Applications of SHIPS Diagnostic Files

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Outline

- Summary of SHIPS Diagnostic File
- Applications
  - Verification of large scale variables
  - Contribution to the Statistical Prediction of Intensity with a Consensus Ensemble (SPICE) forecast
  - Fitting to LGEM model in place of data
- Verification of HWRF synthetic GOES imagery

SHIPS Diagnostic File

- Simple ASCII file with SHIPS model predictors
- Input required
  - Model grib files
    - u, v, T, RH, Z at mandatory levels 1000 to 100 hPa
    - SST field if available
  - Model storm track (A-deck format)
- Output
  - Small ASCII file with SHIPS model predictors
  - ~20 kbyte per 126 hr forecast
- Code available from CIRA
- *Much easier to generate in real time than from archived data*
  - e.g., Difficult to extract and read ~500 gbyte FIM tar files

Sample Diagnostic File from HWRF

* HWRF 2011082200 *
* AL09 IRENE *

STORM DATA

NTIME 022 DELTAT 006

TIME (HR)	0	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126
LAT (DEG)	18.0	18.3	18.6	19.1	19.5	19.6	19.9	20.2	20.4	20.8	21.3	21.9	22.7	23.4	24.4	25.4	26.3	27.3	28.2	29.1	30.1	30.9
LON (DEG)	295.1	293.7	292.4	291.5	290.6	289.6	289.1	288.5	287.9	287.3	286.6	285.9	285.2	284.3	283.7	282.9	282.4	281.7	281.2	280.7	280.3	279.9
MAXWIND (KT)	50	57	64	69	76	71	75	76	74	84	89	93	103	108	110	112	110	114	120	113	114	109
RMW (KM)	157	114	94	86	103	103	66	60	70	65	73	66	69	78	72	75	84	90	90	94	92	93
MIN_SLP (MB)	993	991	986	981	975	970	971	967	966	959	955	945	942	937	936	931	930	925	925	925	928	926
SHR_MAG (KT)	7	7	1	4	8	6	5	9	8	12	12	11	9	9	8	10	12	11	9	7	11	12
SHR_DIR (DEG)	233	190	125	283	281	322	300	272	275	295	295	299	280	281	281	250	245	245	258	245	246	249
STM_SPD (KT)	14	13	10	9	9	6	6	6	7	8	9	10	11	11	12	10	12	10	10	11	9	9999
STM_HDG (DEG)	283	284	300	295	276	303	298	290	305	307	313	321	310	331	324	333	328	334	334	341	337	9999
SST (10C)	291	9999	289	286	267	9999	9999	287	289	287	285	287	287	289	290	292	290	285	283	280	295	298
OHC (KJ/CM2)	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999
TPW (MM)	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999
LAND (KM)	91	-22	44	37	22	-16	12	44	70	100	154	162	206	252	316	314	255	181	166	143	152	127
850TANG (10M/S)	110	130	146	156	170	174	179	184	189	193	200	209	215	218	226	231	246	253	262	266	270	275
850VORT (/S)	54	54	68	61	60	62	64	74	81	82	87	93	97	94	90	92	95	96	85	88	88	79
200DVRG (/S)	73	95	80	67	55	58	52	55	47	54	50	57	40	57	63	65	50	71	48	30	33	57

SOUNDING DATA

NLEV 020 SURF 1000 0950 0900 0850 0800 0750 0700 0650 0600 0550 0500 0450 0400 0350 0300 0250 0200 0150 0100

TIME (HR)	0	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126
T_SURF (10C)	285	284	284	285	286	286	287	287	287	287	287	287	287	288	288	289	289	289	289	288	287	286
R_SURF (%)	82	82	82	81	81	81	81	81	81	80	80	80	80	80	79	79	79	80	79	79	78	77
P_SURF (MB)	1012	1010	1012	1010	1011	1008	1010	1007	1009	1007	1009	1007	1008	1006	1009	1008	1009	1007	1009	1008	1009	1007
U_SURF (10KT)	-137	-111	-87	-80	-78	-72	-82	-90	-86	-88	-86	-92	-94	-94	-92	-83	-69	-62	-57	-47	-42	-15
V_SURF (10KT)	-15	1	20	38	27	26	9	8	11	33	28	45	40	51	53	50	50	63	70	82	83	105
T_1000 (10C)	277	278	276	278	279	278	276	278	279	278	277	279	280	278	277	279	278	274	269	272	272	266
R_1000 (%)	77	77	77	77	78	79	79	78	79	79	79	78	79	79	79	79	81	82	83	82	84	85
Z_1000 (DM)	11	9	10	9	9	7	8	6	8	6	8	6	7	6	8	7	8	6	8	7	8	6
U_1000 (10KT)	-166	-132	-104	-94	-92	-83	-95	-102	-98	-98	-98	-102	-105	-104	-105	-94	-80	-71	-65	-53	-48	-17
V_1000 (10KT)	-19	0	22	42	30	29	12	11	15	39	34	52	47	59	63	57	58	69	77	86	85	104
T_0950 (10C)	237	237	235	237	238	236	235	237	238	237	237	239	240	239	238	239	239	236	233	234	236	232
R_0950 (%)	86	88	89	89	90	90	91	90	90	90	90	90	90	90	90	90	91	91	92	92	92	93
Z_0950 (DM)	56	54	56	54	55	53	54	52	53	51	53	51	52	51	53	52	53	52	53	52	53	51
U_0950 (10KT)	-184	-155	-121	-112	-107	-100	-111	-125	-120	-119	-114	-115	-116	-116	-113	-109	-95	-92	-77	-67	-72	-46
V_0950 (10KT)	-16	-2	21	47	38	42	18	16	18	49	43	66	60	74	80	69	62	67	71	79	63	84
T_0900 (10C)	209	203	202	204	204	202	201	202	203	202	201	203	204	204	203	204	204	203	202	202	203	201
R_0900 (%)	84	92	93	94	95	95	96	97	97	97	97	98	97	97	97	98	98	97	96	96	97	96

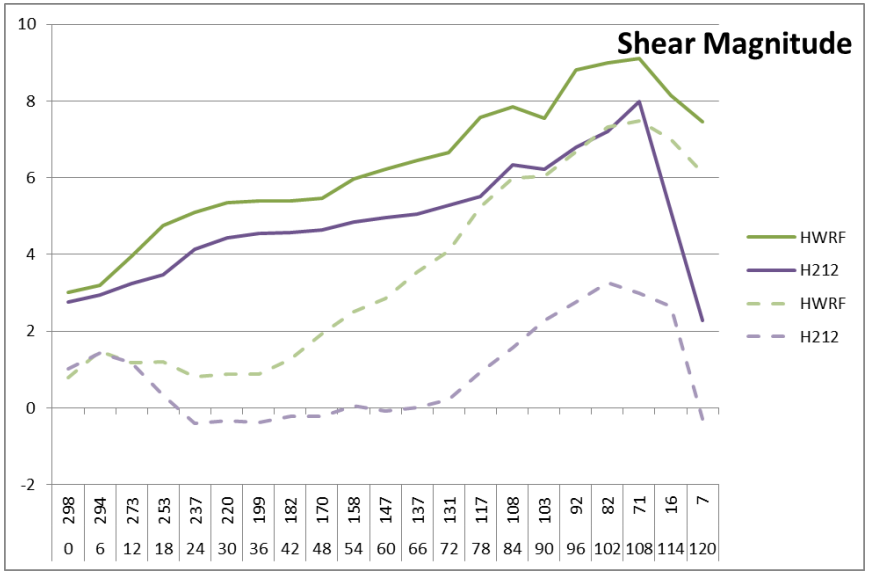
Application of Diagnostic Files: Verification of Large-Scale Variables

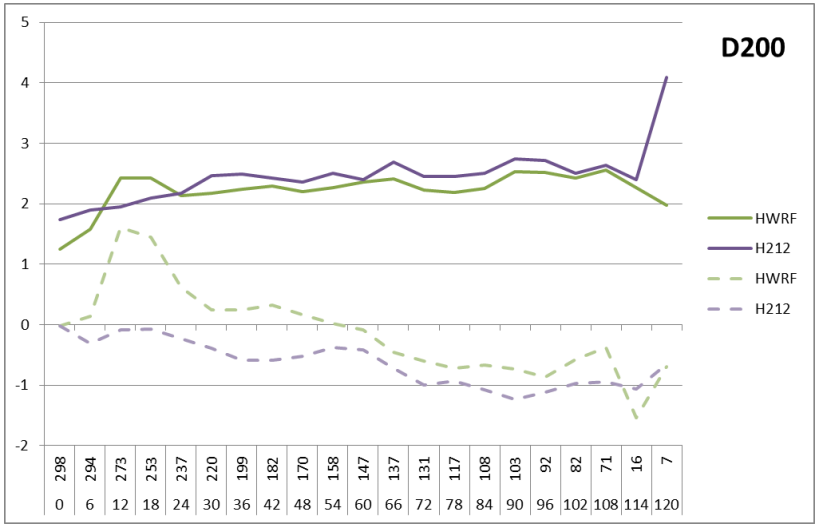
- "Traditional" hurricane model verification includes track and maximum wind errors and biases
- Extension to large scale variables in storm environment
- Use variables from GFS analysis as ground "truth"
- Pre-implementation tests
  - Compare operational HWRF to new H212 versions
  - Sample includes 2010-11 retrospective cases
    - Some problem with longer forecast times (96-120 hr)

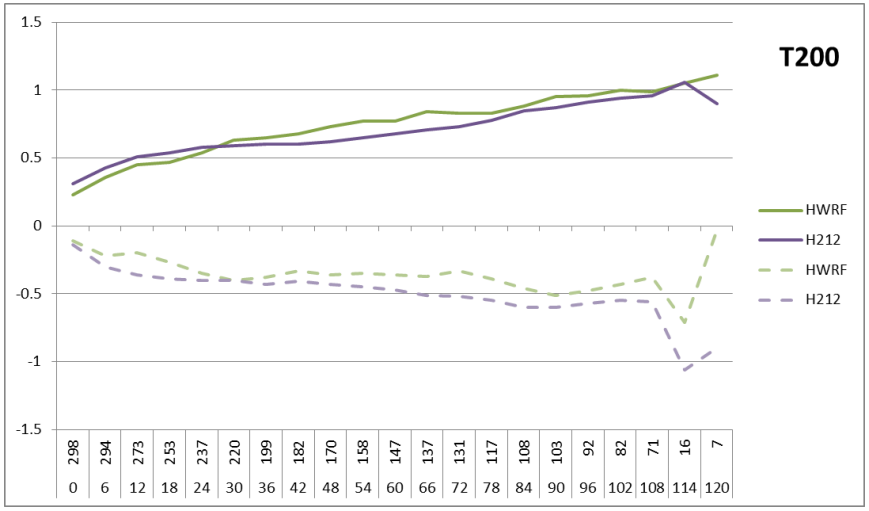
Storm Environmental Variables

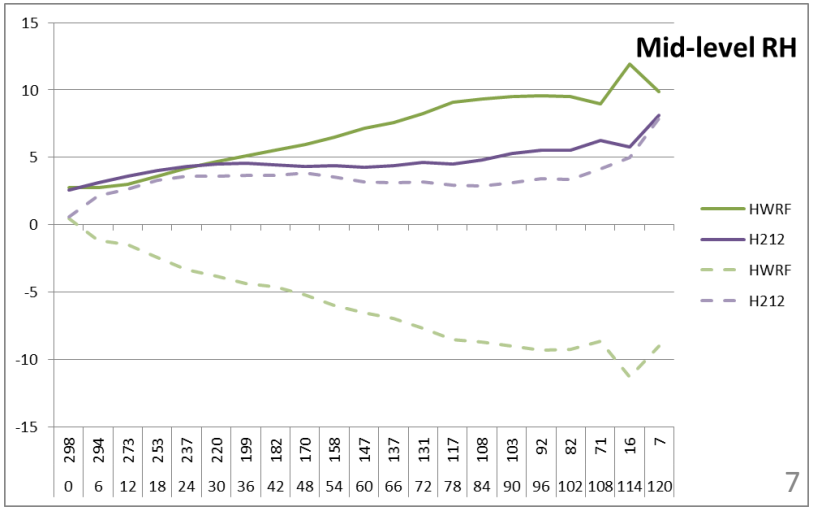
- 200-850 hPa vertical shear (0-500 km radius)
- 200 hPa divergence (0-1000 km radius)
- Mid-level relative humidity (700-500 hPa, 200-800 km radius)
- 200 hPa temperature (200-800 km radius)

Comparison of Operational HWRF and H212 for 2010-2011 Atlantic Cases

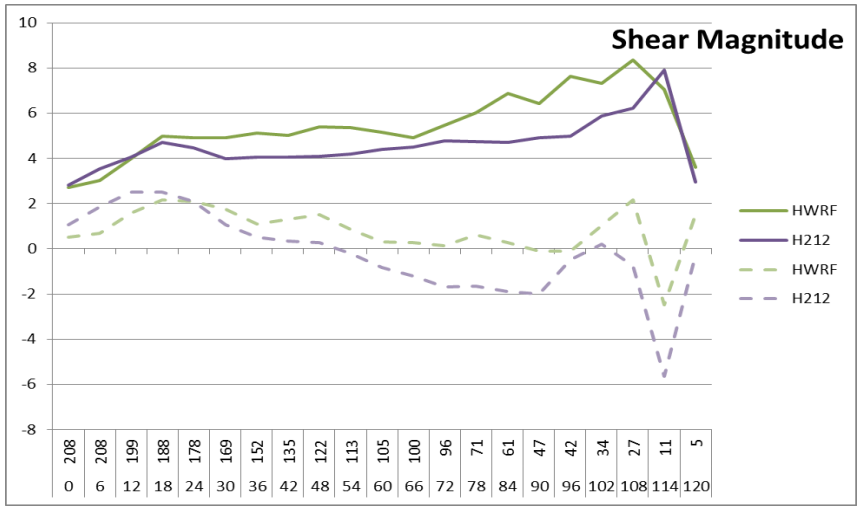


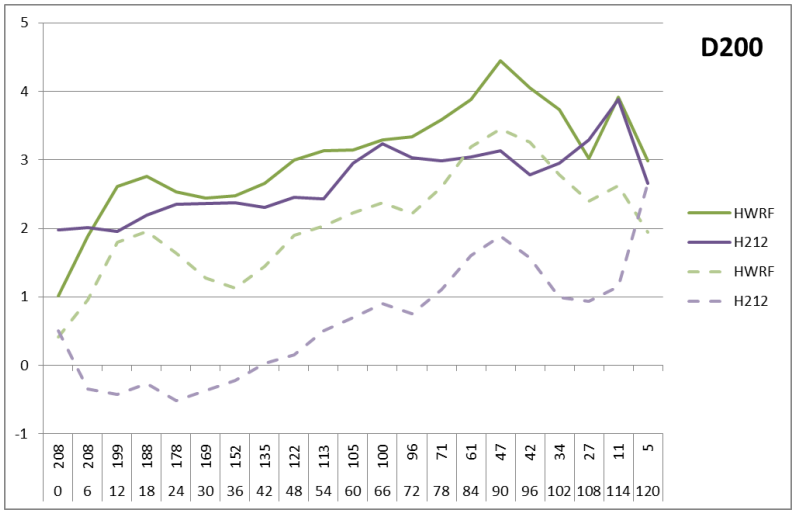


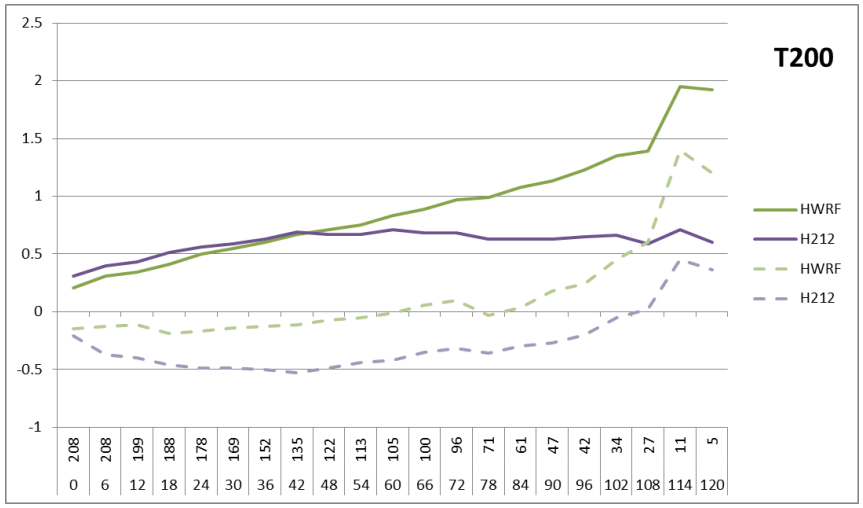


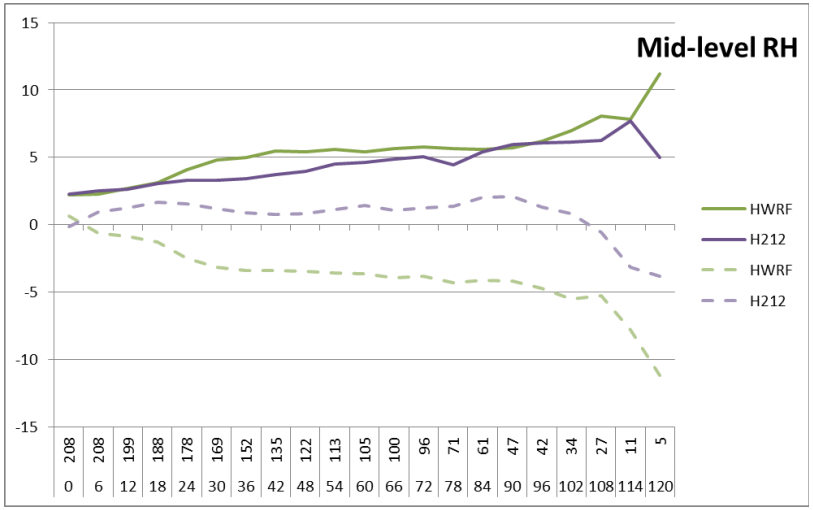


Comparison of Operational HWRF and H212 for 2010-2011 East Pacific Cases





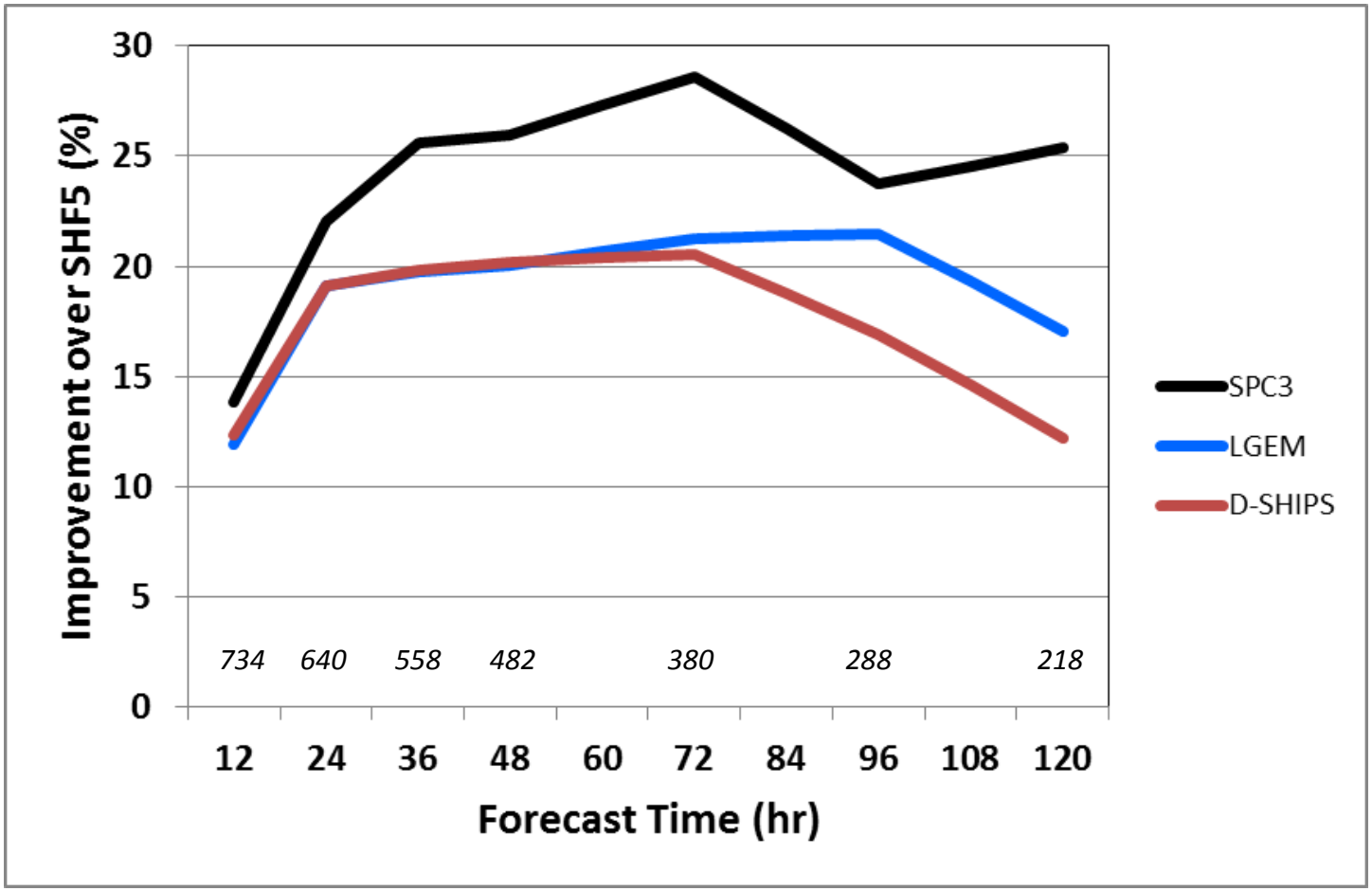


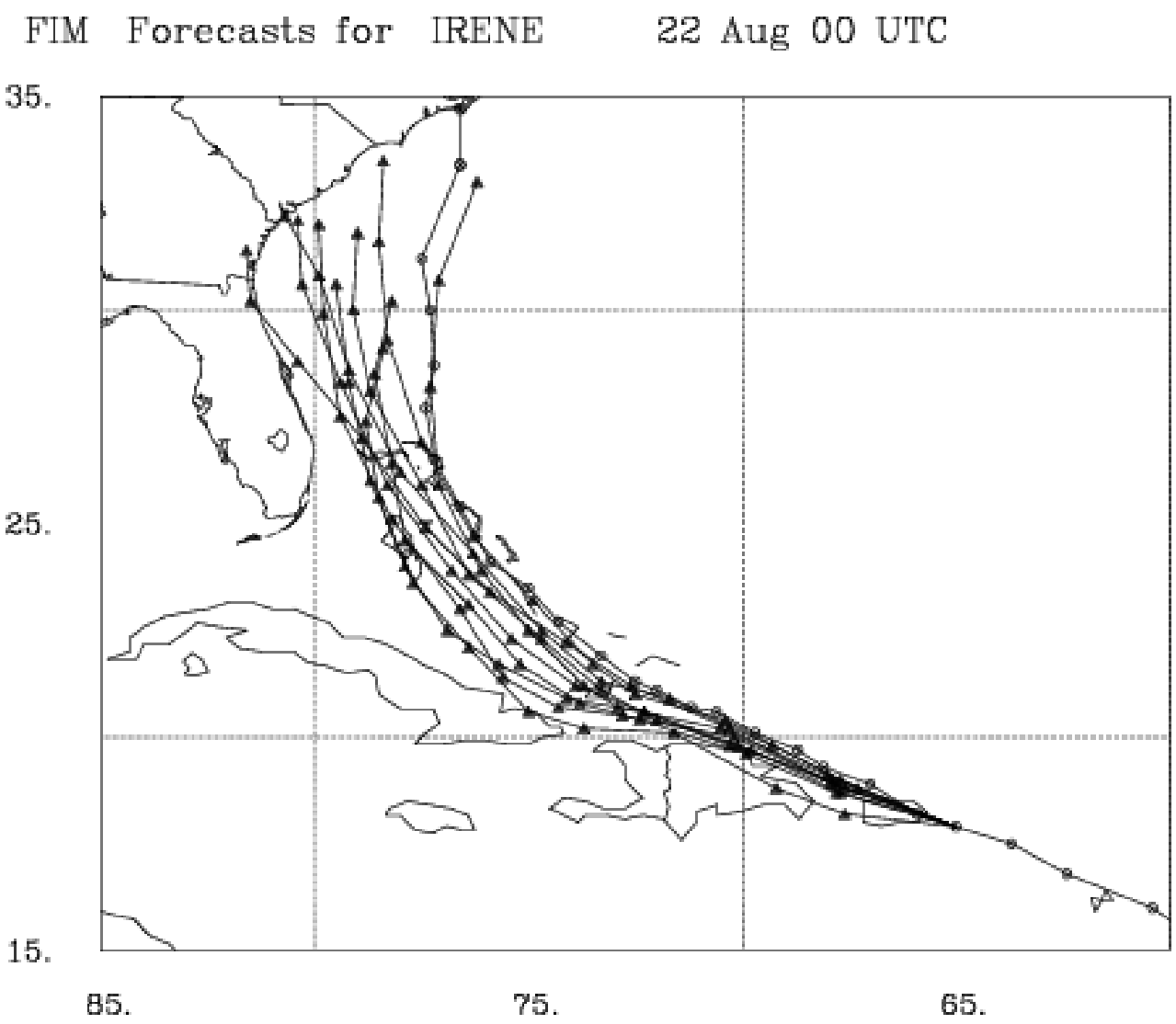


Application of Diagnostic Files: The SPICE Model

- Operational SHIPS and LGEM use GFS input with NHC official forecast
- SPICE Model runs SHIPS/LGEM with input from other models and tracks, forms consensus
  - SHIPS diagnostic file is all that is needed
- Planned for 2012
  - SPC3: GFS, HWRF, GFDL (stream 1.5 candidate)
  - SPCR: SPC3 + COAMPS-TC (stream 1.5 candidate)
  - SPCG: Global model ensemble input (stream 2)
    - 30 FIM, GFS ensemble members
- *Nice to have diagnostic files from other HFIP models for future versions of SPICE*

Skill of Atlantic SPC3
2009-2011 Retrospective Runs

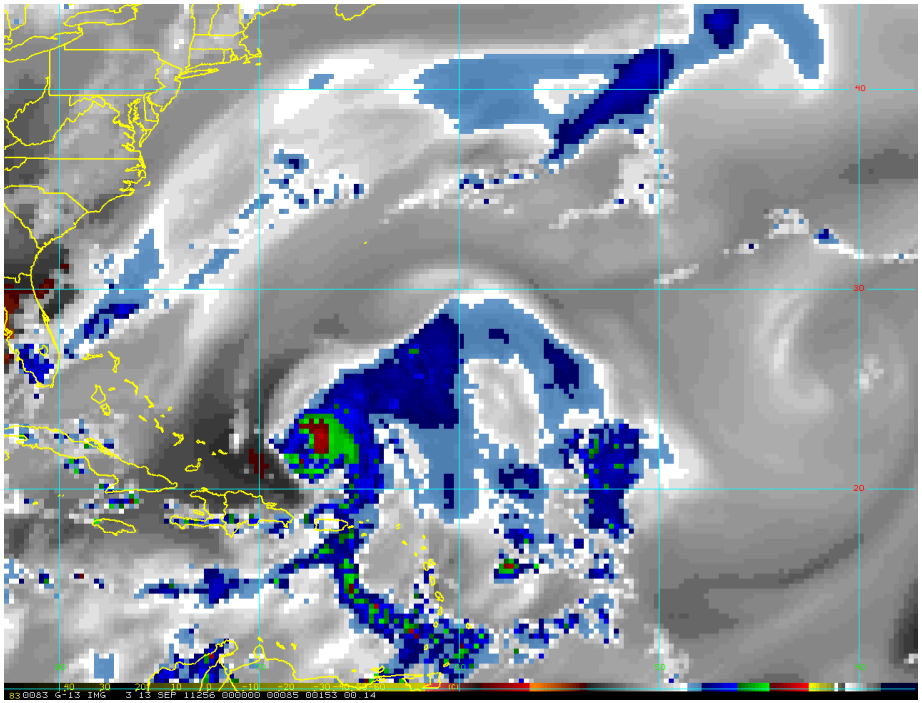



FIM Forecasts for IRENE 22 Aug 00 UTC
35.
25.
15.
85.
75.
65.

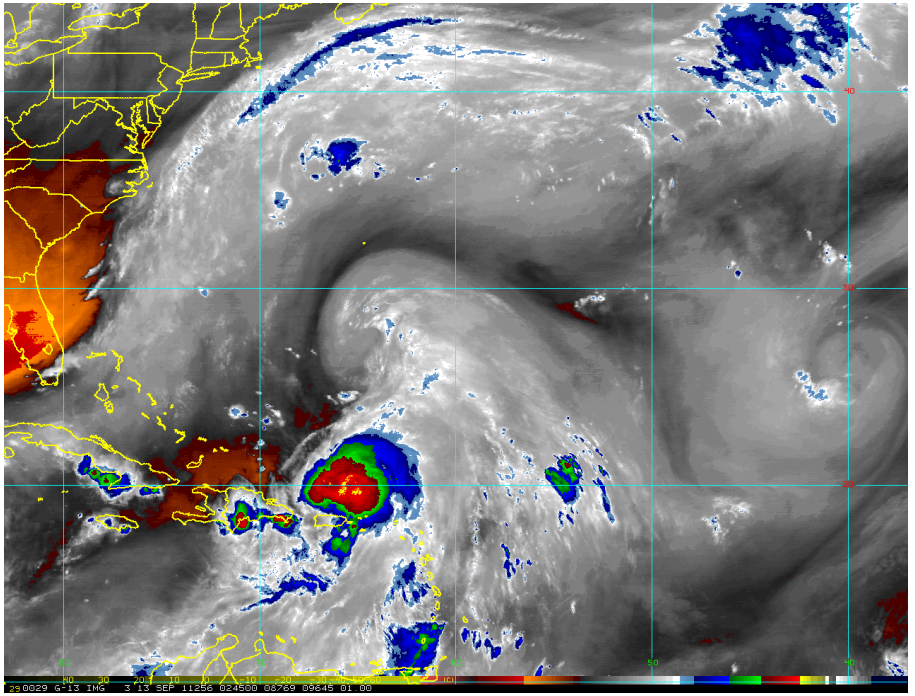
Infrared T_B Verification

- Use radiative transfer code to calculate synthetic infrared (IR) data from HWRF output
  - GOES channel 3 (water vapor) and 4 (window channel)
- Compare synthetic IR with real GOES data
- Mean absolute error, bias, brightness temperature histograms
- Compare verification for H212 and 2011 operational HWRF
- Preliminary tests with Irene and Maria(2011) cases

Comparison of Operational HWRF and H212 for 2010-2011 East Pacific Cases

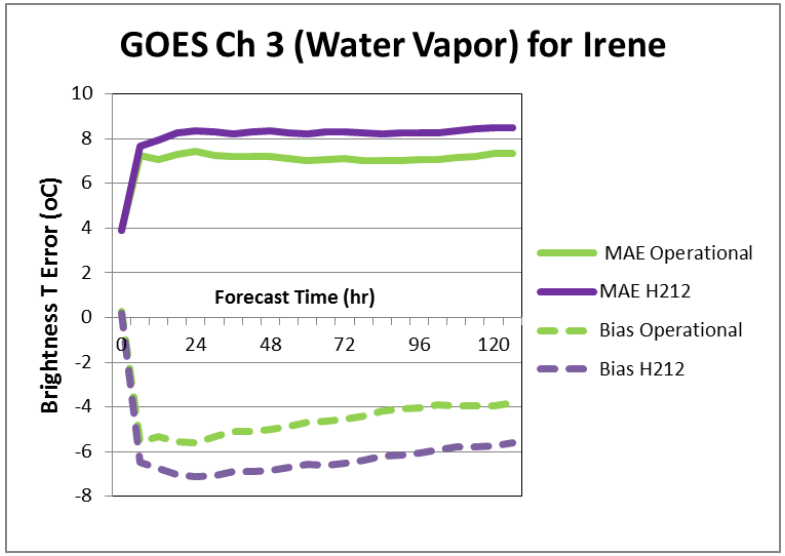


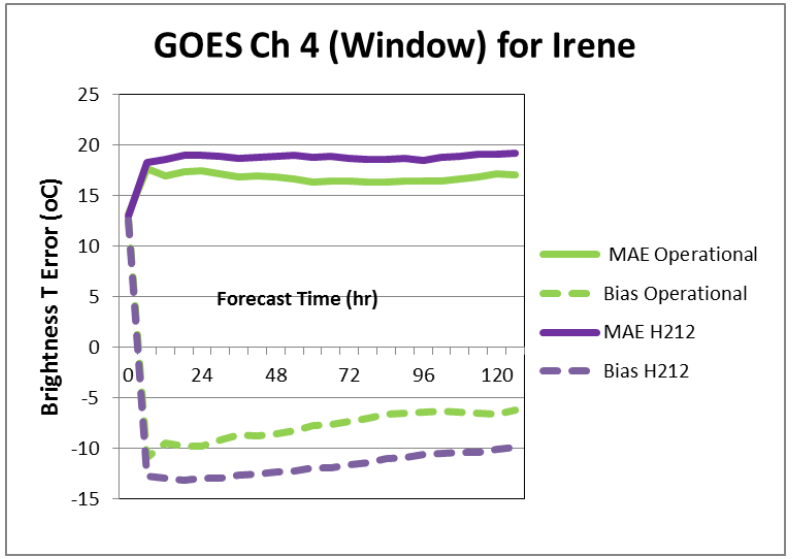
Synthetic GOES WV Image
24 hr HWRF Forecast valid
at 00 UTC on 13 Sept 2011

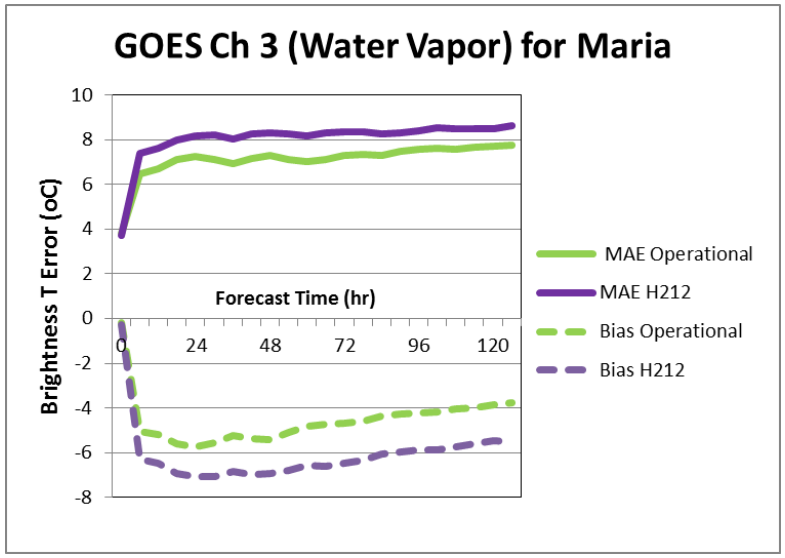


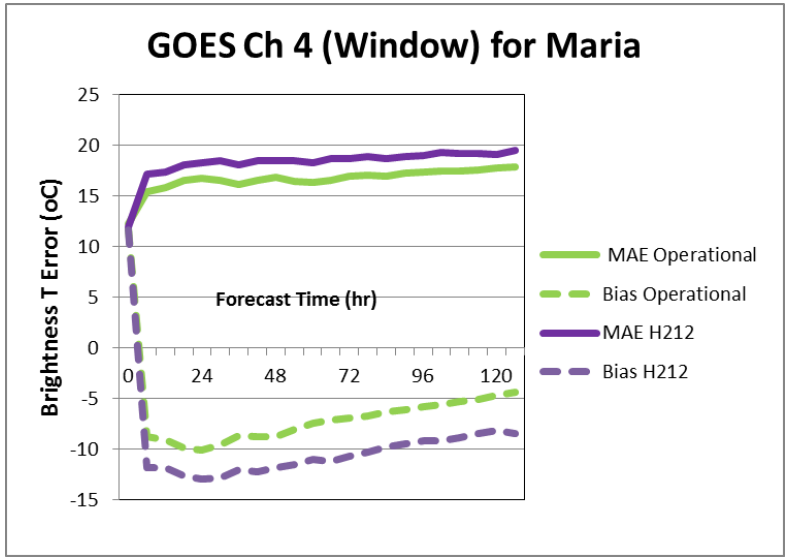
Real GOES WV Image
at 00 UTC on 13 Sept 2011

Validation of GOES Ch3 and Ch4 for Hurricane Irene and Maria Forecasts

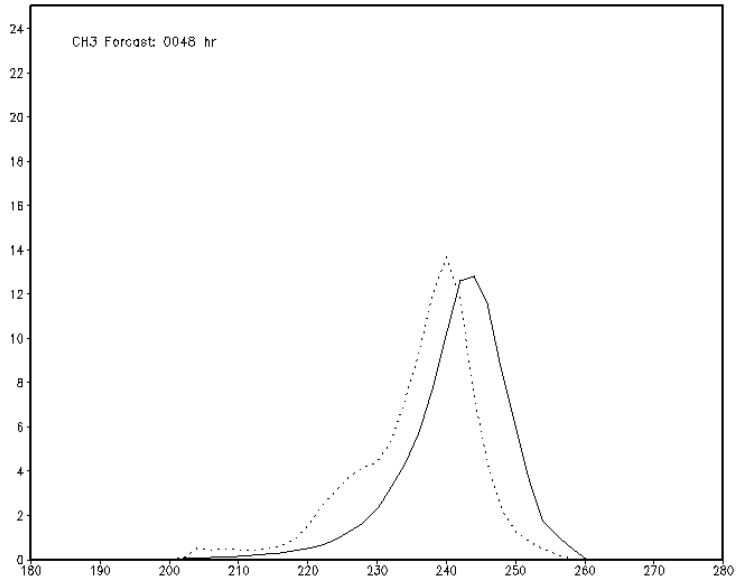




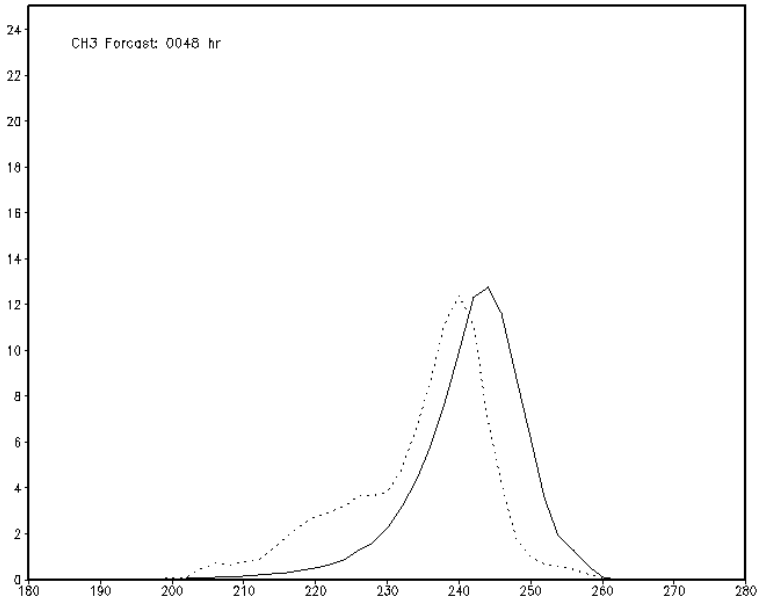




GOES Water Vapor T_B Histograms for 48 h Maria Forecasts



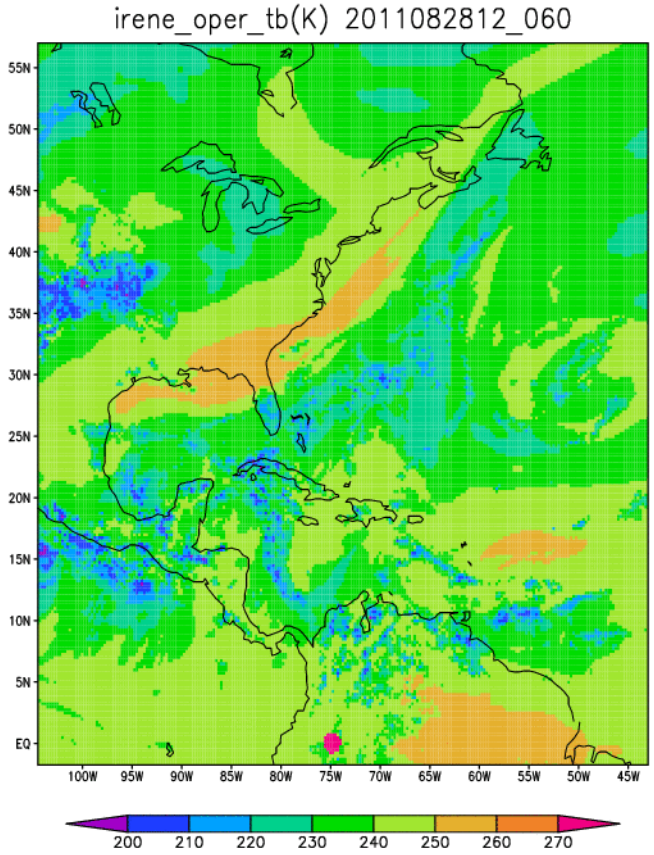
HWRF Operational

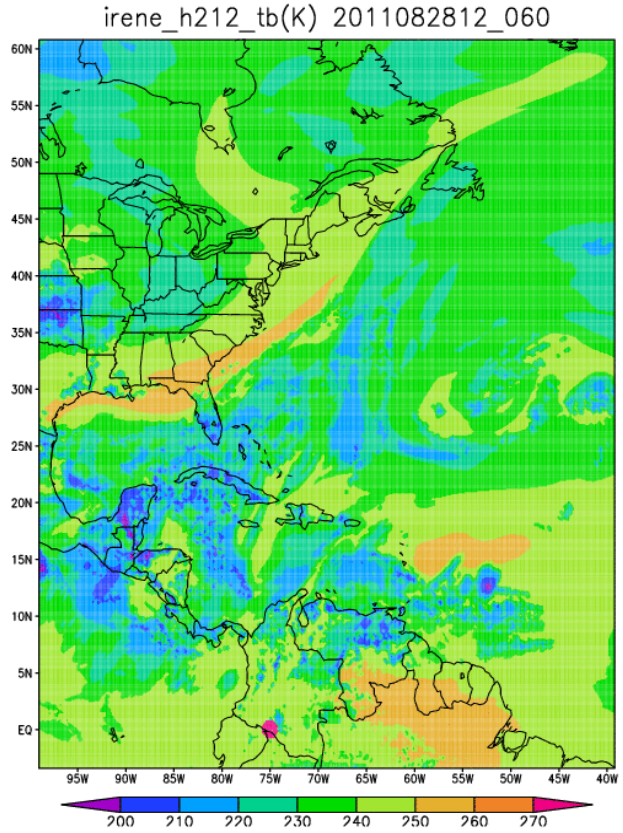


HWRF H212

(Dashed= Model, Solid=Observed)

HWRF Operational and H212 GOES WV Imagery Comparison





Summary

- SHIPS diagnostic files provide easy way to inter-compare model forecasts
  - Provides additional forecast metrics
- SPICE model should benefit from greater diversity of input models
  - Coordinate with NESDIS/CIRA if interested for 2012 stream 1.5 and 2 runs
- Large scale variables similar or more accurate in H212 versus operational HWRF
- Cold bias in HWRF synthetic GOES data
- Even colder in H212
  - Upper tropospheric moist bias
  - More active deep convection