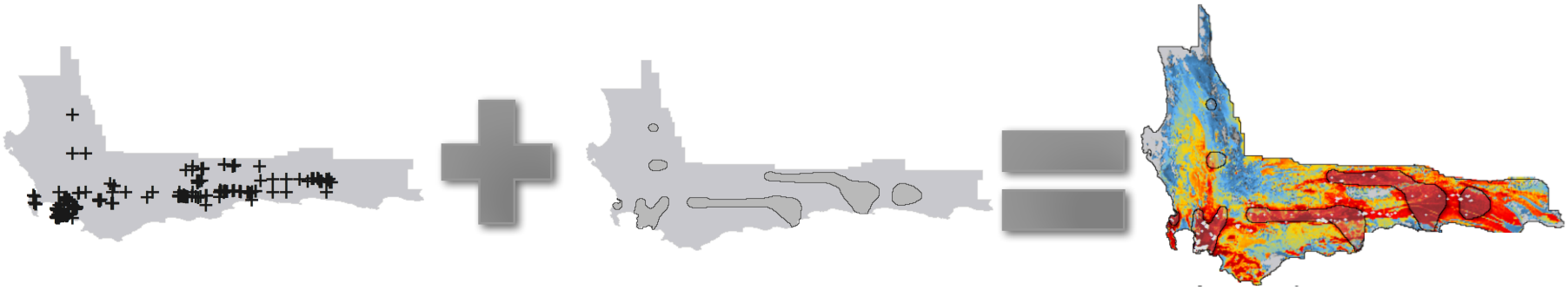
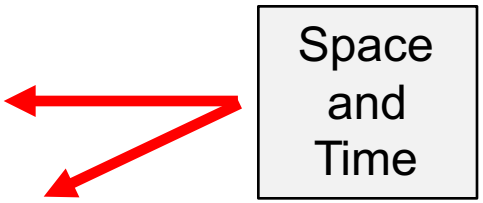


Combining data sources…

… is our only chance for general predictions

- Small sampling
- Biased samples
- Missing processes

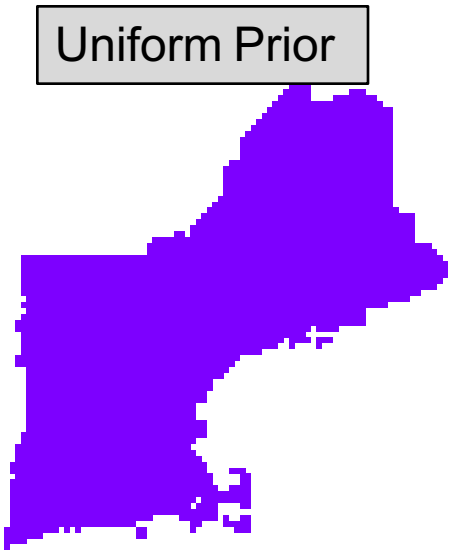


Some nice advances

- Presence Only + Abundance
  - Pagel et al. 2014 MEE
- Presence Only + Presence Absence:
  - Fithian et al. 2014 MEE
  - Dorazio 2014 GEB
- Joint SDMs
  - Harris 2015 MEE
  - Clark et al. 2014 Ecol. App
  - Fithian et al. 2014 MEE
- Presence-Only + Map
  - Merow et al. 2016 GEB
  - Merow et al. 2017 GEB
- Demography + Occurrence:
  - Pagel and Schurr 2012 GEB

Maximum entropy

- Machine learning -> flexible models for exploration
- Stay as close to the null model as possible
- Update null model based on data



Phillips et al. 2006

Maximum entropy

- Machine learning -> flexible models for exploration
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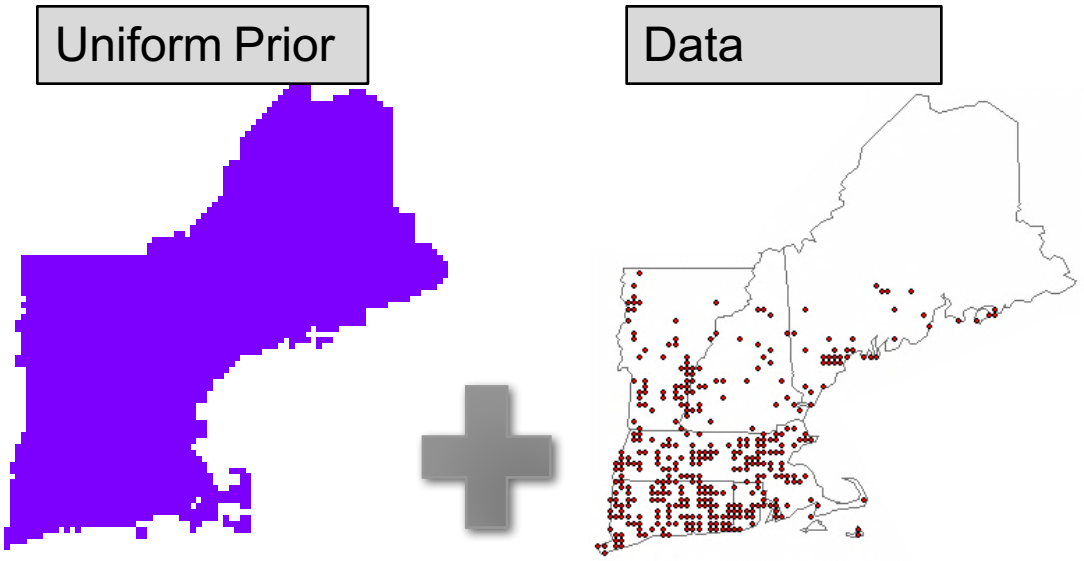

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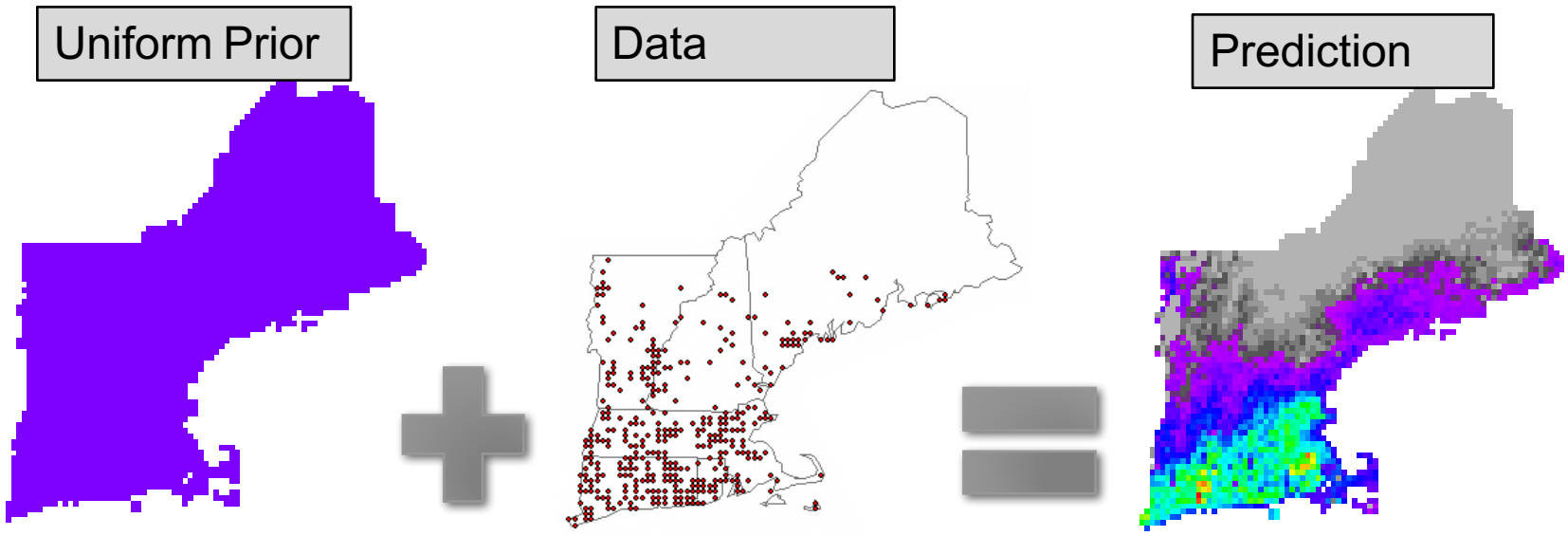

Maximum entropy

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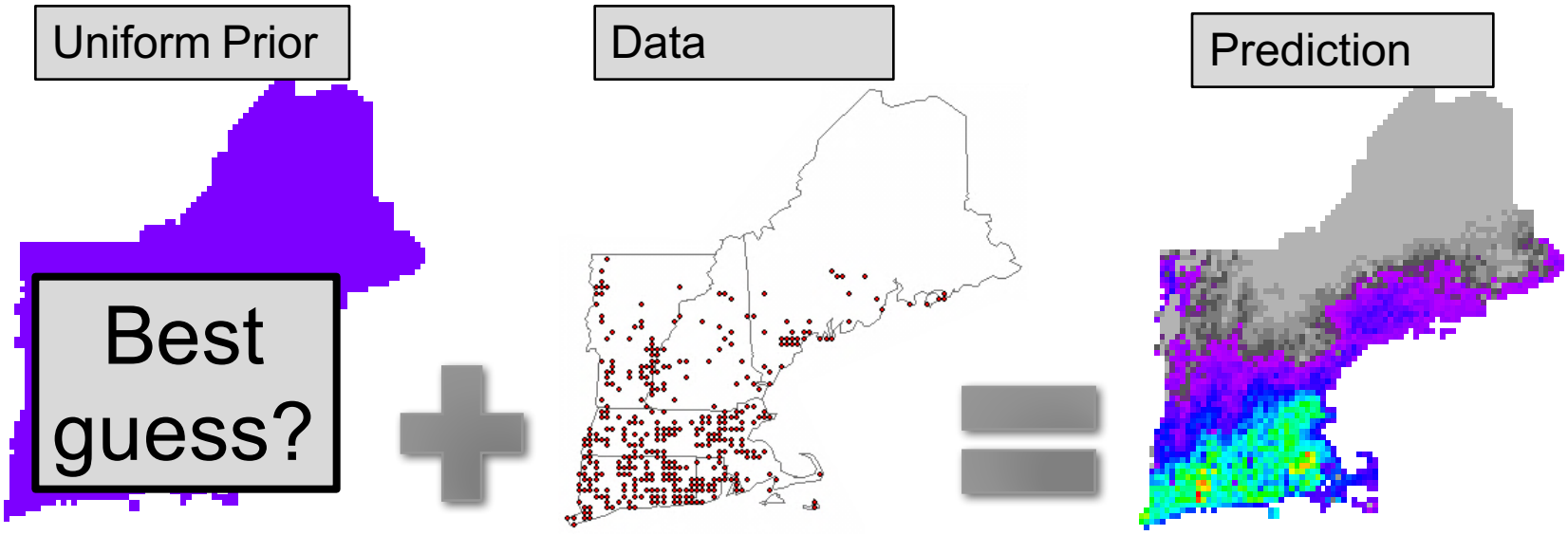
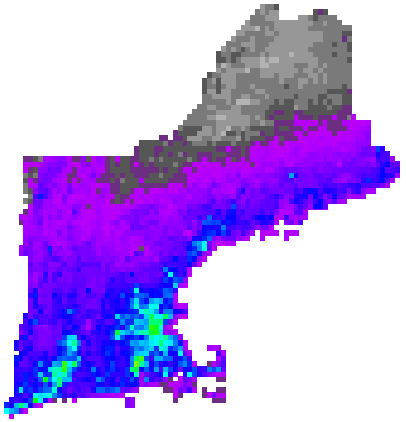


Maximum entropy

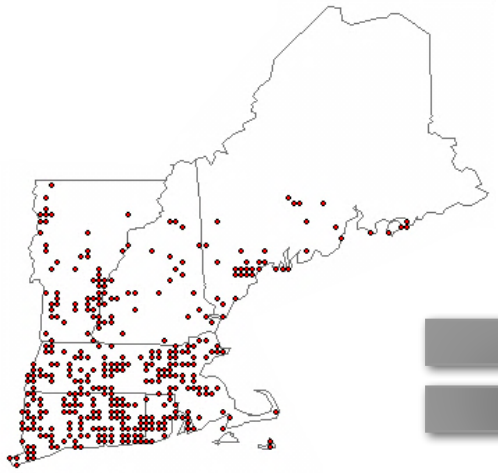
Spatially explicit prior information

Expert
Dispersal
Native range
Related species

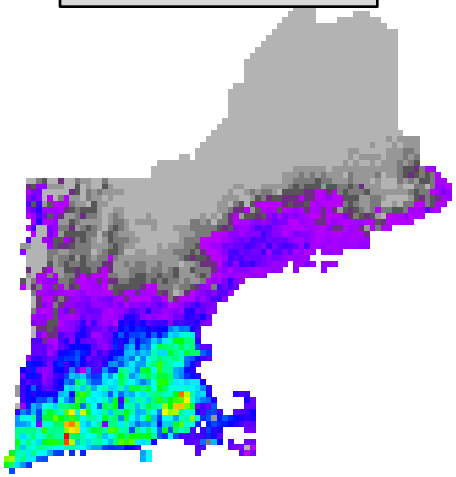


Uniform Prior

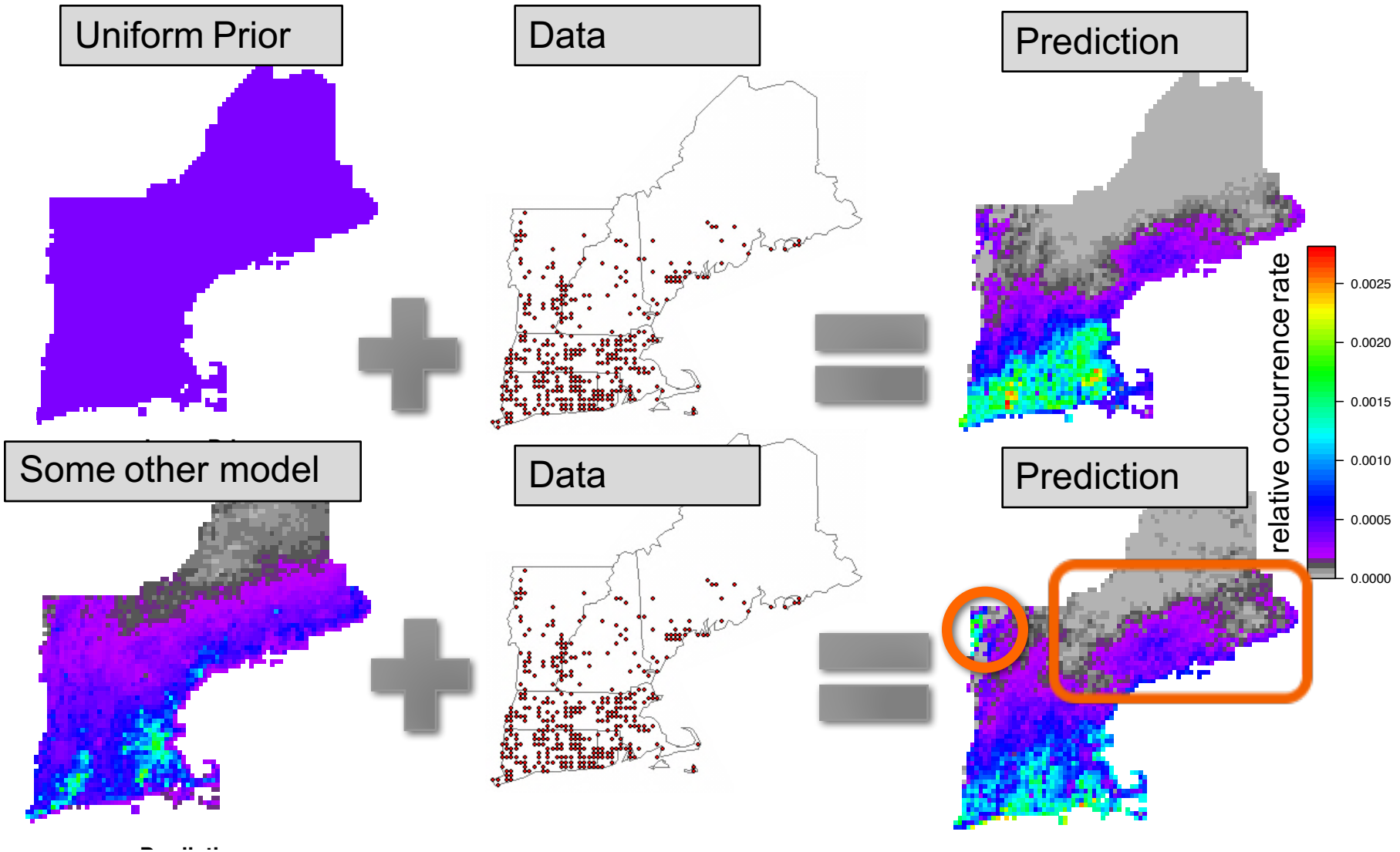
Data



Prediction



Priors based on other models



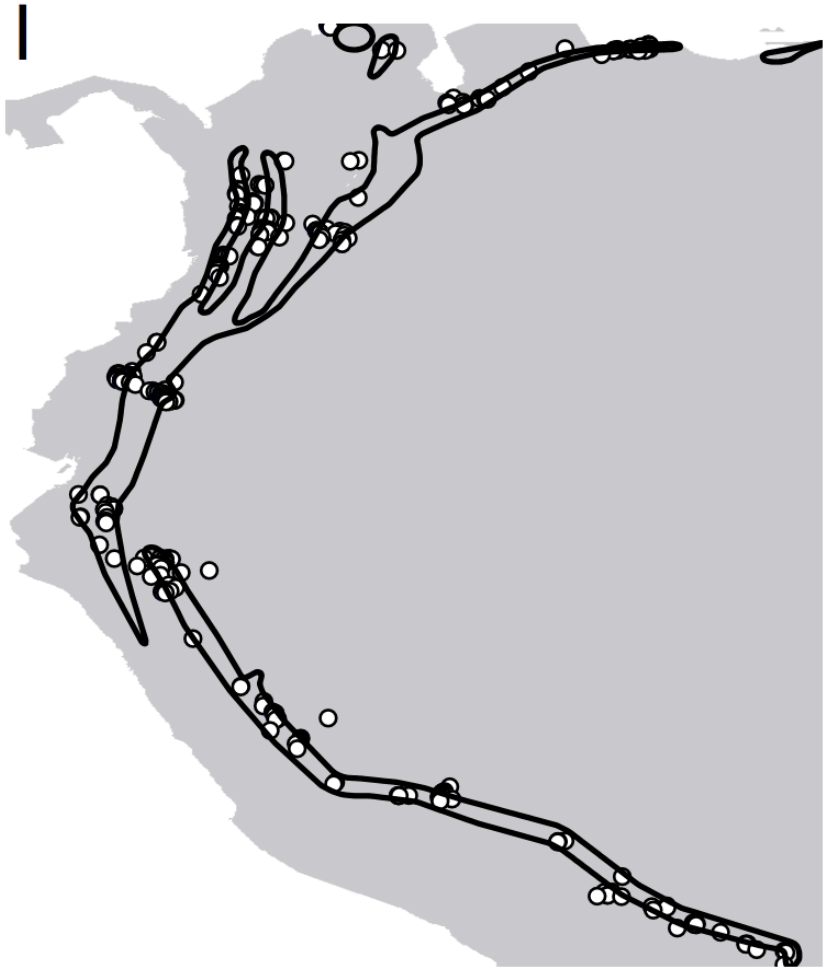
What is an offset?

- When sampling abundance (which entails a Poisson model), twice as much sampling effort should yield twice as many individuals
- Sampling effort = Offset
- A way to say ‘more samples are expected here’

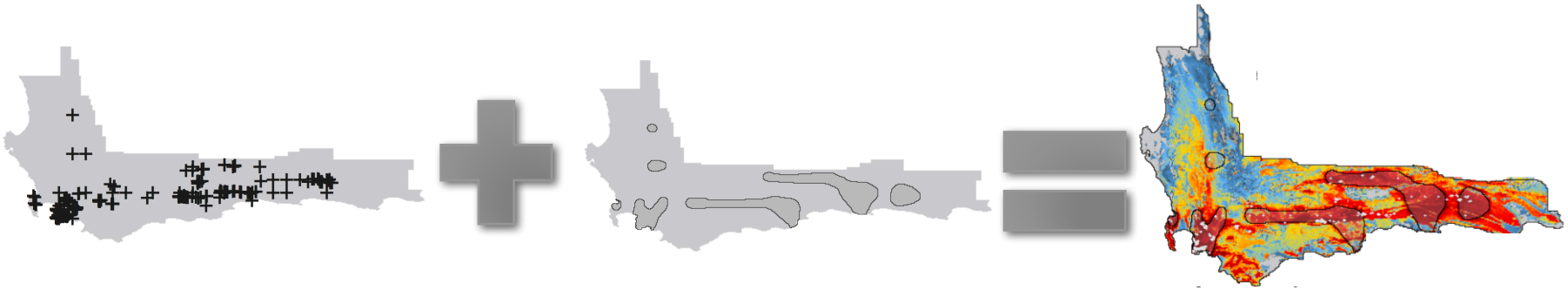
Expert Maps

How can we translate this to a prior/offset?

How much more likely is presence inside vs outside?



By combining their powers….



- High resolution
- Links to Environment
- Suitability
- Large data bases

BUT…

- Biased sampling

- Field experience
- Low bias
- Range edges
- Non-climate processes

BUT…

- Coarse resolution
- No explicit environment
- False presence
- Not updated
- Not reproducible
- Binary

Other useful Priors

- **Expert maps**
- Sampling Bias
- Native range info
  - Realized vs
  - Potential Distributions
- Phylogenetic constraints
- Combining different types of occurrence data

Merow et al. GEB 2016

Questions?

Thanks:

Matt Aiello-Lammens
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John Silander
Adam Wilson