Weighting Function Modified DOAS for Ozone Retrieval from GOME

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- Weighting Function Modified DOAS
- Application to synthetic data
- Application to GOME data

Weighting Function Modified DOAS — WFM-DOAS

$$\ln I_i^{mea}\left(V^t, \vec{b}^t\right) \approx \ln I_i^{mod}\left(V_0, \vec{b}_0\right)$$

$$+\frac{\partial \ln I_i^{mod}}{\partial V}|_{V_0} \times (\hat{V} - V_0)$$

$$+\sum_{j=1}^{F} \frac{\partial \ln I_i^{mod}}{\partial b_j}|_{b_{0,j}} \times (\hat{b_j} - b_{0,j})$$

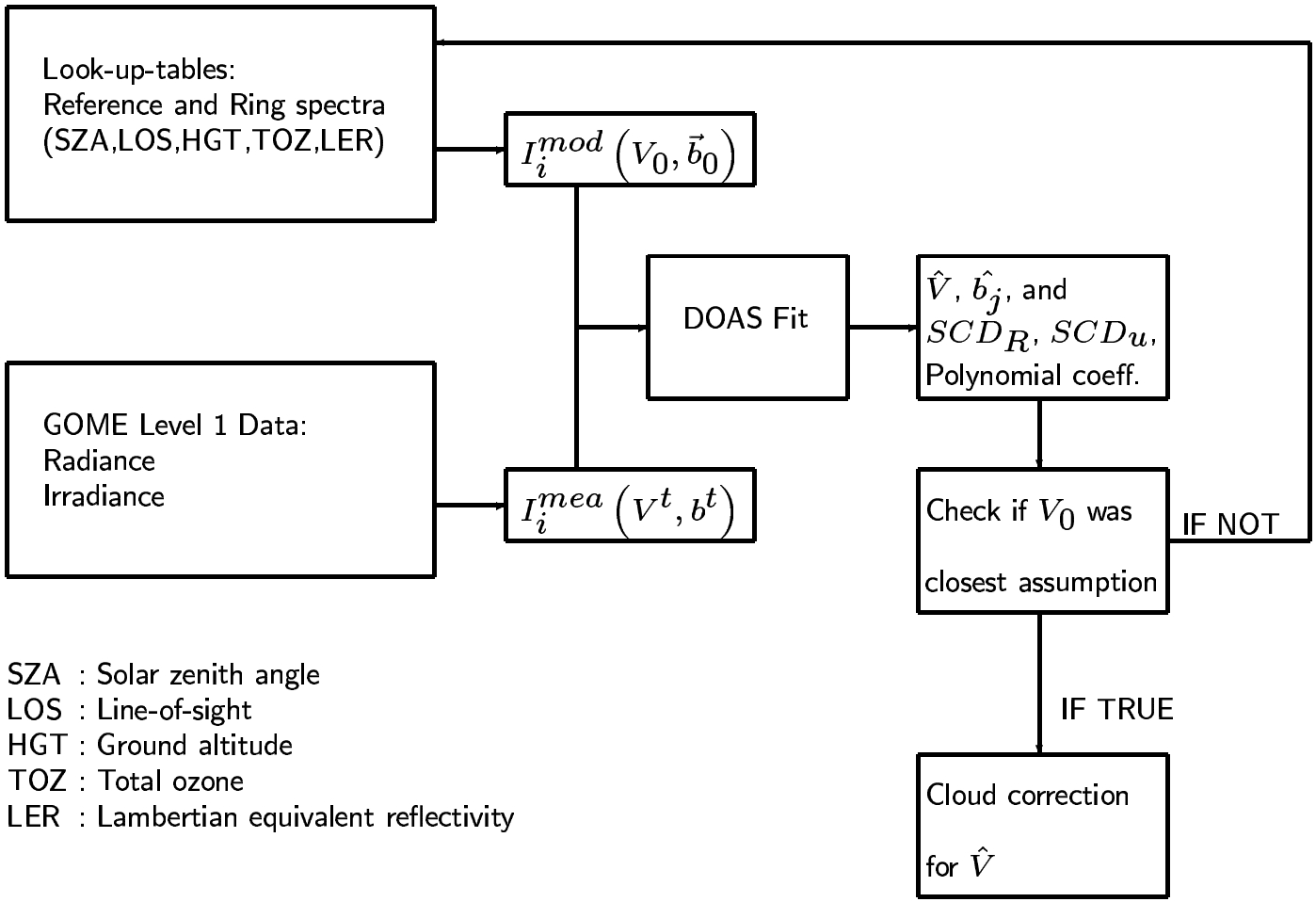
$$+SCD_{Ring} \cdot \sigma_{i,Ring}$$

$$+SCD_{usamp} \cdot \sigma_{i,usamp}$$

$$+P_i$$

I_i	Sun-normalized spectral radiance
P_i	Low-order polynomial
V^t	True vertical column
$\vec{b}^t$	True atmosphere (albedo,temperature,...)
V_0	Assumed model vertical column
$\vec{b}_0$	Assumed model atmosphere
$\hat{V}$	Vertical column fit parameter
$\hat{\vec{b}}$	Atmospherical fit parameters
σ_{Ring}	Ring-Spectrum
σ_{usamp}	Undersampling-Spectrum
i	Wavelength index

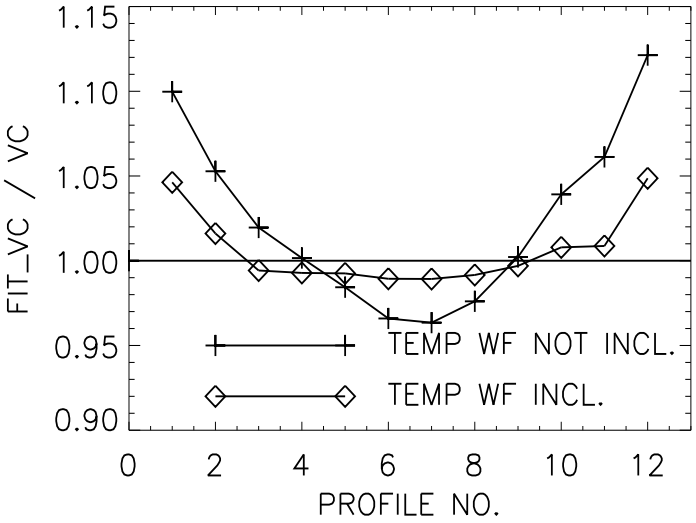
WFM DOAS Iterative Scheme

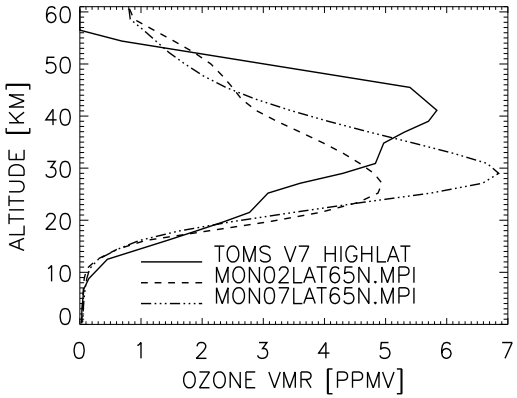


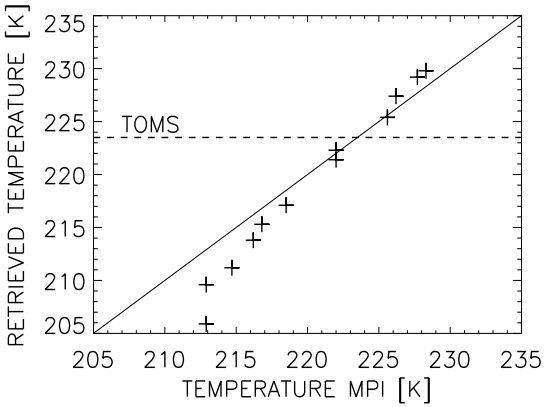
SZA : Solar zenith angle
LOS : Line-of-sight
HGT : Ground altitude
TOZ : Total ozone
LER : Lambertian equivalent reflectivity

Influence of Temperature and Ozone Profile

- 12 simulated spectra using different MPI profiles (High latitudes)
- WF DOAS reference spectra calculated using one TOMS V7 profile (High latitudes)







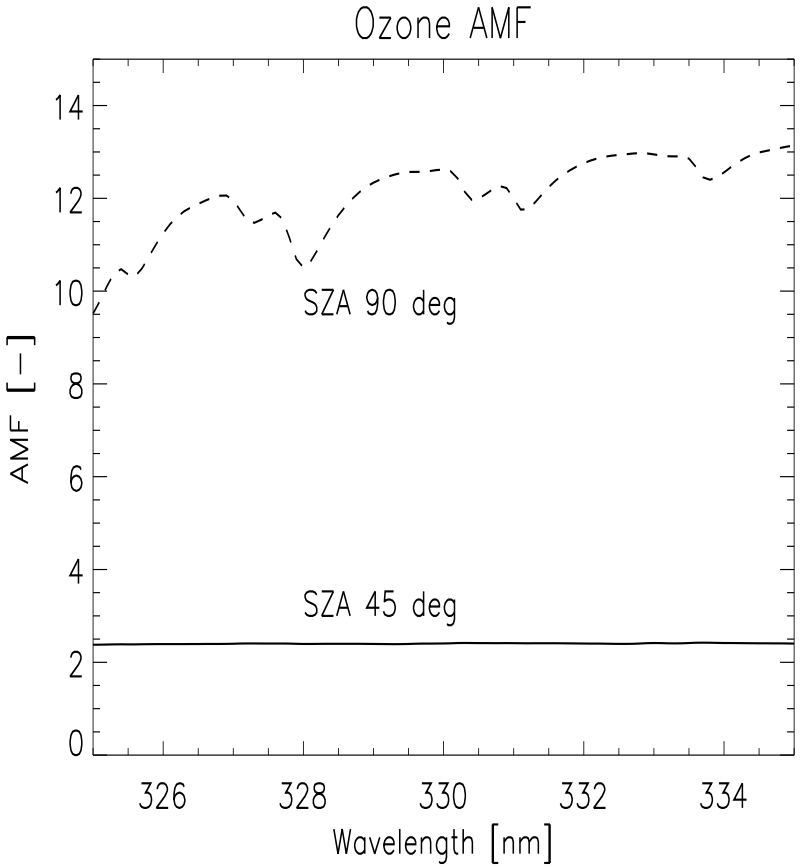
⇒ Include temperature weighting function !

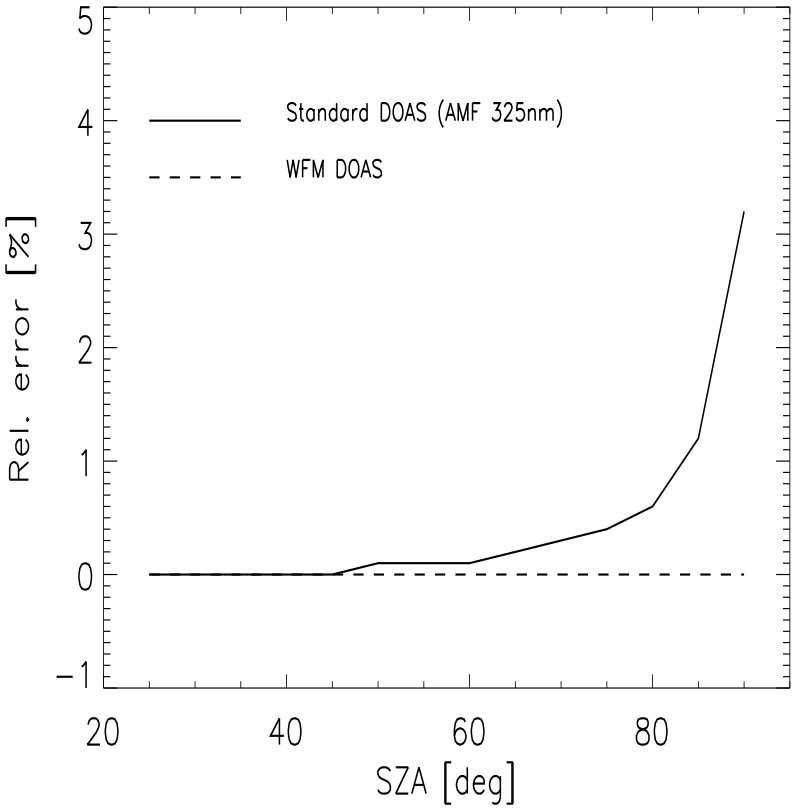
First Setup of Look-Up-Table

Optimum spacing has to be defined !

Atmospheric Parameter	Min	Max	Δ	N
Total Ozone (high latitudes)	125 DU	575 DU	50 DU	10
Total Ozone (mid latitudes)	125 DU	575 DU	50 DU	10
Total Ozone (low latitudes)	225 DU	475 DU	50 DU	6
Solar Zenith Angle	15°	90°	5° if SZA $\leq$ 70° 1° if SZA $>$ 70°	30
Line-Of-Sight	-34.5°	34.5°	11.5°	7
Surface Albedo	0.05	0.98	$\sim$0.2	6
Ground Altitude	0 km	6 km	2 km	4

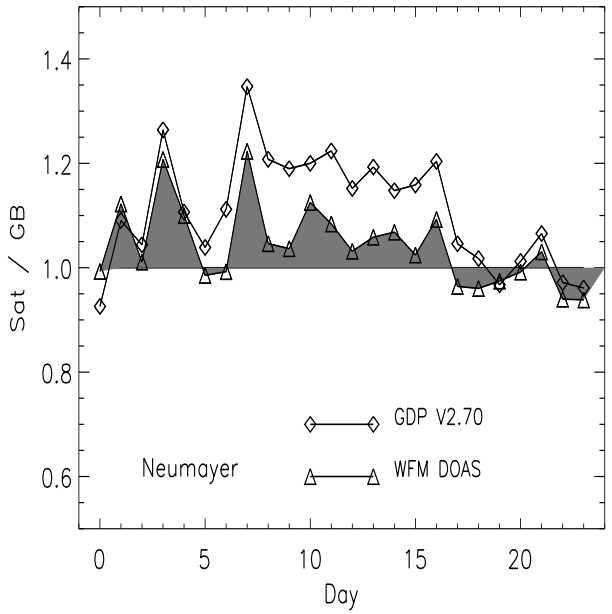
Model Studies: WFM DOAS vs. Standard DOAS





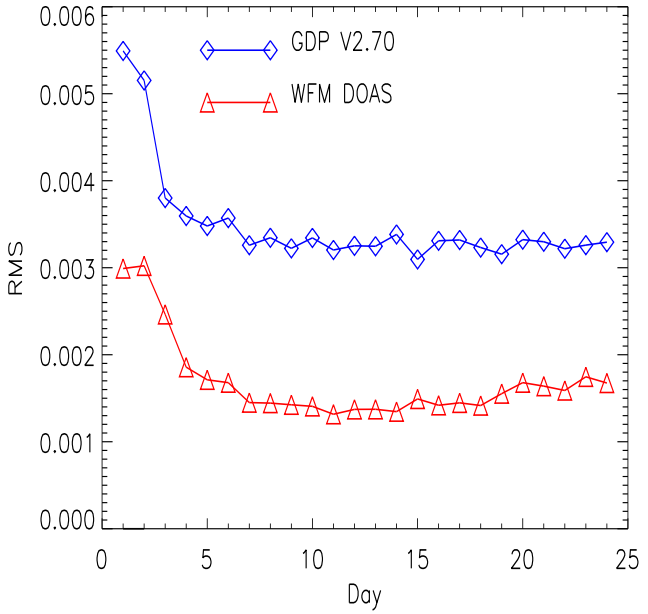
Comparison with Sonde Data from Neumayer

O_3 Column

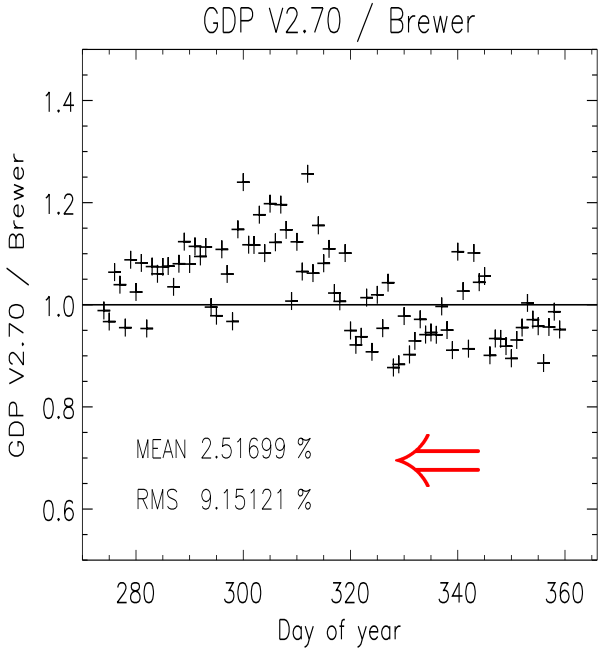


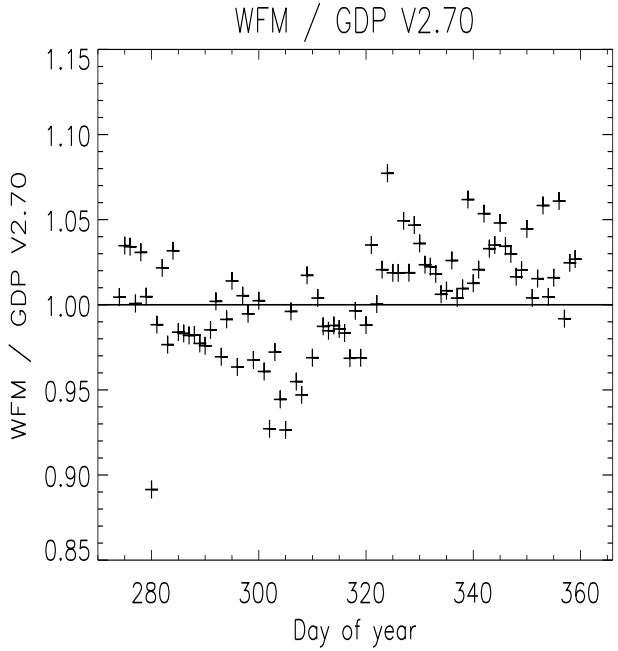
GDP V2.70 :	
Mean	12%
RMS	16%
WFM-DOAS :	
Mean	4%
RMS	9%

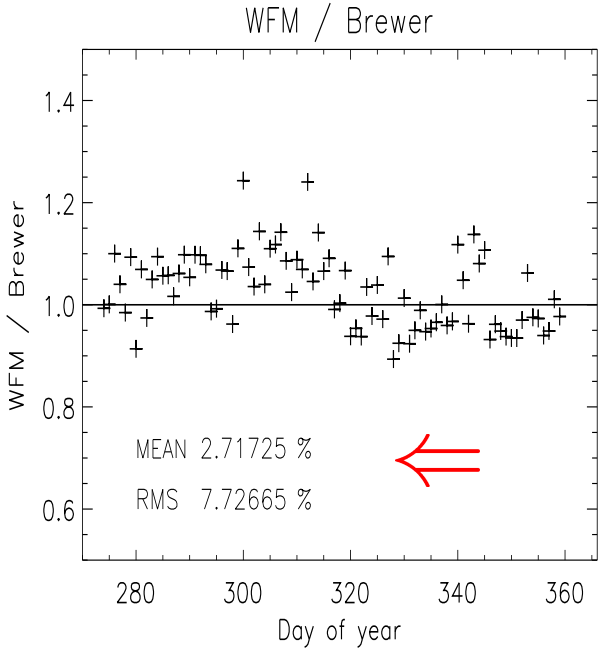
Fit RMS



Comparison with Brewer Data from Belgrano II Station



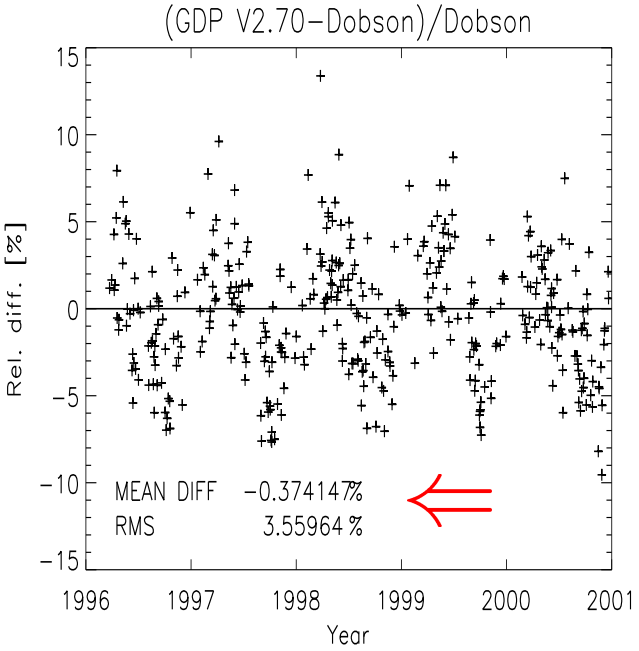


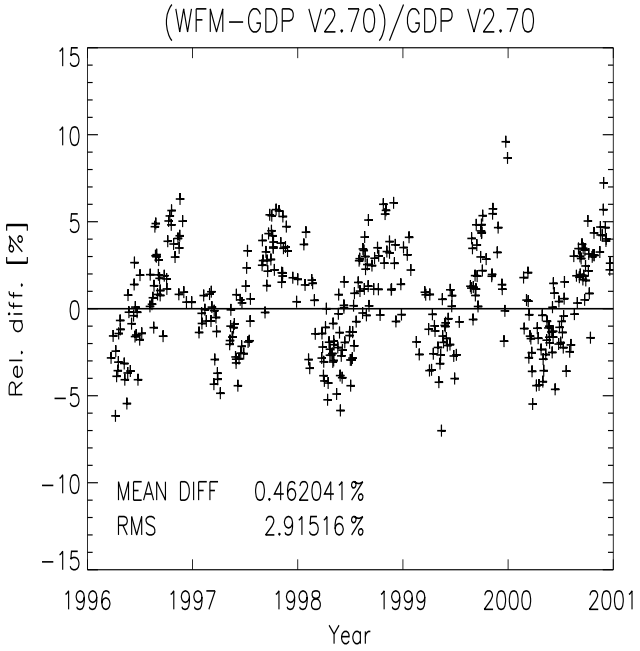


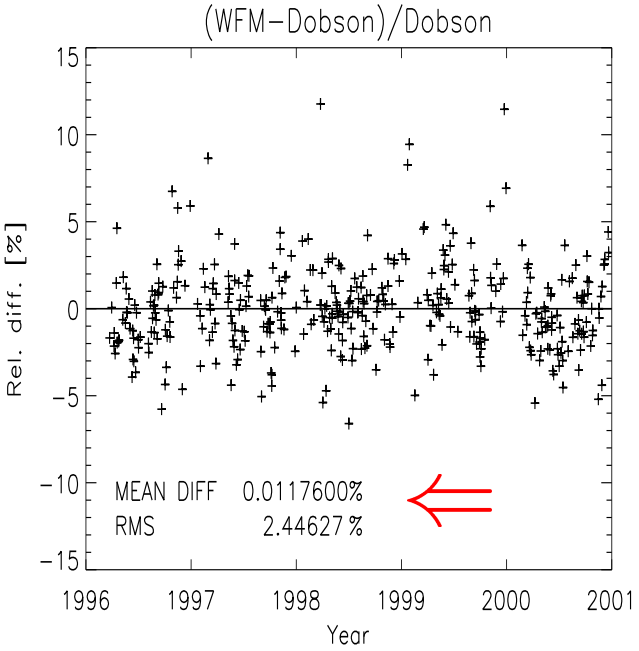
- ▷ RMS slightly reduced
- ▷ Include improved Ring climatology

Comparison with Ozone Data in Northern Mid Latitudes

- ▷ Hradec Kralove, Czech Republic (50°N, 15°E), Daily means
- ▷ GOME overpasses from 1996 to 2000







- ▷ Comparison Dobson-Brewer : RMS 1.5%

Conclusions and Outlook

- First case studies have shown very promising results using the new WFM DOAS approach → seasonal cycle and fit RMS reduced
- ESA Study : GOME Total Ozone Column Retrieval Development (GOTOCORD)
  - Define optimum look-up-table and number of fitting parameters
  - Perform Ring effect studies