Positioning system for Baikal-GVD

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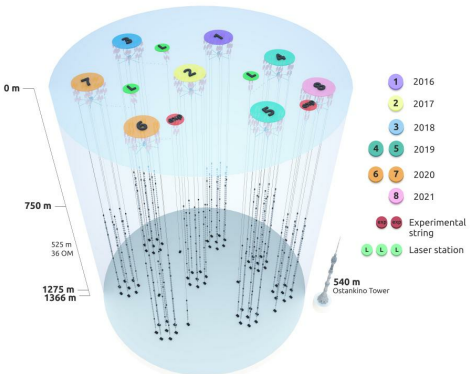
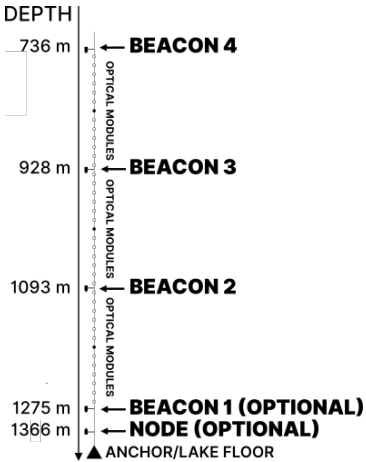
37th International Cosmic Ray Conference (ICRC2021)



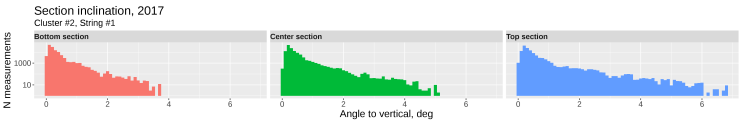
- GVD 2021 configuration: 8 clusters, 8 strings in each cluster.
- Each string is strung between an anchor (depth 1366m) and subsurface buoys (30 meters under water).
- Strings are flexible, can move with Baikal currents.

Baikal-GVD positioning system



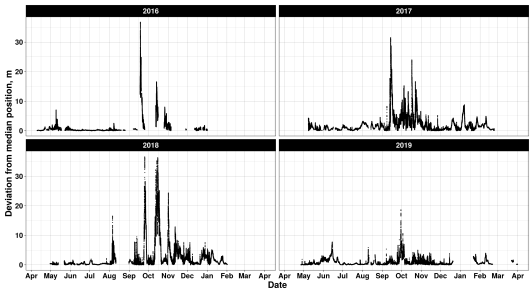
EvoLogic S2CR 42/65 acoustic modem used in Baikal-GVD

- We use a network of acoustic modems (AMs) broadcasting within 42 to 65 kHz range installed along the strings to determine geometry of the detector.
- Acoustic modems installed near string anchors (nodes) are used to trilaterate coordinates of modems installed along the strings (beacons).
- Beacon coordinates are reconstructed online and the acoustic distances are measured every 100-200 seconds.
- Coordinates of the mounted components are interpolated from beacon coordinates assuming piecewise-linear string model.
- OM rotation around the string not currently taken into account.

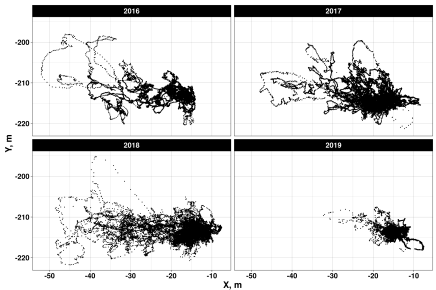


GVD 2021 planar coordinates

Long term behaviour of beacon #48, installed at the depth of 920 m over 4 seasons.

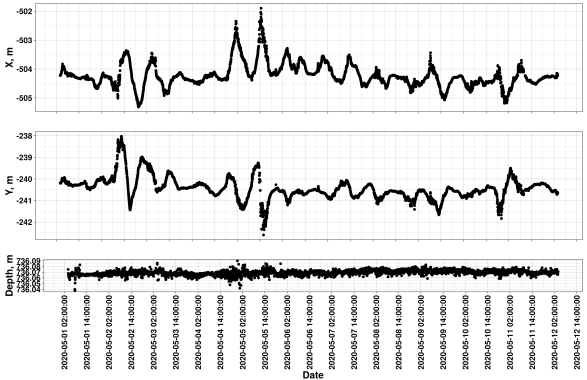


Deviation from stable position over time.

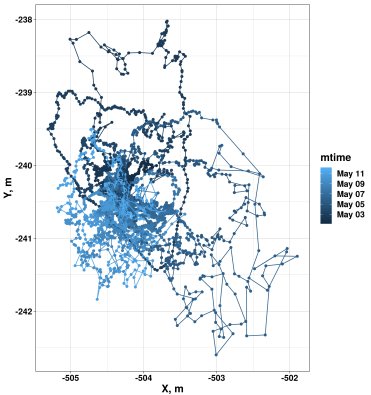


Total planar coordinates

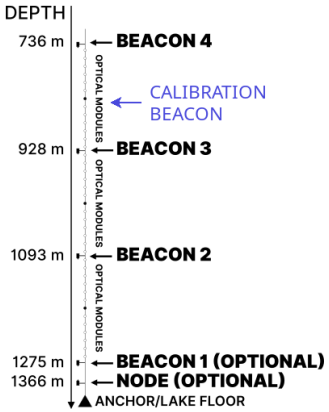
Beacon #306 drift between May 1 and May 12 2020, during a regular drift period.



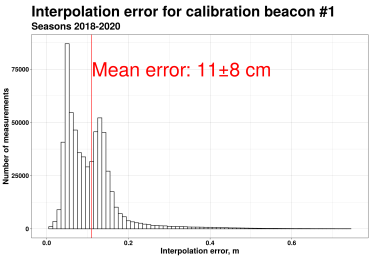
Coordinate scans

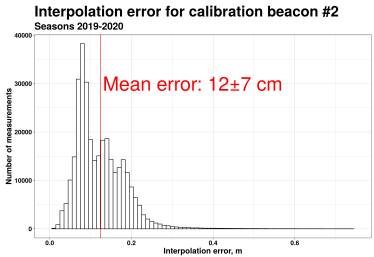


Planar coordinates

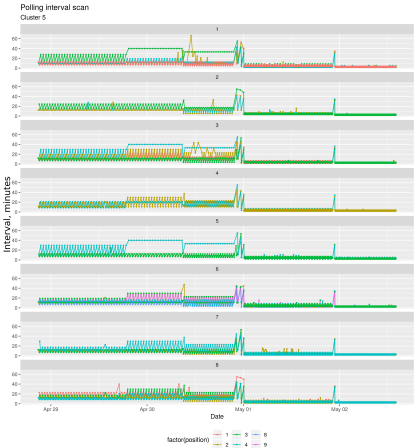


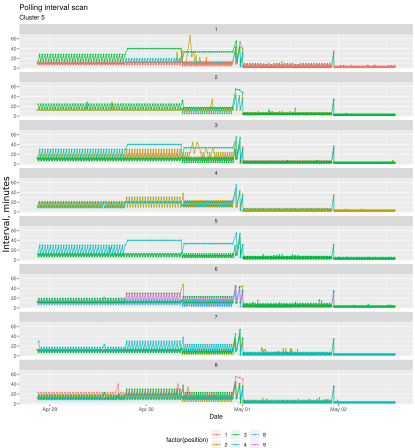
- The interpolation error will vary with the distance between OM and AM, curvature, and string mobility.
- The difference between calibration beacon positions obtained with linear interpolation and acoustic trilateration provides an upper bound on positioning error.





Polling





- 29.04 - 1.05: non-optimized polling
- 1.05 - 2.05: old polling procedure
- 2.05 onwards: new polling algorithm

Conclusions:

- The Baikal-GVD acoustic positioning system is currently in operation.
- Short-term and long-term beacon drift behaviour was presented. Long term drift behavior is consistent for all observed seasons.
- Following an improvement in the polling algorithm in May 2020, the median polling interval in 2021 is 180 seconds.
- The mean positioning error has been estimated with three years of data to be below 15 cm, which corresponds to a subnanosecond uncertainty in hit times and is in agreement with previous work.

Thank you