Dolines of Dinaric Karst
Case Study of Menišija, Slovenia

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Abstract

Dolines are a frequent karst feature. Their shape, genesis and dynamics are conceptually described by various models. However, to the author's knowledge there was no data about exact shape and size of a larger set of karst dolines that could be used for statistical analysis. We developed and used a numerical method to analyze $60km^2$ of $1m$ grid resolution lidar data of digital relief model of Menišija, an levelled karst surface, former polje near Postojna, Slovenia. We identified 8.700 dolines (about 145 dolines$/m^2$). We then used numerical tools to calculate the average shape of the identified dolines and proposed a function to describe this shape.

Due to the geological history of Menišija and similarity of dolines in the area we propose that they were shaped by the same geomorphological processes, that ultimately lead to a common geomorphologically stable form of doline which is already reached in this area.

Using this hypothesis we propose two possible dynamical models for dolines that would lead to the shape of relief that we observe in Menišija today.

About dinaric karst dolines

- Kaj in kje so vrtace
- Kaj se ve o vrtacah
- Od kje podatki
- Motivacija

Aliquam non lacus dolor, *a aliquam quam* [2]. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Nulla in nibh mauris. Donec vel ligula nisi, a lacinia arcu. Sed mi dui, malesuada vel consectetur et, egestas porta nisi. Sed eleifend pharetra dolor, et dapibus est vulputate eu. **Integer faucibus elementum felis vitae fringilla.** In hac habitasse platea dictumst. Duis tristique rutrum nisl, nec vulputate elit porta ut. Donec sodales sollicitudin turpis sed convallis. Etiam mauris ligula, blandit adipiscing condimentum eu, dapibus pellentesque risus.
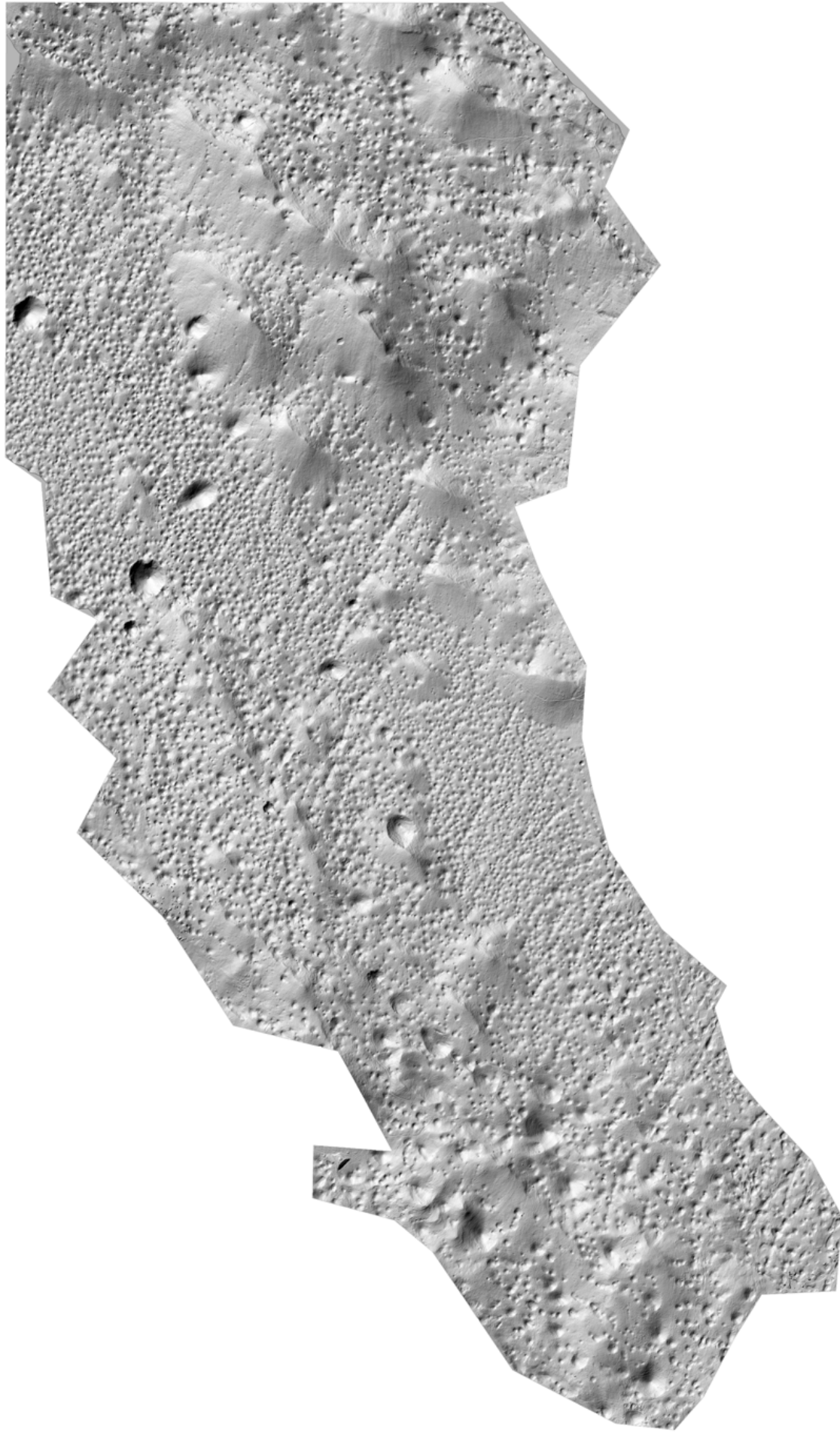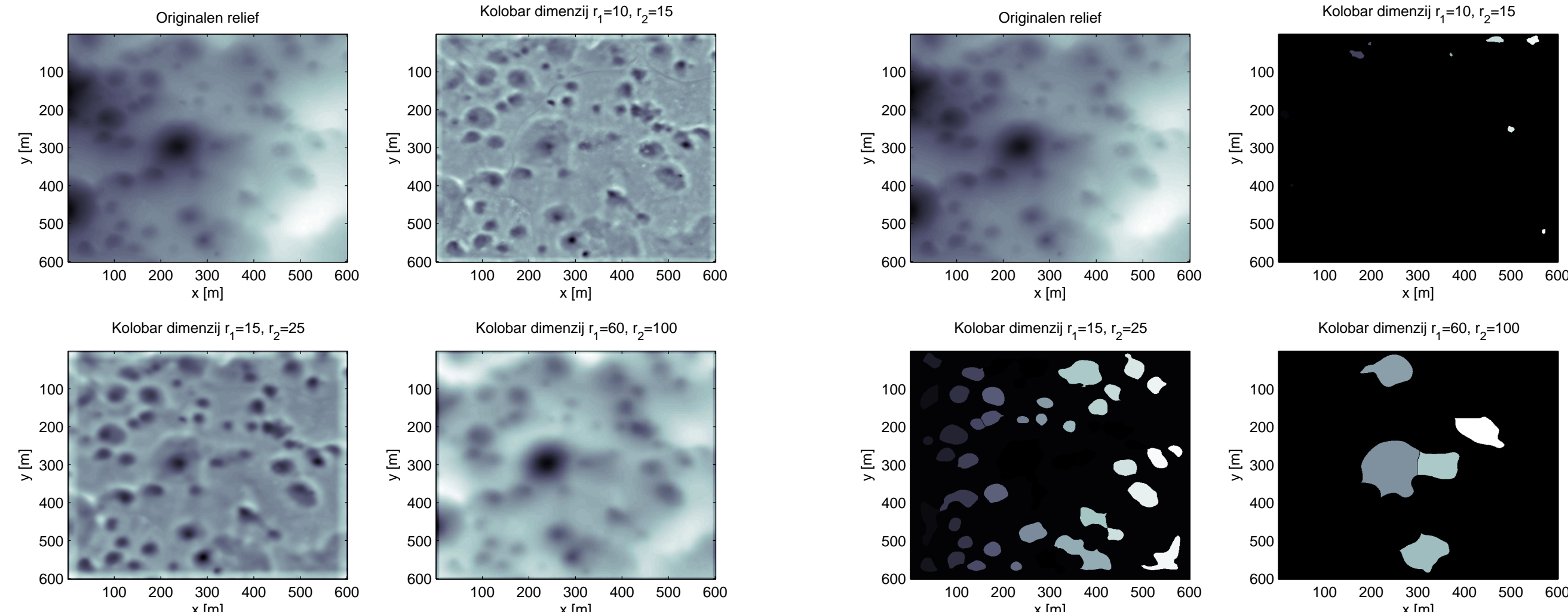
Computer vision method

- Kako dela metoda

Figure 1: Some figure

Results
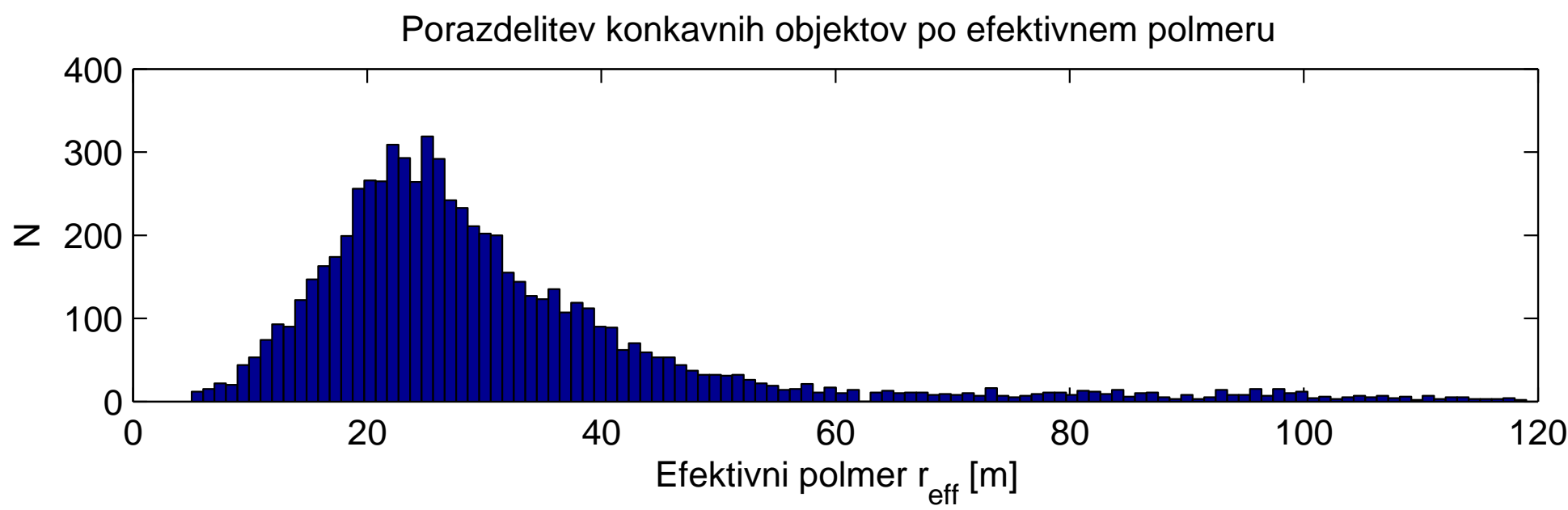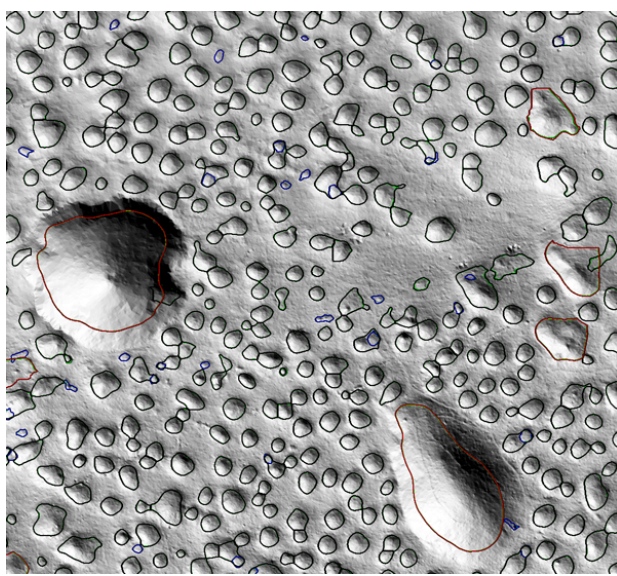
- Kaj in kje so vrtace
- Od kje podatki

Figure 2: Some figure

Fusce magna risus, molestie ut porttitor in, consectetur sed mi. Vestibulum ante ipsum primis in faucibus orci luctus et ultrices posuere cubilia Curae; Pellentesque consectetur blandit pellentesque. Sed odio justo, viverra nec porttitor vel, lacinia a nunc. Suspendisse pulvinar euismod arcu, sit amet accumsan enim fermentum quis. In id mauris ut dui feugiat egestas. Vestibulum ac turpis lacinia nisl commodo sagittis eget sit amet sapien.

Average doline

- Kako sem povprecil vrtace
- S kaksno funkcijo aproksimiramo vrtaco

Nulla vel nisl sed mauris auctor mollis non sed.

$$E = mc^2 \qquad (1)$$

Curabitur mi sem, pulvinar quis aliquam rutrum. (1) edf (2) , $\Omega = [-1, 1]^3$, maecenas leo est, ornare at. $z = -1$ sed interdum felis dapibus sem. x set y ytruem. Turpis j amet accumsan enim y-lacina; ref k-viverra nec porttitor x-lacina.
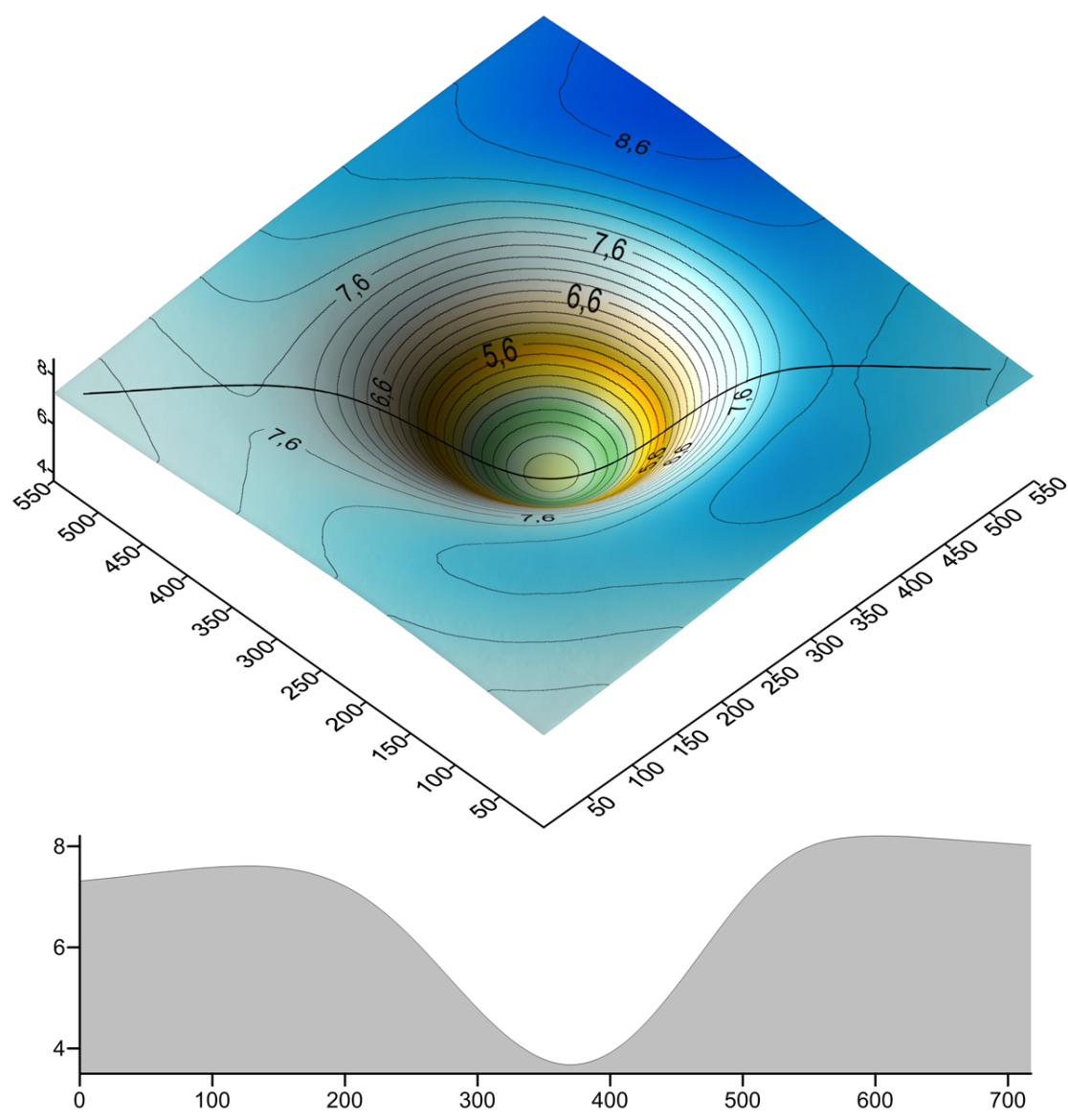

Figure 3: Figure caption

Vestibulum ac diam a odio tempus congue. Vivamus id enim nisi:

$$\cos \bar{\phi}_k Q_{j,k+1,t} + Q_{j,k+1,x} + \frac{\sin^2 \bar{\phi}_k}{T \cos \phi_k} Q_{j,k+1} =$$
$$- \cos \phi_k Q_{j,k,t} + Q_{j,k,x} - \frac{\sin^2 \phi_k}{T \cos \phi_k} Q_{j,k} \quad (2)$$

and

$$\cos \bar{\phi}_j Q_{j+1,k,t} + Q_{j+1,k,y} + \frac{\sin^2 \bar{\phi}_j}{T \cos \bar{\phi}_j} Q_{j+1,k} =$$
$$- \cos \phi_j Q_{j,k,t} + Q_{j,k,y} - \frac{\sin^2 \phi_j}{T \cos \phi_j} Q_{j,k}. \qquad (3)$$

Nulla sed arcu arcu. Duis et ante gravida orci venenatis tincidunt. Fusce vitae lacinia metus. Pellentesque habitant morbi. $A\underline{\xi} = \underline{\beta}$ Vim $\underline{\xi}$ enum nidi $3(P+2)^2$ lacina. Id feugain A nun quis; magno.

Results and comments

- Kako prilegamo funkcijo najdenim vrtacam
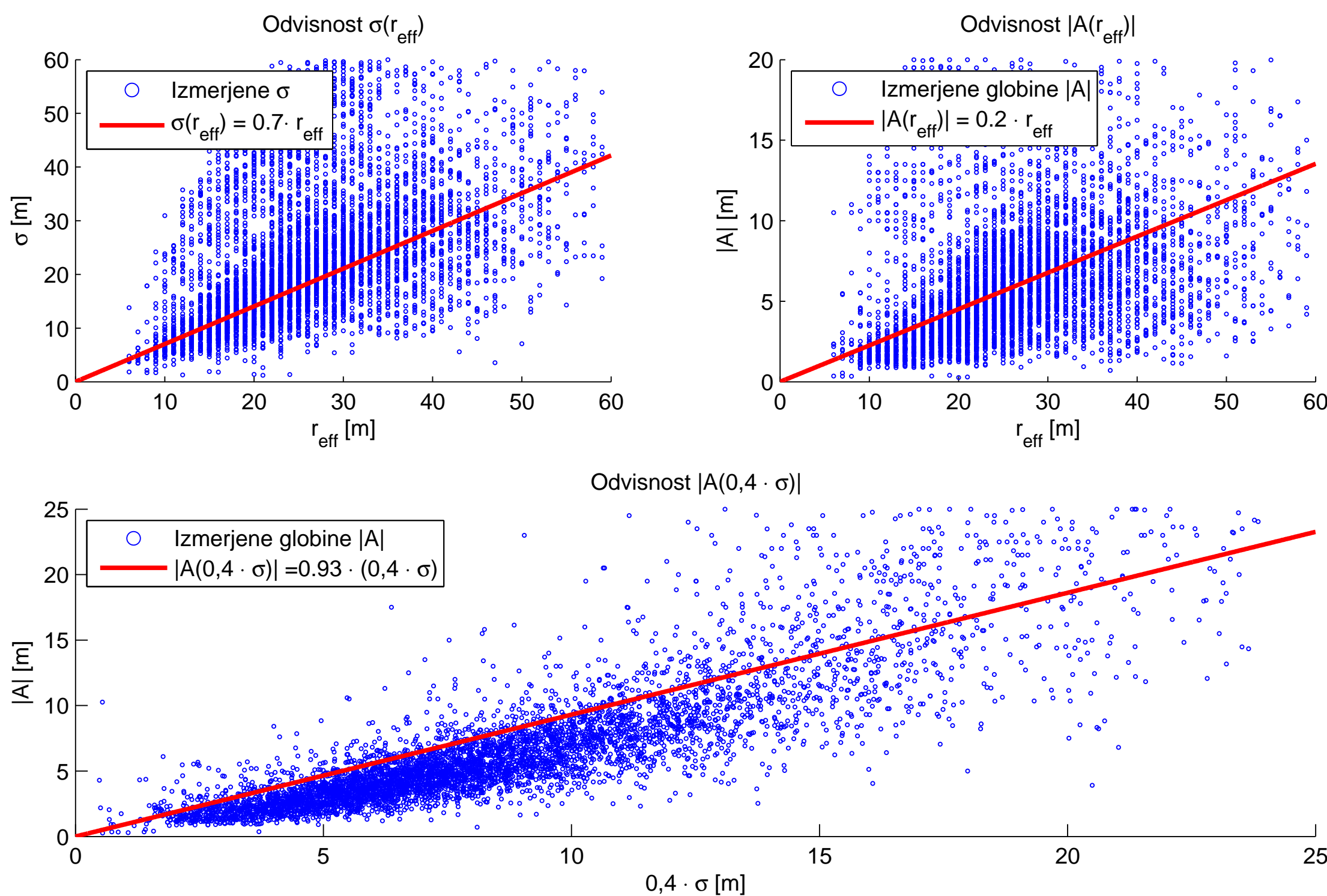- Kaksna je porazdelitev tako izmerjenih parametrov

Figure 4: Figure caption

Donec faucibus purus at tortor egestas eu fermentum dolor facilisis. Maecenas tempor dui eu neque fringilla rutrum. Mauris *lobortis* nisl accumsan. Aenean vitae risus ante. Phasellus imperdiet, tortor vitae congue bibendum, felis enim sagittis lorem, et volutpat ante orci sagittis mi. Morbi rutrum laoreet semper. Morbi accumsan enim nec tortor consectetur non commodo nisi sollicitudin. Proin sollicitudin. Pellentesque eget orci eros. Fusce ultricies, tellus et pellentesque fringilla, ante massa luctus libero, quis tristique purus urna nec nibh.

In hac habitasse platea dictumst. Etiam placerat, risus ac.

Treatments	Response 1	Response 2
Treatment 1	0.0003262	0.562
Treatment 2	0.0015681	0.910
Treatment 3	0.0009271	0.296

Table 1: Table caption

Vivamus sed nibh ac metus tristique tristique a vitae ante. Sed lobortis mi ut arcu fringilla et adipiscing ligula rutrum. Aenean turpis velit, placerat eget tincidunt nec, ornare in nisl. In placerat.

Proposed dynamic model

- Kaksni so casovni robni pogoji (geologija)
- Kaksni so prostorski robni pogoji
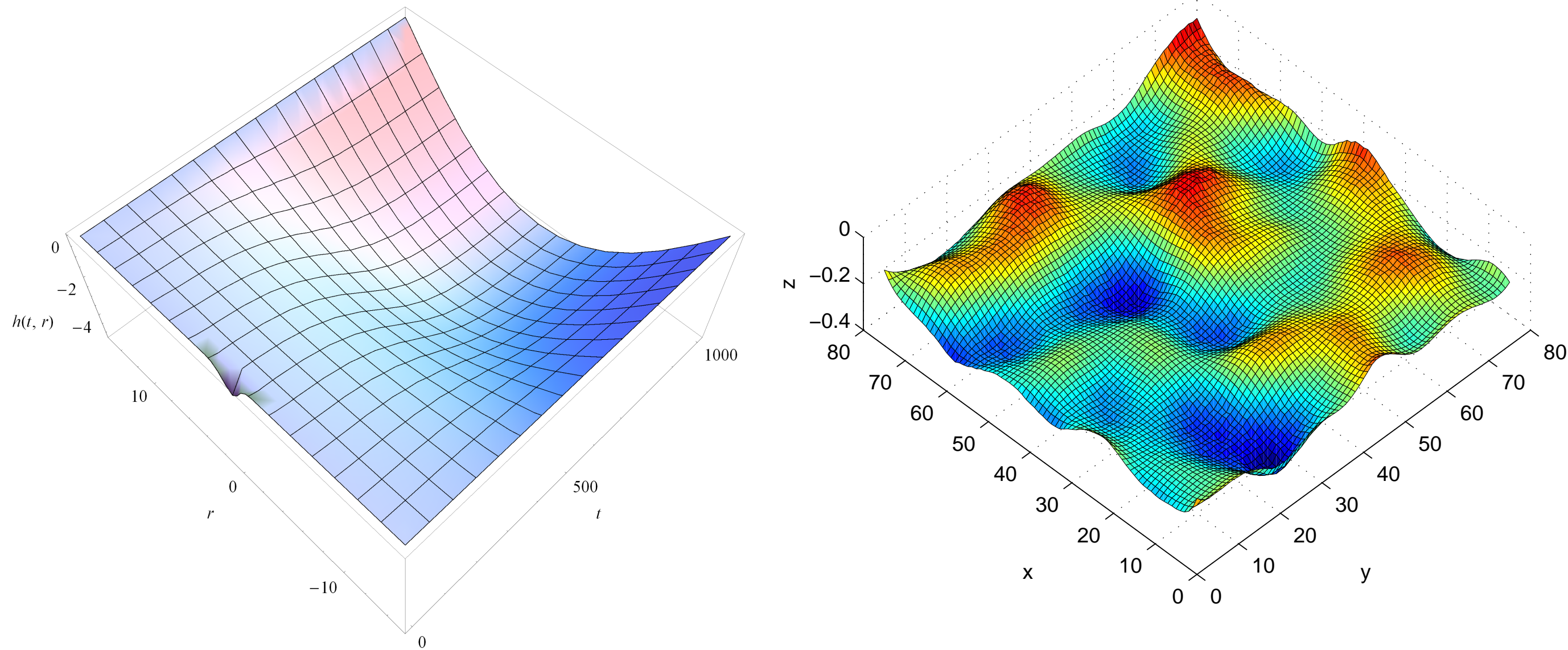- Predlagane enacbe
- Rezultati enacb

Figure 5: Some figure

- Pellentesque eget orci eros. Fusce ultricies, tellus et pellentesque fringilla, ante massa luctus libero, quis tristique purus urna nec nibh. Phasellus fermentum rutrum elementum. Nam quis justo lectus.

References

[1] A. B. Jones and J. M. Smith. Article Title. *Journal title*, 13(52):123–456, March 2013.

[2] J. M. Smith and A. B. Jones. *Book Title*. Publisher, 7th edition, 2012.