Reply to Piero Lionello (referee #2) comment of 2 April 2014-04-11

General comments

1) The initial paragraph of section 4 is honest discussion of what can (should) be considered part of MEDEX. This is not an easy issue and this sort of "problem" is common to many bottom-up initiatives, which have no dedicated centralized funds for their activities. In think that MEDEX was a very valuable initiative in spite of this problem with identifying strictly whether a result or a paper belong to MEDEX. Probably "part of the research performed by people belonging or connected to the MEDEX community could have been done even if MEDEX had not existed", but at the same time part of the work was motivated by MEDEX and would have probably not have been done without MEDEX. My point here is that at the end of this initial paragraph, I suggest authors write clearly the criterion (or criteria) used for including a "clear" MEDEX scientific achievement in the rest of section 4. How was the selection done?

First, we have included your sentence ***", but at the same time part of the work was motivated by MEDEX and probably would not have been done without MEDEX"****, because we think it clarifies the idea.*
With regard to the criteria used for inclusion or omission of different papers in section 4, we have tried to clarify this issue by changing part of the introductory text. In particular, we changed

"Part of this work 5 was performed by groups external to MEDEX and even part of the research performed by people belonging or connected to the MEDEX community may have been done even if MEDEX had not existed. ***On the contrary, t****he contributions directly presented to some of the MEDEX meetings (see Table 1) can be considered strict MEDEX production, although preliminary or informal; the same holds 10 for many contributions to the Plinius Conferences on Mediterranean Storms (Table 1), as already mentioned in Sect. 2. Part of both sets of informal scientific contributions became later formal literature****. In the following subsections, some clear and significant MEDEX scientific achievements will be mentioned,*** *grouped according to the specific objectives of the two phases of MEDEX"*

to

*"Part of this work was performed by groups external to MEDEX and even part of the research developed by members belonging or connected to the MEDEX community could have been done even if MEDEX had not existed****, but at the same time some work was motivated by MEDEX and would probably not have been done without MEDEX.***

T*he contributions directly presented to some of the MEDEX meetings (see Table 1) can be considered strict MEDEX production, although preliminary or informal; the same holds for many contributions to the Plinius Conferences on Mediterranean Storms (Table 1), as already mentioned in section 2. Part of both sets of informal scientific contributions became later formal literature.* ***Papers elaborated in this way can be considered MEDEX production and many of***

them, according to their relevance, have been included in the following subsections. These subsections also include as MEDEX production other papers that have used MEDEX data explicitly, including the list of selected cases, or that are closely related to the MEDEX objectives and whose authors or co-authors are MEDEX community members.

In order to facilitate a more comprehensive view to the reader, the following sections also mention some papers that are clearly not MEDEX production but which represent a necessary antecedent of the MEDEX work or serve to appropriately frame or complement the MEDEX activities. As far as possible, MEDEX and non-MEDEX contributions are distinguished in the text.

In the following subsections, the papers that are mentioned, both genuine MEDEX work and connected studies are *grouped according to the specific objectives of the two phases of MEDEX."*

2) Further the authors might consider being more specific on the results that have been obtained. Section 4 is rather detailed on objectives and activities of MEDEX, but rather vague on conclusions. Examples in section 4.1: Which areas are characterised by a high concentration of cyclones? Which areas are active throughout the year? Which present a very marked seasonal behaviour? Later is section 4.1: which conclusion was reached for time evolution of the frequency and characteristics of the Mediterranean cyclones in connection with climatic change? Which patterns were found to be linked to the occurrence of cyclones producing high impact weather? To some extent this list of questions can be continued across several parts of section 4. In my view adding sharp focused sentences on the conclusion, would greatly increase the usefulness of this manuscript and provide a guide across literature.

With regard to highlight some results, within section 4.1 we have added or modified the following texts:

*"(…) some areas are characterised by a high concentration of cyclones****, namely Cyprus, Genoa and some secondary zones. S****ome of these areas are active throughout the year****, particularly Genoa****, but some tend to present a very marked seasonal behaviour****, like interior of the Iberian Peninsula or Saharan areas, with cyclones occurring almost exclusively during summer (and spring). On the contrary, the Ionian Sea has a minimum of activity during summer. In Cyprus the maximum activity is during summer, but the activity remains important the rest of the year. Partial seasonality can also be found in the Aegean Sea or the Adriatic Sea, with relative maximum activity during winter, or in the Palos-Oran maritime zone, with maximum activity during summer.****"*

"If the total cyclonic circulation in a region is defined by the sum of the geostrophic circulations associated with all detected cyclonic centres (intense, moderate or weak) during the 45 years of the ERA-40 period, the annual total cyclonic circulation shows a significant decrease in the Western Mediterranean, mostly in winter and spring, and an increase in

the Eastern, mainly due to the summer and autumn growth in the frequency of Cyprus weak (thermal?) lows. The decrease of circulation in the Western Mediterranean can be mostly associated with the decline in the frequency of all Genoa gulf cyclones. No significant changes are detected in the frequency of Palos-Oran cyclones, for instance."

"In general, the work done in MEDEX or in connection with MEDEX confirms the relatively near presence of a cyclonic centre in most of the atmospheric patterns associated with heavy precipitation. The associated cyclones are sometimes weak and/or shallow, that is not necessarily intense and/or vertically deep. The association between strong wind and close cyclone is less frequent. The cyclones associated with strong wind tend to be intense and deep and can be centred relatively far from the strong wind area (even out of the Mediterranean, as Nissen et al. (2010) stated working independently of MEDEX)."

In section 4.2 we propose to add the following:

"The quantity and variety of works related to the understanding and numerical simulation of the physical processes involved in the Mediterranean cyclogenesis and eventually in the subsequent adverse weather make difficult to summarise the main scientific results in this field. However, very synthetically, an idea that can be highlighted is that significant cyclogenesis in the Mediterranean only occurs with the concurrence of a large scale baroclinic or upper level disturbance, although the geographical factors (orography and land-sea contrast) redirect the process to some preferential areas. In a certain way this is validation of the old idea of considering the Mediterranean cyclogenesis as a secondary cyclogenesis with regard to the oceanic storms tracks. The shape, intensity and exact location of the resulting surface cyclone can be decisive to trigger or locate strong wind and/or heavy rain."

In section 4.3 we can add:

"As a general result, we can confirm that, as expected, the highest sensitivities tend to be located upstream of the main development zones of Mediterranean cyclones, that is, many times in the open ocean or inland Africa, where the operational observing network is scarce."

A short sentence has been added in the Conclusion (section 5):

"Some particularly significant scientific results have been highlighted on each of these aspects in the corresponding subsection along the section 4"

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3) I suggest that the authors consider carefully the use of "High impact" and "severe" across their paper. The first line of the second paragraph of the introduction uses "severe or high impact" , suggesting they are equivalent terms. They should not. "Severe" means that the intensity of the event is remarkable

(generally adopting a criterion related to a low probability threshold), while “high impact” relates to the fact that it produces a damage. Depending on vulnerability and exposure, and accounting often for cascade effects, not all “severe” weather conditions are “high impact” and sometimes, though rarely, high impact weather can be not particularly severe (this is in fact stated in the second paragraph of the introduction). My impression is that most of the material refers to “severe” weather and that, in fact, it was not possible to investigate to a satisfactory degree the links between severe and high impact weather (see also section 4.6), so that substantial research is still needed on this issue. I suggest that the author comment on this, at least in the conclusion.

We fully agree with the observations made here by Piero Lionello. Although the following is not a truly justification, the problem comes from the initial definition of MEDEX. MEDEX was designed with the idea of endorsing it within the WMO World Weather Research Programme (WWRP). WMO desired that the projects included in WWRP were dealing with high impact weather in the true sense (events producing serious social and economical damage). Keeping this idea in mind, MEDEX was defined as a project about “cyclones that produce high impact weather” but for many purposes we relaxed the notion and we accepted to deal more generally with severe weather, thus with some potential to produce high impact. Nevertheless, in order to avoid confusion, the text has been reviewed and some changes have been introduced.

In particular, in the abstract we have modified the following sentence:

“MEDEX has produced a specific database, with information about cyclones and ***severe or*** *high impact weather events”*
[Note that the MEDEX Database contains information about severe weather and also information about social impacts]”

In the Introduction the following sentences have been completed:

“The basic motivation of MEDEX is that at least part of the Mediterranean cyclones produce high impact weather ***or at least severe weather, thus potentially generating high impacts on exposed and vulnerable sectors.****”*

“However, ***severe weather and high impact weather*** *in the Mediterranean are not exclusively associated with intense cyclones.”*

“Obviously there are many weak or moderate cyclones or shallow depressions in the Mediterranean that do not produce any ***severe or*** *high impact weather”*

In section 2 the following sentences have been modified:

“During the First Phase MEDEX was mostly oriented to the improvement of knowledge about the cyclones that produce ***severe and/or*** *high impact weather in the Mediterranean.”*

“observational platforms would improve most significantly our forecasts of cyclones and ***severe and/or*** *high impact weather in the Mediterranean”*

*In 3.1, "**high impact** weather calendars" has been changed by "**severe** weather calendars"*

*In 3.3 and 3.4, "**high impact** weather" has been changed by "**severe and/or high impact** weather", except if the expression is included in a public document.*

*In 4.1, "calendars of **high impact** weather" has been changed to "calendar of **severe** weather" and "Another group of papers focuses on the link between cyclones and **high impact** weather" has been changed by "Another group of papers focuses on the link between cyclones and **severe** weather"*

*In 4.2, "**high impact** weather" has been changed to "**severe** weather", except with reference to the high impact cyclone of Italy 1966.*

*In 4.3, 4.4, 4.5 and 5, "**high impact** weather" has been changed to "**severe and/or high impact** weather"*

Other points

Third paragraph of introduction: Actually the link between precipitation and cyclones depends substantially on the definition of precipitation event. If the total amount of rain during the event is considered as a measure of its intensity (eventually including more than one day) the correlation is actually strong (Reale and Lionello, 2012). Further this paragraph is dealing only with precipitation. In general high impact cyclones could include also those related to strong winds (e.g. those producing high waves in the sea and storm surges), and may be also producing heavy snowfalls. Line 6 to 14 refer to only to intense precipitation only and not to high impact weather in general. This could be reconsidered by the authors.

In some way as a response to Referee #1 and also to you, in the Introduction, and in other parts of the paper, we have added some non-MEDEX bibliography, in order to better orient the reader. One of the introduced references is Reale and Lionello (2013).

With regard to lines 6-14 in page 4 (initial composition), you are right that it is only dealing with heavy precipitation and this is a mistake. We have split the paragraph, with modifications in the first part, and we have added a new one in between.

The first paragraph would say:

*"In summary, **heavy precipitation** in the Mediterranean, **including heavy snowfall** is in some cases directly related to intense cyclones and in some events indirectly linked to weak or moderate cyclones. In any case, a distinct cyclonic signature is usually found in connection with the onset of **this kind of severe** weather."*

The added new paragraph would be:

"Regarding strong winds, it is clear that in the vicinity of an intense cyclonic centre large pressure gradients are present and strong winds are generated, but some local disturbances, connected to the complex Mediterranean geography, would also exert a key role in the generation and/or intensification of some Mediterranean strong winds, mainly those known as "local winds" (like Mistral-Tramontane, Bora, Etesian and so on). Many of the local disturbances take the shape of dipolar pressure anomalies (see, for instance, Jansa, 1987, Campins et al., 1995, Jansa, 1997). On the other hand, although many Mediterranean windstorms can be related to Mediterranean cyclones, some of them are mainly associated to external intense cyclones (Nissen et al., 2010)."

This means new references (see later)

I think that the authors could also mention at the end of section 2 that some of the climate analysis carried out by MEDEX is being continued by MEDCLIVAR, a WCRP endorsed project (Lionello et al. 2012) which includes some of the objectives on cyclone climatology of MEDEX. Authors of this "MEDEX" article have been involved in the writing of the MedCLIVAR books (Lionello et al. 2008, chapter 6) which shows a real, though informal cooperation between the two initiatives). Further two chapters of the MedCLIVAR book (chapter 6 of the first , Lionello et al. 2008, and chapter 5 of the second, Ulbrich et al 2012) contain material relevant for the discussion in introduction section

It is clear for us than the MEDEX and MedCLIVAR collaboration and the MedCLIVAR books had to be mentioned in this paper. We are grateful to Piero Lionello for permitting us to rectify this initial omission.

The following are additions to the text and to the list of references:

*At the end of section 2***: *"In addition to EUMETNET/EUCOS, THORPEX or HyMeX, MEDEX has maintained contacts and collaborations with other international projects. It is worth mentioning the collaboration with MedCLIVAR. The Mediterranean cyclones that produce high impact weather, which are the main subject of MEDEX, have been analysed by MedCLIVAR from the climatological point of view. The cooperation with MedCLIVAR was agreed by P. Lionello with A.Jansa. P.Alpert acted as link between both projects. Apart from cross participations in some respective meetings, Lionello et al. (2006) is a tangible result of the MEDEX / MedCLIVAR cooperation."***

In the beginning of subsection 4.1: "Before MEDEX and simultaneously with it, although independently of this project, important work has been done concerning the climatology of the Mediterranean cyclones. Prior to describe the climatological work done within MEDEX, it is worth mentioning some of the more relevant non-MEDEX papers since 1990: Alpert et al., 1990a, 1990b; Flocas and Karacostas, 1996; Trigo et al., 1999, 2002; Flocas et al., 2001, 2010;

Maheras et al., 2001, 2002, Kouroutzoglou, 2011. ***It is also relevant to mention climatological MedCLIVAR work, partially done in collaboration with MEDEX (see Lionello et al., 2006, and Ulbrich et al., 2012, for a review)"***.

It is not clear to me from section 4.4 to which extent data assimilation has been explored in MEDEX? Could the author comment on data assimilation use in regional weather prediction, its feasibility and utility?

The participation of MEDEX in the DTS Preview campaign of 2008 and the DTS MEDEX campaign of 2009 have been used to explore the usefulness of the assimilation of some additional data. This question is mentioned in subsection 4.4, although the results are not spectacular ("Another way is to analyse the direct impact in the forecast of the additional observations or even of the additional assimilation of some available and non used data, like high density satellite data (Campins et al., 2013). The results obtained until now are not conclusive, but indicate partial usefulness of some additional data")

Added references (among other: see also responses to Referee #1):

Campins, J.; Jansà, A.; Benech, B.; Koffi, E. and Bessemoulin, P.: PYREX Observation and Model Diagnosis of the Tramontane Wind. Meteorol. Atmos. Phys., 56, 209-228, 1995.

Dee, D.P., S. M. Uppala, A. J. Simmons, P. Berrisford, P. Poli, S. Kobayashi, U. Andrae, M. A. Balmaseda, G. Balsamo, P. Bauer, P. Bechtold, A. C. M. Beljaars, L. van de Berg, J. Bidlot, N. Bormann, C. Delsol, R. Dragani, M. Fuentes, A. J. Geer, L. Haimberger, S. B. Healy, H. Hersbach, E. V. Hólm, L. Isaksen, P. Kållberg, M. Köhler, M. Matricardi, A. P. McNally, B. M. Monge-Sanz, J.-J. Morcrette, B.-K. Park, C. Peubey, P. de Rosnay, C. Tavolato, J.-N. Thépaut and F. Vitart; The ERA-Interim reanalysis: configuration and performance of the data assimilation system, Q. J. Roy. Meteor. Soc. 137 (656), 553–597, 2011, DOI: 10.1002/qj.828

Jansa, A.: Distribution of the Mistral. A satellite observation. Meteorol. Atmos. Phys., 36, 201-214, 1987.

Lionello, P., Bhend, J., Buzzi, A., Della-Marta, P.M., Krichak, S., Jansa, A., Maheras, P., A. Sanna, A., Trigo, I.F. and Trigo, R.: Cyclones in the Mediterranean region: climatology and effects on the environment. in Lionello, P., Malanotte-Rizzoli, P., Boscolo, R. (Eds.) Mediterranean Climate Variability. Elsevier, Amsterdam, The Netherlands, pp. 325-372, 2006.

Nissen, K.M.; Leckebusch, G.C.; Pinto, J.G.; Renggli, D.; Ulbrich, S. and Ulbrich, U. Cyclones causing wind storms in the Mediterranean: characteristics, trends and links to large-scale patterns. Nat. Hazards Earth Syst. Sci., 10, 1379-1391, 2010.

Reale, M. and P. Lionello: Synoptic climatology of winter intense precipitation events along the Mediterranean coasts. Nat. Hazards Earth Syst. Sci., 13, 1707–1722, 2013, doi:10.5194/nhess-13-1707-2013

Ulbrich, U., Lionello, P., Belusic, D., Jacobeit, J., Knippertz, P., Kuglitsch, F.G., Leckebusch, C., Lutebacher, J., Maugeri, M., Maheras, P., Nissen, K.M., Pavan, M., Pinto, J.G., Saaroni, H., Seubert, S., Toreti, A., Xoplaki, E., and Ziv, B.: Climate of the Mediterranean: Synoptic Patterns, Temperature, Precipitation, Winds, and Their Extremes. In Lionello, P. (Ed.), The Climate of the Mediterranean Region: from the Past to the Future. Elsevier, Amsterdam, The Netherlands, pp. 301-346, 2012.

Uppala, S.M., Kållberg, P.W., Simmons, A.J., Andrae, U., da Costa Bechtold, V., Fiorino, M., Gibson, J.K., Haseler, J., Hernandez, A., Kelly, G.A., Li, X., Onogi, K., Saarinen, S., Sokka, N., Allan, R.P., Andersson, E., Arpe, K., Balmaseda, M.A., Beljaars, A.C.M., van de Berg, L., Bidlot, J., Bormann, N., Caires, S., Chevallier, F., Dethof, A., Dragosavac, M., Fisher, M., Fuentes, M., Hagemann, S., Hólm, E., Hoskins, B.J., Isaksen, L., Janssen, P.A.E.M., Jenne, R., McNally, A.P., Mahfouf, J.-F., Morcrette, J.-J., Rayner, N.A., Saunders, R.W., Simon, P., Sterl, A., Trenberth, K.E., Untch, A., Vasiljevic, D., Viterbo, P., and Woollen, J.:*The ERA-40 re-analysis. Quart. J. R. Meteorol. Soc., 131, 2961-3012*, 2005, *doi:10.1256/qj.04.176*

Very specific comments

- Page 12 line 4-6. Why the threshold for precipitation is fixed, while the threshold for wind depends on the local climatology

About thresholds, MEDEX adopted the simplest decision: a unique threshold where possible and two thresholds when it was absolutely necessary. In the case of rainfall the large spatial variability permits a very large diversity of values almost everywhere. On the contrary, strong winds tend to be very repetitive at some locations and/or in some regions. The following is a complete response given to Referee #1 about the same question:

There are several options to define thresholds for heavy precipitation and strong wind, when thinking on calendars of events with potential social impact.
As known, the (negative) social impact of an intense meteorological event depends, not only on the intensity of the phenomenon, but also on the vulnerability. The vulnerability depends on the population density, degree of urbanisation, presence and condition of infrastructures and so on. But it also depends on the rarity or frequency of the phenomenon, that is, of the climatology, because there is a certain natural and human adaptation to frequent phenomena, even if they are very intense. Extreme options are to determine different thresholds everywhere, by taking into account all the aforementioned factors (a really difficult task) or to adopt unique thresholds for the whole territory. An intermediate option is the pure climatological approach, through computing thresholds for every station, with reference to pre-defined percentiles or return periods; this is also complicate and needs complete climatological information. Note that MEDEX has used thousands of climatological stations.

The decision taken in MEDEX was to adopt a threshold system as simple as possible. There is only a very partial reference to climatology. The decision was taken by consensus within the MEDEX community and it was not contested by the WMO WWRP Steering Committee.
Regarding precipitation, it is assumed that accumulations of 60 mm per day can produce damages, mainly trough flash flooding, if they affect inhabited zones or headers of certain rivers or streams. Therefore, although in some areas 60 mm do not produce significant impact, this threshold was adopted for simplification by the MEDEX community for the whole Northern Mediterranean area. It was already used as a threshold for the Northern Mediterranean in the former WMO Mediterranean Cyclone Project (MCP). On the contrary, a threshold of 30 mm per day was adopted in MCP for the Southern Mediterranean. This climatological differentiation probably would also have been considered if data from the Southern Mediterranean were actually integrated in the MEDEX calendar. Note, for instance, that one of the most dramatic hydro meteorological events in the Mediterranean, the 1-2 November 1994 flooding in Egypt, with 500 human life looses (Obassi, 1997, Address, INM/WMO International Symposium on Cyclones and Hazardous Weather in the Mediterranean, Palma de Mallorca, Spain, April, pp. 21–25), occurred with relatively modest precipitations, under 20 mm according to direct measurements or up to 58 mm according to estimations (Krichak et al, 2000, Atmos. Res., 53, 45-62; Gheith and Sultan, 2002, Jour. of Hydrology, 263, 36-55).
Regarding wind and also thinking on impacts, sustained winds of 18 m/s or gusts of 25 m/s are considered to be dangerous in general, but not in the most windy locations or regions. On the other hand, in the most windy locations or regions the general threshold is so frequently overpassed that it would be inconvenient to retain so many events. For that reason, for some particular weather stations in Spain and for the whole French Mediterranean areas the thresholds were increased to 25 m/s for sustained wind and 33 m/s for gusts. From some farther work, it seems that, thinking on impacts, the adopted thresholds are quite representative (see, for instance, Amaro et al, 2010, or Papagiannaki et al., 2013).

To gain clarity, we propose to change the initial text in pg 546, lines 4-8,

"The threshold for precipitation is 60 mm/day. The thresholds for wind depend on the climatological characteristics of the station. The usual thresholds are 18 m/s for maximum sustained wind (ten minutes average) and 25 m/s for the maximum daily gust, but for the windiest stations the thresholds are increased to 25 m/s and 33 m/s respectively."

to the following:

*"**The MEDEX community adopted a very simple threshold system for precipitation and wind. The threshold for precipitation is unique for the Northern Mediterranean, 60 mm/day. Note that the MEDEX calendar does not include data from the Southern Mediterranean, which is climatologically drier, what would demand a lower threshold. The thresholds for wind do depend on the climatological characteristics of the station or the region. The general thresholds are 18 m/s for maximum***

sustained wind (ten minutes average) and 25 m/s for the maximum daily gust, but for the windiest stations or windiest regions the thresholds are increased to 25 m/s and 33 m/s respectively.*"*

- I do not understand line 13 at page 21.

Perhaps the following addition clarifies the sentence:

"After some parallel work with adjoint models (Homar and Stensrud, 2004), ***sensitivity computations made with*** *the MM5 adjoint model was the first method adopted to face the work agreed between MEDEX and EUCOS with regard to the systematic identification of sensitive zones for generic cases of Mediterranean severe and/or high impact weather"*

- Line 13 page 16 is "summery" English?

It was a mistake. It has been corrected: "most of the **summer** cyclones are warm and shallow depressions"

- Indicators is misspelled at line 2 of page25

Corrected: "**indicators** of societal impact"

- Last par of 4.5 why is this in the section about ensemble methods?

As described in the document that defines the MEDEX Second Phase (Jansa et al., 2005), the specific objective of the First Phase referred to societal impacts includes questions related to the forecasting verification. The following is a literal transcription: "*The societal impact branch, including the evaluation of the societal impact of the hazardous weather associated to some Mediterranean cyclones, as well as the development of verification procedures to determine the quality of the forecasts and the establishment of ways to translate the scientific achievements to the operational meteorological community." This question is only implicit in the corresponding objective of the Second Phase.*

To be more clear in this sense, we have added a sentence on section 2, at the end of the paragraph in which the specific objectives of the First Phase are related:

"Note that the specific objective 4 included subjects on forecasting verification."

- Fig.3: Which quantity is shown here? The density of cyclone center when intensity was above the threshold? What is the unit used? On which data is this figure based ? ERA-Interim?

The figure caption has been modified to include the necessary information:

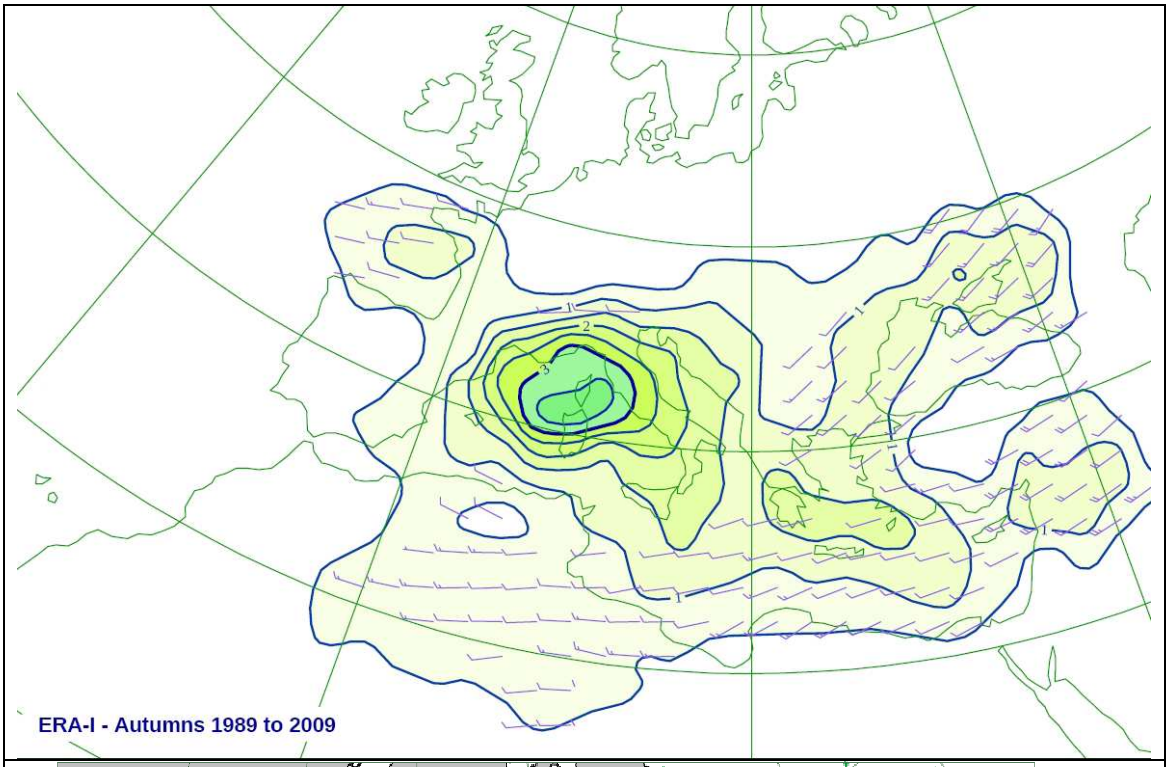
"Figure 3. Geographical distribution of intense cyclones, that is, cyclones with a geostrophic circulation larger than $7x10^7$ m^2 s^{-1} and with a duration of at least 24 hours. The isolines refer to average number of cases per year, in 2,25ºx2,25º lat-lon squares. The data are based on ECMWF-ERA-40 reanalysis, 1957-2002 (Homar et al., 2007; courtesy of Joan Campins, AEMET; Uppala et al., 2005")

- Fig.4 what are the units? Fig.4 what the arrows show? Please specify period off the data ERA-INTERIM that have been used.

When trying to respond to the questions related to Fig. 4 we have noted that there is a possible confusion: the text mentions "winds" but Fig. 4 (as it is in the submitted manuscript) does not show winds (the arrows on it represent average displacement velocity of the cyclone centres). Therefore we have considered that Fig. 4 has to be completed, including a second panel, initially foreseen, but missed in the original manuscript.

Fig. 4 has been improved and completed (see at the end of this document), and the figure caption has been modified to answer the questions:

Figure 4.
Upper panel: Density of cyclone tracks in autumn. A cyclone location is defined by the 850 hPa vorticity maximum. Only cyclones with vorticity of at least $1x10^{-4}$ s^{-1} are considered. The tracking has been made on 1° resolution lat-lon grid vorticity fields, using ERA-Interim reanalyses, over the 1989-2009 period. The counting is normalised to periods of two months. The arrows are average displacement velocities (barbs, in knots); only average velocities of at least 10 kts are plotted; in areas with high cyclone track density the average becomes lower.
Lower panel: Location of wind maxima within a ring between 300 and 600 km radius around the cyclone centre when a Mediterranean cyclone is present.
(Courtesy of Bruno Joly, Météo-France; Dee et al., 2011).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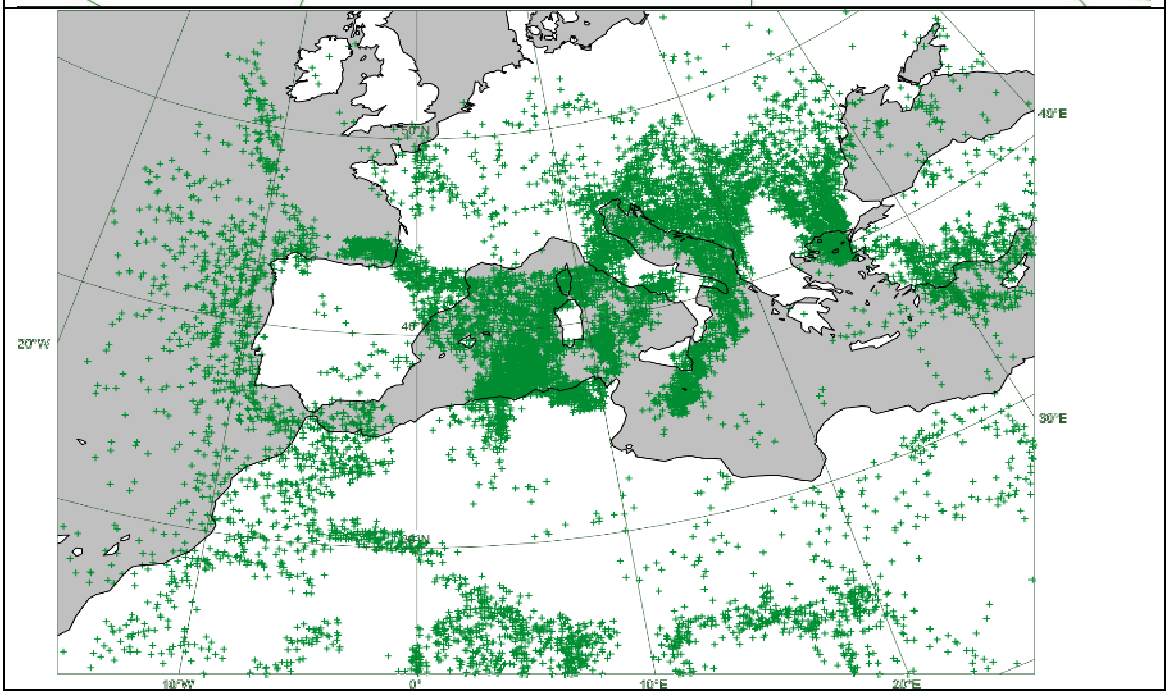
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