User Consultation Platform: Agriculture introduction

Stefan Schneider

07/11/2023 Sevilla
User Consultation Platform
All EU Space Program components with an integrated market/user driven approach

8 parallel sessions

- Agriculture and Forestry
- Environment
- Road and Automotive
- Rail
- Public Transport
- Space
- Resilient Societies
- SST

**Market & User Knowledge**
- Extended *Market and technology* monitoring and forecasting
- Extended and synergic *User Consultation Platform*
- Better understanding the *MS needs* and adding Copernicus Other Users satisfaction survey

**Demand Support & users**
- A common *market segments* approach for all EU space downstream
- Extended key account with *main players* of the value chain

**Offer Creation**
- Creation of new “made in Europe” products and services.
- Large implementation of end-to-end solutions leveraging synergies.
- Supporting entrepreneurship, SME and start-ups

**EU SPACE WEEK 2023**
Report on **Agriculture** and Forestry

User Needs and Requirements

<table>
<thead>
<tr>
<th>Sub-segments</th>
<th>Applications</th>
<th>Types of Application</th>
<th>Level of Investigation</th>
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<tr>
<td>Environmental monitoring</td>
<td>Carbon capture &amp; content assessment</td>
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<td>Environmental Impact monitoring</td>
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<td>Natural resources monitoring</td>
<td>Biomass monitoring</td>
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<td>Crop yield forecasting</td>
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<td>Soil condition monitoring</td>
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<td>Vegetation monitoring</td>
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<td>Operations management</td>
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<td>Automatic steering</td>
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<td>CAP monitoring</td>
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<td>Farm machinery guidance</td>
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<td>Farm management systems</td>
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<td>Field definition</td>
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<td>Livestock wearables</td>
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<td>Pastureland management</td>
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<td>Precision irrigation</td>
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<td>Variable rate application</td>
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<td>Weather services for agriculture</td>
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**Applications covered in 2023 edition**

**Legend**
- **A**: An in-depth investigation
- **B**: A partial specification
- **C**: Will be analysed in next versions

EO only application

GNSS only application

Hybrid/synergetic application (combined use of EO and GNSS)
Session Guidelines
Agriculture Session - Guidelines

ZOOM rules

• **Raise your hand** for questions (menu bar - “Reactions” button – “Raise Hand”) and simultaneously write your question in the chat (“To everyone”)

• Wait for one of the sessions’ moderators to give you the floor. Please note: due to time constraints, only some questions will be selected by the moderators

• Please remind to mute yourself once finished the intervention and **lower your hand** (“Lower Hand”)

• If you are not a speaker, please do not share your screen without moderators’ consent

Timing rules

• We kindly invite all participants to **respect the timing** indicated in the agenda. Not respecting our time constraints would have major impacts on the overall event

• To this end, we will let speakers know when their interventions shall be ending

• Q&A/debate sessions duration may vary depending on the time available. Please feel free to kick-off and feed the debates as soon as the floor will be open, to take advantage of the time at our disposal

• **Reminder**

• Please remember to fill in your information on the list of participants that is being circulating in the room

Thank you for your cooperation!
Agriculture session - Agenda
# Agriculture session - Agenda

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<tr>
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EU Space Programme Components
Status and future services for users

UCP Agriculture

Javier De Blas (EUSPA)
A new EU Space Programme

EU space activities under one umbrella

<table>
<thead>
<tr>
<th><strong>EGNOS</strong></th>
<th><strong>Galileo</strong></th>
<th><strong>Copernicus</strong></th>
<th><strong>GOVSATCOM</strong></th>
<th><strong>SSA</strong></th>
<th><strong>Others</strong></th>
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</thead>
<tbody>
<tr>
<td>EGNOS “Makes navigation signals more accurate and trustworthy for Safety-critical applications”</td>
<td>Global satellite navigation and positioning system (GNSS) More than 3 billion Galileo receivers worldwide</td>
<td>Earth Observation (EO) and monitoring based on satellite &amp; non-space data <strong>Nr.1 world provider</strong> of space data and information (&gt;20TB/day)</td>
<td>Secure satellite communications for EU governmental actors Rapid support over crisis areas</td>
<td><strong>Space Situational Awareness (SSA)</strong> Space Surveillance and Tracking (SST) Space Weather Events (SWE) Near-Earth Objects (NEO)</td>
<td>Access to Space Research &amp; Innovation Entrepreneurship Certification &amp; standardisation Capacity Building</td>
</tr>
</tbody>
</table>
Copernicus
Copernicus components

SPACE

IN SITU

SERVICES

EU SPACE WEEK 2023

#EUSpace
Copernicus services

https://atmosphere.copernicus.eu/

https://marine.copernicus.eu/


https://climate.copernicus.eu/


https://emergency.copernicus.eu/
GALILEO and EGNOS
### Galileo and EGNOS Services

#### Galileo Initial Services
- **Open Service (OS)**: Freely accessible service for positioning and timing*
- **Public Regulated Service (PRS) – Governmental Service**: Encrypted service designed for greater robustness and higher availability – secure satellite communication
- **Search and Rescue Service (SAR)**: Locates people in distress and acknowledges that the distress signal has been received
- **High Accuracy Service (HAS)**: Delivers high accuracy services, freely accessible
- **Under preparation**
- **Commercial Service Authentication (CS)**: Delivers authentication services for commercial applications

#### EGNOS services
- **Open Service (OS)**: Improving GNSS accuracy, intended mainly for high-volume satellite navigation applications for use by consumers
- **Safety of Life Service (SoL)**: Providing a high level of integrity for users for whom safety is essential (e.g., civil aviation, in accordance with ICAO standards)
- **Data Access Service (EDAS)**: Offering EGNOS data with greater added value through internet, intended mainly for professional or commercial use

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* OS Navigation Message Authentication (OSNMA) is currently under testing
Galileo Open Service

• Galileo entered Initial Operational Capability (IOC) phase in 2016. Since then, anyone with a Galileo-enabled device is able to use its signals providing free of charge outstanding seamless performance worldwide, in terms of ranging, positioning and timing.

• The Open Service ranging performance ranks first among all GNSS service providers.
Galileo Open Service

- Galileo OS users can already benefit from an improved navigation message, being broadcast by the Galileo constellation since mid-2023, which considerably boosts their performance in terms of robustness and Time To First Fix (TTFF)

- An update of the Galileo Open Service (OS) Service definition Document (SDD) is planned for the end of this year.

- This fourth issue of the OS SDD will bring to the users:
  - new MPLs (e.g. Ranging rate accuracy, Ranging accuracy at high percentiles)
  - improvements of existing MPLs, such as the timeliness of certain Notice Advisory to Galileo Users (NAGU)

- This updated OS SDD will also introduce the OS Extended Operation Mode, which is characterized by a gradually degrading ranging accuracy with respect to the nominal operational mode, even in case the Galileo Ground Segment is affected by certain issues, thus increasing the robustness of the OS.
Galileo OSNMA

Scope

OSNMA server at GNSS Service Centre (GSC)

Galileo Satellite

OSNMA signal

PUBLIC KEY

OSNMA enabled user receiver

CRYPTOGRAPHIC FUNCTION is navigation data authentic?

No

Navigation data not authenticated

Yes

Navigation data authenticated

Trusted use for positioning
OSNMA status and roadmap

• OSNMA SiS ICD (final format) and Receiver Guidelines published in Dec’2022

• Transmission of SiS as per OSNMA SiS ICD (final format) since August 2023

• Operational cryptographic data to be published by end 2023

• Initial Service Declaration (Service Definition Document publication and signal switch to ‘operational’ mode) foreseen by Q1’24
What is the Galileo HAS

- Galileo HAS provides precise corrections for satellite orbit, clock and signal biases
- Galileo HAS corrections distributed via
  - Galileo satellites, E6-B signal (1278.75 MHz)
  - Internet
- Typical accuracy in the decimetre level (after convergence), with Precise Point Positioning (PPP) receivers
- (Almost*) global coverage and free

*global coverage of corrections but no global performance commitment yet*
What is HAS – Initial Service Area

European Union Agency for the Space Programme (EUSPA), HAS SDD [Online]:
What is HAS - Initial Service Performance

- **Full compliance** to HAS SDD MPLs since HAS service declaration.

<table>
<thead>
<tr>
<th>HAS MPLs</th>
<th>target</th>
<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
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<tr>
<td><strong>orbit</strong></td>
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<td>Galileo</td>
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<td>GPS</td>
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<tr>
<th>availability of HAS corrections, in %</th>
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<tr>
<td>Galileo only</td>
</tr>
<tr>
<td>(≥ 5 corrected satellites)</td>
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<tr>
<td>Galileo and GPS</td>
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<tr>
<td>(≥ 8 corrected satellites)</td>
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</table>

**service coverage, in %**

- **availability of corrections**: 100

- **Sig Dissemination** | **ID0 Dissemination**

- **HAS Quarterly Performance Reports** regularly published at the GSC website (https://www.gsc-europa.eu/electronic-library/performance-reports/galileo-high-accuracy-service-has)
Galileo HAS
What comes next?

- **Short-term: use it!**
  - User segment development
  - More HAS-enabled receivers
  - HAS R&D actions
  - HAS Reference Algorithm publication
  - HAS based applications development

- **Mid / long-term: HAS Full Service**
  - Increased global performance (e.g. better accuracy)
  - Faster positioning in EU (atmospheric corrections)
  - HAS authentication and error characterization

EGNOS Services

EGNOS services are provided to users since October 2009

**Open Service (OS)**
- Improving GNSS accuracy, intended mainly for high-volume satellite navigation applications for use by consumers

**Safety of Life Service (SoL)**
- Providing a high level of integrity for users for whom safety is essential (e.g. civil aviation, in accordance with ICAO standards)

**Data Access Service (EDAS)**
- Offering EGNOS data with greater added value through internet, intended mainly for professional or commercial use

EGNOS services foreseen evolution

**Primary means of navigation for Aviation in 2030**
- Performance Based Navigation (PBN)
- Better availability (99.9%), more resilience, EU autonomy (with Galileo)
- New Airspace users (helicopters, small aerodromes, drones, ...)

**Maritime**
- Initial service in 2023 for maritime and in-land navigation
- Towards autonomous vessels navigation and zero-emissions shipping
- Not only EGNOS: end to end solutions using HAS/OSNMA and Copernicus

**Rail**
- Making ERTMS accessible on all lines
- R&I substantial investment to prepare railway operators and signalling industry
- A new service under preparation, facing the challenge of Rail safety standards
Secure Satcom
IRIS²
Infrastructure for Resilience, Interconnectivity and Security by Satellite

Regulation 2023/588 in force since 20 March 2023

Signature of the Regulation by EP President and Swedish Presidency
Space Surveillance and Tracking (SST)
EUSPA manages and operates the **EU Space Surveillance and Tracking (SST) Front Desk**

The Agency cooperates with the **SST Partnership** to provide **space safety services**:

- **Collision Avoidance (CA)**: risk assessment of collision between spacecraft or between spacecraft and space debris
- **Re-entry Analysis (RE)**: risk assessment of uncontrolled re-entry of artificial space objects into the Earth’s atmosphere
- **Fragmentation Analysis (FG)**: detection and characterization of in-orbit fragmentations, break-ups or collisions
Space Surveillance and Tracking (SST) Front Desk

- Services and Coordination Platform
  portal.eusst.eu

- Performance Reporting

- SST Helpdesk
  sst.helpdesk@euspa.europa.eu

- SST Taskforce

- User Consultation Platform
  7th Nov 2023 afternoon

- Communication
## Agriculture session - Agenda

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Horizon Europe EGNSS Mission and Service related R&D activities + Contribution to Ionospheric Prediction Service

Leo BIBOLLET, Hanaa AL BITAR (TAS-F)
Javier OSTOLAZA (EUSPA)
In 2022, European Commission entrusted EUSPA with technical supervision of 2 non-delegated projects under Horizon Europe EGNSS Upstream ‘Mission and Service (MAS)’: 

- Applied R&D on EGNSS Authentication → E-GIANTS
- EGNSS Additional dissemination means → IDEEAS
E-GIANTS
European GNSS Improved Authentication Solutions

- T0 (signature of the contract): 05/05/2023
- Duration 18 months
- Budget 720 k€

**Objective:** to assess potential EGNSS authentication solutions that exploit the synergies between EGNOS and Galileo

**Focus on:**
- Improving the performance and security of the authentication services provided by EGNSS
- Supporting the definition of optimal authentication solutions for EGNSS, measure the level of protection achieved and the impact on the EGNSS service for non-aviation users

The solution must be validated by a proof of concept.
Scope:

• analyze and define the cost-effective potential data delivery means complementary / alternative to the current EGNOS and Galileo HAS ones either from space and/or from ground/air

• improve the current dissemination capabilities in terms of potential users and enhanced commitments (e.g. provision of integrity through EDAS)

• propose a meaningful timeframe for the proposed dissemination mean, taking into account standardization and user terminal activities

• perform a proof of concept of the service

IDEEAS

INNOVATIVE DISSEMINATION MEANS AS ENABLERS FOR EGNSS AUGMENTATION SERVICES

• T0 (signature of the contract): 14/03/2023
• Duration 18 months
• Budget 620 k€
The results of both projects (e.g. user needs, concepts proposed, costs and benefits, implementation roadmaps) shall be validated by a representative set of stakeholders across different sectors.

To participate or if you have any question, please feel free to contact us:

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<td>Hanaa.AlBitar@thalesalenia space.com</td>
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Contribution to Ionospheric Prediction

YES

BUT

EGNOS SoL SDD commitments

https://www.discover-the-world.com/

EGNOS SoL real performance
Contribution to Ionospheric Prediction

Next steps

Assess main contributors to space weather impact on EGNSS (EGNOS and Galileo)
Assess feasibility of predictions/forecast
Assess impact on user operations
Assess how to inform users on potential EGNSS underperformance
Define an operational service concept

To participate or if you have any question, please feel free to contact us:

javier.OSTOLAZA@euspa.europa.eu
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Copernicus for agriculture - products

UCP Agriculture

Usue Donezar Hoyos, European Environment Agency
**Copernicus Land Monitoring Service**

- **Geographical** information on land cover and its changes, land use, vegetation state, water cycle and Earth's surface energy variables on European and global levels for environmental applications.

- **Harmonized** and **consistent** in time and space.

- Products and manuals are free and open.

- Implemented by JRC and EEA.

- Website: [https://land.copernicus.eu/](https://land.copernicus.eu/)

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
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<tbody>
<tr>
<td>Land cover and land use mapping</td>
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<td>Priority area monitoring</td>
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<td>Bio-geophysical parameters</td>
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<tr>
<td>Ground motion monitoring</td>
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<tr>
<td>Satellite data</td>
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<td>Reference and validation data</td>
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</table>
HR Vegetation Parameters

- Spatial resolution: 10 m, no MMU
- Update frequency: Daily/10-daily/Yearly
- Most recent reference layer: 2022/2023
- Examples of applications:
  - Mapping peatlands and modelling their CO$_2$ emissions
  - Assessing and adapting to drought impact
  - Biodiversity conservation

Upcoming webinar series:
HRL Vegetated Land Cover Characteristics

- Spatial resolution: 10 meter
- Update frequency: Annual
- Most recent reference layer: 2021
- Examples of applications:
  - CAP
  - LULUCF
Corine Land Cover

- Spatial resolution: 25/5 ha MMU
- Update frequency: 6 years
- Most recent reference layer: 2018
- Examples of applications:
  - Habitat mapping
  - Impact assessment
Corine Land Cover+ Backbone

- Spatial resolution: 10 m, pixel based
- Update frequency: 3 (soon 2) years
- Most recent reference layer: 2018
- Examples of applications:
  - Land cover classification
  - Impact assessment
HRL Small Woody Features

• Spatial resolution: 5/100 m, vector layer
• Update frequency: 3 years
• Most recent reference layer: 2018
• Examples of applications:
  – CAP monitoring of Good Agro Ecological Conditions
  – Urban Greening
HR Water, Snow, Ice

- Spatial resolution: 10m, pixel based, no MMU
- Update frequency: 3 years, moving to NRT starting on 2017
- Most recent reference layer: 2018
- Full integration of Snow and Ice and former HRL Water and Wetness
- Examples of applications:
  - Water reservoirs,
  - Drought monitoring,
  - Flood assessment
European Ground Motion Service

- Spatial resolution: 5x20/ 100x100 m
- Update frequency: Yearly, with time series
- Most recent reference layer: 2015 – 2022
- Example of applications:
  - Monitoring evolution → asset management and impact assessment

Webinar:
Thank you!

Usue.Donezar@eea.Europa.eu
https://land.copernicus.eu/
Copernicus Climate Change Service For Agriculture

Cristina Ananasso
Delphine Deryng (on line)

European Centre for Medium Range Weather Forecasts
... all climate data you had always dreamed of and never dared asking

- Regional climate datasets
- Sectoral datasets (energy, water, agriculture, extremes,..)
- Open source applications running on a cloud platform and able to generate tailored indicators on the fly

Typical download: ~100 TB /day
Typical number of requests: 500k/day

climate.copernicus.eu
cds.climate.copernicus.eu

Operational (not research) Unrestricted OPEN AND FREE
Global warming reached an estimated 1.24°C in September 2023. If the 30-year warming trend leading up to then continued, global warming would reach 1.5°C by September 2034.
**Trends in global mean temperatures**

Global warming reached an estimated 1.24°C in September 2023. If the 30-year warming trend leading up to then continued, 0.5°C by September 2034.

**Climate-related drivers of impacts on crops**

- Warming trend
- Extreme temperature
- Drying trend
- Extreme precipitation
- Carbon dioxide fertilization
- Frost
### Key risks for Europe under low to medium adaptation

<table>
<thead>
<tr>
<th>Global surface air temperature change relative to 1850-1900</th>
<th>Key Risk 1</th>
<th>Key Risk 2</th>
<th>Key Risk 3</th>
<th>Key Risk 4</th>
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<tbody>
<tr>
<td>Human heat stress, mortality and morbidity</td>
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<td>Marine ecosystems disruptions</td>
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<td>Terrestrial ecosystems disruptions</td>
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<td>Losses in crop production</td>
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<td>Water scarcity in Southern Europe (SEU)</td>
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<td>Water scarcity in Western and Central Europe (WCE)</td>
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<td>River and pluvial flooding</td>
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<td>Coastal flooding</td>
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<tr>
<td>Delayed risks for cultural heritage and long-living infrastructure</td>
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</table>

**Level of risk**
- Very high
- High
- Moderate
- Undetectable

**Confidence**
- Low → High

The ember colour gradient indicates the level of additional risk to society and ecosystems as a function of global temperature change. Confidence is provided for the change of risk level at given temperature ranges.
Climate change risks on European agriculture

Key risks for Europe under low to medium adaptation

- **Key Risk 1**: Losses in crop production, Water scarcity in Southern Europe (SEU), Water scarcity in Western and Central Europe (WCE), River and pluvial flooding
- **Key Risk 2**: Coastal flooding
- **Key Risk 3**: Delayed risks for cultural heritage and long-living infrastructure

The intensity of the color gradient indicates the level of additional risk to society and ecosystems as a function of global temperature change. Confidence is provided for the change of risk level at given temperature ranges.
Indirect drivers of climate change impacts on agriculture

- Pests, diseases
- Land degradation, soil erosion
- Sea level rise and coastal erosion
- Fires from extreme heat and droughts
Adaptation

- Agronomic practices:
  - fertiliser, irrigation
  - shift in planting dates, cultivars
  - change in cropping density
- Agroecological practices:
  - tillage
  - diversification
  - agroforestry
- Technological innovation: genetic improvement
- Risk transfer strategy: insurance
- Planning with better information -> climate services (Copernicus)
Climate Change

3 data product groups

1. Climate forcing data for crop models
   • all time scales, downcaled, bias corrected, model adaptors

2. Agroclimatic indicators (generic & crop specific)
   • Growing degree days, huglin index, cold/heat stress days, insect flight index...

3. Climate enhanced Earth Observation based indicators
   • Dry Matter Productivity (crop specific), $\text{ET}_{\text{actual}}$, ...

All aggregated to crop specific
• phenological calendars
• growing areas

https://climate.copernicus.eu/global-agriculture-project
Agroclimatic indicators explorer for Europe from 1970 to 2100: the application is the evolution of the EU LIFE AgriAdapt project.

Objective: explore agro-climate indicators present climate conditions (1970-present) and as well as comparing future climate scenarios (2011-2100).

Spatial resolution: European continent, 0.25° x 0.25°


Climate projection: 9 climate models, bias-adjusted CORDEX regional, RCP4.5 or 8.5.

Indicators:
- Heat stress, Average temperature, Precipitation, Frost days, Days above 25°C, Date of last spring frost.
- Adjustable threshold and/or period.

Documentation available.
Thank you for your attention
## Agriculture session - Agenda

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Digital Solutions

Developing Requirements from Automation to Autonomy

Georg Larscheid
Vice President, Global Digital Business, CLAAS

EU SPACE WEEK 2023_7-9 NOV, Sevilla, Spain
CLAAS Product Portfolio.

Combine Harvesters

Forage Harvesters

Tractors

Mowers

Balers

Telescopic Loaders

Wheel Loaders

Software & Systems

Service & Parts
Global agricultural mega trends

Today's living conditions are changing expectations of agricultural machinery engineering

- World population is growing.
- Agricultural area is shrinking.
- Eating habits are changing.
- People are mobile and globally networked.
- Climate change is steadily proceeding.
- Renewable energy sources are in demand.
Our Vision

We enable farmers to be the best in their field.
Precision farming offers more possibilities with increased efficiency and sustainability.
What is Precision Farming?

**Precision Farming is all about managing spatial- and temporal variability, in a field (outdoors)**

### Input

- **Satellites**: 750 km
- **Drones**: 100 m
- **CROP SENSOR**: 1.5 m
- **Yield Mapping**: 0 m
- **Soil Sampling**: ~0.3 m
- **Soil Mapping**: ~1.2 m

### Output / Precision Field Work

- **Automatic seed drill control**
- **Optimised fertiliser application**
- **Automatic section control for sprayers**
- **Optimised harvesting**
- **GPS steering with route optimisation**
- **Robots, swarm technology**

---

**Data Stream**

- **Data input**: Precision Farming Data Stream
- **Services**: Data interpretation
- **Customer**: Transfer to machine / terminal
- **Success analysis**: Data logging and documentation

---

**EU SPACE WEEK 2023_7-9 NOV, Sevilla, Spain**
It’s a Journey
CLAAS has been a pioneer in Precision Farming and will continue to invest
Precision

Automation

Autonomy
3A - ADVANCED AUTOMATION AND AUTONOMY
The open partnership for more efficiency
Precise Positioning (GNSS)

Remote Sensing (Observation)

Communication (SATCOM)
Precise Positioning
Precise positioning, core-capability #1 required for the Precision, Automation and the Autonomy journey

Our Requirement:
• Globally available, in-field, reliable and repeatable, cm-level accuracy positioning through GNSS established
  • through differential correction **cm-level accuracy** is obtained, either via satellite (i.e. EGNOS) or local terrestrial (RTK)
    → as mobileRTK becomes standard, outages occur due insufficient to cell-phone coverage in rural areas
  → driving need for supplemental SATCOM solution at affordable price point to ensure reliability
• through sensor fusion, which is required to reach **mm-level accuracy** i.e. for single-plant localization (treatment)

Our Need:
• Continued, stable operation of GNSS network, as prof. farmers are fully relying on it
• More affordable SATCOM availability to improve RTK availability and stability
• Subsidy programs to encourage retrofit installations of older machine population

Our Achievement:
- est. > 50% of arable farm land is treated with GNSS-based auto steering and/or section control appl. technology
- accountable for higher application precision in fuel, fertilizer and chemical usage, leading to reductions of 5-15%
Remote Sensing, core-capability # II required for the Precision, Automation and the Autonomy journey

Our Requirement:
• Easy access to reliable, highly repetitive satellite imagery through Sentinel 2 (mainly via NDVI) available and proven, but:
  − Image repetition too low (i.e. every 5 days)
  − High risk of image disturbance due to cloud coverage

Our Achievement:
• est. > 10-20% of arable farm land is treated with GNSS-based VRT appl. technology
• lead to an est. < 5% reduction in application volume but slightly higher yields

Our Challenge:
Step1: Identifying spatial variability
Step2: Creating a variable rate (VRT) prescription based on crop- and/or field attributes

Our Need:
• Higher image repetition (i.e. every 1-2 days)
• More research in image interpretation related to plant growth/health indicators
Communication

Communication, core-capability # III required for the Precision, Automation and the Autonomy journey

Our Requirement:

- Stable data communication, incl. rural areas, infrastructure to enable continues machine tracking at affordable price levels
  - currently mainly relying on mobile-/cell phone technology (4G) with too many outages in rural areas

Our Need:

Stable data communication infrastructure to enable continues machine tracking at affordable price levels for farmers

- coverage beats bandwidth
- required for broad adoption of autonomous machines in Ag
1. The availability of GNSS and Earth Observation programs from the EUSPA have enabled Agriculture & Forestry in the EU to become more efficient & sustainable over the past 20 years.

2. There is further potential identified to improve the efficiency and sustainability of Agriculture & Forestry, by enhancing the adoption of Precision & Automation solutions in the market.

3. Autonomous solutions are on the horizon, which in particular require SATCOM as a key enabler.
Developing Requirements for Growing Automation and Autonomy: Open Debate
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**KEY AREAS**
User Consultation Platform Agriculture
Esther López Casariego (ACORDE Technologies S.A.)
esther.lopez@acorde.com

CALIRUMI R&D project – EGNSS based robots for organic farming
GALIRUMI H2020 Project

Galileo-assisted robot to tackle the weed *rumex obtusifolius* and increase the profitability and sustainability of dairy farming.

(partially funded by EC-EUSPA under GA 870258)

Main objective

Harness the possibilities that **GALILEO** brings...

... to deliver robot weeding for **herbicide-free weed control** in dairy farming

Robotic weeding will **eliminate herbicide use and reduce exposure** of farm workers (remove obstacle for organic production).

*Broad-leaved dock (Rumex obtusifolius)* is a **problematic weed** that expands and cover large parts of the farm if uncontrolled.
Objectives

• Integrate GALILEO receiver
• Improve weed detection
• Construct electrocuting and laser prototype robot
• Software for robot navigation and mission planning and control
• Field-test robots in operational environment
• Evaluate business model

Benefits: will reduce...

• Labour for weeding
• Weed management cost
• Damage to grass from the application of herbicide
• Impact of dairy farming on the environment
• Dairy cow discomfort
End users KOO, PEK and IDE will provide user requirements as well as operational scenarios. This input will be forwarded to ACO, DTU, WR and STE who are responsible for design and development of the robotic systems.

<table>
<thead>
<tr>
<th>Area of expertise</th>
<th>ACO</th>
<th>WR</th>
<th>DTU</th>
<th>KOO</th>
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</table>
Benefits from GALILEO adoption

- **GALILEO differentiators** (multiple frequencies with modern modulations) enable robust navigation for autonomous agricultural robots even in locations where other GNSS do not work sufficiently well.

- **GALIRUMI benefits** from GALILEO adoption:
  - Better **resilience to multipath** due to more robust modulations, appropriate for scenarios without a clear vision of the sky due to near obstacles
  - An improvement of the **availability of satellites** in sight when used in combination with other GNSS constellations
  - **Sub-metric position** accuracy using E1+E5 (AltBOC) frequency bands without RTK corrections

- **New GALILEO improvements**:
  - High Accuracy Service (HAS). <20 cm **accuracy** without using RTK corrections
  - OS Navigation Message Authentication (OS-NMA). **Authentication** of navigation data: resilience to spoofing
GALILEO integration

- Laser and electric weeding platforms developed
- Navigation and positioning based on GALILEO dual-receiver (heading)
Field test in operational environment

Demonstrations in Netherlands, France and Denmark, attended by farmers
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The EU Space Opportunity for Small and Medium Sized Farmers

User Consultation Platform Agriculture

Maurizio Laterza, Planetek Italia
The Overview
Agriculture activities

Agriculture is one of the business sectors of Planetek Italia since years.

Some projects in which we took part:

- **RESO**
  - Resilienza e Sostenibilità delle filiere ortofrutticole e cerealìcole per valorizzare i territori

- **CRITE**
  - Coffee Rehabilitation In Timor-Leste

- **EO AFRICA**

- **ReDOX**
  - Experimental service for agricultural parcels monitoring for

- **ADB**
  - Water and Food Security Planning in Indonesia for

- **IRMAT+**
  - Irrigation Management Tool +
The Story

• EUGENIUS « European Group of Enterprise for a Network of Information Using Space »
• Market: Precision Farming for viticulture
• PARTIES INVOLVED: Planetek Italia (EO data provider) and Tormaresca (the winery)
• OBJECTIVE: The goal is to understand
  – how gradually incorporating Space data into their work can help the winery support their growers in optimising the process and resources through the adjustment of what is needed against what is available (costs)
  – how the level of interconnection and interdependence between the users and the project promoting EO data
• The market target:
  o Agronomic consultant, Italy
  o The winery (the market actor in Italy), and
  o The association of farmers in Italy (the vineyard)
• The technical actions are:
  o Support for the selection of sampling points for laboratory analysis, cost-effectively and efficiently
  o Support with agronomic advice on fertilization and irrigation
  o Identification of other structural criticalities
COMMERCIALISING TECHNOLOGY IN SMEs:
The ROLE OF EUROPEAN R&I PROJECTS

Raffaele SILVESTRI, Francesco PETRUCCI, Savino SANTOVITO
Dipartimento di Economia e Finanza
University of Bari

✓ the present research has primarily focused on the project relationship emerged between Planetek and Tormaresca to understand:

1. how the new technology has been progressively implemented in the user’s setting through progressively developing and adapting both project resources and firms’ resources;

2. how the project context has influenced, and has been influenced by, the emerging relationship and the underlying process of resource interaction.
The study conclusion

It successfully works if the customer:

- Has clear goals
- Is open to change
- Has the needed resources
- Manages the value chain production, transformation, commercialization
The bottlenecks and the mitigation actions
Capacity of innovation

• **The bottleneck**: small farmers have limited capacity of innovation:
  
  – the average value of Utilised Agricultural Area (UAA) per farm in Italy was 11.1 hectares in 2020 (although growing) [1];
  
  – almost two-thirds of the EU's farms were less than 5 hectares in size in 2020 [2]

• **The mitigations**:
  
  – work together with agronomists and associations of farmers
  
  – act on the whole agricultural supply chains

Credit facilities

• **The bottleneck**: smaller agri-food innovators that focus on digital, data-driven offerings find it particularly difficult to access financing in order to grow ([1]), also because credit facilities related to buying digital services are very few or absent.

• **The mitigation**: provide farmers' associations with effective means to lobby for having more opportunities of credit facilities related to digital services.

Awareness

• The bottlenecks:
  – often farmers are not fully aware of satellite capabilities
  – often farmers are not able to choose the best solutions for them
  – training actions are needed

• The mitigations:
  – provide training opportunities
  – provide farmers with pilot cases and success stories
Certifications from independent parties

• **The bottleneck:** there is lack of certifications about service accuracy and reliability by a third party (different from the vendor)

• **The mitigation:** identify independent actors and collaborate with them to get a third-party certification of the service
The Success Stories
Professionals training: ISMEA open school

• ISMEA (Istituto di Servizi per il Mercato Agricolo Alimentare) organized in 2022 the Copernicus open school to train Italian agronomists in Campania and Veneto.

• Planetek Italia participated as a trainer presenting some use cases for precision farming and CAP, and organized a 1-day hackathon.
The Story

• **TITLE**: EO AFRICA Water resource management – A support to farmers and planners to improve irrigation water management.

• **PARTIES INVOLVED**: Planetek Italia (Space data provider), Planetek Hellas (partner), International Centre for Advanced Mediterranean Agronomic Studies Bari (CIHEAM Bari) (partner), National Authority for Remote Sensing & Space Sciences, Egypt (NARSS) (stakeholder), and October sixth for agricultural projects company (stakeholder).

• **OBJECTIVE**: To estimate crop water stress and evapotranspiration, exploiting ECOSTRESS and PRISMA data by experimental EO analysis techniques.
One of the main bottlenecks is water loss due to the failure to rationalize water consumption in an all-consuming sectors like agriculture. In this context, the goal is to employ thermal Earth Observation data to accurately estimate the effective crop water consumption represented by the actual evapotranspiration.

**Objective**

To estimate crop water stress and evapotranspiration, exploiting ECOSTRESS and PRISMA data by experimental EO analysis techniques. Sentinel-2 data are used as support for comparative purposes.

**Outcomes**

- Prediction and mitigation of crop stress as a result of water losses (evapotranspiration)
- Precision irrigation planning and scheduling as a result of data-driven water use optimisation
- Better policies on regional water management, allocation, and distribution
Specific objectives

- Crop growth monitoring;
- Stressed crop monitoring;
- Yield prediction;
- Water productivity;
- Water use efficiency.

Engaging small farmers with space data requires a holistic approach that combines technology, training and support. It is essential to adapt the approach to the local context and the specific challenges faced by small-scale farmers in the targeted region.

The main objective of engaging small farmers to space data can be summarized in enhancing sustainability and farmers income based on data-driven decision making.

Demo site:
(Left) Initial area of interest captured on June 2023.
(Right) Prototype of evapotranspiration map for crops calculated with Prisma and Ecostress data (June 2023), depicting several pivots.
Planetek Italia with the support of CIHEAM Bari made important steps to engage small farmers with space data, including:

- Understanding the specific needs of small farmers, faced challenges
- Organizing workshops and training sessions to educate farmers about the benefits of space data
- Offering basic training on how to access and interpret space data and integrate it into their farming practices
- Presenting real-cases examples of improved yields with reduced water consumption;
- Strengthen the technical and analytical skills of local agricultural advisors to effectively use space data and support small farmers

Demo site:

“October sixth for agricultural projects” company in El Salheya El Gedida, a city in Sharqia Governorate, in the north of Egypt
# Agriculture session - Agenda

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SPACE and REGENERATIVE AG

UCP Agriculture
Tamme van der Wal
Take away message

• Transition to regenerative farming is taking off;
• Protecting soil quality and improving carbon levels is essential;
• Data is essential to re-balance ecology and economy for farmers (and other stakeholders);
• Monitoring and benchmarking are crucial data analyses tasks supporting the transition;
• Space data is relevant to make objective and scaled data monitoring solutions;
• 3 important steps to make that happen.
Regenerative Agriculture

Mainstream farming (extractive agriculture):
- Declining yield levels
- Increasing risks
- More and more machines, fertilisers, PPP

Regenerative farming:
- Conservation of soil / soil health
- Climate smart practices
- Stable yields → better margins

- Technology can help to make the transition (IoT, data, AI, robotics, etc.) to agro-ecological practices.
Regenerative Agriculture
Role of EO in transition to ReGen Ag

• Monitoring of fields, farms, regions, countries
  – Scouting, Benchmarking, Performance indicators

• Applications maps
  – Translate spatial differences in applications differences

• Monitoring of practices (e.g. for certification / insurance)
  – Crop Rotation;
  – Tilling; Harvest; Cover crops;
  – Applications (manure/water).
Many platforms

Make better farming decisions with the Farm21 assistant
3 steps to support farmers with space

• 1. Start quick and small → involve farmers (awareness)
  – Demonstrate
  – Collect feedback / criticism

• 2. Think data / information → Beat the farmer in information value (attitude)
  – Set clear monitoring goals
  – Scope (what’s in and what’s out)

• 3. Make monitoring valuable → change the farmer’s frame (action)
  – Address farmer’s entrepreneurship
  – Address the agricultural ecosystem
1. Involve the farmer
Easy and affordable tools
2. Beat the farmer in information value
Benefits of EO

• Overview
• Whole spectrum
• Timely / Low latency

Do not bother farmers with:
• Cloud cover
• Atmospheric disturbances
• Geometric errors
3. Change the farmer’s frame
Use data in daily processes
Soil carbon monitoring

• Advancements in ‘measuring’ carbon
• EO only looks at ‘topsoil’
• What is relevant? 30cm? 100cm?
• Carbon dynamics → when to measure
• Annual increase in carbon levels = uncertainty level in lab analyses
Take away message

• Transition to regenerative farming is taking off;
• Protecting soil quality and improving carbon levels is essential;
• Data is essential to re-balance ecology and economy for farmers (and other stakeholders);
• Monitoring and benchmarking are crucial data analyses tasks supporting the transition;
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EU Space Role within Regenerative Agriculture: Open Debate
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SPACE4GREEN (HE Project)
EU Space & Blockchain for traceability and sustainability

UCP Agriculture
Juan Pablo García – INTEGRASYS S.A.
Outline

• SPACE4GREEN Project: General concept
• Use cases and demonstrators
• Current implementation and integration
• Conclusion
SPACE4GREEN Project: General Concept
SPACE4GREEN: Overview

EGNSS applications for the Digital Age (HORIZON-EUSPA-2021-SPACE-02-53)

**Planning**
- GA signature: 17th Oct. 2022
- Project start: 1st Nov. 2022
- Project end: 31st Oct. 2024

**Consortium**
- 9 partners
- 5 countries

**Budget**
- 2.95 Millions €

**Funding rate**
- ~79% [avg.]

**Statistics**
- Call
- 50 proposals
- Topic
- 10 proposals

HE Innovative Action
SPACE4GREEN: Overview

EGNSS applications for the Digital Age (HORIZON-EUSPA-2021-SPACE-02-53)

Consortium
- 9 partners
- 5 countries

COORDINATOR: INTEGRASYS, Spain
SPACE4GREEN: Core Concept

SPACE4GREEN seamlessly combines blockchain technology and Galileo OS-NMA signals to provide a comprehensive solution that effectively tackles common challenges across multiple sectors.

This harmonious fusion of technologies serves to boost operational efficiency, reduce costs, and empower a more self-reliant and dependable certification process within the framework of SPACE4GREEN.
SPACE4GREEN: Core Concept

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This harmonious fusion of technologies serves to boost operational efficiency, reduce costs, and empower a more self-reliant and dependable certification process within the framework of SPACE4GREEN.
SPACE4GREEN: Use Cases and Demonstrators
General Scheme of the Use Cases
Demonstration Case 1: Transparency, Traceability and Trust in Local Food Production [Slovenia, ITC]

“SPACE4GREEN introduces and demonstrates an advanced traceability system that leverages the power of blockchain technology while enhancing its records with verified information of position and time, thanks to the cutting-edge Galileo OS-NMA.”

- **Enhanced Transparency**: Integration of blockchain technology and Galileo OS-NMA for unparalleled transparency in local food production.
- **Consumer Empowerment**: Access to accurate and trustworthy information empowers consumers to make informed food choices.
- **Support for Local Economies**: Increased consumer trust drives demand for local products, supporting local businesses and agriculture.
- **Food Safety and Quality**: Verified information ensures safe and high-quality food products for consumers.
- **Environmental Benefits**: Promoting local production reduces carbon footprint from long-distance transportation.
Demonstration Case 2: Enhancing Common Agriculture Policy Rules Monitoring and Auditing [Spain, CAAND]

“SPACE4GREEN introduces and demonstrates the enhancement of monitoring and auditing of the common agricultural policy’s schemes.”

- **Efficiency and Accuracy:** Improved CAP monitoring processes enhance efficiency and accuracy in data collection and analysis.
- **Faster Audits:** Streamlined audit procedures lead to quicker identification of compliance issues and more timely aid disbursements.
- **Enhanced Transparency:** Better data traceability and validation processes increase transparency in CAP monitoring.
- **Better Policy Decision-Making:** Real-time, accurate data empowers data-driven policy decisions to address agricultural challenges.
- **Cost Savings:** Efficient audits and reduced administrative burdens result in cost savings for the CAP program.
- **Sustainable Agriculture:** The system supports sustainable farming practices by targeting incentives and interventions effectively.
- **Compliance Assurance:** Improved monitoring capabilities reduce the risk of non-compliance, benefiting farmers and the CAP program.
Demonstration Case 3: Transparency and Traceability of Olive Oil [Spain, LUCENA]

“SPACE4GREEN demonstrates how the advanced traceability system allows consumers to have convenient access to the most pertinent and authenticated details regarding extra-virgin olive oil production.”

- **Enhanced Brand Integrity**: advanced traceability enhances the reputation and integrity of Appellation of Origin Lucena's Olive Oil.
- **Quality Assurance**: powered by blockchain and Galileo OS-NMA, ensures the accuracy of Extra Virgin Olive Oil's origin and quality.
- **Market Competitiveness**: LUCENA gains a competitive advantage by offering verifiable product authenticity.
- **Consumer Confidence**: Buyers can trust in the authenticity and quality of the product, fostering loyalty.
- **Regulatory Compliance**: The system helps in meeting and exceeding regulatory requirements and standards.
- **Data-Driven Decisions**: Valuable data assists in making informed decisions and responding to market trends effectively.
Demonstration Case 4: Traceability and Authenticity of Wine [Cyprus, OMNIA]

“SPACE4GREEN introduces and demonstrates how the enhanced traceability increases the added value of the local wines and opens new market horizons for the benefit of the producers and the local and national economy.”

- **Enhanced Traceability**: By facilitating accurate documentation of the origin of Cypriot wines, enhancing transparency and consumer trust.
- **Quality Assurance**: Improved traceability and sustainability measures result in higher-quality Cypriot wines.
- **Competitive Edge**: Cypriot wines gain a competitive advantage by emphasizing their unique origins, sustainability, and quality.
- **Promotion of Local Culture**: By helping the preservation and promotion of the cultural identity of the region through its wines.
Demonstration Case 5: Environmental Sustainability Index of Cotton & Vineyards Cultivation
[Greece, ACP & AgroApps; Cyprus, OMNIA & AgroApps]

“SPACE4GREEN introduces and demonstrates a ground-breaking solution — ESI (Environmental Sustainability Indicator)—that revolutionizes the assessment, monitoring, and improvement of sustainability practices within the agricultural sector.”

- **Data Precision and Integration:** Space4Green ensures precise location data integration through Galileo and EGNOS, enhancing sustainability assessments for ESI.

- **Blockchain Integration:** Space4Green strengthens ESI's data security and transparency via blockchain, safeguarding supply chain sustainability records.

- **Environmental Sustainability Compliance:** ESI facilitates compliance with stringent environmental sustainability standards by providing biodiversity, soil, water, and greenhouse gas indicators.

- **Transparency and Supply Chain:** ESI offers supply chain traceability to meet consumer demand for sustainable products, building trust and tapping into growing markets.

- **Data-Driven Decision-Making:** ESI provides accurate and up-to-date agricultural data for informed decisions, optimizing resource use, increasing efficiency, and reducing operational costs.

"SPACE4GREEN introduces and demonstrates a ground-breaking solution — ESI (Environmental Sustainability Indicator)—that revolutionizes the assessment, monitoring, and improvement of sustainability practices within the agricultural sector.”
SPACE4GREEN: ESI module case
Environmental Sustainability Index of Cotton & Vineyards Cultivation

- User logs in the S4G App
- Selects a parcel to register an activity
- Selects the activity
- Fills in the requested details
- Submits the activity
Environmental Sustainability Index of Cotton & Vineyards Cultivation

- S4G App geolocates and timestamps the activity and makes the respective register on the blockchain

-> At the same time in the ESI Platform
Environmental Sustainability Index of Cotton & Vineyards Cultivation

->The parcel specific calendar is being populated with every incoming activity
Environmental Sustainability Index of Cotton & Vineyards Cultivation

->Activities are aggregated, and the full calendar for each of the parcels appears
Environmental Sustainability Index of Cotton & Vineyards Cultivation

-> With every activity the respective CO2 emissions are calculated
Environmental Sustainability Index of Cotton & Vineyards Cultivation

And finally at the end of the crop season the ESI Score is calculated.
SPACE4GREEN: Current implementation and integration
Implemented SPACE4GREEN architecture

- SPACE4GREEN App V1
- SPACE4GREEN Server V1
- KSI Service: Blockchain
- Auxiliary OSNMA processing element: Galmon device.
- ESI Platform V1
- IPFS preliminary tests
- Spoofing tests
SPACE4GREEN Roadmap

- **Start of the Project**: October 2022
- **February 2023**: User & Tech Requirements
- **April 2023**: Overall Architecture
- **June 2023**: Draft Design
- **V1 Solution**
  - **October 2023**
- **V2 Solution & Demonstration Phase**
  - **October 2024**
  - **March 2024**: Final Design & Pilot preparation
Conclusion
To sum up...

• Galileo OS-NMA & Copernicus enable more accurate navigation and timing
• Galileo OS-NMA & Copernicus support traceability and sustainability
• Versatile solution with multiple applications in the agrifood industry: short food supply chains, CAP management, olive oil & wine production, sustainable crops.
• Trusted information that can be easily shared among agri-food stakeholders.
• Smartphones are uncapable of fully decoding OSNMA fields near real-time: Auxiliary OSNMA processing element.
• Demonstration phase from March 2024 to October 2024.
# Agriculture session - Agenda

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Conclusions and next steps

CONCLUSIONS

Thank you for your active participation to the Agriculture User Consultation Platform!
Your feedback and inputs are of key importance to us, as they will feed into the Report on Agriculture and Forestry User Needs and Requirements. The report will be published in early 2024 (on EUSPA website)

NEXT STEPS

• The minutes of today’s session will be soon made available online
• From 14.00 to 17.00 today you are welcome to join the Forestry User Consultation Platform.
Thank you!