UTAH SYSTEM OF HIGHER EDUCATION
*Building a Stronger State of Minds*

**State Board of Regents**
Board of Regents Building, The Gateway
60 South 400 West
Salt Lake City, Utah 84101-1284

**Phone** 801.321.7101
**Fax** 801.321.7199
**TDD** 801.321.7130
www.higheredutah.org

September 7, 2016

MEMORANDUM

TO: State Board of Regents

FROM: David L. Buhler

SUBJECT: Utah State University – Bachelor of Science in Climate Science

## Issue

Utah State University (USU) requests approval to offer a Bachelor of Science in Climate Science effective Spring Semester, 2017. The proposed program was approved by the institutional Board of Trustees May 6, 2016.

## Background

Utah State University has developed master's and doctoral degree programs in climate science. This proposed baccalaureate degree completes a strategic approach to offer students an opportunity to complete their entire course of study at USU in climate science at both undergraduate and graduate levels.

The Climate Science Degree (CSD) program will be offered in the Department of Plants, Soils and Climate (PSC) where the exisitng gradaute programs in the discipline reside. The program will help students understand the nature and change of the climate system by applying principles of mathematics, physics, and chemistry. The core preparation of the CSD program focuses on the physical science of the climate system with the objective of better understanding how natural laws determine climate. This includes measurements of the atmosphere, soil, water and plants, and how data are used to address practical issues related to climate change.

The program will play a role in preparing the upcoming generation of global leaders in climate change sciences while helping to promote an informed citizenry. The proposed program is unique in that it incorporates fundamental knowledge of physical climate with the emergence of a new and more complete approach, encompassing all components of the climate system—atmosphere, water, and land surface—to gain a comprehensive understanding of climate change. The intent is to provide students with an understanding of the overall science of climate and of the various inter-relationships among the multiple factors that affect climate, and not just focus on singular issues or theories.

The PSC department has arranged a student exchange program with the National Central University (NCU) in Taiwan. Under this arrangement, four required program courses and several elective courses will be taught by NCU either in person for USU students who travel to Taiwan or via distance learning formats for students who stay in Utah. As part of the exchange, students from NCU will come to USU to take USU climate science courses. National Central University is a non-profit public institution of higher education

recognized by the Ministry of Education, Republic of China. The institution has received respectable rankings as a globally recognized institution from a number of sources including a global universities ranking conducted by US News and World Report where NCU received a score of 46.1 (based on a 0 – 100 scale) among a group of 750 top global institutions.

Program graduates will be prepared to pursue graduate education, not only in climate and/or atmospheric sciences but in a range of physical sciences. Graduates who choose to not pursue graduate school will be prepared to work in a variety of related positions and industries. Program graduates will be prepared to work as researchers or technicians in federal, state and university laboratories. They will also be qualified to work with private sector organizations to design and conduct observations and data analyses for tasks related to weather, climate, water, and energy.

An occupational report from the Utah Department of Workforce Services projects that the Atmospheric and Space Scientists occupational group (SOC Code 19-2021), a related occupational group to the program, will have an average of 10 annual job openings in Utah from 2012 through 2022 with median annual income of $91,280. On a national level, the United States Bureau of Labor Statistics (BLS) projects a total of 1,100 job openings for atmospheric scientists between 2014 and 2024, or an average of 110 openings per year. Nationally, median pay in 2015 was reported to be $89,820 per year. While these numbers may suggest that the projected employment demand for atmospheric scientists is not particularly strong, the compensation for people in this occupational category is noteworthy.

Even though the projected employment outlook for Atmospehric and Space Scientists shows realtively few job openings, it should be noted that future employment demand may extend beyond this occuaptional group and may not be reflected in state and federal labor data. The insitution noted that organizations that want to improve their climate-resilence often do not have the internal staff to develop climate impact solutions and that corporate hiring of climate-related majors has grown in a variety of industry sectors.

## Policy Issues

The proposed program has been developed through established institutional procedures and Board of Regents policy. Chief academic officers as well as faculty in related departments from the Utah System of Higher Education institutions have reviewed the proposal and have provided input. There are no additional policy issues that need to be addressed relative to approval of the program.

## Commissioner's Recommendation

The Commissioner recommends the Board of Regents approve the Bachelor of Science in Climate Science.

_____

David L. Buhler
Commissioner of Higher Education

DLB/BKC
Attachment

Program Description – Full Template
Higher Education Institution
Bachelor of Science Degree in Climate Science

## Section I: The Request

Utah State University requests approval to offer Climate Science Bachelor of Science (BS) Degree effective Spring Semester, 2017.

## Section II: Program Description

### Complete Program Description

The Climate Science Degree (CSD) Program in the Department of Plants, Soils and Climate is focused on understanding the nature and change of the earth's climate system by applying the basic principles of mathematics, physics, and chemistry. The program emphasizes the scientific study of the behavior of weather and climate, and applications to the important practical problems of climate prediction and weather forecasting for natural resources. The CSD Program integrates basic and applied principles of climatology, environmental physics, and meteorology, which are concerned with how natural laws determine the climate. Physical meteorology and land surface physics are also part of climate science because the Earth's climate variability is strongly coupled to the oceans and the land. In addition, interactions between land ecosystems, water and climate are studied. This includes understandings and measurements of the atmosphere, soil, water and plants, and how the data are used to address practical issues related to climate change. The graduates will be well prepared to pursue graduate education in interdisciplinary science programs. They will also be suited for continuing graduate studies in atmospheric science, climatology, hydrology and most other physical sciences. The skills instilled in graduates will qualify them as researchers or technicians in federal, state and university laboratories. They will also be qualified to work with private sectors to design and conduct observations and data analyses for tasks related to weather, climate, water, and energy.

The core training of the CSD Program focuses on the physical science of the climate system, one that concerns how natural laws determine the climate. As such, the basic curriculum will meet the guidelines of the American Meteorological Society and the requirements for employment in the National Oceanic and Atmospheric Administration and a variety of consulting and professional meteorological/hydrological services. Utah State University is a member of the University Corporation for Atmospheric Research, a consortium of more than 100 North American member colleges and universities focused on research and training in the atmospheric and related climate system sciences. The CSD program is unique in that it also incorporates fundamental knowledge of physical climate with the emergence of a new and more complete approach, encompassing all components of the climate system—atmosphere, water, and land surface—to gain a comprehensive understanding of climate change as realized in current times.

The program shares four core courses and four elective courses with the National Central University's (NCU) Department of Atmospheric Sciences in Taiwan, located 30 miles south of the capital city Taipei. The USU President and the Dean of USU College of Agricultural and Applied Sciences have signed a student exchange agreement with NCU. In these agreements, students will participate in an exchange program where USU students in their third or fourth year will live in Taiwan and attend classes there, while only paying tuition at USU. Students not able to make the physical exchange possible will participate in

shared courses via Interactive Video Conferencing established by the USU Regional Campuses and Distance Education.

## Purpose of Degree

The CSD Program will train the next generation of global leaders in climate system and climate change sciences while promoting a citizenry informed on the science behind the environmental and hazard issues of contemporary times. The Program aims to teach students about the dynamics and physics of the oceanic and atmospheric circulations and associated variability across different timescales, with a focus on weather systems, water cycles, and extreme events. Students graduating with a Climate Science degree will have built a solid foundation in the physical aspects of climate system and climate change, enabling them to pursue specific graduate degrees (either in mitigation or physical research) or work in various sectors.

Climate and climate change studies are among the most rapidly growing topics in research, crossing physical science and social science. These are quintessential interdisciplinary studies, involving not only the physical aspects of earth science, but also the science of climatic impacts to natural systems and humanity, and mitigation of rapid change in natural systems. In Utah, these subjects are facing future planning not only for energy and agriculture, but also for water, soil, economics, recreation, and air pollution. Development in the subjects of climate and climate change will form broad umbrellas under which rapidly increasing research funds are being offered and deployed.

Institutions across the nation around the world are creating and/or expanding academic programs, research programs, and research centers around climate and climate change. The net effect of these efforts has attracted faculty, students, and research funds. In 2014 alone, at least 11 major universities in the U.S. have launched cluster-hires of interdisciplinary nature that includes faculty in climate sciences to meet the increased demand. It appears timely for USU to augment its climate science offerings to include an undergraduate degree in the discipline.

## Institutional Readiness

Utah State University is well-positioned to implement this new program. There are a number of faculty already involved in climate science, climate change science, and sustainability. These faculty have expertise in climate science and meteorology, as well as geology, ecology, water science, soil science, sociology, and engineering. Utah State University also possess a successful extension program necessary to expand the educational goals of climate sciences to the grassroots level, as well as to respond to critical and emerging climate issues with research-based information.

Current faculty and curriculum in the Department of Plants, Soils and Climate (PSC) comprise the research, teaching and outreach capacity to build a degree in climate and climate change sciences:

- A Climate Science Master and PhD Degree Program was established in 2013
- PSC climate faculty are gaining international research prominence with a strong academic record
- The Utah Climate Center (UCC) has a state mandate for providing climate information to the state and region, and has been more than successful in reaching this goal
- Climate faculty and UCC are part of the strong USU ecology and water centers that can build and broaden a degree program

The PSC department's climate science faculty and climate center are nationally and internationally recognized leaders in the research of climate diagnostics, prediction and extreme events, particularly as it pertains to the western United States.

Drawing on the faculty expertise within the Climate Science master's and doctoral programs, the research provided through the Utah Climate Center, the PSC department's close association with USU's Ecology Center and Water Lab, and the two new climate faculty hires in Spring 2016, USU is well positioned to offer this new degree program.

Departmental Faculty

| Department Faculty Category | Dept Faculty Headcount – Prior to Program Implementation | Faculty Additions to Support Program | Dept Faculty Headcount at Full Program Implementation |
|---|---|---|---|
| With Doctoral Degrees (Including MFA and other terminal degrees, as specified by the institution) | | | |
| Full-time Tenured | 25 | 2 | 27 |
| Full-time Non-Tenured | 0 | 0 | 0 |
| Part-time Tenured | 0 | 0 | 0 |
| Part-time Non-Tenured | 0 | 0 | 0 |
| With Master's Degrees | | | |
| Full-time Tenured | 0 | 0 | 0 |
| Full-time Non-Tenured | 5 | 0 | 5 |
| Part-time Tenured | 0 | 0 | 0 |
| Part-time Non-Tenured | 0 | 0 | 0 |
| Other | | | |
| Full-time Tenured | 0 | 0 | 0 |
| Full-time Non-Tenured | 0 | 0 | 0 |
| Part-time Tenured | 0 | 0 | 0 |
| Part-time Non-Tenured | 0 | 0 | 0 |
| Total Headcount Faculty in the Department | | | |
| Full-time Tenured | 25 | 2 | 27 |
| Full-time Non-Tenured | 5 | 0 | 5 |
| Part-time Tenured | 0 | 0 | 0 |
| Part-time Non-Tenured | 0 | 0 | 0 |
| Total Department Faculty FTE *(As reported in the most recent A-1/S-11 Institutional Cost Study for "prior to program implementation" and using the A-1/S-11 Cost Study Definition for the projected "at full program implementation.")* | 30 | 2 | 32 |

Staff

Currently, the PSC department has one dedicated academic advisor whose role is advising incoming students. In the initial years of the program, it is anticipated that this advisor will be able to serve the additional students who enroll in the baccalaureate program. It is not anticipated that additional staff will need to be hired to support the program.

## Library and Information Resources

The institution currently has the needed library resources.

## Admission Requirements

Requirements for admission into the CSD program in the College of Agricultural and Applied Sciences are consistent with general University admission requirements. Students must also meet performance requirements (ACT composite of 20 or higher OR combined SAT score of 950 or higher OR rank in the top one-half of graduating class). Transfer students must have a 2.5 (on a 4.0 scale) cumulative grade point average and 2.5 on most recent term of attendance.

In addition to the minimum grade point average (GPA) requirements described in university academic policies, MATH 1210 must also be completed with a minimum grade of C.

## Student Advisement

To enhance student success, students will be assigned to support groups consisting of six students and one faculty member. Support groups will meet 1-2 times per semester to discuss matters of mutual concern. Department faculty members will serve as faculty advisors. In addition, upper-level climate students and faculty will work with two charter schools, InTech Early Collegiate High School (InTech) and the Academy for Math, Engineering, and Science (AMES), to build better high-school-to-university transition opportunities for diverse STEM-interested students. The department will form a Student Progress Committee that will review academic deficiencies and recommend a course of action for each student.

## Justification for Graduation Standards and Number of Credits

Total credit hours for required for degree completion is 120. This is consistent with Regent policy. T

## External Review and Accreditation

External consultants were not involved in the development of the program. The degree was developed by a group of USU faculty with expertise in climate science, climate change science, resources management and sustainability and a variety of related disciplines. It is not anticipated that external accreditation will be sought for the program.

## Projected Program Enrollment and Graduates; Projected Departmental Faculty/Students

| Data Category | Current – Prior to New Program Implementation | PROJ YR 1 | PROJ YR 2 | PROJ YR 3 | PROJ YR 4 | PROJ YR 5 |
|---|---|---|---|---|---|---|
| **Data for Proposed Program** | | | | | | |
| Number of Graduates in Proposed Program | X | X | X | 5 | 15 | 25 |
| Total # of Declared Majors in Proposed Program | X | X | 5 | 10 | 15 | 25 |
| **Departmental Data – For All Programs Within the Department** | | | | | | |
| Total Department Faculty FTE *(as reported in Faculty table above)* | 30 | 32 | 34 | 34 | 34 | 34 |
| **Program accreditation-required** | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| ratio of Student FTE/Faculty FTE, if applicable: (Provide ratio here:_____) | | | | | | |

Expansion of Existing Program

This program adds an undergraduate program to complement graduate offerings in Climate Science.

## Section III: Need

Program Need

The recent increases in weather/climate extreme events and the irregular climate variability, together with the broader and connected challenge of global sustainability, are poised to dominate human endeavor and direction this century. The outcome of the 2015 Paris Climate Submit was historical. It concluded with a landmark agreement to curb greenhouse gas emissions around the globe including the United States. The impact of this outcome in the decades to come remains far from certain, and will touch every corner of the world's societies. The new treaty ends the strict differentiation between developed and developing countries that characterized earlier efforts, replacing it with a common framework that commits all countries to put forward their best efforts and to strengthen them in the years ahead. This includes, for the first time, requirements that all parties report regularly on their emissions and implementation efforts, and undergo international review. Therefore, in 10 or 20 years' time it will be up to the next educated generation to provide such complicated information, assessment, and mitigation plans. Utah State University will play a leading role in providing higher education of climate for this new generation.

As Utah's land-grant institution, USU is a logical place to provide expertise within the state in climate research and with the development of new talent in the discipline. With its wide range of expertise in basic sciences, agriculture, engineering, and extension infrastructure, USU is positioned to lead regionally in educating the state's young generation in climate and climate change science.

Earth's climate will continue to change. The pace of that change will likely accelerate and the impacts to natural and human systems will likely become more severe. The simple truth of these statements is manifest in a slew of recent national and international synthesis reports representing a scale of effort unprecedented in science[*]. Made clear in these reports is that meaningful response to these climate-induced challenges is not likely through incrementalism, rather, transformational change is needed. Higher education provides an effective and necessary means to facilitate such a change. In view of these realities the following vision has been established for the program:

> Utah State University will be a nationally and internationally recognized leader in the science of regional climate change and climate variability — particularly as it pertains to the U.S. West — and in transforming this science into a strong and rigorous degree program.

The purpose of establishing the Climate Science Degree Program is to position USU as the base for higher education on climate and climate change for Utah's next-generation citizens. One cannot effectively study climate change science — and all that it entails — without first learning climate science. Understanding

[*] See, for example: IPCC Fifth Assessment Report, Working Groups I-III (2014); The National Climate Assessment (2014); Climate Change, Evidence and Causes, An overview from the Royal Society and the US National Academy of Sciences (2014); What We Know: the Reality, Risks, and Response to Climate Change, AAAS (2014);

future impacts to natural and human systems, formulating impact mitigation strategies, and formulating adaptation scenarios all begin with climate science itself.

## Labor Market Demand

According to an occupational report from the United State Bureau of Labor Statistics Climate scientists, including meteorologists, held about 11,800 jobs in 2014. Employment of climate scientists is projected to grow 9 percent from 2014 to 2024, about as fast as the average for all occupations. New computer models have vastly improved the accuracy and extent of forecasts and allowed climate scientists or meteorologists to tailor climate prediction to specific purposes. This will increase the need for climate scientists working in private industry as businesses demand more specialized weather and climate information. The best job prospects for climate science major are projected to be in private industry. The industries that employed the most climate scientists in 2014 were as follows:

| | |
|---|---|
| Professional, scientific, and technical services | 40% |
| Federal government, excluding postal service | 26% |
| Colleges, universities, and professional schools; state, local, and private | 20% |
| Radio and television broadcasting | 6% |

The job market for climate-background personnel has been going through a transformational change, from sections asking people of diverse backgrounds to conduct climate-related tasks into companies directly recruting climate scientists or social scientists. Climate scientists involved in research often work in either govenmental or university laboratories. Climate scientists who work in private industry will have to analyze climate change impact on society as a way to formulate insurance policy; this has been on growing demand for the costal regions (hurricanes and sea level rise), the Great Plains (tornado alley), and western states (drought and large fires).

The National Oceanic and Atmospheric Administration (NOAA) has recently established the National Weather Service Climate Services Division, a comprehensive and integrated office responsible for NOAA's climate science, data, information and services. It provides an integrated government entity for users across the nation in much the same way NOAA's National Weather Service has been providing weather information and services for 140 years. Individuals, local and national governments and the private sector are increasingly demanding this information to be able to better understand, adapt to, and plan for a changing climate. The expertise needed for the NOAA Climate Service will include research labs, climate observing systems, modeling facilities, integrated monitoring systems and extensive on the ground service delivery infrastructure.

## Student Demand

A survey conducted by USU among department chairs of a few newly established climate undergraduate programs indicates a potential student demand. Results at USU would be

- School of Earth and Climate Sciences, University of Maine – Within the first four years has enrollment of approximately 50 students and an increasing trend in enrollment and job placements.
- BS for Climate Science, University of Idaho – established for 2.5 years with 16 students completed.
- BS in Earth Sciences with a Climate emphasis, San Francisco State University – established less than 1 year with approximately 24 students enrolled.

Having taught climate-related classes for the past five years, current USU climate faculty members have noted an increase in student interest regarding climate science at USU. Professors are regularly queried by students with an interest in climate change and how to obtain and apply such knowledge. This emergence of interest in climate science is an indication that underscores why institutions around the nation (and around the world) are either creating or expanding academic programs, research programs, and centers around climate and climate change sciences. It is anticpated that the effect of these efforts will attract faculty, students, and research funds.

### Similar Programs

While similar programs exist that focus on atmospheric sciences, the proposed program at USU will focus on the physical aspect of climate looking at the various factors of land, water, and plant life that interrelate and impact climate. The University of Utah (U of U) has a Department of Atmospheric Sciences that is focused on meteorological training, weather forecasting, and physical or chemical properties of the atmosphere (e.g., microphysics). In recent years, the U of U Atmospheric Sciences department recruited two faculty members with specialties in large-scale climate dynamics. These two faculty members have been in collaboration with USU climate faculty over the past five years.

### Collaboration with and Impact on Other USHE Institutions

It is not anticipated that the proposed program will negatively impact other USHE institutions. Chief academic officers as well as faculty in related departments from the Utah System of Higher Education institutions have reviewed the proposal and have provided input.

### Benefits

The changing climate is a major scientific and social challenge of contemporary times that will dictate many career options and also demands particular technical skills. The proposed program addresses the need to train students to understand, use, integrate, interpret and communicate disparate data to advance climate and climate change sciences. The interdisciplinary research and education infrastructure of USU and the PSC department can provide an additional working model for other USHE institutions to observe and adopt.

### Consistency with Institutional Mission

The mission of USU is to be one of the nation's premier land-grant and space-grant universities by fostering the principle that academics come first, and by serving the public through learning, discovery, and engagement. The proposed degree program in Climate Science fits this mission and it will facilitate the emerging research themes across disciplines to study climate change impacts, such as sociology, ecology and agriculture.

## Section IV: Program and Student Assessment

## Program Assessment

To assess program success, formative and summative data will be collected from program students and faculty, as well as from individuals from outside the university.

At each semester end, students will complete anonymous course evaluations and surveys eliciting opinions on the value of program learning experiences, the extent of skill development toward their professional goals, and facets of the program (courses, mentorship, research experiences, etc.) they find to be most and least helpful. Open-ended items will invite suggestions for concrete ways to improve the program in both the near and long terms. In addition to these survey elements, students receiving supervised lab-based research or conducting undergraduate research projects will complete brief scales of graduate advisement experiences and research experiences. Students participating in extra-academic internships will also complete research self-efficacy and access to research infrastructure subscales. Program faculty will meet once per semester with an evaluator to discuss their perspectives on the strengths and weaknesses of the program as implemented, with the goal of reaching consensus on approaches to refining the program to better meet its articulated goals.

Key indicators of program effectiveness are students' persistence and completion of the degree program (with particular attention to underrepresented groups), their abilities to contribute to substantive scientific advances, interpret findings from scholarly articles, and conducted research in their final semester. Additionally, students' ability to obtain employment in a climate-related capacity following completion of their degree will reflect the opinions of employers as to graduates' capacity to serve as professionals in climate forecasting or adaptation careers. The rate of student attainment in fulfilling these markers will be compared against that of students from other comparable programs within USU through collaboration with USU's Office of Accreditation, Analysis, and Assessment.

As students meet others in professional interactions (e.g., extra-academic experiences, internships), USU's Office of Accreditation, Analysis, and Assessment will contact non-faculty supervisors to request the completion of a short comparative assessment of the students' skills, abilities, and knowledge base as reflected in performance. This survey will ask about students' quality on both a criterion basis and in comparison to their previous encounters with students from non-Climate Science programs regarding readiness to solve important problems in the field through data analysis, scientific communication ability, and ability to engage productively as part of an interdisciplinary team.

## Expected Standards of Performance

The program is designed to provide students with a solid grasp of the fundamentals in physical climate systems, and will also focus on general science concepts, mathematics, and data-analytical skills. In addition to developing scientific knowledge, bachelor's degree students must also build writing, communication and critical thinking skills. Learning assessment will take place at two levels of performance. At the level of the individual course or program element (e.g., suite of core courses), student performance on exams, papers, and other demonstrations of adequate performance will be compared against students from other PSC programs, as well as against pre-existing standards of academic performance. Faculty will use integrated rubrics to assess research quality and quality of scientific communication.

Climate Science students will be expected to apply their knowledge to solve meaningful and challenging problems facing the field. To evaluate student progress, faculty will use the rubrics described above to assess research performance in supervised term paper settings after students complete upper-level

courses. Program faculty will identify and evaluate students' use of specific skills and concepts taught earlier in the program. During faculty meetings or through semester-end interviews with the students, faculty will identify those skills that students successfully and unsuccessfully applied in new contexts, so that weaknesses in academic preparation can be remedied and successful practices may be leveraged more broadly throughout the program.

## Section V: Finance

Department Budget

| Three-Year Budget Projection | | | | | | | |
|---|---|---|---|---|---|---|---|
| Departmental Data | Current Departmental Budget – Prior to New Program Implementation | Departmental Budget | | | | | |
| | | Year 1 | | Year 2 | | Year 3 | |
| | | Addition to Budget | Total Budget | Addition to Budget | Total Budget | Addition to Budget | Total Budget |
| **Personnel Expense** | | | | | | | |
| Salaries and Wages | $676,828 | $55,158 | $731,986 | $0 | $731,986 | $0 | $731,986 |
| Benefits | $30,457 | $2,482 | $32,939 | $0 | $32,939 | $0 | $32,939 |
| Total Personnel Expense | $707,285 | $57,640 | $764,925 | $0 | $764,925 | $0 | $764,925 |
| **Non-Personnel Expense** | | | | | | | |
| Travel | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Capital | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Library | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Current Expense | $90,206 | $0 | $90,206 | $0 | $90,206 | $0 | $90,206 |
| Total Non-Personnel Expense | $90,206 | $0 | $90,206 | $0 | $90,206 | $0 | $90,206 |
| Total Expense *(Personnel + Current)* | $797,491 | $57,640 | $855,131 | $0 | $855,131 | $0 | $855,131 |
| **Departmental Funding** | | | | | | | |
| Appropriated Fund | $797,491 | | $855,131 | | $855,131 | | $855,131 |
| Other: | | | | | | | |
| Special Legislative Appropriation | | | | | | | |
| Grants and Contracts | | | | | | | |
| Special Fees / Differential | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Tuition | | | | | | | |
| Total Revenue | $797,491 | | $855,131 | | $855,131 | | $855,131 |

| Difference | | | | | | | |
|---|---|---|---|---|---|---|---|
| Revenue-Expense | $0 | $ | $0 | $ | $0 | $ | $0 |
| Departmental Instructional Cost / Student Credit Hour* *(as reported in institutional Cost Study for "current" and using the same Cost Study Definition for "projected")* | $374.40 | $ | $374.40 | $ | $374.40 | $ | $374.40 |

** Projected Instructional Cost/Student Credit Hour data contained in this chart are to be used in the Third-Year Follow-Up Report and Cyclical Reviews required by R411.*

### Funding Sources

To make the program possible, additional faculty are needed to teach courses not presently offered at USU. Two new faculty positions have been approved and are being recruited. The additional funding amounts indicated above reflect additional Education and General dollars that are planned to be allocated to support the positions.

### Reallocation

No reallocation is anticipated.

### Impact on Existing Budgets

Minimal impacts are expected on existing budgets. Program support such as advising and some teaching support will be managed by current staff and current operating budgets.

## Section VI: Program Curriculum

### All Program Courses (with New Courses in Bold)

Four required core courses and an additional four elective courses will be taught through a curriculum exchange established between USU and the Department of Atmospheric Sciences, National Central University (NCU) in Taiwan. Agreements are being secured to enable USU students to travel to NCU for one year, taking these courses within two semesters. For those who do not or cannot travel, these NCU courses will be taught through distance education. An equal number of NCU students will come to USU for the same amount of time taking courses offerred in the Climate Science program.

| Course Prefix and Number | Title | Credit Hours |
|---|---|---|
| Required Courses | | |
| MATH 1210, 1220 | Calculus I & Calculus II | 8 |
| MATH 2250 | Linear Algebra and Differential Equations | 4 |
| MATH 2210 | Multivariable Calculus | 3 |
| STAT 2000 | Statistical Methods | 3 |
| PSC 2000 | The Atmosphere and Weather | 3 |
| CHEM 1210 | Principles of Chemistry | 4 |
| PSC 3000 | Fundamentals of Soil Science | 4 |
| PHYS 2210 | Physics for Scientists & Engineers I | 4 |
| WATS 3000 | Oceanography | 3 |
| *PSC NCU-R2* | Atmospheric Thermodynamics | 3 |
| GEO 1110 | Dynamic Earth-Physical Geology | 3 |
| *PSC NCU-R1* | Atmospheric Instrumentation and Operation | *4* |
| *PSC NCU-R3* | Atmospheric Dynamics I | *3* |
| *PSC NCU-R4* | Atmospheric Physics | *3* |
| PSC 5900 | Boundary Layer Meteorology | 3 |
| PSC 5500 | Land-Atmosphere Interactions | 3 |
| PSC 5003 | Remote Sensing of Land Surfaces | 4 |
| PSC 5400 (new hire) | General Meteorology | 3 |
| GEO 5680 | Paleoclimatology | 3 |
| POLS 4820 | Natural Resources and Environmental Policy | 3 |
| PSC 5123 | Climate Data Analyses | 3 |
| | Sub-Total | 74 |

| Course Prefix and Number | Title | Credit Hours |
|---|---|---|
| Elective Courses (take up to 7 credits of the following courses) | | |
| JCOM 1130 | Beginning Newswriting for the Mass Media | 3 |
| GEO 3100 | Natural Disasters | 3 |
| ENVS 3600 | Living with Wildlife | 3 |
| ECN 3170 | Law and Economics | 3 |
| ENVS 5550 | Sustainability: Concepts and Measurement | 3 |
| CEE 3610 | Environmental Management | 3 |
| APEC 5560 | Natural resources and environmental economics | 3 |
| WATS 4490 | Small Watershed Hydrology | 4 |
| CEE 5940 | Snow Hydrology | 3 |
| PSC 5270 | Environmental Plant Physiology | 2 |
| CEE 3430 | Engineering Hydrology | 3 |
| GEO 3200 | The Earth Through Time | 4 |
| CS 3430 | Computational Science: Python and Perl Programming | 3 |
| PSC 5000 | Environmental Instrumentation | 2 |
| *PSC NCU-E1* | *MATLAB Programming and Application* | *3* |
| *PSC NCU-E2* | *Climatology & Monsoons* | *3* |
| *PSC NCU-E3* | *Boundary Meteorology* | *3* |
| *PSC NCU-E4* | *Air Pollution* | *3* |
| PSC 5670 | Environmental Soil Physics | 3 |
| PSC 3600 | Intro to Plant Breeding and Heredity | 2 |
| PSC 3800 | Fundamentals of Organic Agriculture | 3 |
| PSC 4000 | Soil and Water Conservation | 4 |
| PSC 4280 | Forage Production and Pasture Ecology | 3 |
| PSC 4320 | Field Crops | 3 |
| PSC 5130 | Soil Genesis, Morphology, and Classification | 4 |
| WILD 4000 | Principles of Rangeland Management | 3 |
| ADVS 5030 | Sustainable Agric. Production Systems with Animals | 3 |
| | Sub-Total | 10 |
| General Education + Capstone | | 32 + 4 |
| | Sub-Total | 36 |
| Track/Options (if applicable) | | |
| | Sub-Total | n/a |
| | Total Number of Credits | 120 |

Example of Program

| Admissions Requirements for this Program | | | | |
|---|---|---|---|---|
| New freshmen | Admitted to USU in Good Standing | | Transfer students from other institutions or other programs at USU | 2.75 GPA |
| First Year | | | | |

| Fall Semester | Credits | General Education Info and Notes: | Spring Semester | Credits | General Education Info and Notes: |
|---|---|---|---|---|---|
| GEOG 1110: Physical Geology | 3 | | CHEM 1110: General Chemistry (BPS) | 4 | |
| MATH 1210: Calculus I (QL) | 4 | | PSC 2000: The Atmosphere and Weather | 3 | |
| ENGL 1010: Introduction to Writing: Academic Prose (CL1) | 3 | | ENGL 2010: Intermediate Writing: Research Writing in a Persuasive Mode (CL2) | 3 | |
| SOC 1010: Introductory Sociology (BSS) | 3 | | MATH 1220: Calculus II (QL) | 4 | |
| POLS 1100: United States Government and Politics | 3 | | USU 1360: Climate Change on Earth | 3 | |
| Comments 16 credits | | | Comments 17 credits | | |

Second Year

| Fall Semester | Credits | General Education Info and Notes: | Spring Semester | Credits | General Education Info and Notes: |
|---|---|---|---|---|---|
| WILD 2200: Ecology of Our Changing World (BLS) | 3 | | PSC 4810: Climate and Climate Change (DSC/QI) | 3 | |
| Breadth Humanities (BHU) Course | 3 | | GEO 3300: Geology of the World's Ocean | 3 | |
| PHYS 2210: Physics for Scientists and Engineers I (QI) | 4 | | MATH 2210: Multivariable Calculus | 3 | |
| MATH 2250: Linear Algebra and Differential Equations (QI) | 4 | | CHEM 1210: Principles of Chemistry | 4 | |
| PSC 3000: Fundamentals of Soil Science | 3 | | WATS 3000: Oceanography | 3 | |
| Comments 17 credits | | | Comments 16 credits | | |

Third Year

| Fall Semester | Credits | General Education Info and Notes: | Spring Semester | Credits | General Education Info and Notes: |
|---|---|---|---|---|---|
| PSC NCU-R2: Atmospheric Thermodynamics | 3 | | GEO 5680: Paleoclimatology | 3 | |
| PSC NCU-R4: Atmospheric Physics | 3 | | PSC 5003: Remote Sensing of Land Surfaces | 4 | |
| PSC 5400: General Meteorology | 3 | | PSC 5270: Environmental Plant Physiology | 3 | |
| PSC NCU-R1: Atmospheric Instrumentation and Operation | 4 | | PSC NCU-R3: Atmospheric Dynamics I | 3 | |
| Comments 14 credits | | | Comments 14 credits | | |

Fourth Year

| Fall Semester | Credits | General Education Info and Notes: | Spring Semester | Credits | General Education Info and Notes: |
|---|---|---|---|---|---|
| PSC 5900: Boundary Layer Meteorology | 3 | | Practicum | 4 | |
| PSC 5123: Climate Data Analyses | 3 | | PSC NCU-E4: Air pollution | 3 | |
| PSC 5000: Environmental Instrumentation | 4 | | POLS 4820: Natural Resources and Environmental Policy | 3 | |
| GEO 3100: Natural Disasters | 3 | | PSC 5500: Land-Atmosphere Interactions | 3 | |
| | | | | | |
| Comments<br>13 credits | | | Comments<br>13 credits | | |

## Section VII: Faculty

List of current faculty within the institution with their qualifications:

- Robert Gillies, Professor, PSC – Areas include remote sensing, meteorology, climatology
- Larry Hipps, Professor, PSC – Areas include air-land interaction, boundary layer meteorology, instrumentation
- Simon Wang, Associate Professor, PSC – Specialized in climate dynamics, synoptic meteorology, climate prediction
- Jiming Jin, Associate Professor, PSC/WATS – Areas cover hydroclimatology, regional climate modeling
- Scott Jones, Professor, PSC – Expert in soil physics, hydrological science, instrumentation
- Sarah Null, Assistant Professor, WATS – Areas include water resource management, climate change
- Patrick Belmont, Associate Professor, WATS – Specialized in watershed hydrology, sediment dynamics, geomorphology
- Beth Nelson, Associate Professor, CEE – Research in stream dynamics, climate change impact
- Tammy Rittenour, Associate Professor, GEOL – Specialized in paleoclimatology
- (New Hire 2016), PSC – Areas include tree-ring climatology, dendro-hydrology, climate variability
- (New Hire 2016), PSC – Areas are in the physical and computational sciences of climate dynamics
- (Potential New Hire 2017), PSC – Extension Climatologist