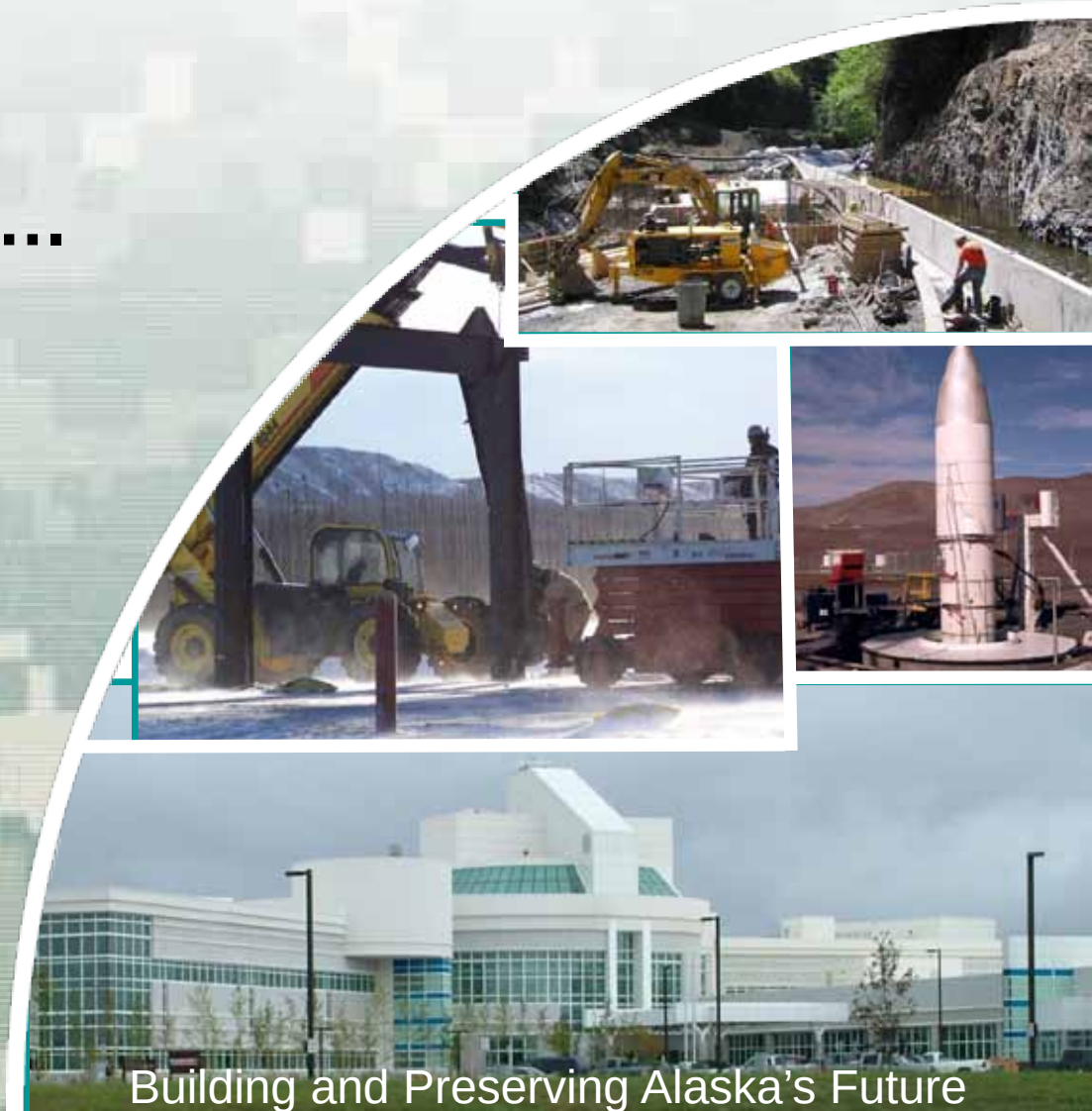
U.S. ARMY CORPS OF ENGINEERS, ALASKA DISTRICT

CLIMATE CHANGE RELATED STUDIES….

Mary Azelton

Hydraulic Engineer

Hydraulics Hydrology Section



US Army Corps of Engineers
BUILDING STRONG®

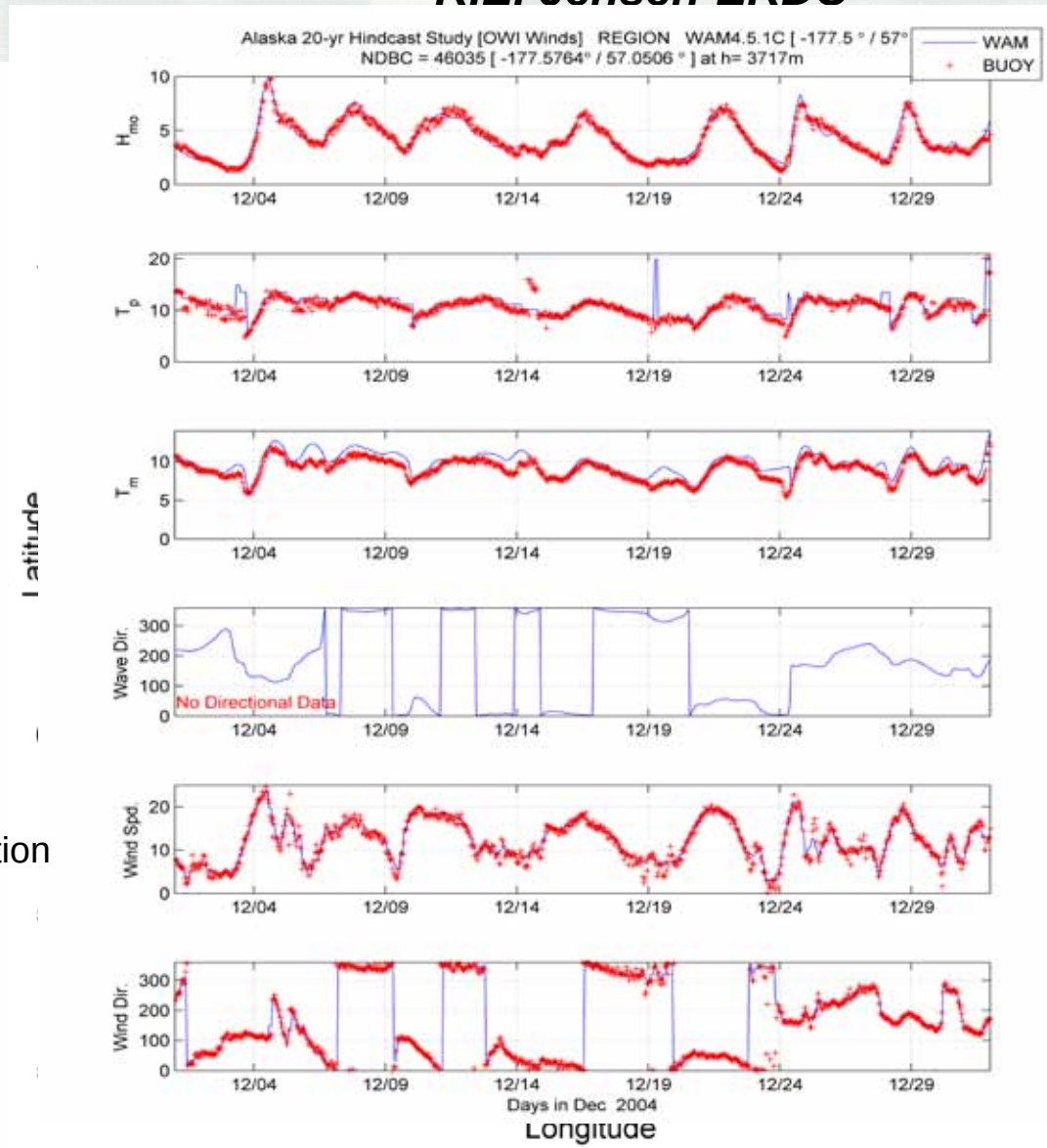
Building and Preserving Alaska's Future

Alaska Hindcast Studies

R.E. Jensen-ERDC

Uniqueness

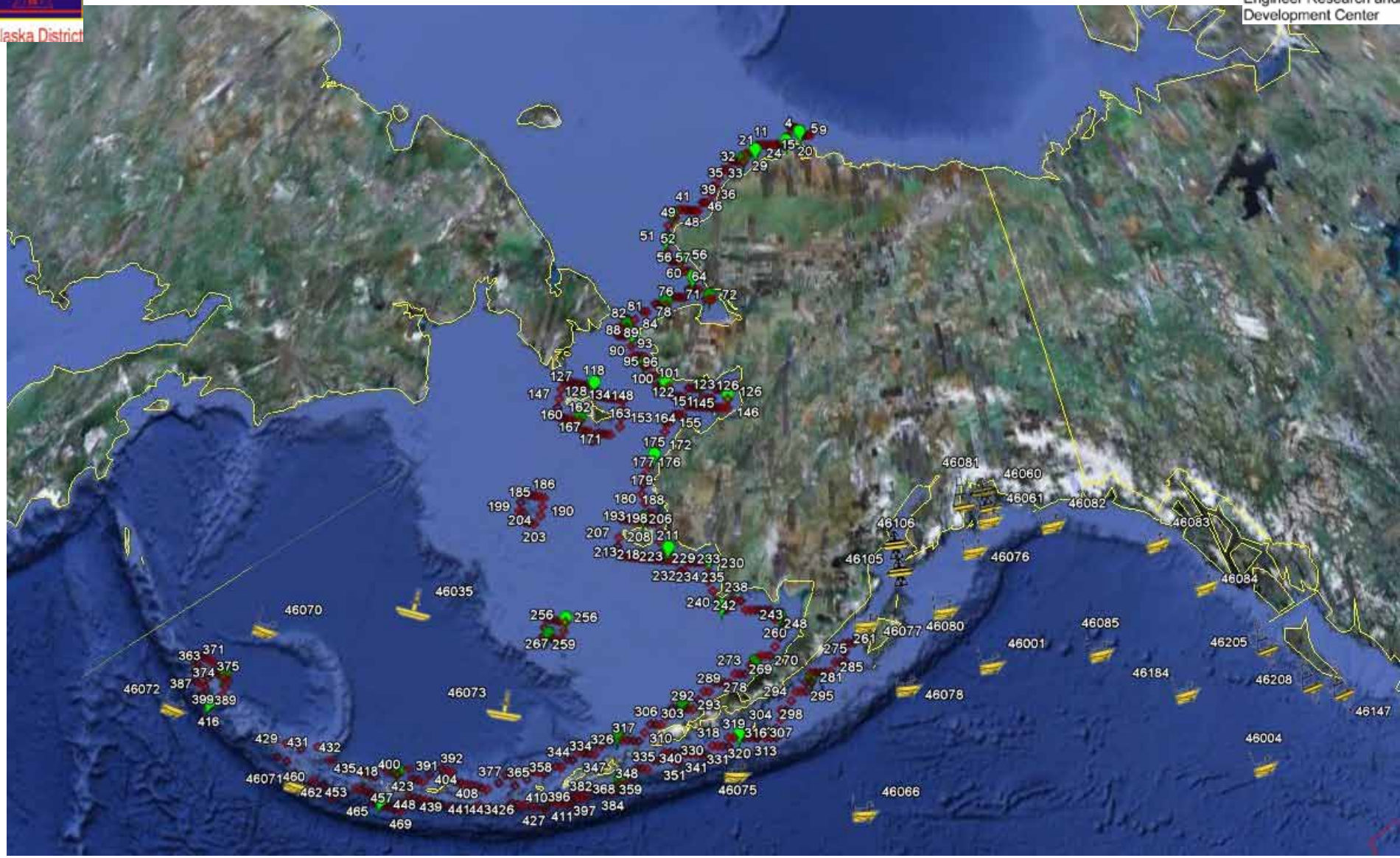
- Winds:
  - Orographic-Terrain Steering
  - Low Pressure *Bombs*
- Ice Coverage:
- Wave Systems
  - North Pacific Storms (synoptic)
  - Decaying Typhoons (meso-)
  - Aleutian Island blocking (sub-meso)
  - Wind-sea generation (meso-)
  - Shelf and island steering (micro-)
- Diverse Wave Climate
  - 1,538 Miles of Shoreline
  - Tidal Variations ~ 3m
  - Climate Change / Global Warming
    - Decrease of Ice Coverage
    - Increase in Storminess / Duration
- Limited Buoy Data / Validation
  - One: Long-term
  - Increasing in 2000's

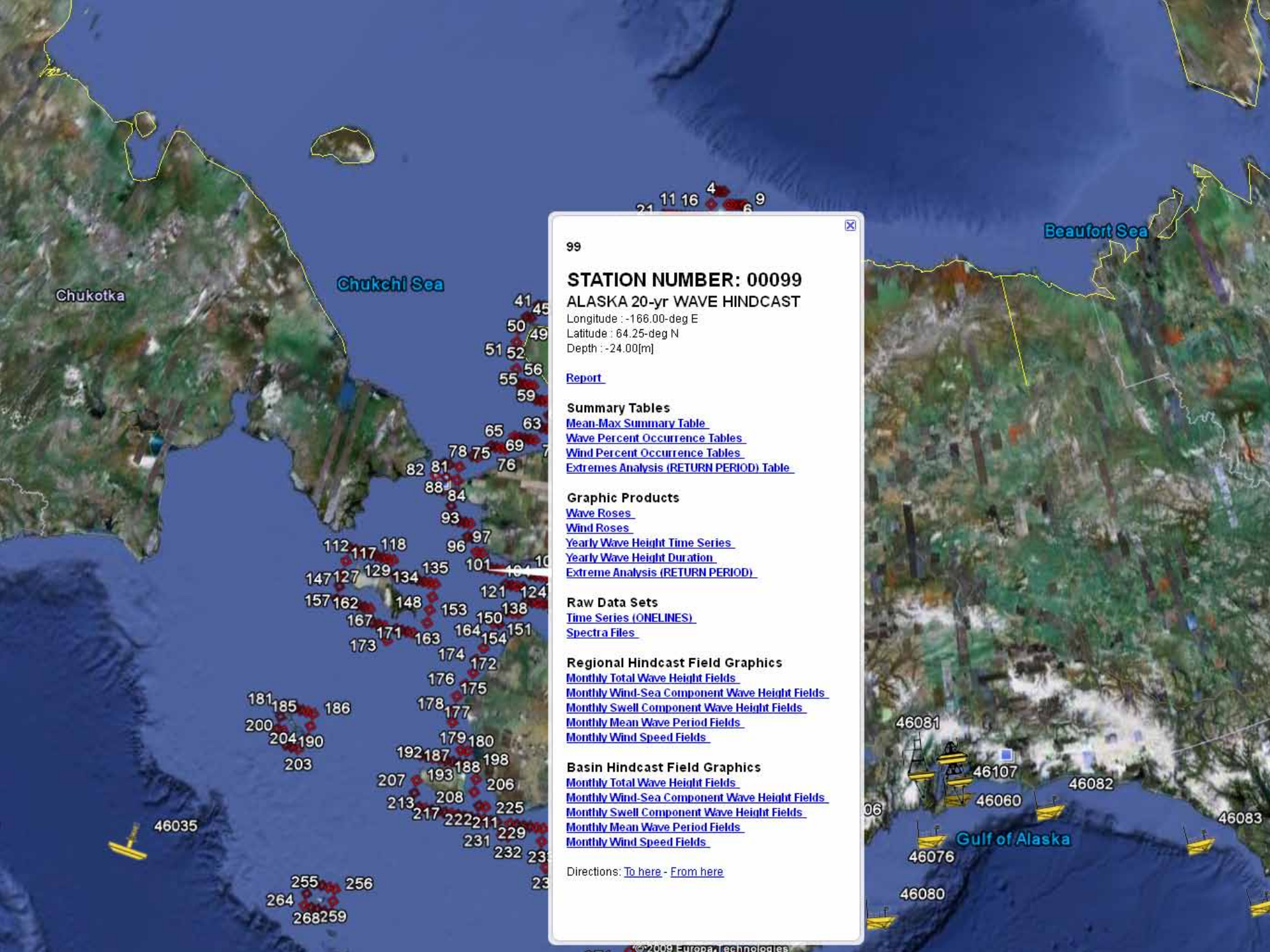


Special Output Locations and 36 Documented in Report

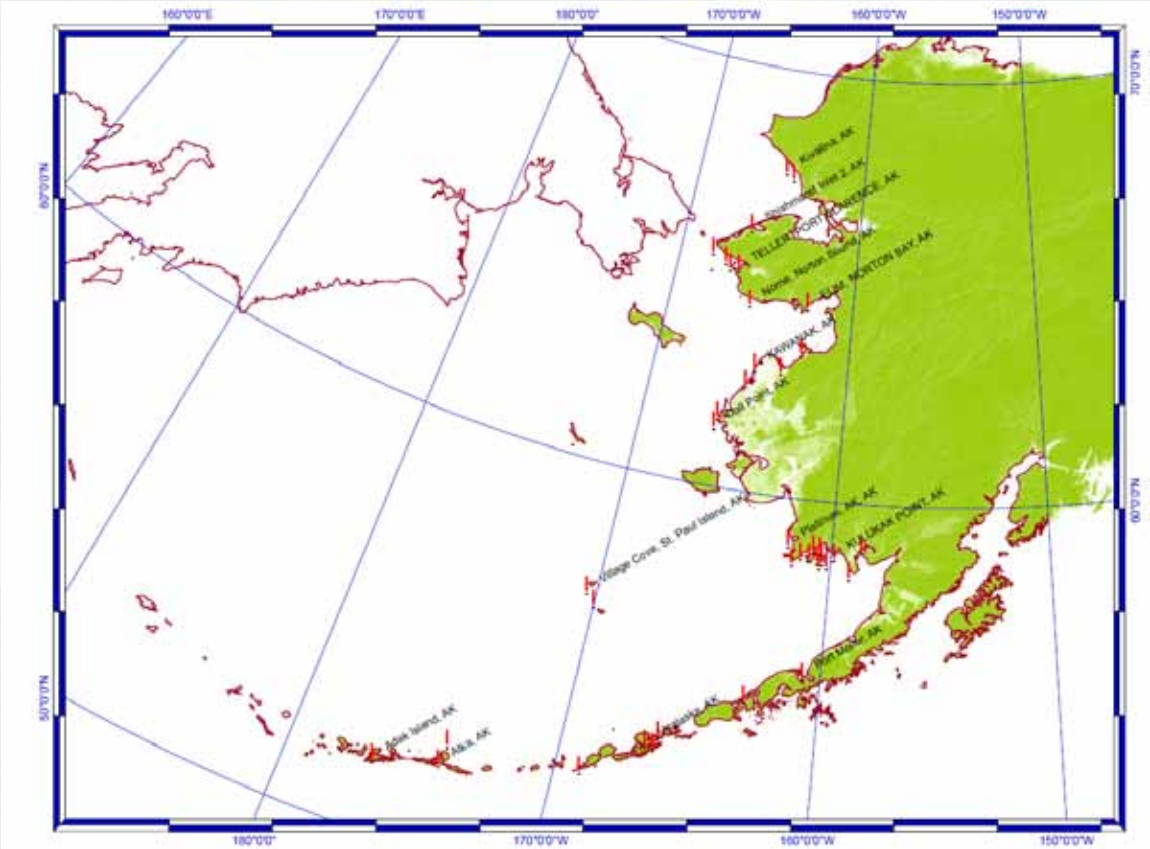
Alaska District

US Army Corps of Engineers®
Engineer Research and Development Center




Chukotka
Chukchi Sea
Beaufort Sea
Gulf of Alaska
46035
46081
46107
46082
46060
46083
46076
46080
99
STATION NUMBER: 00099
ALASKA 20-yr WAVE HINDCAST
Longitude : -166.00-deg E
Latitude : 64.25-deg N
Depth : -24.00[m]
Report
Summary Tables
Mean-Max Summary Table
Wave Percent Occurrence Tables
Wind Percent Occurrence Tables
Extremes Analysis (RETURN PERIOD) Table
Graphic Products
Wave Roses
Wind Roses
Yearly Wave Height Time Series
Yearly Wave Height Duration
Extreme Analysis (RETURN PERIOD)
Raw Data Sets
Time Series (ONELINES)
Spectra Files
Regional Hindcast Field Graphics
Monthly Total Wave Height Fields
Monthly Wind-Sea Component Wave Height Fields
Monthly Swell Component Wave Height Fields
Monthly Mean Wave Period Fields
Monthly Wind Speed Fields
Basin Hindcast Field Graphics
Monthly Total Wave Height Fields
Monthly Wind-Sea Component Wave Height Fields
Monthly Swell Component Wave Height Fields
Monthly Mean Wave Period Fields
Monthly Wind Speed Fields
Directions: To here - From here

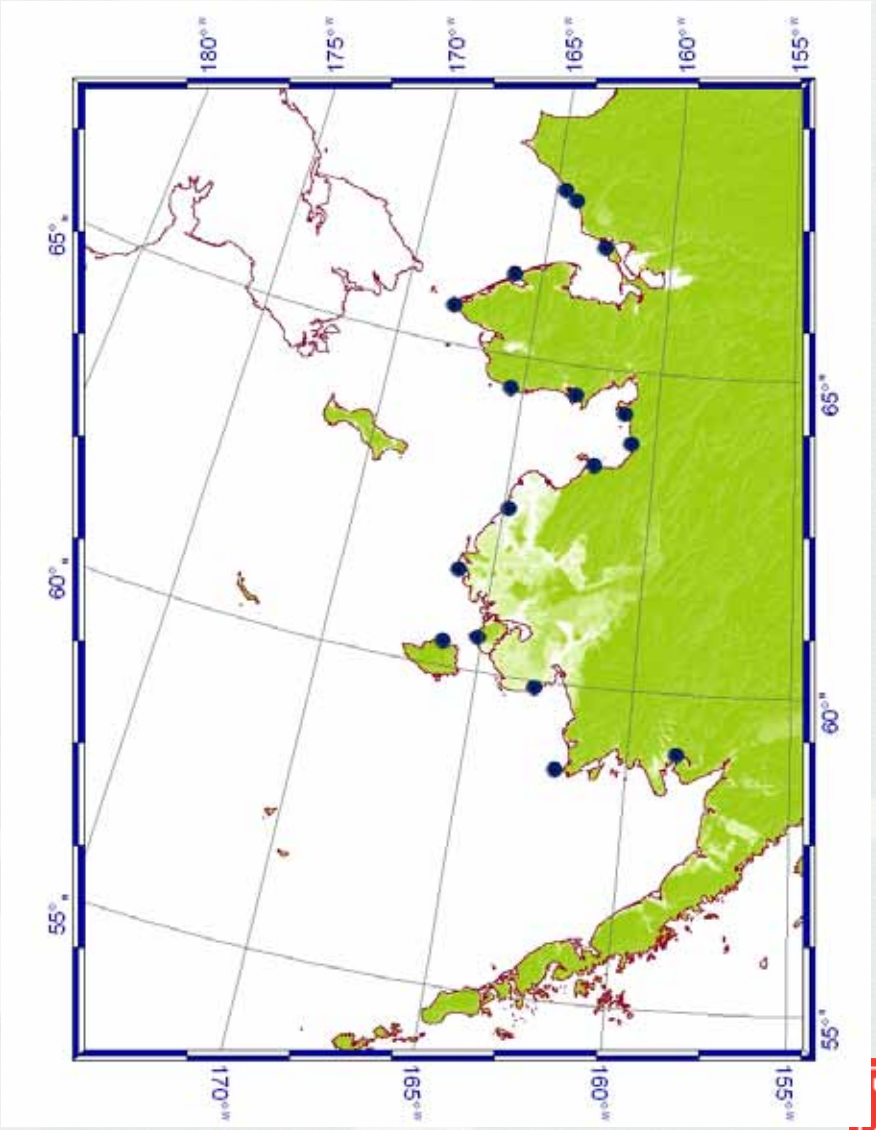
Water Level Prediction Study for the Western Coast of Alaska



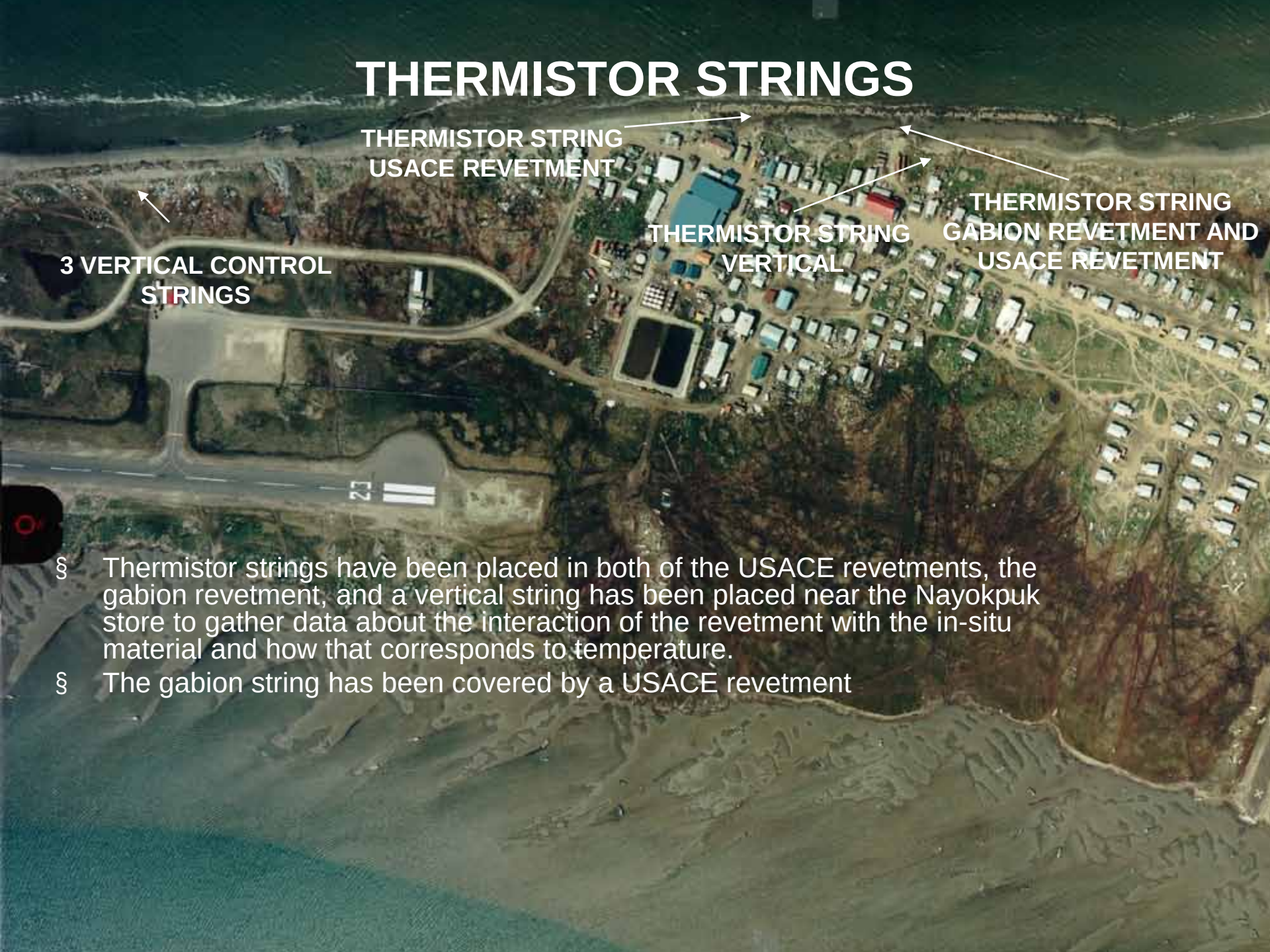
NOAA Tide Gage Locations

Water Level Prediction Study for the Western Coast of Alaska

- Kivalina
- Red Dog
- Kotzebue
- Shishmaref
- Wales
- Nome
- Golovin
- Shaktoolik
- Unalakleet
- Saint Michael
- Agcklarok
- Hooper Bay
- Toksook Bay
- Mekoryuk
- Kongiganak
- Cape Newenham
- Dillingham



THERMISTOR STRINGS



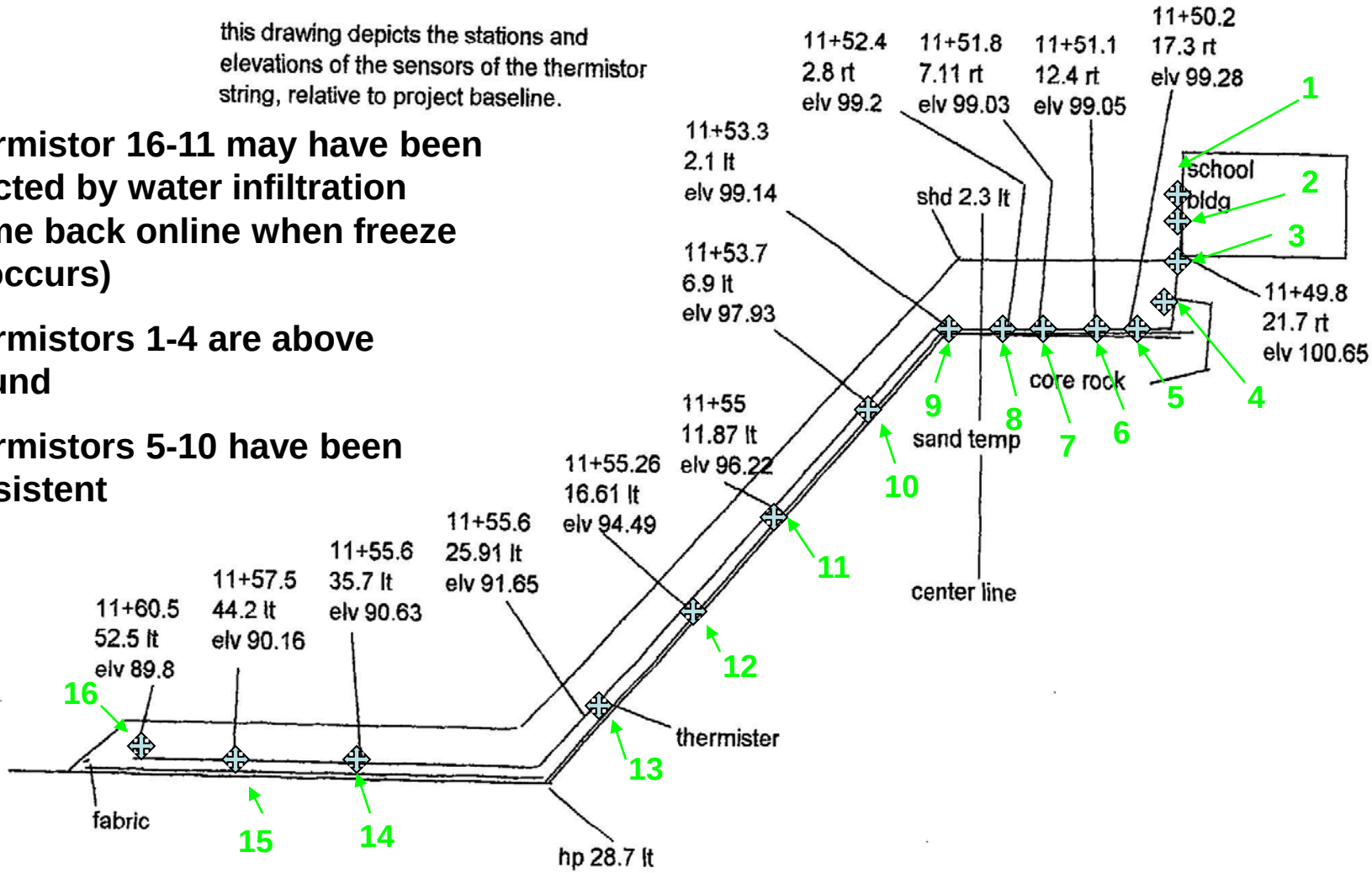
- Thermistor strings have been placed in both of the USACE revetments, the gabion revetment, and a vertical string has been placed near the Nayokpuk store to gather data about the interaction of the revetment with the in-situ material and how that corresponds to temperature.
- The gabion string has been covered by a USACE revetment

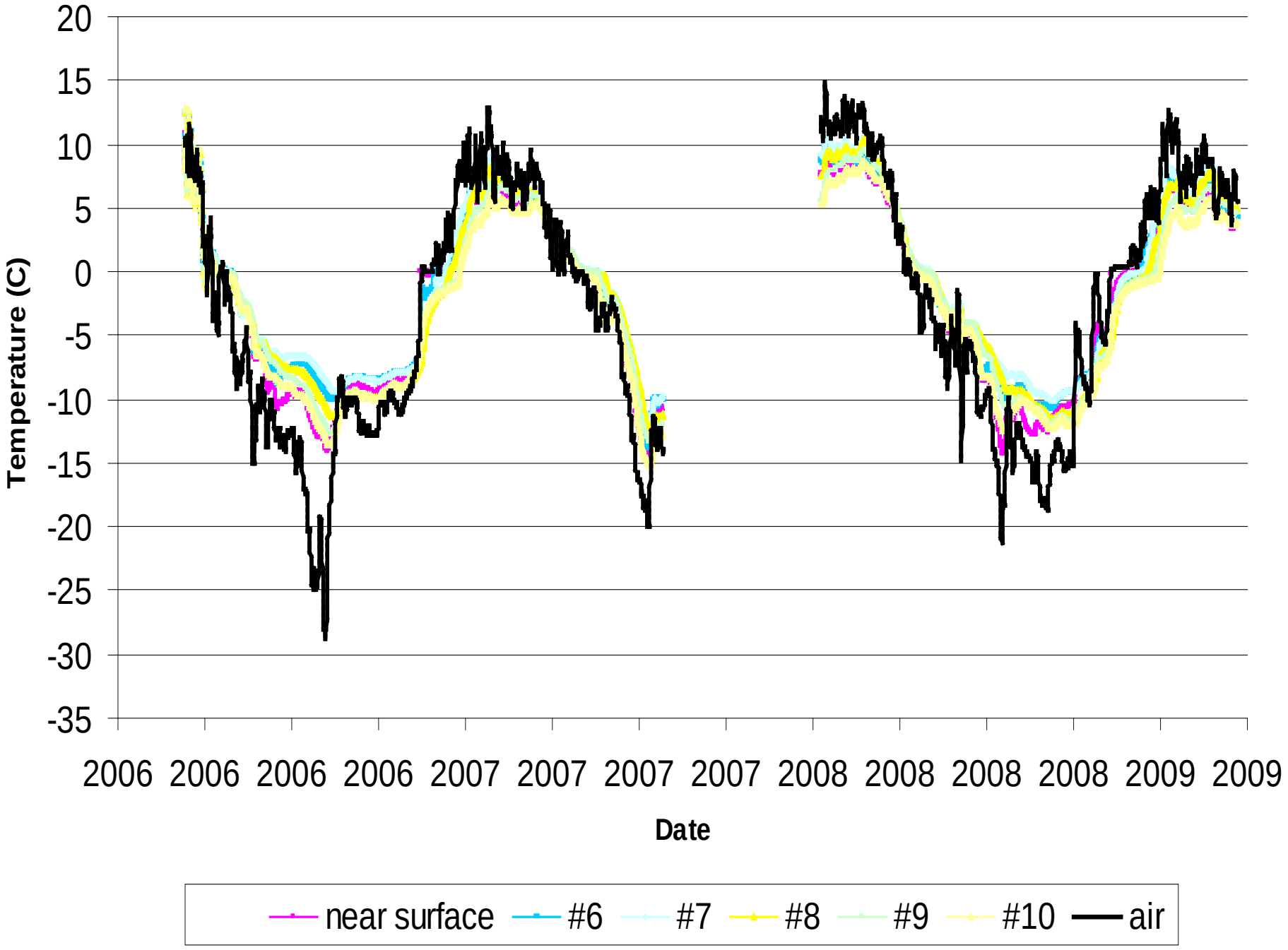
Rock Revetment Thermistor Locations

Thermistor 16-11 may have been effected by water infiltration (come back online when freeze up occurs)

Thermistors 1-4 are above ground

Thermistors 5-10 have been consistent

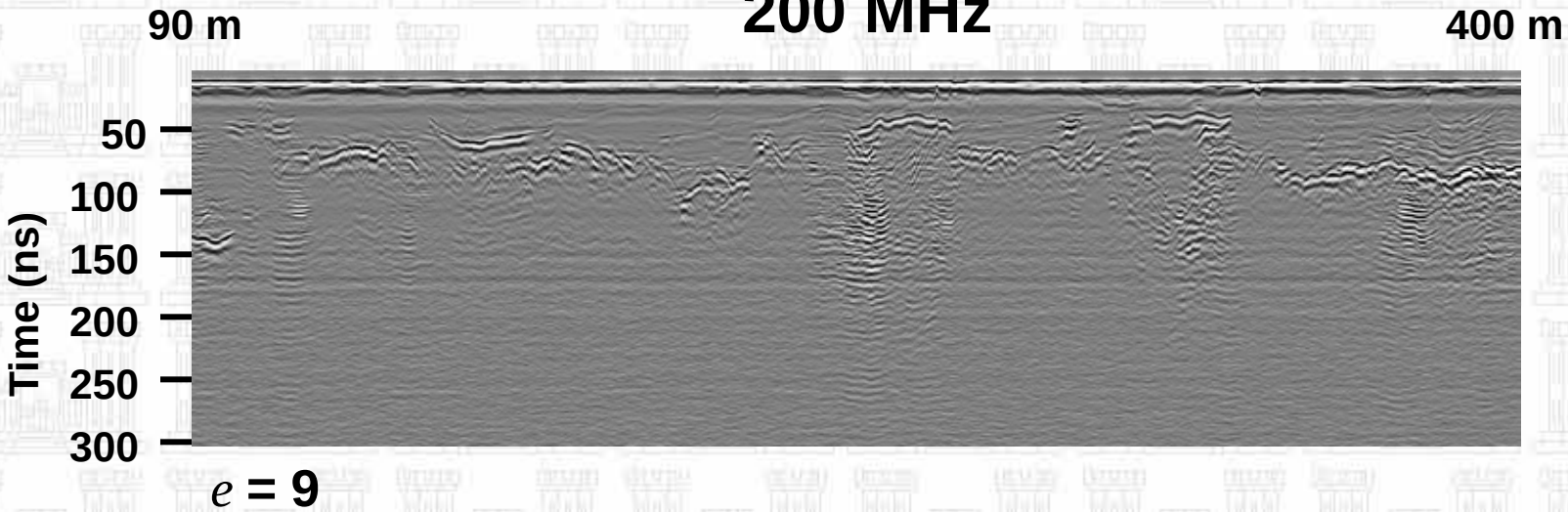



20
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
Temperature (C)
2006
2006
2006
2006
2007
2007
2007
2007
2008
2008
2008
2008
2009
2009
Date
near surface
#6
#7
#8
#9
#10
air

GPR – Shishmaref

GPR

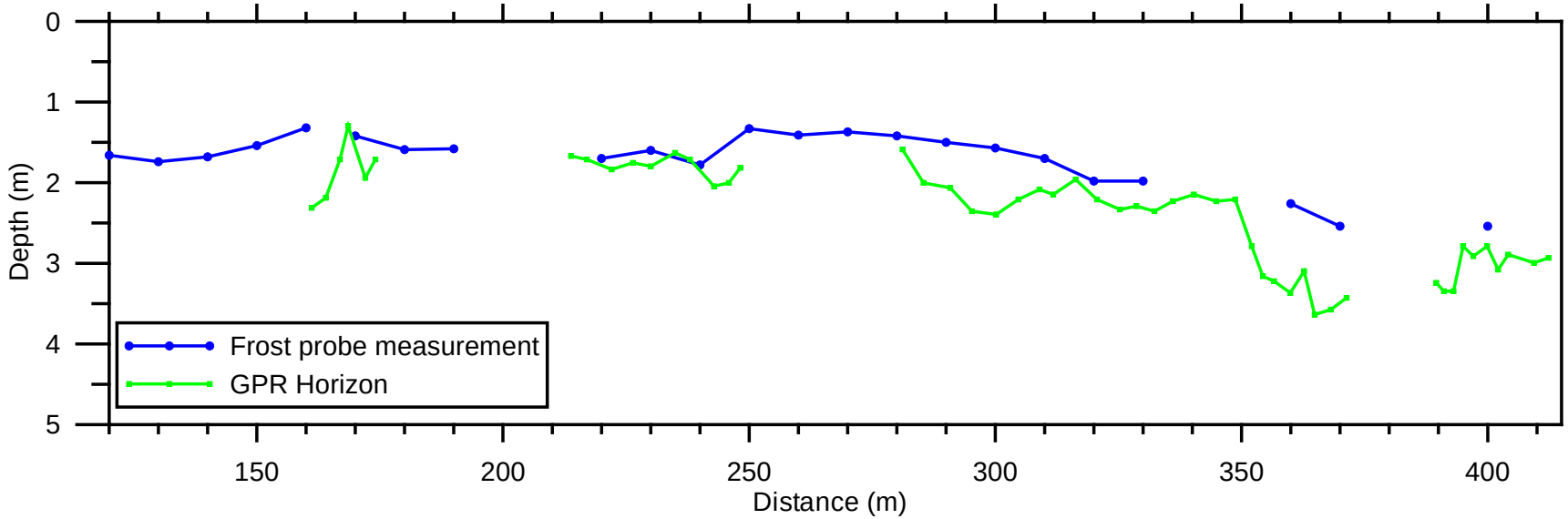
Profile 2 (Line D)
200 MHz



- Note bright reflection between 50 and 150 ns
- Profile 1 returns were highly attenuated and provided little data other than some evidence of thawing near the lagoon

GPR

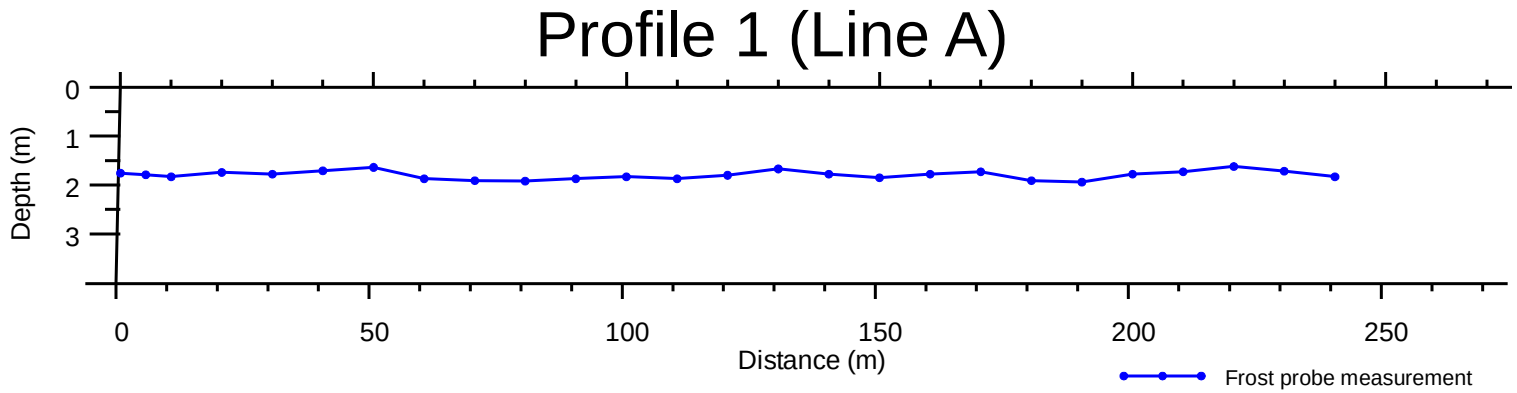
GPR Profile 2 (Line D) Interpretation

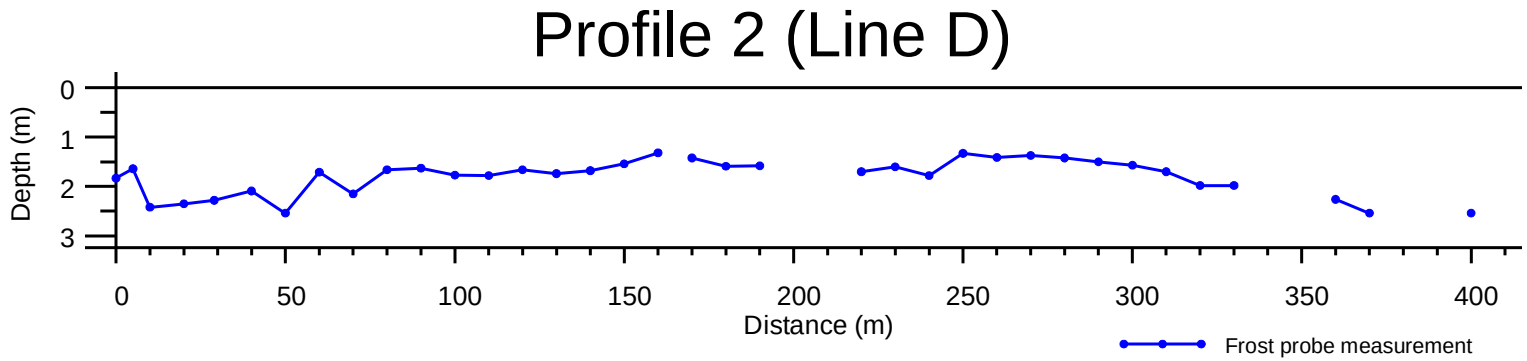


- Bright reflection (previous slide) assumed to correlate with the bottom of the active layer
- Dielectric permittivity of the material assumed to be 9 from the surface to the reflection, 4.5 below.

FROST PROBING – SEPTEMBER 2008

- Top of permafrost found to be between 1.5 and 3 meters below the surface in most places.





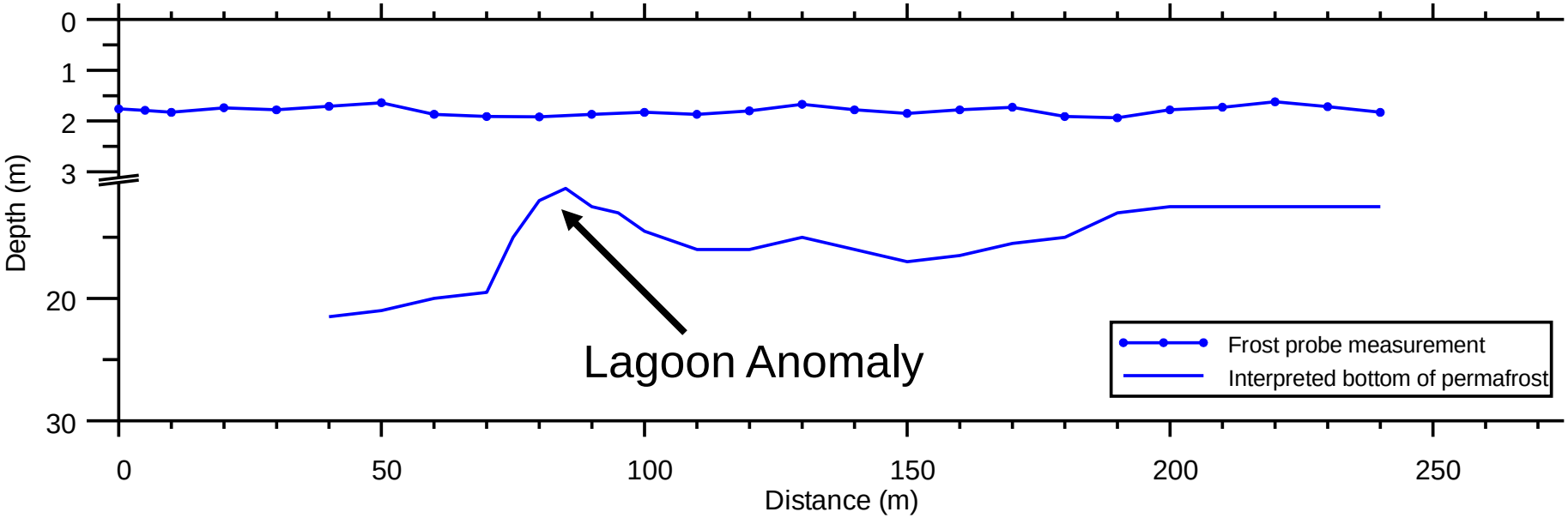
RESISTIVITY

Profiles

RESISTIVITY

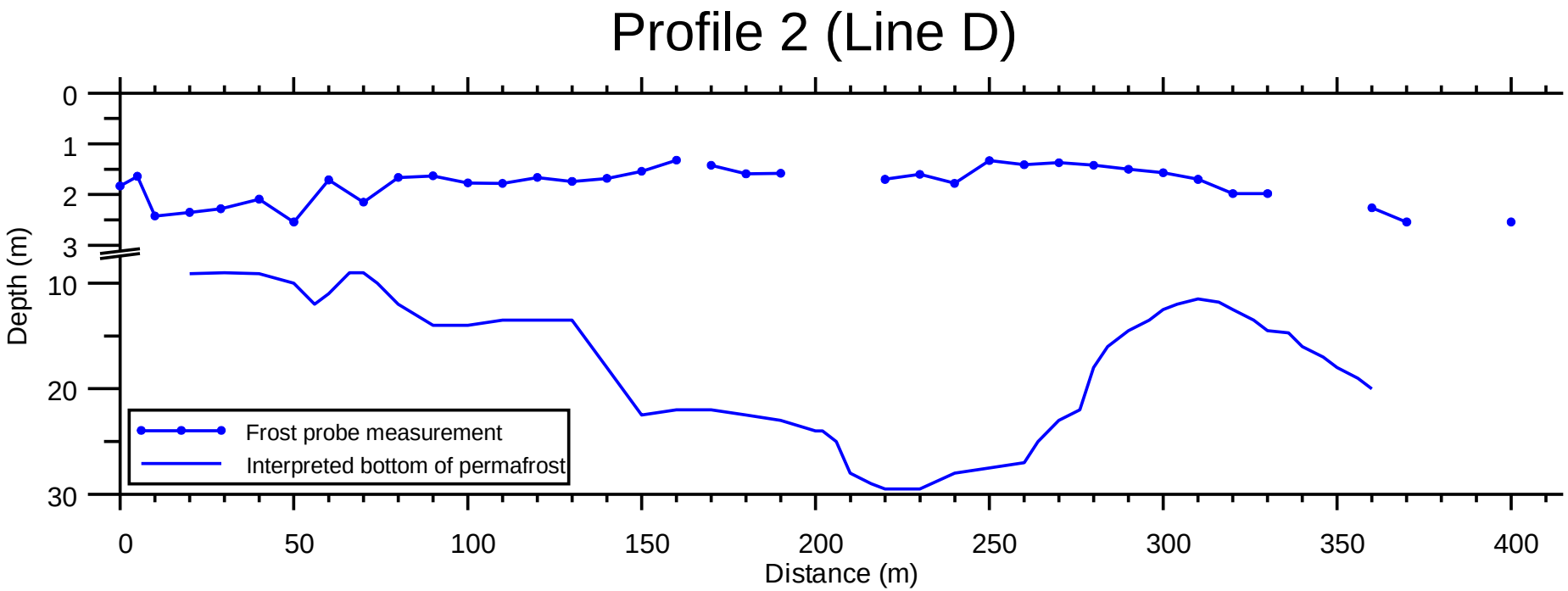
- Bottom of permafrost interpreted to be 15 to 20 meters below the surface.

Profile 1 (Line A)



RESISTIVITY

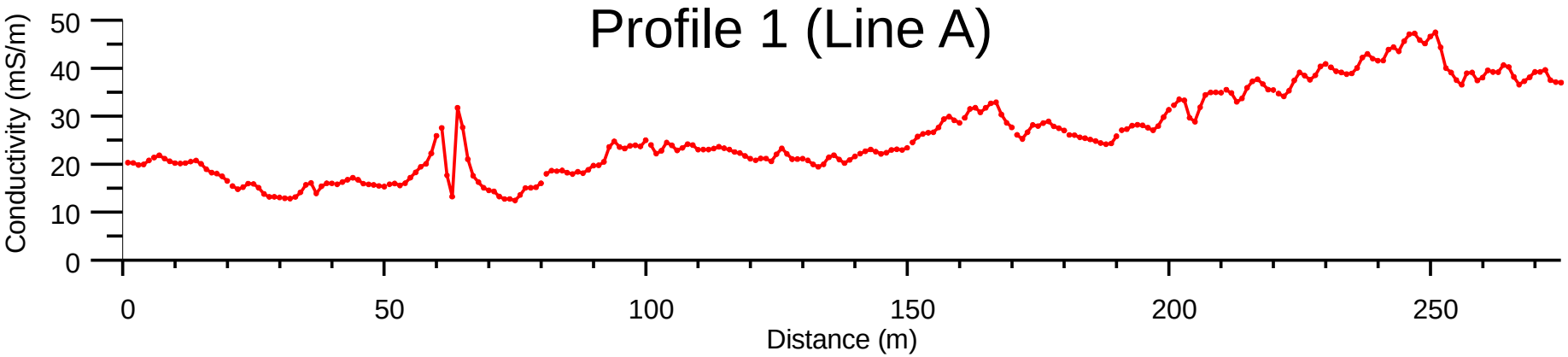
- Bottom of permafrost interpreted to be 9 to 30 meters below the surface

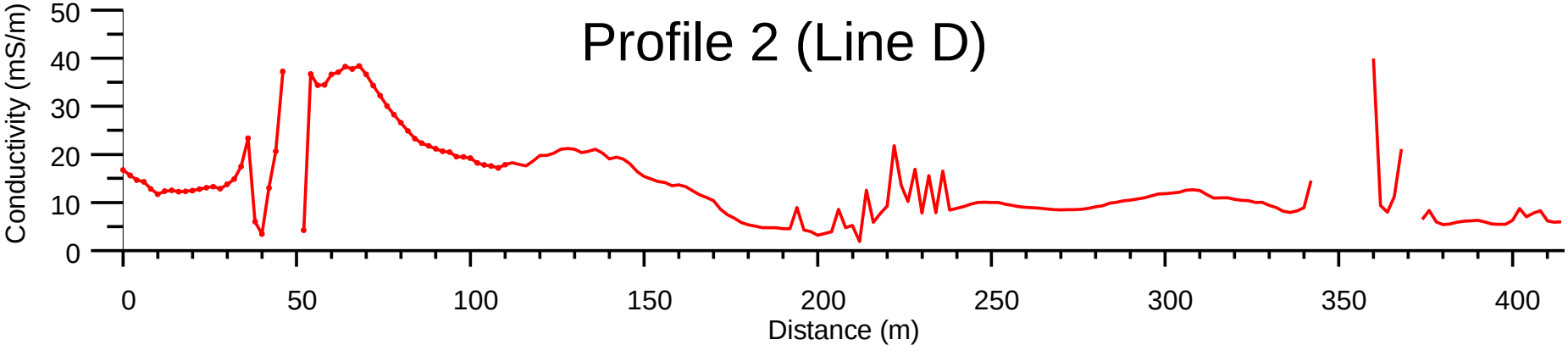


CONDUCTIVITY

Conductivity varied significantly with surface materials

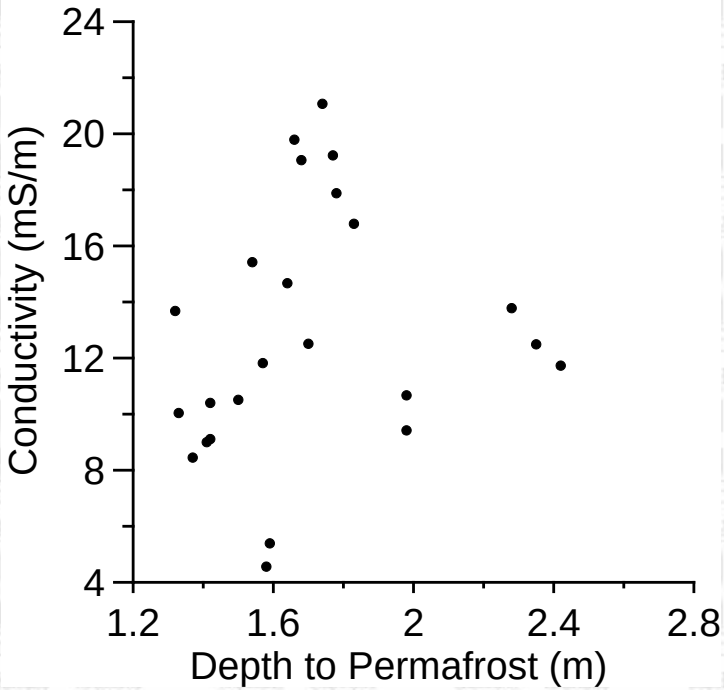
Spiky sections of Profile 2 may indicate metallic debris





CONDUCTIVITY

- Correlation of conductivity versus depth to permafrost found by frost probing along Profile 2. Note there is no defined relationship, possibly due to differences in salinity along the profile.



QUESTIONS??

SHISHMAREF, ALASKA
FEBRUARY 17, 2006