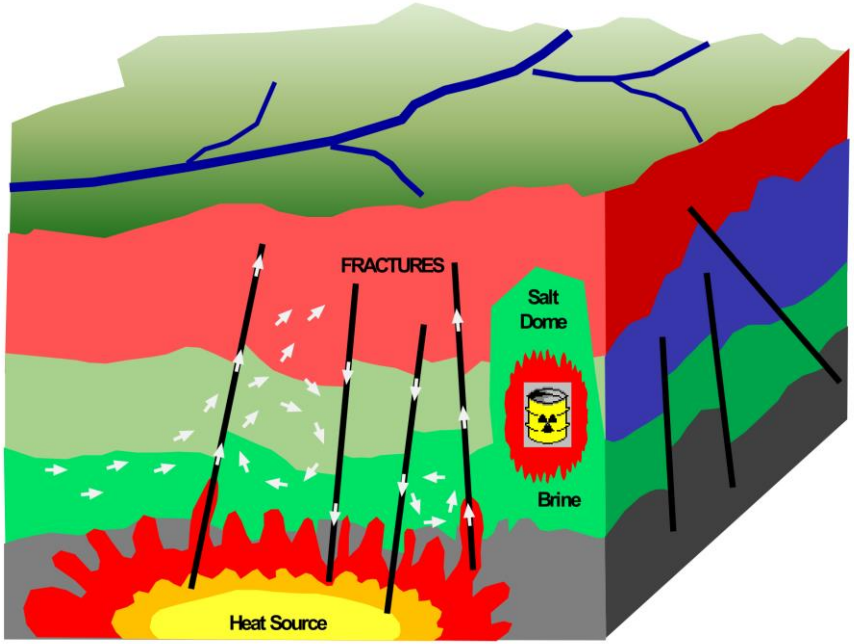
INSTITUTE FOR RISK AND RELIABILITY

ISU

URS2022

Leibniz Universität Hannover

Risk-based Assessment of Salt Domes as Disposal Sites for Nuclear Waste (RADON)

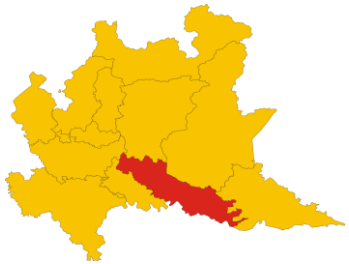


Jonas Suilmann & Andrea Perin

Self-Presentation: Where I am from

Italy

Lombardy



Cremona

Self-Presentation: Background

Educational

- **Bachelor of Science**
  Energy Engineering, Politecnico di Milano
- **Master of Science**
  Nuclear Engineering, Politecnico di Milano
  Thesis: *"A Deep-Learning based Method for the Detection of Defects from Images in Industrial Equipment"* (CERN collaboration)
- **High Educational Master in Deep-Learning**
  Advanced Global Solution & Politecnico di Milano

Professional

- **Accenture**
  ICT Consultant, IoT and Cloud transformation for Oil&Gas Companies

- **Deloitte Consulting**
  Operation Transformation Consultant, Artificial Intelligence Solutions (iOCR, NLP and Object Detection) for Banks and Insurance Companies

Uncertainties – Salt Dome Problem 1

Salt Domes have been studied as possible long-term radiactive waste disposal for one main reason:
They already exist as deep geological void volume

TH-Model

- Geometrical properties of the dome
- Geological properties of the dome
- Hydraulic properties of the dome
- Thermal properties of the dome

Every inputs that model accept can be source of uncertainty.

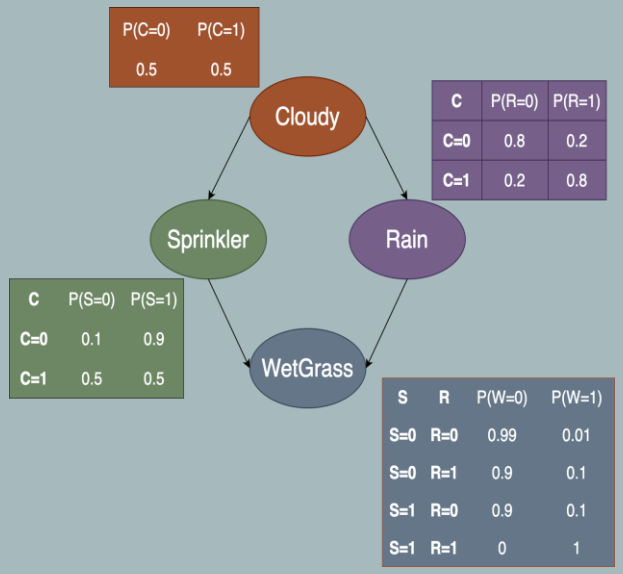
Hazardous Events

- Analysis of the impact of hazardous events on radiocative waste disposal have been so far done qualitatively.
- Needs to provide a quantitative assesment of the probability of the hazardous events

Uncertainties – Salt Dome Problem 2

Analysis of long-term safety ideally make use of simulations of scenarios that combine uncertainty and possible unknowns of geological characteristics relevant to the transport of accidentally released radionuclides

Bayesian Framework

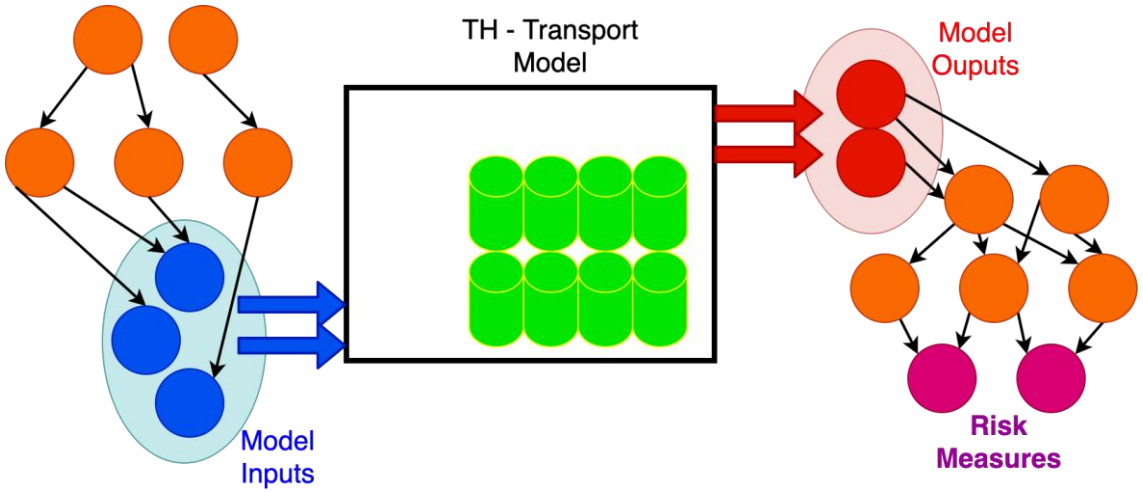


Fields of application:

- Subsurface flow and transport problem considering:
  - shallow contamination
  - uncertainty related to the hydraulic conductivity only
- Nuclear waste deposit studies without taking into account the copuled flow and transport phenomena

Safety Assessment for Radioactive-Waste Disposal

Existing numerical simulations for safety assessment of nuclear waste deposits are **mostly deterministic** or consider **uncertainty only due to heterogeneous hydraulic conductivity**



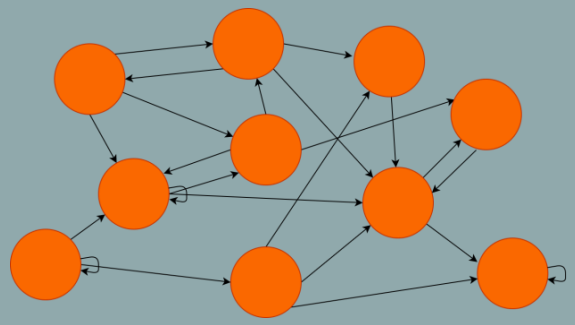
Novelty

Exploit eBN framework to introduce the ***TH-model's uncertainties*** and the ones related to ***hazardous events***

Uncertainties Quantification

Uncertainties Quantification is necessary to provide a *reliable risk-informed tool* for **decision making**

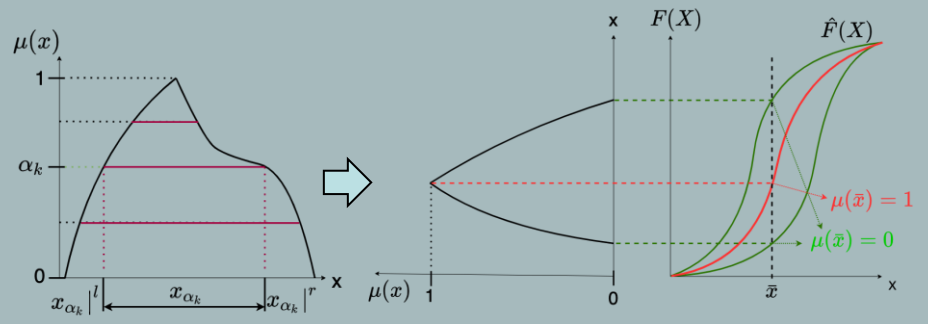
Enhanced Bayesian Networks



- Identification of the ”important” events
- Enabling “What if” analysis
- Bayesian update

1st-step

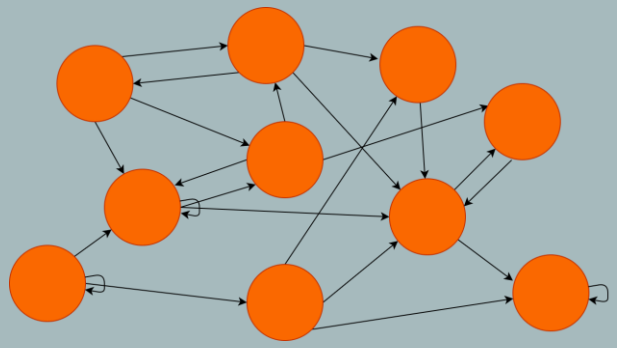
Imprecise Probability

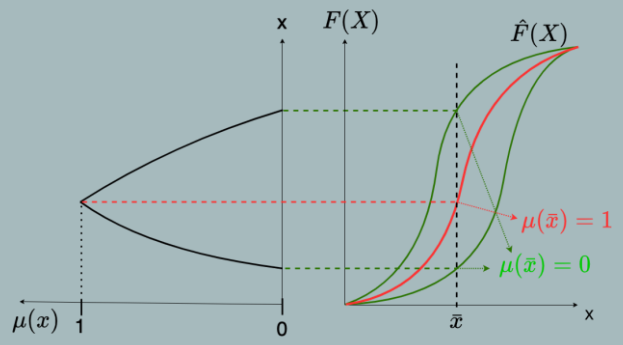


- ”Imprecision” on data with a set of plausible models
- Sensitivity of failure to imprecisions

2nd-step

Uncertainties Quantification – 2nd step





Enhanced "Credal" Network

allows to include models and inputs covering multiple disciplines involved in the analysis and multiple interconnected failure events.