



**HEXAGON**

White Paper

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# **Weather Prediction and Analysis**

Where Are We Since James Stagg?

14 June 2019

## Weather Forecasts for D-Day Landing and Waterloo

On June 4, 1944, British meteorologist James Stagg, backed by his Norwegian colleague Sverre Pettersen, made the biggest call in weather forecasting history when they persuaded General Dwight Eisenhower to delay the D-Day landings by 24 hours. Twelve hundred aircraft, 5,000 naval vessels and nearly 160,000 troops were kept on standby as he correctly predicted a 36-hour gap between two storms on the morning of June 6 – just enough time to undertake the initial beach landings in clear weather.

Stagg and Pettersen gave their advice based upon numerical weather forecasting, predicting the weather by solving mathematical equations, a technique formulated in 1904 by Vilhelm Bjerknes of Norway and developed by British mathematician Lewis Fry Richardson. Despite the advances made by Richardson, it took him, working alone, several months to produce a wildly inaccurate six-hour forecast for an area near Munich, Germany. By 1944 Stagg was able to provide a far more accurate prediction for a specific area using the polar front theory combined with real-time observations and measurements in the Atlantic.

Knowledge of the weather has always been vital in military planning. In June 1815, Napoleon lost to the British at Waterloo, in part because he was told it would not rain on the day of the battle. Ultimately, it did rain, and the ground became too soft, which delayed a flank attack that should have taken place first thing in the morning to the early afternoon.



Weather variation over time over the coast of Japan

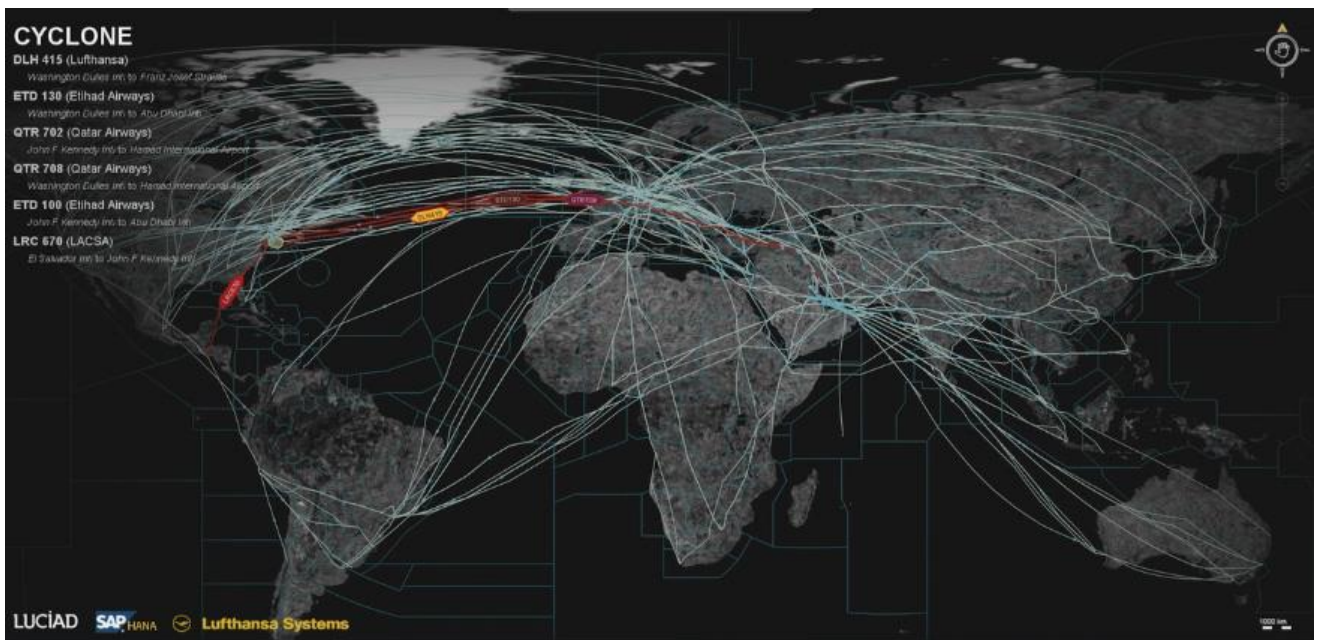
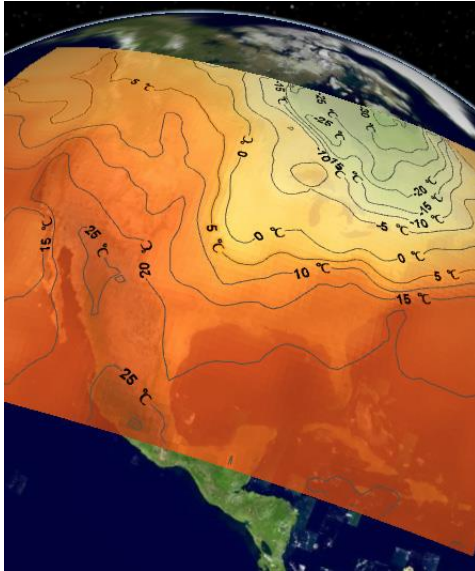
## Integrating Weather Data for Military Operations Today

Today, military operations combine weather information such as satellite observations, upper atmosphere temperature and multi-height wind speed with wider data sets such as logistics and real-time video feeds to provide a total operational picture. Organizations like Lufthansa Systems use Luciad technology weather capabilities to increase efficiency and make flights safer. Luciad technology is increasingly being used as the basis for systems across many sectors.

**Commanders and flight controllers can load current weather information like temperature, wind speed and direction, cloud density, and forecasted information for a specific location or area of interest.**



We can now go beyond traditional GIS systems to bring full situational awareness of current and future events. Using LuciadLightspeed, these multiple sources and formats can be visualized in a single view across multiple devices. In addition, advanced analysis capabilities provided in Luciad technology gives users the ability to assess the available information, create models, and generate simulations in order to predict the possible impact that nearby weather hazards may have on operations.



Lufthansa Systems and Luciad technology have revolutionized air traffic management by providing a powerful platform to visualize and analyze the impact of weather data on flight routes

In a real-life scenario, a commander can:

- Load and visualize all operational data on interactive maps together with weather information (current or forecasted)



- Compare meteorological data such as weather hazards (storms, hurricanes, tornados, etc.) against current available assets to determine how, when, and where they have been or will be impacted.
- Load weather information into simulators, models, workflows, and analytics to produce efficient logistics (for example, planning routes or flight paths to avoid bad weather conditions)
- Integrate weather information into business intelligence platforms and analysis tools to generate automated alarms and suggest possible contingency plans
- Generate reports that explain the possible threats to distribute to other decision makers and stakeholders


Unlike many comparable applications, Luciad technology solutions offer the ability to combine common weather formats such as NetCDF, METAR, KML, and GRIB with aviation formats such as ASTERIX and AIXM 5 data, and even raw Radar feeds and Shapefiles into one 3D operational picture. The resulting image can be formatted to correctly indicate common symbols such as wind barbs and sparse arrows as well as military symbology overlays for a complete battlefield scene.

James Stagg made the right call in June 1944 based on an incredibly small amount of data – it was informed guesswork in many ways. But today, because of the quantity, quality, and diversity of data available, an unprecedented level of accuracy can be delivered to the front-line soldier with confidence.

## Contact Us

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## About Hexagon

Hexagon is a global leader in digital solutions that create Autonomous Connected Ecosystems (ACE). Our industry-specific solutions create Smart Digital Realities™ that improve productivity and quality across manufacturing, infrastructure, safety and mobility applications.

Hexagon's Geospatial division creates solutions that visualize location intelligence. From the desktop to the browser to the edge, we create ACE that bridge the divide between the geospatial and the operational worlds.

Hexagon (Nasdaq Stockholm: HEXA B) has approximately 20,000 employees in 50 countries and net sales of approximately 4.3bn EUR. Learn more at [hexagon.com](https://www.hexagon.com) and follow us @HexagonAB.

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