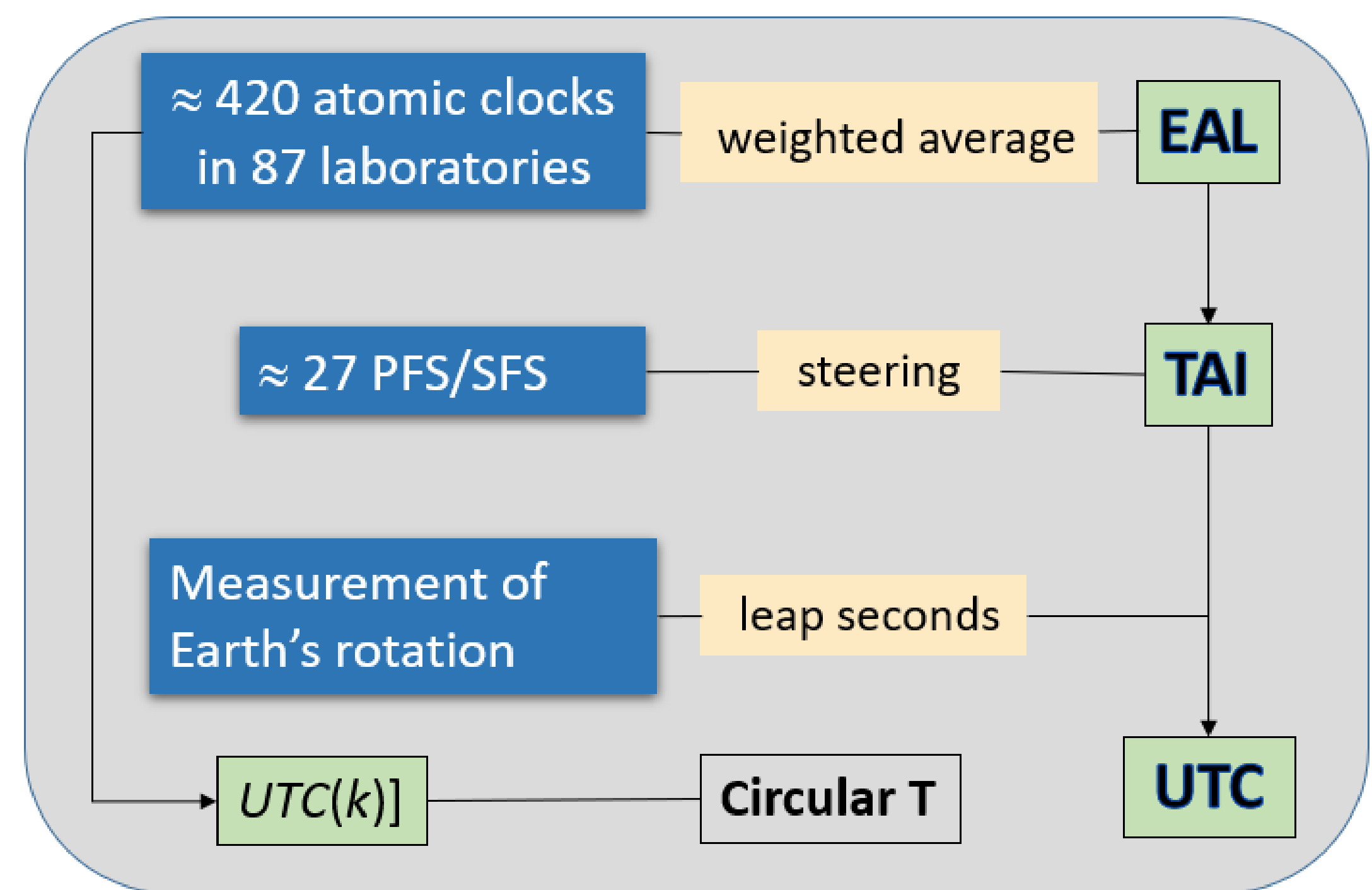


A long-term vision for UTC

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- The Coordinated Universal Time (**UTC**) has been calculated by the BIPM Time Department since **January 1988**.
- UTC is the **global reference time**, serving as the international atomic time scale used as a reference by **National Metrology Institutes (NMIs)** and in many applications, such as **navigation, communication, finance**, and more.

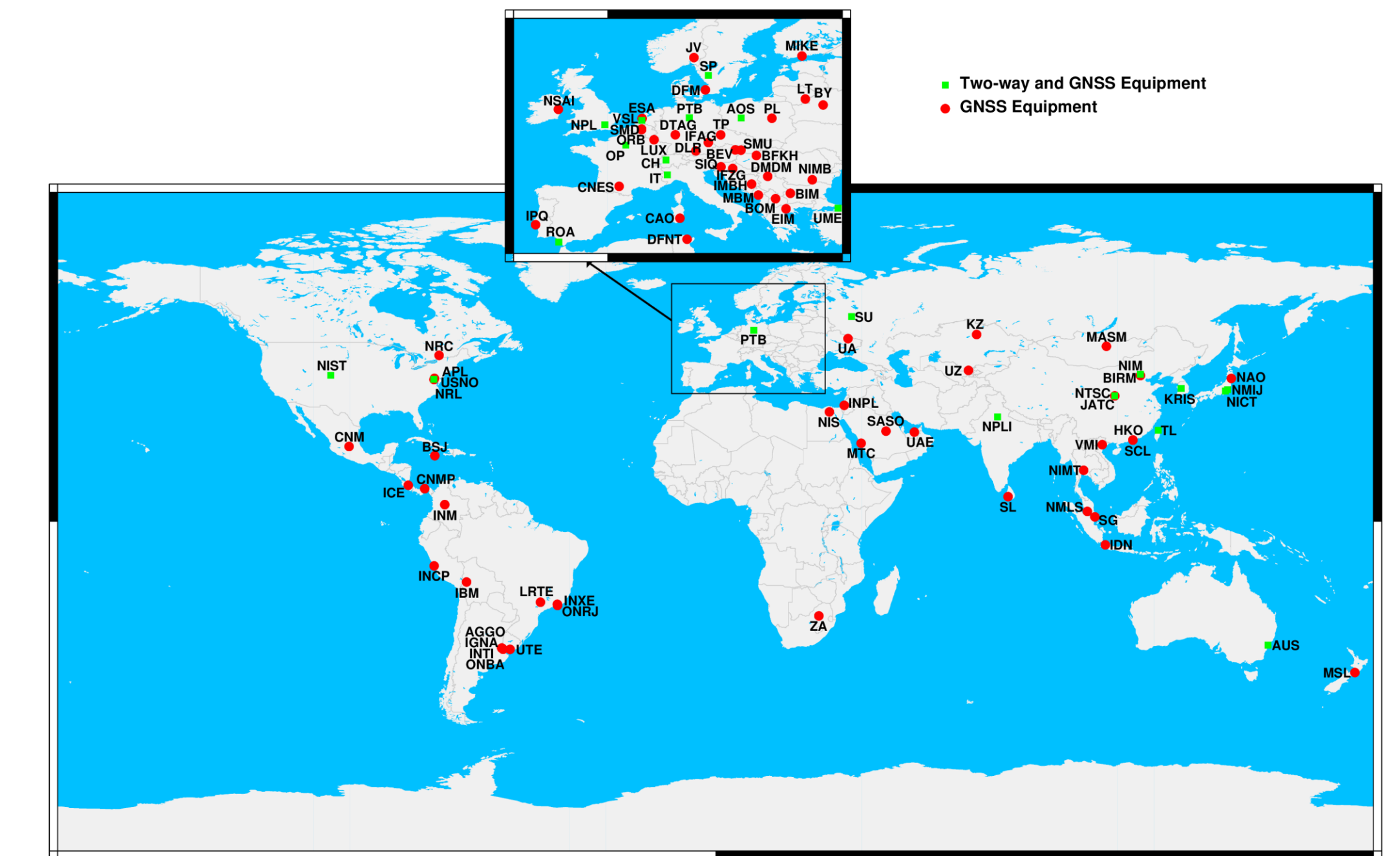
UTC calculation



UTC facts:

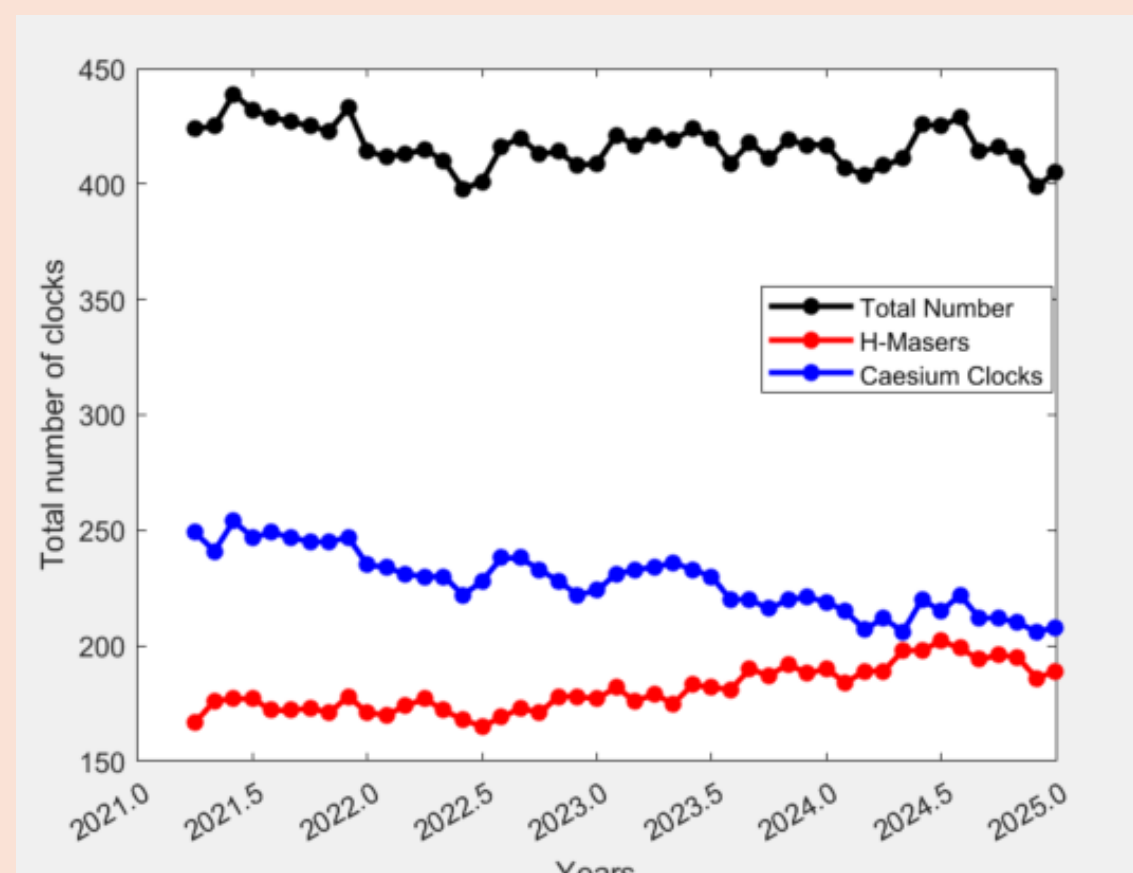
- 87 laboratories spread worldwide
- Calculated at 5-day interval on batches of about 30 days
- Monthly published in **Circular T**
- Instability:** few parts in 10^{16} at 30 days
- Accuracy:** few parts in 10^{16} (PSFS)
- GNSS** and **TWSTFT** techniques are used to compare clocks
- Clocks: **Cesium clocks, H-Masers** and **Rubidium fountains**
- Primary and secondary frequency standard (PSFS)** for the accuracy

Geographical distribution of the laboratories that contribute to TAI and time transfer equipment (2024)

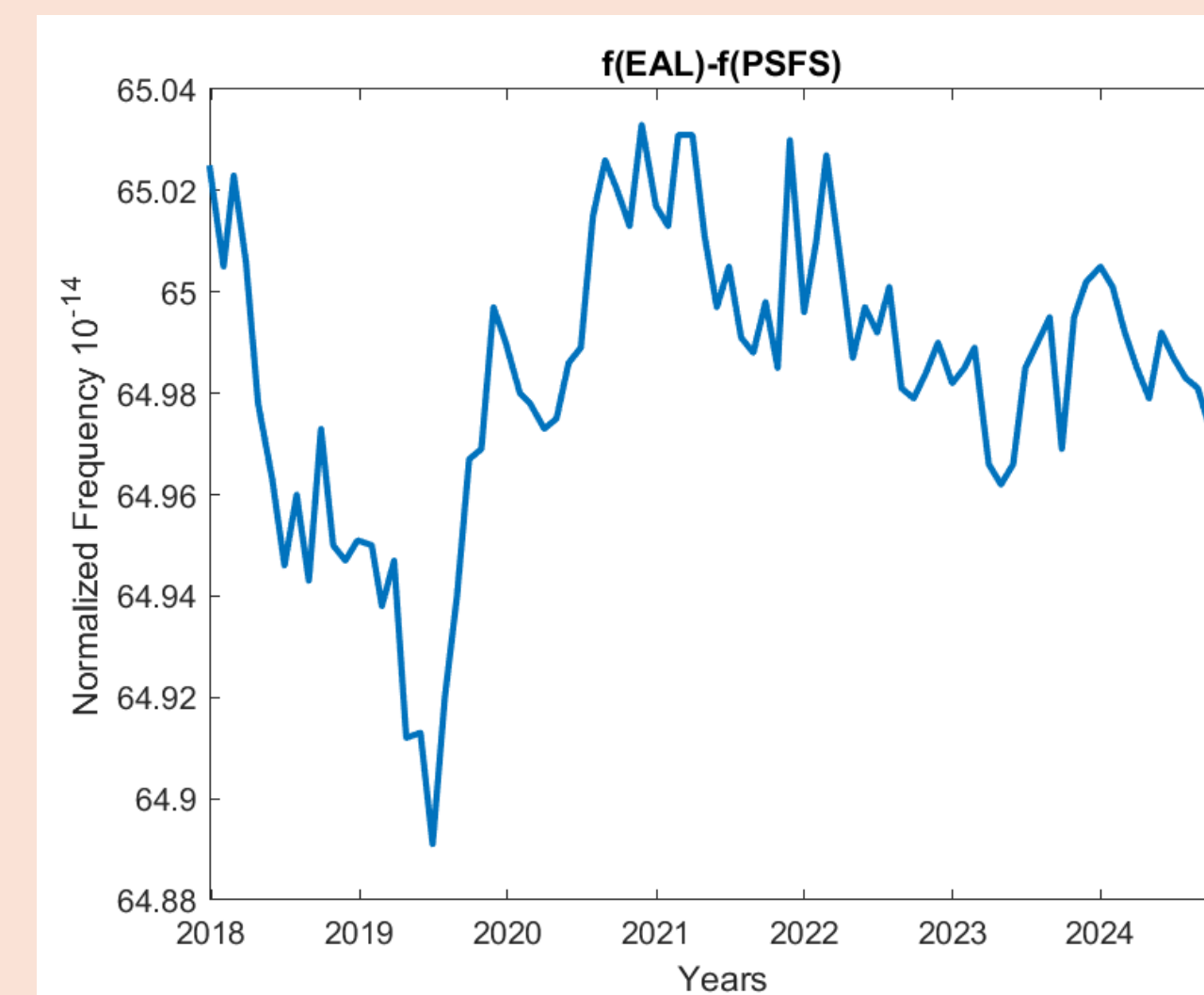
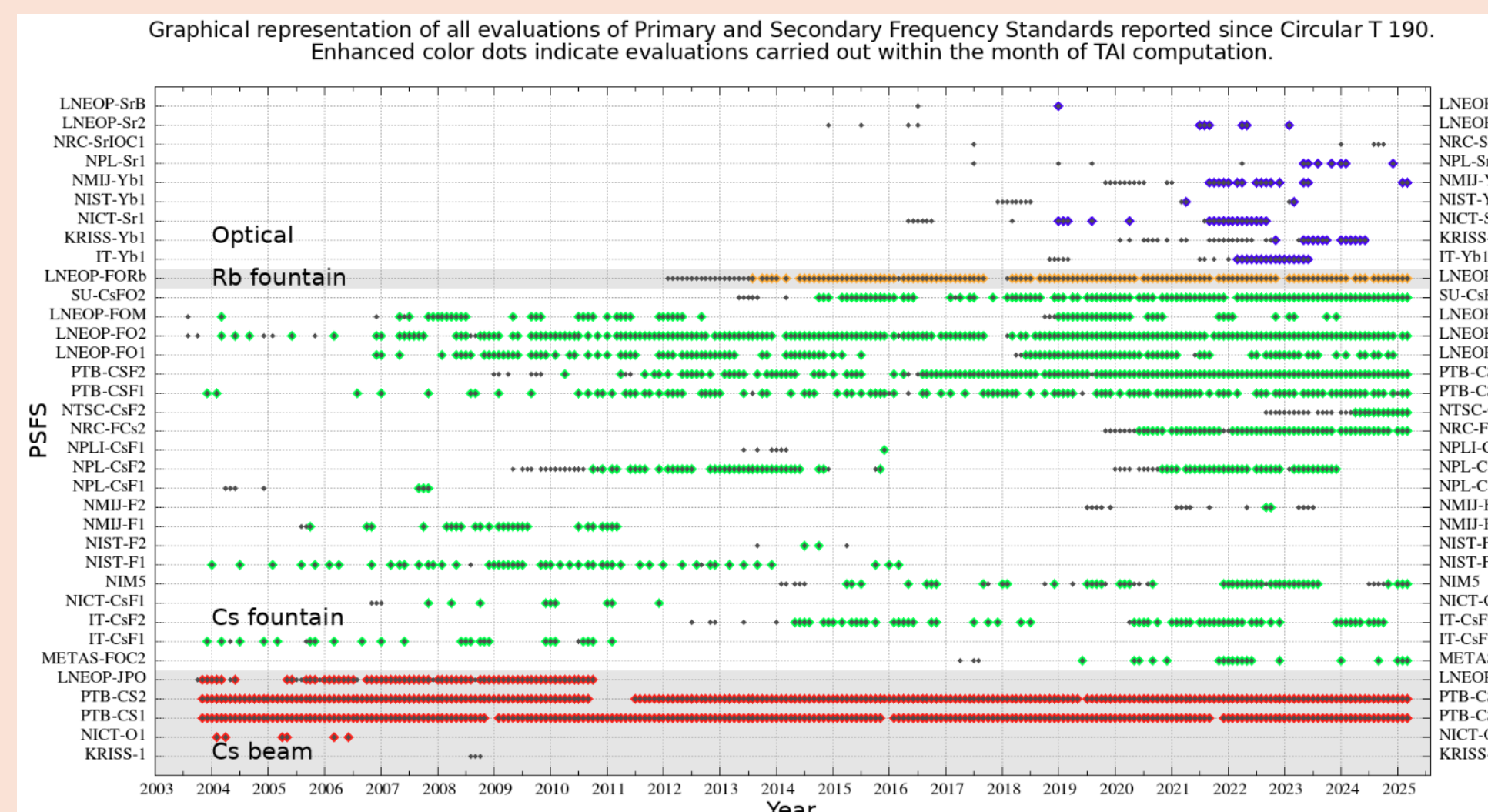
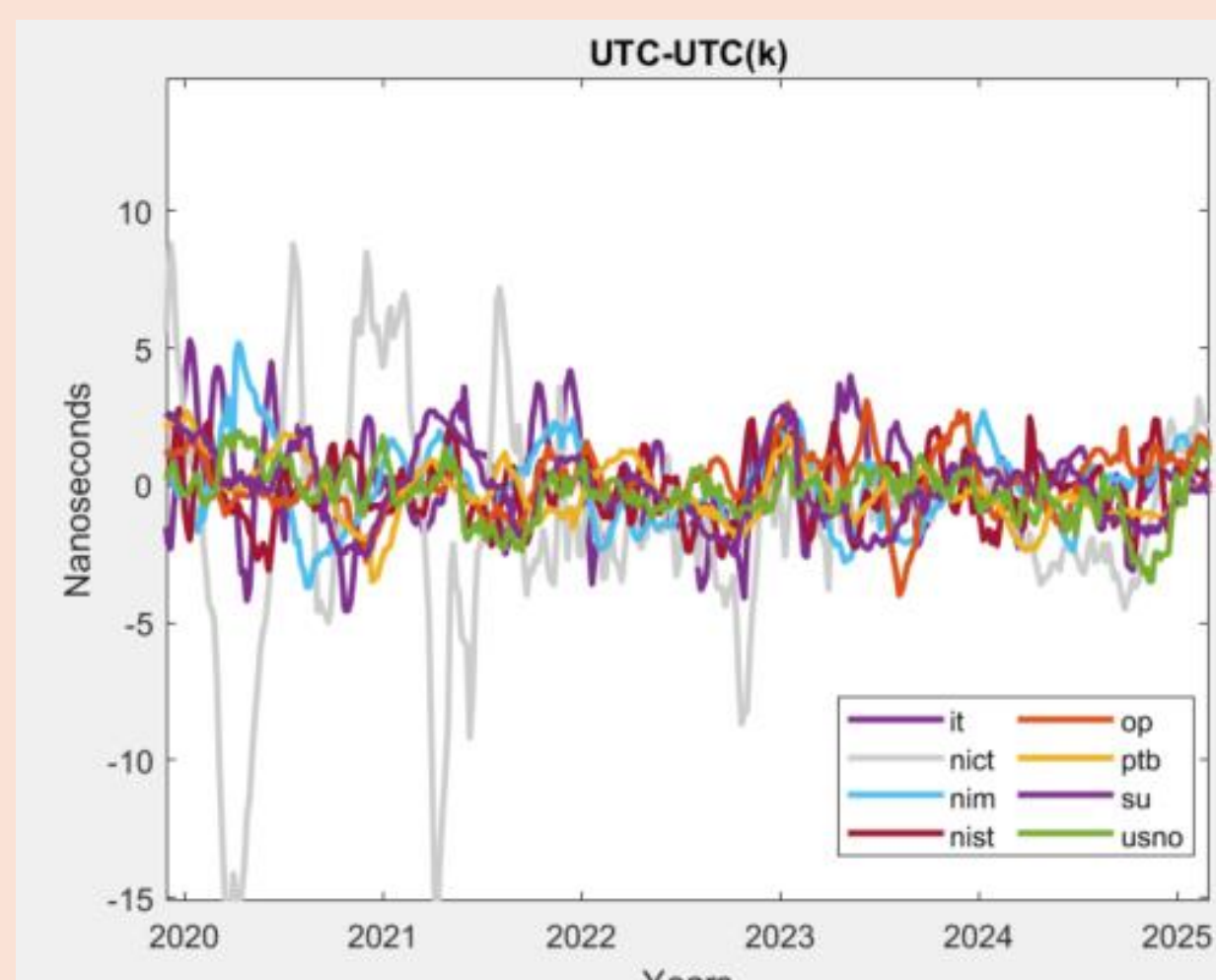
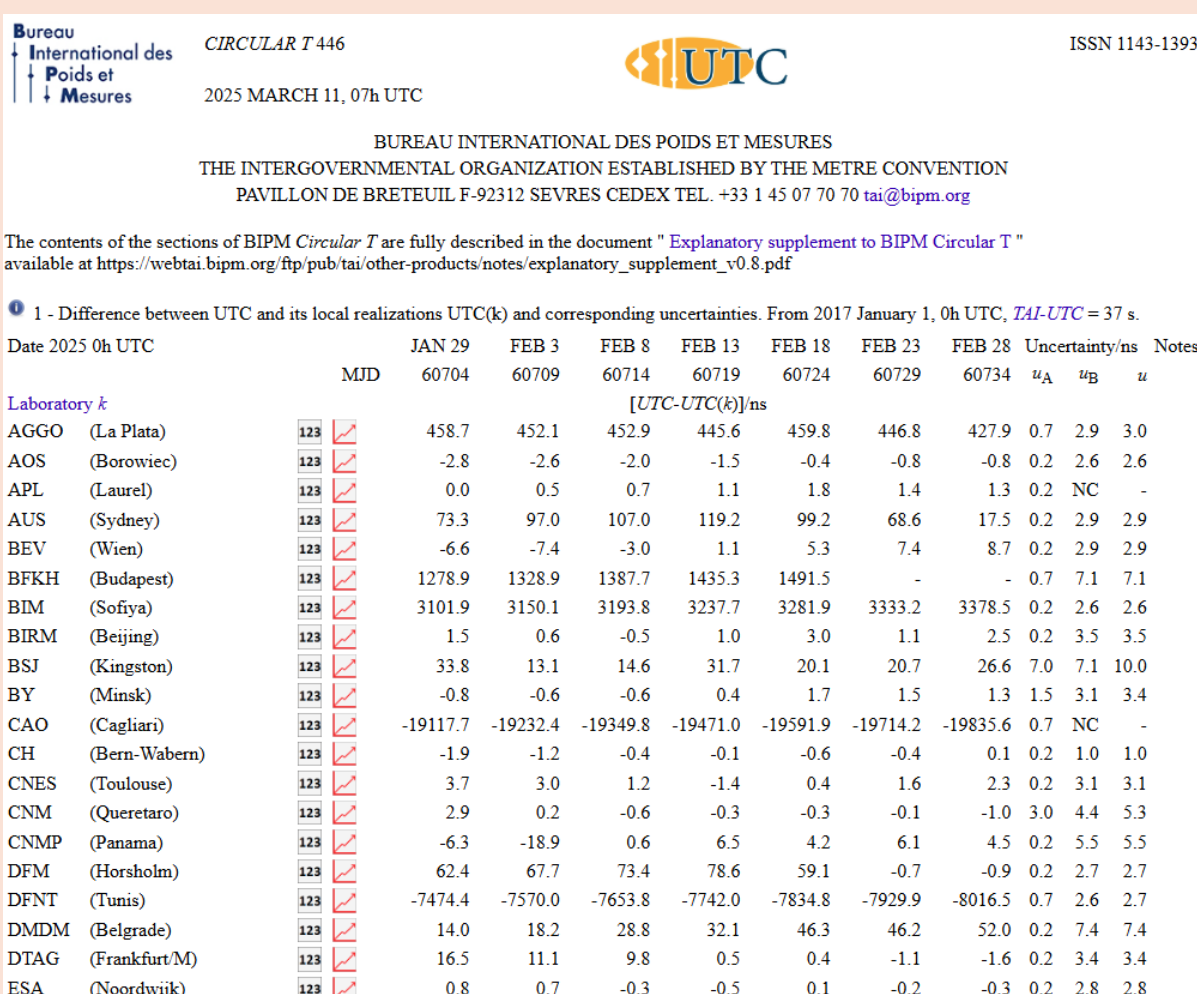


UTC properties

- reliability & redundancy (*Atomic clocks*)
- frequency stability
- accuracy (*PSFS*)



- A global, universally accessible timescale (*Circular T, UTC(k)*)



The long-term vision for UTC

Atomic clocks: The diversification of the contributing clocks will require revising the algorithms that optimize clock contributions, potentially incorporating **Artificial Intelligence (AI)** and **machine learning**.

Time links: As new technologies such as **optical fiber links** and **advanced satellite-based frequency comparisons** are developed, improvements in UTC's performance are expected

PSFS: As more PFS and SFS are introduced, **direct comparisons** between them will further strengthen UTC's accuracy.

Accessibility: Combining advancements in time scale generation with quasi-real-time comparison could lead to a reassessment of the **ideal latency for UTC and Rapid UTC calculations**.

Future goals for UTC could include offering picosecond-level resolution, daily data publication, and potentially a more rapid UTC with lower latency.

Acknowledgments: The authors would like to thank the time laboratories for their participation to the computation of UTC.

Feedback on possible future needs from NMIs and their stakeholders is welcome