New features of otgui 2018

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OpenTURNS users day #11, Saclay, France

Contents

otgui summary

- Generic "OpenTURNS" gui
- Aims at exposing uncertainty methods to non-experts
- Partnership EDF-Phimeca
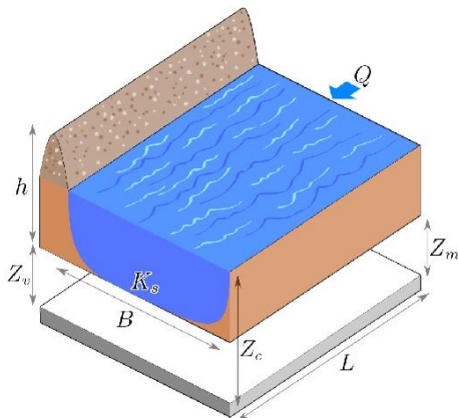- Distributed since 2016 at EDF through Salome

otgui methods

- ▶ Data analysis (moments, visualisation, inference)
- ▶ Probabilistic modeling (continuous marginals, copulas)
- ▶ Meta modeling (chaos, kriging), Optimization
- ▶ Sensitivity analysis (Sobol', SRC, Morris)
- ▶ Reliability (Taylor, Monte Carlo, FORM, SORM, FORM-IS)

study example 1/13: math model

The flood model of a river compares the water level to the dike height:

$$S = \left(\frac{Q}{Ks \times 300 \times \sqrt{(Zm - Zv)/5000}} \right)^{3/5} + Zv - 55.5 - 3$$

study example 2/13: physical model definition

study example 3/13: study diagram
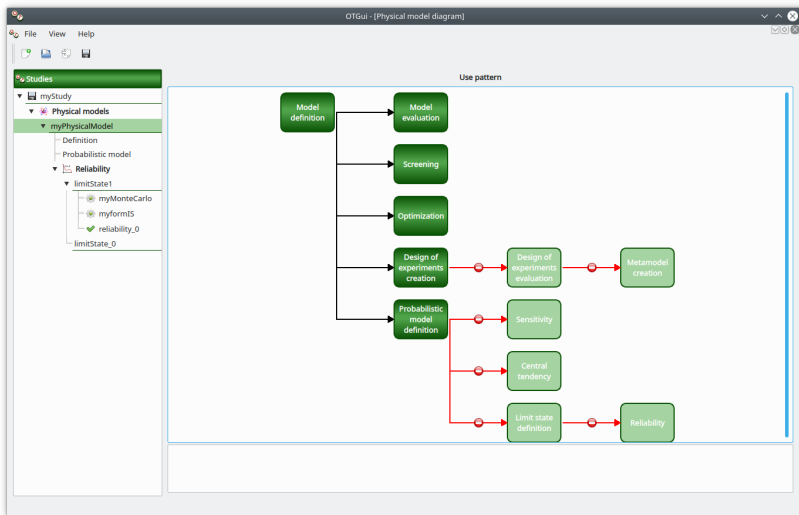
study example 4/13: math model

Probabilistic model:

- ▶ Q ∼ Gumbel(alpha=0.00179, beta=1013), flow rate $[m^3 s^{-1}]$
- ▶ Ks ∼ Normal(mu=30.0, sigma=7.5), strickler $[m^{1/3} s^{-1}]$
- ▶ Zv ∼ Uniform(a=49, b=51), downstream depth [m]
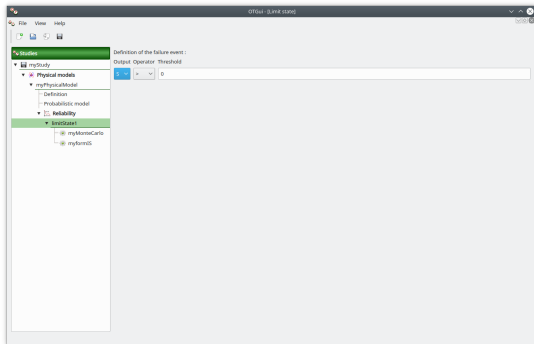- ▶ Zm ∼ Uniform(a=54, b=56), upstream depth [m]

study definition 5/13: probabilistic model definition

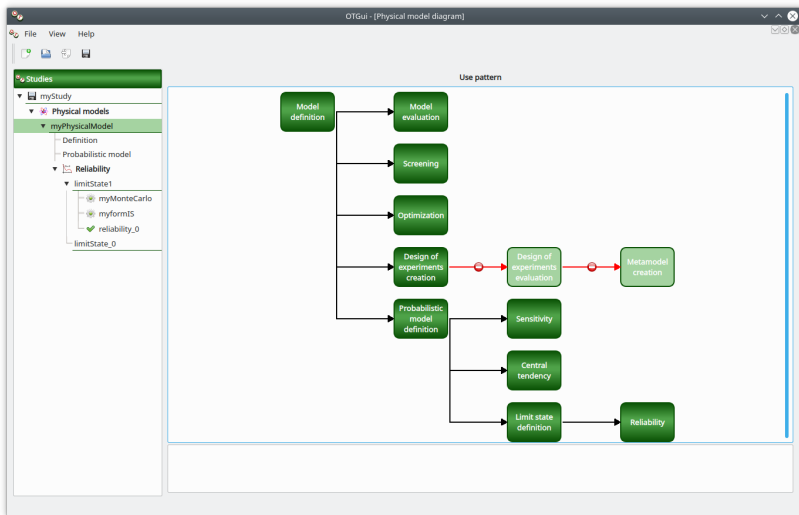# study example 6/13: study diagram
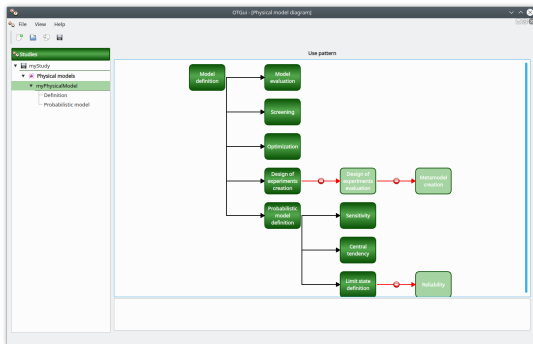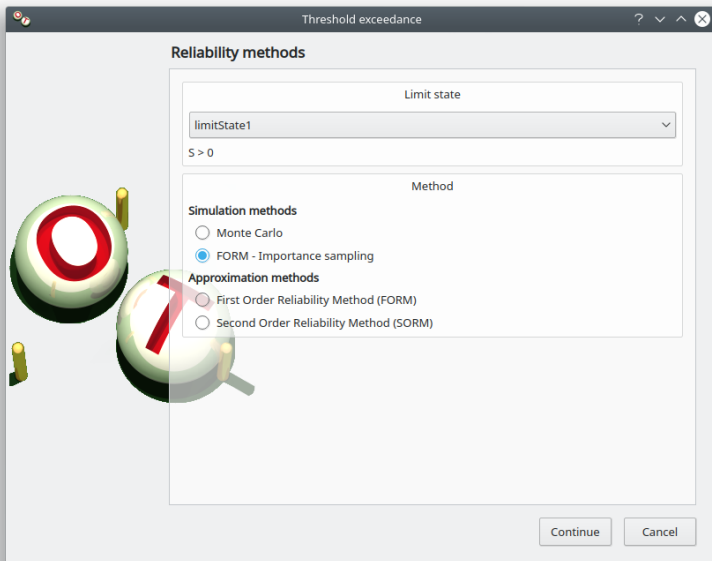
study example 7/13: limit-state definition

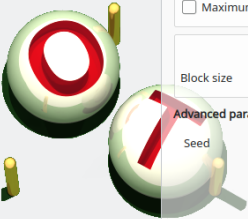Failure occurs when S is positive, lets estimate $P_f = \mathbb{P}\left(S(\underline{X}) > 0\right)$.

study example 8/13: study diagram

study example 9/13: simulation wizard

study example 10/13: simulation wizard

study example 11/13: simulation wizard
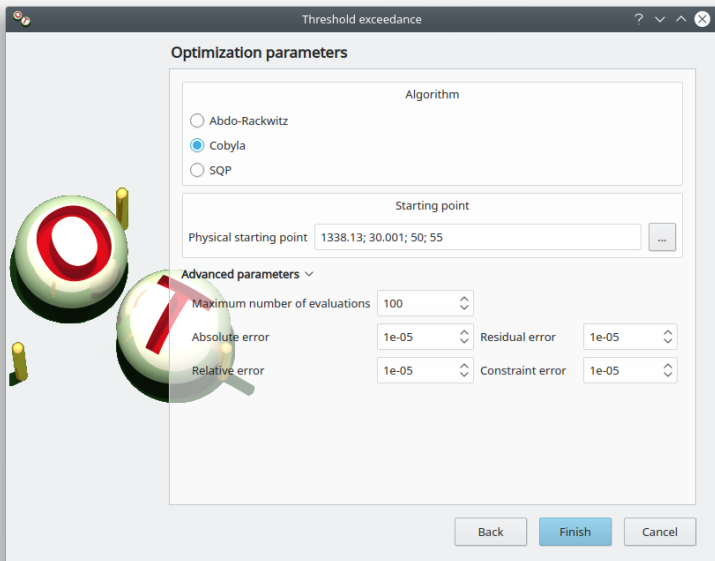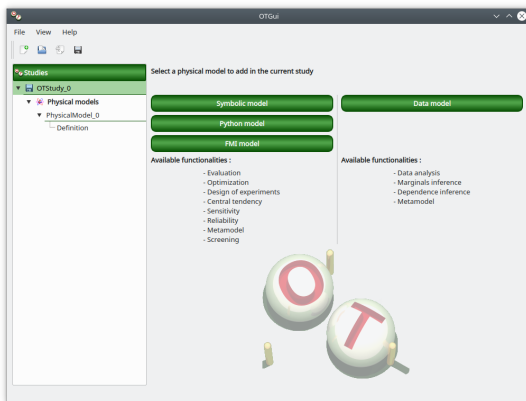
study example 12/13: simulation result window

study example 13/13: simulation result window
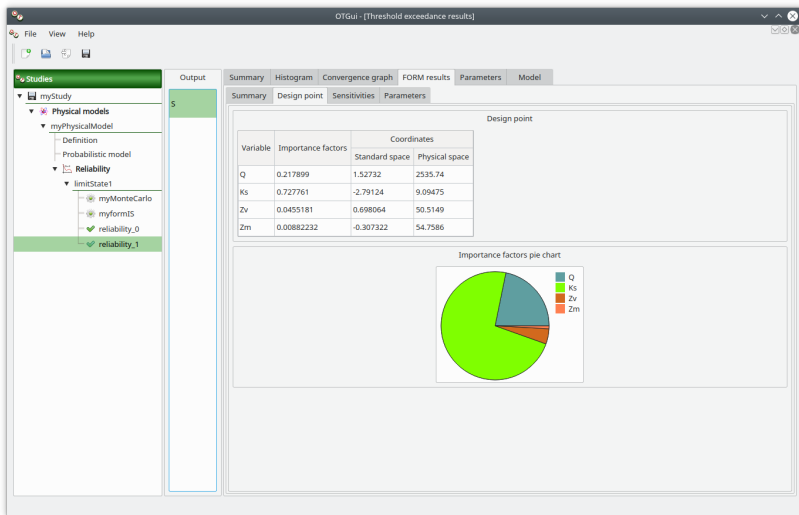
FMI models

Different types of models already available:

- ▶ Symbolic
- ▶ Python
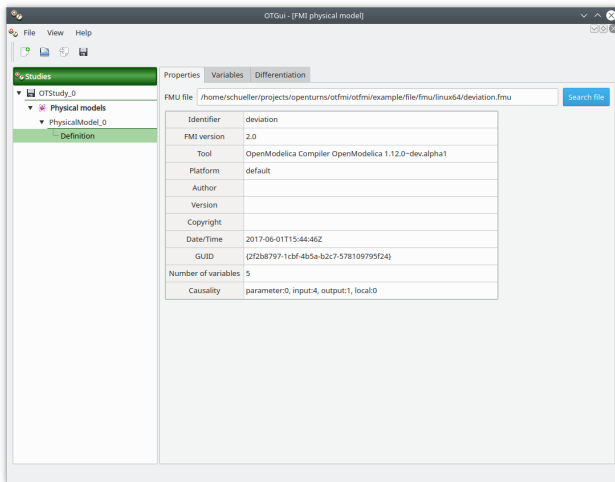- ▶ YACS (Salome execution engine)

FMI models

New model type:

- ▶ Evaluate system models in the FMI standard
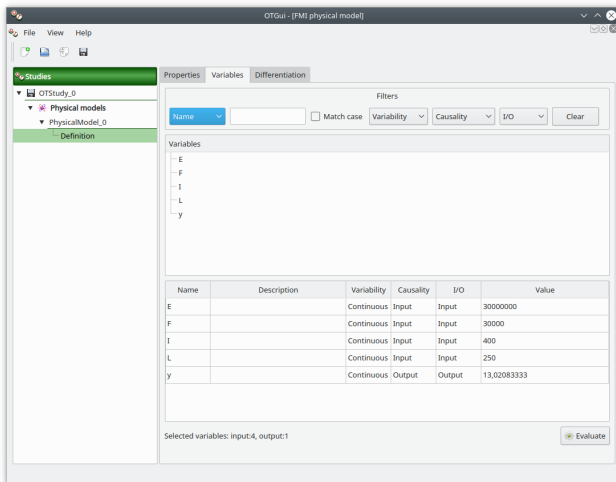- ▶ Open FMU binaries from Modelica simulation IDEs (OpenModelica, Dymola, ...)

FMI models

Inspect model properties (tools, author, version, ...)
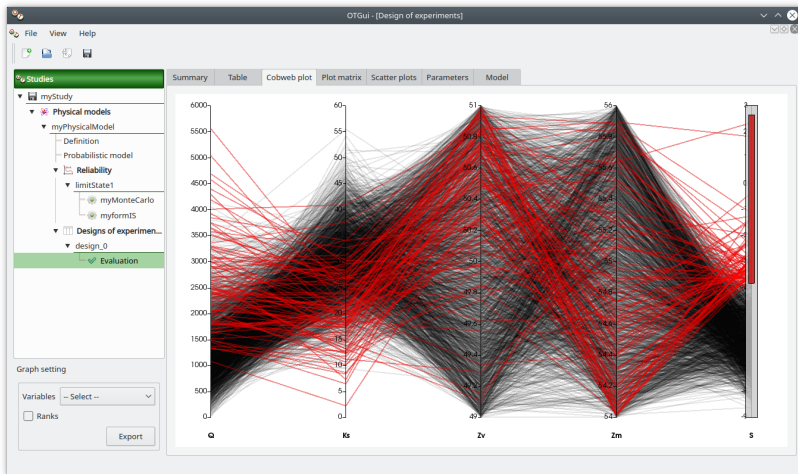
FMI models

Inspect model variables (type, causality, ...), select inputs/outputs
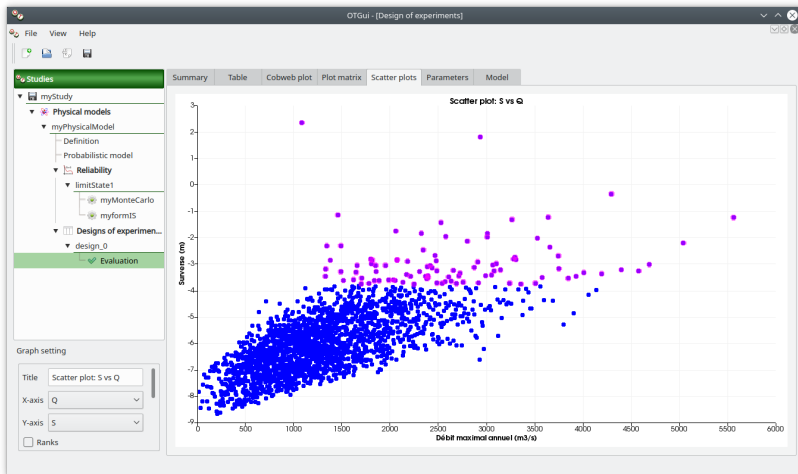
Advanced visualization

- ▶ Using Paraview graphics library
- ▶ Interactive widgets
- ▶ Model/view paradigm: several views on the same data
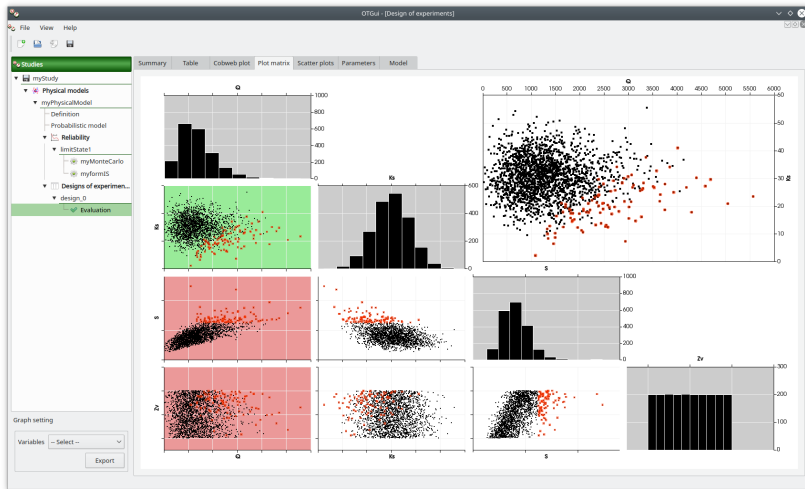- ▶ Help visualize DOEs (Monte Carlo simulation, outliers, ...)

Cobweb plots

Scatter plots

Matrix plot

Table

Dependency treatment

▶ Only Normal copula was available (Spearman)
▶ Now all parametric copulas available
▶ Copula inference

Copula inference 1/5: data import

Copula inference 2/5: study diagram
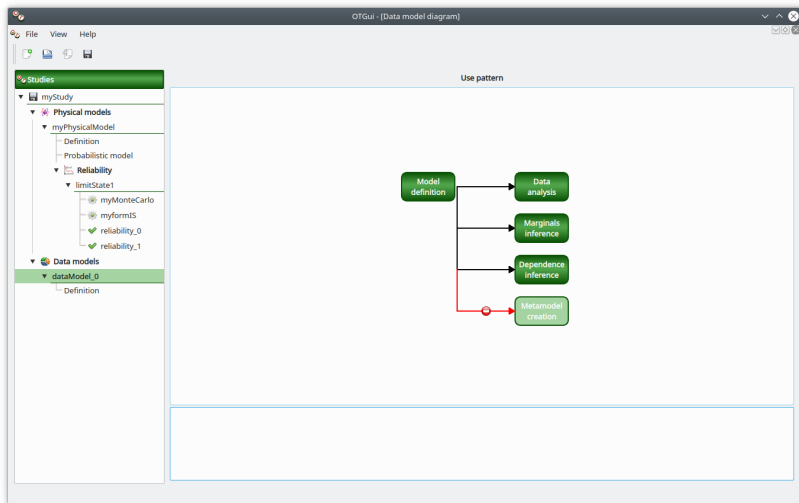
Copula inference 3/5: dependency blocs
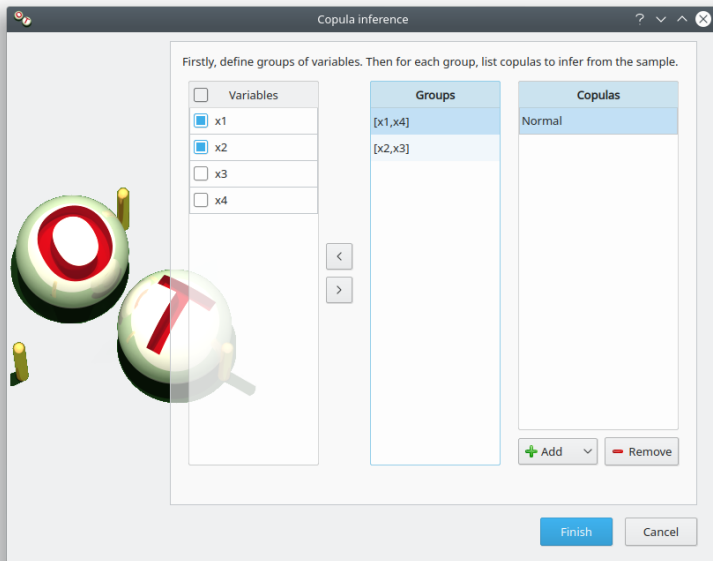
Copula inference 4/5: Kendall plot

Copula inference 5/5: pdf

Probabilistic model copulas

Future work

▶ Vector-Field models (first 1-d meshes)
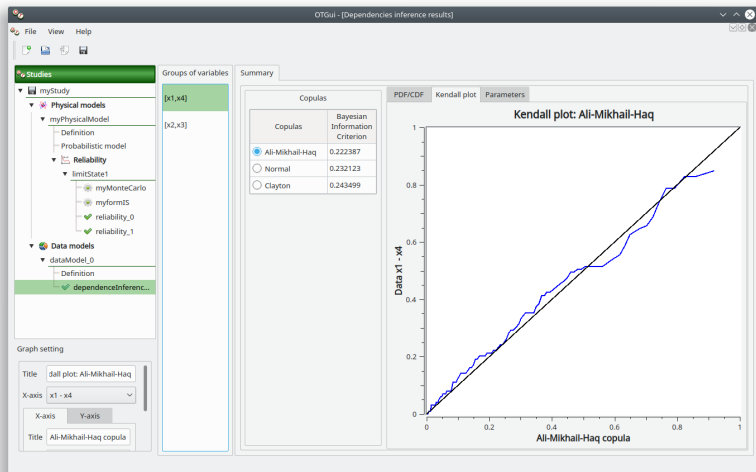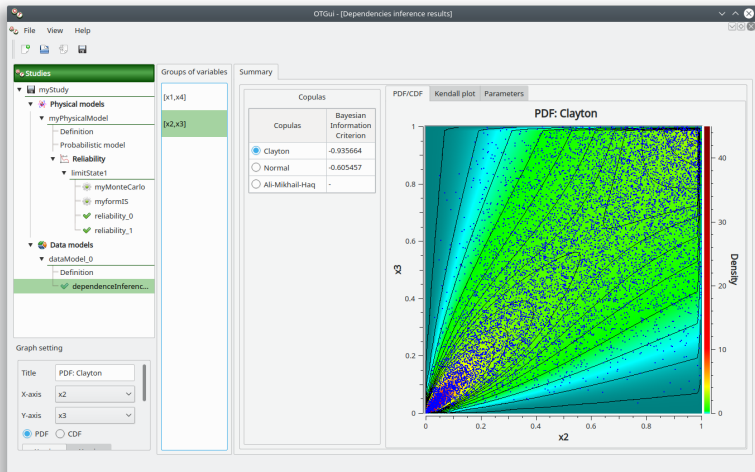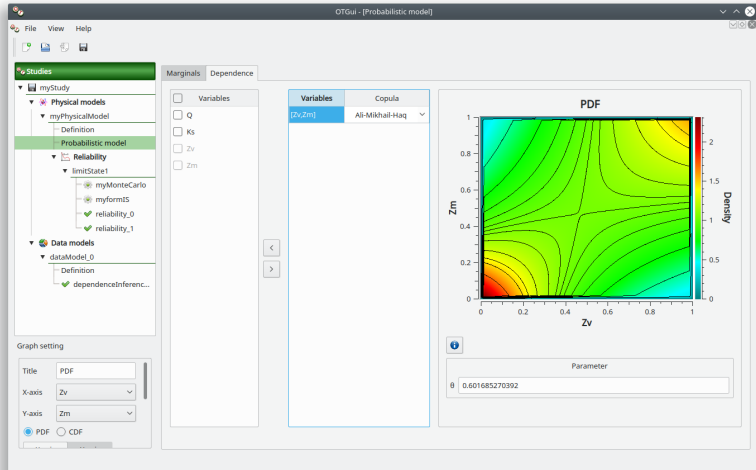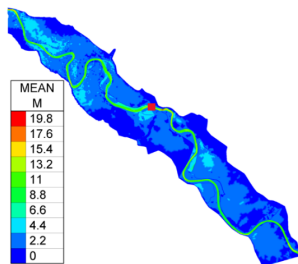▶ Parallel evaluation (Python)
▶ Remote computations (YACS engine)

END

Thank you for your attention!
Any questions?

Bibliography

▶ Airbus, EDF, Phimeca Engineering, IMACS. OpenTURNS, a scientific library usable as a Python module dedicated to the treatment of uncertainties, `www.openturns.org`.

▶ Airbus, EDF, Phimeca Engineering, IMACS. Documentation of OpenTURNS, version 1.9.
`http://openturns.github.io/openturns/1.9/contents.html`

▶ Michaël Baudin, Anne Dutfoy, Bertrand Iooss, and Anne-Laure Popelin. OpenTURNS: An Industrial Software for Uncertainty Quantification in Simulation, Handbook of Uncertainty Quantification, pages 1-38. Springer International Publishing, 2016

▶ Open TELEMAC-MASCARET. Electricité de france, Sogreah, Hydraulic Research Wallingford, Centre d'Etudes Techniques Maritimes et Fluviales, Bundesanstalt fur Wasserbau, and Daresbury Laboratory. `www.opentelemac.org`.