Description of VGASV.f

The computer program provided here estimates the soil hydraulic parameters of the van Genuchten/Mualem model (van Genuchten, 1980) from soil water retention data or simultaneously from soil water retention data and soil hydraulic conductivity data. Parameters to estimate are θr, θs, α, n and in case of simultaneous fitting τ and Ks.
No initial estimates are required.
As a second option soil water retention data may be fitted to the so-called ASV model (Alfaro Soto et al., 2017) which is related to fractal descriptions of the soil pore system. The model is given by the equations

$$\theta(h)=\theta_r[1+(\frac{h}{h_0})^{-\lambda}], h>h_a$$

$$\theta(h)=\theta_s, 0<h<h_a$$

$$h_a=h_0[\frac{\theta_r}{\theta_s-\theta_r}]^{1/\lambda}$$ (slightly rearranged)

The model predicts values of the relative hydraulic conductivity by

$$S_e=\frac{\theta-\theta_r}{\theta_s-\theta_r}$$

$$K(S_e)=S_e^{(\frac{19-5D}{6-2D})}$$ with D = 3 - λ

All figures except θ and h are free parameters. For details readers are referred to the reference given.

At the present time only few experiences using this model are available.

The basic idea of this computer program was to prepare an easy to operate code that supports batch processing. To improve the reliability of finding the global error minimum, as a first step parameters are being estimated by a Monte Carlo technique. In the second step the FIBONACCI procedure is used to improve the accuracy of results. Both of the steps are processed subsequently without interruption.
RMSE stands for "root mean square error". RMSE2 gives the standard error of water retention data and RMSE3 displays the standard error of logarithms to the base 10 of hydraulic conductivity values.

Options
There are three options to run the program:
ksimul =0: Estimation of soil hydraulic parameters from water retention data

ksimul=1: Estimation of soil hydraulic parameters simultaneously from soil water retention and hydraulic conductivity data (van Genuchten/Mualem model only).

ksimul=2: Estimation of soil hydraulic parameters from soil water retention data. For an arbitrary list of pressure head values, soil hydraulic conductivity is predicted. The default tortuosity coefficient of the Mualem model is 0.5. Furthermore, a matching point must be chosen where the pressure head and the hydraulic conductivity are known. The common practice to use the saturated hydraulic conductivity as matching point is not the best option. Use of any other point of the conductivity function would improve the prediction of extended parts of the conductivity function.

Input data

Keyboard input
Name of the input file (max. 8 characters)
Selection of model (van Genuchten or ASV model)
Option ksimul as explained above
ksimul=0 Fit of the vanGenuchten model to water retention data only
ksimul=1 Simultaneous fit (water retention and hydraulic conductivity data)
ksimul=2 Like option 1, a prediction of hydraulic conductivity data is provided
In case the Fractal model is chosen, ksimul is set to 2 by the program.

Input file
ksimul=0
1st line: soil number, number of water retention data points (separated by space character, only 20 data sets are permitted).
2nd line: Up to 20 values of soil water pressure head in one line, positively taken, separated by space character.
3rd line: Water content data (cm^3/cm^3 or vol%) corresponding to given pressure head data.

ksimul=1
1st line: Soil number, number of water retention data points, number of conductivity data points (separated by space character)
2nd line: Up to 20 values of soil water pressure head, positively taken, separated by space character.
3rd line: Water content data corresponding to given pressure head data

4th line: Up to 20 values of soil water pressure head, positively taken, separated by space character.
5th line: Hydraulic conductivity data (preferred unit: cm/d) corresponding to the pressure head data as mentioned in the 4th line.

ksimul=2
1st line: soil number, number of water retention data points (separated by space character, max: 20), in case of vanGenuchten/Mualem: pressure head and hydraulic conductivity at the matching point chosen.
2nd line: Up to 20 values of soil water pressure head, positively taken, separated by space character.
3rd line: Water content data (cm^3/cm^3) corresponding to given pressure head data.

Example:
Input file „case0s“, model=1 (van Genuchten), ksimul=1 (simultaneous fit).
The output file is named automatically „Outcase0s“

References
M.A. Alfaro Soto , H.K. Chang , M.Th. van Genuchten : Fractal-based models for the unsaturated soil hydraulic functions. - Geoderma 306 (2017) 144–151