



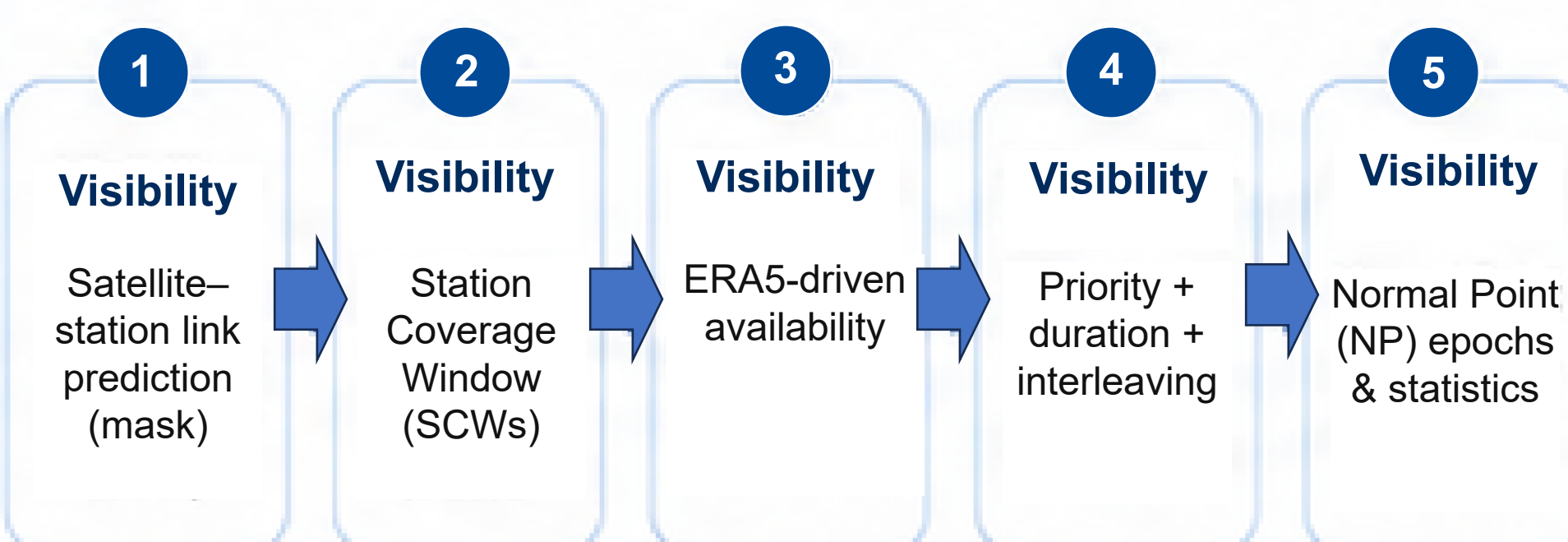
1. Background / Motivation

- GENESIS will co-locate GNSS, DORIS, SLR, and VLBI on one satellite platform.
- The study estimates realistic SLR observation yield achievable by the global ILRS network.
- The work focuses on practical station behavior under competing tracking demands, weather constraints, and interleaving

2. Objective

- Develop a probabilistic scheduling simulation framework for GENESIS-oriented SLR performance assessment.
- Combine geometric visibility, SCW construction, weather-gated availability, target priority, duration modeling, and interleaving statistics.

3. Methodology: five layers



Methodology Steps

- Visibility from GENESIS orbit plus CPF/TLE-based satellite prediction.
- Construct station coverage windows (SCWs) from visibility arcs.
- Apply dynamic, spatially and weather-gated availability using ERA5 wind & gust.
- Model scheduler resolving competing demands and enforcing target priorities.
- Model laser duration and interleaving, then reconstruct Normal Point epochs.

Scenario 2023 simulation, realistic environment

Network 35 stations, 122 targets

Temporal Resolution 1 hour

Weather Data ERA5(hourly) wind gust & cloud fraction

4. Key Results (Network-Level Performance, 2023)

| Satellite | Phase | Union tracked (h/yr) | Sum tracked (h/yr) | NP count | P95 NP gap (h) |
|-----------|-------|----------------------|--------------------|----------|----------------|
| GENESIS | DAY | 593.905 | 656.919 | 22738 | 3.009 |
| | NIGHT | 775.112 | 898.483 | 32020 | 2.543 |
| | TOTAL | 1314.515 | 1555.402 | 54758 | 1.134 |
| LAGEOS1 | DAY | 628.126 | 733.209 | 24061 | 2.907 |
| | NIGHT | 776.753 | 969.939 | 31766 | 2.057 |
| | TOTAL | 1383.172 | 1703.148 | 55827 | 0.814 |
| LAGEOS2 | DAY | 569.462 | 650.382 | 21475 | 3.008 |
| | NIGHT | 762.740 | 978.331 | 32136 | 0.989 |
| | TOTAL | 1302.603 | 1628.713 | 53615 | 0.644 |

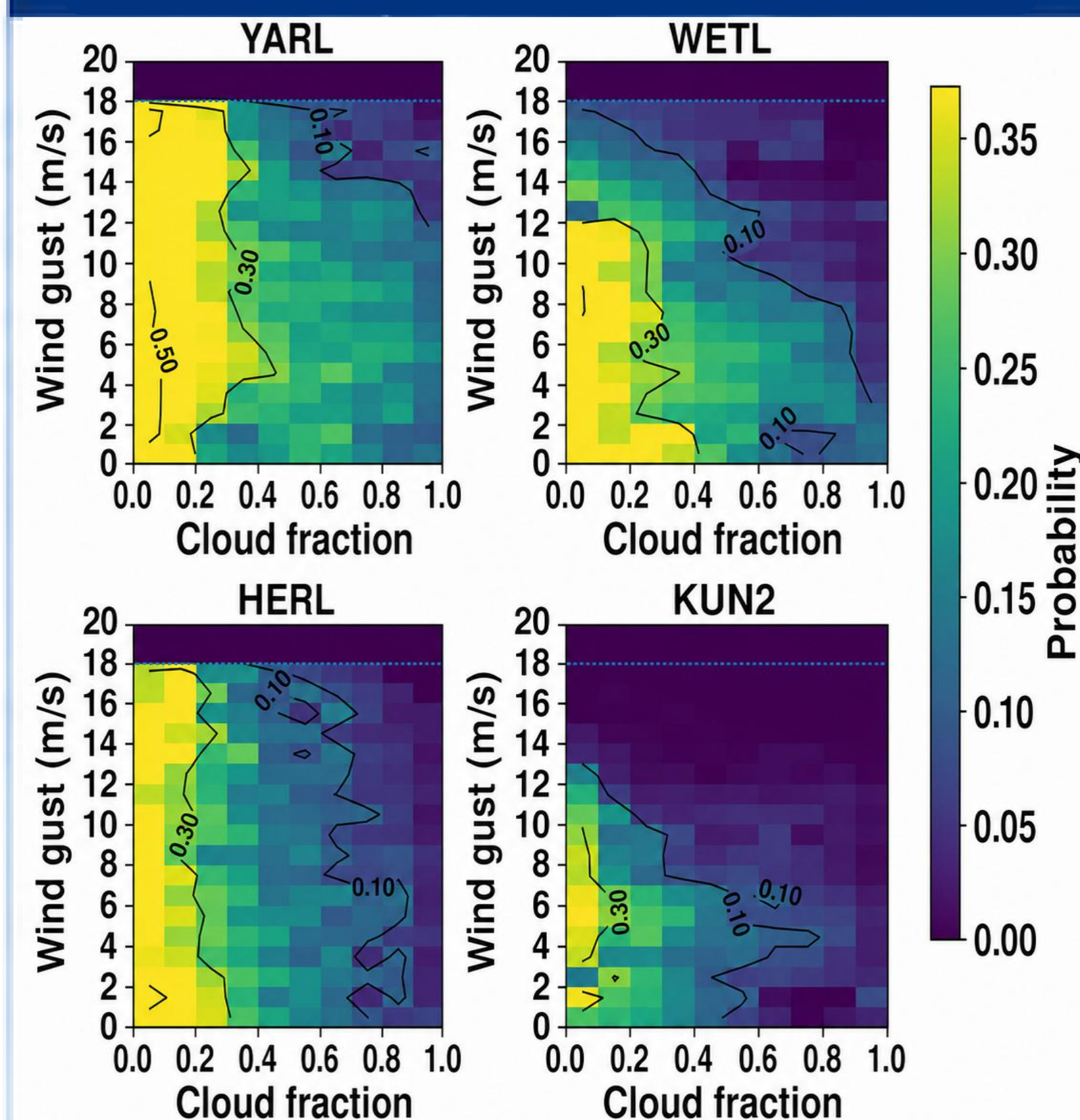
Annual union tracked time: 1314.515 h

Annual summed tracked time: 1555.402 h

Simulated NP count: 54,758

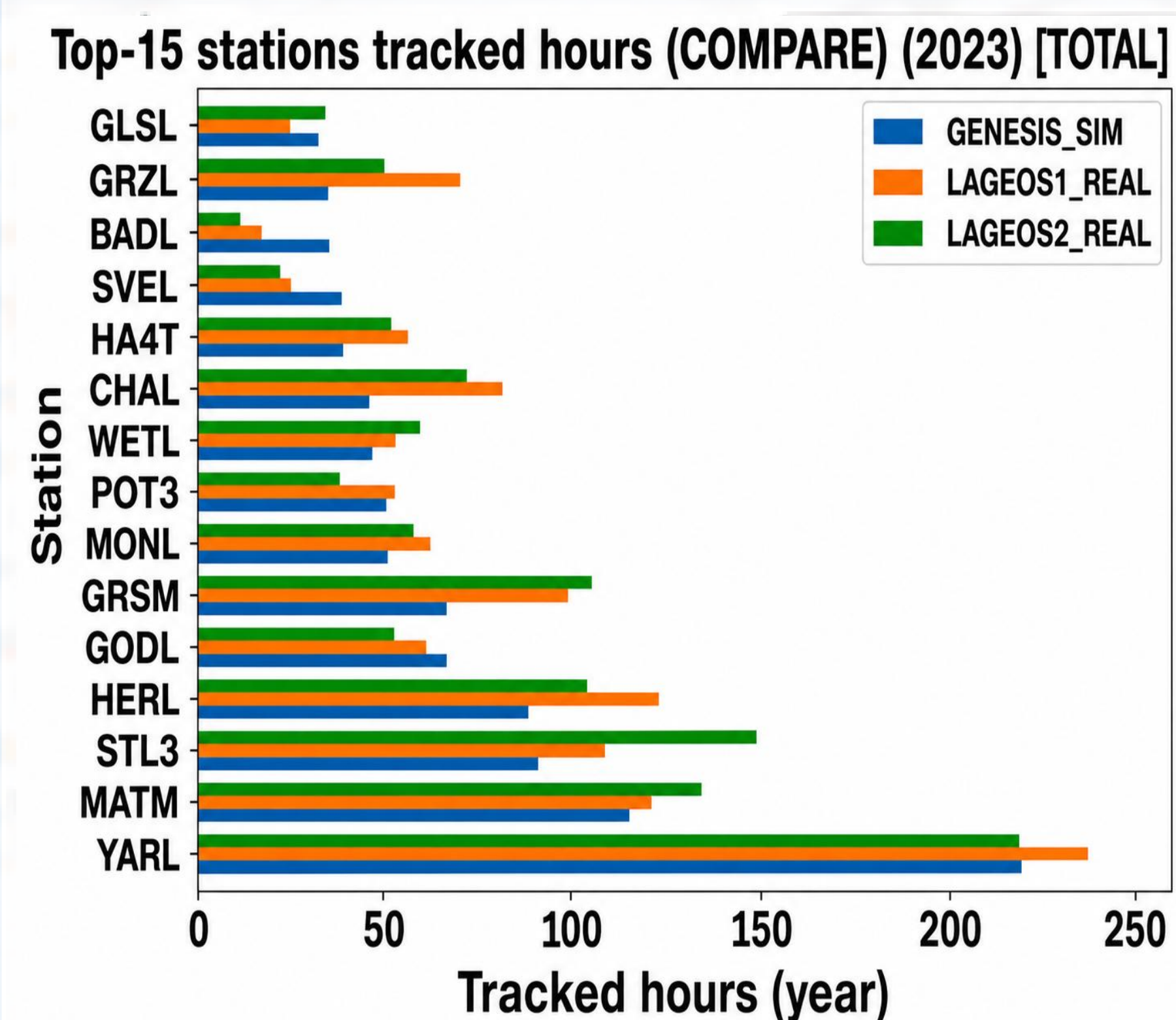
P95 network NP gap: 1.134 h

Figure 1. SCW weather-gated probability results for representative stations



Probability that a station SCW is usable given cloud fraction and wind gust.

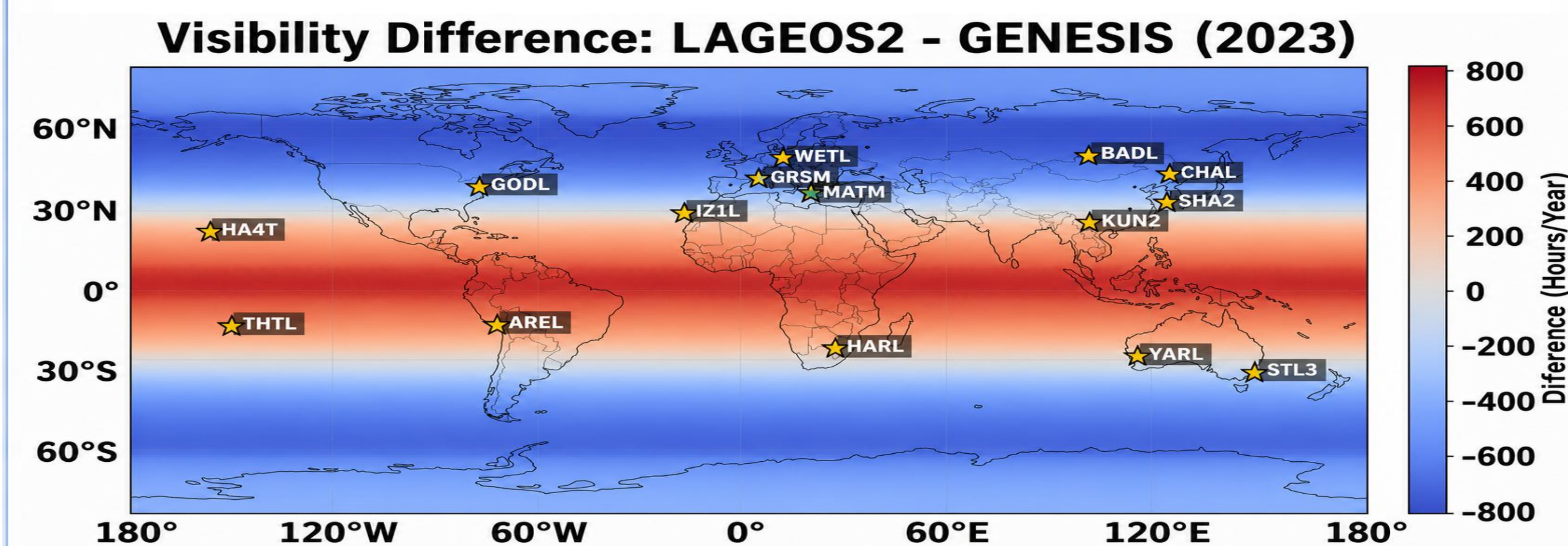
Figure 2. Top-15 stations tracked hours (2023)



Top-15 ILRS stations by total tracked hours (year) for GENESIS (simulated) and LAGEOS satellites (real).

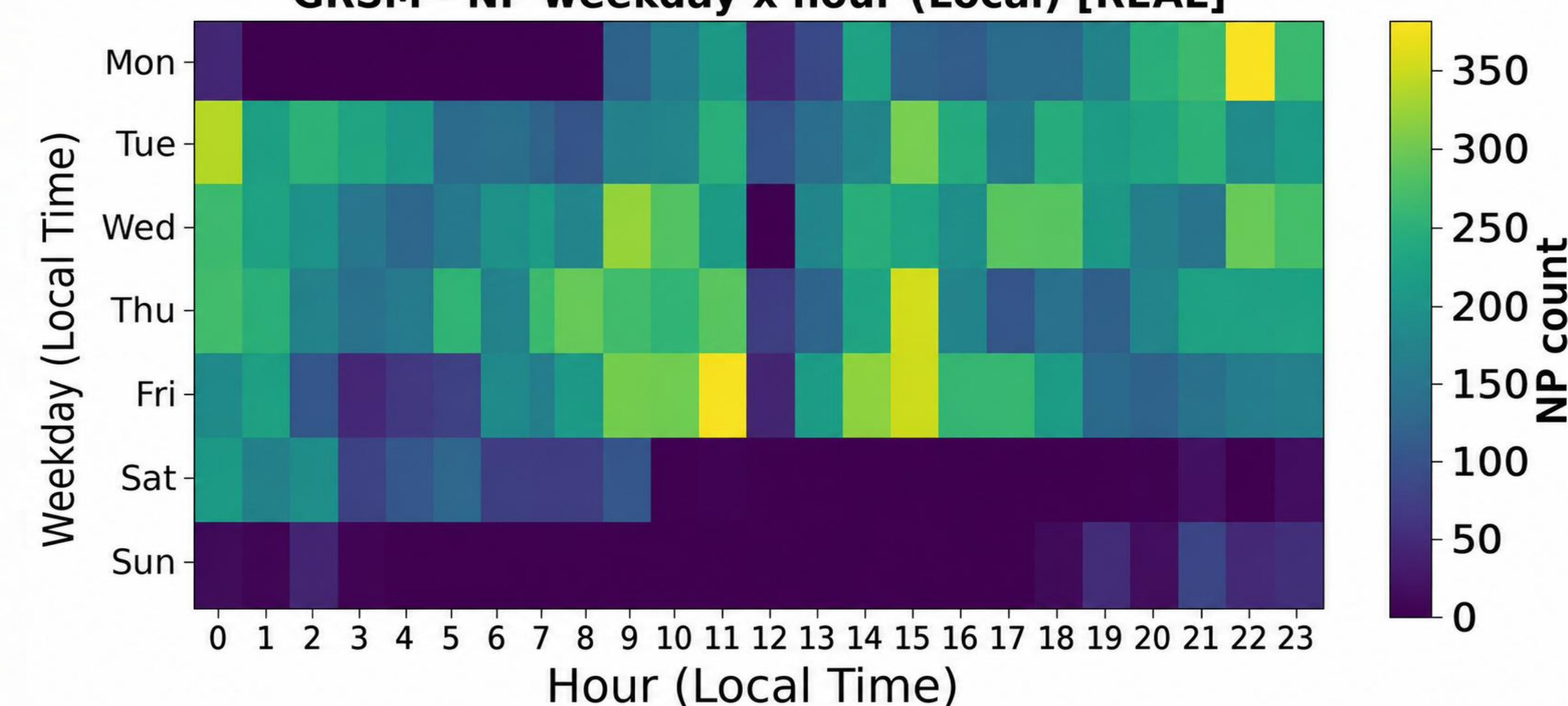
5. Supporting Results & Discussion

Figure 3. Visibility difference (LAGEOS2 - GENESIS, 2023)



Positive values indicate longer accumulated visibility duration for LAGEOS2 compared with GENESIS. Differences arise from station density.

Figure 4. Embedded non-weather factors (GRSM, REAL) GRSM - NP weekday x hour (Local) [REAL]



Pattern reflects staffing, operations, and maintenance windows.

6. Discussion and Limitations

- GENESIS shows a slightly larger long-gap tail than historical LAGEOS tracking.
- One driver is orbit geometry and station distribution, especially in low latitudes.
- Non-weather factors (e.g., staffing, maintenance) create near-empty blocks not captured by weather gates.
- Results reflect 1-hour scheduling resolution for 2023.
- Future work: incorporate operational calendars and higher-resolution analyses.

7. Outlook

- Integrate better geometry-aware cube screening.
- Use higher-resolution weather information.
- Incorporate realistic operational calendars.
- Extend the framework for multi-year scenario analysis.