JOANNE SIMPSON

1923–2010

Elected in 1988

"For far-reaching advances in the mechanisms of atmospheric convection, clouds, and precipitation and their application to weather prediction and modification."

BY DAVID ATLAS AND MARGARET A. LEMONE

JOANNE SIMPSON (*nee* Gerould), former leader of the Tropical Rain Measuring Mission and storm modeling program at the National Aeronautics and Space Administration's (NASA) Goddard Space Flight Center and the "mother" of modern research on tropical clouds and hurricanes, died on March 4, 2010, at the age of 86.

She was born Joanne Gerould on March 23, 1923, in Boston to two journalists. Her father, an outdoor enthusiast with an interest in aviation, introduced her to sailing and flying. Simpson became interested in clouds while learning to sail and as a student pilot.

Simpson broke family tradition by going west to the University of Chicago, after reading about its approach to education. Her interest in flying led her to enroll in Rossby's course in meteorology. By the time she received her bachelor's degree in 1943, she was able to go to New York University to teach "war courses" to future military forecasters. She returned to Chicago in 1944, continuing to teach war courses. She obtained her master's degree in meteorology under Carl-Gustaf Rossby at the University of Chicago in 1945. Although she was first discouraged from pursuing a Ph.D., a class by Professor Herbert Riehl reignited her interest in clouds, which became the topic of her Ph.D. studies, with Riehl as her advisor. She obtained support by teaching courses at the

Illinois Institute of Technology, which, combined with taking courses there cost-free, broadened her scientific education. During the summers she would pursue her research at Woods Hole. She received her doctorate in 1949, the first woman to have done so, and moved to Woods Hole in 1951.

While at Woods Hole (1951–1960), she developed the first numerical model of a cloud, which was developed and validated using data from an instrumented patrol bomber (PBY) aircraft on loan from the U.S. Navy. Although the Navy did not want her to fly on the airplane, the Woods Hole director and the Office of Naval Research said that they did not want the airplane if she did not fly on it. Indeed, she was instrumental in breaking barriers for women in subsequent field programs.

Simpson's conceptual model of cumulus clouds differed from that espoused by Richard Scorer and Frank Ludlam of Imperial College, leading to sharp exchanges both in the literature and in person and then to a visit to Imperial College in 1954. There, based on laboratory experiments, theory, and observations of glider pilots, she and Scorer developed the first finite-difference model of a cumulus cloud, which was envisioned as a buoyant bubble entraining air from the environment, which, thanks to Rossby, was run on a computer in Stockholm, Sweden, in 1955.

She subsequently collaborated with Riehl on seminal papers (1958, 1979) on the role of "hot towers" or convective clouds in maintaining the trade wind circulation, providing the solution to an apparent paradox. As every school child knows, air in the trade-wind belts converge near the Equator, where it rises and carries the excess heat energy aloft and then poleward into both hemispheres. However, observations in the early to mid-1950s showed a minimum in energy at midlevels separating high-energy values near the surface and aloft. Clearly this was not possible for a broad rising updraft. With Riehl she showed that the energy exchange could be explained by updrafts in convective clouds carrying high-energy air through midlevels. Occupying only a small fraction of the area, these "hot tower" clouds were missed in observed energy profiles.

During the same period, she also collaborated with Riehl on a set of papers explaining aspects of the mature hurricane, including structure and maintenance of the eye, and the hurricane's inflow area. Once again, the "hot towers" would play a significant role.

It is notable that Riehl and Simpson recognized that hot towers had to be imbedded in mesoscale convective systems that were an order of magnitude larger in area than the towers themselves. This awareness foreshadowed the more recent work by others on convective updraft in clouds and the role of convective clouds in mesoscale convective systems.

Simpson started working on weather modification while at the University of California at Los Angeles (1960–1964). By 1963 she was associated with Project Stormfury, aimed at weakening hurricane winds, first as a member of the advisory panel (1962–1965) and then as director (1965–1966). Although she believed that the preliminary results were promising, the program was discontinued because of the possibility that the seeding might change the path of the storm.

From 1965 to 1974, Simpson directed the National Oceanic and Atmospheric Administration's Experimental Meteorology Laboratory in Coral Gables, Florida, dealing mainly with the Florida Area Cumulus Experiment (FACE). Simpson pioneered the development of a one-dimensional model that was used to evaluate the effect of cloud seeding on individual tropical cumulus clouds. While seeding was found to increase cloud heights significantly, evidence for the increased areawide rainfall was questionable. Nevertheless, others have gone on to similar experiments elsewhere with claims of positive results.

Simpson moved to the University of Virginia in 1974. However, the quiet, reflective academic life with a few students evidently did not suit her tastes after the excitement of Stormfury and FACE. So in 1979 she accepted an offer to lead the Severe Storms Branch at the NASA Goddard Space Flight Center. There her research first focused on convective cloud systems and tropical cyclones using advanced numerical models and observations. In 1986, NASA asked Simpson to

lead the study for the proposed Tropical Rainfall Measuring Mission (TRMM), a joint program with Japan. The satellite would carry the first *spaceborne* rain radar and a passive microwave system to accurately measure rainfall across the tropics. In 1987 she became the project scientist for TRMM, bringing it from concept to reality. No longer was there any doubt that a woman could handle a job of this magnitude.

Like many other satellite systems, TRMM has led to many new insights that were not originally anticipated. It has exceeded by far its original goal of advancing our understanding of the distribution of tropical rainfall and its relation to global water and energy cycles. It has become the primary satellite in a system of research and operational satellites used for analyzing precipitation characteristics on timescales from three hours to interannually and beyond. In particular, it is now used operationally to monitor convective systems and tropical cyclones. One cannot imagine the many Eureka moments of discovery that TRMM has yielded. It is for these reasons that Simpson often stated that TRMM was the most important accomplishment of her career.

The TRMM satellite and instruments are in excellent shape, and there is sufficient fuel on board to maintain scientific operations until 2014, thus providing a 17-year record for climatological purposes. If it continues until 2014, it will overlap the launch of the Global Precipitation Mission in 2013, thus extending the record and providing for intercalibration between the TRMM and GPM.

Simpson played a major role in planning and leading large observational experiments on convective cloud systems while she was a member of the various institutions mentioned above. She was a leading participant in the aircraft aspects of several Global Atmospheric Research Program (GARP) experiments in the 1970s, particularly the GARP Atlantic Tropical Experiment (GATE), Monsoon Experiment (MONEX), and Tropical Oceans Global Atmosphere (TOGA)–Coupled Ocean Atmosphere Response Experiment (COARE, 1992–1993).

Simpson's many awards and recognitions include the following from the American Meteorological Society: Meisinger

Award (1962), Rossby Medal (1983), Charles Franklin Brooks Award (1992), Charles E. Anderson Award (2001), fellow (1969), president (1989), and honorary member (1995). Other awards include the U.S. Department of Commerce Gold (1972) and Silver (1967) medals, NASA medals for Exceptional Scientific Achievement (1982) and Outstanding Leadership (1998), and the first William Nordberg Memorial Award for Earth Sciences (1994). She was elected a fellow of the American Geophysical Union (1994), an honorary member of the Royal Meteorological Society (1999), and a member of the National Academy of Engineering (1988). She received the prestigious International Meteorological Organization Prize from the World Meteorological Organization in 2002 and was inducted into the American Academy of Arts and Sciences in 2006.

In addition to her distinguished scientific career, Simpson is known for lowering the barriers for future generations of women. She was instrumental in enabling women to participate in field programs. She demonstrated to younger women that it was possible for them to be successful in the field. She spoke out in favor of opportunities for women, but she picked her battles wisely. She backed up her talk by providing qualified women with a chance to succeed by hiring them, suggesting them to colleagues seeking new hires or collaborators, and choosing them for volunteer jobs in the American Meteorological Society. She was a valued mentor not only to women but also to men, both younger and older.

This tribute to Joanne Simpson must acknowledge Bob, her husband of 45 years. He was the first director of the Hurricane Research Project and coauthor of the Saffir-Simpson hurricane intensity scale. Much of her work was stimulated by discussions with Bob.

Joanne and Bob Simpson greatly enjoyed sailing, until they could no longer handle the boat themselves. They frequently invited associates and friends to join them. Just as he kept her on a true course in their sailing adventures, he did the same in their lives at home.

They lived on the eighth floor of a high rise in southeast Washington, D.C., with a wonderful view of the Potomac

River, so that they could continue to enjoy sailing vicariously. They also had a wide view to the West to carry on their cloud observations. Their location was an easy drive to the Kennedy Center and the Shakespeare Theater to take pleasure in music, opera, and theater and also to the Cosmos Club to savor gourmet dinners. They also gave of their time to authors who needed advice on the authenticity of their accounts of thunderstorms and hurricanes.

Joanne is survived by her husband, Robert H. Simpson; her children, David Starr Malkus (of Madison, Wisconsin), Steven Malkus (of Falmouth, Massachusetts), and Karen Malkus (of Brewster, Massachusetts); her brother, Dan Gerould (of New York City); six grandchildren; and two great-grandchildren.

Joanne Simpson certainly did not live a peaceful lifestyle. That was impossible for her. There are surely hundreds of us who owe our success in various endeavors, even our careers, to her inspiration and encouragement, her courage and determination, and her friendship.