How important is it to account for spatial variation in growth for data-limited fisheries?

Part 1. Is there bias in estimates of stock status when there is spatial variation in growth, but it is ignored in the assessment?

Operating model 1: No spatial variation in growth. Fishing mortality constant/endogenous, recruitment constant with process error

Operating model 2: Spatial variation in growth (via asymptotic length). Fishing mortality constant/ endogenous, recruitment constant with process error

Estimation model: Assumes no spatial variation in the growth process, estimates annual fishing mortality as random effects and random effects on recruitment

Answer Part 1: Over 100 iterations of different patterns in spatial variability in asymptotic length, estimates of stock status (spawning potential ratio) are under-estimated when length composition data is pooled across sites and spatial variation is ignored. These estimates may be less biased when fishing mortality is increasing over time, as opposed to relatively constant, due to more information contained within the length composition data as the stock is further exploited. However, for both scenarios of fishing mortality over time, precision in estimates of stock status is low compared to when there is no spatial variation in growth. This means that even if the estimator is unbiased when more information on fishing mortality is contained within the data, we have greater uncertainty in our ability to estimate stock status for any given population when there is more variability in the system dynamics than is accounted for.

Part 2. Is it more important to account for temporal variation in fishing mortality, temporal variation in recruitment, or spatial variation in growth for estimates of stock status?

Adjust estimation model:

* Estimate F as constant (one parameter) or time-varying (multiple parameters)
* Fix recruitment at 1 (relative value), or estimate random effects over time
* Fix asymptotic length, or estimate random effects by space

Same operating models as Part 1 (but perhaps change to constant F rather than endogenous)