Draft
Points of discussion
NAEFS operational data-related issues

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

- Included are a number of NAEFS operations data-related issues that merit clarification

- Where possible, clarification was provided but more formal approvals by NAEFS management team may be required

- This document could summarize the main points of discussion concerning these issues and could possibly be presented as a supporting document of the 6th NAEFS workshop

- Outstanding issues could be tracked via the NAEFS conference calls

Quick Overview of NAEFS parameters

Complete details regarding NAEFS variables are available in Appendix 1 and 2

NAEFS GEPS dataset – May 2012

Total GB: CMC = 8.5 GB NCEP = 7.4 GB 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
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

Overview of NAEFS parameters - May 2012

Upper Air Parameters	Level(s)	CMC Raw | Bc	NCEP Raw | Bc	FNMOC 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

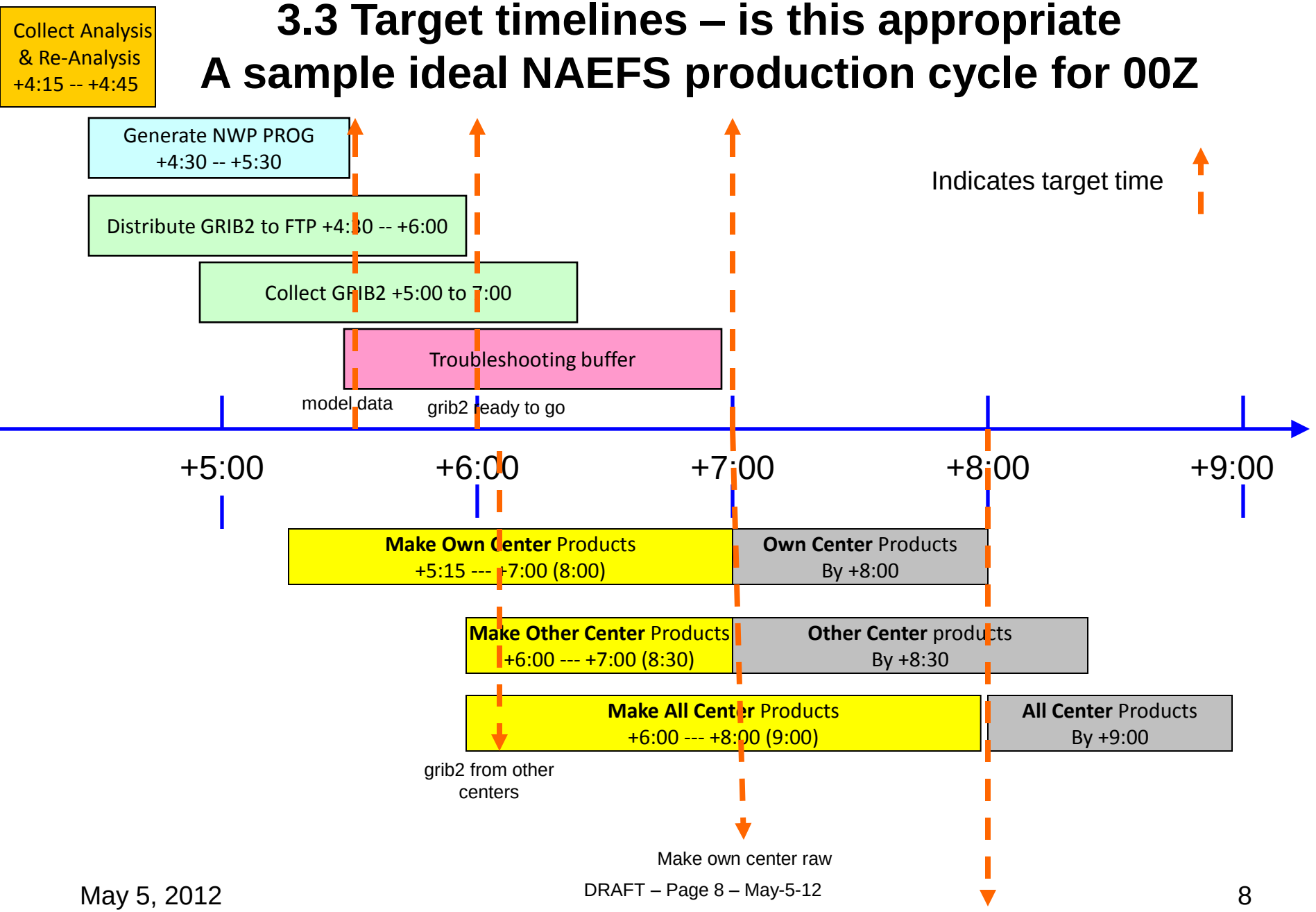
Overview of issue
NAEFS operational data related issues

- NAEFS ideal production timeline
- NAEFS EPS required components
  - Analysis file – required, List of mandatory analysis variables
  - Control member – required
  - Perturbed members – required
- Analysis questions
- Re-analysis questions
- NAEFS – adding new parameters to the exchange
- NAEFS Raw & BC parameters
- GRIB2 related issues
- Product generation issues
- Sharing other center data in grib2 – Have a way to communicate with users of grib2 data
- NAEFS – adding new models
  - Short range EPS
  - Longer range EPS
  - WAM
- List of issues not yet resolved that require further information

NAEFS ideal production timeline

- Fine tune appropriate NAEFS production timeline on next slide
- Confirm how closely to production timeline participating centers must perform w.r.t. ideal timeline
- Strive to adjust systems to deliver NAEFS as per target timelines
- Ensure target timelines for production reflect today's capacity and anticipates upcoming production capacity, i.e. don't design production timeline that a future implementation won't be able to deliver
- A proper NAEFS target timeline will help teams plan installation of components

3.3 Target timelines – is this appropriate
A sample ideal NAEFS production cycle for 00Z



EPS Analysis and Control

Component	Description of issue	Comments	Recommendation	Date last update	Status	Author
EPS Analysis	Analysis file n/a for FNMOC dataset	NAEFS partner should provide analysis file	Analysis file required by generating center	2012-05-03	Open	
Control member	Control member missing from FNMOC	NAEFS partner should provide analysis file	Control member to be provided by generating center		Open	

Confirmation of the importance of the analysis file

1. With centers bias correcting their own data w.r.t. their own analysis, is other center analysis as critical for collection by other centers?
2. Which file should be used?
    1. CMC collects NCEP's gec00_tHHz.pgrb2af00 as ncep's analysis
    2. Convenient – many variables available as 00hr prog
    3. What is best analysis for centers to collect and use
    4. What is FNMOC's analysis, is it available?

NAEFS re-analysis considerations

Names of NCEP re-analysis files that should be used

What about new generation of reanalysis data?

NAEFS partners need guidance to help migrate towards best reanalysis data

If using grib1, then arrange to migrate to grib2 version of this data

Comments

Required

Recommendations

Adding NAEFS new variables

- A checklist could assist in the decision making process related to adding new NAEFS variables

Possible questions for a new variables checklist

- Can user generate new variable from existing variables?
  - If yes then no need to add
- Is it easier to add basic variables so users can calculate it themselves?
  - If yes, consider adding basic variables instead of more complex derived variables
- If users calculate their own post processed variable(s), should NAEFS centers still provide a version of that variable so users can validate their post processing?
- For variables that are to be added:
  - What is appropriate resolution for the new variable? Does it have to be high resolution?
  - What is appropriate and sufficient time resolution for that variable? Does the variable have to be at each time interval of the model? (ex: model topography only at fhr=000)

Adding NAEFS new variables - continued

Planning

- Important to plan which parameters required / added
- Need clear, realistic plan for adding variables to NAEFS
- Clarify which parameters should be bias corrected?
- Clarify which parameters should NOT be bias corrected
- Keep list of desired parameters updated, accessible
- Plan realistically: From experience, adding new variables takes time

- Where should master “wish list” of new variables maintained?

- Provide an update to Dick Wobus’ list of new variables

- Carefully prioritize the list of requested variables

NAEFS parameters

Component	Description of issue	Comments	Recommendation	Date last update	Status	Author
Full set of NAEFS parameters	FNMOC missing full set of NAEFS variables	Will FNMOC provide full set of NAEFS parameters?			Open	
Soil parameters	Is more clarification required to ensure variables are consistent between centers?					
Flux variables	CMC shares cumulative from 00hr NCEP shares 6hourly average FNMOC shares some instant fluxes, not necessarily the same as CMC and NCEP, Also, not all fluxes available yet from FNMOC					
Model topography		Shared at fhr=000. NCEP also provides at fhr=204	Users must be aware of this information			

Component	Description of issue	Comments	Recommendation	Date last update	Status	Author
Total cloud	NCEP shares 6hr average CMC and FNMOC share instant value of total cloud		NAEFS partners should share 6hr average, or the average for the NAEFS interval used in the data sharing			
Cape/Cinh		Do we need more detailed documentation of CAPE and CINH to ensure we are sharing similar enough variables?				
Total Precipitation	CMC shares cumulative, Others share 6hr interval amounts	Options allowed? Cumulative or amounts by interval of the data	Has been working well so far			
Precipitation by type		CMC shares cumulative precipitation types FNMOC shares 6hourly precipitation types NCEP only shares categorical precipitation type	Clarification if/when all centers can share accumulations of precipitation by type			

NAEFS operational parameters

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

- If possible, start from list of parameters from 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, this helps establish new procedures as we move to operations. Datasets and grids can be fine tuned later

Comments

Required?

Recommendations:

Component	Description of issue	Comments	Recommendation	Date last update	Status	Author
GRIB2 file sizes		Should max file sizes be required in order to optimize the exchange?				
GRIB2 encoding differences	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?				

Component	Description of issue	Comments	Recommendation	Date last update	Status	Author
GRIB2 documentation for NAEFS	Should NAEFS provide grib2 documentation to assist partners in the encoding of naefs variables in grib2? See info in http://collaboration.cmc.ec.gc.ca/cmc/cmoi/product_guide/docs/naefs/NAEFS_Overview.xls					
Share and test new grib2 prior to going operational	When adding variables or bringing grib2 files to operations Users should share samples of grib2 files in advance helps debug problems prior to going operational					

QC on GRIB2 data from all centers

Component	Description of issue	Comments	Recommendation	Date last update	Status	Author
Proactive QC on GRIB2 datasets	Users should ensure they use rigorous validation techniques for inspecting and QC on own center and other center datasets	Ex: check for -# records - range of values by record -Alert generating center when there is a problem		2012-05-03		

Meta info of public NAEFS datasets

Component	Description of issue	Comments	Recommendation	Date last update	Status	Author
Sharing CMC NAEFS data	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?	Meta information should eventually be corrected			

NAEFS GRIB2 data access issue

How to manage real time corrections to grib2 data

Recommended:

- Consider asking users of grib2 data for contact information so that a distribution list is available via which information to users can be easily sent or provided
- Consider having mechanics for parallel data feed that could be easily activated when corrections or parallel runs are require
- Ensure appropriate user notes are posted data access sites

- Background:
- CMC had to correct encoding of ice pellets and freezing rain parameters in their grib2 file yet this had to be carefully coordinated with NCEP to not impact its potentially many downstream users

NAEFS Bias Correction of parameters

- Not all parameters are bias corrected.
- Should we develop a priority list for these?

Comments

Required?

Recommendations

NAEFS exchange – Adding QC to monitor data

Strongly recommended - Adding enhanced quality control components

- Ex: to detect in real time possible problems with the data
- 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

Comments

Required?

Recommendations

Concerning NAEFS product generation

- Develop NAEFS strategy for [late,missing] member data
  - Late or missing data does not happen frequently
  - 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?

Comments

Required?

Recommendations

Managing increasing volumes of NAEFS grib2

- How are we going to handle increasing GB of data?
- Spread out the distribution of the grib2 so large files not necessarily distributed at the same time
- Should we redefine the NAEFS datasets?
  - Ex: main dataset could be ex: day 1-[8,10,??]
  - Then move the day [9,11,??+1] into the long range global ensemble NAEFS dataset?
  - Or do we make 4 x 10-day (40 days) datasets with different priorities of transmission?
- Other considerations?

Managing increasing volumes of NAEFS grib2

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Issues not yet resolved that require further clarification
NAEFS Bias Correction Products

- Bias corrected products

- CMC:
- Week2 map is presently only bias corrected product produced by CMC. CMC does not yet make available its bias corrected grib2

- NCEP
- makes available all NAEFS raw and bias corrected grib2 on NOMADS
- NCEP may also make available other bias corrected products

Comments
- Do we need criteria for when bias corrected products should or must be made available by each or all centers?

Required

Recommendations

Issues not yet resolved that require further clarification
Short Range Ensemble discussion

Description of issue	Comments	Recommendation	Date of last update	Status	Author
Should all centers share same run times? Or can staggered runs be handled	If possible avoid having global and regional eps datasets compete with each other				
Exchange grid	Do we exchange on original grid? Rotated lat long?	Full global lat long grid at 15 km resolution with a bitmap to map out grid points that are not on the short range ensemble grid Tests to be undertaken			
Variables for Short Range Ensemble exchange	Easier if we start from NAEFS variables list Likely need for new variables but this will have to be planned out carefully				

Challenge of NAEFS verification

- It is very challenging to verify multi-center models while centers are making ongoing changes, and datasets are not necessarily unified

- Careful planning required to ensure ongoing verification efforts can be more easily sustained and extended.

Issues not yet resolved that require further clarification NAEFS and its support for Thorpex, GIFS, WIS

- When making decisions regarding changes to NAEFS, carefully consider if/how NAEFS activities can best support:
  - Thorpex
  - GIFS
  - WIS
- Should NAEFS try and test-drive in the operational exchange, some of the science and verification activities that are promoted by Thorpex, GIFS and WIS?
- CMC has offered assistance to deliver NAEFS and NCEP verification data as part of the WIS verficiation activities – this area requires more clarification and confirmation

Appendix 1
Details of NAEFS parameters

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	FNMOC Raw BC
Surface model topography	HGT	Model topography	CMC and FNMOC 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

Column parameters

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	FNMOC Raw Bc
Total Precipitation	APCP	Surface	NCEP per 6 hr interval CMC cumulative from 000hr FNMOC 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	FNMOC 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 FNMOC per 6 hour interval	Raw n/a	n/a n/a	Raw n/a
Ice Pellets	WEAPE	Surface	CMC cumulative from 00hr FNMOC per 6 hour interval	Raw n/a	n/a n/a	Raw n/a
Freezing Rain	WEAFR	Surface	CMC cumulative from 00hr FNMOC 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 - Bourgouin, 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

FNMOC - For information on method used by FNMOC 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	FNMOC Raw Bc
Latent heat flux	LHTFL	Surface	NCEP 6hr average CMC cumulative from 00hr *FNMOC Net Instantaneous*	Raw n/a	Raw n/a	Raw n/a
Sensible heat flux	SHTFL	Surface	NCEP 6hr average CMC cumulative from 00hr *FNMOC: Net Instantaneous*	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
Net long wave top of atmosphere *(coded as Net but actually outgoing)*		*Nominal Top Atmosphere*	*FNMOC Net Instantaneous*			*Raw* *n/a*

Raw = Direct model data
BC = Bias Corrected model data

Appendix 2
GRIB2 encoding
NAEFS parameters

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	8			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 topography**	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 - Bourgouin, 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?

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** **FNMOC**
SMOIST	**0-10 cm below ground**	2	0	192			106 106 n/a	106	**CMC** **NCEP** **FNMOC**
WEASD	**Surface**	0	1	13			1 1 n/a		**CMC** **NCEP** **FNMOC**
SNOD	**Surface**	0	1	11			1 1 n/a		**CMC** **NCEP** **FNMOC**

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 0	0 0 0	10 10 10	1 - -	11 - -	1 1 1		**CMC** **NCEP** **FNMOC**
SHTFL	**Surface**	0 0 0	0 0 0	11 11 11	1 - -	11 - -	1 1 1		**CMC** **NCEP** **FNMOC**
DSWRF	**Surface**	0 0 x	4 4 x	192 192 x	1 - x	11 - x	1 1 x		**CMC** **NCEP** **FNMOC**
DLWRF	**Surface**	0 0 x	5 5 x	192 192 x	1 - x	11 - x	1 1 x		**CMC** **NCEP** **FNMOC**
OLR	**Nominal Top of Atmosphere**	0 0 0	5 5 5	193 193 5	1 - -	11 - -	8 8 8		**CMC** **NCEP** **FNMOC**
USWRF	**Surface**	0 0 x	4 4 x	193 193 x	- - x	11 - x	1 1 x		**CMC** **NCEP** **FNMOC**
ULWRF	**Surface**	0 0 x	5 5 x	193 193 x	- - x	11 - x	1 1 x		**CMC** **NCEP** **FNMOC**