

Jim McWilliams (UCLA), June, 16, 2014

I first knew Lien Hua when she came to work with me as a postdoc in the early 1980s at NCAR in Boulder, Colorado. The programmatic excuse was an interpretive analysis of measurements from the POLYMODE Local Dynamics Experiment on mesoscale eddies in the southern flank of the Recirculation Zone in the subtropical North Atlantic. Her primary responsibility was to work with Breck Owens and me to devise a rather elaborate state estimation procedure for the flow fields, buoyancy, and potential vorticity during the experiment --- this type of methodology was then called, somewhat more modestly, objective analysis. The methodological challenge was to be fully 3D and multi-variate in both the input data and estimand fields, relying on the time continuity of the measurements during a two-month period to fill out the unincorporated fourth dimension. The purpose was to assess the dynamical balances in advance of having reliable simulation models for mesoscale eddies. The conclusions, which have stood the test of time, were that the barotropic mode had essentially a linear Rossby wave balance while the baroclinic mode was more advectively controlled and underwent a frontogenetic sharpening event into a local thermocline jet due to the straining deformation by the passing barotropic waves. The general conceptual framework was recent, exploratory studies of homogeneous geostrophic turbulence, with an overall conclusion of observational consistency. A somewhat similar dynamical-balance study was made around that time for Tourbillon measurements by Michel Ahran and Alain Colin de Verdiere.

This state estimation work was done well in advance of the later widespread mania for oceanographic data assimilation --- apart from some anticipatory advocacy by Francis Bretherton and Russ Davis --- and both Lien and I decided, like them, to quit this scientific path while we were ahead.

Her primary passion was fluid dynamics. During this period at NCAR she was involved in a variety of problems of vortex dynamics, geostrophic turbulence, and coherent vortices. Three in particular later became major foci of her own research:

1. The "internal barotropic instability" of mesoscale vortices, i.e., the occurrence of a vortex instability with a vertical scale smaller than that of the parent vortex, even when horizontal Reynolds stress work was the primary energy source. She offered this process as a dynamical interpretation of the Tourbillon experiment.
2. Lagrangian trajectories and isopycnal stirring of tracers in geostrophic turbulence. We wrote a paper together with Patrice Klein in 1998, one of several she wrote on this topic.
3. Submesoscale coherent vortices, e.g., Meddies, which was her primary research interest in her last years, matching detailed simulations of the fine-structure around Meddies to observed geoseismic inversions. Claire Menesguen, who was lent to me as a postdoc by Lien, has now come back to France to carry on in this direction.

Our last paper together was in 2008: a demonstration --- led by Xavier Capet and also with Patrice Klein and Guillaume Lapeyre --- that kinetic energy has only an inverse cascade, apart from viscous effects, in the surface quasigeostrophic model being considered as a relevant to upper-ocean submesoscale frontal turbulence. In these results we each saw what we wanted see: the success of this simple model for explaining the relatively flat wavenumber spectrum

for surface velocity, or its limitations in light of accumulating evidence for explosive frontogenesis and forward energy cascade at the smaller scales in this range.

Lien's aspiration for scientific rigor and insight burned as a steady flame, and this was one of her most admirable qualities. Lien's moods, her periods of discouragement, and her combativeness when challenged were more flickering. Our time together in Colorado was alternatively exhilarating and tempestuous. Once in anger she said to me, "You wouldn't last a day on the streets of Djibouti!" She was right, of course. But in this remark you can see a hint of her remarkable journey, with her family, from Vietnam, to Somalia, to darkest France, with excursions in Colorado, Hawaii, and Japan --- as well as her remarkable successes as an Asian woman in a mostly male Caucasian science.

I was her colleague and friend. I miss her company and greatly regret her unexpectedly early death.