

## Description of Additional Supplementary Files

**File Name:** Supplementary Data 1

**Description:** Data presented in Figures 2-5.

### Supplementary Movies

- 1. Supplementary Movie 1.** Water meniscus connecting soil particles and chip structures. The movie was recorded in an initially air-filled chip from experiment 1.
- 2. Supplementary Movie 2.** Mobile soil particles blocking connectivity of channels. The movie was recorded in an initially malt medium-filled chip from experiment 1.
- 3. Supplementary Movie 3.** Passage opening by hyphae that broke through the borders of an artificial pore space. The movie was recorded in an initially air-filled chip from experiment 1.
- 4. Supplementary Movie 4.** Habitat fragmentation by hyphae. The movie was recorded in an initially air-filled chip from experiment 1.
- 5. Supplementary Movie 5.** Hypha-facilitated bacterial dispersal across air gaps (“fungal highways”). The movie was recorded in an initially malt medium-filled chip from experiment 1.
- 6. Supplementary Movie 6.** Passage obstruction by a hypha that blocked all entrances of a rectangle pore. The movie was recorded in an initially malt medium-filled chip from experiment 1.
- 7. Supplementary Movie 7.** Particle transportation by an amoeba. The movie was recorded in an initially water-filled chip from experiment 1.
- 8. Supplementary Movie 8.** Flagellated protozoa foraging around soil aggregates. The movie was recorded in an initially malt medium-filled chip from experiment 1.
- 9. Supplementary Movie 9.** Patchy bacterial colonization of water droplets. The movie was recorded in an initially air-filled chip from experiment 3.
- 10. Supplementary Movie 10.** Microbial succession in the soil chips incubated with soil in the laboratory, air filled (Expt. 2). Image sequences of the time-resolved changes in microbial colonization of a diamond-shaped widening.
- 11. Supplementary Movie 11.** Microbial succession in the soil chips incubated with soil in the laboratory, water filled (Expt. 2). Image sequences of the time-resolved changes in microbial colonization of a diamond-shaped widening.
- 12. Supplementary Movie 12.** Microbial succession in the soil chips incubated with soil in the laboratory, malt medium filled (Expt. 2). Image sequences of the time-resolved changes in microbial colonization of a diamond-shaped widening.
- 13. Supplementary Movie 13.** Microbial succession in air-filled soil chips incubated with soil in the laboratory (Expt. 3). Image sequences of the time-resolved changes in microbial colonization of a diamond-shaped widening.

- 14. Supplementary Movie 14.** Microbial succession in air-filled soil chips incubated with soil in the laboratory (Expt. 3). Image sequences of the time-resolved changes in microbial colonization of a diamond-shaped widening.
- 15. Supplementary Movie 15.** Microbial succession in air-filled soil chips incubated with soil in the laboratory (Expt. 3). Image sequences of the time-resolved changes in microbial colonization of a diamond-shaped widening.
- 16. Supplementary Movie 16.** Displacement of bacteria and soil particles along a water flow. The movie was recorded in an initially air-filled chip from experiment 1.
- 17. Supplementary Movie 17.** Particle tracking analysis within water stream channels. The movie was recorded in an initially air-filled chip from experiment 1.
- 18. Supplementary Movie 18.** Particle tracking original movie, corresponding to Supplementary Movie 10. The movie was recorded in an initially air-filled chip from experiment 1.
- 19. Supplementary Movie 19.** Obstruction of soil organisms such as nematodes and protists by hyphae. The movie was recorded in an initially air-filled chip from experiment 3.
- 20. Supplementary Movie 20.** Ciliate pushing into soil particles and aggregates. The movie was recorded in an initially malt medium-filled chip from experiment 1.
- 21. Supplementary Movie 21.** Bacterial accumulation around a fragmented hypha. The movie was recorded in an initially malt medium-filled chip from experiment 1.
- 22. Supplementary Movie 22.** Bacterial dispersal along a hypha in a channel is blocked by an air barrier. The movie was recorded in an initially air-filled chip from experiment 3.