1 AVK > 1

If the AVK is greater than one, it does not mean, it is getting more information from the measurement than when the AVK is 1, but the measurement looses influcence again. This can be seen when reordering using the equation

$$\hat{x} = (I - A)x_a + Ax_T \tag{1}$$

where x_T is the true variable and $\hat{x}$ is the derived estimation of the quantity x. Clearly, if the AVK A is the unity matrix, $\hat{x}$ is solemly determined by the measurement. However, if A is the scaled (scale > 1) unity matrix, the estimated result is only partially determined by the measurement. For getting a really large A it has only 50 % influence.

2 Logarithmic state vector

SFIT4 has the possibilty to work on a logarithmic state vector. The internal statevector wont be the ratio $\frac{\hat{x}}{x_A}$ but $x = ln(x)$.

The statevctor will be reverted to VMR in the result, but the AVK is still for the statevector in the $ln(x)$ form, denoted by A'.

In order to recalculate the AVK for the linear state (VMR). The statevector is in the form $x' = g(x) = ln(x)$, where x is the profile vector in VMR units. The forward model can be written as

$$y = F(x) = F(g^{-1}(x') \tag{2}$$

The weighting function matrix, K, is the derivative of the forward model F

$$K = \frac{\partial F}{\partial x} \overset{\text{CHAINRULE}}{=} \frac{\partial F}{\partial g^{-1}} \frac{\partial g^{-1}}{\partial x} = K' \frac{\partial g^{-1}}{\partial x} \tag{3}$$

Using the fact that

$$\frac{\partial f^{-1}}{\partial x} = \frac{1}{\frac{\partial f}{\partial x}} \tag{4}$$

we obtain

$$K = K' \frac{1}{\frac{\partial g}{\partial x}} = Kx \tag{5}$$

Hence

$$A = DK = x^{-1} A' x \tag{6}$$