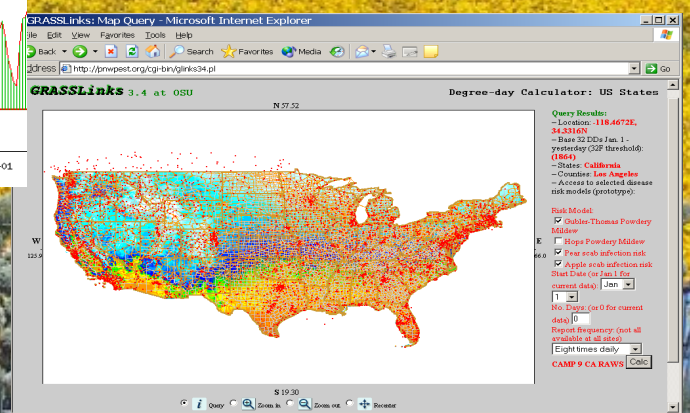
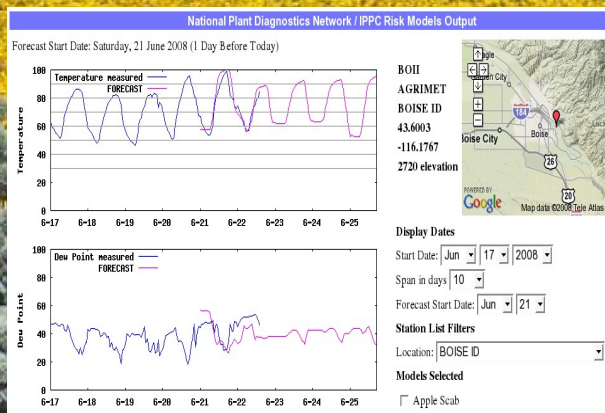
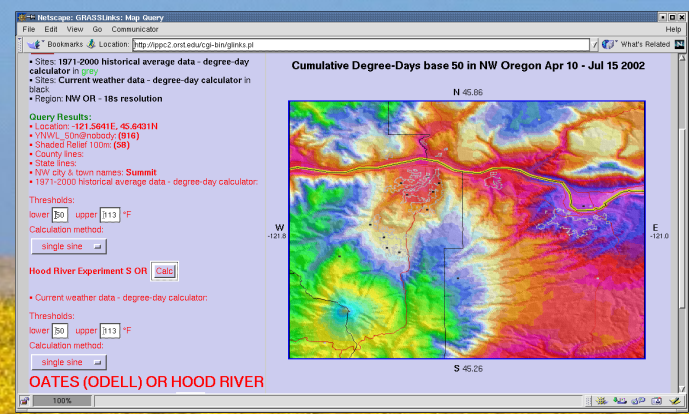
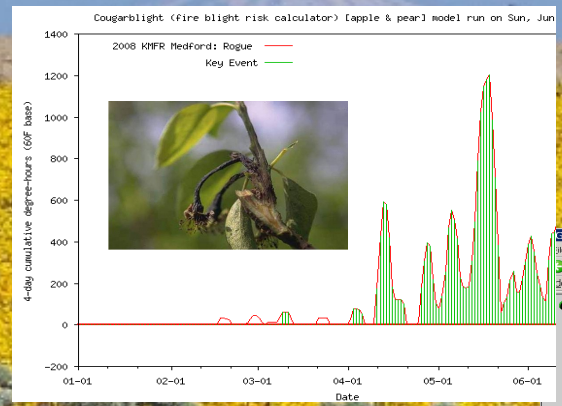
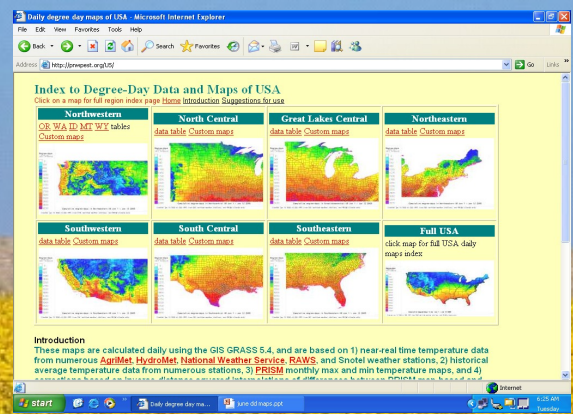


# Delivery of IPM Tools in Real Time for Decision Support - Pull

L. Coop, P. Jepson, G. Grove, A. Fox, C. Daly, W. Mahaffee, C. Thomas

Thomas



# Developmental stages of web-based IPM decision support systems

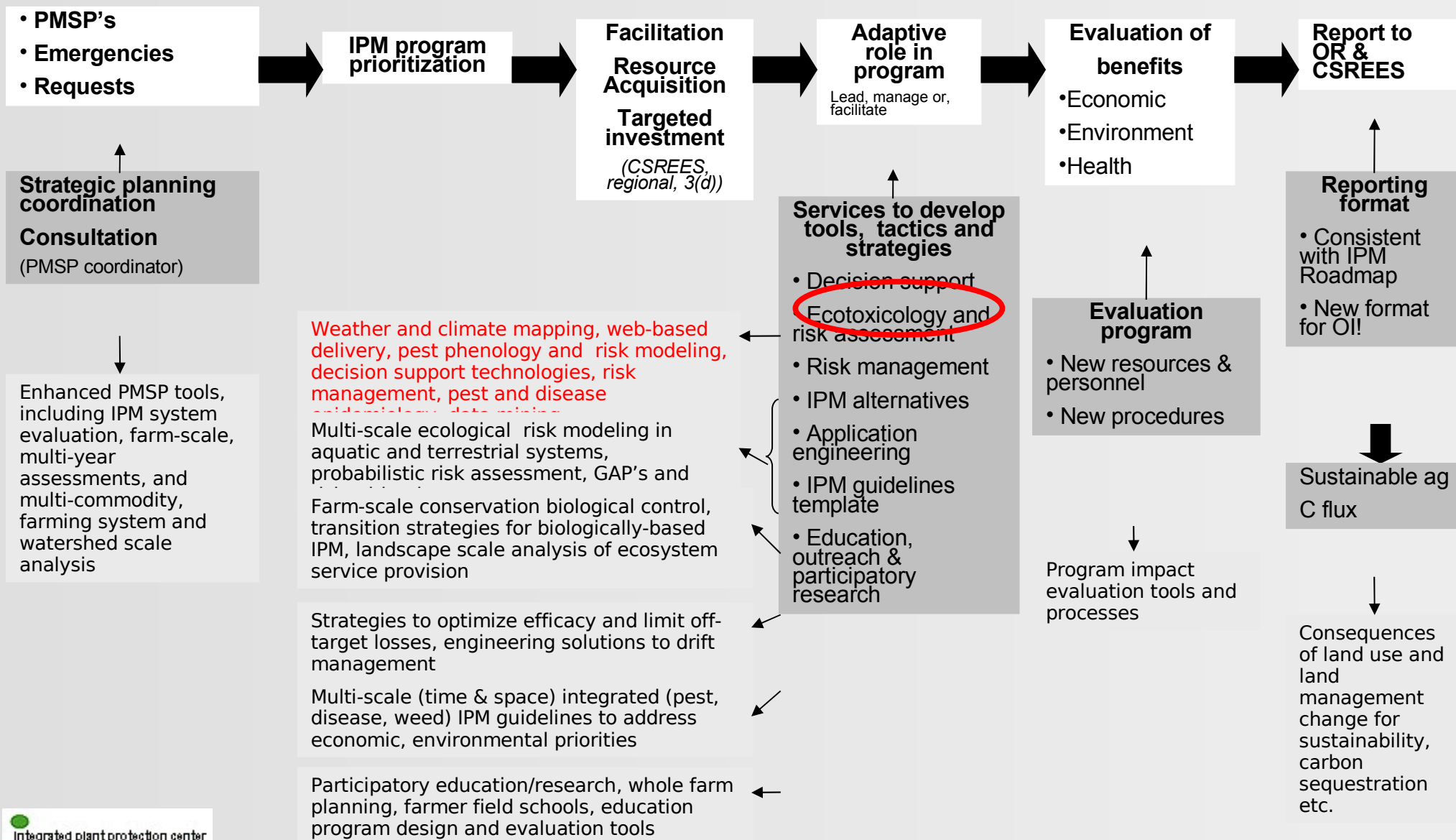
1st cases	Technology	Direction	User involvement & training
	<b>Static</b>	<b>1</b>	<b>click/search only</b>
pre95	Text		
1995	Graphics		
	<b>Dynamic</b>	<b>1</b>	<b>user input req.</b>
1996	Calculators		
<b>1997+ Models (WSWG/IPPC working to improve weather driven models)</b>			
1996	Databases, general search engines		
	<b>Interactive</b>	<b>2/multiway</b>	<b>user initiated</b>
1990s	email, chat		
1998	mail-lists, web conferences,		<b>pest alert systems</b>
2000?	mail-list archive, knowledge bases		
	<b>Integrated</b>	<b>multiway</b>	<b>user initiated</b>
2001+	multiple seamlessly integrated		
	<b>Push</b>	<b>2</b>	<b>server-send</b>
2007+	end-user customized model outputs sent by fax, email, pda, etc.		

# IPM PROGRAM GOALS: AREAS OF SCHOLARSHIP AND INNOVATION

## IPM PROGRAM MODE OF OPERATION

White box: IPM program coordination role

Grey box: IPPC program activities



# Expanding weather-driven pest models at OSU-IPPC

- 1984-95 – Brian Croft - Ag Weather Dialup system (using AGRIMET Network)
- 1996-7 – First IPPC online degree-day calculator, parameter database developed for DD models, 45 weather stations in Oregon
- 1998-2000 – First PRISM/CAI DD maps developed, 1<sup>st</sup> online DD mapping calculator, 288 weather stations in PNW
- 2001 – First max/min forecasts via weather.com; 500 weather stations in PNW; 1<sup>st</sup> online-GIS interactive DD maps
- 2002 – 1<sup>st</sup> Grower-run networks added (Adcon Hood River & Medford); sub-hourly weather data and disease models
- 2003 – 900+ weather stations, 45 pest models; 5 state NW; begin PRISM/CAI missing Tmax/Tmin data estimation
- 2005-6 – Begin NPDN/NRI plant biosecurity funding/focus, US coverage, 4-6K+ weather stations, 49 pest models, begin focus on disease models
- 2007-8 – 10-12K+ weather stations, 2 additional grower networks, 60+ pest and plant disease models, Fox Weather LLC/IPPC hourly weather forecasts

**Integrated Plant Protection Center**  
Oregon State University

**ONLINE IPM WEATHER DATA - 1997**  
for pest management decision making in Oregon

Map to online weather data (backup site)

**Contents**

- Introduction and description of the data and its uses
- Backup Table of online and historical weather data
- Backup Map of online weather data
- Java Degree-Day Calculator linked to the weather data

1997

**IPM Weather Data and Degree-Days** for agricultural and pest management decision making in the Northwest

Basics | Read Only Data | Degree-day Calculators | Degree-day Models

**What's new**  
Map access to many and Oregon 2001, 2000, 1999, 1998 and 1997 weather data files and to full station list

**Frequently asked questions (FAQ)**

Mar. 2001 Report  
Nov. 2001 Decision Tools - slide presentation

Related web sites

2001

**IPM Weather Data and Degree-Days** for agricultural and pest management decision making in the West

Basics | DD Maps | Degree-day Calculators | Degree-day Models

**What's new**  
Calculator linked from 1300+ weather stations via table: 110 Oregon, 176 Oregon, 12 Washington, 12 Montana, 8 Hood River OR grower networks, 201 Washington, 235 Idaho, 294 Montana, 141 Wyoming, 241 SW USA, 30 Alaska, and 51 BC, AB & SK Canada locations

**Frequently asked questions (FAQ)**

6/02 Report 4/03 Poster 1/01 Decision Tools and DD mapping - slideshows

Related web sites

2004

**IPM Weather Data, Degree-Days, and Plant Disease Risk Models** for agricultural and pest management decision making in the US

Basics | Daily DD maps | Plant disease risk and degree-day calculator | Degree-day Models

NWS forecasts enter Place, State or Zipcode

**What's new**  
Degree-day usage instructions, Frequently asked questions

4/03 Poster 09/06 Grower network support - slideshow

Related web sites

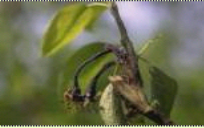
2008



File Edit View History Bookmarks Tools Help

http://pnwpest.org/cgi-bin/ddmodel.pl?fbl

## Online Phenology and Degree-day Models for agricultural and pest management decision making in the US



### cougarblight (fire blight risk calculator) [apple & pear]

disease model of [Smith \(1998\)](#) [Fire Blight model by Tim Smith](#)

Select degree-day model or calculator mode ([instructions](#)):  
 cougarblight (fire blight risk calculator) [apple & pear] Smith (1998)

(hint: after selecting all form options, click here:  then make a [bookmark](#) for future use)

For calculator mode, enter thresholds in °F (or celsius °C: ) and calculation method:  
 lower: 60 ° upper: ° single sine

Select starting Jan 1 2008 and ending Jul 31 2008 dates  
 Starting date/BIOFIX instructions: risk begins at first bloom

Select location: Only one column should display a location, otherwise "None"

Oregon, Canada, Alaska Medford Rogue Val Int or mtr	Washington, Idaho None	Montana, Wyoming None
--	---------------------------	--------------------------

Or upload your own weather data file to calculate: (see [format description](#) or [example file](#))  
 Browse...

Forecasts: NWS zipcode/city, state: or weather.com site: Medford Or

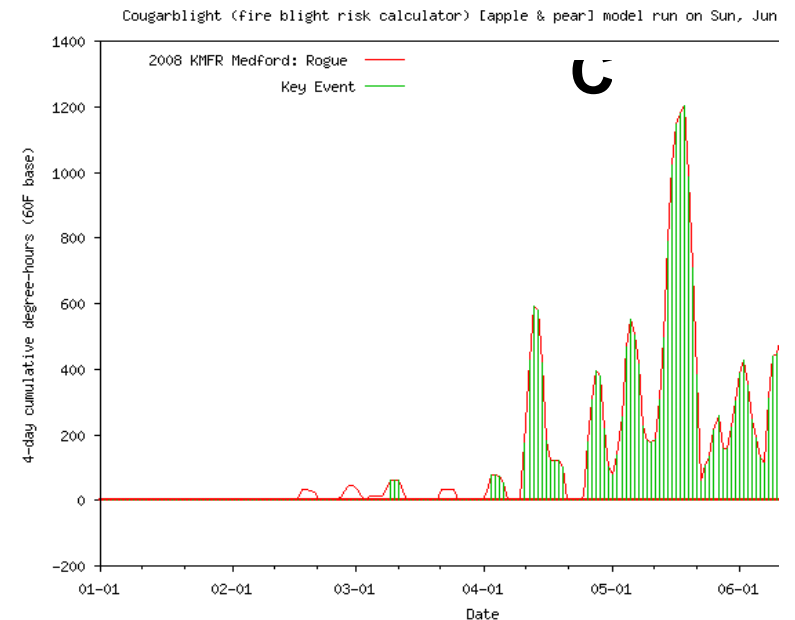
Select [historical average](#) forecast location: Should line up with selected location above

None	None	None
------	------	------

Output:  Simple header  Table  Graph  Include precipitation in graph

Click here to run the model: Calc Reset Clear all values

4 1	62.96	26.96	0.00	5.00	5.0	
4 2	66.02	32.00	0.00	20.00	25.0	
4 3	69.98	32.00	0.00	52.00	77.0	very low risk
4 4	55.94	39.02	0.00	0.00	77.0	very low risk
4 5	46.94	35.06	0.00	0.00	72.0	very low risk
4 6	54.00	41.00	0.00	0.00	52.0	very low risk
4 7	54.00	35.00	0.05	0.00	0.0	
4 8	51.98	37.94	0.04	0.00	0.0	
4 9	59.00	41.00	0.02	0.00	0.0	
4 10	64.04	39.92	0.00	10.00	10.0	
4 11	78.08	35.96	0.00	162.00	172.0	normally low risk
4 12	84.02	39.92	0.00	257.00	429.0	moderate risk
4 13	78.08	42.98	0.00	162.00	591.0	high risk if local last year
4 14	53.96	37.94	0.23	0.00	581.0	high risk if local last year
4 15	53.06	33.98	0.00	0.00	419.0	moderate risk
4 16	66.02	33.98	0.00	20.00	182.0	low risk unless blight local last year
4 17	73.94	39.02	0.00	100.00	120.0	normally low risk
4 18	60.98	37.94	0.00	1.00	121.0	normally low risk
4 19	48.02	33.08	0.03	0.00	121.0	normally low risk
4 20	48.92	33.80	0.01	0.00	101.0	normally low risk
4 21	50.00	33.80	0.00	0.00	1.0	
4 22	55.94	41.00	0.17	0.00	0.0	
4 23	53.96	35.96	0.01	0.00	0.0	
4 24	60.98	33.98	0.00	1.00	1.0	
4 25	64.94	35.06	0.00	14.00	15.0	
4 26	78.08	39.92	0.00	162.00	177.0	normally low risk

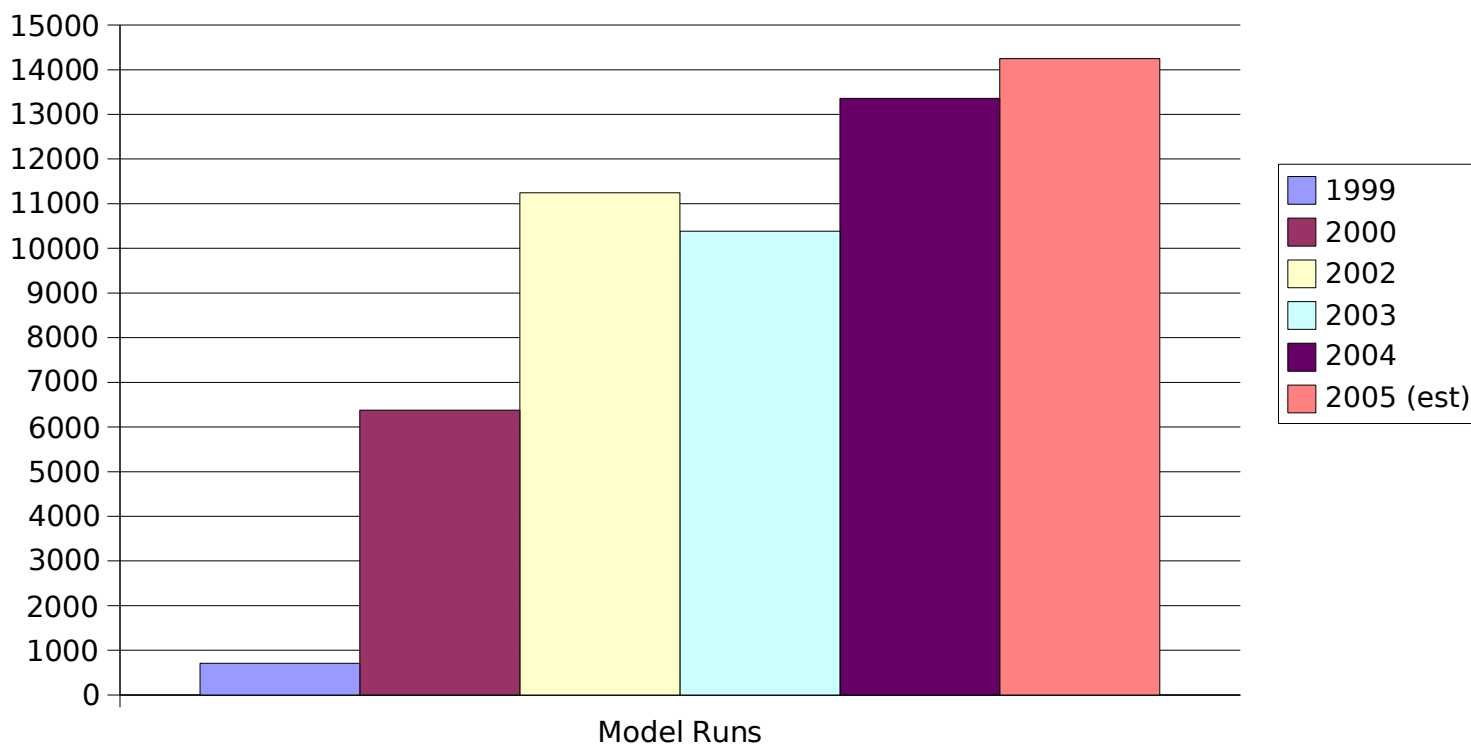


Example plant disease model (fire blight, since 1998)  
 at IPPC website <http://pnwpest.org/wea>  
 A) Interface B) Text output C) Graphical output

# •Degree-day/Phenology Calc./Model Usage – PNWPEST.ORG

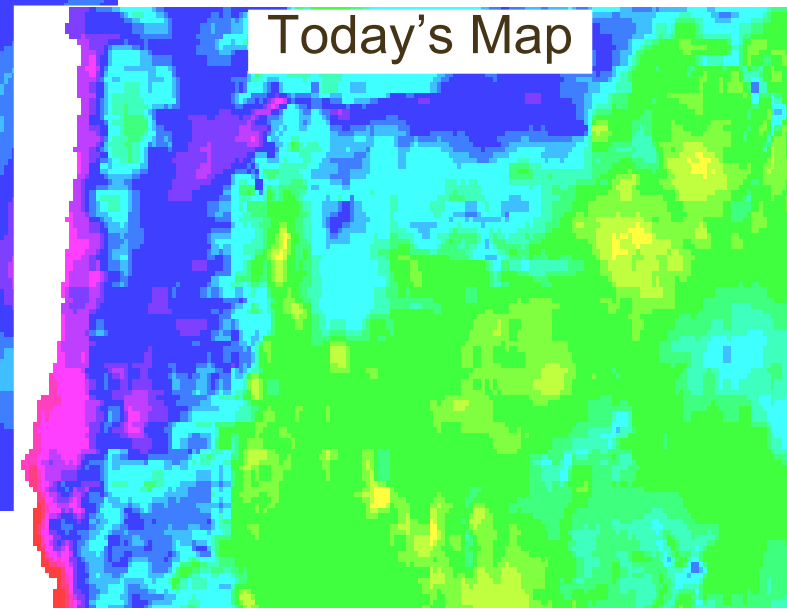
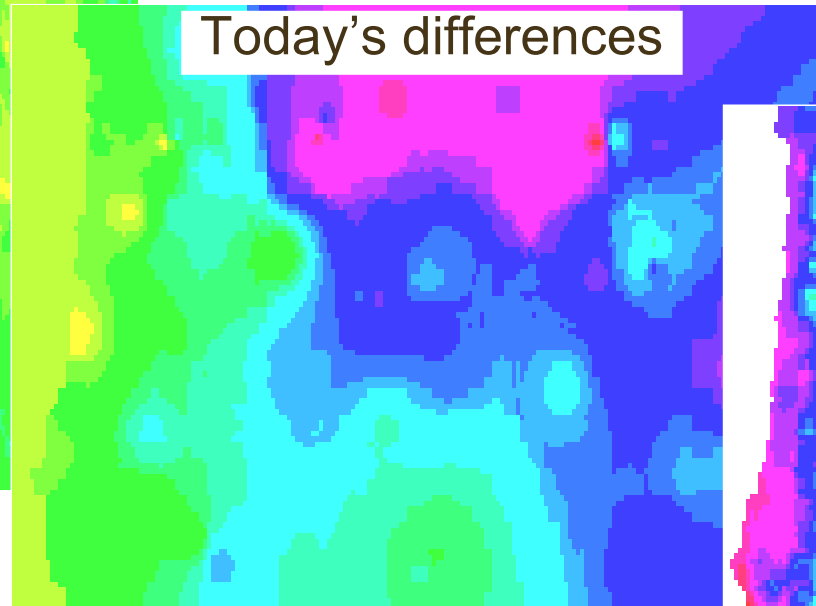
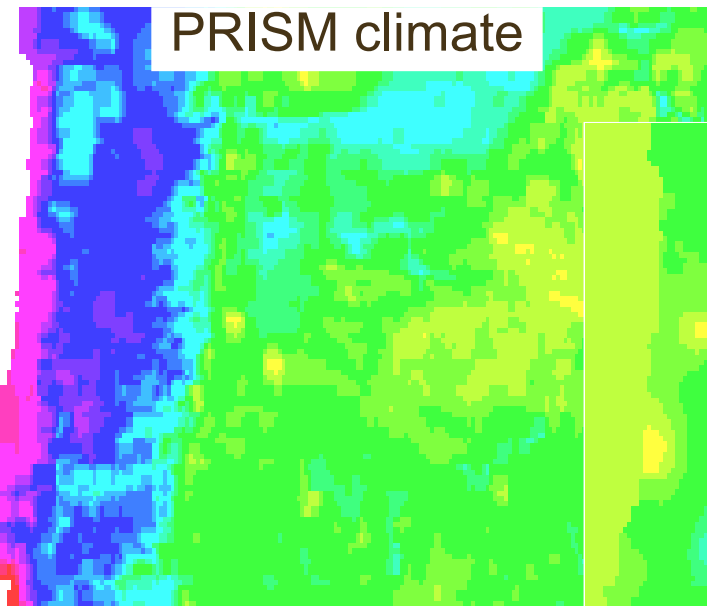
•Example	1999	2000	2002	2003	2004	2005-Oct24
•Degree-Day Calculator generic	454	3219	6048	5162	7761	7599
•codling moth [apple & pear]	83	1123	2019	2053	2428	1827
•fire blight [apple & pear]	17	300	699	1115	778	560

## Calculator/model usage per year



# Near Real-Time Temperature and Degree-Day Calculation

- Uses CAI (PRISM temperature climatologies)
- Current operational uses at IPCC:
  - Daily DD accumulation maps
  - Web-based dynamic DD maps with end-user settings
  - Missing Tmax and Tmin data estimation



# Daily Online Degree-Day Maps: 48 contiguous states

Daily degree day maps of USA - Microsoft Internet Explorer

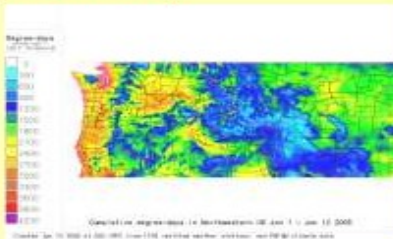
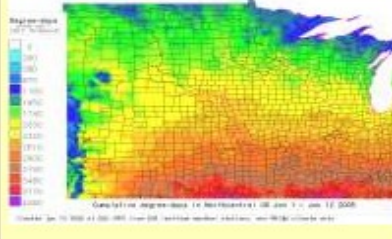
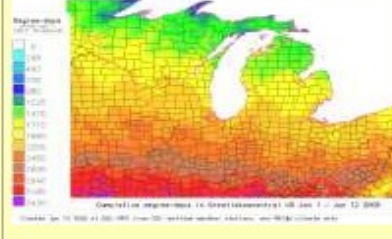
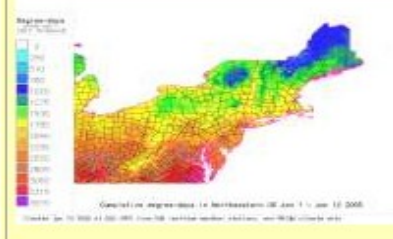
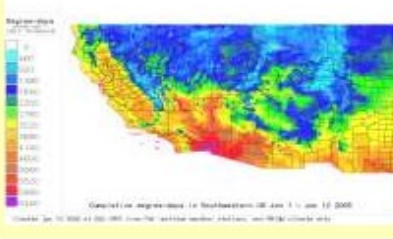
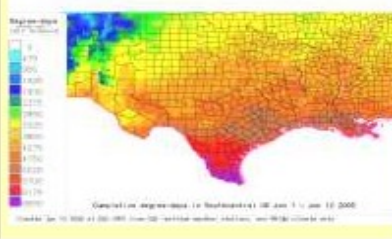
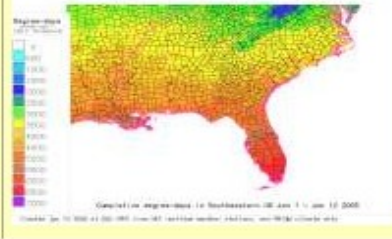

File Edit View Favorites Tools Help

Back Forward Stop Refresh Home Search Favorites

Address <http://pnwpest.org/US/> Go Links

## Index to Degree-Day Data and Maps of USA

Click on a map for full region index page [Home](#) [Introduction](#) [Suggestions for use](#)

<h3>Northwestern</h3> <p><a href="#">OR</a> <a href="#">WA</a> <a href="#">ID</a> <a href="#">MT</a> <a href="#">WY</a> tables <a href="#">Custom maps</a></p>  <p>Completed degree-days in North America: 08 Jun 1 to Jun 12 2005 Created: Sun 10:50:00 AM '05 from 110 weather weather stations, using 1000 climate sites</p>	<h3>North Central</h3> <p><a href="#">data table</a> <a href="#">Custom maps</a></p>  <p>Completed degree-days in North America: 08 Jun 1 to Jun 12 2005 Created: Sun 10:50:00 AM '05 from 100 weather weather stations, using 1000 climate sites</p>	<h3>Great Lakes Central</h3> <p><a href="#">data table</a> <a href="#">Custom maps</a></p>  <p>Completed degree-days in Great Lakes Central: 08 Jun 1 to Jun 12 2005 Created: Sun 10:50:00 AM '05 from 100 weather weather stations, using 1000 climate sites</p>	<h3>Northeastern</h3> <p><a href="#">data table</a> <a href="#">Custom maps</a></p>  <p>Completed degree-days in North America: 08 Jun 1 to Jun 12 2005 Created: Sun 10:50:00 AM '05 from 100 weather weather stations, using 1000 climate sites</p>
<h3>Southwestern</h3> <p><a href="#">data table</a> <a href="#">Custom maps</a></p>  <p>Completed degree-days in North America: 08 Jun 1 to Jun 12 2005 Created: Sun 10:50:00 AM '05 from 100 weather weather stations, using 1000 climate sites</p>	<h3>South Central</h3> <p><a href="#">data table</a> <a href="#">Custom maps</a></p>  <p>Completed degree-days in North America: 08 Jun 1 to Jun 12 2005 Created: Sun 10:50:00 AM '05 from 100 weather weather stations, using 1000 climate sites</p>	<h3>Southeastern</h3> <p><a href="#">data table</a> <a href="#">Custom maps</a></p>  <p>Completed degree-days in North America: 08 Jun 1 to Jun 12 2005 Created: Sun 10:50:00 AM '05 from 100 weather weather stations, using 1000 climate sites</p>	<h3>Full USA</h3> <p>click map for full USA daily maps index</p>  <p>Completed degree-days in North America: 08 Jun 1 to Jun 12 2005 Created: Sun 10:50:00 AM '05 from 100 weather weather stations, using 1000 climate sites</p>

### Introduction

These maps are calculated daily using the GIS GRASS 5.4, and are based on 1) near-real time temperature data from numerous [AgriMet](#), [HydroMet](#), [National Weather Service](#), [RAWS](#), and Snotel weather stations, 2) historical average temperature data from numerous stations, 3) [PRISM](#) monthly max and min temperature maps, and 4) corrections based on inverse distance squared interpolation of differences between PRISM maps based on

start Daily degree day ma... june dd maps.ppt

Internet 6:25 AM Tuesday



# Dynamic Online Degree-Day Maps: ex. corn GDDs May 8- June 22

Wisconsin  
degree-days  
5-8 to 6-22 2008  
(50 F threshold)

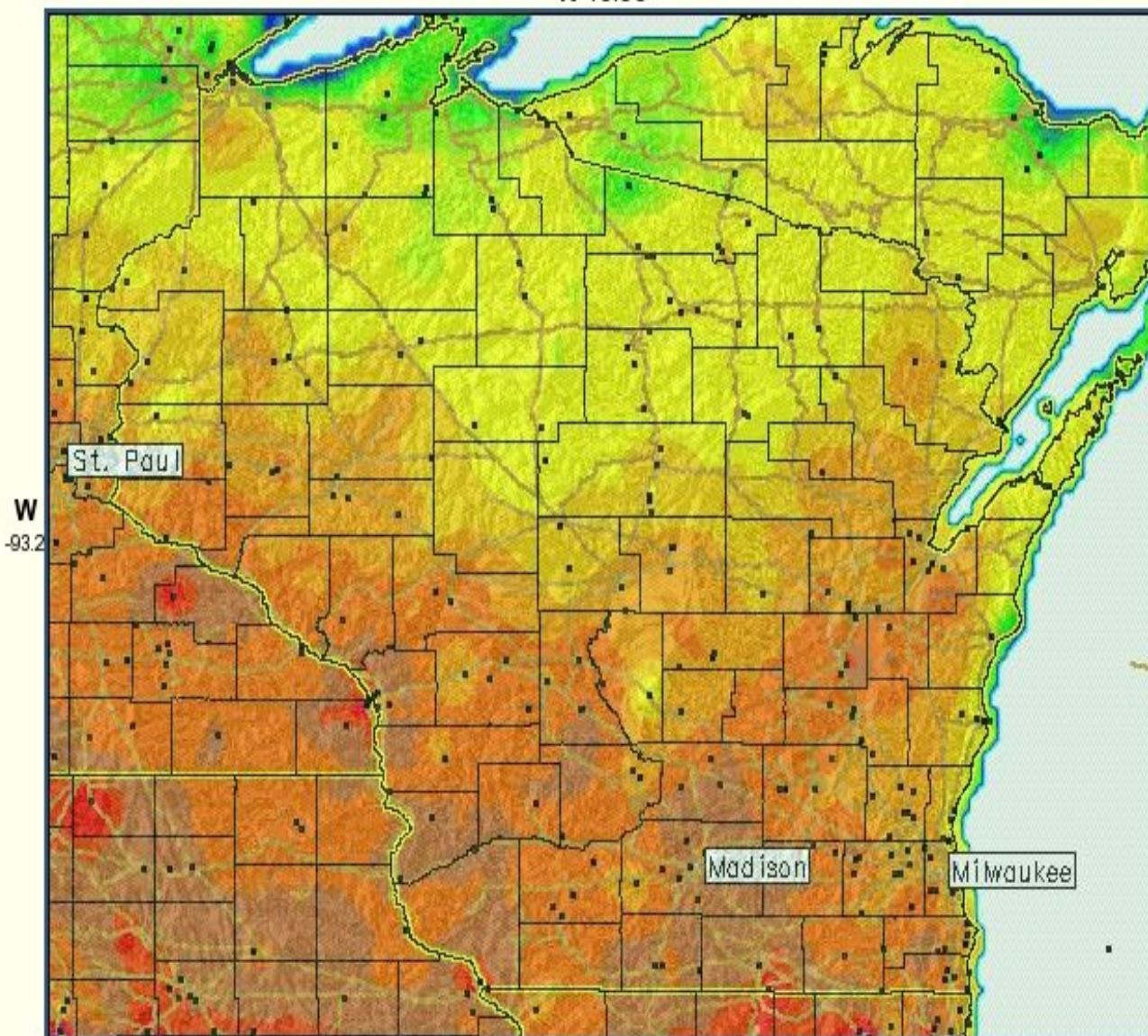


**GRASSLinks 3.5 at OSU**

Degree-day and Disease Risk Calculator: US States - [home](#)

Cumulative degree-days base 50 in Wisconsin May 8 - Jun 22 2008

N 46.99



**Query Results:**

- Location: **-88.6139E,**  
**43.8064N**

- Base 50 DDs: **589**

- Counties: **Fond du Lac**

- States: **55 Wisconsin**

- Current weather data -  
degree-day calculator.

Thresholds: lower

upper  degrees

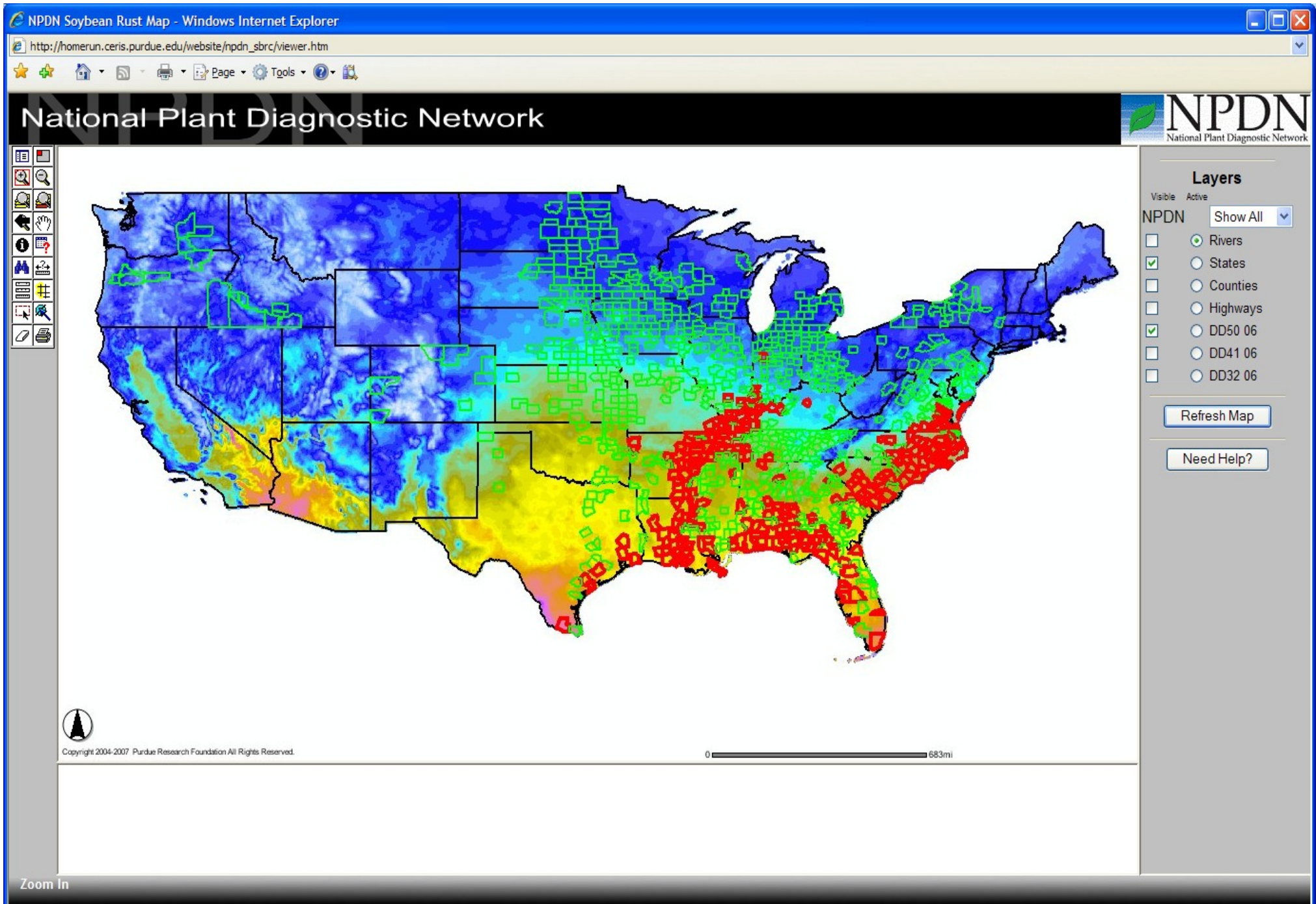
Calculation method:

Start (biofix) date:

End date:

**N9QBW Eldorado**  
**WI APRSWXNET**

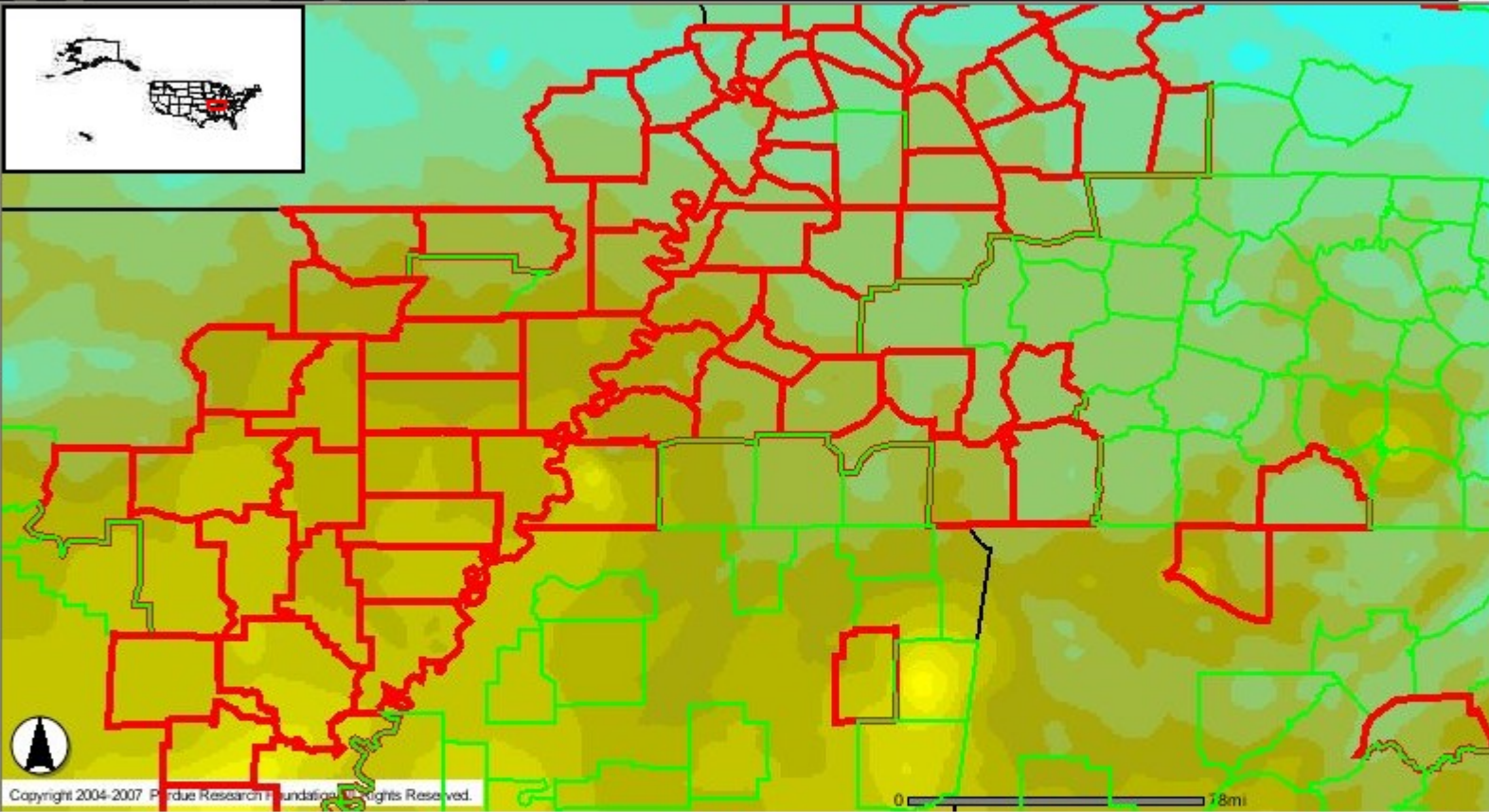
# Degree-days compared to diagnostic records - NPDN



# Degree-days compared to diagnostic records - NPDN

NPDN Soybean Rust Map - Windows Internet Explorer  
http://homerun.ceris.purdue.edu/website/npdn\_sbrc/viewer.htm

National Plant Diagnostic Network



**Layers**

Visible	Active	Layer
<input type="checkbox"/>	<input type="checkbox"/>	Rivers
<input checked="" type="checkbox"/>	<input type="checkbox"/>	States
<input type="checkbox"/>	<input type="checkbox"/>	Counties
<input type="checkbox"/>	<input type="checkbox"/>	Highways
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	DD50 06
<input type="checkbox"/>	<input type="checkbox"/>	DD41 06
<input type="checkbox"/>	<input type="checkbox"/>	DD32 06

Refresh Map  
Need Help?

Copyright 2004-2007 Purdue Research Foundation. All Rights Reserved.

DD50 06

2006 Cumulative Degree Days Base 50F	
Value	3467
Lat (dec.deg)	-87.8231
Long (dec.deg)	34.5081

Pan

# Tmax/Tmin PRISM/CAI Estimation Error Evaluation

Temperature/degree-day estimates compared to actual station values. 132 stations (AGRIMET, METAR, COOP, and 2 Adcon agricultural networks) in OR and WA over 103 days.

	MAE	ME (bias)	$r^a$ (est vs actual)
<b>Max Temps (°C)</b>			
Climate Map (CAI)	1.13	-0.14	0.983***
Date Method	2.02	0.21	0.948
<b>Min Temps (°C)</b>			
Climate Map (CAI)	1.60	-0.01	0.921 <sup>n.s.</sup>
Date Method	1.66	0.16	0.919
<b>Cumulative degree-days (10 °C threshold)</b>			
Actual	887 dd	----	----
Climate Map	875 dd	----	0.978***
Date Method	885 dd	----	0.965

<sup>a</sup>r is correlation coefficient for linear regression between estimated and actual temperatures. Test for differences between correlation coefficients; \*\*\* signifies  $p < 0.001$

# PRISM-Based Climatologically Aided Interpolation For Missing Data Estimation Operational Example @IPPC (Since 2003)

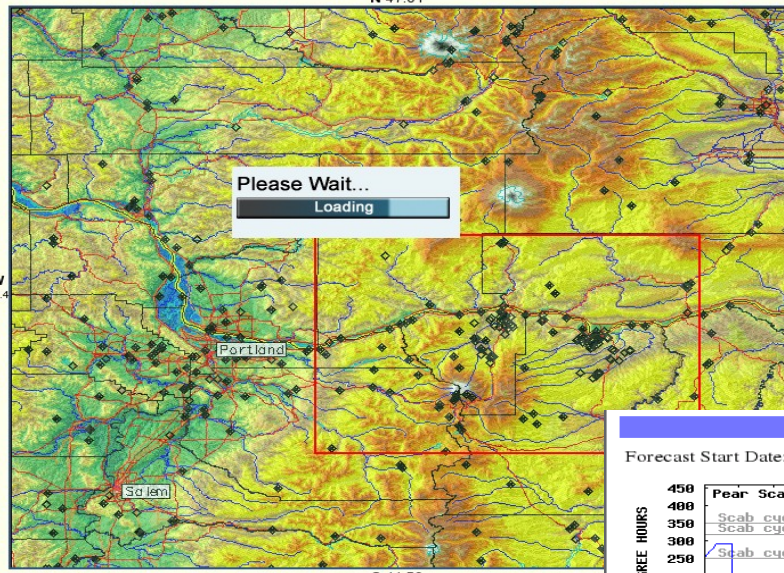
CAI Missing Max/Min Estimation Report (excerpt)  
Example 05/27/08

Network and State	-----% Missing/Estimated----- 2008-05-22	2008-05-26
<b>Example 1<sup>st</sup>-order networks:</b>		
AGRIMET ID	0 / 16 = 0.0%	0 / 16 = 0.0%
AGRIMET MT	0 / 25 = 0.0%	1 / 25 = 4.0%
AGRIMET OR	0 / 29 = 0.0%	0 / 29 = 0.0%
<b>Example mixed quality network:</b>		
METAR AL	0 / 28 = 0.0%	0 / 28 = 0.0%
METAR AZ	0 / 27 = 0.0%	1 / 27 = 3.7%
METAR CA	2 / 98 = 2.0%	3 / 98 = 3.1%
<b>Example late networks:</b>		
APRSWXNET CA	77 / 368 = 20.9%	83 / 368 = 22.6%
APRSWXNET CO	28 / 143 = 19.6%	31 / 143 = 21.7%
COOP OR	13 / 35 = 37.1%	35 / 35 = 100.0%
W_UNDERGRND OR	8 / 48 = 16.7%	48 / 48 = 100.0%
Overall	1668/13050 = 12.8%	2123/13050 = 16.3%

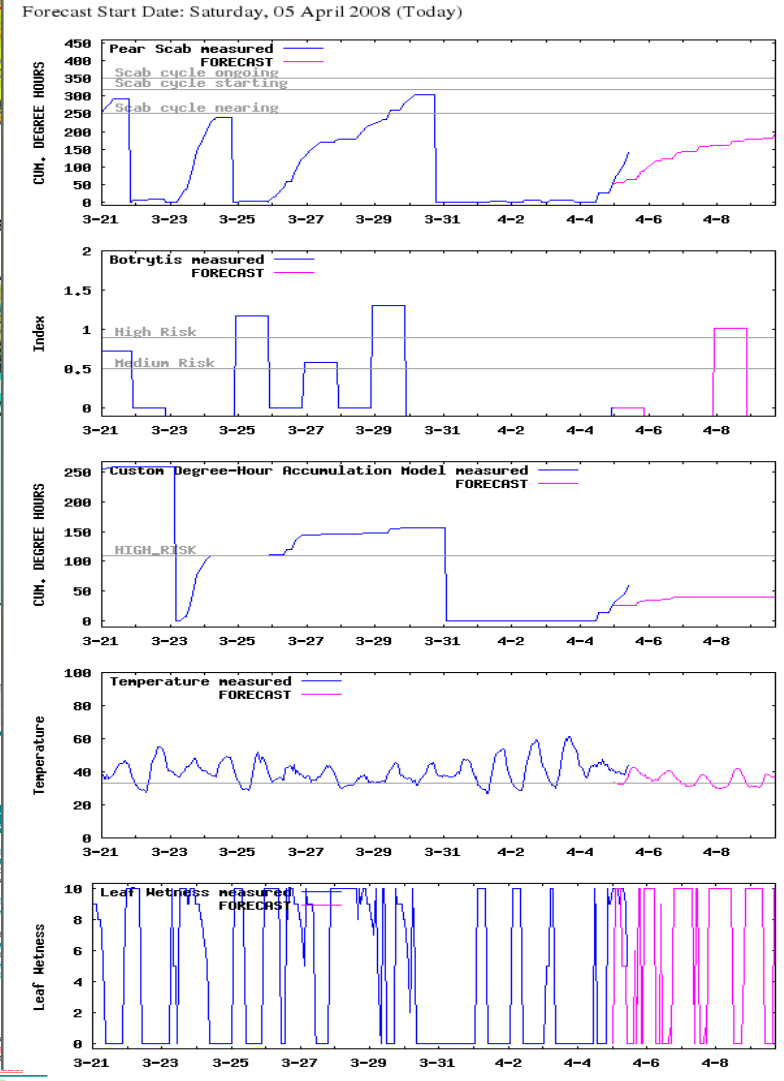
Click in map for disease risk and degree-day models

Query Results:  
 - Location: **-121.5278E, 45.6892N**  
 - Base 41 DDs Jan. 1 - yest. -  
 Nat. (41F threshold): **221**  
 - High Resol. Elevation N.  
 America: **166**  
 - Counties: **Hood River**  
 - States: **41 Oregon**  
 - Access to selected disease\_risk models (prototype):  
 Click "submit" to run the following models and weather parameters:  
 • Botrytis  
 • Custom generic model  
 Weather parameters:  
 • Temperature  
 • Leaf Wetness  
**HOOD RIVER OR AGRIMET**  
 submit  
 - Current weather data - degree-day calculator.  
 Thresholds: lower **50**

# Hourly driven plant disease models (map interface)



## National Plant Diagnostics Network / IPPC Risk Models Output



**HOXO AGRIMET HOOD RIVER OR**  
45.6842 -121.5181

**Display Dates**  
 Start Date: Mar 21 2008  
 Span in days: 20  
 Forecast Start Date: Apr 5

**Station List Filters**  
 Location: HOOD RIVER OR

**Models Selected**

- Apple Scab
- Pear Scab
- GT Powdery Mildew
- Cleistothelial Powdery Mildew
- Anjou Pear Scald
- Botrytis
- Tomato Potato Late B light
- Tomcast DSV
- Custom Degree-Hour Accumulation Model

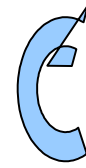
**Accumulative Degree-Hours using these Parameters**

- 100°F Upper Temperature Threshold
- 37°F Lower Temperature Threshold
- 18 Reset Threshold (dry hours)
- Ignore Leaf Wetness
- 110 Event Threshold (degree-hours)
- HIGH\_RISK Event Label

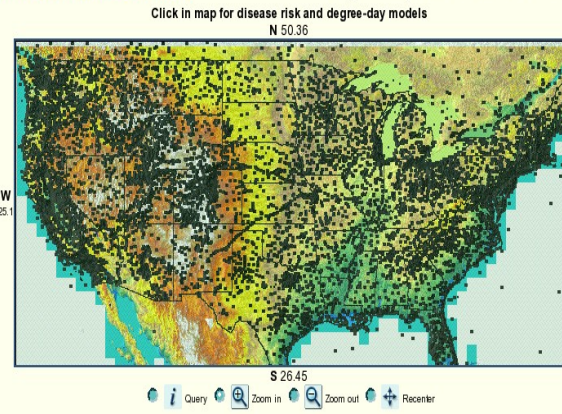
Previous Day    Redraw    Next Day

**Weather Params**

- Temperature
- Dew Point
- Relative Humidity
- Wind Speed
- Rain
- Leaf Wetness



## GRASSLinks 3.5 at OSU Degree-day and Disease Risk Ca



IPM models - Weather data Home Page - Mozilla Firefox

See the [what's new page](#), and please fill out our [brief user survey](#).

**IPM Weather Data, Degree-Days, and Plant Disease Risk Models for agricultural and pest management decision support in the US**

- Basics
- Daily DD maps
- Plant disease risk and degree-day calculator
- Degree-Models

NWS forecasts enter Place, State or Zipcode

Base 41, 50 DD Maps for 10 MT  
 Maps for 10 MT  
 Base 32, 41, 50 maps for all US regions updated daily

Calculator and disease risk models linked from 12,500+ weather stations via tables: Index of all state and network tables, 694 Oregon, 12 Medford, 27 Hood River, 16 Milton-Freewater, 15 Newburg, 679 insect shortcuts: 1036 Great Lakes, 1057, 3293, 974 S. Central, 1380 S.E., 380 Anishkin, 43 Canada

Online phenology models and degree-day calculator: linked to weather stations via tables: 1036 Great Lakes, 1057, 3293, 974 S. Central, 1380 S.E., 380 Anishkin, 43 Canada

Select crop models: Vineyard, Corn, Plant Disease shortcuts: Fire, B, Apple, scab, etc.

Shortcut to 52 DD models linked to weather stations via map: coding moth [apple & pear] Brunner and Hoyt (1987) Mapsize| 680 | pixels Region| 48-state US | GO

Other plant disease models: Grass, stem rust, and E for Swiss needles

4/03 Poster  
 09/06 Grasses network support - slideshow

Related web sites  
 Full station list

Make your own custom degree-day maps: new version for 48 US states - updated May 2007

ippc OSU NPDN WESTERN REGION

# Hourly Driven Plant Disease Models – verify recent forecast

## Access via table

TABLE OF ONLINE IPM WEATHER DATA  
For agricultural and pest management decision making in the US

Online current and historical weather data/degree-days:  
Oregon USA Weather Data and Pest Models

AGRIMET Network  
Other network tables for OR include: All Networks, CDOF, NELAR, APRSNMNET, Waia, Waia, Yach, GIGOT, PHTWFO, RAINN, Weather-Underground, see also: Oregon (past data), Medford OR, Grants network, Hood River OR, Grants network, Waia, Waia, Yach, OR, Grants network, Alaska, Hawaii, NW USA, SW USA, NE USA, SE USA, South Central USA, North Central USA, Great Lakes/Central USA, and Canada

Degree-day & Phenology Model Calculator  
Also by the full treatment calculator (DD model) (NW network)

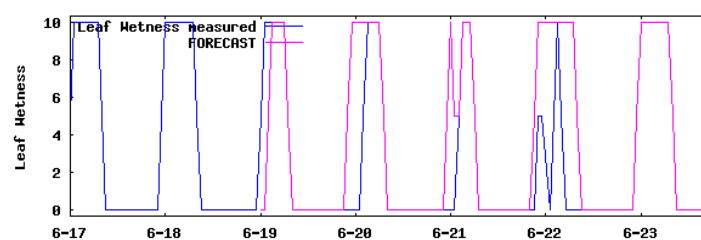
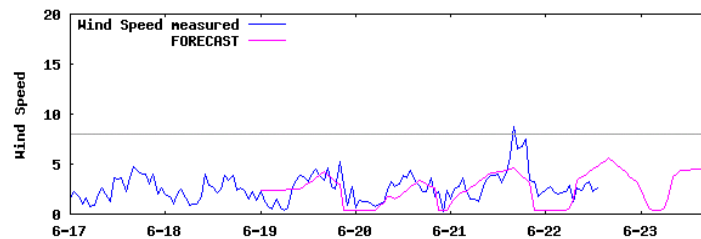
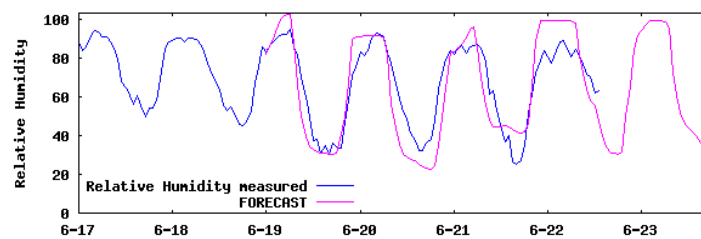
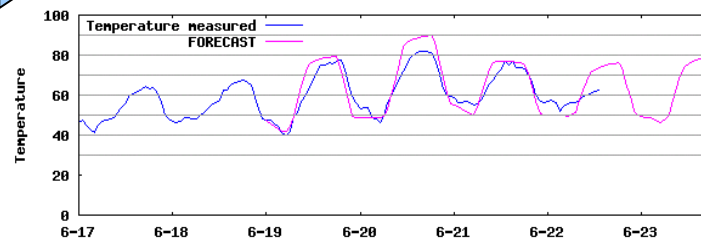
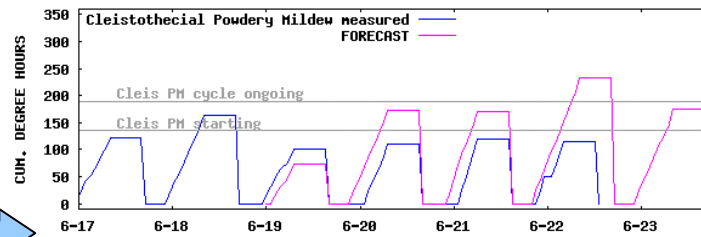
To calculate degree-days: Select model or enter thresholds, calc. method, optional NWS forecast zone, and click radio button for location/year in the table.

Select model: Degree-Day Calculator enter your own thresholds  
Thresholds: lower: 41 °F upper: °F (or Celsius °C) Calc. method: Single sine  
Start (host's) date: Jan 1 End date: Oct 1  
Forecast zipcode or city, state: and Calc.

#	Location, link to weather, plant disease models and forecasts, map (if avail.)	Hourly data	Code, link to NWS recent weather	Link to NWS forecast	Network	Latitude (Decimal Degree)	Longitude (Decimal Degree)	Elev. (ft)	30 day AVG	2007	2006	2005	
1.	Agency Lake	us	AGKO	forecast	AGRIMET	42.5653	-121.9825	4150	ANG	2008	2007	2006	2005
2.	AJUKORA	us	ARAO	forecast	AGRIMET	45.2817	-122.7503	141	ANG	2008	2007	2006	2005
3.	Baker Valley	us	BKVO	forecast	AGRIMET	44.8817	-117.9631	3420	ANG	2008	2007	2006	2005
4.	BANDON	us	BANO	forecast	AGRIMET	43.0966	-124.4167	79	ANG	2008	2007	2006	2005
5.	Beatty	us	BATO	forecast	AGRIMET	42.4778	-121.2739	4320	ANG	2008	2007	2006	2005
6.	Bend	us	BRWO	forecast	AGRIMET	44.0469	-121.3203	3650	ANG	2008	2007	2006	2005
7.	BROOKINGS	us	BRKO	forecast	AGRIMET	42.0300	-124.2406	79	ANG	2008	2007	2006	2005
8.	CHUPARRAS VALLEY	us	CHVO	forecast	AGRIMET	43.2414	-120.7281	4360	ANG	2008	2007	2006	2005
9.	CORVALLIS	us	CRVO	forecast	AGRIMET	44.6342	-123.1894	230	ANG	2008	2007	2006	2005
10.	DEFEAT	us	DEFO	forecast	AGRIMET	45.5864	-121.6406	1260	ANG	2008	2007	2006	2005

## National Plant Diagnostics Network / IPPC Risk Models Output

Forecast Start Date: Thursday, 19 June 2008 (3 Days Before Today)



CRVO  
AGRIMET  
CORVALLIS  
OR  
44.6342  
-123.1894  
230 elevation



### Display Dates

Start Date: Jun 17 2008

Span in days 10

Forecast Start Date: Jun 19

### Station List Filters

Location: CORVALLIS OR AGRIMET

### Models Selected

- Apple Scab
- Pear Scab
- GT Powdery Mildew
- Hops Powdery Mildew
- Cleistothelial Powdery Mildew
- Anjou Pear Scald
- Botrytis
- Tomato Potato Late B light
- Tomcast DSV
- Custom Degree-Hour Accumulation Model

Previous Day Redraw Next Day

### Weather Params

- Temperature
- Dew Point
- Relative Humidity
- Wind Speed
- Rain
- Leaf Wetness

### Custom Threshold Lines for Weather Graphs

Temperature Threshold(s) 30,40,50,60,70,80,90

Windspeed Threshold(s) 8

Download Data Display Data Table

IPM models - Weather data Home Page - Mozilla Firefox

See the what's new page, and please fill out our brief user survey.

IPM Weather Data, Degree-Days, and Plant Disease Risk Models

Basics Daily DD maps Plant disease risk and degree-day calculator Degree-day Models

NWS forecasts enter Place, State or Zipcode: go 2 minute user survey this site is free - please provide us feedback!

Base 41,50 DD Maps for ID, MT, OR, WA, WY, base 32,41,50 maps for all US regions updated daily.

Calculator and disease risk models linked from 12,500+ weather stations via tables: Index of all state and network tables, 694 Oregon, 12 Medford, 27 Hood River, 16 Wilson-Freewater OR, 13 NW Ruben, 679 WA, 34 ID, 451 MT, 335 WY, 1083 NE Central, 1036 Great Lakes, 1057 NE, 3233 SW, 974 S. Central, 1383 SE, 386 Alaska, 443 Canada

Shortcut to 10 hourly plant disease risk models via map: Shortcut to calculator linked to weather stations via map: Mapsize| 680 pixels Region| 48-state US GO

Shortcut to 52 DD models linked to weather stations via map: coding moth [apple & pear] Brunner and Hoyt (1987) Mapsize| 680 pixels Region| 48-state US GO

Select crop models shortcuts: Wheat, sweet corn, Plant Diseases shortcuts: Fire Blight, Apple scab, Pear scab.

Other plant disease models: Grass seed stem rust, and Douglas fir Swiss needle cast

Make your own custom degree-day maps: new version for 48 US states - updated May 2007

Related web sites Full station list

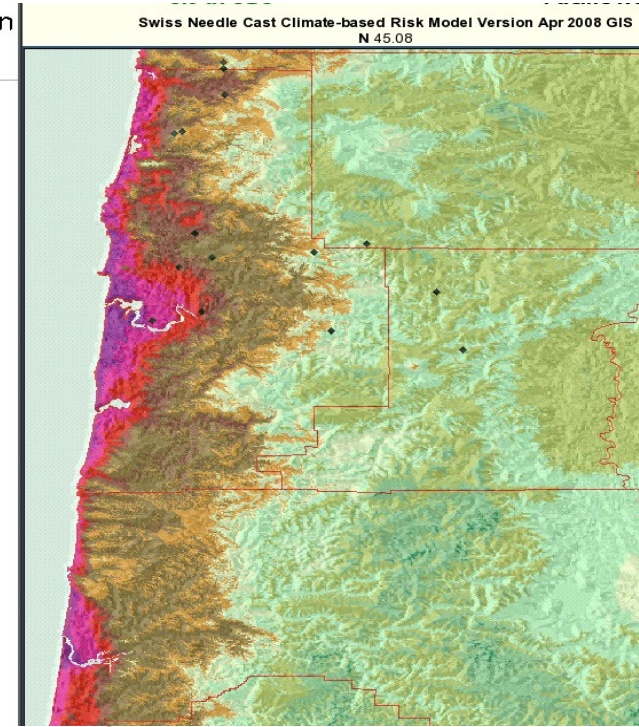
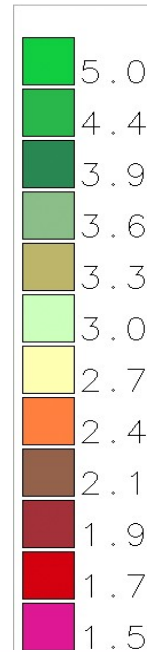
integrated plant protection center  
ippc  
National Plant Diagnostic Network  
OSU  
WESTERN REGION  
Pest Management Center

# Major Uses for Virtual Weather Data



A. Provide a surrogate for actual weather stations

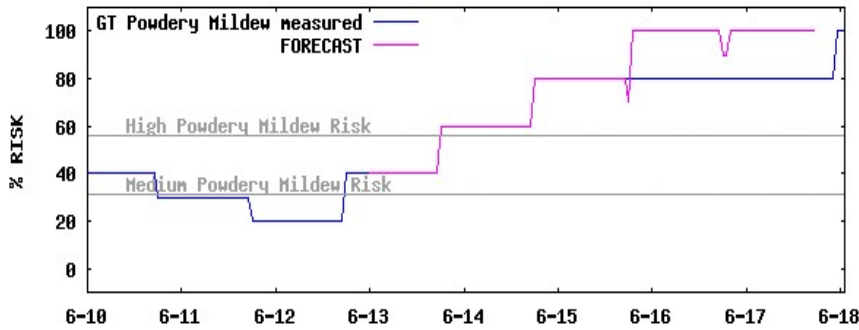
foliar retention (years)



C. Pest and disease risk mapping

National Plant Diagnostics Network / IPPC Risk Models Output

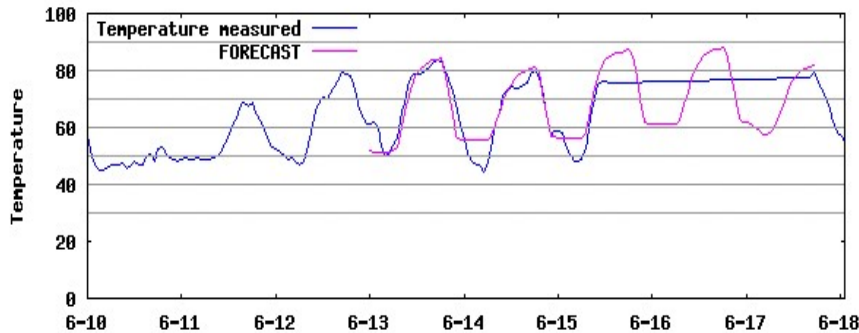
Forecast Start Date: Friday, 13 June 2008 (7 Days Before Today)



MF26036  
MILTON\_  
FREEWATER\_  
GROWERS  
Davis  
Mackenzie Gala  
OR  
45.9714  
-118.4039  
861 elevation



B. Estimate missing data in near-real time



Display Dates

Start Date: Jun 10 2008

Span in days 10

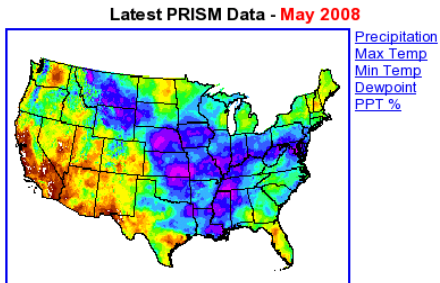
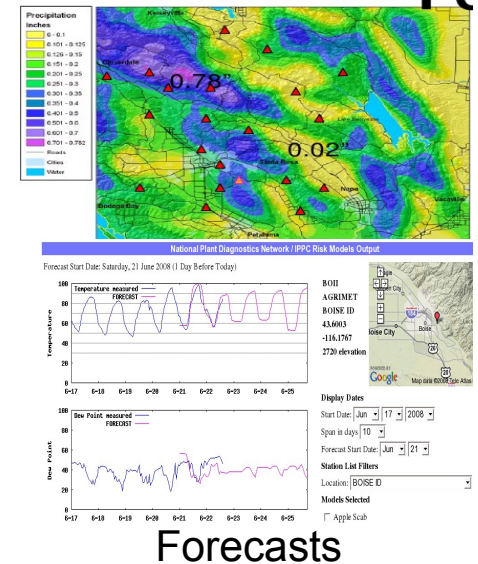
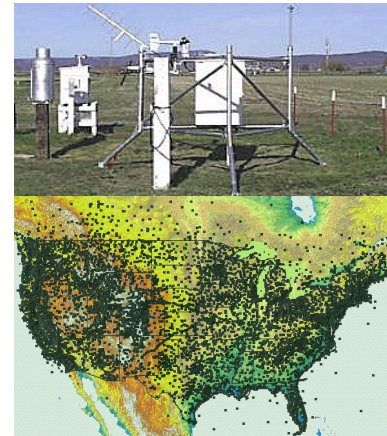
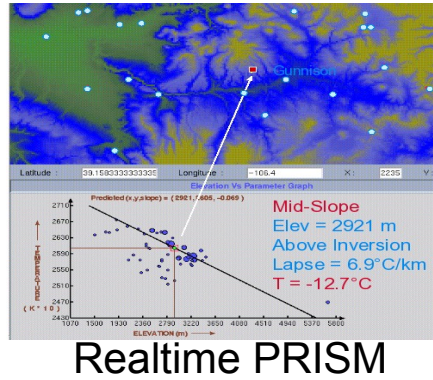
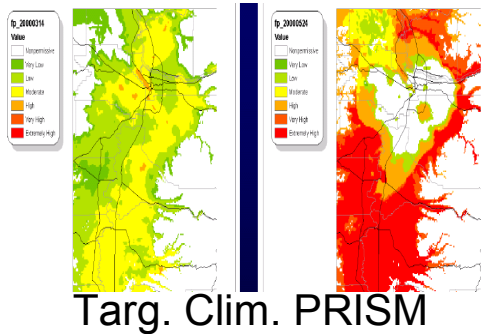
Forecast Start Date: Jun 13

Station List Filters

Location: Davis Mackenzie Gala OR



# WSWG Proposed stages in development of virtual weather data and forecasts

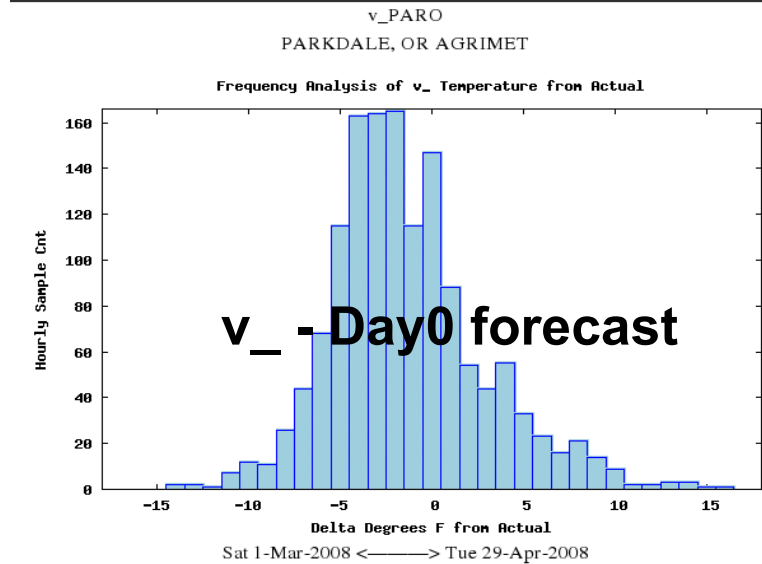
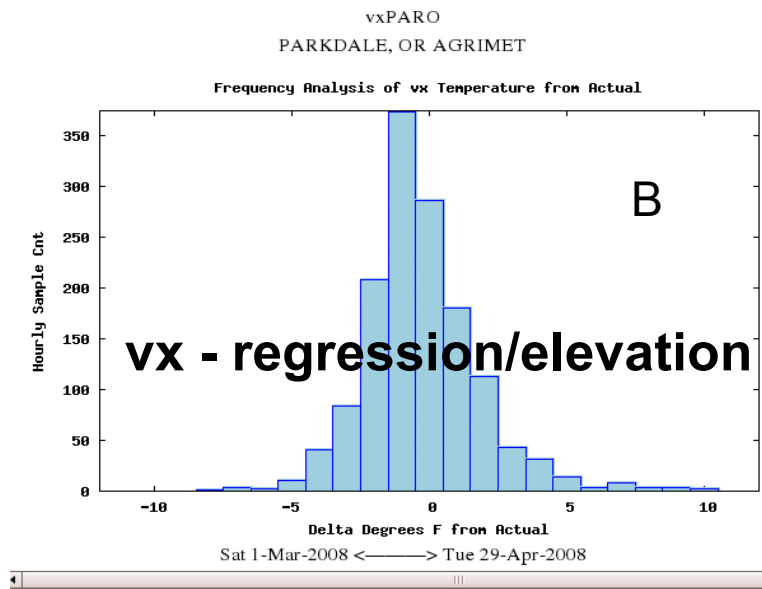


## Technologies Used

	PRISM climatol.	PRISM targeted climatol.	PRISM realtime processing	near-Ground Station Observs	Forecasts Day0	Forecasts Day0-6
					X	
				X	X	
				X		
		X		X		
			X	X		
	X				X	X
		X			X	X
	X	X	X	X	X	X

## Description (year tested/implemented)

1. Day0 forecast (2007-8)
2. Day0 forecast+bias correction (2008)
3. Nearby Obs w/regression elevation (2008)
4. Nearby Obs w/CAI (since 2003 tmax, tmin)
5. Nearby Obs w/PRISM-TC (2007+)
6. Nearby Obs w/Realtime PRISM interps. (2009+)
7. PRISM downscaled forecasts (2008+)
8. PRISM-TC downscaled forecasts (2009+)
9. Performance-based integration of above (2008+)



Temperature Delta Mean = -1.37845499645641  
 Temperature Delta Std. Dev. = 4.18  
 Temperature Absolute\_Delta Mean = 3.51169383416017  
 Temperature Absolute\_Delta Std. Dev. = 2.65077674076235

Forecast Start Date: Sunday, 18 May 2008 (8 Days Before Today)

**VIRTUAL**  
 v\_PARO  
 v\_AGRIMET  
 PARKDALE  
 OR  
 45.5442  
 -121.6167  
 1480 elevation

**Display Dates**  
 Start Date: May 11 2008  
 Span in days: 20  
 Forecast Start Date: May 18

**Station List Filters**  
 Location: PARKDALE OR

**Models Selected**

- Apple Scab
- Pear Scab
- GT Powdery Mildew
- Hops Powdery Mildew
- Cleistothecial Powdery Mildew
- Anjou Pear Scald
- Botrytis
- Tomato Potato Late B light
- Tomcast DSV
- Custom Degree-Hour Accumulation Model

**Evaluate Forecast Parameters vs Actual - Mozilla Firefox**

File Edit View History Bookmarks Tools Help

OSU IPPC and Fox LLC IPM Weather Forecast Verification System for Oregon and S. Washin

**PARKDALE OR**  
 PARO -- AGRIMET  
 45.5442 -121.6167

Date: 20080520  
 Location: PARKDALE OR

Display Forecasts		Display Parameters	
Day 0	<input checked="" type="checkbox"/> line <input checked="" type="checkbox"/> pts	<input checked="" type="checkbox"/> Temperature (F)	<input type="checkbox"/> Dew Point (F)
Day 1	<input checked="" type="checkbox"/> line <input type="checkbox"/> pts	<input checked="" type="checkbox"/> Windspeed (mph)	<input checked="" type="checkbox"/> Rain (in.)
Day 2	<input checked="" type="checkbox"/> line <input checked="" type="checkbox"/> pts	<input checked="" type="checkbox"/> FL Leaf Wetness	<input checked="" type="checkbox"/> Approx. Leaf Wetness
Day 3	<input checked="" type="checkbox"/> line <input type="checkbox"/> pts		
Day 4	<input type="checkbox"/> line <input type="checkbox"/> pts		
Day 5	<input type="checkbox"/> line <input type="checkbox"/> pts		
Day 6	<input type="checkbox"/> line <input type="checkbox"/> pts		

**Web-based evaluation examples: A) Models and virtual data, B) Virtual data error histograms, C) Day0-5 forecast validation tool**

# Virtual Weather Error Analysis

Averages of 21 AGRIMET stations in OR, WA, ID, hourly data, March 1-April 29, 2008.

	Day 0 forecast (V_)	Bias- Corrected Day 0 (V1)	Local sta- tion based <sup>a</sup> (VX)
<b>Temperature</b>			
Mean Error (bias)	-1.43	0.01	0.03
Mean Absolute Error	2.64	2.41	1.04
<b>Dewpoint Temperature</b>			
Mean Error (bias)	1.35	-0.08	-0.11
Mean Absolute Error	2.75	2.64	1.22
<b>Relative Humidity (%)</b>			
Mean Error (bias)	14.73	na	-1.48
Mean Absolute Error	6.98	na	6.24

<sup>a</sup>using local elevation-regression; not dependent on forecast

# Grass Stem Rust Estimator (2008) ?

Required inputs: **Location:** ?  ?

**Rust scouting date:** ?   ?

**Number of pustules found:**

per:  ft. of row  10 tillers

**Date of flag sheath emergence:** ?

(leave blank for unknown)

**Fungicide application date and type:** ?

DMI  Strob  mixture  none

DMI  Strob  mixture  none

DMI  Strob  mixture  none

DMI  Strob  mixture  none

DMI  Strob  mixture  none

Compute new

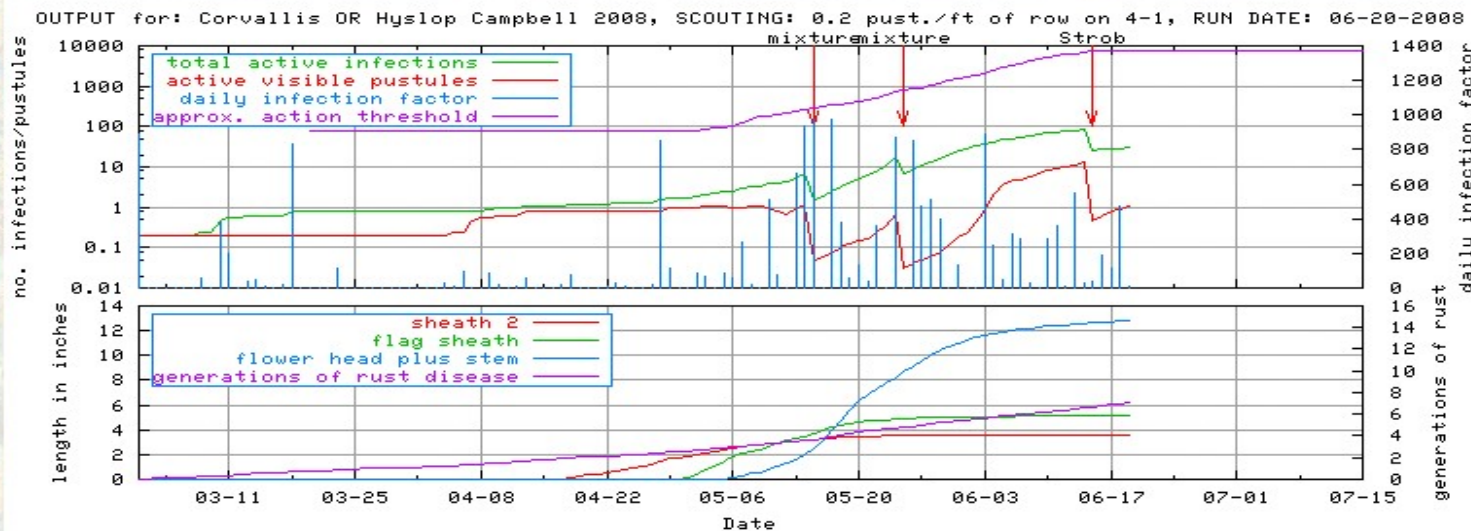
graphs ?

Compute

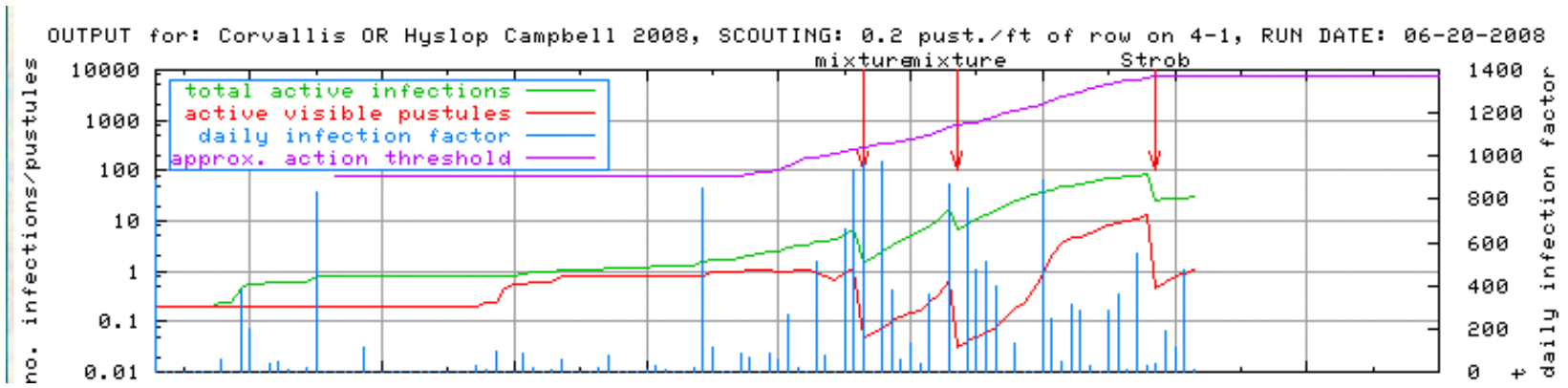
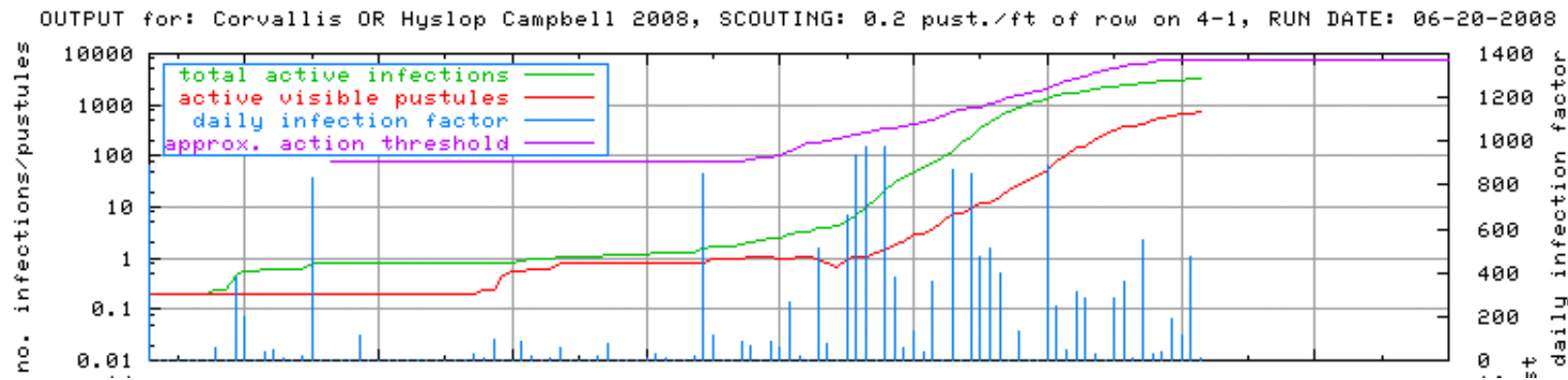
**Help/Comments:** ?

Introduction: This web page is a tool to estimate the development of stem rust in grass seed fields, and to compare fungicides and application times for their relative effects in disease management. The estimator tool is based on ongoing research with one cultivar (Morningstar) of perennial ryegrass in the Willamette Valley of Oregon, and is subject to revision as additional research results are obtained and incorporated. Stem rust in cultivars of exceptionally early or late maturity may not be well described by this model. Please review

## Graphs of rust activity ? and plant growth ?



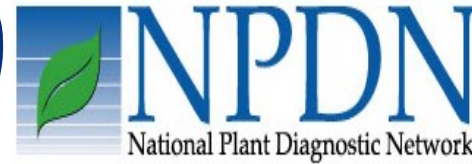
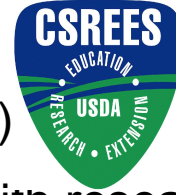
**Web-based simulation model of stem rust – Bill Pfender, hosted by IPPC**



**Web-based simulation model allows game-playing, optimization of treatments**

# Current goals and approach <http://pnwpest.org/wea>

1) Building system jointly for:  
 plant biosecurity (research and development)  
 IPM (real-world cases, validation and feedback)



2) Free access and use; evolve operationally with research-led, open source technologies, publicly shared weather

3) Emphasize breadth and robustness (e. g. generic models and tools) rather than local unique customizations (e. g. push technologies)

Custom Degree-Hour Accumulation Model

Accumulative Degree-Hours using these Parameters

90°F Upper Temperature Threshold

36°F Lower Temperature Threshold

15 Reset Threshold (dry hours)

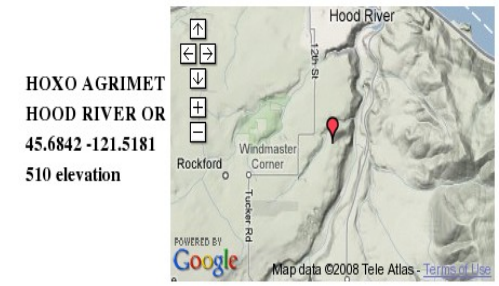
Ignore Leaf Wetness

60 Event Threshold (degree-hours)

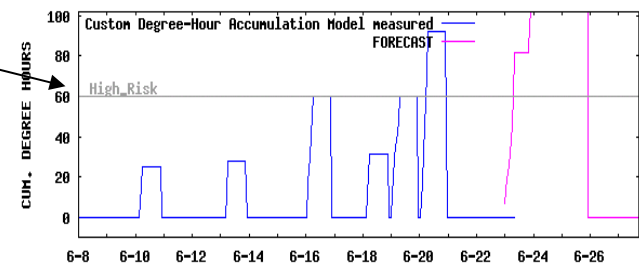
High\_Risk Event Label

4) Plant biosecurity/IPM risk models are primarily site specific and are changing over time. Therefore, single site, time series are the current standard of emphasis

5) Expect primary users to be trained experts to some degree, those who know that models depend on good inputs and sound judgement for interpretation; i. e. emphasize risk levels rather than action thresholds



6) Support regional programs to test IPM capabilities over the long term (e. g. Oregon – Hood River, The Dalles, Medford, Milton Freewater: all tree fruits; Willamette Valley: grass seed stem rust), each with own home page allowing “shortcut links” to frequently used models



Oregon USA Walla Walla View Network weather station table **NEW** (click on most headers to SORT table)

#	Location, link to weather, apple scab, GT-PM, CL-PM, and Botrytis plant disease models and forecasts, map (if avail.)	Link to NWS forecast	Latitude (Decimal Degree)	Longitude (Decimal Degree)	Elev. (ft)	Apple model shortcuts	Stone fruit model shortcuts	30 yr AVGS	2008 data calc	2007 data calc
1.	<a href="#">Ash Hollow Vineyard MF24190</a>	<a href="#">forecast</a>	46.0539	-118.7292	591	<a href="#">Fireblight</a> , <a href="#">Codling moth</a> , <a href="#">Codling moth (new)</a> , <a href="#">Pandemis moth</a> , <a href="#">OBLR</a> , <a href="#">San Jose scale</a>	<a href="#">W. Cherry Fruit Fly</a> , <a href="#">Oriental fruit moth</a> , <a href="#">Peach twig borer</a>	<a href="#">AVG 2008</a>	<a href="#">2007</a>	<a href="#">2007</a>
2.	<a href="#">Blue Mt Cherry MF22700</a>	<a href="#">forecast</a>	45.9569	-118.4367	864	<a href="#">Fireblight</a> , <a href="#">Codling moth</a> , <a href="#">Codling moth (new)</a> , <a href="#">Pandemis moth</a> , <a href="#">OBLR</a> , <a href="#">San Jose scale</a>	<a href="#">W. Cherry Fruit Fly</a> , <a href="#">Oriental fruit moth</a> , <a href="#">Peach twig borer</a>	<a href="#">AVG 2008</a>	<a href="#">2008</a>	<a href="#">2007</a>

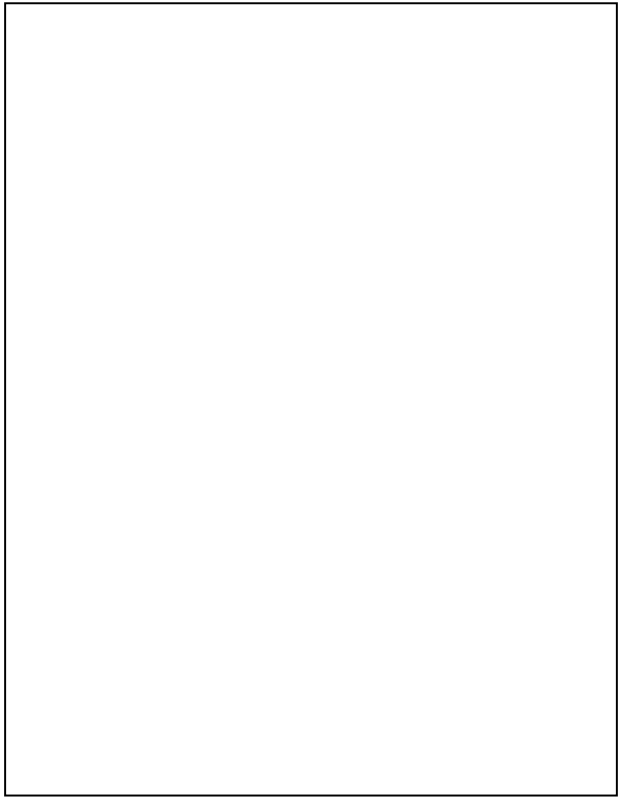
# Summary of IPPC weather-driven pest models – features and ongoing issues

- **PRISM climate map CAI** based daily maps, dynamic maps, and max-min temperature estimation of missing data
- **Numerous networks**; higher chance of nearby stations to help estimate missing data
- Current virtual station types, based on a) IPPC/Fox weather **Day 0 forecast** data, b) Elevation/regression approach with nearby stations
- Future virtual station types will be improved iteratively using web-based evaluation/validation tools
- Are missing/bad data feeding the models? How will you know? Need to have option to **show the input weather data** with model outputs, **quality assurance flags**, **online analysis of errors** for all types of estimated data
- Forecasts: as of 2008: 5-day hourly **site-specific** forecasts for all pest models OR, S. WA, W. ID, soon to expand (Fox Weather LLC collaborating with The PRISM Group and IPPC)



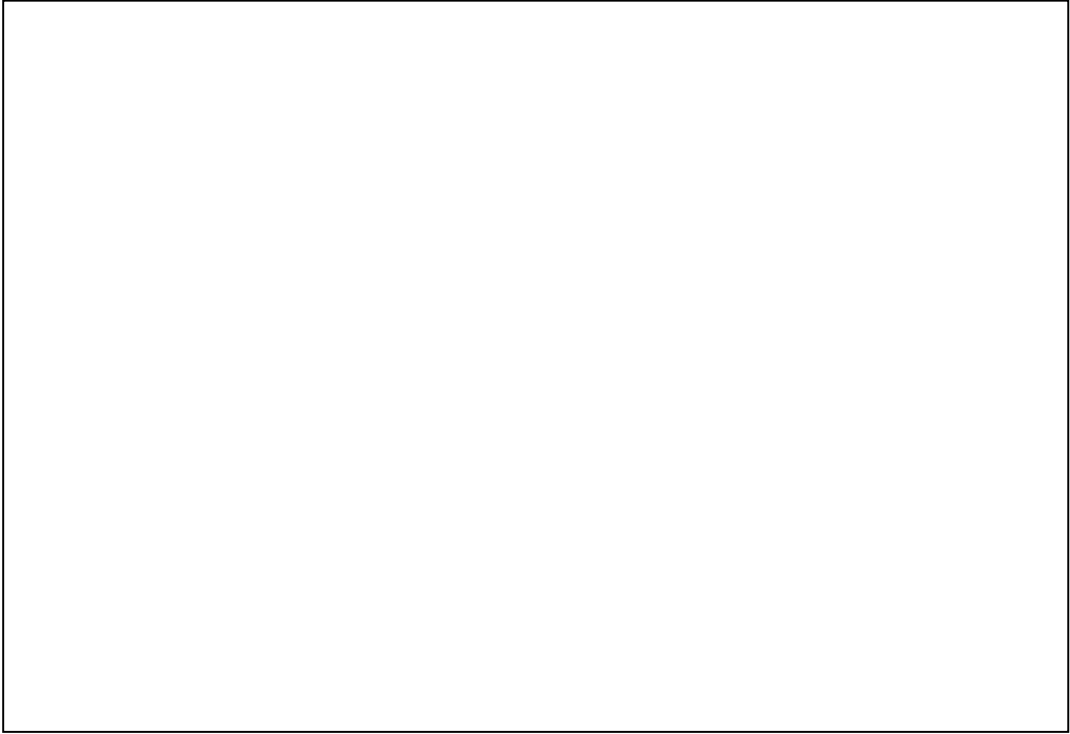


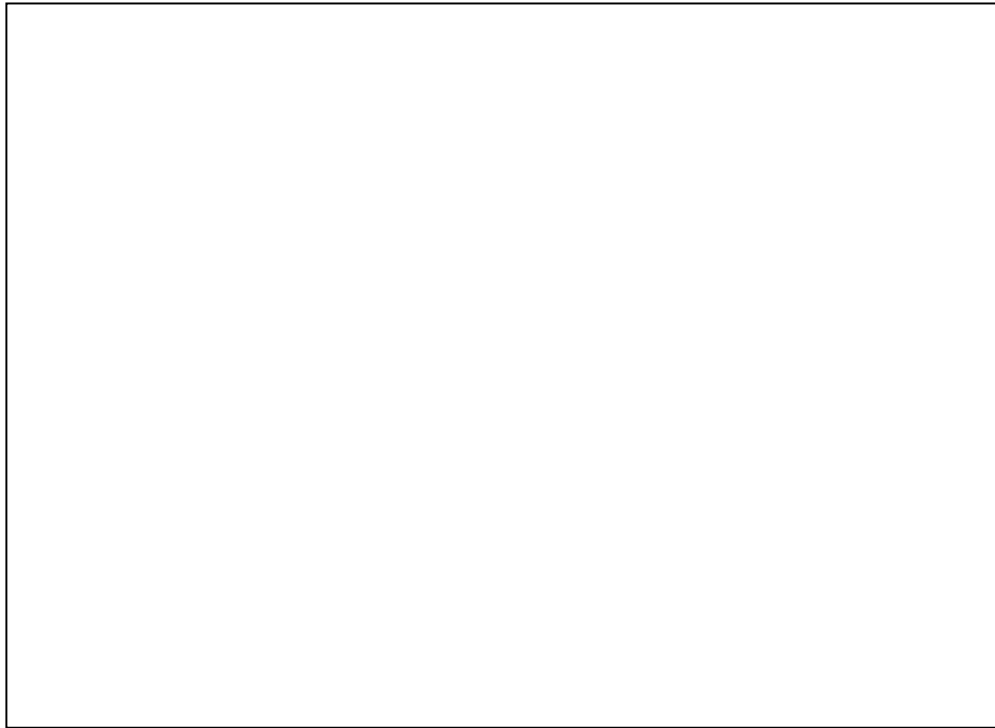










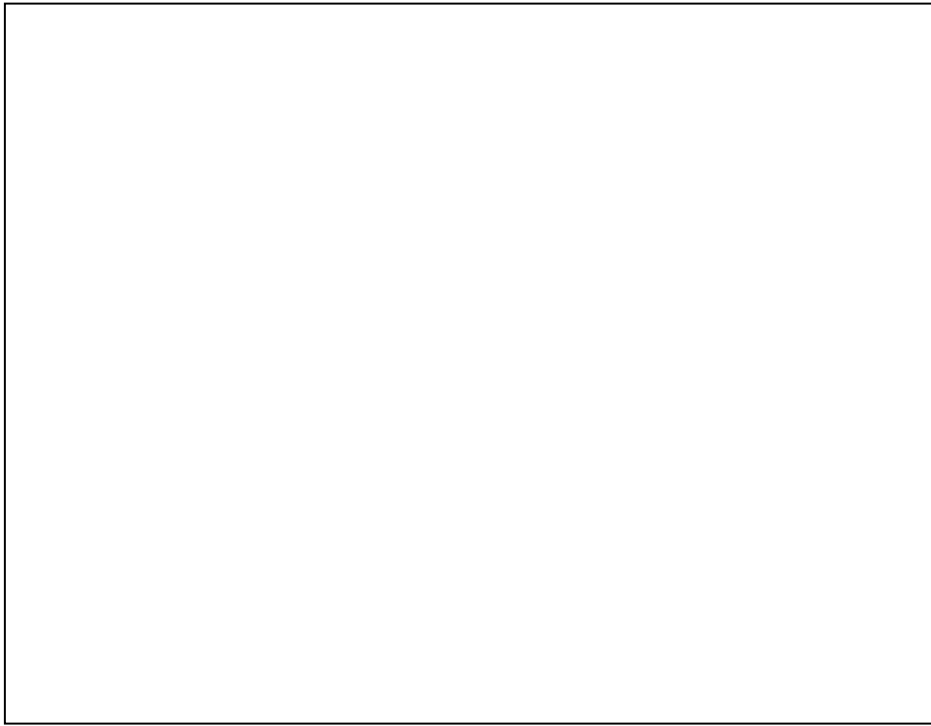


IPPC then uses CAI to transform a PRISM temperature climatology into today's temperature map by interpolating each station's deviation from the PRISM average. Degree-day maps are also created in this way.

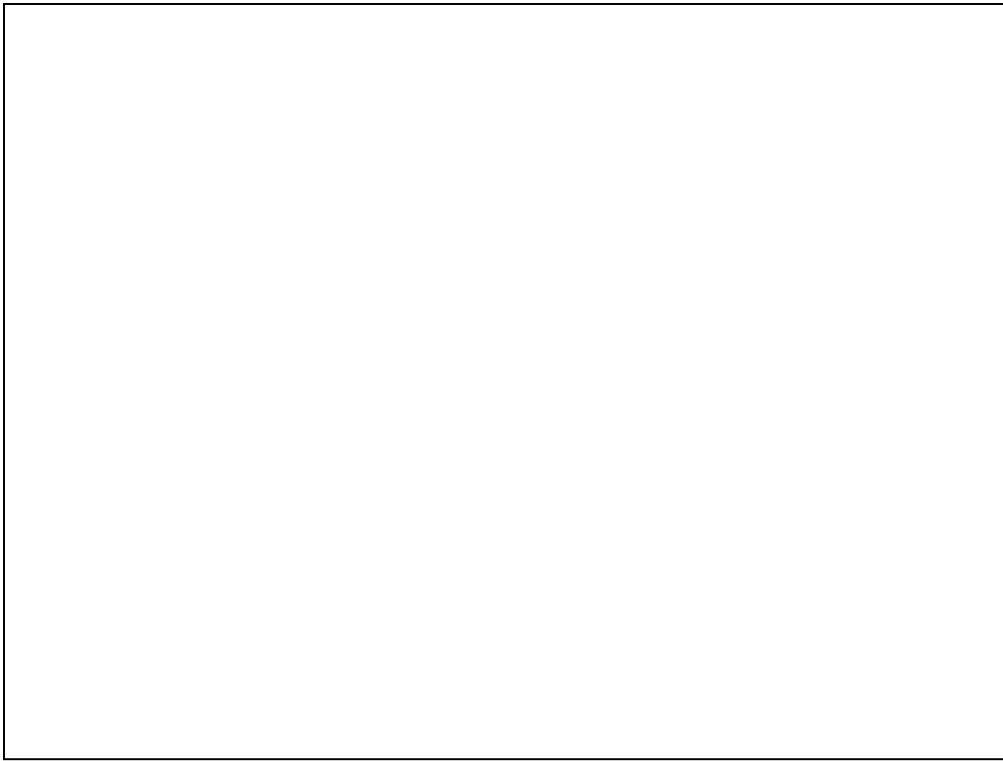




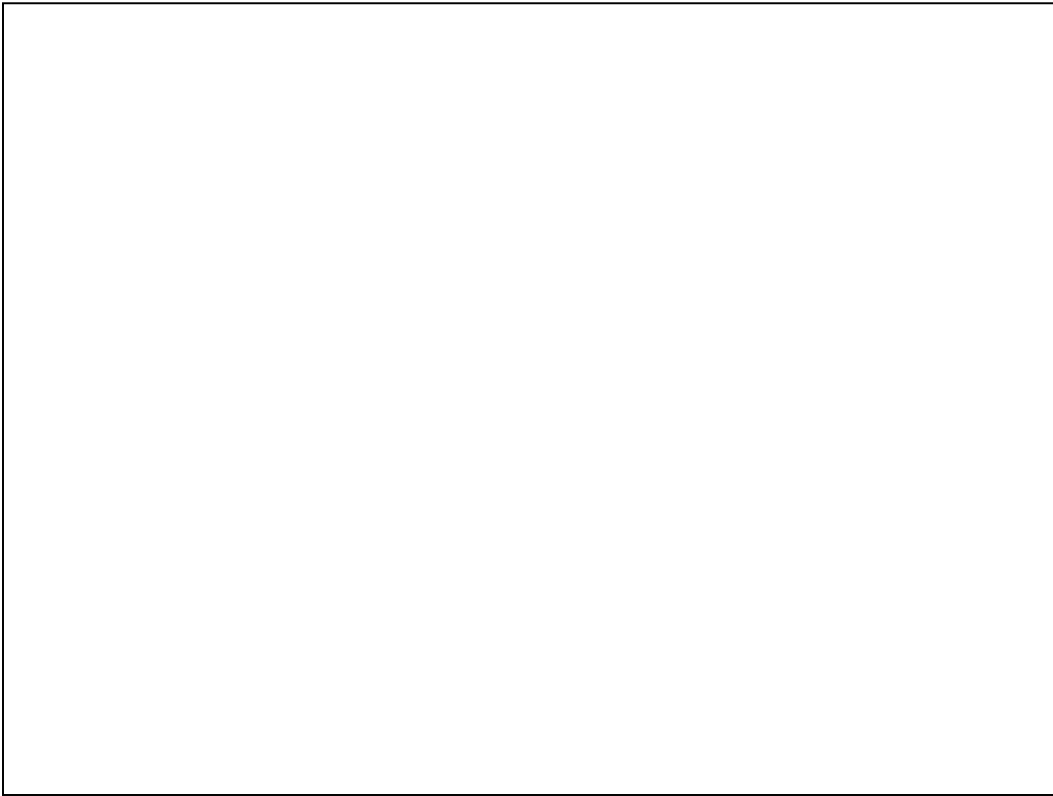




IPPC Degree day maps are being ported over to NPDN CERIS website at Purdue Univ. where they are providing the basemaps for the NPDN national invasive pest repository. Plant disease scientists can use these tools to track how weather may influence pest dispersal across entire regions anywhere in the US, a capability not available without the NPDN program. Displayed here are soybean rust observations and diagnoses.



Zoomed to the subcounty level for degree days. A current hypothesis derived from these tools are that the disease moves north with cumulative degree-days, and produces outbreaks from weather conditions similar to common apple scab.



Both temperature and degree-days were compared between simple date averaging, PRISM-base (CAI) estimated, and actual values. The CAI method had nearly half the average error value for max temperatures. The two methods performed nearly identically for min temperatures. R-square values reflect these results, and show that while the nearest date averaging method works well for min temperatures, for max temperatures and degree-days the CAI method is preferable.



The IPPC/NPDN disease weather system integrates over 12,000 weather stations in the US and Canada with dozens of insect pest and plant disease models. It can help predict when and where outbreak risks are elevated for invasive and established pests.

Here we see the tool zoomed to the Pacific Northwest and a Weather Station in the Hood River Pear growing region. Several generic plant disease models are selected that show current and forecasted risk of infection. This tool is currently being used to compare disease model outputs with observed soybean rust by NPDN. Degree days are being tracked and used by CDFA for Light Brown Apple Moth and fruit flies, and by USDA APHIS for several pest species.





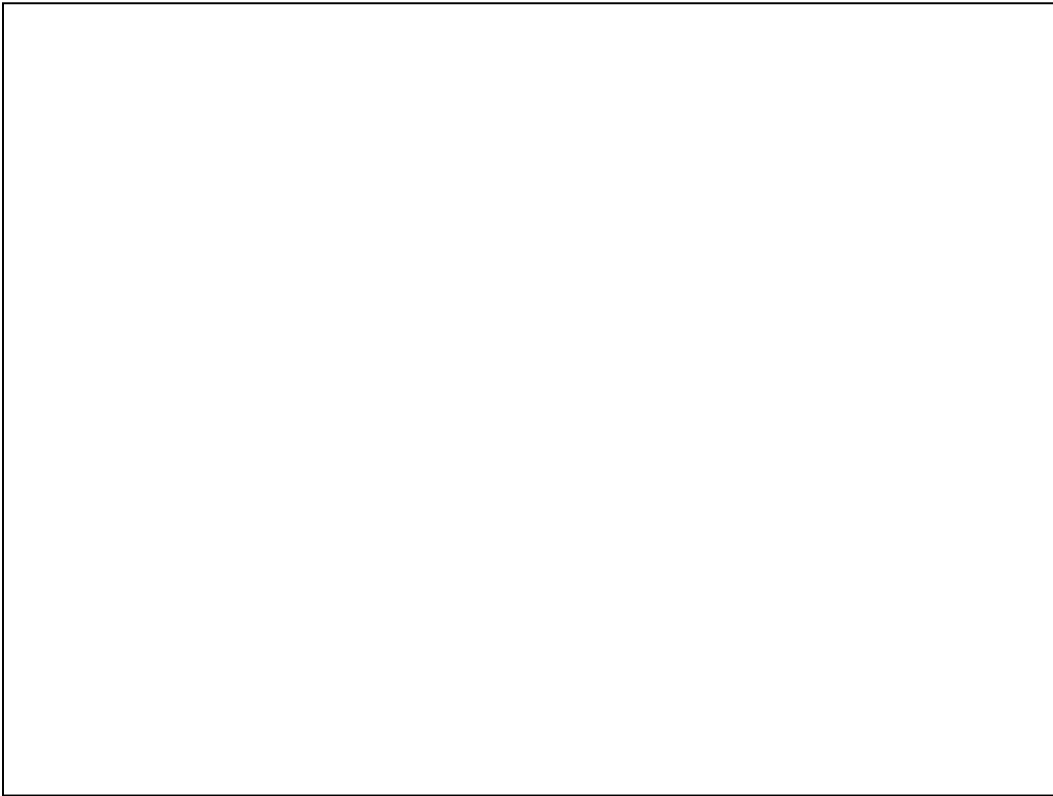








Using the online virtual station error analysis tools, we analyzed the mean error (bias) and mean absolute error of 3 types of virtual weather for 21 weather stations in three states. For temperature, and dewpoint, the MAE was highest for forecast only data, about 2.5 times as high as the elevation-regression (VX) data. Bias was also higher for forecast-based virtual temperatures,  $-1.4^{\circ}\text{C}$  on avg vs only  $0.01^{\circ}\text{C}$  for bias corrected (V1) and  $0.03^{\circ}\text{C}$  for VX data. Results were similar for dewpoint and RH, where elevation-regression displayed both lower bias and mean absolute error than either the forecast or bias-corrected data.



The IPPC website also includes a state of the art simulation model for grass seed stem rust used in W. Oregon. This model features a single web page interface, ability to input field specific initialization values, ability to implement multiple spray treatments, graphical output, and online help.







Once a high-quality climate is developed, it can be used as the basis for other maps, because basic spatial patterns of climate are relatively stable. This is the basis for “climatologically-aided interpolation,” in which a climate map is used as the explanatory variable in the PRISM regression function, rather than a DEM.