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ShakeMap fed by macroseismic data in France: feedbacks and contribution for improving SHA

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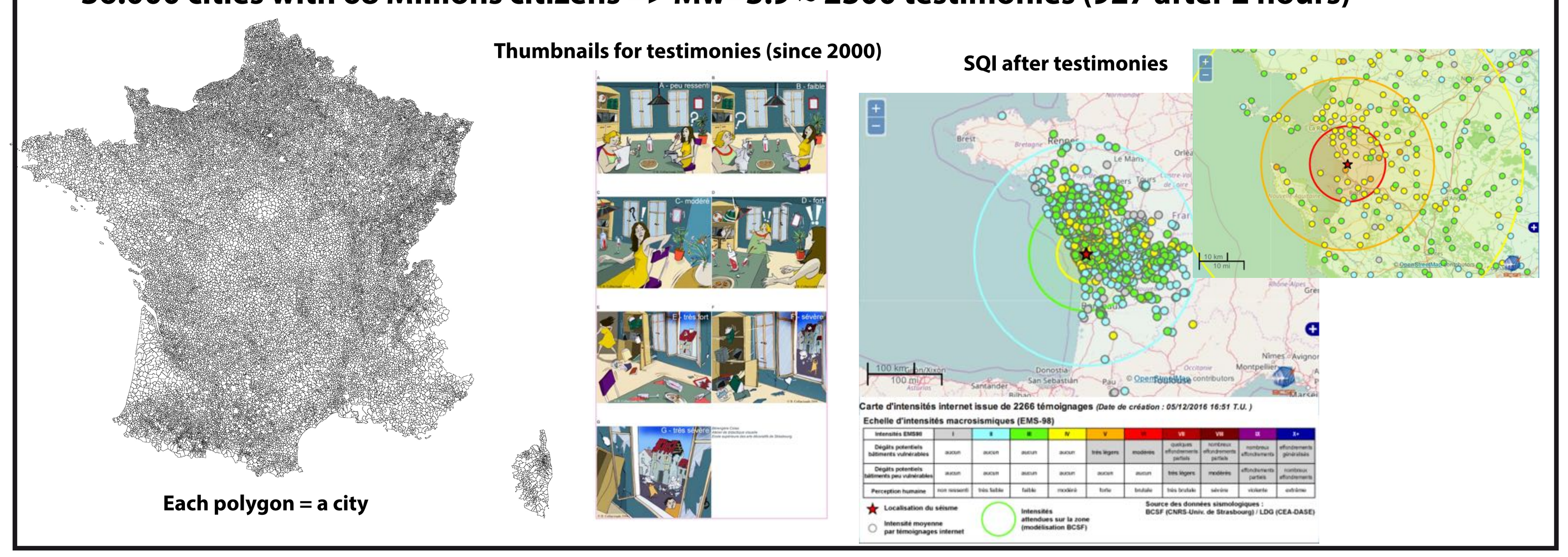
The USGS ShakeMap software V3.5 allows including intensity as input in association with instrumental data. We have been collecting citizen testimonies for 17 years in France, a region of moderate seismicity for the Mainland part and in a subduction context for the West Indies part. We collect frequently several thousands testimonies after Mw>≈4.5. Thanks to the selection of "intensity characteristic thumbnails", we can provide in real time a single questionnary intensity (SQI) averaged at the city scale for a preliminary EMS98 intensity. We observed that about 65% of these "thumbnails SQI" are identical to the "final expert SQI" and the remaining part is shifted by only an intensity degree. With about 36000 cities (1 per 14 square km), we are able to sample in details the territory when the about 400 seismic stations give irreplaceable precise ground motion parameters but very local and most of the times at a farther epicentral distance. Since 2012, we contribute as intensity provider for ShakeMap in Pyrenees range (www.SisPyr.eu). Since spring 2016, we run the ShakeMap V3.5 in a "beta version" for the whole territory of France with several adaptations for region with moderate size events. The BCSF provides Intensities (www.franceseisme.fr), RESIF the instrumental data (www.resif.fr) with the West Indies observatories (OVSG-OVSM) and few stations of bordering countries. Feedbacks are: a huge improvement at any distance by including intensities, need to use regional attenuation law, detection of important ML overestimation in few regions, strong dependence to the epicenter localization, recent published GMICE well adapted, difficulty to represent non circular isoseismals. What we learn from ShakeMap is also a valuable contribution for hazard assessment. We aim to continuously improve the results for a state reference ShakeMap through a specific "ShakeMap transverse action" and its working group in the frame of RESIF.

Mainland France

Macroseismic data

36.000 cities with 68 Millions citizens => Mw=3.9 ≈ 2300 testimonies (927 after 2 hours)



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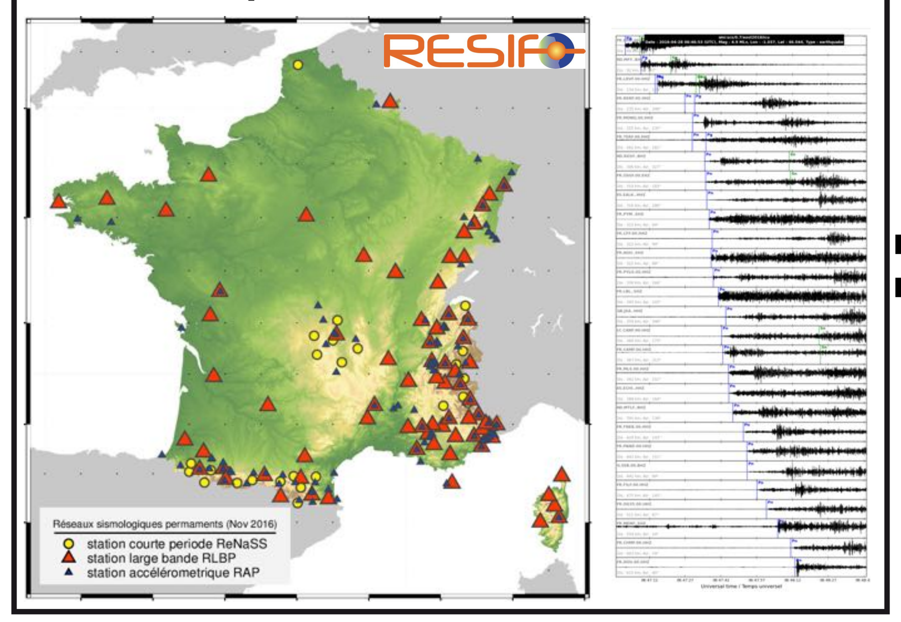
Instrumental data

(Event parameters from CEA/LDG)

≈200 stations (soon up to 400)

2016-04-28 Mw=3.9: Dmin- station = 50km



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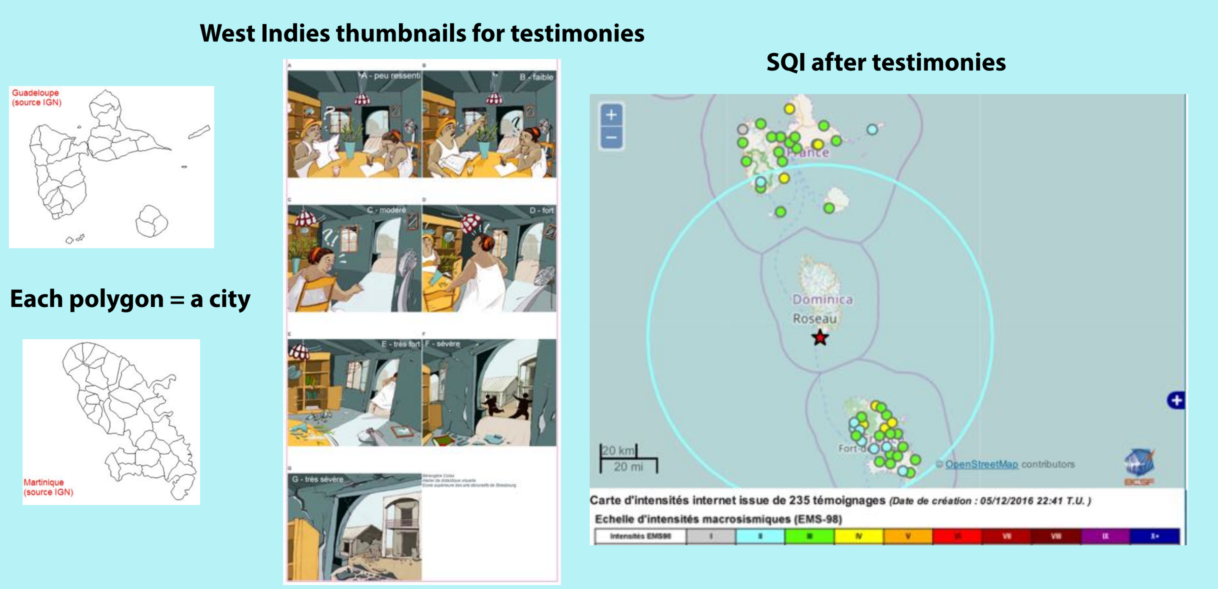
French West Indies

Macroseismic data

66 cities with ≈0.8 Million citizens
example: Mw=5.5, distance>160 km => 235 testimonies



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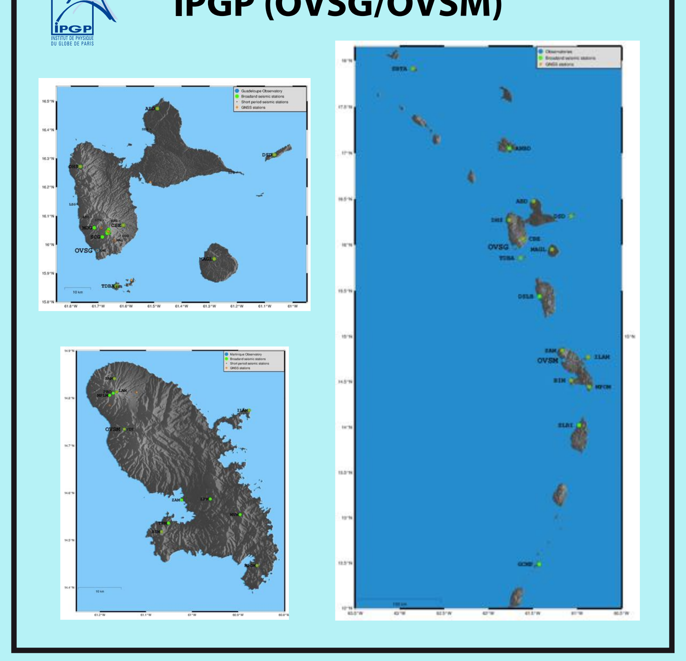
Instrumental data

Event information from IPGP (OVSG/OVSM)



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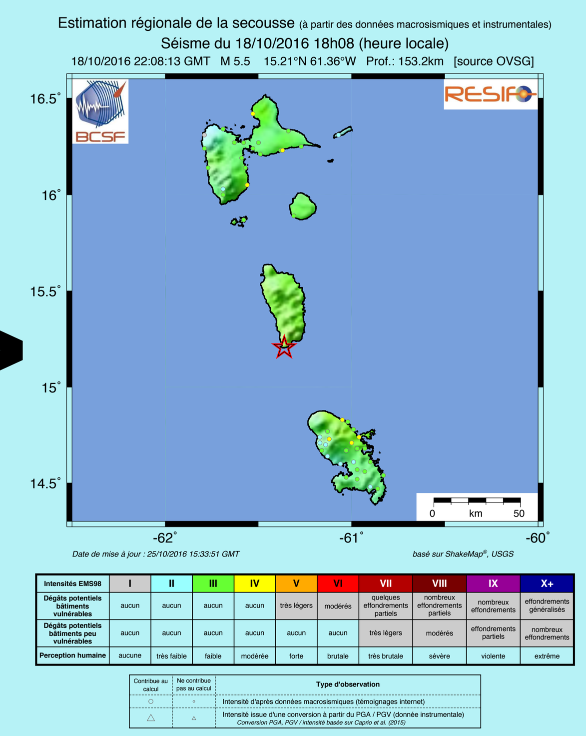
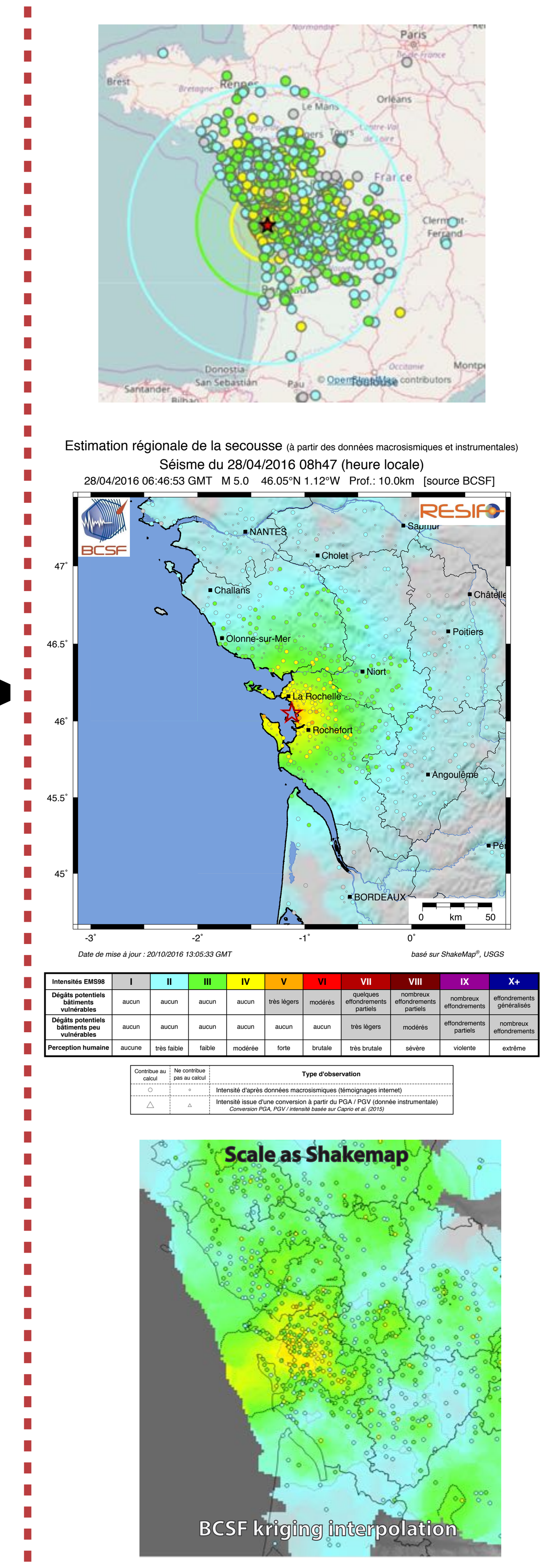


Web intensities (rapid but preliminary)



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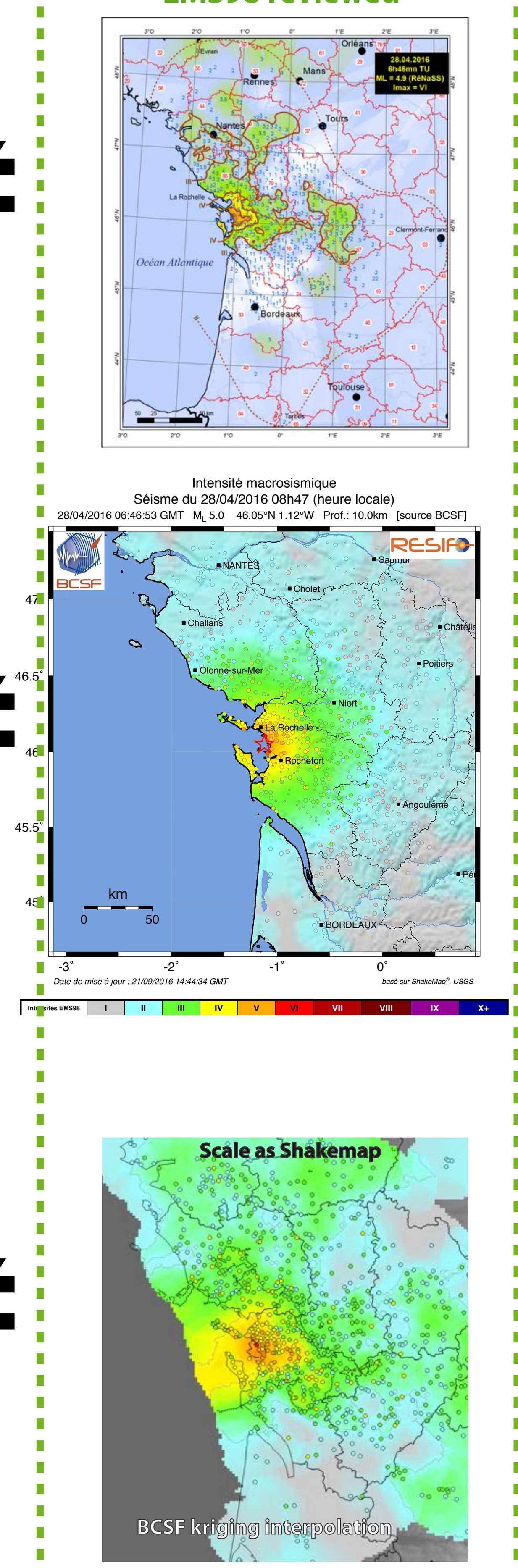
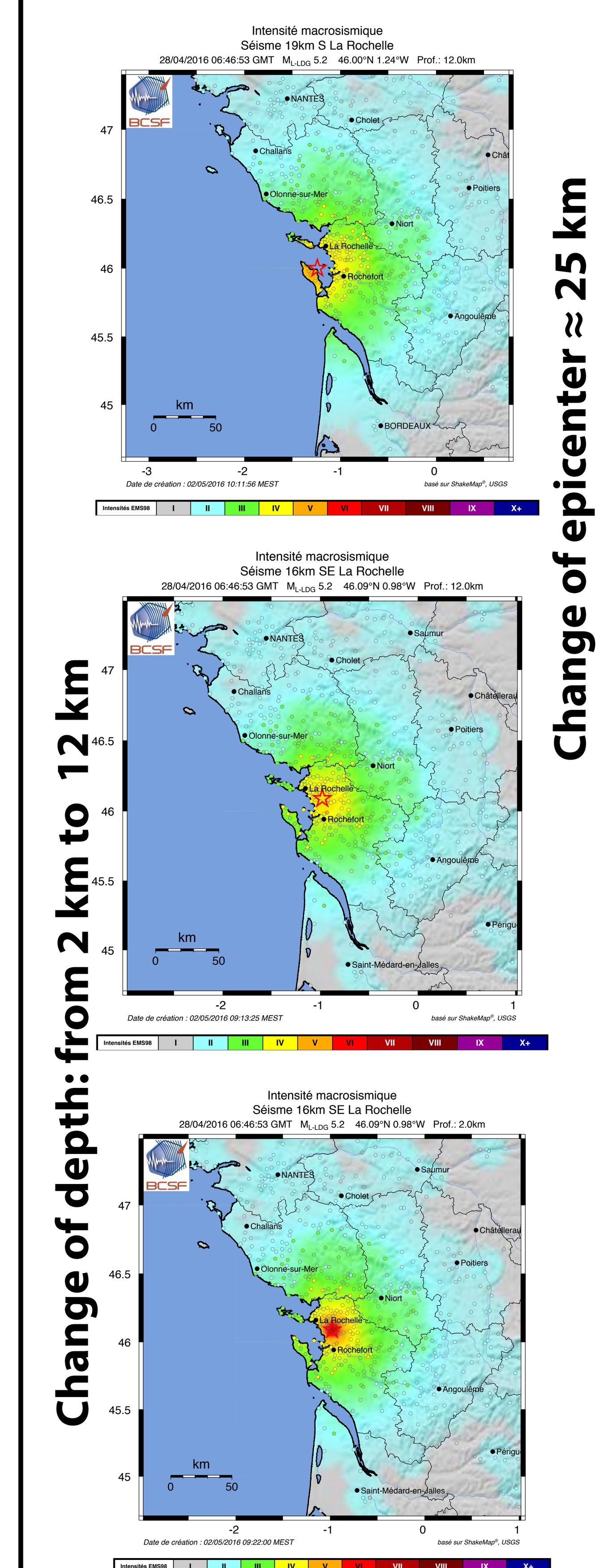
Final intensities (enquiry) EMS98 reviewed



Impact of location and depth uncertainties



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- Huge improvement by including intensities especially at short distance.
- Magnitude correction (Bias value) to fit the data.
- Rapid and regular upgrade of the shakemap (take advantage of the increase of testimonies)
- Integration of site effects
- Validation of recent GMICE from Caprio et al. 2015 (but not yet for I>VI)
- Good consistency between macroseismic observation (floor correction) and instrumental observation
- Rapid feedback on consistency between instrumental and macroseismic data (depth, epicenter, magnitude)

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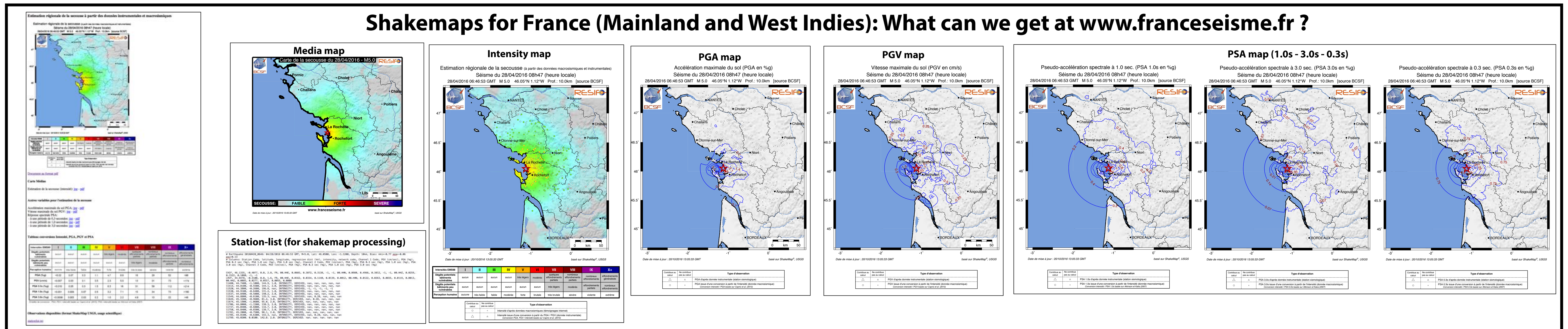
- Highly dependent on epicenter location and depth (not corrected)
- Highly dependent on «shape» of attenuation law (not corrected).
- Highly dependent on site effects for the bias.
- Smooth the observations and reduce the «directivity» of the ground shaking
- Does not fit to the real shaking, the «average» model seems to have the priority

Next

- Working group «shakemap»
- Use separate attenuation law for small and large events.
- Integration of source dimension (fault)
- Include regional attenuation law (important for France with high variation between West part (Armorica) and East part (Alps)
- Improve site effect input parameters (today use of slope as proxy for site effect)
- Follow USGS python upgraded version
- Define the «best» shakemap associated to an event. New information for improving SHA?

Shakemaps for France (Mainland and West Indies): What can we get at www.franceseisme.fr ?



Changes applied to the «shakemap» program

- Colour scale / intensity (BCSF scale, red for I=VI)
- Size of circle or triangle is reduced if data not used by «shakemap».
- Add of attenuation laws for France
- Details in design

Partners and Members of Shakemap working group