The photolysis-modules **messy_photo.f90** and **messy_jval.f90** and their interface to ECHAM5

- Based on the fast on-line scheme by Landgraf and Crutzen, 1998, JAS, updated by C. Brühl, R. v.Glasow, R. Sander and P. Jöckel
- 8 spectral intervals from far UV (179nm) to visible (682nm) with precalculated effective cross sections (including quantum yields), using lookup tables and polynominal coefficients derived from a model with 176 spectral intervals (Brühl and Crutzen, 1989, GRL); Ly-α included (Chabrilla and Kockarts, 1997/98, GRL). In code intervals sometimes counted from 1 to 8.

	name	λ,nm	λ-range,nm	Absorber	Absorber
	Lyman alpha	122		O_2	
0	Schumann Runge	param.	178.6-202.0	O_2	O_3
1	Herzberg	205.1	202.0-241.0	O_2	O_3
2	Hartley	287.9	241.0-289.9		O_3
3	O^1D	302.0	289.9-305.5		O_3
4	UV-B	309.0	305.5-313.5		O_3
5	tail	320.0	313.5-337.5		O_3
6	UV-A	370.0	337.5-422.5		
7	Chappuis	580.0	422.5-682.5		O_3

- Overhead ozone above the model top taken from UARS/HALOE climatology
- Cloud cover, liquid and ice water content, surface albedo and ozone (climatology option in namelist) taken interactively from ECHAM. Standard aerosol types dependent on relative humidity and sea fraction, extension on interactive ECHAM aerosol soon
- Calculation of actinic fluxes in the 7 spectral regions between 202 and 657 nm with the δ-two-stream-method PIFM by Zdunkowski et al, 1980, Beitr.Phys.Atm., Schumann Runge bands Koppers Murtagh parameterization for O_2 (1996, Ann. Geophysicae) and Allen-Frederick for NO (1982, J. Atmos. Sci.)
- Extrapolation for solar zenith angles between 88 and 94.5 degrees included
- Different options to include 11yr solar cycle, consistent with **rad4all_fubrad**
- Photolysis calculated for
  O_2, $O_3 \rightarrow O(^3P)$, $O_3 \rightarrow O(^1D)$, H_2O, H_2O_2, CO_2,
  N_2O, NO, NO_2, NO_3 (both channels), N_2O_5, HNO_3, HNO_4, HONO,
  PAN, CH_3OOH, CH_2O (both channels), CH_3CHO, acetone, CH_3COCHO,
  HCl, HOCl, OClO, Cl_2O_2, $ClONO_2$, $ClNO_2$, Cl_2, CH_3Cl, CH_3CCl_3, CCl_4, CFC11, CFC12,
  BrO, HOBr, BrCl, $BrONO_2$, $BrNO_2$, Br_2, CH_3Br, H1301, H1211,
  IO, HOI, I_2, ICl, IBr, $IONO_2$, INO_2, CH_3I, C_3H_7I, CH_2ClI, CH_2I_2,
  SO_2, SO_3, OCS, CS_2, SF_6, CH_4 (often with temperature and/or pressure dependence)
- optional solar heating rates from absorption by O_3, O_2 (and NO_2 if activated)

How to introduce new species or update the effective cross sections

- Go to '/usr/users/chb/echam/jochen/sig_cal' (and copy everything to your own directory)
- Interpolate cross sections to 176 interval grid, use e.g. 'uvcrossg.f'
- edit result-file into 'data/sig2.new2', edit 'data/init.dat' (interval); if other name of sigma-file edit 'sig.f'
- if new species edit 'sig_eff.f' and 'sig.f' and introduce the new arrays (use c6-versions and data/sig2.new6 for most recent)
- introduce or update formulae for temperature and/or pressure dependence in 'sig.f' if necessary
- check parameter- and init-files and adjust for spectral interval if necessary, Schumann-Runge is different here
- compile main.f, deltatm.f, sig.f and sig_eff.f to create new 'run'-file
- execute 'run'
- rename the file 'result/sig_eff.dat' to 'result/sig_eff.n' (n number of interval, 1-8)
- go to directory 'fit' and use the pwave/idl-file (.pro) for desired interval and species, view the error range and repeat with larger order of polynominal if error too large; copy resulting lookup-table or coefficients into 'lookthal'-input-file for ECHAM
- if there is a temperature dependency, the 3 previous steps have to be repeated for 15 temperatures (example see result), then use the 'temp*pro'-routines to get the coefficients. Similar procedure if p- or ρ dependence
- define the arrays and include the read-statements in 'messy_photo', broadcast the arrays in 'messy_photo_e5', define the stream-elements and tracer-flags; set path to new 'lookthalx' in nml/photo.nml
- add new blocks for effective cross sections in 'photo_cal' in 'messy_photo'.
- a more user friendly procedure is in preparation, contact R. Sander