**Statistical relationships and Model validations**

**Validation of Whole-Forest Simulations Using Flooded Plot Demographic Rates**

The model results assessed:

1. The stats from flooded output
2. The stats from P81\_82 output

Correlation between basal areas: 0.992238

Intepretation: Strong positive correlation

Verdict: Model is consistent;

The results indicate that the **PPA model's demographic rates** drive most of the basal area dynamics, as the basal areas are highly aligned despite differing initial conditions.

This suggests the **PPA model is stable and consistent**, meaning that the demographic rates dominate the long-term simulation outcomes, regardless of initial state variability.

Regression function: Basal AreaFlooded ~ Basal AreaP81-82

Regression results:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Term | Estimate | Std.error | Statistic | P.value |
| (intercept) | 14.3006741 | 0.60010094 | 23.8304479 | 1.29e-15 |
| Basal AreaP81-82 | 0.72692017 | 0.02090026 | 34.7804346 | 1.14e-18 |

The intercept (14.3007) and slope (0.7269) in the regression show that the two datasets are **not identical**, which means the initial states still have a measurable influence.

A slope less than 1 suggests that changes in basal area in one dataset (ba2) grow faster than in the other (ba1).

However, the high correlation (0.99) and R² (98.45%) suggest that these differences diminish over time as the model's inherent processes dominate.

In overall

The results validate the robustness of the demographic rates used in the PPA model for both scenarios (full forest and only on flooded plots). It indicates that these **rates are capable of producing consistent forest growth dynamics over different spatial contexts** (e.g., plot-level vs. forest-wide initial conditions).

**####THIS SHOULD GO UNDER THE INTEPRETATION OF THE SIMULATED RESULTS**

**Comparing Temporal Trends in Basal Area Growth Across Groundwater Conditions**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Condition** | **DTG (m)** | **Intercept (Initial BA)**  **m2/Ha** | **Slope (Growth Rate of basal area) m2/Ha** | **R² (Fit)** | **Residual Std. Error** | **Observation**  **(time step = 5 years)** |
| **Dry** | 2.3 | 30.25 | 0.2354 | 0.9921 | 0.6677 | Highest initial basal area and steady growth rate. |
| **Intermediate** | 1.8 | 25.99 | 0.1424 | 0.9176 | 1.359 | Moderate initial basal area and growth rate, balanced conditions. |
| **Moist** | 1.3 | 22.56 | 0.0624 | 0.6688 | 1.398 | Lowest growth rate with significant residual variability. |
| **Flooded** | 0.8 | 19.63 | 0.2746 | 0.9384 | 2.239 | Low initial basal area but high growth rate, indicating resilience. |

A graph of different colors

AI-generated content may be incorrect.

\*For all relationships the p value is much smaller than the standard significance level of 0.05 (5.87 X 10−13 for flooded regression model) which suggest that all the models are highly significant which means the relationship between time and basal area is statistically significant, and changes in time are strongly associated with changes in basal area.

**Key takeaways**

**Dry conditions** support the highest initial basal area and steady growth, likely due to less water stress and favorable growth conditions.

**Flooded conditions** show a strong growth rate despite a lower starting basal area, suggesting resilience to waterlogged conditions.

**Intermediate conditions** fall between dry and flooded in both initial basal area and growth rate, possibly reflecting moderate soil moisture availability.

**Moist conditions** have the lowest growth rate and highest residuals, indicating that waterlogging may be limiting basal area accumulation.

Model Validations

|  |  |  |
| --- | --- | --- |
| Metric | Plots | Full forest |
| RMSE | 0.7455 | 11.25962 |
| MAE | 0.7455 | 11.25962 |
| Percentage Error | 6.04 | -91.2415 |

**Plot Simulation**:

**RMSE and MAE**: Both are low (0.7455 m²/ha), indicating an excellent match between the observed and simulated basal area at time step 0.

**Percentage Error**: At 6.04%, this shows a small deviation, meaning the simulated values align closely with the observed data.

**Reasoning**:

The demographic rates and initial states used for this smaller-scale simulation are well-calibrated to the observed conditions.

This suggests that the PPA model performs reliably at the plot level when both the initial data and demographic rates are measured/calculated at the same census interval.

**Full Forest Simulation**:

**RMSE and MAE**: Both are significantly higher (11.25962m²/ha), indicating substantial deviations between the observed and simulated basal area at time step 0.

**Percentage Error**: The error is negative (-91.24%), indicating the simulated basal area is almost closer to twice the observed value.

**Reasoning**:

The initial state for the full forest simulation (2013 values) might not accurately represent the actual observed conditions which is 12 years apart from the new census date.

To validations