

Modeling lowland tree species with LANDIS-II

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23 Species Considered for planting in ash stands





Fully flooded conditions (best performers)

1. Bald cypress

2. Sycamore

3. River birch



Moderate flooding (14 cm to water table or lower)

4. Bur oak	11. Black spruce
5. Swamp white oak	12. Northern white cedar
6. Hackberry	13. Tamarack
7. Silver maple	14. Trembling aspen
8. Red maple	15. Yellow birch
9. Basswood	16. American elm
10. White spruce	

Not recommended for lowland planting

17. Red oak

18. Sugar maple

19. Black walnut

20. Red pine

21. White pine

22. White oak

23. Bitternut hickory

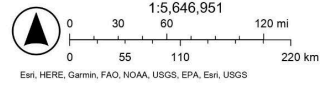


Cold hardiness testing across Wisconsin

Wisconsin Nursery Locations



12/22/2022



Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, Esri, USGS



Plant high-performers in ash stands

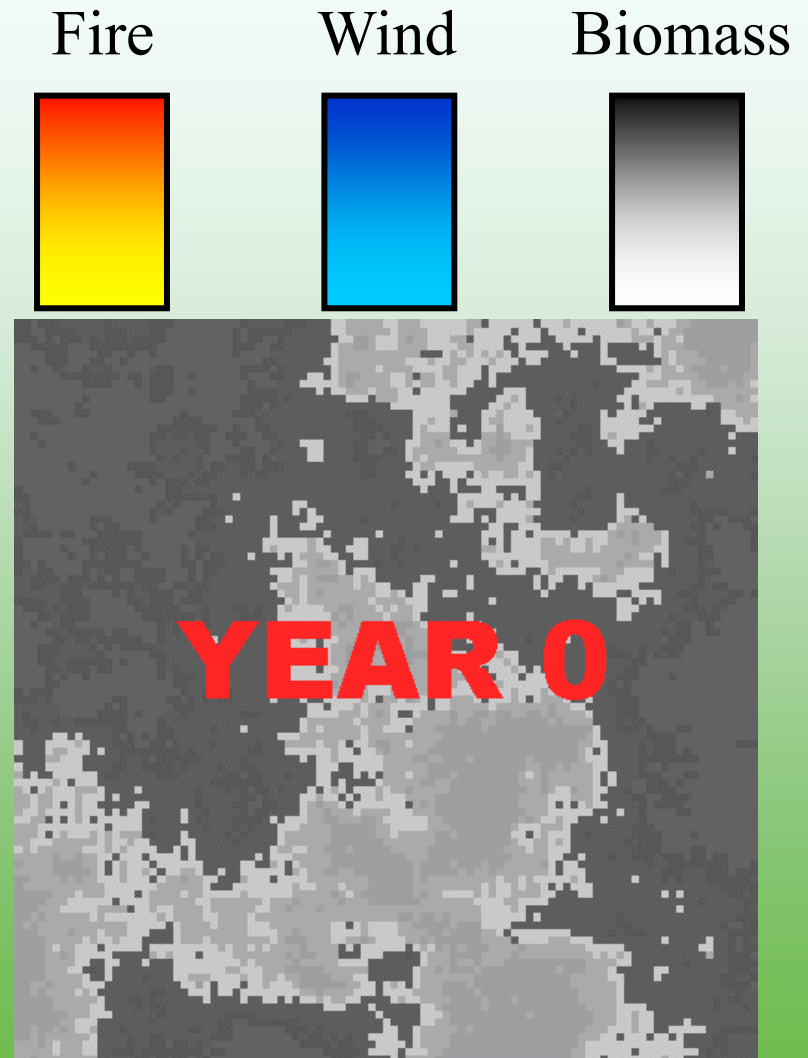
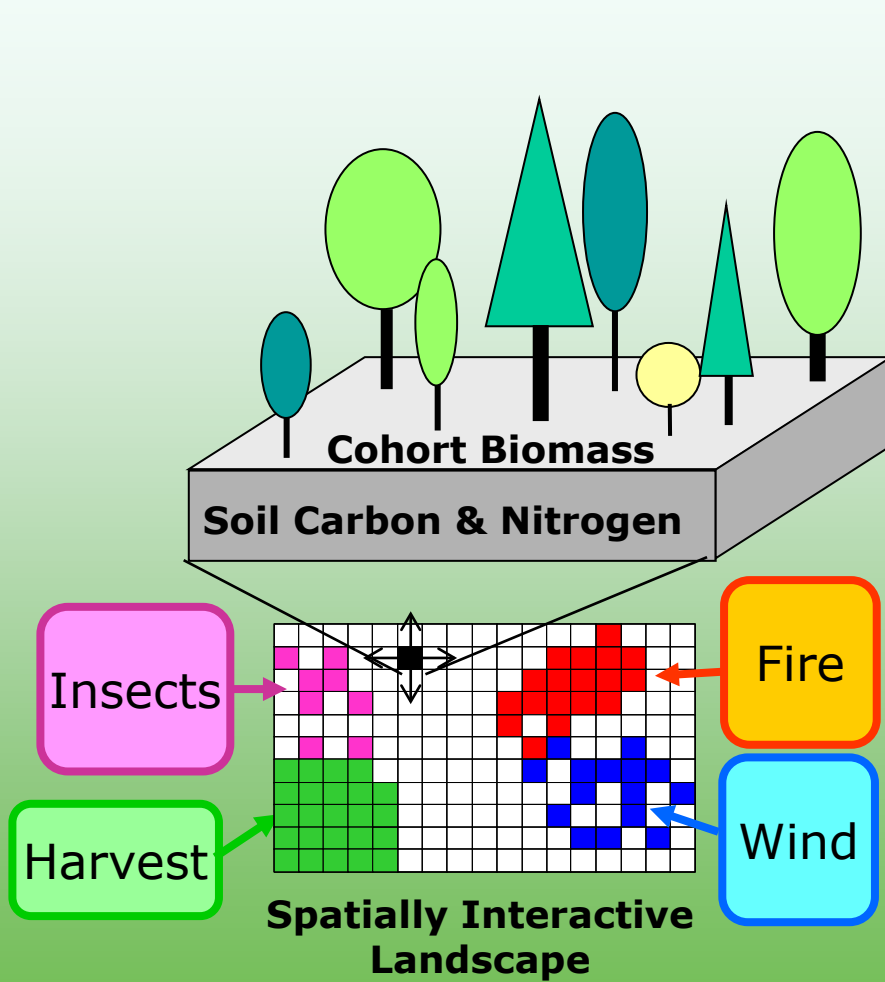


Chequamegon-Nicolet NF
& Ottawa NF

Photosynthesis measurements to parameterize LANDIS model

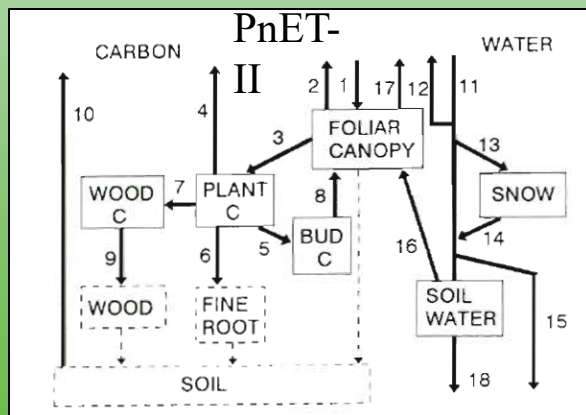


LANDIS Overview



PnET-Succession

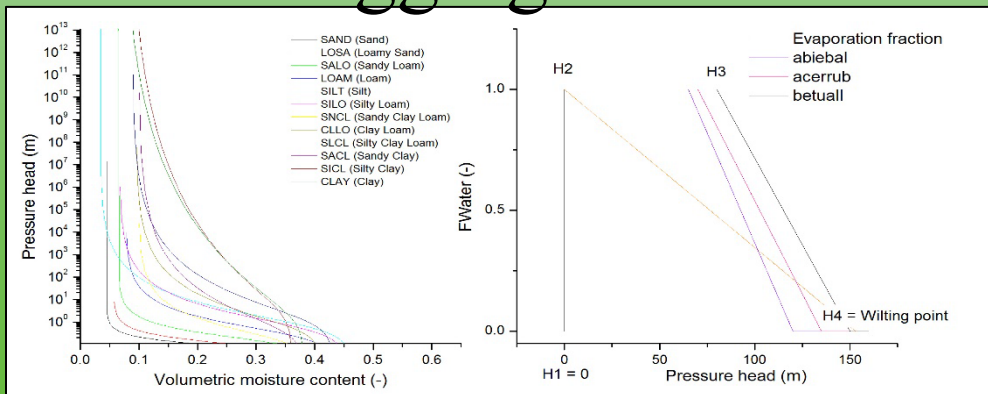
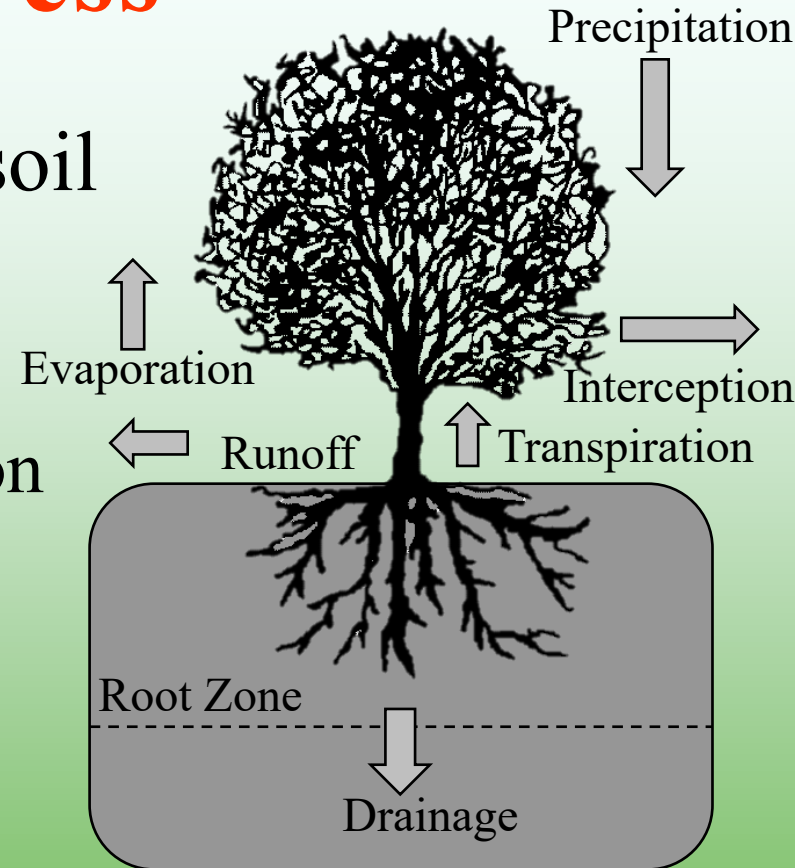
- A succession extension designed to better incorporate physiological first principles to simulate growth
 - Explicitly embeds photosynthesis and respiration equations from PnET-II



Soil Water

Water Stress

- Bulk-hydrology model of soil water
 - Precipitation, soil texture, interception and transpiration
- Stress determined by species drought and waterlogging tolerance



PnET-Succession

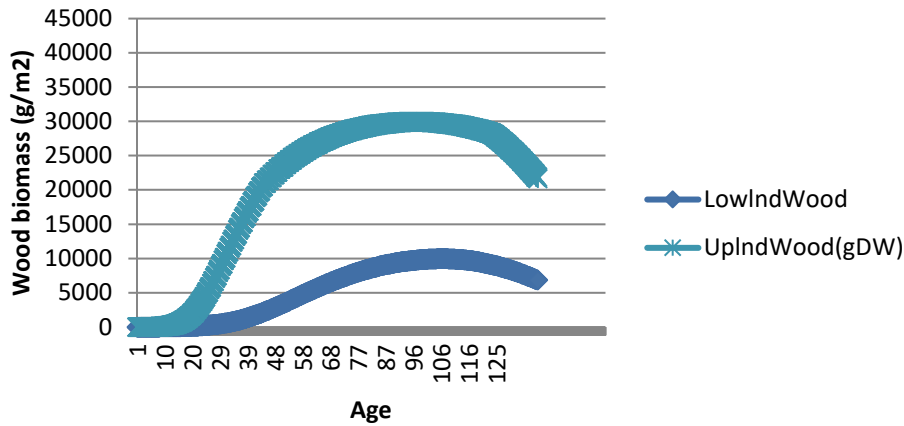
- Desirable model dynamics:
 - Self-thinning mortality of cohorts occurs automatically when competition is high
 - Drought and waterlogging mortality occurs automatically when water stress chronically exceeds tolerance of cohorts
 - CO₂ effects on growth, including its moderation of drought and ozone effects, are included
 - Temperature automatically increases evapotranspiration and respiration, and affects photosynthetic efficiency
 - Combined effects of weather and CO₂ on competition, mortality and establishment are simulated at monthly time step
 - Weather variability and extremes (to an extent) are easily included

Elm-Ash progress to-date

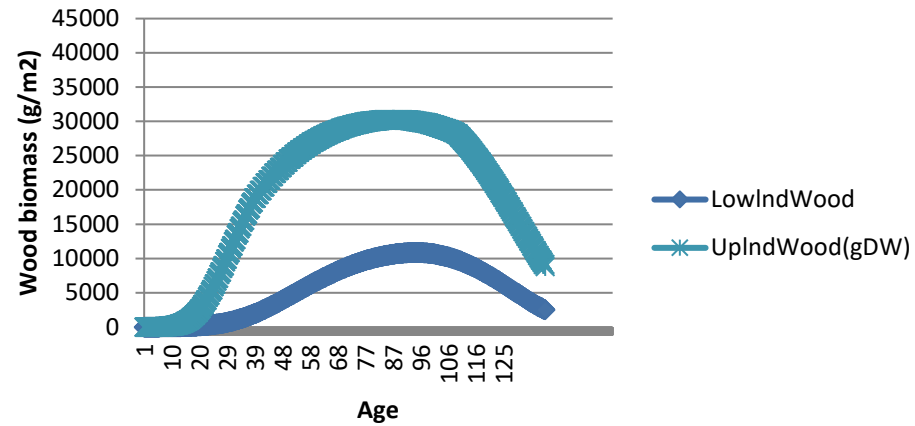
- Revised waterlogging parameters based on experimental data
- Used LANDIS-II to scale up the 2-year experiment to 130 years
 - Compared growth curves of single cohort on empty upland and lowland sites
 - Compared growth using prior parameters (inferred from literature) to new empirical parameters for selected species

Effect of lowland conditions on growth curves

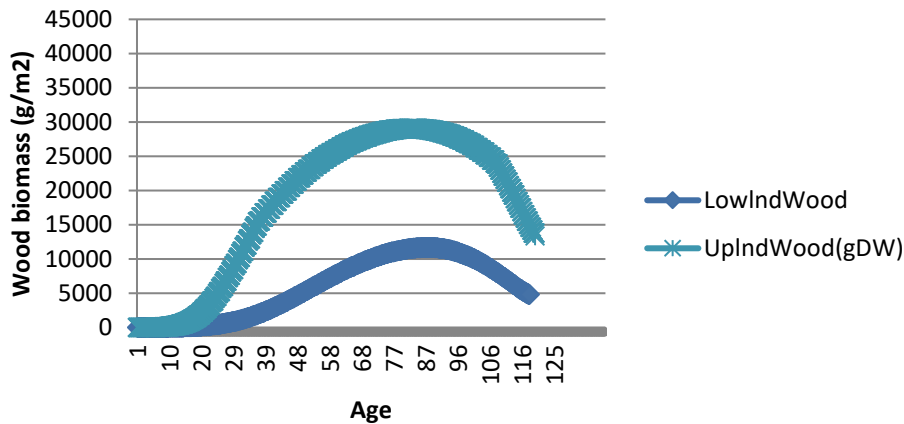
Red maple



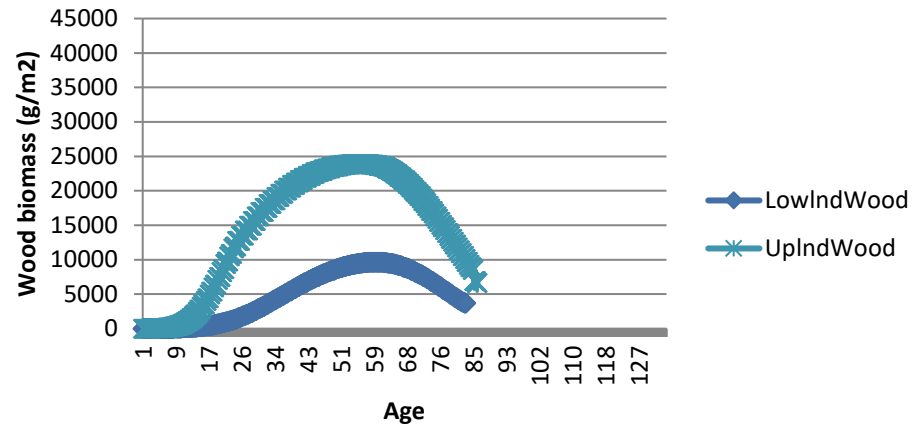
Silver maple



American Elm

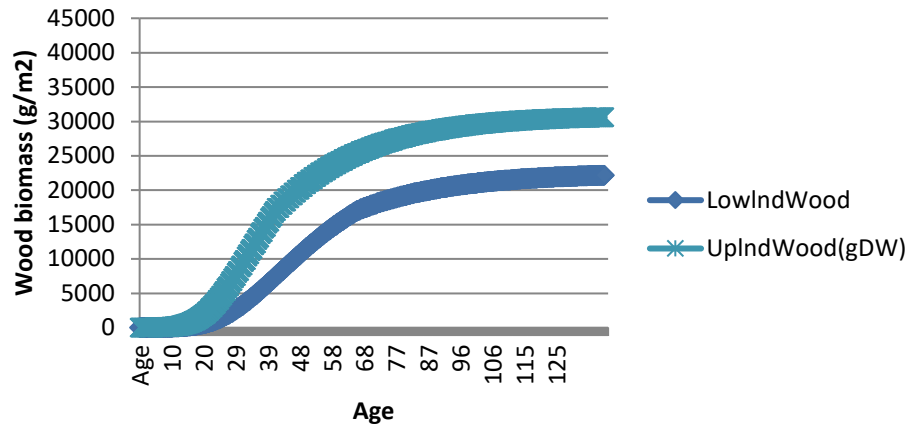


Quaking aspen

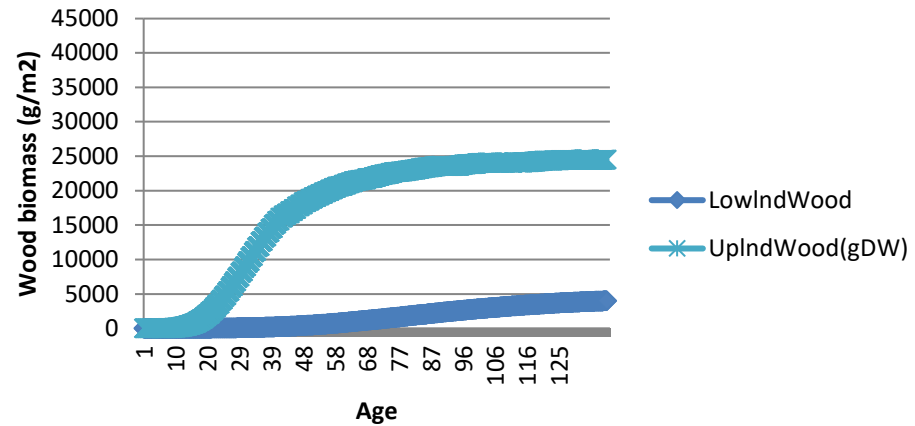


Effect of lowland conditions on growth curves

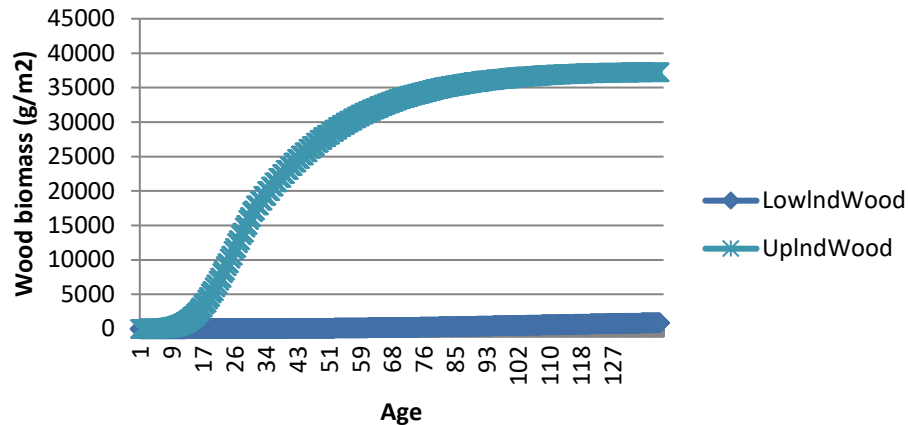
Bald cypress



White cedar

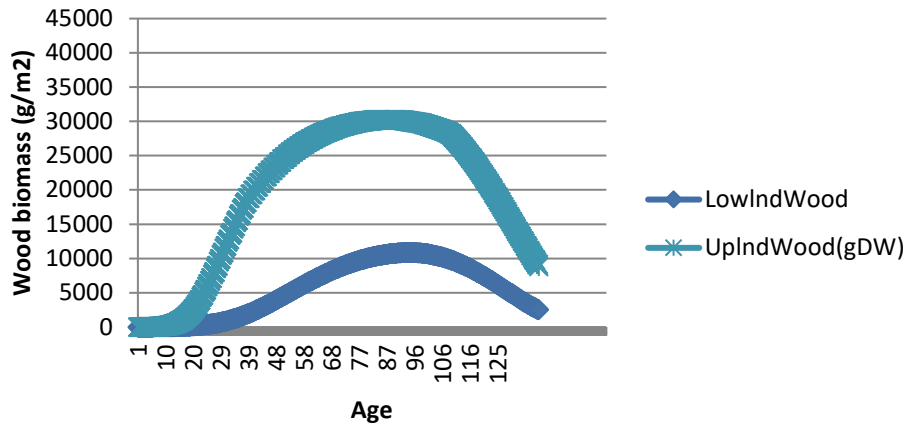


Bur oak

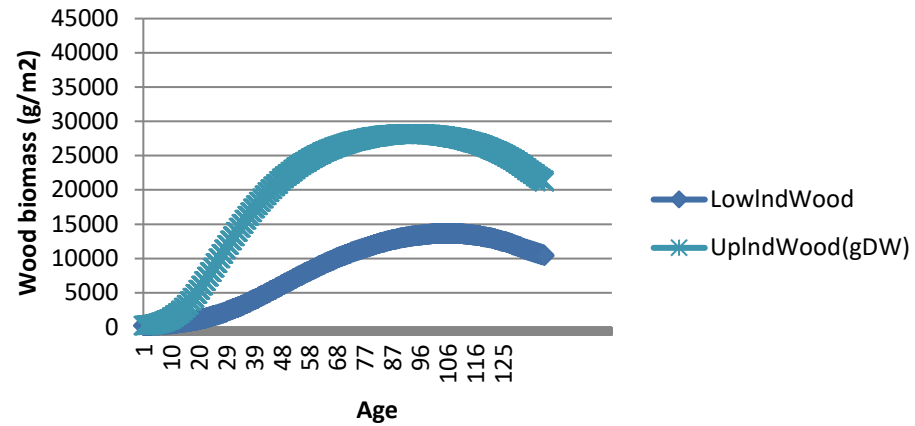


Comparison with old parameters

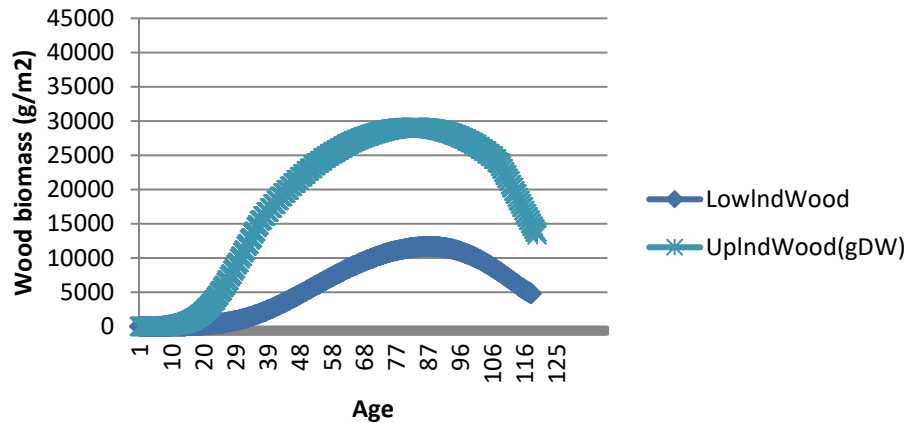
Silver maple



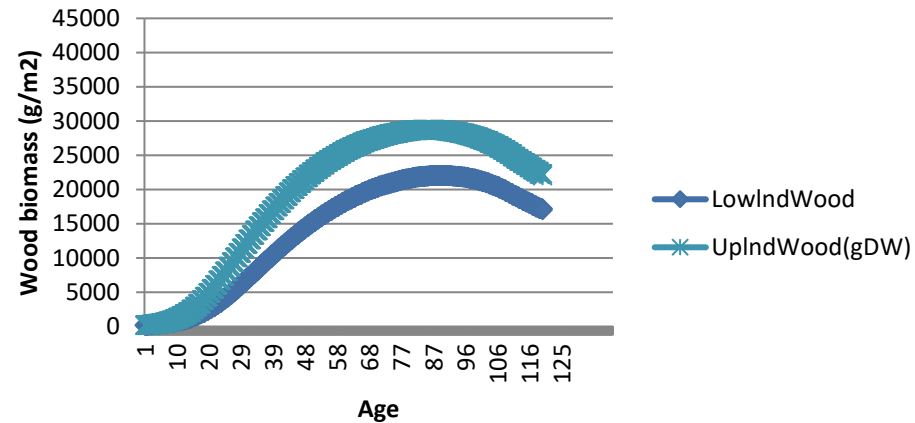
Silver maple - old



American Elm

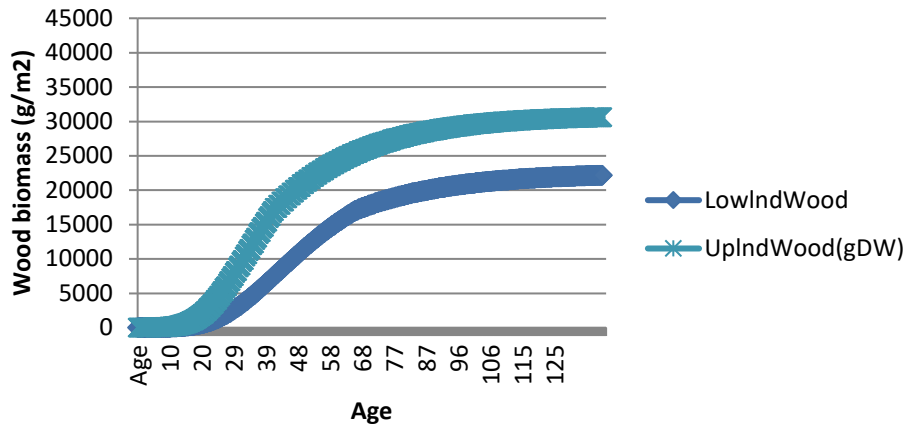


American elm-old

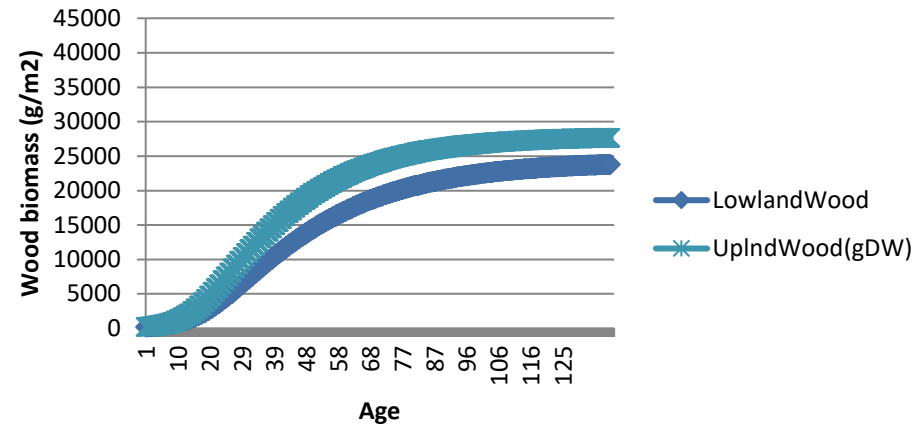


Comparison with old parameters

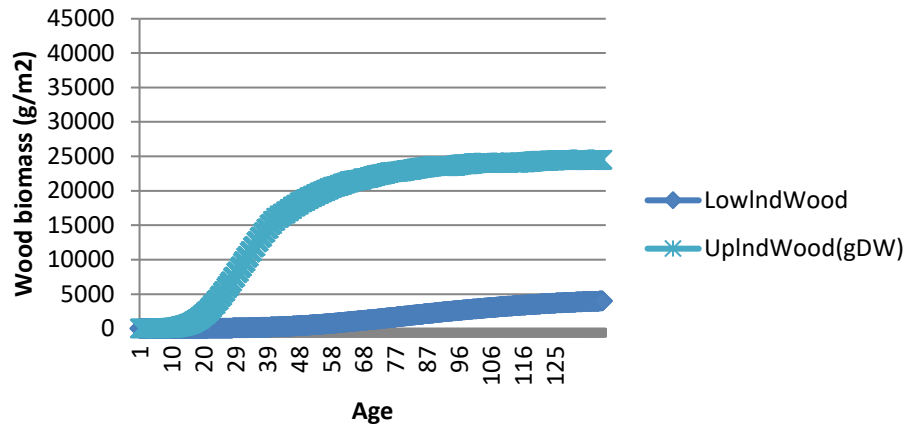
Bald cypress



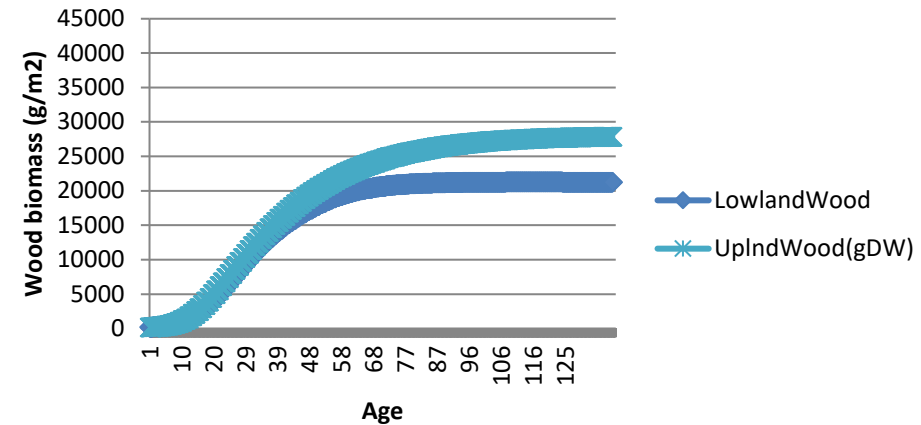
Bald cypress - old



White cedar



White cedar - old



Next steps

- Generate new parameters for more species
- Use LANDIS-II to scale up to landscape scale

Questions? Discussion

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