I consider that the paper of Wu et al. is the strong contribution and support to the plenty of papers devoted to the L'Aquila earthquake and especially to the precursors observed before this earthquake. In this regard the comment of F. Masci that there few publications on the L'Aquila case is absolutely wrong. The number of publications on the L'Aquila case will occupy several pages and I do not intend to make the bibliographic review and will stop only on few moments demonstrating that Masci is wrong.

1. Dobrovolsky earthquake preparation zone.

It is not only Dobrovolsky et al. conclusion but many authors from different countries and different specialties. The geochemists from France Toutain and Baubron in their paper:

Toutain J.-P., Baubron J.-C., Gas geochemistry and seismotectonics: a review, Tectonophysics, 304, 1-27, 1998

demonstrated that radon distribution before earthquake follows the Dobrovolsky zone, i.e. inside of the area rounded by Dobrovolsky radius.

Bowman, D.D., Ouillon, G., Sammis, C.G., Sornette, A., Sornette, D. An observation test of the critical earthquake concept, J. Geophys. Res. – 1998. – 103. – B10. – P. 24359–24372

discussing the critical concept in seismology confirm the Dobrobolsky zone approach. I cite from the text of the paper:

We now turn to a possible interpretation of figure 7, which suggests that the logarithm of the critical region radius scales directly with the magnitude of the final event in the sequence. A line with a slope of 1/2 gives an excellent fit to the data. Dobrovolsky et al. [1979] and Keilis-Borok and Kossobokov [1990] report a similar scaling log R = 0.43 M for the maximum distance between an earthquake and its precursors, based on a completely different procedure, namely the optimization of pattern recognition techniques [Gelfand et al, 1976].

As one can see, Keilis-Borok and Kossobokov also come to the same conclusion. All of the mentioned persons are the first rank scientists in seismology and it is difficult to have doubts in their ratio.

The modern technique permits directly to check the conception of Dobrovolsky zone.

Tsolis and Xenos in their paper devoted to the ionospheric precursors of earthquakes exactly before the L'Aquila earthquake

Tsolis G.S., Xenos T.D. A qualitative study of the seismo-ionospheric precursors prior to the 6 April 2009 earthquake in L’Aquila, Italy, Nat. Hazards Earth Syst. Sci. – 2010. – 10. – P. 133–137.

using the cross-correlation technology proposed by Pulinets et al.

Pulinets S.A., T.B. Gaivoronska, A. Leyva Contreras, L. Ciraolo, Correlation analysis technique revealing ionospheric precursors of earthquakes, Natural Hazards and Earth System Sciences, 4, pp. 697-702, 2004

demonstrated the validity of the Dobrovolsky zone conception (see Figure 1). They show the drop of cross-correlation coefficient between the stations inside of Dobrovolsky zone and no reaction for the configuration of stations outside the Dobrovolsky zone (red curve in the figure 2).

Fig. 1. The geographical location of Rome, San Vito and Athens the ionospheric stations, regarding the epicenter (blue triangle). Earthquake preparation area is plotted in red.

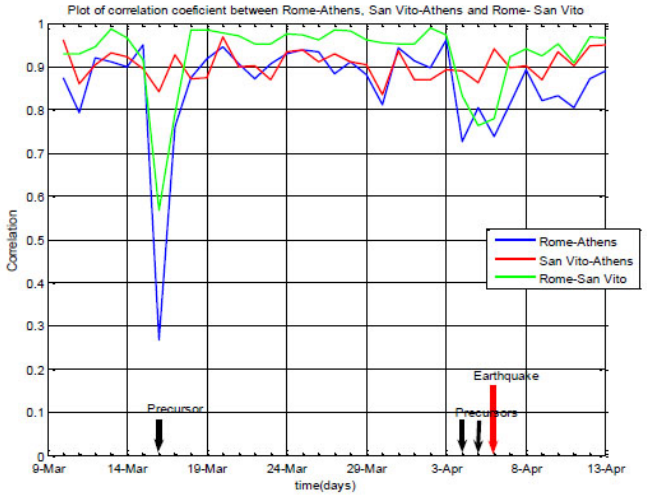

Fig. 2. Plot of the correlation coefficient of the denoised foF2 signals between Rome-Athens, Rome-San Vito, and San Vito Athens. Red arrow indicates the day of the seismic event and, black arrows represent ionospheric precursors.

The group of Valerio Tramutoli in the set of publications devoted to the TIR anomalies before the L'Aquila earthquake (again returning to Masci's comments that their no publications on L'Aquila precursors)

Genzano N., Aliano C., Corrado R., Filizzola C., Lisi M., Mazzeo G., Paciello R., Pergola N., Tramutoli V., RST analysis of MSG-SEVIRI TIR radiances at the time of the Abruzzo 6 April 2009 earthquake, Nat. Hazards Earth Syst. Sci., 9, 2073-2084, doi:10.5194/nhess-9-2073-2009, 2009

N. Pergola, C. Aliano, I. Coviello, C. Filizzola, N. Genzano, T. Lacava, M. Lisi, G. Mazzeo, and V. Tramutoli, Using RST approach and EOS-MODIS radiances for monitoring seismically active regions: a study on the 6 April 2009 Abruzzo earthquake, Nat. Hazards Earth Syst. Sci., 10, 239-249, doi:10.5194/nhess-10-239-2010, 2010

M. Lisi, C. Filizzola, N. Genzano, C. S. L. Grimaldi, T. Lacava, F. Marchese, G. Mazzeo, N. Pergola, and V. Tramutoli, A study on the Abruzzo 6 April 2009 earthquake by applying the RST approach to 15 years of AVHRR TIR observations, Nat. Hazards Earth Syst. Sci., 10, 395-406, doi:10.5194/nhess-10-395-2010, 2010

demonstrated the spatial distributions of TIR anomalies before L'Aquila earthquake from different satellite sources, and all of them have shown the Large scale TIR anomalies before the earthquake. Having in mind that there could be critics similar to Dr. Masci, they made analysis not only for the month

and year to L'Aquila earthquake but for other years demonstrating that the observed TIR anomalies a the real pre-earthquake anomalies.

Pulinets et al. and their presentations and publications

Pulinets S.A., Tramutoli V., Genzano N., Yudin I.A., TIR anomalies scaling using the earthquake preparation zone concept, 2013 AGU Meeting of the Americas, Cancun, Mexico, 14-17 May 2013, Paper NH42A-06

Pulinets, S.A., Ouzounov, D.P., Davidenko, D.V., Is Earthquake Forecasting Possible?! Integral Technologies of Multiparameter Monitoring over Geoeffective Phenomena in the Framework of the Complex Model of the Earth's Lithosphere–Atmosphere–Ionosphere Coupling, Moscow: Trovant, 2014.

provided the scaling of TIR anomalies using the Dobrovolsky $R = 10^{0.43}$ and Bowman et al. $R = 10^{0.44}$ estimations what id presented in the Figure 3

Fig. 3. TIR anomalies (yellow and red) registered before the L'Aquila earthquake (after Genzano et al., 2010). Blue circle – Dobrovolsky zone; red circle – Bowman et al. zone.

And now we return to the Masci's comment on Preparation zone size and epicenter determination. He is absolutely right that for the Tohoku earthquake the radius of preparation zone will be 7413 km. By the way it is confirmed by many experimental evidences. I can comment this by two arguments:

1. We provide mutimarameter monitoring of the different type of precursors. One of them give more precisely the position of epicenter, other give estimation of the magnitude, and the last – the time of event. Looking from perspective of short-term forecast – the most difficult is just the time of earthquake, and having in mind that the maximum intensity of anomalies is observed ~5 days before earthquake, the registering of anomaly of large scale give us at least estimation of time of earthquake. But here we come to the second point.

2. All of us learned elementary geometry in school, and determination of the circle center position should not present the great problem for majority of us regardless on the circle radius size. I would like to present such a procedure like in L'Aquila case but for the larger M7.8 Gujarat 2001 year earthquake for which Genzano et al. also measured the TIR anomalies:

Genzano, N., C. Aliano, C. Filizzola, N. Pergola, V. Tramutoli, A robust satellite technique for monitoring seismically active areas: The case of Bhuj–Gujarat earthquake, Tectonophysics. – 2007. – 431. – P. 197–210.

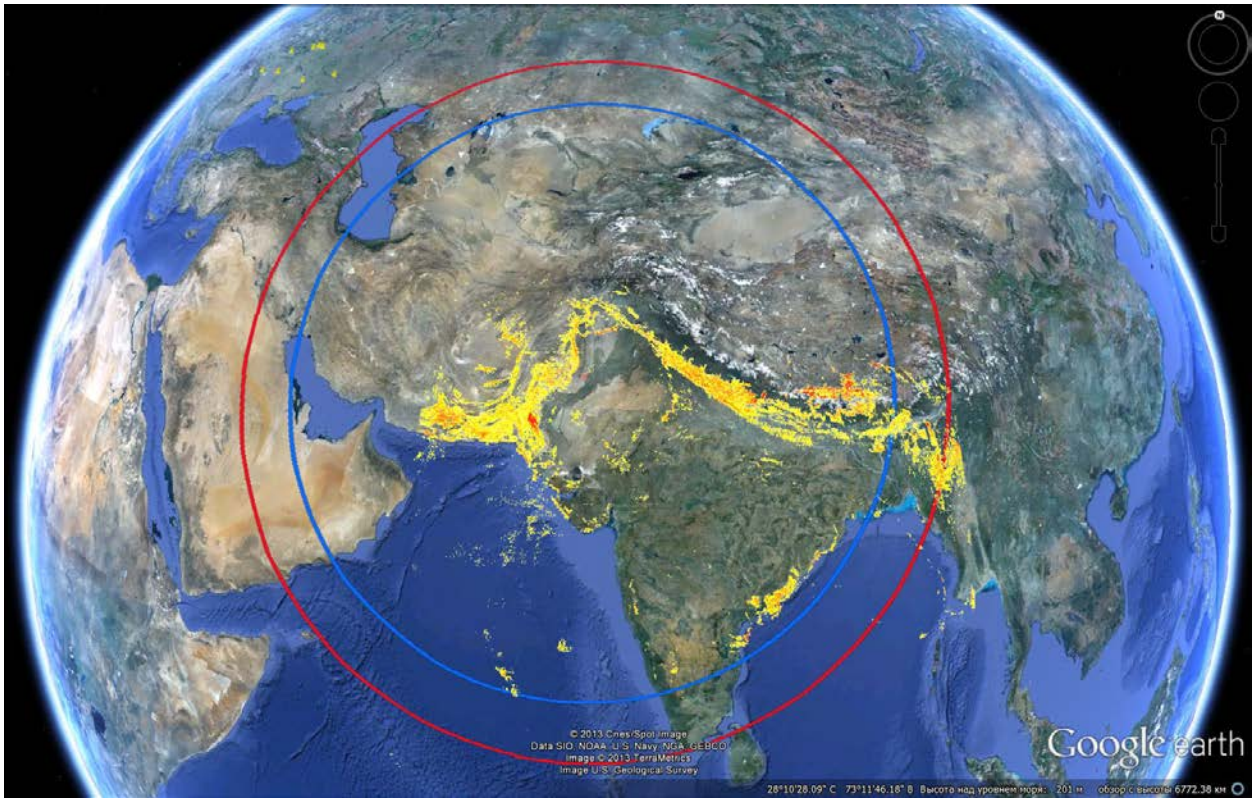

Fig. 4. TIR anomalies (yellow and red) registered before the Gujarat earthquake (after Genzano et al., 2007). Blue circle – Dobrovolsky zone; red circle – Bowman et al. zone.

So one can see that 7413 km for the Tohoku earthquake is reality. The problem of TIR anomalies is that thy depend of cloudiness and are not seen for every earthquake (is matter of lack). The determination of the circle center is also problem resolved using other type of precursors. For example. the ionospheric anomaly before the L'Aquila earthquake is "sitting" exactly over the epicenter (see Figure 5).

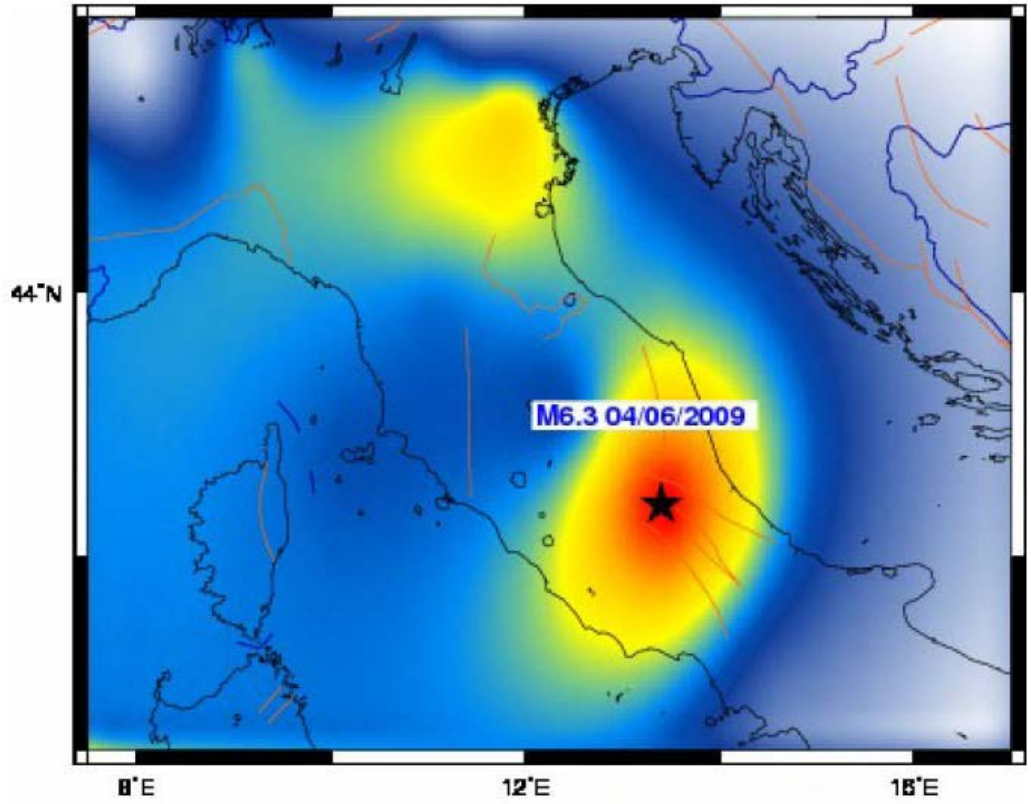

Fig. 5. GPS TEC differential map registered on 5 April 2009 using the data of Italian network of GPS receivers (Pulinets and Ouzounov 2016)

Pulinets S., Ouzounov D., Earthquake precursors in atmosphere and ionosphere. A review and future prospects, EGU 2016, Session NH4.7/AS4.37/EMRP4.21/SM3.5 - Short-term Earthquakes Forecast (StEF) and multi-parametric time-Dependent Assessment of Seismic Hazard (t-DASH), 2016

Concluding the first part of my comments I want firmly state that the Dobrovolsky et al. estimation of the earthquake preparation zone has the same order of fundamental meaning for seismology as the Gutenberg-Richter FMR relationship.

The second my concern from the Masci comments is that coincidence in time is not enough to classify the anomaly as a precursor. It could be so if to consider every anomaly individually. But we deal with the complex system approaching to the critical state what was perfectly demonstrated by Angelo de Santis et al:

De Santis A., Cianchini G., Favali P., Beranzoli L., Boschi E., The Gutenberg–Richter Law and Entropy of Earthquakes: Two Case Studies in Central Italy, *Bulletin of the Seismological Society of America*, 101, 1386–1395, 2011

Using the Shannon approach to the entropy estimation the authors calculated the period of approaching the system to critical state which coincides with the foreshock period determined by Papadopoulos (also for the L'Aquila case):

Papadopoulos G.A., Charalampakis M., Fokaefs A., Minadakis G., Strong foreshock signal preceding the L'Aquila (Italy) earthquake (Mw 6.3) of 6 April 2009, Natural Hazards and Earth System Sciences, 10, 19–24, 2010

But even more interesting fact is that the all geophysical anomalies detected before the L'Aquila earthquake (including those described in the reviewed paper) arose within the same time interval what

means that this is not simple coincidence in time and these anomalies are part of the general process of the development of the latest stage of the seismic cycle. All these processes are in state of synergetic interaction characteristic to the open systems, and this interaction is described in the paper:

Pulinets S.A., The synergy of earthquake precursors, Earthquake Science, 24, 535-548, 2011, doi:10.1007/s11589-011-0815-1

IT is possible to observe the anomalies propagation from ground up to the ionosphere presented in the Figure 6

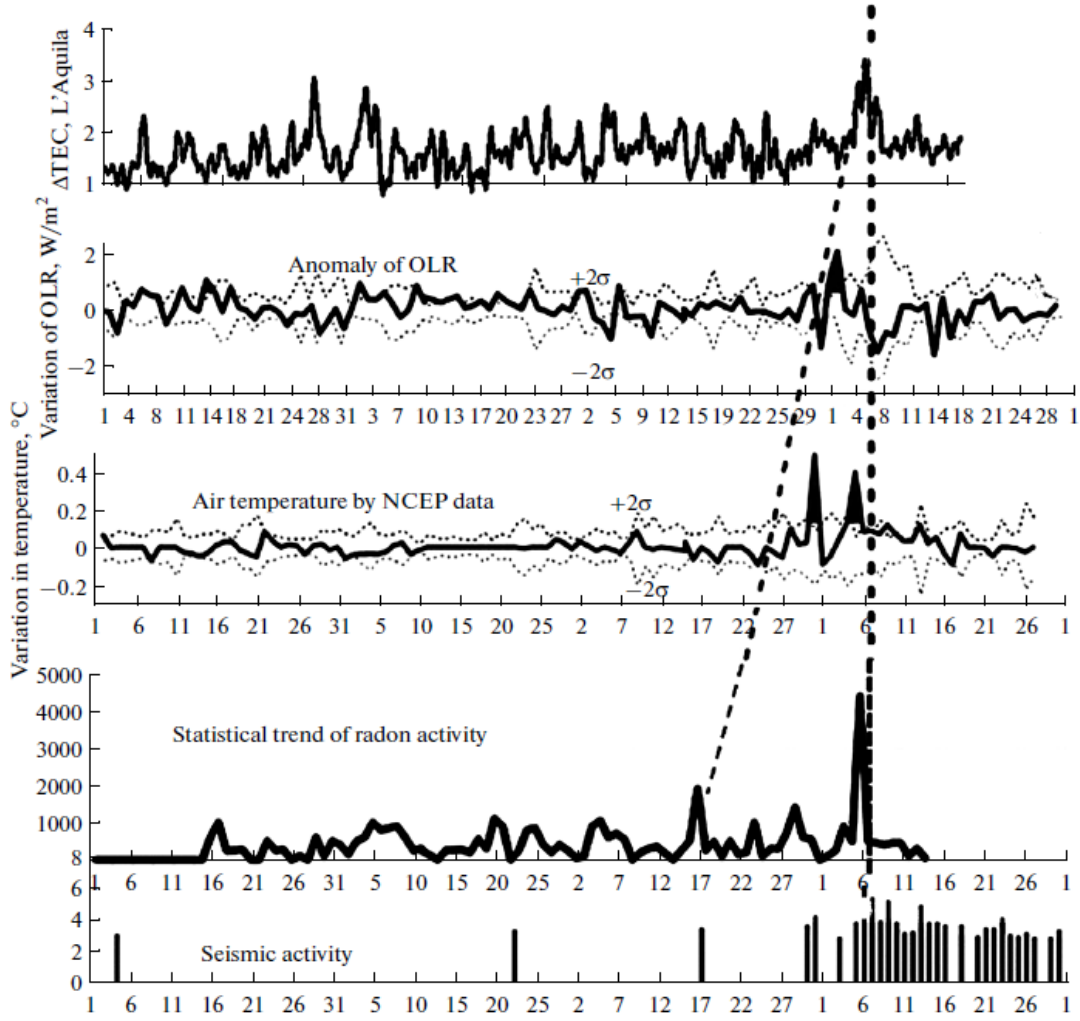

Fig. 6. Temporal dynamics of radon release and variations of atmospheric and ionospheric parameters before the L'Aquila earthquake.

This interaction has also the physical background described in the paper:

Pulinets S.A., Ouzounov, D.P., Karelin A.V., Davidenko D.V., Physical Bases of the Generation of Short-Term Earthquake Precursors: A Complex Model of Ionization-Induced Geophysical Processes in the Lithosphere–Atmosphere–Ionosphere–Magnetosphere System, Geomagnetism and Aeronomy, 55, No.4, 540-558, 2015

and including the Coversphere in the set of interacting geophysical shells before earthquake is important contribution into this model.