Spatio-temporal Statistical Analysis of Extremes of Measured and Simulated Fine-resolution Datasets Generated From the North Wyke Farm Platform

Stelian Curceac[1,3], Paul Harris[1], Peter Atkinson[3], Alice Milne[2], Lianhai Wu[1]

[1]Rothamsted Research, North Wyke, Okehampton, Devon, UK EX20 2SB
[2]Rothamsted Research, Harpenden, Hertfordshire, UK AL5 2JQ
[3]Lancaster University, Lancaster Environment Centre, Lancashire, UK LA1 4YQ

1. Introduction

The North Wyke Farm Platform (NWFP) is a systems-based experiment with the remit to research grassland livestock productivity and ecosystem responses to alternative management practices. The system consists of three 21 ha farmlets, each comprising five hydrologically-isolated sub-catchments. Now in its post-baseline phase, each farmlet uses a different management system and the effects of the timing and intensity of management and the transport of nutrients and pollutants from the farm are evaluated using a variety of data collections.

2. Data

☐ **Hydrometeorological** time series of 15 min temporal resolution (rainfall, **water discharge** & chemical/physical attributes, soil temperature & moisture).

☐ Livestock (numbers and location, live weights, date of sale, carcase weights, conformation/fat class score).

☐ GHG (CO_2, CH_4, N_2O)

☐ Field Events (dates and application rates of fertiliser, farm yard manure, herbicides, cultivations, seeding).

☐ Field Surveys (geo-referenced silage yields; co-located sampling-grid-based data on soil attributes).
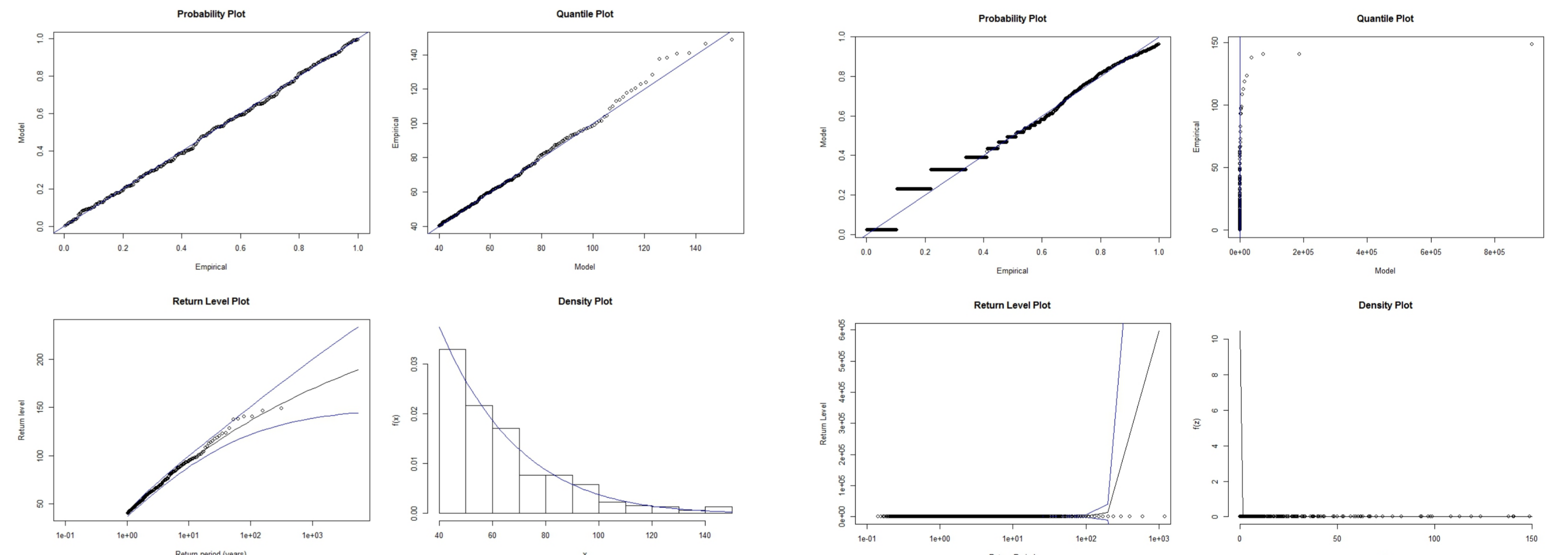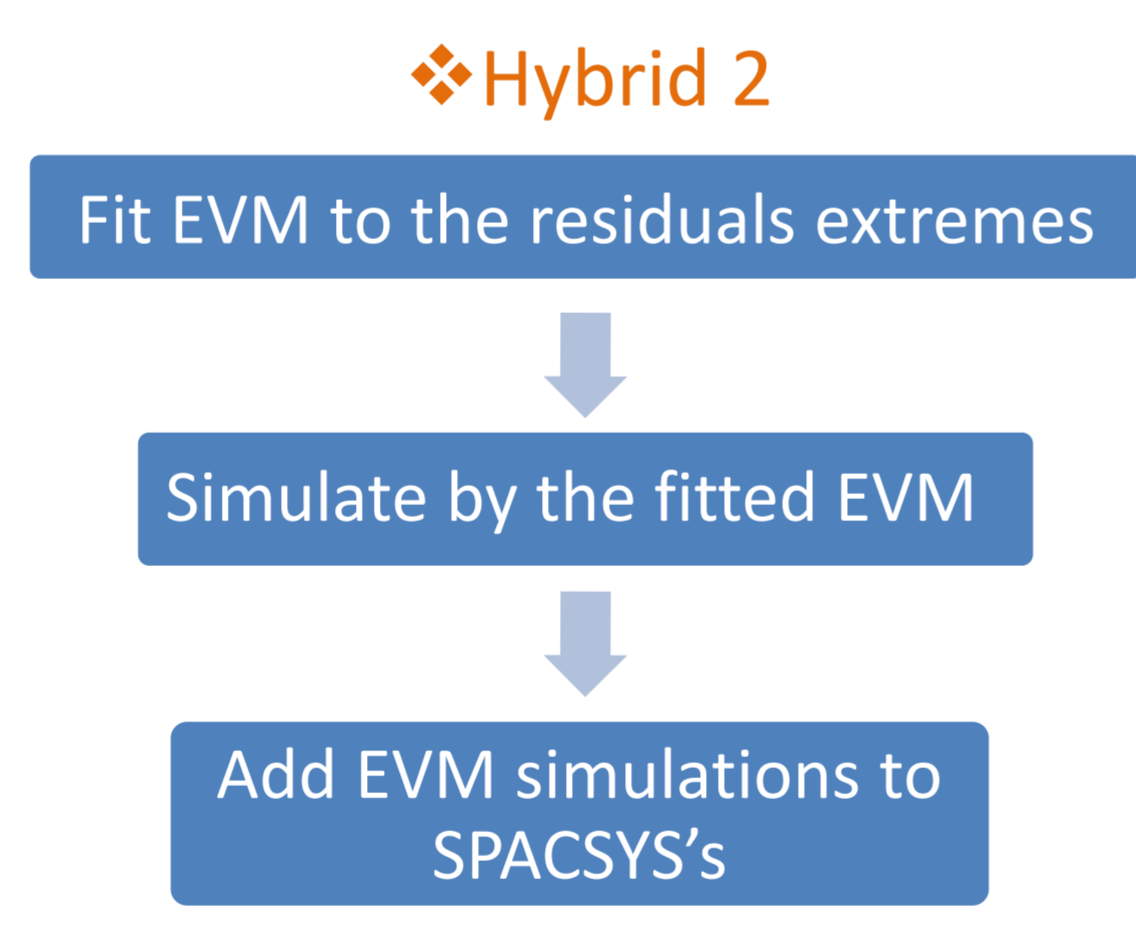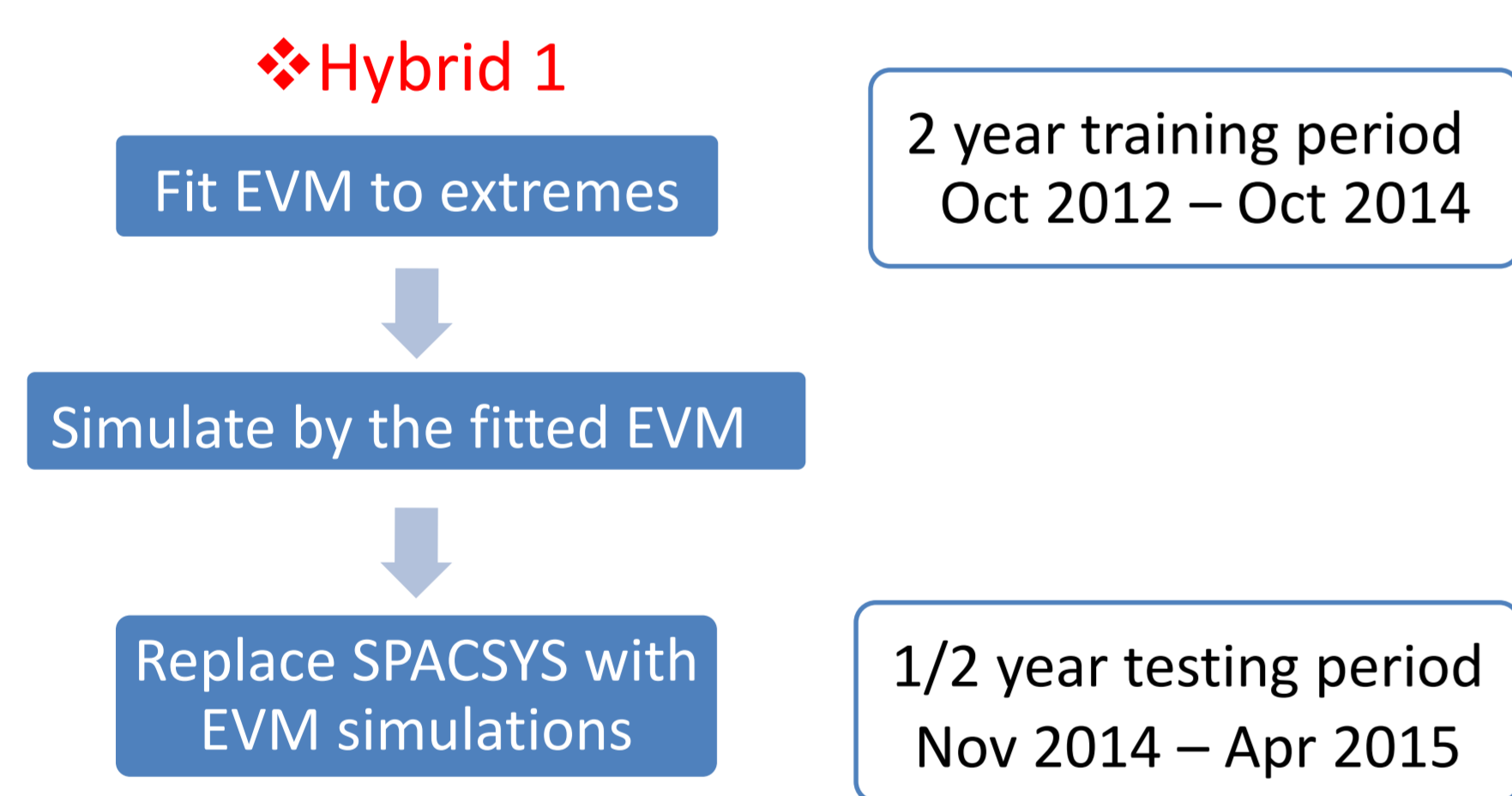
3. Process-based model

The measured datasets are also used as a test bed for process-based models. These models can be used to answer key questions about the experiment and for future scenarios forecasting. The most frequently used model for such purposes is **SPACSYS**. It is a multiparametric model that uses meteorological data as inputs and simulates various processes at a daily resolution. The simulations include surface and soil water movement, plant growth and development, soil (N) and carbon (C) cycling and heat transformation. SPACSYS provides simulations of the flow that capture the general behaviour but has a poor performance in accounting for the extremes.

Soil Plant and Atmosphere Continuum SYStem SPACSYS
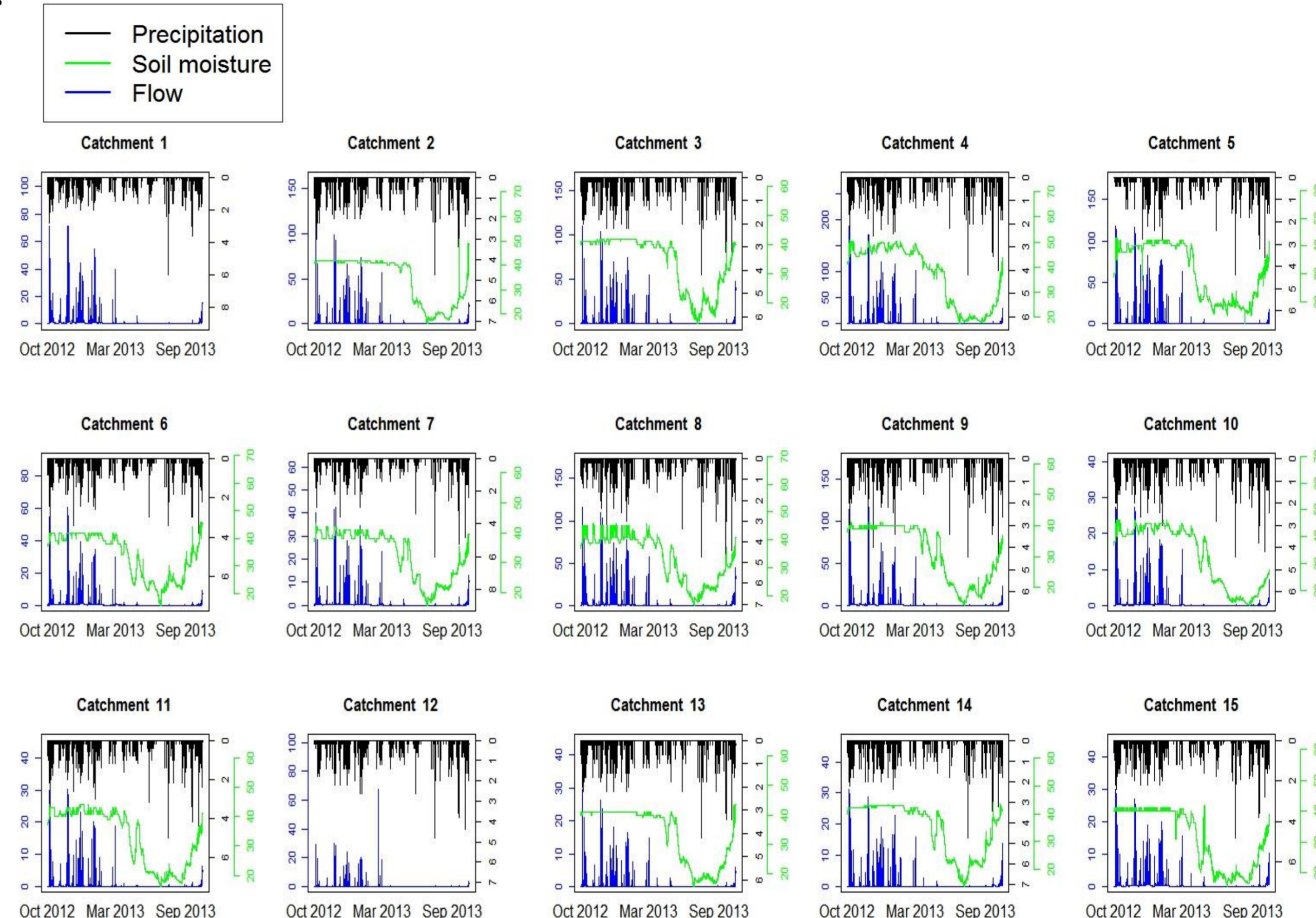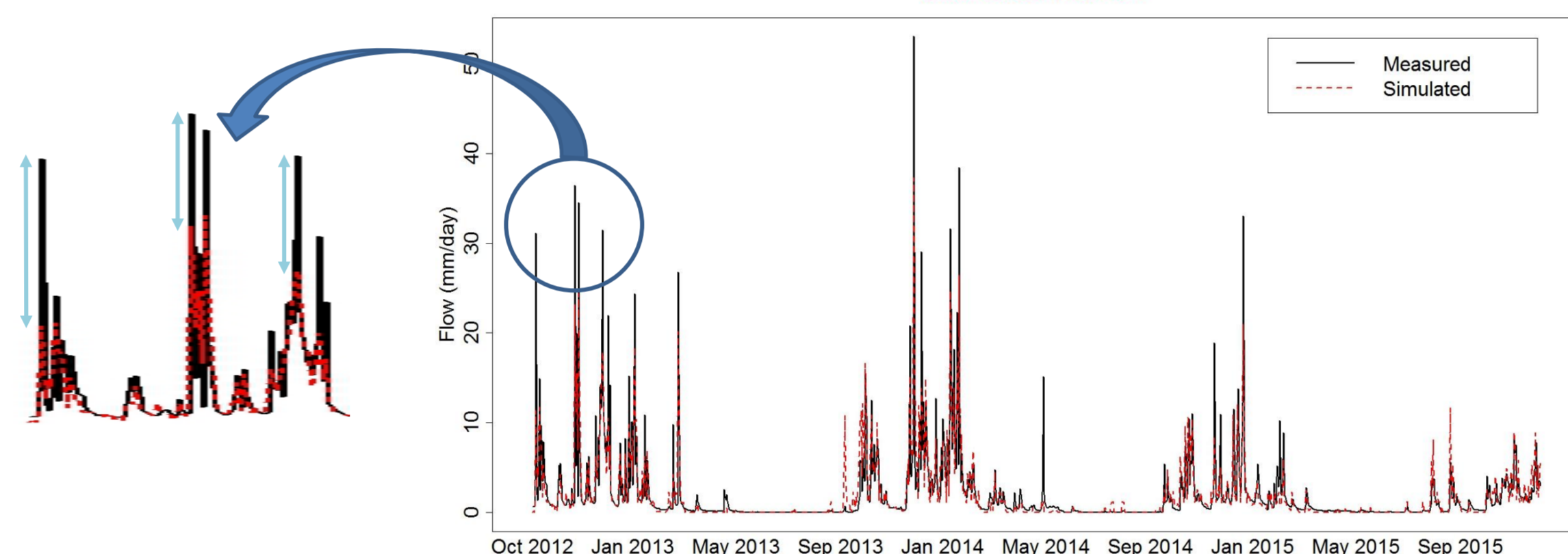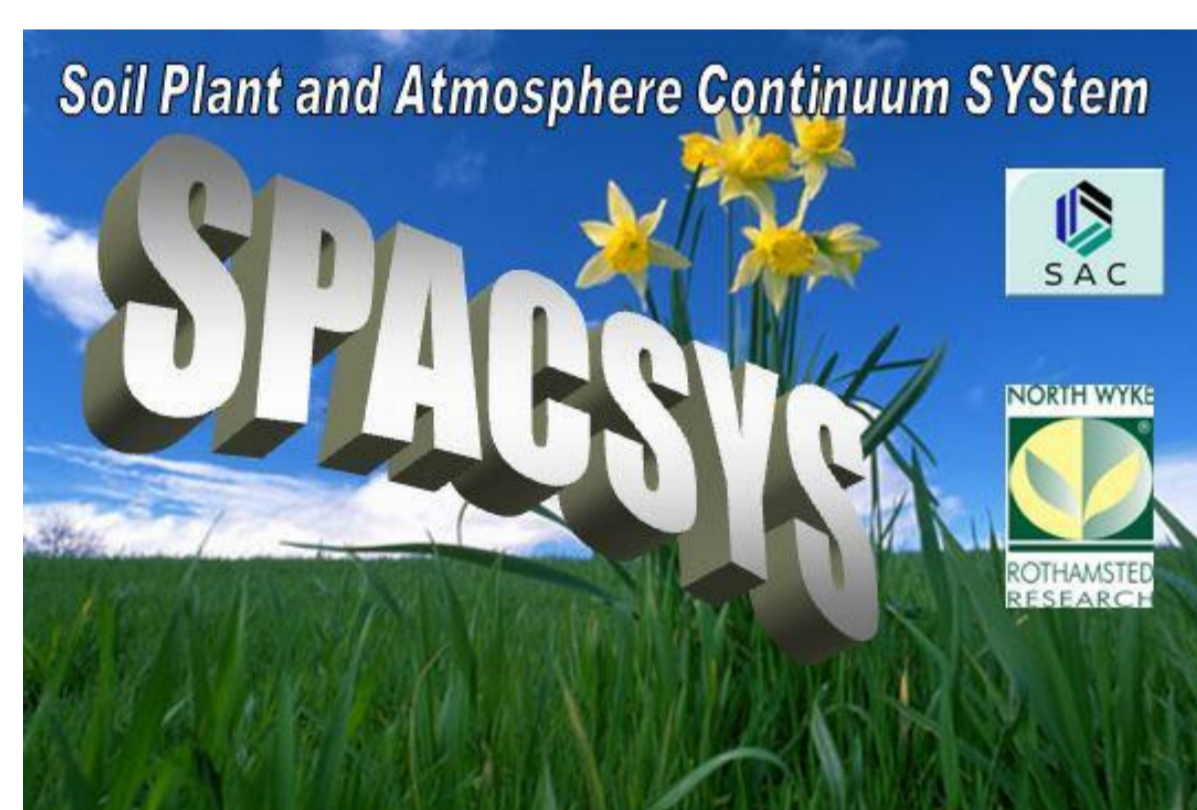
4. Research Objective and methods

❖ Improve **SPACSYS** simulations of extremes by hybridizing with **Extreme Value Models (EVM)**

❖ **Hybrid 1**
- Fit EVM to extremes
- Simulate by the fitted EVM
- Replace SPACSYS with EVM simulations

2 year training period Oct 2012 – Oct 2014

1/2 year testing period Nov 2014 – Apr 2015

❖ **Hybrid 2**
- Fit EVM to the residuals extremes
- Simulate by the fitted EVM
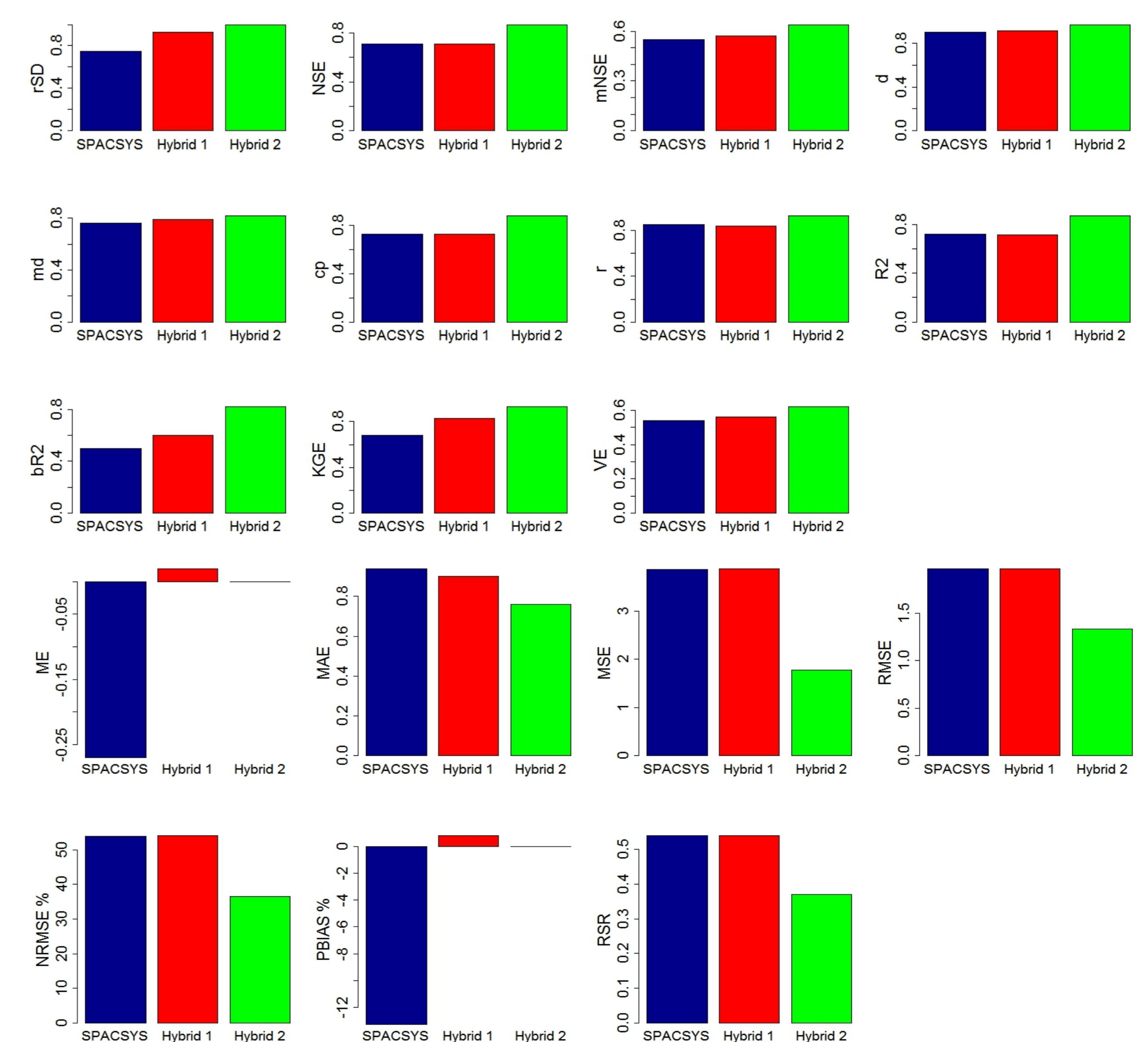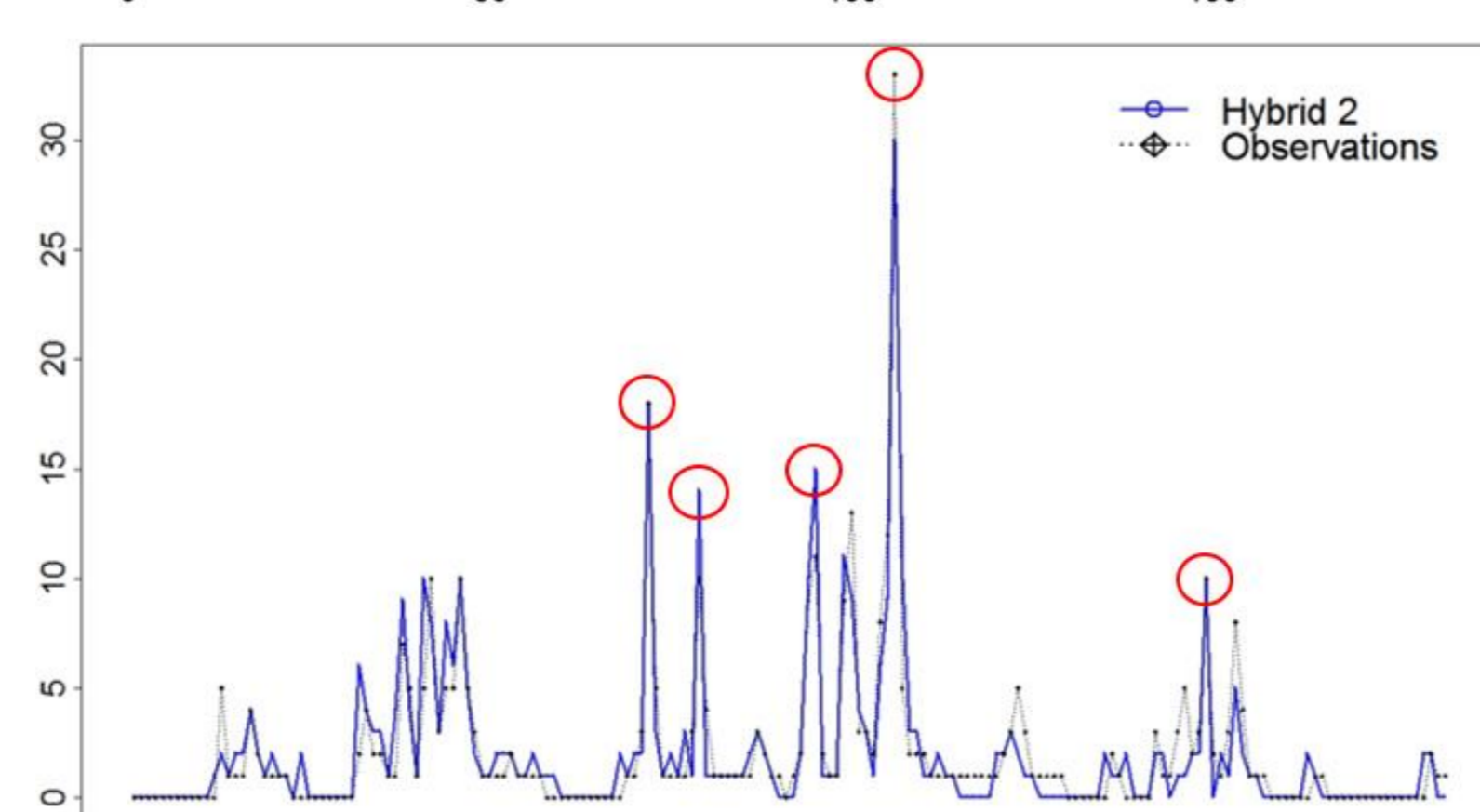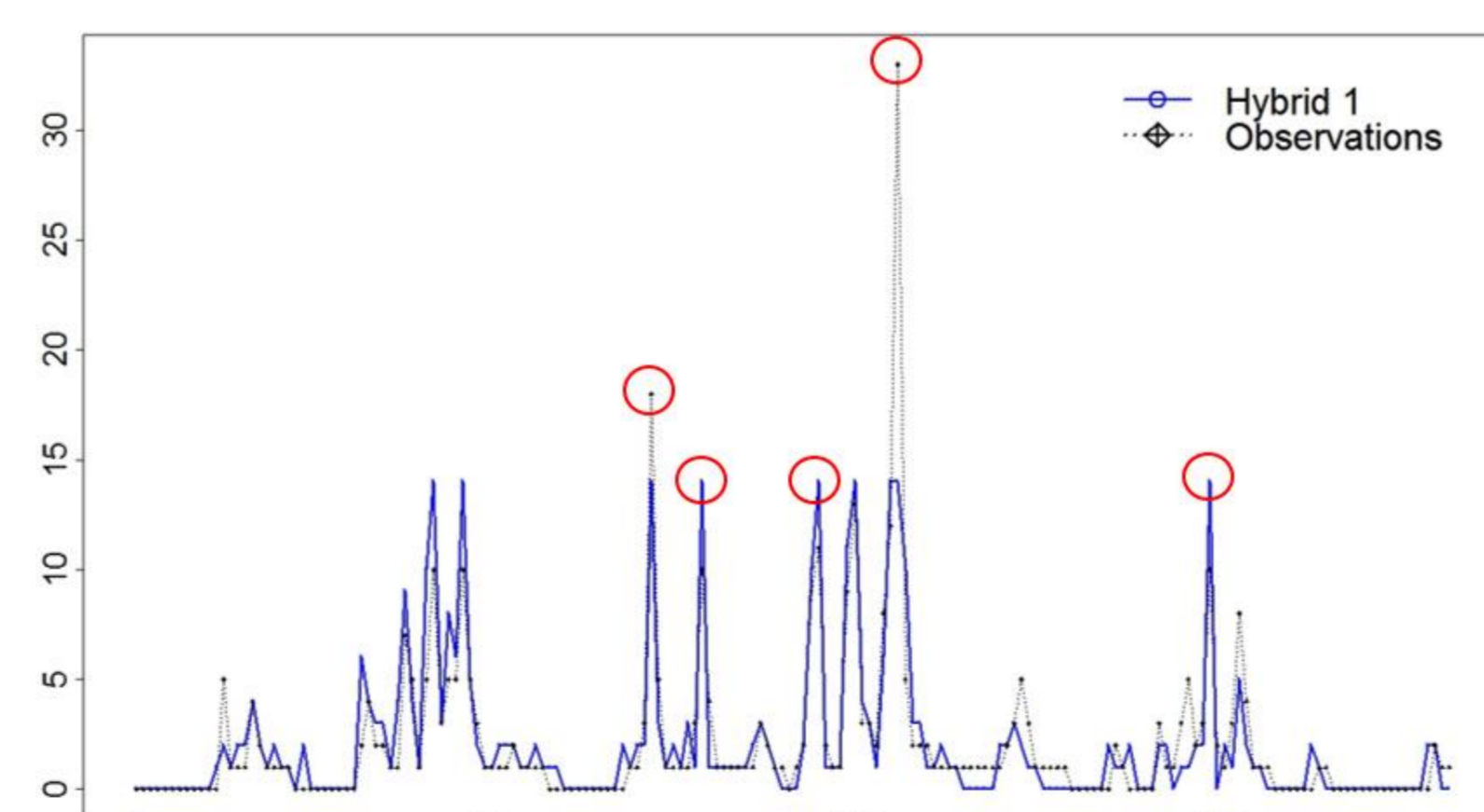- Add EVM simulations to SPACSYS's

Generalized Pareto Distribution (GPD) ✓   **Generalized Extreme Value (GEV)** ✗

5. Results

✓ Both proposed models provide better results compared to SPACSYS

✓ Hybrid 1 captured some of the extremes and showed improved performance according to some indices

✓ Hybrid 2 is the best performing model according to all the indices

To be continued...

✓ Improve the temporal resolution of SPACSYS
✓ Applicability to other more difficult variables (e.g. Nitrates)
✓ Covariates
✓ Autoregressive (time series) model
✓ Space-time extension to all 15 catchments