

# MATLAB EXPO 2018

What's New in MATLAB  
R2018a and R2018b

Ned Gulley





matlab release notes

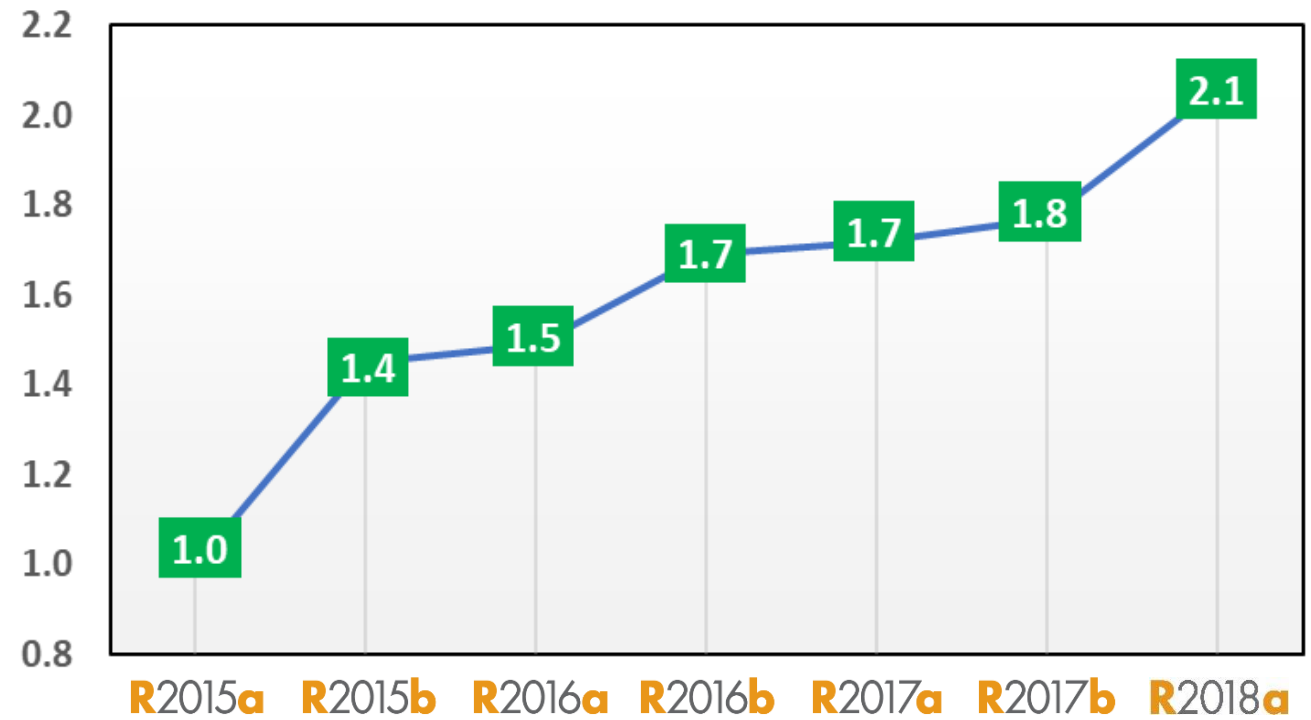


Google Search

I'm Feeling Lucky

# Speed

Average Speedup in Customer Workflows



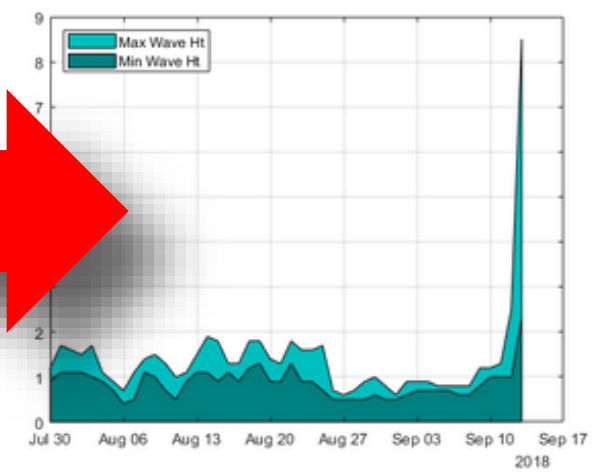
#YY	MM	DD	hh	mm	WDIR	WSPD	GST	WVHT	DPD	APD	MWD	PRES	ATMP	WTMP	DEWP	VIS	PTDY	TIDE
#yr	mo	dy	hr	mn	degT	m/s	m/s	m	sec	sec	degT	hPa	degC	degC	degC	nmi	hPa	ft
2018	09	18	16	00	MM	MM	MM	1.5	5	4.6	205	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	15	30	MM	MM	MM	1.5	5	4.5	202	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	15	00	MM	MM	MM	1.6	5	4.6	199	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	14	30	MM	MM	MM	1.6	5	4.6	202	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	14	00	MM	MM	MM	1.5	5	4.7	198	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	13	30	MM	MM	MM	1.5	5	4.8	199	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	13	00	MM	MM	MM	1.5	6	4.8	141	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	12	30	MM	MM	MM	1.5	13	4.9	104	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	12	00	MM	MM	MM	1.5	5	4.9	165	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	11	30	MM	MM	MM	1.5	7	5.0	113	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	11	00	MM	MM	MM	1.6	6	5.0	141	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	10	30	MM	MM	MM	1.5	12	5.0	102	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	10	00	MM	MM	MM	1.6	8	5.1	116	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	09	30	MM	MM	MM	1.5	8	5.1	116	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	09	00	MM	MM	MM	1.6	10	5.2	119	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	08	30	MM	MM	MM	1.6	10	5.3	116	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	08	00	MM	MM	MM	1.5	8	5.2	113	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	07	30	MM	MM	MM	1.5	13	5.3	112	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	07	00	MM	MM	MM	1.5	10	5.3	113	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	06	30	MM	MM	MM	1.6	11	5.2	116	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	06	00	MM	MM	MM	1.6	12	5.3	111	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	05	30	MM	MM	MM	1.5	11	5.2	112	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	05	00	MM	MM	MM	1.5	8	5.2	119	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	04	30	MM	MM	MM	1.5	9	5.2	123	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	04	00	MM	MM	MM	1.6	11	5.2	125	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	03	30	MM	MM	MM	1.5	11	5.2	125	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	03	00	MM	MM	MM	1.6	11	5.3	118	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	02	30	MM	MM	MM	1.6	11	5.1	116	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	02	00	MM	MM	MM	1.6	12	5.1	106	MM	MM	27.9	MM	MM	MM	MM

```

ttMax = retime(buoyTt,'daily','max');
ttMin = retime(buoyTt,'daily','min');

area(ttMax.t, ttMax.WaveHt, ...
     'FaceColor',[0 0.75 0.75],'DisplayName','Max Wave Ht')
hold on
area(ttMin.t,ttMin.WaveHt, ...
     'FaceColor',[0 0.5 0.5],'DisplayName','Min Wave Ht')
hold off
ylabel('Wave Height (m)')
grid on
legend('Location','NorthWest')

```



Speed from

# Data to Insight to Results

# Features

- Live Editor
  - Table Sorting
  - Table Filtering
  - Live Controls
  - Code Generation
- Data Import Tool
- Tables, TimeTables
- Geo plots
- Stacked plots
- Data Preprocessing
- Data Analysis
- Strings
- Error messages
- Code compatibility
- Hardware integration
- Deep learning
- Web Apps
- Live Functions
  - Debugging
  - User Documentation

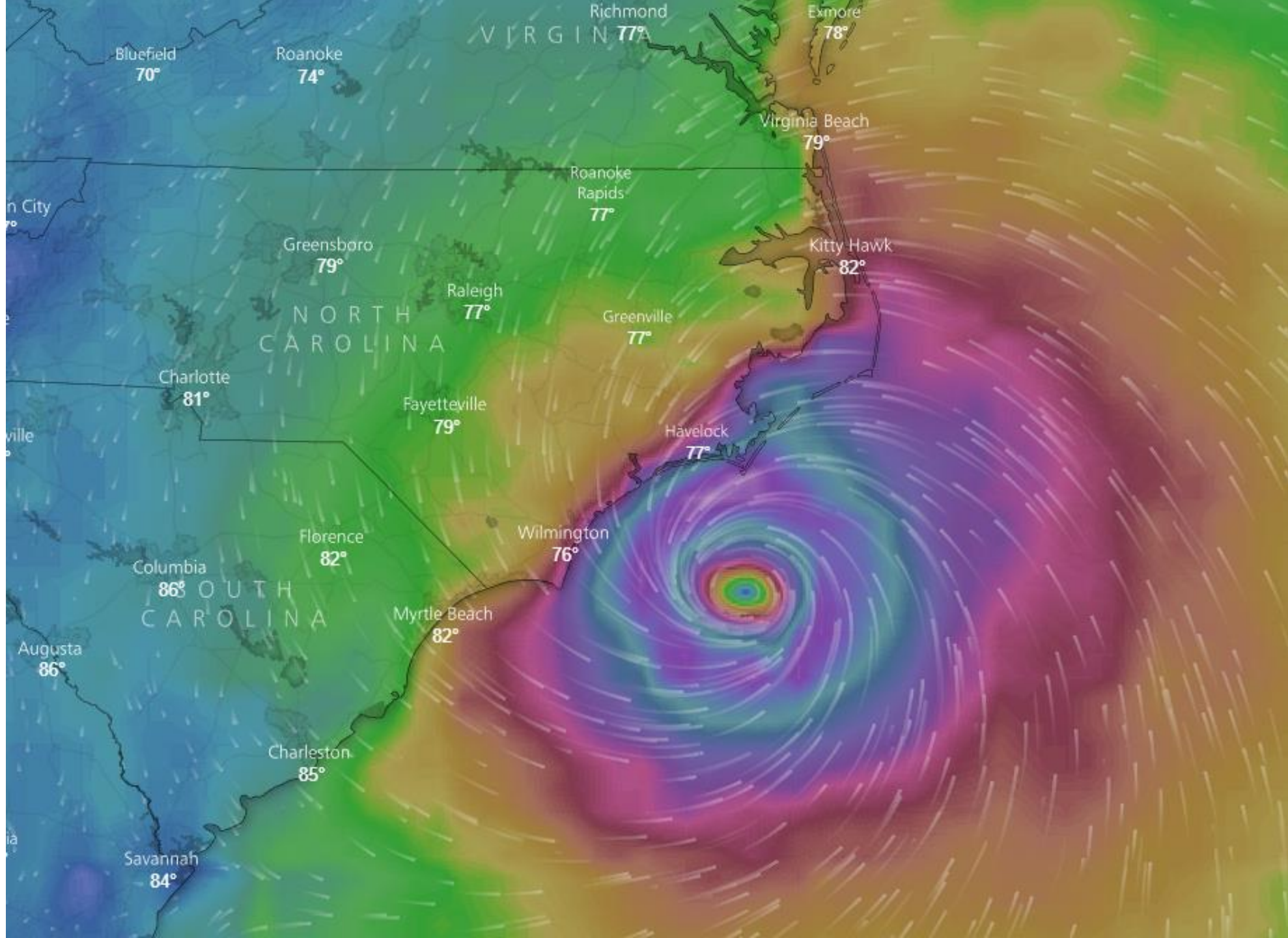
# Two Stories

I. Storm 6

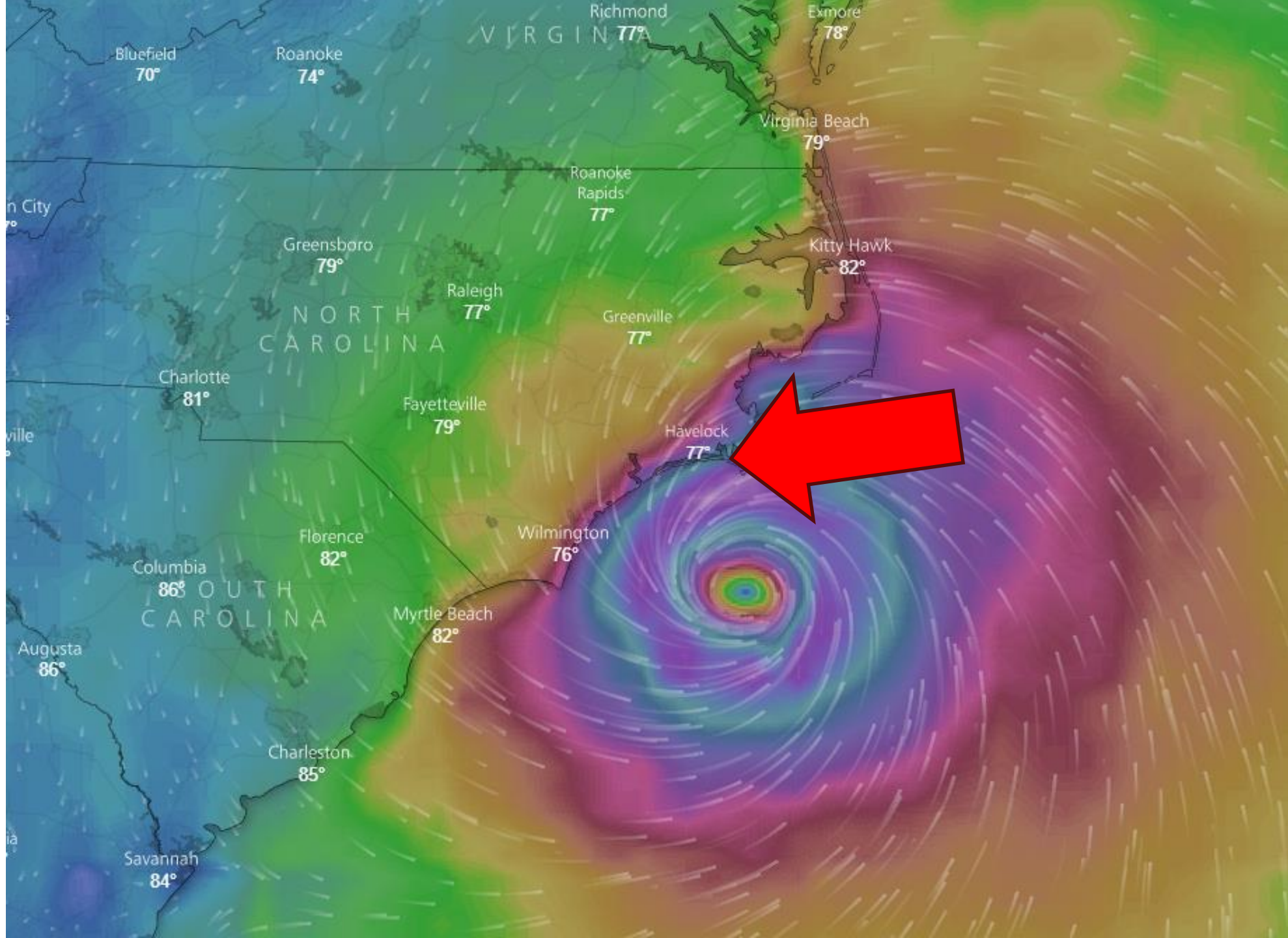
II. The Mysterious Pendulum

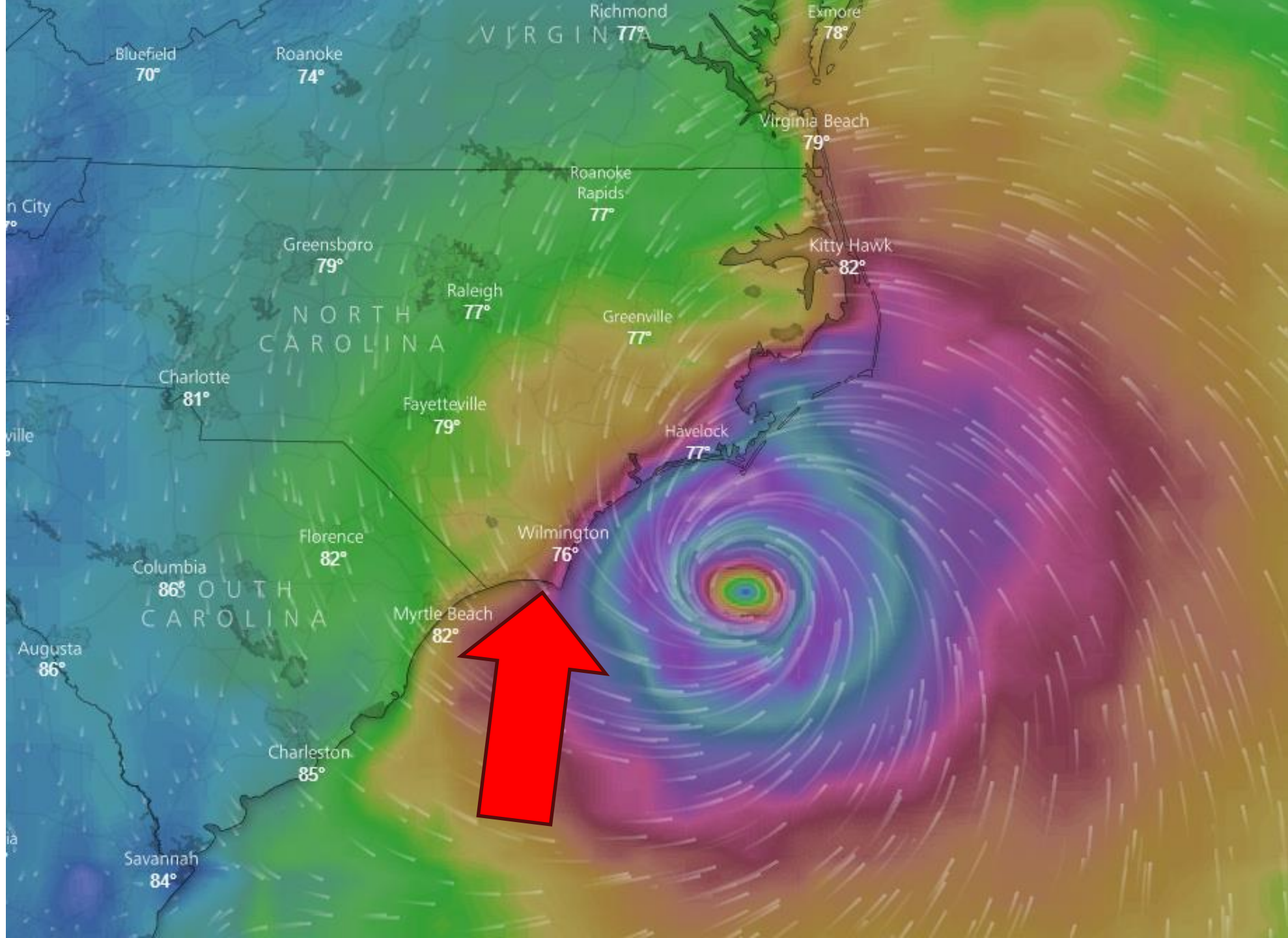
Act I:

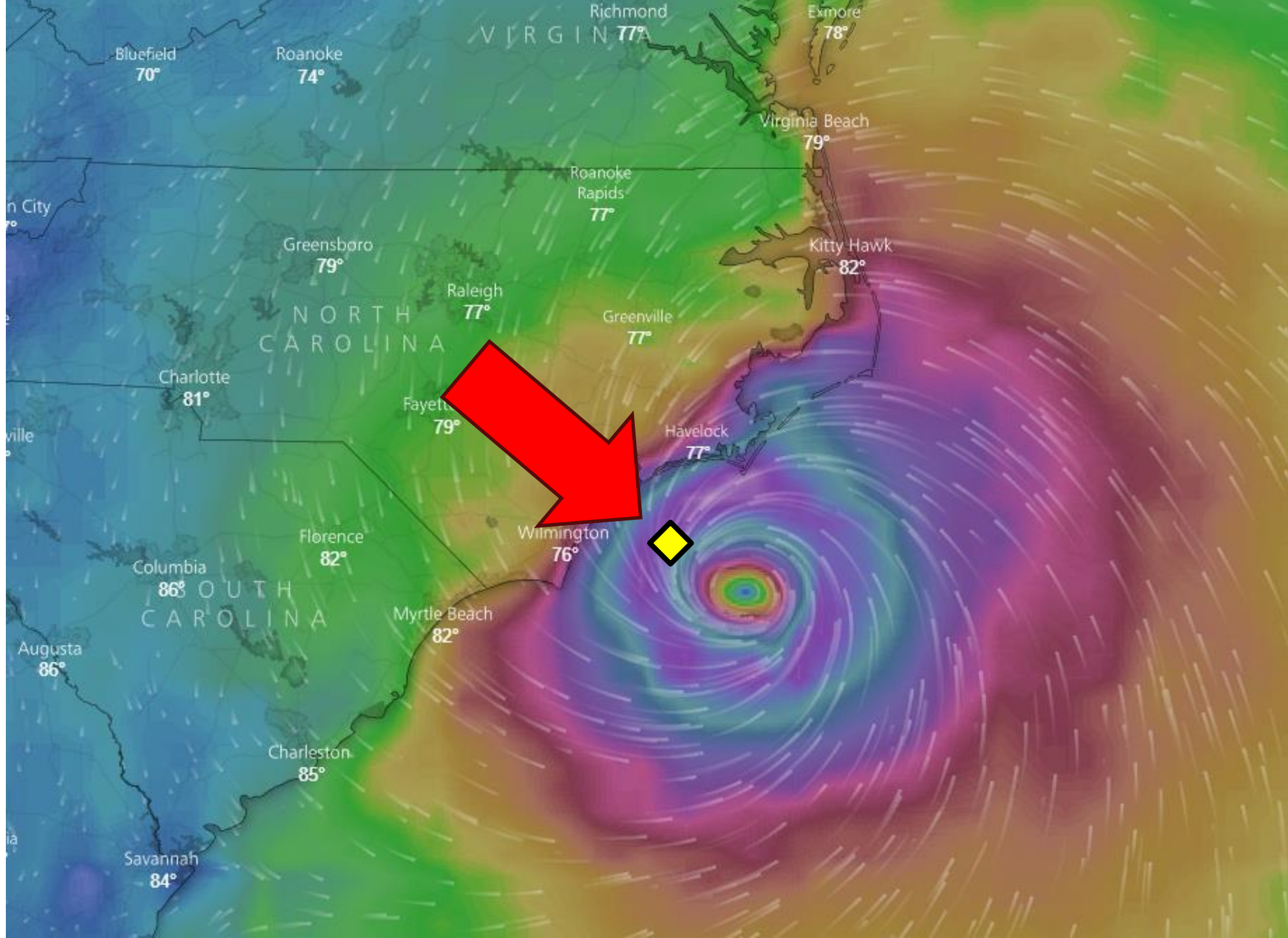
Storm 6

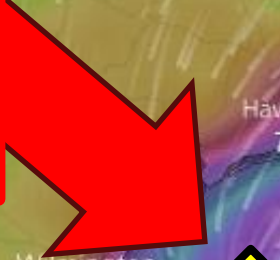
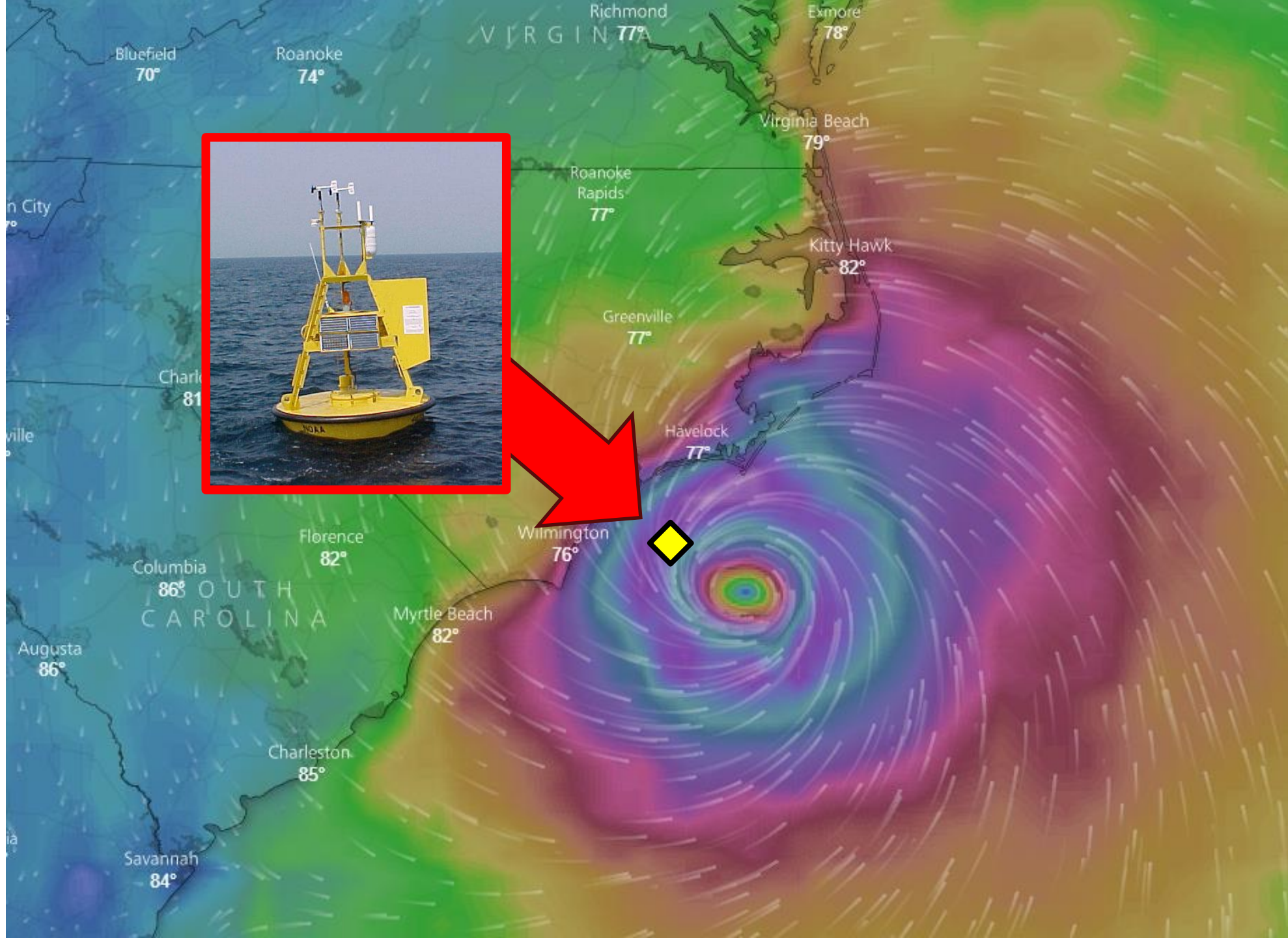


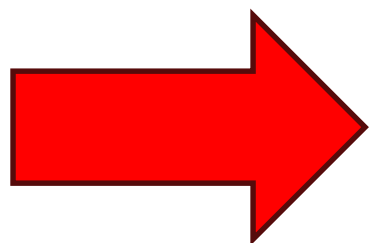













 National Oceanic and Atmospheric Administration's  
**National Data Buoy Center**  
Center of Excellence in Marine Technology

[Home](#) [About Us](#) [Contact Us](#)

**Station ID Search**  
   
**Station List**

**Data Access**  
[Mobile Access](#)  
[Classic Maps](#)  
[Recent DART®](#)  
[Obs Search](#)  
[Ship Obs Report](#)  
[BuoyCAMS](#)  
[TAO](#)  
[DODS](#)  
[OceanSITES](#)  
[HF Radar](#)  
[OSMC](#)

**Storm Special!** View the latest observations near [Atlantic Tropical Depression Joyce](#).

The NDBC website is now available only via HTTPS. Please update your bookmarks and/or links to


Recent Data  Historical Data  Show Labels Map Type:

**Program Filter:**

- NDBC Meteorological/Ocean
- International Partners
- IOOS Partners

**Owner Filter:**

- NDBC
- Alaska Ocean Obse
- Amerada Hess



DART®

- Obs Search
- Ship Obs Report
- BuoyCAMs
- TAO
- DODS
- OceanSITES
- HF Radar
- OSMC
- Dial-A-Buoy
- RSS Feeds 
- Web Widget
- Email Access
- Web Data Guide
- Maintenance Schedule
- Station Status Report

Program Info

- TAO
- DART®
- IOOS®

Publications

- NDBC PEA
- NDBC FONSI
- NDBC DQC Handbook

FAQ

Visitor Information

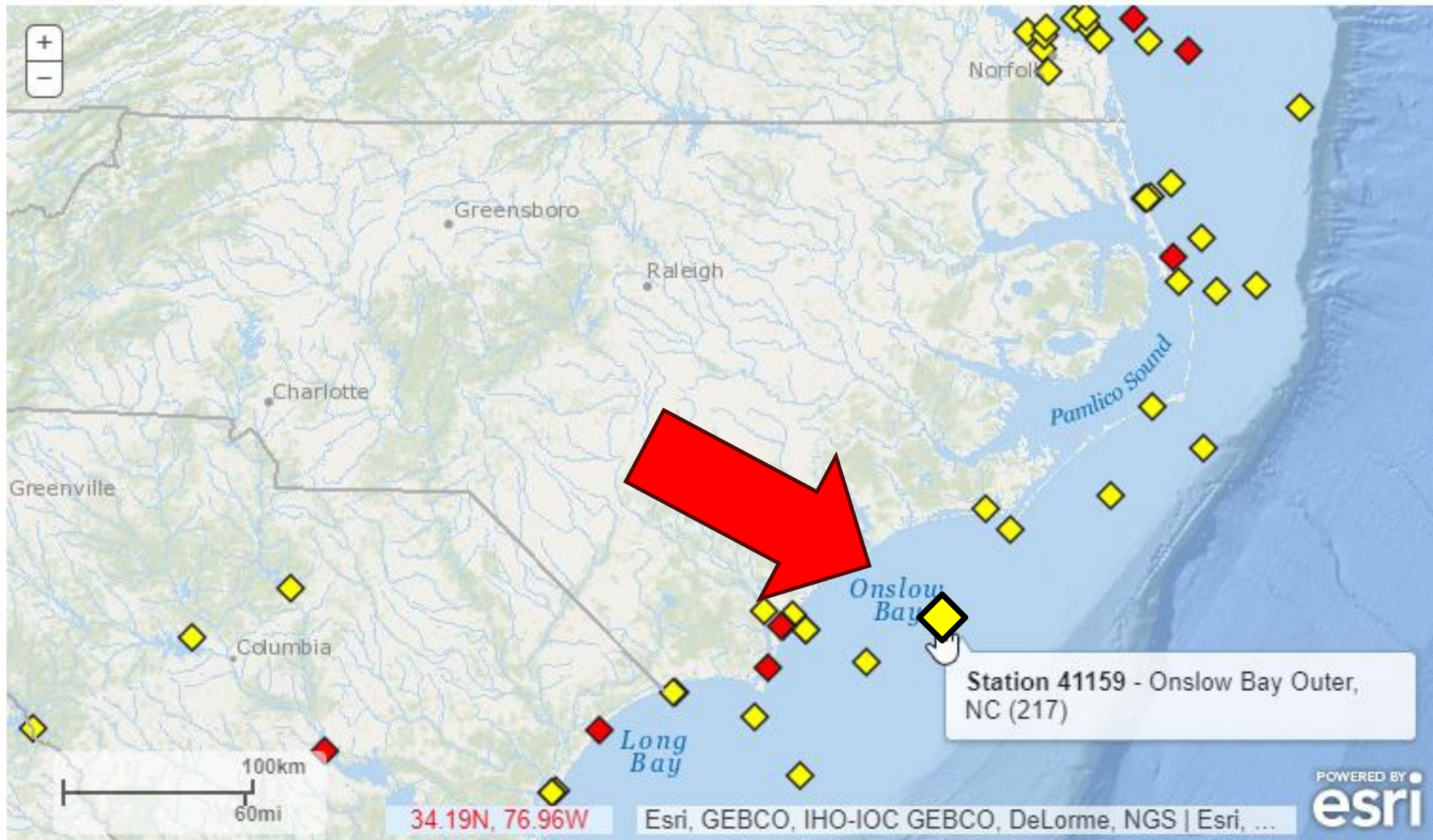


Program Filter:

- NDBC Meteorological/Ocean
- International Partners
- IOOS Partners

Owner Filter:

- NDBC
- Alaska Ocean Observing System
- Amerada Hess



[DART®](#)  
[Obs Search](#)  
[Ship Obs Report](#)  
[BuoyCAMs](#)  
[TAO](#)  
[DODS](#)  
[OceanSITES](#)  
[HF Radar](#)  
[OSMC](#)  
[Dial-A-Buoy](#)  
[RSS Feeds !\[\]\(08a82c22d89d6b027ff69762ad096586\_img.jpg\)](#)  
[Web Widget](#)  
[Email Access](#)  
[Web Data Guide](#)  
[Maintenance Schedule](#)  
[Station Status Report](#)

**Program Info**  
[TAO](#)  
[DART®](#)  
[IOOS®](#)

**Publications**  
[NDBC PEA](#)  
[NDBC FONSI](#)  
[NDBC DQC Handbook](#)

[FAQ](#)  
[Visitor Information](#)

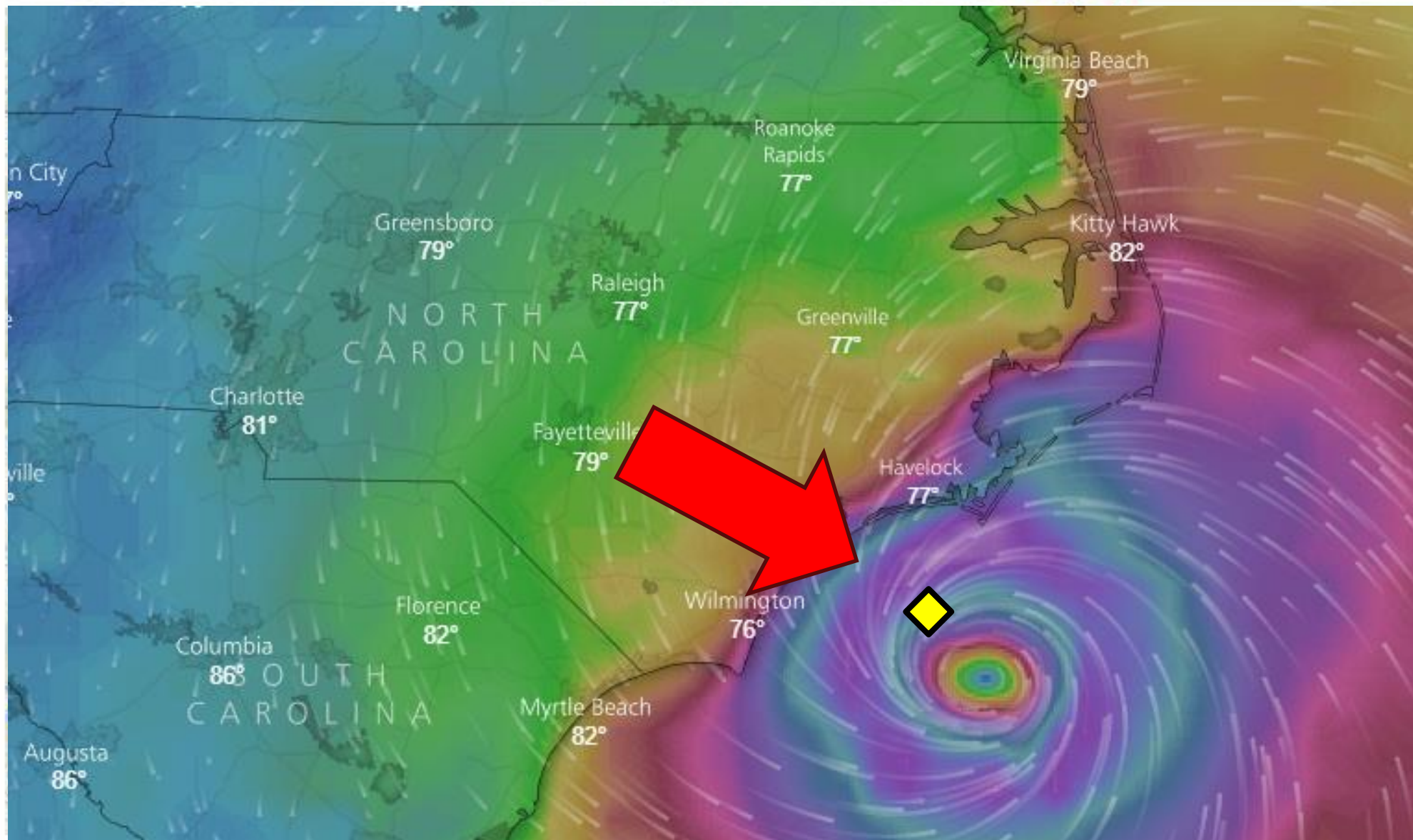


Program Filter:

- NDBC Meteorological/Ocean
- International Partners
- IOOS Partners

Owner Filter:

- NDBC
- Alaska Ocean Observing System
- Amerada Hess





## Station 41159 - Onslow Bay Outer, NC (217)

Owned and maintained by [Coastal Ocean Research and Monitoring Program \(CORMP\)](#)

Data provided by [Scripps Institution of Oceanography](#)

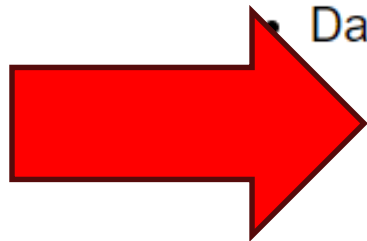
34.213 N 76.946 W (34°12'46" N 76°56'47" W)

Links for real time data for station 41159 are listed below:

(Times are in GMT, Wind Speed is in m/s, and Wave Height is in meters)

• Data for last 45 days:

- [Real time standard meteorological data](#) and their [description](#).
- [Real time spectral wave data](#) and their [description](#).
- [Real time raw spectral wave data](#) and their [description](#).
- [Real time raw spectral wave \(alpha1\) data](#) and their [description](#).
- [Real time raw spectral wave \(alpha2\) data](#) and their [description](#).
- [Real time raw spectral wave \(r1\) data](#) and their [description](#).
- [Real time raw spectral wave \(r2\) data](#) and their [description](#).





#YY	MM	DD	hh	mm	WDIR	WSPD	GST	WVHT	DPD	APD	MWD	PRES	ATMP	WTMP	DEWP	VIS	PTDY	TIDE
#yr	mo	dy	hr	mn	degT	m/s	m/s	m	sec	sec	degT	hPa	degC	degC	degC	nmi	hPa	ft
2018	09	18	16	00	MM	MM	MM	1.5	5	4.6	205	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	15	30	MM	MM	MM	1.5	5	4.5	202	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	15	00	MM	MM	MM	1.6	5	4.6	199	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	14	30	MM	MM	MM	1.6	5	4.6	202	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	14	00	MM	MM	MM	1.5	5	4.7	198	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	13	30	MM	MM	MM	1.5	5	4.8	199	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	13	00	MM	MM	MM	1.5	6	4.8	141	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	12	30	MM	MM	MM	1.5	13	4.9	104	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	12	00	MM	MM	MM	1.5	5	4.9	165	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	11	30	MM	MM	MM	1.5	7	5.0	113	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	11	00	MM	MM	MM	1.6	6	5.0	141	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	10	30	MM	MM	MM	1.5	12	5.0	102	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	10	00	MM	MM	MM	1.6	8	5.1	116	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	09	30	MM	MM	MM	1.5	8	5.1	116	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	09	00	MM	MM	MM	1.6	10	5.2	119	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	08	30	MM	MM	MM	1.6	10	5.3	116	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	08	00	MM	MM	MM	1.5	8	5.2	113	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	07	30	MM	MM	MM	1.5	13	5.3	112	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	07	00	MM	MM	MM	1.5	10	5.3	113	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	06	30	MM	MM	MM	1.6	11	5.2	116	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	06	00	MM	MM	MM	1.6	12	5.3	111	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	05	30	MM	MM	MM	1.5	11	5.2	112	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	05	00	MM	MM	MM	1.5	8	5.2	119	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	04	30	MM	MM	MM	1.5	9	5.2	123	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	04	00	MM	MM	MM	1.6	11	5.2	125	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	03	30	MM	MM	MM	1.5	11	5.2	125	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	03	00	MM	MM	MM	1.6	11	5.3	118	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	02	30	MM	MM	MM	1.6	11	5.1	116	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	02	00	MM	MM	MM	1.6	12	5.1	106	MM	MM	27.9	MM	MM	MM	MM

#YY	MM	DD	hh	mm	WD
#yr	mo	dy	hr	mn	de
2018	09	18	16	00	M
2018	09	18	15	30	M
2018	09	18	15	00	M
2018	09	18	14	30	M
2018	09	18	14	00	M
2018	09	18	13	30	M
2018	09	18	13	00	M
2018	09	18	12	30	M
2018	09	18	12	00	M
2018	09	18	11	30	M
2018	09	18	11	00	M
2018	09	18	10	30	M
2018	09	18	10	00	M
2018	09	18	09	30	M
2018	09	18	09	00	M
2018	09	18	08	30	M
2018	09	18	08	00	M
2018	09	18	07	30	M
2018	09	18	07	00	M
2018	09	18	06	30	M
2018	09	18	06	00	M
2018	09	18	05	30	M
2018	09	18	05	00	M
2018	09	18	04	30	M
2018	09	18	04	00	M
2018	09	18	03	30	M
2018	09	18	03	00	M
2018	09	18	02	30	M
2018	09	18	02	00	M



KEEP  
CALM  
AND  
WRITE  
CODE

DWP	VIS	PTDY	TIDE
gC	nmi	hPa	ft
MM	MM	MM	MM
MM	MM	MM	MM
MM	MM	MM	MM
MM	MM	MM	MM
MM	MM	MM	MM
MM	MM	MM	MM
MM	MM	MM	MM
MM	MM	MM	MM
MM	MM	MM	MM
MM	MM	MM	MM
MM	MM	MM	MM
MM	MM	MM	MM
MM	MM	MM	MM
MM	MM	MM	MM
MM	MM	MM	MM
MM	MM	MM	MM
MM	MM	MM	MM
MM	MM	MM	MM
MM	MM	MM	MM
MM	MM	MM	MM
MM	MM	MM	MM
MM	MM	MM	MM
MM	MM	MM	MM
MM	MM	MM	MM
MM	MM	MM	MM

The image shows the MATLAB R2018b ribbon interface. The 'SHORTCUTS' tab is active, and the 'Import Data' button is highlighted with a red arrow. A tooltip 'Import data from file' is visible over the button. The ribbon is divided into sections: FILE (New Script, New Live Script, New, Open, Compare, Find Files), VARIABLE (Save Workspace, New Variable, Open Variable, Clear Workspace), CODE (Favorites, Analyze Code, Run and Time, Clear Commands), and SIMULINK (Simulink). The current file path is '\\mathworks\...Ned\_Gulley\share\Fractal Basin Boundaries\waveheight.mlx'.

The 'Import Data' dialog box is open, showing the following file list:

Name	Date modified	Type	Size
simulink_files	10/23/2017 12:53 ...	File folder	
basin1.gif	10/11/2017 5:59 PM	GIF File	63 KB
basin2.gif	10/11/2017 5:58 PM	GIF File	64 KB
fractal_basin_runner.gif	10/18/2017 2:16 PM	GIF File	107 KB
massPendulumAnimator.gif	2/23/2018 10:53 AM	GIF File	2,219 KB
phasePlaneAnimator.gif	10/19/2017 1:37 PM	GIF File	913 KB
six_pend.gif	10/23/2017 2:22 PM	GIF File	372 KB
wavedata.mat	9/18/2018 4:00 PM	Microsoft Access ...	11 KB
wavedata_orig.mat	9/18/2018 2:07 PM	Microsoft Access ...	38 KB

The 'File name' field at the bottom contains the URL: `https://www.ndbc.noaa.gov/data/realtime2/41159.txt`. The file type is set to 'Recognized Data Files (\*.aiff;\*.a)'. The 'Open' button is highlighted with a red arrow.

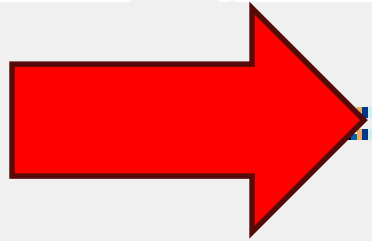
tractal Basin Bou

emp

K Trip

opbox

nki



<https://www.ndbc.noaa.gov/data/realtime2/41159.txt>

HOME PLOTS APPS SHORTCUTS

New Script Live Script New Open Compare Import Data Save Workspace

FILE VARIABLE

Import data from file

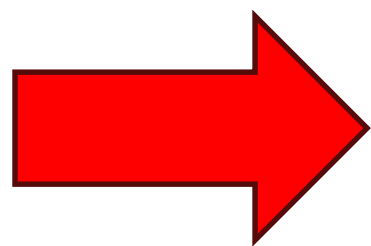
Import - C:\Users\gullej\AppData\Local\Microsoft\Windows\INetCache\IE\2H5M1E07\41159[1].txt

IMPORT VIEW

Column delimiters: Space Range: A3:S1871 Output Type: Table

Delimited Fixed Width Delimiter Options Variable Names Row: 1

UNIMPORTABLE CELLS Import Selection



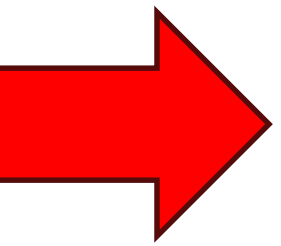
41159[1].txt

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S		
	Untitled																				
	YY	MM	DD	hh	mm	WDI	RWSP	DGST	VVHT	DPD	APD	M...	PRES	ATMP	WTMP	DEWP	VIS	PTDY	TIDE		
N...	...	...	...	...	...	C...	Cat...	Cat...	Num...	Num...	Num...	N...	Categ...	Cate...	Num...	Cate...	Cat...	Cate...	Cate...		
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		
	#YY	MM	DD	hh	mm	WDI	R	WSP	D	GST	VVHT	DPD	APD	MWD	PRES	ATMP	WTMP	DEWP	VIS	PTDY	TIDE
	#yr	mo	dy	hr	mn	deg	T	m/s	m/s	m	sec	sec	deg	T	hPa	degC	degC	degC	nmi	hPa	ft
3	2018	09	19	20	00	MM	MM	MM	0.5	10	5.0	112	MM	MM	28.5	MM	MM	MM	MM		
4	2018	09	19	19	30	MM	MM	MM	0.5	11	4.7	112	MM	MM	28.4	MM	MM	MM	MM		
5	2018	09	19	19	00	MM	MM	MM	0.6	11	4.6	109	MM	MM	28.2	MM	MM	MM	MM		
6	2018	09	19	18	30	MM	MM	MM	0.6	11	4.6	115	MM	MM	28.1	MM	MM	MM	MM		
7	2018	09	19	18	00	MM	MM	MM	0.6	11	4.5	116	MM	MM	28.0	MM	MM	MM	MM		
8	2018	09	19	17	30	MM	MM	MM	0.6	10	4.4	98	MM	MM	27.9	MM	MM	MM	MM		
9	2018	09	19	17	00	MM	MM	MM	0.7	11	4.3	113	MM	MM	27.9	MM	MM	MM	MM		
10	2018	09	19	16	30	MM	MM	MM	0.7	11	4.4	101	MM	MM	27.8	MM	MM	MM	MM		
11	2018	09	19	16	00	MM	MM	MM	0.7	11	4.3	108	MM	MM	27.7	MM	MM	MM	MM		
12	2018	09	19	15	30	MM	MM	MM	0.8	11	4.2	109	MM	MM	27.6	MM	MM	MM	MM		
13	2018	09	19	15	00	MM	MM	MM	0.8	11	4.2	102	MM	MM	27.6	MM	MM	MM	MM		
14	2018	09	19	14	30	MM	MM	MM	0.8	10	3.9	116	MM	MM	27.5	MM	MM	MM	MM		
15	2018	09	19	14	00	MM	MM	MM	0.9	11	4.1	96	MM	MM	27.5	MM	MM	MM	MM		
16	2018	09	19	13	30	MM	MM	MM	0.9	5	3.8	202	MM	MM	27.5	MM	MM	MM	MM		
17	2018	09	19	13	00	MM	MM	MM	0.8	10	3.9	104	MM	MM	27.4	MM	MM	MM	MM		
18	2018	09	19	12	30	MM	MM	MM	0.8	5	4.2	203	MM	MM	27.4	MM	MM	MM	MM		
19	2018	09	19	12	00	MM	MM	MM	0.8	5	4.4	217	MM	MM	27.4	MM	MM	MM	MM		
20	2018	09	19	11	30	MM	MM	MM	0.8	5	4.5	210	MM	MM	27.5	MM	MM	MM	MM		
21	2018	09	19	11	00	MM	MM	MM	0.9	5	4.8	205	MM	MM	27.5	MM	MM	MM	MM		
22	2018	09	19	10	30	MM	MM	MM	0.8	11	4.8	111	MM	MM	27.5	MM	MM	MM	MM		

HOME PLOTS APPS SHORTCUTS LIVE EDITOR INSERT VIEW

New Script New Live Script New Open Find Files Import Data Save Workspace Open Variable Clear Workspace Favorites Run and Time Clear Commands Simulink

Import - C:\Users\gulle\AppData\Local\Microsoft\Windows\INetCache\E\2H5M1E07\41159[1].txt



IMPORT VIEW

Delimited 
 Column delimiters: Space 
 Range: A3:S1871 
 Output Type: Table

Fixed Width 
 Variable Names Row: 1 
 Text Options

DELIMITERS SELECTION IMPORTED DATA UNIMPORTABLE CELLS

41159[1].txt

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
Untitled																		
	YY	MM	DD	hh	mm	WDI	RWSP	DGST	WVHT	DPD	APD	M...	PRES	ATMP	WTMP	DEWP	VIS	PTDY
N...	...	...	...	...	...	C...	Cat...	Cat...	Num...	Num...	Num...	N...	Categ...	Cate...	Num...	Cate...	Cat...	Cat...
1	#YY	MM	DD	hh	mm	WDI	R WSP	D GST	WVHT	DPD	APD	MWD	PRES	ATMP	WTMP	DEWP	VIS	PTDY
2	#yr	mo	dy	hr	mn	deg T	m/s	m/s	m	sec	sec	deg T	hPa	degC	degC	degC	nmi	hPa
3	2018	09	19	20	00	MM	MM	MM	0.5	10	5.0	112	MM	MM	28.5	MM	MM	MM
4	2018	09	19	19	30	MM	MM	MM	0.5	11	4.7	112	MM	MM	28.4	MM	MM	MM

HOME PLOTS APPS SHORTCUTS LIVE EDITOR INSERT VIEW

New Script New Live Script New Open Find Files Import Data Save Workspace New Variable Open Variable Clear Workspace Favorites Run and Time Clear Commands Simulink

Live Editor - \\mathworks

Import - C:\Users\gulle\AppData\Local\Microsoft\Windows\INetCache\E\2H5M1E07\41159[1].txt

IMPORT VIEW

Column delimiters: Delimited Fixed Width

Range: A3:S1871

Variable Names Row: 1

Output Type: Table Text Options

DELIMITERS SELECTION IMPORTED DATA

41159[1].txt

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	
Untitled																			
	YY	MM	DD	hh	mm	WDI	RWSP	DGST	WVHT	DPD	APD	M...	PRES	ATMP	WTMP	DEWP	VIS	PTDY	
N...	...	...	...	...	...	C...	Cat...	Cat...	Num...	Num...	Num...	N...	Categ...	Cate...	Num...	Cate...	Cat...	Cat...	
1	#YY	MM	DD	hh	mm	WDI	R WSP	D GST	WVHT	DPD	APD	MWD	PRES	ATMP	WTMP	DEWP	VIS	PTDY	
2	#yr	mo	dy	hr	mn	deg	T m/s	m/s	m	sec	sec	deg	T	hPa	degC	degC	degC	nmi	hPa
3	2018	09	19	20	00	MM	MM	MM	0.5	10	5.0	112	MM	MM	28.5	MM	MM	MM	
4	2018	09	19	19	30	MM	MM	MM	0.5	11	4.7	112	MM	MM	28.4	MM	MM	MM	



HOME PLOTS APPS SHORTCUTS LIVE EDITOR INSERT VIEW

New Script New Live Script New Open Find Files Import Data Save Workspace New Variable Open Variable Clear Workspace Favorites Analyze Code Run and Time Clear Commands Simulink

Live Editor - \\mathworks

Import - C:\Users\gulle\AppData\Local\Microsoft\Windows\INetCache\E\2H5M1E07\41159[1].txt

IMPORT VIEW

Delimited Fixed Width Column delimiters Space Variable Names Row: 1 Range: A3:S1871 Output Type: Table Text Options UNIMPORTABLE CELLS

DELIMITERS SELECTION IMPORTED DATA

41159[1].txt

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
	Untitled																	
	YY	MM	DD	hh	mm	WDI	RWSP	DGST	WVHT	DPD	APD	M...	PRES	ATMP	WTMP	DEWP	VIS	PTDY
	N...	...	...	...	...	C...	Cat...	Cat...	Num...	Num...	Num...	N...	Categ...	Cate...	Num...	Cate...	Cat...	Cat...
1	#YY	MM	DD	hh	mm	WDI	R WSP	D GST	WVHT	DPD	APD	MWD	PRES	ATMP	WTMP	DEWP	VIS	PTDY
2	#yr	mo	dy	hr	mn	deg T	m/s	m/s	m	sec	sec	deg T	hPa	degC	degC	degC	nmi	hPa
3	2018	09	19	20	00	MM	MM	MM	0.5	10	5.0	112	MM	MM	28.5	MM	MM	MM
4	2018	09	19	19	30	MM	MM	MM	0.5	11	4.7	112	MM	MM	28.4	MM	MM	MM

HOME PLOTS APPS SHORTCUTS LIVE EDITOR INSERT VIEW

New Script New Live Script New Open Find Files Compare Import Data Save Workspace New Variable Open Variable Clear Workspace Favorites Run and Time Clear Commands Simulink

Live Editor - \\mathworks

Import - C:\Users\gulle\AppData\Local\Microsoft\Windows\INetCache\E\2H5M1E07\41159[1].txt

IMPORT VIEW

Delimited Fixed Width Column delimiters: Space Variable Names Row. Output Type: Table UNIMPORTABLE CELLS

DELIMITERS SELECTION IMPORTED DATA

41159[1].txt

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
Untitled																		
	YY	MM	DD	hh	mm	WDI	RWSP	DGST	WVHT	DPD	APD	M...	PRES	ATMP	WTMP	DEWP	VIS	PTDY
N...	...	...	...	...	...	C...	Cat...	Cat...	Num...	Num...	Num...	N...	Categ...	Cate...	Num...	Cate...	Cat...	Cat...
1	#YY	MM	DD	hh	mm	WDI	R WSP	D GST	WVHT	DPD	APD	MWD	PRES	ATMP	WTMP	DEWP	VIS	PTDY
2	#yr	mo	dy	hr	mn	deg T	m/s	m/s	m	sec	sec	deg T	hPa	degC	degC	degC	nmi	hPa
3	2018	09	19	20	00	MM	MM	MM	0.5	10	5.0	112	MM	MM	28.5	MM	MM	MM
4	2018	09	19	19	30	MM	MM	MM	0.5	11	4.7	112	MM	MM	28.4	MM	MM	MM

LIVE EDITOR

INSERT

VIEW

A N ?

New Open Save Find Files Compare Print Go To Find Text Code Section Break Run Section Run and Advance Run to End Run Step Stop

FILE NAVIGATE TEXT CODE SECTION RUN

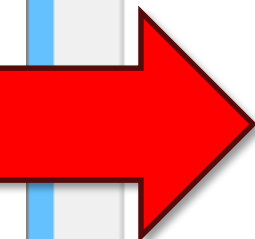
Data is from <https://www.ndbc.noaa.gov/data/realtime2/41159.txt>

buoy

buoy = 1856x19 table

	YY	MM	DD	hh	mm	WDI	RWSP	DGST	WVHT
1	2018	7	30	0	0	MM	MM	MM	1.0000
2	2018	7	30	0	30	MM	MM	MM	1.1000
3	2018	7	30	1	0	MM	MM	MM	0.9000
4	2018	7	30	1	30	MM	MM	MM	1.0000
5	2018	7	30	2	0	MM	MM	MM	1.0000
6	2018	7	30	2	30	MM	MM	MM	1.0000
7	2018	7	30	3	0	MM	MM	MM	1.0000
8	2018	7	30	3	30	MM	MM	MM	1.0000
9	2018	7	30	4	0	MM	MM	MM	1.0000

plot(buoy.WVHT)



2

3

LIVE EDITOR

INSERT

VIEW

A N ?

Toolbar with icons for: New, Open, Save, Find Files, Compare, Print, Go To, Find, Text, Code, Section Break, Run Section, Run and Advance, Run to End, Run, Stop.



Data is from <https://www.ndbc.noaa.gov/data/realtime2/41159.txt>

2

buoy

buoy = 1856x19 table

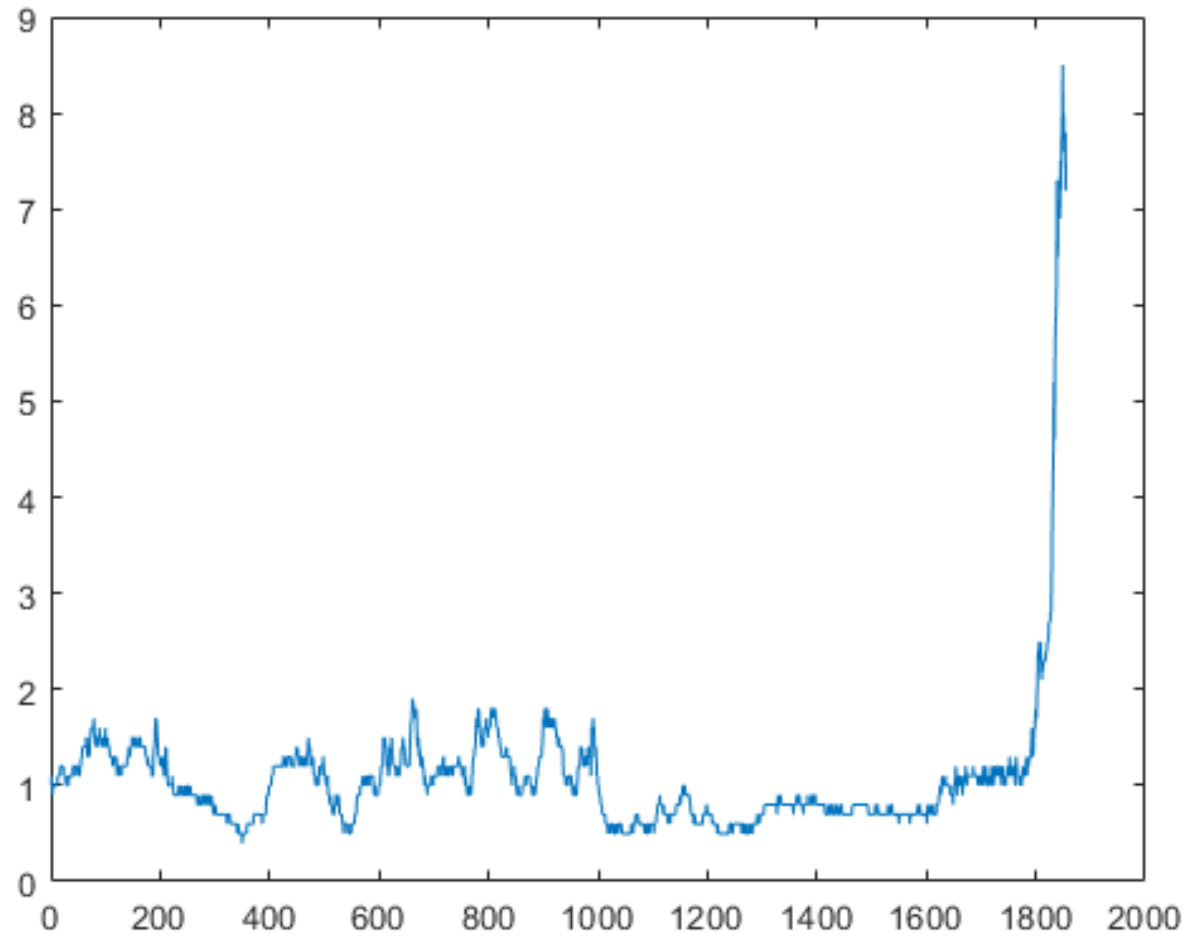
	YY	MM	DD	hh	mm	WDI	RWSP	DGST	WVHT
1	2018	7	30	0	0	MM	MM	MM	1.0000
2	2018	7	30	0	30	MM	MM	MM	1.1000
3	2018	7	30	1	0	MM	MM	MM	0.9000
4	2018	7	30	1	30	MM	MM	MM	1.0000
5	2018	7	30	2	0	MM	MM	MM	1.0000
6	2018	7	30	2	30	MM	MM	MM	1.0000
7	2018	7	30	3	0	MM	MM	MM	1.0000
8	2018	7	30	3	30	MM	MM	MM	1.0000
9	2018	7	30	4	0	MM	MM	MM	1.0000

3

plot(buoy.WVHT)

9	2018	7	30	4	0	MM	MM	MM	1.0000
---	------	---	----	---	---	----	----	----	--------

```
plot(buoy.WVHT)
```



script

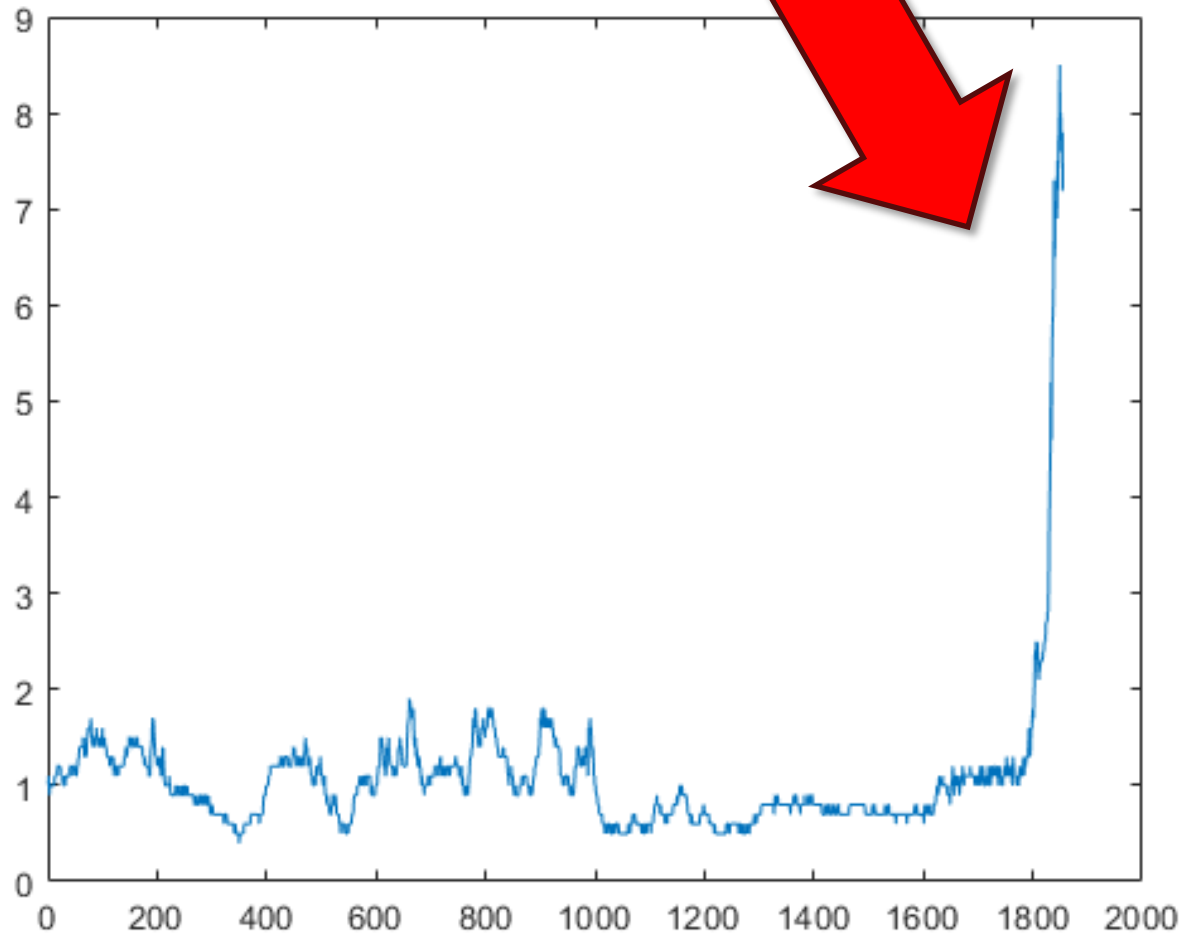
Ln 2

Col 5

9	2018	7	30	4	0	MM	MM	MM	1.0000
---	------	---	----	---	---	----	----	----	--------

3

```
plot(buoy.WVHT)
```



script

Ln 2 Col 5

\\mathworks\public\Ned\_Gulley\share\Fractal Basin Boundaries\waveheight.mlx

LIVE EDITOR    INSERT    FIGURE    VIEW    A\* N\* ?

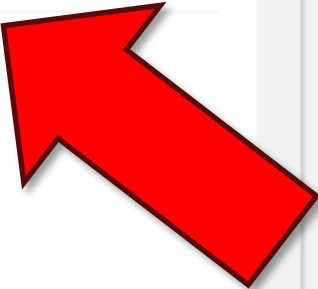
New Open Save Find Files Compare Print    Go To Find    TEXT CODE SECTION    Run Step Stop

FILE    NAVIGATE    RUN

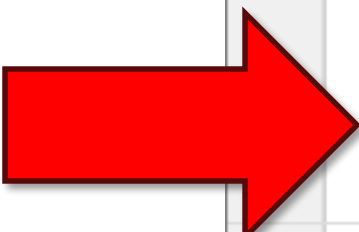
```
4 t = datetime(buoy.YY, buoy.MM, buoy.DD, buoy.hh, buoy.mm, 0)

t = 1856x1 datetime array
30-Jul-2018 00:00:00
30-Jul-2018 00:30:00
30-Jul-2018 01:00:00
30-Jul-2018 01:30:00
30-Jul-2018 02:00:00
30-Jul-2018 02:30:00
30-Jul-2018 03:00:00
30-Jul-2018 03:30:00
30-Jul-2018 04:00:00
30-Jul-2018 04:30:00
30-Jul-2018 05:00:00
30-Jul-2018 05:30:00
30-Jul-2018 06:00:00
30-Jul-2018 06:30:00
30-Jul-2018 07:30:00
30-Jul-2018 08:00:00
30-Jul-2018 08:30:00

5 buoyTt = timetable(t, buoy.WVHT, buoy.DPD, buoy.MWD, buoy.WTMP, ...
6     'VariableNames',{'WaveHt','WavePeriod','WaveDir','WaterTemp'});
```



```
t = 1856x1 datetime array
30-Jul-2018 00:00:00
30-Jul-2018 00:30:00
30-Jul-2018 01:00:00
30-Jul-2018 01:30:00
30-Jul-2018 02:00:00
30-Jul-2018 02:30:00
30-Jul-2018 03:00:00
30-Jul-2018 03:30:00
30-Jul-2018 04:00:00
30-Jul-2018 04:30:00
30-Jul-2018 05:00:00
30-Jul-2018 05:30:00
30-Jul-2018 06:00:00
30-Jul-2018 06:30:00
30-Jul-2018 07:30:00
30-Jul-2018 08:00:00
30-Jul-2018 08:30:00
```



```
buoyTt = timetable(t, buoy.WVHT, buoy.DPD, buoy.MWD, buoy.WTMP, ...
    'VariableNames',{'WaveHt','WavePeriod','WaveDir','WaterTemp'});
```

7

```
stackedplot(buoyTt);
```



```
variablenames = { waveHt , wavePeriod , waveDir , waterTemp },  
  
stackedplot(buoyTt);
```

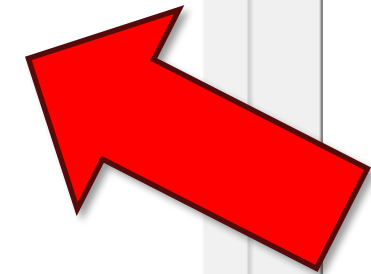
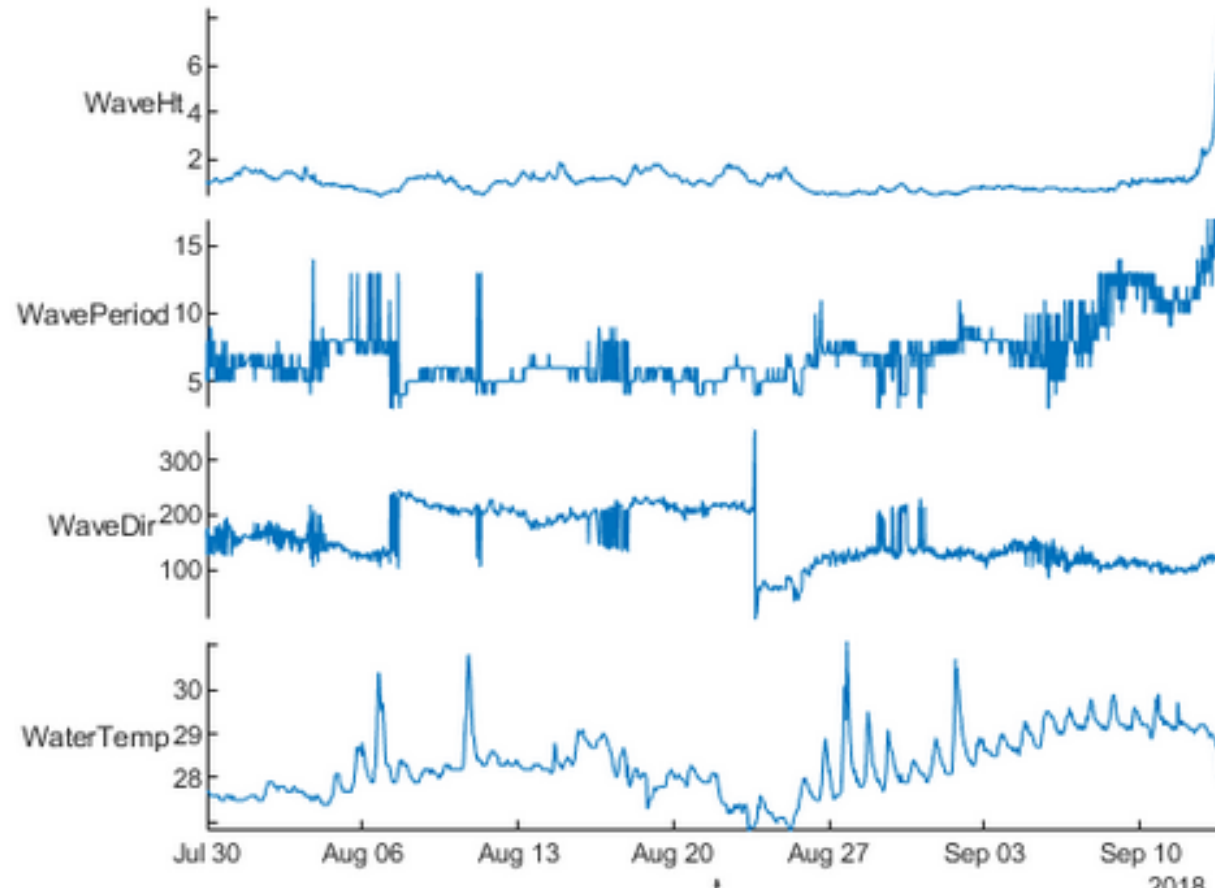
script

Ln 8

Col 33

R2018b

```
stackedplot(buoyTt);
```



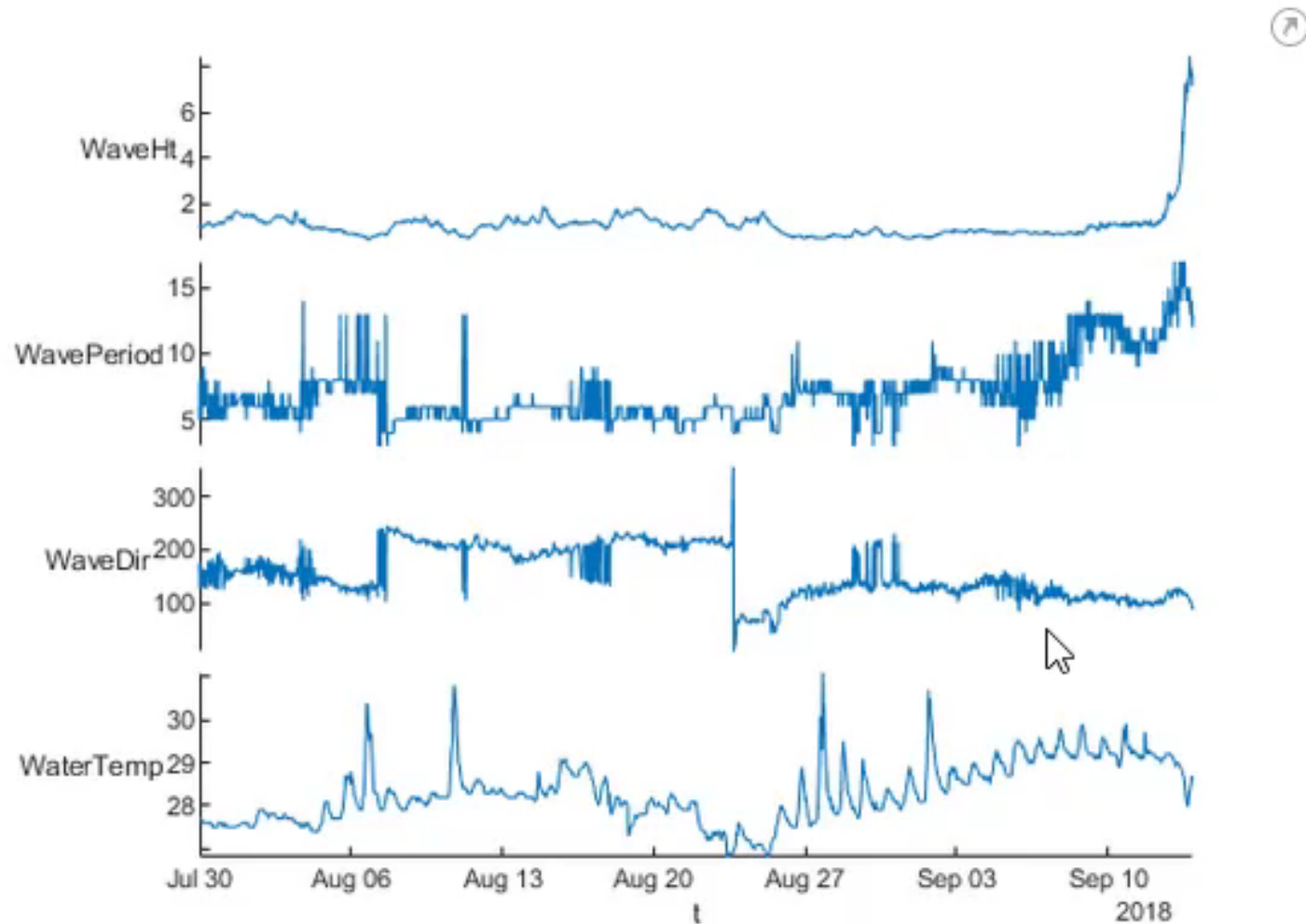
script

Ln 8

Col 33

R2018b

```
stackedplot(buoyTt);|
```



LIVE EDITOR    INSERT    VIEW    A, N, ?

New    Open    Save    Find Files    Compare    Go To    TEXT    CODE    SECTION    Run    Step    Stop

Print    Find    FILE    NAVIGATE    RUN

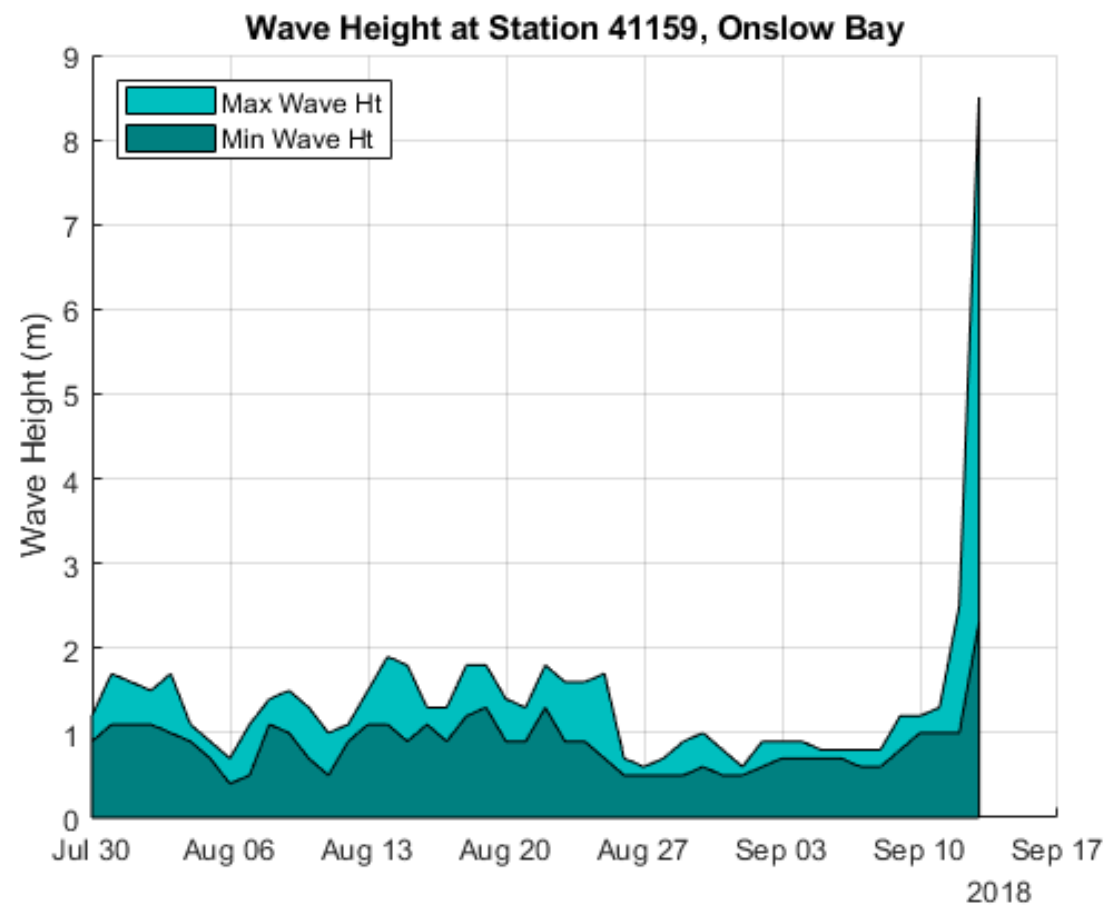
```
9 plot(buoyTt.t, buoyTt.WaveHt, '.')
10
11 buoyTtSmooth = smoothdata(buoyTt, 'movmean');
12 hold on
13 plot(buoyTtSmooth.t, buoyTtSmooth.WaveHt, ...
14      'LineWidth', 2, 'DisplayName', 'smoothed')
15 hold off
```

16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41

```
ttMax = retime(buoyTt, 'daily', 'max');  
ttMin = retime(buoyTt, 'daily', 'min');
```

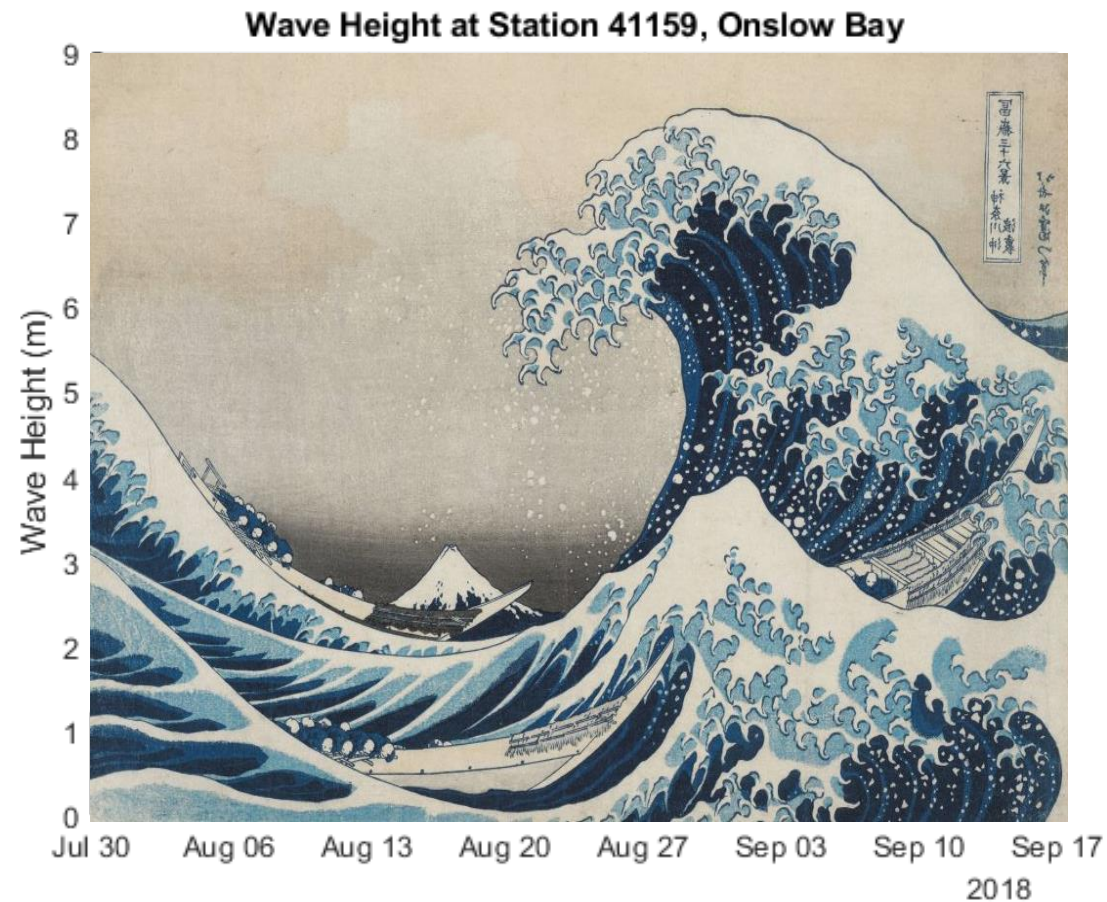
```
ttMax = retime(buoyTt,'daily','max');
ttMin = retime(buoyTt,'daily','min');

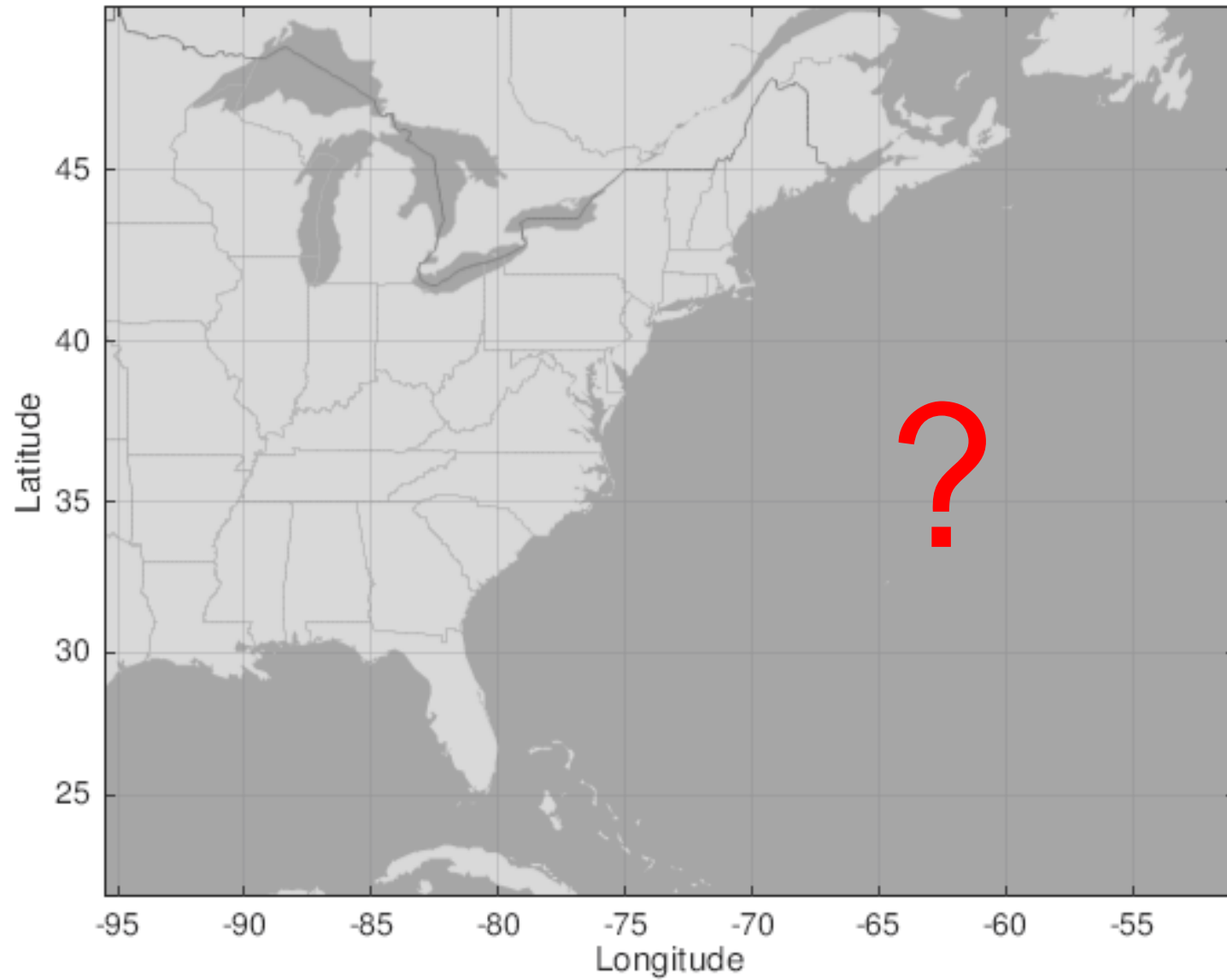
hold on
area(ttMax.t, ttMax.WaveHt,'FaceColor',[0 0.75 0.75])
area(ttMin.t,ttMin.WaveHt,'FaceColor',[0 0.5 0.5])
hold off
title('Wave Height at Station 41159, Onslow Bay')
ylabel('Wave Height (m)')
legend({'Max Wave Ht','Min Wave Ht'},'Location','NorthWest')
grid on
```



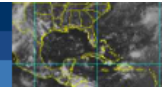
```
ttMax = retime(buoyTt,'daily','max');
ttMin = retime(buoyTt,'daily','min');

hold on
area(ttMax.t, ttMax.WaveHt,'FaceColor',[0 0.75 0.75])
area(ttMin.t,ttMin.WaveHt,'FaceColor',[0 0.5 0.5])
hold off
title('Wave Height at Station 41159, Onslow Bay')
ylabel('Wave Height (m)')
legend({'Max Wave Ht','Min Wave Ht'},'Location','NorthWest')
grid on
```









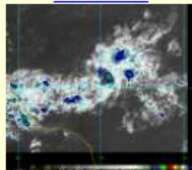
[LOGIN](#) [NEW VISITOR](#)

**NEWS**

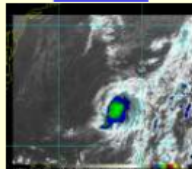
- [Main Page](#)
- [News Only](#)
- [Met Blogs](#)
- [News Archives](#)
- [Search](#)

**CURRENT STORMS**

[Invest 97L](#)



[Invest 98L](#)



[HypeScale: 1.5](#)

**COMMUNICATION**

- [Forum \(Newest\)](#)
- [Site Donations/Tips and thanks](#)

**STORM DATA**

- [Maps and Coordinates](#)
- [Image Recordings](#)
- [Forecast Models](#)
- [Recon Info](#)
- [More Recon](#)
- [Florida Radar](#)

**CONTENT**

- [General Info](#)
- [Site Links](#)
- [Data Links](#)
- [Site usage tips](#)
- [Text WXData](#)
- [CFHC Data Feeds](#)
- [About CFHC](#)
- [Mobile Website](#)

**FOLLOW US**

- [facebook](#)
- [twitter](#)

Days since last H. Landfall - US: Any 6 (Florence) , Major: 365 (Maria) Florida - Any: 375 (Irma) Major: 375 (Irma)

**Position History For Post-Tropical Cyclone Florence (2018)**

[\[ Other Storms \]](#) - [\[ Google Map of this Storm \]](#) [\[ xml \]](#) [\[ csv \]](#)

Adv#	Date	Lat	Long	Wind	Pres	Movement	Type	Name	Received	Forecaster
<a href="#">1</a>	08/30 11:00 AM	12.9N	18.4W	30MPH	1007mb	W at 12 MPH (280 deg)	Ptnl	Six	08/30 10:45 AM	<a href="#">Avila</a>
<a href="#">1A</a>	08/30 2:00 PM	12.9N	19.0W	30MPH	1007mb	W at 12 MPH (280 deg)	Ptnl	Six	08/30 1:36 PM	<a href="#">Avila</a>
<a href="#">2</a>	08/30 5:00 PM	12.9N	19.4W	30MPH	1007mb	W at 9 MPH (280 deg)	Ptnl	Six	08/30 4:36 PM	<a href="#">Avila</a>
<a href="#">2A</a>	08/30 8:00 PM	13.1N	20.4W	30MPH	1007mb	W at 11 MPH (280 deg)	Ptnl	Six	08/30 7:44 PM	<a href="#">Beven</a>
<a href="#">3</a>	08/30 11:00 PM	13.2N	20.9W	35MPH	1007mb	W at 13 MPH (280 deg)	Ptnl	Six	08/30 10:42 PM	<a href="#">Beven</a>
<a href="#">3A</a>	08/31 2:00 AM	13.4N	21.2W	35MPH	1007mb	W at 13 MPH (280 deg)	Ptnl	Six	08/31 1:42 AM	<a href="#">Berg</a>
<a href="#">4</a>	08/31 5:00 AM	13.6N	21.4W	35MPH	1006mb	Wnw at 12 MPH (285 deg)	Ptnl	Six	08/31 4:39 AM	<a href="#">Berg</a>
<a href="#">4A</a>	08/31 8:00 AM	13.7N	21.8W	35MPH	1006mb	Wnw at 12 MPH (285 deg)	Ptnl	Six	08/31 7:33 AM	<a href="#">Avila</a>
<a href="#">5</a>	08/31 11:00 AM	13.7N	22.7W	35MPH	1006mb	Wnw at 13 MPH (285 deg)	Ptnl	Six	08/31 10:38 AM	<a href="#">Avila</a>
<a href="#">5A</a>	08/31 2:00 PM	13.8N	23.3W	35MPH	1006mb	Wnw at 13 MPH (285 deg)	Ptnl	Six	08/31 1:33 PM	<a href="#">Avila</a>
<a href="#">6</a>	08/31 5:00 PM	13.8N	24.7W	35MPH	1004mb	W at 15 MPH (270 deg)	TD	TD#6	08/31 4:36 PM	<a href="#">Avila</a>
<a href="#">6A</a>	08/31 8:00 PM	14.0N	25.0W	35MPH	1004mb	W at 15 MPH (270 deg)	TD	TD#6	08/31 7:44 PM	<a href="#">Beven</a>
<a href="#">7</a>	08/31 11:00 PM	14.2N	25.5W	35MPH	1004mb	Wnw at 14 MPH (285 deg)	TD	TD#6	08/31 10:42 PM	<a href="#">Beven</a>
<a href="#">7A</a>	09/01 2:00 AM	14.4N	26.2W	35MPH	1004mb	Wnw at 14 MPH (285 deg)	TD	TD#6	09/01 1:36 AM	<a href="#">Berg</a>
<a href="#">8</a>	09/01 5:00 AM	14.5N	26.7W	40MPH	1003mb	Wnw at 14 MPH (285 deg)	TS	Florence	09/01 4:57 AM	<a href="#">Berg</a>
<a href="#">8A</a>	09/01 8:00 AM	14.6N	27.2W	40MPH	1003mb	Wnw at 14 MPH (285 deg)	TS	Florence	09/01 7:36 AM	<a href="#">Avila</a>
<a href="#">9</a>	09/01 11:00 AM	14.8N	27.8W	45MPH	1003mb	Wnw at 14 MPH (285 deg)	TS	Florence	09/01 10:48 AM	<a href="#">Avila</a>
<a href="#">10</a>	09/01 5:00 PM	15.6N	29.0W	45MPH	1002mb	Wnw at 16 MPH (285 deg)	TS	Florence	09/01 4:38 PM	<a href="#">Avila</a>
<a href="#">11</a>	09/01 11:00 PM	16.0N	30.2W	50MPH	1000mb	Wnw at 14 MPH (290 deg)	TS	Florence	09/01 10:57 PM	<a href="#">Beven</a>
<a href="#">12</a>	09/02 5:00 AM	16.5N	31.4W	60MPH	999mb	Wnw at 15 MPH (290 deg)	TS	Florence	09/02 4:53 AM	<a href="#">Zelinsky</a>
<a href="#">13</a>	09/02 11:00 AM	17.0N	33.2W	50MPH	1000mb	Wnw at 18 MPH (285 deg)	TS	Florence	09/02 10:51 AM	<a href="#">Stewart</a>
<a href="#">14</a>	09/02 5:00 PM	17.4N	34.6W	50MPH	1000mb	Wnw at 17 MPH (285 deg)	TS	Florence	09/02 4:36 PM	<a href="#">Brennan</a>
<a href="#">15</a>	09/02 11:00 PM	17.9N	35.9W	50MPH	1000mb	Wnw at 16 MPH (290 deg)	TS	Florence	09/02 10:36 PM	<a href="#">Cangialosi</a>
<a href="#">16</a>	09/03 5:00 AM	18.0N	37.5W	60MPH	999mb	Wnw at 16 MPH (285 deg)	TS	Florence	09/03 4:51 AM	<a href="#">Zelinsky</a>
<a href="#">17</a>	09/03 11:00 AM	18.3N	38.7W	65MPH	997mb	Wnw at 16 MPH (285 deg)	TS	Florence	09/03 10:45 AM	<a href="#">Brennan</a>
<a href="#">18</a>	09/03 5:00 PM	18.6N	39.8W	70MPH	995mb	W at 15 MPH (280 deg)	TS	Florence	09/03 4:33 PM	<a href="#">Cangialosi</a>
<a href="#">19</a>	09/03 11:00 PM	18.9N	41.0W	70MPH	995mb	Wnw at 14 MPH (290 deg)	TS	Florence	09/03 10:33 PM	<a href="#">Cangialosi</a>
<a href="#">20</a>	09/04 5:00 AM	19.3N	42.0W	70MPH	995mb	Wnw at 13 MPH (290 deg)	TS	Florence	09/04 4:39 AM	<a href="#">Roberts</a>
<a href="#">21</a>	09/04 11:00 AM	19.7N	42.5W	75MPH	990mb	Wnw at 12 MPH (295 deg)	H1	Florence	09/04 10:39 AM	<a href="#">Berg</a>
<a href="#">22</a>	09/04 5:00 PM	20.3N	43.2W	85MPH	984mb	Wnw at 12 MPH (300 deg)	H1	Florence	09/04 4:33 PM	<a href="#">Berg</a>
<a href="#">23</a>	09/04 11:00 PM	20.7N	43.9W	100MPH	976mb	Wnw at 12 MPH (300 deg)	H2	Florence	09/04 10:54 PM	<a href="#">Blake</a>
<a href="#">24</a>	09/05 5:00 AM	21.4N	44.8W	105MPH	976mb	Nw at 13 MPH (305 deg)	H2	Florence	09/05 4:50 AM	<a href="#">Roberts</a>
<a href="#">25</a>	09/05 11:00 AM	22.0N	45.7W	125MPH	957mb	Nw at 13 MPH (305 deg)	H3	Florence	09/05 10:42 AM	<a href="#">Berg/rhome</a>
<a href="#">26</a>	09/05 5:00 PM	22.7N	46.6W	130MPH	953mb	Nw at 13 MPH (305 deg)	H4	Florence	09/05 4:33 PM	<a href="#">Berg/rhome</a>
<a href="#">27</a>	09/05 11:00 PM	23.4N	47.2W	125MPH	956mb	Nw at 10 MPH (310 deg)	H3	Florence	09/05 10:51 PM	<a href="#">Blake</a>
<a href="#">28</a>	09/06 5:00 AM	24.1N	47.9W	115MPH	964mb	Nw at 12 MPH (315 deg)	H3	Florence	09/06 4:44 AM	<a href="#">Zelinsky</a>
<a href="#">29</a>	09/06 11:00 AM	24.6N	48.6W	105MPH	975mb	Nw at 10 MPH (315 deg)	H2	Florence	09/06 10:42 AM	<a href="#">Berg</a>
<a href="#">30</a>	09/06 5:00 PM	25.0N	49.6W	80MPH	989mb	Nw at 10 MPH (305 deg)	H1	Florence	09/06 4:45 PM	<a href="#">Berg/rhome</a>
<a href="#">31</a>	09/06 11:00 PM	25.1N	49.8W	70MPH	993mb	Wnw at 7 MPH (290 deg)	TS	Florence	09/06 10:45 PM	<a href="#">Blake</a>

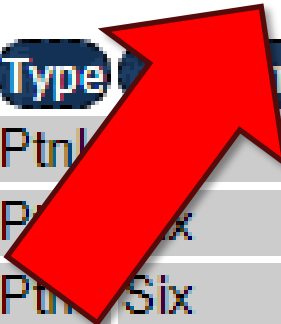
also on the radar. Reminder that Atlantic Hurricane Season runs through end of Nov.

Days since last H. Landfall - US: Any 6 ([Florence](#)) , Major: 365 ([Maria](#)) Florida - Any: 375 ([Irma](#)) Major: 375 ([Irma](#))

### Position History For Post-Tropical Cyclone Florence (2018)

[ [Other Storms](#) ] - [ [Google Map of this Storm](#) ] [ [xml](#) ] [ [csv](#) ]

Lat	Long	Wind	Pres	Movement	Type	Name	Received	Forecaster
18.9N	18.4W	30MPH	1007mb	W at 12 MPH (280 deg)	Ptnl		08/30 10:45 AM	<a href="#">Avila</a>
18.9N	19.0W	30MPH	1007mb	W at 12 MPH (280 deg)	Ptnl	Six	08/30 1:36 PM	Avila
18.9N	19.4W	30MPH	1007mb	W at 9 MPH (280 deg)	Ptnl	Six	08/30 4:36 PM	<a href="#">Avila</a>
19.1N	20.4W	30MPH	1007mb	W at 11 MPH (280 deg)	Ptnl	Six	08/30 7:44 PM	Beven
19.2N	20.9W	35MPH	1007mb	W at 13 MPH (280 deg)	Ptnl	Six	08/30 10:42 PM	<a href="#">Beven</a>
19.4N	21.2W	35MPH	1007mb	W at 13 MPH (280 deg)	Ptnl	Six	08/31 1:42 AM	Berg
19.6N	21.4W	35MPH	1006mb	Wnw at 12 MPH (285 deg)	Ptnl	Six	08/31 4:39 AM	<a href="#">Berg</a>
19.7N	21.8W	35MPH	1006mb	Wnw at 12 MPH (285 deg)	Ptnl	Six	08/31 7:33 AM	Avila



AdvisoryNumber	Date	Lat	Long	Wind	Pres	Movement	Type	Name	Received	Forecaster
"1"	"08/30/2018 11:00"	"12.9"	"18.4"	"30"	"1007"	"W at 12 MPH (280 deg)"	"Potential Tropical Cyclon			
"1A"	"08/30/2018 14:00"	"12.9"	"19.0"	"30"	"1007"	"W at 12 MPH (280 deg)"	"Potential Tropical Cyclo			
"2"	"08/30/2018 17:00"	"12.9"	"19.4"	"30"	"1007"	"W at 9 MPH (280 deg)"	"Potential Tropical Cyclone			
"2A"	"08/30/2018 20:00"	"13.1"	"20.4"	"30"	"1007"	"W at 11 MPH (280 deg)"	"Potential Tropical Cyclo			
"3"	"08/30/2018 23:00"	"13.2"	"20.9"	"35"	"1007"	"W at 13 MPH (280 deg)"	"Potential Tropical Cyclon			
"3A"	"08/31/2018 02:00"	"13.4"	"21.2"	"35"	"1007"	"W at 13 MPH (280 deg)"	"Potential Tropical Cyclo			
"4"	"08/31/2018 05:00"	"13.6"	"21.4"	"35"	"1006"	"WNW at 12 MPH (285 deg)"	"Potential Tropical Cycl			
"4A"	"08/31/2018 08:00"	"13.7"	"21.8"	"35"	"1006"	"WNW at 12 MPH (285 deg)"	"Potential Tropical Cyc			
"5"	"08/31/2018 11:00"	"13.7"	"22.7"	"35"	"1006"	"WNW at 13 MPH (285 deg)"	"Potential Tropical Cycl			
"5A"	"08/31/2018 14:00"	"13.8"	"23.3"	"35"	"1006"	"WNW at 13 MPH (285 deg)"	"Potential Tropical Cyc			
"6"	"08/31/2018 17:00"	"13.8"	"24.7"	"35"	"1004"	"W at 15 MPH (270 deg)"	"Tropical Depression", "SIX			
"6A"	"08/31/2018 20:00"	"14.0"	"25.0"	"35"	"1004"	"W at 15 MPH (270 deg)"	"Tropical Depression", "SI			
"7"	"08/31/2018 23:00"	"14.2"	"25.5"	"35"	"1004"	"WNW at 14 MPH (285 deg)"	"Tropical Depression", "S			
"7A"	"09/01/2018 02:00"	"14.4"	"26.2"	"35"	"1004"	"WNW at 14 MPH (285 deg)"	"Tropical Depression", "			
"8"	"09/01/2018 05:00"	"14.5"	"26.7"	"40"	"1003"	"WNW at 14 MPH (285 deg)"	"Tropical Storm", "Floren			
"8A"	"09/01/2018 08:00"	"14.6"	"27.2"	"40"	"1003"	"WNW at 14 MPH (285 deg)"	"Tropical Storm", "Flore			
"9"	"09/01/2018 11:00"	"14.8"	"27.8"	"45"	"1003"	"WNW at 14 MPH (285 deg)"	"Tropical Storm", "Floren			
"10"	"09/01/2018 17:00"	"15.6"	"29.0"	"45"	"1002"	"WNW at 16 MPH (285 deg)"	"Tropical Storm", "Flore			
"11"	"09/01/2018 23:00"	"16.0"	"30.2"	"50"	"1000"	"WNW at 14 MPH (290 deg)"	"Tropical Storm", "Flore			
"12"	"09/02/2018 05:00"	"16.5"	"31.4"	"60"	"999"	"WNW at 15 MPH (290 deg)"	"Tropical Storm", "Floren			
"13"	"09/02/2018 11:00"	"17.0"	"33.2"	"50"	"1000"	"WNW at 18 MPH (285 deg)"	"Tropical Storm", "Flore			
"14"	"09/02/2018 17:00"	"17.4"	"34.6"	"50"	"1000"	"WNW at 17 MPH (285 deg)"	"Tropical Storm", "Flore			
"15"	"09/02/2018 23:00"	"17.9"	"35.9"	"50"	"1000"	"WNW at 16 MPH (290 deg)"	"Tropical Storm", "Flore			
"16"	"09/03/2018 05:00"	"18.0"	"37.5"	"60"	"999"	"WNW at 16 MPH (285 deg)"	"Tropical Storm", "Floren			

LIVE EDITOR    INSERT    FIGURE    VIEW

New    Open    Save    Find Files    Compare    Print    Go To    Find    Text    Code    Section Break    Run Section    Run and Advance    Run to End    Run    Step    Stop

FILE    NAVIGATE    TEXT    CODE    SECTION    RUN

Data is from <http://flhurricane.com/cyclone/stormhistory.php?p=1&year=2018&storm=6>

storm

storm = 105x11 table

	Advisor...	Date	Lat	Long	Wind	Pres	Movem...	Type	Name
1	1	08/30/2018...	12.9000	-18.4000	30	1007	W at 12 MP...	Potential Tr...	Six
2	1	08/30/2018...	12.9000	-19.0000	30	1007	W at 12 MP...	Potential Tr...	Six
3	2	08/30/2018...	12.9000	-19.4000	30	1007	W at 9 MP...	Potential Tr...	Six
4	2	08/30/2018...	13.1000	-20.4000	30	1007	W at 11 MP...	Potential Tr...	Six
5	3	08/30/2018...	13.2000	-20.9000	35	1007	W at 13 MP...	Potential Tr...	Six
6	3	08/31/2018...	13.4000	-21.2000	35	1007	W at 13 MP...	Potential Tr...	Six
7	4	08/31/2018...	13.6000	-21.4000	35	1006	WNW at 12...	Potential Tr...	Six
8	4	08/31/2018...	13.7000	-21.8000	35	1006	WNW at 12...	Potential Tr...	Six
9	5	08/31/2018...	13.7000	-22.7000	35	1006	WNW at 13...	Potential Tr...	Six

storm.Type = categorical(storm.Type);

geobubble(storm, 'Lat', 'Long', 'SizeVariable', 'Wind', 'ColorVariable', 'Type');

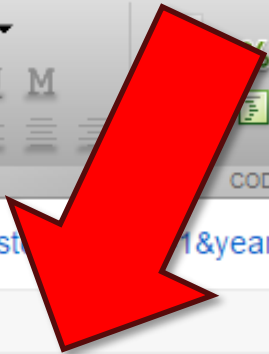
Code v

LIVE EDITOR    INSERT    FIGURE    VIEW

Find Files    Compare    Go To    Find    Text    Section Break    Run Section    Run and Advance    Run to End    Run    Step    Stop

FILE    NAVIGATE    TEXT    CODE    SECTION    RUN

Data is from [http://flhurricane.com/cyclone/stormhist...&year=2018&storm=6](http://flhurricane.com/cyclone/stormhist...)



storm

storm = 105x11 table

	Advisor...	Date	Lat	Long	Wind	Pres	Movem...	Type	Name
1	1	08/30/2018...	12.9000	-18.4000	30	1007	W at 12 MP...	Potential Tr...	Six
2	1	08/30/2018...	12.9000	-19.0000	30	1007	W at 12 MP...	Potential Tr...	Six
3	2	08/30/2018...	12.9000	-19.4000	30	1007	W at 9 MP...	Potential Tr...	Six
4	2	08/30/2018...	13.1000	-20.4000	30	1007	W at 11 MP...	Potential Tr...	Six
5	3	08/30/2018...	13.2000	-20.9000	35	1007	W at 13 MP...	Potential Tr...	Six
6	3	08/31/2018...	13.4000	-21.2000	35	1007	W at 13 MP...	Potential Tr...	Six
7	4	08/31/2018...	13.6000	-21.4000	35	1006	WNW at 12...	Potential Tr...	Six
8	4	08/31/2018...	13.7000	-21.8000	35	1006	WNW at 12...	Potential Tr...	Six
9	5	08/31/2018...	13.7000	-22.7000	35	1006	WNW at 13...	Potential Tr...	Six

```
storm.Type = categorical(storm.Type);
```

```
geobubble(storm, 'Lat', 'Long', 'SizeVariable', 'Wind', 'ColorVariable', 'Type');
```

LIVE EDITOR    INSERT    FIGURE    VIEW

FILE    NAVIGATE    TEXT    CODE    SECTION    RUN

New    Open    Save    Find Files    Compare    Print    Go To    Find    Text    Normal    Code    Section Break    Run    Step    Stop

Data is from <http://flhurricane.com/cyclone/stormhistory.php?p=1&year=2018&storm=6>

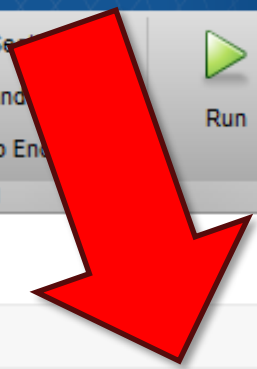
3    storm

storm = 105x11 table

	Advisor...	Date	Lat	Long	Wind	Pres	Movem...	Type	Name
1	1	08/30/2018...	12.9000	-18.4000	30	1007	W at 12 MP...	Potential Tr...	Six
2	1	08/30/2018...	12.9000	-19.0000	30	1007	W at 12 MP...	Potential Tr...	Six
3	2	08/30/2018...	12.9000	-19.4000	30	1007	W at 9 MP...	Potential Tr...	Six
4	2	08/30/2018...	13.1000	-20.4000	30	1007	W at 11 MP...	Potential Tr...	Six
5	3	08/30/2018...	13.2000	-20.9000	35	1007	W at 13 MP...	Potential Tr...	Six
6	3	08/31/2018...	13.4000	-21.2000	35	1007	W at 13 MP...	Potential Tr...	Six
7	4	08/31/2018...	13.6000	-21.4000	35	1006	WNW at 12...	Potential Tr...	Six
8	4	08/31/2018...	13.7000	-21.8000	35	1006	WNW at 12...	Potential Tr...	Six
9	5	08/31/2018...	13.7000	-22.7000	35	1006	WNW at 13...	Potential Tr...	Six

4    storm.Type = categorical(storm.Type);

5

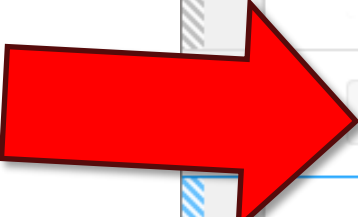


3

storm

storm = 105x11 table

	Advisor...	Date	Lat	Long	Wind	Pres	Movem...	Type	Name	
1	1	08/30/2018...	12.9000	-18.4000	30	1007	W at 12 MP...	Potential Tr...	Six	
2	1	08/30/2018...	12.9000	-19.0000	30	1007	W at 12 MP...	Potential Tr...	Six	
3	2	08/30/2018...	12.9000	-19.4000	30	1007	W at 9 MP...	Potential Tr...	Six	
4	2	08/30/2018...	13.1000	-20.4000	30	1007	W at 11 MP...	Potential Tr...	Six	
5	3	08/30/2018...	13.2000	-20.9000	35	1007	W at 13 MP...	Potential Tr...	Six	
6	3	08/31/2018...	13.4000	-21.2000	35	1007	W at 13 MP...	Potential Tr...	Six	
7	4	08/31/2018...	13.6000	-21.4000	35	1006	WNW at 12...	Potential Tr...	Six	
8	4	08/31/2018...	13.7000	-21.8000	35	1006	WNW at 12...	Potential Tr...	Six	
9	5	08/31/2018...	13.7000	-22.7000	35	1006	WNW at 13...	Potential Tr...	Six	



```
storm.Type = categorical(storm.Type);
```

5

3

storm

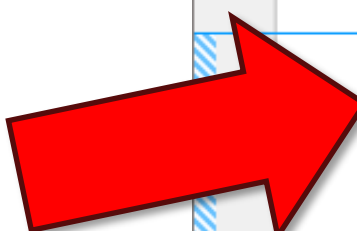
storm = 105x11 table

	Advisor...	Date	Lat	Long	Wind	Pres	Movem...	Type	Name	
1	1	08/30/2018...	12.9000	-18.4000	30	1007	W at 12 MP...	Potential Tr...	Six	
2	1	08/30/2018...	12.9000	-19.0000	30	1007	W at 12 MP...	Potential Tr...	Six	
3	2	08/30/2018...	12.9000	-19.4000	30	1007	W at 9 MP...	Potential Tr...	Six	
4	2	08/30/2018...	13.1000	-20.4000	30	1007	W at 11 MP...	Potential Tr...	Six	
5	3	08/30/2018...	13.2000	-20.9000	35	1007	W at 13 MP...	Potential Tr...	Six	
6	3	08/31/2018...	13.4000	-21.2000	35	1007	W at 13 MP...	Potential Tr...	Six	
7	4	08/31/2018...	13.6000	-21.4000	35	1006	WNW at 12...	Potential Tr...	Six	
8	4	08/31/2018...	13.7000	-21.8000	35	1006	WNW at 12...	Potential Tr...	Six	
9	5	08/31/2018...	13.7000	-22.7000	35	1006	WNW at 13...	Potential Tr...	Six	

4

```
storm.Type = categorical(storm.Type);
```

```
geobubble(storm, 'Lat', 'Long', 'SizeVariable', 'Wind', 'ColorVariable', 'Type');
```

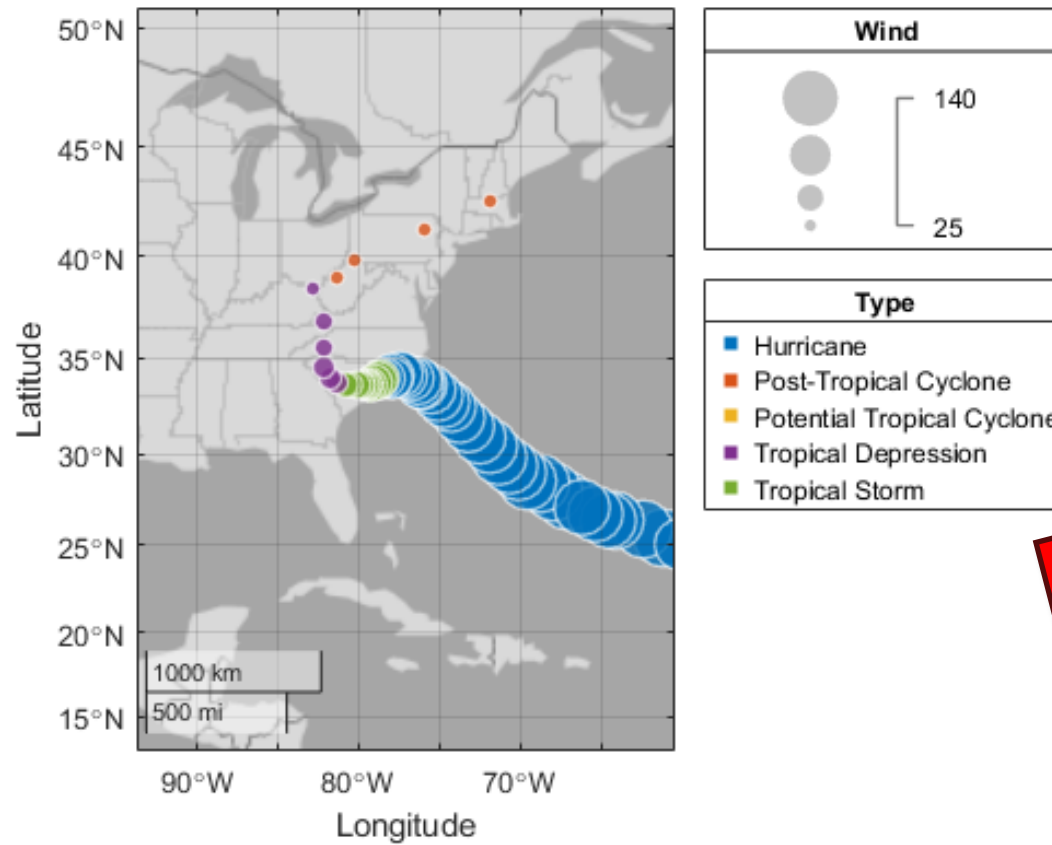




5

```
geobubble(storm, 'Lat', 'Long', 'SizeVariable', 'Wind', 'ColorVariable', 'Type');
```

Code ▾



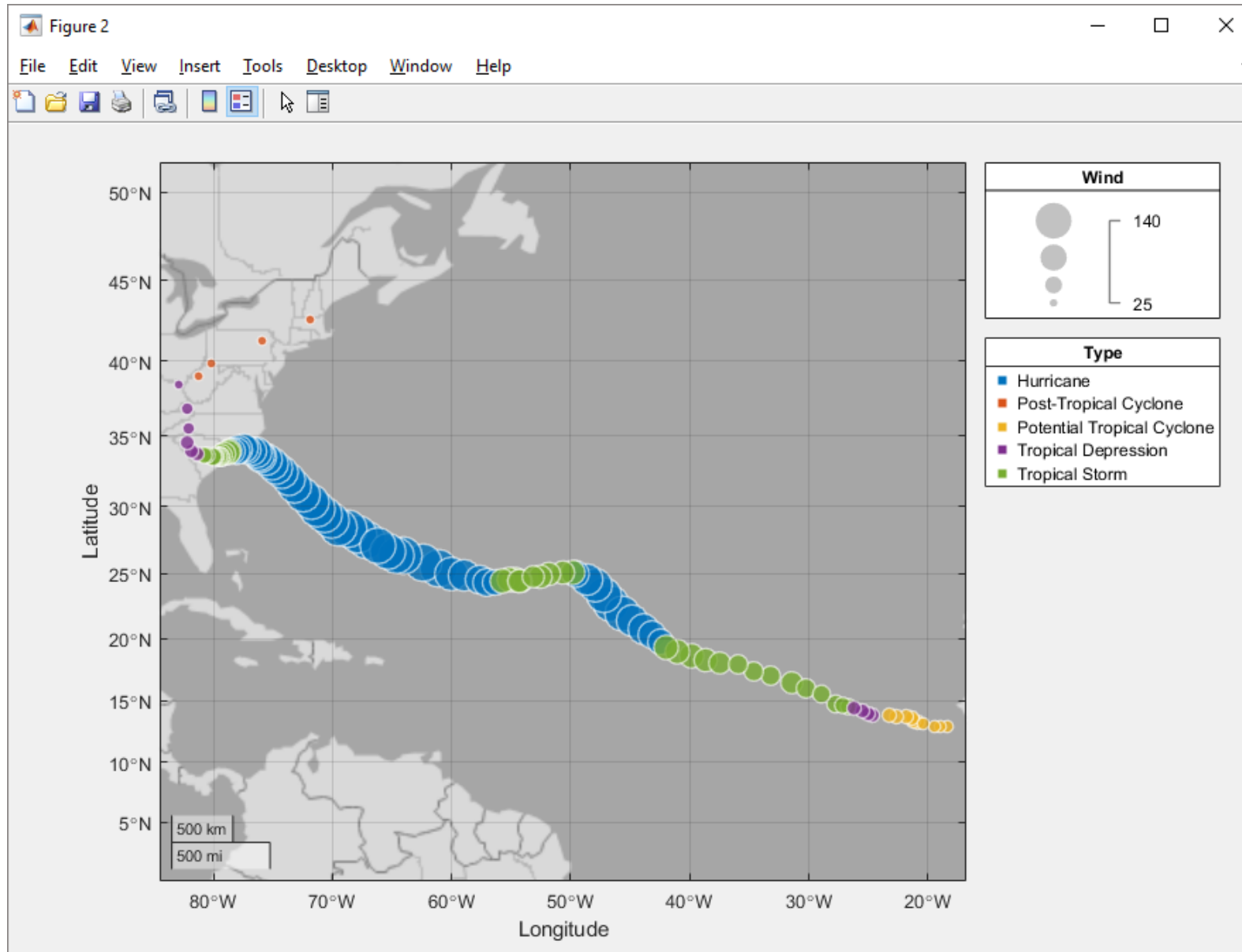
6

script

Ln 6

Col 1

# Two commands!



storm

I



Act I

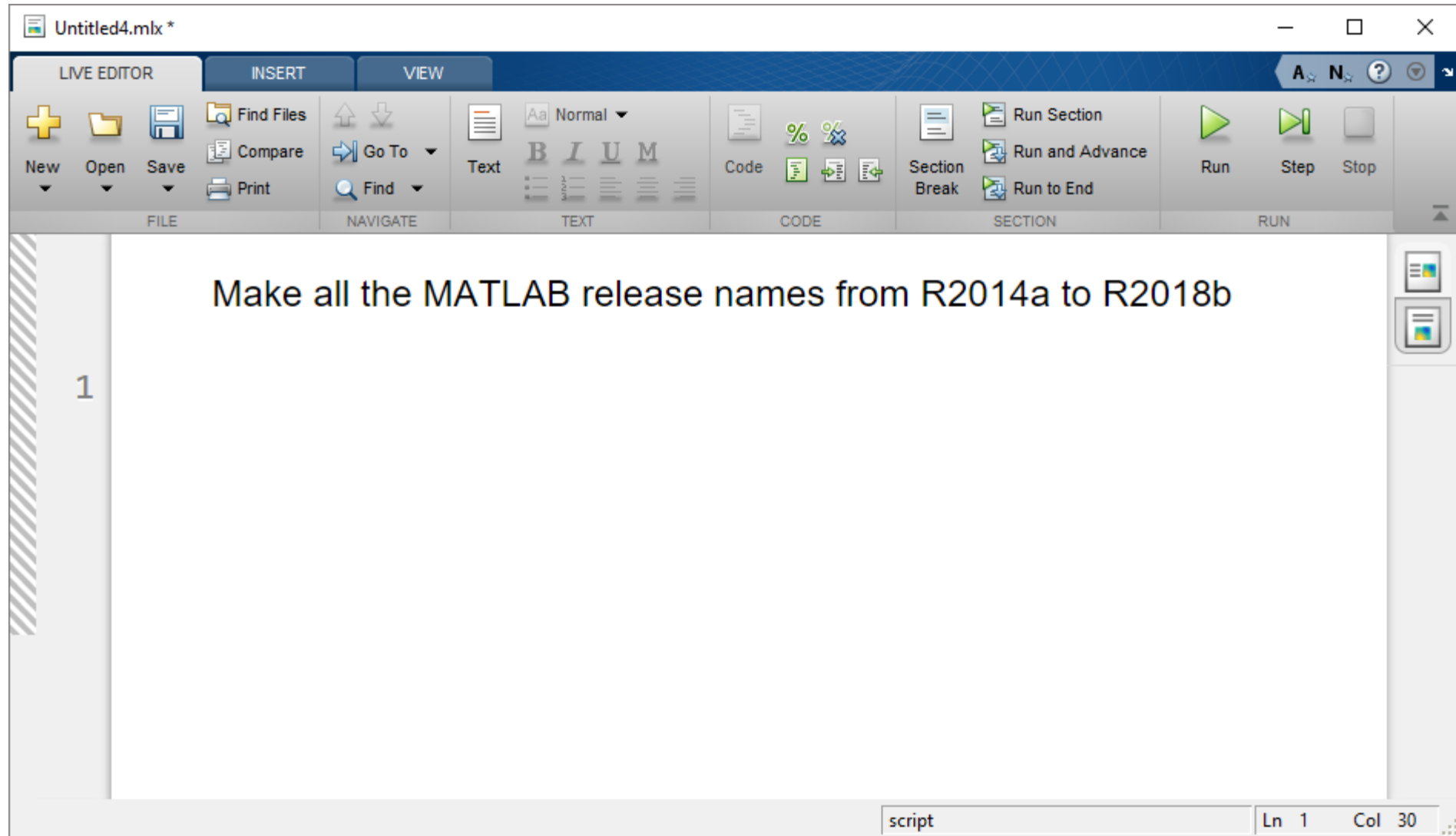
**Intermezzo**

Act II

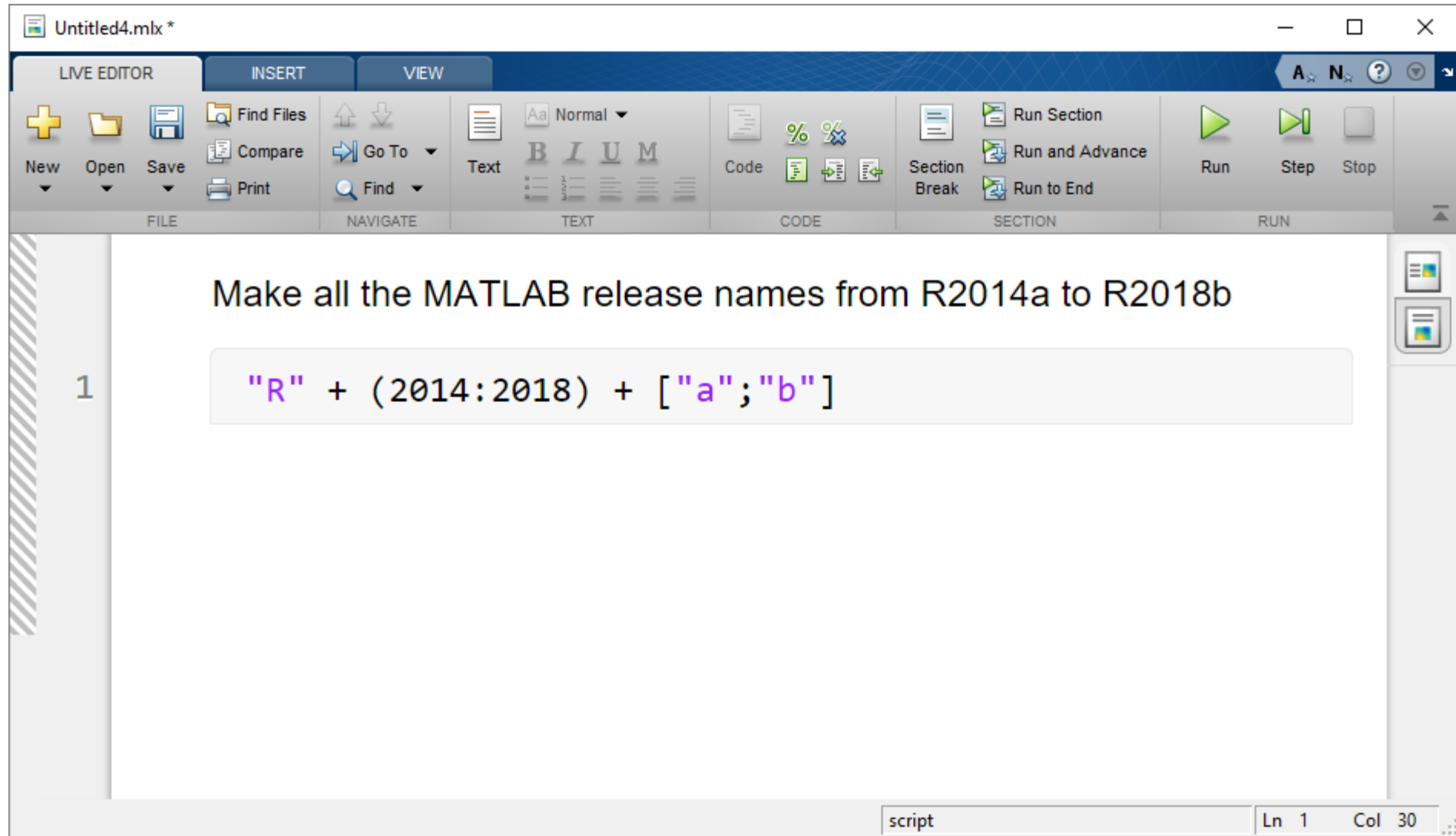
# Steady improvements

- Strings
- Better error messages
- Code Compatibility Reports
- Hardware Integration
- Deep Learning

# Strings



# Strings



The screenshot shows the MATLAB Live Editor interface for a file named "Untitled4.mlx". The interface includes a ribbon with tabs for LIVE EDITOR, INSERT, and VIEW. The ribbon contains various toolbars: FILE (New, Open, Save, Print), NAVIGATE (Find Files, Compare, Go To, Find), TEXT (Text, Bold, Italic, Underline, Monospace), CODE (Code, Comment, Uncomment), SECTION (Section Break, Run Section, Run and Advance, Run to End), and RUN (Run, Step, Stop). The main workspace displays the text "Make all the MATLAB release names from R2014a to R2018b" followed by a code snippet on line 1: `"R" + (2014:2018) + ["a";"b"]`. The status bar at the bottom indicates the current position is "script" at "Ln 1 Col 30".



# Strings

The screenshot shows the MATLAB Live Editor interface for a file named 'Untitled4.mlx'. The ribbon includes tabs for LIVE EDITOR, INSERT, and VIEW. The ribbon contains various toolbars: FILE (New, Open, Save, Print), NAVIGATE (Find Files, Compare, Go To, Find), TEXT (Text, Bold, Italic, Underline, Mark), CODE (Code, Comment, Run), SECTION (Section Break, Run Section, Run and Advance, Run to End), and RUN (Run, Step, Stop). The main workspace displays the following MATLAB code and output:

```
1 "R" + (2014:2018) + ["a";"b"]
```

ans = 2x5 string array

"R2014a"	"R2015a"	"R2016a"	"R2017a"	"R2018a"
"R2014b"	"R2015b"	"R2016b"	"R2017b"	"R2018b"

The status bar at the bottom indicates the current position is 'script' at 'Ln 1 Col 30'.

# Error Messages

The screenshot shows a MATLAB Live Editor window titled "Untitled.mlx \*". The interface includes a ribbon with tabs for "LIVE EDITOR", "INSERT", and "VIEW". The "LIVE EDITOR" tab is active, displaying a toolbar with icons for file operations (New, Open, Save, Compare, Print), navigation (Go To, Find), text formatting (Normal, Bold, Italic, Underline, Monospace), code execution (Run, Step, Stop), and other tools. The main workspace contains a script editor with three lines of code:

```
1 a = 0; b = 1;  
2  
3 |
```

The cursor is positioned at the end of the third line. The status bar at the bottom indicates the current position is "Ln 3 Col 1".

Untitled.mlx \*

LIVE EDITOR INSERT VIEW A N ?

New Open Save Find Files Compare Print Go To Find Text Normal B I U M Code SECTION Run Step Stop

FILE NAVIGATE TEXT CODE RUN

```
1 a = 0; b = 1;  
2  
3 a != b
```

script Ln 3 Col 3

Untitled.mlx \*

LIVE EDITOR INSERT VIEW

New Open Save Find Files Compare Print Go To Find Text Code SECTION Run Step Stop

```
1 a = 0; b = 1;
2
3 a != b
```

Invalid use of operator.

Did you mean:

```
a ~= b
```

Fix

script Ln 3 Col 8

Untitled.mlx \*

LIVE EDITOR INSERT VIEW

New Open Save Find Files Compare Print Go To Find Text Normal B I U M Code SECTION Run Step Stop

```
1 a = 0; b = 1;
2
3 a != b
```

Invalid use of operator.

Did you mean:

```
a ~= b
```

Fix

script Ln 3 Col 8

Untitled.mlx \*

LIVE EDITOR    INSERT    VIEW    A N ?

New Open Save Find Files Compare Print Go To Find Text Code SECTION Run Step Stop

FILE    NAVIGATE    TEXT    CODE    RUN

```
1 a = 0; b = 1;
2
3 a ~= b

ans = logical
    1
```

script    Ln 3 Col 8

# Code compatibility report

R2017b

codeCompatibilityReport

## Code Compatibility Report

[Top](#)    73 [Syntax](#)    17 [Errors](#)    21 [Warnings](#)  
180 [Improvements](#)    380 [Checks](#)    2163 [Files](#)

**Analysis Date:** 22-May-2018 09:41:41

**MATLAB Version:** R2018b

### ▼ Syntax Errors

Update your code. Syntax errors result in nonrunnable code and impact code compatibility. Typically, syntax errors are not introduced with a new version of MATLAB.

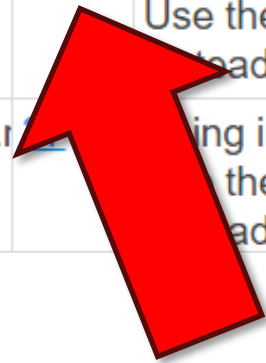
Occurrence	Filename
12	<a href="#">dicomConvertServer.m</a>
10	<a href="#">hdrInitDcm.m</a>
8	<a href="#">SynovcoElectroChromicGlass_3Sim</a>
7	<a href="#">findTracer.m</a>

# Fix incompatibility errors from the report

## ▼ Incompatibility Errors

Update your code to work in the current release. Incompatibility errors indicate that functionality has been removed.

Row ▲	Filename	Line	Description	Details
1	fanno_demo.m	<a href="#">83</a>	Using integers to specify location not supported. Use the location parameter name and value pair instead.	<a href="#">Details</a>
2	friction_free_demo.m		Using integers to specify location not supported. Use the location parameter name and value pair instead.	<a href="#">Details</a>



```
81 - ylabel('bar')
82 - title Pressure
83 - legend('SRK', 'Ideal gas', 1)
```

Editor



# Fix incompatibility errors from the report

## ▼ Incompatibility Errors

Update your code to work in the current release. Incompatibility errors indicate that functionality has been removed.

Row ▲	Filename	Line	Description	Details
1	fanno_demo.m	<a href="#">83</a>	Using integers to specify location not supported. Use the location parameter name and value pair instead.	<a href="#">Details</a>
2	friction_free_demo.r	<a href="#">37</a>	Using integers to specify location not supported. Use the location parameter name and value pair instead.	<a href="#">De</a>



## ▼ Functionality being removed or changed ⚠

Functionality	Result	Use This Instead	Compatibility Considerations
plotyy function	Still runs	<a href="#">yyaxis</a>	Replace all instances of plotyy with yyaxis
polar function	Still runs	<a href="#">polarplot</a>	Replace all instances of polar with polarplot

# Fix incompatibility errors from the report

## ▼ Functionality being removed or changed ⚠

Functionality	Result	Use This Instead	Compatibility Considerations
plotyy function	Still runs	<code>yyaxis</code>	Replace all instances of <code>plotyy</code> with <code>yyaxis</code>
polar function	Still runs	<code>polarplot</code>	Replace all instances of <code>polar</code> with <code>polarplot</code>

## ▼ polar is not recommended

Not recommended starting in R2016a

`polar` is not recommended. Use `polarplot` instead. There are no plans to remove `polar`.

**To update your code**, change instances of the function name `polar` to `polarplot`. You do not need to change the input arguments. For example, use `polarplot(rho, theta)`.

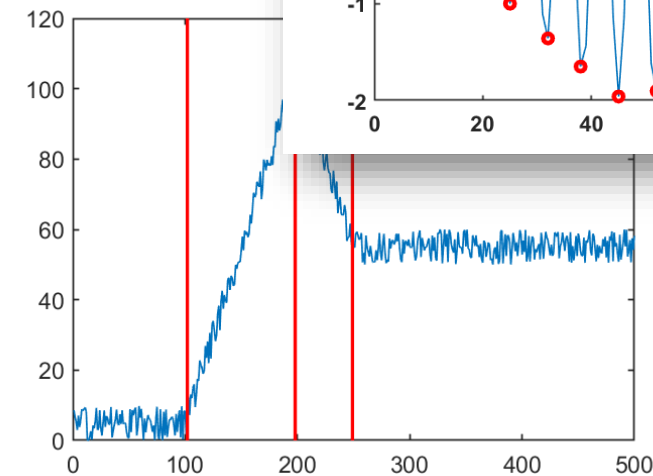
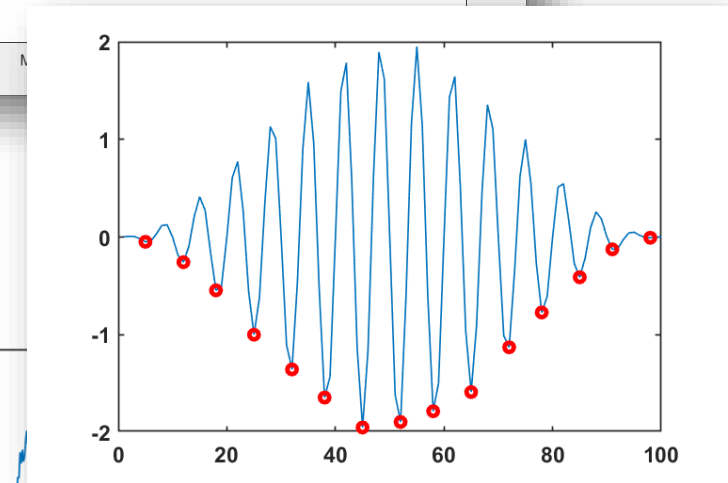
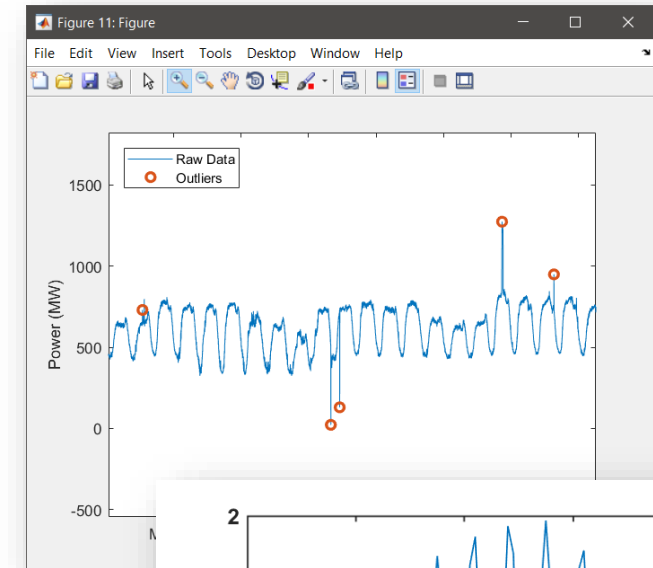
**Unlike the `polar` function**, which uses an `Axes` object, the `polarplot` function uses a `PolarAxes` object.

- More detailed compatibility release notes

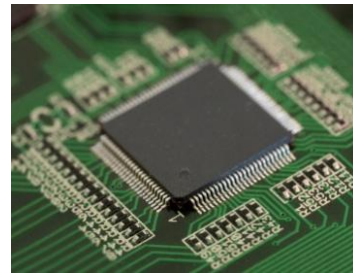
**R2018b**

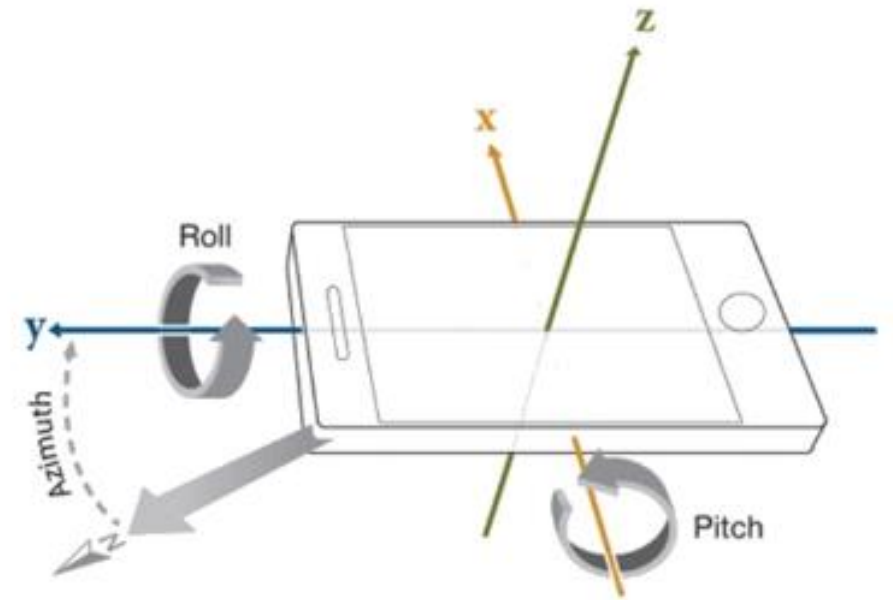
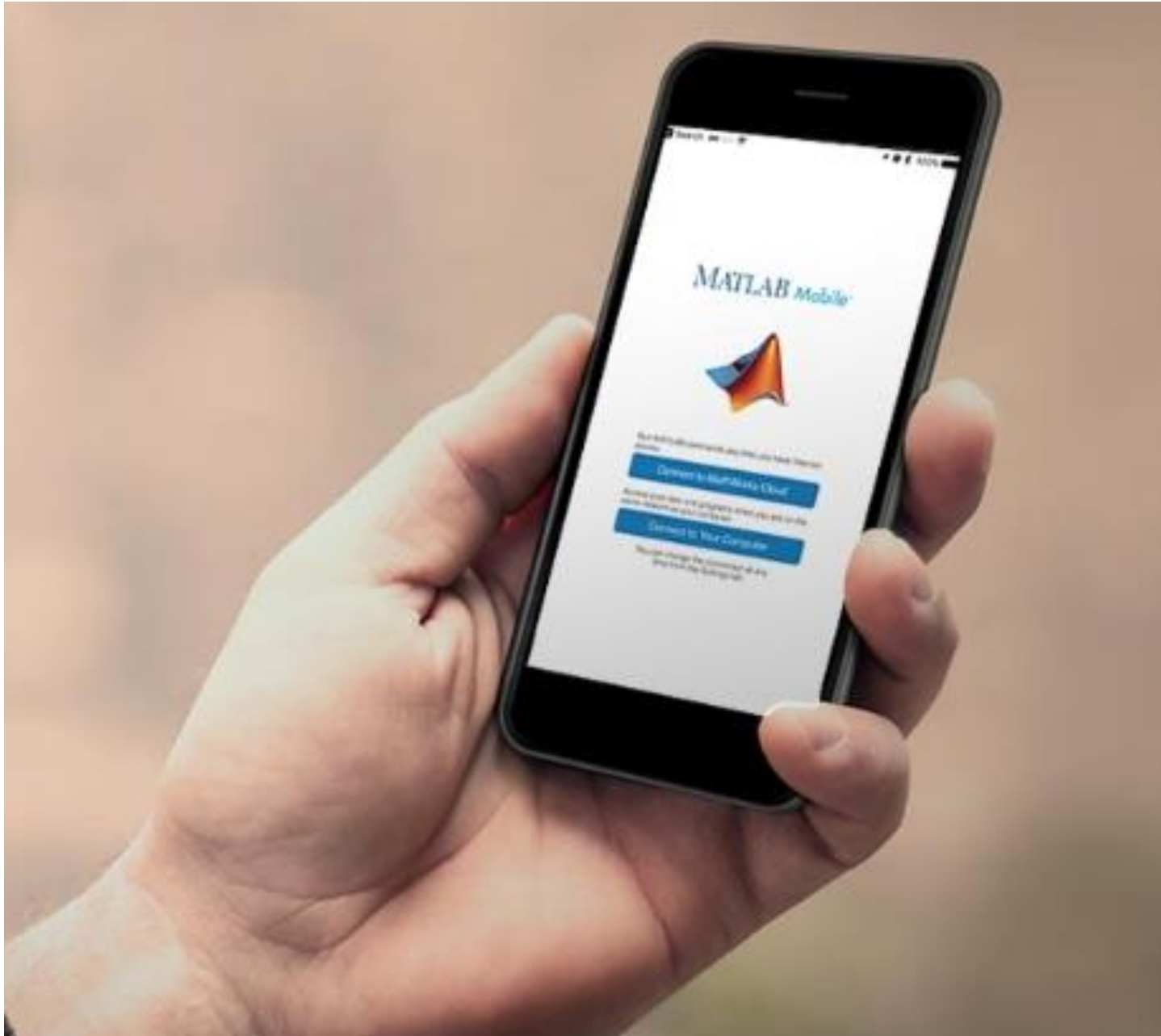
# Preprocessing & Analysis

- More easily deal with outliers with
  - `isoutlier` and `filloutliers` **R2017a**
  - `rmoutliers` **R2018b**
- Detect local minima and maxima **R2017b** using `islocalmin` and `islocalmax`
- Detect abrupt changes in data with `ischange` **R2017b**



# Hardware Connectivity





# Hardware Integration

The image shows the MATLAB R2018b software interface. The top ribbon includes tabs for HOME, PLOTS, APPS, and SHORTCUTS. The ribbon contains various tool icons for file operations, workspace management, code execution, and environment settings. The current folder path is `\\mathworks\public > Ned_Gulley > share > Fractal Basin Boundaries`. The workspace table lists several files and folders:

Name	Date Modified	Type
pendulum	9/24/2018 2:24 PM	Folder
phantom	9/19/2018 6:29 PM	Folder
simulink_files	10/23/2017 12:53 PM	Folder
animate_pendulum.m	9/19/2018 1:51 PM	Script
basin1.gif	10/11/2017 5:59 PM	GIF File
basin2.gif	10/11/2017 5:58 PM	GIF File
florence.mlx	9/26/2018 6:26 PM	Live Script
flying_phone.m	9/11/2018 5:34 PM	Script
fractal_basin_boundaries.mlx	9/25/2018 1:31 PM	Live Script
fractal_basin_runner.gif	10/18/2017 2:16 PM	GIF File
fractal_basin_runner.m	10/23/2017 2:22 PM	Script
massPendulumAnimation.mlx	2/22/2018 7:25 PM	Live Script
massPendulumAnimator.gif	2/23/2018 11:53 AM	GIF File

The Command History window shows the following commands:

```
a = 1
b = 2
a ~= b
- a != b
a ~= b
1
a
3
%-- 9/25/2018 2:33 PM --%
get(gca, 'colororder')
dbcont
y
- max(theta)
max(theta0)
y(1,end)
```

The Add-Ons menu is open, showing options: Get Add-Ons, Manage Add-Ons, Package Toolbox, Package App, Get Hardware Support Packages, and Check for Updates.

The Command Window at the bottom shows the prompt `fx >>`.

Search Documentation Ned

Analyze Code Run and Time Clear Commands

Simulink Layout Set Path Parallel

CODE SIMULINK ENVIRONMENT

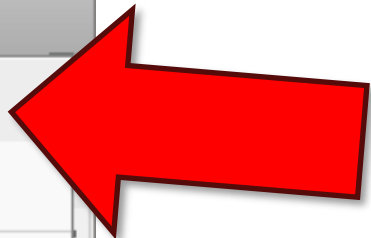
asin Boundaries

Type

- Folder
- Folder
- Folder
- Script
- GIF File
- GIF File
- Live Script
- Script
- Live Script
- GIF File
- Script
- Live Script
- GIF File

Command History

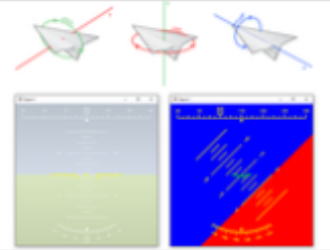
```
a = 1
b = 2
a ~= b
- a != b
a ~= b
1
a
3
%-- 9/25/2018 2:33 PM --%
get(gca, 'colororder')
dbcont
y
- max(theta)
max(theta0)
y(1,end)
```



- Get Add-Ons
- Manage Add-Ons
- Package Toolbox
- Package App
- Get Hardware Support Packages
- Check for Updates >

Add-On Explorer Contribute | Manage Add-Ons

Search for add-ons



## Artificial horizon

version 1.2.0.0 (13.9 KB) by Eric Ogier

Artificial horizon for aircraft

Collection

★★★★★ 5 Ratings

4 Downloads ⓘ

Updated 21 Nov 2017

[View License](#)

[Add ▾](#)

- Add to MATLAB
- Download and add to path ☞
- Download Only...

Overview Functions

"Artificial horizon" is a graphical object consisting of an on screen artificial horizon for aircraft, including.

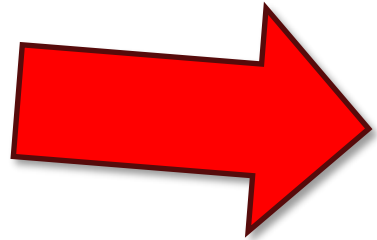
- Virtual horizon line between sky and ground symbols
- Reticle symbolising aircraft longitudinal axis or speed vector
- Attitude indicators :
  - . Pitch indicator, range :  $]-180^\circ, +180^\circ]$ , field of view :  $40^\circ$
  - . Roll indicator, range :  $]-180^\circ, +180^\circ]$ , field of view :  $60^\circ$
  - . Heading indicator, range :  $[-90^\circ, +90^\circ]$ , field of view :  $60^\circ$

All attitude gauges have the following characteristics:

- Reference markings : cardinal points, null pitch and null roll
- Resolution of  $2.5^\circ$  for graduating
- Specific graduatings for modulo  $2.5^\circ$ ,  $5^\circ$  and  $10^\circ$  angles

Attitude can be updated by an object method through the three Euler angles [rad], respecting this aeronautical

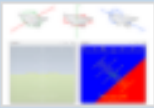


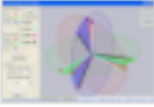

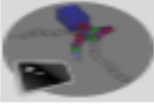


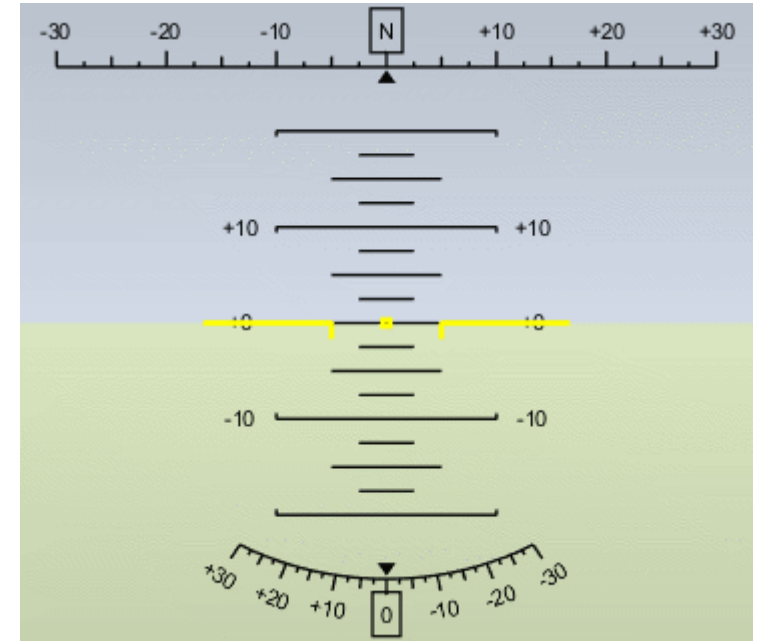
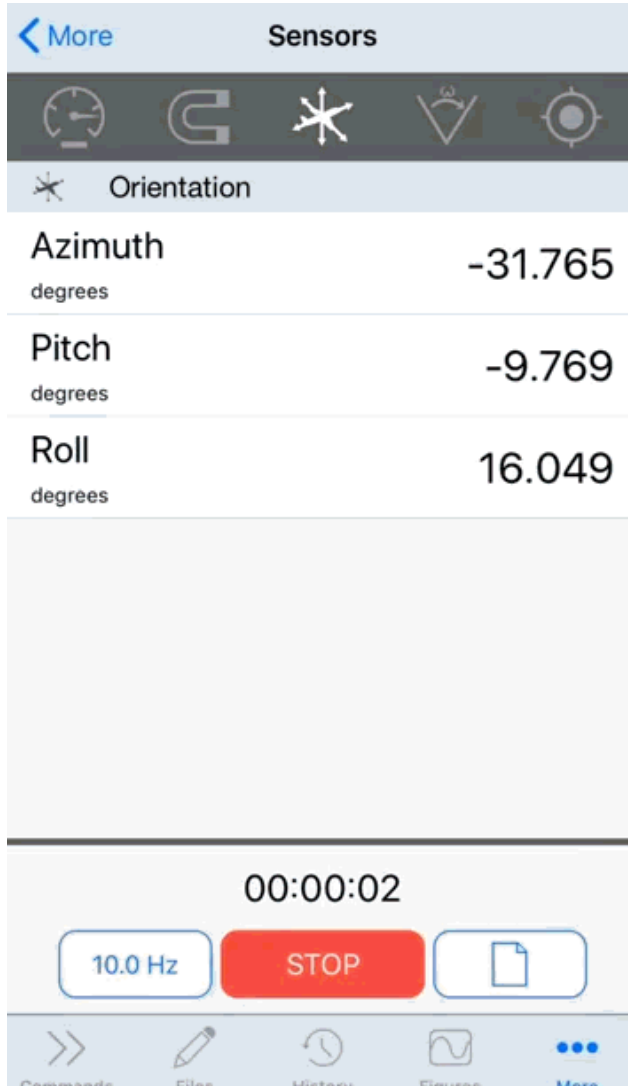


Add-On Manager

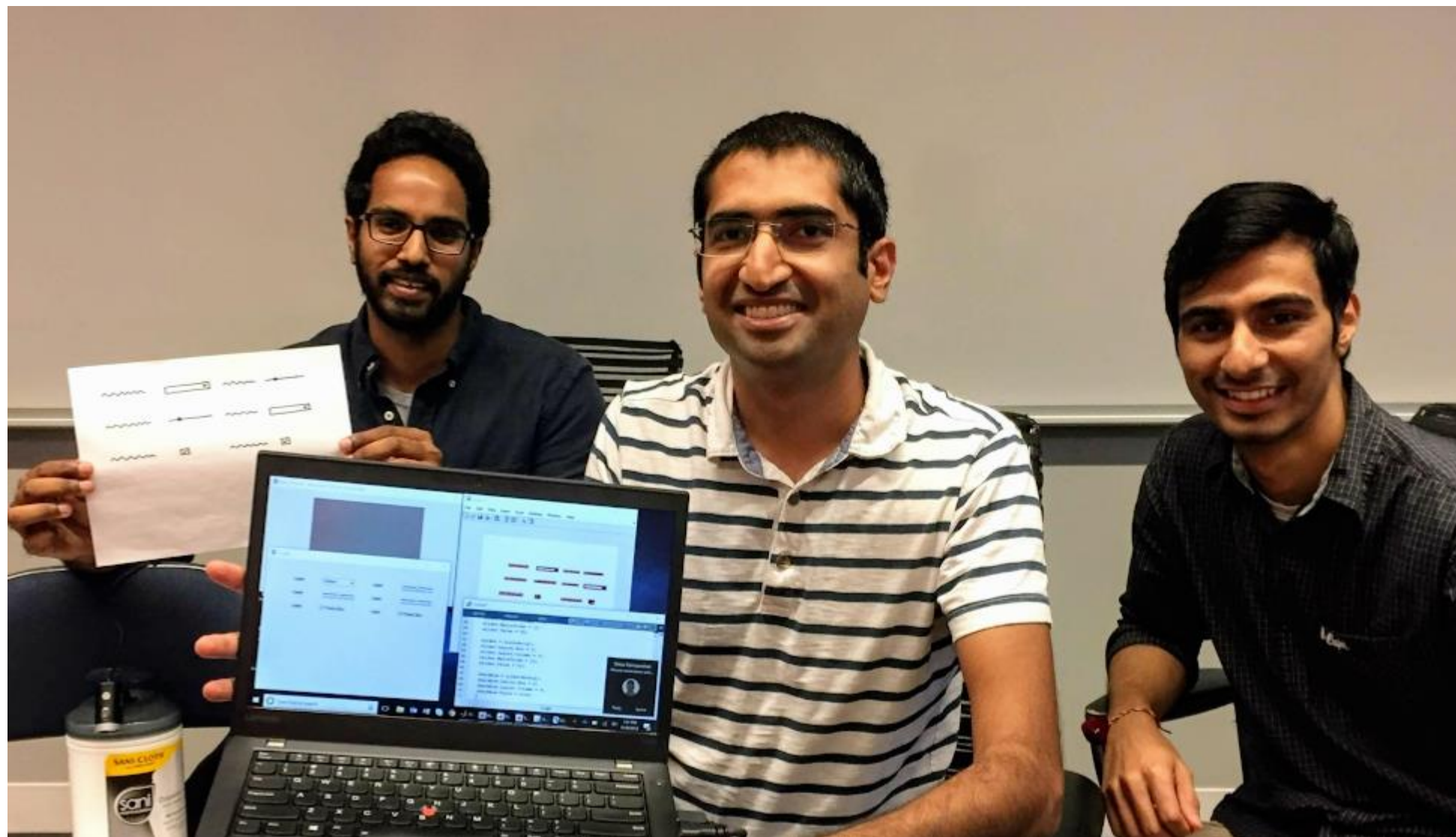
Get Add-Ons

Installed (19)

Name	Type	Author	Install...	
 <b>Artificial horizon</b> version 1.2.0.0	Collection	Eric Ogier	27 Septem...	⋮
 <b>Flight Visualization</b> version 1.0.0.0	Collection	Gus Brown	19 Septem...	⋮
 <b>A380</b> version 1.0.0.0	Collection	Stepen Stepen	19 Septem...	⋮
 <b>Understanding the Euler Angles</b> version 1.0.0.0	Collection	Divahar Jayaraman	23 August ...	⋮
 <b>mArrow3.m - easy-to-use 3D arrow</b> version 1.0.0.0	Function	Georg Stillfried	22 August ...	⋮
 <b>Rigid motions and robotics toolbox</b> version 1.1	Toolbox	Antonio Tristán Vega	22 August ...	⋮

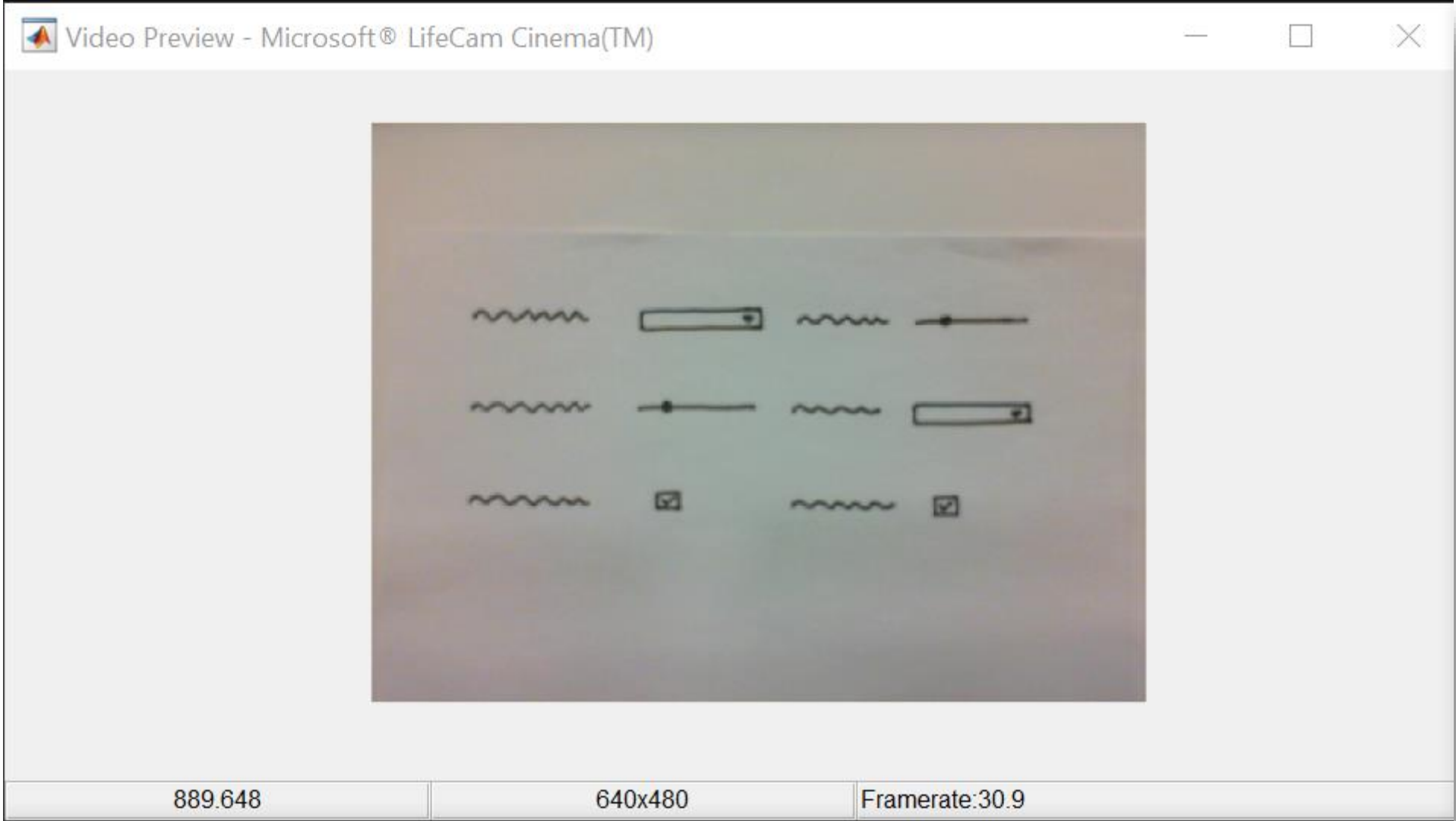


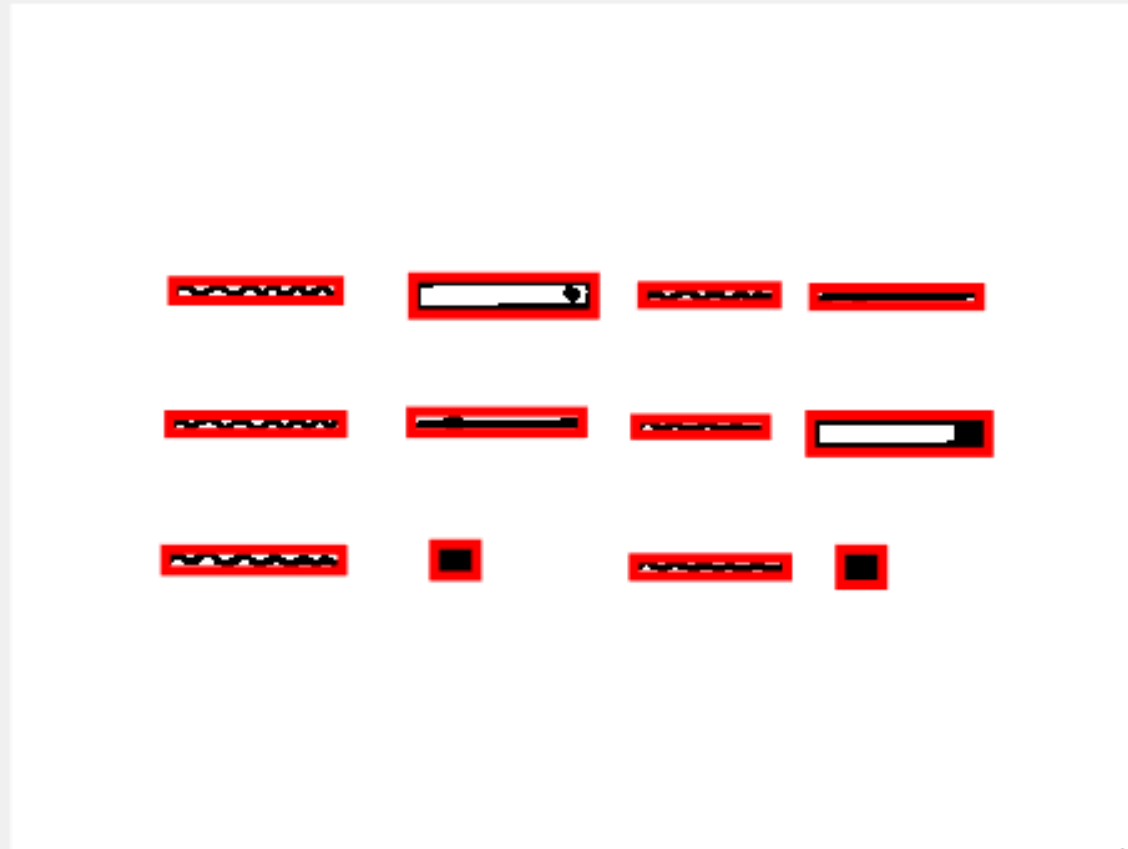
# Deep Learning



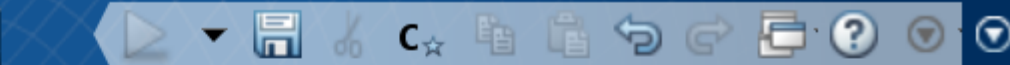
# MathWorks Hack Day





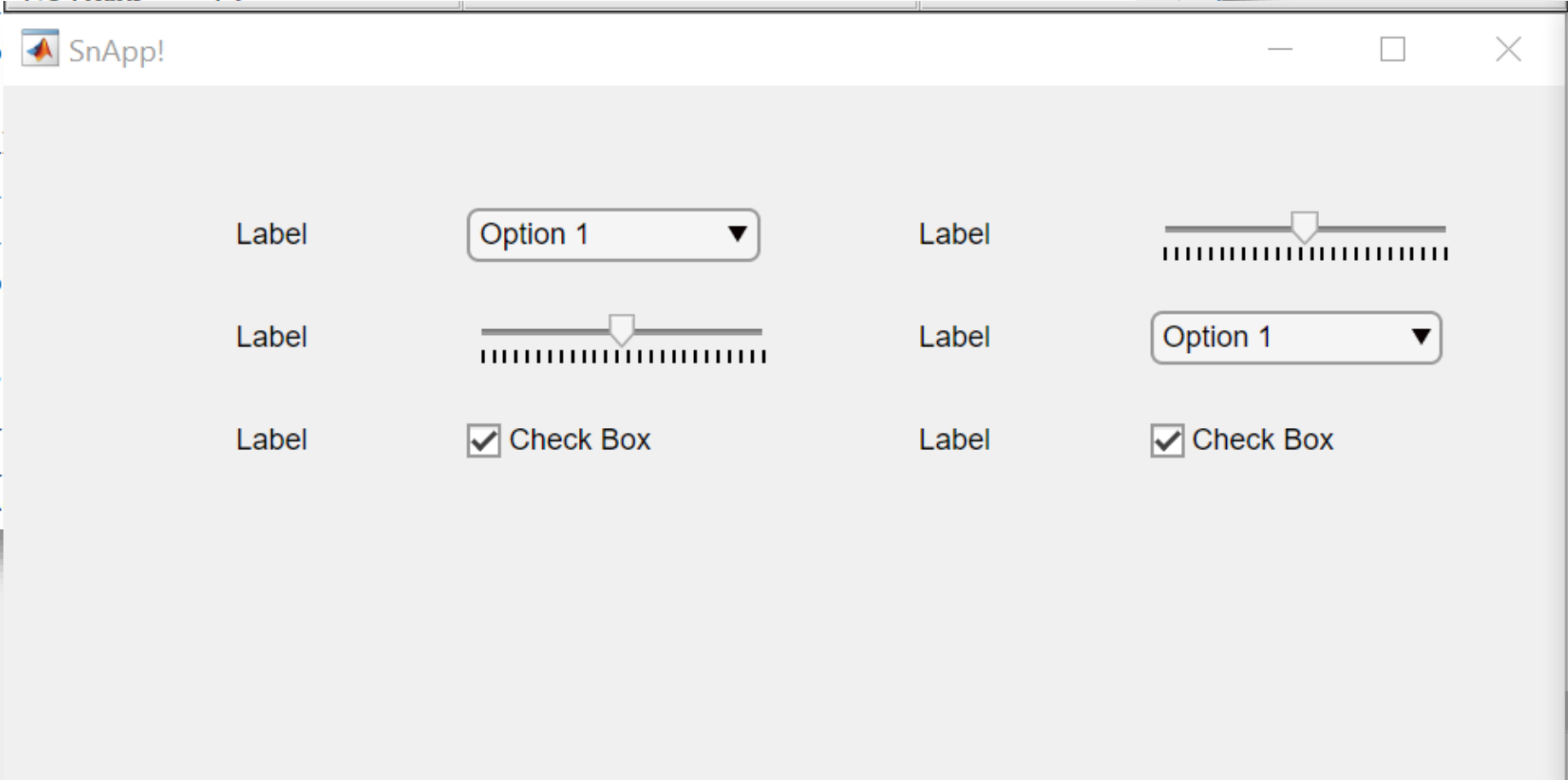


```
14
15     label = UILabel(g);
16     label.Layout.Row = 2;
17     label.Layout.Column = 1;
18     label.HorizontalAlignment = 'center';
19
20     label = UILabel(g);
21     label.Layout.Row = 1;
22     label.Layout.Column = 1;
23     label.HorizontalAlignment = 'center';
24
25     slider = UISlider(g);
26     slider.Layout.Row = 2;
27     slider.Layout.Column = 2;
28     slider.MajorTicks = [];
```

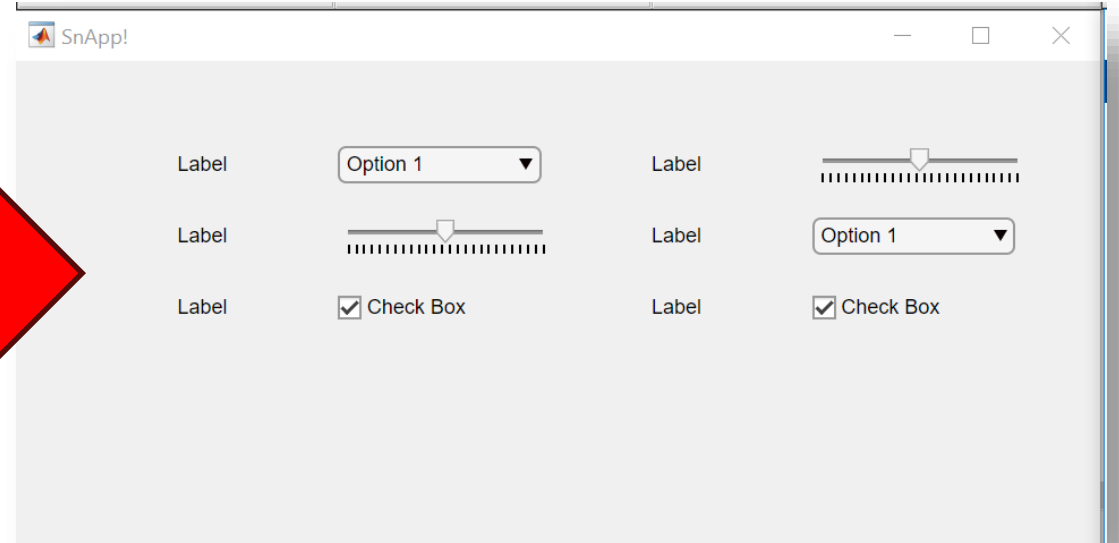
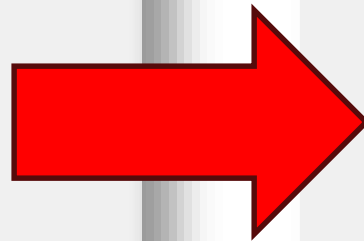
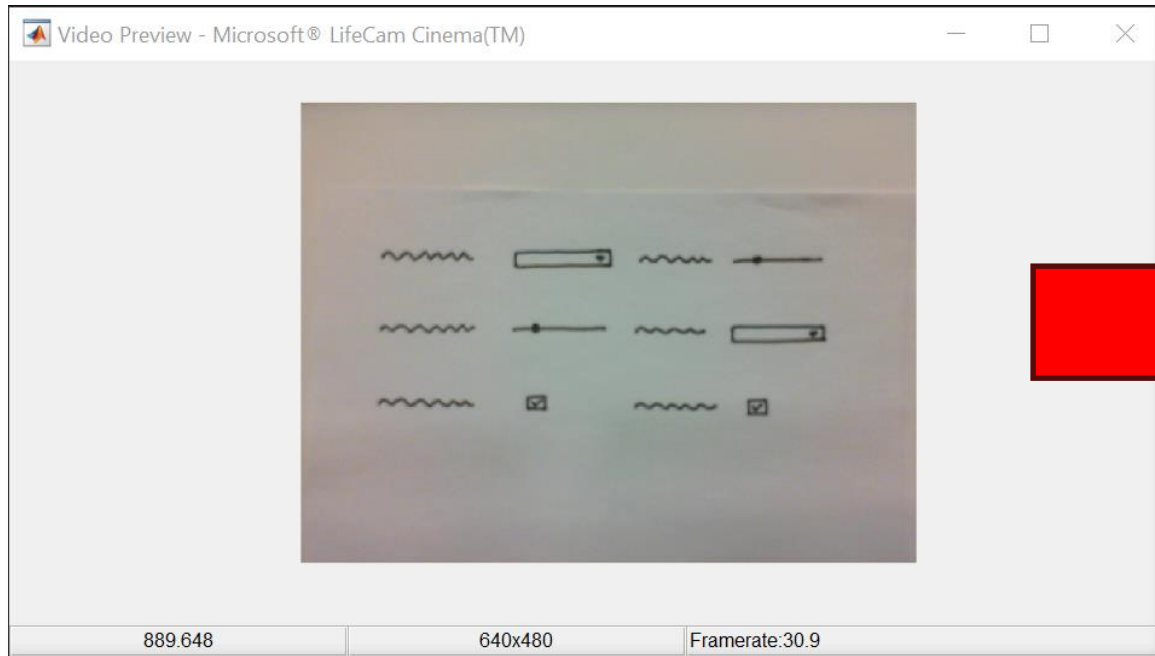


```

14
15 label = uilabel(g);
16 label.Layout.Row = 2;
17 label.Layout.Column = 1;
18 label.Horizontal = 'left';
19
20 label = uilabel(g);
21 label.Layout.Row = 2;
22 label.Layout.Column = 1;
23 label.Horizontal = 'left';
24
25 slider = uislider(g);
26 slider.Layout.Row = 2;
27 slider.Layout.Column = 1;
28 slider.MajorTicks = 10;
    
```







# MATLAB and Simulink Training

Overview | Course Offerings | Course Schedule | Self-Paced

## Deep Learning Onramp

This free, two-hour deep learning tutorial provides an introduction to practical deep learning methods to use deep learning techniques in MATLAB® for image recognition.

889.648

640x480

Framerate:30.9

### Documentation

All Examples Functions More ▾

Search R2018b Document...

☰ CONTENTS Close

« Documentation Home  
« Deep Learning Toolbox

Getting Started with Deep Learning Toolbox

#### Deep Learning with Images

Deep Learning with Time Series, Sequences, and Text

Deep Learning Tuning and Visualization

Deep Learning in Parallel and in the Cloud

Deep Learning Applications

Deep Learning Import, Export, and Customization

Deep Learning Code Generation

Function Approximation and Clustering

Time Series and Control Systems

⏴ Trial Software

## Deep Learning with Images

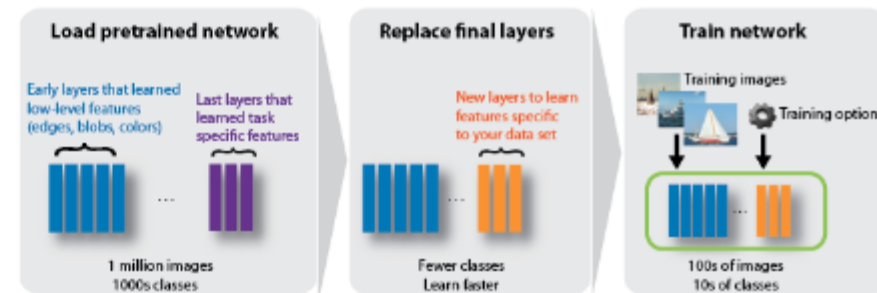
Train convolutional neural networks from scratch or use pretrained networks

Create new deep networks for image classification and regression tasks by defining a network from scratch. You can also use transfer learning to take advantage of a pretrained network to learn new patterns in new data. Fine-tuning a pretrained image classification network is typically much faster and easier than training from scratch. Using pretrained networks for regression tasks without defining and training a new network, having millions of images, is also possible.

After defining the network architecture, you must define training parameters and then train the network using `trainNetwork`. Use the trained network to predict class probabilities.

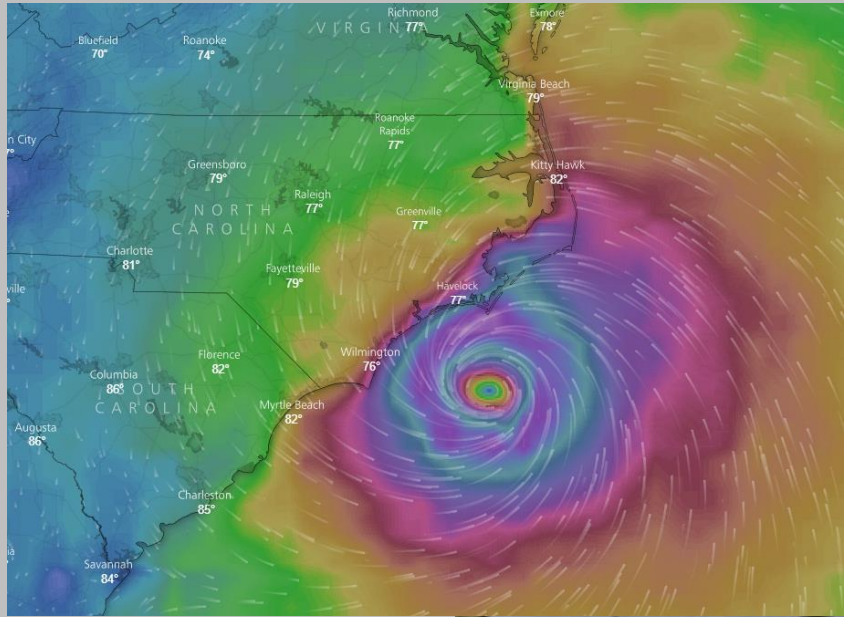
You can train a convolutional neural network on a CPU, a GPU, multiple CPUs, or a cloud. Training on a GPU or in parallel requires Parallel Computing Toolbox™. Training on an NVIDIA® GPU with compute capability 3.0 or higher. Specify the execution environment using `ExecutionEnvironment`.

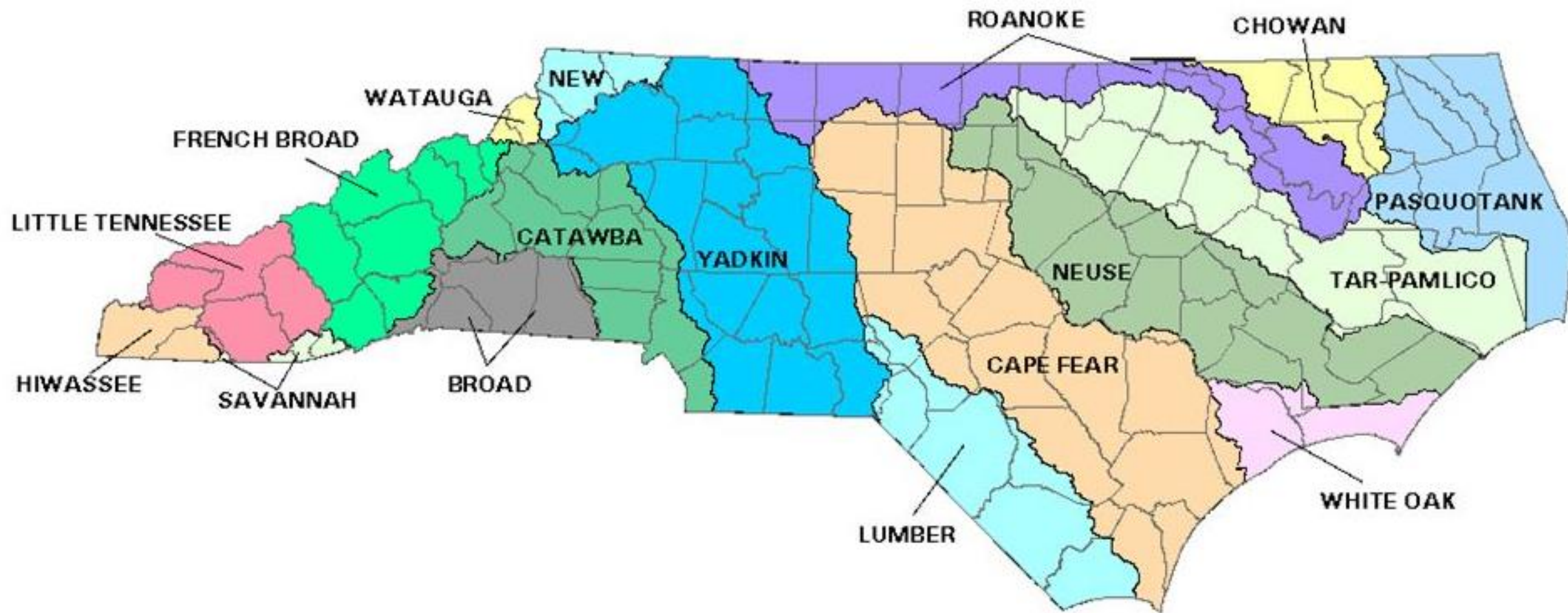
### Reuse Pretrained Network

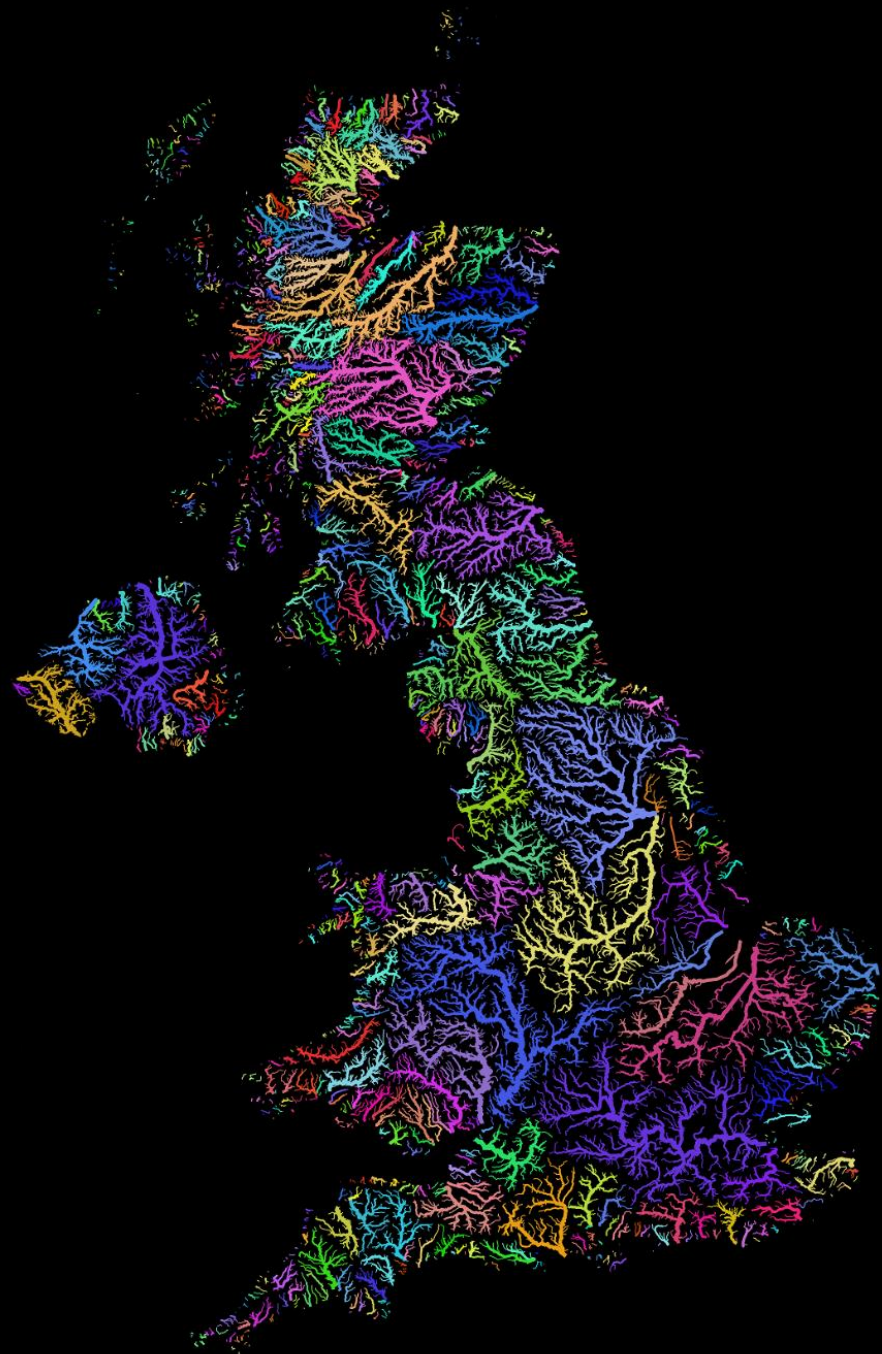


Act II:

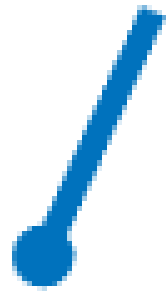
# The Mysterious Pendulum



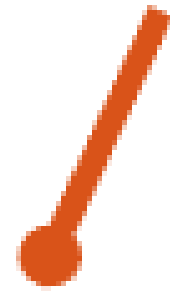
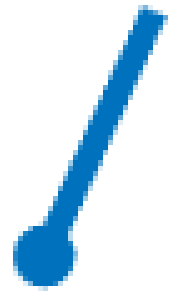


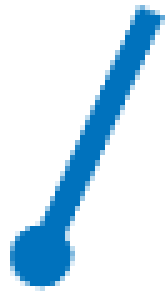






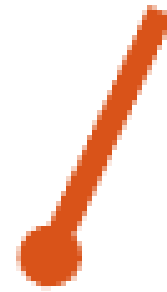






Basin 1.

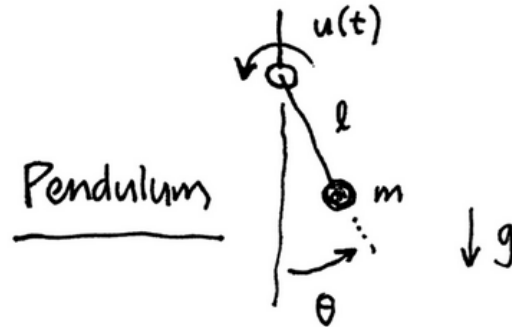
$$\theta \rightarrow 0$$



Basin 2.

$$\theta \rightarrow 360$$

## A Mysterious Pendulum



$$\ddot{\theta} + 0.1 \cdot \dot{\theta} + \sin \theta = 0$$

$$y = \begin{bmatrix} \theta \\ \dot{\theta} \end{bmatrix}$$

$$\dot{y} = \begin{bmatrix} y(2) \\ -0.1 \cdot y(2) - \sin y(1) \end{bmatrix}$$

```

1 pend = @(t,y) [ ...
2   y(2);
3   -0.1*y(2) - sin(y(1)) ];
4
5 r2d = 180/pi;
6 tFinal = 40;

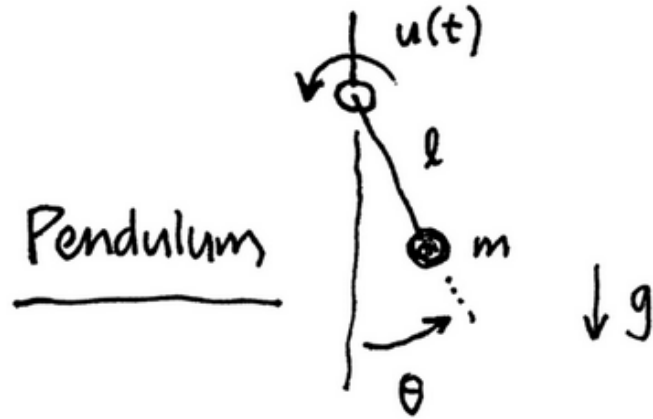
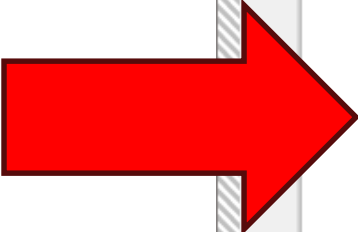
```

```

7 theta0 = 101  ;
8 thetaDot0 = 64  ;
9
10 y0 = [theta0 thetaDot0] / r2d;
11
12 [t,y] = ode45(pend,[0 tFinal],y0);
13 plot_theta(t,y(:,1)*r2d)

```

## A Mysterious Pendulum



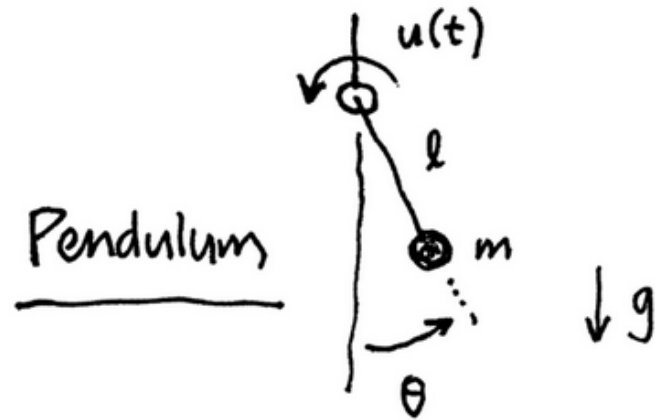
$$\ddot{\theta} + 0.1 \cdot \dot{\theta} + \sin \theta = 0$$

$$y = \begin{bmatrix} \theta \\ \dot{\theta} \end{bmatrix}$$

$$\dot{y} = \begin{bmatrix} y(2) \\ -0.1 \cdot y(2) - \sin y(1) \end{bmatrix}$$

```
1 pend = @(t,y) [ ...
2   y(2);
3   -0.1*y(2) - sin(y(1)) ];
4
5 r2d = 180/pi;
6 tFinal = 40;
```

## A Mysterious Pendulum

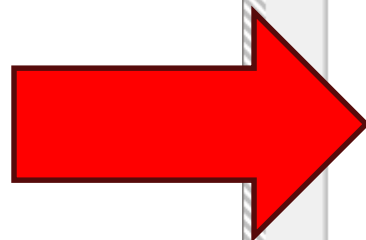


$$\ddot{\theta} + 0.1 \cdot \dot{\theta} + \sin \theta = 0$$

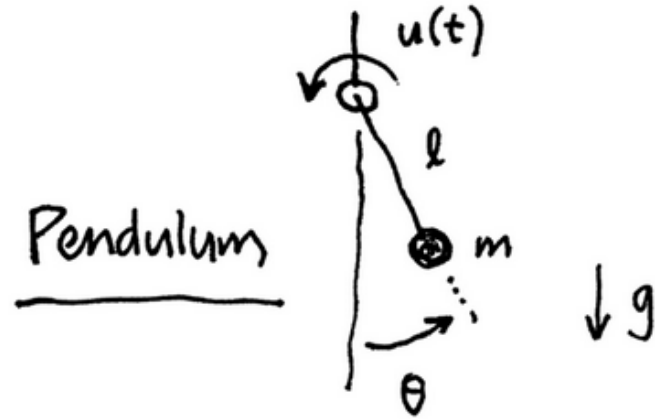
$$y = \begin{bmatrix} \theta \\ \dot{\theta} \end{bmatrix}$$

$$\dot{y} = \begin{bmatrix} y(2) \\ -0.1 \cdot y(2) - \sin y(1) \end{bmatrix}$$

```
1 pend = @(t,y) [ ...
2   y(2);
3   -0.1*y(2) - sin(y(1)) ];
4
5 r2d = 180/pi;
6 tFinal = 40;
```



## A Mysterious Pendulum



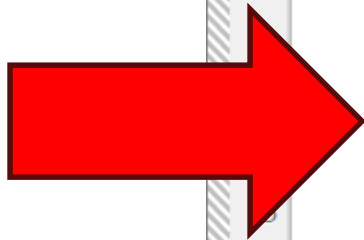
$$\ddot{\theta} + 0.1 \cdot \dot{\theta} + \sin \theta = 0$$

$$y = \begin{bmatrix} \theta \\ \dot{\theta} \end{bmatrix}$$

$$\dot{y} = \begin{bmatrix} y(2) \\ -0.1 \cdot y(2) - \sin y(1) \end{bmatrix}$$

```
pend = @(t,y) [ ...  
    y(2);  
    -0.1*y(2) - sin(y(1)) ];
```

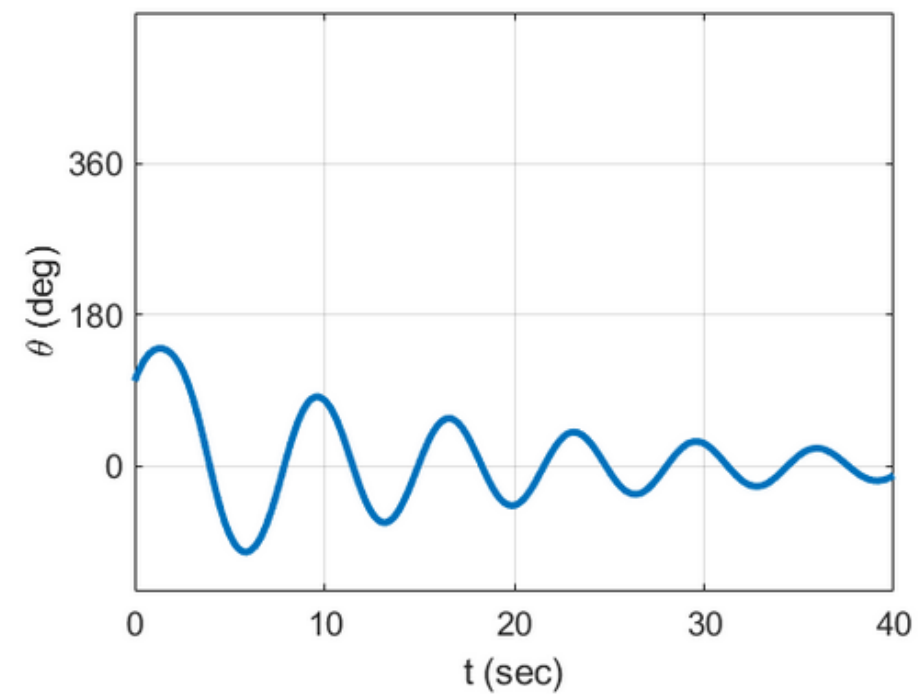
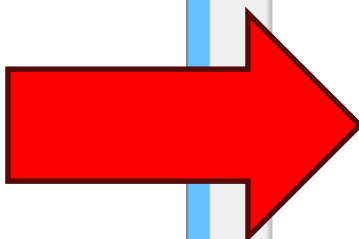
```
r2d = 180/pi;  
tFinal = 40;
```



6  
7  
8  
9  
10  
11  
12  
13

```
r2d = 180/pi;  
tFinal = 40;
```

```
theta0 = 101 ;  
thetaDot0 = 64 ;  
  
y0 = [theta0 thetaDot0] / r2d;  
  
[t,y] = ode45(pend,[0 tFinal],y0);  
plot_theta(t,y(:,1)*r2d)
```



Plotting function

6

```
r2d = 180/pi;  
tFinal = 40;
```

7

```
theta0 = 101 _____ ;
```

8

```
thetaDot0 = 64 _____ ;
```

9

10

```
y0 = [theta0 thetaDot0] / r2d;
```

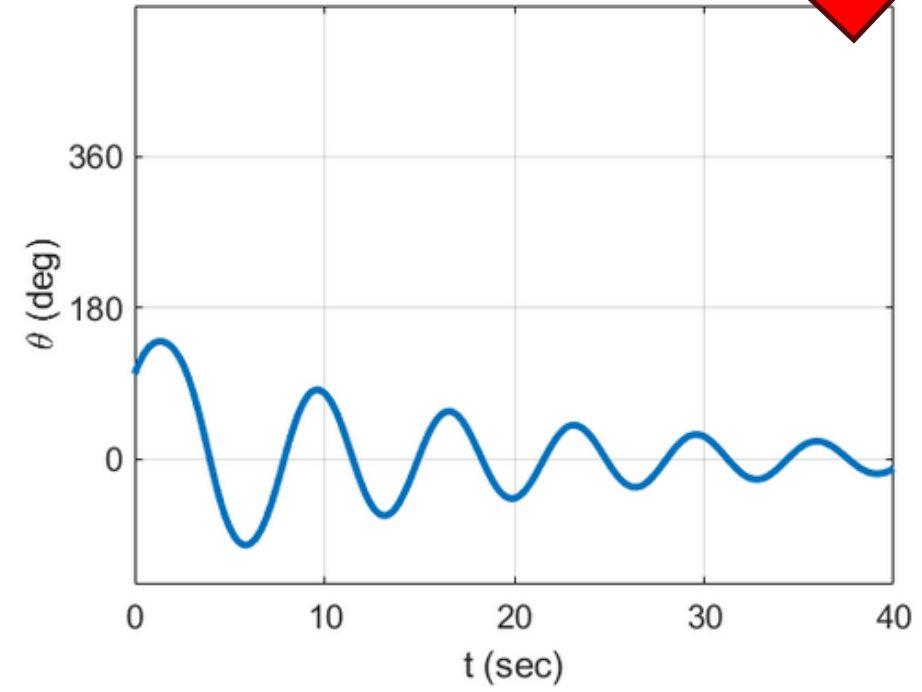
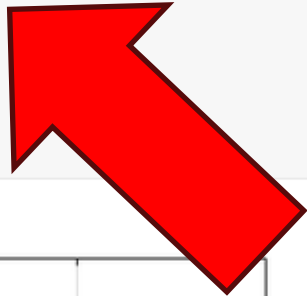
11

12

```
[t,y] = ode45(pend,[0 tFinal],y0);
```

13

```
plot_theta(t,y(:,1)*r2d)
```



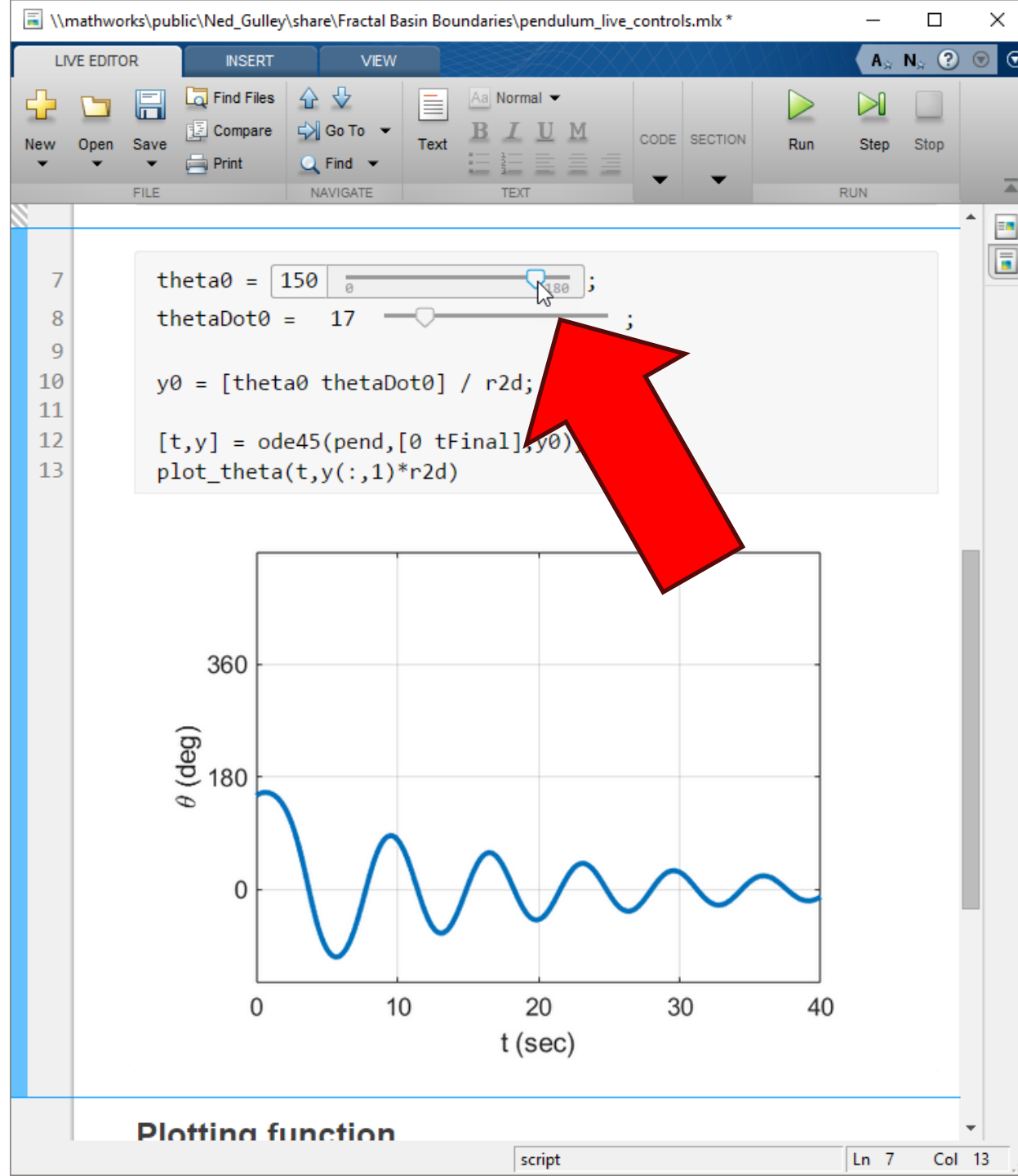
Plotting function

script

Ln 13 Col 25



# Live Controls



\\mathworks\public\Ned\_Gulley\share\Fractal Basin Boundaries\pendulum\_live\_controls.mlx \*

LIVE EDITOR    INSERT    VIEW    A, N, ?

New    Open    Save    Find Files    Compare    Go To    Text    Normal    CODE    SECTION    Run    Step    Stop

FILE    NAVIGATE    TEXT    RUN

```
7    theta0 = 124   180 ;  
8    thetaDot0 = 17   ;  
9  
10    y0 = [theta0 thetaDot0] / r;  
11  
12    [t,y] = ode45(pend,[0 tFinal],y0);  
13    plot_theta(t,y(:,1))*r2d
```

**Plotting function**

script    Ln 7    Col 13

\\mathworks\public\Ned\_Gulley\share\Fractal Basin Boundaries\pendulum\_live\_controls.mlx \*

LIVE EDITOR    INSERT    VIEW    A, N, ?

New    Open    Save    Find Files    Compare    Go To    Text    Normal    CODE    SECTION    Run    Step    Stop

FILE    NAVIGATE    TEXT    RUN

```
7    theta0 = 62      ;  
8    thetaDot0 = 17      ;  
9  
10    y0 = [theta0 thetaDot0];  
11  
12    [t,y] = ode45(pend,[0 tFinal] y0);  
13    plot_theta(t,y(:,1)*r2d)
```

**Plotting function**

script    Ln 7    Col 12

DESIGNER CANVAS

Save Apply Horizontally Apply Vertically Evenly Show grid Show alignment hints Show snap to grid Show resizing hints Interval: 10 Run

FILE ALIGN ARRANGE SPACE VIEW RUN

pendulum.mlapp x

COMPONENT LIBRARY

COMMON

- Axes
- Button
- Check Box
- Date Picker
- Drop Down
- Edit Field (Numeric)
- Edit Field (Text)
- Label
- List Box
- Radio Button Group
- Slider
- Spinner
- State Button
- Table
- Text Area
- Toggle Button Group
- Tree

CONTAINERS

- Panel
- Tab Group

Design View Code View

## Pendulum Simulation

Initial Conditions

theta 0 45 90 135 180

theta dot 0 25 50 75 100

### Pendulum Angle

$\theta$  0.5 0

0 0.2 0.4 0.6 0.8 1

time

Animate

COMPONENT BROWSER

Search

- app.UIFigure
  - app.UIAxes
  - app.AnimateButton
  - app.PendulumSimulationLabel
  - app.InitialConditionsPanel
    - app.thetaSlider
    - app.thetadotSlider

SLIDER & LABEL PROPERTIES

Configuration | Callbacks

Search

Label theta dot

SLIDER

Value 0

Limits 0,100

Orientation

TICKS

MajorTicks 0,25,50,75,100

MajorTickLabels 0,25,50,75,100

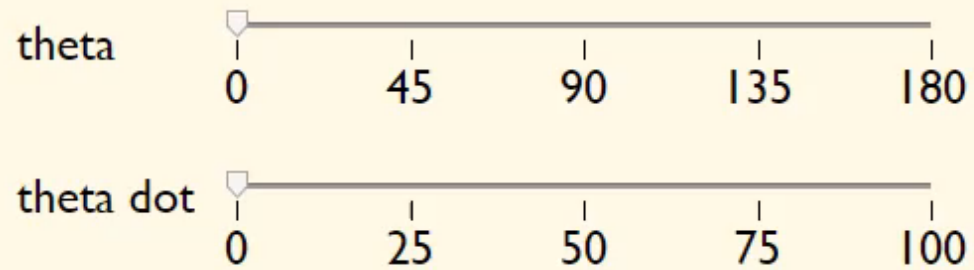
MinorTicks

FONT

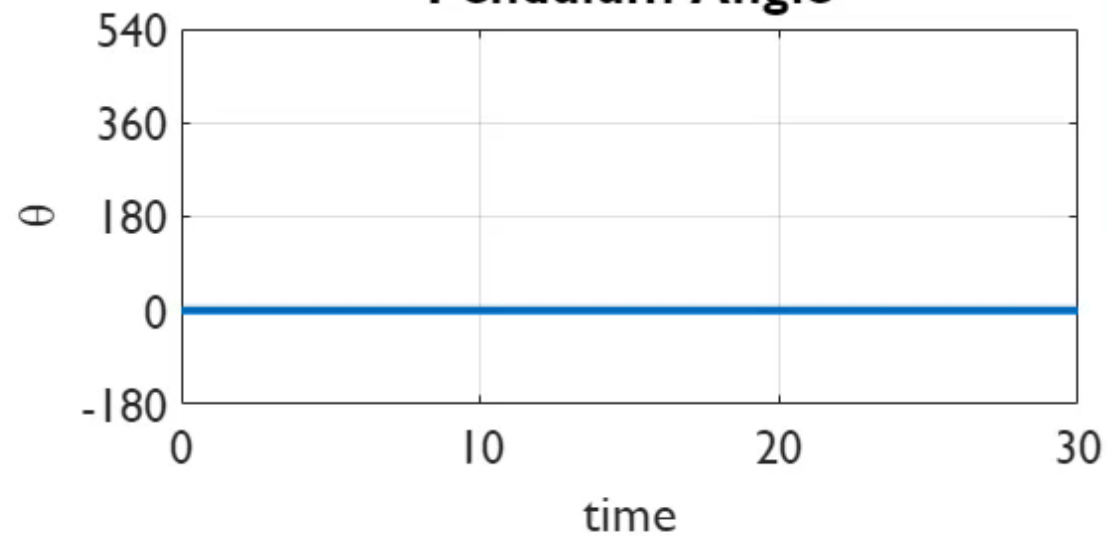
FontName Gill Sans MT

# Pendulum Simulation

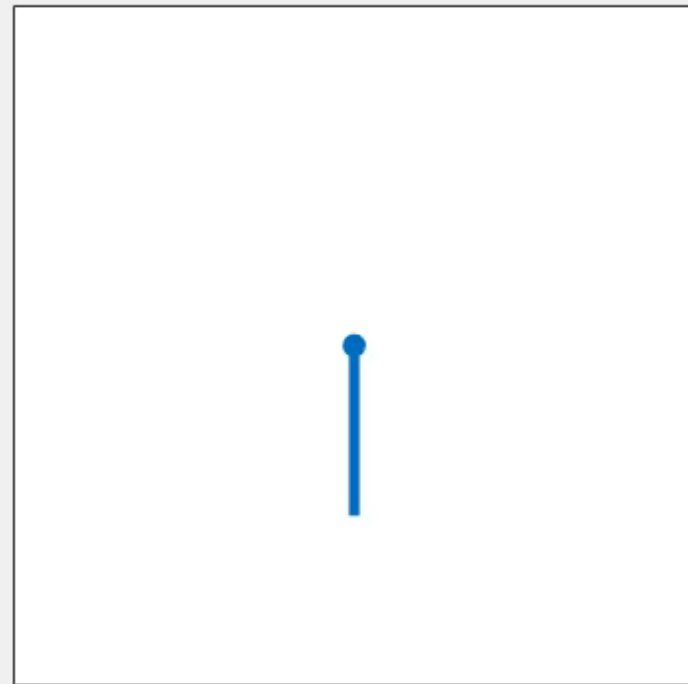
## Initial Conditions



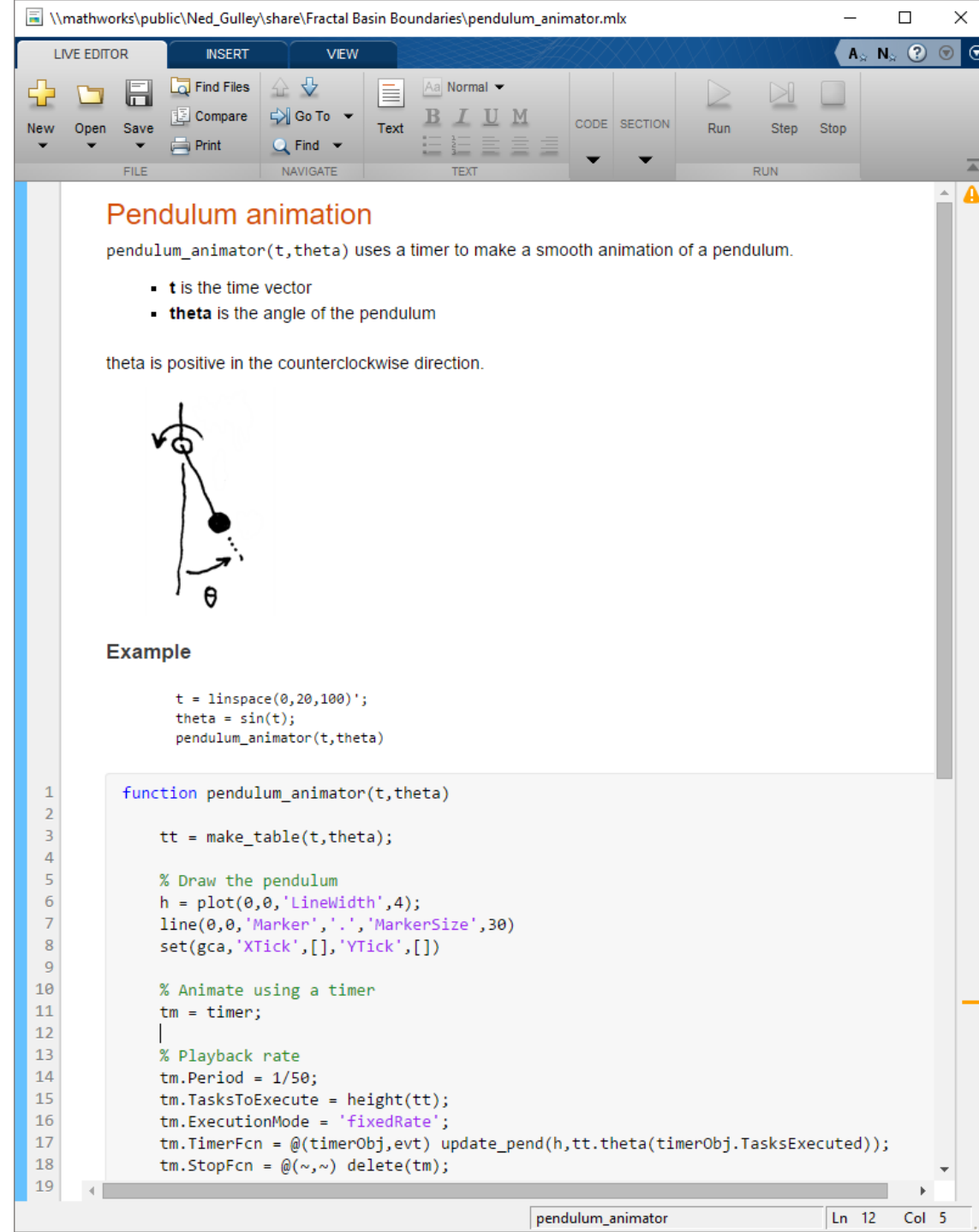
## Pendulum Angle



Animate



# Live Functions




The screenshot shows the MATLAB Live Editor interface. At the top, there are tabs for 'LIVE EDITOR', 'INSERT', and 'VIEW'. Below these are various toolbars including 'FILE', 'NAVIGATE', 'TEXT', and 'RUN'. The main content area displays the following text:

## Pendulum animation

pendulum\_animator(t,theta) uses a timer to make a smooth animation of a pendulum.

- **t** is the time vector
- **theta** is the angle of the pendulum

theta is positive in the counterclockwise direction.



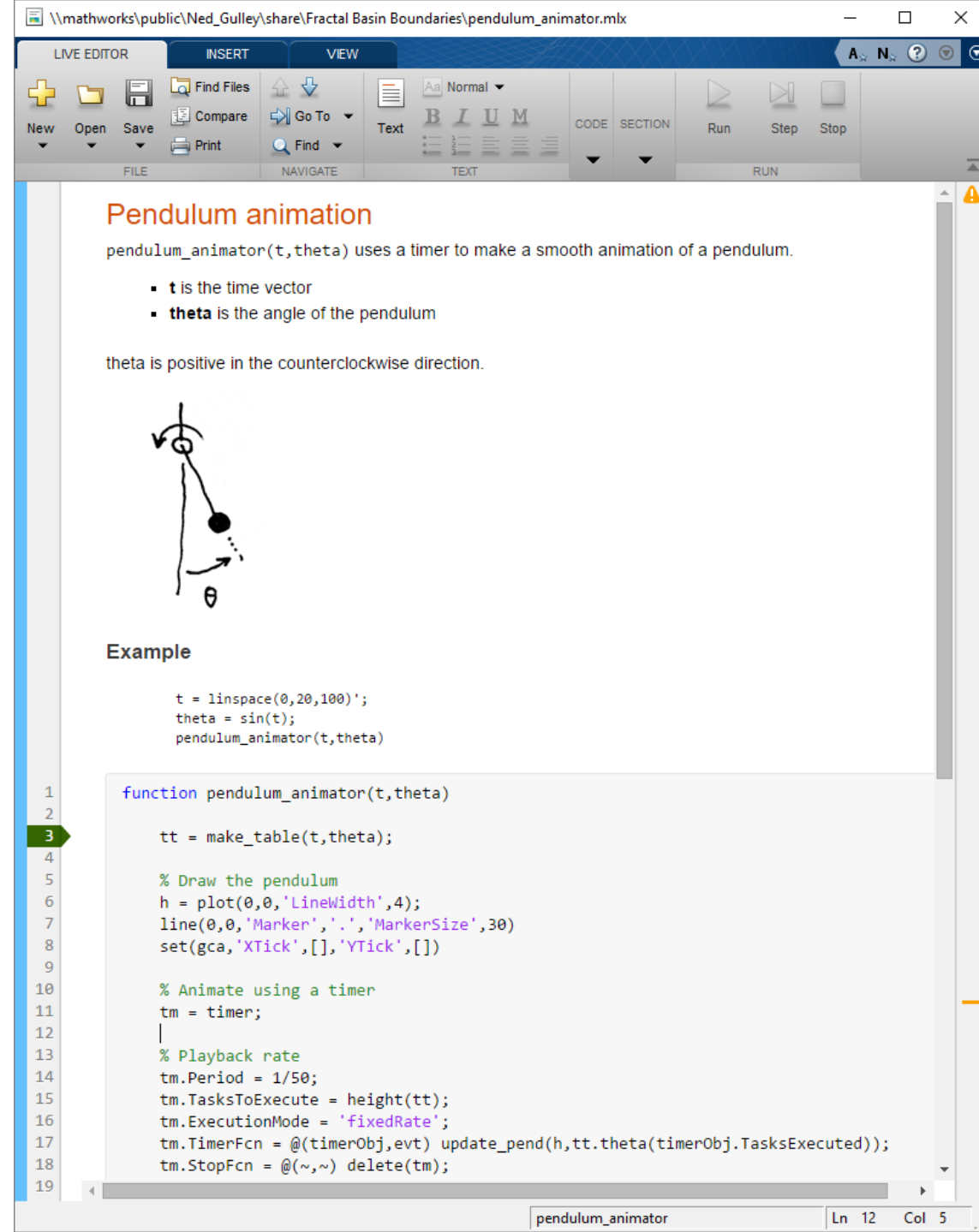
### Example

```
t = linspace(0,20,100)';  
theta = sin(t);  
pendulum_animator(t,theta)
```

```
1 function pendulum_animator(t,theta)  
2  
3     tt = make_table(t,theta);  
4  
5     % Draw the pendulum  
6     h = plot(0,0,'LineWidth',4);  
7     line(0,0,'Marker','.', 'MarkerSize',30)  
8     set(gca,'XTick',[], 'YTick',[])  
9  
10    % Animate using a timer  
11    tm = timer;  
12    |  
13    % Playback rate  
14    tm.Period = 1/50;  
15    tm.TasksToExecute = height(tt);  
16    tm.ExecutionMode = 'fixedRate';  
17    tm.TimerFcn = @(timerObj,evt) update_pend(h,tt.theta(timerObj.TasksExecuted));  
18    tm.StopFcn = @(~,~) delete(tm);  
19
```

The status bar at the bottom indicates the file name 'pendulum\_animator', line 12, and column 5.

# Debugging




The screenshot shows the MATLAB Live Editor interface. The title bar indicates the file path: \\mathworks\public\Ned\_Gulley\share\Fractal Basin Boundaries\pendulum\_animator.mlx. The interface is divided into three main sections: LIVE EDITOR, INSERT, and VIEW. The LIVE EDITOR section contains a toolbar with icons for New, Open, Save, Find Files, Compare, Print, Go To, and Find. The INSERT section contains a text editor with formatting options (Normal, Bold, Italic, Underline, Monospace) and a CODE SECTION dropdown. The VIEW section contains Run, Step, and Stop buttons. The main content area displays the following text:

**Pendulum animation**  
pendulum\_animator(t,theta) uses a timer to make a smooth animation of a pendulum.

- **t** is the time vector
- **theta** is the angle of the pendulum

theta is positive in the counterclockwise direction.



**Example**

```
t = linspace(0,20,100)';  
theta = sin(t);  
pendulum_animator(t,theta)
```

The code editor shows the function definition for pendulum\_animator:

```
1 function pendulum_animator(t,theta)  
2  
3     tt = make_table(t,theta);  
4  
5     % Draw the pendulum  
6     h = plot(0,0,'LineWidth',4);  
7     line(0,0,'Marker','.', 'MarkerSize',30)  
8     set(gca,'XTick',[], 'YTick',[])  
9  
10    % Animate using a timer  
11    tm = timer;  
12    |  
13    % Playback rate  
14    tm.Period = 1/50;  
15    tm.TasksToExecute = height(tt);  
16    tm.ExecutionMode = 'fixedRate';  
17    tm.TimerFcn = @(timerObj,evt) update_pend(h,tt.theta(timerObj.TasksExecuted));  
18    tm.StopFcn = @(~,~) delete(tm);  
19
```

The status bar at the bottom indicates the current position: pendulum\_animator, Ln 12, Col 5.

\\mathworks\public\Ned\_Gulley\share\Fractal Basin Boundaries\pendulum\_animator.mlx

LIVE EDITOR INSERT VIEW


FILE NAVIGATE TEXT CODE SECTION RUN

## Pendulum animation

pendulum\_animator(t,theta) uses a timer to make a smooth animation of a pendulum.

- **t** is the time vector
- **theta** is the angle of the pendulum

theta is positive in the counterclockwise direction.



### Example

```
t = linspace(0,20,100)';
theta = sin(t);
pendulum_animator(t,theta)
```

```
1 function pendulum_animator(t,theta)
2
3 tt = make_table(t,theta);
4
5 % Draw the pendulum
6 h = plot(0,0,'LineWidth',4);
7 line(0,0,'Marker','.', 'MarkerSize',30)
8 set(gca,'XTick',[], 'YTick',[])
9
10 % Animate using a timer
11 tm = timer;
12
13 % Playback rate
14 tm.Period = 1/50;
15 tm.TasksToExecute = height(tt);
16 tm.ExecutionMode = 'fixedRate';
17 tm.TimerFcn = @(timerObj,evt) update_pend(h,tt.theta(timerObj.TasksExecuted));
18 tm.StopFcn = @(~,~) delete(tm);
19
```

pendulum\_animator Ln 3 Col 5



# Step In

The screenshot shows the MATLAB Live Editor interface. At the top, there are tabs for 'LIVE EDITOR', 'INSERT', and 'VIEW'. Below these are various toolbars including 'FILE', 'NAVIGATE', 'TEXT', 'CODE', 'SECTION', and 'RUN'. The main workspace contains the following text:

**Pendulum animation**  
pendulum\_animator(t,theta) uses a timer to make a smooth animation of a pendulum.

- **t** is the time vector
- **theta** is the angle of the pendulum

theta is positive in the counterclockwise direction.

**Example**

```
t = linspace(0,20,100);  
theta = sin(t);  
pendulum_animator(t,theta)
```

The function definition is shown below:

```
1 function pendulum_animator(t,theta)  
2  
3 tt = make_table(t,theta);  
4  
5 % Draw  
6 h = plot(0,0,'Marker','.', 'MarkerSize',30)  
7 line(0,0,'Marker','.', 'MarkerSize',30)  
8 set(gca,'XTick',[], 'YTick',[])  
9  
10 % Animate using a timer  
11 tm = timer;  
12  
13 % Playback rate  
14 tm.Period = 1/50;  
15 tm.TasksToExecute = height(tt);  
16 tm.ExecutionMode = 'fixedRate';  
17 tm.TimerFcn = @(timerObj,evt) update_pend(h,tt.theta(timerObj.TasksExecuted));  
18 tm.StopFcn = @(~,~) delete(tm);  
19
```

A green arrow points to line 3, and a callout box says: "Step into make\_table. Run current line and step into make\_table".

At the bottom, the status bar shows "pendulum\_animator", "Ln 3", and "Col 5".



## Example

```
t = linspace(0,20,100)';  
theta = sin(t);  
pendulum_animator(t,theta)
```

```
1 function pendulum_animator(t,theta)  
2  
3 tt = make_table(t,theta);  
4  
5 % Draw  
6 p = plot(t,theta, 'Marker', '.', 'MarkerSize', 30)  
7  
8 set(gca, 'XTick', [], 'YTick', [])  
9  
10 % Animate using a timer  
11 tm = timer;  
12  
13 % Playback rate
```

A large red arrow points from the bottom left towards the green step-through button on line 3 of the code.

Step into make\_table  
Run current line and step into make\_table

```
2
3 tt = make_table(t,theta);
4
5 % Draw the pendulum
6 h = plot(0,0,'LineWidth',4);
7 line(0,0,'Marker','.', 'MarkerSize',30)
8 set(gca,'XTick',[],'YTick',[])
9
10 % Animate using a timer
11 tm = timer;
12
13 % Playback rate
14 tm.Period = 1/50;
15 tm.TasksToExecute = height(tt);
16 tm.ExecutionMode = 'fixedRate';
17 tm.TimerFcn = @(timerObj,evt) update_pend(h,tt.theta(timerObj.TasksExecuted));
18 tm.StopFcn = @(~,~) delete(tm);
19
20 tm.start;
21
22 end
```

### make\_table

```
23 function tt = make_table(t,theta)
24
25 % Make a timetable
26 tt = timetable(seconds(t),theta,'VariableNames',{'theta'});
27
28 % Resample it
29 period = 1/10;
30 tt2 = retime(tt,seconds(0:period:t(end)),'linear');
31 end
32
```

### update\_pend

```
33
```

\\mathworks\public\Ned\_Gulley\share\Fractal Basin Boundaries\pendulum\_animator.mlx

LIVE EDITOR

INSERT

VIEW



New



Open



Save



Find Files



Compare



Print

FILE



Go To



Find

NAVIGATE



Text



Normal



TEXT

CODE

SECTION



Continue



Step

RUN

pendulum\_animator

make\_table



```
t = linspace(0,20,100)';  
theta = sin(t);  
pendulum_animator(t,theta)
```

1

```
function pendulum_animator(t,theta)
```

2

3

```
tt = make_table(t,theta);
```

4

5

```
% Draw the pendulum
```

6

```
h = plot(0,0,'LineWidth',4);
```

7

```
line(0,0,'Marker','.', 'MarkerSize',30)
```

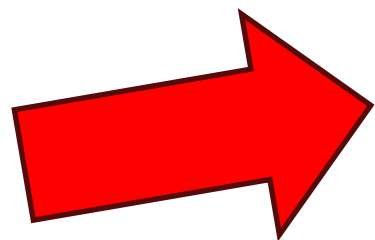
8

```
set(gca,'XTick',[],'YTick',[])
```

9

10

```
% Animate using a timer
```

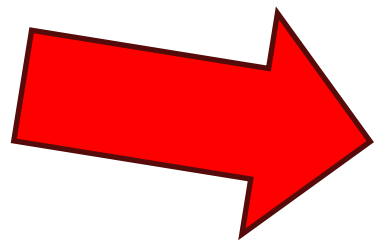


LIVE EDITOR    INSERT    VIEW

New    Open    Save    Find Files    Compare    Print    Go To    Find    Text    Normal    B    I    U    M    CODE    SECTION    Continue    Step    St

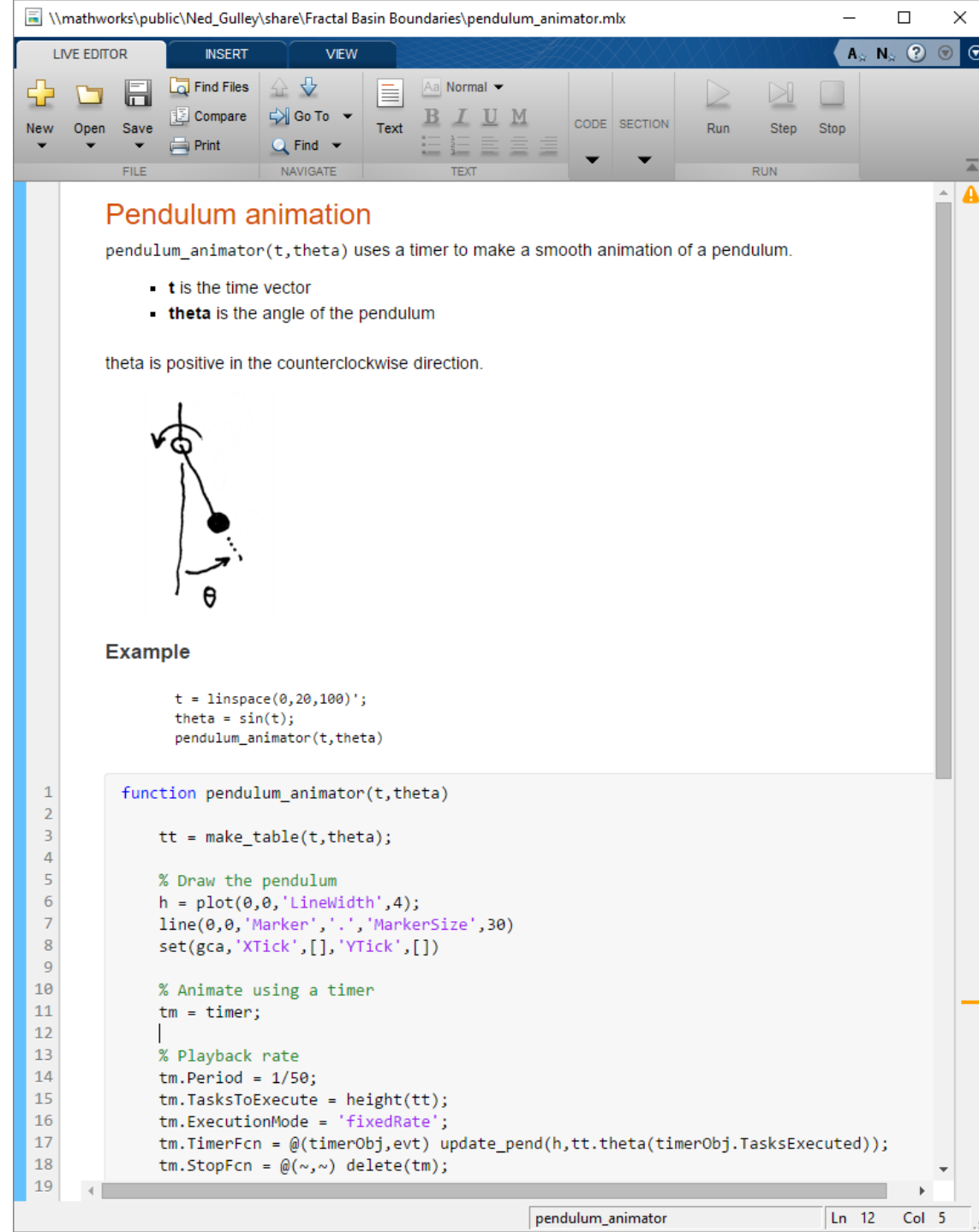
FILE    NAVIGATE    TEXT    RUN

pendulum\_animator    make\_table



```
1            t = linspace(0,20,100)';  
2            theta = sin(t);  
3            pendulum_animator(t,theta)  
4  
5            function pendulum_animator(t,theta)  
6            tt = make_table(t,theta);  
7  
8            % Draw the pendulum  
9            h = plot(0,0,'LineWidth',4);  
10           line(0,0,'Marker','.', 'MarkerSize',30)  
11           set(gca,'XTick',[],'YTick',[])  
12  
13           % Animate using a timer  
14           tm = timer;  
15  
16           % Playback rate  
17           tm.Period = 1/50;  
18           tm.TasksToExecute = height(tt);
```

# Your Documentation




The screenshot shows the MATLAB Live Editor interface. The top toolbar includes options for LIVE EDITOR, INSERT, and VIEW, along with various icons for file operations, navigation, and execution. The main workspace contains the following content:

## Pendulum animation

pendulum\_animator(t,theta) uses a timer to make a smooth animation of a pendulum.

- **t** is the time vector
- **theta** is the angle of the pendulum

theta is positive in the counterclockwise direction.



### Example

```
t = linspace(0,20,100);  
theta = sin(t);  
pendulum_animator(t,theta)
```

```
1 function pendulum_animator(t,theta)  
2  
3     tt = make_table(t,theta);  
4  
5     % Draw the pendulum  
6     h = plot(0,0,'LineWidth',4);  
7     line(0,0,'Marker','.', 'MarkerSize',30)  
8     set(gca,'XTick',[], 'YTick',[])  
9  
10    % Animate using a timer  
11    tm = timer;  
12    |  
13    % Playback rate  
14    tm.Period = 1/50;  
15    tm.TasksToExecute = height(tt);  
16    tm.ExecutionMode = 'fixedRate';  
17    tm.TimerFcn = @(timerObj,evt) update_pend(h,tt.theta(timerObj.TasksExecuted));  
18    tm.StopFcn = @(~,~) delete(tm);  
19
```

The status bar at the bottom indicates the file name is pendulum\_animator, with the cursor at line 12, column 5.

\\mathworks\public\Ned\_Gulley\share\Fractal Basin Boundaries\pendulum\_animator.mlx

LIVE EDITOR    INSERT    VIEW    A... N... ?


New Open Save Find Files Compare Print Go To Find Text B I U M CODE SECTION Run Step Stop

## Pendulum animation

pendulum\_animator(t,theta) uses a timer to make a smooth animation of a pendulum.

- **t** is the time vector
- **theta** is the angle of the pendulum

theta is positive in the counterclockwise direction.



### Example

```
t = linspace(0,20,100)';
theta = sin(t);
pendulum_animator(t,theta)
```

```
1 function pendulum_animator(t,theta)
2
3     tt = make_table(t,theta);
4
5     % Draw the pendulum
6     h = plot(0,0,'Linewidth',4);
7     line(0,0,'Marker','.', 'MarkerSize',30)
8     set(gca,'XTick',[],'YTick',[])
9
10    % Animate using a timer
11    tm = timer;
12    |
13    % Playback rate
14    tm.Period = 1/50;
15    tm.TasksToExecute = height(tt);
16    tm.ExecutionMode = 'fixedRate';
17    tm.TimerFcn = @(timerObj,evt) update_pend(h,tt.theta(timerObj.TasksExecuted));
18    tm.StopFcn = @(~,~) delete(tm);
19
```

### Command Window

```
>> doc pendulum_animator
fx >>
```

pendulum\_animator    Ln 12    Col 5

Help

pendulum\_animator

## Documentation

### pendulum\_animator

Pendulum animation

#### Syntax


```
pendulum_animator(t,theta)
```

#### Description

`pendulum_animator(t,theta)` uses a timer to make a smooth animation of a pendulum.

- **t** is the time vector
- **theta** is the angle of the pendulum

theta is positive in the counterclockwise direction.



The diagram shows a vertical line representing the pivot point. A curved arrow at the top indicates a counter-clockwise direction. A solid line representing the string extends downwards and to the right from the pivot. At the end of the string is a solid black circle representing the bob. A dashed line extends from the pivot point downwards and to the right, representing the vertical reference position. An arc between the vertical dashed line and the string is labeled with the Greek letter  $\theta$ , representing the angle.

#### Example

```
t = linspace(0,20,100)';  
theta = sin(t);  
pendulum_animator(t,theta)
```



Help

Documentation

## pendulum\_animator

Pendulum animation

### Syntax


```
pendulum_animator(t,theta)
```

### Description

pendulum\_animator(t,theta) uses a timer to make a smooth animation of a pendulum.

- t** is the time vector
- theta** is the angle of the pendulum

theta is positive in the counterclockwise direction.



### Example

```
t = linspace(0,20,100)';
theta = sin(t);
pendulum_animator(t,theta)
```

Help

Documentation

CONTENTS

## eig

R2018b

Eigenvalues and eigenvectors [collapse all in page](#)

### Syntax

```
e = eig(A)
[V,D] = eig(A)
[V,D,W] = eig(A)

e = eig(A,B)
[V,D] = eig(A,B)
[V,D,W] = eig(A,B)

[ _ ] = eig(A,balanceOption)
[ _ ] = eig(A,B,algorithm)

[ _ ] = eig( _ ,eigvalOption)
```

### Description

`e = eig(A)` returns a column vector containing the eigenvalues of square matrix A. [example](#)

`[V,D] = eig(A)` returns diagonal matrix D of eigenvalues and matrix V whose columns are the corresponding right eigenvectors, so that  $A \cdot V = V \cdot D$ . [example](#)

`[V,D,W] = eig(A)` also returns full matrix W whose columns are the corresponding left eigenvectors, so that  $W' \cdot A = D \cdot W'$ . [example](#)

The eigenvalue problem is to determine the solution to the equation  $A v = \lambda v$ , where A is an n-by-n matrix, v is a column vector of length n, and  $\lambda$  is a scalar. The values of  $\lambda$  that satisfy the equation are the eigenvalues. The corresponding values of v that satisfy the equation are the right eigenvectors. The left eigenvectors, w, satisfy the equation  $w' A = \lambda w'$ .

`e = eig(A,B)` returns a column vector containing the generalized eigenvalues of square matrices A and B. [example](#)

# App Designer

The screenshot displays the MATLAB App Designer interface. At the top, the 'DESIGNER' and 'CANVAS' tabs are visible. The top toolbar includes icons for 'New', 'Open', 'Save', 'App Details', 'Share', and 'Run'. Below the toolbar, the 'FILE' and 'SHA' menus are shown. The main workspace is titled 'pendulum.mlapp x' and contains a 'Pendulum Simulation' app. The app's design view features a yellow 'Initial Conditions' panel with two sliders: 'theta' (ranging from 0 to 180) and 'theta dot' (ranging from 0 to 100). Below this is a plot titled 'Pendulum Angle' showing the angle  $\theta$  versus 'time' from 0 to 1. A blue 'Animate' button is located at the bottom right of the plot area. On the left, the 'COMPONENT LIBRARY' is organized into 'COMMON' and 'CONTAINERS' sections, listing various UI components like Axes, Button, Check Box, Date Picker, Drop Down, Edit Field, Label, List Box, Radio Button Group, Slider, Spinner, State Button, Table, Text Area, Toggle Button Group, Tree, Panel, and Tab Group. On the right, the 'COMPONENT BROWSER' shows a search bar and a tree view of the app's components: 'app.UIFigure', 'app.UIAxes', 'app.AnimateButton', 'app.PendulumSimulationLabel', 'app.InitialConditionsPanel', 'app.thetaSlider', and 'app.thetadotSlider'. The 'COMPONENT PROPERTIES' panel is currently empty.

DESIGNER **CANVAS**

New Open Save App Details Share Run

FILE SHA

pendulu

COMP

COMMON

- Axes
- Button
- Check Box
- Date Picker
- Drop Down
- Edit Field (Numeric)

**MATLAB App**  
Create an app installation file to share your app with MATLAB users

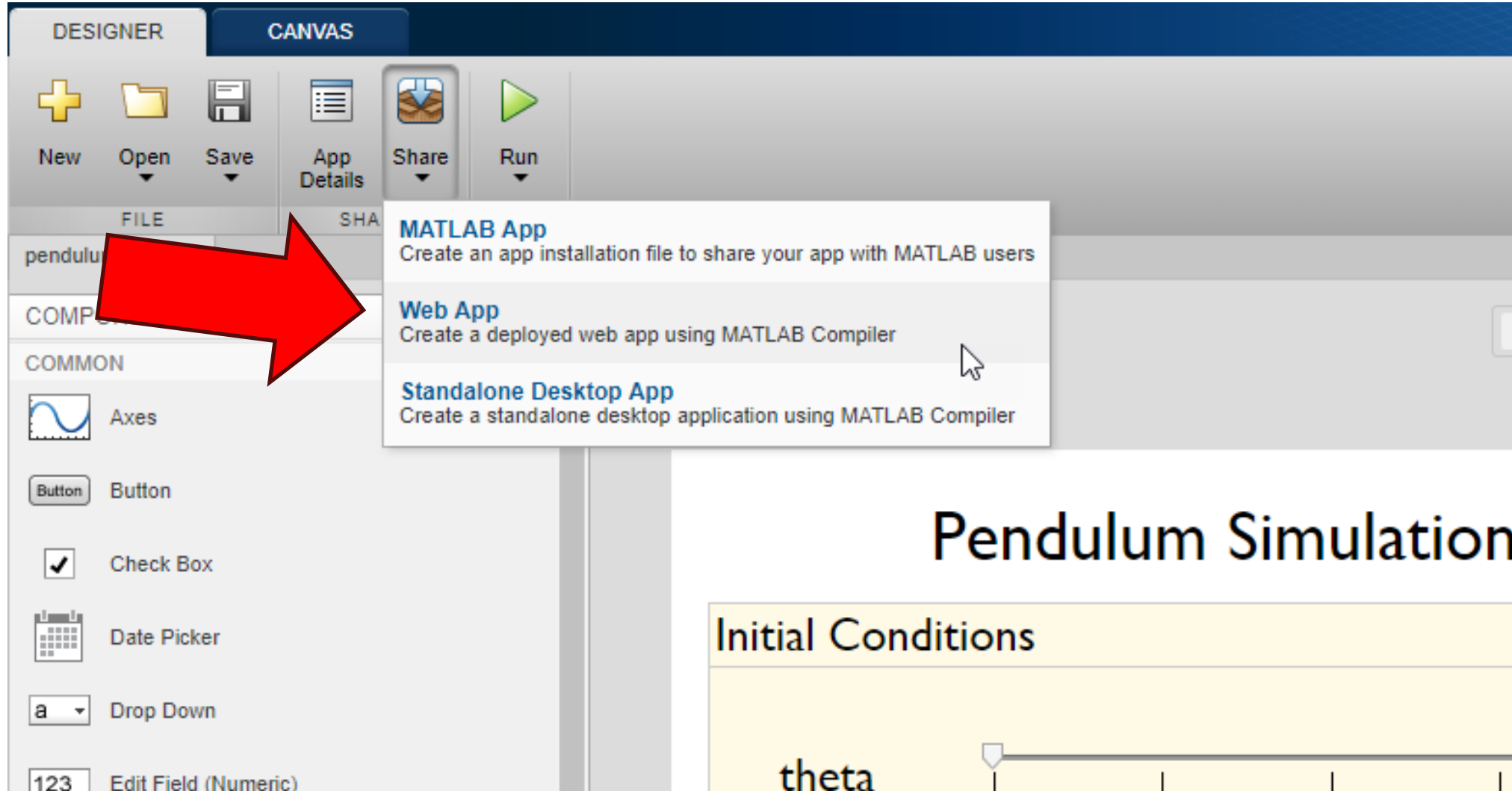
**Web App**  
Create a deployed web app using MATLAB Compiler

**Standalone Desktop App**  
Create a standalone desktop application using MATLAB Compiler

# Pendulum Simulation

## Initial Conditions

theta



Web App Compiler - pendulum.prj\*

COMPILER

New Open Project Save pendulum.mlapp Settings Package

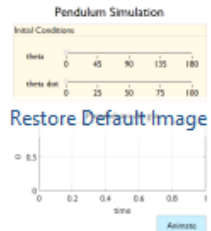
FILE MAIN FILE SETTINGS PACKAGE

### Archive information

Archive name: pendulum

Server app folder: \\webapp-00-ah\webapps\R2018b\apps Browse...

### Web app information



Pendulum Simulation

Initial Conditions

theta 0 45 90 135 180

theta dot 0 25 50 75 100

Restore Default Image

0.5

0 0.2 0.4 0.6 0.8 1

time

Animate

pendulum 1.1

Ned Gulley

For investigating the initial condition phase plane of a pendulum.

### Files required for your app to run

pendulum\_anim... +

# Web Apps

The screenshot shows a web browser window with three tabs: MATLAB Trendy, MATLAB ShareDrive, and MATLAB Web Apps. The address bar shows the URL <https://webapp-00-ah.mathworks.com:9989/webapps/home/index.html>. The page title is "MATLAB Web Apps". At the top right, there are buttons for "Show Unavailable Apps" and "Diagnostics".

The main content area displays a grid of 12 web application cards, each with a thumbnail image, a title, author, description, and version number:

- just\_a\_test** by Nicolas Schmit: "Playing around during the R2018b bash party", version 1.6.
- LogScanner** by Igor Kuklin: version 1.0.
- MassSpringDamper** by Igor Kuklin: "Test crash in g1857620", version 1.0.
- Mortgage** by MATLAB AppDesigner Examples: "Calculate your monthly payment for a mortgage. You will need to enter amount, interest rate and loan...", version 2.0.
- Mortgage\_ik**: version 1.0.
- NFLPlayersApp** by MATLAB Connector Team: version 1.0.
- PatientsDisplay** by MATLAB AppDesigner Examples: version 1.0.
- Patients TreeAppExample** by MATLAB AppDesigner Examples: version 1.0.
- pendulum** by Ned Gulley: "For demonstrating Web Apps at the UK Expo, October 2018.", version 1.0.
- PlotSelector** by MATLAB Graphics Team: version 1.0.
- PulseGenerator** by MATLAB AppDesigner Examples: version 1.0.
- Simoneator4200** by Matt Tearle: "A first pass as a Simoneau number app", version 1.4.

version 1.0

version 1.0

version 1.0



### pendulum

by Ned Gulley

For demonstrating Web Apps at the UK Expo, October 2018.

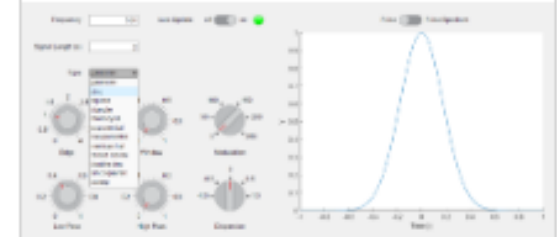
version 1.0



### PlotSelector

by MATLAB Graphics Team

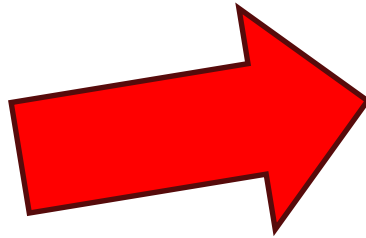
version 1.0



### PulseGenerator

by MATLAB AppDesigner Examples

version 1.0



MATLAB Web Apps

## Pendulum Simulation

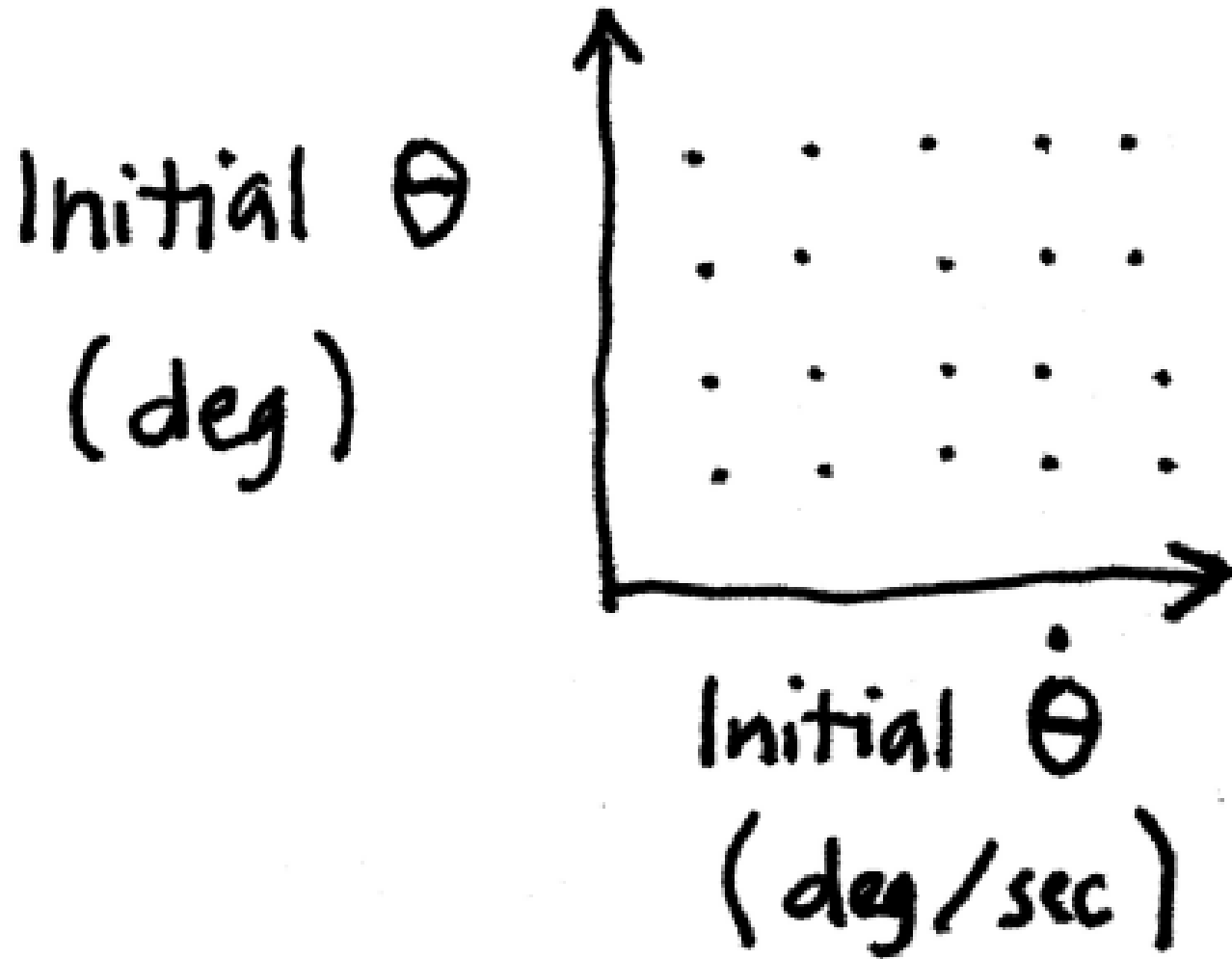
Initial Conditions

theta

theta dot

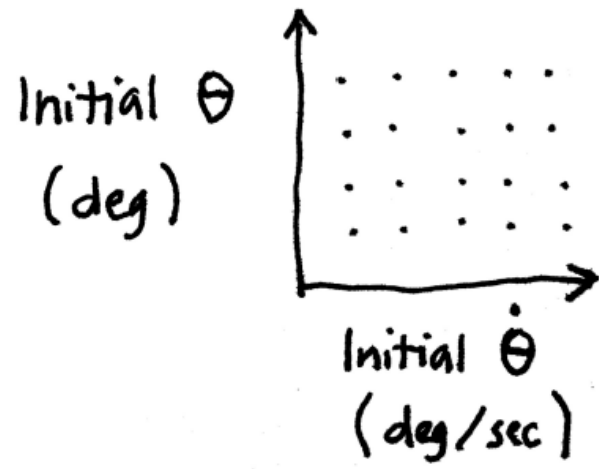
### Pendulum Angle

show log



```
Live Editor - \\mathworks\public\Ned_Gulley\share\Fractal
Parallel simulation
1 function [a,rowLims,colLi
2
3     a = zeros(sz);
4
5     parfor (n = 1:numel(a)
6         a(n) = runsim(fun
7     end
8
9 end
10 |
```





Live Editor - \\mathworks\public\Ned\_Gulley\share\Fractal Basin Boundaries\phasePlaneOde.mlx

## Parallel simulation across the pendulum phase plane

1  
2  
3  
4  
5  
6  
7  
8  
9  
10

```
function [a,rowLims,colLims] = phasePlaneOde(fun,sz,tf,rowLims,colLims)

    a = zeros(sz);

    parfor (n = 1:numel(a))
        a(n) = runsim(fun,sz,n,rowLims,colLims,tf);
    end

end
```

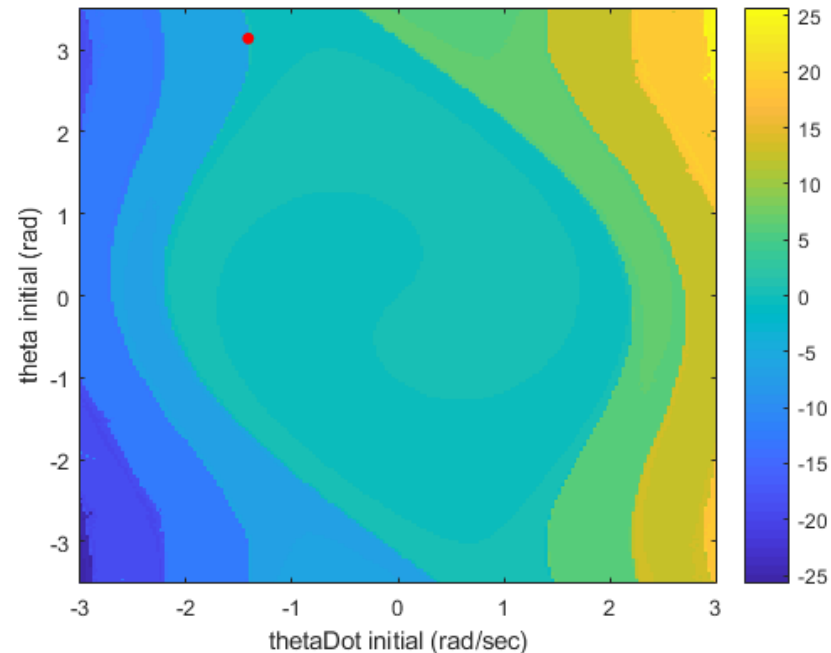
## The Phase Plane

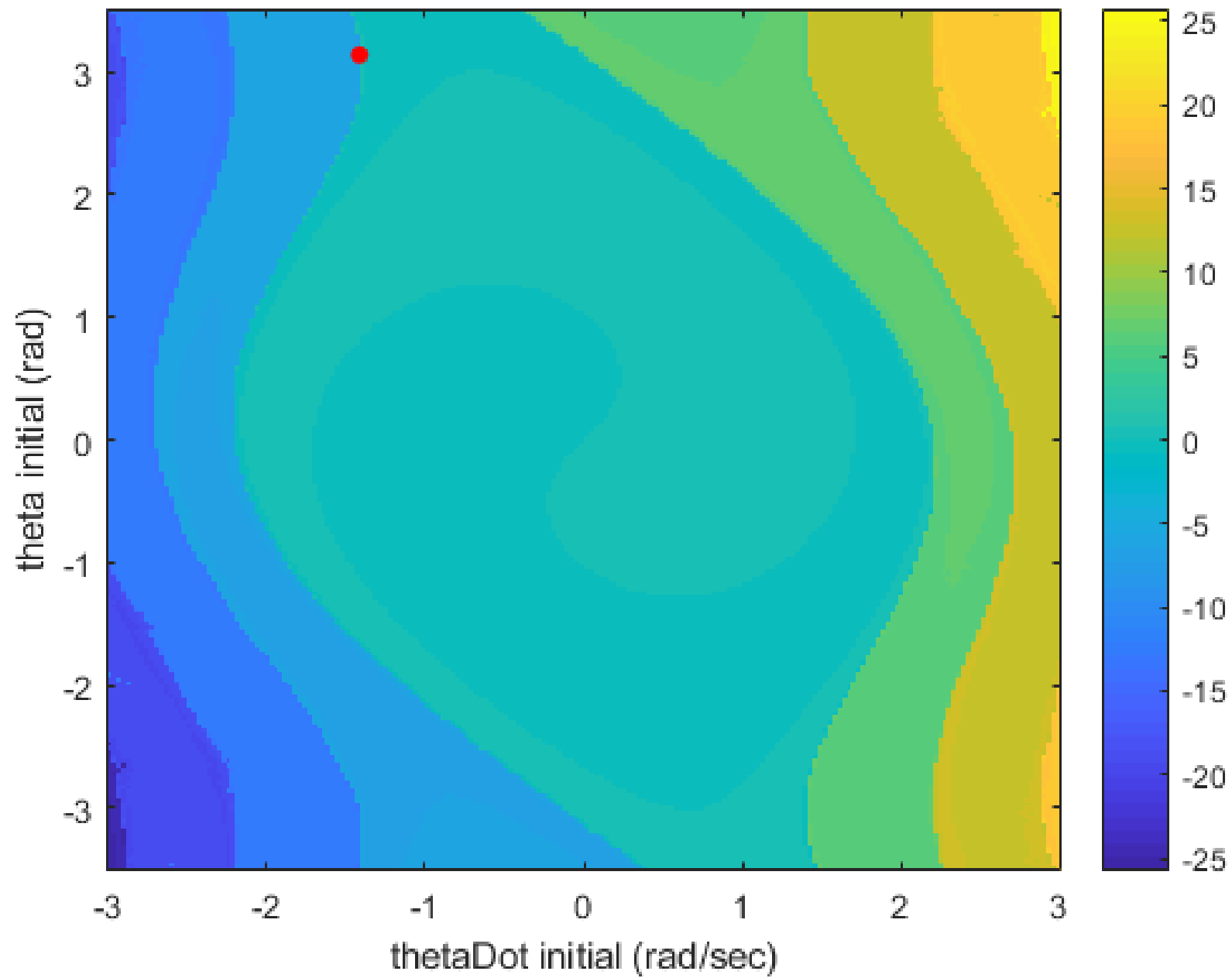
Let's run the simulation for a large number of points on the phase plane defined by  $\theta_{initial}$  and  $\dot{\theta}_{initial}$ . Each simulation runs for 40 seconds, which is sufficient for the pendulum to come to rest, or close to it.

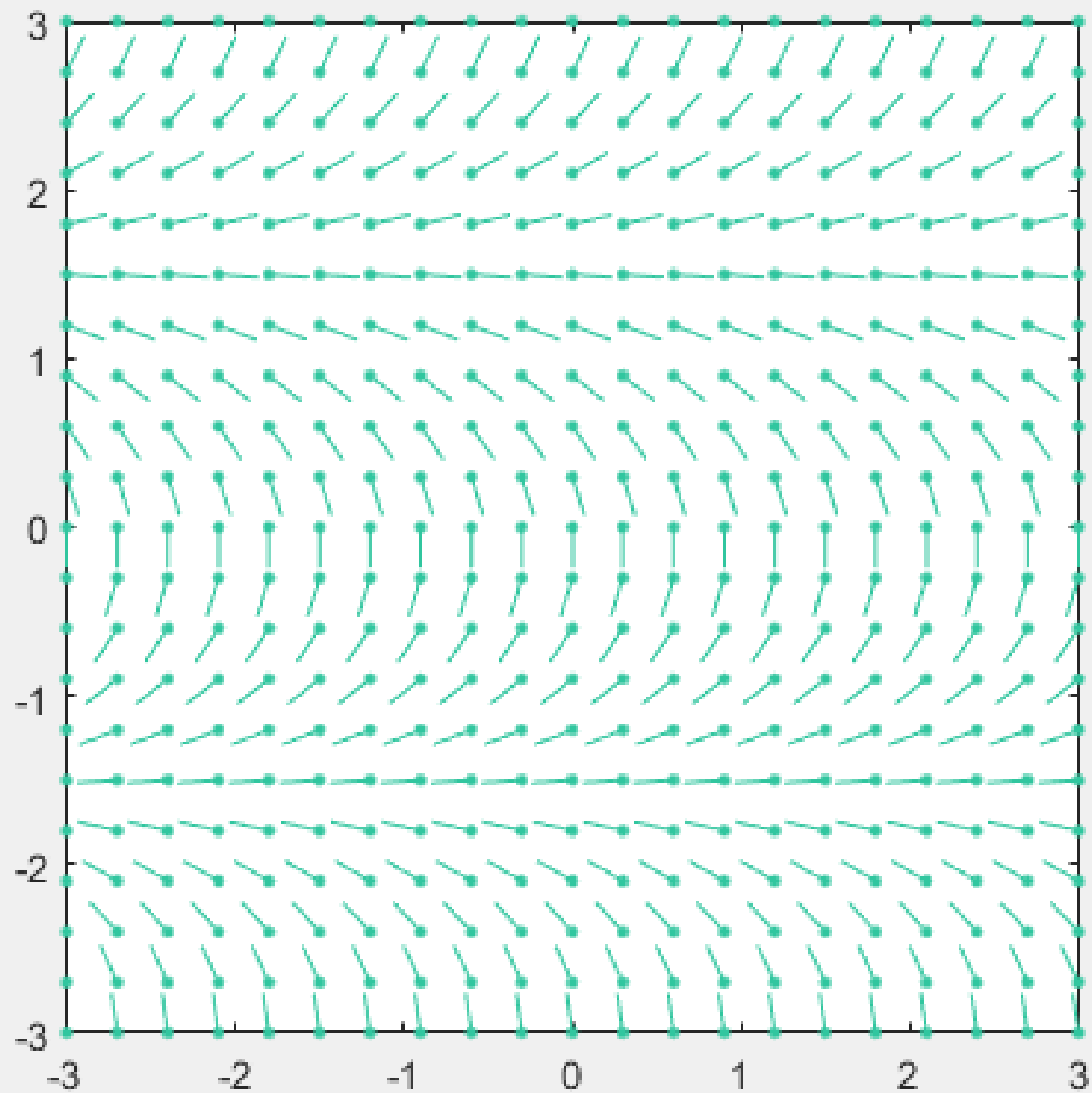
```
sz = 200;  
tFinal = 40;  
thetaLims = [-3.5 3.5];  
thetaDotLims = [-3 3];  
thetaFinal = phasePlaneOde(pend,sz,tFinal,thetaLims,thetaDotLims);
```

In the image below, *every pixel is a single simulation*. The color shows the final resting angle of the pendulum. We've placed a red dot to show the point in phase space represented by the animation above. As you would expect, it's right on the boundary between the  $\theta_{Final} = 0$  basin and the  $\theta_{Final} = -2\pi$  basin.

```
imagesc(linspace(thetaDotLims(1),thetaDotLims(2),sz), ...  
        linspace(thetaLims(1),thetaLims(2),sz),thetaFinal)  
axis xy  
xlabel('thetaDot initial (rad/sec)')  
ylabel('theta initial (rad)')  
colorbar  
line([y01(2) y02(2)],[y01(1) y02(1)],'Marker','.', 'MarkerSize',18,'Color','red')
```







The screenshot shows a MATLAB Live Editor window titled "Untitled2.mlx". The interface includes a ribbon with tabs for "LIVE EDITOR", "INSERT", and "VIEW". The "LIVE EDITOR" tab is active, displaying a toolbar with icons for file operations (New, Open, Save, Find Files, Compare, Print), navigation (Go To, Find), text formatting (Normal, Bold, Italic, Underline, Monospace), and execution (Run, Step, Stop). The main workspace contains the following text:

Unforced motion

$$\ddot{\theta} + 0.1 \cdot \dot{\theta} + \sin \theta = 0$$

With forcing function

$$\ddot{\theta} + 0.1 \cdot \dot{\theta} + \sin \theta = 2.1 \cos t$$

```
1 pend2 = @(t,y) [ ...  
2     y(2);  
3     -0.1*y(2) - sin(y(1)) + 2.1*cos(t)];
```

A large red arrow points from the left side of the image towards the unforced motion equation.

Untitled2.mlx \*

LIVE EDITOR    INSERT    VIEW    A N ?

New Open Save Find Files Compare Print    Go To Find    Normal B I U M    CODE SECTION    Run Step Stop

FILE    NAVIGATE    TEXT    RUN

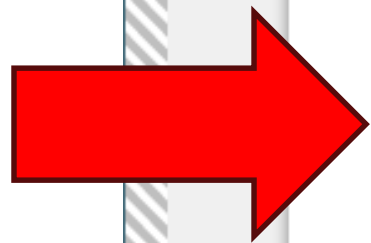
Unforced motion

$$\ddot{\theta} + 0.1 \cdot \dot{\theta} + \sin \theta = 0$$

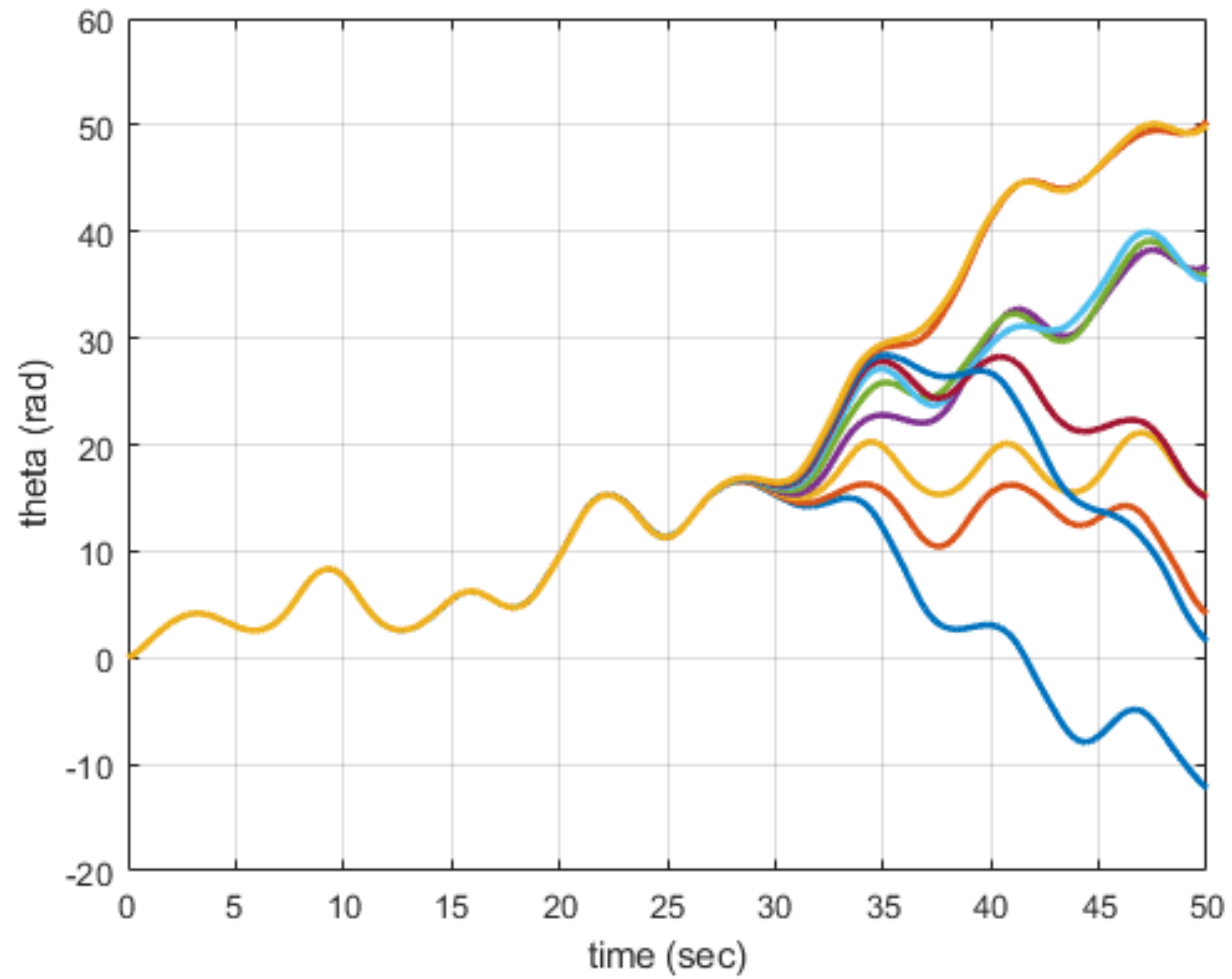
With forcing function

$$\ddot{\theta} + 0.1 \cdot \dot{\theta} + \sin \theta = 2.1 \cos t$$

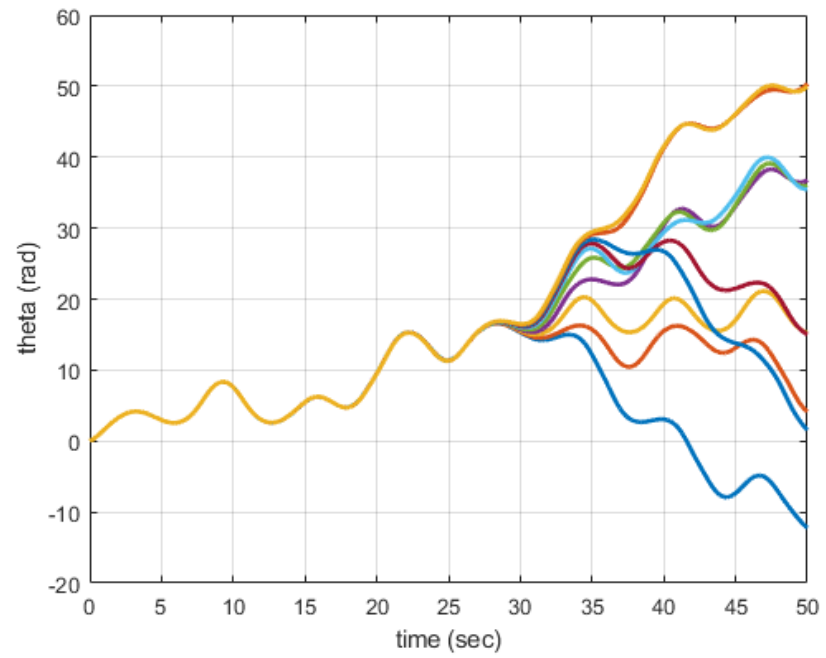
```
1 pend2 = @(t,y) [ ...
2     y(2);
3     -0.1*y(2) - sin(y(1)) + 2.1*cos(t)];
```



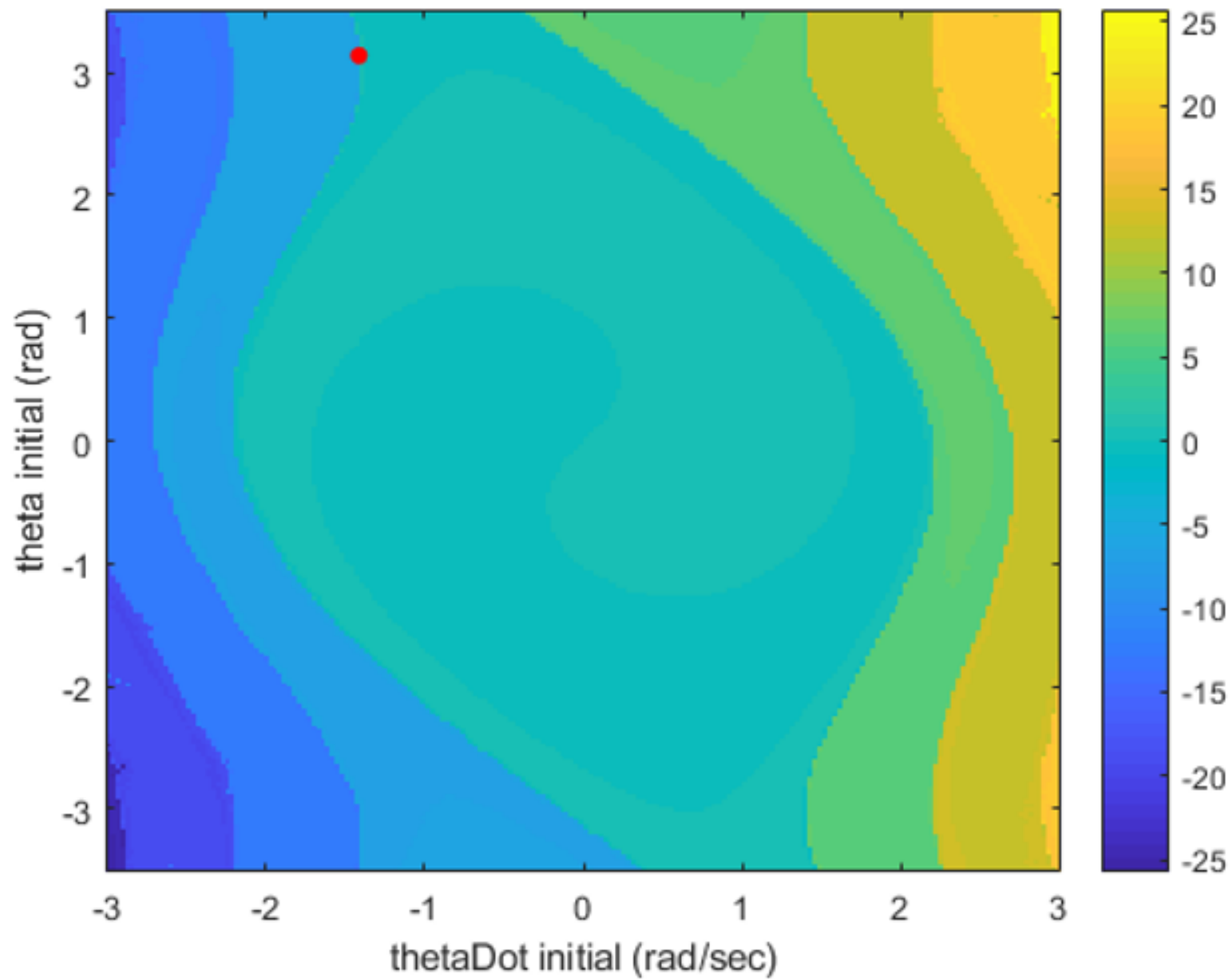
```
xlabel('time (sec)')
ylabel('theta (rad)')
grid on
xlim([0 50])
```

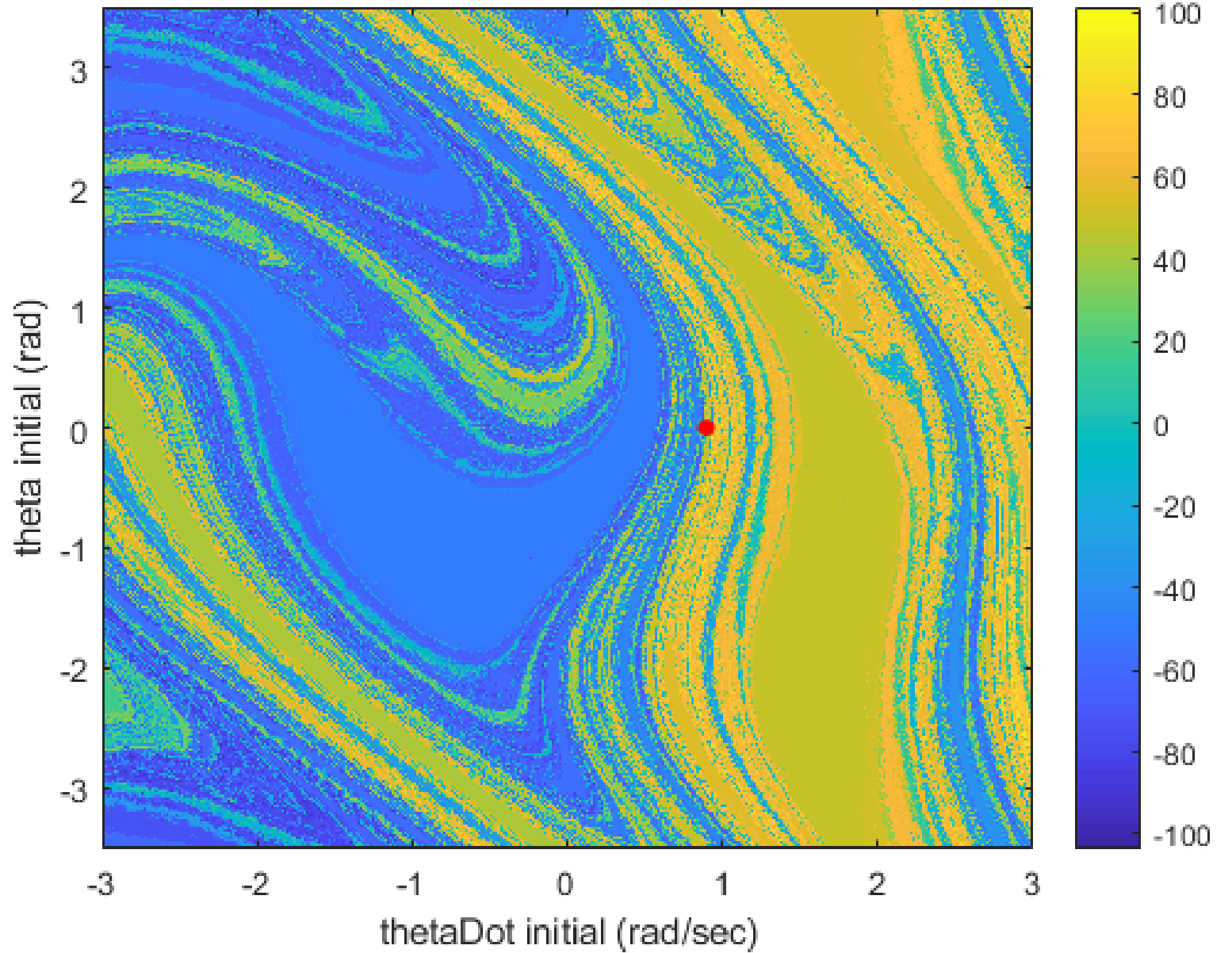
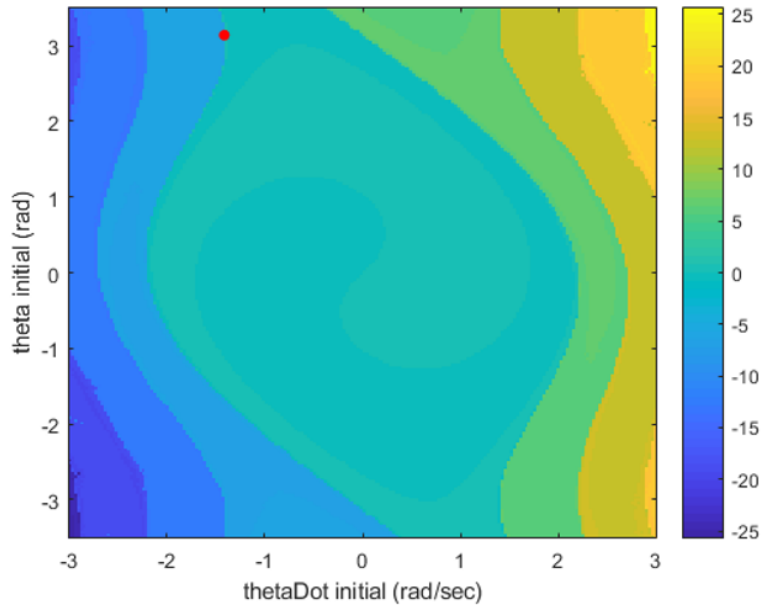


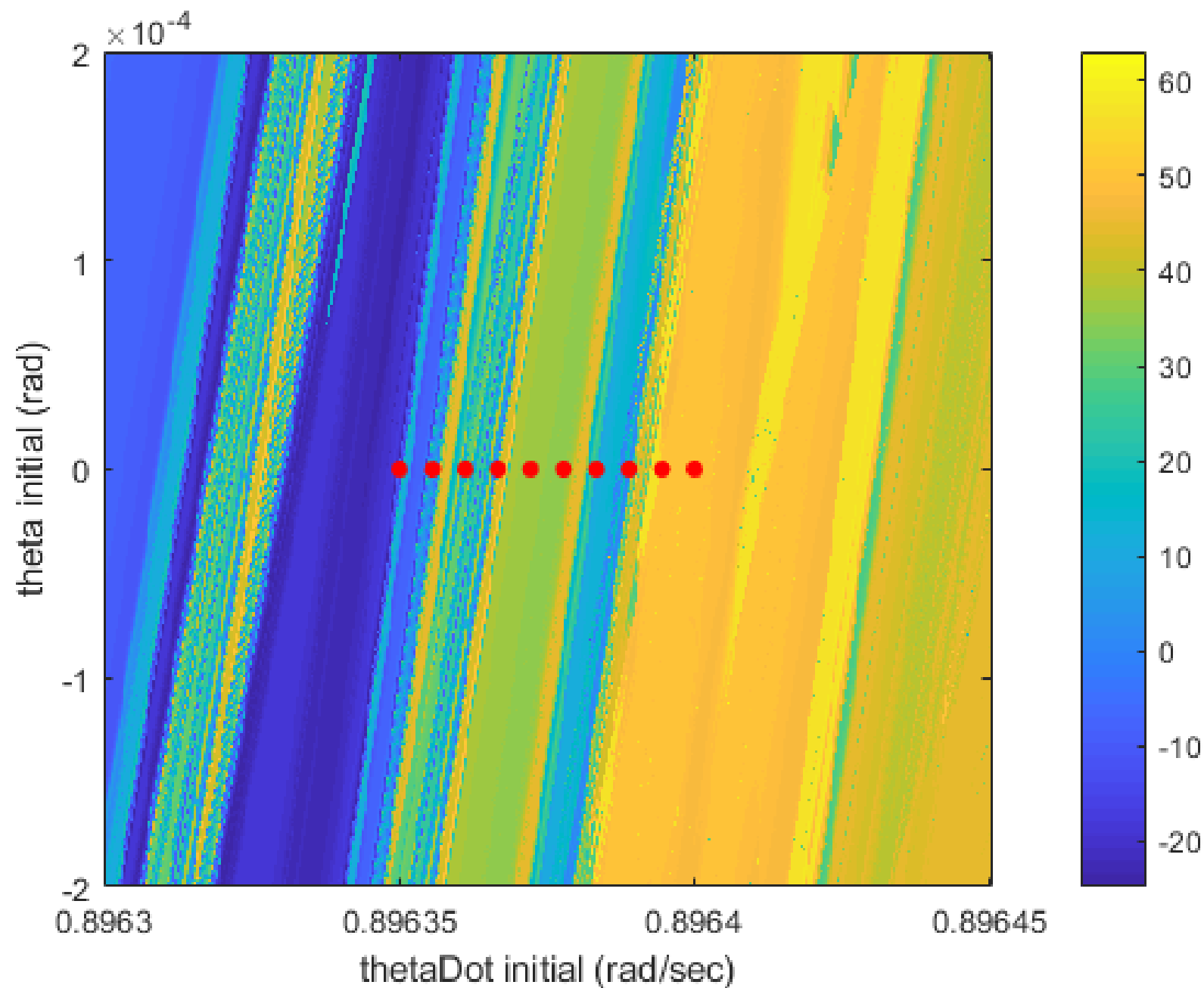
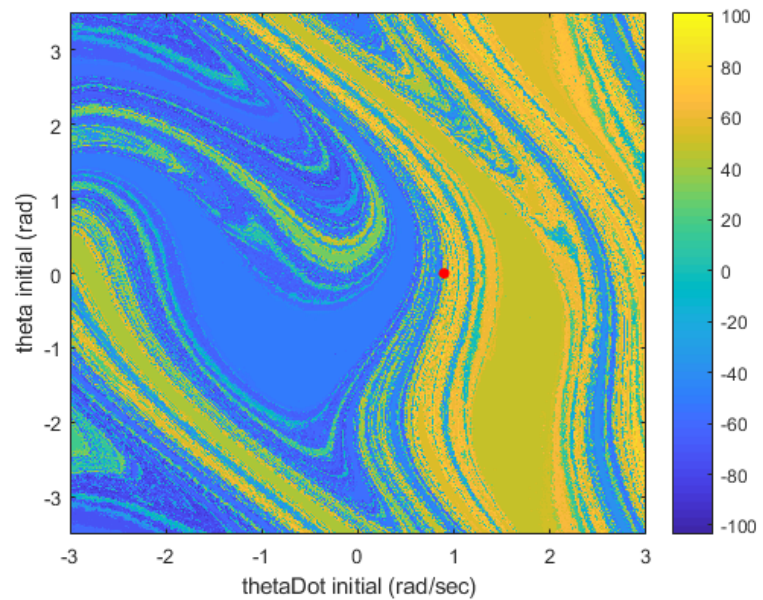
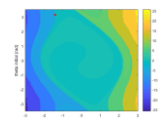
```
xlabel('time (sec)')
ylabel('theta (rad)')
grid on
xlim([0 50])
```

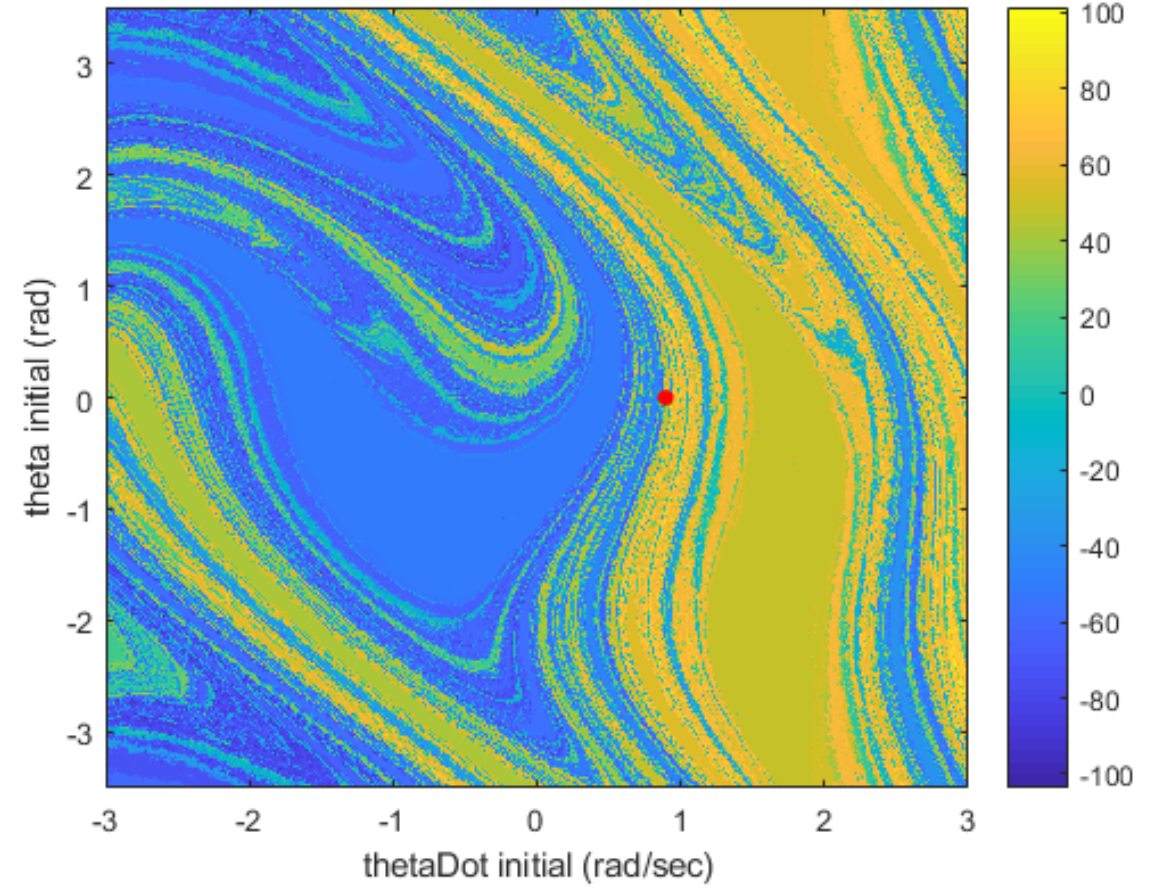
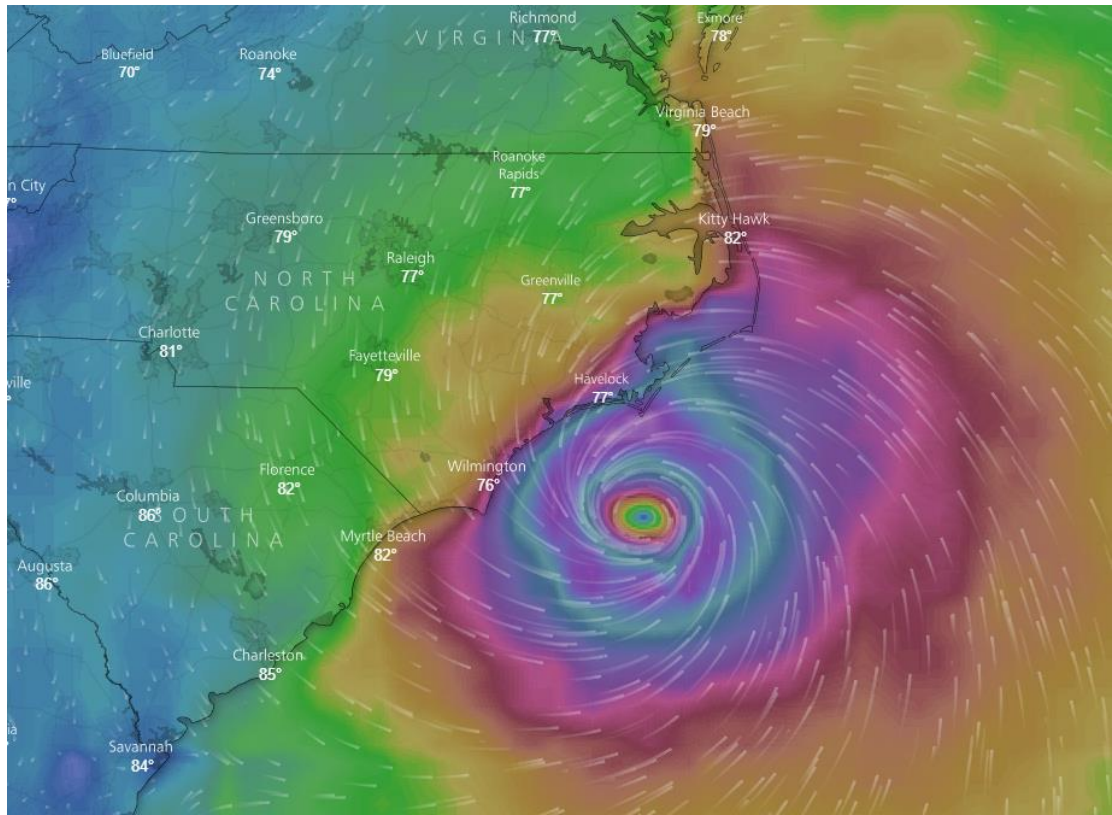












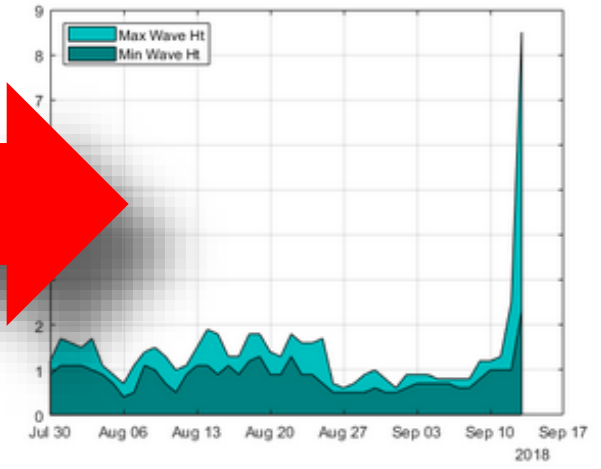
#YY	MM	DD	hh	mm	WDIR	WSPD	GST	WVHT	DPD	APD	MWD	PRES	ATMP	WTMP	DEWP	VIS	PTDY	TIDE
#yr	mo	dy	hr	mn	degT	m/s	m/s	m	sec	sec	degT	hPa	degC	degC	degC	nmi	hPa	ft
2018	09	18	16	00	MM	MM	MM	1.5	5	4.6	205	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	15	30	MM	MM	MM	1.5	5	4.5	202	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	15	00	MM	MM	MM	1.6	5	4.6	199	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	14	30	MM	MM	MM	1.6	5	4.6	202	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	14	00	MM	MM	MM	1.5	5	4.7	198	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	13	30	MM	MM	MM	1.5	5	4.8	199	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	13	00	MM	MM	MM	1.5	6	4.8	141	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	12	30	MM	MM	MM	1.5	13	4.9	104	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	12	00	MM	MM	MM	1.5	5	4.9	165	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	11	30	MM	MM	MM	1.5	7	5.0	113	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	11	00	MM	MM	MM	1.6	6	5.0	141	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	10	30	MM	MM	MM	1.5	12	5.0	102	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	10	00	MM	MM	MM	1.6	8	5.1	116	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	09	30	MM	MM	MM	1.5	8	5.1	116	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	09	00	MM	MM	MM	1.6	10	5.2	119	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	08	30	MM	MM	MM	1.6	10	5.3	116	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	08	00	MM	MM	MM	1.5	8	5.2	113	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	07	30	MM	MM	MM	1.5	13	5.3	112	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	07	00	MM	MM	MM	1.5	10	5.3	113	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	06	30	MM	MM	MM	1.6	11	5.2	116	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	06	00	MM	MM	MM	1.6	12	5.3	111	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	05	30	MM	MM	MM	1.5	11	5.2	112	MM	MM	28.0	MM	MM	MM	MM
2018	09	18	05	00	MM	MM	MM	1.5	8	5.2	119	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	04	30	MM	MM	MM	1.5	9	5.2	123	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	04	00	MM	MM	MM	1.6	11	5.2	125	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	03	30	MM	MM	MM	1.5	11	5.2	125	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	03	00	MM	MM	MM	1.6	11	5.3	118	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	02	30	MM	MM	MM	1.6	11	5.1	116	MM	MM	27.9	MM	MM	MM	MM
2018	09	18	02	00	MM	MM	MM	1.6	12	5.1	106	MM	MM	27.9	MM	MM	MM	MM

```

ttMax = retime(buoyTt,'daily','max');
ttMin = retime(buoyTt,'daily','min');

area(ttMax.t, ttMax.WaveHt, ...
'FaceColor',[0 0.75 0.75],'DisplayName','Max Wave Ht')
hold on
area(ttMin.t,ttMin.WaveHt, ...
'FaceColor',[0 0.5 0.5],'DisplayName','Min Wave Ht')
hold off
ylabel('Wave Height (m)')
grid on
legend('Location','NorthWest')

```



Speed from

# Data to Insight to Results

**Thanks!**

