Plant-mediated sediment oxygenation facilitate the spread of *Elymus athericus* in European marshes

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Elymus athericus

Characteristics:

Name: *Elymus athericus*

Distribution: Native to *Europe*

Habitat: *High marsh*

Length: 20-120 cm

Roots: long rhizomes, Most root biomass in 0-10cm

Geographical distribution and study area:

Geographical distribution of *Elymus athericus*:
Europe: Atlantic coast and Mediterranean coast

Green: Distribution of *Elymus athericus*

(http://www.plantsoftheworldonline.org/taxon/urn:lsid:ipni.org:names:912429-1)

Study area: The Wadden Sea is the largest tidal flats system in the world, where natural processes proceed largely undisturbed.

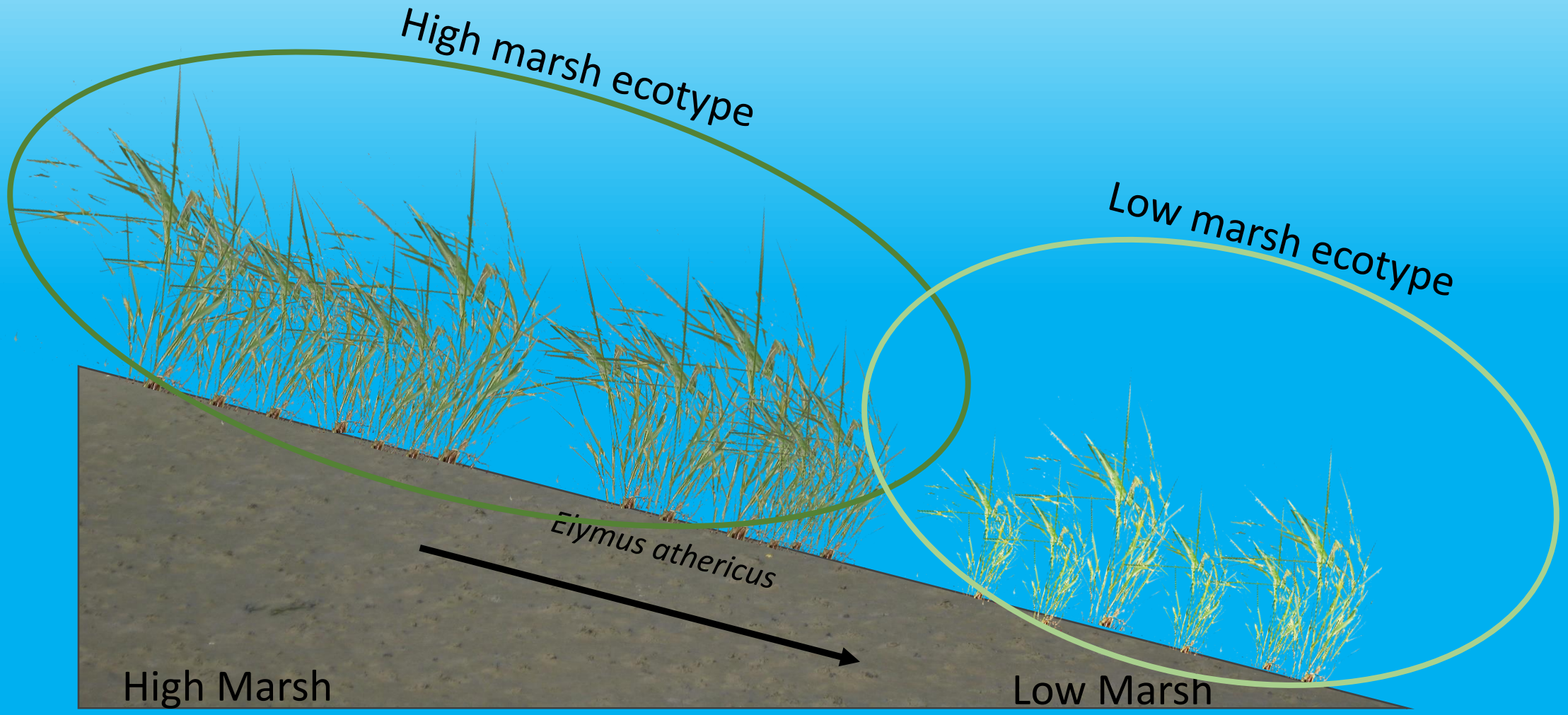
Wadden Sea salt marsh

Photo: Koop-Jakobsen, AWI

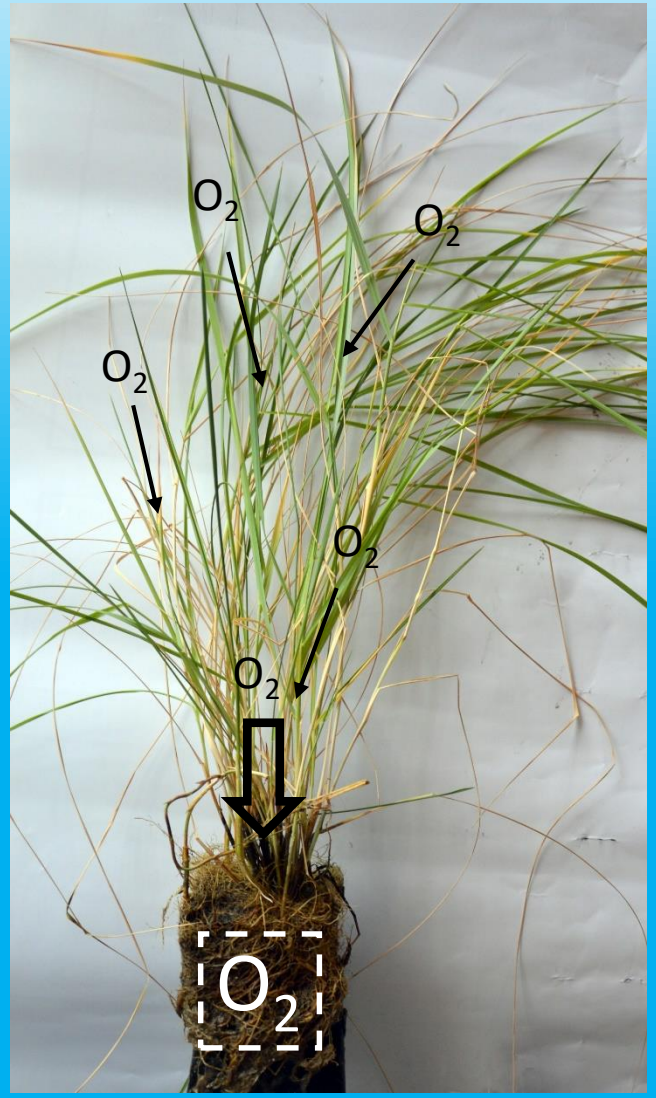
Elymus arthericus is spreading in European marshes

- Is *Elymus arthericus* capable of plant-mediated sediment oxygenation?

- Are there differences in the sediment oxygenation between the low and high marsh ecotype?



Plant-mediated sediment oxygenation



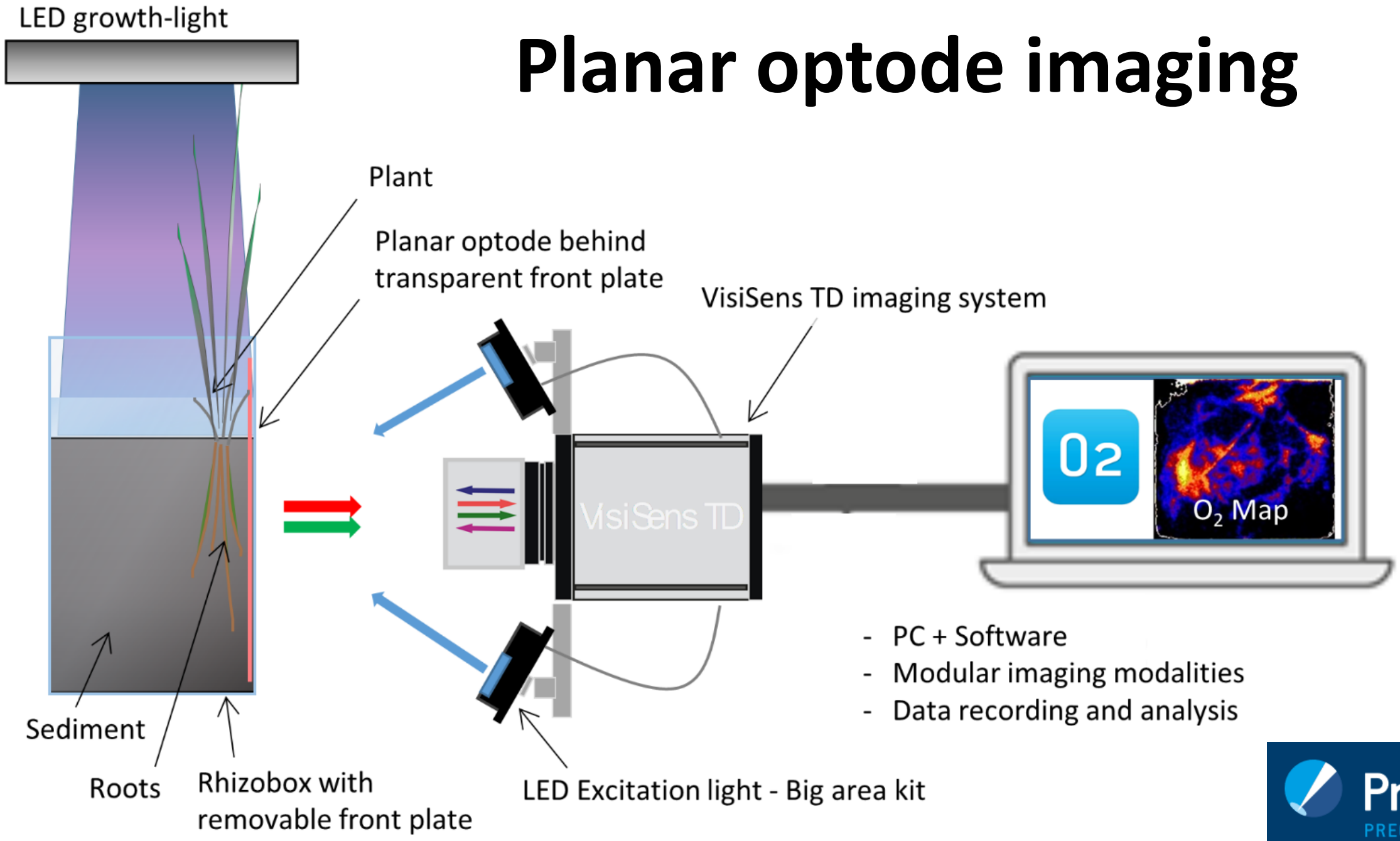
Plant-mediated sediment oxygen - Mechanisms

Well-developed aerenchyma facilitate belowground transport of oxygen (O_2) into the root system, where it may leak out and oxygenate the surrounding sediment, generating oxic root zones below the sediment surface

Plant-mediated sediment oxygen - Trait

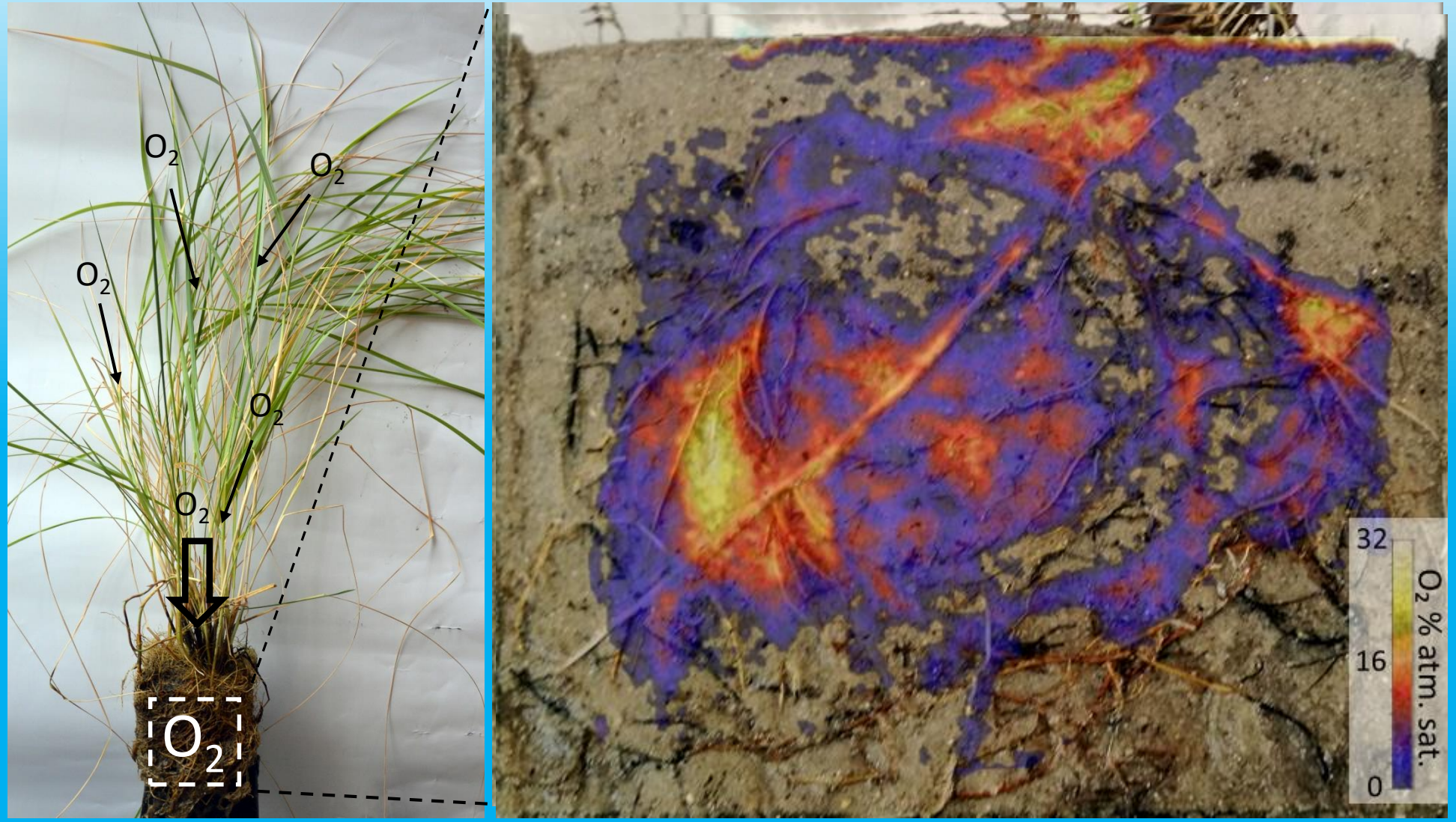
Plant-mediated sediment oxygenation is a trait, which enable plants to cope with the harsh living conditions in wetland soils reducing the phytotoxic impact of sulfide accumulation and improving nutrient uptake.

Planar optode imaging



Plant-mediated sediment oxygenation release oxygen into the rhizosphere

Elymus athericus - Wadden sea marshes, Germany



Study design

Plant-mediated sediment oxygenation in *Elymus arthericus* was investigated comparing the low-marsh and high-marsh ecotype

4 **Low-marsh** ecotype samples

VS

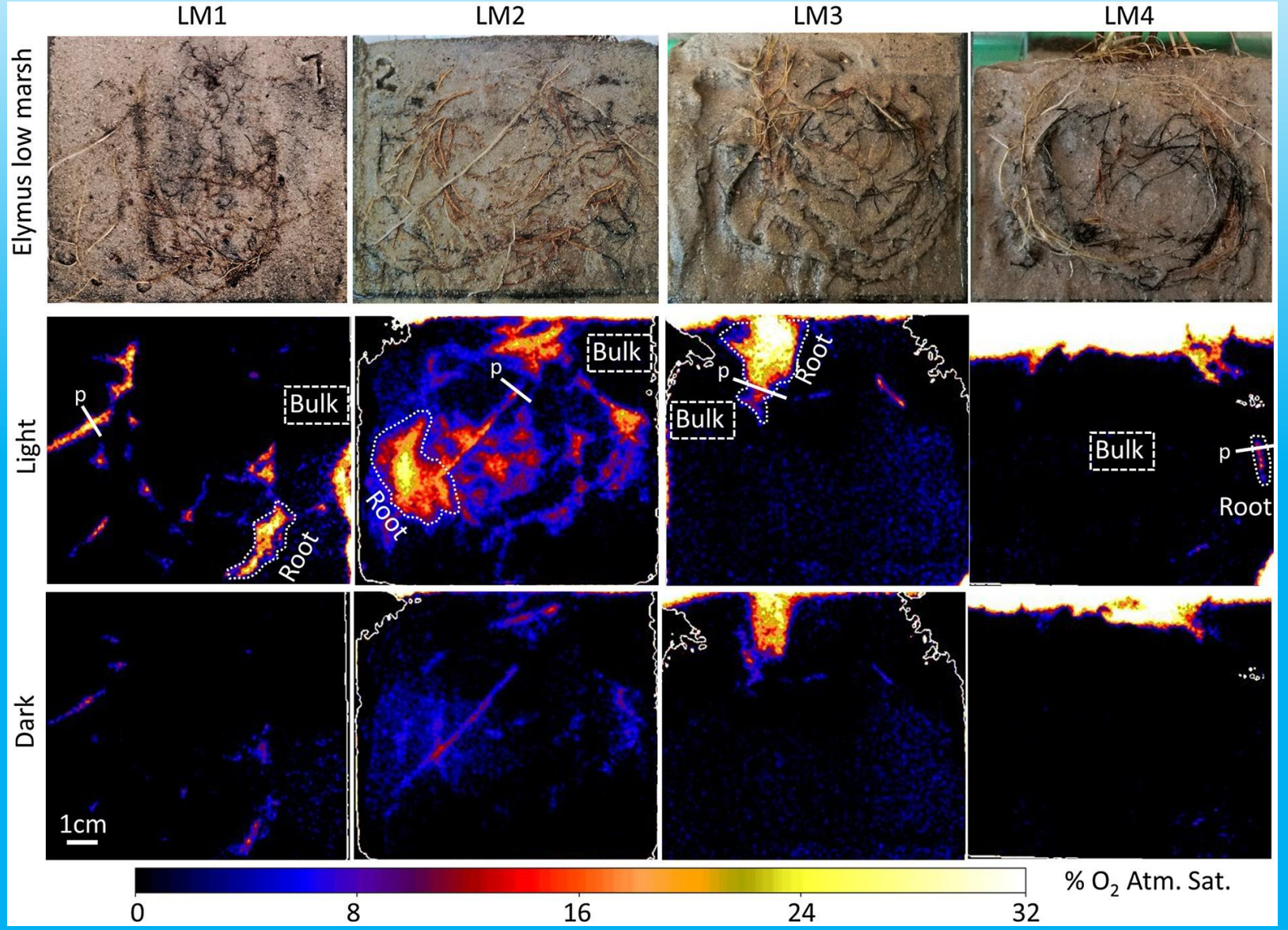
4 high marsh ecotype samples

Time-Series – 3 days – 12h light / 12h dark – 2 images/h – total 144 images

12h / 24 Images	12h / 24 Images	12h / 24 Images	12h / 24 Images	12h / 24 Images	12h / 24 Images

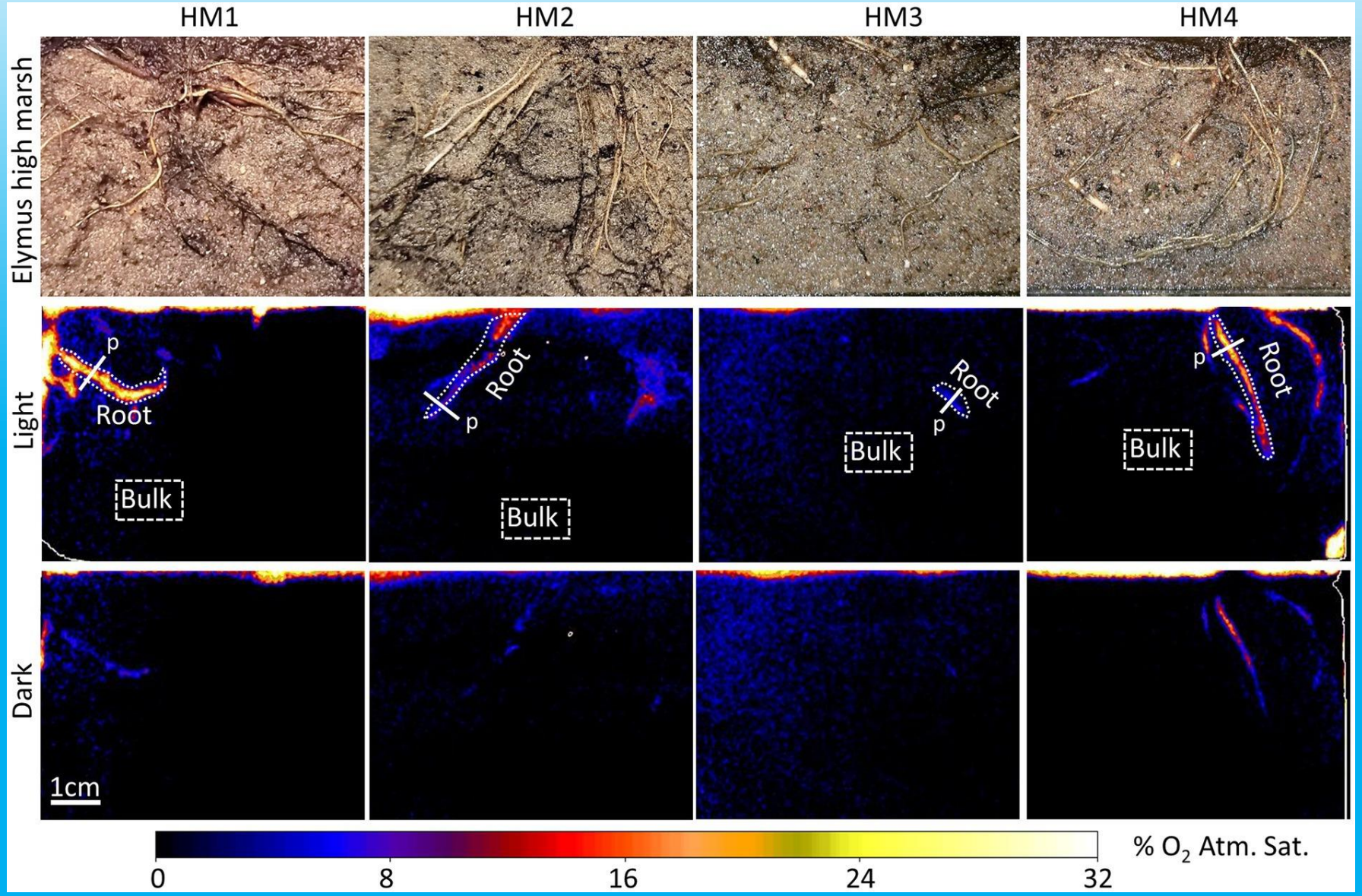
Spatial oxygen distribution in *Elymus athericus* rhizosphere

Low marsh ecotype



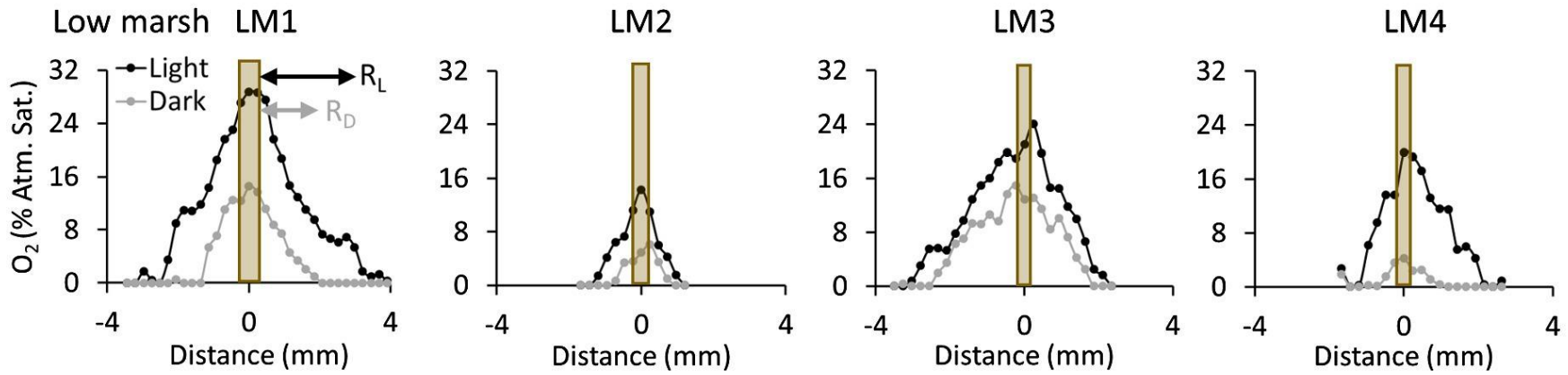
Spatial oxygen distribution in *Elymus athericus* rhizospheres

High marsh ecotype

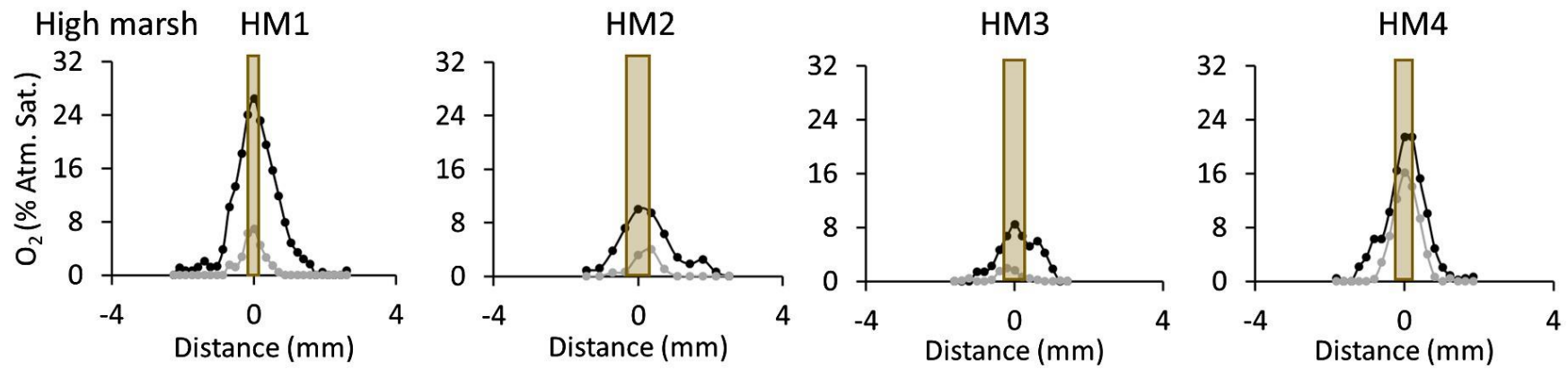


Spatial oxygen distribution in *Elymus arthericus*

A



B

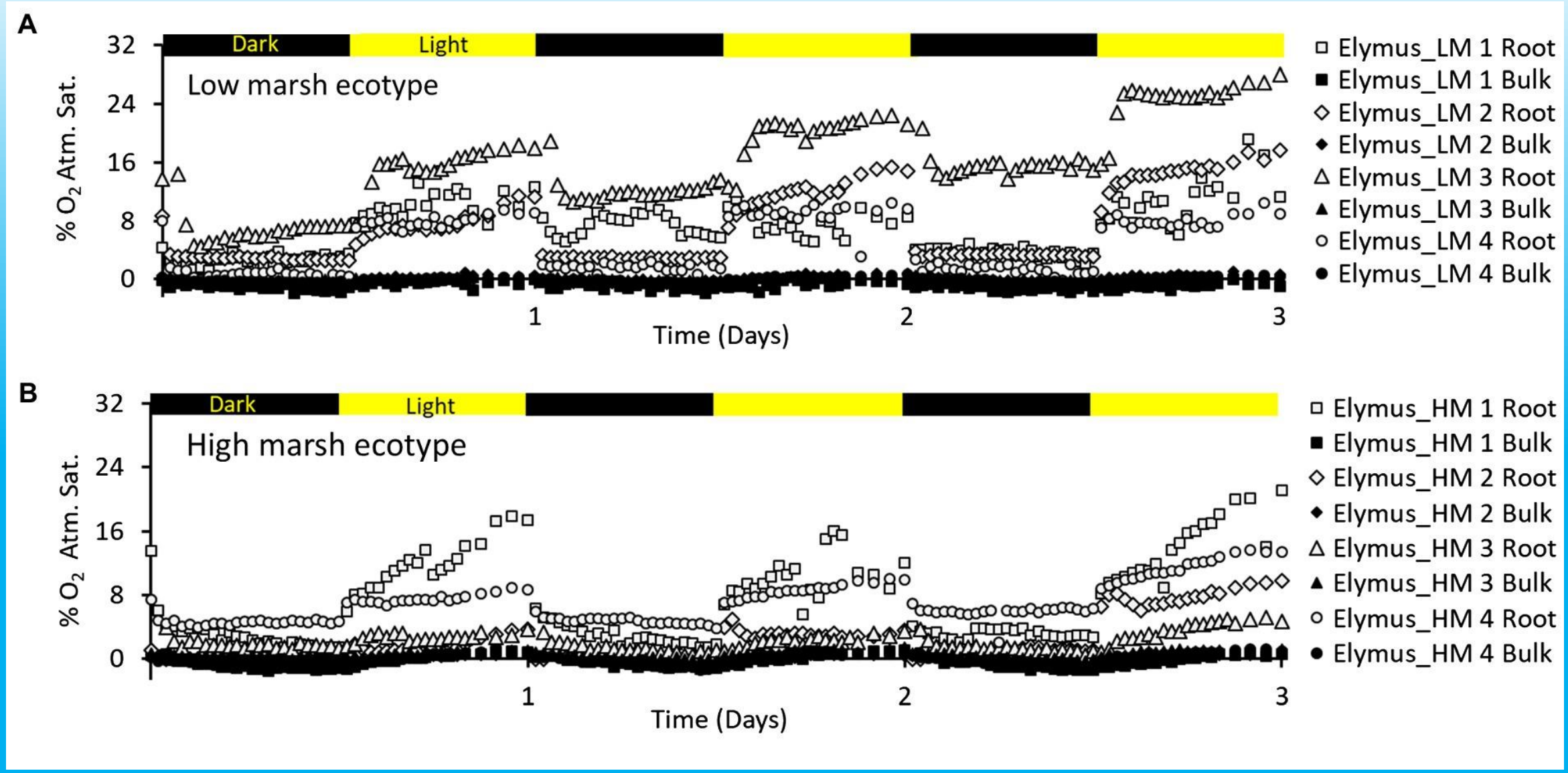


C

	Radius Light R_L (mm)	Radius Dark R_D (mm)	Radius reduction
Elymus LM 1	2.62	1.36	-48%
Elymus LM 2	1.04	0.69	-33%
Elymus LM 3	2.59	2.01	-23%
Elymus LM 4	1.68	0.72	-57%
Low Marsh			

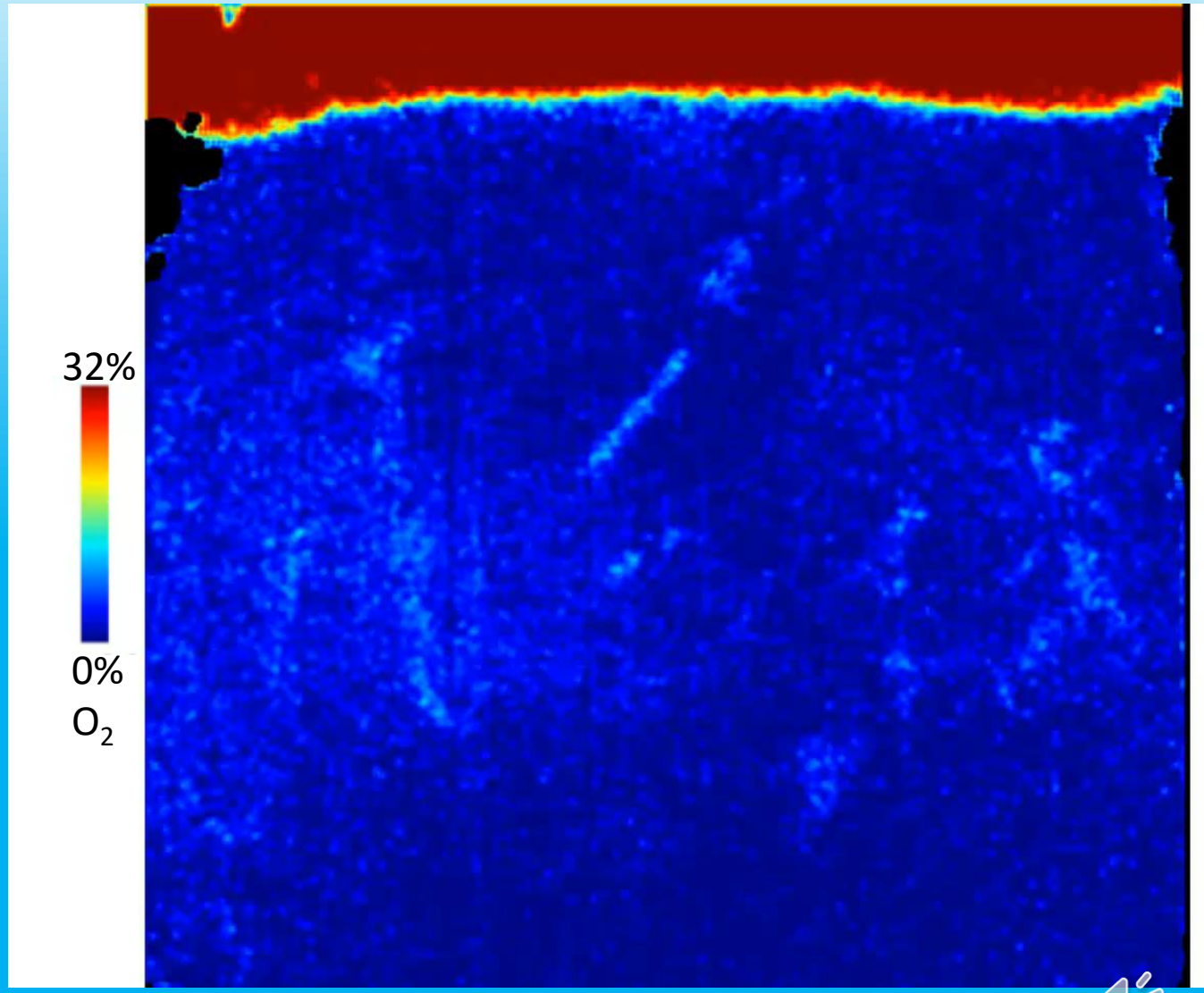
	Radius Light R_L (mm)	Radius Dark R_D (mm)	Radius reduction
Elymus HM 1	1.82	0.69	-62%
Elymus HM 2	1.04	0.68	-35%
Elymus HM 3	0.87	0.46	-47%
Elymus HM 4	1.13	0.72	-36%
High Marsh			

Temporal oxygen distribution in *Elymus arthericus*



Spatial oxygen distribution in *Elymus arthericus* rhizospheres

Low marsh ecotype



***Conclusion*:**

- *Elymus athericus* is capable of plant-mediated sediment oxygenation
- Plant-mediated sediment oxygenation can have significant impact on *Elymus* rhizosphere chemistry
- This specific trait facilities *Elymus* to spread into the more waterlogged parts of the marshes
- In light of sea-level rise, it is likely the Elymus will play a more prominent role under future climate conditions

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