Students of Purdue Observing Tornadic Thunderstorms for Research (SPOTTR): A Severe Storms Field Work Course at Purdue University

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1. Motivation

At Purdue University, atmospheric science undergraduate and graduate students in the Earth, Atmospheric, and Planetary Sciences (EAPS) department have consistently expressed a strong interest in working closely with professors on research projects involving severe storms. Leveraging this desire to enhance student learning of atmospheric science, a four-week summer "**severe storms field work**" course was created within Purdue EAPS in 2016. The primary objectives of the **Students of Purdue Observing Tornadic Thunderstorms for Research (SPOTTR) course** were:

- For students to ***learn*** current severe weather forecasting and observation techniques;
- For students to ***experience*** an authentic atmospheric science field program, using research-grade observing instruments, and to continue to work with these data if they chose to do so;
- To ***expose*** students to diverse career paths in severe storms research and forecasting;
- To ***enhance*** their learning of severe storms forecasting and research through reflective journaling and other active learning exercises.

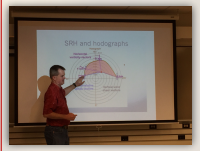
The approach of taking atmospheric science students on an extended field excursion to Tornado Alley to forecast and observe severe storms is not new (Godfrey et al. 2011; Barrett and Woods 2012). In a typical course participants (6-20 students and two or more instructors) travel to Tornado Alley in one or more large passenger vehicles, each containing at least one experienced instructor, who guides the students in the field as they select a target storm to intercept and observe safely. **The principal differences between our course and previous ones are (1) integration of a suite of research-grade meteorological instrumentation, (2) a reflective journaling active learning exercise conducted at the end of each day, and (3) the inclusion of career awareness activities such as a career "gallery walk."**

2. Course design / schedule

We rooted SPOTTR course field activities in the four-phase experiential learning cycle (ELC) model (Kolb 1984). Severe storms forecasting and observation, which typically occurs in a daily cycle, lends itself naturally to this model (Fig. 1). By repeating this cycle over several consecutive days of the trip, it was hoped that an experiential learning "spiral" would be established that would enhance the students' learning of severe weather forecasting.

Purdue's SPOTTR course was taught by three of the authors (Baldwin, Dawson, and Tanamachi) in 2016 and two of the authors (Dawson and Tanamachi) in 2017. Because of budgetary and transportation constraints, the SPOTTR course was limited to eight students in both years. During the four-week course, students completed **storm spotter training** (Moller 1978), which was administered in person by a National Weather Service employee, learned the **ingredients-based method of severe weather forecasting** (Johns and Doswell 1992) and **polarimetric radar interpretation**, and were **oriented to each of the meteorological instruments** to be used. A seven-day nomadic field trip to the Great Plains region followed, with each day following a schedule adapted from past field programs (table at right). Students were asked to keep a detailed **daily journal** (or log) of each day's activities. Instructors live-tweeted meteorological observations (Fig. 2). Upon returning to Purdue, students presented a **retrospective case study** of one of the days of the field trip.

Weeks 1 & 2: Preparation



Classroom instruction

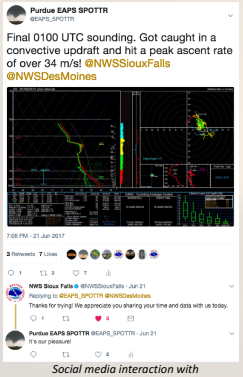
Instrument orientation

Storm spotter training

Week 4: Wrap-up

Retrospective case studies

Career "gallery walk"



Social media interaction with NWS & other researchers

Preconvective environmental sounding launch

Week 3: Field work

Visiting the National Weather Center

Time (local)	Activity
9:00 a.m. – 10:00 a.m.	Student-led weather briefing
10:00 a.m. – 2:00 p.m.	Drive to target area
2:00 – 4:00 p.m.	Preconvective observations: • Soundings • Surface observations with handheld weather meters
4:00 – 6:00 p.m.	Observations of convective initiation: • Soundings • Radar observations over volumes spanning convective tower depth • Surface observations with handheld weather meters
6:00 – local sunset	Observations of deep convective storms: • Soundings • Drop size distribution measurements with disdrometers • Storm-scale radar observations over volumes spanning storm depth (up to 12 km AGL) • SWIR imaging of convective thunderstorm cloud bases (2016 only) • Surface observations with handheld weather meters
After sunset	Adjourn to hotel, complete logs / journals

Tornado near Woodward, OK on 23 May 2016

Tornado observation with mobile radar

Daily weather briefing

Formal and informal mentoring

Fig. 1. Adapted conceptual diagram of the Kolb (1984) experiential learning cycle, showing which daily SPOTTR activities are associated with each phase.

3. Lessons Learned / Future Plans

The 2016 SPOTTR course provided valuable insights that led to course redesign and more formal assessment of the 2017 course. The 2017 SPOTTR students were given **two questionnaires**, one at the beginning and one at the end of the course, that were designed to assess changes in their knowledge levels, confidence in field work techniques, and career aspirations. With the caveat that these results are anecdotal because of the small class size (five students), we offer tentative conclusions and future plans below:

- **Continue using research-grade meteorological instrumentation.** All five students either strongly agreed or agreed with the statement, "The use of research-grade equipment enhanced my research experience," and also indicated that the field work had contributed either "a good amount" or "a great deal" to their SPOTTR experience.
- **Allow two weeks for instruction prior to field work.** During the 2017 course, scheduling constraints forced the class to take their field trip during Week 2 rather than Week 3. Students felt that this compressed timeline was detrimental to their understanding and retention of the information presented. Nonetheless, four of the five students reported that their severe weather forecasting skills had improved at the conclusion of the 2017 SPOTTR course. In the future, we plan to implement more objective assessment of change in severe weather forecasting skill.
- **Continue to incorporate professional site visits and career awareness activities.** All five students indicated that visits to sites like the NWC and SWIRLL had contributed either "a good amount" or "a great deal" to their SPOTTR experience. Four of the five students indicated that course the had improved their awareness of career opportunities available to them, as well as career tracks that they could specialize in. Students asked for additional information, e.g., salary for the various career tracks, that will be obtained and conveyed in future versions.
- **Retain reflective journaling exercises**. All of the students indicated that keeping a daily journal (or log) of the day's events was a beneficial activity. Four out of five students either agreed or strongly agreed with the statement, "My SPOTTR journal helped me clarify my thoughts about my experience." In written responses, students reported that journaling helped them remember details, organize their thinking, and connect principles learned in the classroom to the severe weather forecasting and scenarios that they encountered. In addition, three of the five students reported an increase in their skill at keeping a daily journal as a result of the SPOTTR course.

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