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Development of a geodetic monitoring system using seafloor extensometers for the state of the submerged North Anatolian Fault in the Sea of Marmara

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Failure of the North Anatolian Fault (NAF) accompanied by a large earthquake is sequentially propagating to the west in Turley during the last century. However the region of the Marmara Sea, close to populous Istanbul, still remains unmoved and hence expected to have an impending devastating earthquake. In order to evaluate stress accumulation along the unmoved fault, which possibly controls the magnitude of the earthquake, it is crucial to know coupling ratio between the segments across the fault. The NAF is submerged beneath the Marmara Sea and inaccessible using onshore GNSS data. Therefore we have developed five seafloor extensometers and started their operation since September 2014 under SATREPS program between Japan and Turkey to directly measure the fault movement. The installation site is just on the Western High (∼700m of depth), where strain partitioning is expected smaller (i.e. strain is concentrated at the main fault) because fewer sub-branches are observed. Four out of the five extensometers are alternately aligned across the fault in oblique direction with a baseline of roughly 1-km for each. The exact position of the fault is inferred from fine-scale bathymetric data based on multibeam surveys provided by Ifremer. The extensometers are designed that the main ranging data with associated information, such as temperature of sea water and etc., can be recovered through an acoustic modem at any time visiting the site without disruption of the measurement and is continuously worked at least 5 years with sampling rate of 12 hours. Based on the high-sampling (30 min.) preliminary data for 24 hours just after the installation, we found that the temporal variation of bottom temperature is quite stable due to strong density stratification in the Marmara Sea. Because of such stable condition, we confirmed that the system can potentially resolve 2-3 mm of shortening or extension along the 1-km-baseline. Maximum displacement across the fault is expected to be 2 cm/year for the case of no coupling (fully unlocked) as an endmember. Therefore we expect that it will be able to quantitatively address the state of coupling ratio of the main fault or strain partitioning among sub-branches after a few years of continuous operation. We plan to recover temporal data on March 2015 for the first half-year data. The presentation in the meeting includes this half-year data for possible movement in the short period as well as the initial one-day high-sampling data for accuracy assessment.