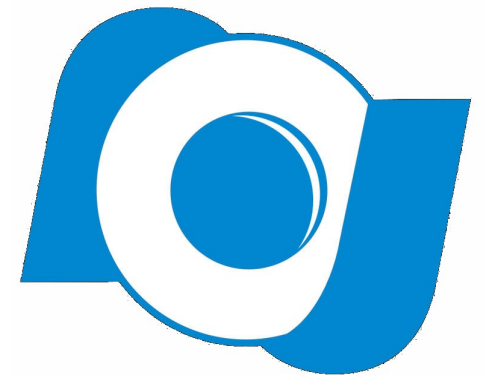


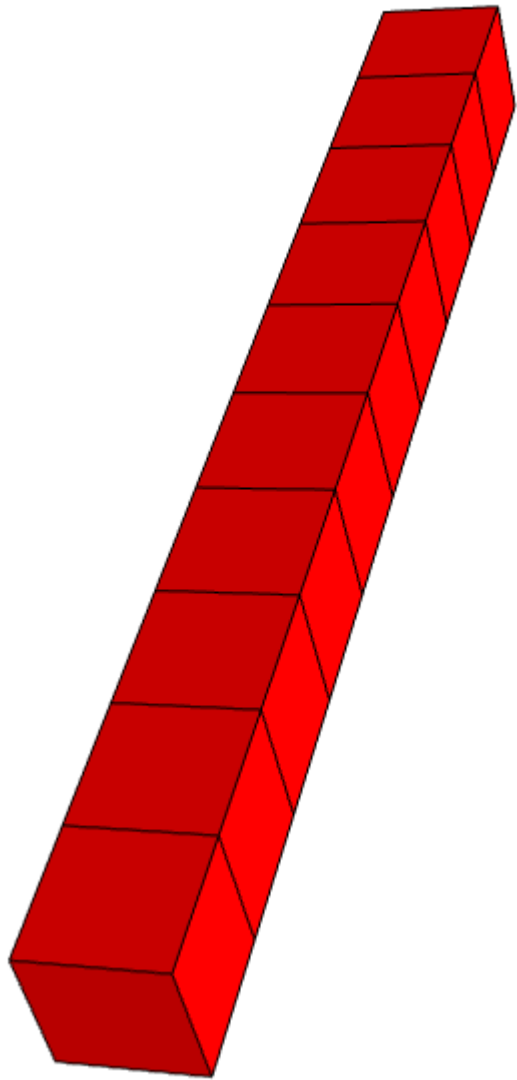
# Gravity inversion in spherical coordinates using tesserooids



Leonardo Uieda  
Valéria C. F. Barbosa

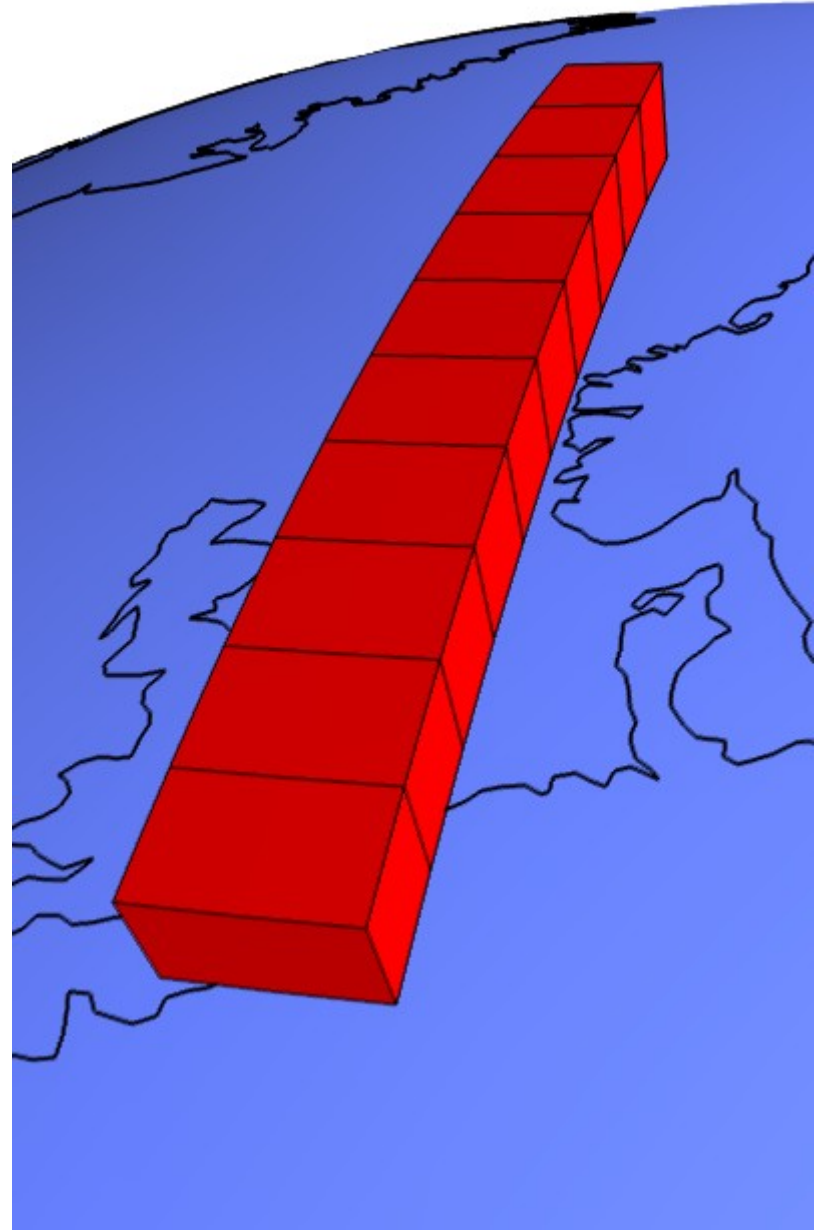


# Cartesian



# VS

# Spherical



# Existing inversion with tesseroids

## (Chaves and Ussami, 2013)

- Geoid height anomalies
- Space domain
- Regularization:
  - Depth-weighted Minimum Volume
  - Similarity to seismic tomography

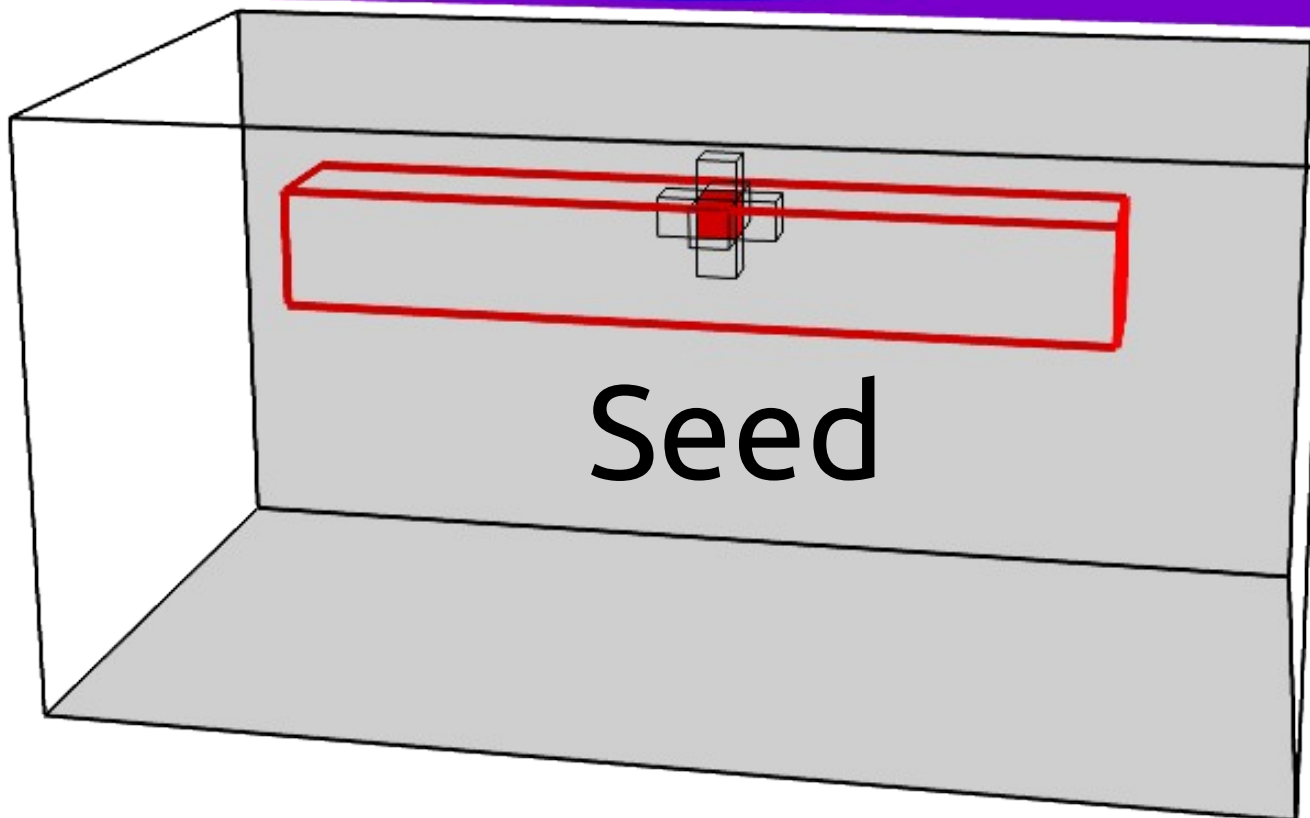
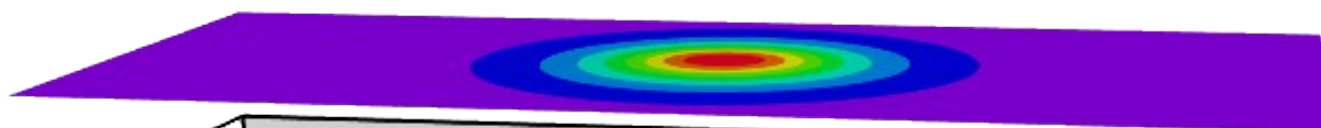
# Adapt

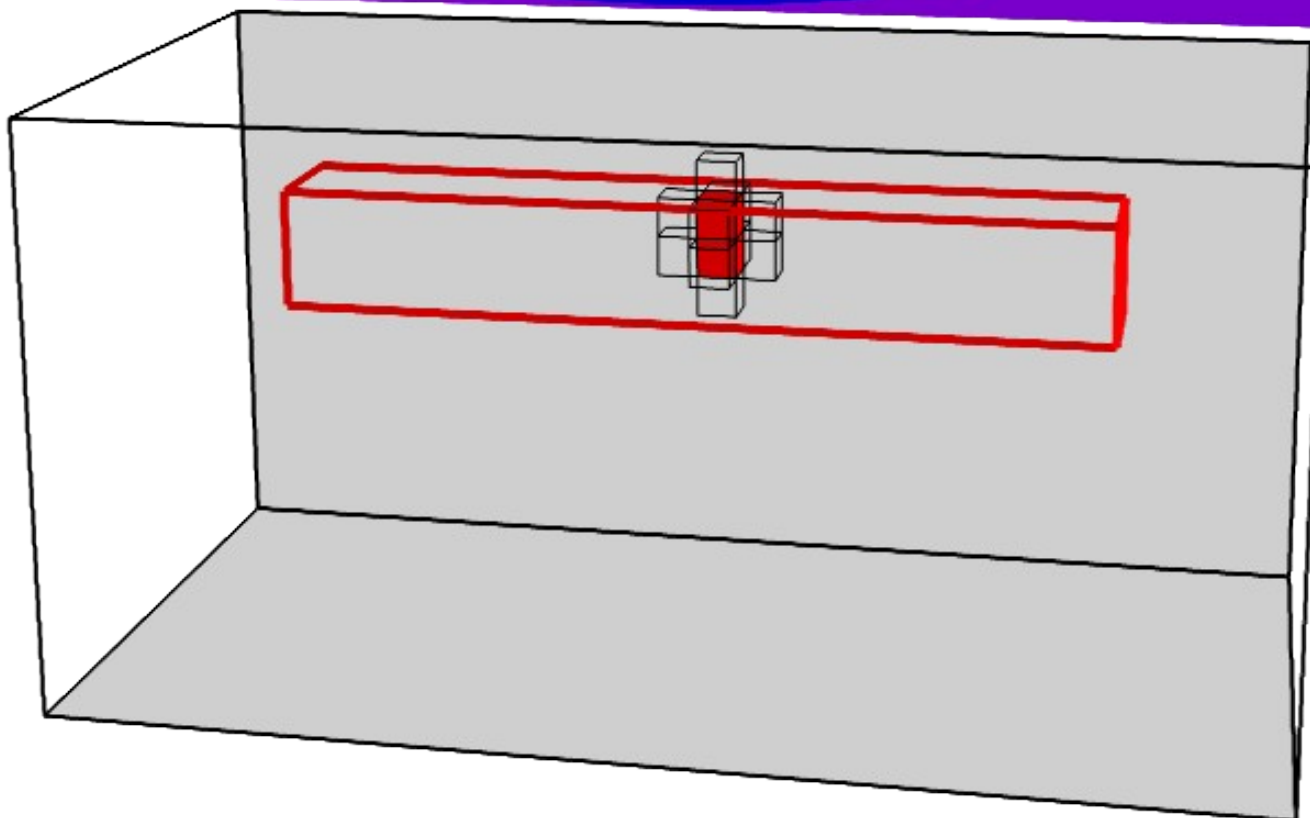
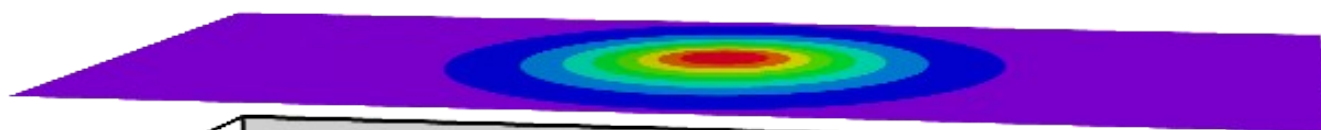
Planting anomalous densities

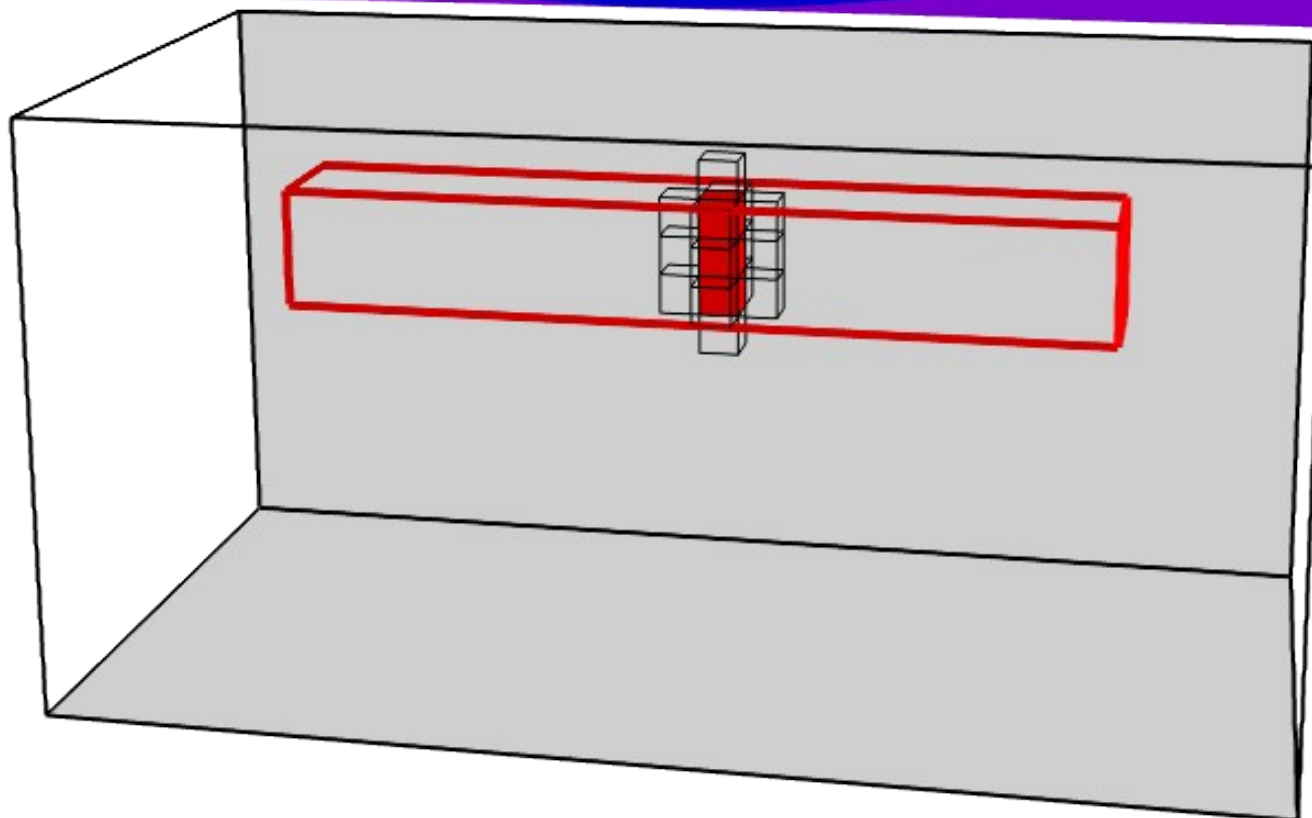
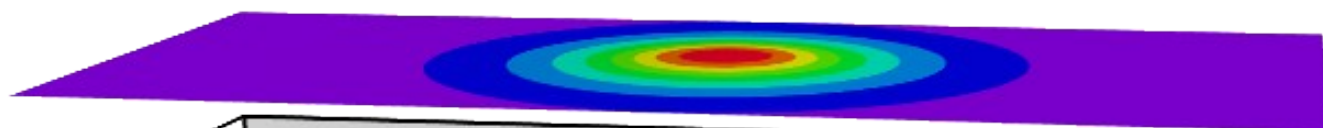
(Uieda and Barbosa, 2012)

# Planting anomalous densities

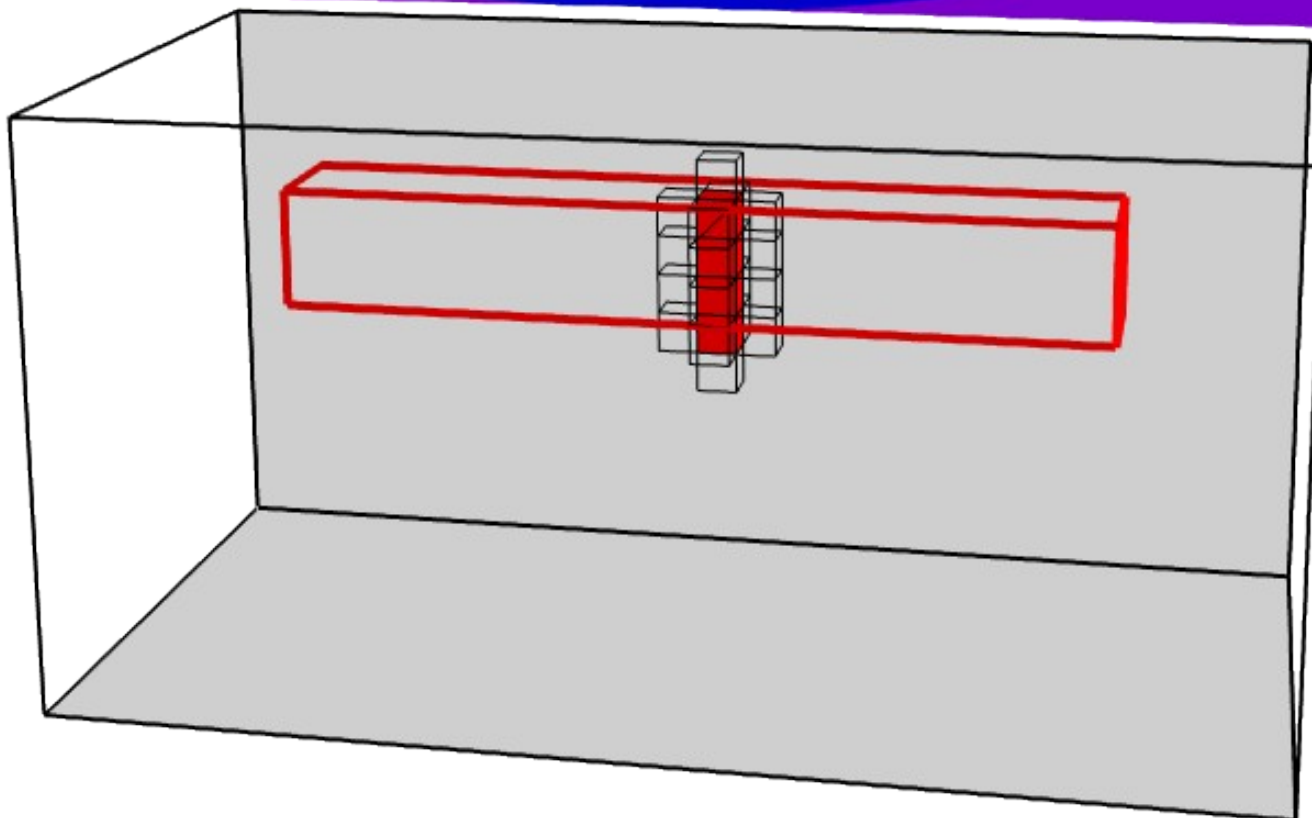
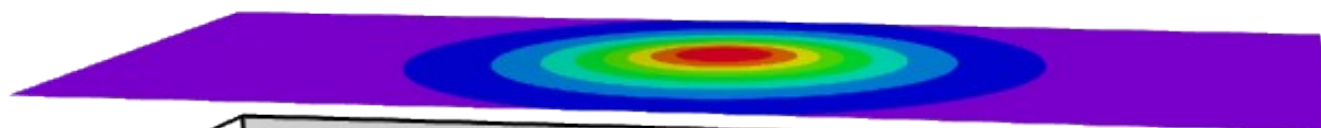
- Space domain
- Multicomponent: gravity + gradients
- Non-conventional inversion
  - Growth algorithm
  - No linear systems
  - Efficient sensitivity computations

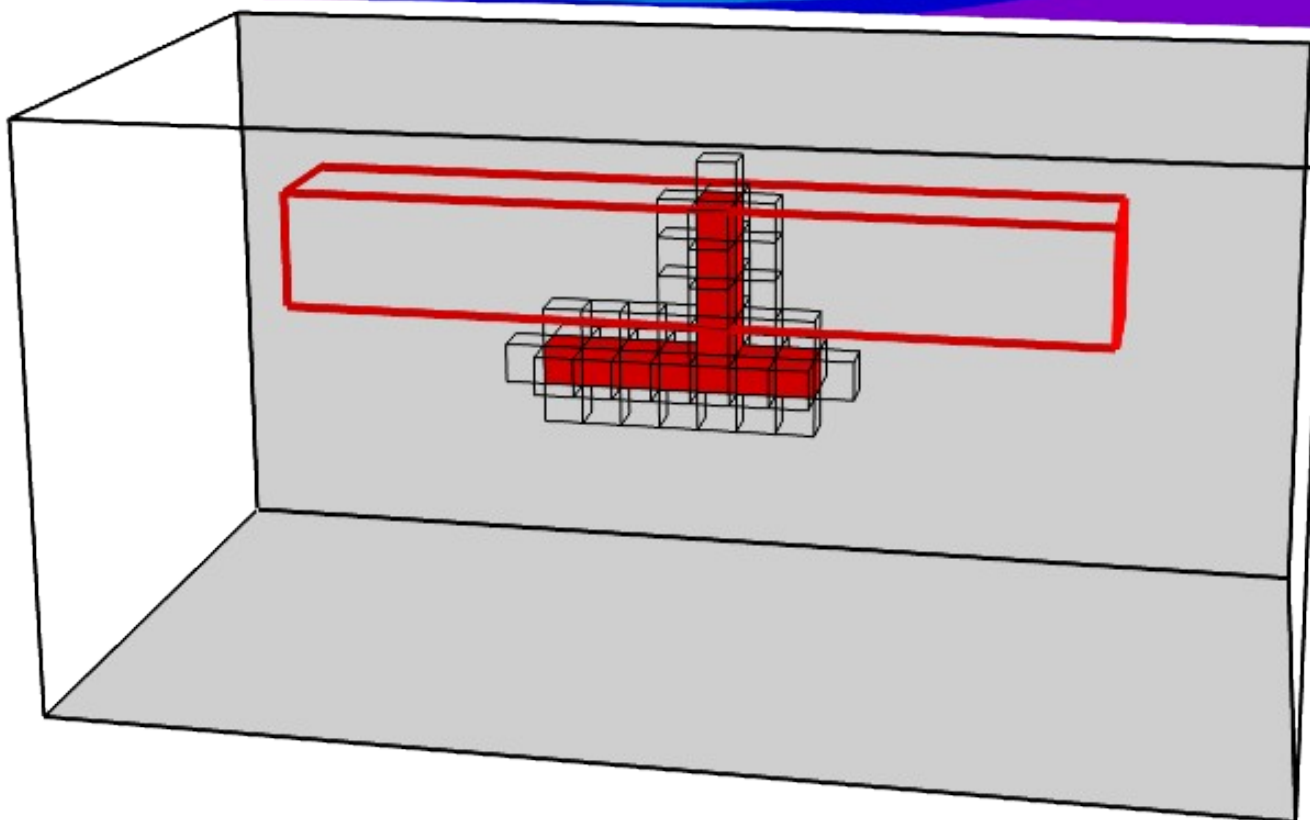
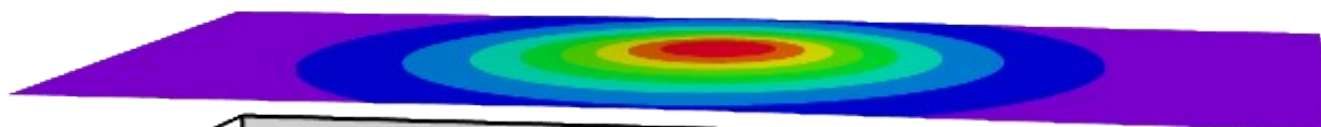


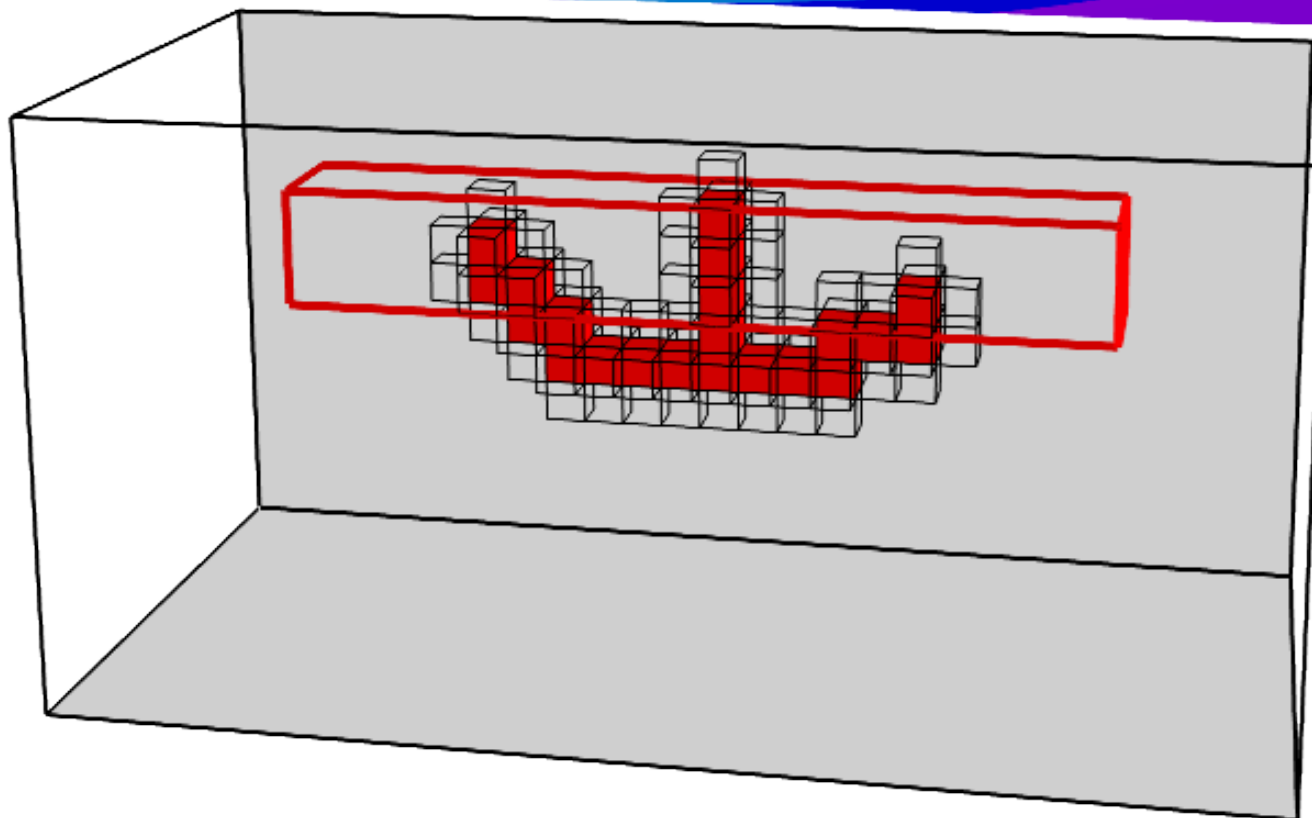
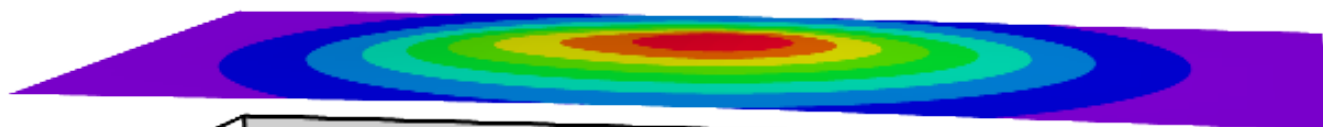


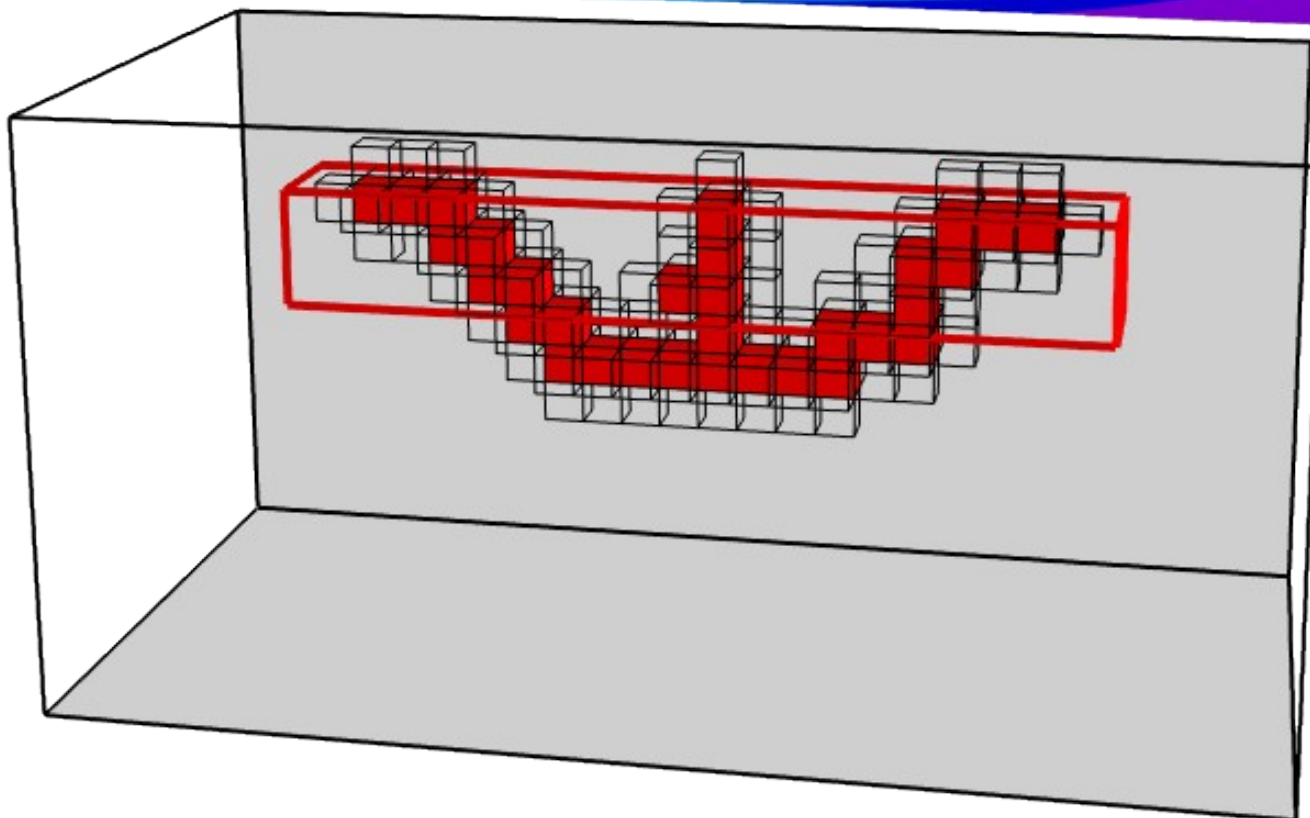
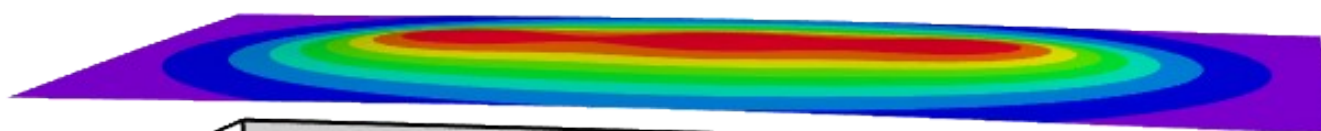


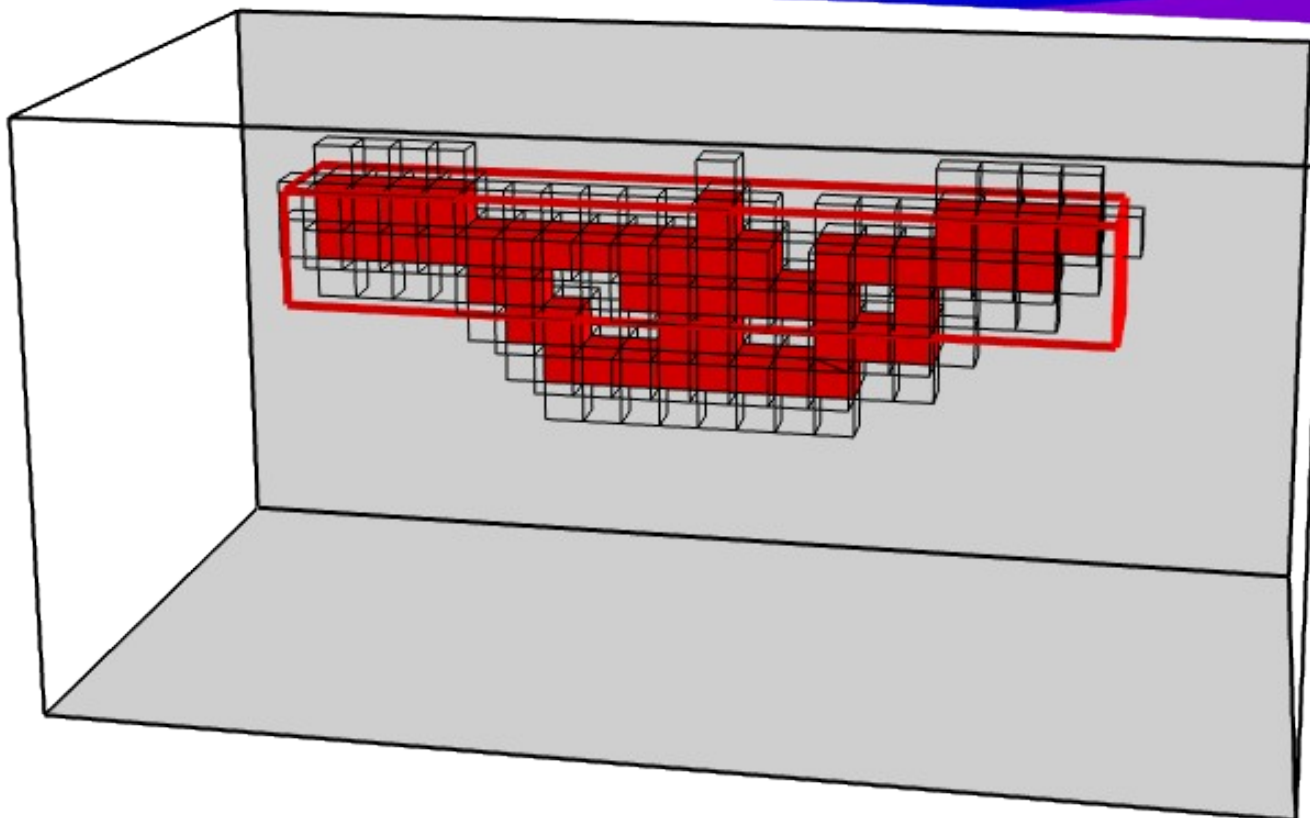
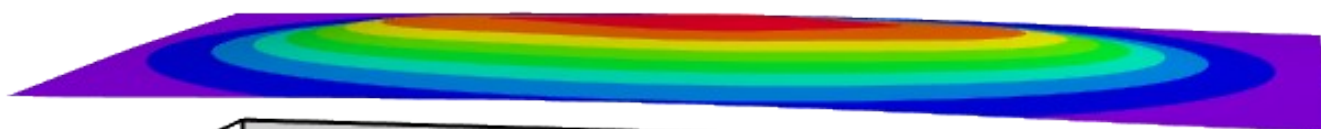


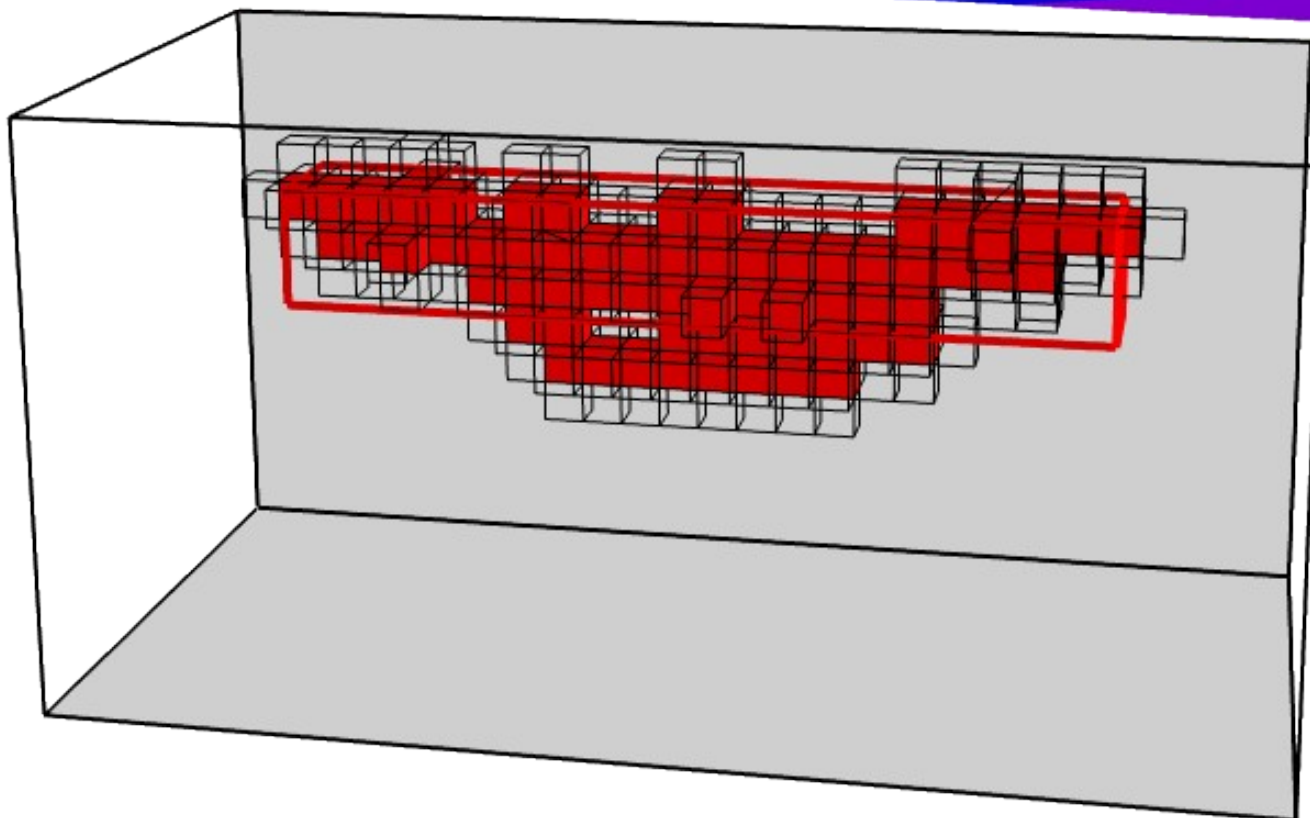


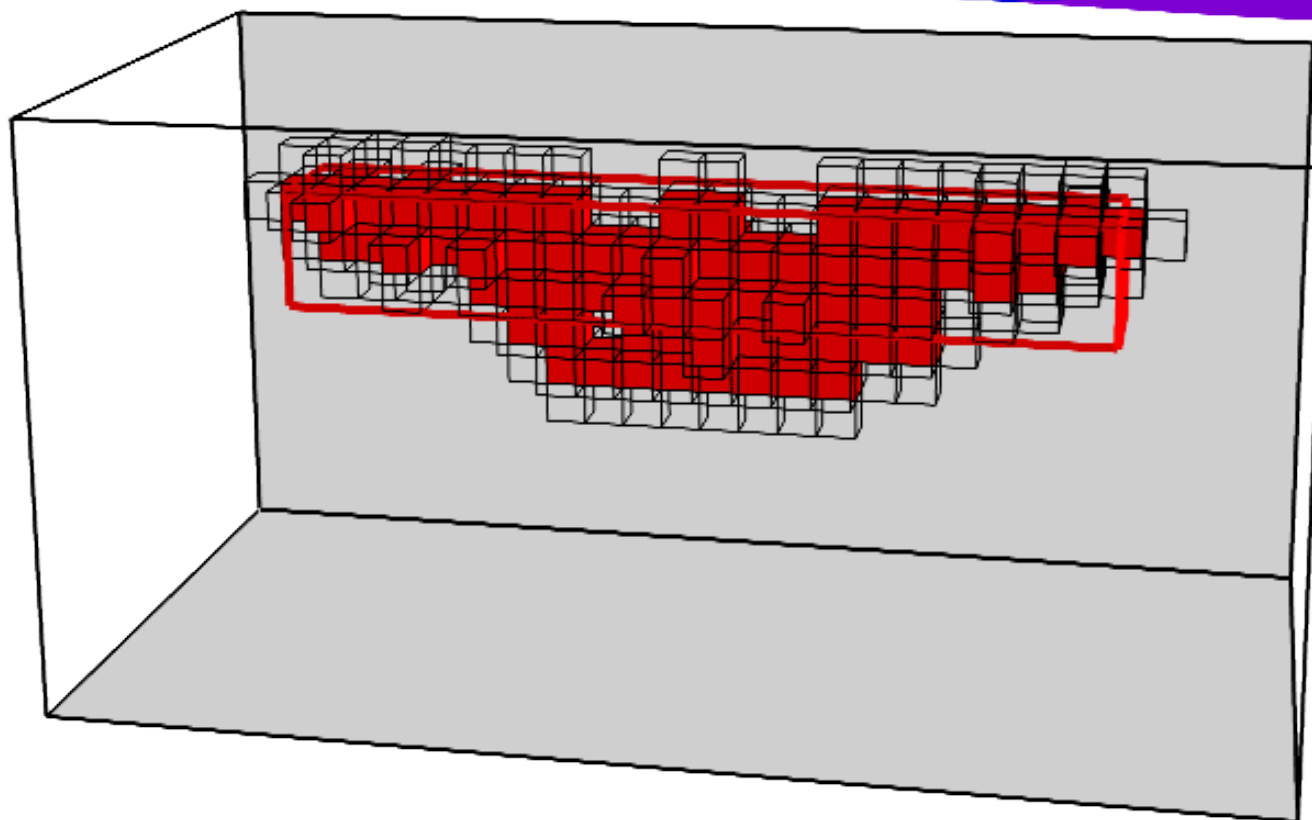




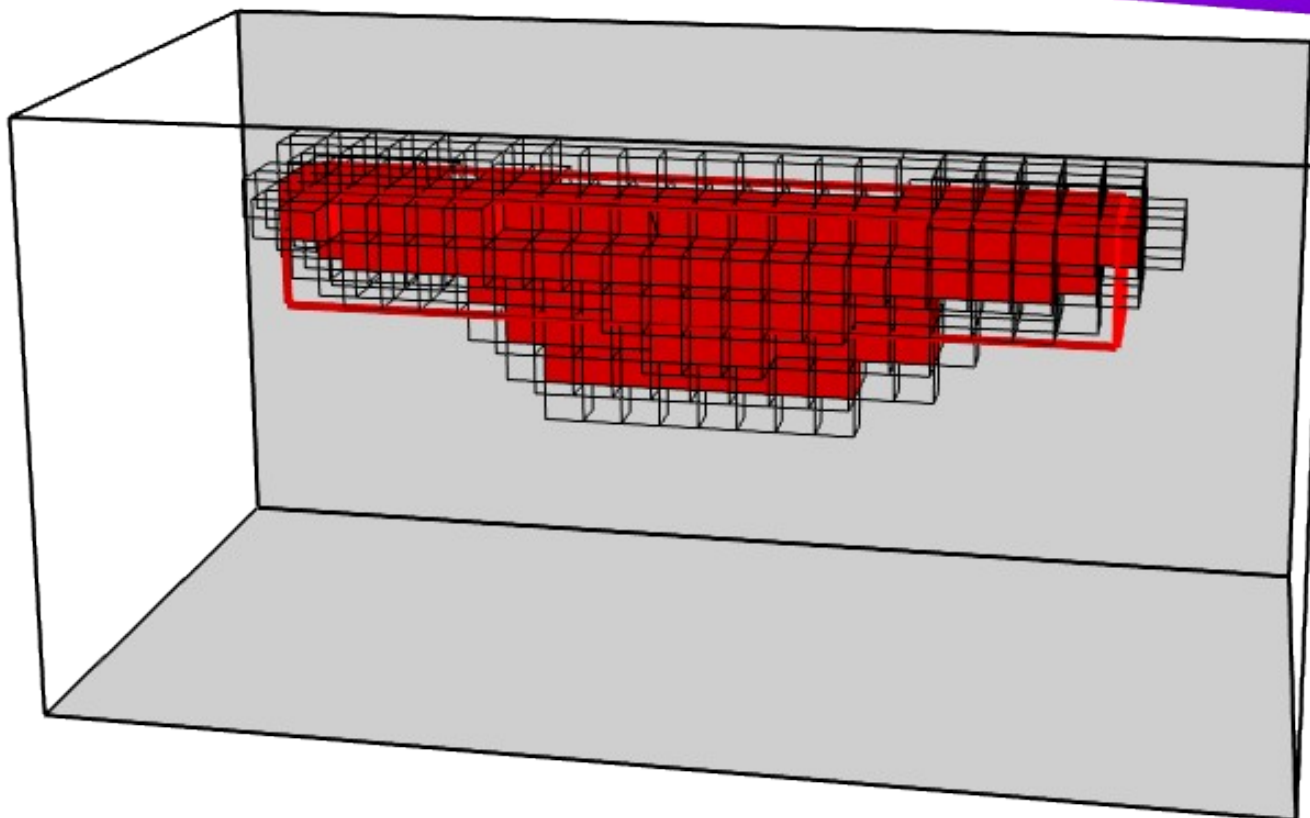




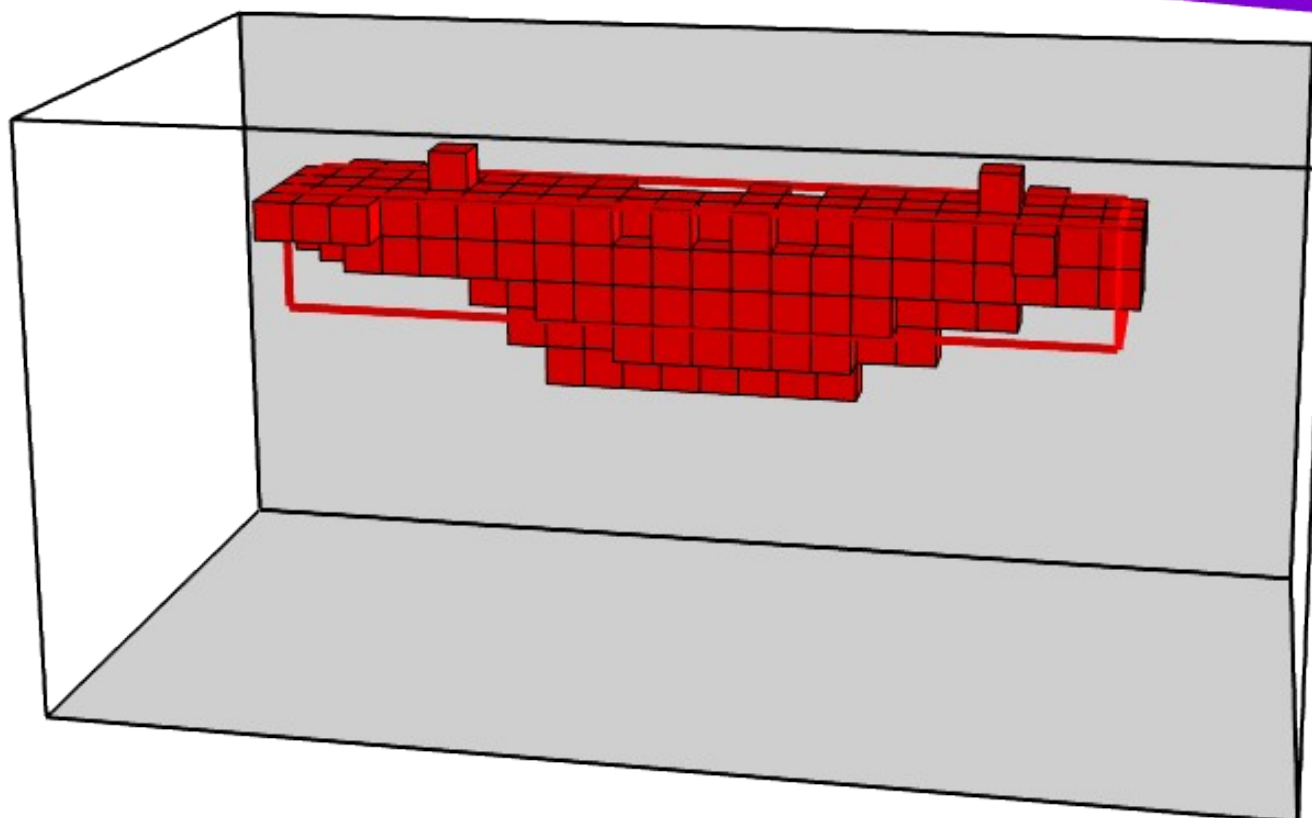
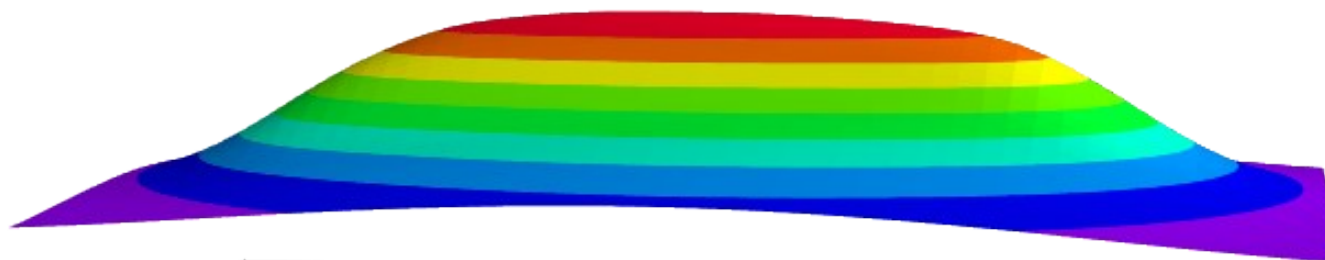










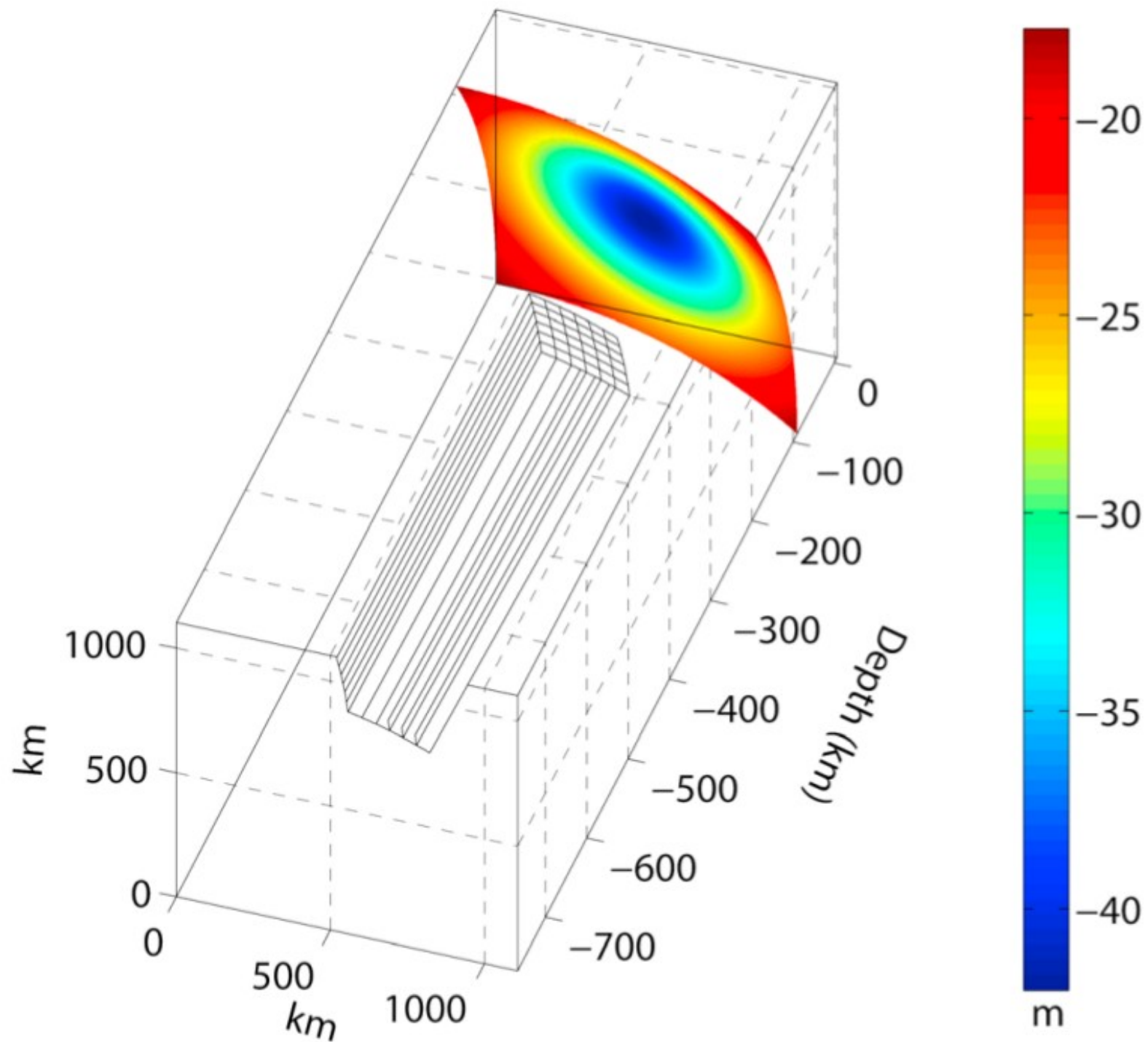


# Synthetics

- Possible applications
- Advantages
- Shortcomings

# (Hypothetical) Mantle Plume

Inspired by synthetics in Chaves and Ussami (2013)



After Chaves and Ussami (2013)

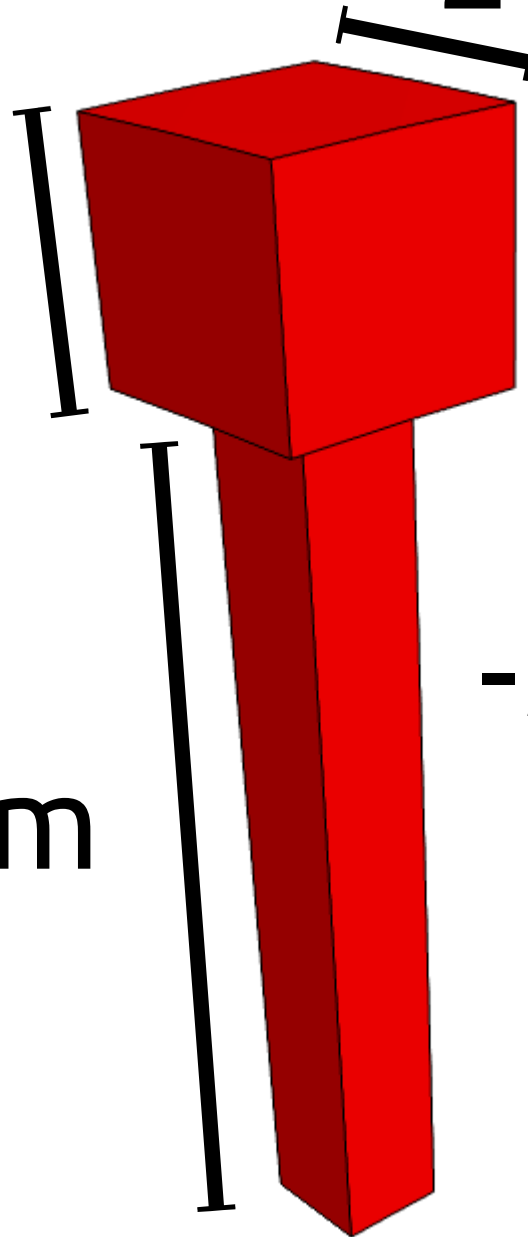
top=100 km

2°

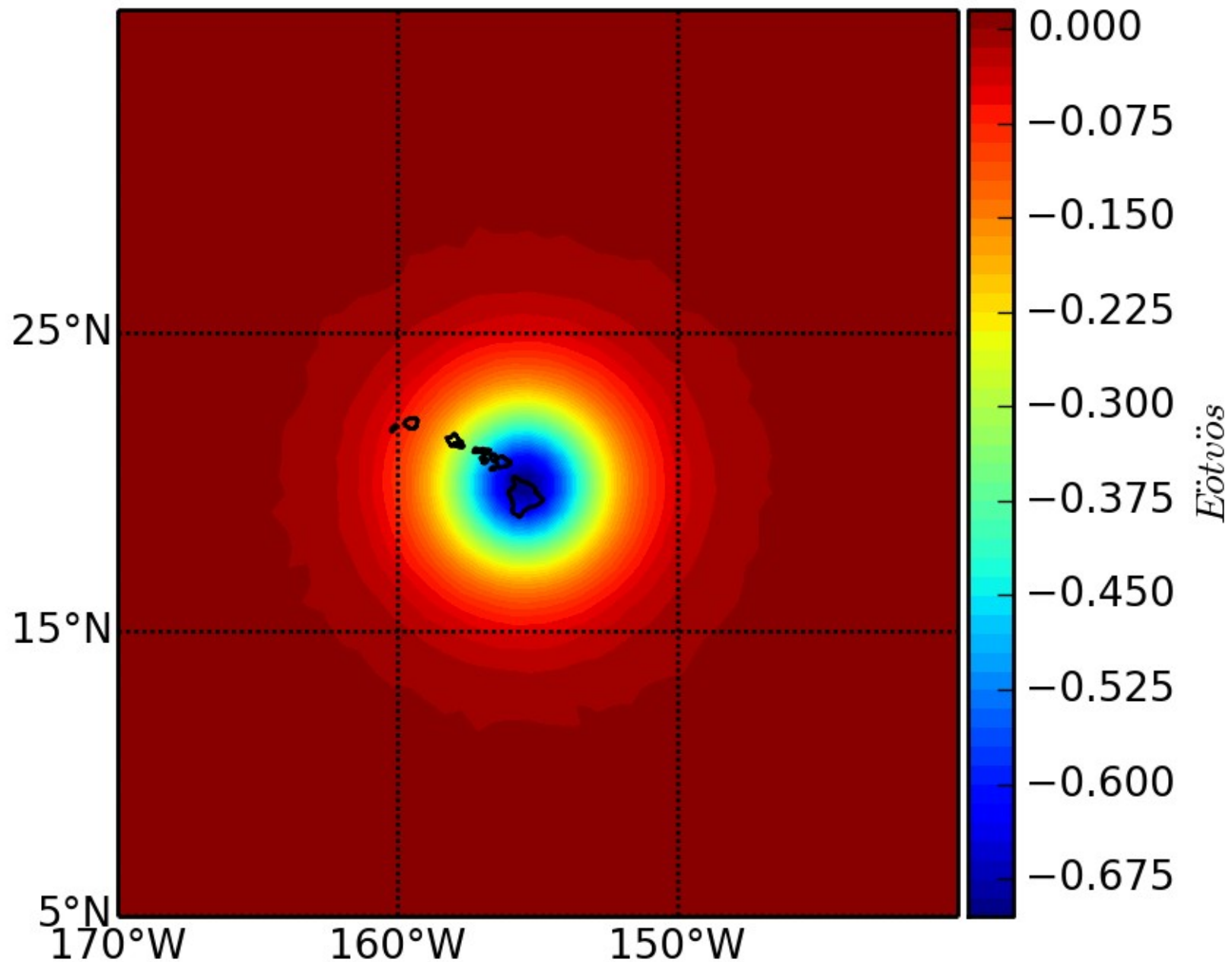
200 km

700 km

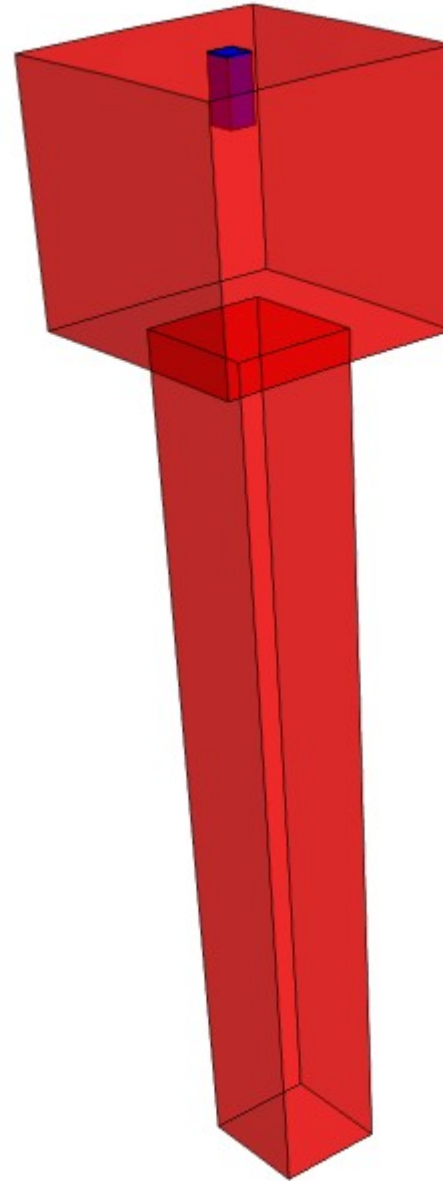
-50 kg.m<sup>-3</sup>

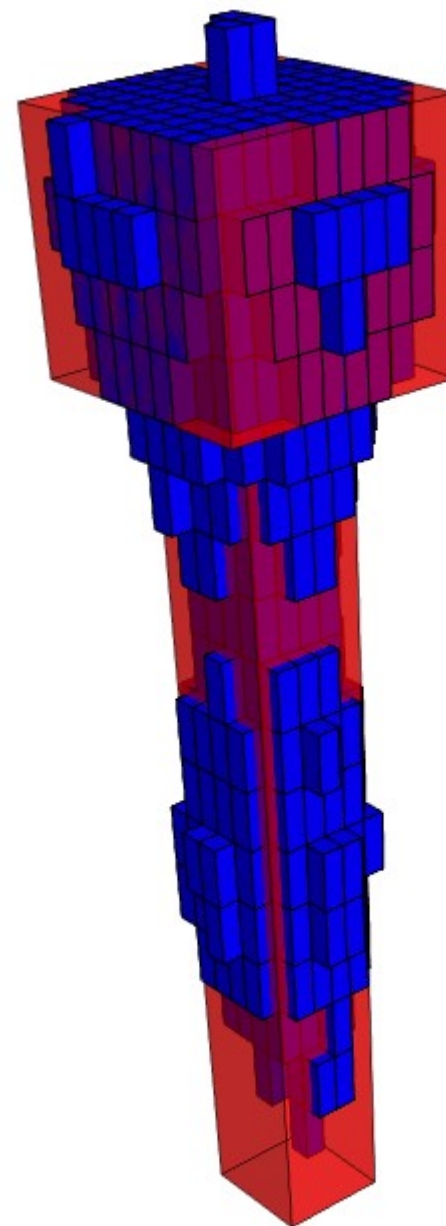
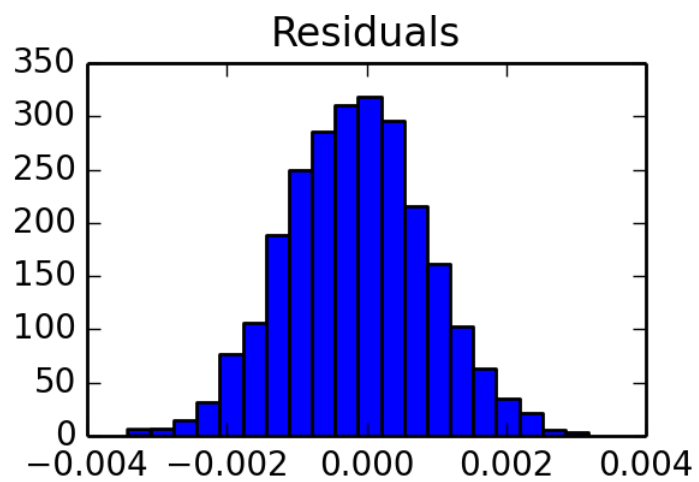
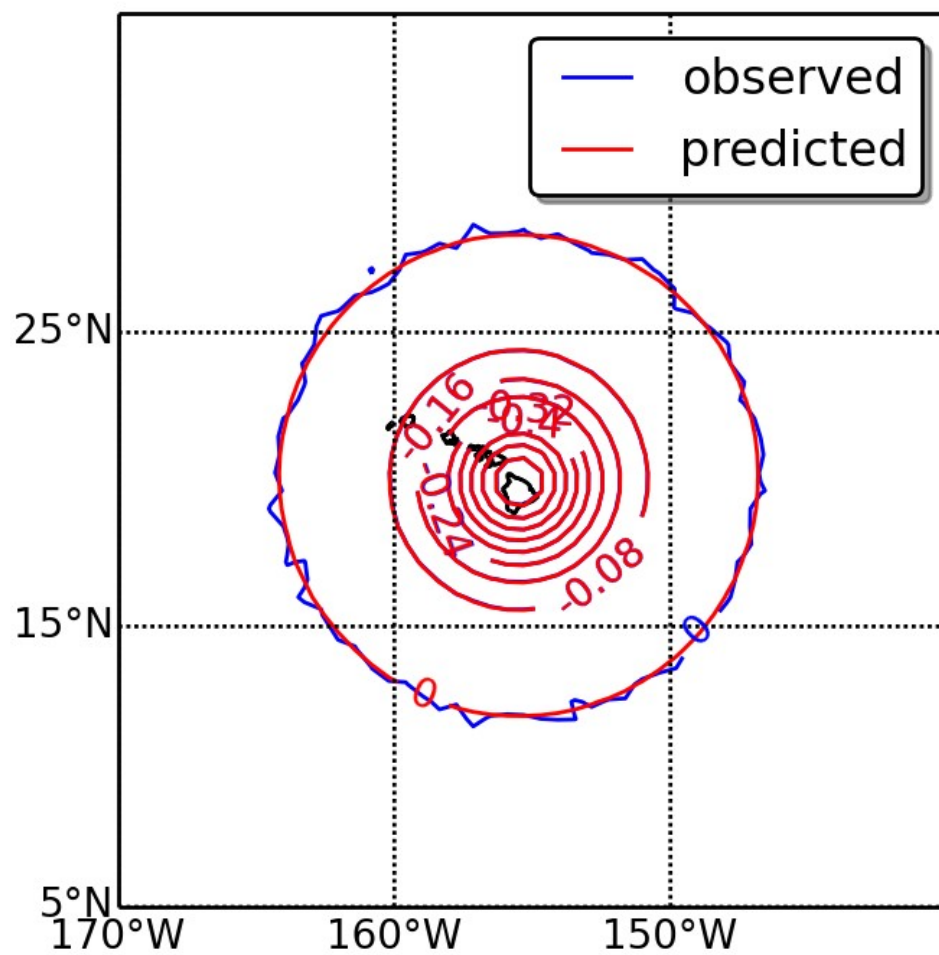


# $g_{zz}$ at 250 km



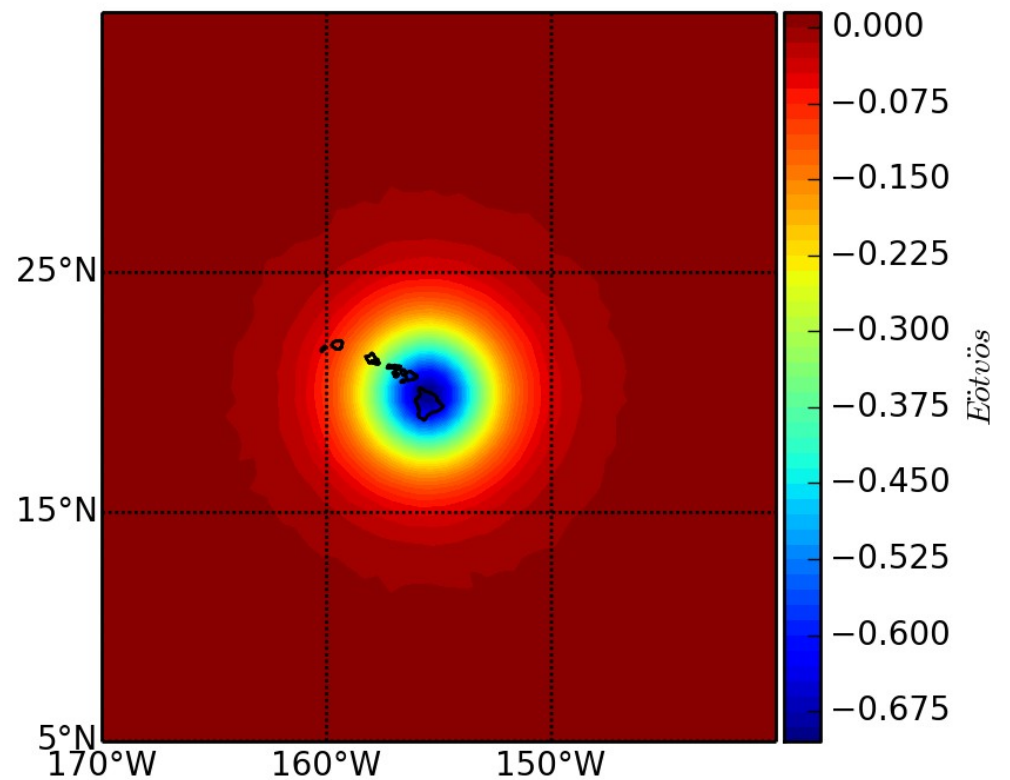
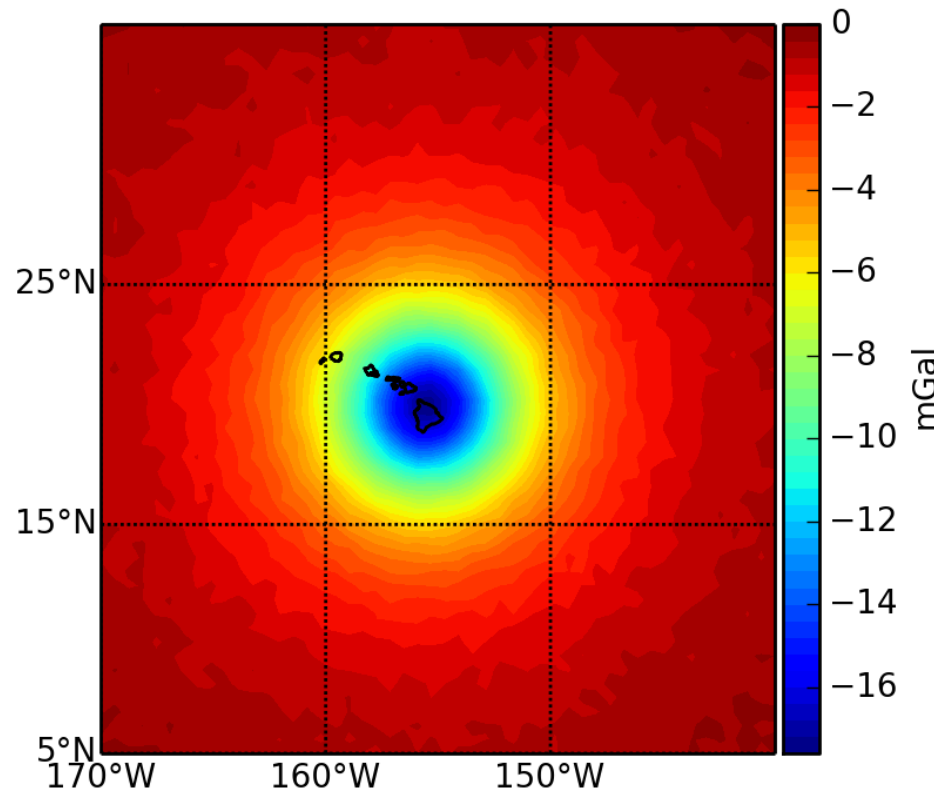
Seed



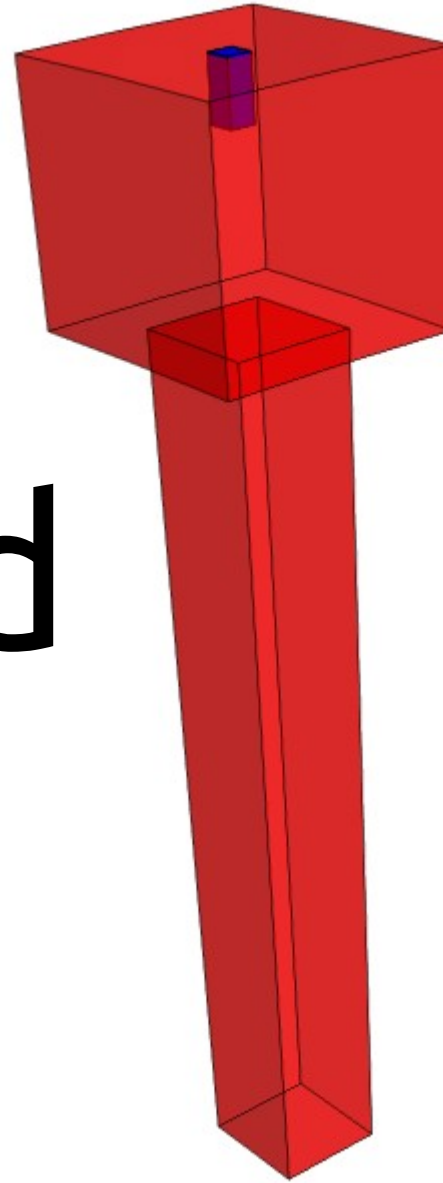


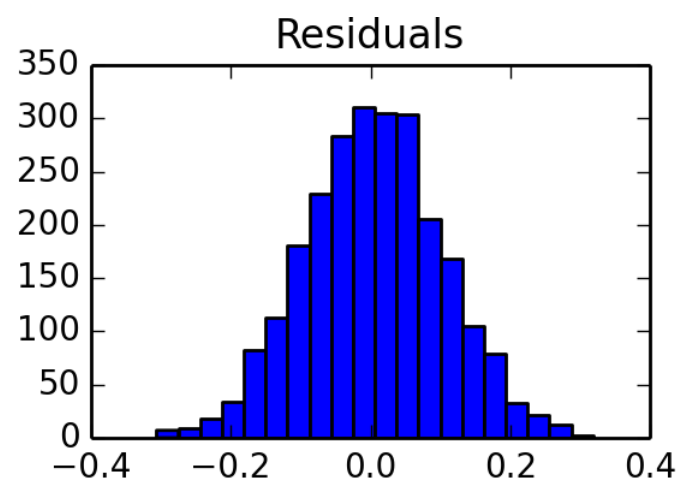
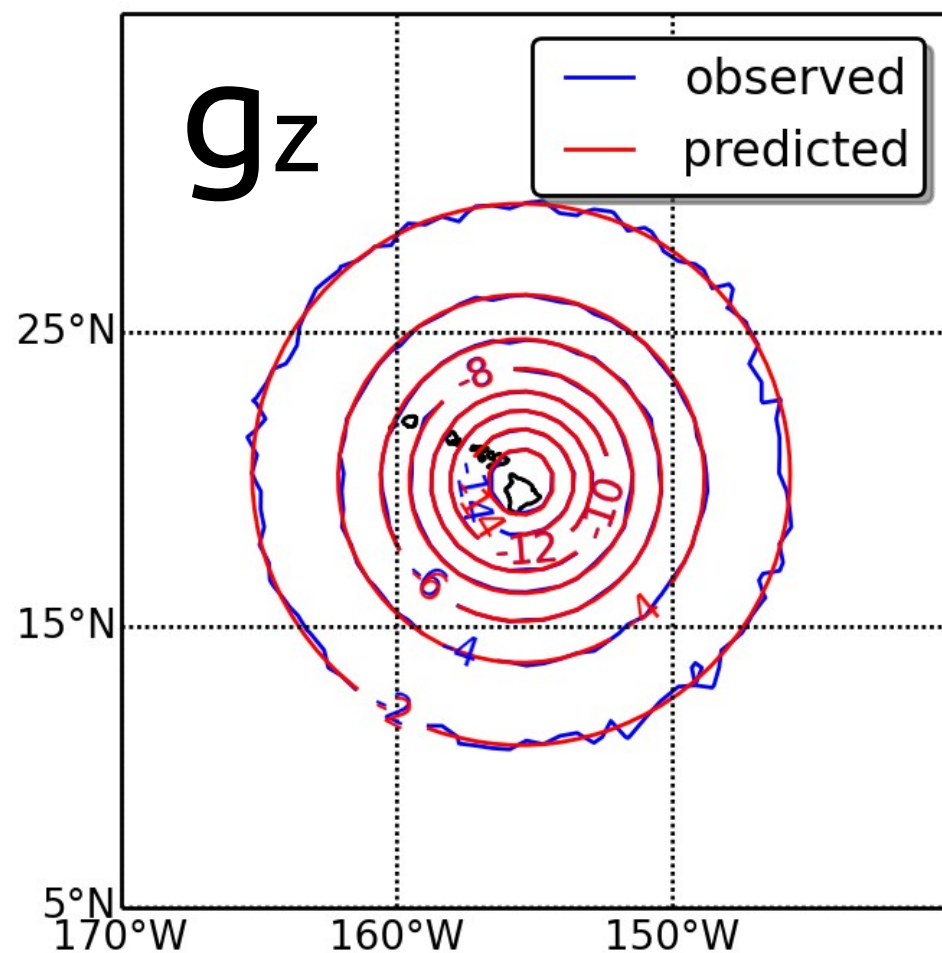
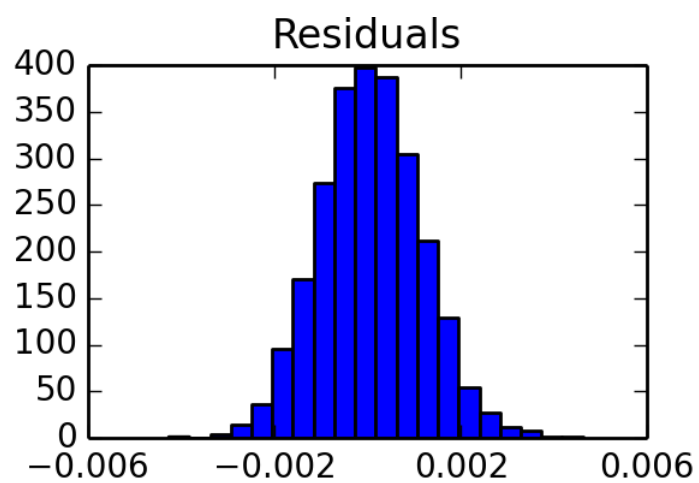
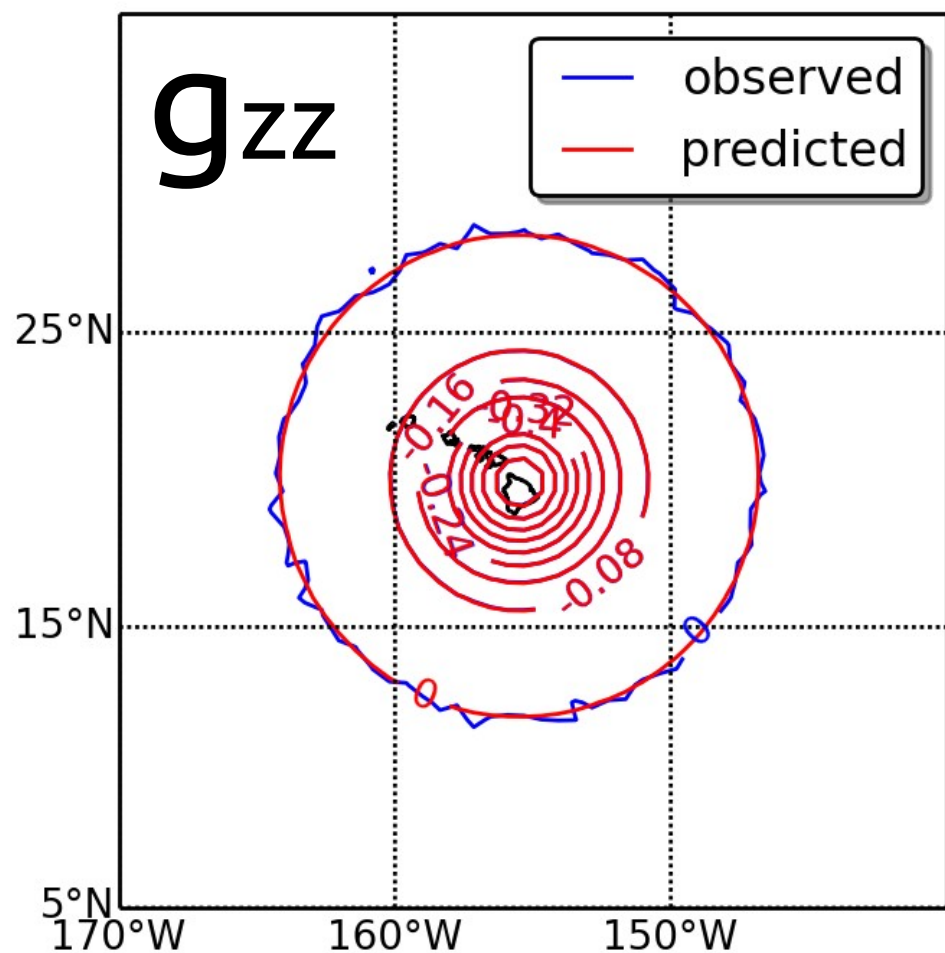


# Joint $g_z + g_{zz}$ ?

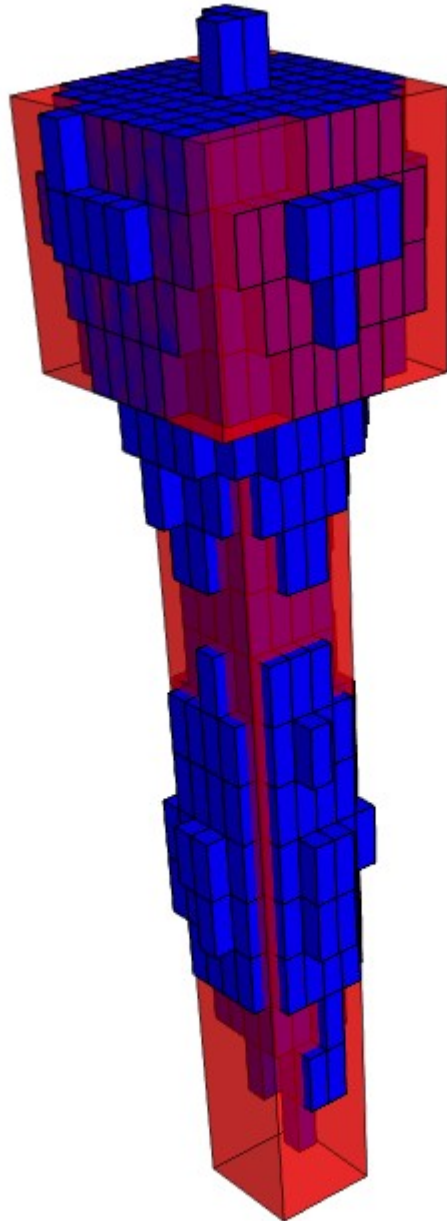


Same seed

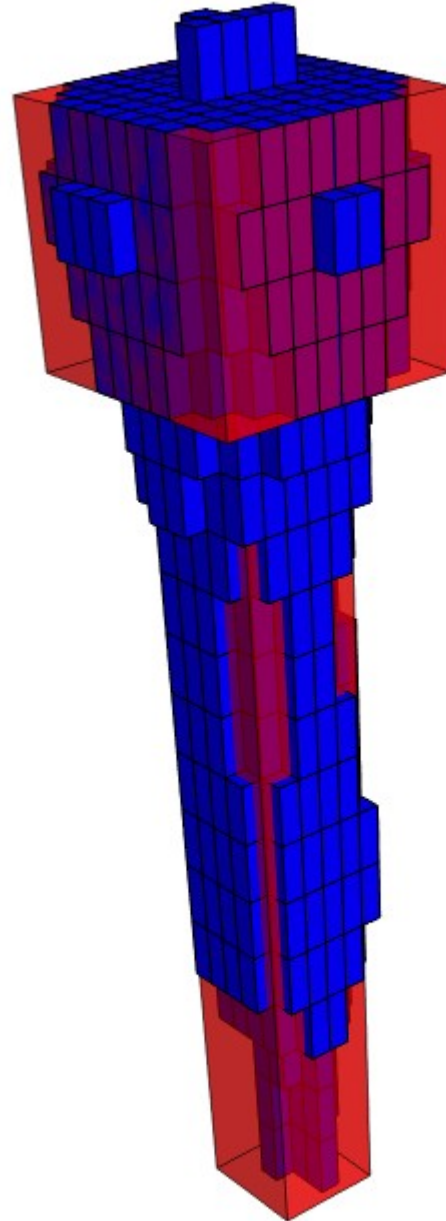




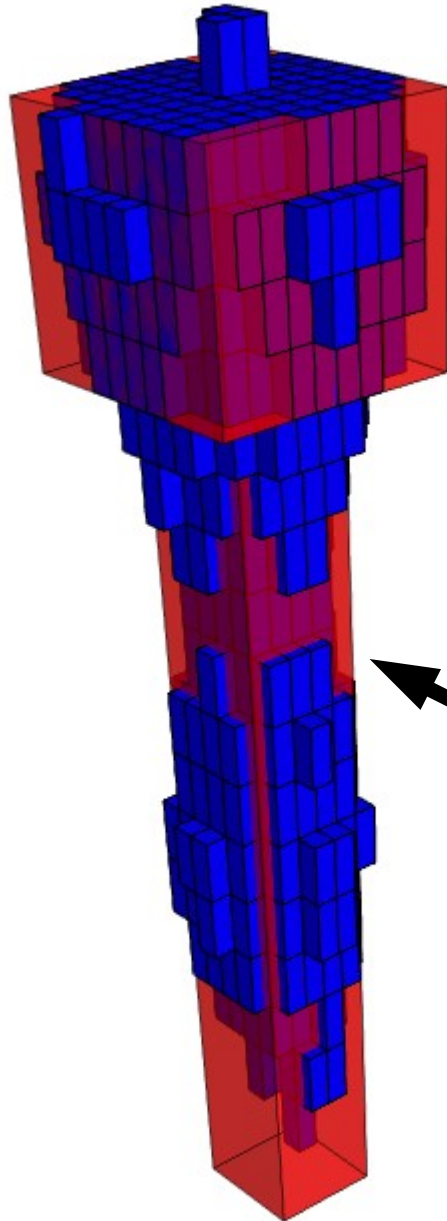
$g_{zz}$



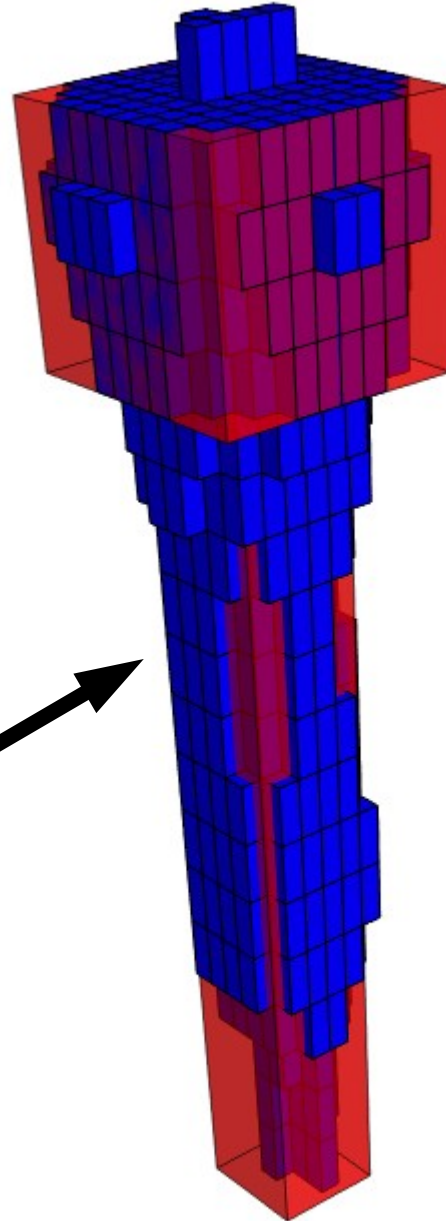
Joint



$g_{zz}$



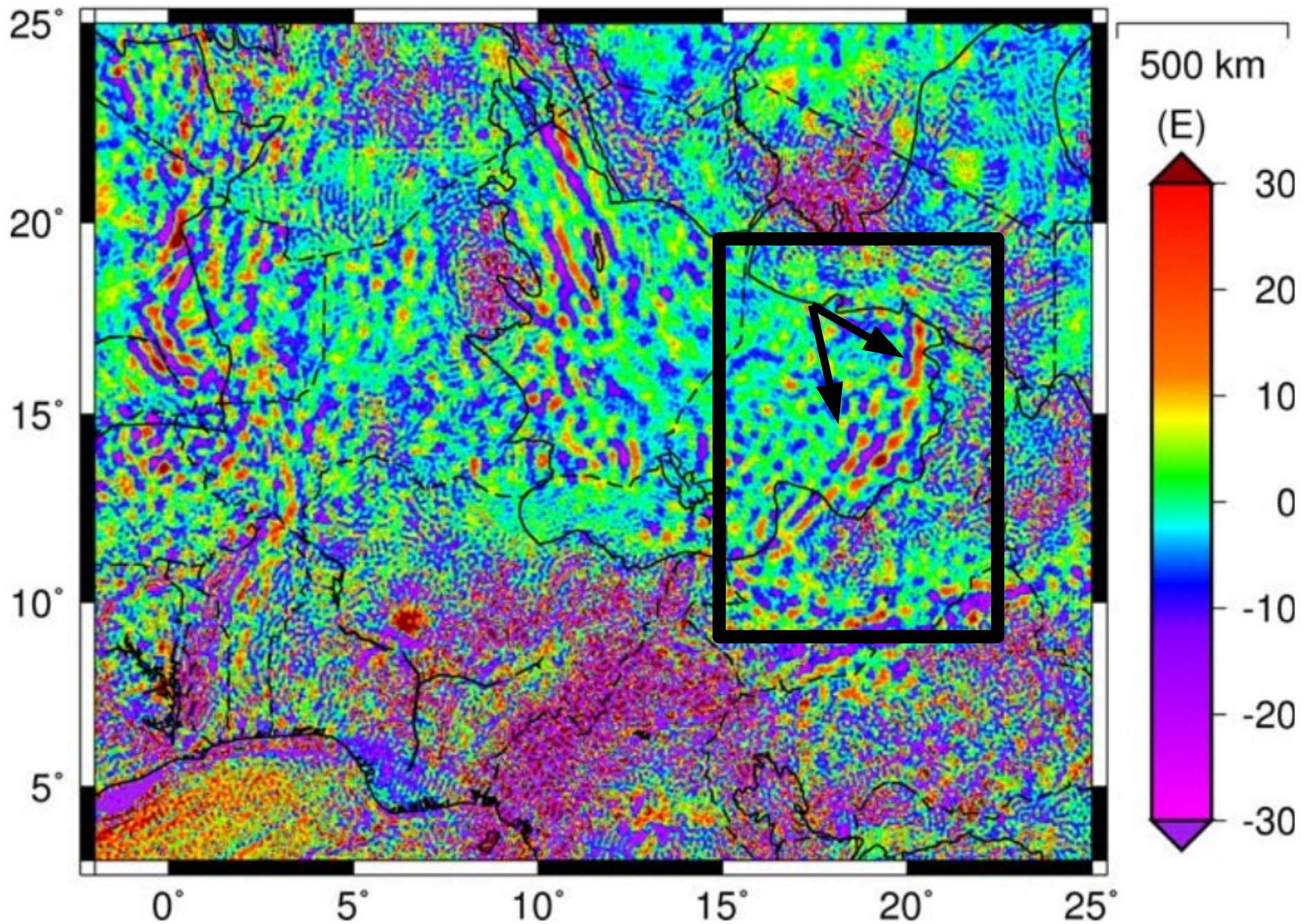
Joint



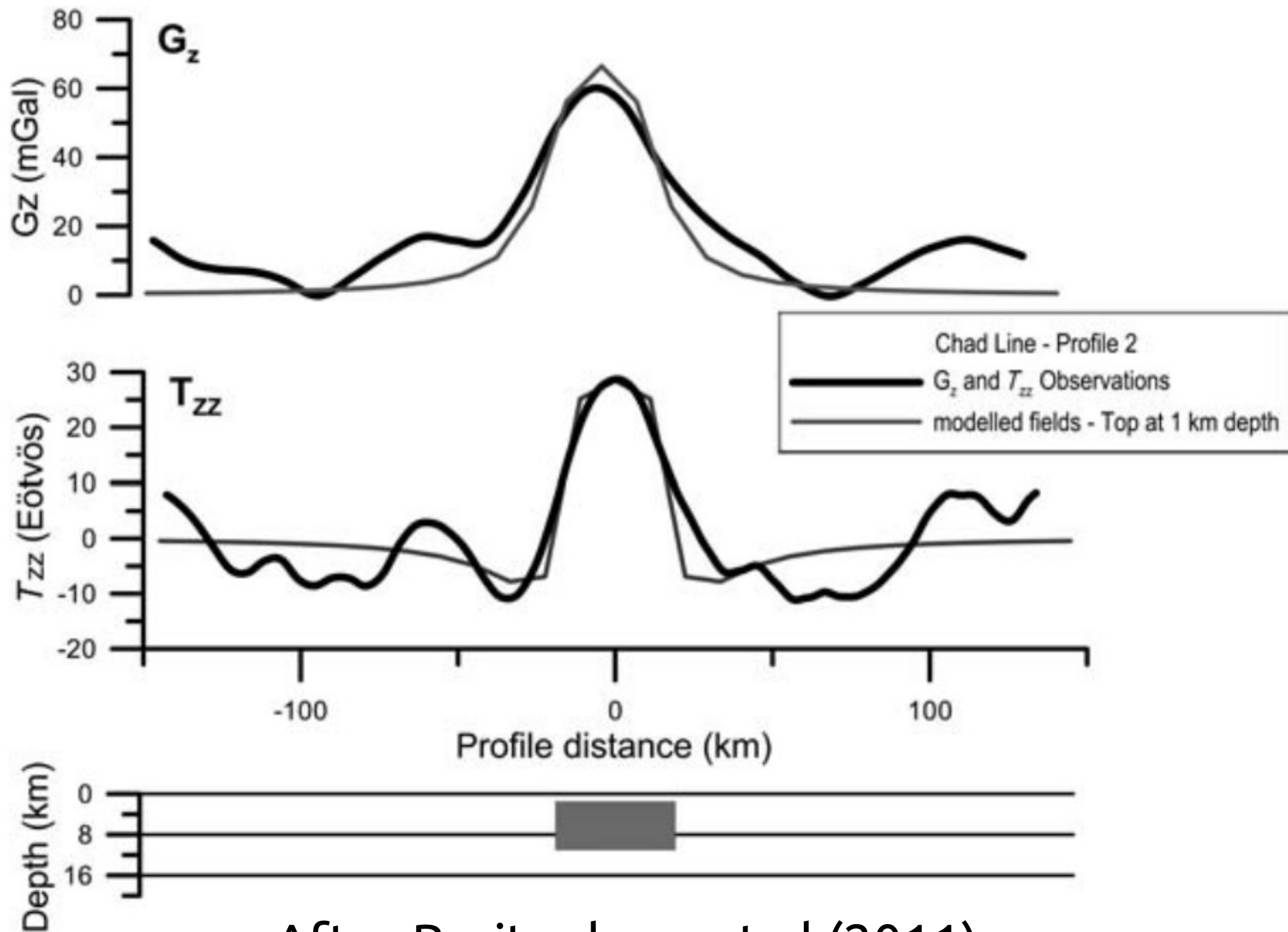
# Lineament with dense rocks (magmatic)

Inspired by Chad lineament model  
(Braitenberg et al, 2011)



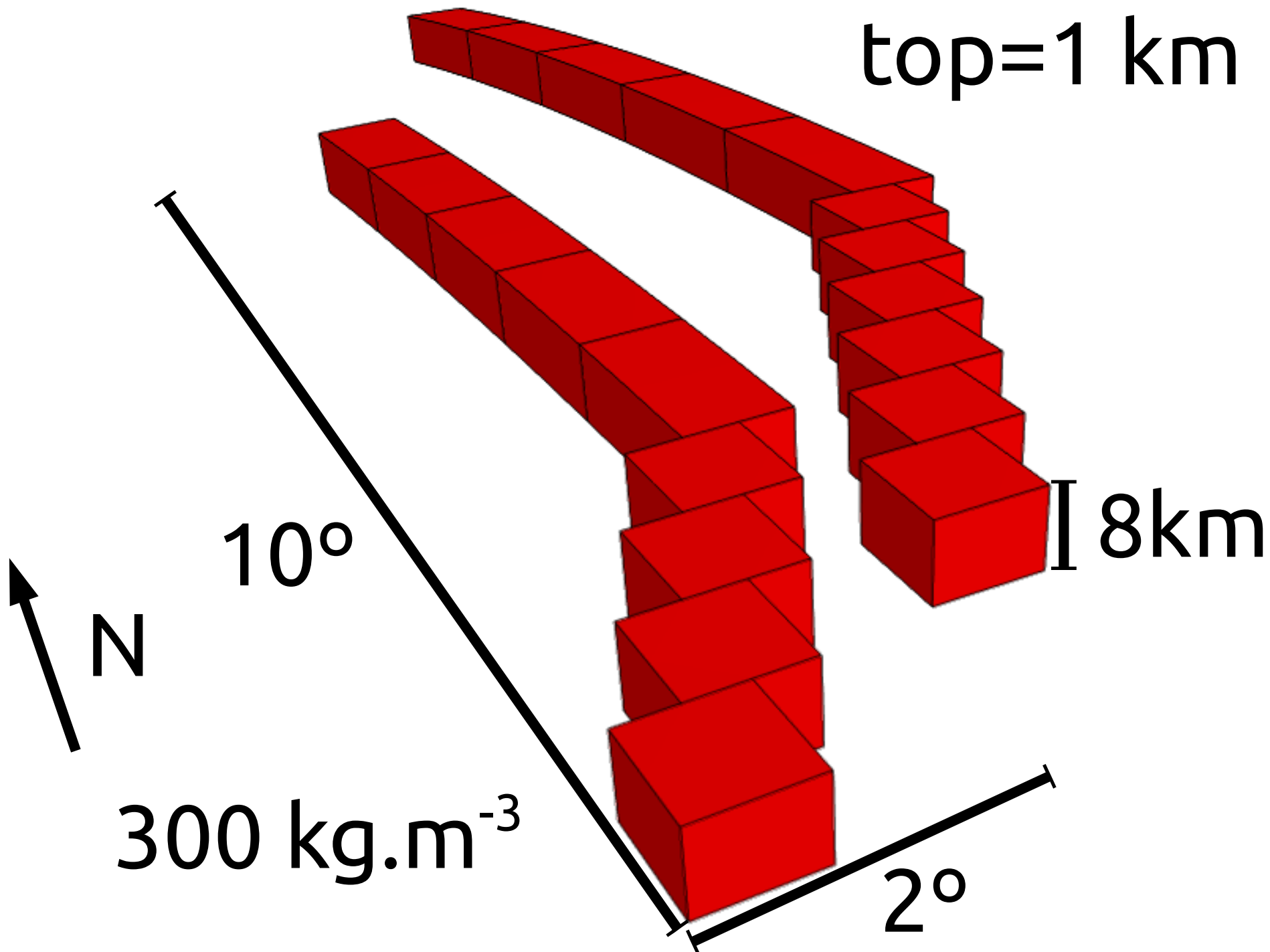


After Braitenberg et al (2011)

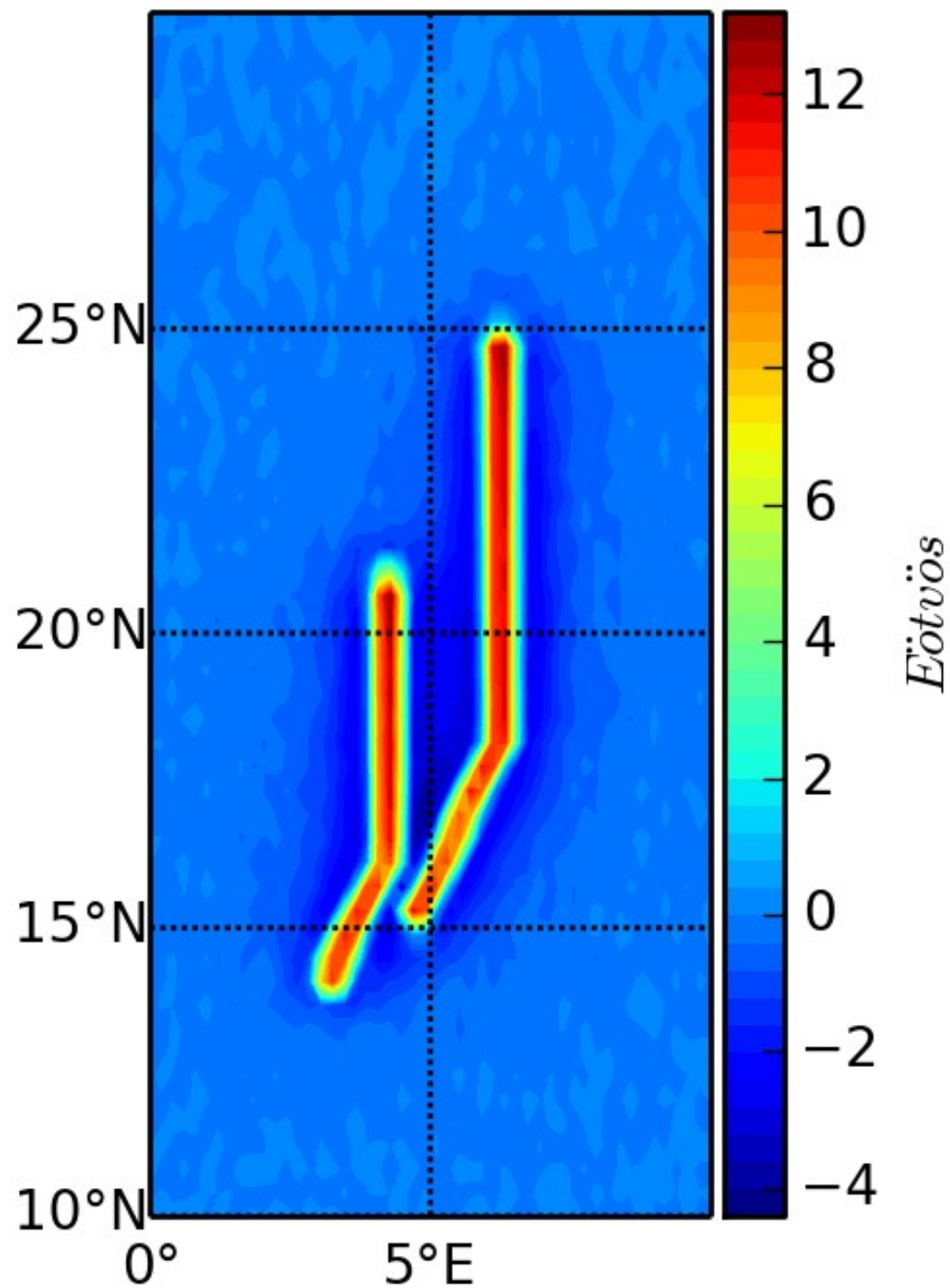


After Braitenberg et al (2011)

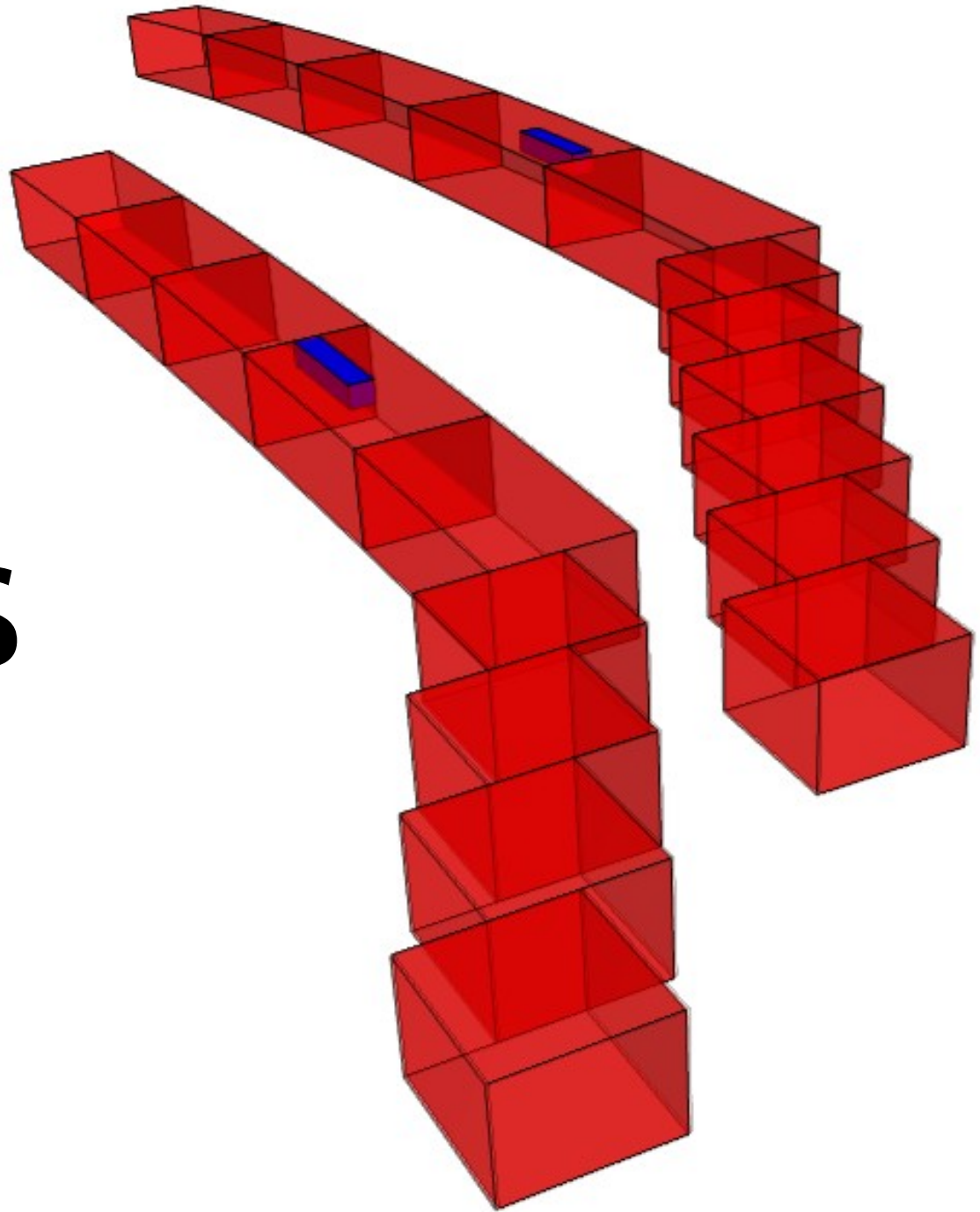




$g_{zz}$   
At 20 km

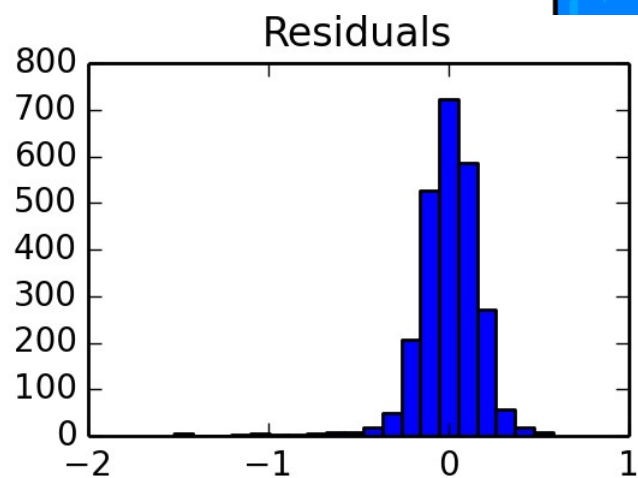
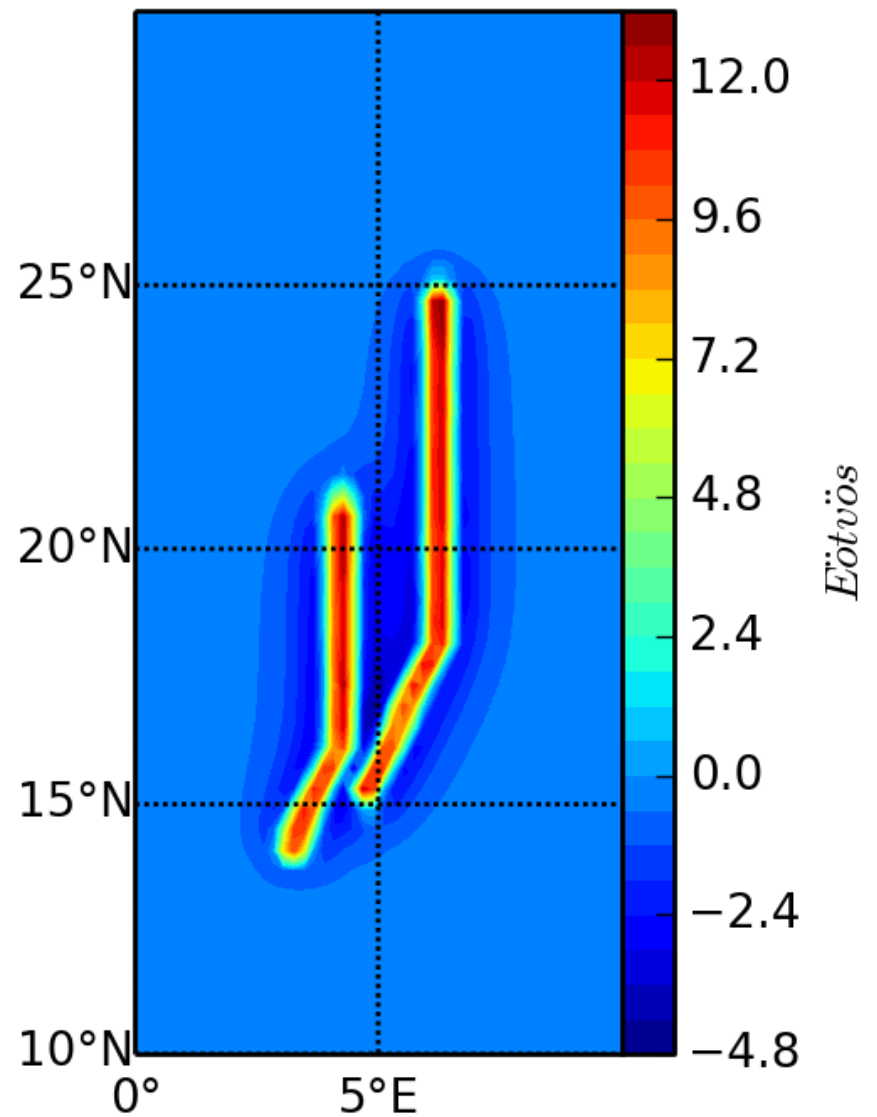
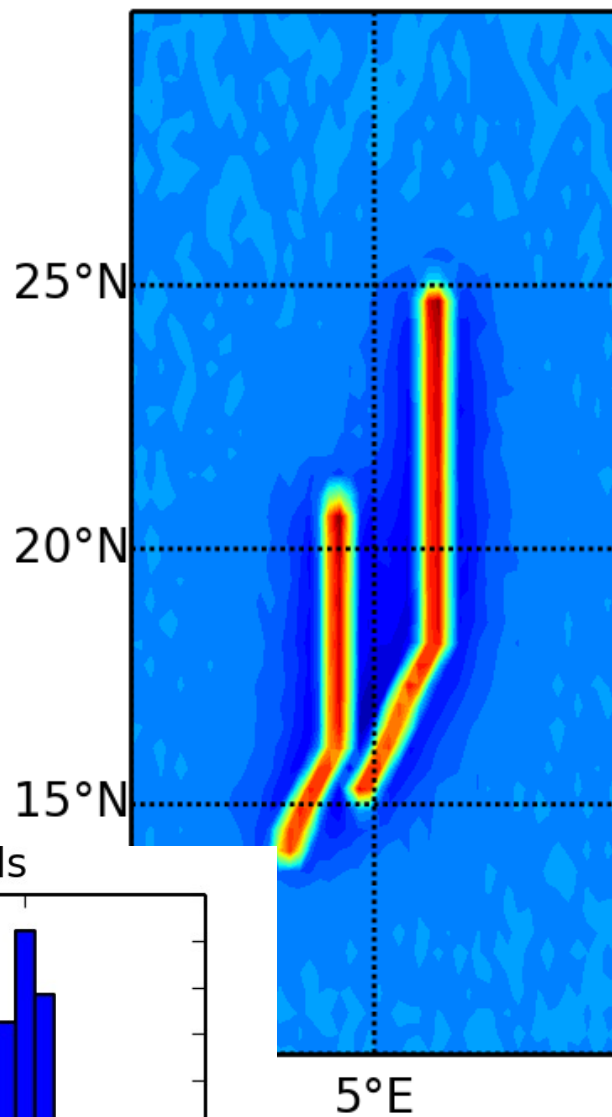


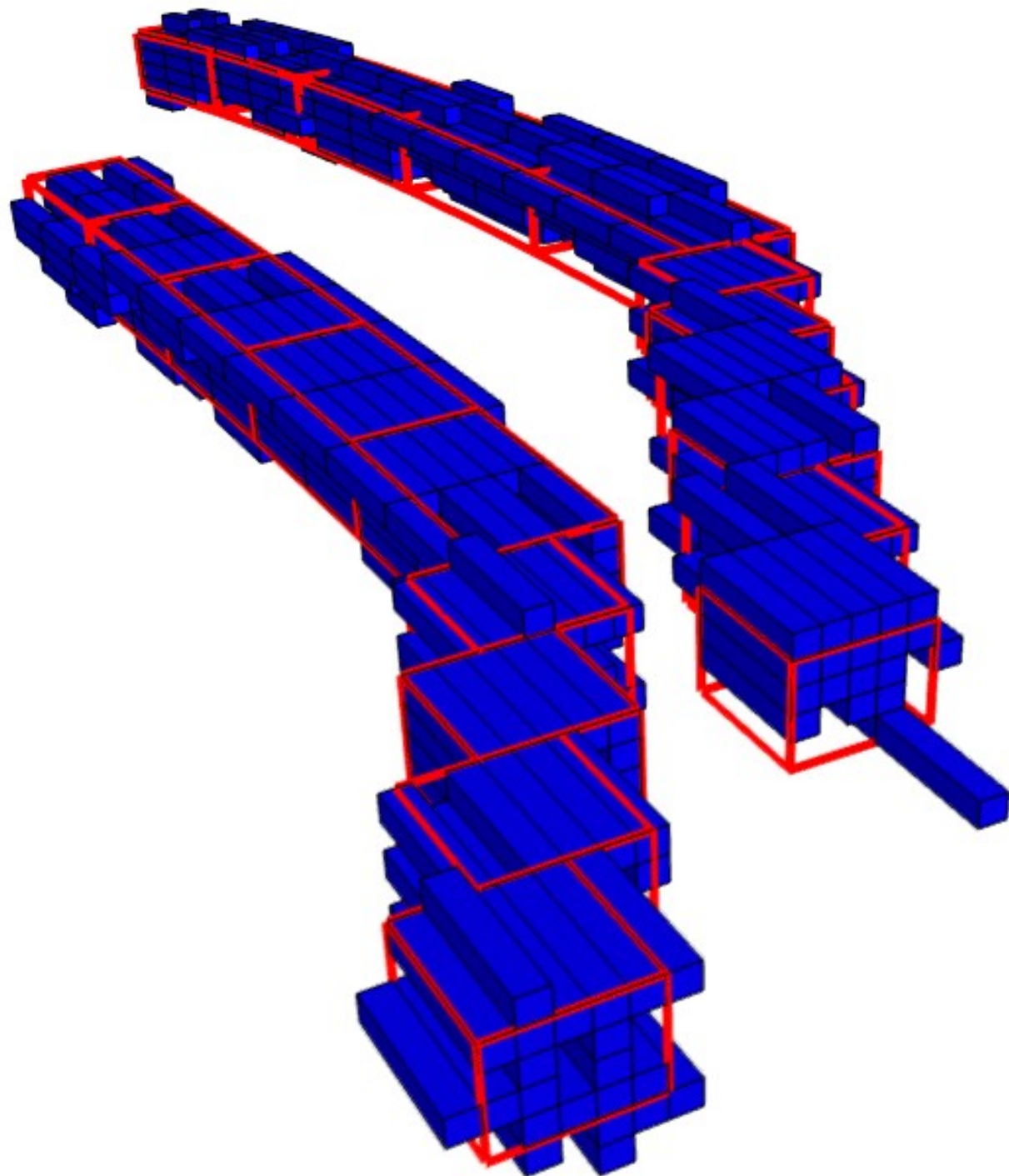
# Seeds



# observed

# predicted

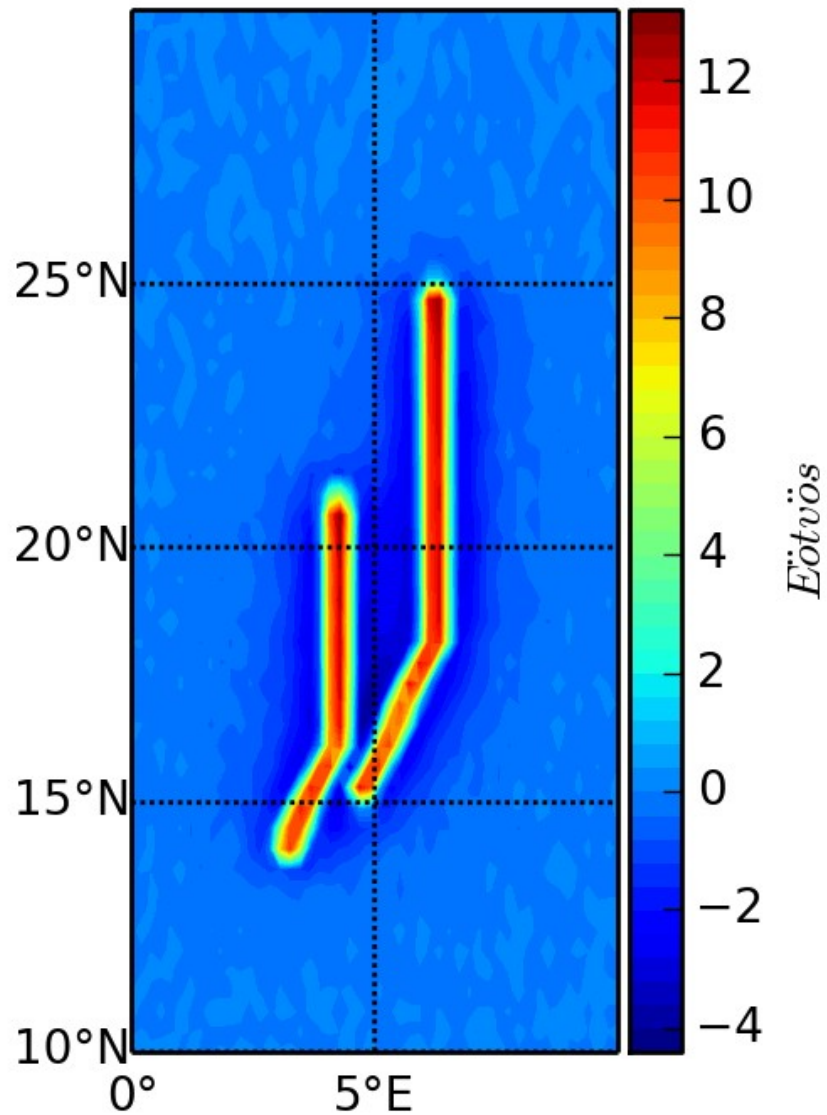




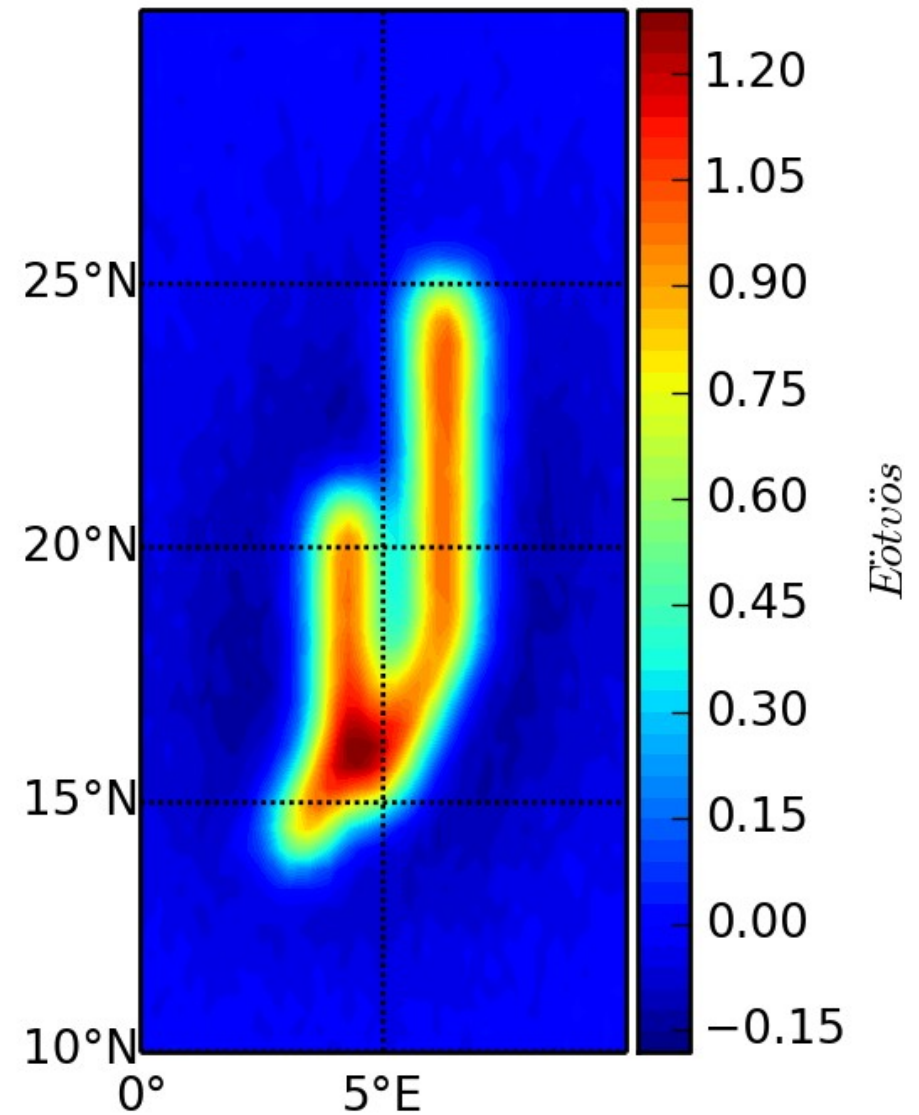
What if height=120 km?



at 20 km

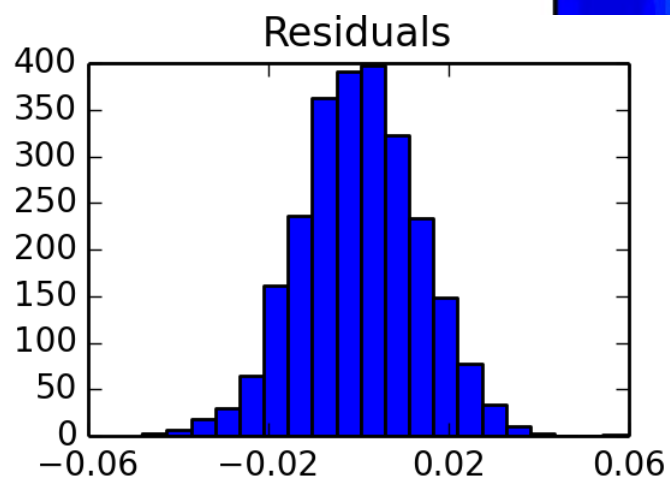
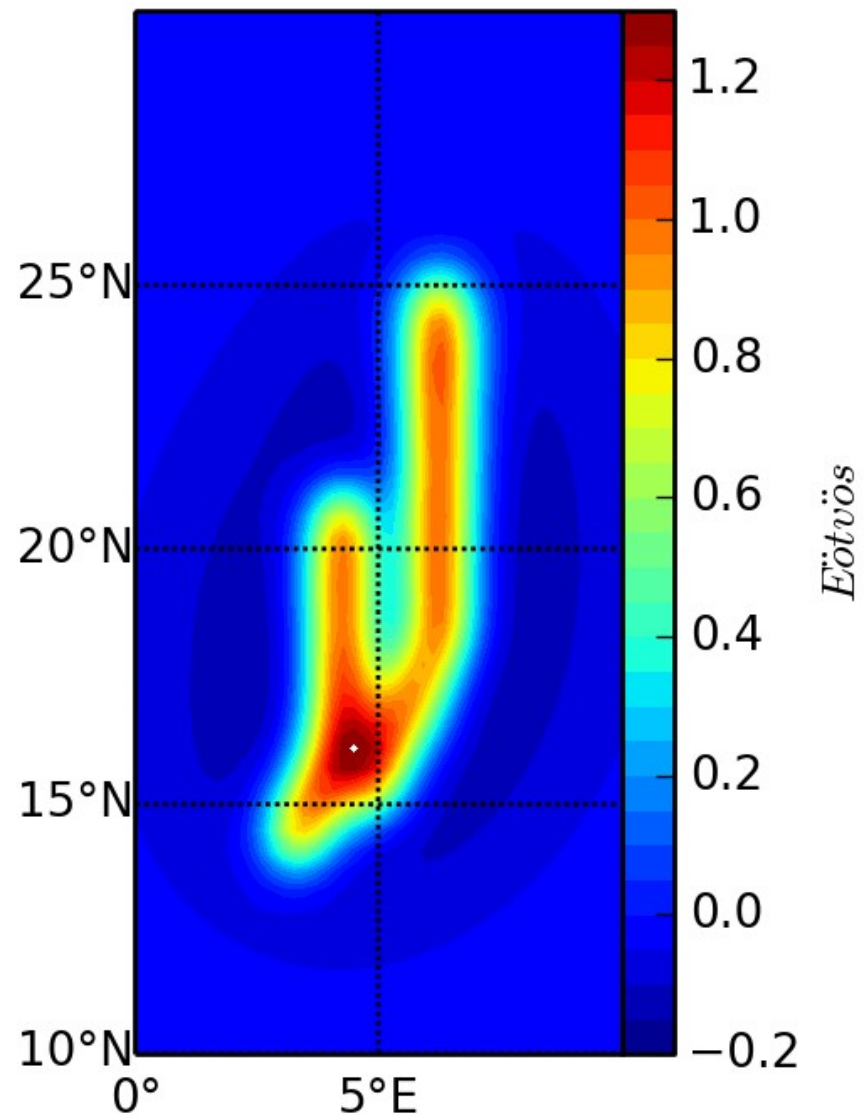
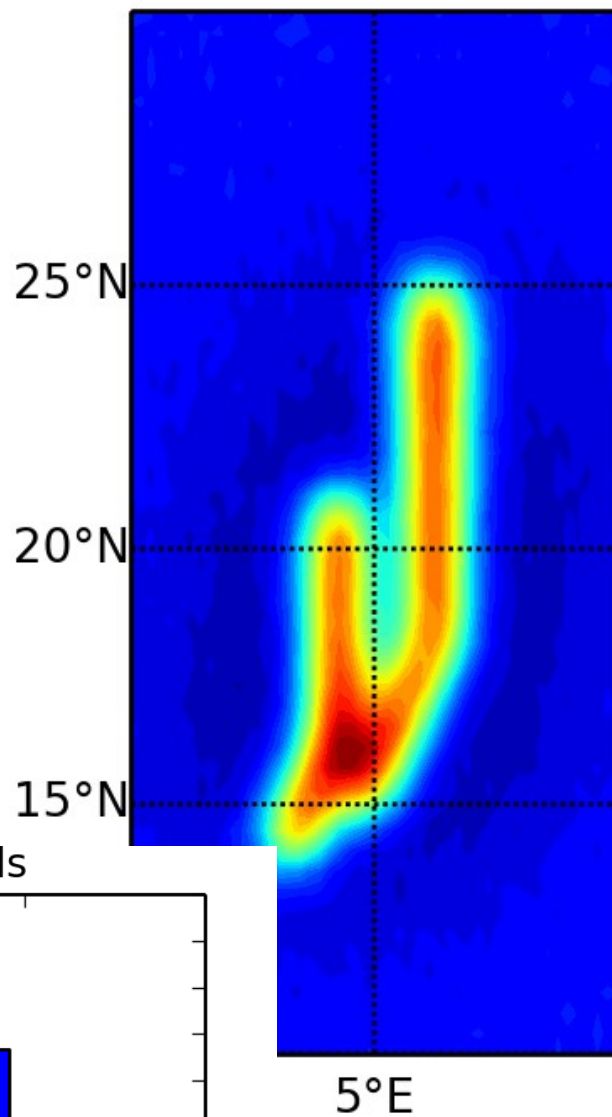


at 120 km



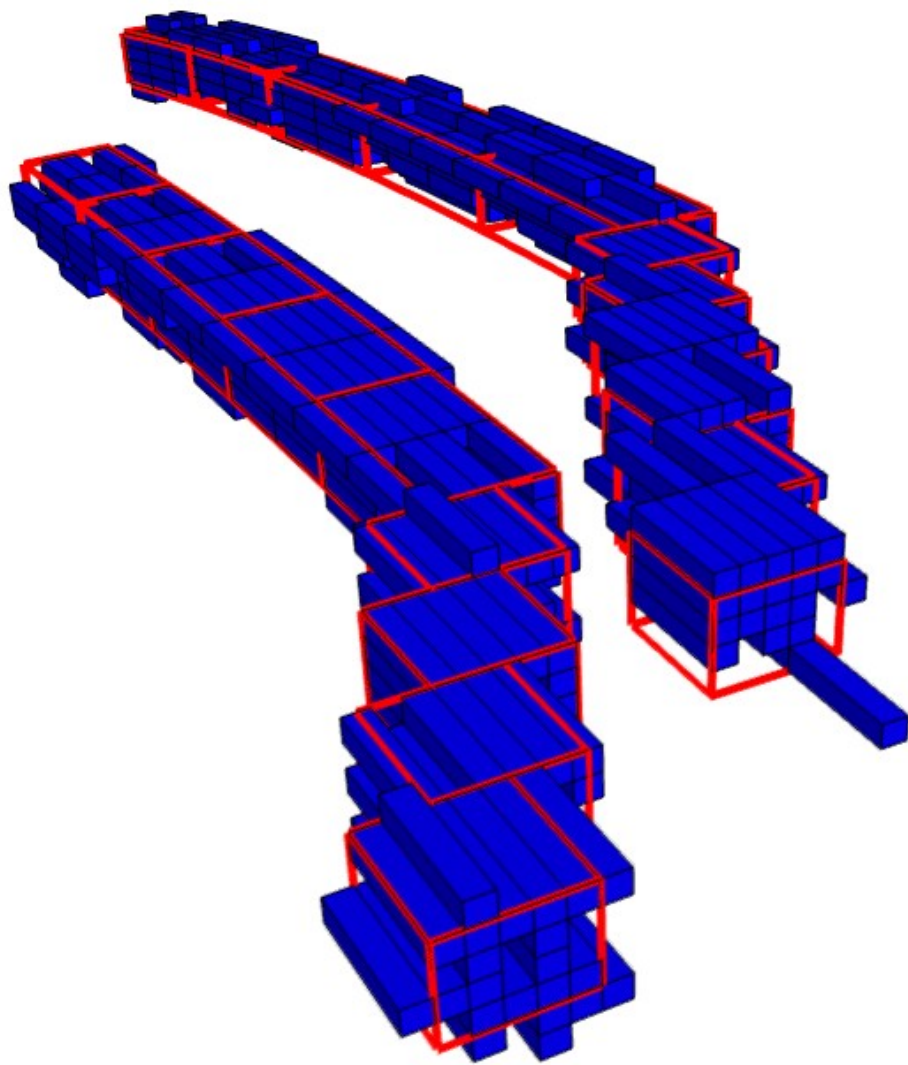
# observed

# predicted

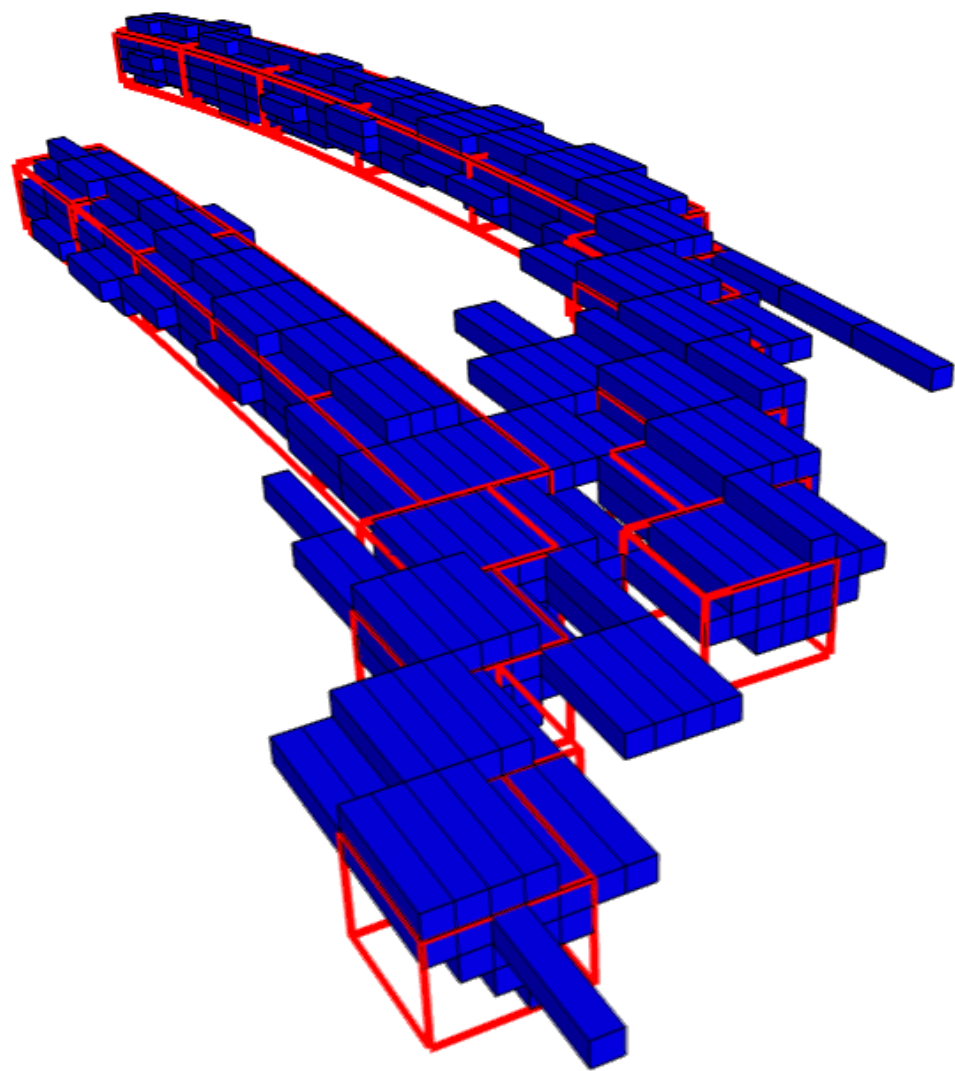




at 20 km

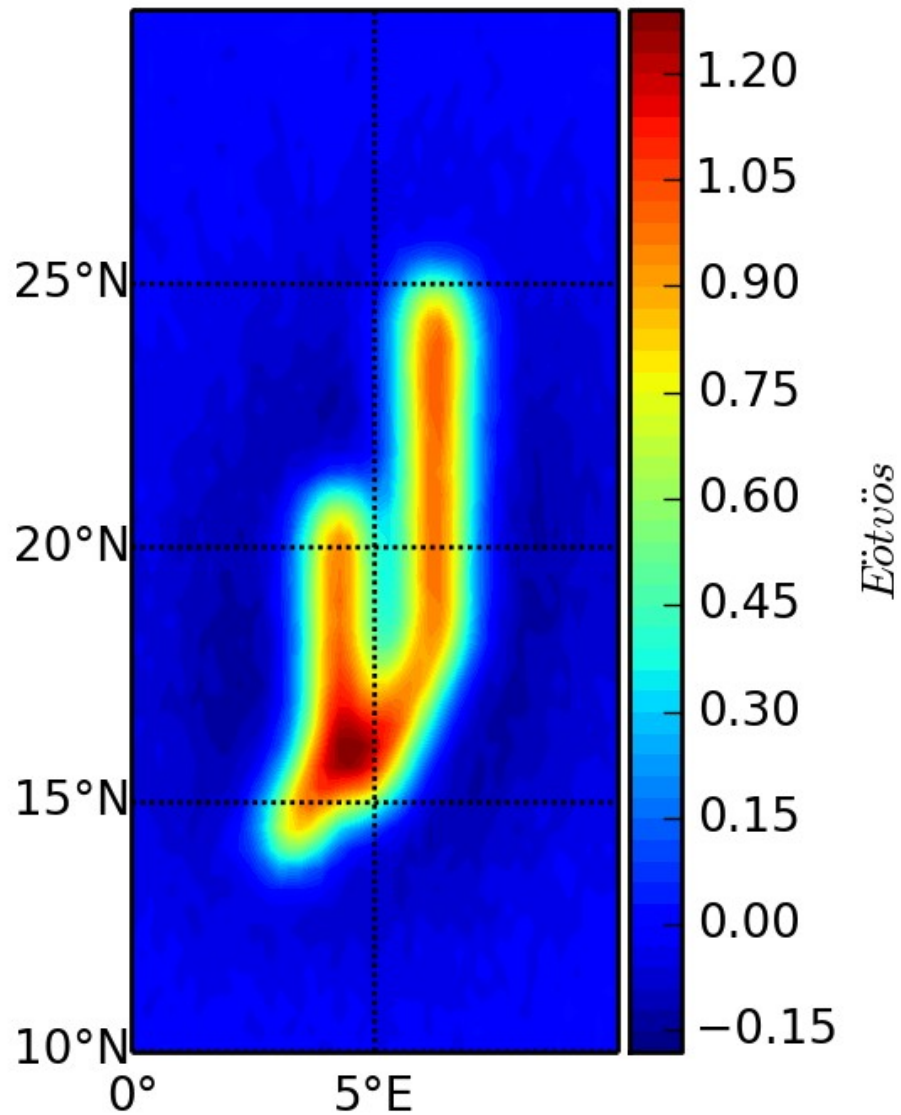


at 120 km

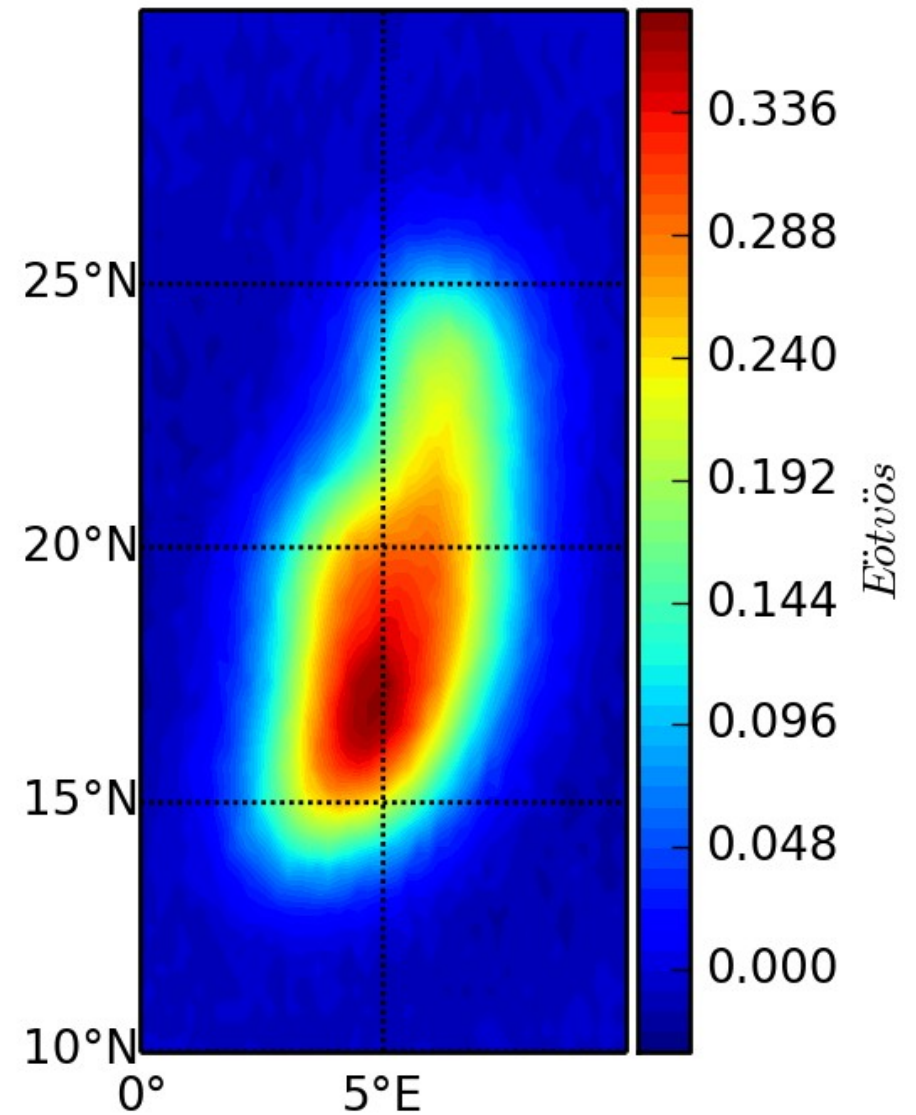


Even higher  
height=270 km

at 120 km

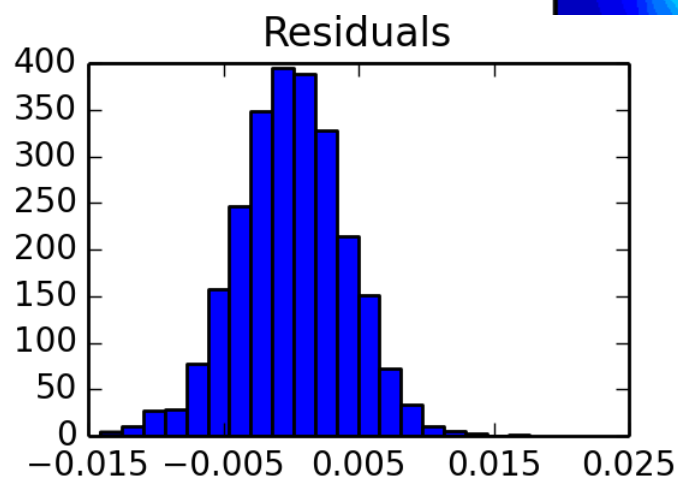
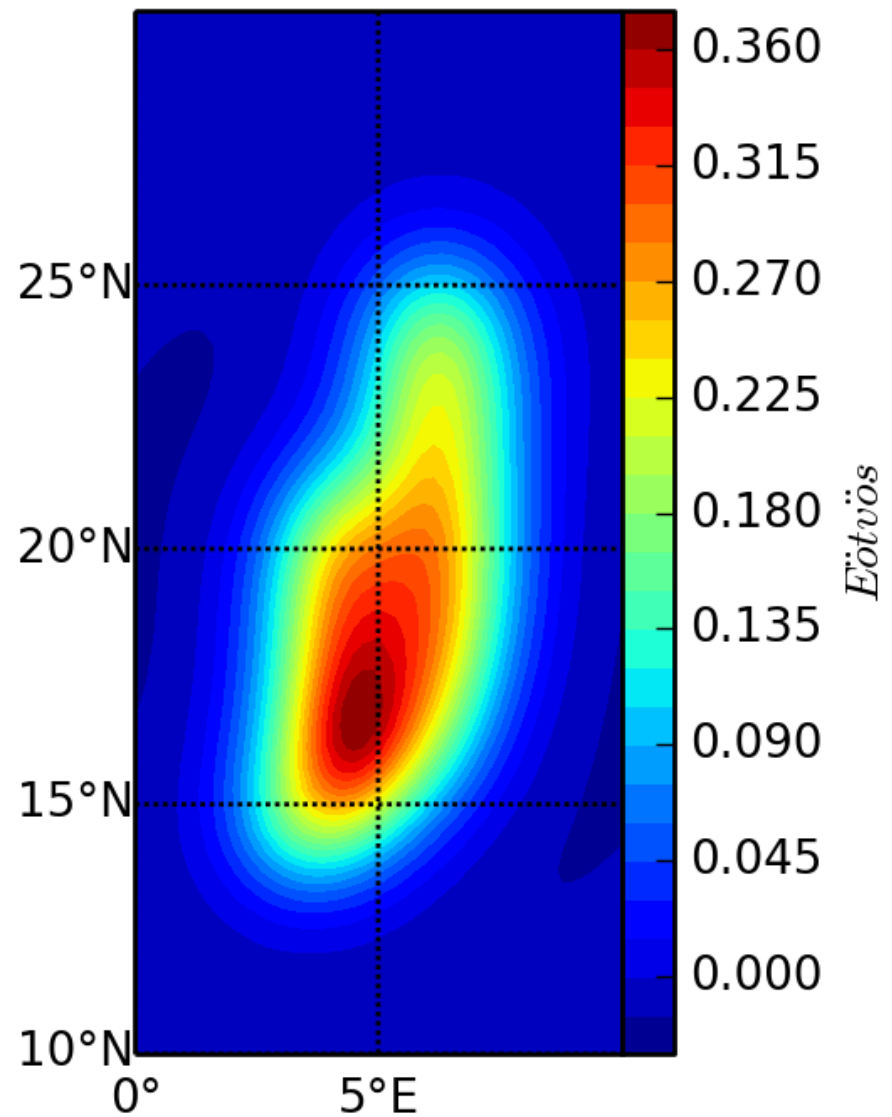
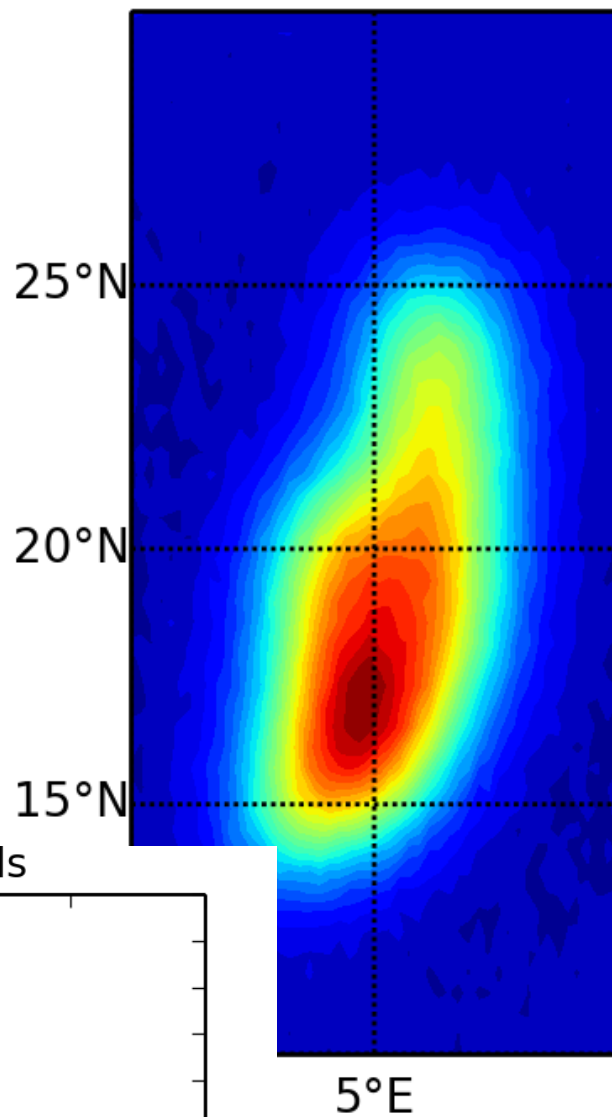


at 270 km

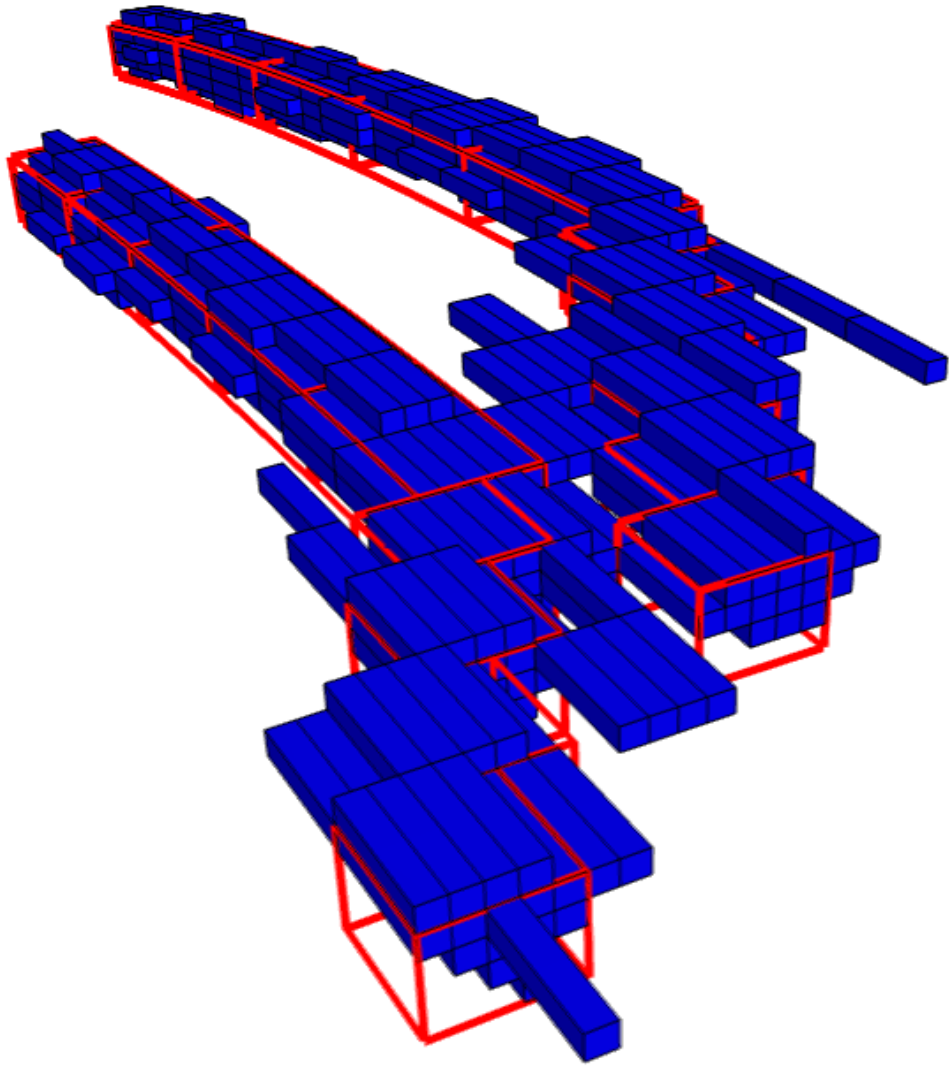


# observed

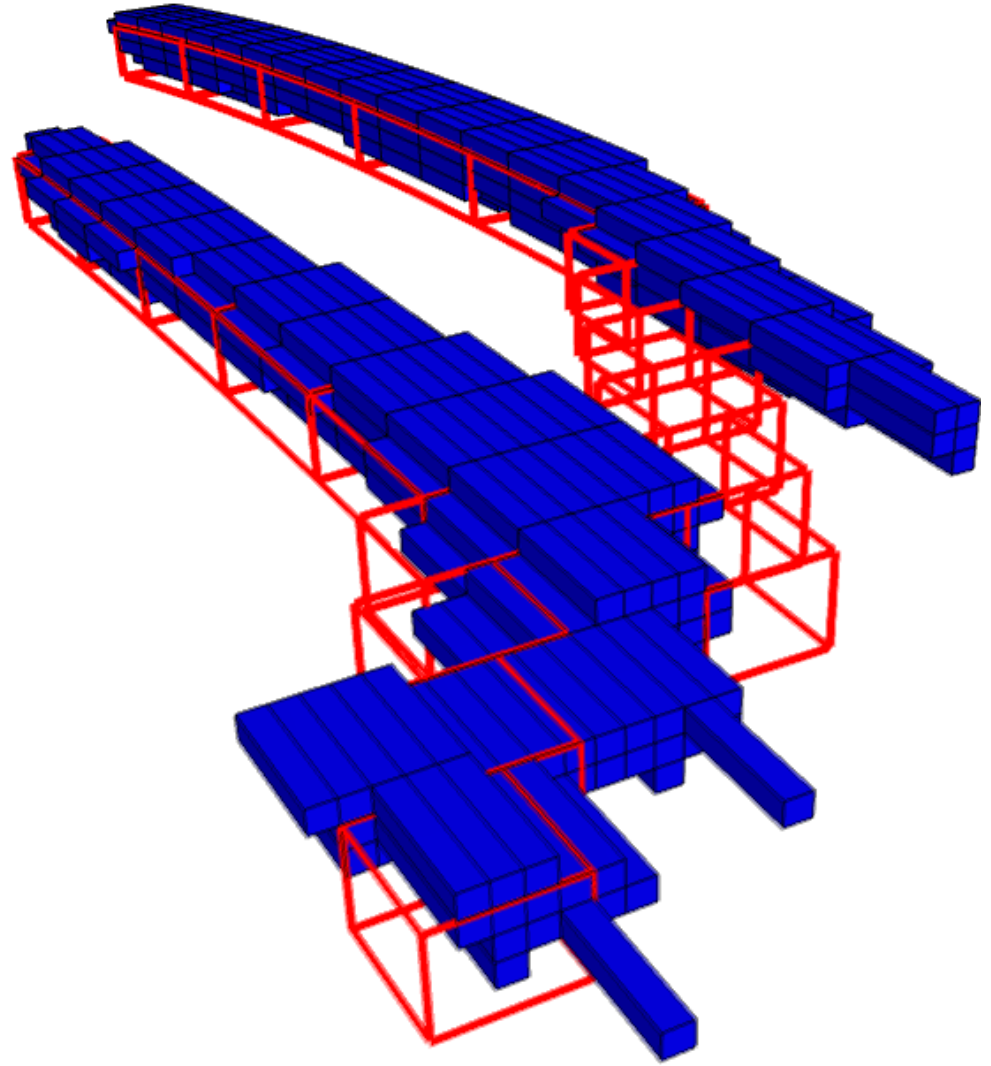
# predicted



at 120 km



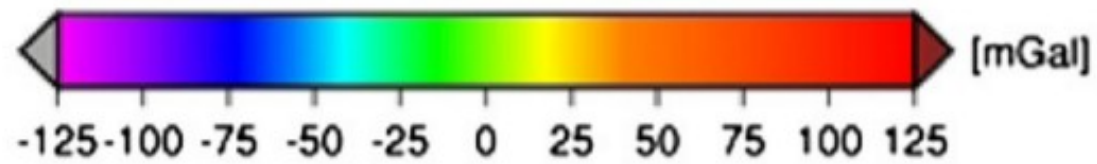
at 270 km



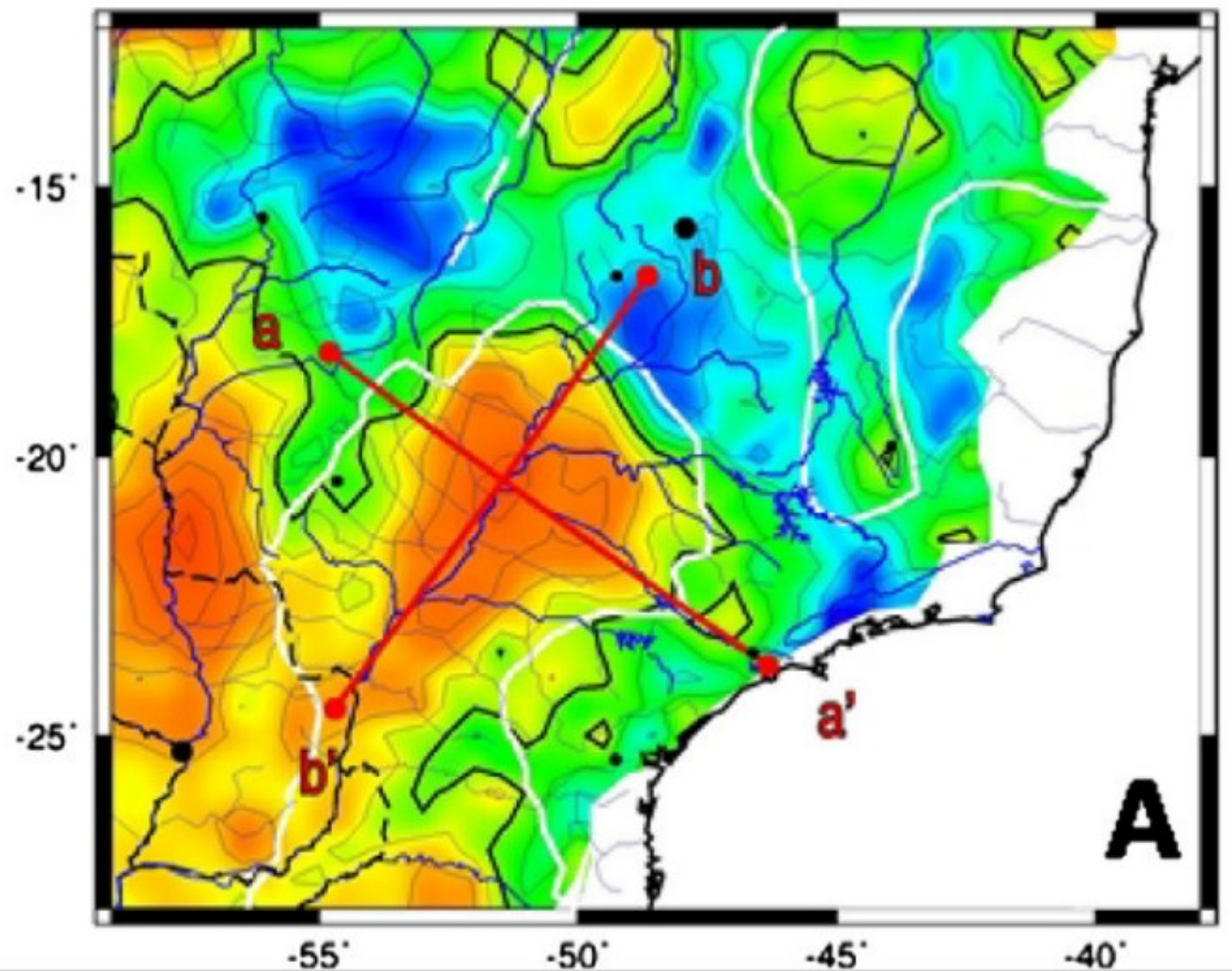
# Magmatic underplating

Inspired by model of the Paraná basin  
by Mariani et al (2013)

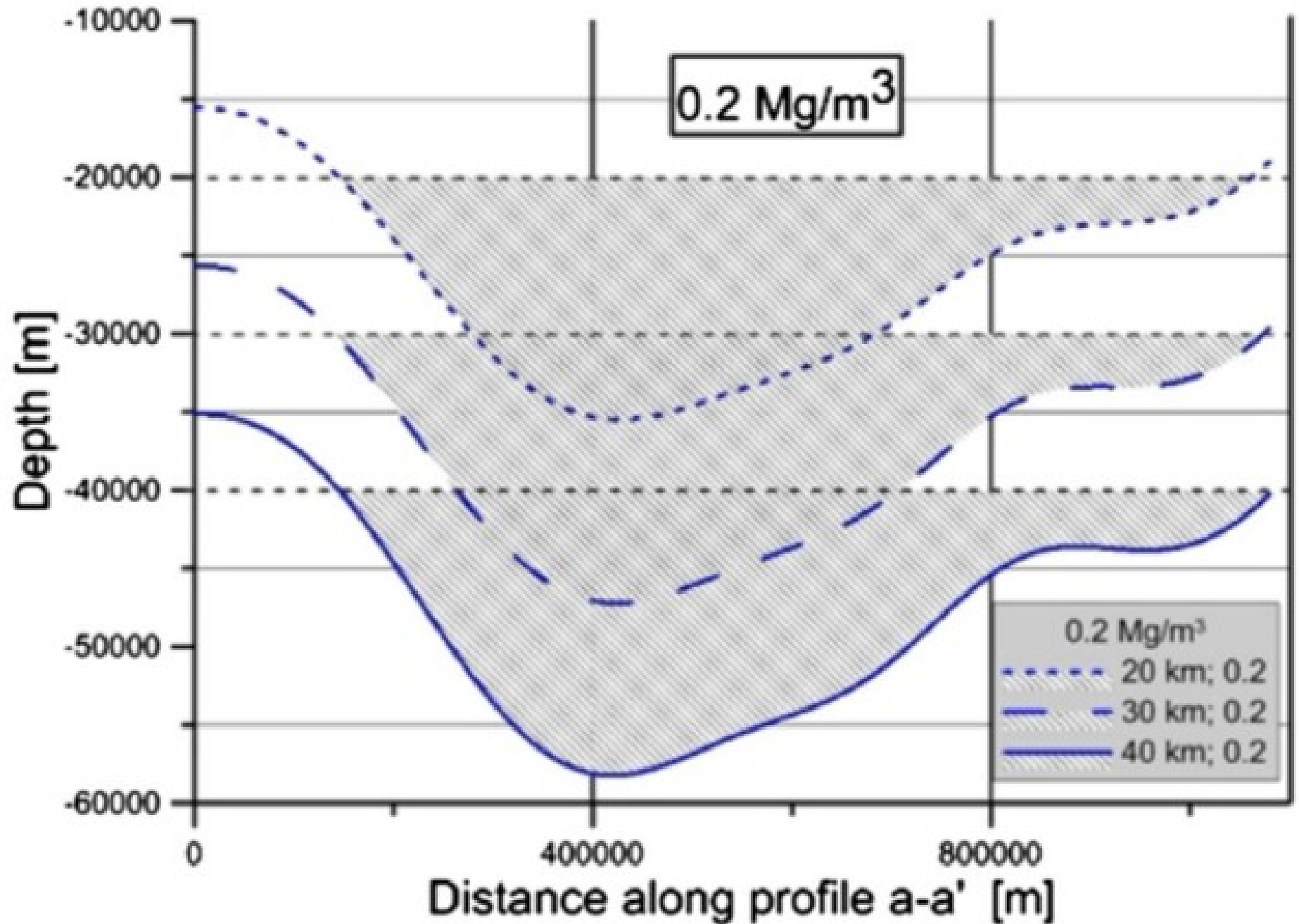




BOUGUER CORR. MOHO\_A\_0.3 & SED



After Mariani et al (2013)



After Mariani et al (2013)



top=30 km

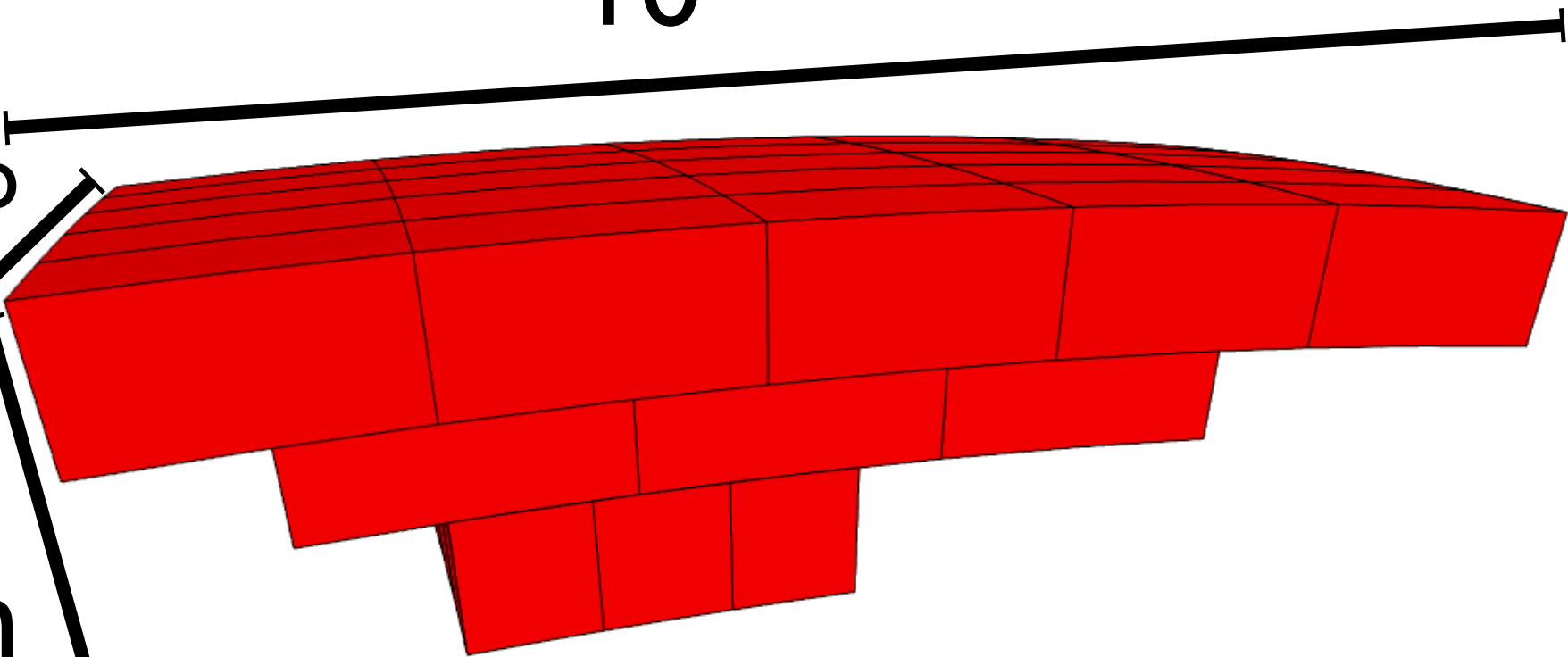
$10^\circ$

$5^\circ$

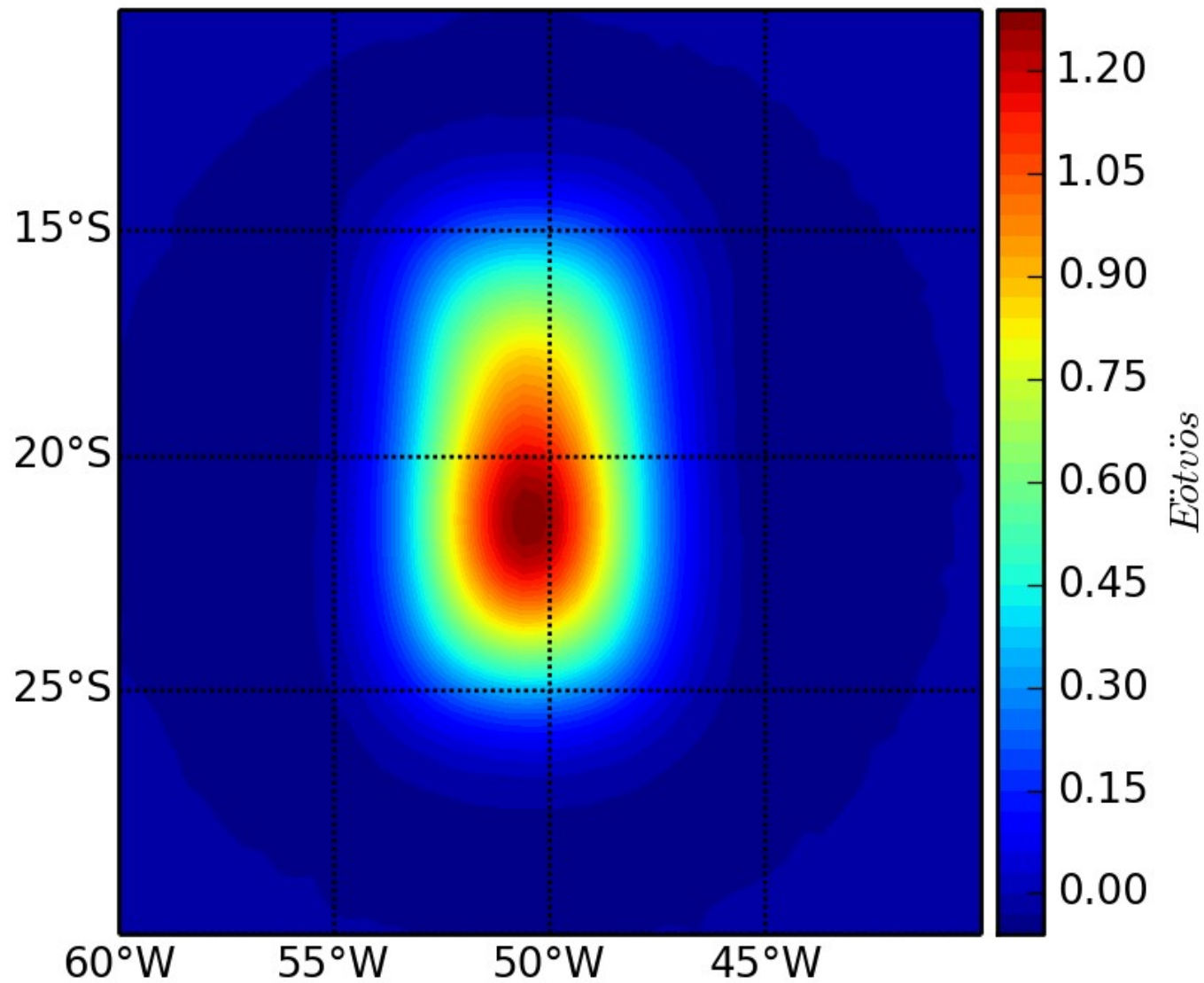
15  
km

N

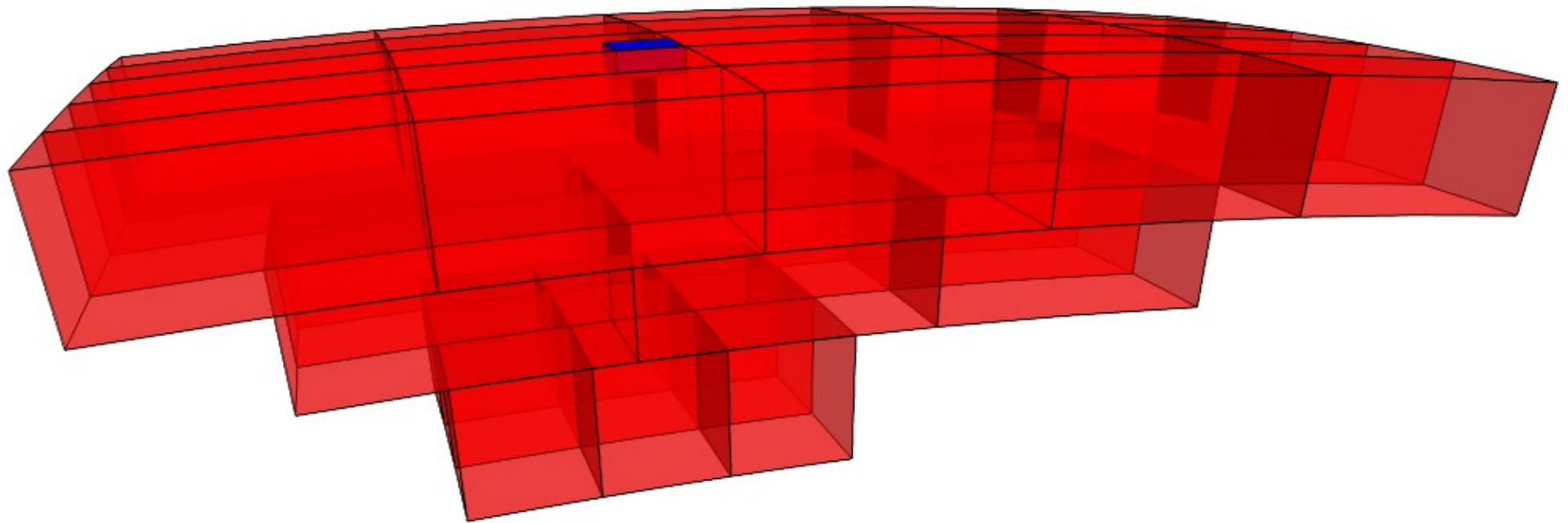
$200 \text{ kg.m}^{-3}$

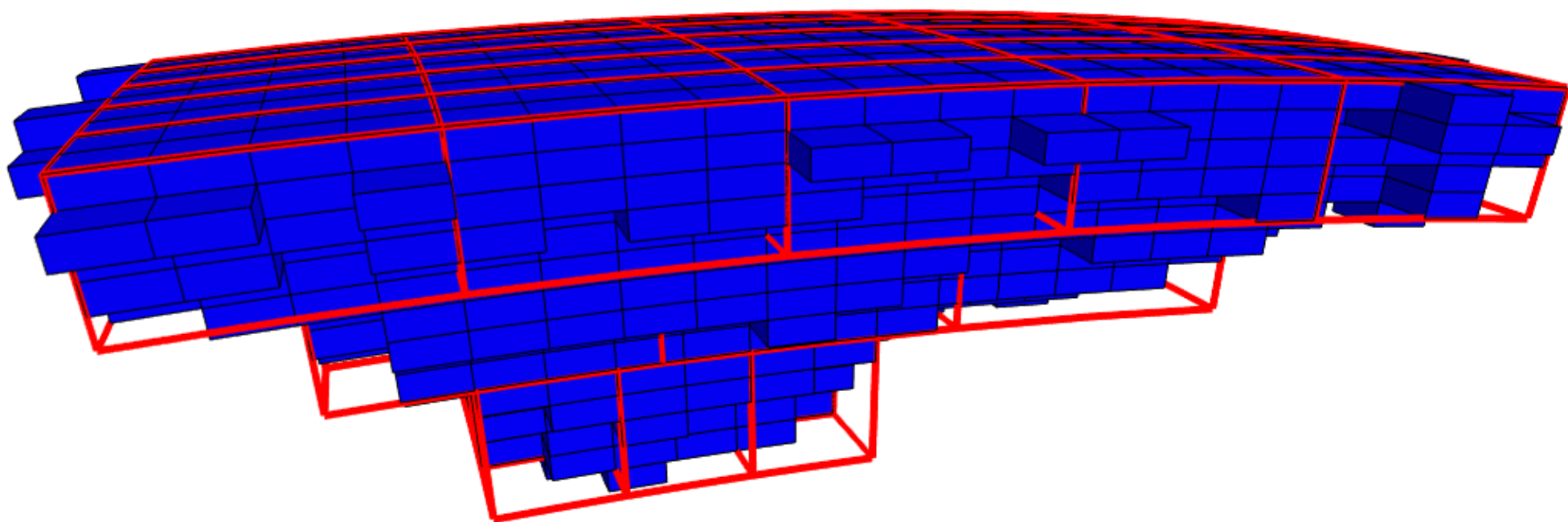
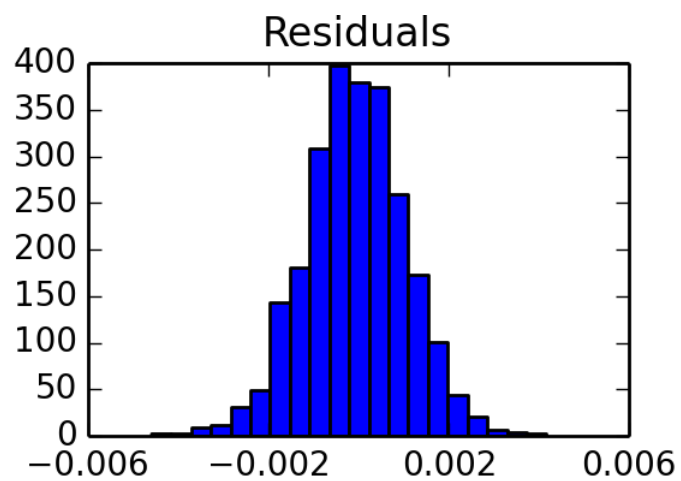
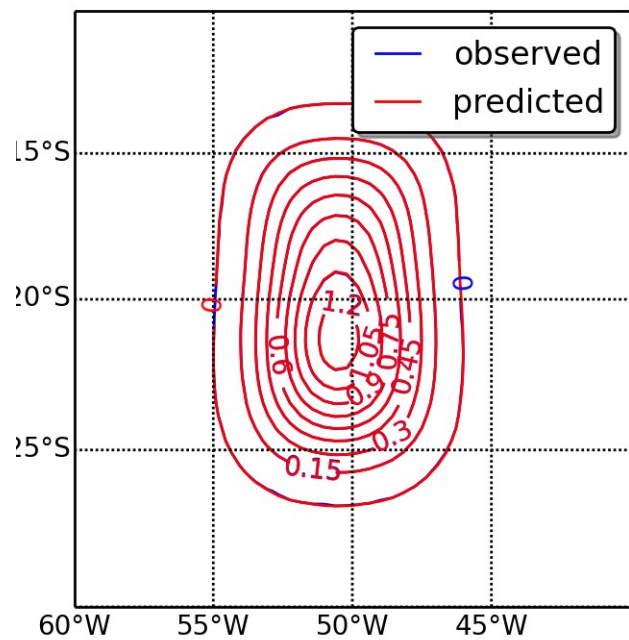


# $g_{zz}$ at 250 km

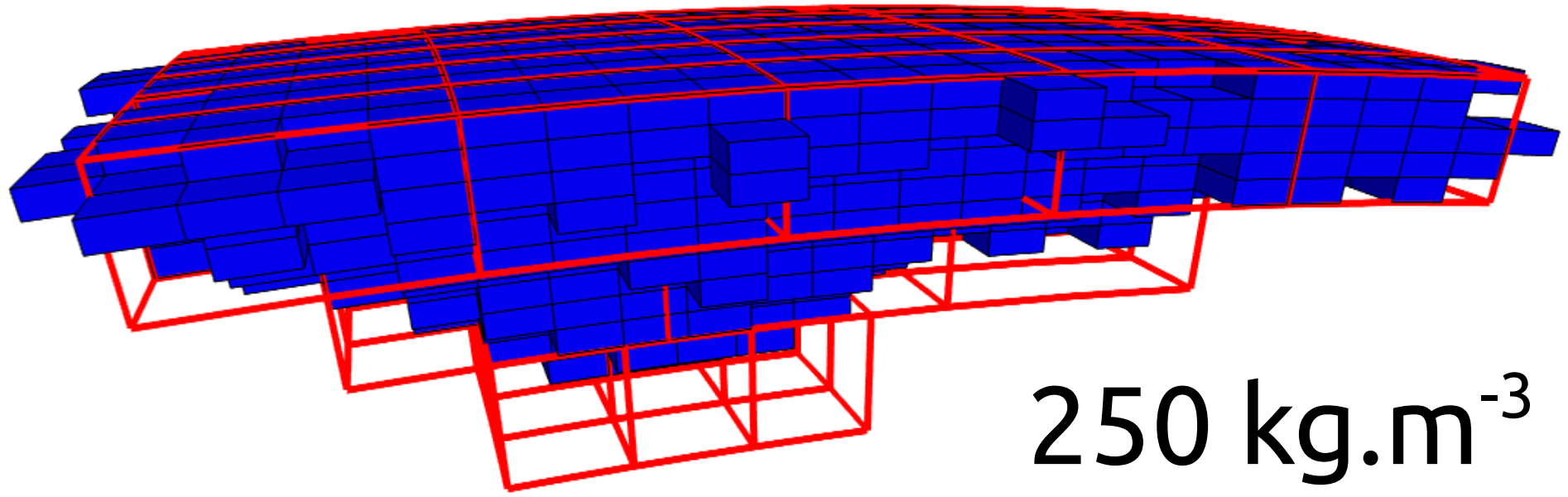


# Seed

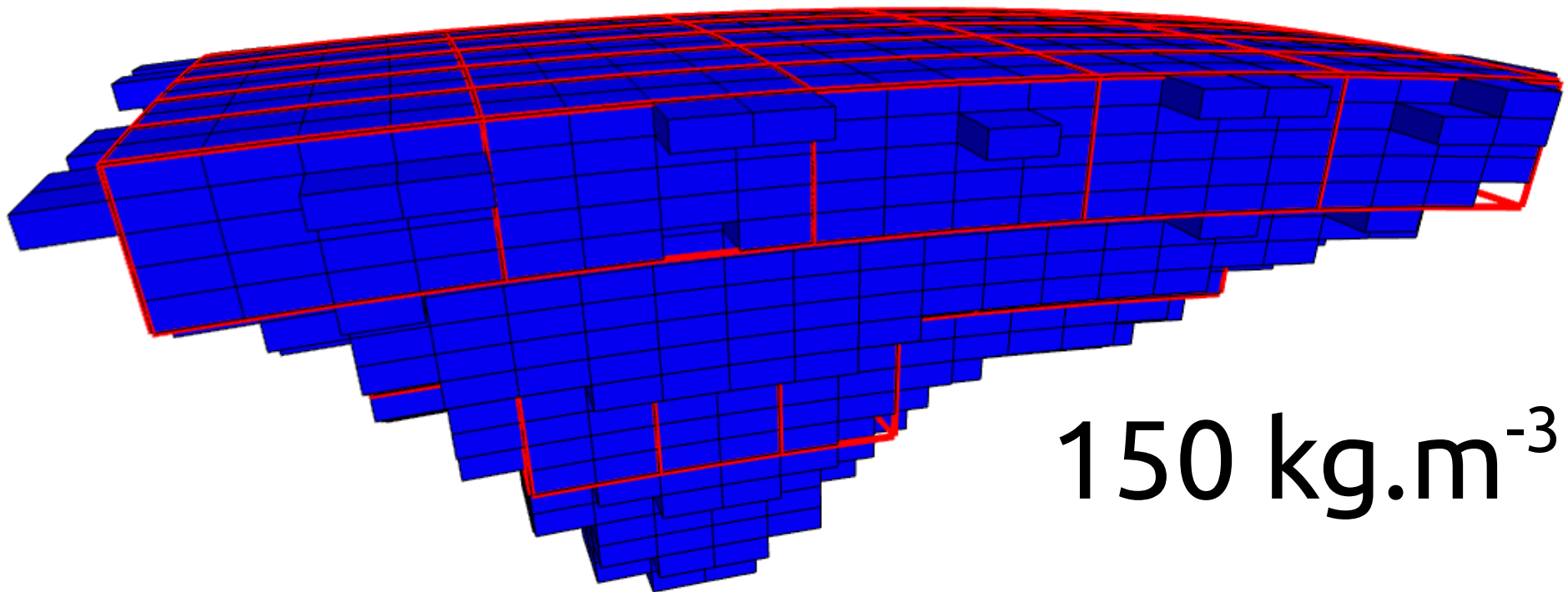




What if I use wrong density?



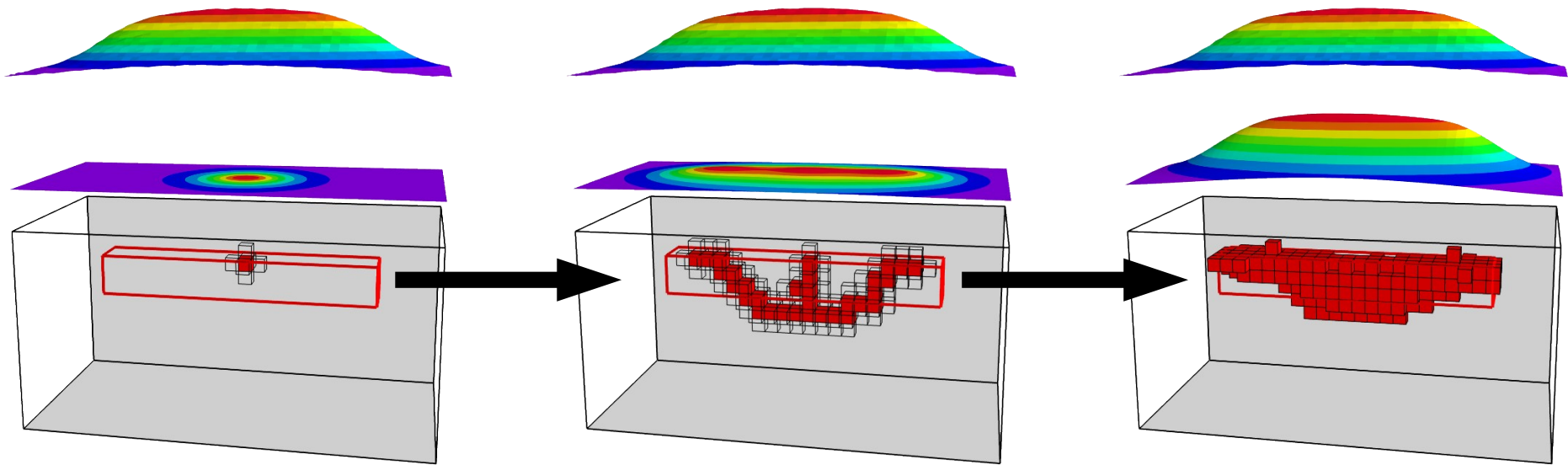
$250 \text{ kg.m}^{-3}$

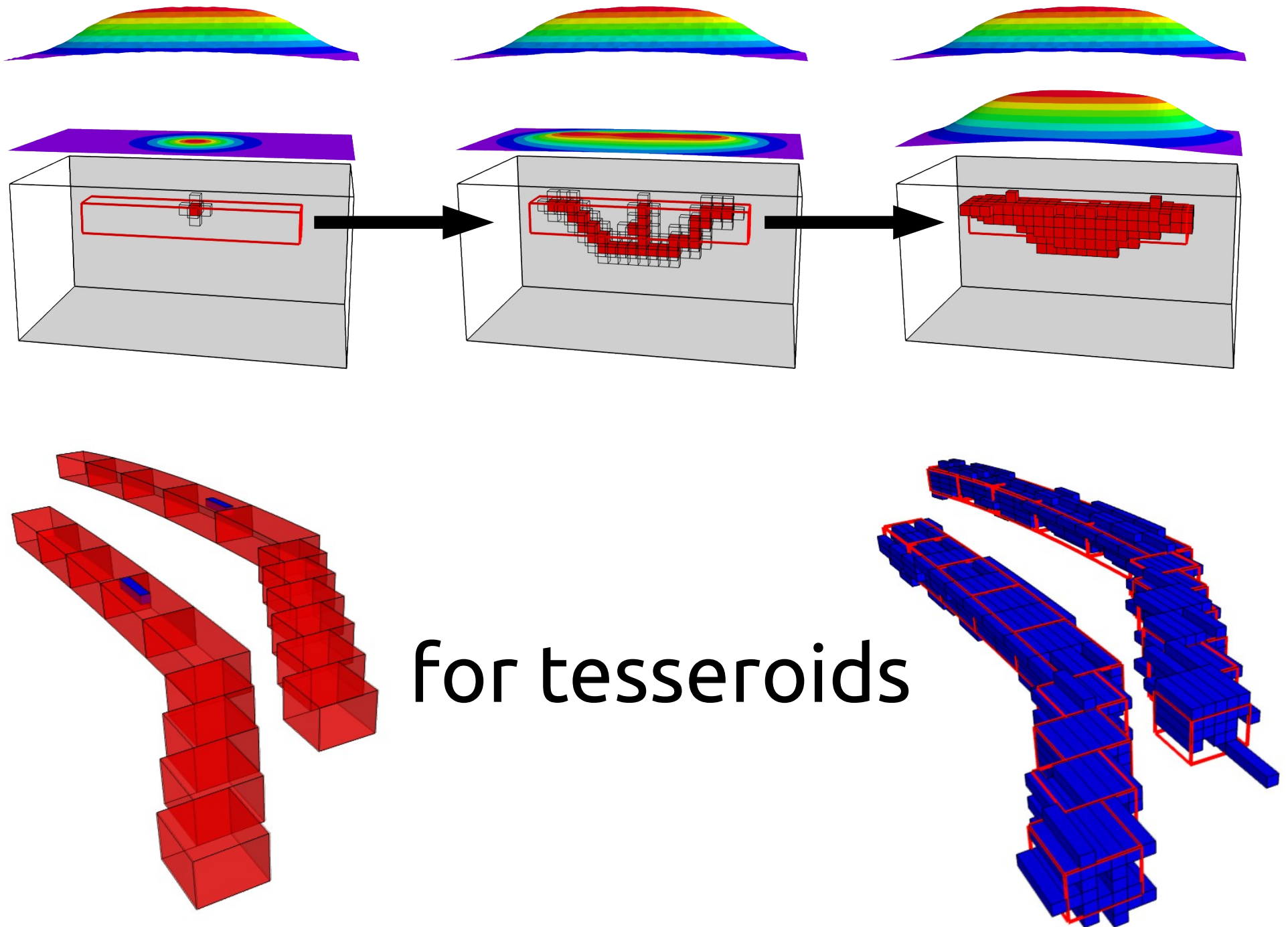


$150 \text{ kg.m}^{-3}$

In conclusion



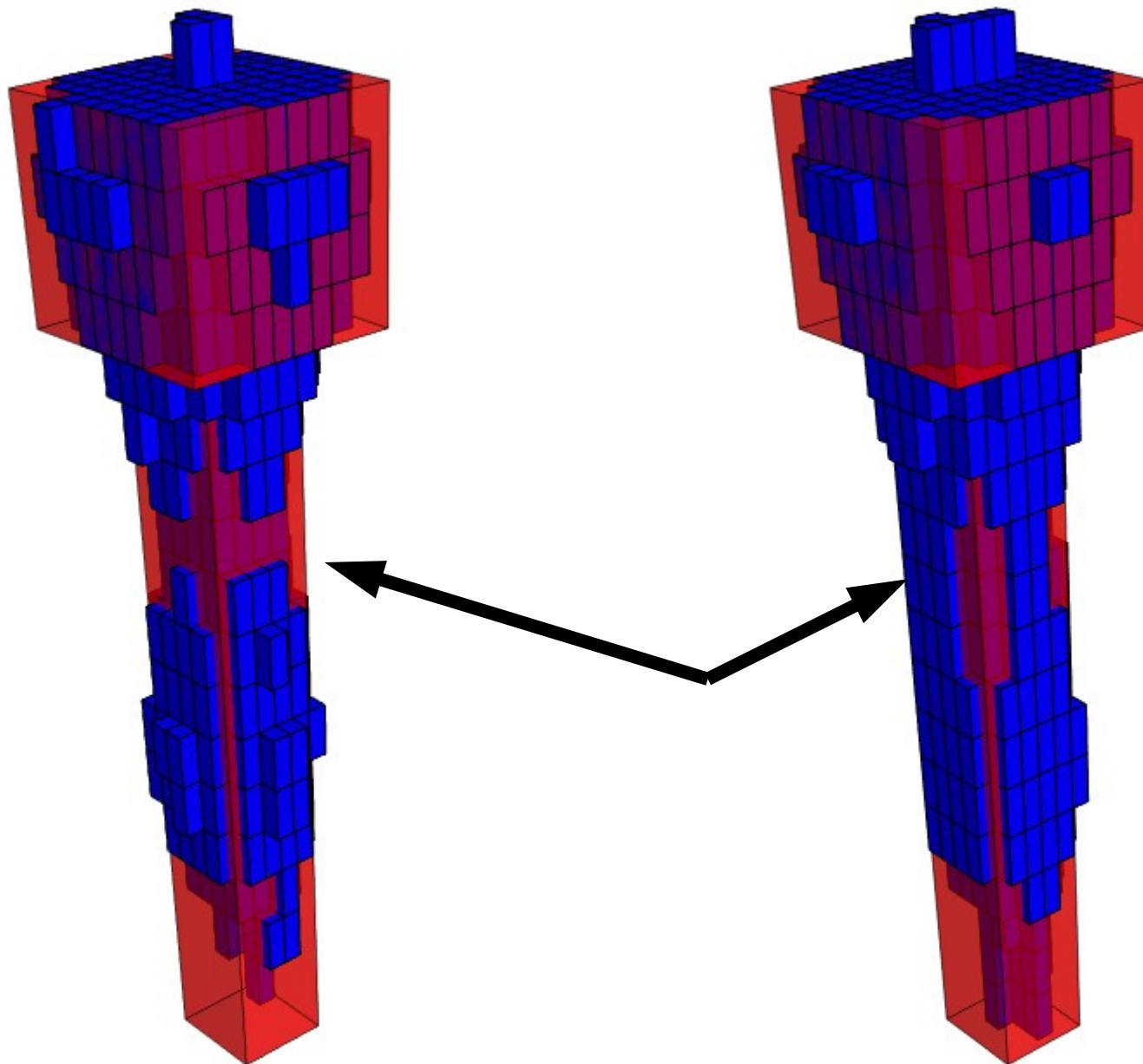




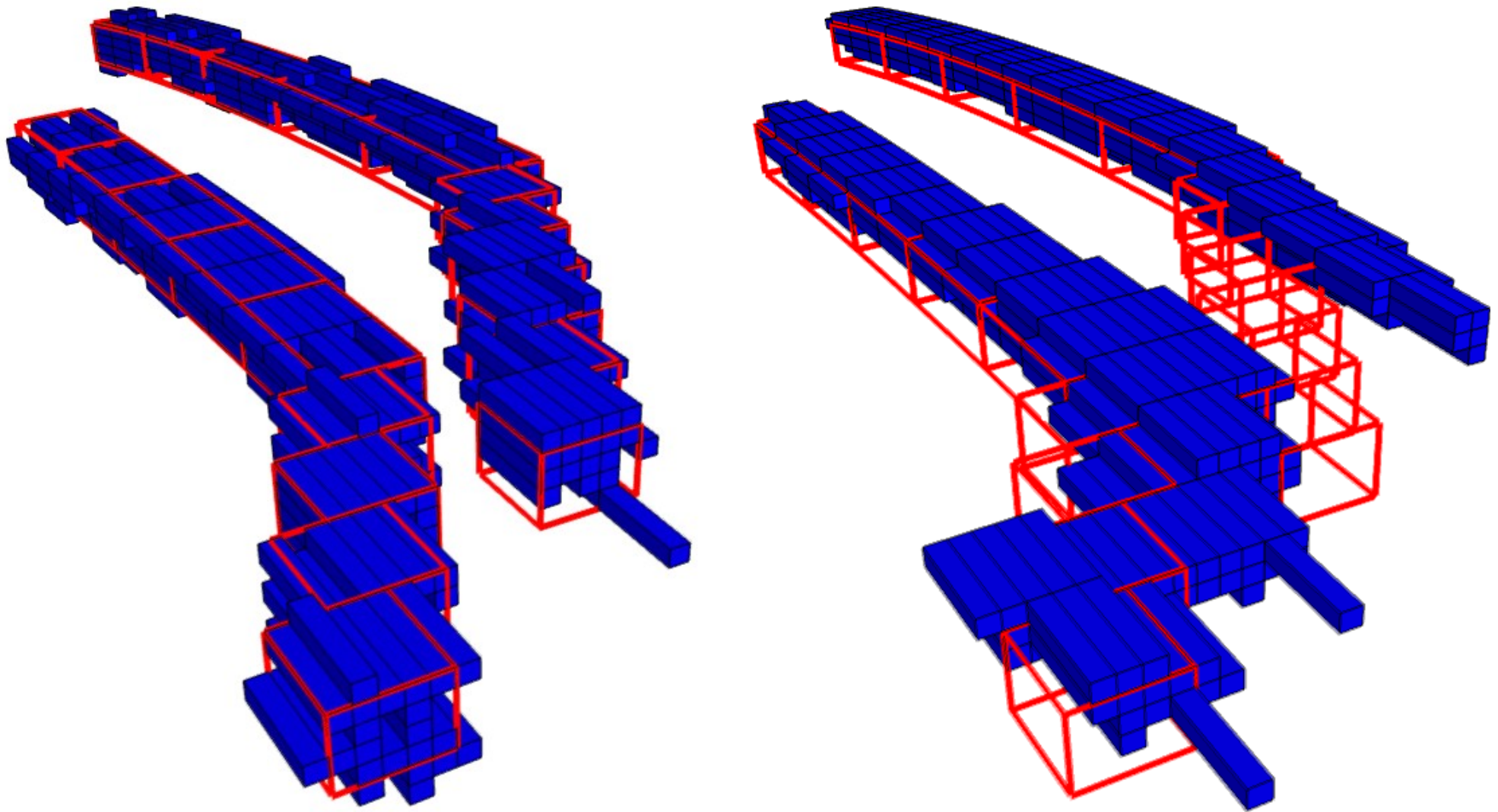
single

vs

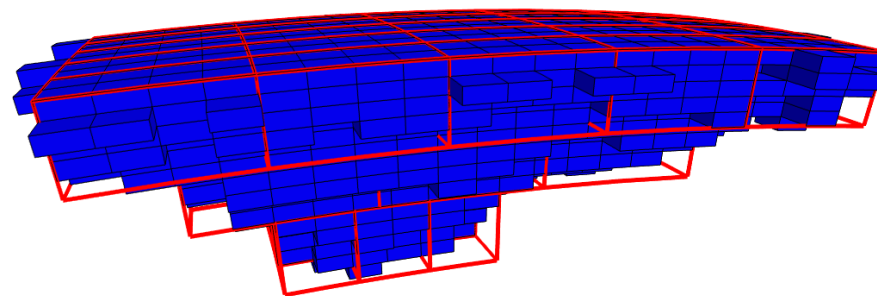
joint



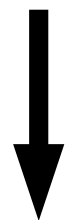
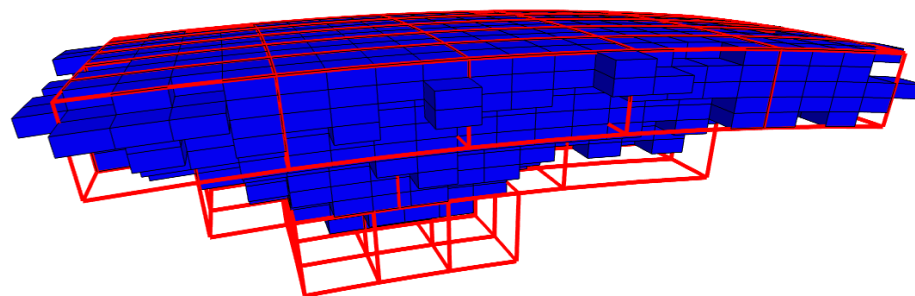
# height matters



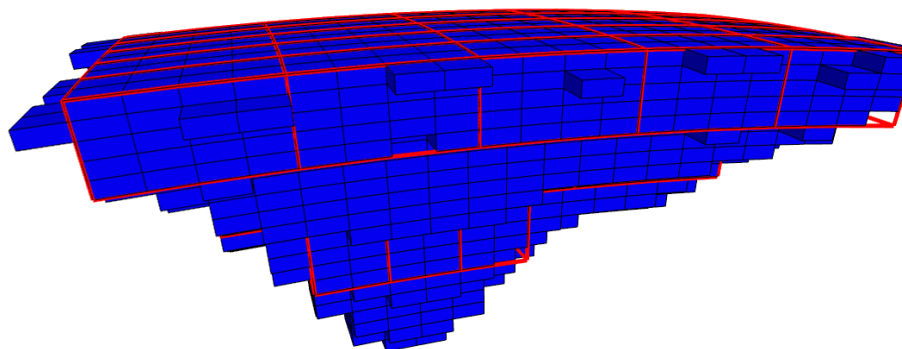
correct



dense



dense



# Future

- Combinations of tensor components
- Dipping models (subducting plate)
- Real data (open for collaboration)

# OPEN SOURCE

## **Fatiando a Terra**

Geophysical modeling and inversion



[fatiando.org](http://fatiando.org)

[github.com/leouieda/egu2014](https://github.com/leouieda/egu2014)