



Kartverket

Satellite Laser Ranging at Brandal

Evan Hoffman

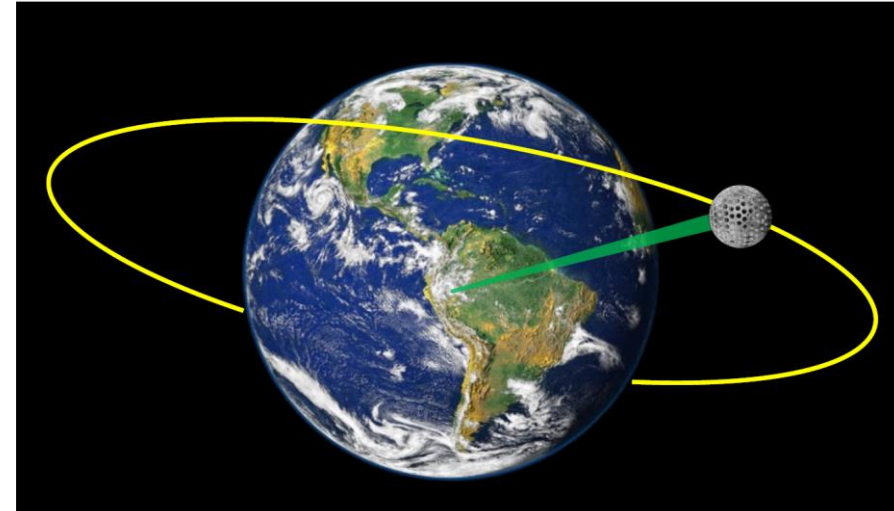
Ole Johan Klingan



27 February 2024

Satellite Laser Ranging

- Fire a short laser pulse to a satellite equipped with a retro-reflecting mirror
- Time when the laser pulse leaves the station
- Laser pulse reflects off the mirror back towards the station
- Time when the laser pulse is received
- Correct for atmospheric delay
- Range measurement!



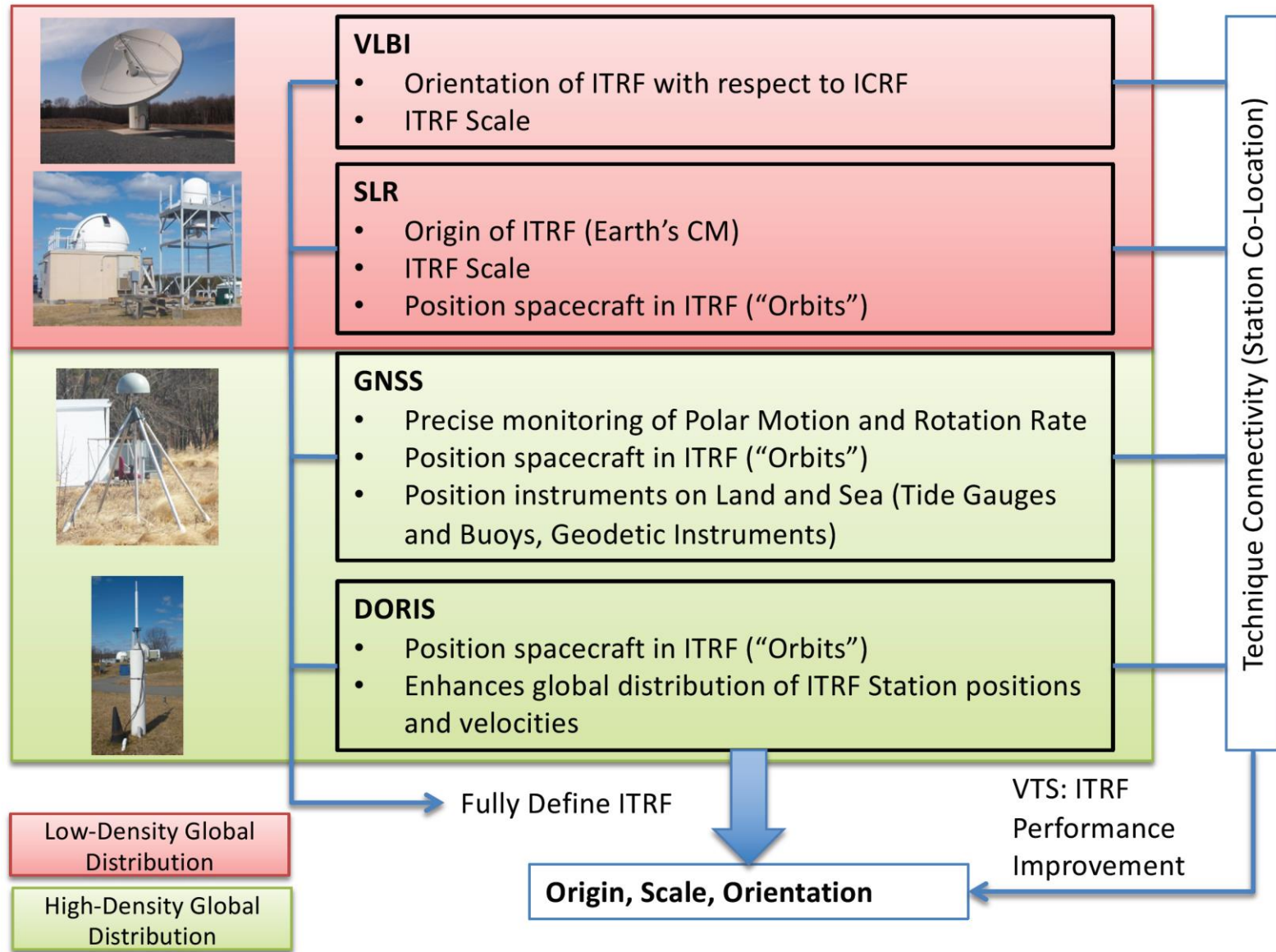
No electronics on the space segment

1-2 mm precision measurements

Centimeter-level accuracy orbits

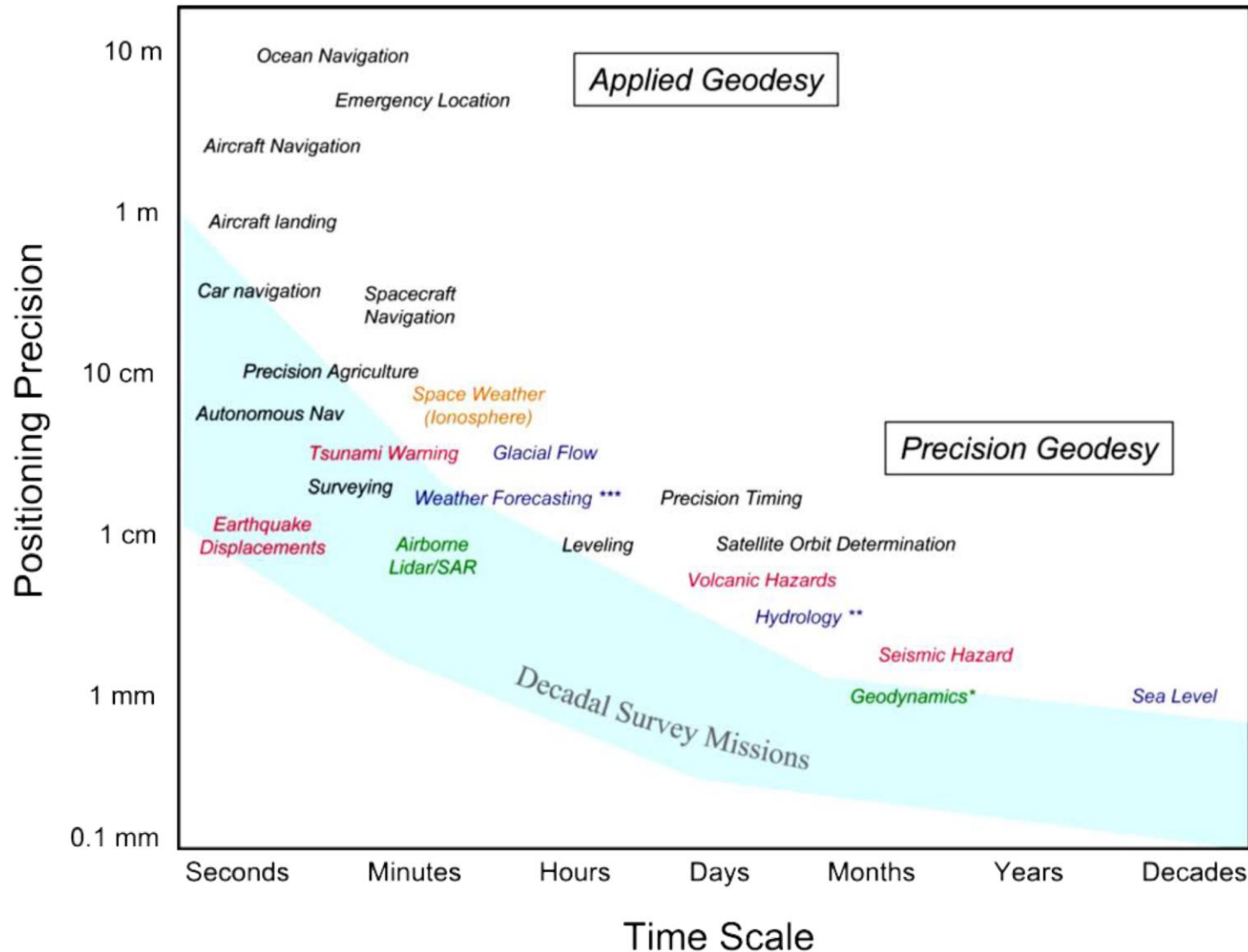


Geodetic Techniques



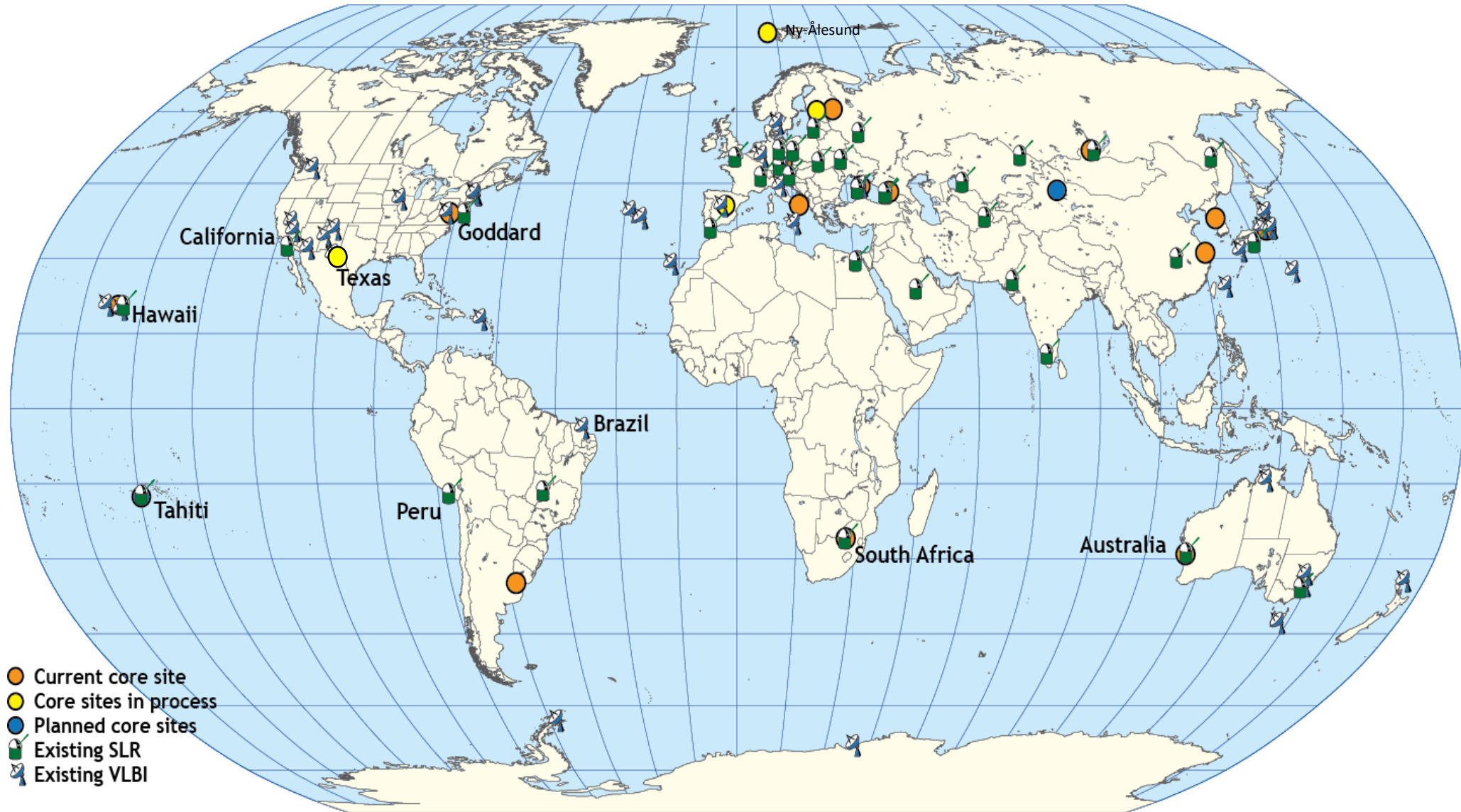


Why do we need this?



National Research Council.
Precise Geodetic
Infrastructure: National
Requirements for a Shared
Resource. Washington, DC: The
National Academies Press,
2010.

The Global SLR/VLBI Network



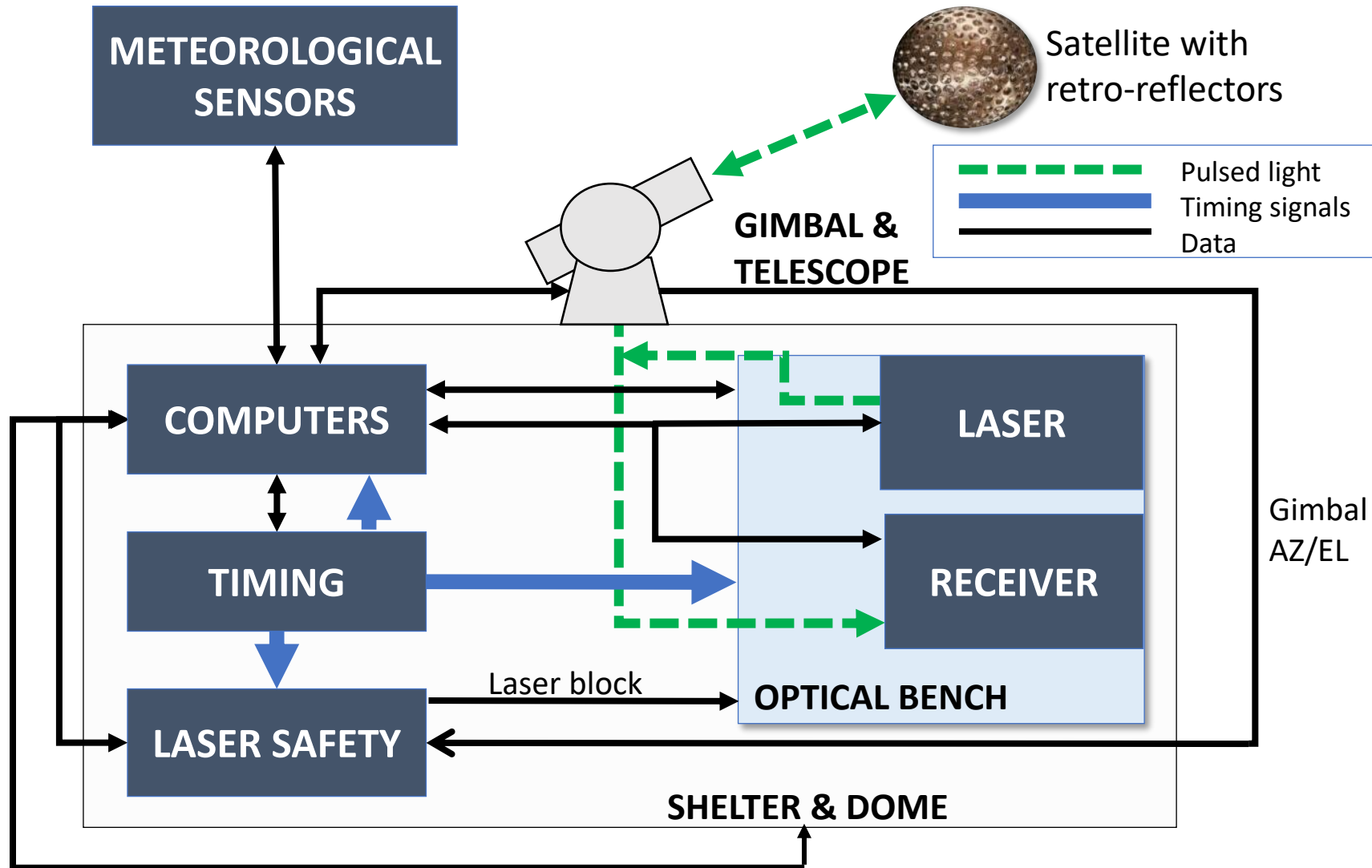
NASA's Space Geodesy Satellite Laser Ranging

SGSLR is a component of NASA's Space Geodesy Project, an initiative to renew and expand NASA's Geodetic Network

SGSLR at Ny-Ålesund is being developed, deployed, and integrated into the NASA Network by KBRWyle, in partnership between NASA and Kartverket



SGSLR Building Blocks



Gimbal and Telescope Assembly (GTA)

Manufactured and installed by CAES

< 0.0008 degree pointing RMS accuracy

For reference, the moon is ~0.5 degrees in the sky



Knowledge of the invariant point < 1 mm

The invariant point is the intersection of azimuth and elevation and is the 'origin' of the system. Critical for range measurement!



Brandal in 2014, 2018, 2022, and 2024

2014



2018



2022 - 2024



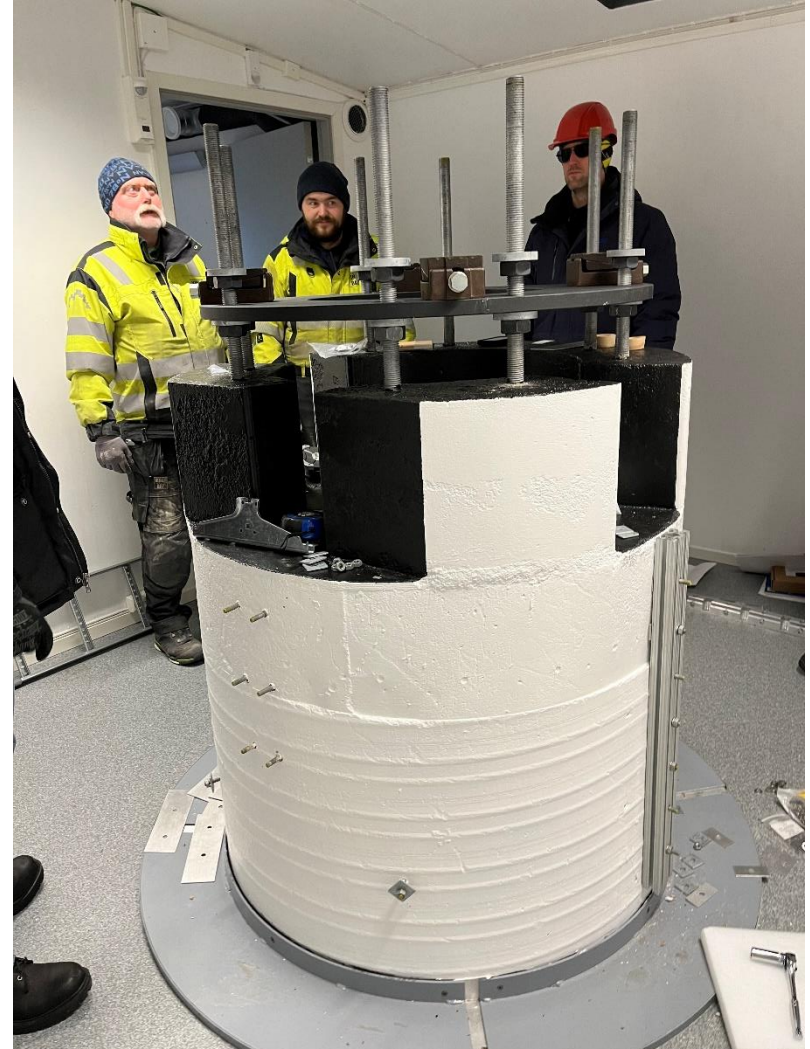
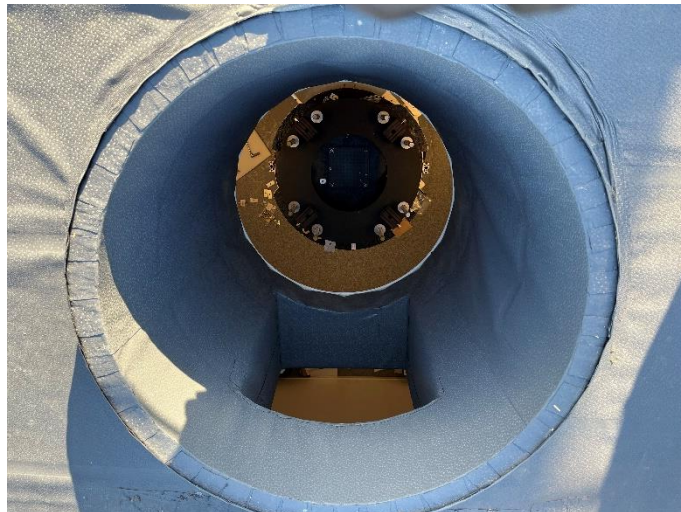
Casting of SLR concrete pier (Dec-2014)



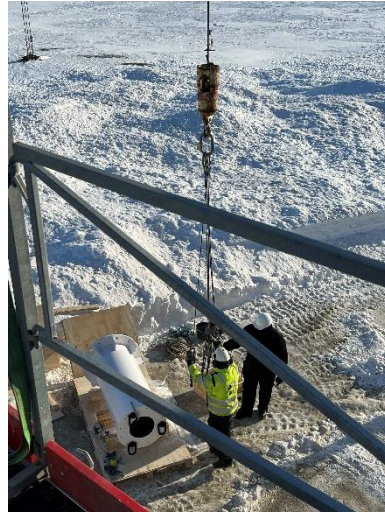
SLR building constructed (May-2015)



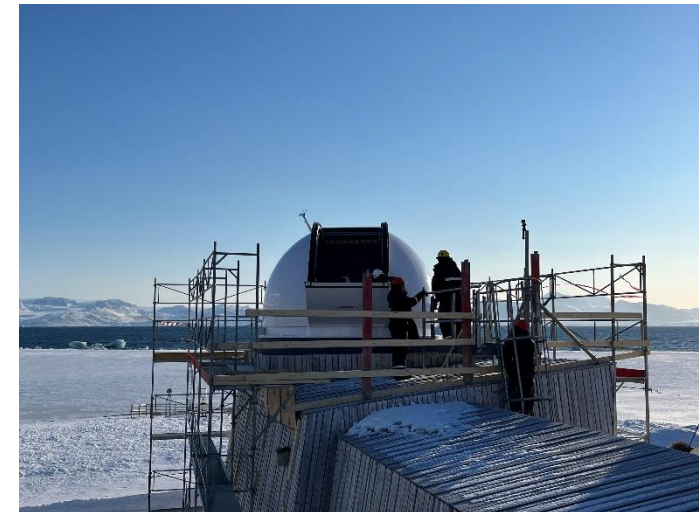
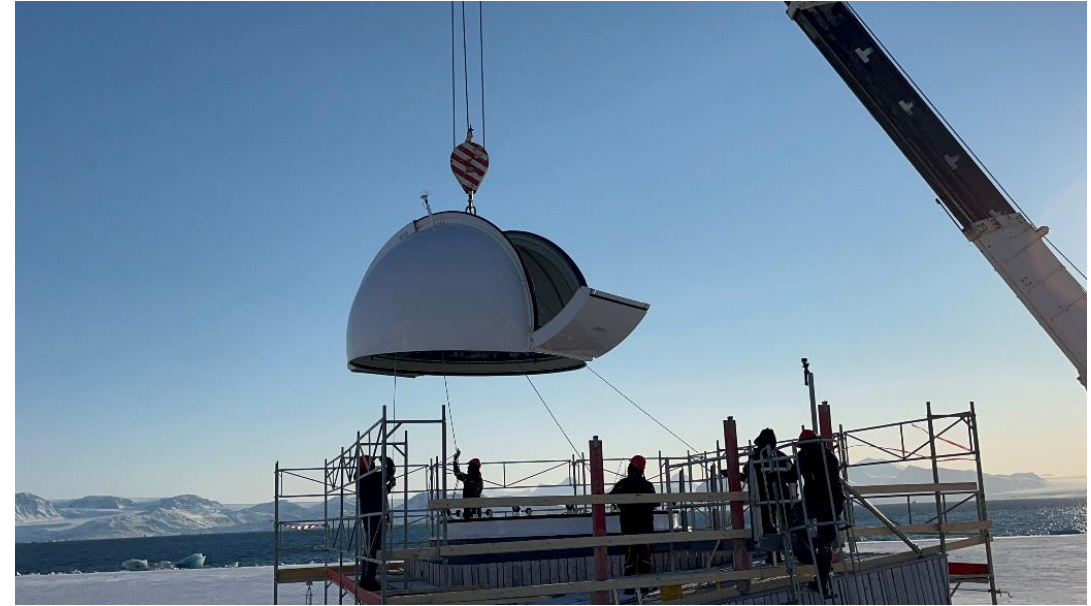
Preparing for the dome and riser (April -22)



Lifting the riser (April -2022)



Lifting the dome (April -2022)



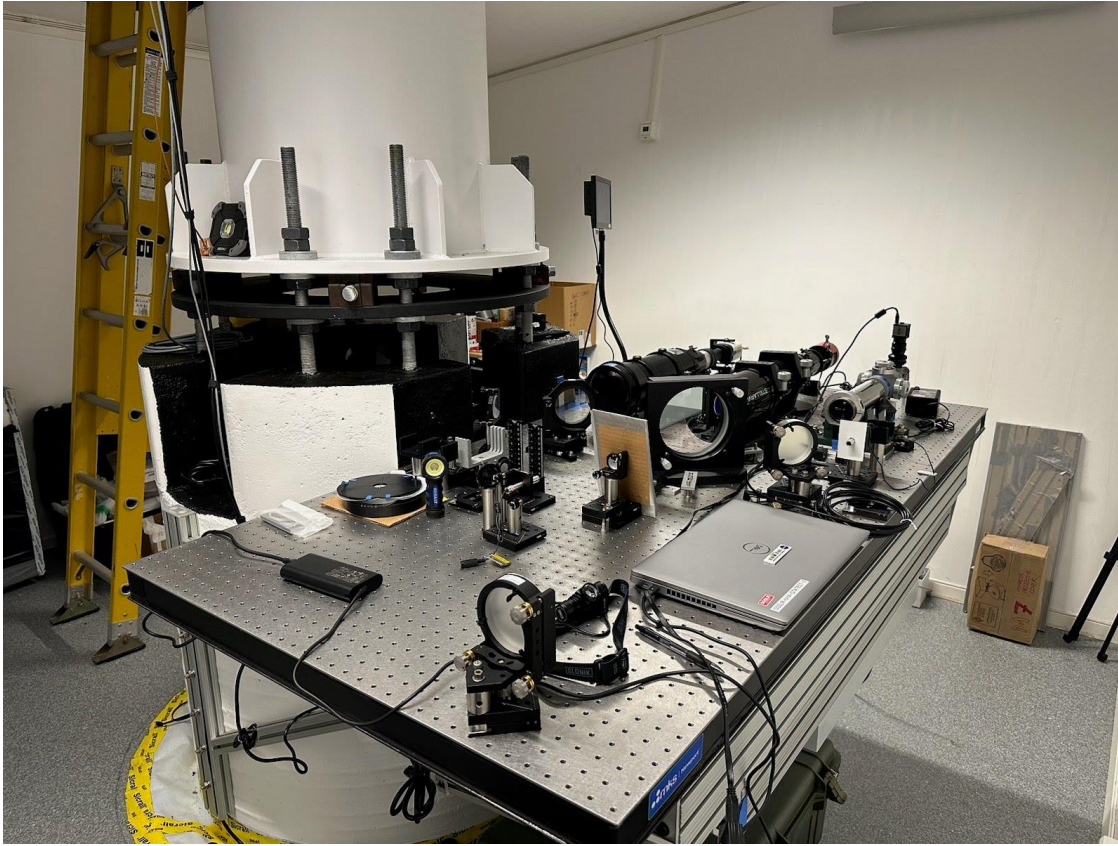
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Lifting the GTA (Feb -2024)

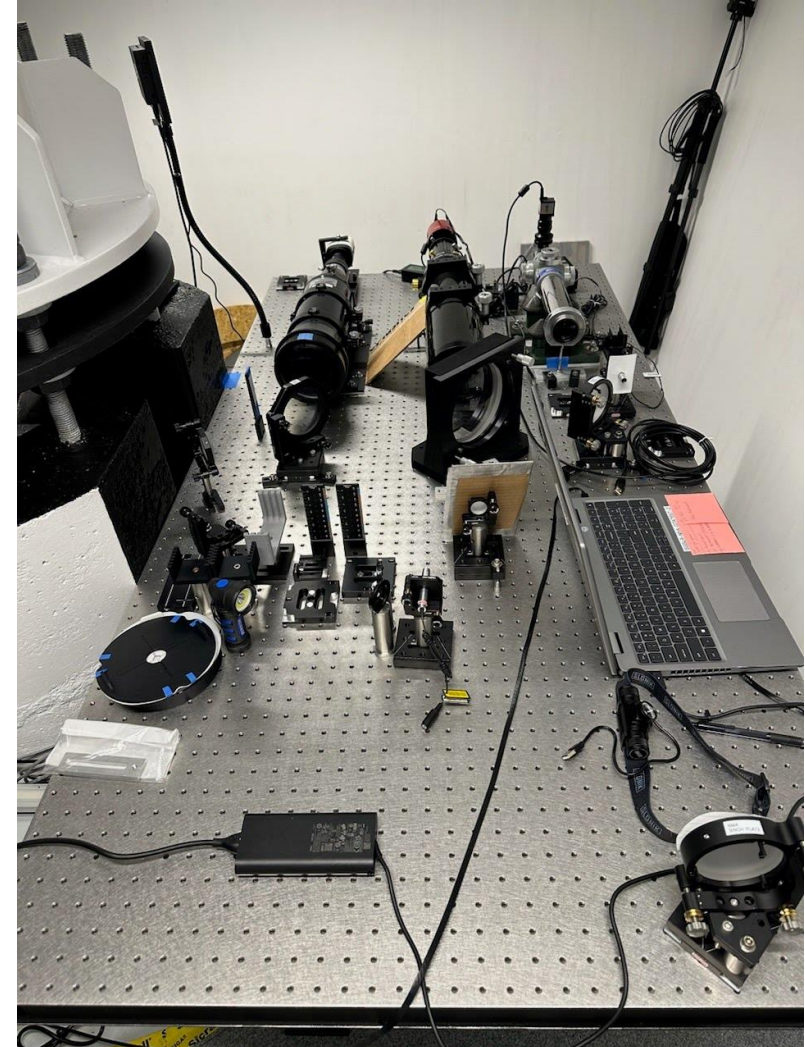
Gimbal and Telescope Assembly



Optical Bench for Testing the GTA



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Star Calibration and Sunlit Satellite Tracking

We look at stars to tell how well we are pointing, because we know very accurately where the stars are supposed to be in the sky.

Collecting the position of a number of stars throughout the sky, we can build a mathematical model to correct for pointing errors we might have.



Questions?

