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SticsRpacks: a set of packages for managing Stics from R

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Introduction

The SticsRpacks project has been initiated end 2018 to develop tools for piloting the STICS model via the high-level language R. These tools aim at:

- easily performing operations that are not provided in JavaSTICS: e.g. production of various graphs, statistical processing, link with databases ...,
- automating these operations using scripts,
- reducing the computation time required to perform simulations.

It is composed of a set of R packages. These packages are addressed to Stics users and developers and will be used in its automatic test and performance evaluation system (Buis et al. 2016). Methodological packages are developed in a generic way to be coupled with other crop models.

SticsRfiles, SticsOnR and CroptimizR

First versions of the packages SticsRfiles, SticsOnR and CroptimizR (Fig. 1) will be released for the Stics 2020 seminar. Other packages may be developed later (e.g. IdeSticsR).

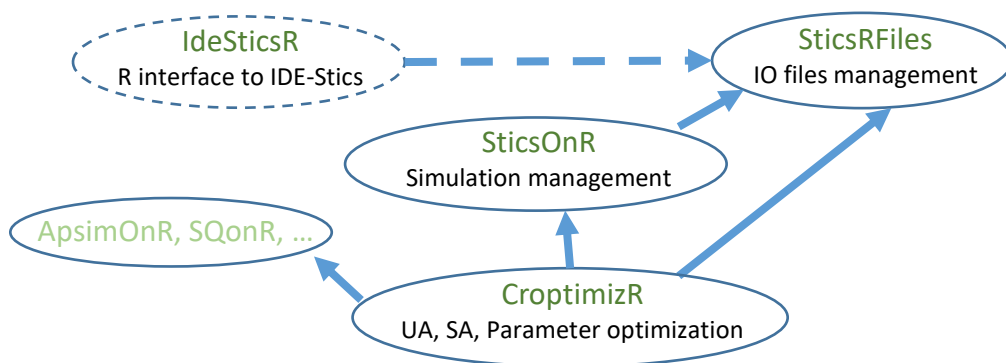


Figure 1. Architecture of the SticsRpacks packages. ApsimOnR and SQonR are external packages / functions. Development of IdeSticsR package has not yet started.

They will include functions for:

- converting XML input files (JavaStics) into text input files (Stics) ; replacing (getting) parameters and option codes values in (from) XML and text files ; getting simulated and observed variables values from Stics output and observation files (SticsRfiles package)
- generating Stics input files from JavaStics working directory ; running Stics simulations from JavaStics or Stics input files with possible forcing of input parameters / option codes and parallelization of the simulations (SticsOnR package)
- multi-step parameter estimations with frequentist (multi-start Nelder-Meade simplex, Nelder and Mead (1965)) or bayesian (DREAM, Vrugt (2016)) methods, with possible simultaneous estimation of specific and varietal parameters on multi-varietal datasets (CroptimizR package)

Development tools

SticsRpacks is a collaborative and opensource project. Source code versioning is handled in gitHub (<https://github.com/SticsR Packs>). A common [coding style](#) has been adopted. Automatic documentation is performed using [Roxygen2](#). Websites are generated using [pkgdown](#) (see <https://sticsrpacks.github.io/SticsOnR/>, <https://sticsrpacks.github.io/SticsRfiles/>, <https://sticsrpacks.github.io/CroptimizR/>). User documentation is provided through function help and vignettes available on the packages websites. Automatic tests (including CRAN checks and unit tests) are performed using [testthat](#) and [Travis](#).

Conclusion and perspectives

The development of the packages included in SticsRpacks just began. Other features are already planned and future versions should include additional functions for:

- downloading (uploading) USMs from (to) the IDE-Stics database (Beaudoin et al. 2015)
- converting (Stics input) text files into (JavaStics input) XML files,
- generating new USMs by combining existing climate, soils, plant and management files,
- analyzing crop models inputs and outputs (diagnosis, statistical criteria, graphics), including comparison with observations,
- probabilistic uncertainty analysis (multiple distributions and sampling methods) and sensitivity analysis (screening, importance measures, Multivariate Sensitivity Analysis, graphical Sensitivity Analysis, methods for dependent factors),
- other parameter estimation methods (e.g. evolutionary algorithm, Hamiltonian MCMC) and objective function criteria / likelihoods,
- selection of parameters to estimate,
- taking into account prior information and constraints (e.g. inequality constraints) on estimated parameters and output variables,
- evaluating the predictive performance in parameter estimation process (cross validation ...).

In addition to Stics, CroptimizR has already been coupled with ApsimX and SiriusQuality crop models. Its genericity will make it possible to evaluate multiple calibration approaches on different crop models and pool crop modelling team efforts to provide relevant methods for users of those models.

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