How much did it rain in Ames on 25 June 2010?

daryl herzmann
Department of Agronomy

Anybody remember what happened that day?

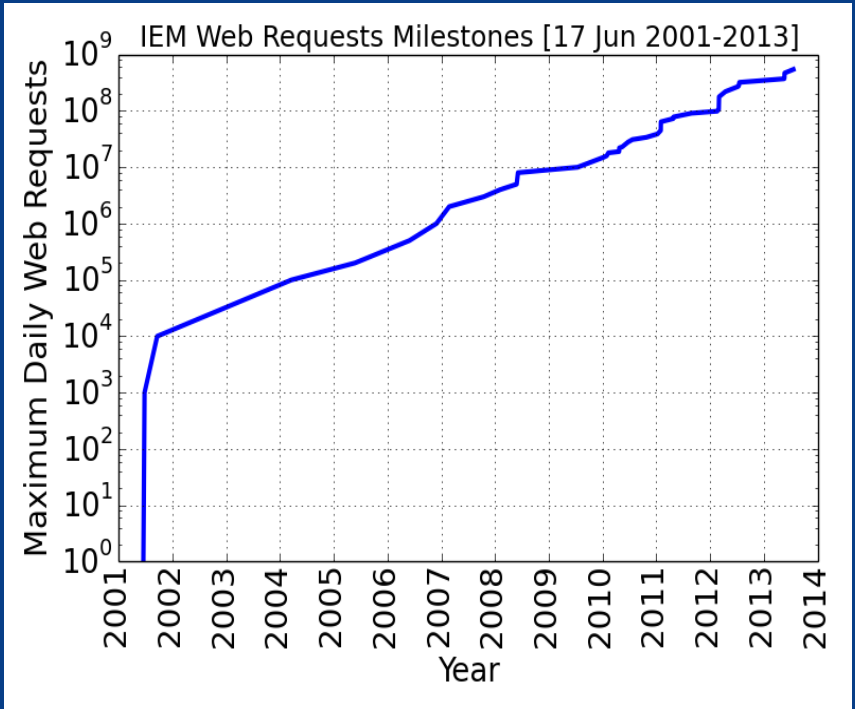
Answer: NOTHING

A presentation about “Nothing” Goals

- To confuse you:
  - Provide over 18 answers to the posed question!!!
- To inform you:
  - Highlight data made available by the Iowa Environmental Mesonet

- To bore you:
  - Go into the excruciating minutiae of precipitation reporting

Iowa Environmental Mesonet (IEM)



- ISU Agronomy data collection effort since 2001.
- Most trafficked ISU research website.
- Our website is a confusing collection of rabbit holes.
- We are data pigs.
- Dr Ray Arritt, supervisor

Quantitative, Yes we can do that!

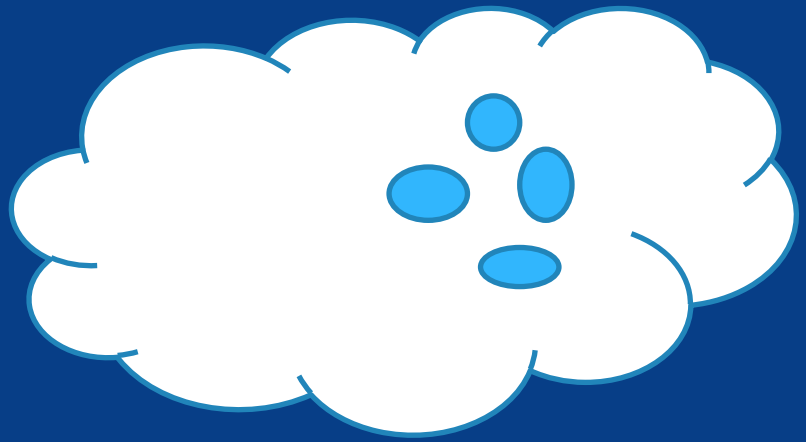
Good, the past! We should know what happened.

How much did it rain in Ames on 25 June 2010?

Central Post Office?
Incorporated Polygon?
Airport?
Flory's House?

UTC Day?
Calendar Day?
Daylight Hours?
Some 24 Hour period?

What is precipitation?



The Ground

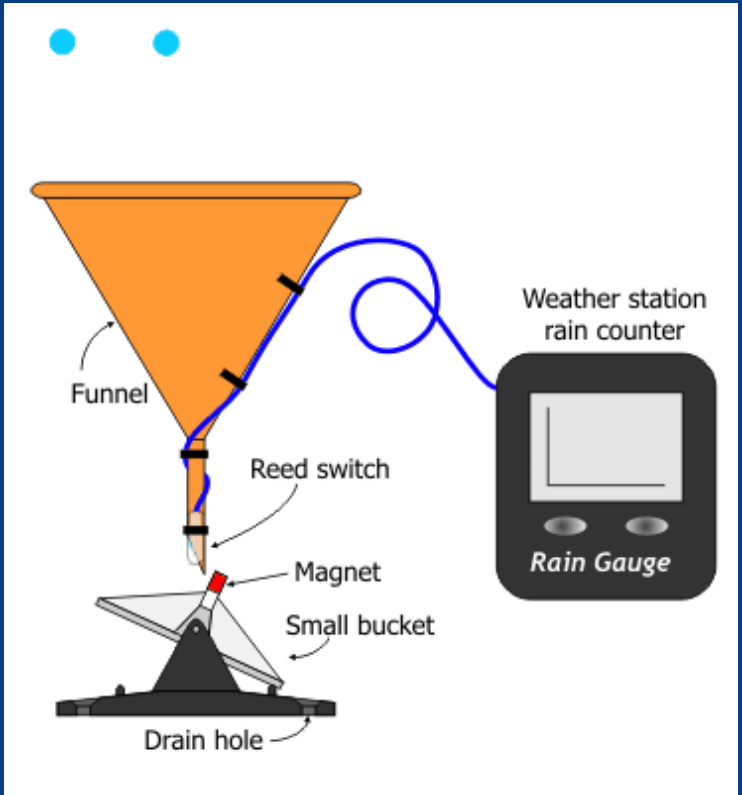
- “the action or process of precipitating a substance from a solution.”
  - So “water”, in any phase, leaving the air and delivered to the ground
- Dew is a form of precipitation

How do we measure precipitation?

Image Source: http://i4weather.net

- Manual gauge
  - Official NWS gauge has an 8 inch diameter opening and 0.01 inch precision
  - Nearly all sites are once per day reporting
- Automated gauge
  - Typically 0.01 inch precision, but many caveats
- Neighbor Extrapolation
  - "My neighbor got 3 inches last night and I got a bit less than that, so I got 2.5 inches"
- Precipitation is a flux: amount of stuff per unit area per some amount of time
  - Typically express as an accumulated depth

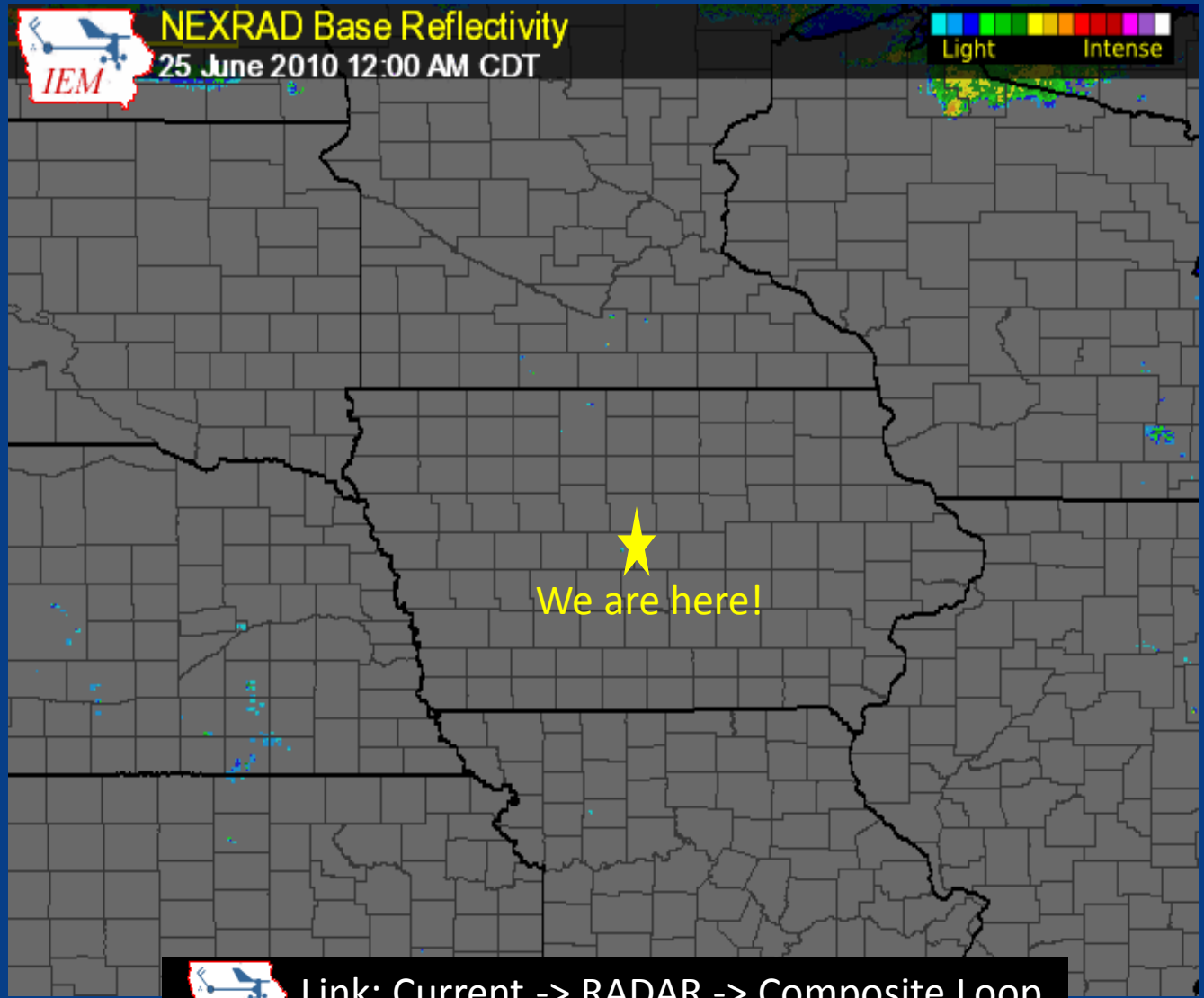
Tipping Bucket Rain Gauge



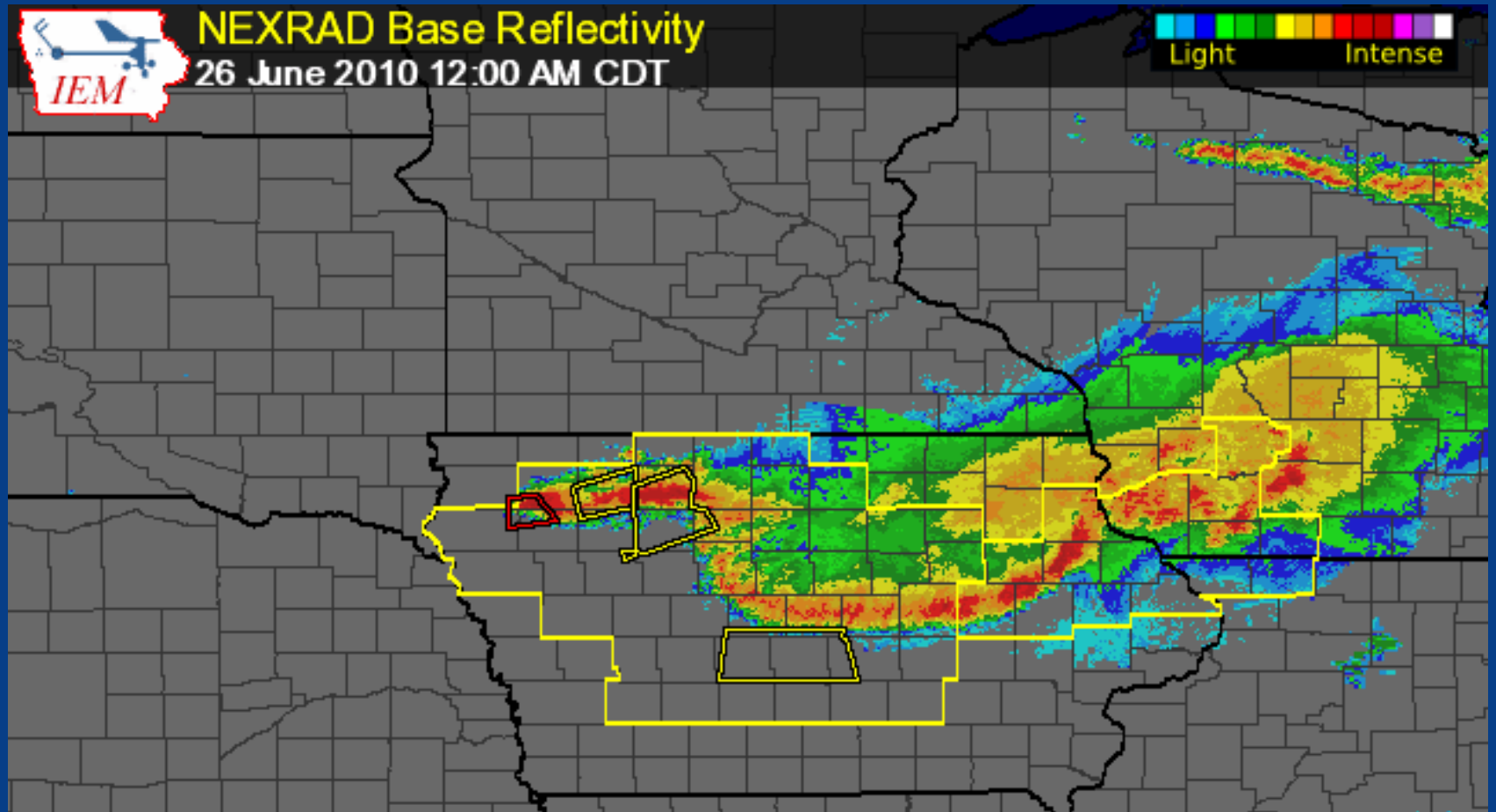
- Each tip is 0.01 inch
- Some are “heated” to melt frozen precip in funnel
- Intense rainfall rates ~2.5 inches/hr lead to under-reporting

Adapted from http://weather.about.com

Enough introduction, let us have at it.


NEXRAD Base Reflectivity
25 June 2010 12:00 AM CDT
Light
Intense
We are here!
IEM
Link: Current -> RADAR -> Composite Loop

It would appear to be raining in Ames at midnight, oh joy!



Iowa Environmental Mesonet - Chromium

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Iowa Environmental Me

mesonet.agron.iastate.edu

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Iowa Environmental Mesonet
Iowa State University Department of Agronomy

Plot carbon and radiation flux time series

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The Iowa Environmental Mesonet (IEM) collects environmental data from cooperating members with observing networks. The data are stored and made available on this website.

Ag Weather NWS Users Researchers

Daily IEM Feature: RSS

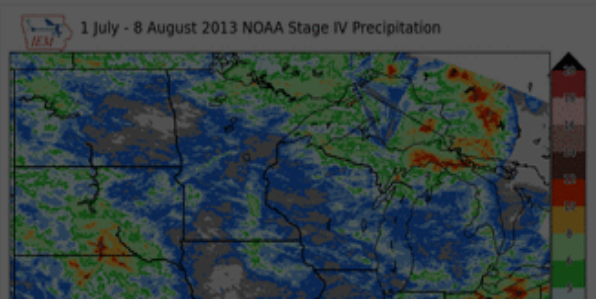
One to Twenty Inches

Posted: 09 Aug 2013 05:34 AM

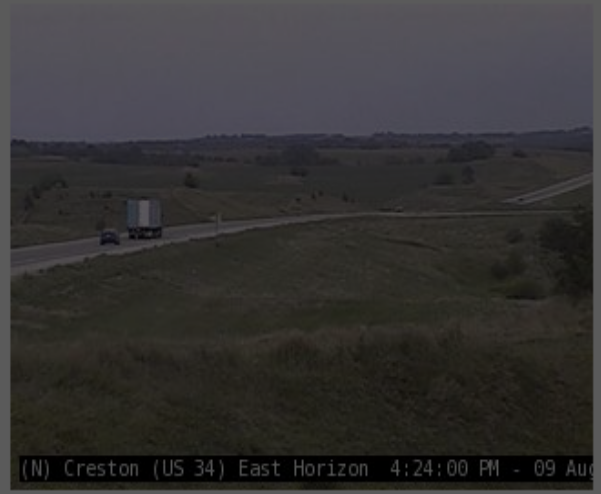
Tags: jul13

Facebook Permalink Past Features Tags

The featured map presents total precipitation since the first of July as estimated by NOAA's stage IV product. Much of western Iowa is shown in the less than an inch up to two inches for the period. You do not have to travel far to find extremely high totals in eastern Kansas and



Creston (US 34) East Horizon, IA Webcam:



Iowa Environmental Mesonet - Chromium

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Related Archive Climate Current Info GIS Networks Roads Severe Weather Web Cams

- ASOS
- AWOS
- NWS COOP
- DCP
- ISU AG
- NLAE Flux
- RWIS
- SCAN
- SchoolNet
- Other

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Ag Weather | NWS Users | Research

Daily IEM Feature: RSS

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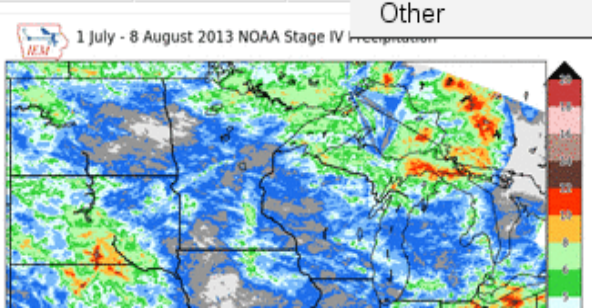
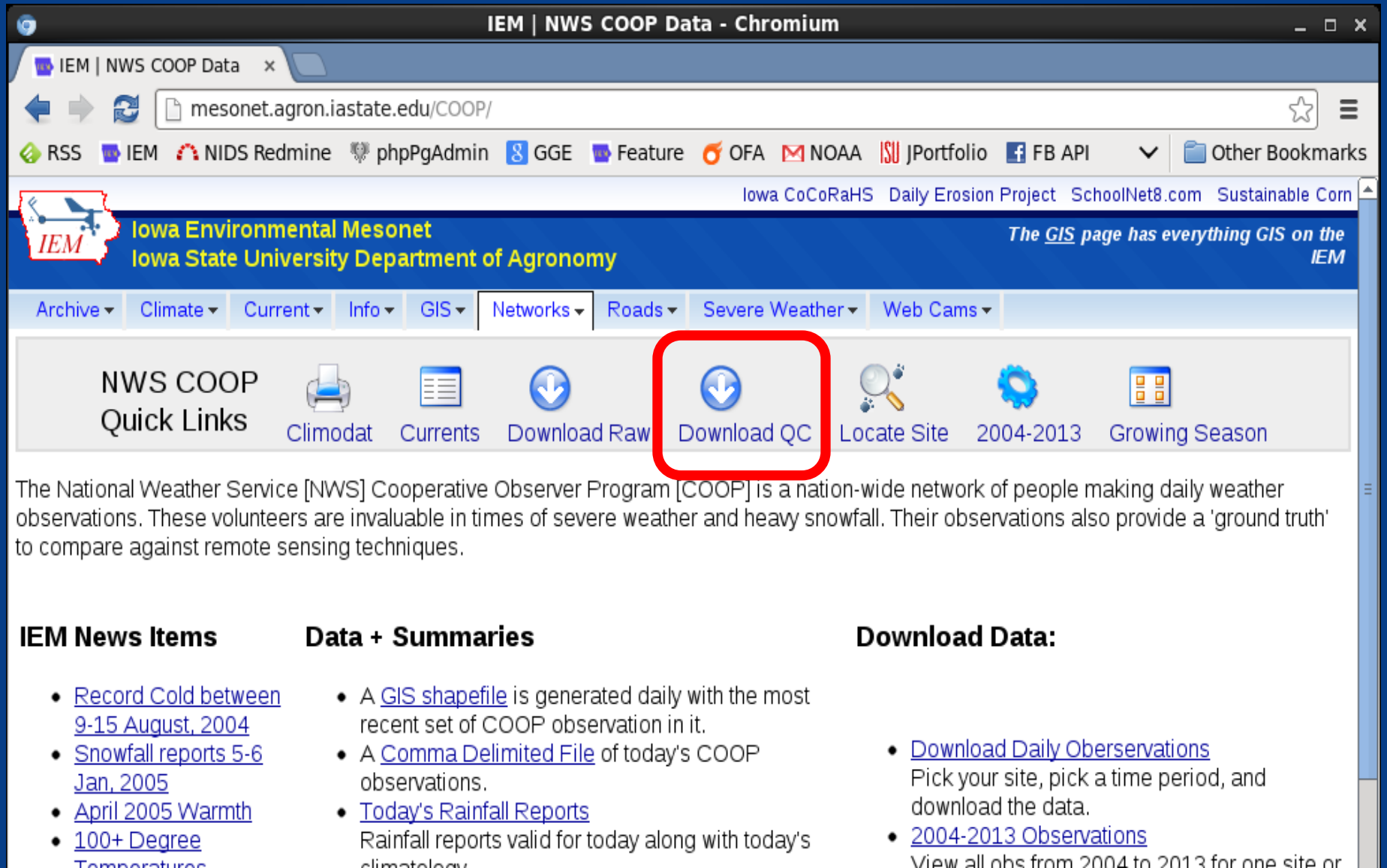


…ston (US 34) East Horizon, IA …cam:


IEM | NWS COOP Data - Chromium
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mesonet.agron.iastate.edu/COOP/
RSS IEM NIDS Redmine phpPgAdmin GGE Feature OFA NOAA JPortfolio FB API Other Bookmarks
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IEM
Iowa Environmental Mesonet
Iowa State University Department of Agronomy
The GIS page has everything GIS on the IEM
Archive Climate Current Info GIS Networks Roads Severe Weather Web Cams
NWS COOP Quick Links
Climodat Currents Download Raw Download QC Locate Site 2004-2013 Growing Season
The National Weather Service [NWS] Cooperative Observer Program [COOP] is a nation-wide network of people making daily weather observations. These volunteers are invaluable in times of severe weather and heavy snowfall. Their observations also provide a 'ground truth' to compare against remote sensing techniques.
IEM News Items
Record Cold between 9-15 August, 2004
Snowfall reports 5-6 Jan, 2005
April 2005 Warmth
100+ Degree
Data + Summaries
A GIS shapefile is generated daily with the most recent set of COOP observation in it.
A Comma Delimited File of today's COOP observations.
Today's Rainfall Reports
Rainfall reports valid for today along with today's
Download Data:
Download Daily Oberservations
Pick your site, pick a time period, and download the data.
2004-2013 Observations

Data is available from the following states: Illinois , Indiana , Iowa , Kansas, Kentucky , Michigan , Minnesota , Missouri , Nebraska , Ohio , North Dakota , South Dakota , Wisconsin.

1. Select Station:

Select One or More or All stations in the network.

[IA0157] ALLISON -- 1951-01-01
[IA0200] AMES-8-WSW -- 1893-01-01
[IA0213] ANAMOSA-1-WNW -- 1951-01-01
[IA0241] ANKENY-3-S -- 1951-01-01
[IA0364] ATLANTIC-1-NE -- 1893-01-01

2. Select Start/End Time:

Please note the start year in the station selector. Some sites start in 1951 others are earlier. If you only want data for one day, set the start and end times to the same value.

	Year	Month	Day
Start:	2010	June	25
End:	2010	June	26

3. Select Variables / Model Input Format:

Select either one or more data variables or a predefined format that should work within the specified Model input format. Please contact us to have your format added to the list!

Variable: Low Temperature [C]
Variable: Precipitation (rain+melted snow) [inch]
Variable: Precipitation (rain+melted snow) [mm]

4. How to view?

View on-line

5. Data Delimitation:

How shall the output values be seperated?

Comma

6. Include Lat / Lons?

GIS READY! No

7. Submit Form:

Please be patient and only submit this form once. It may take 10-20 seconds to get a response.

Process Data Request Reset

ANSWERS

Source	Total
IEM QC COOP	0.00

And the answer is…

station	station_name	day	julianday	precip
IA0200	AMES-8_WSW	2010/06/25	176	0

Link: Networks -> COOP -> Download QC

ANSWERS

Source	Total
IEM QC COOP	0.00

Whiskey Tango Foxtrot

station	station_name	day	julianday	precip
IA0200	AMES-8_WSW	2010/06/25	176	0

This is from the ISU Agronomy Farm, which is outside of Ames!

Link: Networks -> COOP -> Download QC

ANSWERS

Source	Total
IEM QC COOP	0.00

NWS Cooperative Network

- Once daily observations typically at 7 AM with 24 hour totals
- Precipitation is typically very high quality due to manual collection
- IEM's "quality controlled" archive is provided by State Climatologist, who attempts to align data to calendar day!

ANSWERS

Source	Total
IEM QC COOP	0.00
ASOS	0.13

Ames :: Automated Surface Observation System (ASOS)

station	valid (local timezone)	p01i
AMW	2010-06-25 11:36 PM	M
AMW	2010-06-25 11:53 PM	0.13
AMW	2010-06-26 12:10 AM	0.46
AMW	2010-06-26 12:33 AM	0.72
AMW	2010-06-26 12:43 AM	0.88
AMW	2010-06-26 12:53 AM	0.97
AMW	2010-06-26 12:59 AM	0.01

Precipitation is hourly accumulation since last rest at :53 after.

0.46” fell between 11:53 PM and 12:10 AM. So we don’t know!

Link: Networks -> ASOS -> Download

ANSWERS

Source	Total
IEM QC COOP	0.00
ASOS	0.13
ASOS DSM	1.11

ASOS produces an explicit Daily Summary Message (DSM), our problems are solved!

"Daily" Total of 1.11 inches, case closed!

KAMW DS 25/06
871615/610459//87/61//9761919/**111**/00/00/00/00
/00/00/00/00/00/00/00/00/00/00/00/00/00/00/00/00/
00/00/00/33/78/87/01322222/36412227/13=

Link: Current -> NWS Text Archive -> Enter DSMAMW

ANSWERS

Source	Total
IEM QC COOP	0.00
ASOS	0.13
ASOS DSM	1.11
ASOS DSM Hr	0.33

ASOS
Daily Summary Message (DSM)

Gotcha. The daily summary message is for a 12 AM to 12 AM period in local standard time, so in daylight time, it is 1 AM to 1 AM!

KAMW DS 25/06
871615/610459//87/61//9761919/**111**/00/00/00/00
/00/00/00/00/00/00/00/00/00/00/00/00/00/00/00/00/
00/00/00/**33**/78/87/01322222/36412227/13=

11 PM to Midnight total: 0.33

Link: Current -> NWS Text Archive -> Enter DSMAMW

ANSWERS

Source	Total
IEM QC COOP	0.00
ASOS	0.13
ASOS DSM	1.11
ASOS DSM Hr	0.33

Station	valid	precip
AMW	11:46 PM	0.01
AMW	11:47 PM	0
AMW	11:48 PM	0.02
AMW	11:49 PM	0.01
AMW	11:50 PM	0.02
AMW	11:51 PM	0.01
AMW	11:52 PM	0.02
AMW	11:53 PM	0.04
AMW	11:54 PM	0.02
AMW	11:55 PM	0.03
AMW	11:56 PM	0.03
AMW	11:57 PM	0.04
AMW	11:58 PM	0.04
AMW	11:59 PM	0.05
AMW	12:00 AM	0.05

ASOS One Minute Interval Data

Get out your calculator.
0.33” prior to 12:00 AM

When did this 0.05” fall?
11:59 PM to 12:00 AM
or
12:00 AM to 12:01 AM ?

Link: Networks -> ASOS -> One Minute Download

ANSWERS

Source	Total
IEM QC COOP	0.00
ASOS	0.13
ASOS DSM	1.11
ASOS DSM Hr	0.33
ASOS 1min	0.36

Answer is neither!

- ASOS timestamps are not exact at :00 seconds, but :23 seconds after.
- So 12:00 AM observation is a period from 11:59:24 PM to 12:00:23 AM
- So we'll split the 0.05" report in half and round up!

Link: Networks -> ASOS -> Note About Precip Timing

ANSWERS

Source	Total
IEM QC COOP	0.00
ASOS	0.13
ASOS DSM	1.11
ASOS DSM Hr	0.33
ASOS 1min	0.36

Daryl, this is more tedium than I care for.

- Let us put aside these issues going forward:
  - Exact seconds timing of data
  - Issues with tipping bucket latency

ANSWERS

Source	Total
IEM QC COOP	0.00
ASOS	0.13
ASOS DSM	1.11
ASOS DSM Hr	0.33
ASOS 1min	0.36
SchoolNet	0.57

KCCI-TV SchoolNet @ St Cecilia

datetime	pday
11:40 PM	0.01
11:55 PM	0.43
11:56 PM	0.46
11:57 PM	0.49
11:58 PM	0.52
11:59 PM	0.55
12:00 AM	0.57
12:01 AM	0.59
12:02 AM	0.01

Data is streamed live to IEM, which places timestamps on the data. So 0.57" reported was reported at midnight…

Actual reset came two minutes later as the logger clock on site is off!

Link: Networks -> SchoolNet -> Download

ANSWERS

Source	Total
IEM QC COOP	0.00
ASOS	0.13
ASOS DSM	1.11
ASOS DSM Hr	0.33
ASOS 1min	0.36
SchoolNet	0.57
RWIS	0 ?

Ames Roadway Weather Information System

datetime	pcpn
11:22 PM	0
11:33 PM	0
11:43 PM	0
11:52 PM	0
12:06 AM	0
12:12 AM	0

Maintained by Iowa Department of Transportation.

Some sites have an optical precipitation sensor. The Ames site does but did not report precip?

Link: Networks -> RWIS -> Download

ANSWERS

Source	Total
IEM QC COOP	0.00
ASOS	0.13
ASOS DSM	1.11
ASOS DSM Hr	0.33
ASOS 1min	0.36
SchoolNet	0.57
RWIS	0 ?
Lincoln Way	0 ?

USGS Squaw Creek at Lincoln Way

datetime	HG	PCI	PPH
11:00 PM	2.51	0	0
11:15 PM	2.51	0	
11:30 PM	2.51	0	
11:45 PM	2.51	0	
12:00 AM	2.56	0	0
12:15 AM	2.84	0	
12:30 AM	3.05	0	
12:45 AM	3.15	0	
1:00 AM	3.14	0	0

While the sensor reported a change in stream flow (HG), the precipitation counter (PCI) and hourly precipitation (PPH) reported zero.

Link: Networks -> DCP -> Download

ANSWERS

Source	Total
IEM QC COOP	0.00
ASOS	0.13
ASOS DSM	1.11
ASOS DSM Hr	0.33
ASOS 1min	0.36
SchoolNet	0.57
RWIS	0 ?
Lincoln Way	0 ?
Ada Hayden	0.93

USGS Skunk River near Ada Hayden

datetime	HG	PCI	PPH
11:00 PM	4.53	13.76	0
11:15 PM	4.52	13.76	
11:30 PM	4.51	13.76	
11:45 PM	4.55	14.04	
12:00 AM	4.61	14.69	0.93
12:15 AM	4.64	14.89	
12:30 AM	4.64	15.05	
12:45 AM	4.66	15.12	
1:00 AM	4.67	15.16	0.47

Whew, we have a station that appears to be working!

Link: Networks -> DCP -> Download

ANSWERS

Source	Total
IEM QC COOP	0.00
ASOS	0.13
ASOS DSM	1.11
ASOS DSM Hr	0.33
ASOS 1min	0.36
SchoolNet	0.57
RWIS	0 ?
Lincoln Way	0 ?
Ada Hayden	0.93
H2O Trtment	0.47

USGS Skunk River near Water Treatment Plant

datetime	HG	PCI	PPH
11:00 PM	11.92	39.14	0
11:15 PM	11.92	39.14	
11:30 PM	11.92	39.14	
11:45 PM	11.92	39.14	
12:00 AM	11.96	39.61	0.47
12:15 AM	12.03	39.89	
12:30 AM	12.2	40.02	
12:45 AM	12.38	40.22	
1:00 AM	12.57	40.3	0.79

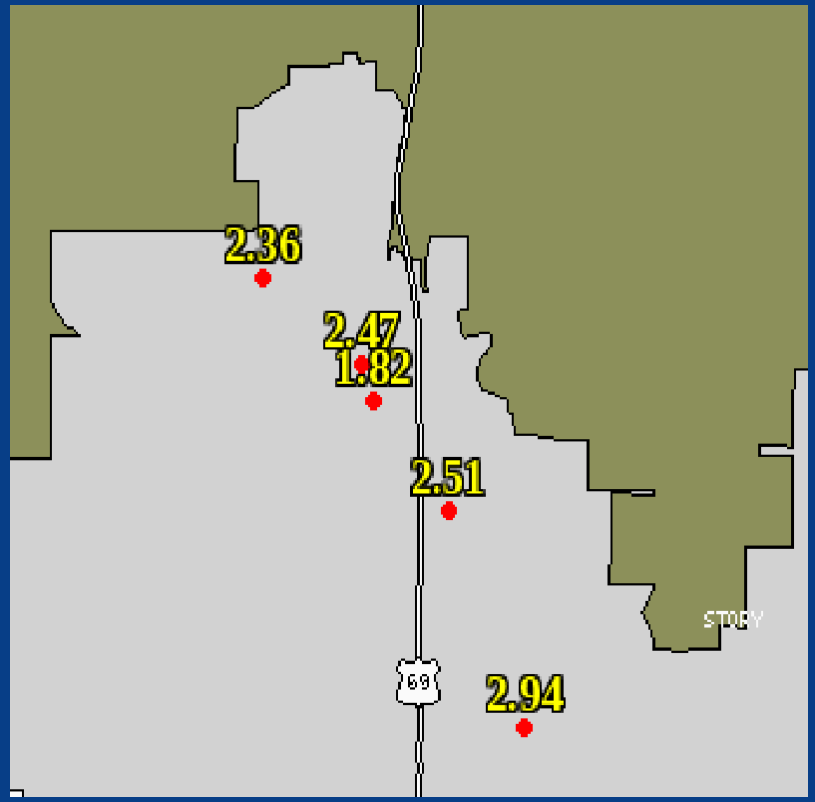
Another site that appears to be working just fine!

Link: Networks -> DCP -> Download

ANSWERS

Source	Total
IEM QC COOP	0.00
ASOS	0.13
ASOS DSM	1.11
ASOS DSM Hr	0.33
ASOS 1min	0.36
SchoolNet	0.57
RWIS	0 ?
Lincoln Way	0 ?
Ada Hayden	0.93
H2O Trtment	0.47
CoCoRaHS	???

CoCoRaHS 24 Hour totals for morning of June 26th



Human volunteers that report once daily, around 7 AM.

Link: Iowa CoCoRaHS -> View Observations

ANSWERS

Source	Total
IEM QC COOP	0.00
ASOS	0.13
ASOS DSM	1.11
ASOS DSM Hr	0.33
ASOS 1min	0.36
SchoolNet	0.57
RWIS	0 ?
Lincoln Way	0 ?
Ada Hayden	0.93
H2O Trtment	0.47
CoCoRaHS	???
ISUAG AgFm	0.25

ISUAG Station at AgFarm

datetime	Hourly Precip	Flag
11:00 PM	0	e
12:00 AM	0.25	e
01:00 AM	0.48	e

Precipitation data from this network is almost always estimated by High Plains Climate Center.

Link: Networks -> ISUAG -> Daily Download

ANSWERS

Source	Total
IEM QC COOP	0.00
ASOS	0.13
ASOS DSM	1.11
ASOS DSM Hr	0.33
ASOS 1min	0.36
SchoolNet	0.57
RWIS	0 ?
Lincoln Way	0 ?
Ada Hayden	0.93
H2O Trtment	0.47
CoCoRaHS	???
ISUAG AgFm	0.25
Others	0.53

Honorable Mentions

Site	Precipitation
NRCS Scan Site	Offline
Agronomy Hall Wx Station	0.52
Agronomy Hall AMS Station	0.53
Dave Flory's House	0.54
NLAE Beliot Station	0.52

Link: Networks -> Other

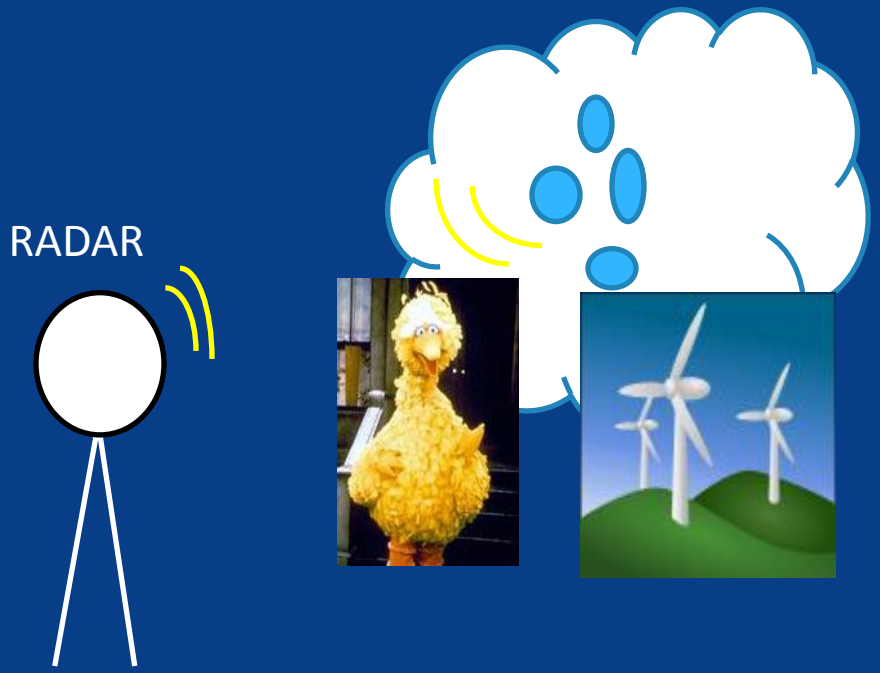
ANSWERS

Source	Total
IEM QC COOP	0.00
ASOS	0.13
ASOS DSM	1.11
ASOS DSM Hr	0.33
ASOS 1min	0.36
SchoolNet	0.57
RWIS	0 ?
Lincoln Way	0 ?
Ada Hayden	0.93
H2O Trtment	0.47
CoCoRaHS	???
ISUAG AgFm	0.25
Others	0.53

Halftime Report

- Have we definitively answered the initial question yet? -No
- Individual station data is yucky, so we produce gridded analyses to make pretty pictures

RAdio Detection And Ranging (RADAR)

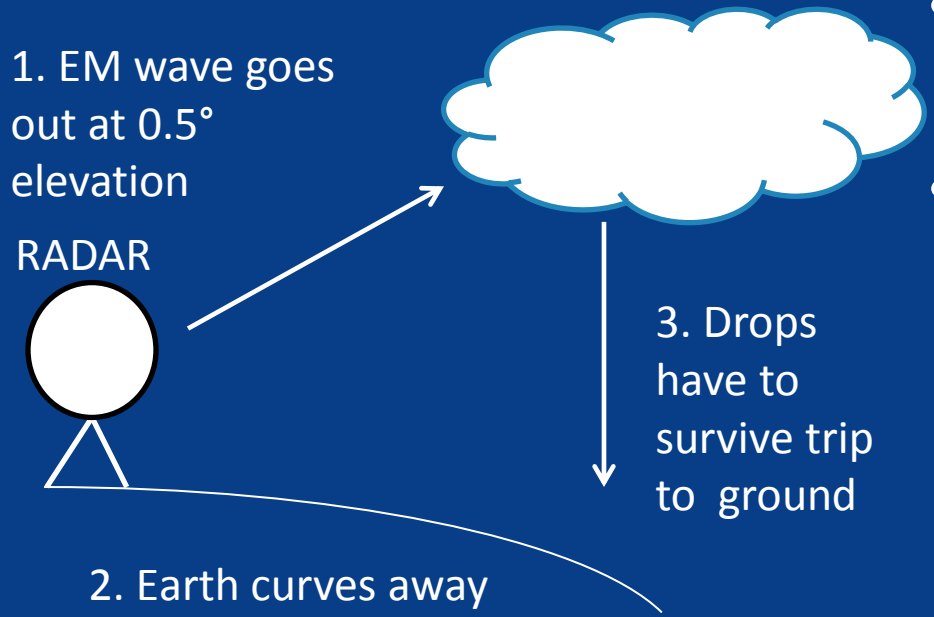


- National Weather Service RADAR is an effective tool at seeing raindrops, birds, bugs, planes, and wind turbines.
- ***RADAR does not observe precipitation!***
- RADAR measures power returned, which is put into equations to estimate precipitation.

Big Bird: Public Domain USGOV
Turbine: CCSA by lukipuk

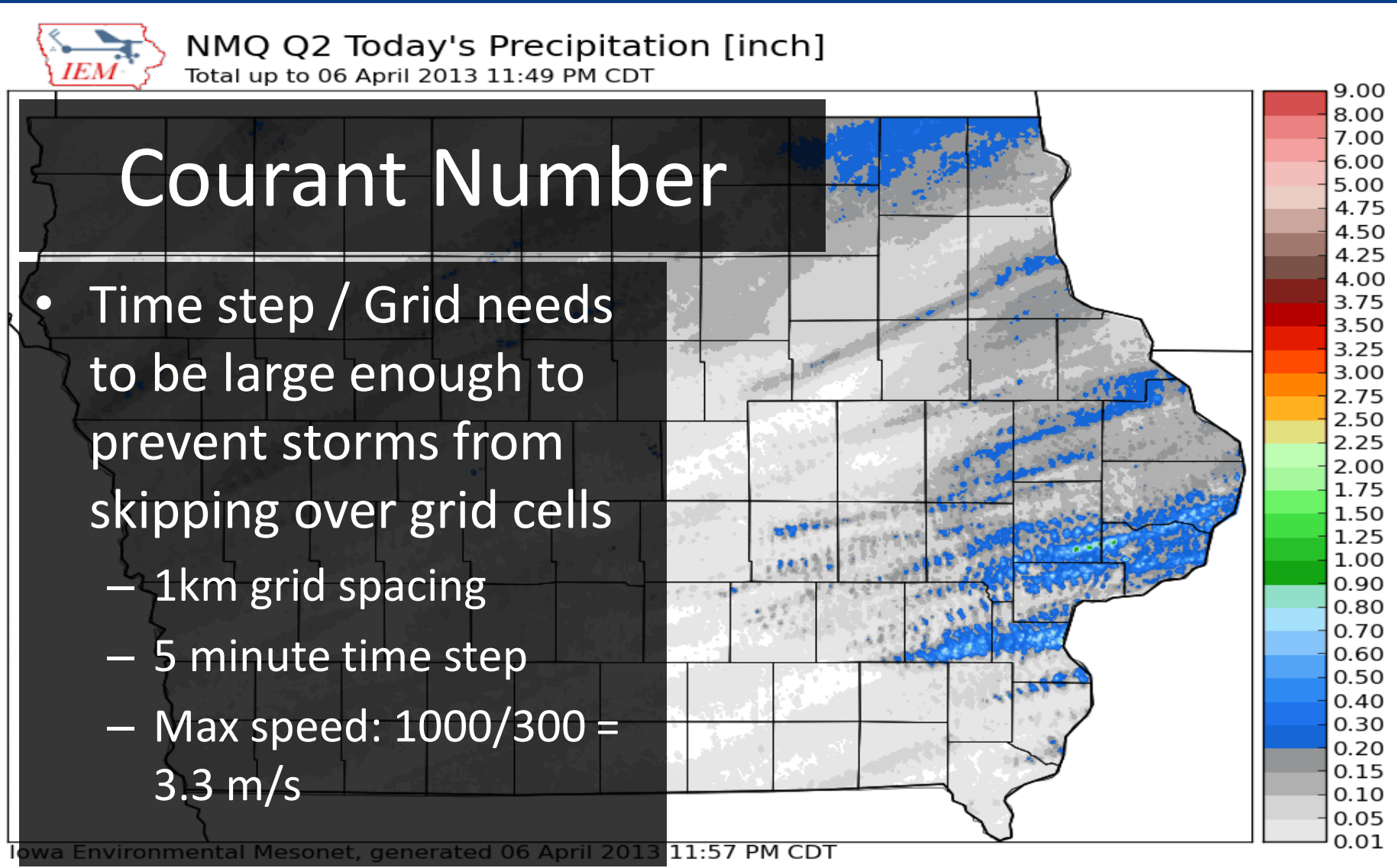
RADAR is above our heads

- The Des Moines RADAR “beam” is about 1,000 feet above the ground over Ames.



- ~30 seconds for drop to reach the ground
- Does not account for drift

Tumblr: windexwaker



Courant Number

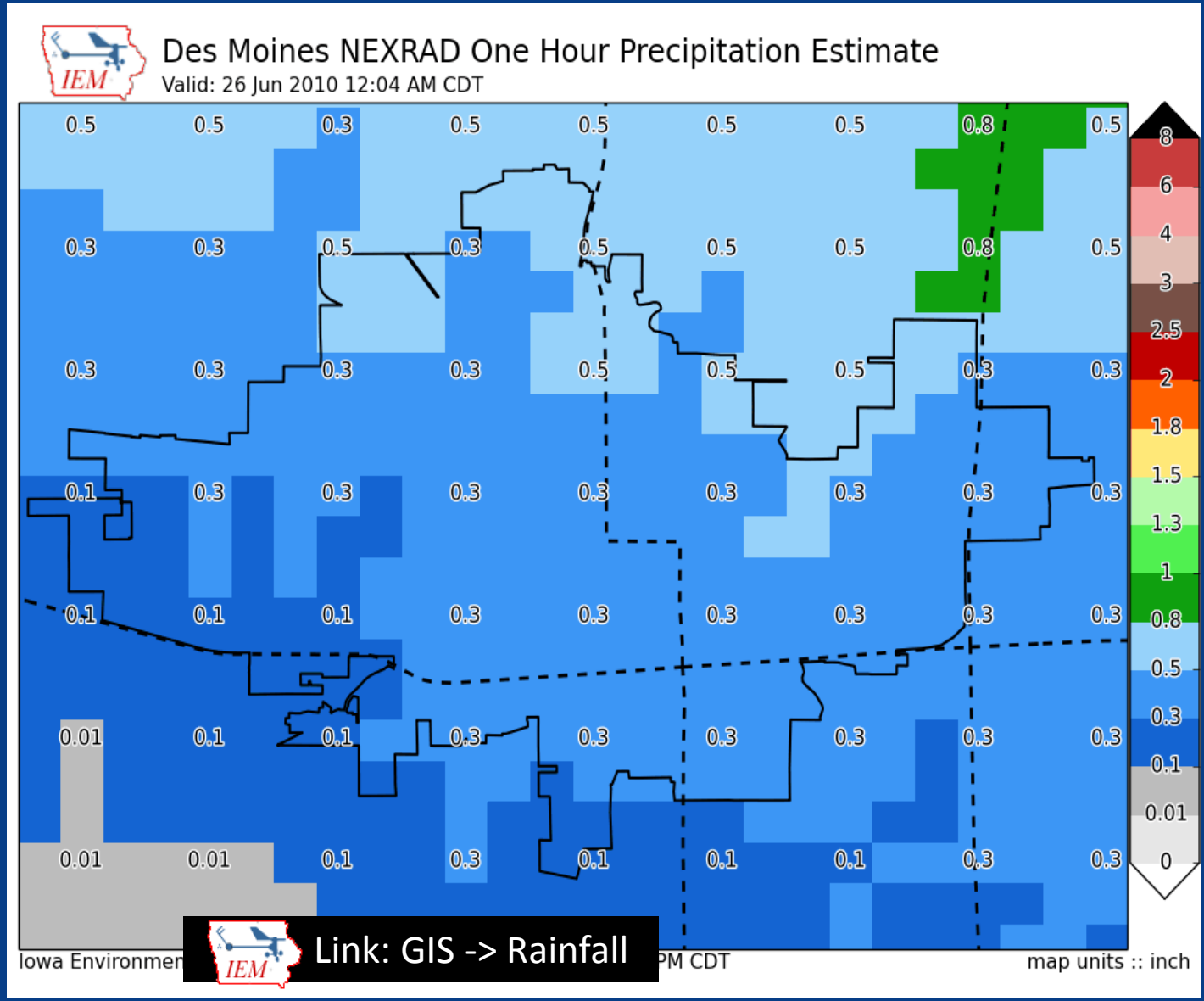
- Time step / Grid needs to be large enough to prevent storms from skipping over grid cells
  - 1km grid spacing
  - 5 minute time step
  - Max speed: 1000/300 = 3.3 m/s

Even more RADAR caveats

- Recall our recent discussion of ASOS providing four different answers to one question.
- Guess what, RADAR does the same!
  - Most rainfall products are 4 bit data! 16 levels
  - The timing of 1 hour total precipitation product is nebulous at best.
  - Different rainfall products are not directly comparable.

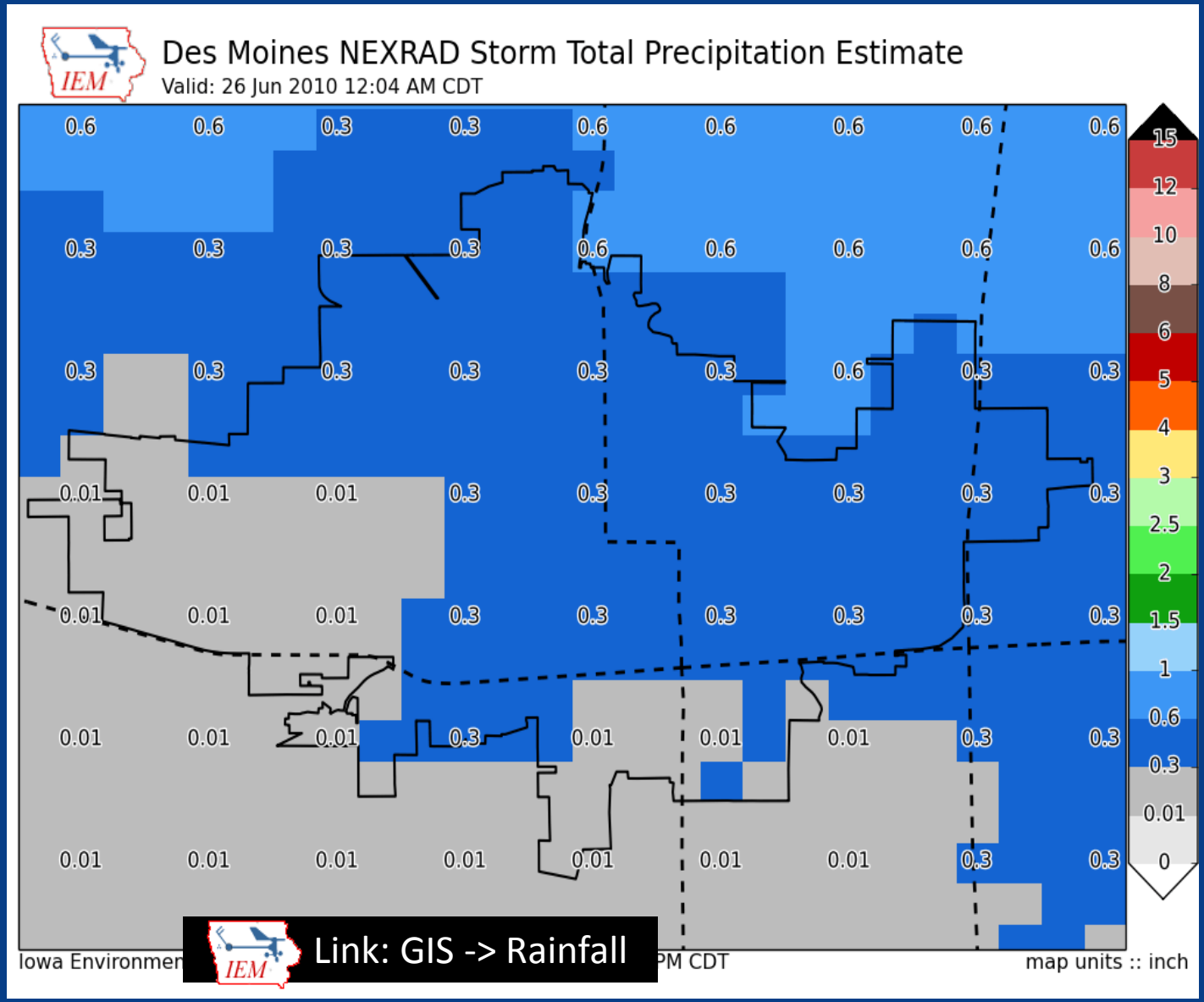
MORE ANSWERS

Source	Total
DMX 1hr	0.30



MORE ANSWERS

Source	Total
DMX 1hr	0.30
DMX Storm T	0.25



Discrete Levels (in inches)

One Hour Precipitation Bins

No Data	1.5
Trace	1.8
0.1	2.0
0.3	2.5
0.5	3.0
0.8	4.0
1.0	6.0
1.3	8.0

Storm Total Precipitation Bins

No Data	3.0
Trace	4.0
0.3	5.0
0.6	6.0
1.0	8.0
1.5	10.0
2.0	12.0
2.5	15.0

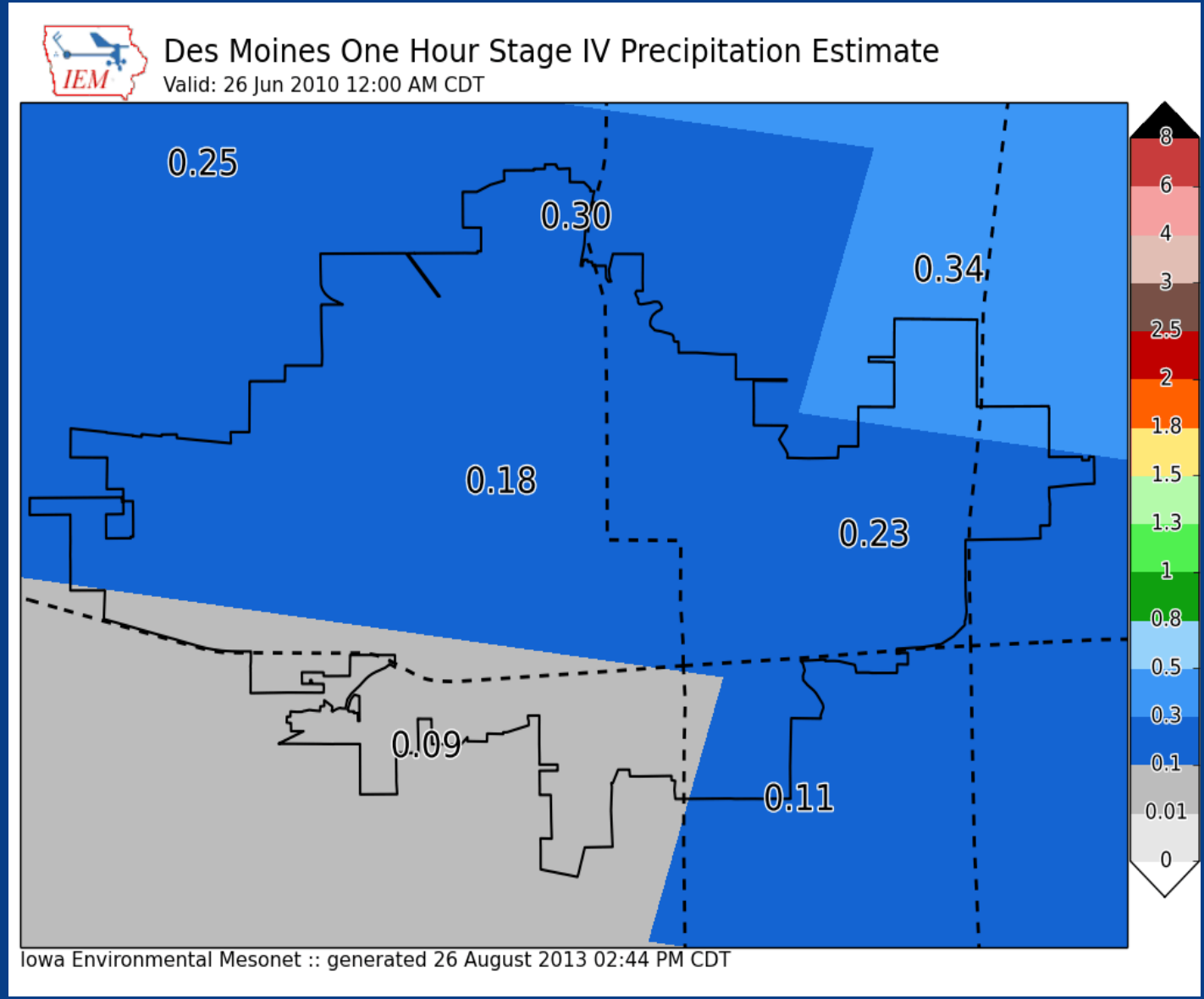
NCEP Stage IV Precipitation

- Popular mosaicked dataset combining manual quality control, RADAR data, and point observations.
- Caveat: Hourly data is rarely quality controlled!
- The best product is a 24 hour total between 12 UTC and 12 UTC (7 AM), not calendar day!

Link: Archive -> Browse Archive

MORE ANSWERS

Source	Total
DMX 1hr	0.30
DMX Storm T	0.25
Stage IV	0.22



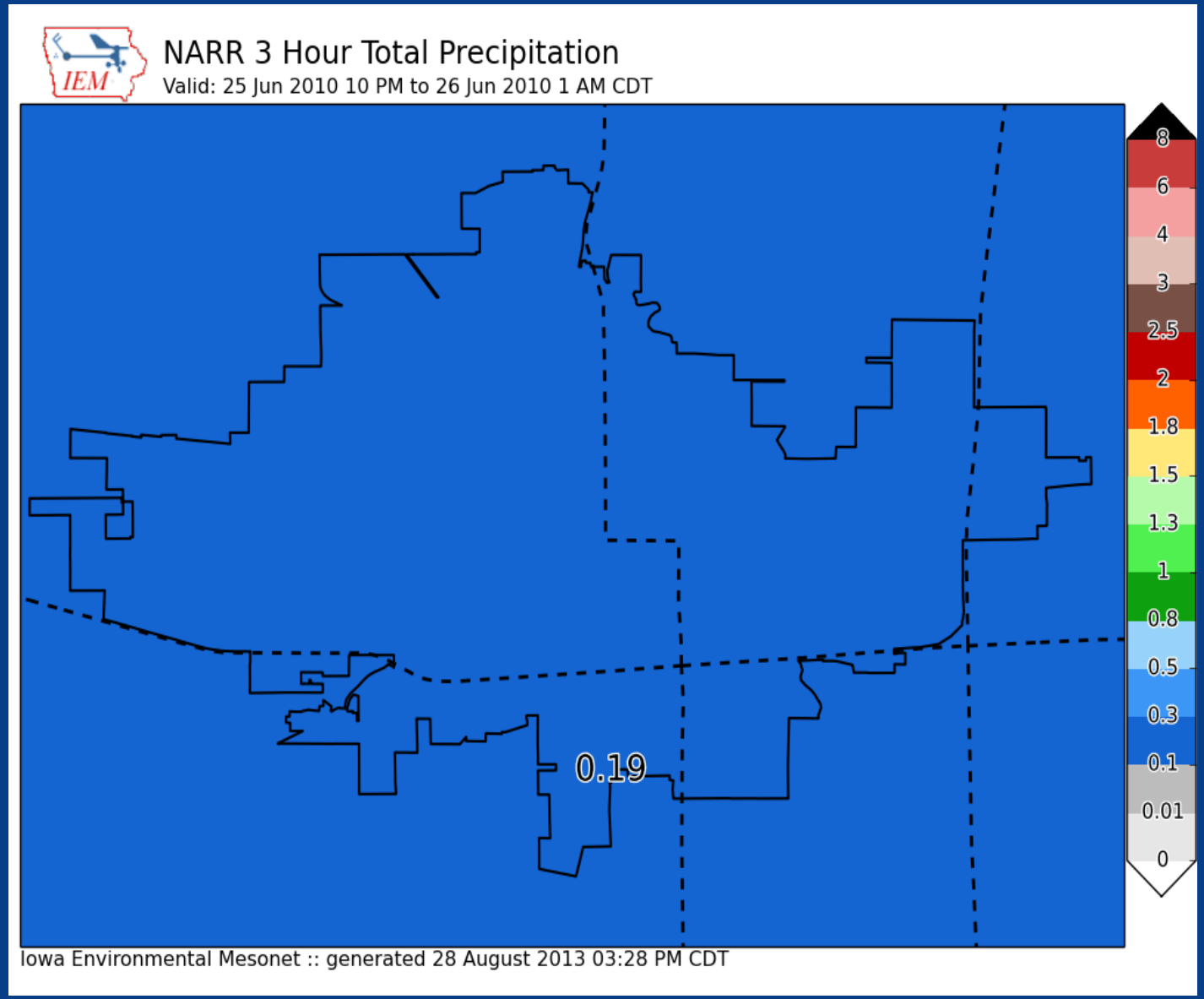
North American Reanalysis (NARR)

- Retrospective combination model and data assimilation dating back to 1 Jan 1979
- 3 hour interval data
- 32 km grid spacing
  - Ames fits within one grid cell.

Link: Archive -> NARR NCDC NOMADS Site

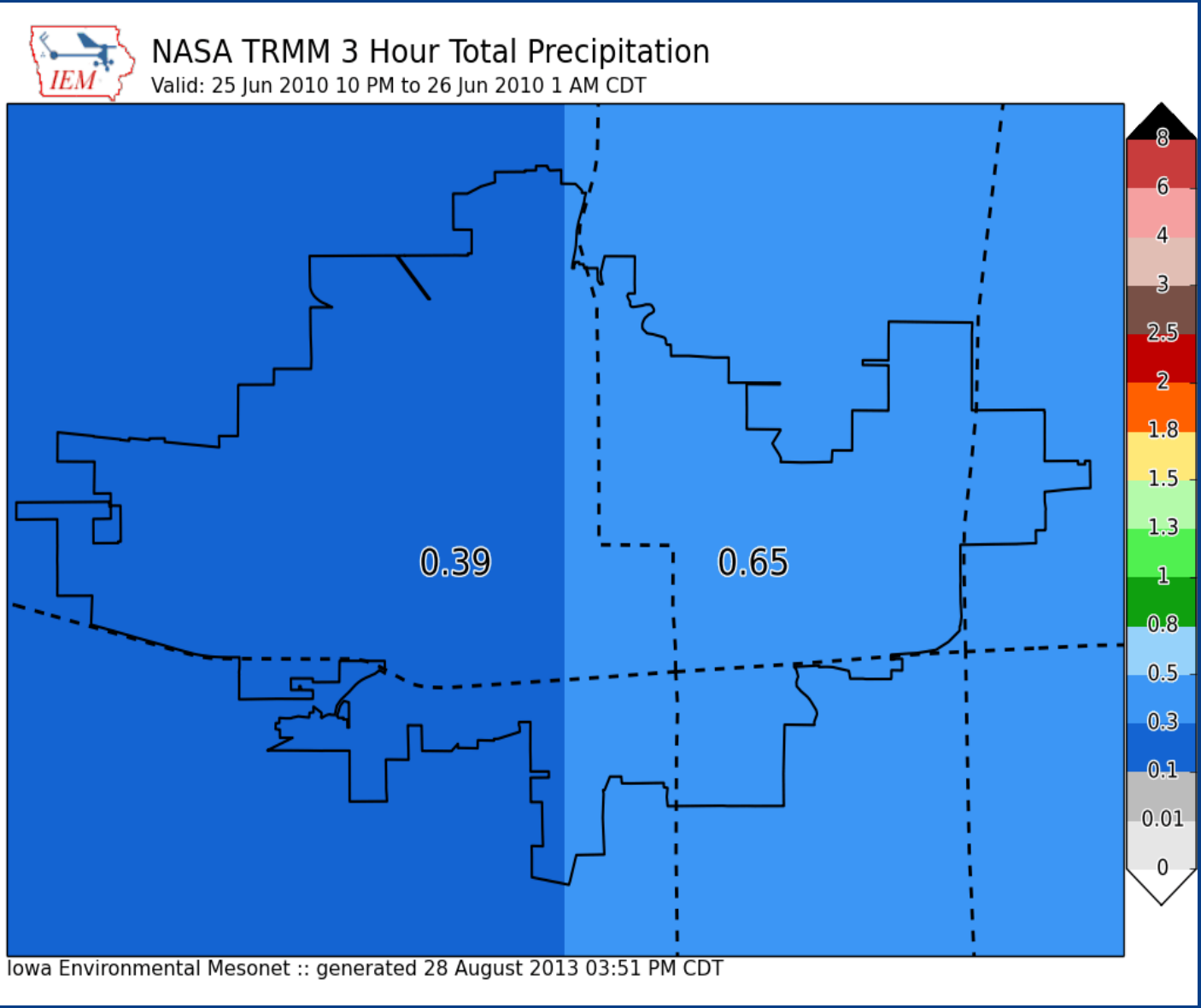
MORE ANSWERS

Source	Total
DMX 1hr	0.30
DMX Storm T	0.25
Stage IV	0.22
NARR	0.19



MORE ANSWERS

Source	Total
DMX 1hr	0.30
DMX Storm T	0.25
Stage IV	0.22
NARR	0.19
TRMM	0.51



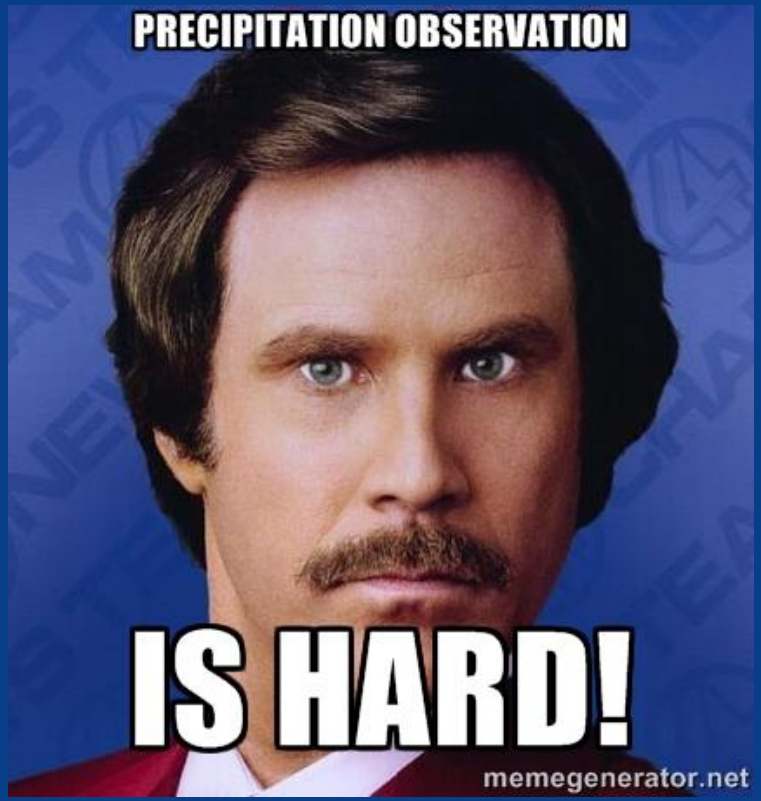
And the answer is....

IEM QC COOP	0.00	SchoolNet	0.57	CoCoRaHS	???	Stage IV	0.22
ASOS	0.13	RWIS	0 ?	ISUAG AgFm	0.25	NARR	0.19
ASOS DSM	1.11	Lincoln Way	0 ?	Others	0.53	TRMM	0.51
ASOS DSM Hr	0.33	Ada Hayden	0.93	DMX 1hr	0.30		
ASOS 1min	0.36	H2O Trtment	0.47	DMX Storm T	0.25		

We simply average and get: 0.36176470588 inches! What precision!

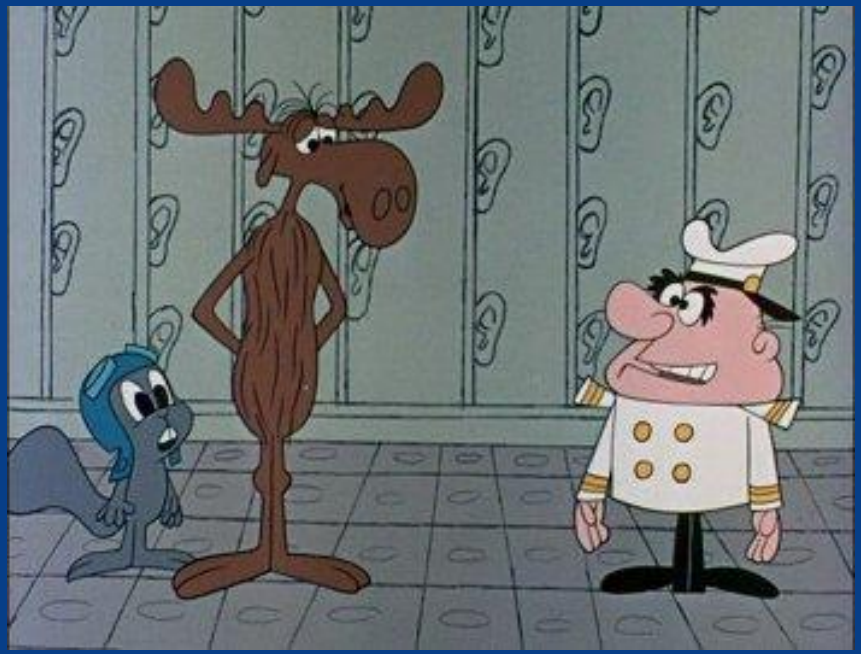
In Summary

- Know your application and source of precipitation data before using it.
- The hope is that irregularities at small time scales even out in time.
- If you think Meteorologists are always wrong, none of this mattered to you!



Be sure to be with us next time for:

- Was it cloudy at sunrise on 15 November 2003?
- What was the air temperature at 4 PM on 10 February 2013?
- Will it ever rain in Ames again?



Source: DVD of The Rocky & Bullwinkle Show

Questions?

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