

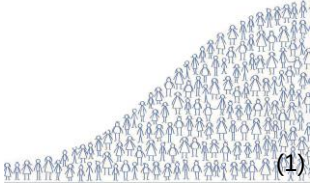


ESTIMATING THE EFFECT OF MAIZE CROPS ON TIME-LAPSE HORIZONTAL CROSSHOLE GPR DATA

25.05.2022 | LENA LÄRM, FELIX BAUER, JAN VAN DER KRUK, JAN VANDERBORGHT, HARRY VEREECKEN, ANDREA SCHNEPF, ANJA KLOTZSCHE

Investigating soil-plant system using GPR

Growing human population



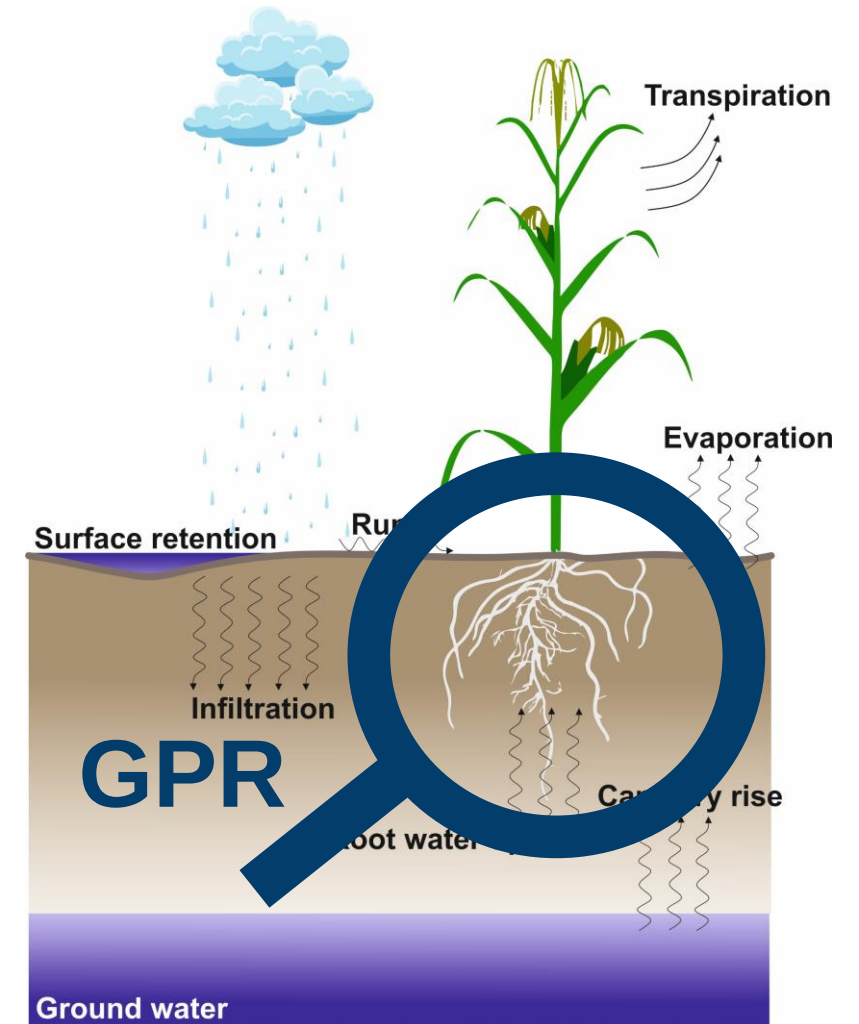
Climate change



Political conflicts



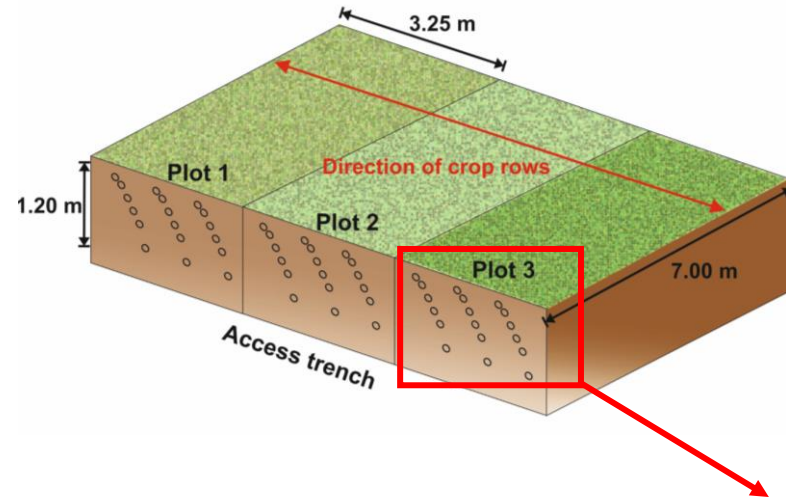
Sustainable agriculture



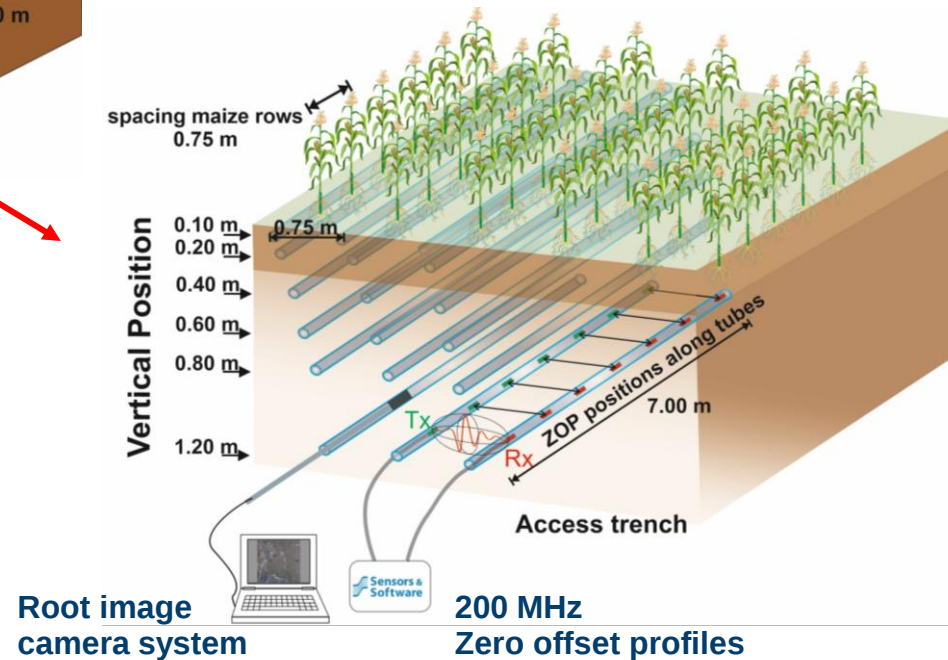
modified after Sławiński & Sobczuk, 2011

Mini-rhizotron facilities

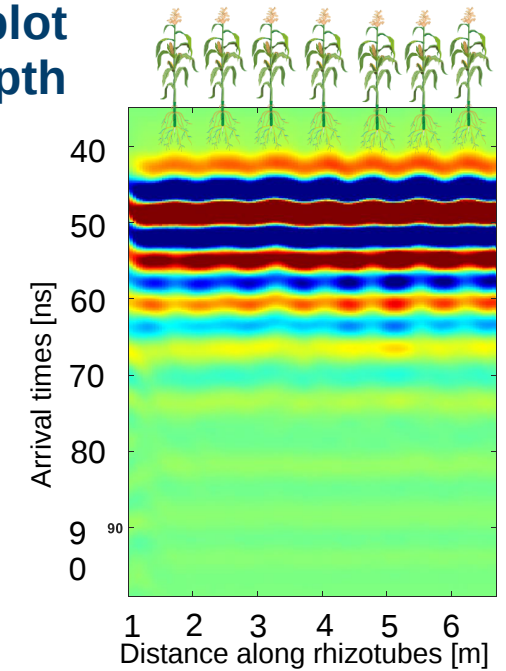
Facility overview



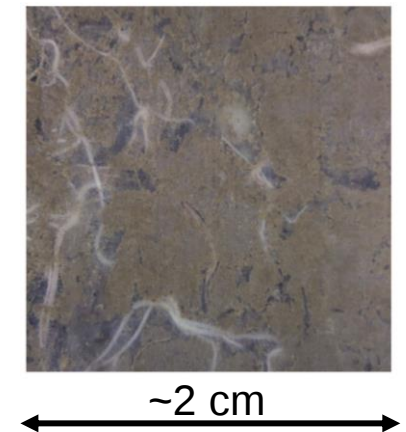
Plot overview



GPR image plot For 0.2 m depth

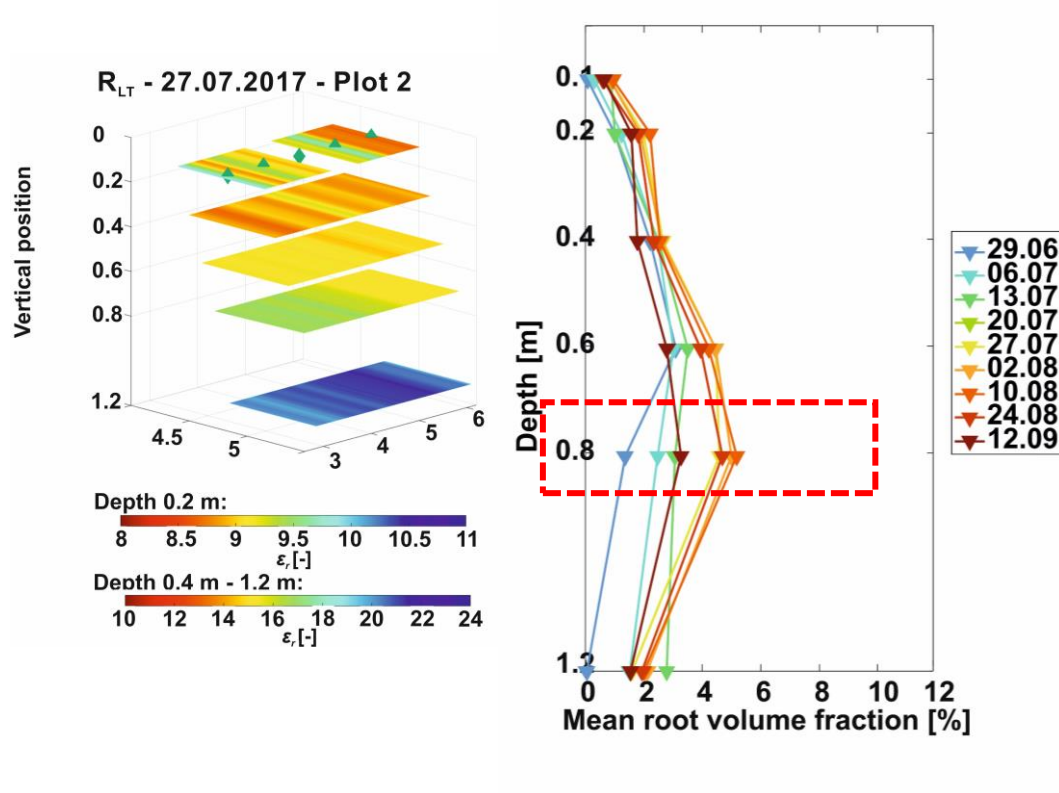


Root image*

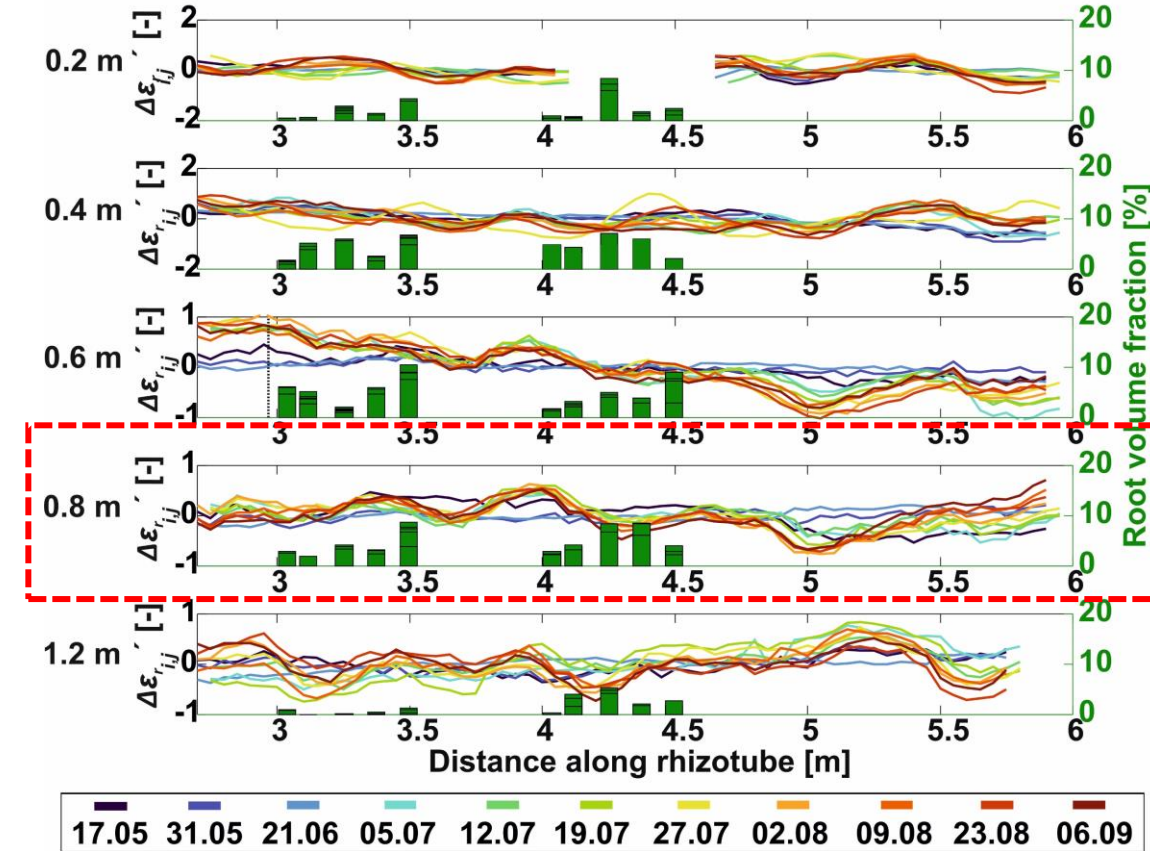


*Image analysis pipeline: Bauer et al. (2022)
Construction of the sites: Cai et al. (2016)

Spatial & temporal variability analysis

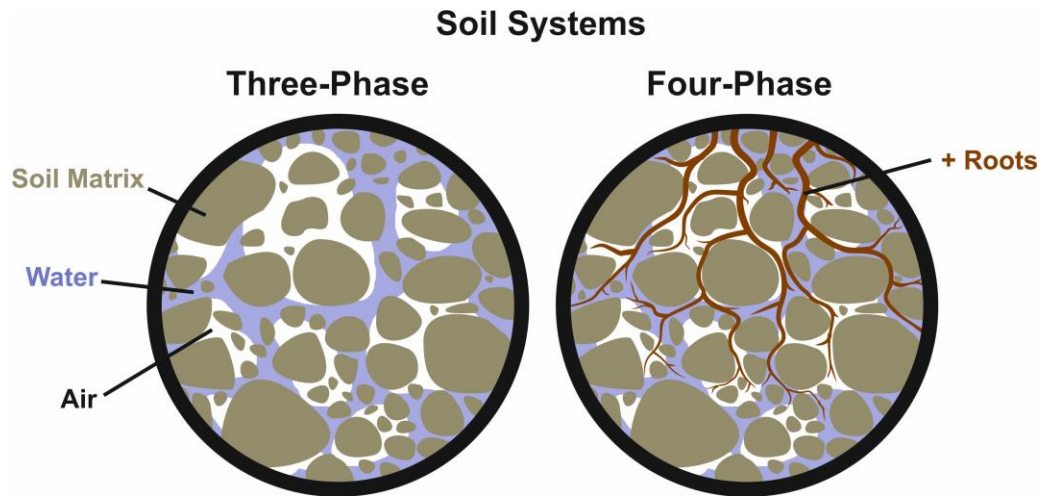


Minimizing
static &
dynamic
effects



Details on the data processing: Klotzsche et al. (2019)

GPR-derived SWC - accounting for root fraction

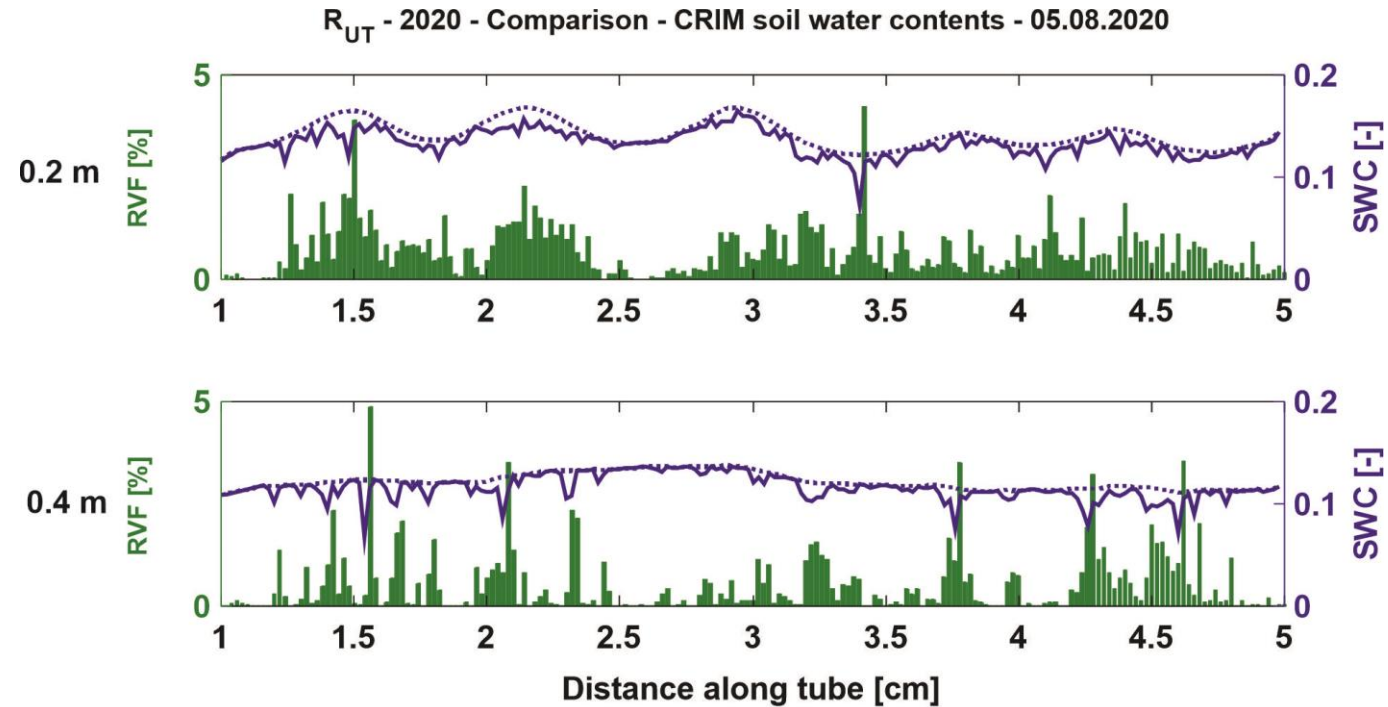


CRIM including roots:

$$\theta = \frac{\sqrt{\epsilon_r} - \boxed{(1 - \phi) \cdot \sqrt{\epsilon_s}} - \boxed{(\phi - RVF)}}{\boxed{\sqrt{\epsilon_w} - 1}} - \boxed{RVF \cdot \sqrt{\epsilon_{RV}}}$$

Soil Matrix
Air
Roots

Water

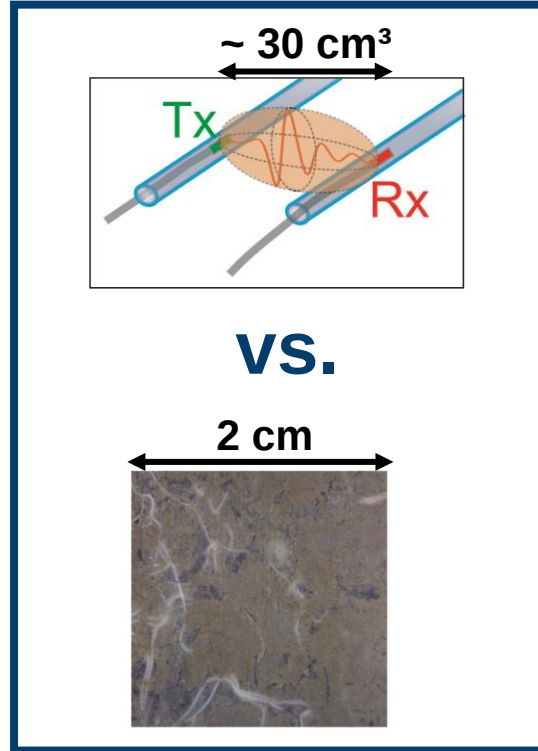


Conclusion & Outlook

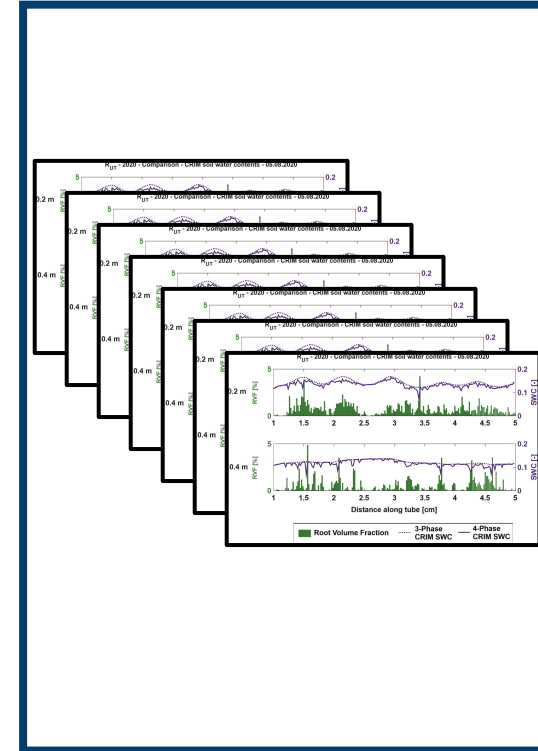
➔ GPR can investigate soil-plant system



➔ Differing spatial resolution



➔ More high spatial resolution image data sets



➔ Application to field-scale



THANK YOU FOR YOUR ATTENTION

For further questions and discussion contact:

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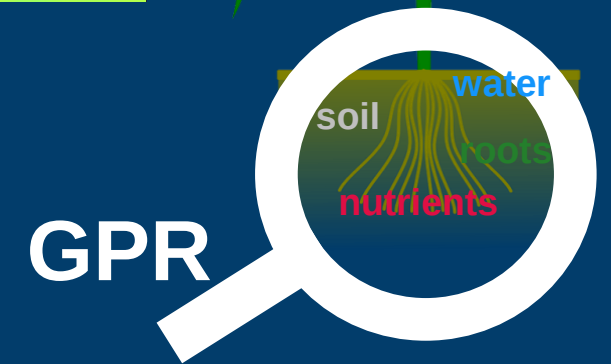
Cai, G.; Vanderborght, J.; Klotzsche, A.; van der Kruk, J.; Neumann, J.; Hermes, N. & Vereecken, H. "Construction of minirhizotron facilities for investigating root zone processes", *Vadose Zone Journal*, GeoScienceWorld, 2016, 15

Bauer, F.M.; Lärm, L.; Mohandage, S.; Lobet, G.; Vanderborght, J.; Vereecken, H., Schnepf, A. "Development and validation of a deep learning based automated minirhizotron image analysis pipeline", *Plant Phenomics*, 2022

Klotzsche, A.; Lärm, L.; Vanderborght, J.; Cai, G.; Morandage, S.; Zörner, M.; Vereecken, H. & Kruk, J., "Monitoring Soil Water Content Using Time-Lapse Horizontal Borehole GPR Data at the Field-Plot Scale", *Vadose Zone Journal*, Wiley, 2019, 18, 190044

Ślawiński C., Sobczuk H. (2011) Soil–Plant–Atmosphere Continuum. In: Gliński J., Horabik J., Lipiec J. (eds) *Encyclopedia of Agrophysics*. Encyclopedia of Earth Sciences Series. Springer, Dordrecht.

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