ΠΕΔΟΜΕΤRON

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International Working Group on Pedometrics – Provisional Commission on Pedometrics of the International Union of Soil Sciences (IUSS)

Pedometrics Chair: Gerard Heuvelink Secretary & Editor: Sabine Grunwald

1. From the Chair
(Gerard Heuvelink)

Dear Pedometricians!

A new Pedometron for you. Sit down and relax, give yourself a break to absorb the latest news from the wonderful world of Pedometrics. Pedometron is meant to entertain and inform (and sometimes even to provoke), and I am confident that after reading Pedometron 14 you will agree that Sabine has succeeded once again in compliling a very enjoyable issue.

More serious now. As you know we have requested to become a commission on Pedometrics of the International Union of Soil Sciences. At the Bangkok World Soil Congress, in August last year, the IUSS Council decided to grant us the status of 'provisional' commission. A final decision will be taken at the mid-congress Council meeting in Philadelphia, April 2004.

Recently, we received a letter from the Secretary General of the IUSS, Dr. Stephen Nortcliff. In the letter Dr. Nortcliff informed us that the position of Pedometrics was discussed at a recent meeting of the Executive Committee of the IUSS. Two decisions that concern us were taken: (1) it was concluded that Pedometrics would be most suitably placed in Division 1, 'Soils in Time and Space'; (2) the Pedometrics group was asked to provide a formal request to become a Commission, by presenting a brief case including a list of recent activities by August 1, 2003. We are happy with both decisions. It was our preference to be placed in Division 1. Some confusion had arisen as to whether we could (partly) be placed under Division 2 ('Soil Properties and Processes'). Now all confusion is removed, that is good. The second decision means that we have to produce a summary to make our case. This should not be too difficult because we can report on the many activities that the Pedometrics community undertakes.

It is important for the Pedometrics community to be active and organise all sorts of events. Not only because it brings us closer to our goal of becoming a commission, but more importantly because it unites us and creates the opportunity to meet and discuss Pedometrics issues. We are fortunate to have several events awaiting us in the near future. First of all there is the Pedometrics 2003 meeting in Reading, UK. Excitement all over, it is getting closer! Next, in November our group organises a special session at the SSSA Annual meeting in Denver, Colorado. One year from now we have the Digital Soil Mapping workshop in Montpellier, France. The organisers have already started working on a detailed programme. In this Pedometron you will read more about all three events; among others you will find the detailed programme of Pedometrics 2003.

INSIDE THIS ISSUE

Sabine's contribution on 'The Dilemma of Pedometrics in the U.S.' in Pedometron 13 has stirred a bit the traditional soil surveying community in the U.S. There was a lively email exchange....... It is good that we have started the discussion. I believe that it is important that we engage with other groups within the IUSS to jointly address some of the scientific challenges that soil science faces. We are not that arrogant that we think that we can solve all problems ourselves, or are we? We will have the opportunity to discuss with other soil scientists in Reading, Denver and Montpellier, but it may also be a good idea to fairly soon have a true joint meeting with approximately equal participation from various groups. Any ideas? Anyone interested to take the lead?

Let me finish. Enjoy reading Pedometron 14. To be honest, it is not all 'sit down and relax' that awaits you. You will also need to get to work. The quest for THE definition of Pedometrics continues, and I hope this time many people will respond to my call (it takes only 10 minutes). Another bit of work that awaits you is to rank the papers nominated for the best Pedometrics paper awards in 2001 and 2002. At Pedometrics 2003 we will take the votes, but let me advise you to make your order of preference already now. Now you have the opportunity to read the full papers and make a more reliable ranking. In Reading you may have to go with only the titles and author names. Do not forget: any time spent on reading these ten nominated papers is well spent because only the best work makes it to the list.

Gerard Heuvelink

Gerard, has a new joint appointment as
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Congratulations!

2. Members of the Advisory Committee

Gerard and Sabine asked members of the Pedometrics Working Group to support the work of the Chair and Secretary. An Advisory Committee was formed to help discuss and address issues related to pedometrics.

The following members agreed to volunteer:

- Marc van Meivenne (Ghent University, Belgium)
- Alex McBratney (University of Sydney, Australia)
- Marc Voltz (INRA, France)
- Pierre Goovaerts

Thank you very much for your support and time.

3. The Definition of Pedometrics (Gerard Heuvelink)

You will recall that in the previous Pedometron we had an item on the definition of pedometrics. Four candidate definitions were put forward:

1 Pedometrics = the application of mathematical and statistical methods for the quantitative modelling of soils, with the purpose of analysing its distribution, properties and behaviour

2 Pedometrics = the application of mathematical and statistical methods for the description of soils

3 Pedometrics = the development and application of statistical and mathematical methods applicable to data analysis problems in soil science

4 Pedometrics = soil science under uncertainty

We then asked all of you: which of the four definitions do you like most? Or do you have another alternative that you think is even better?

Six people replied.

Of course we had hoped for many more reactions but six is more than zero (infinitely more, in fact). These days people sometimes even do not reply to personally addressed (non-spam) emails, so perhaps we should consider ourselves lucky with six responses to a general call. Also, the feedback that we did get was valuable and constructive. Thank you Alex, Dan, Dick, Graham, Linda and N. for taking the time to form your opinion and share it with us!

The general feeling of the six respondents was that definitions 3 and 4 were less attractive than definitions 1 and 2. But it was also felt that definitions 1 and 2 could still be improved. All six came with modifications to the existing definitions or suggested completely new ones (see also the contribution by Alex elsewhere in this Pedometron). The result is that we now have eight more candidate definitions:

5 Pedometrics = the application of mathematical and statistical methods for the study of soils

6 Pedometrics = soil measures

7 Pedometrics = the use of quantitative methods for the study of soil distribution and genesis and as a sustainable resource

8 Pedometrics = soil mathematics

9 Pedometrics = study of variation in the properties of soil

10 Pedometrics = the study and manipulation of experimental data in soil science

11 Pedometrics = the application of mathematical and statistical methods for analysing and modelling soil distribution, properties or behaviour.

12 Pedometrics = the application of mathematical and statistical methods for the quantitative modelling of soils, with the purpose of analysing their distribution, properties and behaviour

Let me add to this list my personal preference, which takes a bit from the various definitions above:

13 Pedometrics = the application of mathematical and statistical methods for the study of the distribution and genesis of soils.

How to proceed? A next call for reactions may yield another dozen definitions, that is not what we want. Perhaps Alex is right when in so many words he states that we will never have a perfect definition of pedometrics. Perhaps there are as many definitions as there are pedometricians. But we need to move on. We need a widely accepted definition of pedometrics that we can use for communication with the outside world.

So this is what we are going to do now. We give all of you another chance to react to the 13 definitions that have now been suggested. Please send me (gerard.heuvelink@wur.nl) your opinion, rank the 13 definitions in order of preference if you like. Please note that you are no longer allowed to make new suggestions! I will not even look at them! I will simply collect the rankings, add them up and present the number 1 definition in the next Pedometron. Once this is done, we will make a list of all the important topics that are covered by pedometrics (Alex already made a start).

Don't postpone sending in your reaction. Take 10 minutes and do it now!

Gerard

4. Are Soils Spatially a Continuum?

(Dan Yaalon)

I wish to comment on the notion that spatial variation in soil properties, both within and between mapping polygons are essentially expressions of continuous change (continuum) most easily quantitatively separated by computerized methodologies. There is an inaccurate deception to this notion.

Out of the five soil-forming factors acting as driving forces for the nature of the surficial soils, at least two – parent material and topography – do frequently change abruptly over small distance. Geological and geomorphic maps amply document this. Sudden vegetation change is also a good expression of such discontinuities. I have no statistical data of the frequency of this occurrence (it would be good to obtain them from examples), but my experience indicates that for most medium and large scale maps it would be between one quarter and one half of the soil boundary lines drawn on them, especially in tectonically active non-glaciated regions; a not insignificant proportion. There is at least one recent paper (Schaetzl, 1998, Soil Sci., 163: 570-590) showing data that the frequency of vertical lithologic discontinuities in US soil series (based on a sample of 1000 soil series descriptions) is 33 percent. Surely it cannot be much different for spatial discontinuities. Thus slowly changing continua can't always be taken for granted.

Such lithologic and geomorphic spatial discontinuities and abrupt delineations obviously confirm that there are well recognized pedological individuals or soil bodies, irrespective of the inevitable additional variations within the polygons, which too are essentially of deterministic origin (called 'deterministic uncertainty' by Phillips, 2001, Annals Assoc.Amer.Geog. 91: 609-621). All soil classifications are man-made, produced to serve specific purposes. Even when called 'genetic' and based on selected pedogenic features, they need to be useful and to demonstrate common sense. Soil mapping is a synthesis of many observations and attributes of soil landscapes, not only the use of classification (On logic of mapping cf. Varnes, 1974. Geol. Survey Prof. Paper 837, 48 pp). Let us not forget that geostatistical methods are being developed partly to help us improve the classification or mapping of soils and to better understand or predict pedodiversity. Pedometrics is essentially a tool for the study of soils observed and for data analysis and need not be considered a challenge or contradiction of soil taxonomies. The notion of soil continuum needs to be carefully examined and then applied in a proper way.

Some of what is said in the above paragraphs has already been discussed in part at the Conference on Soil Classification 2001, especially by Ibanez and Boixadera, and published in 2002 (p. 93-110, European Soil Bureau, Research Report No 7, 248 pp).

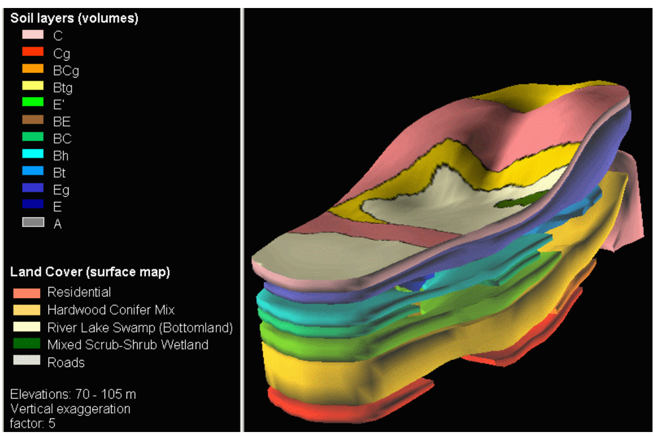


Fig. 1. 3D soil model showing continuous soil layers, terrain and land cover attributes for a soil-landscape in north-central Florida (S. Grunwald, 2002).

5. Pedometrics in a Sentence

(Alex McBratney)

"Language is like a blob of paste which can only be broken up by sentences. If you abandon sentences, it will be like falling into a quagmire and you will flounder about helplessly."

> Gao Xinjian, 2000. Soul Mountain, p.351. Flamingo (Harper-Collins), Sydney. Gao Xinjian, 2000. La Montagne de l'âme. Editions de l'Aube, Paris.

So we need a sentence to describe pedometrics, to keep us out of the mire. Perhaps as soil scientists we shouldn't be afraid to wallow in hydrosols and aquepts.

Still, I wholeheartedly welcome Gerard Heuvelink's call for a discussion on the definition of pedometrics. It is timely, especially since we are about to be recognised, indeed honoured, by the status of a Commission. My working definition of pedometrics has been something like, 'The use of quantitative methods for the study of soil distribution and genesis and as a sustainable resource'. Clearly this definition is somewhat limited, and limiting. Indeed, I agree, to a fair degree, with all of the definitions on p.6 of Pedometron 13, and no doubt there are others in the current issue with which I shall agree. They all have the flavour of what I think pedometrics is. Some of us will favour narrower definitions, others wider ones. I prefer a *sensu-lato* definition. I think it will take some time for us to work out the promontories, inlets, capes, bays, and even archipelagoes of the land that is pedometrics, and its geography will change with time. We could define pedometrics by complete enumeration of all the things that it does. For most this would be less than satisfactory, for pedometricians value elegance and parsimony.

I see in the definitions various aspects of pedometrics – data analysis, uncertainty, quantification, soil variation, etc. In the same way, that I think pedometrics is not just soil geostatistics (and geostatistics is an important pedometric tool, and pedometricians have done a lot to hone and refine that tool), I don't believe it is only soil-landscape analysis. I certainly believe the quantitative aspect of soil-landscape analysis is part of pedometrics. This is really the area of overlap sketched in McBratney et al., 2000, Fig. 1. It is one of the more, perhaps the most, important aspects of pedometrics. For me, pedometrics is more than soil geostatistics, more than quantitative soil-landscape analysis.

What more? For example, in Pedometrics 2003, there is a section on contaminated sites assessment. Pedometrics has much to offer here. Currently I am working on deriving soil attribute information from soil spectra, another aspect of pedometrics (which in this case overlaps with the discipline of chemometrics). Pedometrics can make great strides in the area of quantitative soil measurement and description, e.g., the development of sensors – an area that has become almost fossilised until recently. (Another definition of pedometrics could be simply 'soil measure'. Soil measure is certainly an important aspect of pedometrics.) At the fine scale, pedometrics has a role to play in the study of the stochastic geometry of soil fabric and pore structure. I'm pretty sure pedometrics will make substantial contributions to studies of pedodiversity and soil biodiversity.

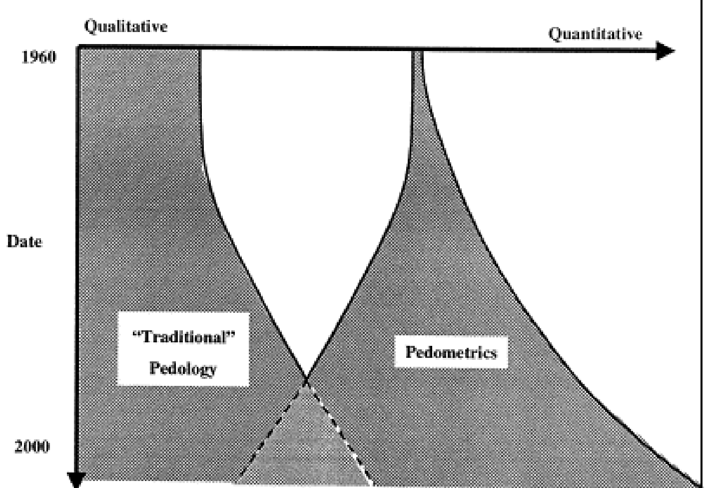
So an all-singing, all-dancing, all-embracing definition might be difficult. As pedometricians we might be happy with a fuzzy one, e.g., 'mathematical and statistical aspects of soil'. Indeed, I think that Winfried

Blum's concept of pedometrics as 'soil mathematics', analogously with soil physics, soil chemistry and soil biology, has a lot of merit. In this context, mathematics subsumes, *inter alia*, probability, statistics and computation.

Finally, a short anecdote, vaguely suggesting a more mystical definition. In the mid-'eighties before the word 'pedometrics' became widely extant, and I was even more unbearable than I am now, I was asked, as we often are, by a visiting colleague what was my particular area of specialisation in soil science. "I'm a pedometrican", I proudly replied. "A pedomagician?" "That's right." (These days I simply say I'm a soil scientist).

Reference

McBratney, A.B., Odeh, I.O.A., Bishop, T.F.A., Dunbar, M.S., Shatar, T.M., 2000. An overview of pedometric techniques for use in soil survey, Geoderma 97, 293-327.



McBratney et al., 2000, Fig. 1. A time line of the growth of pedology and pedometrics.

6. Pedology Polemics
(Dick Arnold)

1. The heartbeat of Pedology is the genesis of soils in their landscapes.
2. Soils, as we know them, are scale-dependent.
3. The truth about soils is in the soils themselves, but techniques provide us new relationships and insights among facts.
4. The human mind recognizes continua but works with discrete segments.
5. Boundaries are matters of opinion.
6. Computers can't classify until trained by humans.
7. Aggregating soil class maps may hold keys to operationally disaggregating soil class maps. Reverse fractals.
8. Specific purpose soil maps are costly but may perpetuate employment opportunities.
9. Thanks to the Great Being for the diversity of the pedosphere.
10. Where genetic processes radiate from a point, factor interactions constrain their spatial growth.
11. Prettier maps are better budget getters.
12. The pedopshere doesn't understand good intentions.
13. A classification abstracts the state of knowledge at a point in time.

Don't forget that we study soils……..
Photographs: Hydric soils (courtesy, Soil and Water Science Dept., University of Florida)

7. Best Paper Awards

It is time to select the annual best papers in Pedometrics published in 2001 and 2002 in peer-reviewed international journals. This year, Dr. Achim Doberman (University of Nebraska, Lincoln, USA), Dr. David Brown (Montana State University, Bozeman, MO, USA), and Dr. Hocine Bourennane (INRA Orléans, France) nominated the papers which are listed below. The election will proceed as follows:

a) Only pedometricians on the mailing list and registered participants of Pedometrics 2003 are considered as eligible voters.

b) Each vote must consist of a ranking of all 5 papers for 2001 and 2002, respectively. Rank 5 for the highest preference to 1 for the lowest preference.

c) The votes will be collected during Pedometrics 2003.

d) Pedometricians on the mailing list that are not attending Pedometrics 2003 may cast their votes by sending an email with their ranking to Sabine (SGrunwald@mail.ifas.ufl.edu).

e) The awards will be formally announced at the Pedometrics Meeting in Reading, UK.

Nominations Pedometrics Best Paper Award 2001:

1. Minasny, B. and McBratney, A.B., 2001. A rudimentary mechanistic model for soil production and landscape development II. A two-dimensional model incorporating chemical weathering. Geoderma, 103: 161-179.

Abstract. The necessity for a quantitative analysis of pedogenesis has become more compelling in the last few decades. In part one of this paper we proposed a rudimentary mechanistic model that considers soil formation spatially at the catena scale. This paper extends the model for soil formation in a landscape conditioned by a digital elevation model and further illustrates the application of the model in quantifying pedogenesis. The current model states that the change in soil thickness over time depends on the physical weathering rate of rock, the loss due to chemical weathering and the transport of soil through erosion. The rate of physical weathering or lowering of the bedrock surface is represented as an exponential decline with soil thickness. The chemical weathering rate is modelled as a negative exponential function of both soil thickness and time. Assuming uni-dimensional weathering, the rate of chemical weathering can be expressed as a reduction in soil thickness. The movement of materials in the landscape is characterized by diffusive transport. The model is solved numerically using the finite-difference approach and applied to a digital elevation model. The results for simulation of soil formation in a landscape after 10,000 years shows that the soil accumulates (thickens) in the gullies and erodes (thins) in the ridges. The soil from the upper slope is transported down-slope by the erosion processes and fills the gullies. Soil thickness is highly correlated with the profile curvature. The effect of climate, rock type and land management is illustrated by different combinations of weathering rate and erosive diffusivity. To illustrate the effect of irregularity and randomness on the stability of the solution and the soil development, spatially correlated normally distributed random numbers were added to the initial soil elevation. The small randomness appears to cause instability (chaos) in the system. Dimensionality analysis of the soil thickness as a function of time confirms the non-linear chaotic behaviour of the model rather than merely random noise. A difference plot of the soil thickness time series unveiled the presence of a strange attractor. Alternatively, these results may be a result of numerical instability.

2. Lark, R.M., and R. Webster. 2001. Changes in variance and correlation of soil properties with scale and location: analysis using an adapted maximal overlap discrete wavelet transform. Eur. J. Soil Sci. 52:547-562.

Abstract: The magnitude of variation in soil properties can change from place to place, and this lack of stationarity can preclude conventional geostatistical and spectral analysis. In contrast, wavelets and their scaling functions, which take non-zero values only over short intervals and are therefore local, enable us to handle such variation. Wavelets can be used to analyse scale-dependence and spatial changes in the correlation of two variables where the linear model of coregionalization is inadmissible. We have adapted wavelet methods to analyse soil properties with non-stationary variation and covariation in fairly small sets of data, such as we can expect in soil survey, and we have applied them to measurements of pH and the contents of clay and calcium carbonate on a 3-km transect in Central England. Places on the transect where signifiant changes in the variance of the soil properties occur were identified. The scale-dependence of the correlations of soil properties was investigated by calculating wavelet correlations for each spatial scale. We identified where the covariance of the properties appeared to change and then computed the wavelet correlations on each side of the change point and compared them. The correlation of topsoil and subsoil clay content was found to be uniform along the transect at one important scale, although there were significant changes in the variance. In contrast, carbonate content and pH of the topsoil were correlated only in parts of the transect.

3. Walvoort, D.J.J. and de Gruijter, J.J., 2001. Compositional kriging: A spatial interpolation method for compositional data. Mathematical Geology, 33: 951-966.

Abstract. Compositional data are very common in the earth sciences. Nevertheless, little attention has been paid to the spatial interpolation of these data sets. Most interpolators do not necessarily satisfy the constant sum and nonnegativity constraints of compositional data, nor take spatial structure into account. Therefore, compositional kriging is introduced as a straightforward extension of ordinary kriging that complies with these constraints. In two case studies, the performance of compositional kriging is compared with that of the additive logratio-transform. In the first case study, compositional kriging yielded significantly more accurate predictions than the additive logratio-transform, while in the second case study the performances were comparable.

4. Holden, N.M. 2001. Description and classification of soil structure using distance transform data. Eur. J. Soil Sci. 52:529-545.

Abstract. Classification of soil based on structure is useful for conveying information about physical properties and soil processes. The distance transform is an im age analysis technique suitable for quantifying soil structure. An analysis of distance transform data, in the form of cumulative area distribution curves for previously published images of soil structures of various types, is presented. The images were used to derive a quantitative classification of structure using maximum distance of solid from a macropore (Dmax, measured), the distance from macropore space containing 50% of the solid area (k, derived by fitting a sigmoidal function to the cumulative area distribution curve), the total interface length between pore and solid per area of sample (IA, measured), the porosity or the proportion of pores per area of sample (PA, measured) and the pore distribution characteristic (n, derived by fitting a sigmoidal function to the cumulative area distribution curve) which is related to the number, continuity and distribution of pores. The influence of image resolution was investigated, and within limits found to be fairly small. The final classifiation of soil structure was based on the hypothesized relations between the descriptors and structure-forming processes.

5. Viscarra Rossel, R.A., P. Goovaerts, and A.B. McBratney. 2001. Assessment of the production and economic risks of site-specific liming using geostatistical uncertainty modelling. Environmetrics 12:699-711.

Abstract. Precision agriculture (PA) offers the potential to improve the efficiency and environmental impact of conventional crop production systems. However, its implementation will depend on perceptions of how the adoption of technology will increase their yields and profit, and lower their production risk. This article presents an approach to help with this type of decision making. In this instance the consequences of three management scenarios (no lime, single-rate liming and site-specific lime applications to acidic field soil) were assessed in terms of production and economic risks. The methodology involved modeling the uncertainty about wheat yield, accounting for the local uncertainties about soil pH and lime requirement, and the uncertainties about crop model parameters used in the simulations. Indicator kriging (IK) was used together with Latin hypercube sampling (LHS) of the probability distributions of variables and model parameters for the propagation of uncertainties through to the output yield and net profit maps. These maps, together with a sensitivity analysis, were used to aid with decision making. Comparison of the three scenarios showed that, under the economic conditions of the analys is, the optimum was reached for a single-rate application of 3.5 Mg/ha over the entire field instead of site-specific lime applications.

Nominations Pedometrics Best Paper Award 2002:

1. Saito, H., Goovaerts, P., 2002. Accounting for measurement error in uncertainty modeling and decision-making using indicator kriging and *p*-field simulation: application to dioxin contaminated site. Environmetrics 13, 555-567.

Abstract. In many environmental studies spatial variability is viewed as the only source of uncertainty while measurement errors tend to be ignored. This article presents an indicator kriging-based approach to account for measurement errors in the modeling of uncertainty prevailing at unsampled locations. Probability field simulation is then used to assess the probability that the average pollutant concentration within remediation units exceeds a regulatory threshold, and probability maps are used to identify hazardous units that need to be remediated. This approach is applied to two types of dioxin data (composite and single spoon samples) with different measurement errors which were collected at the Piazza Road dioxin site, an EPA Superfund site located in Missouri. A validation study shows that the proportion of contaminated soil cores provides a reasonable probability threshold to identify hazardous remediation units. When a lower probability threshold is chosen, the total remediation costs are unreasonably high while false negatives are unacceptably frequent for a higher probability threshold. The choice of this threshold becomes critical as the sampling density decreases.

2. Minasny, B., McBratney, A.B., 2002. Uncertainty analysis for pedotransfer functions. European Journal of Soil Science 53, 417-429.

Abstract. Both empirical and process-simulation models are useful in predicting the outcome of agricultural management on soil quality and vice versa, and pedotransfer functions have been developed to translate readily available soil information into variables that are needed in the models. The input data are subject to error, and consequently the transfer functions can produce varied outputs. A general approach to quantifying the resulting uncertainty is to use Monte Carlo methods. By sampling repeatedly from the assumed probability distributions of the input variables and evaluating the response of the model, the statistical distribution of the outputs can be estimated. Methods for sampling the probability distribution include simple random sampling, the sectioning method, and Latin hypercube sampling. The Latin hypercube sampling is applied to the quantification of uncertainties in pedotransfer functions of soil strength and soil hydraulic properties. Hydraulic properties predicted using recently developed pedotransfer functions are also used in a model to analyse the uncertainties in the prediction of soil-water regimes in the field. The uncertainties of hydraulic

properties in soil-water simulation show that the model is sensitive to the soil's moisture state.

3. Bogaert, P., D'Or, D., 2002. Estimating soil properties from thematic maps: The Bayesien Maximum Entropy approach. Soil Science Society of America Journal 66, 1492-1500.

Abstract. Current soil process models require the most accurate values for each of their input parameters at the finest spatial scale. Traditionally, soil property values are obtained either from soil maps or from geostatistical methods using exact laboratory measurements. Both data types convey substantial information: soil maps provide exhaustive but soft (vague) information, whereas laboratory analyses provide hard (accurate) but scarce measurements. Ideally, they should be combined. This objective can be reached using a recently developed method, namely the Bayesian maximum entropy (BME) approach that allows the user to incorporate hard and soft data in a spatial estimation context. In this work, both the regular BME algorithm and a new variant of it using a Monte Carlo procedure (BME/MC) are proposed for obtaining an estimated map for the textural (sand, silt, and clay) fractions from a limited number of accurate measurements and a spatially exhaustive soil map. Compared with popular geostatistical methods like ordinary kriging (OK), this approach has the advantage of using soft information on a sound theoretical basis. The entire probability distribution function can be estimated at each estimation location, allowing the computation of confidence intervals, probability of exceeding a threshold, etc. Using expectation properties in a Monte Carlo procedure, the BME/MC algorithm takes additionally into account the fundamental constraints on the textural fractions (they are summing to one and belong to the [0, 1] interval). As illustrated with a real data set from Belgium, using BME results in much more accurate textural fractions estimates and more realistic maps than those obtained with regular geostatistical algorithm.

4. Lark, R.M., 2002. Optimized spatial sampling of soil for estimation of the variogram by maximum likelihood. Geoderma 105, 49-80.

Abstract. Recent studies have attempted to optimize the configuration of sample sites for estimation of the variogram by the usual method-of-moments. This paper shows that objective functions can readily be defined for estimation by the method of maximum likelihood. In both cases an objective function can only be defined for a specified variogram so some prior knowledge about the spatial variation of the property of interest is necessary.
This paper describes the principles of the method, using Spatial Simulated Annealing for optimization, and applies optimized sample designs to simulated data. For practical applications it seems that the most fruitful way of using the technique is for supplementing simple systematic designs that provide an initial estimate of the variogram.

5. Moyeed, R.A., Papritz, A., 2002. An empirical comparison of kriging methods for nonlinear spatial point prediction. Mathematical Geology 34, 365-386.

Abstract. Spatial prediction is a problem common to many disciplines. A simple application is the mapping of an attribute recorded at a set of points. Frequently a nonlinear functional of the observed variable is of interest, and this calls for nonlinear approaches to prediction. Nonlinear kriging methods, developed in recent years, endeavour to do so and additionally provide estimates of the distribution of the target quantity conditional on the observations. There are few empirical studies that validate the various forms of nonlinear kriging. This study compares linear and nonlinear kriging methods with respect to precision and their success in modelling prediction uncertainty. The methods were applied to a data set giving measurements of the topsoil concentrations of cobalt and copper at more than 3000 locations in the Border Region of Scotland. The data stem from a survey undertaken to identify places where these trace elements are deficient for livestock. The comparison was carried out by dividing the data set into calibration and validation sets. No clear differences between the precision of ordinary, lognormal, disjunctive, indicator, and model-based kriging were found, neither for linear nor for nonlinear target quantities. Linear kriging, supplemented with the assumption of normally distributed prediction errors, failed to model the conditional distribution of the marginally skewed data, whereas the nonlinear methods modelled the conditional distributions almost equally well. In our study the plug-in methods did not fare any worse than model-based kriging, which takes parameter uncertainty into account.

8. Geostatistics Textbooks
(Alex McBratney)

Geostatistics is one of the key methods of pedometrics. It is now taught quite widely, and luckily, many geostatistics text books are now available, e.g., more recently, Armstrong (1997), Chilès and Delfiner (1997), Christakos (2000), Clark and Harper (2000), Deutsch and Journel (1998), Goovaerts (1997), Isaaks and Srivastava (1990), Lantuéjoul (2002), Olea (1999), Rivoirard (1994), Stein (1999), Wackernagel (1998), and Webster and Oliver (2001). The texts by Goovaerts (1997) and Webster and Oliver (2001) are clearly the most soil-oriented (pedometric).

I hear many of you murmuring, 'the list is far from complete, he's missed x and y'. This is from pure ignorance tinged with a smattering of forgetfulness. It would be useful to have an up-to-date list, say, on Tomislav Hengl's (hengl@itc.nl) excellent official Pedometrics website (http://www.itc.nl/personal/hengl/PM/). So please send additional titles to Tomislav.

Armstrong, M., 1997. Basic Linear Geostatistics. Springer Verlag.

Chiles, J.-P., Delfiner, P., 1999. Geostatistics: Modeling Spatial Uncertainty. Wiley-Interscience

Christakos, G., 2000. Modern Spatiotemporal Geostatistics. Oxford University Press, New York.

Christakos G., Bogaert P., Serre M. 2001. Temporal GIS. Springer, Berlin.

Clark, I., Harper, W., 2000. Practical Geostatistics 2000 Book and CD. Ecosse North America, LLC;

Cressie N.A.C. 1993. Statistics for Spatial Data. John Wiley & Sons, New York.

Deutsch, C.V., Journel, A.G., 1998. GSLIB: Geostatistical Software Library and User's Guide. Oxford University Press, New York.

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Book review (Sabine Grunwald):

A new soil classification book by Eswaran et al. published in Spring 2003 summarized past, present, and future soil surveying efforts.

Eswaran H., Rice T., Ahrens R., and Stewart B.A. 2003. Soil Classification – A Global Desk Reference. CRS Press, New York.

The first part of the book discussed concepts and innovations in soil classification. The history and philosophy of soil classification was discussed by Buol in chapter 1. Dudal in chapter 2 pointed out the difficulties with specialized soil taxonomy and called for a shift from a qualitative genetic approach in soil classification to a quantitative approach. Dudal argued for georeferenced databases of soil properties rather than taxonomic soil map units. Ahrens et al. (chapter 3) and Bryant and Galbraith (chapter 7) immersed into taxonomic nomenclature and Arnold and Eswaran (chapter 4) focused on why we need soil classification. Blum and Laker (chapter 5) stated that “scientists working in soil physics, chemistry, biology, and mineralogy have little or no soil classification information, because of a lack of scientific interest.” They pointed out, “this frequent apathy, and in the worst cases even antagonism, of specialists in these fields toward soil classification is unfortunate”. Bouma pointed out in chapter 6 that taxonomy has increasingly become a two-dimensional activity. He suggested considering three-dimensional landscape processes and focusing on studying real and potential effects of different types of management within a given type of soil. Uehara (chapter 8) discussed soil chemistry and soil classification. The second part of the book described numerous national soil classification systems.

Overall, the textbook attempted to contrast traditional soil surveying / soil classification and alternative techniques. The second part of the book exclusively focused on soil classification.

9. Upcoming Meetings

GeoComputation 2003
University of Southampton, Southampton, UK
8-10 September 2003
http://www.geog.soton.ac.uk/conferences/geocomp/

Pedometrics 2003
5th Conference of the Provisional Commission on Pedometrics of the International Union of Soil Sciences

Reading, UK, September 10 - 12, 2003

Contact: Margaret Oliver, University of Reading, UK (m.a.oliver@reading.ac.uk)

Special Topic Session
Advances in Thematic Soil Mapping
2003 ASA-SSSA-CSA Meeting,
November 2 to 6, 2003; Denver, CO, USA

Jointly organized by Division S-5, SSSA & International Working Group on Pedometrics – Provisional Commission on Pedometrics of the International Union of Soil Science

Important:
If you submitted a title to SSSA, please, email a copy of your title submission information to Achim Doberman (adobermann2@unl.edu) or Sabine Grunwald (SGrunwald@mail.ifas.ufl.edu).

Deadline to submit abstracts: July 23, 2003
(you can only submit an abstract if you have already submitted a title)

Global Workshop on Digital Soil Mapping
(First Announcement)
Agro-Montpellier, France, September 15-17, 2004
Organized by the International Working Group on Pedometrics – Provisional Commission on Pedometrics of the International Union of Soil Science
Contact: Phillippe Lagacherie
(lagacherie@ensam.inra.fr)

Pedometrics-2003 11th–12th September: Provisional Programme

Margaret Oliver and Murray Lark have put together a programme based on the four sessions for which abstracts were sought. Each abstract has been reviewed by two of the scientific committee. Where there was a marked difference in the assessment given by the reviewers they were reviewed again by the above members of the local organising committee. The programme is provisional at present until authors have registered. The form is now available on the web site: http://www.rdg.ac.uk/AcaDepts/as/Pedometrics/. Authors should ensure that they register before August 14th to retain their place in the session allocated.

Each speaker will be given 20 minutes for their presentation, which includes 5 minutes for questions. **Please note that the order of the speakers has not yet been decided; they are in alphabetical order at present**.

The authors of both oral and poster presentations will be invited to submit full papers of previously unpublished work for potential publication in the special issue of a journal.

The formal part of the meeting will be opened by Dr Stephen Nortcliff, Secretary General of the International Union of Soil Science and Head of Soil Science at the University of Reading. His opening remarks will be followed immediately by our first keynote presentation.

Session 1: Thursday 11th September

New developments and applications in pedometrics.

Author(s)	Title
Keynote speaker	
Pascal Monestiez	**Geostatistical modelling of spatial processes on trees: applications to drainage networks**.
E. Bosch *et al.*	The analysis of soil transect data by a wavelet-based generalized variogram
T. Hengl	A grid-based soil information system based on the hybrid model of spatial variation.
R. M. Lark et al.	Using the wavelet transform to analyse spatial variation of gaseous fluxes from the soil and their covariation with soil properties.
U. Leopold	Handling support problems in accuracy assessment of an environmental process model
B. P. Marchant and R. M. Lark	Adaptive schemes for geostatistical sampling and survey.
K. Oleschko *et al.*	Radar imaging of soil variation using fractal analysis
U. Weller	Wavelet decomposition on scattered data – a comparison to kriging based on EM38 measurements

Poster session:
Five minutes will be allocated for the presentation of each poster in the main lecture theatre.

Lunch

Session 2: Thursday 11th September

Multivariate methods, including space/time applications.

Author(s)	Title
A. Douaik *et al.*	Soil salinity using spatio-temporal kriging and Bayesian maximum entropy.
G. B. M. Heuvelink *et al.*	Spatio-temporal prediction of soil redistribution using the Kalman smoother
P. Lagacherie	Using a fuzzy pattern matching algorithm for allocating soil individuals to pre-existing soil classes.
G. Jost and G. B. M. Heuvelink	Comparing the space-time distribution of soil water storage for two forest ecosystems using spatio-temporal kriging
A. B. McBratney *et al.*	Multivariate indices of soil heterogeneity estimated from topsoil UV-visible NIR diffuse reflectance spectra.
B. Minasny *et al.*	On the stability of the fuzzy k-means solution
A. Papritz and G. Jost	Fitting models to space-time variograms by least squares

Poster session:
Five minutes will be allocated for the presentation of each poster in the main lecture theatre.

Conference dinner

Session 3 Friday 12th September

What can pedometricians offer in the field of contaminated land?

Author(s)	Title
Marc Bierkens	**Methods that span the soil, water and agricultural interface**
G. J. Brus and J. J. de Gruijter	Uncertain soil quality standards for heavy metals in soil derived with regression models from food quality standards in crops.
A. Douaioui *et al*	Detecting soil salinity hazard using a regression-kriging approach based on remote-sensed and topographical data.
P. Goovaerts and H. Saito	Selective remediation of contaminated sites using a two-level multiphase strategy and geostatistics.
C. Herzig and A. Papritz	Non-linear, non-stationary and change of support: modelling soil contamination around a metal smelter for additional soil sampling.
R. M. Lark *et al.*	Using robust multivariate geostatistical modelling of spatio-temporal variability to monitor change in metal concentrations in the topsoil.
I. Odeh et *al.*	Modelling the risk of soil degradation: (multiple) indicator kriging approach to mapping the potential for soil sodification and structural decline.
E. Savelieva *et al.*	BME application for uncertainty assessment of the Chernobyl fallouts.

Poster session:
Five minutes will be allocated for the presentation of each poster in the main lecture theatre.

Lunch

Session 4 Friday 12th September

Methods that span the soil, water, agriculture interface.

Author(s)	Title
A. Dobermann *et al.*	Using secondary information for improving fine-scale mapping of soil properties.
S. Grunwald *et al.*	Spatial methods for assessing the distribution and impact of soil phosphorus in a subtropical wetland.
Z. L. Frogbrook and M. A. Oliver	ElectroMagnetic Induction (EMI) surveys: is this the key to inexpensive soil information?
V. Hennings *et al.*	Identification of the most suitable approach to determine soil spatial variability for precision agriculture.
B. Minasny and A. B. McBratney	Modelling soil profile evolution.
J. Triantafilis *et al.*	Resolving the spatial distribution of soil electrical conductivity using EM38 and EM31 signal data and Tikhonov regularisation.
A. Zhu	Assisting the development of a soil-landscape model for predictive mapping using a fuzzy *c*-means classification.

Poster session:
Five minutes will be allocated for the presentation of each poster in the main lecture theatre.

Conference ends