Not a Paper Chase

Purdue's Severe Storms Field Work Course

Adapted from "Students of Purdue Observing Tornadoic Thunderstorms for Research (SPOTTR)," by Robin L. Tanamachi (Purdue University), Daniel T. Dawson II, and Loran Carleton Parker. Published online in *BAMS*, June 2020. For the full, citable article, see [DOI:10.1175/BAMS-D-19-0025.1](https://doi.org/10.1175/BAMS-D-19-0025.1).

SPOTTR students observe
a decaying supercell near
Spearman, Texas, on
30 May 2018.

A summer course developed at Purdue University leverages students' intrinsic desire to observe tornadoes as a motivator for learning severe storms forecasting. Relative to previous "storm chasing" courses, the Students of Purdue Observing Tornadoic Thunderstorms for Research (SPOTTR) course is enhanced by active learning, career exploration, and research-grade meteorological instrumentation to provide authentic, in-field experiential learning.

The SPOTTR course was first piloted in summer 2016 at the request of six undergraduate students. Three Purdue professors (authors Tanamachi and Dawson, and Michael Baldwin) chose the university's 4-week "Maymester" session in May–June, in the climatological peak for severe weather in the central United States.

SPOTTR (worth one course credit) was originally designed for students to learn current severe weather

forecasting and observation techniques. There are also opportunities to continue to work with collected data. The exposure to career paths came mainly through interactions with meteorologists.

The experiential learning scenario for the course is designed in four stages. First, in *concrete learning*, students record observations of storms in the field. Second, in *reflective thinking*, students keep journals to compare the observed storm to the forecast generated by the group that morning. The students contemplate factors that may have led to imperfections in the forecast, discussing their insights with instructors and spontaneously mentoring with fellow students. Third, in *abstract conceptualization*, students distill insights into “lessons learned” in their journals. Fourth, in *active experimentation*, students update their forecast technique the next day based upon these lessons.

The cycle is then repeated to consolidate the students’ understanding. Severe storms forecasting and observation, which typically occurs in a daily cycle, lends itself naturally to this model.

Students were selected for the SPOTTR course based on an admission questionnaire that assessed their intrinsic motivation to learn severe storms forecasting and field work

▲ *** SPOTTR students and instructors in the field. (a) Instructor Dawson (center, holding balloon) demonstrates radiosonde assembly for students in 2017. (b) Students train on deployment of the UMass LowPower Radar in 2018. (c) Students prepare to launch a radiosonde into the inflow of a tornadic supercell near Beloit, Kansas, in 2019. (d) Deployment of two PIPS in central Colorado in 2019. Photos (a), (c), and (d) are courtesy of Tom Uhlman.**

techniques, and any previous experience they had performing field work. The questions conveyed to prospective students that the course would require active participation and contribution from the students. Most students were primarily motivated to observe a tornado.

After teaching severe weather forecasting skills and deployment techniques for several meteorological instruments (such as a mobile radar, radiosondes, and disdrometers), the instructors guide the students on a one-week field trip to the Great Plains. There, the group executes a miniature field campaign to collect observations in and near supercell thunderstorms. The principal differences between our course and previous ones is the

▲ *** SPOTTR students read brief professional biographies during the career “gallery walk” in 2017. A “gallery walk” asks students to consider and discuss their goals and desired work-life balance. They then view the lineup of biographies, choosing three of the subjects to be panelists in a subsequent video chat where students can interact with them directly.**

* SPOTTR student V. Garcia pauses to write down observations after observing a tornado in Kansas in 2019. Because days on the chase can start to blur together in memory, instructors emphasized that the journals should be updated in near-real time and be as detailed as possible. Students also were instructed to spend a half-hour at the end of each day filling in gaps in the journals. Students also take pictures of the storms, which they annotate by identifying features; the instructors then provide feedback on the annotations.

combination of the high-quality meteorological instrumentation in the framework of a small severe storms field campaign and the active dissemination of the meteorological observations obtained with that equipment to operational and research meteorologists in near-real time.

Each student was expected to master not only handheld measuring devices (Kestral 4000 Pocket Weather Tracker) in the field but also at least one of the larger instruments. In addition to their journals, students logged each deployment. In “chase mode,” instructors solicited students’ input regarding where each instrument should be deployed. Students prepared instruments for data collection, inflating and launching radiosonde balloons, deploying disdrometers, and suggesting sites and scanning strategies for the UMASS portable radar. On days with no targetable severe weather, the participants visited sites deemed beneficial to the students’ professional development.

In the final week of the four-week course, students worked in pairs to perform retrospective case studies of one of the chase days for

* (a) Sean Waugh describes field preparations to the SPOTTR group during their visit to the National Weather Center in 2018. (b) The SPOTTR group, led by the first author (center), had a chance meeting with David Hoadley (left), a well-known storm chaser, in a field northeast of Denver on 27 May 2019 (photo courtesy of Tom Uhlman). (c) The SPOTTR group holds a joint weather briefing with another severe storms forecasting class from Ball State University.

which they had provided the morning briefing. Each pair articulated which aspects of their forecasts were accurate and which were not, what happened that day that had met or defied their expectations, and what they learned about the complexities of severe storms forecasting and intercepts. The final activity is an active exploration of career options in meteorology.

Each iteration of the SPOTTR class has been slightly different, owing to the year-to-year variations in weather, the makeup of each cohort, and lessons learned by the instructors. For example, the weather briefing changed from being instructor led in 2016 to being student led from 2017 on. And student feedback turned the career exploration into a virtual career panel, with instructors connecting the students to potential role models in the career tracks that the students wished to explore more deeply. In surveys, SPOTTR students show improved understanding of severe storms forecasting, technical skills, and careers as a result of the course.

After the 2016 course, some of the undergraduate participants asked to continue working with the instructors, or sought them out for closer mentorship. These mentoring activities included an undergraduate research experience that culminated in a presentation at a professional conference and requests for letters of reference from all three of the instructors by students applying to graduate school and for employment.

Based on pre- and postcourse surveys of the 18 students from SPOTTR 2017–19, we determined that the course is effective for improving both self-reported skills and objectively evaluated knowledge. Students reported substantial (medium to large) gains in skills related to severe weather forecasting, deploying meteorological instruments safely in severe weather, and logging deployments. They reported substantial (again, medium to large) gains in confidence in understanding research procedures, expanded awareness of available career paths, and an increased desire to pursue graduate education. The SPOTTR course has helped students envision themselves as potential future graduate students, researchers, and/or forecasters. Perhaps the most remarkable aspect of these gains is that they occur over only four weeks.

We envision offering an expanded version of SPOTTR as a spring–summer–fall sequence of three courses aimed at providing a more complete research experience. The first (spring) course will focus on developing working hypotheses and designing experiments related to severe weather, the second (field work) will apply those experiment designs in the field, and the third (fall course) will consist of data analysis and preparation of conference presentations. The summer SPOTTR course will thereby serve as the linchpin in a directed course sequence, providing focused professional preparation to atmospheric science students hoping to enter graduate school and pursue research-oriented careers. ●●

≡ METADATA

BAMS: What would you like readers to learn from this article?

Robin Tanamachi (Purdue University): *I hope other atmospheric science professors will come away with ideas for how they can seamlessly incorporate undergraduates into field work. It's a win-win: students gain valuable field experience, skills, knowledge, and confidence; PIs gain a motivated workforce excited to go into the field and help out with real research.*

BAMS: How did you become interested in educational field projects?

RT: *Purdue University currently doesn't have a very large footprint in severe storms research, and the students were practically begging for a course like this to be created. Owing to the expense and logistical complexity associated with bringing undergraduates into the field, I had to justify the cost of this one-week excursion, and show that it was actually creating significant benefits for the students. I looked to my colleagues in geology and educational research for evidence-based methods to maximize the educational impacts of the field trip.*

BAMS: What surprises/surprised you the most about the SPOTTR?

RT: *The biggest surprise was that the students accrued such large educational and aspirational benefits from participating field work over a course that was just four weeks long. This course is labor-intensive for both the instructors and the students, and it was gratifying to see that the payoff was large relative to the time investment.*

BAMS: What was the biggest challenge you encountered while evaluating this effect?

RT: *I was not trained in education research. I had the good fortune to collaborate with Loran Carleton Parker, who helped design the survey and introduced me to relevant literature on which I could draw during the formulation of the study.*

BAMS: What's next?

RT: *One aspect of follow-up is a longitudinal study. Do the benefits of participating in SPOTTR last? We have snapshots of the students at the beginning and end of the course. But what about a year later? Do they still feel confident about the knowledge and skills that they gained during SPOTTR?*