Proposal Writing

ES383

Colby College, September 2018

Bigelow | Laboratory for Ocean Sciences

Hypothesis

- A tentative, testable, and falsifiable explanation for an observed phenomenon in nature.

- Some types of hypothesis
  - Simple: cause → effect
    - eg: smoking leads to cancer
  - Complex: multiple cause → multiple effect
  - Null hypothesis: no relationship
    - H0: There is no relationship between atmospheric CO_2 and global temperature.
  - Alternative hypothesis: an alternative to a discounted (usually null) hypothesis
    - H1: Increasing atmospheric CO_2 leads to increasing global temperature by trapping heat.
  - Statistical hypothesis: validated statistically

Abstract

- Provides background context or motivation
- States briefly the problem or the purpose of the research
- Includes the theoretical or experimental plan used
- Summarizes the principal hypothesis or expected findings
- Is concise, self-contained, and complete enough to appear separately in abstract publications
- Is optimally one paragraph (between 100 and 200 words) in length; length depends on the subject matter and length of the paper

Abstract

Annotated example taken from *Nature* **435,** 114–118 (5 May 2005).

One or two sentences providing a **basic introduction** to the field, comprehensible to a scientist in any discipline.

Two to three sentences of **more detailed background**, comprehensible to scientists in related disciplines.

One sentence clearly stating the **general problem** being addressed by this particular study.

One sentence summarizing the main result (with the words "**here we show**" or their equivalent).

Two or three sentences explaining what the **main result** reveals in direct comparison to what was thought to be the case previously, or how the main result adds to previous knowledge.

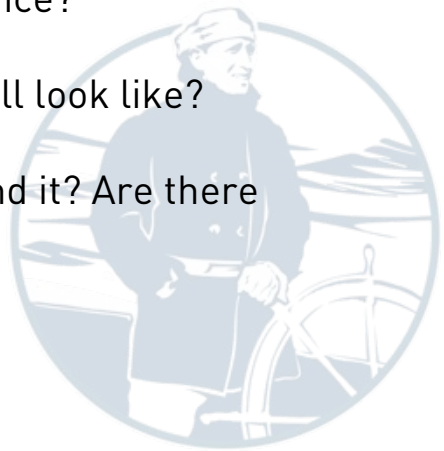
One or two sentences to put the results into a more **general context**.

Two or three sentences to provide a **broader perspective**, readily comprehensible to a scientist in any discipline, may be included in the first paragraph if the editor considers that the accessibility of the paper is significantly enhanced by their inclusion. Under these circumstances, the length of the paragraph can be up to 300 words. (This example is 190 words without the final section, and 250 words with it).

During cell division, mitotic spindles are assembled by microtubule-based motor proteins[1,2]. The bipolar organization of spindles is essential for proper segregation of chromosomes, and requires plus-end-directed homotetrameric motor proteins of the widely conserved kinesin-5 (BimC) family[3]. Hypotheses for bipolar spindle formation include the 'push–pull mitotic muscle' model, in which kinesin-5 and opposing motor proteins act between overlapping microtubules[2,4,5]. However, the precise roles of kinesin-5 during this process are unknown. Here we show that the vertebrate kinesin-5 Eg5 drives the sliding of microtubules depending on their relative orientation. We found in controlled *in vitro* assays that Eg5 has the remarkable capability of simultaneously moving at ~20 nm s^{-1} towards the plus-ends of each of the two microtubules it crosslinks. For anti-parallel microtubules, this results in relative sliding at ~40 nm s^{-1}, comparable to spindle pole separation rates *in vivo*[6]. Furthermore, we found that Eg5 can tether microtubule plus-ends, suggesting an additional microtubule-binding mode for Eg5. Our results demonstrate how members of the kinesin-5 family are likely to function in mitosis, pushing apart interpolar microtubules as well as recruiting microtubules into bundles that are subsequently polarized by relative sliding. We anticipate our assay to be a starting point for more sophisticated *in vitro* models of mitotic spindles. For example, the individual and combined action of multiple mitotic motors could be tested, including minus-end-directed motors opposing Eg5 motility. Furthermore, Eg5 inhibition is a major target of anti-cancer drug development, and a well-defined and quantitative assay for motor function will be relevant for such developments.

Hypothesis & Abstract

- A tentative, testable, and falsifiable explanation for an observed phenomenon in nature.
  - Is it tentative (i.e. not certain or obvious)?
  - Is it testable (can you envision a mesocosm setup that would test it)?
  - Is it falsifiable (what measurements could be made to confirm or refute the hypothesis)?
- Can you answer these question about the abstract
  - Why is the study being undertaken? Are you sold on its importance?
  - Can you picture (at a very general level) what the experiment will look like?
  - Can the abstract stand alone? I.e. could a non-expert understand it? Are there extraneous words or jargon?



Title

- Point to the outcome in the title
- Title should contain words that might be used in a keyword search
- Use plain, direct language

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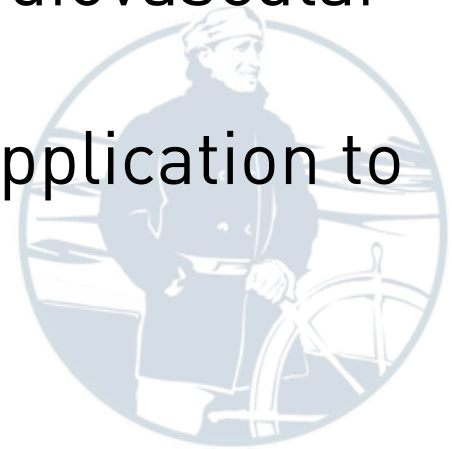
Title

- Examples of successful titles
  - Earth systems data solutions for dynamic resource management
  - **Genetic and Physiological Mechanisms of Local Climatic Adaptation in a Widespread Perennial Plant Species**
  - Negative Impact of Alcohol on Cardiovascular Neurobiology
  - DNA Replication Control and Its Application to Selective Killing of Cancer Cells



Title

- Some nice examples of **bad** titles
  - **How to mitigate climate change!**
  - **Human-Animal Conflicts in Kenya**
  - **A holistic survey of global lizards in order to understand lizard diversity and the roles lizards play in the ecosystems and to help start a lizard museum**
- **From: "How to write a bad proposal" by Colin Donahue**
  - http://colindonihue.com/2012/10/10/how-to-write-a-bad-research-proposal/

Introduction

- Lay the foundation of what is currently known
- Identify why your research question represents a knowledge gap
- Argue for the importance of filling this research gap

Introduction

- Citations: information should come from the primary literature
  - Despite its importance, fog has been difficult to study and to accurately forecast (Gultepe et al. 2007)
  - In contrast to the single-discipline approach, Weathers et al. (2014) propose considering coastal fog as a system (Fig. 1).
- Direct quotes are fairly rare – instead, try to paraphrase the take-home message
- Citations should then appear in "References" section (use consistent style – e.g. APA, MLA, Chicago…)

Introduction

- What to cite – it's a bit of a fine line
- Wikipedia-level information (very general): don't need citation
  - Maine's bivalve aquaculture industry is rapidly becoming an important component of the coastal economy. Marine microbes serve as the primary food-source for filter-feeding marine bivalves. Some potentially harmful microbes (e.g., harmful algal species, protozoan parasites, and *Vibrio* bacteria) can impart toxicity, pathogenicity, or cause mortality to a wide-range of economically important marine species, especially filter-feeding shellfish. These multiple microbial stressors of marine shellfish have the potential to negatively impact regional marine-based economies, the health of marine ecosystems, and in extreme cases both fishermen and seafood consumers. Monitoring and understanding these microbes is key to ensuring a safe and robust aquaculture industry in Maine.

Introduction

- Specialized or specific information should be cited
- Usually is scientific, hypothesis-driven, cause-effect
  - Biological threats to the health and safety of shellfish populations and aquaculture operations are generally thought to be increasing in prevalence and expanding into new regions with increased likelihood of becoming a persistent problem; in many cases (e.g. harmful algae) these changes in marine ecosystems appear to be climate-driven [1, 2]. Marine protozoan parasites have been associated with the collapse of shellfisheries worldwide [3]. In some cases, the expansion of the geographic range of these parasites has been associated with global warming of marine ecosystems [4, 5]. The harmful oyster parasite *Haplosporidium nelsoni* (a.k.a. MSX) was recently detected in Maine's Damariscotta River estuary [6] and as far north as Penobscot Bay [7]. We have also recorded a 15-65 fold increase for *Perkinsus* spp. (a.k.a. Dermo) in nearshore habitats of the Gulf of Maine [7]. Emerging data from the Baltic Sea region of Northern Europe suggest a similar 'northward advance' of *Vibrio*-based bacterial infections in humans that appear to be related to spikes in sea-surface temperatures at higher latitudes due to global climate change [8].

Materials and Methods

- Description of the experiment
  - Does it include a control?
  - What measurements will be made
  - How often will measurements be made
  - What analysis will be done?
  - Consider using a table or schematic
  - Be thorough but not excessive
  - You can cite method details in other papers without needing the full description

Broader Significance

- A final chance to sell your idea
  - How will the results advance the frontiers of science?
  - What positive outcomes will this work lead to?
  - How might the results change scientific practices, policy decisions, or generally benefit society?

Content vs Style

- Content
  - Background
  - Motivation
  - Hypotheses
  - Methods
  - …
- Style
  - Audience
  - Purpose (inform vs persuade?)
  - Expectations
  - Format
  - …

Complexity

- "Make things as simple as possible, but not simpler" -Einstein
- Too much complexity at the word level:
  - "The aforementioned design has the operationability required to facilitate the project goals"

Orwell's Six Rules

- Never use a metaphor, simile, or other figure of speech which you are used to seeing in print.
- Never use a long word where a short one will do.
- If it is possible to cut a word out, always cut it out.
- Never use the passive where you can use the active.
- Never use a foreign phrase, a scientific word, or a jargon word if you can think of an everyday English equivalent. *(*This one might not hold for a proposal.)*
- Break any of these rules sooner than say anything outright barbarous.

Figures

- Schematic

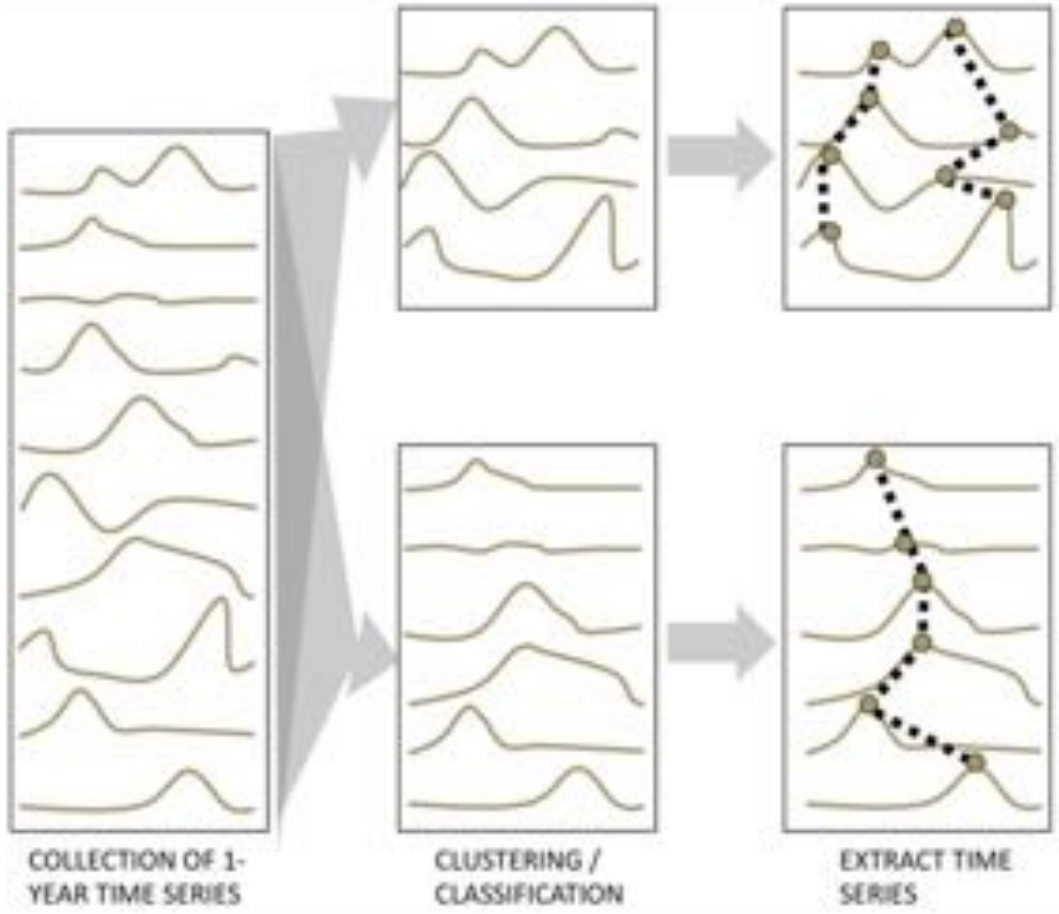
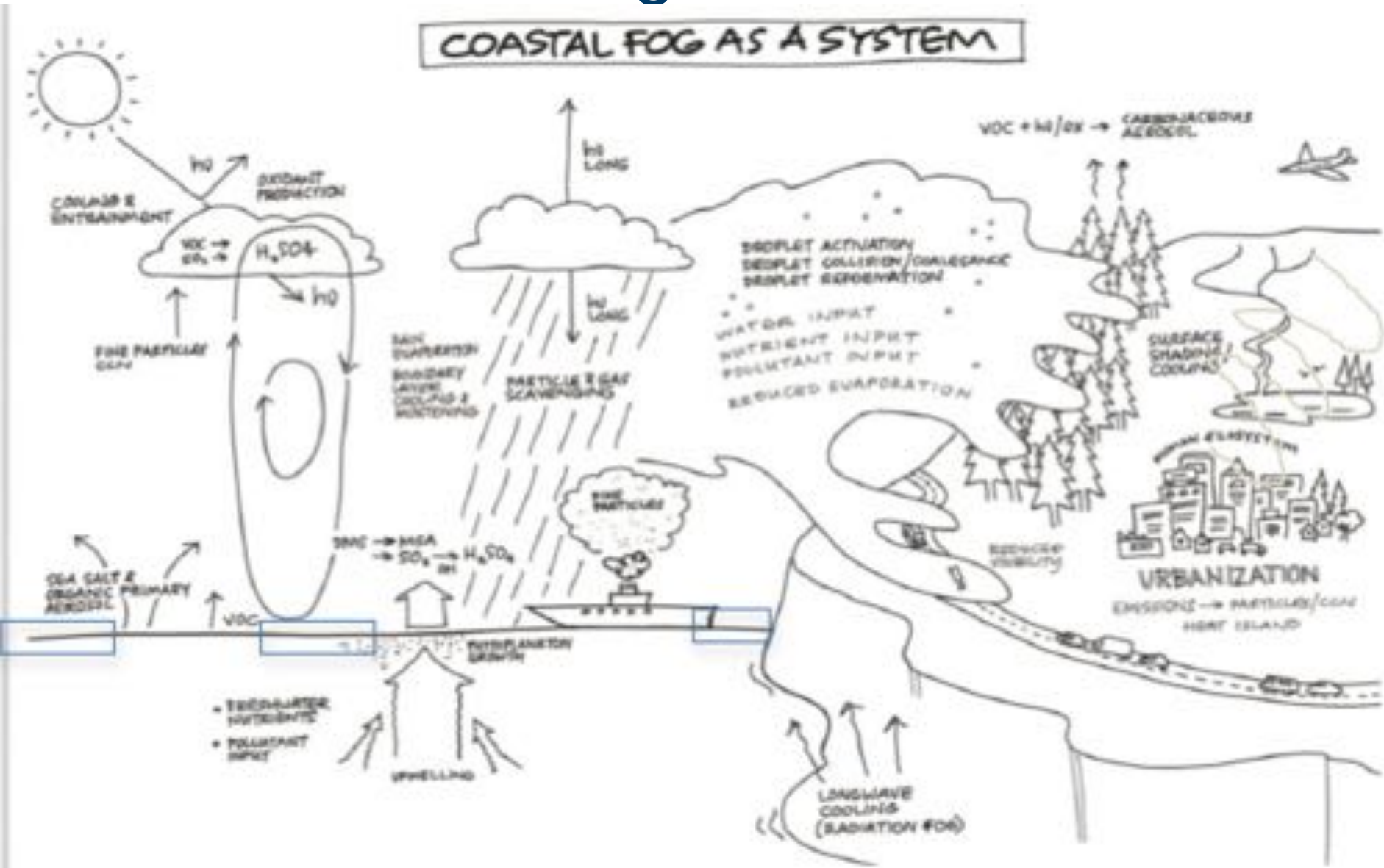


Figure 1 Schematic of two-step methodology for calculating phenological time series. Each curve represents a time series of a measurement made at one location for a single year. The first step is to classify seasonal patterns by their characteristic functional form. Here we've illustrated separating bimodal from unimodal curves. The second step is to extract phenological indices—shown hear as the timing of peaks.

Figures


COASTAL FOG AS A SYSTEM
hν
hν LONG
hν LONG
H_2SO_4
H_2SO_4
VOC
VOC + hν/ox → CARBONACEOUS AEROSOL
DROPLET ACTIVATION
DROPLET COLLISION/COALESCENCE
DROPLET SEDIMENTATION
WATER INPUT
NUTRIENT INPUT
POLLUTANT INPUT
REDUCED EVAPORATION
SURFACE SHADING / COOLING
URBANIZATION
LONGWAVE COOLING (RADIATION FOG)
UPWELLING

Figures

- Showing data

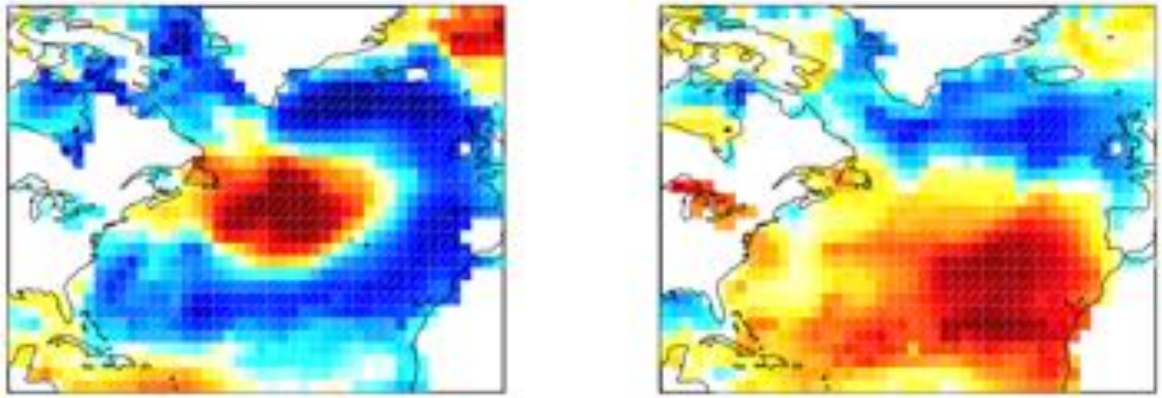


Figure 2 First two modes in empirical orthogonal function analysis of seasonal timing of maximum sea surface temperature across a portion of the North Atlantic. Yellow and red areas show positive loading, blue shows negative

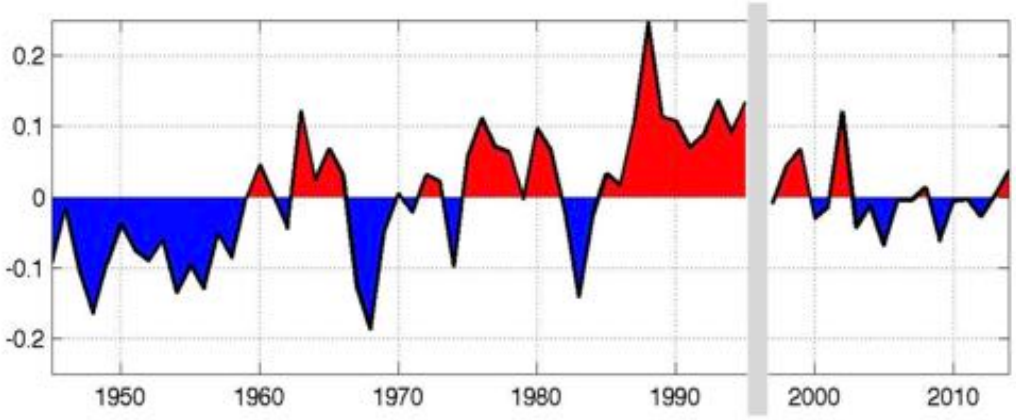
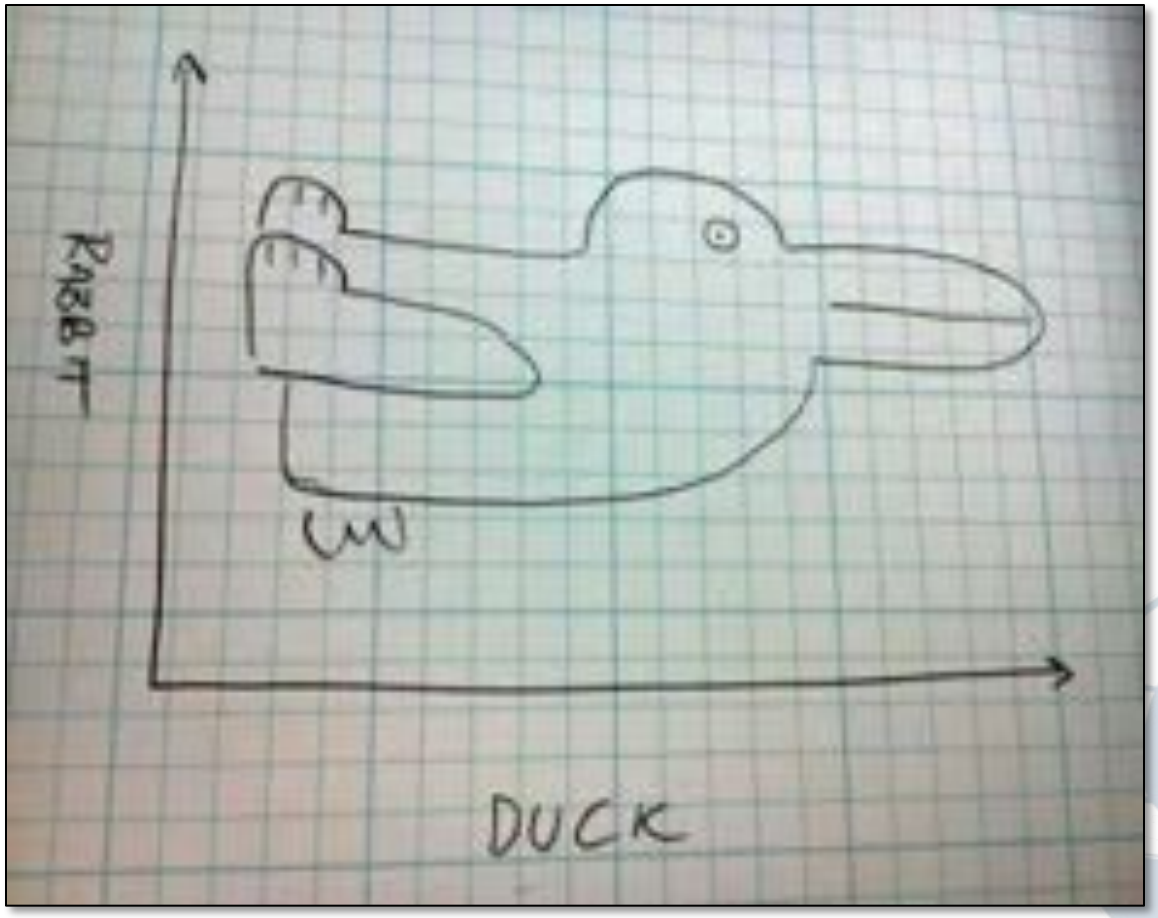


Fig. 2: Fog occurrence anomaly for Barrow, AK. Weather observations became automated at Barrow on 6/1/1998, requiring a break (pre- and post-1998) in statistical trends.

Figures

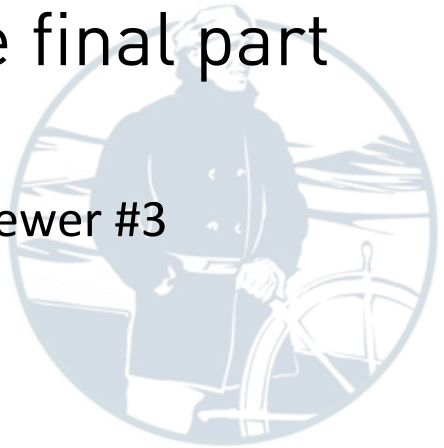
- Proper labeling of axis is absolutely crucial



Peer Review

- Beware of unprofessional review
  - "Despite their presentation of various colorful images, the authors entirely fail to diminish this quite apparent explanatory gap"
  - "I apologize first for being very late. I read the paper…then went on two, long camping trips."
  - "I deliberately skipped reading the final part of the manuscript."

- Reviewer #3



Proposal Grading Rubric

- Contents (~5 pages, not including references)
  - Title 5 %
  - Abstract 15%
  - Introduction 20%
  - Hypothesis 10%
  - Methods 10%
  - Broader Significance 10%
  - Schematic figure 10 %
  - Figure using R and cruise data 15%
  - References 5%

- Style
  - Consistent language. E.g. If you use first person, do so consistently. Same with tense.
  - Appropriate use of references
  - Lines of argumentation are clear and concise
  - Clear how methods address hypothesis
  - Compelling overall proposal

- Time line
  - Hypothesis: Sept 21
  - Draft for in-class peer review: Sept 28
  - Final proposal: Oct 2 (end of day, 11:59:59 pm)