Advanced Special Topics:
Environmental Data Visualization
ESM 439 – Winter 2019

Class times: Tuesdays and Thursdays 8:00–9:15 am, February 12 – March 14, 2019
(10 meetings)
Class location: GIS Lab (BH 3035)
Final project due during exam week: March 16-22

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Description: This course will focus on basic principles for effective communication through data visualization. Students who complete the course will deepen their understanding of how people perceive and interpret graphical representations, and will learn about information visualization frameworks they can apply to design intuitive and impactful data visualizations. Beyond effective visualization design, we will explore 'storytelling with data' -- integration of visual elements and text in a way that is clear, concise and engaging. Class time will consist of brief periods of lecture interspersed with small group and whole group discussions, peer critiques, and hands-on data visualization activities. Assignments will involve applying such frameworks and concepts in critique of existing visualizations, and in creation of data visualizations using popular software packages. We will focus on data visualization that can be done using tabular data (e.g., spreadsheets) and point-and-click software tools; assignments will not require experience with a coding environment or use of programming languages, but students already proficient with such tools may use them to complete course assignments, if desired. Students may use this short course to prepare and receive feedback on data visualizations that will be useful for other coursework or projects.

COURSE READINGS
TBA, will be provided through GauchoSpace

Pre-work: to be completed by February 8th
Enrolled students will receive information and reminders through GauchoSpace .

- **Submit data visualization and data:** Students should provide a data visualization they have created, and the data upon which it is based (e.g., a spreadsheet and chart created in Excel). These data and visualization files should be submitted via GauchoSpace. Students will benefit the most from the coursework if the data visualization they submit presents key information relevant to a topic they would like to communicate about. ***Students are encouraged to submit materials they have created as part of other courses or projects; creation of new materials is not necessary.***
- **Complete a short survey:** Students input provided via a brief survey will be used to tailor the focus of the course. Questions will focus on goals/expectations for the course, current use of data visualization tools, and data visualization skill self-

assessment. This survey will be available online approximately one week prior to the first course meeting.

ASSIGNMENTS
All assignments will be submitted digitally via GauchoSpace. Detailed assignment descriptions will be available through GauchoSpace.

Grading

	Due Date	**Value**
Pre-work	February 8	10 points
Observing your visualization in action assignment	February 17	10 points
Preparing your data with Tableau Prep assignment	February 24*	5 points
Trying out data visualization with Tableau assignment	February 24*	5 points
Visualization redesign assignment	March 1	10 points
Exam: visual design theory and best practices	March 5 (in class)	20 points
Visual storytelling: poster redesign assignment	March 10*	10 points
Visual storytelling: final project draft	March 13	10 points
Final project	March 22	20 points

* These activities will be mostly completed during the lab portions of class, but may require some additional work outside of class before submission.

SCHEDULED TOPICS AND ACTIVITIES

Week 1: Visual Perception and Cognition; Principles of Visual Design
(2 x 1.25 hrs) - *Feb 12 & 14*

We will begin by discussing students' existing ideas regarding what makes a good data visualization, and then proceed to lecture segments focusing on a brief overview of human perception and cognition of visual information, basic design principles, and multimedia communication principles. We will identify and apply ideas related to visual hierarchy in discussions of example visualizations we consider effective or ineffective.

Hands-on activity: Discussion of visual tasks and basic design principles associated with own and peers' pre-course data visualization submissions
Assignment: Observing a visualization in action (due February 17)

Week 2: Communicating Research Visually; Visual Variables and Basic Chart Types
(2 x 1.25 hrs) – *Feb 19 & 21*

We will identify some of the challenges we face when attempting to communicate about research data and findings, and discuss some ways to safeguard against inducing bias or misunderstanding in response to scientific data visualizations. We will explore the visual variables that can be used to represent data effectively, and gain a deeper understanding of how basic chart types rely on perceiving and performing visual tasks based on these variables. We will learn how to perform basic data preparation and chart creation using Tableau 10.1.

Hands-on activity: Introduction to Tableau and Tableau Prep: data preparation and basic chart creation

Assignment: Clean and shape a dataset and create a new data visualization using Tableau; describe rationale for choice of chart type and visual variables. (due February 24)

Week 3: Measurement Theory and Visual Design; Preparing Data for Visualization
(2 x 1.25 hrs) – *Feb 26 & 28*

We will begin by reviewing basic principles of measurement theory and examining how measurement properties of variables inform appropriate strategies for visual design. We will explore how selection, normalization, classification and simplification techniques can be used to prepare data for visualization. We will use existing data to practice these data preparation strategies, and apply appropriate visualization techniques to critique and re-design a variety of data visualizations.

Hands-on activity: Preparation and visualization of Global Sea Ice data
Assignment: Re-design a popular visualization of Global Sea Ice data; document choices and reasoning behind redesign with particular attention to data preparation techniques, intended audience, purpose, message and visual task (due March 1). **Study for exam covering key ideas in visual design theory and best practices. Exam will be administered in class on Tuesday, March 5.**

Week 4: Visual Storytelling; Infographics
(2 x 1.25 hrs) – *Mar 5 & 7*

We will begin by exploring visual storytelling genres and techniques, and review case studies that demonstrate (or fail to demonstrate) application of these techniques. We will examine infographics in some detail, and discuss strategies for using basic design principles and tools together with data visualization principles to create engaging visual representations that also tell a story based on patterns in data. We will practice techniques using both Excel and Tableau to create non-standard chart types such as dumbbell/DNA charts, waterfall charts, and diverging bar charts.

Hands-on activity: Visual storytelling practice: poster redesign (due March 10). **Exam covering key ideas from visual design theory and best practices (Tuesday, March 5, during class).**
Assignment: Visual storytelling: final project draft (due March 13).

Week 5: Design Tips and Inspiration; Typography
(2 x 1.25 hrs) – *Mar 12 & 14*

During the final week of class, we will focus on techniques for using typography effectively, overcoming special challenges faced for map-based visualization, and accessing resources for deepening or expanding data visualization skills (tutorials, courses, user communities), and also inspiring sources of information – in essence, a launch pad for the next steps with data visualization! We will also explore how charts can be integrated into Tableau dashboards to create web-ready interactive data visualizations. On the last day of class, we will spend ~15 minutes discussing course outcomes and student feedback for how to

improve the course and/or additional visualization-related skills or knowledge the students would like to acquire. (Students will also be invited to complete a survey providing more detail on these topics.)

Hands-on activity: Tableau Public, including dashboards and interactive graphics; peer review of final project drafts
Assignment: Final project! (due last day of finals week, March 22)

Final Project: Visual Design and Storytelling – *due Mar 22*
Students choose a dataset (of their own, or one provided by instructor), create one or more data visualizations based on this data, and apply visual storytelling techniques to combine visualization and text in a way that tells an engaging story about the topic of interest. This project may be a re-design and elaboration upon the pre-course data visualization submission or may be based upon any other dataset that is relevant to the student's interest. Students may choose the format in which to prepare their visual storytelling artifact – written documents, web pages, posters, slide decks, and video recordings are all acceptable.
To submit:

- Visual storytelling artifact
- Brief document (no more than 1 page) that describes:
    - the main intended message(s) of the visual story
    - the visual task(s) required to interpret the story
    - the visualization design choices and visual storytelling techniques applied to make the message engaging, intuitive, and impactful

The only exam for this course will be the one given on March 5th. There will be no final exam.