One Model ... or Three

The use of model averaging to streamline the stock assessment process

Colin Millar
Ernesto Jardim
Richard Hillary
Ruth King

European Commission
Joint Research Center

Context

This has all been developed within the a4a framework

The Problem

There are often several plausible assessment models

Solutions

- Choose one model
- Present several models
- Hierarchical modelling
- Combine models

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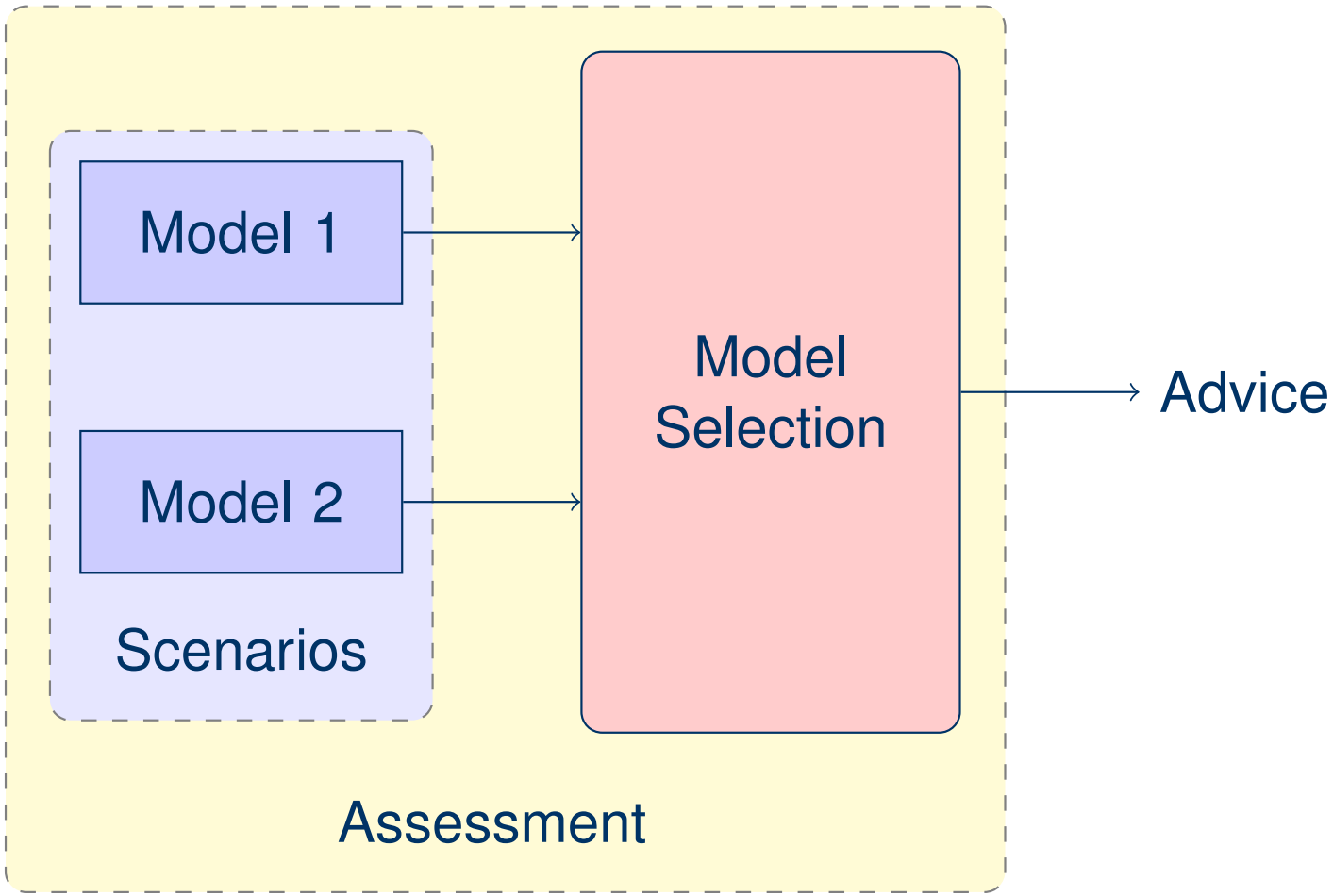
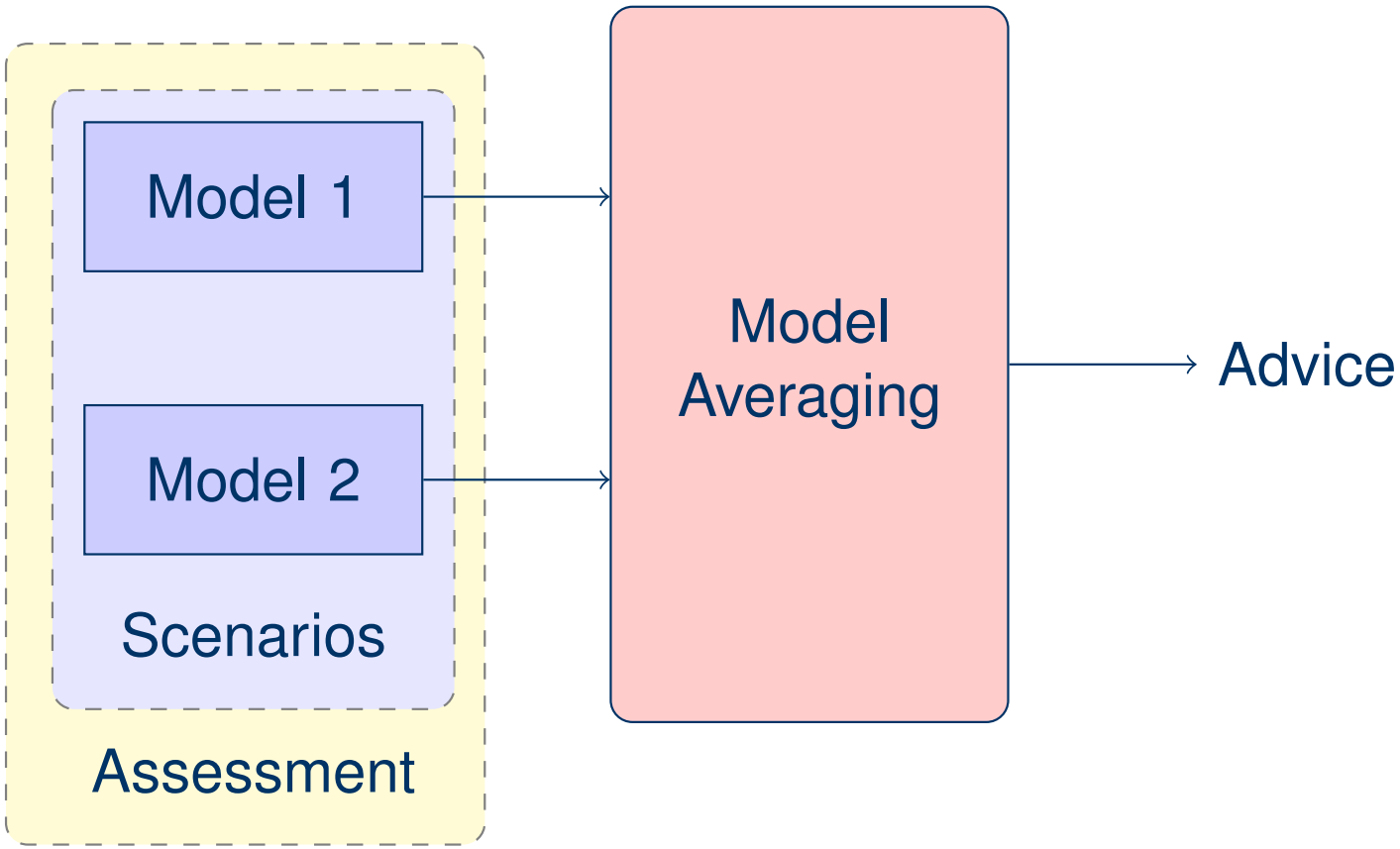
An Assessment Process



Model Averaging



Model Choices in a4a

With a linear model you can fit

- linear and smooth functions of age and year
- seperable models
- partially seperable
- non-seperable
- step changes (in level, in smoother form)
- covariates (smoothed and linear)

These can be applied to log **F**, log **catchability**, **stock recruit** parameters, observation **variance**.

Model Choices in a4a

For example in selectivity

$$\log Q \sim \overbrace{\log \text{Contact Selectivity}}^{\text{offset}} + \underbrace{\log \text{Availability}}_{\text{formula}}$$

Model Selection in a4a

- likelihood based
  - **AIC** (Akaike Information Criterion)
  - **BIC** (Bayesian or Schwarz Information Criterion)
- Posterior model probabilities
  - **HME** (Harmonic Mean Estimator)
  - **BMA** (Bayesian Model Averaging)

All these balance complexity and fit.

Model Choices

(log) fishing mortality

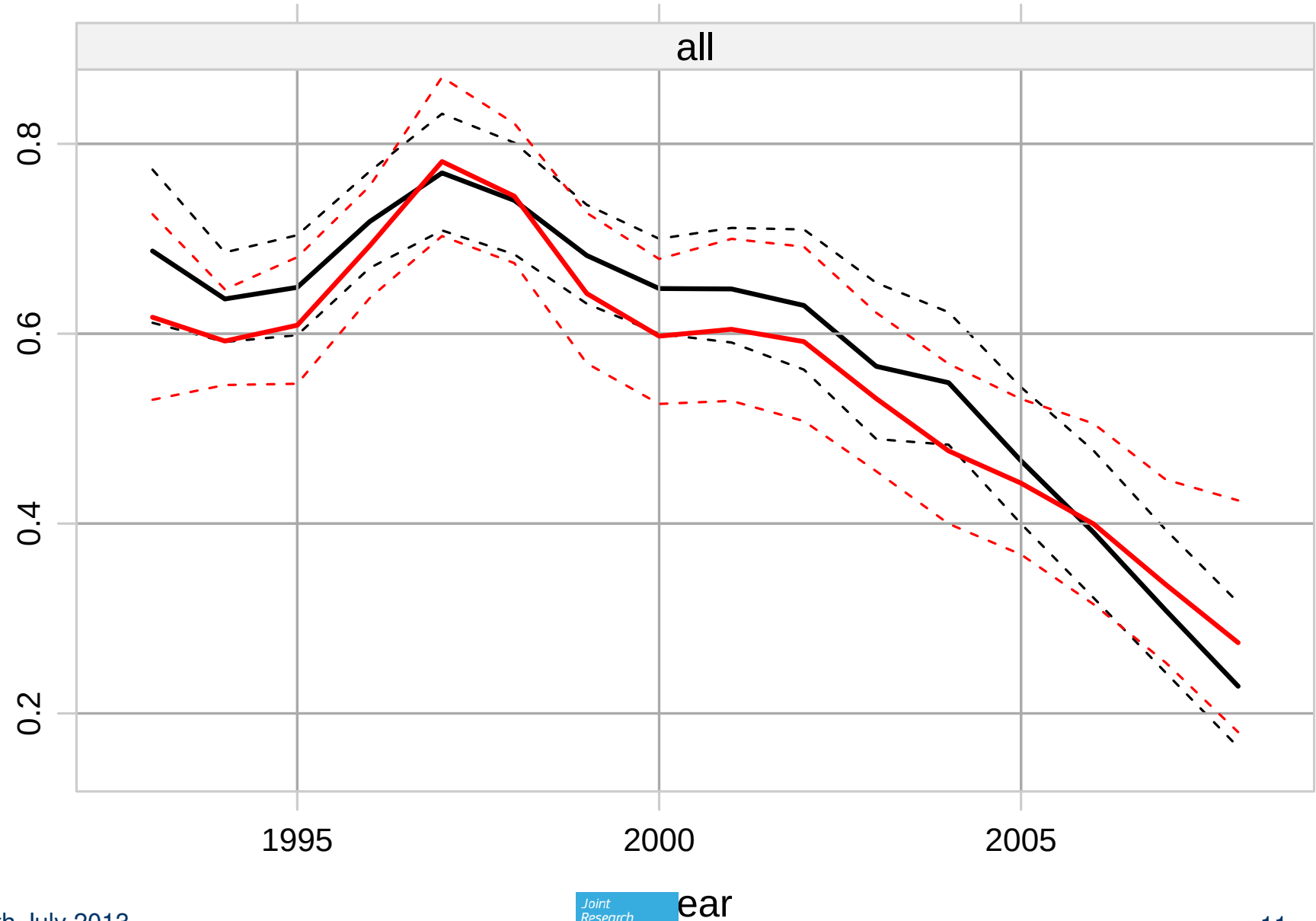
```
fmodel1 <- ~ s(age, k = 4, by = breakpts(year, c(199
+ s(year, k = 8)
fmodel2 <- ~ te(age, year, k = c(4, 8))
```

(log) survey catchability

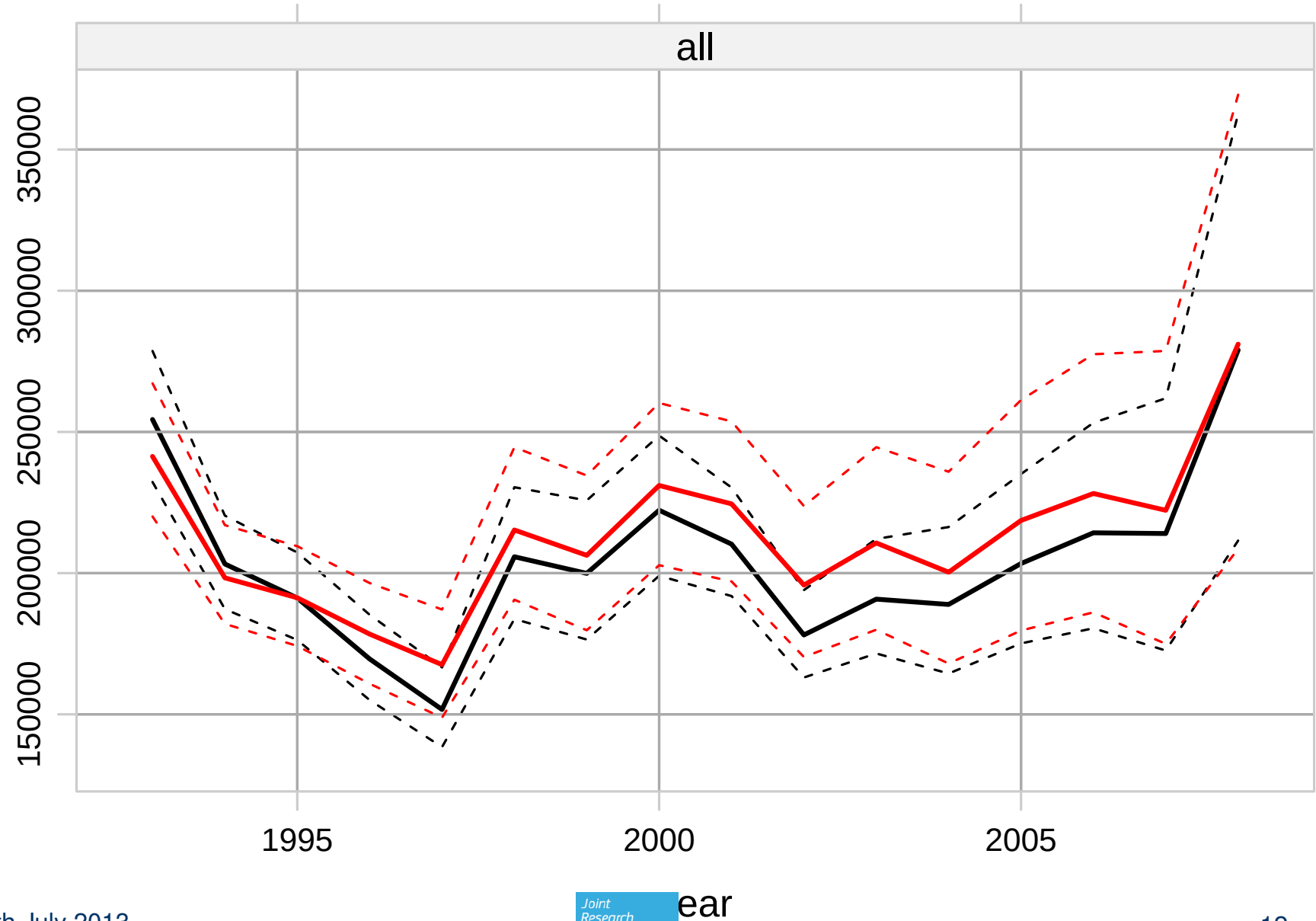
```
qmodel1 <- ~s(age, k = 4)
qmodel2 <- ~poly(age, 2)
```

AIC	fmodel1	fmodel2
qmodel1	317.238	316.506
qmodel2	317.174	316.0118

Model Fits: Fbar



Model Fits: SSB



Approaches to Model Averaging

- weighted simulation schemes
  - AIC
  - posterior model probability (HME)
- Full model averaging schemes
  - smooth AIC (bootstrap)
  - RJMCMC

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Approaches to Model Averaging

We want to sample from:

$$P(\text{model, model parameters} \mid \text{data})$$

Weighted simulation schemes do:

1. simulate: $\tilde{P}(\text{model} \mid \text{data})$
   $\tilde{P}(\text{parameters} \mid \text{model})$

Approaches to Model Averaging

We want to sample from:

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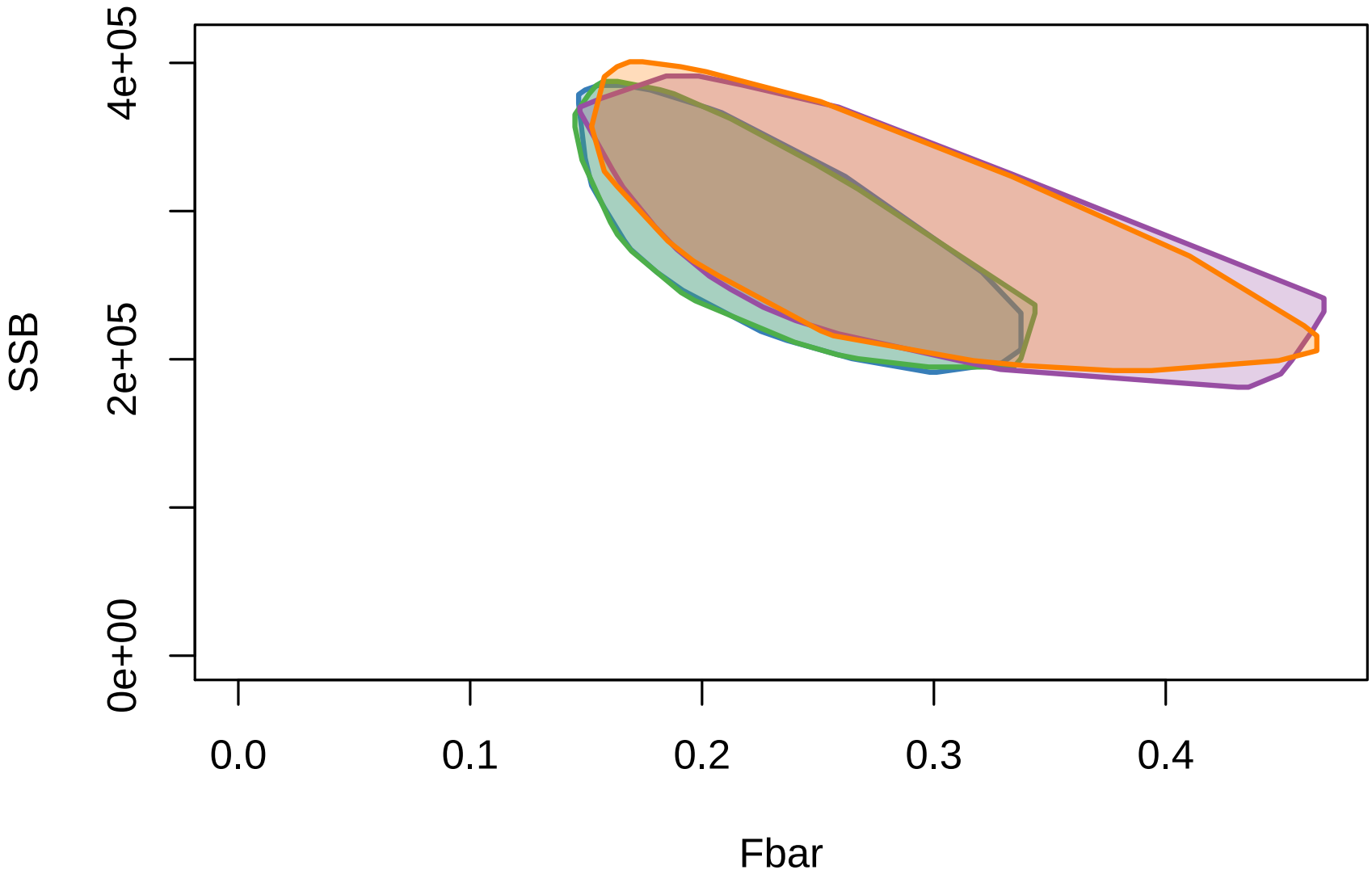
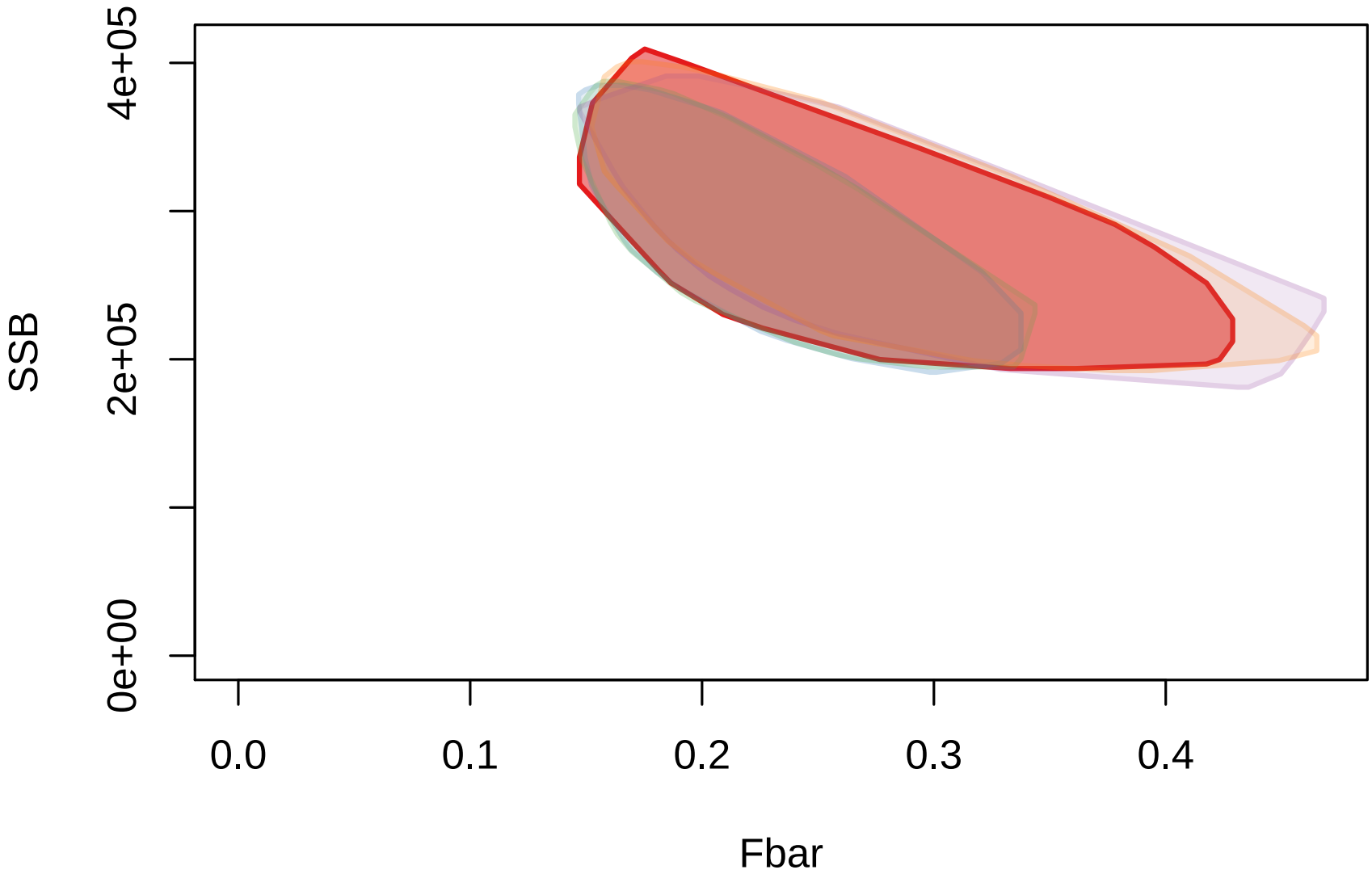
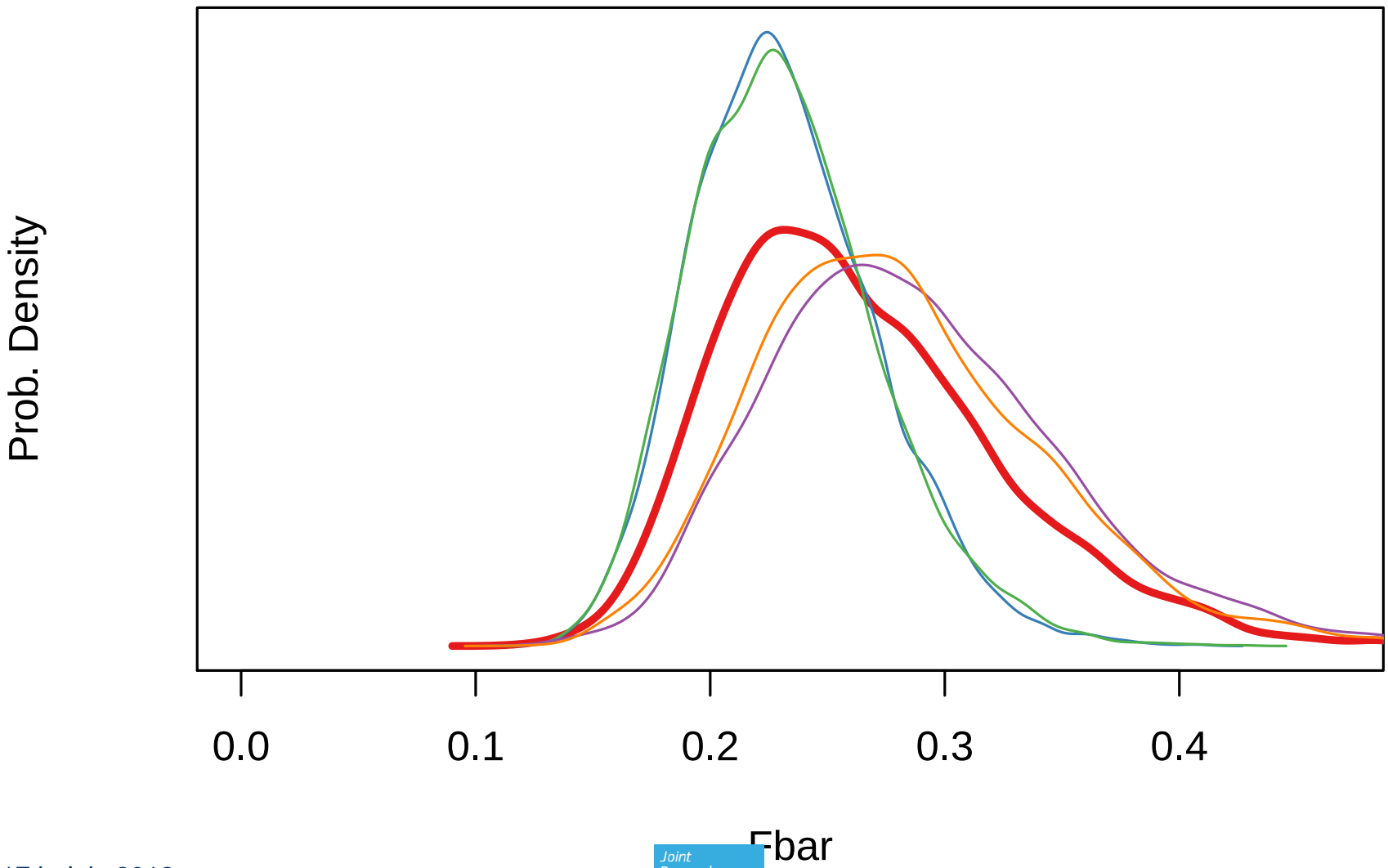
Full model averaging schemes do:

1. simulate: $\tilde{P}(\text{model, model parameters} \mid \text{data})$


SSB
0e+00
2e+05
4e+05
0.0
0.1
0.2
0.3
0.4
Fbar


SSB
4e+05
2e+05
0e+00
0.0
0.1
0.2
0.3
0.4
Fbar

Final year Fbar



Final thoughts

With model averaging

- We **incorporate uncertainty** from scenario choice
- It removes the need for model selection
- moves focus onto specifying **plausible** scenarios
- we can simulate, Fbar, reference points, current state w.r.t. ref points