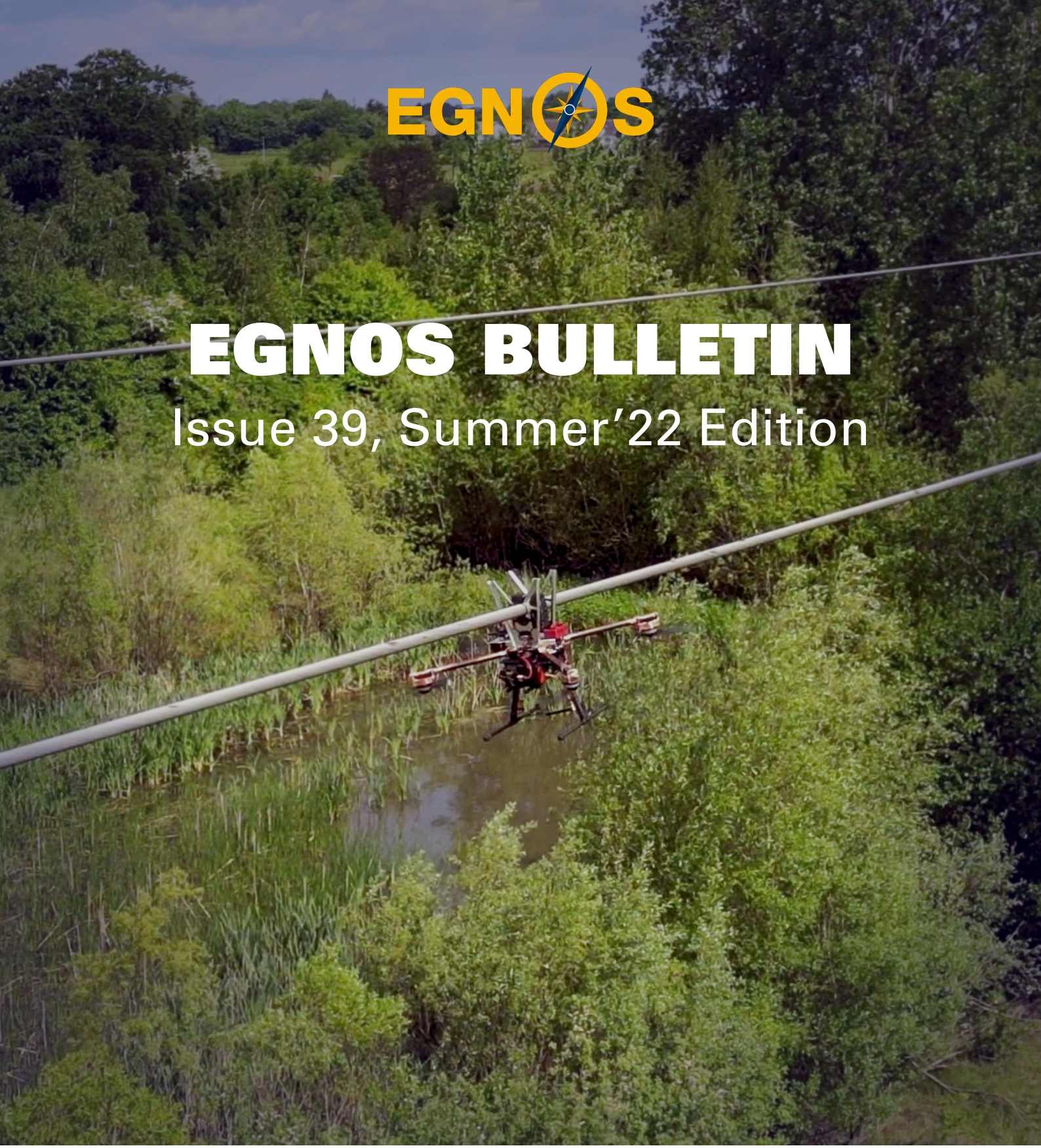
EGNOS

EGNOS BULLETIN

Issue 39, Summer'22 Edition



Credits: Drones4Safety

EUSPA
European Union Agency for the Space Programme

NAVIGATION MADE IN EUROPE

https://egnos-user-support.essp-sas.eu/

ESSP

https://www.essp-sas.eu/

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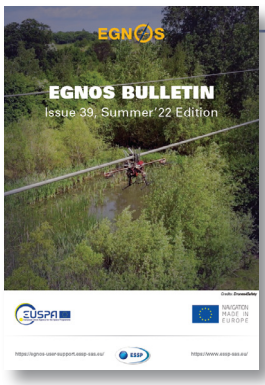

Cover Story

Talking about EGNOS with…Drones4Safety

Drones4Safety is a European project that aims to develop a system of autonomous, self-charging, and collaborative drones capable of inspecting a large part of transport infrastructures in a continuous operation. This ambitious project is funded by the European Union's Horizon 2020 Research and innovation programme under the Research and Innovation Actions (RIA) scheme and is coordinated by the University of Southern Denmark (SDU), involving nine partners from five EU countries .

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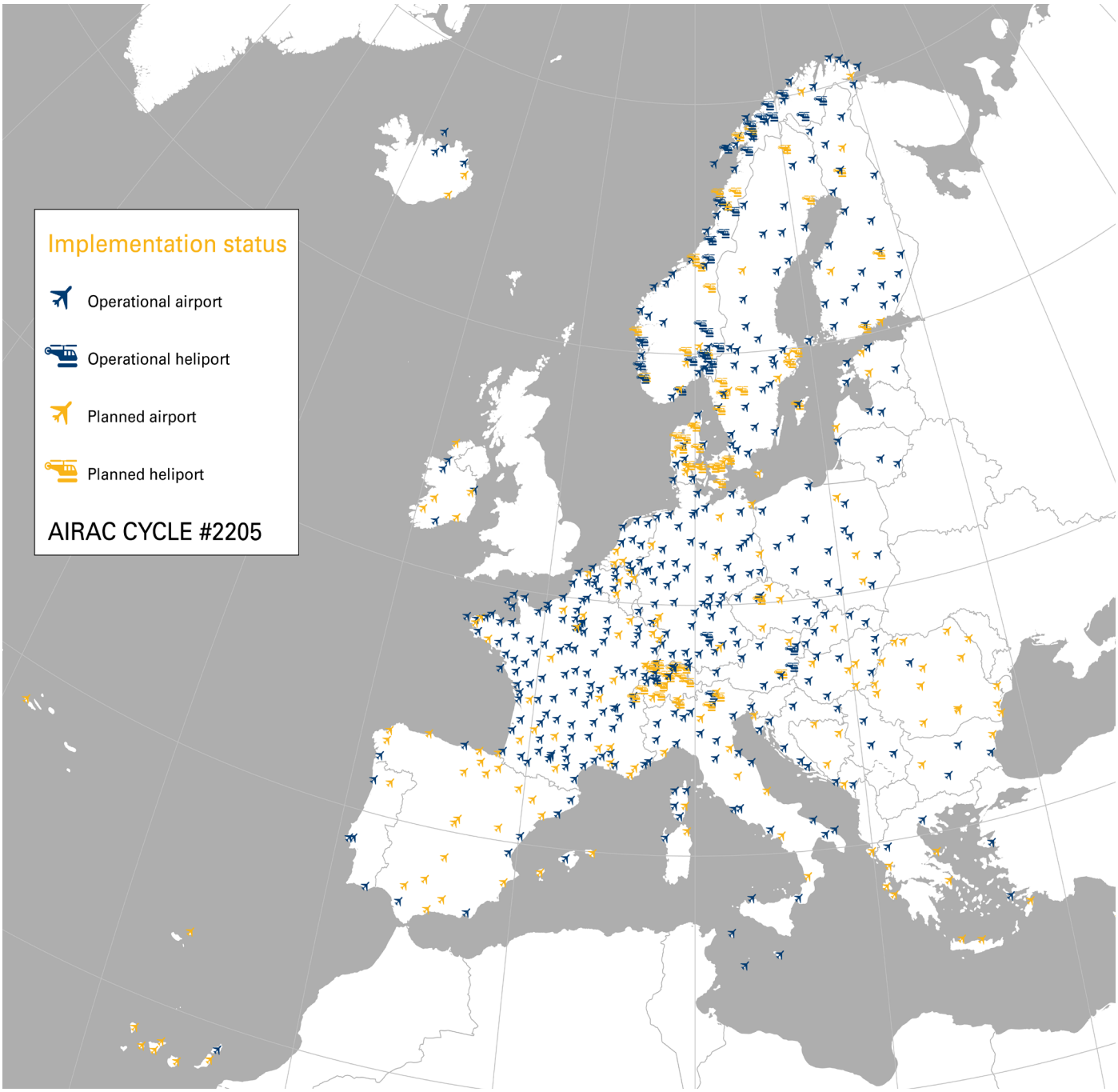
EGNOS implementation



EGNOS Success Stories

EGNOS MAKES FLYING SUSTAINABILITY "EASY"

Credits: Airbus

EGNOS, the European Geostationary Navigation Overlay Service, has revolutionised the way we fly: creating greater access to small and regional airports, increasing safety and facilitating more sustainable flight routes across Europe.

"From the commercial, regional, general and business aviation sectors to original equipment manufacturers (OEMs), airports and the end user – everyone benefits from EGNOS", says Jean-Marc Piéplu, Head of EGNOS Services Department at the EU Agency for the Space Programme (EUSPA).

With news that Airbus has delivered the first EGNOS-enabled A320neo to the popular low-cost airline EasyJet, soon even more passengers will be flying with EGNOS. The A320neo is the world's most popular aircraft family for short-haul flights, claiming the greatest number of aircraft sold and delivered.

Accurate guidance for safer landings

As an alternative to ground-based Instrument Landing System (ILS) navigational aids, EGNOS-enabled approaches, often referred to as localiser performance with vertical guidance (LPV), utilise geostationary satellites and a network of ground stations to receive, analyse and augment GNSS signals. In doing so, it enables aircraft approaches that are operationally equivalent to ILS CAT I, providing lateral and vertical guidance without the need for visual contact with the ground until a decision height of only 200 feet above the runway as minimum.

In addition to providing pilots with accurate guidance for safer landings (even in poor weather conditions), EGNOS is also more cost effective to install, maintain and operate than equivalent ground-based systems. This makes EGNOS particularly attractive to Europe's many small and regional airports that simply cannot afford the high cost of ILS.

"Having the ability to cost-effectively offer accurate vertical guidance makes these airports safer and more attractive to short-haul flights", explains Piéplu. "Moreover, EGNOS based procedures are mandatory in all instrument runways by 2024, and will be the main means for CAT-I by 2030 in EU."

Towards a more sustainable aviation sector

Not only are these EGNOS-enabled approaches safer, they're also more sustainable. "Having LPV in all airports give more choices for alternate airports, which means that the distance to be flown could be shorter, and results in less fuel being burned and more emissions being released", adds Carmen Aguilera, Operational Market Development Officer at EUSPA. "EGNOS approaches, as enabler of PBN, allows shorter trajectories with respect to conventional approaches, which is more fuel efficient."

Thanks to its lower decision height, EGNOS can help pilots better evaluate visibility conditions, which in many cases means avoiding the need to circle or divert – two manoeuvres that burn a lot of fuel. "Minimising diversions and aborted landings mean less fuel consumption, a win-win for both the environment and the airlines", concludes Aguilera.

EGNOS services are delivered by the EGNOS service provider (ESSP) under a contract with EUSPA.

Article originally published by EUSPA

HEART AEROSPACE EQUIPS ES-19 WITH EGNOS

Credits: Heart Aerospace

Who is Heart Aerospace?

Heart Aerospace is a Swedish electric airplane company born in 2018 and based in Gothenburg, Sweden, responsible for developing the ES-19. The company is a spin-off from the Elise research program funded by the Swedish Government through the Swedish Innovation Agency Vinnovav. Heart participated in the Y Combinator start-up accelerator in 2019 and closed its seed round in 2019 with lead investments from EQT Ventures and Norrsken Foundation. In 2021, United Airlines and Mesa Airlines made a purchase order for 200 ES-19 aircraft with an option for an additional 100 aircraft. The airlines also made large investments in the company, and in conjunction with the order, Heart Aerospace announced the closing of its Series A round, led by Breakthrough Energy Ventures.

Heart Aerospace is one of the founding members of the Nordic Network for Electric Aviation, together with airlines, airport operators, and other stakeholders across the Nordic countries. In 2020, Heart was awarded a €2.5M grant from the European Investment Council as part of the European Green Deal.

The vision of the company is to change regional aviation whilst helping the environment by decarbonizing short-haul air travel.

Heart Aerospace's mission is to create the fastest, most affordable, and sustainable transportation for regional travel to every corner of the world.

ES-19

Heart Aerospace's first aircraft is the ES-19, a 19-passenger regional airplane driven entirely by batteries and four propped electric motors.

The first-generation aircraft will have a maximum range of up to 400 km (250 miles) using today`s lithium-ion batteries. The maximum capacity is expected to increase as battery energy densities improve.

The core of the ES-19 is the electric propulsion system, consisting of a 400kW electric motor, an

electric motor controller, and a battery pack.
The ES-19 will have zero operational emissions. It will also be quieter, with less vibration and noise than the turboprop aircraft.
The aircraft is set to be certified for commercial operation by the end of 2026.

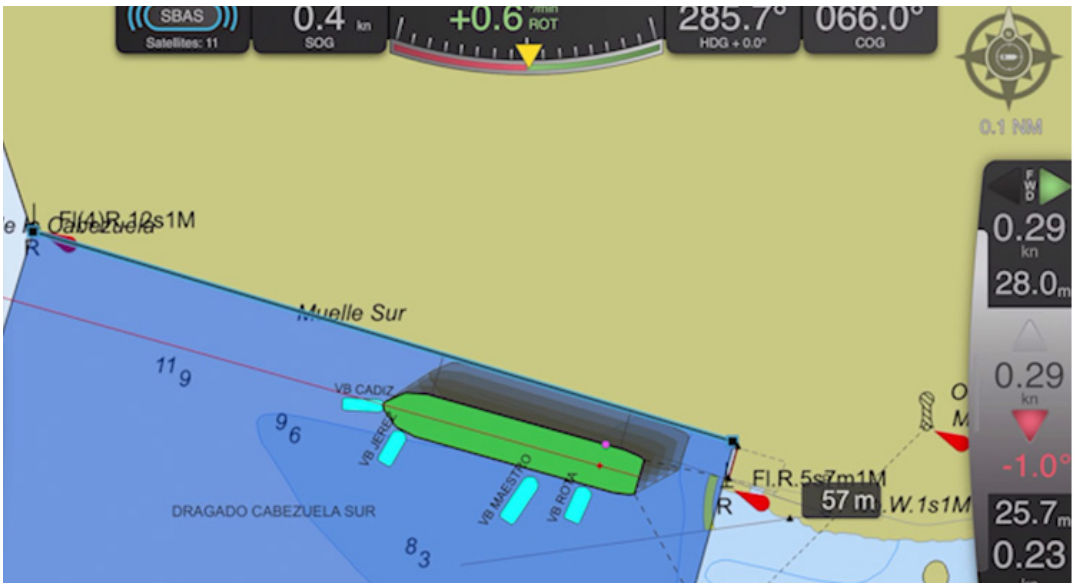
ES-19 and LPV

In December 2021, Heart Aerospace announced its partnership with Garmin to incorporate the industry-leading G3000 integrated flight deck into the ES-19 airliner.
The recently acquired G3000 is fully capable of performing LPV approaches. Designed as a STOL (Short Take-Off and Landing) aircraft, the ES-19 will operate from runways as short as 750 m. LPV will help future operators to reach smaller airfields with precision and safety.
When asked about EGNOS and LPV, Etienne Lemarchand, Head of Avionics Systems, and Sophie Laperche, Avionics Systems Engineer, both mentioned the importance of LPV in the decision making for the choosing of the flight deck panel and avionics. "Among other needs, LPV was a mandatory design requirement for us. We wanted ES-19 to be able to perform LPV approaches."
Also, with the new PBN IR regulations, they considered it compulsory for any new aircraft type in Europe to be equipped with EGNOS and LPV capability, as the new regulation establishes GNSS as the standard means to enable approach operations to CAT I minima, excluding the use of conventional navigation procedures, except in case of PBN contingencies or when other performance-based navigation methods are no longer available.
Finally, when asked about the future needs of ES-19 future operators, Etienne said, "Of course, not only were we convinced of equipping EGNOS, but operators and stakeholders have shown a huge interest in the ES-19 being able to perform LPV."

"Of course, not only were we convinced of equipping EGNOS, but operators and stakeholders have shown a huge interest in the ES-19 being able to perform LPV."

The future of aviation, including fully electrically powered aircraft, seems to be aware of the importance of EGNOS' use in the near future, and manufacturers such as Heart Aerospace are designing new aircraft with EGNOS and LPV capabilities as standard.
Heart Aerospace, along with EGNOS, is paving the future for greener and more sustainable aviation.

EGNOS FOR MARITIME - THE USE OF PORTABLE PILOT UNITS IN THE PORT OF CADIZ



Credits: Cadiz pilots

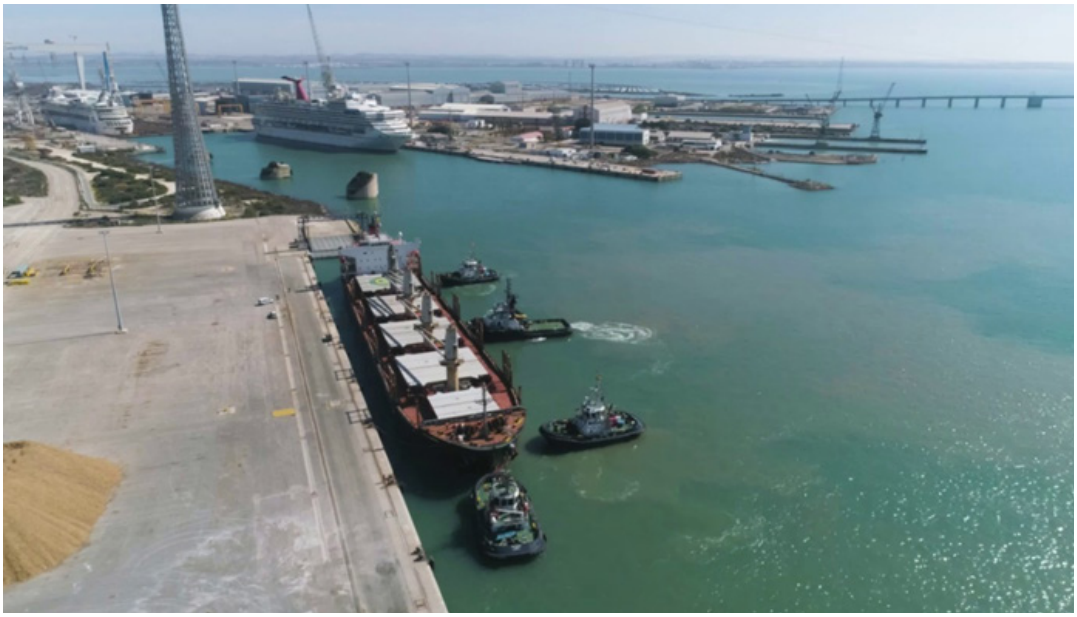
At the confluence of the Mediterranean Sea and the Atlantic Ocean lies the Port of Cadiz Bay, one of the busiest maritime traffic points on the planet. Maritime operations in the port involve a high degree of complexity due to a combination of factors: from the confined entrance channels (250 meters wide, 2,000 meters long, and 13 meters deep) together with large cargo vessels with limited manoeuvrability to the occurrence of strong wind gusts and currents of up to 2 knots (0.5 m/s).

Official figures related to maritime traffic reflect a high occurrence of berthing/unberthing operations throughout the year and a high potential for an increase in the coming years (1,795 port arrivals in 2020, according to official entry declarations; more than 4,000 total vessel movements per year; 110,000 ships crossing the Strait of Gibraltar annually).

With these figures, the role of the pilots, as responsible for the support of berthing operations, becomes crucial to meet the demanding needs of the maritime sector and, at the same time, overcome the environmental factors affecting this relevant European port.

Technology is a crucial part of the pilots' work in this scenario. In that sense, they are well aware of the benefits that the Portable Pilot Unit (PPU), in combination with EGNOS, can bring to plan, monitor and execute manoeuvres accurately and safely throughout the operation.

A great example of the applicability of EGNOS in port operations in the context described above is the complex berthing operation successfully carried out by the team of pilots at the Port of Cadiz Bay, which can be accessed at the following link:



Credits: Red Noise Films

As described by Antonio Sánchez, Pilot Manager of the Port of Cadiz Bay, the specific operation is exceptional in terms of complexity.

A propulsion problem affects the large cargo vessel (176 meters in length, 29.4 meters breadth, 9.80 meters draught), Manta Hatice, when facing the already demanding operation of entering the port and berthing a fully-loaded 31,931 Tonnes bulk carrier. This eventuality results in a notable increase in the difficulty of manoeuvring and the need for highly accurate planning and monitoring support, given the dimensions of the vessel and channel.

Under these exceptional circumstances, the operation requires the activation of the whole Tug ship fleet to support the manoeuvre. The pilots used PPUs configured to process the EGNOS corrections to reach the 50-centimetre position accuracy, as pointed out by Carlos de Bricio, Pilot on the Port of Cadiz Bay and participant in the operation.

The assets that the PPU provides to the Pilots are key to manoeuvring and include, among others, the provision of indication of the rate of turn, position of the pilot and target vessel position, distances to the docks, turning areas, and highly accurate heading and speed.

The EGNOS service is used to improve GNSS reliability and positioning accuracy up to three times the level of demand required by pilots (who need to anticipate manoeuvres and inertia of the target vessel), optimising the use of PPUs at no additional cost, as a major benefit of the service.

All this makes EGNOS the most cost-effective solution to achieve the precision pilots need in day-to-day port operations.

> "The EGNOS service is used to improve GNSS reliability and positioning accuracy up to three times the level of demand required by pilots"

EGNOS APPLICATION IN ROBOTICS FOR AGRICULTURE

Credits: INESC TEC

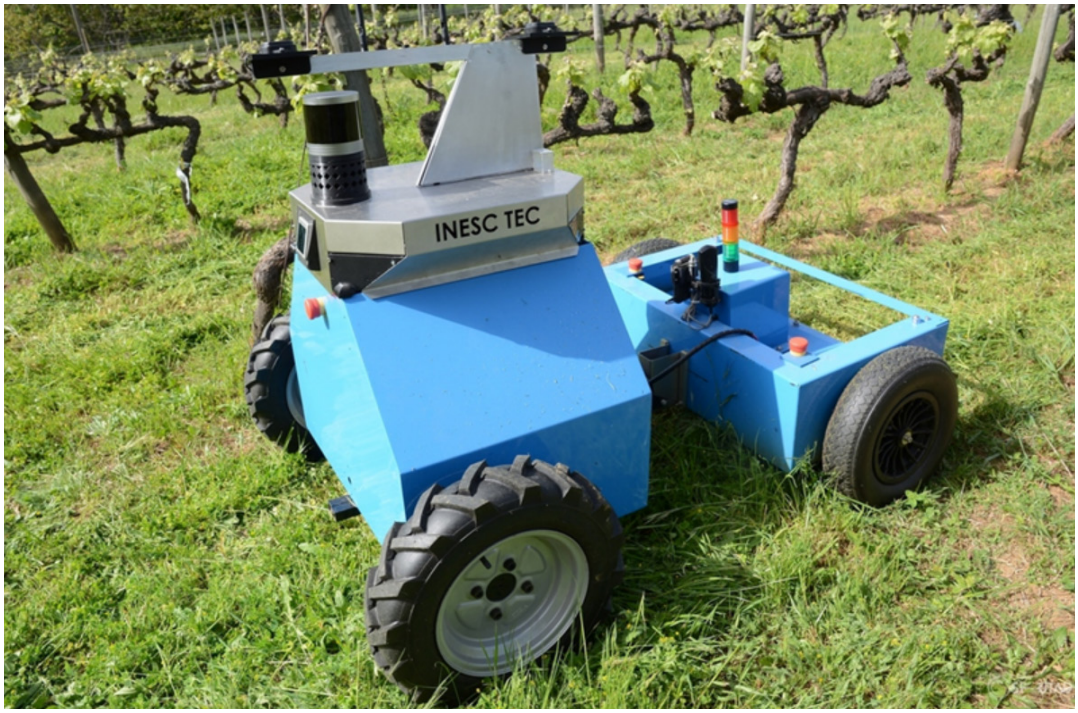


Figure: INESC TEC Robot Modular-E developed under the NOVATERRA project (H2020 number 101000554).

The Laboratory of Robotics and IoT for Smart Precision Agriculture and Forestry uses EGNOS in robots to improve positioning. EGNOS is used in Variable Rate Technologies, such as spraying and fertilisation tasks. The accuracy provided by EGNOS helps reduce the overdosage of fertilisers or phytochemicals-based products and contributes to a more precise distribution of these products. There are also other benefits, such as creating virtual fences and assisted mapping.

> "The accuracy provided by EGNOS helps reduce the overdosage of fertilisers or phytochemicals-based products and contributes to a more precise distribution of these products"

INESC TEC is a Portuguese Associate Laboratory with 35 years of experience in R&D and technology transfer, having as associates the University of Porto, INESC, the Polytechnic Institute of Porto, University of Minho and University of Trás-os-Montes and Alto Douro. This private and non-profit research institution, dedicated to scientific research and technological development, has a Laboratory of Robotics and Internet-of-Things (IoT) for Smart Precision Agriculture and Forestry. This lab was established in 2013 with the mission to develop solutions based on robotics, automation, and IoT. They contribute to improving levels of precision agriculture and forestry ("right time, right amount, right place"), profitability and automation

in three main environments: permanent crops (such as steep slope vineyards, olive groves, tree fruits), forest biomass harvesting and protected cultivation (conventional and urban).

Filipe Neves dos Santos is the manager of the Laboratory and sees the potential of EGNOS "when we acquire GNSS receivers." In fact, "EGNOS compatibility is a prerequisite to achieving basic functions in the agricultural context." He heard about EGNOS early in his research career, around 2005, "at that time, I was developing GPS algorithms for aerial vehicles attitude estimation, and EGNOS emerged as a promising solution to replace DGPS base stations/solutions."

The use of GNSS-based positioning is relevant in almost all their machines. They have smart traps (IoT devices), variable rate technologies and robots that need medium localisation accuracy provided by GNSS receivers. Regarding the use of EGNOS, Filipe explains: "In most of our acquired GNSS receivers, we have easy access to the configuration of EGNOS feature. In fact, most of the time, we activate it in a matter of minutes (when it is not activated by default), and it is clear and very simple to use, requiring nothing else from us."

In some agricultural robotics applications (e.g., arable farming), EGNOS is combined with other positioning techniques to improve overall accuracy and reliability. According to their tests, Filipe clarifies: "we get horizontal accuracy below 1 metre; sometimes in harsher conditions (dense canopy or surrounding buildings) we get an accuracy below 1.5 metres."

They currently use EGNOS fused with simultaneous localisation and mapping algorithms (sometimes as ground truth) or ground-penetrating RADAR and advanced spectrum-based sensors to extract relevant maps to feed into agronomic decision support systems. In the future, they plan to use satellite imagery from the Copernicus programme to merge with in-situ data collected by IoT devices and ground robots.

Did you know...?

As of May 2022, more than 85% of the European fleet is flying again after COVID-19? We have all seen pictures of grounded aircraft during the pandemic. In fact, 60% of EU aircraft were grounded two years ago, and it was not until 2022 that we can see a stable trend in the rate of aircraft in service/grounded. Reports from other sources, such as Eurocontrol, when analysing the activity of operators and airports, confirm that EU aviation is slowly returning to its pre-COVID-19 status.

EASA publishes FAQs on PBN Airspace Usage Requirements

Credits: EUSPA

Since the publication of the COMMISSION IMPLEMENTING REGULATION (EU) 2018/1048 of 18 July 2018 laying down airspace usage requirements and operating procedures concerning Performance-Based Navigation (PBN), the so-called PBN Implementing Rule (PBN IR), European aviation stakeholders have raised several questions regarding its particularities and details. What is the geographical scope of the PBN IR? Is EGNOS the only SBAS to be considered for implementing RNP APCH procedures down to LPV minima? To ease the implementation of PBN procedures in Europe, but also the interpretation of the PBN IR, the European Union Aviation Safety Agency (EASA) has answered these and many other questions on their FAQ website.

The PBN Implementing Rule

The long-awaited PBN IR was finally published as Commission Implementing Regulation (EU) 2018/1048. This regulation underlines the benefits of PBN for the increasing demands of airspace use in terms of safety, capacity and efficiency through the optimisation of air traffic routes and instrument approach procedures toward a full PBN environment.

It applies to Air Traffic Management/Air Navigation Services (ATM/ANS) providers and Aerodromes Operators responsible for establishing instrument approach procedures or Air Traffic Service (ATS) routes. It requires them to ensure a smooth and safe transition and to consult all involved parties while drafting a transition plan to be submitted to the competent authority.

When it comes to EGNOS - European Geostationary Navigation Overlay Service - and localiser performance with vertical guidance (LPV), the regulation establishes that the use of SBAS - EGNOS in particular - should be promoted, as safety and cost-effectiveness considerations support the establishment of LPV minima approaches.

But what are the regulatory means to achieve this objective? The PBN IR require implementation by December 2020 of RNP[1] approach procedures at all instrument runway ends, including LNAV[2], LNAV/VNAV[3] and LPV lines of minima. For instrument runway ends that already have precision approach procedures or are located at PCP airports, the implementation may be delayed until January 2024, at the latest.

Airspace users and their aircraft should be prepared for a full PBN environment

In addition, Article 5 of the PBN IR, which applies from 6 June 2030, establishes that PBN should be the "normal" means for air navigation, supplemented with navigation supported by CAT II/III landing systems, where necessary. Article 5 defines the end of a gradual transition to a PBN environment, where, apart from CAT II/III operations, conventional navigation will only be allowed in the event of contingencies.

According to other EU laws, aircraft and their flight crew must be prepared to operate published routes and approach procedures. Due to the ongoing transition to PBN, airspace users will see national AIPs confirming a gradual decommissioning of ground-based navigation aids and a consequent reduction in the number of conventional flight procedures, which PBN compliant procedures will replace.

For example, if aircraft operators do not have LPV-capability by June 2030, they will face difficulties using category I (CAT I) minima, as SBAS approaches will be the only means of performing CAT I precision approach operations, while part of the existing ILS/GLS CAT I procedures will only

"When it comes to EGNOS and LPV, the regulation establishes that the use of SBAS - EGNOS in particular - should be promoted, as safety and cost-effectiveness considerations support the establishment of LPV minima approaches"

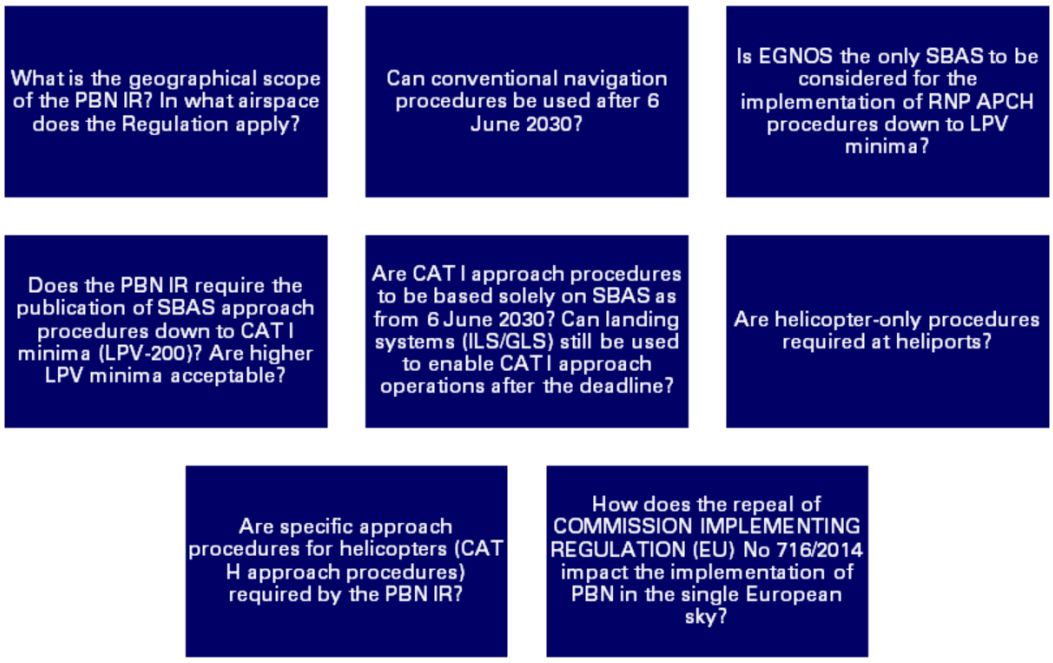
EASA European Aviation Safety Agency

[1] *RNP: Required Navigation Performance.*
[2] *LNAV: Lateral Navigation*
[3] *LNAV/VNAV: Lateral Navigation/ Vertical Navigation*

be retained to deal with PBN contingencies, e.g., in the event of local or wide-area GNSS outages.

EASA's FAQ on PBN Airspace Usage Requirements

Even though EASA cannot provide legally binding interpretations of EU Regulations – that is reserved for the European Court of Justice and National Courts of the Member States – EASA can assist aviation stakeholders by answering the most popular questions regarding PBN Airspace Usage Requirements as part of its implementation support activities. Our readers are encouraged to consult EASA's FAQs on PBN Airspace Usage Requirements to resolve their doubts concerning the Regulation mentioned above. So far, the following questions have been published:



Feedback received from readers

EASA and its collaborators had identified the need to clarify several further questions that had been brought to its attention through different means to complement the EASA guidance material (GM) that was published as Issue 2 of AMC & GM to AUR in 2018, shortly after the entry into force of the PBN IR. For the time being, EASA has successfully published two issues of answers to the FAQ on PBN implementation. The questions have been shared with a number of EASA Advisory Bodies, who provide EASA with technical advice in all areas of aviation, and who can contribute to further disseminating the messages to the stakeholders concerned. The feedback received so far has been very positive, including several suggestions to clarify and expand the explanations. EASA is open to answering new questions and will continue developing these FAQs if the need of interested parties is identified, so do not hesitate to read them all and submit your questions if you have further doubts.

Evaluation of satellite-based improved positioning by Skogforsk

Credits: Skogforsk

Skogforsk (Forestry Research Institute of Sweden) is a research institute based in Uppsala and financed by the national forestry industry and the Swedish Government. Its main objective is to generate and disseminate knowledge to support the Swedish forestry industry's sustainable and cost-efficient growth. Skogforsk's research activity embraces a broad spectrum of subjects such as forest tree breeding, forest technology and raw-material utilization, among others.

Thanks to technological advances of the last decade in Global Navigation Satellite Systems, new opportunities to improve satellite-based position accuracy have emerged in the form of new satellite receivers, new satellite systems and free real-time correction services. Since GNSS positioning is considered a key enabler for forestry management activities (e.g., inventory, thinning, harvest…), Skogforsk worked on analysing and testing these novelties' potential.

Skogforsk's senior researcher, Björn Hannrup, and his team recently published a comprehensive comparative study for the Evaluation of new possibilities for improved positioning with satellite-based systems applied to forestry activities.

Credits: Skogforsk

Figure 1: Sample sites situation

The triggers for the study were the possibilities of enhancing precision forestry and improving decision support during forest operations and the chance to combine forest ground truth with remote sensing data for producing more detailed forest estimates.

The study focuses on evaluating the performances of various GNSS techniques in different scenarios (e.g., advanced receivers, satellite multi-constellation, real-time corrections…). Therefore, the research focused on three main objectives:

1) to evaluate the effect of real-time corrections by comparing Swepos (Swedish CORS network) and EGNOS.
2) to compare position accuracy among several GNSS receivers (from the simplest to the most advanced ones) under different degrees of canopy cover.
3) to gauge the contribution of Galileo satellites.

> "The EGNOS service will contribute to reducing positioning errors on clearcuts and in thinning stands"

The study was carried out at three locations in Sweden (Figure 1) and in three different forest types for each site (Figure 2): open areas (clearcuts), forests about 10-15 meters high (forest thinning), and final felling stands.

Firstly, the "true" position of the sample locations was very precisely calculated (at cm level) using advanced surveying methods. These coordinates were the baseline to subsequently define the accuracy of the succeeding measurements, defined as the deviation of each positioning measurement regarding the "true" coordinates.

The comparison between the effects in positioning provided by the EGNOS and Swepos corrections in a multi-constellation environment (GPS, GLONASS and BeiDou) was carried out using two Arrow 200 receivers in simultaneous measurements: with and without real-time corrections.

In order to maintain homogeneity between measurements, positioning data were always collected through 30-second observations using the same devices and/or configurations for each scenario (e.g., with/without Galileo, with/without real-time corrections.)

A strong positive effect of the EGNOS correction was observed in both clearcuts and thinning stands forest types. In contrast, the correction effect is weaker under denser forestry canopy cover due to the difficulty of the signal to penetrate through the treetops and reach the receiver.

CLEARCUT

THINNING

FINAL FELLING

Credits: Skogforsk

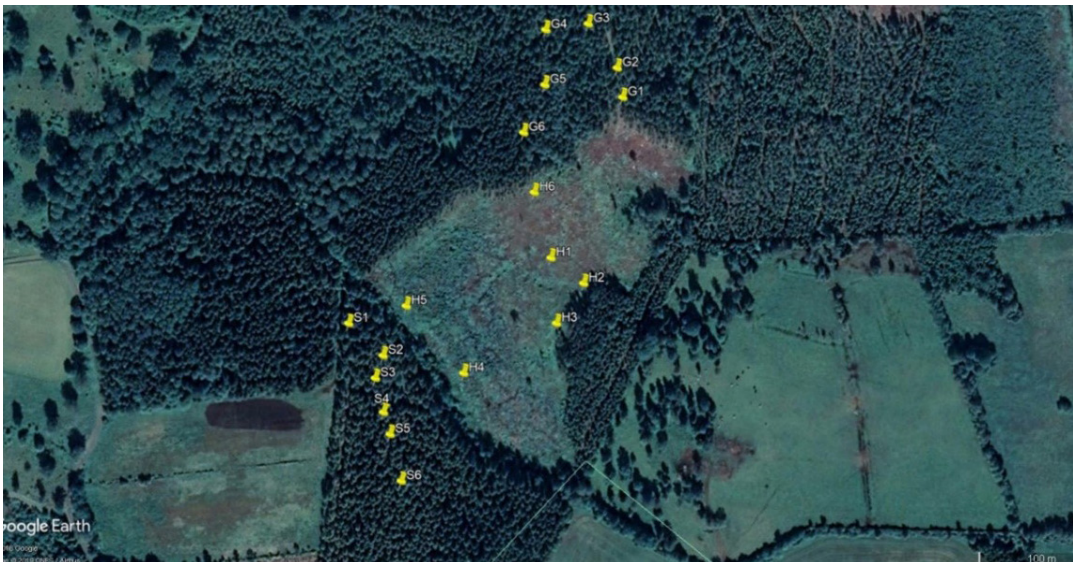
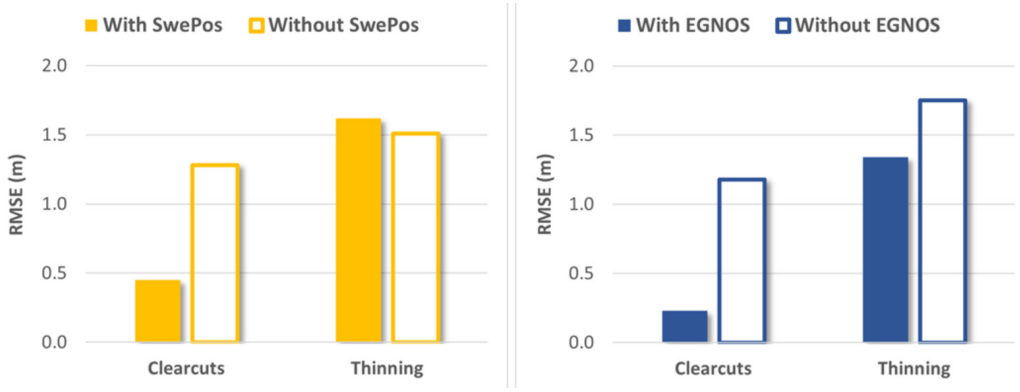


Figure 2: Map of the measurement points in Remningstorp, where, from left to right, H=Clear-cuts, G= Thinning stands, and S= Final felling stands. The measurement points were marked with wooden sticks.



Credits: Skogforsk

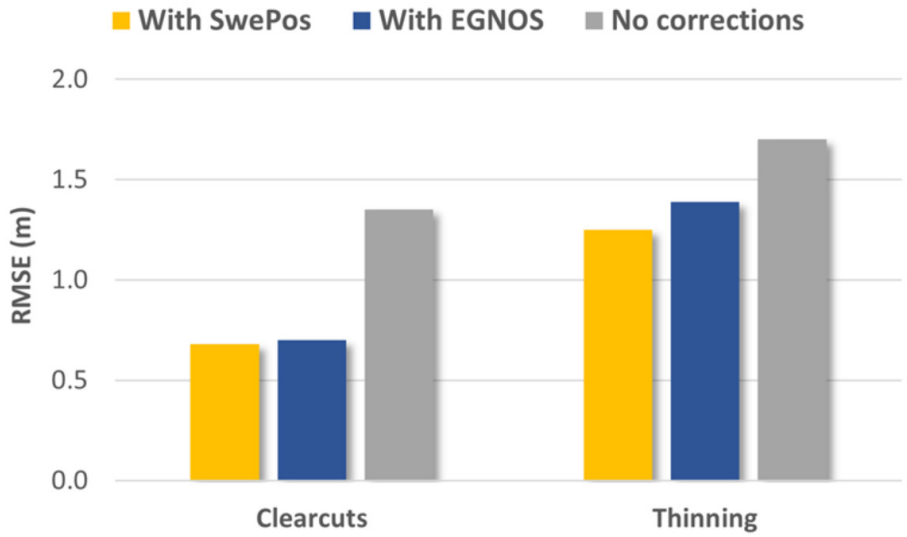
Figure 3: Calculated RMSE with Swepos (left) and EGNOS (right) in comparison with no-corrections measurements at Remningstorp.

Figure 3 shows the results obtained with Swepos and EGNOS at the Remningstorp site, compared to measurements made without real-time corrections.

The overall results show a noticeable reduction of the RMSE (root-mean-square error) in the tests performed in the thinning forest areas (around 0.3 m) and more prominent (about 0.8 m) in clearcuts (Figure 4). This improvement in accuracy makes the use of real-time correction systems very advisable and useful in forestry activities.

Both EGNOS and Swepos showed up as important assets, with similar results, to improve positioning accuracy for forestry applications (Figure 4). EGNOS capability of broadcasting its signal independently of GPRS coverage or base stations (needed for Swepos correction transmission) makes it a preferable option in remote forestry areas where mobile coverage is poor.

In addition, this study demonstrates that using more sophisticated GNSS receivers with advanced features contributes to improving GNSS performances. The tests have also analysed a multi-constellation environment adding Galileo



Credits: Skogforsk

Figure 4: Overall calculated effect of correction systems for different forest types in the three proposed locations

Navigation Signals, and it has been proven that this mitigates the GNSS positioning error.

Skogforsk has presented the results for all major forest companies in Sweden and continues with R&D activities on how to use the improved opportunities for positioning along the forest value chain.

In fact, senior researcher Björn Hannrup declared: "The EGNOS service will contribute to reducing positioning errors on clearcuts and in thinning stands. This is positive in several forestry applications such as positioning in harvesters and for field-planning purposes."

Talking about EGNOS with… Drones4Safety

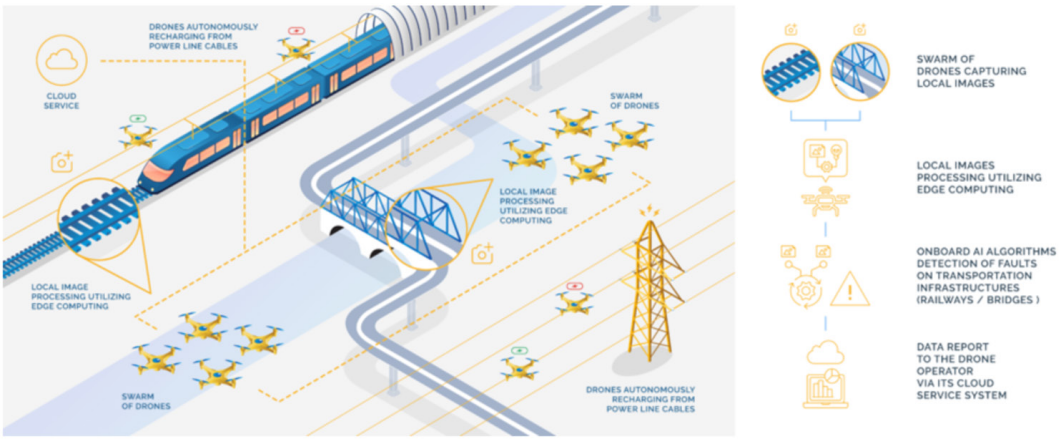
Drones4Safety is a European project that aims to develop a system of autonomous, self-charging, and collaborative drones capable of inspecting a large part of transport infrastructures in a continuous operation. This ambitious project is funded by the European Union's Horizon 2020 Research and innovation programme under the Research and Innovation Actions (RIA) scheme and is coordinated by the University of Southern Denmark (SDU), involving nine partners from five EU countries (https://drones4safety.eu/). There, in Odense, the Drones4Safety team has several drones with which they carry out their missions and tests. But how can EGNOS help them reach their ultimate objective? For that purpose, a dedicated ESSP team approached them to support the configuration of their GNSS receivers and perform some tests to demonstrate EGNOS benefits in their missions.

Credits: Drones4Safety

After performing the tests and before knowing the exact data results, we took the opportunity to interview Emad Samuel Malki Ebeid, associate professor at SDU and coordinator of the Drones4Safety project, Oscar, a PhD engineer at SDU, Frederik, a PhD student at SDU and Nicolaj, also a PhD student at SDU, to find out about the details of the project and obtain feedback on the drone flights, which took place on 5 May 2022, coordinated with ATC at Odense aerodrome to harmonise drone and aircraft operations.

Emad, let's start by telling us about how Drones4Safety started

(Emad) "It all started with Drones4Energy, a Danish funded project with the aim of using drones to inspect high voltage lines and even recharge



Credits: Drones4Safety

the drone's batteries from the same powerlines. Making use of onboard computers and processing, neuronal networks, and specific onboard sensors, the drone can reach and autonomously land at powerline cables for inspection and recharge.

The project was well advanced when we saw an incident in Italy of a bridge collapsing and it all changed: Why not apply Drones4Energy expertise for inspecting bridges as well? We proposed the Drones4Safety project to the European Commission through the open call for using drones to ensure safety in transport, and here Drones4Safety started. The project is aiming at building autonomous drones to find cracks in bridges, railways, and transport infrastructure in general."

What is the status of the project, and which are the next steps?

(Emad) "I imagine the future with smaller, smarter drones that can fly to a power line, recharge, go to a bridge, take pictures, analyse and send them to the bridge owner. When the battery of this drone is low, the drone will go back to the power line to recharge and restart the process by coming back to the mission – inspecting a road, a bridge, a railway, etc.-. Drones4Safety is expected to be completed next year (2023)."

How well did you know EGNOS before? And about the GNSS receiver, are engineers and pilots aware of the kind of model they mount?

(Emad) "I was not aware of the specific GNSS configuration of the drone. We used the one enabled by default on the receivers -ublox M8N- but we did not know it could be enhanced with EGNOS at no cost. Thanks to a helpful discussion with ESSP, we acknowledged this possibility and were able to configure EGNOS on our drones. It was really appreciated."

(Oscar) "I was not aware of the EGNOS system either. I knew the different GNSS systems such as GPS, Galileo, and Beidou, but I was not completely sure if the drones were EGNOS-enabled or not because we assumed it was the best accuracy we could get from the receiver."

(Frederik) "As explained by Oscar and Emad, we use the default settings, but I see huge benefits in configuring EGNOS, especially when you fly longer missions and longer range. In the end, what we need is to be in a precise position, and for that, EGNOS is really helpful."

(Nicolaj) "I totally agree. We have used whatever the system came with. EGNOS has been difficult to know because GPS has commonly become a synonym for general satellite-based navigation."

After performing the tests, what are your first impressions before analysing the data?

(Oscar) "It definitely gives a more consistent result, mainly when we saw the vertical behaviour when using GPS-alone vs GPS and EGNOS. The horizontal navigation enhancement is pretty good, but the altitude accuracy was the best. I would surely recommend that to other drone operators and will most definitely continue to use it."

(Emad) "We have to wait until we get the analysis results, but I could clearly see the difference in the tests. I will continue using it and even teach my students how to use EGNOS and SBAS -I have already done it-. It is quite simple and clear; free accuracy."

Emad, when ESSP first talked to Drone4Safety, we figured the GNSS receivers on your drones were EGNOS-capable, but it wasn't activated. What would be your advice to other drone operators who might benefit from enhanced accuracy?

(Emad) "My main advice for drone operators is

Credits: Drones4Safety

to read about the available GNSS configurations in Europe and understand which one meets your needs. When one assesses it, EGNOS might be the better option. The market needs more awareness in this sense. If I had not heard of EGNOS, we would be still using the default configuration. I also believe EGNOS would be helpful to the robotic market and will make a difference. The "plug and play" design mentality will make it attractive to try out and evaluate. Nowadays, nobody asks themselves: Can we get better navigation signals? The reality is that yes, we can, and with no cost. I must say, GPS is understood as the only satellite-based navigation, and it is not the same."

The stability of the drone can be a "side-effect" of having a better position accuracy, leading to more stable handling and the possibility of saving some battery, thus increasing the overall operative time. Do you think that by enabling EGNOS on your operations, you will be able to perform other missions or modify existing ones?

(Emad) "We use expensive and battery-consuming sensors when the drone is close to the power line, such as Cameras, LIDAR, or Millimeter Wave sensors. We have to activate them when the drone

is within 5m of the power line to compensate for the missing GPS accuracy. Using EGNOS, we can reach the target shorter than 5m with low-range sensors. This way, we save battery and cost since we use cheaper sensors."

Finally, please feel free to share anything you would like our readers to know.

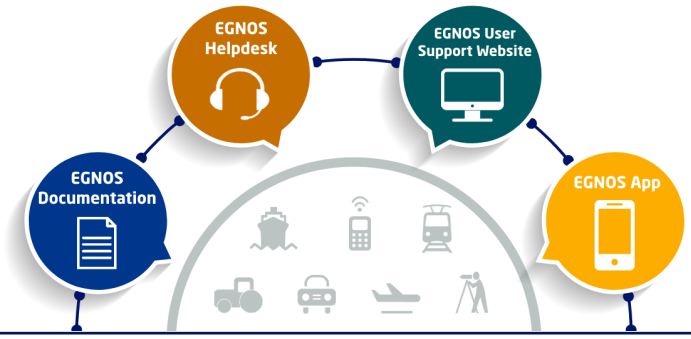
(Emad) "It has been a great opportunity, in general, to promote the EGNOS system in Europe. It is a really smart system that drones and robotics can benefit from. Odense is the capital city of robots and now drones. Having a more precise navigation system is important for robotic applications. Thank ESSP for coming here and supporting us on how to configure the drones."

Credits: Drones4Safety

EMAD SAMUEL MALKI EBEID	OSCAR BOWEN SCOTFIELD	FREDERIK NYBOE	NICOLAJ MALLE
Associate Professor – He teaches embedded systems and robotic programming for bachelor's and master's students. He supervises PhD students in constructing autonomous drones to inspect power and transport infrastructures. He coordinates the H2020 Drones4Safety and IFD Drones4Energy projects.	Engineer at the SDU UAS centre, he is involved in research projects such as Drones4Safety, contributing to the software and hardware sides. In addition, he is deeply involved in the flights as a drone pilot	PhD student at SDU contributing to the Drones4Safety project. As a drone pilot, he works on the perception, control, planning and performance of landing missions on power lines.	PhD student at SDU contributing to the Drones4Safety project. His role within the project is perception, building systems for safe navigation within power lines. For him, the main goal is to achieve robust landings on power lines.

EGNOS SUPPORT SERVICES

Support Services for Users from any Market Segment



EGNOS USER SATISFACTION SURVEY 2021

Legend: 2020 results

The questionnaire has been filled by

124 (124) respondents

37 (33) Non-EGNOS Users + **87** (91) EGNOS Users

26 (*)	30	Safety of Life (SoL)
18 (*)	9	EDAS
22 (*)	24	Open Service (OS)

(*) Each respondent can use more than one service.

8.7 ▲ Global Satisfaction (8.5)

Grading scale of 10 points

SATISFACTION PER MARKET SEGMENT

Agriculture	15 respondents, 8.6 ▲ (7.9)	Aviation	48 respondents, 8.8 ▲ (8.6)
Rail	0 respondents, -- (5.0)	Maritime	3 respondents, 9.2 ⟷ (9.2)
Road	5 respondents, 8.7 ▼ (9.7)	Sur. & Map.	8 respondents, 8.0 ▲ (7.1)
LBS (*)	2 respondents, 7.7 ▼ (9.6)		

NOTE.- 6 respondents marked "other" Market segment.

(*) LBS = Location-Based Services.

EGNOS TIME SERVICE

5 respondents are using EGNOS Time Service. (7)

9.0 ▼ (9.4)

11% could be interested in using this service. (18%)

EGNOS SUPPORT

Support Website	8.2 ▲	(8.0)
Documentation	8.8 ▲	(8.5)
Helpdesk	9.0 ▲	(8.5)

Your SATISFACTION is our reason for being!

EGNOS SERVICES

(*) Each respondent can use more than one service. 38 respondents did not indicate their EGNOS Service.

SoL	OS	EDAS
30% EGNOS Users (*)	25% EGNOS Users (*)	21% EGNOS Users (*)
▲ 9.0 (8.7)	▼ 8.4 (8.7)	▲ 9.0 (8.1)

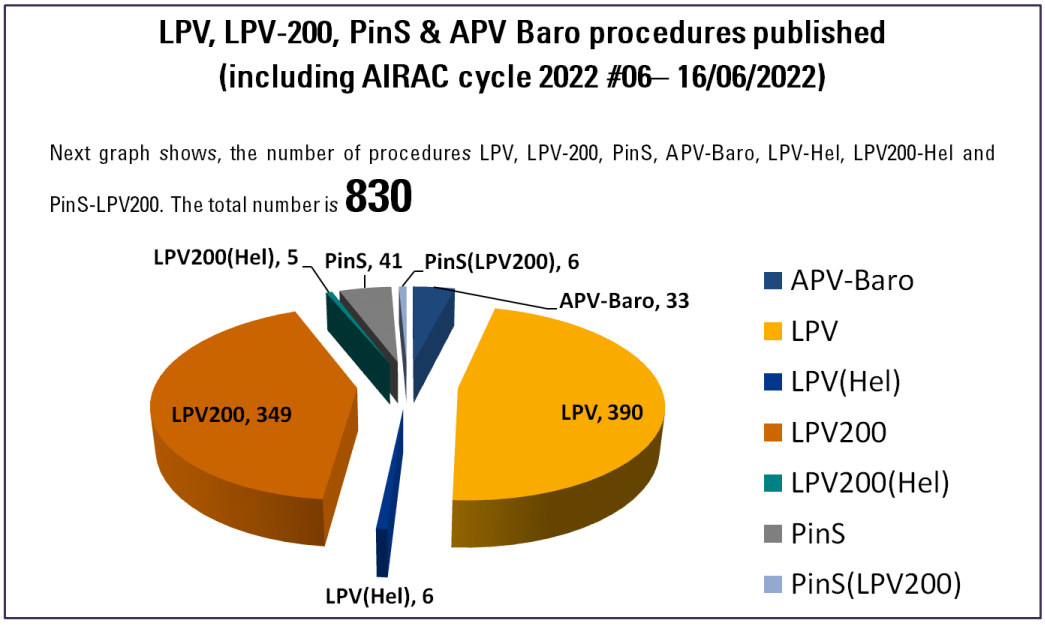
Performance

9.3 ▲	9.0 ▲	8.5 ▲	9.2 ▲	8.2 ▼	8.9 ▲	7.9 ▼
EGNOS SoL accuracy	EGNOS SoL availability	EGNOS SoL continuity	EGNOS SoL coverage	EGNOS OS accuracy	EGNOS OS availability	EGNOS OS coverage
(9.2)	(8.6)	(8.4)	(8.6)	(8.6)	(8.4)	(9.0)

What's new?
Since the last bulletin...

LPV, LPV-200, PinS & APV Baro procedures published

(including AIRAC cycle 2022 #06 - 16/06/2022)



FAA PROCEDURES

Courtesy of the FAA WAAS Team.

SBAS in the world

INDIA SUCCESSFULLY CARRIES OUT TRIALS FOR THE FIRST-EVER LPV APPROACH PROCEDURE USING GAGAN

Last April, an Indigo Airlines ATR aircraft carried out the first Instrument Approach Procedure (IAP) with 250ft LPV minima using GAGAN (GPS Aided GEO Augmented Navigation) at Kishangarh airport in Rajasthan. The AAI (Airports Authority of India) and ISRO (India Space Research Organization) collaborated in the trial. The successful completion is a great achievement and a significant milestone in the field of Air Navigation Services (ANS) in the history of the Indian Civil Aviation sector, as India has become the first country in the Asia-Pacific region with an LPV approach. Once the DGCA finally approves the procedure, it will be available for use on commercial flights. LPVs will enable aircraft to land at airports that are not equipped with expensive instrument landing systems. India has become the fourth nation, after the US (WAAS), Europe (EGNOS), and Japan (MSAS), to have an inter-operable Satellite-based Augmentation System (SBAS).

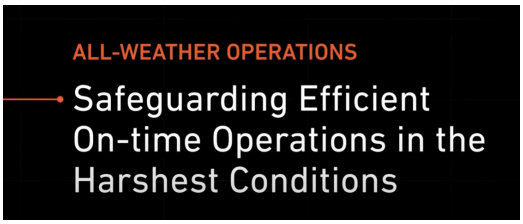
Did you know...?

From 30 October 2022, the new ED 2022/005/R will apply? The new Decision aims to facilitate the implementation of new fuel planning and management requirements that will allow operators to reduce fuel on board, reducing aircraft weight and thus lowering flight emission levels.

What's going on...

in aviation.

ALL WEATHER OPERATIONS BY COLLINS AEROSPACE



Credits: Collins Aerospace

Collins Aerospace, one of the world's leading aviation providers, has recently released a video introducing All Weather Operations. By using SBAS systems such as EGNOS to perform LPV procedures, together with EFVS, operators will benefit from more sustainable, efficient, and profitable aviation. Watch the video here.

WORLD ATM CONGRESS

EGNOS was once again present at the World ATM Congress held in Madrid from 21-23 June to connect the global aviation industry.

This year's Europe for Aviation stand was the largest to date, with a record 399 square metres of floor space. The stand, located at number 595, was attended by nine groups: CINEA (European Climate, Infrastructure and Environment), EASA (European Union Aviation Safety Agency), EDA (European Defence Agency), EUROCAE (European Organisation for Civil Aviation Equipment), EUROCONTROL, European Commission, SDM (Sesar Deployment Manager), SJU (SESAR Joint Undertaking) and finally EUSPA (European Union Space Programme Agency).

The Europe for Aviation stand attracted many visitors interested in GNSS concepts and applications in the aviation sector to get an update on the latest EGNOS features, service status, and implementation scale at European airports.

The showcased cockpit simulator contributed as a demonstration tool to show how EGNOS can improve landings by reducing delays and diversions and increasing safety by avoiding missed approaches. Many visitors used the LPV simulator and succeeded in landing!

in aviation.

DRONEXPO

On 11 and 12 May, ESSP attended DroneExpo. Located in the Pabellón de Cristal of the Casa de Campo in Madrid, this event brought together numerous operators and manufacturers from the national scene. ESSP, as the EGNOS service provider, visited several stands promoting and encouraging the use of EGNOS in drones by Spanish operators. Overall, the acceptance of EGNOS was well received, and many operators will be configuring their receivers to integrate EGNOS corrections shortly.

AERO FRIEDRICHSHAFEN

AERO Friedrichshafen (27-30 April), the well-known aviation trade fair mainly dedicated to general aviation, proved to be a valuable hub where EGNOS was able to serve the purposes of several exhibitors by providing reliable high precision that improves the operations of many companies within various market segments: Business Aviation, drones… EGNOS was represented at the event, offering free assistance to interested potential users.

AMSTERDAM DRONE WEEK (ADW)

The Amsterdam Drone Week (29-31 March) was the perfect opportunity to meet potential EGNOS users in the drone market segment. Manufacturers, drone operators, pilots and even equipment manufacturers attended the event. They were briefed about the advantages of activating EGNOS and advised on how to deploy a proper configuration or contact our engineering team for assistance.

A SERIES OF EGNOS WEBINARS

On 31 March 2022, the role of EGNOS in Helicopter Emergency Medical Services (HEMS) was presented in a webinar dedicated to this type of operation: How HEMS operations can benefit from EGNOS, its implementation status for rotorcraft operations in Europe and real cases and stories where operators and heliports have benefited from this service. Participation in this webinar, which focused on HEMS operations, was the first session in a series of webinars dedicated to EGNOS.

The second webinar, "Equipping with EGNOS and LPV capability: how we can help operators in the decision-making," took place on 9 June and showcased the resources and tools available to operators when equipped with EGNOS and LPV. Collins Aerospace participated as a guest speaker, providing the manufacturer's perspective on the topic.

In early autumn 2022, "EGNOS for a greener aviation" will close this webinar series by providing an overview of how EGNOS can help European aviation reduce GHG emissions and fuel consumption, thus becoming environmentally sustainable.

If you missed it, you can watch it again through this link.

Keep up-to-date on new EGNOS webinars on our EGNOS User Support website!

EBACE 2022

The European Business Aviation Convention & Exhibition (EBACE), the annual meeting of the European business aviation community, took place in Geneva from 23-25 May 2022. This yearly event is always an opportunity for professionals from Europe and worldwide to exchange knowledge and best practices in the Business Aviation (BA) sector. This 2022 edition had a particular focus on innovation and environmental sustainability.

EGNOS was again present at this event, and ESSP promoted its use among business aviation stakeholders. It was great to discover how EGNOS has already become a standard option for BA aircraft manufacturers, and it has gained popularity among BA operators and lessors. Attendees and

exhibitors were able to delve deeper into the benefits of EGNOS, learning how it is key to securing industry access to airports, especially when combined with EFVS systems.

in aviation.

ERA OPERATIONS MEETING

ERAA - the European Regions Airline Association- organised its first face-to-face meeting after COVID-19, bringing together the Operations and Safety groups in a two-day session on 11-12 May 2022. Hosted by EUSPA at its headquarters in Prague, Czech Republic, it was a great opportunity to discuss the various issues of concern to the aviation community.

Carmen Aguilera from EUSPA gave an overview of all European Space programmes, explaining their current and future status and applications for aviation. In addition, ESSP gave a presentation summarising two of the key activities of the current EGNOS Multimodal Adoption Plan in Aviation: Environmental benefits of EGNOS and Guidelines for the combined use of EFVS systems and SBAS operations.

in maritime

REVIEW OF THE IALA GUIDELINES 1129

During the 15th IALA Aids to Navigation (AtoN) Engineering and Sustainability (ENG) Committee held in March 2022, ESSP, on behalf of EUSPA, led the process of updating the IALA Guidelines G1129 on the retransmission of SBAS corrections via MF-radio beacon and AIS.

This document sets out a guide for marine AtoN service providers and Authorities wishing to understand where SBAS information could support maritime navigation and how to employ such data. The main objective of the document is to describe the use of SBAS within augmentation services via marine radio beacon and AIS transmissions.

The revision, which includes technical and financial information for AtoN managers, was successfully completed. The updated text was submitted to IALA Council 75 for approval during the first week of June. As a result, the new IALA Guidelines G1129 were approved and will be available for download on the IALA website.

Credits: IALA

15TH EDITION OF THE BAŠKA GNSS CONFERENCE

15th Baška GNSS Conference:
Technologies, Techniques and Applications Across PNT
and
The 2nd Workshop on
Smart, Blue and Green Maritime Technologies

The 15th Baška GNSS Conference took place on 9-10 May 2022. It was organised as a face-to-face and virtual event by the Royal Institute of Navigation to present its contribution to this annual conference based on technologies, techniques and applications through PNT.

There was a session dedicated to GNSS augmentation systems in which four presentations included EGNOS as the main theme. Three of the four dealt with EGNOS performance and services in the North of Africa, particularly Algeria. Two of them also dealt with EGNOS performance in the maritime domain.

On the one hand, the presentations made by the Algerian Space Agency showed their interest in extending the EGNOS coverage area to take advantage of EGNOS services on their territory.

On the other hand, the presentation "Three Months of EGNOS Performance in the Baltic Sea on an Oil Tanker," made by ESSP, showed how EGNOS could support "Harbour entrances/approaches and coastal/ocean waters" along the Baltic Sea according to IMO Res A.1046 (27), meeting the 10-metre confidence level at 95% and the signal-in-space availability requirement at 99.8%.

Other presentations were related to GNSS use cases, such as bathymetric measurements, positioning for precise video capture or integrating inertial systems in navigation.

GNSS events are back on the calendar, and EGNOS is present at them!

in agriculture.

FIMA

FIMA, a large agricultural machinery trade fair, took place in Zaragoza, Spain, from 26-30 April. It was a fruitful meeting for many relevant agricultural companies who had the opportunity to discuss the latest innovations and future challenges in agriculture.

More than 100,000 visitors attended the event, with more than 1,000 exhibitors. EGNOS representatives were also present to promote EGNOS, focusing mainly on machinery manufacturers, irrigation companies and agricultural sensor companies.

in geomatics.

LECTURE AT THE UNIVERSITY OF VALENCIA

As part of the EGNOS promotion activities, one of the EGNOS Service Adoption Team members gave a lecture to the Polytechnic University of Valencia to promote the EGNOS programme. The session, which took place on 28 April, was given to students and Geomatics and Surveying Engineering professors. More than 60 people live, and 12 virtually had the opportunity to learn about EGNOS, its architecture, services and applications, focusing mainly on the field of geomatics.
This lecture is included in the EGNOS Multimodal Adoption Plan to promote the use and knowledge of EGNOS in the university community.
Don´t hesitate to contact us if you are interested in EGNOS training for your university.

Did you know...?

The International Federation of Surveyors (FIG) has published "EU Space Programmes for Geomatics?" An article providing an overview of the EU Space Programmes Galileo, EGNOS and Copernicus, their synergies and applications for geomatics users.
This report is part of the FIG Articles of the Month to highlight a topic of interest to all surveyors each month.
FIG is a non-governmental organisation recognised by the United Nations and the World Bank - with national member associations covering the full range of professional fields within the world surveying community. It provides an international forum for discussion and development to promote professional practice and standards.

Upcoming Events

SMM HAMBURG

6 - 9 Sept

The world's leading trade fair for the maritime economy is the SMM in Hamburg. Held every two years, it is the most international trade fair for shipbuilding, machinery, and marine technology. Visitors and exhibitors from all over the world represent the current state of the maritime industry worldwide. Here, they can introduce their latest technologies or receive information on the latest products, innovations, trends, and services.

ION GNSS+

19 - 23 Sept

ION GNSS+ is the world's largest technical meeting and a showcase of GNSS technology, products and services. This year's conference will bring together international leaders in GNSS and related positioning, navigation and timing fields to present new research, introduce new technologies, discuss current policy, demonstrate products and share ideas.
ION GNSS+ 2022 will take place from 19-23 September 2022 at the Hyatt Regency Denver in Denver, Colorado.

INNOTRANS BERLIN

20 - 23 Sept

InnoTrans is the leading international trade fair for transport technology held every two years in Berlin. It is sub-divided into the five trade fair segments Railway Technology, Railway Infrastructure, Public Transport, Interiors and Tunnel Construction.
Organised by Messe Berlin, InnoTrans occupies all 42 Berlin Exhibition grounds halls. The InnoTrans Convention, the event's top-level supporting programme, complements the trade fair and will be streamed live. The thirteenth edition will take place from 20-23 September 2022.

Upcoming Events

EU SPACE WEEK

3 - 6 Oct

The EU Space Week is an annual event for anybody interested in current and future trends in the EU Space Programme. It will address entrepreneurship and innovation in space-related businesses across the EU. The EUSW is organised by the European Commission, the European Union Agency and the European Union Agency for the Space Programme. It is also supported by the Czech Presidency of the Council of the European Union and with the cooperation of the Ministry of Transport of the Czech Republic and the City of Prague. EGNOS will be present at a dedicated session on 5 October.

ERA GENERAL ASSEMBLY 2022

11 - 13 Oct

This year's ERA General Assembly will take place in Vila Moura, Portugal, from 11–13 October. Founded in 1980, the ERA (European Regions Airline Association) is a non-profit trade association, and, since its inception, the ERA has developed and grown in size and reputation to represent 50 airlines and 144 service providers, including airframe and engine manufacturers, airports, suppliers, and service providers from across Europe. As an ERA member, EGNOS will have a stand where we will have the opportunity to promote EGNOS to all aviation stakeholders.

era
european regions airline association

Upcoming Events

MRO

18 - 20 Oct

MRO Europe 2022 will be held in London at the end of October 2022 and will bring together leading MROs, DOAs and manufacturers from the aviation industry. EGNOS will be present at the event to discuss its implementation on current avionics, new solutions available for other aircraft and future developments. Do not miss the opportunity!

METSTRADE

15 - 17 Nov

The METSTRADE Show is the world's largest trade exhibition of equipment, materials and systems for the international recreational boating industry. It offers everything there is to know about building and equipping a recreational craft. This global business platform and community focuses on innovation, market developments, and on-site networking.

EGNOS will be present in hall 1, stand 01.500

EGNOS

https://egnos-user-support.essp-sas.eu

EGNOS applications. Developers platform. Business support.
Information on historical and real-time EGNOS performance. EGNOS Signal in Space (SIS) status. Forecast on SIS availability and EGNOS performance. EDAS information and registration. EGNOS adoption material and tools.

For questions & information

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EUSPA European Union Agency for the Space Programme

ESSP

NAVIGATION MADE IN EUROPE