

Merging Field Measurements and High Resolution Modeling to Predict Possible Societal Impacts of Permafrost Degradation

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Societal Impacts of Permafrost Degradation



Impact on Infrastructure



Changes in the ground surface

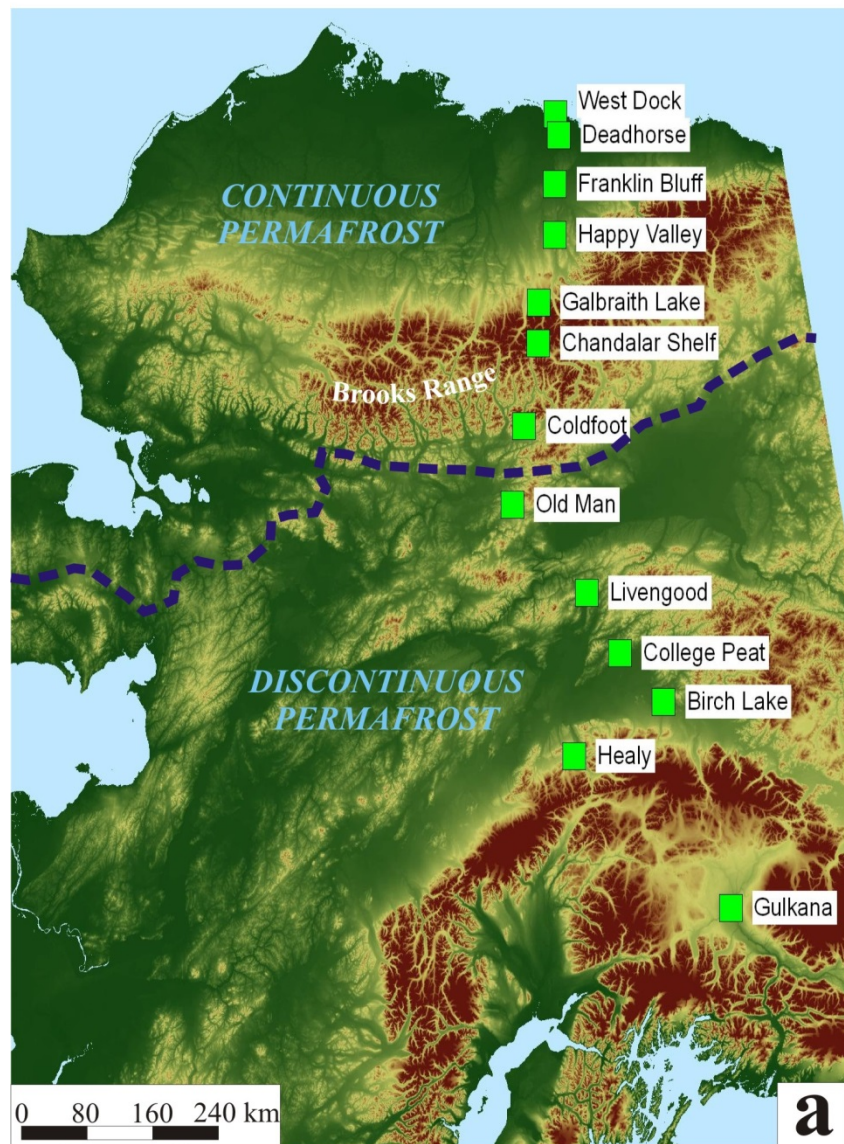




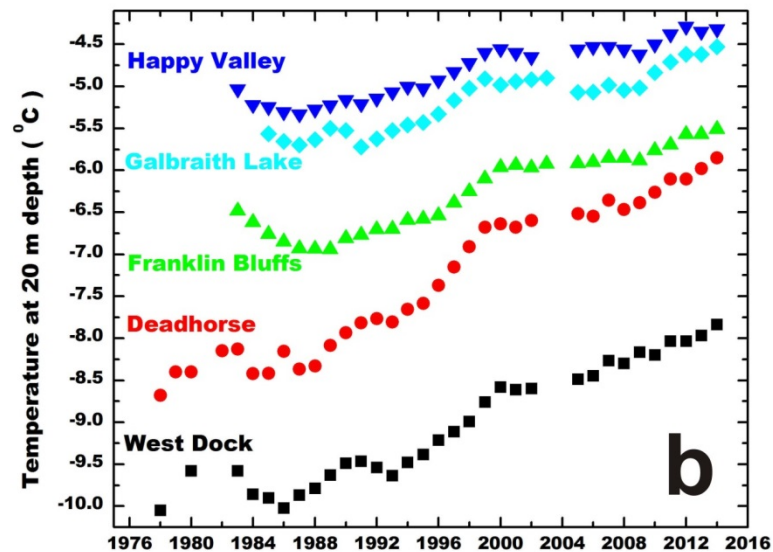
Photo provided by the Fairbanks DOT office



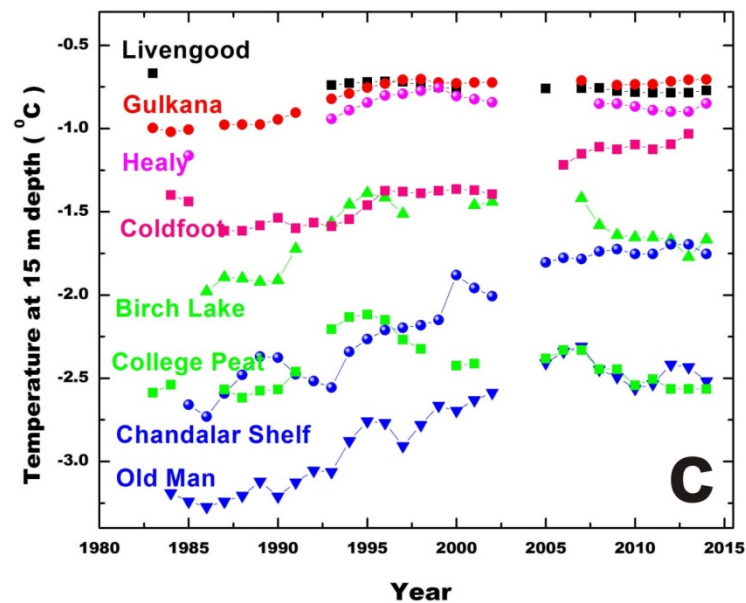
Photo provided by the Fairbanks DOT office



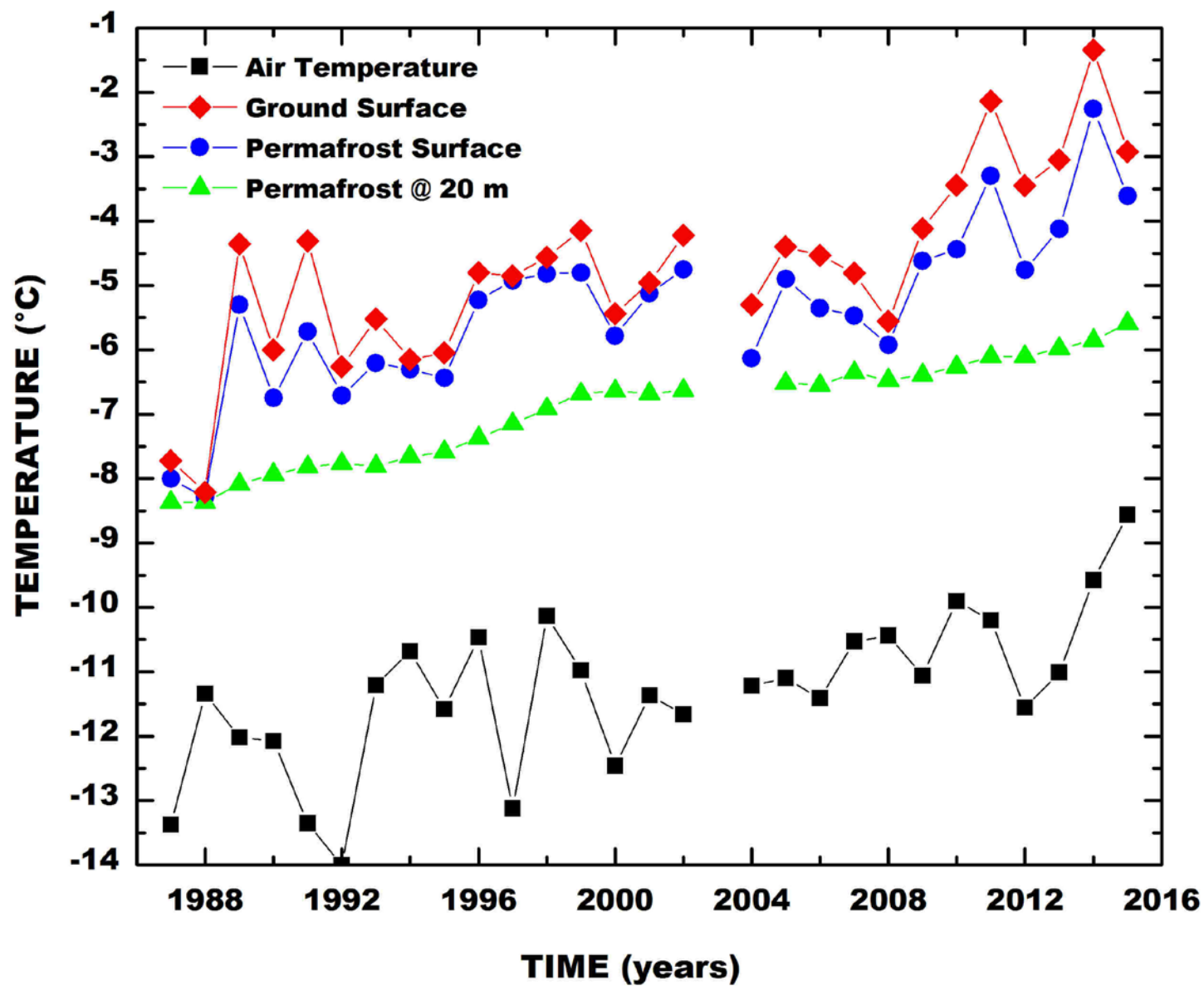
Northern Alaska



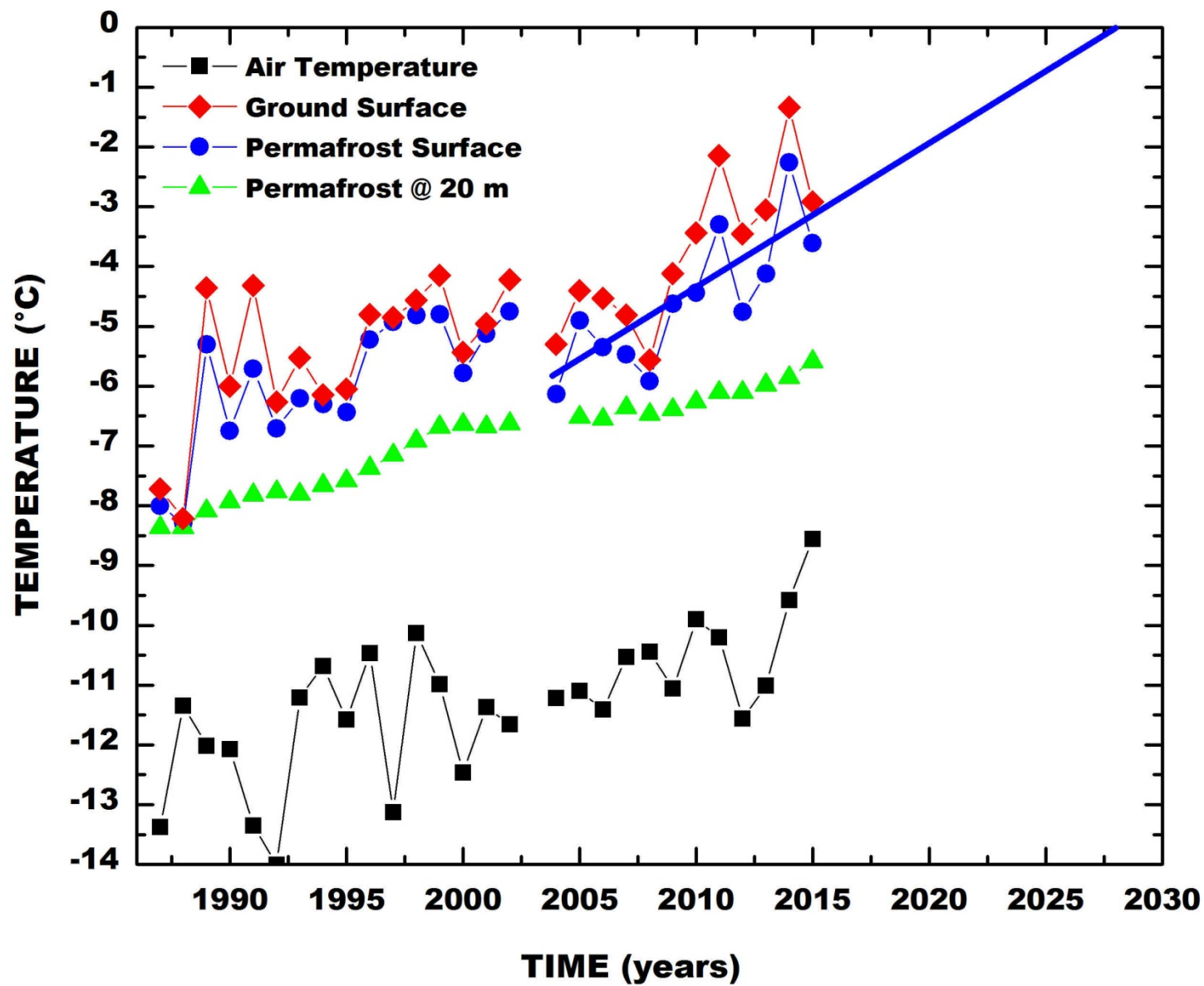
Interior Alaska



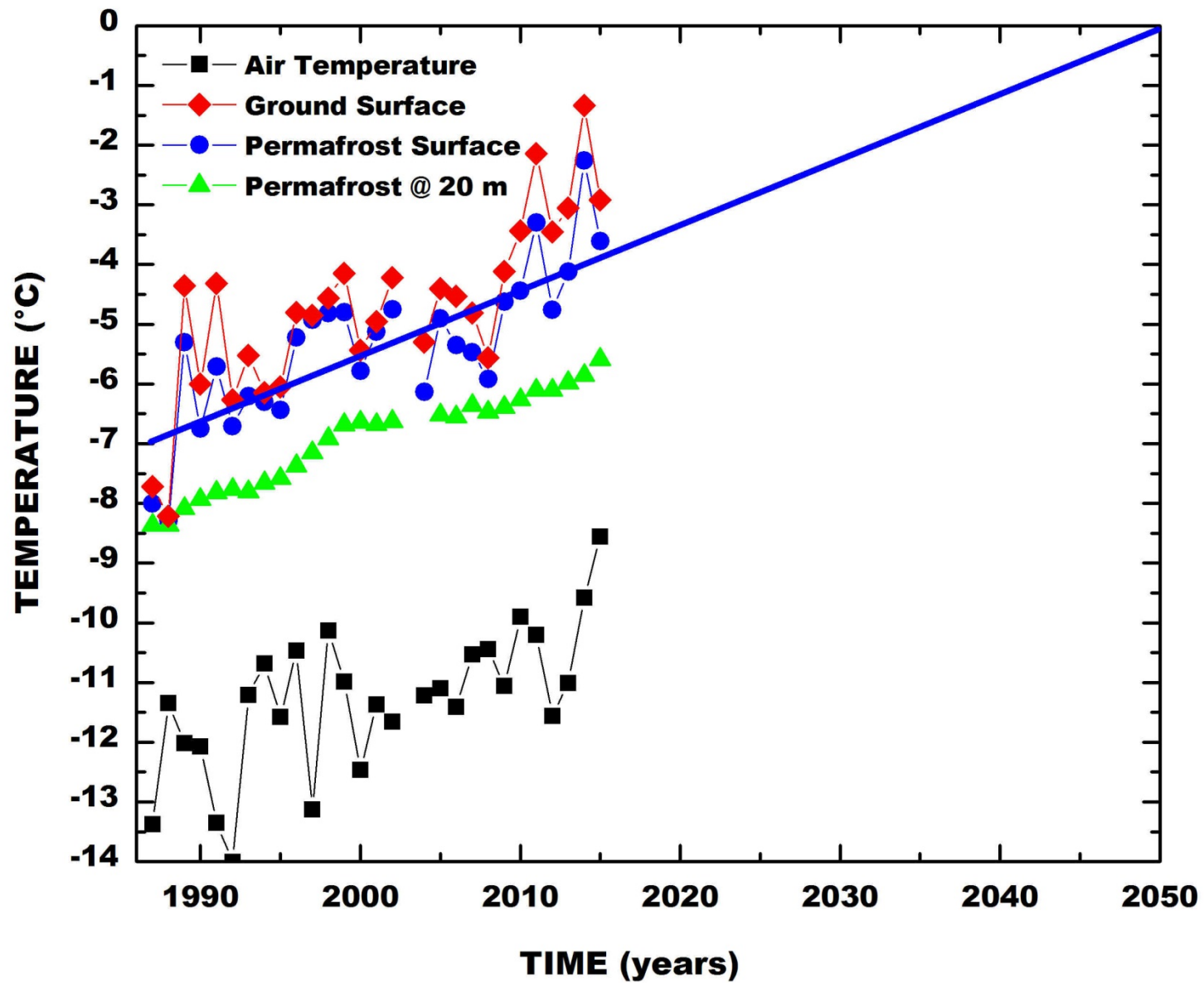
DEADHORSE, 1987-2015



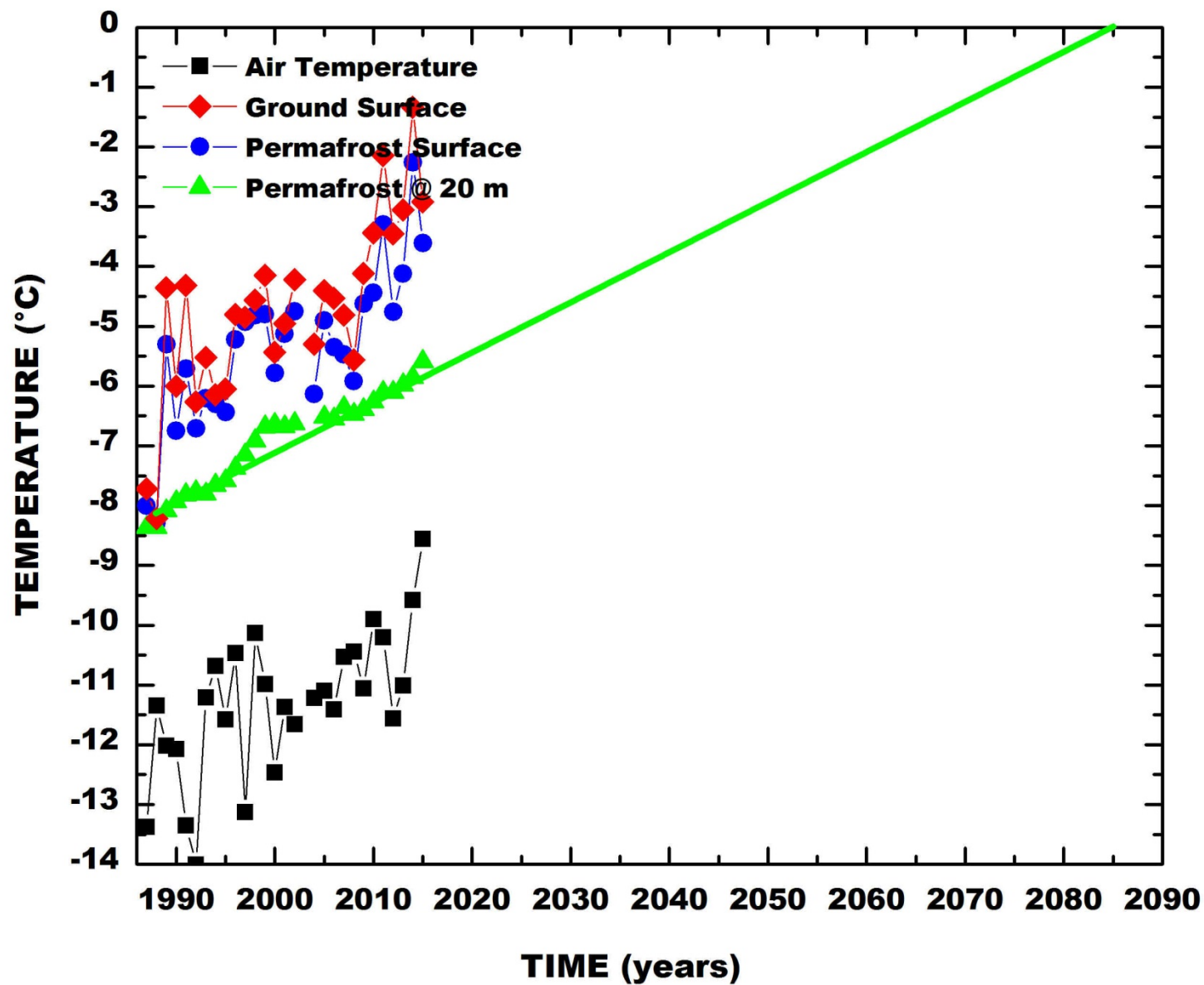
DEADHORSE, 1987-2030



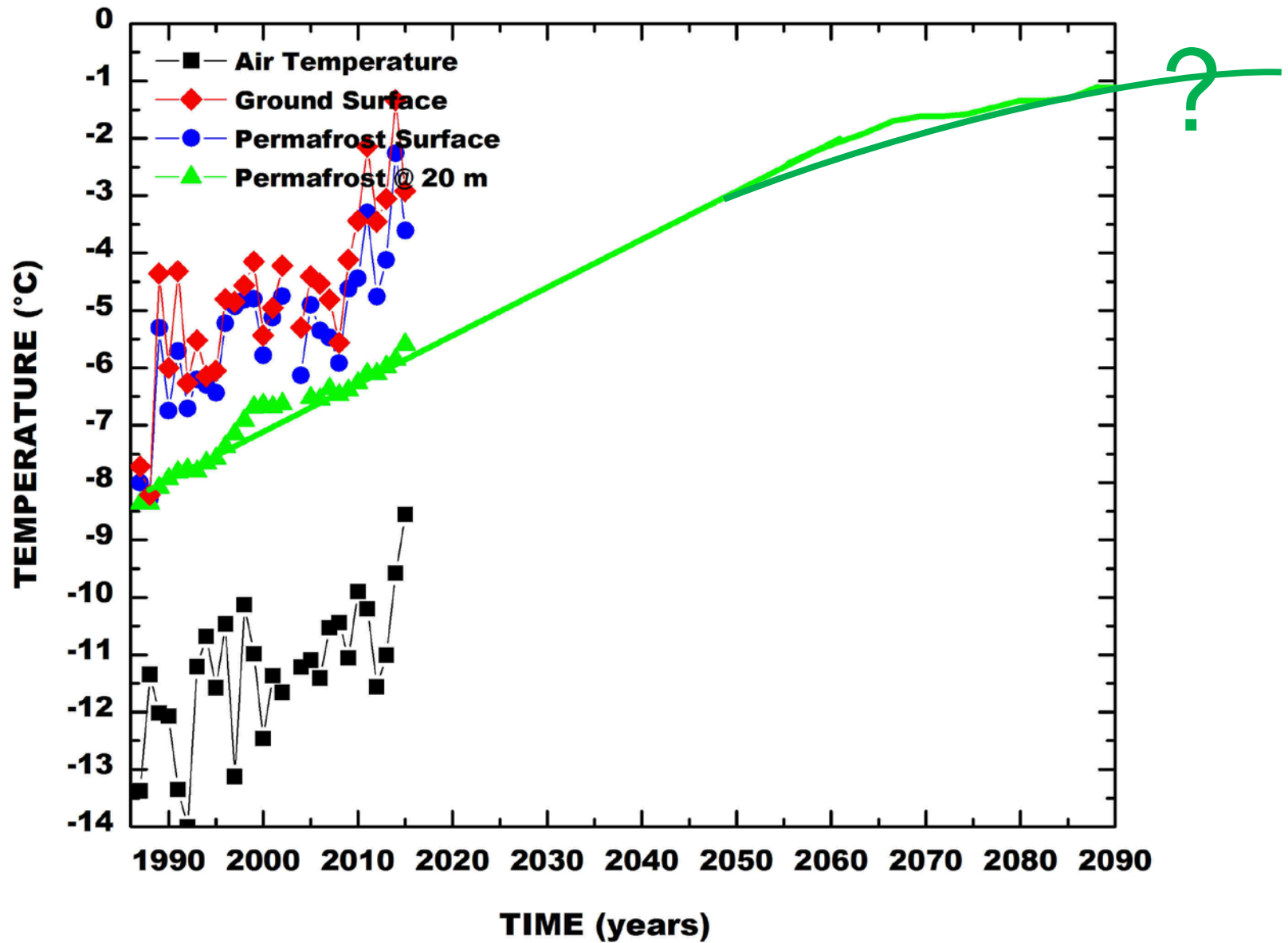
DEADHORSE, 1987-2050



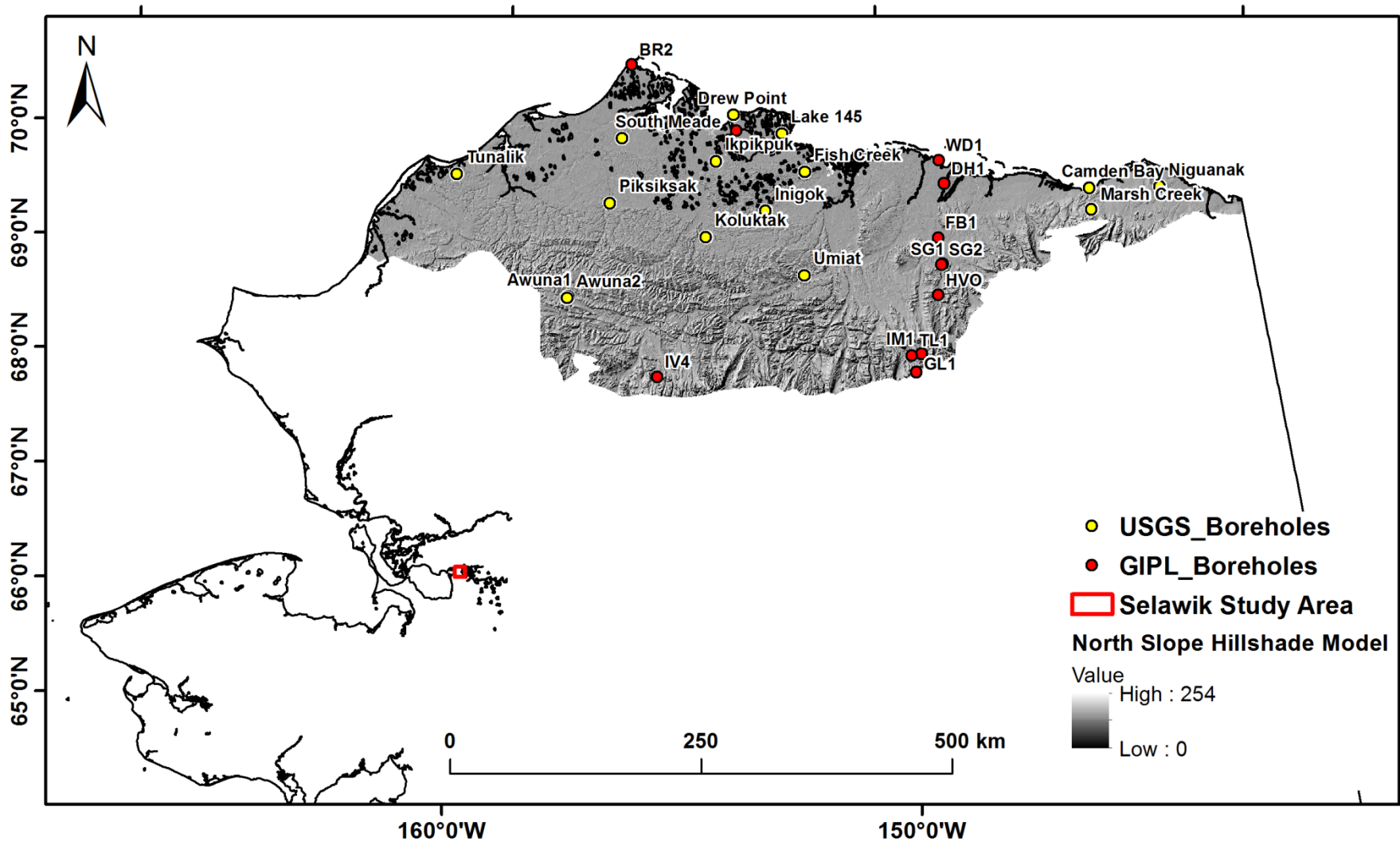
DEADHORSE, 1987-2085



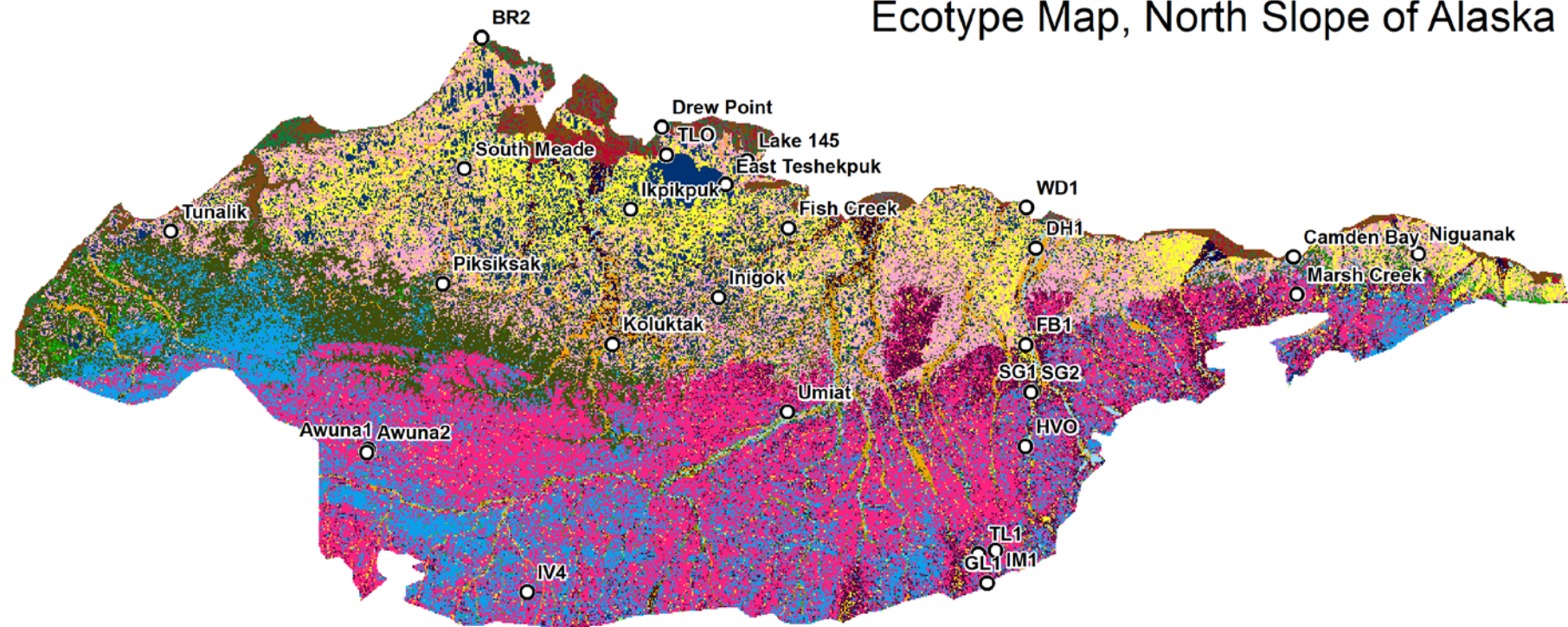
DEADHORSE, 1987-2085



Study Area



Ecotype Map, North Slope of Alaska



Class

1-Cloud, Ice (Indeterminate)

10-Riverine water

11-Riverine dwarf scrub

12-Lowland wet meadow (sedge tundra)

13-Lowland lake

14-Lowland moist meadow (sedge-shrub tundra)

15-Lowland mixed scrub (shrub-birch scrub)

16-Upland tussock tundra

17-Upland dwarf scrub tundra (Dryas tundra)

18-Upland shrubby tussock tundra (foothills)

19-Upland low scrub (shrub birch-willow tundra)

2-Coatal Barrens

20-Upland moist meadow (sedge-shrub tundra)

21-Upland tall scrub (alder scrub)

22-Alpine noncarbonate barrens

23-Alpine carbonate barrens

24-Alpine noncarbonate Dryas DST

25-Alpine carbonate Dryas DST

3-Coastal wet meadow (sedge tundra)

4-Coatal water

5-Coastal grass & DST (dwarf scrub tundra)

6-Riverine Barrens

7-Riverine low & tall scrub (scrub tundra)

8-Riverine moist meadow (sedge-shrub tundra)

9-Riverine wet meadow (sedge tundra)

Ecotypes covered by permafrost boreholes

Ecotypes	% Cover
Coastal grass & dwarf shrub tundra	0.8
Riverine wet sedge tundra	1.1
Lowland wet sedge tundra	11.2
Lowland moist sedge-shrub tundra	13.4
Upland tussock tundra	11.3
Upland shrubby tussock tundra	24.7
Upland low birch-willow shrub tundra	14.2
Upland moist sedge-shrub tundra	5.3
Total cover	82.0

Coastal, river, and lake water bodies cover 9.3% of the study area excluded from permafrost modeling.

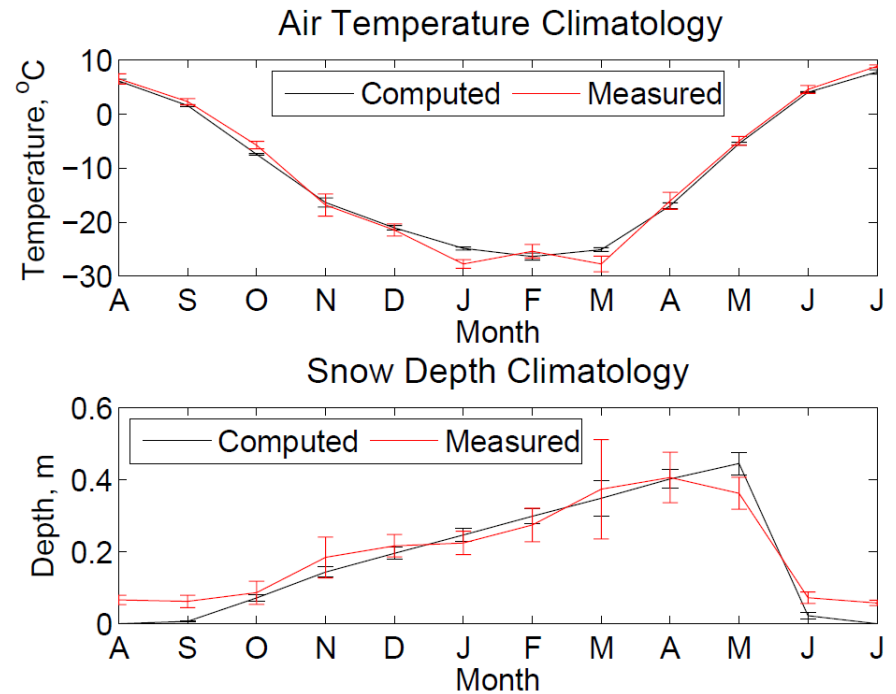
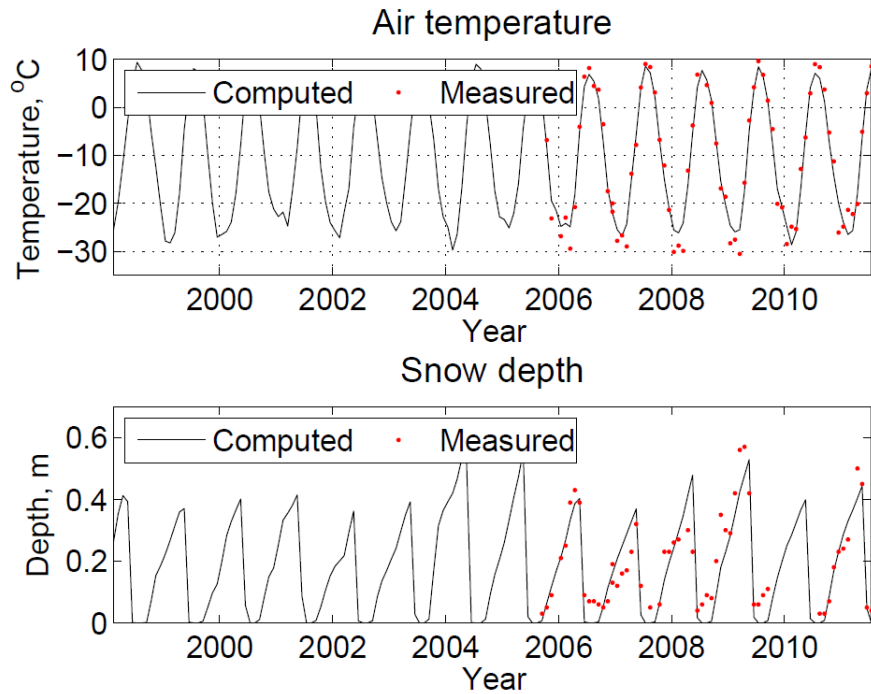
Ecotypes NOT covered by permafrost boreholes

Ecotypes	% Cover
Coastal barrens	0.3
Coastal wet sedge tundra	0.9
Riverine barrens	1.2
Riverine low willow shrub tundra	0.8
Riverine moist sedge-shrub tundra	3.1
Riverine dryas dwarf shrub tundra	0.0
Lowland low birch-willow shrub tundra	1.3
Upland dryas dwarf shrub tundra	0.6
Upland tall alder scrub	0.0
Alpine non-carbonate barrens	0.0
Alpine carbonate barrens	0.0
Alpine non-carbonate dryas dwarf shrub	0.2
Alpine carbonate dryas dwarf shrub	0.0
Total cover	8.7

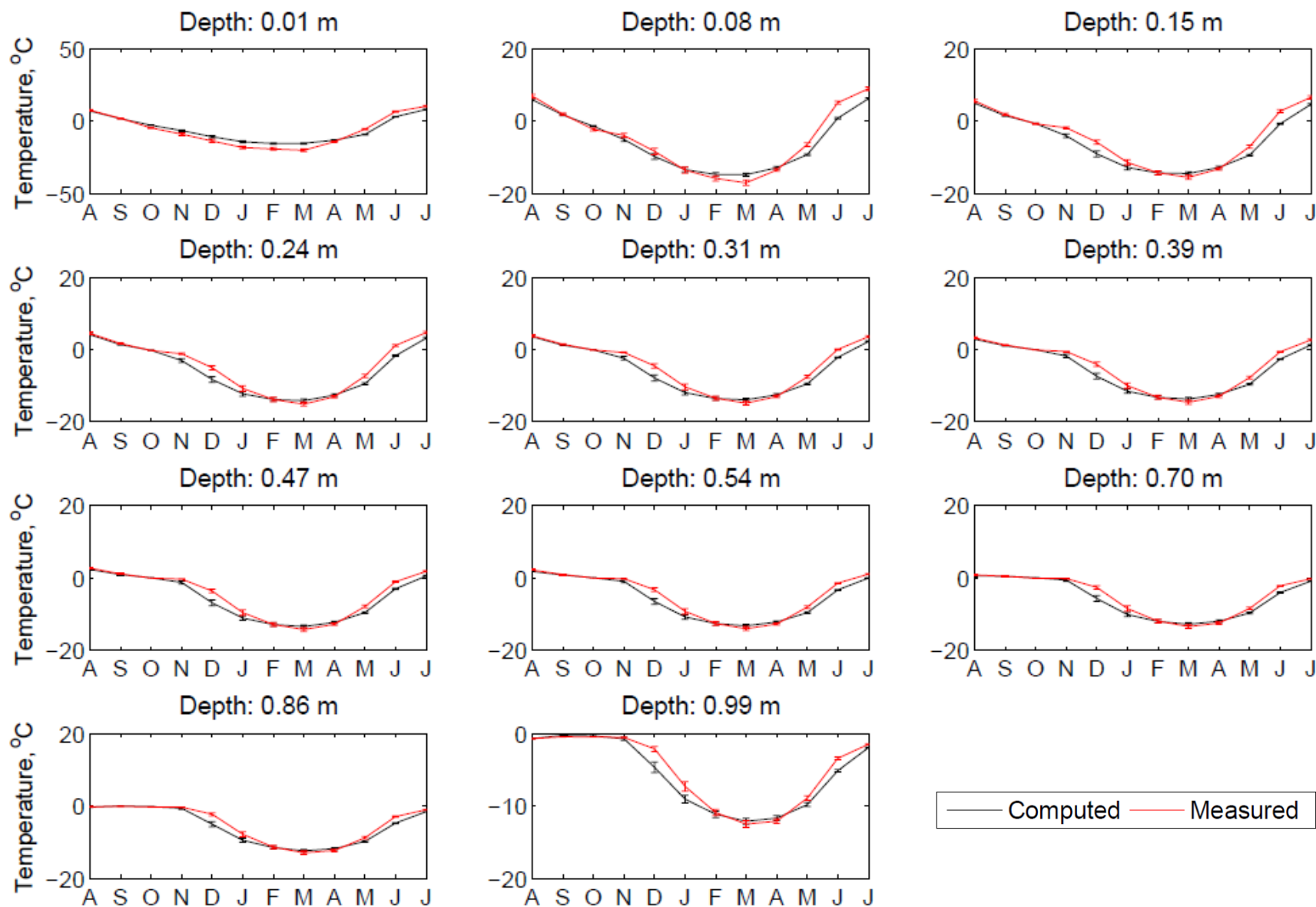
Climate Forcing

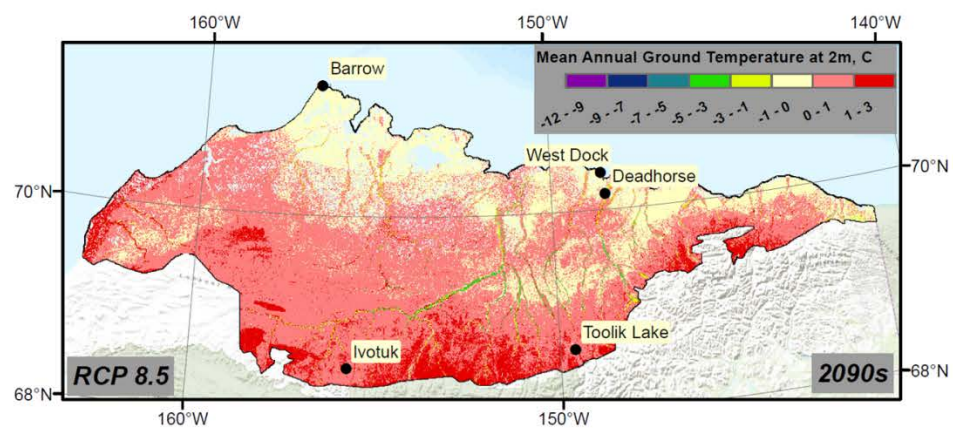
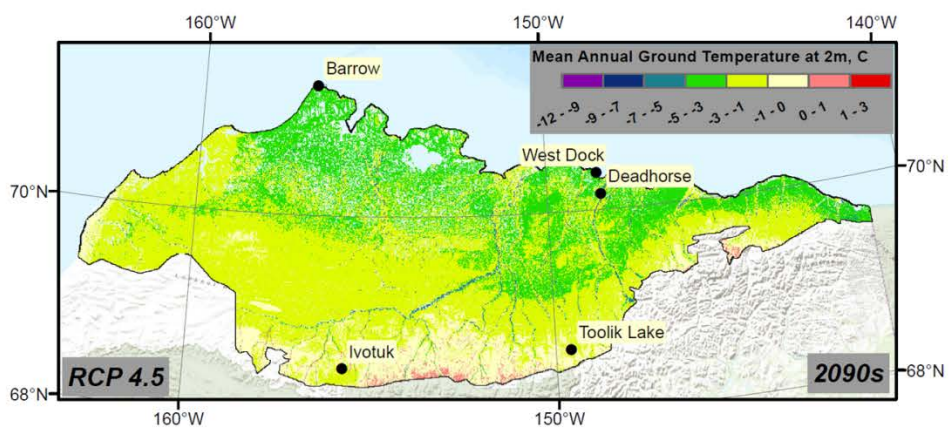
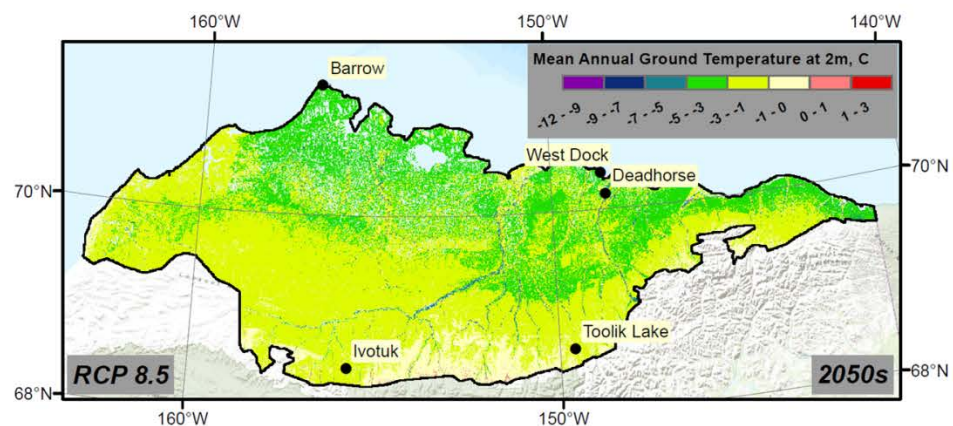
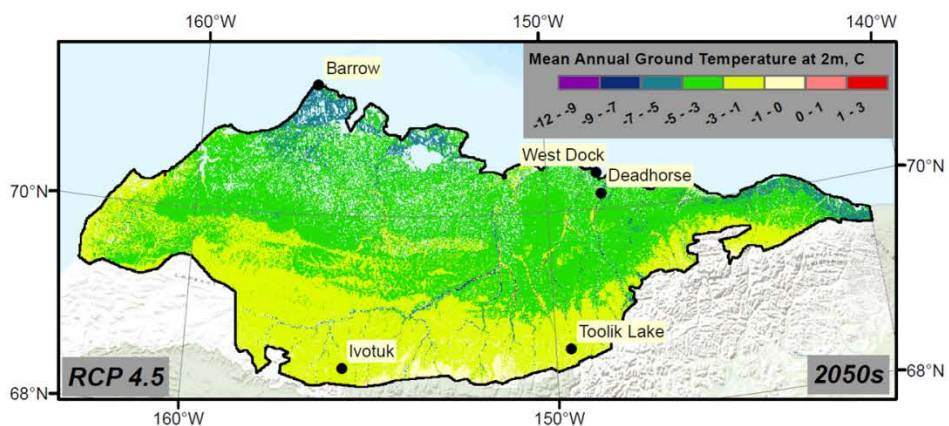
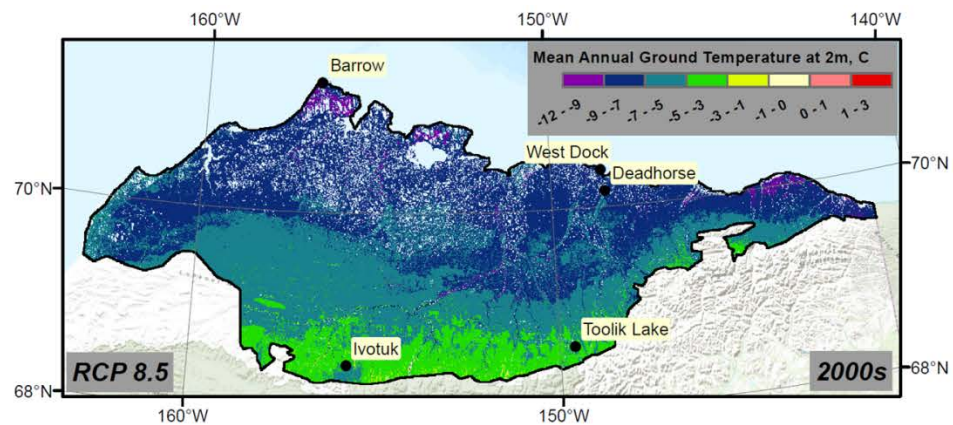
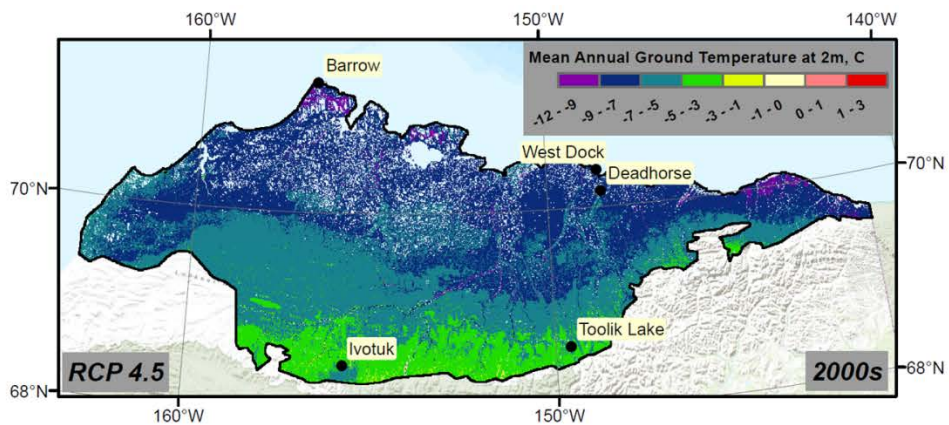
- **Source: Scenario Network for Alaska and Arctic Planning**
(www.snap.uaf.edu/)
 - Monthly average air temperature and total precipitation
 - 771 m
- **Downscaled Climatic Research Unit (CRU) Forcing**
 - CRU TS31 (1901 – 2009)
- **Coupled Model Intercomparison Project (CMIP/AR5) Forcing**
 - **Five Model Average RCP 4.5 and RCP 8.5** (2006 – 2100)
 - Community Earth System Model 4: NCAR-CCSM4
 - Coupled Model 3.0: GFDL-CM3
 - ModelE/Russell: GISS-E2R
 - IPSL Coupled Model v5A: IPSL-CM5A-LR
 - Coupled General Circulation Model v3.0: MRI-CGCM3
 - **GFDL-CM3 RCP 4.5 and RCP 8.5** (2006 – 2100)

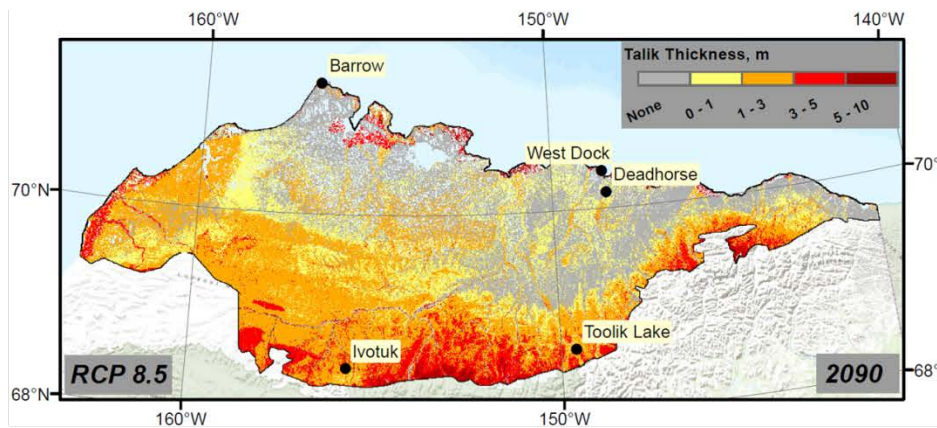
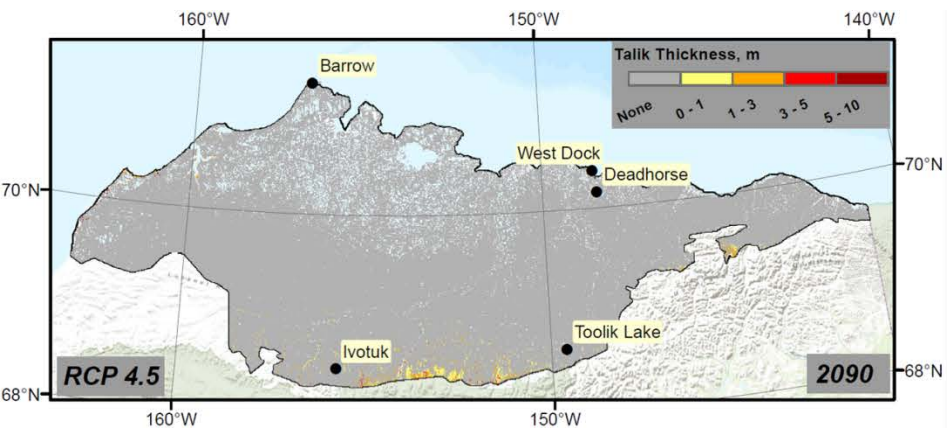
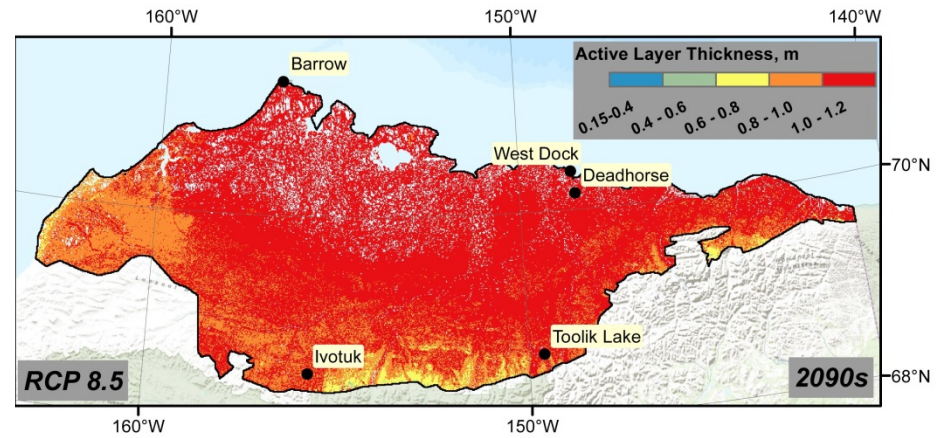
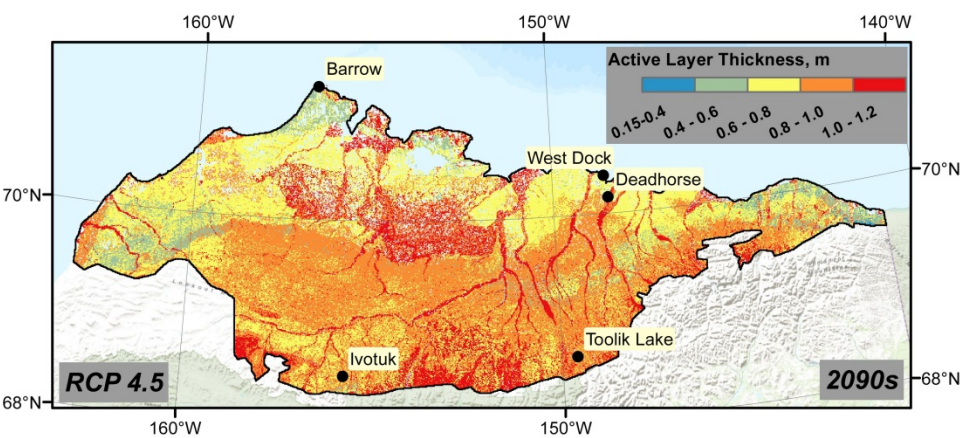
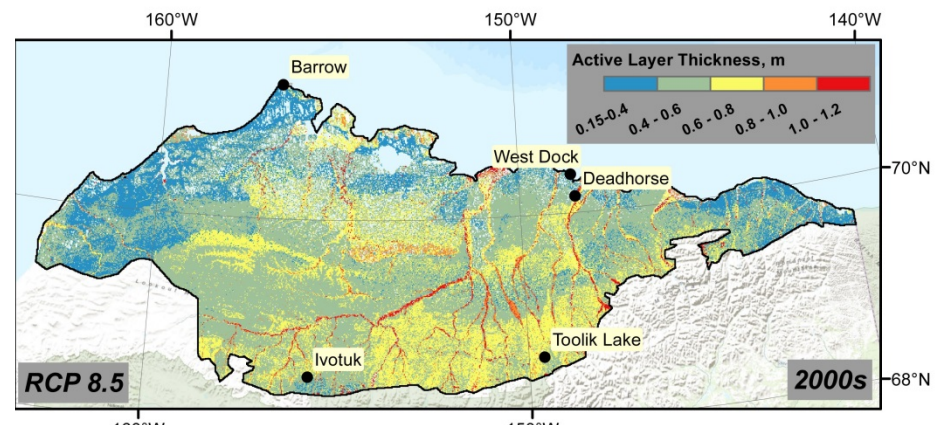
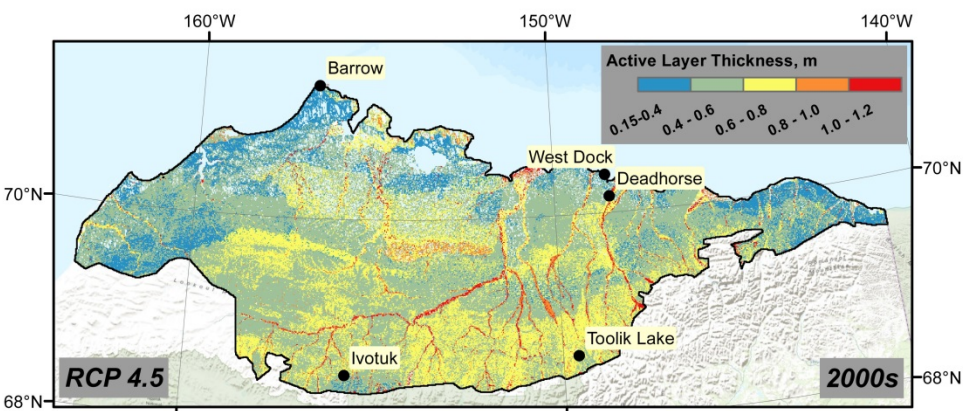
Air temperatures and snow depth at **Ikpikpuk**

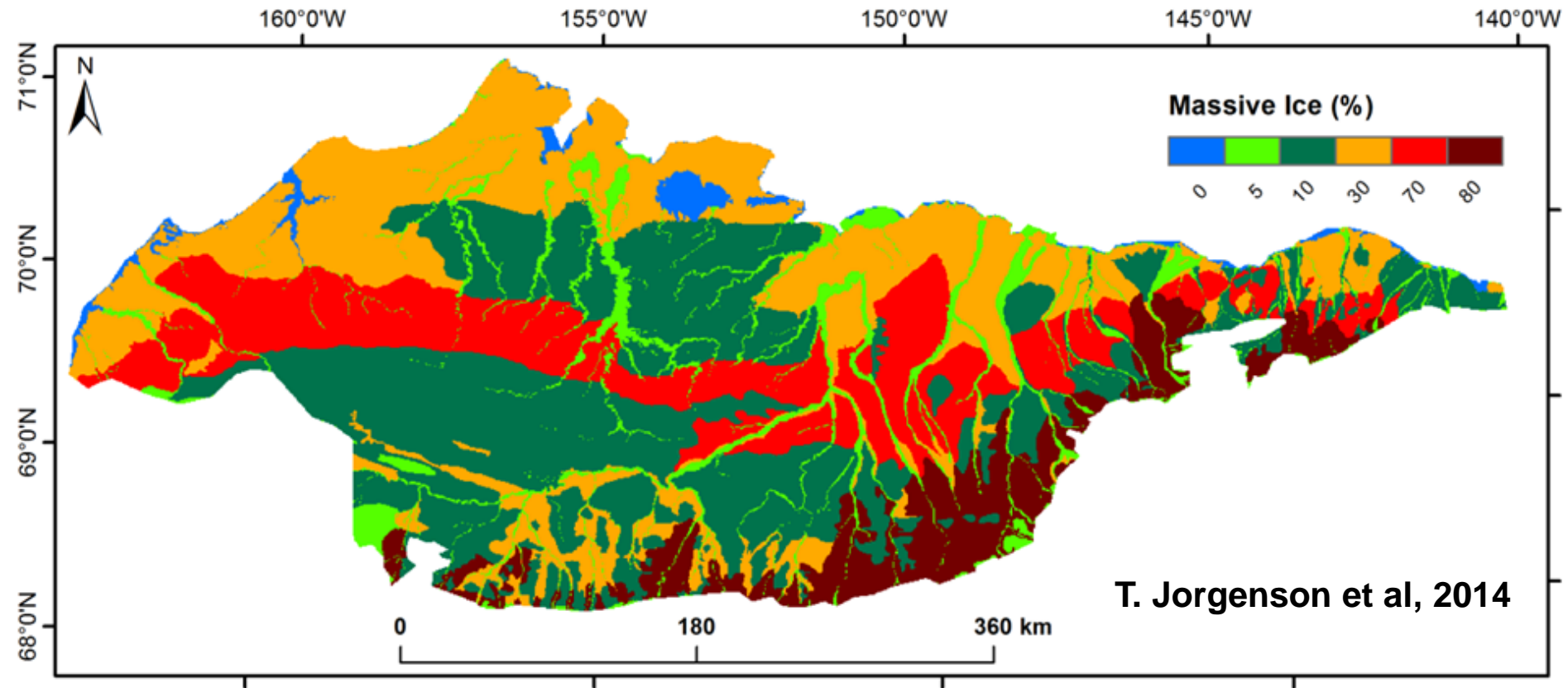


Measured and computed ground temperatures at **Deadhorse**



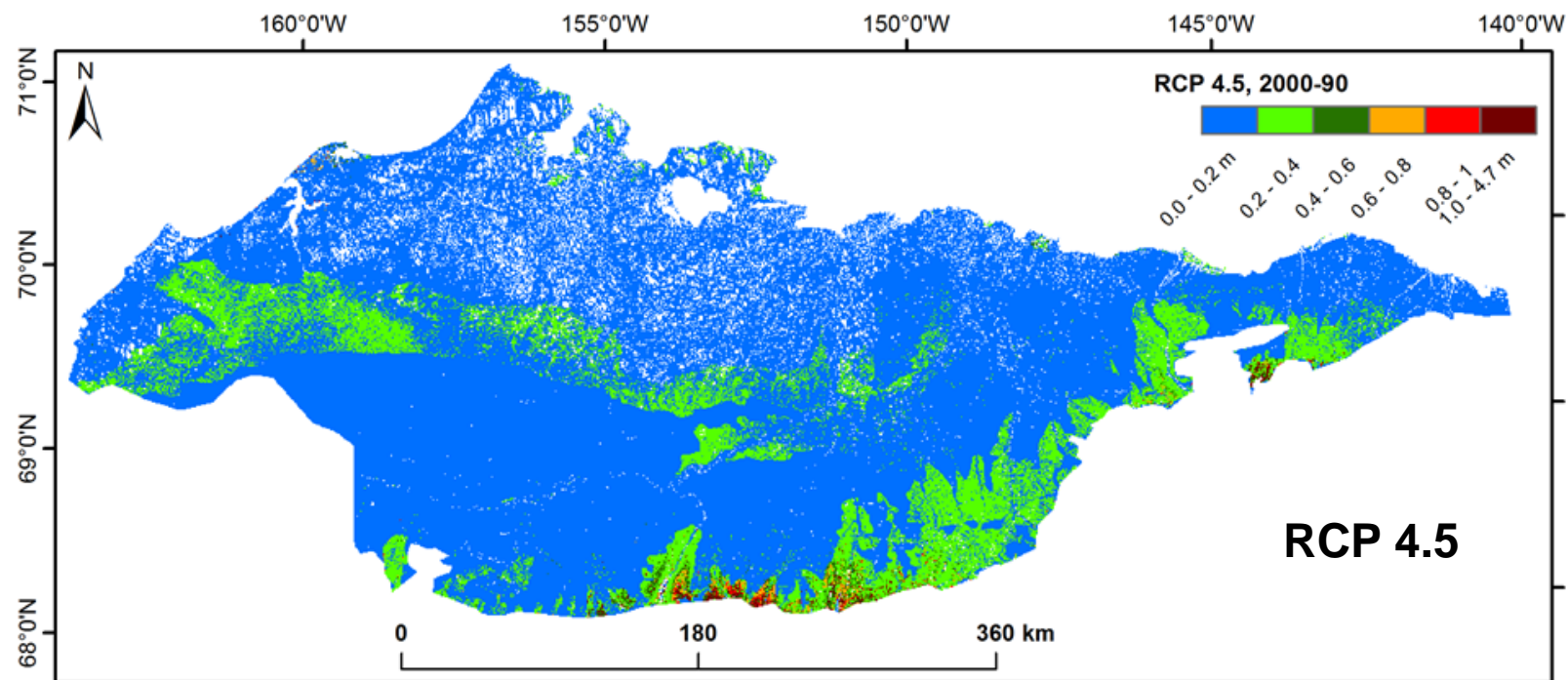




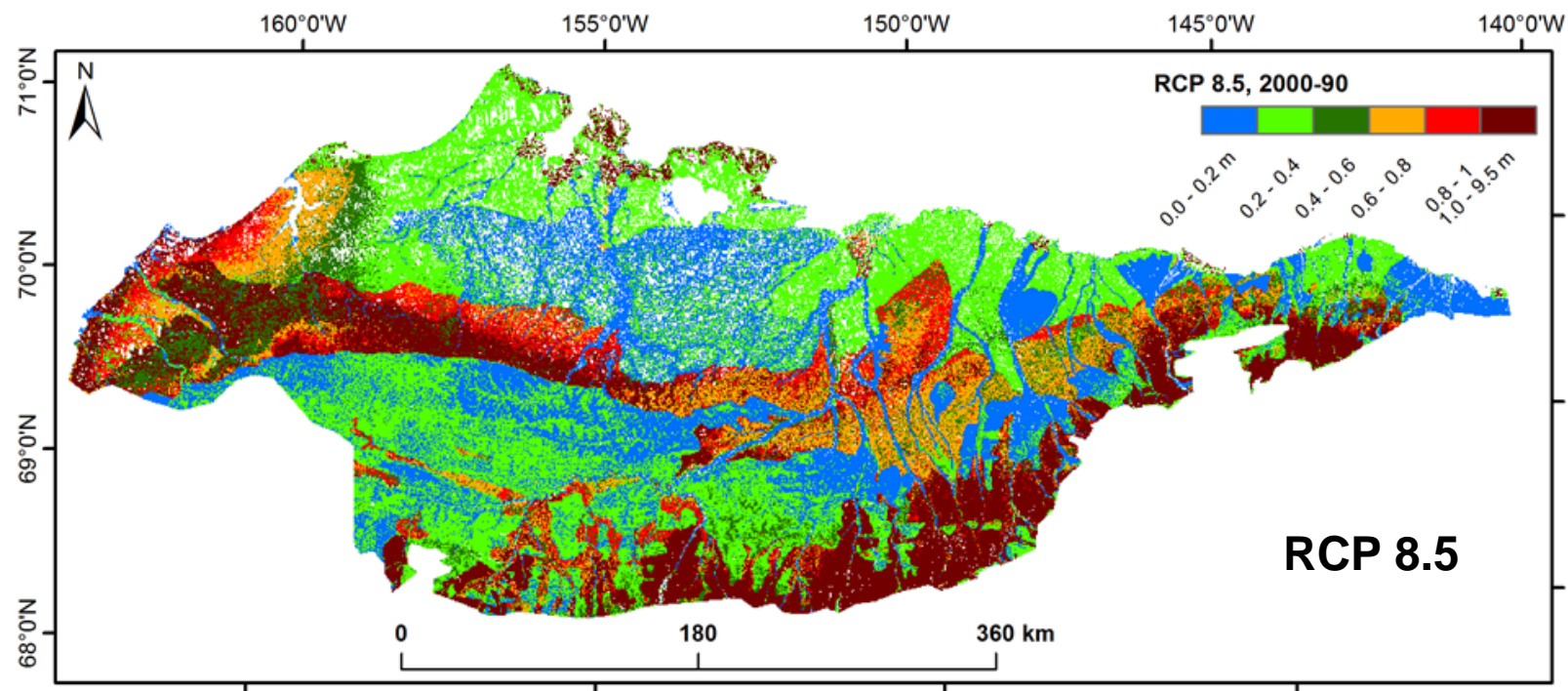


Thaw thickness = (ALD 2090 + TTH 2090) – (ALD 2000 + TTH 2000)

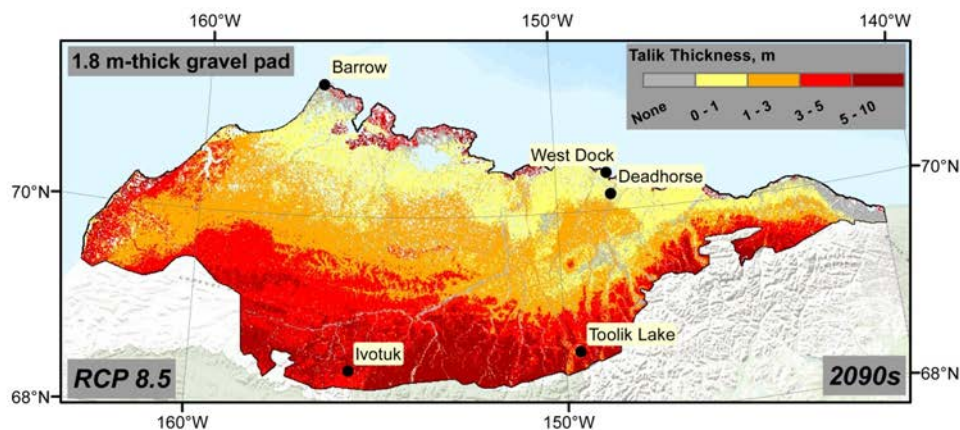
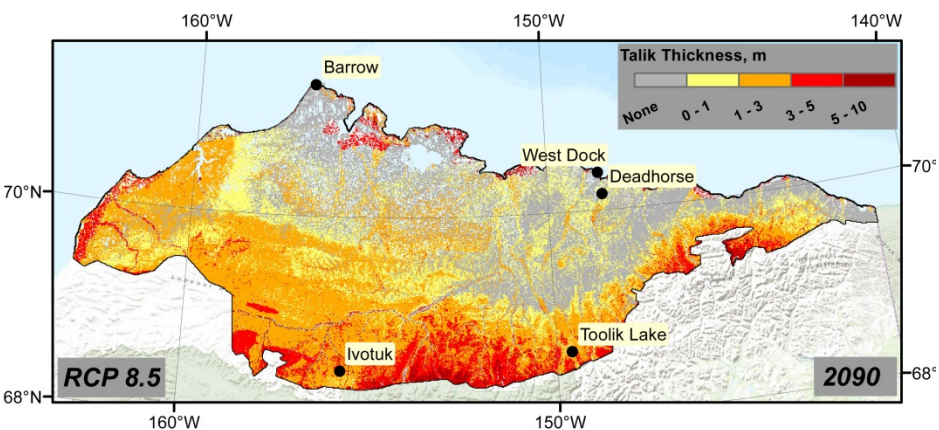
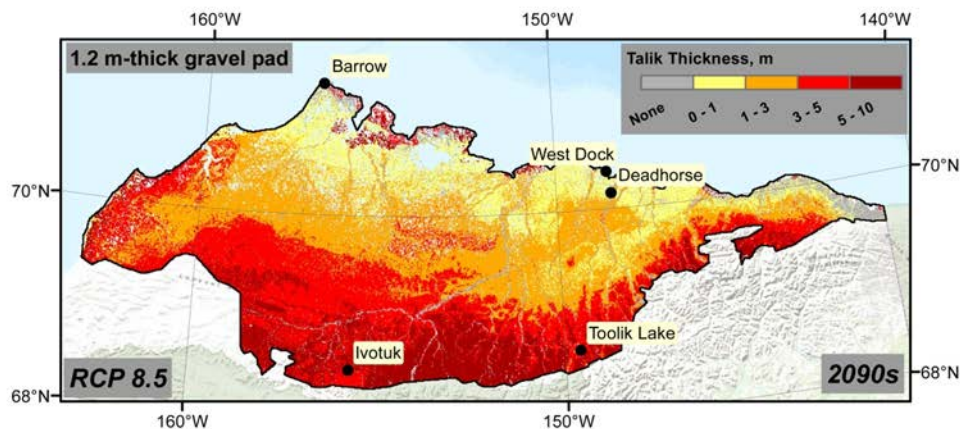
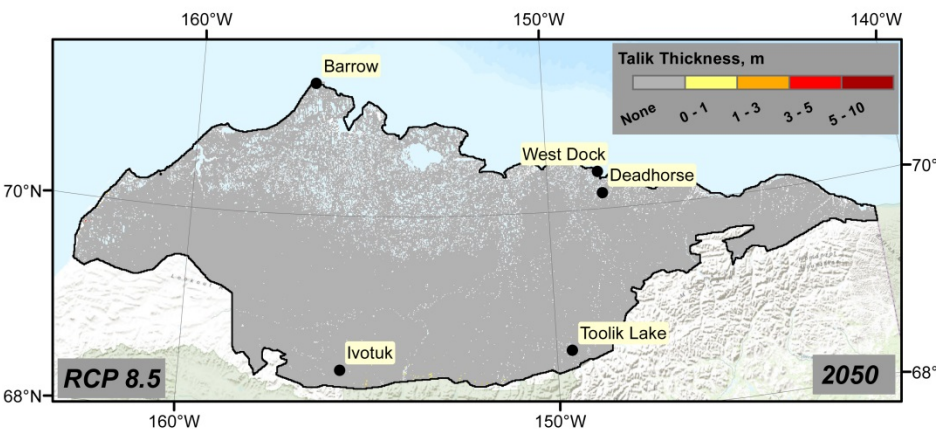
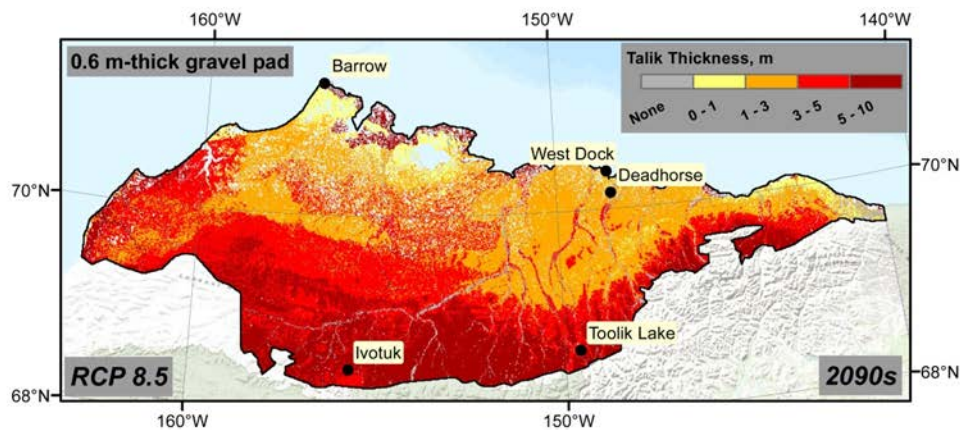
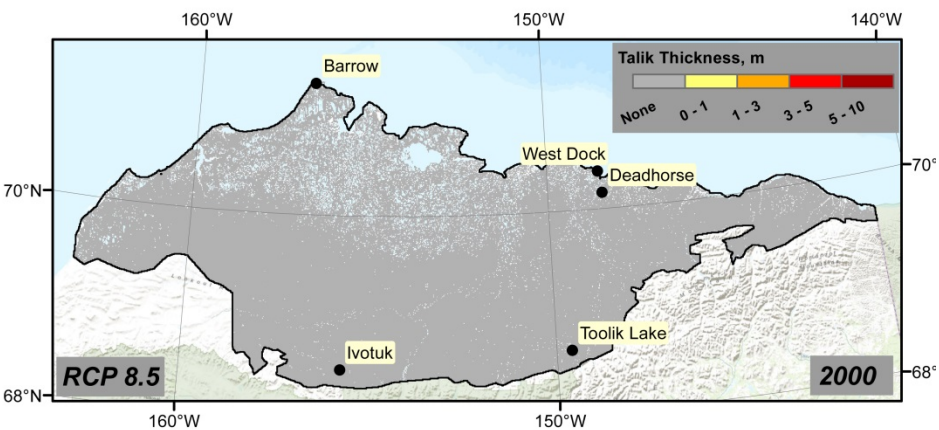
Thaw settlement = Thaw thickness * (Massive ice%)/100

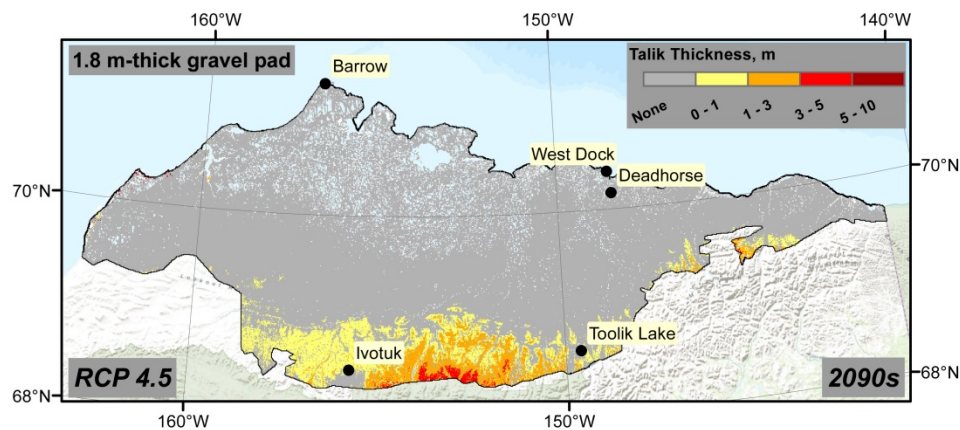
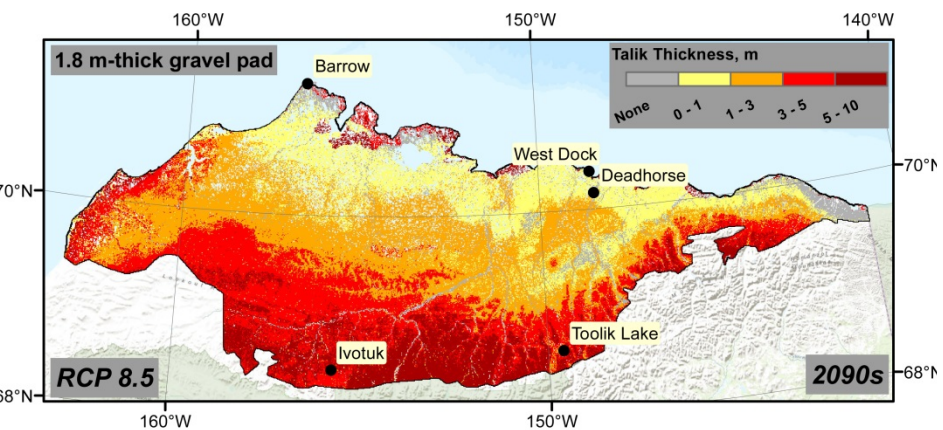
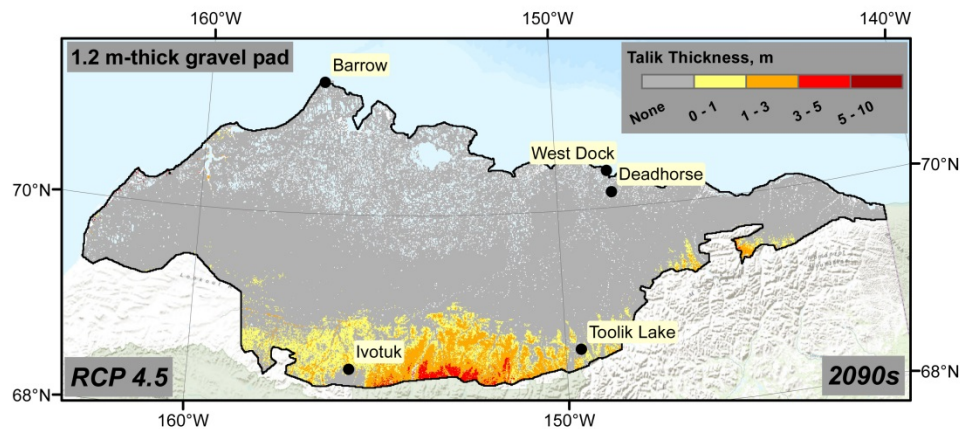
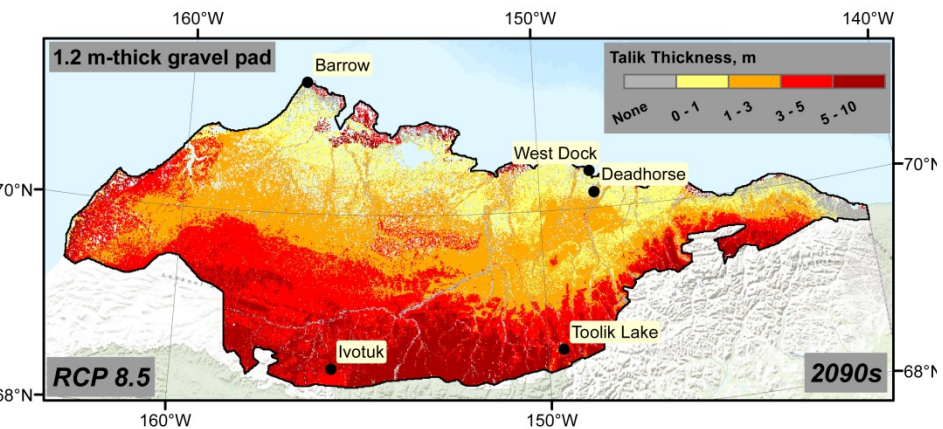
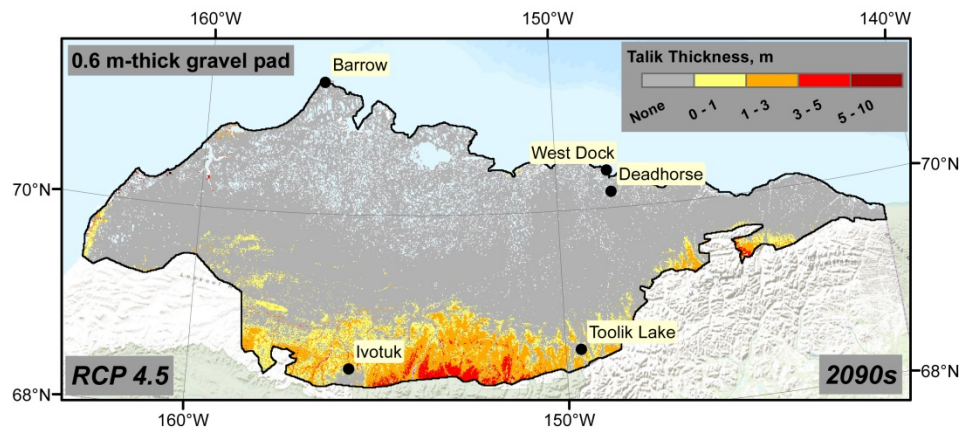
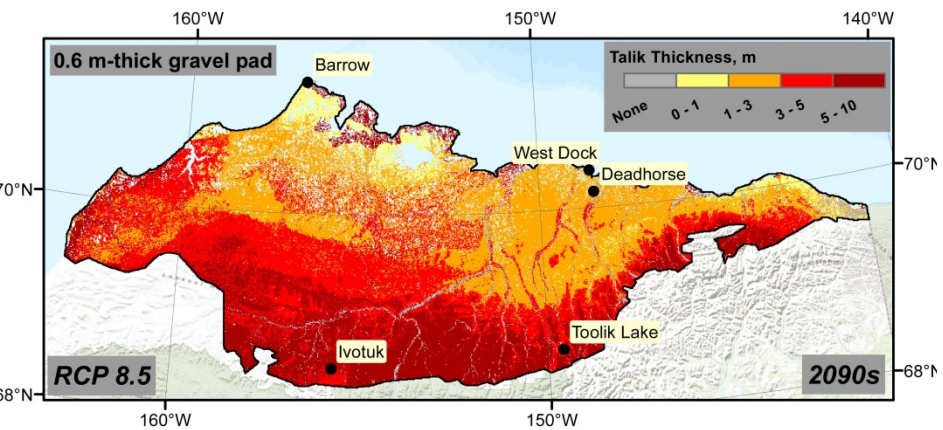


Thaw settlement (m) between 2000 and 2090 from RCP 4.5. Maximum settlement is 4.7 m



Thaw settlement (m) between 2000 and 2090 from RCP 8.5. Maximum settlement is 9.5 m





Thank you very much !

www.permafrostwatch.org

