Oregon State University (OSU)
Academic Program

Temesgen Hailemariam, PhD, RPF (#3764)

Dept. of Forest Engineering, Resources and Management

Oregon State University, Corvallis, Oregon

Operational LiDAR Inventory Meeting

April 7, 2021

Overview
OSU Academic Program – Forest Biometrics & Geomatics

I. Organizational Structure

II. Forest Biometrics and Geomatics (FB&G) Area of Concentration

- Programs/Labs
- Skills Required
- Courses

III. Opportunities

Oregon State University

- 2 campuses, 11 colleges, 12 experiment stations, Extension programs in all 36 counties, 200+ academic programs

A top 1% university in the world.

More research funding than any university in Oregon.

*1 of 2 L*and, Sea, Space and Sun Grant Universities in the U.S.

Oregon State University

TOP-TIER ACADEMICS

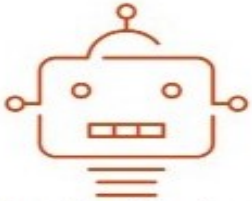
TOP-RANKED COLLEGE TOWN

Oregon State University is an international public research university that draws people from all 50 states and more than 100 countries. We go wherever the challenges are, push ourselves to the very edge of what's known and keep going.

#2 Forestry Program in the World

#3 Oceanography Program in the World

#3 Best Online Programs in the U.S.



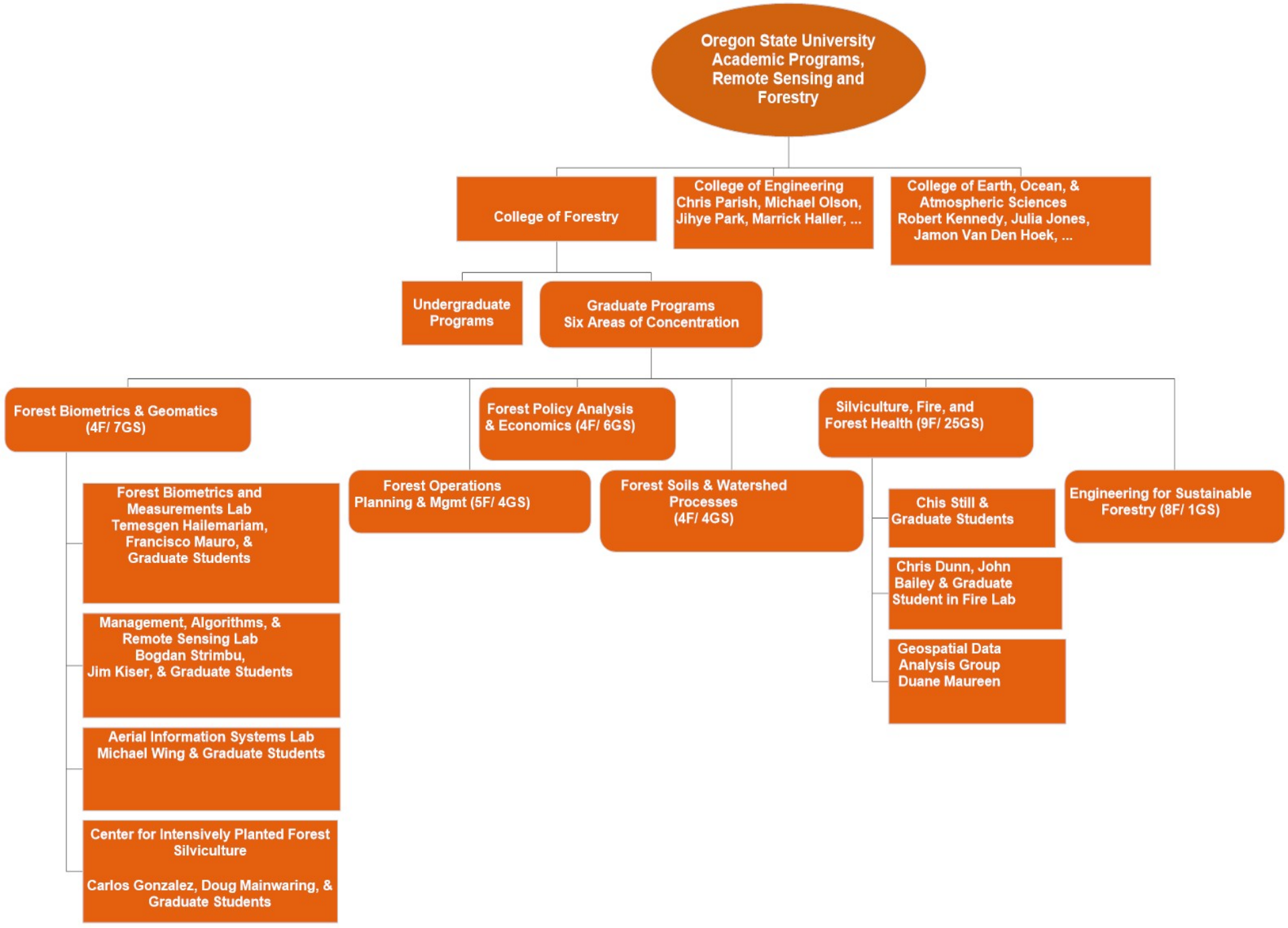
#4 Robotics Engineering School in the U.S.

#10 Best Big Data Degree in the U.S.

#2 Friendliest College Town

#4 Most Innovative U.S. City

Gold Rating for Bike Friendliness


Oregon State University Academic Programs, Remote Sensing and Forestry
College of Forestry
College of Engineering Chris Parish, Michael Olson, Jihye Park, Marrick Haller, ...
College of Earth, Ocean, & Atmospheric Sciences Robert Kennedy, Julia Jones, Jamon Van Den Hoek, ...
Undergraduate Programs
Graduate Programs Six Areas of Concentration
Forest Biometrics & Geomatics (4F/ 7GS)
Forest Policy Analysis & Economics (4F/ 6GS)
Silviculture, Fire, and Forest Health (9F/ 25GS)
Forest Biometrics and Measurements Lab Temesgen Hailemariam, Francisco Mauro, & Graduate Students
Forest Operations Planning & Mgmt (5F/ 4GS)
Forest Soils & Watershed Processes (4F/ 4GS)
Chis Still & Graduate Students
Engineering for Sustainable Forestry (8F/ 1GS)
Chris Dunn, John Bailey & Graduate Student in Fire Lab
Management, Algorithms, & Remote Sensing Lab Bogdan Strimbu, Jim Kiser, & Graduate Students
Geospatial Data Analysis Group Duane Maureen
Aerial Information Systems Lab Michael Wing & Graduate Students
Center for Intensively Planted Forest Silviculture
Carlos Gonzalez, Doug Mainwaring, & Graduate Students

Skills Required for the FB&G Area of Concentration

- Quantitative/ mensurational
- Statistical (MF, MSc, PhD)
- Remote Sensing and Image Processing
- Programming (R, Pyhton, C^{++}, MATLAB, IDL, Google Earth Engine, …)
- Mapping and Geographic Information Systems (GIS)
- Communication – Oral and Written

Courses at OSU – Examples of MSc programs

Forest Biometrics option

SFM Core:		**Credits**
FOR 550	Sustainable Forest Management	3
FES 521	Natural Resource Research Planning	3
ST 521	Introduction to Mathematical Statistics I	4
ST 522	Introduction to Mathematical Statistics II	4
Required Concentration Courses (6 credits, pick two courses):		
FE 544	Forest Remote Sensing & Photogrammetry	4
FOR 524	Forest Biometrics	3
FOR 525	Forest Modeling	3
Example Pool of Supporting Courses (12-19 credits):		
FOR 520	Geospatial Forest Analysis	3
FOR 549	Silvicultural Influences on Forest Eco. Dynamics	3
BOT 588	Environmental Physiology of Plants	3
FES 524	Natural Resources Data Analysis	4
FES 543	Advanced Silviculture	3
GEOG 562	GIScience III: Programming for Geospatial Analysis	4
GEOG 565	Spatio-Temporal Variation in Ecology & Earth Sci	4
GEOG 566	Advance Spatial Statistics and GIS Science	4
ST 531	Sampling Methods	3
ST 541	Probability, Computing, & Simulation in Statistics	4
ST 551	Statistical Methods I	4
ST 552	Statistical Methods II	4
ST 553	Statistical Methods III	4
ST 565	Time Series	3
ST 599	Special Topics: Data Programming in R	2
Other Required:		
FOR 503	Thesis	6-12
FOR XXX	Seminar – *see Communication Training*	2
	Total	**45+**

Forest Geomatics option

SFM Core:		**Credits**
FOR 550	Sustainable Forest Management	3
FES 521	Natural Resource Research Planning	3
ST 511	Methods for Data Analysis I	4
ST 512	Methods for Data Analysis II	4
Required Concentration Courses (6 credits, pick two courses):		
FOR 520	Geospatial Forest Analysis	3
FOR 524	Forest Biometrics	3
FES 524	Natural Resources Data Analysis	4
GEOG 561	GIScience II: Analysis and Applications	4
Example Pool of Supporting Courses (11-19 credits):		
FE 515	Forest Road Engineering	4
FE 523	Unmanned Aircraft System Remote Sensing	3
FE 532	Forest Hydrology	4
FOR 536	Wildland Fire Science and Management	4
CE 513	GIS in Water Resources	3
CE 562	Digital Terrain Modeling	4
GEOG 562	GIScience III: Programming for Geospatial Analysis	4
GEOG 565	Spatio-Temporal Variation in Ecology & Earth Sci	4
GEOG 566	Advance Spatial Statistics and GIS Science	4
GEOG 580	Remote Sensing I: Principles and Applications	4
GEOG 581	Remote Sensing II: Digital Image Processing	4
ST 513	Methods of Data Analysis III	4
Other Required:		
FE 503	Thesis	6-12
FOR XXX	Seminar – *see Communication Training*	2
	Total	**45+**

Courses at OSU – Examples of PhD programs

Forest Biometrics option

SFM Core:		**Credits**
FOR 550	Sustainable Forest Management	3
FES 521	Natural Resource Research Planning	3
ST 521	Introduction to Mathematical Statistics I	4
ST 522	Introduction to Mathematical Statistics II	4
Required Concentration Courses (6 credits, pick two courses):		
FE 544	Forest Remote Sensing & Photogrammetry	4
FOR 524	Forest Biometrics	3
FOR 525	Forest Modeling	3
Example Pool of Supporting Courses (51-53 credits):		
FOR 520	Geospatial Forest Analysis	3
FOR 549	Silvicultural Influences on Forest Eco. Dynamics	3
FOR 561	Forest Policy Analysis	3
BOT 570	Community Structure and Analysis	4
BOT 588	Environmental Physiology of Plants	3
FES 524	Natural Resources Data Analysis	4
FES 543	Advanced Silviculture	3
FES 561	Physiology of Woody Plants	3
GEOG 562	GIScience III: Programming for Geospatial Analysis	4
GEOG 565	Spatio-Temporal Variation in Ecology & Earth Sci	4
GEOG 566	Advance Spatial Statistics and GIS Science	4
ST 525	Applied Survival Analysis	3
ST 541	Probability, Computing, & Simulation in Statistics	4
ST 551	Statistical Methods I	4
ST 552	Statistical Methods II	4
ST 553	Statistical Methods III	4
ST 555	Advanced Experimental Design	3
ST 557	Applied Multivariate Analysis	3
ST 561	Theory of Statistics I	3
ST 562	Theory of Statistics II	3
ST 563	Theory of Statistics III	3
ST 565	Time Series	3
ST 567	Spatial Statistics	3
ST 599	Special Topics: Data Programming in R	2
ST 623	Generalized Regression Models I	3
ST 625	Generalized Regression Models II	3
Other Required:		
FOR 603	Dissertation	36+
FOR XXX	Seminar – *see Communication Training*	2
	Total	**108+**

Forest Geomatics option

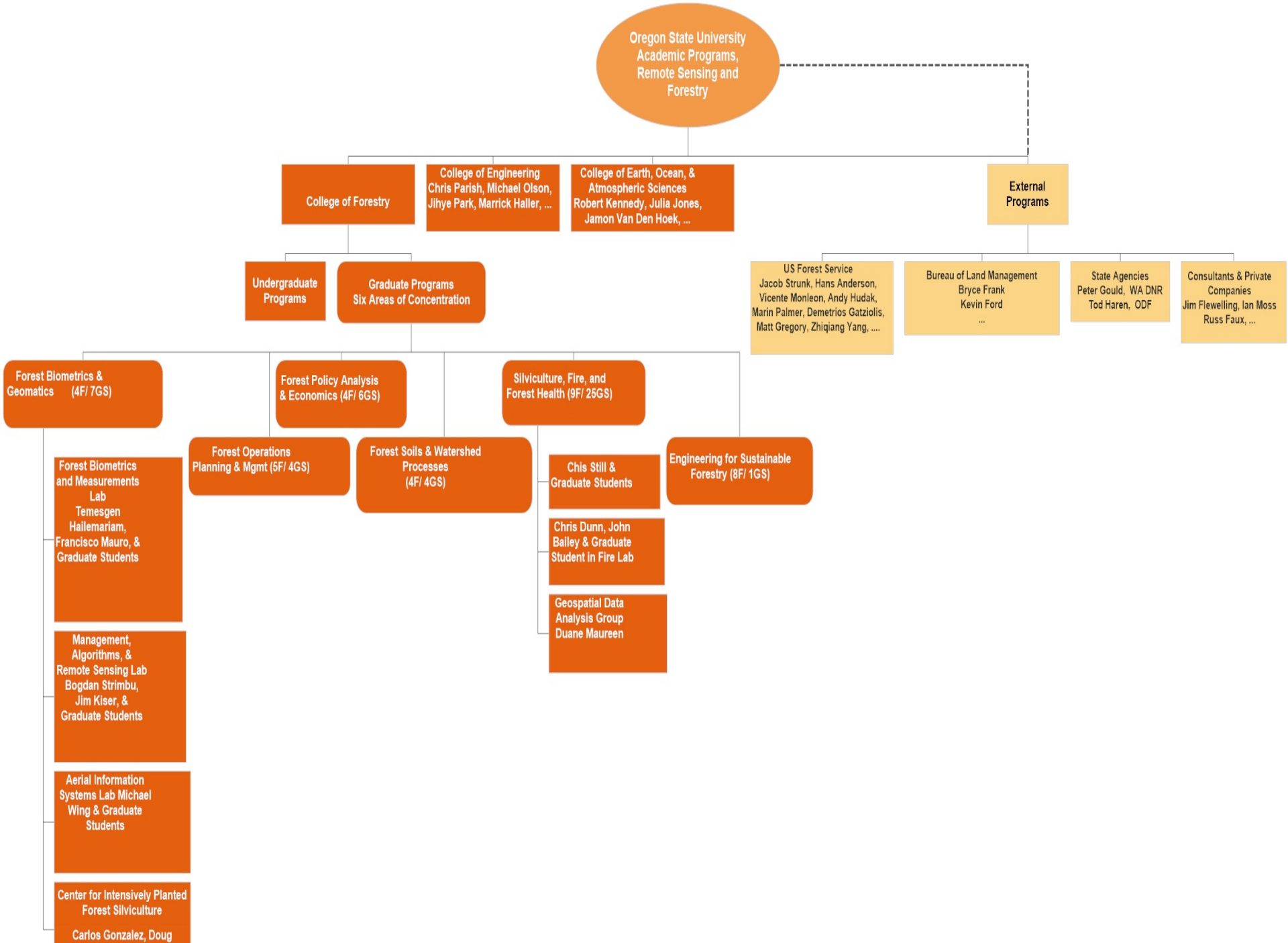
SFM Core:		**Credits**
FOR 550	Sustainable Forest Management	3
FES 521	Natural Resource Research Planning	3
ST 511	Methods for Data Analysis I	4
ST 512	Methods for Data Analysis II	4
Required Concentration Courses (6 credits, pick two courses):		
FE 544	Forest Remote Sensing and Photogrammetry	4
FOR 520	Geospatial Forest Analysis	3
FOR 524	Forest Biometrics	3
FES 524	Natural Resources Data Analysis	4
GEOG 561	GIScience II: Analysis and Applications	4
Example Pool of Supporting Courses (51-53 credits):		
FE 515	Forest Road Engineering	4
FE 523	Unmanned Aircraft System Remote Sensing	3
FE 532	Forest Hydrology	4
FE 640	ST: Heuristics for Combinatorial Optimization	3
FOR 525	Forest Modeling	3
FOR 536	Wildland Fire Science and Management	4
CE 513	GIS in Water Resources	3
CE 561	Photogrammetry	3
CE 562	Digital Terrain Modeling	4
CE 564	Global Navigation Satellite System	4
CE 566	3D Laser Scanning and Imaging	4
CS 553	Scientific Visualization	4
GEOG 562	GIScience III: Programming for Geospatial Analysis	4
GEOG 565	Spatio-Temporal Variation in Ecology & Earth Sci	4
GEOG 580	Remote Sensing I: Principles and Applications	4
GEOG 581	Remote Sensing II: Digital Image Processing	4
ST 513	Methods of Data Analysis III	4
ST 565	Time Series	3
Other Required:		
FE/FOR 603	Dissertation	36+
FOR XXX	Seminar – *see Communication Training*	2
	Total	**108+**

Programming Languages Useful to FB&G Area of Concentration (Extracted from Florin-Daniel Cioloboc @Geomatics Canada)

- Data processing, analysis, and modeling (Python, R)
- GIS Scripting and applications (Python, R)
- Web Mapping (JavaScript, Python)
- Geospatial databases (SQL)
- MapServers (Java, C# .NET, C++)
- GIS heavy-weight development (Java, C/C++, C#)
- Mobile development (Android, iOS, JavaScript)
- Geospatial libraries (JavaScript, Python, Java, R, C/C++)

OSU offers the above languages in different colleges or schools (e.g., CoE, School of Electrical and Computer Science, CEOAS, Dept. of Statistics, etc.)

Facing the Gap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College of Earth, Ocean, & Atmospheric Sciences Robert Kennedy, Julia Jones, Jamon Van Den Hoek, ...
External Programs
Undergraduate Programs
Graduate Programs Six Areas of Concentration
US Forest Service Jacob Strunk, Hans Anderson, Vicente Monleon, Andy Hudak, Marin Palmer, Demetrios Gatziolis, Matt Gregory, Zhiqiang Yang, ...
Bureau of Land Management Bryce Frank Kevin Ford ...
State Agencies Peter Gould, WA DNR Tod Haren, ODF
Consultants & Private Companies Jim Flewelling, Ian Moss Russ Faux, ...
Forest Biometrics & Geomatics (4F/ 7GS)
Forest Policy Analysis & Economics (4F/ 6GS)
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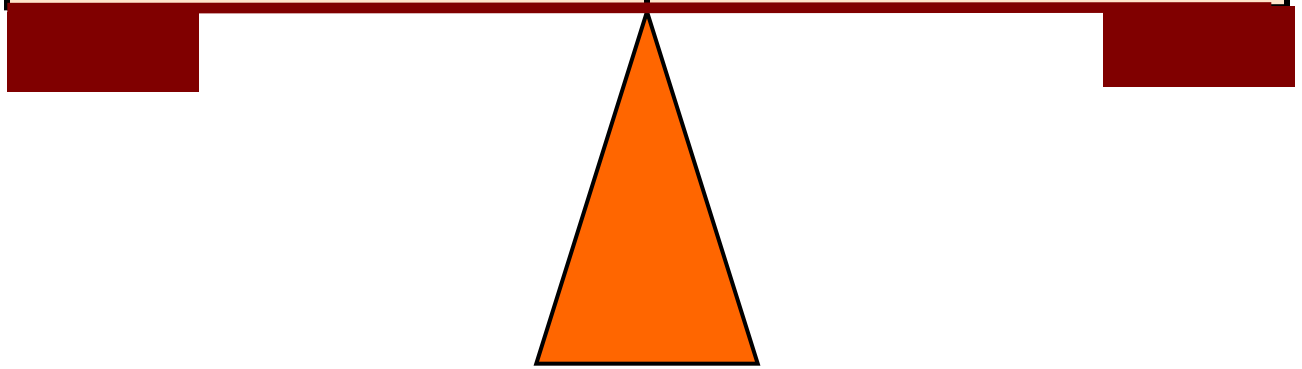
Aerial Information Systems Lab Michael Wing & Graduate Students
Center for Intensively Planted Forest Silviculture
Carlos Gonzalez, Doug

Opportunities

Forest Biometrics Option

Advance statistical and mensurational methods & add value to data	Improve efficiencies (e.g., identify stands for thinning, minimize error)
Expand the use of new technologies (e.g., mobile LiDAR, TLS, remotely sensed data)	Examine growth and yield projections at varying spatio-temporal scales (e.g., tree taper, …, millions of acres)



Applies to Public Land Management Agencies, Forest Companies, Consulting Firms, Academia, NGOs, …

Completed Research Projects (24 articles)

1) LiDAR-based Forest Inventory and Monitoring/Assessment
   - ❖ Generating tree-lists
   - ❖ Imputing and mapping predictions of selected forest attributes

2) Using LiDAR for identifying sites for restoration using LIDAR or satellite images to quantify stand structure and spatial distribution of trees

3) Examination of uncertainty in per unit area estimates of above ground biomass using terrestrial lidar

4) Fusing multi-level remote sensing and ground data to estimate forest biomass resources in remote regions of Alaska

5) Estimation of changes of forest structural attributes at three different spatial aggregation levels in Northern California using multi-temporal LiDAR

Completed Research Projects (Cont'd) (24 articles)

6) Develop/compare **small area estimation methods** using LIDAR and other remote sensing data to:
   - ❖ Extend the use of limited ground data to a larger area
   - ❖ Borrow strength from remotely sensed data

7) Using mobile LiDAR to quantify wood quality. Relating spatial distribution patterns to stand structure, growth and mortality.

8) Estimating fire induced basal area mortality with multi-temporal LiDAR

9) Using airborne LiDAR as decision support tools for selecting stands for thinning

Current Research Projects
(Use Remotely Sensed Data, LiDAR)

1) Generating tree-lists from airborne LiDAR (Mauro, Temesgen, Palmer, Bryant, Wolken and Rudisil)

2) Using airborne LiDAR to quantify size and distribution of invasive species E.g.,*Ventenata dubia* (ventenata, North Africa grass) in the Blue Mountains Ecoregion. (Nietupski, Kerns, Kennedy, & Temesgen)

3) Evaluation of maintenance of post-fire forest cover in National Forests (Smith, Ritchie, Mauro, & Temesgen)

4) Using airborne LiDAR as decision support tools for Land acquisitions and dispositions (NDA)

Current Research Projects
(Use Remotely Sensed Data, LiDAR)

5) Species-composition modeling using airborne LiDAR and spectral Indices (Mauro, Strunk, Temesgen)

6) Small area models for stand-level inventories using variable radius plot data (Temesgen, Mauro, Frank, Hudak, Palmer,…,)

7) *Using airborne LiDAR as decision support tools for stratifying and identifying stands for carbon credits* (Temesgen et al.)

Acknowledgments

I thank:

- Former Graduate Students
- Current Graduate Students: PhD Candidates Karin Kralicek and Ty Nietupski; and Kelly Smith (MSc)
- Drs. Francisco Mauro, Bryce Frank, and Jacob Strunk
- Drs. Ian Moss and Jim Flewelling
- …