

EXPECTED OUTCOMES AND CONCLUSION. Implementing these recommendations will better enable individuals, communities, businesses, and governments to manage risks and explore opportunities associated with changing WWC conditions. Economic and social prosperity will be enhanced, and further progress will be made toward saving lives, enhancing commerce, protecting property,

and adapting to a changing world. In so doing, our nation will advance its leadership in promoting technological innovations that are critical to the success and well-being of a global society.

[This statement is considered in force until May 2021 unless superseded by a new statement issued by the AMS Council before this date.]

OBITUARIES

William Mason (Bill) Gray passed away peacefully surrounded by his family on April 16, 2016 at the age of 86. He had been on the faculty at Colorado State University specializing in tropical meteorology from 1961 through his formal retirement in 2005. Following his retirement, he

WILLIAM M. GRAY
1929–2016

remained active in both hurricane and climate change research up until the time of his death. He was best known among the general public for his seasonal Atlantic basin hurricane forecasts but also contributed many fundamental studies in tropical cyclone structure, intensity, and climatology as well as cumulus convection, radiation, and the energetics of the tropics. Among the research community, he was legendary as a professor with more than 70 masters and Ph.D. students, many of whom went on to become leaders in the field of tropical meteorology. He was also a forceful presence at major scientific meetings, forever challenging the existing paradigms or current understanding of the field.

Internationally, he united the field of tropical cyclone researchers and forecasters around the world. He spent several months in 1978 on a World Meteorological Organization (WMO)-sponsored trip touring 28 global tropical cyclone warning centers. His report following that trip thoroughly detailed the observational challenges facing these centers. He initiated and organized the first WMO International Workshop on Tropical Cyclones (IWTC) in Bangkok in 1985. The IWTC continues to be held every four years and is a critical forum where forecasters and researchers can get together and discuss areas of progress and fundamental

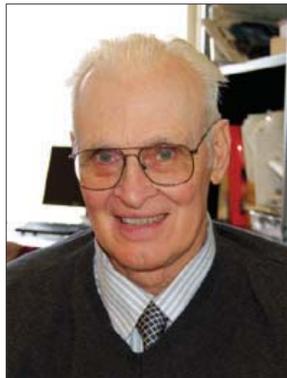
challenges that still need to be solved. Subsequently, in the era of e-mail availability, his research project set up an international tropical storms e-mail discussion list, open to professionals in the field from anywhere around the globe. Through the IWTC and the tropical storms e-mail discussion list, hurricane forecasters and researchers feel they are part of a global community, thanks largely to the initiatives and foresight of Gray.

Gray was born in Detroit, Michigan, on October 9, 1929. He was the eldest son of Ulysses S. and Beatrice Mason Gray. In 1939, the family moved to Washington, D. C., where Bill grew up in the northwest section of the district. He graduated from Wilson High School and George Washington University (1952), and was very active in high school football and baseball. A knee injury at age 21 prevented a desired career in professional baseball.

Gray received a second lieutenant commission in the U.S. Air Force in 1953 and served as a weather forecast officer for four years, the majority of which was overseas in the Azores and then in England. After joining Colorado State University, he remained active in the Air Force Reserves as a weather officer until 1974, when he retired as a lieutenant colonel.

After his active U.S. Air Force duty in 1957, he obtained an M.S. (meteorology, 1959) and then a Ph.D. (geophysical sciences, 1964) from the University of Chicago under the tutelage of Herbert Riehl, often referred to as “the father of tropical meteorology.” He joined the newly formed Department of Atmospheric Science at Colorado State University in 1961.

Bill married Nancy Price from Oshkosh, Wisconsin, on October 1, 1954. They had four children,



William M. Gray

Sarah, Anne (deceased), Janet, and Robert. Nancy Gray was very active for many years in Fort Collins community affairs and politics—including serving as mayor of Fort Collins in 1980–81—before her death in 2001.

Bill's early research work at Colorado State University in the 1960s consisted of fundamental research into hurricane structure. His seminal research paper in 1968 titled "Global View of the Origin of Tropical Disturbances and Storms" published in *Monthly Weather Review* was the first paper to thoroughly document a global climatology of tropical cyclone frequency with physical mechanisms forcing the global variations and annual cycle, the contents of which are still the basis of many studies on tropical cyclones. One of his fundamental contributions was an elucidation of six necessary parameters for tropical cyclone genesis. These six genesis parameters are still utilized extensively by the hurricane research and forecasting community today. He and his students also spent considerable time painstakingly analyzing hurricane aircraft reconnaissance data that helped improve the understanding of the inner and outer circulations of the hurricane. Throughout his career, he and his students published extensively on various aspects of tropical cyclone genesis, structure, intensity change, climatology, and motion.

In addition to his work on tropical cyclones, Gray spent considerable amounts of time studying tropical convection and its associated impacts on radiation. His papers documenting how the heat release in tropical convection is transferred to the larger-scale circulation are fundamental to the cumulus parameterization schemes that are utilized by climate models today. He also provided better understanding of the diurnal cycle of deep convection, convincingly demonstrating that tropical convection has a maximum in the early morning and a minimum in the late afternoon—a concept that has been proven recently using satellite observations.

Beginning in 1984 and continuing to his death, Gray authored seasonal Atlantic basin hurricane forecasts. Prior to 1984, there were no predictions of Atlantic seasonal hurricane activity. These forecasts arose from the discovery that El Niño decreased Atlantic hurricane activity through increases in vertical wind shear, along with several other factors. He continued to refine the statistical models and incorporate new data sources as they came online through the 1980s and the 1990s. This

initiative has prompted many others to follow suit, which has led to a number of seasonal tropical cyclone forecasts for different ocean basins. Even after stepping down as first author on the forecasts following the 2005 hurricane season, he continued to provide guidance with all predictions, including the April 2016 forecast that was released only two days before his death.

Gray had strong disagreement with the science behind the human-induced global warming hypothesis, and devoted the major portion of the last decade to researching this area. His primary argument was that the increased global temperature associated with CO₂-induced warming would lead to an increased hydrologic cycle. The faster hydrological cycle would decrease surface temperature through the evaporation term in the surface energy balance while simultaneously increasing tropospheric temperatures. The faster hydrologic cycle would also result in enhanced cumulus convection with increased surrounding-area subsidence. Overall, he argued that this would lead to a decrease in upper-level tropical relative humidity, resulting in a negative water vapor feedback mechanism that would counteract significant levels of global warming.

Gray was famous as a professor. His enthusiasm and passion for research and data were boundless, and he always encouraged his students to be curious and to solve big problems. He always had a large research project team, including many international students who came to the United States specifically to work with one of the world's leading researchers on tropical cyclones. There were group meetings held every week, long discussions and arguments through the afternoon into the early evening, and regular social events at his house in downtown Fort Collins. When the students accompanied him to science conferences, they were always introduced to the leaders in the field, and the work of his students was widely advertised. The research seemed to go on, as a team, nonstop, 24 hours, seven days a week, and for the students, it seemed they were at the center of the research universe.

His presence at the biannual AMS conference on hurricanes and tropical meteorology was a feature of these meetings. His presentation was always to a packed room, and he became famous for various expressions. In studies of the general circulation and of tropical convection, he always extolled the importance of vertical mixing by cumulonimbus convec-

tion, and became known for his catch-phrase “up moist-down dry,” referring to the upward motion in a convective core following a moist adiabat, and the large-scale downward motion in the Hadley Cell and trade wind regions following the dry adiabat. There was also the famous

expression known as “the Bill Gray question,” where after a theoretical or dry presentation, he would congratulate the author on his insights, enthusiasm, and hard work, but would ask, “But what does it all mean?”

Gray received many awards during his distinguished career, including being named a Fellow of AMS. He won AMS’s Jule G. Charney Award in 1993 and was a corecipient of the AMS’s Banner Miller Award that same year. The National Hurricane Conference gave him the Neil Frank Award in 1995. He was ABC television’s “Person of the Week” in September of 1995. The National Tropical Weather Conference gave him the Bob and Joanne Simpson Award in 2014.

He also worked extensively with AMS during his career. He was a panel member of the AMS’s Committee on Hurricanes and Tropical Meteorology from 1968 to 1973 and 1978 to 1981. He later served as the chair of that committee from 1987 to 1990.

Gray’s imprint on the field of tropical meteorology is enormous, as evidenced by the very large number of meteorologists under his lineage in the tropical meteorology family tree produced by Bob Hart at Florida State University.

In most fields of science, the aged professors are treated with deference and reverence due to their past contributions. Unfortunately, Gray missed that period. Following his scientific instincts, he rejected much of the modern science of climate change and became a prominent climate change skeptic. The gentlemanly manners and generosity of spirit for which he was famous occasionally deserted him, and he sometimes engaged other scientists in personal attacks. His former students and colleagues rallied around him, and many colleagues went to great efforts to temper this behavior.

After Gray’s death, the tropical storms e-mail discussion list that his research project first developed lit up with personal reminiscences from scientists around the world. Lance Bosart of SUNY-Albany wrote about the climate skeptic: “We all know that Bill became a skeptic about the significance of human

IN MEMORIAM

WILLIAM EDWARD FOX
1918–2016

JOHN IMBRIE
1926–2016

ELMER ROBINSON
1924–2016

activity with regard to climate change. While I believe that Bill was on the wrong side of this debate, there is no question that he was very passionate about what he believed was insufficient hard evidence to justify the widespread conclusion that human activity was the cause of

ongoing climate change. I am also aware that hurt feelings arose between Bill and some of his colleagues and former students over this issue. I fervently hope that with the passage of time these hurt feelings will recede. After all, in the ‘ledger of life’ there is no one alive or dead who doesn’t have at least a few marks on the negative side of his/her own personal ledger. We have lost a giant in the field who will leave a lasting legacy in the science of hurricanes, tropical meteorology, and operational hurricane forecasting. We need to remember, treasure, and celebrate Bill’s many outstanding intellectual, educational, and personal achievements.”

Gray kept working, and kept publishing to the end. His publication career spanned 54 years. It began with a paper in the *Quarterly Journal of the Royal Meteorological Society* in 1962 on the radial balance of forces in hurricanes, and ended with a paper that he cowrote with a team including his final Ph.D. student, Phil Klotzbach, in *Nature Geoscience* in 2015, the year before he died, discussing the potential end of the active Atlantic hurricane era.

William Gray was a scientist through and through. He lived, breathed, ate, and drank science. He always told his colleagues he wanted to die “with his boots on.” A few days before he died, he was released from the hospital to be at home under hospice care. During those last few days, he corresponded by e-mail with all his former students via his administrative assistant, who read the response e-mails to him. He had pages of yellow legal pad with equations and graphs scattered around his bedroom, as he continued working on a paper that he was preparing for publication. In his view, he died “with his boots on.”

Gray is survived by his two daughters, Sarah (of San Diego) and Janet (of Fort Collins), and his son, Robert, and two grandsons, Mason and Liam (of San Diego).

—PHIL KLOTZBACH, JOHN MCBRIDE, CHRIS LANDSEA, JOHNNY CHAN, WILLIAM FRANK, PAT FITZPATRICK, AND LANCE BOSART