



NIVA – NEW IACS VISION IN ACTION

Data Product Specification for Nitrate leaching indicator Tier 1 (computed at pixel level).



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Document Control Page

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Contributors	Dominique Laurent, Ludovic Arnaud , Christian Bockstaller
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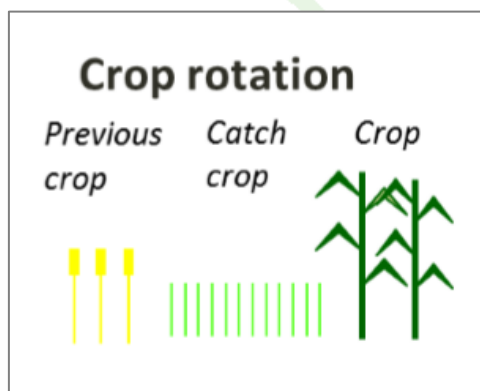
1. Introduction

1.1 Document scope and structure

This data product specification aims to document the characteristics of data about nitrate leaching indicator Tier 1 . It is organised following the principles of ISO 19131 (Data Specification Product for geographic information).

1.2 Product overview

The nitrate leaching indicator Tier 1 measures the risk of nitrate leaching due to crop rotation over a drainage period. In practice, it is computed from summer of year N-1 (previous year) to summer of year N (current considered year) as in Europe, the drainage period takes place mainly in winter.



This nitrate leaching indicator is based on following principle:

- After its harvest, the crop of previous year may release nitrate due to mineralisation effects
- A catch crop or other intermediary cover (if any, e.g. volunteers of cereals or oilseed rape) is mainly taking up nitrate for its growing but may also release nitrate after its harvest due to mineralisation effects
- The crop of current year is taking up nitrate for its growing.

The information about the main crops of year (N-1) and year N is coming from IACS data, i.e. from the information systems of Paying Agencies dealing with CAP payments and providing from farmer declarations.

The information about catch crops and or other intermediary cover is derived from the temporal series of NDVI values obtained from Sentinel-2 optical images.

This document aims to be self-understanding. However, more detailed information about the computation method may be found in the first part of the functional analysis whereas the user guide provides details about the computation tool.

Both documents may be found on: [niva.eu / uc1b_indicators_tool](https://niva.eu/uc1b_indicators_tool) · [GitLab](#)

1.3 Product context

- **Rationale for this indicator**

Agricultural practices have a strong impact on environment; this why the NIVA project developed various agro-environmental indicators, including the nitrate leaching indicator Tier 1 on agricultural territory.

Nitrate leaching is to be reduced as much as possible because it represents a risk for the water quality (risk for health on each citizen) with indirect effect on greenhouse gases emissions, and a loss of nutrients (risk for fertilizer overspending on farmers).

This nitrate leaching indicator Tier 1 is tackling only the impact of crop sequence; it is not taking into account the impact of soil and climate and of fertilizer management. In Europe, it is assumed that the Nitrate Directive has strongly reduced the impact of fertilizer management

- **Context of development**

This indicator is based on a scientific method elaborated by a previous European project (DiverImpact) and is based on data widely available in EU: agricultural parcels coming from national or regional IACS (CAP payment information system including the GSAA: Geo-Spatial Aid Application) and Sentinel-2 data.

The computation open-source tool was developed by INRAE, one of the French partners of the NIVA project and was also tested in Spain.

The NIVA project decided to publish the geographic data resulting from these tests, in order to make it available to any potential user.

The data is coming from an innovation project and shall be considered as research data.

1.4 Glossary

Definitions of acronyms and other key terms may be found in the last version of the NIVA glossary (D3.1 Common glossary) : <https://www.niva4cap.eu/deliverables/>

2. Data structure

The data is supplied as an image with several layers, providing the nitrate leaching indicator itself and some intermediary results or quality indication.

The image is covering the whole territory whereas the nitrate leaching indicator can be computed only on agricultural areas. As a result, for most of the following attributes, the pixels located outside the agricultural areas receive a default “NaN” value (“Not a Number”) to indicate lack of information.

Layer 1 - Parcel ID year N-1

Definition:

Identifier of the corresponding agricultural parcel of year (N-1).

This layer is a rasterized version of the IACS vector data of the year (N-1) and aims to keep track of the correspondence between pixel and parcel.

NOTE 1: In case the native identifier of agricultural parcels in IACS was carrying any personal information, it was replaced by an anonymised identifier for privacy reasons. Nevertheless, this new identifier still enable a potential aggregation of results on the parcels of year (N-1).

NOTE 2: The pixels intersecting the parcel boundary receive the value “NaN”

Type : Integer

Multiplicity : [0..1]

Layer 2 – Nmin

Definition:

Mineralisation score assessing the amount of nitrogen released after harvest of the year (N-1) crop. Expressed on a scale between 0 (low) and 1 (high). Main sources are mineralization of crop residue and soil mineralization after harvest.

Type : Float

Multiplicity : [0..1]

Layer 3 - Parcel ID year N

Definition:

Identifier of the corresponding agricultural parcel of year N.

This layer is a rasterized version of the IACS vector data of the year N and aims to keep track of the correspondence between pixel and parcel.

NOTE : In case the native identifier of agricultural parcels in IACS was carrying any personal information, it has been replaced by an anonymised identifier for privacy reasons. Nevertheless, this new identifier still enables a potential aggregation of results on the parcels of year N.

Type : Integer

Multiplicity : [0..1]

Layer 4 - Ncup

Definition

Score assessing the amount of nitrogen taken up by the year N crop. Expressed on a scale between 0 (low) and 1 (high).

Type : Float

Multiplicity : [0..1]

Layer 5 - Length of longest data hole

Definition

The number of consecutive days when there is no valid NDVI data input over the calculation time period (defined for each pixel).

Description

In Europe, average frequency of Sentinel-2 data is around 5 days. However, there may be longer “data holes” mainly due to cloud coverage or cloud shadows. These kinds of “data holes” are almost inevitable when manipulating optical remote sensing data. This value can be seen as a quality flag of the next 5 layers.

Type : Integer

Multiplicity : [0..1]

Layer 6 - NDVI_decimalinit

Definition

Initial minimal NDVI value in the candidate period for catch crop (or other intermediary cover).

NOTE : The candidate period for catch crop (or other intermediary cover) is provided by a (theoretical) calendar giving the end date of the main crop of year N and the beginning of the main crop of year N.

Type : Float

Multiplicity : [0..1]

Layer 7 - NDVI_Max

Definition

Maximum NDVI value in the candidate period for catch crop (or other intermediary cover). This maximum is always found after NDVI init.

Type : Float

Multiplicity : [0..1]

Layer 8 - Ncup_cc

Definition

Score assessing the amount of nitrogen taken up by a potential catch crop. Expressed on a scale between 0 (low) and 1 (high).

NOTE: The Ncup_cc depends on $NDVI_{max} - NDVI_{init}$

Type : Float

Multiplicity : [0..1]

Layer 9 - Nmin_cc

Definition

Score assessing the amount of nitrogen released after harvest of a potential catch crop. Expressed on a scale between 0 (low) and 1 (high).

NOTE: This value is set by default to 0.1 when a catch crop (or other intermediary cover) is detected and to 0 in other cases.

Type : Float

Multiplicity : [0..1]

Layer 10 - Nitrate leaching indicator:

Definition

Score assessing nitrate leaching, calculated from layers 2, 4, 8 and 9. Expressed on a scale between 0 (low) and 1 (high).

Type : Float

Multiplicity : [0..1]

3. Reference systems

3.1 Coordinate Reference System

Any Coordinates Reference System (CRS) can be used in the tool as soon as all input files are encoded relatively to the same CRS. In practice, it is either the national CRS used for the IACS data (agricultural parcels) or the CRS used for the Sentinel-2 images.

3.2 Temporal Reference System

The dates (file naming) are provided according to the Gregorian calendar.

4. Quality

4.1 Reliability

There are two main sources of issues that may impact the reliability of nitrate leaching indicator.

- **Information about crop seasonality**

The method is mainly based on crop rotation. Therefore, a winter crop is not expected to have the same influence as a spring or summer crop and the coefficients N_{min} and N_{cup} depend on the crop seasonality.

Unfortunately, this information is not present in all the crop classifications used in Europe. In case this information is not present, it has been considered by default that the crop is a winter crop, what is the most frequent case.

- **The characteristics of the NDVI temporal series**

In case of clouds, the Sentinel-2 image is not exploitable and the NDVI can't be measured. In practice, these gaps in observation are filled by linear interpolation but this entails some uncertainties especially in case of long gaps.

For this data product, the general principle is to provide the nitrate leaching indicator wherever it can be computed and to document the main uncertainty factor; this is done through layer 5 Length of longest data hole

4.2 Precision

The nitrate leaching indicator is not considered with an infinite precision. It is therefore provided as a decimal value rounded to the 2nd decimal place. All other decimal values are also rounded to the 2nd decimal place.

4.3 Completeness

The nitrate leaching is not computed on whole territory but only on the agricultural territory under CAP payments, as IACS data is necessary to compute it.

4.4 Up-to-dateness

The nitrate leaching indicator has been computed on a few test areas and periods by the NIVA project. This is a one-time computation. There is no plan to provide this data on a regular basis.

The published nitrate leaching data aims mainly to enable users to assess the interest of such data. If users are willing to migrate to more regular and operational use of the nitrate indicator, the NIVA project is offering the basic means to compute it: an open-source computation tool using as input, data that is widely available in Europe, often for free (Sentinel-2 images, agricultural parcels).

5. Metadata

This data product specification describes the common and generic characteristics of the data about nitrate leaching indicator.

The national specificities linked to a specific data set (such as data provider, geographic extent, Coordinate Reference System) are documented in an associated metadata file.

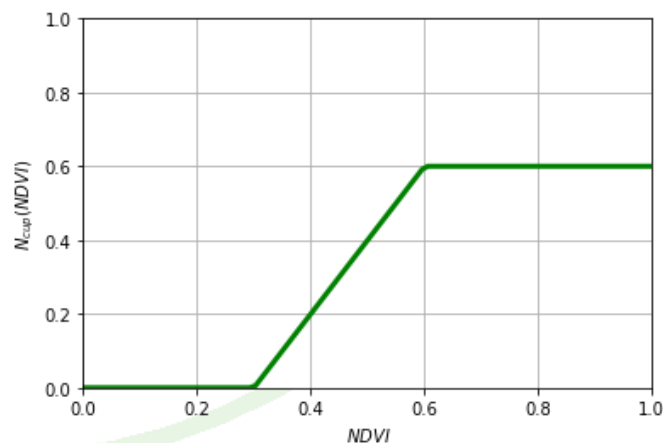
6. Delivery

The data is provided in GeoTIF format. In addition, a default legend is provided for the representation of the nitrate leaching indicator: https://gitlab.com/niva/uc1b_indicators_tool/-/blob/master/tests/nitrate_indicator_files/nitrate_tier1_indicator_legend.txt

The files are named according the following convention:

uc1b_nitrate_indicator_tier1_[ZONE]_[START]_[END]_NDVI_STACK_[TH1]_[TH2].tif

- “uc1b_nitrate_indicator_tier1” is a generic tag used by all files to indicate the main information contained by the file, in this case the NT1 nitrate leaching indicator
- The **[ZONE]** documents the area on which the nitrate leaching indicator has been computed. In practice, it is often the code of a Sentinel-2 tile.
- The computation period is the period for which the indicator has been computed (generally corresponding to a yearly drainage period from the **[START]** date to the **[END]** date, written according to YYYYMMDD format.
- **NDVI_STACK** indicates that the above time window also matches the used NDVI time series.
- **[TH1]** and **[TH2]** indicates the NDVI threshold values used to calculate the N_{cup} functions according to:
 - $N_{cup} = 0$ when $NDVI < TH1$
 - $N_{cup} = N_{cup\ max} \frac{NDVI - TH1}{TH2 - TH1}$ when $TH1 < NDVI < TH2$
 - $N_{cup} = N_{cup\ max}$ when $TH2 < NDVI$. $N_{cup\ max}$ has been adjusted to 0.6. With $TH1=0.3$ and $TH2=0.6$, the function looks like this:





Example:

uc1b_nitrate_indicator_tier1_T31TCJ_20180602_20190602_NDVI_STACK_0.3_0.6.tif

In this case, the Tier1 nitrate leaching indicator has been calculated on the T31TCJ Sentinel 2 tile (that correspond roughly to the Occitanie French region), for the campaign year 2018-2019, with the N_cup function parameterized with TH1=0.3 and TH2=0.6.