Bayesian Methods for Ecological and Environmental Modelling

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Recap Comprehensive Uncertainty Quantification

1. No model represents the true system perfectly. Often we don't know what this error (discrepancy) is so we need to quantify this uncertainty.
2. If we ignore this uncertainty we will often end up with a model that is confidently wrong.
3. Another consequence of this could be that the model is over-fitted to parts of the system for which there are many observations at the expense of the few.
4. If thinning the observations improves the calibration this diagnoses that model structural error is causing problems in the calibration.
5. Adding terms to the calibration to represent uncertainty in model errors improves the parametric fit of the model. Uncertainty also increases reflecting the fact that the model has errors and that we don't know what they are.
6. The 'discrepancy model' could be useful for diagnosing model structural errors.

Recap Emulation

If our model (simulator) is too expensive for MCMC:

- create a faster emulator of the simulator
- interpolates the model and quantifies uncertainty
- very similar in concept to spatial modelling (geostatistics) but in parameter/input space rather than physical space
- need to specify a prior mean function and covariance hyperparameters (similar to geostatistics)
- fit the emulator to output (data) from the simulator - emulator is the posterior
- can calibrate simulator parameters using the emulator but don't forget about simulator structural error (discrepancy).