

# How to Access NOAA Weather Forecast Data for Use in Agriculture Decision Models



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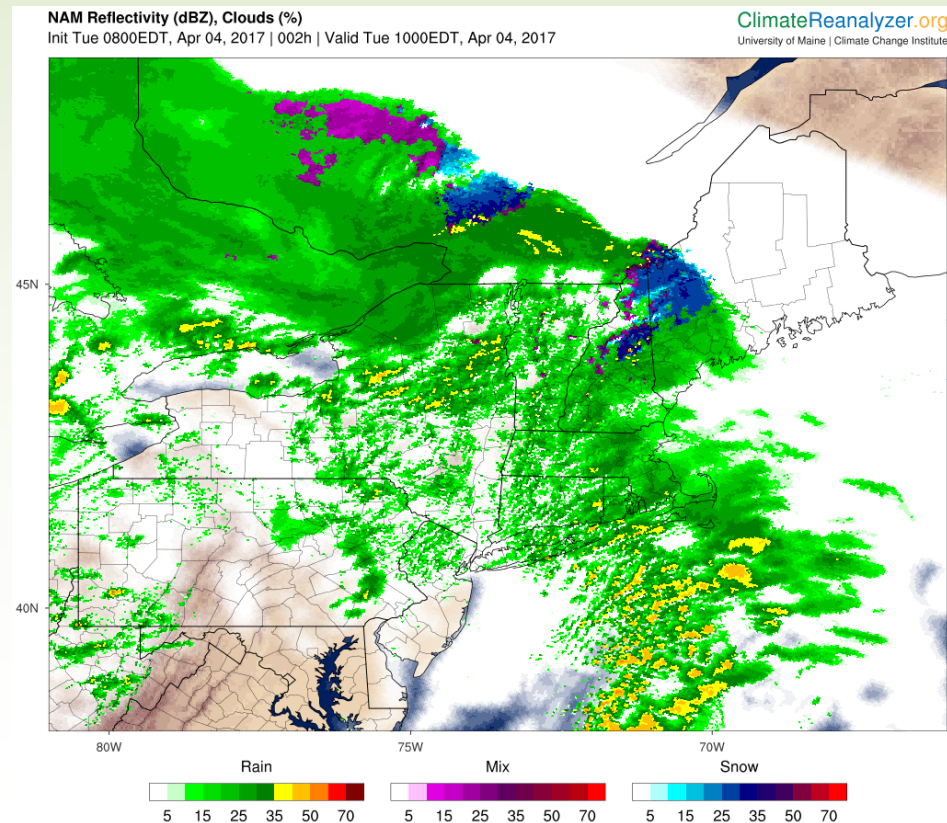


Glen W. Koehler

Associate Scientist Integrated Pest Management  
Cooperative Extension Pest Management Office  
University of Maine

# Presentation Outline

- Project Rationale and Background (Glen; 5 min)
- Accessing NOAA Forecast Output (Sean; 20 min)
  - Agricultural Weather (AgWx)  
Script Overview
  - NOMADS data portal
  - Forecast Models
  - Continuing Work
- Q & A (5 min)
- Example Applications (Glen; 15 min)
- Q & A (15 min)



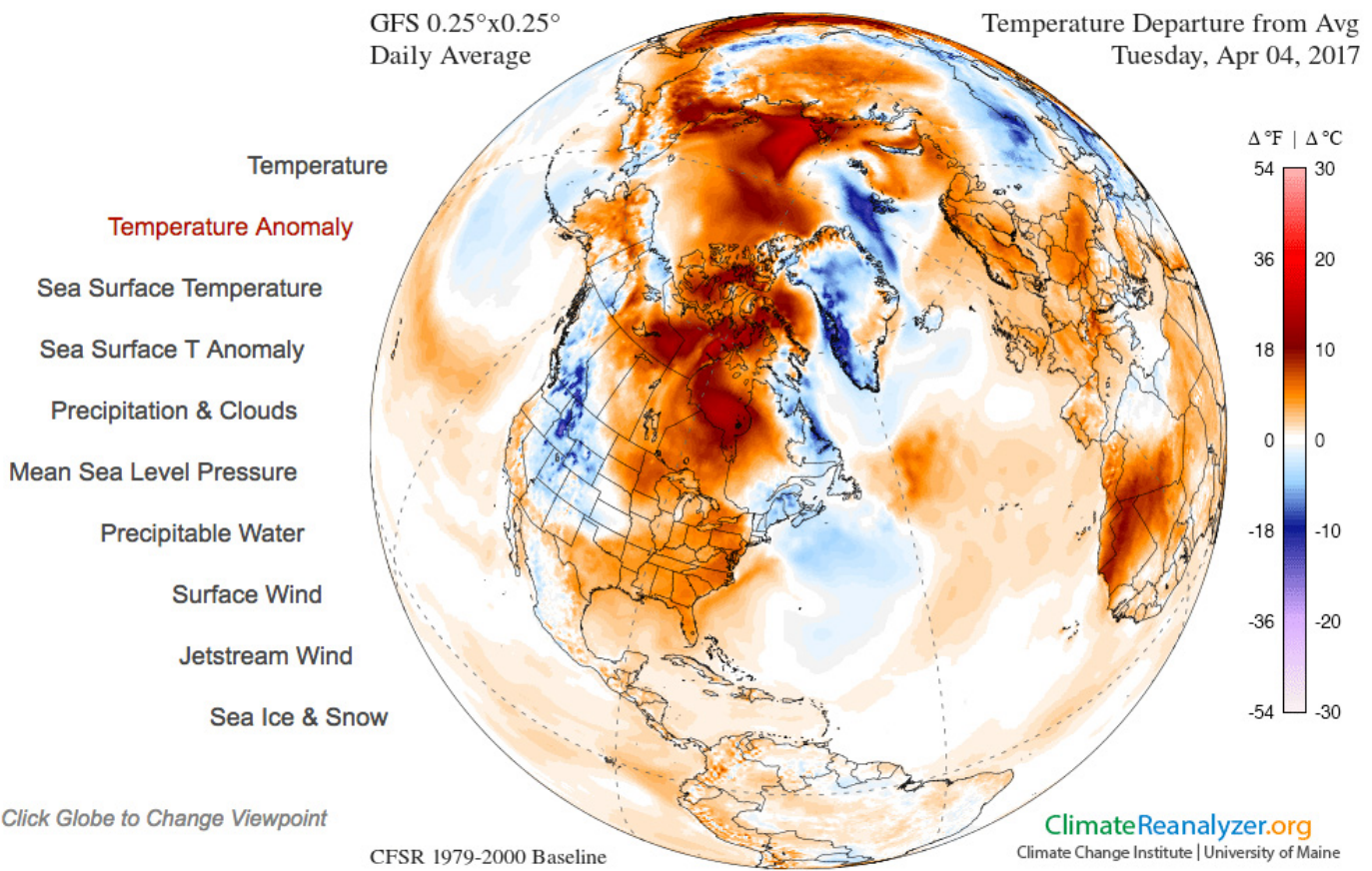
Climate is what you expect;  
Weather is what you get.

Farmers need weather intelligence.

NOAA has weather data, but...



## Today's Weather Maps



World	Northern Hemisphere	Arctic
+ 0.69 °C	+ 0.97 °C	+ 3.63 °C
Tropics	Southern Hemisphere	Antarctic
+ 0.39 °C	+ 0.40 °C	+ 0.41 °C

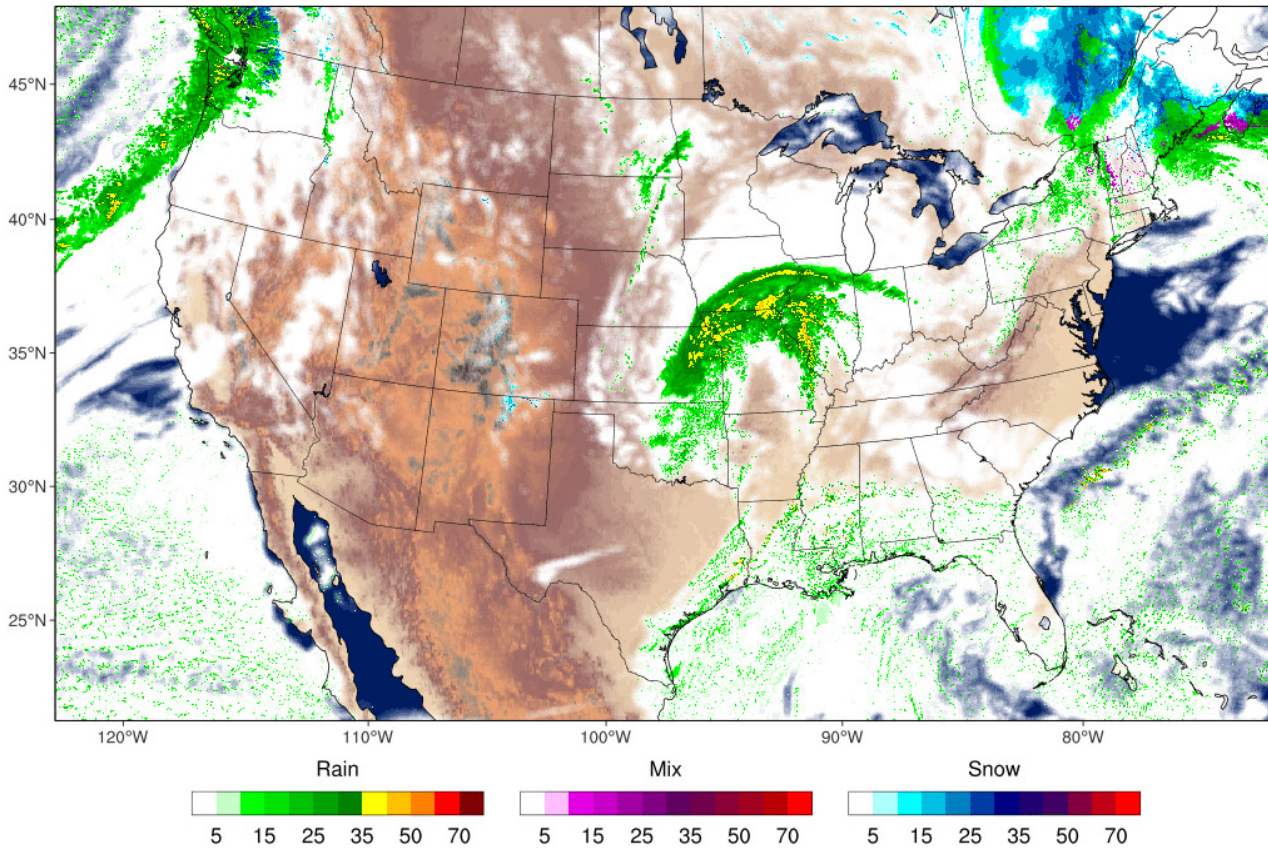
## Weather Forecast Maps

Forecast Type: U.S. Regional 60-hour (NAM 3km) | Map Area: United States | Variable: Precipitation / Cloud Cover (topography)

Image Slider: [Slider] | Fast Image Load: Off

**NAM Reflectivity (dBZ), Clouds (%)**  
Init Tue 0800EDT, Apr 04, 2017 | 021h | Valid Wed 0500EDT, Apr 05, 2017

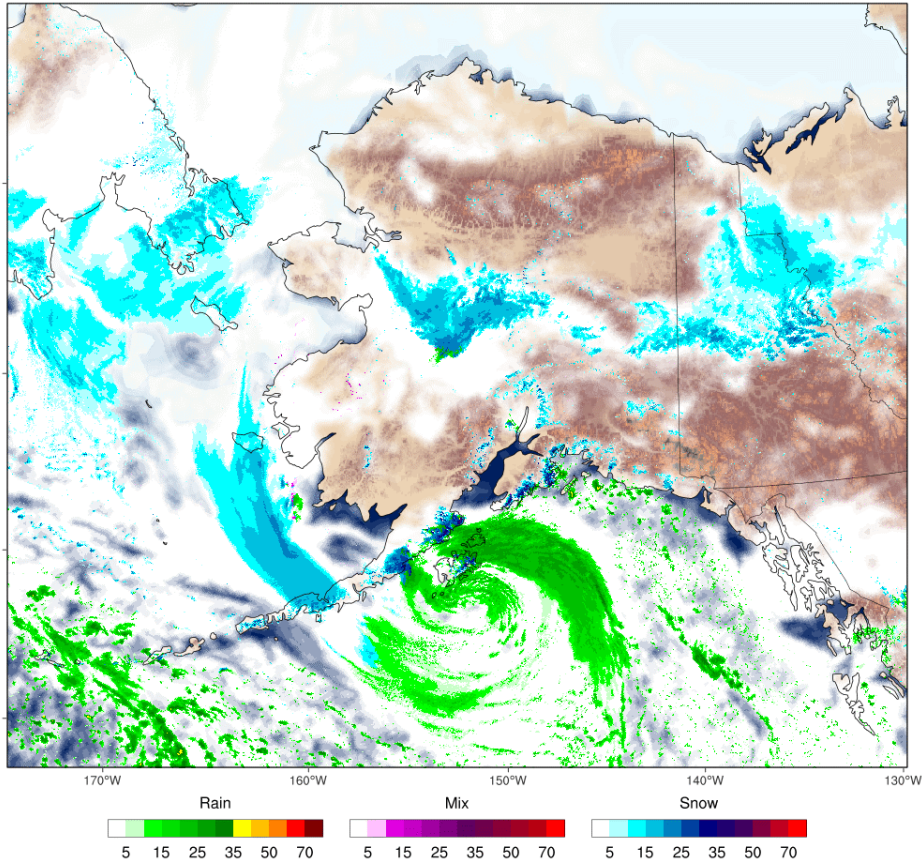
ClimateReanalyzer.org  
University of Maine | Climate Change Institute



# Alaska too!

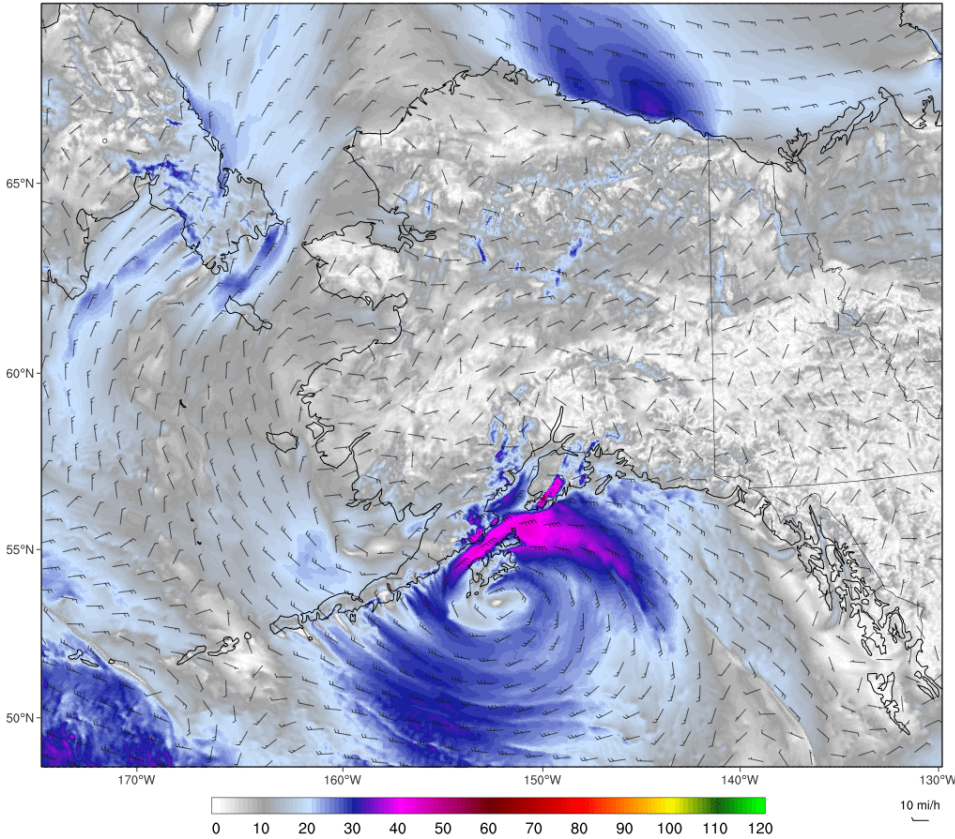
NAM Reflectivity (dBZ), Clouds (%)  
Init Wed 1600AKDT, Apr 05, 2017 | 034h | Valid Fri 0200AKDT, Apr 07, 2017

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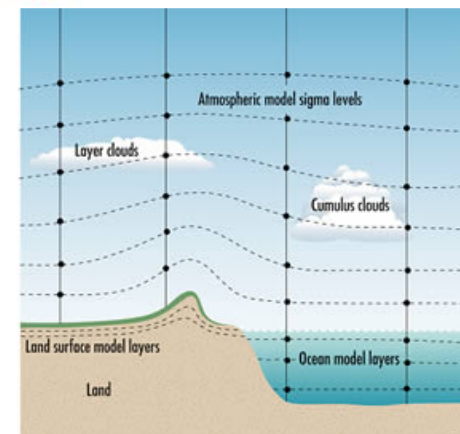
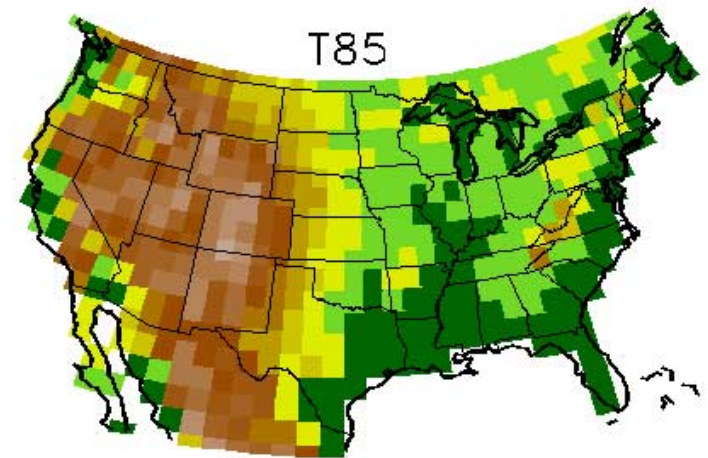
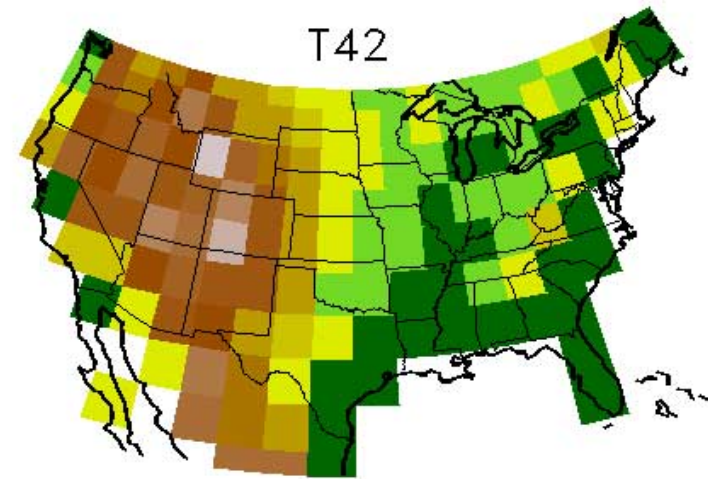
NAM 10m Wind (mi/h)  
Init Wed 1600AKDT, Apr 05, 2017 | 034h | Valid Fri 0200AKDT, Apr 07, 2017

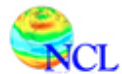
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# Numerical Forecast Models

- Equations solved on horizontal and vertical grids
- Initialized from station and satellite data at regular intervals (e.g., 00, 06, 12, 18 UTC)
- Model outputs typically 1 or 3-hourly
- Global and regional models run in cooperation between the National Centers for Environmental Prediction (NCEP), National Oceanic and Atmospheric Administration (NOAA), and the National Weather Service (NWS).





## NCAR Command Language



NCL is an interpreted language designed specifically for scientific data analysis and visualization.

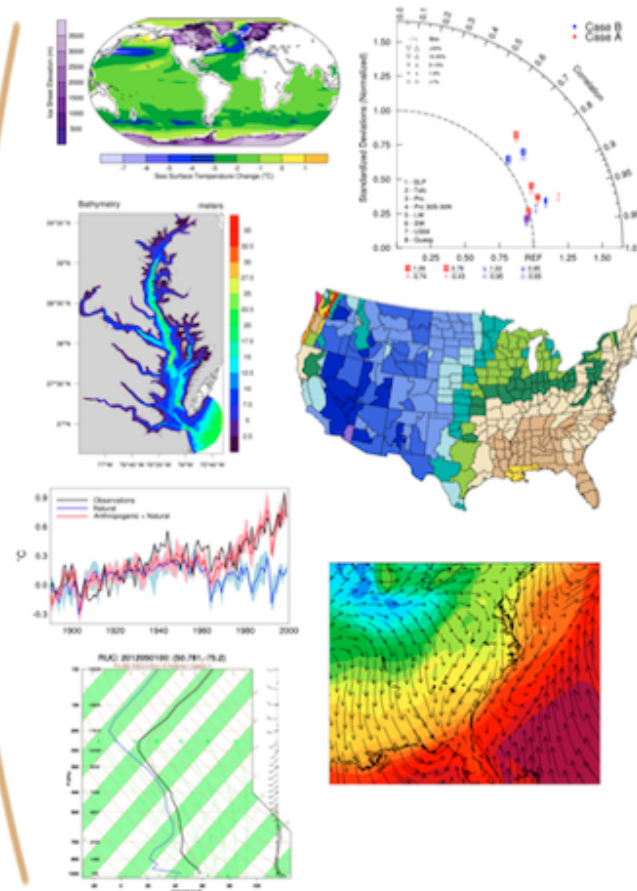
Portable, robust, and free, NCL is available as binaries or open source.

Supports NetCDF 3/4, GRIB 1/2, HDF 4/5, HDF-EOS 2/5, shapefile, ASCII, binary.

Numerous analysis functions are built-in.

High-quality graphics are easily created and customized with hundreds of graphic resources.

Many example scripts and their corresponding graphics are available.



# What is a script?

```
plot_wx_maps_v3.ncl

547 precip_acc      =string_to_bool(wm_meta(wm,32))
548 wind            =toint(wm_meta(wm,33))          ; 0=none, 1=10m, 2=850hPa, 3=500hPa, 4=250hPa
549 wind_v         =toint(wm_meta(wm,34))          ; 0=none, 1=10m, 2=850hPa, 3=500hPa, 4=250hPa
550 wind_clr       =toint(wm_meta(wm,35))          ; 0=black, 1=dark gray, 2=med gray, 3=light gray, 4=white,
551 wind_thick     =tofloat(wm_meta(wm,36))
552 gust           =string_to_bool(wm_meta(wm,37))
553 mslp           =string_to_bool(wm_meta(wm,38))
554 mslp_c         =string_to_bool(wm_meta(wm,39))
555 mslp_c_clr     =toint(wm_meta(wm,40))          ; 0=black, 1=dark gray, 2=med gray, 3=light gray, 4=white,
556 mslp_c_thick  =tofloat(wm_meta(wm,41))
557 HighLow       =string_to_bool(wm_meta(wm,42))
558 plot_rivers    =toint(wm_meta(wm,43))
559 plot_pts_var   =toint(wm_meta(wm,44))
560 wind_lvl       =0                             ; needed to prevent crash for non-wind vars
561 explicit_lvls  =False
562 v_meta=new(/20,5/),"string"                  ; variable metadata array
563
564 weasd=False
565 if (model_short .ne. "HRRR" .and. (wm_id .eq. "WEASD-TOPO" .or. wm_id .eq. "WEASD-MSLP")) then
566     snowd=False
567     weasd=True
568 end if
569
570 plot_dF=False
571 if (model_short .eq. "GFS-025deg" .and. dm_name .eq. "CONUS-LC2" .and. wm_id .eq. "T2") then
572     plot_dF=True
573     wm_title="2m Temperature ("dF+", 32"dF+" (white)"
574 end if
575 if (model_short .eq. "HRRR" .or. model_short .eq. "NAM3km-CONUS" .or. model_short .eq. "NAM3km-ALASKA" .or. \
576     model_short .eq. "RAP32km") then
577     if (model_short .ne. "RAP32km") then
578         icefill=False
579     end if
580     if (wm_id .eq. "T2" .or. wm_id .eq. "T2-MSLP-WS10_mph") then
581         plot_dF=True
582         wm_title="2m Temperature ("dF+", 32"dF+" (white)"
583     end if
584     cfillmode=cfill
585     if (model_short .eq. "HRRR") then
586         if (T2_zero_c) then
587             if (dm_name .eq. "USNE-CED" .or. dm_name .eq. "USSE-CED" .or. dm_name .eq. "USNW-CED" .or. \
588                 dm_name .eq. "USSW-CED" .or. dm_name .eq. "USNC-CED" .or. dm_name .eq. "USSC-CED" .or. \
589                 dm_name .eq. "USNC_test-CED") then
590                 T2_zero_c_thick=2.0
591             else
592                 T2_zero_c_thick=1.2
593             end if
594         end if
595     end if
```

Line 66 Col 13 | NCAR Command Language | Unicode (UTF-8) | Unix (LF) | Last saved: 4/5/17 2:45:30 PM | 128,148 / 15,938 / 2,284

# AgWx Script Overview

1. Query NOAA forecast model data portal twice daily (00, 12 UTC) using UNIX shell scripts.
2. Retrieve gridded observations from surface analyses and forecasts from global and regional models.
3. Extract and process weather metrics using NCL scripts.
4. Output spreadsheet-readable CSV files with 10-day forecast metrics for a list of site locations.
5. Files placed into web accessible folder on UMaine Climate Reanalyzer.

# AgWx Variables

T (2m and surface)

Dewpoint T

Relative Humidity

Surface Pressure

Wind Speed and Direction

Wind Gust

Precipitation

*Precipitation probability (in the works)*

Water Equivalent Snow Depth

Total Cloud Cover

Soil T at 2" and 10"

Soil Moisture at 2" and 10"

Downward/Upward Short/Long Wave Radiation

Ground Heat Flux

Potential Evaporation

Plant Canopy Surface Water (NAM only)

Evapotranspiration (Penman-Monteith from NCL function)

GFS\_MACSO\_2017-04-01\_00Z.csv

Search in Sheet

Calibri (Body) 12

Home Layout Tables Charts SmartArt Formulas Data Review

1 GFS 10-day forecast init 2017/04/01 at 00Z

2 Location MACSO 42.2551N 72.3596W 328 ft

3 =====

4 File generated by Climate Reanalyzer (<http://cci-reanalyzer.org>)

5 University of Maine | Climate Change Institute (<http://climatechange.umaine.edu>)

6 Operational forecast model output obtained from NOMADS (<http://nomads.ncep.noaa.gov/>)

7 =====

8 FH / FD = Forecast Hour / Forecast Day

9 YYYY = Year

10 MM = Month

11 DD = Day

12 HH = Hour

13 DOY = Day of Year

14 T = 2m Temperature (deg F)

15 TS = Surface Temperature (deg F)

16 DPT = Dewpoint Temperature (deg F)

17 RH = 2m Relative Humidity (%)

18 PRES = Surface Pressure (hPa)

19 WS10 = 10m Wind Speed (mi/h)

20 GUST = 10m Gust (mi/h)

21 WDIR = Wind Direction (degrees)

22 APCP = Total Precipitation (in)

23 WEASD = Water Equivalent of Accumulated Snow Depth (in)

24 TCLD = Total Cloud Cover (%)

25 SOILT\_2IN = 0-0.1m Soil Temperature (deg F)

26 SOILT\_10IN = 0.1-0.4m Soil Temperature (deg F)

27 SOILW\_2IN = 0-0.1m Volumetric Soil Moisture Content (Fraction)

28 SOILW\_10IN = 0.1-0.4m Volumetric Soil Moisture Content (Fraction)

29 DSWRF = Surface Downward Short-Wave Radiation Flux (W m-2)

30 DLWRF = Surface Downward Long-Wave Radiation Flux (W m-2)

31 USWRF = Surface Upward Short-Wave Radiation Flux (W m-2)

32 ULWRF = Surface Upward Long-Wave Radiation Flux (W m-2)

33 GFLUX = Ground Heat Flux (W m-2)

34 PEVAP = Potential Evaporation Rate (W m-2)

35 CNWAT = Plant Canopy Surface Water (kg m-2)

36 ETO = Evapotranspiration [short crop] (in/d)

37 === 3-hourly =====

FH	YYYY	MM	DD	HH	DOY	T	TS	DPT	RH	PRES	WS10
0	2017	4	1	0	91	31	30.8	30.6	98	992	8
3	2017	4	1	3	91.125	31.4	31.2	31	98	990	13
6	2017	4	1	6	91.25	32.5	32.1	32.1	99	988	13
9	2017	4	1	9	91.375	32.6	32.1	32.5	100	986	15
12	2017	4	1	12	91.5	32.6	32.3	32.6	100	986	10
15	2017	4	1	15	91.625	32.8	32.5	32.8	100	988	11
18	2017	4	1	18	91.75	33	32.8	33	100	990	10

Sample file at  
[http://cci-reanalyzer.org/misc/agwx\\_sample\\_GFS.csv](http://cci-reanalyzer.org/misc/agwx_sample_GFS.csv)



# National Weather Service NCEP Central Operations



- Local forecast by "City, St"  
   
 Search NCEP
- Current Hazards  
 Watches/Warnings  
 Outlooks  
 National
- Current Conditions  
 Observations  
 Satellite Images  
 Radar Imagery  
 Lakes & Rivers  
 Space Weather  
 Unified Surface Analysis
- Northern Hemisphere  
 Surface Analysis
- Product Loops
- Environmental Models  
 Product Info  
 Current Status  
 Model Analyses & Guidance
- Forecasts  
 Current  
 6 to 10 Day  
 Aviation  
 Hurricane  
 Marine  
 Tropical Marine  
 Fire Weather  
 Forecast Maps
- Climate  
 Climate Prediction  
 Climate Archives
- Weather Safety  
 Storm Ready
- NOAA  
 Central Library  
 Photo Library  
 Public Affairs  
 Employment  
 Education  
 Resources  
 Question of the Month  
 Image of the Day
- About Us  
 Our Mission  
 The Centers  
 Contact Us  
 Website Questions

## NOMADS

### NOAA Operational Model Archive and Distribution System

Description of NOAA's NOMADS servers hosting NCEP model data

- Help Desk:** Questions or problems please use the link to submit a service ticket.
- Background** Background documents about the NOMADS project.
- Service Description:** OCWWS Service Description Document
- Archive of Model Data:** Some data sets are archived by NCEI, check availability with the link.
- Terms of Data Usage:** Use this link to view the Term of Data Usage / Disclaimer.

Based on user requests NCEP will now be utilizing a subscriber list to make announcements with regards to all of our data servers. [Follow this link](#) to subscribe and review the list details.

If you have issues with any NCEP server please send your email to:  
 ncep.pmb.dataflow@noaa.gov

Include as much information about the error as you can - your connection information, the syntax of your request, when the problem started, the error reported, can you replicate the problem, etc.

Click on link in the Data Set field for description and availability info.  
 Click on the column headings for description of each data access method.

Data Set	freq	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">gds-alt</a>
<b>Global Models</b>				
<a href="#">GDAS</a>	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-alt</a>
<a href="#">GFS 0.25 Degree</a>	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-alt</a>
<a href="#">GFS 0.25 Degree Hourly</a>	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-alt</a>



Data Set	freq	grib filter	http	gds-ait
<b>Global Models</b>				
GDAS	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
GFS 0.25 Degree	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
GFS 0.25 Degree Hourly	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
GFS 0.25 Degree (Secondary Params)	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	-
GFS 0.50 Degree	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
GFS 1.00 Degree	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
GFS Ensemble 1.00 Degree	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
GFS Ensemble 0.50 Degree	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	-
GFS Ensemble Precip Bias-Corrected	daily	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
GFS Ensemble 1.00 Degree Bias-Corrected	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
GFS Ensemble NDGD resolution Bias-Corrected	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
NAEFS high resolution Bias-Corrected	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
NAEFS NDGD resolution Bias-Corrected	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
NGAC 2D Products	daily	<a href="#">grib filter</a>	<a href="#">http</a>	-
NGAC 3D Products	daily	<a href="#">grib filter</a>	<a href="#">http</a>	-
NGAC Aerosol Optical Depth Products	daily	<a href="#">grib filter</a>	<a href="#">http</a>	-
<b>Regional Models</b>				
AQM Daily Maximum	06Z, 12Z	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
AQM Hourly Surface Ozone	06Z, 12Z	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
HIRESW Alaska	06Z, 18Z	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
HIRESW CONUS	00Z, 12Z	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
HIRESW Guam	00Z, 12Z	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
HIRESW Hawaii	00Z, 12Z	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
HIRESW Puerto Rico	06Z, 18Z	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
HRRR	hourly	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
HRRR Sub Hourly	hourly	<a href="#">grib filter</a>	<a href="#">http</a>	-
HWRP	3 hours	-	<a href="#">http</a>	-
HYSPLIT	6 hours	-	<a href="#">http</a>	-
NAM Alaska Pressure Level Vars (11.25km)	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
NAM Alaska Surface Vars (11.25km)	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	-
NAM CONUS (12km)	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
NAM North America (32km)	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
NAM Caribbean/Central America	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
NAM Pacific	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
NAM NEST Alaska	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
NAM NEST CONUS	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
NAM NEST HAWAII	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
NAM NEST Puerto Rico	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
National Water Model	6 hours	-	<a href="#">http</a>	-
North American Land Data Assimilation System	daily	-	<a href="#">http</a>	-
RTMA ALASKA	hourly	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
RTMA2.5 CONUS	hourly	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
RTMA Guam	hourly	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
RTMA Hawaii	hourly	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
RTMA Puerto Rico	hourly	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
RAP	hourly	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
RAP 32km North America	hourly	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
RAP Eastern North Pacific	hourly	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
NARRE	hourly	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
SREF CONUS (40km)	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
SREF CONUS (40km) Bias-Corrected	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
SREF North America (32km)	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
SREF North America (16km)	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-ait</a>
URMA	hourly	-	<a href="#">http</a>	-
<b>Climate Models</b>				
Climate Forecast System Flux Products	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	-
Climate Forecast System 3D Pressure Products	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	-
Climate Data Assimilation System - 1	6 hours	-	<a href="#">http</a>	-
Climate Data Assimilation System - 2	6 hours	-	<a href="#">http</a>	-

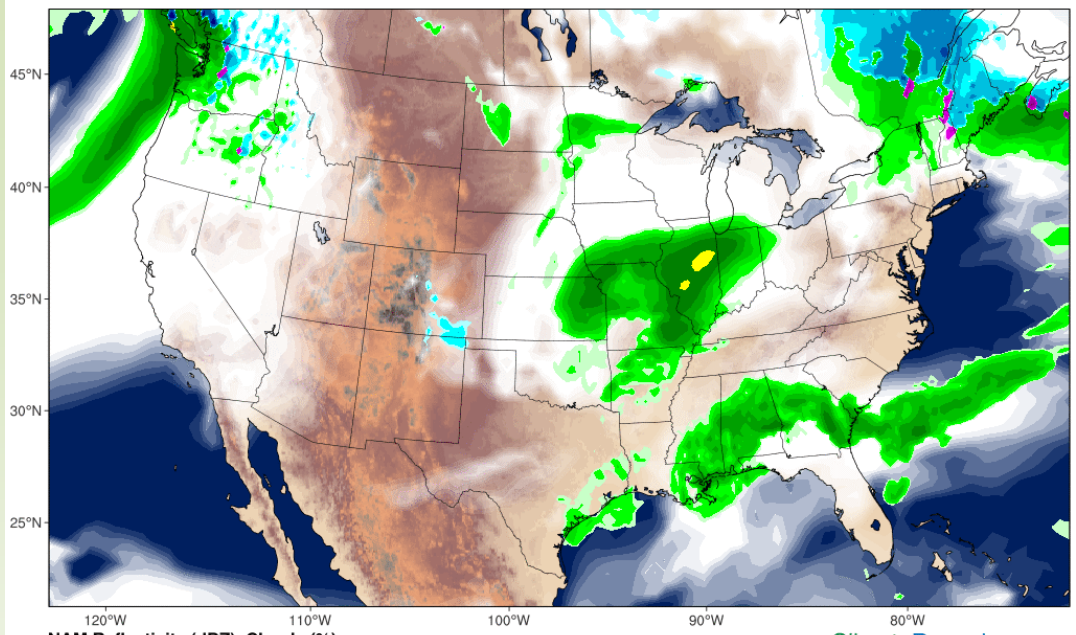
NOMADS provides access to dozens of operational models!

# Models of Interest

- Real-Time Mesoscale Analysis (RTMA)
  - 2.5 km
    - Used for hourly observations
- North American Mesoscale (NAM)
  - 3 km
    - Hourly from 0 to 60h (2.5 days)
  - 12 km
    - 3-hourly from 63 to 84h (3.5 days)
- Global Forecast System (GFS)
  - 0.25° (~30 km)
    - 3-hourly from 87 to 240h (10 days)

GFS Precipitation (mm/h), Clouds (%)  
Init Tue 0800EDT, Apr 04, 2017 | 024h | Valid Wed 0800EDT, Apr 05, 2017

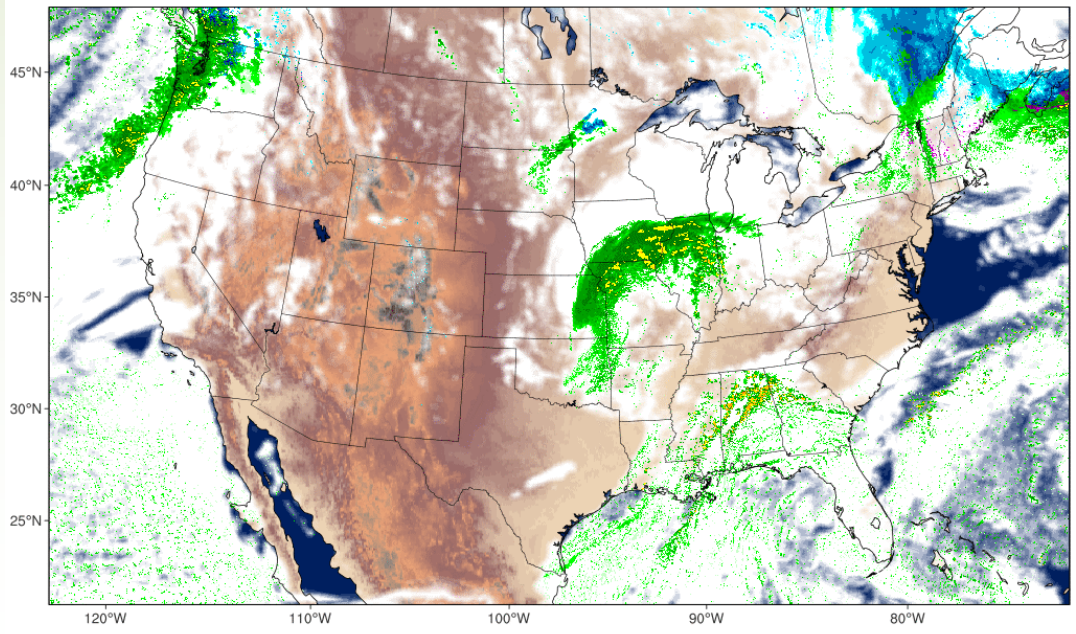
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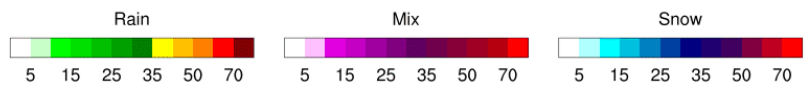
GFS (~30 km)

NAM Reflectivity (dBZ), Clouds (%)  
Init Tue 0800EDT, Apr 04, 2017 | 024h | Valid Wed 0800EDT, Apr 05, 2017

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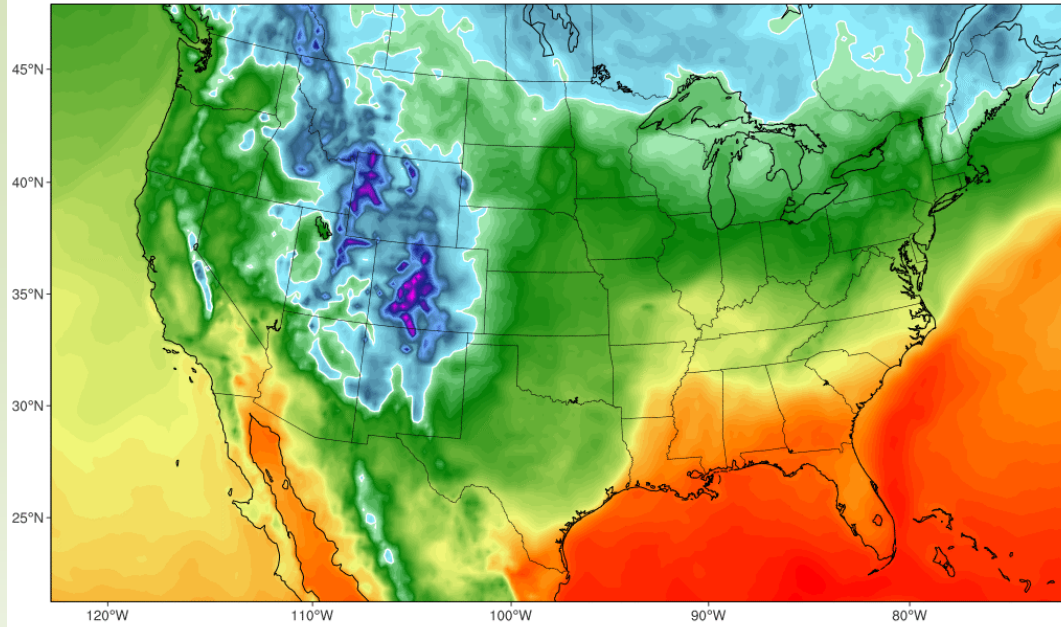


NAM (3 km)



GFS 2m Temperature (°F), 32°F (white)  
Init Tue 0800EDT, Apr 04, 2017 | 024h | Valid Wed 0800EDT, Apr 05, 2017

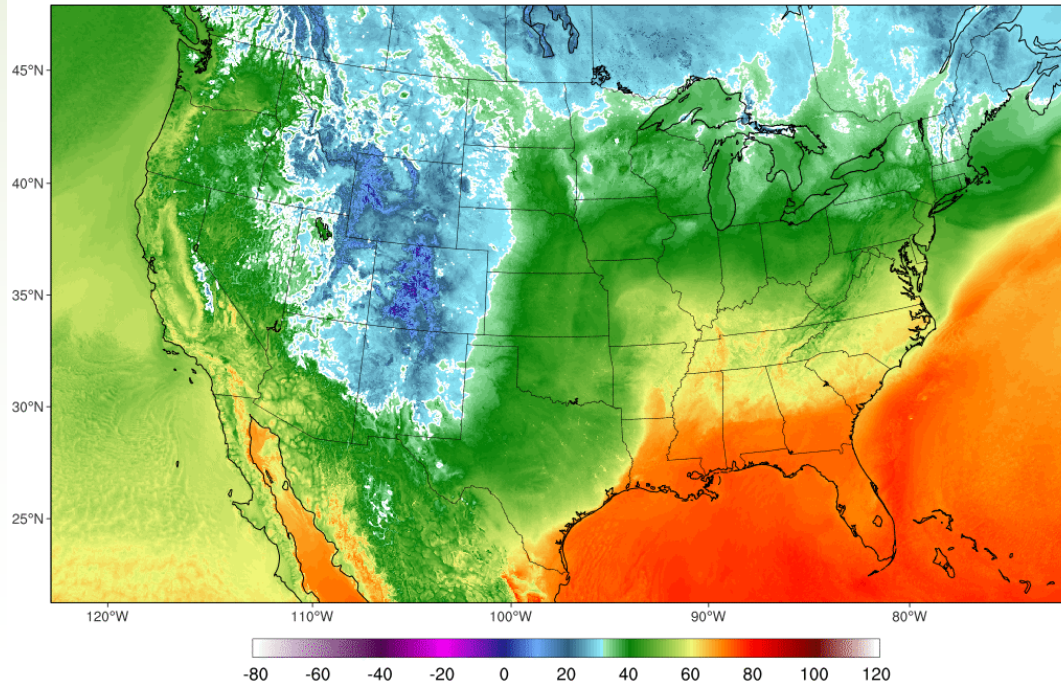
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GFS (~30 km)

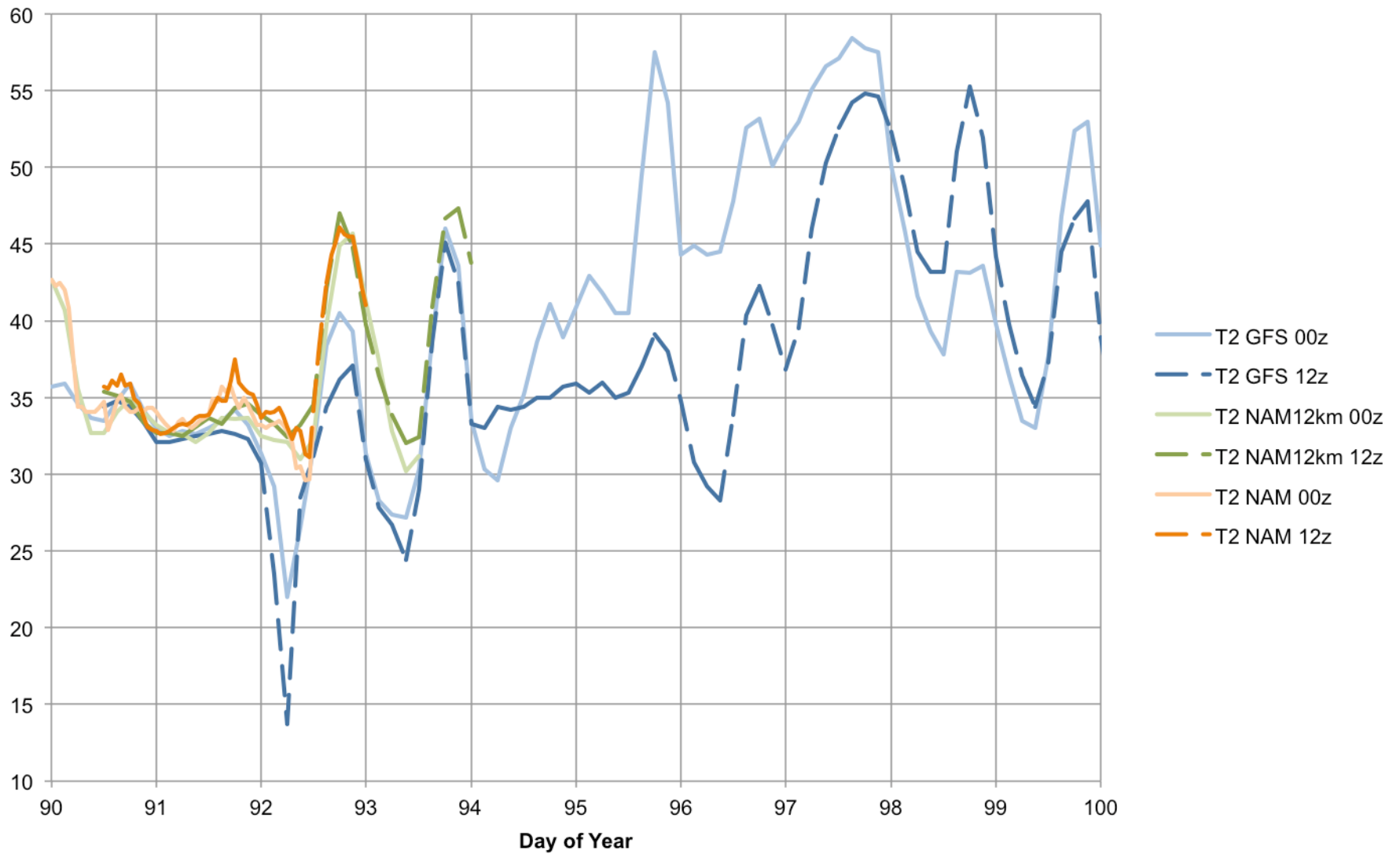
NAM 2m Temperature (°F), 32°F (white)  
Init Tue 0800EDT, Apr 04, 2017 | 024h | Valid Wed 0800EDT, Apr 05, 2017

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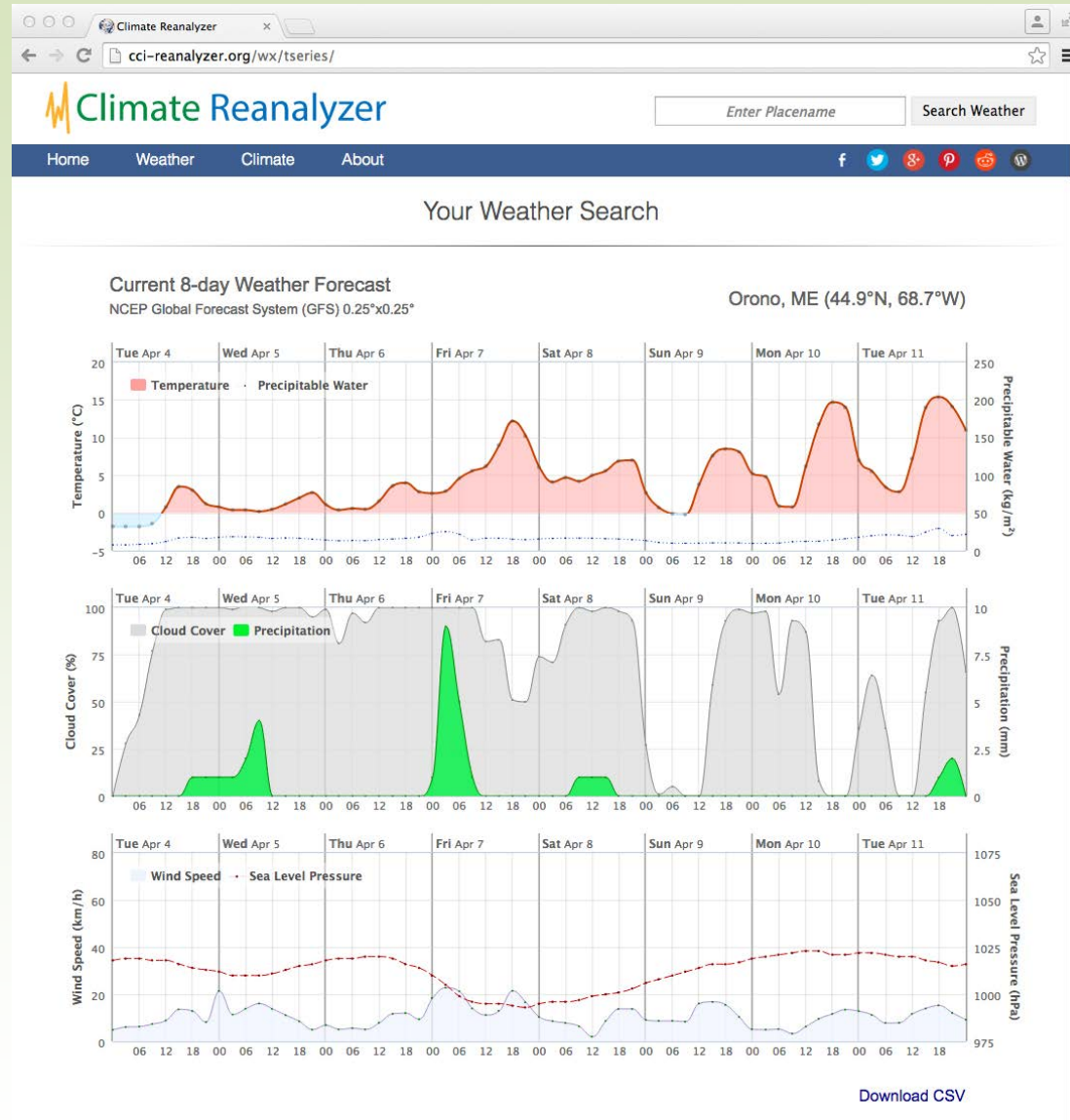
NAM (3 km)

# Forecasted 2-meter Air Temperature (°F) 3/31/2017



# Continuing Work

- Integration of data streams from the NWS National Digital Forecast Database (NDFD)
- Web interface for accessing AgWx CSV files



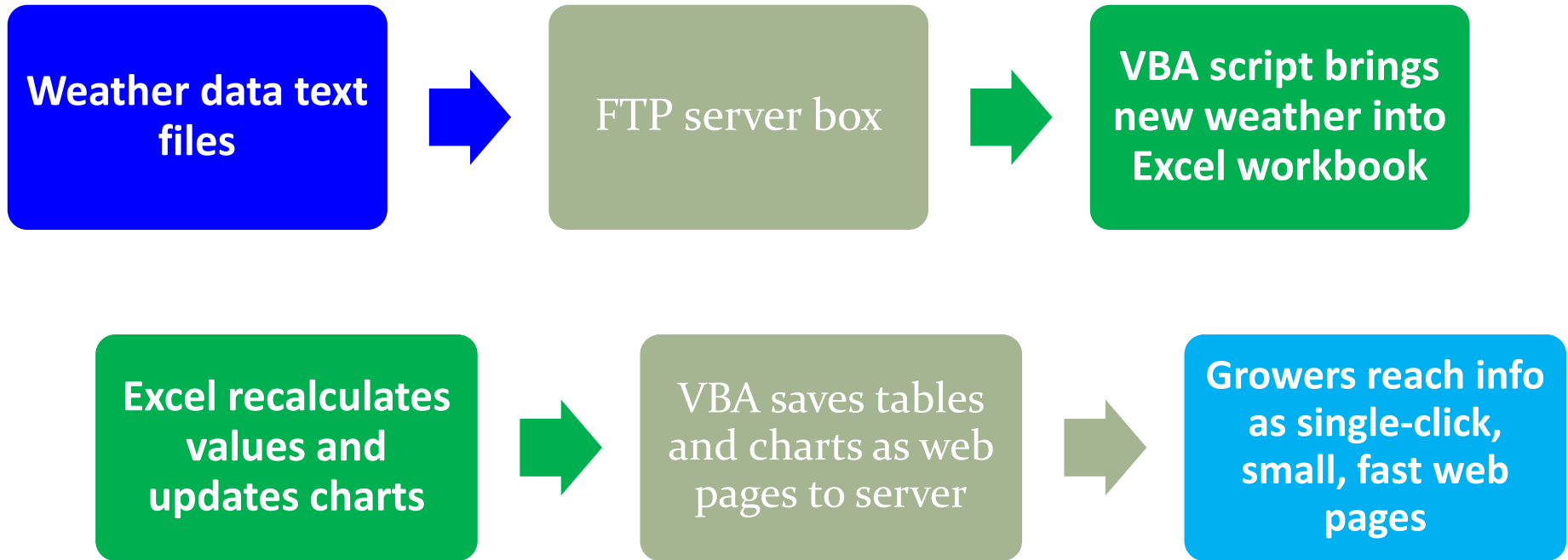
Questions?

# **A low cost, easy to use, & powerful platform for using weather data in farm decisions**



Love makes the world go 'round  
But weather makes the crops grow





**New for 2017**

**... free weather data for anywhere**



Photo: public domain

The great question

Is Excel up to the job?

Yes!

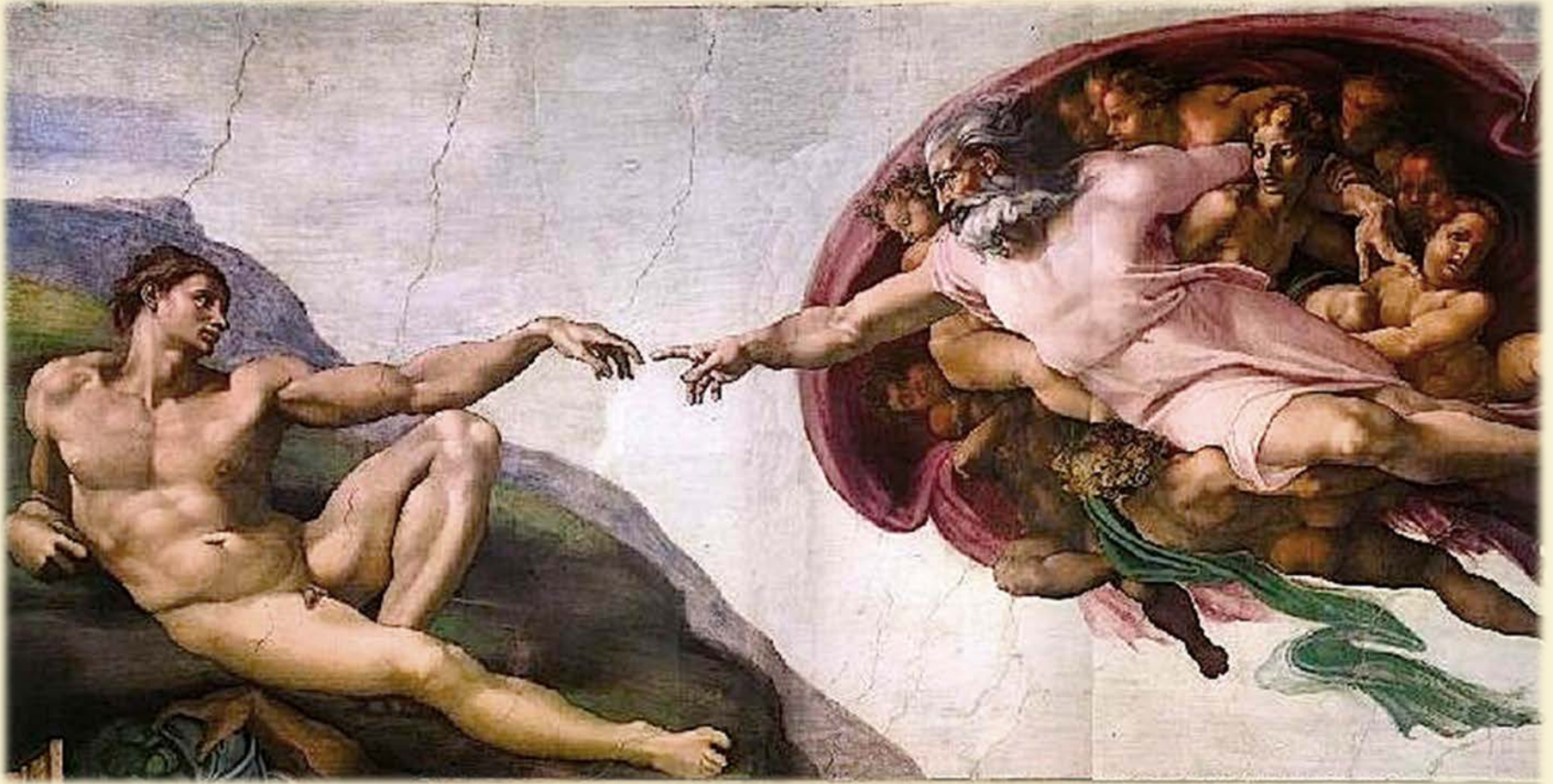
# ↑ Pros and ↓ Cons of using Excel vs. a database query system

- ↑ Direct access for crop expert to define and adjust models.  
You just do it.
- ↑ Simple & Inexpensive. Low technical overhead. Off the shelf software
- ↑ No limits on calculation *OR* presentation options.
- ↑ Direct access to info for end users.  
(no drop down boxes, click through layers)
- ↓ Brute force use of computer processing and file storage.
- ↑ But plenty of Speed and Scale capacity  
for what we need to serve Maine agriculture!

Zorba the Greek,  
the original “Just Do It” guy



**Visual Basic automation  
is the spark that makes it happen**





*** MAINE	*** MASSACHUSETTS
♣ <u>ME-Monmouth</u> (Highmoor Farm Ag Res Sta.)	♣ <u>MA-Belchertown</u> (UMass Hort. Res. Farm)
♣ <u>ME-Sanford</u>	♣ <u>MA-Easthampton</u>
♣ <u>ME-East Corinth</u>	♣ <u>MA-Deerfield</u>
<u>ME-Masardis</u>	♣ <u>MA-Groton</u>
<u>ME-Monticello</u>	♣ <u>MA-Phillipston</u>
♣ <u>ME-Old Town</u>	♣ <u>MA-Sutton</u>
<u>ME-Presque Isle</u>	
*** RHODE ISLAND	*** NEW BRUNSWICK
♣ <u>RI-Greenville</u>	♣ <u>NB-Fredericton</u>
♣ <u>RI-Middletown</u>	
*** VERMONT	*** NEW YORK
♣ <u>VT-South Burlington</u> (UVM Hort Res. Center)	♣ Private research site 1

# Monmouth ME

## Apple Pest Monitoring Pocket Guide

Apple Calendar – Early season

Apple Calendar – Late season

Jump down to sections:

Scab

Fire blight

Flyspeck

Insects & Mites

Horticulture

Weather archive

## \* CURRENT WEATHER \*

3 Day Weather Chart

7 Day Weather Chart

30 day Temperature Chart & update times

30 day Rain Chart

Hourly Forecast Table – NEXT 7 days

Hourly Observations Table – PAST 7 days

Weather archive is at bottom of this page.

Honeybee Avoidance Forecast

## \* APPLE SCAB \*

Apple Scab – KEY DATES

### SCAB BIOLOGY

#### DAILY PRIMARY SCAB Infection Chart

Relative primary scab infection risk based on spore maturity, leaf surface area and sensitivity, temperature etc.  
Absolute risk depends on infection pressure, cultivar, site, canopy thickness etc.

Daily primary scab infections in TABLE format

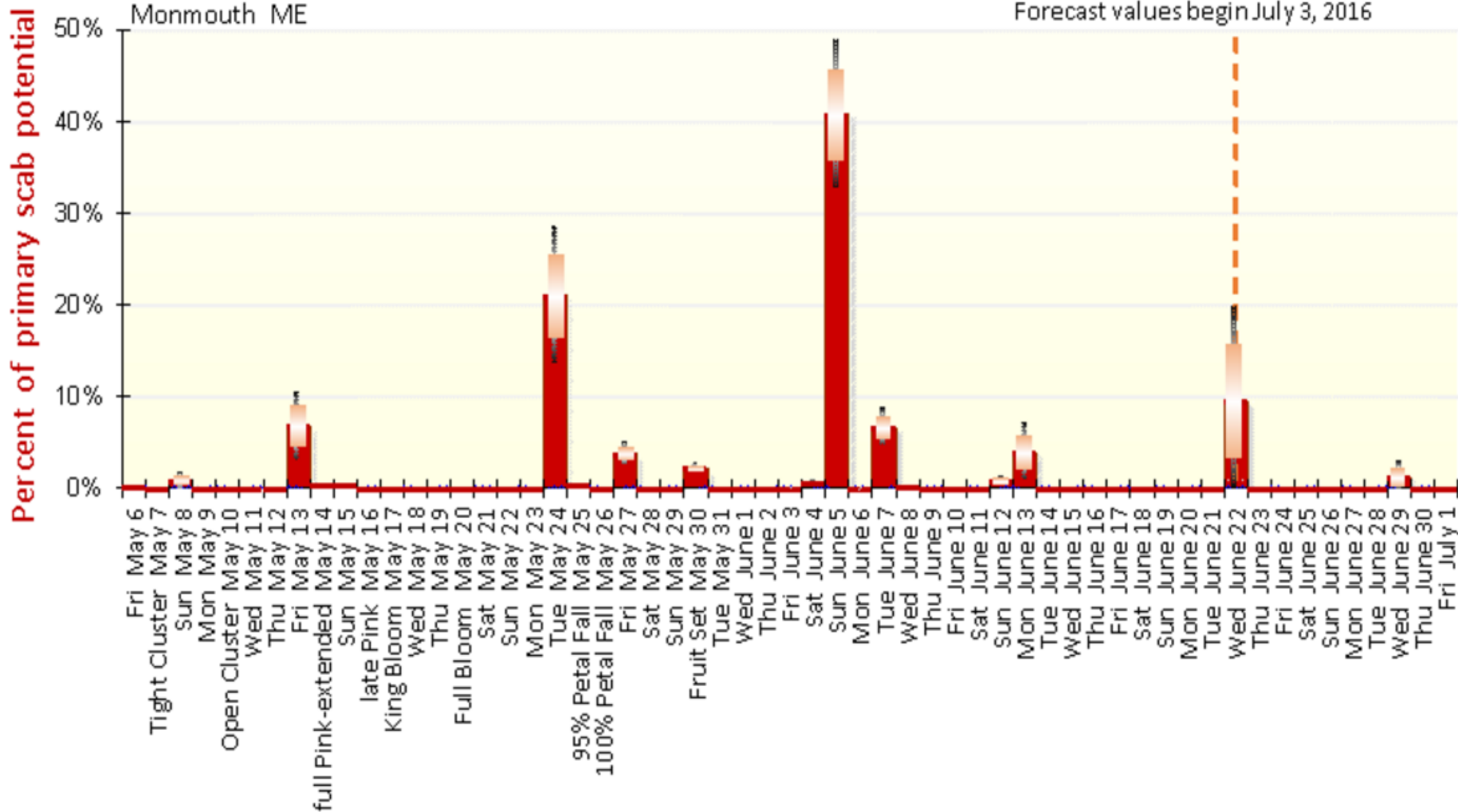
# Forecasting



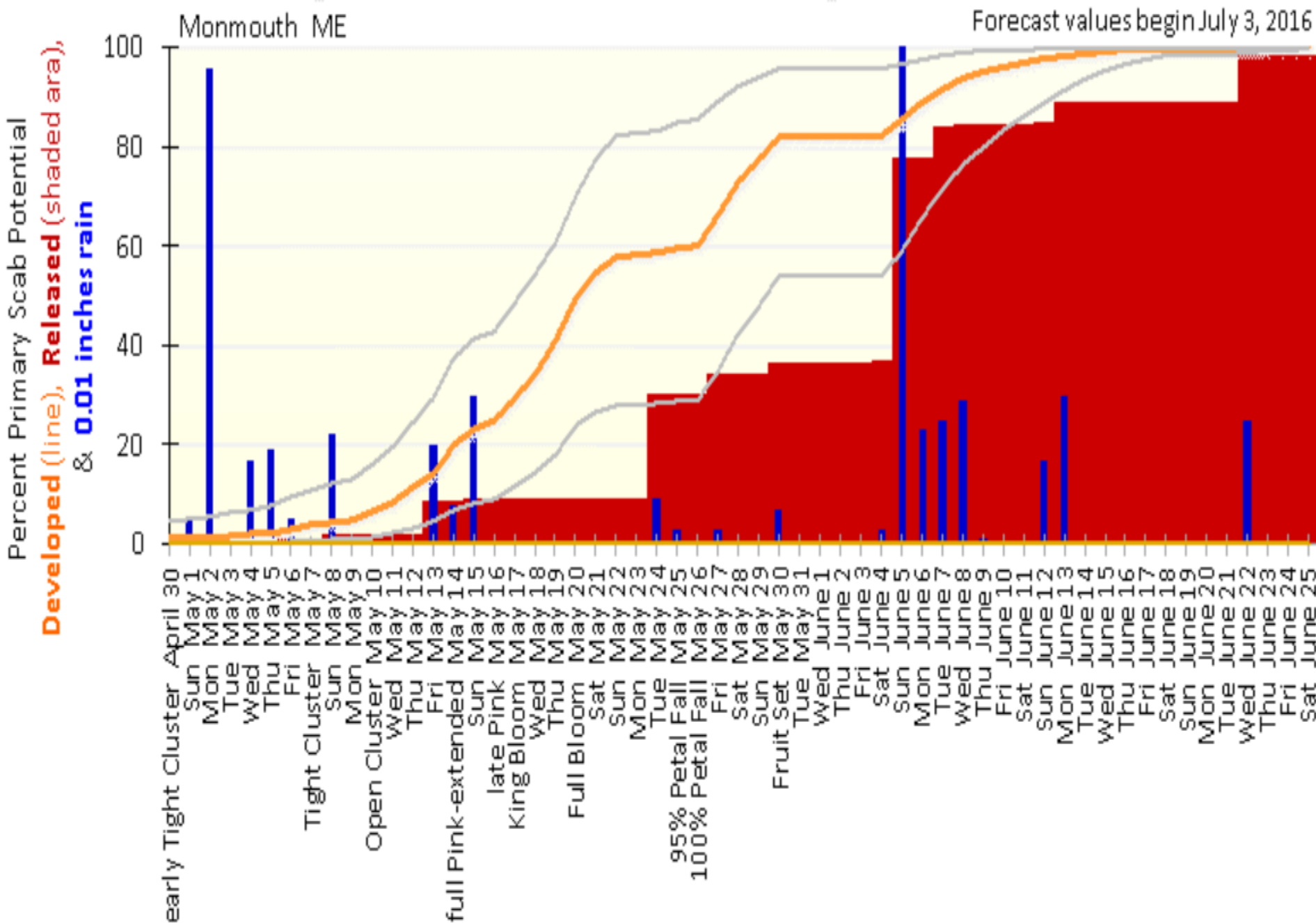
# Daily primary scab infection potential as % of yearly total

Monmouth ME

Forecast values begin July 3, 2016



# Development and **Release** of Primary Scab Infection Potential



# Fungicide guidance for Apple Scab protection



Find most recent spray date in left column

Columns in same row show estimates for end of protection and start of next infection period

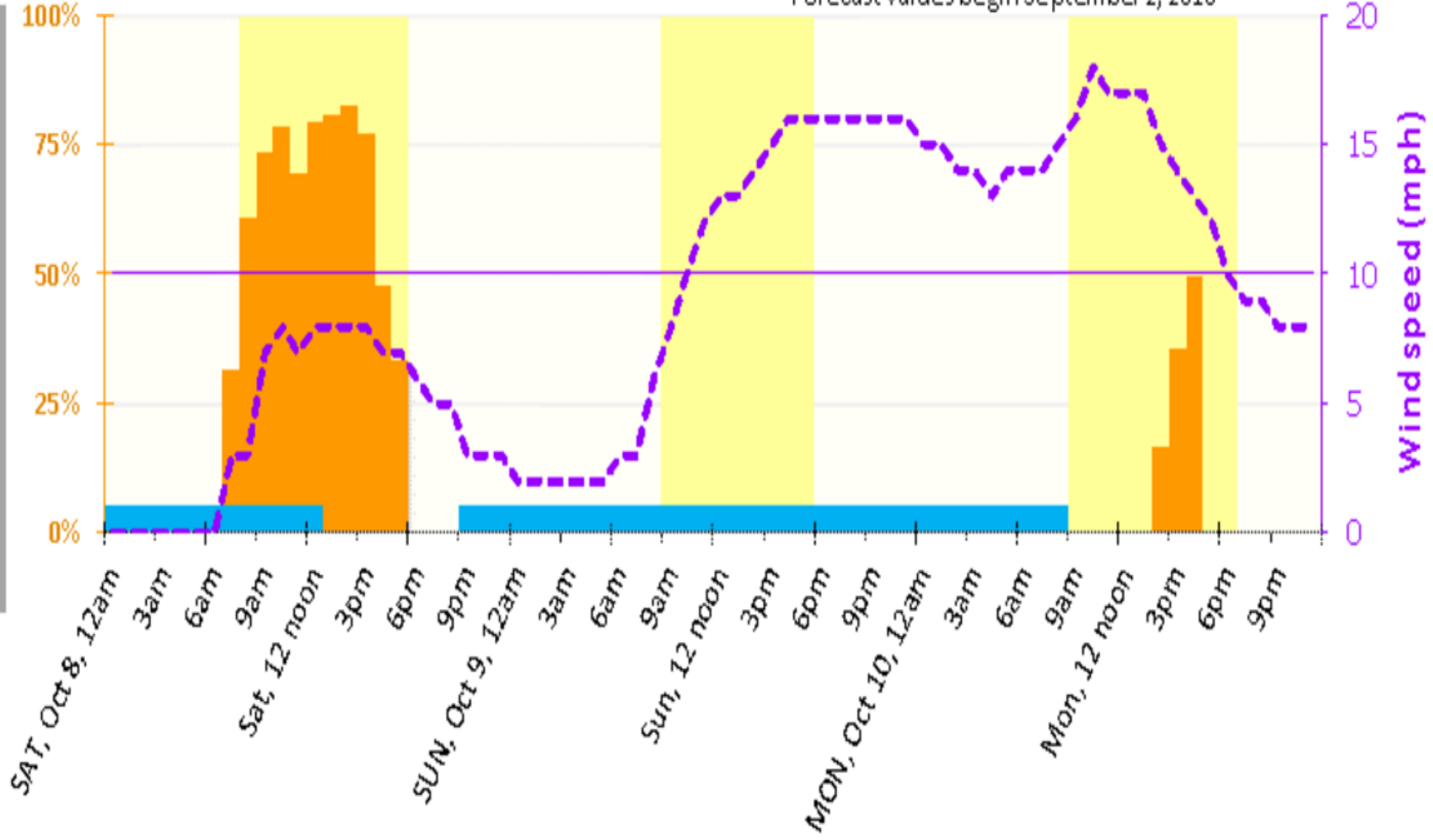
<b>Full-dose 'Protectant' fungicide</b> <b>(captan, mancozeb, SDHI, Syllit)</b> <b>SPRAY DATE</b> 6am application time assumed	<b>Inches Rain</b>	END of Protectant fungicide residue protection & limiting factor	<b>DEADLINE for next Pre-Infection Application</b> This is the start time for the next infection period that has rain after fungicide depletion time.	<b>72-hour Deadline for post-infection fungicide</b> to reach back to start time of subsequent infection period (1 col. to left), or back to depletion time of previous fungicide spray (2 cols. to left), whichever is later. Assumes no scab resistance.
<b>Sat, April 30</b>	0	May 9, 6AM slow growth at 9 day limit	<b>Fri, May 13, 2pm</b>	Mon, May 16, 2PM
<b>Sun, May 1</b>	0.05	May 10, 6AM slow growth at 9 day limit	<b>Fri, May 13, 2pm</b>	Mon, May 16, 2PM
<b>Mon, May 2</b>	0.96	May 11, 6AM slow growth at 9 day limit	<b>Fri, May 13, 2pm</b>	Mon, May 16, 2PM
<b>Tue, May 3</b>	0	May 12, 6AM slow growth at 9 day limit	<b>Fri, May 13, 2pm</b>	Mon, May 16, 2PM

# Honeybee Foraging Activity and Potential Wet Residue Exposure

Honeybee Foraging Index & Mason bee threshold status

Middletown RI

Forecast values begin September 2, 2016



**THI = Temperature Heat Index** for livestock  
Productivity per dairy cow has rapidly increased,  
but so has **sensitivity** to THI stress.

Warming temperatures from climate change are **increasing THI**.

## Cooling improves:

- Cow comfort and **health**
- Milk **production**
- Reproductive **efficiency**
- Water and Feed **efficiency**

But cooling systems cost Money to operate

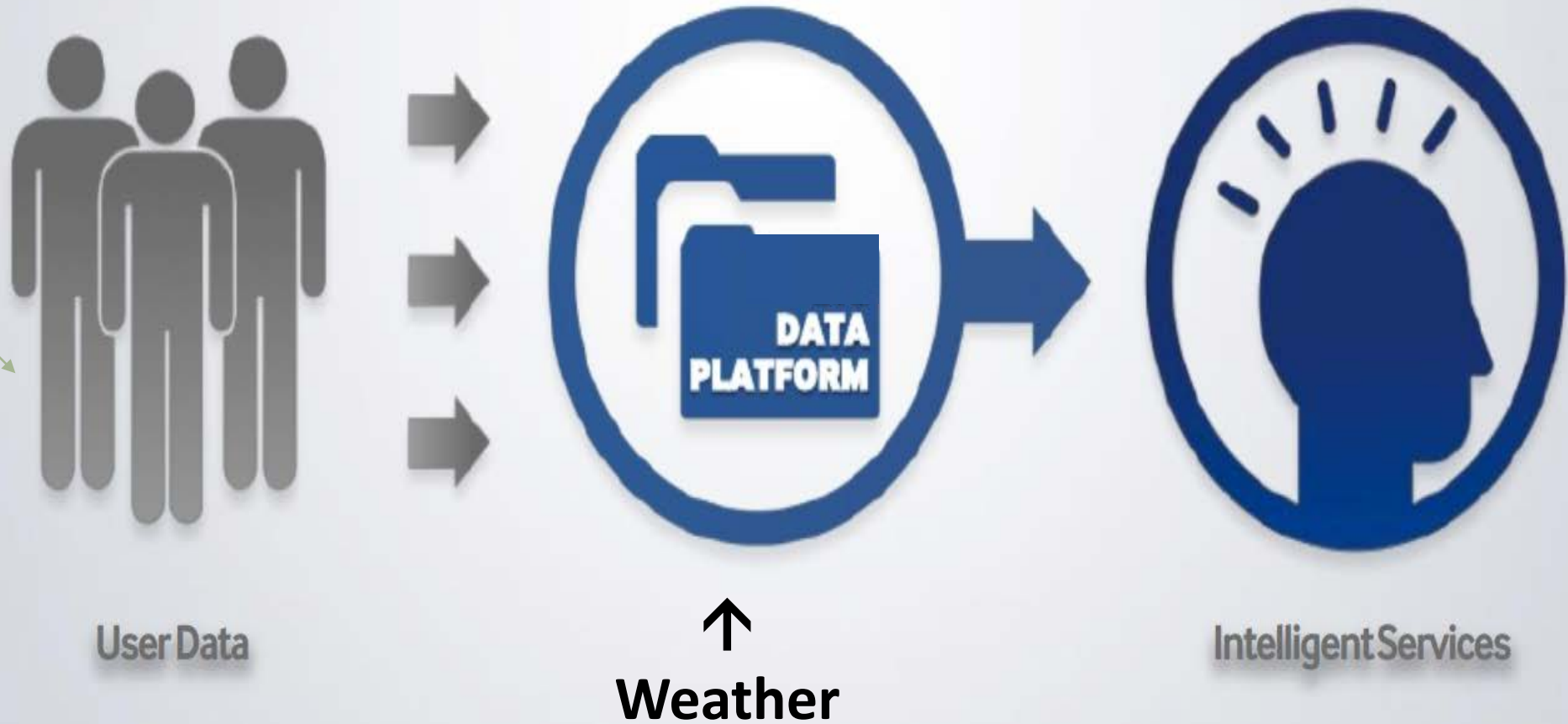
## Response:

**Monitor and Forecast  
site-specific hourly THI**



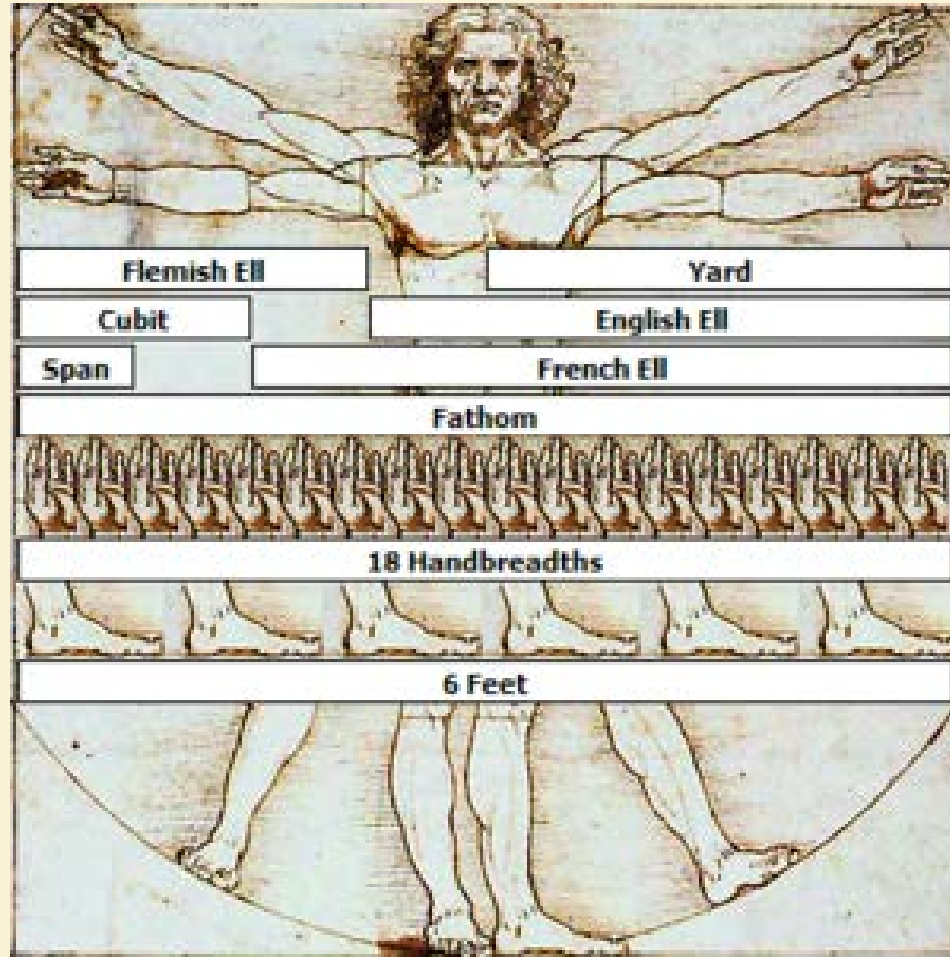
Photo: ArieTh. Public domain

# Personalized Decision Support



**“Future agricultural adaptation will occur in a decision environment characterized by high complexity, and the increasing pace and intensity of climatic change.” ~ USDA, 2012**

"If you can't measure it, you can't manage it."



"If you do measure it,  
You can manage it better."



# Weather-based farm management records increase capacity for:

**Needs Justification** for irrigation water, fertilizer & pesticide.

**Evaluation** – Diagnose, understand, and correct problems.

**Planning** – Estimate how different options are likely to perform under different weather scenarios.

**Reporting** – Food safety and GAP certifications

# Contact Information

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