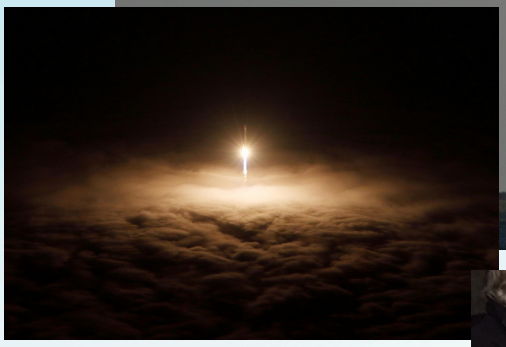
EOSC 211: Computer Methods in Earth, Ocean and Atmospheric Sciences

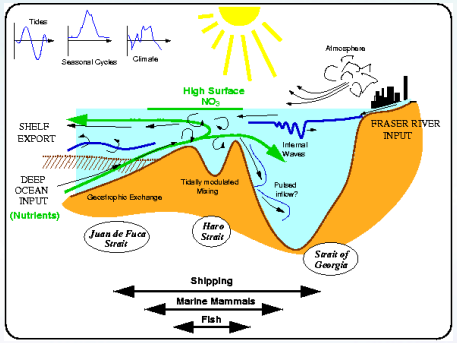
Week 1: Introduction

- Today's Class:
  - Introductions
  - Logistics:
    - syllabus, text, computer accounts, grading, workload, notes
  - Why MATLAB?
  - What can we do with it?
  - In-class exercise
  - Problem solving
  - To Do for next time

Who We Are and What We Do

- Instructors: Catherine Johnson and Rich Pawlowicz
- TAs: Georgia Peterson, Sam Stevens, Geena Littel





Course Logistics - I

…See course syllabus for details

- Canvas
  - We will use Canvas for disseminating notes, worksheets, labs etc and for you to hand stuff in.
- Class is built around labs:
  - “lectures” are mostly paper worksheets to prepare for labs (RP or CJ)
  - Tuesday class introduces concepts, Thursday summarizes…
  - “labs” are computer work, modeled to be “pieces” of a real problems. At least one instructor usually present plus TAs.
- Assignments:
  - like labs but more complex – like real problems.
- Mid-term + final are like in-class worksheets

Course Logistics - II

Week	Date	Lab	Assignments	Office Hrs Mon: 11 am-noon	Office Hrs Fri: 9:00-10:00am	Topic	Instructor
1	Sep 6	**no**	-	-	-	Introduction	**CJ**
2	Sep 11/13	Load/plot/scripts	-	-	-	Syntax & Variables	**CJ**
3	Sep 18/20	image/contour/indexing	-	-	yes	Data Structures	**CJ**
4	Sep 25/27	Claus.Clap.Eq/ Meshgrid/style	-	-	yes	Operators	**RP**
5	Oct 2/4	if/if-else/local slope		-	yes	Selection/Algorithms	**RP**
6	Oct 9/11	Running mean		-	yes	Loops/Algorithms	**RP**
7	Oct 16/18	**no**	**MIDTERM**	**yes**	**-**	Review	**CJ**
8	Oct 23/25	Running median function	A1 - part 1 due	-	yes	Functions	**CJ**
9	Oct 30/Nov 1	fprintf		-	yes	Text formatting / functions	**RP**
10	Nov 6/8	Debug existing code	A1 - part 2 due	yes	yes	Debugging	**RP**
11	Nov 13/15	interpolation		-	yes	Interpolation	**CJ**
12	Nov 20/22	**no**		-	-	Graphics	**RP**
13	Nov 27/29	**no**	A2 due	-	-	Review	**CJ**

Course Logistics - III

…See course syllabus for details

- Group Work class/exams
  - we will assign you a group (4-5 people/group)
  - we will use groups for in-class work
  - also a group component to exams
- "Pair Programming" in Labs
  - just like it sounds, work in pairs
  - enforced in first few labs, later up to you
  - assignments will be done in pairs (or max groups of 3)
- Collaboration, Copying and Plagiarism Policy
  - "For labs we encourage collaboration using a pair-programming method. However, you are expected to TRUTHFULLY REPORT: the name of your partner(s), and the level of collaboration. Using someone else's code and claiming it as your own is plagiarism and will be treated as such."

Course Logistics - IV

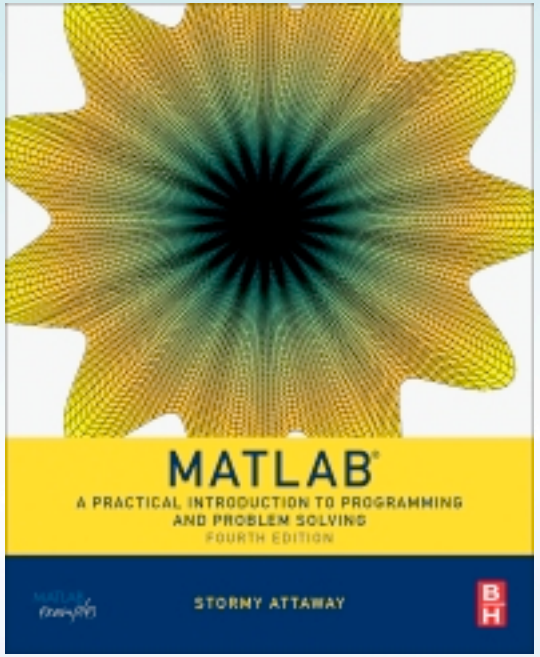
…See course syllabus for details

- Final Assessment
  - Labs 30%; assignments 25%, midterm 15%, final 25%; mini-quizzes 5%
  - IF you fail individual parts of midterm / final combined you fail the course.
- Labs
  - 9, but week 2 not graded and final mark is best 7 of remaining 8
  - Graded out of 10 – usually one of 10/8/5/0 mark
  - Due ELECTRONICALLY 4pm Fridays, they take more time then the 2-hr lab section
- Assignments
  - 2 of them 2 weeks each,
  - Letter grade
  - Due ON PAPER 4pm Wednesdays (except Part 1 of A1 which is due on Mon 10/22).
- Exams: Mid-term (in class) and Final (during exams)
  - 80% individual, 20% group

Course Logistics - V

…See course syllabus for details

- Getting access to MATLAB
  - need either an EOS account $25 for year
  - …OR…
  - Install MATLAB on your laptop and bring it to the lab (free for UBC students this year)
- Textbook (required)
  - TEXT: MATLAB: A Practical Introduction to Programming and problem Solving. At bookstore.
  - NB: The old text is “Problem Solving using MATLAB” (a custom text, no longer in print)



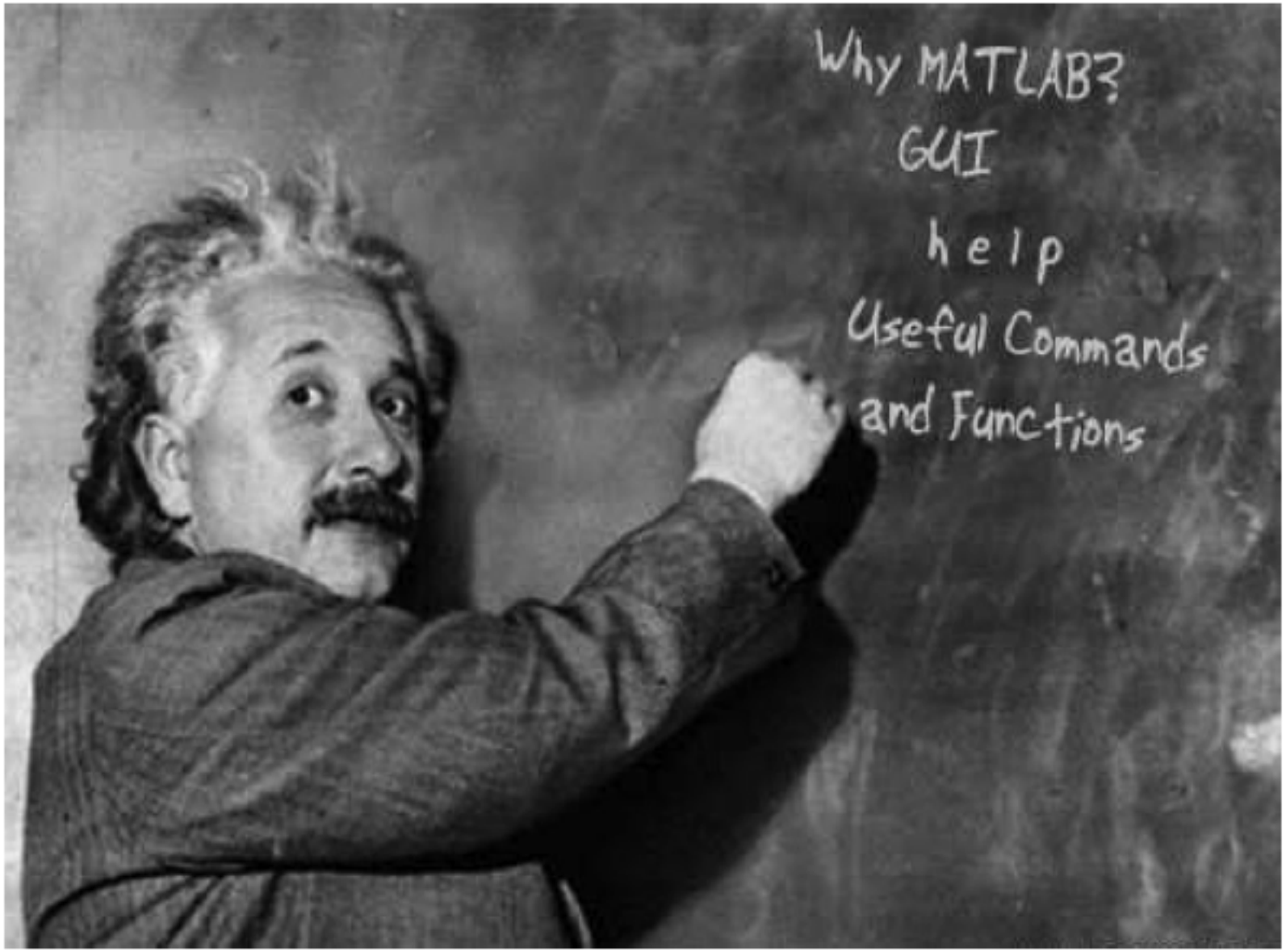
Course Logistics - VI

- Wait list
  - Moved everyone from waitlist into course last week.
  - Course is now FULL: waitlist is blocked and if you're not in the course already you will NOT get in.

But Now to More Fun Stuff…..

- Why MATLAB?
- What will you be able to do at the end of the course?

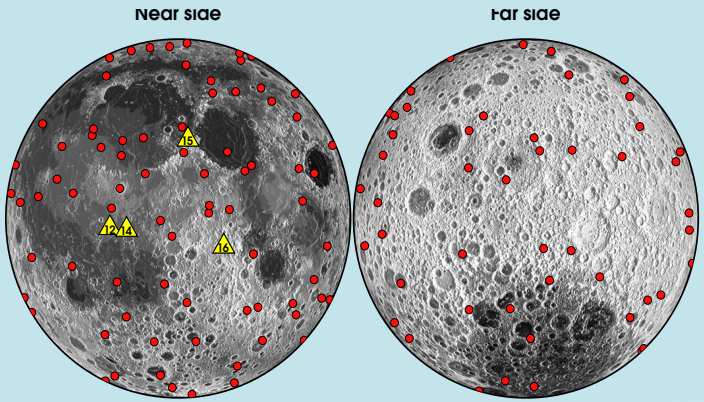
Why MATLAB?

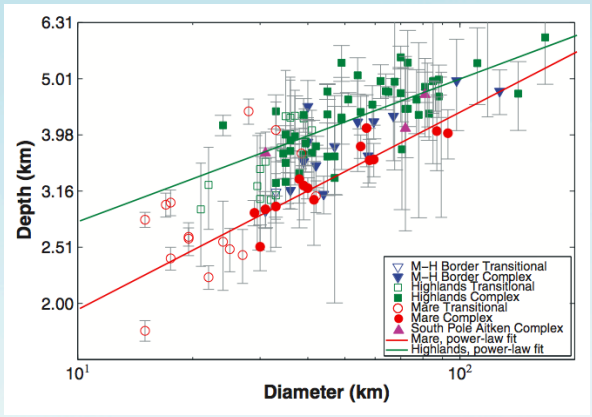


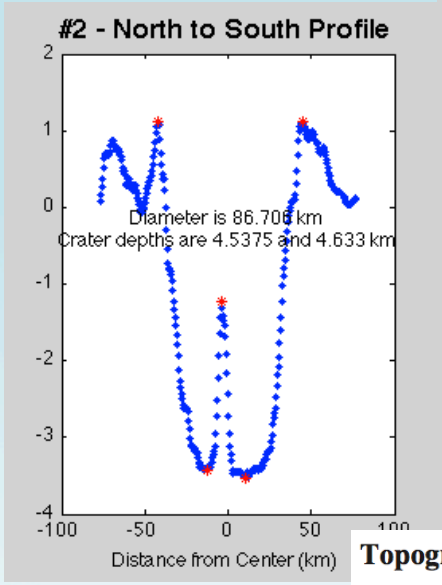
But Now to More Fun Stuff…..

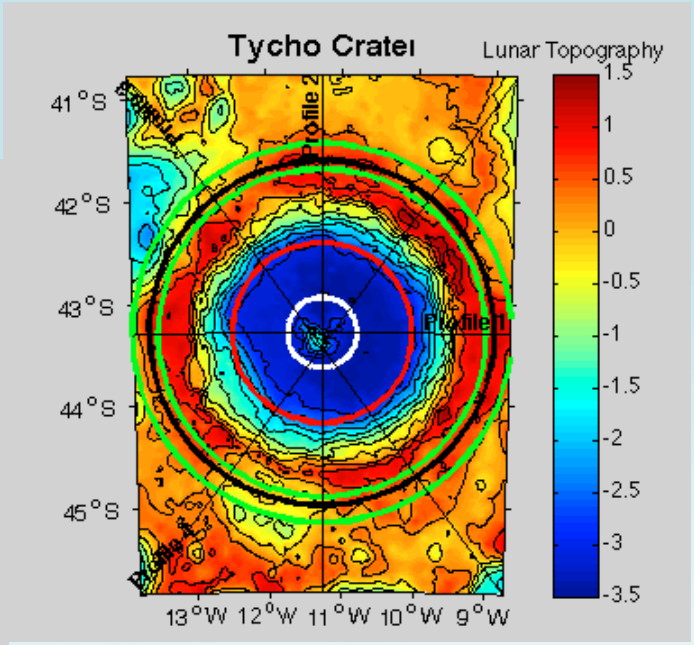
- Why MATLAB?
- What will you be able to do at the end of the course?
  - write computer programs to model and analyze data in the earth sciences

Examples ….









GEOPHYSICAL RESEARCH LETTERS, VOL. 40, 38–42, doi:10.1029/2012GL053608, 2013

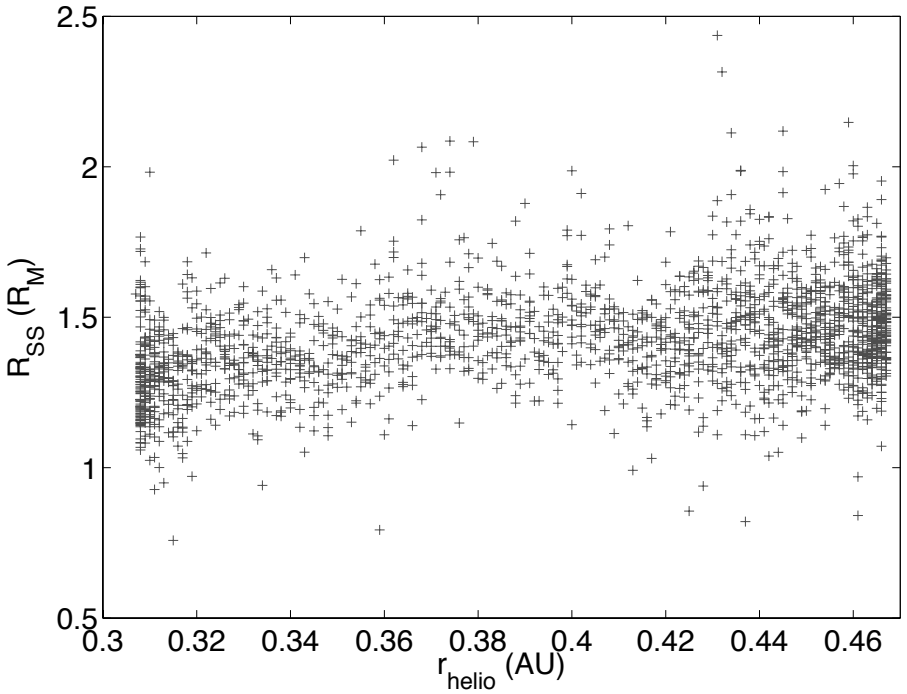
Topographic characterization of lunar complex craters

Jessica Kalynn,[1] Catherine L. Johnson,[1,2] Gordon R. Osinski,[3] and Olivier Barnouin[4]

- plotting: time series, geographically, histograms, contour plots
- extract data from given geographical region
- smooth data; deal with data gaps; compute variability in data
- compute a simple model and see how well it fits your data

Examples ….

- Here's an example of a data set where physics predicts that the quantity on the y axis will increase as the quantity on the x-axis increases.

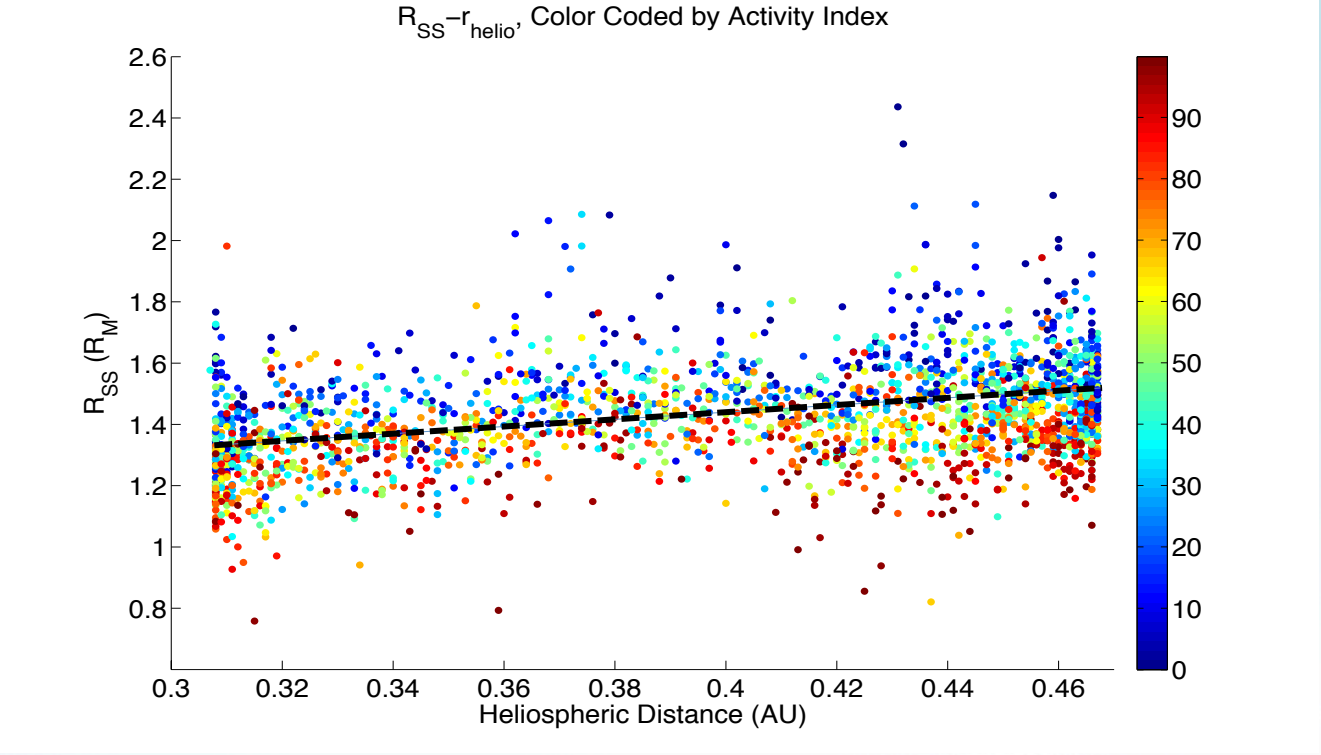


…hmmm…. well kinda… but……

- my points are hard to see – I could improve my plot
- what is all the scatter?

Examples ….

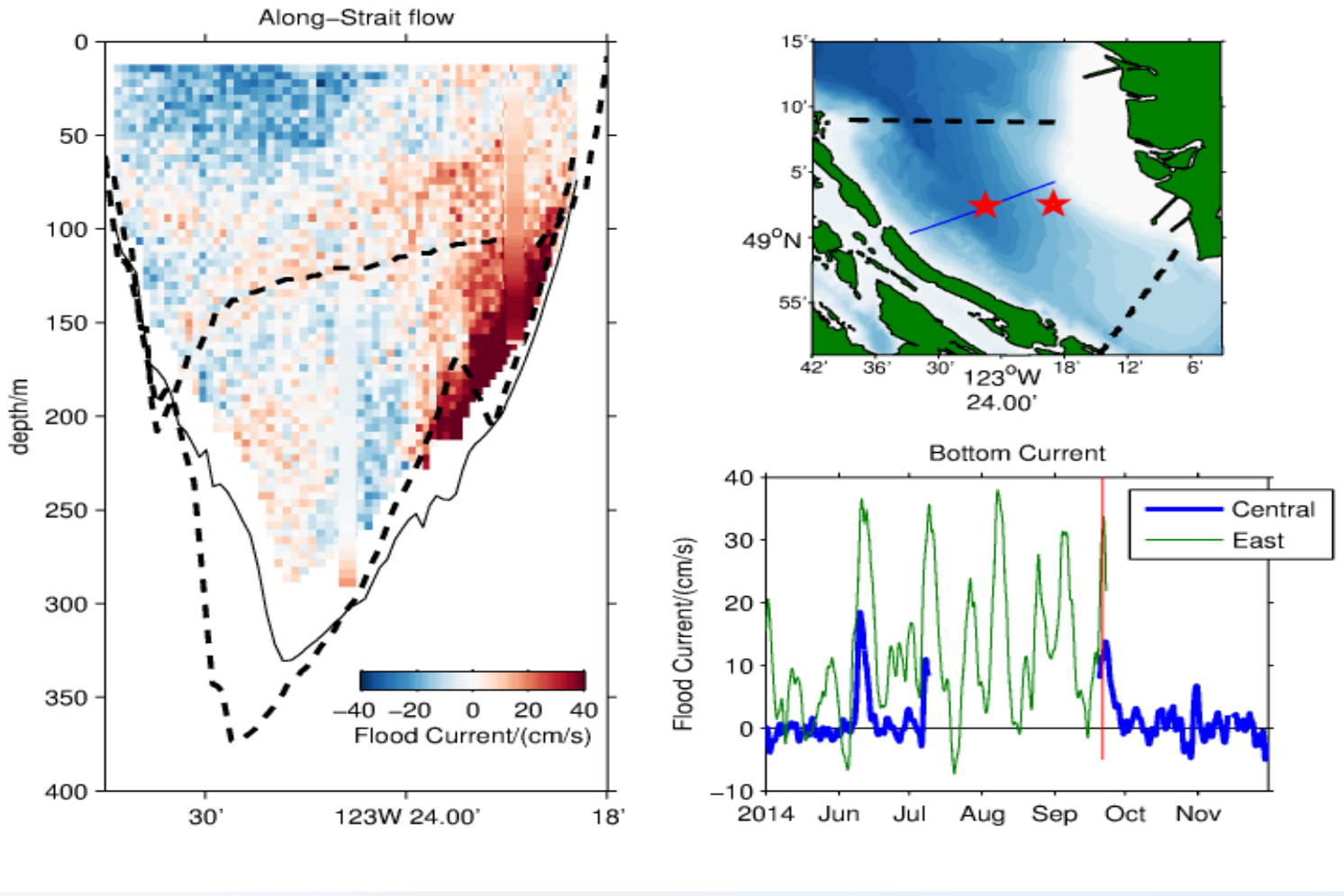
- I suspect that another quantity that I also measure might be playing a role. I can color-code my points by this quantity:



Now we can see that indeed this quantity is important.

- When it is high (reddish points) the quantity on the y-axis is systematically lower and vice versa

…a complicated figure comparing 3 different data sources measuring currents at different palces and times in the Strait of Georgia…



Deep-Sea Research I 101 (2015) 71–79

Contents lists available at ScienceDirect

Deep-Sea Research I

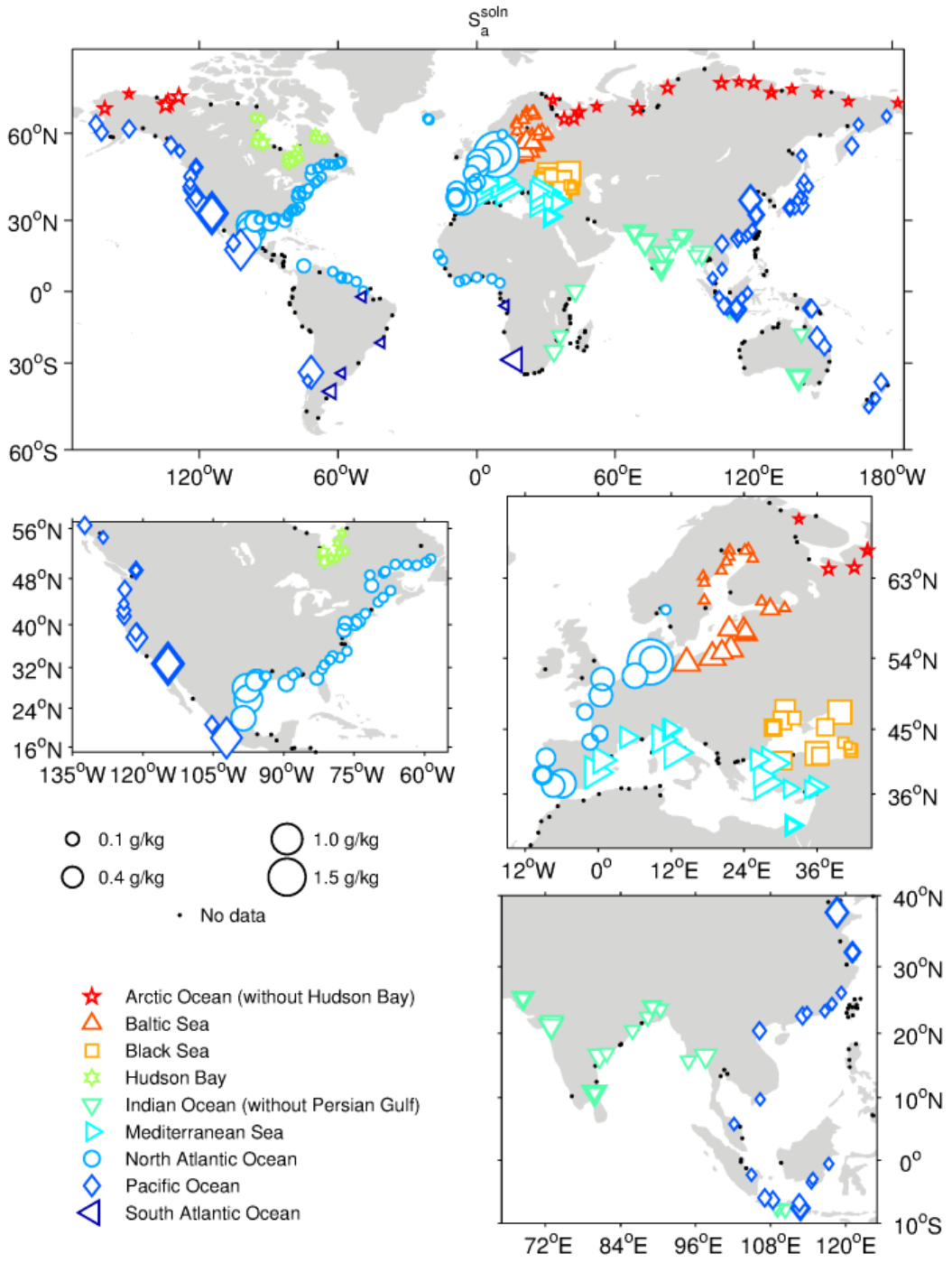
journal homepage: www.elsevier.com/locate/dsri

The Absolute Salinity of seawater diluted by riverwater

Rich Pawlowicz

Department of Earth Ocean and Atmospheric Sciences, University of British Columbia, 6339 Stores Rd., Vancouver, B.C., Canada, V6T 1Z

…or plot on a map to see spatial trends!

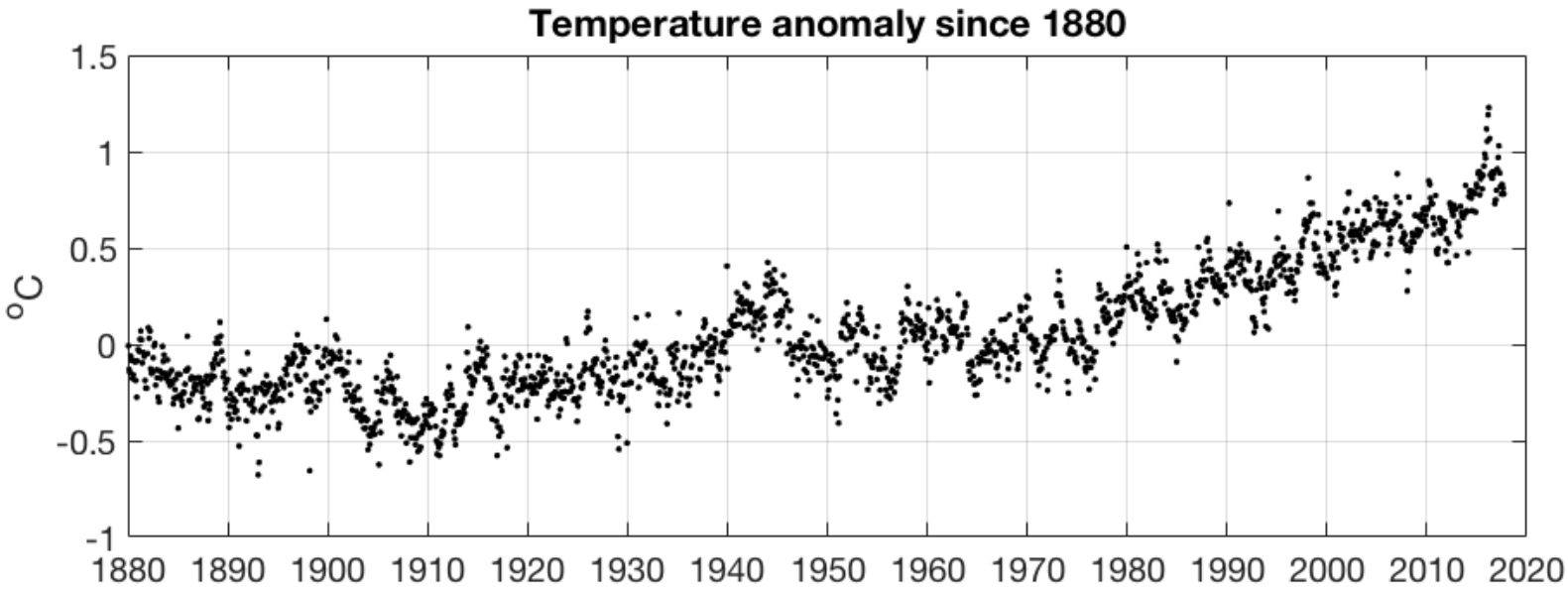


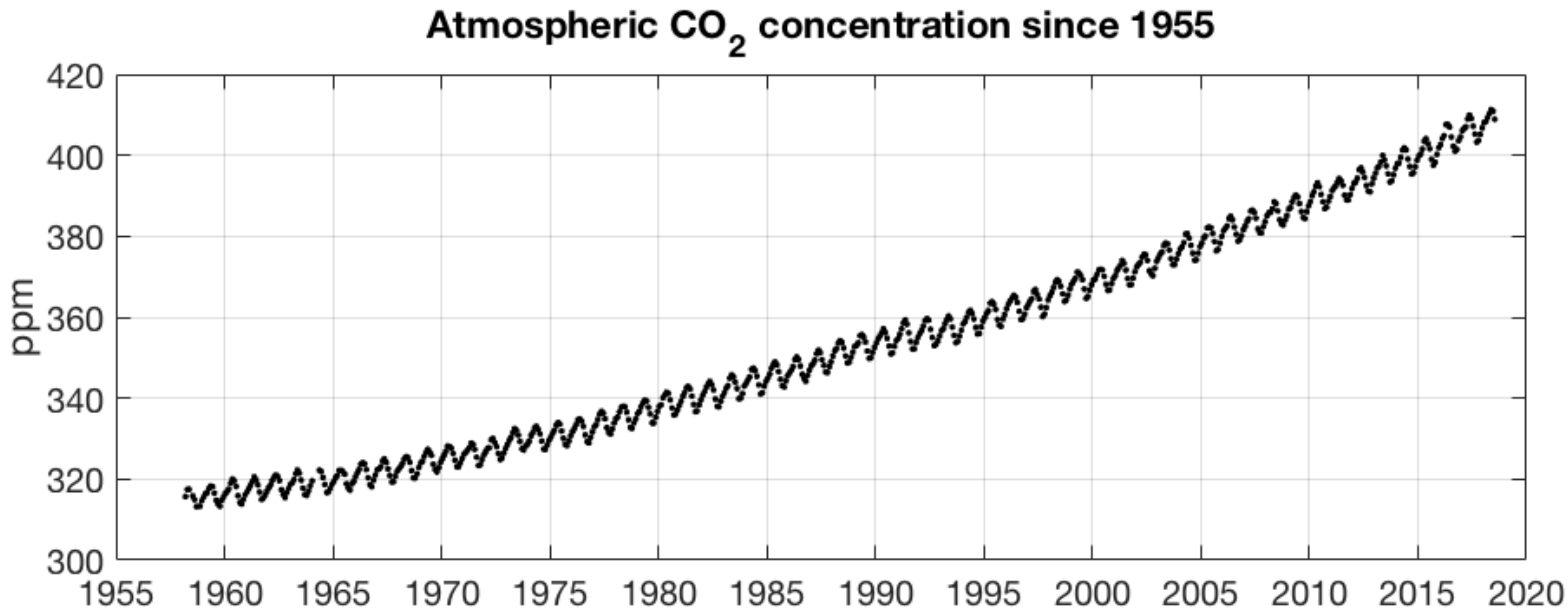
But Now to More Fun Stuff…..

- Why MATLAB?
- What will you be able to do at the end of the course?
  - write computer programs to model and analyze data in the earth sciences

- What we have to practice to get to this…
  - Breaking down a problem into a set of logical steps (an algorithm)
  - Writing and debugging MATLAB programs to implement your algorithm
  - Modifying existing code to make it more readable / efficient / well-documented
  - Creating scientifically informative and appealing plots

Worksheet


Temperature anomaly since 1880
°C
1.5
1
0.5
0
-0.5
-1
1880 1890 1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010 2020


Atmospheric CO2 concentration since 1955
ppm
420
400
380
360
340
320
300
1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020

5 Steps in Solving a problem

1. State the problem clearly
2. Describe inputs and outputs
3. Work the problem by hand for a simple set of data
4. Develop a MATLAB solution
5. Test with a variety of data

To DO for next week:

BEFORE first lab

- get computer account - $25: go to front desk in Earth Sciences Building, Room 2020, 9:00am-11:30 or 2:00-4:00pm
- See Ian or Alicia
- **Exact cash only**

OR

- Install MATLAB on your laptop (free for UBC students)

BEFORE TUES CLASS:

- Week02 reading
  - Pg 3-40, 75-80, 89-101 (parts of Chaps 1-3), and skim 557-564 (Appendix 1).