



One Tree
Alaska



Green-up in Interior Alaska: What, when and Why it Matters

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Today's Agenda

- Defining green-up and Fairbanks' unique observational record
- 1998: Predicting green-up with focus on the past
- 2017-Now: Predicting green-up and now sap flow ahead of time



What is green-up & why is it important?

- **Boreal Ecosystem**

- Birch/Aspen biology
- Moose change diet

- **Human activities**

- Birch sap tapping!

- **Weather and climate**

- Higher humidity (through evapotranspiration)
- Early season showers

Interior Alaska green-up: “birch and aspen leaves open just enough to produce a faint but distinct green flush through the forest canopy” *Jim Anderson, UAF, 1986*



Photo by Ned Rozell/UAF

Happenings before Green-up

- **Weather Happenings**

- Solar heating increasing (days longer, sun higher)
- Warming air temperatures
- Snowpack ripening then melting
- Ground thawing, water infiltration

- **Forest Happenings**

- “Snow Wells” develop around trees
- Birch/Aspen Trees
 - Winter buds swell, change color and elongate
 - Sap flow begins





Fairbanks' unique green-up record

- **Institute of Arctic Biology**

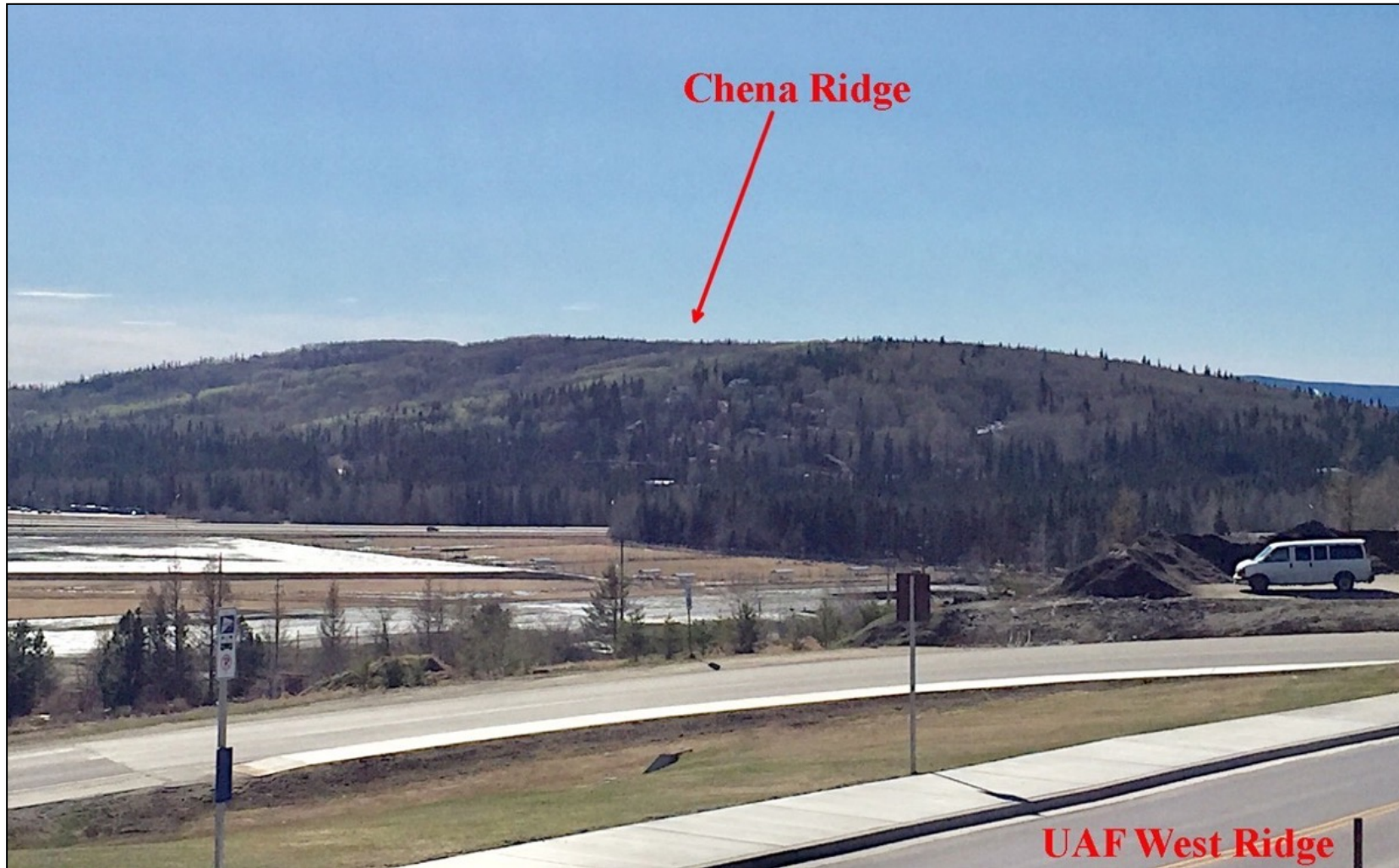
- Jim Anderson & Bob Elsner
- Systematically noting date of green-up of Chena Ridge as seen from UAF starting mid-1970s

- **NWS Fairbanks**

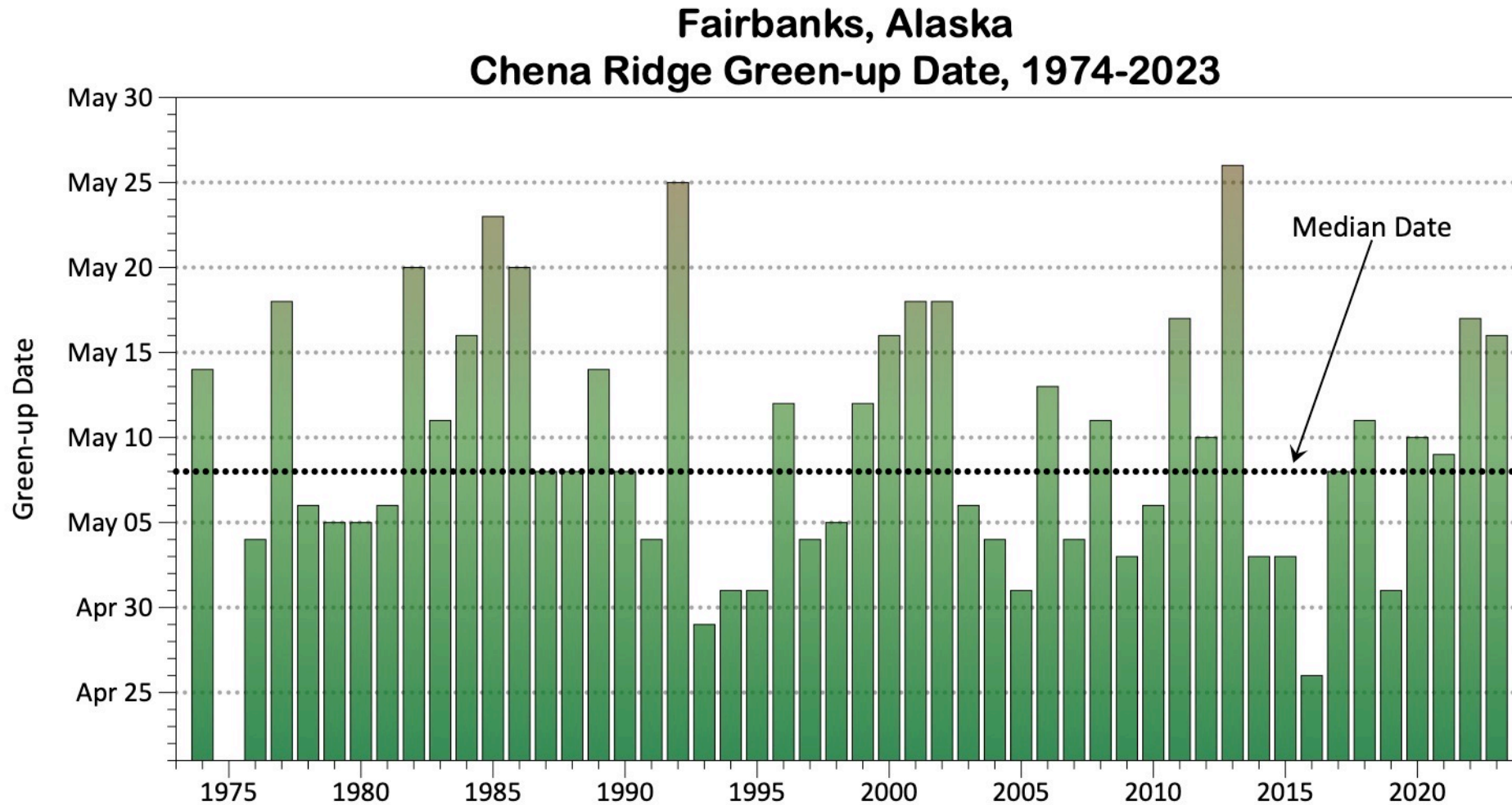
- Ted Fathauer: green-up dates starting in mid 1980s
- 1999-present: NWS records green-up of West Ridge as seen from UAF



The view for green-up



Variability but no trend in green-up dates

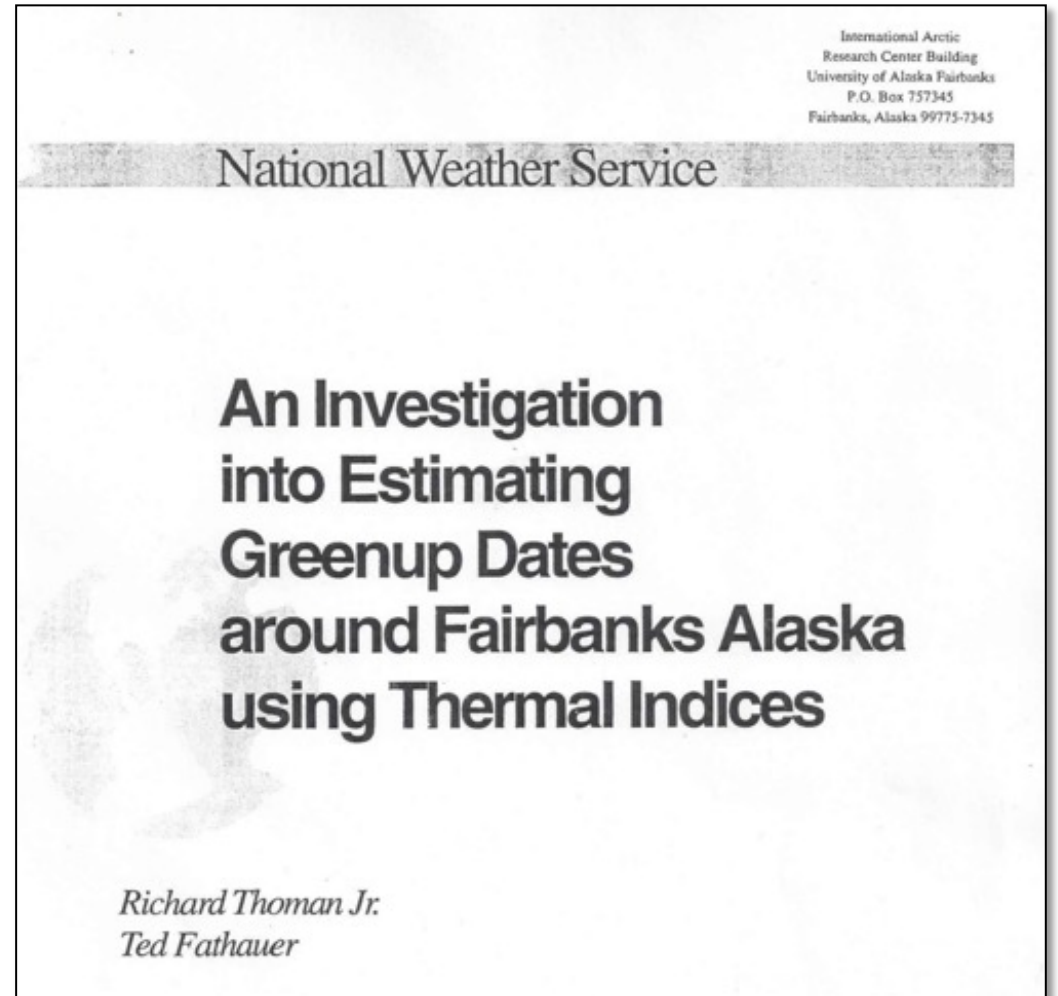


Data source: NWS Fairbanks



Can we estimate green-up date from climate data?

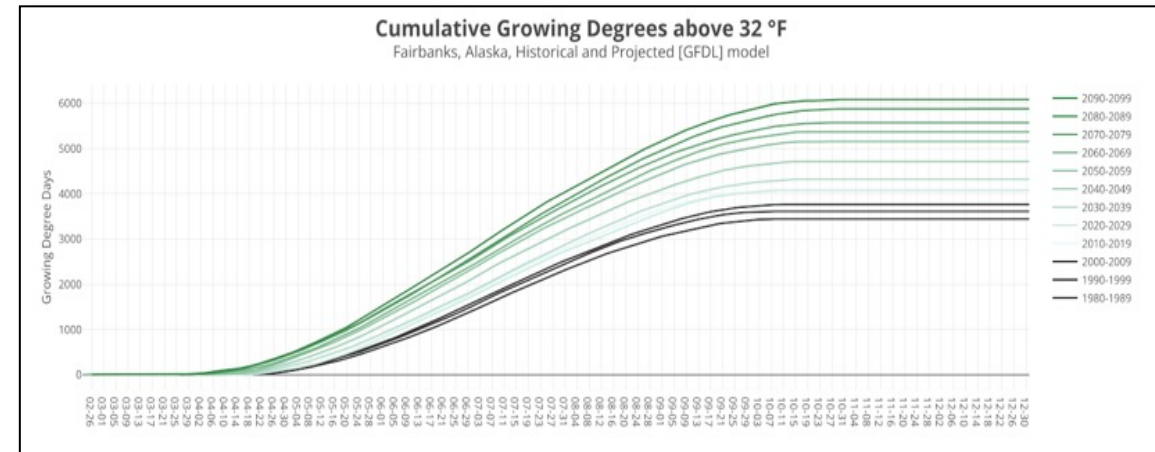
- **1998:** Following several very early green-ups in mid-1990s, Ted Fathauer and Rick Thoman developed a technique to predict green-up using climate data
- **2017:** 20 years of additional data & Jan Dawe's urging, Rick took a fresh look at the technique and made some refinements



The “Green-up Index”

A cumulative temperature threshold-based measure

- Widely used, e.g. agriculture, hydrology, engineering
- Applicable to places/times (at least for Interior Alaska) with just basic climate data
- Simple enough to use to make real-time forecasts



SNAP Garden Helper Tool

The “Green-up Index”: experiential considerations

- A few thawing days in mid-winter irrelevant to green-up
- Green-up first on south-facing lower hillsides spreads quickly down and more slowly up
 - Suggests daily high temps more important than average daily temperature
- Spring precipitation not likely important
 - Typically the “Dry season”
 - Snowmelt = lots of moisture



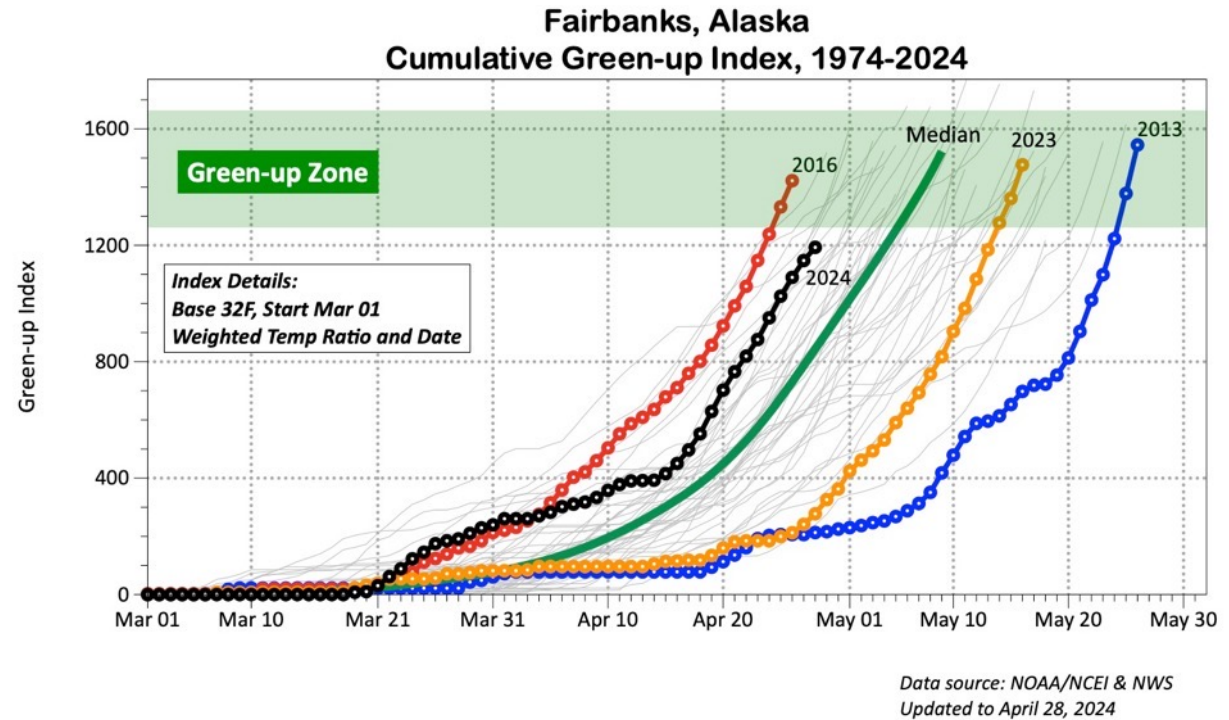
Constructing the index with historical data

- Test various combinations of
 - Start dates, thresholds and weightings
 - Solar considerations (2017 addition)
- Winner= the lowest variation relative to the typical value at green-up
- Current index:
 - Starts March 1, base 32F, 2 weightings

Sum of Daily High Temp-32F, or 0,
times Temp^W times Solar^W

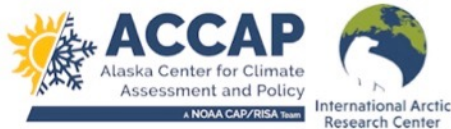
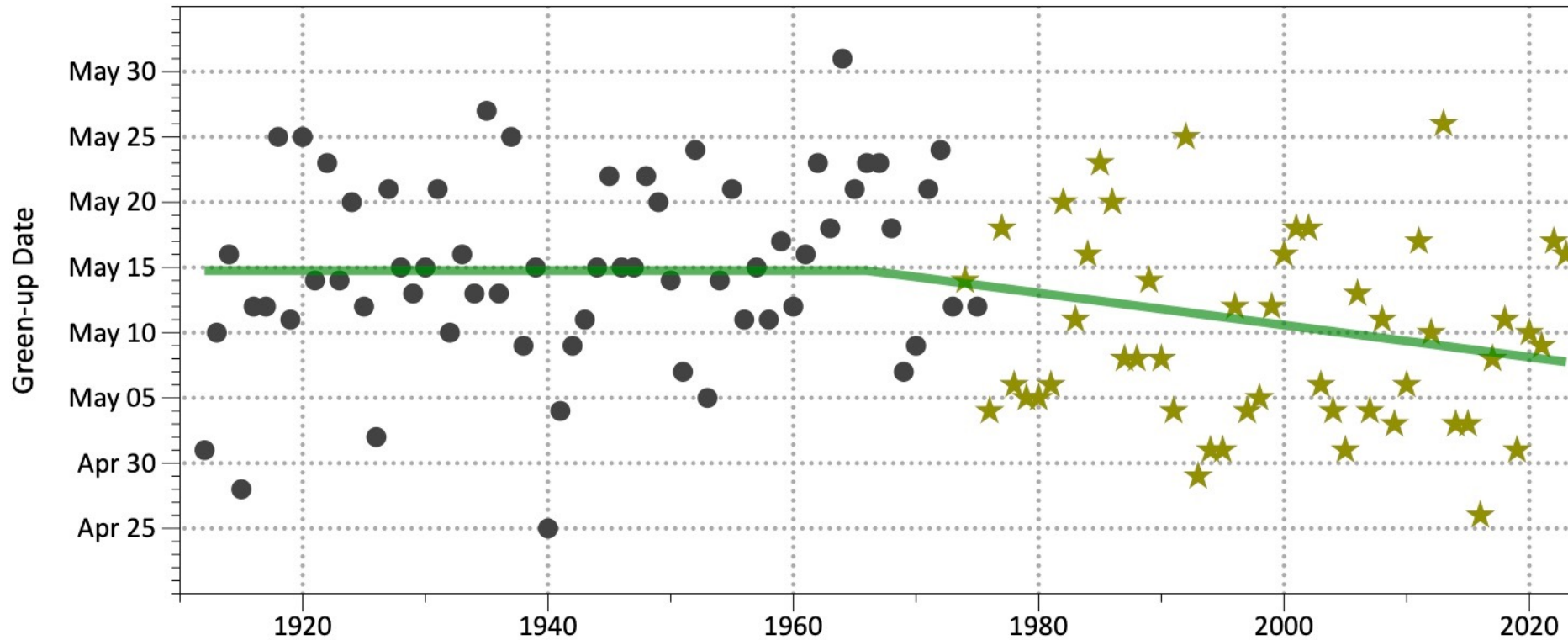
Gives more weight to really warm temps

Accounts for increasing solar input through the Spring



Fairbanks Green-up Hindcast

Fairbanks, Alaska (West Chena Ridge) Observed and Estimated Green-up Date 1912-2023



- Estimated Green-up Date
- ★ Observed Green-up Date
- Smoothed Average

Data source: NOAA/NCEI & NWS





How about a future prediction for sap flow and green-up?

The toolbox

- **Preseason**

- High temperature climatology, possibly tweaked with Climate Prediction Center outlooks
- Correlation with larger scale climate drivers, e.g. El Niño, La Niña

- **In-Season**

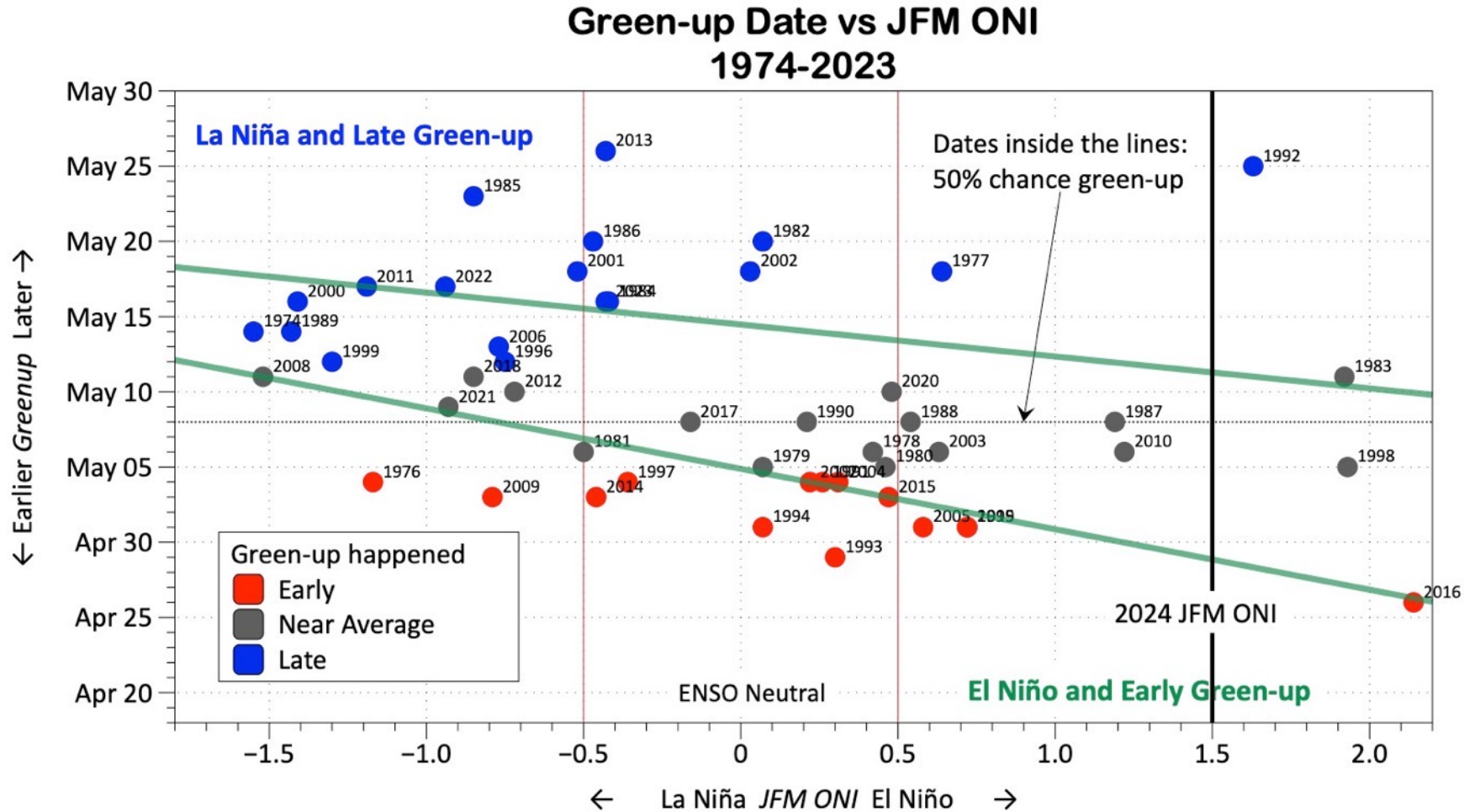
- Weather model high temperatures forecasts
- High temperature climatology, possibly tweaked with CPC outlooks

- **Throughout**

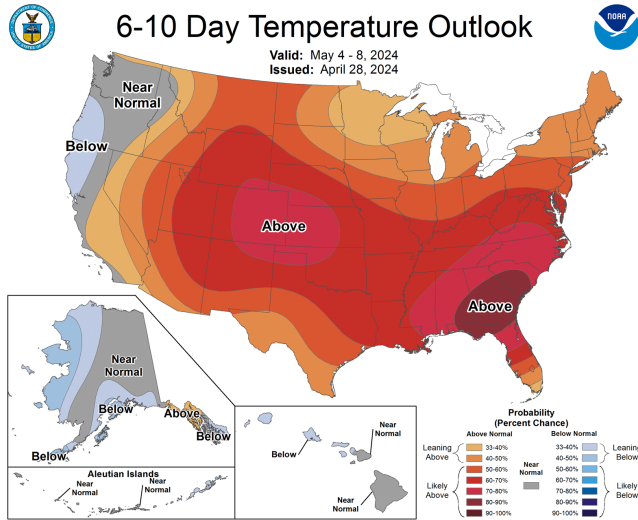
- Probabilistic outlooks due to both uncertain temperature forecasts & other climate & biological factors



El Niño/La Niña as a green-up guide?

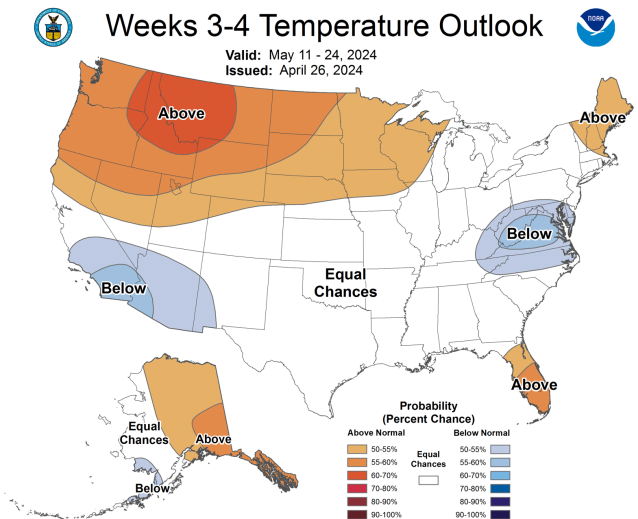
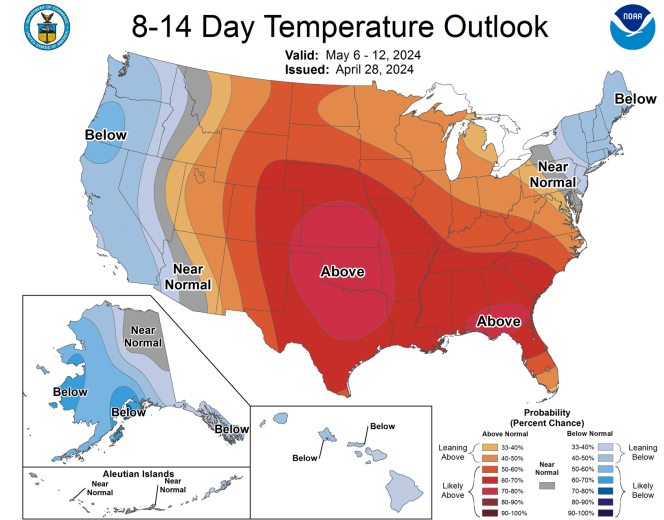


Climate Prediction Center outlooks



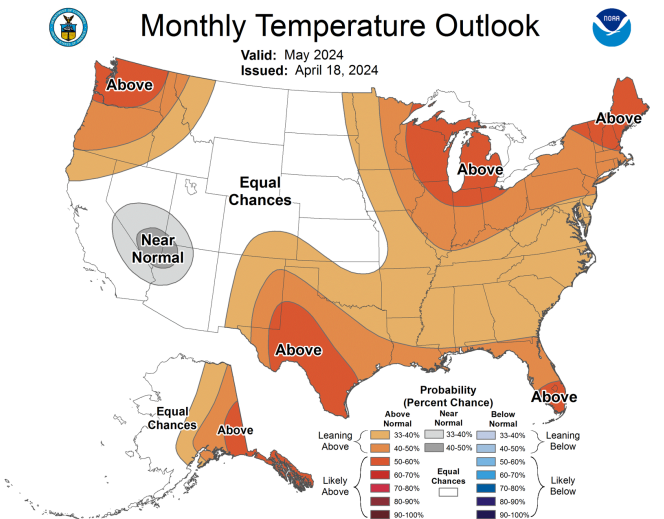
← 6-10 Day

8-14 Day →

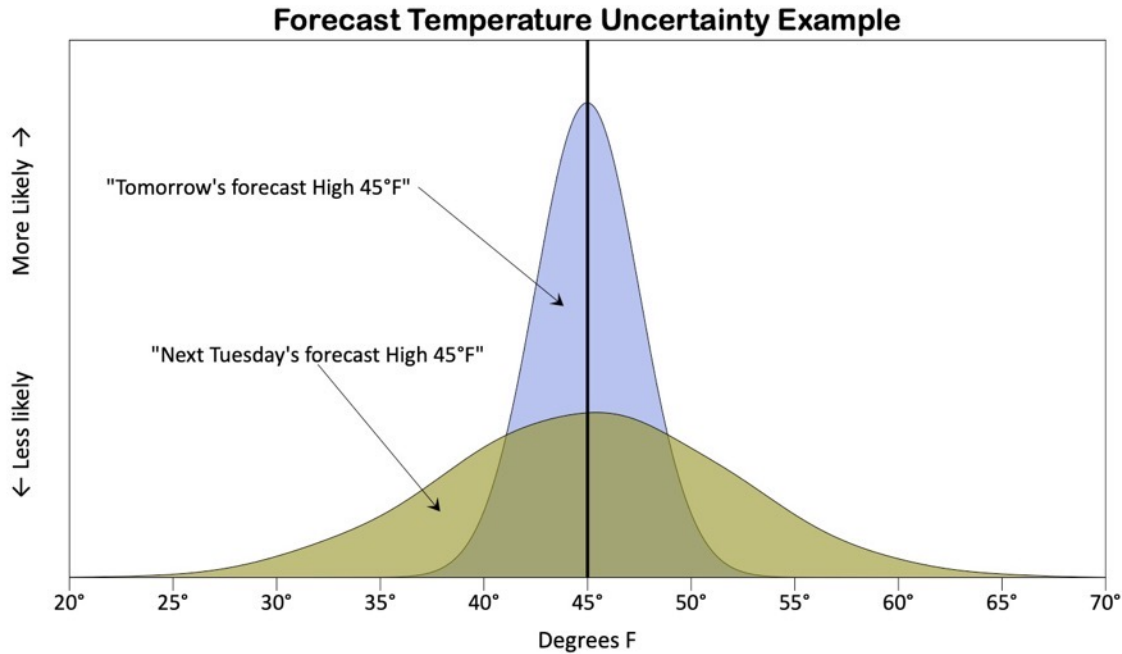


← 15-28 Day

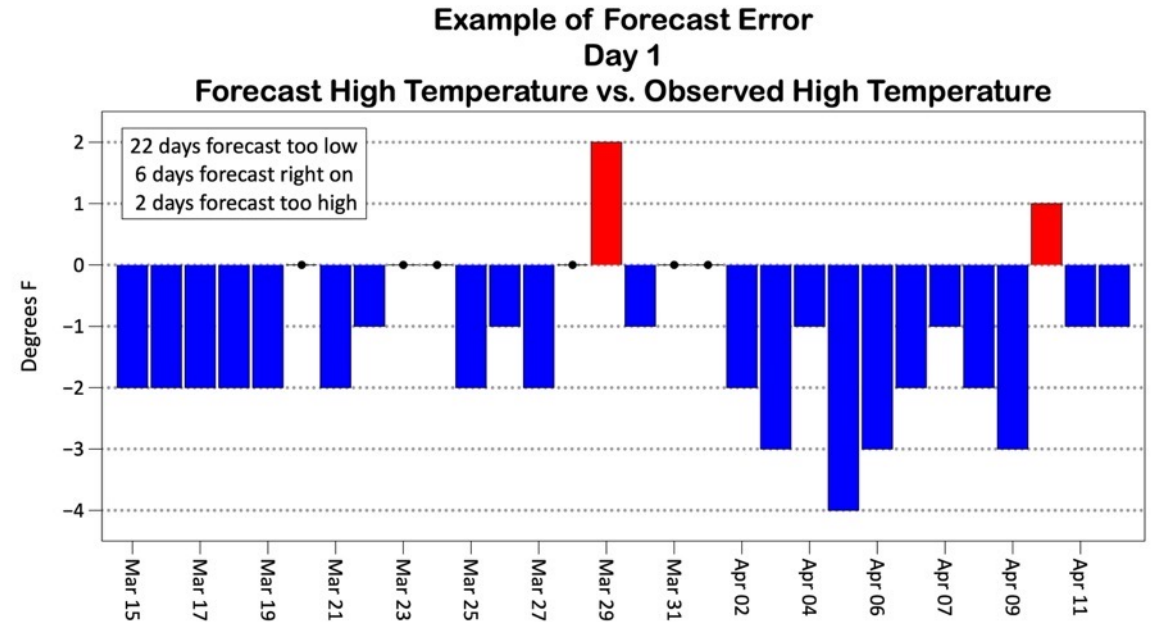
Monthly →



In-season forecasts: single day uncertainty



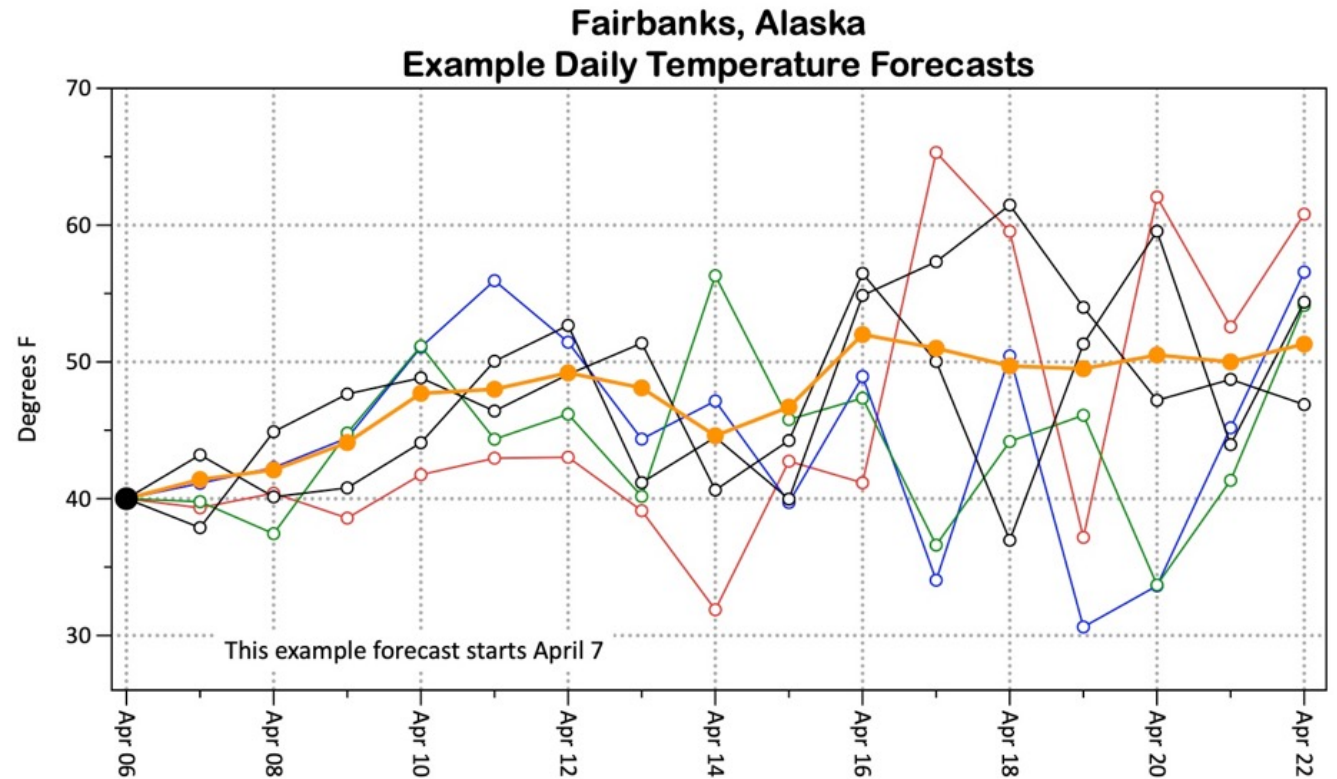
Uncertainty in day-to-day weather forecasts increases with time



Systematic error in weather model forecasts

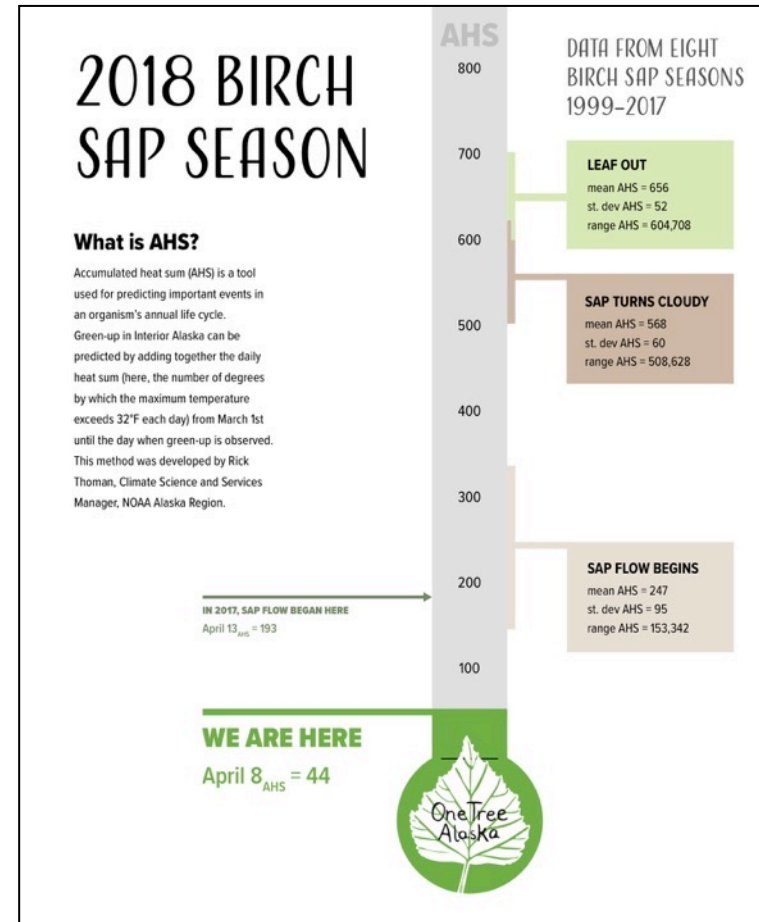
In-season forecasts: multi-day uncertainty

- Account for day-to-day persistence
- Constrained to climate reasonability
- 1000s of simulations



When does sap flow start?

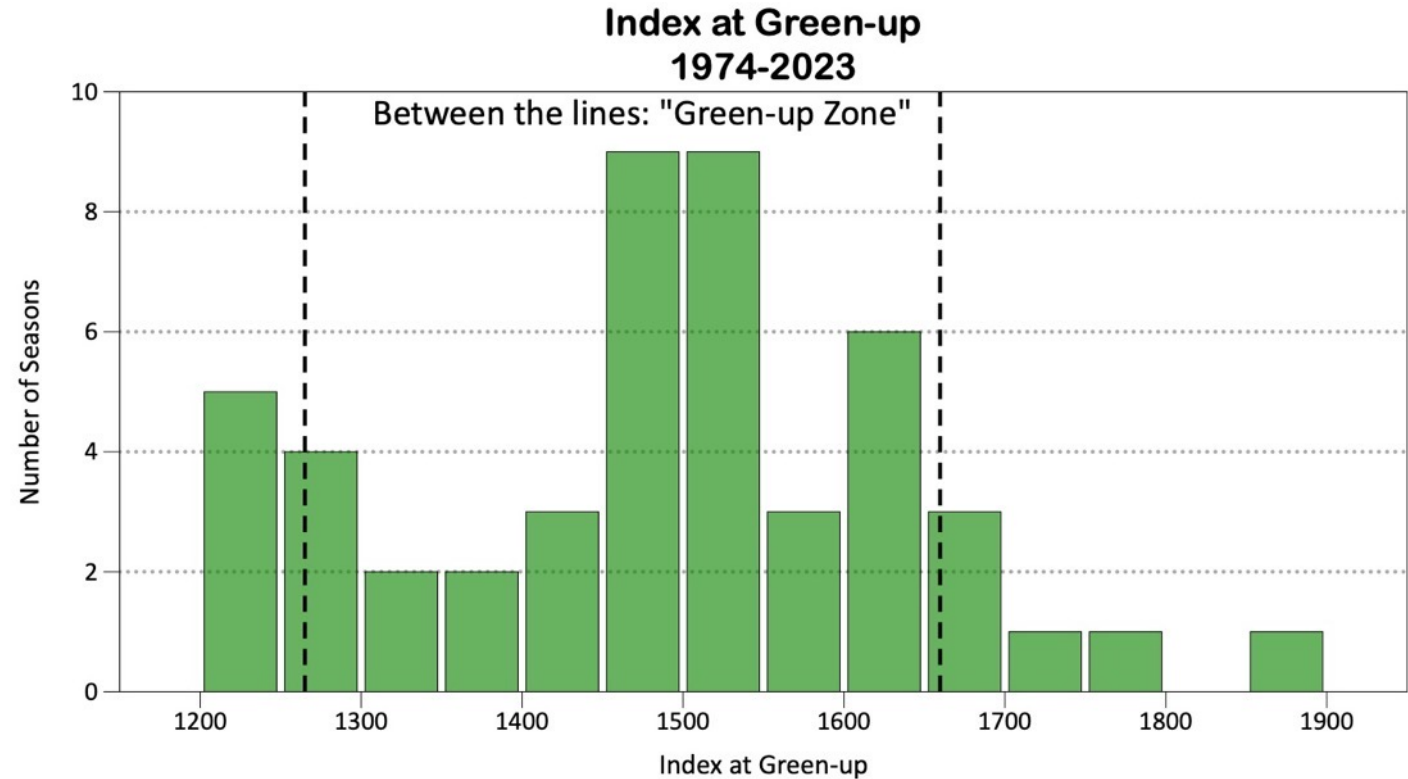
- Sap flow initiation date more variable than green-up
 - Location, elevation and aspect
- Fewer years of observations than green-up and not all directly comparable
- Based on sum of high temperatures above freezing starting March 1
 - Once we have temperature forecasts we can make a sap flow initiation forecast



OneTree Sap Flow

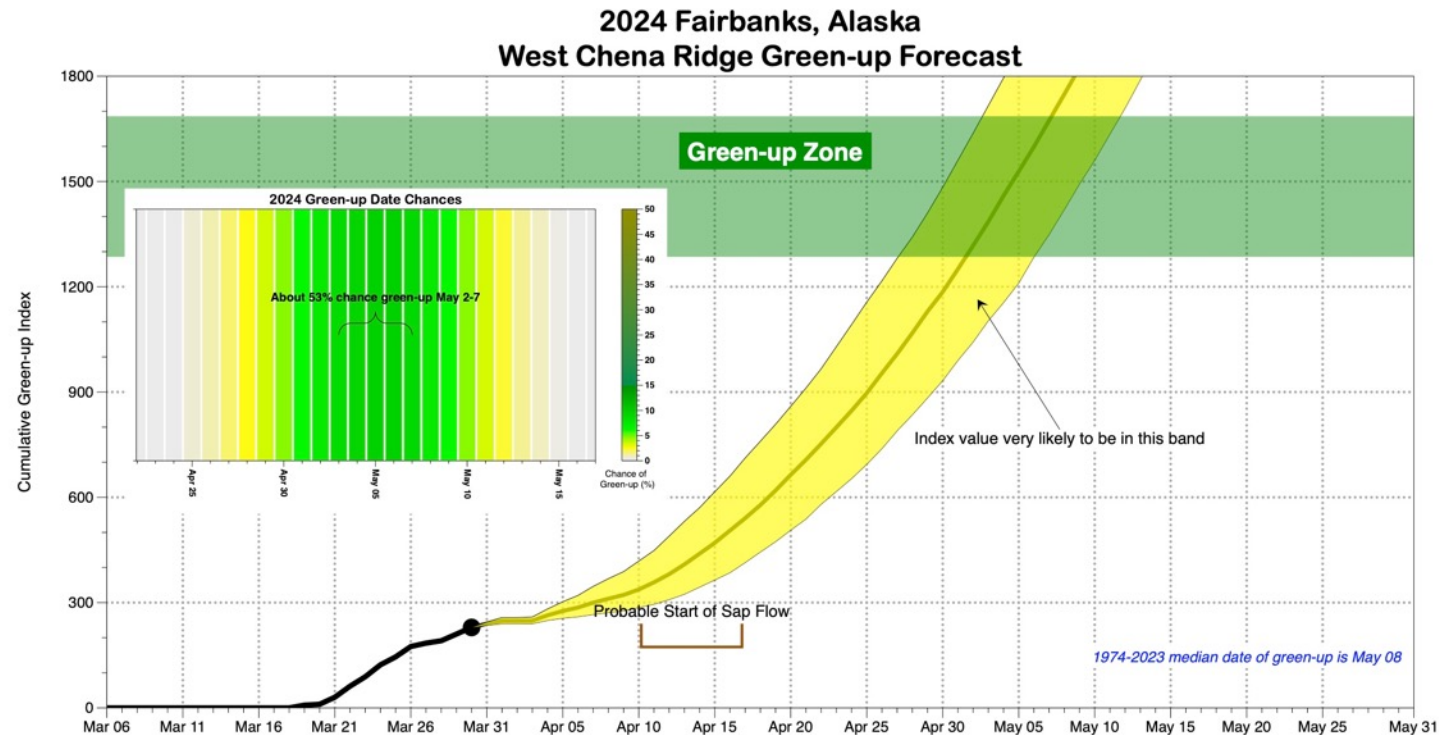
So when will it green-up?

- Using 49 years of index values at green-up, we can assign a probability of green-up every day of the forecast
- Green-up occurred 80% of springs while index in the “green-up zone”



In-season forecasts: putting it together

- First 12 days: weather model high temps with spread and systematic error adjustments
- 13-days to end of May: climate normal high temps (possibly tweaked by CPC outlooks) plus climate spread
- Summarize 1000s of simulations



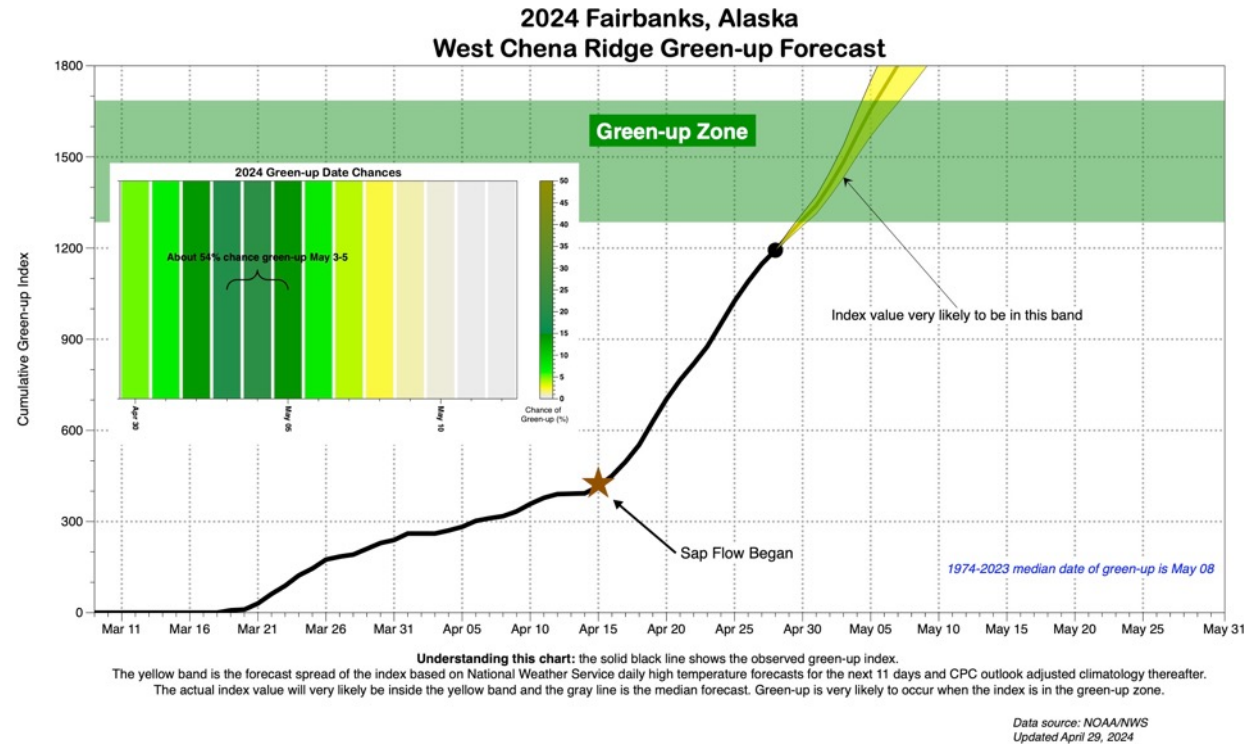
Understanding this chart: the solid black line shows the observed green-up index.
The yellow band is the forecast spread of the index based on National Weather Service daily high temperature forecasts for the next 11 days and CPC outlook adjusted climatology thereafter.
The actual index value will very likely be inside the yellow band and the gray line is the median forecast. Green-up is very likely to occur when the index is in the green-up zone.

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Data source: NOAA/NWS
Updated March 31, 2024

2024 green-up: it's imminent

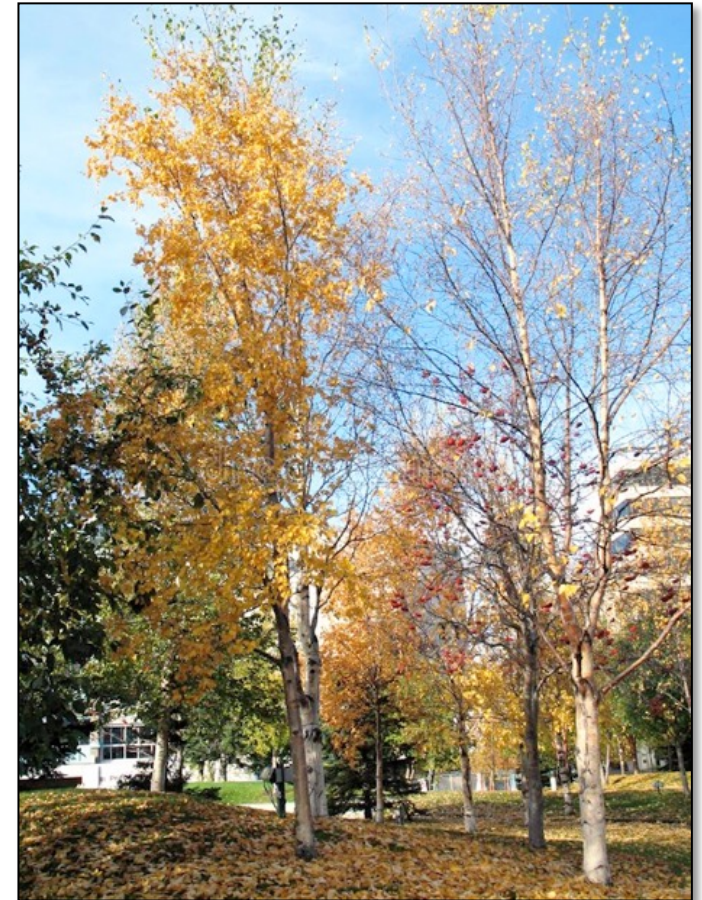
- Early boast with March mildness
 - March 27: Model showed a 51% chance green-up May 2-7
- Index moving into the green-up zone
- As of Monday
 - 49 percent chance of green-up by late Friday
 - 54 percent chance of green-up Friday or this weekend



Does this work elsewhere?

Developed exclusively for one Interior Alaska southeast facing ridge

- Some local systematic differences around Fairbanks (e.g. south facing Birch Hill)
- Delta Junction: works okay
- Anchorage: seems to work okay BUT only for birch/aspen
- Central British Columbia: not so good



Summary

- Fairbanks has a unique, multi-decadal time series of green-up dates
- Green-up Index to estimate green-up date with simple climate data
- Predicting sap flow and green-up possible given reasonable daily high temperature forecasts

Thursday, April 13, 2017 Fairbanks Daily News-Miner **A3**

INTERIOR

Put your guessing skills to the test with green-up contest

Spring is finally here. Or is it? Some say the season arrives when the first goose is spotted at Creamer's Field. But some insist spring officially begins when the leaf buds of birch and aspen trees burst open.

 **Kris Capps**
COMMUNITY EDITOR
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Service makes the official call on that day. In 2016, green-up was

tvwatershed.org/greenupday. You can also go to the TVWA office in the Lathrop Building downtown, 516 Second Ave., Suite 412. Proceeds from the contest, after administrative costs, are divided between TVWA and ThrivAlaska.

nature trails near Creamer's Field for children to explore, through Thread Alaska, another agency that connects early childcare and education. "We made slices of trees, so kids could count rings," said Bryn McElroy, of TVWA. Alaska Fish and Wildlife

the green-up contest is two Alaska Airlines tickets. Second place is two Ravn airline vouchers.

Storm drain art

Storm drains on Gillam Street are the focus of this



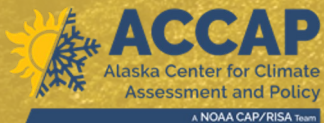
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Thank you

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- To ACCAP, OneTree Alaska & Jan Dawe for encouraging this work.
- To those who recorded green-up over the decades
- To Ted Fathauer for starting this project all those years ago

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ACCAP is housed at the International Arctic Research Center on the University of Alaska Fairbanks Troth Yeddha' Campus