ZLand 3C 5Hz Node Test Results

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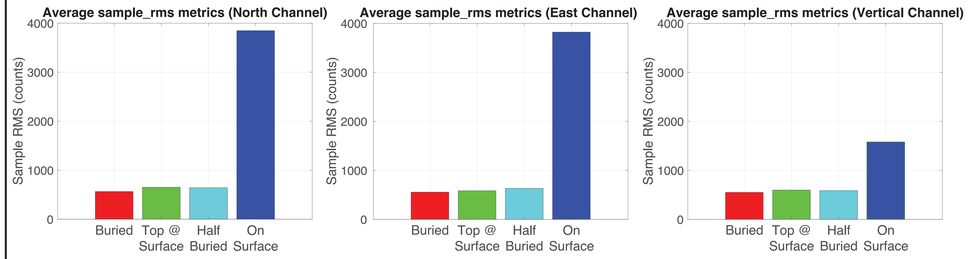
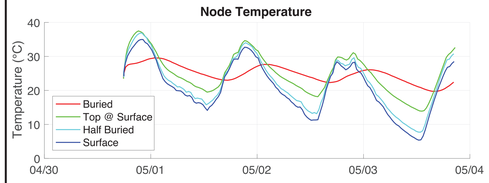
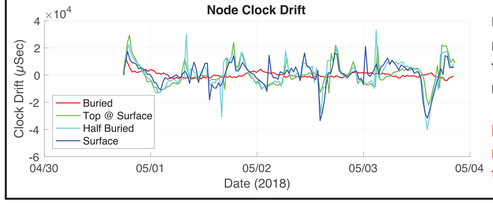
Burying nodes for better quality data -- how deep is deep enough?

We deployed 4 nodes near IRIS/PASSCAL to test how different burial depths would impact noise levels. Our earlier work has already shown that buried nodes are significantly quieter than surface nodes--especially for the horizontal channels. For this test, we wanted to ask: how deep do nodes need to be buried to achieve significant noise reduction?







We find that even when only half buried (cyan bars, above) node noise levels dropped significantly (factor of 6 for horizontals, factor of 2.5 for vertical) from those for a node placed directly on the surface (blue bars, above).

We also examine node state of health information, specifically temperature and clock drift, to see how these vary for the 4 different nodes we deployed (left).

Unsurprisingly, temperature variations are smallest for the buried node and largest for the surface node. We see similar patterns in the clock drift, with the surface node showing much larger drifts relative to the buried node.

Even though noise levels drop significantly just by half burying nodes, PIs need to consider the thermal stability improvements that come with fully burying the sensor.

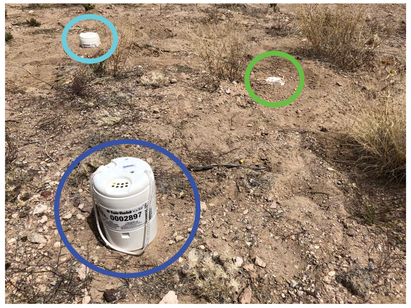
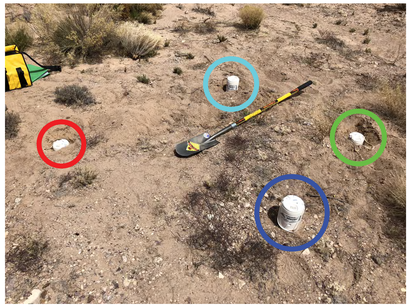


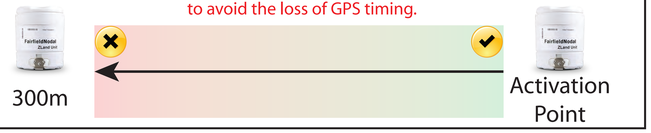
Photo (above) shows the surface node (blue), half buried node (cyan) and node buried to its top (green) following deployment. The photo (below) shows all 4 nodes prior to burial, including the fully buried node (red circle).



How far can an activated node move and still get GPS timing?

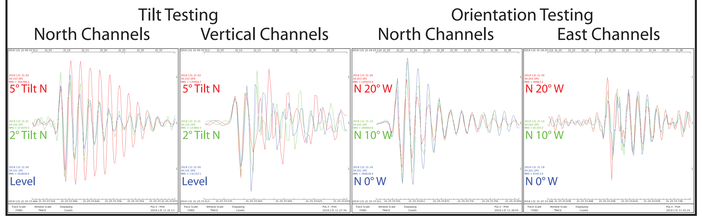
Past node deployments have lost GPS timing after moving nodes following activation. To test this issue we activated several nodes at a single location and then moved them different distances along a straight section of road near the IRIS/PASSCAL Instrument Center. After leaving the nodes deployed for ~1 hour, nodes moved <300m did not lose GPS timing, though this does not guarantee PIs will see similiar results in their deployments. Future node deployments on fast-moving glaciers will need to consider this during experiment planning.

IRIS/PASSCAL strongly recommends that nodes be activated at their deployment location to avoid the loss of GPS timing.



Effects of tilt and orientation on node data quality

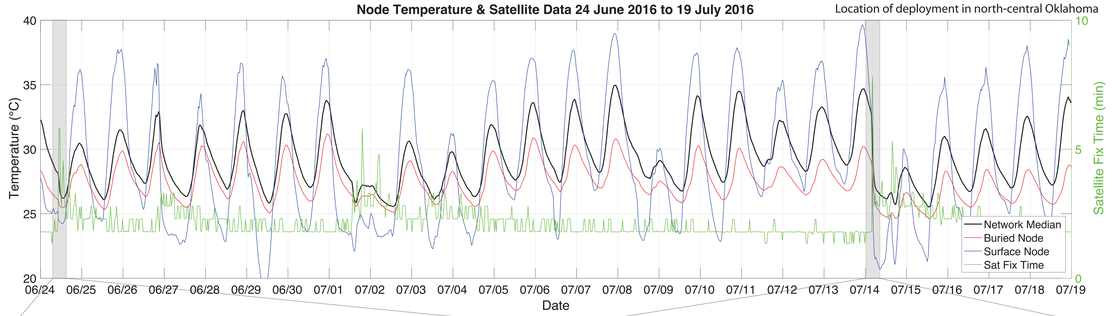
We installed several nodes on a PASSCAL test pier to investigate the effects of tilt and orientation on data quality. A dead-blow hammer strike to the floor of the room was used as a source.



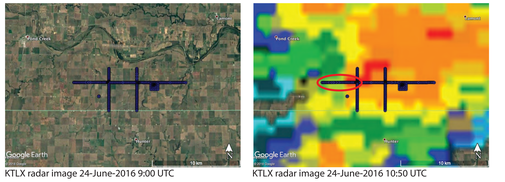
Mining node temperature data from the Oklahoma Wavefields Experiment

We examined state of health (SOH) data recorded every 30 minutes by ~360 nodes deployed during the Wavefields Community Demonstration Experiment in June/July 2016 in north-central Oklahoma (see map, right). The node network median temperature is plotted below (black), along with temperature data for a single buried node (red) and single co-located surface node (blue). Also plotted is the median time required for a GPS satellite fix across the network (green). The satellite fix time is observed to spike during periods of rapid temperature drop which occured when storms moved over the network. Two instances of storms are shown below, along with coincident drops in temperature seen in node network plots (bottom).

Location of deployment in north-central Oklahoma

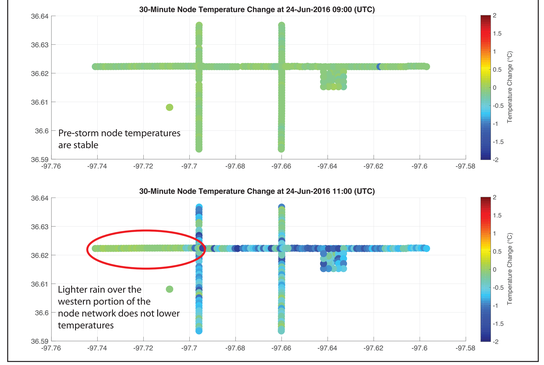


Storm on 24 June 2016

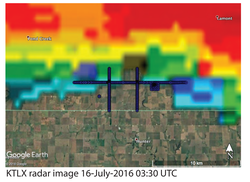


KTLX radar image 24-June-2016 9:00 UTC

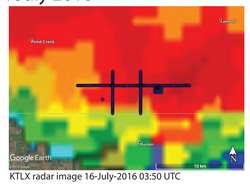
KTLX radar image 24-June-2016 10:50 UTC



Storm on 14 July 2016



KTLX radar image 16-July-2016 03:30 UTC



KTLX radar image 16-July-2016 03:50 UTC