Nearshore Wave Prediction System v1.1.0 CCB Meeting

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Nicole Kurkowski (OSTI)

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Jeffrey Hansson (USACE/CHL), Eve-Marie Devaliere (NESDIS/STAR), Joe Long and Hilary Stockdon (USGS), Greg Dusek (NOS CO-OPS)

Internal presentation to EMC, July 7, 2016

Outline

1. Quad chart (project timeline)
2. Scope of changes
3. Resource changes
4. Timing of jobs
5. Data input/output additions
6. Validation results

Nearshore Wave Prediction System (NWPS) V1.1.0

Project Status as of 03/14/2016

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Project Information and Highlights

Lead: Hendrik Tolman, EMC and Steven Earle, NCO

Scope:

1. Completing the national roll-out of NWPS. Centralized implementation of NWPS that is currently run locally at coastal WFOs in WR, AR and PR
2. Involves separate implementations for approx. 13 WFOs, using shared basic scripting (already running on WCOSS).
3. Potentially include rip current and wave runup guidance products at 4-5 pilot WFOS

Expected Benefits:

1. Resolution of coastal wave model guidance improved from 4 arc-min (with ww3 multi_1) to at least 1 arc-min.
2. Wave guidance consistent with forecaster-developed wind fields.
3. Improved economy of scale of centralized computing compared to distributed computing.

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Scheduling

Milestone (NCEP)	Date	Status
EMC testing complete	05/15/16	
EMC CCB	06/01/16* Now Jul 7	
SPA begins prep work for 30-day parallel	06/01/16	
Technical Information Notice Issued	07/01/16	
CCB approve parallel data feed	07/01/16	
Parallel and IT test begins at NCO	07/01/16	
NCO IT Testing complete	07/15/16	
Parallel Evaluation Ends	08/01/16	
Management Briefing	08/15/16	
Implementation	09/01/16 * Now Oct 25	

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Issues/Risks

Issues: Additional computing capacity required to support full NWPS roll-out (96 cores); Multiple implementations (each of approx. 13 WFOs).

Risks: On-demand operation and associated data feed pose risks to system stability.

Mitigation: Extended EMC testing period planned, during which the reliability of data feed can be assessed and improved.

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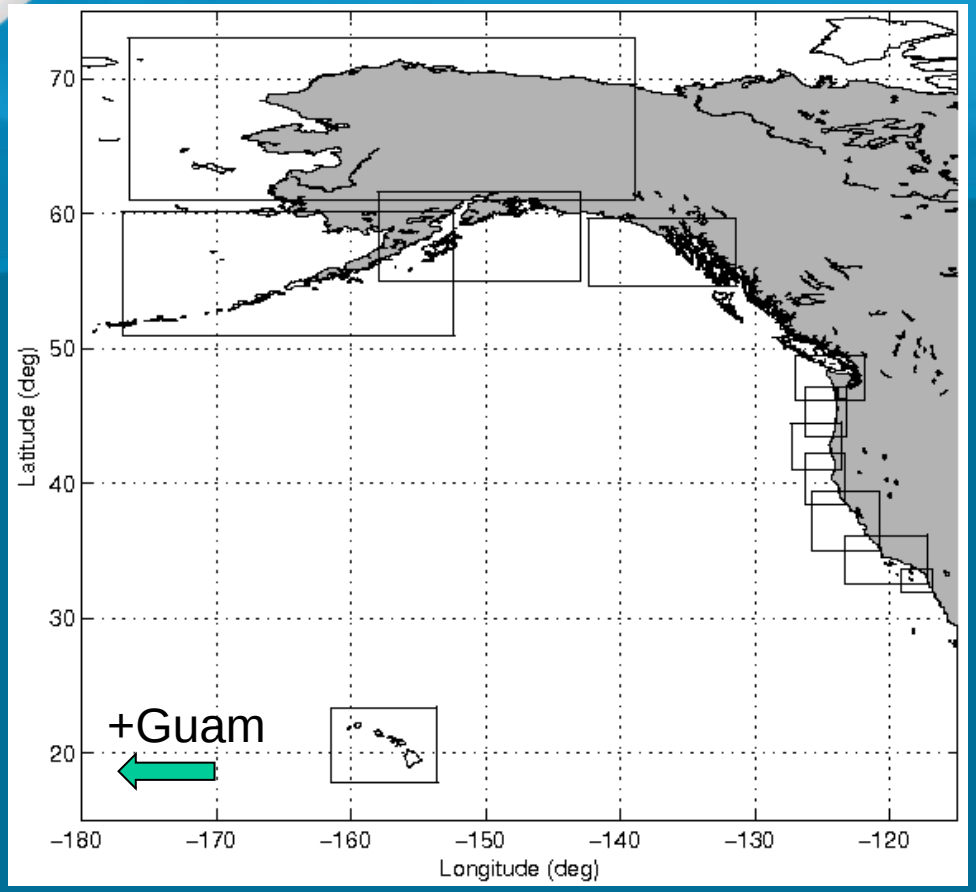
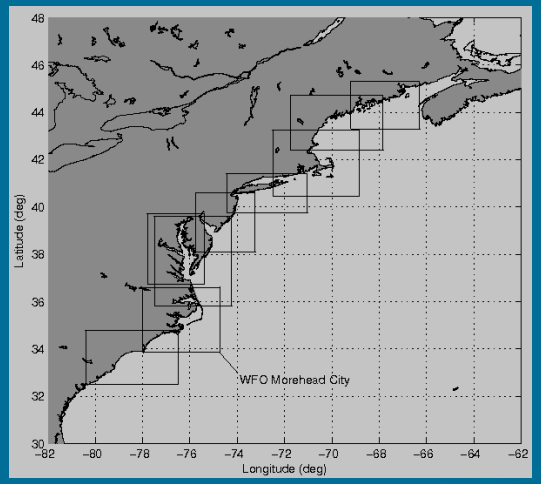
Finances

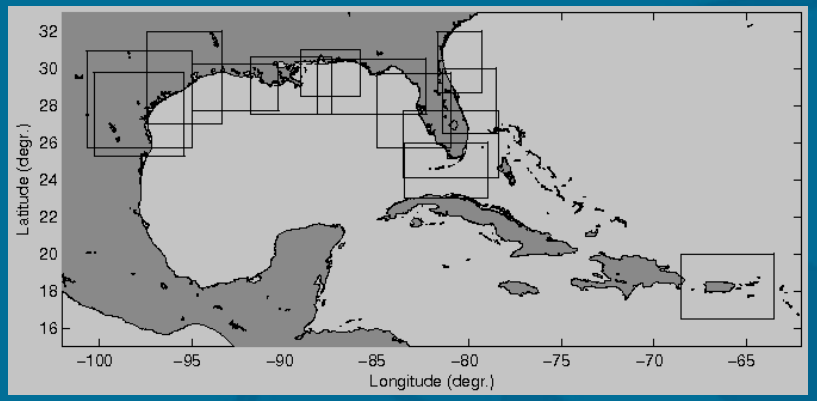
Associated Costs:

1) EMC contractor for system testing and implementation (base)
2) $150,000 development funding to build and test WR, PR and AR WFO domains for NWPS.

Funding Sources: EMC base; OSTI development funding.







Scope of changes: Additional 13 domains in WR/PR/AR

Scope of changes: Overall system
(Also applies to existing SR/ER domains)

1. System ported to WCOSS Cray
2. Addition of 13 domains in WR, PR and AR, completing a total of 36 WFO domains.
3. Expansion of OFS prep to accommodate Pacific basin, and include ice analysis fields (Alaska domains).
4. Increase spectral resolution from 24 to 36 directional bins over CG1 (overall) domains.
5. Experimental rip current guidance added to WFO San Diego.

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Scope of changes: Bug Fixes
(Also applies to existing SR/ER domains)

Bugzilla/ NCO-requested fixes

1. Bug ID 316: Replace degrib with degrib2/wgrib2 - Not possible
2. Bug ID 359: Error checking – Various *err_chk*s added after ush/* & scripts/* ✓
3. Bug ID 364: Remove GOTO statements – SWAN is community code. Checked with code manager (TU Delft), but not possible
4. Bug "Key West": Numerical instability – Added numerical limiter and checked error handling ✓
5. Changed output dir to com/nwps/prod/${REGION}.${PDY}/${WFO} ✓
6. Cleaned up redundant code/directories. Added doc/ directory ✓
7. Added module file with build environment ✓*
8. P-SURGE extraction script trigger – SPA-side change to be completed

Minor bug fixes:

1. Correct the handling of exception values in GRIB2 files (for AWIPS GFE/D2D display).
2. Changed web graphics color scales from "breathing" to fixed.

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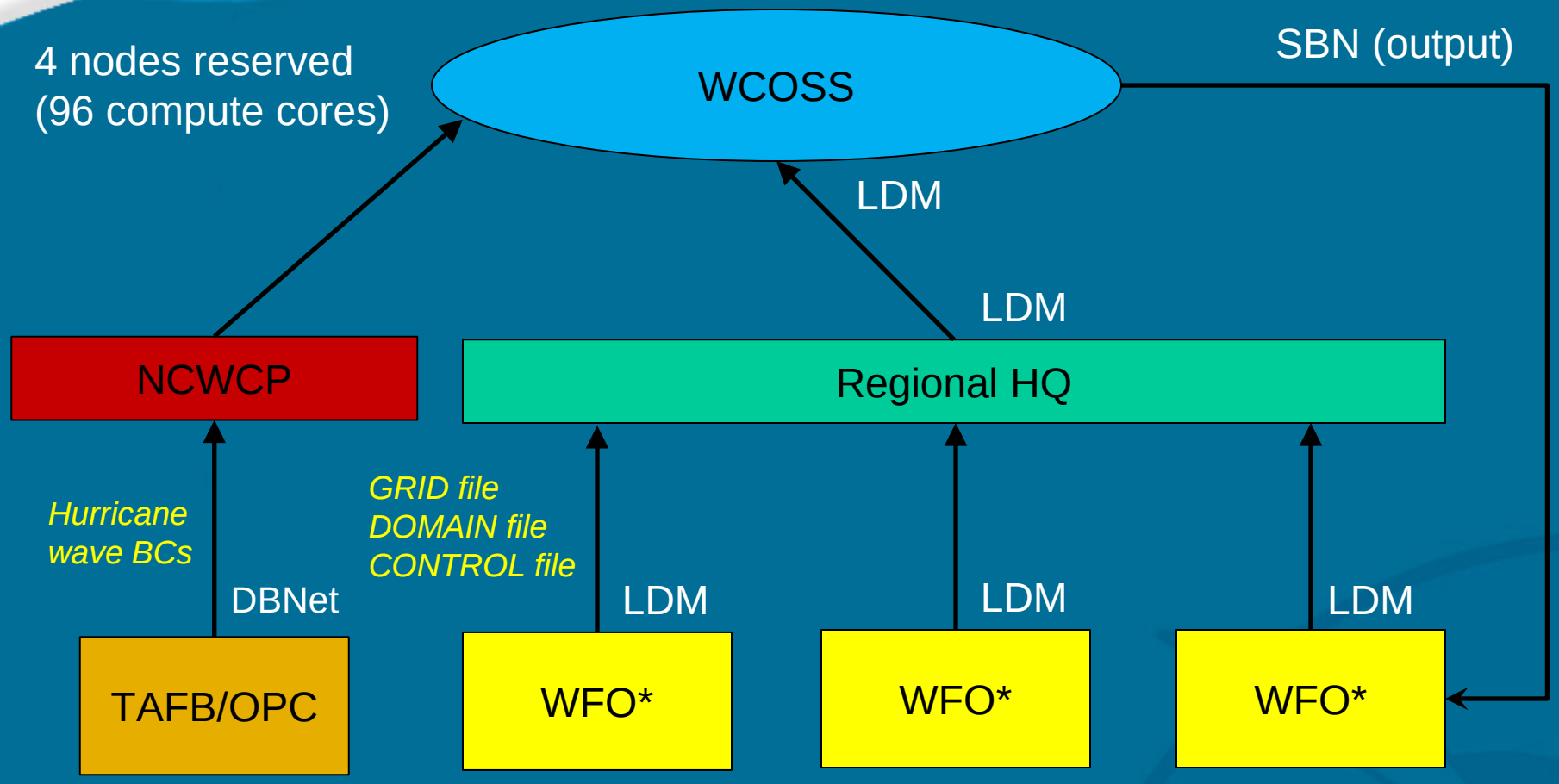
Model configuration
(Changes in yellow)

- Spectral wave model SWAN v40.81, enhanced with wave partitioning (similar to WW3 v4.18).
- Wave system tracking from WW3 v4.18 (IBM optimized).
- Rip currents using Dusek & Seim (2013) and wave runup using Stockdon et al. (2006).
- Source terms, deep water (SWAN default): Komen et al. (1984), as recalibrated by Rogers et al. (2003).
- Source terms, shallow water (SWAN default): JONSWAP bed friction, Battjes & Janssen (1978) depth breaking, LTA triads.
- Run length = 102 h, ~2 cycles/day. Initiated on-demand by WFOs.
- Geographical resolution: 1.8-7.5 km res outer grid (CG1), with optional nests typically at 500 m res (CG2-5).
- Spectral resolution: **36 dirs**, 37 freqs (0.05-1.5 HZ)

NWPS Regional Architecture



* Data upload robustness improved with AWIPS v16.2.1

Scope of changes: Monitor additional WFOs

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Nearshore Wave Prediction System
WFO Status

Quick Find:

Clear All Filters

WFO ID	Start Time	End Time	Region	Status	Job Running	Run Info
Selec	Selec	Selec	Selec	Selec	Select...	Selec
MFL	1802		SR	ACTIVE	FORECAST_CG1	click
MLB	1801		SR	ACTIVE	FORECAST_CG1	click
JAX	1751		SR	ACTIVE	POST_CG1	click
TBW	1731		SR	ACTIVE	POST_CG1	click
AKQ	0743	0826	ER	DONE		click
BOX	0601	0722	ER	DONE		click
BRO	1311	1345	SR	DONE		click
CAR	1258	1357	ER	DONE		click
CHS	1017	1103	ER	DONE		
CRP	1544	1620	SR	DONE		
GYX	1402	1508	ER	DONE		
HGX	0931	1035	SR	DONE		
ILM	1601	1632	ER	DONE		
KEY	1539	1708	SR	DONE		
LCH	0723	0813	SR	DONE		
LIX	0742	0856	SR	DONE		
LWX	1642	1700	ER	DONE		
MOB	0731	0905	SR	DONE		
OKX	0636	0747	ER	DONE		
PHI	0704	0752	ER	DONE		click
SJU	0747	0928	SR	DONE		click
TAE	1631	1757	SR	DONE		click

NOAA National Weather Service
National Centers for Environmental Prediction
5830 University Research Court
College Park, MD 20740
NCEP Internet Services Team

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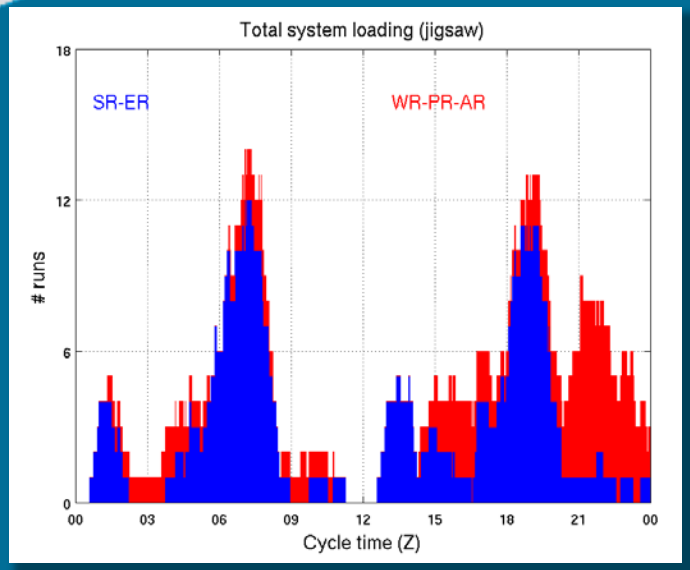
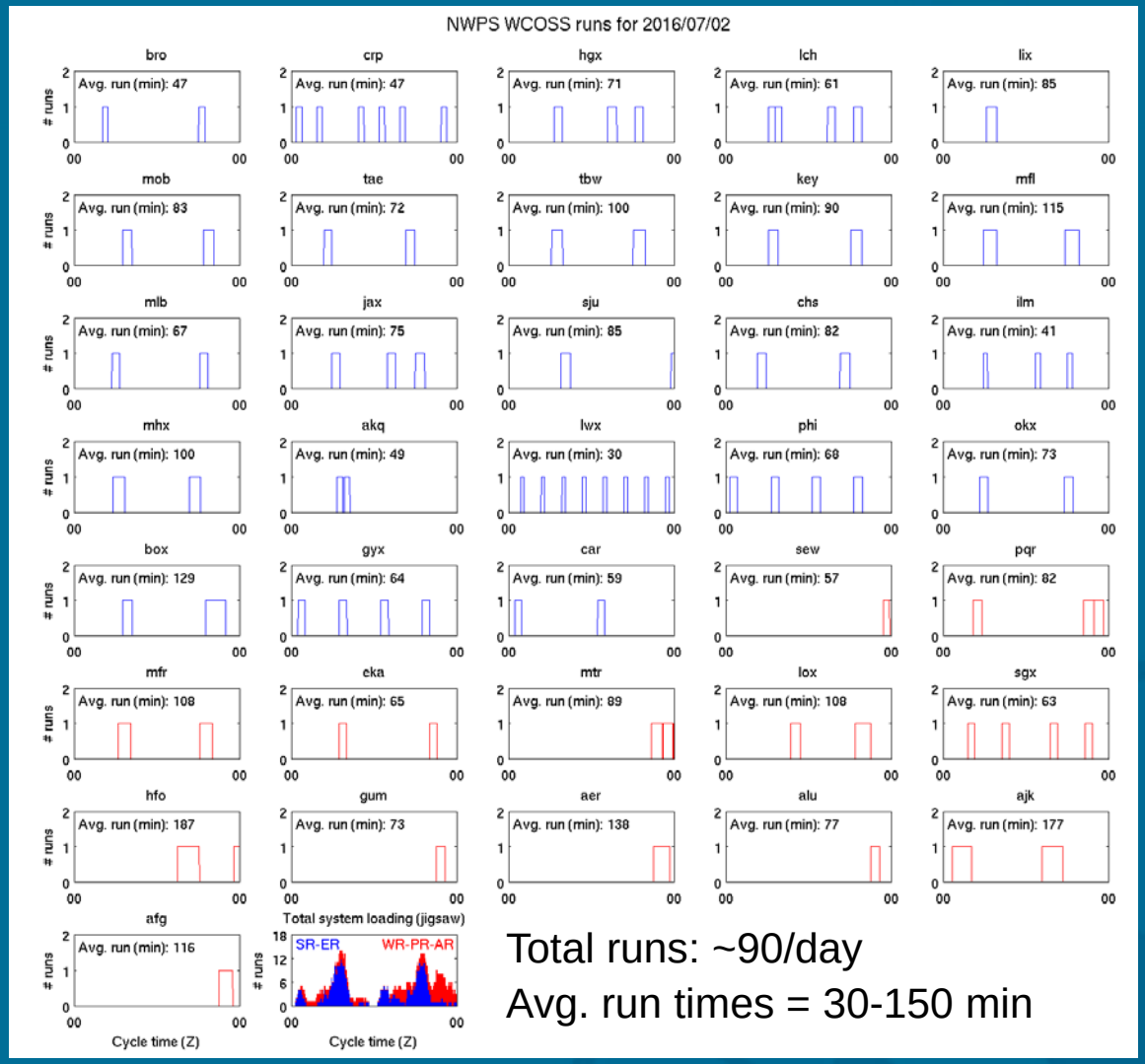
```
NWPS run started on Thu Dec  3 17:59:34 UTC 2015
MFL wind file: 201512031756_WIND.txt
Run was configured with forecaster settings
Run settings: RUNLEN=102 WNA=WNAWave NESTS=Yes RTOFS=Yes
WINDS=FORECASTER WEB=Yes PLOT=Yes USERDELTAC=600
HOTSTART=TRUE WATERLEVELS=ESTOFS MODELCORE=SWAN
Forecast analysis time: 20151203 18Z
```

Resource changes/Timing of jobs



New WR/PR/AR domains in red.

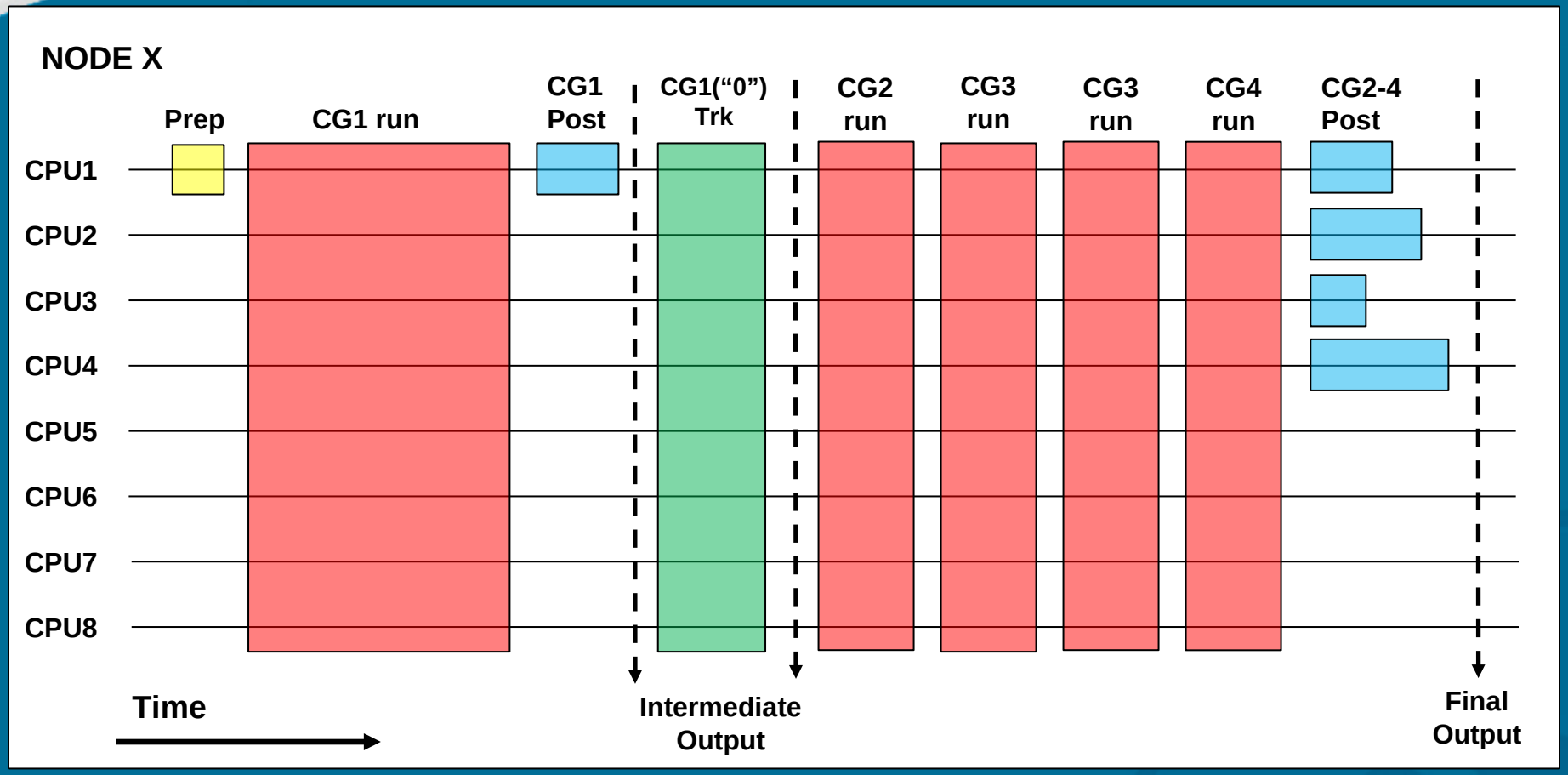
Estimated 48 additional reserved cores required (total 96+48 for NWPS)



Total runs: ~90/day

Avg. run times = 30-150 min

Scheduling of jobs (single WFO)



Timing of jobs
(Recorded 07/01/16; Current IBM runtimes in parentheses)

SR:

BRO:45 min (47)
CRP: 46 min (48)
HGX: 69 min (72)
LCH: 73 min (67)
LIX: 87 min (87)
MOB: 76 min (81)
TAE: 72 min (55)
TBW: 92 min (107)
KEY: 82 min (103)
MFL: 113 min (119)
MLB: 64 min (72)
JAX: 67 min (69)
SJU: 90 min (103)

ER:

CHS: 83 min* (60)
ILM: 41 min (44)
MHX: 100 min (99)
AKQ: 54 min (51)
LWX: 29 min (32)
PHI: 68 min (64)
OKX: 70 min (66)
BOX: 82 min (94)
GYX: 62 min (59)
CAR: 57 min (62)

PR:

HFO: 181 min
GUM: 65 min

WR:

SGX: 59 min
LOX: 88 min
MTR: 86 min
EKA: 56 min
MFR: 104 min
PQR: 73 min
SEW: 57 min

AR:

AJK: 174 min
AER: 137 min
ALU: 78 min
AFG: 110 min

* Due to user-requested additional domains

Timing of jobs – Supporting preproc

ESTOFS water level extraction:

CPU time: 3:17:02 h:min:sec (4:01:00 h:mm:sec)

Max/Ave Memory : 199 MB / 57.86 MB

Num of CPUs : 1 (Serial, on 1 node)

RTOFS surface current extraction:

CPU time: 0:12:27 h:min:sec (0:10:00 h:mm:sec)

Max/Ave Memory : 100 MB / 34.18 MB

Num of CPUs : 1 (Serial, on 1 node)

P-Surge water level extraction (tropical conditions in SR/ER):

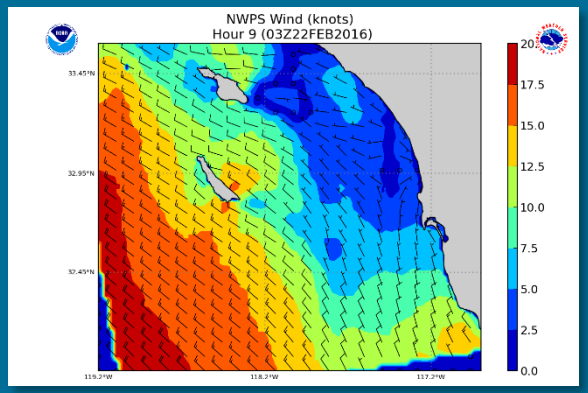
CPU time : 2:59:20 h:min:sec

Max/Ave Memory : 27 MB / 22.08 MB

Num of CPUs : 23 (cfp parallel, distrib. over 2 nodes)

Data input additions (from each WFO via LDM)

1. GFE wind file (GRIB2)
(produced in AWIPS)



2. DOMAIN file (txt)

```
#-----------------------------------------------------------------------
# Domain File
# Original Author(s): Roberto Padilla-Hernandez,Douglas Gaer,
# Alex Gibbs, Pablo Santos,Tony Freeman
# File Creation Date: 06/01/2012
# Date Last Modified: 02/01/13
#
# Version control: 1.33
#
# Support Team:
#
# Contributors:
#
# -------------------------------------------------------------------
# ---------------------- Description and Details ---------------------
# -------------------------------------------------------------------
#
# File used to setup a geographical domain for SWAN and WW3
#
# -------------------------------------------------------------------
#=====================================================================
#                                  MFL                                =
#  GEOGRAPHICAL DOMAIN, GEOGRAFICAL RESOLUTION AND OUTPUT TIME STEP   =
#=====================================================================
export SITEID="MFL"
export REGIONID="SR"
export NELAT="27.70"
export NELON="-78.41"
export SWLAT="24.10"
export SWLON="-83.54"
#export RES=".8"
export RES="6"
export TSTEP="3"
```

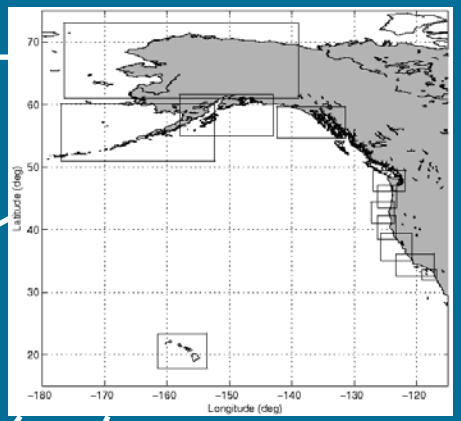
3. CONTROL file (txt)
(produced in AWIPS)

```
ssh ${SSHARGS} ldad@ls1 echo "$RUNLEN:$WNA:$NEST:$GS:$WINDS:$WEB:$PLOT:$DELTAC:$HOTSTART:$ESTOFS:$CORE >
/data/ldad/nwps/input/inp_args" 2>&1 | tee -a $logfile
```

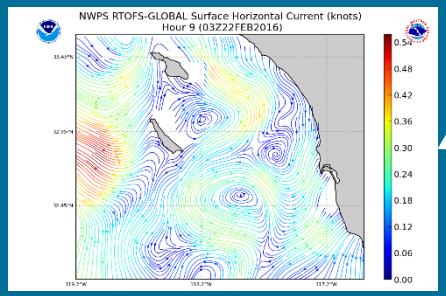
Size = ~2 Mb zipped/WFO site

Data input additions (Staged on WCOSS)

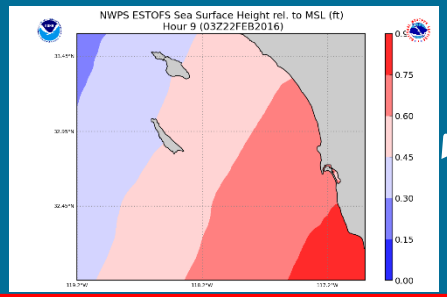
1. WAVEWATCH III boundary spectra (txt)



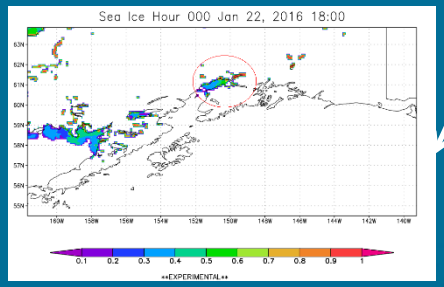
2. RTOFS surface current fields (txt)



3. ESTOFS water levels (txt)
(Extra-tropical conditions)



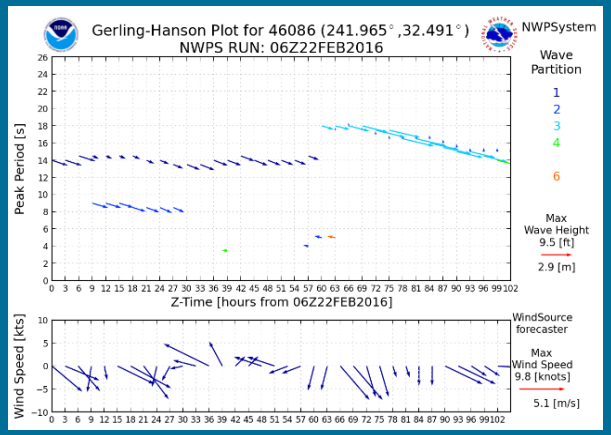
4. Ice analysis fields (txt)
NEW ADDITION

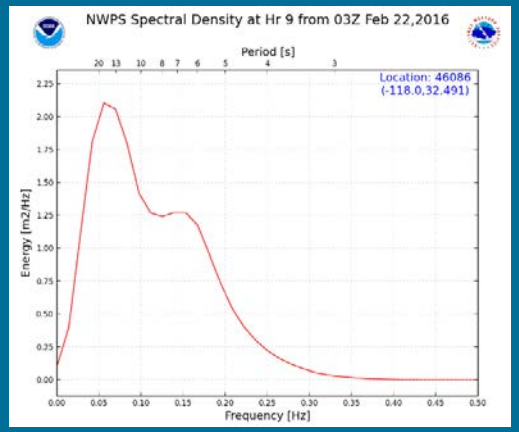


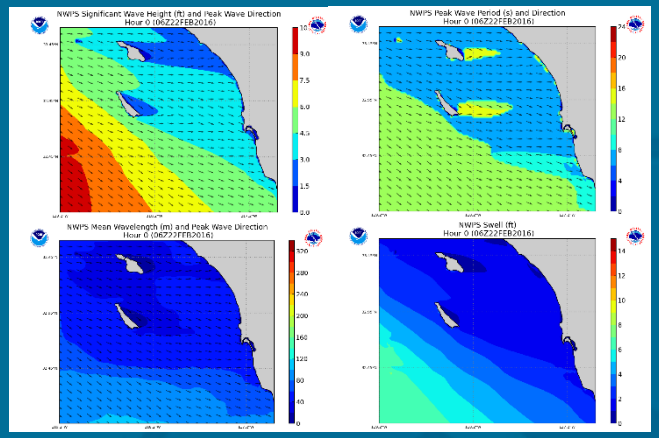
Data output additions

1. **GRIB2** output fields, per WFO per grid (CG1-5), with **WMO Headers -> SBN**
2. **Png files** of wave partition time series (Gerling-Hanson plots)
3. **Png files** of wave spectra
4. **Png files** of wave fields
5. **Text files** with experimental rip current output (WFO SGX)
6. **Text files** with 2D wave spectra

EMC's Polar

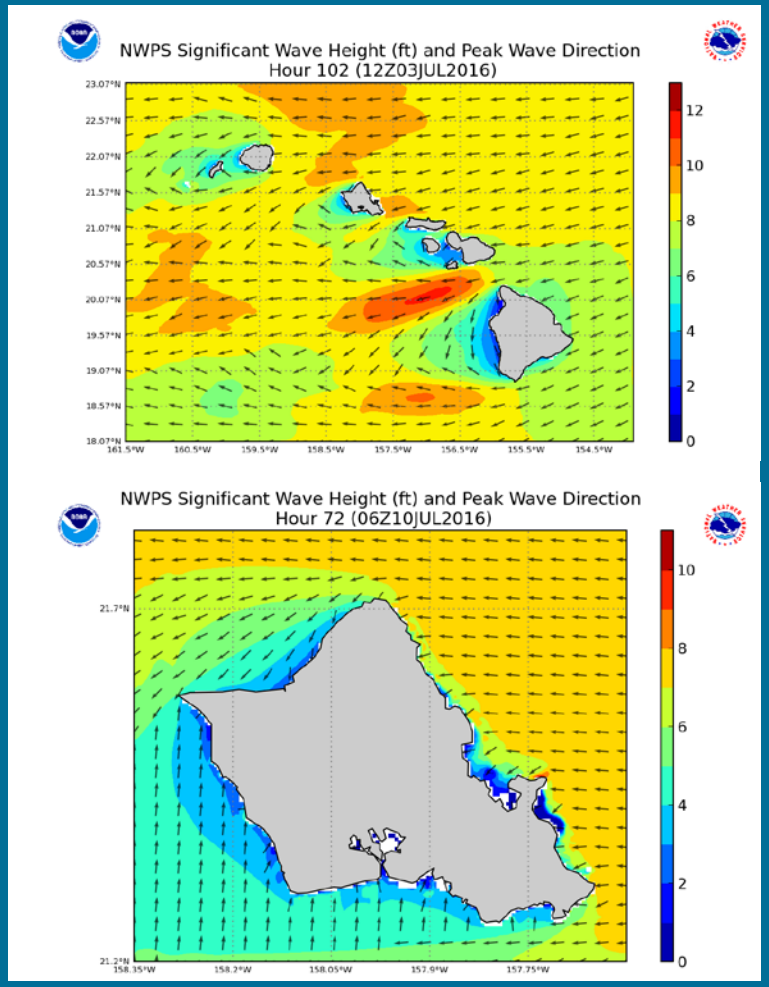


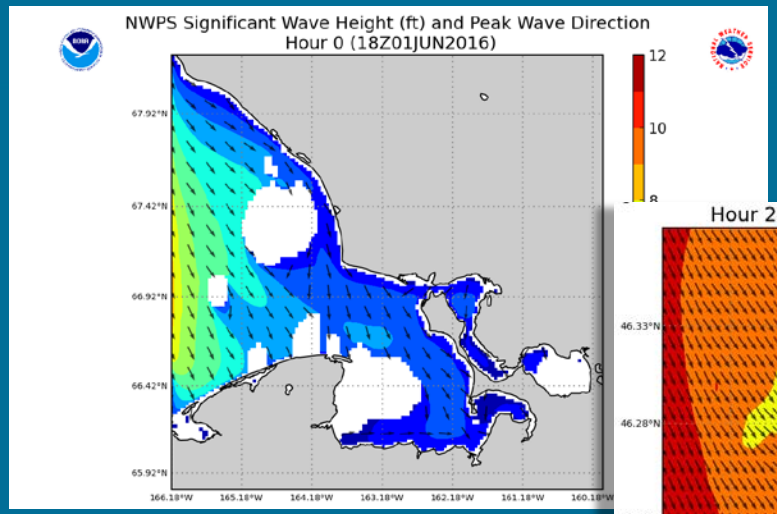


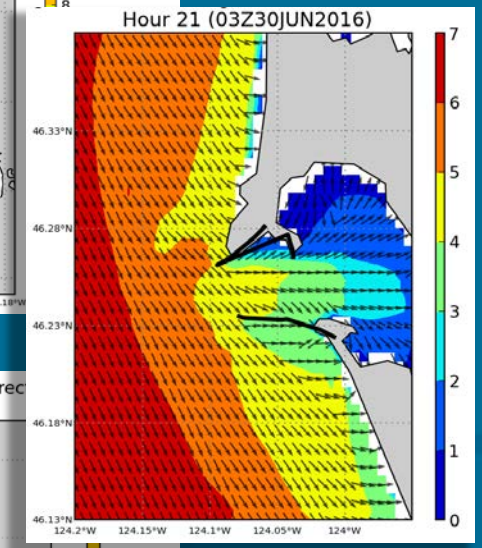


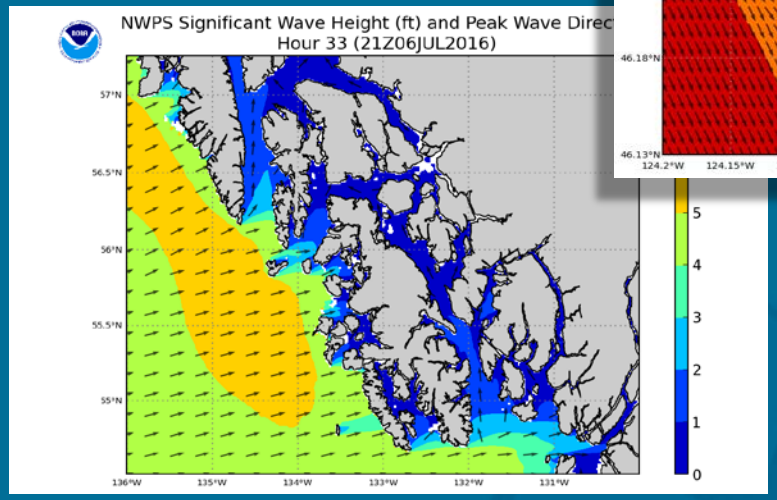
Total volume incl. 13 new WFO domains = 1.5+0.9 GB/cycle ~ 2x /day

Example output on WR, PR and AR

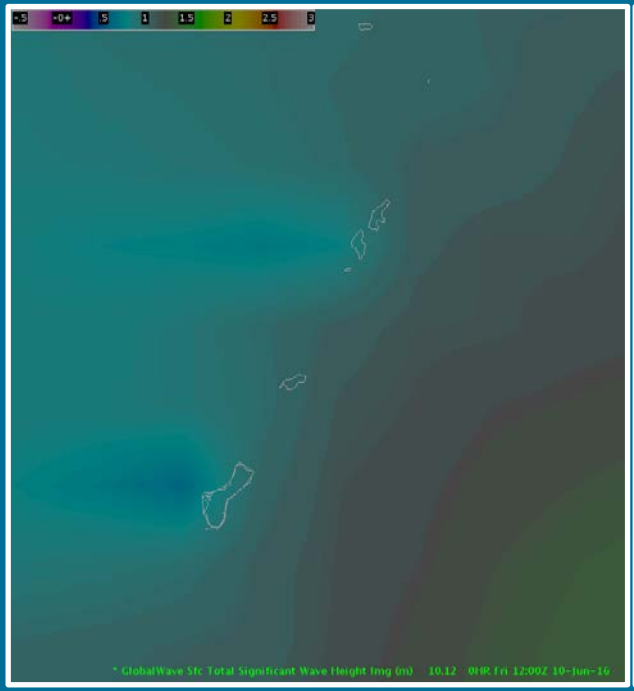




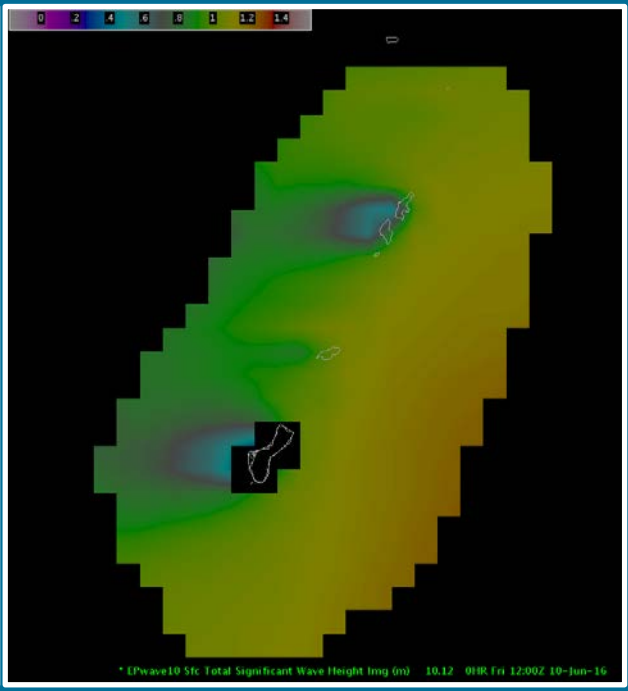




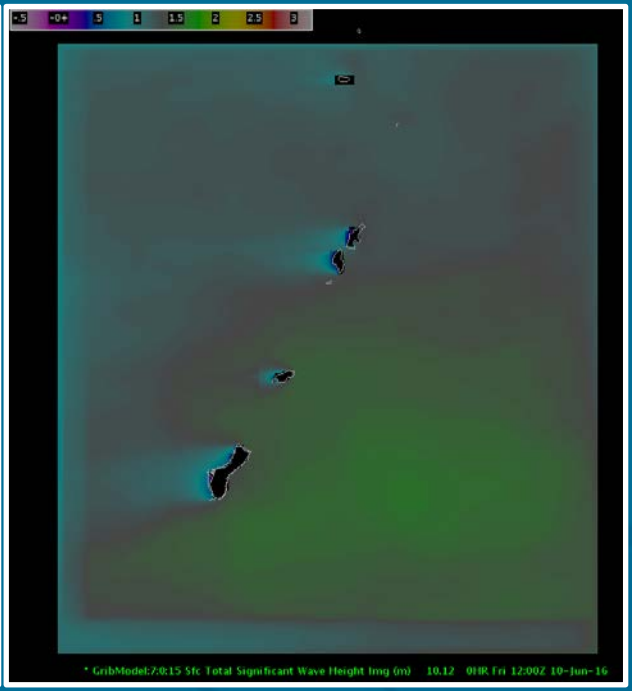
WFO Guam: Example output in AWIPS



WW3_Multi1: 0.5 deg

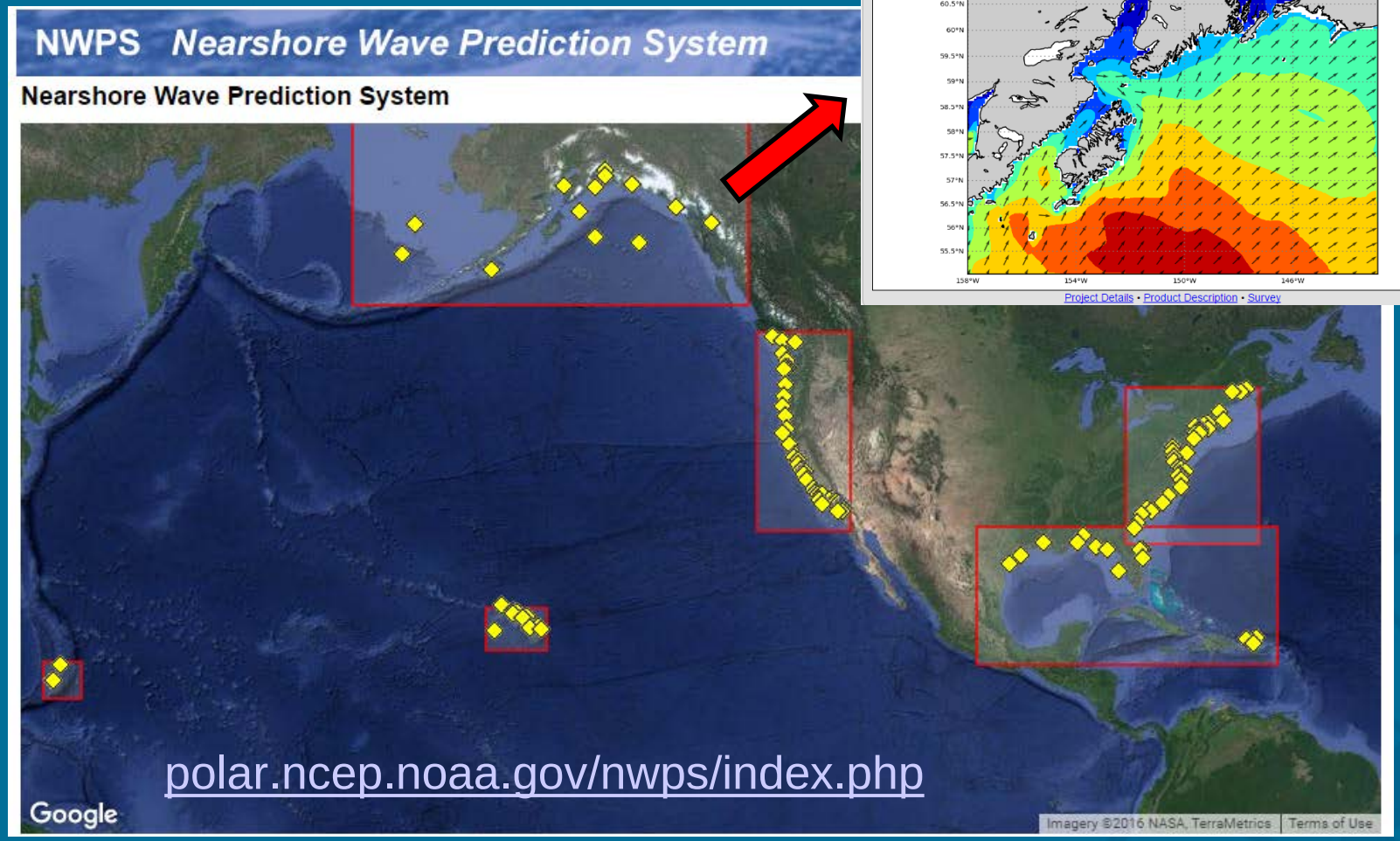


WW3_Multi1 EPwave10: 10 arc-min

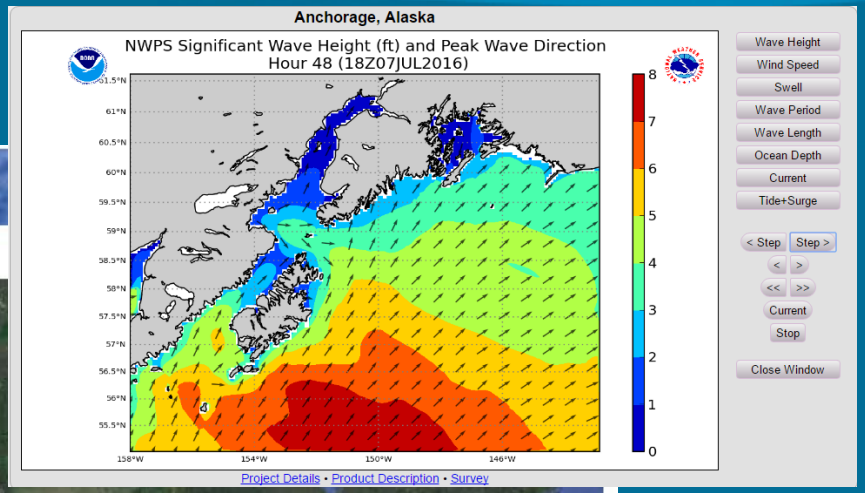


NWPS: 2 arc-min (4 km) – 30 arc-sec (1 km)

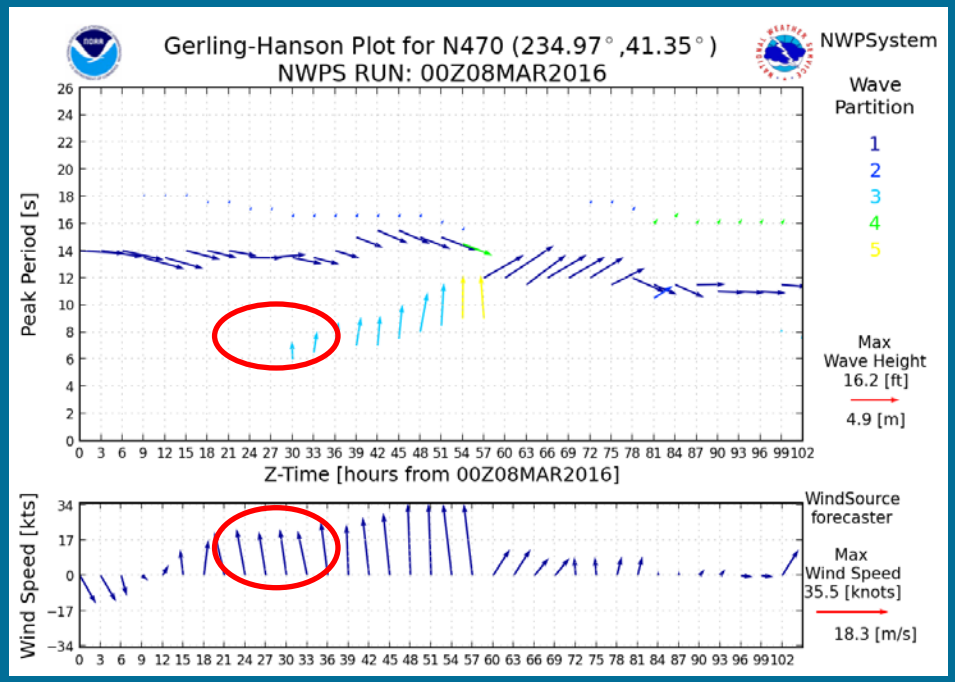
Animations and validation on Polar

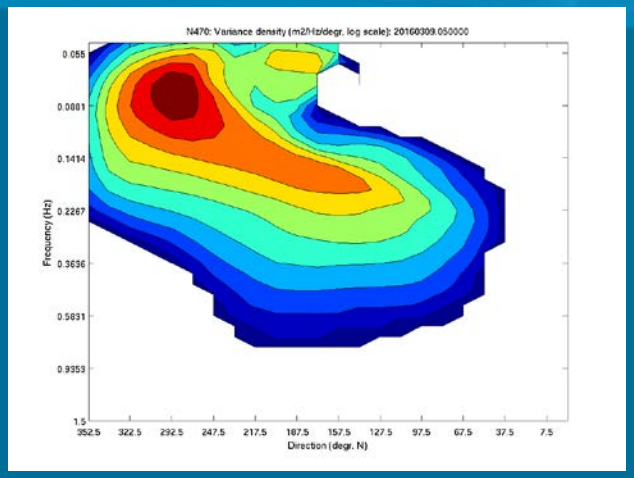


polar.ncep.noaa.gov/nwps/index.php

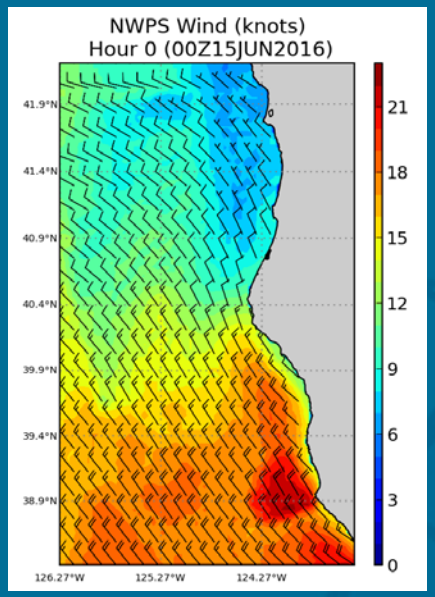


Validation: Wave partitioning/tracking

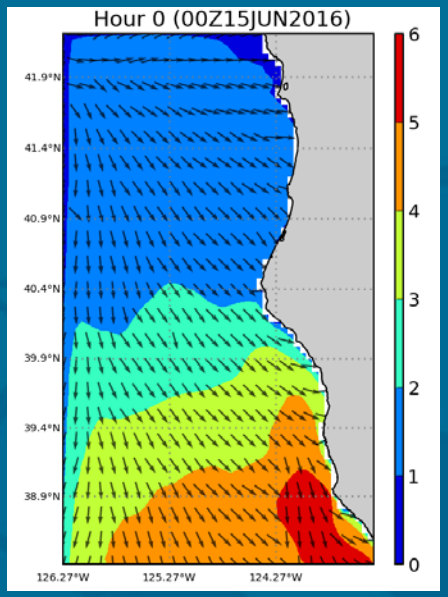




GFE U10 grid

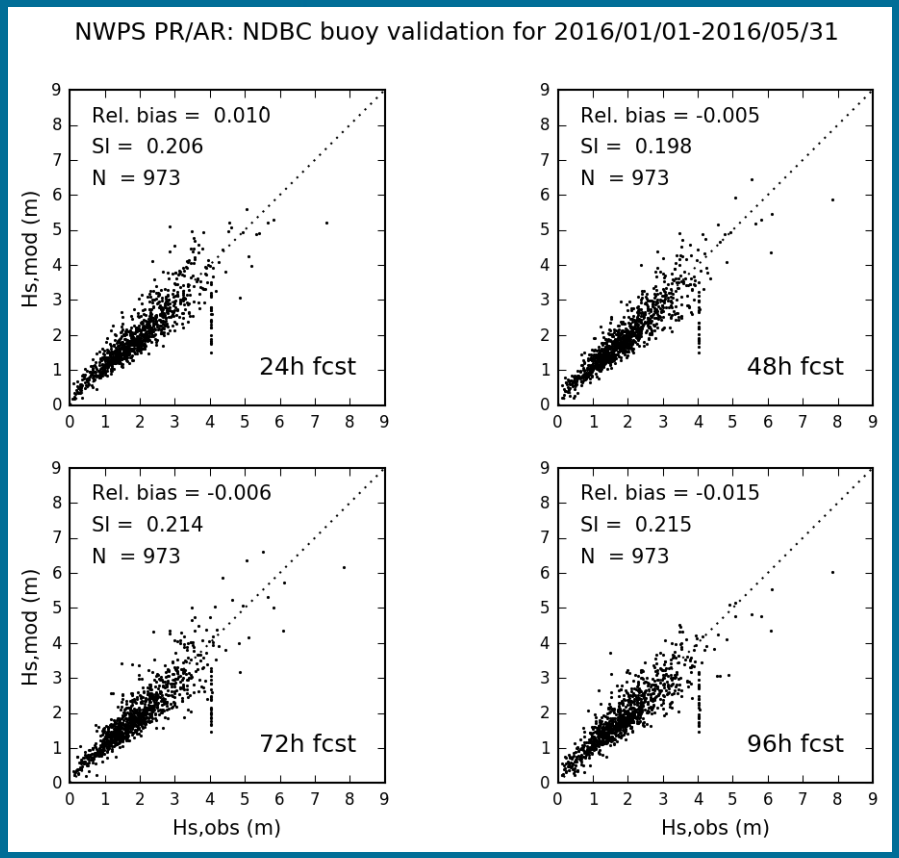


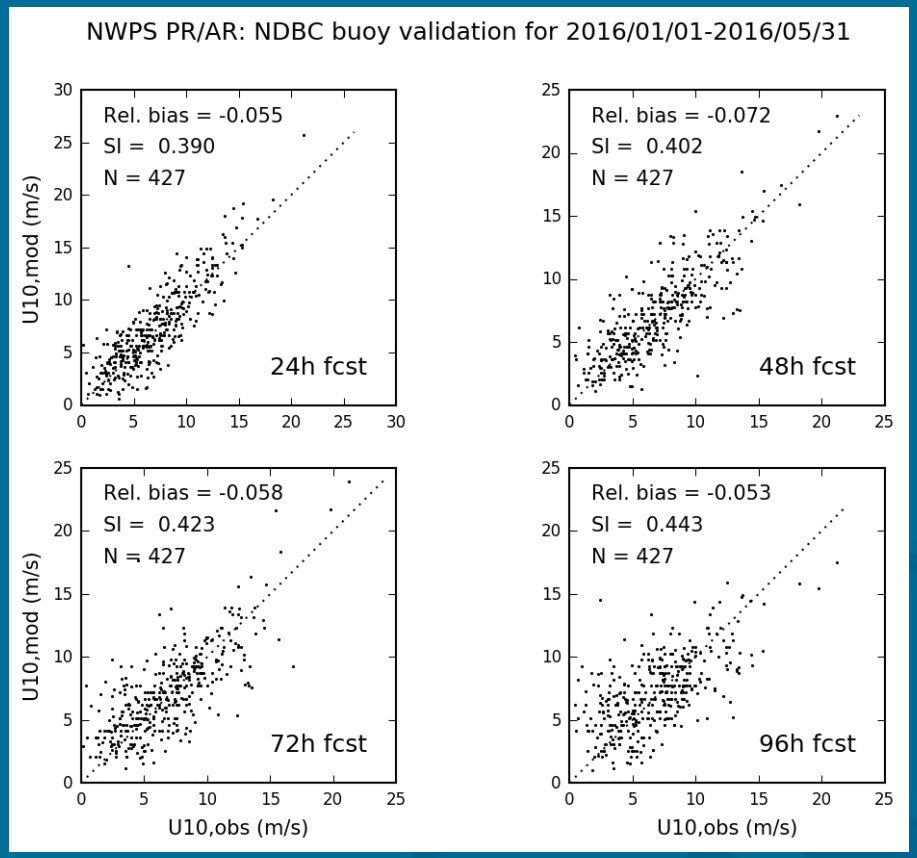
Add. "wind-only" Hs grid



Validation at nearshore NDBC buoys

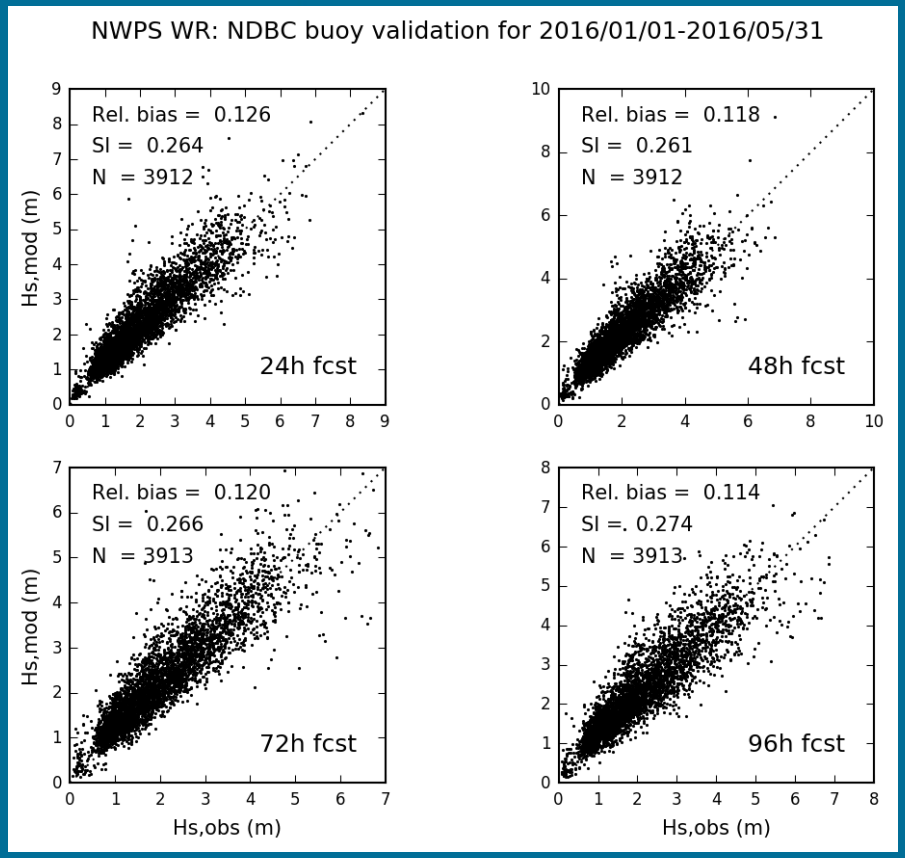
Operational runs in PR/AR: 2016/01/01-2016/05/31

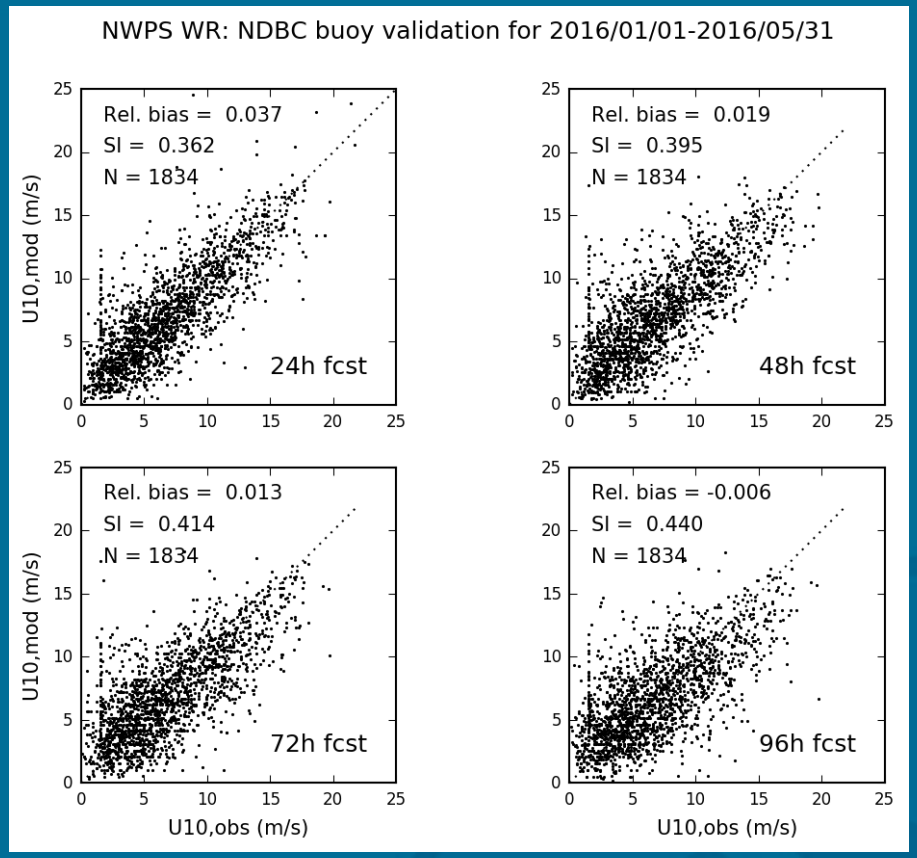




Validation at nearshore NDBC buoys

Operational runs in WR: 2016/01/01-2016/05/31





Nearshore Wave Prediction System (NWPS) V1.1.0

Project Status as of 03/14/2016

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Project Information and Highlights

Lead: Hendrik Tolman, EMC and Steven Earle, NCO

Scope:

1. Completing the national roll-out of NWPS. Centralized implementation of NWPS that is currently run locally at coastal WFOs in WR, AR and PR
2. Involves separate implementations for approx. 13 WFOs, using shared basic scripting (already running on WCOSS).
3. Potentially include rip current and wave runup guidance products at 4-5 pilot WFOS

Expected Benefits:

1. Resolution of coastal wave model guidance improved from 4 arc-min (with ww3 multi_1) to at least 1 arc-min.
2. Wave guidance consistent with forecaster-developed wind fields.
3. Improved economy of scale of centralized computing compared to distributed computing.

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Scheduling

Milestone (NCEP)	Date	Status
EMC testing complete	05/15/16	
EMC CCB	06/01/16* Now Jul 7	
SPA begins prep work for 30-day parallel	06/01/16	
Technical Information Notice Issued	07/01/16	
CCB approve parallel data feed	07/01/16	
Parallel and IT test begins at NCO	07/01/16	
NCO IT Testing complete	07/15/16	
Parallel Evaluation Ends	08/01/16	
Management Briefing	08/15/16	
Implementation	09/01/16 * Now Oct 25	

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Issues/Risks

Issues: Additional computing capacity required to support full NWPS roll-out (96 cores); Multiple implementations (each of approx. 13 WFOs).

Risks: On-demand operation and associated data feed pose risks to system stability.

Mitigation: Extended EMC testing period planned, during which the reliability of data feed can be assessed and improved.

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Finances

Associated Costs:

1) EMC contractor for system testing and implementation (base)
2) $150,000 development funding to build and test WR, PR and AR WFO domains for NWPS.

Funding Sources: EMC base; OSTI development funding.