USE-CASES – Advanced Agricultural Monitoring and Management Solutions

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This document outlines the use cases for the “Advanced Agricultural Monitoring and Management Solutions” thematic call for proposals. It is intended to develop sustainable services using space assets and technology together to address key challenges and opportunities for developing operational solutions. The use cases presented are the result of a collaboration between the European Space Agency (ESA) and agricultural representatives, including members of the Danish Agency for Green Transition and Aquatic Environment. The use cases are categorized by the agency that provided them. When writing the initial proposal (APQ/APQ+ proposal), the applicant should specify which use case(s) their solution will address, if selected from those listed here.

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The Danish Agency for Green Transition and Aquatic Environment

The Agency for Green Transition and Aquatic Environment is the primary state authority for Danish agriculture. The agency drafts the majority of the laws and regulations that govern the agricultural sector and provides grants for agricultural production. Inspections of Denmark's agriculture sector are closely linked to the EU subsidies disbursed to agriculture. These inspections are central to the activities of the Agency for Green Transition and Aquatic Environment and are carried out to ensure compliance with applicable rules and regulations.

In the current system, detailed land use analyses are carried out, with a focus on crop classification and agricultural-related activities. The main crop within each parcel is identified, the presence of multiple main crops in a single field, and detection of permanent elements such as water bodies, infrastructure, and buildings within parcel boundaries. In addition, the activity on the parcels is continuously monitored throughout the calendar year, including tillage, harvesting, mowing, and grazing. This is achieved using a combination of Sentinel-1 and Sentinel-2 satellite data, supplemented by Landsat imagery and annual spring and summer orthophotos covering Denmark.

In 2020, an app was launched, making it possible for beneficiaries to send geo-tagged photos of the parcels assessed as non-compliant.

The Danish Agency's main interest is to cooperate with Danish suppliers, so they will only be interested in supporting Danish teams.

Use case #1: Estimating Soil Organic Carbon in agricultural soils

Drained carbon-rich soils emit more carbon dioxide than mineral soils. Rewetting these soils will reduce emissions. There is an existing mapping of carbon-rich soils in Denmark executed by Aarhus University. This mapping is based on soil samples, environmental data and remote sensing data from satellite images. The purpose of this use case is to develop a method using hyperspectral satellite data to predict the soil organic carbon in agricultural soils. If soil organic carbon is above 6 pct., the method should include properties such as peat thickness and proximity to ground water level.

Use case # 2: Identify green house emissions on agricultural land

The purpose of the use case is to develop a method for identifying emission of greenhouse gasses on agricultural land with a focus on carbon dioxide and methane. The identification is to be carried out using only satellite data, and should not take a priori knowledge of soil properties etc in consideration. The method needs to have a calibration/mechanism for including local fluxes and transport of wind. The prediction of areas with higher emission of green house gasses needs to be verified with in situ data.

Use case #3: Classifying rarely used crops or mixed crops

The agency for Green Transition and Aquatic Environment already receives a yearly crop classification based on Sentinel data. The existing analysis classifies crops into approximal 60 different categories (e.g. winter barley or spring barley, being two different categories). The purpose of this use case is to further improve the classification of specific rarely used crops (e.g. strawberry and pumpkin), and also to develop a method on how to classify mixed crop species (e.g. cereal mixed with legumes, but where legumes may not make up more than 50 % of the mixture) and catch crop species.

Use case # 4: Detection of catch crop vegetation density

The purpose of this case is to develop a method to detect and predict the vegetation density on parcel level in relation to catch crops. Catch crops are planted after the main crop and they are essential in order to reduce nutrient leaching and soil erosion. The vegetation density on parcel level must be at a certain level to have the expected uptake of nutrients. As catch crops are sown in august and are present on the fields until 20.th of October the development period is characterized by a dense cloud cover. This means optical data are limited during this period and the method must be based on data that is weather independent. Furthermore, the method should include a projection of expected plant cover. E.g. if the vegetation density is at a certain level 3 weeks after the establishment of the catch crop, then the plant cover are projected to be sufficient.

Use case # 5: Classifying common trees

The purpose of this use case is to classify the most common trees in Denmark, and to investigate the possibilities for determining the age of the trees.