Responses to Referee #2

Dear Reviewer,

We are very grateful for the constructive comments of Referee #2. We totally agree with all major and specific comments and recommendations. We propose to substantially modify the manuscript and totally restructure it according to the referee's advises. We will expand the introduction and methodology as recommended. The bibliography will be expanded.

We give in this letter our responses to the comments in blue.

Kind regards,

Antoine Allam, Roger Moussa, Wajdi Najem, Claude Bocquillon

Overview

This article attempts a new classification of the Mediterranean climates using the most recent WorldClim dataset. It also attempts to study how climate change will change the climates of the area of study. This is an interesting object of study, but the article cannot be published without a complete rewriting and improvement of the methods used. Thus, I recommend it to be rejected and resubmitted again in the future.

We thank you for finding the topic interesting. We agree on your comments and the article will be restructured accordingly.

The main problems of the article are:

1. Incomplete introduction.

Ok, we agree. The introduction will be expanded in order to include more details on the background of the climatic classification and its purpose. We will expand and detail the literature on the climatic classification within Mediterranean context.

2. Insufficient literature review.

Ok, we agree, the following references will be added:

Breiman, L., J. Friedman, C. J. Stone and R. A. Olshen (1984). Classification and Regression Trees, Taylor & Francis.

Cramer Wolfgang, Guiot Joël, Fader Marianela, Joaquim Garrabou, Jean-Pierre Gattuso, Ana Iglesias, Manfred A. Lange, Piero Lionello, Maria Carmen Llasat, Shlomit Paz, Josep Peñuelas, Maria Snoussi, Andrea Toreti, Michael N. Tsimplis, Elena Xoplaki. Climate change and interconnected risks to sustainable development in the Mediterranean. Nature Climate Change, 2018; DOI: 10.1038/s41558-018-0299-2 http://www.medecc.org/climate-and-environmental-change-in-the-mediterraneanmain-facts/

Dell'Aquila, A., A. Mariotti, S. Bastin, S. Calmanti, L. Cavicchia, M. Deque, V. Djurdjevic, M. Dominguez, M. Gaertner and S. Gualdi (2018). "Evaluation of simulated decadal variations over the Euro-Mediterranean region from ENSEMBLES to Med-CORDEX." Climate dynamics 51(3): 857-876.

Diouf, O. C., Weihermüller, L., Ba, K., Faye, S. C., Faye, S., & Vereecken, H. (2016). Estimation of Turc reference evapotranspiration with limited data against the Penman-Monteith Formula in Senegal. Journal of Agriculture and Environment for International Development (JAEID), 110(1), 117-137.

Drobinski, P., N. D. Silva, G. Panthou, S. Bastin, C. Muller, B. Ahrens, M. Borga, D. Conte, G. Fosser, F. Giorgi, I. Güttler, V. Kotroni, L. Li, E. Morin, B. Önol, P. Quintana-Segui, R. Romera and C. Z. Torma (2018). "Scaling precipitation extremes with temperature in the Mediterranean: past climate assessment and projection in anthropogenic scenarios." Climate Dynamics 51(3): 1237-1257.

Giorgi, F. (2006). Regional climate modeling: Status and perspectives. Journal de Physique IV (Proceedings), EDP sciences.

Kotlarski, S., Keuler, K., Christensen, O. B., Colette, A., Déqué, M., Gobiet, A., Goergen, K., Jacob, D., Lüthi, D., van Meijgaard, E., Nikulin, G., Schär, C., Teichmann, C., Vautard, R., Warrach-Sagi, K., and Wulfmeyer, V.: Regional climate modeling on European scales: a joint standard evaluation of the EURO-CORDEX RCM ensemble, Geosci. Model Dev., 7, 1297–1333, https://doi.org/10.5194/gmd-7-1297-2014, 2014.

Koutroulis A., Dryland changes under different levels of global warming. Science of The Total Environment 655, DOI: 10.1016/j.scitotenv.2018.11.215

Lionello, P., and Scarascia, L.: The relation between climate change in the Mediterranean region and global warming, Reg. Env. Change, 18, 1481-1493, doi: 10.1007/s10113-018-1290-1, 2018.

Menne, M. J., I. Durre, B. Korzeniewski, S. McNeal, K. Thomas, X. Yin, S. Anthony, R. Ray, R. S. Vose and B. E. Gleason (2012). "Global historical climatology network-daily (GHCN-Daily), Version 3." NOAA National Climatic Data Center 10: V5D21VHZ.

Raymond, F., Ullmann, A., Camberlin, P., Drobinski, P., and Chateau Smith, C.: Extreme dry spell detection and climatology over the Mediterranean Basin during the wet season, Geophys. Res. Lett., 43, 7196–7204, https://doi.org/10.1002/2016GL069758, 2016.

Rivoire, P., Tramblay, Y., Neppel, L., Hertig, E., and Vicente-Serrano, S. M.: Impact of the dry-day definition on Mediterranean extreme dry-spell analysis, Nat. Hazards Earth Syst. Sci., 19, 1629–1638, https://doi.org/10.5194/nhess-19-1629-2019, 2019.

Romera R., Sánchez E., Domínguez M., Gaertner M.Á., Gallardo C. (2015) Evaluation of present-climate precipitation in 25 km resolution regional climate model simulations over Northwest Africa. Clim Res 66(2):125–139.

Ruti, P. M., S. Somot, F. Giorgi, C. Dubois, E. Flaounas, A. Obermann, A. Dell'Aquila, G. Pisacane, A. Harzallah and E. Lombardi (2016). "MED-CORDEX initiative for Mediterranean climate studies." Bulletin of the American Meteorological Society 97(7): 1187-1208. https://doi.org/10.1175/BAMS-D-14-00176.1

Tramblay, Y. and S. Somot (2018). "Future evolution of extreme precipitation in the Mediterranean." Climatic Change 151(2): 289-302.

Turc, L. (1961). "Estimation of irrigation water requirements, potential evapotranspiration: a simple climatic formula evolved up to date." Ann. Agron 12(1): 13-49.

Zittis, G. (2018). "Observed rainfall trends and precipitation uncertainty in the vicinity of the Mediterranean, Middle East and North Africa." Theoretical and applied climatology 134(3-4): 1207-1230. https://doi.org/10.1007/s00704-017-2333-0.

3. Messy document structure. Many paragraphs are in the wrong section and/or are incomplete.

Ok. The articles will be restructured according to the reviewer's comments. The introduction and methodology will be expanded. A discussion section will be added.

4. Methodology insufficiently explained.

The methodology will be detailed so anyone could reproduce or apply the study on another database. The methodology will be expanded to include 3 additional subsections in Section 3 (which will have 7 in total):

3.1 Hydrology driven climatic indices

This subsection will be moved from section 4 Results to section 3 Methodology. It will be also expanded to justify the choice of these indices to highlight the hydrological specificity.

3.6 Verification methodology

This subsection will describe the grid-based and ground station classification verification steps within section 3 methodology

3.7 RCP Scenarios

This subsection will detail the procedure to assess the climate change impact on the classification. The delta change calculation and transposition to the WorldClim-2 grid cells using GIS.

5. The article proposes its classification for hydrological purposes, but I do not see any hydrological specificity in the indices and methods used.

This paper described the first stage of a larger study within the thesis of Allam on Mediterranean hydrology entitled "Hydrological characterization of Mediterranean catchments based on climatic and physiographic features"

Most of the climatic indices considered in this study reflects the Mediterranean seasonality and precipitation intermittence such as the frequency indicators (I_S, $P_{25\%}$, $P_{75\%}$) or periodical indicator like ($S_{P1.5}$, $S_{P1.7}$, S_{P2}) or the dispersion index of precipitation I_{Hor}.

The same could be said about temperature indices ($\Delta T1$, $\Delta T2$, $T_{25\%}$ & $T_{75\%}$ $S_{T1.2}$) which describe the seasonality and variability of evapotranspiration or intermittence of dry and humid seasons.

All these indices reflect the precipitation seasonality and variability which constitute the main climatic forcing into the hydrological regimes of Mediterranean rivers.

Motivated by the quest for a specific hydrology for the Mediterranean we first established a new high-resolution climatic classification for hydrology purposes based on Mediterranean specific climate indices like precipitation seasonality and aridity that play an important role in the hydrological mechanisms of Mediterranean catchments and flow intermittence.

This classification is useful with the projection of future scenarios, in following up hydrological (water resources management, floods, droughts, etc.) and ecohydrological applications such as Mediterranean agriculture like olive cultivation and other environmental practices.

Hydrologically, Haines in 1988 has classified river regimes based on monthly average flows only and identified the Mediterranean regimes under 3 of the 15 global classes and found a clear relation to Köppen's Mediterranean climate (Haines et al., 1988).

The hydrological similarity between catchments should be judged based on specific metrics taking into account the complexity of the environmental factors impacting the catchment response (Wagener, Sivapalan, & Troch, 2007). This approach has been adopted in Mediterranean regional studies like Oueslati in 2015 who classified Mediterranean rivers into 6 flow regimes, based on Richter's hydrological indices and broad-scale catchment characteristics (Richter et al., 1996; Oueslati et al., 2015) and by Di Prinzio for the classification of 300 Italian catchments making use of Self Organization Maps (Di Prinzio et al., 2011).

Di Prinzio, M., Castellarin, A., & Toth, E. (2011). Data-driven catchment classification: application to the pub problem. Hydrol. Earth Syst. Sci., 15(6), 1921-1935. doi:10.5194/hess-15-1921-2011

Haines, A., Finlayson, B., & McMahon, T. (1988). A global classification of river regimes. *Applied Geography, 8*(4), 255-272.

Oueslati, O., De Girolamo, A. M., Abouabdillah, A., Kjeldsen, T. R., & Lo Porto, A. (2015). Classifying the flow regimes of Mediterranean streams using multivariate analysis. Hydrological Processes, 29(22), 4666-4682. doi:10.1002/hyp.10530

Richter, B. D., Baumgartner, J. V., Powell, J., & Braun, D. P. (1996). A Method for Assessing Hydrologic Alteration within Ecosystems. Conservation biology, 10(4), 1163-1174. doi:doi:10.1046/j.1523-1739.1996.10041163.x

Wagener, T., Sivapalan, M., & Troch, P. (2007). Catchment Classification and Hydrologic Similarity. Geography Compass, 901-931.

6. The catchment-based classification seems unnecessary. Its utility should be justified, or it should be removed.

This section will be clarified in the text.

The catchments constitute the elementary unit of any hydrological study, and as clarified in our response to the previous question this classification is for hydrological purposes. By classifying the Mediterranean catchments climatically and physiographically, we will be able to classify them hydrologically and predict the hydrological characteristics on Ungauged basins.

7. Some decisions are not well justified (index selection, use of delta change approach, etc.).

Ok we agree, the sections concerning the indices choice and delta change approach will be detailed and justified in the text.

The delta change consists of the temperature and precipitation difference between the baseline period 1970-2000 and the projected period 2070-2100.

After the calculation of delta changes, MED-CORDEX grid was overlaid on WorldClim-2 grid and using spatial join algorithm, the attributes of the delta change grid cells were transposed to WorldClim-2 grid cells, to obtain the projected data on WorldClim-2. The indices were then recalculated using the projected values of monthly temperatures and precipitation.

Spatial join tool corresponds to joining attributes from a source feature to a target source based on the spatial relationship. The source feature is the calculated MED-CORDEX delta change grid and the target feature is the WorldClim-2 grid.

Proximity analysis correspond to finding target features located within a buffer zone or a distance of a source feature. In our case. The MED-CORDEX grid is the source feature and the WorldClim-2 grid is the target feature. The features of MEDCORDEX grid cells were transposed to the nearest grid cells of WorldClim-2.

8. Insufficient discussion of the results. A Discussion section is necessary.

Ok we agree, a discussion section will be added to include the new results of the additional simulations.

9. The classification is not sensitive to climate change (the scenarios are very close to the baseline map). Is this a sign that climate change won't have much impact? Or that the method is unable to represent these changes?

Ok, we agree that one simulation is not enough to highlight the climate change impact on the classification, therefore two RCM simulations CCLM 4-8-19 and RegCM 4.3 for both RCP 4.5 and 8.5 scenarios will be added. The discussion will be expanded accordingly.

However, and according to the obtained results, we can see that the classes area and spatial evolution is not major however, the seasonality index I_S has varied between 7% and 9% as for the $S_{P1.5}$ it increased between 70% and 96% for classes 4 and 5.

Specific comments

In my specific comments I will only comment the structural problems. I will not mention the many language issues, such as missing commas or orthography.

Ok, the text will be reviewed by a colleague whose English is his native language.

Introduction

- Expand the introduction to provide more context and better describe relevant literature.

Ok, we agree, the introduction will be expanded to include more literature on the climatic classification within Mediterranean context.

- P2L13: You should mention that MED-CORDEX is a HyMeX initiative.

Ok, this information will be added, and the sentence will become:

"Med-CORDEX, a HyMeX initiative, (Ruti et al., 2016) is part of the…"

- P2L15: Start new paragraph when discussing RCP.

Ok.

- P2L15-L29: This should be moved to the dataset section, where you describe the Med-CORDEX simulation.

Ok, this paragraph will be moved to 2.3 Climatic data, under MEDCORDEX paragraph (3).

- P2L30-P3L2: Expand. Explain the methodologies that are used, their pros and cons, etc.

Text will be expanded and used methodologies of each mentioned study will be included.

- P3L7-L10: Move to datasets section.

Ok, paragraph was moved to section 2.3 Climatic data.

- P3L11-L21: Move to Methodology section. Study area and database

Ok, paragraph was moved as an introduction to section 3. Methodology.

- You describe the different methods to determine the geographical extent of the Mediterranean area, but you do not justify your choice.

Ok, we agree. As the main purpose is hydrological, we chose the hydrological boundary as a study area. The hydrological boundary could also be considered as the topographic, morphological or landform boundary which constitute an important boundary to microclimates.

- P3L29: Are you sure that "Ecumune" is the right word in this context? To my knowledge Ecumene is the "known world" of the Romans. It seems a more historical term that a geographical one.

It was also used to define a geographical extent of the old inhabited world.

- P4L16: "a personal way" is not correct here.

Ok, the expression will be modified to be:

"*Since the geographic extent of the study is very wide, the delimitation of catchments was imported from international references.*"

- In "Climatic data" you must justify that WorldClim is appropriate in the Mediterranean. Is the number of stations used by this dataset high enough all over the area?

Ok, this section will be modified to include the details on the number of stations considered in WorldClim-2 for the Mediterranean region. Refer to figures S1 and S2 in the supporting information of Fick and Hijmans (2017) article.

"The WorldClim-2 database was built over 23 regions with different coverage for each parameter. For the precipitation an overlap of 3 regions covered the Mediterranean area with a total of 10410 stations for the 3 regions (euw n= 3730; eue n = 3632; naf n = 3048). For average temperature, the Mediterranean was covered by one region (eu1) with number of stations n = 1760; n = 1627 for Maximum temperature and n = 1626 for Minimum temperature;"

- P4L31-L32: Move to methodology.

The sentence "Both classifications were compared for validation." will be moved from 2.3 climatic data, (1) Woldclim to 3.4 Adopted Methodology to become:

"The classification was verified and compared to WorldClim-2 gridded indices and ground stations indices"

Methodology

- This section is insufficient as it is. You spend more time explaining the history of the methods than describing how you applied them. You should explain all the details so anyone can reproduce your work. You should remove text about the history of the methods and add text detailing you own implementation details. This applies mainly to PCA and K-Means clustering. How do you apply the PCA? How do you normalize the variables? ...

Ok, we agree. The historical part will be reduced. The PCA implementation steps will be detailed so the methodology could be reproduced.

- Some text that should be in this section is found in other sections and vice-versa.

Ok we agree, the article structure will be modified according to the reviewer's comments with additional modifications of the author.

- P5L13: there is no need to talk about taxonomy.

Ok, the sentence about taxonomy was removed.

- P5L18-L29: This belongs to the Introduction. You should explain and compare the methods.

Ok, this section will be moved to the introduction. And the different methods will be explained.

Genetic classification is based on the cause of the climate. A genetic system relies on information about climate elements like solar radiation, air masses, pressure systems, etc.

Bioclimatology studies the relationship between the climate and the distribution of living beings and their communities on the Earth. This discipline began to take shape on connecting mean climate values (temperature and precipitation) with values on areas occupied by plants and plant formation.

Bioclimatic classification provides a typology of bioclimates which has an accurate relationship between vegetational models and climate values and considering the high predictive value of bioclimatic units it could be used in the studies of biodiversity and habitats.

Agro-climatic classification describes the inter relationship between agronomy, farming systems and climate

- P5L30-L32: This belongs to the Introduction.

Ok, this section will be moved to the introduction.

- P6L5-L6: delete the titles of the books. You already provide the citation in the bibliography: "... we advise to consult Krzanowski (1988) and Jolliffe (2002).

Ok, it will be modified.

- P7L6: can you better explain the part about kernel 1? I don’t fully understand.

This information will be added to the text.

“By forcing the kernel 1, corresponding to class 1, into the first node of the decision tree, the classification rules (distances to kernels) were generated according to kernel 1. Otherwise, we could have forced kernel 2 (of class 2) into the first node of decisions and obtained another set of rules.”

- P7L10: Here you talk about validation. There should be a subsection in Methodology about the validation method.

Ok, a new subsection will be added 3.5 Validation methodology.

Section 4

- You should rename this section "Results".

Ok, the section title will be modified to “results”.

- P7L22-P8L7: you should move this subsection to the Methodology section. Furthermore, you must justify your selection of indices. Why did you choose these indices? Why are they relevant in the Mediterranean? Why are they relevant for hydrology? Did other studies use these same indices?

Ok, this subsection will be moved to the methodology, and choice of indices will be justified as follow:

Most of the climatic indices considered in this study reflects the Mediterranean seasonality and precipitation intermittence such as the frequency indicators (I_S, $P_{25\%}$, $P_{75\%}$) or periodical indicator like ($S_{P1.5}$, $S_{P1.7}$, S_{P2}) or the dispersion index of precipitation I_{Hor}.

The same could be said about temperature indices ($\Delta T1$, $\Delta T2$, $T_{25\%}$ & $T_{75\%}$ $S_{T1.2}$) which describe the seasonality and variability of evapotranspiration or intermittence of dry and humid seasons.

All these indices reflect the precipitation seasonality and variability which constitute the main climatic forcing into the hydrological regimes of Mediterranean rivers.

- P7L22: what do you mean by "subjectively developed"?

The indices were chosen subjectively to emphasize Mediterranean climate contribution into hydrological behaviour of Mediterranean catchments. Sentence will be modified as follow:

"The hydrology driven independent climatic indices were chosen subjectively and developed at the catchment scale from WorldClim-2 monthly average data."

- P8L9-L10: You should explain the reduction of indices by means of the correlation matrix in the Methodology section.

Ok, the following sentence will be added to the methodology section.

"The number of indices is reduced at two steps. The first step is based on the correlation matrix, where strongly correlated indices higher than 0.85 were eliminated. The second is based on PCA results where indices that doesn't contribute into the principal component that represent the greatest variabilities are eliminated."

- P8L11-14: These results are for catchments or for the grid?

The results in this section are for catchments as no PCA was applied on grid indices but instead the classification was transposed using the decision tree.

- P8L23: Change subsection title to "4.3. Catchment based classification".

Ok, it will be modified.

- P8L24: how did you choose 5 classes? Is this arbitrary?

Ok, the choice will be justified and the following information will be added:

"Figure 1 and text in page 5 line 30, shows that the Mediterranean hydrological boundary includes in addition to Csa and Csb climates, the desertic BWh and Bsk and continental Cf and Cs climates. We chose 5 classes as we hoped for a classification that delimits the Mediterranean climate from North and South and divides the intermediate coastal zone. Therefore, one class would cover the southern desertic region, another class would cover the northern continental region and 3 classes to cover the intermediate coastal region. Thus, a distribution into 5 classes. A larger number would produce an uninterpretable fragmented classification."

- P8L31: "from the southern tip of Spain to Syria".

Ok, the text will be modified.

- P9L13: Remove 4.4 subsection title.

Ok, it will be modified.

- P9L14: Change title to "Grid base classification" and change numbering from 4.4.1 to 4.4.

Ok, it will be modified.

- P9L21-L29: There are many problems here. First, in the data section you don't mention where you obtained the data on the limits of the olive tree geographical domain. Also, I don't see how you conclude that the comparison between the olive domain and your classifications validates the classification. Looking at the maps I don't see that they match well. The olive tree distribution also depends on geology and human practices. I don't see that you can predict the olive tree area using your classification map.

Ok, we agree. The comparison between the olive cultivation boundary and climatic classification needs more clarification.

The olive cultivation boundary was included in section 2.1 under the description of the Agricultural-bioclimatic boundary (P4L9) and it was obtained from Moreno, 2014.

We agree that olive tree cultivation depends on factors other than climatic, however in this paper we were just pointing out on the relationship between the typical Mediterranean climate expressed by classes 2, 3, and 4 and the olive cultivation which matches as olive tree cultivation boundary and classes 1 and 5 boundaries rarely intersect.

- P9L20: promote the heading one level to 4.5.

Ok, it will be modified.

- P10L5: Promote the heading one level to 4.6

Ok, it will be modified.

- P10L6: How did you divide the data into two subsets. Randomly?

Yes randomly. The sentence will be modified to "The total population of gridded indices was divided randomly into two equal subsets".

- P10L12: Integrate these results into the Results section (4.7).

Ok, it will be modified.

- P10L13: The delta change approach must be explained in the Methodology. Also, you need to justify that this is the right approach, as you are using percentiles and the delta change approach may produce unrealistic percentiles, such as P75%. Don't forget that the delta change approach only changes the mean of the distribution, but climate change may change the mean and the extremes differently.

Ok, this section will be moved to methodology into a new subsection 3.7 RCP Scenarios.

- P11L3-L5: I don’t understand what you are trying to convey with this paragraph.

The following paragraph about indices and data uncertainties will be added into the subsection 2.3 climatic data.

The use of ground-based stations time series or gridded observational data is limited by several uncertainties mainly density and interpolation processing methods, especially in Mediterranean region where North African and Levantine countries are poorly covered (Zittis, 2017). Nevertheless, the use of specific indices like seasonality and aridity, which are averaged on 30 years periods and based on monthly and annual values, while avoiding extreme event indices, reduces data quality uncertainties. On the other hand, several studies have revealed the uncertainties connected to the resolution of RCM simulated gridded data in the Mediterranean complex domain (Romera et al., 2015) hence the use high-resolution data like MEDCORDEX 12 km grids and WorldClim-2 1-km and overall, the regional aspect of this study makes it less sensitive to local errors.

- The main result I see in the climate change part is that there is almost no change. This may mean that your method is not sensitive to climate change, or that there is almost no impact of climate change. I guess the right answer is the first one, which means that maybe your classification is not good enough. You should elaborate on that.

We agree, therefore two additional scenarios (CCLM 4-8-19 and RegCM 4.3) will be included in the climate change section for RCP 4.5 and RCP 8.5. The classification evolution under all scenarios will be discussed accordingly.

A Discussion section is missing before the conclusions.

A discussion section will be added

Conclusions

- Re-write once the other issues have been solved.

Ok, we agree

Figure 1

- I don’t understand the existence of non Mediterranean enclaves within the Mediterranean area. Look at the "islands" found in, for example, Tunisia or Libya.

Actually, these are enclosed catchment that drain into a lake or pond and not into the Mediterranean Sea.

- Is this Köppen classification made using WorldClim data? You should mention the data source in the datasets section. Same for the Olive Cultivation Boundary.

The references are mentioned in the dataset section.

The Köppen classification was revised by Peel in 2007 based on a set of stations and not based on WorldClim-2 data.

Figure 4

- I don’t find this catchment based classification interesting. Why is interesting to have the whole Rhône, Ebro or Po with the same climate classification when they have diverse climates?

Yes, Rhône, Ebro and Po are very wide catchments (above than 10000 km^2) and have diverse climates, however smaller catchments (less than 3000 km^2) belong to only one climatic class. It is interesting to have a catchment based climatic classification that shall be cross analysed with a catchment based physiographic classification (article in preparation) that both classifications will be used for a hydrological characterization of Mediterranean catchments. Hence the utility of hydrology oriented climatic indices.

- I cannot see the blue line. What does CAT mean?

CAT = Catchment boundary, thin blue line that indicated the hydrological boundary, legend modified to hydrological boundary

- I can't see the green olive domain line.

The dark green colour was modified for a brighter green that should be seen clearly

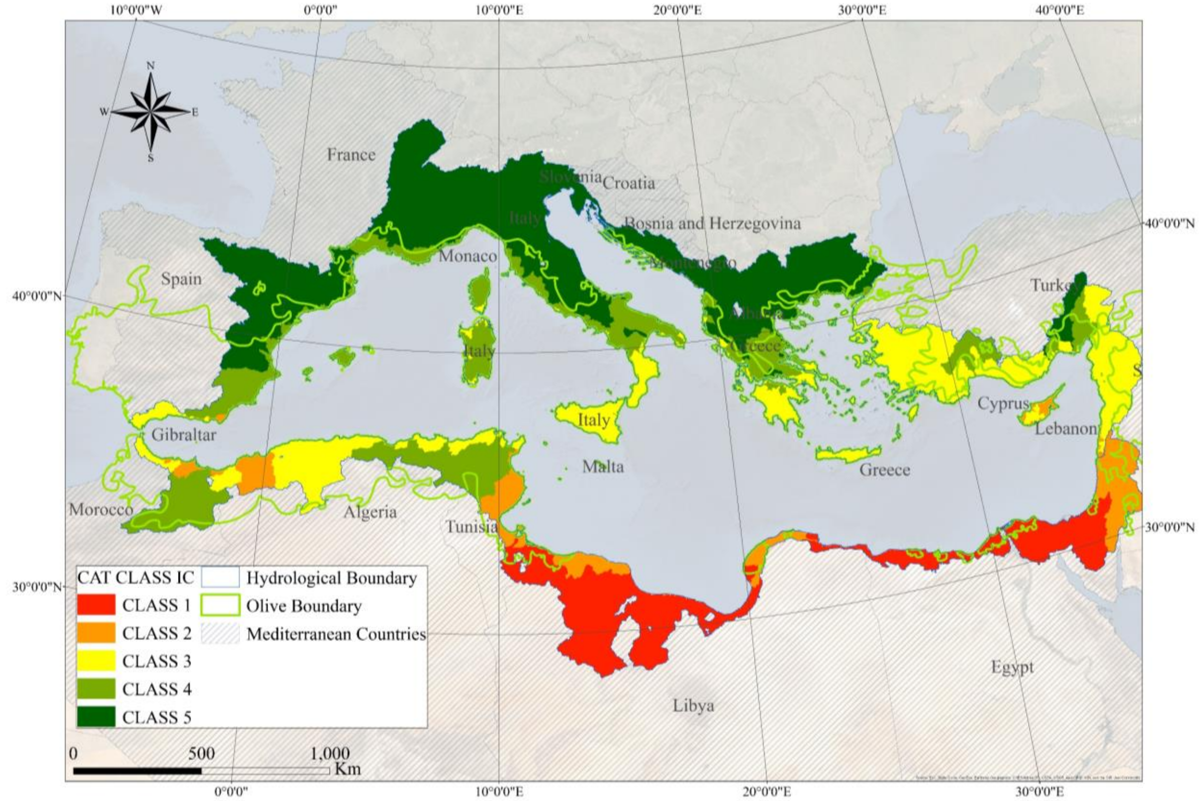

Figure 4. Geographical distribution of the Mediterranean climatic classes based on catchments average indices using WorldClim-2 monthly data.

Figure 5

- I don't understand why the Ebro basin is class 4, as is the coastal area. If you look at the Köppen classification you'll see that the coastal area and the Ebro valley are classified differently, as they have different climates and vegetation types. The same happens with the Rhône and the Po.

The climatic classification might differ for wide catchments classification between the catchment based classification and grid based classification because of the climatic variables averaging for catchments.

- I can't believe that the Alps have the same climate than the Po valley. Your method does not take into account the different climates found at different altitudes.

Alps and Po valley don't have the same climate, but they belong to the same climatic class according to this classification approach. They both share close seasonality index (around 0.47) and close aridity index I_{Arid} (around 1.06). It should be reminded that this classification was developed for hydrological purposes within the Mediterranean context, which makes it different from Köppen's or other pure climatic classifications.

- I don't understand the yellow area close to Austria, in Italy. You should explain and discuss these missclassifications in the results and discussion sections.

The classification gives a deterministic result where each grid should belong to one of the 5 classes. Grid classification is a result of a set of decision rules based on its distances to classes kernels where distance is calculated from the grid indices each with a different range of values. Therefore, grids could belong to different classes but were classified according to the nearest kernel.

Figure 6

- I see two yellow points in NW Spain. That area has an Köppen classification Cfb. Their climate is very different to the climate of Sicily, for example! I guess this results is due to the fact that you trained your method with data in the Med bassin and, thus, the method cannot deal well with climates situated outside the domain. If you want to use stations outside the domain, you must train your method with data outside the domain.

Not all the stations located within Csa or Csb and in the Mediterranean region belong to the same climatic class.

The two yellow points stations are closer to the class 3 kernel than of other classes' kernels. They might have neighbouring indices' values as of other Class 3 points without sharing the same climate.