Modelling and predicting residential water damage insurance claims in a climate change perspective

Ola Haug*
Norwegian Computing Center, Oslo, Norway - ola.haug@nr.no

Ida Scheel
University of Oslo, Oslo, Norway - idasch@math.uio.no

Arnoldo Frigessi
University of Oslo and Norwegian Computing Center, Oslo, Norway - arnoldo.frigessi@medisin.uio.no

Peter Guttorp
University of Washington and Norwegian Computing Center, Seattle, United States - peter@stat.washington.edu

The insurance industry is highly exposed to risks caused by weather related events. In a warming world there is evidence for changes in the spatial distribution, frequencies, and intensities of both catastrophic and ordinary bad-weather events. Turning anticipated weather patterns into robust and reliable claim estimates at a local scale is imperative for the successful modelling of impacts of climate change on the insurance sector. In order to understand patterns of risk in the light of climate change, over time and space, the relation between weather events and incurred losses is explored via Generalised Additive Models using historical data over the Norwegian mainland and then combined with future climate projections. A Bayesian Poisson hurdle statistical model that explains number of residential water damage claims in terms of various meteorological and hydrological variables under a spatially smooth variable selection is established at municipality level. In a prediction setting this model depicts changes in claim frequency feeding it either with certain synthetic changes in reference weather patterns or weather projections obtained from regionally downscaled global climate model scenarios. The dynamic downscaling model HIRHAM is evaluated applying full range as well as local effect statistical tests to 40 years of past ERA-40 reanalysis model precipitation along with gridded observations, with no hope of climate models performing better than a reanalysis. The evaluation reveals that in general inconsistencies in downscaled products leave demand for a full distributional calibration. Applying Doksum's shift function, a credible bias correction is established for downscaled ERA-40 reanalysis precipitation locally. With such a calibration in place for downscaled climate model scenarios as well, projections of future claim frequencies could be derived from feeding calibrated scenarios into our Bayesian Poisson hurdle model. Extending the calibration of the reanalysis to climate model data has not proven successful so far, however.

Keywords: Bayesian Poisson hurdle; Spatial variable selection; Dynamic downscaling; Doksum's shift function.