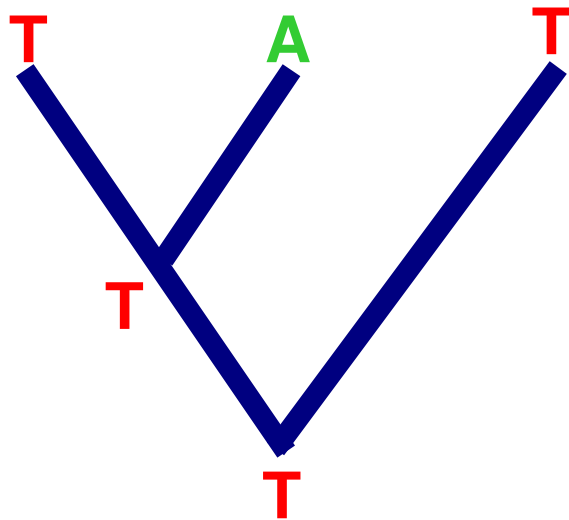


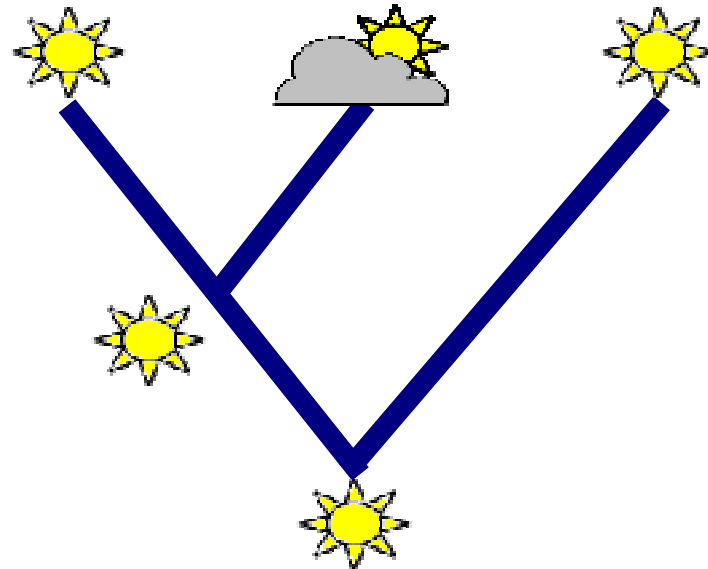
Ancestral state reconstruction

ZSL

- If we have data for the terminal taxa on a phylogeny then we can use techniques of ancestral state reconstruction to 'estimate' the characters of ancestral lineages



Parsimony optimisation on a phylogenetic tree

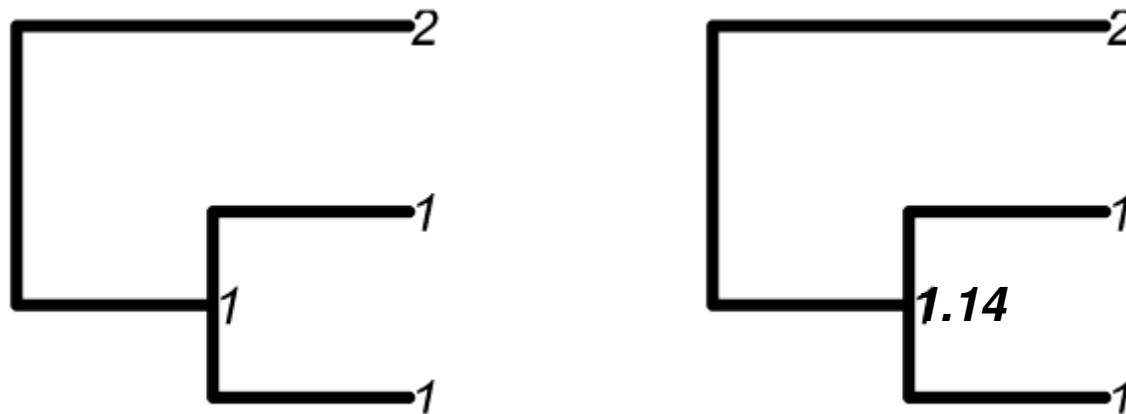


Parsimony optimisation of environmental character

Ancestral state reconstruction

ZSL

- Characters can be regarded as discrete or continuous



- Environmental characters are measured on continuous scales so continuous optimisation seems best
- Both are constrained by the observed range of states
- This may ignore 'real' environmental boundaries (frost?)

Continuous character state reconstruction



- Seek to minimise the ‘distance’ between adjacent nodes
- Several methods are available, most are implementations of a ‘random walk model’
- Those implemented in R’s ape package:
 - Maximum likelihood
 - Least squares
 - Generalised least squares
- Other packages can run the same analyses (i.e. Mesquite)

Ancestral reconstruction in R

ZSL

```
# Get a tree
```

```
T<-read.tree(text="((A:1,B:1):1,C:2);")
```

```
# Make a data set
```

```
M<-c(1,1,2)
```

```
# calculate niche overlap between species
```

```
TM <-ace(M,T)
```

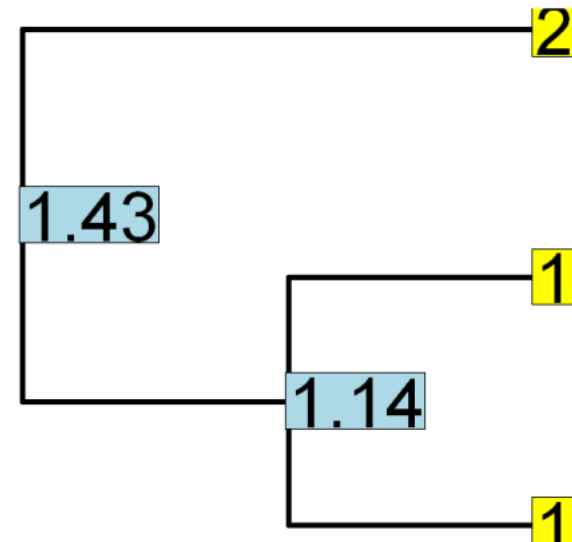
```
# show tree
```

```
plot(T,show.tip.labels=F)
```

```
# add node labels
```

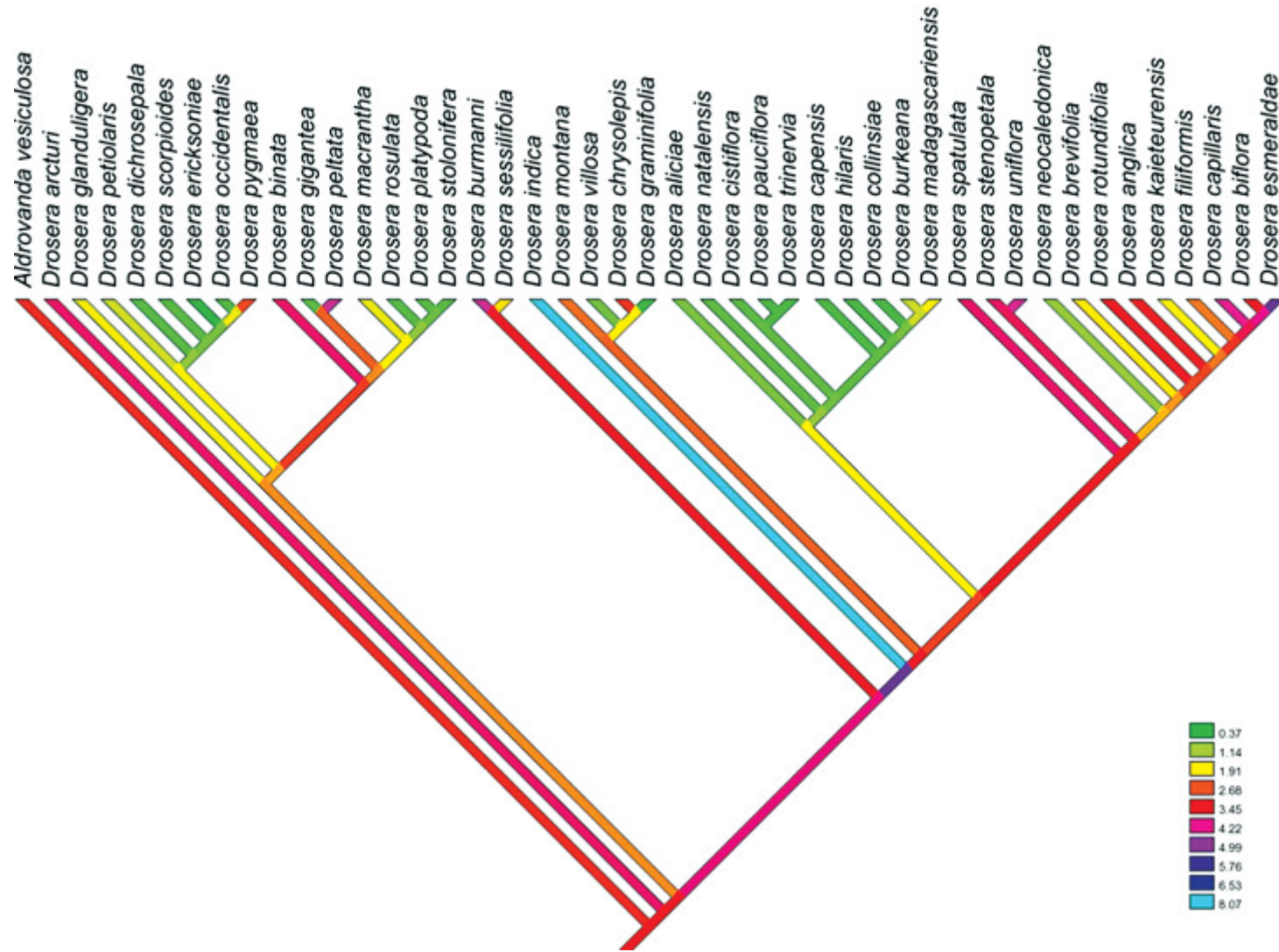
```
nodeLabels(round(TM$ace,2))
```

```
tiplabels(M,adj=1)
```



Ancestral state reconstruction – an example

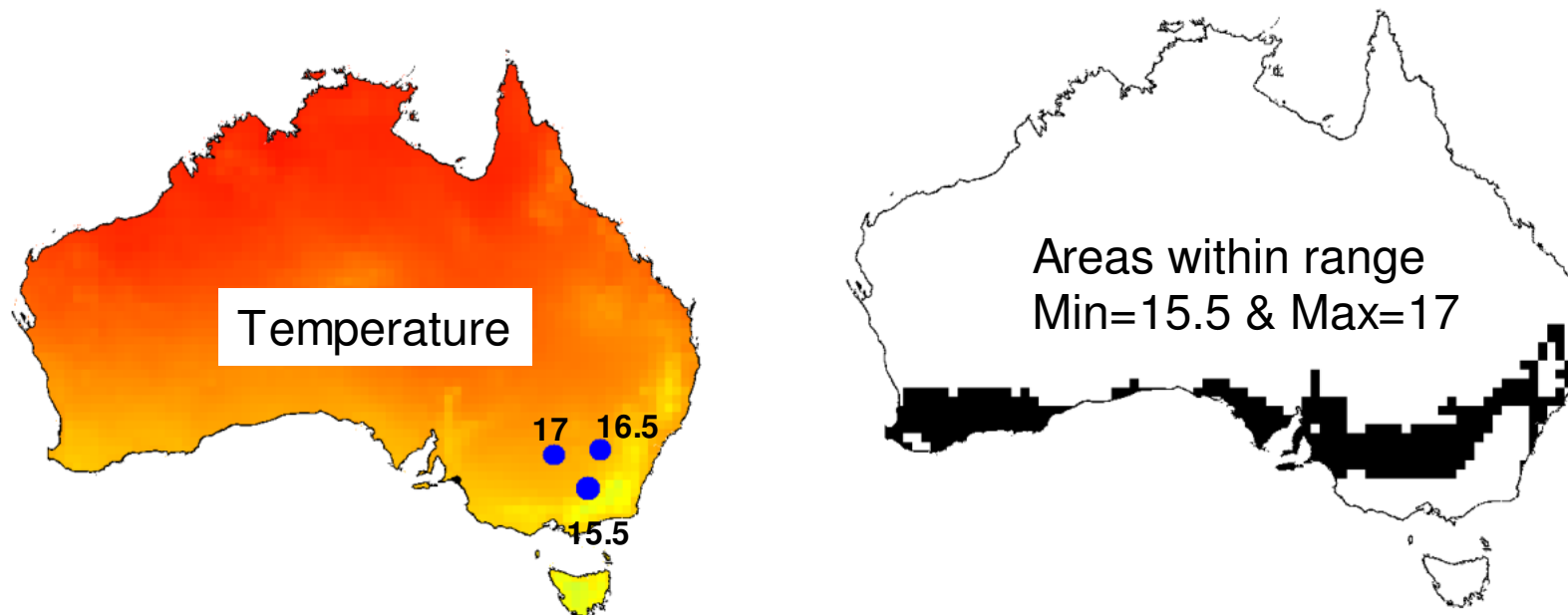
ZSL



Phyloclimatic models

ZSL

- A bioclim niche model is defined by the min & max observed values for a species

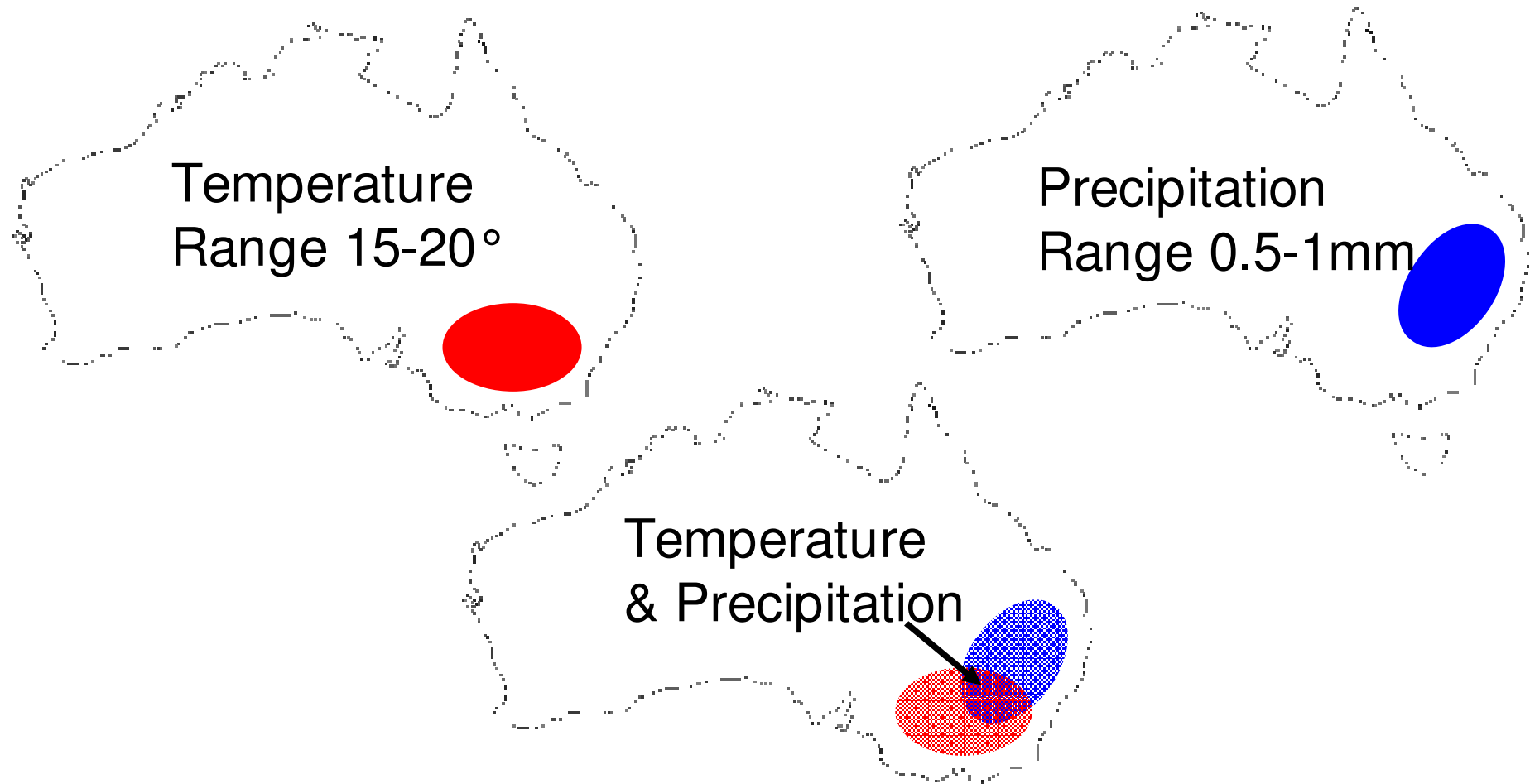


- ... ancestral state reconstruction provides min & max values for ancestral lineages

Phyloclimatic models

ZSL

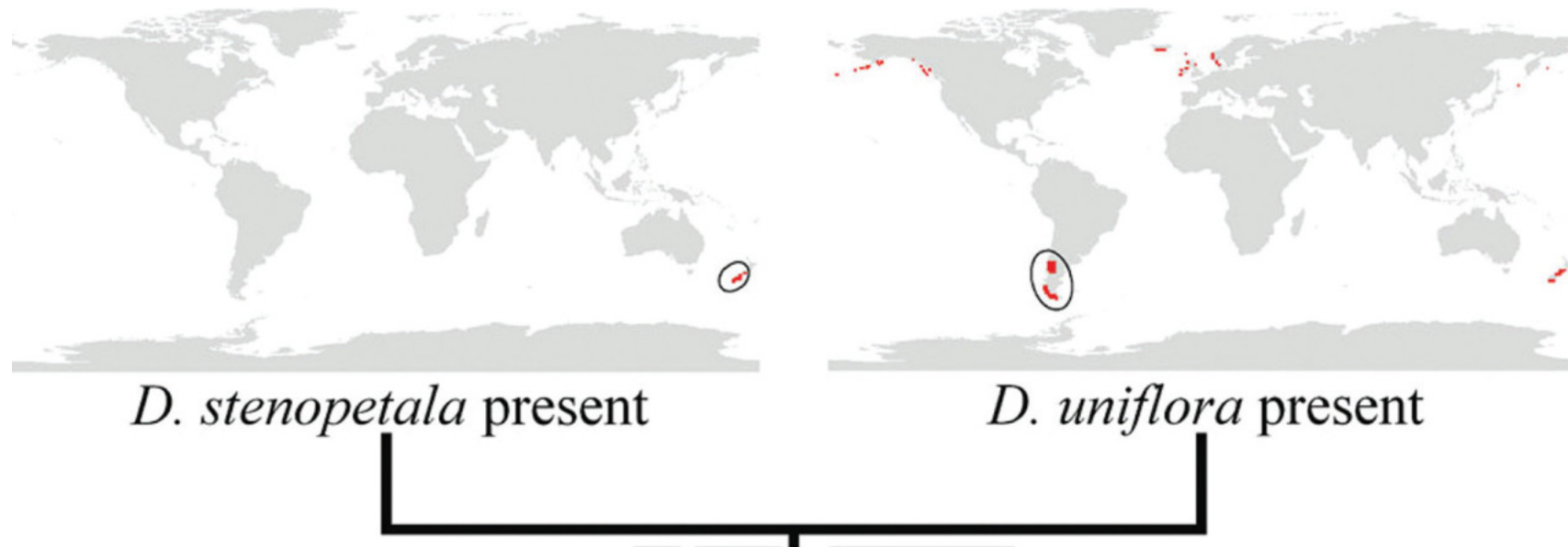
- Multiple environmental layers add additional constraints



- But we must choose carefully or end up with no area selected

Phylogenetic modelling – an example

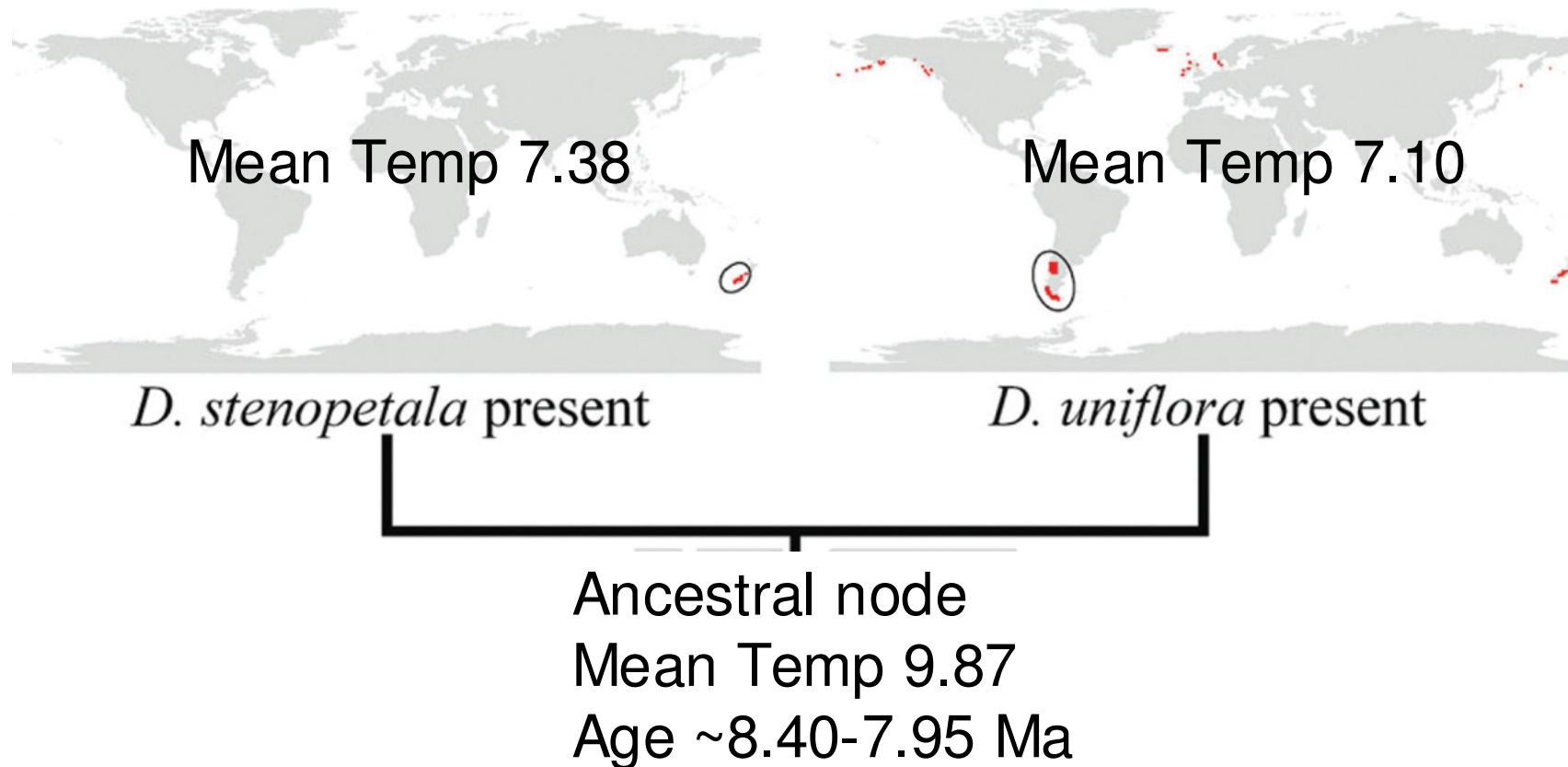
ZSL



- *D. stenopetala* and *D. uniflora* are sister taxa
- One is from New Zealand, the other is from South America
- We estimate an ancestral area?

Phylogenetic modelling – an example

ZSL

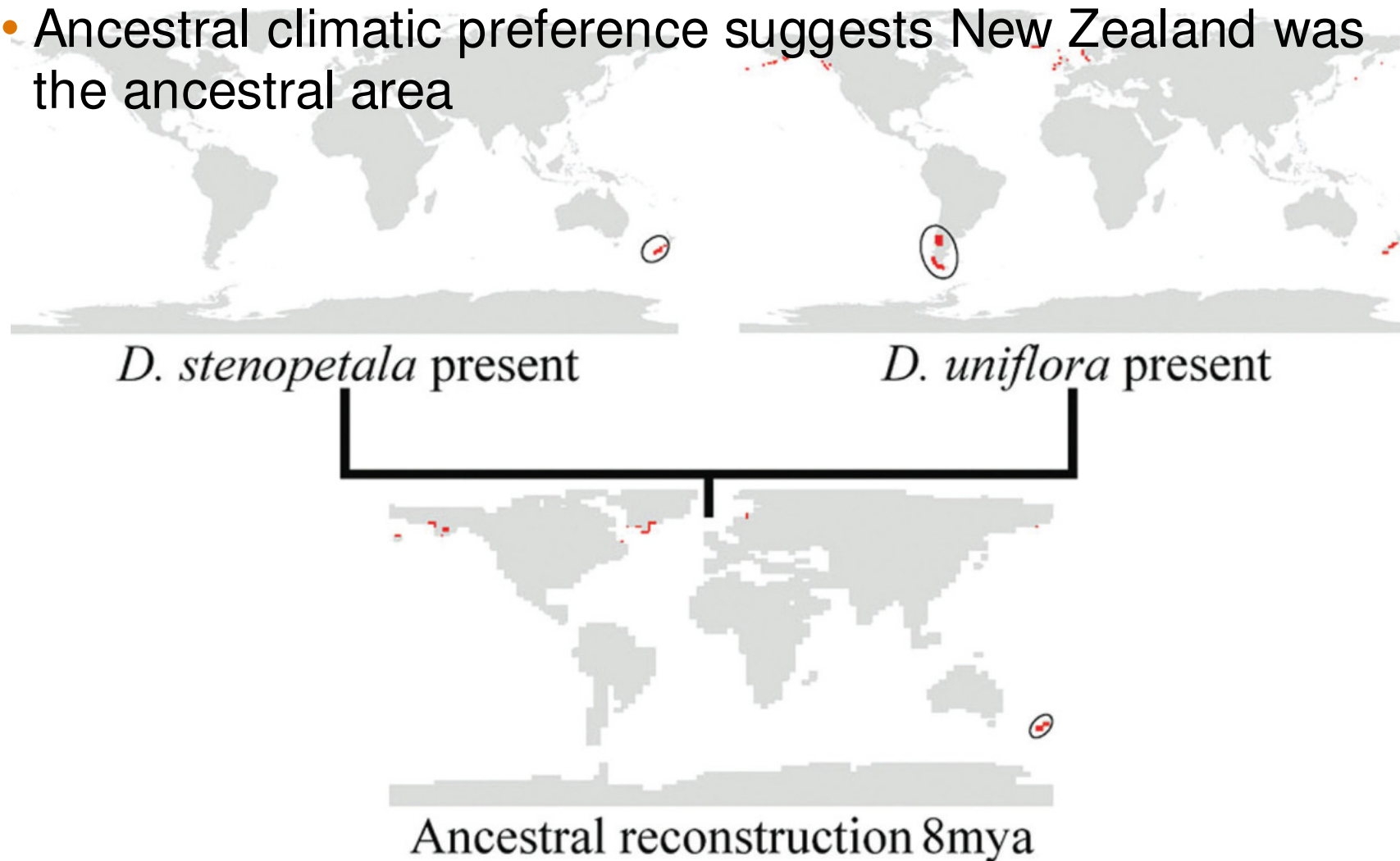


Project ancestral niche into palaeoclimate for ~8Ma

Phyloclimatic modelling – an example

ZSL

- Ancestral climatic preference suggests New Zealand was the ancestral area



R practical – DON'T PANIC

ZSL

