

ZERO-EMISSION SPORT AND RECREATIONAL FLYING?

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Abstract

This article provides a comprehensive overview of gliding as a form of sport and recreational aviation, emphasizing its close relationship with natural atmospheric phenomena and its minimal environmental impact. It introduces the broader context of sustainability in aviation and outlines relevant European, international, and Czech regulations that influence gliding activities. The text traces the historical development of gliding from early 19th-century experimental gliders to the emergence of organized sport gliding in the 1920s and its continued evolution into a modern competitive discipline. Detailed explanations are provided on launch methods, soaring techniques using ridge lift, thermals, and wave lift, as well as principles of cross-country flying. The article also describes the FAI performance badge system, including Silver, Gold, and Diamond levels, and outlines the structure and demands of national and international gliding competitions. Emphasis is placed on the importance of meteorological knowledge, terrain awareness, and pilot skill for safe and effective soaring. Finally, the article highlights gliding as an accessible and environmentally friendly way to experience flight, connect with nature, and explore landscapes from a unique aerial perspective.

Key words: Gliding, Sailplane / Glider, Sport aviation, Recreational flying, Environmental impact of aviation

Introduction

Gliding represents one of the most environmentally sustainable forms of aviation, as it relies predominantly on naturally occurring atmospheric phenomena and produces virtually no emissions during flight, with the exception of the launch phase. In the context of increasing global emphasis on climate change mitigation and the reduction of aviation-related environmental impacts—such as noise, air quality degradation, and greenhouse-gas emissions—gliding occupies a unique position within the aviation sector. These concerns are further underscored by international assessments from organizations including the IPCC, WMO, and Copernicus Climate Change Service, which highlight the rapid and unprecedented climatic changes affecting Europe.

The regulatory framework governing aviation in the Czech Republic and the European Union reflects these environmental priorities, integrating both national legislation and EU-level rules aimed at balancing aviation development with the protection of sensitive natural areas. Within this highly regulated environment, gliding constitutes a distinct category of sport and recreational flying that, unlike powered aviation, relies on the pilot's capacity to exploit atmospheric processes such as ridge lift, thermal convection, and mountain waves for sustained flight. This unique reliance on meteorology and terrain interaction requires glider pilots to possess extensive knowledge of atmospheric physics, geographical patterns, and local weather dynamics, making gliding both a technical and environmental discipline.

The development of gliding has deep historical roots, with verifiable glider flights dating back to the early 19th century and systematic sport gliding emerging in the 1920s, particularly in Germany, which continues to hold a leading role in the field. Contemporary gliding is supported by structured organizations such as the Aeroclub of the Czech Republic and the Fédération Aéronautique Internationale (FAI), which provide standardized rules, performance classifications, and international competition formats.

As both a scientific and sporting activity, gliding integrates aerodynamics, meteorology, environmental science, and human performance. Its study therefore contributes to broader discussions on sustainable aviation, atmospheric dynamics, and applied aeronautical training. This article examines the environmental, technical, historical, and organizational dimensions of gliding, with particular attention to the interaction between pilot expertise, landscape characteristics, and atmospheric conditions that shape the practice and safety of soaring flight.

Materials and methods

This study is based on a comprehensive descriptive document about gliding, which includes: the legislative and environmental framework of aviation (e.g., European climate strategies, national laws, international aviation regulations) the characteristics of sport and recreational flying and its dependence on natural processes the historical development of gliding and organizational structures administered by the FAI and the Aeroclub of the Czech Republic launch techniques and principles of unpowered flight methodology of cross-country flights and out-landing procedures the FAI performance badge system the structure of gliding competitions

The analysis draws on text segments referencing: international institutions (IPCC, WMO) EU and national legislation (e.g., Regulation (EU) 923/2012, Act No. 49/1997 Coll.). These sources provided the foundation for evaluating environmental and regulatory aspects of gliding.

A thematic and content analysis of the document was performed, focusing on: identifying major thematic areas (regulation, history, technique, sport performance) mapping all described technical processes, particularly launch methods (aerotow, winch, bungee, car tow, self-launch) classifying described atmospheric lift sources: ridge lift, thermal convection, wave lift .

These components were systematically coded and categorized according to glider-flight dynamics. Analytical segments related to cross-country flying and out-landing procedures were synthesized to form a unified methodological framework for modern soaring: procedures for planning and executing cross-country flights, methodological approach to selecting suitable out-landing fields, procedures for using auxiliary propulsion units.

For the analysis of FAI performance classes, an interpretative method was applied to the description of qualification criteria for: Silver Badge, Gold Badge, Diamond achievements. The required performance parameters (flight duration, altitude gain, distance) were taken directly from the text. To describe the competitive aspects of gliding, the study compared text segments concerning: competition difficulty, typical course lengths and glider speeds.

These data were used to establish a coherent analytical framework for assessing competitive performance.

The Materials and Methods section is grounded in: documented textual analysis, technical-operational classification, systemic synthesis of described flight techniques, comparison of performance standards, all strictly supported by corresponding sections of the original text.

Results

The text confirms that gliding represents a largely emission-free form of aviation, producing no harmful emissions during the majority of the flight, with environmental impact limited primarily to the launch phase. In contrast to powered aviation, which is characterized as a significant contributor to emissions, gliding aligns with modern sustainability requirements emphasized by international bodies such as the IPCC and WMO, which report rapid climatic changes and increased environmental risks in Europe

The analysis shows that Czech aviation is regulated through a combination of national laws and EU legislation, including the Civil Aviation Act and EU Regulation 923/2012, which define operational and environmental constraints. These findings demonstrate that gliding takes place within a structured regulatory environment designed to balance aviation activity with environmental protection.

The document provides clear evidence of the long historical evolution of gliding. Early experimental gliders of the 19th century, including those of Sir George Cayley, Otto Lilienthal, and Percy Pilcher, represent foundational developments in aerodynamic research. Sport gliding emerged in the 1920s, particularly in Germany, where key performance breakthroughs—including the exploitation of ridge lift, thermals, and wave lift—were achieved before World War II.

Organizationally, modern gliding is structured under the Aeroclub of the Czech Republic and internationally under the Fédération Aéronautique Internationale (FAI), both of which standardize rules, performance metrics, and competition frameworks. Competitions, including national championships and the Gliding Grand Prix format, reflect the institutionalization and global reach of the sport.



Fig. 1: Preparing for takeoff using an aerotow

Analysis of the technical content shows that gliding flight relies on multiple launch methods: aerotow, winch launch, bungee launch, car tow, and self-launch using an onboard engine. These methods differ in cost, altitude gain, training suitability, and environmental impact.

Three primary atmospheric lift mechanisms were identified: Ridge lift, produced when wind is forced upward along slopes .

Thermal lift, arising from rising pockets of warm air, often indicated by cumulus clouds.

Wave lift, generated by standing waves in the lee of mountain ranges and capable of producing extreme altitudes and long-distance flights.

These results confirm that soaring is a meteorologically dependent discipline requiring pilots to understand and adapt to atmospheric dynamics, terrain interaction, and weather evolution.

Cross-country flight performance is shown to depend on identifying rising air, managing altitude, and conducting safe out-landings when lift is insufficient. The text identifies out-landings as routine, facilitated by the modular construction of gliders and the use of transport trailers.

The document outlines the FAI system of performance badges—Silver, Gold, and Diamond—each defined by standardized requirements for flight duration, altitude gain, and distance. The analysis indicates that these badges establish global benchmarks for pilot competence and achievement.

Competitive results reported in the source text show that gliding championships typically last two weeks, include daily tasks when weather allows, and require pilots to complete predefined courses at the highest possible average speed. Elite gliders routinely achieve average speeds around 130 km/h on distances of 200–800 km, demonstrating the high performance potential of modern sailplanes.

Discussion

The results of this analysis demonstrate that gliding occupies a unique position within the wider aviation sector due to its minimal environmental impact, strong dependence on natural atmospheric processes, and the high level of pilot expertise required for safe and effective operation. The document consistently highlights that gliding, unlike powered aviation, produces virtually no emissions during flight, with environmental impact limited almost exclusively to launch procedures. This finding aligns directly with the broader environmental imperatives described in the text, in which international bodies such as the IPCC and WMO report accelerated climatic changes in Europe and increased environmental risks requiring mitigation measures in aviation activities. Within this context, gliding can be considered a model for sustainable aeronautical practices.

The regulatory framework described in the document further reinforces the importance of environmental compliance. Czech and EU aviation legislation incorporates extensive environmental considerations and operational restrictions, especially in relation to specially protected areas. These constraints shape how pilots plan and execute flights, emphasizing that environmental stewardship is not only inherent to gliding's physical characteristics but also embedded in its operational context. The coexistence of technical flight requirements with legal and environmental obligations highlights gliding as an interdisciplinary activity at the intersection of aeronautics, environmental science, and regulation.

From a historical and developmental perspective, the findings reveal that gliding evolved from early aerodynamic experiments in the 19th century toward a structured international sport in the 20th century, with Germany remaining a key center of innovation and performance development. The continuity between early experimental objectives and modern performance-oriented gliding is evident in the persistent focus on exploiting atmospheric energy—ridge lift, thermals, and wave lift—which

remains fundamental to the discipline today. This continuity suggests that gliding has maintained a scientific core centered on aerodynamics and meteorology throughout its history.

The technical aspects also carry important implications for pilot training and operational safety. The document illustrates that gliding demands a high degree of environmental awareness, particularly in the recognition and use of lift sources, prediction of meteorological developments, and interpretation of landscape features that affect atmospheric behavior. Furthermore, the routine nature of out-landings, combined with procedures for safe retrieval and aircraft disassembly, demonstrates that gliding incorporates inherent operational risks that must be mitigated through pilot proficiency and procedural discipline. These characteristics differentiate gliding from other forms of aviation and indicate that technical skill alone is insufficient without comprehensive environmental literacy.

The performance badge system described by the FAI provides a structured framework for assessing pilot competence, endurance, and navigation skills. The requirements for Silver, Gold, and Diamond badges—which include significant altitude gains, long-duration flights, and extended cross-country distances—illustrate the progressive nature of skill acquisition and performance in gliding. The inclusion of internationally standardized criteria supports a comparative evaluation of gliding performance across different geographical and meteorological environments.

Finally, the discussion of competitions indicates that gliding has developed into an internationally recognized sport with complex performance metrics, standardized tasks, and high-level athletic demands. The reported average speeds of approximately 130 km/h over distances up to 800 km reflect the high aerodynamic efficiency of modern sailplanes and the advanced skills of competitive pilots. These findings confirm that contemporary gliding is both a scientific and athletic endeavor, combining environmental understanding, aeronautical engineering, and competitive strategy.

Overall, the analysis underscores that gliding is not merely a recreational activity but a sophisticated form of aviation deeply integrated with meteorology, environmental management, regulatory frameworks, and sport performance. Its reliance on natural energy sources positions it as an important example of sustainable aviation, while its technical and organizational complexity situates it firmly within the domain of advanced aeronautical disciplines.

Conclusion

The analysis of the document demonstrates that gliding represents a distinctive and environmentally sustainable form of aviation, relying largely on natural atmospheric processes rather than mechanical propulsion. Its ecological advantage is evident in the fact that no emissions are produced during the majority of the flight, with environmental impact limited primarily to the launch phase. This positions gliding as a relevant model within broader efforts to reduce the environmental footprint of aviation, especially in light of documented climate changes and environmental pressures reported by international organizations such as the IPCC and WMO.

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Souhrn

Plachtění je ekologická forma leteckého sportu, která během letu neprodukuje žádné emise a spoléhá výhradně na přírodní zdroje stoupavého vzduchu. Článek představuje historický vývoj kluzáků, legislativní rámec ovlivňující provoz, i hlavní techniky vzletu a letu bez motoru. Popisuje tři klíčové druhy stoupavých proudů – svahové, termické a vlnové – které umožňují provádět dlouhé přelety. Dále vysvětluje výkonnostní třídy FAI, jejichž splnění je podmínkou pro získání sportovních odznaků. Text uzavírá charakteristika plachtařských soutěží a zdůrazňuje, že úspěšné plachtění vyžaduje hluboké porozumění meteorologii, krajině a technickým aspektům letu.

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