Copernicus land monitoring

CLMS High Resolution Layers (HRL) with potential relevance for Ecosystem Analysis
Focus on Grassland HRL

Land Monitoring

Copernicus
Europe's eyes on Earth

European Commission

Portfolio overview

Land Monitoring

HR images
(20m pixels)

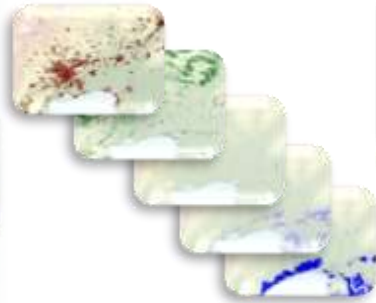VHR images
(2.5m pixels)

SAR + ...
(SRTM, S1, Aster GDEM)

EU-DEM
2012

CLC & CLCC
1990-2000-06-12-18

HRLs
2006-09-12-15-18

UA
2006-12-18

RZ
2012-18

N2K
2006-12

EU-Hydro
2012

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Lot	Topic	Products	Input imagery
1	**Imperviousness**	• Imperviousness density • Imperviousness density change • Imperviousness density change classified	Multi-temporal HR and VHR for calibration
2	**Forest**	• Tree Cover Density • Dominant Leaf Type • Forest type • Tree Cover density change • Leaf Type change	Multi-temporal HR and VHR for calibration
3	**Grassland**	• Grassland	Multi-temporal HR and VHR for calibration + SAR (S1)

4	**Wetness and Water**	• Wetness and water in 4 classes:
		   • permanent water
		   • temporary water
		   • permanent wet
		   • temporary wet
			Multi-temporal HR and VHR for calibration + SAR

5	**Small Woody Features (SWF)**	• Small woody features (vector, 5m and 100m raster)	VHR IMAGE 2015

Overview 2012 to 2015 HRL product evolution

|	2012 production	2015 production
Imperviousness	Imperviousness and imperviousness change (and predecessor status and change products 2006-2009)	Imperviousness and imperviousness change Full re-processing of 2006, 2009, 2012 and change products, and 2015 status products
Forest	Tree cover density and Forest Type products	Tree cover density, dominant leaf type and forest type products + new change products
Natural Grassland	Limited grassland product with a focus on natural grasslands	discontinued
Grassland	n.a.	New grassland baseline product based on 7-year time series, including all grasslands
Wetlands	Wetland product mapping wet areas. Often confused with ecological definition of "wetland"	discontinued
Permanent Water-bodies	Permanent water bodies	discontinued
Wetness and Water	n.a.	New combined baseline product based on time series analysis mapping temporary and permanent wet and temporary and permanent water
Small Woody Features	n.a.	New product based on VHR data, mapping small patchy and linear woody features as vector product, but also available in 5m and 100m raster version

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- All imperviousness, forest, grassland and wetness/water products delivered

- Production of HRL Small Woody Features delayed due to input image issues

- Publication on https://land.copernicus.eu/pan-european ongoing

- Detailed specs documents https://land.copernicus.eu/user-corner/technical-library

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Imperviousness Density
Tree Cover Density
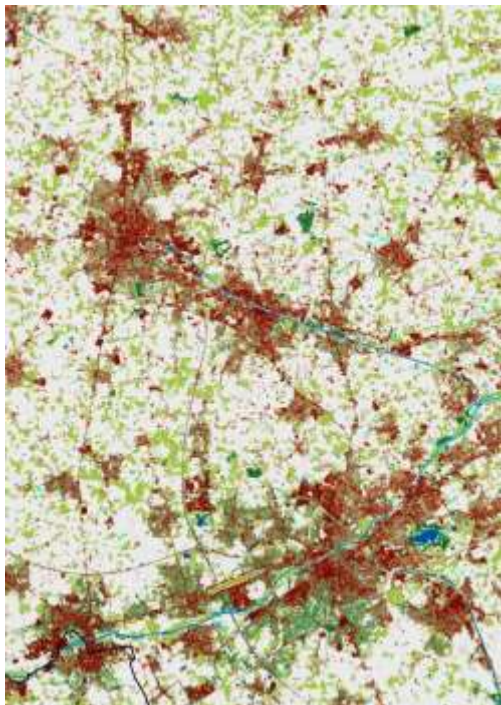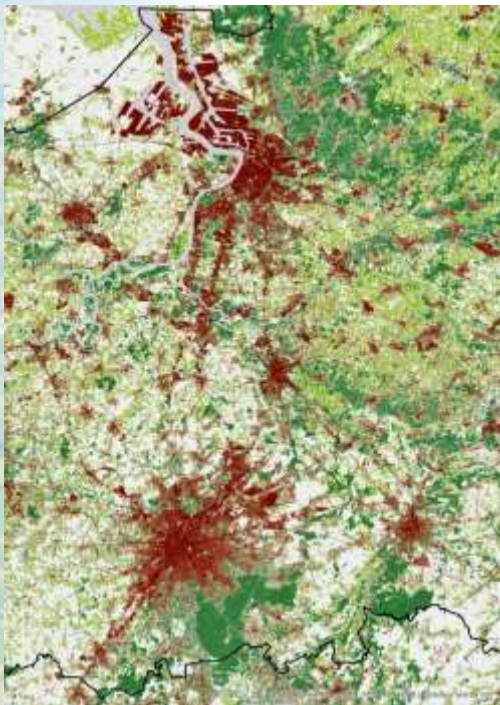Permanent Water
Temporary Water
Permanent Wet
Temporary Wet
Grassland
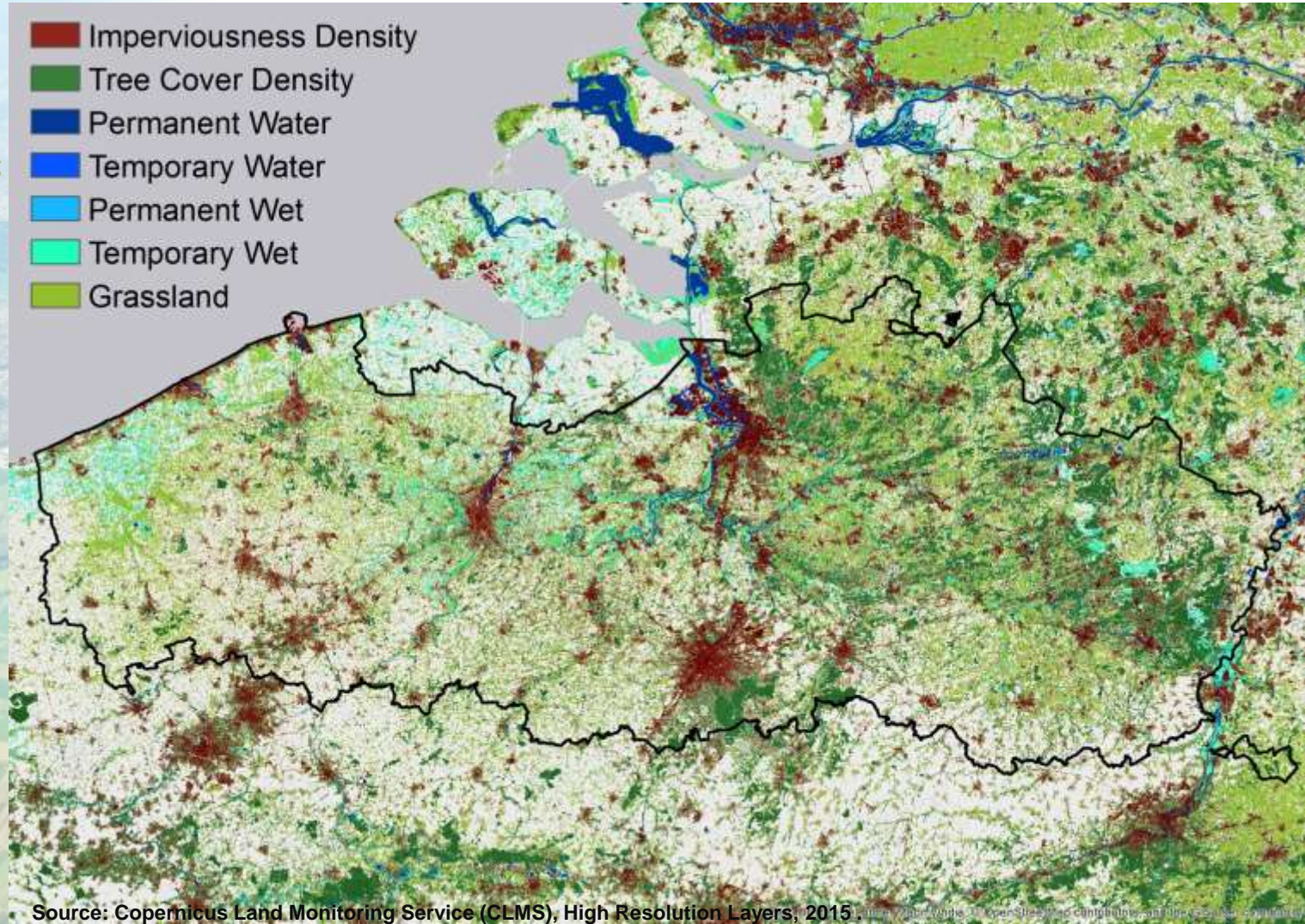
Source: Copernicus Land Monitoring Service (CLMS), High Resolution Layers, 2015

Zoom-in areas

Source: Copernicus Land Monitoring Service (CLMS), High Resolution Layers, 2015

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- Initial 2012 reference year grassland classification failed and was stopped

- As mitigation measure: much more limited natural grassland (NGR) product was produced for 2012

- Now fully replaced by new grassland baseline product with 2015 reference year, but considering 7 year time period

- GRA product 2015 already available on CLMS website, but update to correct regional issues with commission errors expected end April!

- Challenges:

  - Grasslands show huge variation across Europe depending on altitude, part of the season, biogeographic region, agricultural practice etc

  - Grassland is not a pure land cover class that can be mapped using spectral and textural information from RS imagery alone

  - Additional information necessary (multiple seasonal composites, ploughing indicator, region specific information on growing season, crops etc)

Table 2: Definition of HRL2015 Grassland Layer

Elements to be included in the grassland product	Elements to be excluded from the grassland product
• Natural, semi-natural, agricultural / managed grass-covered surfaces. • Grasslands with scattered trees and shrubs covering a maximum 10 %. • Heathland with high grass cover, maximum of 10 % non-grass cover • Coastal grasslands, such as grey dunes and salt meadows located in intertidal flat areas with at least 30 % graminoid species of vegetation cover • Sparsely vegetated grasslands (> 30% vegetation cover – see comment below) • Grasslands in urban areas: parks, urban green spaces in residential and industrial areas • Semi-arid steppes with scattered Artemisia scrub • Meadows: grassland which is not regularly grazed by domestic livestock, but rather allowed to grow unchecked in order to produce hay • Grasslands in urban areas: sport fields, golf courses • Grasslands on land without use • Natural grasslands on military sites	• Peat forming ecosystems dominated by sedges. • Reed beds and helophytes dominated systems. • Tall forbs, fern, shrub dominated vegetation. • Grasslands that have been observed as tilled (in the reference year or a certain period before, in that case they are considered as arable fields) • Rice fields • Vineyards, orchards, olive groves, (if more than 10 % shrubs or trees) • Tundras dominated by shrubs and lichens • Grassland on fresh (and older) clear-cuts in the woods

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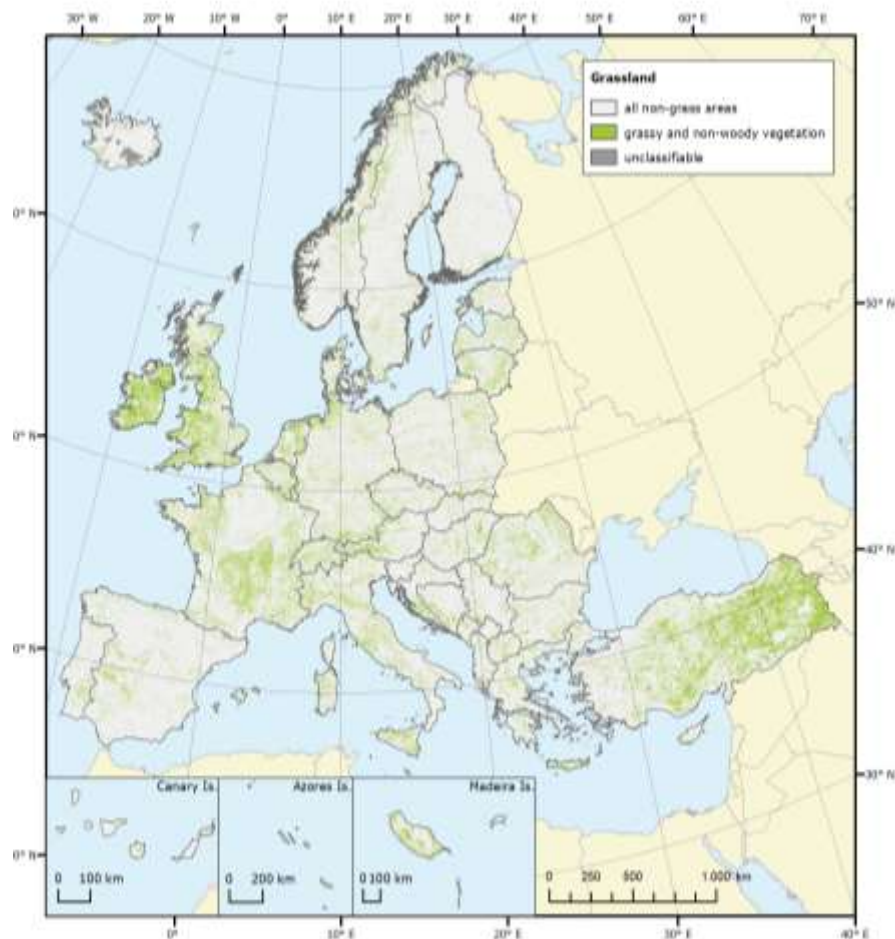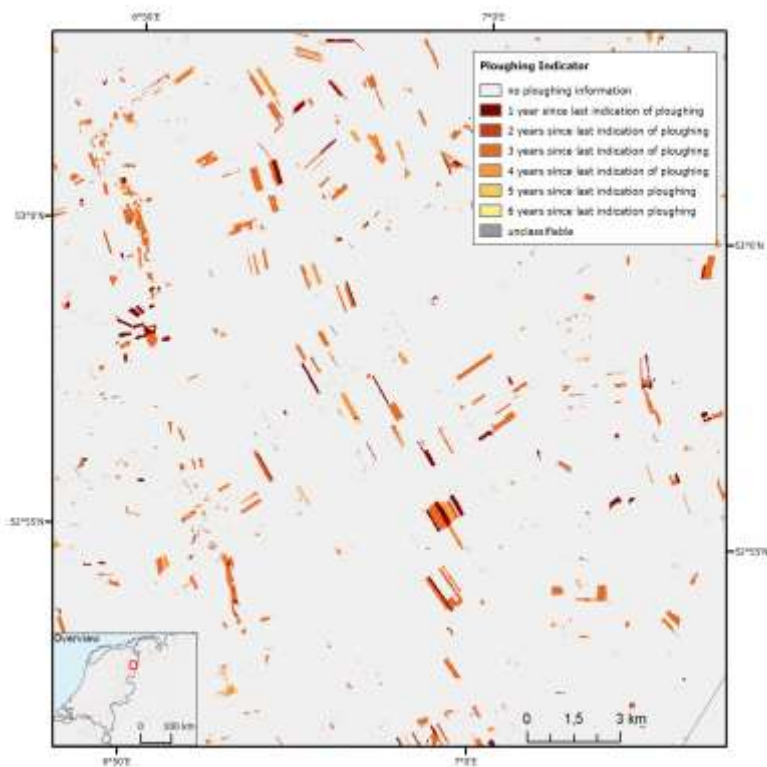
Products (3):

- Permanent Grassland Mask (20m)
- Grass Vegetation Probability Index
  (*additional product for expert users, 20 m*)
- Ploughing Indicator
  (*additional product for expert users, 20m*)

Input Data:

- Sentinel-1: (2015+/-1: 30 amplitude & short-term coherence images)
- Sentinel-2/Landsat8 (2015+/-1)
- Landsat 5-8/HR IMAGE 2012 (2008-2013)

Highlights:

First high-resolution retrieval of both managed and (semi-)natural grasslands on continental scale.

Optical-SAR multi-temp/multi-seasonal evaluation.

New multi-year product (ploughing indicator).

Ploughing Indicator

0

1

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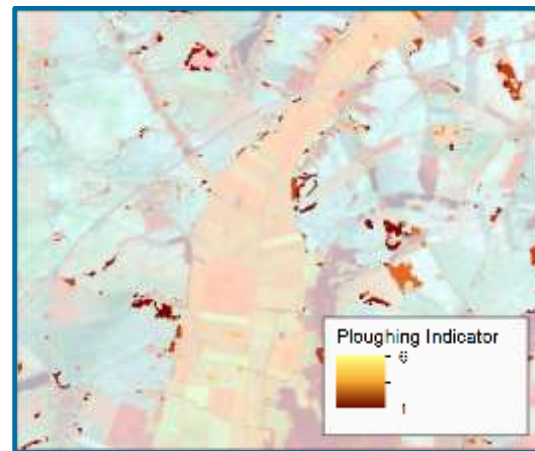
Advanced Methods/Techniques:

- Complex LC/LU classification of **highly dynamic** grassland requiring expert knowledge: Careful **selection** of optimal set of optical images of reference year for classification: wet/dry season, growing season, grassland types, grassland use, main crops, agricultural practices, altitude

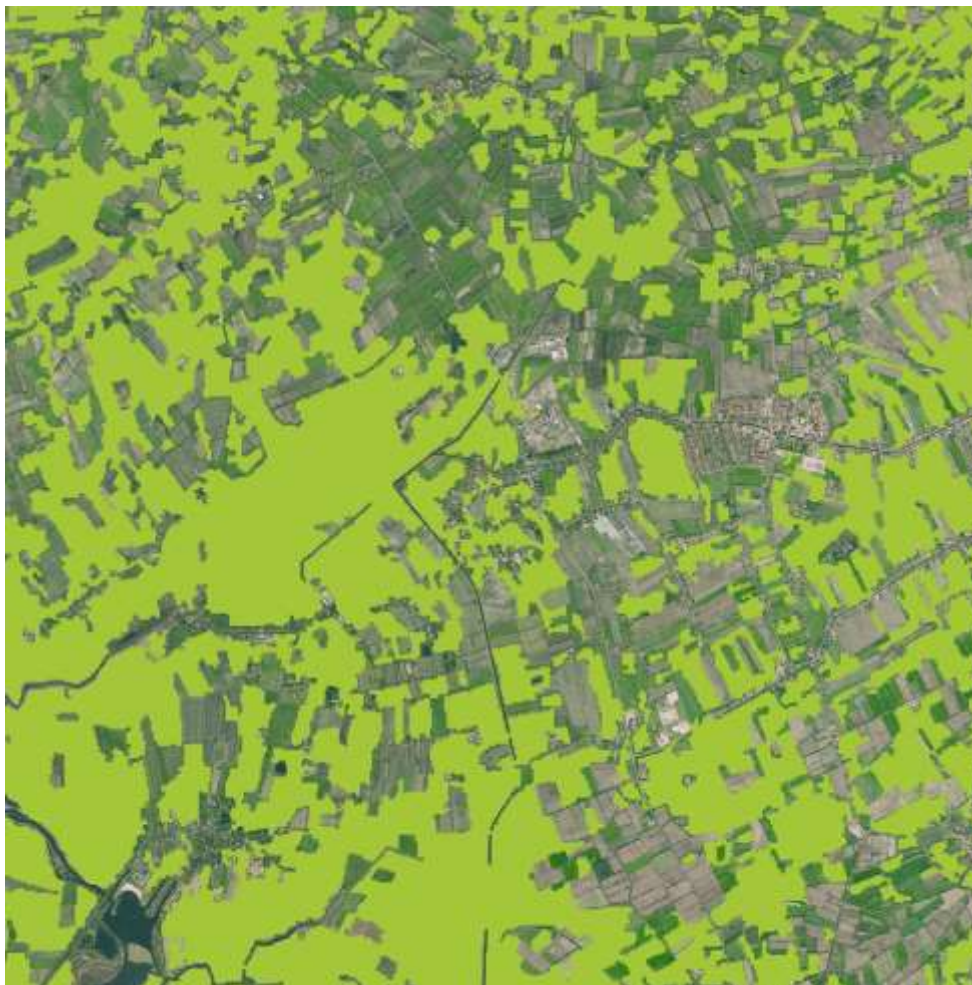- Integrated use of **optical** & **SAR** time series (rule-based evaluation)
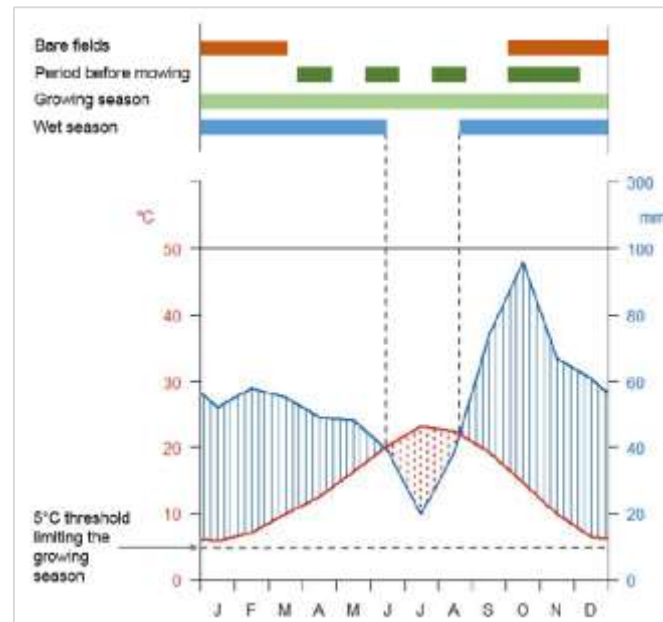
Grassland example

- Plouging indicator
- Grass Vegetation Probability Index
- Grassland mask

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- For 2015 reference year production:
  - Increasing move from mono/bi-temporal <u>to multitemporal image analysis</u> and <u>time series analysis</u>
  - Increasing use of <u>multi-sensor</u> data
  - Largely <u>improved calibration</u> of density values using reference samples
  - <u>Re-processing</u> of whole time series to improve consistency of trends and absolute values
  - Improvements in production speed (12 months for most status layers and 15 months for change products)
- Future (planned improvements)
  - Move to <u>10m pixel size</u> for all HRL's
  - <u>Aquire all necessary EO data for a reference year in the reference year</u>: production start at the end of the vegetation period, and available product 12 months later (or better)
  - Current meaning of reference year: +-1 year. From 2018 reference year we will have products at the end of 2019, up to only 10-12 months after the end of the 2018 season.