The chemical composition of Earth's atmosphere V: the major carbon-bearing species

Mole %	*Name*	*Chemical formula*	*Residence Time*
78.084	Nitrogen	N_2	10^6-10^7 years
20.948	Oxygen	O_2	3000-10,000 yea
0.934	Argon	Ar	Forever
0.004 - 4	Water vapor	H_2O	~10 days
0.0385 (385 ppm)	**Carbon dioxide**	CO_2	**2-10 years**
0.001818 (18.18 ppm)	Neon	Ne	Forever
0.000524 (5.24 ppm)	Helium	He	~10^6 years
0.00017 (1.7 ppm)	**Methane**	CH_4	**2-10 years**
0.000114 (1.14 ppm)	Krypton	Kr	Forever
0.00005 - 0.0010	Stratospheric ozone	O_3	
0.000055 (0.55 ppm)	Hydrogen	H_2	4-8 years
0.000033 (0.33 ppm)	Nitrous oxide	N_2O	5-200 years
0.0000050 - 0.0000200	**Carbon monoxide**	CO	**60-200 days**
0.0000087 (87 ppb)	Xenon	Xe	Forever
0.0000010 - 0.0000500	Tropospheric ozone	O_3	
0.0000005 - 0.0000020	**NMHC (Non-methane hydrocarbons)**	C_xH_y	
0.0000000540 (540 ppt)	CFC12	CF_2Cl_2	>80 years
0.00000005 (500 ppt)	Carbonyl sulfide	OCS	~ 2 years
0.0000000265 (265 ppt)	CFC11	$CFCl_3$	~80 years
0.00000001 - 0.000001	Hydrogen peroxide	H_2O_2	1 day
0.00000001 - 0.0000001	Formaldehyde	CH_2O	5-10 days
0.0000000098 (98 ppt)	Carbon tetrachloride	CCl_4	≥ decades
0.0000000065 (65 ppt)	Methylchloroform	CH_3CCl_3	~7 years
0.000000001 - 0.0001	Nitrogen oxides	NO_x	A few days
0.000000001 - 0.0000001	Ammonia	NH_3	A few days
0.000000001 - 0.0000001	Sulfur dioxide	SO_2	hours to week
0.000000001 - 0.00000001	Dimethyl sulfide	CH_3SCH_3	<1 day
0.0000000001 - 0.00000003	Carbon disulfide	CS_2	~40 days
0.0000000005 - 0.00000005	Hydrogen sulfide	H_2S	<5 days
0.0000000002 (2 ppt)	Hydroperoxyl radical	HO_2	
0.000000000005 (0.05 ppt)	Hydroxyl radical	OH	≤ a few second

Carbon is present in a variety of forms in Earth's atmosphere. The four most abundant forms, which are highlighted here, span the range of carbon's nominal oxidation numbers. For example, the most abundant form of carbon is CO_2, with C in its nominal 4+ and thus most oxidized state, as one would expect in an oxidizing atmosphere. However, the second most abundant is methane, CH_4, where C is in its nominal 4- and thus most reduced state. Next is carbon monoxide, CO, where carbon has a nominal charge of 2+. Fourth is a mixture of various hydrocarbons (ethane, propane, and the longer hydrocarbon chains), where the nominal charge on carbon is 2- to 3-. This range of oxidation states of carbon is an illustration of the extent to which the atmosphere is *not* a system at redox equilibrium.

A single number is shown here for the concentration of CO_2, but it's very much a moving target. The CO_2 concentration of the atmosphere varies seasonally, reaching lesser values in summer with increased photosynthesis and greater values in winter with less photosynthesis. That seasonal oscillation is superposed on a long-term increase that began in the 1800s with humans' burning of fossil fuels. Another reason for that long-term increase has been human land use (mostly deforestation and plowing of grasslands), which both lessens carbon storage in plant biomass and facilitates oxidation of soil organic matter.

Methane's concentration has also increased as the result of human activity. Rice paddies and landfills generate methane, and the cattle that humans raise generate methane in their digestive tracts. Human production of CO_2 and methane has been a source of concern because increased concentrations of both cause an enahnced greenhouse effect and thus warming of the atmosphere.

Sources: see Part I of this series.