User Manual:
the Precipitation Imaging Package (PIP)

Visualize and Quantify Falling Precipitation:
Rain and not-Rain (Snow)

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July 2017

Table of Contents (TOC)

Section 0: Express Setup Guide (ESG)

**The ESG facilitates getting a PIP operational quickly.
It hopefully contains just enough info for that.**

**Tool Box Button #19 defaults to the ESG,
Which is at**

C:\PIP\Software\User_Guide\Express_Setup_Guide.pdf

**On the other hand,
This PIP User Manual contains many more details
And is the reference for PIP users.**

Section 1: Overview

❖**[Background](#)**

❖**[Desktop](#)**

❖**[PIP Tool Box Primer](#)**

❖**[Express Setup](#)**

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❖Background

**This guide is the reference to PIP hardware and software, i.e. operating a PIP.
PIPs Record Falling Precipitation and
Produces Figures, Tables and Movies**

Input

**Video logging at ~380 frames per second for entire seasons (24/7).**

Output

- ✓ **Visualizations: show particle motion,**
- ✓ **Tables: facilitate user analysis and**
- ✓ **Plots: display common products.**

Operations

**Each PIP is calibrated before shipping, so it is ready to use – out of the box.
You can learn to operate your PIP inside, then install it at your field site.**

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Visualize: Movie

Click on pic to see PIP movie of falling precipitation.

5 mm
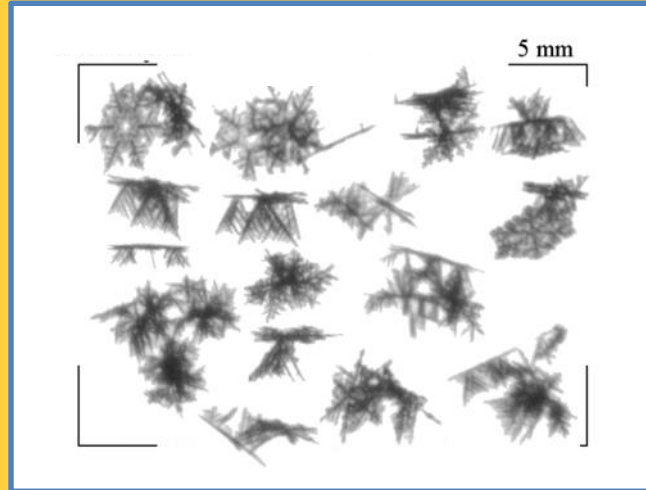
PIPs record all video images to *.pvi files,
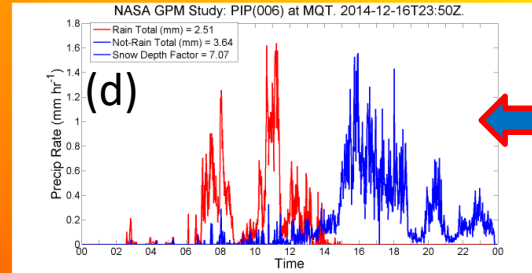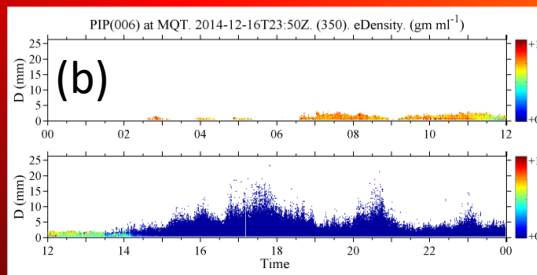**A compression algorithm developed at GSFC is used.**

PVI format is useless for watching movies with generally available apps.
Therefore a PIP app makes *.avi files.

A movie is made for each minute with precipitation.
Each movie shows the first 2000 frames with particles.

Quantify with Figures: Daily Summary

PIP at MQT. 2014/12/16.
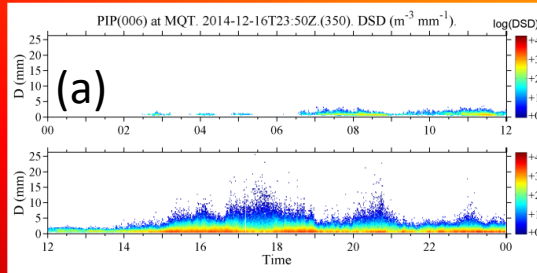
Rain and **not-Rain** **Measured** *Independently* and *Simultaneously*!
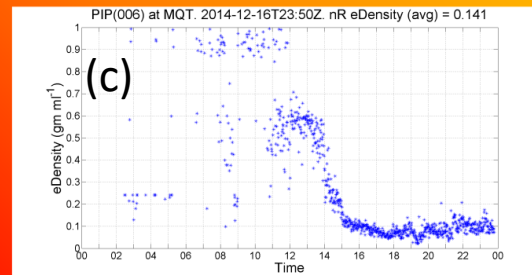
Time Series Of not-Rain Density (Cold Front)

High Speed Video Images Yield
(a) Particle Size Distributions
(b) Fall Velocity Distributions

Models Produce
(d) Rain & not-Rain Water Flux
(c) Density Estimates

Quantify with Tables: They exist for data in all figures
And for accumulations (by day and by minute).

(a)

(b)

(c)

(d)
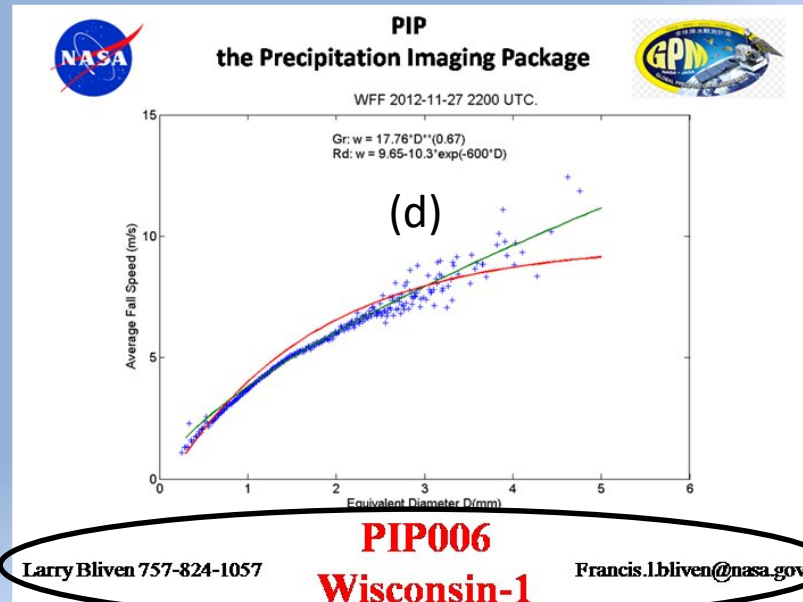
When a PIP-PC boots, the desktop should look like this one.

(a) the PIP Tool Box connects to routine processes.

(b) Handy reference stuff.

(c) Icons of running PIP apps (video recording\processing).

(d) The first rain event monitored by a PIP shows excellent agreement between measured fall speeds and models.

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❖PIP Tool Box Primer
You select commonly used processes and products.
Note that by default, Button #20 displays this quick guide, which is also in the User Manual (#1).

PIP Tool Box

Button	Tip	Description
1. User Manual	How operate a PIP	1. Quick setup guide. 2. Operations Details 3. Example Data Products
2. Hardware	Lamp & Camera Details	Run National Instruments NI IMAQ app, which (a) enables physical alignment of camera to lamp, (b) adjustment of light intensity gain, and (c) setting of other camera options. Useful for PIP installation and then for periodically checking light bulb.
3. Setup File	Software Control File for all PIP Apps	Control all PIP Apps from a single setup file. ASCII text file. Descriptor, tab, the instruction. *Must* have tab!
4. Log File	Listing of PIP_3 operations.	Daily file shows PIP_3 progress by records containing time stamps and processing instructions. Useful for documentation and assessing system performance. Daily files are zipped to the Zip directory.
5. Dir	Directory of PIP Products	Windows Explorer to the root for data products from PIP-1, PIP-2 and PIP3.
6. Movie Now	Recent Precipitation AVI	(1) To see what recent precipitation looks like, goto the most recent precipitation AVI , which is C:\PIP\Current_Weather\Recent_Lar.avi.zip. (2) Note that largest AVI for each 10 minute interval is located in root_1\PIP_3\f_10_Summary\Movies, where Analysis Root Directory_1 is defined in the Setup File. (3) AVIs for each minute of precipitation are in root2\PIP_2\q_Viewer, where Analysis Root Directory_2 is defined in the Setup File.
7. Figures All	Daily Summary Figures	DSD, Vel, eDen, P Summary Plot for each days. This 4-Figure presentation displays the basic input and output, i.e. DSD & Vel distributions, as well as the volume average density by minute and the rain & not-rain precipitation rates by minute. Additionally, Rain and not-Rain accumulations are presented.
8. Figures Now	Today's Summary Plot	Current Conditions: DSD, Vel, eDen, P Summary Plot. This 4-Figure presentation displays the basic input and output, i.e. DSD & Vel distributions, as well as the volume average density by minute and the rain & not-rain precipitation rates by minute.. Additionally, Rain and not-Rain accumulations are presented.
9. PSD Vel	Daily PSD & Velocity Summary	Time history of PSD, Fall Velocity, Relative Fall Velocity and Fall Speed Variability. Visual display of storm characteristics.
10. Vel	Today's 10 Minute Fall Velocity Plots	Fall Speed by Size for each 10 minute increment. Visualization of storm evolution by particle size. Rain and not-rain fall speed changes are useful for seeing frontal passage and other features. See (a) root_1\PIP_3\f_2_3_1_Velocity_Ebar and (b) root_1\PIP_3\f_2_3_0_Velocity_Plots_seg for mean & error bar, as well as individual particle fall speeds. For daily archiving, these are zipped to the Zip Directory.

PIP Tool Box

Button	Tip	Description
11. Task Mngr	What's running?	Windows Task Manger shows which Apps are running.
12. Scheduler	Schedule Startup Apps	Run Windows Scheduler and Goto PIP subdirectory. Turn on PIP startup apps (Tool_Bar and PIP_123). Note that Tool _Bar is always useful, however for setup, PIP_123 should not be running. Use button 14. Kill PIP as necessary.
13. Run PIP	*Run* PIP App	Run PIP_1, PIP_2, PIP_2a, and PIP_3 apps as desired.
14. Kill PIP	*Kill* PIP Apps	Kill PIP_1, PIP_2, PIP_2a, and PIP_3 apps as desired.
15. Re-Start PIP	*Re-Start* PIP Apps	Re-Start PIP_1, PIP_2, PIP_2a, and PIP_3 apps as desired.
16. PC Health	Monitor PC Temperature	Check Temps to ensure cool operations, i.e. don't want to see temperatures in the 60's degree C.
17. Fig\Tables Web	Figures and Tables for Web	Daily tables and figures in one place enables backup and web distribution.
18. Movie Web	Movies for Web	Daily AVI's enables backup and web distribution.
Button_19.bat	Link to an app of your choice	This button links to: C:\PIP\Software\Setup\Tools_16\button_19.bat At NWS-MQT, links to URL for MRR-PIP daily figures.
Button_20.bat	Link to an app of your choice	This button links to: C:\PIP\Software\Setup\Tools_16\button_20.bat At NWS-MQT, links to this file.

Mouse Roll Over = Tip
Right Click = Description

Section 2: Hardware

❖**[Hardware Components](#)**
❖**[Calibration](#)**
❖**[Alignment](#)**

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❖Hardware Components

This PIP is located at the GPM field site at NASA Wallops Flight Facility.
Outside are (1) the high speed video-camera and (2) the halogen lamp.
Inside there is (3) the PIP workstation, which is connected via (4) Ethernet cable to the camera.
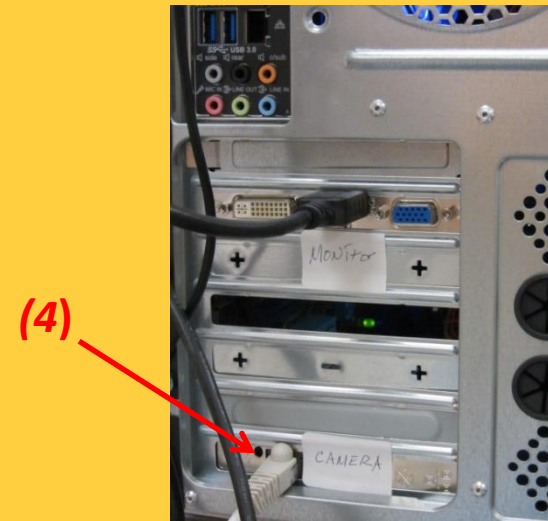
❖Calibration

Each PIP is calibrated at NASA WFF.
The camera points at a meter stick that is located in the focal plane at ~ 133 cm
and the lens is adjusted such that the horizontal length of the image is ~6.4 cm.
The lens components are then locked in place.
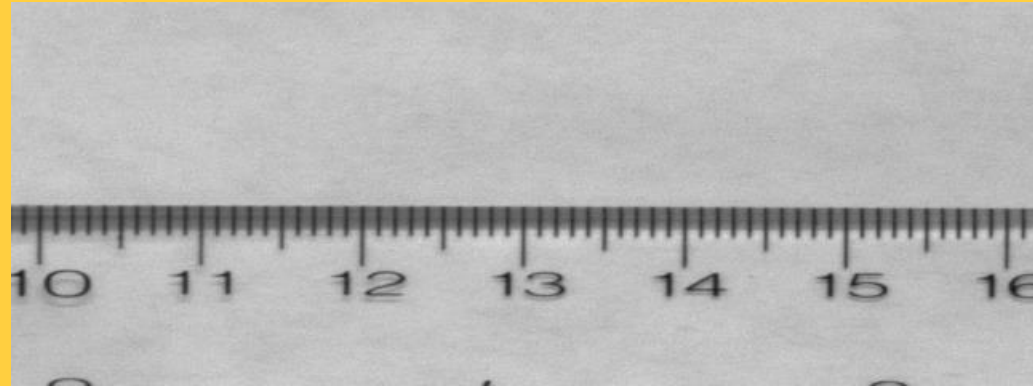
Lens adjustments are secured in the lab at WFF,
So PIP calibration is permanent,
i.e. there are no user adjustments.

To see your Calibration,
go to C:\PIP\Software\Calibration

PC Time Zone Must Be UTC!
Clock Time Must Be Correct!

❖Alignment

○Initial Alignment

**A string provides rough alignment between the camera housing and the lamp.
Then go to Fine Alignment (next page).**

String

String

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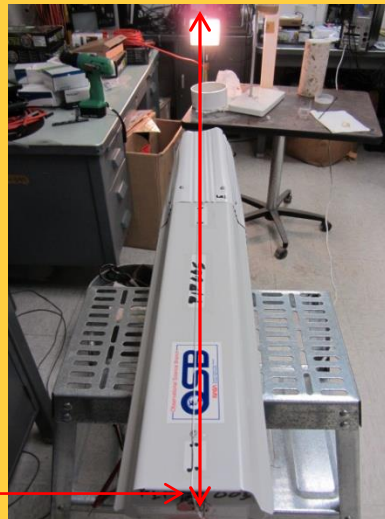
2. Alignment

Adjust things so that light from the halogen lamp is <u>centered.</u>
Move the camera and\or lamp to get the NI-MAX image to look like this one,
Then adjust the Gain (next page).
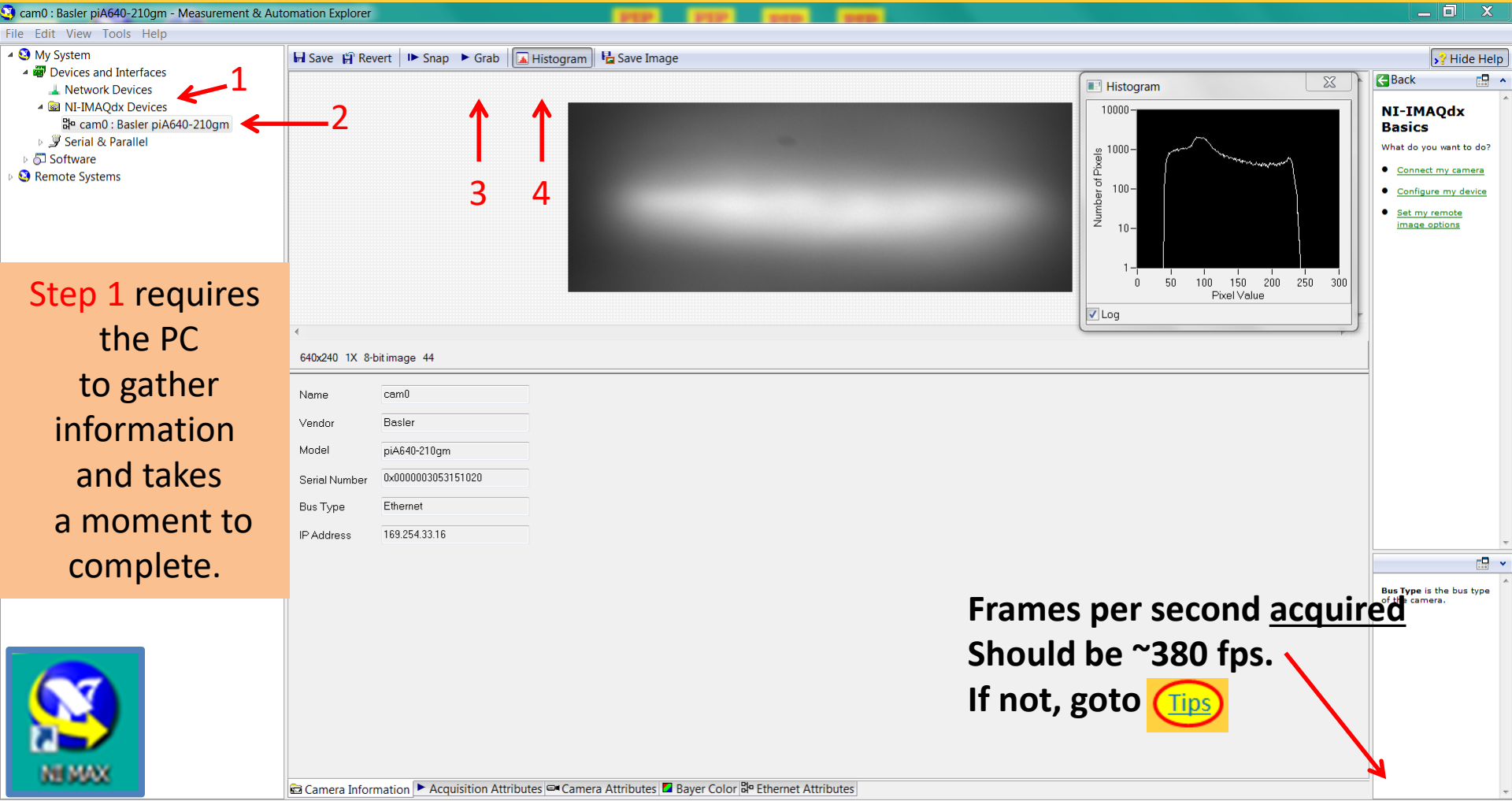
Step 1 requires
the PC
to gather
information
and takes
a moment to
complete.

Frames per second <u>acquired</u>
Should be ~380 fps.
If not, goto **Tips**

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2. Alignment

○ **Gain**

Adjust the Gain so the histogram looks like this one, i.e.
Max ~220 & min ~50. Want >200 but never saturate (>255).
Be sure to *Save*.

5. Save

6. Exit

1. Grab
2. Histogram

4. Adjust Raw Gain to get histogram like above.

3.1 Confirm and reset if needed.
It is unusual for these to change.

3. Attributes

Frames per second acquired
Should be ~380 fps.
If not, goto Tips

GoTo Scheduler **When you are sure that settings are saved, you are ready to run PIP Apps.**

If you *can not* set them as needed, goto Tips **. (Other settings sometimes change during shipment.)**

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○ **Falling Drops**
Adju

Click on the center image to see an example video.
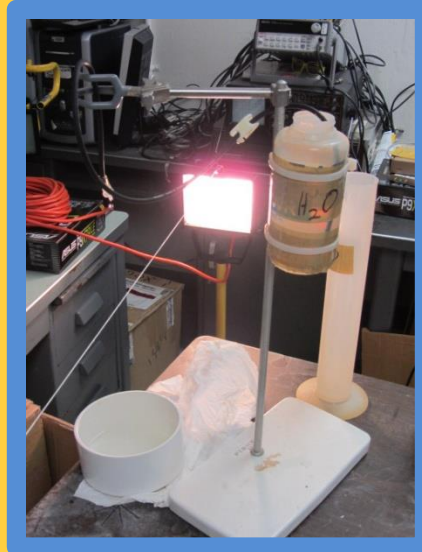
Section 2: Software

- ❖ **[PIP-123 Apps](#)**
- ❖ **[PIP Tool Box Clusters](#)**
- ❖ **[Tips](#)**

❖ PIP-123 Apps

o PIP-1,

o PIP-2, PIP-2a,

o PIP-3

PIP apps run independently and\or in parallel.

During normal operations, they all are running.

Each app cycles continuously.

icons of running PIP apps

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PIP-1

✓ **C:\PIP\Software\bin\A_PIP_3.exe (Labview)**

✓ **Purpose: Video acquisition and logging**

✓ **Input: video camera images. 380 frames per second at 640x240 pixels, 64x48 mm**

✓ **Output: Compressed video files (*.piv). 8-bit grey-scale images. 10 minutes each.**

PC Time Zone Must Be UTC!
Clock Time Must Be Correct!

Startup takes Awhile to Initialize Camera
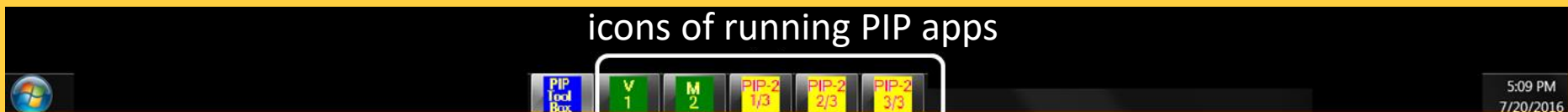
Time Should Agree With PC & FPS Should Be ~380. Otherwise, Re-start

Use this Kill button For clean Exit.

Start: Date Time

PIP_VideoLogger_1606.vi

File Edit Operate Tools Window Help

PIP Video Logger Rev 1606

C:\PIP\Rev_1506\SN_PIP006\2016_MQT\PIP_1\Raw_Video\00620160725\0062016072512300.piX

AGC'd_Video_Input

Click for 5 minutes Video

ON

Hour
12

Minute
33

Sec
12

Logging FPS
378

Click to Rename *.piX to *.piv & Exit

start_date
7/20/2016

start_time
7:40 PM

640x480

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○ PIP-2 App

PIP-2

✓Purpose: Particle Tables with time stamps and various particle characteristics
✓C:\PIP\Software\bin\PIP_Particle_Table_Control_1.exe (Labview)
✓C:\PIP\Software\bin\PIP_Particle_Table_Control_2.exe (1 fires off 2&3)
✓C:\PIP\Software\bin\PIP_Particle_Table_Control_3.exe
✓Input: Compressed video files (*.piv)
✓Output: Particle table files. Ascii_csv.dat (easy access) & binary_format.pv2 (speed)
✓3-Particle Table apps run in parallel to reduce processing time
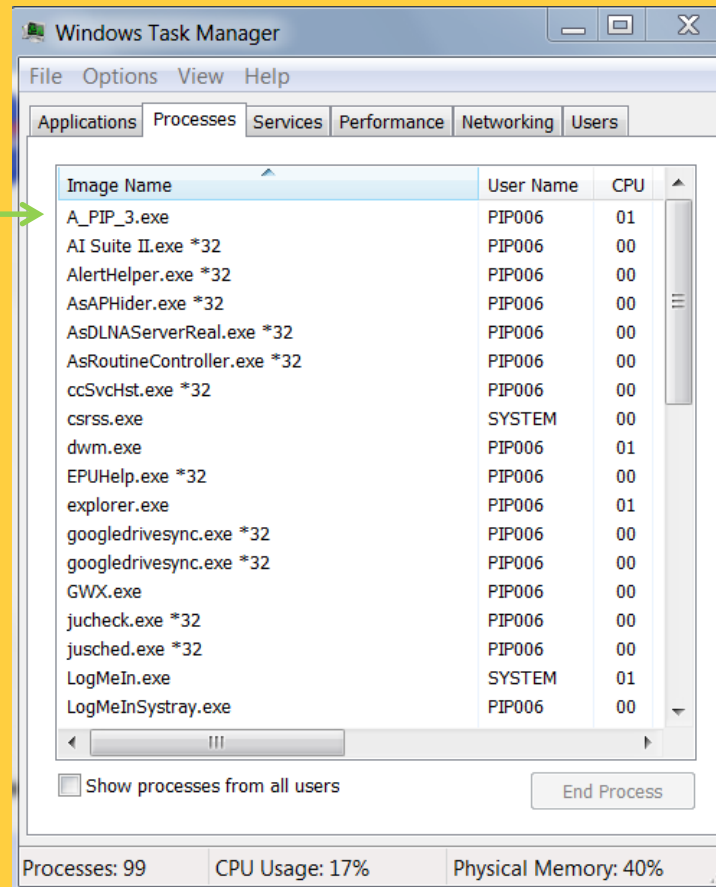✓No desktop display other than icon in task tray, i.e. runs hidden.

○ PIP-2a App

PIP-2a

✓C:\PIP\Software\bin\PIP_AVI_Control_1506.exe (Labview)
✓Purpose: User friendly video files for falling particle visualizations
✓Input: Compressed video files (*.piv)
✓Output: friendly video files (gray-scale.avi). Each minute, first 2000 images with particles.
✓No desktop display other than icon in task tray, i.e. runs hidden.

○ PIP3 App

PIP-3 (no icon displayed)

✓C:\PIP\Software\bin\A_PIP_3.exe (Matlab)

✓Purpose: Tables and Figures to characterize precipitation

✓Input: Particle table files. binary_format.pv2

✓Output: Particle Tracking Tables, Velocity Tables & Plots, DSD Tables & Plots, etc.

✓No desktop display, i.e. runs completely hidden.

**Use Task Manager
To See That
PIP_3 Is Running**

Windows Task Manager

File   Options   View   Help

Applications | Processes | Services | Performance | Networking | Users

Image Name	User Name	CPU
A_PIP_3.exe	PIP006	01
AI Suite II.exe *32	PIP006	00
AlertHelper.exe *32	PIP006	00
AsAPHider.exe *32	PIP006	00
AsDLNAServerReal.exe *32	PIP006	00
AsRoutineController.exe *32	PIP006	00
ccSvcHst.exe *32	PIP006	00
csrss.exe	SYSTEM	00
dwm.exe	PIP006	01
EPUHelp.exe *32	PIP006	00
explorer.exe	PIP006	01
googledrivesync.exe *32	PIP006	00
googledrivesync.exe *32	PIP006	00
GWX.exe	PIP006	00
jucheck.exe *32	PIP006	00
jusched.exe *32	PIP006	00
LogMeIn.exe	SYSTEM	01
LogMeInSystray.exe	PIP006	00

☐ Show processes from all users   End Process

Processes: 99   CPU Usage: 17%   Physical Memory: 40%

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❖ PIP Tool Box Clusters

PIP Tool Box

1. User Manual	2. Hardware
3. Setup File	4. Log File
5. Dir	6. Movie Now
7. Figures All	8. Figures Now
9. PSD Vel	10. Vel
11. Task Mngr	12. Scheduler
13. Run PIP	14. Kill PIP
15. Re-Start PIP	16. PC Health
17. Fig\Tables Web	18. Movie Web
Button_19.bat	Button_20.bat

Mouse Roll Over = Tip
Right Click = Description

the PIP Tool Box is organized
by grouping buttons
of similar tasks together
In Clusters.

Basics Cluster (1-3)
Products Cluster (4-10)
PC System Cluster (11-12)
Run\Kill PIP Apps Cluster (13-15)
PC Health Cluster (16)
Web Ready PIP Products Cluster (17-18)
User Defined Cluster (19-20)

Get a PIP ready to operate.

1. User Manual	**1. Adobe Reader displays this file** **C:\PIP\Software\User_Guide\PIP_User_Guide.pdf**
2. Hardware	**2. Alignment App (instructions)** **G:\Program Files (x86)\National Instruments\MAX\NIMax.exe**
3. Setup File *	**3. File that controls processing of all PIP Apps** **C:\PIP\Software\Setup\PIP_setup.txt**

PIP Tool Box

1. User Manual	2. Hardware
3. Setup File	4. Log File
5. Dir	6. Movie Now
7. Figures All	8. Figures Now
9. PSD Vel	10. Vel
11. Task Mngr	12. Scheduler
13. Run PIP	14. Kill PIP
15. Re-Start PIP	16. PC Health
17. Fig\Tables Web	18. Movie Web
Button_19.bat	Button_20.bat

Mouse Roll Over = Tip
Right Click = Description

*Example Setup File (Tab Delimitated)

Video Input Root Directory_1	**c:\PIP\Rev_1506\SN_PIP001\2015_WFF**
Analysis Root Directory_1	**c:\PIP\Rev_1506\SN_PIP001\2015_WFF**
Instrument......................................	**PIP**
Instrument Tag................................	**001**
software rev. default(2).................	**2**
Camera number. Default(1).................	**1**
Title for plots	**WFF**
Station Name...(3 char is nice)............	**WFF**
Latitude	**37.9343**
Longitude	**-75.4727**
Video Input Root Directory_2	
	d:\PIP\Rev_1506\SN_PIP001\2015_WFF
Analysis Root Directory_2 (AVI)	
	d:\PIP\Rev_1506\SN_PIP001\2015_WFF
Camera Rotation (0 or 180)	**0 1**
Subset Sampling (1=all, 2= 1/2, ...	**1**

✓ Products Cluster (4-10)
Access PIP Products
Most of these Buttons are all automatically Configured by PIP_setup.txt

PIP Tool Box

1. User Manual	2. Hardware
3. Setup File	4. Log File
5. Dir	6. Movie Now
7. Figures All	8. Figures Now
9. PSD Vel	10. Vel
11. Task Mngr	12. Scheduler
13. Run PIP	14. Kill PIP
15. Re-Start PIP	16. PC Health
17. Fig\Tables Web	18. Movie Web
Button_19.bat	Button_20.bat

Mouse Roll Over = Tip
Right Click = Description

Button	Description
4. Log File	**4. Record of PIP_3 Processing Sequence** C:\PIP\Current_Weather\ PIP_daily_chronology.log
5. Dir	**5. PIP Product Directory Root** **Configured using PIP_setup.txt**
6. Movie Now	**6. Display most recent precipitation video.** C:\PIP\Current_Weather\Recent_Lar.avi.zip
7. Figures All	**7. 4-Figure summary plots for all days** **Configured using PIP_setup.txt**
8. Figures Now	**8. Today's 4-Figure summary plot** **Configured using PIP_setup.txt**
9. PSD Vel	**9. 4-Figure summary plot of PSD and Vel distributions for all days** **Configured using PIP_setup.txt**
10. Vel	**10. Particle Velocities for 10 minute intervals** **Configured using PIP_setup.txt**

4. Log File

Opens **C:\PIP\Current_Weather\ PIP_daily_chronology.log**

Daily Log File records PIP_3 processing sequence.

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○ **PIP Product Directory Root**

Dir Button shows path to PIP_1, PIP_2, PIP_3 directories.

\PIP_1: Video

\PIP_2: Particle Tables & AVI movie clips.

\PIP_3: Particle Tracking Tables, Velocity Tables & Plots, DSD Tables & Plots.

\Study: Development products, i.e. not yet journal reviewed. For example, eDensity.

Computer ▸ C_home_2T (C:) ▸ PIP ▸ Rev_1506 ▸ SN_PIP006 ▸ 2014_MQT ▸ PIP_1 ▸ Raw_Video ▸ 00620140401

Name	Date modified	Type	Size
0062014040100000.piv	12/27/2015 7:25 PM	PIV File	11,110 KB
0062014040101000.piv	12/27/2015 7:25 PM	PIV File	17,359 KB
0062014040102000.piv	12/27/2015 7:25 PM	PIV File	42,946 KB
0062014040103000.piv	12/27/2015 7:25 PM	PIV File	8,148 KB
0062014040104000.piv	12/27/2015 7:25 PM	PIV File	4,237 KB
0062014040105000.piv	12/27/2015 7:25 PM	PIV File	156 KB
0062014040106000.piv	12/27/2015 7:25 PM	PIV File	171 KB
0062014040107000.piv	12/27/2015 7:25 PM	PIV File	709 KB
0062014040108000.piv	12/27/2015 7:25 PM	PIV File	25,674 KB
0062014040109000.piv	12/27/2015 7:25 PM	PIV File	272 KB
0062014040110000.piv	12/27/2015 7:25 PM	PIV File	156 KB
0062014040111000.piv	12/27/2015 7:25 PM	PIV File	225 KB
0062014040112000.piv	12/27/2015 7:25 PM	PIV File	141 KB
0062014040113000.piv	12/27/2015 7:25 PM	PIV File	141 KB
0062014040114000.piv	12/27/2015 7:25 PM	PIV File	141 KB
0062014040115000.piv	12/27/2015 7:25 PM	PIV File	740 KB
0062014040116000.piv	12/27/2015 7:25 PM	PIV File	57,282 KB
0062014040117000.piv	12/27/2015 7:25 PM	PIV File	57,512 KB
0062014040118000.piv	12/27/2015 7:25 PM	PIV File	59,113 KB
0062014040119000.piv	12/27/2015 7:25 PM	PIV File	54,161 KB
0062014040120000.piv	12/27/2015 7:25 PM	PIV File	61,623 KB
0062014040121000.piv	12/27/2015 7:25 PM	PIV File	34,251 KB
0062014040122000.piv	12/27/2015 7:25 PM	PIV File	69,547 KB
0062014040123000.piv	12/27/2015 7:25 PM	PIV File	166,646 KB

Products are derived from these raw video files, which are in a binary format.
Essential products are (a) particle size tables and (b) avi movies.

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C:\PIP\Rev_1506\SN_PIP006\2014_MQT\PIP_2\a_Particle_Tables\
0062014040409550_a_p.dat

1	PIP_Rev																		
2	1403																		
3	nstr_Num																		
4	6																		
5	yr	mo	dy	hr															
6	2014	4	4	9															
7	Station																		
8	MQT																		
9	RecNum	RecClass	IciLoc	IciTime	FT	ReadHere	Year	Month	Day	Hr	Min	Sec	PlotTime	Frames	x_cen	y_cent	Jum_Hole	Ellip_Maj	Ellip_Min	Tot_Area	Wad_Dia
10	0	nd	Site	nd	Logical	nd	nd	nd	nd	nd	nd	nd	nd	Interval	Interval	Interval	nd	mm	mm	mm^2	mm
11	1	0	6	4E+09	0	5828	2014	4	4	9	55	16	0.4134	1	609	72	0	1.866	0.928	1.36	1.32
12	2	0	6	4E+09	0	5828	2014	4	4	9	55	16	0.4134	1	111	79	0	0.827	0.37	0.24	0.55
13	3	0	6	4E+09	0	5828	2014	4	4	9	55	16	0.4134	1	136	121	0	1.78	0.916	1.28	1.28
14	4	0	6	4E+09	0	5828	2014	4	4	9	55	16	0.4134	1	377	126	0	0.616	0.248	0.12	0.39
15	5	0	6	4E+09	0	5828	2014	4	4	9	55	16	0.4134	1	609	165	0	1.043	0.268	0.22	0.53
16	6	0	6	4E+09	0	5828	2014	4	4	9	55	16	0.4134	1	442	167	0	1.366	0.522	0.56	0.84
17	7	0	6	4E+09	0	5828	2014	4	4	9	55	16	0.4134	1	407	261	0	4.73	1.454	5.4	2.62
18	8	0	6	4E+09	0	5828	2014	4	4	9	55	16	0.4134	1	559	270	0	1.674	0.943	1.24	1.26
19	9	0	6	4E+09	0	5828	2014	4	4	9	55	16	0.4134	1	360	271	0	1.418	0.7	0.78	1
20	10	0	6	4E+09	0	5828	2014	4	4	9	55	16	0.4134	1	340	351	0	2.32	1.23	2.24	1.69

9	RecNum	Long_X	Part_Or	Rec_BS	Rec_SS	Hy_Rad	Diag	LCol_x	RCol_x	UpRw_y	LwRw_y	Box_x	Box_y	Min_Grey	Q	R
10	0	mm	deg	mm	mm	mm	mm	nd	nd	nd	nd	mm	mm	nd	16_bit	8_bit
11	1	1.5	2.33	1.16	1.16	1.17	1.64	602	617	66	78	1.64	1.64	133	0	2
12	2	0.7	0.01	0.62	0.39	0.48	0.73	108	115	78	82	0.73	0.73	132	0	2
13	3	1.3	41.32	1.11	1.11	1.15	1.57	129	143	116	128	1.57	1.57	158	0	2
14	4	0.4	135.27	0.49	0.24	0.33	0.55	376	380	124	128	0.55	0.55	142	0	2
15	5	0.3	109.18	0.97	0.23	0.37	1	608	612	160	170	1	1	127	0	2
16	6	0.9	35.49	1.13	0.5	0.69	1.23	437	446	162	172	1.23	1.23	107	0	2
17	7	3	145.57	4.21	1.28	1.97	4.41	392	426	246	274	4.41	4.41	39	0	2
18	8	1.3	162.91	1.07	1.07	1.16	1.51	553	566	264	276	1.51	1.51	58	0	2
19	9	0.9	67.89	0.88	0.88	0.89	1.24	356	365	266	278	1.24	1.24	101	0	2
20	10	1.6	110.7	1.46	1.46	1.54	2.06	331	348	342	362	2.06	2.06	138	0	2

Particle tables contain time stamps and particle characteristics.
The frame rate is ~380 fps, so particles are *not* independent –
Indeed many particles can be identified and tracked between successive images.
Particle table format is tab delimitated ascii.

PIP-3: Particle Size Distribution Example
C:\PIP\Rev_1506\SN_PIP001\2015_WFF\PIP_3\f_1_4_DSD_Tables_ascii \
001201505012350_01_dsd.dat

5. Dir

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	PIP_Rev																									
2	1506																									
3	Instr_Num																									
4	1																									
5	yr	mo	dy																							
6	2015	5	1																							
7	Station																									
8	WFF																									
9	NaN	NaN	NaN	NaN	DSD_avg	0	107.6	108.7	269.7	145.2	73.51	36.46	19.25	9.462	4.666	2.326	1.354	0.769	0.3547	0.2301	0.1278	0.08982	0.05391	0.0315	0.0225	0.02148
10	NaN	NaN	NaN	NaN	Bin_edge	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4
11	NaN	NaN	NaN	NaN	dBin	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
12	day_time	hr_d	min_d	Num_d	Bin_cen	0.1	0.3	0.5	0.7	0.9	1.1	1.3	1.5	1.7	1.9	2.1	2.3	2.5	2.7	2.9	3.1	3.3	3.5	3.7	3.9	4.1
13	0:01	0	1	15	NaN	0	0	0	68.4	44.5	29.24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0:02	0	2	24	NaN	0	0	0	148.2	89	7.309	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0:03	0	3	42	NaN	0	0	15.9	250.8	115.7	21.93	18.62	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0:04	0	4	41	NaN	0	0	47.71	239.4	124.6	21.93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0:05	0	5	19	NaN	0	0	15.9	136.8	26.7	7.309	0	5.4	0	4.295	0	0	0	0	0	0	0	0	0	0	0
18	0:06	0	6	16	NaN	0	26.41	15.9	91.2	26.7	0	6.207	0	4.782	4.295	0	0	0	0	0	0	0	0	0	0	0
19	0:07	0	7	9	NaN	0	0	0	45.6	8.9	0	18.62	5.4	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0:08	0	8	3	NaN	0	0	0	0	0	0	6.207	0	4.782	0	0	0	3.301	0	0	0	0	0	0	0	0
21	0:09	0	9	33	NaN	0	0	0	79.8	26.7	29.24	49.66	32.4	23.91	0	0	0	0	0	0	0	0	0	0	0	0
22	0:10	0	10	22	NaN	0	26.41	0	11.4	26.7	43.85	31.04	16.2	0	4.295	0	0	6.602	0	0	0	0	0	0	0	0
23	0:11	0	11	16	NaN	0	0	0	11.4	62.3	43.85	12.41	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0:12	0	12	8	NaN	0	26.41	0	22.8	17.8	7.309	6.207	5.4	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0:13	0	13	1	NaN	0	0	0	0	0	0	6.207	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0:14	0	14	15	NaN	0	0	0	0	8.9	21.93	37.24	21.6	4.782	0	0	0	0	0	0	0	0	0	0	0	0
27	0:15	0	15	21	NaN	0	26.41	0	22.8	0	36.54	43.45	21.6	9.565	0	0	0	0	0	0	0	0	0	0	0	0
28	0:16	0	16	3	NaN	0	0	0	0	0	7.309	0	0	0	0	7.801	0	0	0	0	0	0	0	0	0	0
29	0:17	0	17	7	NaN	0	0	0	0	0	7.309	6.207	5.4	0	4.295	3.901	7.15	0	0	0	0	0	0	0	0	0
30	0:18	0	18	1	NaN	0	0	0	0	0	0	0	0	0	0	3.901	0	0	0	0	0	0	0	0	0	0

PSD tables contain time stamped size distributions.
The frame rate is ~380 fps,
so *sub-sampling* is used to help ensure independent observations.
Particle table format is tab delimitated ascii.

ToC

○ **PIP-3:** Velocity Table Examples

5. Dir

C:\PIP\Rev_1506\SN_PIP006\2014_MQT_Zip\PIP_3\f_2_2_Velocity_Tables\00620140404\

0062014040409550_a_v_1.dat

	A	B	C	D	E	F
1	PIP_Rev					
2	1506					
3	Instr_Num					
4	6					
5	yr	mo	dy	hr		
6	2014	4	4	9		
7	Station					
8	MQT					
9	RecNum	Part_ID	Wad_Dia	vel_h_1	vel_v_1	minute_p
10	6	6	0.84	1.76	10.99	55
11	192	134	2.67	2.79	0.93	55
12	367	257	3.18	2.58	3.62	55
13	449	313	0.75	3.05	1.58	55
14	603	421	1.34	3.12	1.85	55
15	647	453	2.29	3.04	1.57	55
16	694	487	0.36	3.13	1.44	55
17	746	522	0.97	2.98	1.84	55
18	775	539	1.13	3.09	1.97	55
19	789	552	1.22	2.93	1.77	55
20	828	578	3.73	2.8	1.91	55
21	873	615	1.18	3.06	1.99	55
22	889	627	1.99	3.11	0.43	55
23	907	640	0.39	3.08	1.67	55
24	908	641	2.13	2.96	0.44	55
25	920	648	0.28	2.81	0.38	55

0062014040409550_a_v_2.dat

	A	B	C	D	E	F
1	PIP_Rev					
2	1506					
3	Instr_Num					
4	6					
5	yr	mo	dy	hr		
6	2014	4	4	9		
7	Station					
8	MQT					
9	RecNum	Part_ID	Wad_Dia	vel_h_2	vel_v_2	minute_p
10	53	41	3.08	3.58	1.67	55
11	73	41	2.99	3.53	1.68	55
12	92	41	2.89	3.5	1.63	55
13	77	63	1.86	4.46	2.31	55
14	95	63	1.87	4.38	2.29	55
15	114	63	1.89	4.33	2.25	55
16	133	92	3.14	3.48	1.66	55
17	149	92	3.06	3.43	1.63	55
18	154	112	1.74	3.99	1.99	55
19	164	112	1.68	3.92	1.97	55
20	497	345	2.45	3.69	1.7	55
21	511	345	2.45	3.67	1.67	55
22	525	345	2.56	3.68	1.61	55
23	534	345	2.65	3.65	1.56	55
24	543	345	2.71	3.59	1.53	55
25	510	355	3.61	3.89	2.5	55

*v_1.dat is for particles in only 2 images.
*v_2.dat is for particles in more than 2 images.
Particle table format is tab delimited ascii. ms^{-1}

30

ToC

PIP-3: Velocity Distribution Example
C:\PIP\Rev_1506\SN_PIP001\2015_WFF\PIP_3\f_2_4_VVD_Tables\001201505012350_01_vvd_A.dat

5. Dir

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
1	PIP_Rev																								
2	1506																								
3	Instr_Num																								
4	1																								
5	yr	mo	dy																						
6	2015	5	1																						
7	Station																								
8	WFF																								
9	NaN	NaN	NaN	Vel_avg	0	1.803	2.44	3.068	3.689	4.295	4.814	5.176	5.532	5.891	6.22	6.509	6.704	6.849	7.03	7.12	6.327	6.653	5.588	4.683	4.763
10	NaN	NaN	NaN	Bin_edge	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4
11	NaN	NaN	NaN	dBin	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
12	day_time	hr_d	min_d	Bin_cen	0.1	0.3	0.5	0.7	0.9	1.1	1.3	1.5	1.7	1.9	2.1	2.3	2.5	2.7	2.9	3.1	3.3	3.5	3.7	3.9	4.1
13	0:01	0	1	NaN	0	0	0	3.164	3.738	4.49	4.59	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0:02	0	2	NaN	0	0	0	3.092	3.652	4.382	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0:03	0	3	NaN	0	0	0	3.11	3.622	4.16	4.887	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0:04	0	4	NaN	0	2.48	0	3.076	3.6	4.406	4.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0:05	0	5	NaN	0	0	0	3.042	3.562	4.035	-0.2	0	0	-0.23	0	0	0	0	0	0	0	0	0	0	0
18	0:06	0	6	NaN	0	0	2.56	3.078	3.504	4.454	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0:07	0	7	NaN	0	0	0	2.89	3.538	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0:08	0	8	NaN	0	0	0	2.872	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0:09	0	9	NaN	0	0	0	1.045	0.1633	0.04607	0.01722	0.095	0.02	0	0	0	0	0	0	0	0	0	0	0	0
22	0:10	0	10	NaN	0	0	0	0.04	0.02467	0.2053	0.02036	0.085	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0:11	0	11	NaN	0	0	0	1.486	0.2668	0.04019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0:12	0	12	NaN	0	0	0	1.71	-0.1046	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0:13	0	13	NaN	0	0	0	0	0	0.225	0.2767	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0:14	0	14	NaN	0	0	0	0	0.01667	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0:15	0	15	NaN	0	0	0	0	0	0.04974	0.1156	0.03875	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0:16	0	16	NaN	0	0	0	2.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0:17	0	17	NaN	0	0	0	0	0	0	0	0	0	0	0	-0.175	0	0	0	0	0	0	0	0	0
30	0:18	0	18	NaN	0	0	0	0	0	0	0	0	0	0	0.63	0	0	0	0	0	0	0	0	0	0
31	0:19	0	19	NaN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.13	0.15	0.2075	0.185	0.1833	0
32	0:20	0	20	NaN	0	0	0	3.09	3.575	4.095	0	0	0	0	0	0.38	0.14	0.16	0	0	0	-0.87	0	0	0
33	0:21	0	21	NaN	0	0	0	3.182	3.6	4.347	5.055	5.61	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0:22	0	22	NaN	0	0	0	3.185	3.464	4.194	4.695	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	0:23	0	23	NaN	0	0	0	2.962	3.395	4.202	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0:24	0	24	NaN	0	0	0	2.906	3.75	0	0	0.125	0.06167	0.122	0.08375	0.05	0	0	0.255	0	0	0	0	-0.6225	0
37	0:25	0	25	NaN	0	0	0	2.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0:26	0	26	NaN	0	0	0	3.22	3.965	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0:27	0	27	NaN	0	0	0	3.11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0:28	0	28	NaN	0	0	0	3.213	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Vel Distribution tables contain time stamped fall-speed distributions.
Format is tab delimitated ascii. ms^{-1}

ToC
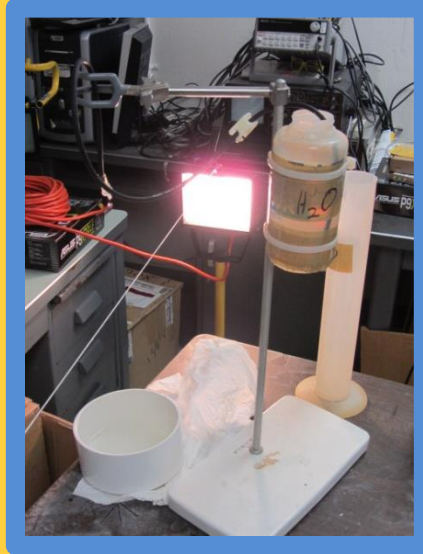
View recent precipitation.
C:\PIP\Current_Weather\Recent_Lar.avi.zip

Enables scrolling thru Daily Summary Figures
C:\PIP\Rev_1506\SN_PIP001\2015_WFF\Study\f_10_Summary\Plots\4eDen_Final
00120150217_4eDen_Final.png

ToC
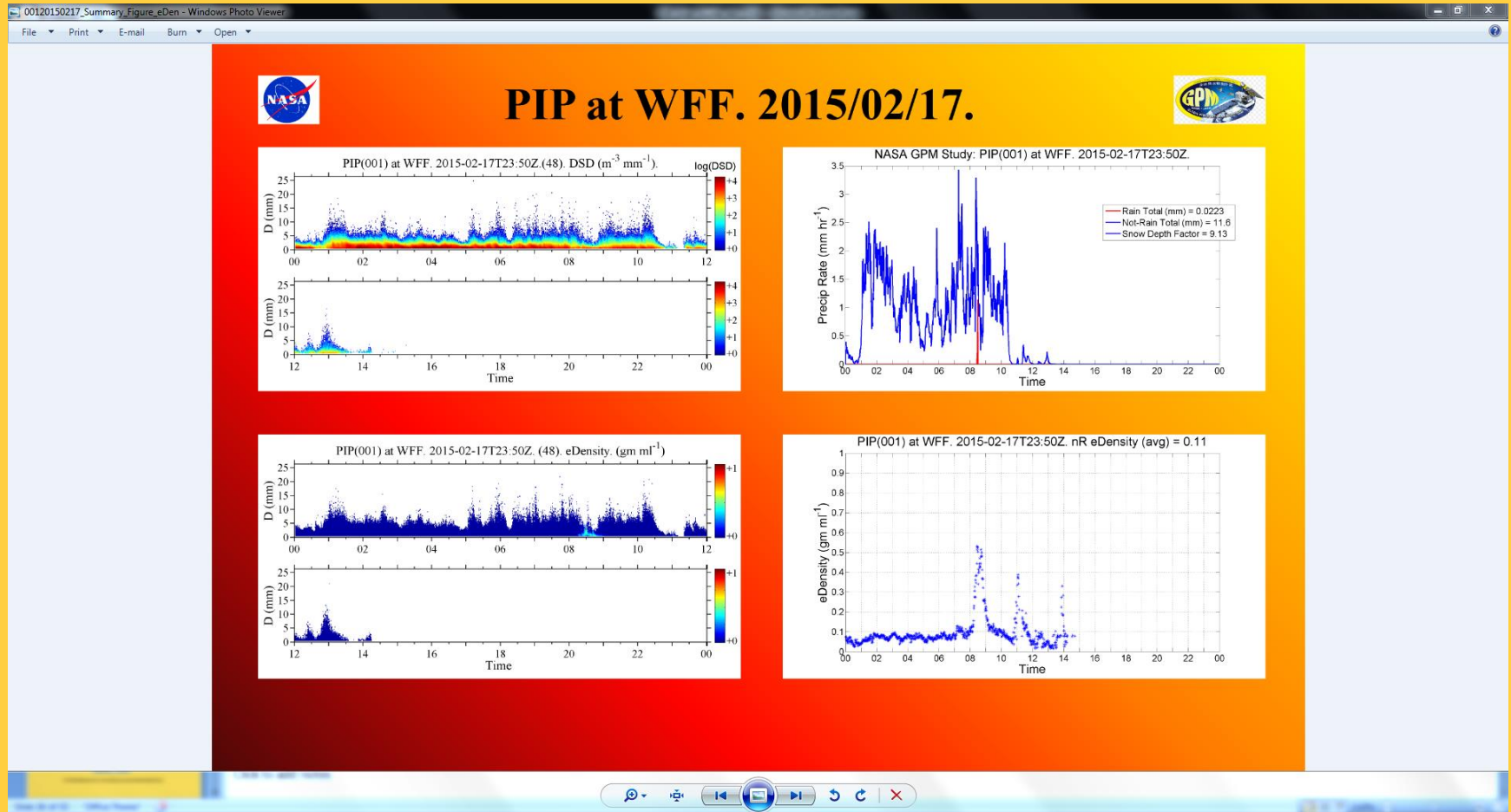
Goto Current Weather Figures
C:\PIP\Current_Weather\PIP_4Fig.png
This example shows transition from rain to snow.

ToC
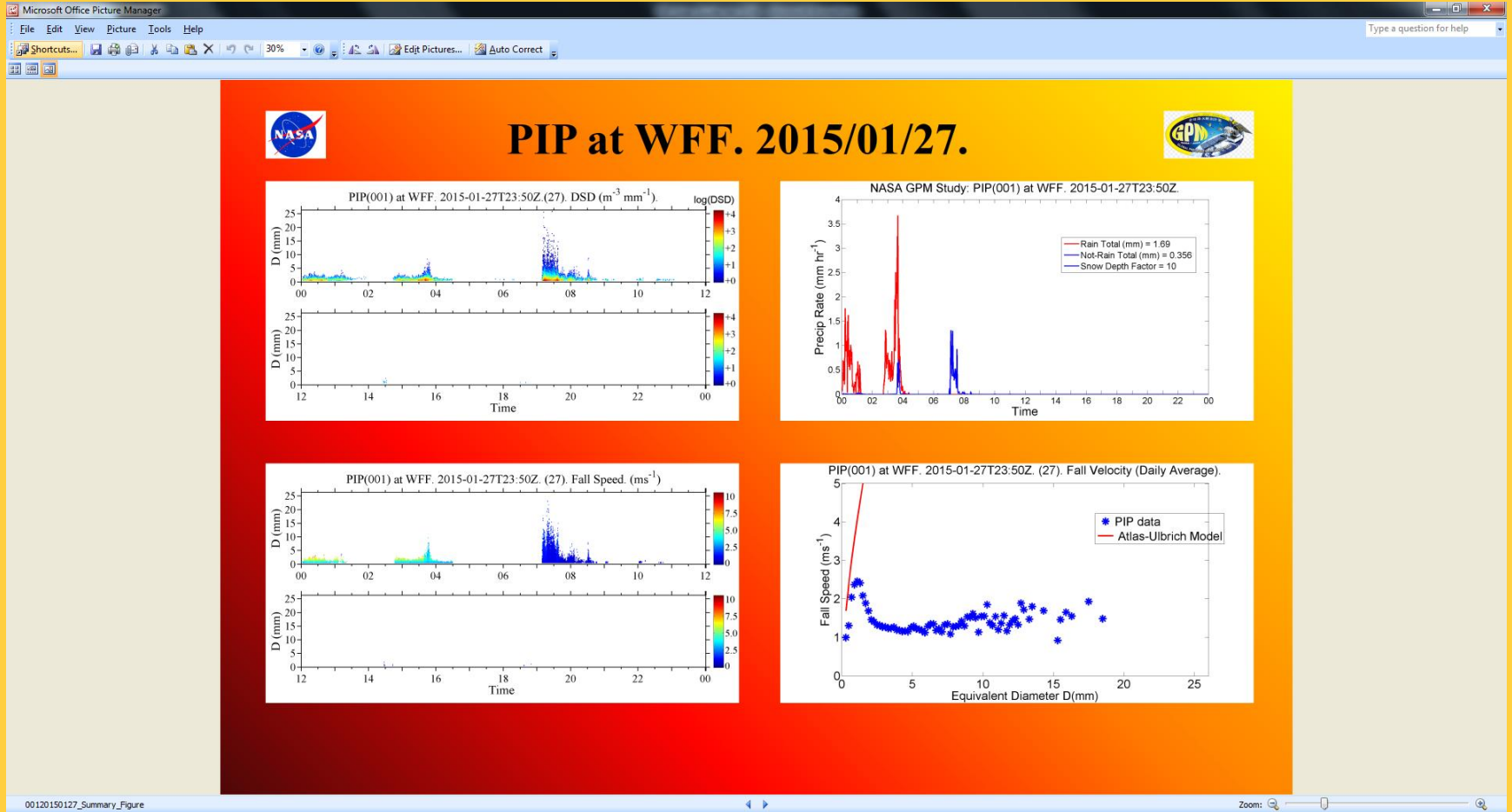
Enables scrolling thru PSD-Vel Figures
C:\PIP\Rev_1506\SN_PIP001\2015_WFF\PIP_3\f_10_Summary\Plots\DSD_VEL_4
00120151207_Summary_4_DSD_VEL.png
This example shows transition from rain to snow.
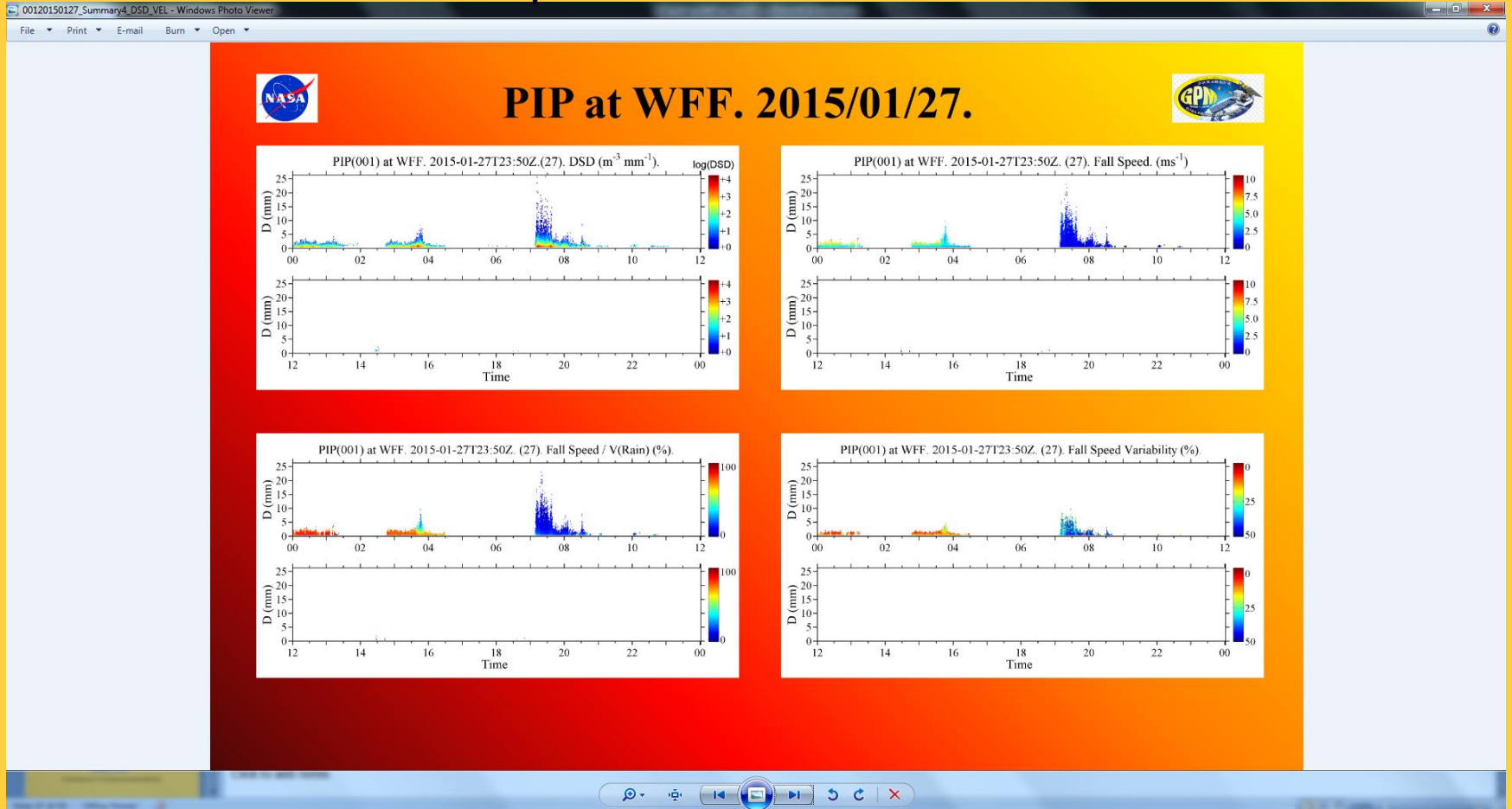
ToC

Enables scrolling thru 10-minute Velocity Figures
C:\PIP\Rev_1506\SN_PIP001\2015_WFF\PIP_3\f_2_8_Velocity_Ebar
This example shows transition from rain to snow.

ToC

Windows Apps

11. Task Mngr	11. **Manage running apps. View system performance.** **11_Task_Mngr.bat**
12. Scheduler	12. **Enable\disable PIP apps at bootup.** **12_Task_Schlr.bat**

ToC

○ **Task Manager**
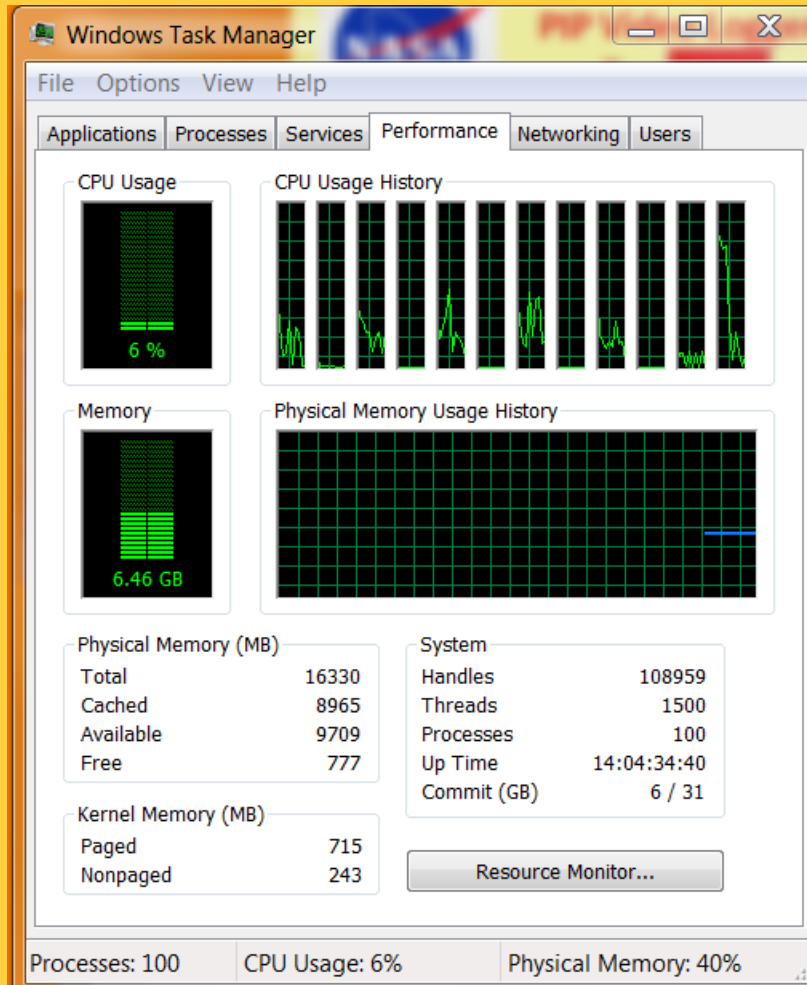
CPU Usage
Should Normally Be
<75%,
It may bounce off of
100% briefly.

If it is persistently
 greater than
85%,
Kill some app,
Such as PIP_2a.

ToC

Setup PIP to run automatically at boot.
(Also recovers from power failures.)
Run the Windows Task Scheduler program.
Change Status of PIP_123 to Enabled.
>> exit program. Re-boot. PIP should come up running the PIP Apps.

PIP directory.
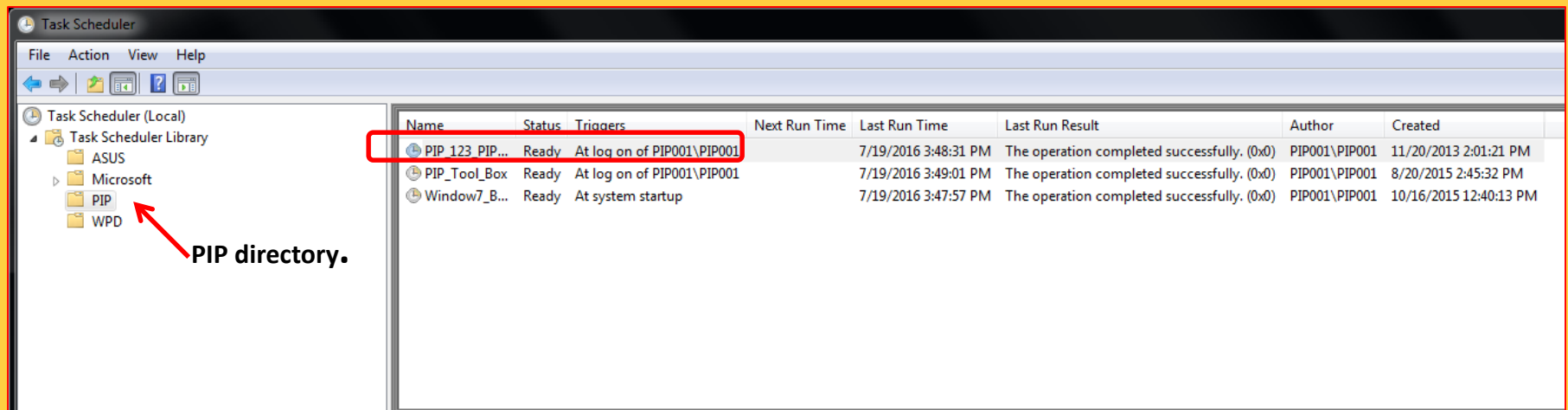
❖ Run\Kill PIP Apps Cluster (13-15)
Button pads that turn PIP apps on\off.
Used extensively during app development. Also useful when an app or PC has issues.
For example, if PC is running hot (>60 degrees C) due to cpu overload, kill PIP_2a and Restart it during fair weather.

PIP Tool Box

1. User Manual	2. Hardware
3. Setup File	4. Log File
5. Dir	6. Movie Now
7. Figures All	8. Figures Now
9. PSD Vel	10. Vel
11. Task Mngr	12. Scheduler
13. Run PIP	14. Kill PIP
15. Re-Start PIP	16. PC Health
17. Fig\Tables Web	18. Movie Web
Button_19.bat	Button_20.bat

Mouse Roll Over = Tip
Right Click = Description

Re-Start PIP Apps

1. PIP_1 (Camera)

2. PIP_2 (Particle Talbes)

3. PIP_2a (AVI Movies)

4. PIP_3 (Products)

5. Run All

EXIT

13. Run PIP	**13. When PIP apps are *not* running, click button #13 to selectively start PIP apps.** Start PIP apps
14. Kill PIP	**14. When PIP apps are running, click button #14 to selectively kill PIP apps.** Kill PIP apps
15. Re-Start PIP	**15. Whenever, click button #15 to selectively re-start PIP apps.** Re-Start PIP apps

16. Check PC conditions, especially temperature.

   16_PC_Health.bat

PIP Tool Box

1. User Manual	2. Hardware
3. Setup File	4. Log File
5. Dir	6. Movie Now
7. Figures All	8. Figures Now
9. PSD Vel	10. Vel
11. Task Mngr	12. Scheduler
13. Run PIP	14. Kill PIP
15. Re-Start PIP	16. PC Health
17. Fig\Tables Web	18. Movie Web
Button_19.bat	Button_20.bat

Mouse Roll Over = Tip
Right Click = Description

Sensor

⚡ Vcore	1.028 V
⚡ +12V	12.288 V
⚡ +5V	5.000 V
⚡ +3.3V	3.328 V
🌡 CPU	43.0 °C
🌡 MotherBoard	49.0 °C
🌡 VCORE	48.0 °C
🌡 VCCSA	45.0 °C
🌡 VTTCPU	42.0 °C
🌡 PCH	42.0 °C
🌡 DRAM-AB	47.0 °C
🌡 DRAM-CD	41.0 °C

◄ Monitor ►

**< 60 degrees C ok.
Otherwise, kill PIP_2a (avi) and
Restart it in fair weather.**

**Note that PIP apps are started
From bat files that set
Their priority – in order
To Avoid overheating.**

❖ Web Ready PIP Products Cluster (17-18)
Pointers to directories with summary material for website distribution.
These directories can be mirrored to other computers.

PIP Tool Box

1. User Manual	2. Hardware
3. Setup File	4. Log File
5. Dir	6. Movie Now
7. Figures All	8. Figures Now
9. PSD Vel	10. Vel
11. Task Mngr	12. Scheduler
13. Run PIP	14. Kill PIP
15. Re-Start PIP	16. PC Health
17. Fig\Tables Web	18. Movie Web
Button_19.bat	Button_20.bat

Mouse Roll Over = Tip
Right Click = Description

17. Fig\Tables Web	**17. Summary Tables and Figures for Web Distribution** **17_Fig\Tables Web**
18. Movie Web	**18. Summary movies for Web Distribution** **18. Movie Web**

Summary tables for web distribution.
Results are updated as new material becomes available.
Tables Folder includes PSD, Fall Velocity and eDensity distributions (by minute),
As well as
Hourly and by minute precipitation accumulation files.

ToC

Summary figures for web distribution.

Results are updated as new material becomes available.

Figures Folders include PSD-Vel Summary Figures and Daily Summary Figures.
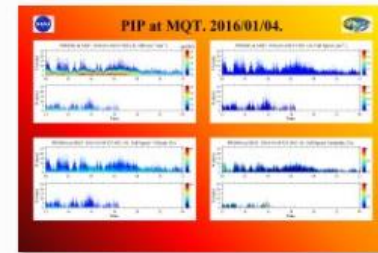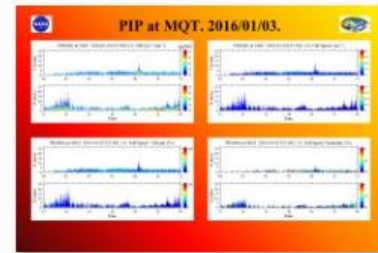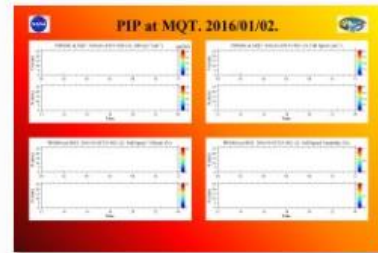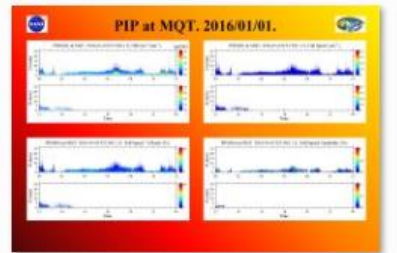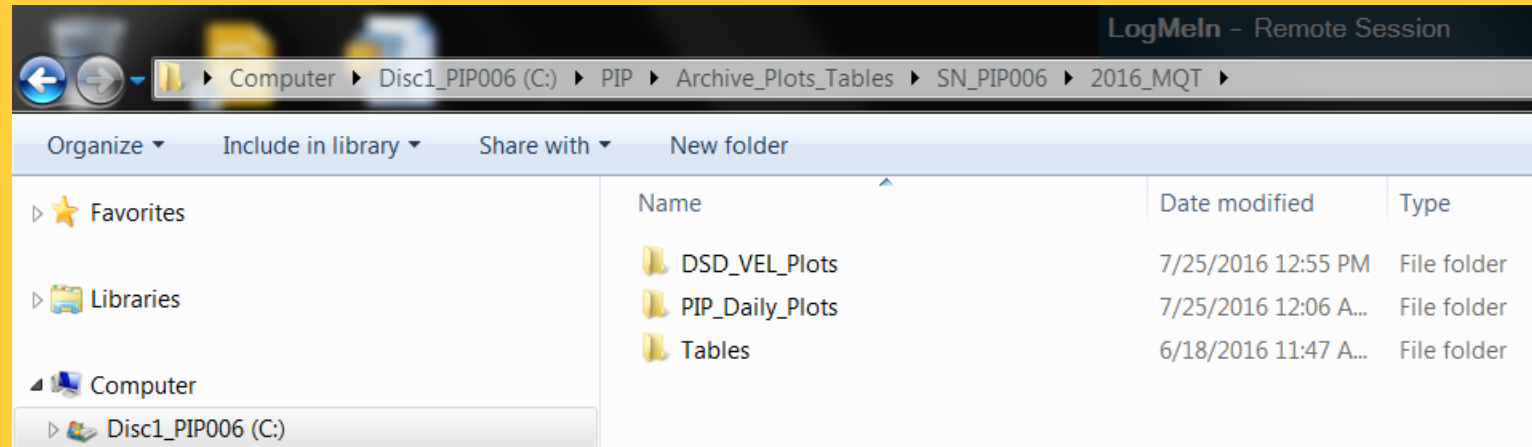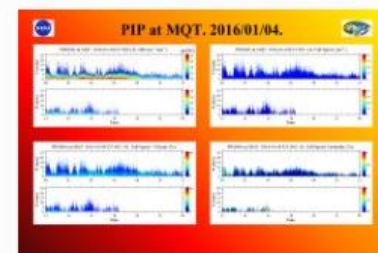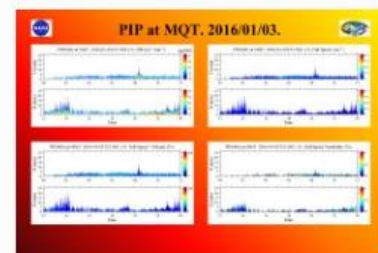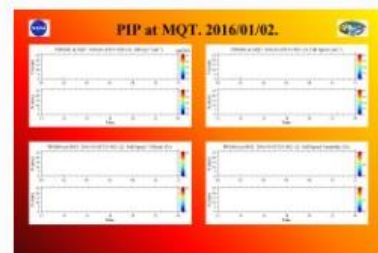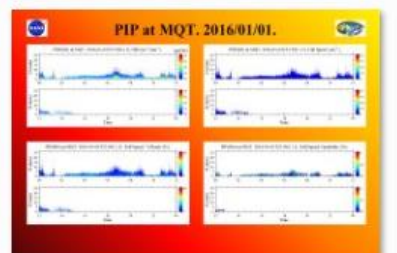
These Folders contain summary movies for web distribution.
Results are updated as new material becomes available.
Archive_Movies Folders include the largest avi from each 10 minute interval.
The movie folder is separated from the Tables\Fig folder because avi's are much larger,
So they may\may not be in an automated download sequence.

PIP Tool Box

1. User Manual	2. Hardware
3. Setup File	4. Log File
5. Dir	6. Movie Now
7. Figures All	8. Figures Now
9. PSD Vel	10. Vel
11. Task Mngr	12. Scheduler
13. Run PIP	14. Kill PIP
15. Re-Start PIP	16. PC Health
17. Fig\Tables Web	18. Movie Web
Button_19.bat	Button_20.bat

Mouse Roll Over = Tip
Right Click = Description

Button_19.bat	19. User Defined button (could be to PIP products website) **19_button.bat**
Button_20.bat	20. User Defined button (could be to PIP Tool Box cheat sheet) **20_button.bat**

Link to an app of your choice.
Default: This button links to: C:\PIP\Software\Setup\Tools_16\button_19.bat
The bat file at NWS-MQT brings up the website that posts MRR and PIP daily results – using command
start /B chrome.exe http://www.ssec.wisc.edu/lake_effect/mqt/?action=view_data

ToC

Button_20.bat

Link to an app of your choice.
Default: This button links to: C:\PIP\Software\Setup\Tools_16\button_20.bat
Which points at the PIP_Tool_Box_Guide
start /B C:\PIP\Software\Setup\Tools_16\PIP_Tools_Description.png

PIP Tool Box

Button	Tip	Description
1. User Manual	How operate a PIP	1. Quick setup guide. 2. Operations Details 3. Example Data Products
2. Hardware	Lamp & Camera Details	Run National Instruments NI IMAQ app, which (a) enables physical alignment of camera to lamp, (b) adjustment of light intensity gain, and (c) setting of other camera options. Useful for PIP installation and then for periodically checking light bulb.
3. Setup File	Software Control File for all PIP Apps	Control all PIP Apps from a single setup file. ASCII text file. Descriptor, tab, the instruction. *Must* have tab!
4. Log File	Listing of PIP_3 operations.	Daily file shows PIP_3 progress by records containing time stamps and processing instructions. Useful for documentation and assessing system performance. Daily files are zipped to the Zip directory.
5. Dir	Directory of PIP Products	Windows Explorer to the root for data products from PIP-1, PIP-2 and PIP3.
6. Movie Now	Recent Precipitation AVI	(1) To see what recent precipitation looks like, goto the most recent precipitation AVI , which is C:\PIP\Current_Weather\Recent_Lar.avi.zip. (2) Note that largest AVI for each 10 minute interval is located in root_1\PIP_3\f_10_Summary\Movies, where Analysis Root Directory_1 is defined in the Setup File. (3) AVIs for each minute of precipitation are in root2\PIP_2\q_Viewer, where Analysis Root Directory_2 is defined in the Setup File.
7. Figures All	Daily Summary Figures	DSD, Vel, eDen, P Summary Plot for each days. This 4-Figure presentation displays the basic input and output, i.e. DSD & Vel distributions, as well as the volume average density by minute and the rain & not-rain precipitation rates by minute. Additionally, Rain and not-Rain accumulations are presented.
8. Figures Now	Today's Summary Plot	Current Conditions: DSD, Vel, eDen, P Summary Plot. This 4-Figure presentation displays the basic input and output, i.e. DSD & Vel distributions, as well as the volume average density by minute and the rain & not-rain precipitation rates by minute.. Additionally, Rain and not-Rain accumulations are presented.
9. PSD Vel	Daily PSD & Velocity Summary	Time history of PSD, Fall Velocity, Relative Fall Velocity and Fall Speed Variability. Visual display of storm characteristics.
10. Vel	Today's 10 Minute Fall Velocity Plots	Fall Speed by Size for each 10 minute increment. Visualization of storm evolution by particle size. Rain and not-rain fall speed changes are useful for seeing frontal passage and other features. See (a) root_1\PIP_3\f_2_3_1_Velocity_Ebar and (b) root_1\PIP_3\f_2_3_0_Velocity_Plots_seg for mean & error bar, as well as individual particle fall speeds. For daily archiving, these are zipped to the Zip Directory.

PIP Tool Box

Button	Tip	Description
11. Task Mngr	What's running?	Windows Task Manger shows which Apps are running.
12. Scheduler	Schedule Startup Apps	Run Windows Scheduler and Goto PIP subdirectory. Turn on PIP startup apps (Tool_Bar and PIP_123). Note that Tool _Bar is always useful, however for setup, PIP_123 should not be running. Use button 14. Kill PIP as necessary.
13. Run PIP	*Run* PIP App	Run PIP_1, PIP_2, PIP_2a, and PIP_3 apps as desired.
14. Kill PIP	*Kill* PIP Apps	Kill PIP_1, PIP_2, PIP_2a, and PIP_3 apps as desired.
15. Re-Start PIP	*Re-Start* PIP Apps	Re-Start PIP_1, PIP_2, PIP_2a, and PIP_3 apps as desired.
16. PC Health	Monitor PC Temperature	Check Temps to ensure cool operations, i.e. don't want to see temperatures in the 60's degree C.
17. Fig\Tables Web	Figures and Tables for Web	Daily tables and figures in one place enables backup and web distribution.
18. Movie Web	Movies for Web	Daily AVI's enables backup and web distribution.
Button_19.bat	Link to an app of your choice	This button links to: C:\PIP\Software\Setup\Tools_16\button_19.bat At NWS-MQT, links to URL for MRR-PIP daily figures.
Button_20.bat	Link to an app of your choice	This button links to: C:\PIP\Software\Setup\Tools_16\button_20.bat At NWS-MQT, links to this file.

PIP Tool Box

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Mouse Roll Over = Tip
Right Click = Description

Section 4: Tips (Tips)

1) PIP_setup.txt controls all PIP apps. Use Tool Box button #3, edit as needed.
2) **Camera exposure settings (advanced).**

Camera exposure settings (advanced).
Confirm that your settings are as shown.
These are need for exposure time and frame rate!
After adjustments, GoTo.

End of PIP User Manual