Chilling & Prunes

Katherine Pope

UCCE Farm Advisor

Yolo-Solano-Sacramento

TAKE AWAYS

1) Chill is not great, but not too bad

2) Chill portions is a better way to count chill

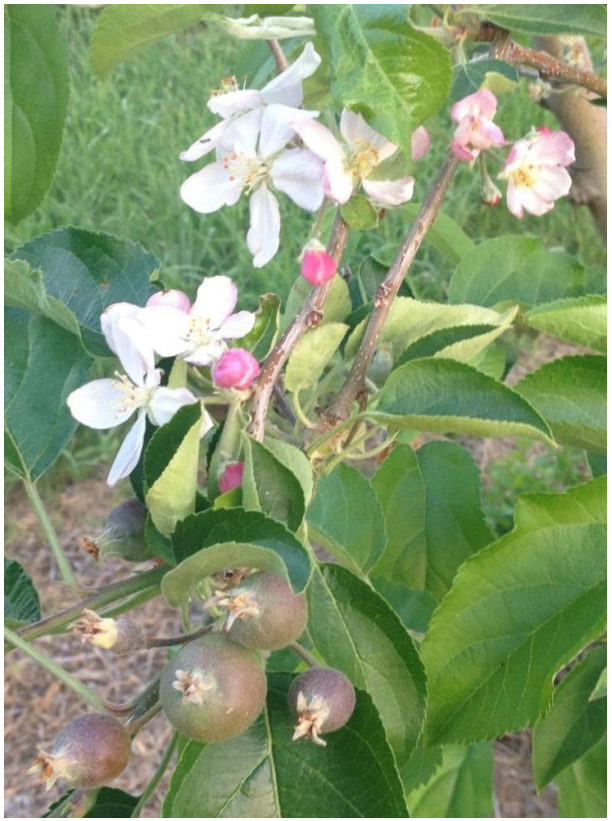
3) Follow chill portions at the
UC Fruit & Nut Center website.

Overview

- Why chill matters
- Why *how* you count chill matters
- Bonus complication: Fog
- What's under the hood of Chill Portions model
- How to count and use chill portions
- What to do *this* year

Why Chill Matters – Poor, Erratic Bloom

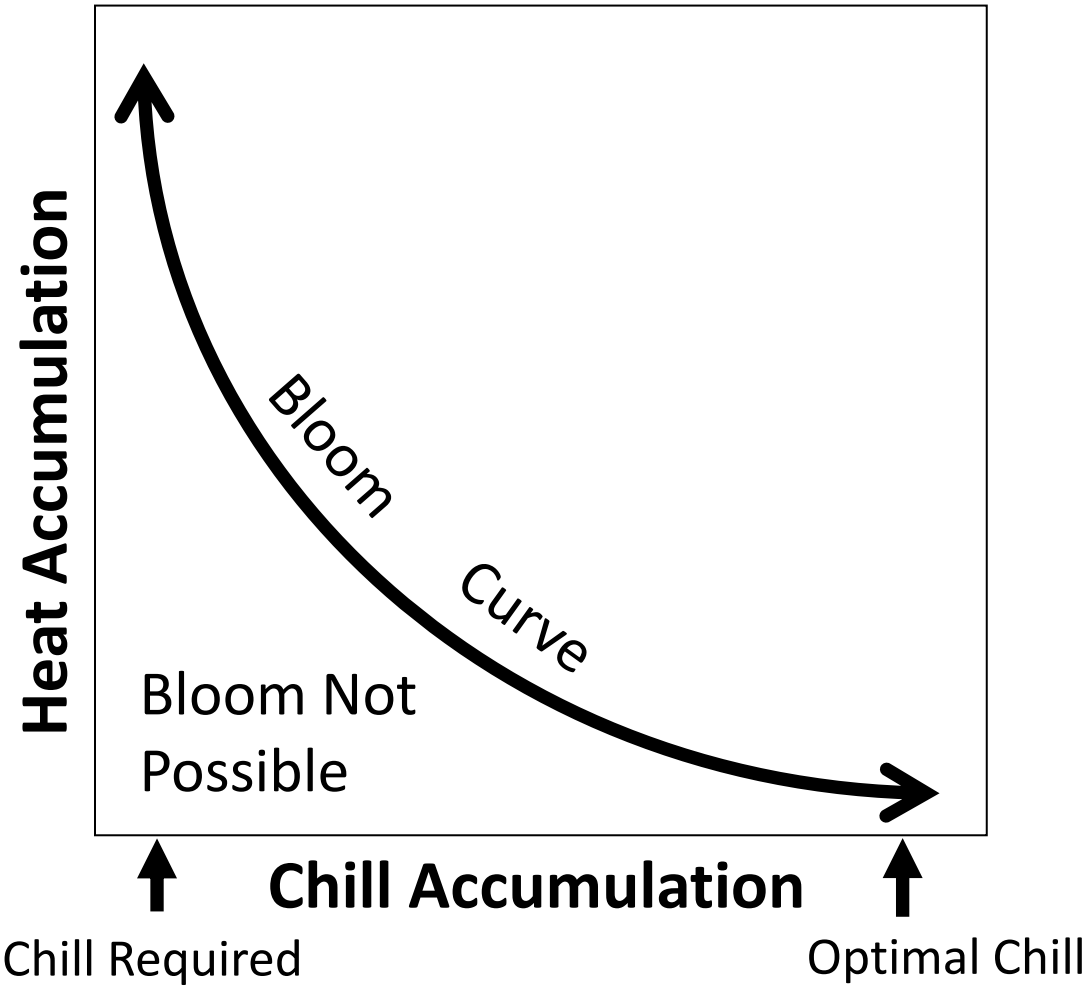
- Delayed, protracted, weak budbreak
- Bare shoots, spur shortage



- Poor fruit devel't, irregular ripening
- Underdeve'pd, abscising buds

Saure, 1985 ; Black, 1952 Photos: K. Pope

Why Chill Matters – Delayed Bloom



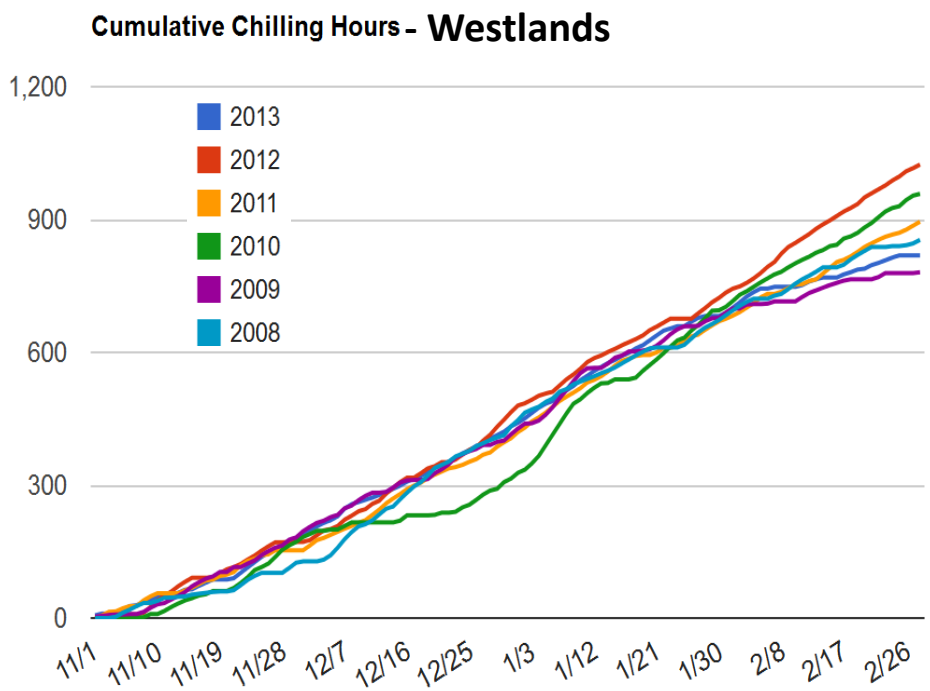
Pope et al. (2014) AFM

Why how you count chill matters: Literature supporting chill portions

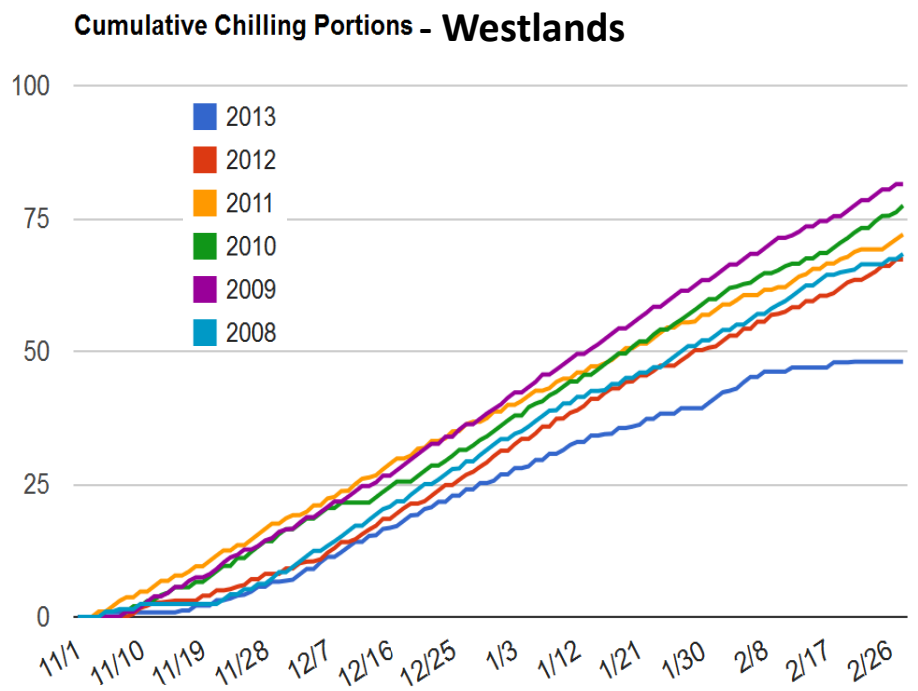
Lead Author	Year Pub'd	Crop	Location
Ramirez	2010	Almond	Chile
Viti	2010	Apricot	Spain, Italy
Gao	2012	Apricot	China
Ruiz	2007	Apricot	Spain
Alburquerque	2008	Cherry	Spain, Fr., Can., NY, CA
Glozer	2005	Cherry	California
Allan	1995	Peach	South Africa
Linsley-Noakes	1994	Peach	South Africa
Erez	1990	Peach	South Africa
Ghrab	2014	Peach	Tunisia
Maulion	2014	Peach	Argentina
Miranda	2013	Peach	Spain
Glozer	2008	Pear	California
Elloumi	2013	Pistachio	Tunisia
Zhang	2011	Pistachio	Australia
Glozer	2006	Prune	California
Luedeling	2009	Walnut	California

Last Year's Experience: Chill Hours vs. Chill Portions

According to chill hours, 2013-2014 was an **average** winter.



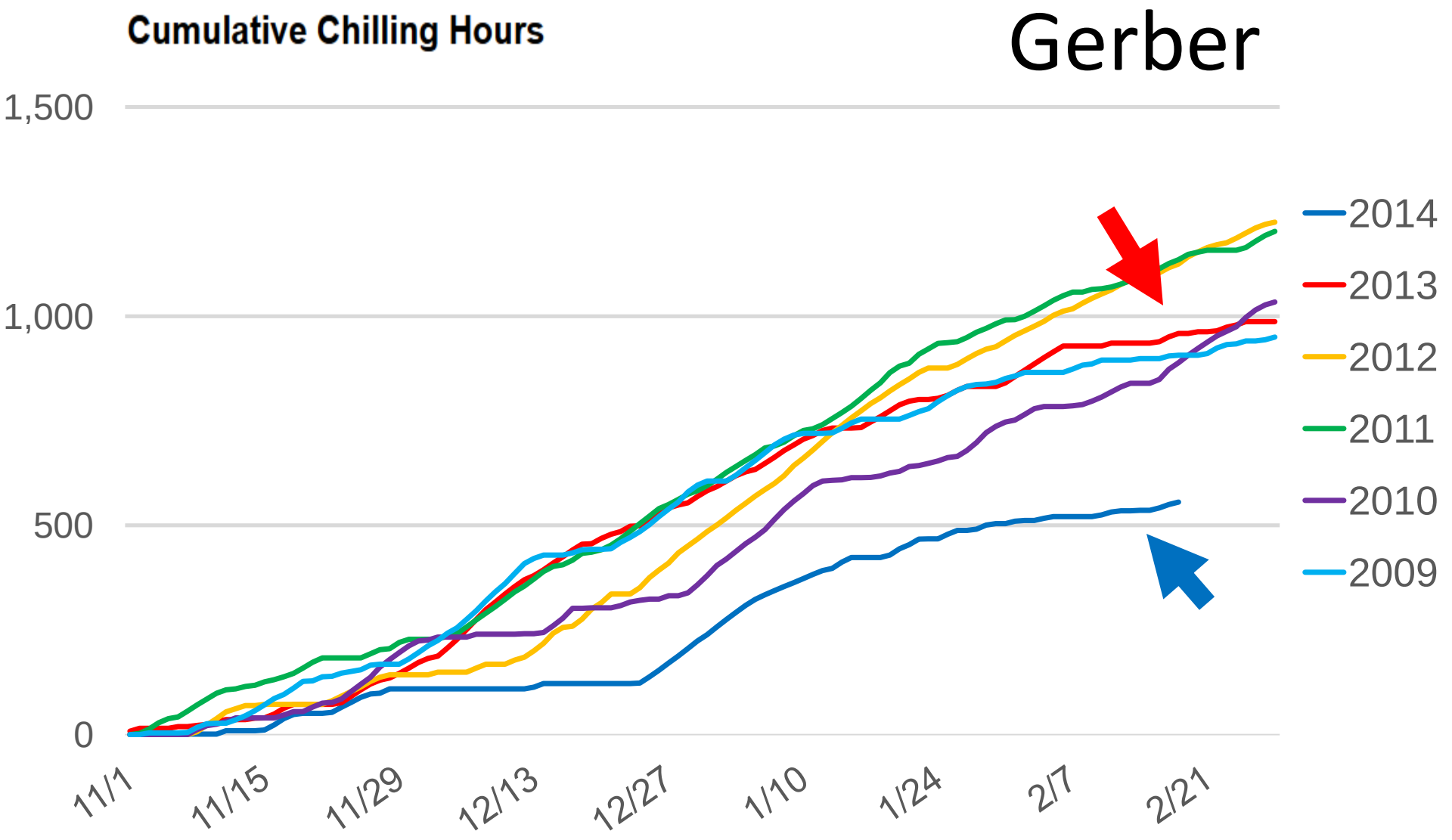
According to chill portions, 2013-2014 was unusually warm.



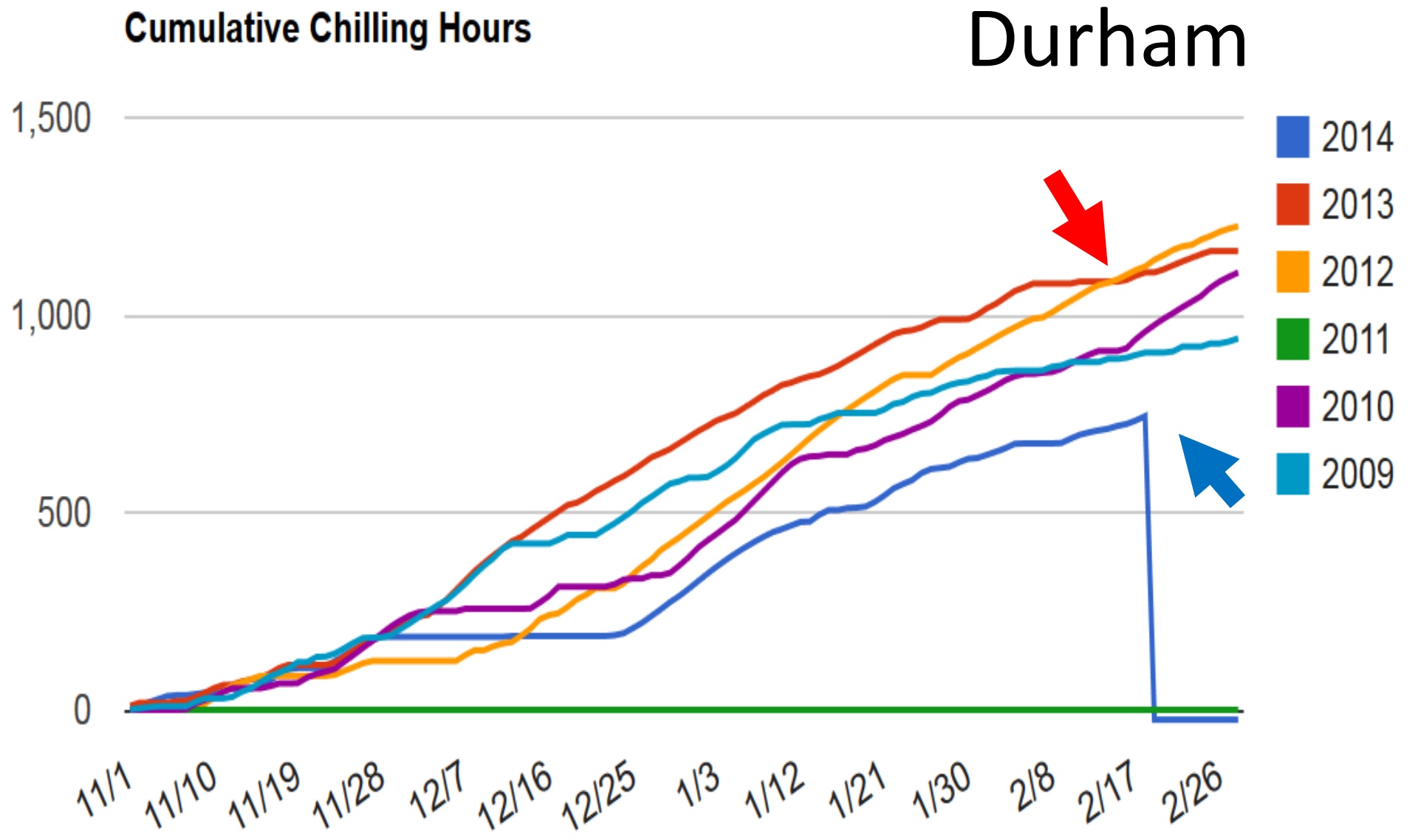
Figures: fruitsandnuts.ucdavis.edu

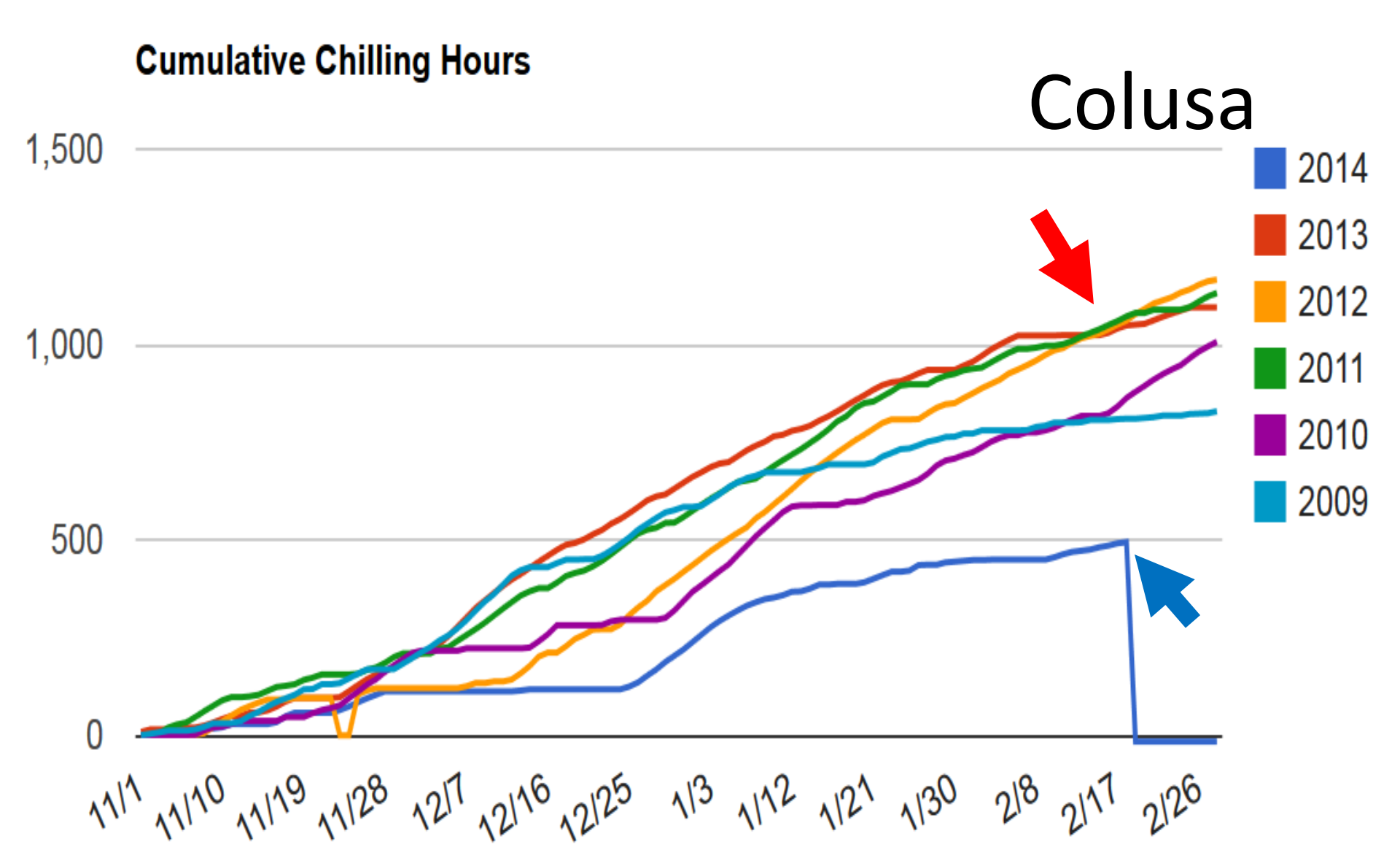
This year, chill hours look awfully low. But chill portions are on track with last year.

Gerber


Cumulative Chilling Hours
1,500
1,000
500
0
11/1
11/15
11/29
12/13
12/27
1/10
1/24
2/7
2/21
2014
2013
2012
2011
2010
2009

Durham


Cumulative Chilling Hours
1,500
1,000
500
0
11/1
11/10
11/19
11/28
12/7
12/16
12/25
1/3
1/12
1/21
1/30
2/8
2/17
2/26
2014
2013
2012
2011
2010
2009


Cumulative Chilling Hours
Colusa
1,500
1,000
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11/1
11/10
11/19
11/28
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2/8
2/17
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2014
2013
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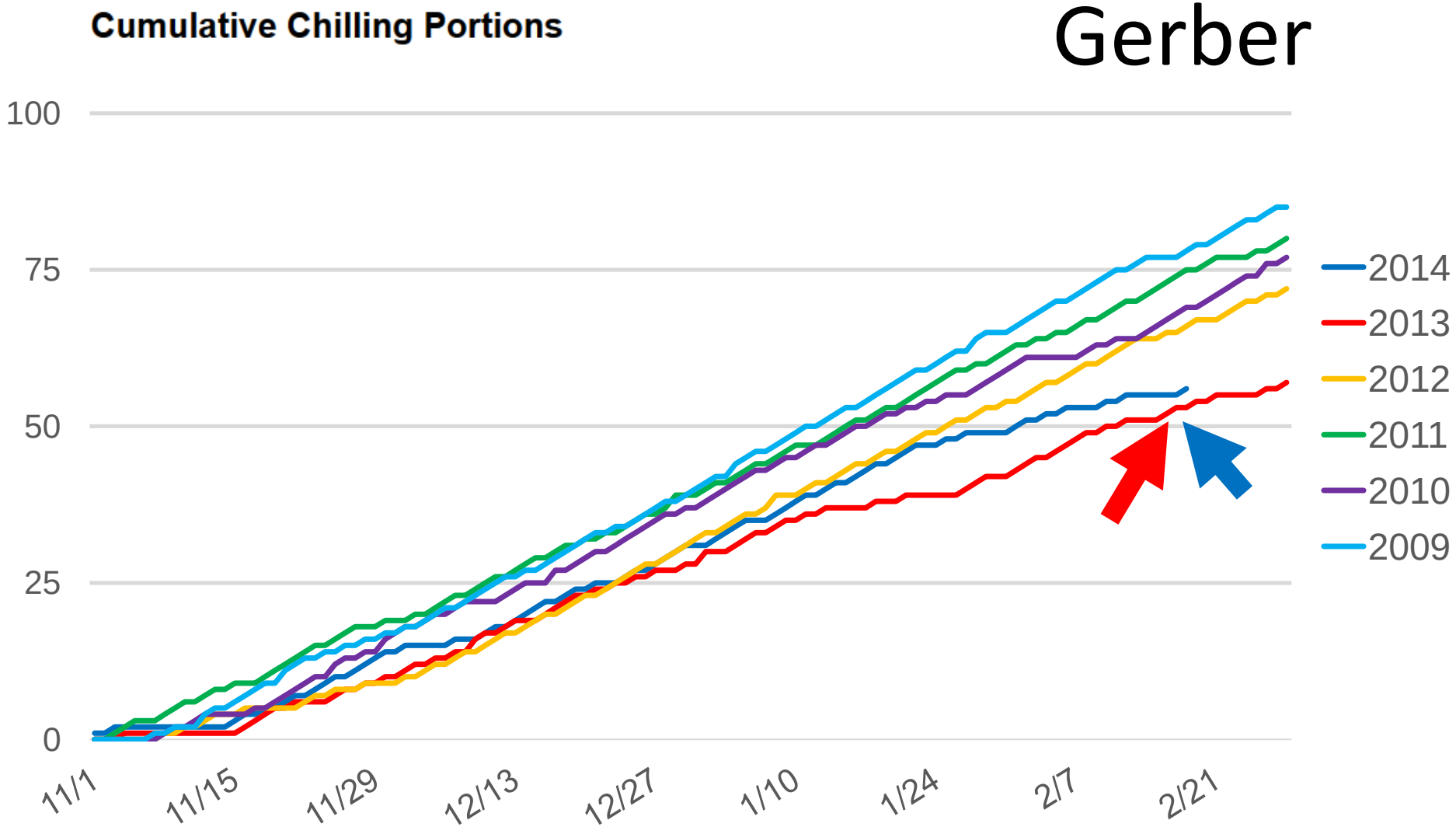
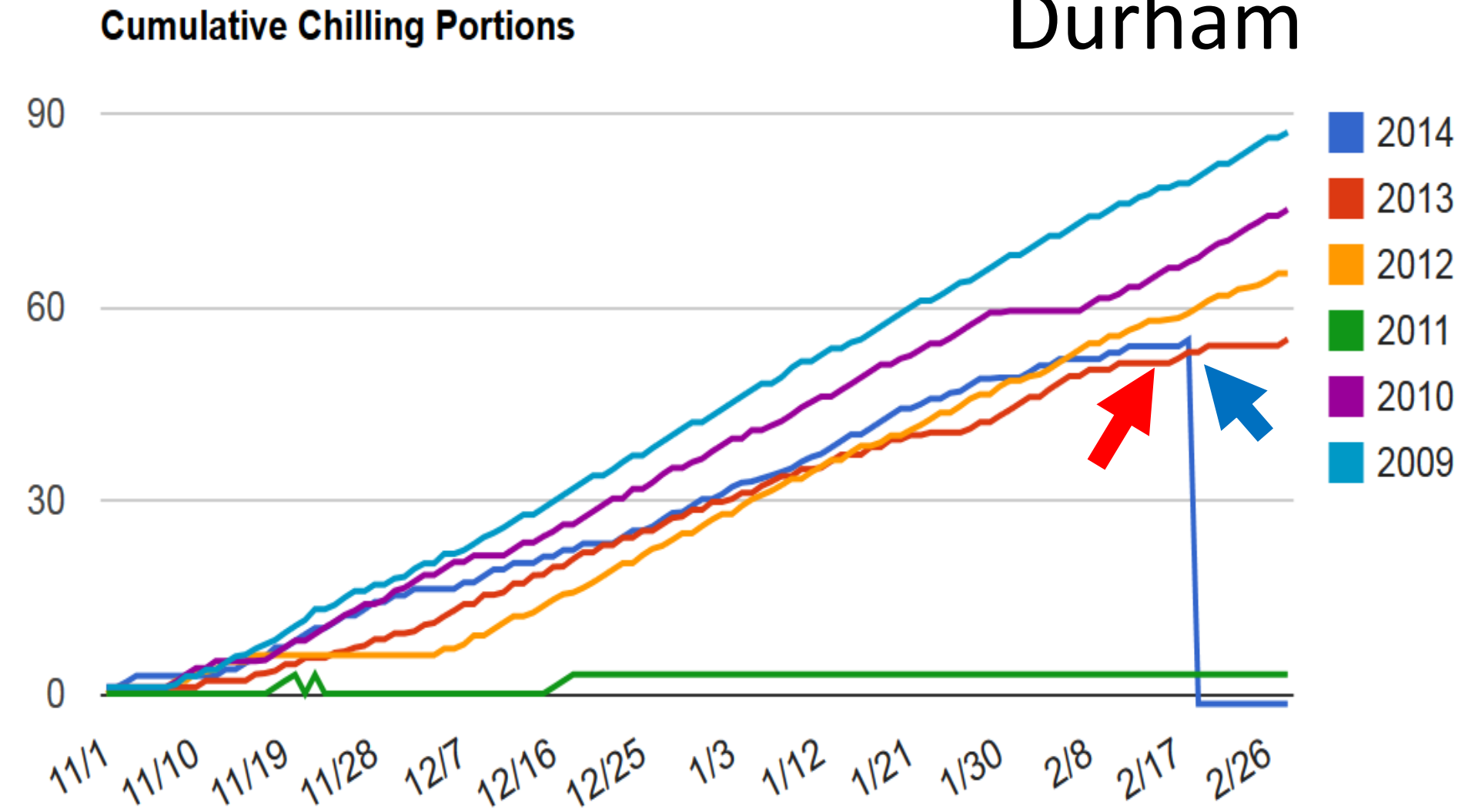
2011
2010
2009

Gerber


Cumulative Chilling Portions
100
75
50
25
0
11/1
11/15
11/29
12/13
12/27
1/10
1/24
2/7
2/21
2014
2013
2012
2011
2010
2009

Durham


Cumulative Chilling Portions
90
60
30
0
11/1
11/10
11/19
11/28
12/7
12/16
12/25
1/3
1/12
1/21
1/30
2/8
2/17
2/26
2014
2013
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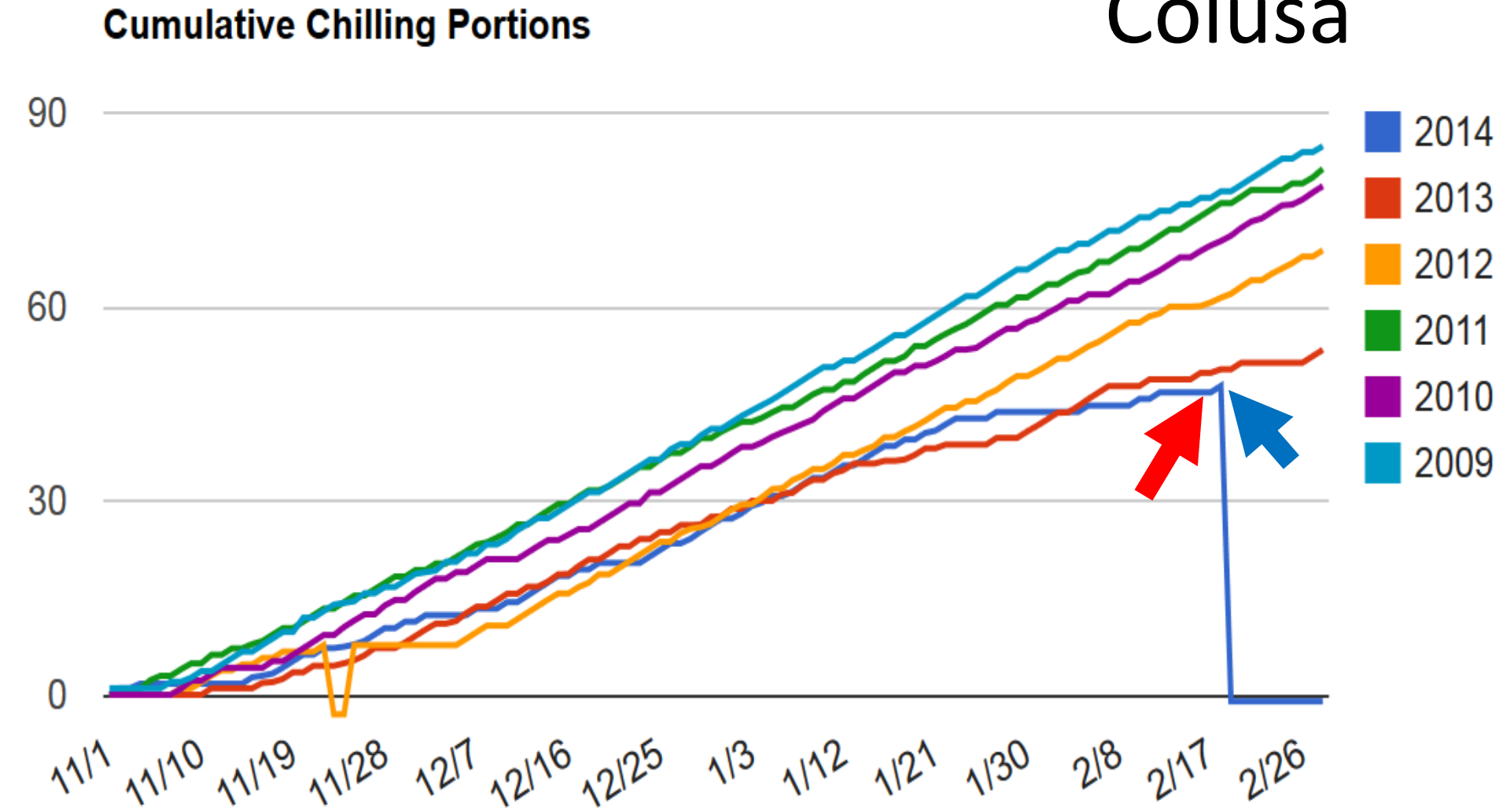
Colusa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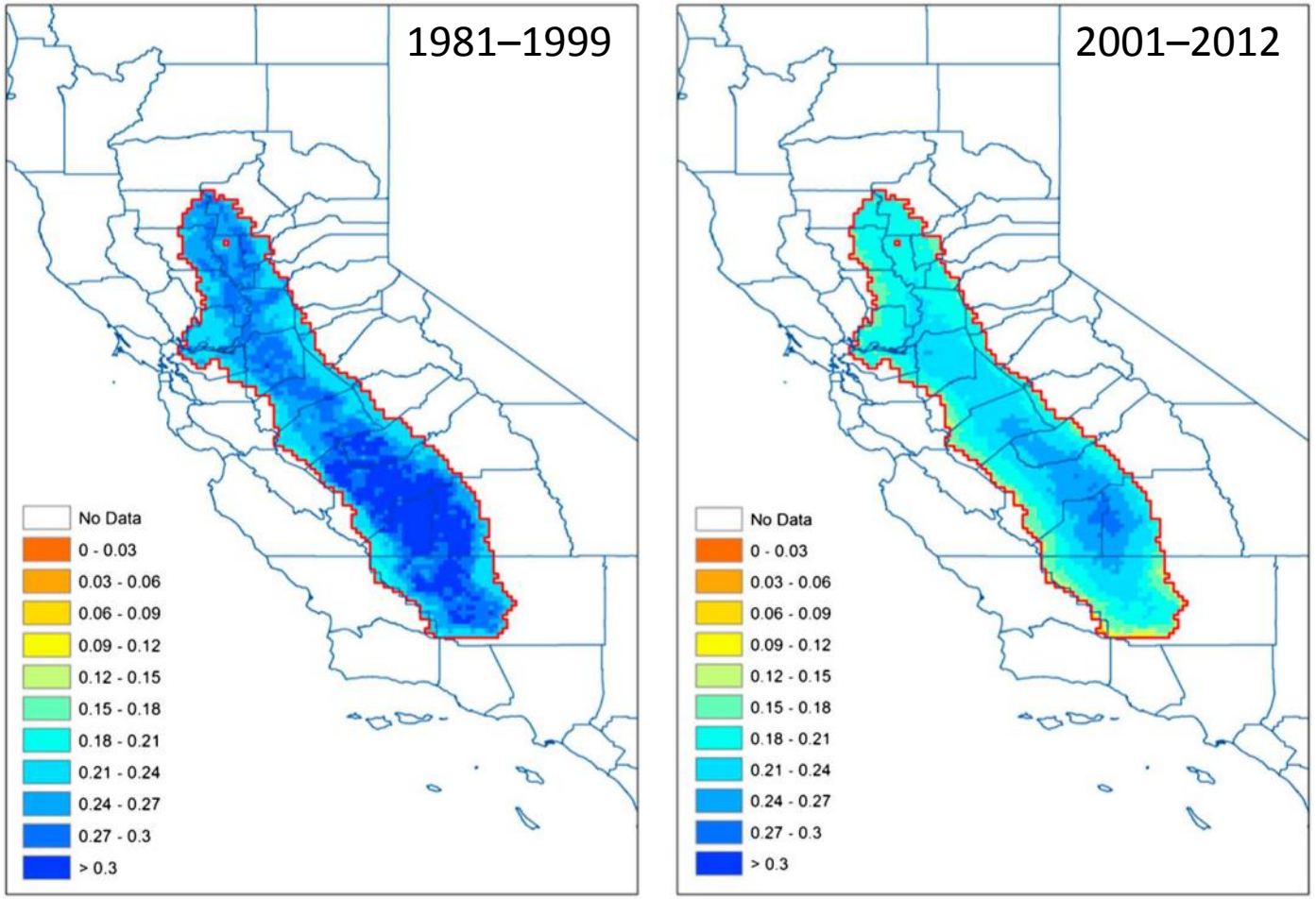
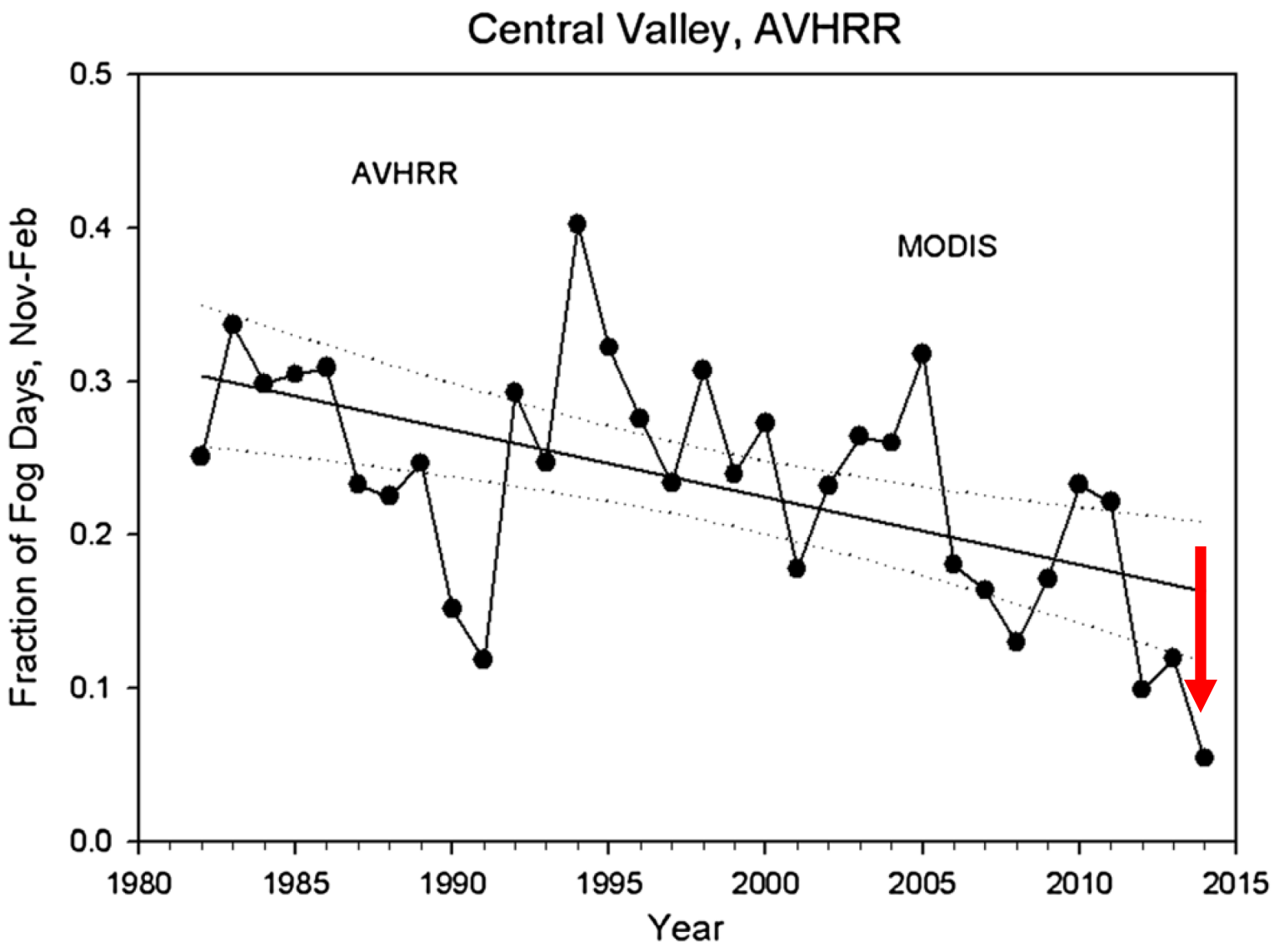
1/3
1/12
1/21
1/30
2/8
2/17
2/26
2014
2013
2012
2011
2010
2009

Bonus Complication: Fog
Fog has been decreasing

Time fogged in



Baldocchi & Waller (2014)



Baldocchi & Waller (2014)

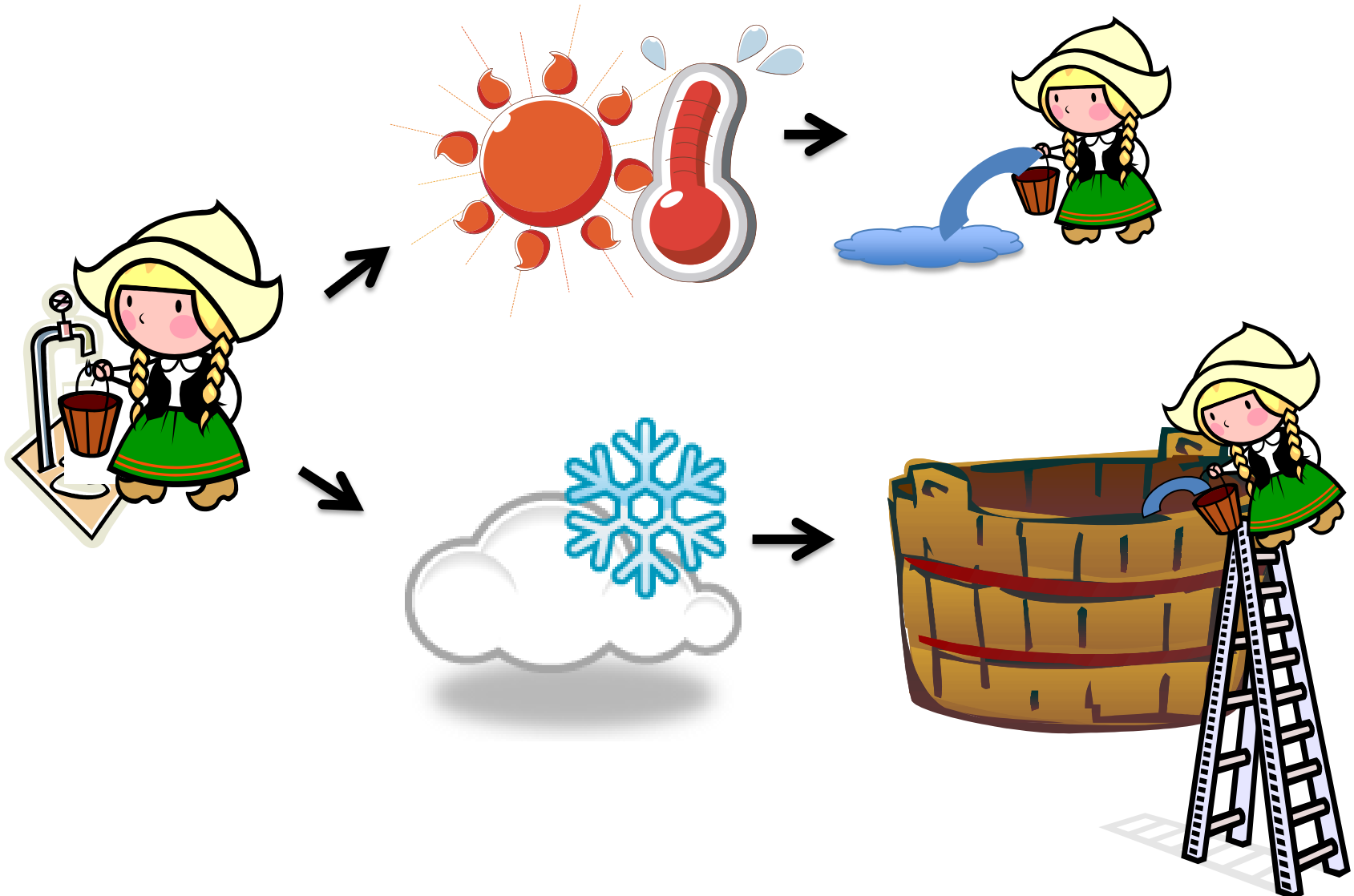
What's "under the hood" of the Chill Portions model?

Dynamic Model – Chill Portions

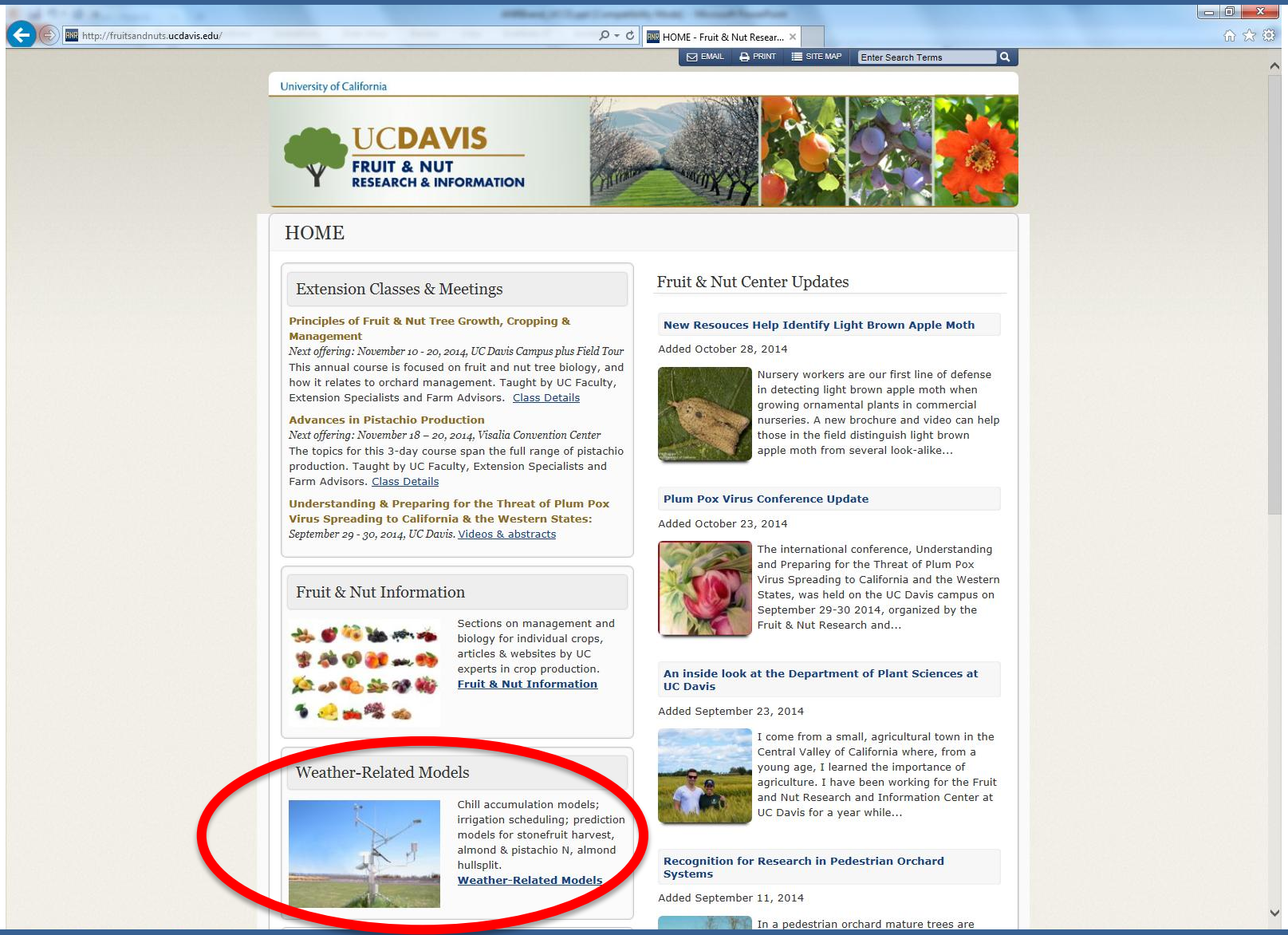
- Different temps have dif. 'chill value.'
  - Max: hours at 43-47° F.
  - No chill value at 32° F and 54° F.
- Rather than saying, 'We had X chill hours but they were warm chill hours.'
- Expands the range of temps considered effective for chill accumulation.

Fishman et al., 1987

Dynamic Model: Filling the Chill Tank

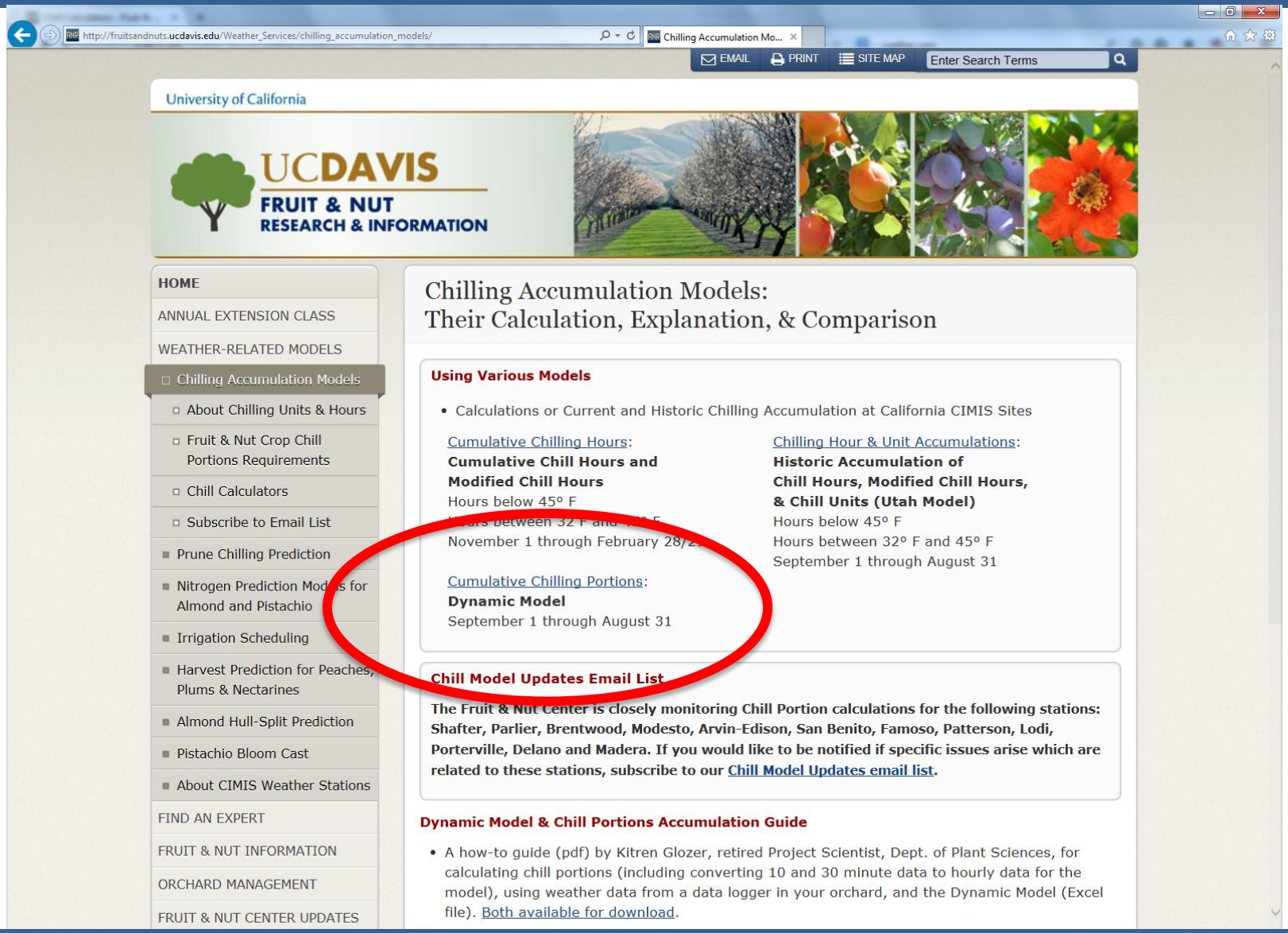


How to count and use chill portions

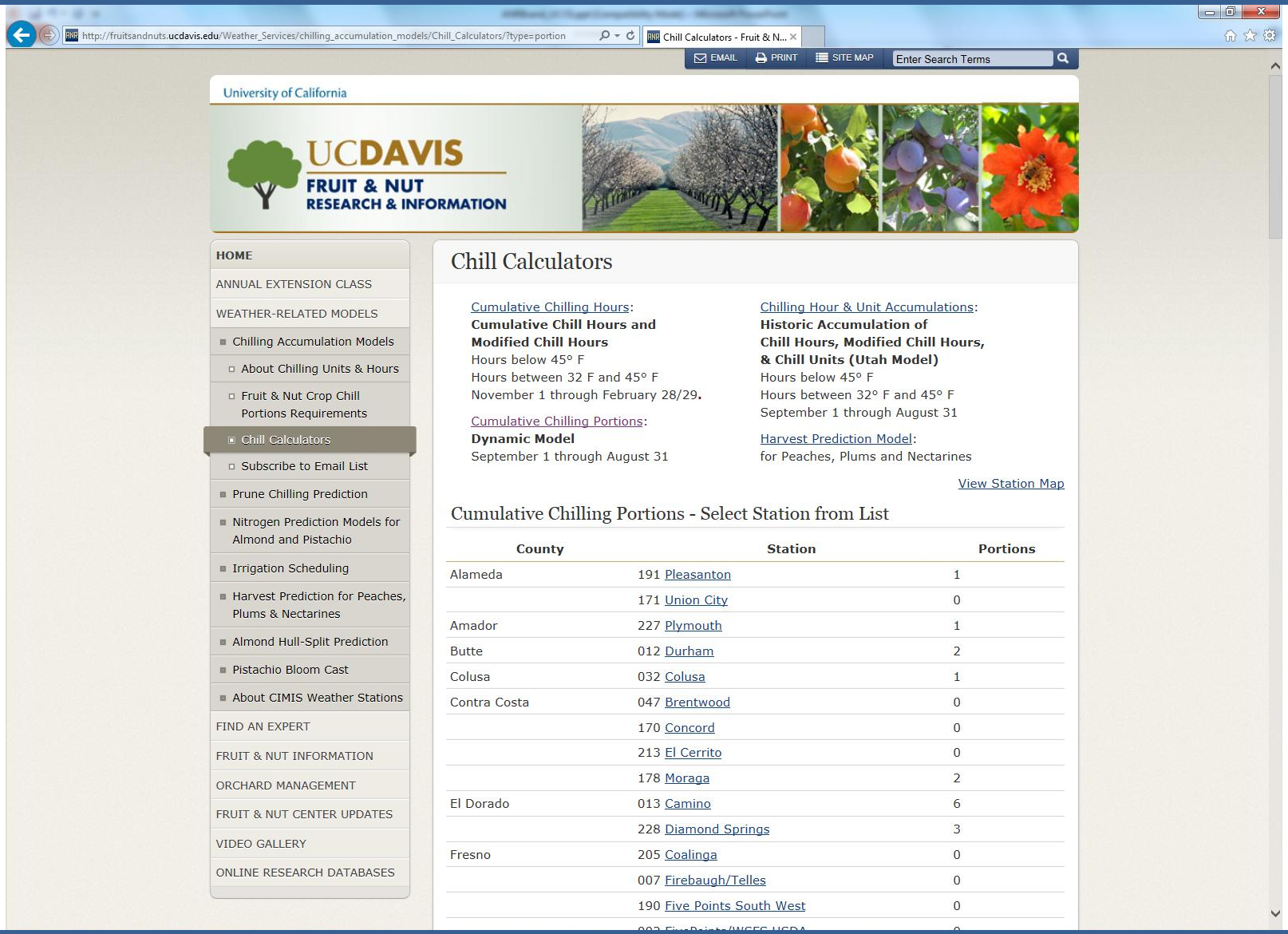


Tracking chill portions on FNRIC

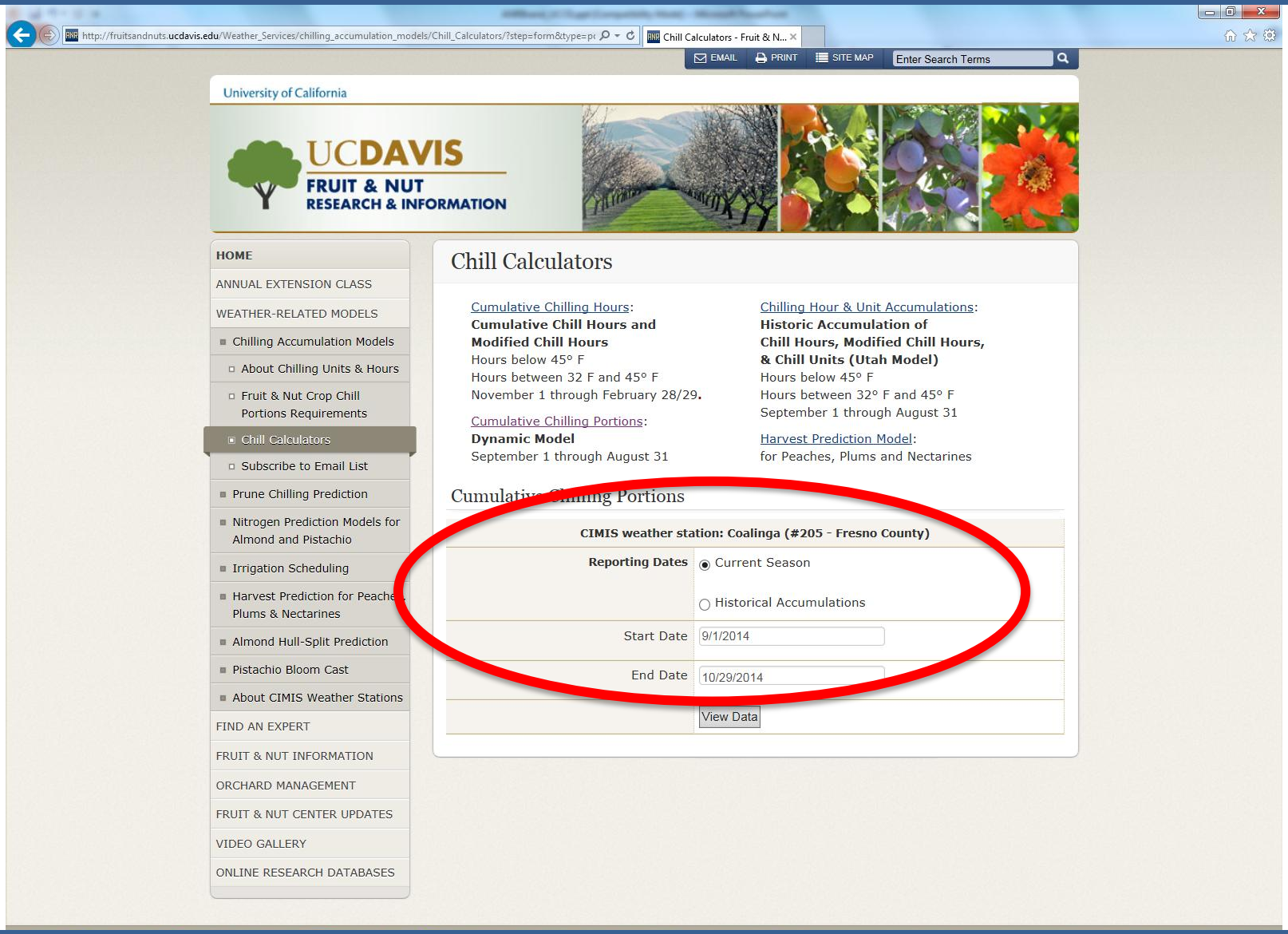
Tracking chill portions on FNRIC



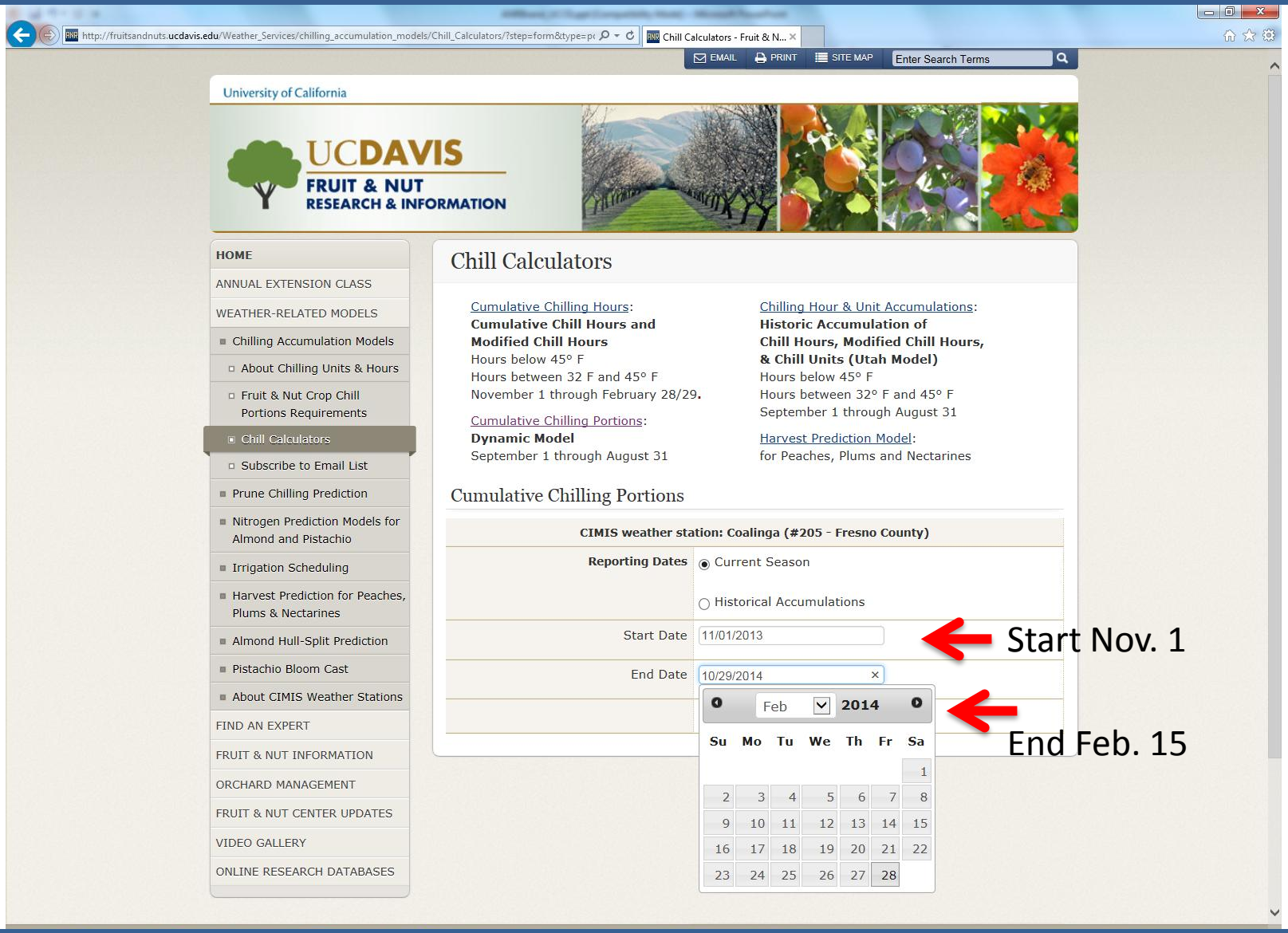
Tracking chill portions on FNRIC



Tracking chill portions on FNRIC



Tracking chill portions on FNRIC



Tracking chill portions on FNRIC

http://fruitsandnuts.ucdavis.edu/Weather_Services/chilling_accumulation_models/Chill_Calculators/index.cfm

Chill Calculators - Fruit & N...

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Chill Calculators

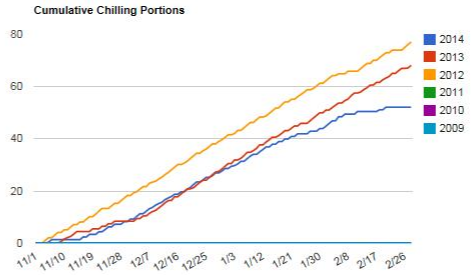
Cumulative Chilling Hours:
Cumulative Chill Hours and Modified Chill Hours
Hours below 45° F
Hours between 32 F and 45° F
November 1 through February 28/29.

Cumulative Chilling Portions:
Dynamic Model
September 1 through August 31

Chilling Hour & Unit Accumulations:
Historic Accumulation of Chill Hours, Modified Chill Hours, & Chill Units (Utah Model)
Hours below 45° F
Hours between 32° F and 45° F
September 1 through August 31

Harvest Prediction Model:
for Peaches, Plums and Nectarines

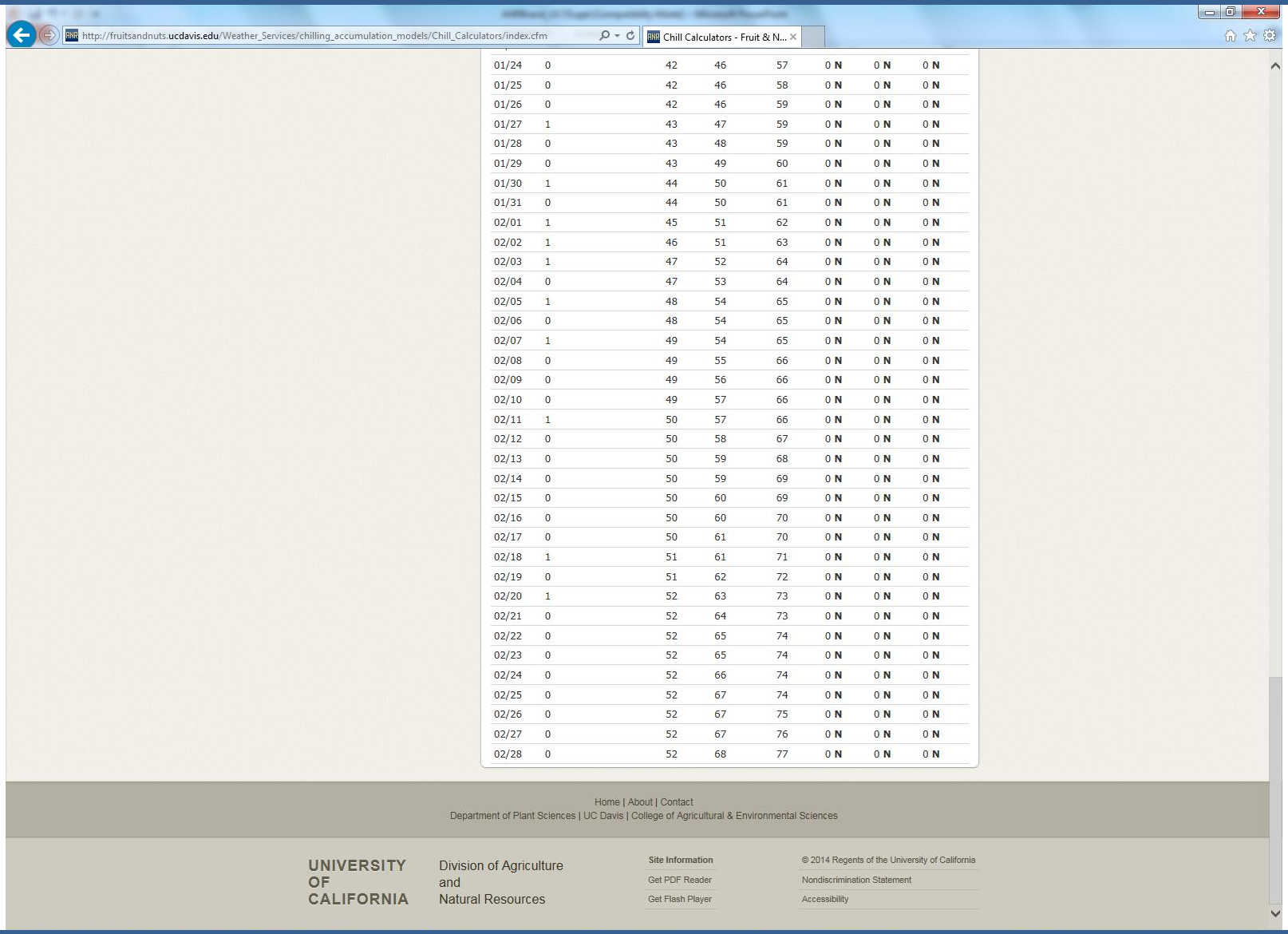
Cumulative Chilling Portions - Station #205 Coalinga - Sep 1 2014 - Oct 29 2014



Log Scale / Normal Scale

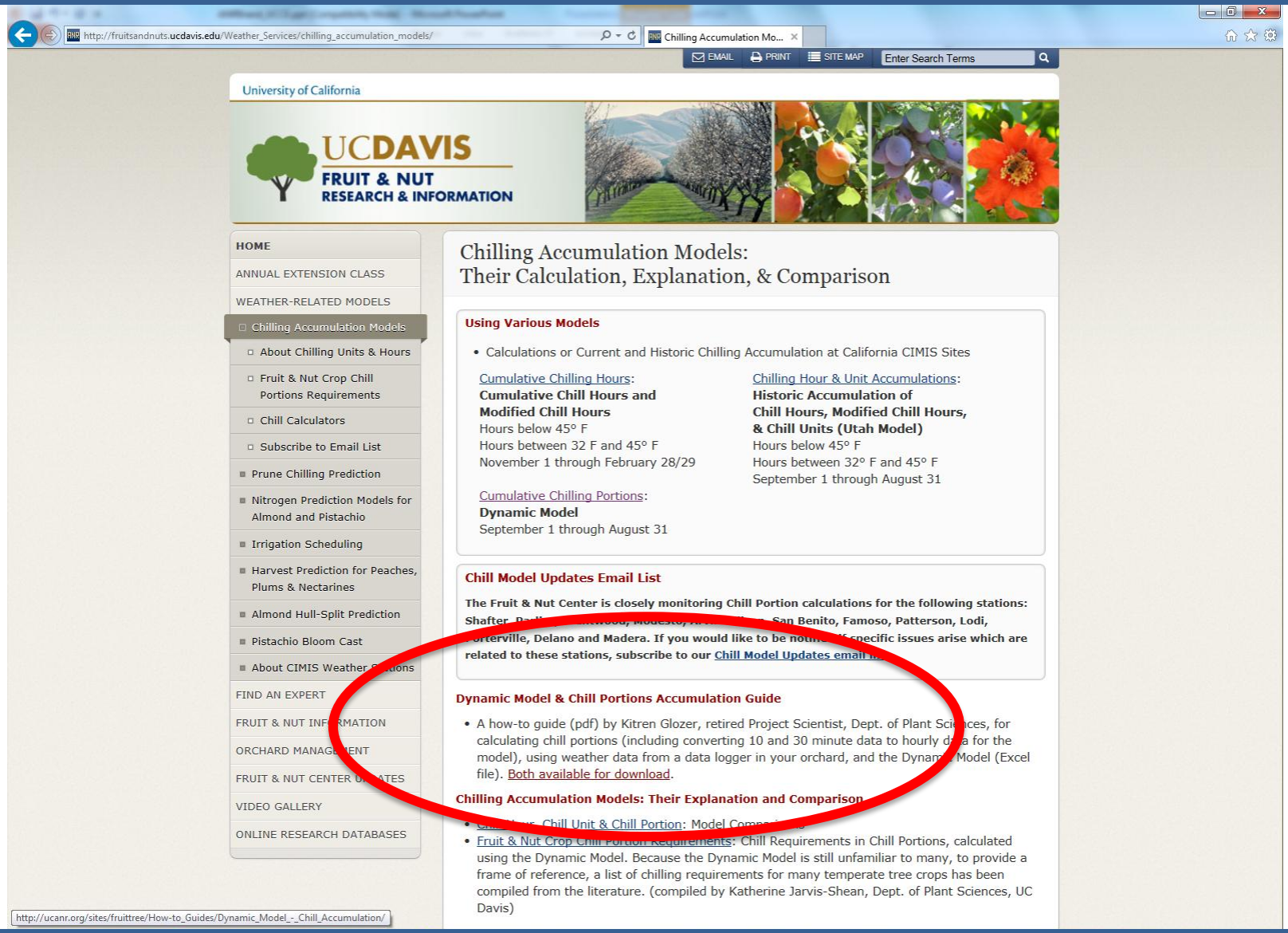
Date	Daily Portions	2014	2013	2012	2011	2010	2009
11/01	0	0	0	0	0 N	0 N	0 N
11/02	0	0	0	0	0 N	0 N	0 N
11/03	0	0	0	0	0 N	0 N	0 N
11/04	0	0	0	1	0 N	0 N	0 N
11/05	0	0	0	2 M	0 N	0 N	0 N
11/06	1	1	0	2	0 N	0 N	0 N
11/07	0	1	0	3	0 N	0 N	0 N
11/08	0	1	0	4	0 N	0 N	0 N
11/09	0	1	1	4	0 N	0 N	0 N
11/10	0	1	2	5	0 N	0 N	0 N

Tracking chill portions on FNRIC



01/24	0	42	46	57	0 N	0 N	0 N
01/25	0	42	46	58	0 N	0 N	0 N
01/26	0	42	46	59	0 N	0 N	0 N
01/27	1	43	47	59	0 N	0 N	0 N
01/28	0	43	48	59	0 N	0 N	0 N
01/29	0	43	49	60	0 N	0 N	0 N
01/30	1	44	50	61	0 N	0 N	0 N
01/31	0	44	50	61	0 N	0 N	0 N
02/01	1	45	51	62	0 N	0 N	0 N
02/02	1	46	51	63	0 N	0 N	0 N
02/03	1	47	52	64	0 N	0 N	0 N
02/04	0	47	53	64	0 N	0 N	0 N
02/05	1	48	54	65	0 N	0 N	0 N
02/06	0	48	54	65	0 N	0 N	0 N
02/07	1	49	54	65	0 N	0 N	0 N
02/08	0	49	55	66	0 N	0 N	0 N
02/09	0	49	56	66	0 N	0 N	0 N
02/10	0	49	57	66	0 N	0 N	0 N
02/11	1	50	57	66	0 N	0 N	0 N
02/12	0	50	58	67	0 N	0 N	0 N
02/13	0	50	59	68	0 N	0 N	0 N
02/14	0	50	59	69	0 N	0 N	0 N
02/15	0	50	60	69	0 N	0 N	0 N
02/16	0	50	60	70	0 N	0 N	0 N
02/17	0	50	61	70	0 N	0 N	0 N
02/18	1	51	61	71	0 N	0 N	0 N
02/19	0	51	62	72	0 N	0 N	0 N
02/20	1	52	63	73	0 N	0 N	0 N
02/21	0	52	64	73	0 N	0 N	0 N
02/22	0	52	65	74	0 N	0 N	0 N
02/23	0	52	65	74	0 N	0 N	0 N
02/24	0	52	66	74	0 N	0 N	0 N
02/25	0	52	67	74	0 N	0 N	0 N
02/26	0	52	67	75	0 N	0 N	0 N
02/27	0	52	67	76	0 N	0 N	0 N
02/28	0	52	68	77	0 N	0 N	0 N

DIY Spreadsheet Chill Portions



DIY Spreadsheet Chill Portions

http://ucanr.edu/sites/fruittree/How-to_Guides/Dynamic_Model_-_Chill_Accumulation/

Chilling Accumulation Models... | Dynamic Model & Chill Acc...

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Growth Regulators in Orchard Management

Fruit & Nut Research & Information Center

- **Introduction**
- How-to Guides
  - Using the Pull Force Gauge: An FRF Guide
  - Leaf Area Measurment Alternatives
  - Dynamic Model & Chill Accumulation
  - Sorting Temperature Data to Get Hourly Data
- Annual Research Reports
- Research Team
- Support

Dynamic Model & Chill Accumulation

An illustrated step-by-step guide for calculating Chill Portions (CP) using weather data collected from personal data loggers and the Dynamic Model. Available here: The guide, a PowerPoint presentation: **Dynamic Model & Chill Accumulation Guide - Glozer (pdf)** and The Dynamic Model, an Excel file: **Dynamic Model (excel file)**

- California often provides too little chilling for optimum dormancy and rest breaking for some chill-requiring crops. Research to overcome lack of chilling includes developing methods to measure chill accumulation under California's conditions.
- Chill accumulation can be calculated using various mathematical models. UC Davis researchers, with the cooperation of many growers, have tested the Dynamic Model as a way of calculating chill accumulation. The model calculates chilling accumulation as 'chill portions' using a range of temperatures from ~35-55°F, and accounts for chill cancellation due to fluctuating warm temperatures.

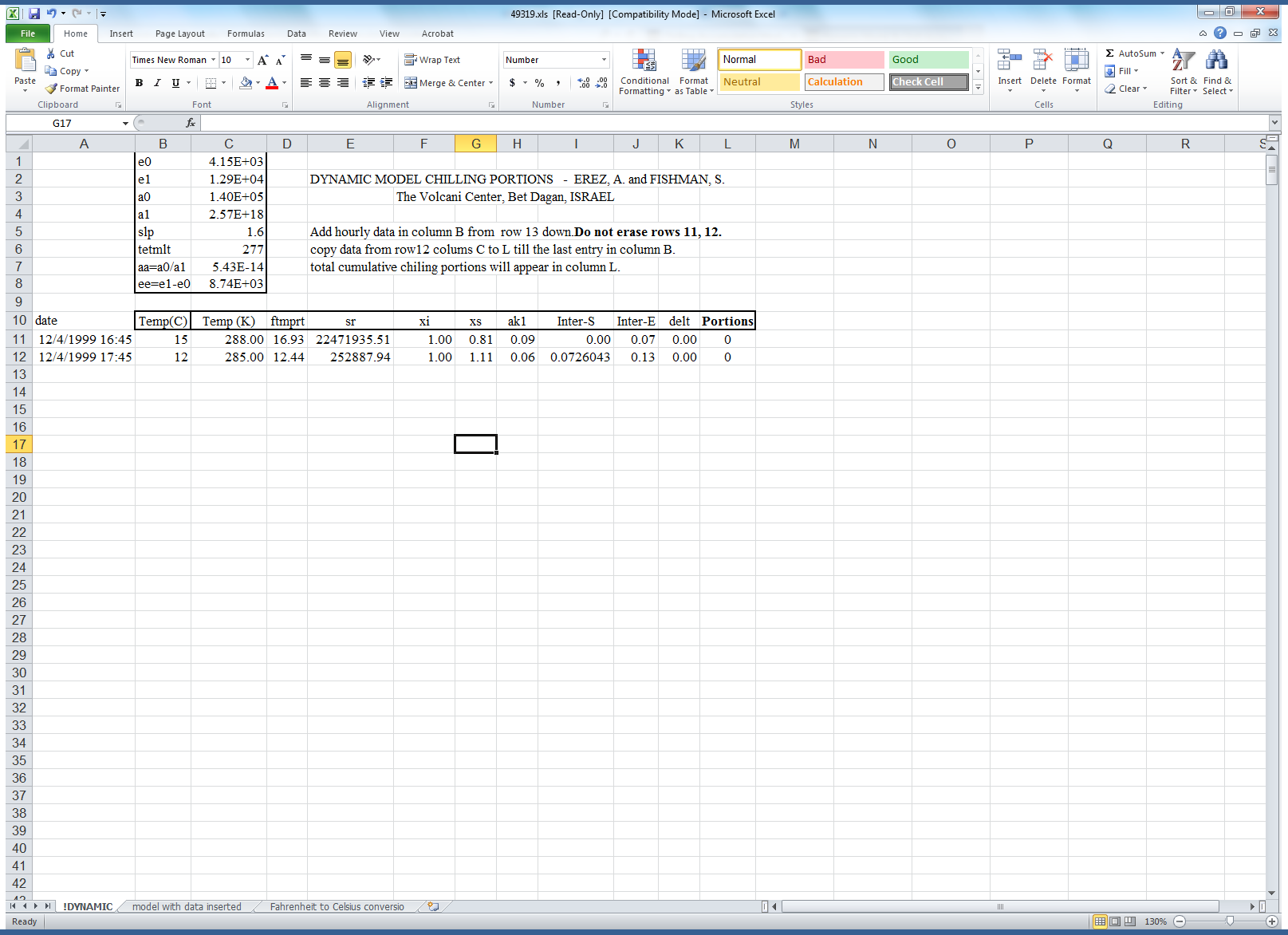
Hourly data is needed for Dynamic Model calculations. For those who collect temperature data every 1-0 minutes is provided: Information and calculation instructions are provided here: **Sorting Temperature Data to Get Hourly Data**

Department of Plant Sciences | UC Davis | College of Agricultural & Environmental Sciences

UNIVERSITY Division of Agriculture

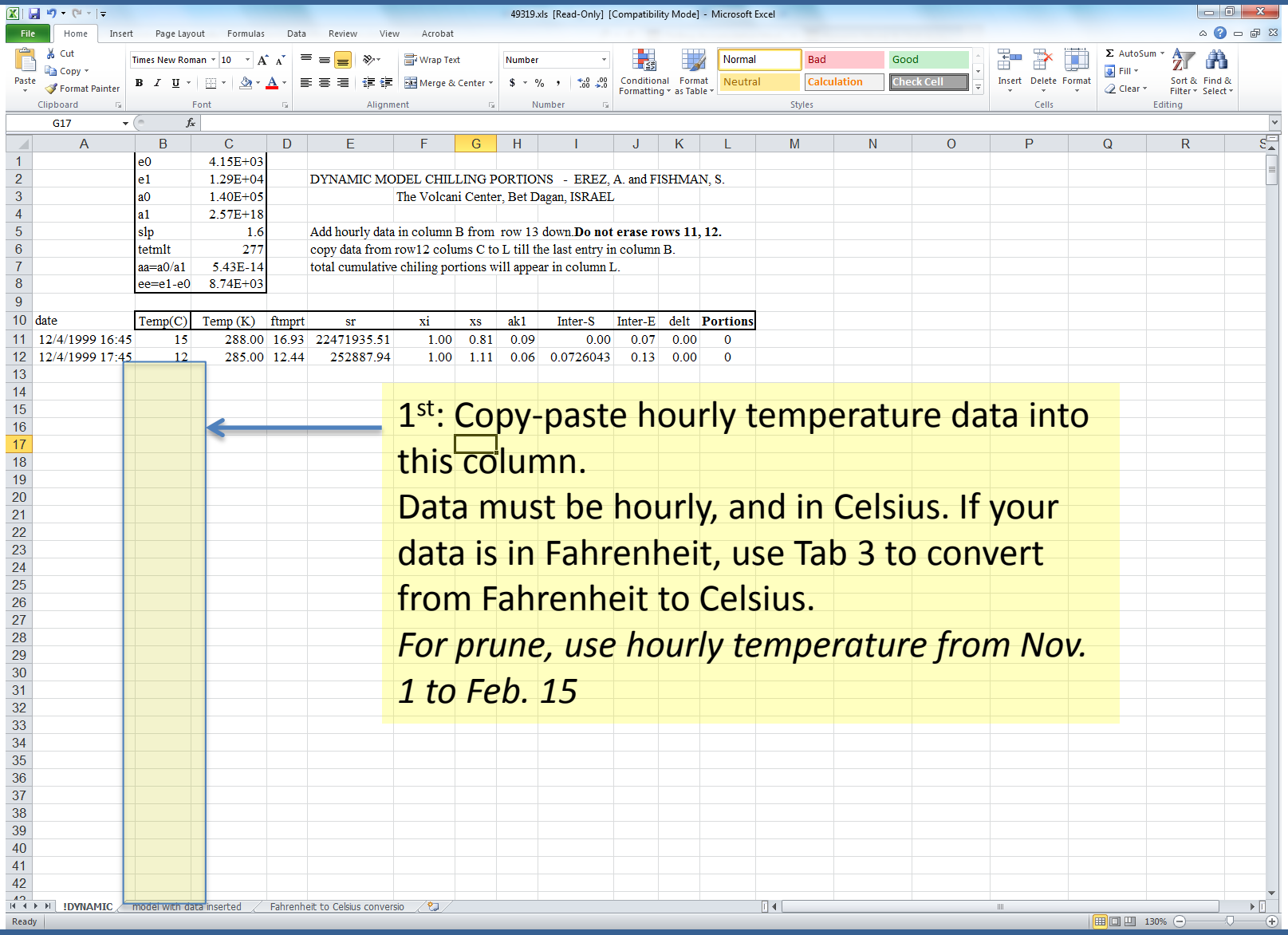
Site Information

DIY Spreadsheet Chill Portions



		e0	4.15E+03									
		e1	1.29E+04		DYNAMIC MODEL CHILLING PORTIONS - EREZ, A. and FISHMAN, S.							
		a0	1.40E+05		The Volcani Center, Bet Dagan, ISRAEL							
		a1	2.57E+18									
		slp	1.6		Add hourly data in column B from row 13 down.**Do not erase rows 11, 12.**							
		tetmlt	277		copy data from row12 colums C to L till the last entry in column B.							
		aa=a0/a1	5.43E-14		total cumulative chiling portions will appear in column L.							
		ee=e1-e0	8.74E+03									
date	Temp(C)	Temp (K)	ftmprt	sr	xi	xs	ak1	Inter-S	Inter-E	delt	**Portions**	
12/4/1999 16:45	15	288.00	16.93	22471935.51	1.00	0.81	0.09	0.00	0.07	0.00	0	
12/4/1999 17:45	12	285.00	12.44	252887.94	1.00	1.11	0.06	0.0726043	0.13	0.00	0	

DIY Spreadsheet Chill Portions



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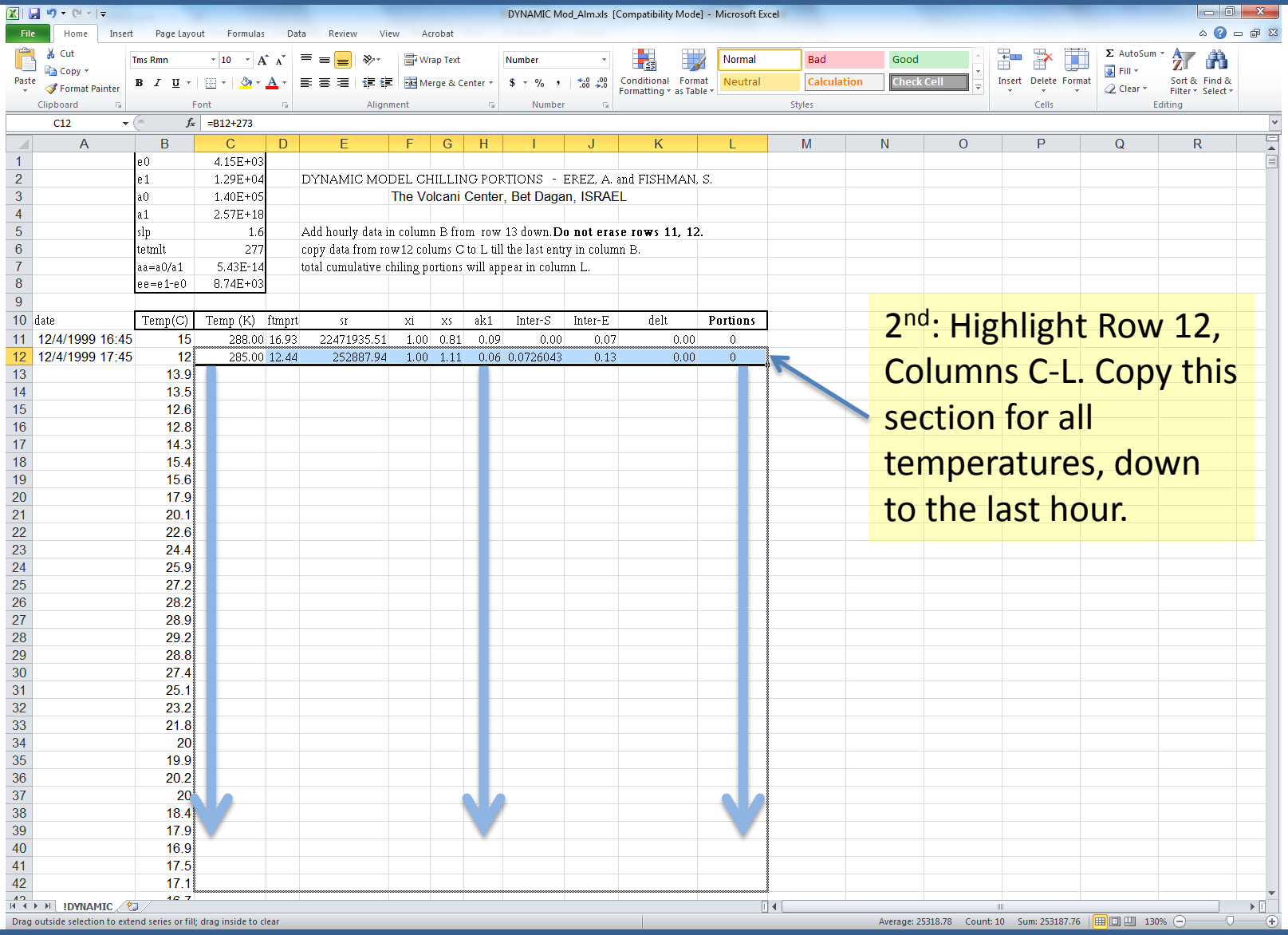
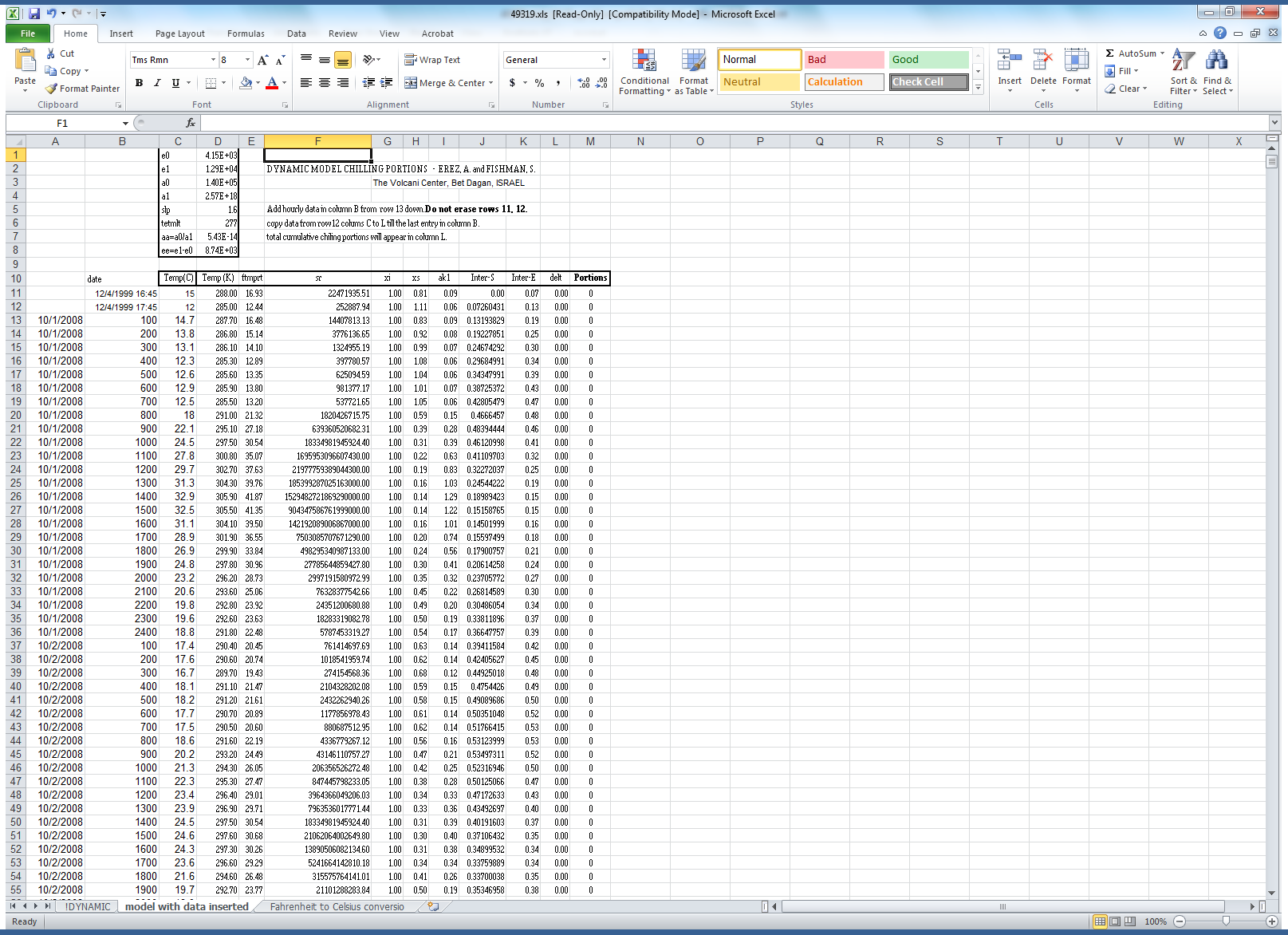


2nd: Highlight Row 12, Columns C-L. Copy this section for all temperatures, down to the last hour.

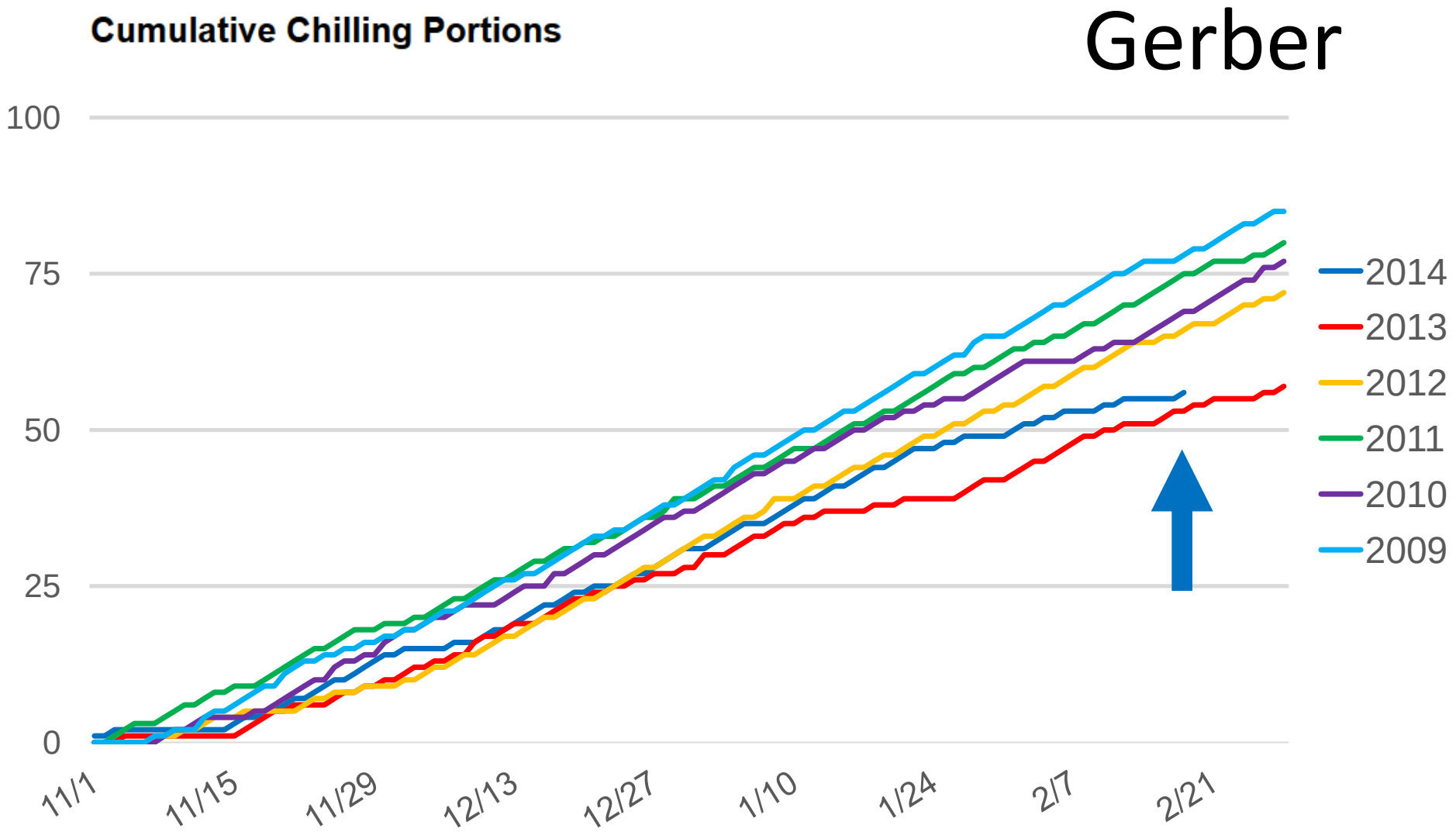
DIY Spreadsheet Chill Portions



What to do *this* year?

- Watch chill accumulation in January and compare with last few years. Are you on track with previous ‘good chill’ years?
- Based on last year French appears to need ~55-60 Chill Portions

What can be done if chill looks low?



What can be done if chill looks low?

- Count chill better – Chill Portions
- Wake trees up early
  - CAN17 & Horticultural Oil have had mixed results.
  - CAN17 moved bloom but decreased set in warm winters.
  - Best results for earlier bloom with improved set: 4% oil at 40-50 chill portions (~Jan) → 1.6-2.4 days early
  - White washing delays bloom.

Niederholzer et al, Prune Reports 2008-2014

What can be done if chill looks low?

- Count chill better – Dynamic model/Chill portions
- Wake trees up early
- Cool orchard at bloom
  - Trees on dry soil wake up later
  - Risk is when flowers get 10+ hours >80 F.
  - Running irrigation can decrease temps 1-2° F.
    Start mid-AM before it gets hot.
- Keep a temperature recorder in your orchard
- Support on-going UC research

Niederholzer et al, Prune Reports 2008 & 2009

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Sections on management and biology for individual crops, articles & websites by UC experts in crop production.
Fruit & Nut Information

Weather-Related Models

Chill accumulation models; irrigation scheduling; prediction models for stonefruit harvest, almond & pistachio N, almond hullsplit.
Weather-Related Models

Annual Extension Class

Principles of Fruit & Nut Tree Growth, Cropping & Management
Next offering: Feb. 2016, UC Davis Campus plus Field Tour
This annual course is focused on fruit and nut tree biology, and how it relates to orchard management. Class Details

Tree Biology & Orchard Management

New content: Flower Anatomy & Pollination, Tree Growth,

Events Calendar

Event Name	Date
Pomology Extension Continuing Conference (PECC)	3/23/2015
Advances in Walnut Production Short Course	11/16/2015
Walnut Research Conference	1/27/2016
Pomology Research Coordination Mtg (PAC)	2/2/2016
Principles of Fruit & Nut Tree Growth Cropping & Management	2/22/2016

View More Events

Fruit & Nut Center Updates

A History of UC Research

Added February 13, 2015

The UC Fruit & Nut Research & Information Center (FNRIC) website, http://fruitsandnuts.ucdavis.edu, has been around for about twenty years and in that time, gone through several formatting updates and expansions. The website provides...

Happy Holidays!

Added December 22, 2014

It has been an honor serving our California clientele as the Director of the Fruit & Nut Research and Information Center (FNRIC) for one more active year. I am blessed to have great support from Ms. Janet Zalom, Ms.

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ONLINE RESEARCH DATABASES

Fruit & Nut Information

Your click on any of the fruits and nuts from the following list will access information in these areas: General Education, Specific articles in production economics and management, and links to centers, programs, and organizations. For up-to-date statistics on US and World production, see: USDA NASS and United Nations FAOSTAT.

Temperate Crops | Subtropical & Tropical Crops

Temperate Fruit & Nut Crops

Almond | Apple | Apricot | Caneberries | Blueberry | Sweet Cherry | Chestnut

Fig | Kiwifruit | Nectarine | Olive | Peach | European Pear | Pecan

Persimmon | Pistachio | Plum | Pomegranate | Dried Plum/Prune | Quince | Strawberry

Table Grapes & Raisins | Walnut

Tropical & Subtropical Fruit & Nut Crops

Fruit and Nut Information

Return to Main Fruit & Nut Information

All of the Categories by Fruits & Nuts: Prune/Dried Plum

Search

General Sources

- California Tree Fruit Agreement Research Reports Database
  A database, currently under development, to archive research projects supporting the California stone fruit industry from 1939 to 2010.
- Dried Plum Research Reports
  A searchable database of annual reports of research in various aspects of dried plum/prune production. This database provides reports in pdf format from 1961 to the present.
- Plum Pox Virus: 2011 UC Davis Conference materials
  'Understanding & Preparing for the Threat of Plum Pox Virus Spreading to California & the Western States'. Includes videos of presentations.

Production Management

- Decision Support System for IPM of Prune Brown Rot
  UC Kearney Agricultural Research and Extension Center
- Dormant Spray Alternatives Calculator
  UC IPM Online
- Growing Prunes (Dried Plums) in California: An Overview
  Maxwell Norton, UCCE Merced Co., and William Krueger, UCCE Glenn Co. & Tehama Co., 2005 (7 pp.) UC ANR Pub. 8264
- Growth Regulators in Orchard Mgt: Technical Reports for Prune: 2003 to 2011
  Kitren Glozer, Dept. of Plant Sciences, UC Davis. Topics include use of the Dynamic Model to time applications of defoliants, dormant oil and RBAs and impact of growth regulators on fruit quality
- Integrated Prune Farming Practices Orchard Monitoring Calendar (pdf)
  excerpt (1 p.) from: Integrated Prune Farming Practices (IPFP) Decision Guide, 2004
- Introduction to Brown Rot of Stone Fruits
  UC Kearney Agricultural Research and Extension Center
- IPM-Based Guidelines for Replanting Prunus Orchards in 2002 without Methyl Bromide (pdf)
  Michael McKenry, Nematology Dept., UC Riverside. 2002 (5 pp.)
- Muir Beauty Dried Plum/Prune Description (pdf)

University of California, Division of Agriculture and Natural Resources

Dried Plum Research Reports Database

Overview
Reports by Year
Reports by Category
Acknowledgments

UCDAVIS FRUIT & NUT RESEARCH & INFORMATION

CALIFORNIA DRIED PLUMS

Reports by Category

Categories

Cultivars & Rootstocks
Varietal Improvement | Rootstocks

Tree Nutrition
Boron | Nitogen | Potassium | Sulfur | Zinc | Carbohydrate Partitioning | Foliar Fertilizers | Salt Tolerance

Water & Soil Management
Drip Irrigation | Sprinklers | Infiltration | Impact on Tree Growth | Soil Modification

Flower & Fruit Development
Crop Control | Fruit Set | Fruit Size | Indices of Fruit Quality | Maturity Advancement | Orchard Management | Preharvest Fruit Drop | Reference Date | Fruit Side Cracking

Tree Growth & Development
High Density Planting | Modified Tree Training | Alternate Year Pruning | General Pruning | Growth Regulators

Insects
Aphids | Carob Moth | Honey Bee | Indianmeal Moth | Mealybug | Medfly | Oblique Banded Leafroller | Peach Twig Borer | Scale | Spotted Wing Drosophila | Insect Parasites | Insect Pathogens | Insect Monitoring | Chemical Applications | Insects: Other Topics

Postharvest Insects
Fumigation | Packaging | Temperature Teatments | Irradiation

Disease
Brown Rot | Canker | Crown Gall | Leaf Scorch | Prune Dieback | Russett Scab | Rust | Virus | Wood Decay Fungi | Postharvest Disease | Disease: Other Topics

Postharvest
Dehydration | Health Benefits | Juice | Moisture | Sorting | Postharvest: Other Topics

Other Categories
Mites | Nematodes | Weeds | Integrated Farming Practices | Harvest Topics | Food Safety
Miscellaneous Topics Including Literature References | Crops Other Than Dried Plums

TAKE AWAYS

1) Chill is not great, but not too bad

2) Chill portions is a better way to count chill

3) Follow chill portions at the
UC Fruit & Nut Center website.

QUESTIONS?

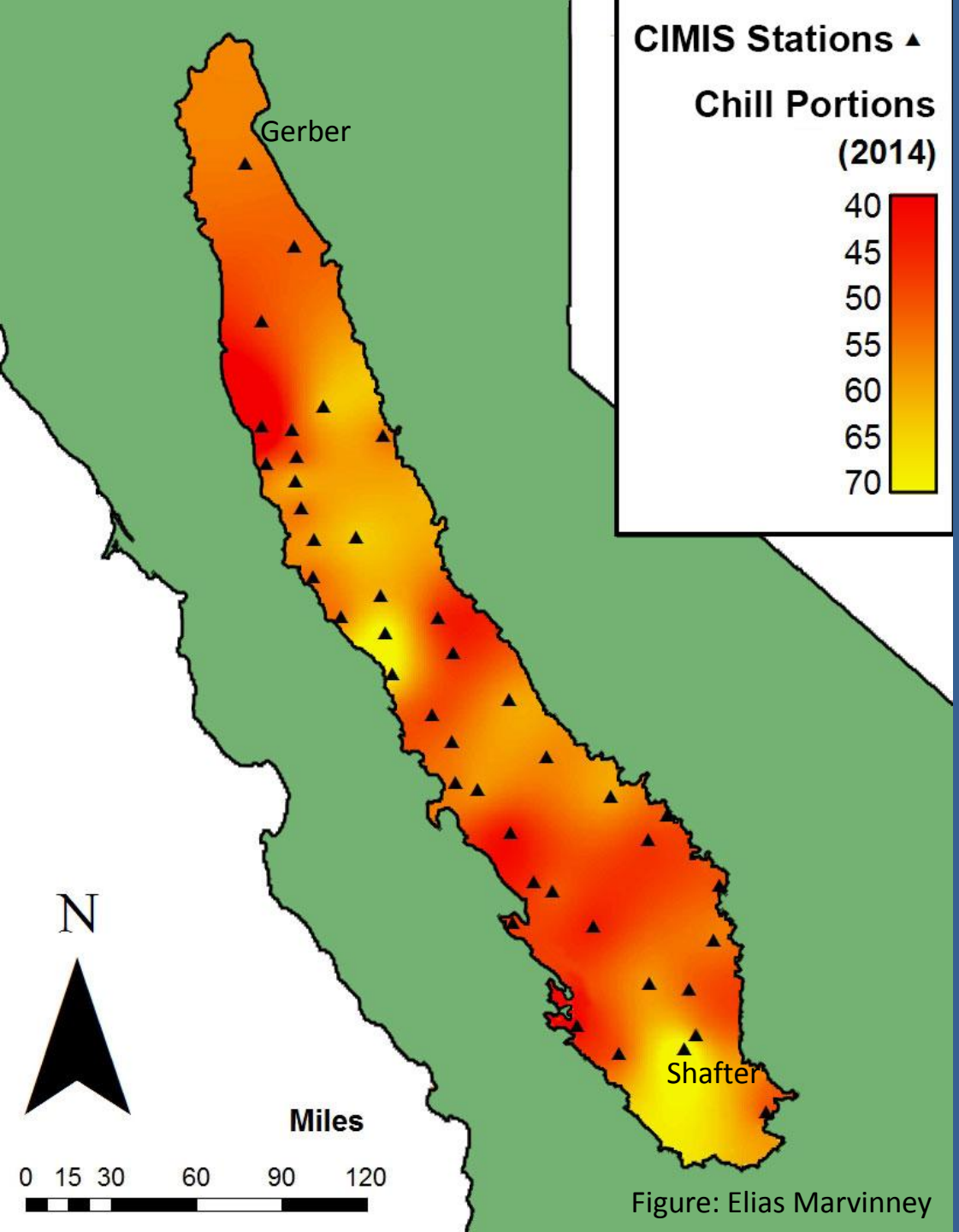

Figure: Elias Marvinney

Chill 2013: Down 25% across the Central Valley from 5-year average