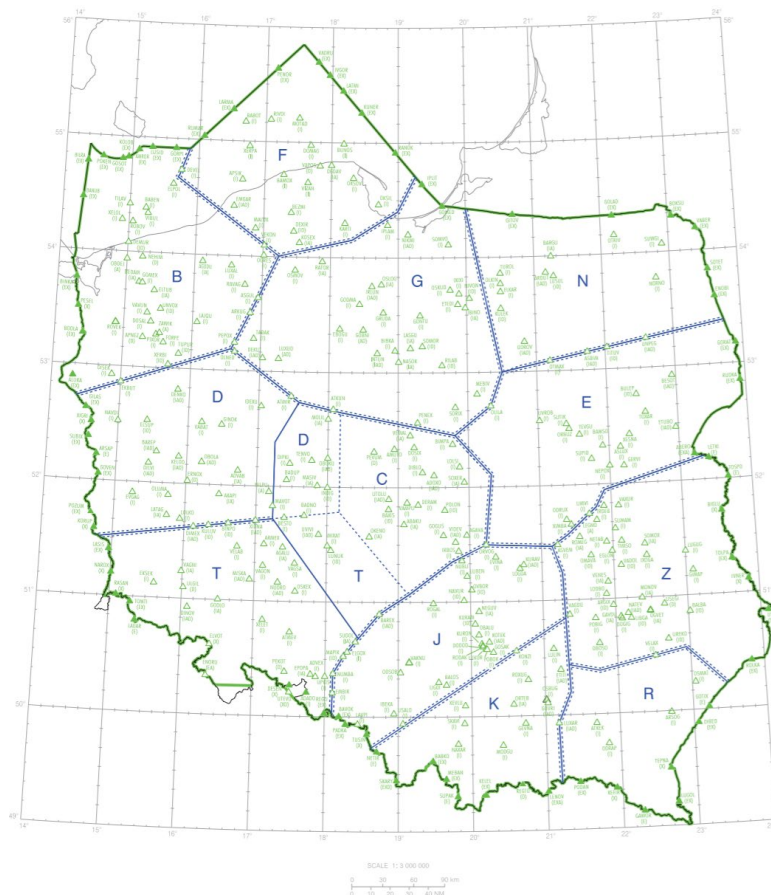


Report on PANSA ATM activities affecting the environmental aspect.

1. Free Route Airspace

Free Route Airspace (FRA) was introduced on February 28, 2019. That was the first stage of implementing FRA operations in FIR Warszawa, known as **POLFRA**. FRA provides airspace users with greater freedom to plan flights, bypassing the existing air route network. This allows free planning of shorter and more optimal routes between selected navigation points. POLFRA covered the entire ACC Warsaw airspace (from FL095 to FL660) excluding TMA airspace. Unlike most other ANSPs in Europe, PANSA implemented FRA in full scope in one stage (H24 availability, full ACC AoR horizontally and vertically). Most ANSPs divided the implementation into several steps: FRA in upper airspace available only at night -> FRA in upper airspace available H24 -> FRA in lower ACC airspace available at night -> FRA in entire ACC airspace available H24.



Estimated analyses after POLFRA implementation showed an average potential reduction in route length for an aircraft in FIR EPWW by 7.594 NM, flight time by 1 min 5 s, fuel consumption by 28.5 kg, CO₂ emissions by 86.9 kg, and NO_x by 0.24.

Estimated benefits in 2019 in FIR EPWW after POLFRA implementation for 870,220 operations could have been:

- Reduction in realized flight distance by 6,608,451 NM,
- Flight time by 939,837 minutes,
- Fuel consumption by 23,920 tons,
- CO2 emissions by 75,590 tons.

2. Cross Border FRA

The direct continuation of POLFRA implemented in 2019 was the implementation of the BALTIC FRA project - the introduction of free route airspace in Polish and Lithuanian airspaces in February 2022, along with the parallel introduction of cross-border FRA operations with Slovakia (as part of SEE FRA). Since 2022, FRA airspace in FIR EPWW (POLFRA) has been combined into a single cross-border FRA airspace of Poland and Lithuania (within Baltic FAB) called Baltic FRA. At the same time, cross-border FRA operations were implemented between Baltic FRA and SEE FRA (at that time, the common cross-border FRA airspace of Slovakia, Hungary, Bulgaria, Romania, and Moldova).

In the next stage, in November 2024, cross-border FRA operations were expanded between Poland and the Czech Republic (Baltic FRA and SEE FRA, to which the Czech Republic joined in 2023) and Poland and Sweden (between Baltic FRA and DK-SE FAB FRA – the common cross-border FRA airspace of Denmark and Sweden).



Cross-border FRA operations between Baltic FRA, DK-SE FAB FRA, SEE FRA, and SECSI FRA allow for the optimization of flight operations and provide further operational, environmental, and financial benefits in a significant part of Europe from the Arctic Circle to the Mediterranean Sea and from the Black Forest to the Black Sea.

3. Vertical Airspace Division

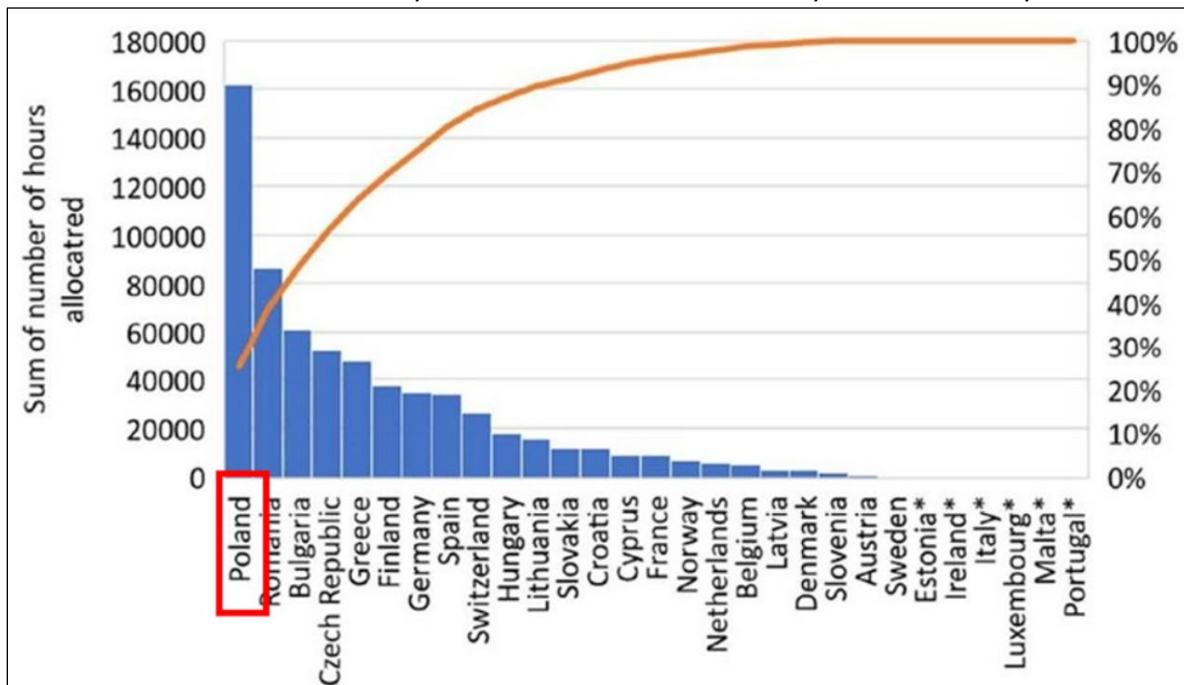
Vertical division of Warszawa ACC airspace introduced in FIR EPWW increases airspace capacity, allowing for more efficient air traffic management and reducing the number of regulations and resulting delays. In case of regulations in a given area control sector, some airlines often seek an alternative, usually longer route, which allows them to bypass the overloaded sector and avoid flight delays (especially in case of receiving a significant time slot). Increasing airspace capacity indirectly reduces the probability of extending the flight route for the reasons described above and increasing the negative impact on the natural environment.

- The first vertical division into 2 layers (ALL Warszawa ACC sectors) was introduced in March 2016.
- The division into 3 layers in sectors J and R was introduced in 2023.
- Planned introduction of 3 layers ACC in the entire Warszawa FIR – Q3 2025.

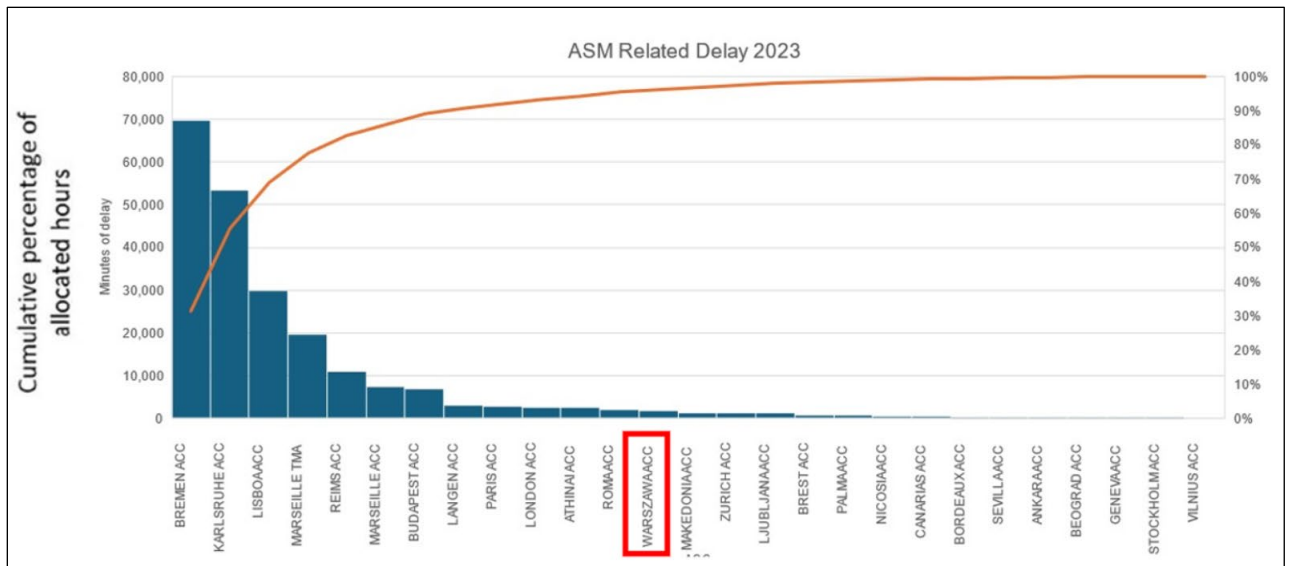
4. Pre-tactical and Tactical Airspace Management

The implemented high level of advancement of the flexible airspace management concept FUA (AFUA) results in very low (one of the lowest in Europe) values of delays caused by ASM (restricted areas).

Despite the significant military activity (about 30% higher than before the war in Ukraine), no increase in GAT delays was noted due to this. Poland ranks first in terms of the total time of restricted areas reservations (over 20% of zone reservation time in Europe is attributed to Poland) while maintaining a low number of delays. Delays generated in Poland due to ASM constitute only a fraction of ASM delays in Germany or France.



Total time of restricted areas reservations in 2023



Accumulated delay in 2023 categorized as ASM Related

As mentioned earlier, delays can deteriorate the horizontal flight efficiency indicator by causing operators to seek alternative flight routes. Large military exercises can also significantly disrupt horizontal flight efficiency by necessitating the bypassing of large exercise areas. However, analyses conducted before the outbreak of the war indicated a limited impact of large military exercises in Warszawa FIR on the KEA (Key Performance Indicator for horizontal flight efficiency) and ATFM (Air Traffic Flow Management) delays:

Year	Military Exercise		Date	Day	Traffic	Total en-route ATFM delay in EPWW (in minutes)	CAPE (J/kg)	Airspace unavailability ratio	KEA
2017	BISON DRAWSKO	Highest MIL activity	16/02/2017	Thu	1754	45	0.00	2.89%	1.51%
		Similar day	09/02/2017	Thu	1706	4	0.00	1.30%	1.53%
	M-346	Highest MIL activity	27/02/2017	Mon	1786	30	0.00	3.89%	1.50%
		Similar day	20/02/2017	Mon	1771	0	0.00	1.16%	1.60%
	EAGLE TALON / RAMSTEIN GUARD	Highest MIL activity	16/05/2017	Tue	2080	0	0.00	1.32%	1.64%
		Similar day	25/04/2017	Tue	2061	0	0.00	1.07%	1.56%
BALTOPS	Highest MIL activity	07/06/2017	Wed	2517	377	0.00	3.04%	1.68%	
	Similar day	05/07/2017	Wed	2669	302	0.00	0.66%	1.70%	
2018	SABER STRIKE / SWIFT RESPONSE	Highest MIL activity	05/06/2018	Tue	2608	387	0.00	1.74%	1.92%
		Similar day	29/05/2018	Tue	2459	574	0.00	0.68%	1.94%
	BALTOPS	Highest MIL activity	07/06/2018	Thu	2681	1431	0.00	2.39%	1.78%
		Similar day	24/05/2018	Thu	2513	1531	0.00	0.85%	1.85%
ANAKONDA	Highest MIL activity	15/11/2018	Thu	2132	0	0.00	1.91%	1.95%	
	Similar day	08/11/2018	Thu	2092	79	0.00	0.75%	1.79%	
2019	DRAGON	Highest MIL activity	17/06/2019	Mon	2869	575	0.00	1.06%	1.93%
		Similar day	24/06/2019	Mon	2915	616	0.00	0.65%	1.89%
	BALTOPS	Highest MIL activity	10/06/2019	Mon	2795	98	532.59	2.36%	2.48%
		Similar day	20/05/2019	Mon	2543	223	604.89	0.24%	2.64%
	EAGLE TALON, RAMSTEIN GUARD, TOBRUQ LEGACY	Highest MIL activity	06/06/2019	Thu	2855	1139	0.00	1.56%	2.57%
		Similar day	15/08/2019	Thu	2899	848	0.00	0.35%	2.28%
KARAKAL	Highest MIL activity	07/10/2019	Mon	2678	450	0.00	2.34%	1.86%	
	Similar day	30/09/2019	Mon	2768	444	0.00	0.11%	1.77%	

Egis Report, 2019

In the case of the BALTOPS 2019 exercise, the increase in KEA was likely caused mainly by storms occurring on that day.

5. Dynamic RAD

The implementation of the Dynamic RAD concept allows for dynamic management of RAD restrictions. The concept enables the departure from static determination of the time of validity for given RAD restrictions and transition to tailored activation of restrictions through their publication in AUP based on the planned traffic in Warszawa FIR the day before the operation. This reduces the time of RAD restrictions, allowing for the shortening of unnecessary limitations/restrictions for airspace users. The concept was implemented on February 20, 2025, and is currently in the pilot phase.

6. Instrument arrival and departure procedures

CDO/CCO – Continuous Descent/Climb Operations Continuous descent operations – an approach technique involving continuous descent, optimally from the Top of Descent, with minimal engine power and clean configuration. (Sometimes also called CDA – Continuous Descent Approach) Continuous climb operations – a technique of climbing to cruising level using optimal engine power and vertical speed.

CDO/CCO procedures have been implemented in all APP units in PANSO. CDO/CCO procedures reduce fuel consumption and thus CO₂ emissions (CCO - 4.3 kg of fuel/13.7 kg of CO₂, CDO - 35 kg of fuel/110 kg of CO₂) and also reduce noise affecting the surroundings of airports.

Operations Manuals/Instructions of all APP units in Warszawa FIR mandate the use of CDO procedures (considering traffic situation) according to local procedures described in mentioned documents. Below is an example of such a procedure in APP Warsaw Operations Manual:

Continuous Descent Operation (CDO) Technique

- CDO is a flight technique in which the arriving aircraft performs descent:
 - a) at the minimum possible thrust;
 - b) avoiding level flight (stopping the descent);
 - c) in a clean configuration (flaps and landing gear retracted).
- CDO starts from an intermediate altitude of 7000 ft or higher (depending on traffic and meteorological situation).
- No later than approximately 30 track miles to RWY, at an altitude of FL 100 or lower, the APP controller will provide the aircraft with information about the planned distance.

Compared to other European airports with comparable air traffic, the share of CDO operations at Chopin Airport in Warsaw is above average.

Comparison of CDO share (calculated from ToD) in all landing approaches for Warsaw and comparable European airports in 2024 is significantly better than airports with higher traffic level:

2024	Warszawa Chopina	Berlin Brandenburg	Stockholm Arlanda	Brussels	Prague	Oslo Gardermoen	Lisbon	Helsinki Vantaa
Landings	85 754	88 178	91 317	94 288	57 963	106 641	112 501	74 403
CDO share	46,5%	23,5%	48,9%	17,6%	22,3%	59%	36,7%	63,1%

Based on: PRU data, 2024

However, it should be remembered that the possibility of performing CDO and CCO operations is significantly influenced by the complexity of the airspace, the volume of air



traffic, and geographical conditions such as terrain and nearby cities (noise abatement procedures).

All STAR procedures in Poland allow for the performance of CDO procedures.

7. Technology and Tools for ATCO's

Thanks to the limited number of altitude/FL restrictions in the vertical flight profile used in trajectory building in the P21 ATM system, controllers can flexibly approach the requests of aircraft crews and give clearances based on the pilot's decision and TOD (top of descent) designated by the ATM system. This allows for smooth flight management in the vertical plane without imposing restrictions on descents and climbs between ACC sectors and for arrivals and departures from domestic airports. Thanks to this, for most flights in FIR EPWW, we can ensure an optimal vertical profile of climb and descent (from TOD or to TOC).

ATC work methodology and agreements between ACC Warsaw and regional APPs assume that when the operational situation allows, controllers mutually offer shortcuts to the furthest possible points in their area of responsibility using electronic coordination in P21.

8. Future Plans

In the coming years, the implementation of further projects that may contribute to reducing the negative impact on the environment is planned:

1. Introduction of the 3rd ACC layer in Q3 2025 and planned implementation of the 4th layer in 2026.
2. Implementation of further stages of cross-border FRA operations:
 - a. With Germany: 2026-2028
 - b. With Ukraine: date dependent on the end of the war in Ukraine and the plan to rebuild air traffic control capabilities in UkSATSE.
3. Project to optimize fuel planning for flights in TMA Warsaw for arrivals at EPWA airport.