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Tidal rifting of the Mertz glacier tongue

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The IPY CRAC-ICE project is aimed at monitoring the calving of the Mertz Glacier tongue in East Antarctica, which extends 140km from its grounding line. Legresy et al. (2004) observed dramatic ice flow changes at daily time scales linked to tide currents, using limited GPS observations and SAR interferometry. In November 2007, we deployed a network of GPS beacons on the glacier. Two months of GPS data were collected at the end of the field season from two stations straddling the main rift. We have analyzed ERS INSAR, SAR, Landsat and SPOT images, Radio echo sounding and the GPS data together to draw an overall description of the rifting and calving process for the Mertz glacier tongue. We describe the history of this rifting during the available 14 years observation period. The ice tongue is freely floating and has a longitudinal velocity of about 3m/day. It is clear that the ice flow is affected at daily time scales by the tides. A kind of stick-slip effect appears to also occur at daily scales. We see a modulation of the flow at fortnightly time scales; however, we also observe that the maximum speed occurs a few days after the spring tides. The ice tongue moves in an E-W direction in response to the force exerted by tide currents at all time scales. We find that the rifting is likely initiated by the tide current induced lateral hinging of the ice tongue, creating regularly spaced ($\sim$1km) weak lines on the glacier tongue across flow. The rifts further propagate into these weakness lines. Now that the rifts on both east and west sides of the glacier have significantly progressed, the daily to seasonal scale hinging is now happening between the down stream and upstream parts of the ice tongue. The rift is opening quickly at some 0.12 m/day at an angle of 35° from the main flow direction. We observe a residual rotation of the rift opening with a radius of 15 km. The rotation center is situated in the eastern part of the rift, which appears active at the daily scale. We present the results with an emphasis on the future possible calving scenarios.