**Slide 3 – malaria prevalence in Ghana & SNT**

* Malaria burden in Ghana is highly heterogeneous and reducing this burden requires effective malaria control to achieve a more targeted response. – **part 1**
* These strategies are often designed and implemented at a sub-national level to address the heterogeneity of malaria transmission – **part 2**
* Agent-based models such as **OpenMalaria** play a crucial role in modeling malaria interventions to prioritize intervention combinations and malaria control strategies
* It does so By considering local transmission dynamics, vector species, human population characteristics, and healthcare infrastructure ---, policymakers can optimize intervention strategies to target high-risk areas effectively
* Despite the crucial role abms play in modeling interventions, they are faced with the challenge of uncertainty in their outputs and this uncertainty may stem from different sources:

**Slide 4 – sources of uncertainty**

* **Model uncertainty** measures the error between model outputs and observed data stemming from model design choices
* **Stochastic uncertainty** occurs due to randomness in the real-world system.
* **Parameter uncertainty** arises due to the challenge of not knowing the values of the parameters
* **Observation uncertainty** arises when there are inaccuracies in measuring the real-world system.

**Slide 5 – uncertainty in intervention modeling**

* In order to obtain more robust and accurate model outputs for decision-making, these sources of uncertainty need to be identified and quantified and taken into account during the model calibration process.
* **forward uncertainty propagation** (i.e. sensitivity analysis), which investigates the impacts of random input values of model parameters on the outputs of a model, whereas **inverse**
* **uncertainty quantification** (i.e. calibration or parameter estimation) is the process of using experimental data to learn about the sources of modelling uncertainty
* Despite the various sources of parameter uncertainty, currently, the AMB Openmalaria that simulates the dynamics of malaria transmission and the impact of interventions only takes into account the entomological Innoculation rate.
* This phd seeks to identify and quantify the uncertainty from various parameters in the OpenMalaria Ghana model, beyond just the entomological inoculation rate (EIR) and to determine the impact of these uncertainties on simulating the effect of malaria interventions at the sub-national level

**Slide 7- research objectives**

Obj1:

* Fig shows the effects of three uncertain variables (X1, X2, and X3) on the variance of output Y. V(E(Y|Xi)) indicates the variance in Y if factor Xi is left to vary freely while all other factors remain fixed to nominal values. In this case, factor X2 makes the largest contribution to the variability of output Y and it should therefore be prioritized

Obj 2:

Obj3:

* Study Amanda’s questions
* Check vaccine implementation schedule

Relevance:

1. More generally, our group is committed to providing modeling support to NMCPs through intervention modeling and this phd is geared toward making our methods better to obtain more robust model outputs which will translate into robust conclusions for the NMCPs for future planning of interventions.
2. Secondly, Ghana is in the pre-elimination phase in the fight against malaria and optimal allocation of resources is required to make more impact. Stratifying interventions using a better calibrated model will help
3. In addition, Ghana has a history of approving novel interventions and since objective t