NASA Biodiversity & Ecological Forecasting

Understanding biological diversity and its effects on the Earth system to forecast changes and develop resource management strategies

Winter 2019

Send Us Your Apps

We are amassing a record of all the websites and applications that have been created through our program. Our aim is to create a database similar to our publications and projects search tool that directs our community to the appropriate data, tools, and methodologies related to Biological Diversity and Ecological Forecasting. This list will be housed and advertised on our newly remodeled program website. Even if your tool is several years old, please send it on to Keith (keith.gaddis@NASA.gov) to add to our list.

Updates Reminder

Please send us manuscripts that have been accepted to journals. The best time to email is after the manuscript has been accepted, but well before it appears online or in print. This allows us to work internally to have your work highlighted when your paper is actually published. Also, please let us know if you or your collaborators have received recognition from your institution or community for your research. These updates help us advertise our program to the public, administration, and our community.

Earth Science Director Michael Freilich Retires

Michael Freilich, director of the Earth Science Division in the Science Mission Directorate at NASA Headquarters since 2006, retired in February. Freilich helped drive the evolution of NASA Earth science from a program that launched an Earth-observing space mission every few years to one that launches several missions each year while preserving balance between orbital flight missions, research, applications, and technology development activities. During Freilich's tenure, he oversaw 16 successful major mission and instrument launches, 8 CubeSat/small-satellite launches, and leaves 20 additional large Earth-observing missions and major hosted instruments well along in development for launch before 2023. We thank Mike for his wisdom, guidance, and service.

2019 NASA Biological Diversity & Ecological Forecasting (BEF) Annual Team Meeting

The 13th annual NASA BEF Team Meeting is scheduled for **May 21 - 23 at the Hyatt Regency Crystal City** with the **MBON Team Meeting on the 24th**. Current PIs, please register and check updates here.

As in year's past, our program will highlight the year's advances in the use and application of biological remote sensing. All funded PIs (more than a year into their activity) will present 12-minute project talks. New PIs and NESSF Fellows will present posters during the Tuesday happy hour. In response to feedback from our community, we are adding training sessions on Wednesday. These hands-on tutorials will highlight platforms and tools funded by our programs.

We will hold a mentor lunch to pair early and late/mid-career professionals together on Wednesday. We received very positive feedback on this activity from mentors and mentees. Please contact Keith (keith.gaddis@nasa.gov) if you are interested in participating.

Funding Opportunities

Research Opportunities in Space and Earth Sciences 2019

The 2019 NASA ROSES announcement was released on March 14th. While the Biodiversity and Ecological Forecasting elements will not be solicited this year, our program will support one sub-element of IDS:

A.32 Interdisciplinary Science in Earth Science

IDS investigations offer a fundamental advance in our understanding of the Earth system through the use of remote sensing data that goes beyond simple correlation and merges disparate disciplines of the Earth sciences. The ***'Exploring the Microbial Biodiversity of the Atmosphere'*** *sub-element solicits proposals that integrate existing observations from NASA sensors with microbiological tools to characterize the aerosolized microbial biodiversity of the atmosphere. The NOIs for this solicitation are due 10/15/19 and full proposals are due 11/15/19.*

In addition, **these other NASA ESD solicitations may be relevant to our community:**

A.16 Modeling Analysis and Prediction

The MAP program funds the development of comprehensive, physically-based models of the Earth system, observation / model syntheses, and supporting research. The NOIs for this solicitation are due 5/3/19 and full proposals are due 7/2/19.

A.38 PACE Science and Applications Team

This solicitation welcomes proposals from prospective PACE Science and Applications Team members who wish to pursue basic or applied research using remotely sensed data (hyperspectral, polarimetric, etc) from OCI, HARP-2, and SPEXone. The NOIs for this solicitation are due 3/15/19 and full proposals are due 7/15/19.

A.2 Land Cover Land Use Change

The LCLUC program supports studies that quantify land-cover and land-use changes, examines their impact on the environment, climate, and society, or models future LCLUC scenarios. The step one submissions for this solicitation are due 5/15/19, with step 2 scheduled for 3/20/20.

Upcoming Conferences

International Association for Landscape Ecology
Fort Collins, CO (4/7 – 4/11/19)

Evolution
Providence, RI (6/24 – 6/28/19)

Society for Conservation GIS
Monterey, CA (7/15 – 7/17/19)

I.C. for Conservation Biology
Kuala Lumpur, Malaysia (7/21 – 7/25/19)

Behaviour
Chicago, Il (7/23 – 7/27/19)

Embedding Ecology in Sustainable Development Goals
Lisbon, Spain (7/29 – 8/3/19)

Ecological Society of America
Louisville, KY (8/11 – 8/16/19)

The Wildlife Society & The American Fisheries Society Conference
Reno, Nevada (9/29 – 10/3/19)

Applied Remote Sensing Trainings

Investigating Time Series of Satellite Imagery

April 15 & 17 (10-12:00 & 18-20:00 EDT)

This training will focus on two tools, AppEEARS from the LPDAAC and LandTrendr via Google Earth Engine (GEE). AppEEARS enables users to integrate point or polygon ground-based data with satellite imagery. The GEE implementation of LandTrendr enables users to analyze land cover dynamics, including short and long-term trends.

Remote Sensing for Disasters Scenarios

April 16, 23, & 30 (10-12:00 & 14-16:00 EDT)

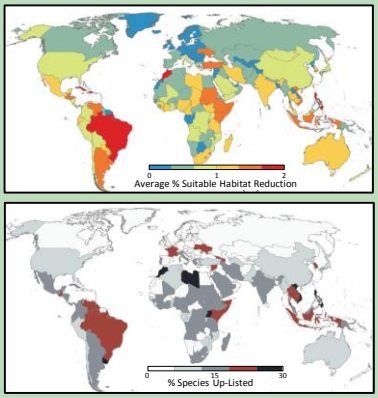
This training will show participants how NASA data can be used to characterize and monitor disaster related events and support relief efforts. Each session will cover a different disaster and its supporting data, including tropical storms, flooding, earthquakes, and landslides.

Research Briefs

Habitat loss and extinction under future land-use scenarios

Jetz & Powers (2019) Nat Clim Change

The authors used global decadal land-use projections to the year 2070 for a range of shared socioeconomic pathways (linked to RCPs) to evaluate potential losses in range-wide suitable habitat and extinction risks for approximately 19,400 species of amphibians, birds and mammals. Substantial declines in suitable habitat are identified for species worldwide, with approximately 1,700 species expected to become imperiled due to land-use change alone. These geographically explicit projections and model workflows embedded in the Map of Life infrastructure are provided to facilitate the scrutiny, improvements and future updates needed for an ongoing and readily updated assessment of changing biodiversity. These informatics tools are intended to support conservation action and policies for addressing climate change and land-use change impacts on biodiversity.

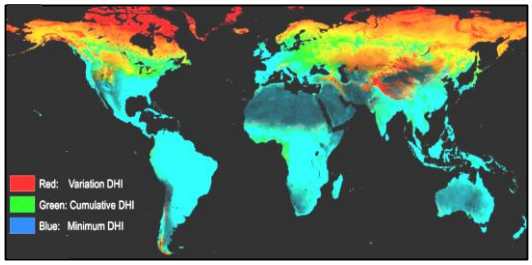


Projected 2070 changes in suitable habitat and increase in imperiled species of amphibians, birds and mammals.

The Dynamic Habitat Indices from MODIS and global biodiversity

Radeloff et al (2019) RSE

Dynamic Habitat Indices (DHIs) are three metrics designed to summarize remotely sensed data so that they are most relevant for biodiversity analyses. The authors derive the DHIs globally (at 1-km resolution from MODIS vegetation products) and use these to test three central biogeographic hypotheses at global scales for amphibians, birds, and mammals (measured as species richness derived from IUCN Red List range maps). These three DHIs (and their respective hypotheses) are: annual cumulative productivity (the energy hypothesis), minimum productivity (the environmental stress hypothesis), and seasonality (the environmental stability hypothesis). Multiple linear models of all three DHIs explained 67%, 65%, and 61% of the variability in species richness of amphibians, resident birds, and mammals, respectively. The DHIs are promising for application in biodiversity science and conservation.

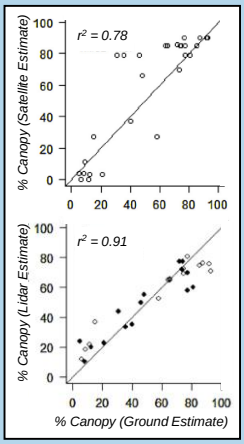


The global patterns of the DHIs, a color composite of the 3 DHIs based on median MODIS NDVI data from 2003-14

Definition and measurement of tree cover

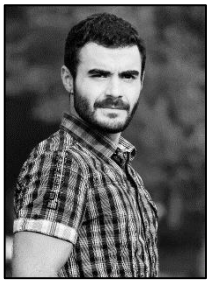
Tang et al. (2019) Agric For Meteorol

The authors conducted a comparative analysis of different tree cover data sets, derived from field sample, terrestrial and airborne lidar scans, and Landsat imagery, to investigate factors affecting tree cover estimation in the western US mountainous conifer forest. They found that satellite-based tree cover maps, even those derived from the same sensor, tended to have lower agreements over sparsely vegetated areas, due to both definitional discrepancies and estimation errors in establishing tree cover. When compared with tree cover measurements from ground-based hemispherical photography and terrestrial laser scanner, both airborne waveform lidar and discrete return lidar provided consistently more accurate tree cover estimates than three of the existing Landsat-based tree cover products. The authors recommend incorporating lidar data as a complement or an alternative to ultra-fine resolution images in training Landsat class images (e.g. Sentinel-2AB) for more precise mapping of forest extent.



Comparison of GLAD and LVIS canopy cover estimate to ground validation data.

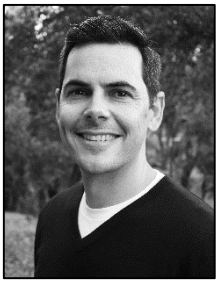
Researcher Spotlight



Celio Sousa

Research Scientist,
NASA's Goddard Space Flight Center

Dr. Celio Sousa is a NASA scientist with expertise using cloud-computing and multi-temporal/multi-sensor data for characterizing and quantifying land cover extent and change in tropical regions and its biophysical and socioeconomic impacts. He is currently supported through the NASA Earth Science Division's Partnerships Program which seeks to build commercial and NGO relationships that amplify our understanding of the Earth as an integrated system and enable societal benefits. In partnership with Conservation International, Dr. Sousa is providing decision support tools for African countries who have committed themselves to incorporating ecosystem service accounting into national decision making through the Gaborone Declaration for Sustainability in Africa. With CI and AGEOS scientists, Dr. Sousa has developed repeatable methodologies to map ecosystem extent, meet international standards for ecosystem accounting, and satisfy the requirements of a broad range of nation specific decision support needs. Dr. Sousa's work pushes the frontier of remote sensing and applied science.



Neil Carter

Assistant Professor,
Boise State University

Dr. Neil Carter is a NASA Ecological Forecasting funded researcher studying the dynamics and governance of complex socio-environmental systems, particularly as they relate to wildlife conservation. Dr. Carter's project examines the effects of anthropogenic nightlight and noise on the behavior and habitat integrity of wildlife across the US. In partnership with the US National Park Service, this information is being used to mitigate the impacts of sensory pollutants on the park system. NASA data are absolutely vital to this project. In particular, the Day-Night Band on NASA's Visible Infrared Imaging Radiometer Suite (VIIRS) sensor provides a synoptic measure of nightlight at an unprecedented global scale and daily temporal resolution. These data, combined with other NASA imagery, enable a data-driven approach to forecast locations where reduction of light and noise pollution will yield the greatest benefits for large landscape conservation. This project supports Dr. Carter's aim to inform management strategies that allow sustainable coexistence of humans and wildlife in shared spaces.

- Dr. Carter's Website

Recent Publications From The Program

Abrahms, B., E. Hazen, E. Aikens, M. Savoca, J. Goldbogen, S. Bograd, M. Jacox, L. Irvine, D. Palacios, and B. Mate. Memory and resource tracking drive blue whale migrations. Proceedings of the National Academy of Sciences (2019): 201819031.

Arostegui, M., Braun, C., and P. Gaube. Movement and thermal niche of the first satellite-tagged Mediterranean spearfish (*Tetrapturus belone*). Fisheries Oceanography (2019).

Carozza, D., D. Bianchi, and E. Galbraith. Metabolic impacts of climate change on marine ecosystems: Implications for fish communities and fisheries. Global Ecology and Biogeography 28 (2) (2019): 158-169.

Clare, J., S. McKinney, E. Simons-Legaard, J. DePue, and C. Loftin. Satellite-detected forest disturbance forecasts American marten population decline: The case for supportive space-based monitoring. Biological Conservation (2019).

Recent Publications From The Program (continued)

Clare, J., P. Townsend, C. Anhalt-Depies, C. Locke, J. Stenglein, S. Frett, K. Martin, A. Singh, T. Van Deelen, and B. Zuckerberg. Making inference with messy (citizen science) data: when are data accurate enough and how can they be improved? Ecological Applications (2019): e01849.

Doughty, C., and K. Cavanaugh. Mapping Coastal Wetland Biomass from High Resolution Unmanned Aerial Vehicle (UAV) Imagery. Remote Sensing 11 (5) (2019): 540.

Herrera, M., D. Wethey, E. Vázquez, and G. Macho. Climate change implications for reproductive success: temperature effect on penis development in the barnacle *Semibalanus balanoides*. Marine Ecology Progress Series 610 (2019): 109-123.

Jetz, W., M. McGeoch, R. Guralnick, S. Ferrier, J. Beck, M. Costello, M. Fernandez, G. Geller, P. Keil, C. Merow, and C. Meyer. Essential biodiversity variables for mapping and monitoring species populations. Nature Ecology & Evolution (2019).

Lewis, K., A. Arntsen, P. Coupel, H. Joy-Warren, K. Lowry, A. Matsuoka, M. Mills, G. van Dijken, V. Selz, and K. Arrigo. Photoacclimation of Arctic Ocean phytoplankton to shifting light and nutrient limitation. Limnology and Oceanography 64 (1) (2019): 284-301.

Mims, M., C. Day, J. Burkhart, M. Fuller, J. Hinkle, A. Bearlin, J. Dunham, P. DeHaan, Z. Holden, and E. Landguth. Simulating demography, genetics, and spatially explicit processes to inform reintroduction of a threatened char. Ecosphere 10 (2) (2019): e02589.

Powers, R., and W. Jetz. Global habitat loss and extinction risk of terrestrial vertebrates under future land-use-change scenarios. Nature Climate Change (2019): 1.

Ramirez-Reyes, C., K. Brauman, R. Chaplin-Kramer, G. Galford, S. Adamo, C. Anderson, C. Anderson, G. Allington, K. Bagstad, M. Coe, and A. Cord. Reimaging the potential of earth observations for ecosystem services assessments. Science of the Total Environment (2019).

Radeloff, V., M. Dubinin, N. Coops, A. Allen, T. Brooks, M. Clayton, G. Costa, C. Graham, D. Helmers, A. Ives, and D. Kolesov. The Dynamic Habitat Indices (DHIs) from MODIS and global biodiversity. Remote Sensing of Environment 222 (2019): 204-214.

Sawaya, N., A. Djurhuus, C. Closek, M. Hepner, E. Olesin, L. Visser, C. Kelble, K. Hubbard, and M. Breitbart. Assessing eukaryotic biodiversity in the Florida Keys National Marine Sanctuary through environmental DNA metabarcoding. Ecology and Evolution (2019).

Shore, A., and J. Caldwell. Modes of coral disease transmission: how do diseases spread between individuals and among populations? Marine Biology 166 (4) (2019): 45.

Simpson, L., C. Stein, T. Osborne, and I. Feller. Mangroves dramatically increase carbon storage after 3 years of encroachment. Hydrobiologia (2019): 1-14.

Smith, N., T. Keenan, I. Colin Prentice, H. Wang, I. Wright, Ü. Niinemets, K. Crous, T. Domingues, R. Guerrieri, F. Yoko Ishida, and J. Kattge. Global photosynthetic capacity is optimized to the environment. Ecology letters (2019).

Tang, H., X. Song, F. Zhao, A. Strahler, C. Schaaf, S. Goetz, C. Huang, M. Hansen, and R. Dubayah. Definition and measurement of tree cover: A comparative analysis of field-, lidar-and landsat-based tree cover estimations in the Sierra national forests, USA. Agricultural and Forest Meteorology 268 (2019): 258-268.

Zarnetske, P., Q. Read, S. Record, K. Gaddis, S. Pau, M. Hobi, S. Malone, J. Costanza, K. Dahlin, A. Latimer, and A. Wilson. Towards connecting biodiversity and geodiversity across scales with satellite remote sensing. Global Ecology and Biogeography (2019).

NASA Biodiversity and Ecological Forecasting
Woody Turner – Program Scientist, NASA HQ
Maury Estes – Program Associate, Marshall Space Flight Center
Cindy Schmidt – Program Associate, Ames Research Center
Jay Skiles – Program Associate, Ames Research Center
Keith Gaddis – Senior Support Scientist, NASA HQ