'spup' – an R package for uncertainty propagation in spatial environmental modelling

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Uncertainty propagation overview







Motivation

@RISK

UQLab

SimLAB



UNCSIM



UNCSAM

COSSAN

Crystall Ball



PSUADE

SAFE

| 0.0 | | MATL | 48.82013a |
|--|---------------------------------------|------------|--|
| HOME | PLOTS | ARE | CSeanh Documentation |
| EET Folds Rene Folds Rene Folds RET Folds RSA samplin VBSA visualized workflor chic folds | i i i i i i i i i i i i i i i i i i i | ■ Farcesca | parent - Dankar - Left, R.1.5()) Constant Works - State - Constant - State - State - State - State - State - State - State - Stat |

R packages:

- propagate
- FME
- mcmcse
- ArArRedux
- betaper
- UncerIn2
- usdm
- sensitivity
- and others...





OpenTURNS

| DAKOTA | | |
|---|--|--|
| # Dakota Input File: textbook_uq_sampling.in | | |
| tabular_graphics_data tabular_graphics_file = "textbook_uq_sampling.dat" | | |
| method | | |
| sampling | | |
| samples = 10 | | |
| seed = 98765 rng rnum2 | | |
| response_levels = 0.1 0.2 0.6 | | |
| 0.1 0.2 0.6 | | |
| 0.1 0.2 0.6 | | |
| sample_type lbs | | |
| | | |
| variables | | |
| uniform_uncertain = 2 | | |
| lower_bounds = 0, 0. | | |
| upper_bounds = 1. 1. | | |
| descriptors = 'xl' 'xl' | | |
| interface | | |
| fork asynch evaluation_concurrency = 5 | | |
| analysis_driver = "text_book" | | |
| | | |

OSTRICH



PEST

UCODE

FRAMES

TIME





Underlying methodology

Monte Carlo approach principle



'spup' – spatial uncertainty propagation analysis







Defining uncertainty model (UM)





> my_uncert_inp <- defineUM(uncertain = TRUE,

mean = raster_of_mean, sd = raster_of_sd, crm = my_crm)





Monte Carlo sampling



- Simple random sampling ("srs")
- Stratified sampling ("strats")
- Latin hypercube sampling ("lhs")





Propagation through the model



Model must be written as a function in R





Visualization of the results (1)



Static methods:







Visualization of the results (2)



Interactive methods:









Realisations of single-click point



Class probabilities of realisations







Planned applications

Uncertainty propagation analysis with process-based model LandscapeDNDC

| | Site input Site/regional input LandscapeDNDC regional input preprocessing GIS database • Grid (polygons) • Land use • Vegetation/crops • Soil properties • Management |
|---------------------|--|
| | LandscapeDNDC site/regional simulation |
| | Weather input T, prec., rad.,) Site initialization Soil, litter layer Forest type & age classes, cutting, thinning, replanting |
| | Forest • Physiology • Vegstructure • Airchemistry • PNET • Stand dev. • Microclimate • Vater-Cycle • Management |
| | Weather input T, precipitation Soil properties Crop and soil cultivation, fertilization & manuring, |
| | Arable • Physiology • DNDC crops • Water-Cycle • Management • Microclimate - DNDC arable |
| | Weather input T, precipitation Soil properties |
| | Grassland • Physiology - DNDC grass • Microclimate • DNDC grass |
| Haas et. al. (2013) | Site/regional output LandscapeDNDC postprocessing •Regional plots •C & Nalances •GHG emissions •Yields |



Uncertainty propagation analysis with Metaldehyde Prediction Model





Acknowledments





