Reply to referees - WCD-2020-54 - "A numerical study to investigate the roles of former hurricane Leslie, orography, and evaporative cooling in the 2018 Aude heavy precipitation event"

We thank the referee #3 for its thoughtful comments on the revised version, which we have addressed below. Comments from the referee #3 are in *italics* and our response is in upright font. Parts added to the manuscript are in blue and deleted parts are in ~~red~~. Lines refer to the lines of the version commented by the referee.

Reply to anonymous referee #3

Replace 'resolution' with 'grid spacing' when using numbers to discuss your model setup (e.g. 1 km, 500 m). L7: 1 km and 500 m horizontal grid spacing

> Several occurrences have been replaced:
L7: [...] numerical simulations are run at 1 km and 500 m horizontal ~~resolutions~~ grid spacing and evaluated [...]
L141: [...] ANTILOPE quantitative precipitation estimate (QPE) at 1 km horizontal ~~resolution~~ grid spacing blending [...]
L154-156: A 960 × 900 km^2 horizontal domain ~~at~~ with a 1 km ~~resolution~~ grid spacing covering [...] and a 180 × 135 km^2 horizontal domain ~~at~~ with a 500 m ~~resolution~~ grid spacing centred over Aude is chosen for the child domain (Fig. 1).
L208: is close to the horizontal ~~resolution~~ grid spacing of REF.
L441: [...] numerical simulation at 1 km and 500 m horizontal ~~resolutions~~ grid spacing is carried out [...]
L506: For the child model ~~at~~ with a horizontal grid spacing of 500 m~~horizontal resolution~~, [...]
L508: At ~~resolutions~~ horizontal grid spacing lower or equal to 1 km, [...]

Refer directly to one of the schematic diagrams of heavy precipitation events that you listed in your previous response (e.g. Fig. 1 of Ducrocq et al. 2016; Fig. 11 of Ricard et al. 2012), rather that just the paper. This way, the reader won't be expecting you to produce a schematic diagram of your own.

L30. 'a maritime part of the Occitanie region...'.

> References have been added and corrections have been made.
With this climatology, synoptic situations favouring HPEs over Languedoc-Roussillon, the maritime part of the Occitanie region in southern France (Fig. 1), are now well known ~~.~~(e.g. Fig. 11 of *Ricard et al.* 2012; Fig. 1 of *Ducrocq et al.* 2016).

L38. 'abnormally warm SSTs...'.

> It has been corrected.
[...] abnormally warm SSTs [...]

L44-45. Couple of other references for outflow boundaries of cold pools, local convergence lines and mesoscale pressure troughs?

> New references have been added. Mesoscale pressure troughs have been removed from the enumeration because they are often collocated with convergence lines and we have not found a recent reference supporting this claim (in France for example, pressure is only observed at a synoptic scale by conventional networks).
Such stationary boundaries can be fronts (*Trapero et al.*, 2013), outflow boundaries of cold pools (*Ducrocq et al.*, 2008), local convergence lines (*Buzzi et al.*, 2014) ~~, mesoscale pressure troughs,~~, among others.

L79. 'A similar dynamic feedback...'.

> It has been corrected.
~~Similar~~ A similar dynamic feedback [...]

Spell out 'Section' fully, rather than using 'Sect'.

> It has been corrected.
~~Sect.~~Section

I can't see the labels "A" and "P" on Figure 5, even though you refer to them in the figure caption.

> White boxes have been added to improve the readability of labels. Also, the dashed line showing CF1's position has been replaced by the standard symbol of a quasi-stationary front.

L146. Include a couple of references for the sentence on the catastrophic consequences of the rainfall (from the earlier list on L65-66).

> Two references have been added.
[...] because most of the rain fell in 6 to 12 h (*Préfecture de l'Aude*, 2018; *Ayphassorho et al.*, 2019).

L251. Replace 'what' with 'which'.

> It has been replaced.
This section investigates ~~what~~ which mechanisms supply [...]

L283. Delete 'brutally'.

> It has been deleted.
[...] horizontal wind speed ~~brutally~~ decreases [...]

L287. Replace 'increase' with 'increases'.

> It has been replaced. "Mean" has also been added to be more precise.
Their ~~water vapour mixing ratio increase~~ mean water vapour mixing ratio increases through [...]

L293. '...over the sea'.

> It has been corrected.
[...] over the sea.

L309. '...local forcing'.

> It has been corrected.
[...] local forcing~~s~~ [...]

L310. 'Convection triggered over the sea...'

> It has been corrected.
Convection triggered over the sea [...]

L388. Instead of 'south–south-eastern wind', use 'south south-easterly wind'. Do the same for any other instances throughout the paper.

> You're right, all instances have been corrected.
L236: [...] simulates ~~south-eastern instead of eastern~~ south-easterly instead of easterly wind directions in some places.
L279: the speed of this ~~south-eastern~~ south-easterly LLJ exceeds
L356: [...] showing that convective cells are aligned with the ~~south–south-eastern~~ south–south-easterly mid-level wind direction.
L388-389: [...] as they are advected by the ~~south–south-eastern~~ south–south-easterly mid-level wind ~~, the south-eastern LLJ~~ (Fig. 14a), the south-easterly LLJ (Fig. 14c) supplies

L387-390. The reworked sentence is slightly confusing to read. Can you reword by splitting into two sentences, or changing the order of the points you're making?

> The sentence has been split and reworded.

~~Because of the slight directional vertical wind shear simulated in the lower part of the troposphere (see wind direction in Figs. 14a,c), once~~ Once convective cells are on the lee side of the mountain, as they are advected by the ~~south–south-eastern~~ south–south-easterly mid-level wind ~~, the south-eastern LLJ~~ (Fig. 14a), the south-easterly LLJ (Fig. 14c) supplies conditionally unstable air parcels that do not cross the Albera Massif to the cells from their south-eastern flank. Backward trajectories starting from their updraughts (not shown) indicate that the number of low-level moist air parcels that do not cross the Albera Massif found inside the cells increases as they are advected. This ~~supply mechanism~~ slight directional vertical wind shear simulated in the lower part of the troposphere possibly explains the maintenance of the convective cells long after they are formed.

L395. Reword to avoid starting the sentence with an abbreviation ('REF').

> The sentence has been reworded.

~~REF maximum~~ Maximum precipitation over plains is reduced from 338 mm in REF to 310 mm in NOALB, and the maximum in NOALB (332 mm) is shifted over mountains.

L406. Replace 'relief' with 'peak'.

> It has been replaced.

[...] of these ~~reliefs~~peaks, [...]

L424-425. '...explained by the evaporative cooling being switched off.'

> It has been corrected.

[...] by the evaporative cooling being switched off.

L434-435. Although you have added a couple of sentences at the end of this section addressing Leslie's role as part of a discussion on future work, you still also have a sentence here where you indicate that Leslie's remnants are involved in the formation of the surface low and cold front (CF2). Did you not mean to remove this sentence?

> You're right. The sentence has been removed and the first paragraph has been adapted accordingly.

The synoptic situation on 14 and 15 October 2018 was favourable to a HPE over Languedoc-Roussillon. The ~~remnants of hurricane Leslie were involved in the formation of a Mediterranean surface low and its associated cold front (CF2). The rapid deepening of this surface low~~rapid deepening of a Mediterranean surface low, extended by a trough over Languedoc-Roussillon, contributed to strengthen a low-level jet (LLJ) over the Mediterranean Sea. Meanwhile, a decaying cold front (CF1) remained quasi-stationary in the middle of the Aude department, west of the trough. The slow movement northwards of the surface low and its associated cold front (CF2) as well as the quasi-stationarity of the trough sustained quasi-stationary atmospheric conditions that continuously supplied conditionally unstable air parcels during several hours over the Aude department.

References

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