Global Flight Time Variability

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1 Overview

The trajectory-based operations concept describes an ATM environment where the flown flight path is as close as possible to the user-preferred flight path by reducing potential conflicts and resolving demand/capacity imbalances earlier and more efficiently.

PBWG is interested in studying TBO. As an initial step PWBG agreed to assess the flight time variability for flights operating between the study airports.

2 Data Preparation

2.1 PBWG - regions & study airports

```
#apts_pbwg <- read_csv("./data/pbwg-apts.csv", )
apts_pbwg <- readxl::read_xlsx("./data/pbwg-apts.xlsx")
```

2.2 Global Connectivity

Determine daily international connections between PBWG study airports.

To-do: calculate share per region

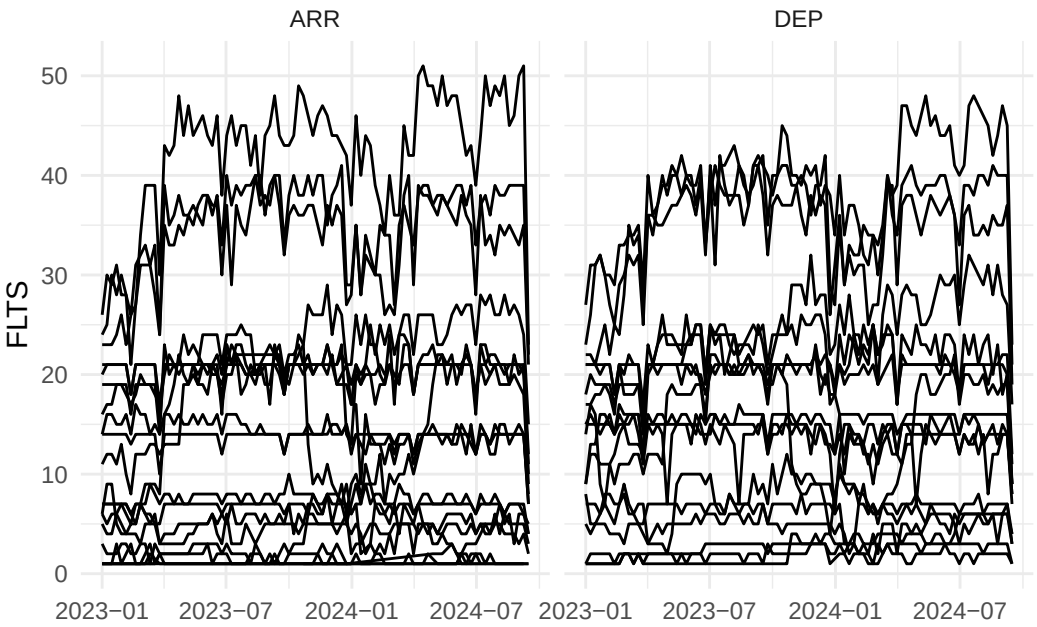
```r
nm_flt <- list(
     yr_2023 = arrow::read_parquet("./data/nm-flt-2023.parquet")
    ,yr_2024 = arrow::read_parquet("./data/nm-flt-2024-123.parquet")
) |> bind_rows()

nm_flt <- nm_flt |>
    mutate( ADEP_PBWG = ADEP %in% apts_pbwg$ICAO
           ,ADES_PBWG = ADES %in% apts_pbwg$ICAO
           ,.after = ADES)
```

```r
pbwg_cons <- nm_flt |>
    filter(ADEP_PBWG, ADES_PBWG)

intra_eur <- apts_pbwg |> filter(REG_3 == "EUR") |> pull(ICAO)
intra_eur <- expand_grid(ADEP = intra_eur, ADES = intra_eur)

pbwg_cons <- pbwg_cons |>
    anti_join(intra_eur, by = join_by(ADEP, ADES)) |>    # remove intra-EUR
    mutate(
        DOF = case_when(
            ADEP_PBWG ~ date(AOBT)
          , ADES_PBWG ~ date(AIBT)
          , .default = NA)
        )
pbwg_cons |> arrow::write_parquet("./data/pbwg-cons-eur.parquet")
```

```r
pbwg_cons <- arrow::read_parquet("./data/pbwg-cons-eur.parquet")
apts_eur  <- apts_pbwg |> filter(REG_3 == "EUR") |> pull(ICAO)

binned_cons <- pbwg_cons |>
    mutate(BIN = floor_date(DOF, unit = "week") ) |>
    group_by(ADES, ADEP, BIN) |>
    reframe(FLTS = n()) |>
    mutate(
        PHASE = case_when(
            ADES %in% apts_eur ~ "ARR"
          , ADEP %in% apts_eur ~ "DEP"
          , .default = NA)
      ) |>
    drop_na()
```

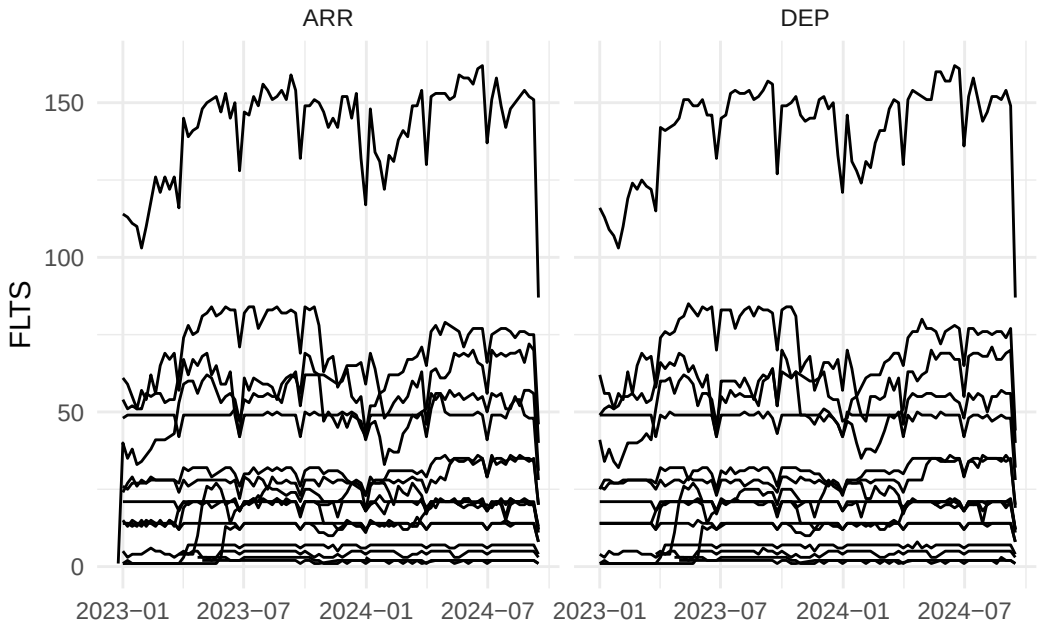
```r
binned_cons |>
    filter(ADES == "EDDF" | ADEP == "EDDF") |>
    ggplot() +
```

```
    geom_path(aes(x = BIN, y = FLTS, group = paste0(ADEP,"-", ADES))) +
    facet_wrap(. ~ PHASE) +
    labs(x = element_blank())
```



For the case of Frankfurt international connectivity varies and we observe a higher number of connections outside the summer of 2024. For example KATL-EDDF accounted for 26 flights on a weekly basis in November and December 2023.

```
apt <- "EGLL"
binned_cons |>
    filter(ADES == apt | ADEP == apt) |>
    ggplot() +
    geom_path(aes(x = BIN, y = FLTS, group = paste0(ADEP,"-", ADES))) +
    facet_wrap(. ~ PHASE) +
    labs(x = element_blank())
```



London Heathrow also shows some decreasing international connections between PBWG airports when comparing summer 2024 with summer 2023.

> **Note**
>
> Todo:
>
> - study evolution of international connectivity.