

Evaluating climate-like models

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- Not enough data
 - timescale of desired (detailed) prediction is longer than timescale of (detailed) observational record
- Changing underlying conditions
 - old data may not even be relevant if the system is in a new/changing state
 - how can we define what we are measuring?
- Complex dynamical system
 - can suffer from severe predictability constraints

- Is it feasible to make predictions that are longer-term than your observational record?
 - hurricanes, sea ice, ...
- What gives confidence in model results?
 - agreement with past observations
 - agreement with physical principles
 - agreement with other models

- Statistics:
 - What parameters are you trying to estimate?
 - Will they remain the same?
- Dynamics:
 - What physical relationships are you trying to understand?
 - Will they remain the same?

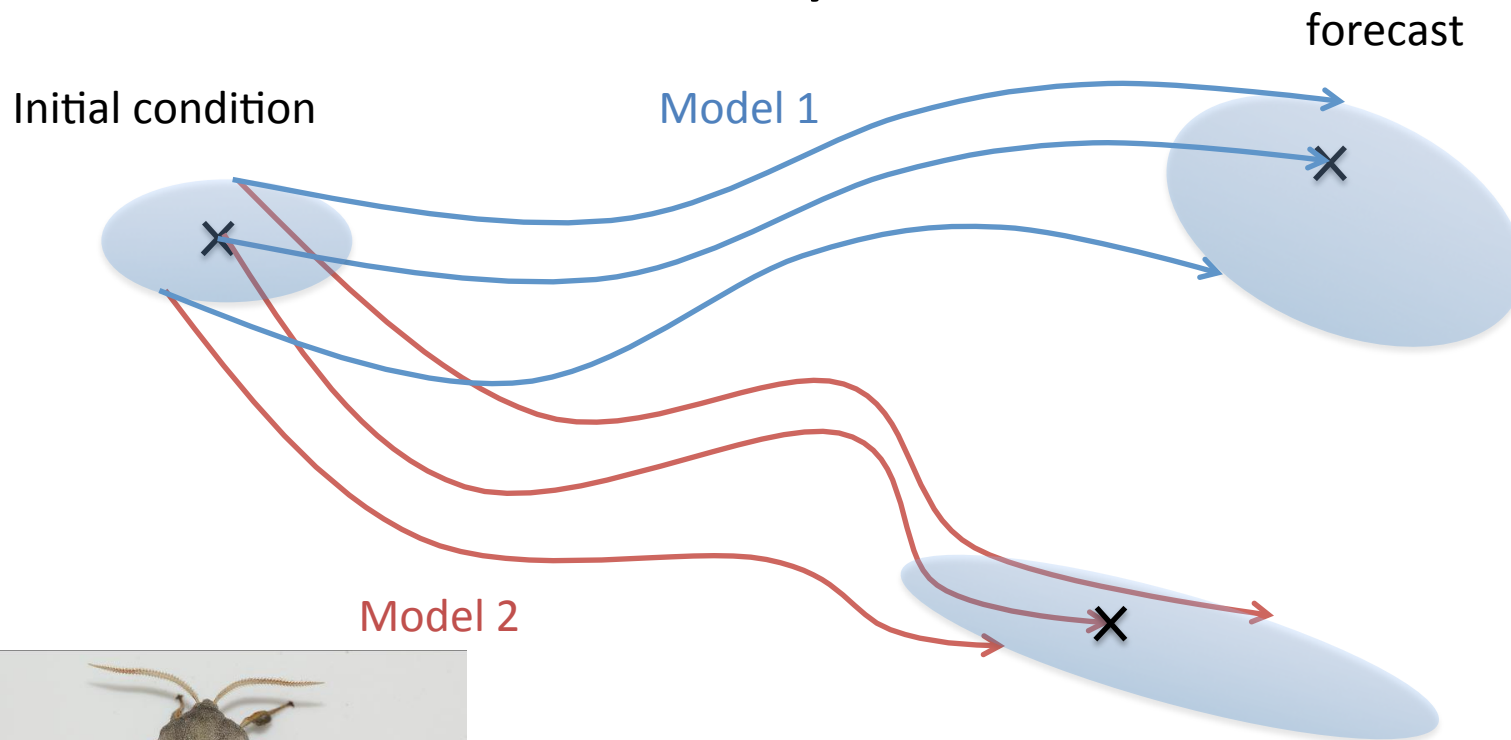
- Initial condition uncertainty:



“the butterfly effect”



- Structural uncertainty:



“the Hawkmoth effect”

How valid are my assumptions?

- Some assumptions may be tested against data
- Some require subjective assessment (“expert judgement”)
- Expert judgement is an entirely valid approach
- However... it may lead to disagreements

Confronting imperfect models with data



Models



Confronting imperfect models with data

Imperfect models DO provide useful info

Imperfect models DON'T tell us everything

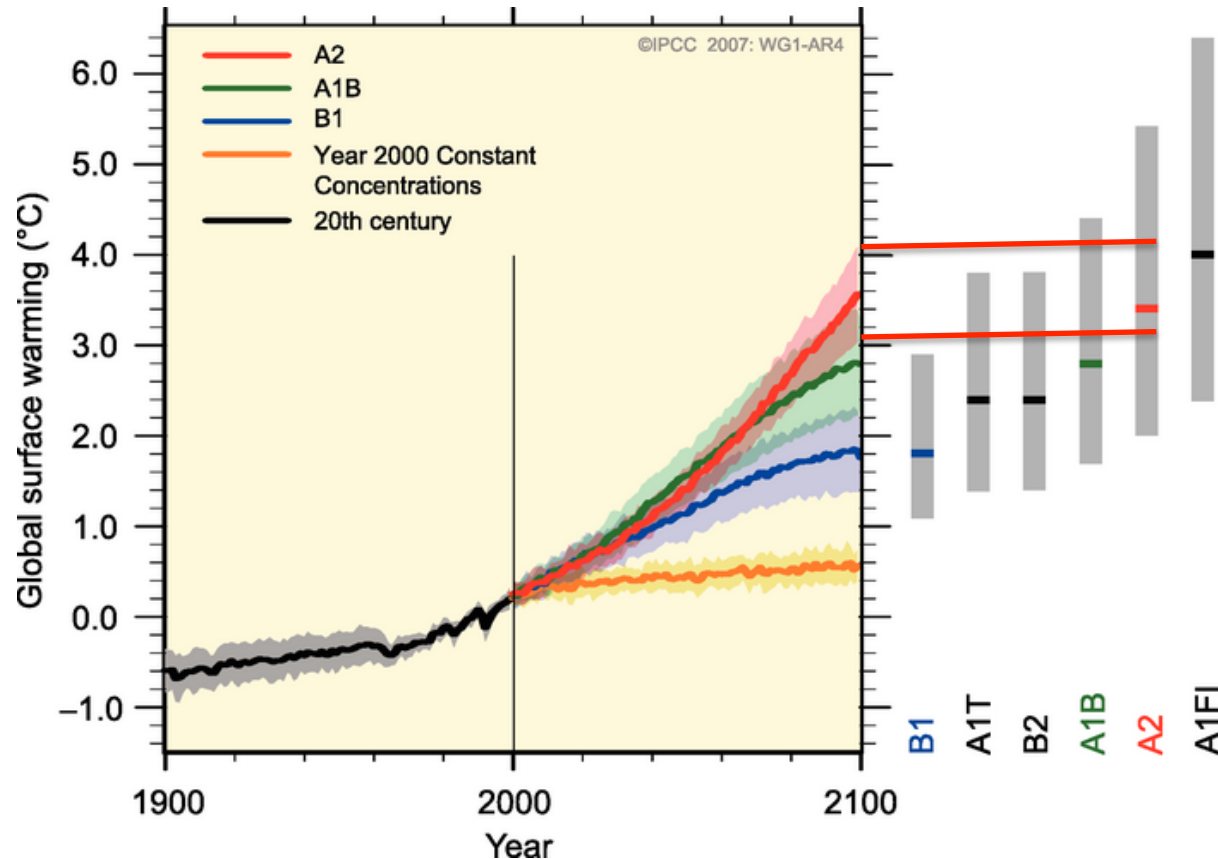
Reality

Statistical methods MUST account for structural uncertainty

This is very difficult

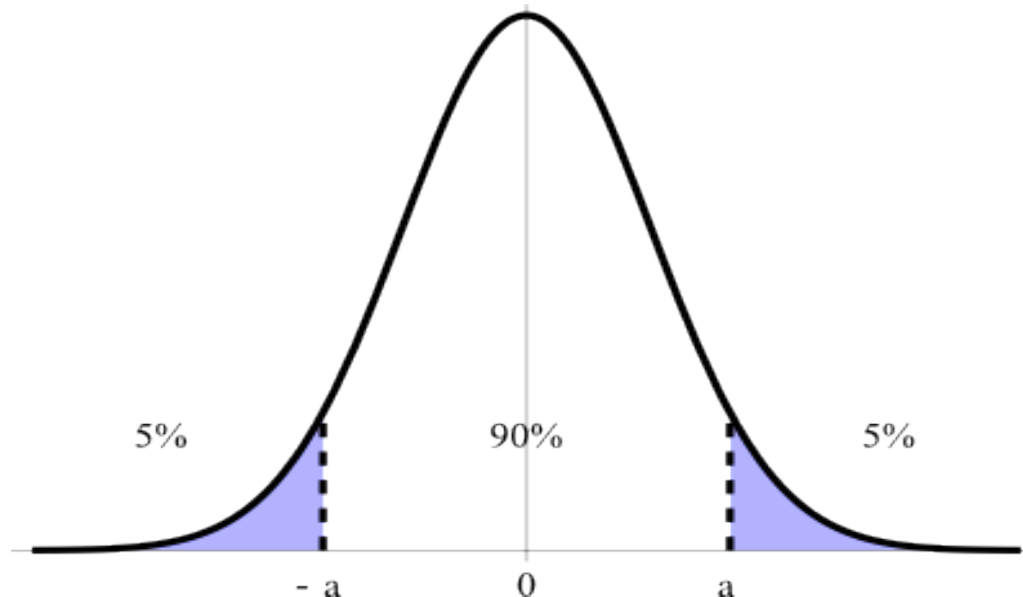


IPCC methods (2007)



“Likely” (>66%) assessment ranges:
Add 60% to multi-model mean
Subtract 40% from multi-model mean

- AR5 (recently published) changes strategy:
 - Find “*very likely*” (>90%) range of models, based on Gaussian assumption
 - Downgrade probability to “*likely*” (>66%)



- Some aspects of model evaluation can be done with reference to data, where available
(Follow Emma's methods)
- Some aspects are inevitably subjective
 - Is the model good *enough*?
 - Is the assumption good *enough*?
- Physical insight (“expert judgement”) is not an optional extra, it is required
 - Must be done systematically, and justified clearly