INTERCOMPARISON OF ATMOSPHERIC RADIATION SCHEMES FOR THE LOWER MARTIAN ATMOSPHERE.
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Interpretation of the vast data flow from the recent and ongoing Mars missions requires extensive modeling activity to support the investigations and conclusions drawn from the observations. We have initiated a campaign to compare atmospheric radiation schemes for the lower Martian atmosphere with least-compromise reference line-by-line calculations (Meadows and Crisp 1996, Crisp 1986). By using fixed reference conditions we are introducing an intercomparison framework to enable atmospheric modeling teams to compare their modeling results with the reference line-by-line calculations, and to improve their models.

The atmosphere of Mars is thin and therefore its response to local radiative forcing is strong when compared to that of the Earth's troposphere. Airborne dust and also the water vapor give significant contributions to the radiative fluxes. Thus models of the Martian atmosphere should have fairly accurate radiative transfer (RT) algorithms. This is specifically important for the net radiative flux at the surface, which is the main driver for the surface temperature evolution, since the surface turbulent fluxes are small due to the thin atmosphere (*e.g.* Haberle et al. 1993, Savijärvi 1991a, Savijärvi 1991b, Savijärvi 1999). However, the accuracy of the RT schemes has not been rigorously tested in many cases as reference calculations have been rare.

We introduce a set of reference cases for Martian atmospheric conditions with profiles for temperature, pressure, dust optical depth (Conrath 1975, Clancy et al. 1995, Ockert-Bell et al. 1997, Smith et al. 2000), water, CO_2, O_3, CO and O_2 (Table 1). The reference atmosphere uses a diurnally and globally averaged thermal structure derived from Mariner 9 IRIS observations acquired during late southern summer. Thermal structures for nighttime and daytime conditions will be included shortly. Computationally expensive reference simulations were performed by applying a spectrum resolving (line-by-line multiple scattering) model, SRM, to give the least-compromise base for comparisons.

We call for other groups to join in future comparisons. This resembles the International Comparison of Radiation Codes for Climate Models (ICRCCM; *e.g.* Ellingson and Fouquart 1991, Ellingson et al. 1991). The ICRCCM led to many improvements in the Earth GCM radiation codes. The intercomparison framework presented in this paper is a step toward that direction for Mars. We have already five modeling teams participating in this intercomparison exercice. Additional teams investigating the Martian atmosphere are cordially invited to join this effort of comparing the radiation schemes in fixed conditions. The results achieved will be reported and some additional features to be included in the intercomparison will be discussed.

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Table 1: The reference temperature profile $T(z)$ with the suggested mass mixing ratios for water vapour, carbon dioxide, ozone, carbon monoxide and oxygen. Shown is also the dust optical depth profile for τ_{vis} = 1 at the surface.

p (Pa)	T (K)	H_2O	CO_2	O_3	CO	O_2	τ_{vis}	z(km)
1.000E-02	1.638E+02	0	9.53E-01	2.00E-08	3.80E-04	9.50E-04	0	100.0
2.744E+00	1.638E+02	6.72E-06	9.53E-01	2.00E-08	3.80E-04	9.50E-04	0	50.0
4.916E+00	1.668E+02	7.41E-06	9.53E-01	2.00E-08	3.80E-04	9.50E-04	4.413E-04	45.0
8.716E+00	1.703E+02	9.08E-06	9.53E-01	2.00E-08	3.80E-04	9.50E-04	2.464E-03	40.0
1.532E+01	1.732E+02	9.34E-06	9.53E-01	2.00E-08	3.80E-04	9.50E-04	8.431E-03	35.0
2.674E+01	1.757E+02	8.94E-06	9.53E-01	2.00E-08	3.80E-04	9.50E-04	2.228E-02	30.0
4.639E+01	1.782E+02	8.47E-06	9.53E-01	2.00E-08	3.80E-04	9.50E-04	5.035E-02	25.0
5.176E+01	1.788E+02	8.45E-06	9.53E-01	2.00E-08	3.80E-04	9.50E-04	5.876E-02	24.0
5.772E+01	1.794E+02	8.65E-06	9.53E-01	2.00E-08	3.80E-04	9.50E-04	6.822E-02	23.0
6.434E+01	1.802E+02	9.03E-06	9.53E-01	2.00E-08	3.80E-04	9.50E-04	7.885E-02	22.0
7.172E+01	1.810E+02	9.38E-06	9.53E-01	2.00E-08	3.80E-04	9.50E-04	9.081E-02	21.0
7.986E+01	1.820E+02	1.01E-05	9.53E-01	2.00E-08	3.80E-04	9.50E-04	1.041E-01	20.0
8.891E+01	1.830E+02	1.09E-05	9.53E-01	2.00E-08	3.80E-04	9.50E-04	1.191E-01	19.0
9.897E+01	1.840E+02	1.18E-05	9.53E-01	2.00E-08	3.80E-04	9.50E-04	1.358E-01	18.0
1.100E+02	1.853E+02	1.34E-05	9.53E-01	2.00E-08	3.80E-04	9.50E-04	1.542E-01	17.0
1.222E+02	1.866E+02	1.53E-05	9.53E-01	2.00E-08	3.80E-04	9.50E-04	1.747E-01	16.0
1.358E+02	1.879E+02	1.73E-05	9.53E-01	2.00E-08	3.80E-04	9.50E-04	1.977E-01	15.0
1.506E+02	1.894E+02	2.03E-05	9.53E-01	2.00E-08	3.80E-04	9.50E-04	2.228E-01	14.0
1.671E+02	1.909E+02	2.35E-05	9.53E-01	2.00E-08	3.80E-04	9.50E-04	2.509E-01	13.0
1.852E+02	1.924E+02	2.73E-05	9.53E-01	2.00E-08	3.80E-04	9.50E-04	2.818E-01	12.0
2.049E+02	1.939E+02	3.19E-05	9.53E-01	2.00E-08	3.80E-04	9.50E-04	3.155E-01	11.0
2.268E+02	1.955E+02	3.72E-05	9.53E-01	2.00E-08	3.80E-04	9.50E-04	3.531E-01	10.0
2.508E+02	1.971E+02	4.34E-05	9.53E-01	2.00E-08	3.80E-04	9.50E-04	3.944E-01	9.0
2.769E+02	1.988E+02	5.15E-05	9.53E-01	2.00E-08	3.80E-04	9.50E-04	4.394E-01	8.0
3.057E+02	2.005E+02	6.10E-05	9.53E-01	2.00E-08	3.80E-04	9.50E-04	4.892E-01	7.0
3.373E+02	2.021E+02	7.08E-05	9.53E-01	2.00E-08	3.80E-04	9.50E-04	5.439E-01	6.0
3.716E+02	2.035E+02	7.88E-05	9.53E-01	2.00E-08	3.80E-04	9.50E-04	6.033E-01	5.0
4.095E+02	2.049E+02	8.73E-05	9.53E-01	2.00E-08	3.80E-04	9.50E-04	6.690E-01	4.0
4.510E+02	2.062E+02	9.65E-05	9.53E-01	2.00E-08	3.80E-04	9.50E-04	7.410E-01	3.0
4.960E+02	2.075E+02	1.05E-04	9.53E-01	2.00E-08	3.80E-04	9.50E-04	8.192E-01	2.0
5.202E+02	2.081E+02	1.10E-04	9.53E-01	2.00E-08	3.80E-04	9.50E-04	8.612E-01	1.5
5.455E+02	2.087E+02	1.15E-04	9.53E-01	2.00E-08	3.80E-04	9.50E-04	9.052E-01	1.0
5.721E+02	2.094E+02	1.20E-04	9.53E-01	2.00E-08	3.80E-04	9.50E-04	9.515E-01	0.5
5.887E+02	2.098E+02	1.23E-04	9.53E-01	2.00E-08	3.80E-04	9.50E-04	9.803E-01	0.2
5.983E+02	2.100E+02	1.25E-04	9.53E-01	2.00E-08	3.80E-04	9.50E-04	9.970E-01	0.03
6.000E+02	2.100E+02	1.25E-04	9.53E-01	2.00E-08	3.80E-04	9.50E-04	1.000E-00	0