Comparison of methods for spatially explicit impact assessment of marine renewables

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Abstract: Three spatial modelling methods were identified for methodological comparison: Generalised Additive Models (GAM), Generalised Additive Mixed Models (GAMM) and Complex Region Spatial Smoother (CReSS; Scott-Hayward *et al.*, 2013) with spatially adaptive knot placement using SALSA (Spatially Adaptive Local Smoothing Algorithm; Walker *et al.*, 2011). Three simulated impact scenarios (no-change post impact, 30% decrease and post-impact redistribution) were based on offshore data collected from existing renewables developments. Data was generated for each case using both GAM and CReSS models to prevent favouring one in the comparison process. Five measures were used to assess performance; model choice, model fit to the underlying process, spatially explicit bias and coverage and spatially explicit post-impact differences.

We present results from the off-shore GAM generated, scenario along with a summary of the entire comparison process. GAMs fit the underlying surfaces well but were poor at assessing if impact-related effects were present and at locating spatially explicit change. GAMMs performed very poorly when assessing if impact-related effects were present but performed well at locating spatially explicit change. Similar to GAMs, CReSS performed well at approximating the underlying process. CReSS performed the best of the three methods at assessing if impact-related effects were present and at identifying spatially explicit change.

Our conclusion is that CReSS gives the best results for identifying the impact of marine renewables. For both developers and government licensing organisations it is important to identify any change in density or distribution of animals at marine renewables sites and if those changes can be attributed to the presence of renewables devices (Mackenzie *et al.*, 2013). An R package, `MRSea`, was developed to assist with this type of modelling and can be found at `http://creem2.st-andrews.ac.uk/software.aspx`.

References

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