

## ***Interactive comment on “Developing an index for heavy convective rainfall over a Mediterranean coastal area” by M. Korologou et al.***

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Received and published: 15 April 2014

Dear Dr Sioutas,

I would like to thank you for your comments and for your time.

We studied them and our responses to every comment are listed below.

### **Specific comments**

1. **In the Title, some word like "forecasting" should be added to define the index operation and role.**

The Title of the article could be:**“Developing an index for heavy convective rainfall forecasting over a Mediterranean coastal area.”**  
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**rainfall forecasting over a Mediterranean coastal area.”**

2. **In Section 2 (Data), lines 37 – 105: A too long and rather confusing phrase that should be rewritten in order to give a more clear meaning. A similar small change should be considered for lines 106 – 109.**

The lines 95 – 112 are revised as follow:

“For this category, the Group Method of Data Handling (GMDH) algorithm (Acock, 2000) was employed with dependent variables:

- the Temperature at 850hPa at the time of the missing observation ( $T_{850_0}$ )
- the 24 – *hour* trend of the  $T_{850}$  at the specific time related to the same time of the previous and the next day ( $T_{850_0} - T_{850_{-24}}$  and  $T_{850_{+24}} - T_{850_0}$ )
- the Dry Temperature at the same time of the next ( $T_{+24}$ ) and of the previous day ( $T_{-24}$ )
- the 24 – *trend* of the next 6-hour Dry Temperature related to the corresponding hour of the next day ( $T_{+30} - T_{+6}$ )
- the 24 – *trend* of the previous 6-hour Dry Temperature related to the corresponding hour of the previous day ( $T_{-6} - T_{-30}$ )
- the 6 – *hour* Wind Runs at the same time, before 24 hours and after 24 hours.

The accuracy ( $+/ - 1^{\circ} C$ ) was found to be as high as 88%.

The second category is consisted of 113 cases, being characterized by available observations at Araxos station at the referring times of the missing observations at Andravida. In this case, the GMDH algorithm was also employed with one more dependent variable, namely the Dry Temperature of this nearby station. The accuracy ( $+/ - 1^{\circ} C$ ) was found up to 90%.”

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3. In Section 3 (Data) after line 134: An improvement of Figure 1 is recommended, i.e. including in a small box the whole Greece and highlighting the area in question.

A figure following reviewer's suggestion will be added in the final version.

4. In Section 2 (Data), lines 205 – 106 and 111 – 112: Concerning data accuracies, as they estimated at 88% and 90% levels, respectively, some more explanation is needed about what those accuracies are expressing, i.e. an average estimate for all the parameters examined?

The GMDH algorithm was used to estimate the missing values of Dry Temperature. The specific algorithm was applied to the available data. An estimate was considered accurate when the difference between the specific estimate and the corresponding observation value is less than  $1^{\circ}$ . As the accuracy was found satisfactory the algorithm was used to fill the gaps.

Thus, we revised the respective text (see comment 2).

5. In Section 2 (Data), line 151: Some information should be added, about how these 143 cases were identified as flash flood events.

The lines 149 – 151: "This analysis showed 508 6 – hour intervals with thunderstorms events over the examined area. 143 cases of these are considered severe being associated with flash flood events."

are revised as follows:

"This analysis showed 508 6 – hour intervals with thunderstorm events over the examined area, including 143 intervals of severe thunderstorms associated with rainfall intensity greater than  $5\text{mm}/\text{min}$  for at least 5 minutes duration or with  $10\text{strokes}/\text{hour}$  according to aforementioned paragraphs. The specific events potentially lead to flash floods."

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6. In Section 3 (Methodology), lines 188 – 190: the statement " : : their performance found to be poor (Dimitrova et al., 2009) and thus of no practical value" is not acceptable as it is expressed. There are many references supporting a good performance of the instability indices examined, depending on a variety of meterological conditions and other factors, thus some revision in the text is needed here.

The lines 186 – 190: "According to HeVeS (Hellenic Verification Scheme) (Petrou et al., 2009) and to Yule Index (Marinaki et al., 2006) their performance found to be poor (Dimitrova et al., 2009) and thus of no practical value."

are revised as follows:

"Although these indices are satisfactory in many cases worldwide, for the examined area their performance, following the HeVeS (Hellenic Verification Scheme) (Petrou et al., 2009) and the Yule Index (Marinaki et al., 2006), was found to be poor (Dimitrova et al., 2009) and thus of no practical value."

7. In Section 3 (Methodology), line 246: For the "Combined Hypothesis Development" tool, some more description of the concept and some reference is needed.

The concept is explained in (Graham et al., 2010) and the term "Combined Hypothesis Development" is introduced by our research team to denote the combination of two methodologies for assumption developing, i.e. experience based and theoretical.

Thus we considered that the lines 209 – 211 "An index is a successfully tested hypothesis that can be developed from experience, literature or theory, or combination of these (Graham et al., 2010)."

should be rewritten to introduce the term as follows:

"An index is a successfully tested hypothesis that can be developed from experience, literature or theory, or combination of these (Graham et al., 2010) i.e.

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Combined Hypothesis Development."

8. **In Section 4 (Developing the New Local Instability Index), lines 318 – 320: Some reference is needed here, about the tools and methods used.**  
Nemhauser, George L. and Laurence A. Wolsey, Integer and Combinatorial Optimization, John Wiley & Sons, 1988.
9. **In Paragraph 4.1 (ACAPE Term), lines 343 – 352: Some explanations should be given in the text about the various threshold values set, i.e. what criteria have been used.**

The estimation of the thresholds were calculated using the branch-and-bound algorithm as described in Nemhauser, George L. and Laurence A. Wolsey, Integer and Combinatorial Optimization, John Wiley & Sons, 1988. The objective function to be maximized was the precision of LII and the thresholds of parameters were the changing variables with constrain the recall value to be 100%. This reference will be inserted

10. **In Paragraph 4.2 (Moisture Term), 377 – 380: This phrase should be a little revised, since cooling at lower levels generally results to a more stable airmass.**

Here we are referring to the "evaporative cooling mechanism". The air-cooling due to evaporation inside precipitation makes the air denser than its surrounding and thus increases instability and accelerates the "cold ball" downwards and causing strong burst and usually the amount of precipitation is rather small.

We are revising the lines 377 – 380 as follows :

"In the opposite, when mid-level moisture increases, the atmospheric instability can decrease because moist air is less dense and therefore less able to evaporate precipitation than the drier air. The evaporation of precipitation at or beneath cloud level causes the air-cooling inside precipitation downdrafts, making the air

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denser and increases instability although that the amount of precipitation is usually small."

11. **In Section 5 (Calculations, Evaluation and Discussion): Some comment is needed about the size of the data sample and its representativeness in relation to the extracted results. Except September and October, all the remaining months exhibit a small number of thunderstorm cases. Future work may consider a larger number of cases, possibly including severe summertime thunderstorm cases.**

We agree with the reviewer and we will consider this issue in our future work.

12. **In Section 6 (Conclusions): Future research as it mentioned in the last paragraph, is also recommended, to implement a more representative severe thunderstorm data sample, including hail, windy conditions and possibly other areas, i.e. northern Greece that is usually affected by severe thunderstorms mainly in May and June. The use of weather radar data for a more accurate specification of thunderstorm intensity is also highly recommended, to a further improvement and strength of the proposed LII index, towards a more widely research and operational forecasting use.**

We agree with the reviewer and we will consider this issue in our future work.

### Technical corrections

**The paper should be checked for corrections of small errors in English expressions.**

We have performed additional checking and revision in language.