**NON-METEOROLOGICAL SUBJECT AREAS AND COURSEWORK TO PREPARE STUDENTS FOR EMPLOYMENT IN THE PRIVATE SECTOR**

Presented by the AMS Financial Weather/Climate Risk Management Committee and the

Board of Private Sector Meteorologists

In 2019, the Financial Weather/Climate Risk Management(FinWxRisk) Committee and the Board of Private Sector Meteorologists(BPSM) has created a mission to build tangible links between the weather/climate community and the broad community of business and government decision-makers whose financial performances are affected by weather/climate risk. This effort will focus on developing human capital that maximizes enterprise value across the economy.

Students and universities form the basis from which human capital is developed and prepared to influence financial decisions and the broader marketplace. The FinWxRisk team and BPSM will link the most relevant and practical intelligence from industry and government to the academic sector. This is an educative effort to spark interest, bring awareness, and encourage further academic exploration of the financial weather risk sector. We will not only reach students, but also encourage meteorology programs to incorporate relevant curriculum and coursework that will most effectively prepare students for post-graduation opportunities. Our desired outcome is to increase the quality and quantity of students with domain expertise in managing weather/climate risk.

These domain experts will then embed themselves in enterprises across the breadth of sectors that apply meteorological expertise to manage financial risk. Industries include energy, insurance, weather data/forecasting, commodities trading, supply chain management, and others. These industries increasingly rely on meteorological expertise but often leverage this expertise in professional positions called “Energy Analyst”, “Insurance Analyst”, “Supply Chain Analyst”, “Transportation Manager”, “Manufacturing Coordinator”, “Business Continuity Analyst”, “Quantitative Researcher”, “Data Scientist”, “Crop Analyst”, “Flight Dispatcher”, “Commodity Trader”, and others.

This document, created by the FinWxRisk committee and BPSM, proposes supplemental coursework aimed to enhance the skillset for undergraduates seeking specific non-traditional roles. The subject areas listed below can be viewed as common non-meteorological industries where meteorology graduates find employment. The courses listed beneath each subject area can complement the standard offerings of the meteorology curriculum. At most universities, the courses would be offered outside of the meteorology or atmospheric science department. The FinWxRisk committee and BPSM recommends these courses for any students considering one of these unconventional career paths.

**Sections Page**

**I General..................................................................................................................................3**

**II Finance..............................................................................................................................3-4**

**III Insurance..........................................................................................................................4-6**

**IV Energy..............................................................................................................................7-8**

**V Supply Chain....................................................................................................................8-11**

**VI Agriculture...................................................................................................................11-13**

**VII Advanced Computing and Modeling...........................................................................13-14**

**VIII Marine.......................................................................................................................14-16**

**IX Aviation.......................................................................................................................16-17**

**I General:**

1) Oral and written communications:

Description: The best science, project plan or presentation, or research results will fail if it is not effectively communicated. Whether it’s communicating to business colleagues, clients, students or companies, information must be shared to the knowledge level of your audience. In any future role, odds are that it will require frequent client and colleague interaction. The skill of translating complex knowledge into simple terms will be necessary for success.

2) Networking:

Description: For better or worse, many opportunities in the private sector for employment are shared by word of mouth rather than job boards and postings. Building your network as early as possible, coupled with a passion for what you look to achieve with your education and eventual career, will aid a smooth transition in your next career steps. Networking is key.

**II Finance:**

Global financial markets are exposed to weather and climate. This is because the value of an enterprise can be linked directly to weather conditions. Weather-sensitive sectors like energy, agriculture, and water services, amongst others, are particularly susceptible to variable weather. For example:

* The cost of a loan to finance the construction of a wind farm is impacted by the amount of wind resource that is available to generate revenue and repay debt.
* The value of shares of an agribusiness can fluctuate based upon the most recent crop yields.
* The revenue of a water utility, and the billing rates charged to water customers, can vary based upon the likelihood of drought and associated water shortages.
* The creditworthiness of a government whose economy is weather dependent can be linked to the performance and growth of natural resource sectors like agriculture and forestry.

Individuals that possess knowledge and skills in atmospheric and data sciences and a strong interest in finance and risk management should strongly consider applying to analytical, marketing, management, and other roles within such weather sensitive sectors. These individuals are well poised to quantify the dollar impact of weather to enhance financial risk analyses.

Suggested Courses:

1) Financial Risk Management

Description: All major firms engage in financial risk management. Learn the basics of how firms can use financial instruments to manage their financial risks which include threats to financial viability from the weather. Specific topics: structure and pricing of options, the theory of arbitrage, financial statistics and the use of options to hedge financial risk, creation and use of VaR models.

**III Insurance:**

Think about it! Almost every property insurance company is a weather company. Their biggest risk is likely extreme weather and catastrophes, and all insurance companies are regulated to manage this risk to avoid going insolvent. Because of these requirements, insurance companies need to employ or use services that help them understand weather risks. This opens up the door across many of the atmospheric perils: Hurricanes, Floods, Severe Thunderstorm, Winter Weather, and Wildfires. The goal is to understand the probabilities of occurrence at many different return periods and if there is a change in these probabilities. Climate change and resiliency are also finding their places across the insurance industry. The industry is asking complex questions of weather and climate risks, and the answer depends on the temporal and spatial scales over which one is concerned, the entities of interest, criteria, and the desired level of certainty. Many of these answers are provided by performing research on scenarios and assessing the potential risk so insurance companies can have a better idea of the likely scenarios of loss and help dramatically alter the risk management landscape. This risk management need spreads across primary insurance companies, reinsurance companies and retrocessionaires and across the globe. Not only does the insurance industry need to understand the overall risk, insurance is one of the tools to help get society back to normal. Because of this, there is a whole subfield within the insurance industry which can also use weather expertise around the catastrophe response and the claims process within the insurance industry. Outside of understanding weather and climatology, these types of positions in the insurance industry could also require the knowledge of data science, inclusive of coding in statistical languages (SQL, R, Python), data visualization, geospatial technologies and data synthesis/business intelligence platforms are increasingly valuable skills to have.

Suggested Courses:

1) SQL 101

Description: SQL is utilized across several industries to manage databases, query information, build solutions, etc. Insurance companies use SQL heavily in their policy management systems, actuarial systems, and cat modeling systems. Experience utilizing this language will help prospective employees in everyday work tasks. (R, Python, and Matlab are other useful programming languages used in the industry)

2) Introduction to Insurance/Reinsurance

Description: Many people do not understand insurance and stumble into the industry needing to learn on the fly. Learning the basics of insurance can provide a head start when pursuing a career in the industry while also offering a personal advantage when purchasing insurance. Ideally, this course would cover rudimentary material necessary to work in the industry and would answer the following questions: What is the purpose of insurance and why is it needed? What are the different types of insurance? Why do reinsurance companies exist? What other forms of risk transfer exist? An excellent resource for students and professionals to learn more about the (re)insurance industry can be found at <https://www.theinstitutes.org/>. In particular, the Associate in Reinsurance (<https://www.theinstitutes.org/program/associate-reinsurance-are>) covers both primary and reinsurance.

3) Natural Hazards & Catastrophes

Description: Insurance companies are exposed to many environmental risks and are concerned with events that could generate large losses or even lead to bankruptcy / insolvency. Accordingly, many insurance companies desire individuals with an advanced understanding of geological, hydrological, and meteorological disasters.

4) Introduction to Statistics

Description: A wide variety of statistical methods are used in the insurance industry. This course will provide a foundation for understanding how to display, describe, and interpret data. Preferably, this course would give students a background on regression and probability, statistical inference, confidence intervals, hypothesis tests, types of distributions around data and curves, and return period calculation.

5) GIS (ArcGIS or QGIS focused)

Description: Geographical Information Systems (GIS) are defined as a collection of computer hardware, software, geographic data and highly trained individuals functioning together to input, store, manipulate, query, analyze and display geographic data. ArcGIS and QGIS are standard GIS software packages used in the insurance industry. Any course that introduces these software packages will give students an extremely relevant skills desired by most employers. The course should emphasize practical applications of GIS and the underlying GIS theory to improve spatial data analysis and decision making.

6) Public Speaking / Writing

Description: Strong verbal and written communication skills are critical to connect the science to the business. Being able to effectively communicate and express complex Earth science and catastrophe modeling concepts in a way that can be understood by a wide range of insurance and reinsurance practitioners is important. Most professionals in the insurance industry do not have a background in Earth science, but rely on data and information that has a strong Earth science component. Therefore, it is key that a professional working in this industry be able to effectively communicate. While these courses are generally required in any academic program, students should take advantage of opportunities that would allow them to present / publicly speak in front of an audience.

7) Project Management / Business-related courses

Description: Being able to efficiently manage time is critical. Often times there are numerous projects ongoing that requires strong multi-tasking abilities in order to meet deadlines and keep the workflow in a positive direction. Insurance is a complex system with many moving parts, therefore it is important that interruptions be minimized. College in general teaches one to be effective at managing their time, but taking a business-related course that focuses on project management or operations can help the prospective student have a head start when entering / transitioning into the business world.

**IV Energy:**

Weather is one of the most influential drivers of both supply and demand on our nation's energy grid. From the summer heat waves across Texas to the punches of Arctic air across the Upper Midwest and Northeast in the winter, the weather is constantly impacting the price of power and natural gas as it is delivered to customers. With the footprint of renewable energy sources growing rapidly, a formal understanding of our nation's weather is becoming increasingly crucial for companies ranging from energy trading shops, large scale energy distributors with numerous types of power plants, and wind turbine and solar panel manufacturers/operators. Hydrological impacts can also play a critical part of energy generation, either as the cooling fluid for some thermal power generation units or as the engine for hydropower generation. Overall, weather and climate are one of the most fundamental determinants in energy operations.

This knowledge can help answer many questions such as:

* What the cost of energy will be in the coming hours and days in certain areas of the country
* Where is the best location for a solar or wind farm to maximize generation
* How much energy will the customers of a large or small scale distributor demand in the coming hours and days
* How the power grid will be impacted after a disaster such severe weather or hurricanes
* What is the probability of occurrence of certain weather features in a given area like days over 90°F or inches of rain for a certain time period

To varying degrees, the answers to all these questions involve an understanding of weather.

The combination of atmospheric and data science skills would prepare an individual very well for roles in the energy sector such as meteorologist, pricing or energy analyst, and risk portfolio manager.

Suggested Courses:

1) Introduction to statistics and data analytics through Python, R, SQL, and Excel

Description: The ubiquity of data in today’s world has changed the landscape of skill sets needed across industry, and energy is no exception. Basic programming skills in an object oriented language such as Python or R is essential in today’s energy industry. As a meteorologist, analyst, risk manager, or any other role that an atmospheric science major can work in, dealing with data is a daily task. Being able to create basic visualizations, simple probabilities, statistical models, and time series analysis will greatly enhance one’s skill set needed in today’s energy industry. Energy markets never close and require hourly monitoring. This course type will expose students to statistical analysis and forecasting approaches for the massive amounts of data available in the industry. Additionally, courses like these will help one gain the skills to explore daily and seasonal trends in energy prices, as well as other important grid components such as generation, demand, and outages. Another important note here is that data dissemination is an important mode of communication along with written and verbal.

2) Introduction to Economics/Finance

Description: The energy industry fundamentally revolves around the basics of economics: supply and demand. As stated above, the largest factor in energy demand is weather which gives great importance to weather related roles/personnel in the industry. However, supply constraints are also largely weather driven with severe weather and tropical impacts. Energy pricing, contracts, and business decisions all revolve around the basics of finance and economics so having basic knowledge of these disciplines upon entering the industry will greatly enhance one’s efficacy in an energy related role.

3) Public Speaking and Writing

Description: Strong verbal and written communication skills are critical to connect the science of meteorology to the energy industry. As an individual with an atmospheric science background in the industry, one will bring a unique, but essential skill set to an employer. Proper dissemination of more complex weather and climate information is an absolute must across the industry. Doing so both verbally and written will be a daily task that needs to be completed in a timely and effective manner. Dissmentating weather and climate risks can be done both probabilistically (preferred) and deterministically with the common language of statistics bridging most co-workers across the industry. An individual with strong meteorology and statistics skills will be rather ineffective without good verbal and written communication skills. Thus, public speaking and english/writing courses are a must for all science undergraduate students.

4) Introduction to Electricity Markets (if available)

Description: Fundamental understanding of the power generation stack and how different forms of energy that vary in price are utilized to meet the ever changing level of demand across the power grid is necessary for students entering the field. This course will help build familiarity with the impact that renewable forms of energy have on the efficiency of the power grid and energy prices.

**V Supply Chain:**

Weather was once considered an uncontrollable force in the supply chain. In the past, private companies haven’t done much to deal with threats; they were simply a cost of doing business. For example, a national retail chain with more than 4,000 locations printed a map and drew dots to represent stores and facilities. They then overlaid a transparency of a forecasted hurricane track. This is how a billion-dollar-a-year business tried to understand the potential impact of a threat. Meanwhile, transportation professionals have traditionally looked at radar on weather websites and attempt to mentally match it against their shipping network.

Within the last decade, however, weather has increasingly become a risk management priority. A recent study by the American Productivity and Quality Center revealed that the most common causes of unexpected supply disruption during the last two years were natural disasters. As a result, supply chains are becoming proactive in addressing weather-related threats. Manufacturers and transportation/logistics companies see this as an opportunity to improve customer relationships and mitigate risk of losses. Analysis techniques and tools are becoming integrated with enterprise resource planning systems and transportation management systems. Supply chain situation rooms and control towers are becoming commonplace where shippers, carriers and customers can assess weather impact by event type, lane, or even product SKU.

Supply Chain managers increasingly incorporate more sophisticated technology and analytic techniques to support decision-making from point of origin to final destination and all points in between. Systems provide a consistent, real-time measurement of risk incorporating multiple data inputs including geocoded networks and real-time location for goods across each company’s total supply chain; environmental data; other hazards such as transportation outages, health pandemics, crime, etc.

Students studying weather/climate with an emphasis in supply-chain management should become aware of short- and long-term precautionary measures to mitigate the weather’s impact as well as the methods and systems that are commonly used. Examples include: creating continuity plans, understanding transportation management systems, understanding enterprise resource planning systems, understanding customer relationship management systems, understanding stock on essential materials, ensuring operations/communication during power outages, diversifying the company’s total supply-chain network, establishing long-term partnerships with suppliers and logistics providers.

Suggested Courses:

1) Introduction to Business Logistics

Description: This course will take a systems approach to managing activities associated with traffic, transportation, inventory management, warehousing, packaging, order processing and materials handling.

2) Domestic and International Transportation Management

Description: An overview of the principles and practices of transportation and its role in the distribution process. This course will place emphasis on the physical transportation systems involved in the United States as well as on global distribution systems. Topics include carrier responsibilities and services, freight classifications, rates, tariffs, and public policy and regulations. Also includes logistical geography and the development of skills to solve logistical transportation problems and issues.

3) Warehouse and Distribution Center Management

Description: A course focused on physical distribution and total supply chain management, including warehouse operations management, hardware and software operations, bar codes, organizational effectiveness, just-in-time, and continuous replenishment.

4) Global Supply Chain Management

Description: This course will build an understanding of international purchasing or sourcing, including the advantages and the barriers of purchasing internationally, global sourcing, procurement technology, and purchasing processes. The course highlights issues of contract administration, location, and evaluation of foreign suppliers, total cost approach, exchange fluctuations, customs procedures, and related topics.

5) Operations Management

Description: Examines positioning, design and operating decisions and their interrelationships in the context of the overall competitive strategy of the firm. The international dimensions of operations management, as well as the relationships of operations management to other functional areas are stressed. Topics include operations strategy, quality management, product and service design, process design, capacity planning, facilities layout, design of work systems, location planning, total quality control, aggregate planning, independent demand inventory system, push and pull systems, enterprise resources planning, supply chain management, and scheduling.

6) Logistics & Analysis

Description: Logistics is the mathematics of managing goods along a supply chain. The complexity of logistics can be modeled, analyzed, visualized and optimized with a variety of mathematical techniques and software programs. This course provides you with fundamental frameworks for considering logistics analysis. Beginning with the key trade-offs between transportation and inventory cost, the course covers the major analytical frameworks of logistics including optimization and simulation. This course conducts a broad overview of the trade, transportation and logistics activities at the center of any supply chain operation, and highlights the relationship between infrastructure and trade.

7) Inventory Management

Description: Inventory management has a significant impact on a company’s financial performance. This course tackles the common problem of supply-demand mismatch, exploring methods of forecasting that enable you to understand the market demand for products in a supply chain and identify strategies for optimizing inventory in response to that demand. You will undertake a comprehensive analysis of the tools and methods used to manage inventory SKUs (stock-keeping units) with different characteristics – demand, lead-time and more. We also cover sourcing and contingency planning as well as current best practices in supply chain management, including the trade-offs that exist between lean and resilient supply chain principles.

8) External Supply Chain Transportation Risks

Description: This course focuses on how supply chain managers can identify and manage external supply chain transportation risk factors. These include engine technologies, fuel prices and congestion, elements that are influenced by transportation system maintenance and operations, energy issues and government policy decisions regarding air quality and greenhouse gases. We analyze how policy decisions are made at the local, regional, and national level and discuss current legislative trends. You also explore how these risk factors relate to other supply chain risks – such as product source location, quantity and price – and how strategies to mage these risks might be complementary.

9) Freight Transport

Description: The transport of freight – everything from B2B industrial materials to B2C e-commerce to the home – plays a critical role in terms of cost and competiveness for any enterprise that moves physical goods. This course addresses the key components of transportation in the context of strategic, business and operational management of complex supply chains. Given today’s rapid evolution of freight transport business models, technologies, regulation, sustainability and time, we explore current aspects of transportation with focus on impactful trends over the next five-plus years. You will learn techniques to develop strategies and plans over multiple time horizons execute freight movement and analyze a wealth of information to continuously improve enterprise freight performance in the global business environment.

**VI Agriculture:**

We have all likely heard the many lores of a local farmer. Example: “Horse (cows) tails in the west – the weather is the best! Horse (cows) tails in the east is weather coming at the least.” These local farmers at times have just as much knowledge of the weather and the weather forecast than the local weather person. This is because weather is the life blood of the agricultural industry. With an estimated $2.4 trillion USD of assets worth protecting worldwide weather and climate impact almost every aspect of this industry. Agricultural Meteorology major integrates knowledge from a variety of scientific disciplines in order to determine how crops and the markets that trade the product are affected by weather and climate, and how corps by themselves can affect local weather and climate. Agricultural Meteorology supports farmers, herders and fishermen by

* develop sustainable agricultural systems
* improve production and quality
* reduce losses and risks
* decrease costs
* increase efficiency in the use of water and chemicals
* conserve natural resources and soil

So with weather being a large component of agriculture industry there is also a need to understand crop growth and development, soil management and science, and other aspects of agronomic and agronomy.

Suggested Courses:

1) Climatology

Description: A fundamental understanding of the typical weather of world crop growing areas is necessary as an agriculture meteorologist. Outside of the United States, growing hot spots include Brazil, Argentina, India, and China. The course will place emphasis on the interactions between global atmospheric processes and regional climatic responses as they are manifested in synoptic-scale features and processes in different parts of the world. Ideally, this course would focus on earth’s “problem climates” and climatically sensitive zones that are susceptible to floods, droughts, and other climatic extremes.

2) ECON 101

Description: This course will provide students with a basic understanding of the principles of microeconomics. At its core, the study of economics deals with the choices and decisions we make to manage the scarce resources available to us. Microeconomics is the branch of economics that pertains to decisions made at the individual level, such as the choices individual consumers and companies make after evaluating resources, cost, and tradeoffs. An understanding of these basics will apply to any work consulting with farmers, traders, or other occupations where cost-control and financial risks are apparent. Major topics covered include: consumer and producer behavior, the nature of supply and demand, the different kinds of markets and how they function, and the welfare outcomes of consumers and producers.

3) Global Economics

Description: In a constantly changing and growing global trade environment, it’s necessary to understand how global economic policy and practice has an influence on the commodity markets. This course will study the theory and concepts fundamental to understanding the global economy. Students will learn to analyze the global business environment of industrialized developing countries, and to think strategically, using micro and macroeconomics principles. This background will develop the necessary critical thinking skills used daily for those immersed in the agriculture sector.

4) Agrinomy

Description: Agronomy is the science and technology of producing plants that serve humans, using practices essential for maintaining and improving life. It deals with a complex system involving soil, plant, atmosphere, agricultural management options.

5) Pyton, SQL, and R

Description: These are common programing languages that are used to in the industry that help with manipulation of data. These general purpose languages can be sued to build just about anything. Python is great for backend web development, data analysis, artificial intelligence, and scientific computing. SQL is utilized across several industries to manage databases, query information, build solutions, etc. Experience utilizing these language will help prospective employees in everyday work tasks.

**VII Advanced Computing and Modeling:**

Computing and information technology skills are a significant and rapidly growing skills requirement for private sector employers. These skills requirements go beyond the standard tools and applications that are part of current college and university curricula as well as the skills that many current private sector employees possess. The private sector market is investing heavily in applications, development and operations and research that rely on skills in artificial intelligence, including machine learning, data science and data engineering and cloud computing. There are also growing opportunities and requirements in simulation and modeling as they relate to the atmospheric sciences and associated impacts. This would include high performance computing in systems and programming. While some of the suggested coursework applies to atmospheric/meteorology undergraduate minors, concentrations and electives when available, many of the topical areas listed can be accessed online in both structured courses and tutorials via: YouTube, Coursera, Itunes, Google, Podcasts, UCAR and many other sources, including professional organizations like the AMS, AGU and IEEE.

Suggested Courses:

Artificial Intelligence (Machine Learning, Fuzzy Logic, Rule Based Systems)

Cloud Computing

C Programming

Data Engineering

Data Science

Data Mining

Data Modeling

Data Visualization

Fortran Programming

GIS Applications

High Performance Computing (Models, Systems, Infrastructure)

Internet Programming and Web Applications

Java Programming

Machine Learning

Numerical Weather Prediction

Python Programming

R Programming

Software Container Technology (e.g. Docker)

Software Engineering

Visualization

**VIII Marine:**

Private sector firms in the marine sector have a global reach, which requires their meteorologists to understand global and regional weather patterns as well as a wide variety of customers. Meteorology and oceanography courses with a broader curriculum would allow students to become more knowledgeable of weather and climate beyond the United States and better position them for a career in the marine industry. In addition, a basic understanding of maritime shipping, wind energy, offshore drilling, and dredging operations will provide better comprehension of customer operations. As individuals gain experience in this field, opportunities will arise to diversify skill sets. An advanced business degree (MBA), programming skills, marketing skills, and training in customer-facing roles such as customer success, sales, and product management will help the individual move beyond the traditional role of marine forecaster.

The following courses would significantly reduce training time and streamline the onboarding process for new hires as well as provide better awareness of marine customer needs and weather risks to their daily operations.

Suggested Courses:

1) Introduction to the Oil & Gas Industry

Description: The course provides students with a basic knowledge and understanding of the oil and gas industry, including the upstream, midstream and downstream sectors. The primary emphasis is on coastal and offshore operations in exploration and production. Offshore oil rig disasters such as Deepwater Horizon will also be discussed. At the end of the course, the student will have a better understanding of the industry, the importance of safety in operations, and the impacts to the environment.

2) Meteorological Risk Communication

Description: Techniques for effectively communicating weather risks and impacts. Students will learn how to effectively communicate weather forecasts and risk information while also learning about the social science behind the communication.

* + How will users react to the information I provide?
	+ Differences between communication to the public and communication to businesses

3) World Geography

Description: This course reviews the physical characteristics of the earth’s surface including landforms, climate, and vegetation. By the end of this course, students will be able to identify countries, islands, capes, and peninsulas around the world.

4) Physical Oceanography & Climate Dynamics

Description: This course begins with a review of the factors that drive atmospheric circulations and then moves into general and regional ocean circulations. Ocean circulation topics include surface currents, oceanic gyres, Ekman theory & transport, ocean temperature structure, and coastal upwelling. The course would also introduce and explain the following:

* + Equatorial dynamics in the Pacific and Indian Ocean: equatorial currents, ENSO, Kelvin and Rossby waves, monsoons, and resulting weather impacts across the globe.
	+ Ocean waves, their properties, the generation process, and dispersion.
	+ Tidal patterns and circulation including tides in confined basins (such as the Bay of Fundy, Canada)
	+ Tsunamis, rip currents, and freak/rogue waves.

5) Operational Applications of Marine Meteorology

Description: An introduction to the fundamentals of marine forecasting. Students are introduced to the components of a marine weather forecast including marine boundary layer winds, wind waves, swells, and significant wave height calculations. Students learn how to use Wave Analysis and Forecasting Nomograms to forecast sea heights. The NOAA Wavewatch III forecast system, various forecast products, and limitations are explained and used in marine forecast simulation exercises. Some regionalized marine forecast topics and techniques are discussed, including sea breeze circulations, sea fog, and gap winds. The course concludes with a lesson on observation, modeling, forecasting, and impacts of tropical cyclones. Students will learn how to interpret data from Hurricane Reconnaissance missions and satellites to create a baseline for tropical cyclone track and intensity forecasts.

 6) Offshore Wind Energy

Description: Introduction to wind energy technology and the economical and environmental aspects related to wind energy and future impacts. Offshore wind farm construction, characteristics, and economical benefits.

7) Ship Structure & Stability

Description: This course provides students with a basic understanding of ship stability and construction. Videos and illustrations are used to introduce various nautical terms, ship designs, load lines, draft marks, and stability. A field trip to tour a ship in port would build the students’ understanding of these principles and the importance of keeping a vessel stabilized to minimize risk to the ship, cargo, and crew.

**IX Aviation:**

Private sector firms in the aviation industry consists of major airlines, aviation contractors, and aviation forecasting companies. Most if not all of these firms have a global reach, which requires their meteorologists to understand global and regional weather patterns at the surface level but also at higher altitudes. Meteorology, Aviation, Mathematics, and Science courses with a broader curriculum would allow students to become more knowledgeable of the physics, weather, and climate across the globe and better position them for a career in the aviation industry. As individuals gain experience in this field, opportunities will arise to diversify skill sets. An advanced business degree (MBA), programming skills, marketing skills, and obtaining a Dispatch and Commercial Pilot license will help the individual move beyond the traditional role of aviation forecaster.

Suggested Courses:

1) Synoptic and Mesoscale Meteorology

Description: Having a good solid foundation in forecasting is critical when it comes to working in aviation weather. Most of the time as an aviation forecaster you are dealing with weather impacts on a smaller scale that will be directly affecting the airport. However, you will also be working with dispatchers and helping them decide which flight plan is best when there is a large storm system involved. You will have to forecast and analyze the weather from the surface up to about 40,000ft just slightly above cruising altitude. Forecast soundings and upper level winds are two things you will look at every day to help with your decision-making.

2) Tropical Meteorology

Description: Tropical storms and hurricanes impact both west and east coast, the gulf coast and the tropical islands for several months of the year. During this season, the airlines like to plan ahead as much as possible. They want to know how long they can continue operations while it is still safe before an airport will likely shut down. Sometimes airports will take a direct hit and can be out of commission for weeks or even months.

3) Radar and Meteorology

Description: This is a great class for anyone going into a forecasting job. However, in real-time operations you will be watching radar like a hawk so being able to analyze and understand what you see on radar and convey that information is extremely important for those making decisions for the airlines such as delays, cancellations or even shutting down an airport.

4) Satellite/Remote Sensing

Description: Being able to analyze satellite imagery is helpful in so many ways for aviation. The main one being turbulence. Obviously thunderstorms and winter storms can put out some dangerous turbulence reports, so it important to be able to recognize these signatures on satellite, include them in your forecast and be able to give dispatchers the best option for a flight plan.

5) Weather Communications/Intro to Aviation Weather

Description: Taking a class on how to read/decode METARS and read/write TAFs. Learning the aviation lingo: phonetic alphabet, airport codes, etc. Learning how translate different sky coverages, precip/storm chances and winds into TAF form. An aviation forecast is very different than just a regular area forecast from the NWS. In aviation, you are taking into account the minimum requirements for each airport and airline to give the operation the best possible chance at success.

6) Public Speaking and Written Communication

Description: These classes are great for any job in the weather industry, especially aviation. It is very important to be able to deliver a weather briefing that is clear and concise to dispatchers, Air traffic controllers, airline managers, etc. Also being able to write a brief but informative forecast discussion for your TAFs is also crucial to the job. Some dispatchers and pilots will be able to understand more technical meteorology terms, but it’s best to keep the discussion simple.