Term Information

Effective Term	Autumn 2017

General Information

Course Bulletin Listing/Subject Area	Earth Sciences
Fiscal Unit/Academic Org	School of Earth Sciences - D0656
College/Academic Group	Arts and Sciences
Level/Career	Undergraduate
Course Number/Catalog	2310
Course Title	Sensing Planet Earth
Transcript Abbreviation	SensingPlanetEarth
Course Description	Fundamentals of modern technologies used in remote sensing from satellites and airborne platforms. Uses of remote sensing data to address earth science and social science problems of the contemporary world.
Semester Credit Hours/Units	Fixed: 4

Offering Information

Length Of Course	14 Week, 7 Week
Flexibly Scheduled Course	Never
Does any section of this course have a distance education component?	No
Grading Basis	Letter Grade
Repeatable	No
Course Components	Recitation, Lecture
Grade Roster Component	Lecture
Credit Available by Exam	No
Admission Condition Course	No
Off Campus	Never
Campus of Offering	Columbus

Prerequisites and Exclusions

Prerequisites/Corequisites

Exclusions

Cross-Listings

Cross-Listings

Subject/CIP Code

Subject/CIP Code	40.0601
Subsidy Level	General Studies Course
Intended Rank	Freshman, Sophomore, Junior

Requirement/Elective Designation

General Education course:

Physical Science; Human, Natural, and Economic Resources

The course is an elective (for this or other units) or is a service course for other units

Course Details

Course goals or learning objectives/outcomes

- Students demonstrate a basic understanding of remote sensing technologies and remote sensing data.
- Students demonstrate an ability to manipulate and visualize remote sensing data using modern techniques (e.g., Google Earth Pro).
- Students can explain the uses of remote sensing data for identifying and addressing scientific and social issues of human, economic, and natural resources.

Content Topic List

- Fundamentals of remote sensing systems
- Radar altimetry, LandSat, synthetic aperture radar, and photogrammetry; techniques, data, and their applications to scientific, environmental, and social issues.
- Satellites and their orbits
- Environmental, social, economic, and military uses of remote sensing data.
- GPS, satellite gravimetry, and satellite magnetometry; techniques, data, and their applications to scientific, environmental, and social issues.

Attachments

- ASC GE Sensing Planet Earth course proposalVer9.21.16.docx: Course proposal and syllabus

  (Syllabus. Owner: Krissek,Lawrence Alan)
- Earth Sci 2310 support letter_AEDE.pdf: Support letter from AEDE

  (Other Supporting Documentation. Owner: Krissek,Lawrence Alan)
- Earth Sci 2310 support letter_SES.pdf: Support letter from SES

  (Other Supporting Documentation. Owner: Krissek,Lawrence Alan)

Comments

- The proposed course could not be used to fulfill requirements for the Earth Science B.S. degree. It could be used to fulfill requirements for the Earth Science B.A. degree, but would help meet the Earth Science B.A. program learning goals at the basic level. Given the small number of B.A. students in Earth Sciences (presently ~10 students), the proposed course will have little impact on the Earth Science undergraduate major program. The primary impact of the proposed course will be as a GE course for students from outside SES. *(by Krissek,Lawrence Alan on 09/21/2016 03:42 PM)*

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Krissek,Lawrence Alan	09/21/2016 03:44 PM	Submitted for Approval
Approved	Krissek,Lawrence Alan	09/21/2016 03:45 PM	Unit Approval
Approved	Haddad,Deborah Moore	09/21/2016 04:19 PM	College Approval
Pending Approval	Nolen,Dawn Vankeerbergen,Bernadette Chantal Hanlin,Deborah Kay Jenkins,Mary Ellen Bigler Hogle,Danielle Nicole	09/21/2016 04:19 PM	ASCCAO Approval

Proposal for a
Team-Taught, Cross-Disciplinary ASC General Education (GE) Course

Sensing Planet Earth

(Earth Science 2310; 4 credits)
[*https://go.osu.edu/SensingPlanetEarth*](https://go.osu.edu/SensingPlanetEarth)

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Submitted to:
Executive Dean **David Manderscheid**, ASC, manderscheid.1@osu.edu
Associate Executive Dean **Steve Fink**, ASC, fink.5@osu.edu

September 21, 2016

Course Objectives

To introduce students to learn basic concept to enable a rudimentary understanding of modern technologies to observe the Earth from space or using airborne platforms, and to use the knowledge to undertake a wide variety of Earth and social science applications and to address problems of the contemporary world.

Summary

We propose a *new* general education (GE) 2000-level 4 credit hour course in the Arts & Science College (ASC), with the *objective* to educate students to better understand the *methods of modern* science *and technology to address problems of the contemporary world, including studies of the natural science-human-economic interactions which may govern these problems*, addressing the ASC GE goals for both physical and social sciences. Contemporary Earth orbiting satellite and airborne platforms are generating ever-increasing *big data* for cross-disciplinary science and applications. They may include broad disciplines of Earth sciences, climate change and sea level rise, hazards and water resources management, energy resources exploration, weather forecasting, navigation/location service, agriculture, public health, food and water security, national security, risk analysis, resilience adaption, and socio-economic assessment. This course would *bridge the gaps* of GE courses offered at The Ohio State University, and to our knowledge, at Universities nationally and world-wide. We propose to

teach students to learn the basic concept of contemporary *geodetic* or active remote sensing data, and to use hands-on, computer/device based *data analytic* and GIS visualization tools for Earth and socio-economic applications. The proposed faculty members have cross-disciplinary scholarships with expertise in satellite geodesy, GIS/geo-visualization, Earth sciences, and socio-economics. The proposed course is endorsed by the Director/Chair of the School of Earth Sciences (SES), College of Arts & Sciences; and the Department of Agriculture, Environmental & Development Economics (AEDE), College of Food, Agriculture and Environmental Sciences. We anticipate the course to be sustainable and fully team-taught every year commencing on Autumn semester, 2017.

Rationale and Motivations

The advent of the Space Age allows the use of artificial satellites for innovative applications and studies of Planet Earth and other terrestrial bodies. The onset of climate change and its ensuing effects on the society require our students to learn of diverse disciplinary fields to be better prepare for the real world. These cross-disciplinary fields include natural and social sciences, health, agriculture and food, ecology, environment, water scarcity and quality, sustainability, economy and national security [e.g., *Sullivan et al.*, 2007; *Koji et al.*, 2012]. An exponentially increasing number of international and commercial *Earth sensing* satellites and airborne platforms, including aircrafts and unmanned aerial systems or UAS, are delivering global and timely *big data*, sensing the Earth from space, on the surface or inside the Earth.

Many of these contemporary satellite sensors are *not yet* covered in the curricula at The Ohio State University and Universities nationally or worldwide, and the associated GIS and *visualization* tools (e.g., Google Earth/Engine) at the GE level to allow students to *exploit* this *big data* source to prepare them for the world. The current related remote sensing courses are offered (CIVILEN 5420, *Remote Sensing of Environments*; GEOG 5225, *Geographic Applications of Remote Sensing;* and Earth Sci 4310, *Remote Sensing in Earth Sciences*) are *not* at the GE level and all the courses, except Earth Sci 4310 do not cover the modern geodetic (active) remote sensing tools, and mainly deal with passive remote sensing tools (optical/NIR imageries). Examples of *the geodetic (active remote sensing)* platforms include the Global Navigation System of Satellites (GNSS, Global Positioning System or GPS is the US component), altimeters, LiDAR, gravimeters, synthetic aperture radar (SAR) and SAR Interferometry (InSAR), ground penetrating radars, magnetometers, radiometers, spectrometers, scatterometers, and sounders. The Earth sensing technology is evolving from large and expensive spacecrafts/aircrafts to CubeSats, nano-satellites, and UAS. The applications using these additional *geodetic sensing* platforms [*Minster et al.*, 2010] enable location-based service, navigation, analyses of natural hazards including floods and droughts, hydrology, wetland dynamics, glaciers and ice sheet ablations, sea level rise, ocean circulations, tides, tsunamis, land cover, bathymetry, digital elevation/topography models, land subsidence, earthquakes, volcanism, geodynamics, subsurface processes, space physics, atmospheric occultation, satellite precipitation, oil/gas exploration, water-related infectious diseases, precision farming, ecology, agriculture and land cover change, food security, harmful algal blooms, urban and city planning, population dynamics, coastal vulnerability/ resilience, water resources and disasters management, climate change adaption/mitigation.

Our innovation in the proposed course includes the *generation* of hands-on data processing and *visualization* tools via interactive or *black-box* type of computer modules on the web or cloud computing, without requiring students to have advanced mathematical nor computing skills, and able to learn the basic knowledges to enable modern and near future cross-disciplinary applications using these technologies, e.g., http://gisgeography.com/100-earth-remote-sensing-applications-uses.

In summary, the proposed course would be:

- *Interdisciplinary* or cross-disciplinary, bridging GE goals for broad disciplines of Earth sciences, and also for environment, economy, development and sustainability (EEDS) with applications to social sciences and agriculture
- *Beneficial to students* across multiple colleges in the University, and it directly addresses the GE goals for natural and social science students, to "understand the *methods of modern science, and its relationship with technology* and the potential of science and technology to address problems of the contemporary world", and study interactions of "human, natural, and economic resources".
- With significant added values as it would be team-taught by three lecturers with distinct expertise (geodetic/Earth sciences, geospatial science, and socio-economics)
- Taught in three separate but closed link sessions (remote sensing/Earth observations, GIS/geo-visualization, and for cross-disciplinary applications), in which all or more than one lecturer would be responsible for each of the sessions.

Proposed General Education (GE) Course

We propose to develop a 2000-level 4 credit GE course (**EarthSci 2310**) to be taught tentatively every year, that students can use to satisfy their respective GE category or requirements in ASC (Physical and Social Sciences). The anticipated enrollment is 200 students per class. The proposed course has no laboratory session, but with a 1-hour per week recitation/assignment period, during which students participate in a session with (multiple) GTAs, preferably one from each discipline from the respective lecturers, for in-depth teaching of the class materials, for students to work on assignments, survey questions, or exam reviews.

Credit Sharing Mechanism

The call for ASC Team-Teaching course proposals indicated that the proposed course should be cross-listed by the collaborating departments. In light of the situation that the lecturers are from two different colleges, ASC and CFAES, the submissions and evaluations of the courses will *not* be within just *one* college's (ASC's) curriculum committees. We request that we have an opportunity to have dialogues with cognizant curriculum committee members in both ASC and CFAES, to consider an optimal mechanism to implement the courses with the goal to achieve maximum benefits to the students taking the cross-disciplinary class, to the lecturers, and to their respective department and colleges.

Teaching Method

A blended teaching approach is proposed. Traditional lecture deliveries will be reinforced through digital and online media resources as primary or supplementary reading material which will be made available via course website electronically.

Student learning will be monitored through two-page short reports at the end of each standalone topic for reflection on the taught course content, including questions posed by the students for further clarification. These reports will be read by the instructors and the feedback will be provided during the subsequent lectures. This practice will enable the instructors to identify student learning difficulties and allow course adjustments during the semester.

In addition, periodic short online questionnaires will be used to receive feedback from the students to monitor their learning experience.

Course Texts/References

There is no required text book. Lecture materials including eBooks, articles, and other reading materials are available via the course webpage, http://go.osu.edue/SensingPlanetEarth, click on the **Syllabus** button. This will include updates beyond what is stated in this document.

Aplin, P. *et al*., Advances in Photogrammetry, Remote Sensing and Spatial Information Sciences: 2008 ISPRS Congress Book, Edited by *Z.L. Li, J. Chen & E. Baltsavias*, ISBN: 978-0-203-888344-5, 2008.

Blewitt, G., Basics of the GPS technique: Observation Equations, in: *Geodetic Applications of GPS*, Swedish Land Survey, 1997.

Dell, M., B.F. Jones, B.A. Olken, What do we learn from the weather? The new climate-economy literature, *Jl. Economic Literature*, 52(3), 740-798, dx.doi.org/10.1257/jel.52.3.740, http://economics.mit.edu/files/9138, 2014.

Elert, G., The Physics Hypertextbook, http://physics.info, 1998–2016.

Famiglietti, J.S., The global groundwater crisis. *Nature Climate Change*, 4(11), 945–948, 2014.

GIS Geography, 100 Earth Shattering Remote Sensing Applications &

Uses, http://gisgeography.com/100-earth-remote-sensing-applications-uses, accessed 2016.
Hess, K., Working Knowledge: STEM Essentials for the 21st Century, *Springer Science Business Media*, ISBN 978-1-4614-3275-3, New York, 2013.
Kerle, N., C. Site, Principles of Remote Sensing, International Institute for Geo-Information Science & Earth Observation, ISBN: 90-6164-227-2, ITC, Enschede, The Netherlands, 2004.
Koji, C, J. Gartin, M.J. Burrows, M. Roth, C. Yost, C. Manning, Global Water Security, Intelligence Community Assessment, *National Intelligence Council*, ICA 2012-08, 2012.
McNutt, M., The drought you can't see. *Science*, *345*(6204), pp.1543-1543, 2014.
Minster, J.B., Z. Altamimi, G. Blewitt, W.E. Carter, A. Cazenave, H. Dragert, T.A. Herring, K.M. Larson, J.C. Ries, D. Sandwill, J. Wahr, Precise Geodetic Infrastructure: National Requirement for a Shared Resources, *The National Academies Press*, ISBN: 978-0-309-15811-4, doi:10.17226/12954, 156 pages, 2010.
Patrick, B., G. Kroll, T. Madon, Micro-satellite Data: Measuring Impact from Space, *IPA Innovation for Poverty Action*, https://www.povertyaction.org/sites/default/files/publications/Goldilocks-Deep-Dive-Micro-satellite-Data-Measuring-Impact-from-Space_4.pdf, 2016.
Sullivan, G.R., F. Bowman, L.P. Farrell Jr., P.J. Kern, T.J. Lopez, D.L. Pilling, J.W. Prueher, R.H. Truly, C.F. Wald, A.C. Zinni, National Security and the Threat of Climate Change, edited by S. Goodman, *Report of the CNA Corporation*, Alexandria, VA, 2007.
The World Bank. *World Development Report: Development and Climate Change*. Washington, D.C. http://siteresources.worldbank.org/INTWDR2010/Resources/5287678-1226014527953/WDR10-Full-Text.pdf, 2010.
The esri ArcGIS Imagery Book: https://learn.arcgis.com/en/arcgis-imagery-book/
Google Earth pro app: https://www.google.com/earth/
Google Earth Engine: https://earthengine.google.com

The lecture materials are free or accessible via OSU library for free, including the ones generated by the lecturers and their colleagues. They may include state-of-the-art, not yet published materials or information.

Detailed Draft Syllabus

During the course implementation stage, specific ELOs (**a–g**, see ***§Expected Learning Outcomes***) with be assigned to specific lectures associated with each topics. The syllabus is proposed to be updated on the draft course webpage: http://go.osu.edue/SensingPlanetEarth, click on the **Syllabus** button. This will include updates beyond what is stated below.

Lecture Topics (Subject to change) **Fall 2017**

Week	Day	Topic	Readings
1	Tues	Review syllabus. Course objectives.	http://go.osu.edu/SensingPlanetEarth

Topic 1		Introduction to geodesy and remote sensing, GIS and geo-visualization	The Esri Imagery Book, Ch. 0, Ch. 1
1 **Topic 2**	Thurs	Introduction to remote sensing applications: Earth sciences, coastal vulnerability, socio-economic applications, agriculture	Bangladesh Delta coastal vulnerability project: http://Belmont-BanDAiD.org, Bay of Hope video
		Longest, continuous multi-spectral remote sensing platform: Landsat, 1972–present	Landsat's temporal sampling and spatial resolution
2 **Topic 3**	Tues	Global Disaster Monitoring Organization: flood and earthquake monitoring. Using radar altimetry and imageries to monitor 2016 Louisiana flood. 24 August 2016 earthquakes: shallow Central Italy earthquake (M6.2), ~129 causalities; deep Myanmar earthquake (M6.8), no causalities.	NASA: Predicting Flood – Global Flood Monitoring System video, Global Disaster Monitoring Organization Search online and understand the differences between shallow and deep earthquakes.
		Earth science applications of using Landsat. Land cover/agricultural classification using 5-m resolution, Planet Inc. Dove imagery. Harmful Algal Bloom imaging using Envisat MERIS in western Lake Erie.	Esri Landsat application examples Planet, Inc. daily sampled, 5-m resolution imagery
2 **Topic 4**	Thurs	Earth and social science applications (continued): ocean circulation, El Nino, sea level, floods, using altimeter, gravity sensors	100 Earth Shattering Remote Sensing Applications & Uses
		Introduction to online ArcGIS tool and visualization exercises	Esri ArcGIS tool, OSU free GIS software
3 **Topic 5**	Tues	Earth and social science applications (continued): MODIS monitoring flood in Bangladesh, migration and adaption of monsoonal flood.	Social science and migration of Bangladesh Delta coastal vulnerability project: http://Belmont-BanDAiD.org
		Synthetic aperture radar monitoring of permafrost over Tibetan Plateaus; combined SAR and	Read and identify your top 3–5 applications using remote sensing data: 100 Earth Shattering Remote

		altimeter observed Sandarbans mangrove forest wetland water level change	Sensing Applications & Uses
3 **Topic 6**	Thurs	Introduction to photogrammetry: what is photogrammetry?	Photogrammetry resources What is photogrammetry?
		High-resolution imageries: NASA EOSDIS Worldview	NASA EOSDIS Worldview
		Differences between photogrammetry & synthetic aperture radar. Microsoft's Photo Tourist and Photsynth.	What is synthetic aperture radar interferometry? ESRI's Drone2Map
4 **Topic 7**	Tues	Principle of remote sensing: electromagnetic spectrum, passive and active remote sensing	Kerle & Site, Principles of Remote Sensing, Ch. 2
		Esri's MOOC (massive open online courses (MOOCs) on Earth Imagery at Work	Esri Earth Imagery at Work Online Course: extra credit for taking the course (8% of the course grade)
4 **Topic 8**	Thurs	Gravity and Kepler's Laws: how do satellites work? High, medium and low Earth orbiters. Geosynchronous satellites	NASA's Juno Jupiter explorer: trajectories Read Physics hypertext: Orbital Mechanics I
5 **Topic 9**	Tues	Low Earth orbiters, design of sun synchronous orbits, Earth's oblateness, prograde and retrograde orbits. Aqua/Terra MODIS swath and Landsat sampling, Planet Inc. Dove satellites	Landsat sampling, Aqua MODIS swath sampling
		Satellite orbit visualization tools	Orbital debris, Earth orbit visualization tool
5 **Review**	Thurs	Review for First Exam	
6 **Exam**	Tues	First Exam	Online test system: http://etest.elogi.com
6 **Topic 10**	Thurs	Discussion of First Exam results	http://etest.elogi.com
		Science or application in agriculture, precision farming and remote sensing	Read: Micro-satellite Data: Measuring Impact from Space
7	Tues	Social implication of natural	http://economics.mit.edu/files/9138

Topic 11		hazards, and risk assessment and resilience adaption	
7 Topic 12	Thurs	Population migration, economics analysis using MODIS data for flood monitoring	Micro-satellite Data: Measuring Impact from Space
8 Topic 13	Tues	The impact in economy and national security, socio-economic assessment	Sullivan et al., 2007 World Development Report 2010
8 Topic 14	Thurs	Remote sensing of water color (HAB), public health, food and water security, water-related infectious diseases	Micro-satellite Data: Measuring Impact from Space
Semester Break			
9 Topic 15	Tues	Visualization using Google Earth API and Google Earth Engine	Google Earth Pro, Google Earth Engine
9 Topic 16 Review	Thurs	Visualization using Google Earth API and Google Earth Engine (continued)	Google Earth Pro, Google Earth Engine
		Review of Second Exam	
10 Exam	Tues	Second Exam	Online test system: http://etest.elogi.com
10 Topic 17	Thurs	Principle of GNSS and location service, trilateration: how does GPS work? Interdisciplinary applications of GPS, GPS occultation GPS remote sensing	Blewitt, G., The Basics in GPS, Ch.2, Ch. 7
11 Topic 18	Tues	Principle of satellite radar altimeter: sea level, ocean circulation, water level, ice sheet elevation change, land subsidence	Fu & Cazenave, Satellite Altimetry and Earth Sciences, Ch. 1
11 Topic 19	Thurs	Principle of satellite gravimetry, GRACE, and its observations of hydrology, sea level, earthquake, geodynamics, flood, drought, glacier and ice sheet mass balance.	http://www.csr.utexas.edu/grace/
12 Topic 20	Tues	Principle of satellite laser altimeter, airborne LiDAR, DEM, land cover change	Aplin, P. et al., Advances in Photogrammetry, Remote Sensing and Spatial Information Sciences, Ch.

			6, LiDAR
12 Topic 21	Thurs	Principle of SAR and InSAR and its applications, earthquake and volcanic deformation, land subsidence, wetland water level, ecology, ice sheet mass balance	*Kerle et al.*, Principles of Remote Sensing, Ch. 6.2, radar
13 Topic 22	Tues	Introduction on magnetometers, gradiometers, for oil/gas resources exploration	*Kerle et al.*, Principles of Remote Sensing, Ch. 7. remote sensing below the surface
13 Topic 23 Review	Thurs	GRACE as a tool for water resources management	*Koji et al.*, 2012
		Review for third Examination	
14 Exam	Tues	Third Examination	Online test system: http://etest.elogi.com

Proposed Additional Work to Develop the General Education (GE) Course

We propose to develop a 2000-level 4 hour ASC GE course (**Earth Science 2310**) to be taught tentatively every year, that students can use to partially satisfy their GE requirements in either Natural Sciences: Physical Sciences or Social Science: *Human, Natural, and Economic Resources*. The anticipated enrollment is 200 students per class. The proposed course has no laboratory session, but with a 1-hour per week *recitation period*, during which students participate in a session with multiple GTAs, preferably one from each discipline from the respective lecturers, for in-depth discussions of the class materials, working on assignments, training of web-based computer tools, or exam reviews.

Pre-requisites

None. This is intended to be a GE course.

Expected Learning Outcomes (ELOs)

Students are expected to learn the following. During the lectures a number of new topics including new concepts, methods and technologies will be discussed. In order to receive a passing grade students are expected to correctly answer the following questions regarding the course they would have learned. The specific ASC ELOs have been rewritten to satisfy the relevant ASC GE goals, https://asccas.osu.edu/curriculum/ge-goals-and-learning-outcomes.

The following specific ELOs will address the ASC *Physical Science* goals:

a. What are these new concepts?
b. What is the basic science behind these technologies?
c. How do these new methods and technologies operate?
d. What are their advantages and disadvantages?

The following specific ELOs will address with the ASC *Social Science* component of the ELOs, *Human, Natural, and Economic Resources*:

e. What are the pertinent social theories and methods of scientific inquiry in the use and distribution of human, natural, and economic resources and decisions and policies concerning such resources?
f. Why do we need them? What are their impacts on political, economic, and social trade-offs reflected in individual and societal policymaking and decisions with respect to resources use?
g. How are these new methods, techniques and concepts relate to the other disciplines in students' study areas and their respective resources usage?

GE Course Assessment

Method of assessment consists of the following formative and summative components:

<u>Formative assessments</u>

Three multiple choice (MC) tests will be carried out to assess and monitor students learning (Direct Measures). Three tests will be used as part of the formative assessment. Each question will have three to four distracters with a minimum of 30-40 questions during the semester.

Student learning will also be monitored throughout the semester through two-page reports at the end of each standalone topic for reflection on the taught content, including questions posed by the students for further clarification. These reports will be uploaded to the course website by the student to be read by the instructors and the feedback will be provided during the subsequent lectures. This practice will enable the instructors to identify student learning difficulties and the reports will become part of student overall assessment at the end of the semester.

<u>Summative Assessment</u>

- A comprehensive final MC test will be used to assess students overall learning during the semester in line with ELO learning. The test questions will cover all the topics discussed during the semester and will emphasize to test students' synthesis of the lecture topics in the context of ELO.
- An online exit questionnaire with Likert scale will be offered before the final MC test to as an indirect measure of student learning experience.

Grading: Letter Graded

- Short Reports/Assignments: 25%
- Three multiple-choice exams including the final exam: 25% each

The grade differences are summarized as below:

A: 93–100 | **A-**: 90–92 | **B+**: 87–89 | **B**: 83–86 | **B-**: 80–82 | **C+**: 77–79
C: 73–76 | **C-**: 70–72 | **D+**: 67–69 | **D**: 60–66 | **E**: < 60

<u>Subject Grade Specific Descriptions Addresses Respective ELO Assessments</u>

<u>Level of Expected Achievement</u>

Subject Grade	***Percentage Standards***	***Short Description***	***Elaboration on Subject Grading Description***
A	93-100	Excellent	The student's work is outstanding. It exceeds the course ELO in all regards. ELO: a–g.
A–	90-92		The student's work is excellent. It exceeds the course ELO in nearly all regards. ELO: a–g.
B+	87-89	Good	The student's work is very good. It exceeds the course ELO in the majority of regards. ELO: a–g.
B	83-86		The student's work is good. It exceeds the course ELO in some regards. ELO: a–g.
B–	80-82	Satisfactory	The student's work is wholly satisfactory. It fully meets all the course ELO. ELO: a–g.
C+	77-79		The student's work is satisfactory. It largely meets all the course ELO. At least 5 components of ELO: a–g.
C–	70-72	Marginal	The student's work is barely adequate. It fails marginally to meet all the ELO. At least 4 components of ELO: a–g.
D+	67-69		The student's work is weak. It fails to meet the course ELO in some regards. At least 2 components of ELO: a–g.
D	60-66	Failure	The student's work is inadequate. It fails to meet most of the course ELO.
E	<60	Failure	The student's work is inadequate. It fails to meet all of the course ELO.

The major component for the level of success the summative assessment results (final comprehensive MC test) will play a major role. Because this course is being offered for the first time, a baseline success rate will be established by examining the performance of the students after two to three semesters. The degree of engagement of the students evidenced by the interim short reports will also be used as an indicator. The interim reports together with the final MC test results and student exit questionnaire will be used as a gauge to detect student learning difficulties and improve the course's ELO and guide the required improvements for the subsequent offerings.

Development and Use of Online Tool for Multiple-Choice Exams
We will use an available tool, http://etest.elogi.com, [*Courtesy & Pers. Comm.*, H. Bâki Iz, *Hong Kong Polytechnic Univ.*, 2016] for generating the exams, students to take the exams, and the exams graded with results to the instructors, all online:

Instructor login:
http://etest.elogi.com/Instructor/en/
Username: instructor
Password: password

- The instructor uploads the attached test file and prepares the necessary information.
- The instructor takes the test by himself. His answers become the key.
- Student login to the site using the following URL and the information.

Student login:
http://etest.elogi.com/Student/en/
Assessment ID: assigned by the instructor (during test preparation)
Access Code: assigned by the instructor (during test preparation)

- Student takes the test.

Grades returned and recorded by http://etest.elogi.com

Additional work to Develop and Sustain the Proposed ASC Cross-Disciplinary GE Course
The three faculty members on the team proposing this cross-disciplinary GEC have met and have numerously discussions via phone calls or emails. We have also discussed/communicated with SES faculty including **Michael Bevis**, **Chris Jekeli**, **Larry Krissek**, **Frank Schwartz**, at OSU, **H. Bâki Iz**, at Hong Kong Polytechnic University, and with potential advocates, including **Dorota Grejner-Brzezinska** and **Frank Croft** (Civil, Environmental and Geodetic Engineering), **Craig Jenkins** (Sociology), **Joel Johnson** (Electrical and Computer Engineering), **Jay Martin** (Food, Agricultural, and Biological Engineering Department), **Jiyoung Lee** (Environmental Health Sciences, College of Public Health), and **Marty Kress** (Interim Director of Global Water Initiative). We have sought advice from **Steve Fink** (Associate Executive Dean, ASC). **Larry Krissek** and **H. Bâki Iz** have provided substantial help and advice on the proposed course development and this proposal.

During the course implementation stage, specific ELOs (**a–g**, see ***§Expected Learning Outcomes***) with be assigned to specific lectures associated with each topics.

During the course preparation and after the course is offered, the team (may be alternating with other faculty to teach the course) will focus on updating the course materials are updated relevant to the respective expertise of the lecturers, and respond to the SEI and course surveys. We will continue to seek opinions from advocates and critiques towards improving the course.

Academic Misconduct

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct, http://studentlife.osu.edu/pdfs/csc_12-31-07.pdf.

Students with Disabilities

Students with disabilities that have been certified by the Office for Disability Services will be appropriately accommodated and should inform the instructor as soon as possible of their needs. The Office for Disability Services is located in 150 Pomerene Hall, 1760 Neil Avenue; T: +1-614-292-3307; TDD: +1-614-292-0901; http://www.ods.ohio-state.edu/.

THE OHIO STATE UNIVERSITY

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David Manderscheid, Executive Dean
College of Arts and Sciences
University Hall
Campus

August 31, 2016

Dear Dean Manderscheid,

I am writing in my capacity as the Chair of the Department of Agricultural, Environmental, and Development Economics (AEDE) to endorse the proposal submitted by C.K. Shum, Alan Saalfeld, and Joyce Chen for the offering of a new team-taught, multidisciplinary General Education (GE) course called "Sensing Planet Earth Combining Remote Sensing and Socio-Economic Data to Understand the Human-Environment Interface." The course is proposed at the GE 2000-level (e.g., 2310) and intended to be taught annually commencing Autumn 2017. The proposing team involves a teaching pool of two professors from SES (Shum and Saalfeld) and one professor (Chen) from AEDE. The human-environment interface is the most critical one facing future generations. Without a better understanding of environmental processes and their interaction with anthropogenic climate change, we will be grossly underprepared for any adaptation, much less mitigation efforts. Remote sensing tools based on mostly optical/infrared sensors have been used, however, a suite of active geodetic remote sensing tools are now available to provide more accurate, detailed and timely information on a wide variety of environmental factors. But social researchers and policy makers have been slow to exploit these data from space- or airborne- based tools – in part because these are quintessentially "big data" requiring significant processing and analysis to extract useful measures. This course will also bridge disciplinary divides, resulting in minimal use of remote sensing data in socio-economic analyses, precisely at the time when it is most needed.

This course will address this gap, which exists not only in the academic literature but in policy analysis and planning efforts as well, in a truly cross-disciplinary manner. There is not yet such a GE course offered at The Ohio State University. Each faculty member of the proposal will address one critical aspect of the issue. C.K. Shum will introduce the basic principles of these active remote sensing tools; Alan Saalfeld will cover the associated visualization tools (e.g., Google Earth/Engine tools) to allow easy and efficient (without sophisticated computer or mathematics skills) data access. After students have received this basic training in the fundamentals of remote sensing data, Joyce Chen will introduce key topics in sustainability, resilience, adaptation, and mitigation, as well as basic methods to integrate socio-economic data with remote sensing data. She will also provide a brief introduction to regression analysis, giving students the basic tools to understand regression output and conduct simple analyses. All instructors will focus their attention on non-technical instruction – from a disciplinary perspective – in order to promote practical applications. However, disciplinary rigor will still be provided, to ensure that students understand the fundamentals upon which the instructional tools and models are built.

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We expect that this course will be of interest and use to students in our inter-disciplinary Environment, Economy, Development, and Sustainability (EEDS) major, and towards fulfilling the goal of their GE requirements. Employers are increasingly turning towards data-driven approaches, and sustainability is no exception. Those students who are able to utilize timely remote-sensing data to anticipate the impact of various sustainability policies will find those skills in high demand, and we look forward to providing this training.

Sincerely,

Timothy C. Haab
Professor and Chair

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To: Dean David Manderscheid and Associate Dean Steve Fink

From: W. Berry Lyons, Director, SES WBLyons

The School of Earth Sciences supports the submission of the proposed introductory, interdisciplinary course in remote sensing, cross-listed between SES and AEDE submitted by Prof. C.K. Shum. This course will provide non-science undergraduate students with a valuable overview of how remote sensing data are collected, and how remote sensing data can be used to improve the human condition. Thank you for these considerations.