Geophysical Research Abstracts
Vol. 14, EGU2012-7394, 2012
EGU General Assembly 2012

From Earth rotation to seismology – measuring rotations over 10 decades of frequencies

A. Gebauer (1), U. Schreiber (2), and T. Klügel (2)

(1) Technical University Munich, FESG, Munich, Germany (gebauer@fs.wettzell.de), (2) Federal Agency for Cartography and Geodesy, Geodetic Observatory Wettzell, Germany

Ring lasers are absolute rotation sensors and allow the observation of geophysical signals over a broad spectral range. The large ring laser "G" operating in an underground facility at the geodetic observatory Wettzell (Germany) was constructed to monitor Earth rotation and actually achieves a relative stability of $5 \cdot 10^{-8}$ over an integration time of about 30 minutes. While variations in Earth rotation occur at periods ranging from hours to days up to 1 year, the G ring laser records signals in the seismic frequency band as well, thus covering more than 10 decades.

In the seismic band teleseismic events, marine microseisms and locally induced rotations caused by wind are clearly detectable. Both latter effects occur in a similar frequency range and are denoted as noise in seismology. When combining the observed rotations with data from collocated instruments, i.e. a three-axis seismometer and several high resolution tiltmeters, an extensive data set of rotations, translations and horizontal accelerations are used to study the components of the different wave fields. While the partly coherent microseisms is present in all sensors allowing the detection of the source direction using a combination of seismometer and ring laser data, the local wind strongly affects the ring laser, but is weakly visible in the tiltmeter, and nearly absent in the seismometer data. This points to a strong contribution of horizontally polarized waves of Love type producing rotations around the sensitive axis of the ring laser.

As the "G" ring laser yields only one component of rotation, a three axis rotational sensor is currently developed on the basis of fiberoptic gyroscopes. This instrument is by far less sensitive than the "G"-ring, however, it will be sensitive enough to record surface waves of mid-size earthquakes. When combining this instrument with a seismometer or tiltmeters, the complete deformation matrix of three translational and three rotational motions is accessible.