An Automated Parameter Grouping Strategy for Efficient Sensitivity Analysis of Large-scale Hydrological Models

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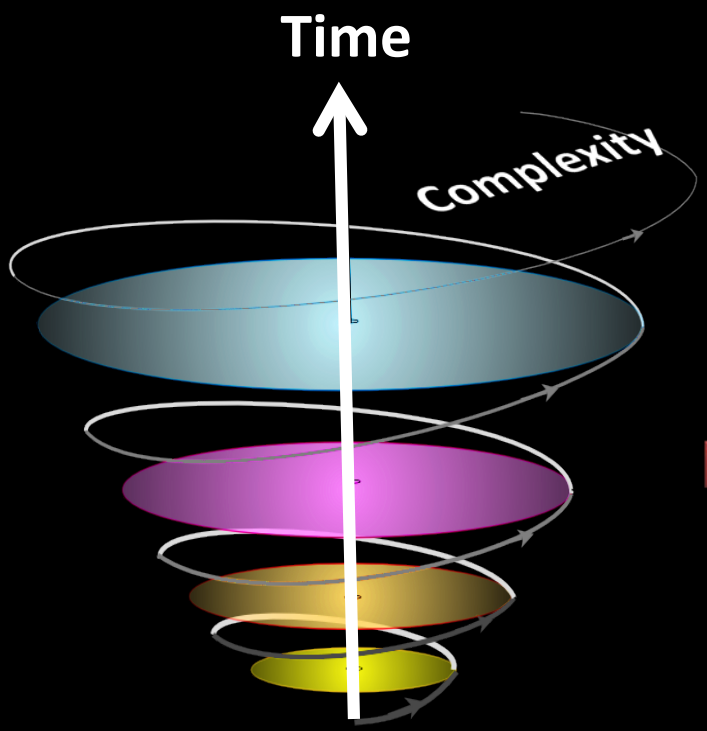
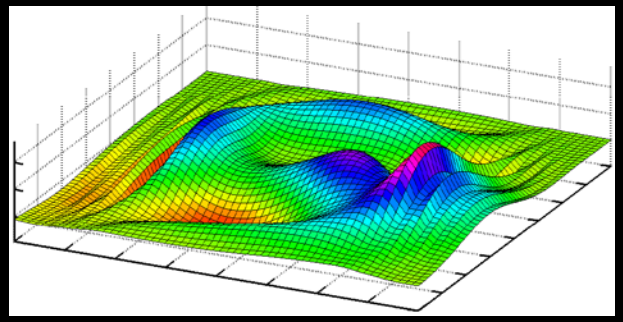
Challenges..

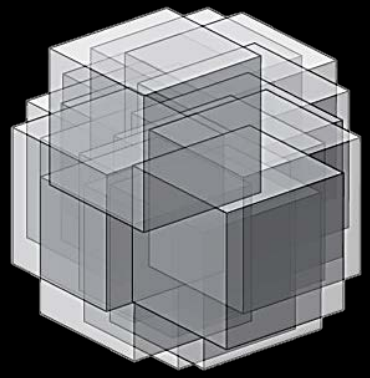
Modern Large-scale Hydrological Models:



- Highly nonlinear

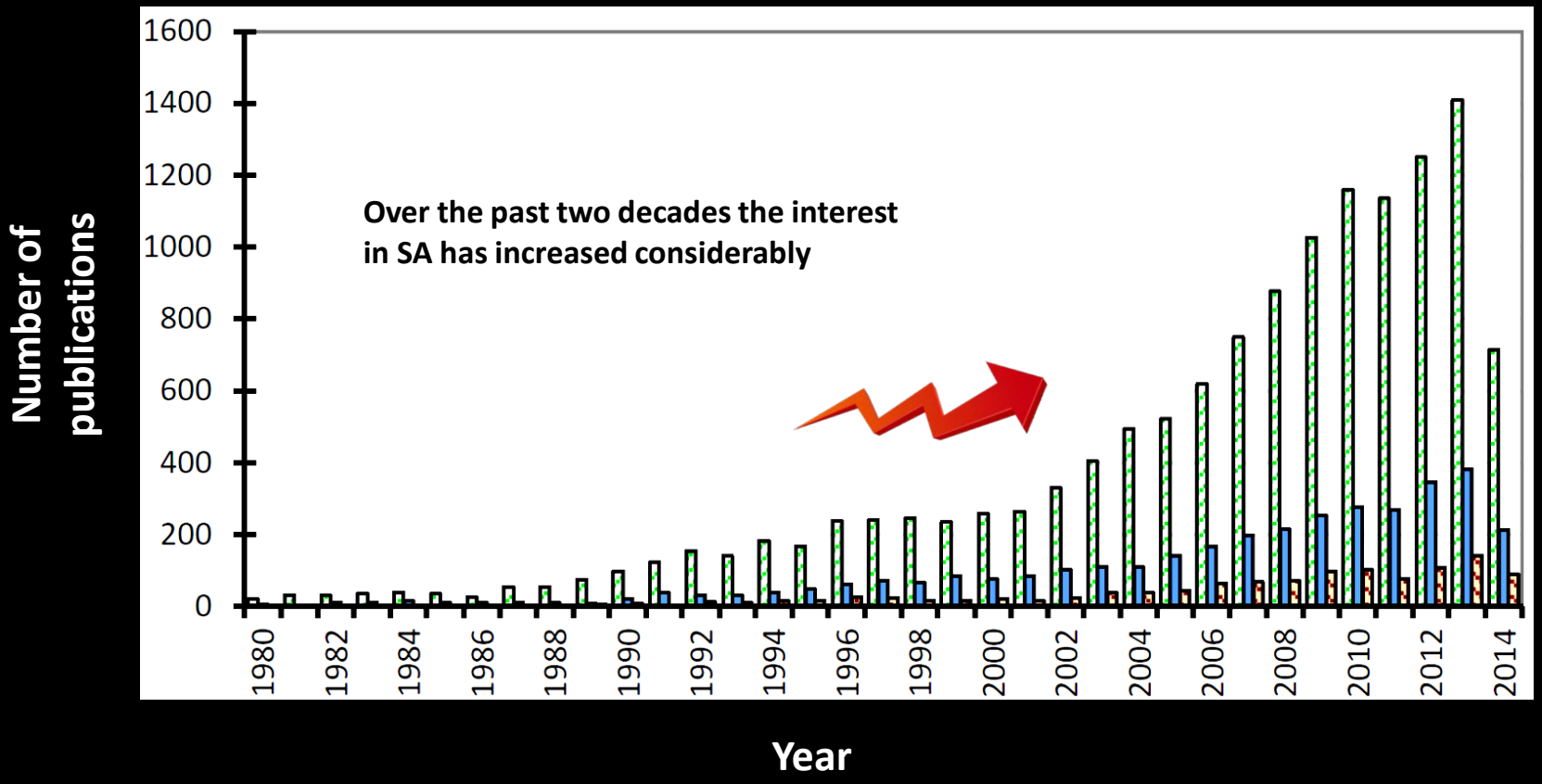


- High-dimensional



- Computationally intensive

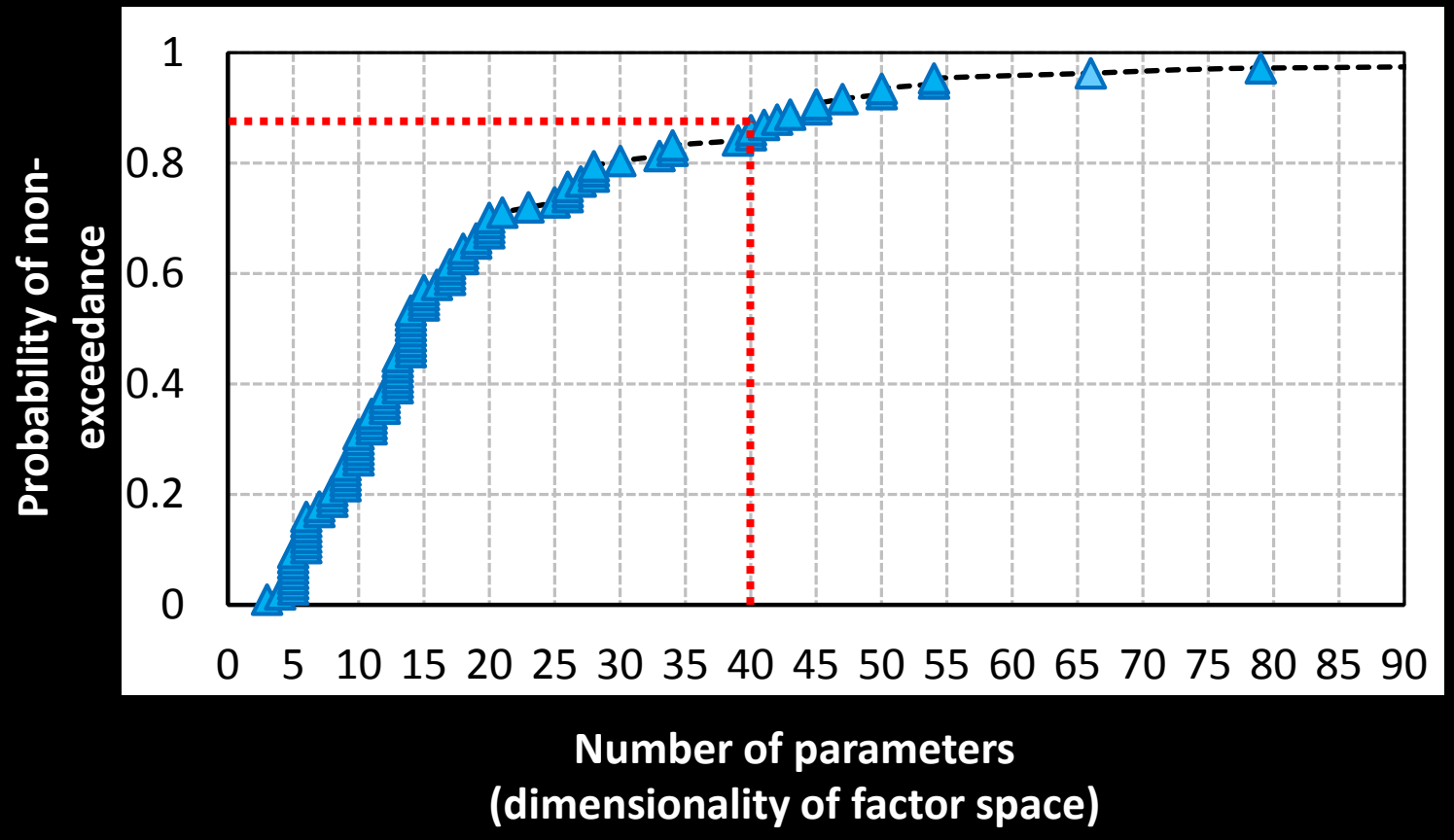
Challenges..



Adapted from *Razavi and Gupta (2015)*

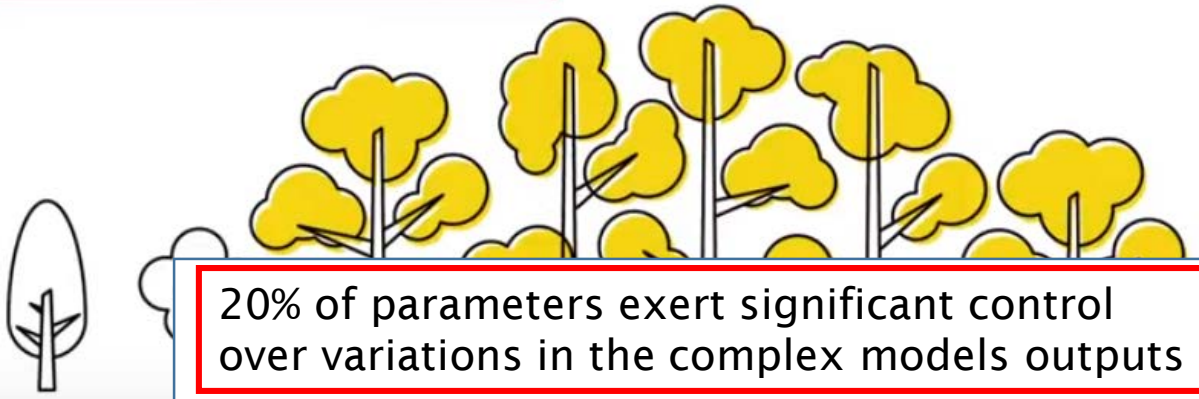
Challenges..

Recent reported studies that employed GSA in the Environmental Modelling context

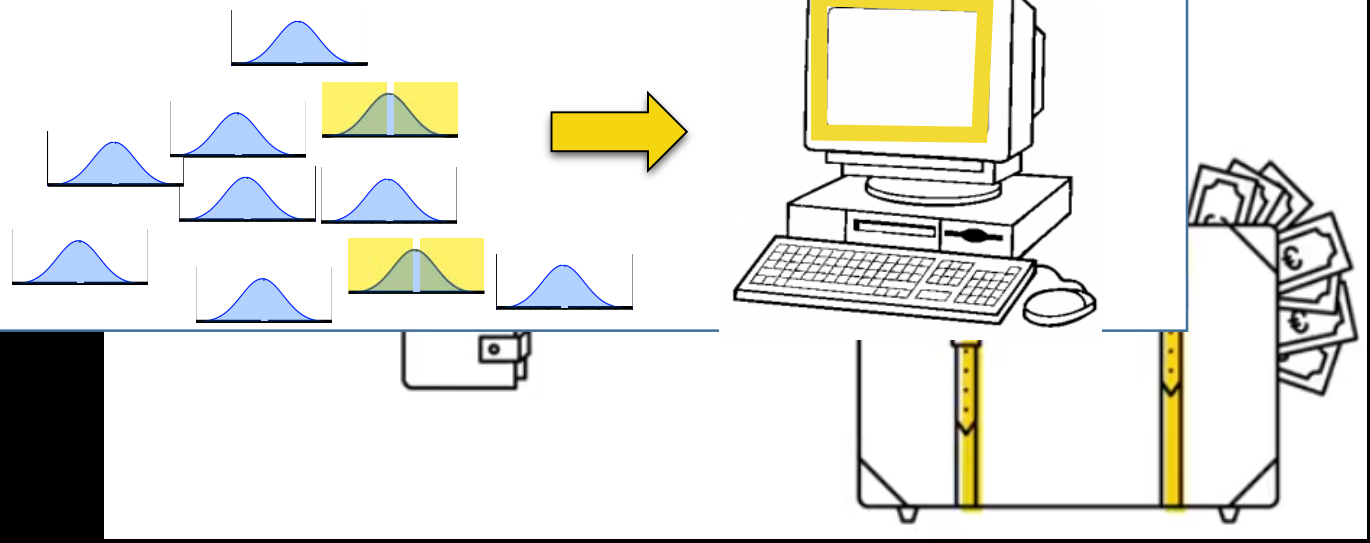


Challenges..

1% of tree species in the Amazon account for 50% of all biomass;



20% of parameters exert significant control over variations in the complex models outputs

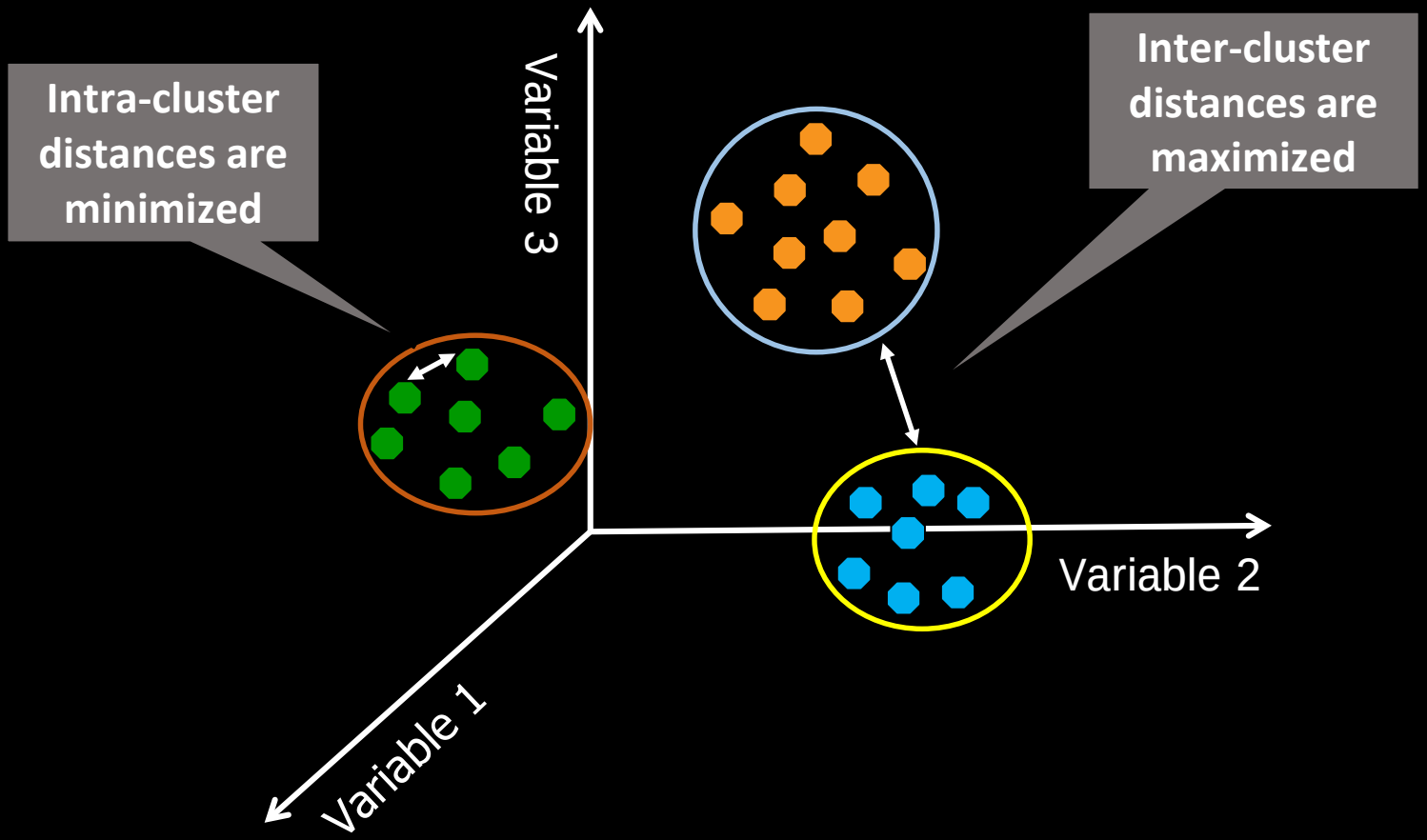


Tackling difficulties in Sensitivity Analysis: A Grouping Solution

In high-dimensional models..

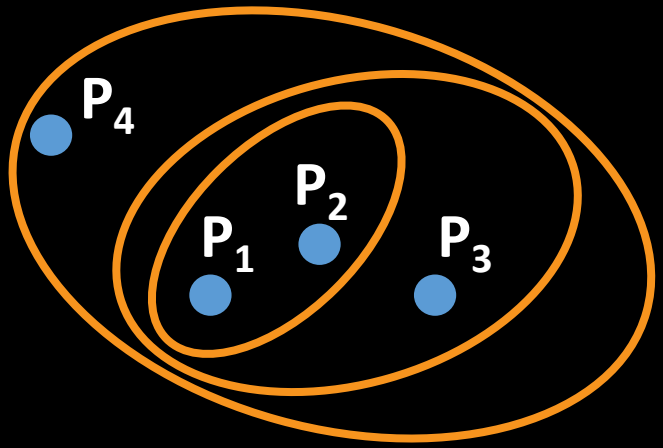
- Regardless of the SA method used, only a small sub-group of parameters are important (sparsity-of-factors).
- We are typically not interested in an exact ranking of parameters. Instead, it may be more profitable to categorize parameters into few groups; flagged as "highly influential", "influential", "moderately influential", "slightly influential", and "non-influential".
- Interpretation of SA results is non-trivial when a problem has many parameters.
- In general, the grouping of parameters was done in a subjective and case-specific manner (prior knowledge of group membership).

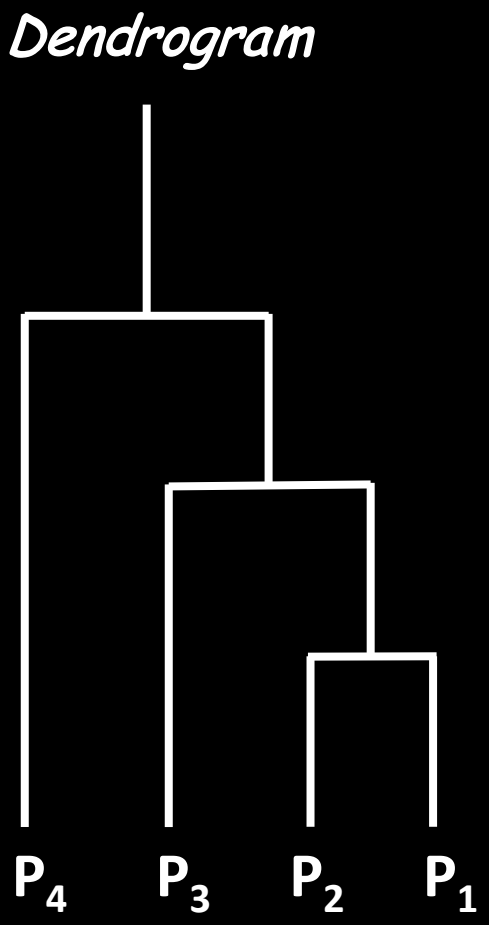
Cluster Analysis



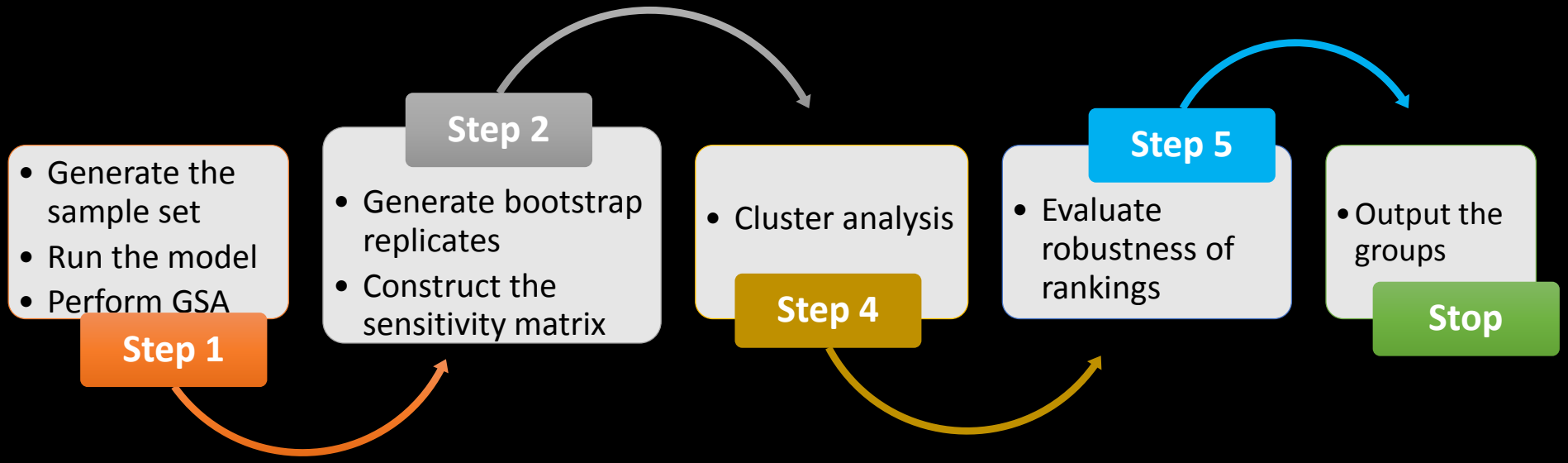
Cluster Analysis

- Hierarchical Clustering





An Automated Parameter Grouping Strategy

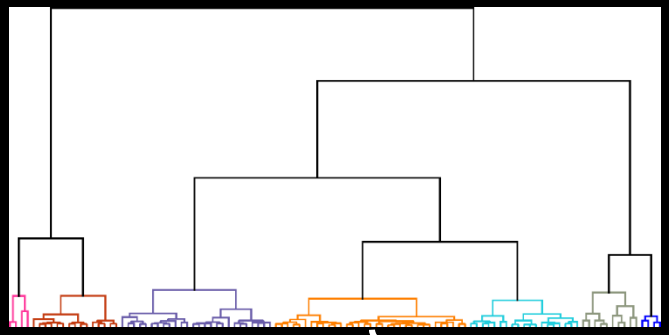


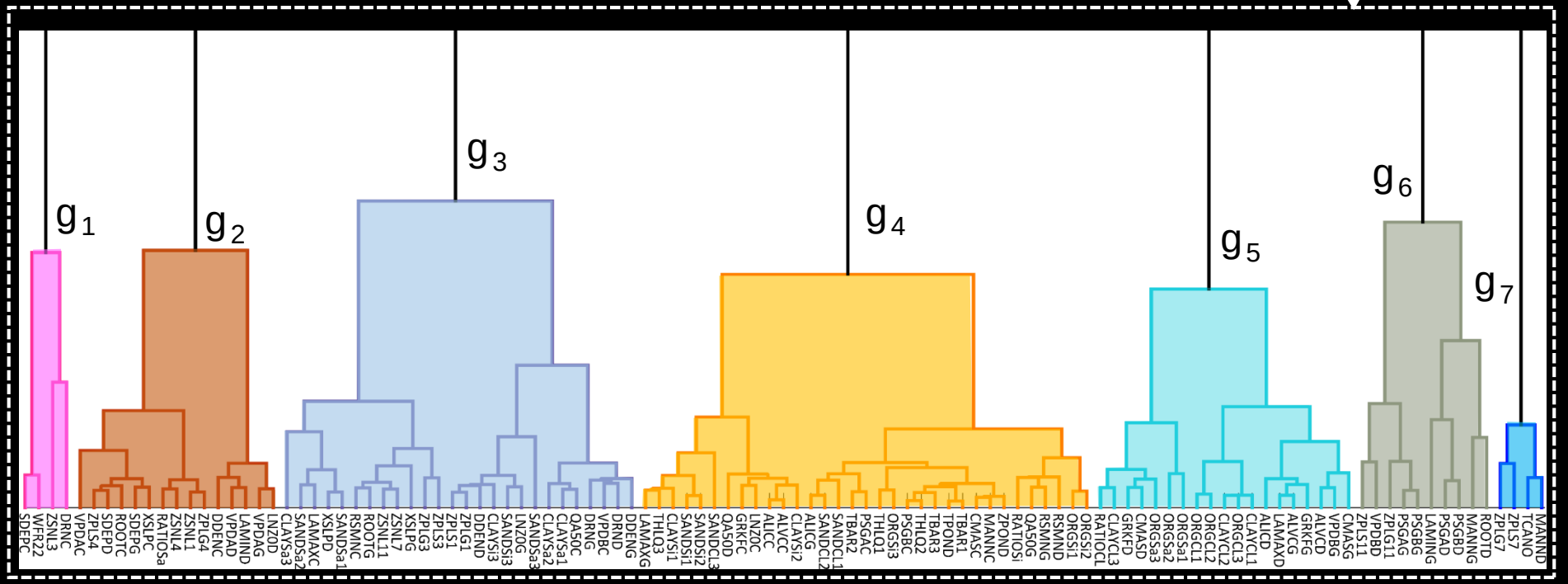
Case Study

Modelling case study: MESH

More than 100 parameters

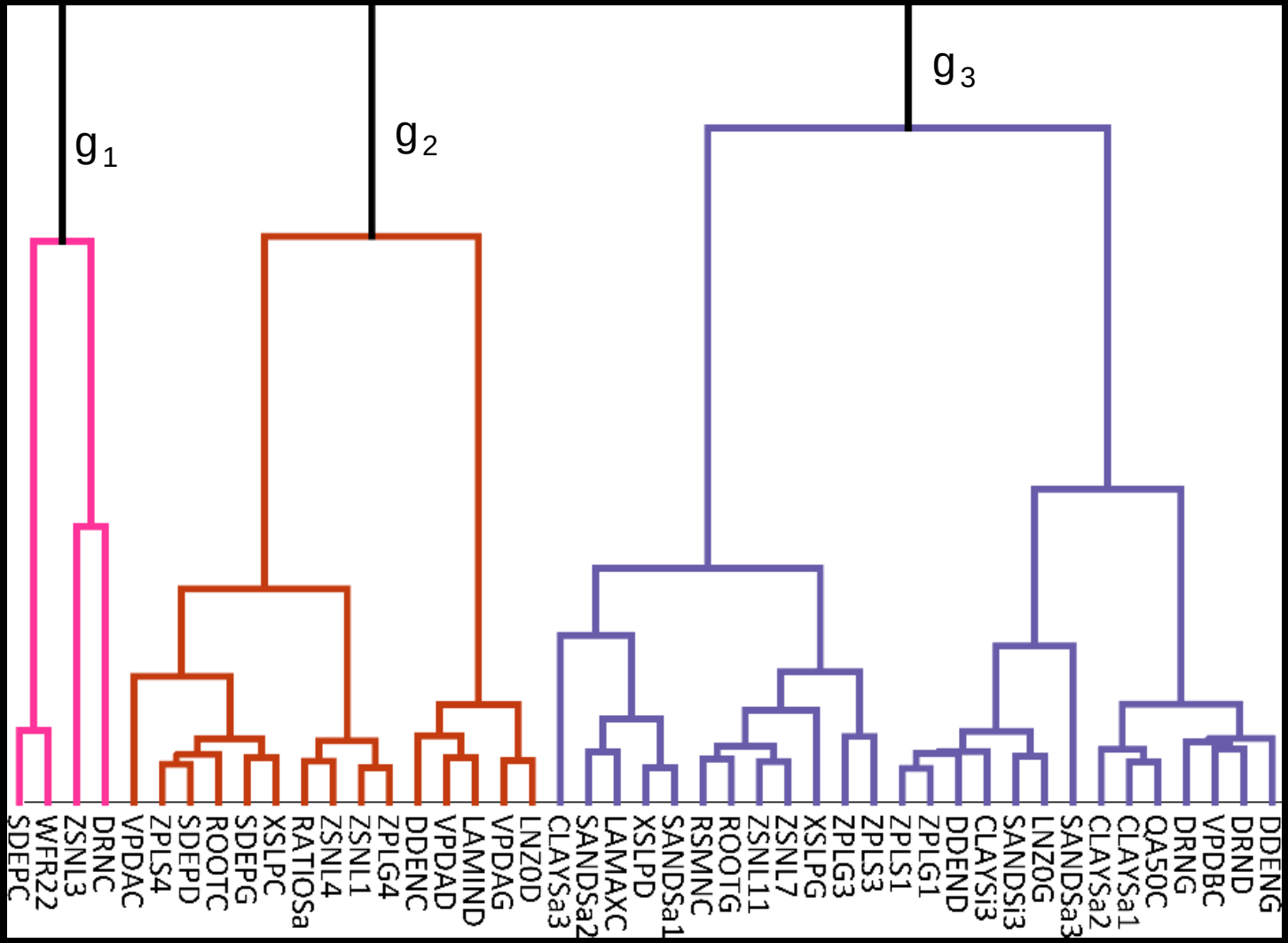
Parameter Grouping Results



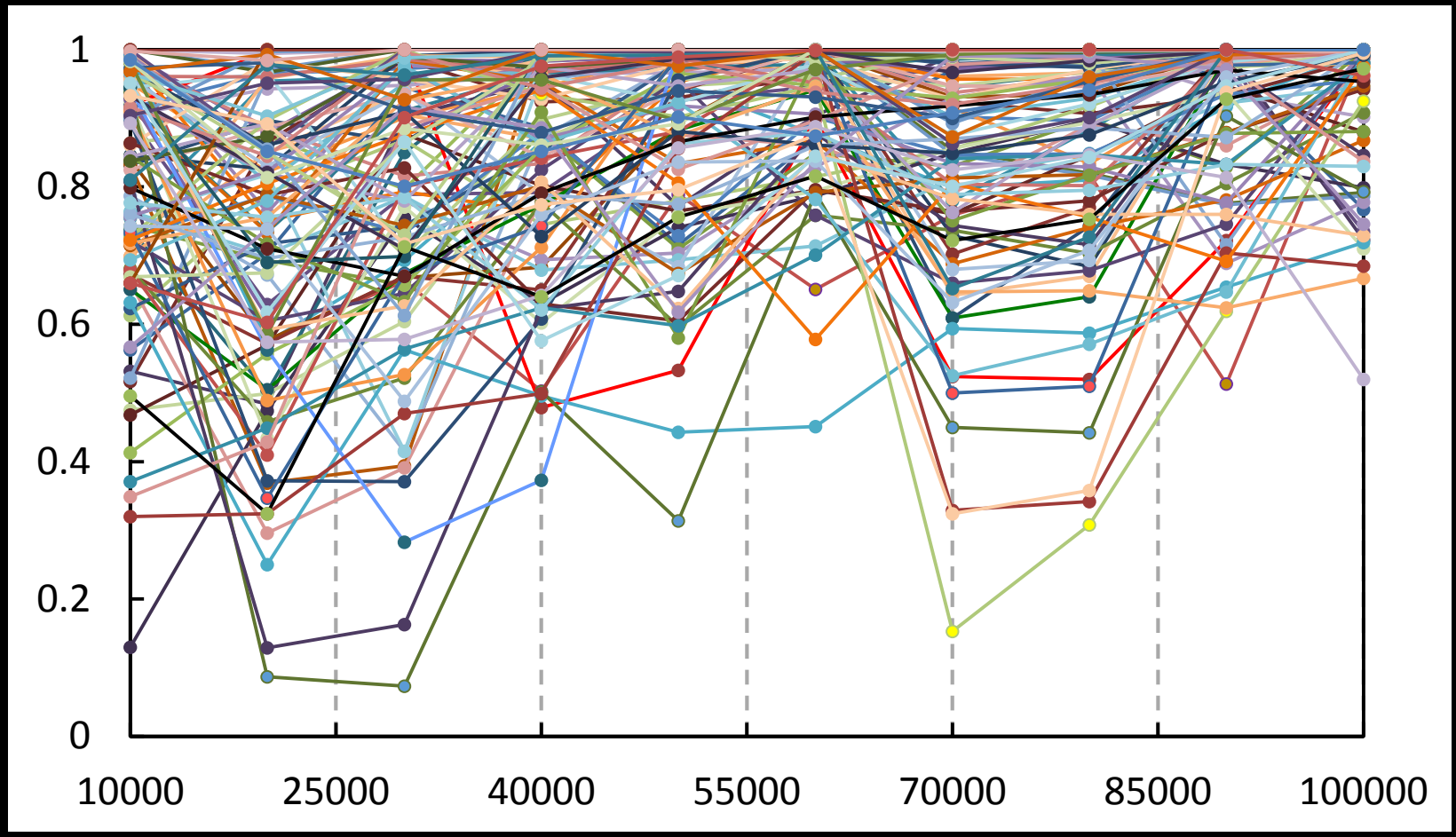


Model Parameters

Parameter Grouping Results



Monitoring Convergence and Robustness



Concluding Remarks:

- An automated factor grouping strategy is proposed to cluster input factors of high-dimensional models according to their sensitivity.
- A new measure of robustness is introduced based on factor grouping to evaluate and monitor convergence of the GSA techniques.
- The grouping-enabled GSA approach successfully recognized the dominant groups of factors that significantly contribute to the variability of the model outputs.
- The grouping-enabled GSA approach converged within a limited number of function evaluations.

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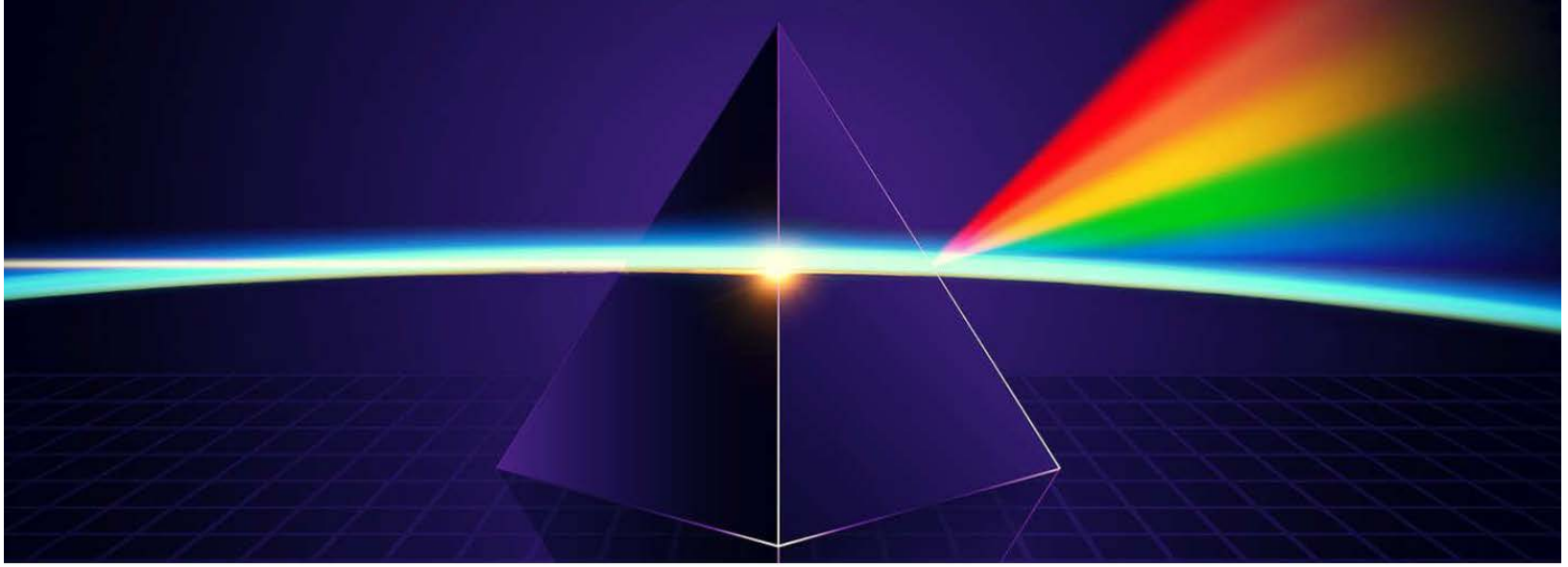
Thank You



VARS-TOOL

A toolbox for

Sensitivity and Uncertainty Analysis

http://vars-tool.com