Chapter 5. Model Estimates of Lifetimes

Version 3 September 30, 2011

Lifetime evaluations will require three new model simulations. (time-slice 2000, time-slice 2100, transient 1960-2010), including flux boundary conditions, for the species listed in Table 1. At a minimum, we request that each group simulate all mixing ratio-based Priority 1 species in Table 1 and flux-based Priority 1a species, along with an age of air tracer. Simulations of Priority 2 and 3 species are encouraged. We try to minimize the output requirements by limiting output to quantities required for lifetime calculations and for evaluation of the essential chemistry and transport processes.

I). MODEL PRE-REQUISITE TESTS

1) PhotoComp (with latest JPL 10-6 data) – for models which did not successfully do this in CCMVal-2 or who have updated their code significantly.
2) Reactions – check list of included reactions for omissions (cf CCMVal Chapter 6).
3) Fast Chem – for models which did not successfully do this in CCMVal-2 or which have changed significantly.

II. MODEL EXPERIMENTS

1) MBC Model Simulation:

- Full chemistry model ('CCMVal 2010') with mixing ratio boundary conditions (MBC).
- Kinetics from NASA/JPL 10-6 (http://jpldataeval.jpl.nasa.gov/)
- Models without tropospheric chemistry will use provided tropospheric OH fields (current). Models with coupled stratosphere-troposphere chemistry will use AR5 tropospheric emissions.

Table 3. Targetted species:

	Species
Priority 1	CFC-11, CFC-12, CCl4, CH3CCl3, HCFC-22, N2O, CH4
Priority 2	Halon-1211, Halon-1301, CFC-113, CFC-115, HFC-134a, HFC-143a, HFC-23
Priority 3	CFC-114, HCFC-141b, HCFC-142b, CH3Cl, CH3Br, Halon-1202, Halon-2402, HFC-32, HFC-125, HFC-152a, HFC-227ea, HFC-245fa

Table 2. Planned Model Runs

Run	Period	Length	Input	Notes
TS2000	Time slice 2000	30 years	MBC Initial condition from CCMVal REF-B1	For timeslice runs MBC will be in equilibrium.
TS2100	Time slice 2100	30 years	MBC Initial condition from CCMVal REF-B2	Compare how lifetimes change wrt 2000.

"**REF-C1**"	Transient 1960-2010	50 years	MBC	Like CCMVal REF-B1

Table 3. Optional Model Runs (sensitivity runs to be started in Jan 2012 with to-be-released new JPL kinetic updates, particularly important for Halons)

Run	Period	Length	Input
TS2000b	Time slice 2000	30 years	MBC
TS2100b	Time slice 2100	30 years	MBC
"**REF-C2**"	Transient 1960-2010	50 years	MBC

2) Flux Boundary Condition (FBC) tracers:

Targetted species:

- Priority 1a: CFC-11, flux-based mass conservation tracer
- Priority 1b: CFC-12, HCFC-22, and CH3CCl3
- Other Priority 1 species could be included if groups wish.

Model setup:

- Uncoupled tracers embedded in full chemistry MBC simulations.
- Same loss kinetics as full chemistry (MBC) tracers.

Run	Input	Notes
TS2000	• Same initial mixing ratio as the MBC tracers on 1 Jan 2000. • 2000 emission for CFC-11, CFC-12 , HCFC-22, CH3CCl3 • Mass conservation tracer: 1 Tg/yr surface emission and is evenly distributed per cm2	
TS2100	• Same initial mixing ratio as the MBC tracers on 1 Jan 2100 (from existing REF-B2 runs from all models). • 2100 emission for CFC-11, CFC-12 , HCFC-22; 2000 emission for CH3CCl3 • Mass conservation tracer: 1 Tg/yr surface emission and is evenly distributed per cm2	
"**REF-C1**"	• 1960-2010 emission • Mass conservation tracer: 1 Tg/yr surface emission and is evenly distributed per cm2	

Emissions needed for FBC tracers will be provided by late August/early September.

3) Optional tracers

- **Idealized age tracers in all runs**
  (Data will be used by Chapter 2 - Theory):
  - i) Pulse age tracer
    - Initial surface mixing ratio =1, everywhere else =0. Keep surface mixing ratio =1 for 1 day.
    - Surface mixing ratio =0 after 1 day and for rest of run (until tracer is reset).
    - Reset tracer every 20 years: Set global values to zero and set surface mixing ratio to 1 for a day (as above) at the 1st and 21st year of TS200 and TS2100, and 1960, 1980, 2000 of REF-C1.
  - ii) Linearly increasing age tracer:
    - Initial mixing ratio equal 0 everywhere;
    - Surface mixing ratio increases by 1 every day;
  - iii) "Ideal age" (in Hall & Waugh's terminology)
    - Surface mixing ratio equals 0 all time
    - Everywhere: initial mixing ratio equals 1, and increases by 1 every day.

- **Five constant emission tracers in transient run "REF-C1"**
  (Data will be used by Chapter 2 - Theory & Chapter 4 –Observations)
  - Species: CFC11_constant
    CFC12_constant
    N2O_constant
    CH4_constant
    CH3CCl3_constant
  - Constant 100 pptv surface mixing ratio boundary condition for 1960-2010
  - Same loss kinetics as CFC-11, CFC-12, CH4, N2O, CH3CCl3