Advanced Special Topics:  
**Environmental Data Visualization**  
ESM 439 – Winter 2021

Class times: Tuesdays 3:30–4:45 pm, January 5 – March 10, 2021  
(10 meetings)
Class location: Zoom, link on GauchoSpace course page  
Final project due March 16

**Instructor:** Stacy Rebich Hespanha  
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Phone: 805-637-3229  
Office: Zoom ☎  
Office Hours: Thursdays 4:45-5:45 pm or by appointment

**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.

**Format:** This will be a 100% online course. Class meetings, discussions, and office hours will take place via Zoom. We will use breakout rooms to alternate between whole-class lectures and discussions and small-group work sessions and discussions. Because we will not be meeting in the lab, students should make arrangements to use a computer on which they can install a trial version of Tableau. Class meetings will be recorded and made available via GauchoSpace for later viewing and review.

**COURSE READINGS**  
TBA, will be provided through GauchoSpace

**Data visualization sample & pre-course survey:** *to be completed by January 11*th  
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; a .csv file and chart created in R; etc.). 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 during the first week of class, and must be submitted by January 11.

**ASSIGNMENTS**

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

**Grading**

Grades of **S** (satisfactory) or **U** (unsatisfactory) will be assigned at the end of the course. Students who have satisfactorily completed the final project and performed enough of the coursework to earn at least 70 points will receive an S grade. Students who earn less than 70 points total will receive a U grade for the course.

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Due Date</th>
<th>Value</th>
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<tbody>
<tr>
<td>Sample data visualization</td>
<td>January 11</td>
<td>5 points</td>
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<tr>
<td>Pre-course survey</td>
<td>January 11</td>
<td>5 points</td>
</tr>
<tr>
<td>Observing your visualization in action assignment</td>
<td>January 18</td>
<td>10 points</td>
</tr>
<tr>
<td>Preparing your data with Tableau Prep assignment</td>
<td>January 25</td>
<td>5 points</td>
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<tr>
<td>Trying out data visualization with Tableau assignment</td>
<td>January 25</td>
<td>5 points</td>
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<tr>
<td>Visualization redesign assignment</td>
<td>February 8</td>
<td>10 points</td>
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<tr>
<td>EXAM: visual design theory and best practices</td>
<td>February 9</td>
<td>20 points</td>
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<tr>
<td>Visual storytelling: poster redesign assignment</td>
<td>February 22</td>
<td>10 points</td>
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<tr>
<td>Visual storytelling: final project draft</td>
<td>February 28</td>
<td>10 points</td>
</tr>
<tr>
<td>Final project</td>
<td>March 16</td>
<td>20 points</td>
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**SCHEDULED TOPICS AND ACTIVITIES**

**Weeks 1&2: Visual Perception and Cognition; Principles of Visual Design**

(2 x 1.25 hrs) - Jan 5 & 12

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 January 18)

**Weeks 3&4: Communicating Research Visually; Visual Variables and Basic Chart Types**

(2 x 1.25 hrs) – Jan 19 & 26
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 viewers perceiving and performing a sequence of visual queries and tasks. We will learn how to perform basic data preparation and chart creation using Tableau 2019.4.

*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 January 25)

**Week 5 & 6: Measurement Theory and Visual Design; Preparing Data for Visualization**
(2 x 1.25 hrs) – Feb 2 & 9

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 February 8).

**Study for exam covering key ideas in visual design theory and best practices. Exam will be administered in class on Tuesday, February 9.**

**Weeks 7 & 8: Visual Storytelling; Infographics**
(2 x 1.25 hrs) – Feb 16 & 23

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.

*Assignment:* Visual storytelling: final project draft (due February 29).

**Weeks 9 & 10: Design Tips and Inspiration; Typography**
During the final weeks 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 first day of finals week, March 16)

Final Project: Visual Design and Storytelling – due Mar 16
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 sample data visualization submitted at the beginning of the course, 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 during class on February 9th. There will be no final exam.