**Modelling multivariate temporal extremes for the design of offshore facilities**

**Stan Tendijck1, Emma Eastoe2, Jonathan Tawn2,**

**David Randell3, Philip Jonathan2,4**

1STOR-i Centre for Doctoral Training, Department of Mathematics and Statistics, Lancaster University, Lancaster, UK. E-mail: s.tendijck@lancaster.ac.uk

2Department of Mathematics and Statistics, Lancaster University, Lancaster, UK.

3Shell Global Solutions International B.V., Amsterdam, Netherlands.

4Shell Research Limited, London, UK.

**Abstract**

We are motivated by the question of whether current offshore facilities are able to withstand extreme storms. For such structures, damage is caused by both short intense storms and long but less intense storms. It is crucial for the design of these offshore facilities to be able to describe a 10,000 year storm. Possible characteristics for such an extreme event include the temporal distribution of multiple met-ocean variables, like wave height and wind speed, each of which can be extreme.

In this talk, we present our ideas on modelling such storms. More specifically, we present our extension to an existing univariate Markov extremal time-series model, which allows for asymptotic dependence and asymptotic independence at different lags and components, to the multivariate case. For our model, it is important that both types of extremal dependence are modelled well, since it is not uncommon for frequently observed data from a time-series to exhibit asymptotic dependence at small lags and asymptotic independence at larger lags. We apply our methodology to a case study in which we jointly model the extremes of significant wave height and wind speed at a location in the North Sea over time. We use this model to characterize extreme storms in this region.