“The Spatial Diffusion of Technology”

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Space, Time, and Technology Diffusion

How does technology diffuses across countries and over time?

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- CDR study empirically and theoretically the role of **cross-country interactions** in the technology adoption process.
- Main idea: technology diffuses by interactions with adopters, and interactions are more likely with agents located nearby. As a result:
  1. Technology diffuses **more slowly** to locations far away from adoption leaders.
  2. The effect of distance vanishes over time.
- Empirically: use CHAT dataset (cool!) to construct a measure of **spatial distance from technology (SDT)** and show that SDT has a robust negative effect on adoption.

Space, Time, and Technology Diffusion (contd.)

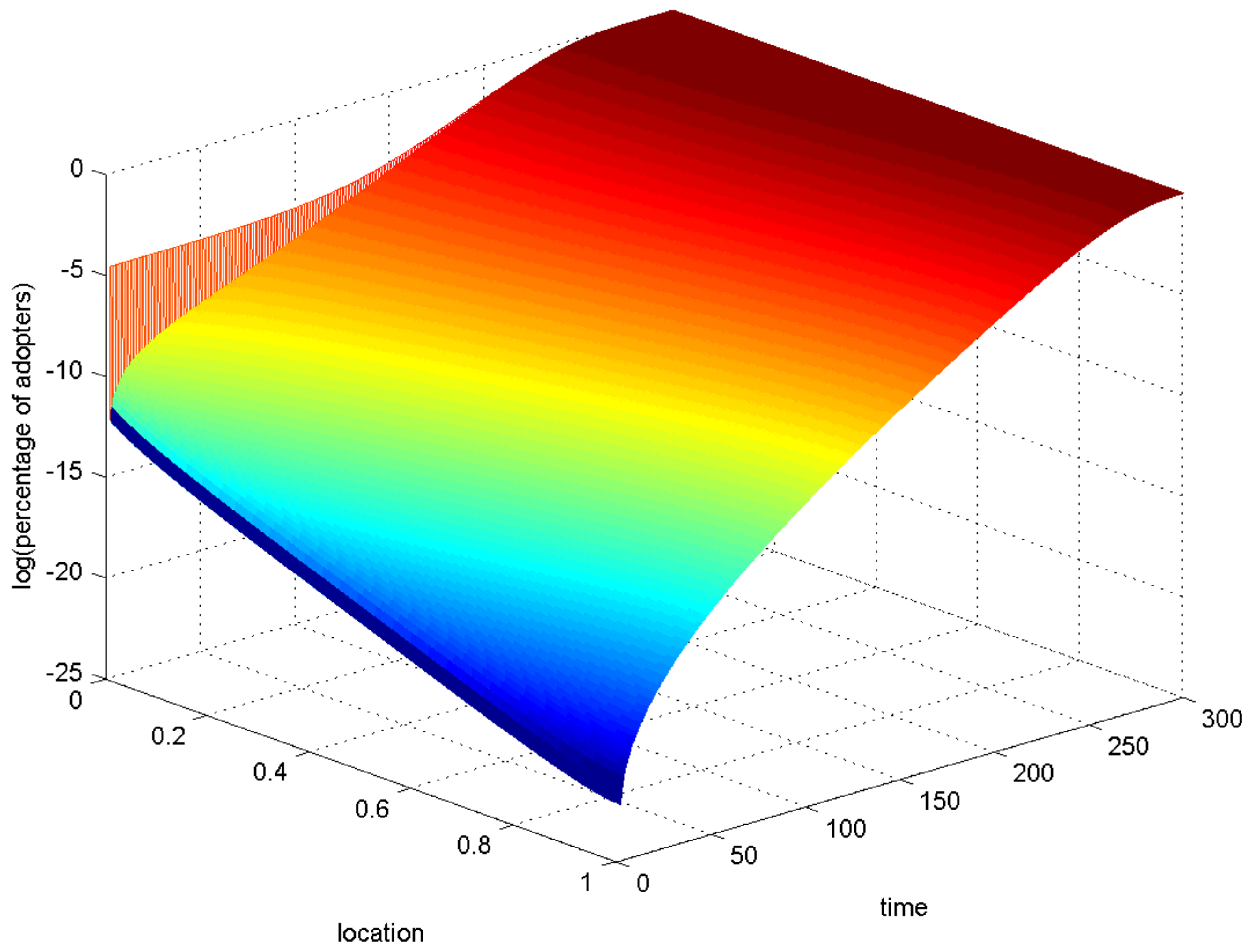

Figure 1: Adoption Rate in CDR.

This Discussion

- The empirical analysis is VERY clear and careful about identifying the effects of country interactions on technology adoption.
- CDR provide **the simplest model** that is able to generate the desired relationship between time, space and technology.

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This discussion:

1. shows why we may or may not need a more complicated model to address these facts;
2. asks a few questions about the interpretation of the model.

Interactions and Space

Key equation in CDR:

$$G(0,r,t+h) = G(0,r,t)\left[\frac{\int_0^1 G(0,l,t)e^{-\delta|l-r|dl}}{\int_0^1 e^{-\delta|l-r|dl}}\right]^{\alpha h}$$

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2. Define locations on a **bi-dimensional space** $\Rightarrow$ might be important for the empirical implementation.

Interactions in a Bi-Dimensional Space: Innovator at the Boundary

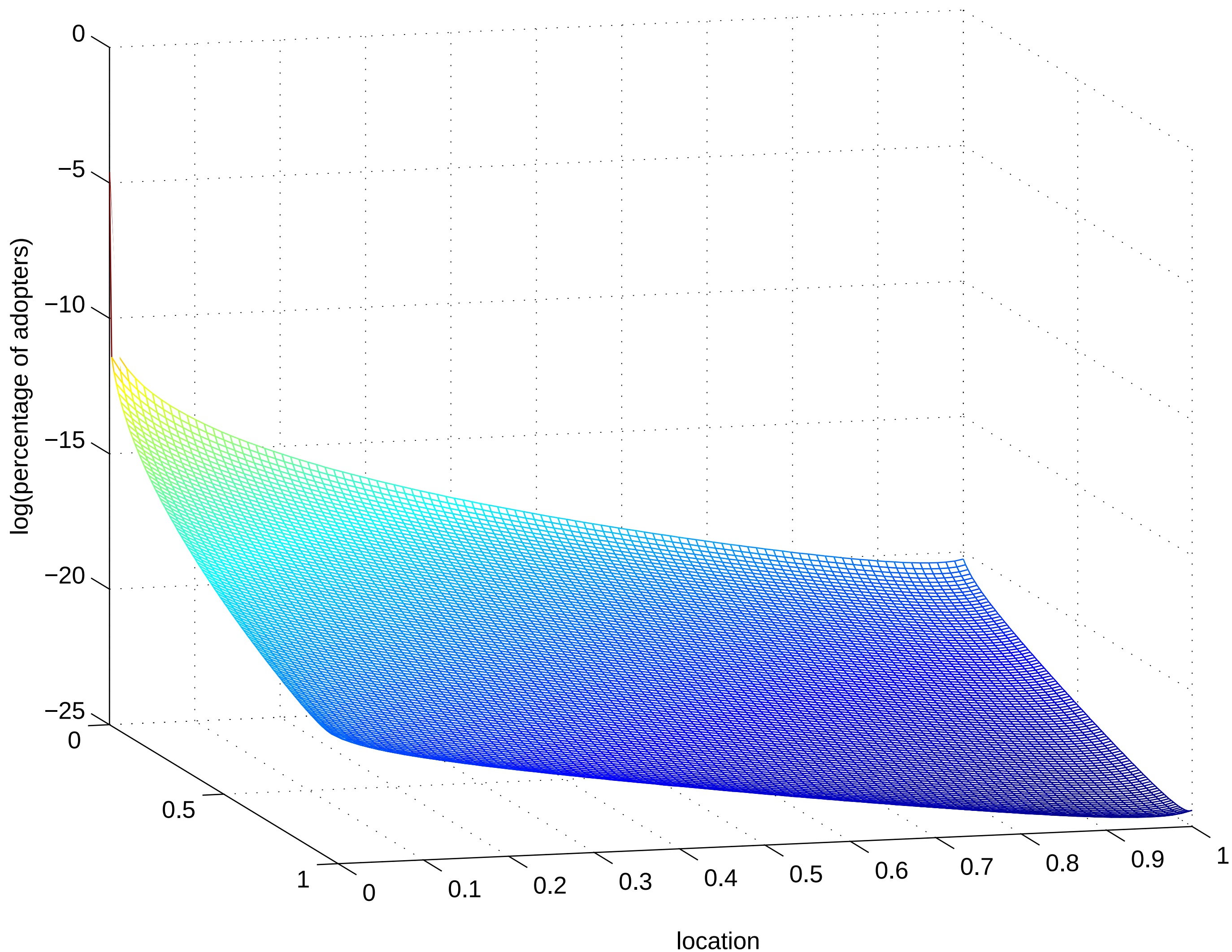

Figure 2: Percentage of Adopters in a bi-dimensional space, $t = 2$.

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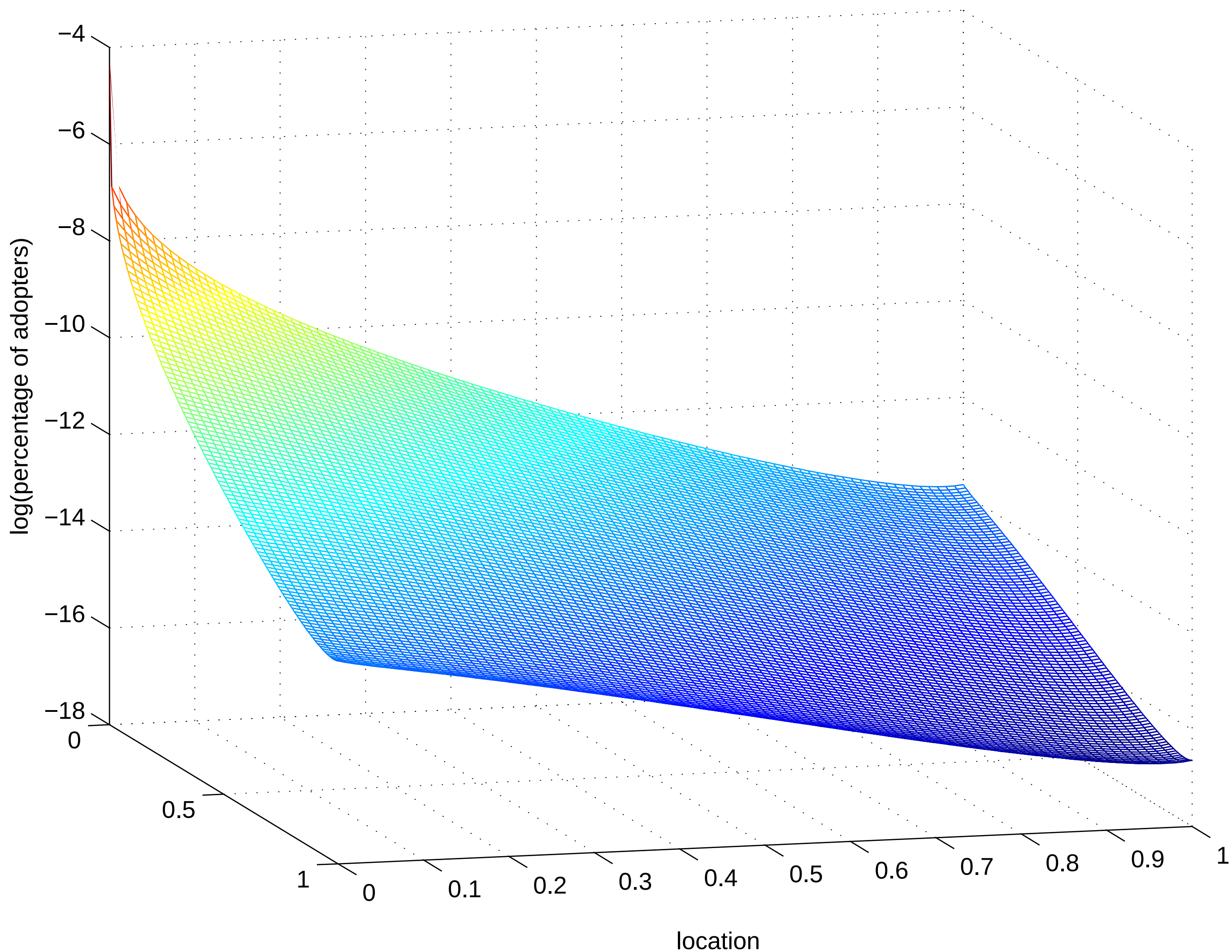

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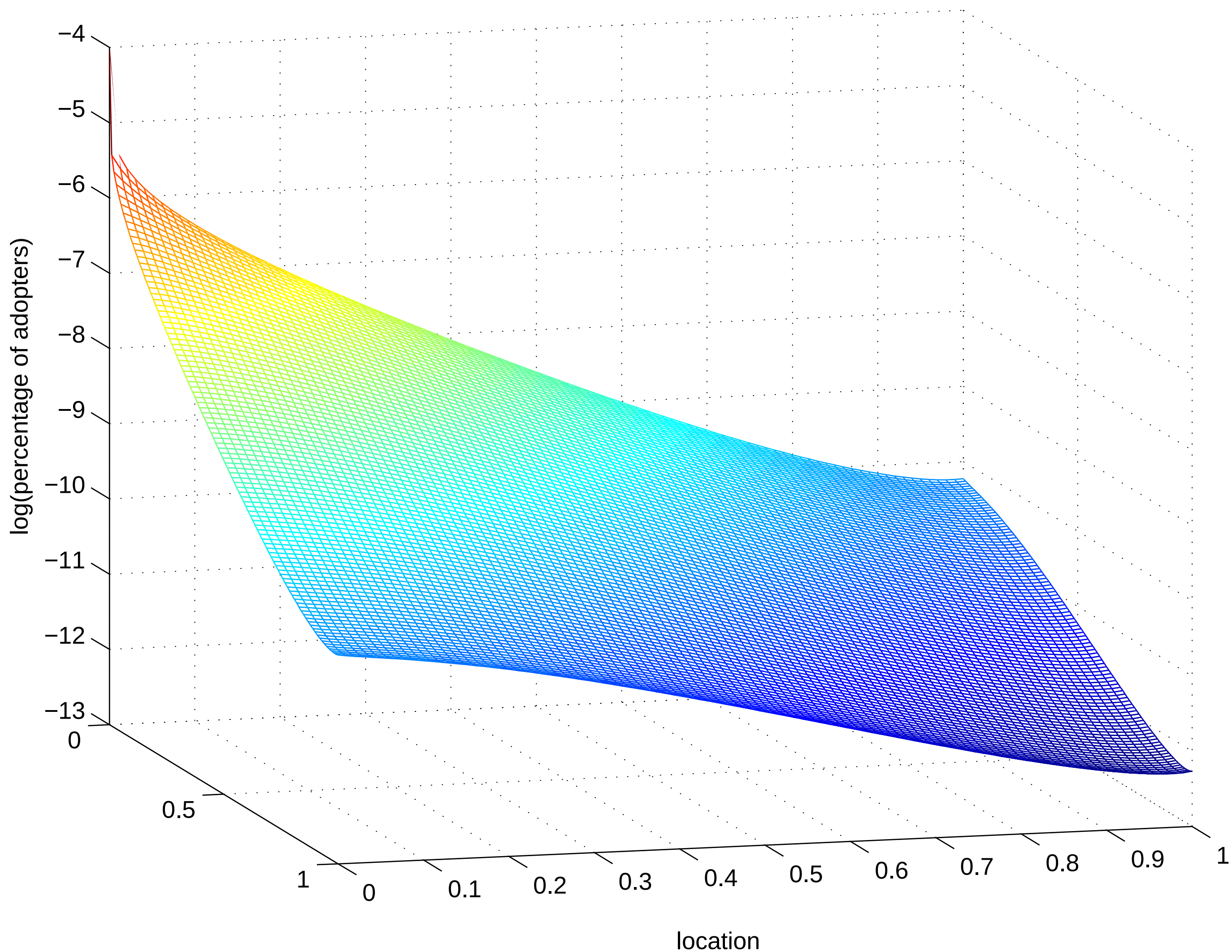

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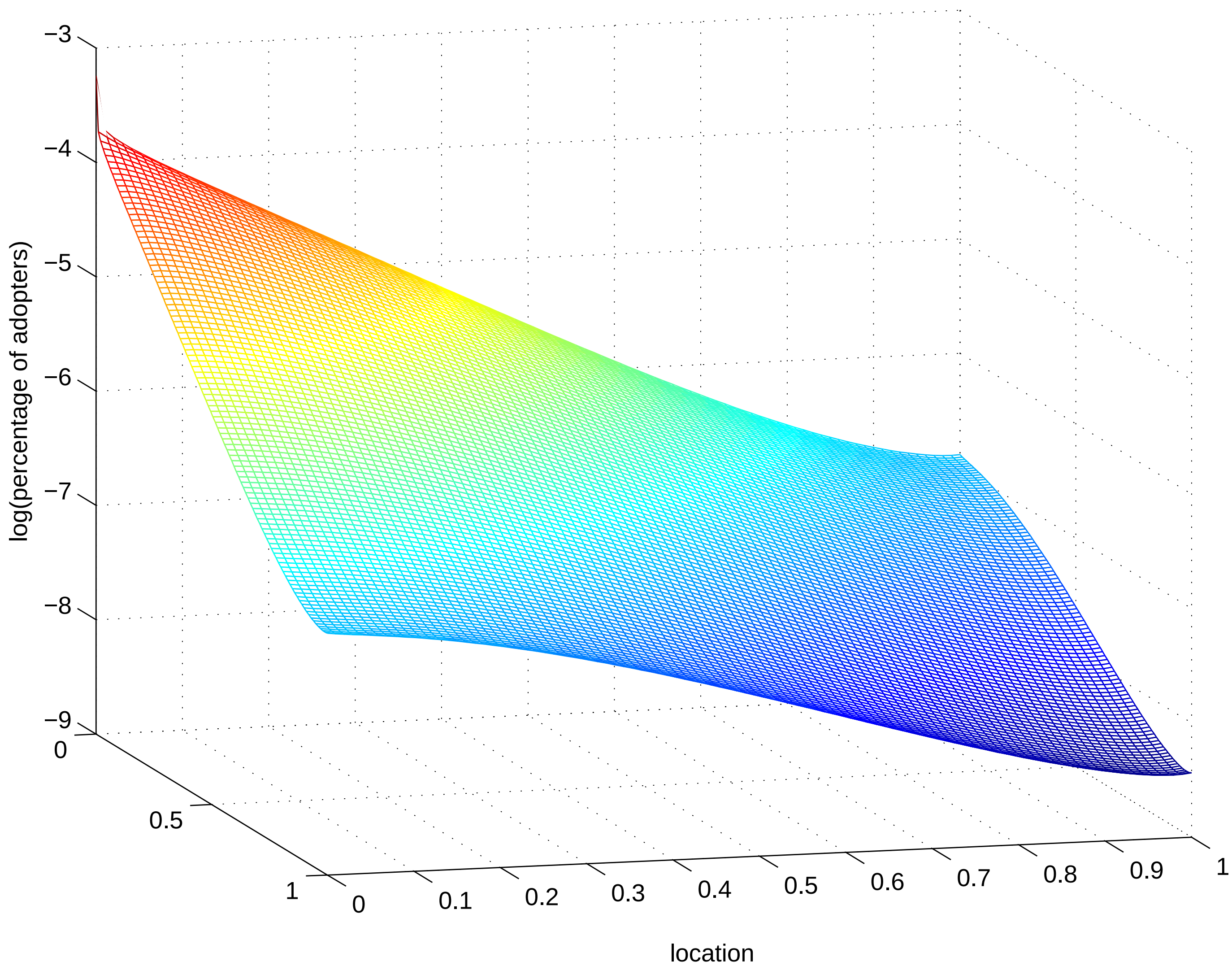

Figure 2: Percentage of Adopters in a bi-dimensional space, $t = 180$.

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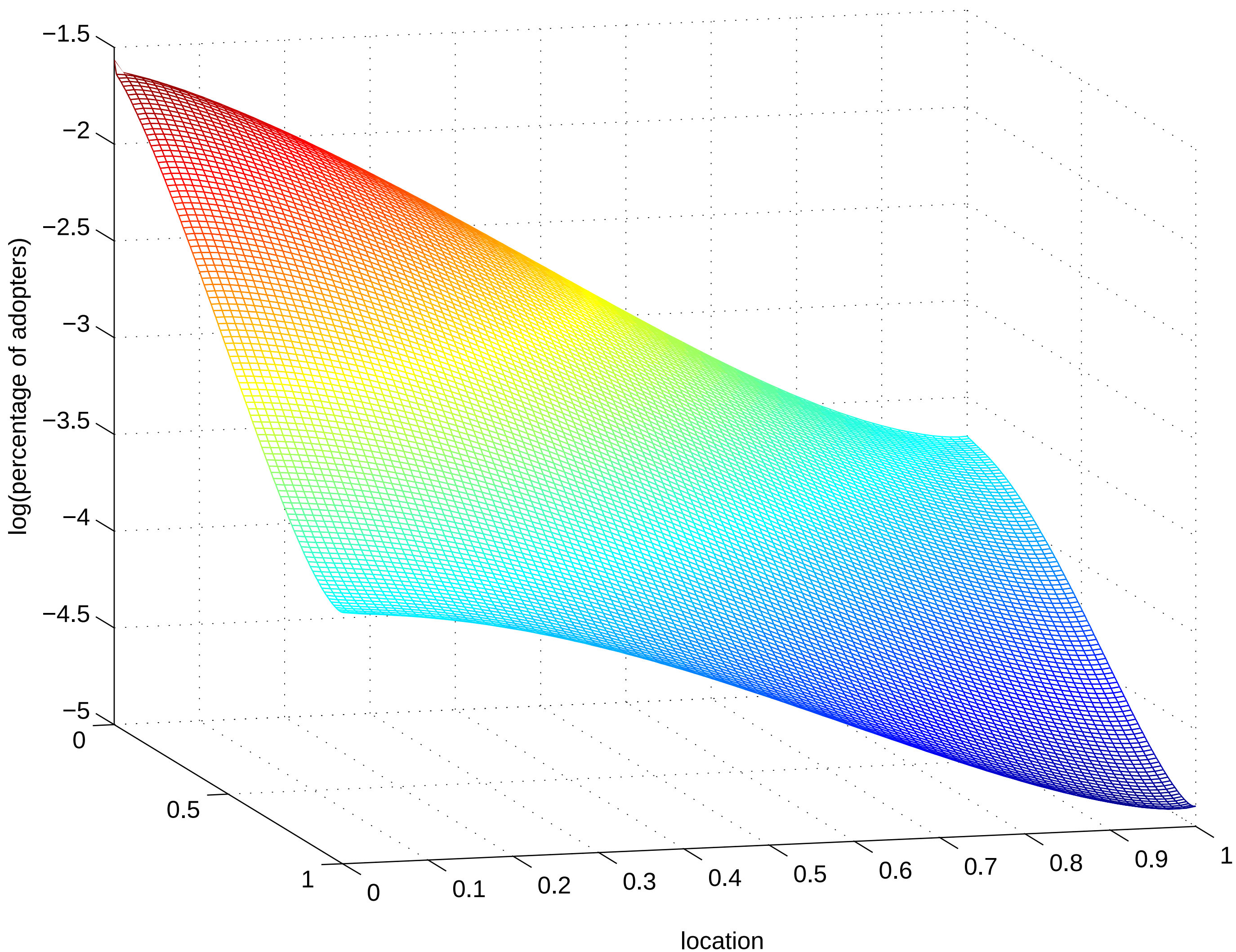

Figure 2: Percentage of Adopters in a bi-dimensional space, $t = 240$.

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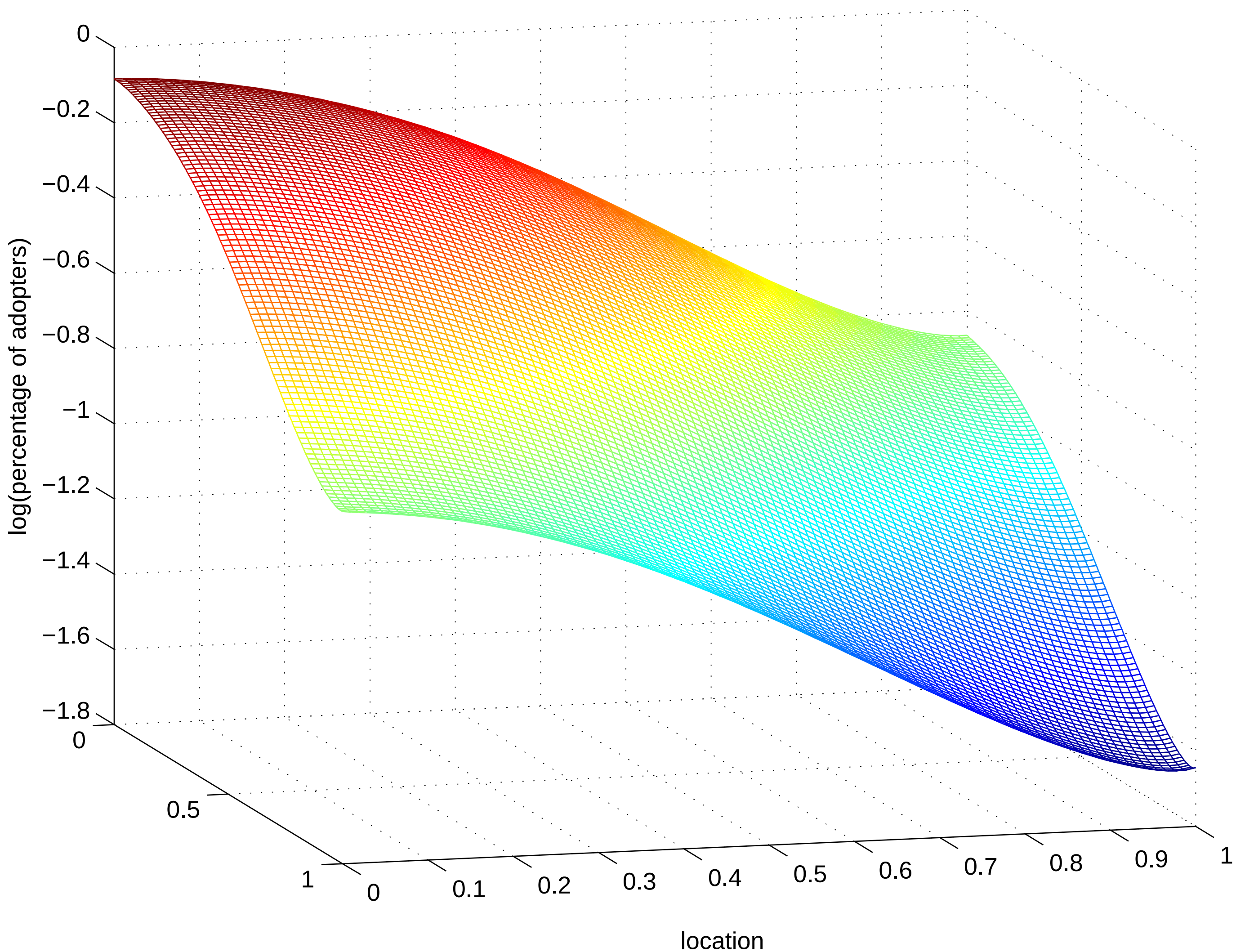

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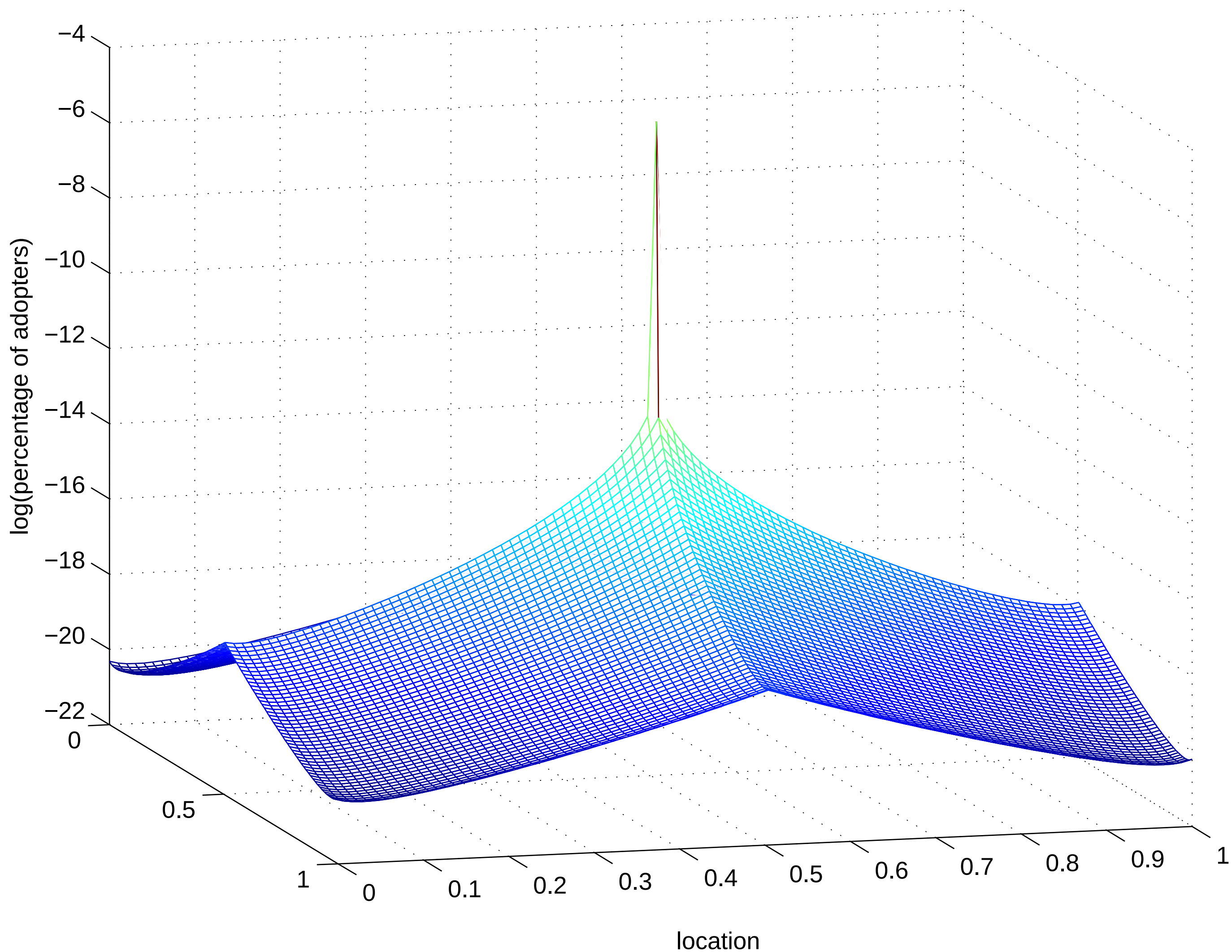

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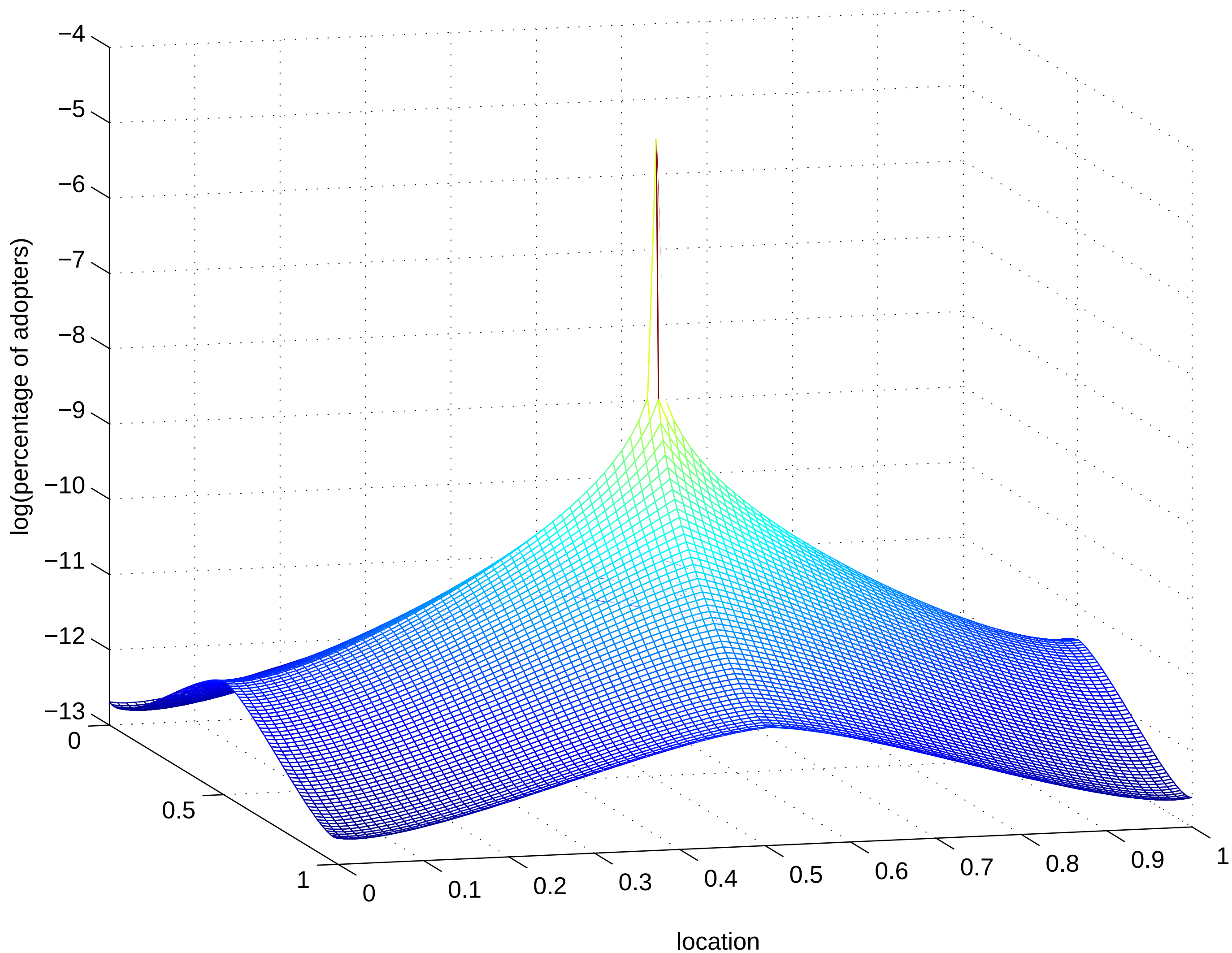

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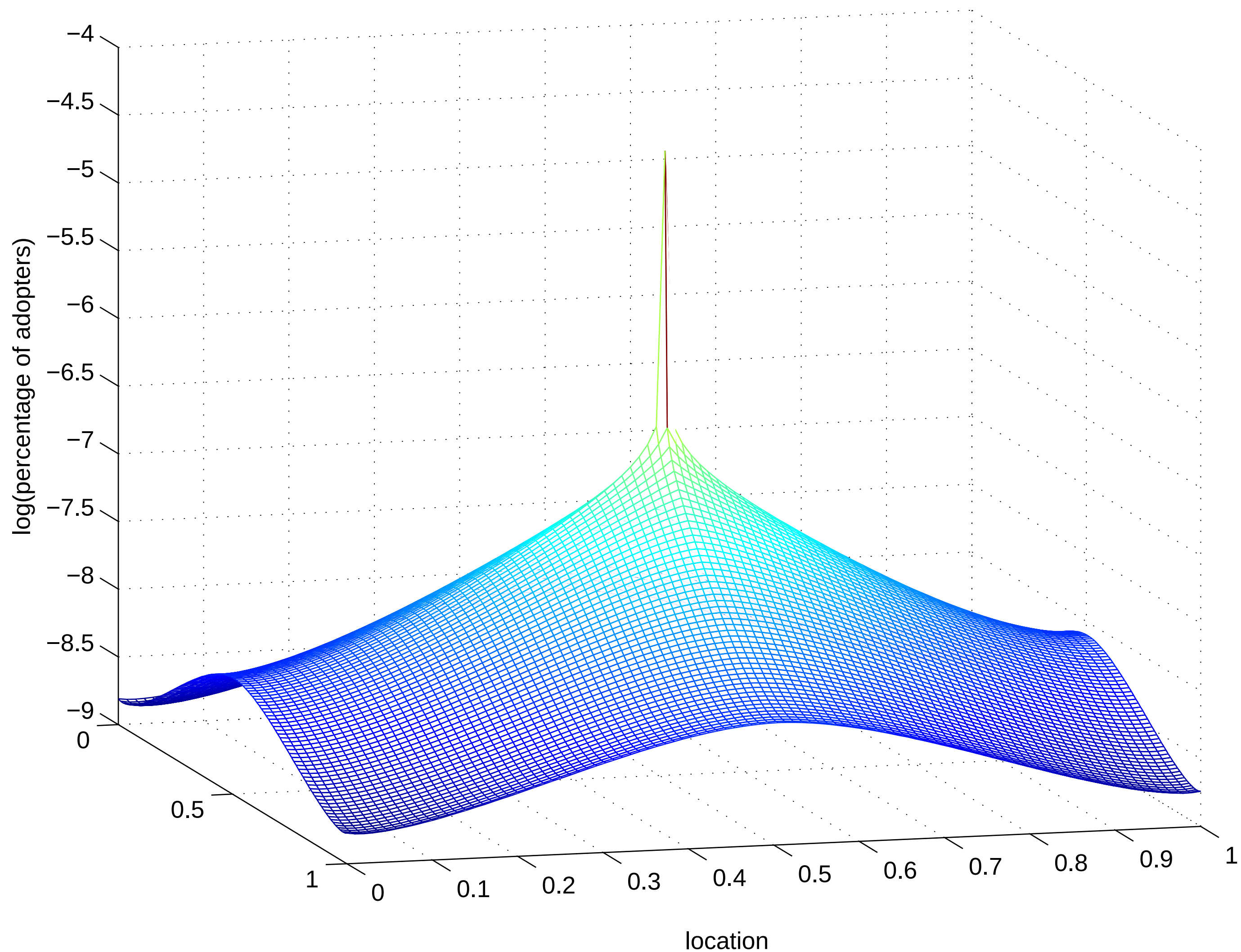

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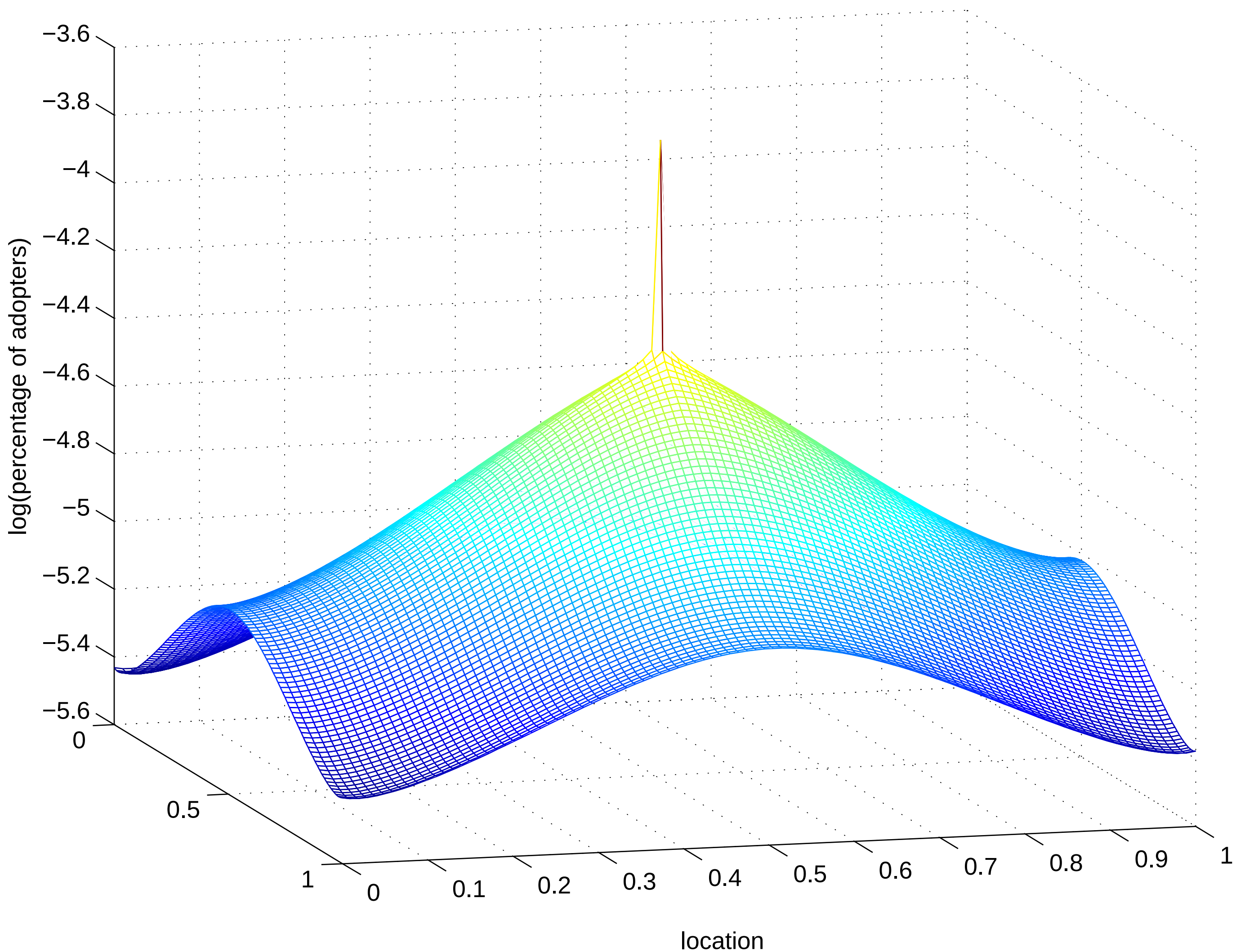

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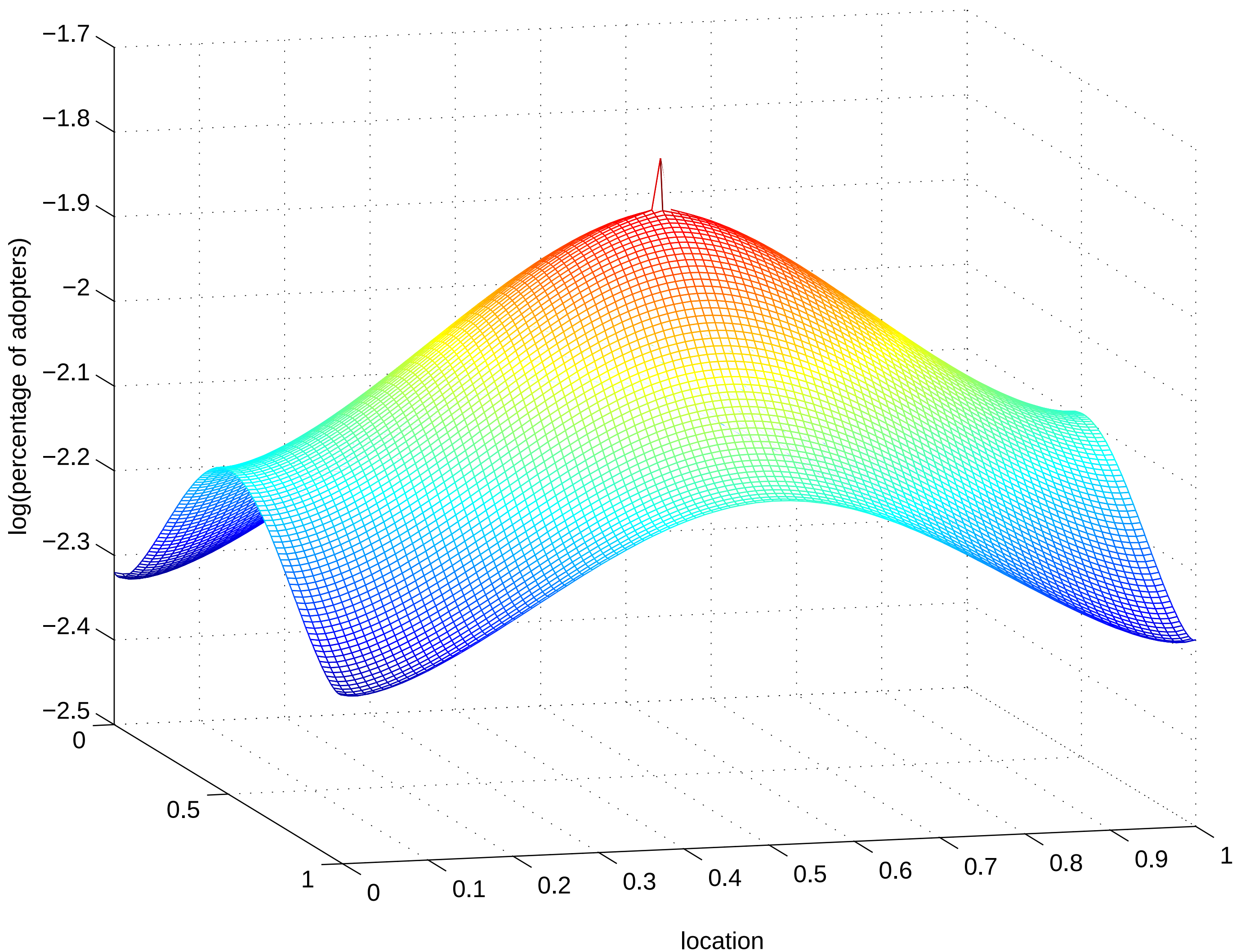

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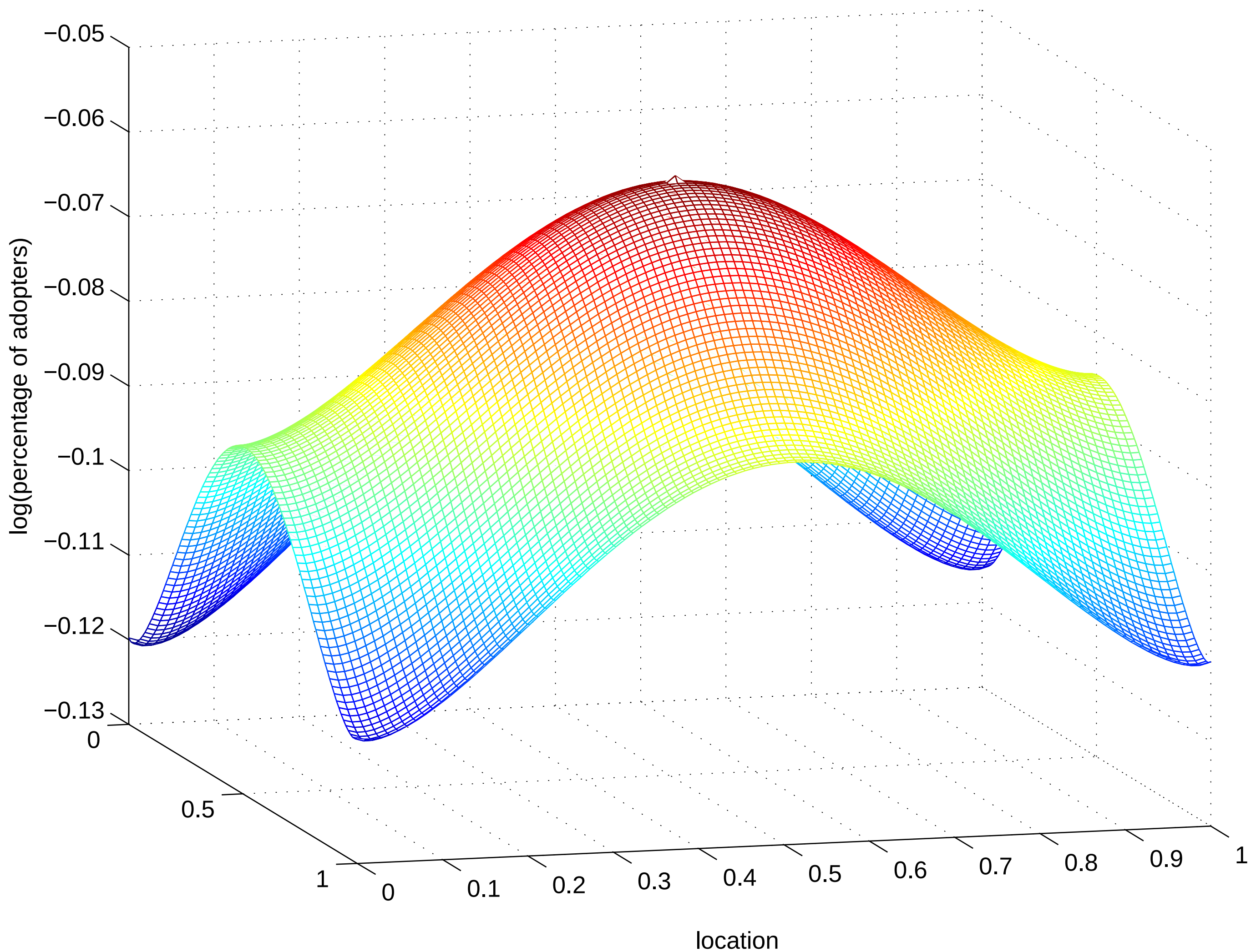

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Interactions in a Bi-Dimensional Space: Comparison

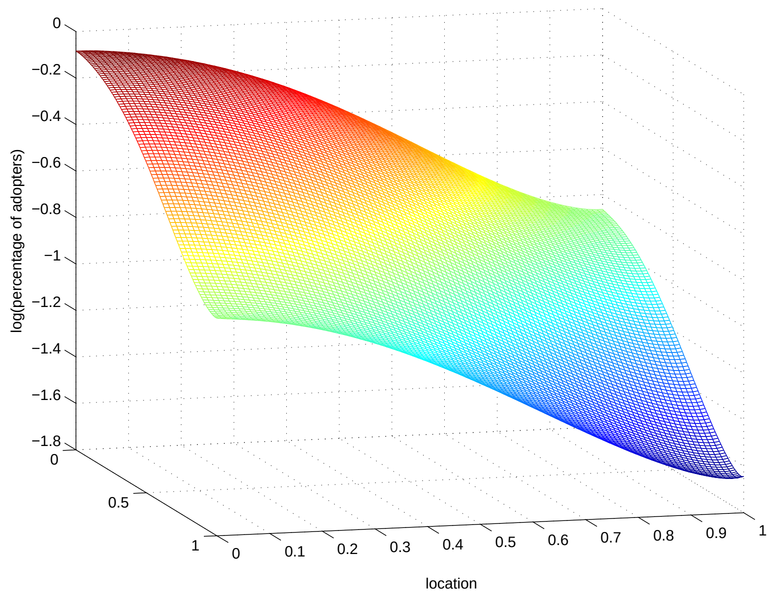

Figure 4: Percentage of adopters, innovator at the boundary, $t = 300$.

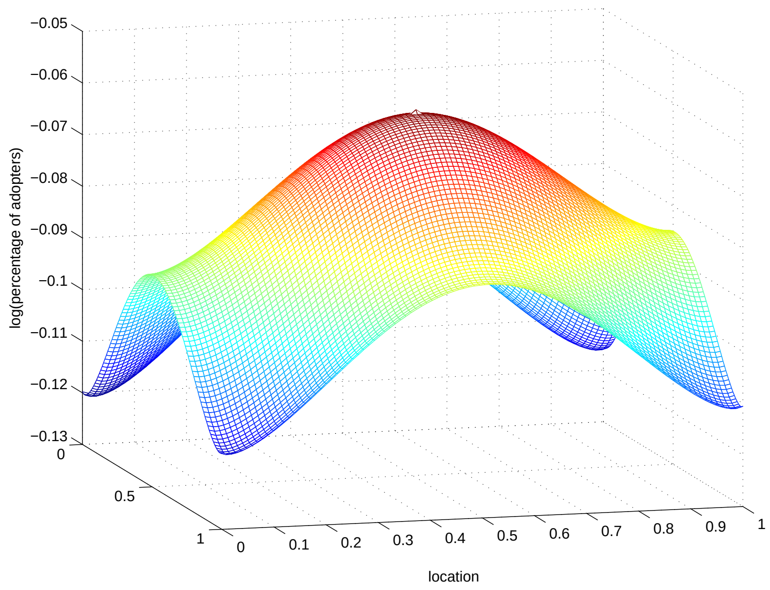

Figure 5: Percentage of adopters, innovator in the center, $t = 300$.

- Diffusion is **much faster** when the innovator is in the center!!! (compared to what happens in a one-dimensional space)
- Also allows more realistic initial conditions and to differentiate the N-S and E-W dimensions.

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  Diffusion of the internet/transportation technologies might have affected the diffusion of other technologies.

Conclusions

In this paper:

- New data measuring technology adoption DIRECTLY sheds light on how technology diffusion happens over time and across space.
- A very simple model is able to account for the diffusion patterns observed in the data.

The mechanism in the paper can be fruitfully used in more complex settings:

- Moving “forward”: Desmet and Rossi-Hansberg (2011) nest a similar idea in a spatial growth model;
- Moving “backward”: how can economic agents affect technology diffusion?

Meeting Rate and Distance

$$G(0,r,t+h) = G(0,r,t)\left[\frac{\int_0^1 G(0,l,t)e^{-\delta|l-r|dl}}{\int_0^1 e^{-\delta|l-r|dl}}\right]^{\frac{\alpha}{(\mathbf{1}+|\mathbf{r}-\mathbf{0.5}|)}h}$$

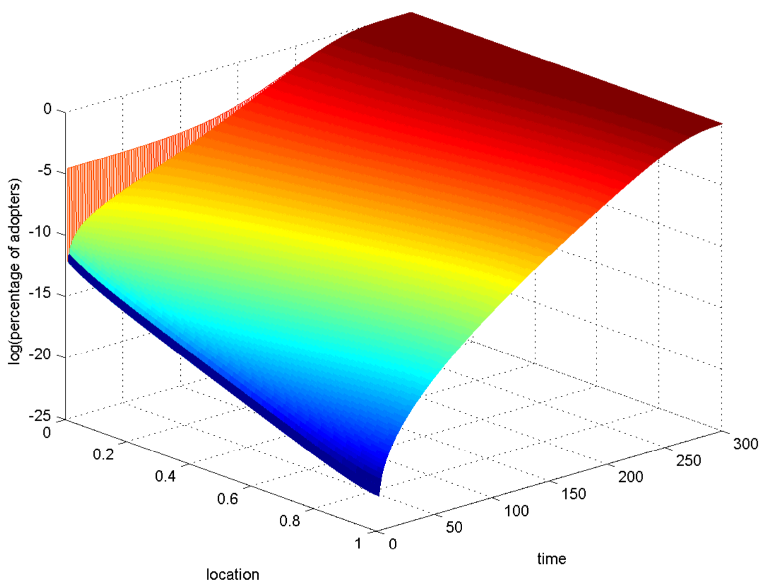

Figure 6: Adoption Rate in CDR.

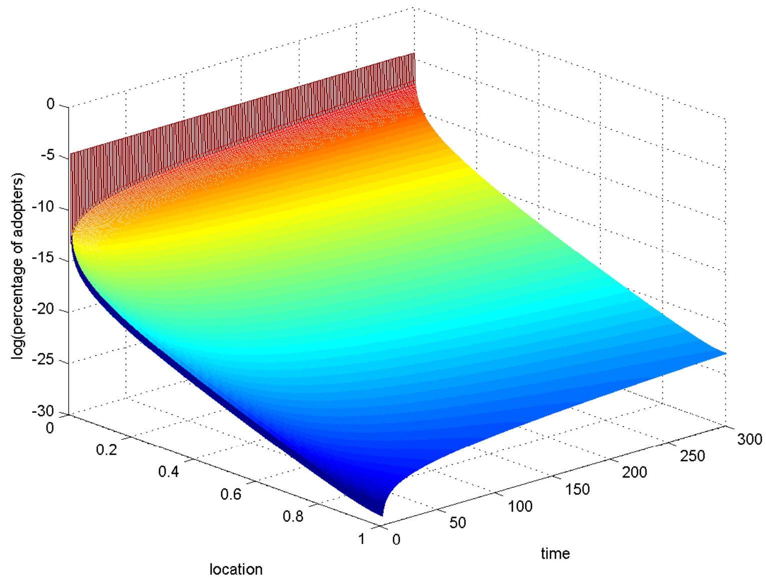

Figure 7: Adoption Rate in CDR allowing the meeting rate to depend on distance.