Assessing the severity of diatom deformities using geometric morphometry

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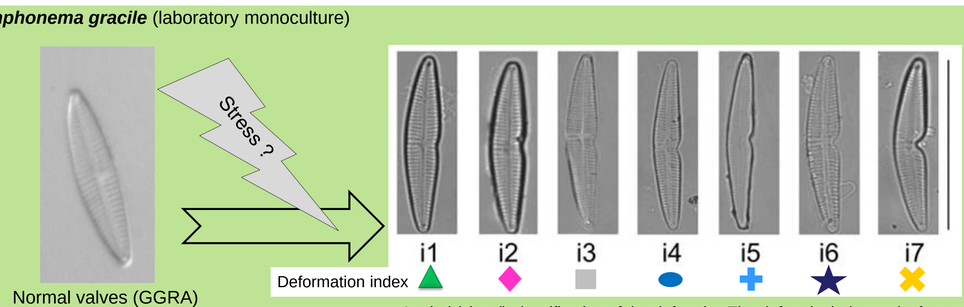
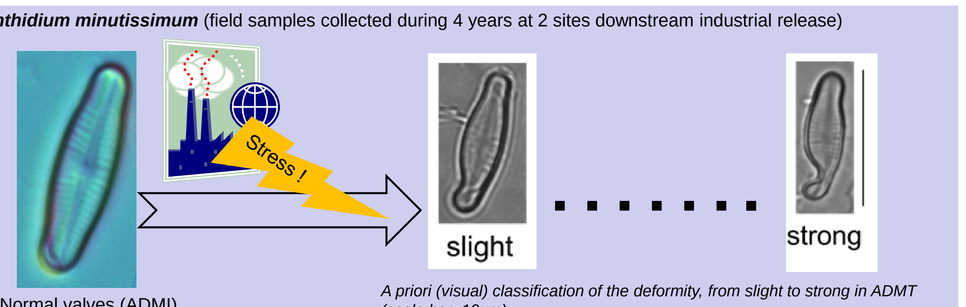
Introduction

Deformities in diatoms are increasingly used as an indicator of toxic stress in freshwaters. However, the percentage of deformities alone often fails at highlighting the magnitude of toxic exposure. It has been suggested that the severity of the deformation (degree of departure from normal form) could be a valuable aspect to consider in addition to the percentage of deformities in an assemblage. An approach combining the assessment of deformities coupled with information on their severity could improve the sensitivity of this biomarker.

Gomphonema gracile (laboratory monoculture)

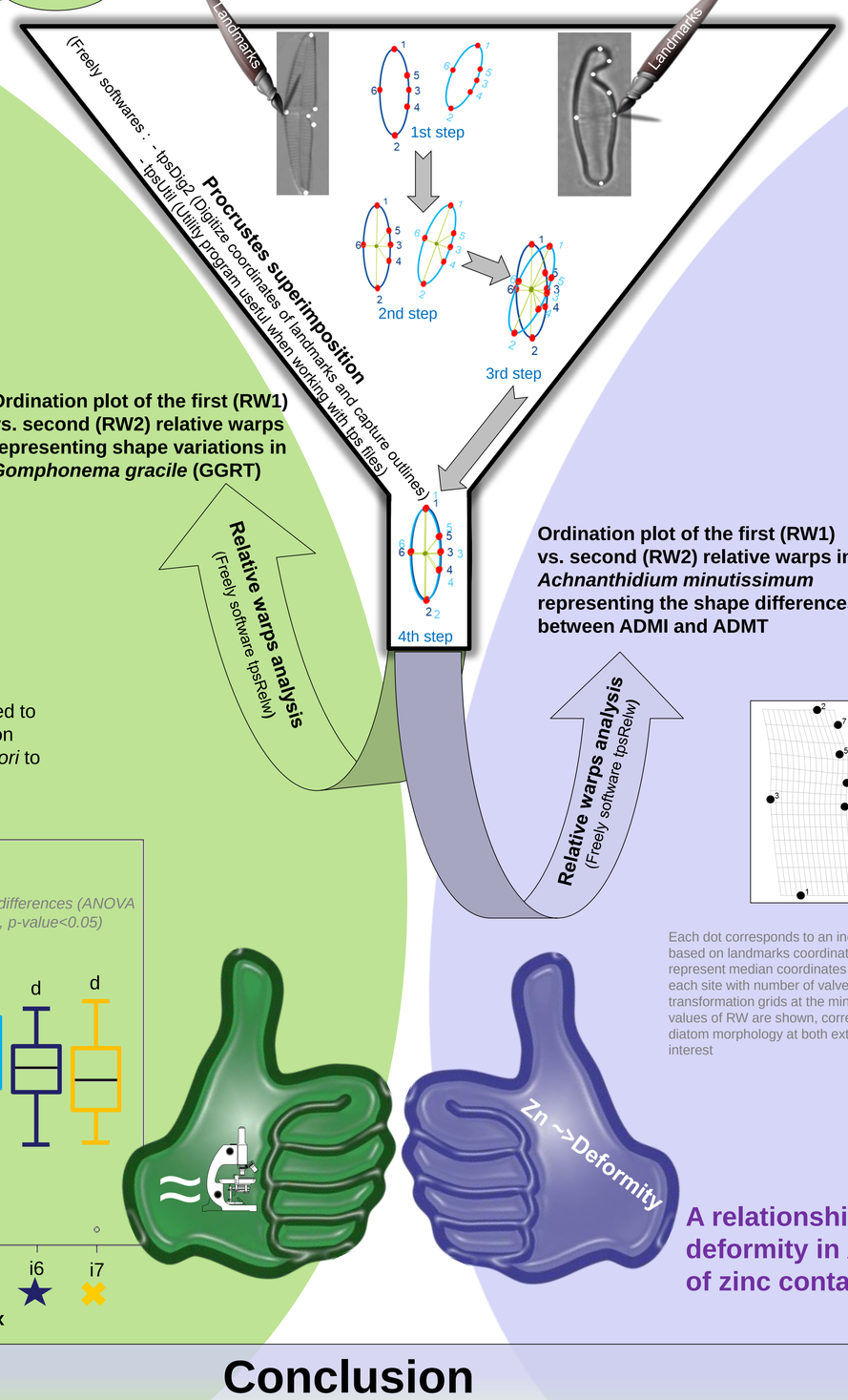


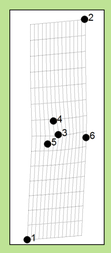
Achnanthidium minutissimum (field samples collected during 4 years at 2 sites downstream industrial release)



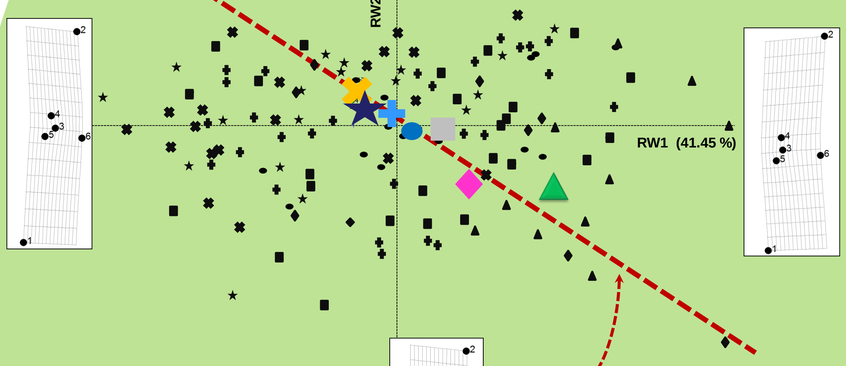
Can geometric morphology objectively quantify a deformation gradient ?

Is the degree of deviation from the normal form a marker of stress intensity ?





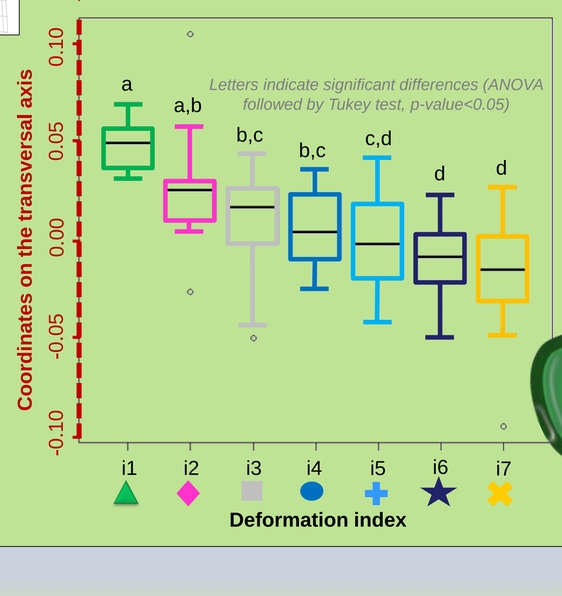
legend :
Deformation index
i1 i2 i3 i4 i5 i6 i7



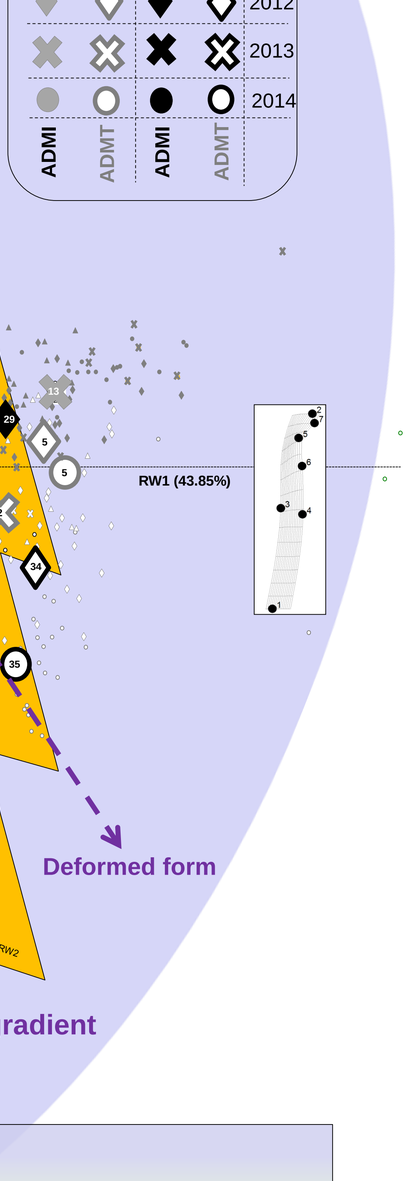
Ordination plot of the first (RW1) vs. second (RW2) relative warps representing shape variations in *Gomphonema gracile* (GGRT)

Each symbol represents a deformation index (see legend); small symbols represent individuals, and larger symbols correspond to the median of the individual coordinates on RW1 and RW2 for each deformation index.
TPS transformation grids at the minimal and maximal values of RW are shown, corresponding to virtual diatom morphology at both extremities of the RW of interest.

Transversal axis : was calculated to best fit the gradient in deformation indices and was added *a posteriori* to the TPS representation



Ordination plot of the first (RW1) vs. second (RW2) relative warps in *Achnanthidium minutissimum* representing the shape differences between ADMI and ADMT



Each dot corresponds to an individual on the TPS, based on landmarks coordinates. Larger symbols represent median coordinates for each year and each site with number of valves counted. TPS transformation grids at the minimal and maximal values of RW are shown, corresponding to virtual diatom morphology at both extremities of the RWs of interest

A relationship between the degree of deformity in *A. minutissimum* and a gradient of zinc contamination was found

Conclusion

Geometric morphometry provided encouraging results to objectively quantify the intensity of diatom deformities affecting valve outline, and could easily be implemented in further automatic diatom identification developments.

Prospect

Further investigations could assess the possible application of other features in geometric morphometry, such as landmarks located on valve ornamentations (striation patterns, raphe).

References:
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Acknowledgement
This study was carried out with financial support from the French National Research Agency (ANR) within the framework of the Investments for the Future Programme, within the Cluster of Excellence COTE (ANR-10-LABX-45).