Alex K. Chen

Contact Information

Email: chenalexk@gmail.com
Website: http://www.geo.brown.edu/People/Grads/Chen/
Quora: http://www.quora.com/Alex-K-Chen
Google+: http://profiles.google.com/simfish

Research Interests

- Highly-generalizable climate modeling, with possible applications to paleoclimatology, idealized atmospheres, exoplanet atmospheres, and the future Earth millions of years from now.
- Astrobiology
- Long-term habitability and sustainability of the biosphere of both Earth and possible Earth-like exoplanets, similar to objectives outlined in the Lifeboat Foundation.

Education

Brown University, Providence, RI, USA

- PhD Student in **Geological Sciences Department**

University of Washington, Seattle, WA, USA

- B.S. March 2012
- Astronomy, Physics, and Mathematics,
- Minor in Applied Mathematics

Summer Programs

- SIMUW (Summer Institute of Mathematics at the University of Washington) Participant
- CASS 2011 (Computational Astrobiology Summer Symposium 2011 at the University of Hawaii - Manoa) participant - a summer program (primarily for graduate students) where we attended presentations from astrobiologists and proposed ideas for projects that integrate these topics with a new 3D CAVE visualization system.
- Unidata 2012 Users Workshop student participant. I presented a poster at the workshop.
- Advanced Climate Dynamics Course in Norway participant - attended a workshop on the interaction of climate and landscape on a range of timescales (from synoptic to tectonic). I did a presentation of my research at the workshop and participated in the write-up of an article that we are submitting to EOS.

Awards and Achievements

- Top Quora Writer in 2012 (officially nominated by the Quora Team)
- University Fellowship (Brown University)
- 2012 McCormick Fellowship (University of Chicago) - awarded to top applicants in its Physical Sciences Division
- Advanced Placement National Scholar (all through 8 self-studied APs - Calculus BC, Biology, European History, World History, Chemistry, Microeconomics, English Language, and Psychology)
- Qualifier for the American Invitational Mathematics Examination
- Entered the University of Washington 2 years early through UW Academy early entrance program

Self-Perceived Areas of Comparative Advantage

- Asking Questions, Finding Resources, Interdisciplinarity (particularly the intersection of Climate Science, Astronomy, and Biology), Chance-Configuration Thinking

SKILLS

Languages and APIs

- Comfortable: C, C++, MATLAB(with Curve Fitting Toolbox), Python (with Matplotlib and NumPy), FORTRAN (with OpenMP for parallel computing), LaTeX, HTML/CSS, R
- Some experience (but decaying with time): Java, Javascript, PHP
- Actively trying to learn (through asking questions on Quora and Stack Exchange) - I often get very rapid answers to my questions: Shell Scripting, vim

Applications and Other Technical Skills

- Mathematica, NCAR CCSM 3.0, NetCDF and ncview. Some experience with ENVI, Regular Expressions, and IRAF

Operating Systems

- Microsoft Windows family, Linux (Red Hat and Ubuntu), Android

RESEARCH EXPERIENCE

- May 2005 - November 2005: I did experimental research under the guidance of Dr. Victor Debattista and examined how the relationship between the peak velocity (maximum measured rotational velocity) and mean dispersion of a barred spiral galaxy is affected by its ellipticity. I used IRAF to measure the peak velocity and dispersion of a group of galaxies simulated by N-Body simulations, and wrote C code to process the data outputted from IRAF in order to test a hypothesis of bar formation, and wrote a short paper on it, titled *Measuring the Peak Velocity over Dispersion versus Ellipticity in a N-body Simulation of a Disk and Bulge Galaxy with no Rotation*. I found that for edge-on barred-spiral galaxies with an inclination of 90 degrees - that the relationship between peak velocity and mean dispersion does not seem to be affected by the galaxy's ellipticity.

- December 2005 - May 2006: Under the guidance of Prof. Zeljko Ivezic, I used SuperMongo to select subpopulations of stars (using parameter ranges such as SDSS color band, radial distance, radial velocity, and vertical distance from the galactic plane) from Data Release 6 of the Sloan Digital Sky Survey. I then made plots of the spatial and kinematic distributions of the stellar subpopulations I selected, which were then analyzed by Prof. Ivezic. Plotting these separate subpopulations of stars (of which there are many) helps us produce a 3D structure of the Milky Way. This project showed us that the observed disk of the Milky Way is more complex and asymmetrical than predicted by standard models, implying that the galaxy has had a more violent history than previously thought. This project ultimately resulted in two highly-cited publications and a press release.

- July 2009 - January 2010: With guidance from Dr. Eric Shea-Brown, I wrote a program (first in MATLAB, and then in C, for speed and memory capacity) to simulate neural spiking (when sufficiently depolarized, the neuron will "fire" and generate an action potential). The program then computed the correlation function between the firing rate and the stimulus (we tried two values of stimuli - constant stimuli and white noise stimuli, and various "time bins" to simulate the length of signal decay) - and used that correlation function to produce a diagram of the spike-triggered average stimulus, as well as histograms of the interspike intervals to see if they would match the theoretical model of a predicted Poisson Distribution. After plotting the correlation function over time for a Gaussian stimulus of varying variance values, our next objective was to try to match the figures from Figure 1.9 in Dayan and Abbott's *Theoretical Neuroscience* - unfortunately - unresolved issues I had with segmentation faults, combined with an intense course load of 5 intense courses in Winter 2010, forced me to halt the research for the remainder of the quarter, after which I switched to Astronomy. Were I to do this today though, I do believe that StackOverflow would have helped carry me through the segmentation faults.

- Spring 2010: For a class project on Astronomical Data Analysis, where I went beyond the requirements, I used a telescope to observe the galaxy M106 and then used IRAF to calibrate images of the galaxy (for noise and bias) so that I could then measure the galaxy's surface brightness profile. I then fit an exponential curve to its surface brightness profile so that I could determine that the SAB(s)bc galaxy M106 had a brightness curve that falls off with a Sersic parameter of 3.05, which is closer to that of elliptical galaxies than to spiral galaxies. My results are described at *Exponential Profile Fitting on the Unusual SAB(s)bc galaxy M106*.

- Summer 2010: Under Dr. Lynne Jones, I modified and ran Python code for a simulation of the self-calibration algorithm proposed for the future LSST telescope. This self-calibration helps us predict and reduce the difference between observed and expected magnitudes for stars in the sky, and our objective was to reduce the magnitude of this difference. Every 200 iterations, I generated a test restart file and a 2D plot of the sky and a histogram of the differences between observed and expected magnitudes. I then ran the code for each of the files so that the magnitude of the differences went below a user-specified tolerance. I generated a movie of these difference plots.

- 2010-2011: I worked with Prof. Zeljko Ivezic (the lead scientist of the Large Synoptic Survey Telecope) and Dr. Lynne Jones to write a Python program (with Matplotlib) for plotting the visual magnitude of the sky due to atmospheric noise and the motion of the moon and Sun across the sky. This is important for characterizing the true magnitudes of the very faint objects that the Large Synoptic Survey Telecope is designed to detect - as we have to subtract out the magnitude of this noise in order to get their true magnitudes.

- Winter 2011: For a class project under Prof. Cecilia Bitz, I ran CAM3 models of a tidally locked slab-ocean aquaplanet, and then compared the results (horizontal and vertical profiles of temperature, wind speed, and other variables) to those achieved in Joshi's *Climate Model Studies of Synchronously Rotating Planets* (2003), a paper that used the IGCM model. My results can be summarized in my short final paper for the project. My results were quite different from those of Joshi's, which could be the result of differing assumptions between the models that we can better hope to understand. I also ran CAM3 simulations of planets of various orbital configurations. The results can be summarized in a small paper, with sample simulation outputs here, though I have learned a lot since then, and may have gotten a few things wrong.

- June 2011-July 2012: With Dr. Ian Dobbs-Dixon and Prof. David Catling (and with some technical guidance from Prof. Cecilia Bitz and Prof. Dargan Frierson), continued to use CAM3 simulations of slab-ocean aquaplanets with the end goal of seeing what would happen if I changed the rotation rate and the land distribution of the planet, along with the mean molar mass of the planet's atmospheric constituents - in order to evaluate the suitability of the CAM3 model for simulating the Archaen Earth. I familiarized myself with the FORTRAN-based code of the CAM3 model, ran grep to find and change the hard-coded values of the planet's rotation rate and the atmosphere's mean molecular mass, and then examined how changing the planet's rotation rate affects both the atmospheric circulation and pole-to-equator temperature gradient. I've started to extensively detail my research at http://astroclimatology.wordpress.com, although much of the detail there is scratchwork I use to organize my thoughts (so I won't forget them) and to share them with immediate collaborators. My ultimate goal was to measure the contours of planetary habitability in a multi-dimensional parameter space - by varying parameters that are somewhat different to the ones from Courtney Dressing's fascinating paper.

  Due to various technical issues with CAM3 (e.g. breakdown of the meridional stream-function at 4X rotation rates and an inability to prescribe constant terrain albedo values in CAM3) that we only learned about as we went along, this project's ambition was scaled back to examining how CAM3 affects the scaling relationship between rotation rate and

the maximum speed of the jet streams. I was able to present this research at both the Unidata 2012 Users Workshop and the Advanced Climate Dynamics Course in Norway. A short paper describing the results can be found here. I've archived the outputs of the simulations on an external hard drive, which could eventually be useful for the Aquaplanet Experimental Project.

PUBLICATIONS

- 'From Floods to Faults: the Importance of Precipitation Variability'
  Wills, Robert et al, **(incl. Chen, Alex)**, to be submitted to EOS
- 'The Milky Way Tomography with SDSS. II. Stellar Metallicity'
  Ivezic, Zeljko et al, **(incl. Chen, Alex)**, Astrophysical Journal, **684**,287, 2008
- 'The Milky Way Tomography with SDSS: III. Stellar Kinematics'
  Bond, Nicholas et al, **(incl. Chen, Alex)**, Astrophysical Journal, **716**,1, 2010
- h-index: 2
- Google Scholar Citations Profile

PROFESSIONAL MEMBERSHIPS

- Member of the American Geophysical Union (2012-present)

OTHER

- Content Reviewer on Quora, and one of the top answerers in Astronomy, Neuroscience, Biology, Academia, Scientific-Research and Atmospheric Science. I am also a significant player in the site's growth (particularly with my questions), and am especially active in building up the science sections of the site. My profile is at http://www.quora.com/Alex-K-Chen
- I've also created and maintained numerous science-related boards on Quora, like boards for the Geosciences, Biology of Aging, Toxicology & Environmental Health, Exoplanets, my UNIX learning experience, and Atmospheric Science & Fluid Dynamics Educational Material, among many others.
- Panelist on Reddit AskScience, supporting member on Physics Forums, and active user on Stack Exchange
- Managed to get a 3.7 in a graduate-level neurophysiology course and 810 on the Biology GRE despite only having self-studied AP Biology (and had to self-study senior-level biology textbooks to achieve both ends). I also 'took' a graduate-level course in the Biology of Aging under Matt Kaeberlein without credit, and wrote some literature reviews+critiques for it.
- Volunteer for the public Personal Genome Project (Cohort PGP-1000), which allowed me to attend GET 2012. My full genome is now available online - a summary report is located here.
- I'm a voracious reader (though most of my reading was done in the past when I had more time) - a list of my all-time favorite books is located on Google Books
- I always like to keep up with the latest developments in technology, social media, and all the sciences.

- I often browse through climatology datasets (like NOAA Climate at a Glance and Western Regional Climate Center datasets) for fun.