A multivariate Markov chain model is presented for generating sea state time series based on observed time series. Two ways of capturing the seasonal variation in the sea state parameters resulted in two distinct models which quality was assessed by comparing their statistical properties to what was obtained from observed time series. Two different sea state data sets were considered in the validation, and it was found that both models compared favorably to those empirical data. It was concluded that Model 1 worked best for the longest data set considered, but was challenged by the shorter time series, where Model 2 worked best.

For this purpose a more flexible model is needed.

Two multivariate Markov chain models were implemented:

Model 1 is a generalization of the weather model mentioned. This model estimates transition probabilities separately for each month. The generalization lies in the discretization procedure, where multivariate weather states were constructed. The weather state is represented by an integer which reflects the values for all sea state parameters with uncertainties corresponding to the resolutions.

In Model 2 an other approach of dealing with the seasonal variation for the sea state parameters was used:

The seasonal variation in the mean value and standard deviation for wave height, wind speed and wave period were assumed to be deterministic functions with a period of one year. This seasonal variation were removed from the observed times series with a transformation. The transformed time series were assumed to be stationary by estimating only one transition matrix.

Both models were assed by comparing statistical properties such as first and second order moments, correlations, marginal distributions, persistence of good weather windows and waiting time between these weather windows. Weather windows were characterized by small waves with a large period combined with calm wind. Statistical parameters were calculated for whole time series and on a monthly scale and both visual comparison and calculation of test statistics were performed.

The figures below shows how some of the statistical parameters considered were reproduced by Model 1 for the longest data set.