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NAEFS – Real time data exchange

Session 1: Data exchange & dissemination

6th NAEFS workshop May 1-3, 2012, Monterey, CA

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FNMOOC: Mike Sestak, Keith Morrison

Overview



To provide a summary of present NAEFS data exchange

A quick review of:

- (1) NAEFS Raw & Bias Corrected parameters exchanged
- (2) GRIB2 encoding of NAEFS parameters
 - Quick review of grib2 encoding, some recommendations
- (3) Details of NAEFS multi-center data exchange
 - Idealized NAEFS production cycle for 00Z, target timelines
 - Mechanics of the ftp data exchange, is production within timelines?
 - Information on NAEFS troubleshooting
- (4) Operational considerations summary – of interest to workshop
- (5) Useful Links

(1) NAEFS GEPS dataset – May 2012

Total GB: CMC = 8.5 GB

NCEP = 7.4 GB

FNMOG = ~11 GB

	CMC	NCEP	FNMOG	CMC	NCEP	FNMOG
	RAW	RAW	RAW	Bias Corr.	Bias Corr.	Bias Corr.
Number of variables 00hr	66	73	66	45	48	n/a
Number of variables hhh	79	79	71	47	50	48
Number of members	21	21	20	21	21	20
Start forecast hour	0	0	0	0	0	6
End forecast hour	384	384	384	384	384	384
Hours per time step	6	6	6	6	6	6
Number of time steps	65	65	65	65	65	64
Number of files per run	1365	1365	1300	1365	1365	1280
Size of NAEFS dataset by center GB / [00,12]Z run	5.5	4.1	6.6	3.0	3.3	2.5
Format	grib2	grib2	grib2	grib2	grib2	Grib2

NAEFS GEPS dataset – May 2012

Total GB: CMC = 8.5 GB

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FNMOc = ~11 GB

	CMC	NCEP	FNMOc	CMC	NCEP	FNMOc
	RAW	RAW	RAW	Bias Corr.	Bias Corr.	Bias Corr.
Number of variables 00hr	66	73	66	45	48	n/a
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Overview of NAEFS parameters - May 2012

Upper Air Parameters	Level(s)	CMC Raw Bc	NCEP Raw Bc	FNMOG Raw Bc
GZ, TMP, [U,V]GRD, RELH	10, 50, 100, 200, 250, 500, 700, 850, 925, 1000	Yes Yes	Yes Yes	Yes Yes
Vertical motion	850	Yes No	Yes Yes	Yes Yes
Model topography	Surface	Yes n/a	Yes n/a	Yes n/a
TEMP, TMIN, TMAX, RELH	2m above ground	Yes Yes	Yes Yes	Yes Yes
[U,V]GRD	10m above ground	Yes Yes	Yes Yes	Yes Yes
Pressure	Mean Sea Level and Surface	Yes Yes	Yes Yes	Yes No
CAPE, CINH	Column	Yes No	Yes No	Yes No
Total Cloud	Column	Yes No	Yes No	Yes No
Precipitable Water	Column	Yes No	Yes No	Yes No
Total precipitation	Surface	Yes No	Yes No	Yes No
[Rain, Snow, Ice, Freezing]	Surface, Categorical	No No	Yes No	No No
[Rain, Snow, Ice, Freezing]	Surface, Accumulations by type	Yes No	No No	Yes No
Temperature, Moisture	Soil (0-10 cm)	Yes No	Yes No	No No
Snow depth	Surface	Yes No	Yes No	No No
WEASD	Surface	Yes No	Yes No	No No
[L,S]HTFL	Surface	Yes No	Yes No	No No
D[S,L]WRF	Surface	Yes No	Yes No	No No
OLR	Nominal top of the atmosphere	Yes No	Yes Yes	No No
USWRF	Surface	Yes No	Yes No	No No
UDWRF	Surface	Yes No	Yes Yes	No No



NAEFS upper air parameters - details

Upper Air Parameters	GRIB Abbreviation	Levels (hPa)	CMC Raw Bc	NCEP Raw Bc	FNMOc Raw Bc
Geopotential Height	HGT	10, 50, 100, 200, 250, 500, 700, 850, 925, 1000	10 10	10 10	10 10
Temperature	TEMP	10, 50, 100, 200, 250, 500, 700, 850, 925, 1000	10 10	10 10	10 10
U component of wind	UGRD	10, 50, 100, 200, 250, 500, 700, 850, 925, 1000	10 10	10 10	10 10
V component of wind	VGRD	10, 50, 100, 200, 250, 500, 700, 850, 925, 1000	10 10	10 10	10 10
Relative Humidity	RELH	10, 50, 100, 200, 250, 500, 700, 850, 925, 1000	10 n/a	10 n/a	10 n/a
Vertical motion	VVEL	850	1 n/a	1 1	1 1

Raw = Direct model data

BC = Bias Corrected model data

Surface

Parameter	GRIB Abbreviation	Levels	Comment	CMC Raw BC	NCEP Raw BC	FNMOG Raw BC
Surface model topography	HGT	Model topography	CMC and FNMOG fhr=000 NCEP fhr=000 & fhr=204	Raw n/a	Raw n/a	Raw n/a
Temperature	TEMP	2m above ground		Raw Bc	Raw Bc	Raw n/a
U component of wind	UGRD	10m above ground		Raw Bc	Raw Bc	Raw n/a
V component of wind	VGRD	10m above ground		Raw Bc	Raw Bc	Raw n/a
Relative Humidity	RELH	2m above ground		Raw n/a	Raw n/a	Raw n/a
Tmin at 2m, 6 hr interval	TMIN	2m above ground	Tmin – interval 6 hours prior	Raw Bc	Raw Bc	Raw Bc
Tmax at 2m, 6 hr interval	TMAX	2m above ground	Tmax – interval 6 hours prior	Raw Bc	Raw Bc	Raw Bc

Raw = Direct model data

BC = Bias Corrected model data



Atmospheric Column Parameters	GRIB Abbreviation	Levels	Comment	CMC Raw BC	NCEP Raw BC	FNMOc Raw BC
Surface Pressure	PRES	Surface		Raw Bc	Raw Bc	Raw n/a
Pressure MSL	MSL	Mean Sea Level		Raw Bc	Raw Bc	Raw n/a
Total Cloud	TCLD	Surface	NCEP 6 hr average CMC instantaneous FNMOc instantaneous	Raw n/a	Raw n/a	Raw n/a
Precipitable water	PWAT	Surface		Raw n/a	Raw n/a	Raw n/a
CAPE	CAPE	layer	NCEP: first 180mb above ground CMC surface to top of atmos. FNMOc	Raw n/a	Raw n/a	Raw n/a
Convective Inhibition	CINH	layer	NCEP: first 180mb above ground CMC surface to top of atmos. FNMOc	Raw n/a	Raw n/a	Raw n/a

Raw = Direct model data

BC = Bias Corrected model data

Precipitation Part 1 of 2	GRIB Abbreviation	Levels	Comment	CMC Raw Bc	NCEP Raw Bc	FNMO Raw Bc
Total Precipitation	APCP	Surface	NCEP per 6 hr interval CMC cumulative from 000hr FNMO per 6 hr interval	Raw n/a	Raw n/a	Raw n/a
Categorical rain	CRAIN	Surface	NCEP @ 6 hr interval	n/a n/a	Raw n/a	n/a n/a
Categorical snow	CSNOW	Surface	NCEP @ 6 hr interval	n/a n/a	Raw n/a	n/a n/a
Categorical ice	CICE	Surface	NCEP @ 6 hr interval	n/a n/a	Raw n/a	n/a n/a
Categorical freezing rain	CFRZ	Surface	NCEP @ 6 hr interval	n/a n/a	Raw n/a	n/a n/a

Raw = Direct model data

BC = Bias Corrected model data

Precipitation Part 2 of 2	GRIB Abbreviation	Levels	Comment	CMC Raw Bc	NCEP Raw Bc	FNMO Raw Bc
Rain	WEARN	Surface	CMC cumulative from 00hr	Raw n/a	n/a n/a	n/a n/a
Snow	WEASN	Surface	CMC cumulative from 00hr FNMO per 6 hour interval	Raw n/a	n/a n/a	Raw n/a
Ice Pellets	WEAPE	Surface	CMC cumulative from 00hr FNMO per 6 hour interval	Raw n/a	n/a n/a	Raw n/a
Freezing Rain	WEAFR	Surface	CMC cumulative from 00hr FNMO per 6 hour interval	Raw n/a	n/a n/a	Raw n/a

Raw = Direct model data

BC = Bias Corrected model data

*CMC algorithm - Bourgoiu, Pierre. 2000: **A Method to Determine Precipitation Types.** *Weather and Forecasting*: Vol. 15, No. 5, pp. 583–592. or

<http://journals.ametsoc.org/doi/full/10.1175/1520-0434%282000%29015%3C0583%3AAMTDPT%3E2.0.CO%3B2>

FNMO - For information on method used by FNMO to calculate precipitation types



Soil related parameters

Parameter	GRIB Abbreviation	Levels	Comment	CMC Raw Bc	NCEP Raw Bc	FNMOc Raw Bc
Temperature	TEMP	0-10 cm below ground	CMC instantaneous NCEP instantaneous	Raw n/a	Raw n/a	n/a n/a
Soil moisture	SMOIST	0-10 cm below ground	CMC Instantaneous NCEP Instantaneous	Raw n/a	Raw n/a	n/a n/a
Snow water equivalent	WEASD	Surface	CMC Instantaneous NCEP instantaneous	Raw n/a	Raw n/a	n/a n/a
Snow depth at surface	SNOD	Surface	CMC Instantaneous NCEP Instantaneous	Raw n/a	Raw n/a	Raw n/a

Raw = Direct model data

BC = Bias Corrected model data

Flux parameters

Flux variables	GRIB	Levels	Comments	CMC Raw Bc	NCEP Raw Bc	FNMO Raw Bc
Latent heat flux	LHTFL	Surface	NCEP 6hr average CMC cumulative from 00hr <i>FNMO Net Instantaneous</i>	Raw n/a	Raw n/a	Raw n/a
Sensible heat flux	SHTFL	Surface	NCEP 6hr average CMC cumulative from 00hr <i>FNMO: Net Instantaneous</i>	Raw n/a	Raw n/a	Raw n/a
Downward short wave radiation	DSWRF	Surface	NCEP 6hr average CMC cumulative from 00hr	Raw n/a	Raw n/a	n/a n/a
Downward long wave radiation	DLWRF	Surface	NCEP 6hr average CMC cumulative from 00hr	Raw n/a	Raw n/a	n/a n/a
Outgoing long wave	OLR	Nominal Top Atmosphere	NCEP 6hr average CMC cumulative from 00hr	Raw n/a	Raw Bc	n/a n/a
Upward short wave radiation	USWRF	Surface	NCEP 6hr average CMC cumulative from 00hr	Raw n/a	Raw n/a	n/a n/a
Upward long wave radiation	ULWRF	Surface	NCEP 6hr average CMC cumulative from 00hr	Raw n/a	Raw Bc	n/a n/a
<i>Net long wave top of atmosphere (coded as Net but actually outgoing)</i>		<i>Nominal Top Atmosphere</i>	<i>FNMO Net Instantaneous</i>			<i>Raw n/a</i>

Raw = Direct model data

BC = Bias Corrected model data



Two-step bias correction of NAEFS data

Summary

- (1) Generating center bias corrects own prog data using own analysis
- (2) Centers collect (1) from other centers
- (3) Centers bias correct (1) w.r.t. NCEP reanalysis

NAEFS analysis parameters exchanged

Parameter	GRIB	Levels (hPa)	CMC	NCEP	FNMOG
Geopotential Height Temperature Relative Humidity	HGT TEMP RELH	10, 50, 100, 200, 250, 500, 700, 850, 925, 1000	Yes	Yes	n/a
[U,V] component wind	[U,V]GRD	10, 50, 100, 200, 250, 500, 700, 850, 925, 1000	Yes	Yes	n/a
Model topography?		Surface	Yes	Yes	n/a
Temperature Relative Humidity		2m above ground	Yes	Yes	n/a
U, V component wind		10m above ground	Yes	Yes	n/a
Pressure		Mean Sea Level and Surface	Yes	Yes	n/a
Precipitable water		Atmospheric Column	Yes	Yes	n/a
Total Cloud			Yes	Yes	n/a

Was used mainly originally when each center bias corrected raw prog data from other centers

NCEP reanalysis dataset

NCEP file names	Fhr	Size	Available at
cdas.t[00,06,12,18]z.pgrbf00	000 hr	1.9 MB	00Z: ~16:30 06Z: ~22:30 [45] 12Z: ~04:30 18Z: ~10:30
cdas.t[00,06,12,18]z.sfluxgrbf06	006 fhr	1.2 MB	00Z: ~16:30 06Z: ~22:30 [45] 12Z: ~04:30 18Z: ~10:30
Format			Presently GRIB1 Plans are to migrate to GRIB2
Access to data			Presently pushed by NCEP to CMC CMC preparing to “pull” data

The collection of NCEP reanalysis dataset has been going smoothly

A little bit of a challenge if reanalysis data is very late as it can be complex to update historical bias estimate information

(2) GRIB2 encoding of NAEFS parameters

- Quick review of grib2 encoding in NAEFS
- To appreciate challenge of exchange + encoding/decoding of data from various centers
- Introduction:
 - WMO 306 GRIB2 document
 - NCEP GRIB2 reference
 - Ex: Tigge grib2 data uses all same grib2 encoding
 - Advantage when all centers share same grib2 terminology

NAEFS Upper Air parameters - GRIB2 encoding

Here grib2 encoding is the same between centers

Parameter	Levels	Discipline 0.0	Category 4.1	Parameter ID 4.2	Statistical 4.10	Time range Units 4.4	Level type1 4.5	Level type2 4.5	
HGT	10, 50, 100, 200, 250, 500, 700, 850, 925, 1000 mb	0	3	5			100		CMC NCEP FNMOC
TEMP	10, 50, 100, 200, 250, 500, 700, 850, 925, 1000 mb	0	0	0			100		CMC NCEP FNMOC
UGRD	10, 50, 100, 200, 250, 500, 700, 850, 925, 1000 mb	0	2	2			100		CMC NCEP FNMOC
VGRD	10, 50, 100, 200, 250, 500, 700, 850, 925, 1000 mb	0	2	2			100		CMC NCEP FNMOC
RELH	10, 50, 100, 200, 250, 500, 700, 850, 925, 1000 mb	0	1	1			100		CMC NCEP FNMOC
VVEL	850 mb	0	2	2			100		CMC NCEP FNMOC

NAEFS surface parameters - GRIB2 encoding

Here not all grib2 encoding is the same between centers

Parameter	Level	Discipline 0.0	Category 4.1	Param. ID 4.2	Statistical 4.10	Time range Units 4.4	Level type1 4.5	Level type2 4.5	
HGT	Model topograp hy	0 0 2	3 3 0	5 5 7			1 1 1		CMC NCEP FNMOC
TEMP	2m above ground	0	0	0			103		CMC NCEP FNMOC
UGRD	10m above ground	0	2	2			103		CMC NCEP FNMOC
VGRD	10m above ground	0	2	2			103		CMC NCEP FNMOC
RELH	2m above ground	0	1	1		1	103		CMC NCEP FNMOC
TMIN	2m above ground	0	0	5 5 0	3	11 1 11	103		CMC NCEP FNMOC
TMAX	2m above ground	0	0	4 4 0	2	11 1 11	103		CMC NCEP FNMOC

NAEFS Atmospheric Column parameters - GRIB2 encoding

Here not all encoding is the same between centers

Parameter	Level	Discipline 0.0	Category 4.1	Param ID 4.2	Statistical 4.10	Time range Units 4.4	Level type1 4.5	Level type2 4.5	
PRES	Surface	0	3	0		1	1		CMC NCEP FNMOC
PMSL	Mean Sea Level	0	3	1		1	101		CMC NCEP FNMOC
TCLD	Surface	0	6	1		1	200		CMC NCEP FNMOC
PWAT	Surface	0	1	3		1	200		CMC NCEP FNMOC
CAPE	layer	0	7	6		1	1 108 1	8 n/a n/a	CMC NCEP FNMOC
CINH	layer	0	7	7		1	1 108 1	8 n/a n/a	CMC NCEP FNMOC

NAEFS Precipitation – Part 1 – GRIB2 encoding

Total Precipitation and Categorical by type

Only NCEP provides Categorical Precipitation information

Parameter	Level	Discipline 0.0	Category 4.1	Param ID 4.2	Statistical 4.10	Time range Units 4.4	Level type1 4.5	Level type2 4.5	
APCP	Surface	0	1	8	1 -- --	11 1 1	1		CMC NCEP FNMOC
CRAIN	Surface	n/a 0 n/a	n/a 1 n/a	n/a 192 n/a	n/a -- n/a	n/a 1 n/a	n/a 1 n/a		CMC NCEP FNMOC
CSNOW	Surface	n/a 0 n/a	n/a 1 n/a	n/a 195 n/a	n/a -- n/a	n/a 1 n/a	n/a 1 n/a		CMC NCEP FNMOC
CICE	Surface	n/a 0 n/a	n/a 1 n/a	n/a 194 n/a	n/a -- n/a	n/a 1 n/a	n/a 1 n/a		CMC NCEP FNMOC
CFRZ	Surface	n/a 0 n/a	n/a 1 n/a	n/a 193 n/a	n/a -- n/a	n/a 1 n/a	n/a 1 n/a		CMC NCEP FNMOC

NAEFS Precipitation – part 2 – GRIB2 encoding

Total accumulation of precipitation by type

Only CMC and FNMOC provide precipitation type accumulation information

Parameter	Level	Discipline 0.0	Category 4.1	Param. ID 4.2	Statistical 4.10	Time range Units 4.4	Level type1 4.5	Level type2 4.5	
WEARN*	Surface	0 n/a n/a	1 n/a n/a	65 n/a n/a	1 -- --	11 n/a n/a	1 n/a n/a		CMC NCEP FNMOC
WEASN*	Surface	0 n/a 0	1 n/a 1	66 n/a 241	1 -- ??	11 n/a 1	1 n/a ??		CMC NCEP FNMOC
WEAPE*	Surface	0 n/a 0	1 n/a 1	68 n/a 227	1 -- ??	11 n/a 1	1 n/a ??		CMC NCEP FNMOC
WEAFR*	Surface	0 n/a 0	1 n/a 1	67 n/a 225	1 -- ??	11 n/a 1	1 n/a ??		CMC NCEP FNMOC

CMC algorithm - Bourgoquin, Pierre. 2000: **A Method to Determine Precipitation Types**. *Weather and Forecasting*: Vol. 15, No. 5, pp. 583–592. or

<http://journals.ametsoc.org/doi/full/10.1175/1520-0434%282000%29015%3C0583%3AAMTDPT%3E2.0.CO%3B2>

Does FNMOC have a link to article on precipitation typing algorithm used by model?

May 5, 2012

DRAFT – Page 25 – May-5-12

NAEFS Soil parameters – GRIB2 encoding

Here not all grib2 encoding is the same between centers

Parameter	Level	Discipline 0.0	Category 4.1	Param ID 4.2	Statistical 4.10	Time range Units 4.4	Level type1 4.5	Level type2 4.5	
TEMP	0-10 cm below ground	0	0	0			106 106 n/a	106	CMC NCEP FMOC
SMOIST	0-10 cm below ground	2	0	192			106 106 n/a	106	CMC NCEP FMOC
WEASD	Surface	0	1	13			1 1 n/a		CMC NCEP FMOC
SNOD	Surface	0	1	11			1 1 n/a		CMC NCEP FMOC

NAEFS FLUX parameters - GRIB2 encoding
Here NCEP and CMC share same grib2 encoding

Parameter	Level	Discipline 0.0	Category 4.1	Param. ID 4.2	Statistical 4.10	Time range Units 4.4	Level type1 4.5	Level type2 4.5	
LHTFL	Surface	0	0	10	1	11	1		CMC NCEP FMOC
		0	0	10	-	-	1		
		0	0	10	-	-	1		
SHTFL	Surface	0	0	11	1	11	1		CMC NCEP FMOC
		0	0	11	-	-	1		
		0	0	11	-	-	1		
DSWRF	Surface	0	4	192	1	11	1		CMC NCEP FMOC
		0	4	192	-	-	1		
		x	x	x	x	x	x		
DLWRF	Surface	0	5	192	1	11	1		CMC NCEP FMOC
		0	5	192	-	-	1		
		x	x	x	x	x	x		
OLR	Nominal Top of Atmosphere	0	5	193	1	11	8		CMC NCEP FMOC
		0	5	193	-	-	8		
		0	5	5	-	-	8		
USWRF	Surface	0	4	193	-	11	1		CMC NCEP FMOC
		0	4	193	-	-	1		
		x	x	x	x	x	x		
ULWRF	Surface	0	5	193	-	11	1		CMC NCEP FMOC
		0	5	193	-	-	1		
		x	x	x	x	x	x		

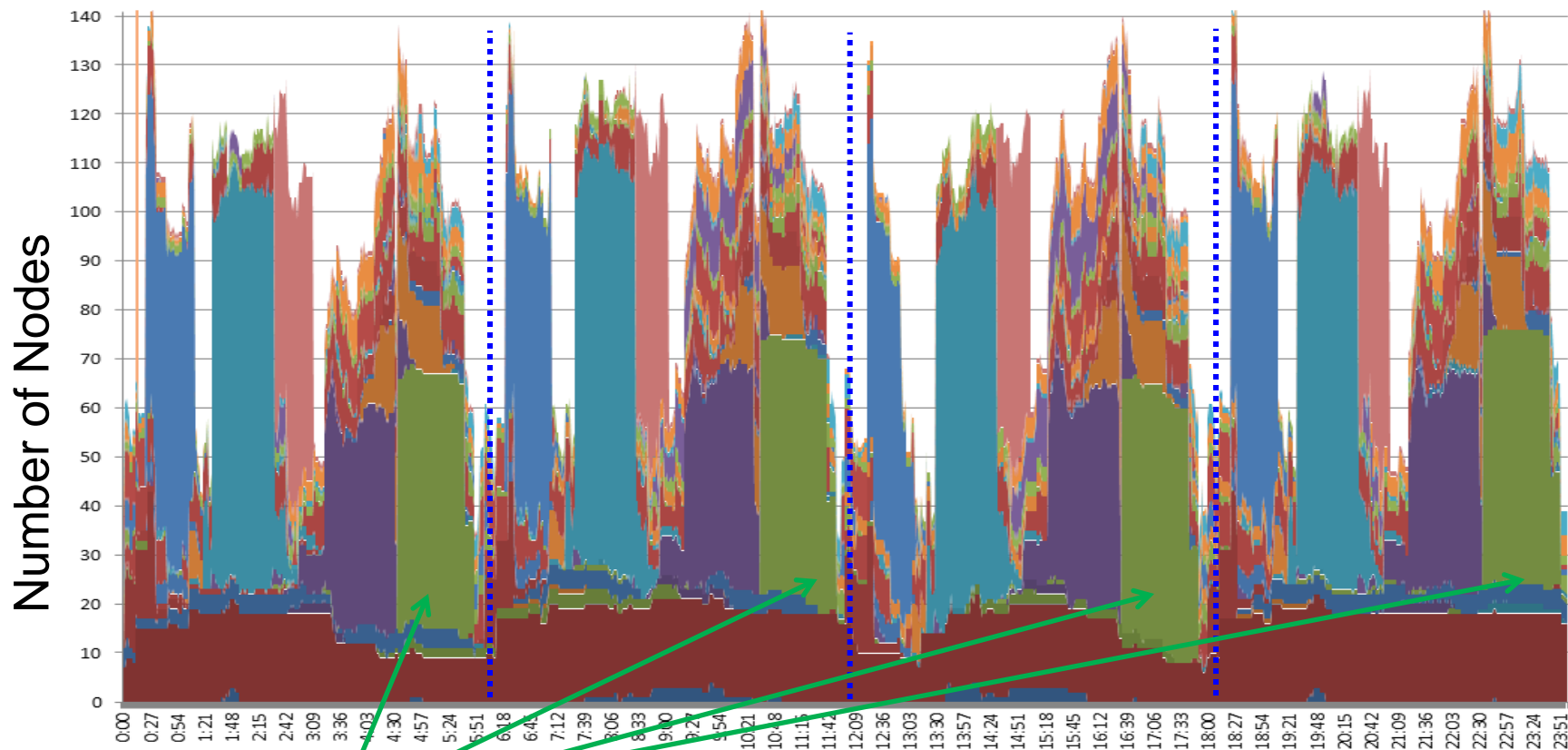


(3) Details of NAEFS multi-center data exchange

Running the models

NCEP Predicted Production Suite on Supercomputer

May 2012



00

GEFS

06

12

18

Time of the day (utc)

75% Production

00 % Development

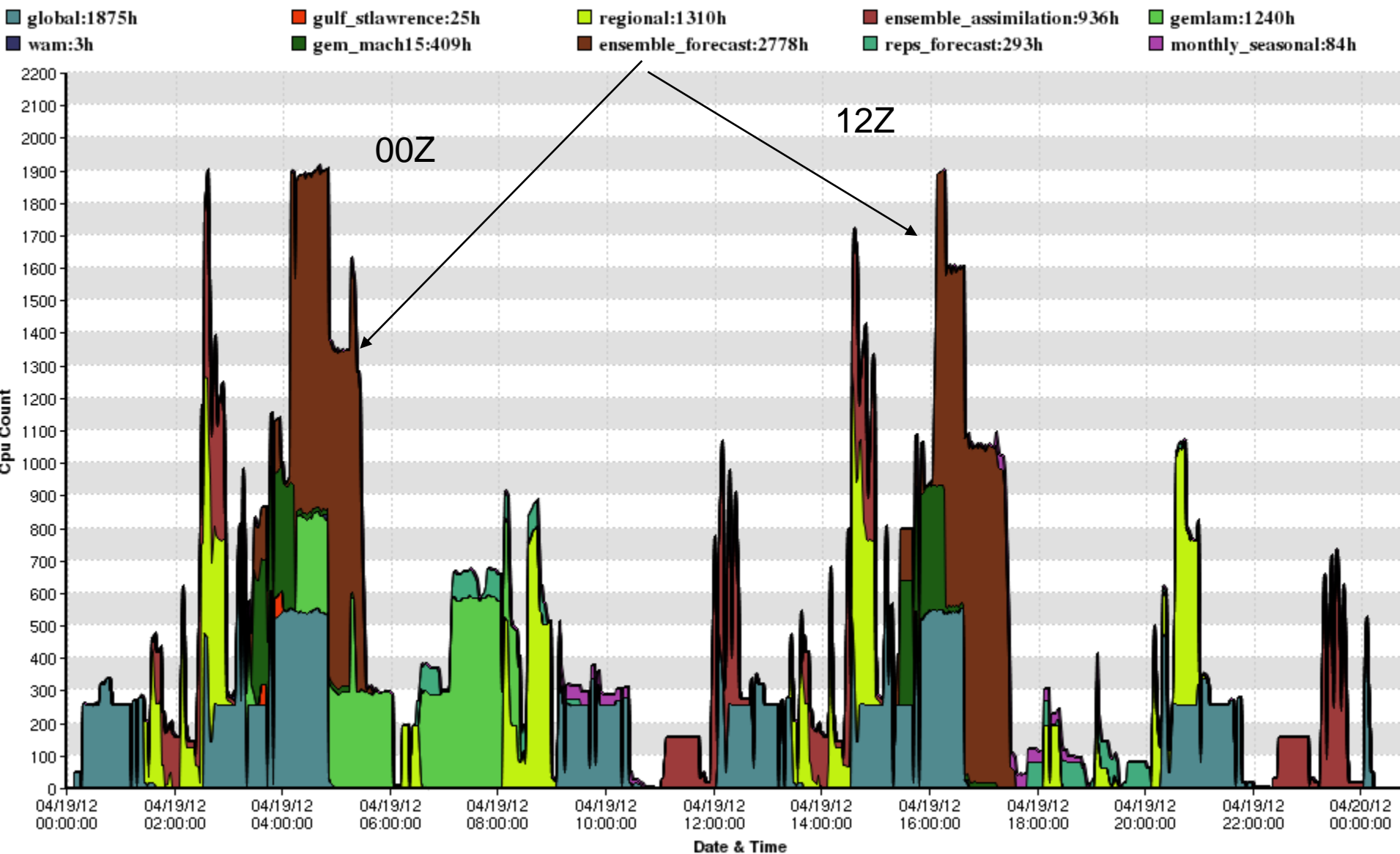
May 5, 2012

DRAFT - Page 29 - May-5-12

Running the models - CMC Production suite on supercomputer

Note New supercomputer will become operational in May 2012

IBM Production Class 2012-04-19 : Operational Total Cpu Hours 8953.30





CMC new supercomputer – May 2012

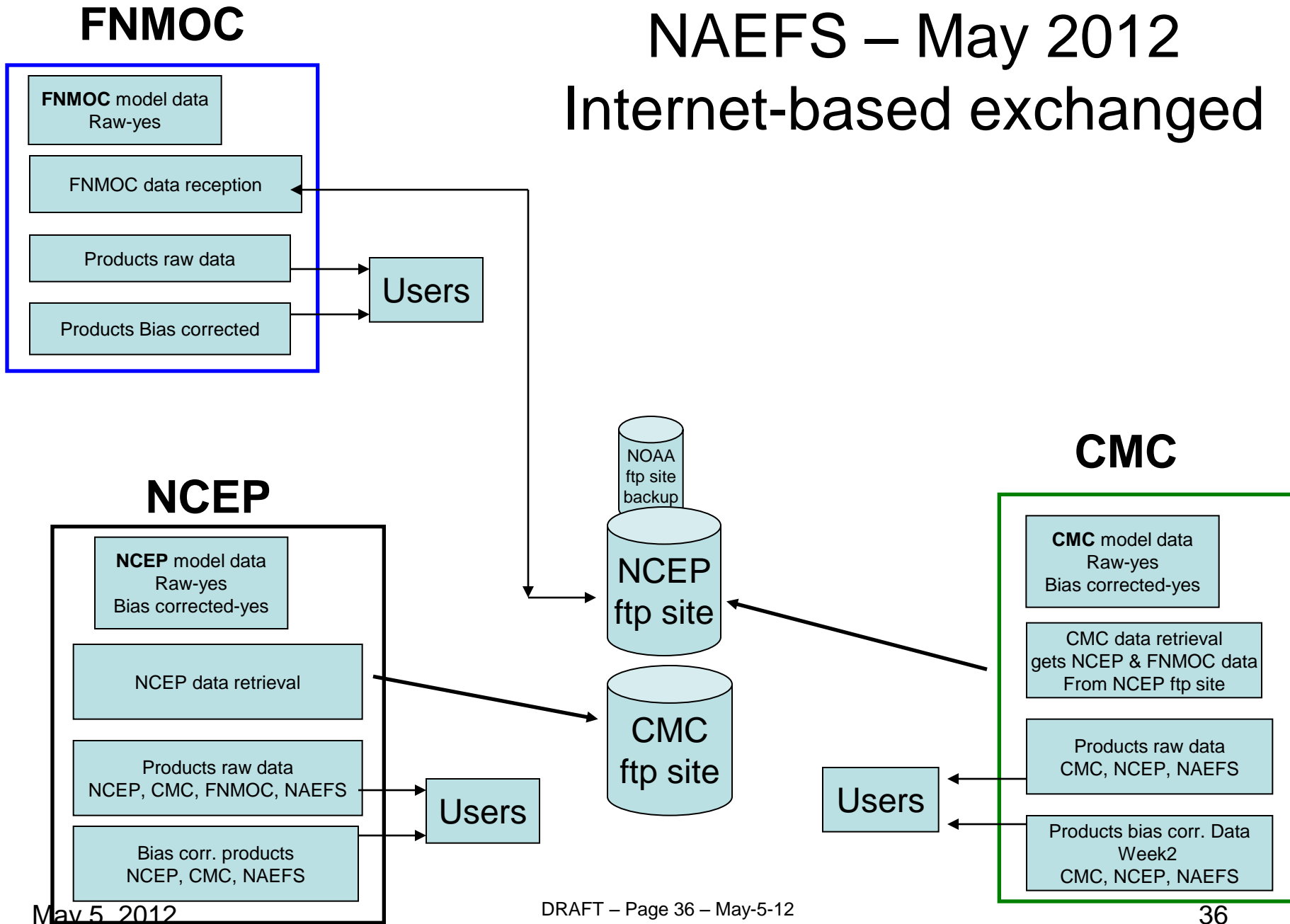
- CMC to declare operational an upgraded supercomputer in may 2012
- Then, CMC ensemble models expected to be available ~45 minutes earlier, but...
- When high resolution GEPS will be installed, the model integration times will become longer (50km expected in 2013)



- 3.2 The mechanics of the data exchange

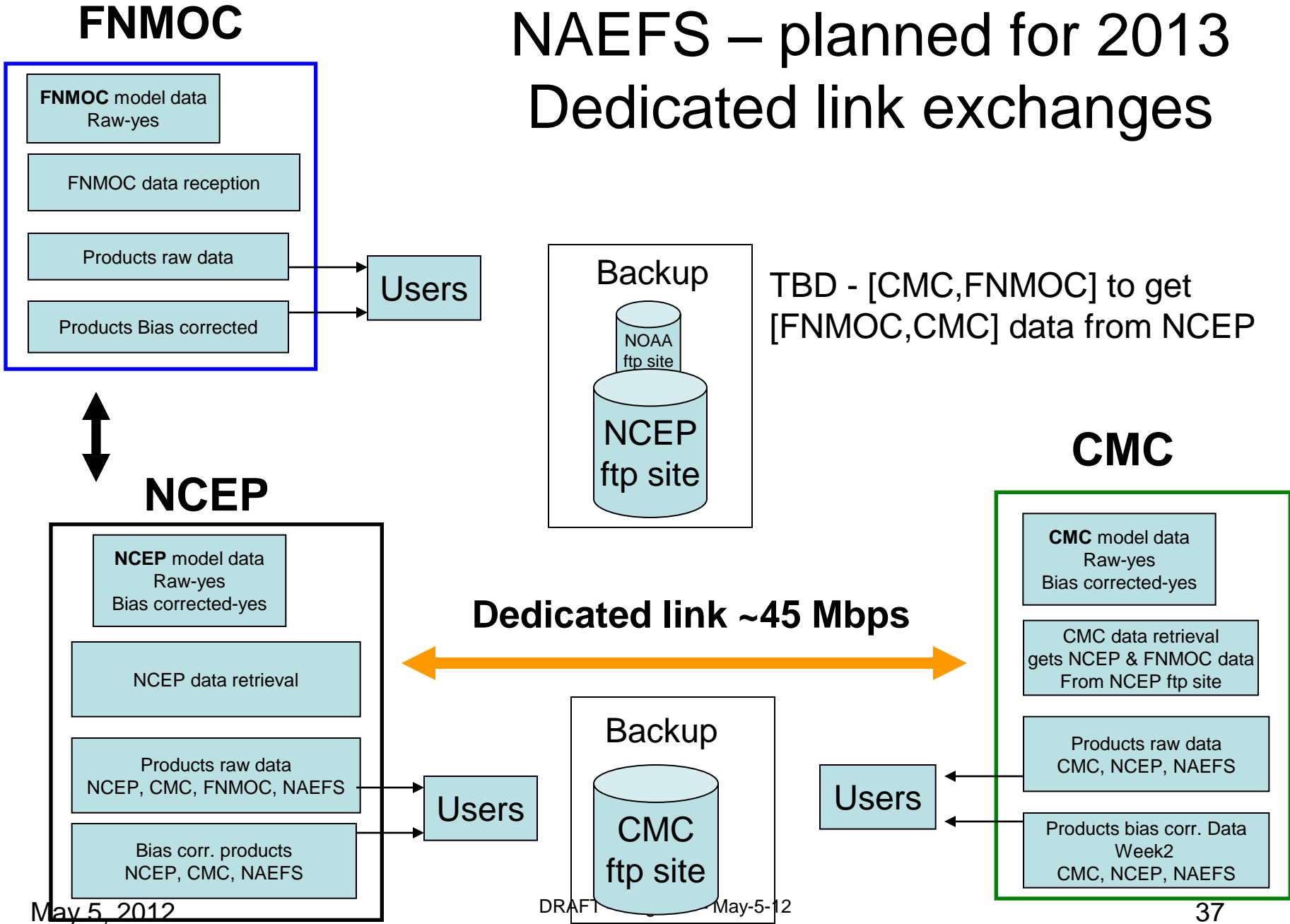
NAEFS – May 2012

Internet-based exchanged



NAEFS – planned for 2013

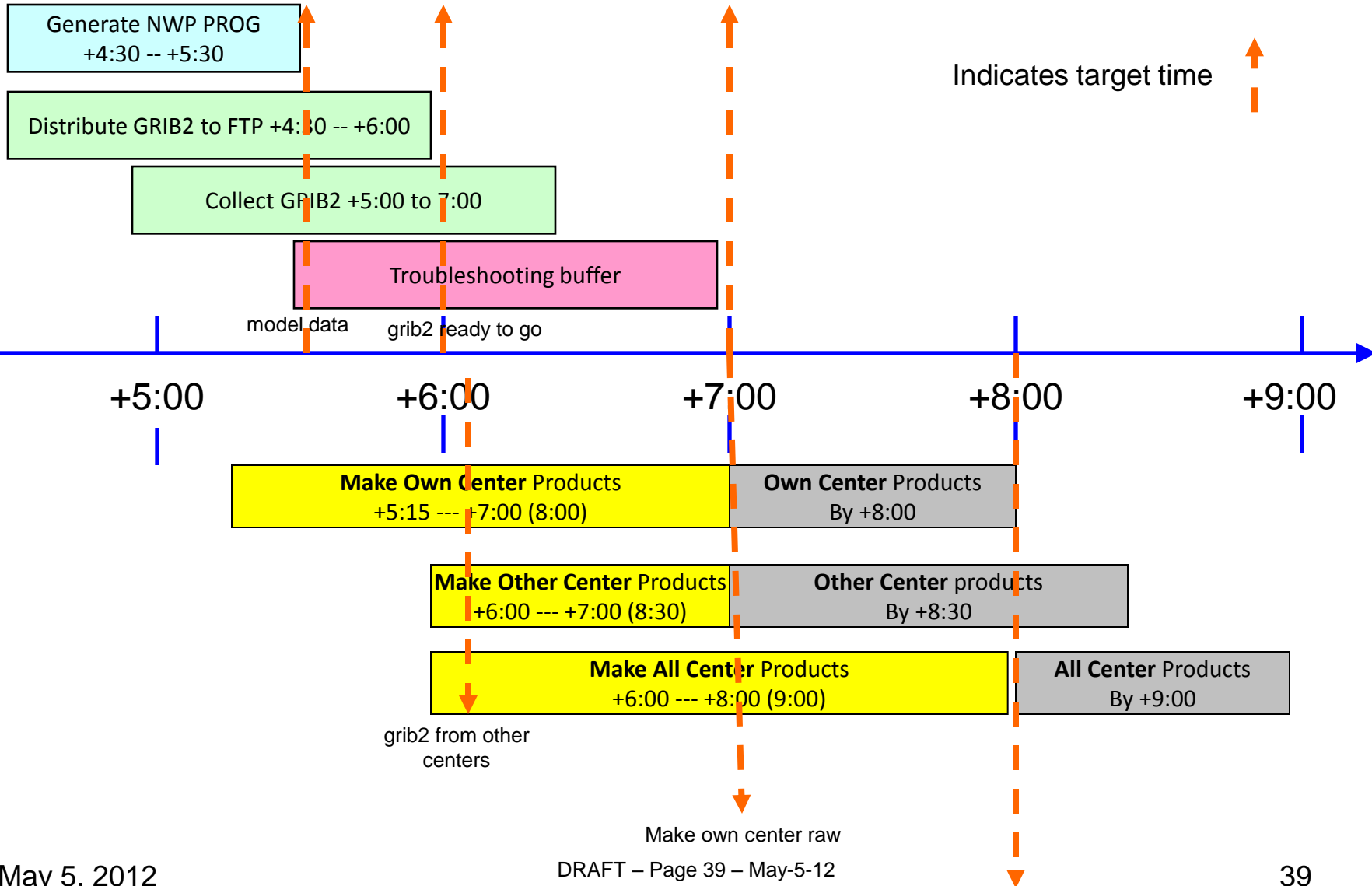
Dedicated link exchanges



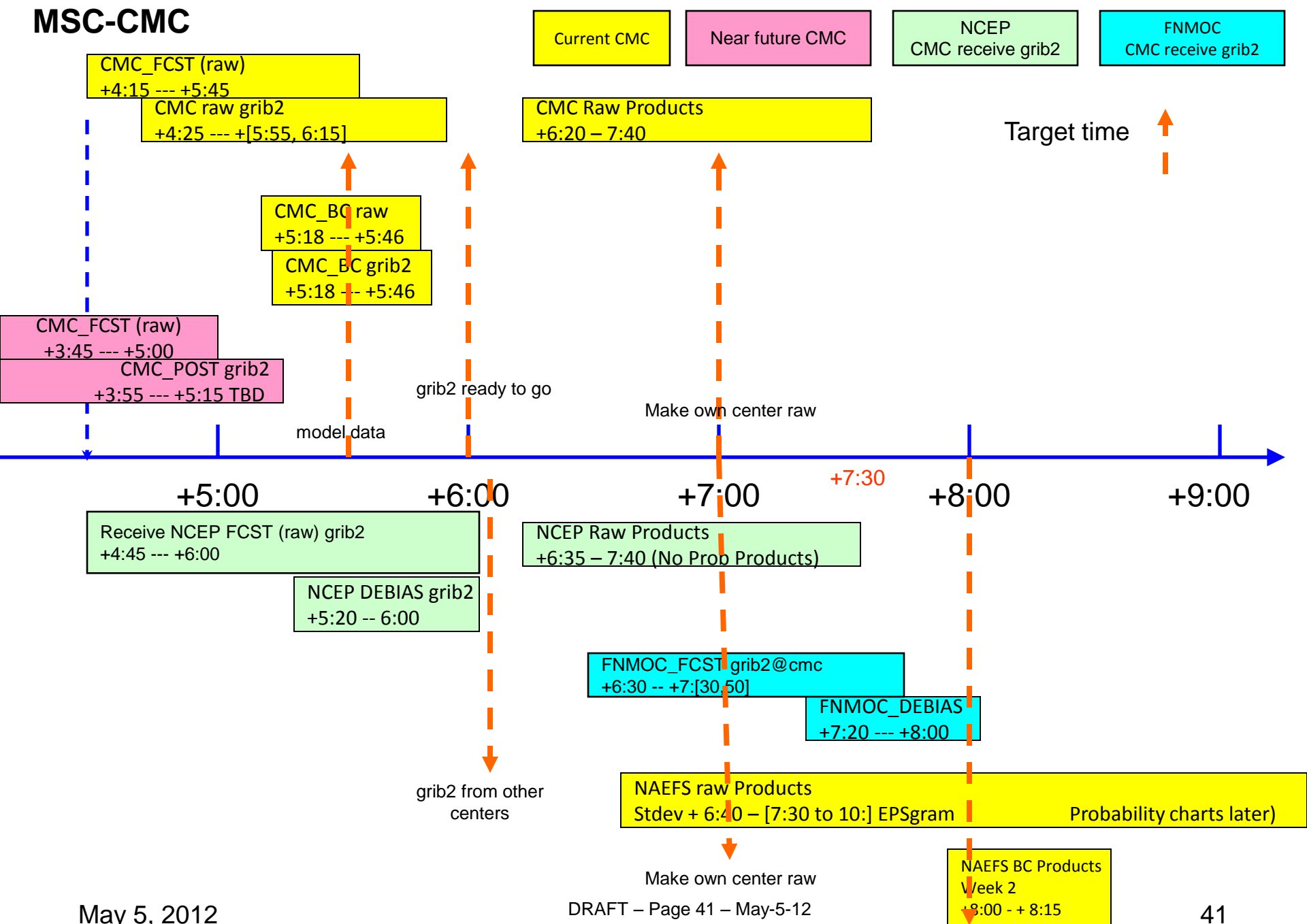
3.3 Target timelines

A sample ideal NAEFS production cycle for 00Z

Collect Analysis & Re-Analysis
+4:15 -- +4:45



MSC-CMC



May 5, 2012

DRAFT - Page 41 - May-5-12

41

MSC-CMC GEPS/NAEFS process flow for 00Z cycle production



Current

Current

Target time

Future

NCEP_FCST (raw)
+4:45 --- +5:45

NCEP_POST (pgrb)
+4:45 --- +5:45

NCEP_DEBIAS
+5:18 -- +5:46

Track distribution
+5:50

NAEFS_PROB(2)
+7:00 - +7:30

NAEFS_PROB(2)
+8:08 --- +9:08

PROB_PRODUCTS
+5:50 --- +6:15

NAEFS_PROB(1)
+6:30 - +7:00

NAEFS_PROB(1)
+7:30 -- +8:08

grib2 ready to go

Make own center raw

model data

+5:00

+6:00

+7:00

+7:30

+8:00

+9:00

CMC_FCST (raw)
+4:25 --- +5:56

CMC_DEBIAS
+6:10 --- +7:30

CMC_DEBIAS
+6:10 - +6:30

FNMOFC_FCST (raw)
+4:30 -- +6:30

FNMOFC_DEBIAS
+6:10 - +6:30

FNMOFC_DEBIAS
+7:30 --- +7:40

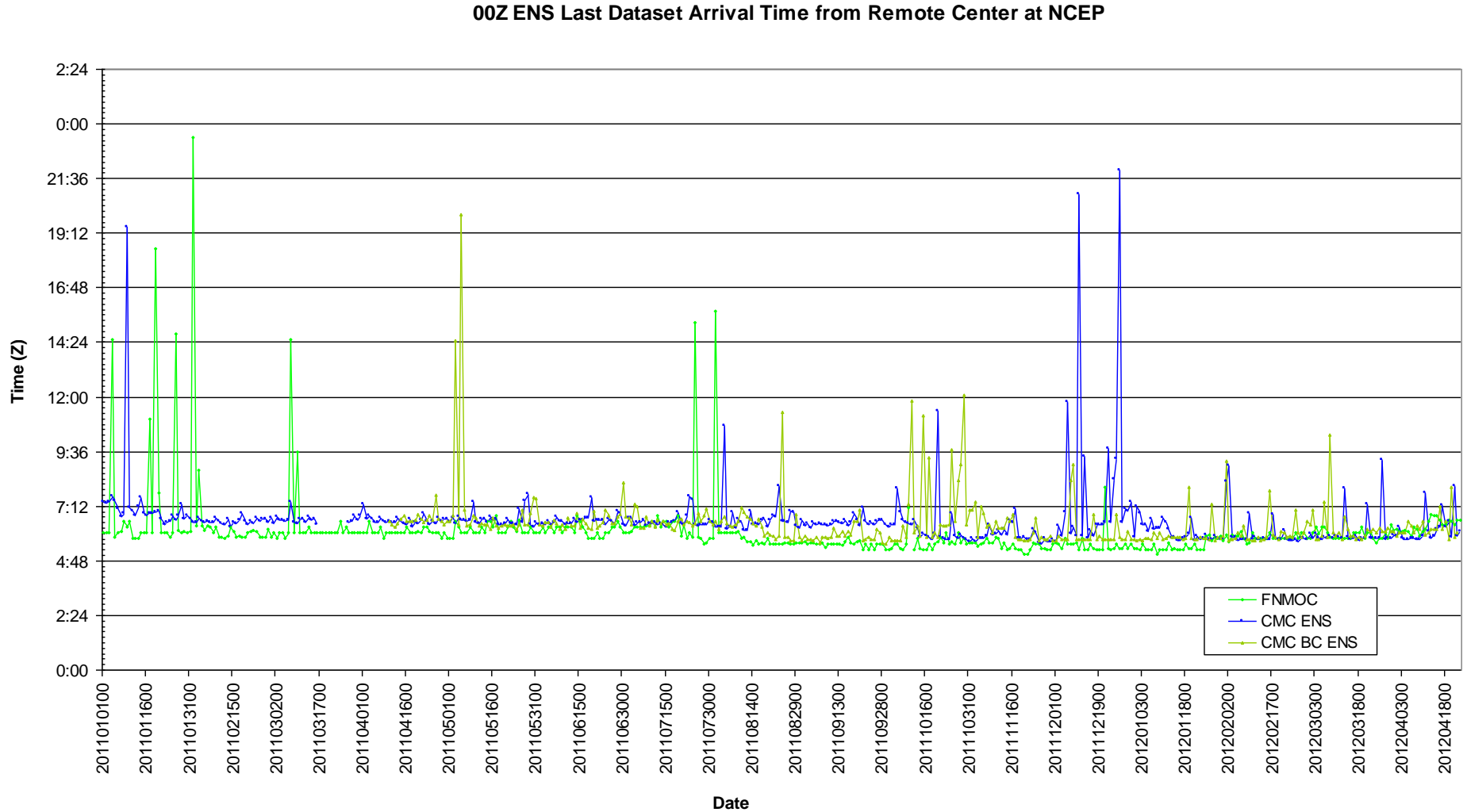
grib2 from other centers

NAEFS_PROB(1) - 1*1 global products

NAEFS_PROB(2) - 5km downscaled products

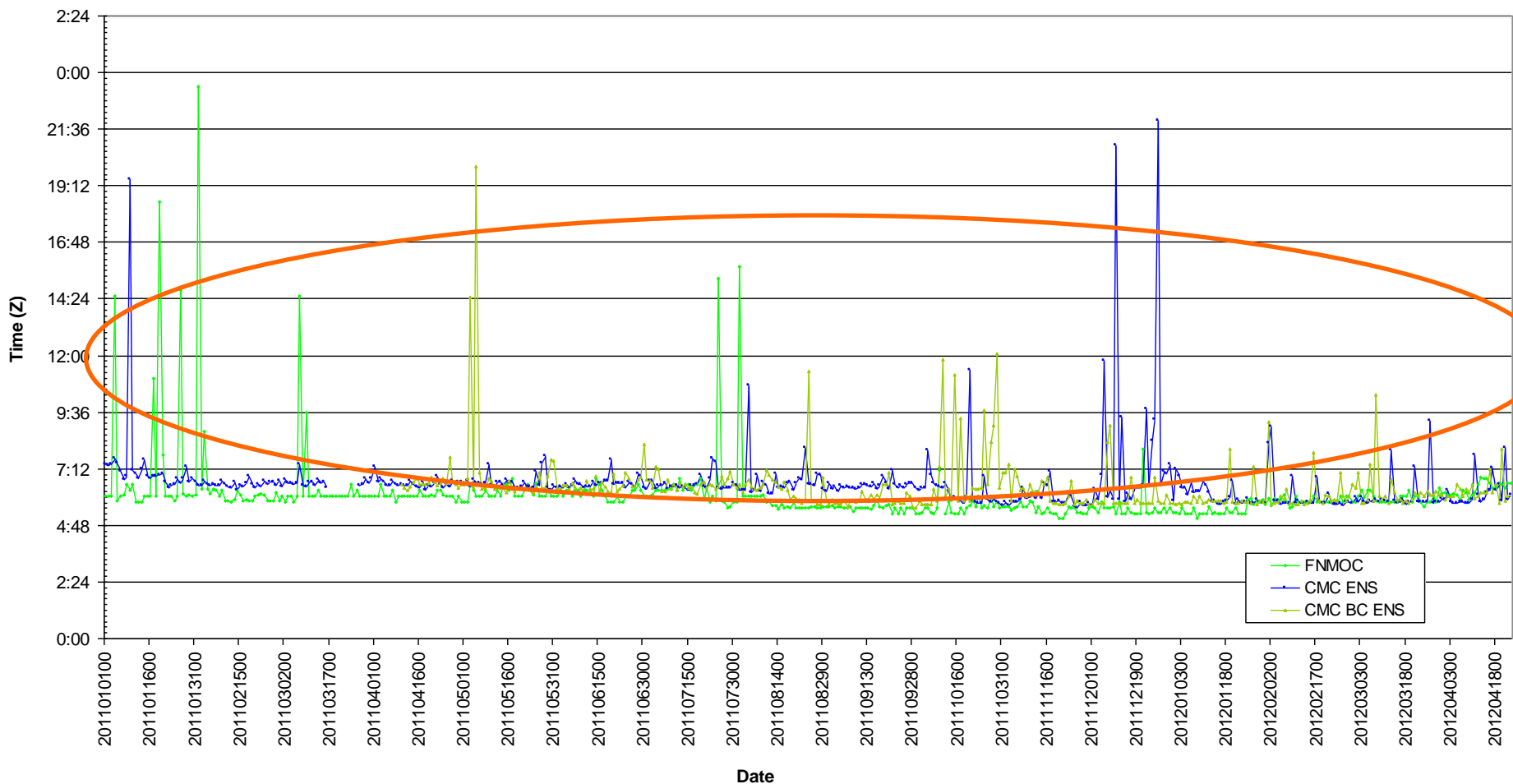
Make own center raw

12Z model run - timeliness of data delivery – NCEP Perspective



12Z model run - timeliness of data delivery – NCEP Perspective

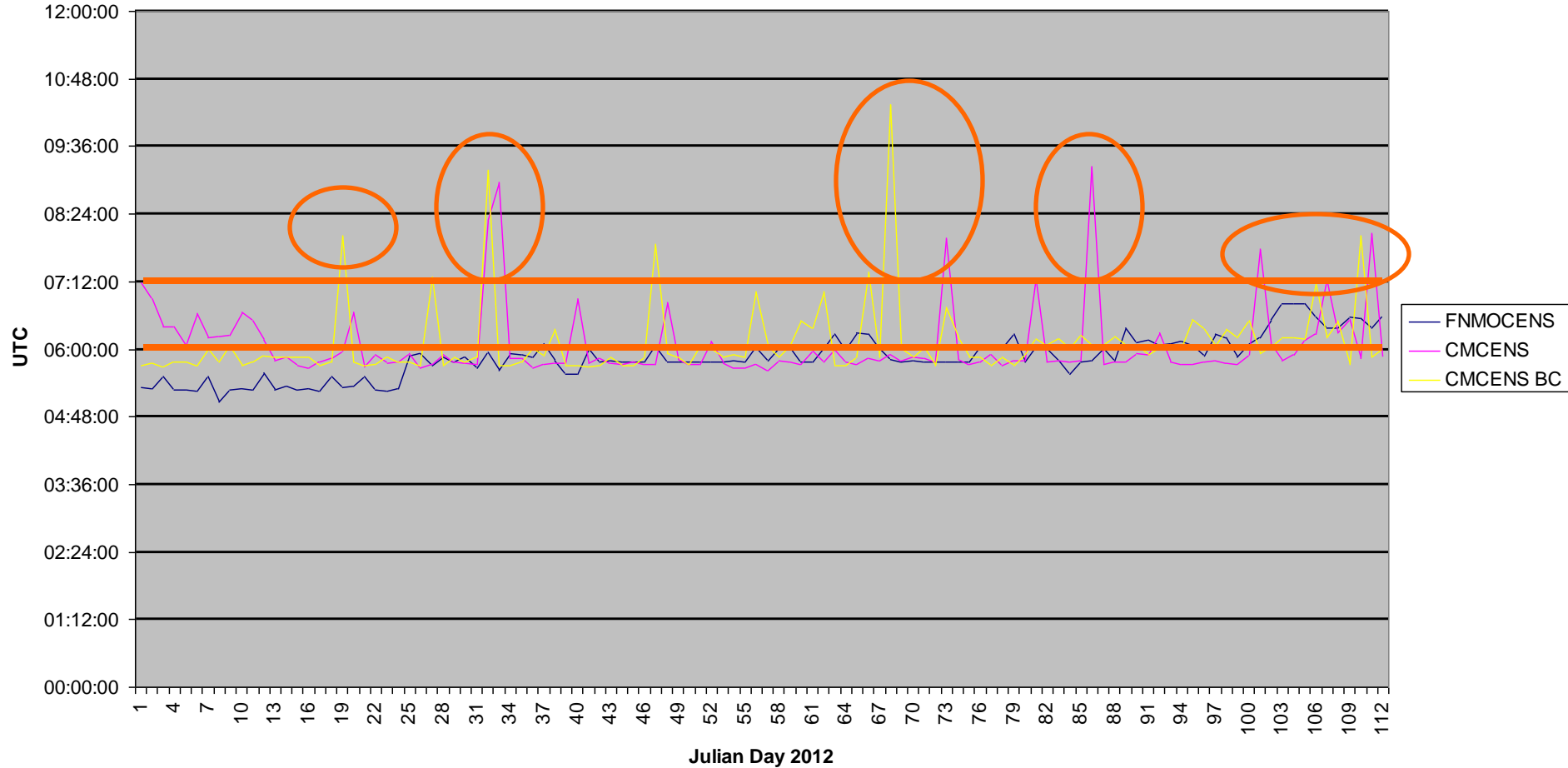
00Z ENS Last Dataset Arrival Time from Remote Center at NCEP



00Z runs - Timeliness of data delivery – NCEP perspective

Highlights need of strategy for when member data missing or late

Arrival time of last file in dataset
From NCEP Log data





3.4 NAEFS troubleshooting

Important part of operational data exchange

- The NAEFS exchange could be the multi-center data exchange project with the most practical, operational experience
- Our ongoing experience is valuable
- Robust troubleshooting and QC strategies are required to ensure timely NAEFS product generation
- Sharing of troubleshooting strategies between centers could assist in improving robustness of NAEFS production
- Clear target timelines help support staff design systems appropriately with supporting troubleshooting info

Some sample data exchange problems / solutions

Continue to collect list of problems, document solutions

Problems

Data exchange

- Missing files - recoverable? ----->
- Missing files – Unrecoverable ----->
- File not named correctly? ----->
- Models running a little late? ----->
- Models running VERY late? ----->
- Data content of files incorrect ----->

Reanalysis data

- Missing or very late files? ----->
- Duplicate file, incorrect content?----->
- Corrupted file? ----->

FTP site / server problems

- FTP site down? ----->
- Server down? ----->

GRIB files

- Random corruption in files? ----->

Products

- Missing or late products at destination --->

Site problems ex: Fire, Weather impacts
May 5, 2012

Solutions

Data exchange

- Recover files in real time
- If possible, substitute member.
- Don't rely on file name, use meta info
- If possible accommodate late data
- Start post proc. with min required data
- Add QC to monitor content of other center files

Problem - Reanalysis data

- Recover next business day, regenerate bias info
- QC input file, Identify missing data, recover QC on input file

FTP site / Server problems

- Transfer to alternate FTP site
- If cannot get data, use other center information?

GRIB files

- Use secure ftp, add Q/C to grib production

Products

- Add Qc to monitor product distribution

Site problems – user other center info as contingency

Centers can track problems and solutions

Continue document challenge of multi-center data exchanges

Event	Contingency	Recommendations
2008-01-22 / Unrecoverable prog file at one time step gep15.t00z.pgrbaf384 unrecoverable	CMC uses member 7 data instead Time step missing is end fhr	
2008-02-[01,02] / 2 reanalysis missing for Feb 1 06Z	cdas data only recovered on next business day if event is on weekend	
2008-02-02/ Missing control file: gec00.t18z.pgrbaf00	Improved CMC documentation on recovery actions	
2008-02-[05,06] / Incorrect reception of 2 reanalysis files Received 2 reanalysis for Feb 5 00Z, but both contained content of *flux* files.	CMC requested re-transmission	
2008-02-18 / Incorrect push of control file gec00.t18z.pgrbaf00 pushed to depot but not renamed correctly, can't be 'seen' by CMC	Several re-transmission requests had to be made, Corrections to ncep script that pushes files, Problem caused by migration to new machines left double versions of scripts running	
2008-02-22 / Problems with a 00Z ensemble run Feb 22 NCEP naefs file missing	CMC received empty ncep file 5:15 Z CMC debiasing bombs naefs file missing Took 3+ [calls, re-transmits] to get correct file File eventually received at about 12Z (+7hrs)	
2008-01-[27,28] / Difficulty accessing NCEP reanalysis data valid for previous day 2008-02-27 00Z	Requested re-transmission	
2008-03-27 / Inadvertent loss by CMC re-analysis file	CMC requests re-transmission of reanalysis files	
2008-06-02 / NCEP server down	CMC has difficulty receiving NCEP files	
January - March 2010 / Late data delivery possible resulting from system upgrades at generating center		

Centers can track problems and solutions – continued

Document challenge of multi-center data exchanges

Event	Contingency	Recommendations
<ul style="list-style-type: none"> - GRIB2 from originating center not decoded properly by other centers 	<ul style="list-style-type: none"> - If necessary, turn off use of problematic grib2 data 	<ul style="list-style-type: none"> -Share grib2 samples with other centers prior to making grib2 files operational - If possible, share the same grib2 encoding -Strive to improved grib2 encoding standards
<ul style="list-style-type: none"> - Models running late disrupt other center production of naefs products 	<ul style="list-style-type: none"> - Build in contingency to launch naefs products with some members possibly missing or late 	<ul style="list-style-type: none"> - Increase range of product generation using various combinations of missing data
<ul style="list-style-type: none"> - Pager (emergency response) personnel not always up to date with most recent NAEFS troubleshooting procedures 	<ul style="list-style-type: none"> -Circulate information on the NAEFS troubleshooting to response personnel 	<ul style="list-style-type: none"> -Work to improve the NAEFS documentation - Consider offering NAEFS troubleshooting simulators



(4) Roundup of considerations based on NAEFS operational experience

- A collection of comments based on our experience
- Feedback also welcome from NCEP and FNMOC
- May assist workshop at setting targets to continue improving operational aspects of NAEFS exchange



NAEFS operational parameters – considerations

Ensemble members

- Control member – Should each partner supply a control member?
Or substitute for control member?

Ongoing improvements to existing NAEFS parameters

- Total cloud –average & instant values – plan for same variable
- Cape/Cinh – Document differences between CAPE & CINH calculations
- Precipitation – CMC cumulative from 000hr, other centers by 6hr interval
- Precipitation – CMC and FNMOC do not provide categorical
- Soil parameters – clarification to ensure variables are consistent
- Flux – CMC cumulative, NCEP Average, FNMOC instant
- Not all fluxes available yet from FNMOC
- NCEP – Note – additional model topography at fhr = 204



NAEFS Raw and BC model parameters

- With new models & parameters to NAEFS exchange
- Important to plan which parameters required / added
- Need clear, realistic plan for adding variables to NAEFS
- Which ones will be bias corrected?
- Keep list of desired parameters updated, accessible
- Plan realistically
- From experience, adding new variables takes time



NAEFS operational parameters – considerations

When adding new models – Ex: REPS, long term GEPS

- If possible, start from list of parameters as operational NAEFS dataset
- If possible, reuse configurations and code from existing data naefs exchanges to manage the new datasets
 - ex: REPS could start by sharing same variables as shared by GEPS
- Value in exchanging prototype (though imperfect) datasets or grids
- Helps establish new procedures as we move to operations
- Datasets and grids can be fine tuned later

Evaluate possible issues when going to 3-hourly time step

- Confirm parameters that cover an interval will be adjusted to go from 6hrly intervals to 3 hourly intervals ex: Tmin, Tmax



NAEFS analysis considerations

With centers bias correcting their own data w.r.t. their own analysis

- Is other center analysis as critical for collection by other centers?

CMC collects NCEP's gec00_tHHz.pgrb2af00 as ncep's analysis

- Convenient – many variables available as 00hr prog
- What is best analysis for centers to collect and use

Should all NAEFS partners provide an analysis or a proxy for it if n/a?

Centers don't produce their own analysis at same times

- CMC analysis produced much later than NCEP's
- This has not been a problem – is that still the case?



NAEFS GRIB2 considerations

GRIB2 – file sizes - # of GB

- Would defined maximum file sizes help optimize exchange
 - Presently grib2 datasets range from ~7 GB to over ~10 GB

GRIB2 encoding by center

- GRIB2 encoding of parameters can be different by center
- Is a standard GRIB2 encoding of NAEFS parameters of interest?
 - May facilitate maintenance of code used to process NAEFS data
 - May facilitate adding new parameters, new NAEFS partners
 - Do we want to converge to TIGGE grib2 standard where possible?

Would a GRIB2 documentation depot for NAEFS parameters may help

- Ex: “TIGGE” has clear information on how tigde parameters are to be encoded for tigde exchange
- NAEFS could provide grib2 documentation in support of NAEFS
- See info in http://collaboration.cmc.ec.gc.ca/cmc/cmci/product_guide/docs/naefs/NAEFS_Overview.xls



GRIB2 encoding recommendations

- When adding variables to NAEFS dataset
 - Helpful to share sample of grib2 files in advance
 - helps debug problems prior to going operational
 - Consider using more rigorous validation techniques for inspecting and QC on own center and other center datasets
- How to better handle real time corrections to grib2 data?
 - Ex: CMC had to correct encoding of precip types, yet this had to be carefully coordinated with NCEP downstream users
 - Consider having mechanics for parallel data feed that could be easily activated when corrections or parallel runs are required
 - Impact of detecting grib2 bugs because of insufficient upstream advance testing of datasets
- NCEP sharing of CMC GRIB2 data via NOMADS
 - NCEP has CMC GRIB2 on NOMADS with meta info different than CMC's
 - Should NOMADS CMC grib2 meta info be same as CMC grib2 meta info?



Operational exchange recommendations

- Generally NAEFS data exchange is going well
- Gaining valuable operational experience – multi center exchanges
- **NAEFS Bias Correction**
 - Not all parameters are bias corrected – Develop a priority list?
 - Week2 presently only bias correct product – do we want other products?
 - Continue with participating centers bias correcting their own data
 - Do we need criteria for when BC products should be produced?
- **Data exchange optimizations**
 - Continue clarifying NAEFS operational timelines, targets
 - Clear scheduling, target timelines can help in optimizing production
 - Ensure local staff familiar with troubleshooting, training



Operational exchange recommendations

Consider more quality control components

- Ex: to detect in advance possibility of drifts in datasets such as bias correction
- Ex: to alert to variables that may be out of range compared to same variables from other centers (ex: Temp at 925 hPa FNMOC)
- Better to detect problems in real time than to have to correct the history of that dataset



Concerning NAEFS product generation

- More clearly define NAEFS target timelines
 - For ensuring GRIB2 format data produced and retrieved
- Develop NAEFS strategy for [late,missing] data
 - Late or missing data does not happen frequently
 - However,
 - If some data is late, but a sufficient # of members have arrived
 - could product generation be launched?
 - If products generated with incomplete set of members
 - clearly indicate to users # of members used on the product
 - Adapt production jobs to run with incomplete # of members?
 - Do we guarantee re-generating of missing products say within 24 hours?



(5) Useful links

MODEL related information

- NWP Model information by center
 - MSC - CMC Ensemble information page
 - http://www.weatheroffice.gc.ca/ensemble/verifs/model_e.html
 - NUOPC page – with links to model information
 - <http://www.nws.noaa.gov/nuopc/index7.shtml>
- COMET Matrix information - high visibility, keep updated ?

GRIB related information

- NCEP GRIB edition 2 reference:
<http://www.nco.ncep.noaa.gov/pmb/docs/grib2/>
- WMO: Manual on Codes: International codes Volume 1.2
 - ftp://www.wmo.int/Documents/MediaPublic/Publications/WMO306_CodesManual/WMO_306_Voll2_en.pdf
 - International codes:
<http://www.wmo.int/pages/prog/www/WMOCodes.html>



Links - continued

External access NAEFS GRIB2 data

- NCEP/NOAA nomads server
 - <http://nomads.ncep.noaa.gov/> NCEP+CMC+FNMOG GRIB2 data
- MSC (CMC GEPS raw data only)
 - http://www.weatheroffice.gc.ca/grib/grib2_ens_naefs_e.html

NAEFS Products and Information by center

- MSC - CMC
 - English: http://www.weatheroffice.gc.ca/ensemble/index_naefs_e.html
 - French: http://www.weatheroffice.gc.ca/ensemble/index_naefs_f.html
 - CMC Product Guide:
 - http://collaboration.cmc.ec.gc.ca/cmc/CMOI/product_guide/docs/naefs/NAEFS_Overview.xls
- NCEP
 - <http://www.emc.ncep.noaa.gov/gmb/ens/NAEFS/NAEFS-prods.html>



Thank you

Questions?