D1.3: 2nd Report on Advisory Board meetings

WP1 – Project Management

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Executive summary

The current deliverable represents the 2nd Report on the Advisory Board meetings and it presents the new members added after M4 (D1.2 1st Report on Advisory Board Meetings) and their input for the APOLLO project. In total two new members were added to the board. The WebEx tool was used for realizing the discussions with both of them. The present document summarises the key points of the meetings, as well as the recommendations that the experts had to offer.

The document is structured as follows: Chapter 1 provides a recap of the role of the EEAB to the APOLLO project, in Chapter 2 the profiles of the newly invited members are briefly presented, while Chapter 3 contains the minutes of the meetings conducted, finally Chapter 4 summarises the recommendations made by the experts.

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1 The role of the External Expert Advisory Board (EEAB) in a nutshell

As previously mentioned the tasks and roles of the Advisory Board can be many. In the present we mention indicatively that some of them are to provide advice, guidance and recommendations, additional quality control and validation, feedback, extend the scientific and market potential of the project and increase the visibility of the project. In order to ensure some of the above the APOLLO advisory board was formed early on the project (M4) and it will follow it until the end of its duration.

The External Expert Advisory Board already consists of experts with word-wide reputation in their scientific and technical fields such as Earth Observation, ICT for agriculture, farm management systems, market exploitation and stakeholder collaboration and engagement. The newly invited members only add up to that, since their widely acknowledged members of their scientific communities.

2 The newly added EEAB members

The invitations that were extended from M4 until M12 from the consortium were: i) to Prof. Dr. Alexander Löw, Ludwig-Maximilians-Universität München (LMU) and ii) to Francesco Mattia, senior research scientist at the Institute of Intelligent Systems for Automation (ISSIA). Both experts have done massive research and work in the field of retrieval of land bio-geophysical parameters from Synthetic Aperture Radar (SAR) data. Furthermore, it should be noted that the APOLLO project, for the measurement of soil moisture, is using the algorithm based on the Löw at al. “Derivation of surface soil moisture from ENVISAT ASAR Wide Swath and Image Mode data in agricultural areas” paper.

2.1 Prof. Dr. Alexander Löw

Prof. Dr. Alexander Löw was a professor in Physical Geography and Microwave Remote Sensing at the Department for Geography at Ludwig-Maximilians-Universität Munich (LMU) since 2015.

Before joining LMU, he joined the Max Planck Institute for Meteorology, Hamburg, Germany in 2009. There he was leading a research group on Terrestrial Global Remote Sensing, focusing on global-scale remote sensing for climate studies. His research interests included the quantitative retrieval of geophysical parameters from remote sensing data, the development of image processing algorithms, coupling of land surface process models with microwave scattering and emission models, and the development of land surface process models and data assimilation techniques.

Prof. Dr. Alexander Löw also received his PhD and his habilitation at LMU, where from 2001 to 2008, during his PostDoc research, he worked on the retrieval of bio- and geophysical parameters from microwave remote sensing data. In addition Prof. Dr. Löw in 2007 was a Visiting Scientist with the NASA Goddard Space Flight Center, Greenbelt, MD.

His scientific activities included his role as an editor for Hydrology and Earth System Science, as a guest editor in Nonlinear Processes in Geophysics, as reviewer for several national and international

journals, as a Board Member in the Scientific Board of ESA CarbonFlux Projekt and as an associate editor for the Remote Sensing of Environment.

He served as an expert in various organisations such as: EUMETSAT, ESA, DWD CMSAF, H-SAF, Netherlands Organization for Scientific Research (NOW), Deutsches Zentrum für Luft- and Raumfahrt (DLR).

Indicatively we are citing below some of his peer reviewed publications, including the one used by the APOLLO project:

- Axel Lauer, Veronika Eyring, Mattia Righi, Michael Buchwitz, Pierre Defourny, Martin Evaldsson, Pierre Friedlingstein, Richard de Jeu, Gerrit de Leeuw, Alexander Loew, Christopher J. Merchant, Benjamin Müller, Thomas Popp, Maximilian Reuter, Stein Sandven, Daniel Senftleben, Martin Stengel, Michel Van Roozendael, Sabrina Wenzel, Ulrika Willén (2017) Benchmarking CMIP5 models with a subset of ESA CCI Phase 2 data using the ESMValTool, Remote Sensing of Environment, doi:10.1016/j.rse.2017.01.007.
- Loew, A., Andersson, A., Trentmann, J., Schröder, M. (2016). Assessing Surface Solar Radiation Fluxes in the CMIP Ensembles. Journal of Climate. 29. 7231-7246. doi: 10.1175/JCLI-D-14-00503.1.
- Loew, A., Bennartz, R., Fell, F., Lattanzio, A., Doutriaux-Boucher, M., and Schulz, J.: A database of global reference sites to support validation of satellite surface albedo datasets (SAVS 1.0), Earth Syst. Sci. Data, 8, 425-438, doi:10.5194/essd-8-425-2016, 2016.
- Loew, A. et al., 2014. Do we (need to) care about canopy radiation schemes in DGVMs? Caveats and potential impacts. Biogeosciences, 11(7), pp.1873–1897. doi: 10.5194/bg-11-1873-2014
- Loew, A., Ludwig, R., Mauser, W. Derivation of surface soil moisture from ENVISAT ASAR Wide Swath and Image Mode data in agricultural areas. IEEE Trans. On Geosc. And Rem.Sens., 2006, 44(4), 889-899.

2.2 Francesco Mattia

Francesco Mattia is a senior research scientist at the Institute of Intelligent Systems for Automation (ISSIA), National Council of Research (CNR), Bari, Italy. His research field is direct and inverse modeling of microwave scattering from land surfaces. He has extensively worked on the retrieval of land bio-geophysical parameters (e.g. soil moisture content, soil roughness, vegetation biomass) from Synthetic Aperture Radar (SAR) data. More recently, his scientific interests have been steered to investigate the integrative use of earth observation data and land surface process models (e.g. hydrologic or crop growth models) for improving water and agricultural resources management.

He has been a visiting scientist at the Centre d'Etudes Spatiales de la Biosphère (CESBIO), Toulouse, France, during 1996, 1997, 1998 and 1999; at University of California Santa Barbara (USA) during 2008; and at Ohio State University (USA) during 2011. He was among the co-organizers the 5th International Workshop on "Retrieval of Bio- and Geo-Physical Parameters from SAR Data for Land Applications" held at Bari (Italy) in 2007 and a member of the Earth Science Advisory Committee of European Space Agency.

Mr. Mattia has managed various projects such as: "GMES Sentinel-1 Soil Moisture Algorithm Development", funded by European Space Agency (ESA); "Use of COSMO-SkyMed SAR data for LANDcover classification and surface parameters retrieval over agricultural sites (COSMOLAND)",

funded by Italian Space Agency (ASI); “Exploiting longer wavelength SAR data for the improvement of surface process modelling”, funded by ESA-ESTEC.

Indicatively we are citing below some of his journal publications:

- J. D. Ouellette, J. T. Johnson, A. Balenzano, F. Mattia, G. Satalino, S.B. Kim, R. Scott Dunbar, A. Colliander, M. H. Cosh, T. G. Caldwell, J. P. Walker, A. A. Berg: A Time-Series Approach to Estimating Soil Moisture from Vegetated Surfaces using L-band Radar Backscatter, IEEE Trans. on Geoscience and Remote Sensing, Vol. 55, No. 6, pp. 3186-3193, 2017, DOI: 10.1109/TGRS.2017.2663768.
- G. Satalino, A. Balenzano, F. Mattia, and M. W. J. Davidson: “C-band SAR Data for Mapping Crops Dominated by Surface or Volume Scattering”, Geosci. and Remote Sensing Letters, Vol.11, Issue 2, pp. 384-388, Feb. 2014, ISSN: 1545-598X, DOI: 10.1109/LGRS.2013.2263034
- V. Iacobellis, A. Gioia, P. Milella, G. Satalino, A. Balenzano and F. Mattia: “Inter-comparison of hydrological model simulations with time series of SAR-derived soil moisture maps”, European Jou. of Remote Sensing, Vol. 46, pp. 739-757, 2013, ISSN: 2279-7254, DOI: 10.5721/EuJRS20134644
- Balenzano, G. Satalino, F. Lovergine, M. Rinaldi, V. Iacobellis, N. Mastronardi, F. Mattia: On the use of temporal series of L- and X-band SAR data for soil moisture retrieval. Capitanata plain case study, European Journal of Remote Sensing, Vol. 46, 2013
- F. Mattia: Coherent and incoherent scattering from tilled soil surfaces, Waves in random media, Vol. 21, 2011

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3 Minutes of the meetings

3.1 Methodology: A few notes about unstructured interviews

As previously mentioned all teleconferences with APOLLO EEAB members were implemented using Webex. Due to the focus of the conversations that concerned the Soil Moisture Data Product, implemented in the APOLLO Platform in order to monitor soil moisture temporally and spatially over agricultural fields and the experts being interviewed, in this occasion the partners have chosen to follow an unstructured interview. Despite the fact that the methods used to realise unstructured interviews vary a lot, the common characteristic is the more relaxed environment that usually makes the interviewee feel more comfortable and reveal more information. As a result more reliable information may be provided in comparison with a structured interview, since usually the people being interviewed feel at ease to bring into the conversation their own experiences and knowledge. Again it should be underlined that the result depends on the interviewer and the interviewee, but in the current occasion it seemed fit to follow that method.

Conducting an unstructured interview does not imply that there are no preparations made beforehand. In order to achieve an in depth and detailed analysis from the interviewee and take advantage of their expertise the interviewer needs to decide the topic and some questions that it is important to focus on and that was the case for the APOLLO Advisory Board Interviews as well.

Briefly the agenda that was followed in both cases was the following:

1. Short presentation of APOLLO project (DRAXIS)
2. Presentation of the soil moisture data product (Starlab)
3. Presentation of the validation of the soil moisture data product (TUW)
4. Discussion on the method used for the soil moisture data product and validation method

In both calls the participants were the following:

1. DRAXIS: Machi Simeonidou (Project Co-ordinator), Dimitra Perperidou and Stelios Kotsopoulos
2. Starlab: Camille Pelloquin and Chiara Pratola (only in the 2nd Meeting)
3. TUW: Alexander Gruber and Matthias Schramm
4. UBFCE: Dragutin Protic

3.2 Advisory Board Meeting with Alexander Löw

The meeting started on time and all members attended. The first to speak was Mrs. Machi Simeonidou that welcomed Mr. Alexander Löw and thanked him for accepting to be a part of APOLLOs' External Expert Advisory Board, as well as the partners that attended the meeting. She continued by briefly explaining that the process would be the following: a "tour de table" for everyone to introduce themselves and say a couple of words about themselves and their companies and/or organisations. Introductions would be followed by a short general presentation of the project, a presentation on the soil moisture product data and the respective validation method, followed by a discussion with the experts on what was presented, asking for their feedback and thoughts.

After the introduction of the partners Mrs. Dimitra Perperidou briefly presented the APOLLO project. She mentioned that APOLLO is a Horizon 2020 Innovation Action aiming to create a commercial advisory platform for small farmers in Europe based on EO data. The project is coordinated by DRAXIS and there are eight other partners namely: AUA, TUW, Starlab, evenflow, ACP, UPOR and AgriSat. She continued by explaining that one of the problems currently faced is the rise of the global

demand for food. Production needs to meet that demand, whilst at the same time becoming sustainably resource efficient and without damaging the environment. Earth observation can support these goals but uptake is limited by affordability and accessibility. APOLLO will address this problem by developing cost affective and affordable services which: i) take advantage of free Copernicus data; ii) use state-of-the-art agronomic models; iii) implement an automated processing chain; and iv) test them with real users in the pilots of the project.

The market that APOLLO will address are small farmers. As research shows 70% of EU farms are small (<5ha), but only few of them take advantage of Earth Observation. Small farms usually struggle to exploit economies of scale, have limited production levels and are hampered by the costs and risks of high tech procurement. Those are the reasons why APOLLO would be useful if not necessary for them.

The services offered through APOLLO are the following: i) Tillage scheduling, for designation of optimum soil workability; ii) irrigation scheduling, for dosage recommendations according to plant growth; iii) crop growth monitoring, for evaluation of crop adaptability, identification of field problems and determination of VAR zones; and iv) crop yield estimation, for analyzing and comparing field productivity and effective transfer to industry (market vs storage).

Mrs. Perperidou continued by showing some screen shots of the platform and making a reference to the three pilots of the project: Municipality of Pella, Greece; Municipality of Ruma, Province of Vojvodina, Serbia and La Mancha Oriental, Spain and finished by explaining that the aim of the project is to move toward a commercial service platform that will have a strong user base willing to pay for sustainable services.

After the presentation of the project Mr. Camille Pelloquin started his presentation on the soil moisture data product. He mentioned that the objectives were: i) to develop an automated service to estimate soil moisture content by using Sentinel 1 data; and ii) to calibrate the Löw at al. algorithm for local cultivation using the soil moisture in-situ data that will be collected during the APOLLO project.

The first steps for the soil moisture data product was to implement the retrieval model in Python and prepare the calibration process, which will be applied on the test sites next in order to validate it.

Mr. Pelloquin went on to explain the SAR data processing chain that is used and that the soil moisture retrieval is done using a semi-empirical backscattering model tuned to C-band for rough dielectric surfaces based on the integral equation model and a generalized power law spectrum (Loew et al. 2006), while the calibration is done by using in-situ soil moisture measurements and fields information to optimize the model parameters.

After that Mr. Pelloquin proceeded with presenting some examples of soil moisture products in Chilean agricultural fields explaining that the in situ sensors there provide hourly values at 10cm, 30 cm and 60 cm. He also mentioned that the Sentinel 1 incidence angle variability is low for the fields of Chile and that Low's parameters for grassland in summer are used for Sentinel 1 images of PE-C (onion and corn fields). He then went on analyzing the data that they have gathered the model calibration and the results that they got there, as well as in the Spanish pilot fields.

Finishing his presentation Mr. Pelloquin mentioned that the next steps for the soil moisture data product are: i) to repeat tests varying despeckle filter (type and kernel size); ii) to analyse the backscattering behavior over crops at different growing stages; iii) to try other calibration approaches; iv) to look for other SM datasets for agricultural fields to improve calibration and generalisation capability and v) to extend data analysis and model calibration to other parcels and pilot areas.

Following the presentation of soil moisture data product, was the respective validation plan, for which Mr. Gruber stated that it is going to examine: i) the quality aspects such as the data completeness, the systematic errors and the random errors; ii) the methods that are going to be used and iii) the reference data.

Mr. Gruber mentioned that for the validation of the soil moisture data product the metrics are twofold: i) standard, including bias, correlation coefficient and RMSD; and ii) advanced including triple collocation and unbiased random error variance estimates possible for Sentinel 1 soil moisture.

He then referred to the datasets that are going to be used for the validation which are the following:

- Project internal in situ data
  - Collected within the pilot areas
    - Aim: At least 2 stations / pilot area / crop type
- Project external in situ data
  - International Soil Moisture Network (ISMN)
  - Austrian Hydrology Open Air Laboratory (HOAL)
- Other (EO) data products
  - Satellite SM products
    - MetOp ASCAT - 1 km / 25 km
  - Land surface models (GLDAS-Noah, ERA-Land)

After the presentations Mr. Löw addressed a question towards Mr. Pelloquin about the validation he mentioned in the three sites and how they are going to access the datasets in order to do so.

Mr. Pelloquin mentioned that for validation purposes all three points have been equipped accordingly. More specifically the pilot in Spain already had the needed equipment at their disposal, but for Serbia and Greece that they did not, the necessary actions were taken and everything is now in place. Mr. Pelloquin also underlined that in order to ensure unbiased results we are going to use triple collocation. In addition all pilot areas have looked into their networks within Europe to see who could provide them with more data. As he pointed out there are hardly any data on crop types. Mrs. Pratola that was not present today, another member of Starlab team working in APOLLO, has also looked into maps (google) and they are now trying to carefully use those data.

Mr. Löw mentioned that there is an agricultural site in Austria with quite accurate data, which may also be a complementary source for the APOLLO project. He then continued with a question to TUW team regarding their presentation. Mr. Löw asked about the triple collocation and if for example they deployed now tenders will they get data for validation?

Mr. Gruber answered that they would mainly get some data from Spain and that it would be a quick and nice sample size.

Mr. Löw then asked again Starlab team if they have had the onion results that they presented from another project and if the data they are based on, are independent data or if they are the same set of data.

Mr. Pelloquin responded that yes the results were from another project as Mr. Löw observed and that they use two different data sets for calibration and Mr. Löw stated that this is what he would expect himself.

Mr. Gruber asked Mr. Löw for which resolution was his algorithm devised and he responded that it is a different question depending on the area. It could for example be 30x30meters and he went on explaining that a big field could not be homogenous changing thus the resolution. Mr. Pelloquin went on to say that this also depends on the size of the footprint and Mr. Löw added that it additionally depends on the pre-processing process that is followed for products that have for example a 10x10

meters resolution, pointing out that this may not necessarily be the resolution of the product but there may be a 3x3 window or a 5x5.

It is something they do in soil moisture retrieval in geocoding, you get your image but you then geocode it and you get average information. For APOLLO there is no need to do the retrieval in geocoding, but maybe it would help to project that information as well, but still Mr. Löw was not sure if that was worth the effort. He then asked if the pre-processing for APOLLO is done in snap python and Mr. Pelloquin responded that no, it is done in Sigma 0.

Mr. Löw mentioned that the radiometric correlation that the team is using when the field is flat is very interesting and he added that a team in a respective project is using the snap toolbox and it is working very well for them.

Mr. Dragutin Protic then mentioned that we are trying to resolve the problem of the lack of in situ data with some of the contacts that we have in the International Soil Moisture Network and asked Mr. Löw if we are going in the right direction regarding the models that we have chosen in tillage and irrigation? Additionally he asked how his model can help in the validation process and if he is aware of any other projects that it is used in?

Mr. Löw responded that he is not up to date on who used the model. He knows thought that there is a commercial company in Germany that is using it and that for sure there is a need for re- calibration. Mr. Gruber asked how this is done and Mr. Löw mentioned that another colleague of the domain Mr. Mattias has developed a different process to optimize irrigation index or absolute value to decrease the uncertainty of soil moisture retrieval.

Then Mr. Protic asked what are the minimum datasets for calibration and Mr. Löw responded that soil moisture still needs a lot of research and that there is not yet a mature methodology available to address this problem, but rather we are still heavily depended on sensors. He also added that do the calibration we will need the services to be as accurate as possible before we use them in the pilots with the farmers.

Mrs. Simeonidou asked if there are any other questions from Mr. Löw to the partners or visa versa and since there were not any, she thanked once again Prof. Dr. Alexander Löw for accepting the consortiums' invitation and for his participation in the call. She mentioned that we would be glad to have him in our next project meeting. Mrs. Simeonidou then thanked the partners that were present for the call and the call ended.

3.3 Advisory Board Meeting with Francesco Mattia

The meeting started on time and all members attended. The first to speak was Mrs. Dimitra Perperidou that welcomed Mr. Francesco Mattia and thanked him for accepting to be a part of APOLLOs' External Expert Advisory Board, as well as the partners that attended the meeting. She continued by briefly describing that the process would be the following: a "tour de table" for everyone to introduce themselves and say just a couple of words and after that the short presentations of the project, the soil moisture product data and the respective validation method, followed by the discussion on what was presented.

All presentations were made in the same order as in the previous meeting of the advisory board (see relevant section 3.1 above).

During the presentation of Starab Mr. Mattia noticed that the objective of the study is to provide automatic services, so in principle they should be applied in large areas without additional information. Doesn't that mean not having additional information on crop type, etc? Mrs. Pratola

answered that we need this information, because the models depend heavily on crop type. For this reason we have to calibrate the model for different crop types and different soil types. Maybe the soil type parameter does not affect the model that much, there may be a bias, but it is not affected that much. In addition, in theory the stage of the growing process is very different per soil and per vegetation density for example tall vegetation.

Mr. Mattia followed up by asking Mrs. Pratola what does automatic service mean? Mrs. Pratola explained that once we have calibrated the model for each of the parcels that we are monitoring, we have in our disposal the information that we need. We know the boundaries and the soil texture. After that we can send a request to start the automatic process of downloading the data that will now be used by the calibrated model to provide the product.

Mr. Mattia then asked if the calibration of the model on some types can then be applied in other ones or not? Mrs. Pratola explained that it will be great if a generalisation was possible for the model. It would be useful for the team in the sense that the model could be applied in different crops.

Mr. Mattia added that in general this approaches (like the APOLLO approach) that can be considered as empirical, can provide quite rational results. Nevertheless, normally when the results are calibrated they change and for that purpose he suggested for the team to do a model calibration. Mr. Mattia also stated that in his opinion since an empirical approach was selected, it should not be applied in parcel level, but in larger areas.

Mr Mattia continued by asking if in Chile the soil moisture sensors measure the soil moisture depth and Mrs. Pratola said that he is correct. Mr. Mattias then said that normally the penetration of C band is up to 5 cm, so in Chile there is a very narrow soil moisture content, as well as in the example that was demonstrated in the presentation. The only difference is that in Chile a good correlation was achieved, but it is not reliable and robust, because the variation of soil moisture during the period of the study was just 5%. Mrs. Pratola responded that she did agree that the variability was not enough and that they were also too much spaced out. She added that they are already aware of that and this is the reason why they are now trying to add a bigger data set. Still though she is not sure that a good generalisation can be achieved.

Mr. Mattia made a suggestion to try to start with the easiest cases like bare soil or wheat or barley that are more sensitive, corn seems to be a rather challenging one, especially developing corn, as well as onion. Mr. Mattia also added that it is not recommended to calibrate corn because it loses its' sensitivity to soil moisture. He then proceeded by asking what is the desired resolution for retrieving soil moisture? Mrs. Pratola said that it is 10x10 meters, which we know that is quite challenging. Mr. Mattia then added that in 10 meters you probably have 2dbs standard deviation due to speckle and it may be better to go at least 100 meter and product at 40meter pixel, otherwise it is too challenging.

Mr. Mattia has also had a question that concerned the validation plan as presented by Mr. Gruber from the TUW team and more specifically the triple collocation and the need of three independent datasets: one to be provided by Starlab; one by in situ data; and one by the satellite soil moisture data product. How they are going to deal with the big differences in spatial resolution? Mr. Gruber replied that the differences in spatial resolution will lead to representativeness errors, which are basically bias in the random error estimates of the data sets. Mr. Gruber continued by explaining that depending on how different the resolutions are they can analytically show how this manifests. He then added that what will happen if you apply in the in situ sensors let's say 100 meters Sentinel sensors and 1 km satellite that are normally half is that the error estimate for the in situ sensor will have such a representativeness bias, errors made of the course resolution model or satellite data that we will have a representativeness bias, but for the sentinel data, for the immediate resolution data should be unbiased.

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Following the questions of Mr. Mattia the partners took the opportunity to ask him some questions. Mr. Protic spoke and firstly he clarified that APOLLO does not need soil moisture as a product per se, but rather as an intermediate product for tillage scheduling, to suggest to farmers when is the optimal time to till and for irrigation by providing them advice on the optimal time to irrigate and the dosage. Also, the agricultural models they need absolute values in terms of soil moisture volume. Additionally, he added that the services will be provided in general terms so that the final services should work well in other regions apart from the three pilots. The team is thus targeting models that can be applied anywhere and not specific regions. After all the final product should be commercial. After explaining the above Mr. Protic asked Mr. Mattia if the consortium is too optimistic about the soil moisture product? Mr. Mattia replied that in his opinion since we had the Sentinel 1 data it is for sure better and he is quite optimistic himself that we will have reliable soil moisture product, but we probably need some more time.

After that Mrs. Perperidou asked Mr. Mattia if he has any questions for the partners and visa versa and since there were none she firstly thanked once again Mr. Mattia for accepting to be a member of the APOLLO advisory board and his participation in the call. She mentioned that they would be glad if he could join the team in the upcoming project meeting in Vienna to further discuss the above issues. Mrs. Perperidou also thanked the partners for their participation and the call ended.

3.4 Continuous consultation procedure

Within the context of the continuous consultation procedure both members were invited to attend the upcoming project meeting in Vienna, Austria in the 4th and 5th of December 2017, as also indicated from the minutes above.

As previously mentioned, all travel expenses of EEAB members (accommodation and flights) will be covered by the project budget. WP1 leader DRAXIS will provide well in advance the EEAB members with a schedule of project meeting.

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4 Results and recommendations for APOLLO

As in D1.2 1st Report on Advisory Board meetings the results and recommendations produced from this chapter are summarized in the table below. The results and recommendations table contains the following fields: a) The name of the EEAB Member, b) the recommendation and advice that resulted from the discussion, c) the respective work package that the recommendation refers to, d) the responsible APOLLO partners that have to incorporate the recommendation, e) the respective deliverable that the recommendation has to be incorporated in, f) a time plan for implementing the recommendations and g) a field for extra comments.

It has to be noted here that all results and recommendations presented in the following table are not binding but rather indicative. They are presented in order to act as a starting point of discussions among the consortium and the EEAB members. The Coordinator in consultation with the project Executive Board and the WP leaders will decide whether these results and recommendations will be included in the project, in which format and in which deliverable.

Name	Recommendations, Suggestion and advice	WP	Partner	Deliverable	Timeplan	Comments / Actions
Alexander Löw	Suggested an agricultural site in Austria with quite accurate data, which may also be a complementary source of data for validation for the project	WP3	Starlab, TUW	-	-	Partners TUW and Starlab should advise on whether there should be a contact in order to include that set of data in the validation
Alexander Löw	Suggested that the resolution for his algorithm depends on the area and should be used accordingly	WP3	Starlab	-	M34	Partner Starlab has already taken that into consideration
Alexander Löw	For APOLLO there is no need to do the retrieval in geocoding, but maybe it would help to project that information as well	WP3	Starlab	-	-	It will be taken into consideration by partner Starlab, nevertheless Mr. Löw himself mentioned that he was not sure if that was worth the effort.
Alexander Löw	Mr. Löw suggested for the pre-processing to alternatively be done in snap python	WP3	Starlab	D3.2	-	Starlab team is already using Sigma 0, but it will be considered in case an alternative is required

Name	Recommendations, Suggestion and advice	WP	Partner	Deliverable	Timeplan	Comments / Actions
Alexander Löw	Mr. Löw mentioned that another colleague of the domain Mr. Mattias has developed a different process to optimize irrigation index or absolute value to decrease the uncertainty of soil moisture retrieval and suggested to look into it	WP3	DRAXIS Starlab TUW UBFCE AgriSat ACP	D3.1, D3.2, D3.3, D3.4, D3.5, D3.6	-	The partners agreed to look into it and also they would have the chance to discuss with Mr. Mattias, since he was the second member towards who an invitation was extended
Alexander Löw	Mr. Löw suggested that in order to do the calibration we will need the services to be as accurate as possible before we use them in the pilots with the farmers	WP3	DRAXIS Starlab TUW UBFCE AgriSat ACP	-	-	Service validation from technical partners
Franceso Mattia	Mr. Mattia suggested that in general approaches that can be considered as empirical can provide quite rational results, but normally when the results are calibrated they change and he suggested a model calibration	WP3	Starlab	D3.2	M34	To be taken into consideration by the Starlab team
Franceso Mattia	Mr. Mattia also stated that in his opinion since an empirical approach was selected, it should not be applied in parcel level, but in larger areas.	WP3	DRAXIS Starlab TUW UBFCE AgriSat ACP	-	-	To be taken into consideration by the team
Franceso Mattia	Mr. Mattia made a suggestion to try to start with the easiest cases like bare soil or wheat or barley that are more sensitive, corn seems to be a rather challenging one, especially developing corn, as well as onion. He also added that it is not recommended to calibrate corn because it loses its' sensitivity to soil moisture	WP3	Starlab	-	-	To be taken into consideration by the Starlab team
Franceso Mattia	Mr. Mattia suggested that it may be better to go at least 100 meter and product at 40meter pixel, otherwise it is too challenging	WP3	Starlab	-	-	To be taken into consideration by the Starlab team

Table 1 - Indicative results and recommendations table

This project is co-funded by the European Union

5 ANNEX I – Updated APOLLO EEAB List

Name	Country	Organisation	Expertise	Proposed by
Paula Antunes	Portugal	Universidade Nova de Lisboa	Policy analysis, Stakeholder engagement	AgriSat
Claus Aage Grøn Sørensen	Denmark	Aarhus University	Operations analyses and modelling, Information modeling	AUA
Milan Miric	Serbia	Regional Development Agency of Srem Municipality	Local regional development	UBFCE
Prof. Dr. Alexander Löw	Germany	Ludwig-Maximilians-Universität Munich	Terrestrial Remote Sensing*[1]	Starlab
Francesco Mattia	Italy	Institute of Intelligent Systems for Automation	Modeling of microwave scattering from land surfaces	TUW

[1] His research interests also include the quantitative retrieval of geophysical parameters from remote sensing data, the development of image processing algorithms, coupling of land surface process models with microwave scattering and emission models, and the development of land surface process models and data assimilation techniques

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6 ANNEX II – Updated Invitation Letter

APOLLO

Co-funded by the European Union

Invitation to participate in the APOLLO project External Expert Advisory Board

Thessaloniki, …. 2017

Dear …..,

We would like to invite you to become a member of the External Expert Advisory Board of the **APOLLO** project. APOLLO has received funding from the EC under the **Horizon 2020** Research and Innovation programme, which is the financial instrument of the EC that will offer funding to research projects for 7 years (2014 to 2020).

The project APOLLO (*Advisory platform for small farms based on earth observation*) aims to develop a **commercial platform** that will provide a suite of **farm management advisory services** (tillage scheduling, irrigation scheduling, crop growth monitoring, and crop yield estimation) specifically designed to address the needs of **small farmers**. APOLLO will use **state-of-the-art methodologies** for the calculation of **agricultural parameters** based on **EO data** and take advantage of the **improved spatial and temporal coverage** of the new **Sentinel satellites**.

The role of the members of the APOLLO External Expert Advisory Board is to **participate in project's meetings**, in which they will review the project activities and outcomes, identify the strong/weak points with respect to the objectives of the project and the applications of the results, and provide expert recommendations. **All travel and accommodation costs will be covered by the project budget.**

The APOLLO External Expert Advisory Board will be convened some times throughout the duration of the project either in **meetings** or in **conference calls**. With your collaboration we will be able to issue recommendations that will ensure the fulfillment of the project's objectives.

We are looking forward to welcoming you as a member of this unique group. Do not hesitate to contact us for any further information or clarification.

Best regards,

Machi Simeonidou

APOLLO Project Coordinator

DRAXIS Environmental S.A.

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