Simulation Model Parameters Description and Workflows

22 June 2020

	Name	Date	Signature
Prepared by	G. Maier (DESY), ...		
Approved by			
Released by			

This version:					
Issue	Rev.	Created	Comment	Ownership	Distribution
0.1	a	2020-06-22			

Change log:				
Issue	Rev.	Created	Comment	Parts affected
0.1	a	2020-06-15	Start of Document	

Table of Contents

1 Introduction

This document describes the CTA MC model parameters, the corresponding workflows for setting and validating them, and the procedures to calculate the corresponding systematic uncertainties.

This document is part of a series describing the CTA MC Simulation Pipeline. It is expected that the reader is familiar with the wider concept of Simulation Pipelines System as described in [1].

2 Glossary

Useful definitions helpful for this document are listed below. We point also to the glossary definitions in Jama and those in [1].

Reference simulation model: Simulation model defined as reference for comparisons with newly introduced model parameters.

Reference simulation production: Simulation production based on reference simulation model.

Reference Instrument Response Functions: Set of instrument response functions (IRFs) calculated from the reference simulation production used for comparisons with IRFs derived from a simulation production with an altered simulation model. Typical instrument response functions are effective areas, reconstructed energy, and gamma-ray point-spread function.

Comment: `MG lists also pointing accuracy; understand`

3 Model parameter description

3.1 Molecular profiles

MC model parameter: atmospheric profile

Description: Atmospheric model profiles with molecular density, atmospheric thickness, and index of refraction as function of altitude.

Comment: `understand if this would be same table for a curved atmosphere`

Format and units:

The following columns are required:

- **altitude** in range [0 km, 120 km]
- **density**
- **index of refraction** calculated at at fixed wavelength of XXX nm

detailed description of the format and the units required

Required accuracy:

Setting procedure: Short description and list of relevant setting / derivation groups

Validation: Short description and list of relevant validation groups

Systematic uncertainty estimation: list of relevant systematic uncertainty estimation procedures; bracketing curves (energy dependence...)

Update frequency and averaging: e.g., averaging over time, or assume that all elements are the same, etc

Data source: ACE, laboratory, etc. (needed)?

Notes: any further description / notes required

4 Workflows for Model Parameter Setting

5 Workflows for Model Parameter Validation

5.1 Cherenkov photon density

Cherenkov photon densities vs distance to shower core for different primary energies

5.2 Effective area calculator

Calculate effective areas for a given set of model parameters. Comparison to a reference set of simulations.

5.3 Atmospheric transmission comparison

Compare transmission probabilities as function of wavelengths for different emission heights.

6 Workflows for the Estimation of Systematic Uncertainties

6.1 Systematic uncertainties from aerosol transmission configurations

Impact on IRFs using different aerosol transmission configuration.

Determination of correction factors on energy for Level A and Level B analysis.

6.2 Systematic error calculator for standard IRFs metrics

Calculates systematic differences of IRFs produced for the given MC model compared to reference IRFs as function of e.g., energy, elevation, etc.

7 Temporary

7.1 Validation

- validation procedure for each parameter

7.2 Algorithms

- averaging
- simulation time interval finder (take also discrete events into account (e.g., change in broken pixel configuration))

7.3 I/O

- reading / writing of MC configuration data base
- reading of TOSS / SOSS data bases

7.4 Open issues

- convert any atmospheric configuration into a time-dependent systematic error if you use a different systematic error
- describe where there is a person in the loop

8 References

[1] Concept for the CTA Simulation Pipelines System Software, CTA-TRE-COM-304000-0003.1b; June 2020

[2] DPPS Requirements (2018)