Dear Editor/Reviewers,

Below we try to answer the second referee's comments and explain how we propose to address the requests, as well as we did for reviewer 1. Our answers are in italics. We hope that we have correctly interpreted the new rules of the review process for NHESS. We tried to address the comments of the reviewer describing how we intend to modify the manuscript, but we await the editor's final decision (rejection or a request for a modified version of manuscript) before submitting the modified manuscript.

Referee 2

It appears to the reader that the study catchment is extensively monitored (120 rain gauges in the region, discharge observations, C-band Doppler radar). Then why not use all the data and analyse all the cases covered by the data and say something more about the proposed system and its performance?
It is suggested, that the authors include such an overall analysis (or explain why they don't do it).

This event, as well as some other events, affected only this particular basin while only partially affecting the surrounding catchments. There are two or three basins which have been impacted by this event, however, they are smaller in size (area around 20-40 km^2) and therefore not all the considerations concerning the anticipation times have the same validity, because of the faster response time of the smaller catchments.

Notwithstanding, we can add the results of the system for these other basins.

On the other parts/basins of the Liguria Region only small amounts of rainfall was recorded with negligible effects in terms of streamflow.

As the authors describe nicely, the "communication" is the crucial or week point in this forecasting chain (as in most other systems too). The main finding of this case study is not so much that the proposed system would have worked, but that it wouldn't have helped anything all the same, as nobody was following the forecasts during the evening/night. The forecast isn't worth anything if it is first seen when the event passed. So what were the consequences of this analysis? Is there any SMS alert to the hydrologists/forecasters in charge? Did the communication ways shorten? Can the operational forecasts be accessed online by the forecasters? And is the presented system implemented operationally now? If yes, how are the experiences, if not, why not?
Please add this information in the conclusion or outlook for example.
Also add a sentence to the abstract, describing this problem: As you showed the problem is not the forecast itself but its accessibility/distribution/communication/authority.

We think the reviewer captured one of the main points of this manuscript (underlined sentence).
The presented chain is actually operational at the Hydro Meteorological Center of Liguria Region, and we referred to actual modalities of running the chain (timing, resolution…). The results are published online and they are easily accessible using Tablets, Smartphones and other similar instruments. This method of communication has become very useful and is used by the hydrologists even though the predictions sometimes fail; they are conscious that results need to be carefully interpreted (as most hydrological tools).

Actually, no operational alert SMS system has been implemented; this is an issue that is still under discussion by the hydrologists of the center.

We can modify the abstract and the conclusions adding the information requested by the reviewer.

Introduction/General: The authors describe their aim well. However they are very sparse with references referring to similar work done in this field . A careful literature review should be done by the authors.

We will improve the literature review in the new version of manuscript.

7499L9-11/7501L8-11: The authors describe the storms affecting the catchment (and also the region) as more persistent then normal thunderstorms, due to the orographic conformation (and therewith orographic forcing). Therefore, I would expect that the conditions leading to such persistent storms are fairly similar every time. As there are many meteorological stations in the region, which have a high temporal resolution it would be possible to use also other meteorological variables like wind to detect critical situations. Additionally there is a radar nearby the catchment. The authors should consider the work done by Panziera et al. (2011) on "NORA - Nowcasting of orographic Rainfall by means of Analogues" and the application of it to flash flood early warning by Liechti et al. (2013).

Yes, we were aware of the first work by Panziera et al. (2011) and we also found very interesting the second by Liechti et al. (2013). We will insert in the paper both references and we will mention the fact that having a dense real time meteorological network and a radar available, such systems (particularly NORA method) could improve the predictability of the cited rainfall events. Moreover, as specified in the text, the nature of these phenomenons is not always well known, in many cases they are due to orographic conformation while in other cases we are not sure this is the only cause. For this reason we also referred to generic local atmospheric conditions. Referring to Panziera et al. (2011), i*n some cases the rainfall events could be triggered by isolated convection, which is one of the cases discarded by NORA system.*

Actually, the critical point is that, if we correctly understand how NORA works, the method is based on quite a large DATA-BASE of events for which all the needed data are available in order to carry out the analogue analysis. This kind of database is not actually available. Anyway, it could be useful to start building such a database.

7499L3-4: I would change this sentence. NWP can not predict the kind of event described in the article with the lead time needed for operational flash flood forecasting. However, NWP, like for example COSMO-2, which assimilates radar rainfall data, and which should also be available for the study region, can forecast the location more accurate then at the 10^3-10^4 km^2 the authors state.

We will modify the sentence mentioning NWP + assimilation systems. They could potentially help in predicting the events similar to the one showed in the manuscript. Such kinds of systems are, unfortunately, still not operationally used/available to the Hydro Meteorological Center of Liguria Region.

7499L11-19: References.

We could cite: Rebora, N., Molini, L., Casella, E., Comellas, A., Fiori, F., Pignone, F., Siccardi, F., Silvestro, F, Tanelli., S., Parodi, A.: Extreme rainfall in the Mediterranean: what can we learn from observations?, Journal of Hydrometeorology e-View, doi: http://dx.doi.org/10.1175/JHM-D-12-083.1, 2013 .

This paper describes the major floods which occurred during the autumn of 2011 in Liguria Region, Italy

7499/00L27-01: I agree that this can not be done by NWP driven systems alone, but there are other studies that demonstrate the power of radar data for this type of problem.

Yes, we will explicitly mention the power of radar data for this type of problem. It is one of the objectives of this work and also of the previous paper Silvestro and Rebora (2012).

7500L5-8: … impossible with a hydrological model running at hourly time steps. If it was possible to run the model at the temporal resolution of the meteorological data (5-10 min as stated on p.7501) the lead time would be about 3h (t_b) – which is in the order of the forecast system presented in this study(p.7507).

We partially agree with this sentence, but we can mention the issue because it could be a point to improve the performances of a generic hydrological nowcasting system.

i) The major advantage is (in our opinion) due to a more detailed temporal evolution of rainfall useful especially for very small basins. Maybe, the fact is that information are updated more frequently; if I work at 1 hour resolution the chain is up to date every 1 hour (at the end of the hour the nowcast is "old"), if I work at 5 minutes the chain is potentially up to date every 5 minutes. This disregarding the issue of data transfer. Lead time could potentially be 3 hours, but with the nowcasting + hydromodel solution (not only the one we used, but any generic model) we can arrive also to 4-5 hours of anticipation (for the basin considered in our case, for smaller basins the lag time is smaller).

ii) We are actually reluctant in applying the operational radar-gauge adjustment technique at high temporal resolution because of the different natures of radar and gauge measurement. It could lead to large over/under estimation even in the case where both systems work well (think of fast moving cells…). This is one of the reasons why the operational chain works at 1 hour resolution.

iii) In many cases, the high resolution data (5-10 min) can't be totally exploited. The data transfer system of the gauge stations network of the study area, for example, updates raw data on the database two or three times per hour. The system will be improved in the coming months/years.

iv) *From a strictly operational point of view, it is not actually sustainable running the system with such high frequency. Hardware, coding, etc. need to be improved (we know we are far away from a scientific discussion…but this is part of the "real" application of the scientific tools).*

7500L11: unpredictable: if the persistent storms are caused by the orographic setting (as described in chapter 2) they are not unpredictable, they most probably follow a certain rule (better use unexpected).

Ok, we will modify the text

7501L25-28: please provide a map of the situation

Ok, it will be inserted in the new version of the manuscript

7502L16-18: Nowcasting model PhaSt: Only one sentence is spent on the model. Short and concise is ok, but please give some basic information about the procedure (last two radar fields as input, number of members …) in the text and not only put the reference.
7502L19-21: The hydrological model DRiFt: Also here the authors spend only one single sentence on the hydrological model. They give reference but for the reader it would be useful to have some minimal information about spatial resolution, temporal resolution, number of parameters …

More details about both the Phast and DRiFt models will be furnished in the new version of the manuscript

7502L28: Why do you use only the last two hours and not all three hours? Please explain.
The forecast time window is two hours, not three.
In the operational chain, because of delay in gauge data availability, the last hour of observation is estimated using only the radar.
We will improve the explanation of this in the new text, the sentence is probably a bit confusing as is.

7503L10/11: For the reader it would be convenient if you gave some basic properties of the models mentioned (eg. spatial resolution, lead time, forecast interval, probabilistic or deterministic …)
Ok, we will insert a table in the new version of the manuscript

7505L15-20: It comes not clear for the reader if there was an SMS alert sent in the case described by the authors or not. And if not, why not.
No, it was not operational; it is our proposal to introduce such a system. We will clarify this point in the new text.

7507L1-3: Does this mean that the forecasters do not have online access to the forecasts when they are not at work? This does not come clear here.
Ok, we will clarify this point.
They have online access to the forecasts. There was not an alarm system (e.g. based on SMS) driven by the nowcasting chain that advise the forecaster of the unpredicted occurring event.

I can't find any information about the discharge measurements. Please add this to the measurement systems.
We will add this information

RIME (Fig. 2) is not explained in the text. Please add.
Reference is present in section 3, but not the name of the algorithm. We will add it.

Minor comments
We will implement all the minor comments directly in the new version of the manuscript.