

PEDOMETRON



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Sydney, January 1997, Number 6

Newsletter of the International Society of Soil Science Working Group on Pedometrics (PM)

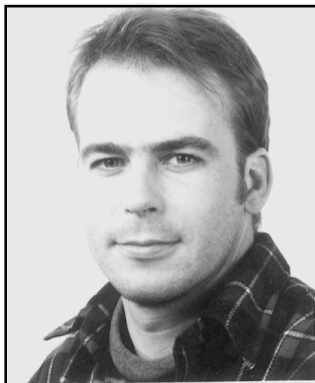
Pedometrics Chair: Professor Alex B. McBratney

Secretary: Dr Jaap J. de Gruijter

Editor: Dr Inakwu O.A. Odeh

PM Best Paper Award

The best Pedometrics paper award for 1994 has been won by **Dr Marc F. P. Bierkens** of the Winand Staring Centre, Wageningen in the Netherlands, and **Dr Henk J.T. Weerts** of the Institute of Geographical Research, University of Utrecht, The Netherlands.



Dr Bierkens ... winner

They won the award for their excellent paper entitled: *Application of indicator simulation to modelling the lithological properties of a complex layer*, published in *Geoderma* Vol. 62, pages 265-284. Their paper was selected by a popular vote from among five very good papers published in various international journals. The five papers were initially nominated by the PM Secretary **Dr J.J. DeGruijter**. Their win was announced by the Chair of the PM Working Group, **Professor A. McBratney**, during the recent

Workshop on Soil and Water Quality at Different Scales held in Wageningen and jointly organised by 3 Working Groups one of which was WG-PM. It is hoped the award and citation will be presented by the Chair of PM, Professor A.B. McBratney, in August 1997 at the **Pedometrics '97** in Madison.

From the (2.5BG 7/4) Chair

During 1996 I had the opportunity to attend several conferences which had a significant "Pedometrics" component.

In late June I went to Minneapolis to attend the 3rd International Conference on Precision Agriculture. It is clear that pedometric techniques have a large part to play in this field. I think we should be aware that the pedometric understanding is not well advanced and there is a tremendous opportunity for pedometricians to bolster the exciting technological advances being made.

Immediately on returning from the US I took part in the Joint Australian and New Zealand Soil Science Societies Conference. During that Conference we had a session on Pedometrics organised by the Pedometrics Working Group and the Australian Collaborative Land Evaluation Program (ACLEP). This was quite successful and very well attended. The Keynote Address was given by **Johan Bouma** and will appear in a few months as a

Discussion Paper in *Geoderma*. Talks were also given on land evaluation, fuzzy soil description, forest and pasture soil evaluation and precision agriculture. Pedometrics is not as widespread in Australia and New Zealand as it might be, but there was some encouraging evidence from this meeting that many of the younger scientists are taking up the mantle. The largest Pedometrics meeting of the year was in August in Wageningen. This was a 3-day workshop on Soil and Water Quality at Different Scales jointly organised by 3 Working Groups one of which was WG-PM. Many fine papers were presented and there was much interesting discussion. I believe the papers will appear in a special issue of *Fertilizer Research*. I came away with the impression that we need to look very carefully at approaches to upscaling and downscaling. A lot of work is required here. This is sort of summed up by the following poem:-

ENGINES OF RESOLUTION

*Our perception is trapped
In a narrow gully
The fine entanglements
And the gross picture
Obscured from our view
Cunning engines
Must be constructed
To take us
Up the snakes
And down the ladders
But still there is
Uncertainty
A dirty handkerchief
And crude resolution*

David van der Linden

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Soil and water quality are still concepts that require rigorous definition – there are too many notions extant at the moment. So I think the linkage between upscaling and soil quality is achievable but a little way off.

Unfortunately I didn't get time to attend the International Geostatistics Congress held here in Australia in September. Several pedometricians did however and I'm sure they made their presence felt.

November took me to an Indianapolis devoid of race cars or architecture but replete with "aggies" – the Annual Meetings of the ASA/CSSSA/SSSA. A couple of Symposia are worth mentioning for their Pedometric content. The Symposium on Space-Time Modelling (organised by the deWit School of Production Ecology) had much useful didactic material. The papers will appear in a Special Issue of *Geoderma*. I guess the main question I was left pondering is: "what should the relative contributions of physically-based process models and non-mechanistic statistical model be in dealing with space-time data?"

Another Symposium organised by Division S5 focused on quantitative approaches to soil mapping. One of the success stories here seems to be advances in updating or improving existing coarse-scale (resolutions of 1-5km pixels) soil maps. This is achieved by combining remote sensing (mainly AVHRR imagery), DEM and other expert information into neural network models and the like. I see this area as being important as it allows soil scientists to be involved in providing good (or known) quality information for continental or global-scale climatic, production or environmental models.

1997 sees the 2nd Pedometrics Conference in Madison, Wisconsin. A wonderful place to be in August. I hope to see you down by the lake. Best wishes for the New Year.

Alex. McBratney

From the Editor

We are a bit late with this issue due to our heavy work load. There is therefore the possibility of having three issues (including this one) this year.

It seems readers are quite complacent on the continued success of *Pedometron*. We continue to need volunteers to contribute to the Newsletter in the form of :

1. Short review of a topic of their choice, e.g., recent advances in pedometrics, developments in soil science and the role of pedometrics, etc.
2. Abstracted version of their recent publication(s) in soil science journals.
3. Titles and abstracts of recent theses in which they were involved.
4. An ode to the gods of earth or something similar.
5. Or any other topic of your choice relevant to pedometrics in particular and soil science in general.

Fuzzy mailing list

There is a new mailing list for the *Fuzzy Analysis of Landforms and Soils*. The list has been established to facilitate discussion on the use of fuzzy logic in Soil Science. The idea to initiate a mailing list was mooted at the Symposium on Fuzzy Sets in Soil Science. Related issues can also be raised and discussed.

To subscribe, send a message to

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Leave the subject line blank. The content of your email should be (without < >)

set <listserver> conceal no>

On recent Pedometrics-related meetings

Like Alex, I was fortunate to have the opportunity to attend a number of meetings held recently - whole or parts of which were devoted to topics in Pedometrics. Two of these, the Pedometrics session of the Joint Australian and New Zealand Soil Science Societies Conference, and the workshop on Soil and Water Quality at Different Scales, have already been covered by Alex. The other notable meeting I attended was the 5th International Geostatistics Congress held in Wollongong, Australia. Among the excellent papers relevant to Pedometrics were on: geostatistical simulation, stochastic imaging for remediation of contaminated soils, spatial-temporal modelling, geostatistics and environmental policy support, assessment of local uncertainty in decision-making, spatial variation in designed field trials, geostatistical simulation for upscaling unsaturated hydraulic conductivity, residual kriging for mapping soil pollution, application

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of multivariate geostatistics, etc.

The sessions on theoretical topics were thought-provoking with keynote speakers such as **Professor A.G. Journel**, **Mohan Srivastava**, **Dr C.V. Deutsch** and **Professor N. Cressie** focusing on future directions and the potential paradigm shift in geostatistics.

Other interesting sessions covered various topics on the tendency to overly use the principles of objectivity in model building. Another was the use of the *homeogram*, instead of the traditional variogram, in *optimal biased kriging* which would allow the user's confidence in the prior information about the underlying process. A discussion session on *deterministic geostatistics* illustrated how to incorporate ancillary information in prediction models. This is particularly relevant in soil science with increasing availability of ancillary information at high resolution, that is highly correlated with soil properties. It may serve us better to use the exhaustively known data set over a finite set of locations as a training set to estimate a less known data set (soil) over the same number of locations.

The proceedings of the Congress will be published in two book volumes by Kluwer Academic Publishers.

On the whole I enjoyed most of the sessions I attended; I also had the rare opportunity to meet and/or mix with the gurus of geostatistics.

On Pedometrics '97 Change of date

The *Second International Pedometrics Conference* will now be held from **August 18 to 20, 1997** instead of August 27 to 31, 1997, as announced in Pedometron no's 4 and 5. The conference venue is the soon-to-be-opened Monona Terrace Convention Centre in Madison, Wisconsin, USA. (See details on page 4).

Australian Great Soil Groups now fuzzified and quantified

By **S A Mazaheri** and A B McBratney
Department of Soil Science
and Agricultural Chemistry
The University of Sydney

In the Australian Great Soil Groups (GSG) soil is classified into 43 great groups (Stace et al., 1968) which have been arranged in a sequence of seven categories, in order of increasing leaching and profile development, starting with the unleached solochaks (the plural indicating that various soil profiles may be allocated to the same profile class), undeveloped lithosols and alluvial soils, and are followed by strongly leached and highly differentiated profiles and finally ending with organic soils. The GSG system has been popular in Australia for nearly three decades, and many people are familiar with the classes and can visualize them readily in broad terms (Moore et al., 1983). However, this system, as with almost every system of soil classification, has disadvantages. One is the identification of a new profile is subjective because no key has been generated. Consequently, it may be difficult to allocate some profiles in Australia to a group. This has resulted in misclassification of soil by different users of GSG, leading to a decline in its use to the point that most Australian soil scientists think a revision of it is necessary. However, the value of this system seems to lie not in its groupings of soils and concepts of genesis but rather in its compilation of data and the role these data play in soil classification and genesis research in Australia (Isbell, 1992).

Why Fuzzy soil classification?

Soil classification, in the traditional sense, is based on the notion that soil forms discrete, internally homogeneous units, with sharp boundaries. In this sense each soil unit can be represented by a central concept known as a typical or representative profile. This model implies that the predicted value of a soil attribute at any unsampled area is either the value for the typical profile or the mean value for the soil unit.

The ultimate aim of soil classification is possibly to produce a soil map with a set of clearly defined and mutually exclusive classes that can be used for transferring information about the soil. The soil map established by conventional concepts is a single display of the spatial distribution of the classes of the initially constructed classification scheme, with soil boundaries interpolated between points where the soil is allocated to different classes (Burgess & Webster, 1984). As it is usually impossible to restrict class boundaries, very similar individuals are often separated by a "taxonomic" chop (Butler, 1980). Therefore, conventional soil classification breaks down because of: (1) the natural variation in soil and landscape-forming processes; (2) the complexity of variation; (3) the practical inability to sample and measure everything, and (4) the uncertainty associated with prediction and soil information.

The problem of dealing with undefined classes and vague boundaries has led to fuzzy soil classification in which soil may belong totally, partially or not at all to soil classes. In practice, the extent of soil membership in any class is permitted from zero (no membership) to one (membership in one class only). The main feature of this system of classification is the grouping of soil individuals into classes where boundaries are not, should not or can not be, exactly defined. These diffuse classes are known as continuous classes and the system itself is called continuous classification (McBratney & De Gruijter, 1992). Allocating unknowns to fuzzy and continuous soil classes is dealt with in detail by McBratney (1994).

Advantages of fuzzy system

This system allows soil scientists to check the results of soil identification through the membership allocation; the greater the membership, the stronger

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the linkage to a great soil group. As this system is more flexible than conventional ones, it can transfer more and better information to users.

Fuzzy soil classification is a continuous, quantitative or objective procedure in which the classes are defined in terms of membership and based on many properties simultaneously (polythetic). Additionally, as for qualitative attributes such as soil structure, this system can accommodate these subjective assessments. No special expertise is required, except for a general knowledge of soil description (Mazaheri et al., 1995a).

GSG in fuzzy system

In this method, classification of individual soil profiles was undertaken using fuzzy set theory in the form of fuzzy k-means with two algorithms: simple and with extragrade. These algorithms were used to produce a fuzzy scheme for Australian Great Soil Groups (GSG). Centroids were generated, together with fuzzy group membership, using data from the 147 soil profile descriptions in the Handbook of Australian Soils. The fuzzy system of soil classification rests basically on the degree of similarity, likeness and closeness to centroids. As an example, in the GSG the degree of membership is firstly distributed among different members of one category and then, among GSGs with less difference in attribute values. The centroids of GSG were examined, and the method of fuzzy k-means was then used to allocate unknown profiles to the GSG. The results show that this system is intuitively reasonable.

The Australian Soil Identification Spreadsheet (ASIS) program

The Australian Soil Identification Spreadsheet (ASIS) (Mazaheri et al., 1995b) is based on the fuzzy k-means with extragrades algorithm. Fuzzy k-means with extragrades has been applied to permit variation in the distance dependence for membership in the outlier group recognized by De Gruijter and McBratney (1988).

The implementation on the Macintosh and PC makes the technique for generalised fuzzy k-means available for soil profile identification for the first time to everyday users. ASIS which is distributed on an 1.44 MB floppy diskette requires an Apple Macintosh or Windows compatible PC with Microsoft Excel version 5.0 installed.

The ASIS describes the user

interface to the Australian Soil Identification Spreadsheet (ASIS). The interface is in the form of dialogue boxes, which are presented in one of two ways (chosen by the user) depending on whether the user is familiar or not with program. In the first case, knowledge of the spreadsheet is not required and all data entry is facilitated by the dialogue boxes wherein which data is entered. In the second case, assuming the user is acquainted with the program, one single dialogue box should be completed. To help the user work with this program, a manual with two examples, one from Australia and the other from the USA, is provided. The first example is for inexperienced users and the other for users acquainted with the scheme. In each example, some dialogue boxes along with tables of required attributes are given. The manual is complete with glossary and an appendix.

Conclusion

The fuzzy set system, as applied to Australian GSG, shows potential for use on existing soil classification systems. The polythetic classes are defined in terms of membership grades rather than absolute memberships. The approach is flexible enough to allow more and better information transfer. Specifically, the system does not require a key or expert knowledge to allocate an unknown profile into a class.

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Pedometrics '97

August 18-20, 1997
Madison, Wisconsin

The Second International Pedometrics Conference will be held at the soon-to-be-opened Monona Terrace Convention Centre in Madison, Wisconsin, USA. This public facility, inspired by the architect Frank Lloyd Wright, is located on the shore of Lake Monona which is two blocks from Madison's Capital Square and the adjoining campus of the University of Wisconsin-Madison.

This leading international scientific conference, held under the auspices of the ISSS Working Group PM, will consist of three days of plenary oral and poster sessions. Options for additional workshops and field excursions are also being developed.

SCIENTIFIC PROGRAM

Topics for the formal program include:

- Soil sampling
- Quantifying pedodiversity/

Continued on page 5

- soil quality
- Soil landscape and pedogenetic modeling
- Aggregation and disaggregation (up- and down-scaling)
- Application of fuzzy set theory

Morning sessions (8:30 to 12:30) will be devoted to oral presentations (25 min. plus 5 min. for discussion). Keynote speakers have been invited to address each major theme. However, a limited number of openings are available for volunteered oral presentations in each major theme. If you wish to have a paper considered for oral presentation, please transmit a two-page abstract (instructions attached) before March 31, 1997.

Afternoon sessions will be devoted to poster presentations (2:00 to 3:30) and an open forum (4:00 to 5:30).

POSTER PRESENTATIONS

Participants are strongly encouraged to consider presenting posters and awards will be presented in a variety of categories for meritorious presentations. Poster presenters are invited to give three 5-minute oral overviews during the course of their presentations. If you wish to have a paper considered for a poster presentation, please transmit a one-page abstract (instructions below) before April 30, 1997.

OPEN FORUM

The open forum will be led by a panel and devoted to a review of the day's presentations. A major thrust of these discussions will be to identify knowledge gaps and emerging research opportunities.

PROCEEDINGS AND PUBLICATIONS

Conference proceedings consisting of abstracts will be issued to each participant at the beginning of the conference. We will also post the abstracts on the Pedometrics '97 Home Page.

submit manuscripts for consideration for publication in a Special Issue of Geoderma devoted to Pedometrics. Manuscripts will be subject to peer review.

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ACCOMMODATION

Lodging and meals (except for the optional banquet) are not included in the registration fee(s). Registrants are responsible for making their own lodging arrangements. Blocks of rooms have been reserved at five hotels, each of which is located within walking distance of the Convention Centre. Prices per night range as follows:

Single - \$50/52/68/79 (+12% tax);
Double - \$56/62/78/89 (+12% tax).
A list of the hotels, their locations and contact information will be sent with your confirmation of registration.

HOME PAGE

Pedometrics '97 INTERNET HOME PAGE (under regular update) can be accessed via the Soil Science Society of America Home Page:

<http://www.soils.org/sss.html>

then go to Div S5 home page

<http://www.essc.psu.edu/sss/>

and access hot link to Symposia and Meetings,

or go directly to:

<http://www.essc.psu.edu/pedometrics>

We propose to use the Pedometrics '97 Home Page as means for providing pre-conference information. Please 'hit' it regularly, we hope to include useful information for visitors to Madison and surrounding areas as well as details about the scientific program.

Prospective attendees should please pay attention to the two different forms enclosed: one for notice of intent to present a scientific contribution; the other for conference registration. Please complete and post them to the addresses indicated.

Short articles and theses information should be sent to:

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**DEADLINE FOR THE
NEXT ISSUE IS**

April 1, 1997.

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return to * the Editor