

Technical Progress for Period Feb. 18, 2012 – July 31, 2012

NOAA Award NA11OAR4310198

**Title: Introducing Diagnostic Variables towards extending the
SHIPS Algorithm for Hurricane Intensity Forecasts**

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August 30, 2012

REPORT

The Modified SHIPs extends the list of predictors of the SHIPS model by including four dynamical variables that are the i) The vertical distribution of the heating in the complete potential vorticity equation, ii) The conversion of divergent kinetic energy into rotational kinetic energy, iii) The import of angular momentum (relative and Earth's) into the inner core of the hurricane, and iv) the conversion of shear vorticity into curvature vorticity. The premise here being that some value can be added to the SHIPS forecasts by bringing in some important dynamical parameters that are known to impact hurricane intensity. This is based on a multiple regression exercise where we first used 9 past hurricanes of the years 2010 and 2011 to generate the weights for the multiple regression. The predictant is the official observed hurricane intensity provided by the National Hurricane Center. That is currently being done separately for each 12 hour interval of forecast data sets. The weights are currently being used, for this research with real time data sets, where the real time forecasts from the GFS and HWRF models provide the inputs with the following time schedules:

We are sending two real-time forecasts daily to Dr. Chris Landsea at 00UTC and 12UTC. We receive SHIPS and SPICE forecasts around 12:15 AM for 00UTC and 12:15 PM for 12UTC at our local time. The HWRF forecast takes almost 1 hour 35 minutes (means at 1:50 AM and 1:50 PM at our local time) to get uploaded to their ftp site. Our scripts take only 15 minutes to download and compute FSU parameters and we finish the real-time forecast around 2:05 AM and 2:05 PM for 00UTC and 12UTC forecast. We use the FSU IBM multi-processing system for all our computations.

For the 2012 season, we started our forecasts from Hurricane Debby. We did not address three earlier storms, Alberto, Beryl and Chris since they were very short lived.

In Table 1 we show the real time forecasts of hurricane intensity made using the Modified SHIPS. Also shown in this table are the forecasts from SHIPS and SPICE (these are two of the better models for hurricane intensity forecasts). We furthermore include (where available, in all tables) the observed best estimates of intensity, as provided by the National Hurricane Center.

For several selected storms (Debby, Ernesto, Gordon and Isaac) the relative performance of the MODIFIED SHIPS, SHIPS and SPICE are shown in Fig 1a, b, c and d. This comparison shows that the addition of diagnostic variables does add to the skill of intensity forecasts for SHIPS in most forecasts.

The summary of results, thus far into the season, are shown from a histogram display (Fig 2a, b and c) of the mean absolute errors for the Modified SHIPS, SHIPS and SPICE. These show that, thus far into the season for the most part the addition of the Modified Ships has been worthwhile.

Off line we are also carrying out further improvements in the methodology and will include further improved results in our final report.

We will complete the forecasts for the entire season by around November 2012 and show the season long performance statistics and assess the usefulness of MODIFIED SHIPS more quantitatively.

Table 1: List of Real-time forecast:

1. OBS (observed)
2. MSHIP (modified SHIPS)
3. SHIPS
4. SPICE

2012 Hurricane season: Real-time forecast submitted from Krish lab												
Debby	HOURS	0	12	24	36	48	60	72	84	96	108	120
2012062400	OBS	45	50	50	40	40	40	30	30	34	35	40
	MSHIP	45	55	60	62	63	63	60	57	60	50	46
	SHIP	45	54	60	63	63	61	59	54	49	45	41
	SPICE	45	53	59	63	65	67	68	68	51	39	35
2012062412	OBS	50	50	40	40	40	30	30	34	35	40	35
	MSHIP	50	54	54	55	57	52	40	39	38	38	39
	SHIP	50	54	57	57	56	57	52	51	44	39	31
	SPICE	50	53	57	60	62	64	58	47	40	39	38
2012062500	OBS	50	40	40	40	30	30	34	35	40	35	
	MSHIP	50	50	51	53	53	52	49	45	40	32	31
	SHIP	50	50	50	49	48	44	40	39	35	30	27
	SPICE	50	53	57	58	59	58	56	51	43	38	31
2012062512	OBS	40	40	40	30	30	34	35	40	35		
	MSHIP	40	34	34	33	38	29	20	22	27	22	25
	SHIP	40	36	35	32	27	25	19	20	18	21	23
	SPICE	40	36	36	35	34	33	33	34	35	37	34
2012062600	OBS	40	40	30	30	34	35	40	35			
	MSHIP	40	39	38	37	39	31	32	35	35	25	29
	SHIP	40	41	41	40	38	33	32	29	29	29	39
	SPICE	40	41	42	38	36	34	31	30	32	35	39

2012062612	OBS	40	30	30	34	35	40	35				
	MSHIP	40	40	38	39	40	37	35	40	46	36	40
	SHIP	40	40	38	36	32	31	29	27	28	31	30
	SPICE	40	43	39	38	37	37	38	41	46	50	48
Ernesto	HOURS	0	12	24	36	48	60	72	84	96	108	120
2012080200	OBS	30	30	45	45	45	45	50	45	45		
	MSHIP	30	31	31	34	35	45	52	53	59	60	70
	SHIP	30	31	34	38	43	48	51	53	59	65	69
	SPICE	30	30	34	36	38	41	44	45	52	61	75
2012080212	OBS	30	45	45	45	45	50	45	45	55	55	55
	MSHIP	30	31	30	34	38	45	57	67	72	71	84
	SHIP	30	32	36	40	46	49	53	57	64	71	75
	SPICE	30	31	34	38	42	47	53	62	73	85	95
2012080300	OBS	45	45	45	45	50	45	45	55	55	55	75
	MSHIP	45	50	51	59	67	68	66	77	87	84	90
	SHIP	45	51	57	62	65	69	71	74	78	89	79
	SPICE	45	50	56	61	66	73	80	86	90	95	97
2912080312	OBS	45	45	45	50	45	45	55	55	55	75	50
	MSHIP	45	50	50	59	67	68	66	77	87	84	90
	SHIP	45	46	50	53	57	66	73	79	84	87	86
	SPICE	45	46	51	56	63	72	81	90	98	100	102
201208400	OBS	45	45	50	45	45	55	55	55	75	50	55
	MSHIP	45	50	50	59	67	68	66	77	87	84	90
	SHIP	45	52	59	64	69	77	83	86	91	92	92
2012080412	OBS	45	50	45	45	55	55	55	75	50	55	55
	MSHIP	45	50	50	56	62	68	73	81	91	61	62
	SHIP	45	52	57	64	69	76	79	84	85	90	90
2012080500	OBS	50	45	45	55	55	55	75	50	55	55	40
	MSHIP	50	51	52	63	72	74	72	78	100	79	76
	SHIP	50	54	61	68	76	84	90	93	96	96	94
2012080512	OBS	45	45	55	55	55	75	50	55	55	40	20
	MSHIP	45	46	47	57	65	65	80	100	92	74	79
	SHIP	45	49	56	61	66	75	78	78	78	79	79
2012080600	OBS	45	55	55	55	75	50	55	55	40	20	
	MSHIP	45	50	56	63	70	77	99	90	86	77	65
	SHIP	45	50	56	63	72	77	78	79	77	76	72
2012080712	OBS	55	75	50	55	55	40	20				
	MSHIP	55	59	44	41	51	55	45	46	44	25	23
	SHIP	55	63	70	75	81	80	79	76	71	66	63
2012080800	OBS	75	50	55	55	40	20					
	MSHIP	75	59	60	70	85	66	60	73	62	32	23
	SHIP	75	88	93	92	87	81	80	78	78	77	76
	SPICE	75	47	46	50	56	46	33	34	35	37	32
2012080812	OBS	50	55	55	40	20						
	MSHIP	50	45	50	39	31	32	45	57	59	36	38

	SHIP	50	47	50	51	55	59	64	68	72	72	
	SPICE	50	44	48	39	31	28	32	35	37	38	39
2012080900	OBS	55	55	40	20							
	MSHIP	55	58	48	35	30	28	32	32	41	54	46
	SHIP	55	61	65	66	70	75	78	81	83	86	87
	SPICE	55	44	41	32	29	30	32	27	33	41	34
Gordon	HOURS	0	12	24	36	48	60	72	84	96	108	120
2012081612	OBS	40	60	55	60	70	95	85	70	60		
	MSHIP	40	49	55	60	65	61	64	63	53	36	35
	SHIP	40	49	57	63	65	66	64	53	46	40	33
	SPICE	40	48	56	61	63	64	62	56	47	39	37
2012081712	OBS	55	60	70	95	85	70	60				
	MSHIP	55	55	59	58	62	52	46	47	47	34	37
	SHIP	55	55	57	59	59	54	48	42	34	27	22
	SPICE	55	55	57	58	59	53	47	42	47	36	35
2012081800	OBS	60	70	95	85	70	60					
	MSHIP	60	63	66	62	60	51	41	41	41	32	41
	SHIP	60	64	64	63	58	51	43	34	26	19	15
	SPICE	60	62	62	60	55	48	43	38	47	34	35
2012081812	OBS	70	95	85	70	60						
	MSHIP	70	74	74	65	57	46	37	38	39	36	45
	SHIP	70	74	72	66	60	50	40	30	23	18	17
	SPICE	70	73	72	65	58	50	45	42	40	39	39
2012081900	OBS	95	85	70	60							
	MSHIP	95	87	74	59	51	38	27	26	0	0	0
	SHIP	95	90	73	57	47	36	24	16	0	0	0
	SPICE	95	89	74	60	51	45	40	43	0	0	0
2012081912	OBS	85	70	60								
	MSHIP	85	66	52	43	42	25	0	0	0	0	0
	SHIP	85	70	54	41	30	20	0	0	0	0	0
	SPICE	85	71	58	49	42	36	0	0	0	0	0
2012082000	OBS	70	60									
	MSHIP	70	52	42	34	36	26					
	SHIP	70	55	42	33	25	18	0	0	0	0	0
	SPICE	70	57	47	41	37	35	0	0	0	0	0

DEBBY FORECASTS

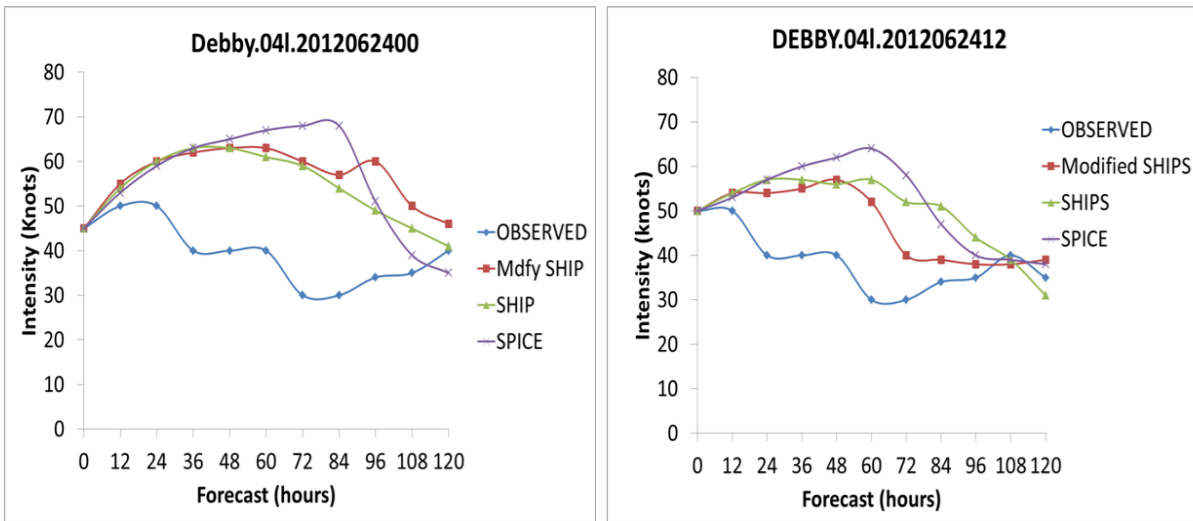


Figure 1a: Debby forecast

ERNESTO FORECASTS

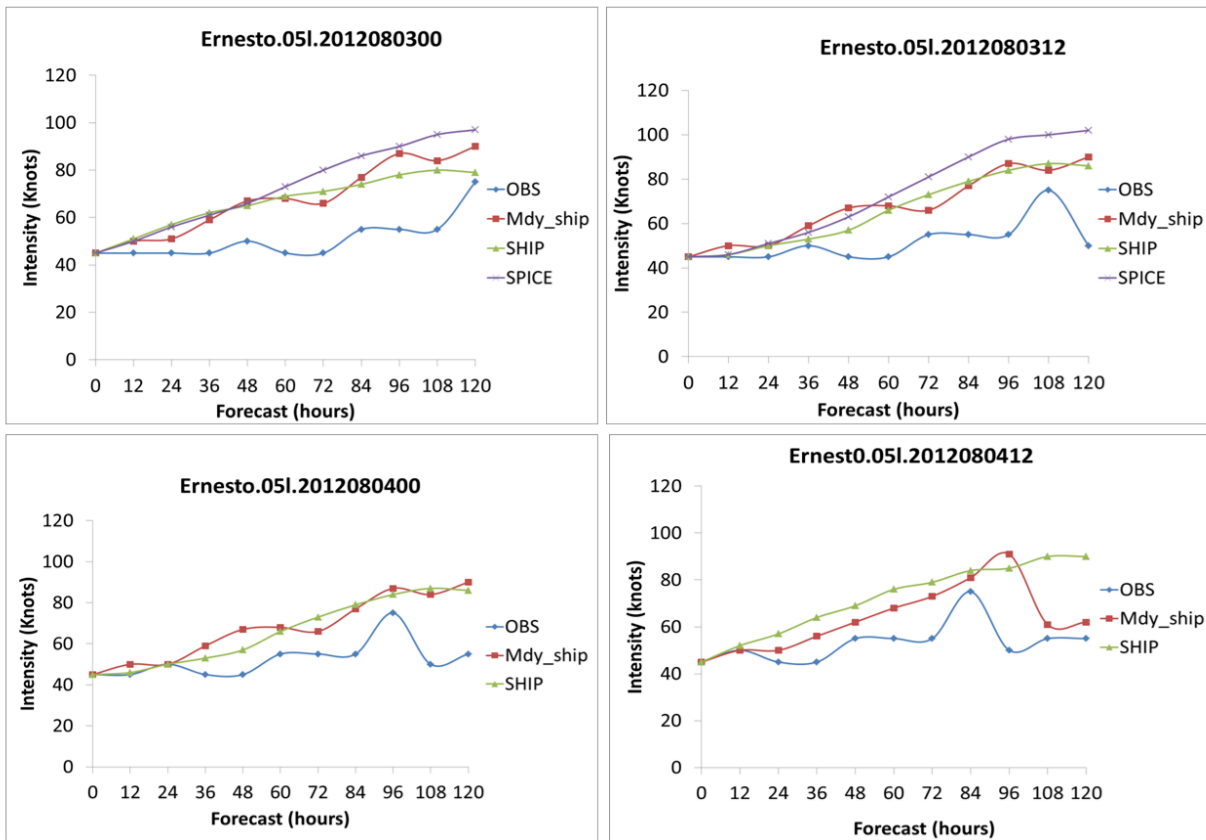


Figure 1b: Ernesto forecast

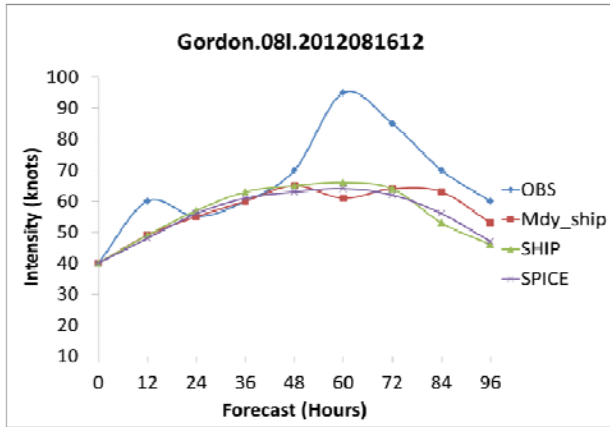
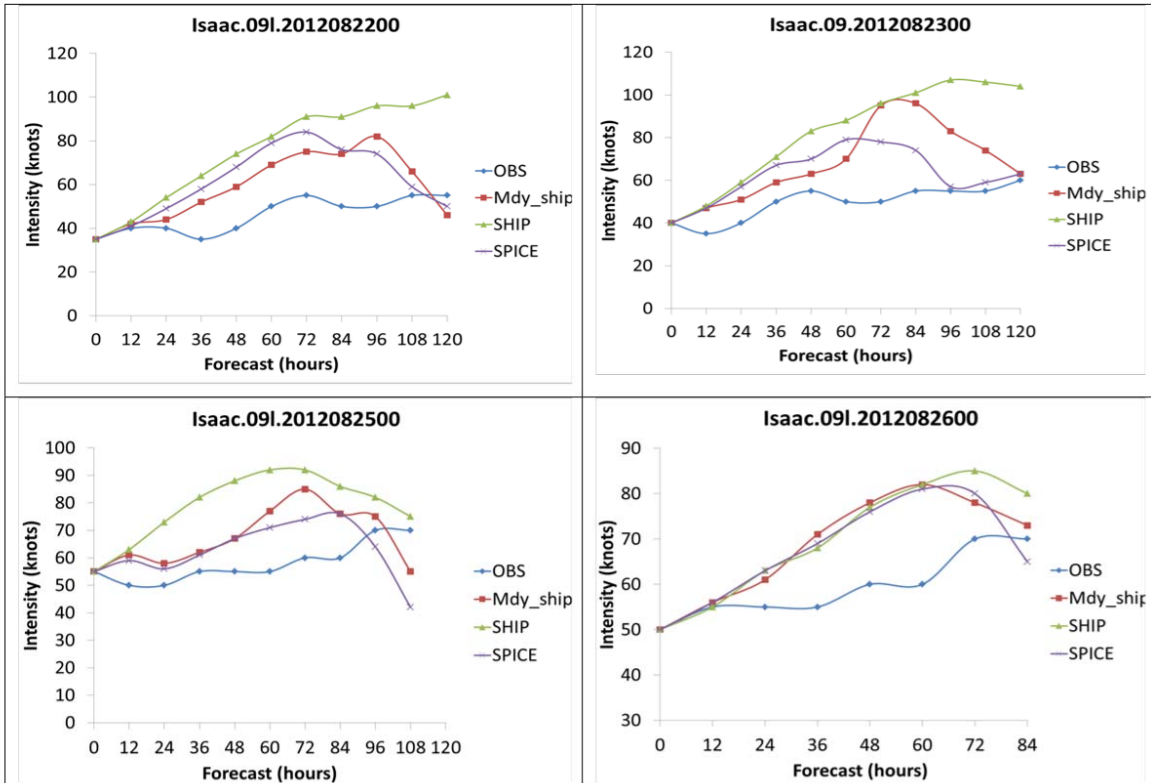


Figure1c: Gordon forecast

ISAAC FORECASTS



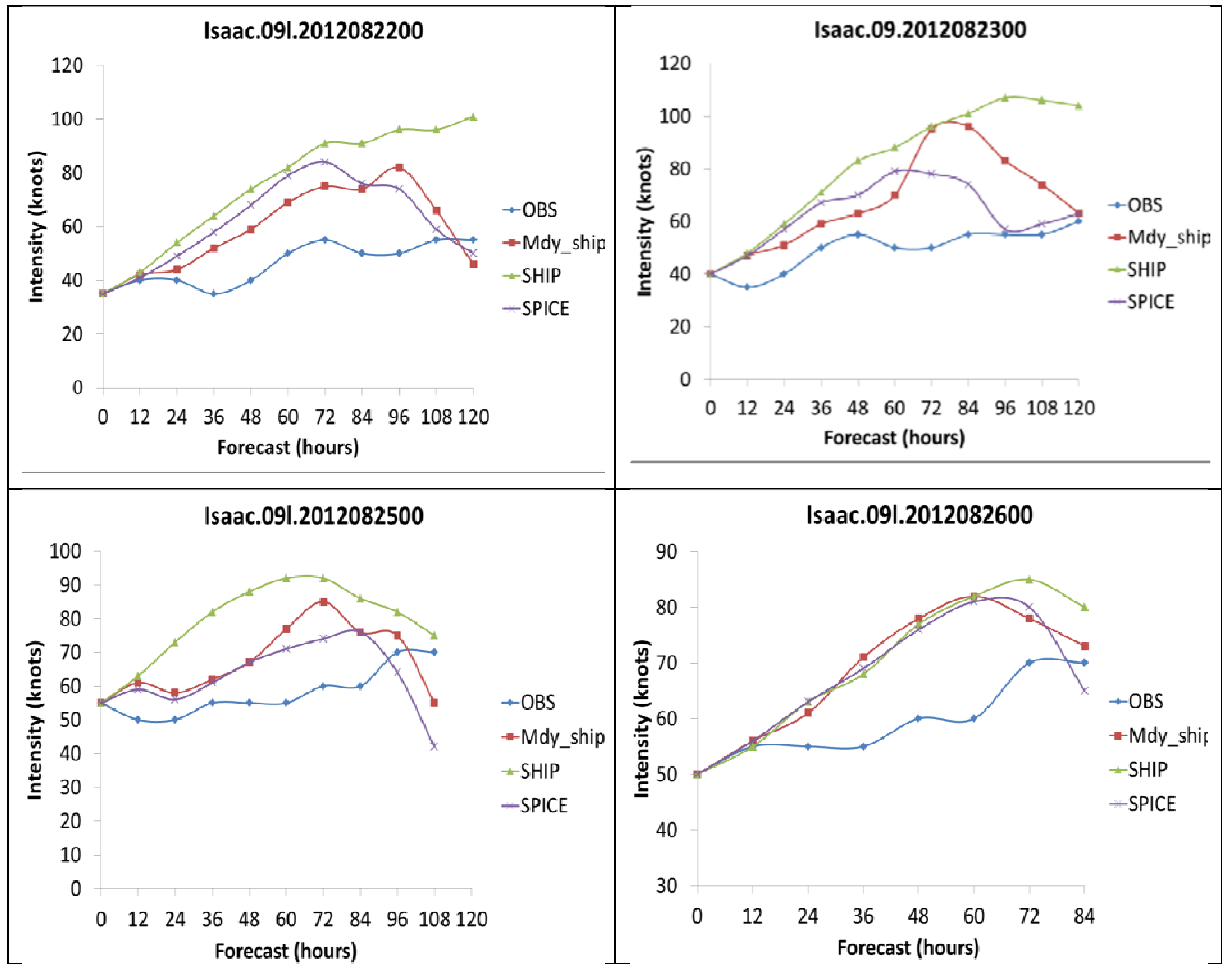


Figure 1d: Isaac forecast

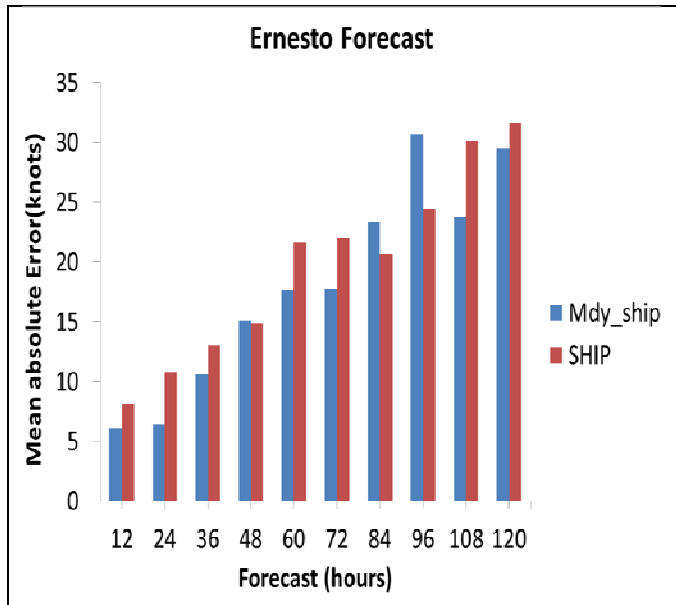


Figure 2a

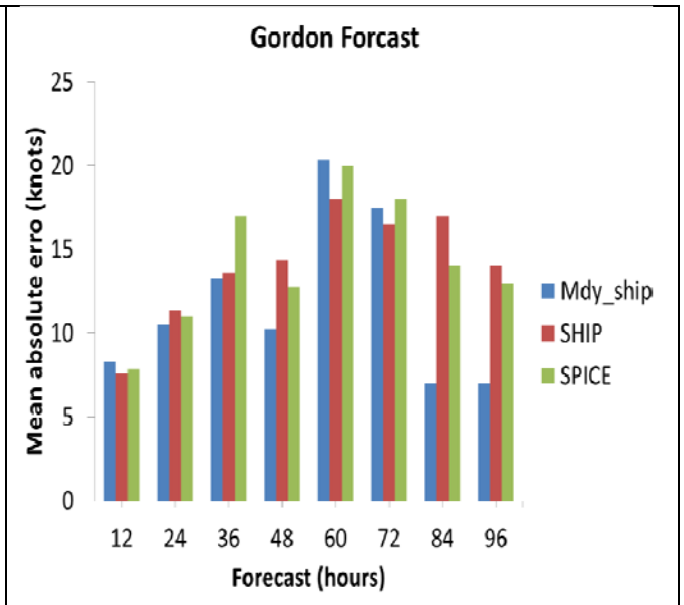


Figure 2b

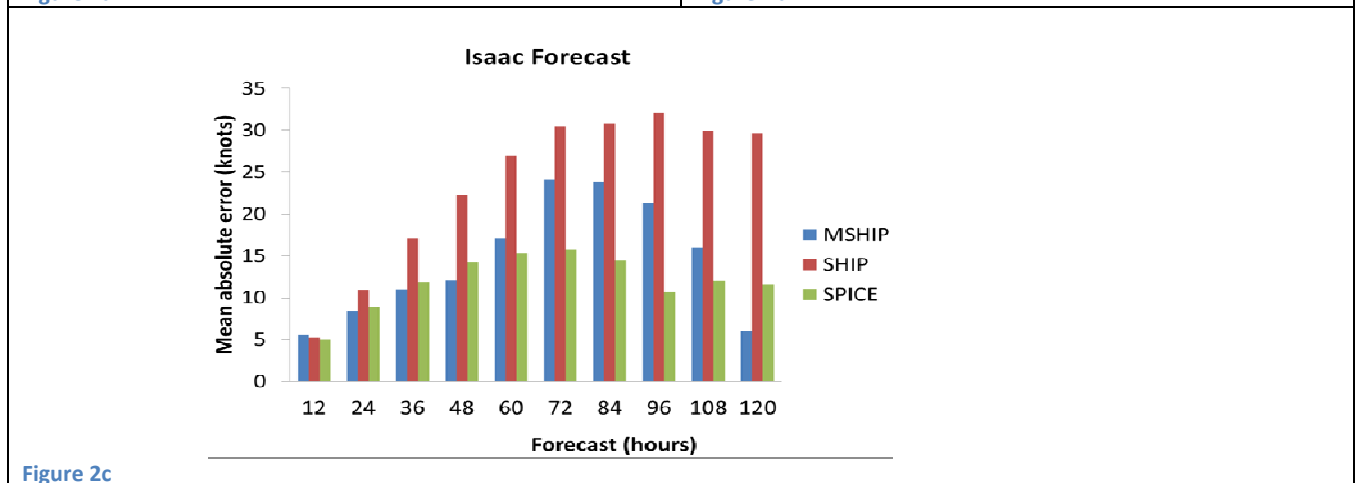


Figure 2c

Figure 2a, b, and c: Mean absolute Error in Ernesto, Gordon and Isaac forecast comparison