I read with pleasure your MS entitled "Evaluation of a long-term optimized management strategy for the improvement of cultivated soils in rainfed cereal cropland based on water retention curves" by Aldaz-Lusarreta et al. The MS deals with the effect of an optimized agronomic protocol on water retention curve, pore size distribution (PSD) and aggregate stability. The Authors concluded that the soil under the optimized system reflected a better quality –or less degradation– compared to conventional management after 18 years of adoption. The MS falls within the Journal's scope and will interest Journal's readers however I have some major and minor issues to draw to your attention.

We appreciate your thorough review and your helpful comments and suggestions that significantly helped to improve our manuscript.

The structure of the abstract should be re-arranged by clearly dividing it into classical sections (introduction, M&M, results, conclusions). In particular, a few sentences regarding M&M should be added to introduce the reader to the work you did.

In fact, the abstract already comprises all these parts each of them as separated paragraphs, but they were automatically merged when uploaded. In addition, since the limited words normally allowed in the abstracts some sections had to be minimized. For instance, the introduction was practically reduced to the presentation of objectives. Anyway, if the Editor finally allows us to send a new draft incorporating all the modifications and suggestions from you and the rest of the reviewers, we will do our best to prepare a better and more complete abstract following your suggestions.

What is the caution of applying organic amendments under no-till? Nitrate Directive and, the more recent NEC Directive claim for greater caution in applying N sources. How can you meet environmental criteria by broadcasting organic waste on the soil surface and not incorporating it? This would result in greater ammonia volatilization and a high risk of leaching. Consequently, also the nitrogen use efficiency would result very low without improving the soil structure due to the low amendments-soil particle mixing.

In the OPM treatment, the measure adopted for the application of the organic amendment in the form of slurry was the distribution by means of a system of hanging tubes that deposit the product almost at ground level, and the moment of application close to a forecasted rainfall event, to minimize volatilization.

Thus, the paragraph has been reformulated to include more information on organic fertilization and its mode of use:

"In both treatments, mineral fertilization consisted of phosphorus addition before seeding (120-150 kg·ha-1 of triple superphosphate 0-46-0) and nitrogen supply of 180 kg N·ha-1 (split and distributed into two cover dressings at 60 kg $N \cdot ha^{-1}$ and 120 kg $N \cdot ha^{-1}$ in January and March, respectively) as urea. Organic fertilization was not used in any of the study treatments until 2021, in which an organic amendment was applied to the soil without disturbing the surface in the OPM treatment. After harvest, pig slurry was applied with an average concentration of 2.5 kg $N \cdot m^{-3}$, by means of a tanker equipped with a system of hanging pipes that deposit the product a few centimeters above the ground and at a time close to a forecasted rainfall event. The application rate was 60 $m^3 \cdot ha^{-1}$ of slurry. These rates are within the legal limits established by legislation for groundwater protection against pollution caused by nitrates from agricultural sources (EU Directive 91/676 (Council of the European Union, 2008)), as the area is within a vulnerable watershed according to this Directive."

The Authors used an indirect method (capillary method) to estimate the PSD however nowadays a lot of direct non-destructive methods are available for a direct assessment of PSD. Therefore, the limitations of your study as related to the adopted methods should be included and discussed in detail.

The reviewer suggests a good point of discussion. In fact, there are several techniques for PSD characterization apart from SWRC (Wardak et al., 2022): (i) X-ray computed tomography (XRCT); (ii) Mercury intrusion porosimetry (MIP); (iii) Electricity resistivity tomography (ERT); and also micromorphological analysis (MA) (e.g., Pagliai et al., 2004).

The **XRCT** is a non-destructive imaging technique which allows the differentiation of materials based on their X-ray attenuation properties. This provides 3D information about soil porosity structure, but not about interconnection of pores.

The **MIP** is a technique used for the evaluation of porosity at micro and meso scale using a porosimeter. This employs a pressurized chamber to force mercury to intrude into the voids in a porous substrate. Although mercury moves only along interconnected pores, its high surface tension limits its access to larger pores connected by relatively small pores. This may lead to a somewhat mischaracterization of the pore network.

The **ERT** is a geophysical technique for imaging sub-surface structures from electrical resistivity measurements. This approach provides 3D information from soil regarding its porous architecture. For instance, unlike compacted soil layer, interconnected pore network may allow the conduction of water and thus increase resistivity. However, resistivity also correlates with many other soil properties (e.g., root systems, mineral surface conductivity) (Abidin et al., 2014; Cimpoiaşu et al., 2020) which constrains data interpretation.

The MA allows a 2D characterization of the pore space –e.g., pore size distribution, shape and pores orientation pattern– from undisturbed soil samples by means of electro-optical image-analysis. Like XRCT, MA does not provide information on pore interconnection, even less being just a 2D analysis.

If we compare all the above techniques with the present one (by using SWRCs), we can say that this approach does not provide information about the porous architecture but it enables an suitable characterization of those interconnected, *functional* pores, and more reliable than that from MIP since water is used instead of mercury. It should be noted that if the SWRC is subjected to several wetting and drying cycles the pore size distribution and other soil morphological properties can be affected –due to hysteresis phenomenon- (Pires et al., 2020). However, our SWRCs were not submitted to any wetting and drying cycle. In short, we understand that other methods are available, but we believe that soil water dynamics and porosity may be well evaluated through the analysis of SWRCs.

The authors presented the water retention curves but only tested the statistical differences between some relevant points (e.g., at saturation). Contrarily, a direct statistical comparison between the curves might give more value to your study.

Thanks for your sound suggestion. Taking advantage of our continuous SWRCs and following the reviewer suggestion we have determined the water retention energy index (WRa) (Eq.1) (Armindo and Wendroth, 2016) obtained from numerical integration including all the points of each SWRC. Needless to say, the accuracy of this index is highly conditioned by the degree of detail of the SWRCs.

$$WR_a = \int_{\theta_{pwp}}^{\theta_{fc}} h(\theta)\, d\vartheta \qquad (1)$$

Where θfc and θpwp is the volumetric water content at field capacity and permanent wilting point, respectively; h is suction (kPa).

WRa quantifies the total absolute energy that has to be applied by the soil to hold water in its pores between field capacity (Θfc) –i.e., after the water drainage process becomes negligible– and wilting point (Θpwp) or any moisture point Θj, where $\Theta pwp \leq \Theta j < \Theta fc$.

This index presents an adequate sensitivity for smaller-scale, high-precision applications and for capturing the dynamic evolution of the soil physical state (Armindo and Wendroth, 2016). More precisely, in the case of two SWRCs measured before and after some natural or anthropogenic changes (e.g., tillage), these energy indices can be used to quantify the change in soil physical quality status (Armindo and Wendroth, 2016). For instance, Fuentes-Guevara et al. (2022) found significantly correlation between hydraulic-energy based indices –including WRa– with some physical properties before and after land leveling operations, indicating their capacity to capture soil structure changes.

We have determined the index for the suction range between field capacity (ca. 10 kPa) and a moisture content corresponding to ca.150 kPa (maximum operating value of the Hyprop device) (Table 1).

Table 1. Absolute water retention energy (WRa) values for the two treatments (OPM, CM).

Treatment	**WRa (kPa)**
OPM - repetition 1	4.8
OPM - repetition 2	4.9
OPM - repetition 3	4.1
CM - repetition 1	*5.4*
CM - repetition 2	3.5
CM - repetition 3	3.3

The soil under OPM (WRa= 4.6±0.5) seems to have better structured than the soils under CM (WRa= 4.1±1.1) –in brackets, average and standard deviation, respectively– (Table 1) because the former holds the same relative fraction of water with more absolute energy in its porous system (Armindo and Wendroth, 2016). However, this difference between treatments was not statistically significant due to a large value of one the repetition on CM treatment (Table 1, in italics), though the rest of the values showed a relative low dispersion (see Table 1).

LL85-86: please insert standard WRB soil classification

We have added to the proposed new version if the Editor allows for it to be submitted, the WRB soil classification as indicated by the reviewer:

“Agricultural fields under two contrasting agricultural management strategies on identical soil types (*Fluventic Haploxerepts* (Soil Survey Staff, 2014)) (*Fluvic Cambisol,* (WRB, 2015)), with loam texture at the upper soil horizon) and use (rainfed cereal cropping) were randomly selected in the municipality of Garinoain (Navarre) (42,59843° N, 1,64959° O).”

A more in deep discussion of your data as related to other published studies is missing in particular in the PSD section. There is a lot of literature on how different agronomic managements impact PSD. Just for example:

- Conservation Agriculture Had a Poor Impact on the Soil Porosity of Veneto Low-lying Plain Silty Soils after a 5-year Transition Period. Piccoli, I., Camarotto, C., Lazzaro, B., Furlan, L., Morari, F. Land Degradation and Development, 2017, 28(7), pp. 2039–2050.

- Zero tillage has important consequences for soil pore architecture and hydraulic transport: A review. Wardak, D.L.R., Padia, F.N., de Heer, M.I., Sturrock, C.J., Mooney, S.J. Geoderma, 2022. 422,115927

Thank you very much for the useful recommended papers. Other published studies will be incorporated into the discussion as suggested by the reviewer. The main statements to be added are summarized next:

"In works in which SWRs were used for the long-term study of pore size distribution in no-tillage (NT) and conventional tillage (CT) management, it was found that there is no unanimity in the results obtained (Wardak et al., 2022).

In the case of macropores, generally, soil macroporosity has been reported to increase in NT systems, especially in the surface soil layers (Wardak et al., 2022). However, there are studies that, like ours, identified a decrease in macropores in the NT treatment, particularly in the surface layer (0-20 cm) (Wardak et al., 2022). In a silty clay loam soil, Lipiec et al. (2006) observed that the pore system of the soil under CT presented greater macroporosity, with the differences between tillage treatments being more pronounced in the 0-10 cm depth than in the 10-20 cm depth. Similar results were obtained in clay soils by Tuzzin de Moraes et al. (2016) and Borges et al. (2019) who identified significantly higher macroporosity in the CT treatment compared to NT. The authors mention that this is because soil plowing in CM causes pore breakage, which contributes to an increase in macroporosity. In contrast, Imhoff et al. (2010) and Gao et al. (2019) saw increased macroporosity in the NT treatment in a silty loam soil and a sandy loam soil, respectively. This disparity of results in different studies suggest a site-dependency of this effect, which supports the need for site-specific assessments.

On the other hand, in the study of micro- and mesopores, most studies have observed an increase of these pores in NT treatment compared to CT. Examples are the works of Borges et al., (2019), Lipiec et al. (2006) and Tuzzin de Moraes et al. (2016) whose analysis of SWRCs showed a higher volume fraction of microsopores and mesopores under NT than under CT. However, in the study by Imhoff et al. (2010) they recorded a decrease in micro- and mesopore volume under NT treatment. Similarly, Gao et al. (2019) saw reduced mesoporosity in NT soil, observing no significant effect of such reduction on soil hydraulic properties."

The conclusion section needs to be re-arranged by removing the summary-like part (LL301-316) and should go beyond the study results.

If the Editor finally allows us to send a new draft incorporating all the modifications and suggestions from all the reviewers, we will do our best to prepare better and more concise conclusions. However, we prefer to follow a common practice among researchers when writing conclusions which is to include some piece of results before giving any real conclusion on this finding.

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