Reviewer 2

The authors thank the Anonymous Referee #2 for their constructive feedback on the work.

COMMENT 2.1*: Check spelling but in line 139*

RESPONSE 2.1: The spelling error was fixed: 'butt' will be replaced by 'but'

COMMENT 2.2*: Section 4.2. lines 332 the naming conventions are very confusing - can't you just refer to depths? For example why do you refer to the surface to 20cm as LAI and deeper as SW?*

RESPONSE 2.2: Yes, we will clarify the naming conventions. LAI refers to the Leaf Area Index variable, whereas SWn refer to the Soil Wetness of layer n (for instance, SWI5 for layer 5 between 20 and 40cm and SWI8 for layer 8 between 80 and 100cm).

COMMENT 2.3*: Do you mean December? Year - line 333 Section 4.2.*

RESPONSE 2.3: We do not understand the reviewer's comment on this particular line.

COMMENT 2.4*: Section 4.2 lines 336 - 338 support with evidence from the literature.*

RESPONSE 2.4: To justify the greater influence of root water extraction on soil moisture in deeper layers than in surface layers, we propose the following modification to the original text:

> [L335-336] 'This effect is much more visible for SWI8 (0.8-1.0 m) than for SWI5 (0.2-0.4 m).~~ We can explain this by the fact that deeper soil layers are more isolated from the surface than shallow ones, so changes in their moisture content are more dependent on root water extraction.~~ **As explained by Ravina (1983), the hydraulic conductivity of the top soil layer decreases with drying to the point where moisture in the deeper layers can remain practically unchanged. Soil moisture variations in deep layers are therefore more dependent on water uptake by roots than on diffusion processes. This explains the large impact of vegetation transpiration and the stronger correlation with LAI.**'

COMMENT 2.5*: In Section 4.2.2 line 423 you mention that household claims are the only available evidence of subsidence. Might you consider other sources such as InSAR which should work at the scale of postcode...we use this to monitor, for example, subsidence from mining operations.*

RESPONSE 2.5: We agree. We propose adding to the discussion section a paragraph developing the possible contribution of remotely-sensed vertical displacements. These techniques are used to track displacements over large areas, and are applicable to clay shrink-swell monitoring. However, such data was not available at the time of the study:

'**A possible alternative to insurance claims as a proxy for subsidence is the direct use of remotely sensed ground motion. More specifically, satellite-borne interferometric synthetic aperture radar (InSAR) data can be used to infer vertical movement after appropriate processing, as done by Burnol et al. (2021). For example, the European Ground Motion Service (Crosetto et al., 2021) provides high spatial and temporal resolution vertical displacements over Europe, based on the Copernicus Sentinel-1 satellites, since 2018. The main advantage of this technique is its large spatial coverage. However, the interpretation of such data is not trivial. In the case of clay shrink-swell, the vertical displacements are non-linear (seasonal periodicity), of small amplitude (few to tens of mm), and spatially heterogeneous, both due to the natural irregularity of clayey soils and to the contrasting responses of reflectors (less movement is expected for tall buildings on pile foundations as explained by Tzampoglou et al., (2022)). It can therefore be challenging to separate a signature expansive soil signal from other phenomena, such as water pumping induced subsidence (Meisina et al., 2006). We recognize the potential of these data, but the EGMS dataset was not yet available at the time of the study. In addition, it begins in 2018, which barely overlaps with our study period, which extends from 2000 to 2018.**'

COMMENT 2.6*: Section 4.4.4. This is a valid and important observation i.e. the claim may be made years after the problem started to occur. To put it slightly differently, the damage may the result of a cumulation of years of movement (shrink swell) in the soil or it may be the result of a once off event. Perhaps you can support this discussion point with some further references supporting your choice of one year timescale OR giving us a better idea of what the uncertainty may look like.*

RESPONSE 2.6: The reviewer asks us to justify our decision to base the drought index on data from a single year, when subsidence is known to be a cumulative problem. To address this point, we propose the following addition to the concerned paragraph:

[L442] 'The cumulative effect is therefore neglected and is a source of uncertainty. **The good agreement obtained here between drought magnitudes and normalized claims indicates that the conditions of a single year are a satisfactory enough predictor of subsidence occurrence. Considering the cumulative effect would improve the correspondence with numbers of claims. This step could be implemented in a damage model by, for example, weighting magnitudes by their history.**'

COMMENT 2.7*: Section 4.4.5. lines 449 - 454 - Can you suggest how this problem might be overcome?*

RESPONSE 2.7: In the article, we identify the resolution of the clay shrink-swell hazard zoning map as a source of uncertainty. The reviewer asks us to mention solutions to overcome this problem. We propose adding the following text to the existing paragraph in Section 4.4.5:

The lack of precision of the clay maps here affects the number of houses in different hazard zones, used in the normalization step. The associated uncertainty is transferred to the value of the normalized number of claims. At this stage, we are not trying to

make precise damage predictions, only to identify drought years. Therefore, this source of uncertainty is not the most dominant.

COMMENT 2.8*: Overall comment: This may be a slightly naive question, but would it be possible to validate the model by comparing to locations where you have subsidence data - or even cross reference with InSar data? You are basically using the claims data as a proxy for subsidence, as pointed out earlier, there may be other sources of data both point and remote sensing data that is publically available, that can be used.*

RESPONSE 2.8: Thank you for this comment. As detailed in response to comment 2.5, InSAR data have potential but were not available at the time of the study, and do not cover the whole period. As for the use of point-data, we do not have and are not aware of any openly-available insurance damage data at a finer spatial scale than the town.

Additional references

Burnol, A., Foumelis, M., Gourdier, S., Deparis, J., and Raucoules, D.: Monitoring of expansive clays over drought-rewetting cycles using satellite remote sensing, Atmosphere, 12, https://doi.org/10.3390/atmos12101262, 2021.

Clapp, R. B. and Hornberger, G. M.: Empirical equations for some soil hydraulic properties, Water Resour. Res., 14, 601–604, https://doi.org/10.1029/WR014i004p00601, 1978.

Crosetto, M., Solari, L., Balasis-Levinsen, J., Bateson, L., Casagli, N., Frei, M., Oyen, A., Moldestad, D. A., and Mróz, M.: Deformation monitoring at european scale: The copernicus ground motion service, in: International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences - ISPRS Archives, 141–146, https://doi.org/10.5194/isprs-archives-XLIII-B3-2021-141-2021, 2021.

Decharme, B., Boone, A., Delire, C., and Noilhan, J.: Local evaluation of the Interaction between Soil Biosphere Atmosphere soil multilayer diffusion scheme using four pedotransfer functions, J. Geophys. Res. Atmospheres, 116, 1–29, https://doi.org/10.1029/2011JD016002, 2011.

Meisina, C., Zucca, F., Fossati, D., Ceriani, M., and Allievi, J.: Ground deformation monitoring by using the Permanent Scatterers Technique: The example of the Oltrepo Pavese (Lombardia, Italy), Eng. Geol., 88, 240–259, https://doi.org/10.1016/j.enggeo.2006.09.010, 2006.

Noilhan, J. and Lacarrère, P.: GCM Grid-Scale Evaporation from Mesoscale Modeling, J. Clim., 8, 206–223, https://doi.org/10.1175/1520-0442(1995)008<0206:GGSEFM>2.0.CO;2, 1995.

Ravina, I.: The influence of vegetation on moisture and volume changes, Géotechnique, 33, 151–157, https://doi.org/10.1680/geot.1983.33.2.151, 1983.

Tzampoglou, P., Loukidis, D., and Koulermou, N.: Seasonal Ground Movement Due to Swelling/Shrinkage of Nicosia Marl, Remote Sens., 14, 1440, https://doi.org/10.3390/rs14061440, 2022.