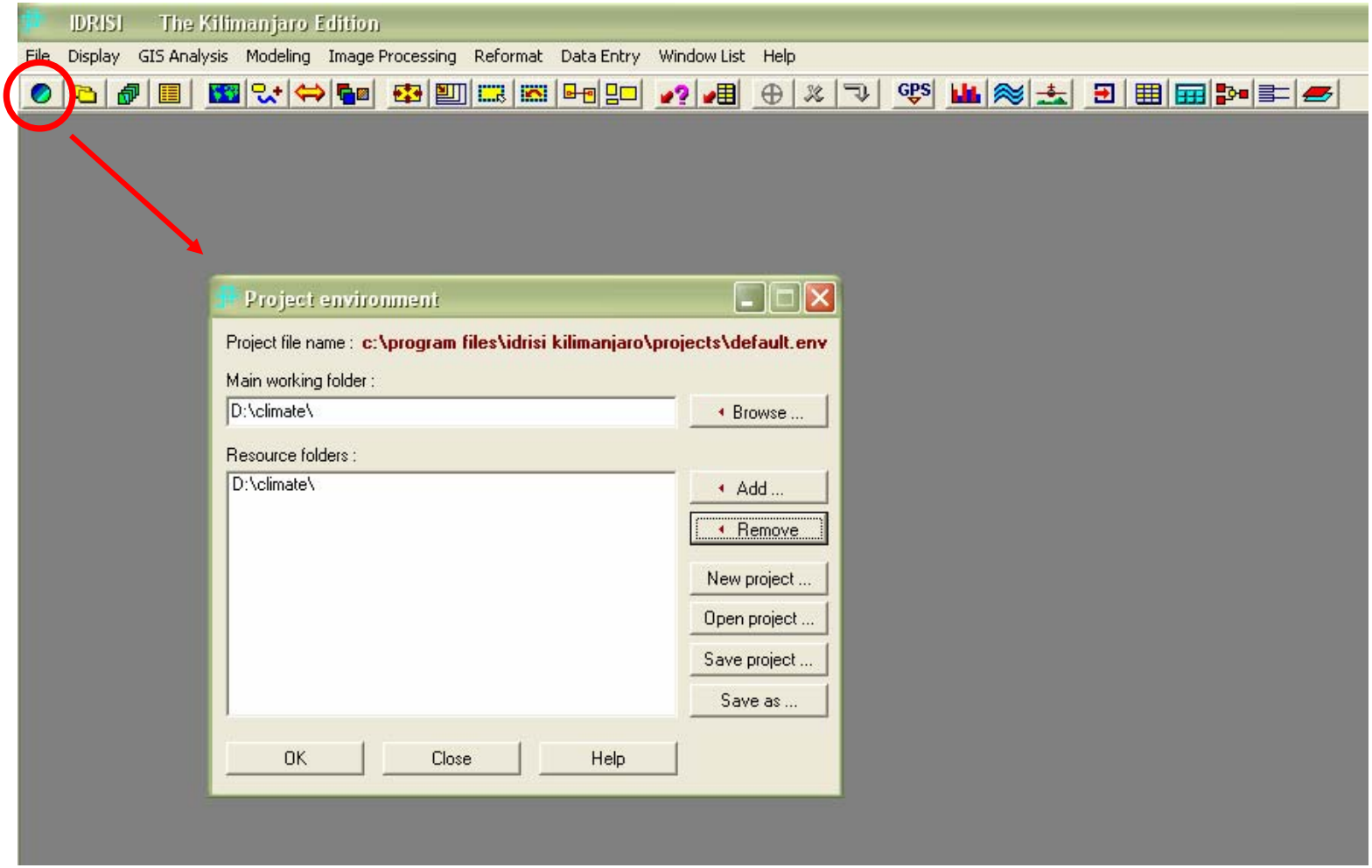
PROJECT ENVIRONMENT



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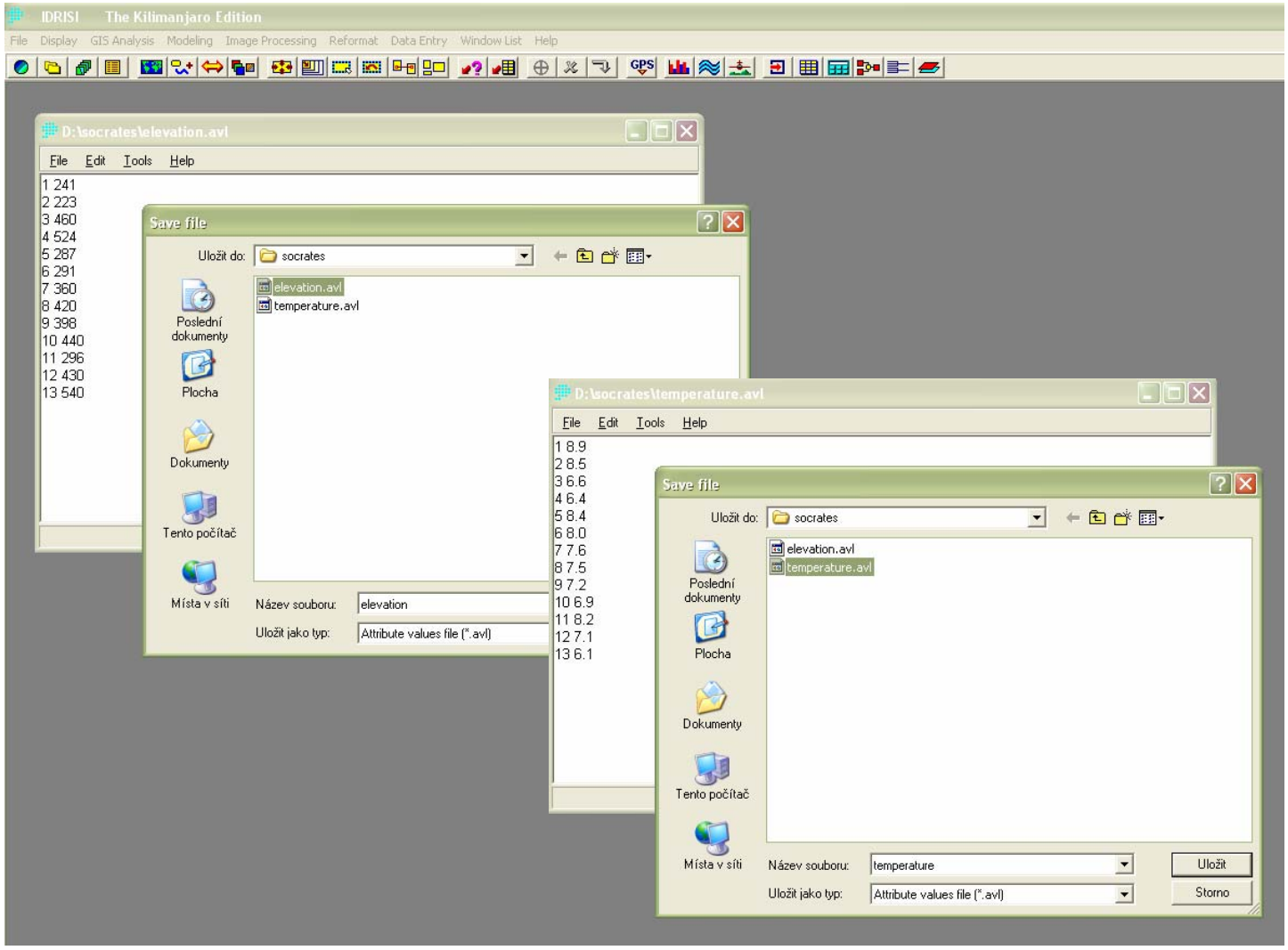
EDIT → elevation.avl, temperature.avl



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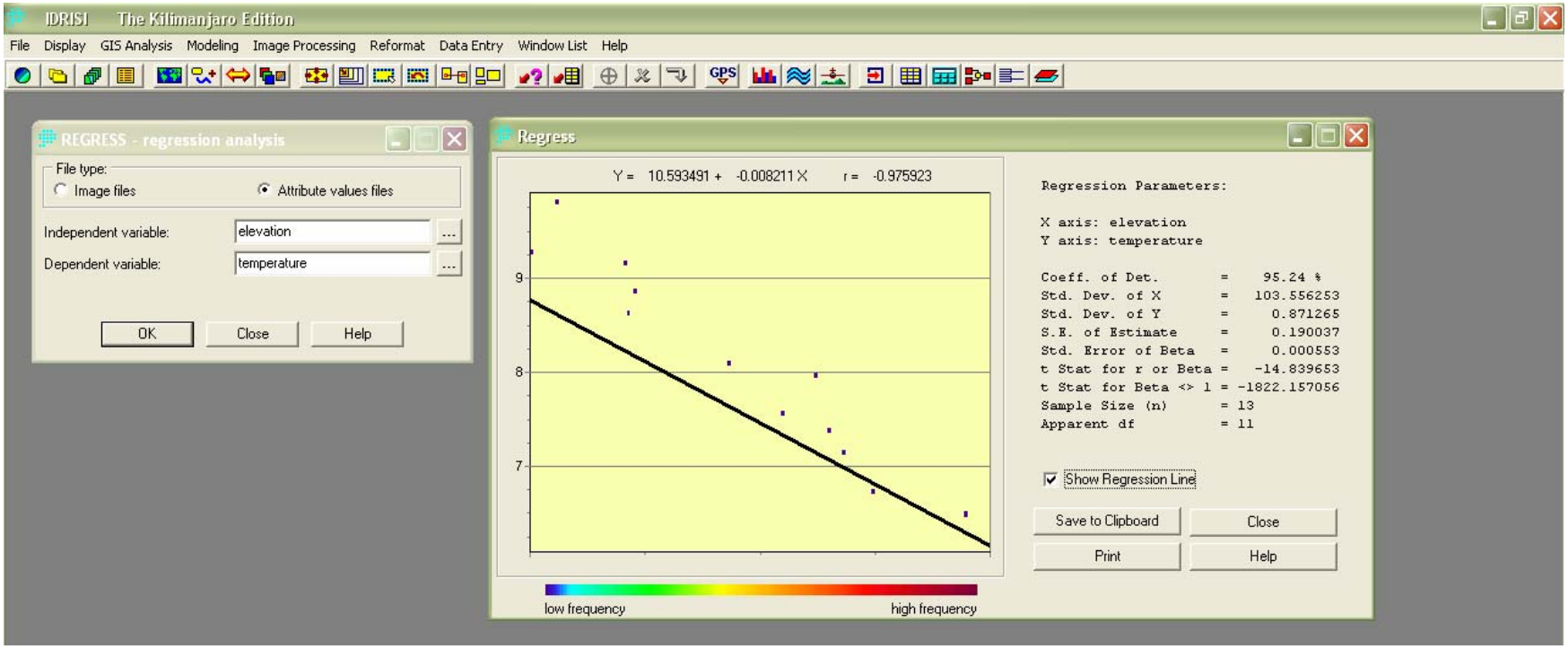
REGRESS → elevation.avl – temperature.avl



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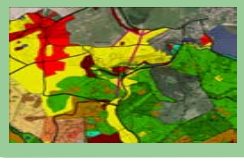
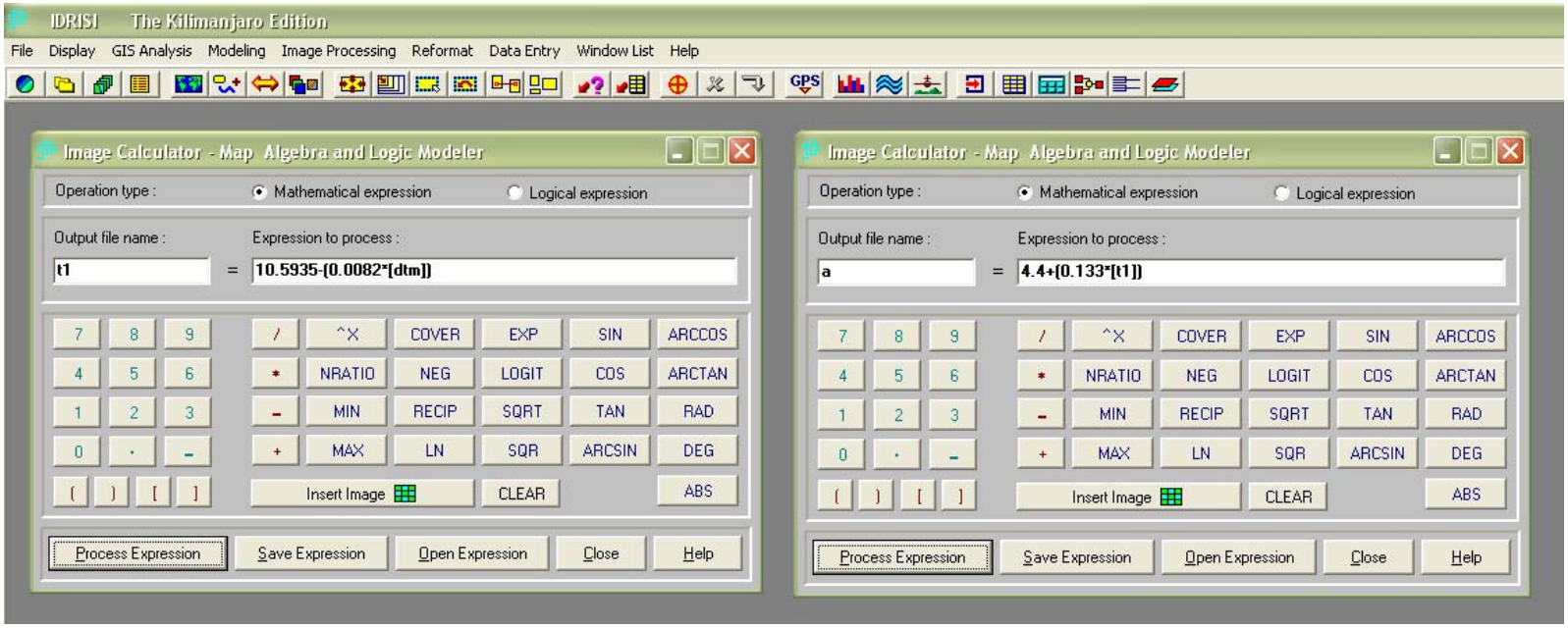


Stationary climatic data extrapolation using digital terrain model

DISPLAY → dtm.rst

IMAGE CALCULATOR → t1 = 10.5935 – (0.0082*[dtm])

a = 4.4 + (0.133*[t1])



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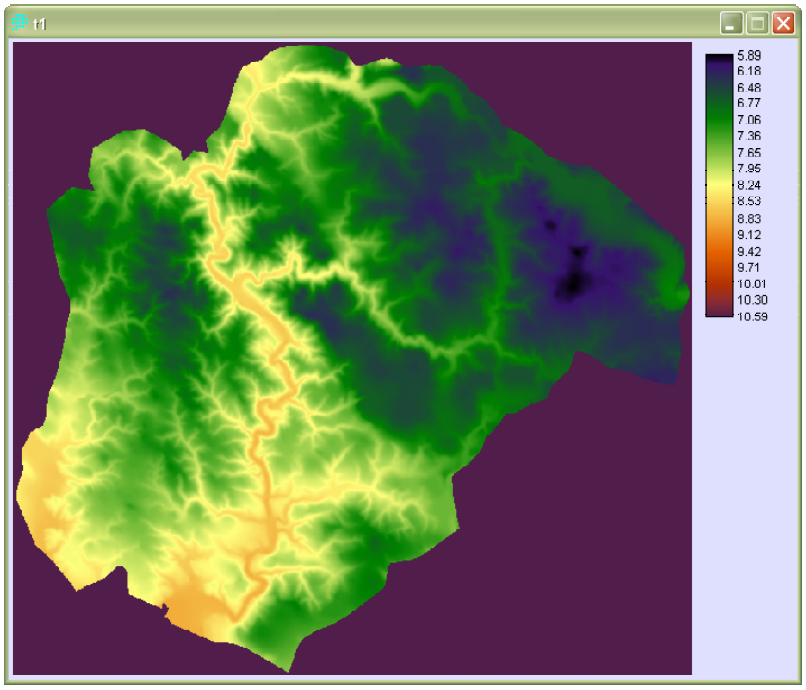
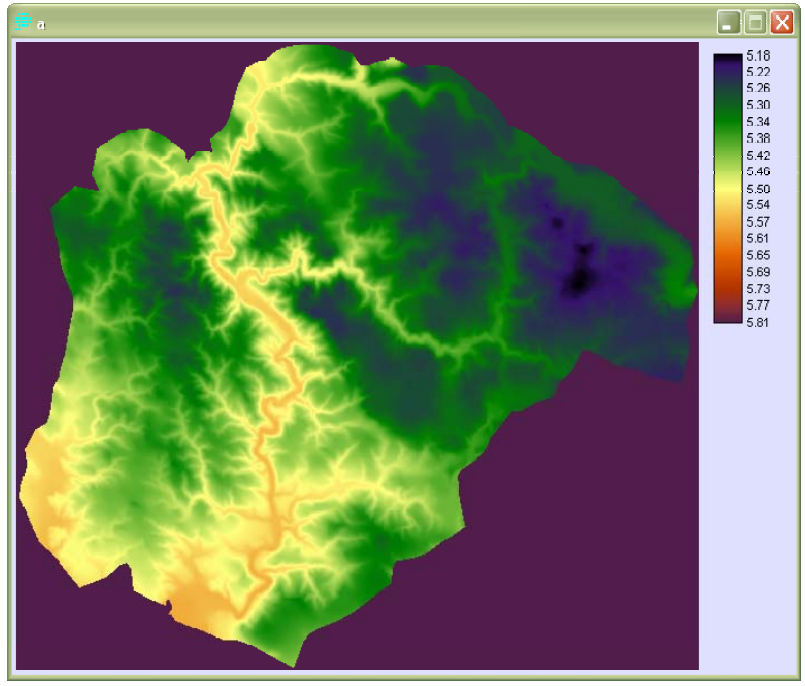
Stationary climatic data extrapolation using digital terrain model

t1.rst, palette: Quant



a.rst, palette: Quant



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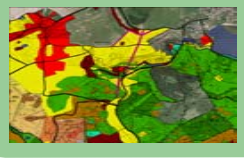
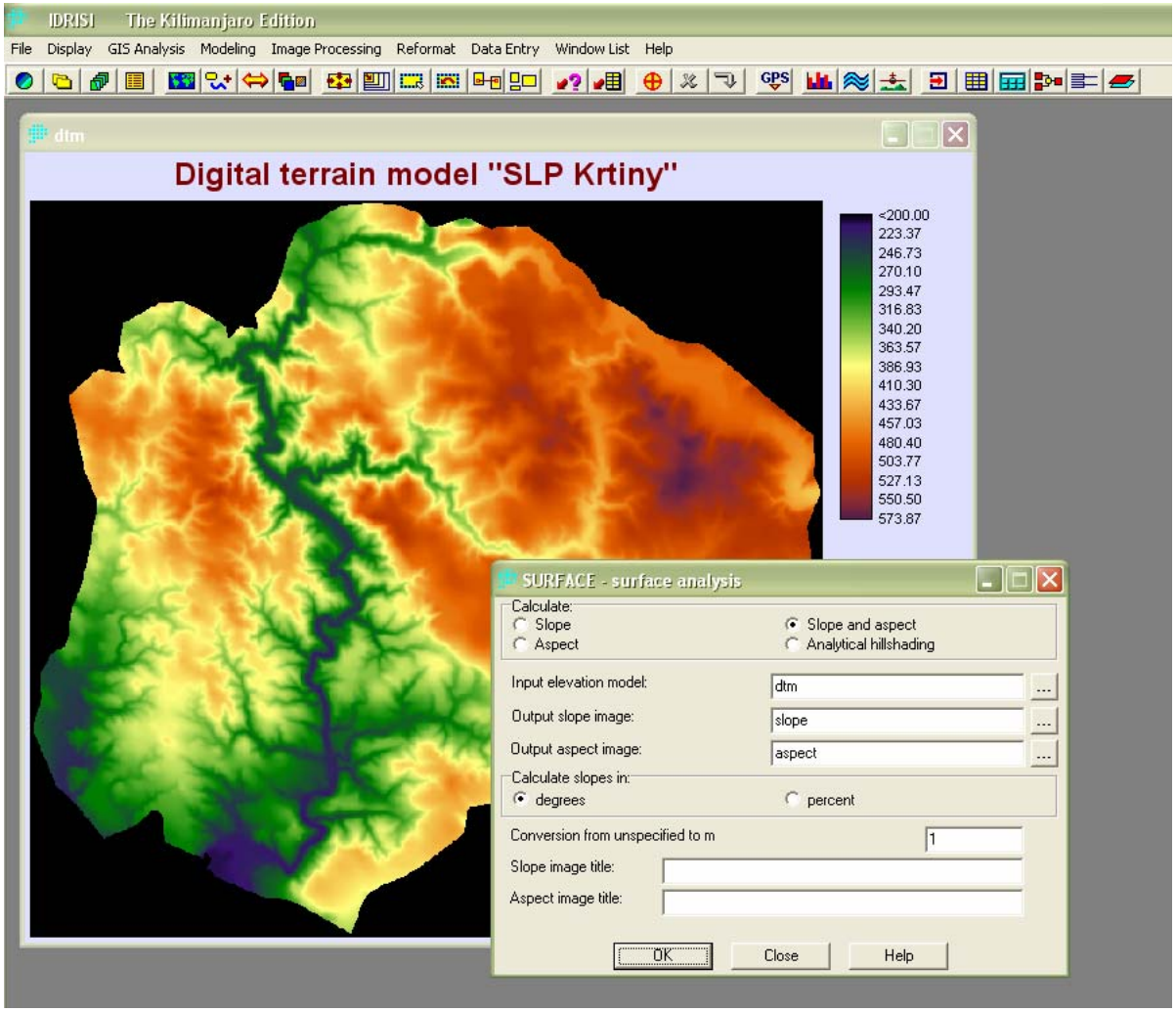


SURFACE → dtm.rst – slope.rst, aspect.rst



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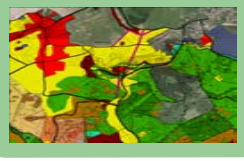
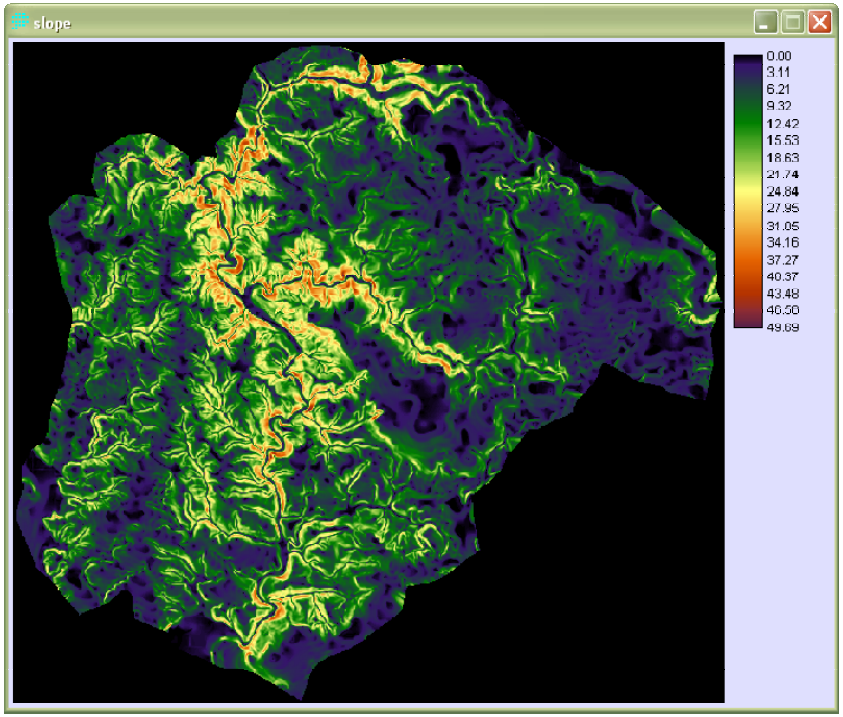
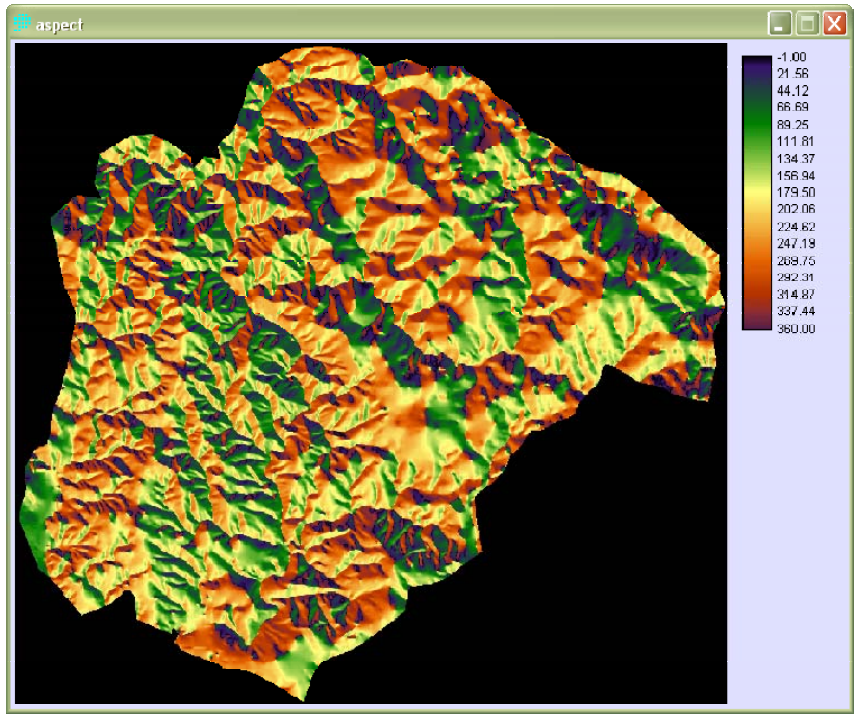


Stationary climatic data extrapolation using digital terrain model

slope.rst, palette: Quant



aspect.rst, palette: Quant



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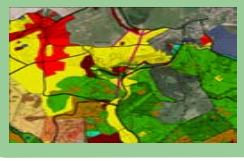
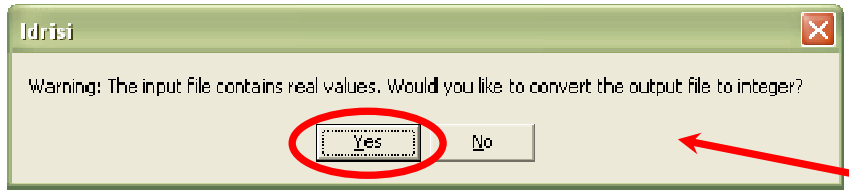
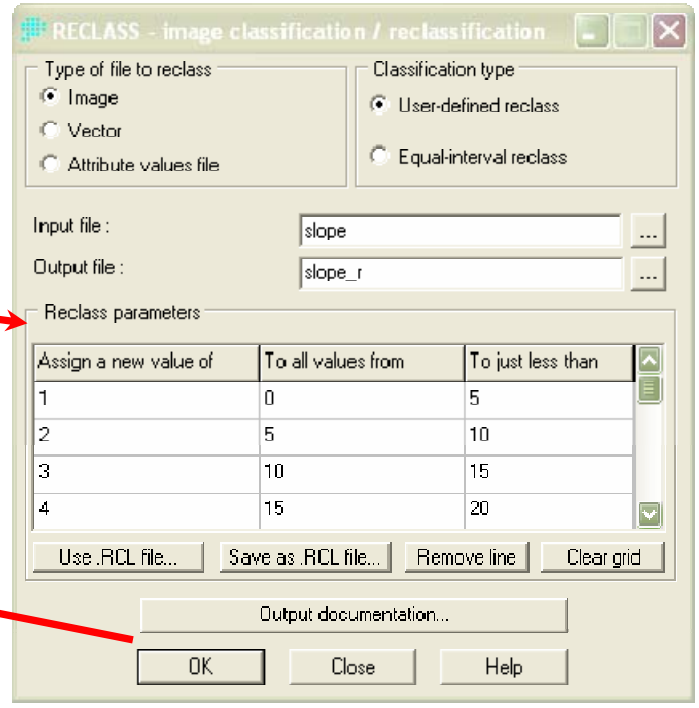


Stationary climatic data extrapolation using digital terrain model

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

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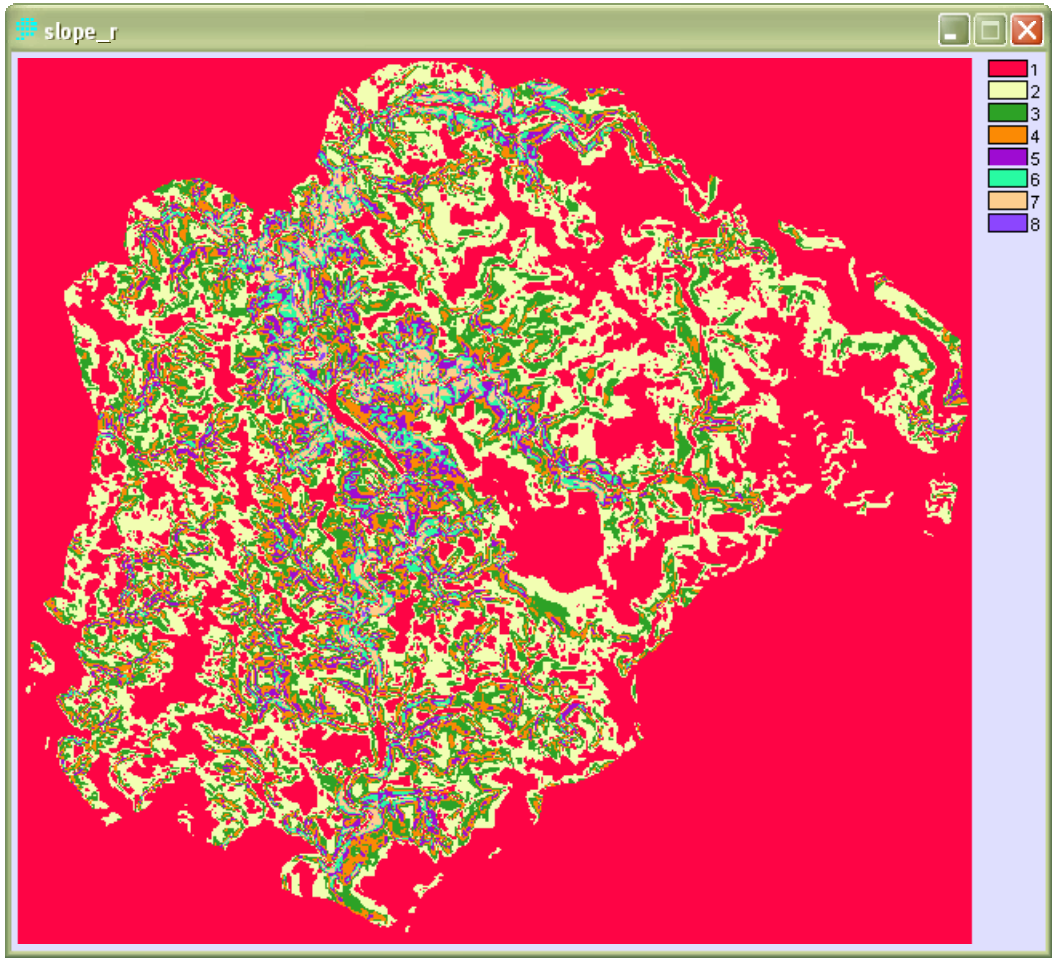
slope_r.rst, palette: Qual



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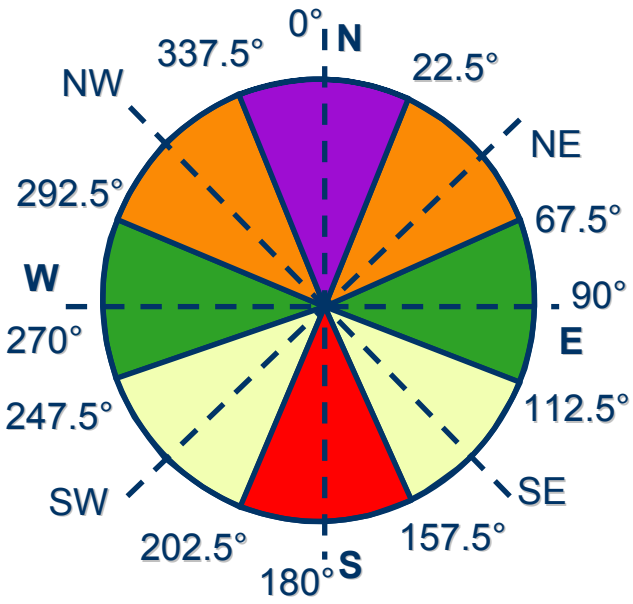
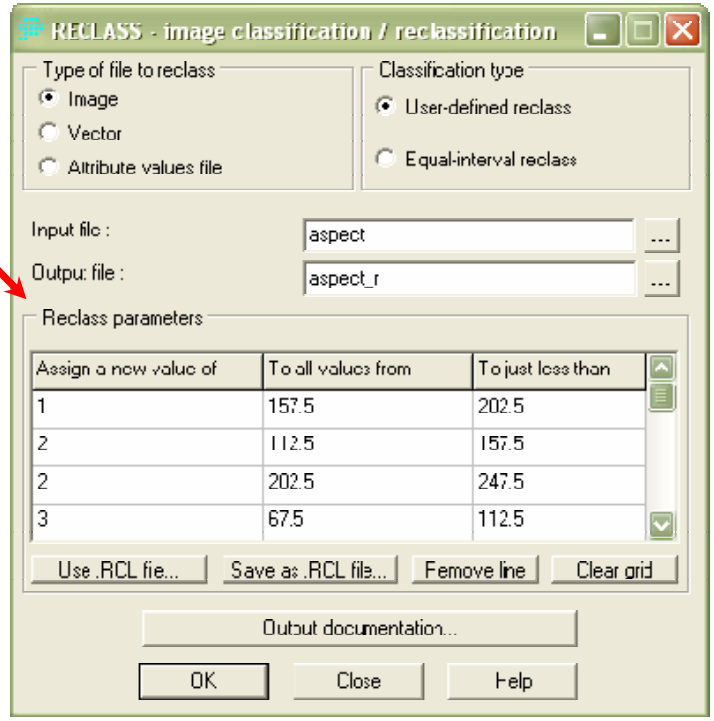
RECLASS → aspect.rst – aspect_r.rst
Save as .RCL File: aspect.rcl




```
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

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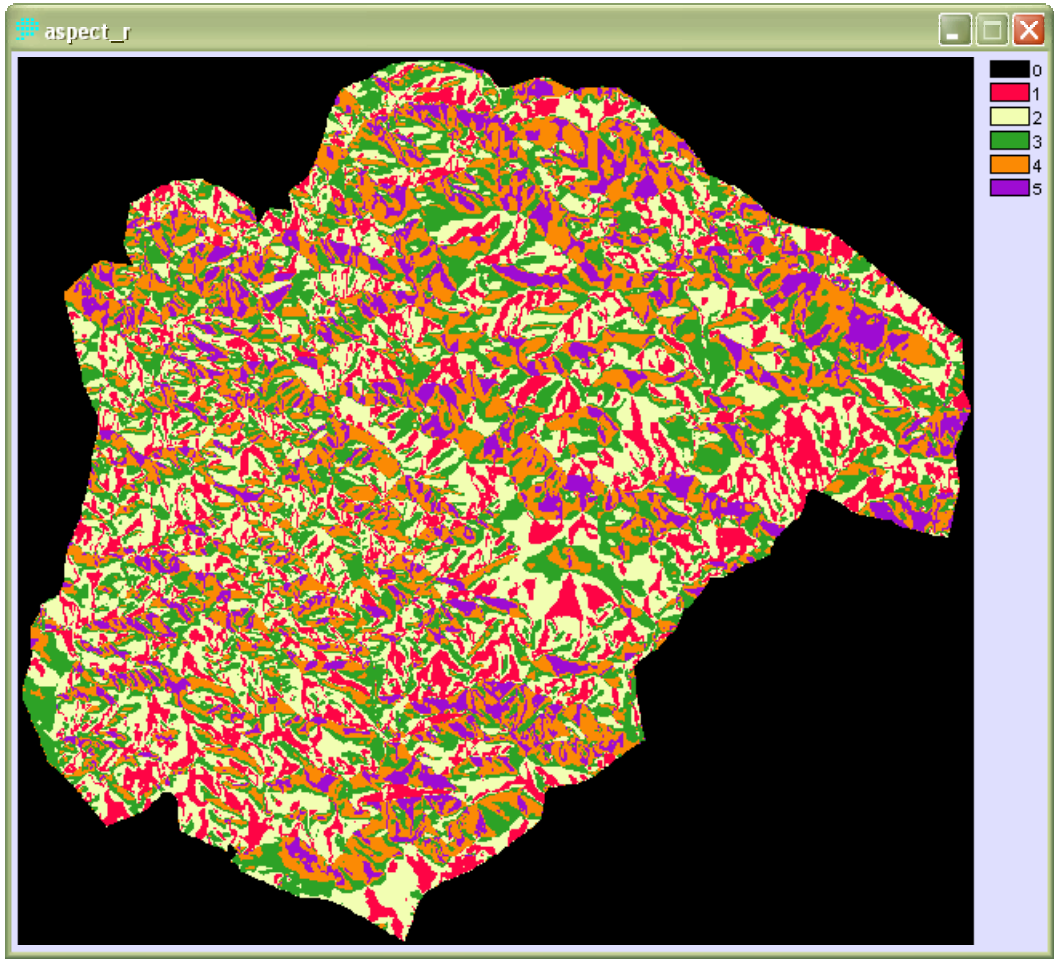
aspect_r.rst, palette: Qual



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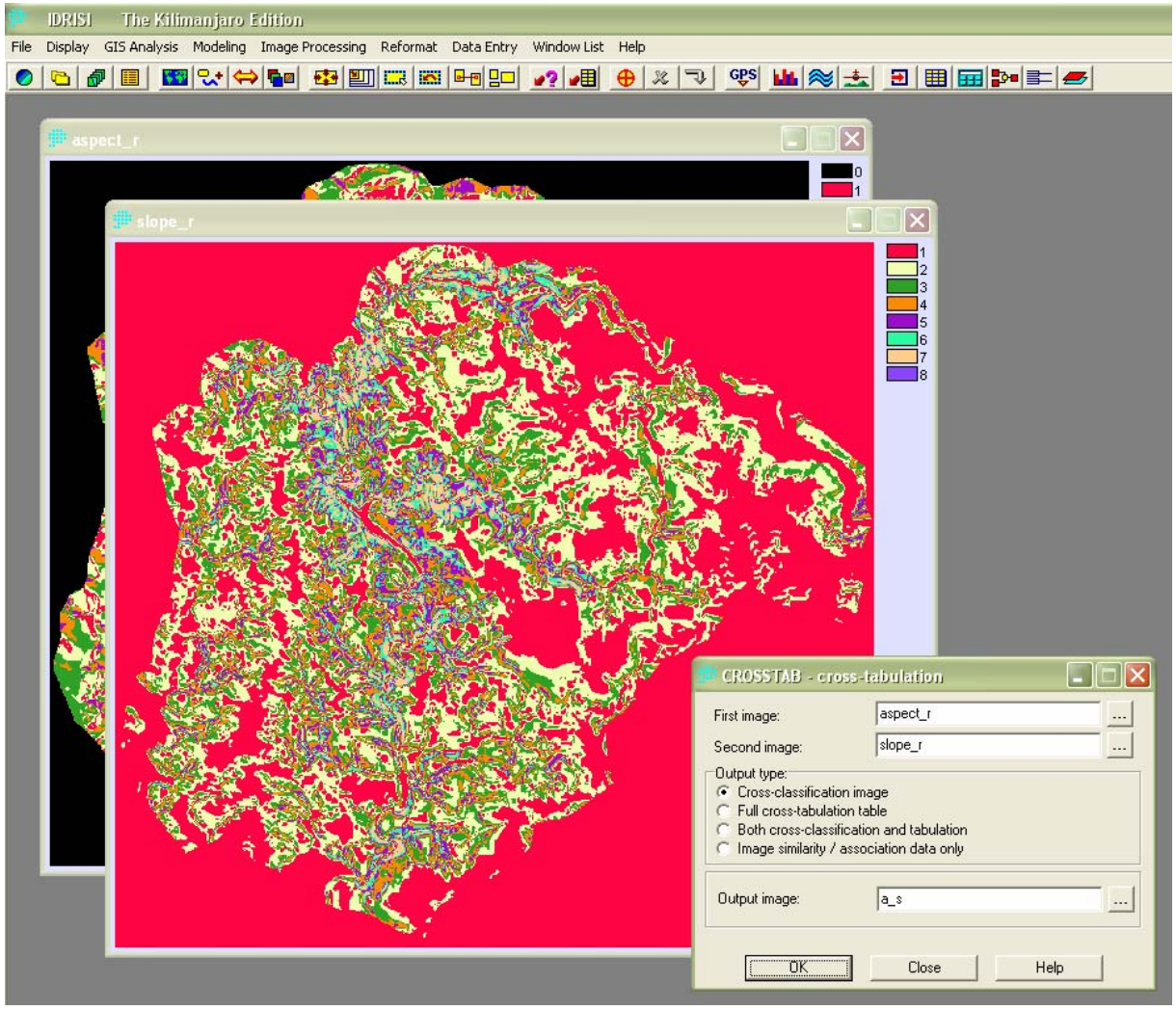
CROSSTAB → aspect_r.rst – slope_r.rst → a_s.rst



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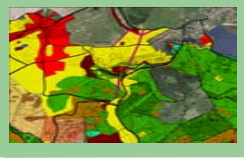
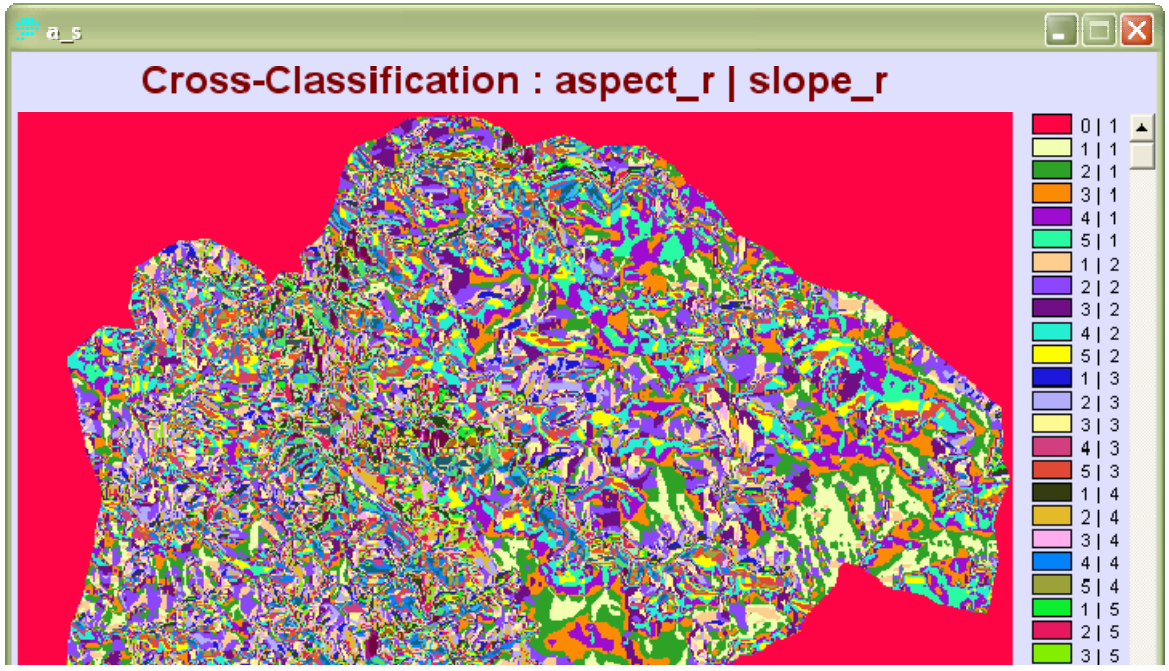


a_s.rst, palette: Qual



„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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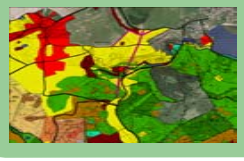
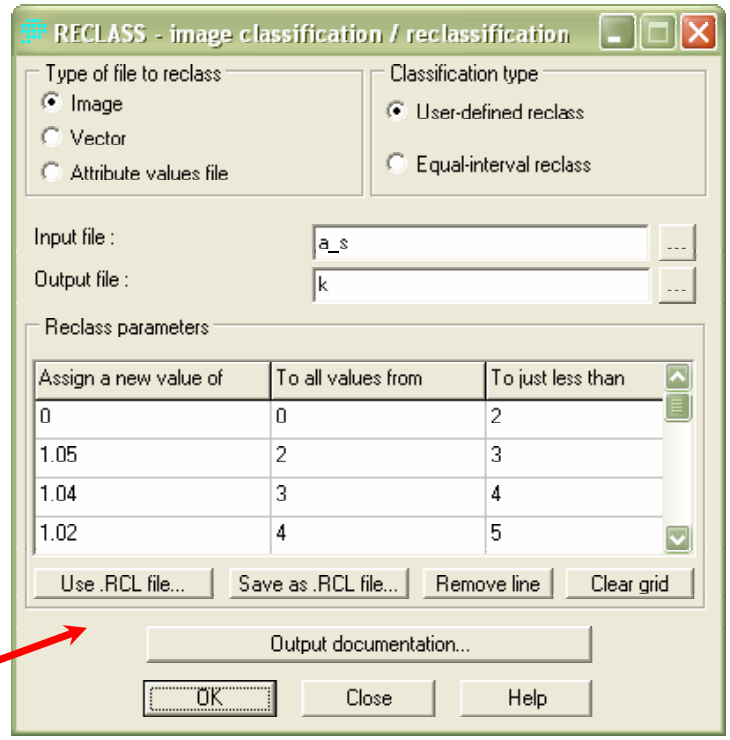


Stationary climatic data extrapolation using digital terrain model

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)

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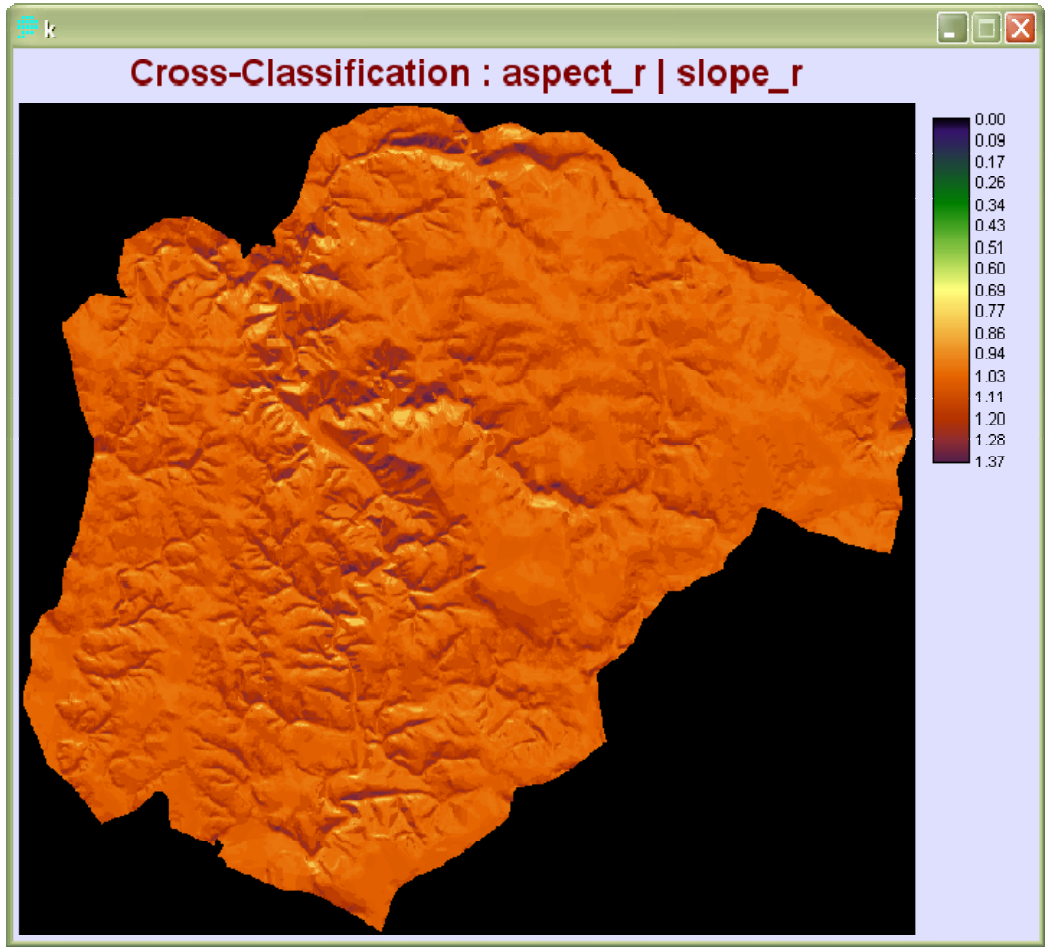
k.rst, palette: Quant



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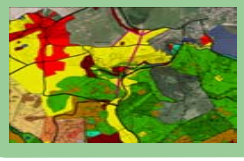
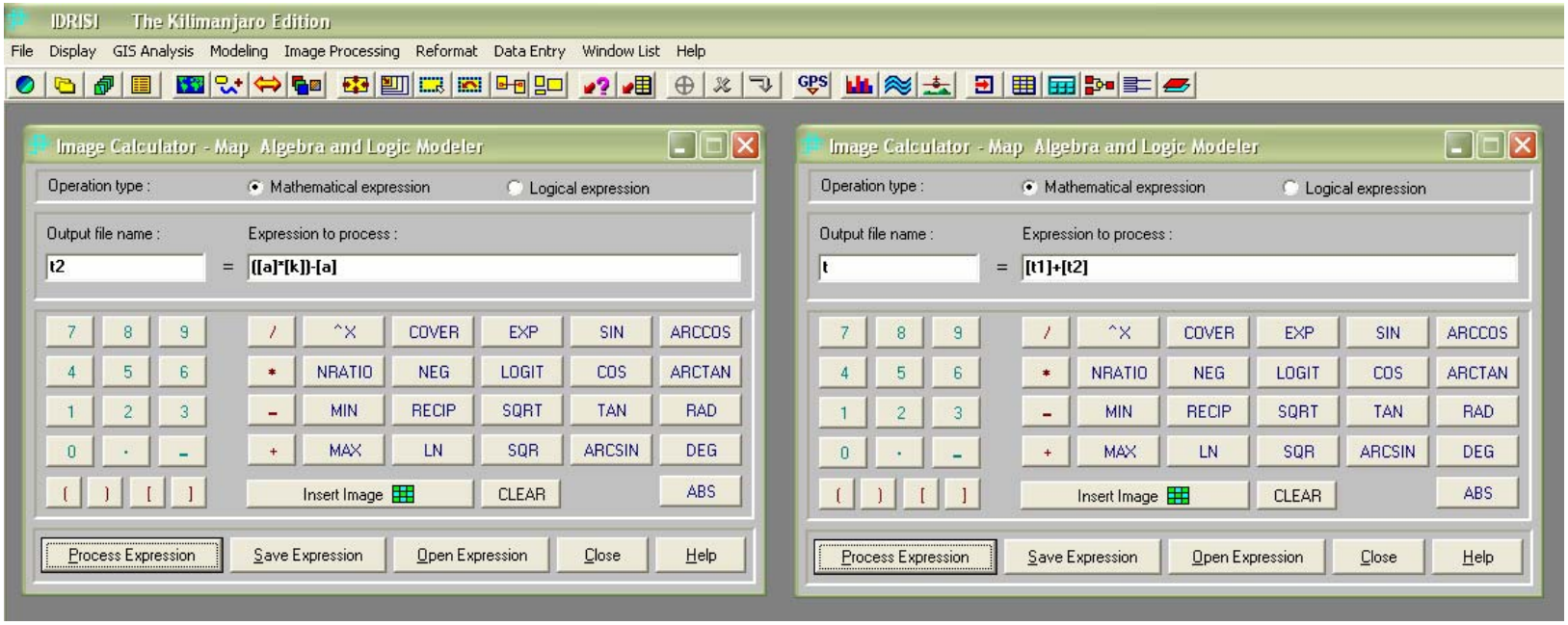


Stationary climatic data extrapolation using digital terrain model

IMAGE CALCULATOR → t2 = ([a]*[k]) – [a]

t = [t1] + [t2]



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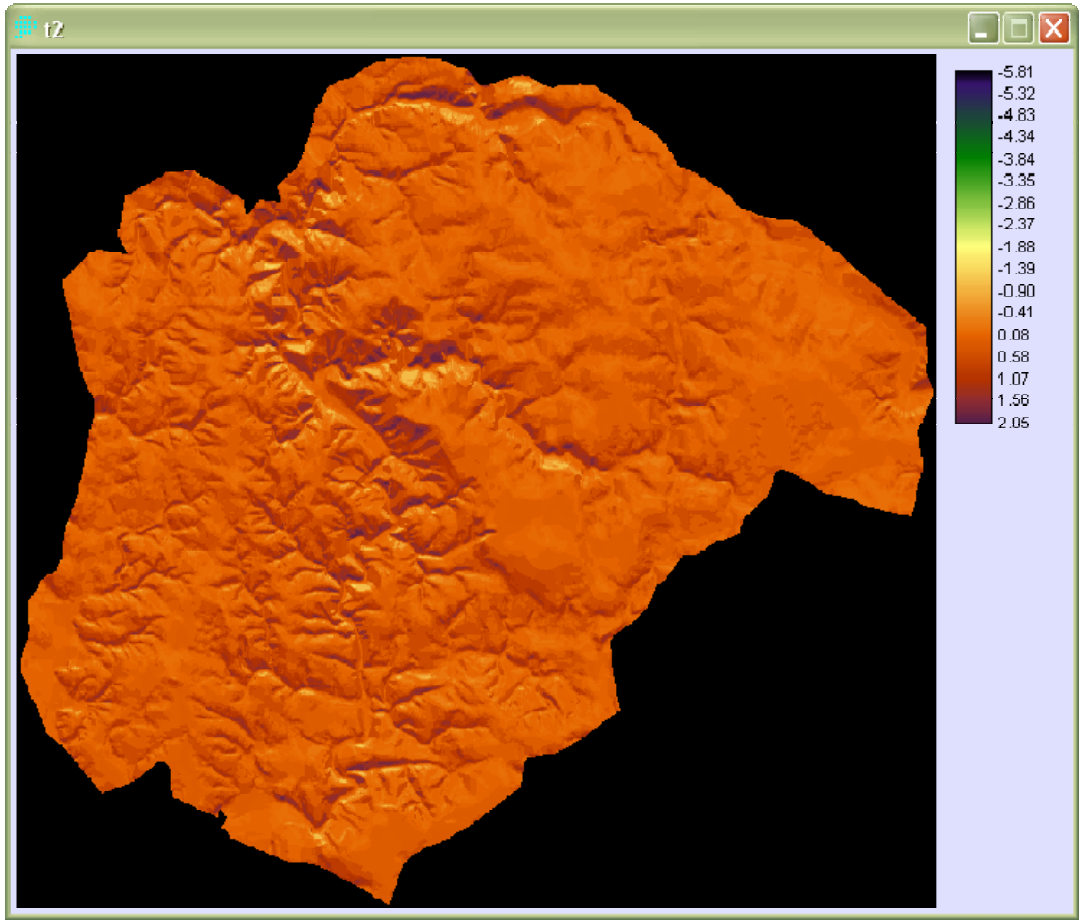
t2.rst, palette: Quant



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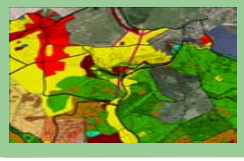
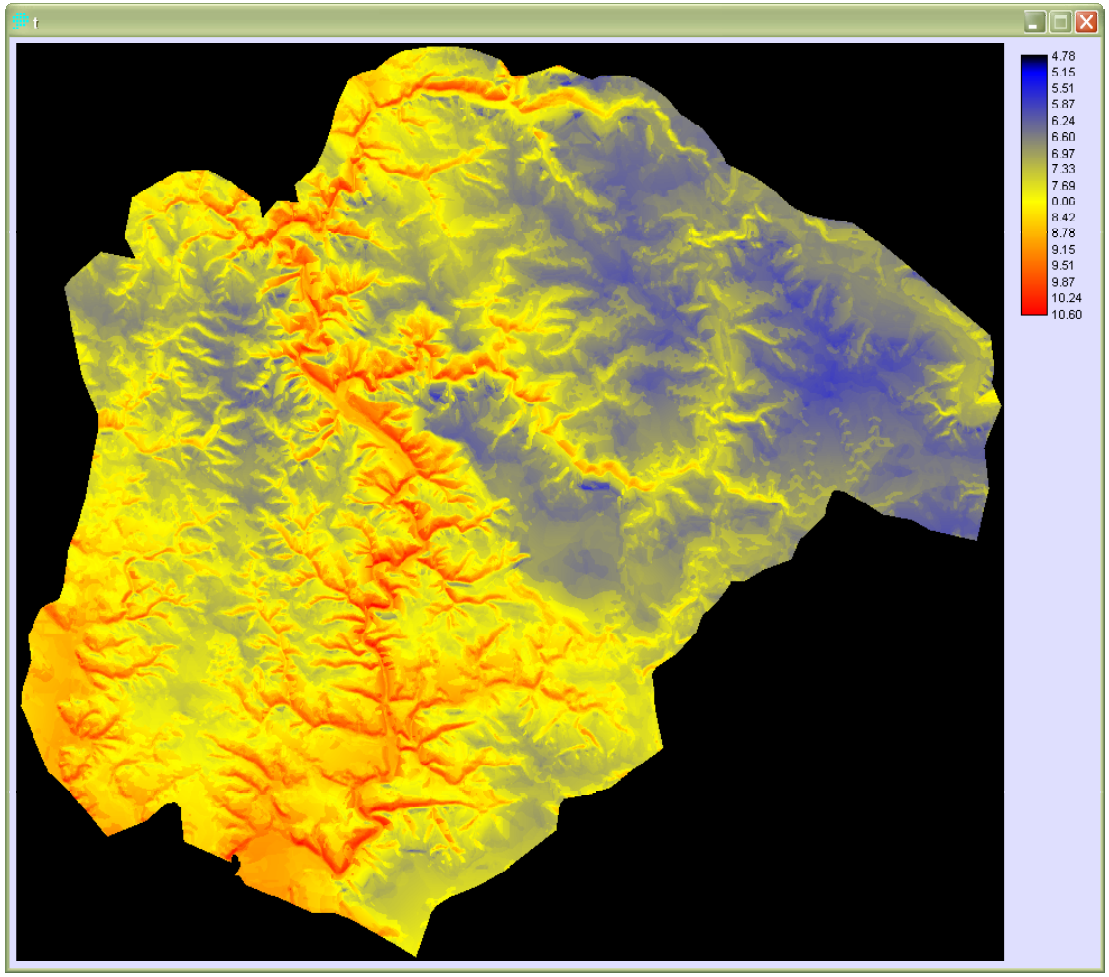


t.rst, palette: t.smp



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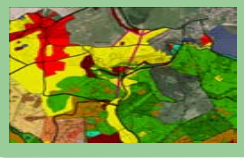

Result assessment:

- 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

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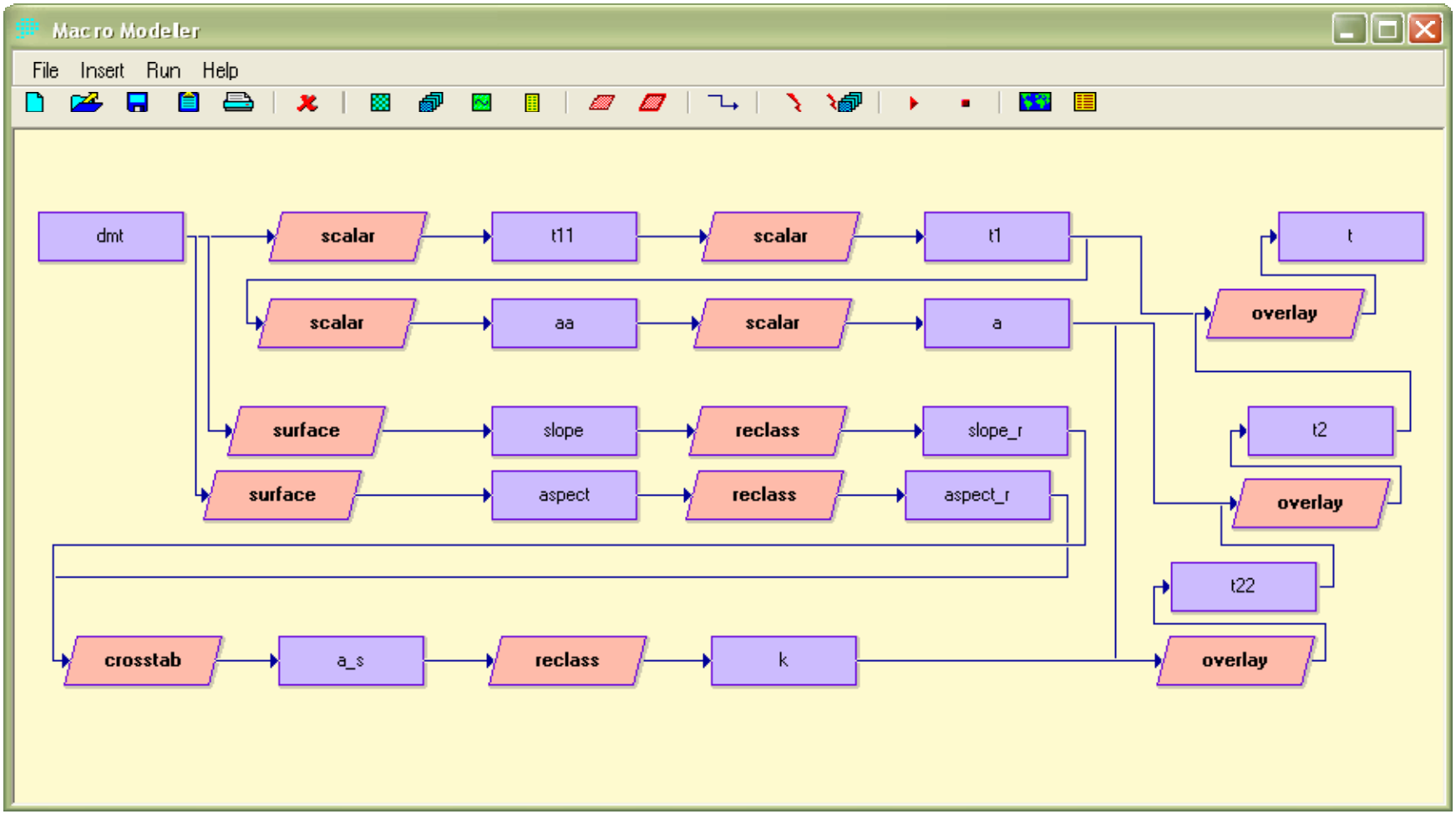
Idrisi Macro Modeller



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