

## Curriculum Vitae

Dr. Taehee Hwang

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### Research Interests

- Vegetation patterns in space and time under imposed geomorphic settings and climate change
- Coupled distributed eco-hydrological modeling using different remote sensing datasets
- Eco-hydrological nowcast and forecast under climate change and human disturbances
- Eco-hydrological controls on hurricane-induced shallow landslides
- Simulating the effect of urban green infrastructures for stormwater management

### Education

- Ph.D., 2010, Department of Geography, University of North Carolina at Chapel Hill
- M.C.P., 2004, *Summa Cum Laude*, Graduate School of Environmental Studies, Seoul National University
- B.S., 2000, Department of Microbiology, Seoul National University

### Professional Experiences

- 2014-current: *Assistant Professor*, Department of Geography, Indiana University Bloomington
- 2010-2013: *Post-doctoral Fellow*, Institute for the Environment, University of North Carolina at Chapel Hill
- 2004-2009: *Research and Teaching Assistant*, Department of Geography, University of North Carolina at Chapel Hill
- 2003-2004: *Research Associate*, Institute of Environmental Planning, Seoul National University
- 1996-1998 (26 months): *Sergeant*, South Korean Military Army (ROK)

### Peer-reviewed Journal Articles

1. Lin, L., Webster, J.R., **Hwang, T.**, Band, L.E. Effects of lateral nutrient input and in-stream nutrient process on nitrogen export in a forested catchment. Submitted to *Water Resources Research*
2. Creed, I.F., **Hwang, T.**, Lutz, B., Way, D. Climate warming causes intensification of the hydrological cycle in northern forests. Submitted to *Hydrological Processes*
3. Dannenberg, M.P., Song, C., Wise, E., **Hwang, T.** Is the El Niño—Southern Oscillation associated with variability in land surface phenology and productivity in the western United States? Submitted to *Remote Sensing of Environment*
4. Band, L.E., McDonnell, J.J., Duncan, J., Barros, A., Bejan, A., Burt, T., Dietrich, W.E., Emanuel, R.E., **Hwang, T.**, Katul, G., Kim, Y., McGlynn, B., Miles, B., Porporato, A., Scaife, C., Troch, P.A. Ecohydrological flow networks in the subsurface. *Ecohydrology*, 7, 1073-1078. (Invited commentary)
5. **Hwang, T.**, Band, L.E., Miniati, C.F., Song, C., Bolstad, P.V., Vose, J.M., Love, J. 2014. Divergent phenological response to hydroclimate variability in forested mountain watersheds. *Global Change Biology*, 20, 2580-2595.
6. Zhou, L., Tian, Y., Myneni, R.B., Ciais, P., Saatchi, S., Liu, Y.Y., Piao, S., Chen, S., Vermote, E.F., Song, C., **Hwang, T.** 2014. Widespread Decline of Congo Rainforest Greenness in the Last Decade. *Nature*, 509, 86-90. (selected as NEWS&VIEWS paper; Chambers, J.Q., Roberts, D.A. 2014. Ecology: Drought in the Congo

- Basin, *Nature*, 509, 36-37)
7. Tang, G., **Hwang, T.**, Pradhanang, S.M. 2014. Does consideration of water routing affect simulated water and carbon dynamics in terrestrial ecosystems? *Hydrology and Earth System Sciences* 18, 1423-1437.
  8. Song, C., Dannenberg, M.P., **Hwang, T.** 2013. Optical remote sensing of terrestrial ecosystem primary productivity. *Progress in Physical Geography*, 37, 834-854.
  9. **Hwang, T.**, Band, L.E., Vose, J.M. Tague, C. 2012. Ecosystem processes at the watershed scale: Hydrologic vegetation gradient as an indicator for lateral hydrologic connectivity of headwater catchments. *Water Resources Research*, 48, W06514. ([A featured article in Editor's Highlights](#) - 'Remote sensing of hydrological connectivity' in EOS Transactions 93, American Geophysical Union, and Top weekly download for three weeks in the journal)
  10. Mittman, T., Band, L.E., **Hwang, T.**, Smith, M.L. 2012. Distributed Hydrologic Modeling in the Suburban Landscape: Assessing Parameter Transferability from Gauged Reference Catchments. *Journal of the American Water Resources Association*, 48, 546-557.
  11. Band, L. E., **Hwang, T.**, Hales, T.C., Vose, J., Ford, C.R. 2012. Ecosystem processes at the watershed scale: Mapping and modeling ecohydrological controls of landslides, *Geomorphology*, 137, 159-167.
  12. **Hwang, T.**, Song, C., Bolstad, P., Band, L.E. 2011. Downscaling real-time vegetation dynamics by fusing multi-temporal MODIS and Landsat NDVI in topographically complex terrain. *Remote Sensing of Environment*, 115, 2499-2512.
  13. **Hwang, T.**, Song, C., Vose, J.M., Band, L.E. 2011. Topography-mediated controls on local vegetation phenology estimated from MODIS vegetation index. *Landscape Ecology*, 26, 541-556.
  14. **Hwang, T.**, Band, L.E., Hales, T.C. 2009. Ecosystem processes at the watershed scale: Extending optimality theory from plot to catchment. *Water Resources Research*, 45, W11425. ([Top 5 download](#) across all AGU journals for two weeks)
  15. Hales, T.C., Ford, C.R., **Hwang, T.**, Vose, J.M., Band, L.E. 2009. Topographic and ecologic controls on root reinforcement, *Journal of Geophysical Research*, 114, F03013.
  16. **Hwang, T.**, Kang, S., Kim, J., Kim, Y., Lee, D., Band, L.E. 2008. Evaluating drought effect on MODIS Gross Primary Production (GPP) with an eco-hydrological model in the Mountainous Forest, East Asia. *Global Change Biology*, 14, 1037-1056.
  17. Lee, B., Kang, S., Kim, E., **Hwang, T.**, Lim, J., Kim, J. 2007. Evaluation of a Hydro-ecologic Model, RHESys (Regional Hydro-Ecologic Simulation System): Parameterization and Application at two Complex Terrain Watersheds. *Korean Journal of Agricultural and Forest Meteorology*, 9, 247-259 (in Korean)
  18. Chae, N., Kim, R., Suh, S., **Hwang, T.**, Lee, J., Son, Y., Lee, D., Kim, J. 2005. Inter-comparison of Chamber Methods for Soil Respiration Measurement in a Phytotron System. *Korean Journal of Agricultural and Forest Meteorology*, 7, 107-114 (in Korean)

### Book chapter

1. Song, C., Chen, J.M., **Hwang, T.**, Gonsamo, A., Croft, H., Zhang, Q., Dannenberg, M., Zhang, Y., Hakkenberg, C., Li, J. 2014. Ecological Characterization of Vegetation Using Multi-Sensor Remote Sensing in the Solar Reflective Spectrum. *In press*. Remote Sensing Handbook
2. Lee, D., Kang, S., **Hwang, T.** 2003. Forested watersheds and water cycle, in *Forest, Water, and Culture* (S. Lee Ed.), Sumun Publication, Seoul, Korea (in Korean)

### Papers in preparation

1. **Hwang, T.**, Band, L.E., Miniati, C.F., Song, C. Temperature increases homogenize landscape vegetation patterns at the catchment scale.
2. **Hwang, T.**, Band, L.E., Miniati, C.F., Vose, J.M. Simulating transient hydrologic behaviors during forest clearcut and pine plantation with dynamic vegetation growth.

3. **Hwang, T.**, Band, L.E., Hales T.C., Miniati, C.F., Price, K.T. Simulating vegetation controls on hurricane-induced shallow landslides in the Southern Appalachians.
4. Gray, J., Song, C., **Hwang, T.**, Sun, G. Climate and land cover effects on the hydrology of the Eno River watershed in central North Carolina.

Google Citation Report: <http://scholar.google.com/citations?user=eA0gQG0AAAAJ&hl=en>

### Dissertation and Thesis

- **Hwang, T.** 2010. Integration of spatio-temporal vegetation dynamics into a distributed ecohydrological model: Application to optimality theory and real-time watershed simulations. A dissertation for fulfillment of a Doctor of Philosophy degree in the Department of Geography, University of North Carolina at Chapel Hill.
- **Hwang, T.** 2004. Spatial analysis of carbon and water processes with RHESys model in the Gwangneung experimental forest, Korea. A thesis for fulfillment of a Masters of City Planning degree in the Graduate School of Environmental Studies, Seoul National University.

### Invited Talks

1. **Hwang, T.** 2013. Ecosystem processes at the watershed scale: Co-evolution of hydrology, forest canopy, and geomorphic systems, *Curriculum for the Environment & Ecology*, University of North Carolina at Chapel Hill, NC, USA.
2. **Hwang, T.** 2013. Hydrosphere and Vegetation Interactions in a Changing Climate: Using Technology to Promote Climate Literacy, *NASA's Innovations in Change Education program*, Institute for the Environment, University of North Carolina at Chapel Hill, NC, USA.
3. **Hwang, T.**, Band, L.E., Song, C., Bolstad, P.V., Vose, J.M., Love, J., Ford, C.R. 2013. Hydroclimatic controls on leaf senescence in a humid temperate broadleaf forest, *The US-IALE Annual Symposium*, Austin, TX, USA.
4. **Hwang, T.** 2013. Ecosystem processes at the watershed scale: Co-evolution of hydrology, forest canopy, and geomorphic systems, *Department of Environmental, Earth, and Ocean Sciences*, University of Massachusetts Boston, MA, USA.
5. **Hwang, T.**, Band, L.E., Vose, J.M. 2012. Ecosystem processes at the watershed scale: Co-evolution of hydrology, forest canopy, and geomorphic systems, *CUAHSI 3<sup>rd</sup> Biennial Colloquium on Hydrologic Science and Engineering*, Boulder, CO, USA.
6. **Hwang, T.** 2012. Vegetation dynamics as a diagnostic tool for forested watershed systems, *Department of Geography*, University of Alabama, Tuscaloosa, AL, USA.
7. **Hwang, T.**, Band, L.E., Song, C., Bolstad, P.V. 2011. Integration of real-time vegetation dynamics into a distributed ecohydrological model by fusing multi-temporal MODIS and Landsat NDVI, *AGU Fall Meeting*, San Francisco, CA, USA.
8. **Hwang, T.** 2011. Space-time vegetation dynamics as a diagnostic tool of forest watershed systems, *Department of Earth and Environmental Sciences*, University of Waterloo, Waterloo, ON, Canada.
9. **Hwang, T.** 2010. Integration of spatio-temporal vegetation dynamics into a distributed ecohydrological model: Application to optimality theory and real-time watershed simulations, *Graduate School of Environmental Studies*, Seoul National University, Seoul, Korea.

### External Funding

- 2014 - 2017: Modeling the Ecohydrological Interactions Among Land Use Change, Climate Variability, and Forest Condition in the Yadkin-Pee Dee River Basin. Principal Investigator, USDA Forest Service. \$150,000.

## Awards and Honors

- *Oak Ridge Institute for Science and Education post-doctoral fellowship*, USDA Forest Service (2013) (declined due to starting date) (\$70,000 per year)
- *Scholars for Tomorrow fellowship*, University of North Carolina at Chapel Hill (2007) (\$10,000)
- *Student travel grant*, Binghamton Geomorphology Symposium (2005)
- Graduated *Summa Cum Laude* (2004)
- *Best Student Presentation Award*, Korea-Japan Joint Symposium of Limnology (2004)
- *Graduate School Fellowship for Top Graduate Student*, Graduate School of Environmental Studies, Seoul National University (about \$6,000)
- *LG Student Fellowship*, Department of Microbiology, Seoul National University (about \$1,000)
- *Department Fellowships*, Department of Microbiology, Seoul National University (totals \$3,000)

## Conference and Meeting Proceedings, Posters, and Abstracts

1. **Hwang, T.**, Band, L.E., Miniati, C.F., Song, C. 2013. Frequent summer droughts homogenize landscape vegetation patterns at the catchment scale, *AGU Fall Meeting*, San Francisco, CA, USA.
2. Band, L.E., **Hwang, T.** Remembrance of ecohydrologic extremes past, *AGU Fall Meeting*, San Francisco, CA, USA.
3. Yang, Y., Schaaf, C., Tague, C., Tenenbaum, D.E., Wang, Z., Douglas, E.M., Chen, R.F., Cialino, K.T., **Hwang, T.** Sensitivity analysis and simulation for DOC concentration and flux in the stream in the Regional Hydro-Ecological Simulation System (RHESSys), *AGU Fall Meeting*, San Francisco, CA, USA.
4. Dannenberg, M., Song, C., **Hwang, T.** 2013. Difference in land surface phenology and primary productivity in the western United States during El Nino and La Nina events from 2000-2012, *AGU Fall Meeting*, San Francisco, CA, USA.
5. Miles, B., **Hwang, T.**, Band, L.E. 2013. Stormwater pollution in suburban Baltimore ecosystems: The role of household-scale management. *Baltimore Ecosystem Study Annual Meeting*, Baltimore, MD, USA.
6. **Hwang, T.**, Band, L.E., Song, C., Bolstad, P.V., Vose, J.M., Love, J.P., Ford, C.R. 2013. Landscape-scale forest senescence patterns as a diagnostic of ecosystem vulnerability to climate change. *AAG Annual Meeting*, Los Angeles, CA, USA.
7. Band, L.E., **Hwang, T.**, Hales, T.C., Ford, C.R. 2012. Ecosystem processes at the watershed scale: Geomorphic patterns and stability of forest catchment water, energy, and nitrogen use efficiency in the southern Appalachians, *AGU Fall Meeting*, San Francisco, CA, USA.
8. **Hwang, T.**, Band, L.E., Vose, J.M. 2012. Simulating transient hydrologic behaviors during forest clearcut and pine plantation with dynamic vegetation growth, *Computational Methods in Water Resources*, University of Illinois at Urbana-Champaign, Urbana, IL, USA.
9. **Hwang, T.**, Song, C., Bolstad, P.V., Band, L.E. 2012. Hydrologic Vegetation Gradient as an Indicator for Lateral Hydrologic Connectivity of Headwater Catchments, *AAG Annual Meeting*, New York City, NY, USA.
10. **Hwang, T.**, Song, C., Bolstad, P.V., Band, L.E. 2010. Precipitation controls on vegetation phenology in a temperate broadleaf forest estimated from MODIS vegetation index, *AGU Fall Meeting*, San Francisco, CA, USA.
11. Band, L.E., **Hwang, T.**, Duncan, J.M., Tague, C. 2010. Coupled ecosystem-geomorphic controls on the generation and transport of nitrogen through watersheds, *AGU Fall Meeting*, San Francisco, CA, USA.
12. **Hwang, T.**, Band, L.E. 2010. Hydrologic gradients of vegetation density as an indicator for lateral connectivity of headwater catchments, *CUAHSI biennial meeting*, Boulder, CO, USA.
13. **Hwang, T.**, Bolstad, P., Band L.E. 2010. Evaluation of phenological signals estimated from MODIS vegetation index with continuous PAR measurements, *Coweeta LTER Science Meeting*, Coweeta Hydrologic Lab, NC, USA.

14. **Hwang, T.**, Song, C., Band L.E. 2010. A catchment-scale simulation of a distributed ecohydrological model with assimilating global satellite products by downscaling techniques, *Association of American Geographers (AAG) annual meeting*, Washington DC, USA.
15. Band L.E., **Hwang, T.** 2010. Climate, geomorphic and species controls on transient canopy development and soil water, carbon and nutrient cycling following disturbances, *Association of American Geographers (AAG) annual meeting*, Washington DC, USA.
16. **Hwang, T.**, Band L.E. 2009. A simulation of a distributed eco-hydrological model with assimilating global satellite products by downscaling techniques, *Second International Conference on Forests and Water in a Changing Environment*, Raleigh, NC, USA.
17. **Hwang, T.**, Band L.E., Song, C. 2009. Topography-mediated controls on local vegetation phenology estimated from MODIS vegetation index, *Coweeta LTER Science Meeting*, Coweeta Hydrologic Lab, NC, USA.
18. Band, L.E., **Hwang, T.** 2009. The Catena Concept Revisited: Spatial Optimization of Ecohydrologic Form and Function, *EGU General Assembly*, Vienna, Austria.
19. **Hwang, T.**, Hales, T.C., Band, L.E. 2008. Regression Analysis of Root and Soil Depth Measurements with Vegetation Factors, *Coweeta LTER Annual Meeting*, Coweeta Hydrologic Lab, NC, USA.
20. **Hwang, T.**, Band, L.E. 2008. A simulation of a distributed eco-hydrological model with assimilating global satellite products by downscaling techniques, *CUAHSI Biennial Colloquium on Hydrologic Science and Engineering*, Boulder, CO, USA.
21. **Hwang, T.**, S. Kang, J. Kim, Y. Kim, D. Lee, L. Band. 2008. Evaluating drought effect on MODIS Gross Primary Production (GPP) with an eco-hydrological model in the Mountainous Forest, East Asia, *AGU Joint Assembly*, Ft. Lauderdale, FL, USA.
22. **Hwang, T.**, Hales, T.C., Band L.E. 2007. Long-term Ecohydrologic Pattern Optimization at the Hillslope Scale, *AGU Fall Meeting*, San Francisco, CA, USA.
23. Shin, D., **Hwang, T.**, Band, L.E. 2007. Towards More Usable and Extendable Watershed Model: an Experience to Integrate RHESys for HydroMet Forecasting System, *AGU Fall Meeting*, San Francisco, CA, USA.
24. Hales, T., **Hwang, T.**, Band, L.E., Vose, J.M., Doyle, M.W. 2007. How changes in hydrology and vegetation control slope stability, *AGU Fall Meeting*, San Francisco, CA, USA.
25. Band, L.E., Shin, D., **Hwang, T.**, Goodall, J.L., Reed, M., Rynge, M., Stillwell, L., Galluppi, K. 2007. HydroMet: Real-time Forecasting System for Hydrologic Hazards, *AGU Fall Meeting*, San Francisco, CA, USA.
26. **Hwang, T.**, Band, L.E. 2007. Ecohydrologic pattern optimization at the hillslope scale: Implications for ecosystem management and restoration, *Coweeta LTER Science Meeting*, Coweeta Hydrologic Lab, NC, USA.
27. Band, L.E., **Hwang, T.**, Hales, T.C., Shin, D., Reed, D., Rynge, M., Doyle, M.W., Stillwell, L., Galluppi, K. 2007. Integration of ecohydrologic and geomorphic processes within a distributed watershed model: Applications to the prediction of ecosystem patterns, runoff production and landslide risk, *Coweeta LTER Science Meeting*, Coweeta Hydrologic Lab, NC, USA.
28. Band, L.E., **Hwang, T.** 2006. Ecohydrologic pattern optimization at the hillslope scale: Implications for ecosystem management and restoration in the Anthropocene, *AGU Fall Meeting*, San Francisco, CA, USA.
29. Shin, D., **Hwang, T.**, Band, L.E. 2006. How to detect vegetation controls on evapotranspiration loss and improve physical process modeling? *AGU Fall Meeting*, San Francisco, CA, USA.
30. **Hwang, T.**, Band, L.E. 2006. Comparison of MOD17 and Distributed Ecohydrological Simulation of Water and Carbon Flux during Extreme Drought, *Global Vegetation Workshop*, Missoula, MT, USA.
31. **Hwang, T.**, Shin, D., Band, L.E. 2006. Signals of Hydrologic Responses to Climatic Changes and External Disturbances, *AGU Joint Assembly*, Baltimore, MD, USA.

32. **Hwang, T.**, Band, L.E., Song, C. 2006. Estimating Spatial Pattern of Vegetation Species by ZELIG Model with Spatially Distributed Micro-climate Data and Soil Moisture Information, *2<sup>nd</sup> Interagency Conference on Research in the Watersheds*, Coweeta Hydrologic Lab, NC, USA.
33. Shin, D., **Hwang, T.**, Band, L.E. 2006. Integrated climate and geomorphic controls on space-time variability in coupled canopy and soil water, carbon and nutrient cycling in an experimental watershed, *European Geophysical Union*, Vienna, Austria.
34. **Hwang, T.**, Band, L.E., Shin, D. 2005. Integrating Spatial Ecosystem Information to Calibration of Watershed Models, *Binghamton Geomorphology Symposium*, Buffalo, NY, USA.
35. **Hwang, T.**, Band, L.E., Shin, D. 2005. Integrating Spatial Ecosystem Information to Calibration of Watershed Models, *Gordon Research Conference*, Colby college, ME, USA.
36. Shin, D., Band, L.E., **Hwang, T.** 2005. Toward more usable environmental model: an experience to integrate RHESSys to CatchLab, *AAG Annual Meeting*, Denver, CO, USA.
37. Kang, S., Eum, S., **Hwang, T.**, Kim, D., Mu, S., Lee, D. A combined effect of climate and topography on inter-annual spatial patterns of net primary production in a rugged temperate forested landscape, *International Conference on High-Impact Weather and Climate*, Seoul, Korea.
38. **Hwang, T.**, Kang, S., Kim, D., Lee, D. 2003. Incorporation of satellite image into an eco-hydrological model to analyze carbon and water processes in the Gwangneung experimental forest, Korea, *Workshop on Flux Observation and Research in Asia*, Beijing, China.
39. Kim, J., Kim, K., **Hwang, T.**, Lee, D. 2003. Validation of the MODIS LAI with the NDVI evaluated from the finer resolution satellite image, *Workshop on Flux Observation and Research in Asia*, Beijing, China.
40. **Hwang, T.**, Eum, S., Lee, D. 2002. Field and laboratory experiments for parameterizing soil variables at complex terrain, *RHESSys workshop*, Missoula, MT, USA.

### Teaching and Advising Experiences

- Primary lecturer: Cartography and Geographic Information (2014 fall; G237), Introduction to Watershed Systems (2011 spring; GEOG441) at UNC
- Guest Lecturer: Modeling of Environmental Systems (2012 Fall; GEOG410, lecturer: Dr. Conghe Song), Seminar in Earth System Science – Catchment Hydrology and Biogeochemistry; (2012 spring; GEOG811, lecturer: Dr. Larry Band), and Introduction to Watershed Systems (2014 spring; GEOG441, lecturer: Dr. Diego Riveros-Iregui) at UNC
- Primary lecturer of RHESSys bootcamps (2009, 2010, 2012, and 2013) at UNC
- Teaching Assistant: Issues in Applied GIS – Watersheds (2008 Spring; GEOG591, lecturer: Dr. Larry Band), Modeling of Environmental Systems (2005 fall; GEOG410, Lecturer: Dr. David Tenenbaum) at UNC
- Ph.D. committee member for Jihyun Kim (Geography, Boston University)
- Served as a mentor for MS work of Tamara Mittmann, published in the *Journal of the American Water Resources Association*, MS work of Matt Dannenberg (Dr. Conghe Song's lab) *in review*, PhD work of Yun Yang (Dr. Crystal Schaaf's lab at University of Massachusetts Boston), MS works of Bora Lee and JR Choi (Dr. Sinkyu Kang's lab - Environmental Remote Sensing Lab, Kangwon National University, Korea), published in *Korean Journal of Agricultural and Forest Meteorology*

### Professional Service

- Reviewer for journals - *Water Resources Research*, *Remote Sensing of Environment*, *Ecological Applications*, *Hydrological Processes*, *Advances in Water Resources*, *Journal of Geophysical Research*, *Ecohydrology*, *Agricultural and Forest Meteorology*, *Hydrology and Earth System Sciences*, *Remote Sensing*, and Book chapter
- Session chair at American Geophysical Union Fall Meeting 2010 for the session on 'Changing dynamics of complex eco-hydrological system'

- Reviewer for proposals and models - National Science Foundation (NSF), US Environmental Protection Agency (EPA), Georgia Water Resources Institute, and Korean-American Geospatial and Environmental Sciences (KAGES)
- Member of American Geophysical Union (AGU), Ecological Society of America (ESA), Association of American Geographers (AAG), and US Regional Association of the International Association for Landscape Ecology (US-IALE)

## **Research Skills**

### *Modeling Skills*

- Hydrological Modeling: RHESSys, SWAT, TOPMODEL, DHSVM, VELMA, SWMM, HEC-RAS
- Bayesian Modeling Framework: Bayesian State-space model, MCMC, Gibbs Sampler, GLUE
- Ecosystem Modeling: Biome-BGC, Grid-BGC, MOD17 (MODIS GPP/NPP), ZELIG
- Landslide Modeling: Infinite slope model, SHALSTAB
- Microclimate Modeling: MT-Clim, Grid-MET

### *Remote Sensing Skills*

- MODIS NDVI/EVI (MOD13), LAI/FPAR (MOD15), and GPP/NPP (MOD17)
- Extraction of phenological signals from satellite images (MODIS, AVHRR)
- Atmospheric and topographic corrections for Landsat, IKONOS imagery
- Canopy structure analysis with LiDAR and Landsat data (e.g. canopy height, vegetation density, crown diameter, and understory evergreen vegetation etc.)
- Fusion of multi-temporal imagery for real-time vegetation dynamics

### *Field Experimental Skills*

- Canopy Structures: LAI-2000, Digital Hemispheric Photos, TRAC
- Canopy Productivity: litter trap, tree ring coring, DBH
- Hydrologic Field Methods: velocimeter, water level sensor, soil moisture TDR Sensors with dataloggers, portable TDR sensors
- Square-pit hand-digging skills: vertical roots distribution, biomass, rooting depth, tensile strength
- Global Positioning System: Trimble GeoExplorer, Pathfinder XRS with GPS pathfinder software
- Soil Respiration: EGM-4, EGM-2
- Climate Monitoring System: temperature, radiation, humidity, precipitation etc.

### *Computer Skills*

- Languages: C/C++, MatLab, IDL, Fortran, Python (basic), Parallel Programming (basic)
- GIS/RS Software: GRASS, ArcGIS, TAS, Whitebox GIS, Erdas Imagine, ENVI, TauDEM
- Statistics: R, Splus, PC-ORD
- Canopy Analysis Software: Gap Light Analyzer, HemiView, FV2000, WinsCanopy
- System Dynamics: VENSIM, STELLA