Selected research direction:

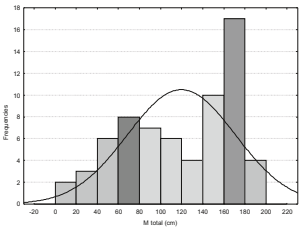
Quantification of slope (colluvial) deposits spatial distribution

The aims of the direction

1. Digital mapping of the spatial variability of the colluvial deposits.
2. Assess the pattern of the spatial variability of colluvial deposits for all catchment.
3. Adapt the methods of general geomorphometry for the tasks of the landscape history reconstruction.

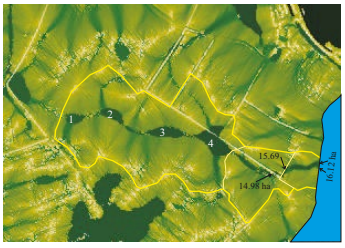
Morphometric variables of general geomorphometry

Variable name, Unit	That describes
Elevation (Z), m	Changes in the state of atmosphere
Morphometric pre-requisites of surface runoff and soil throughflow generation	
Maximal catchment area (MCA), m^2	Maximum area from which material moving downslope may be collected
Maximal dispersal area (MDA), m^2	Maximal area materials moving downslope may be diffused
Slope steepness (GA), degrees	Relative flow rate
Horizontal curvature (kh), 1/m	Flow convergence/divergence
Vertical (=profile) curvature (kv), 1/m	Relative flow deceleration/acceleration
Total accumulation curvature (KA), $1/m^2$	Reveals relative accumulation zones
Difference curvature (E), 1/m	Compares kh (in plane) and kv (in profile)
Characteristics that describe land surface dissection	
Total ring curvature (KR), $1/m^2$	Flow line twisting
Rotor (rot), 1/m	Flow line rotation direction
Horizontal excess curvature (khe), 1/m	Describes to what extent kv (kh) is larger than minimal curvature (kmin) at the same point
Vertical excess curvature (kve), 1/m	
Characteristics of geometrical land forms	
Maximal curvature (kmax), 1/m	Geometrical ridge forms
Minimal curvature (kmin), 1/m	Geometrical valley forms
Total Gaussian curvature (K), $1/m^2$	Separated elliptic and saddle landforms
Mean curvature (H), 1/m	"equilibrium" surface condition
Unsphericity (M), 1/m	Surface deviation from spherical form



Example of non Gaussian statistical distribution of colluvial layers thickness (M total).

Typical study area



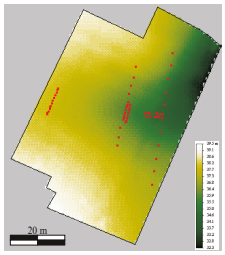
The study area locates near Belau see, Schleswig-Holstein, Northen part of Germany.

The studied catchment includes 4 natural depressions. So, colluvial material is accumulated only from down part of this catchment (area from depression N4 to the lake).

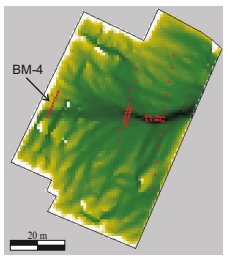
The hedges also play a role of the flows borders.

So, the most part of colluvial material was deposited only from 19 % of catchment area. After hedges creation this area has decreased up to 3 % of all

Depressions	Area, ha
1	1.69
2	3.95
3	7.51
4	12.99



GPS measurements of the elevation for the excavation plot. For 46 red points the colluvial horizons were described in the trenches. Additionally, in 17 points the total thickness of the colluvial horizon was described.

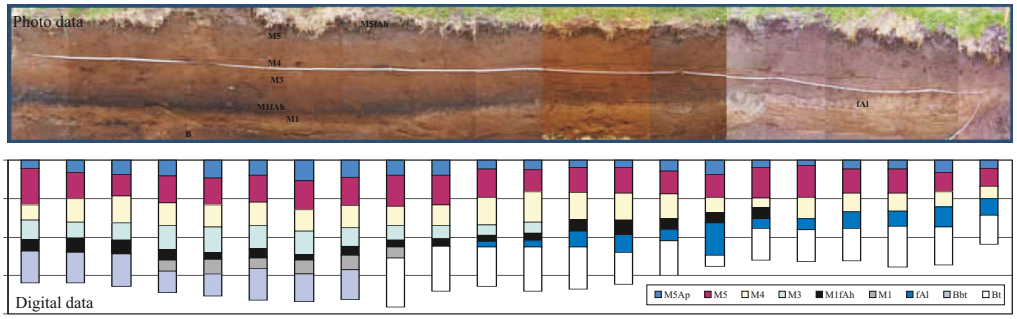


Catchment area map shows the main valley location and the micro valleys system on slopes.

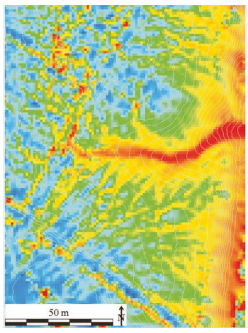
Dark parts - micro valleys.

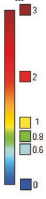
Light parts - micro watersheds.

Real and digital type of colluvial layers description



Model of the spatial distribution of M total





CONCEPTUAL MODEL

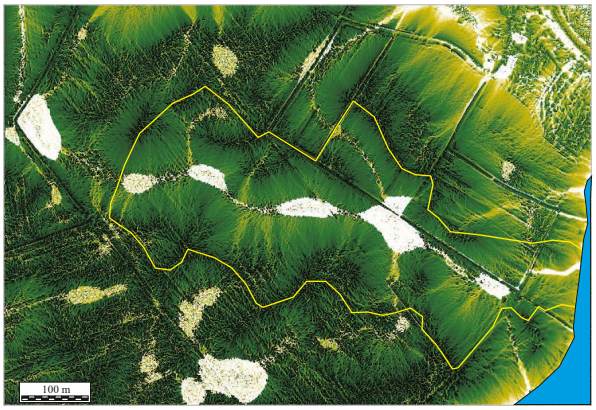
X = a*Var1 + b*Var2 + c*Var3 + d

where: **Var1,Var2,Var3** are three different linearly independent MV's, **a, b, c, d** are regression coefficients, **X** - predicted landscape property (compound MV).

All possible combinations of 3 MVs from the total set of 18 MVs considered in the regression. The predictive map created for compound MV with the greatest Spearman correlation (r_s) with the predicted parameter (Shary, 2001).

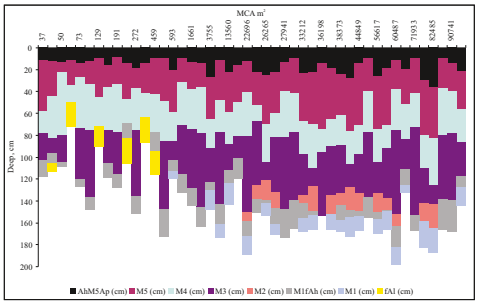
The parameters of the final model are:

Number of sampling points	63
Selected morphometric variables	rot, Z, MCA
Correlation coefficient	0.89 ($P<1*10^{-06}$)



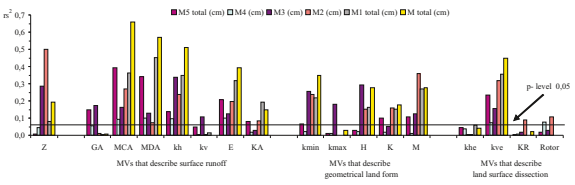
Used approach allows to create similar map for the larger territory. This map is based on the regression law from previous experiment.

The pattern of colluvial matter spatial distribution for all basin can be assessed.



Combination of data from all sampling sites in to one profile in coordinates of maximal catchment area (MCA)

Maximal catchment area is the prerequisite of the physical process in the landscape. So, the integration of the soil data in the coordinates of this morphometric variable is possible. The elevation is not prerequisite of the physical process in the plain landscape and can not be applied for this integration.



Nonparametric Spearman rang correlations coefficient was used for statistical comparisons of the thickness of colluvial layers and morphometric variables.

The best results show the layer "M-total" because during data aggregation random osculations are eliminated.

CONCLUSIONS

1- It was established for the first time that total sum of colluvial layers (M total) has two peaks on the histogram of statistical distribution. The separate layers have more or less normal distribution type. This is result of the poly component interaction of different land form types and non relief factors.

2- The results have shown that > 70% of the spatial variability of colluvial matter is defined by land surface.

3- Statistical comparisons have shown that the traditional morphometric variables are not enough for quantitative description of the relationships between colluvial layers spatial distribution and different orographical processes.

4- Obtained technology allows to assess the pattern of spatial distribution of colluvial materials for the large areas based on the data from the small key plot.

SOURCES

Photo of the basin area
Google Earth
Photo of the profile BM-4
Protocol of field practice in Perdoel(Belauer See). 15./16.06.2007. Group 1.
Digital elevation model from LiDAR
In www.schleswig-holstein.de/~/atkisdgm__node.html
Elevation data from GPS measurements
Preparation of digital elevation model (DEM) and other maps derived from DEM for a small catchment of the lake Belau using Global positioning system (GPS). 2007. Report from the field practice. Module 2.1.5. Long-term development of landscape. Available in archive of department of Ecotechnology and Ecosistem Development, Ecology Centre, Christian-Albrechts-University Kiel.
Description of the morphometric variables
Shary P.A., Sharaya L.S. and Mitusov A.V. 2002. Fundamental quantitative methods of land surface analysis. Geoderma, 107: 1-35.
Software
Shary P.A., 2001. Analytical GIS Eco.

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