



MODELLING AIRFLOW IN SUGAR BEET CLAMPS

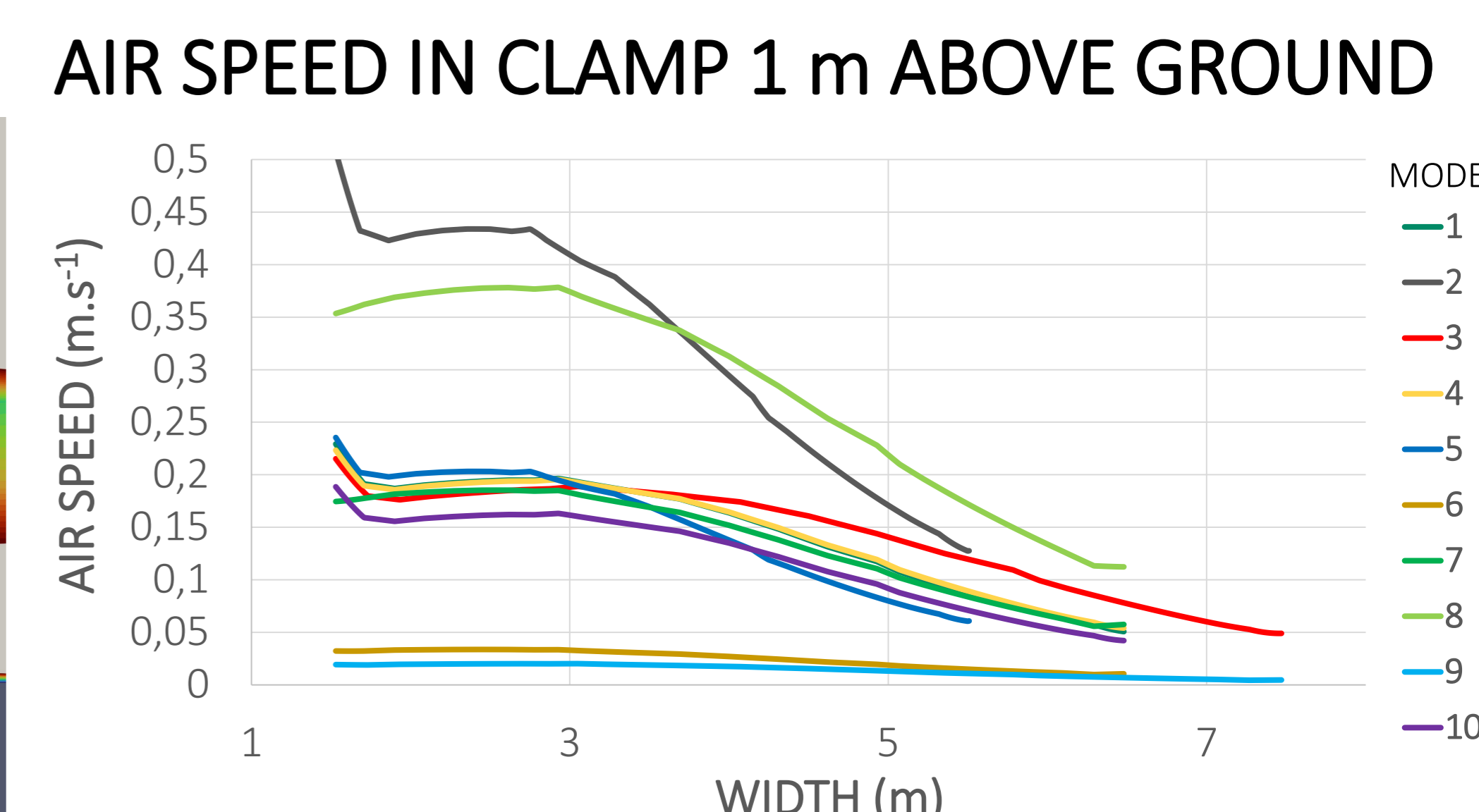
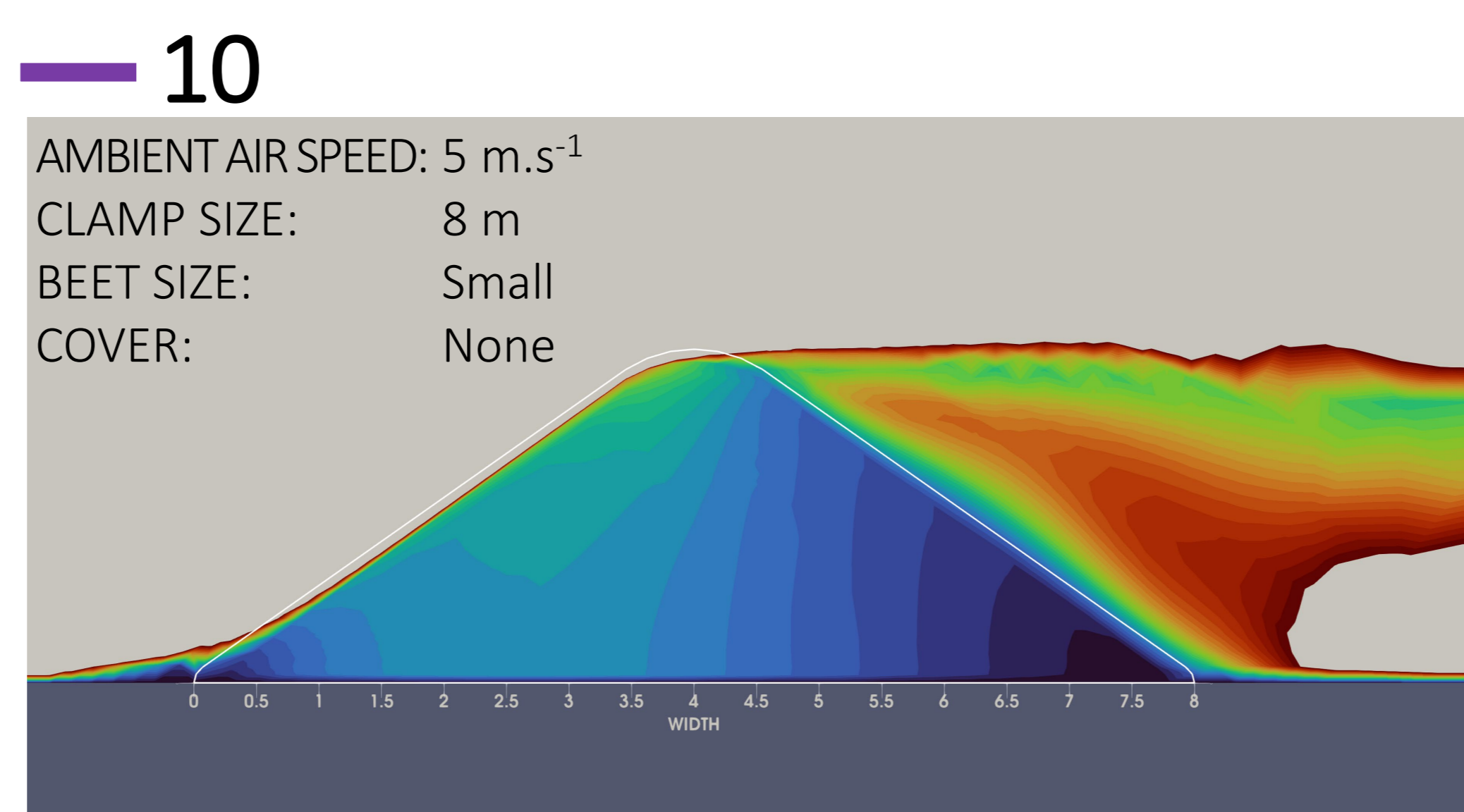
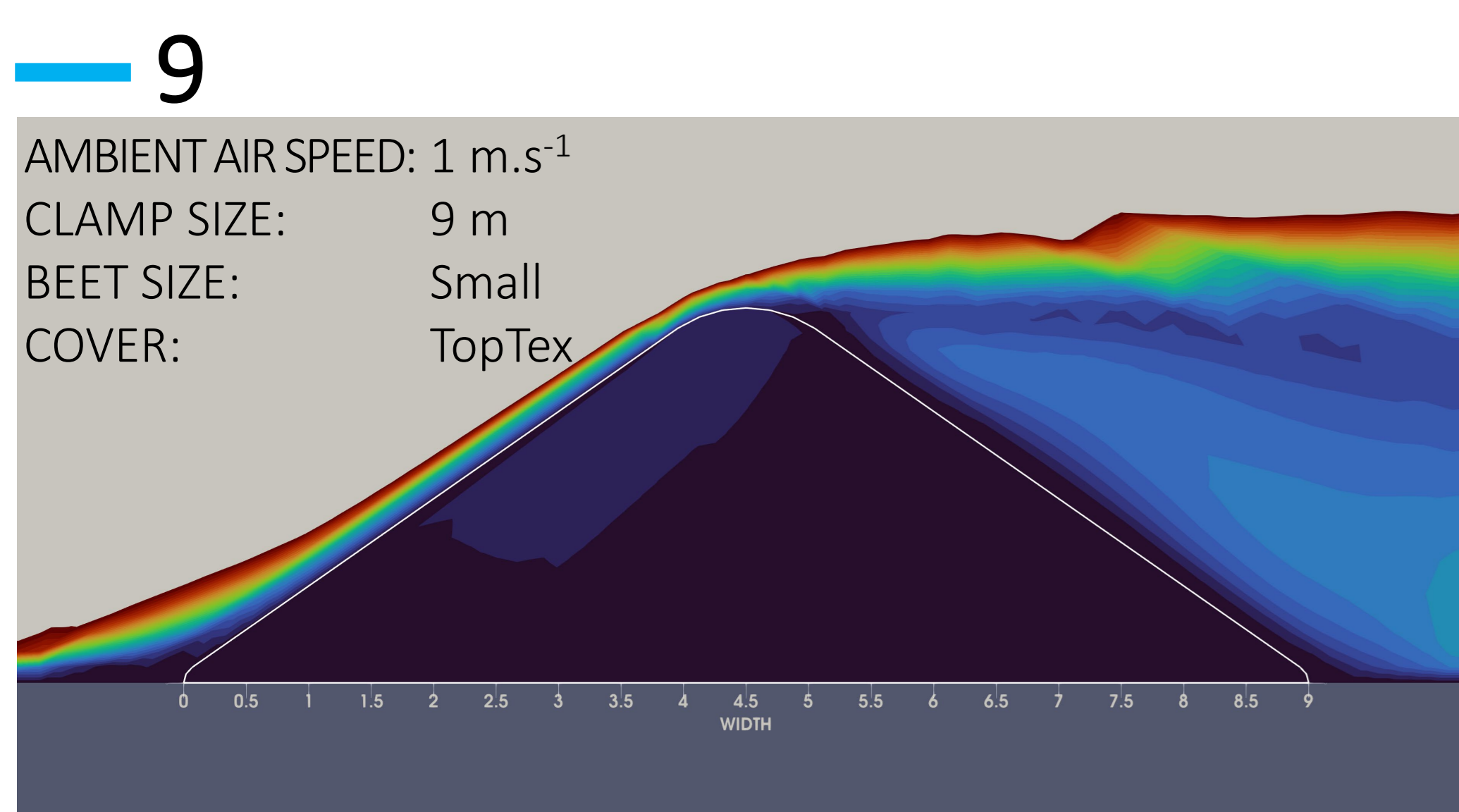
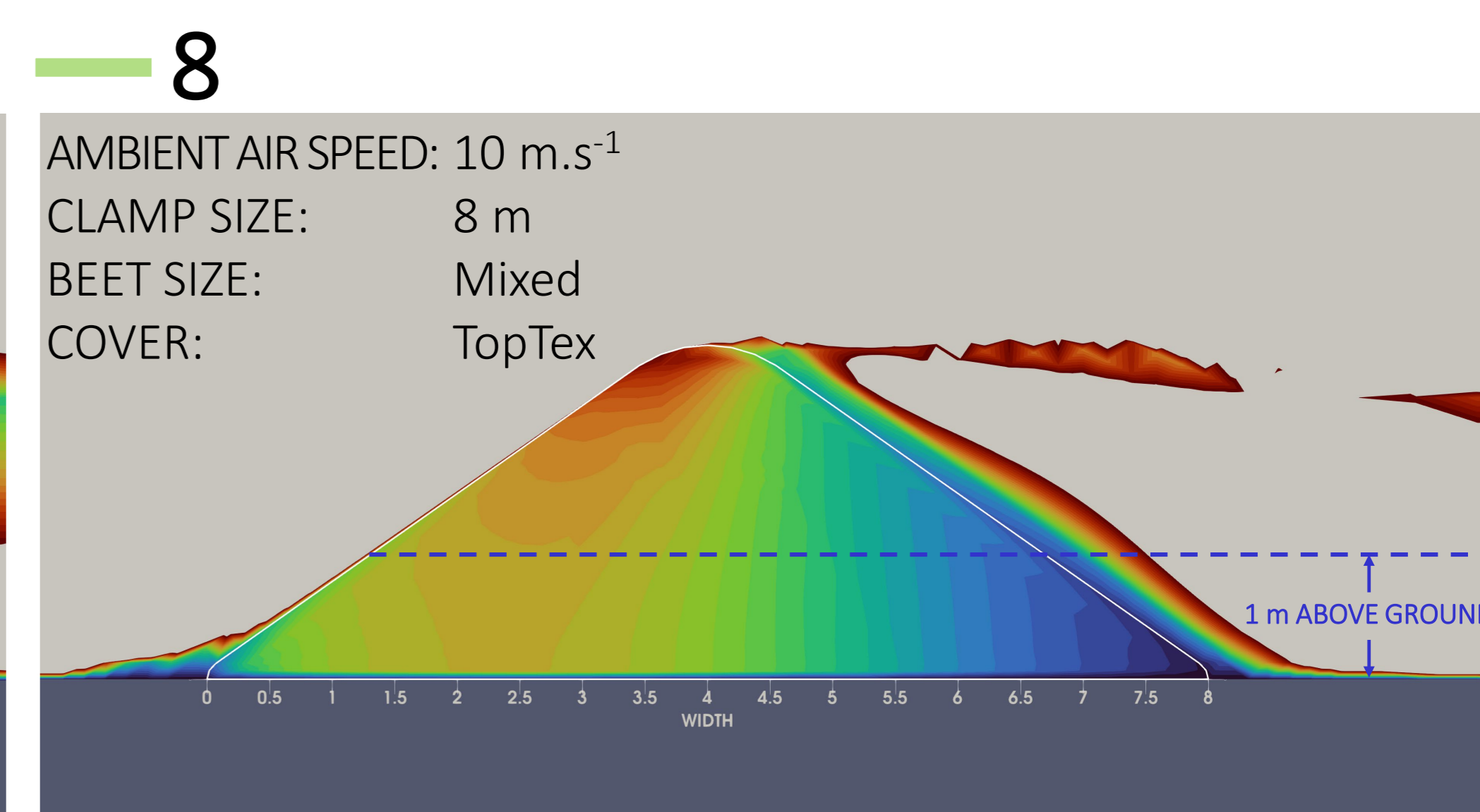
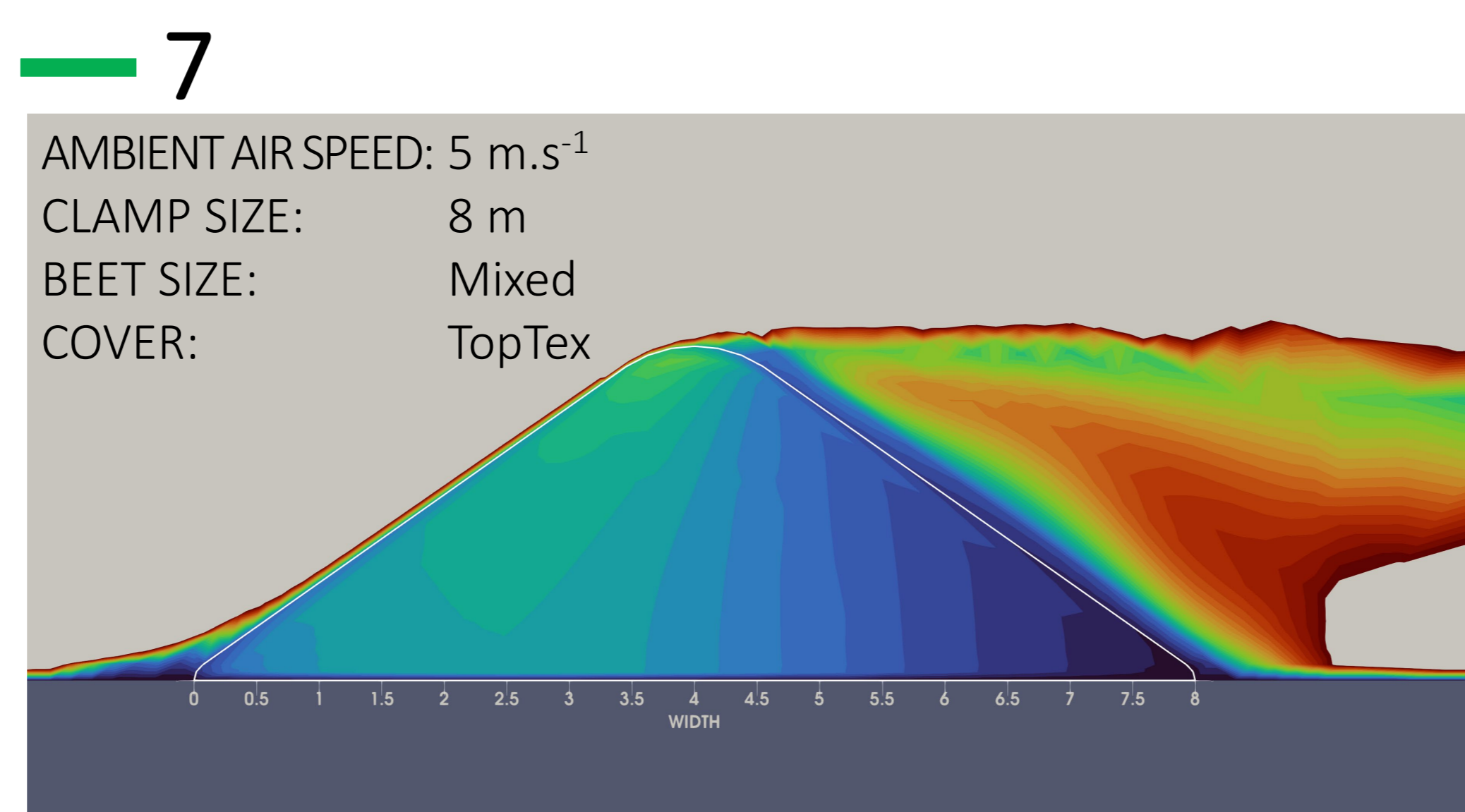
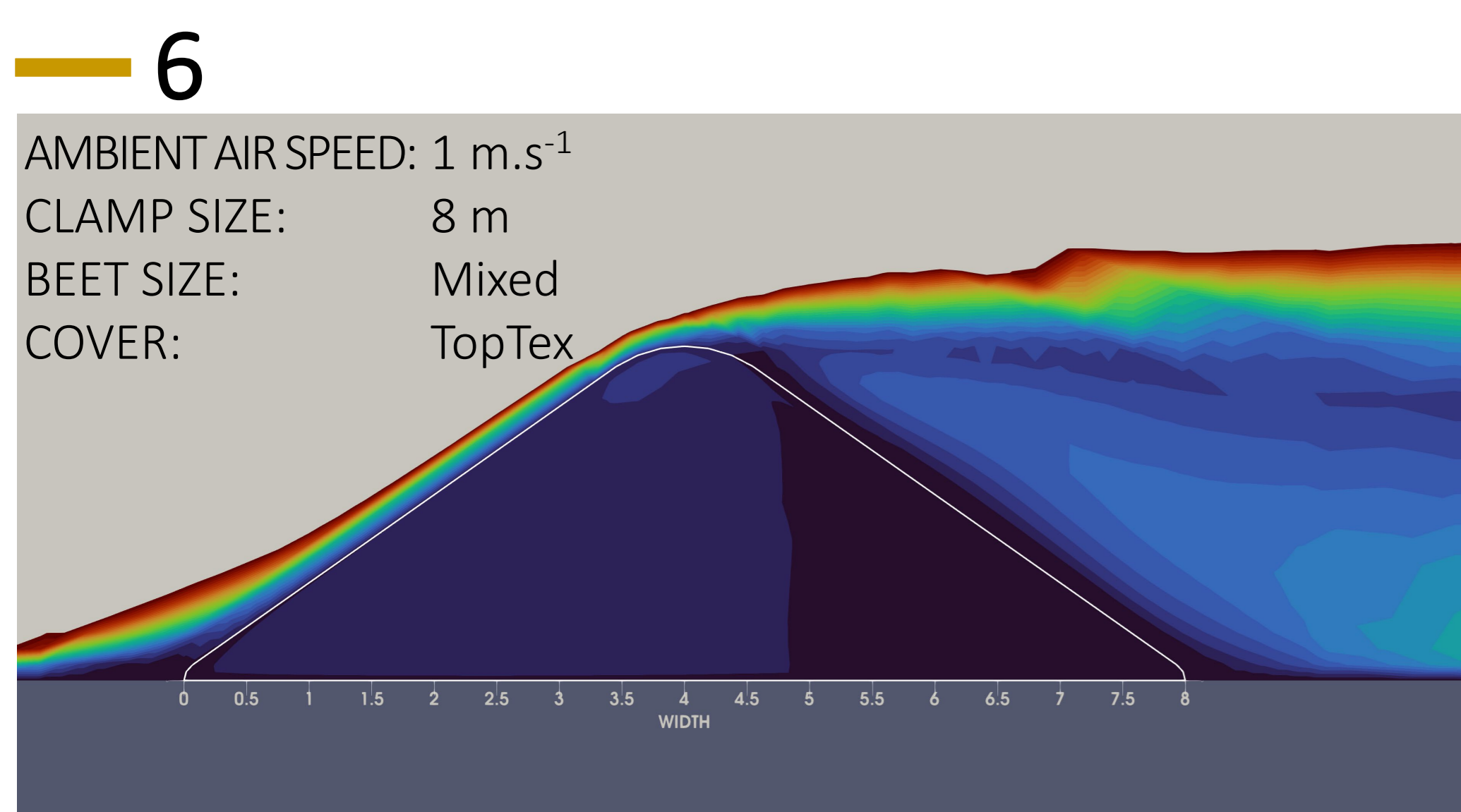
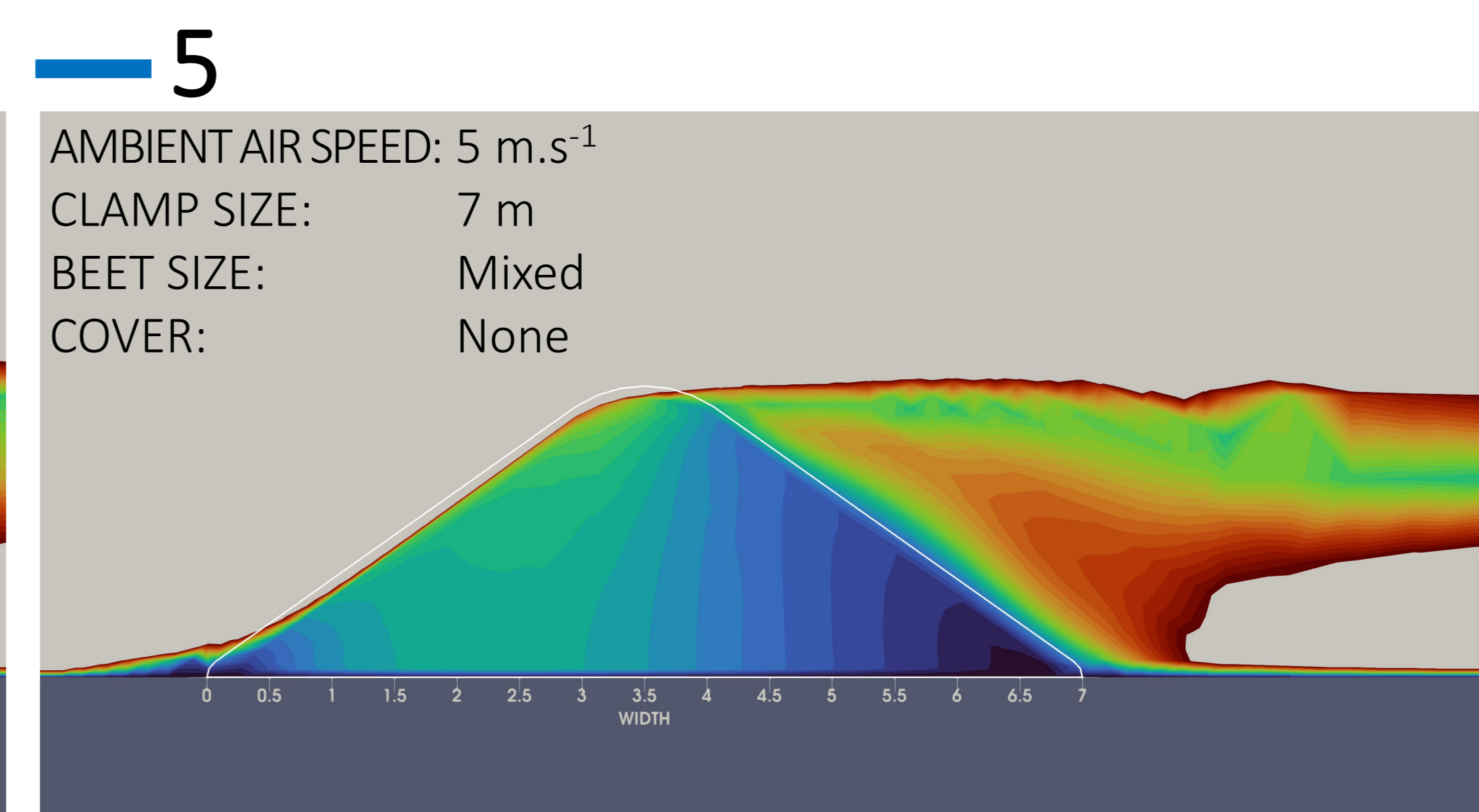
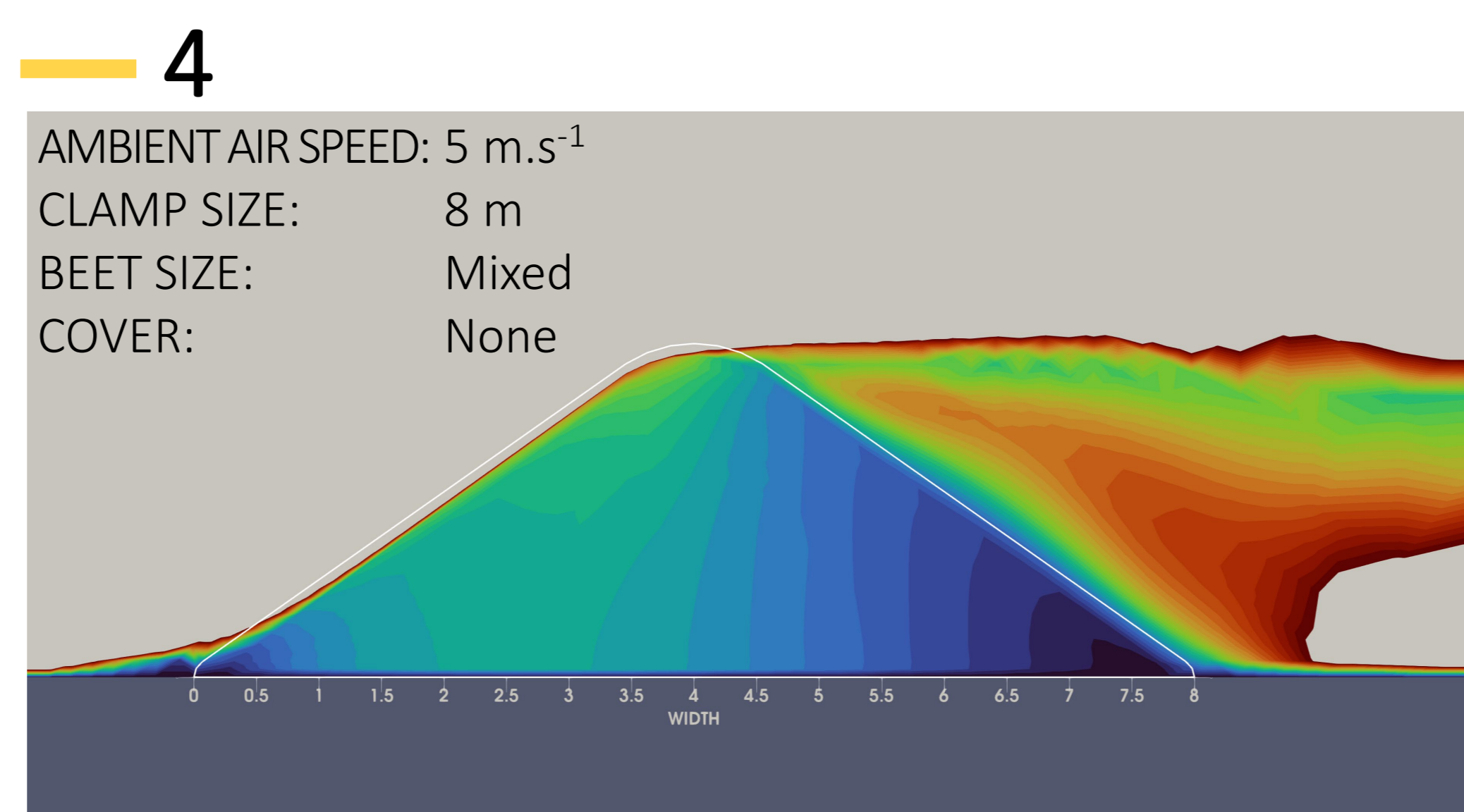
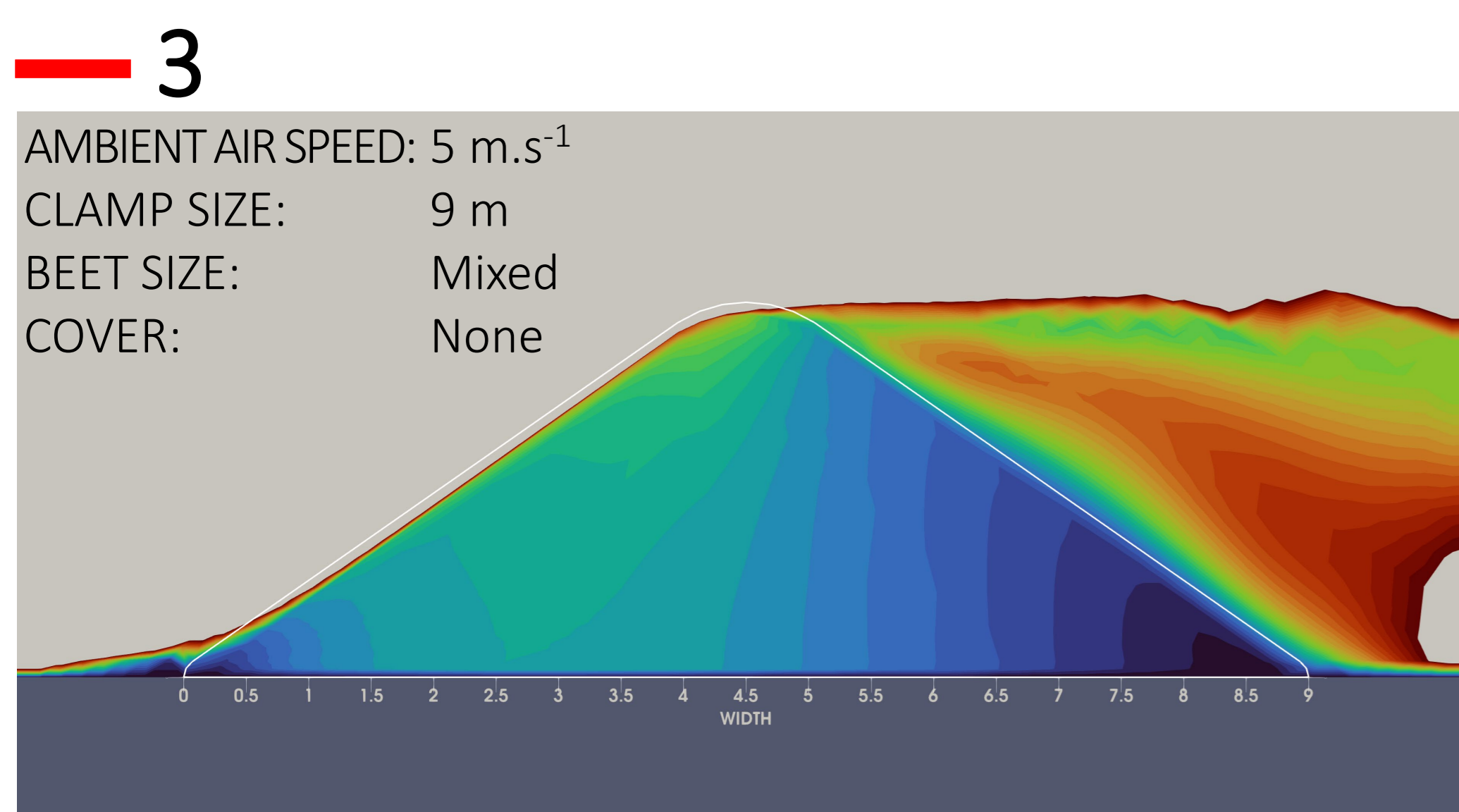
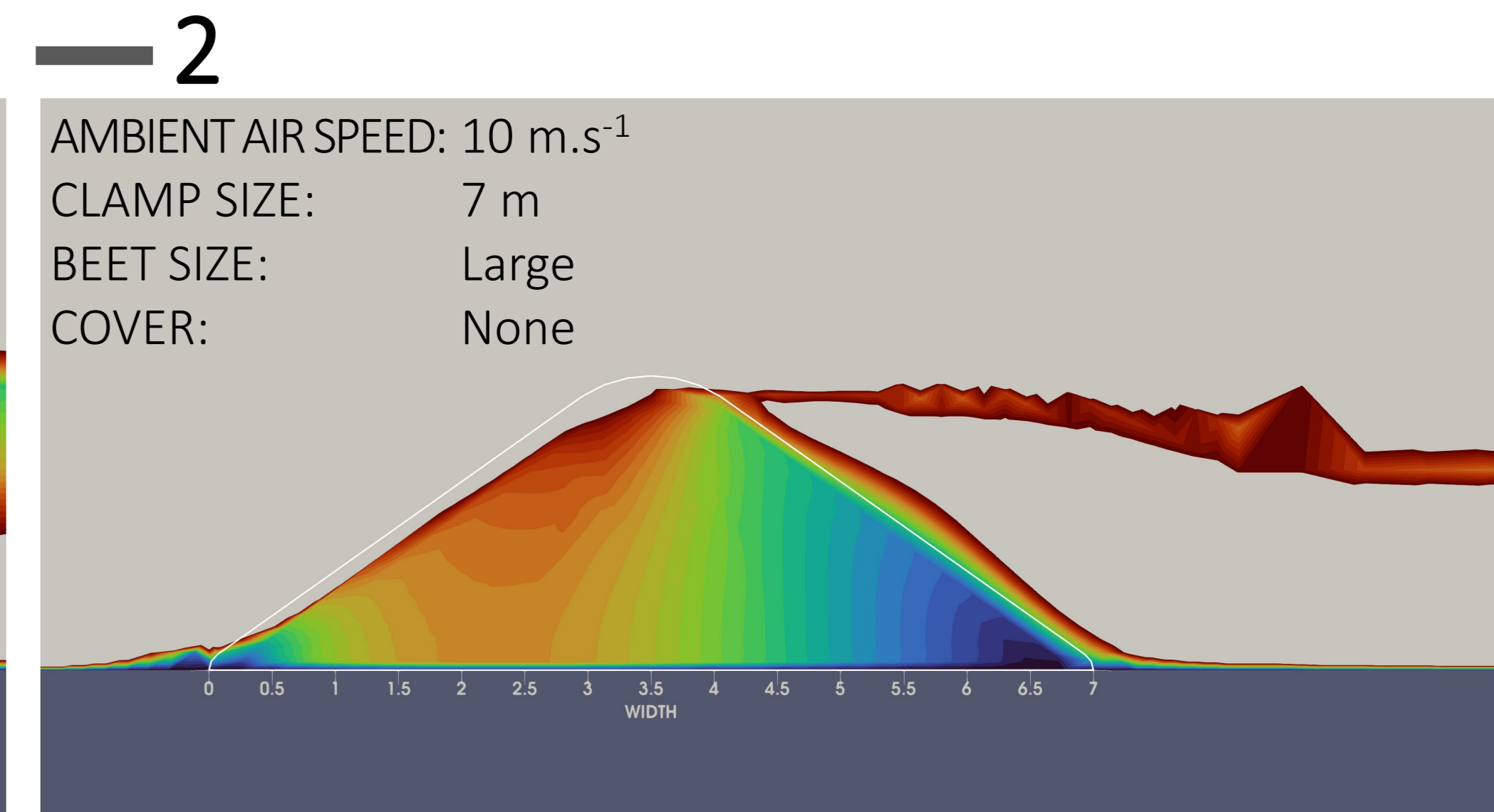
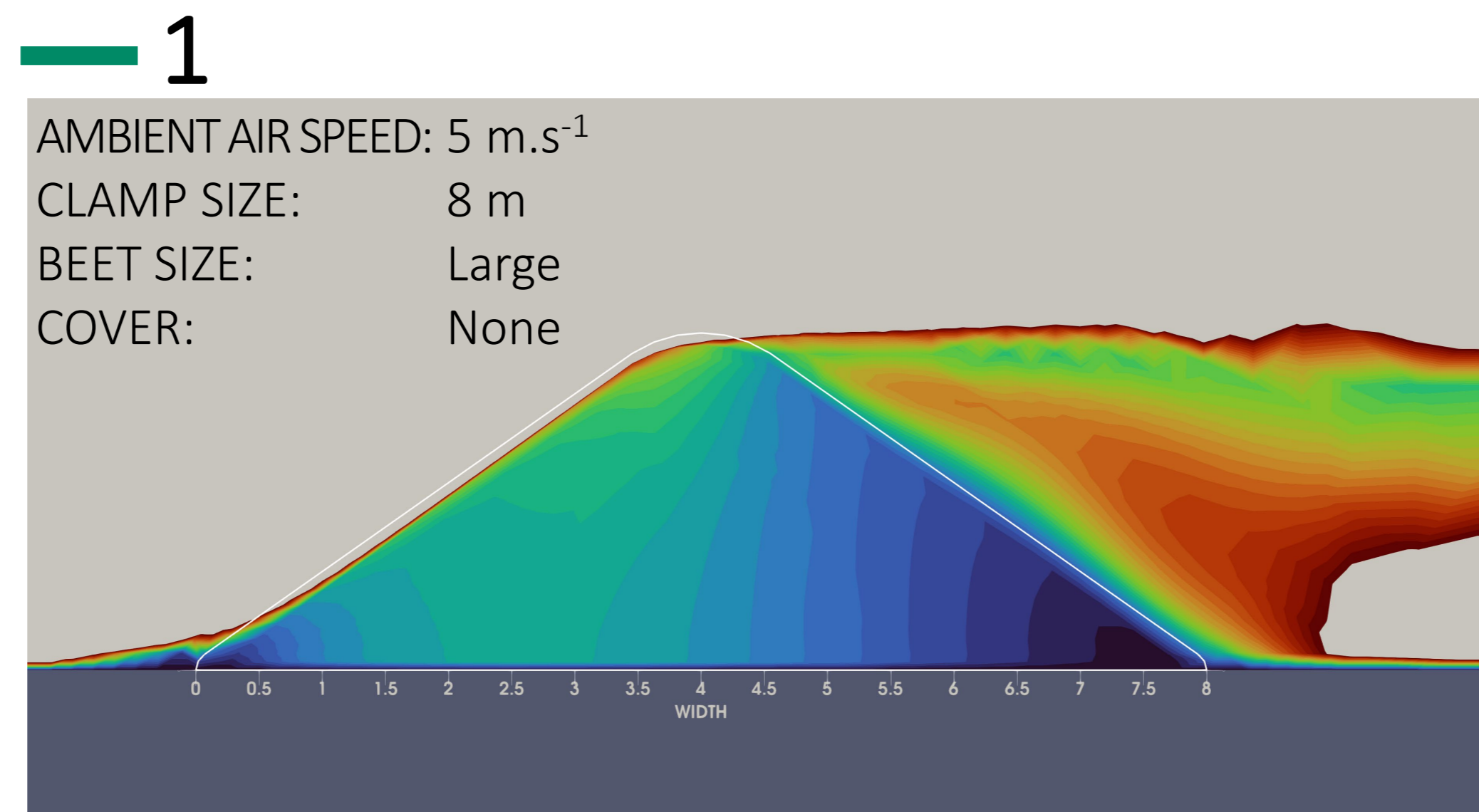
WILLIAM ENGLISH^{1,2}

¹NBR Nordic Beet Research foundation, Bjärred, SE; ²Swedish University of Agricultural Sciences (SLU), Alnarp, SE. e-mail: we@nbrf.nu

BACKGROUND: The movement of air is a major driver of thermodynamic processes in post harvest storage systems. It can have large impacts on the rates of heat and moisture transfer.

PURPOSE: Present profiles of modelled air flow through naturally ventilated sugar beet clamps, as affected by ambient air speed, clamp size, beet size, and cover type. Ambient air flows left to right. Two profiles of an actively ventilated clamp are also presented.

KEY	TO COMPARE...	SEE MODELS...
<p>Air speed m.s⁻¹</p>	AMBIENT AIR SPEED	6, 7, 8
	CLAMP SIZE	3, 4, 5
	BEET SIZE	1, 4, 10
	COVER	4, 7
	EXTREMES	2, 9



METHOD:
Computational Fluid Dynamics Program: OpenFOAM
Temporal model: Transient
Turbulence model: k-epsilon
Solver: PIMPLE
Solution (U): linear upwind
Porous medium approach

Ambient Air Speed (Inlet):
- 1 m.s⁻¹, left to right
- 5 m.s⁻¹, left to right
- 10 m.s⁻¹, left to right

Clamp size:
- 7 x 2.33 m
- 8 x 2.67 m
- 9 x 3.00 m

Beet size Darcy-Forchheimer coeffs.*
- Small: 530000 / 450
- Mixed: 100000 / 370
- Large: 520000 / 300

Cover Darcy-Forchheimer coeffs.**
- TopTex: 150000000 / 1400

Mesh: 2780 cells (2D)

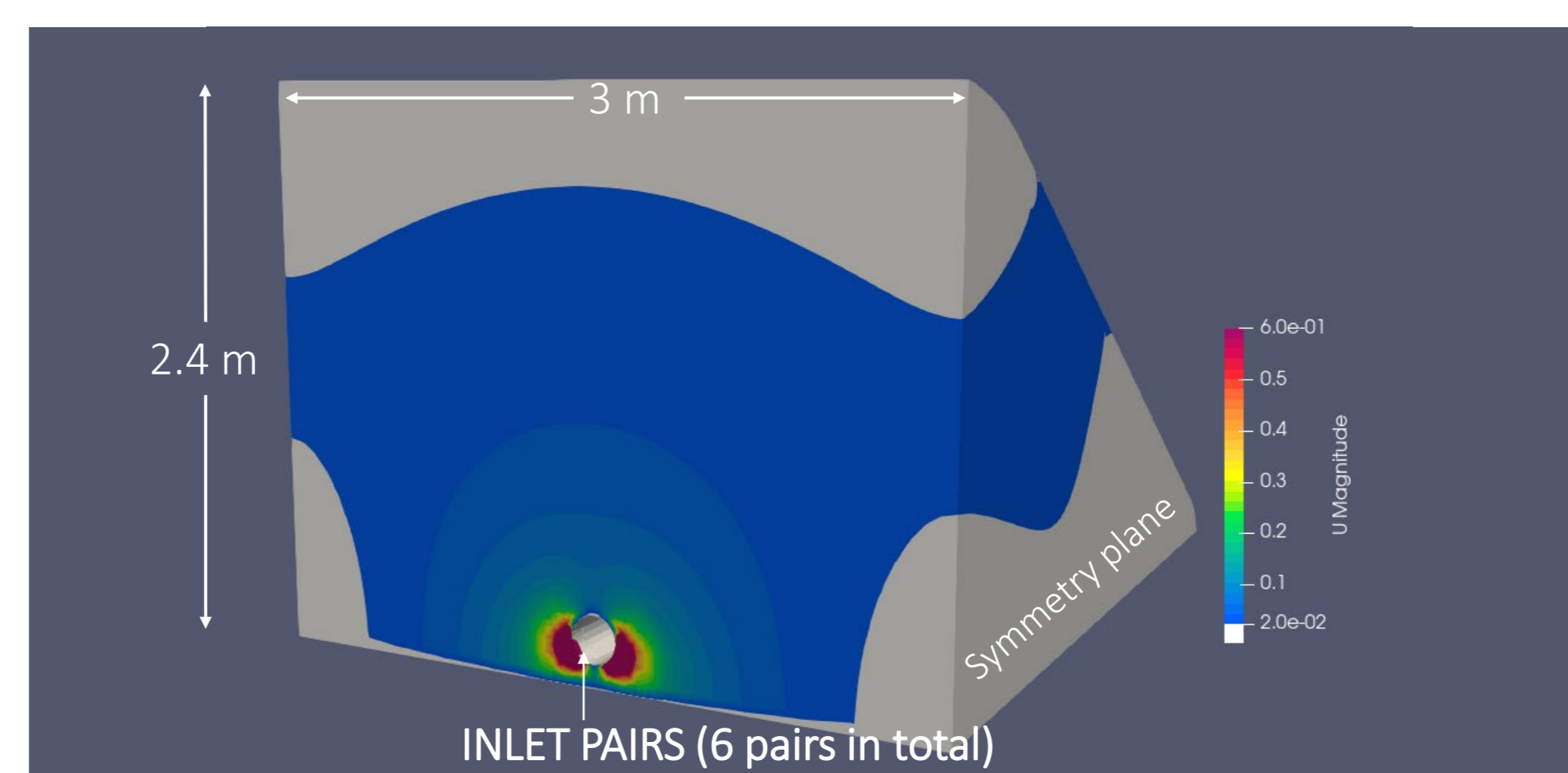
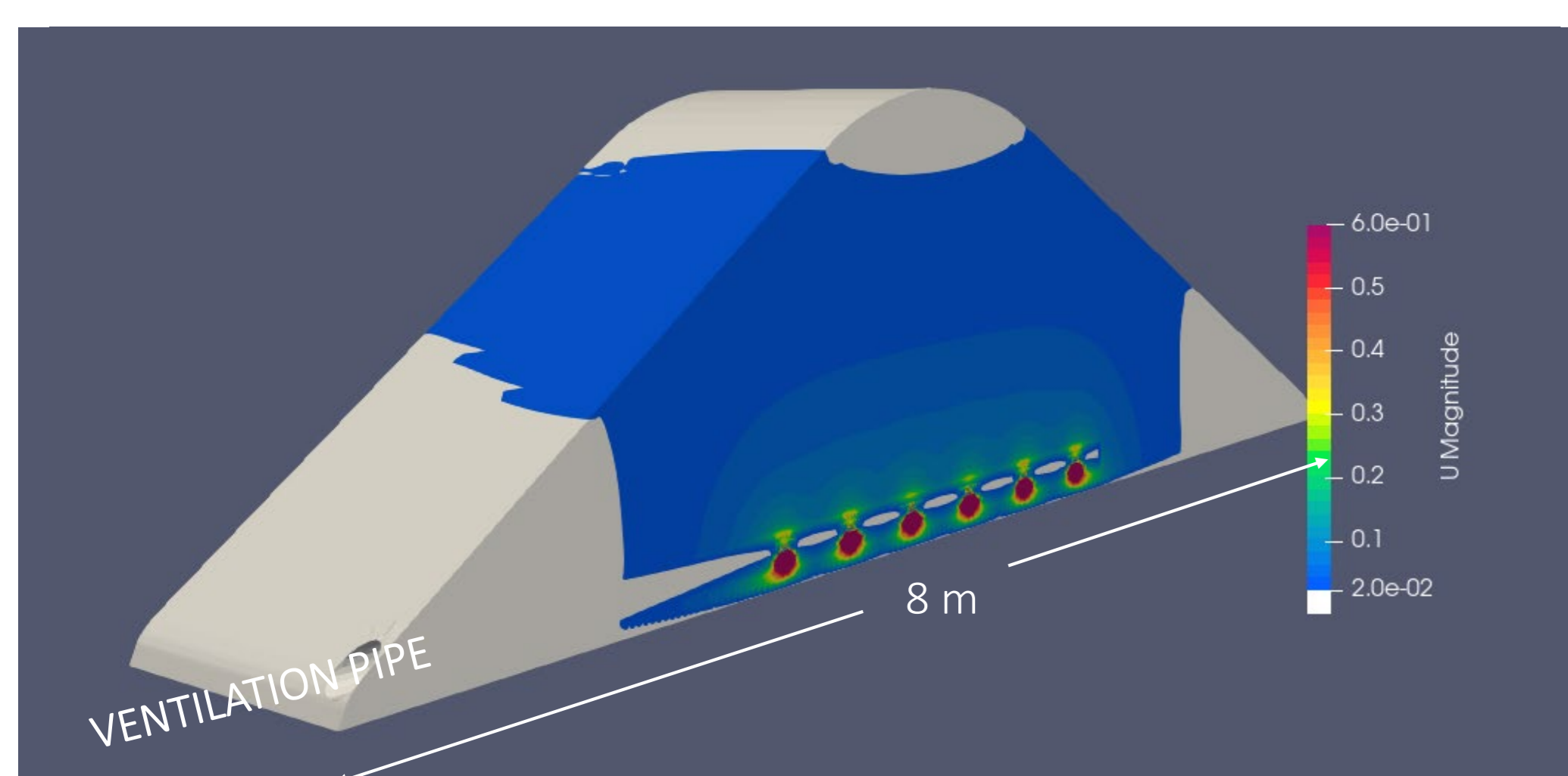
Darcy-Forchheimer coefficients determine the permeability of the porous medium. Higher values indicate lower permeability (i.e. lower airflow).

*Source: L. G. Tabil, J. Kienholz, H. Qi & M. V. Eliason, (2003) "Airflow Resistance of Sugarbeet", Journal of Sugar Beet Research, Vol. 40 Issue 3 Pages 67-86

**Source: TenCate Industrial Fabrics

CONCLUSIONS:
The model appears well behaved: there is higher air flow in the porous clamp region when there is higher ambient air flow, a small clamp, larger beets, and no cover. Ambient air speed has the greatest effect on airflow in the porous clamp region of the model. No data is available for field validation.

ACTIVE VENTILATION. Inlet speed: 20 m.s⁻¹. Mesh: 1.2 mill cells (3D). Ambient air speed: 0 m.s⁻¹. D-F: 100000 / 370



WITH ASSISTANCE FROM:

