

## SITES – lecture program

### **Mon morning                      Fundamentals of probability theory and Information Theory**

8:30 – 8:45

Arrival & Coffee

8:45 – 9:15

Introductions

9:15 – 10:30

Information Theory in Earth Science: Understanding the Origins

Lecturer: Praveen Kumar

10:30 – 12:30

Basics of Probability theory

Basics of Information Theory

Lecturer: Uwe Ehret

### **Mon afternoon                      Practical aspects of working with distributions and information measures**

14:00 – 15:30

Basics of Information Theory (continued)

Lecturer: Uwe Ehret

15:30 – 17:30

Hands-on tutorial: Calculating Entropy, mutual information, and divergence, effect of parameter choices and sample size

Language: Matlab and Python

Lecturer: Grey Nearing

### **Tue morning                      (Eco-)hydrological modeling using process networks**

8:30 – 9:00

Arrival & Coffee

9:00 – 11:00

Introduction to process networks

Lecturer: Allison Goodwell

11:00 – 12:30

Hands-on tutorial: Working with process networks

Language: Matlab

Lecturer: Allison Goodwell

### **Tue afternoon                      Information in (hydrological) data and models**

14:00 – 14:30

Review on hydrological systems and models

General steps in the process of learning and prediction

Lecturer: Cristina Prieto

14:30 – 17:30

The Nature of Information in Models

How Information is structured in Models

Models as Tools for Prediction, Learning, & Decision Making

Lecturer: Hoshin Gupta

**Wed morning                    Information in (hydrological) data and models**

8:30 – 9:00

Arrival & Coffee

9:00 – 11:00

Hands-on tutorial: Model evaluation and process diagnostics using process networks and benchmarking

Language: Matlab and Python

Lecturer: Grey Nearing

11:00 – 12:30

Future Directions for Modelling Research

Lecturer: Hoshin Gupta

**Wed afternoon                Field trip**

13:00 – 19:00

Field trip to the Pas catchment, including Castillo caves with pre-historical rock paintings

Organizer: Cristina Prieto

**Thu morning                    Learning interpreted as data compression**

8:30 – 9:00

Arrival & Coffee

9:00 – 12:30

Basics of data compression

Basics of Algorithmic Information Theory

Analogy between data compression and modeling

Practical approaches

Hands-on tutorial: Data compression

Language: Matlab

Lecturer: Steven Weijs

**Thu afternoon                Information Physics**

14:00 – 17:30

Basics on Information Physics

Information physical approaches to statistical uncertainty and predictability

From Statistical Thermodynamics to Information Geometric Coevolution

Illustrative applications in Hydrology and Earth System Dynamics

Computational examples

Language: Matlab

Lecturer: Rui Perdigao

**Fri morning                    Information Theory applied to spatial problems**

8:30 – 9:00

Arrival & Coffee

9:00 – 11:00

Introduction to spatial models and interpolation methods

Multivariate entropy measures

Multiscale approaches

Lecturer: Florian Wellmann

11:00 – 12:30

Hands-on tutorial

Language: Matlab

Lecturer: Florian Wellmann

**Fri afternoon**

**Information-based design of observational networks**

14:00 – 17:30

Existing work on optimizing monitoring networks using information theory

Objective functions for monitoring network design

Numerical issues

Open challenges and ways forward

Lecturer: Steven Weijs

**Sat morning**

**Discussion and wrap-up**

8:30 – 9:00

Arrival & Coffee

9:00 – 12:30

Summary

Presentation and discussion of potential applications by the participants

Feedback