7.3 Operational Meteorology: A Viable Complement to a Traditional Meteorology Degree Program

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1. Introduction

Undergraduate meteorology programs have been producing graduates at numbers that are outpacing the job market. Knox (2008) estimated, based on 2006 data, there were only 285 entry level meteorology positions available in the U.S. on an annual basis (private sector plus civil and military government), while there were an estimated 567 annual meteorology bachelor degree recipients. To combat this over supply, Knox (2008) identified, as a possible response, for meteorology programs to break from the civil service requirements and tailor majors to other modes of employment. The B.S. in Operational Meteorology (OMET) program at Embry-Riddle Aeronautical University (ERAU) in Daytona Beach attempts to do exactly that--provide a program for students with a passion for meteorology that opens opportunities in non-traditional career fields where the proper *use* of weather information has a significant impact on operations. The OMET degree is offered as a complement to the traditional meteorology program, not a replacement. This paper discusses the goals and curriculum of the OMET program as well as the supporting coursework that makes the program viable. Finally, the paper presents some unique opportunities afforded by the dual degree structure.

2. History of OMET Degree

The OMET degree program grew out of the Applied Meteorology (AMET) program created in 2001. The AMET program included five areas of concentration, two of which were fully calculus based (Research and Computer Applications), and three areas of concentration with limited calculus (Media, Flight, and Commercial). Having areas of concentration with different levels of math requirements presented several challenges for students and potential employers. Students were often confused with the opportunities and limitations afforded by the areas of concentration, while potential employers were uncertain of the skill sets offered by the graduates. For these reasons, the areas of concentration were split into two separate degrees starting in August 2014. The calculus-based areas were combined into a B.S. Meteorology program, while the remaining areas of concentration were combined into the B.S. OMET. The split allowed further tailoring and development of the programs to better support a variety of student career goals.

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3. Goals of OMET Degree

Following the "Provider-User Relationship (PUR)" portion of the weather forecasting business process model proposed by Lanicci (2012), the primary goal of the OMET degree program is to produce expert "users" of weather information. These users are operational experts who not only understand weather products, but who can communicate the associated impacts on specified sectors (*e.g.,* aviation, transportation, agriculture, emergency management). Figure 1 shows the PUR model as adapted from Lanicci (2012). Areas circled in red would be roles performed by traditional meteorologists while those circled in blue could be roles performed by OMET graduates. Because ERAU has historically been focused on the aviation and aerospace science sectors, the ERAU OMET program's primary niche is preparing graduates for aviation-related careers, such as airline dispatching, professional pilot, flight coordination and air traffic control, where the proper use and understanding of weather information promotes safe operations.

In addition to the aviation, a second area of specialization is broadcast media. While, the OMET program gives students the option of pursing broadcasting careers, these graduates would not be eligible for the American Meteorological Society (AMS) Certified Broadcast Meteorologist (CBM) designation. Students desiring to become CBMs still have the option of majoring in meteorology and taking broadcasting and communications courses as electives.

An equally important goal of the OMET program is to reduce competition for scarce meteorology jobs by providing viable alternatives through careers that make significant use of meteorological information. Since the OMET program is *not* designed to meet AMS guidelines for a degree in meteorology, the OMET graduates would not compete for jobs with students completing a more traditional degree in meteorology. It should be noted; however, that while the OMET graduates do not meet AMS or Federal guidelines for a meteorologist, they do meet GS-1341 requirements for a Meteorological Technician.

As mentioned earlier, the OMET degree complements the traditional meteorology program, which does meet American Meteorological Society (AMS) guidelines, World Meteorological Organization (WMO) guidelines, US Air Force guidelines, and U.S. Government GS-1340 series (Meteorologist) requirements. Again using the PUR terms of Lanicci's (2012) business process model, the graduates of the traditional meteorology would be considered expert "providers" of meteorological information. Figure 2 graphically illustrates the difference between the two programs. The meteorology majors are located in the center and comprise the core of expert "providers" of meteorological information. Within the outer ring are operations critically dependent on weather information, which could include, for example, broad operational areas such as commercial aviation. The OMET majors lie in the transition region between two with sample careers listed that could potentially benefit from these graduates. These are careers where the proper use and interpretation of weather products are critical to safe operations, but the user need not be a traditionally educated meteorologist. The OMET graduates would therefore work in careers that require close interaction with both the meteorologists as well as the operations experts. They would require a fundamental understanding of meteorology at the applications level as well as a thorough understanding of the operations and the weather impacts on the operations. Notice broadcast meteorology lies between Meteorology and Operational Meteorology. Clearly CBMs would be in the center as expert providers, while OMET graduates would lie more in the spectrum of expert users.

4. OMET Curriculum

The OMET curriculum differs from the traditional meteorology degree program in two fundamental ways. First, the OMET program is significantly more interdisciplinary, and second, the program is less rigorous mathematically.

Interdisciplinary aspects are introduced through the requirement of an approved minor combined with a capstone experience that integrates operations with meteorological support. Currently, common minors include Aeronautical Science, Flight, Air Traffic Management, Communications, and Aviation Business Administration. Students also have the opportunity to obtain their FAA Airline Dispatch Certification through proper selection of a minor and open electives. These are currently some of the major target careers for the OMET program. One other career currently being examined for possible interdisciplinary opportunities is emergency management operations.

For math and physical science courses, students are required to take two semesters of mathematics (college algebra through basic integral calculus), one semester of elementary statistics, two semesters of technical physics, one semester of basic chemistry, and one semester of geoscience (physical geography, hydrology, oceanography). Meteorological coursework includes courses in introductory meteorology, climatology, instrumentation, aviation meteorology, thermodynamics, atmospheric physics, basic dynamics, analysis and forecasting (four semesters), and a capstone course, all of which focus on operational applications. These courses

are detailed in Table 1. The bolded courses in Table 1 are courses shared by both meteorology and OMET, while the asterisked courses are those heavily populated with students from the meteorology minor. With over 200 meteorology minors, the asterisked courses can be offered more frequently and with enrollment numbers far higher than if they were only supported by the majors alone.

Table 1. Required Operational Meteorology Courses

Course Name	Credit Hours
Meteorology Careers*	**1**
Survey of Meteorology*	**3**
Aviation Weather*	**3**
Introduction to Geoscience	**3**
Weather Information Systems (Instrumentation)*	**3**
Applied Climatology*	**3**
Satellite and Radar Weather Interpretation*	**3**
Operational Thermodynamic Meteorology	3
Operational Physical Meteorology	3
Operational Dynamic Meteorology	3
Synoptic Analysis and Forecasting*	3
Advanced Operational Forecasting	3
Thunderstorms*	3
Climate Change (Advanced Climatology)	3
Operational Capstone	3

*Courses heavily enrolled by the minor. Bolded courses are required by both OMET and Meteorology degree programs.

One frequently asked question is how classes such as thermodynamics, physical meteorology and dynamics can be taught without the full suite of calculus courses? The answer is these classes are taught primarily from an operational applications perspective; therefore, the derivation of fundamental equations from first principles is not the primary focus of any course in the OMET program. This is not to say the courses are not analytical or quantitative in nature. Students are asked to perform a variety of calculations allowing them to explore and quantify various meteorological relationships using primarily finite difference methods with some basic calculus. The textbook used for both the thermodynamics and dynamics courses is Stull's (2000) *Meteorology for Scientists and Engineers, 2ed.*

5. Key Support Coursework

Two key aspects of the Operational Meteorology degree program are the "Weather Careers" course and the Federal Aviation Administration (FAA) approved Dispatcher Certification courses.

The Weather Careers course was designed to ensure students understand the different opportunities and limitations of both the OMET and meteorology degree programs. This one-credit seminar course, which is required of all incoming freshman in either degree program, discusses a variety of career opportunities and their requirements through special guest speakers and discussion sessions. The course culminates with students preparing a four year academic plan for their specific academic goals.

The second key area of support coursework is the FAA Dispatcher Certification coursework. These are aviation-related courses offered through the university, which have been approved by the FAA as meeting dispatcher certification requirements. The coursework, typically taken in partial fulfillment of the minor, includes subjects in pilot operations, navigation, air traffic control, aerodynamics, and meteorology. Once the required courses are completed, students are eligible to take the FAA written and practical exams to become certified aircraft dispatchers. Having this certification opens doors to careers in flight dispatching, fight coordination, and flight scheduling with a variety of airlines and other aviation companies.

6. Future Opportunities

The combination of traditional and operational meteorology programs also provides unique opportunities to exploit existing as well as develop potential new PUR relationships. One such opportunity was an experimental course on air race weather support. The course involved developing and providing weather support to the university's air race team in the Women's Air Race Classic. The course brought together students majoring in aeronautical science, air traffic management, meteorology and operational meteorology. In the initial stages of the course students examined the necessary roles required to provide support ranging from pilot operations to flight planning. Students learned from the instructor and each other to provide effective

weather support by investigating all aspects of the flight, including: aircraft limitations, airspace considerations, existing weather products, and potential new weather products. The course culminated with all students working together to provide operational weather support to ERAU's team competing in the Women's Air Race Classic.

Other potential areas being investigated for new PUR relationships are aviation-related weather web broadcasts and emergency management operations.

7. Summary and Conclusions

ERAU has developed an OMET degree program designed to support careers where the proper use of meteorological information is critical to operations. Given ERAU's long history with the aviation industry, one natural direction was for ERAU to focus on supporting careers within the aviation transportation sector, such as airline dispatching and flight coordination. Other schools with other specializations may be may be able to benefit from similar niche areas.

In addition, ERAU has also worked to support the broadcast industry; although, ERAU students desiring to support the broadcast industry have the option of pursuing either a traditional meteorology degree or the OMET degree. The obvious advantage of the traditional meteorology degree is the ability to obtain the AMS broadcast certification.

The OMET program clearly breaks away from AMS and federal guidelines for a meteorology degree. Because of this, these graduates are not in direct competition for jobs with traditional meteorology graduates. The goal is to improve career opportunities for those students with a strong passion for meteorology but perhaps less math aptitude.

8. References

Knox, J.A., 2008: Recent and Future Trends in U.S. Undergraduate Meteorology Enrollments, Degree Recipients, and Employment Opportunities. . Bull. Amer. Meteor. Soc., 89, 873-883.

Lanicci, J.M., 2012: Using a Business Process Model as a Central Organizing Construct for an Undergraduate Weather Forecasting Course. Bull. Amer. Meteor. Soc., 93, 697-709.

Stull, Roland B., 2000: *Meteorology for Scientists and Engineers, 2Ed*., Brooks/Cole, 502pp.

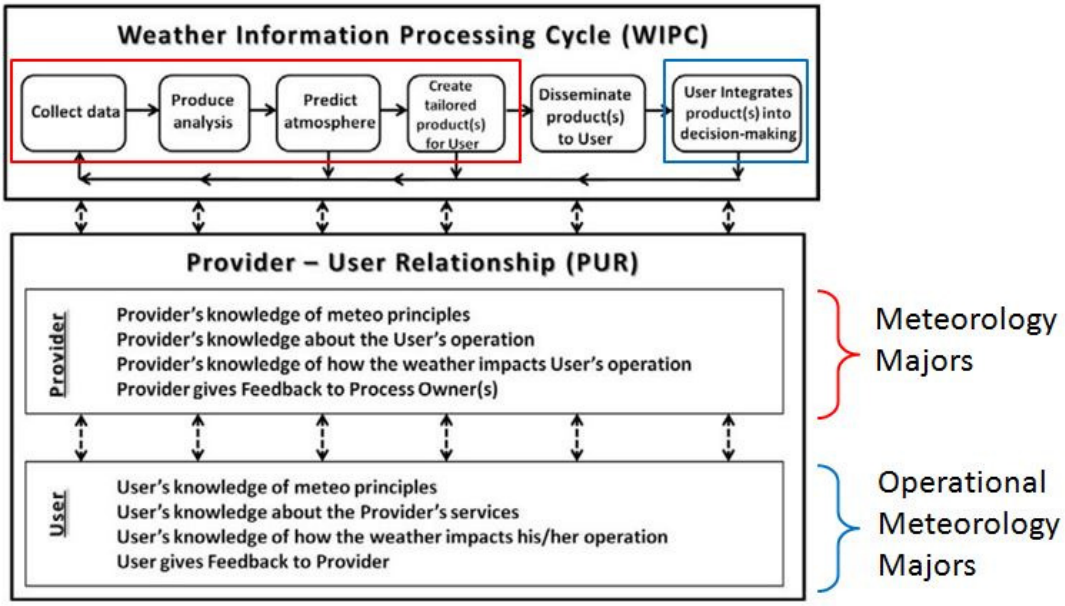

Figure 1. Provider-User Relationship adapted from Lanicci (2012). Traditional meteorology majors are expert weather information "providers" directly supporting the collect, analyze predict and tailor portions of the Weather Information Processing Cycle. Operational Meteorology majors are expert weather information "users" who integrate meteorology products into the decision-making process of their specific operation.

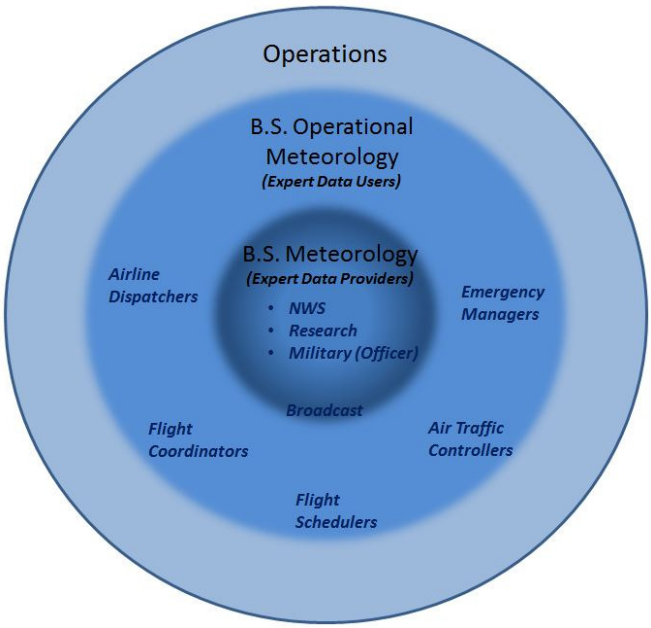

Figure 2. Graphical representation of the continuum between traditional meteorology majors and the operations they support. Operational meteorology majors would support careers outside of traditional meteorology but where the proper use and interpretation of weather information remains critical to the success of the operation. Sample careers of each are shown.