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Authors' final response

P. Da Ronco[1,2] **and C. De Michele**[2]

[1]Centro Euro-Mediterraneo sui Cambiamenti Climatici, Impacts on Soil and Coasts Division, Capua, CE, Italy
[2]Politecnico di Milano, Department of Civil and Environmental Engineering, Milano, Italy

Correspondence to: P. Da Ronco (pierfrancesco.daronco@polimi.it)

We thank referees 1 & 2 for their detailed reviews to our manuscript. The new version of the work has been developed in accordance with reviewers' comments and suggestions.

In the "Introduction" and in the section "Methods" we explain the targets of the combined use of different methods. Then, we emphasize the novelty of the stepwise procedure which starts from previous studies with the aim of maximizing the performance of the methods involved. Moreover, we tried to explain in more detail the reasons of step order.

Regarding the structure of the paper:

- the state-of-art has been added to the Introduction. Here, we briefly discuss advantages and disadvantages of some approaches with respect to the Po river basin. Within the same section we emphasize the novelty of our proposal for cloud removing from MODIS snow products.

- A new section "Methods" contains:
  1) An introduction to MODIS snow products;
  2) A paragraph on "Data pre-processing";
  3) The strategy used for investigating cloud obstruction and its dependence on elevation and season;
  4) The cloud removal procedure, that is preceded by a brief discussion about the assumptions introduced and the reason for step order;
  5) The validation methodology, which includes even a new approach. Here, we provide some considerations about why we preferred to avoid the use ground data in the validation stage.

- The section "Case study" contains now a description of the Po river basin and its major features. In this framework, the importance of snow cover on its hydrologic regime is highlighted, assessing the annual fluctuation of relative snow covered area. A picture showing glaciers derived from MODIS imagery is included to help in understanding the study domain in term of snow cover duration and distribution.

The description of the cloud removal procedure has been substantially improved. First, we provide a summary of the procedure linked to a flowchart that describes the step order and the temporal window of data involved at each stage. Then, we have improved the explanation of step 2, adding a table which report all its intervention rules. The subsections of step 4 and 5 have been integrated with more details.

In the results, we show the impacts of aspect on the snow line altitude at the regional scale within the subsection "efficiency". We have added two pictures showing the altitudes of the regional snow/land lines from January to the end of May of 2005 and 2009 (others are reported as additional material). Lines are drawn per aspect classes (North: $aspect > 315° \,\&\, aspect < 45°$. South: $135° < aspect < 225°$). As it can be noticed in the text, even though meteorologic variables may affect snow distribution on elevations locally, snow lines of south class stand consistently above that of north class. Except for days with extensive snowfalls within the basin (which pull down the snow lines uniformly) snow line altitudes increase during the melting season and the south class maintains higher values for all the study period (2003 - 2012). Overall, this demonstrates that a regional snow line approach which considers exposure improves the representation of topographic effects on snow distribution. Since aspect values can be derived directly from the DEM, our solution in step 3 introduces an improvement without any requirement of additional information and it seems now definitely justified.

Regarding validation strategy, we integrated the previous validation introducing a novel validation methodology. In order to meet the suggestion by Referee 1, we introduced artificial clouds to several continuous days of clear weather. We used 16 clear-sky Aqua/Terra maps extracted from years that were not yet used for the validation (2003, 2007, 2008 and 2010). Cloud masks have been chosen within the same season of other years, in order to ensure the likelihood of the artificial obstruction to cloud cover that may occur. This measure would help in simulating an atmospheric disturbance that lasts several days covering large part of the domain. In this evaluation, the procedure faces the worst case scenario. This additional test is called "spatio-temporal additional cloud mask".

Then, we provide 25 tables containing the results of the validation for each testing day in the first validation approach (named 1-day additional cloud mask). Tables report the performance of the individual steps. Overestimations and underestimations are reported for each passage and for the combined used of steps in series. Such tables are added with the new version of the manuscript as additional material. This would demonstrate that all the steps are tested, as well as they intervene in the application of the procedure to 10 years of images.
Finally, we provide a comparison between our conservative temporal filter in step 2 and a standard 2-day backward filter, as suggested by Referee 2. As expected, the conservative temporal filter has lower efficacy (percentage of cloud pixels re-classified) but with definitely higher accuracy.
Now, the validation involves more than 40 days extracted from all the seasons and over 10 years of data. Two validation strategies are tested. Specific validations were performed for step 2 and 5, and a comparison with two other cloud removal methodologies is provided. Furthermore, 2 and 7-day backward filters are tested in parallel to our novel solution.

The whole paper has been examined for improving the written English and the technical language. In particular, the remote sensing terminology has been reviewed. However, we avoided technical details on remote sensing given the hydrological targets of the journal. The term cloudiness has been removed entirely. The term "satellite crossing time" has been changed to "satellite time of overlapping". Regarding the product legend (MODIS Snow Products User Guide to Collection 5), the name "no snow" is used. We changed it to land, and other pixel classes (sea, lake, lake ice) are named "others", similarly to what was done in several previous contribution. "missing data" and "no decision", are indicated with "0" and "1" in the SCA product. They are processed by our cloud removal procedure in the same way it considers clouds.