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Earthquake catalogue for the XIXth century from the Lower Rhine Embayment to the North Sea: summary and results.

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Earthquake catalogue for the XIXth century from the Lower Rhine Embayment to the North Sea: summary and results.
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The Royal Observatory of Belgium, Cologne University and the Royal Netherlands Meteorological Institute (KNMI) are conducting since 5 years a specific research to establish a reliable earthquake catalogue for the XIXth century based on already known original documents but also on new ones systematically searched for and retrieved from various archives. The transfrontier and multilingual study area reaches from the Lower Rhine Embayment to the North Sea. In parallel a thesis from the University of Liège on the earthquakes felt in Belgium since 1795 until 1911 are studying 28 events on the seismological and historical point of view. Among them the most important events of the century: 1828-02-23; 1828-12-03; 1878-08-26 and 1881-11-18.
One of the most important discovery was done at the occasion of the 3rd December 1828 earthquake: the first official surveys conducted after earthquakes in our regions. They was sent out by the Prussian government to the commissioners and burgomasters of various districts. We collected a significant amount of new material demonstrating that this kind of survey was routinely utilized on a large scale in additional instances of felt earthquakes by the Prussian authorities and that it continued up to the end of the XIXth century. This discovery prove the importance of new historical research on earthquakes to confirm or not some famous works written by previous scientists and revise intensities and epicentre of some events.

Session 2.2 / 20

Surface rupture associated with a moderate intraplate earthquake: the Mw 6.2 Parina event (December 1st, 2016) in the Peruvian Altiplano

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Fault displacement and Seismic hazard analyses employ empirical relationships to predict potential earthquake magnitude ("scaling relationships"; e. g., Wells and Coppersmith, 1994), surface slip), probability functions of surface rupture and surface slip amount (e. g., “conditional probability of rupture” and “probability of exceedance”, respectively; see Youngs et al; 2003). Those

relationships share the common issue that they rely on a limited number of moderate-to-large magnitude (>=6.5) and pre-2000 cases. Earthquakes from western US and Japan are largely represented, and intraplate cases are few. Here, we report surface faulting evidence that occurred during a moderate earthquake that occurred in the Altiplano of Southern Peru. We present field and high-resolution data that improve the geodynamic knowledge of the region and provide clues to upgrade seismic hazard tools. The 2016 Mw 6.2 Parina normal-faulting earthquake occurred within the high Andes of southern Peru in a region with sparse recent seismicity and no observable geodetic horizontal strain. Field observations and high-resolution DEMs of the surface ruptures allow investigating the relationship between slip on the Parina Fault, local geomorphology and the regional tectonics. We mapped one major NW-SE-trending and 6-km-long segment, with up to ˜27 cm vertical slip (downthrown to the SW) and ˜25 cm tensional opening. Surface slip is not distributed off the main fault, with the exception of a parallel strand 200-m off the major one at its northern tip. One striking point is a minor NW-SE-trending and 1.5-km-long ruptured segment with smaller slip values (up to 8 cm) distant by 5 km to the north, along the same fault zone. The two mapped rupture traces directly coincides with the up-dip projection of the co-seismic fault plane inferred from InSAR measurements, and they therefore may represent two distinct surface sections of the primary earthquake fault, separated by a surface gap. This gap occurs where surface geology is constituted of loose sediments. The ruptures coincide with 10-20 m high scarps cutting through fluvio-glacial deposits that are downthrown to the SW, and they form the southeastward extension of the larger Lagunillas-Mañazo fault system that trends NW-SE across the Peruvian Altiplano. A preliminary estimation leads to infer a repeated normal-sense slip on the Parina Fault since the last major glaciation (˜10-30 ka), implying a vertical slip rate ˜1 mm/y. Besides its regional interest in terms of active tectonics and geodynamics (Wimpenny et al., 2018), the Parina surface rupture 1) constitutes a new case to enrich the pending SURE database with new accurate data, especially for intraplate events, 2) surface geology is a key parameter influencing the surface slip, 3) illustrates once again that moderate earthquakes can rupture the surface in a complex pattern, 3) shows that high-resolution techniques allows improving the characterization of surface ruptures (rupture length and max/mean displacement) and 4) potentially questions the fault parameters that were inferred in the past when such approaches were not available. Those are arguments that support the idea of the need for a deep revision of empirical relationships, based on catalogues of modern earthquakes.

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First assessment of recent tectonics and paleoearthquakes along the Irtysh fault (eastern Kazakhstan)

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The Asian plate interiors are known to have host strong earthquakes with magnitudes up to M≈8 in recent history, especially around the border area between Mongolia, Kazakhstan, China and Russia (e.g., M7.3 Chuya earthquake, 2003). Their recurrence times seem to be long, because of the relative low slip rates (less than 1 mm/y) of the faults which caused them. In this study, we focus on a large inherited fault zone (namely the Irtysh Fault Zone) with no historical earthquakes larger than M6, to test whether this structure could have generated surface-rupturing events during the last thousands of years, like some other historically silent similar faults of cratonic southern Kazakhstan did in pre-historic times. To do so, we use tectonic-morphological analyses of satellite images and trenching across several fault portions to detect potential paleoearthquakes. The Irtysh Fault Zone (IFZ) is a 250+ km long basement set of faults that marks a major tectonic block boundary between different units with Paleozoic magmatic rocks and thick deposits of Late