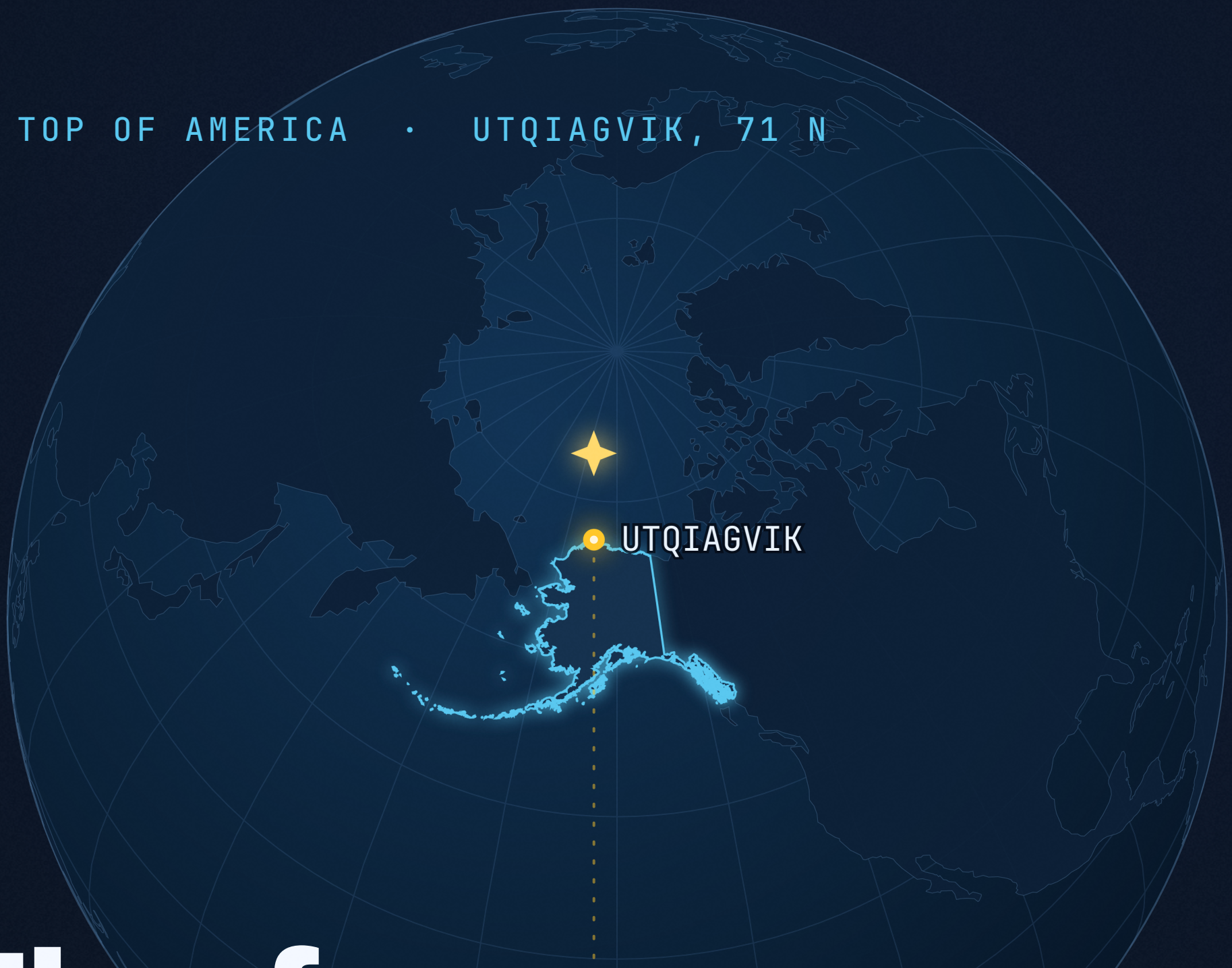
THE TOP OF AMERICA · UTQIAGVIK, 71 N



The frozen ground now forecasts itself

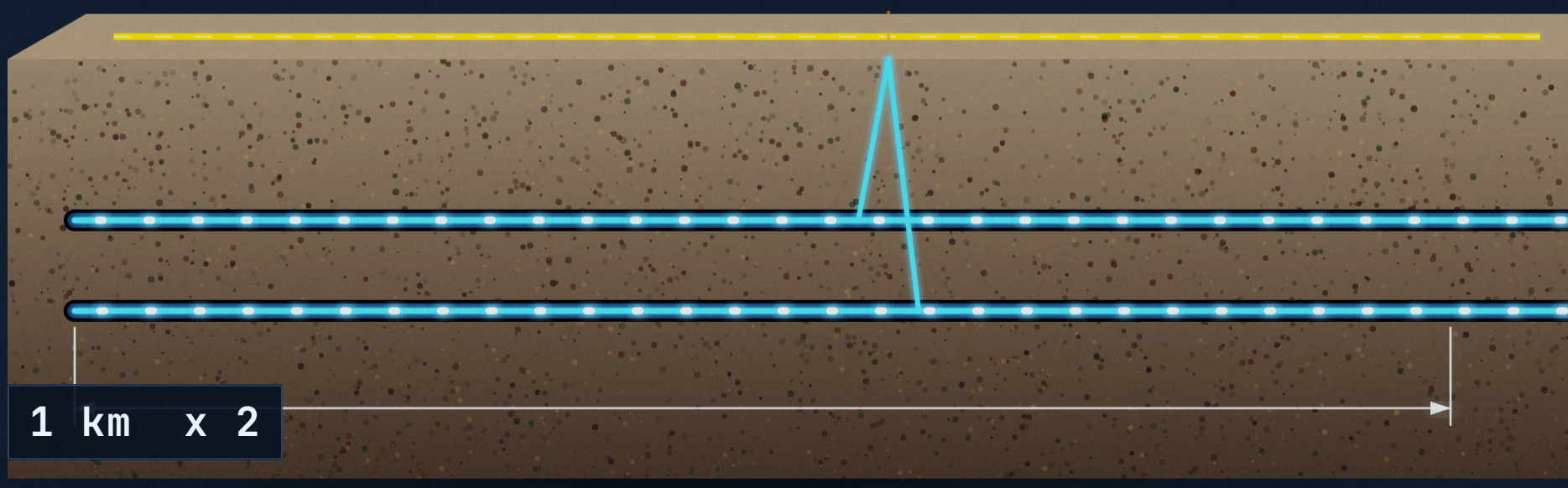
Two buried cables. Three winters of data. One Alaska road.

71 17 N 156 47 W

THE INSTRUMENT

Two cables. One road. A kilometer each.

Under one road embankment in Utqiagvik, the northernmost city in the United States, a Penn State team buried a pair of fiber-optic cables, each 1 km (0.6 mi) long, to feel the ground.



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WHY IT MATTERS

Warming ground breaks what we build on it

Permafrost worldwide is warming, by up to almost 2 F per decade. If the thaw holds, Arctic communities could see billions in damaged roads, pipes, and buildings. The old answer is to guess. The new one is to measure.

- 2 F / decade = global permafrost trend, not this site
- billions = projection, not a measured cost

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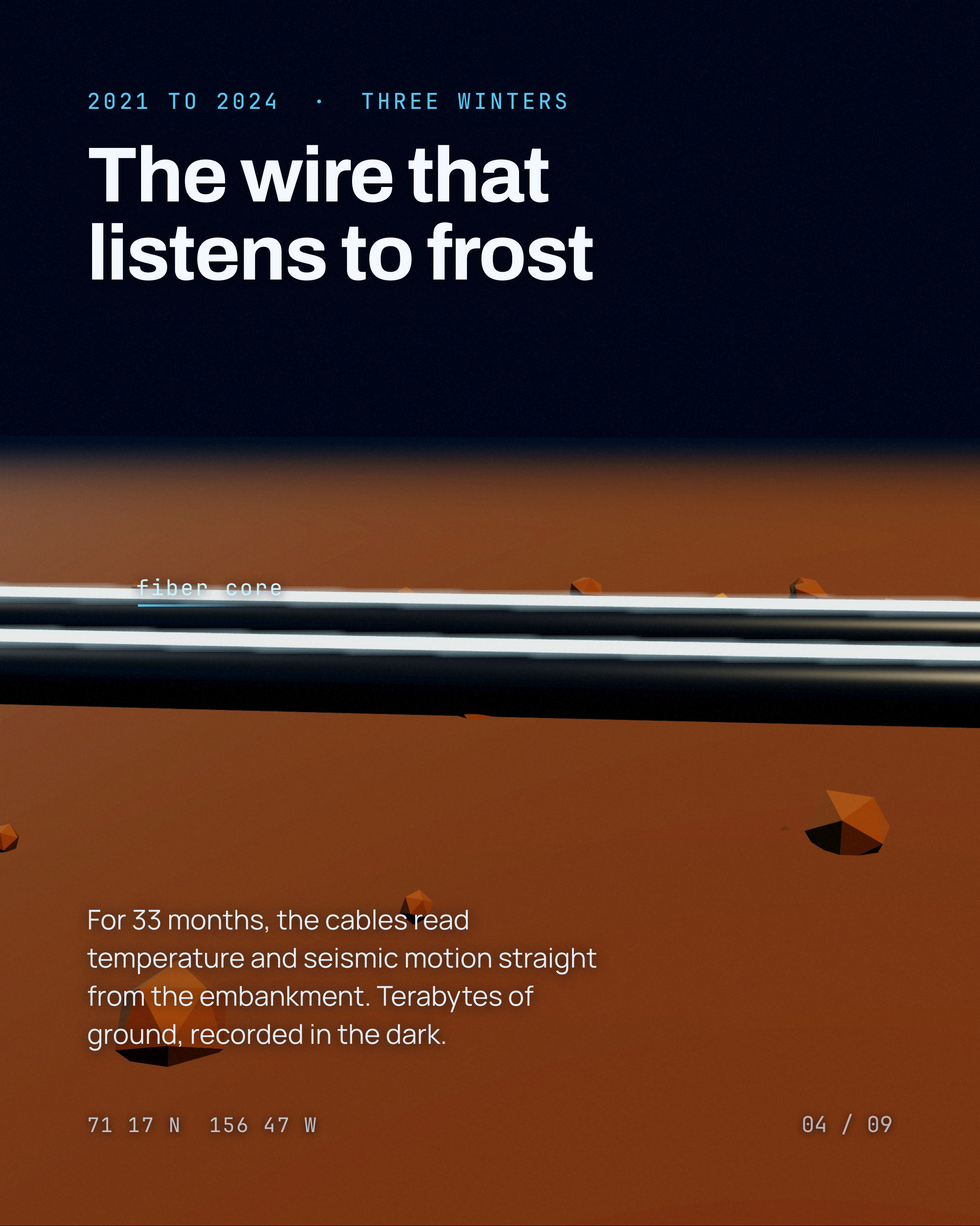
03 / 09

2021 TO 2024 · THREE WINTERS

The wire that listens to frost



For 33 months, the cables read temperature and seismic motion straight from the embankment. Terabytes of ground, recorded in the dark.

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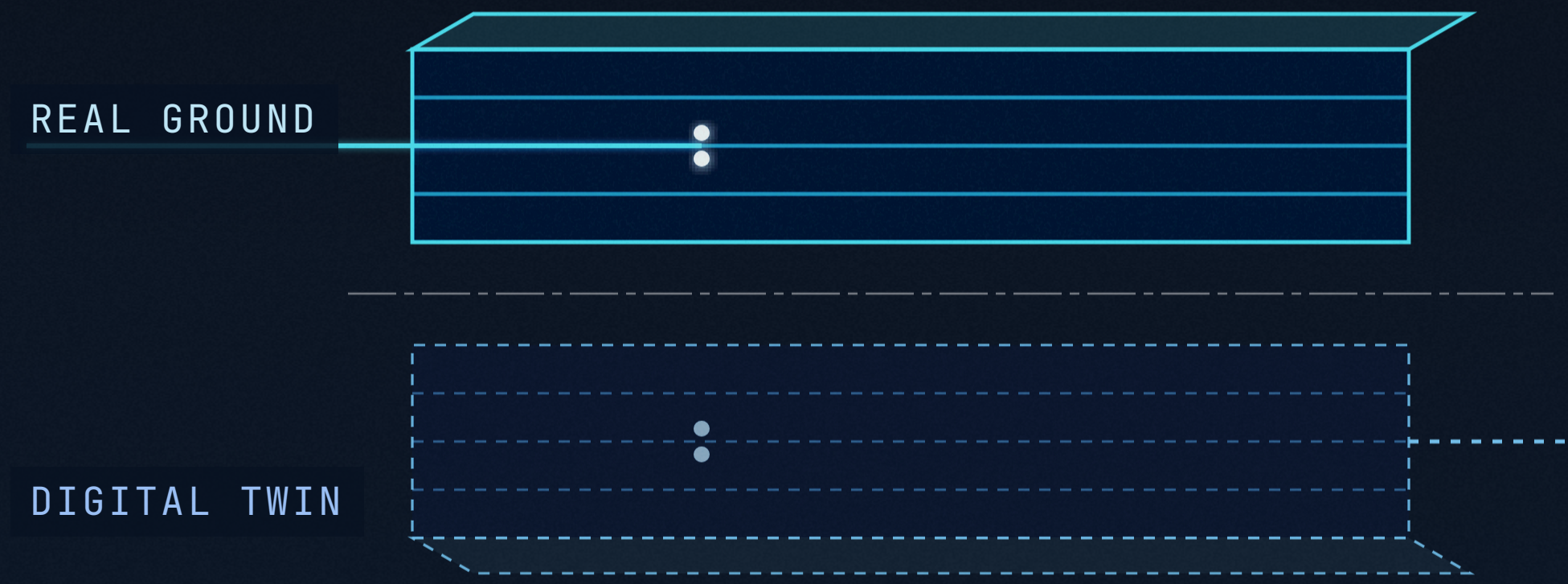
THE METHOD

A live twin, fed by the buried cables



They fused physics equations with machine learning to build a digital twin, a real-time simulation of that embankment, fed by the cables.

`physics-informed ML, not general AI`

THE INSTRUMENT, BY THE NUMBERS

DIGITAL TWIN / UTQIAGVIK EMBANKMENT

2 CABLES

1 km EACH (0.6 MI)

INPUT

2 x 1 km fiber-optic cable, thermal and seismic, Sept 2021 to June 2024

METHOD

physics equations + machine learning (physics-informed ML, not generative AI)

OUTPUT

unfrozen water content, ground temperature, heat flow, in real time

SCOPE

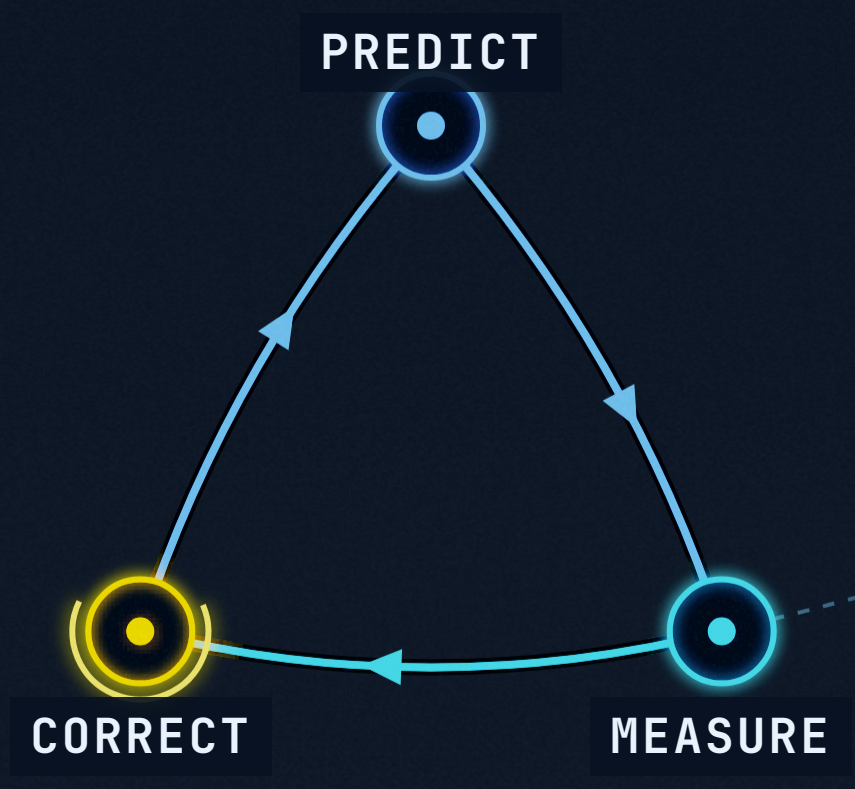
1 embankment, Utqiagvik

forecast, one embankment (per Penn State)

THE POINT

Not a smarter guess. A guess the ground corrects.

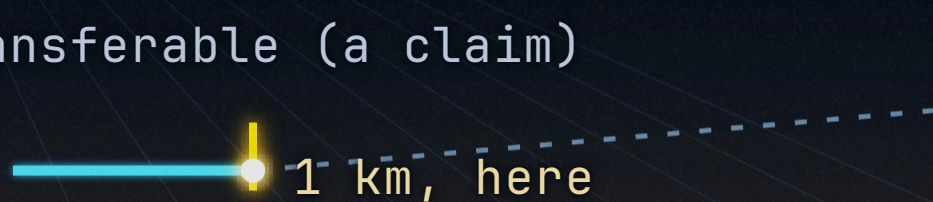
Each forecast meets the next real reading, and the gap teaches the model. The value is not certainty. It is a prediction the frozen ground itself keeps grading, season after season.



THE HONEST LIMIT

One kilometer, lit. The rest is dark ground.

This models one embankment, not the North Slope. The team says the method is broadly transferable, which is a claim, not a deployment.



SOURCED

Phys.org / Penn State
2026-06-16

NOT CHECKED

JGR paper, paywalled
not independently verified

THE QUESTION

Fund a decade more of ground truth?

The lead researcher wants about 10 more years of data, an aspiration, not a funded plan. So the real question for Alaska, keep the wire in the ground, or harden the roads we already know are failing?

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