

**USFS Forest Inventory and Analysis and National Inventory and Monitoring Applications Center
(NIMAC) International Update
February 2019**

FIA invests in international technology transfer for various reasons, some of which include:

- a) helping improve national security by supporting healthy ecosystems and associated social and economic stability in partner countries
- b) developing personal and professional connections that lead to improved international cooperation
- c) improving the state of natural resource monitoring and management science in the U.S. and abroad by sharing with and learning from partner country professionals

The intent of this update is to share a list of activities that FIA staff have conducted in support of IP and the above 3 mission objectives.

Many activities are implemented through the SilvaCarbon program (www.silvacarbon.org), which is a consortium composed of multiple government agencies that provide technical support to countries interested in improving their forest and landscape monitoring efforts. Activities include delivering training on inventory, monitoring and remote sensing topics, consulting on inventory and monitoring system design and implementation, participating in joint research, and forest management strategy consultations.

Below are some examples of international activities in which FIA staff have participated either with or without NIMAC support since our last update in February 2018:

MEXICO

For several years, FIA has worked with IP and Mexico on activities like consultations on statistical design, data cleaning, data recorder development, quality control, carbon measurement strategies, inventory reporting tools, and various science initiatives. In 2019, Tom Brandeis gave a presentation on using inventory data to monitor degradation at a workshop on methodologies for the quantification of forest degradation to members Mexican National Forestry Commission (CONAFOR), and others, in Jalisco, Mexico. Andy Lister gave a presentation and participated in networking meetings at Expo Forestal, Mexico's equivalent to the Society of American Forester's national convention (<http://www.expoforestal.gob.mx/>). Andy Lister and others participated in teleconferences with Mexico and others in Central America on topics related to the design of a forest monitoring system using ocular photointerpretation (PI). Dave Nowak's team produced a translated version of i-Tree Eco for all of Mexico (www.itreetools.org).

CENTRAL AMERICA

FIA has partnered with several Central American countries over the years, mainly on forest monitoring system technology transfer and inventory design.

Honduras: Hobie Perry and others helped deliver a training on wetland soil data collection and analysis in Honduras. Andy Lister and others provided informal email and teleconference consultations with Honduras forest inventory staff on inventory data analysis.

Costa Rica: During the Spring of 2018, Paul Patterson and Tracey Frescino prepared material for and then conducted a workshop and training in Costa Rica on adapting the USFS image-based change estimation (ICE) statistics and tool to the data and needs of Costa Rica's remote image-based land use and land cover inventory. They also assisted in developing the in-country capacity to analyze the data. The training included instruction in the R statistical analysis software, which is used to analyze the data. They assisted with analyzing the data produced by the REDD+ Secretariat and provided guidance on the integration of the land use, land cover, and change data interpreted from imagery with the NFI. After the workshop they produced several white papers to address questions that arose during workshop. This led to the proposal to assist in the production of a manual for use of the software package for analyzing the data, which will occur in 2019.

Chip Scott (retired FIA), Randy Hamilton (contractor) and Andy Lister worked both formally and informally through a combination of face-to-face meetings, conference calls and emails with Costa Rica on forest inventory design issues, including production of estimation tools, documentation and inventory design guidance.

El Salvador: Andy Lister and Randy Hamilton (contractor) worked extensively with El Salvadoran forest inventory practitioners to help analyze their forest inventory data and to design a PI-based forest monitoring system, including software instruction, analysis methods, and estimation tool development.

Multinational: Sonja Oswald participated as a representative of the USFS FIA program at a CATIE workshop in Turrialba, Costa Rica aimed at developing approaches for harmonizing forest inventories from across Central America.

CARIBBEAN

Multinational: Tom Brandeis attended the Caribbean sub-regional workshop for the United National Food and Agriculture Organization's Global Forest Resource Assessment, 2020, held in Bridgetown, Barbados, August 21-23, 2018, to prepare for reporting for Puerto Rico and the U.S. Virgin Islands, plus assistance as a report reviewer for the English-speaking Caribbean countries.

Bahamas: Andy Lister, Chip Scott and others worked via teleconference and emails with Forest Inventory specialists in the Bahamas on plot selection methods for forest inventory plots.

Jamaica: Tom Brandeis, Bill Burkman and others attended a forest inventory scoping trip/planning meeting in Jamaica where they advised on inventory processes and guidelines.

SOUTH AMERICA

Peru: Andy Lister and Marin Palmer participated in a forest inventory status update meeting and follow-up emails and teleconferences in Lima, Peru. Chip Scott, Pat Miles, Andy Lister and Marin Palmer

contributed to data loading and processing of the first panel of the first cycle of Peru's national and forest inventory. Andy Lister developed a series of R programs to analyze the inventory data in parallel with the Evalidator tool that Pat Miles developed a few years ago. Andy Lister developed video lectures and related material that were presented at a continuing education conference for foresters at the National University of the Peruvian Amazon. Sara Goeking and others helped review Peru's quality assurance protocol and field manual.

Colombia: In April, 2018, a group of Colombians and a Mexican attended a forest inventory data analysis workshop in Newtown Square, PA led by Andy Lister and Chip Scott. Sara Goeking, Chuck Barnett, Randy Morin, Katherine Johnson, Jason Brown and others presented aspects of the FIA process to the group and answered questions about best practices. Dave Nowak and others participated in an i-Tree training in Cali, Colombia.

ASIA

Vietnam: FIA specialists from RMRS, NRS and Temple University provided a 5-day technical training on advanced ArcGIS to Vietnam's Forest Inventory and Planning Institute (FIPI) in support of the SilvaCarbon program. The goal of the training was to transfer USFS institutional knowledge about the ArcGIS tools and functionality to FIPI. FIPI requested a training in advanced GIS application to produce high quality products, fulfill assigned mandates and tasks, and to meet the needs of data standardization in the context of international integration and international cooperation. ArcGIS exercises were developed using FIPI's data. Lectures and exercises were translated to Vietnamese and included in hardcopy and digital workbooks that could be shared throughout FIPI for continuing education. Contact: Karen Schleeweis (RMRS), Alexa Dugan (NRS), Tyler Tran (Temple University)

In June, 2018, FIPI Director General Dr. Nguyen Bien along with FIPI members Mr. Vu Hien and Mr. Dang Thuyen visited the Southern Research Station FIA headquarters in Knoxville, as well as, FIA plots on the Long Cane Ranger District of the Francis Marion and Sumter National Forests in South Carolina. The purpose of the visit was to have a detailed exposure to USFS FIA procedures by following one plot through the entire system from pre-field to publication. For the South Carolina field portion of the visit, FIPI members were able to watch South Carolina Forestry Commission members Wesley Bouknight and Steven Broom, along with summer interns Jarred Sparks and Cole Shealy, as they measured an inventory plot during a Hot checkplot. The three FIPI members were also able to witness Blind and Cold checkplots with USFS QA/QC Foresters Jeremy Rogers of South Carolina and Greg Smith of Georgia. The visit was coordinated by Kerry Dooley and Tom Brandeis of SRS FIA through Forest Service International Programs. The FIPI visitors also received a wide range of presentations from SRS FIA staff in the Knoxville office. The goal was to follow the data through the system from collection, to field QA/QC to office editing, to analysis and reporting.

Jeremy Rogers, Kerry Dooley, Tom Brandeis, Andy Lister and others participated regularly in project update conference calls and offered guidance and document review to FIPI staff.

Bangladesh: As part of the SilvaCarbon effort to provide technical assistance on forest monitoring to South and Southeast Asia, the USFS, United Nations Food and Agriculture Organization (FAO) and Bangladesh Forest Department (BFD) cohosted the "Regional Exchange Workshop on Forest Monitoring

and Assessment.” Thirteen countries were represented. The second week of the trip was focused on Bangladesh National Forest Inventory (NFI). FIA specialists from Region 6 and PNW assisted with the Regional Exchange Workshop in Sreemangal. The workshop focused on three major topics:

- National Forest Inventory (NFI) Implementation
- Use of NFI Data for National Plans and Monitoring
- Institutionalization / Sustainability of Forest Monitoring

The second week Chip Scott met with FAO and BFD technical experts on estimation methods for the nearly completed NFI of Bangladesh. Contact: Heather Hayden (Region 6), Charles “Chip” Scott (retired NRS), Colin Meston (PNW).

The Philippines: SRS FIA facilitated a forest inventory study visit to Knoxville and northern Georgia field sites by 3 members of Philippine Eagle Foundation, Department of Natural Resources and Apayao provincial government, August 13-17, 2018, as part of their preparation for a regional forest inventory related to Philippine eagle conservation. This visit included 2 days of presentations in the Knoxville office and 3 days of field work. Samuel Lambert, Jeremy Rogers and Greg Smith were the principal persons involved in planning and implementation of this visit, with Tom Brandeis, Angie Rowe, Andy Lister and several others providing technical material and presenting.

India: FIA specialists from RMRS planned and led a week-long study tour for representatives of the Forest Survey of India. Ten Indian forest monitoring specialists representing multiple Indian ministries traveled to Ogden and Salt Lake City, Utah, with the objective of discussing permanent plot design and parameters, application of synthetic aperture radar data for forest monitoring, use of national forest inventory data in ecosystem services assessment, and real-time fire detection and monitoring. The many contributors to the study tour included nearly two dozen scientists and managers from RMRS-FIA, Region 4 of the National Forest System, State & Private Forestry, and the Geospatial Technical Applications Center. Participants discussed key features of forest inventories, mapping, and ecosystem management, as well as development of diverse applications of forest inventory data and collaboration with stakeholders. Contact: Sara Goeking

Chip Scott participated in a forest inventory technical visit to India. Chip, Andy Lister and Jim Westfall met with a representative of FAO who advises the Indian forest inventory department in Newtown Square, PA.

Nepal: Ty Wilson and Chip Scott attended a national forest inventory study tour and technical transfer activity in Nepal. They met with Nepali forestry officials, provided feedback, and helped develop an estimation tool and documentation to analyze their inventory data.

South Korea: Dave Nowak and the i-Tree team are working with the National Institute of Forest Science to develop an i-Tree Eco version for South Korea.

EUROPE

Multinational: Dave Nowak and the i-Tree team released the version for Europe at www.itreetools.org.

Sweden: Dave Nowak visited Malmo Sweden to discuss i-Tree development in Scandinavia and various projects in Sweden.

AFRICA

Ethiopia: Andy Lister and team members from the National Forest System participated in a rangeland monitoring workshop near Addis Ababa, Ethiopia. Topics covered included use of Remote Sensing technologies in rangeland monitoring and approaches to institutionalizing monitoring in this highly rural landscape. Chip Scott later attended a forest inventory planning meeting in Ethiopia to advise on best practices in inventory design and implementation.

Tanzania: FIA specialists from SRS (Christopher Oswald and Kerry Dooley), along with wildlife biology experts NFS Region 8 collaborated with Tanzanian NGO Mpingo Conservation and Development Initiative. Work was focused on developing and improving forest inventory systems for use in villages with community owned and managed forests. Continued collaboration and follow up visits are anticipated.

Kerry Dooley, Summer Dunn and Michelle Gerdes will be going to Tanzania in 2019 to work on a community-level inventory, an IP-sponsored project.

Democratic Republic of Congo: An FIA specialist from SRS, together with a former Forest Service employee and specialists from the Food and Agriculture Organization of the United Nations, led a four-day training on national forest inventory data analysis for the Democratic Republic of Congo (DRC) Direction des Inventaires et Amenagement Forestiers (DIAF). Ten DIAF analysts who are tasked with summarizing data from the DRC's national forest inventory were provided classroom instruction on probability and statistics with direct application to population-level estimation of forest area, tree density, aboveground biomass, and biodiversity. The former Forest Service employee is engaged in ongoing, follow-up work to develop an analytical package that DIAF can use to analyze their data and complete a national report. Contact: KaDonna Randolph (SRS FIA), Jim Alegria (retired Forest Service)

Multinational: Hans Andersen and others helped deliver a 5-day workshop in RCMRD-Nairobi in April that was funded by the NASA-SERVIR program. It resulted in a book chapter in a handbook and associated materials (R code, etc.) for hands-outs and tutorials.

GLOBAL/OTHER

Dave Nowak and the i-Tree team assessed tree cover change worldwide and presented results at the World Forum on Urban Forests in Mantova, Italy. The paper is in review: Nowak, D.J. and E.J. Greenfield. In review. Recent Changes in Global Urban Tree and Impervious Cover. Urban Forestry and Urban Greening.

Grant Domke attended various meetings as lead author on the 2019 Refinement of the IPCC Good Practice Guidance for National Greenhouse Gas Inventories (<https://www.ipcc-nggip.iges.or.jp/home/2019refinement.html>) (Cairns, Australia and Rome, Italy). He also participated in various consultations and other meetings in support of international carbon accounting protocol development and review, including the GFOI/SilvaCarbon meetings in Bilbao, Spain and Paris, France; a CCI Biomass estimation and uncertainty meeting in Paris, France; an International Boreal Forest

Research Association Meeting in Laxenburg, Austria; and the EIA Task 38/43 – biomass and bioenergy workshop in Uppsala, Sweden.

Tom Brandeis and Bradley Reed (USGS) represented SilvaCarbon at the “Global Forest Observations Initiative Data Component Scoping Workshop”, Global Forest Observation Initiative (GFOI) meeting in Tokyo, Japan, July 2-3, 2018. There they discussed the potential addition of a field plot data component. Specifically, they gave presentations on stock-take of potential contributions and work planning discussion. Material for the presentations and discussions was also provided by Sara Goeking, RMRS FIA.

Brett Butler is Editor in chief of Small-scale Forestry, an international for pure and applied research on small-scale forestry presenting empirical, theoretical, modeling, and methodological papers and thoroughly examining the dimensions of farm, family, non-industrial, and community forestry. Contact: Brett Butler (brett.butler2@usda.gov)

Ron McRoberts participated in various international meetings and workshops: GFOI/SilvaCarbon: (1) Bilbao, Spain; (2) Paris, France; European Space Agency: Climate Change Initiative, Biomass Project, Paris, France; and International Space Science Institute: Bern, Switzerland.

Selected international research/joint publications

Nowak, D.J., S. Hirabayashi, M. Doyle, M. McGovern, J. Pasher. 2018. Tree and forest effects on air quality and human health in Canadian cities. *Urban Forest and Urban Greening*. 29:40-48.
<https://www.fs.usda.gov/treesearch/pubs/55473>

Nowak, David J.; Maco, Scott; Binkley, Mike. 2018. i-Tree: Global tools to assess tree benefits and risks to improve forest management. *Arboricultural Consultant*. 51(4): 10-13.
<https://www.fs.usda.gov/treesearch/pubs/57414>

Ron McRoberts:

FRANCE:

Irulappa-Pillai-Vijayakumar et al. Increasing precision for French forest inventory estimates using the k-NN technique with optical and photogrammetric data and model-assisted estimators. *Remote Sensing of Environment*.

ITALY:

Galluzzi et al. Linking overstory and understory diversity indicators using European forest diversity patterns. *Ecological Indicators*.

Galluzzi et al. Mapping uncertainty if ICP-Forest biodiversity data: from standard treatment of diffusion to density-equalizing cartograms. *Ecological Informatics*

Del Perugia, Barbara, Cristiano Foderi, Davide Travaglini, Enrico Marchi, Francesca Bottalico, Marco Fioravanti, Francesca Giannetti, et al. “Assessing Forest Windthrow Damage Using Single-Date, Post-Event Airborne Laser Scanning Data.” *Forestry: An International Journal of Forest Research* 91, no. 1 (July 6, 2017): 27–37. <https://doi.org/10.1093/forestry/cpx029>.

RUSSIA:

Alekseev et al. A constructive review of the State Forest Inventory in the Russian Federation. *Forest Ecosystems*.

IRELAND:

McInerney et al. Enhancing the Irish NFI using k-Nearest Neighbors and a genetic algorithm. International Journal of Applied Earth Observations and Geoinformation.

McInerney et al. Analysis of broadleaf encroachment in coniferous forest plantations using multi-temporal satellite imagery. European Journal of Forest Research.

IRAN:

Poorazimy et al. Integrating airborne laser scanning data, space-borne radar data and digital aerial imagery to estimate aboveground carbon stock in Hyrcanian forests, Iran. Remote Sensing of Environment

PORTUGAL:

Alberdi, Iciar, Sonia Condés, Ronald E. McRoberts, and Susanne Winter. “Mean Species Cover: A Harmonized Indicator of Shrub Cover for Forest Inventories.” European Journal of Forest Research 137, no. 3 (June 1, 2018): 265–78. <https://doi.org/10.1007/s10342-018-1110-7>.

BURKINA FASO:

Hou, Zhengyang, Ronald E. McRoberts, Göran Ståhl, Petteri Packalen, Jonathan A. Greenberg, and Qing Xu. “How Much Can Natural Resource Inventory Benefit from Finer Resolution Auxiliary Data?” Remote Sensing of Environment 209 (May 1, 2018): 31–40. <https://doi.org/10.1016/j.rse.2018.02.039>.

Papers by American first-authors using international data:

NORWAY:

McRoberts et al. Comparing the stock-change and gain–loss approaches for estimating forest carbon emissions for the aboveground biomass pool. CJFR

NORWAY, ITALY, BURKINA FASO, SPAIN

McRoberts et al. Assessing components of the model-based mean square error estimator for remote sensing-assisted forest applications. CJFR.

INDONESIA

Swails et al. Linking soil respiration and water table depth in tropical peatlands with remotely sensed changes in water storage from the Gravity Recovery and Climate Experiment. Mitigation adaption strategies for global change.

Philosophy and Guiding Principles

The principles that guide NIMAC activities and that we advocate for other FIA staff who deliver technology transfer activities include:

1. The goal of technology transfer is for the countries to use the newly acquired skills to independently monitor their own natural resources without direct foreign intervention.
2. A clearly-articulated needs assessment is the first requirement for sound planning.
3. Chosen technology must be appropriate for the country’s level of institutional readiness
4. Sound inventory science should be used with an emphasis on statistical validity, transparency, and documentation of methods and assumptions.
5. Technology transfer specialists must be respectful, patient and supportive, and be motivated by a true desire to serve the public. This often entails many hours of hard, sometimes physically and psychologically unpleasant work that goes above and beyond what is regularly expected. This is effort for which the detailer might not receive direct rewards beyond a sense of satisfaction and personal and professional growth from contributing to the broader mission of

FIA, the Forest Service, and the community of resource monitoring and management experts that want to improve the status of and trends in the world's forest resources, and thus serve the people that depend upon them.

For FIA employees who do work for IP, please enter some basic information here, so FIA managers can quantify our contributions: <https://goo.gl/forms/ThfTi2GglvTnuxmJ2>.

For FIA employees interested in sharing their expertise internationally *and have not already expressed their interest in being included in a roster of interested staff*, please go to https://docs.google.com/forms/d/e/1FAIpQLSdHy5XXuc7_OSzPGEMF4IlnMINNZ4FkLvsP7tToB2LuURMSRg/viewform.

Thanks to Chris Oswalt, Kerry Dooley and Tom Brandeis for producing the updated roster form.

Any questions, please contact Andy Lister alister@fs.fed.us, 610.557.4038