Flow structure and integral parameters in Baltic artesian basin

Plūsmu struktūra un integrālie parametri Baltijas artēziskajā baseinā

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ESF
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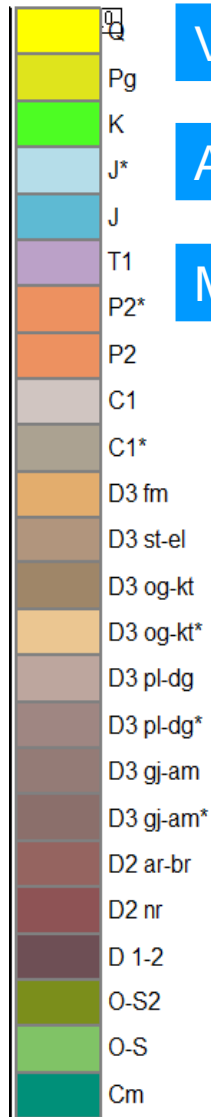**LATVIJAS UNIVERSITĀTE** ANNO 1919

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Contents

· Geometry of the model

· Optimisation and validation of model

· Groundwater flow

  · velocity distributions

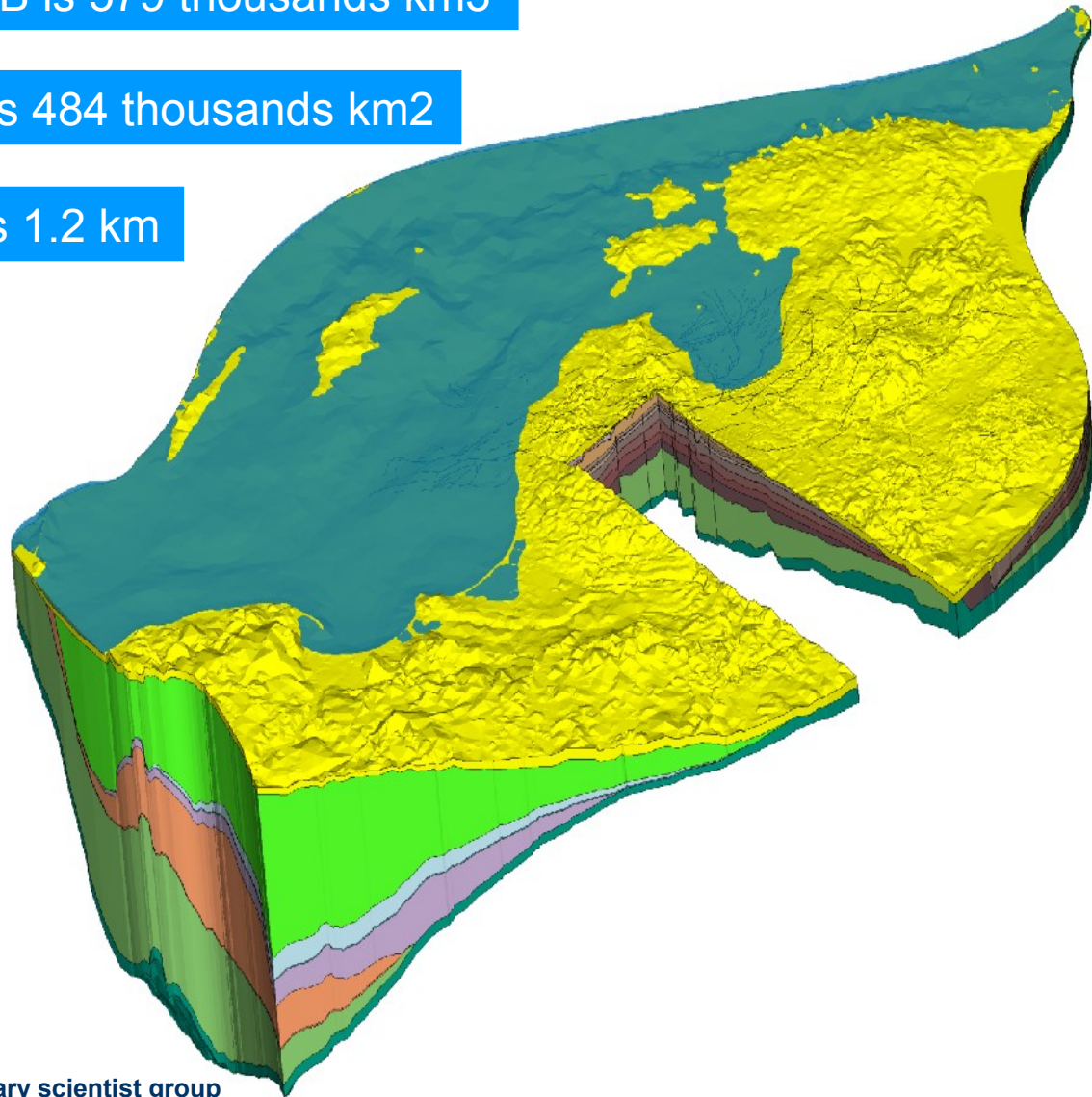 · integral parameters

  · artesian conditions

· Summary

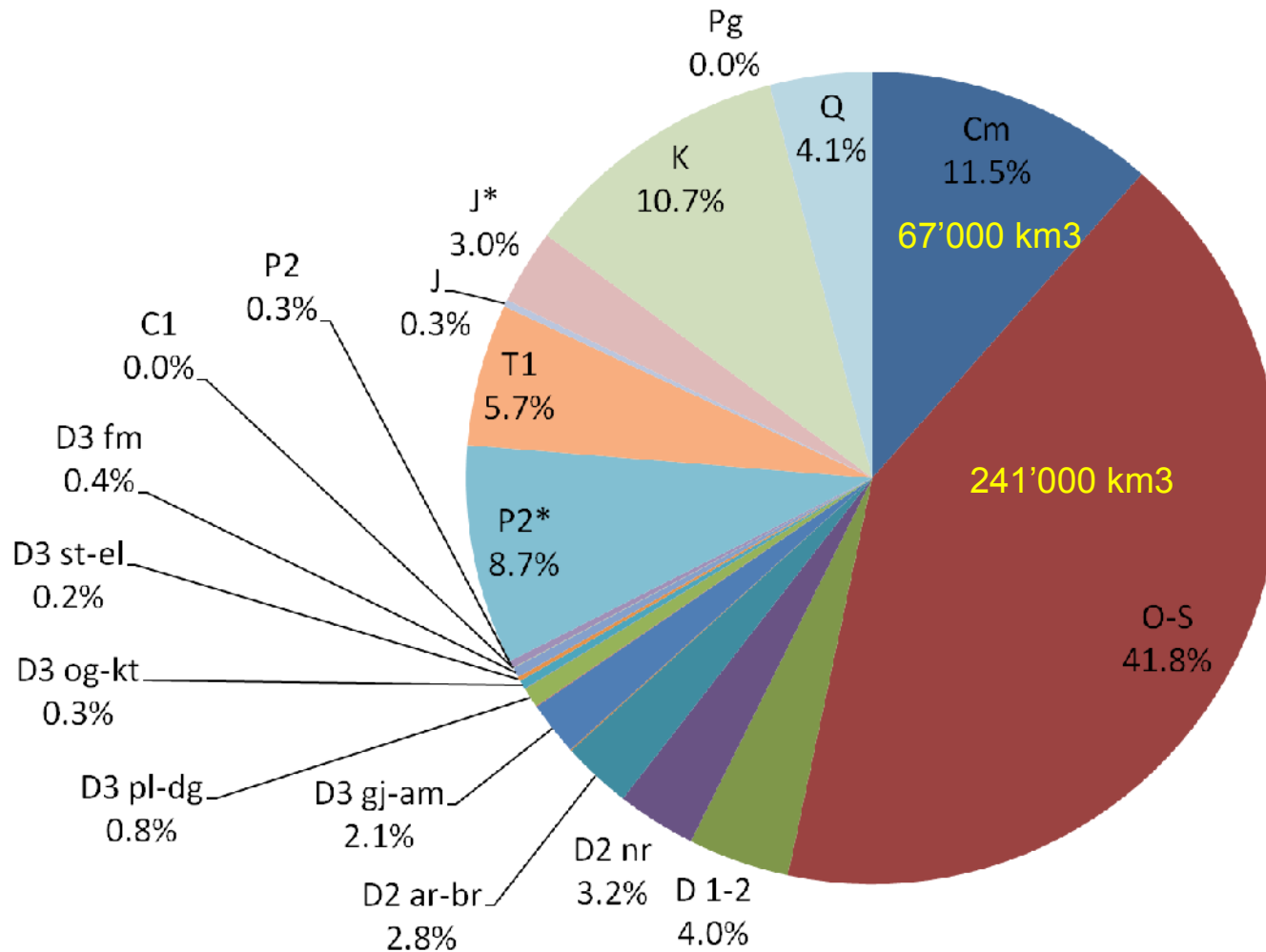# Geometry of BAB

Volume of BAB is 579 thousands km3
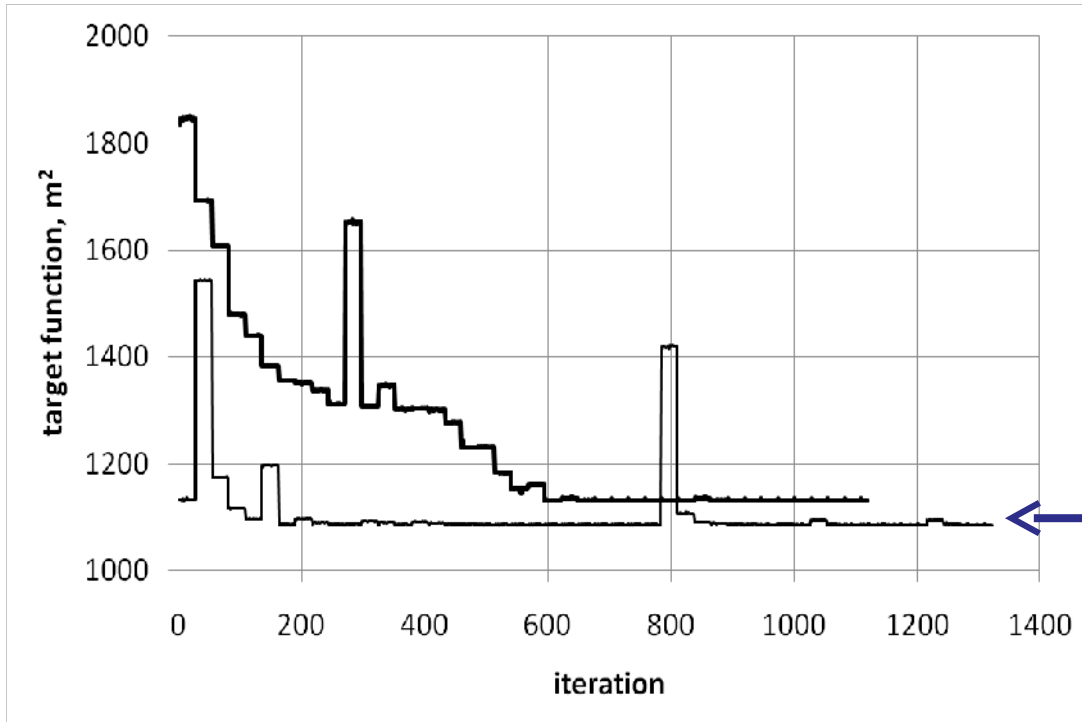
Area of BAB is 484 thousands km2

Mean depth is 1.2 km

Legend:
- Q
- Pg
- K
- J*
- J
- T1
- P2*
- P2
- C1
- C1*
- D3 fm
- D3 st-el
- D3 og-kt
- D3 og-kt*
- D3 pl-dg
- D3 pl-dg*
- D3 gj-am
- D3 gj-am*
- D2 ar-br
- D2 nr
- D 1-2
- O-S2
- O-S
- Cm

Volume distribution in BAB

Total volume of BAB is 579 thousands km3

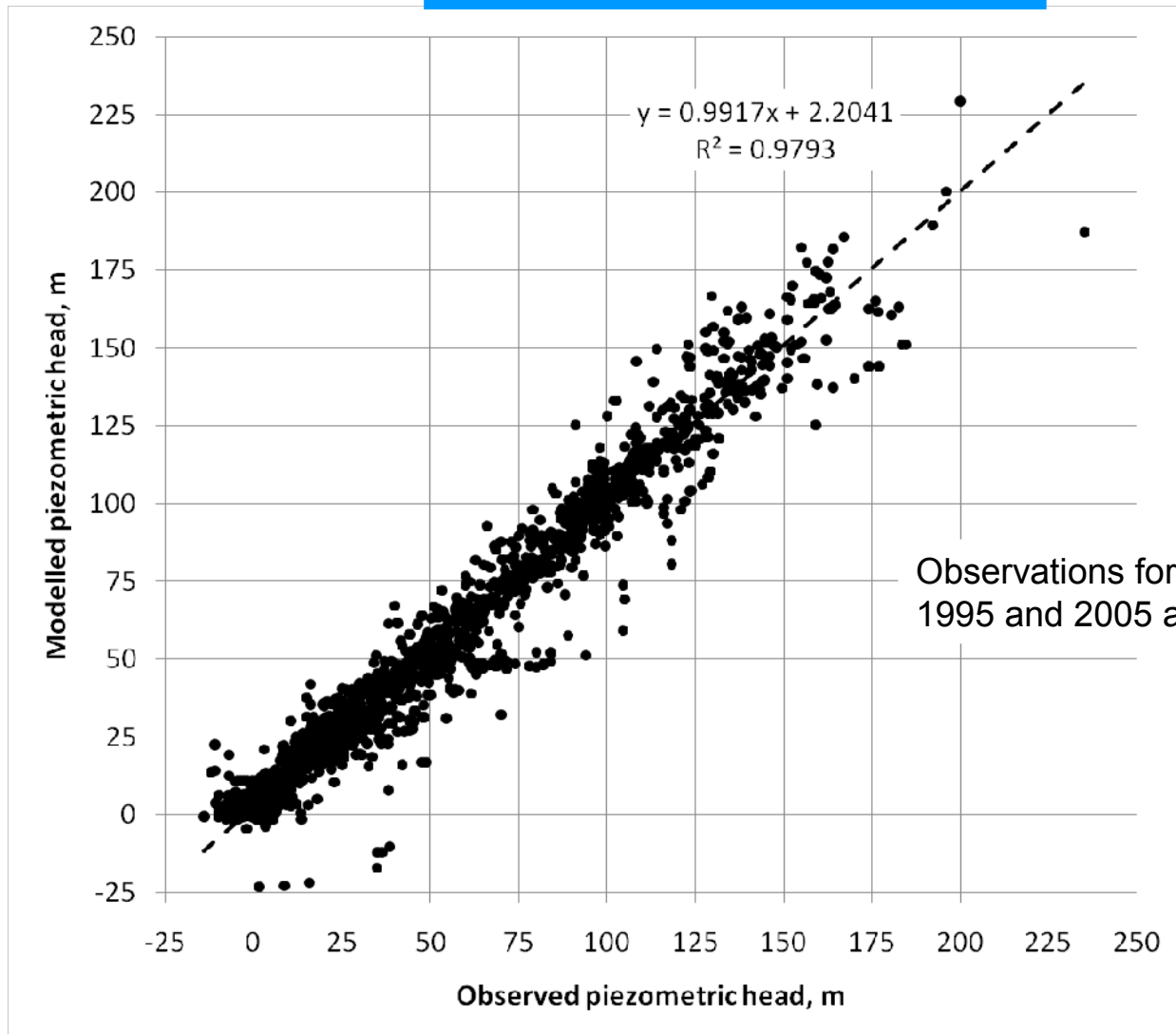# Modelling results

Optimisation procedure of target function

BIAS and RMSE in aquifers

Layer	BIAS	RMSE
Cm	4.1	14.2
D 1-2	-0.9	13.7
D2 nr	-2.5	5.0
D2 ar-br	-4.5	10.0
D3 gj-am	-1.0	9.6
D3 pl-dg	-1.0	8.4
D3 og-kt	-4.4	8.9
D3 st-el	-3.7	4.6
D3 fm	-5.4	9.3
C1	-1.7	6.3
P2	-1.4	8.9
T1	-4.9	5.2
J	-1.0	4.1
Q	-0.7	7.7

Validation of results

Modelled vs. observed head

Observations for time interval between 1995 and 2005 are plotted

Modelling results

Piezometric head in Cm
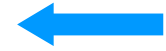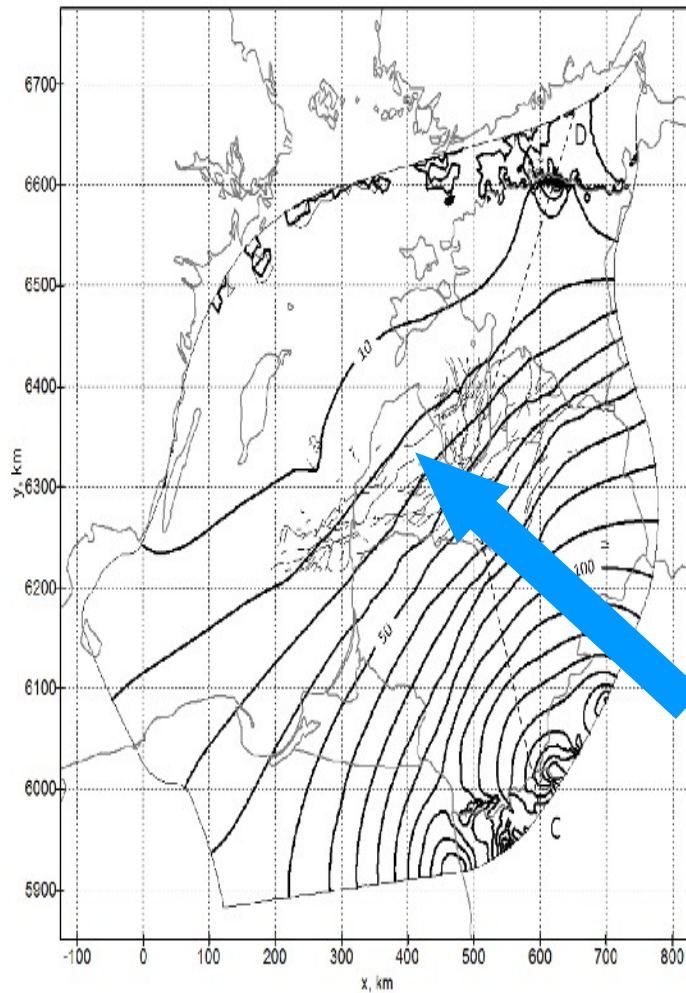
Direction of principial flow
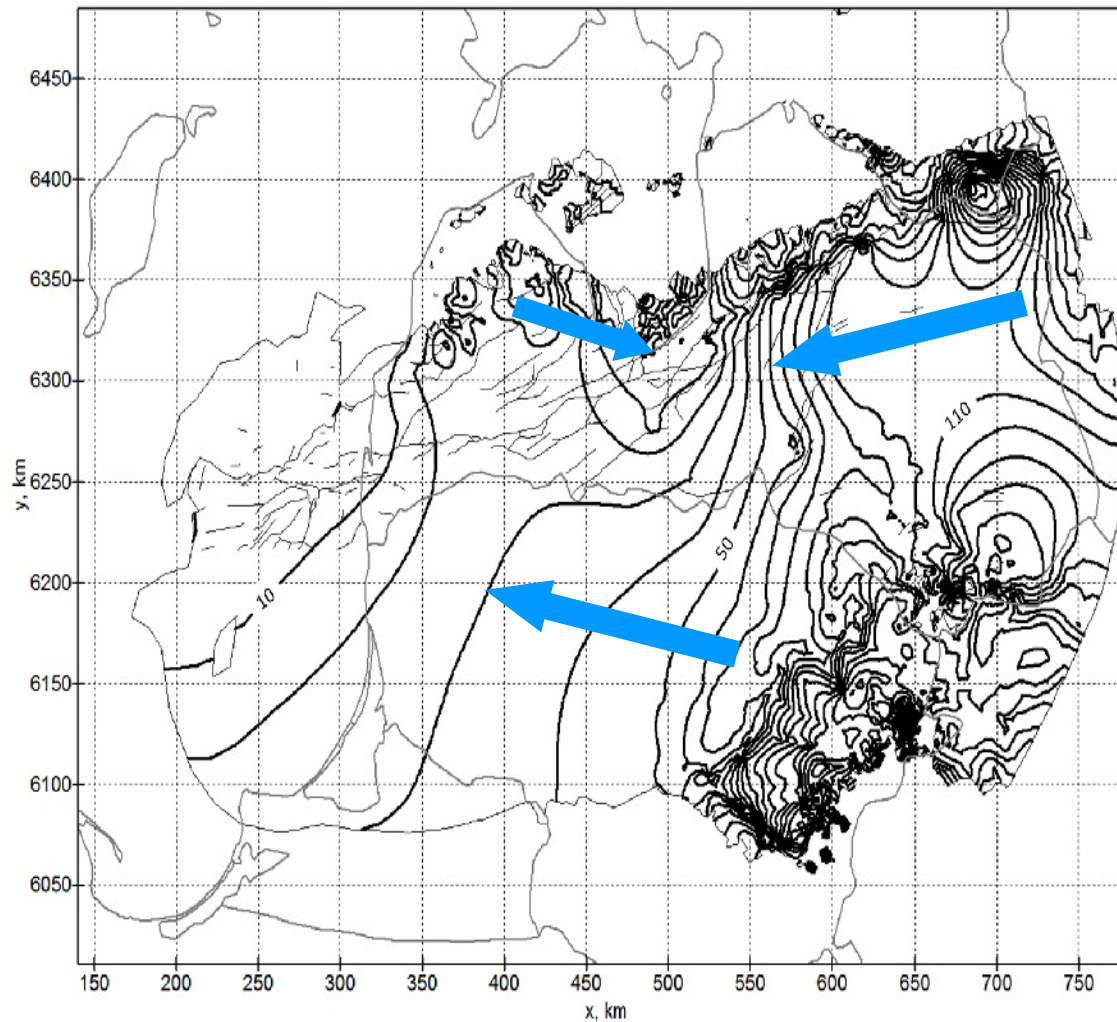
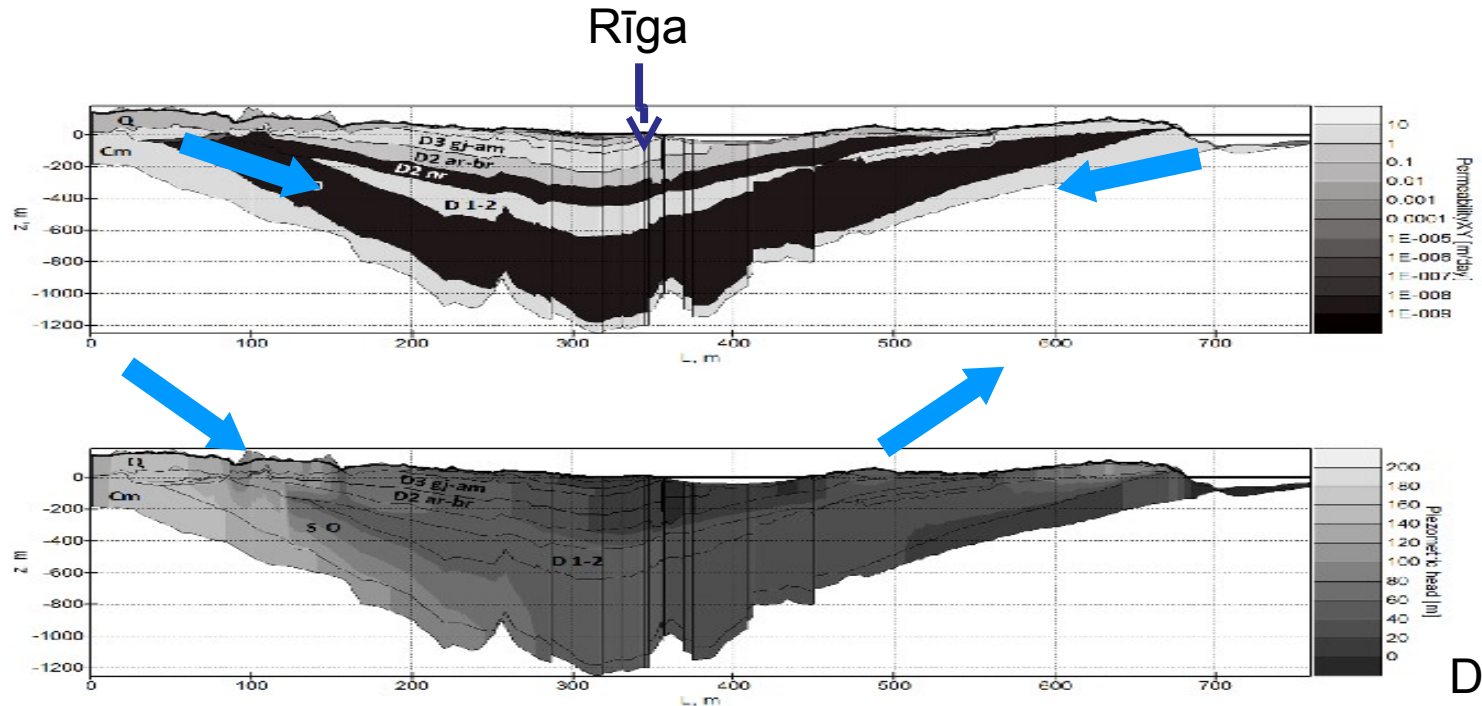# Modelling results
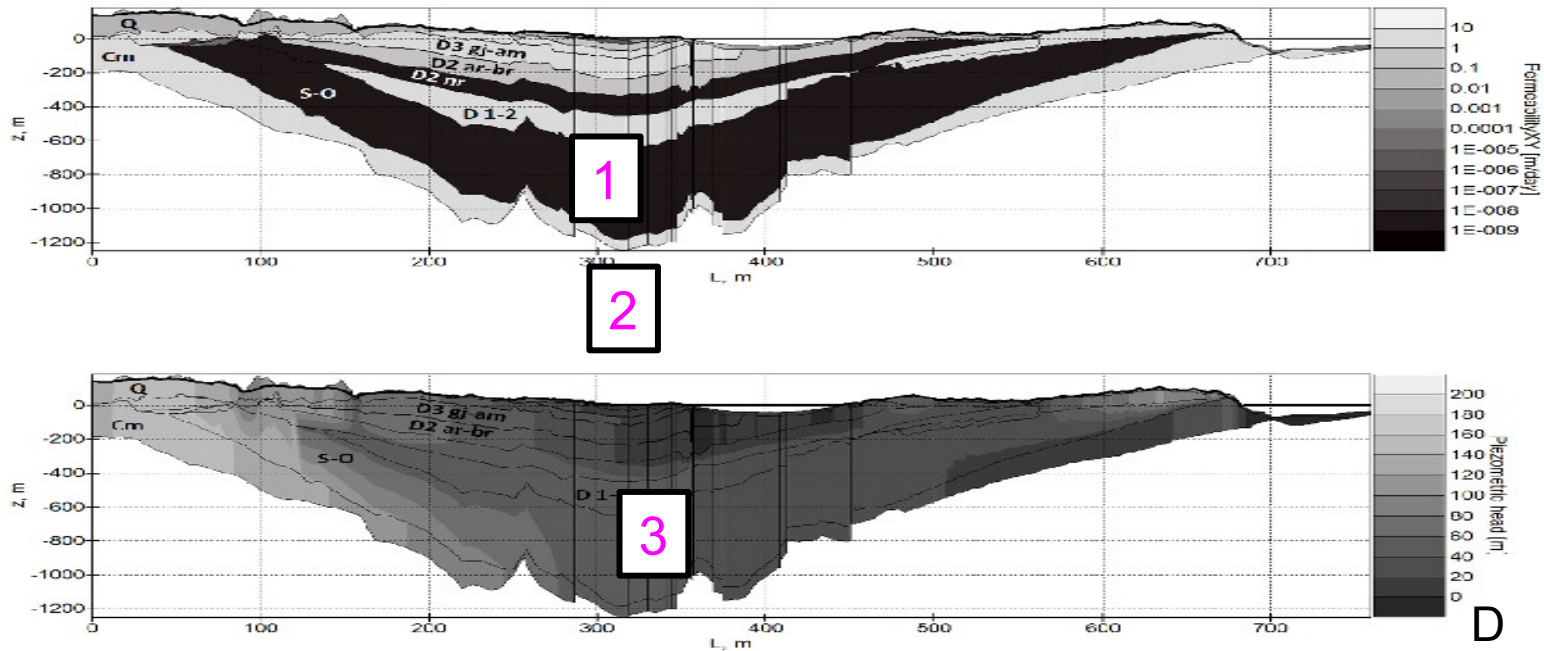
Modelling results

Three parts relatively well isolated from each other :

1) over D2 nr
2) between D2 nr and S-O
3) under S-O
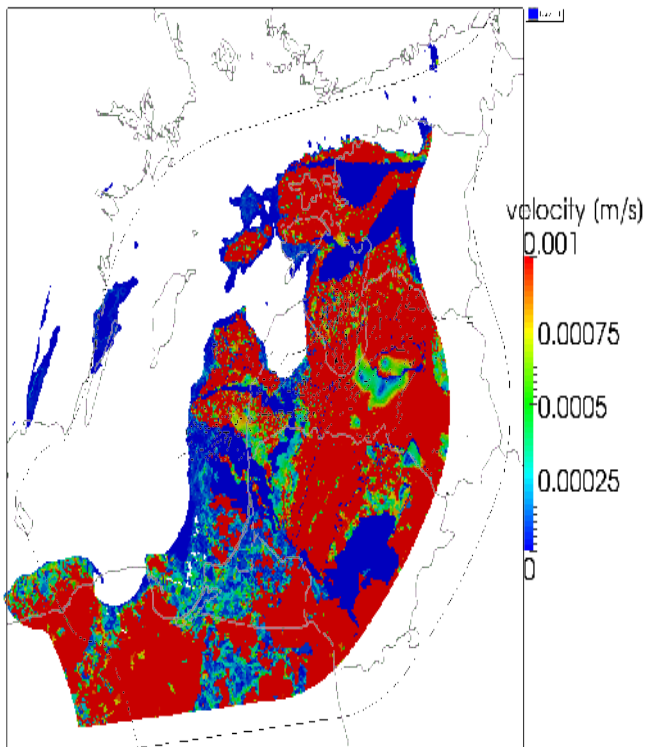
Modelling results

Piezometric head [m] in cross-section

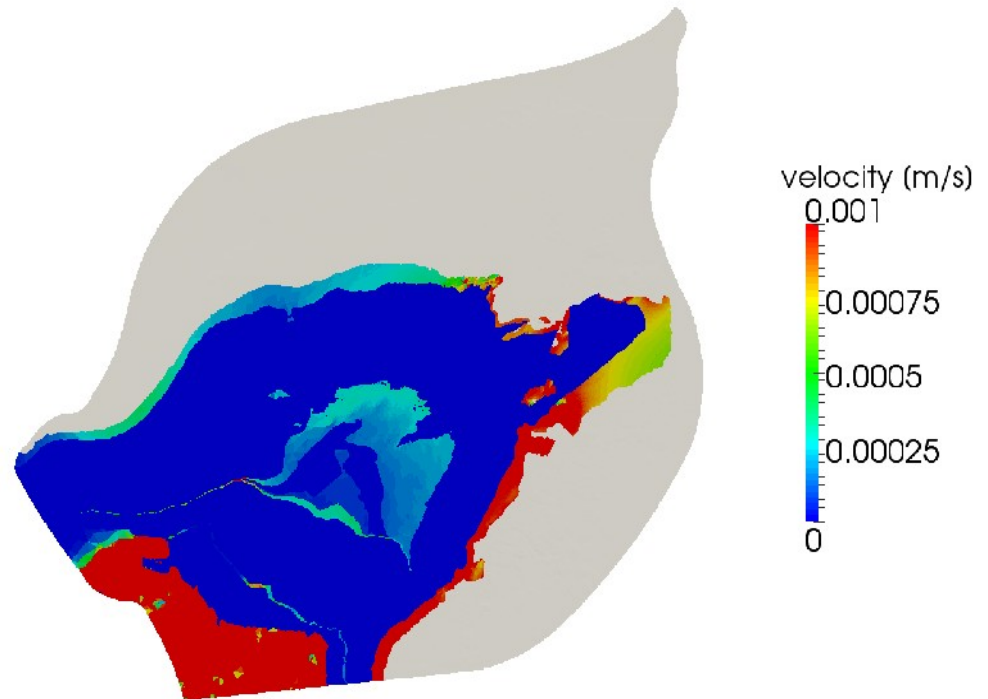Rīga

Transient flow in deeper layers

Velocity of groundwater flow

Modulus of velocity in horizontal sections
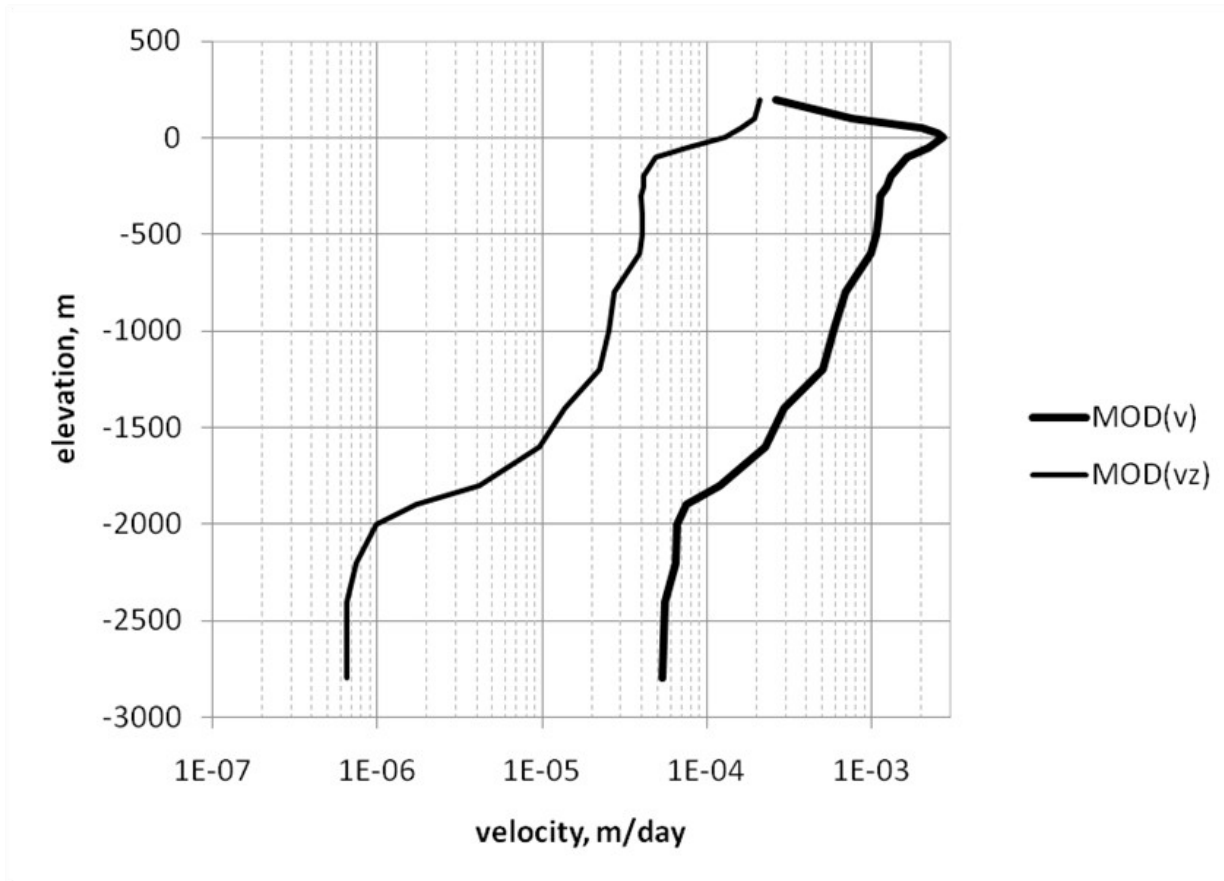
Z = -10 m

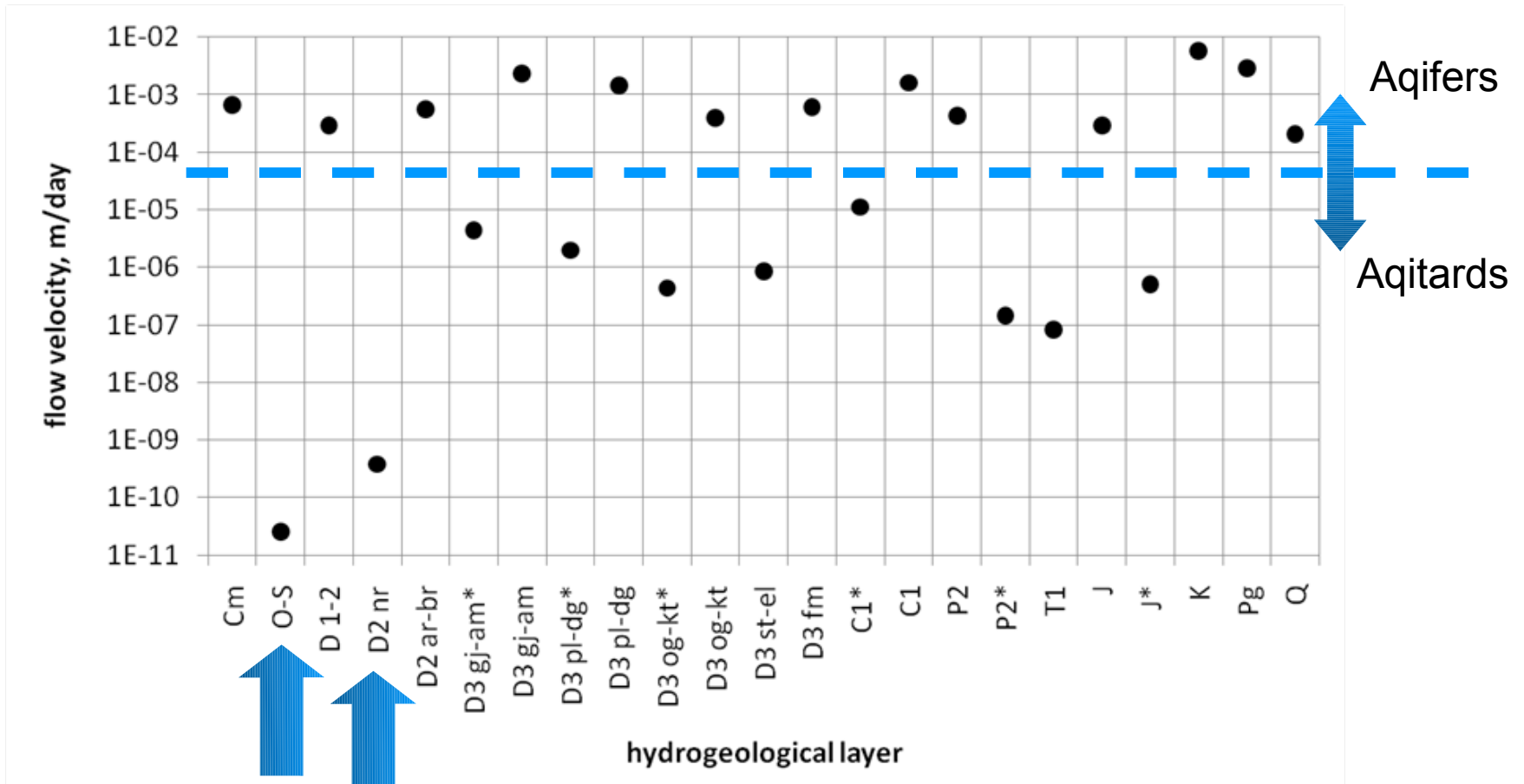z = -800 m

Velocity of groundwater flow

Modulus of velocity and modulus of vertical velocity

- The velocity decreases with the depth
- The vertical velocity is at least by order less than horizontal velocity

Velocity of groundwater flow

Modulus of flow velocity in hydrogeological layers

Thick aquitards O-S and D2 nr:
flow velocities under 1e-9 m/day

Path length in 10000 years is:
Aquifers L = 3.6 km
Aquitards L = 3.6 m

Velocity of groundwater flow

Integral value in BAB

- The mean groundwater flow direction is 333 degrees (from SW to NW)
- The mean groundwater flow velocity over the whole BAB is 0.29 mm/day
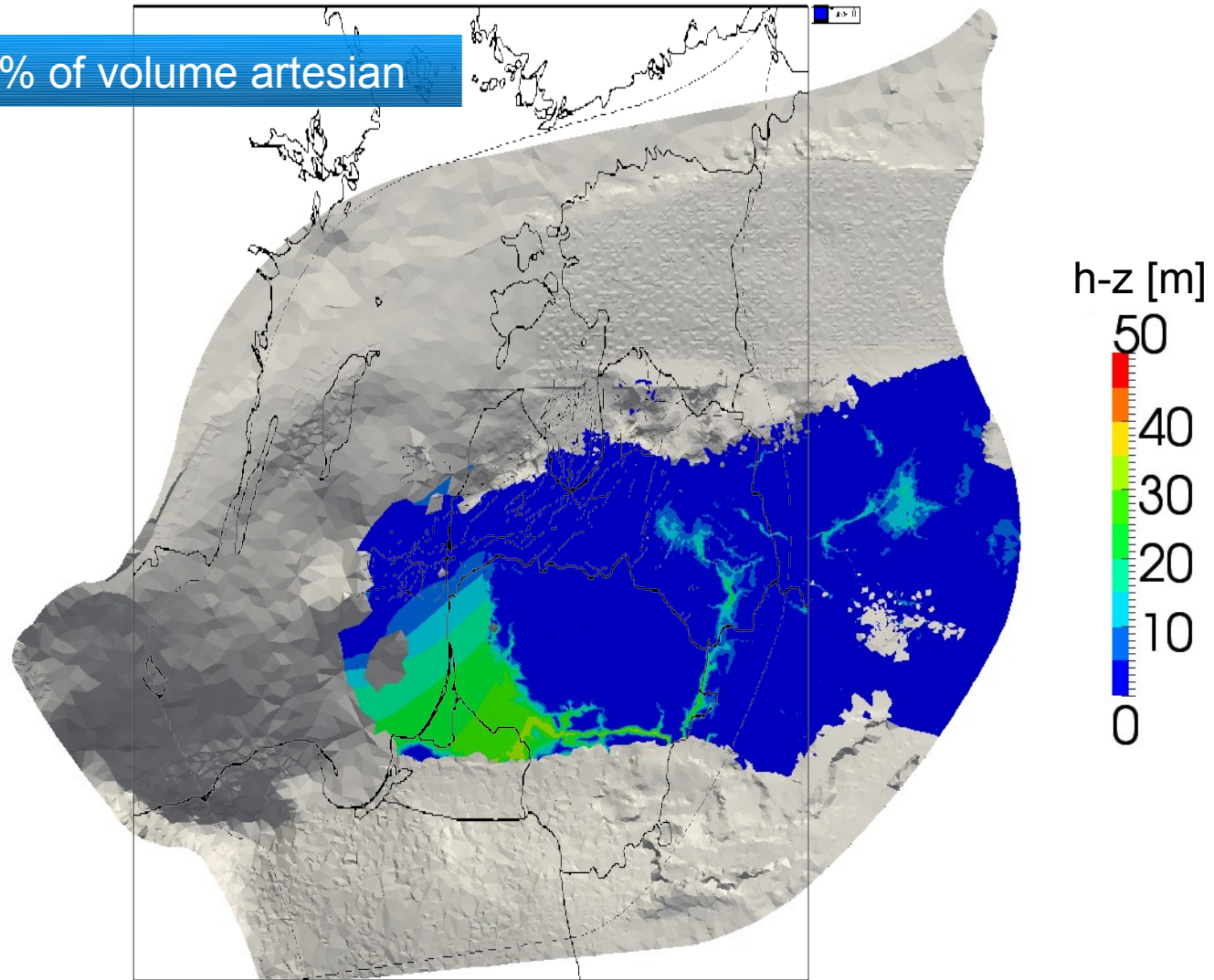- The mean value of velocity modulus over the whole BAB is 0.82 mm/day

Isolines of piezometric head

3D view of Cm layer shown
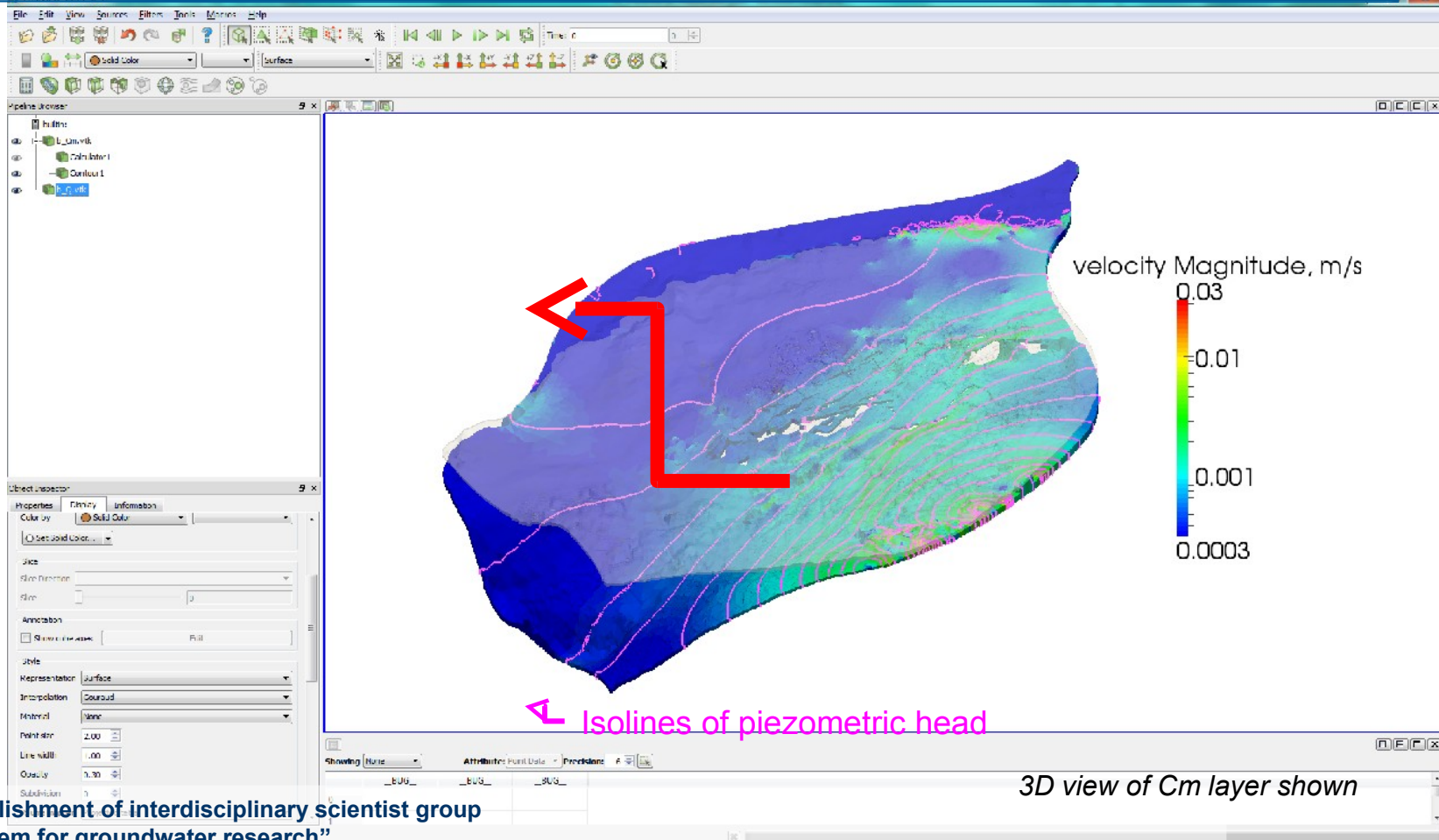
Water under artesian conditions

Free flowing wells – piezometric head higher than the surface elevation
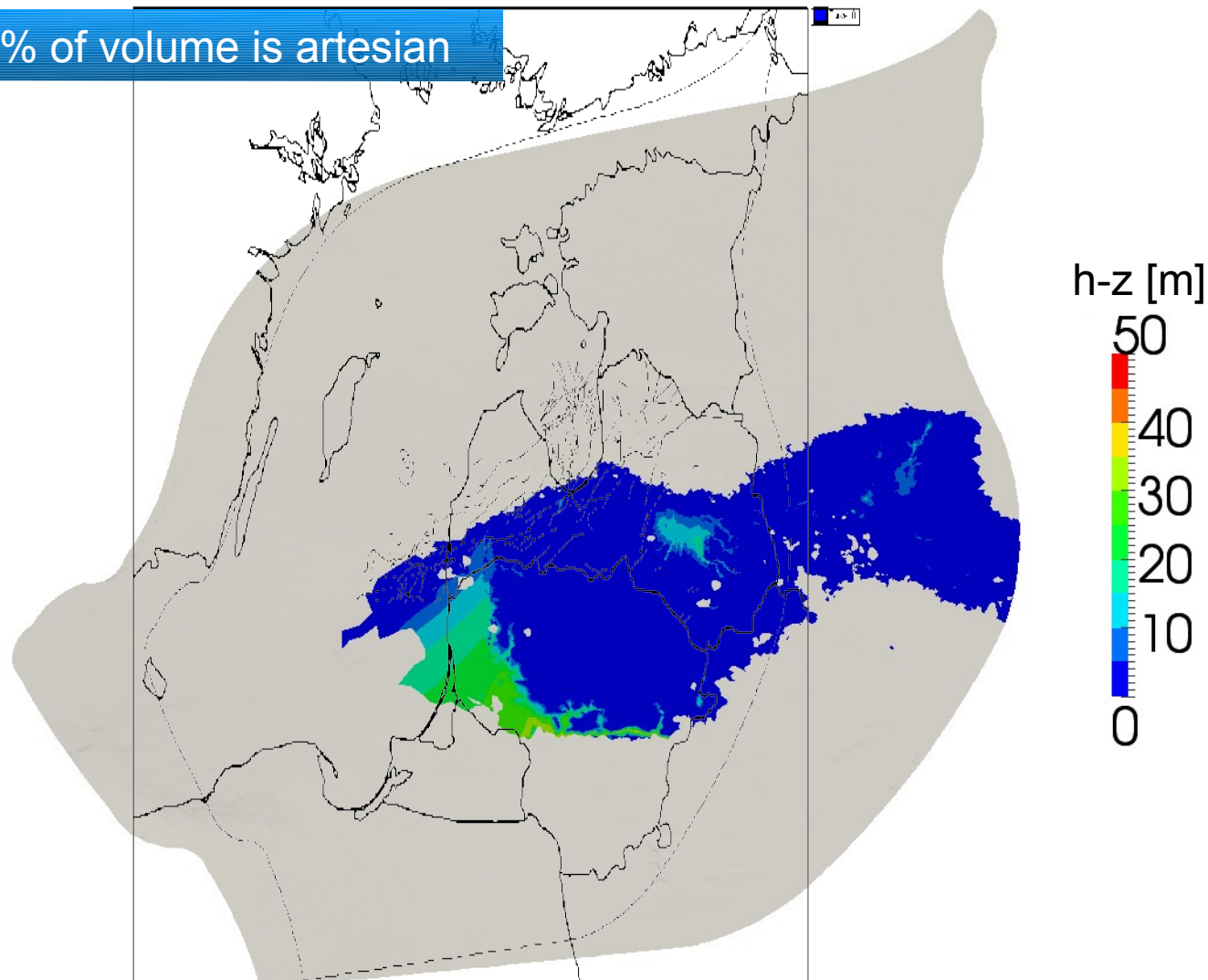
D 1-2 layer: 46% of volume artesian

h-z [m]

50
40
30
20
10
0
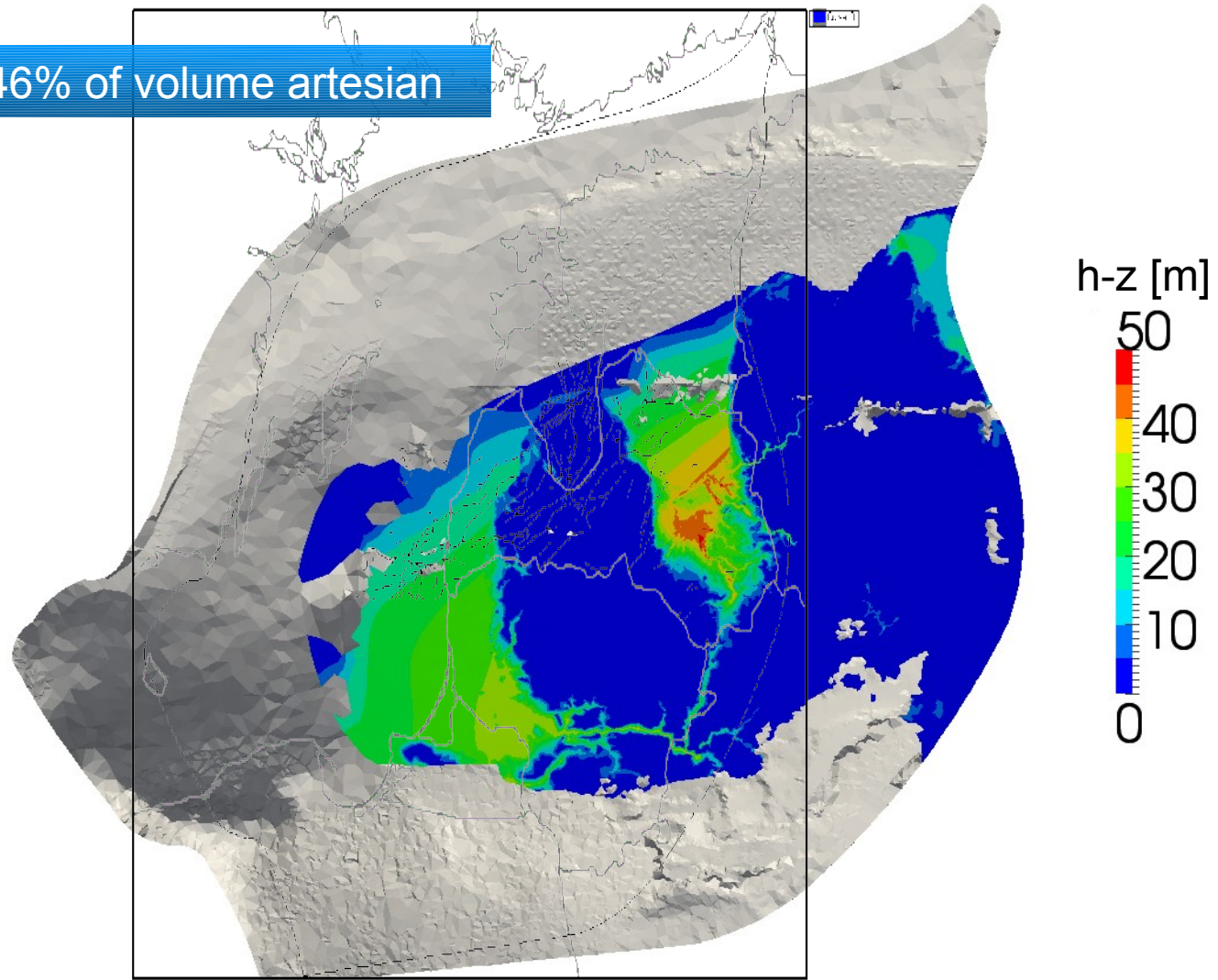
Water under artesian conditions

D3 gj-am: 22% of volume artesian

h-z [m]

Water under artesian conditions

D3 pl-dg: 23% of volume is artesian

h-z [m]

Summary

The distribution of principal flows inside BAB was analyzed based on the model results

Integral geometric measures of BAB:
- volume is 579 000 km3
- area is 484 000 km2
- mean depth is 1.2 km

For the mean groundwater flow
- direction is 333 degrees
- flow velocity is 0.29 mm/day
- modulus of flow velocity is 0.82 mm/day

In most aquifers containing drinking water the part of artesian volume is between 19% and 24%