Earthquake

Kyrgyzstan, Januaary 22, 2015, h 15:52 (UTC)

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A preliminary assesment of expected loss is provided in the following.
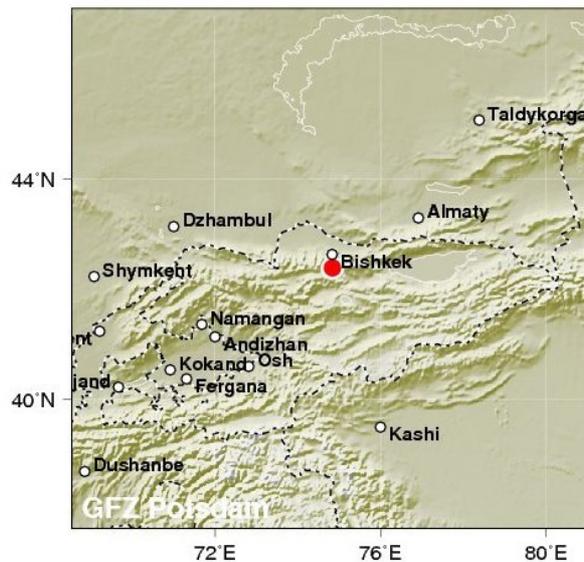
Earthquake scenario

Figure 1:Characterizatin of the event by the GFZ GEOFON service

The event has been assigned magnitude 4.8, depth 23km by GEOFON[1] (Fig. 1), magnitude 4.9, depth 10km by EMSC[2].

The epicentre is located 57km south of Bishkek (pop ~900'000), in Kyrgyzstan, and 200km South-West of Almaty (Kz, pop ~ 2'000'000).

The intenstity of ground motion in macroseismic intensity EMS-98 scale has been promptly estimated using the software CARAVAN (beta version), as shown in Fig. 2. The earthquake´s basic characterization provided by EMSC (epicentre location, magnitude and depth), including uncertainties, has been used.

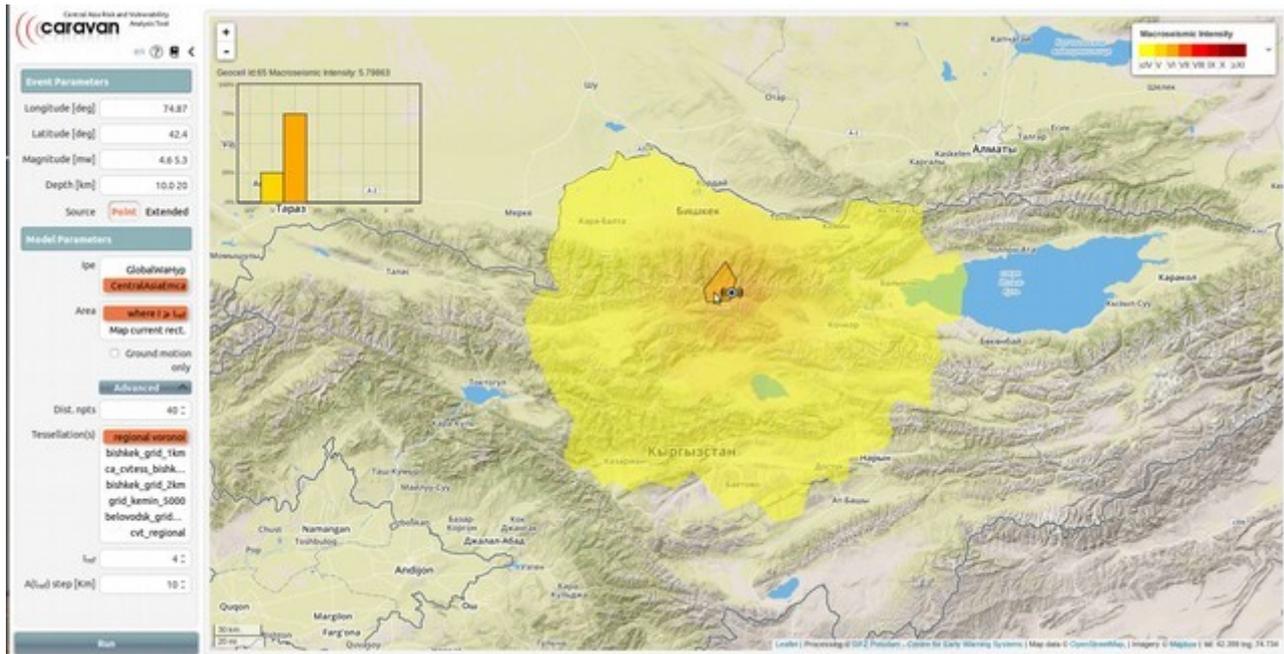*Figure 2: Expected distribution of macroseismic intensity (EMS-98) computed by the CARAVAN web service*

The maximum intensity, in correspondence of the epicentre, is VI. The area where the earthquake could have been felt is approximately 200km radius from the epicentre, including Bishkek, the capital of Kyrgyzstan, and Almaty (Kazakhstan).

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1   http://snipurl.com/29fvneh
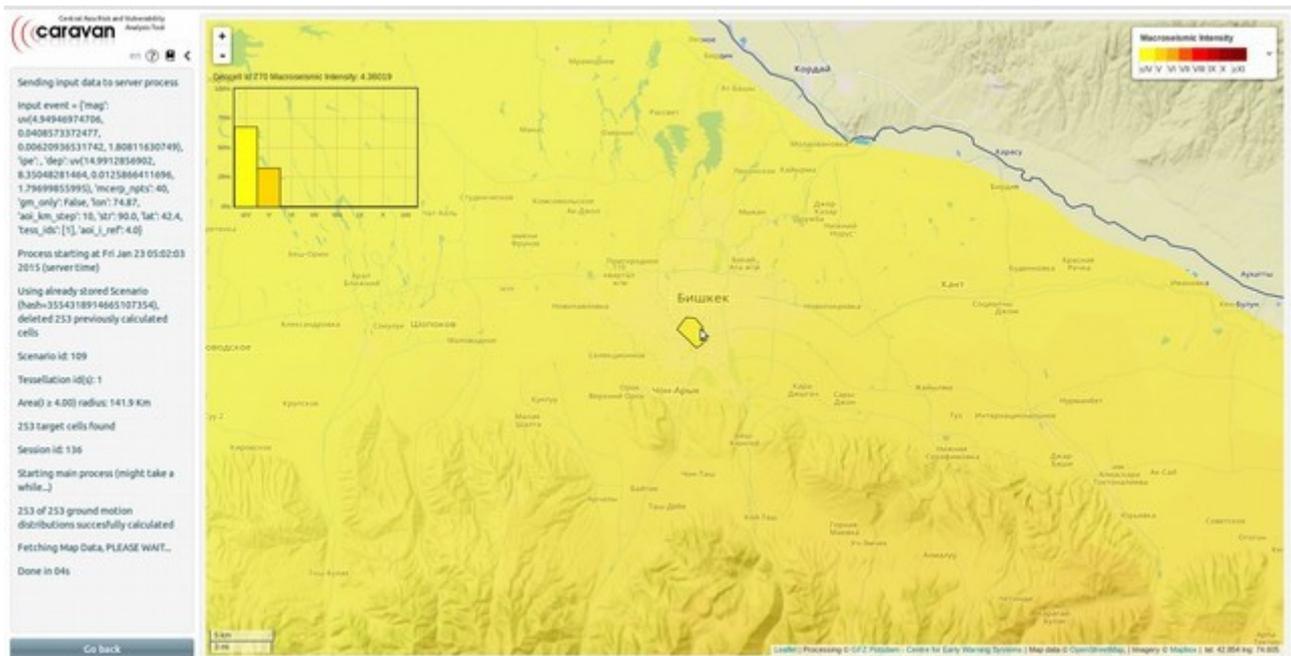2   http://snipurl.com/29fvn4d

Figure 3: Intensity distribution expected in Bishkek. The earthquake is not expected to have produced intensity greater than V in the town.

Exposure

The epicentral area is characterized by a low density of population, mainly with rural characteristics.

The building composition in the target area is dominated by individual buildings in unreinforced masonry and stone, and earthen dwellings with stone bricks, with a very small percentage of buildings with confined masonry and reinforced concrete.

In Fig. 3 The estimated composition of residential buildings inventory is provided), in terms of EMCA-GEM taxonomy. The type of settlements in the target area are mostly of rural type, and the estimated relative percentages are provided in Table 1.

Is clear that majority of residential structures are simple earthen-based dwellings usually built with adobe bricks, which have high physical vulnerability.

Since we are interested in estimating the expected fatalities, we consider only the highest degree of damage, d5 in EMS-98, usually associated to partial or total collapse of structures. Therefore only adobe buildings are considered, since the other building types are expected to be less vulnerable, and therefore their contribution to the fatality estimation should be negligible (also considering the low relative frequencies, and despite the higher occupancy rate).

The population has been disaggregated based on the relative frequencies and expected occupation of the residential buildings, in order to compute the estimated number of buildings.

Moreover, a daily population dynamics is considered (following Coburn and Spence, 2002), for which the daily (6:00-18:00) occupancy rate in a rural area is estimated as **30% of average maximum occupancy**.

Even if most of the buildings show high vulnerability, the average maximum occupancy is relatively low, being usually single-family dwelling and considering the reduced occupancy rate due

to population dynamics.

EMCA-GEM Building Type	Description	Relative %	Most likely Vulnerability (EMS-98)
1.1	Unreinforced masonry -buildings with walls of brick masonry, stone, or blocks in cement or mixed mortar (no seismic design) - wooden floors	20%	B
1.2	Unreinforced masonry - buildings with walls of brick masonry, stone, or blocks in cement or mixed mortar (no seismic design) - precast concrete floors	10%	C
3.1	Precast concrete large panel buildings with monolithic panel joints - Seria 105	1%	C
4	Buildings with adobe or earthen walls	49%	A
5.1	Buildings with load-bearing braced wooden frames	5%	D
	others	15%	

Table 1: Rural Inventory Composition in Kyrgyzstan

Vulnerability and expected fatalities

The probability of collapse (damage state 5) of residential buildings of vulnerability class A (EMS-98), the most vulnerable dwellings composing about the half of the building stock, is
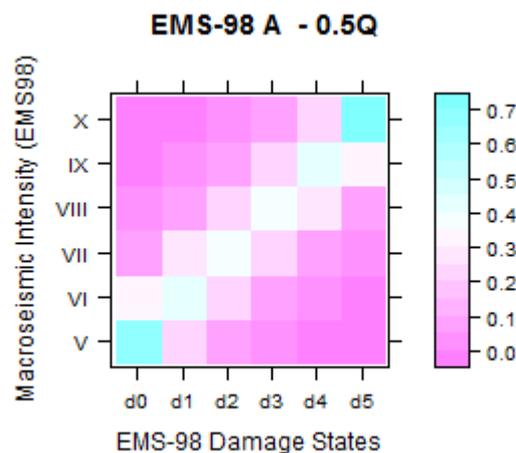

Figure 4: Median Damage Probability Matrix for Vulnerability EMS-98 A

estimated in the range (**0.004, 1e-4)** (with 95% confidence) (see Grunthal et al., 1998, Lagomarsino & Giovinazzi, 2004). The related damage probability matrix is shown in Fig. 4.

The probability of observing collapses is therefore relatively low, while several dwelling could have reported slight damages and the most vulnerable ones could experience structural damage. Considering the exposure estimates provided in the previous section, no collapses are expected.

Accounting for the expected occupancy, no casualties are expected. all the values are provided with 95% confidence considering the above-mentioned hypothesis.
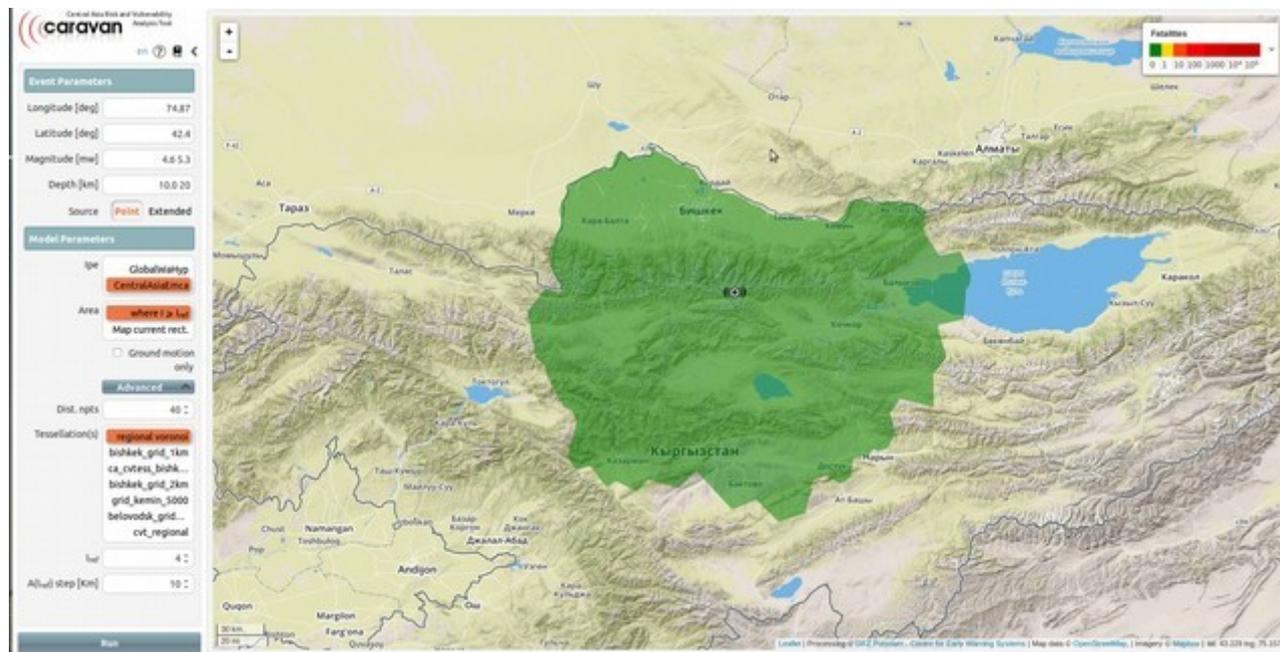

Figure 5: Expected impact as forecasted by the CARAVAN application

Online Questionnaire-based assessment

As a first direct information about earthquake´s preceived intensity, we consider the service provided by the EMSC website, that allows to submit online a report on the subjective perception of
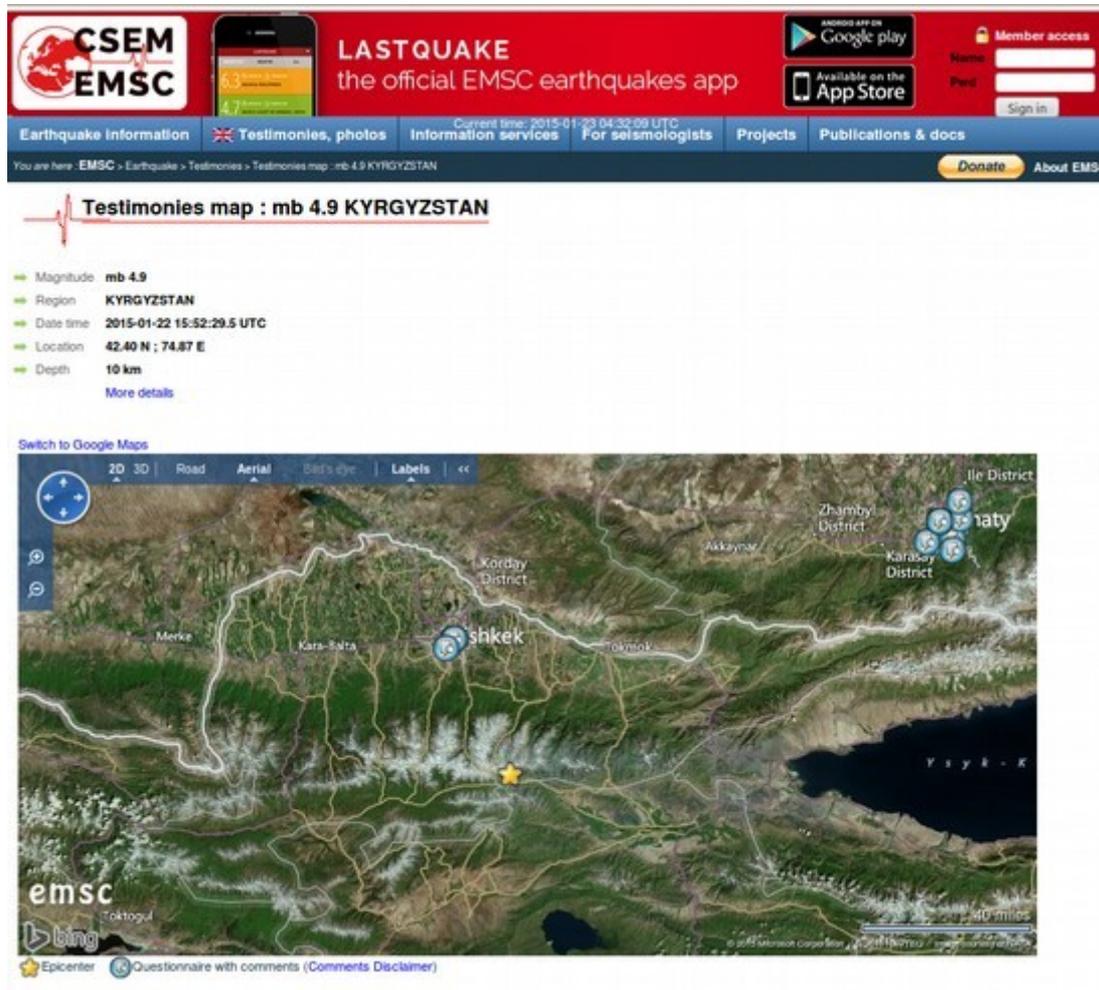

Figure 6: macroseismic reports submitted to EMSC website

the earthquake[3].

A few observation in Bishkek, Kyrgyzstan, ~50km far from the epicenter, would suggest a felt intensity between IV and V (EMS-98).

Reports have been submitted from Kazakhstan (Almaty) 200km far from the epicentre, as shown in Fig. 6.

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3   http://snipurl.com/29fmx59

Reported consequences

No casualties have been reported by the Ministry of Emergency Situations.

The intensity of the ground motion estimatedby local civil protection authorities is in good agreement with the GFZ estimates.