Deutsches Geodätisches Forschungsinstitut (DGFI-TUM)
Technische Universität München

100th anniversary of Commission A2 / 19:

One Century of Earth Rotation research in the framework of IAU

INTERNATIONAL ASTRONOMICAL UNION
1919-2019

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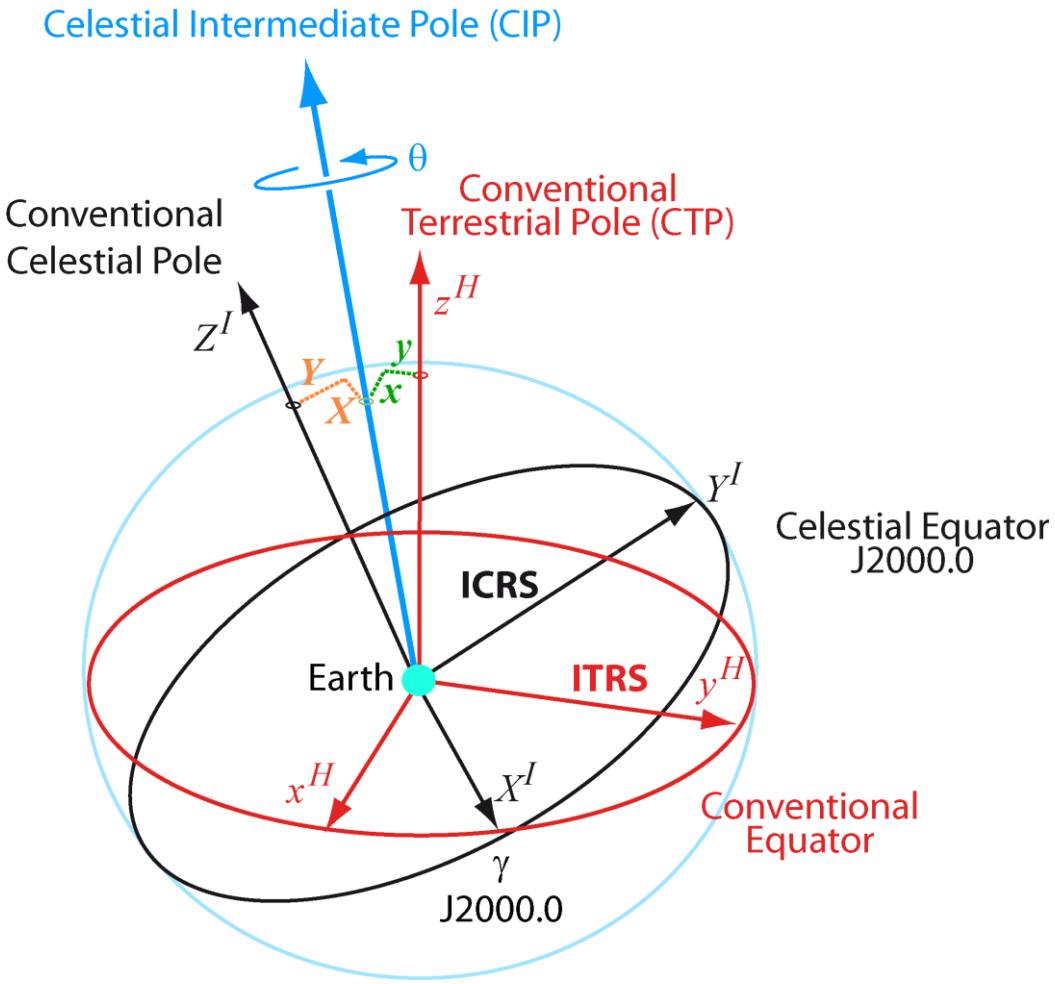
Paris, 7. October 2019

Earth Rotation: A fundamental topic bridging astronomy and geodesy

- The Earth's rotation and their temporal changes are **key quantities for astronomy and geodesy**.
- Determination of these parameters at the highest level of accuracy is **fundamental** for the realization of precise celestial and terrestrial **reference systems**, **time systems**, and for positioning and navigation on Earth and in space.
- **Temporal changes** of Earth rotation occur on various timescales, from sub-daily to decadal and secular
- They reflect external influences and **geodynamic processes**, and their analysis allows for inferences on the internal structure and interactions between various components of the Earth system and the impacts of **global change** phenomena.



Foundation of IAU and Commission A2 / 19

July 28, 2019:
100th anniversary of IAU and of Commission A2 / Commission 19

- Creation of the IAU during the Constitutive Assembly of the International Research Council, Brussels, July 18-28, 1919.
- Together with the IAU, also 32 Standing Committees were created on July 28, 1919.
- Among these was the “Standing Committee 19 on Latitude Variations” in order to study polar motion.
- 1922: Transformation into “Commission 19 on Variation of Latitude”.
- 1964: Renaming into “Commission 19 on Rotation of the Earth”
- 2015: After restructuring the IAU, the designation was changed into “Commission A2 on the Rotation of the Earth”

1964

RESOLUTIONS ADOPTED

BY THE GENERAL ASSEMBLY

SUMMARY OF DECISIONS CONTAINED IN THE REPORT OF THE GENERAL ASSEMBLY

1. *Statutes and By-laws.* The revised texts of the Statutes and By-laws, as indicated on page 37, will be printed in Volume XIIC of the *Transactions*.

2. *Commissions.* The following decisions were taken (see page 43).

(*a*) To create a new Commission no. 45: Spectral Classifications and Multi-band Colour Indices.
(*b*) To create a new Commission no. 46: The Teaching of Astronomy.
(*c*) To re-name Commission no. 17: The Moon
(*d*) To re-name Commission no. 19: The Rotation of the Earth
(*e*) To re-name Commission no. 30: Radial Velocities

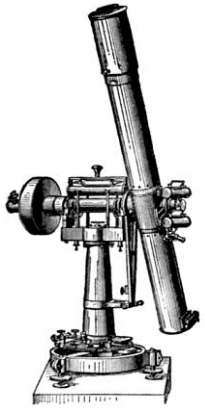
Commission A2 / 19: Objectives

- Encourage collaboration in **observation and theoretical studies of Earth rotation**.
- Encourage the **development of new observation techniques**.
- Develop strategies and methods for **improving the accuracy** of Earth rotation changes and reference frames.
- Ensure agreement and continuity of different (geodetic/astronomical) **reference frames** and their densifications.
- Linking the astronomical community to **international organizations** that are responsible for providing Earth orientation parameters (EOP) and reference frames (ITRF/ICRF), i.e. IAG, IERS and the technique services IVS (Very Long Baseline Interferometry), ILRS (Satellite Laser Ranging), IGS (Global Navigation Satellite Systems) IDS (Doppler Orbitography and Radio positioning Integrated by Satellite).
- Fostering research and discussion on Earth rotation and reference frames through dedicated **symposia and workshops**, and though forming relevant **Working Groups**.

Advancement of technology & development of observing systems

Over the past 100 years, the observation capabilities have greatly improved through technological progress (observing systems, timing, data analysis capacities), global distribution of observatories and international coordination.

- 1919: Latitude observations by means of **optical astrometric techniques**
- **Satellite/Lunar Laser Ranging (SLR/LLR)**:
  First mid 1960s; until today: > 90 SLR stations & various satellites.
- **Geodetic Very Long Baseline Interferometry (VLBI):**
  Operational since early 1980s; until today: > 100 VLBI telescopes.
- **Positioning/navigation satellite systems (TRANSIT, DORIS, GNSS)**
  First 1970s; nowadays: networks comprising hundreds of stations.
- **Ring laser gyroscopes**
  After 2000: Sensitive to the instantaneous pole of rotation, measurement of high-frequency rotational variations (sub-daily / hours)
- Current developments:
  Optical clocks / relativistic geodesy…



Determination of latitude using zenith telescopes

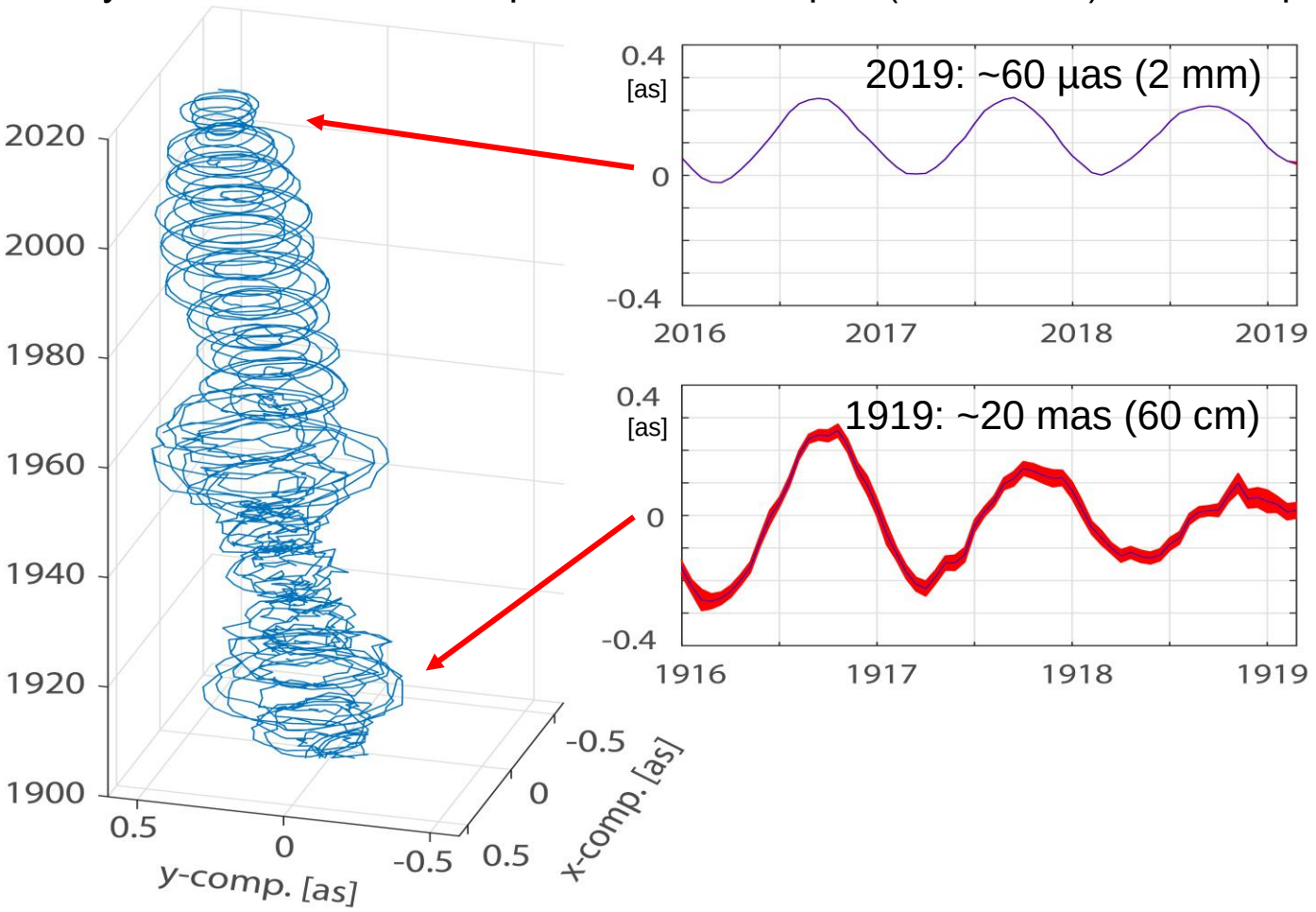
[Picture: Encyclopaedia Britannica]

Geodetic Observatory Wettzell

Quantum leap in precision

Pushing the limits of data quality: Improvement of more than two orders of magnitude, from decimeters to millimeters.

Today’s measurements are precise to < 100 µas (orientation) and ~ 20 µs (spin).



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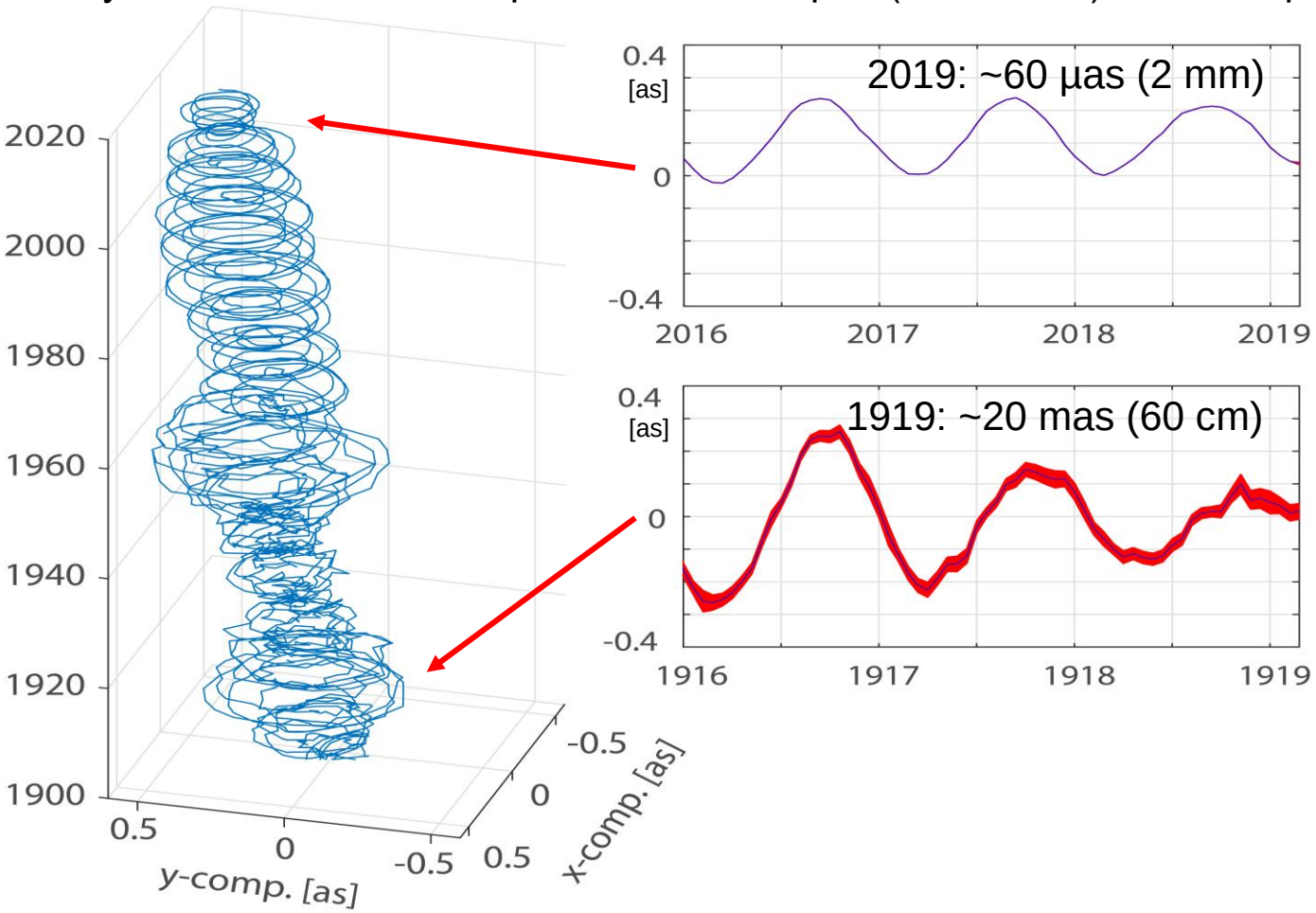
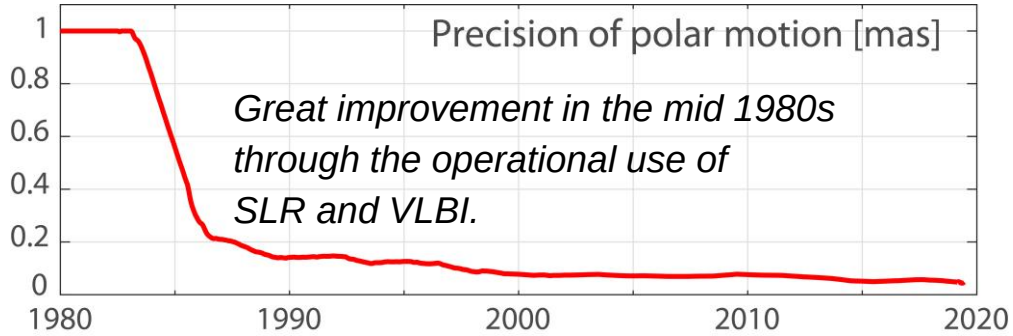
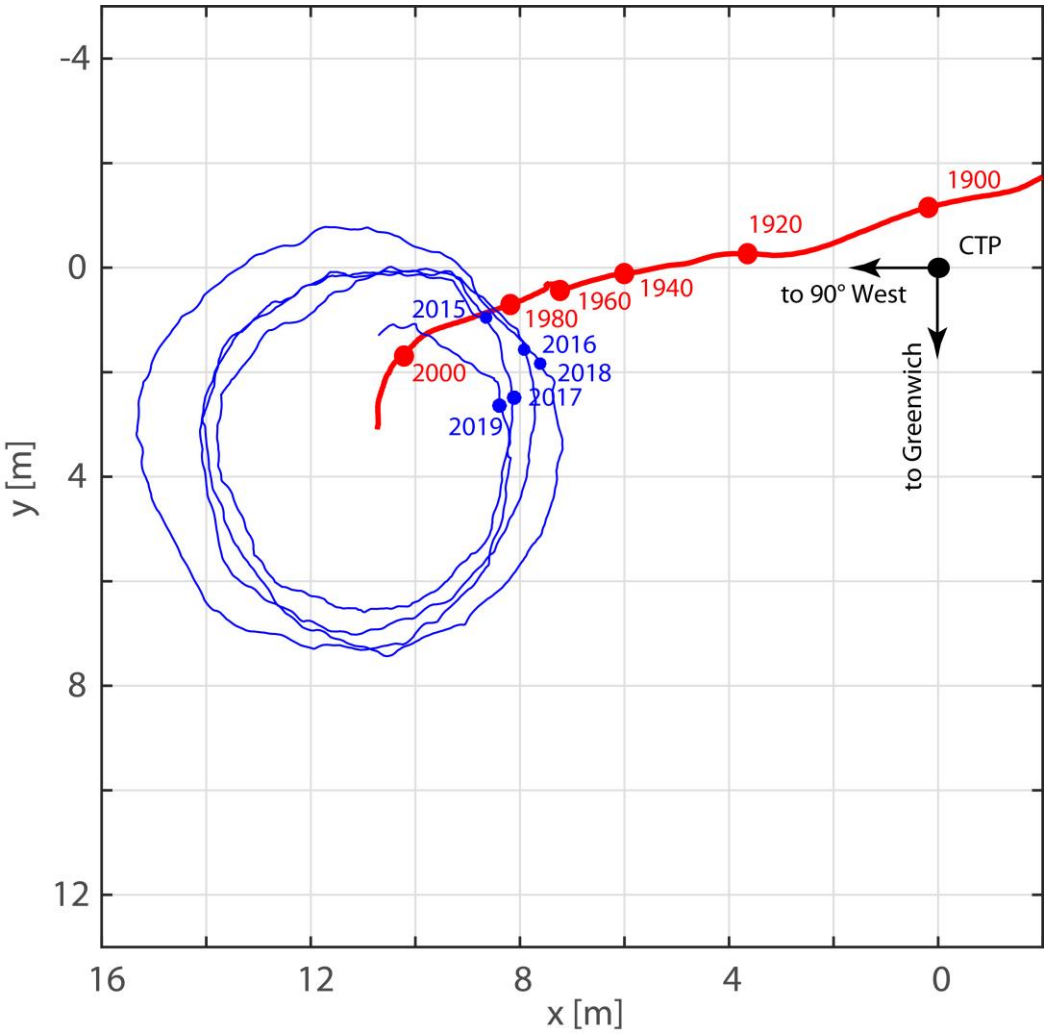




Long-term monitoring data for geodynamics and Earth system studies



EOP monitoring data are **among the longest continuous observation series** related to dynamic Earth processes.

Temporal changes on multiple timescales have been analyzed in a large number of studies with respect to a **wide variety of exogenous and endogenous stimulating processes**.

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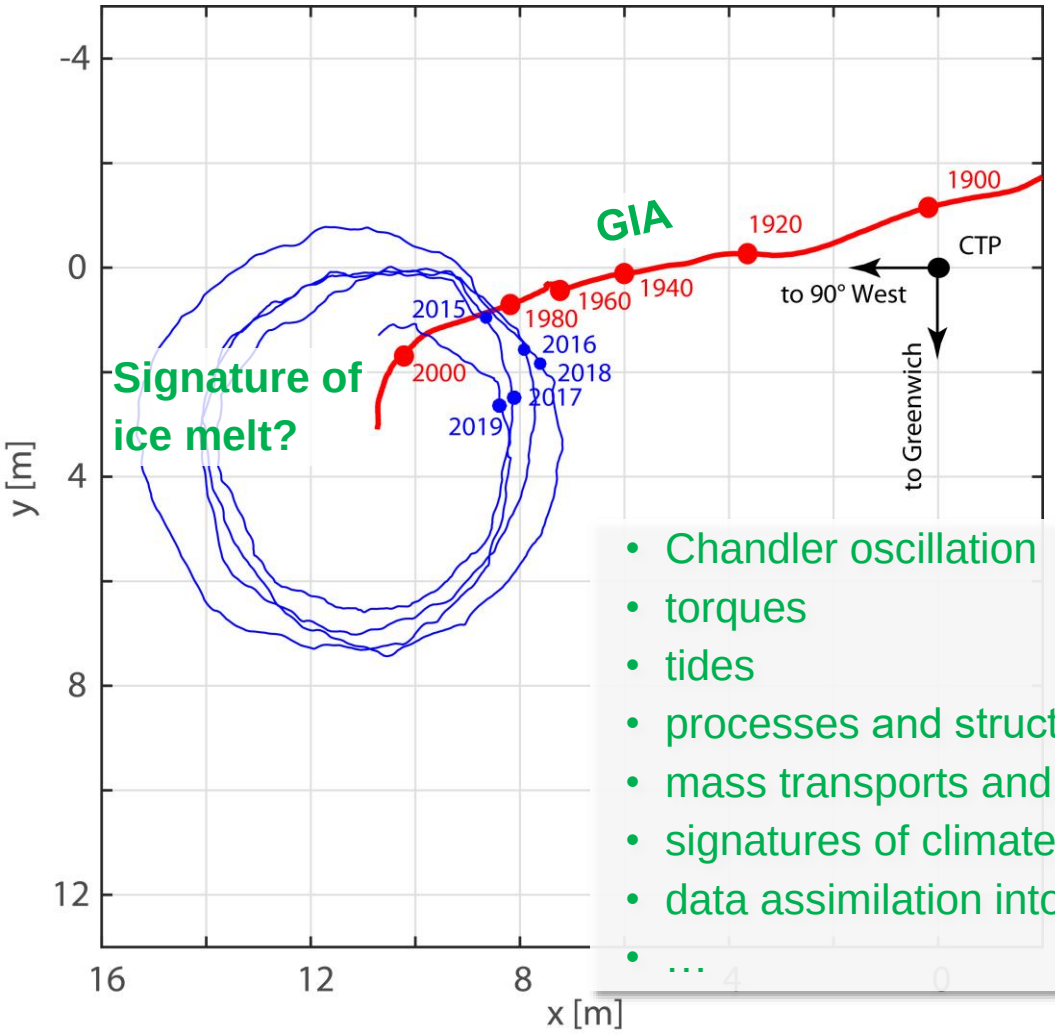

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- Chandler oscillation
- torques
- tides
- processes and structure of the Earth's interior
- mass transports and angular momentum exchanges
- signatures of climate change
- data assimilation into numerical models
- …

Milestones: IAU Symposia and Colloquia related to Earth Rotation

- IAUS 11: The Rotation of the Earth and Atomic Time Standards (1958, Russia)
- IAUS 13: The Future of the International Latitude Service (1960, Finland)
- IAUS 32: Continental Drift, Secular Motion of the Pole and Rotation of the Earth (1967, Italy)
- IAUS 48: Rotation of the Earth (1971, Japan)
- IAUS 78: Nutation and the Earth's Rotation (1977, USSR)
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- IAUS 128: Earth's Rotation and Reference Frames for Geodesy and Geodynamics (1986, USA)
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- 2019: LoI for IAU GA Symposium in 2021: “Reference Systems and Rotation of the Earth and other Solar System Bodies”

100th anniversary of IAU Commission A2 / 19

The upcoming session shall provide the opportunity to look back at the history of our Commission and the developments in Earth rotation monitoring and research during the last century:

- Zinovy MALKIN et al. (invited): Overview of the 100 year history of IAU Commission 19/A2
- Nicole CAPITAINE: The IAU Commission “Earth Rotation” and the IAU definition of the pole and UT1
- Richard GROSS, A. BRZEZINSKI: The International Astronomical Union and Polar Motion
- Obituaries to Bernard GUINOT, Barbara KOLACZEK, Victor ABALAKIN, Veniamin VITYAZEV

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