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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Earthquake-induced deformation estimation of earth dam by multitemporal SAR interferometry: the Mornos Dam case (Central Greece)" *by* S. Neokosmidis et al.

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The authors gratefully acknowledge the Reviewer for the valuable comments. We agree with the comments, which are highly addressable and will help improve the manuscript. We would like to modify our manuscript on the basis of the comments, and all the comments will be carefully included in the revised version of the manuscript.

Due to the fact that the Journal not only refers to knowledgeable on the interferometry issues but to a board scientific public, it is appropriate to analyze further the description

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of the data and the technique used to generate surface deformation time series. Also, this paper prospects to be the trigger for future research by other scientific fields such as seismologists and geotechnical as far as the effect of seismic activity on dam's behavior is concerned.

The motivation of the work was mainly to investigate if by SAR interferometry can monitor an earth dam behavior as in this case Mornos dam and which are the causes of the deformation taken in consideration variations in water volume and the seismic activity in the broader area. The results show clearly that the deformation of the dam is related to water level changes but also is associated with some of the earthquakes that struck the broader area during the period of monitoring. This is clearly proved by the time series analyses of specific points on the dam. But also if we look specific interferograms during an earthquake event such as for example the interferometric pair dated 2009/11/22-2010/04/11 with Bp 80m and Bt 140days, we can observe that there are differences in the dam and the abudments which there aren't in other interferograms in periods without seismic events (interferometric pair 2008/01/27-2008/06/15 with Bp 80m and Bt 140days), (Figure 1). These differences aren't due to atmospheric effects because the changes between the abudment and the dam are abrupt.

As far as the linear or non linear correlation, in the present study, starting from the multi-reference stack of unwrapped phases we derived a time series of deformation using Singular Value Decomposition (SVD) to obtain the least-squares solution for the phase time-series. Using a big volume of multi-reference differential interferograms the temporal uncorrelated errors are being reduced. Tropospheric turbulences being uncorrelated in time have been reduced. On the other hand tropospheric noise due to variable phase delay linked to the altitude (smaller phase delay values in higher altitudes) is not reduced by this estimation procedure. For this reason heavily suffered interferograms have been removed for the procedure. Therefore, the obtained time series of unwrapped phases still includes the atmospheric phases as well as non-linear deformation phase. Tropospheric phases as well as phases relating to non-linear mo-

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tion are part of the deviation of the time series from the linear regression. Moreover Ferretti et al., 2000, used a least-squares estimator and linear deformation phenomena are remained. The products of multitemporal interferometric analysis are time series of deformation history, temporally referenced to the date of the oldest acquisition (containing both the linear and non-linear deformation components) and the (linear) deformation rate (velocity) for each scatterer. Non-linear deformation can be estimated without any modeling and prior knowledge using the SVD as stated by [K. Goel. et al., 2011 and Tao L. et al., 2013]. In order to have a numerical estimation of the statistical dependence between the water level and the deformation we sampled the values of the water level at the acquisition dates and correlated them with the deformation values at the same dates. Thus the resulted correlation value is an index of causation.

The Authors accept to cite part of the information provided on SBAS, SVD, decompositions of E-W and up – down, if the Editor agree with that, given the wide scale of Journal's readers.

At the revised manuscript the Authors will include a discussion section (mentioned on supplement) describing the above mentioned and the limitations of the procedure.

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Please also note the supplement to this comment:
http://www.nat-hazards-earth-syst-sci-discuss.net/2/C3566/2015/nhessd-2-C3566-2015-supplement.pdf

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Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 2, 7807, 2014.

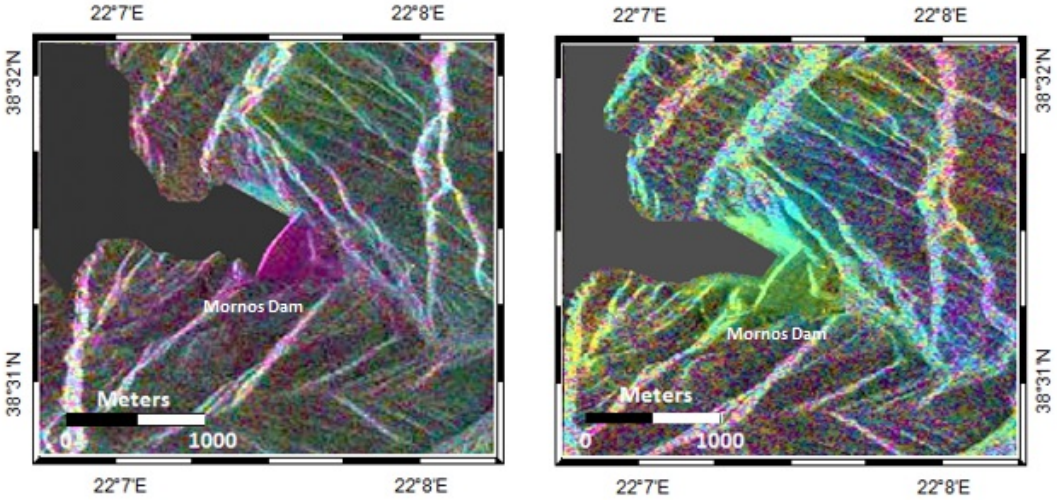

Figure 1: Interferometric pair 20091122-20100411 with Bp 80m and Bt 140d during the earthquake of Eypalio (18-22/01/2010, Mw=5.3) on the left and interferometric pair 20080127-20080615 with Bp 80m and Bt 140d without seismic event on the right.

Fig. 1.

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