

Validation data : keystone to move state-space models for movements to operational models for fisheries and marine ecology

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In line of the recent spread of electronic devices to track animals and of the development of movement ecology, Vessel Monitoring Systems experience a worldwide diffusion allowing tracking fishing boats whose behaviors show similarities with natural top foragers. State-space models are widely used to estimate the states of an unobserved process from tracking data. When tracking data are assumed to be known without error (e.g. GPS position or filtered Argos positions) the unobserved process (also called hidden state process) generally concerns the behavioural states of the tracked individuals. This modelling approach assumes that the characteristics of the movement (speed, turning angle) inform on the behavioural states (fishing/eating, foraging, traveling). In fisheries and in marine ecology, applications concern, up to now, time- and state-discrete versions of these models assuming a Markov or Semi-Markov transition between states and a correlated (or not) random walk to describe movement conditionally upon state. Inferences are usually based on maximum likelihood or Bayesian methods. However the selection and validation of state space model lacks of appropriate statistical tools and suffers computational cost. The reliability in model's outputs is therefore questionable and it becomes essential to better control the assumptions introduced in the model (time-correlation, markov/semi-markov) and their consequences. In this communication, we promote the use of validation data sets to design and validate state-space models for movement analyses in fisheries and marine ecology. Three different state-space models were fitted to several tracking data sets with contrasted frequencies of data acquisition associated with validation data sets informing on the true behavioural states. We assess the robustness of state-space models to model hypotheses and derived some recommendations on the formulation of state-space models with respect to time step of observations and behavioural states.

Keywords : vessels' trajectories, behaviour, discrete state-space models, models comparison and validation, modelling of movement