OBITUARIES

YORAM J. KAUFMAN
1948–2006

Yoram Janusz Kaufman, senior fellow and atmospheric scientist in the Earth Sciences Division at NASA Goddard Space Flight Center, died 31 May 2006 following a tragic accident on 26 May where his bicycle was struck by an automobile near Goddard.

Kaufman was born in Warsaw, Poland, and moved to Haifa, Israel, when he was 10. He subsequently studied physics at the Technion-Israel Institute of Technology in Haifa (B.Sc. and M.Sc.) and received his Ph.D. in atmospheric physics from the Department of Geophysics and Planetary Sciences at Tel Aviv University in 1979. He then came to Goddard as a National Research Council postdoc, where he continued to work under an arrangement with the University of Maryland at College Park until he became an American citizen in 1990, at which point he joined Goddard as a senior scientist.

Yoram Kaufman

Kaufman's professional passion was his research on atmospheric aerosols, tiny solid and liquid particles suspended in the atmosphere. Aerosols occur naturally—due to wildfires, volcanic eruptions, dust storms, suspended salts from sea spray, and plant respiration—and they are produced by humans, including emissions from cars, factories, biomass burning, and agricultural dust. Aerosols are important because they represent an area of uncertainty within the Earth's climate system. Kaufman's research contributed greatly to scientists' understanding of the myriad roles of aerosols in the climate system.

"Aerosols are a 'wild card,'" Kaufman once explained. "They are hard to predict because they act like double agents in the system."

His research on retrieving the optical and microphysical properties of aerosol particles from space was encapsulated in the Moderate Resolution Imaging Spectroradiometer (MODIS) that is now flying on NASA's Terra and Aqua satellites. He was the pioneer in developing aerosol retrieval algorithms over land surfaces globally, an important capability not previously demonstrated from space-based observations. This analysis, for the first time, has led to the important separation of aerosol optical properties arising from fine (small) mode particles (industrial emission and biomass burning) and from coarse (large) mode particles (desert dust and oceanic sea salt). This separation of anthropogenic from natural aerosol emissions and their effect on both the direct and indirect forcing of climate has been reported in numerous publications, including an invited review paper in *Nature* in 2002.

Kaufman's algorithms are in use today on both the *Terra* and *Aqua* satellite platforms, which were launched in 1999 and 2002, respectively. From 1979 to 2001, Kaufman served as project scientist of *Terra,* the first "flagship mission" of NASA's Earth Observing System, and thus oversaw the scientific aspects of the mission in the critical days leading up to and following *Terra's* launch. His earlier work on developing a method to distinguish aerosols over land surfaces using dense, dark vegetation surfaces played a fundamental role in development of aerosol algorithms for MISR and POLDER as well.

He was especially interested in how aerosols affect climate, and used a wide variety of tools to assess their impact. These tools naturally included MODIS and other satellite observations, but also included focused

airborne field campaigns, such as the Smoke, Clouds, and Radiation–Brazil experiment that he led in 1995 to assess the impact of biomass burning on climate. He also advocated, and named, AERONET, NASA's Aerosol Robotic Network, a ground-based network of sun/sky radiometers that were first deployed to validate the accuracy of satellite estimates of aerosol optical thickness (or loading) and to characterize the size distribution of particles in various regions of the globe. He subsequently valued the AERONET network for its ability to obtain absorption characteristics of particles not easily obtainable from satellite, and to assess biases to be expected in aerosol retrievals at times of various satellite overpasses.

In recent years, Kaufman turned his attention to the role that aerosols have in augmenting (nonabsorbing aerosols) or suppressing (absorbing aerosols) cloud formation, and the corresponding impacts aerosols have on precipitation. Over his career, Kaufman wrote or coauthored over 200 scientific papers published in refereed journals, including several papers in *Science, Nature,* and the *Proceedings of the National Academy of Sciences.*

Kaufman was program manager of NASA's Earth Observatory Web site (www.earthobservatory.nasa.gov) from its inception in 1999 through January 2006. His creative genius and leadership led to the site's conception and award-winning reputation.

In honor of Kaufman, teams for the MISR, CERES, and MODIS instruments did not record data for a full minute on 4 June, as NASA's *Terra* and *Aqua* satellites flew over Goddard Space Flight Center in Greenbelt, Maryland. Likewise, the Polarization and Directionality of the Earth's Reflectances instrument aboard the French Centre National d'Etudes Spatiale's *Polarization and Anisotropy of Reflectances for Atmospheric Sciences coupled with Observations from a Lidar (PARASOL)* satellite, and a global network of upward-looking sensors (called sun photometers) within AERONET remained inactive during that same span. In addition, SKYNET, another ground-based observation network with 12 sites in eastern Asia from Mongolia to Thailand, as well as Japan, also observed a moment of data "silence."

Kaufman will be remembered as a brilliant scientist, a charismatic leader, and a positive influence within NASA. He collaborated with many scientists around the world in helping to advance our understanding of Earth's climate system. In the days before his untimely death, Kaufman was not yet aware that he had been selected by the AMS to receive its prestigious Verner E. Suomi Award, which is granted to one individual each year in recognition of highly significant technological achievement in the atmospheric or related sciences. He was also elected a Fellow of AMS in 2005.

Perhaps our best tribute to Kaufman would be to continue the research he started. The *CloudSat* and *Cloud–Aerosol Lidar and Infrared Pathfinder* Satellite Observations missions launched on 28 April will do just that, greatly expanding our understanding of clouds and aerosols and how they impact Earth's climate.

Kaufman is survived by his wife of 35 years, Jean; two children, his son Nadav (and daughter-in-law Amy), of Cranford, New Jersey, his daughter Daphne (and son-in-law Dror Topf), of Philadelphia, Pennsylvania; and a brother, Alex Gersten (and sister-in-law Rina) of the Ben Gurion University of the Negev, Beer-Sheva, Israel.

—Michael D. King, Lorraine A. Remer, and Nadav Kaufman