GEOSPATIAL EVALUATION AND OBSERVATION LAB

ANNUAL REPORT

JAN 2021 - DEC 2021

GEOLAB.WM.EDU

a years' overview

GEOLAB IN 2021

Despite COVID lingering longer than is polite, 2021 turned into an incredible year for the geoLab. Canvassing the teams, we've seen geoData complete a transition to a team focused on external projects - and boy have they delivered, with students leading projects with the FAO, GEF, DHS and more to produce high quality research that's impacting decisionmaking today. geoDev took on a fully-funded project (roadRunner) to estimate road quality with satellite imagery, and did such a good job we now have a followup project expanding to upwards of 60 students across the Commonwealth - not to mention their efforts in taking over a number of our internal tools (SCOPE, our website and more). geoBoundaries launched 4.0 to a huge audience, completely moving our entire pipeline over to github; we are just about to pass the 100,000 download mark, and serve over 1000 unique users a month on the geoboundaries.org website - oh, and we're the defacto standard on HDX now, which is pretty cool! geoParsing has moved to a semester-cadence for articles, with the most recent two articles focused on monitoring Russian and Chinese activities with ultra-high-resolution satellite imagery going out just an hour before I wrote this (check out tearline.mil!).

Turning attention to 2022, we look forward to a number of new partnerships that will be kicking off with the Global Environment Facility, DoD, Commonwealth Cyber Initiative, National Geospatial Intelligence Agency, and a whole suite of other acronyms. We'll also be taking some time to restructure our teams so that even more students can get involved with our external research - something that I'm really excited to see come together, and being plotted out by our magnificent team leads today. And I just had a conversation about teaching students how to build 30 compute servers from scratch - oh what fun it will be.
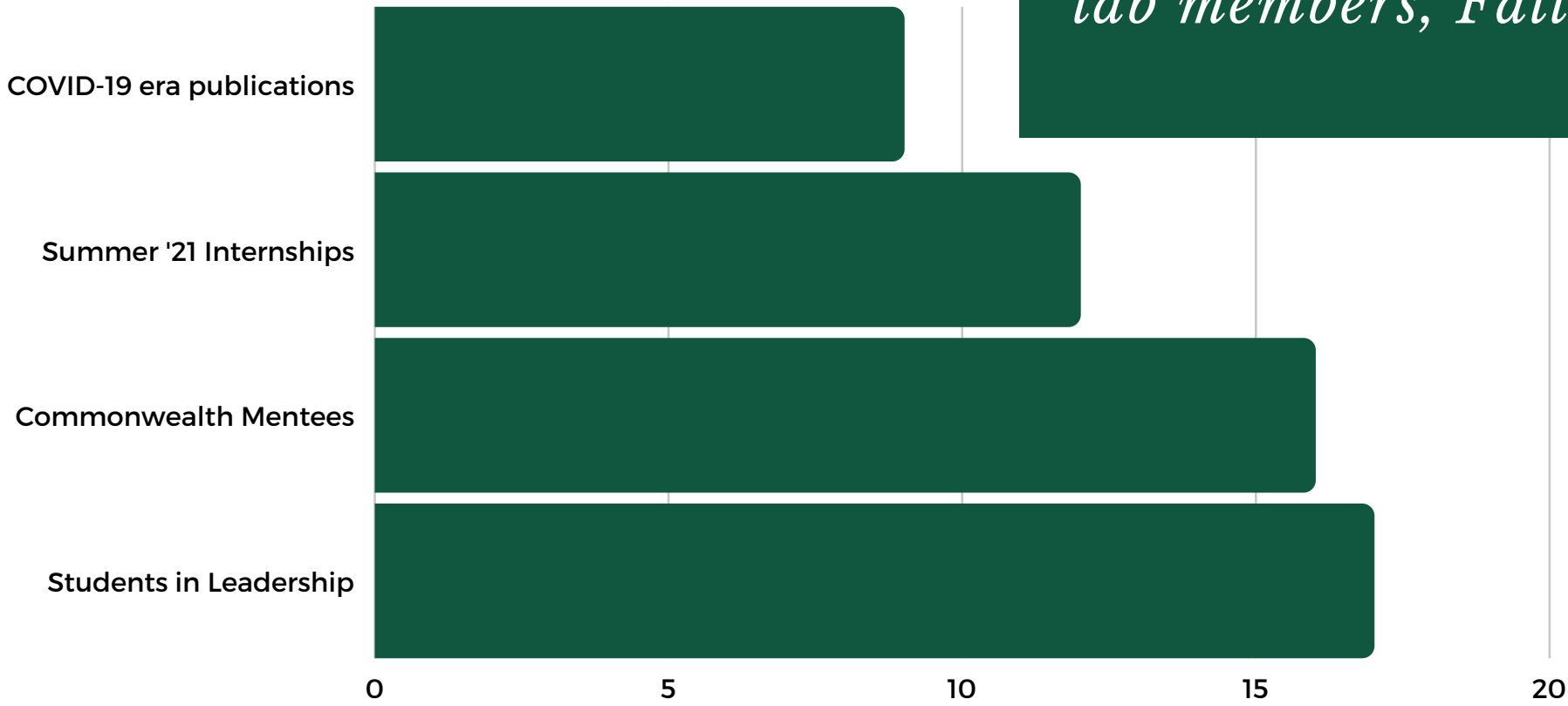
Onward to 2022,

Dan Runfola

NUMBERS & STATISTICS

Leadership. Publications. Internships. Mentoring students from other Commonwealth colleges! geoLab students are challenging our expectations on every front, and we're doing it at scales that were impossible even a year ago.

39
student coauthors

67
lab members, Fall '21

COVID-19 era publications

Summer '21 Internships

Commonwealth Mentees

Students in Leadership

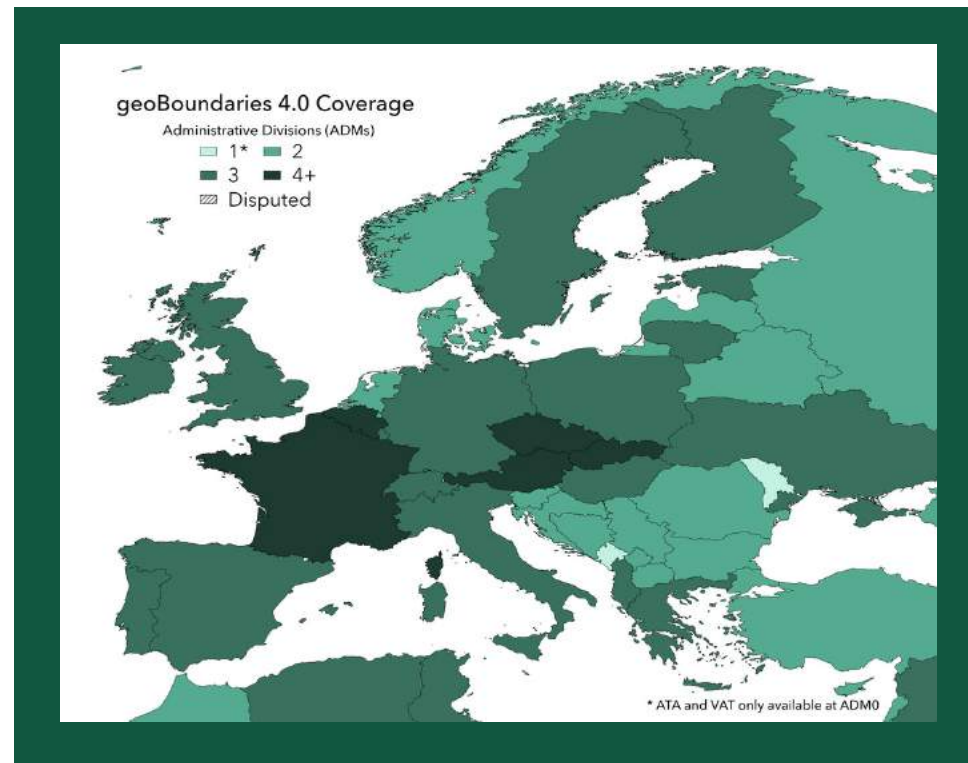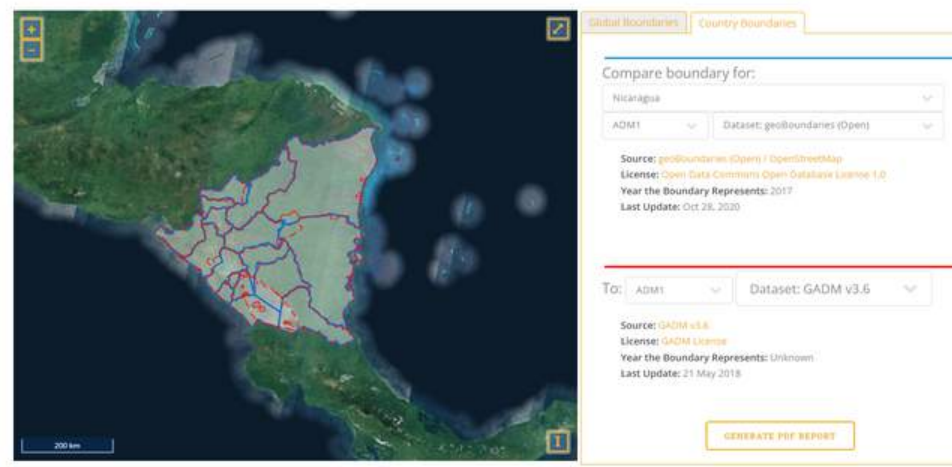0   5   10   15   20

ENGINEERING THE FUTURE @ W&M

Students in the geoLab are constantly pushing the boundaries of what's possible, and you can now see it yourself here at William & Mary. Come walk through the atrium of the Integrated Science Center 3, and if you're not wearing your mask the computer vision system developed by our geoDev team will let you know - and, for good measure, it will also try to estimate your age and gender.
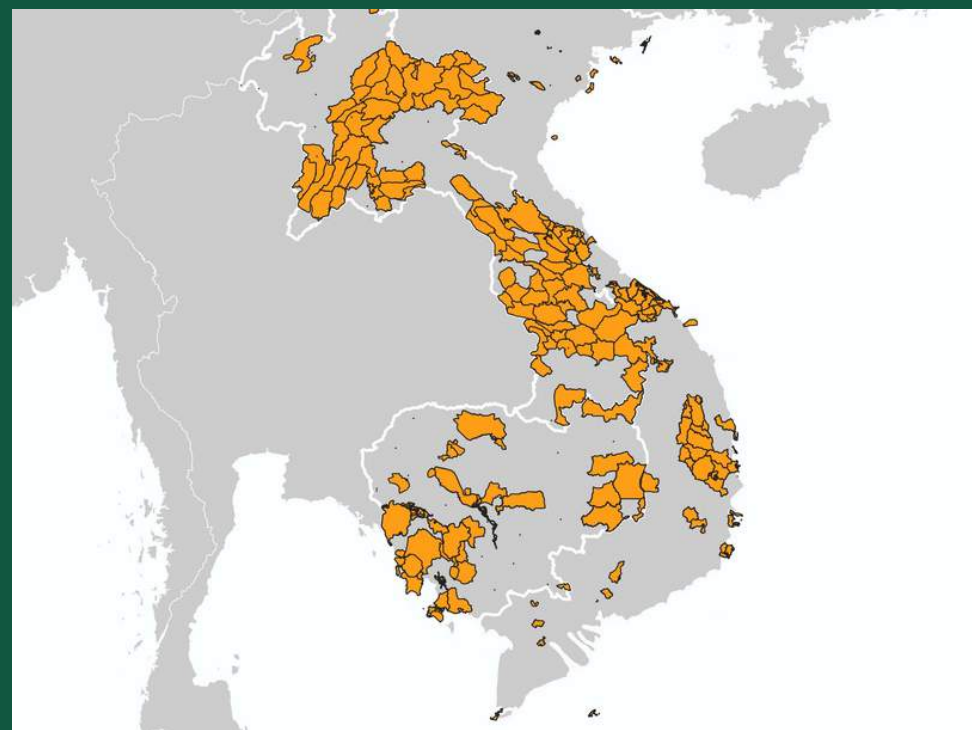
The **geoDev** team is working on the SCOPE project, which seeks to automate collection of and synthesize a variety of international development data sources. A machine learning pipeline is also being developed. The team also worked on the platform for the GEO dataset, allowing data on around 200,000 schools collected by geoData members to be available for filtering and downloading on the site. We also maintained the geoBoundaries and geoLab sites. Finally, following a grant from the CCI, the team has been working on modeling and initial setup for analyzing satellite imagery of hospitals during COVID using CNNs.

The **geoBoundaries** team released geoBoundaries 4.0 this year, offering three separate databases - GBOpen, GBAuthoritative, and GBHumanitarian. We also continued to work with CIESIN and Data Science for Sustainable Development. The team is now focusing on a complete overhaul of acceptable licenses for GBOpen, eliminating all 'viral' and 'share-alike' licensed data from our database to further increase applicability of the data we offer.

In the year 2021, the **geoParsing** team published five geospatial-intelligence based reports investigating Russia and China. Four of these reports are now published by the National Geospatial-Intelligence Agency, have been posted on intel.gov, and subsequently disseminated to the intelligence community and other relevant stakeholders.

Collected Boundaries for Global Environment Facility (GEF) Projects in Laos, Cambodia, and Vietnam

The **geoData** team has become our primary data analytics group. We collected satellite imagery to build a CNN predicting COVID outbreaks while the GEO project worked to clean, collect, and upload data to the new Global Education Observatory website. The GEO team and the COVID CNN will receive funding and an expanded team of researchers next semester thanks to the Commonwealth Cyber Initiative. We also continued working with the DHS to model migration flows to the US from the Northern Triangle. Additionally, students worked with the GEF to collect project boundaries for environmental interventions and began modeling the effectiveness of these projects. Five students will intern with the GEF this summer.

GEOLAB GRADUATES

Keeping Track of What Everyone Does Next

Grace Lee
SAP

Sylvia Shea
VidMob

Kate Muncasey
Mathematica

Ali Reynolds
Duke University

Matt Crittenden
Spectra Studios

Coyote Farrell
Industrial Economics, Inc

Andrew Peck
NOAA

Monica Alicea
Booz Allen Hamilton

Yaw Ofordi-Addae
Booz Allen Hamilton

Hannah Slevin
CGI

Sydney Fuhrig
TDOT

Austin Anderson
Booz Allen Hamilton

Monica Sandu
UVA Law School

Lindsey Rogers
W&M CGA Fellow

Maddy Mulder
W&M CGA Fellow

Joshua Habib
University of Michigan

Laura Opshal-Ong
Deloitte

Emily Maison
Booz Allen Hamilton

100%

The geoLab aims to have 100% of its students employed in a field they love post-graduation; we work towards this goal by involving students in applied projects with external practitioners. Have a good project and want to collaborate? Email us: danr@wm.edu.

LAB TEAM MEMBERS

Acknowledging all of the contributions that make the geoLab go, these are all of the students currently in the lab (Fall '21).

geoBoundaries

Lydia Troup (Team Lead)
Sean Murphy (Team Lead)
Sidonie Horn (Raster Lead)
Hadley Day (CIESIN Lead)
Dominic Fornatora (Cartography)
Natalie Spage
Michael Roth
Dorian Miller
Carolina Rivera
Kristina Pupkiewicz
Tara McLaughlin
Russell (Russ) Biddle
Renee Ritchey
Charlie Altman
Amanda Reed
Hannah Williams
Mikayla Williams
Selwyn Heminway
Shaun Mathew

geoData

Laura Mills (Team Lead)
Joe O'Brien (Team Lead)
Elias Wolman (GEO Lead)
Caroline Edwards
Olivia Wachob
Jane Siwek
Naomi Levin
John Hennin
Fatima Pate
Niraj Patel
Maeve Naughton-Rockwell
Jeremy Swack
Asha Silva
Michael Getaneh
Becca Gurysh
Kaitlyn Crowley
Grace Morales

geoDev

Jason Lin (Team Lead)
Landon Clime (SCOPE Lead)
Tina (Jiaying) Chen
Calvin Bertoncini
Kerry Wang
Jacob Somer
Langston Lee
Linda Ma
Robert West
Michael Foster
Joseph S. Lee
Michael Carter
Isabella DiFulvio
Minkyong Song

Lab Support Staff

Olivia Hettinger (Lab Director)

geoParsing

Caroline Morin (Team Lead & BRIGHT PM)
Cole Spiller (TRACAR PM)
Sophie Pittaluga (BRIGHT APM)
Remington Fritz (BRIGHT APM)
Garrison Goetsch (TRACAR APM)
William Weston
Erin Horrigan
Yiwen Sun(Wendy)
Kaitlyn Wilson
Aliia Woodworth
Zoe Roberts
Yasha Barth
Sebastian (Zak) Zeldon
Charles Pritz
Catherine Cable
Anna Glass

This year we threw a Publication Party—a geoFormal event to celebrate our work this year! Here we are doing a line dance together in the ISC. We can't wait to throw another party next year!

Publications, Presentations, News and Datasets

- Brewer, E., Kemper, P., Lin, J., Hennin, J., and <u>Runfola, D.</u> 2021. Predicting Road Quality using High Resolution Satellite Imagery: A Transfer Learning Approach. **PLoS One**.
- Runfola, D., Stefanidis, A., Baier, H., 2021. Using Satellite Data and Deep Learning to Estimate Educational Outcomes in Data Sparse Environments. **Remote Sensing Letters** 13(1).
- Karim, B., Runfola, D. 2021. Toponym-assisted map georeferencing: Evaluating the use of toponyms for the digitization of map collections. **PLoS One.**
- **geoBoundaries 4.0** welcomes the following new authors: Lindsey Rogers, Joshua Habib, Sidonie Horn, Sean Murphy, Dorian Miller, Hadley Day, Lydia Troup, Dominic Fornatora, Natalie Spage, Kristina Pupkiewicz, Michael Roth, Carolina Rivera, Charlie Altman, Isabel Schruer, Tara McLaughlin, Russ Biddle, Renee Ritchey, Emily Topness, James Turner, Sam Updike, Helena Buckman, Neel Simpson, Jason Lin
- **Intel.gov** Public Daily Brief, 2021. Spotlight: National Geospatial Intelligence Agency Tearline - China's Belt and Road Initiative in Ecuador.
- **WYDAILY**, 2021. Interests Converge as Data Science Program Grows.
- **DHS CAOE Spotlight**, 2021. Undergraduate researcher creating visualizations to better understand migratory patterns.

Summer '21 Internship Destinations

Esri, Library of Congress, Capital One, Fidelity, KPMG, Millennium Management, Department of Homeland Security, Civic Digital Fellowship, U.S. Department of State, U.S. Environmental Protection Agency, U.S. Trade and Development Agency, Rock the Vote, Limber, LendingTree, Ohio State University, Dominion Energy, National Park Service, National Grid, Center for Accelerating Operational Efficiency, James Martin Center for Nonproliferation Studies

Notable Accomplishments & Awards, 2021

Rhodes Scholarship Finalist, W&M Cypher Award, Phi Beta Kappa, Stofan Scholar Award, Cypher VI Hackathon Grand Prize Winner, Courageous Leadership & Authentic Excellence Fellowship, W&M Woman of Influence, Dominion Energy 2021 Diversity Scholar

~~Double~~ Triple Platinum Level Donors (>0.01 USD)

Thanks to all of our donors - ya'll make fun things like T-Shirts & stickers possible.
Ann Marie Stock (see figure 1), Heather ('20), John ('20), Josh ('20), Jack ('19), and Anonymous Donors!

THE WALL OF FAME

Fig 1. Who thought it was a good idea to donate a cooler? -*Dan*

The geoLab works to build a more secure, sustainable and vibrant world through AI, machine learning, and geospatial data. Somewhere along the way we got distracted and also started disrupting how education happens at William and Mary. Learn more about us or give to the lab by visiting geolab.wm.edu.