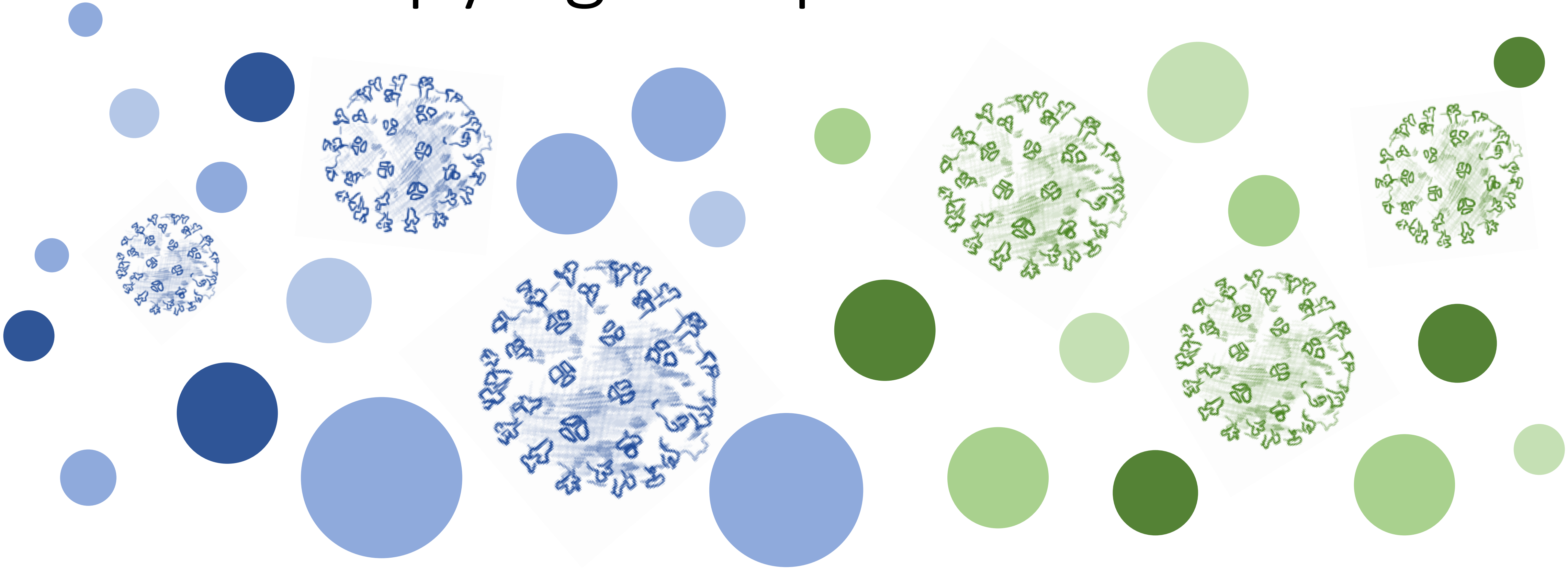
Human pathogenic RNA viruses establish noncompeting lineages by occupying independent niches



Thanks To Coauthors

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Eugene Koonin

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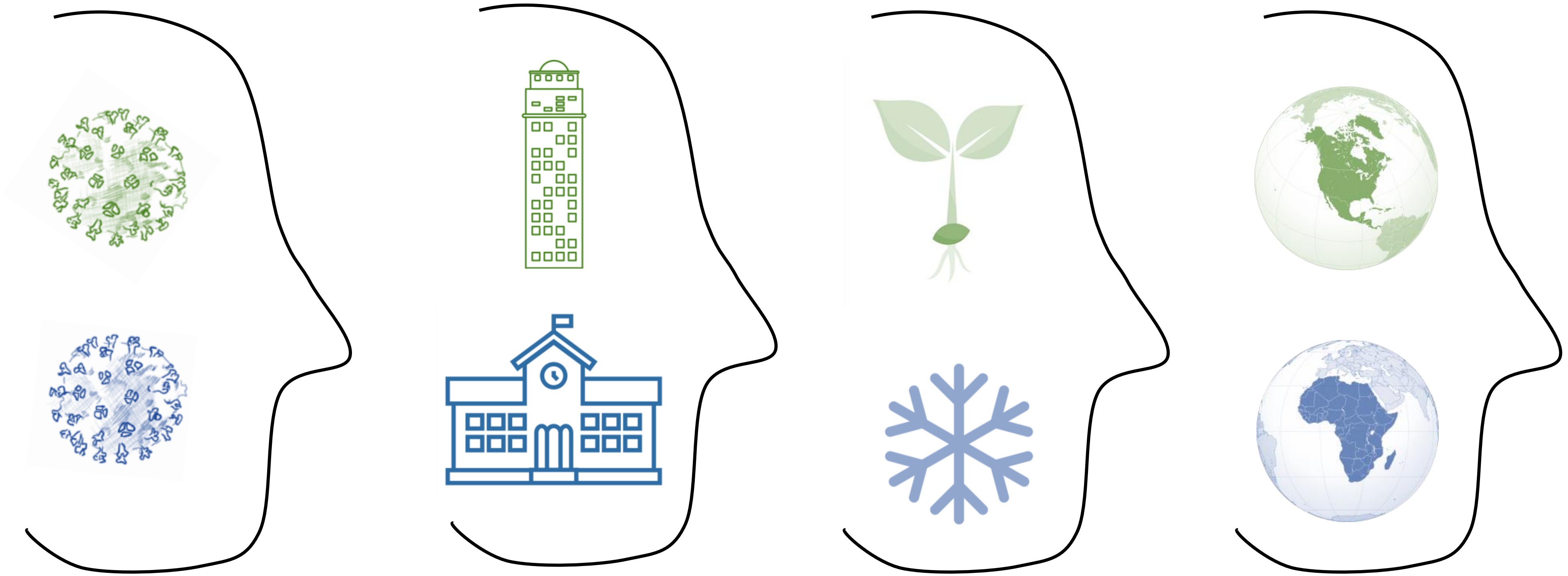

No cross immunity

Local

Seasonal

Regional

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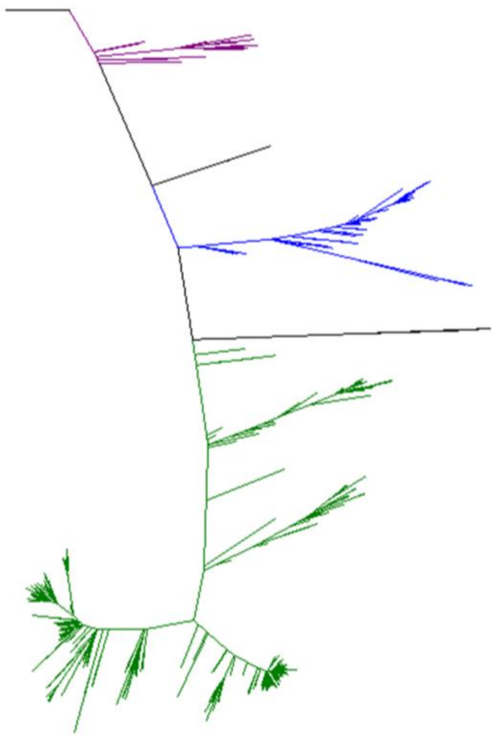
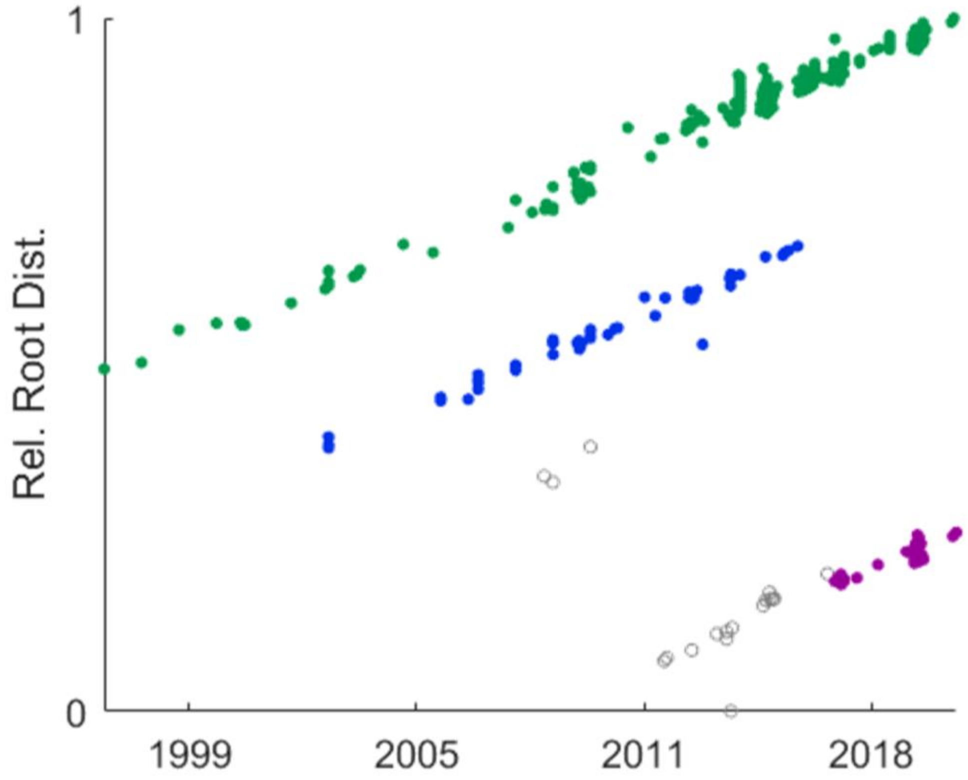
Monophyletic group (clade)
with “good”
date-constrained tree

Breaks down trees into groups
separated by periods of
apparently different
substitution rates,
likely environmental conditions

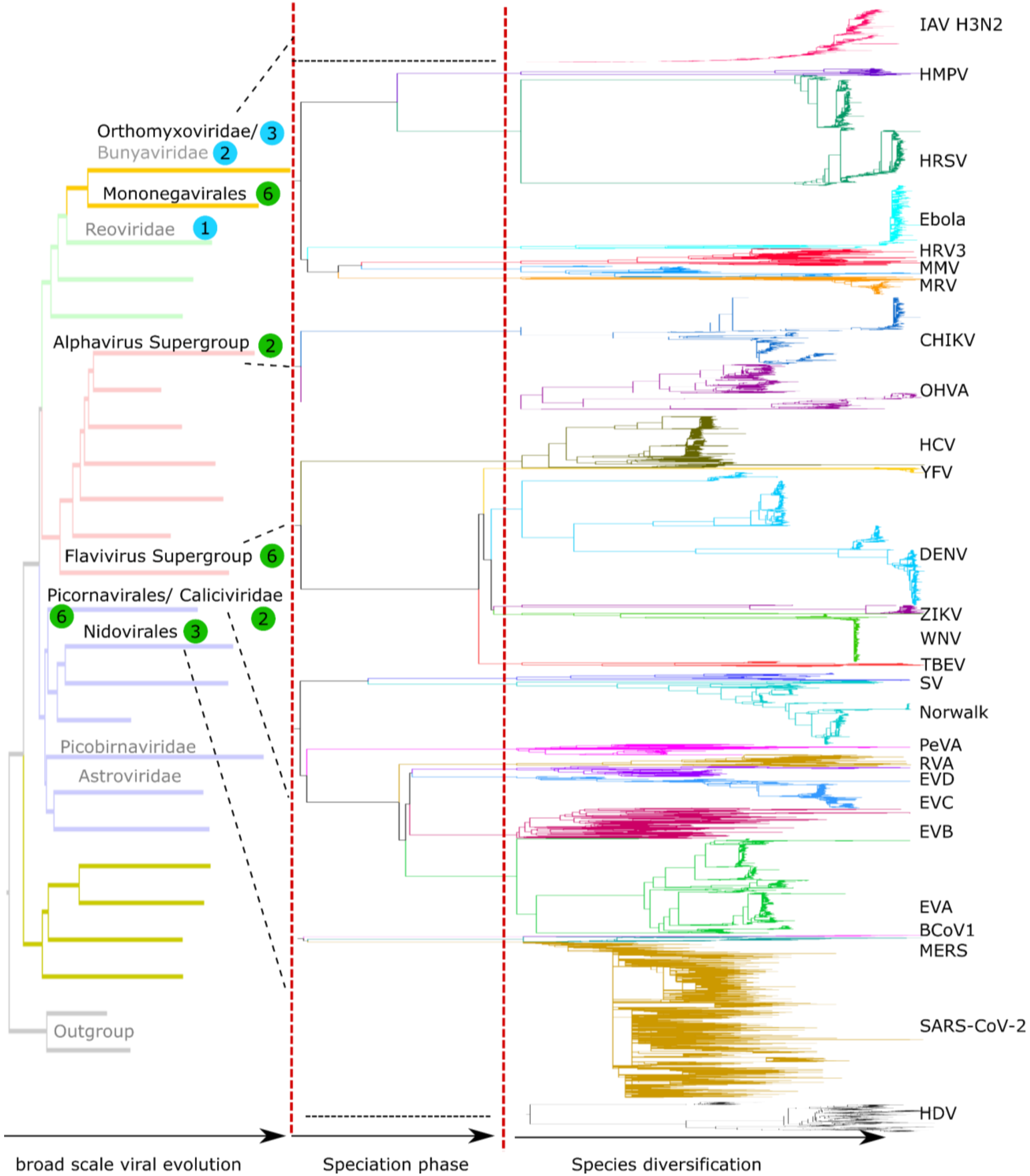




Enterovirus D

Considered all non-segmented RNA viruses with at least ~200 complete genomes.

Consider events at scale of species diversification.



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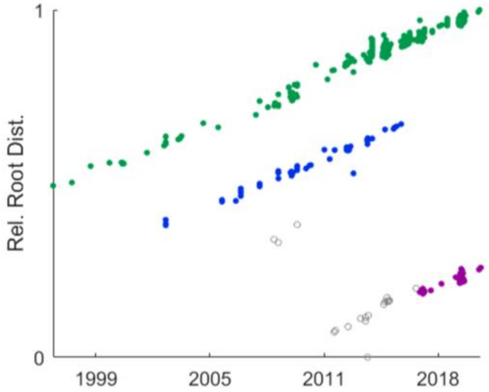
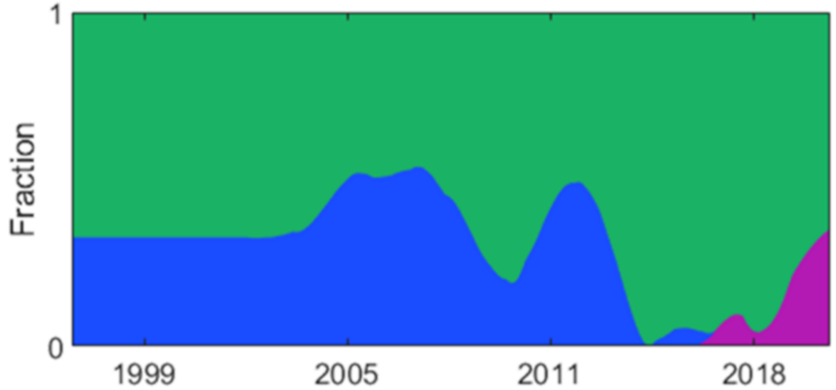
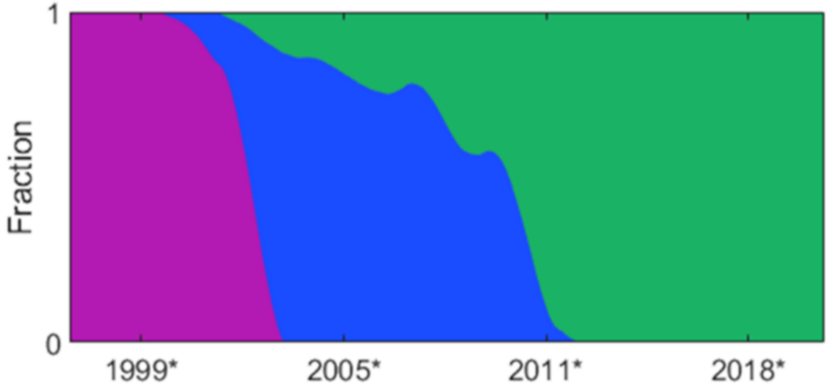
First approach: compare lineage coexistence



Real distribution of isolates



Expected distribution of isolates based on root distances



Enterovirus D

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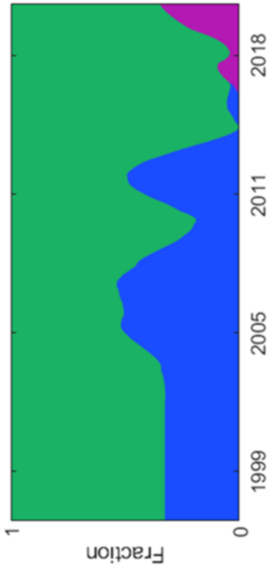
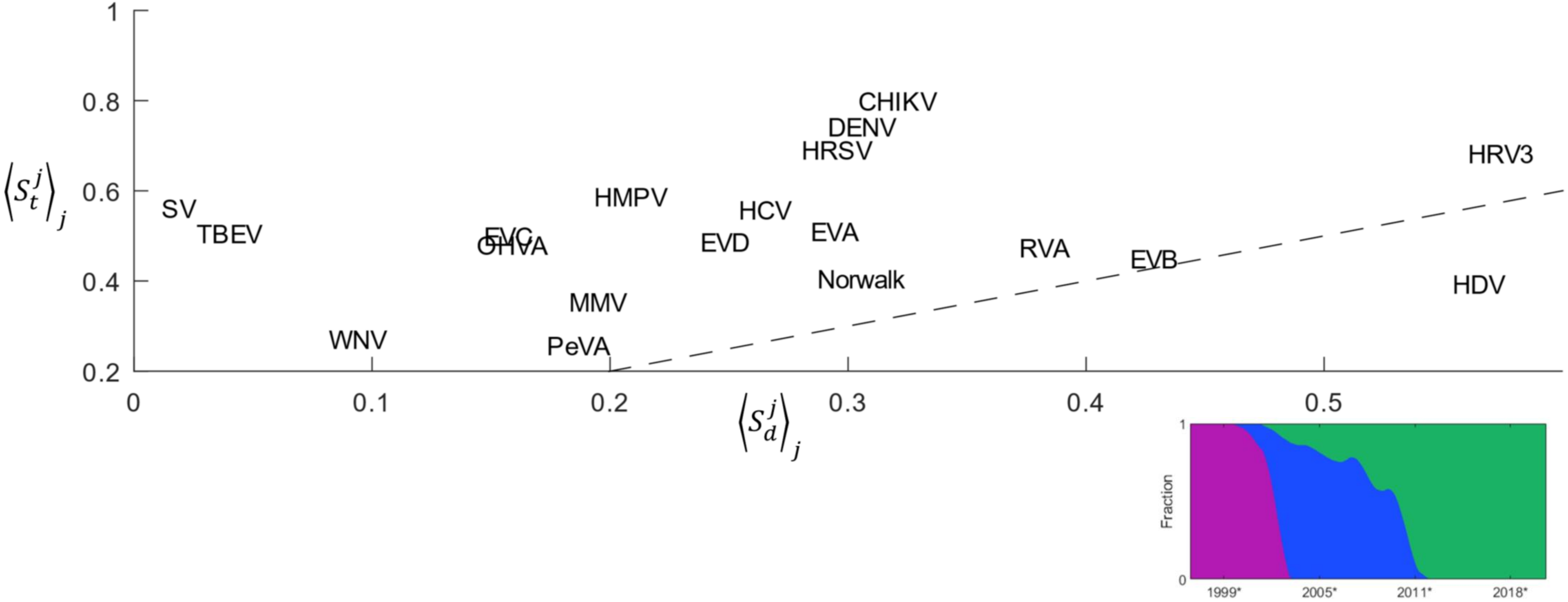
First approach: compare lineage coexistence

Lineages coexist longer than estimated from substitutions alone (no dates)





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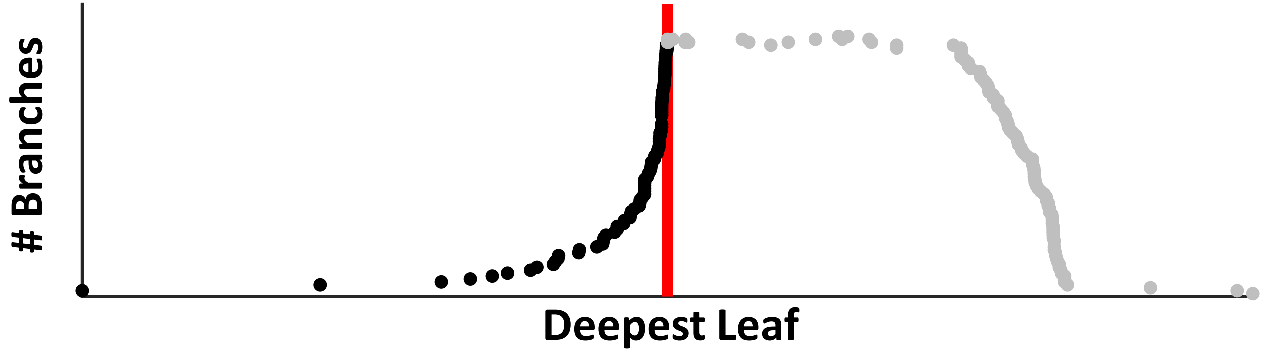
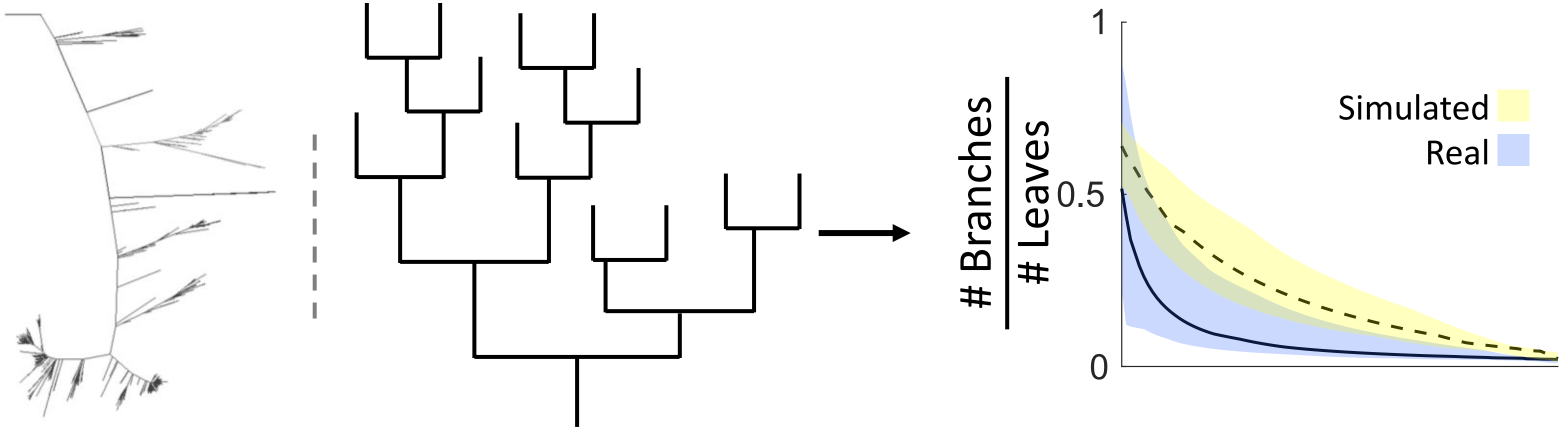
Second approach: measure coalescence rate



Build simulated trees according to neutral expectation (Yule-Harding)



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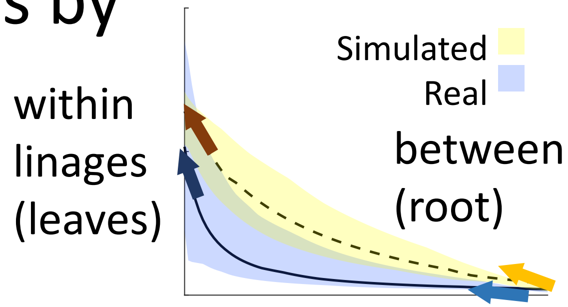


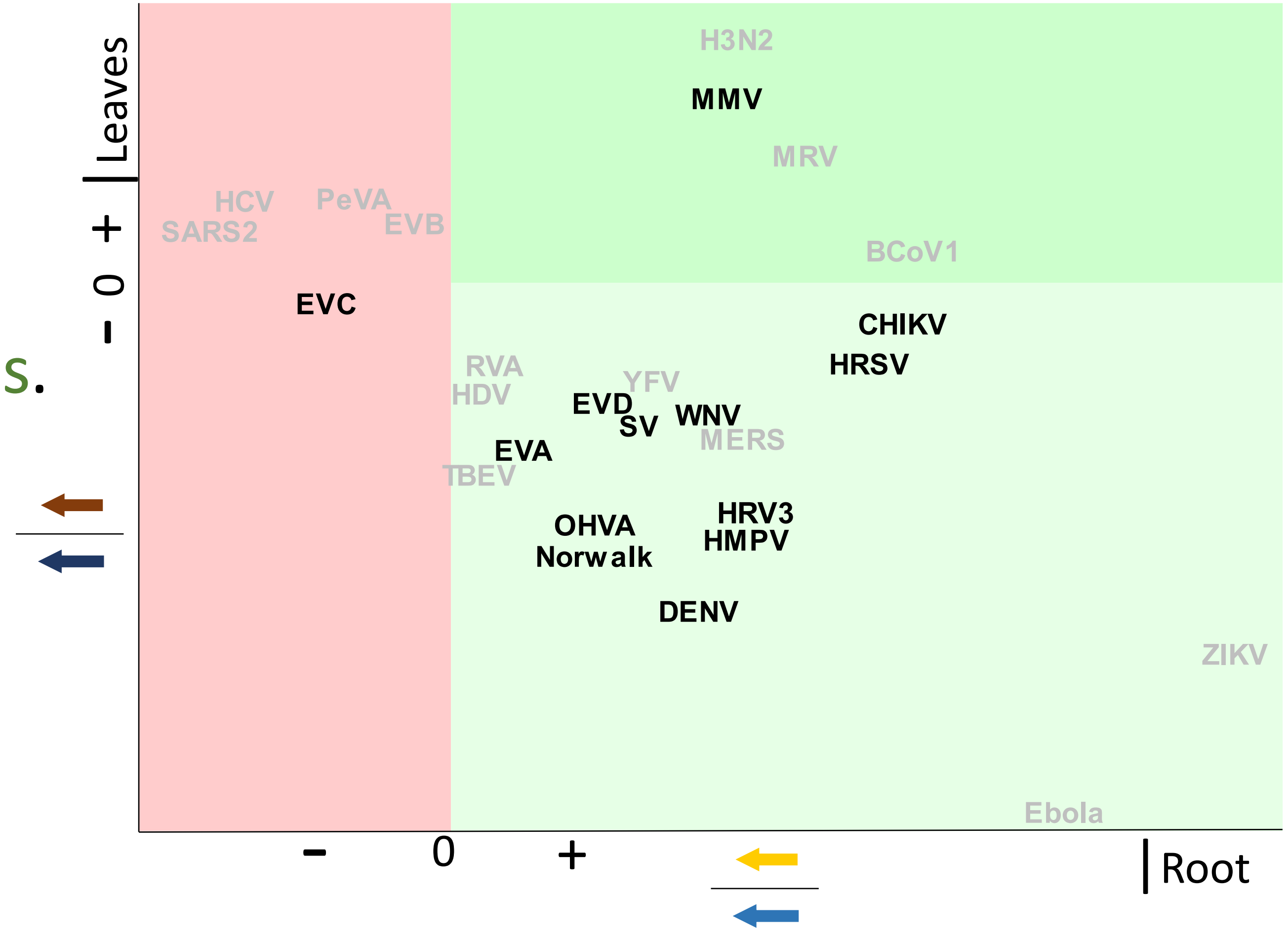
Second approach: measure coalescence rate

2+ lineages, other

All but EVC demonstrates reduced coalescence (competition) relative to neutral expectation between linages.

All but MMV demonstrates increased coalescence within lineages.

Log-fold d/dt # Branches, simulated/real



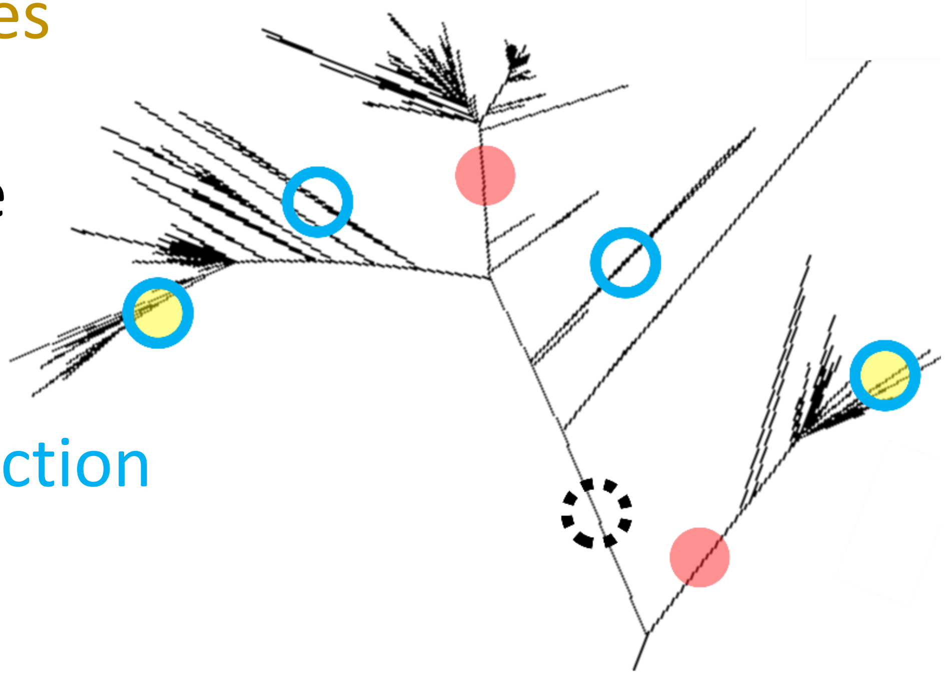
Only tempo, not the mode, of molecular evolution appears to vary substantially intra- vs. inter-lineage.

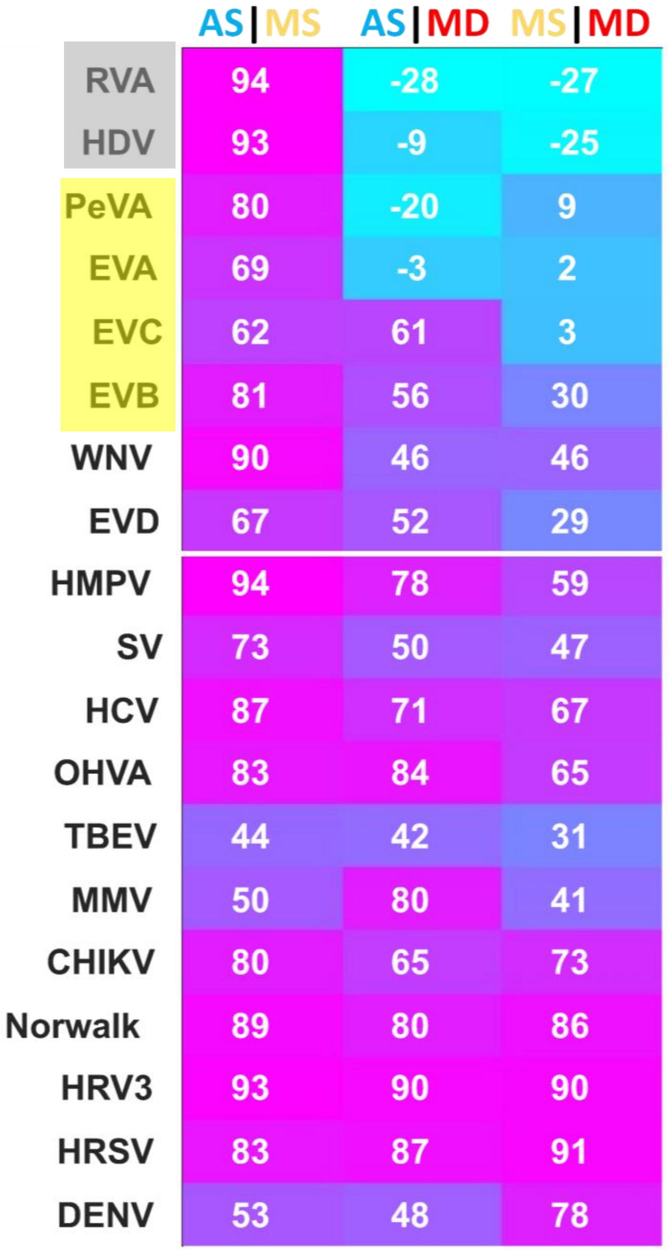
Comparison of site density of Multiple Shallow representing best estimate of adaptive sites

Multiple Deep, best estimate of linage-defining sites

All Shallow, unrelated to selection

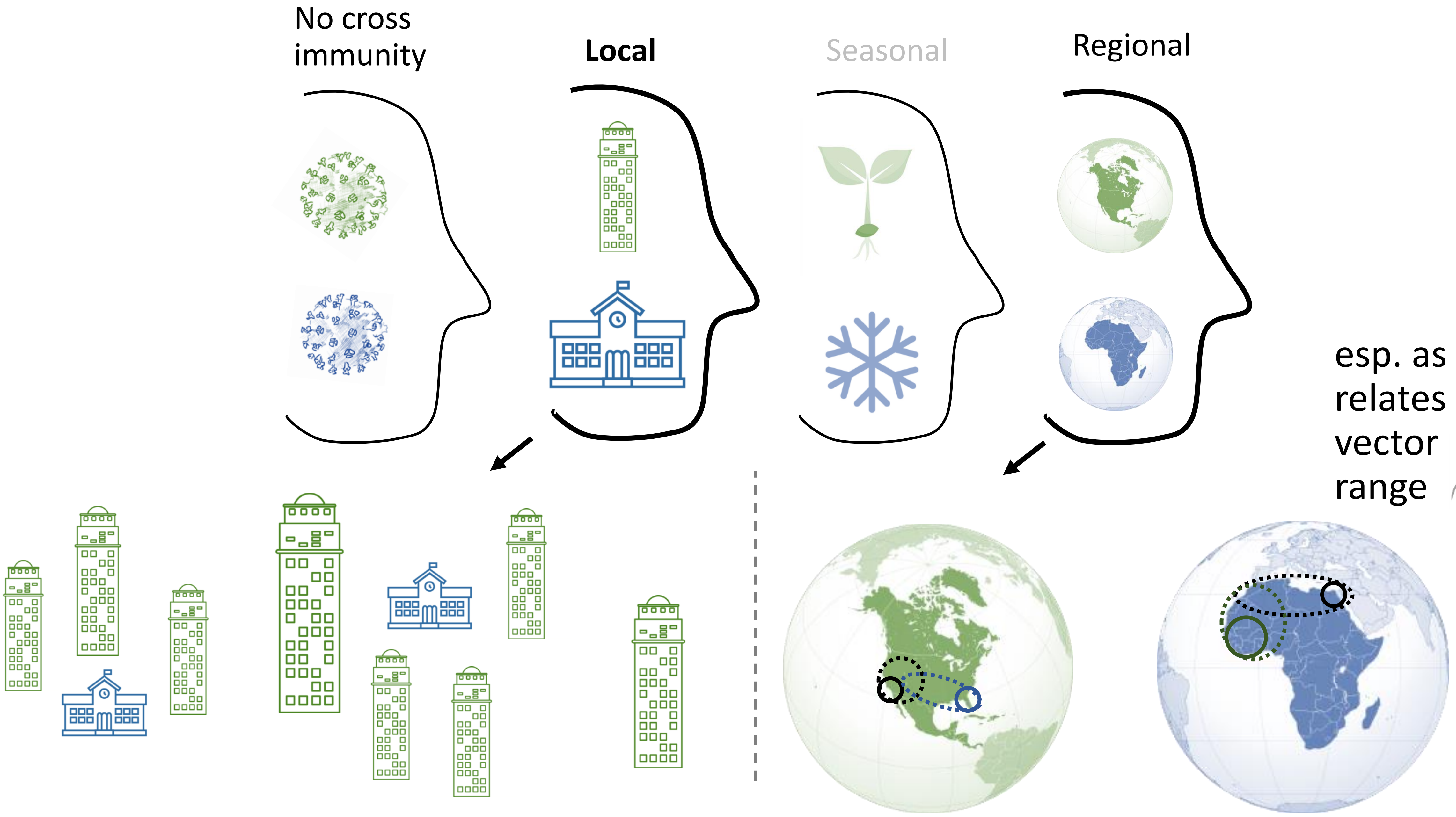
Site densities are correlated (Pearson). Exception, picornaviruses (RVA/HDV low confidence)





	AS|MS	AS|MD	MS|MD
RVA	94	-28	-27
HDV	93	-9	-25
PeVA	80	-20	9
EVA	69	-3	2
EVC	62	61	3
EVB	81	56	30
WNV	90	46	46
EVD	67	52	29
HMPV	94	78	59
SV	73	50	47
HCV	87	71	67
OHVA	83	84	65
TBEV	44	42	31
MMV	50	80	41
CHIKV	80	65	73
Norwalk	89	80	86
HRV3	93	90	90
HRSV	83	87	91
DENV	53	48	78

Environmental change: urbanization and climate change may disrupt niches



esp. as this relates to vector range

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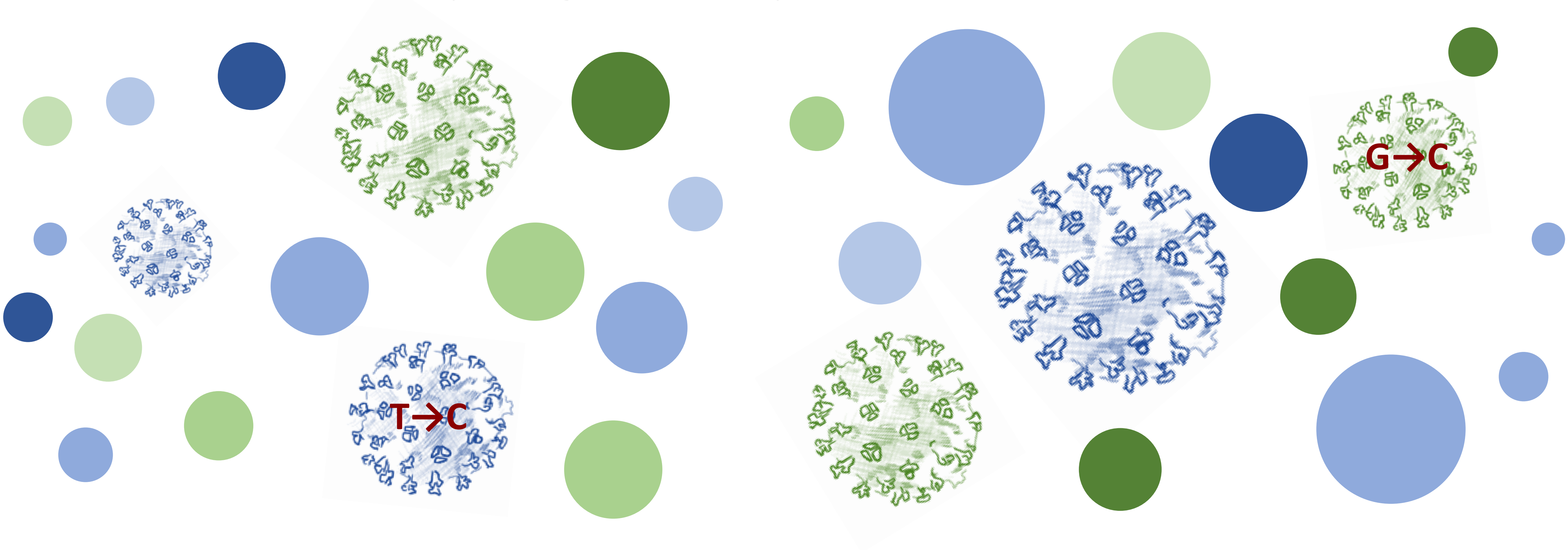

Thanks For Listening

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World Health Organization