Response to comments of B. Rutherford

We like to thank Blake Rutherford for his constructive comments, which help us to improve our manuscript. Below, detailed responses to all comments are given.

1. On Page 29334 Line 17- 'The most important source is local evapotranspiration from the European land surface, followed by moisture from the North Atlantic. Further relevant contributions come from tropical Western Africa (10–20°N). Contrary to expectations, the Mediterranean Sea contributes only about 10% to the precipitation event.' - Here and in other parts of the paper, you downplay the role of the Mediterranean contribution. Even though only 10% of the moisture came from the Mediterranean, a heavy precipitation event is more complicated than total moisture and the sources of the moisture, e.g. why was the system stationary for three days? While interesting, the moisture source composition cannot describe the contributions from a particular source as important or unimportant. This statement and others later in the paper go a bit too far in describing the importance and unimportance of different sources.

The statement in the abstract will be adapted as follows: 'The source with the largest share is local evapotranspiration from the European land surface, followed by moisture from the North Atlantic. Further contributions come from tropical Western Africa (10–20°N) and the Mediterranean Sea. Contrary to what could be expected, the Mediterranean contribution of about 10% is relatively small.' We also checked that in other parts of the paper there are no statements on the importance of the Mediterranean Sea in general, but only on the relatively small contribution of Mediterranean moisture to the event.

2. The differences in height of the sources for both the Lagrangian and Eulerian approaches is an important aspect that I feel has not received enough attention. I recommend providing more details about these differences. For example, at what vertical levels do the different sources originate? A figure describing these differences for a few vertical levels would be helpful.

In the Figure below, the moisture sources from the Lagrangian diagnostic are shown separately for three vertical layers (trajectories started below 1800 m altitude, between 1800 m and 3600 m, and above 3600 m, which yields sim-

ilar numbers of trajectories in each layer). The sum of these three panels gives the total boundary layer moisture sources shown in Figure 8a. While the precipitation forming at lower altitudes in the target region has larger sources in the North Sea and northern North Atlantic (left panel), the more southerly sources contribute more to the precipitation forming further aloft (right panel). A note on this shift of the main source regions with altitude will be added to the paper. Nevertheless, we would not like to include the Figure in the manuscript or add an extended discussion of moisture source differences with altitude, since such a more detailed analysis of the Lagrangian diagnostic is not the main focus of our study, which rather aims at comparing the two different moisture source diagnostics.

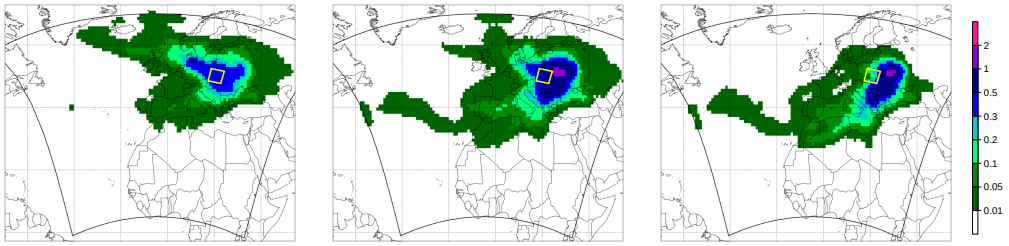

Figure 1: Within boundary layer moisture sources from the Lagrangian diagnostics, as shown in Figure 8a, but for trajectories started from different vertical layers in the target region: below 1800 m altitude (left panel), between 1800 m and 3600 m (middle panel), and above 3600 m (right panel).

3. Page 29341 line 21- The word weight implies that you can assign a value to the importance based on the time of moisture uptake before the event. I would suggest that the wording is changed.
We will replace 'weight' by 'contribution'. The term weight has been referring to the fractional contributions as defined by Sodemann et al. (2008) in their equations 5-7 (which in fact constitute numerical values measuring the importance of each moisture source), but this technical detail probably leads to confusion here.

4. Page 29346 last paragraph- More details are needed on the trajectory integration scheme. How is the target region defined? Why is the vertical distribution chosen this way? What fraction of trajectories satisfies the given

criteria, and what is their initial distribution within the target region? What vertical levels do they come from?
The paragraph will be expanded as follows: ' To further illustrate the transport path of moisture from southerly sources (Tro and Lnd_afr tracer) three-dimensional kinematic backward trajectories have been calculated from a region covering the target domain shown in Figs. 3a and 4 (longitudes between 20° and 30°E, latitudes between 45° and 55°N) based on ECMWF analysis data. The trajectories have been started at 12:00 UTC 16 May 2010 from a horizontal grid of $1° \times 1°$ and vertical levels between 950 hPa and 500 hPa in steps of 50 hPa. Figure 7a shows the selection of trajectories with a northward movement of at least 30° during the calculation time of 168 h. 5% of the trajectories fulfil this criterion, mostly started from the central part of the domain and from levels above 800 hPa.'

5. Page 29347 Section 5- Similar to the previous comment, more details on the trajectory integrations are needed. By 25km x 25 km grid, I assume that 25 km is the horizontal distance between trajectories, not the size of the entire grid. Grid spacing would reduce the ambiguity. Also, it is not clear how the trajectories are distributed in the target region. Do they fill the entire target region? A reference to Figure 3 would be useful at this point. How sensitive are the results to the choice of target region?
The technical description will be complemented: 'Every 6 h between 00:00 UTC 15 May and 00:00 UTC 18 May 2010 backward trajectories have been started from about 8700 starting points covering the entire target region (see Fig. 3a) on a regular grid with 25×25 km grid spacing in the horizontal and on vertical levels from 1000 hPa to 550 hPa in steps of 30 hPa (which implies that each trajectory represents the same total mass).' The target region is chosen to encompass the region of maximum precipitation, as shown in Fig. 3. If it was extended to regions with no or little precipitation, this would hardly affect the results, as there would not be substantial moisture decreases along the additional trajectories. Shifting the region to the south (where some precipitation occurred) may change the results, as the precipitation there may have different source regions. For the comparison of the Eulerian and Lagrangian approaches, it is important that both diagnostics refer to the same target region.

6. Page 29351 Section 7- After looking at Figures 12 and 13, one can deduce that the two trajectories originate at different heights. This should be stated

in the text as well. Do they also originate at the same time and horizontal locations? Are these differences in initial location, especially in height, a more general tendency for all trajectories in this study?
Actually, both trajectories originate from the same height (this is a bit difficult to see in the Figures due to the different vertical scales) and have been started at the same time, but from different horizontal locations. We will add information on the starting locations to the caption of Figure 11. The trajectories have been started from a regular grid, and thus there are no inhomogeneities in the initial distribution. The two examples have not been selected because of their representativeness for certain trajectory clusters, which is not the scope of the present study. They are used for a detailed methodological comparison of the Eulerian and Lagrangian approaches. A note on this will be added to the manuscript.