Soil Freezing Model

- Art DeGaetano, NRCC

Frozen Soil is a Primary Driver of Winter Runoff Risk

NOAA Operational Land Surface Model

- Great Lake RFC

- Minnesota through NY along Lakes

- SAC_HT model

- Satellite, radar, weather station data

- 10-day run-off forecasts from NWS precip, temp and snowfall forecast
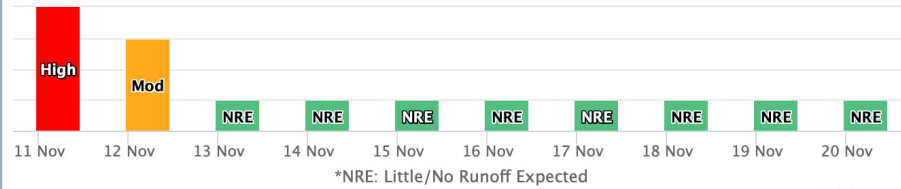
- NRCC role
  - Tailor forecasts to user needs
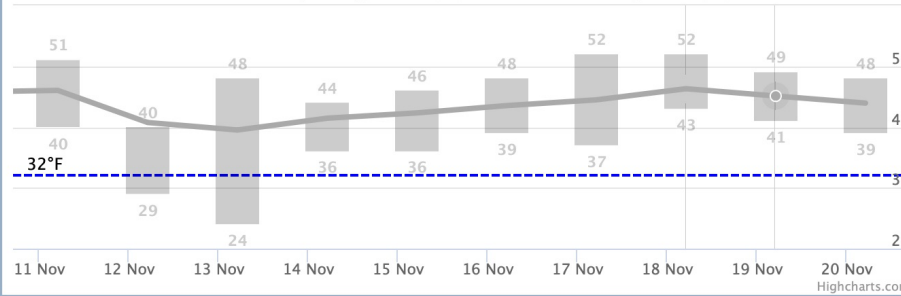 - User-friendly interface
  - Test and improve

- HIDE DETAILS   ?

Runoff Risk Forecasts* (Daily)

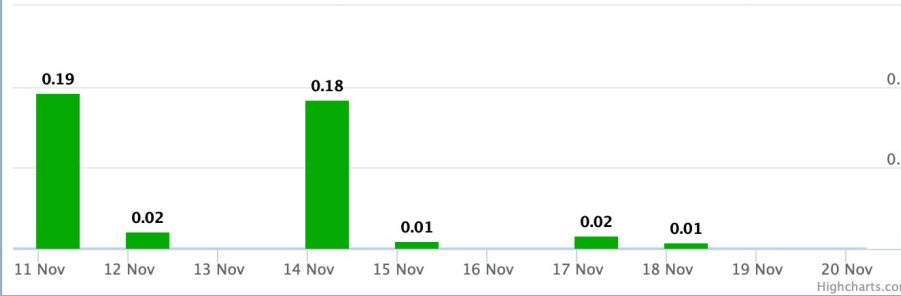| 11 Nov	12 Nov	13 Nov	14 Nov	15 Nov	16 Nov	17 Nov	18 Nov	19 Nov	20 Nov
High	Mod	NRE	NRE	NRE	NRE	NRE	NRE	NRE	NRE

*NRE: Little/No Runoff Expected

Highcharts.com

● Air Temp Range Fcst (°F) — 2" Soil Temp Fcst (°F)

	11 Nov	12 Nov	13 Nov	14 Nov	15 Nov	16 Nov	17 Nov	18 Nov	19 Nov	20 Nov
High	51	40	48	44	46	48	52	52	49	48
Low	40	29	24	36	36	39	37	43	41	39

32°F

Highcharts.com

● Snow Water Equiv Fcst (in) ● Rain+Snowmelt Fcst (in)

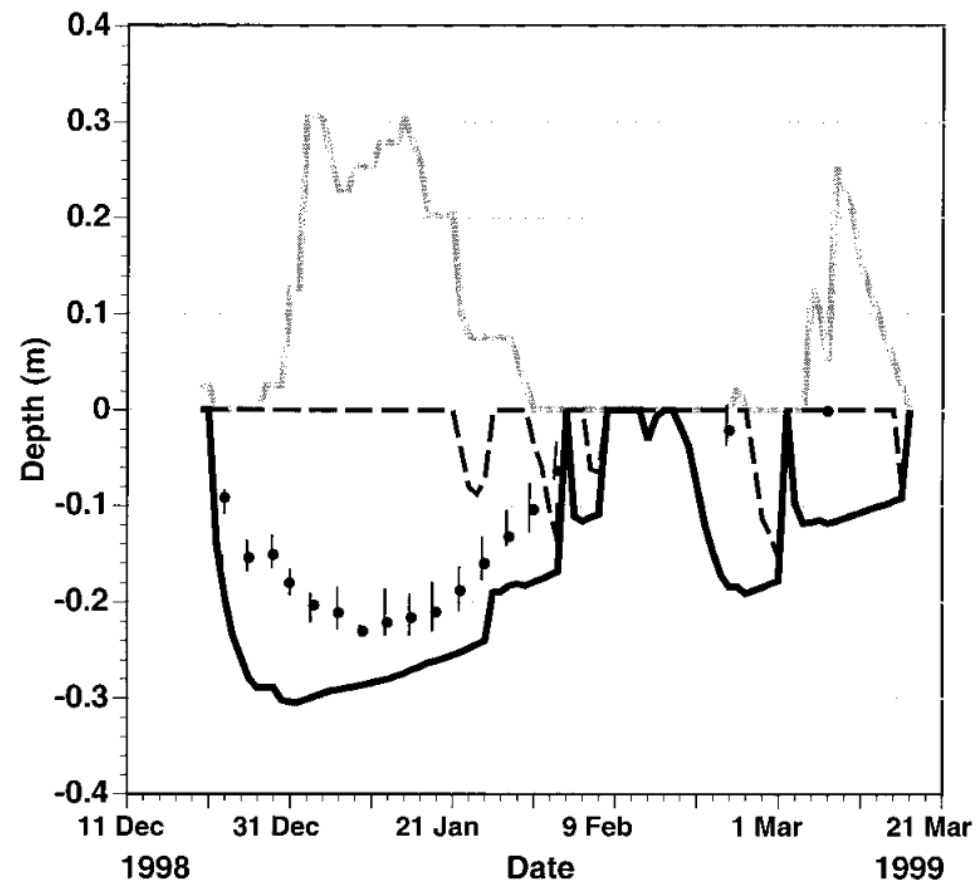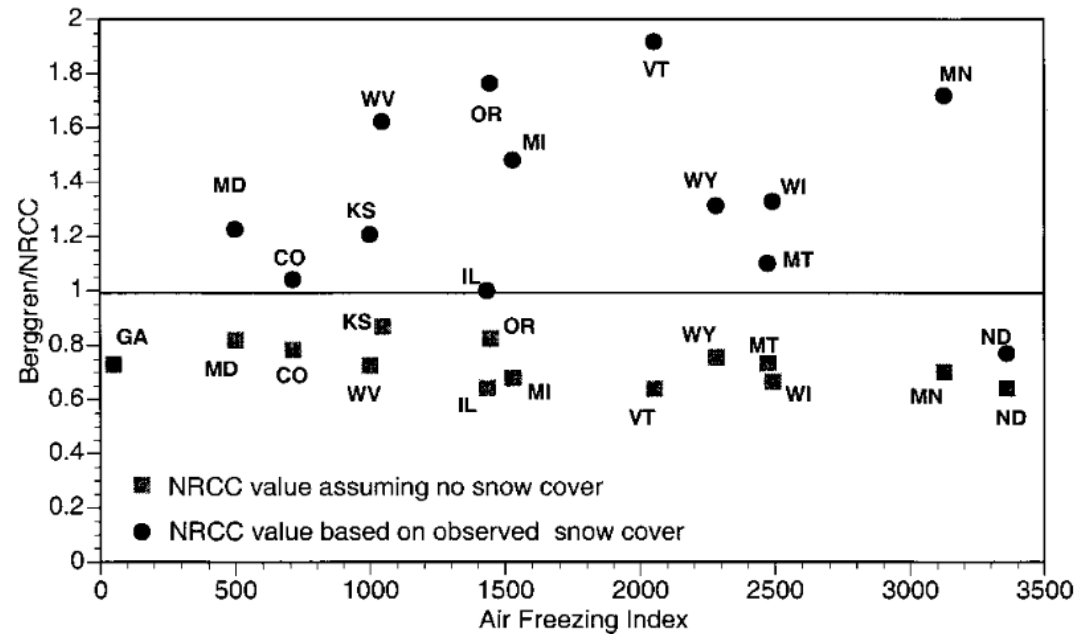| 11 Nov	12 Nov	13 Nov	14 Nov	15 Nov	16 Nov	17 Nov	18 Nov	19 Nov	20 Nov
0.19	0.02		0.18	0.01		0.02	0.01		

Highcharts.com

Climatological Modeling of Soil Freeze depth for Building Codes
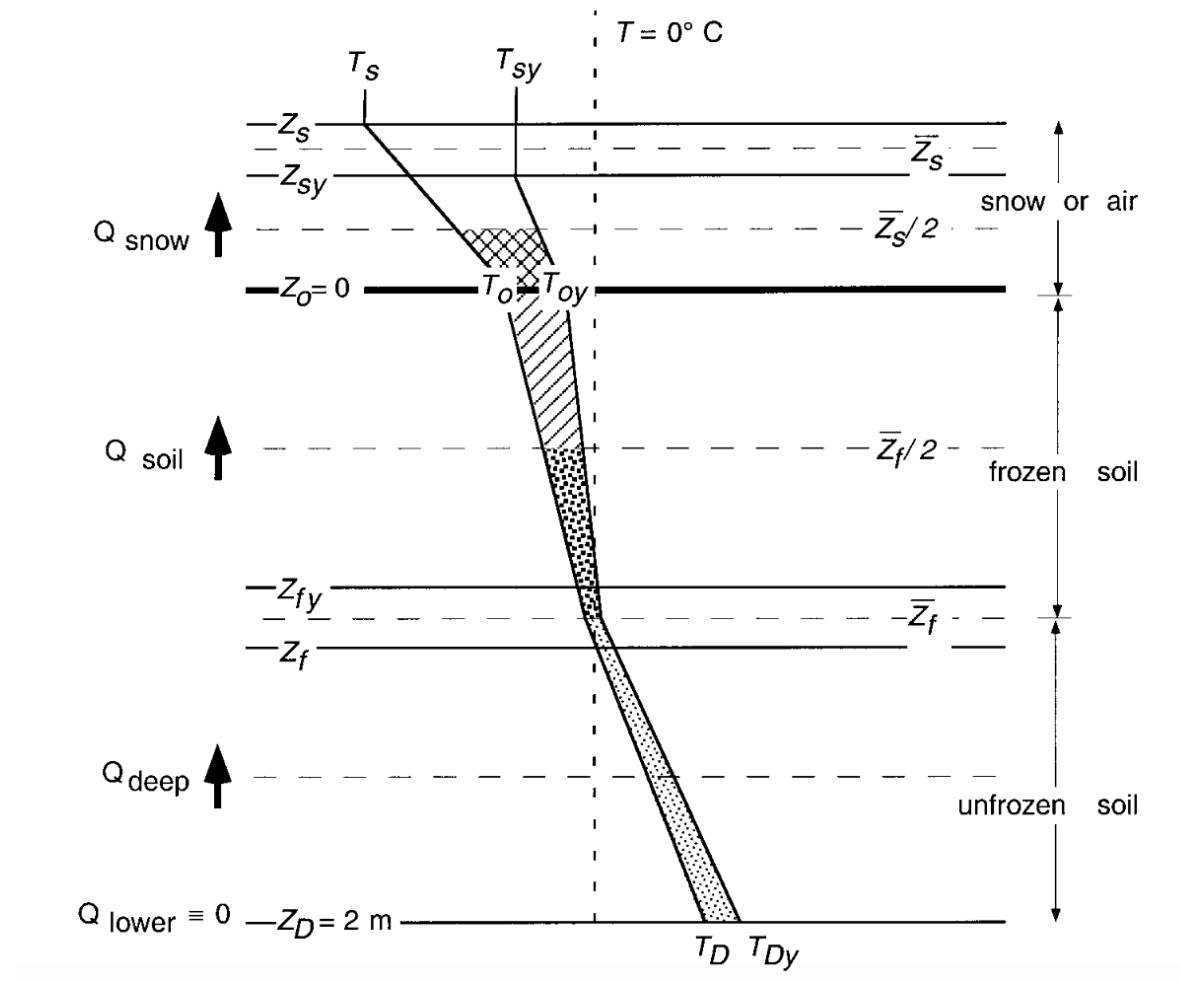
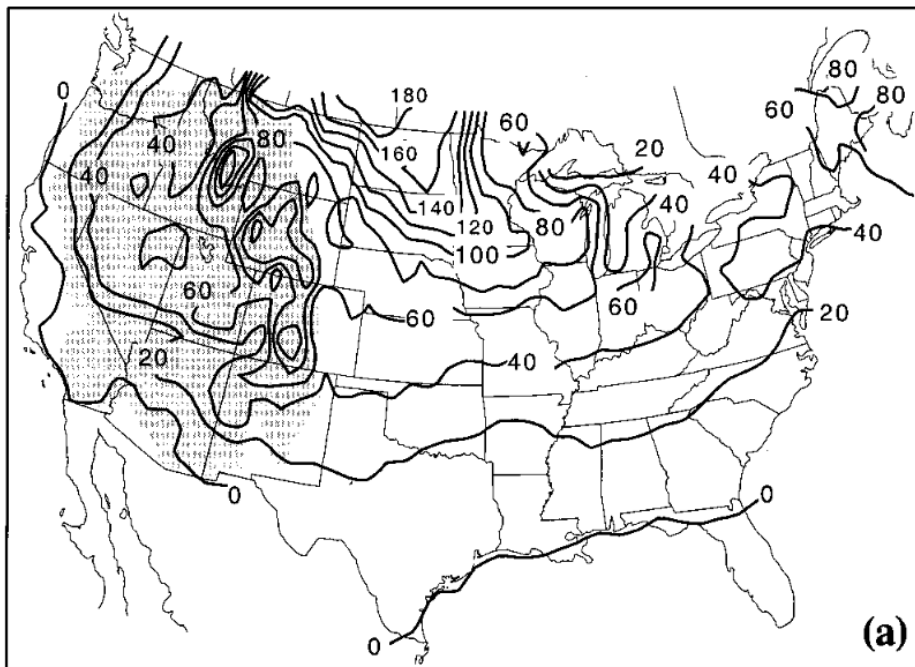# Tested Against Observations

Compared to Previous Methods

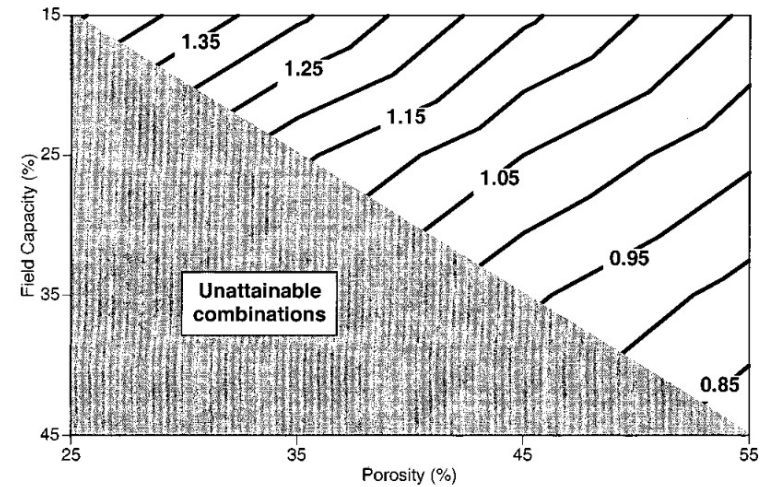Key points about the Modified Berggren Equation:
- Cumulative degree-days below freezing at the ground surface
- Soil properties (e.g. soil thermal conductivity and moisture content)
- Duration of the freezing period

Climatological Products

10-yr (10% ARI) frost depth (cm)

(a)

With ambient snow conditions

Default Soil Adjustments

Other Applications

Site Specific Data for Design of Nuclear Storage Facility

```
1952 -0.347
1953 -0.174
1954 -0.335
1955 -0.343
1956 -0.338
1957 -0.393

2001 -0.502
2002 -0.234
2003 -0.415
2004 -0.540
2005 -0.488
2006 -0.286
2007 -0.386
```

Future conditions based on climate models