Appendix B: Study of the robustness of the simulation results.

The number of parameters we use in the explicit version of the model is fairly restricted and allowed us to study extensively the robustness of the results. Particularly, we checked how the results were influenced by:

- probability of colonization from surrounding patches, from low values (c=0.3), intermediate values (c=0.7) to high values (c=1)
- landscape evenness (ratio h_a/h_b=1,2,4)
- dispersal procedure (dispersal from the 8 neighbor patches, the 24 neighbor patches, or from the whole landscape) which corresponds to a maximum distance of dispersal or 1, 2 and 14 respectively.
- spatial autocorrelation (random vs autocorrelated landscape)
- size of the grid (30*30 and 50*50)
- number of patch types and species (2 species, 5 species).

These various scenarios were studied separately and in combination for a total number of more than 100 investigative simulations. The qualitative messages that are detailed in the main text (progressive erosion of the environmental signal with increasing extinction rates, large part of this signal explained by environment alone while space alone plays a small role) are found to be remarkably robust to these changes of scenarios. Often, the results are even robust quantitatively. Except for discussion about the effect of spatial autocorrelation, that is detailed in the main text, we detail below the variations we found depending on the scenarios described above

Effects of colonization probability

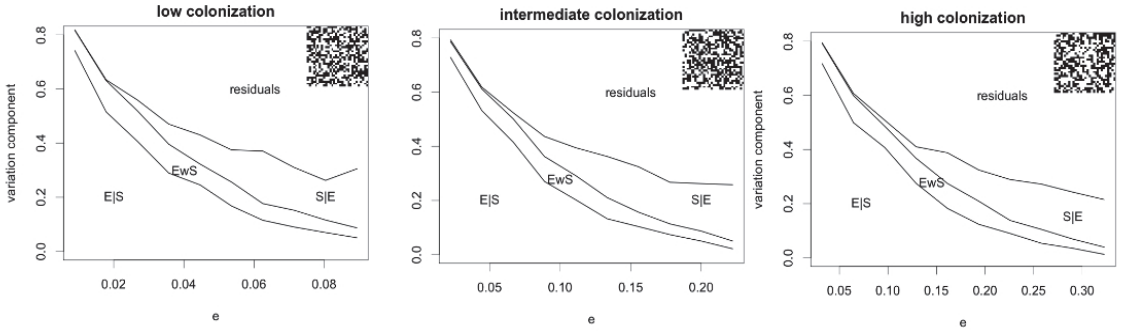

FIG. B1. Variation partitioning for various colonization probabilities. Other parameters as on Fig. 3 of the main text.

As displayed on Fig. B1, the partitioning is robust to changes in colonization probability from surrounding patches. However, note that, as expected from basic Levins' model analysis, the range of existence of the system increases with colonization probability. The system exists for a far larger range of extinction rates when colonization probability is high.

Effects of landscape evenness

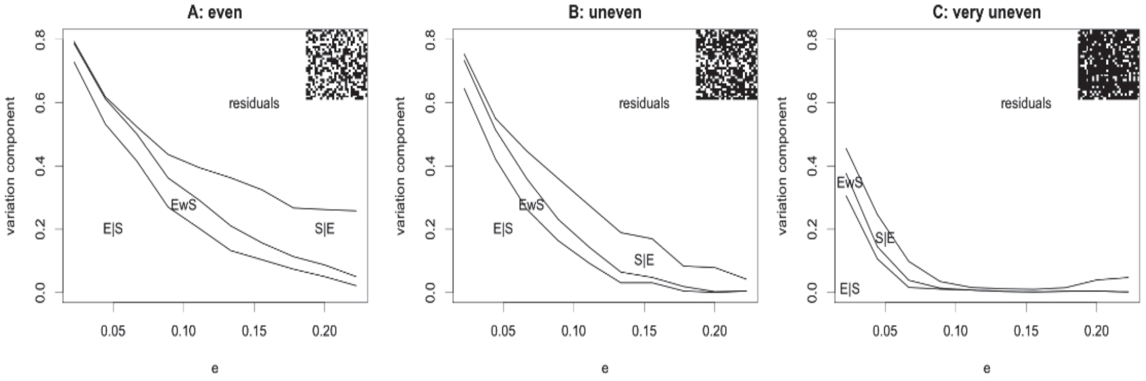

FIG. B2. Variation of the metacommunity structure for various degrees of evenness in patch type. A: $h_a=h_b$; B:$h_a=2h_b$; C:$h_a=4h_b$. Other parameters as in figure 3 of the main text.

While the qualitative trend is robust to changes of evenness, note that the environmental signal erodes much more rapidly when the landscape is more uneven (Fig. B2). This may be explained by the fact that population B in a very uneven landscape is much more prone to extinction, as suitable patches are less and less numerous. When extinctions are prevalent, patches of type B can never be occupied by the suitable species, so that environment matching is less likely. Also, in very uneven landscapes, at large extinction rates, species B does not have enough patches to survive, and goes extinct. Part of these B patches are occupied by species A invading from surrounding patches. This creates a purely spatial signal S|E.

Effects of variations in dispersal range

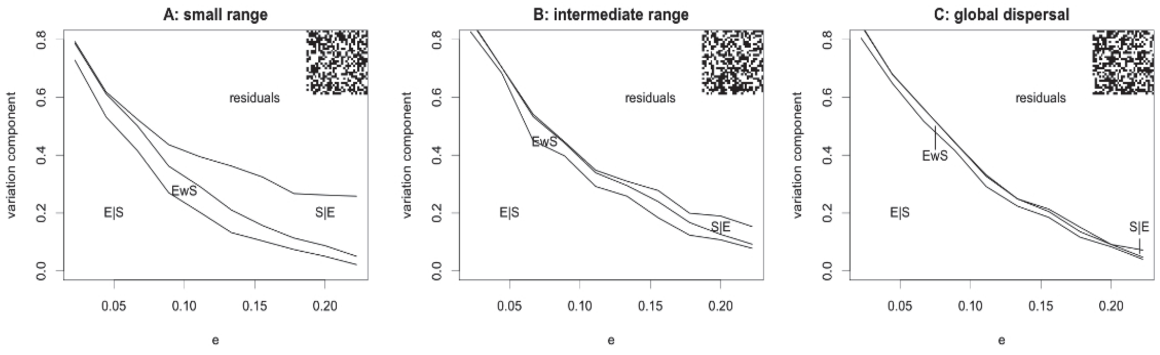

FIG. B3. Variation of the metacommunity structure depending on the range of dispersal. A: dispersal from immediately surrounding patches, dmax=1; B: dmax=2; C: dispersal on the whole landscape (dmax=14). Other parameters as in figure 3 of the main text.

The larger the range of dispersal, the more likely it is that dispersal will eventually bring a population that is perfectly adapted to the local state of the patch. Also, spatial autocorrelation due to dispersal limitation decreases with the range of dispersal. This dual effect explains why the S|E component steadily decreases when dispersal range increases. With global dispersal, the results converge on the analytical model.

Effects of grid size

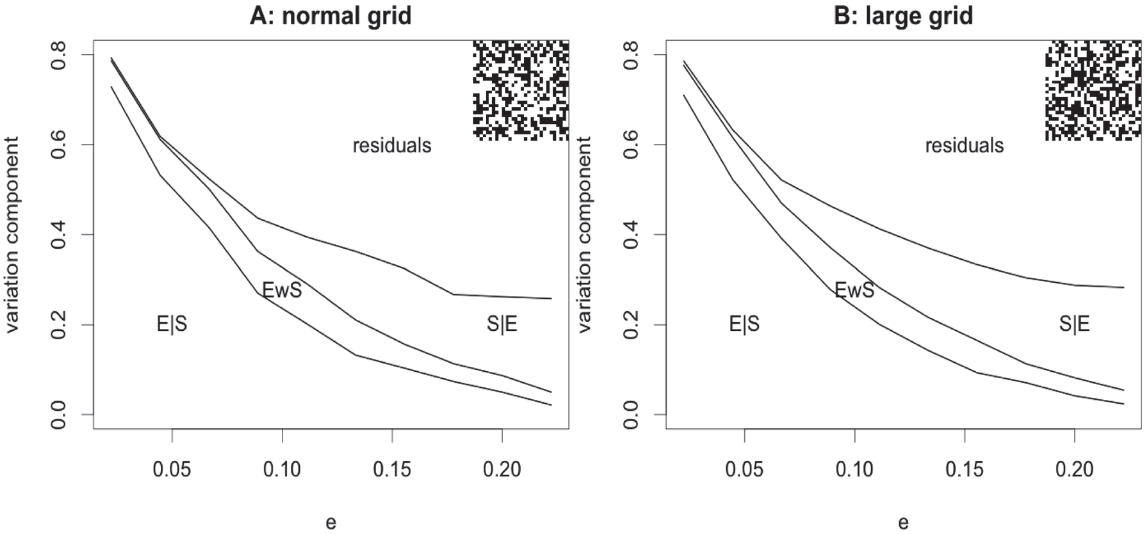

FIG. B4. Variation of metacommunity structure depending on the size of the grid. A: the grid contains 30x30 patches; B: the grid contains 50x50 patches. Other parameters as in Fig. 3 of the main text.

Results seem to be robust to changes in the grid size. The very small difference between panel A and panel B on Fig. B4 may therefore be seen as another hint that edge effects play little role in the patterns we undercover in the present study.

Effect of species number

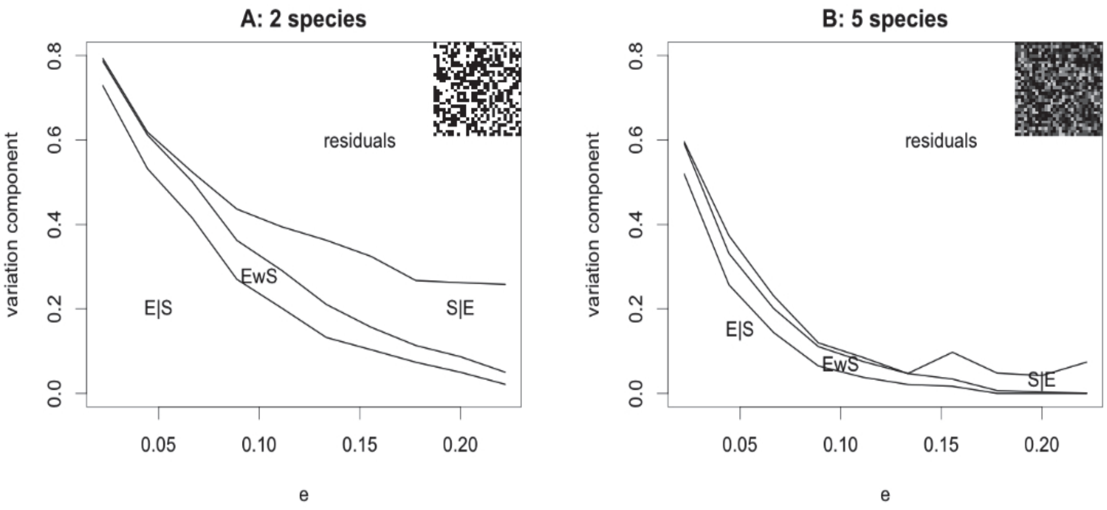

FIG. B5. Variation in metacommunity structure when the number of species changes. A: simulation of the basic 2 species model; B: 5 species. Other parameters as in Fig. 3 of the main text.

To study how our results change with considering more than two species. Extending to a larger number of species implies a similar increase in the number of patch types that are present in the model. It also means choosing rules for competitive interaction between species when confronted in a patch that is not optimal for either of them. We use a simulation with 5 species, numbered from 1 to 5, and 5 patch types, similarly numbered, and of similar frequency. We assume that, after colonization, a species settles in a patch if this patch was previously empty, or if the species present is less adapted to local conditions, as measured by the difference between the patch and the species indices. This creates a competitive hierarchy for a given patch type. For instance, for a patch of type 3, species 3 cannot be displaced. Species 2 or species 4 can only be displaced by species 3. Species 1 can be displaces by species 2, 3, and 4.

When changing the number of species the pattern remains qualitatively robust. Note however that the environmental component of the metacommunity structure is slightly lower and decreases a bit more quickly. We believe that this is due to the fact that, for dispersal from surrounding patches, increasing the number of possible species, hence of patch types, makes it less likely that a well suited species arrives in a given patch type. This is simply a statistical effect, as a given patch type is less likely to have a perfectly adapted species in the neighbor patches when there are 5 types than when 2 patch types exist.