DRAFT Modeling Plans: Utilization of WCOSS
(Weather & Climate Operational Supercomputing System)
Phases 1 and 2

17th GMU Conf. on Atm. Transport & Dispersion Modeling

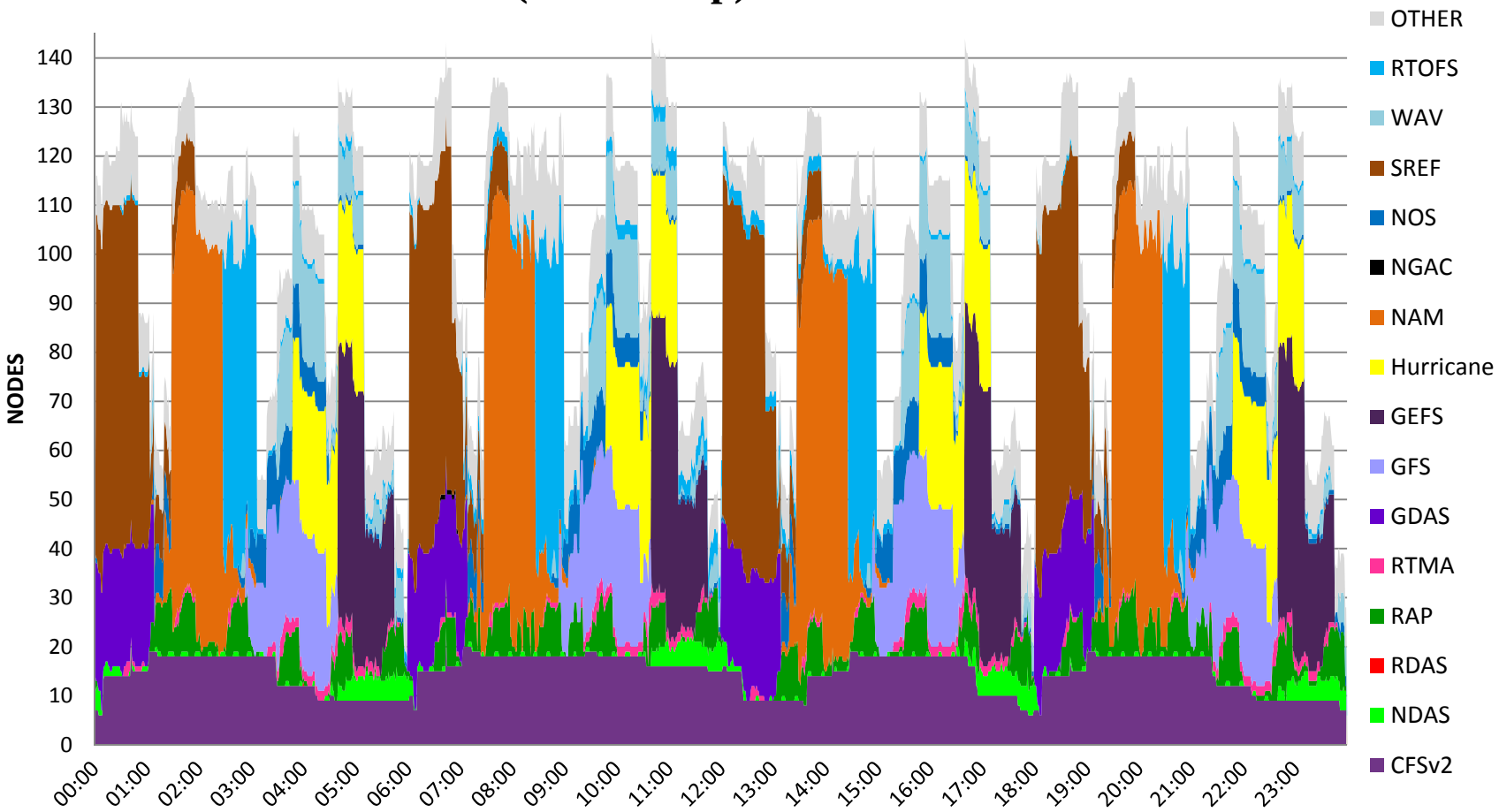
June 25, 2013

"Where America's Climate, Weather, Ocean and Space Weather Services Begin"

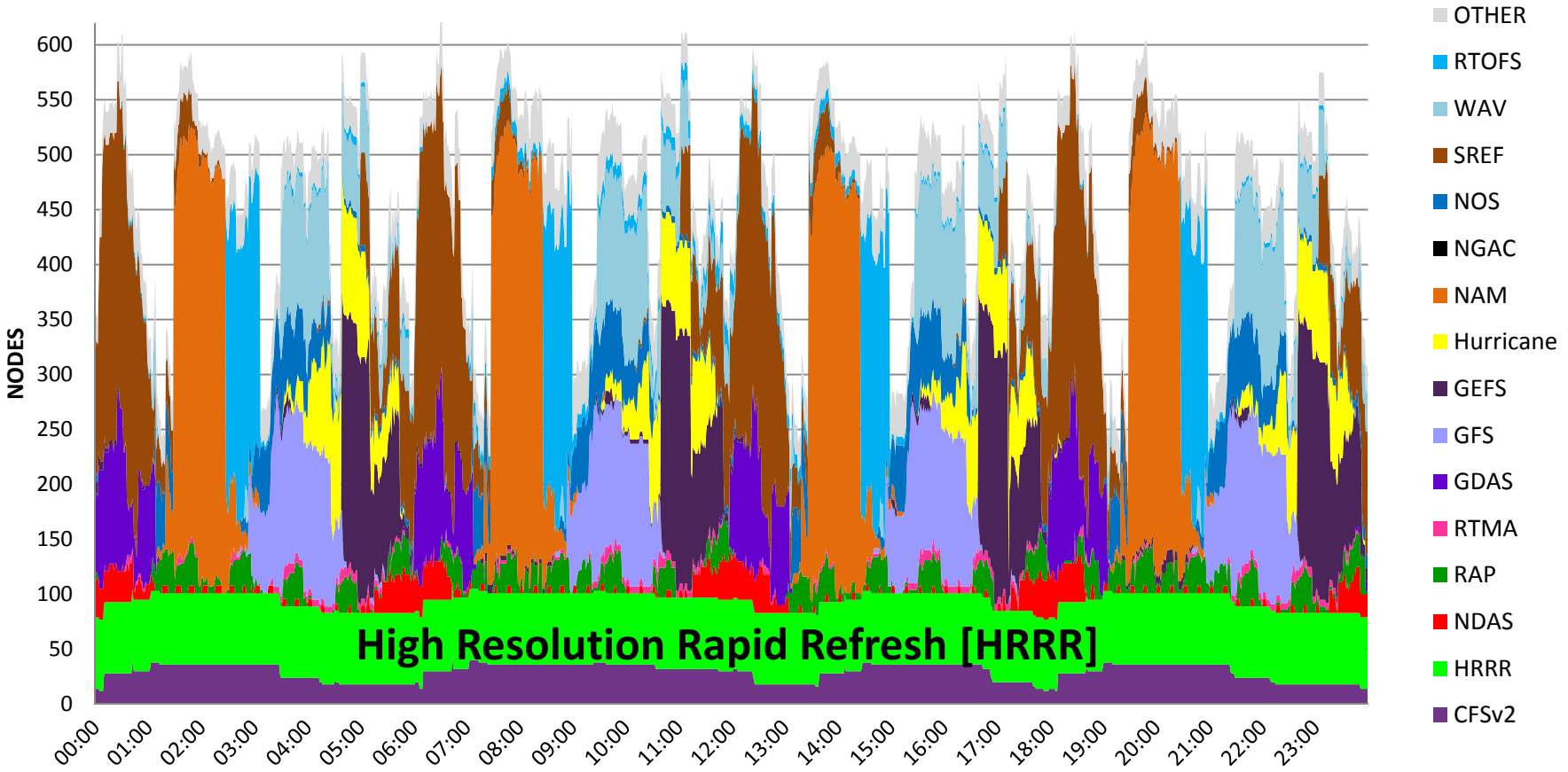
Topics

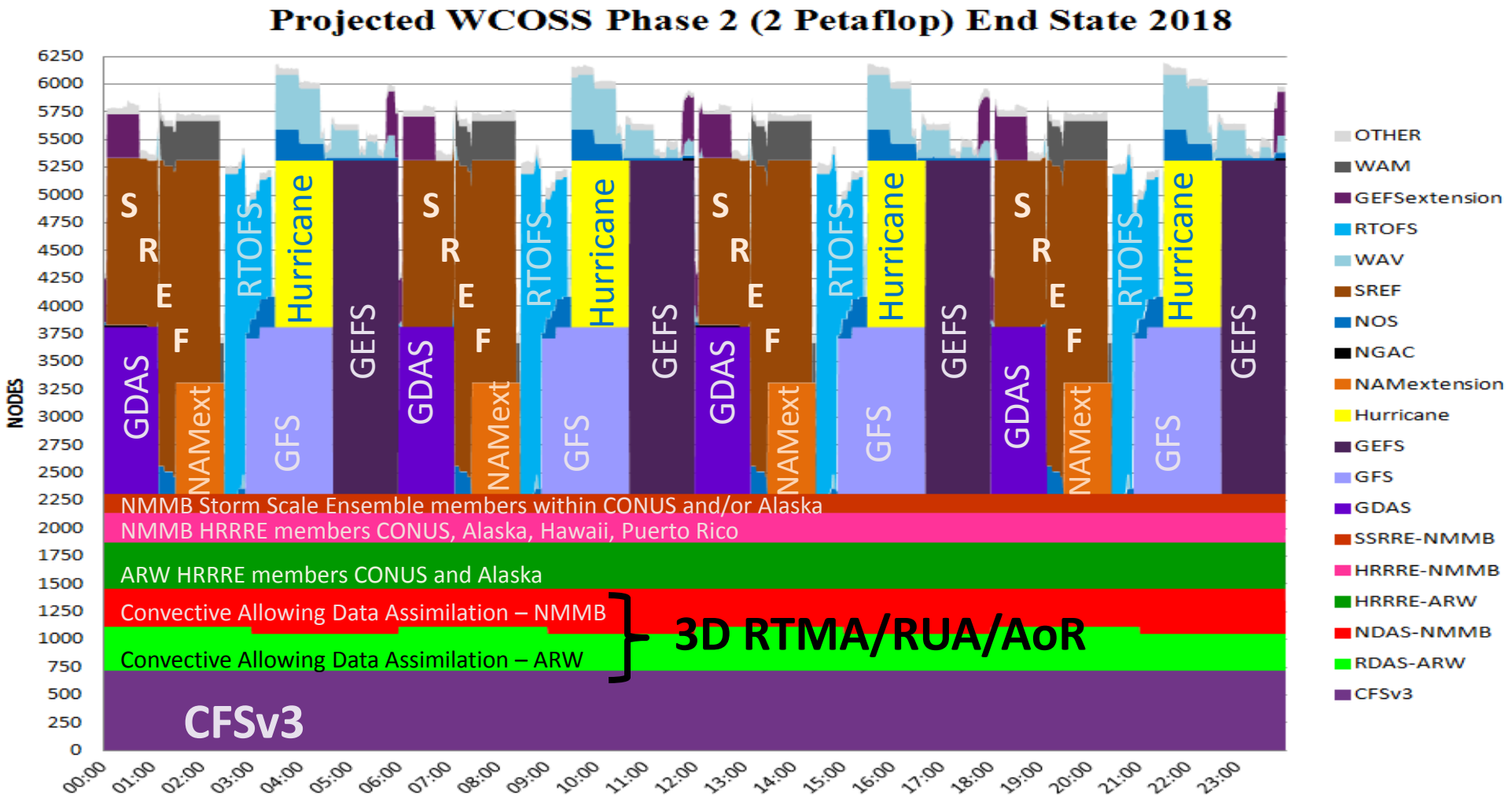
- **Current and possible future utilization based on Sandy Supplemental enhanced WCOSS Phase 2**
- **Expected improvements**
  - Focus on mesoscale, regional & shorter range components
- **Caveats**
  - These are estimates
  - Not enough members in ensembles
  - Can't afford reforecasts
  - Data distribution challenges

CCS (80 Teraflop) Current State 2013



Projected WCOSS Phase 1 (200 Teraflop) End State 2015




Projected WCOSS Phase 2 (2 Petaflop) End State 2018
NODES
6250
6000
5750
5500
5250
5000
4750
4500
4250
4000
3750
3500
3250
3000
2750
2500
2250
2000
1750
1500
1250
1000
750
500
250
0
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
GDAS
SREF
NAMext
RTOFS
GFS
Hurricane
GEFS
NMMB Storm Scale Ensemble members within CONUS and/or Alaska
NMMB HRRRE members CONUS, Alaska, Hawaii, Puerto Rico
ARW HRRRE members CONUS and Alaska
Convective Allowing Data Assimilation – NMMB
Convective Allowing Data Assimilation – ARW
3D RTMA/RUA/AoR
CFSv3
OTHER
WAM
GEFSextension
RTOFS
WAV
SREF
NOS
NGAC
NAMextension
Hurricane
GEFS
GFS
GDAS
SSRRE-NMMB
HRRRE-NMMB
HRRRE-ARW
NDAS-NMMB
RDAS-ARW
CFSv3

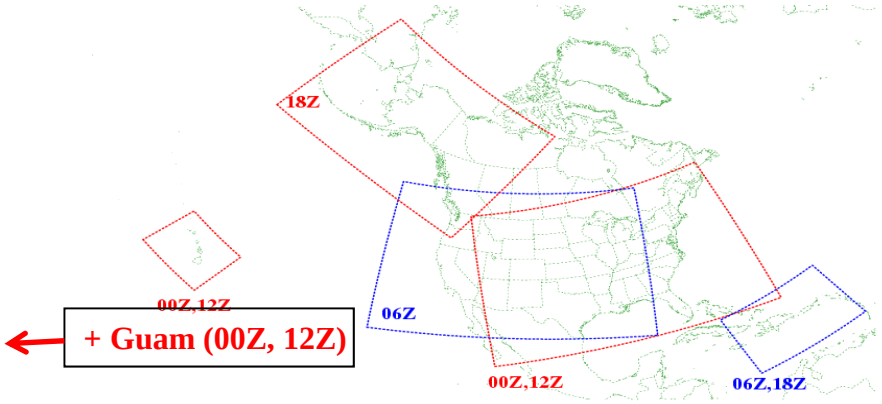
Mesoscale Ensemble

Current	Q2FY14	End of Phase 2 / 2018
WRF-ARW, WRF-NMM, NMMB	WRF-ARW & NMMB	WRF-ARW & NMMB
7 each= 21 members 16 km	10 each= 20 members 12 km	10 each=20 members 12 km (parent)
35 levels 6 hourly to 84 hr	35 levels 6 hourly to 84 hr	50/60 levels 6 hourly to 84 hr
		Product streams will be consolidated & repurposed (i.e. renamed). Later delivery.
Irregular convective allowing scale guidance 6/5/4 km 6 hourly run to 48/60 hr for CONUS, Alaska, HI, PR	Single hourly [HRRR] 3 km 15 hr for CONUS Upgrade irregular convective suite to 3 km still 6 hourly to 48/60 hr CONUS, Alaska, HI, PR	Multiple hourly [HRRRE] 3 km to 18 hr for CONUS, Alaska, Hi, PR 6 hourly extended to 60 hr
Single placeable Storm Scale sub-nest ~1.5km 6 hourly to 36 hr	Single placeable/movable Storm Scale sub-nest ~1.5km 6 hourly to 36 hr	Multiple placeable/movable Storm Scale sub-nests: 1 km hourly to 18 hr 6 hourly to 36 hours

HiResWindow

key to SPC's SSEO & NCEP's NSSE

Current



All domains:

4 km WRF-NMM

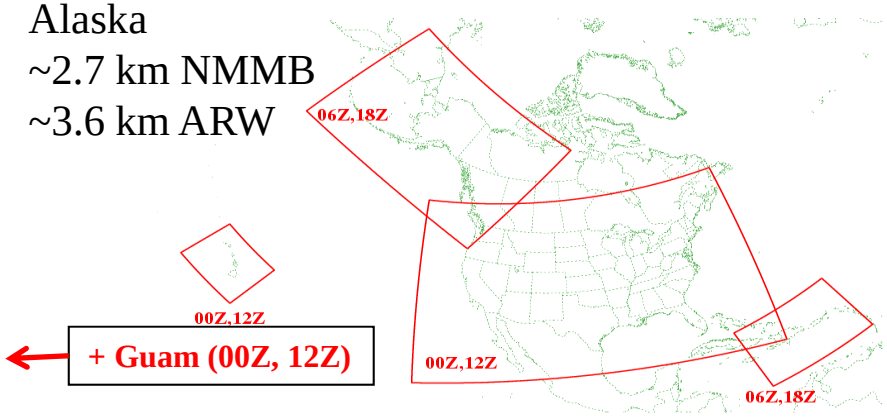
5.15 km WRF-ARW

Future

Alaska

~2.7 km NMMB

~3.6 km ARW

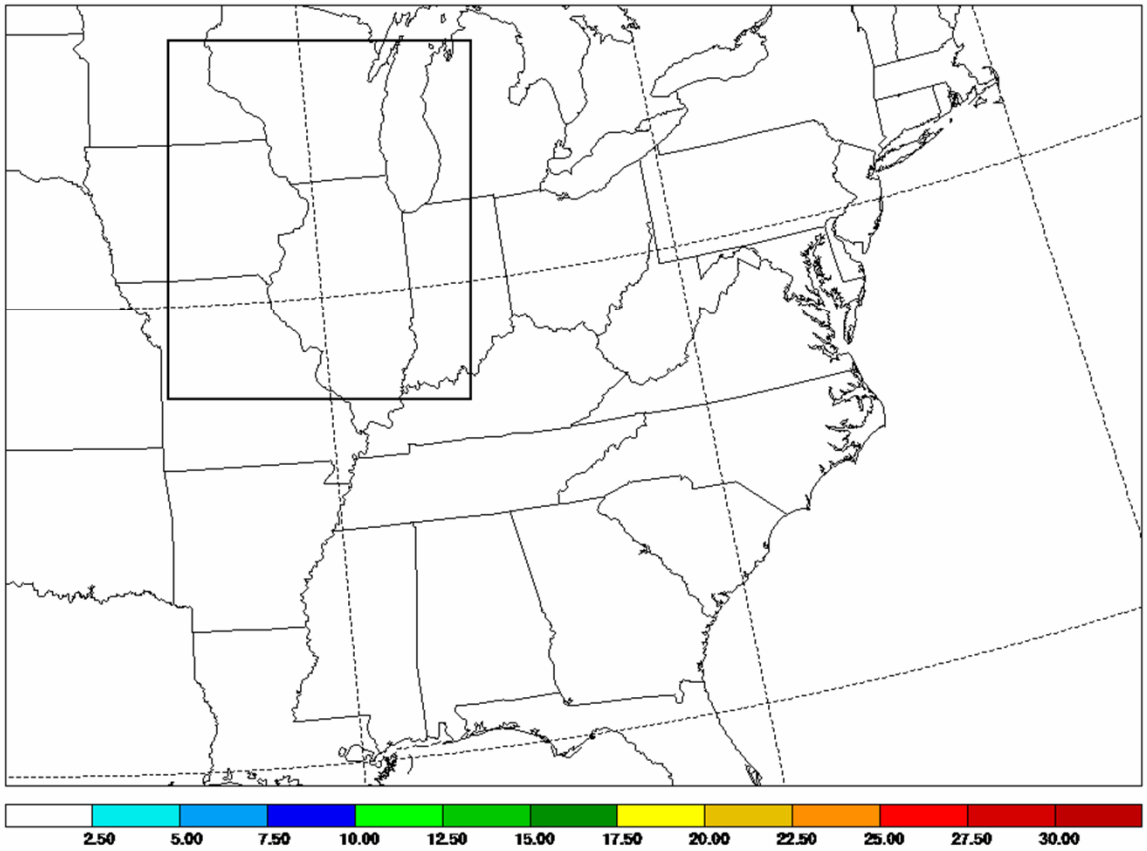


non-AK domains:

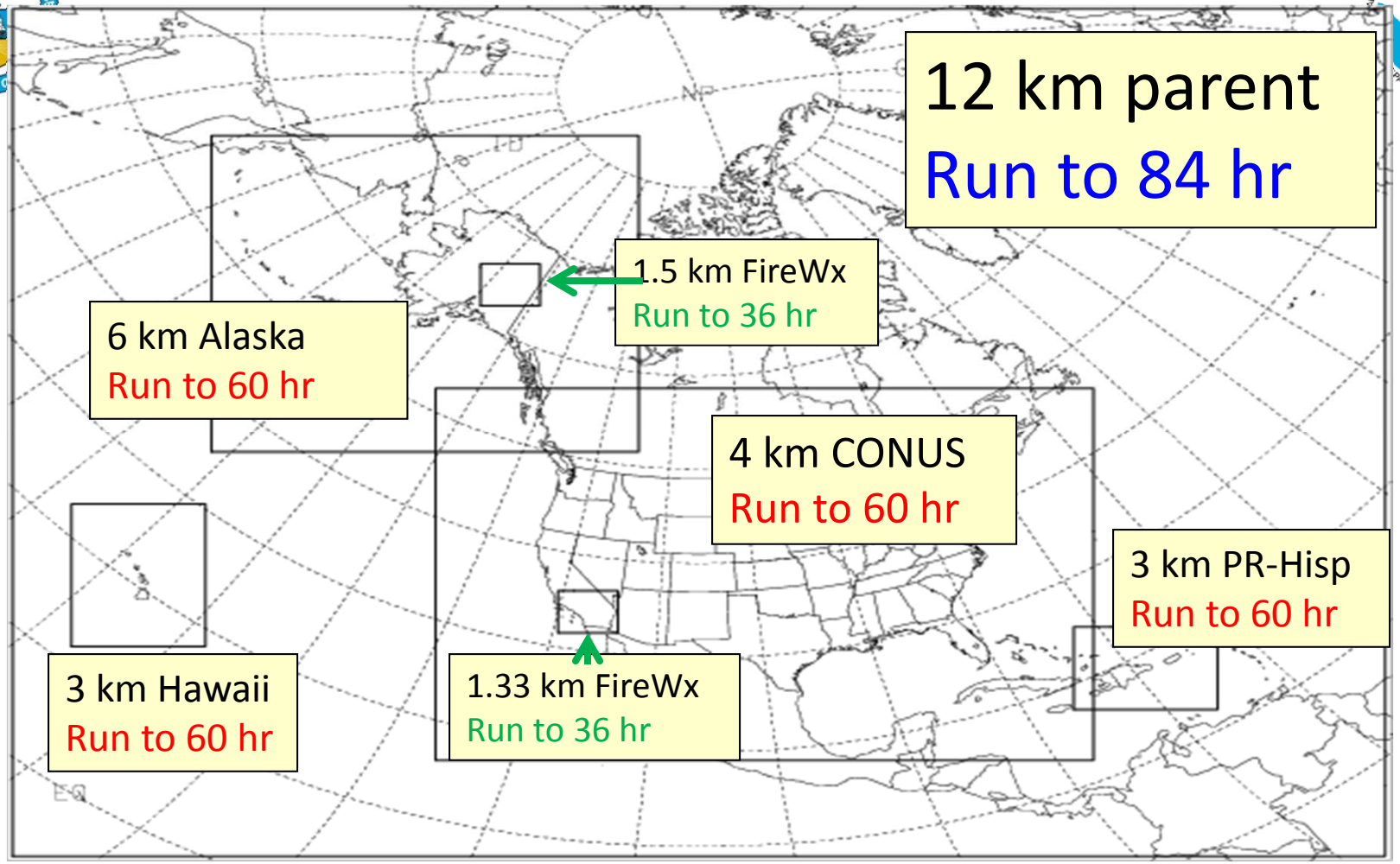
~3 km NMMB

~4 km WRF-ARW

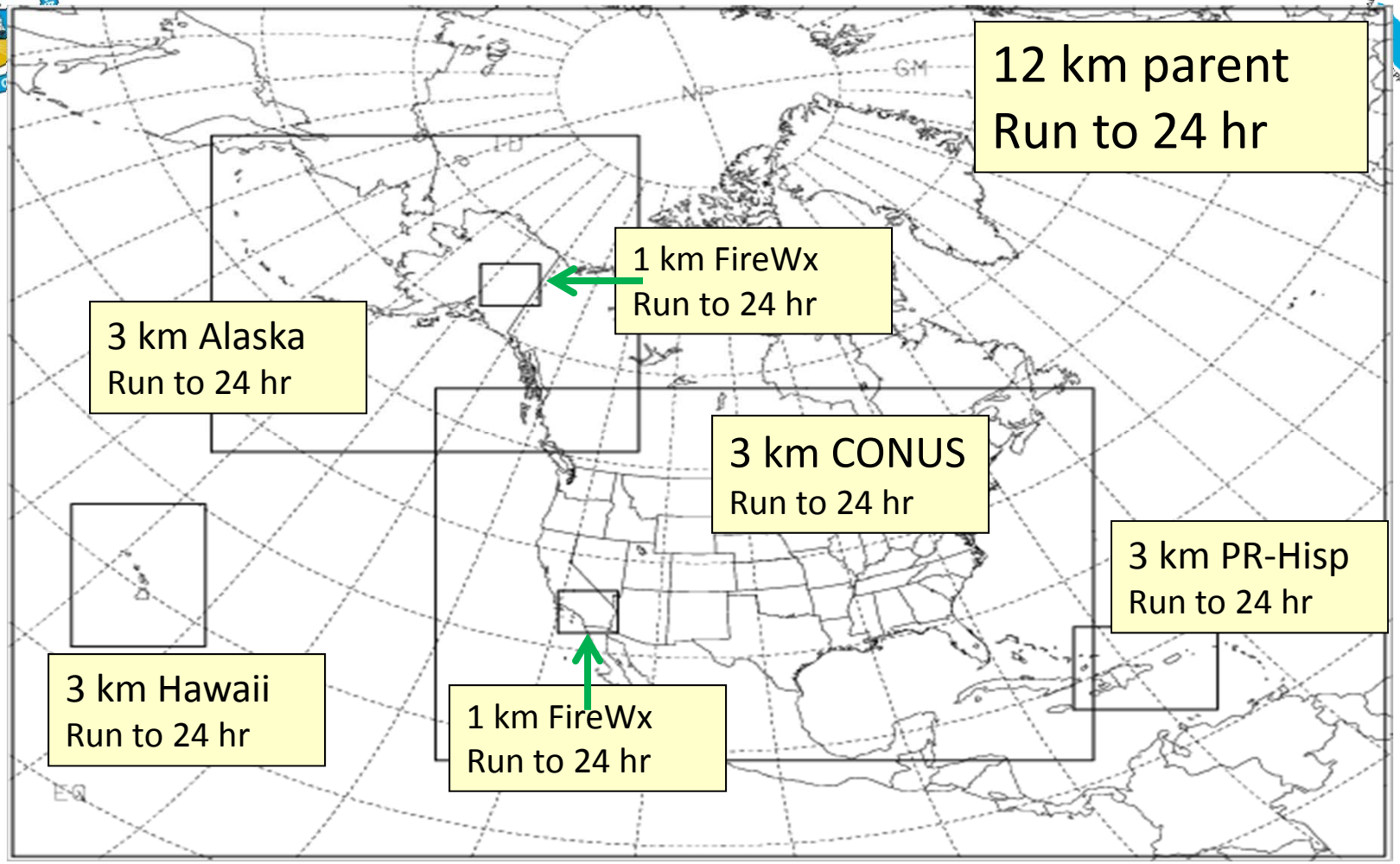
June 2012 Derecho Simulation with Prescribed 1.33 km Nest



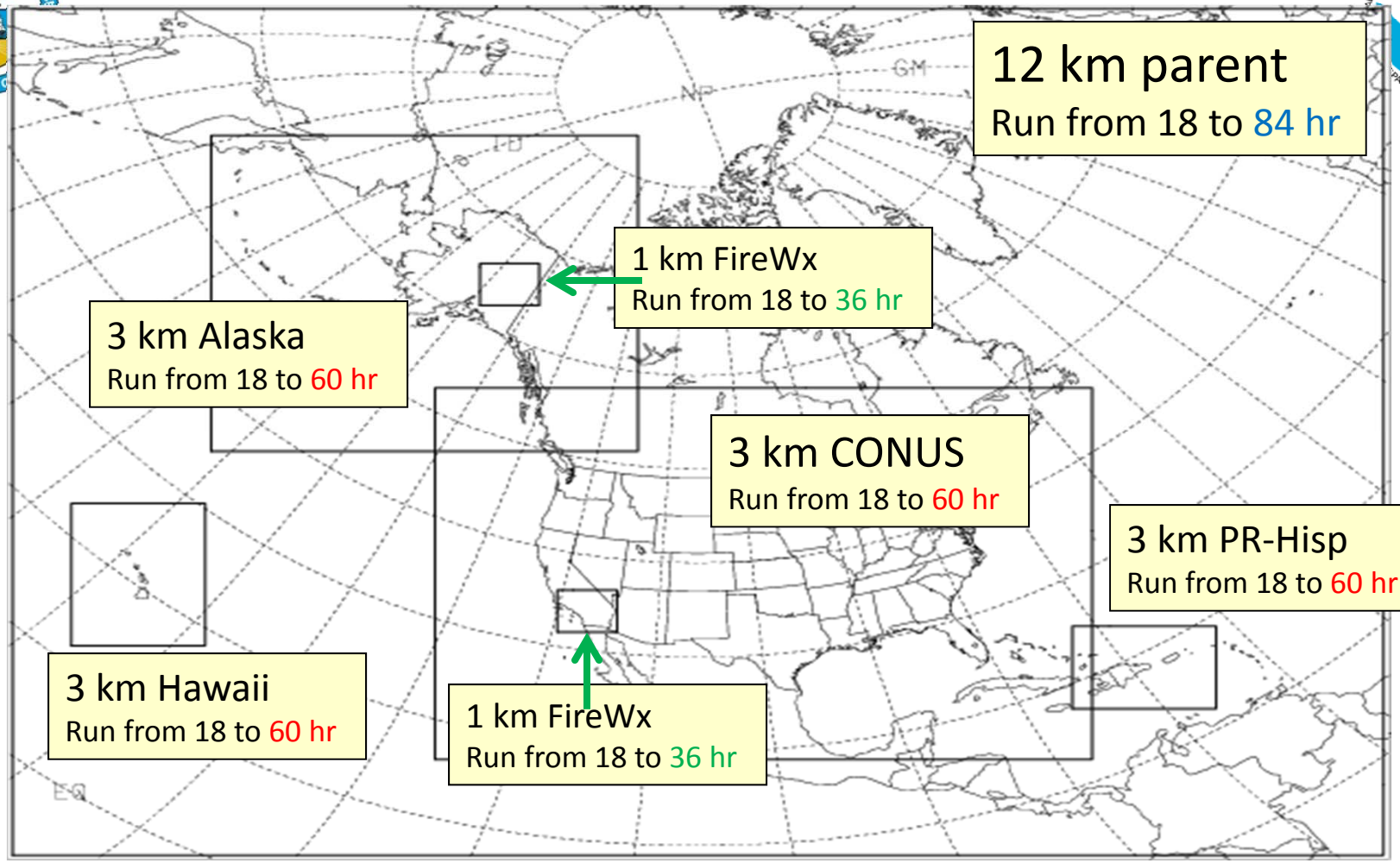
NAM Parent, Fixed Nests & Single/Placeable FireWx Since Oct. 2011



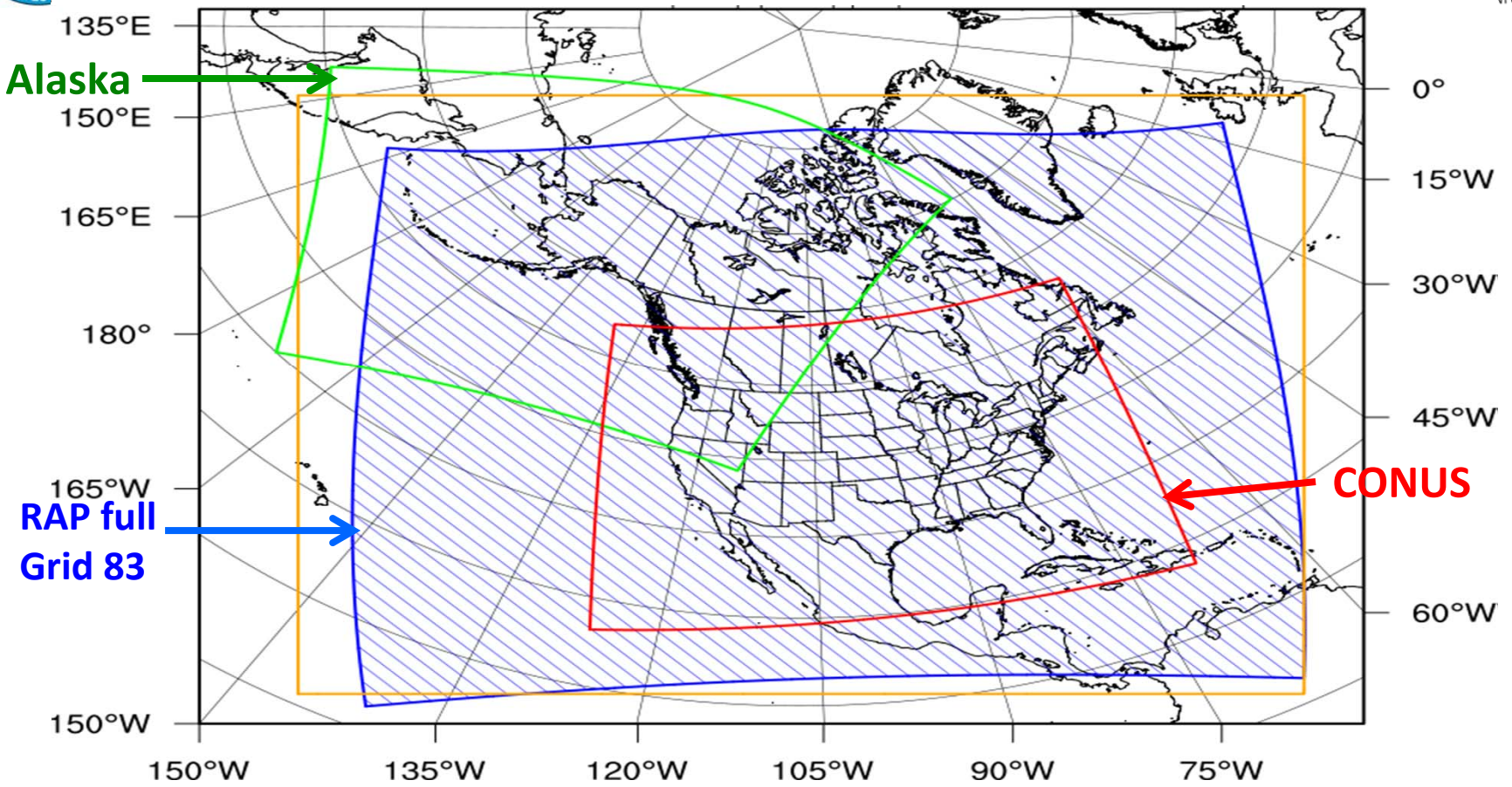
GOAL: Every NMMB-based member of the hourly HRRRE will have this makeup



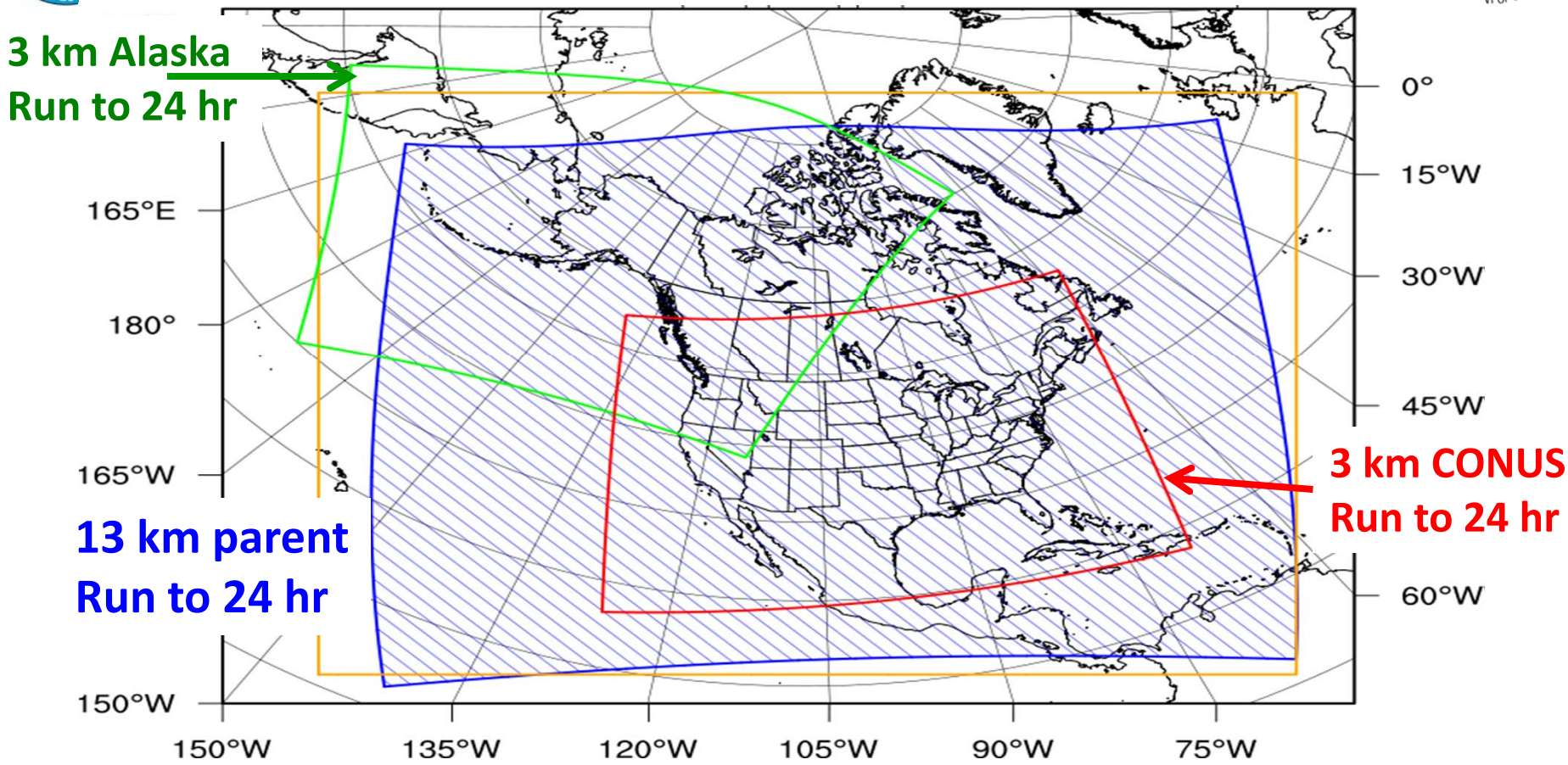
GOAL: Every NMMB-based **member of SREF (extensions of HRRRE members) will have this makeup**



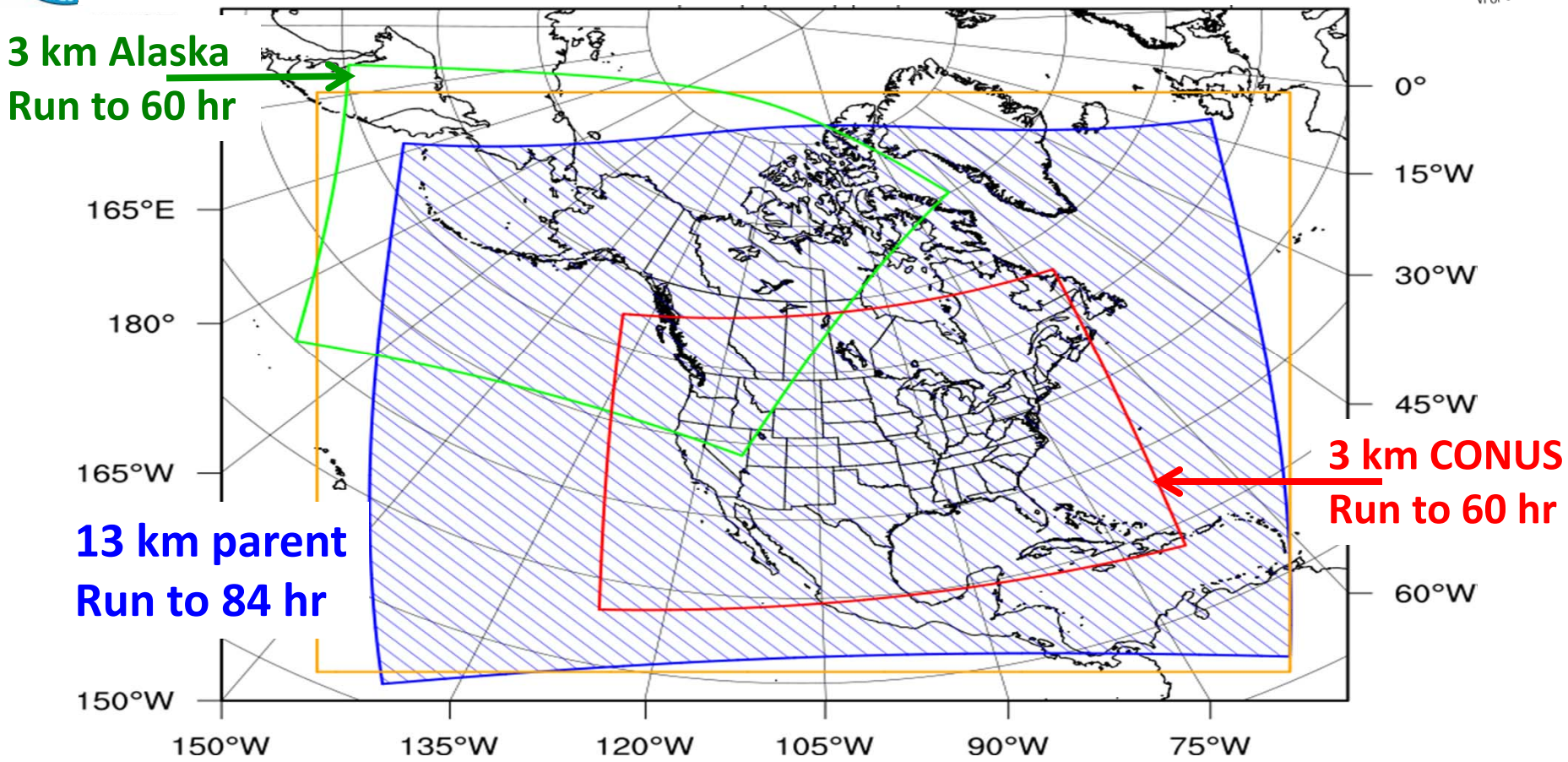
Hourly Rapid Refresh (RAP) 13 km Run to 18 hr Using GSI and WRF-ARW since May 2012



GOAL: Every ARW-based member of the hourly HRRRE will have this makeup



GOAL: Every ARW-based member of SREF (extensions of HRRRE members) will have this makeup



Backup

HiResWindow Evolution To 2018

System	Current	Q2FY14	Q1FY18
HRW	NMM 4 km WRFv2.2+ ARW 5.1 km WRFv2.2+ Forecasts to 48 hr	**NMMB 3 km NEMS** **ARW 3.6 km WRFv3.4** Forecasts to 48 hr	**See NAM deterministic extension** Forecasts to **60 hr**
	Eastern CONUS 00z+12z Western CONUS 06z Alaska 18z	**Full CONUS 00z + 12z** Alaska **06z** + 18z	See NAM det. ext. See NAM det. Ext.
	Hawaii 00z + 12z Puerto Rico 06z +18z Guam 00z+12z	Hawaii 00z + 12z Puerto Rico 06z +18z Guam 00z+12z	See NAM det. ext. See NAM det. ext. Guam 00z+12z
		Supports SPC's SSEO & NCEP Storm Scale Ensemble (NSSE)	**HRRRE+SREF subsume roles of SSEO & NSSE**
Estimated compute factor	1x	4x	**0.1x (Guam only)**

NAM/NDAS System Evolution To 2018

System	Current	End of Phase 1 / 2014	End of Phase 2 / 2018
NAM	North America with CONUS, Alaska, Hawaii, Puerto Rico, FireWx	North America with CONUS, Alaska, Hawaii, Puerto Rico, FireWx	Control Member for SREF & HRRRE North America with CONUS, Alaska, Hawaii, Puerto Rico, FireWx (2)
	Every 6 hours to 84 hr (60 hr for fixed nests and 36 hr for FireWx nest)	Every 6 hours to 84 hr (60 hr for fixed nests and 36 hr for FireWx nest)	**Every hour with forecasts to 18hr** with 4/day catch-up and extensions to 36, 60 & 84hr
	12 km with fixed nests 6km, 4km, 3km and FireWx1.33/1.5km	**12 km with all nests 3km and FireWx 1.5km**	**12 km with all nests 3km and FireWx 1km**
Estimated compute factor	**1x**	**2.5x**	**2.5x**
NDAS	North America from partially cycled NDAS Nests from static GSI	North America from partially cycled NDAS Nests with static GSI **+ DDFI**	North America with control members of CONUS, Alaska, Hawaii, Puerto Rico **HRRRE** and FireWx (**SSRRE**) with static GSI + DDFI
	4/day GSI-based NDAS Incorporates most sat & radar winds	Hourly **update** with GSI hybrid **within** 4/day catch-up Assimilates most sat & all radar	Hourly update with its own 4D-GSI-hybridEnKF and with 4/day catch-up Properly assimilates all sat & radar etc.
Estimated compute factor	**1x**	**4x**	**10x**

RAP/RDAS System Evolution To 2018

System	Current	End of Phase 1 / 2014	End of Phase 2 / 2018
RAP	CONUS and Alaska	CONUS and Alaska	CONUS and Alaska (Hawaii and Puerto Rico)
	Hourly out to 18hr	Hourly out to 18hr	Hourly update with its own 4DhybridEnKF and with 4/day catch-up Properly assimilates all sat & radar etc.
	13 km	13 km	12 km
Estimated compute factor	1x	1x	2.5x
RDAS	North America from partially cycled RAP Data Assimilation	North America with CONUS HRRR with DDFI	North America with control members of CONUS and Alaska HRRRE
	Hourly update, GSI with 2/day catch-up Incorporates most sat & radar reflectivity	Hourly GSI hybrid with 4/day catch-up Assimilates most sat & all radar	Hourly update with its own 4DhybridEnKF and with 4/day catch-up Properly assimilates all sat & radar etc.
Estimated compute factor	1x	4x	10x

SREF/HRRRE/SSRRE System Evolution To 2018

System	Current	End of Phase 1 / 2014	End of Phase 2 / 2018
SREF	3-core Multi-Model (WRF-ARW, WRF-NMM, NMMB)	2 core: WRF-ARW & NMMB	2 core: WRF-ARW & NMMB **Extensions of HRRRE to 84 hr**
	7 each= 21 members 16 km	10 each= 20 members **12 km**	Parent:10 each=20 members 12 km
			Convective Allowing Nests
			CONUS: 3 each = 6 members 3 km
			Alaska: 3 each = 6 members 3 km
			Hawaii: 3 NMMB members 3 km **Puerto Rico: 3 NMMB members 3 km**
			Storm Scale Sub-Nests **2 domains CONUS +/or Alaska**
			3 NMMB members 1 km
			Precise membership is uncertain
Estimated compute factor	**1x**	**2.3x**	**12.5x** **For twice as long**

RTMA Evolution To 2018

System	Current	Q2FY14	Q1FY18
RTMA	Hourly 2D-VAR (GSI)	**Upgraded** Hourly 2D-VAR **adding visibility & wind gust**	**See NDAS/RDAS making RTMA a 3 km but 3D analysis**
	CONUS 2.5 km + 5 km Alaska 5.9 km	CONUS 2.5 km **NWRFC extension** Alaska **3 km**	**See NDAS/RDAS** **See NDAS/RDAS** **See NDAS/RDAS** **Juneau 1 km**
	Hawaii+Puerto Rico 2.5 km	Hawaii+Puerto Rico 2.5 km	**See NDAS/RDAS**
	Guam 2.5 km (3 hrly)	Guam 2.5 km (3 hrly)	Guam 2.5 km **(1 hrly)**
Estimated compute factor	1x	1.5x	**0.5x (for Juneau & Guam only)**

NGAC/WAM/CFS Evolution To 2018

System	Current	Q2FY14	Q1FY18
NGAC	Dust only	Inclusion of daily sources and sink for aerosols	Inclusion of trace gases
	NEMS	Resync with GSFC system	Twice daily
Estimated compute factor	1	1	20
WAM	Under development	Initial deployment	Couple with ionospheric model
		T126L150	T382L150
		High atmosphere physics	Four per day
Estimated compute factor	0	18 nodes	360 nodes (20x)
CFS	CFSV2 GSM: T126L64 coupled to MOM4: 0.5degree 40L	none	CFSV3 GSM: T382L128 coupled to MOM5: 0.25 degree 60L Both running under NEMS
Estimated compute factor	1	36 nodes	20