



University of Queensland

The effect of the K-Pg extinction on mammalian evolution?

Thomas Guillaume

guillert@tcd.ie  @TGuillherme

Acknowledgements



Robin Beck

Natalie Cooper

Phil Donoghue

Anjali Goswami

Thomas Halliday

Graeme Lloyd

Matt Phillips

Mark Puttick

Vera Weisbecker



Figure modified from Brusatte *et al.* 2014 Biol. Rev.



Figure modified from Brusatte *et al.* 2014 Biol. Rev.



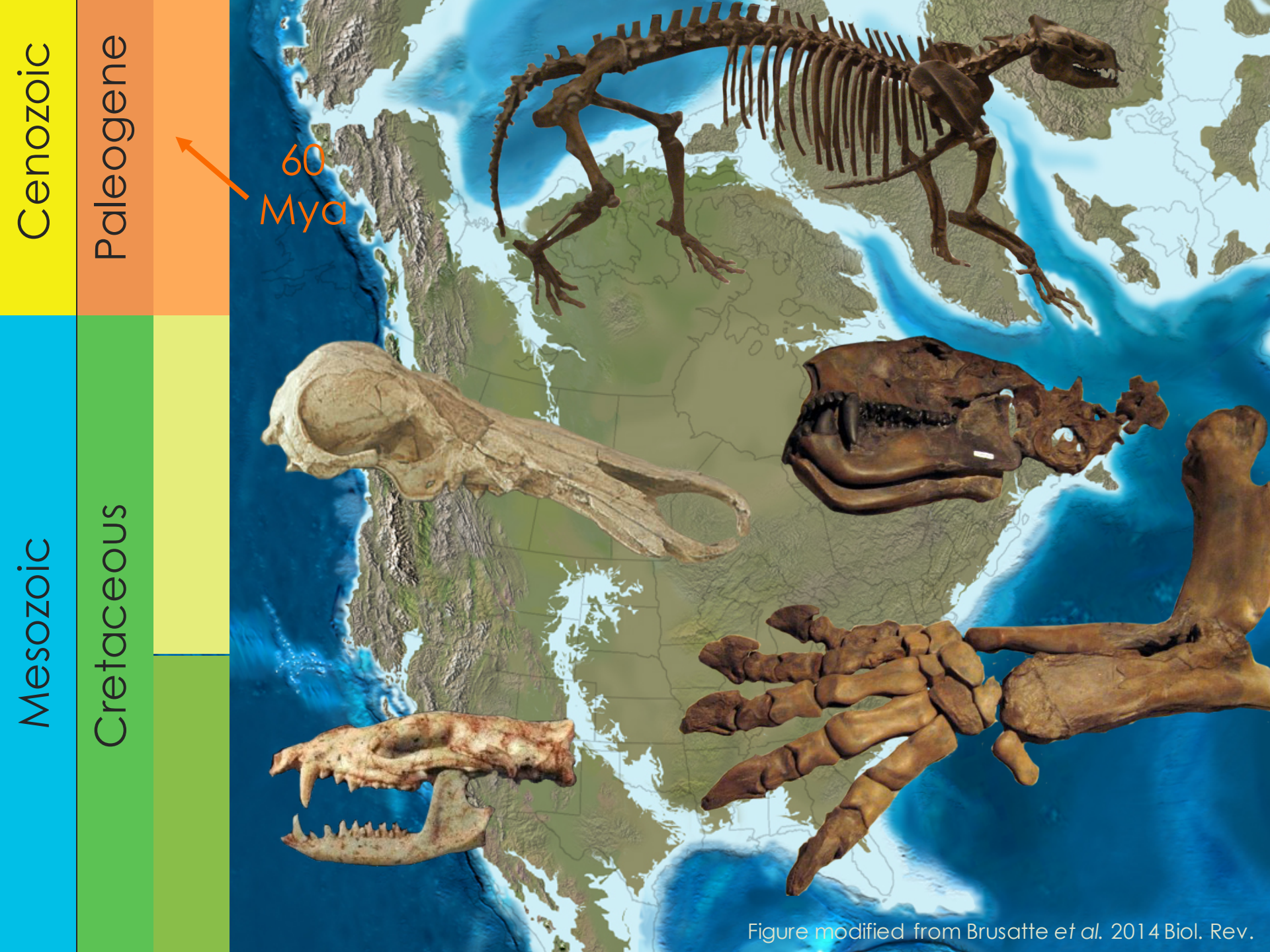


Figure modified from Brusatte *et al.* 2014 Biol. Rev.

SAVE YOURSELF, MAMMAL!

A SATURDAY MORNING BREAKFAST CEREAL COLLECTION

BY ZACH WEINER



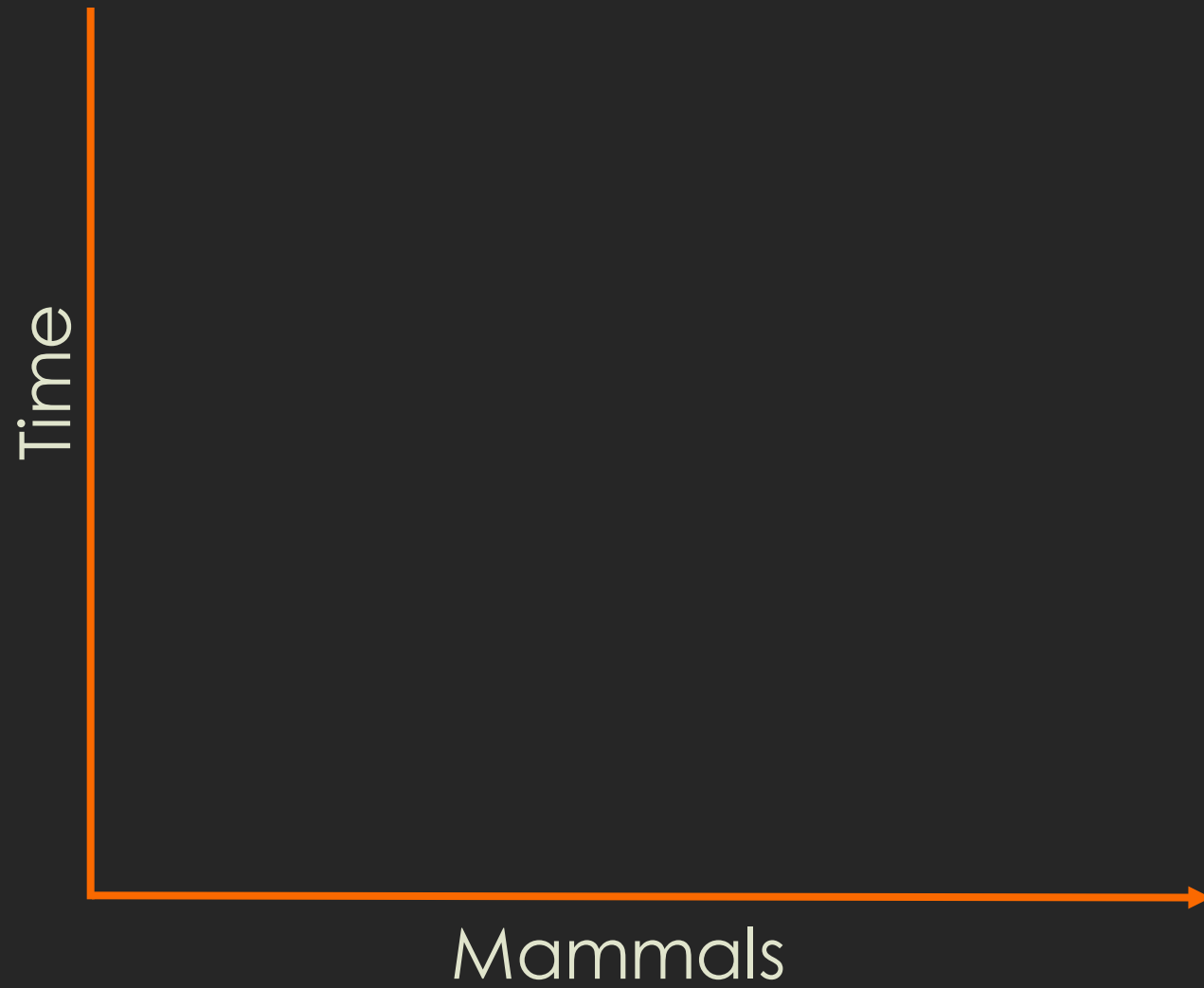
SAVE YOURSELF, MAMMAL!

MORNING BREAKFAST CEREAL COLLECTION

BY ZACH WEINER

We will fend
off the
asteroids!

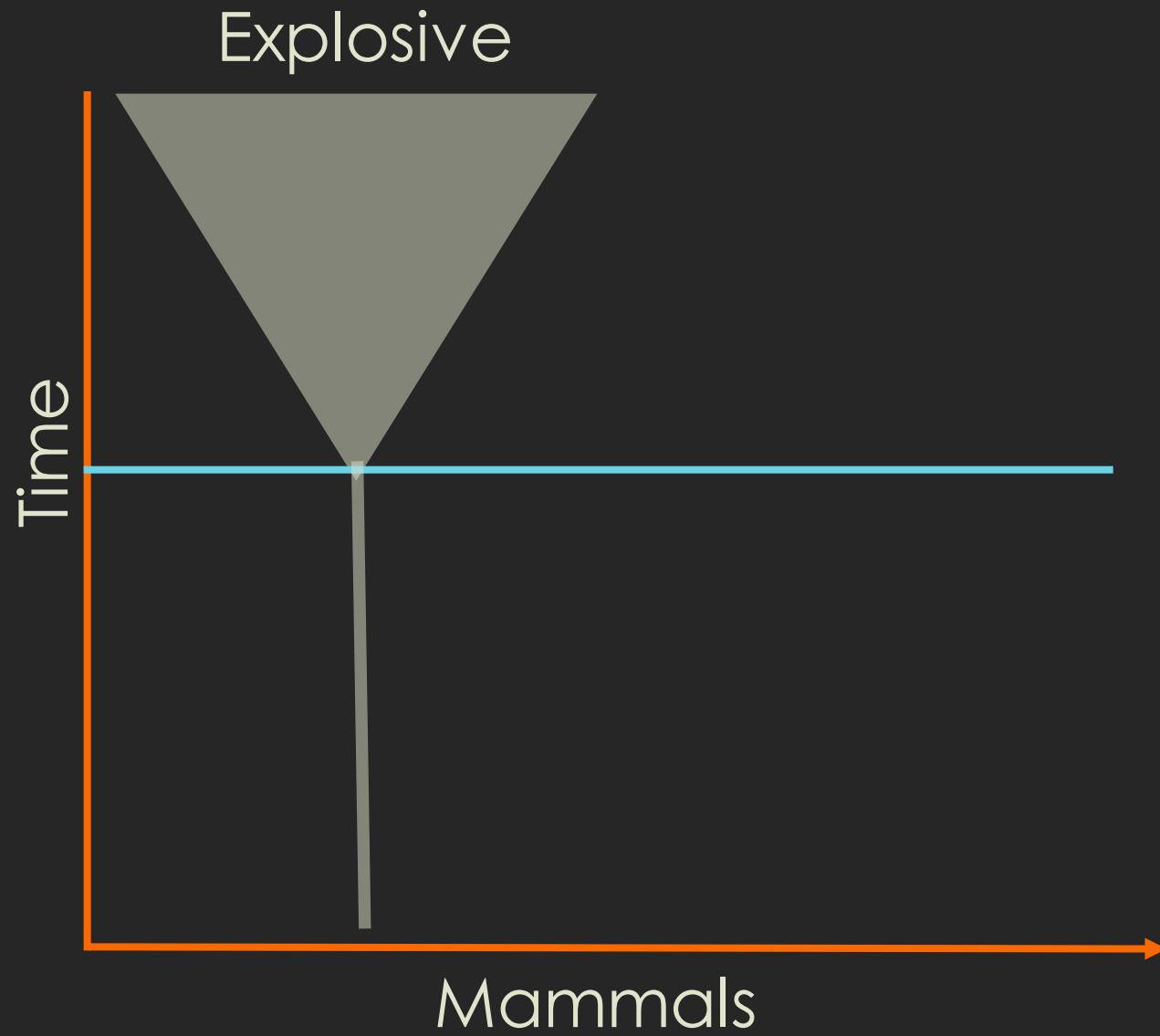


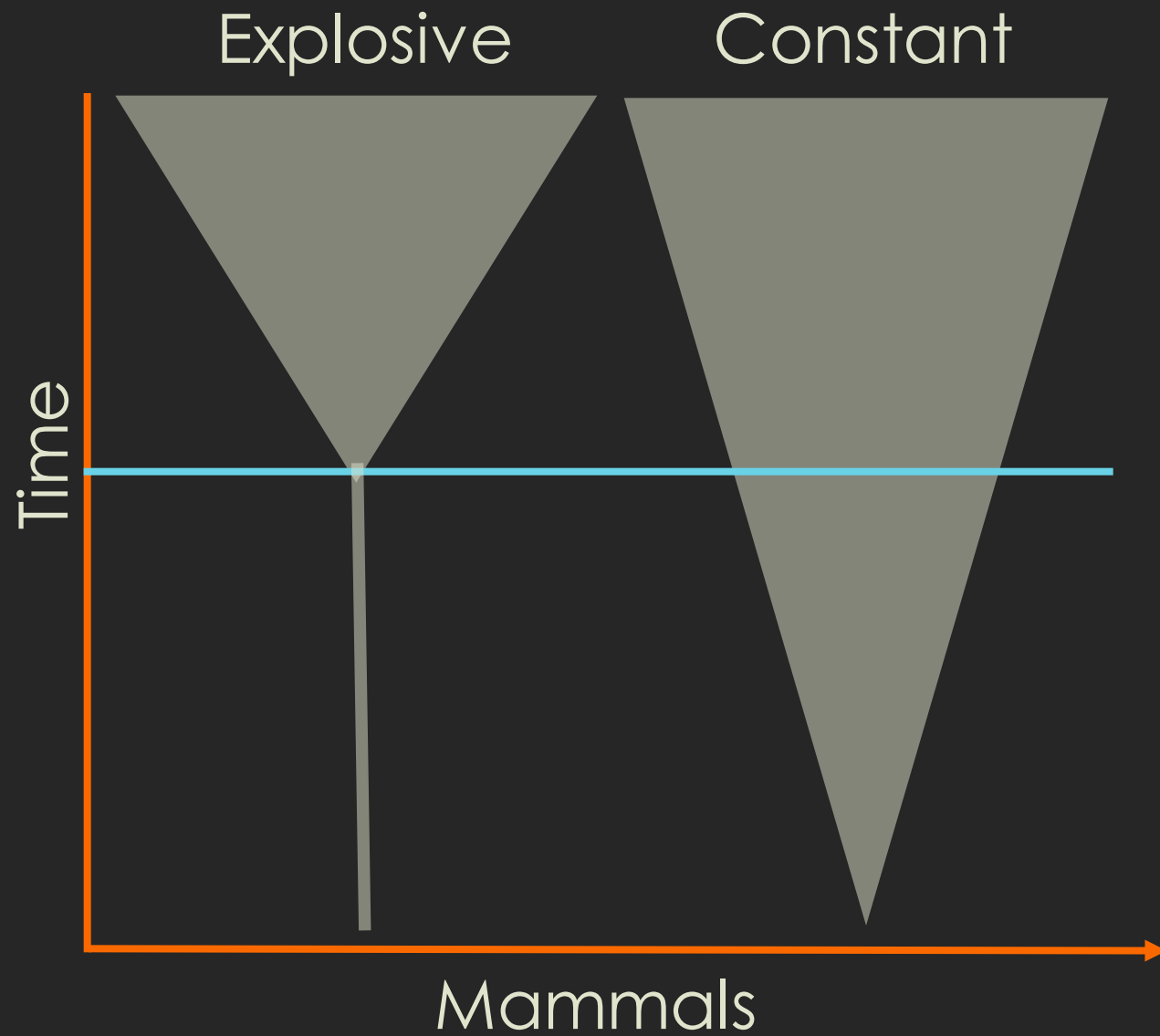


Time

Mammals











= Diversity



= Diversity



= Diversity < Disparity



= Diversity > Disparity





0 1 0 0 0 1 0 2 0



0 1 0 0 1 1 1 1 0



1 0 1 1 1 0 1 1 0



2 1 0 0 0 0 0 1 0



0 ? ? 0 0 1 0 1 0



0 1 1 - ? - 1 1 0

Ordinations (PCA & Co.)



0	1	0	0	0	1	0	2	0
0	1	0	0	1	1	1	1	0
1	0	1	1	1	0	1	1	0
2	1	0	0	0	0	0	1	0
0	?	?	?	0	0	1	0	1
0	1	1	-	?	-	1	1	0



Ordinations (PCA & Co.)

	0	1	0	0	0	1	0	2	0
	0	1	0	0	1	1	1	1	0
	1	0	1	1	1	0	1	1	0
	2	1	0	0	0	0	0	1	0
	0	?	?	?	0	0	1	0	1
	0	1	1	-	?	-	1	1	0



Ordination 1

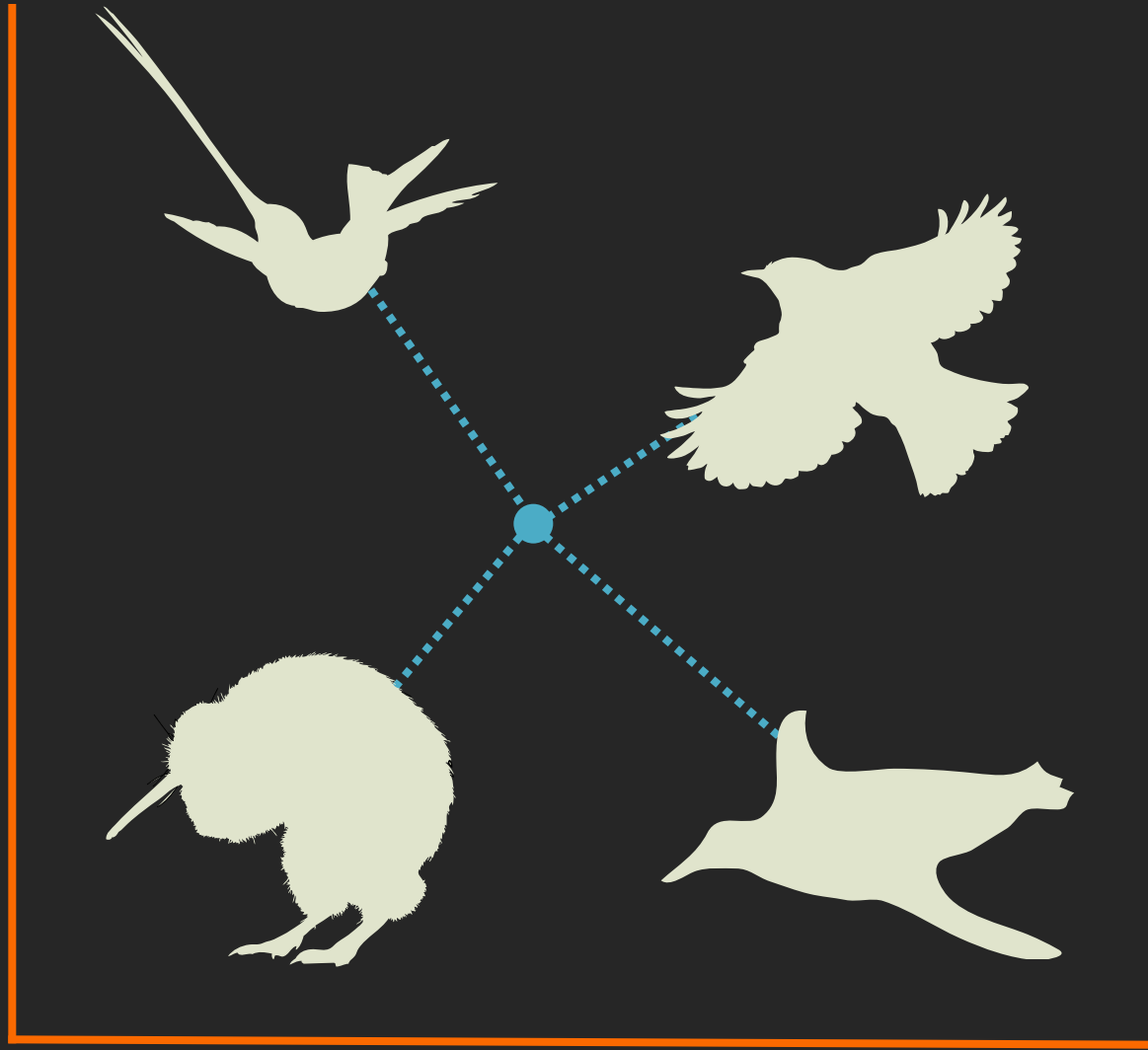
Ordination 3

Ordination 2

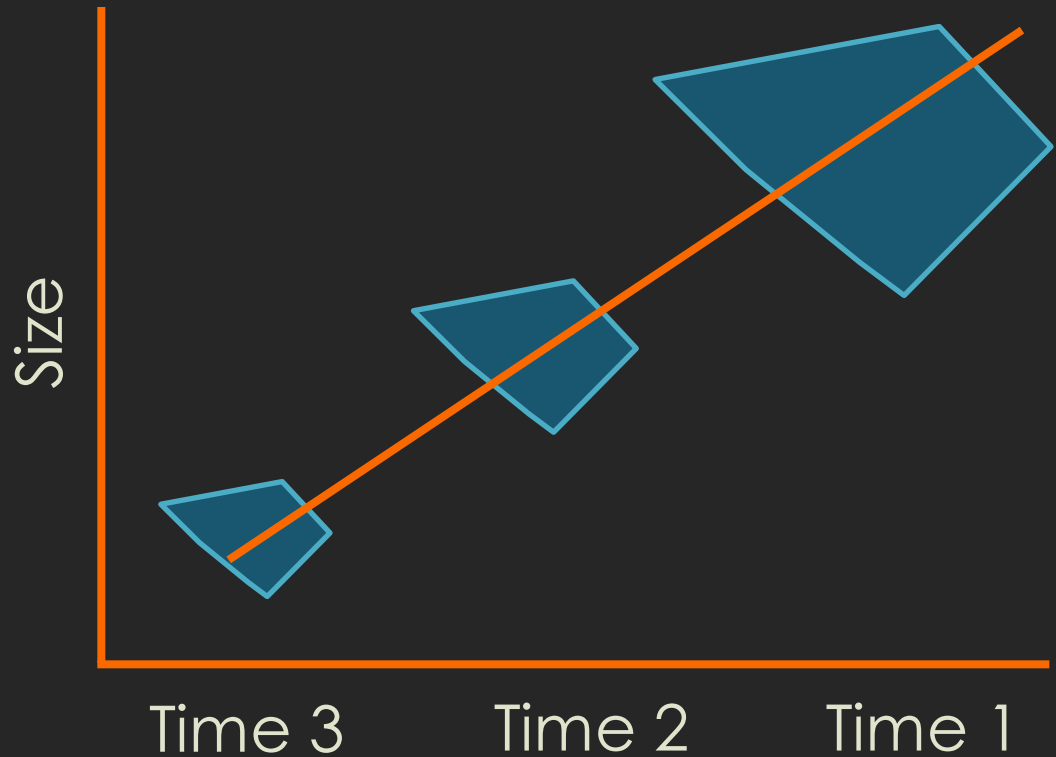
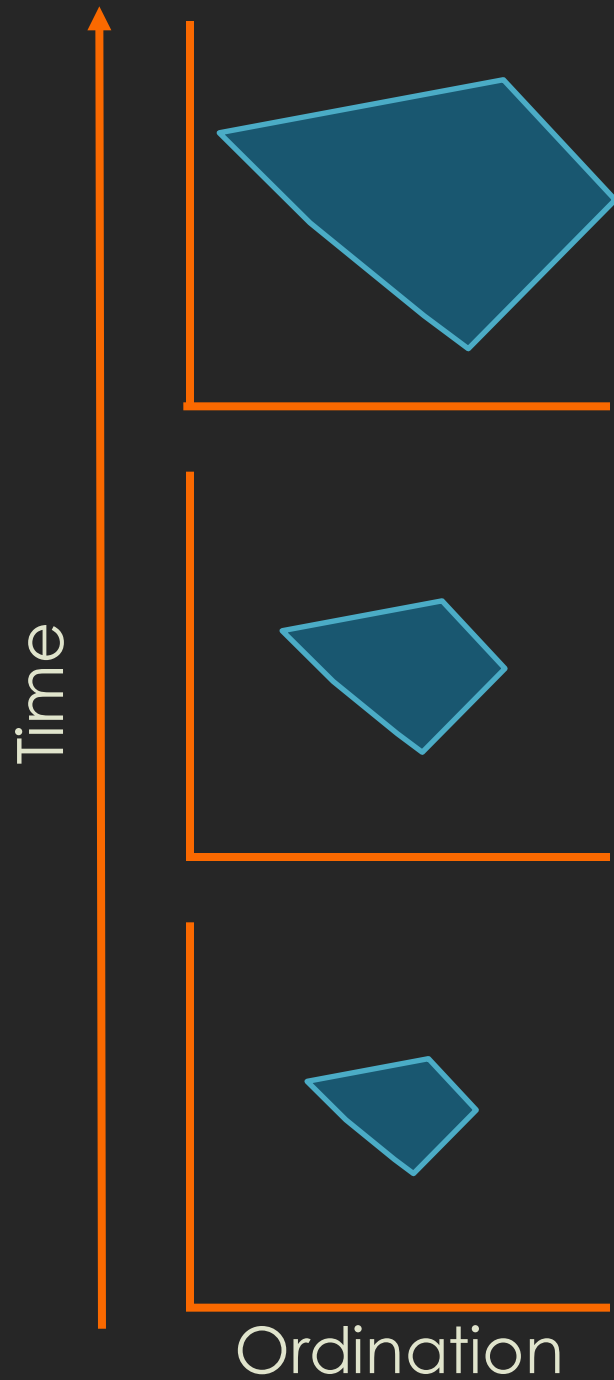
What *IS* disparity?



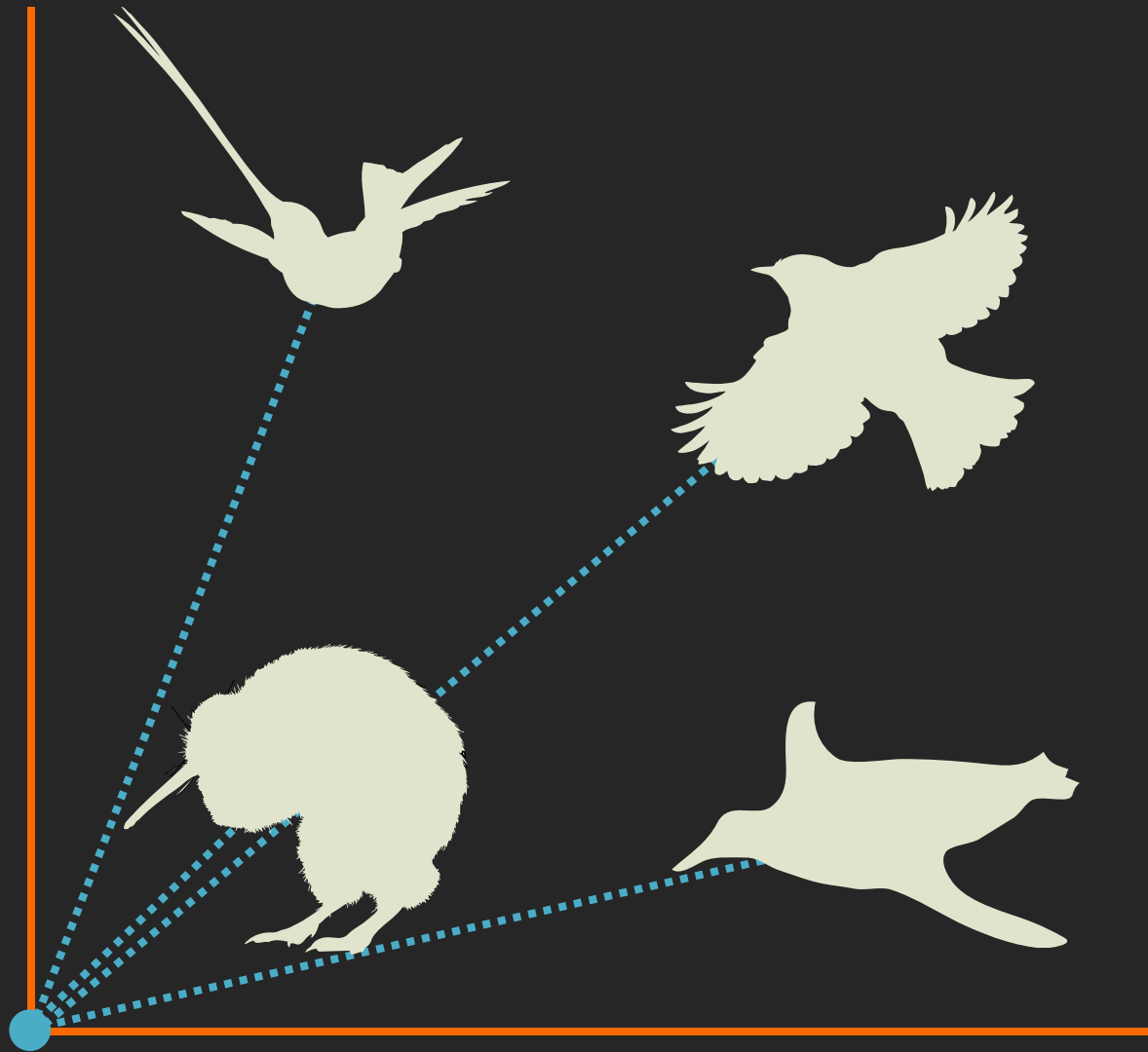
Group's size in the morphospace



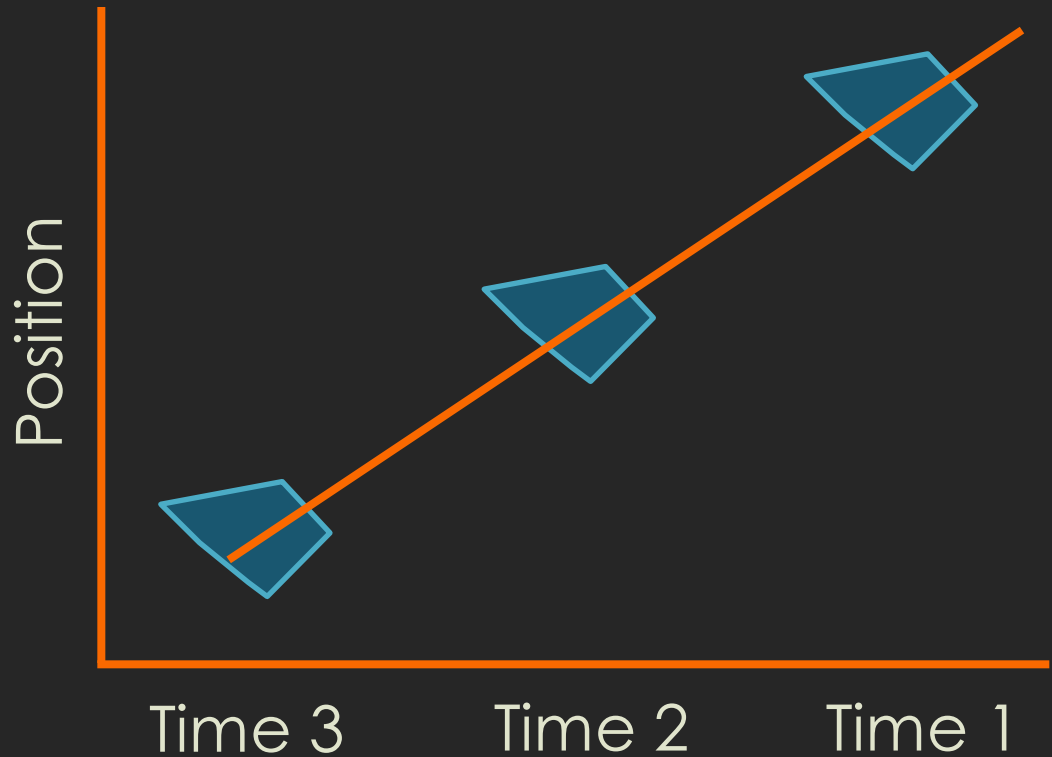
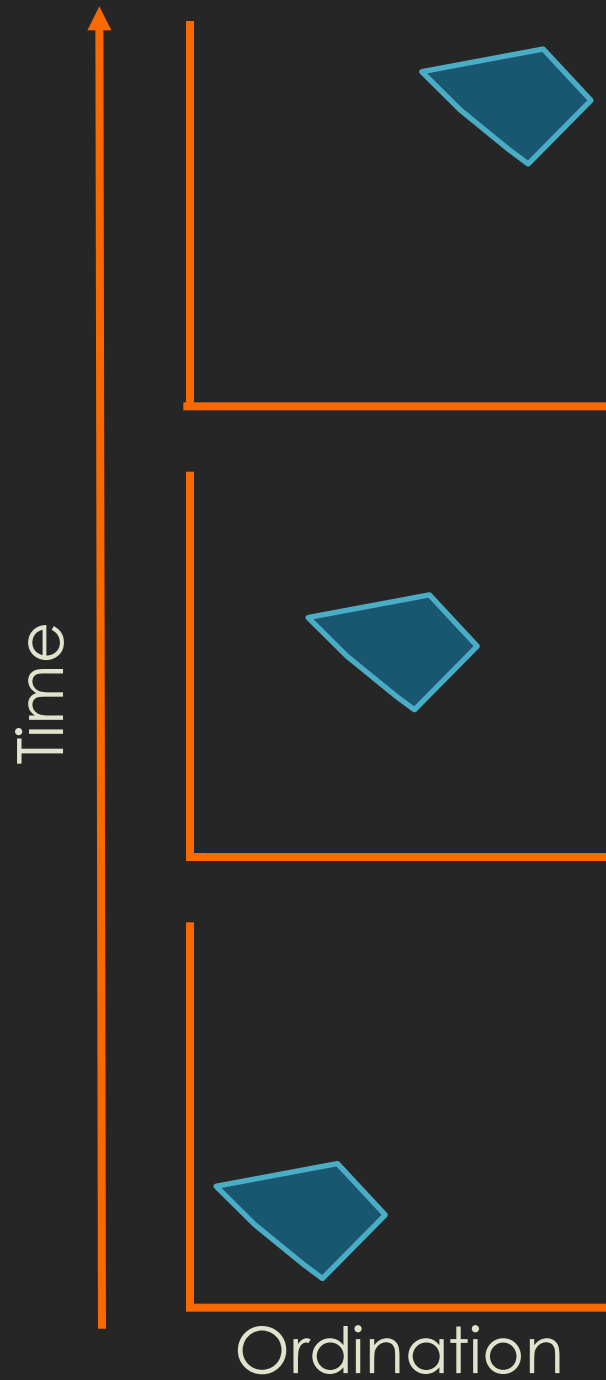
Group size: does it expand/contract?



Group's position



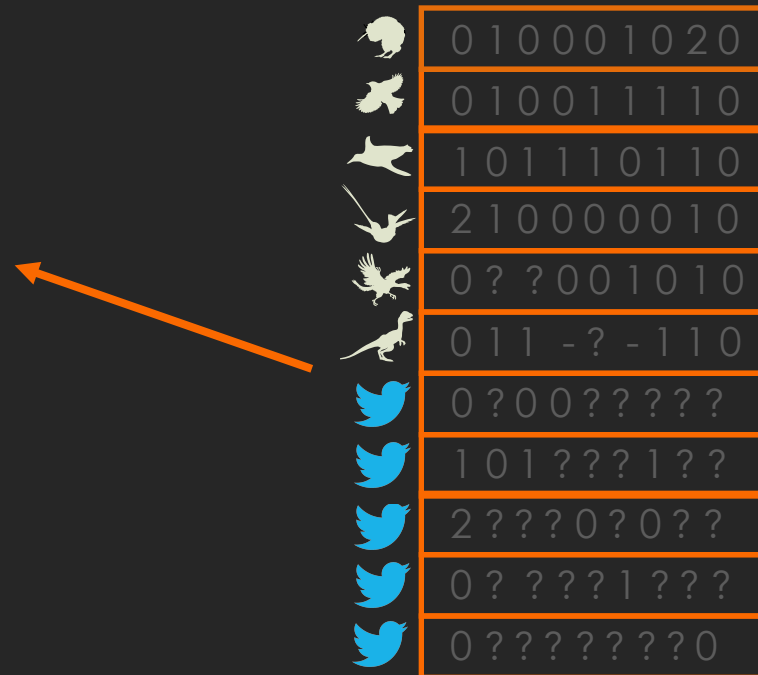
Group position:
does it move?



Disparity through time?

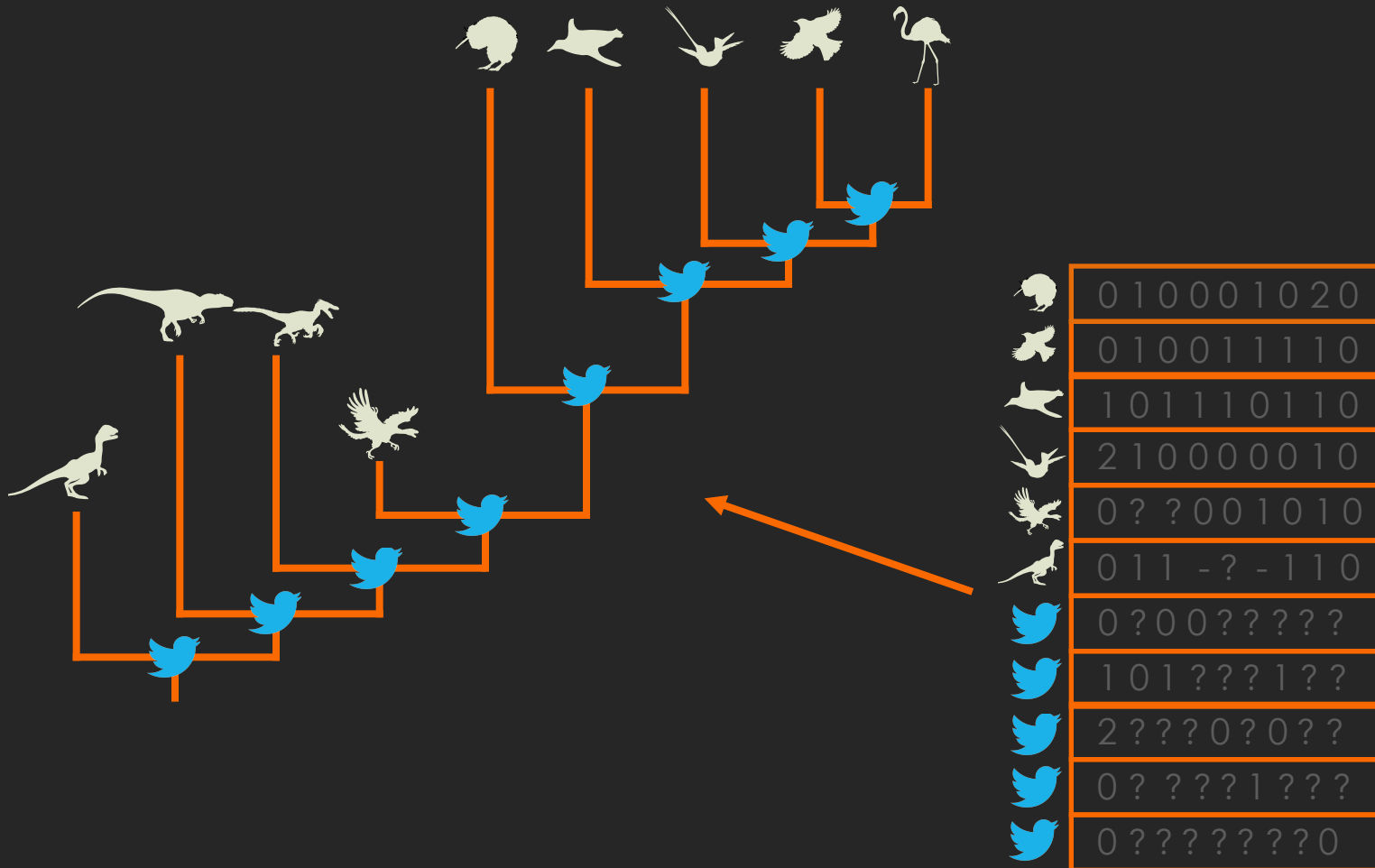
	0	1	0	0	0	1	0	2	0
	0	1	0	0	1	1	1	1	0
	1	0	1	1	1	0	1	1	0
	2	1	0	0	0	0	0	1	0
	0	?	?	?	0	0	1	0	1
	0	1	1	-	?	-	1	1	0

Disparity through time?

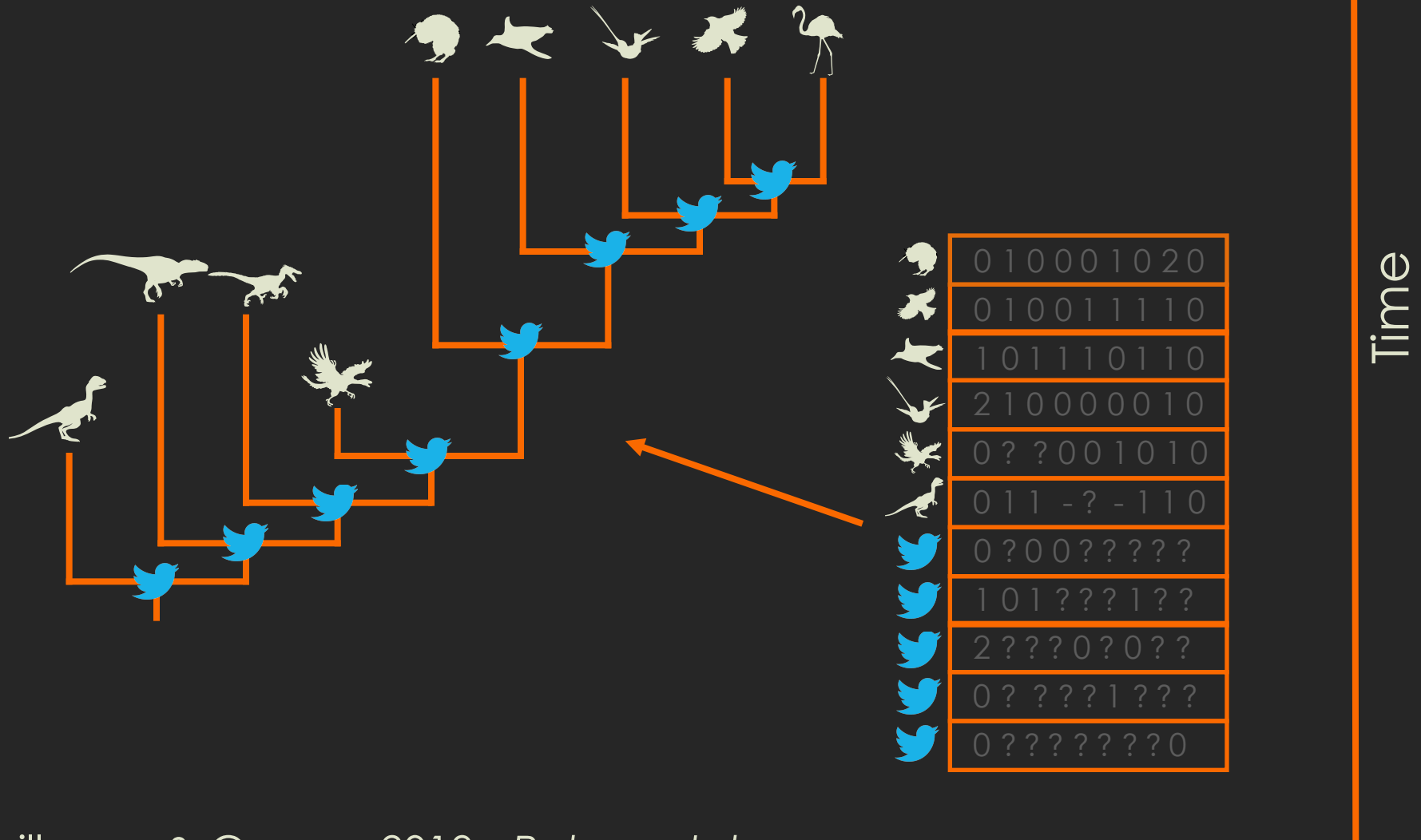


	0 1 0 0 0 1 0 2 0
	0 1 0 0 1 1 1 1 0
	1 0 1 1 1 0 1 1 0
	2 1 0 0 0 0 0 1 0
	0 ? ? 0 0 1 0 1 0
	0 1 1 - ? - 1 1 0
	0 ? 0 0 ? ? ? ? ?
	1 0 1 ? ? ? 1 ? ?
	2 ? ? ? 0 ? 0 ? ?
	0 ? ? ? ? 1 ? ? ?
	0 ? ? ? ? ? ? ? 0

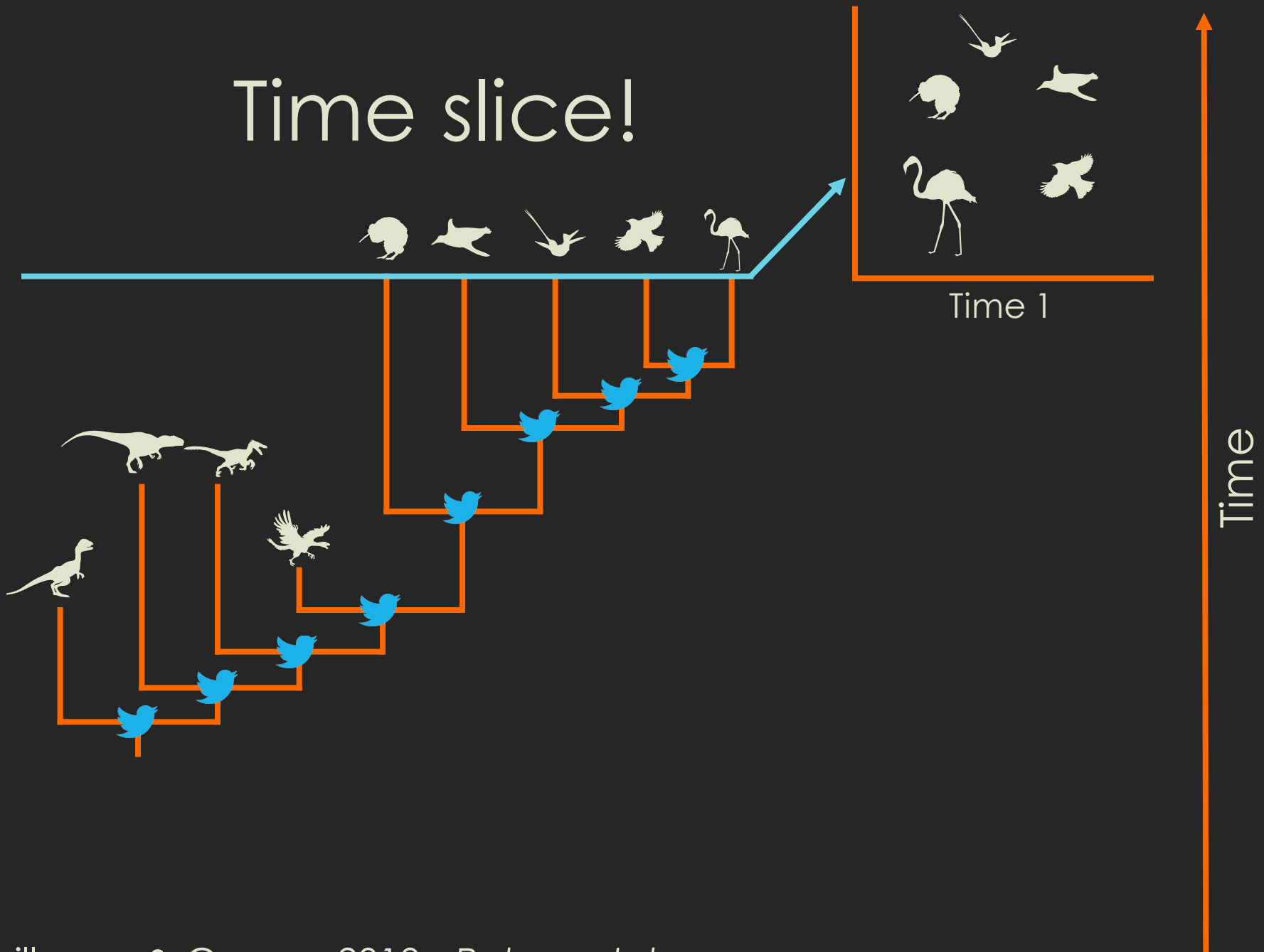
Disparity through time?



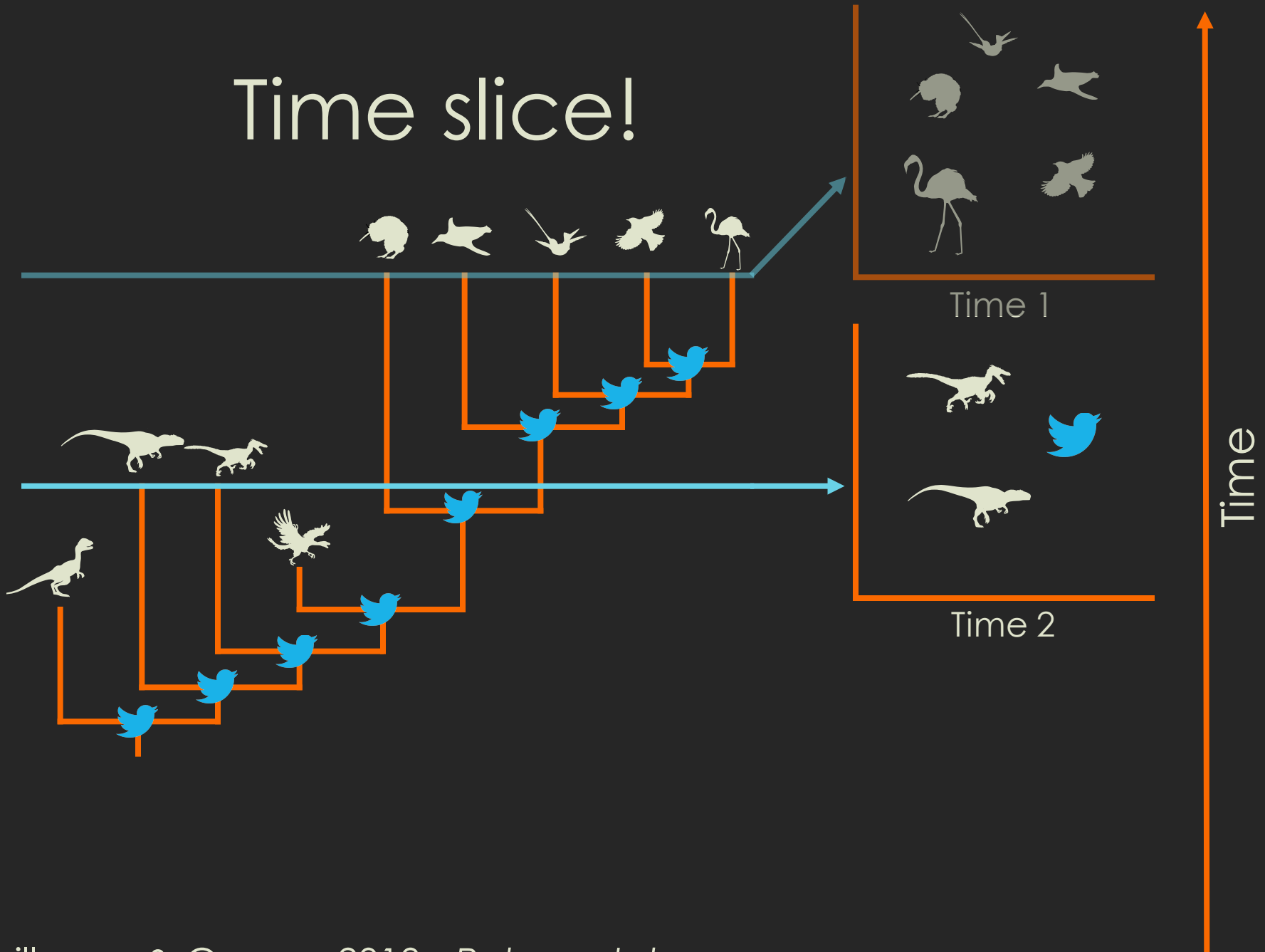
Disparity through time?



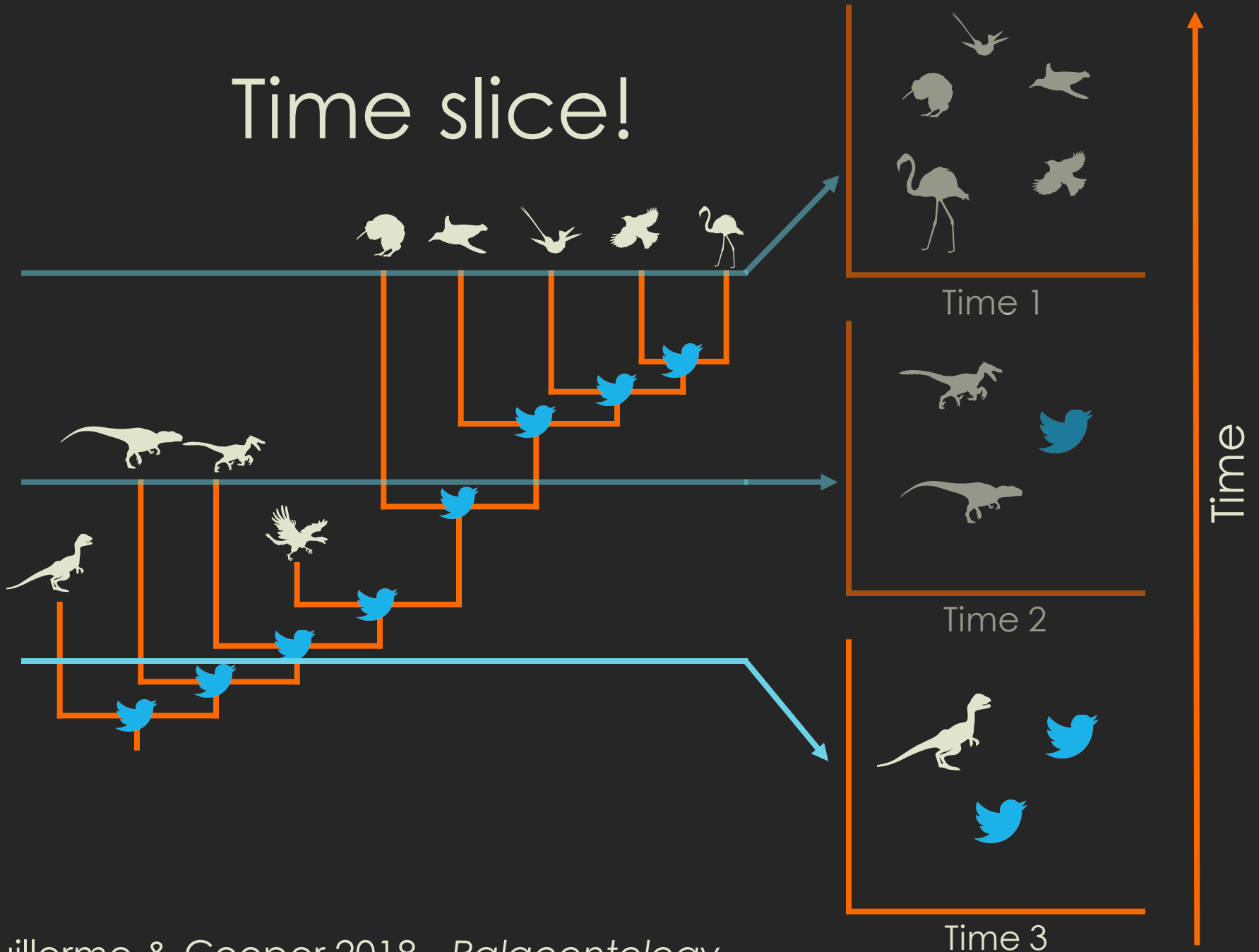
Time slice!



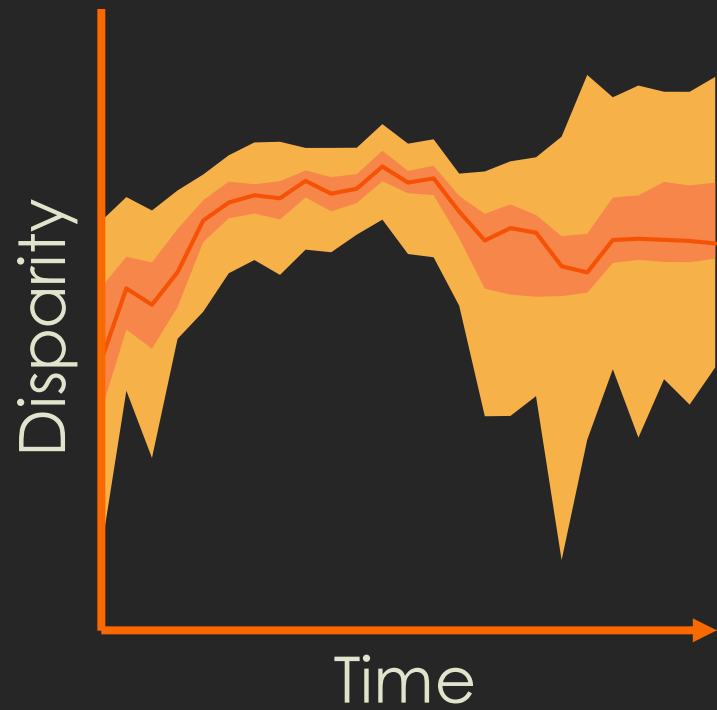
Time slice!

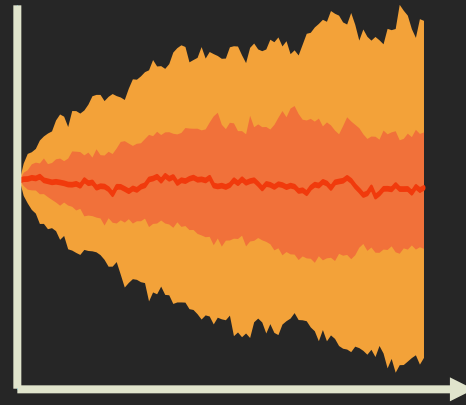
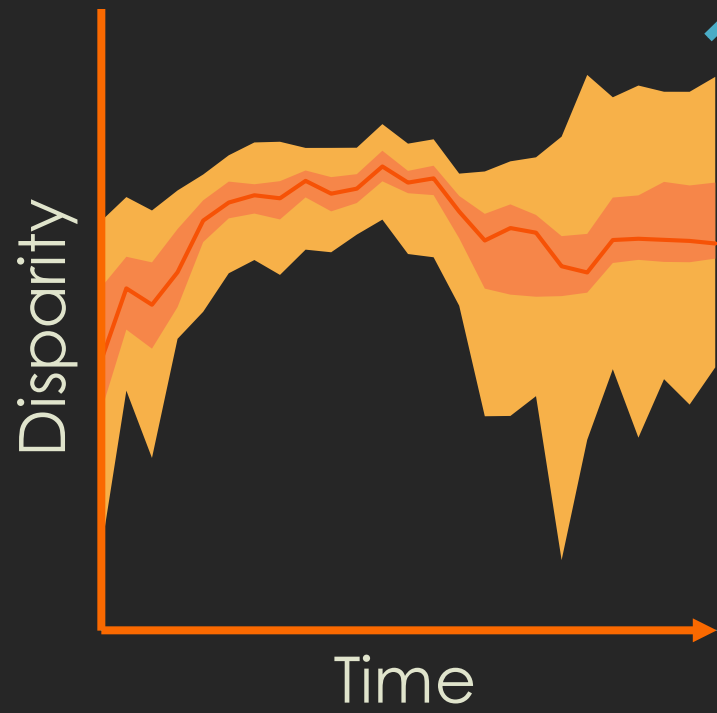


Time slice!

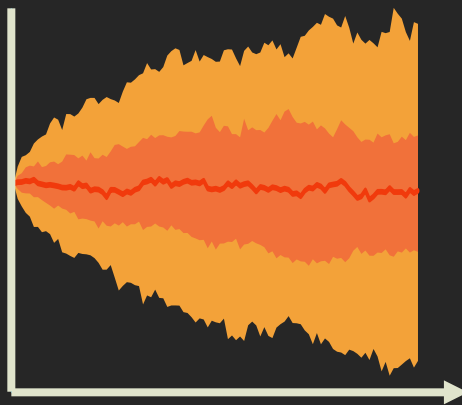
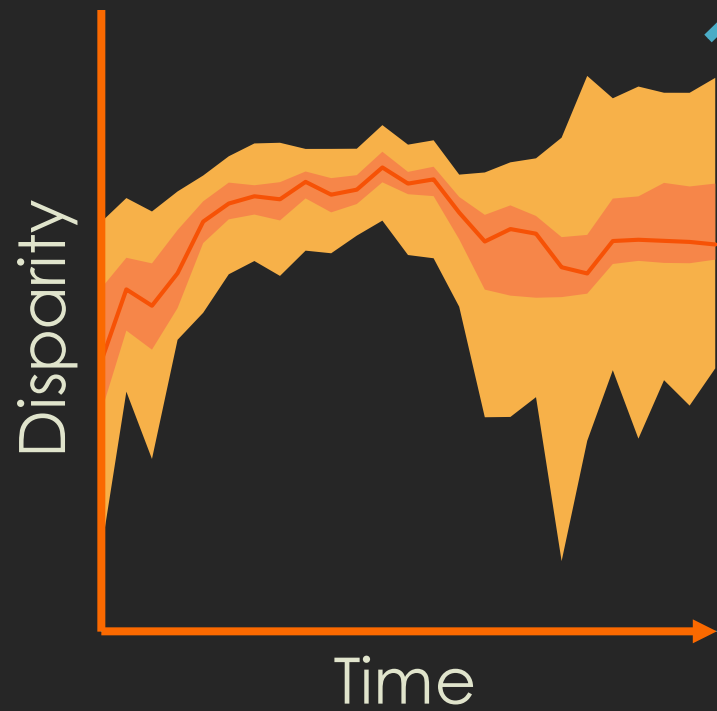


Model fitting?

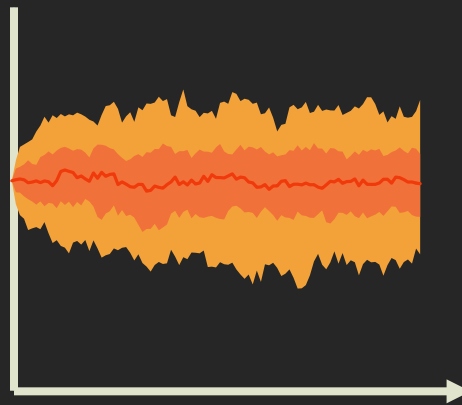




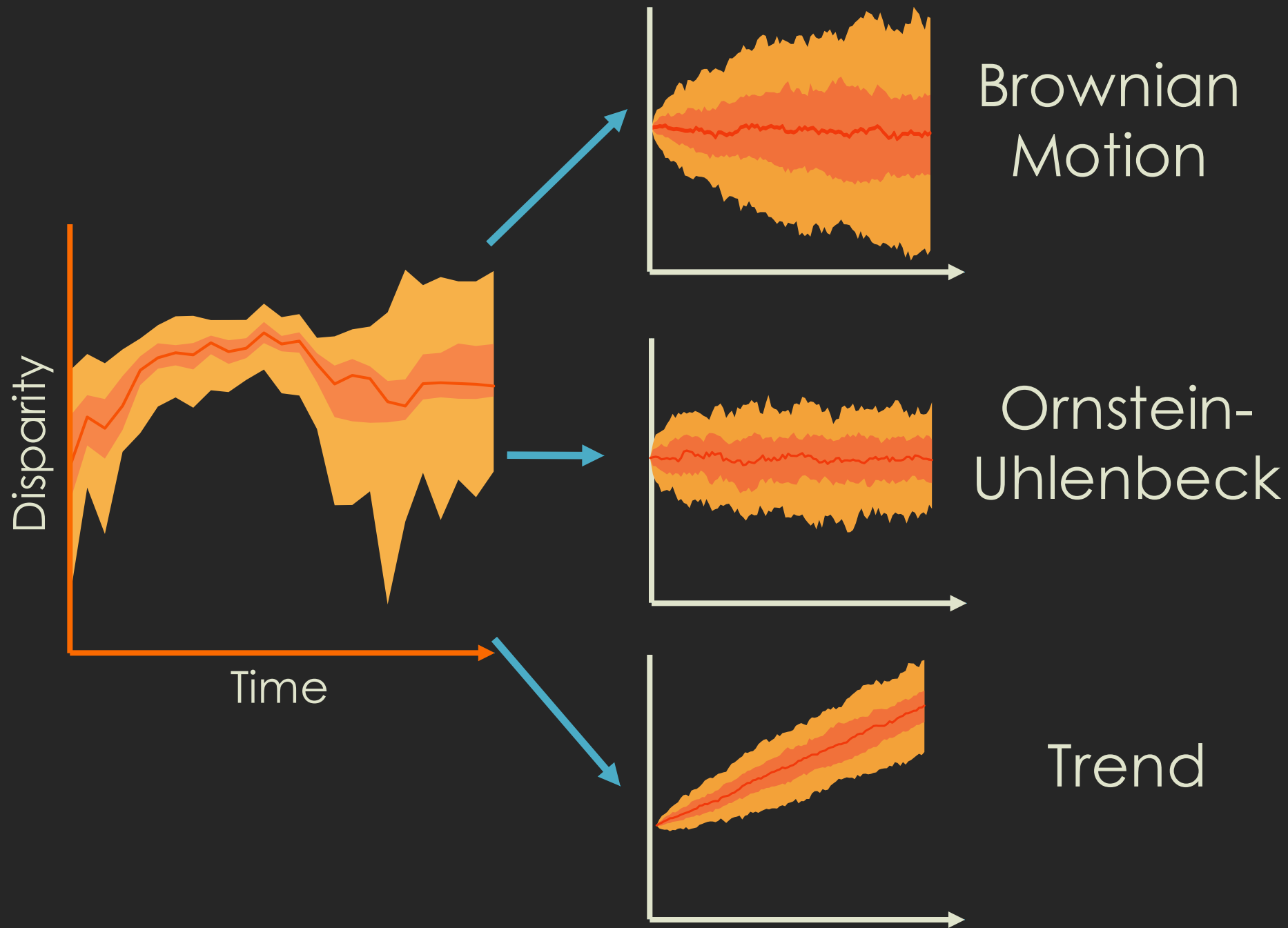
Brownian
Motion

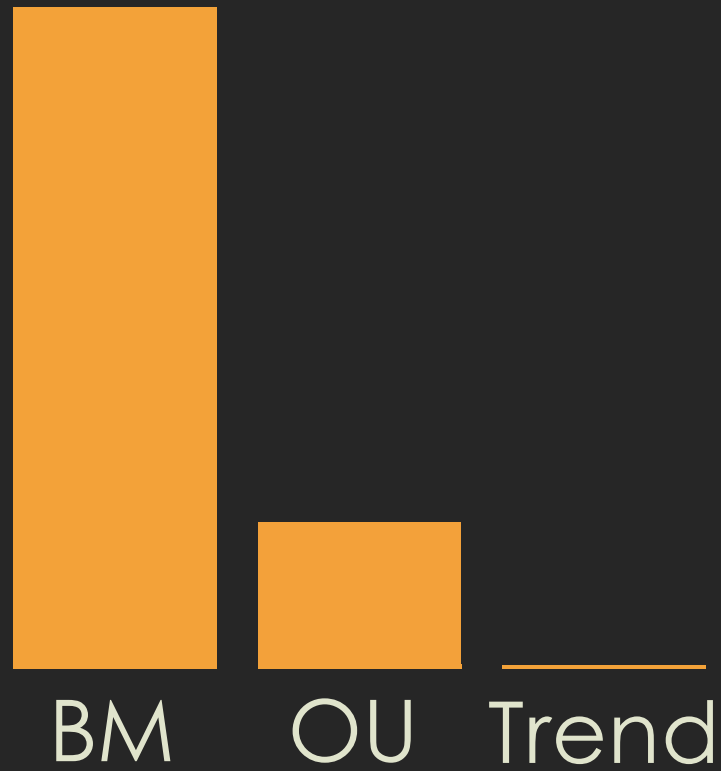
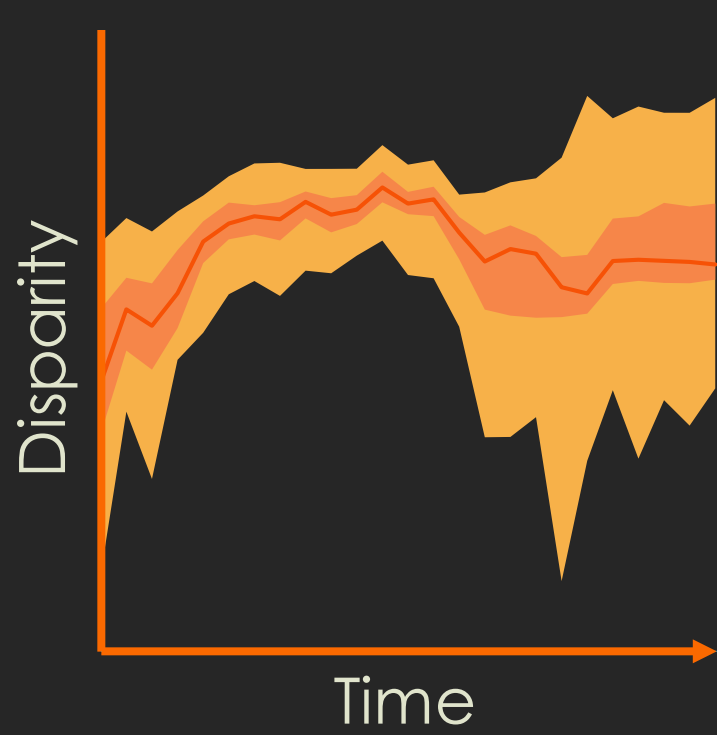


Brownian
Motion

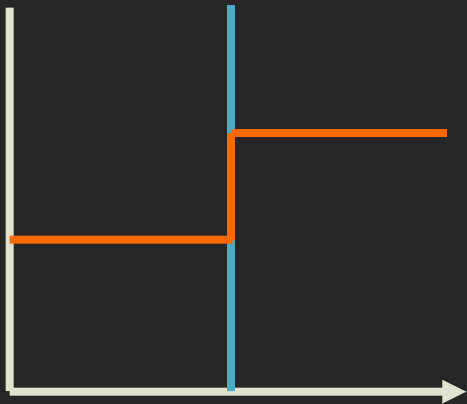


Ornstein-
Uhlenbeck

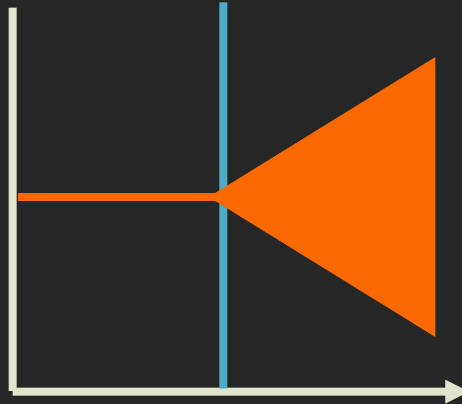




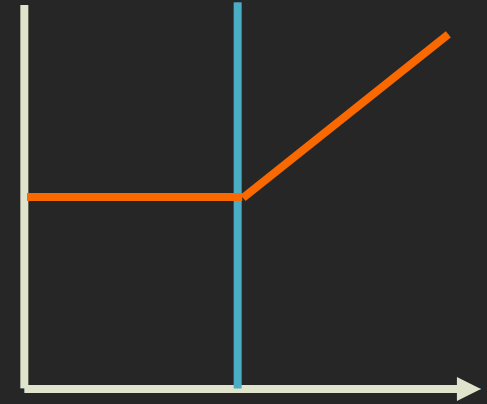
Shift models



Regime shift
Stasis:Stasis



Release shift
BM:EB
OU:EB
Stasis:EB

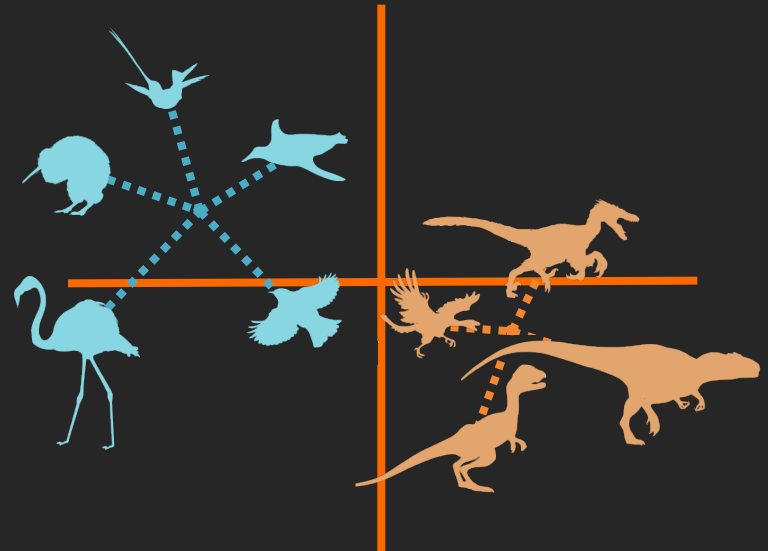
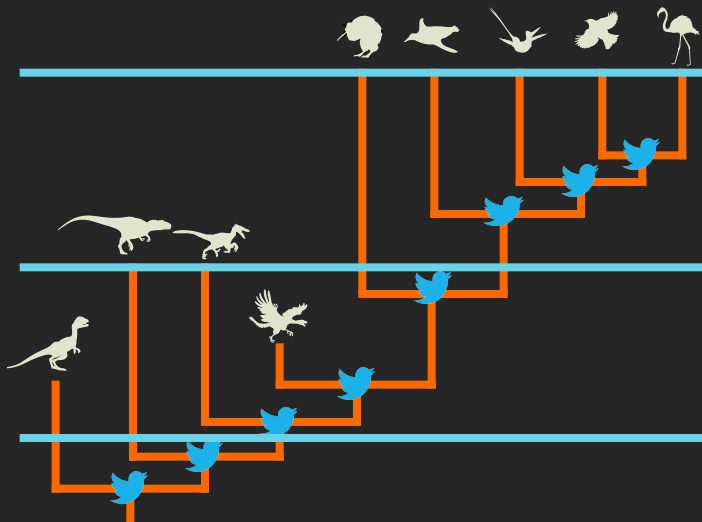


Trend shift
BM:Trend
Stasis:Trend
BM:Trend
OU:Trend

Commercial
break!



github.com/
TGuillerme/dispRity



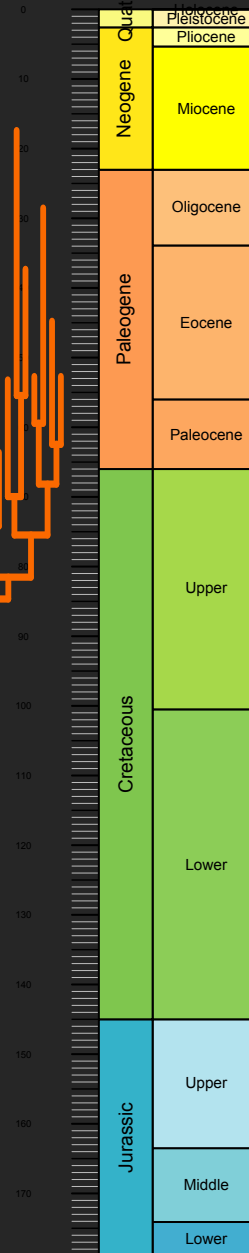
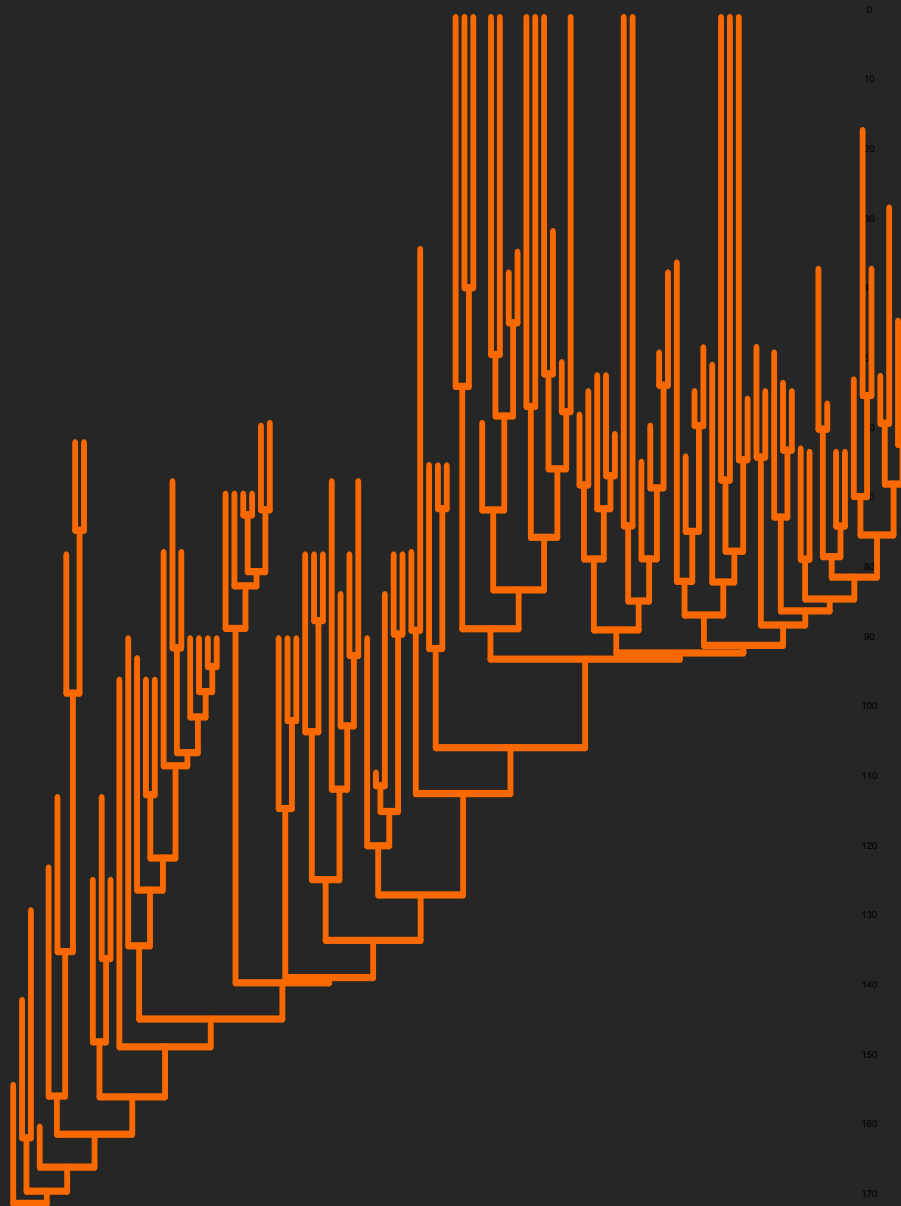
SAVE YOURSELF, MAMMAL!

A SATURDAY MORNING BREAKFAST CEREAL COLLECTION

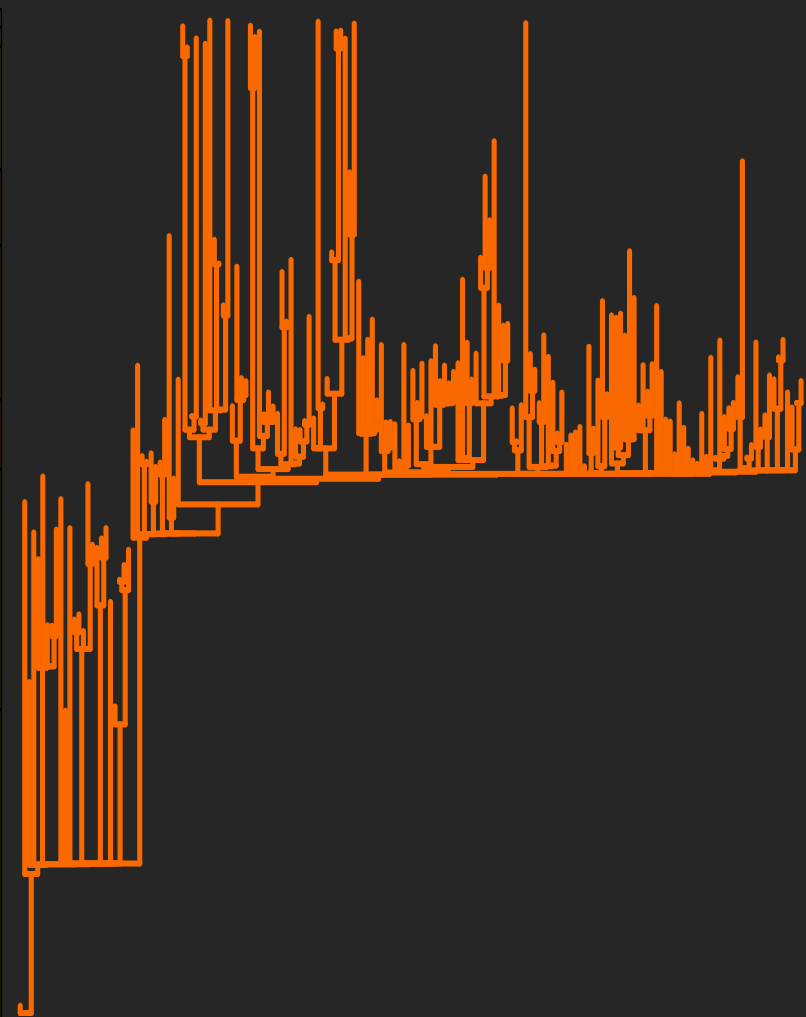
BY ZACH WEINER



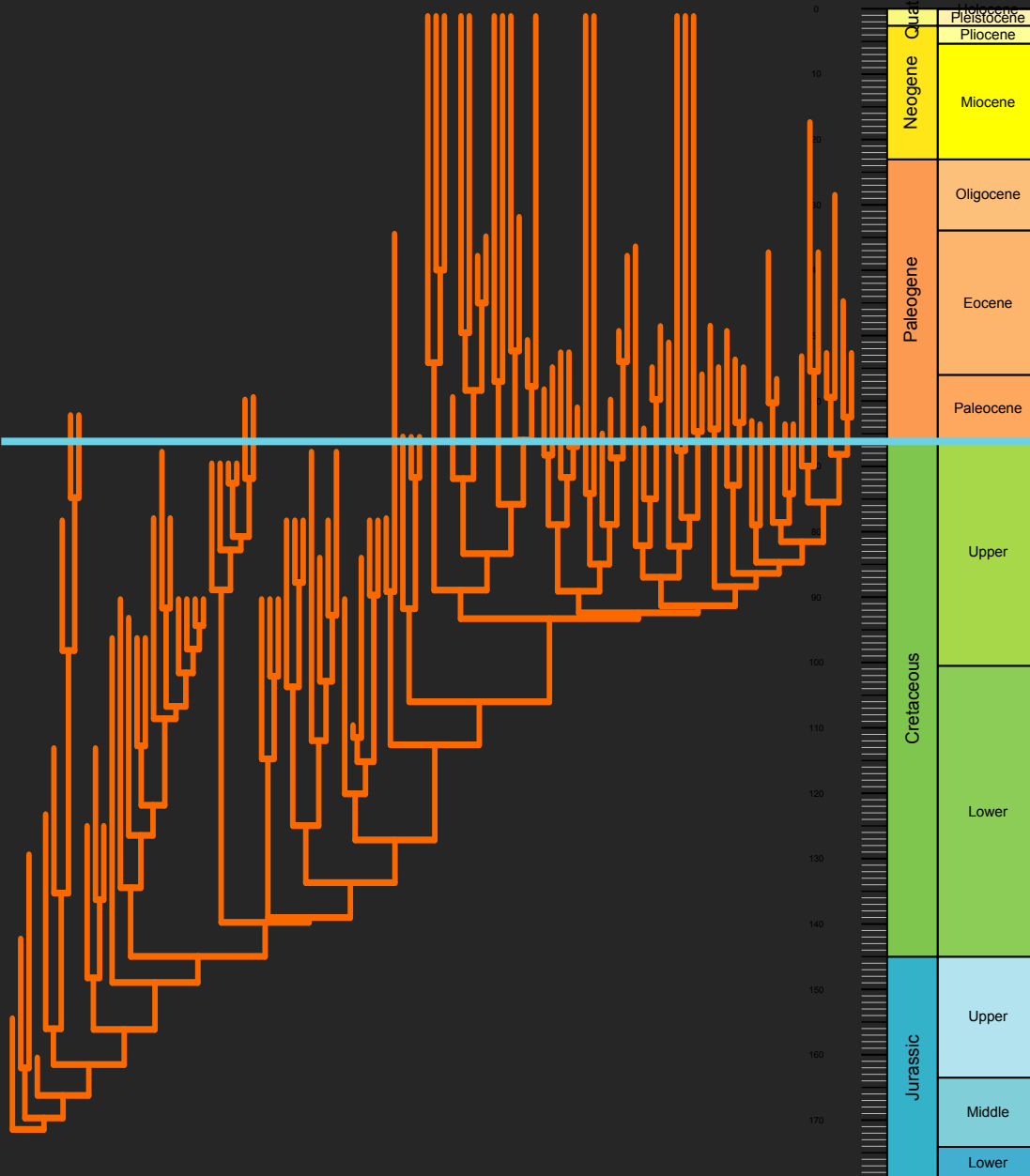
Beck & Lee 2014



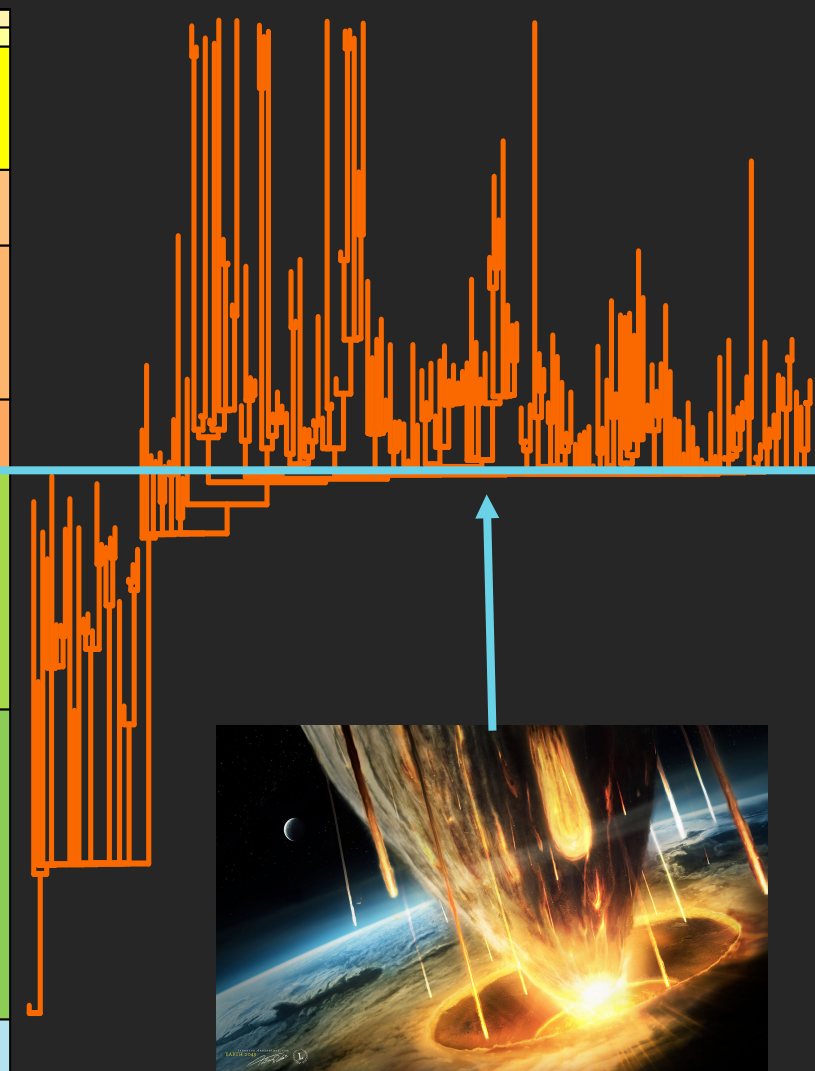
Halliday & Goswami 2015



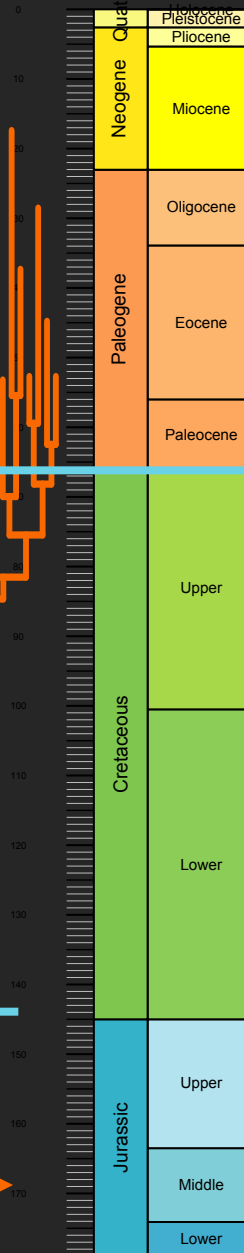
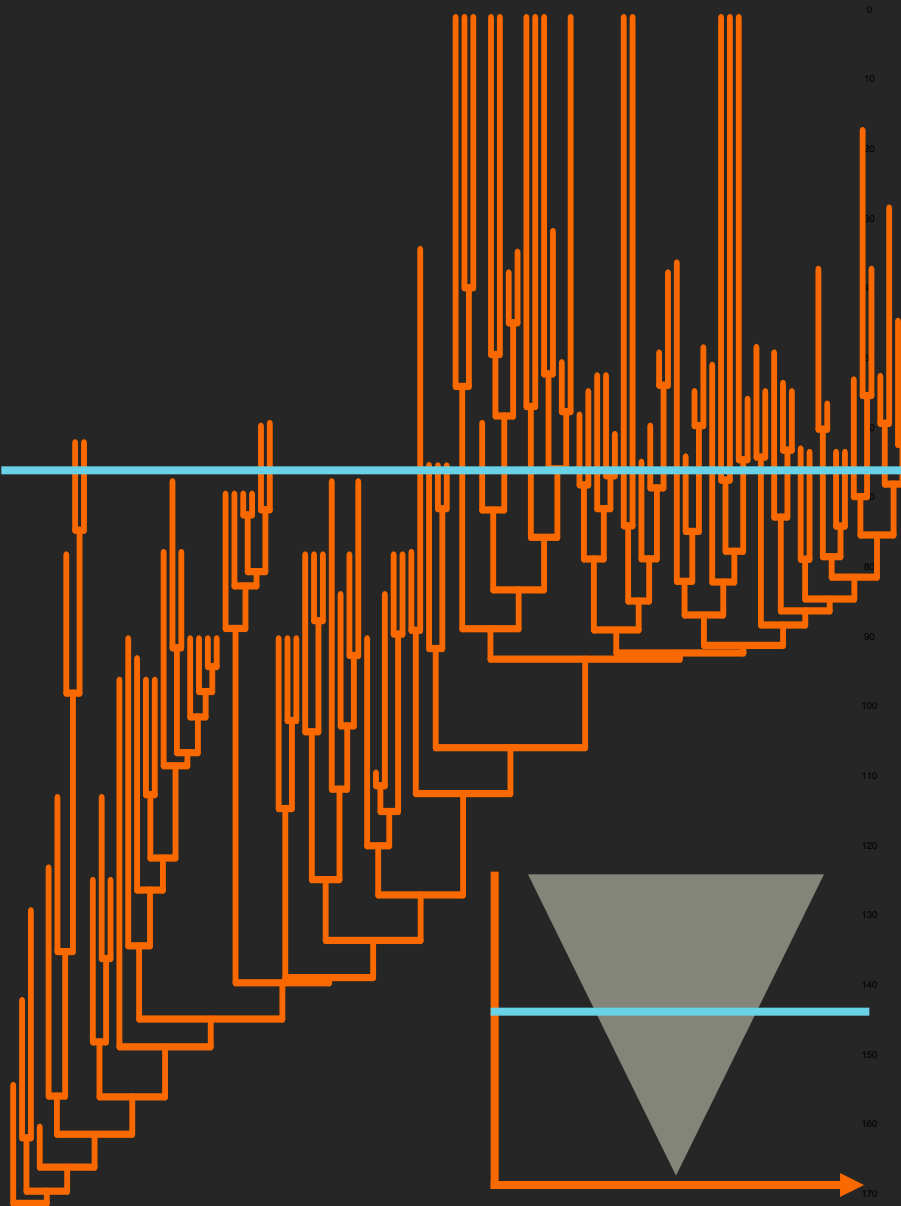
Beck & Lee 2014



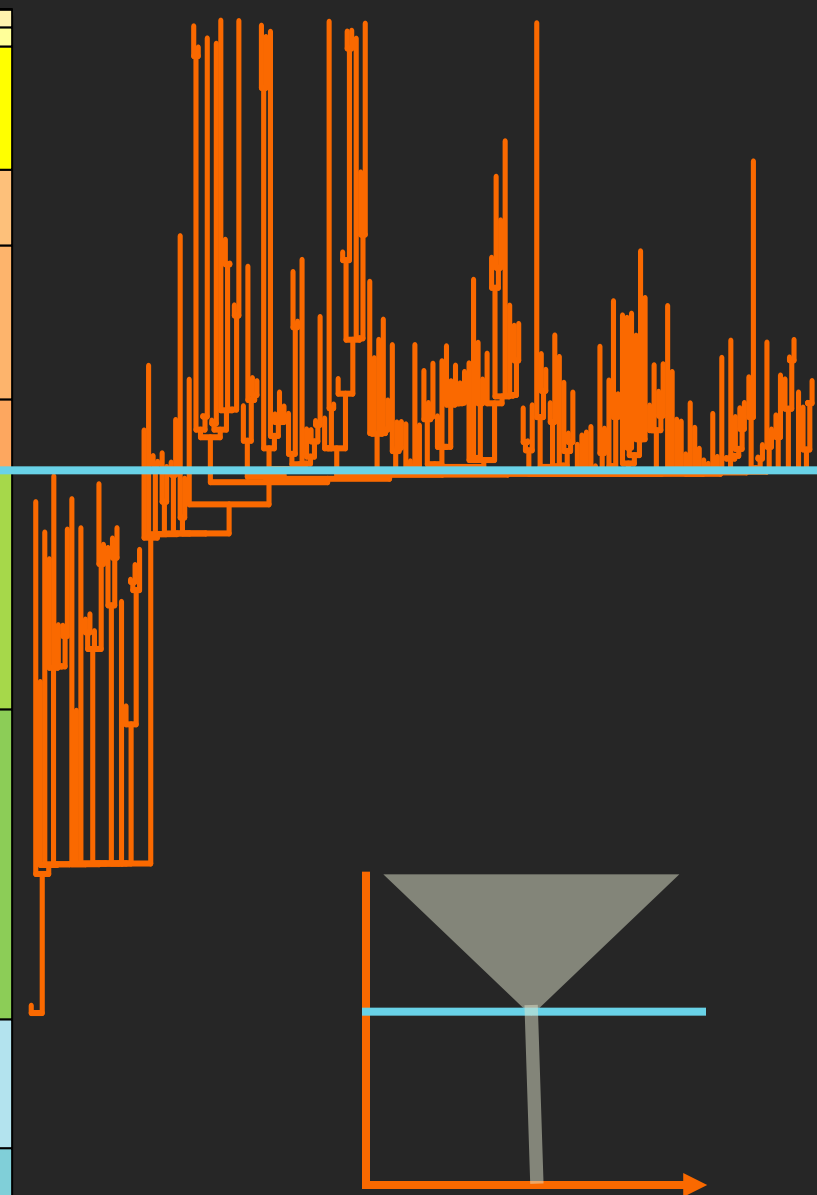
Halliday & Goswami 2015



Beck & Lee 2014



Halliday & Goswami 2015



Trace Files:

Trace File	States	Burn-In
003_TETD_expl...	10203000	1020300
003_TETD_expl...	10203000	1020300
004_TETD_soex...	5522000	552200

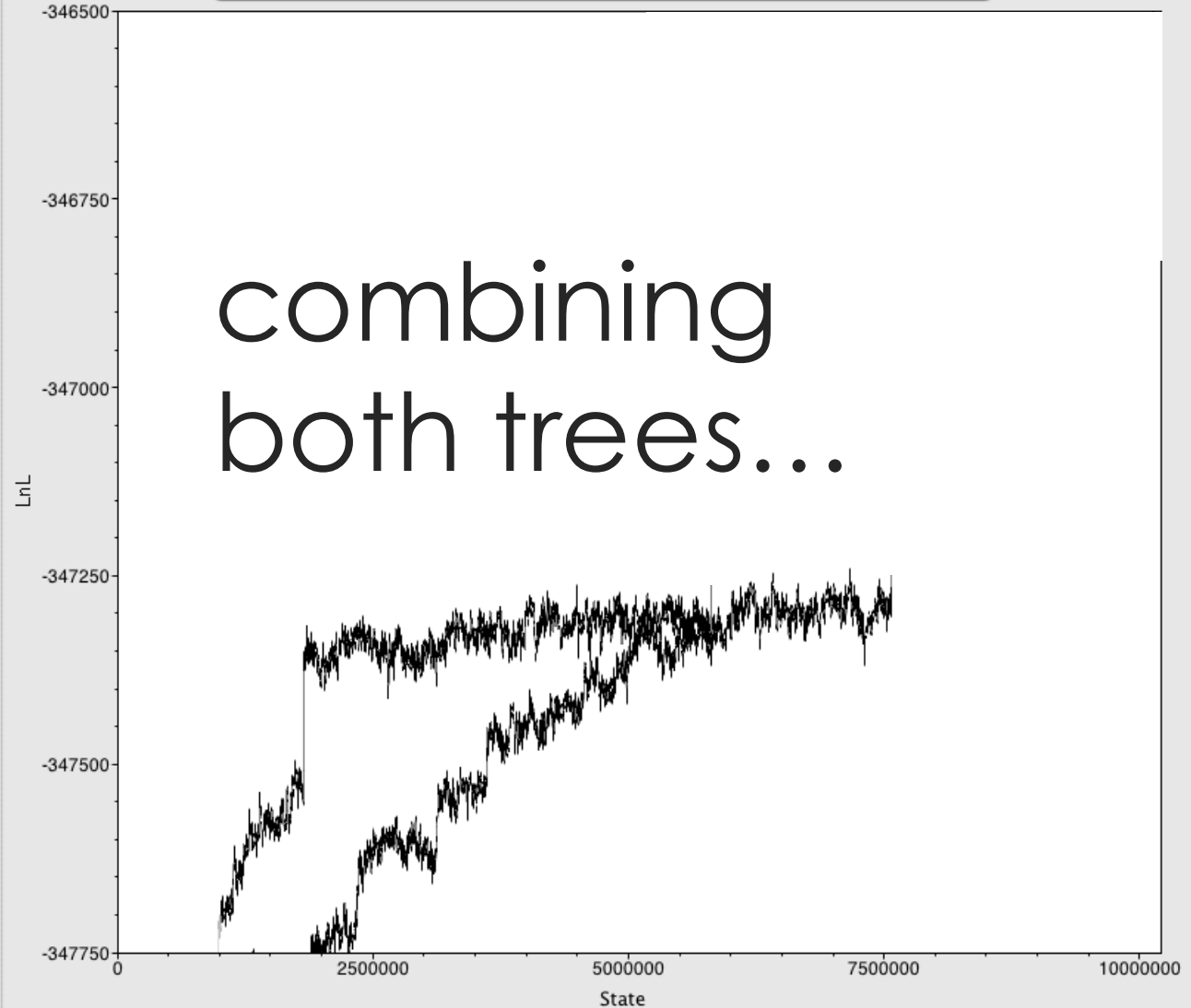
+ -

Traces:

Statistic	Mean	ESS	T...
LnL	-3.471E5	3	R
LnPr	-3593....	20	R
TH{all}	0.197	5	R
TL{all}	14.368	10	R
r(A<->C){1,2,3,4,5,6}	9.479E-2	1086	R
r(A<->G){1,2,3,4,5,6}	0.32	370	R
r(A<->T){1,2,3,4,5,6}	6.346E-2	1383	R
r(C<->G){1,2,3,4,5,6}	8.288E-2	612	R
r(C<->T){1,2,3,4,5,6}	0.372	382	R
r(G<->T){1,2,3,4,5,6}	6.693E-2	1259	R
pi(A){1,2,3,4,5,6}	0.259	416	R
pi(C){1,2,3,4,5,6}	0.26	640	R
pi(G){1,2,3,4,5,6}	0.256	690	R
pi(T){1,2,3,4,5,6}	0.225	523	R
alpha{1,2,3,4,5,6}	0.945	6916	R
alpha{7}	1.525	156	R
pinvar{1,2,3,4,5,6}	0.221	6291	R
m{1}	0.476	3273	R
m{2}	0.945	33	R
m{3}	0.886	45	R
m{4}	0.921	185	R
m{5}	0.962	22	R
m{6}	0.928	17	R
m{7}	4.221	6	R
net_speciation_1{all}	4.665E-2	156	R
net_speciation_2{all}	1.773E-2	36	R
net_speciation_3{all}	5.45E-3	51	R
net_speciation_4{all}	6.427E-3	171	R
net_speciation_5{all}	0.168	72	R
net_speciation_6{all}	8.143E-3	8	R
relative_extinction_1{all}	8.529E-2	364	R

Data type: (R)real (I)nt (C)at

☒ Estimates
 ☒ Marginal Prob Distribution
 ☒ Joint-Marginal
 ☒ Trace



Axes... ☒ Show Burn-in ☐ Sample only ☒ Draw line plot Legend: None Colour by: Trace Listen

Trace Files:

Trace File	States	Burn-In
003_TETD_expl...	10203000	1020300
003_TETD_expl...	10203000	1020300
004_TETD_soex...	5522000	552200

+ -

Traces:

Statistic	Mean	ESS	T...
LnL	-3.471E5	3	R
LnPr	-3593....	20	R
TH{all}	0.197	5	R
TL{all}	14.368	10	R
r(A<->C){1,2,3,4,5,6}	9.479E-2	1086	R
r(A<->G){1,2,3,4,5,6}	0.32	370	R
r(A<->T){1,2,3,4,5,6}	6.346E-2	1383	R
r(C<->G){1,2,3,4,5,6}	8.288E-2	612	R
r(C<->T){1,2,3,4,5,6}	0.372	382	R
r(G<->T){1,2,3,4,5,6}	6.693E-2	1259	R
pi(A){1,2,3,4,5,6}	0.259	416	R
pi(C){1,2,3,4,5,6}	0.26	640	R
pi(G){1,2,3,4,5,6}	0.256	690	R
pi(T){1,2,3,4,5,6}	0.225	523	R
alpha{1,2,3,4,5,6}	0.945	6916	R
alpha{7}	1.525	156	R
pinvar{1,2,3,4,5,6}	0.221	6291	R
m{1}	0.476	3273	R
m{2}	0.945	33	R
m{3}	0.886	45	R
m{4}	0.921	185	R
m{5}	0.962	22	R
m{6}	0.928	17	R
m{7}	4.221	6	R
net_speciation_1{all}	4.665E-2	156	R
net_speciation_2{all}	1.773E-2	36	R
net_speciation_3{all}	5.45E-3	51	R
net_speciation_4{all}	6.427E-3	171	R
net_speciation_5{all}	0.168	72	R
net_speciation_6{all}	8.143E-3	8	R
relative_extinction_1{all}	8.529E-2	364	R

Data type: (R)real (I)nt (C)at

☒ Estimates
 ☒ Marginal Prob Distribution
 ☒ Joint-Marginal
 ☒ Trace



Axes... ☒ Show Burn-in ☐ Sample only ☒ Draw line plot Legend: None Colour by: Trace Listen

Disparity:
size/position

120

Time

0



Disparity:
size/position

120

Time

0



Disparity:
size/position

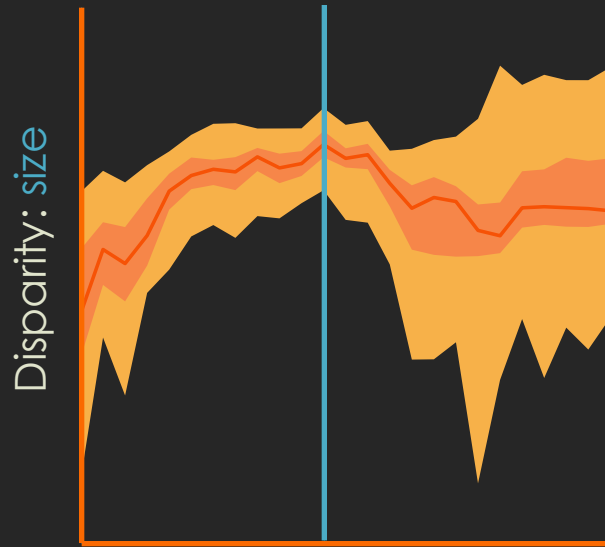
120

Time

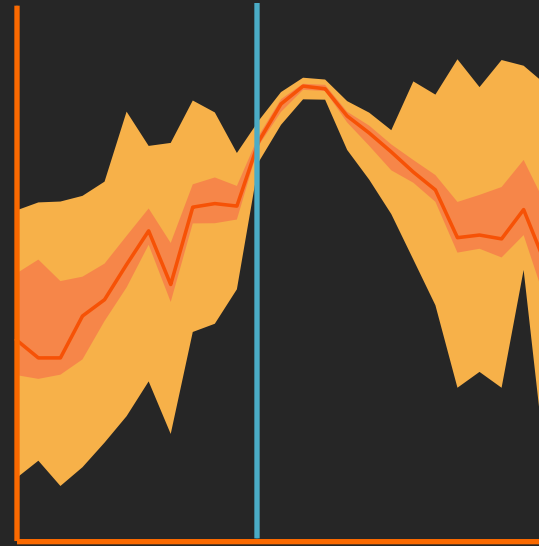
0



Beck & Lee 2014

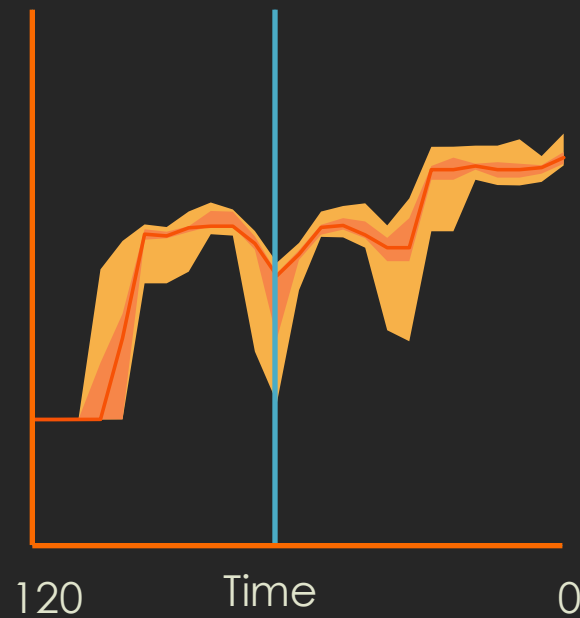
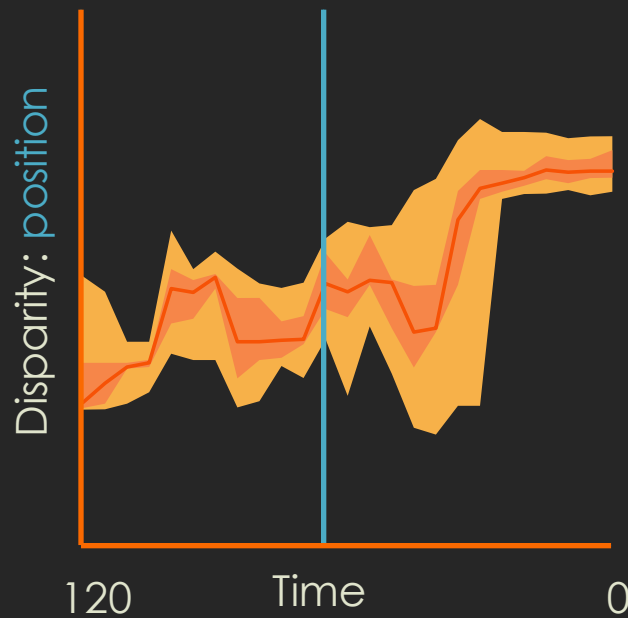
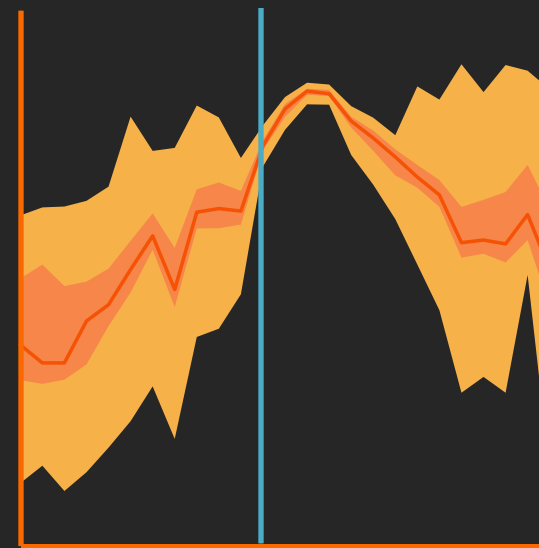
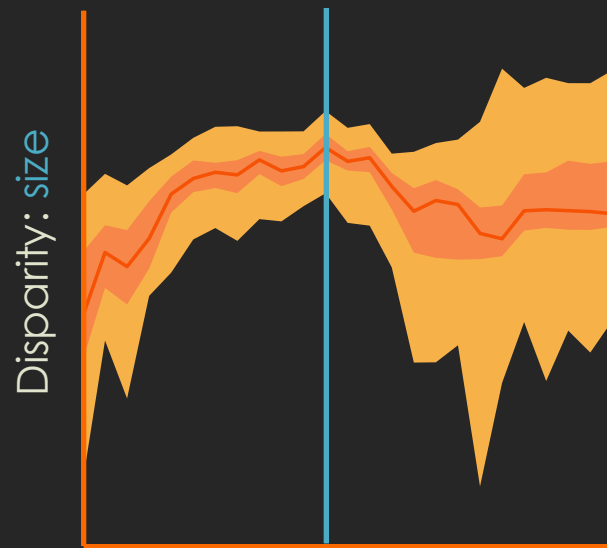


Halliday & Goswami 2015



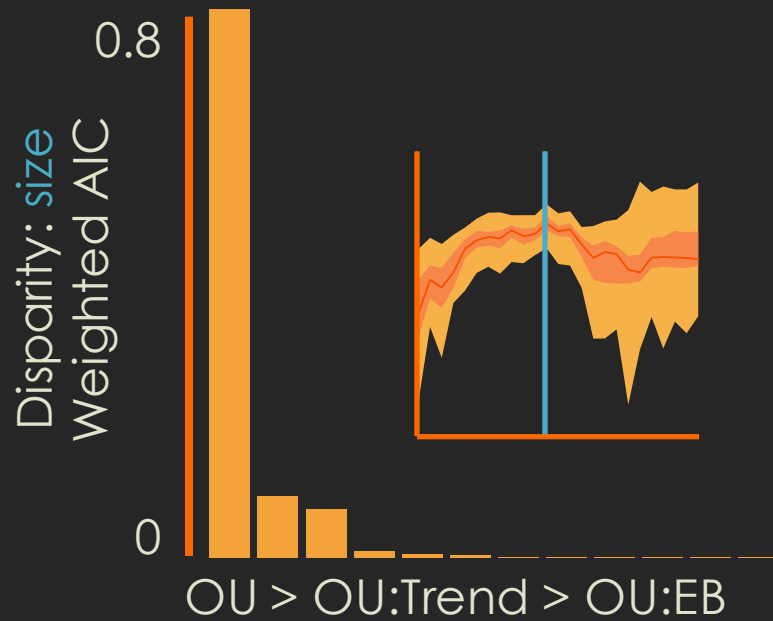
Beck & Lee 2014

Halliday & Goswami 2015

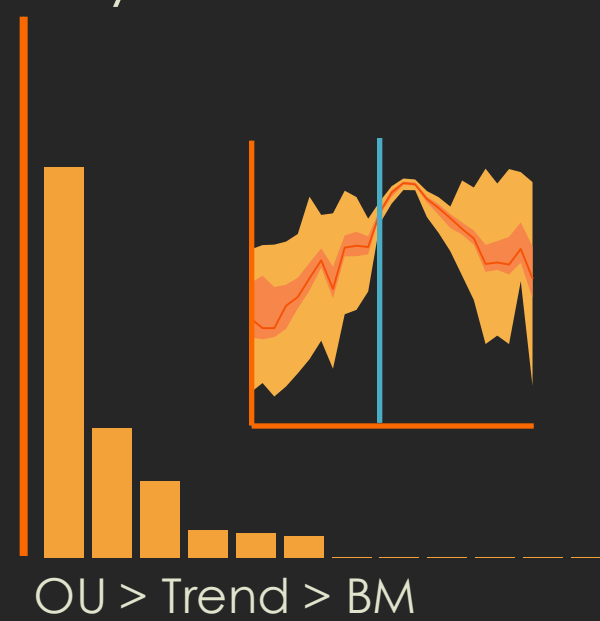


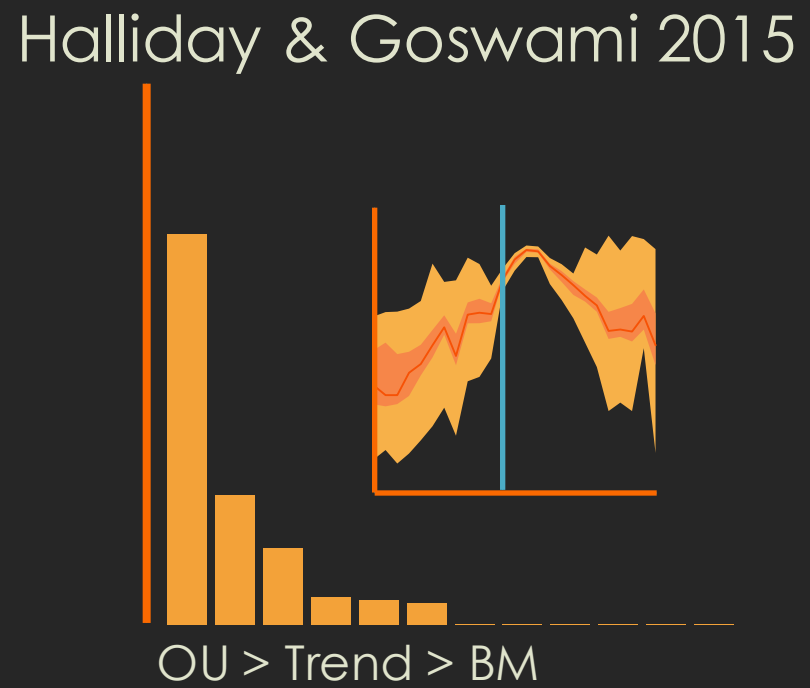
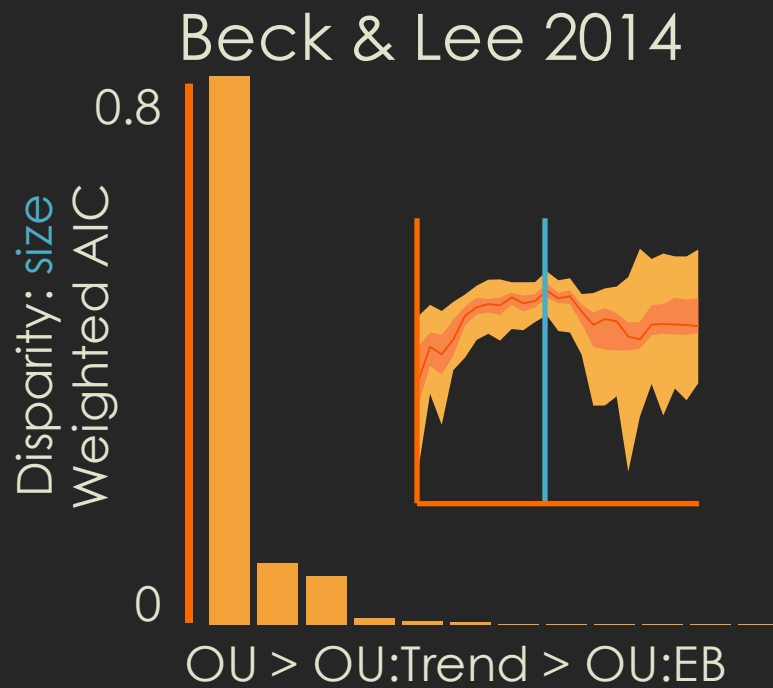
Mode of
disparity
evolution

Beck & Lee 2014

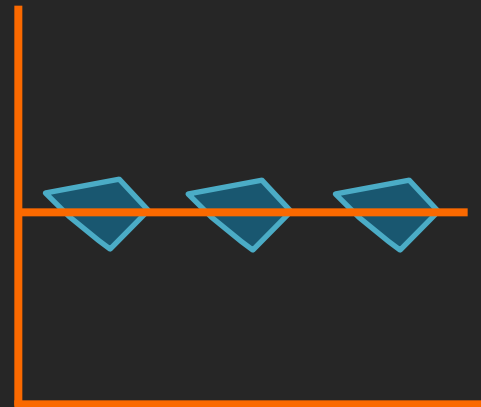
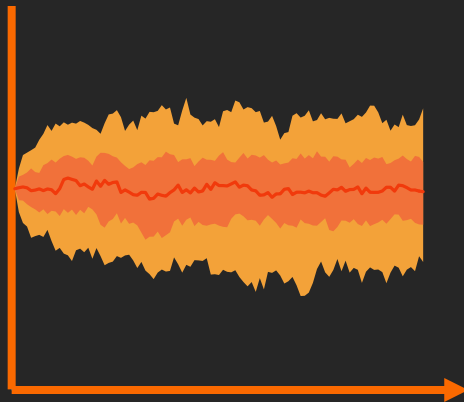


Halliday & Goswami 2015

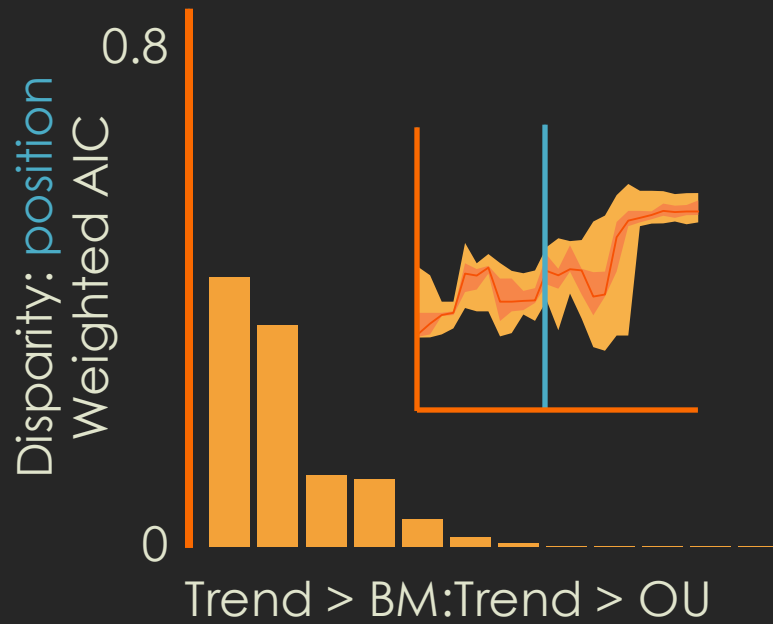




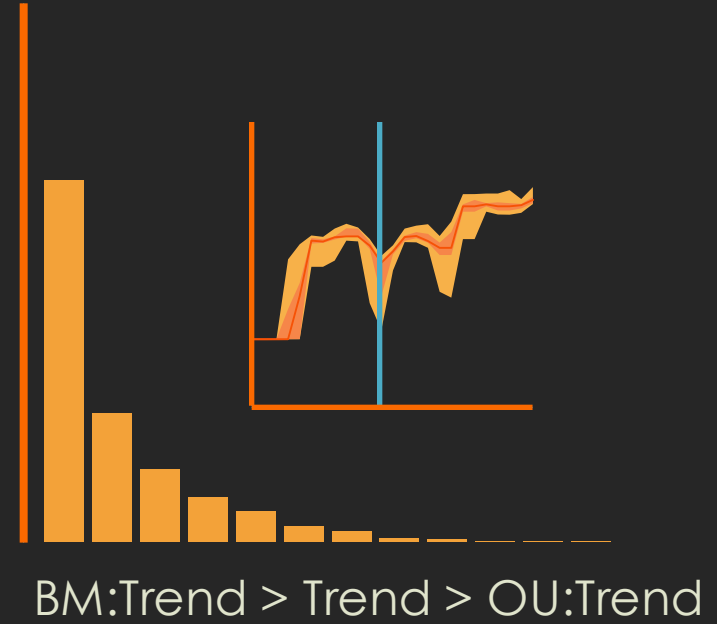
Size is constant and constrained



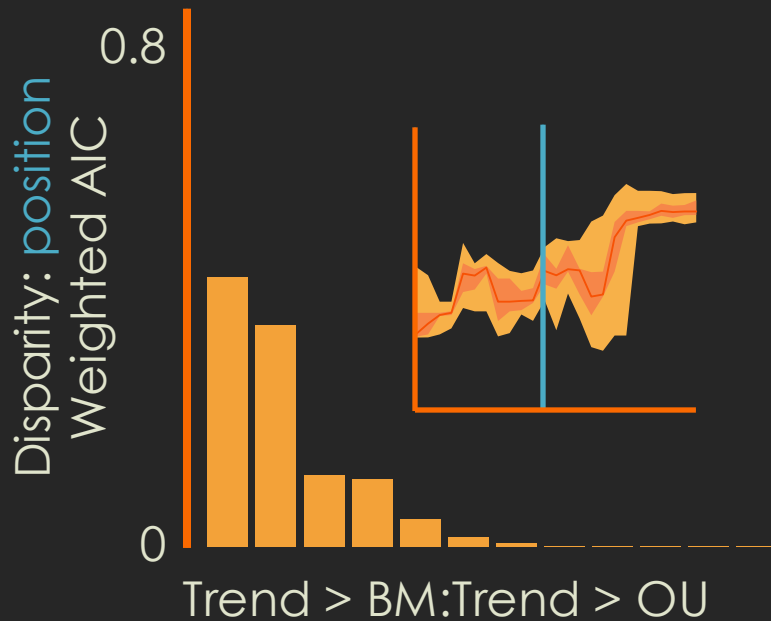
Beck & Lee 2014



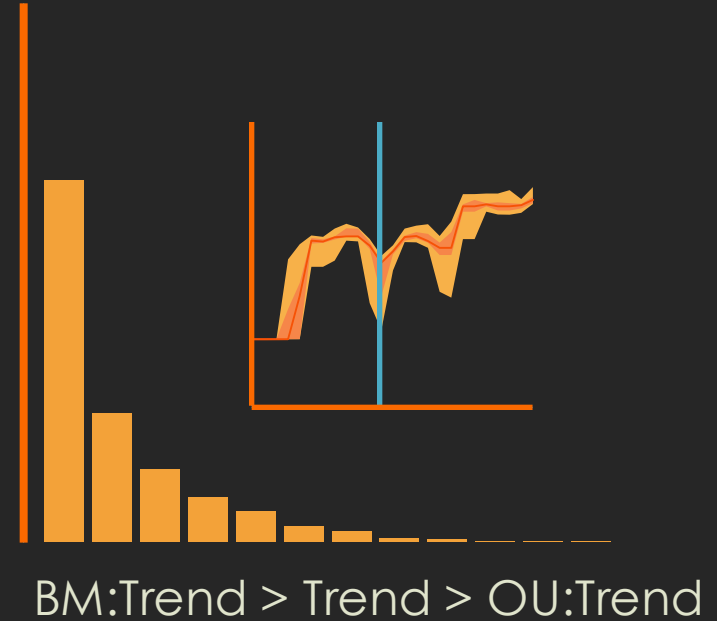
Halliday & Goswami 2015



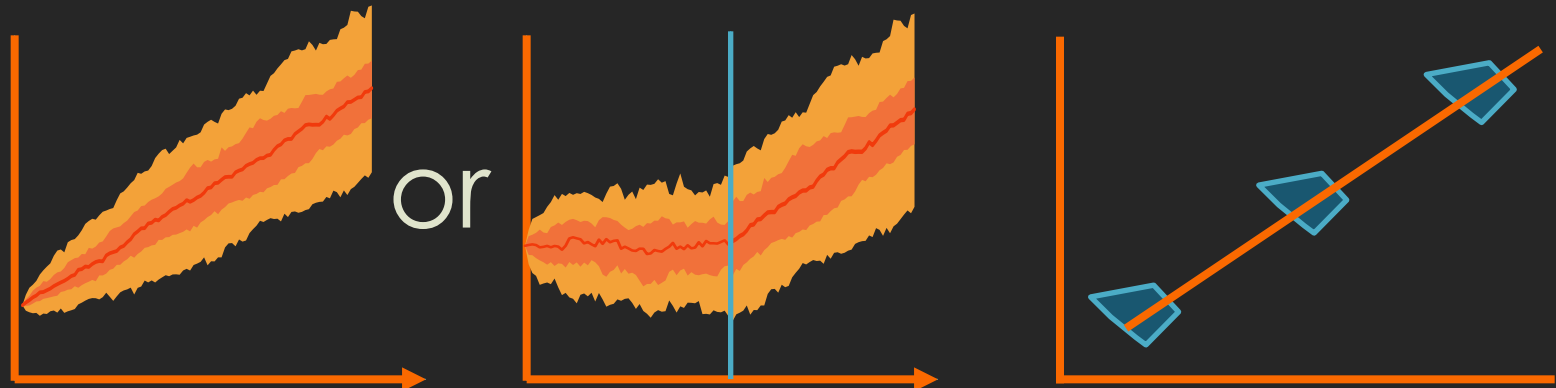
Beck & Lee 2014



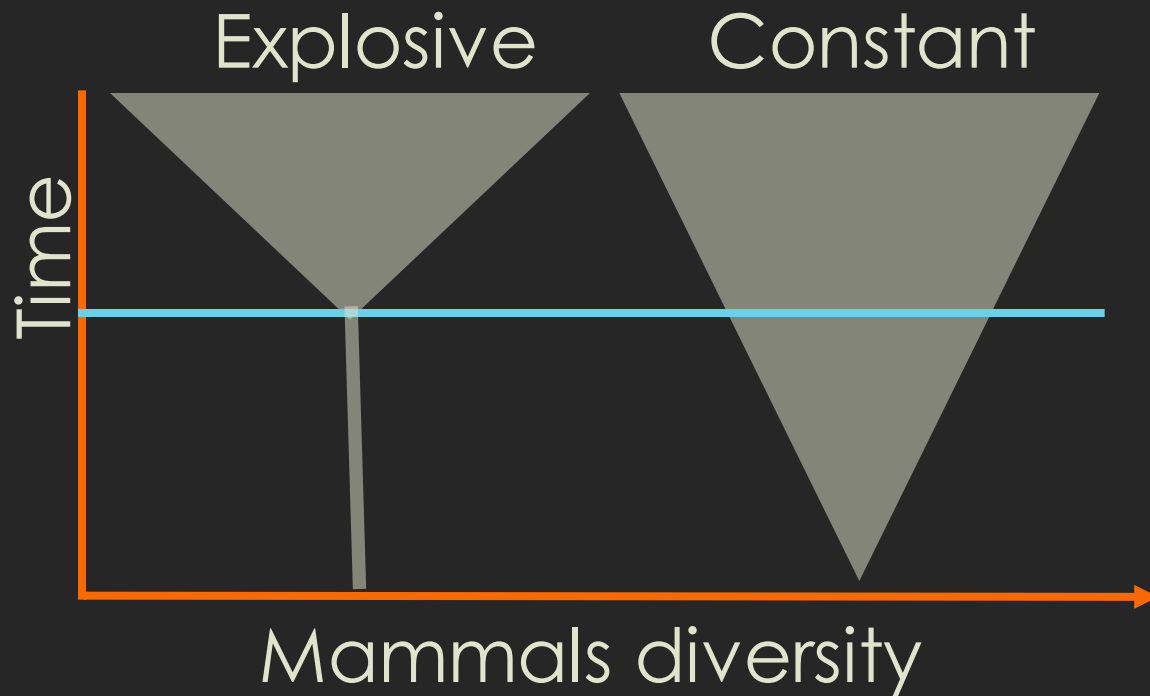
Halliday & Goswami 2015



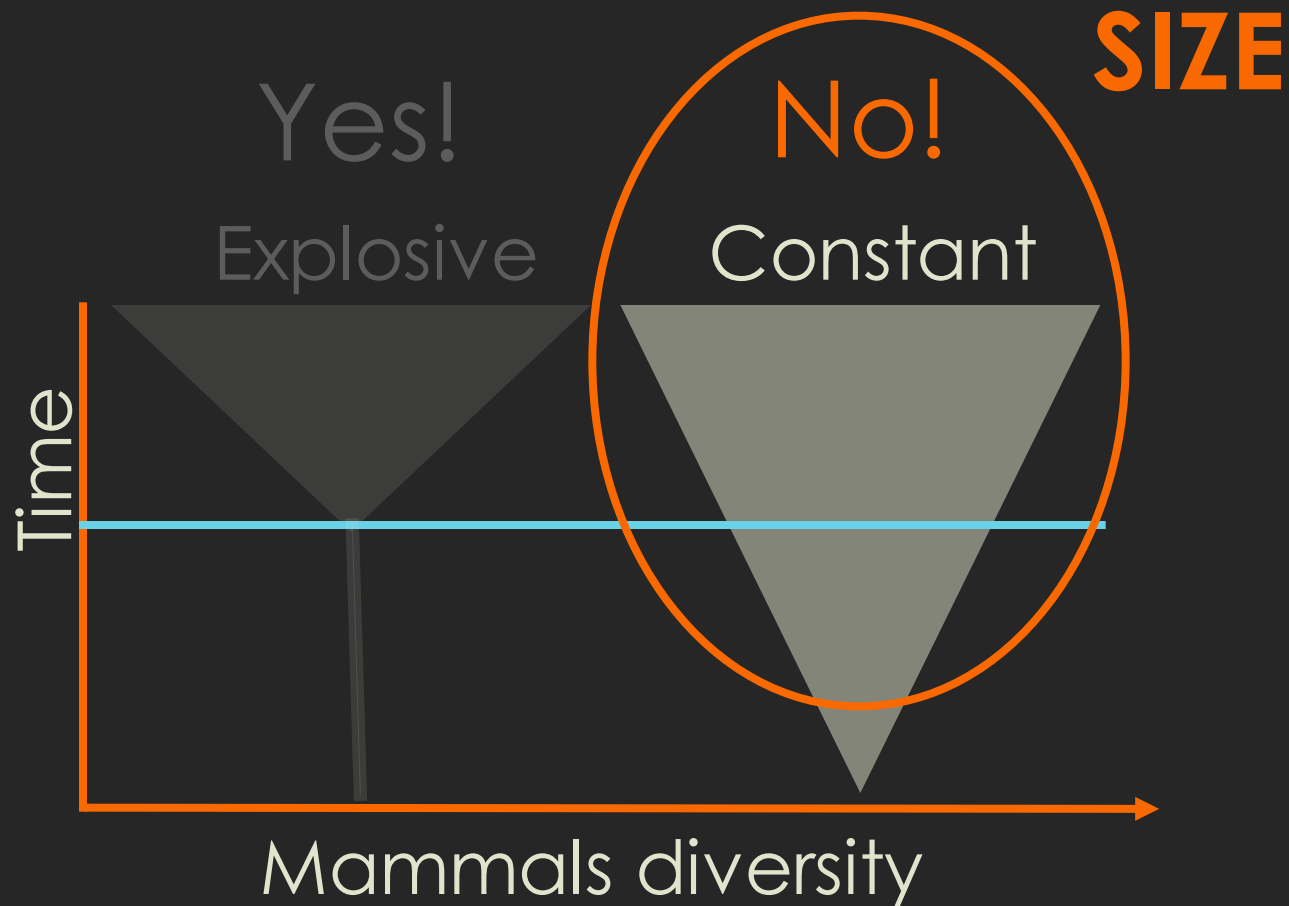
Position trends to increase (away)



Is there an effect of the K-Pg on the mode of mammalian evolution?



Is there an effect of the K-Pg on the mode of mammalian evolution?



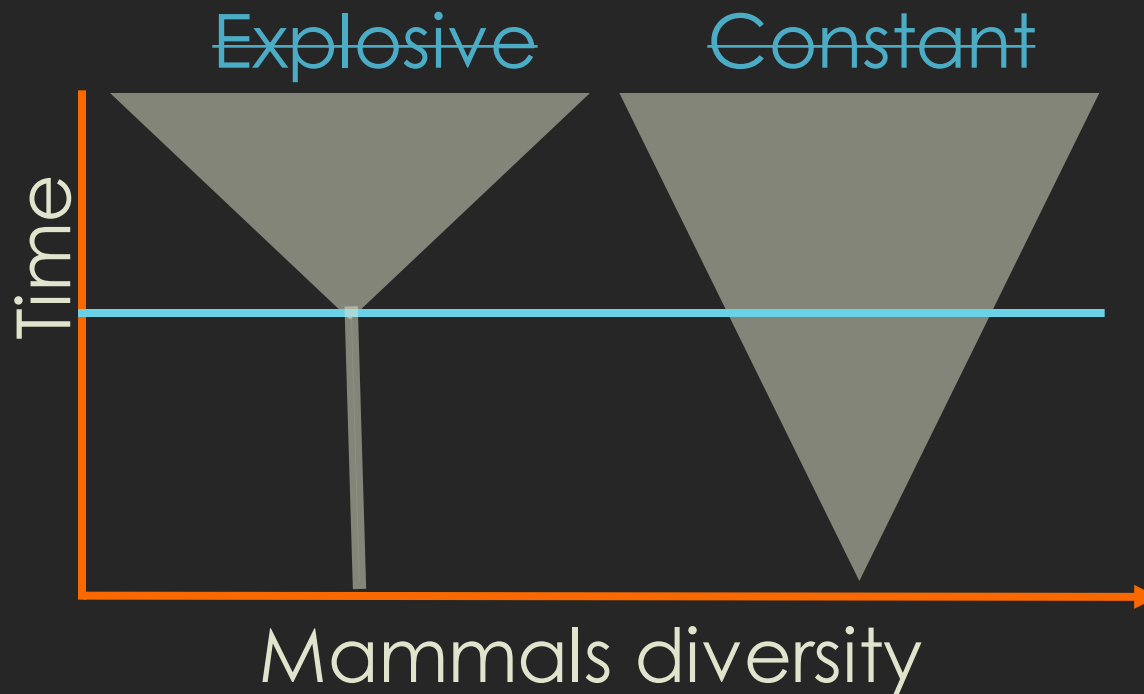
Is there an effect of the K-Pg on the mode of mammalian evolution?

POSITION



Is there an effect of the K-Pg on the mode of mammalian evolution?

It's complicated...



SAVE YOURSELF, MAMMAL!

A SATURDAY MORNING BREAKFAST CEREAL COLLECTION

BY ZACH WEINER



Don't care!
(much...)

SAVE YOURSELF, ~~MAMMAL!~~

A SATURDAY MORNING BREAKFAST

BIRDS ?



SAVE YOURSELF, MAMMAL!

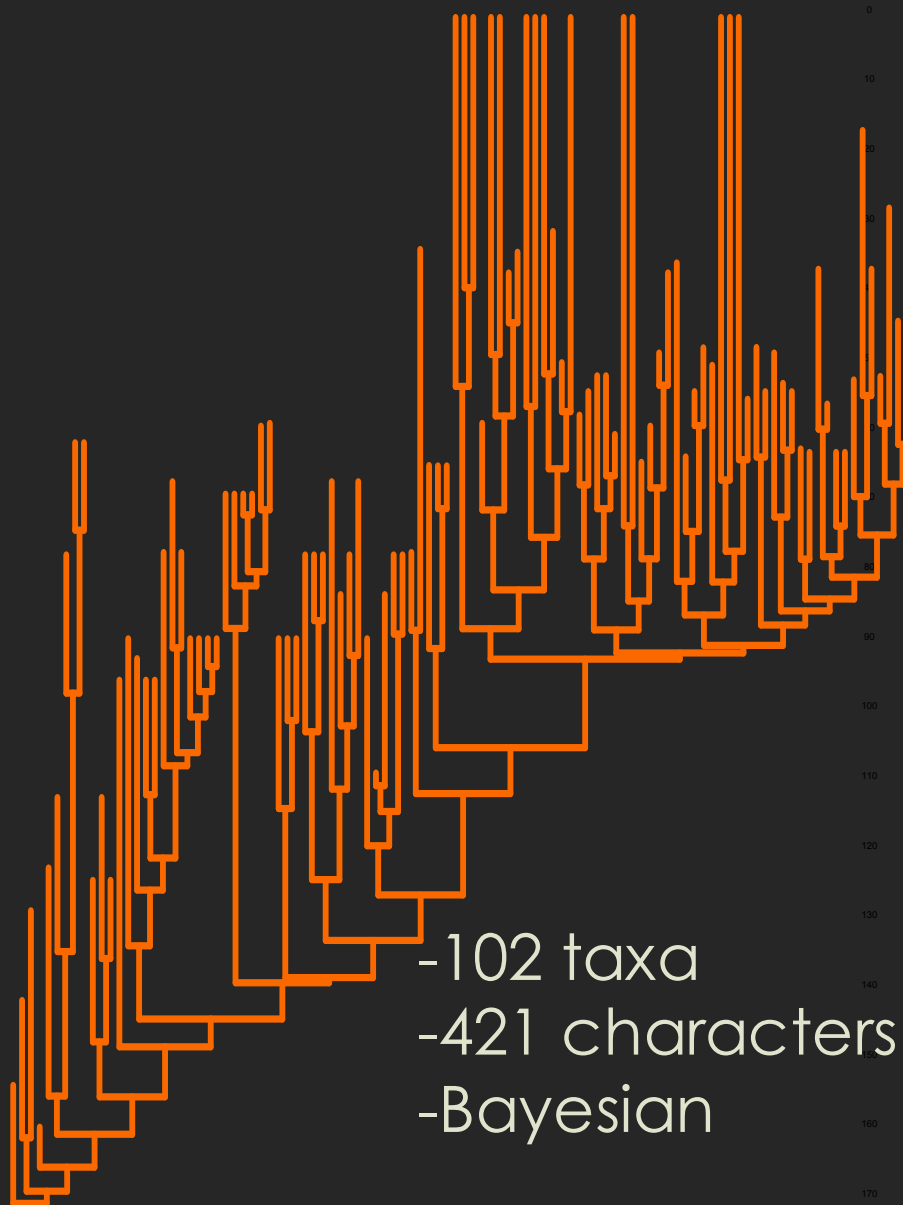
A SATURDAY MORNING BREAKFAST CEREAL COLLECTION

BY ZACH WEINER

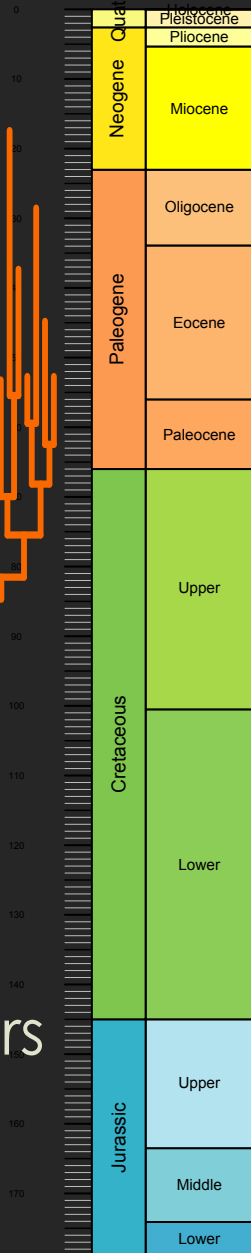
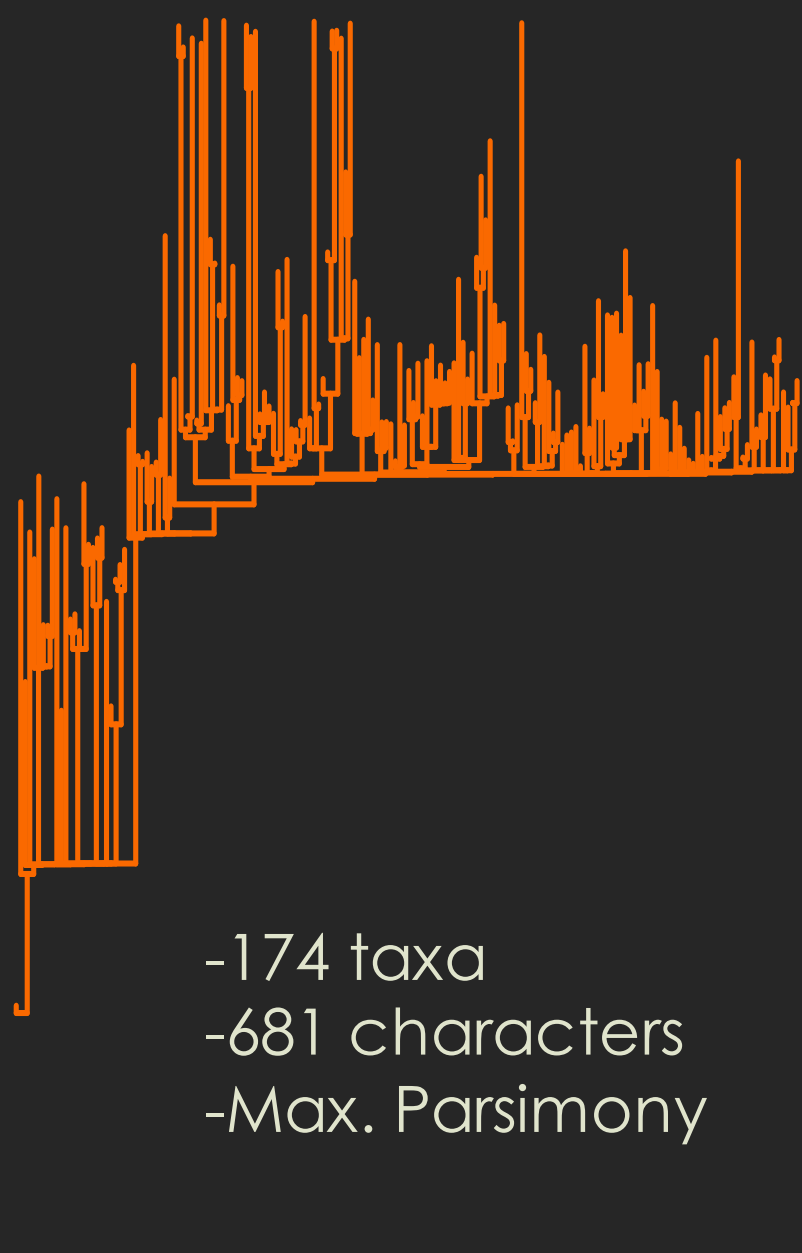
Cheers!



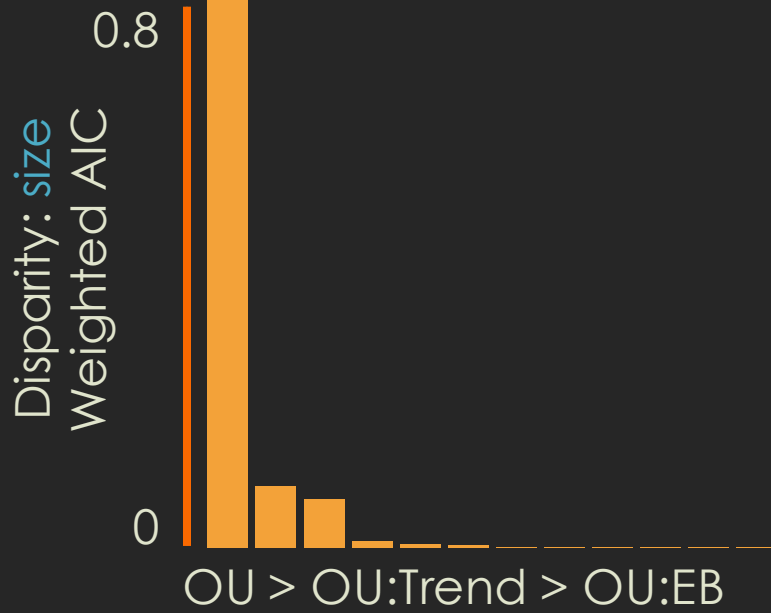
Beck & Lee 2014



Halliday & Goswami 2015



Beck & Lee 2014



Halliday & Goswami 2015

