RFC Ensemble Workshop

The Data Uncertainty Engine (DUE): a tool for assessing and propagating data uncertainties

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Overview

1. Problem definition

- What aspects of modelling are uncertain?
- What aspects did we consider?

2. Data Uncertainty Engine (DUE)

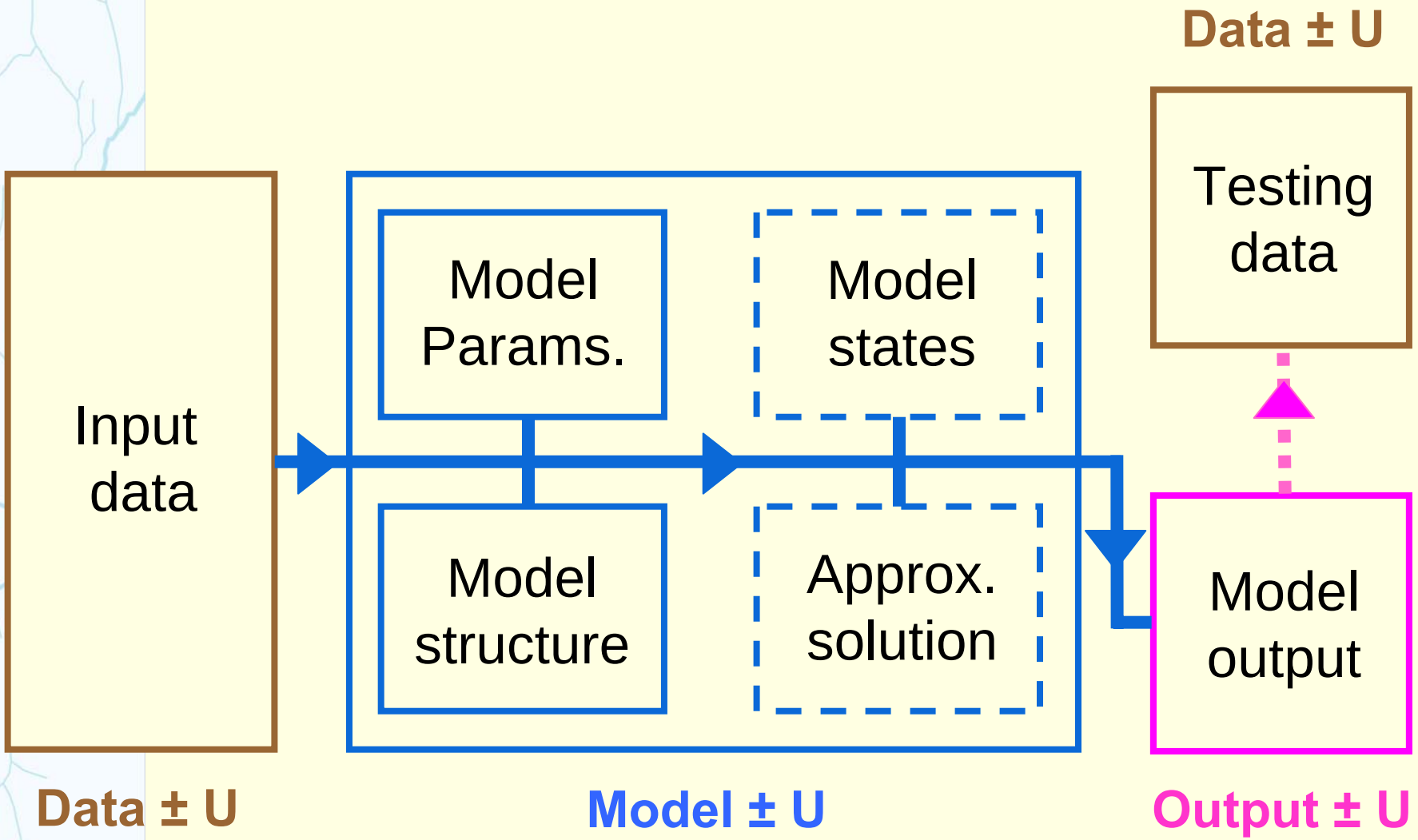
- 'Operational' software tool
- Concepts followed by demonstration

3. Exploitation of results

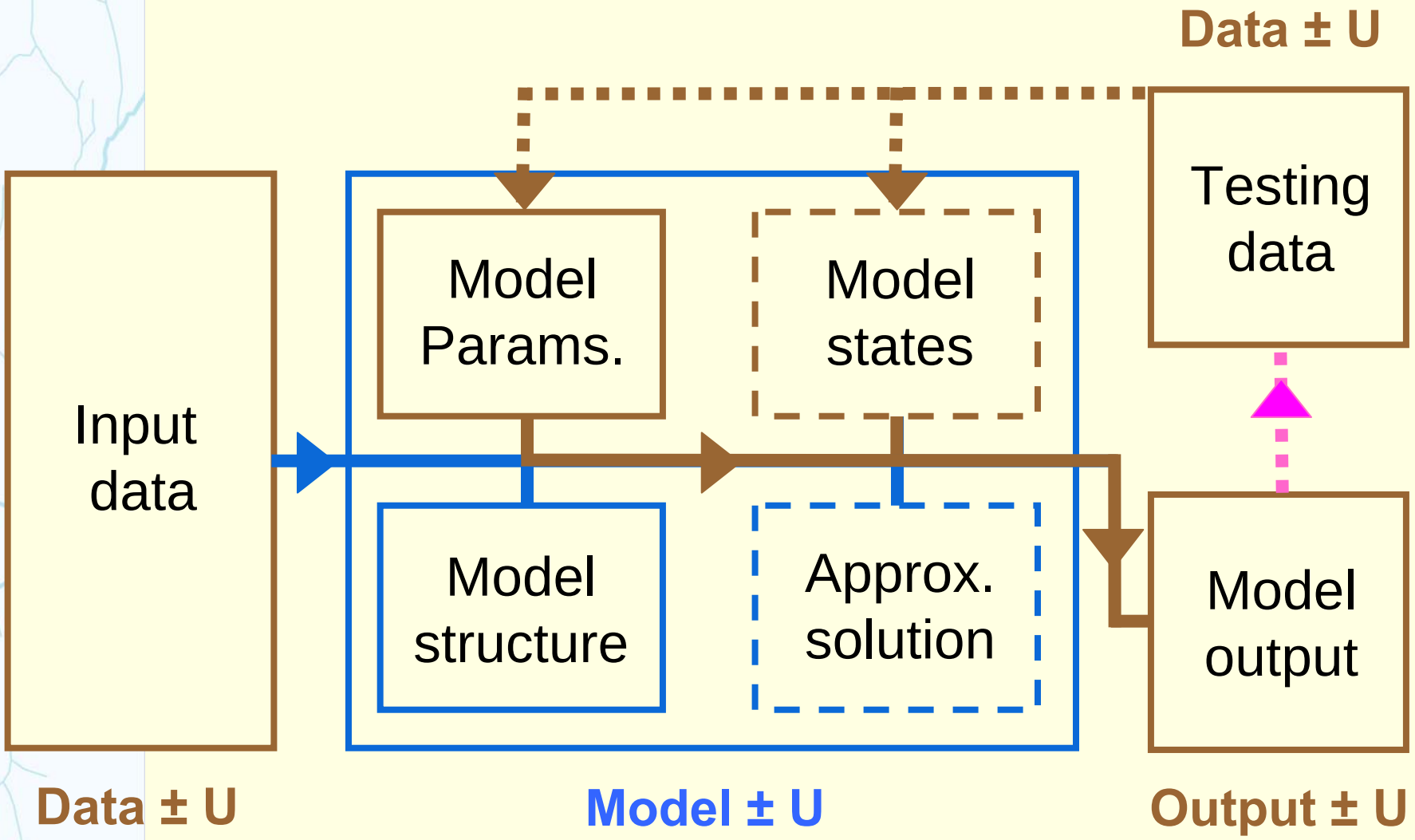
- Ongoing and possible routes: research; applied

1. Problem definition

Sources of uncertainty



Sources of uncertainty



"HarmoniRiB"

1. Tools for handling uncertainty

- Bridging the research/practice gap
- Practical methods and tools

2. Database for uncertain data

- Including measurements, model output etc.
- To support decision making in the WFD

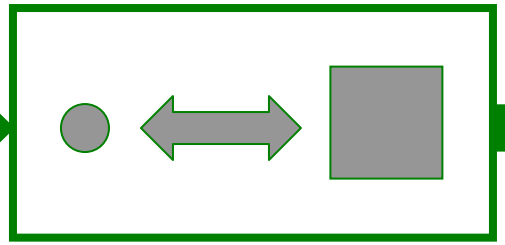
3. Representative river basins

- 7 basins varying physically & socio-economically

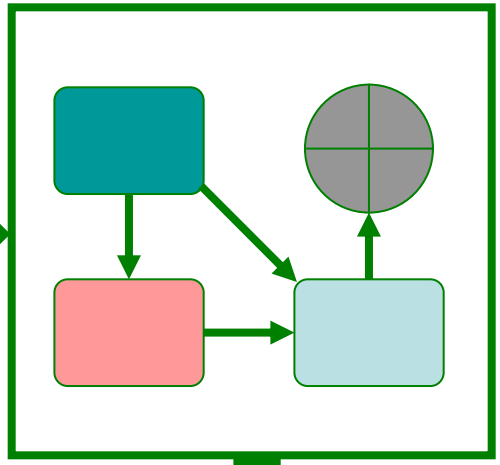
1) Data unc.

X	Y	Z
0.23	0.52	0.41
0.37	0.57	0.27
0.2	0.12	4.26
0.45	0.54	1.43
4.2	0.79	0.01

2) Scale change

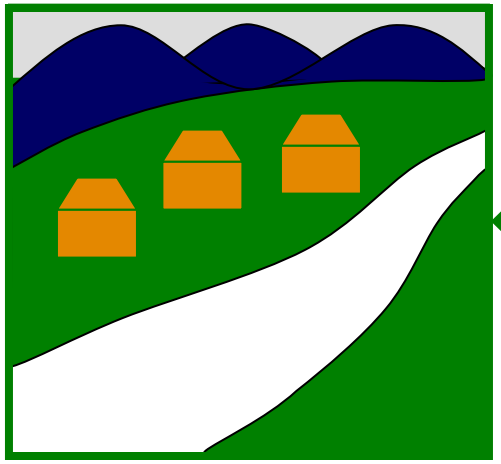


3) Model unc.

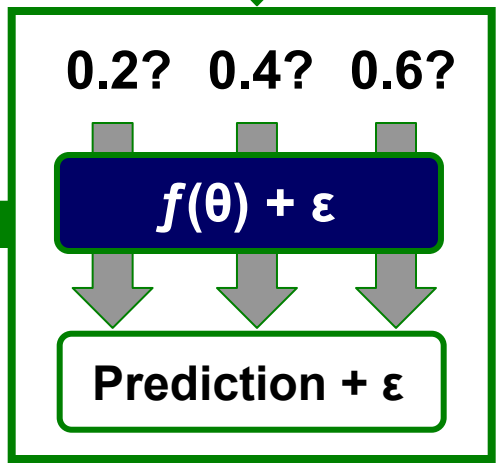


Five activities

1) Data unc.
2) Scale
3) Model unc.
4) Propagate
5) Test

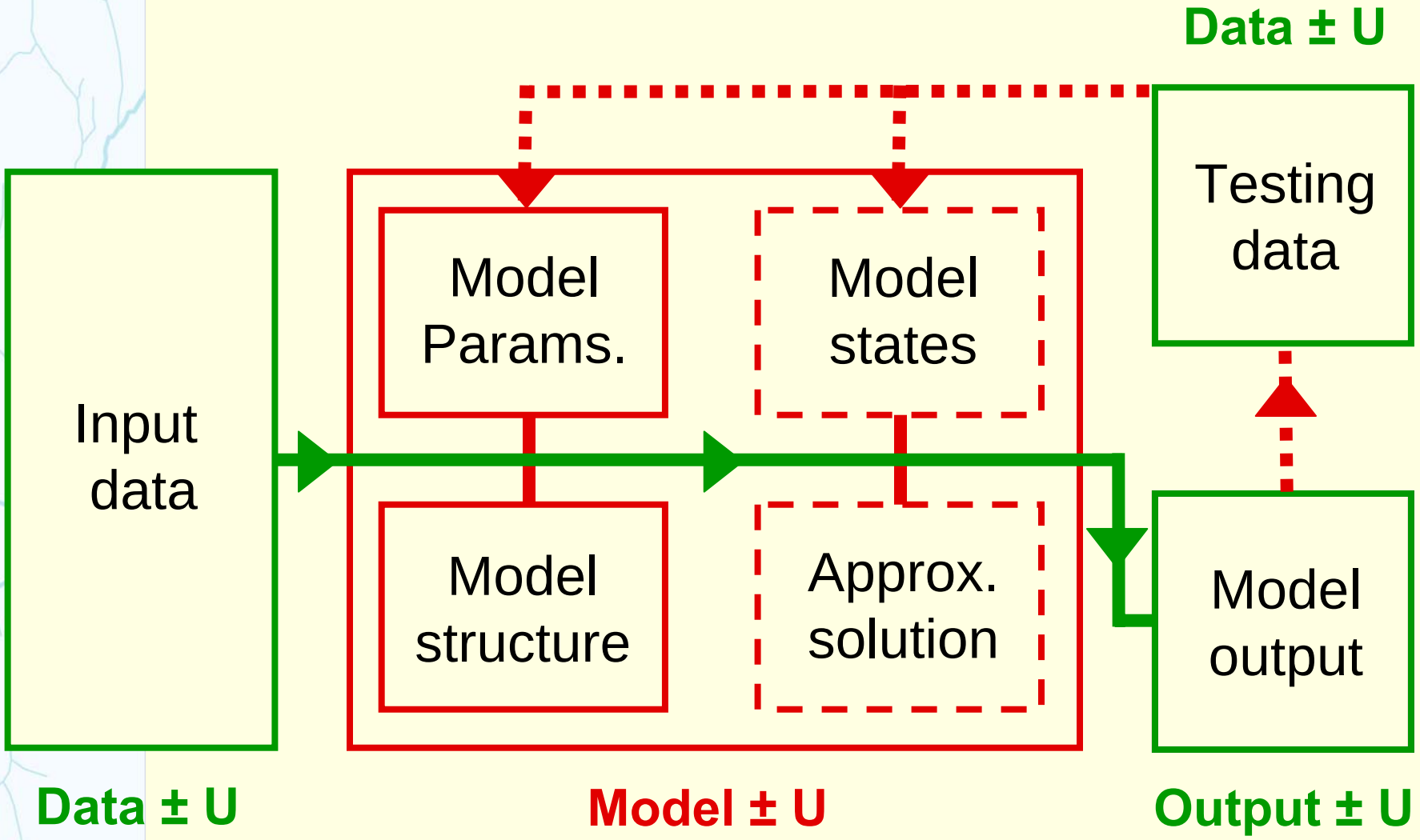


5) Test



4) Propagate

Data uncertainties



2. Data Uncertainty Engine (DUE)

What can DUE do?

1. Assessing (data) uncertainty

- All types of objects and attributes
- Probability distribution functions (for now)
- Expert judgement and supporting (sample) data
- User-friendly environment (structured interface)

2. Propagating uncertainty

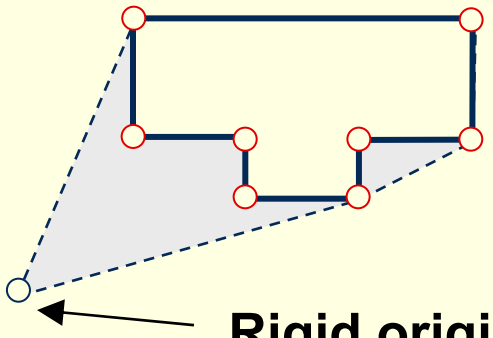
- Wide range of techniques available
- DUE uses Monte Carlo simulation (generic)

Uncertain objects

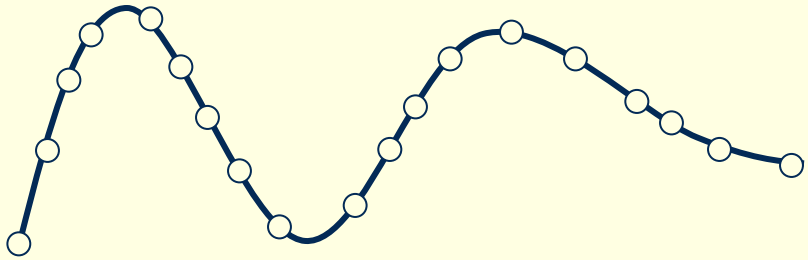
1. Single point object

$F_{X_1Y_1}(x_1,y_1) = P(X_1 \leq x_1, Y_1 \leq y_1)$

2a. Multi-point: 'rigid'



2b. Multi-point 'deformable'



$F_{X_1Y_1..X_{19}Y_{19}}(x_1,y_1....x_{19},y_{19}) =$

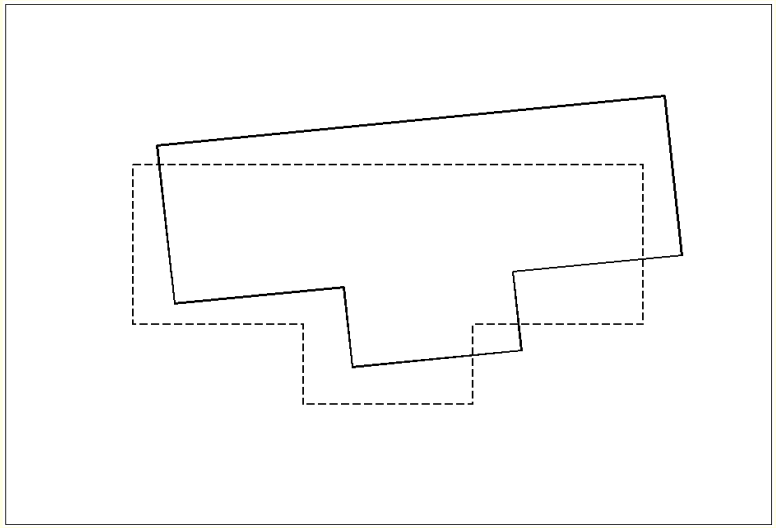
$P(X_1 \leq x_1, Y_1 \leq y_1,... X_{19} \leq x_{19}, Y_{19} \leq y_{19})$

$F_{X_1Y_1}(x_1,y_1) = P(X_1 \leq x_1, Y_1 \leq y_1)$

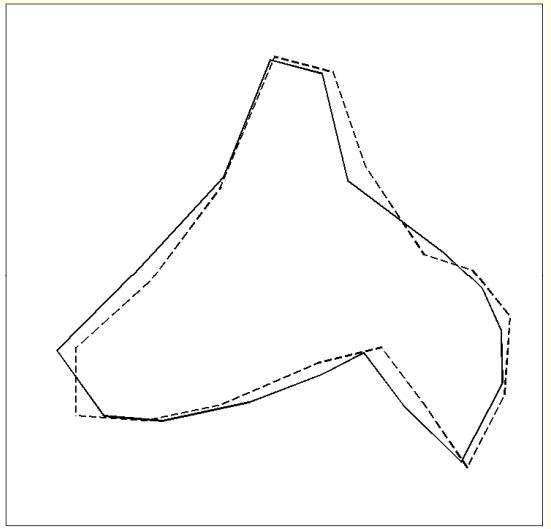
$F_{\theta_{XY}}(\theta_{xy}) = P(\theta_{XY} \leq \theta_{xy})$

Multi-point objects

2a. Rigid



2b. Deformable



Classification of attributes

	A. Continuous Numerical	B. Discrete Numerical	C. Categorical
1. Time	A1	B1	C1
2. Space	A2	B2	C2
3. Neither	A3	B3	C3
4. Both	A4	B4	C4

What can DUE do?

3. Storing uncertainty

- Spatio-temporal database in Oracle/ArcSDE
- HarmoniRiB database is ‘uncertainty enabled’…
- …download to DUE > add uncertainty > upload
- Can also create and save projects to file (*.due)

3. Demonstration of DUE

4. Plans for exploitation

Exploitation plans

1. Academic/commercial research

- Published; open source (free to use and modify)
- Regularly updated; detailed plans for extensions
- External collaboration: e.g. WL|Delft Hydraulics

2. Practical applications

- Seven case studies within HRiB
- Flood early warning with WL|Delft Hydraulics
- Teaching (M.Sc. in Amsterdam and Wageningen)

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