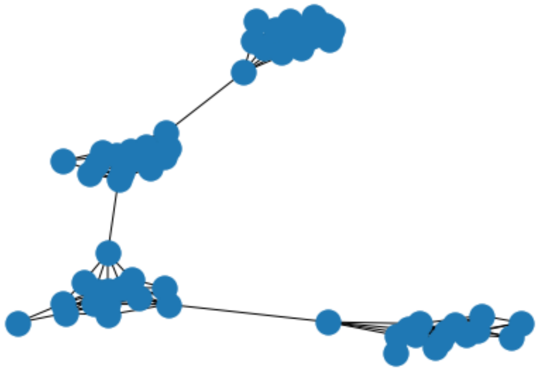
Diffusive dynamics

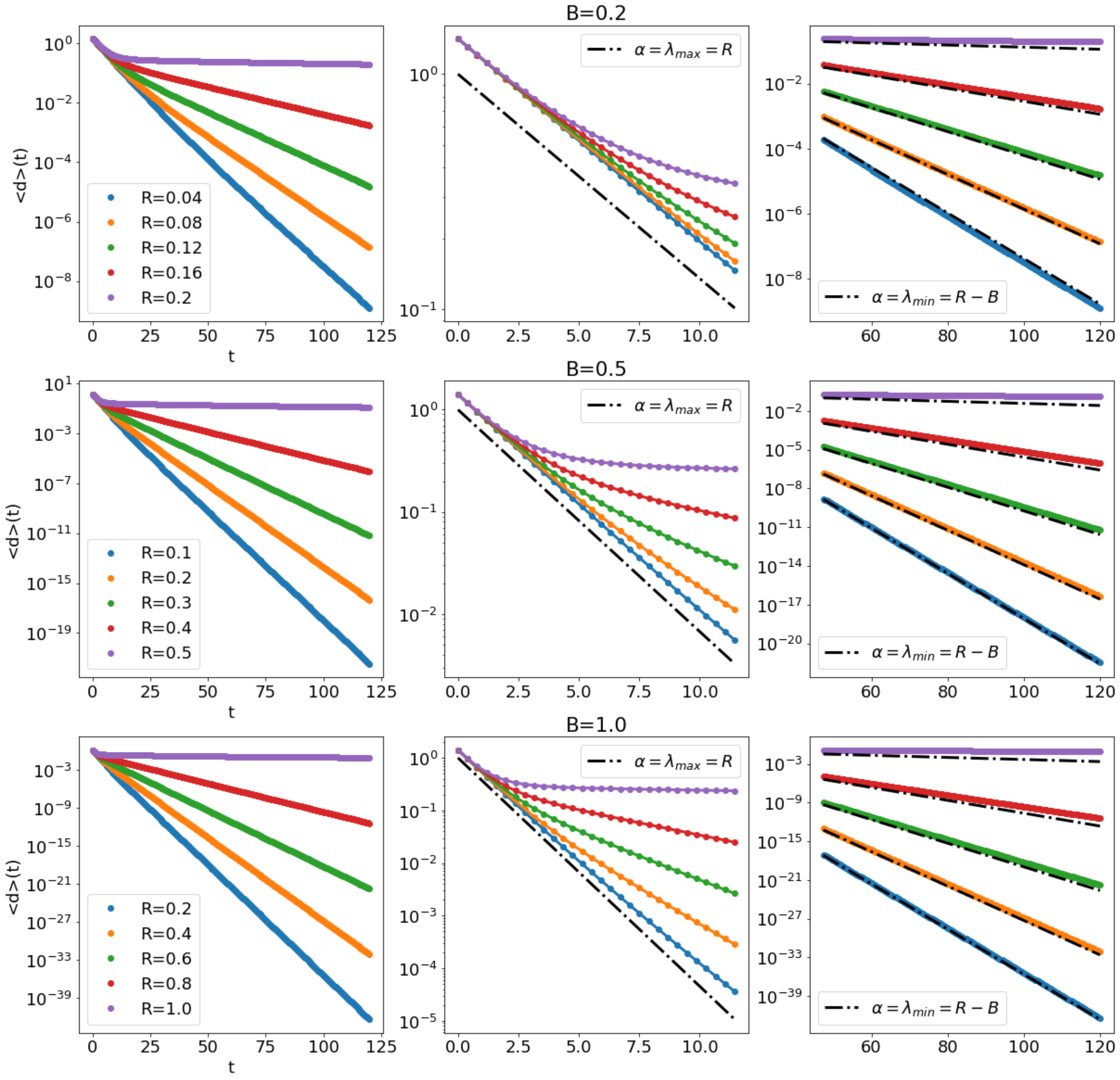
$\dot{x}_i = -Bx_i + Rk_i^{-1}\sum_j A_{ij}x_j$
$J_{ij} = -B * \delta_{ij} + R * k_i^{-1} * A_{ij}$

if B=R=1 -> $J_{ij} = -L_{ij}$

$\lambda_{max} = -B$
$\lambda_{min} = -(B-R)$
stable only if $\lambda_{min} < 0 -> B > R$



Average distance vs. time
for different parameters B and R



it seems that:

- $\langle d \rangle(t) \sim e^{-\lambda_{max} t}$ for small t
- $\langle d \rangle(t) \sim e^{-\lambda_{min} t}$ for large t

BUT not able to prove it analytically

Diffusive dynamics

$\dot{x}_i = -Bx_i + Rk_i^{-1} \sum_j A_{ij} x_j$
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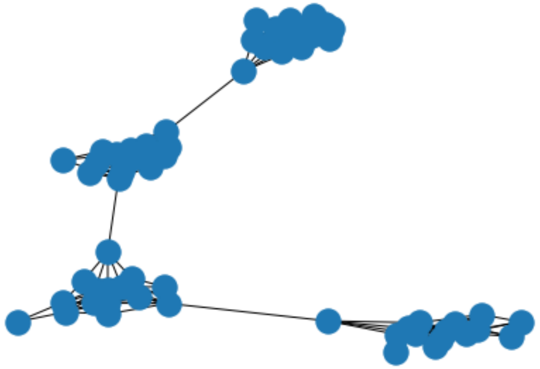
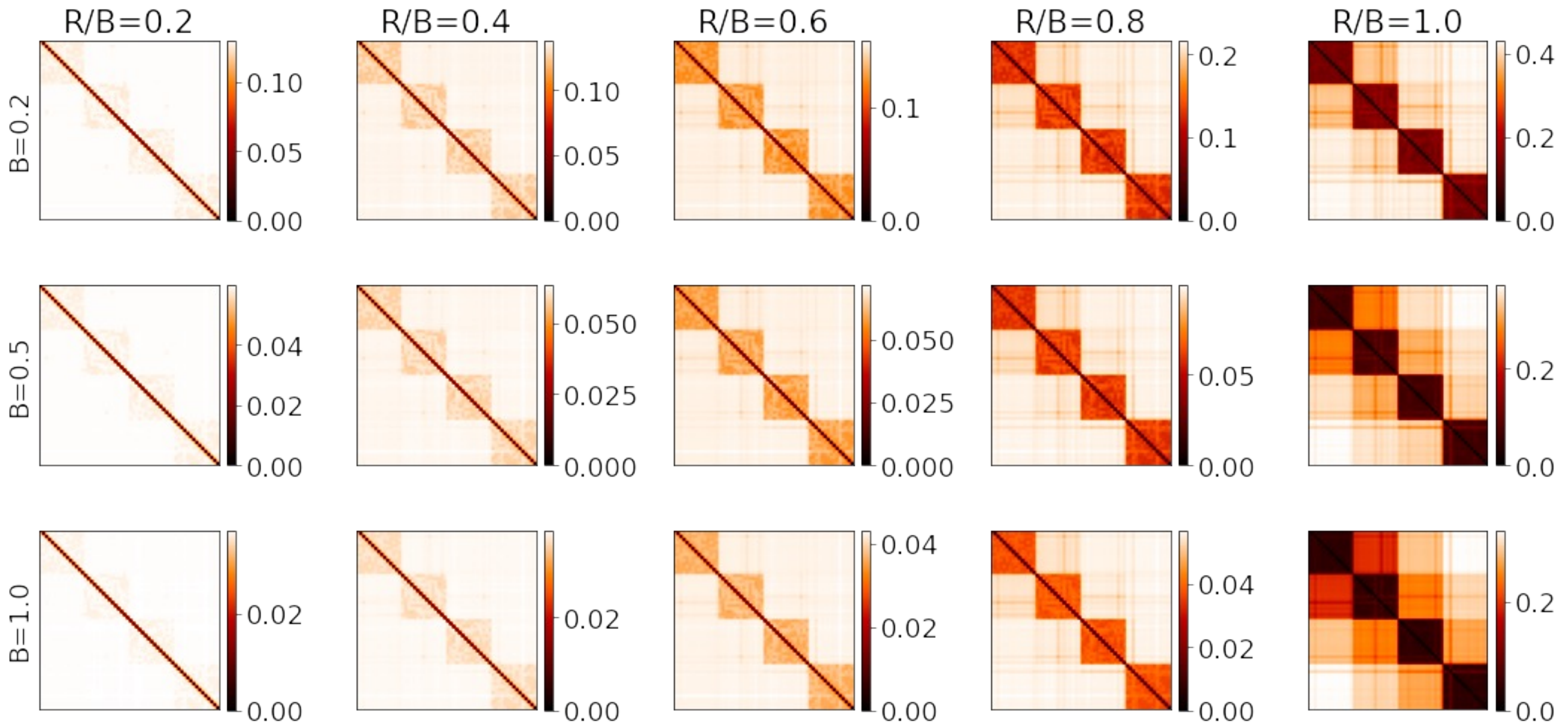


Average distance matrix (for different parameters B and R)



** average up to tmax = N (network size)

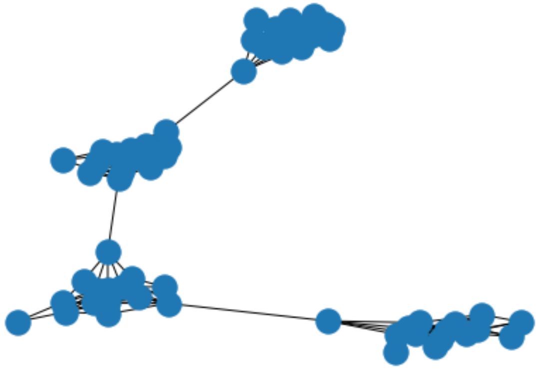
- large B -> more importance on exp decay => less effect of topology
- large R -> more importance on diffusive part => more effect of topology

Diffusive dynamics

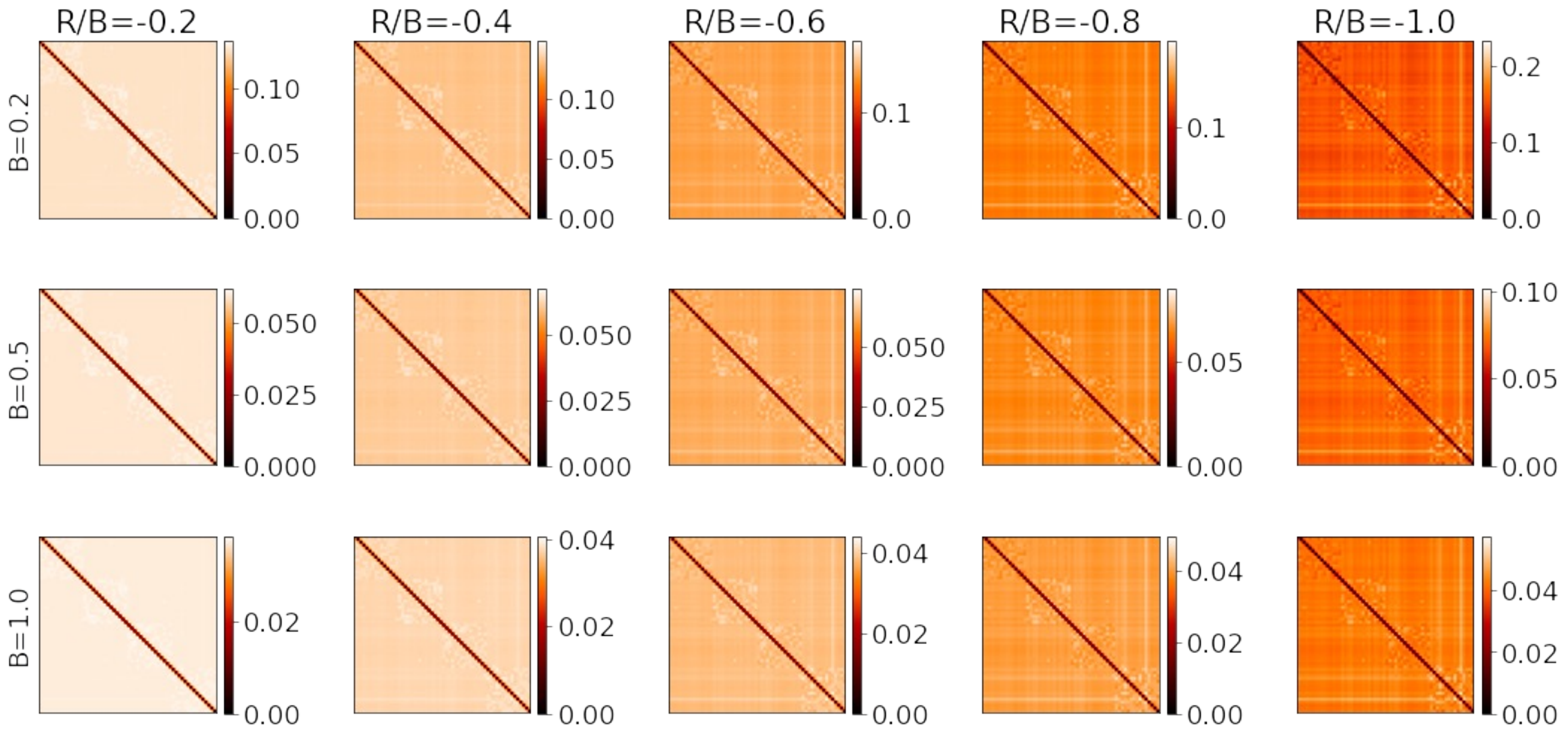
$\dot{x}_i = -Bx_i + Rk_i^{-1} \sum_j A_{ij}x_j$
$J_{ij} = -B * \delta_{ij} + R * k_i^{-1} * A_{ij}$

if B=R=1 -> $J_{ij} = -L_{ij}$

$\lambda_{max} = -B$
$\lambda_{min} = -(B - R)$
stable only if $\lambda_{min} < 0- > B > R$

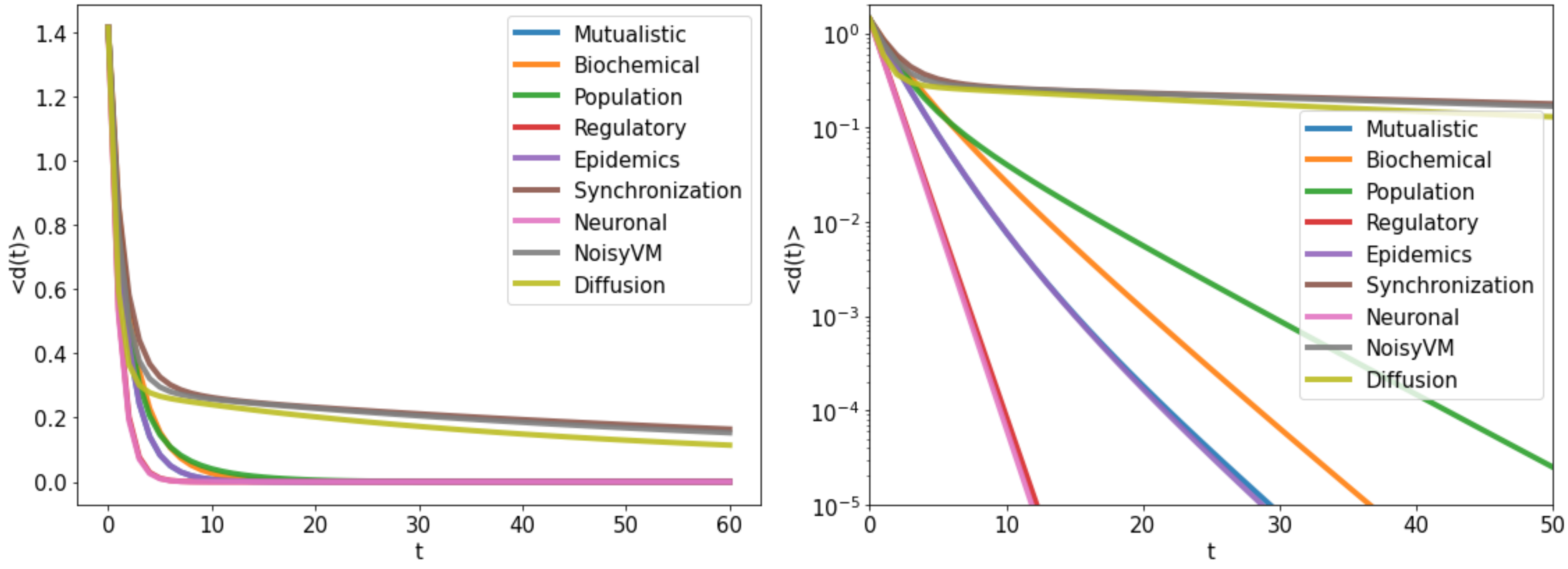


if R is negative -> even less effect of topology



Jacobian dynamics

** all the parameters are fixed to 1
** normalize t -> t / λmax



Jacobian dynamics

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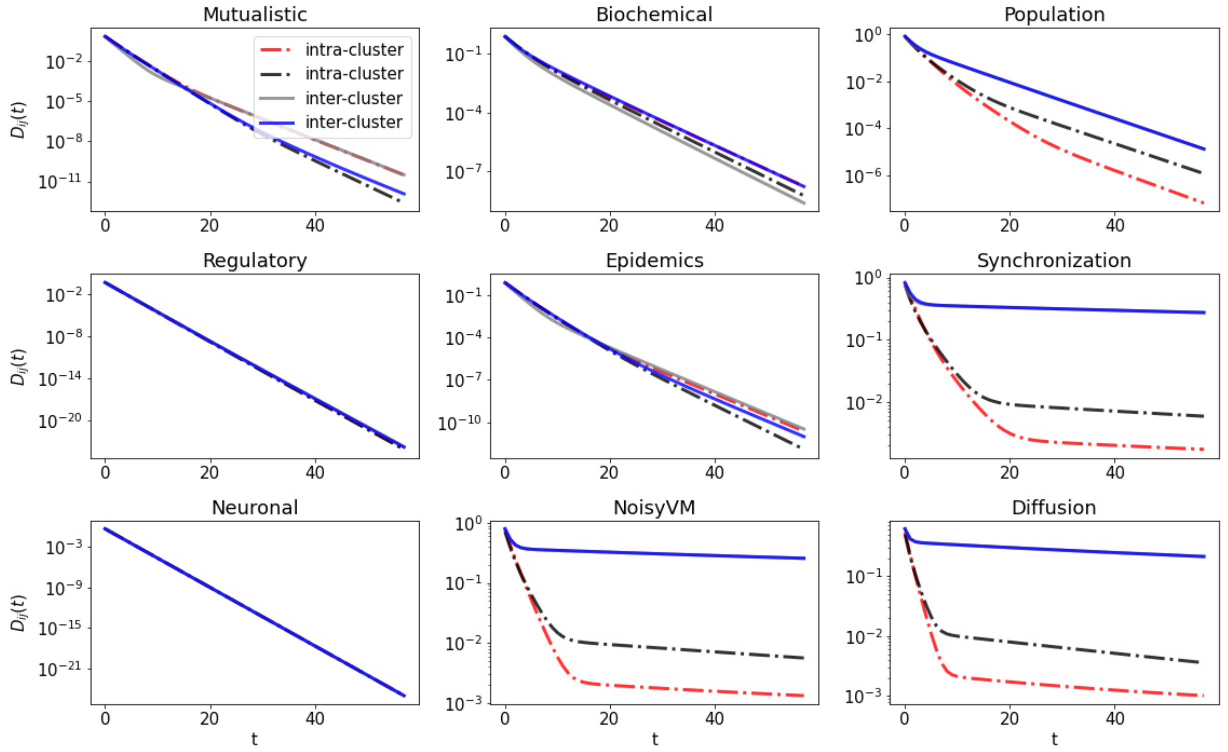
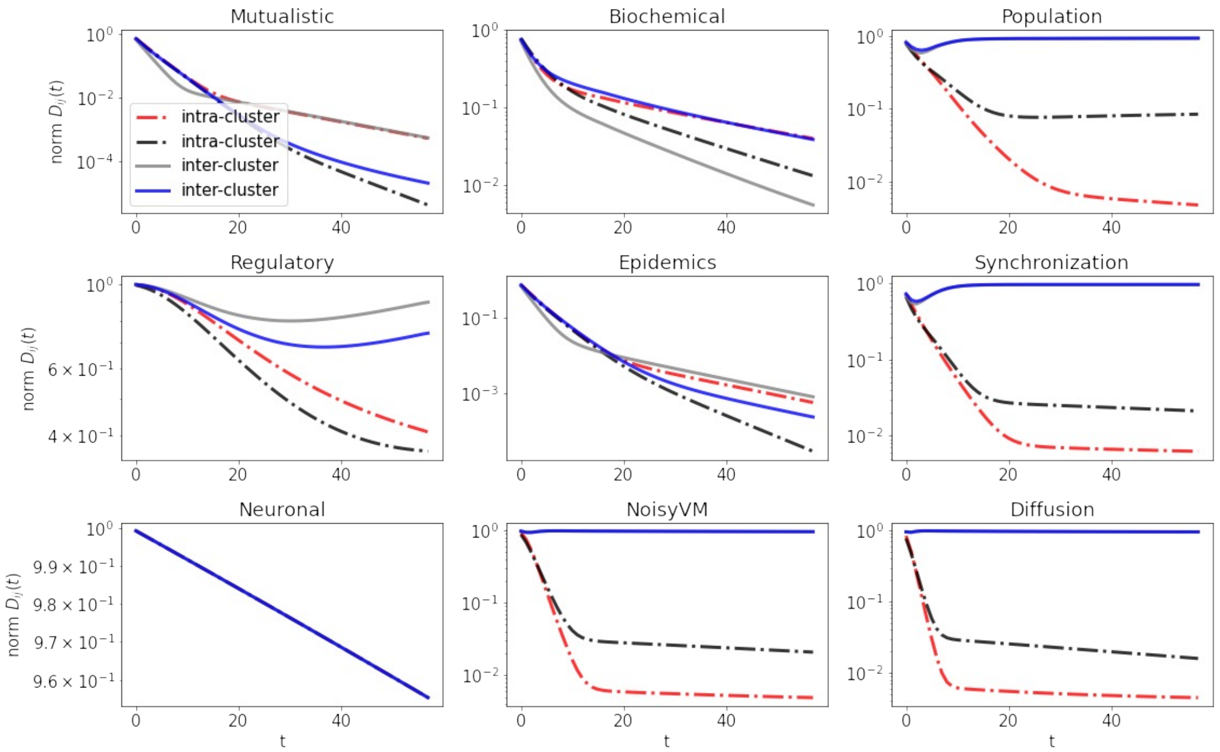


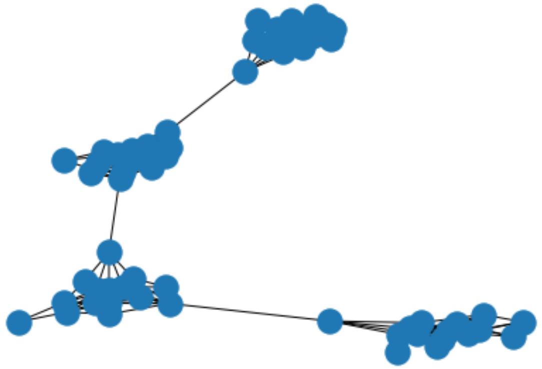
if <d> decay too fast -> when we compute average distance, only the first timesteps will count

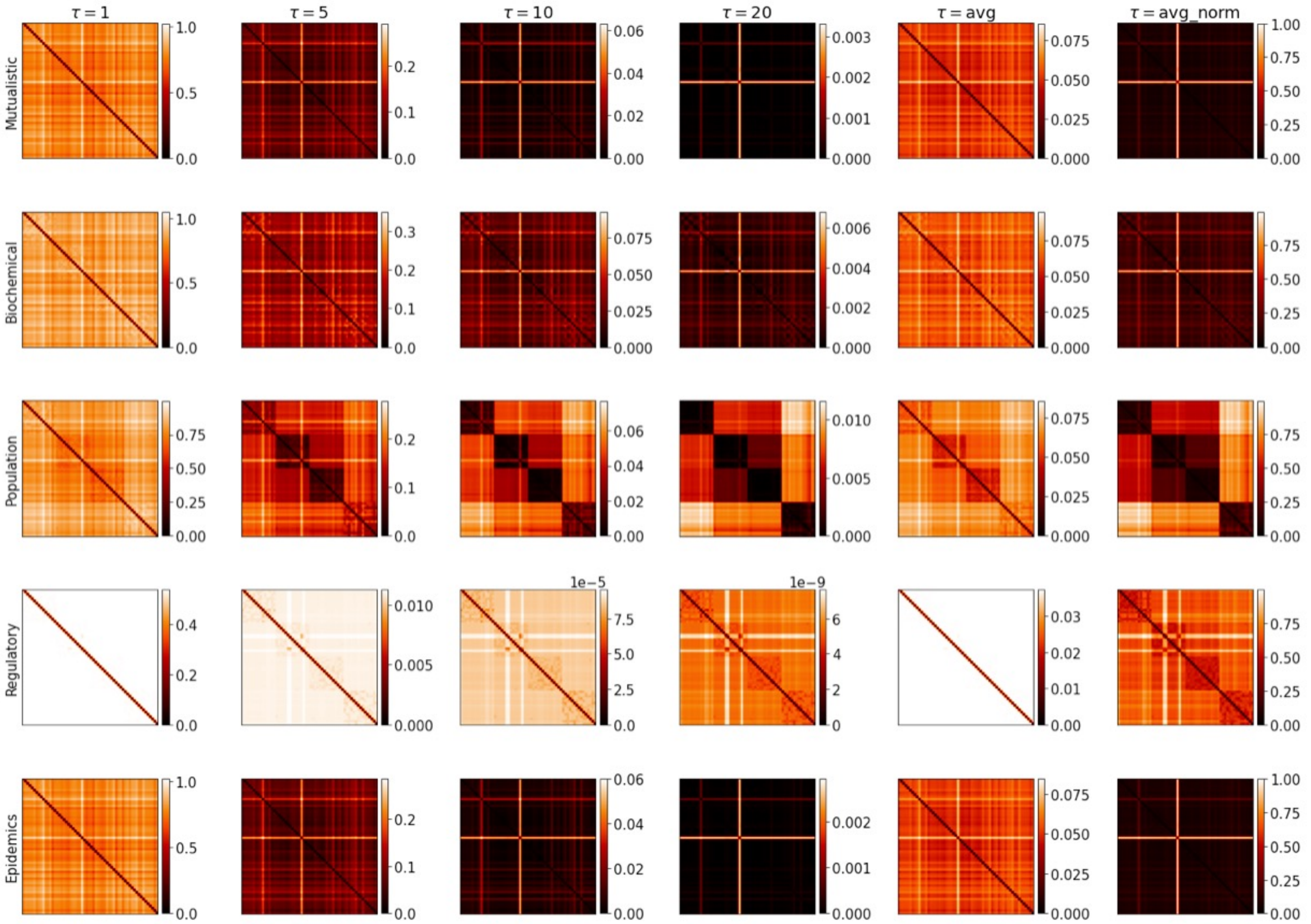


if normalize d_ij(t) wrt max d_ij(t) -> all the timesteps are more evenly taken into account when computing average distance matrix

Jacobian dynamics

** all the parameters are fixed to 1
** normalize t -> t / λmax





Jacobian dynamics

** all the parameters are fixed to 1
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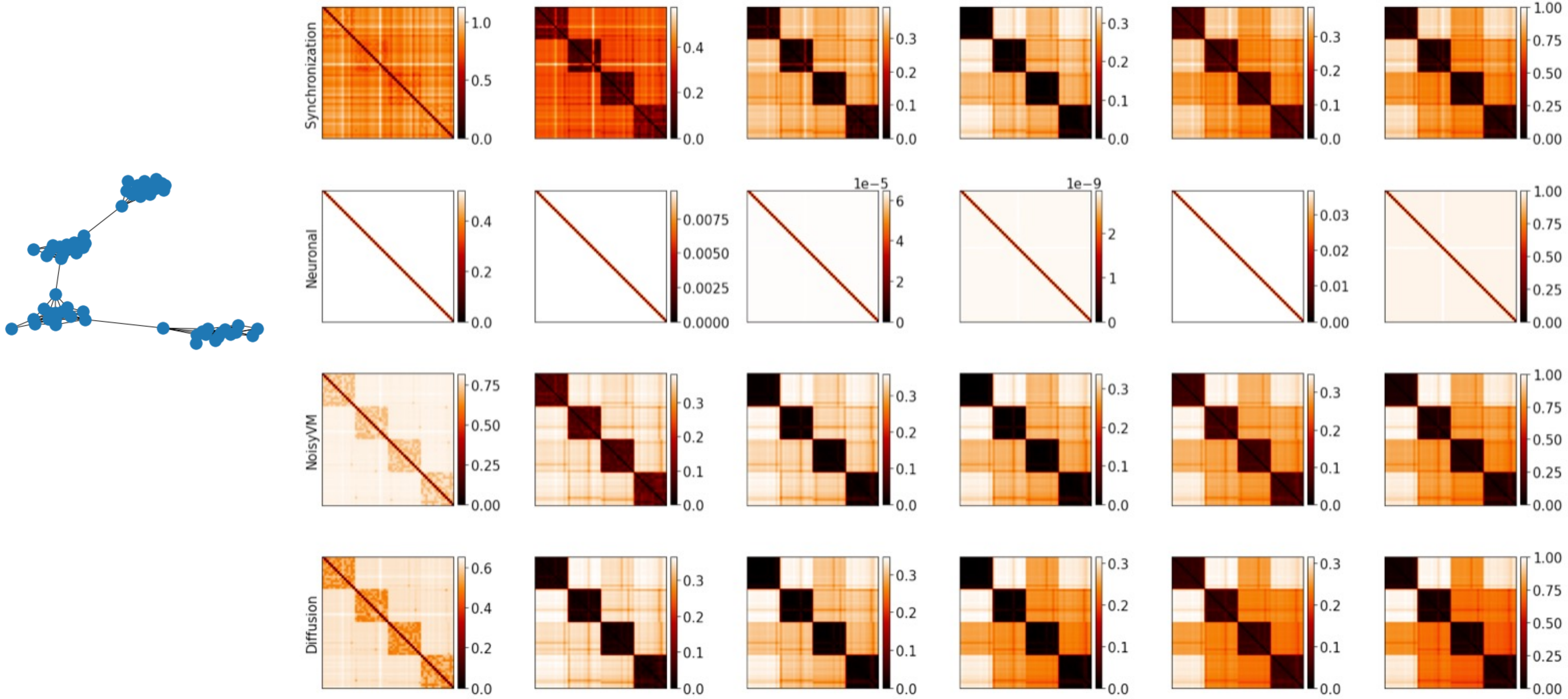

Jacobian dynamics

** all the parameters are fixed to 1
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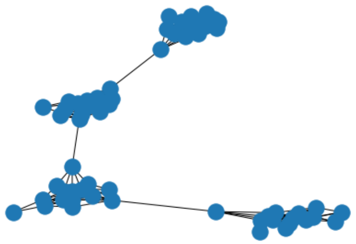
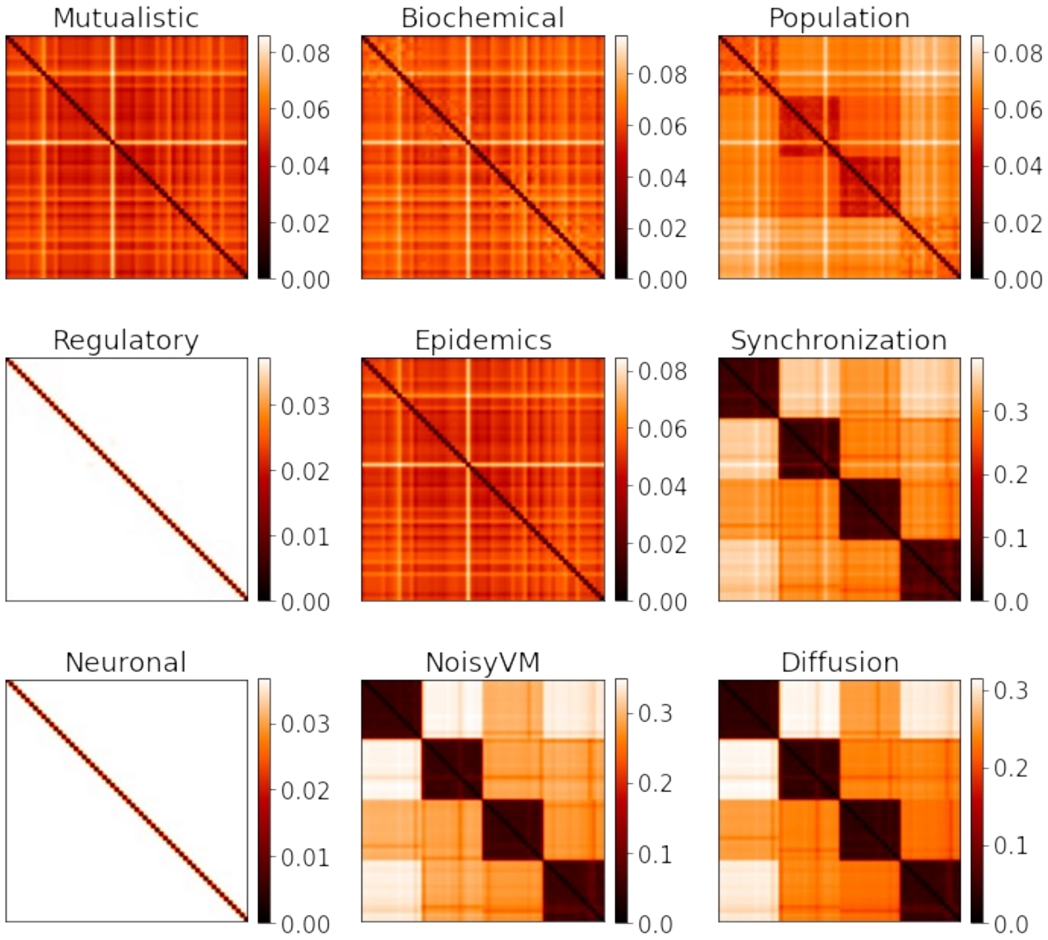
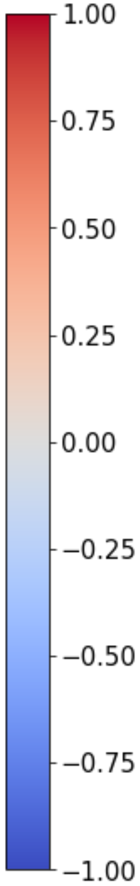


Average



Mantel's test (to compare similarity)

	BIO	POP	REG	EPI	SYN	NEU	NVM	DIF
MUT	0.95	0.59	-0.1	1.0	0.11	0.7	0.04	0.04
BIO		0.47	-0.24	0.94	0.04	0.59	-0.03	-0.02
POP			0.33	0.63	0.71	0.3	0.66	0.66
REG				-0.08	0.55	0.05	0.56	0.54
EPI					0.13	0.69	0.07	0.07
SYN						0.08	1.0	0.99
NEU							0.04	0.04
NVM								0.99

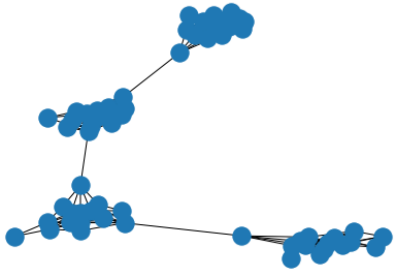


Similar dynamics:
- mut, bio, epi
- syn, nvm, dif

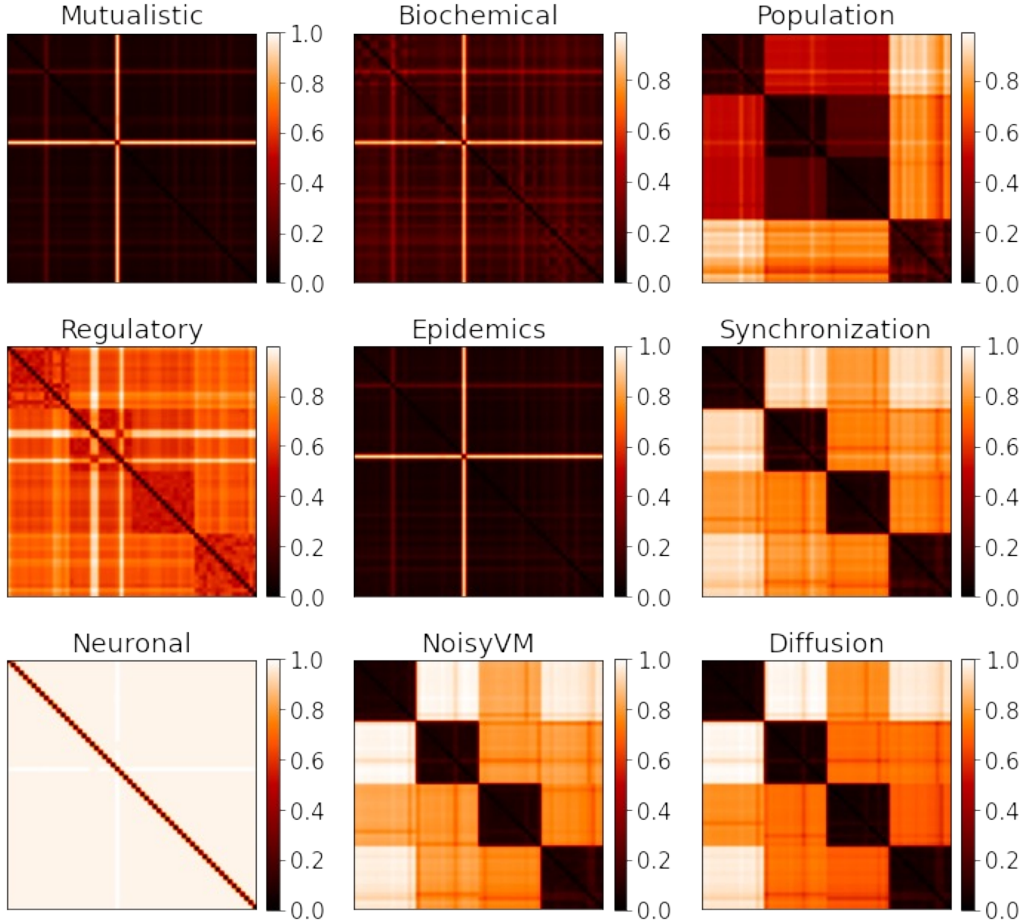
Can we predict these similar patterns from the analytical form of the dynamics?

Jacobian dynamics

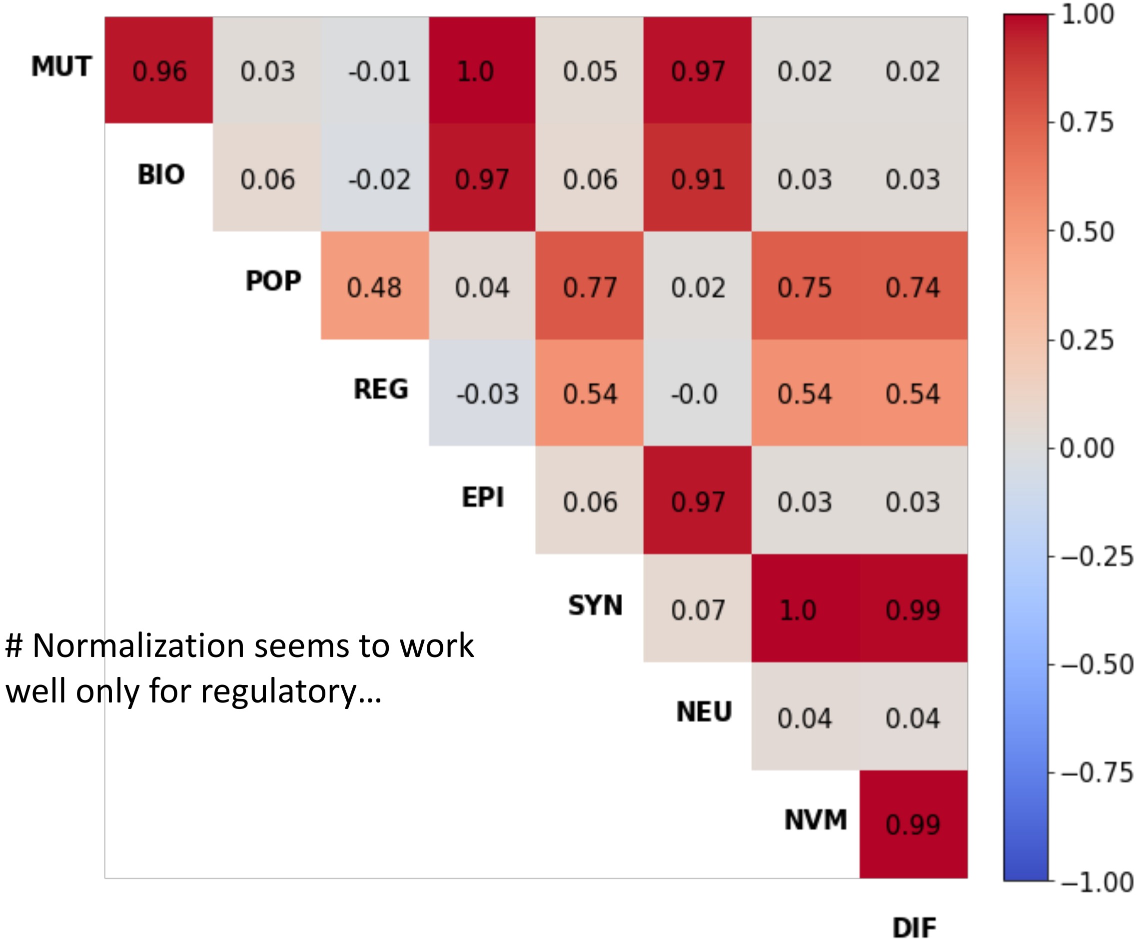
** all the parameters are fixed to 1
** normalize t -> t / λmax



Average Normalized



Mantel's test (to compare similarity)



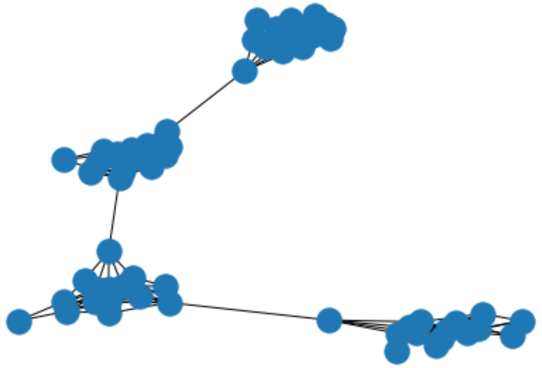
Normalization seems to work well only for regulatory...

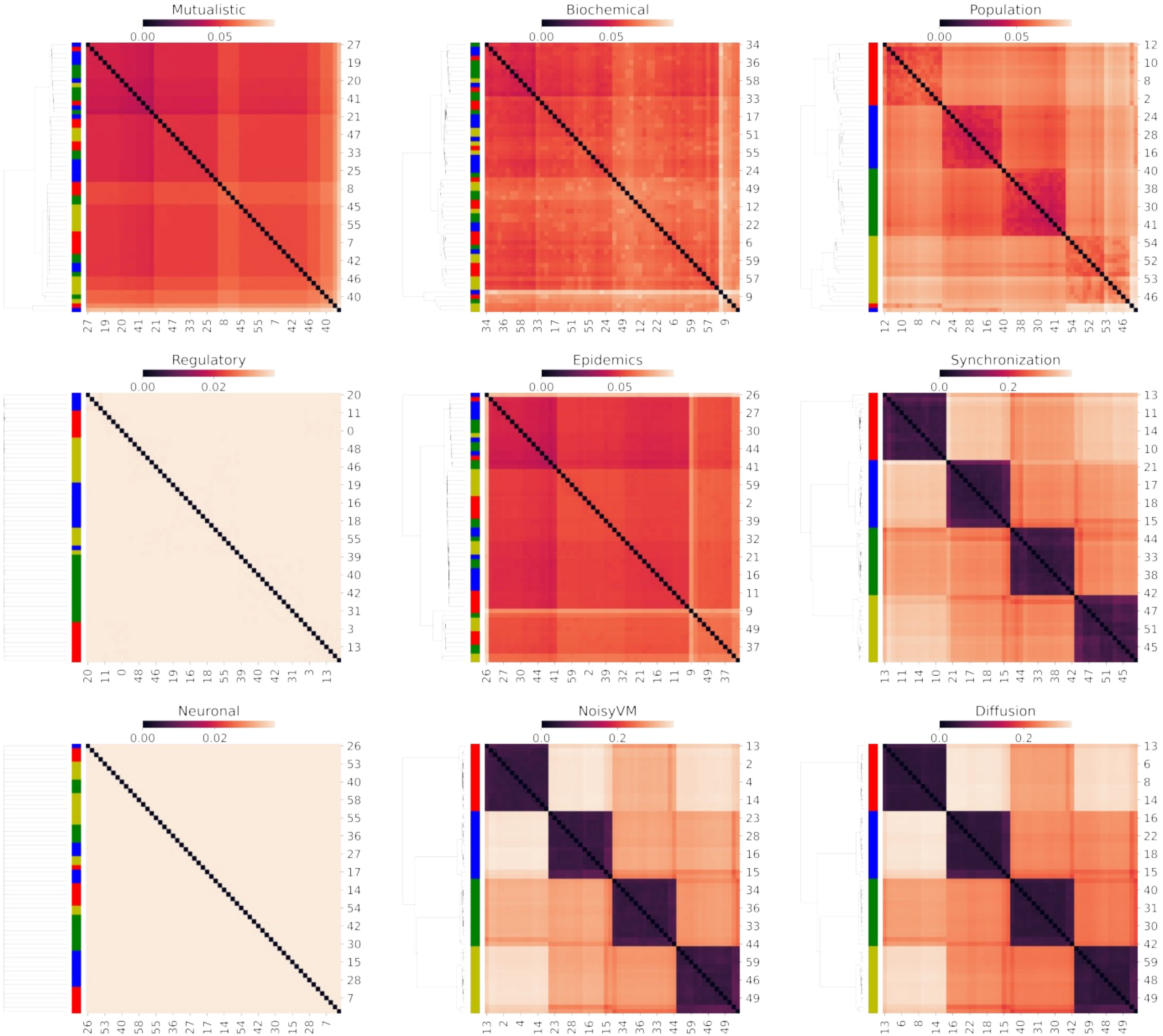
Jacobian dynamics

** all the parameters are fixed to 1
** normalize t -> t / ƛmax

Average distance matrix

** color in dendrogram = structural community





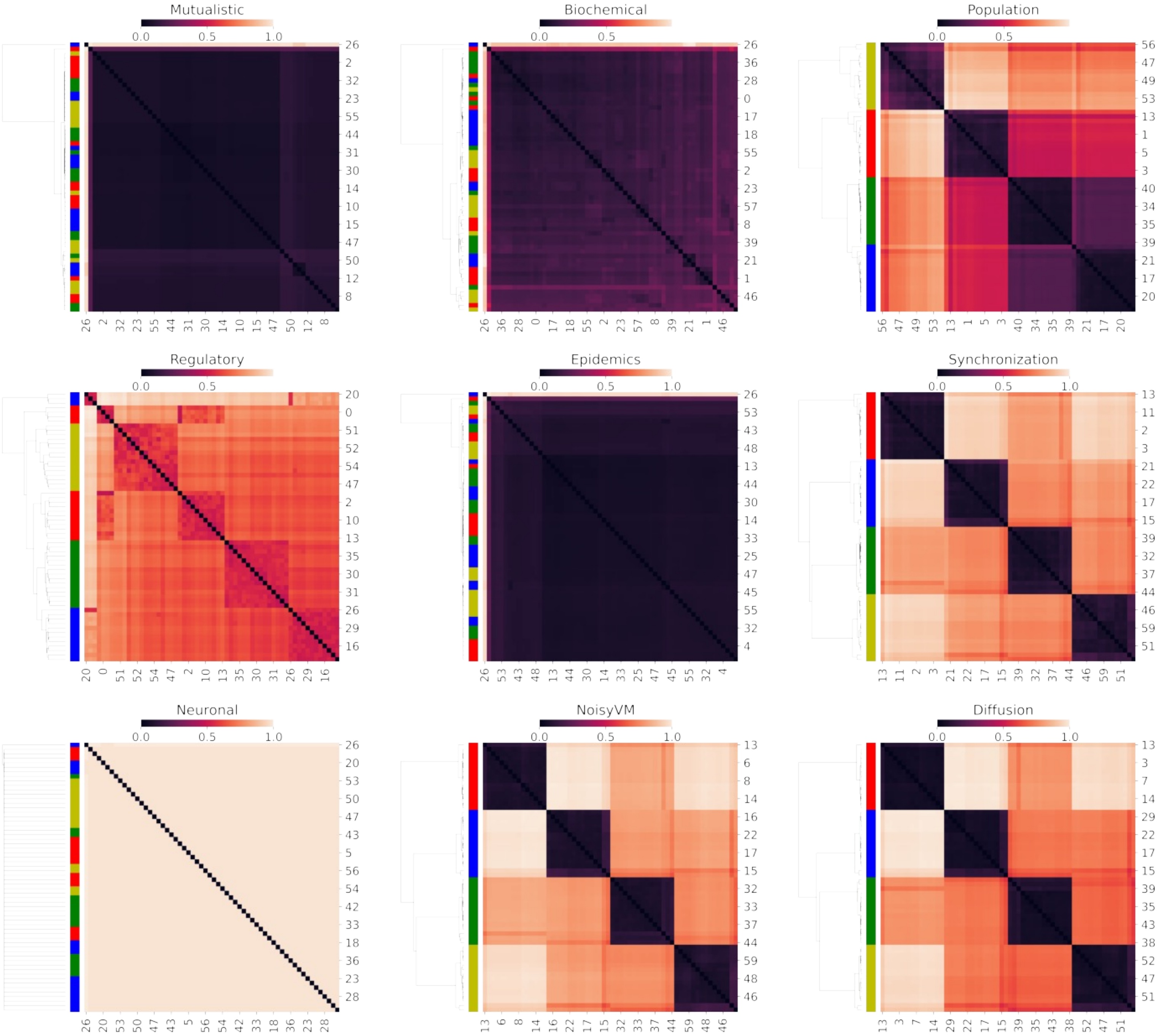
Jacobian dynamics

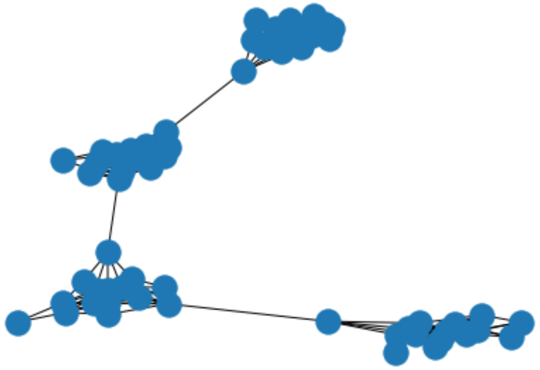
** all the parameters are fixed to 1
** normalize t -> t / λmax

Average normalized distance matrix

** color in dendrogram = structural community

from here the normalization seems not that interesting…

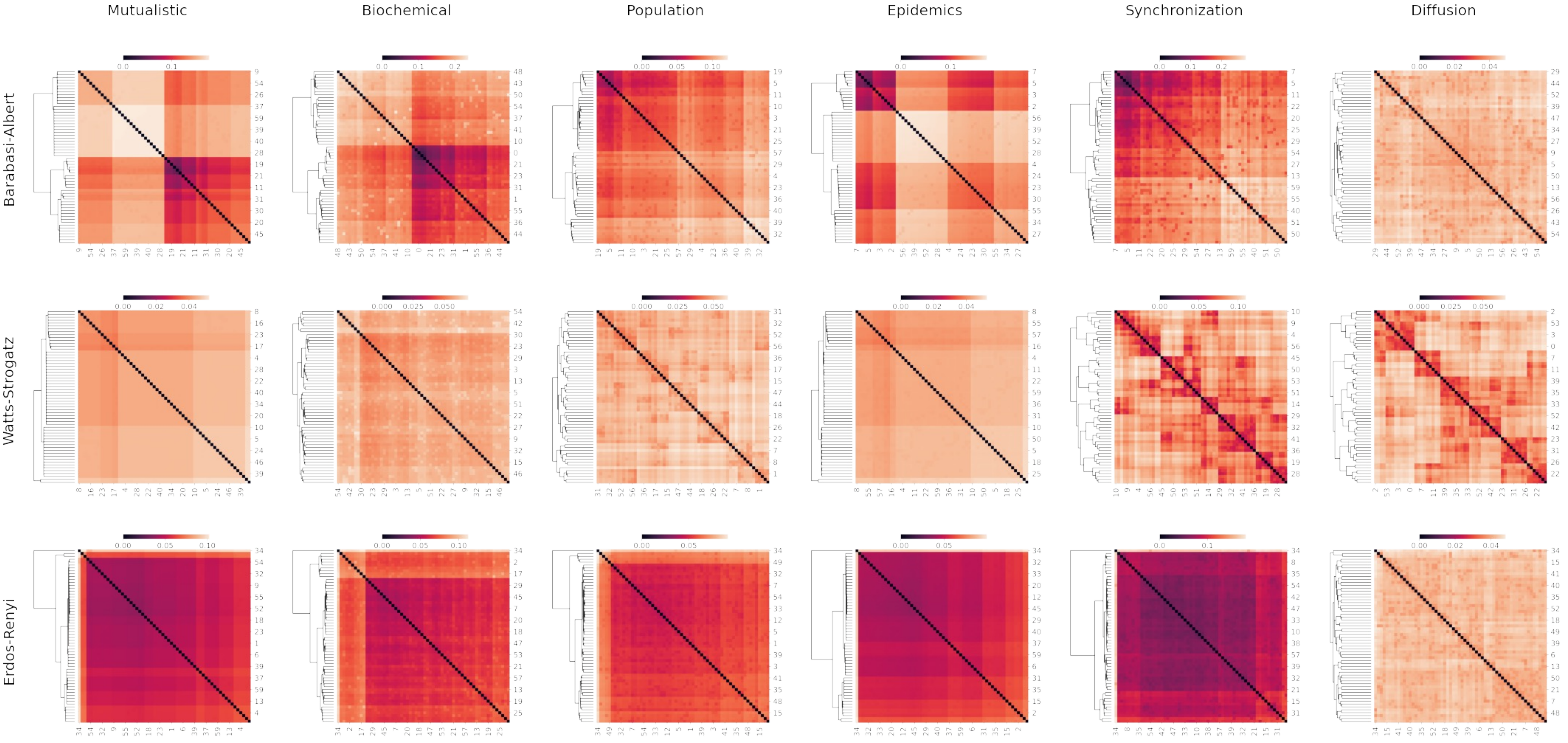




Jacobian dynamics – other type of networks

** all the parameters are fixed to 1

** normalize t -> t / λmax



QUESTIONS:

- Can we prove analytically the dependence of the jacobian distance with the eigenvalues?
- Do we need the normalization?
- Mantel’s test is ok? Other methods for comparing matrices?
- Apply to real networks?