

Curriculum Vitae - Nick Santos

Current Affiliations

- Geospatial Applications Programmer, UC Davis Center for Watershed Sciences, 2011-present
- Instructor, UC Davis Continuing and Professional Education/Coursera, 2013-present
- Software Developer, University of Oregon, 2017-present

Education

University of California, Davis

B.S. with honors in Environmental Policy Analysis and Planning, 2009

Minor in Geographic Information Systems

Enrolled, M.A. in Geography. Specialization in Geographic Methods, Models, and GIS. Expected 2019

Research Activities and Projects

Environmental Flows Optimization

Built application and framework for optimizing environment/economy tradeoffs at the stream segment level in California. Produces tradeoff curves and water allocations using data from the California Environmental Flows framework. Technologies: Python with Platypus for optimization, Django for web API, Azure Pipelines/Comet.ml for run tracking and learning.

Nitrate Loading Curves

Built Python implementation of Nitrate loading model for groundwater, based on initial MATLAB implementation from another programmer. Developed server-side code to run model and API, with web interface to configure, trigger, and manage the model. Technologies: Python/Django for API, Python for processing, JavaScript/Vue.js for web application

California Environmental Flows Framework

Provided geographic data support and development, as well as systems optimization analysis for the development of a stream flow framework based on stream hydrology, human impacts, and species composition and health. Developed statistical clustering of native fish species in the state to support development of functional flows metric. Technologies: Python for control and data management, ArcGIS/GeoDa/QGIS for clustering and visualization.

McMurdo Oceanographic Observatory

Developed custom software for capturing, storing, managing and displaying data, video, and ultrasonic audio coming from the McMurdo Oceanographic Observatory in McMurdo Station, Antarctica. Work included development of custom software to interface with specific instruments. Built a kiosk for display on station, set up restreaming of feeds to station TV, and set up infrastructure to pass limited media to public Internet. <http://moo-antarctica.net>. Technologies: Built Python package to communicate with CTD instrument, Python/Django/PostgreSQL for back end and API. Javascript/JQuery for front end kiosk.

PISCES

PISCES is software and data describing the best-known ranges for California's 133 native fish and numerous non-native fish. The data are compiled from multiple sources and are expert verified. Layers and the software can be downloaded online. My work was in authoring the software, database, and documentation. <http://pisc.es.ucdavis.edu>

Web-based Nitrate Decision Support

Developed a data portal for web-based viewing and download of modeled groundwater nitrate data in the Central Valley. Built data processing pipeline and website, and automated production of static and web-based maps. Technologies: Python/ArcGIS/GDAL for data processing. ArcGIS Server for spatial data hosting. HTML/GitHub Pages for website.

Estimating Evapotranspiration with METRIC and Landsat

In conjunction with evapotranspiration (ET) experts, I translated a model that helps estimate consumptive use of water through ET into JavaScript for use in the Earth Engine remote sensing environment. Additionally, I wrote significant Python code to help compare results from 7 different ET models for use by the State of California in selecting models for policymaking.

Streamlapse

Streamlapse builds time lapse videos of rivers with hydrographic and temperature data. Videos available at <https://vimeo.com/channels/streamlapse>.

Virtual Field Trips

Captured spherical imagery, audio, and localized scientific data for locations in the Tuolumne and Merced River Watersheds in Yosemite National Park and connected them together into educational virtual field trips. [Sample available here](#).

Amaptor

Amaptor is a Python library that unifies the mapping APIs between ArcMap and ArcGIS Pro. It allows developers to code against a single API for cross-platform applications. Free and open source.

Flood Mitigation

Developed calibrated statistical model (random forests) using Python, scikit-learn, and Django, to predict relocation sites for towns at risk of severe flood hazard. Modeled flood risk for small Midwestern communities using Hazus-MH.

Rapid Flood Assessment

Used remotely-sensed data to determine flooding extent at near-peak flooding within a few days of floods in Baton Rouge, LA, and Houston, TX. Used Sentinel 2 visible and near infrared data for Baton Rouge, and Sentinel 1 Radar data for Houston.

California Drought

We classified multiple years of Landsat imagery to estimate crop fallowing resulting from California's drought. Additionally, we are developing tools to optimize water deliveries based on water rights – my involvement has been in generating the hydrologic networks necessary for the economic optimizations.

Monitoring Amphibian Breeding with Remotely Sensed Imagery

Used Landsat and drone imagery to remotely monitor changes in montane meadow toad breeding habitat over the summer season.

Sierra Meadows

Generated hydrologic attributes for our layer of 17,000 Sierra Nevada mountain meadows. See <http://meadows.ucdavis.edu/>.

Cosumnes Research Group

Provided GIS, data management, video, and drone imagery for a multi-campus, multi-decade research study in process-based floodplain restoration.

arcpy_metadata

ArcGIS supports robust geoprocessing and map generation from Python, but provides no interface to add or edit metadata indicating what a program has done to a dataset. This open source library, initially written for PISCES, provides that programmatic interface to ArcGIS metadata from Python.

Climatic Variable Extraction

Built a general-purpose tool for extraction of climatic and elevation data to attach to meadows and catchments generated from dam locations.

Project Support

In addition to the project above, I have supported numerous other projects:

- Built tools for validating, exporting, and assessing hydrologic connectivity of HUC 12 subwatersheds.
- Developed data and tools to support assessment of California dams for ecological health of fish assemblages living downstream.
- Managed development of a web application for display and manipulation of time series agricultural economic data for California's Central Valley.

Software Libraries

In addition to software packages in the above projects, I have developed:

- dypy: A general-purpose backward dynamic programming solver for Python
- launchR: Easily integrates R code with Python code.
- Seabird_CTD: Command, control, and data collection code for Seabird conductivity, temperature, and pressure sensors on long-term deployment.
- USGS-API: Python wrapper for the USGS Water Data for the Nation API to download flow and temperature observations.
- Arcproject-wq-processing: Tools for extracting, transforming, and loading field-based data into a central database, plus tools to chart and download data
- EE-download: Python library to batch download assets from Google Earth Engine.

Other Projects

Climate Mirror

Started and managed a large volunteer effort to collect and provide online copies of climate research information for safety and redundancy. Involved infrastructure, management, and public fundraising.

<https://climatemirror.org>.

ShowerCap

Web application and mobile apps to guide and motivate individuals to reduce shower duration and save water. <http://showercap.us>.

Consumer Environmental Impact Reduction

Through Environmental Consumer, I built web-based tools to enable individuals to: 1) quickly send companies letters about their products' environmental performance; 2) look up profiles for municipal curbside recycling services to easily answer the question "is this recyclable?"; 3) Get answers to questions on how to reduce their environmental impact.

Vote Climate Change

My fellowship project for Roosevelt Institute. A web application allowing individuals to very publicly tell elected officials that votes they received were because of their position on climate change.

Consulting

Recent projects in consulting include [web mapping and applications](#) for the Tahoe Rim Trail Association and GIS services for Nevada County [Municipal Services Review](#) and GIS support for riparian restoration in a major San Francisco Bay Area watershed. Past projects include web-based applications for viewing and delivery of commercial digital photography and a web application for collaborative writing of fiction.

Courses Taught

- Instructor for the [Coursera Specialization in GIS](#), equivalent to ~2 quarters of GIS training – 70,000 student learners as of August 2019 and 4.8/5 rating on over 1000 reviews. Ranked 2nd highest in Data Science on Coursera. Courses are designed to cover four weeks each and include eight hours of lecture and screencasts, eight quizzes, four required tutorial assignments, additional optional practice, links to documentation, resources, and communities, and follow-along materials for all screencasts. Each course finishes with a final assignment that learners must complete on their own. The specialization focuses on the ArcGIS Desktop suite, with increasing use of ArcGIS Pro, QGIS, Python, and web GIS technologies as we update the courses in 2019. By the end of the specialization, a learner will be able to execute accurate spatial analysis projects from conceptualization to map production.
 - [Fundamentals of GIS](#): Runs weekly, since February 2016
 - Learners get a complete introduction to GIS, including history, data types, geoprocessing, map production, and coordinate systems. Upon completing the course they should be able to execute simple GIS analysis projects from obtaining data through analysis and producing a print map.
 - [GIS Data Formats, Design, and Quality](#): Runs weekly, since April 2016
 - Learners gain skills in data formats, types, and structures, including database concepts. They also learn spatial data editing, including topology and how to assess sources of error in spatial data. They will understand how to subset and query data, run field calculations, and chain together actions into simple but powerful workflows. The course culminates in a significant analysis that learners publish as a web map.
 - [Geospatial and Environmental Analysis](#): Runs every two weeks, since June 2016

- Learners become familiar with 3D data and utilize digital elevation models. The course includes an in-depth unit on projections and coordinate systems and introduces new geoprocessing operations and advanced cartographic tools. Throughout the course, I weave screencasts where I execute a project from conceptualization, through obtaining data, exploratory analysis, planning, and generating analysis products, and into map production. Learners get to hear my thought process, see actual challenges and errors I encountered, and understand the full lifecycle of a GIS project. The final assignment is designed to be especially challenging and require students construct a multi-step workflow to complete.
 - [Imagery, Automation, and Applications](#): Runs monthly, since August 2016
 - Learners become familiar with remote sensing and image analysis techniques, as well as running complex analyses with automation such as modelbuilder and Python. The course introduces suitability analyses as an advanced workflow, and touches on many other advanced topics learners may want to pursue after completing the specialization. It culminates with an assignment requiring learners to conceptualize and execute a remote sensing image classification analysis.
 - [Capstone Project](#): Runs every two months, Since October 2016
 - Learners build and execute their own analysis over eight weeks. The first two weeks are dedicated to identifying a question they want to analyze. The third week is for identifying data sources and a potential analysis workflow. Weeks four through six are for executing the analysis and producing the data products. Week seven is for producing a print map and week eight is where they produce a web map. The course includes resources to remind learners of skills and techniques, as well as new content for how learners can effectively present content on the web.
- GIS for Resource Managers and Professionals, fall 2013, 2014, 2015 and 2016
- GIS for Watershed Analysis: Intermediate, fall 2013 and 2014
- GIS for Watershed Analysis: Advanced, fall 2013 and 2014

Professional Activities and Awards

- Member:
 - Society for Conservation GIS
 - Association of American Geographers
 - URISA
 - Gamma Theta Upsilon – International Geographic Honor Society
 - California Water and Environmental Modeling Forum
 - BayGeo
- 2019: Awarded \$10,000 in Azure cloud computing credit from Microsoft
- 2018: Awarded \$5,000 John Muir Graduate Fellowship
- 2018: Affiliate of UC Davis Data Science Initiative
- 2018: COMPASS Science Sentinels Fellowship for Science Communication
- 2012: Fellowship: Roosevelt Institute: Pipeline Fellow for climate change
- 2012: Cofounder, Nevada County Hackers
- 2011: Award, best data integration for poster on PISCES at 2011 Esri International User Conference
- Open source code publishing for open data access (nickrsan on [github](#), [bitbucket](#))
- Active in StackExchange GIS community ([nickrsan](#))

Academic and Professional Service

- 2019: Member of UC Davis Geography Graduate Group curriculum committee
- 2019: Member of SCGIS website committee
- 2018-2019: Member of UC Davis Geography Graduate Group seminar committee
- 2015-2017: Member and administrative support for Sierra Commons, a nonprofit coworking space and business development group in Nevada County
- 2014-2017: IT and website assistance for Sierra Streams Institute
- 2016: GIS for San Juan Ridge Taxpayer's Association in support of their campaign against a local gold mine.
- 2014: Supported redevelopment of YubaShed data portal for the South Yuba River Citizen's League (SYRCL)
- 2010: Volunteered as a docent at UC Davis Tahoe Environmental Research Center (TERC)'s Ericson Education Center.
- General advice and assistance to UC Davis students and staff outside of the scope of my work.

Talks, Presentations, and Media Appearances

- 2019: Evaluating Tradeoffs of Environmental Flows Using Evolutionary Algorithms. Presentation at the 2019 Joint American Fisheries Society/The Wilderness Society Conference. Reno, NV.
- 2019: Evaluating tradeoffs of environmental flows using evolutionary algorithms. Presentation at the 2019 Society for Conservation GIS Conference. Pacific Grove, CA.
- 2019: Using Python for Field Calculations in ArcGIS and QGIS. Presentation to Maptime Davis. Davis, CA.
- 2018: Santos, Alexander, Bell, Scheer, and Medellin-Azuara. *Building the METRIC ET Model in Google Earth Engine*. Presentation at the 2018 California Water and Environmental Modeling Forum Conference. Folsom, CA
- 2018: Santos. *Tasks, Problems, and Solutions for GIS in Python*. Presentation to Maptime Davis. Davis, CA
- 2018: Santos. *Rapid Response Mapping for Hazard Mitigation*. Brownbag presentation. Davis, CA
- 2016: Media appearances in Washington Post, San Francisco Chronicle, BBC Morning News, ABC World News Tonight, among others for work on [Climate Mirror](#).
- 2016: Santos, Bell, and Viers. [PISCES and arcpy metadata](#). Presentation at the 2016 Society for Conservation GIS Conference. Pacific Grove, CA.
- 2014: Viers and Santos. [HydroLapse videography: a coupled hydroinformatic stack for improved visual assessment of river dynamics](#). Proceedings of the International Conference on Hydroinformatics. New York, NY.
- 2014: Santos. [Remote Sensing, Event-Based Monitoring, and Change Detection Using Off-the-Shelf Hardware](#). Presentation to *Groundtruths and Airwaves*. Berkeley, CA.
- 2013: Santos and Viers. *Integration of Geospatial Technology into Multidisciplinary Biophysical Monitoring and Research*. Presentation at the Esri International User Conference. San Diego

Selected Published Works and Presentations

- Howard, Fesenmeyer, Grantham, Viers, Ode, Moyle, Kupferberg, Furnish, Rehn, Slusark, Mazor, Santos, Peek, and Wright. [Getting Strategic about Freshwater Biodiversity Conservation in California](#). California Water Blog. 11/4/2018
- Medellín-Azuara, J., Paw U, K.T., Jin, Y. Jankowski, J., Bell, A.M., Kent, E., Clay, J., Wong, A., Alexander, N., Santos, N., Badillo, J., Hart, Q., Leinfelder-Miles, M., Merz, J., Lund, J.R., Anderson, A.,

- Anderson, M., Chen, Y., Edgar, D., Eching, S., Freiberg, S., Gong, R., Guzmán, A., Howes, D., Johnson, L., Kadir, T., Lambert, J.J., Liang, L., Little, C., Melton, F., Metz, M., Morandé, J.A., Orang, M., Pyles, R.D., Post, K., Roosevelt, C., Sarreshteh, S., Snyder, R.L., Trezza, R., Temegsen, B., Viers, J.H. [A Comparative Study for Estimating Crop Evapotranspiration in the Sacramento-San Joaquin Delta-Final Report, Appendix set, and project datasets](#). Center for Watershed Sciences, University of California Davis, 2018.
- Pinter, Santos, and Hui. [Preliminary Analysis of Hurricane Harvey Flooding in Harris County, Texas](#). California Water Blog. 9/1/2017
 - Santos, Nicholas. 2017. Watershed Analysis in GIS: A Spatial Workbook. <https://leanpub.com/gis-watersheds>
 - Harter, T., K. Dzurella, G. Kourakos, A. Hollander, A. Bell, N. Santos, Q. Hart, A. King, J. Quinn, G. Lampinen, D. Liptzin, T. Rosenstock, M. Zhang, G.S. Pettygrove, and T. Tomich, 2017. *Nitrogen Fertilizer Loading to Groundwater in the Central Valley*. Final Report to the Fertilizer Research Education Program, Projects 11-0301 and 15-0454, California Department of Food and Agriculture and University of California Davis, 333p., <http://groundwaternitrate.ucdavis.edu>
 - Pinter, Santos, Hui, and Schaefer. [New Baton Rouge flood map shows limits of current risk and planning methods](#). California Water Blog. 8/28/2016
 - Grantham, T. E., K. A. Fesenmyer, R. Peek, E. Holmes, R. M. Quiñones, A. Bell, N. Santos, J. K. Howard, J. H. Viers, and P. B. Moyle. 2017. [Missing the Boat on Freshwater Fish Conservation in California](#). Conservation Letters 10 (1).
 - Howard, J. K., K. R. Klausmeyer, K. A. Fesenmyer, J. Furnish, T. Gardali, T. Grantham, J. V. E. Katz, S. Kupferberg, P. McIntyre, P. B. Moyle, P. R. Ode, R. Peek, R. M. Quiñones, A. C. Rehn, N. Santos, S. Schoenig, L. Serpa, J. D. Shedd, J. Slusark, J. H. Viers, A. Wright, and S. A. Morrison. 2015. [Patterns of Freshwater Species Richness, Endemism, and Vulnerability in California](#). PLoS ONE 10 (7):e0130710.
 - Santos. [Finally, a one-stop shop for locating California's fishes](#). California Water Blog. 11/8/2015
 - Viers and Santos. 2014. [HydroLapse videography: a coupled hydroinformatic stack for improved visual assessment of river dynamics](#). Proceedings of the International Conference on Hydroinformatics. New York, NY.
 - Santos, Katz, Viers, and Moyle. 2014. *PISCES: a programmable information system for management and analysis of aquatic species range data*, Environmental Modelling & Software. <http://dx.doi.org/10.1016/j.envsoft.2013.10.024>
 - Viers et al. 2013. [Montane Meadows in the Sierra Nevada: Changing Hydroclimatic Conditions and Concepts for Vulnerability Assessment](#). Center for Watershed Sciences Technical Report. :63.
 - Santos. *Changing our Culture of Consumption*. Book chapter in "Millennials Speak. Essays on the 21st Century."
 - Santos. [Getting to Sustainability: I Have Seen the Enemy and He is Us](#). Blog post for Environmental Consumer. 9/27/2012
 - Santos. [Environmentalism Can't Succeed Without Good Citizens and Good Consumers](#). Blog post for the Roosevelt Institute. 8/9/2012
 - Santos. [Three Reasons the GOP Should Have No Problem with Meatless Mondays](#). Blog post for the Roosevelt Institute. 7/30/2012.
 - Santos. [Seven Reasons Climate Change is a Fact, Not a Belief](#). Blog post for the Roosevelt Institute. 12/14/2011
 - Santos and Gee. [Sierra Climate Change Toolkit](#). Book distributed to planners and resource managers. January 2011.
 - Santos. *Climate Change Case Studies Volume 3: Sacramento Area Council of Governments' Rural-Urban Connections Strategy*. October 2010.
 - Santos. *Climate Change Case Studies Volume 2: The GEOS Institute's ClimateWise Process*. October 2010

- Atwell, Burow, and Santos. *LED Standard Traffic Signals*. Published in 25 Ideas to Solve the Energy Crisis (Spring 2007).
- Santos. *Congestion Charging in Large Cities (Big City Car Tax)*. Published in 25 Ideas to Solve the Energy Crisis (Spring 2007).

Research Interests

- Automated extraction and processing of geographically-based parameters for use in applications and research.
- Data models, databases, and applications for environmental decision support.
- Remote sensing, collection, and transmission networks for environmental monitoring.
- Information systems for changing consumer behavior.

Technology Experience

GIS: ArcGIS, QGIS, GDAL/OGR, Leaflet, ArcGIS Server, Google Earth Engine, ArcGIS Online, Erdas IMAGINE, ENVI

Preferred Languages, frameworks, and Libraries: Python, R, JavaScript, HTML, CSS/LESS/Sass, Django, Vue.js, D3.js, JQuery, Fiona, GDAL/OGR.

Other Languages I've worked in: Perl, PHP, C, C++, Lua

Databases: PostgreSQL/PostGIS, SQLite, MySQL, Microsoft Access

Systems Administration: Linux and Windows servers and services, security management, user support.

Trainings

- 2018: COMPASS Scientist Sentinel Science Communication Training
- 2018: Software and Data Carpentry Instructor Training

Former Affiliations

- A-T-S, GIS Consulting, 2015-2017
- [Environmental Consumer](#), Executive Director, 2007-2015
- [Sierra Nevada Alliance](#), Regional Climate Change Program Assistant, 2010
- 1Sky (now [350.org](#)), Policy Fellow, 2008-2009
- UC Sustainable Agriculture Research and Education Program ([SAREP](#)), 2006-2009

Online Profiles

[Portfolio on nicksantos.com](#)

[Center for Watershed Sciences Website](#)

[Google Scholar](#)

[StackExchange](#)

[GitHub](#)

[Bitbucket](#)

[LinkedIn](#)