SFIT4 – Retrieval parameters

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Overview

- rt The main parameter rt can be used to switch off and one the retrieval altogether.
- rt.Im Switches on or off the Levenberg-Marquardt iteration scheme.
- rt.convergence the iteration is considered converged when rt.convergence > D_CHI = (CHI_2_MAX_{i-1} - CHI_2_MAX_i)

rt.max_iteration maximum number of iterations

For all retrieval parameters a apriori is given and a standard deviation sigma in the form

- rt.x.apriori the apriori of a given value. It is actually applied in the forward calculation. Meaning it can also be used in forward calculations.
- rt.x.sigma the entry in the S_A matrix corresponding to this parameter.



Overview

_	rt The main parameter rt can be used to switch off and one												
1	TER 1	FIT_RMS 25.5294	GAMMA 1.00E+05		CHI^2_Y 886.616	CHI^2	CHI^2_OLD	DCHI^2					
ľ	23	15.7601 9.8038	1.00E+05 1.00E+04	0.000	332.528 134.162	332.528 134.166	886.616 332.528	554.088226 198.361710					
	4 5	5.1080 2.6411	1.00E+03 1.00E+02	0.105	32.608 6.402			101.519910 26.139551					
ľ	6 7 8	1.9136 1.8797 1.8844	1.00E+01 1.00E+00 1.00E-01	0.281	2.831 2.594 2.573			3.458828 0.172872 0.002286					
	FINAL:			6267 MEAN_F									
ľ	BAND		RMSSNR	(CALCULATED)			RETRIEVED)	CHI^2					
1	1 2 3	2 1		53.98	2	53.98 57.52	49.55 56.78	1.19 1.03					
ļ	4			154.48 147.91		54.48 84.62	110.55 50.79	1.95 2.92					
				ALUES FOUND ALUES FOUND									

forward calculations.

rt.x.sigma the entry in the S_A matrix corresponding to this parameter.



Construction of the S_A matrix.

The S_A matrix is constructed from the sigma values given. How this is actually done, depends on the parameters. In principle the S_A is constructed as a diagonal matrix and inverted in the code to yield the S_A^{-1} matrix. Some caveats:

gas.profile.x.correlation off diagonals using the sigma values as maxima

- .type = 1 gaussian with FWHM = .width
- .type = 2 exponentially with FWHM = .width
- .type = 3 not used
- type = 4 the S_A matrix is read in from file.sa_matrix
- .type = 5 the S_A^{-1} matrix is read in from file.sa_matrix



Construction of the S_A matrix.

The S_A matrix is constructed from the sigma values given. How this is actually done, depends on the parameters. In principle the S_A is constructed as a diagonal matrix and inverted in the code to yield the S_A^{-1} matrix. Some caveats:

- gas.profile.x.regmethod lets you chose between OE optimization and the Thikonov-Phillips regularization with L1 constraint (smoothness constraint)
 - .type = 'OE' optimal estimation (Rodgers, 2000)
 - .type = 'TP' Thikonov-Phillips with smoothness constraint

.lambda strength of the regularization in TP. The higher the value the less is the regularization.

The smoothness constraint is calculated from file.stalayers in order to adapt for non-unique altitude layering. The matrix is scaled using the gas.profile.x.sigma values.



SFIT		T_RMS	GAMM		I^2_X		^2_Y	CHI^2	CHI^2_	OLD	DC	HI^2
			1.00E+0 1.00E+0		0.000 0.000		.616 .528	332.528	886.	616	554.08	0226
			1.00E+0		0.004		.162	134.166			198.36	
			1.00E+0		0.038		.608	32.646			101.51	
	52	.6411	1.00E+0	2	0.105	6	.402	6.507	32.	646	26.13	9551
	61	.9136	1.00E+0	1	0.217	2	.831	3.048	6.	507	3.45	8828
	71	.8797	1.00E+0	0	0.281	2	.594	2.875	3.	948	0.17	2872
8	81	.8844	1.00E-0	1	0.300	2	.573	2.873	2.	875	0.00	2286
FIN	NAL:	MEAN	SNR= 86	.6267	MEAN F	IT R	MS(%)=	1.88443	NVAR=	185	NFIT=	3477
I	BAND	SCAN	RMSSNR	(CALC	ULATED)) (EFFECT	IVE) (RETRIEV	ED)		CHI^2
	1	1			53.98	3	5	3.98	49	.55		1.19
	2	1			57.52	2	5	7.52	56	.78		1.03
	3	1			154.48			4.48		.55		1.95
	4	ī			147.91			4.62		.79		2.92
	-	1			147.51		U U	4.02	50	. / 5		2.92
NEO	GATTVE	MIXING	PATTO		FOUND	FOR	• 0366	8				
		MIXING										
NEV	GATIVE	MIAING	KAT10	VAEUES	FOUND	FUR	. 0300	0				

FIT_RMS mean variance of the residuum

GAMMA the Levenberg Marquardt Parameter

CHI_2_X A measure of the deviation of the retrieved state from the A PRIORI



SFIT	ITER	FIT RMS	GAMMA	CHI^2 X	CHI^2 Y	CHI^2	CHI^2 OLD	DCHI^2
			1.00E+05	0.000	886.616			
	2	15.7601	1.00E+05	0.000	332.528	332.528	886.616	554.088226
	3	9.8038	1.00E+04	0.004	134.162	134.166	332.528	198.361710
	4	5.1080	1.00E+03	0.038	32.608	32.646	134.166	101.519910
	5	2.6411	1.00E+02		6.402		32.646	26.139551
	6		1.00E+01				6.507	
	7		1.00E+00				3.048	
	8	1.8844	1.00E-01	0.300	2.573	2.873	2.875	0.002286
	FINAL:	MEAN	_SNR= 86.62	267 MEAN_F	IT_RMS(%)	= 1.88443	NVAR= 185	NFIT= 3477
	BAND	SCAN	RMSSNR (0	CALCULATED)	(EFFEC	TIVE) (F	RETRIEVED)	CHI^2
	1	1 1		53.98		53.98	49.55	1.19
	2			57.52		57.52	56.78	1.03
	3			154.48	1	54.48	110.55	1.95
	4	1		147.91		84.62	50.79	2.92
				UES FOUND				

CHI_2_Y A measure for the retrieval quality

$$\chi_Y^2 = \frac{(y_M - y_C)^T S_\epsilon(y_M - y_C)}{m}$$

 $\chi^2_Y = 1$ if the residuum is reduced to the noise as specified in S_{ϵ}

SFIT		FIT_RMS 25.5294	GAMMA 1.00E+05				2 CHI^2_OLD	DCHI^2
			1.00E+05				886.616	554.088226
	3		1.00E+04					
	4	5.1080	1.00E+03	0.038	32.60			101.519910
	5		1.00E+02				7 32.646	26.139551
	6		1.00E+01			3.04	6.507	3.458828
	7		1.00E+00			4 2.87		
	8	1.8844	1.00E-01	0.300	2.57	3 2.87	3 2.875	0.002286
F	INAL:	MEAN_	_SNR= 86.	6267 MEAN	_FIT_RMS(%)= 1.8844	8 NVAR= 185	NFIT= 3477
	BAND	SCAN	RMSSNR	(CALCULATE	D) (EFF	ECTIVE)	(RETRIEVED)	CHI^2
	1	1		53.	98	53.98	49.55	1.19
	2	1		57.	52	57.52	56.78	1.03
	3	1		154.		154.48	110.55	1.95
	4	1		147.	91	84.62	50.79	2.92
				ALUES FOUN				
	IEGATI	VE MIXING	3 RAIIO V	ALUES FOUN	D FOR : C	3686		

- In the lower half, the retrieval diagnostics for the last calculation are shown for each MW.
- A warning if retrieved profiles have negative parts



Wave number scaling and shifting

rt.wshift wave number shift.

- Shift works on the internal grid band.X.calc_point_space
- This is only useful for microwindows (small) because the mismatch is a wavenumber dependent polynomial. For small wave number regions, this can be approximated by a shift.
- This is on top of rt.wave_factor, which is a scaling.
- The artificial grid needs to be more dense than the measured grid
- rt.dwshift wave number shift for each retrieved gas separately, except the first retrieved one.
 - all lines of each gas are shifted by the same amount (!!!)

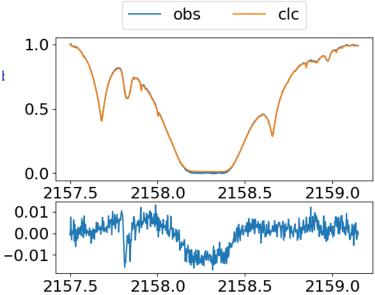


band.zshift calculates and retrieves an offset in the microwindow. Two types:

.type = 1 retrieves the offset in this MW ONLY ONE!!!



offset in window





band.zshift calculates and retrieves an offset in the microwindow. Two types:

- .type = 1 retrieves the offset in this MW ONLY ONE !!!
- .type = 2 uses the offset which is retrieved in another microwindow. THIS MUST BE LATER THAN THE MW USED FOR **ZSHIFT.TYPE=1**

band.zshift.apriori is also an FW parameter



offset in window

band.zshift calculates and retrieves an offset in the microwindow. Two types:

- .type = 1 retrieves the offset in this MW ONLY ONE !!!
- .type = 2 uses the offset which is retrieved in another microwindow. THIS MUST BE LATER THAN THE MW USED FOR **ZSHIFT.TYPE=1**

band.zshift.apriori is also an **FW parameter** RETRIEVAL ONLY POSSIBLE IF THERE IS AN SATURATED PART IN THE MW.



channeling in window

see discussion led by Minqiang Zhou

