

July, 2017

## **CURRICULUM VITAE**

James F. Kasting  
1072 Crabapple Dr.  
State College, PA 16801

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### **PERSONAL DATA**

Birth date: January 2, 1953  
Marital Status: Married (Sharon), 3 children

### **DEGREES RECEIVED**

A.B. Harvard University, 1975 (Chemistry and Physics)  
M.S. University of Michigan, 1978 (Physics)  
M.S. University of Michigan, 1978 (Atmospheric Science)  
Ph.D. University of Michigan, 1979 (Atmospheric Science)

### **WORK EXPERIENCE**

2012 Evan Pugh University Professor, Penn State University  
2010 Visiting Professor, University of Washington, Seattle, Fall semester  
2006 Visiting Scientist, Laboratoire des Sciences du Climat et de  
l'Environnement, Gif-sur-Yvette, France (June-July)  
2003-04 Visiting Professor, California Institute of Technology  
Distinguished Visiting Scientist, NASA Jet Propulsion Laboratory  
2003- Distinguished Professor, Penn State University  
1994- Professor of Geosciences and Meteorology, Penn State University  
1988-94 Associate Professor of Geosciences and Meteorology, Penn State  
1983-88 Research Scientist, Space Science Division, NASA Ames Res. Center  
1981-83 National Research Council Postdoctoral Fellowship, NASA Ames  
Research Center  
1979-81 NCAR Advanced Study Program, National Center for Atmospheric  
Research  
1976-79 Research Assistant, Dept. of Atmospheric and Oceanic Science,  
University of Michigan

## **ACADEMIC HONORS AND AWARDS**

National Merit Scholarship (1971)  
Harvard National Scholarship (1971-75)  
Summa Cum Laude - Harvard (1975)  
Michigan College of Engineering Fellowship (1976)  
Atmospheric, Oceanic, and Space Sciences Department  
(University of Michigan) Distinguished Alumni Award (1992)  
Appointed Distinguished Professor, Penn State (2003)  
Faculty Scholar Award, Penn State (2005)  
Oparin Medal, International Society for the Study of the Origin of Life (2008)  
Appointed Evan Pugh Professor, Penn State (2012)  
NAS Award in Early Earth and Life Sciences (Stanley Miller Medal) (2016)

## **ACADEMIC AND PROFESSIONAL SOCIETIES**

American Association for the Advancement of Science (Fellow, 1995)  
International Society for the Study of the Origin of Life (Fellow, 2002)  
American Geophysical Union (Fellow, 2004)  
Geochemical Society (Fellow, 2008)  
American Academy of Arts and Sciences (Fellow, 2008)

## **SELECTED INVITED LECTURES**

Carl Sagan Lecture, Fall AGU Meeting (2004)  
SCUGOG Public Lecture, University of Western Ontario (2004)  
Klepser Lecturer, Geology Dept., University of Tennessee (2006)  
Wright lecturer, Geneva, Switzerland (2006)  
Opening plenary lecture, American Astronomical Society meeting (2008)  
Sackler Lecture, Cambridge (2012)  
Invited speaker (3 lectures), Department of Atmospheric and Oceanic Science,  
Peking University, Beijing (2015)

## **COMMITTEES AND OTHER PROFESSIONAL DUTIES**

Strategies for Planetary Atmospheres Exploration (SPASE) Working Group  
(1987-88)  
NASA Exobiology Peer Review Panel (1989-1991)  
Editorial Board for Origins of Life (1990-95)  
Chairman, Gordon Conference on the Origins of Life (1990)  
IAMAP Commission on Planetary Atmospheres and their Evolution  
(1991-95)  
NASA Exobiology Discipline Working Group (1991-1998)  
Geology Editorial Board (1994-1996)  
Editorial board for JGR Planets (1995-1998)

AAAS Electorate Nominating Committee (1997-1999)  
NASA Ames Space Science review panel (1998)  
NASA Astrobiology Research Laboratory Science Definition Group (1999)  
SETI Institute Science Working Group (2000)  
Chairman, NASA Exobiology Peer Review Panel (1995- 2000)  
NASA Astrobiology Task Force (1999-2001)  
NASA Terrestrial Planet Finder (TPF) Science Working Group (1999-2002)  
Ball Aerospace TPF Preliminary Design Team (2000-2002)  
NASA Solar System Exploration Subcommittee (2001-2002)  
NRC Committee on the Origin and Evolution of Life, COEL (2003- 2004)  
NRC Committee on Astronomy and Astrophysics: TPF Review Panel (2004)  
Co-Chair, NASA TPF-C Science and Technology Definition Team (2005-06)  
Mars Science and Technology Orbiter (MSTO) Science Advisory Group (2005-07)  
Member, NASA/NSF ExoPlanet Task Force (2007-2008)  
Member, NASA R&A Management Operations Working Group (2008)  
Member, NASA Advisory Council Astrophysics Subcommittee (2008-11)  
Chair, NASA Exoplanet Exploration Program Analysis Group (EXOPAG) (2009-2011)  
Session Chair, Goldschmidt Conference (2011)  
Chair, National Academy of Sciences Biosignatures Workshop (2016)

*Current:*

Member, National Academy Committee on Astrobiology and Planetary Science (CAPS) (2014- )

## **BOOKS PUBLISHED**

- 1) *The Earth System*, L. R. Kump, J. F. Kasting, and R. G. Crane, Prentice-Hall, Upper Saddle River, New Jersey, 1999, 351 pp. (2<sup>nd</sup> ed., 2004, 419 pp.; 3<sup>rd</sup> ed., 2009, 420 pp.)
- 2) *How to Find a Habitable Planet*, J. F. Kasting, Princeton University Press, Princeton, NJ, 2010.
- 3) *Atmospheric Evolution on Inhabited and Lifeless Worlds*, D. C. Catling and J. F. Kasting, Cambridge University Press, Cambridge, 2017.

## **TEACHING OUTSIDE OF PENN STATE**

European Research Course on Atmospheres (ERCA) -- Grenoble, France (1996, 1998, 2000, 2002, 2012)  
Agouron Geobiology Course--Catalina Island, California (2002)  
Extrasolar Planets Winterschool—Tenerife, Spain (Fall, 2004)  
TIARA Winterschool on Extrasolar Planets—Taiwan (Winter, 2008)  
Saas-Fee Winterschool on Astrobiology—Switzerland (Spring, 2011)  
University of Tokyo, Faculty of Earth and Space Science, short course—Tokyo (Spring, 2013)

## LIST OF PUBLICATIONS

James F. Kasting

### 1977

Kasting, J.F. and P.B. Hays. A comparison between  $N_2^+$  4278 Å emission and electron energy flux in the auroral zone. J. Geophys. Res. **82**: 3319-3323 (1977).

### 1979

Kasting, J.F., S.C. Liu, and T.M. Donahue. Oxygen levels in the prebiological atmosphere. J. Geophys. Res. **84**: 3097-3107 (1979).

....., Evolution of Oxygen and Ozone in the Earth's Atmosphere. Ph.D. dissertation, Univ. of Michigan (1979).

### 1980

Kasting, J.F. and T.M. Donahue. The evolution of atmospheric ozone. J. Geophys. Res. **85**: 3255-3263 (1980).

..... and T. Augustsson. Modeling the grasslands data. In: NCAR Summer Colloquium Notes, National Center for Atmospheric Research, Boulder, CO, pp. 134-160 (1980).

....., Determination of deposition velocities for  $O_3$ ,  $NO_x$ , and  $HNO_3$  by the gradient method. In: NCAR Summer Colloquium Notes, National Center for Atmospheric Research, Boulder, CO, pp. 161-172 (1980).

### 1981

Kasting, J.F. and J.C.G. Walker. Limits on oxygen concentration in the prebiological atmosphere and the rate of abiotic fixation of nitrogen. J. Geophys. Res. **86**: 1147-1158 (1981).

..... and R.G. Roble. A zonally-averaged chemical-dynamical model of the lower thermosphere. J. Geophys. Res. **86**: 9641-9653 (1981).

..... and T.M. Donahue. Evolution of oxygen and ozone in the earth's atmosphere. In: Life in the Universe, J. Billingham, ed., MIT Press, Cambridge, MA, pp. 149-162 (1981).

Walker, J.C.G., P.B. Hays, and J.F. Kasting. A negative feedback mechanism for the long-term stabilization of Earth's surface temperature. J. Geophys. Res. **86**: 9776-9782 (1981).

## 1982

Kasting, J.F. Stability of ammonia in the primitive terrestrial atmosphere. J. Geophys. Res. **87**: 3091-3098 (1982).

## 1983

Kasting, J.F., K.J. Zahnle, and J.C.G. Walker. Photochemistry of methane in the Earth's early atmosphere. Precambrian Res. **20**: 121-148 (1983).

..... and J.B. Pollack. Loss of water from Venus. I. Hydrodynamic escape of hydrogen. Icarus **53**: 479-508 (1983).

Kuhn, W.R. and J.F. Kasting. The effects of increased CO<sub>2</sub> concentrations on surface temperature of the early earth. Nature **301**: 53-55 (1983).

Jackson, R.W., R.M. Munoz, C.A. Leidich, J.P. Murphy, G.W. Thorley, and J.F. Kasting. A Pioneer-class Mars aeronomy mission. Paper presented at the AIAA 21<sup>st</sup> Aerospace Sciences Meeting, Reno, Jan. 10-13 (1983).

## 1984

Kasting, J.F., J.B. Pollack, and D. Crisp. Effects of high CO<sub>2</sub> levels on surface temperature and atmospheric oxidation state on the early earth. J. Atmos. Chem. **1**: 403-428 (1984).

....., J.B. Pollack, and T.P. Ackerman. Response of Earth's surface temperature to increases in solar flux and implications for loss of water from Venus. Icarus **57**: 335-355 (1984).

....., Comments on the BLAG model: The carbonate-silicate geochemical cycle and its effect on atmospheric carbon dioxide over the past 100 million years. Amer. J. Sci. **284**: 1175-1182 (1984).

....., The evolution of the prebiotic atmosphere. Origins of Life **14**: 75-82 (1984).

Roble, R.G. and J.F. Kasting. The zonally averaged circulation, temperature, and compositional structure of the lower thermosphere and variations with geomagnetic activity. J. Geophys. Res. **89**: 1711-1724 (1984).

## 1985

- Kasting, J.F., H.D. Holland, and J.P. Pinto. Oxidant abundances in rainwater and the evolution of atmospheric oxygen. J. Geophys. Res. 90: 10,497-10,510 (1985).
- ....., Photochemical consequences of enhanced CO<sub>2</sub> levels in Earth's early atmosphere. In: The Carbon Cycle and Atmospheric CO<sub>2</sub>: Natural Variations Archean to Present, E.T. Sundquist and W.S. Broecker, eds., American Geophysical Union, Washington, D.C., pp. 612-622 (1985).
- ....., Greenhouses and glaciers: Climatic change and the continuously habitable zone around the sun. The Planetary Report 5: 12-15 (1985).
- ..... and T.P. Ackerman. High atmospheric NO<sub>x</sub> levels and multiple photochemical steady states. J. Atmos. Chem. 3: 321-340 (1985).
- ..... and S.M. Richardson. Seafloor hydrothermal activity and spreading rates: the Eocene carbon dioxide greenhouse revisited. Geochim. Cosmochim. Acta 49: 2541-2544 (1985).

## 1986

- Kasting, J.F. and T.P. Ackerman. Climatic consequences of very high CO<sub>2</sub> levels in Earth's early atmosphere. Science 234: 1383-1385 (1986).
- ....., S.M. Richardson, J.B. Pollack, and O.B. Toon. A hybrid model of the CO<sub>2</sub> geochemical cycle and its application to large impact events. Amer. J. Sci. 286: 361-389 (1986).
- ..... and H.B. Singh. Nonmethane hydrocarbons in the troposphere: Impact on the odd hydrogen and odd nitrogen chemistry. J. Geophys. Res. 91: 13,239-13,256 (1986).
- Zahnle, K.J. and J.F. Kasting. Mass fractionation during transonic escape and implications for loss of water from Venus and Mars. Icarus 68: 462-480 (1986).

## 1987

- Kasting, J.F. Theoretical constraints on oxygen and carbon dioxide concentrations in the Precambrian atmosphere. Precambrian Res. 34: 205-228 (1987).
- Toon, O.B., J.F. Kasting, R.P. Turco, and M.S. Liu. The sulfur cycle in the marine atmosphere. J. Geophys. Res. 92: 943-963 (1987).
- Pollack, J.B., J.F. Kasting, S.M. Richardson, and K. Poliakoff. The case for a warm, wet climate on early Mars. Icarus 71: 203-224 (1987).

Reynolds, R.T., C.P. McKay, and J.F. Kasting. Europa, tidally-heated oceans, and habitable zones around giant planets. Adv. Space Res. 7: (5)125 - (5)132 (1987).

## 1988

Kasting, J.F. Runaway and moist greenhouse atmospheres and the evolution of Earth and Venus. Icarus 74: 472-494 (1988).

....., A wet origin for Venus: The water that got away. The Planetary Report, Vol. VIII, No. 6, pp. 13-16 (1988). [Adapted for republication as "How Venus Lost its Oceans," Oceanus 32, Number 2, 1989.]

....., O.B. Toon, and J.B. Pollack. How climate evolved on the terrestrial planets. Scientific American 256: 90-97 (1988).

Reynolds, R.T., C.P. McKay, J.F. Kasting, and S.W. Squyres. Europa: The prospects for an ocean. In Bioastronomy -- The Next Steps, G. Marx, ed., Kluwer Academic Publishers, New York, pp. 21-28 (1988).

Zahnle, K.J., J.F. Kasting, and J.B. Pollack. Evolution of a steam atmosphere during Earth's accretion. Icarus 74: 62-97 (1988).

Singh, H.B. and J.F. Kasting. Chlorine-hydrocarbon photochemistry in the marine troposphere and lower stratosphere. J. Atmos. Chem. 7: 261-285 (1988).

## 1989

Kasting, J.F. Long term stability of the Earth's climate. Palaeogeogr. Palaeoclimat. Palaeoecol. (Global Planet. Change sect.) 75: 83-95 (1989).

....., K.J. Zahnle, J.P. Pinto, and A.T. Young. Sulfur, ultraviolet radiation, and the early evolution of life. Origins of Life 19: 95-108 (1989).

..... and O.B. Toon. Climate evolution on the terrestrial planets. In: Origin and Evolution of Planetary and Satellite Atmospheres, S.K. Atreya, J.B. Pollack, and M.S. Matthews, eds., University of Arizona Press, Tucson, pp. 423-449 (1989).

Hunten, D.M., J.C.G. Walker, T.M. Donahue, and J.F. Kasting. Escape of atmospheres. In: Origin and Evolution of Planetary and Satellite Atmospheres, S.K. Atreya, J.B. Pollack, and M.S. Matthews, eds., University of Arizona Press, Tucson, pp. 386-422 (1989).

Sleep, N.H., K.J. Zahnle, J.F. Kasting, and H. Morowitz. Annihilation of ecosystems by large asteroid impacts on the early Earth. Nature 342: 139-142 (1989).

## 1990

- Kasting, J.F. Bolide impacts and the oxidation state of carbon in the Earth's early atmosphere. Origins of Life 20: 199-231 (1990).
- ....., Earth, the living planet. The Planetary Report 10 (Jan/Feb): 8-9, cont. on 24 (1990).
- ....., Impacts and the origin of life. Earth and Mineral Sciences Bull. (Penn State Univ.) 59: 37-42 (1990).
- Zahnle, K.J., J.F. Kasting, and J.B. Pollack. Mass fractionation of noble gases in diffusion-limited hydrodynamic hydrogen escape. Icarus 84: 502-527 (1990).
- Zahnle, K.J., J.B. Pollack, and J.F. Kasting. Xenon fractionation in porous planetesimals. Geochim. Cosmochim. Acta 54: 2577-2586 (1990).
- Singh, H.B., D. Herlth, D. O'Hara, L. Salas, A.L. Torres, G.L. Gregory, G.W. Sachse, and J.F. Kasting. Atmospheric peroxyacetyl nitrate measurements over the Brazilian Amazon during the wet season: Relationship with nitrogen oxides and ozone. J. Geophys. Res. 95: 16,945-16,954 (1990).

## 1991

- Kasting, J.F. CO<sub>2</sub> condensation and the climate of early Mars. Icarus 94: 1-13 (1991).
- ....., Box models for the evolution of atmospheric oxygen: an update. Global Planet. Change 97: 125-131 (1991).
- ....., Runaway greenhouse atmospheres: applications to Earth and Venus. In: Planetary Sciences: American and Soviet Research, ed. by T.M. Donahue, National Academy Press, Washington, D.C., pp. 234-245 (1991).
- ....., The greenhouse effect: past, present, and future. In Air Pollution: Environmental Issues and Health Effects, S.K. Majumdar, E.W. Miller, and J. Cahir, eds., The Pennsylvania Academy of Science, Easton, Pennsylvania, pp. 106-120 (1991).
- ..... and D.H. Grinspoon. The faint young sun problem. In: The Sun in Time, C.P. Sonett, M.S. Giampapa, and M.S. Matthews, eds., Univ. of Arizona Press, Tucson, pp. 447-462 (1991).
- McKay, C.P., O.B. Toon, and J.F. Kasting. Making Mars habitable. Nature 352: 489-496 (1991).



Whitmire, D.P., R.T. Reynolds, and J.F. Kasting. Habitable zones for Earth-like planets around main sequence stars. In: Bioastronomy: the Search for Extraterrestrial Life, J. Heidmann and M.J. Klein, eds., Springer-Verlag, Berlin, pp. 173-178 (1991).

## 1992

Kasting, J.F. Paradox lost and paradox found (News and Views article), Nature **355**: 676-677 (1992).

Kasting, J.F. and J.C.G. Walker. The geochemical carbon cycle and the uptake of fossil fuel CO<sub>2</sub>. In: AIP Conference Proceedings 247, Global Warming: Physics and Facts, B.G. Levi, D. Hafemeister, and R. Scribner, eds., American Institute of Physics, New York, pp. 175-200 (1992).

Walker, J.C.G. and J.F. Kasting. Effect of forest and fuel conservation on future levels of atmospheric carbon dioxide. Palaeogeogr. Palaeoclimat. Palaeoecol. (Global Planet. Change Sect.) **97**: 151-189 (1992).

Kasting, J.F. and N.G. Holm. What determines the volume of the oceans? Earth Planet. Sci. Lett. **109**: 507-515 (1992).

Caldeira, K. and J.F. Kasting. Susceptibility of the early Earth to irreversible glaciation caused by carbon dioxide clouds. Nature **359**: 226-228 (1992).

Kasting, J.F. and S. Chang. Formation of the planet and the origin of life (Sec. 1.2, pp. 7-12); Holland, H.D. and J.F. Kasting. The environment of the Archean Earth (Sec. 1.4, pp. 21-24); Kasting, J.F., H.D. Holland, and L.R. Kump. Atmospheric evolution: The rise of oxygen (Sec. 4.6, pp. 159-164); Kasting, J.F. Proterozoic climates (Sec. 4.7, pp. 165-168); Kasting, J.F. Models relating to Proterozoic atmospheric and oceanic chemistry (Appendix 26.2, pp. 1185-1188). All in The Proterozoic Biosphere: A Multidisciplinary Study, ed. by J.W. Schopf and C. Klein, Cambridge University Press, New York (1992).

Colin, L. and J.F. Kasting. Venus: A search for clues to early biological possibilities. In: Exobiology in Solar System Exploration, NASA SP 512, ed. by G.C. Carle, D.E. Schwartz, and J.L. Huntington, pp. 45-65 (1992).

Caldeira, K. and J.F. Kasting. The life span of the biosphere revisited. Nature **360**: 721-723 (1992).

## 1993

Kasting, J.F., D.P. Whitmire, and R.T. Reynolds. Habitable zones around main sequence stars. Icarus **101**: 108-128 (1993).

- Kasting, J.F. Earth's early atmosphere. Science 259: 920-926 (1993).
- Kasting, J.F. Algae and oxygen in Earth's ancient atmosphere (Tech. Comment). Science 259: 835 (1993).
- Kasting, J.F. Review of Scientists on Gaia. Origins of Life 23: 145-146 (1993).
- Kasting, J.F., D.H. Egger, and S.P. Raeburn. Mantle redox evolution and the case for a reduced Archean atmosphere, J. Geol. 101: 245-257 (1993).
- Grotzinger, J.P. and J.F. Kasting. New constraints on Precambrian ocean composition, J. Geol. 101: 235-243 (1993).
- Kasting, J.F. and J.C.G. Walker. Long-term effects of fossil fuel burning and deforestation on levels of atmospheric CO<sub>2</sub>. In: Biogeochemistry of Global Change, R.S. Oremland, ed., Chapman and Hall, Inc., New York, pp. 151-165 (1993).
- Kasting, J.F. Photochemistry in the primitive solar nebula (reply to Gladstone and Towe), Science 261, 1058-1060 (1993).
- Kasting, J.F. New spin on ancient climate (News and Views article), Nature 364, 759-760 (1993).
- Kasting, J.F. Evolution of the earth's atmosphere and hydrosphere: Hadean to Recent. In: Organic Geochemistry: Principles and Applications, M.H. Engel and S.A. Macko, eds., Plenum Press, New York, pp. 611-623 (1993).
- Caldeira, K. and J.F. Kasting. Insensitivity of global warming potentials to carbon dioxide emission scenarios, Nature 366, 251-253 (1993).
- Kasting, J.F. Early evolution of the atmosphere and ocean. In: The Chemistry of Life's Origins, J.M. Greenberg, C.X. Mendoza-Gomez, and V. Pirronello, eds., Kluwer Academic Publishers, Dordrecht, The Netherlands, 1993, pp. 149-176 (1993).

## **1994**

- Squyres, S.W. and J.F. Kasting. Early Mars: How warm and how wet?, Science 265: 744-749 (1994).
- Grenci, L.M. and J.F. Kasting. Oceans: The origin of life. In: The Oceans: Physical-Chemical Dynamics and Human Impact, S.K. Majumdar, E.W. Miller, G.S. Forbes, R.F. Schmalz, and A.A. Panah, eds., Pennsylvania Academy of Sciences, Easton, PA, pp. 282-288 (1994).

## 1995

Taubman, S.J. and J.F. Kasting. Carbonyl sulfide: No remedy for global warming, Geophys. Res. Lett. **22**, 803-805 (1995).

Kasting, J.F. O<sub>2</sub> concentrations in dense primitive atmospheres: commentary, Planet. Space Sci. **43**, 11-13 (1995).

Kasting, J.F. Fit for life: climate stability on Earth and the implications for life elsewhere, Science Spectra, issue 2, pp. 32-36 (1995).

## 1996

Kasting, J.F. Atmosphere, origin, in Encyclopedia of Climate and Weather, Oxford University Press, New York (1996).

Kasting, J.F. and P.A. Schultz. Benefit-cost analysis and the environment (letter), Science **272**, 1571-1572 (1996).

Kasting, J.F. Habitable zones around stars: an update, in Circumstellar Habitable Zones, L.R. Doyle, ed., Travis House Publications, Menlo Park, CA, pp. 17-28 (1996).

Williams, D.M., J.F. Kasting, and K. Caldeira. Chaotic obliquity variations and planetary habitability, in Circumstellar Habitable Zones, L.R. Doyle, ed., Travis House Publications, Menlo Park, CA, pp. 43-62 (1996).

Kasting, J.F. and P.A. Schultz. Reservoir time-scales for anthropogenic CO<sub>2</sub> in the atmosphere: commentary, Tellus **48B**, 703-706 (1996).

Kasting, J.F. Planetary atmosphere evolution: Do other habitable planets exist and can we detect them? Astrophys. Space Sci. **241**, 3-24. Reprinted in: The Search for Extra-Solar Terrestrial Planets: Techniques and Technology, J. M Shull, H.A. Thronson, and S.A. Stern, eds., Kluwer Academic Publishers, Dordrecht (1997), pp. 3-24 (1996).

## 1997

Williams, D.M., J.F. Kasting, and R.A. Wade. Habitable moons around extrasolar giant planets, Nature **385**, 234-236 (1997).

Kasting, J.F. Environmental constraints on the origin of life, Commentarii **4**, N. 3, pp. 133-147, Pontifical Academy of Sciences, Rome. Reprinted in: Encyclopedia Italiana (1997).

Kasting, J.F. Habitable zones around low mass stars and the search for extraterrestrial life, Origins of Life 27, 291-307 (1997).

Kasting, J.F. Warming early Earth and Mars (Perspective), Science 276, 1213-1215 (1997).

Kasting, J.F., D.C.B. Whittet, and W.R. Sheldon. Ultraviolet radiation from F and K stars and implications for planetary habitability, Origins of Life 27, 413-420 (1997).

Williams, D.M. and J. F. Kasting. Habitable planets with high obliquities, Icarus 129, 254-267 (1997).

Schultz, P.A. and J. F. Kasting. Optimal reductions in CO<sub>2</sub> emissions, Energy Policy 25, 491-500 (1997).

Kasting, J. F. The early Mars climate question heats up (Perspective), Science 278, 1245 (1997).

## **1998**

Kasting, J. F. Long-term effects of fossil fuel burning, Consequences 4, 15-27 (1998).

Kasting, J. F. Why a water world? Scientific American Presents 9, Number 3, 16-22 (1998).

Williams, D. M., J. F. Kasting, and L. A. Frakes, Were low-latitude Precambrian glaciations caused by high obliquity? Nature 396, 453-455 (1998).

Kasting, J.F. and L.L. Brown. Setting the stage: the early atmosphere as a source of biogenic compounds. In The Molecular Origins of Life: Assembling the Pieces of the Puzzle, A. Brack, ed., Cambridge Univ. Press, pp. 35-56 (1998).

Kasting, J. F. and L. L. Brown, Methanogenesis and the climates of early Earth and Mars. In Planetary Systems: the Long View, Editions Frontières, Blois, France, p 443-448 (1998).

## **1999**

*The Earth System*, L. R. Kump, J. F. Kasting, and R. G. Crane, Prentice-Hall, Upper Saddle River, New Jersey, 351 pp (1999).

Pavlov, A. A., A. K. Pavlov, J. F. Kasting, Irradiated interplanetary dust particles as a possible explanation for the deuterium/hydrogen paradox of Earth's oceans, J. Geophys. Res. 104, 30,725-30,728 (1999).

Kasting, J. F. and others, Signposts of life: detection of life via remote sensing, TPF Report, Ch. 4, JPL/Caltech/IPAC MS 100-22, Pasadena, CA (1999).

## 2000

Pavlov, A. A., J. F. Kasting, L. L. Brown, K. A. Rages, and R. Freedman, Greenhouse warming by CH<sub>4</sub> in the atmosphere of early Earth, J. Geophys. Res. 105, 11,981-11,990 (2000).

Mischna, M. and J. F. Kasting, CO<sub>2</sub> clouds and the climate of early Mars: effect of cloud height and optical depth, Icarus 145, 546-554 (2000).

Schindler, T. L. and J. F. Kasting, Synthetic spectra of simulated terrestrial atmospheres containing possible biomarker gases, Icarus 145, 262-271 (2000).

Churchill, D. and J. F. Kasting, Nitrous oxide in the early atmosphere: a marker for life? In *Proceedings of the Conference: 'Darwin and Astronomy – the Infrared Space Interferometer'*, Stockholm, Sweden (ESA SP-451, May, 2000).

## 2001

Kump, L. R., J. F. Kasting, and M. E. Barley, The rise of atmospheric oxygen and the “upside-down” Archean mantle, Geochem. Geophys. Geosyst., vol. 2, Paper number 2000GC000114 (2001).

Kasting, J. F. Essay review of Peter Ward and Don Brownlee's *Rare Earth: Why Complex Life is Uncommon in the Universe*, Perspectives in Biology and Medicine 44, 117-131 (2001).

Kasting, J. F., A. A. Pavlov, and J. L. Siefert, A coupled ecosystem-climate model for predicting the methane concentration in the Archean atmosphere, Orig. Life Evol. Biosphere 31, 271-285 (2001).

Kasting, J. F. and J. L. Siefert, The nitrogen fix (News and Views article), Nature 412, 26-27 (2001).

Kasting, J. F., The rise of atmospheric oxygen (Perspective), Science 293, 819-820 (2001).

Pavlov, A. A., J. F. Kasting, J. L. Eigenbrode, and K. H. Freeman, Hydrocarbon aerosols as a source of low-<sup>13</sup>C kerogens in Archean sediments, Geology 29, 1003-1006 (2001).

DesMarais, D. J., Harwit, M., Jucks, K., Kasting, J. F., Lunine, J. I., Lin, D., Seager, S., Schneider, J., Traub, W., and Woolf, N., *Biosignatures and Planetary Properties to be Investigated by the TPF Mission*, JPL Publication 01-008, California Inst. Of Technology, Pasadena, CA, 48 pp (2001).

Pavlov, A. A., L.L. Brown, and J. F. Kasting, Shielding of NH<sub>3</sub> and O<sub>2</sub> by organic hazes in the Archean atmosphere, J. Geophys. Res. **106**, 23,267-23,287 (2001).

## 2002

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