First of all, we would like to sincerely thank Reviewer 1 for the interest in this study and the very constructive comments and suggestions on our manuscript. We carefully considered each point. Please find below our responses and related changes (highlighted in red).

General comments

The manuscript describes, with a high level of details, a database of ground measurements of soil and plant parameters and the authors link the importance of such a database with retrievals models for vegetation monitoring. This is certainly a timely paper given (i) the current levels of effort expended on vegetation (and in particular crop) monitoring and (ii) the new era of satellite images that offer new promising perspectives. The paper contains some interesting material, is reasonably well written and is generally well referenced.

While the basic premise of this paper could be highly relevant, in its present form, the paper is a bit disappointing as it only describes the database, including a few comparisons between parameters. Retrieval models have not been applied using the database and no comparison with existing datasets (those cited in the introduction) has been made to show the added-value of having so many parameters at such a high temporal frequency. To my opinion, major revision would be needed before publication, to add content to this paper.

Specific comments

(1) Title

I would suggest characterizing the word "evolution". Authors are referring to seasonality or inter- and intra-annual dynamics - it should appear more clearly in the title.

Answer:

We will change the title to "Seasonal evolution of soil and plant parameters on the agricultural Gebesee test site: a database for the set-up and validation of EO-LDAS and satellite-aided retrieval models"

Changes in manuscript:

Page 1, line 1-3. Modified title: "Seasonal evolution of soil and plant parameters on the agricultural Gebesee test site: a database for the set-up and validation of EO-LDAS and satellite-aided retrieval models"

(2) Introduction

It is well-written if the authors want to show the interest of their database for vegetation monitoring through models retrievals. The authors state that "none of the cited datasets meets the requirements for comprehensive testing and validation of satellite-aided retrieval models that are driven by data assimilation techniques" because "these models require both, data on a large number of vegetation parameters for various crop types and a sufficiently high temporal resolution". This is clearly true but the logical next step after such an introduction would be to run a model using one of these datasets and the new database and to compare the results.

Answer:

We completely agree that the next step is to demonstrate the added value of the large number of parameters and the high temporal resolution. However, we believe that this is beyond the scope of this manuscript. At the moment, we are working on the implementation of realistic prior information in EO-LDAS using the presented data from the Gebesee test site (information has been added to the manuscript at page 13, line 22). We intend to quantify the (expected) uncertainty reduction that can be achieved using different prior information. This requires at least a clarification of the operating principles of EO-LDAS, an explanation on the stratification of the dataset into training and validation data, a methodological description on the generation of prior information and a sound presentation and discussion of the results. We think that this information would better fit into a separate manuscript that is currently in preparation.

The aim of this manuscript submitted to Earth System Science Data (ESSD) is the presentation of the ground reference database including a detailed description of the study design and methods. We are confident that this manuscript, in combination with the database, will stimulate further research on the vegetation monitoring with data assimilation systems and satellite-aided retrieval models. We think that this is in accordance with the foci of ESSD, i.e., articles that “may pertain to the planning, instrumentation, and execution of experiments or collection of data. Any interpretation of data is outside the scope of regular articles” (https://www.earth-system-science-data.net/about/manuscript_types.html).

Changes in manuscript:

Page 13, line 22. Added and modified text: “The database will be used to implement realistic prior information into EO-LDAS and to assess the effects on the accuracy of derived vegetation parameter values.”

(3) Study area and site description

If the 2nd paragraph refers to the test site and not to the Thuringian Basin, I would invert the 2nd and 3rd paragraph. If not, the line 16 should be rephrased.

Answer:

Thank you for pointing us to the lack of stringency in the second and third paragraph. The paragraphs will be restructured and merged to one paragraph in the following way: (1) A definition of the term “Gebesee test site” is provided, followed by (2) a characterization of different parts of the test site and (3) information on the management of the fields and their specifics.

Changes in manuscript:

Page 2, line 16-25. Now it reads: “The Gebesee test site consists of nine acreages ranging in size from 8.57 to 60.49 ha (Table 1). The acreages are situated on the fields 340, 350, 430, 440, 470, 500, 771 in the northern and central part of the test site and the fields 820 and 830 in the south (Fig. 1b; doi: 10.1594/PANGAEA.874249). The northern and central part is characterized by fertile Haplic Chernozems (according to IUSS Working Group WRB, 2015) developed on Quaternary loess deposits (Rau et al., 2000; Anthoni et al., 2004). Relief energy is generally low in these areas with slopes < 2.5° (TLVermGeo, 2008). In the southern part, clayey sedimentary rocks of the Triassic Keuper formation (Rau et al., 2000) are typically associated with Vertic Chernozems (TLUG 2000; TLUG 2002). Here, slope inclination reaches up to 5° (TLVermGeo, 2008). The fields are cultivated based on crop rotation by the Geratal Agrar GmbH & Co. KG Andisleben (Geratal Agrar). In 2013 and 2014, all investigated crops were entirely rain-fed. An eddy covariance flux tower is operated in the center of field 430 since 2000 (MPI BGC, 2015).

(4) Measurement design of the field campaign & Ground measurements

These two sections are very well written, clear and highly detailed. Yet, in section 4, the interest of having so many parameters could be highlighted by explaining, for each of them, their relevance / usefulness in vegetation monitoring applications and models retrieval.

Answer:

In the beginning of each subsection, we will add one to two sentences that highlight the relevance of the parameter(s).

Changes in manuscript:

Page 3, line 24. Added text: “Plant height (Plant h) is a key parameter for the description of the canopy architecture in radiative transfer models as it determines the thickness of the layer in which photons interact with plant compartments (Gobron et al., 1997). Plant height was determined with […]”

Page 3, line 31. Added and modified text: “Fractional vegetation cover (FVC; Purevdorj et al., 1998) depicts the relative proportion of vegetated areas and is, thus, an indicator for the relative contribution of the soil and vegetation signals to the top of canopy reflectance. The vegetation signal itself varies strongly between green and senescent plant compartments. To account for this, the proportion of senescent material (PSM) was ascertained with respect to the overall vegetated area. *FVC* and *PSM* were determined from nadir photos.”

Page 4, line 26. Added text: “The plant area index (PAI), i.e., the leaf area index (LAI) including ears and cornstalks (Neumann et al., 1989), is an important canopy structural parameter in radiative transfer models and retrieval models in general (Gobron, 2008). PAI was ascertained in two different ways: […]”

Page 5, line 36. Added and modified text: “Beside leaves, ears influence the canopy reflectance of cereals. The contribution of ears varies with the awn length (*Awn l*) and the ear inclination (*Inc*; Zou and Mõttus, 2015). Awn length was determined with […].”

Page 5, line 38. Modified text: “Complementary mode, minimum and maximum ear inclination was estimated once per ESU […]”

Page 6, line 2. Added and modified text: “Above ground biomass (*AGB*) has been previously used as an indicator for the density of plant compartments that can interact with radiation (e.g., Park and Deering, 1982). Moreover, *AGB* is an essential parameter for synthetic aperture radar (SAR) applications and is also useful for the prediction of crop yields (Mattia et al., 2003). In 2014, dry *AGB* was determined once per ESU […]”

Page 6, line 9. Added text: “Phenological development stages create a basis for the comparison of biophysical and biochemical parameters of crops growing under different climatic, soil, illumination and management conditions (Hank et al., 2015). Phenological development (*BBCHkey*) on each ESU was documented […]”

Page 6, line 17. Added text: “Leaf chlorophyll pigments absorb radiation in the blue and red domain and play an important role in the assessment of the physiological status of the vegetation and the quantification of the photosynthetic activity (Blackburn, 1998).”

Page 7, line 5. Added and modified text: “Leaf dry matter (*Leaf dry mat*) and equivalent leaf water (*Leaf water*) are variables of the PROSPECT-5 radiative transfer model (Féret et al., 2008) that is implemented in EO-LDAS. Leaf dry matter is an indicator for cellulose and lignin that absorb shortwave infrared radiation (Baret and Fourty, 1997). The equivalent leaf water exerts an influence on the optical path through the leaf and causes water absorption bands in the wavelength range from 1400 nm to 2500 nm (Allen et al., 1969). Leaf dry matter and equivalent leaf water were determined gravimetrically […]”

Page 7, line 26. Added text: “In the visible to middle infrared range soil moisture influences the reflectance of the soil surface (Jacquemoud et al., 1992).”

Page 9, line 13. Added text: “Aerosol optical thickness (AOT) and column water vapor (CWV) characterize the state of the atmosphere and are utilized to correct, for example, influences of aerosol scattering or water absorption on satellite images (Richter and Schläpfer, 2016).”

Page 9, line 22. Added text: “Cloud coverage and the appearing cloud type are indicators for the prevailing illumination conditions and thus relevant metadata for the hyperspectral data acquired with the FieldSpec 3 spectroradiometer (Pfitzner et al., 2006).”

Page 14, line 12. Added reference: Allen, W. A., Gausman, H. W., Richardson, A. J., and Thomas, J. R.: Interaction of Isotropic Light with a Compact Plant Leaf, J. Opt. Soc. Am., 59, 1376–1379, doi:10.1364/JOSA.59.001376, 1969.

Page 14, line 27. Added reference: Blackburn, G. A.: Quantifying Chlorophylls and Caroteniods at Leaf and Canopy Scales: An Evaluation of Some Hyperspectral Approaches, Remote Sens. Environ., 66, 273–285, doi:10.1016/S0034-4257(98)00059-5, 1998.

Page 15, line 5. Added references: Gobron, N.: Leaf Area Index (LAI), in: Terrestrial Essential Climate Variables for Climate Change Assessment, Mitigation and Adaptation, [GTOS 52], Sessa, R. and Dolman, H. (Eds.), Food and Agriculture Organization (FAO), Rome, Italy, 32–33, 2008.

Gobron, N., Pinty, B., Verstraete, M. M., and Govaerts, Y.: A semidiscrete model for the scattering of light by vegetation, J. Geophys. Res., 102, 9431–9446, doi:10.1029/96JD04013, 1997.

Page 15, line 3. Added reference: Féret, J. B., François, C., Asner, G. P., Gitelson, A. A., Martin, R. E., Bidel, L. P., Ustin, S. L., le Maire, G., and Jacquemoud, S.: PROSPECT-4 and 5: Advances in the leaf optical properties model separating photosynthetic pigments, Remote Sens. Environ., 112, 3030–3043, doi:10.1016/j.rse.2008.02.012, 2008.

Page 15, line 33. Added reference: Jacquemoud, S., Baret, F., and Hanocq, J. F.: Modeling Spectral and Bidirectional Soil Reflectance, Remote Sens. Environ., 41, 123–132, doi:10.1016/0034-4257(92)90072-R, 1992.

Page 16, line 19. Added reference: Mattia, F., Le Toan, T., Picard, G., Posa, F. I., D'Alessio, A., Notarnicola, C., Gatti, A. M., Rinaldi, M., Satalino, G. and Pasquariello, G.: Multitemporal C-band radar measurements on wheat fields, IEEE T. Geosci., Remote, 41, 1551–1560, doi:10.1109/TGRS.2003.813531, 2003.

Page 17, line 7. Added reference: Park, J. K. and Deering, D. W.: Simple radiative transfer model for relationships between canopy biomass and reflectance, Appl. Optics, 21, 303–309, doi:10.1364/AO.21.000303, 1982.

Page 17, line 11. Added reference: Pfitzner, F., Bollhöfer, A., and Carr, G.: A Standard Design for Collecting Vegetation Reference Spectra: Implementation and Implications for Data Sharing, J. Spat. Sci., 51, 79–92, doi:10.1080/14498596.2006.9635083, 2006.

Page 17, line 22. Added reference: Richter, R. and Schläpfer, D.: Atmospheric/Topographic Correction for Satellite Imagery, ATCOR-2/3 User Guide, Version 9.0.2, 263 pp., available at: www.rese.ch/pdf/atcor3_manual.pdf, last access: 25 October 2017, 2016.

Page 18, line 26. Added reference: Zou, X. and Mõttus, M.: Retrieving crop leaf tilt angle from imaging spectroscopy data, Agr. Forest Meteorol., 205, 73–82, doi:10.1016/j.agrformet.2015.02.016, 2015.

(5) Results

This section is to me the disappointing one. After having described with so many details this huge database, this section fails to convince of its usefulness. Going to the field every week to collect many parameters is a huge work and the authors need to convince that it is worth doing it. The analyses that are presented in sections 5.1 to 5.3 are rather basic and don't reach this objective. I would recommend running a model based on this dataset to show how and to which extent the results are improved when increasing the number of parameters and the temporal frequency. If no comparison is possible with existing datasets (different years, different places), the authors could remove some parameters and some dates to artificially build a dataset similar to those cited in the introduction.

Answer:

Thank you for this suggestion. Indeed, we are about to test the effect of different prior information on the accuracy of vegetation parameters derived with EO-LDAS. However, we think that this beyond the scope of this manuscript and the foci of Earth System Science Data (see answer on comment (2)).

Changes in manuscript:

Page 13, line 22. Added and modified text: "The database will be used to implement realistic prior information into EO-LDAS and to assess the effects on the accuracy of derived vegetation parameter values."