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Multirisk analysis along the Road 7, Mendoza Province, Argentina

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The National Road 7 crosses Argentina from East to West, linking Buenos Aires to the Chile border. This road is an extremely important corridor crossing the Andes Cordillera, but it is exposed to numerous natural hazards, such as rockfalls, debris flows and snow avalanches. The study area is located in the Mendoza Province, between Potrerillos and Las Cuevas in the Chilean border.
This study has for main goals to achieve a regional mapping of geohazards susceptibility along the Road 7 corridor using modern remote sensing and numerical modelling techniques completed by field investigations. The main topics are:

- Detection and monitoring of deep-seated gravitational slope deformations by time-series satellite radar interferometry (InSAR) methods. The area of interest is mountainous with almost no vegetation permitting an optimized InSAR processing. Our results are based on applying the small-baseline subset (SBAS) method to a time-series of Envisat ASAR images.

- Rockfalls susceptibility mapping is realized using statistical analysis of the slope angle distribution, including external knowledge on the geology and land cover, to detect the potential source areas (quantitative DEM analysis). The run-outs are assessed with numerical methods based on the shallow angle method with Conefall. A second propagation is performed using the alpha-beta methodology (3D numerical modelling) with RAS and is compared to the first one.

- Debris flow susceptibility mapping is realized using DF-IGAR to detect starting and spreading areas. Slope, flow accumulations, contributive surfaces, plan curvature, geological and land use dataset are used. The spreading is simulated by a multiple flow algorithm (rules the path that the debris flow will follow) coupled to a run-out distance calculation (energy-based).

- Snow avalanches susceptibility mapping is realized using DF-IGAR to map sources areas and propagations. To detect the sources areas, slope, altitude, land-use and minimum surfaces are needed. DF-IGAR simulates the spreading by means of the “Perla” methodology. Furthermore, RAS performs the spreading based on the “alpha-beta” method.

All these methods are based on Aster and SRTM DEM (grid 30 m) and observations of both optical and radar satellite imagery (Aster, Quickbird, Worldview, Ikonos, Envisat ASAR) and aerial photographs. Several field campaigns are performed to calibrate the regional models with adapted parameters. Susceptibility maps of the entire area for rockfalls, debris flows and snow avalanches at a scale of 1:100’000 are created. Those maps and the field investigations are cross-checked to identify and prioritize hotspots. It appears that numerous road sectors are subject to highly active phenomena. Some mitigation works already exist but they are often under-dimensioned, inadequate or neglected. Recommendations for priority and realistic mitigation measures along the endangered road sectors identified are proposed.