

# Replication assessment ForeGatherer Model v1.0:

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The ForeGatherer ABM contains several sources of stochasticity, e.g. resource distribution, the movement of the agents during foraging trips and the movement of the group during residential moves. Therefore, consecutive model runs will not yield identical results. In order to produce statistically robust values for the output variables a certain number of model runs is required. Because the impact of the factors varies with the output selected, several output variables need to be monitored.

We performed a replication assessment to identify the number of runs required (Hoad et al. 2010, Lorig 2018). We consider the values of each output variable as normally distributed and calculate the cumulative standard deviation from the cumulative statistical mean. We choose a 95 % confidence interval for the output variables displayed in the model.

## Experimental setup:

For our factors the chosen values correspond to average values of the expected range of each factor.

Tab. 1: Factor specifications applied in the replication assessment

	Factor	In-model name	Factor level
Agent	Number of foragers	<i>number-of-foragers</i>	30
Agent	Hours per day	<i>hours-per-day</i>	12
Agent	Energy demand per day	<i>energy-demand-per-day</i>	2500
Agent	Maximum load	<i>maximum-load</i>	1500
Agent	Ability to Storage?	<i>storage?</i>	off
Environment	Scenario	<i>scenario</i>	random-map
Environment	Net-primary productivity	<i>net-primary-productivity</i>	1500
Environment	NPP-Multiplier	<i>npp-multiplier</i>	15
Environment	Length of dry season	<i>length-dry-season</i>	6
Environment	Productivity reduction in dry season	<i>productivity-reduction-dry-season</i>	50%
Environment	Occurrence of seasonal resource	<i>map-seasonal-resource</i>	70%
Environment	Occurrence of aseasonal resource	<i>map-aseasonal-resource</i>	30%
Environment	Seasonal resource value	<i>seasonal-resource-value</i>	120 kcal/100g
Environment	Aseasonal resource value	<i>aseasonal-resource-value</i>	100 kcal/100g
Environment	Run duration	<i>run-duration</i>	1 Year

## Output responses:

We monitor a wide array of responses describing the movement and the foraging success of the group.

Tab. 2: Model Responses

<b>Residential Mobility:</b>		
Name	In-Model variable	Description
Number of residential moves per year	<i>number-res-moves-year</i>	Every change of the base location per year is counted as a residential move.
Average distance per residential move	<i>distance-res-move-year</i>	The distance of every residential move is calculated cumulatively and divided by the number of residential moves.
Total distance covered through residential mobility per year	<i>covered-distance-year</i>	The average distance per residential move is multiplied by the number of residential moves per year.
Total area covered per year	<i>covered-area-year</i>	Area covered by the group over the whole year. In the model every cell that was visited is counted, independent if the cell was visited during a residential or logistical movement.
Length of occupation of a winter (or rainy season) site	<i>longest-base-year</i>	Measured in days.
<b>Logistical Mobility</b>		
One-way distance	<i>distance-log-moves-year</i>	Average distance moved during per logistical movement, determined by calculating the mean distance of all logistical movements.
<b>Foraging success</b>		
Average yield	<i>average-yield-trip</i> <i>average-yield-hour</i>	Average yield per foraging trip and per hour spent foraging
Diet composition	<i>percentage-seasonal-resource</i> <i>percentage-aseasonal-resource</i> <i>percentage-seasonal-resource-dry</i> <i>percentage-aseasonal-resource-dry</i>	Percentage the two resources contribute to the energy overall consumed during the year or during the dry period
Energy lost from storage	<i>daily-storage-decay</i>	Energy lost per day from the storage due to the decay in energy-units/day

## Results and discussion:

For most responses the desired precision of 0.05 is reached after c. 5 runs. For the shortest duration a residential camp was established (“shortest base”) the desired precision is reached after 23 runs.

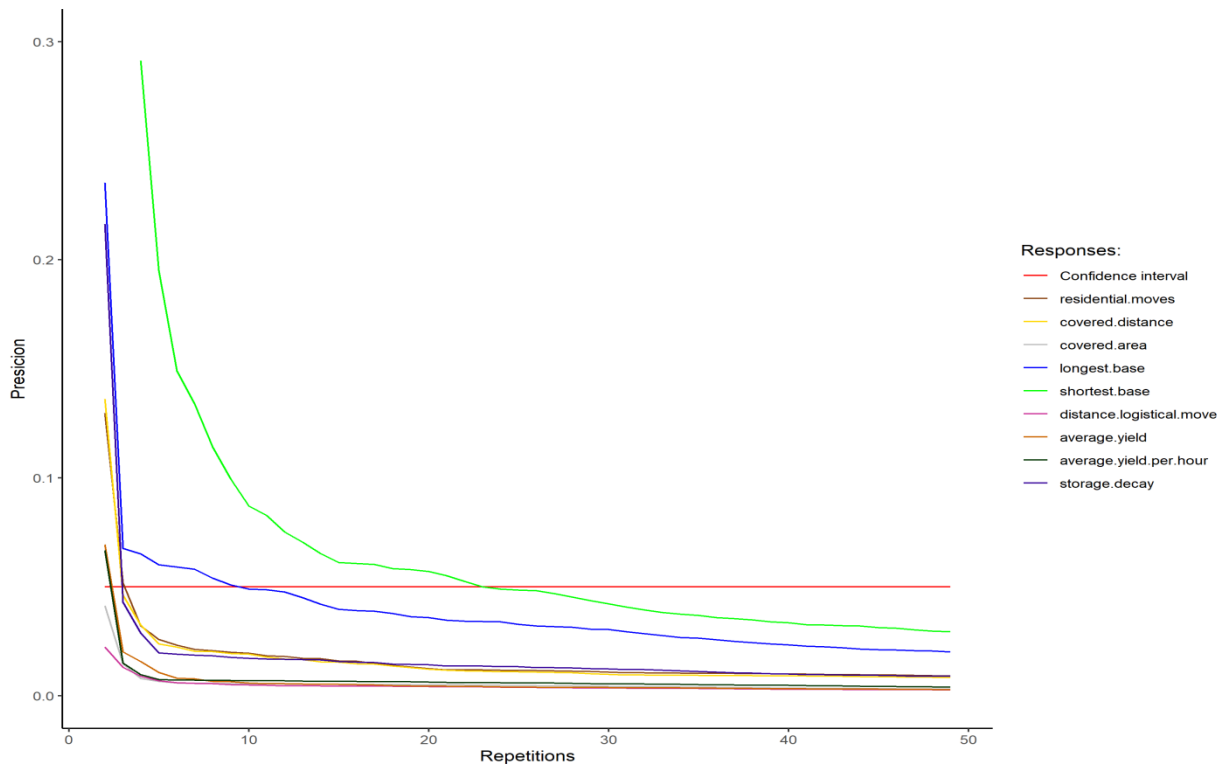


Fig. 1: Precision for a selection of the tested responses; the confidence interval with the desired precision of 0.05 is displayed as a red line.

With respect to all the tested responses of the ForeGatherer ABM, we recommend performing 25 repetitions, which is rather low for simulation-based models.