Introduction to the Special Issue on Upper Ocean Processes: Peter Niiler's Contributions and Inspirations

BY LUCA CENTURIONI AND DONG-KYU LEE

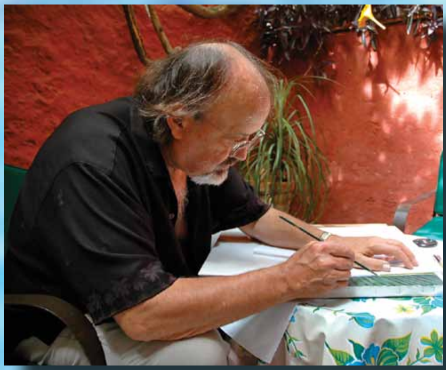
The physical oceanographers were all aboard the bus when they saw Peter Niiler zoom by on a motorcycle.
—Henry Stommel

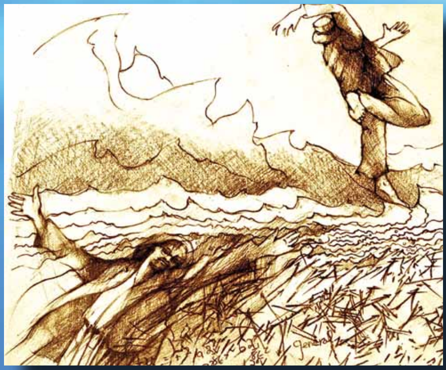
Vision, knowledge, intuition, ingenuity, passion—the list could go on and on and still seem inadequate to describe the talents and the rich, complex personality of Pearn Peter Niiler (b. 1937, Tartu, Estonia, and d. 2010, San Diego, California). A world-renowned authority on ocean currents, his legacy will continue to exert a profound influence on the way we observe the ocean for many years to come.

Peter was an engineer and a mathematician whose early studies in fluid mechanics and geophysical fluid dynamics while a postdoc at Harvard were primarily theoretical. He described the turning point in his career, the very one that made him one of the most influential observational oceanographers of the modern era, as stemming from a meeting he had with Henry Stommel in 1965. Peter had just learned that he would not be joining the Harvard faculty and was seeking Stommel's help and advice to find a job. Instead of a promise for a personal introduction to famous professors in prestigious university departments, he was handed a worn-out file and a suggestion to pay a visit to Bill Richardson and Bill Schmitz at the Key Biscayne Oceanographic Laboratory of the University of Miami. The file contained, among several undecipherable, coffee-stained scribbled sheets of paper, a graph of data from the first direct observations of the Florida Current between Miami and Bimini. The Florida-based group had obtained these observations with profiling sondes they had invented. Quick to realize that he had been handed a jewel, Peter was drawn into the world of observation. Using Peter's own words, "Stommel could not have given a better gift from the real world to a young theoretician."

Peter's driving force was a genuine passion for understanding how ocean currents are shaped and set into motion. He used to say to his colleagues: "I really wanted to know [what] ocean currents look like and how the ocean circulation works. The only way to find out was to measure the currents directly." And so he proceeded to do just that. The direct observation of ocean currents led him to make many valuable contributions to ocean circulation theories. The Niiler cell (Niiler, 1969), which describes the secondary circulation generated by wind-jet interaction, and the Ralph-Niiler Ekman layer model (Ralph and Niiler, 1999) are named after his work.

Luca Centurioni *(lcenturioni@ucsd.edu) is Associate Researcher, Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA, USA.* **Dong-Kyu Lee** *is Professor, Pusan National University, Department of Oceanography, Busan, Korea.*



In the early 1980s, ocean drifters were short-lived, and no one knew much about their water-following capabilities. So Peter and his colleagues began to design ocean surface drifters, tackling the challenge of developing long-lived devices that could measure ocean currents accurately and resist the harsh environment at the ocean's surface where waves and corrosion led to a catastrophic failure of drifters within a few months. His engineering and fluid mechanics background, combined with his hands-on approach, resulted in several generations of Lagrangian surface drifting buoys able to track water "particles" in the upper ocean mixed layer, away from the action of surface gravity waves, with minimal slip. In the late 1980s, Peter and a small team of scientists began deploying drifters in the tropical Pacific Ocean with the support of the Tropical Ocean and Global Atmosphere Program of the World Climate Research Programme and obtained the first accurate record of the near-surface currents in the tropics.

Securing these records was a breakthrough, but Peter also had a vision. In subsequent years, with the continuing support of the US Office of Naval Research, Minerals Management Service, National Oceanic and Atmospheric Administration (NOAA), and National Aeronautics and Space Administration, Peter nurtured and directed several generations of scientists and engineers in perfecting Lagrangian drifter technology and the scientific interpretation of the data collected in several regional experiments. Having demonstrated the success of the Lagrangian approach to observe large-scale, near-surface circulation, Peter was able to gather robust national and international support for establishing a global program. The Drifter Data Center at NOAA's Atlantic Oceanographic and Meteorological Laboratory in Miami, Florida, was created, and mass production of drifters was initiated. The target size of the array was set at 1,250 drifters, based on the requirements for reducing the potential bias of sea surface temperature observations from satellites. By the beginning of the twenty-first century, the Global Drifter Program (Niiler, 2001) was fully established, and accurate global observations of 15 m depth ocean currents and sea surface temperature were routinely obtained. On September 18, 2005, Peter and Mike Johnson of NOAA's Office of Climate Observations deployed drifter number 1,250 from the tall ship *Silva* off Halifax, Nova Scotia—and the global drifter array was complete.

The Global Drifter Program conceived by Peter and his colleagues is now the principal component of the Global Surface Drifting Buoy Array, a branch of NOAA's Global Ocean Observing System and a scientific project of the Data Buoy Cooperation Panel, a joint body of the






Photos collected from Peter Niiler's family, friends, and colleagues reflect a vigorous life.

World Meteorological Organization and the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific, and Cultural Organization. As some colleagues have put it, Peter's ability to communicate enthusiasm, persuade, and encourage, along with his intellectual honesty, fairness, and generosity in sharing ideas and technology, together with his "iron fist within a velvet glove" approach, placed the Global Drifter Program on a very solid foundation.

Peter's relentless activity and political ability succeeded in the difficult task of bringing together representatives from the oceanographic and meteorological communities. By installing barometers on the drifters, he created a very cost-effective network of air pressure sensors that is regarded today as a very important component of the global observing system and is used by all of the most important weather forecast centers worldwide. Drifter observations from the Global Drifter Program have inspired several generations of oceanographers. More than 800 peer-reviewed scientific papers using drifter data have been published to date.

In his later years, Peter expanded the scope of drifter observations to address the complicated interaction between the ocean and tropical cyclones, such as hurricanes and typhoons. Peter died suddenly on October 15, 2010, while an array of his drifters was being released in the Pacific Ocean ahead of typhoons.

Outside of his professional life, Peter's ingenuity and creativity were reflected by his excellence in architecture, painting, drawing, and the culinary arts. Married to choreographer Nancy McCaleb, he was especially fond of contemporary dance.

Peter Niiler's scientific legacy will continue to influence the way oceanographers observe and study the ocean for many years to come. This special issue of *Oceanography* brings together contributions from long-time Niiler collaborators. Some of them were his students or those he served as mentor. Others were colleagues, bonded by a shared curiosity about the ocean. This special issue is a small tribute to a great scientist who still inspires our quest to understand this complex natural environment.

REFERENCES

Niiler, P.P. 1969. On the Ekman divergence in an oceanic jet. *Journal of Geophysical Research* 74(28):7,048–7,052, http://dx.doi.org/10.1029/JC074i028p07048.

Niiler, P.P. 2001. The world ocean surface circulation. Pp. 193–204 in *Ocean Circulation and Climate: Observing and Modelling the Global Ocean*. G. Siedler, J. Church, and J. Gould, eds, International Geophysics Series, vol. *77*, Academic Press.

Ralph, E.A., and P.P. Niiler. 1999. Wind-Driven currents in the tropical Pacific. *Journal of Physical Oceanography* 29:2,121–2,129, http://dx.doi.org/10.1175/1520-0485(1999)029<2121:WDCITT>2.0.CO;2.