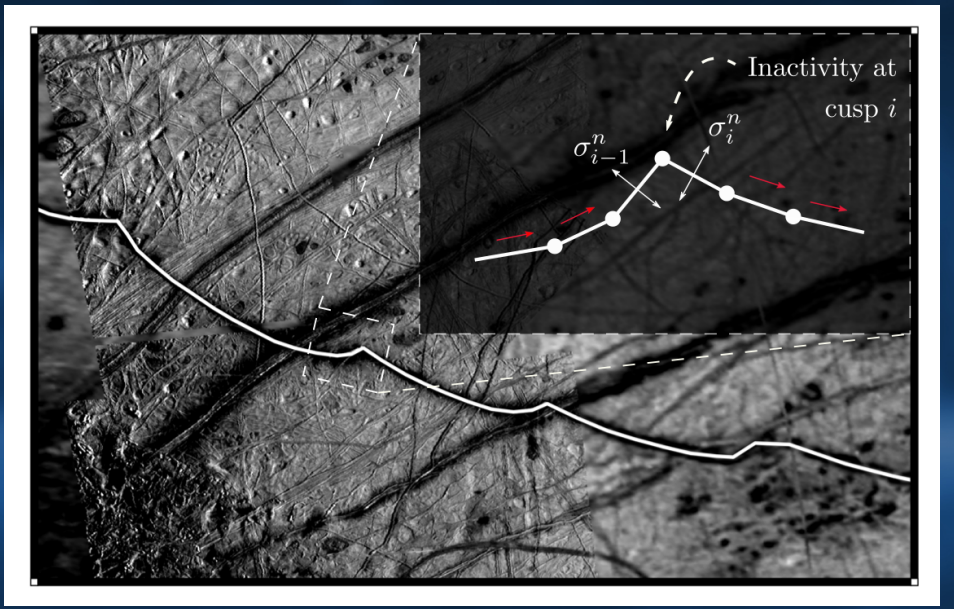
Crevasse propagation on brittle ice: Application to cycloids on Europa

Models based on crevasse/rift analogues on Antarctic ice shelves can explain the presence of similar cracks on Europa and calculate how fast they grow.

- Past exploration missions observed lineaments on the surface of the Jovian moon Europa; these curved features, spaced by cusps, are called cycloids and are thought to be formed as result of ice failure.
- A fracture mechanics model based on Antarctic analogues was developed and applied to observed cracks.
- The model showed cycloids evolve as a series of nearly instantaneous events (propagation rate of ~100 m/s), spaced by periods of inactivity, similar to rifts on Antarctic ice shelves. Considering dormant periods between fracturing events, cycloids grow at 10-100 m/day, but require months to fully develop.
- The introduction of standby periods between fracturing events could inform future studies of the rotation state of Europa crust.



Detail of the cycloid model. Due to the change in the orientation angle between two segments along the cusp (i and i-1), crack growth experiences dormant periods. This is caused by reorientation of the background tidal stress σ^n, at different orbital positions of Europa around Jupiter.

Poinelli, et al. (2019, accepted) GRL