

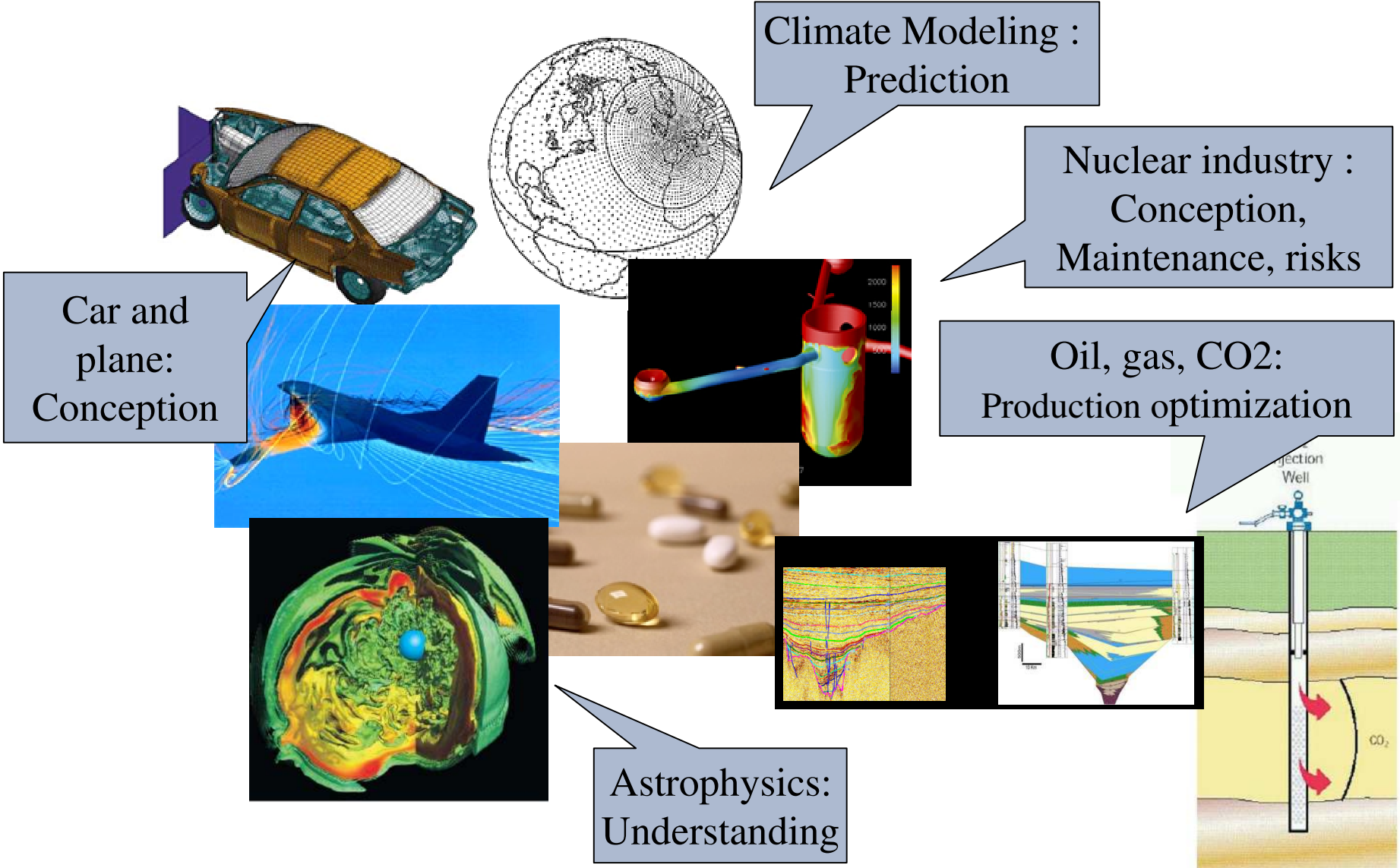
MASCOT-NUM's seminar on “Noisy and stochastic simulators”

Paris
May, 17th, 2011



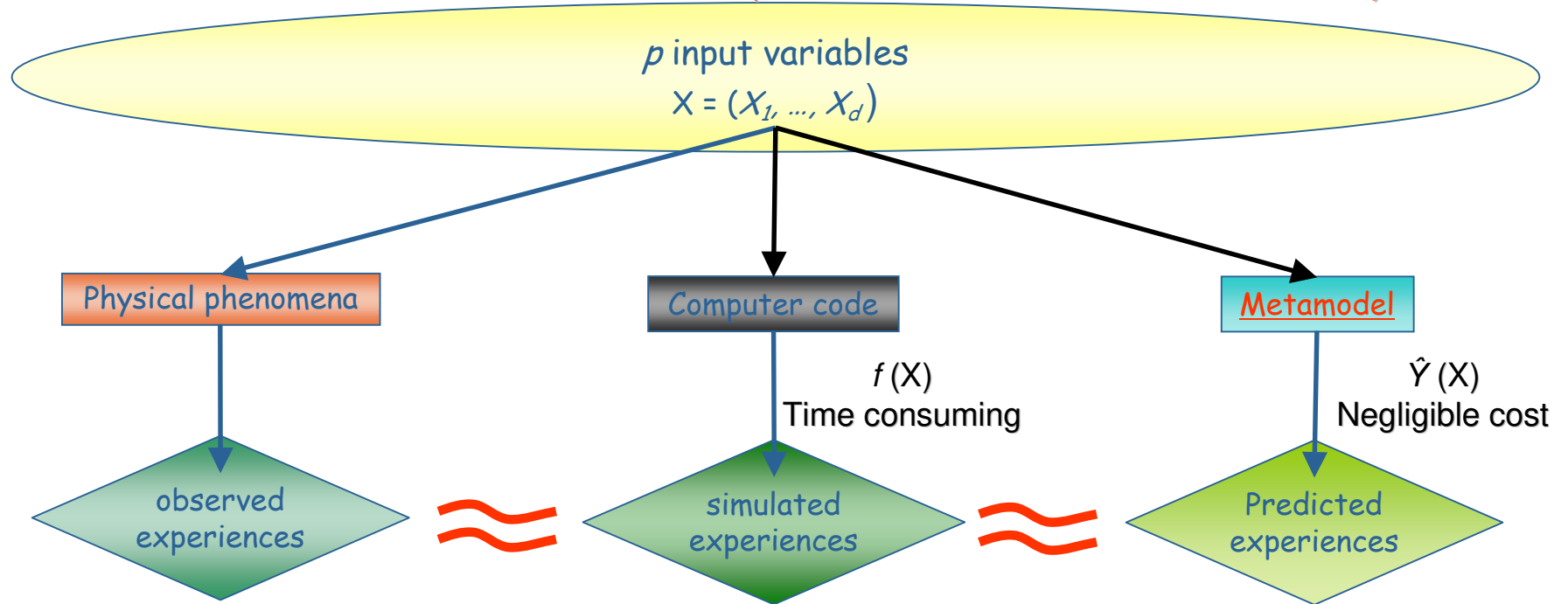
Treating safety and uncertainty issues using CS&E

CS&E : Computational Science & Engineering



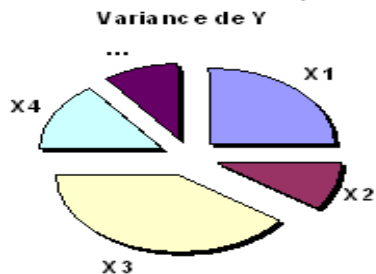
Uncertainties management for cpu time consuming models

A useful solution : the metamodel (model of the numerical model)

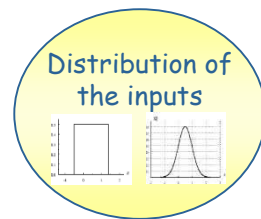


Use of the metamodel :

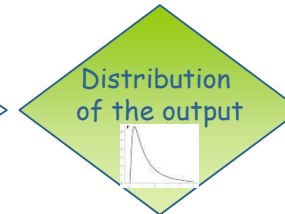
■ C': Sensitivity analysis



■ C: Uncertainty propagation (via Monte Carlo methods)



Metamodel
 $Y_{SR} = f_{SR}(X)$



■ B': Calibration

Identification of input parameters values

Adequation between observed and simulated experiences

Classical view of DACE (Design and Analysis of Computer Experiments)

(compared to the design of physical experiments)

- Large number of input variables,
- Large range of input variation domain,
- Multiple output variables,
- Strong interactions between inputs,
- High non linearity in the model,
- **Deterministic experiments (no error):** $Y = f(\mathbf{X}), \mathbf{X} \in \mathbb{R}^d, Y \in \mathbb{R}$

→ specific techniques are required (e.g. kriging metamodel, space filling designs, etc.)

However, computer codes can be non deterministic

= same set of inputs **X** lead to different outputs **Y**

Examples with first DACE works:

- Queueing models [Kleijnen ,97]
- Agent-based models [Boukavalas, 09 ; Ginot et al. 06]
- Model with stochastic process or random field as inputs [Zabalza et al., 98; Iooss & Ribatet, 09; Marrel et al., 11 , Lurette et al., 09]
- Monte Carlo-based models [Ginsbourger 09, Picheny 09]

Another kind of « non deterministic » simulators:

Noisy model (numerical convergence, discretization errors, ...) [Forrester, 06]

Strong links with the multi-fidelity simulator issue

Many problems

- Formulation of a stochastic or noisy computer code
- Design (replicates?, replicates on stochastic events?)
- Uncertainty analysis
- Sensitivity analysis
- Metamodeling (variance modeling?)
- Optimization (new criteria?)

Some of these problems will be seen in this seminar, illustrated by some examples

The goal of the seminar is to discuss about recent research and issues on this subject

Program of this morning

- 9h45 - Jack Kleijnen (Tilburg University)
Simulation Optimization via Bootstrapped Kriging: Survey
- 10h30 - Yann Richet (IRSN)
Overview of stochastic global optimization practice in nuclear criticality safety assessment

11h00 - Pause

- 11h15 - Régis Duvigneau (INRIA)
Sensitivity analysis and metamodeling techniques for uncertainty quantification and robust design in aerodynamics
- 12h00 - Laurent Grosset (Renault)
Some noisy simulators in automotive industry

Interlude: Future MASCOT-NUM's events

- June, 21, Paris: « Modeling for numerical experimentation and environmental applications », with M. Stein, R. Furrer, and many others
- June, 24, Toulouse: « New trends in kriging », with M. Stein, D. Ginsbourger, J-M. Azaïs, V. Picheny, T. Espinasse
- March 2012, 21-23: « Next conference of MASCOT-NUM », organized by CEA/DAM, Arpajon (91)

Information on : www.gdr-mascotnum.fr