# SCoBi-Veg Simulator

SCoBi-Veg stands for **S**oOp (Signals of Opportunity) **Co**herent **Bi**static scattering simulator for **Veg**etated terrain.

To be continued

## Simulation Modes

SCoBi-Veg simulator currently supports two different simulation modes: Snapshot and Time-series.

### Snapshot Simulation

Snapshot simulation is the appropriate mode for generating large amount of GNSS-R data for comprehensive analysis rather than studying realistic scenarios. The simulator runs simulations for all the snapshots (i.e. combinations) of the following system and scene parameters: Antenna incidence and azimuth angles, vegetation cover, volumetric soil moisture (VSM), and surface roughness (via root mean square height).

How to input

### Time-series Simulation

Time-series simulation mode, on the other side, is the perfect option to analyze realistic scenarios. This mode requires the user input for a time-series of the same parameters as in the Snapshot mode. User should give the same-size sequences of the following parameters for a period in time that the vegetation cover can be assumed to be constant: Antenna incidence (theta) and azimuth (phi) angles, volumetric soil moisture (VSM), and surface roughness (via root mean square height). In other words, separate time-series simulations can be performed for varying canopy through time. In addition, only exemption to need for having all the parameter sequences in the same size is to input exactly one value for a parameter, which means that parameter is constant through the simulations.

How to input

Let us assume we have a time-series data for a specific growth stage of a plant as follows:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Timestamp | Incidence Angle (deg) | Azimuth Angle (deg) | Soil Moisture (g/) | Roughness – rms height (cm) |
|  |  |  |  |  |
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## Vegetation Methods

SCoBi-Veg allows to study with two distinct vegetation modelling: Homogenous and virtual. These modelling methods allow the user to control the degree of precision for generating the scatterers in the medium. Each method leads to a separate simulation directory for meta-data and outputs even if all the other input parameters are the same.

### Homogenous Vegetation

Homogenous vegetation is basically a multi-layer canopy model where the scatterers are spread uniformly between illuminated layer using a given distribution. The current version of the SCoBi-Veg only provides uniform distribution, while additional probabilistic distributions can be added easily.

### Virtual Vegetation

Virtual vegetation is developed to simulate realistic canopy models, where the scatterers are created as connected members of individual plants. In other words, virtual vegetation method offers more realistic modelling than the homogenous one that spreads the scatterers through the medium. Framework enables modelling of row-structured or random virtual vegetation, while the former is the only implemented option for the current version. One can easily adapt the implementation of the random virtual vegetation to the SCoBi-Veg framework by following the SCoBi-Veg Developer’s Manual.

#### Row-Crop

The row-crop virtual vegetation method aims to model vegetation fields that have their crop planted in rows. The well-known examples of such canopy models can be listed as corn, soybean, and cotton.

#### Random

## Ground Cover

Ground cover can be determined to be bare soil or vegetation cover by the user in the SCoBI-Veg simulations. When bare soil is selected, SCoBi-Veg does not operate its functions for canopy computations and only generates the results for bare soil. From this point, vegetation covered simulations can be assumed as the full simulations regarding the calculations and outputs.

# System Requirements

Although there is no proven test of minimum system requirements, the optimum minimal configuration should be as follows:

1. Matlab R2017a or Octave version
2. 8 GB memory
3. To be continued

# Downloading and Installation

SCoBi-Veg software can be downloaded from the following URL:

URL

It can also be accessed from the following ***github*** repository:

<https://github.com/erogluorhan/SCoBi-Veg>

There is no installation requirement for the current version. In other words, it can be directly run from within the source code when it is downloaded.

# Initial Run

The ScoBi-Veg simulator comes with an initial pack of inputs for both homogenous and virtual vegetation methods. It can be run with the initial configuration by calling the function runSCoBi under the directory /lib.

# Example Inputs

Inputs are …

# Simulation Outputs

# Customizing Inputs and Simulations

# SCoBi-Veg for Custom Vegetation

You are done with the SCoBi-Veg User Manual!

Please read the SCoBi-Veg Developer Manual!

# Glossary

runSCoBi: