

## Introduction

The CAPANINA project studies the communication via stratospheric platforms providing broadband wireless access for passengers travelling onboard public means of transport, including fast-moving trains.

HAPs mobile channel characteristics:

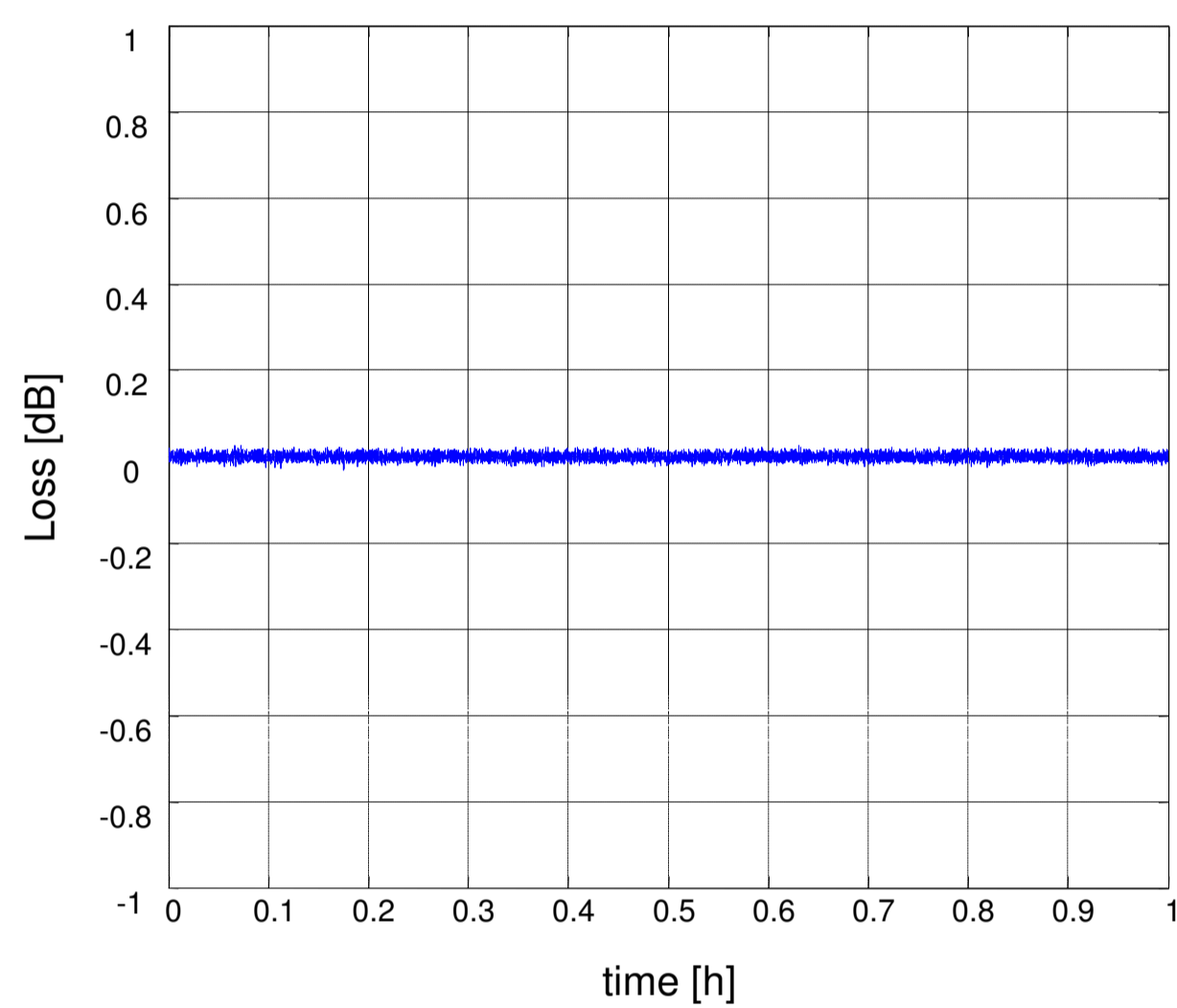
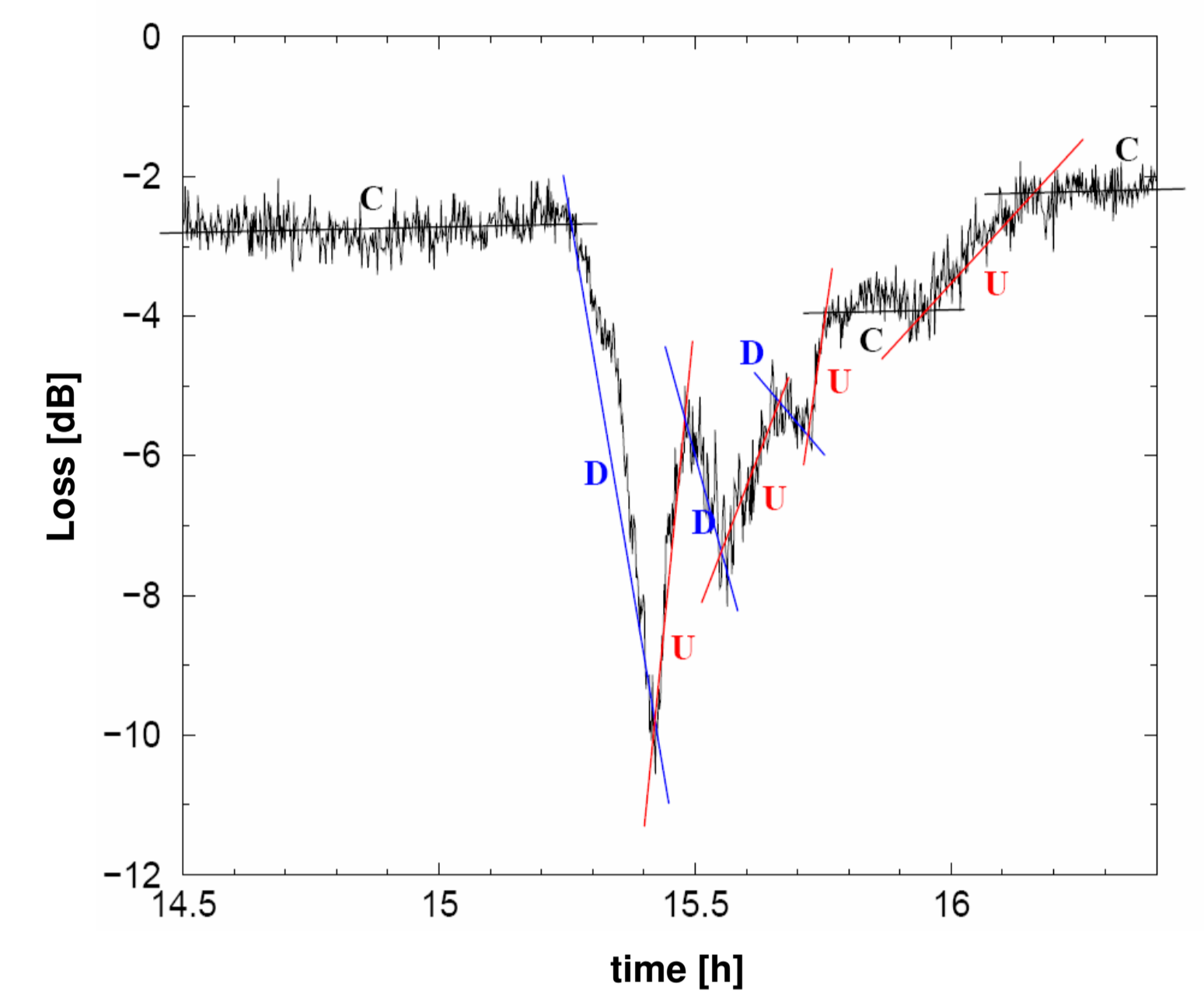
- high probability of LOS with occasional shadowing  $\Rightarrow$  shadowing model,
- variable distance between TX and RX,
- variable (random) elevation angle,
- Ka frequency band  $\Rightarrow$  rain attenuation, shadowing, cross polarisation

## Rain attenuation

Rain fading is attenuation due to precipitation, clouds and other meteorological reasons, where the precipitations have the greatest impact. Three segment model:

- $|\Delta| \leq 1 \Rightarrow C$
- $\Delta \leq 1 \Rightarrow U$
- $\Delta \geq 1 \Rightarrow D$

Gaussian white noise generator which standard deviation and mean value depends on segment and previous attenuation.



## Scintillation

Tropospheric scintillations are variations of the received signal amplitude due to changes in the magnitude and profile of the refractive index of the troposphere.

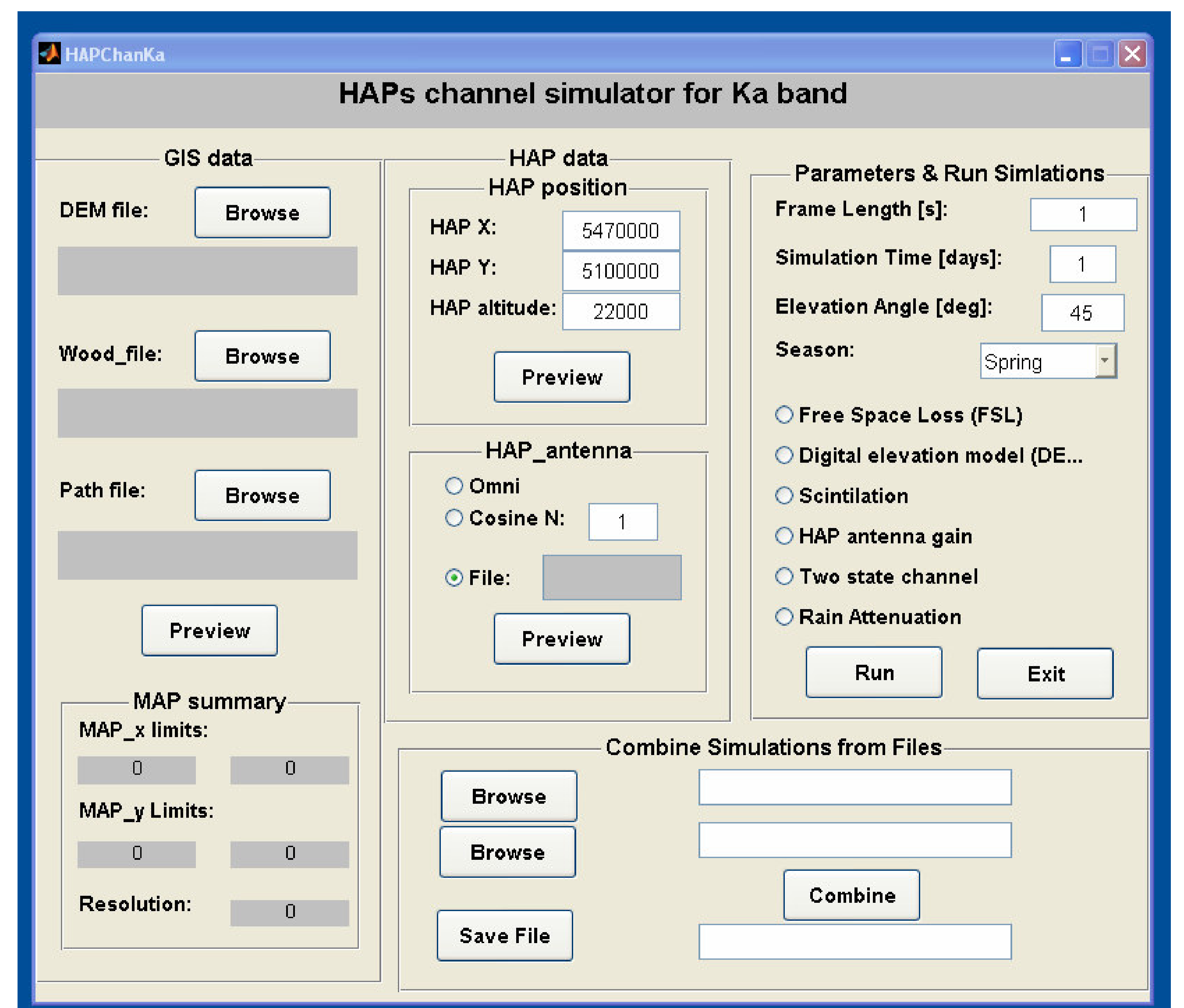
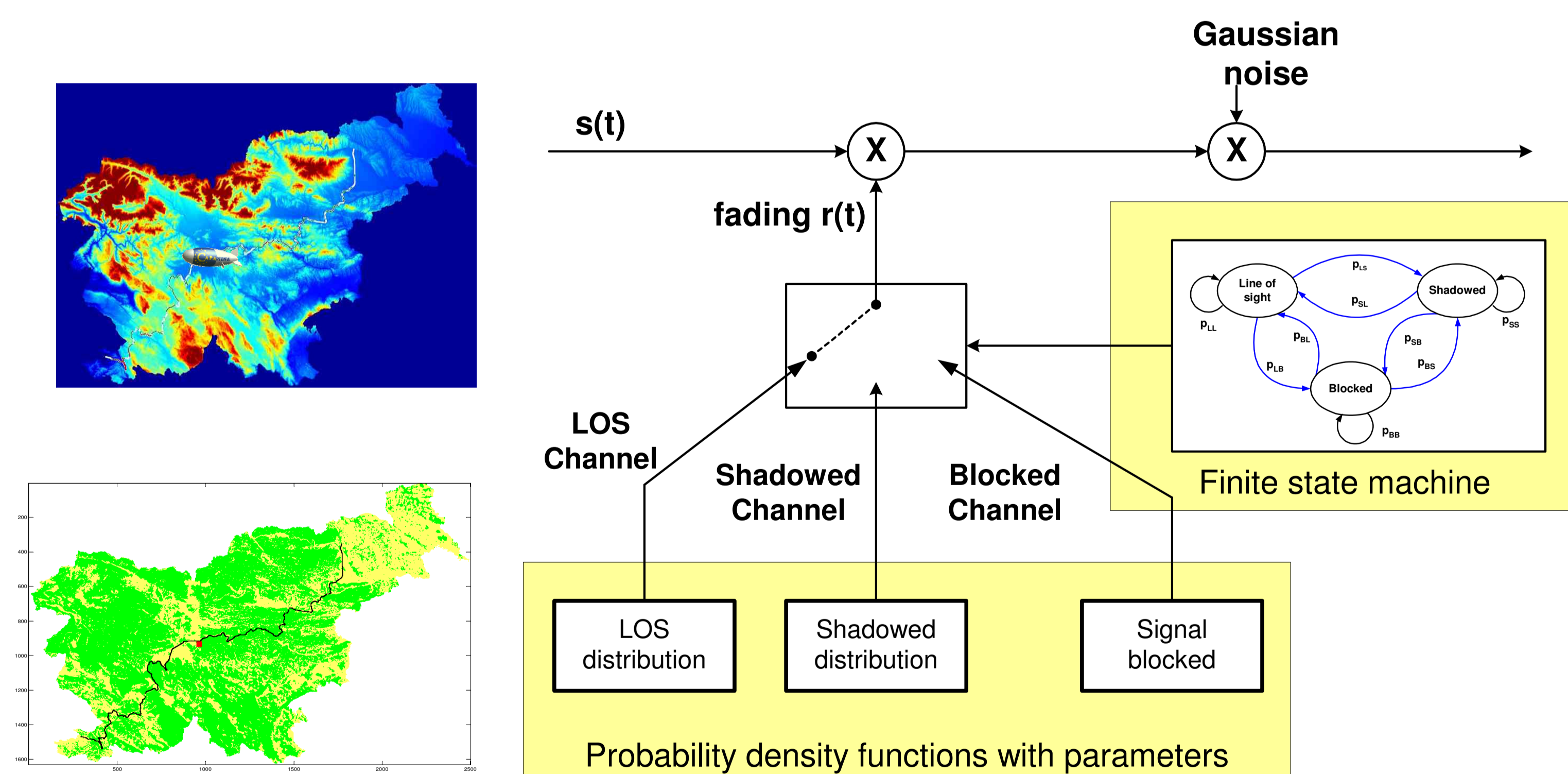
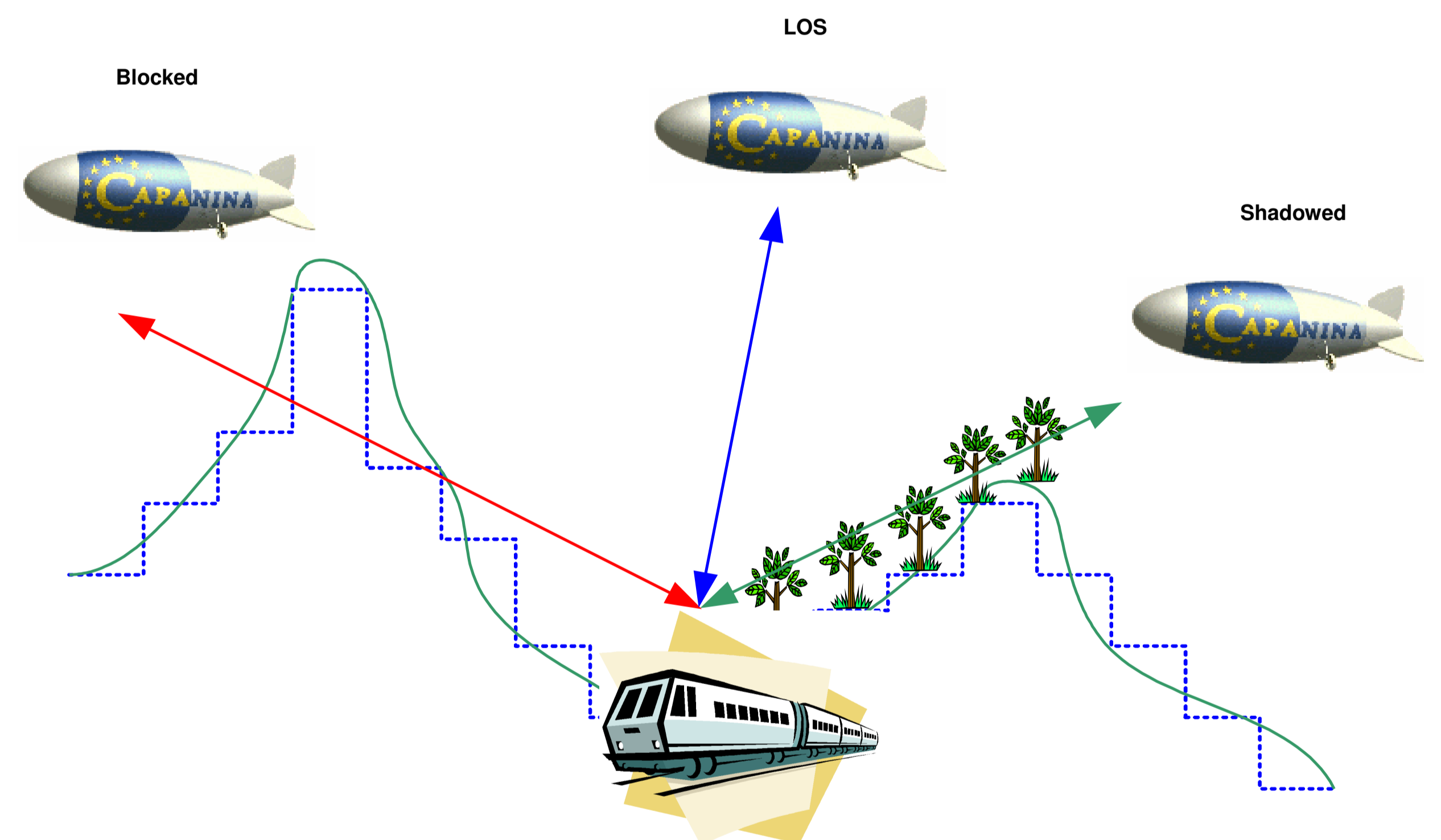
Gaussian white noise filtered by filter with  $f^{8/3}$  roll off.

The standard deviation of the scintillation depends on rain attenuation:

$$\sigma = \sigma_0 A^{(5/12)}$$

## Shadowing

- Finite state machine & PDF for each set
- 3-state model (LOS, shadowed, blocked state)
- FSM parameters obtained from DEM
- PDF obtained from satellite measurement campaigns  $\Rightarrow$  Loo PDF



## HAPs channel simulator

Main simulator windows:

- GIS data input
- HAP position input
- antenna pattern diagram input
- parameters and run simulation window
- two attenuation combine window

Simulator output:

- path loss in dB: display and file