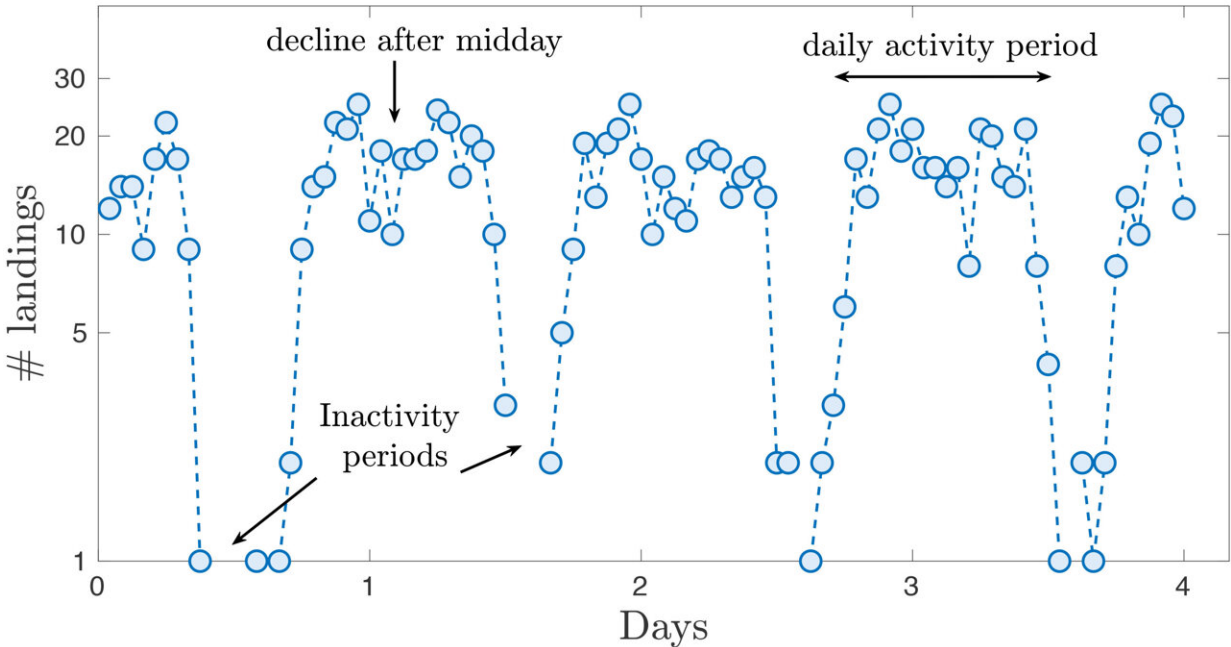


# Prepare for landing: Making airports more efficient

March 28 2023



This graph depicts four days of hourly landing volumes at Milan Malpensa airport, as well as daily oscillations between inactivity periods at night and decreased activity after midday. Credit: Felipe Olivares

Air traffic is a significant and complex problem. Near misses between passenger planes on runways have been making headlines lately and raising safety concerns as airports try to accommodate more travelers in the wake of COVID-19. Also, as any disgruntled air traveler knows, a

single aircraft's late arrival at a busy airport can trigger an avalanche effect and cause a series of subsequent delays.

In the journal *Chaos*, a team of scientists from Spain and Argentina presented an original oscillating short-term memory model, with just two parameters, to study the dynamics of [landing](#) events at 10 major European [airports](#). The model can estimate how landing volumes will influence those in consecutive hours—a critical ability given airport capacity constraints and external events that cause landing delays. The article is titled, "Markov-modulated model for landing flow dynamics: An ordinal analysis validation."

Altogether, the model demonstrates that statistical analyses of hourly plane landing volumes can yield valuable insights into airport operations.

"Characterizing chains of landing delay events, especially quantifying the temporal scale, is key for evaluating an airport's operational performance," said author Felipe Olivares. "If directly identifying interactions is not possible, a solution is to analyze the signatures they leave in time series as representative of the system's aggregated dynamics. The main idea [of the study] is to use [statistical physics](#) tools to obtain insights about airport operations when only macroscale information, the hourly landing volume, is available."

One of the model's parameters represents the correlation between consecutive hours in landing volume as a metric of an airport's landing operations efficiency.

"This could also help assess the evolution of a facility's efficiency, understood as the capacity of handling a given traffic volume while generating minimal interaction between aircraft," said Olivares.

The study also examined the differences between dynamics before and

after the peak of COVID-19, determining that the landing flow became more random post- pandemic. That means consecutive hours in landing flow were less correlated. But this was not only caused by reduced traffic because of [travel restrictions](#): it also might reflect a change in interactions between aircraft.

A first of its kind, the study showcases how, via statistical physics, macroscale aeronautical data analysis can reveal information on microscale dynamics.

**More information:** Markov-modulated model for landing flow dynamics: An ordinal analysis validation, *Chaos An Interdisciplinary Journal of Nonlinear Science* (2023). [DOI: 10.1063/5.0134848](https://doi.org/10.1063/5.0134848)

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