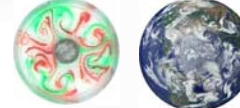


Integrating 'Weather in a Tank' across the curriculum

<http://paoc.mit.edu/labguide>



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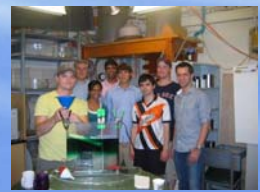
Introduction

We report on the integration of 'Weather in a Tank' rotating fluid laboratory experiments with theory and data into undergraduate and graduate courses at UMass Dartmouth and five partner universities in Spring and Fall 2007.

Integration Across the curriculum

The implementation during the last two semesters includes a general education course in Meteorology, a junior Physics Laboratory course and a fluid dynamics graduate course at UMass Dartmouth, graduate-level GFD and two other undergraduate courses at Penn State University, senior-level dynamics at Millersville University, and undergraduate weather and climate laboratory courses at MIT. More details can be found here:
http://paoc.mit.edu/labguide/assess_courses.html

Dye Stirring



Thermal wind balance and fronts experiment



General Circulation:



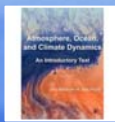
Implementation at Partner Universities

At UMass Dartmouth, four experiments, based on dye stirring, fronts, Ekman circulation, Hadley circulation and baroclinic eddies were implemented as part of senior lab requirement. The portability and ease of use allows the tank system to be integrated in class with very brief preparation. The classroom demonstrations were followed up by students as part of the lab. Concurrent web-based investigations of synoptic and climatological data on thermal wind, geostrophic flow, fronts and Ekman layers connected the phenomenon being observed in the weather tank with the atmosphere. The students designed their own extensions to the experiments, and wrote a comprehensive report at the end of the semester on one of the experiments.

At Penn State and UW Madison, similar demonstrations were implemented in three courses: In graduate course the experiments were conducted first with the instructor in small groups. The students chose, demonstrated and explained one of the experiments to their class.

Similar demonstrations, plus non-rotating convection in a 2-D tank, were conducted by met. majors at Millersville.

Many rotating fluid experiments targeted in the 'Weather in a Tank' project are described in a new undergraduate textbook by Marshall and Plumb:
Atmosphere, Ocean and Climate Dynamics



Student Learning and instructor satisfaction

This implementation made strong connection of the experiments with the synoptic and climatological data.

Despite the variety in background, class size, and level of the students, the instructors noted similarities in enhanced student learning of theoretical concepts, confirmed by formal assessment using pre/post tests by our Education Specialist Kathie Mackin.

Enhancements and student Involvement

The students were challenged at various institutions to come up with extensions or new ideas to demonstrate the concepts they had learned in consultation with the instructors. Two students from UMass Dartmouth used computer cooling fans to demonstrate the Ekman driven divergence and resulting cyclonic flow (see student posters). This idea has been further extended by partnership with MIT to demonstrate wind-driven western boundary current and Sverdrup return flow on a beta-plane. A student at Millersville pursued non-rotating 2-D convection, while two students at NYU pursued demonstration of abyssal flow on a beta plane with a source/sink combination. These new projects have been added to the suite of experiments that can be performed for education and outreach using the portable rotating fluid tank.

Outreach Efforts

The experiments were used at UMass Dartmouth, Johns Hopkins University and MIT for a variety of outreach activities including high school student visits to campus and public lectures.



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Undergrads from UMass Dartmouth, Millersville, NYU and MIT got together for a 2-day meeting in summer 2007 to compare notes on new 'Weather in a Tank' projects.