



# NOAA's National Weather Service (NWS) + Open Data Dissemination (NODD) + Google Cloud Environmental Data Office Hours



**August 16, 2023 | 12-1PM EDT | [REGISTER HERE](#)**

- ❖ Share experiences on use and access of Global Ensemble Forecast System (GEFS) via Google Cloud
- ❖ Hear about data access via NOAA Open Data Dissemination (NODD)
- ❖ Connect with NOAA scientists, data leads, and data users



Adler Santos,  
Engineering Lead,  
Google Cloud  
Datasets



Adrienne Simonson,  
Patrick Keown, Jenny  
Dissen, Kate Szura,  
(NODD)



Cindy Elsenheimer,  
Partnership Engagement  
Lead, NOAA NWS Office  
of Organizational  
Excellence



Yuejian Zhu  
Senior Meteorologist,  
NOAA National Weather  
Service NCEP



Dr. Neil Barton  
Physical Scientist,  
NOAA National  
Weather Service NCEP

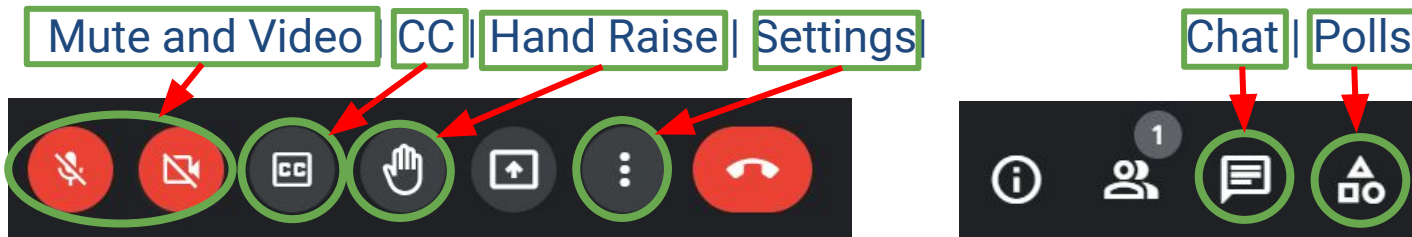


Dr. Bing Fu  
Physical Scientist,  
NOAA National  
Weather Service  
NCEP

# GoogleMeet Webinar Logistics

## How to join the discussion!

- Keep yourself muted throughout (for call-in participants: to mute and unmute use \*6) and videos off
- Raise your hand if you have a question and we'll respond in the order of the queue
- The following features of google meet:



- This webinar will NOT be recorded.
- You can also join by phone line only if you are having connectivity issues.
- (US) +1 508-687-4473 PIN: 297 789 966#

# Guidelines for Discussion

- Keep it brief
- Keep it respectful
- Use the chat function for links, references and/or resources
- Submit questions through the chat function or raise your hand
- Identify who the question is directed to where possible



# Quick Google Poll

## POLL1

- How do you access GEFS data today?
  - On-prem via NOAA
  - Cloud
  - Both/Either
  - 3rd party/Web-based Viewer
  - None/Other

## POLL2

- My primary goal for attending today is:
  - Technical use and access of GEFS data
  - To learn about cloud access to data (e.g. NODD Program)
  - Meet and engage with NOAA staff scientists
  - Learn about Google Cloud access and tools





**NATIONAL  
WEATHER  
SERVICE**

# NOAA Global Ensemble Forecast System (GEFS)

Yuejian Zhu, Bing Fu and Neil Barton

NWS/NCEP/EMC

For NWS NODD Office hour  
August 16 2023



# 1). Introduce of Ensembles



# Description of the Ensemble Forecast System

Each ensemble member evolution is given by integrating the following equation

$$e_j(T) = e_0(0) + \underbrace{de_j(0)}_{\text{Initial uncertainty}} + \int_{t=0}^T \underbrace{[P_j(e_j, t) + dP_j(e_j, t) + A_j(e_j, t)]}_{\text{Model uncertainty}} dt$$

where  $e_j(0)$  is the initial condition,  $P_j(e_j, t)$  represents the model tendency component due to parameterized physical processes (model uncertainty),  $dP_j(e_j, t)$  represents random model errors (e.g. due to parameterized physical processes or sub-grid scale processes – stochastic perturbation) and  $A_j(e_j, t)$  is the remaining tendency component (different physical parameterization or multi-model).

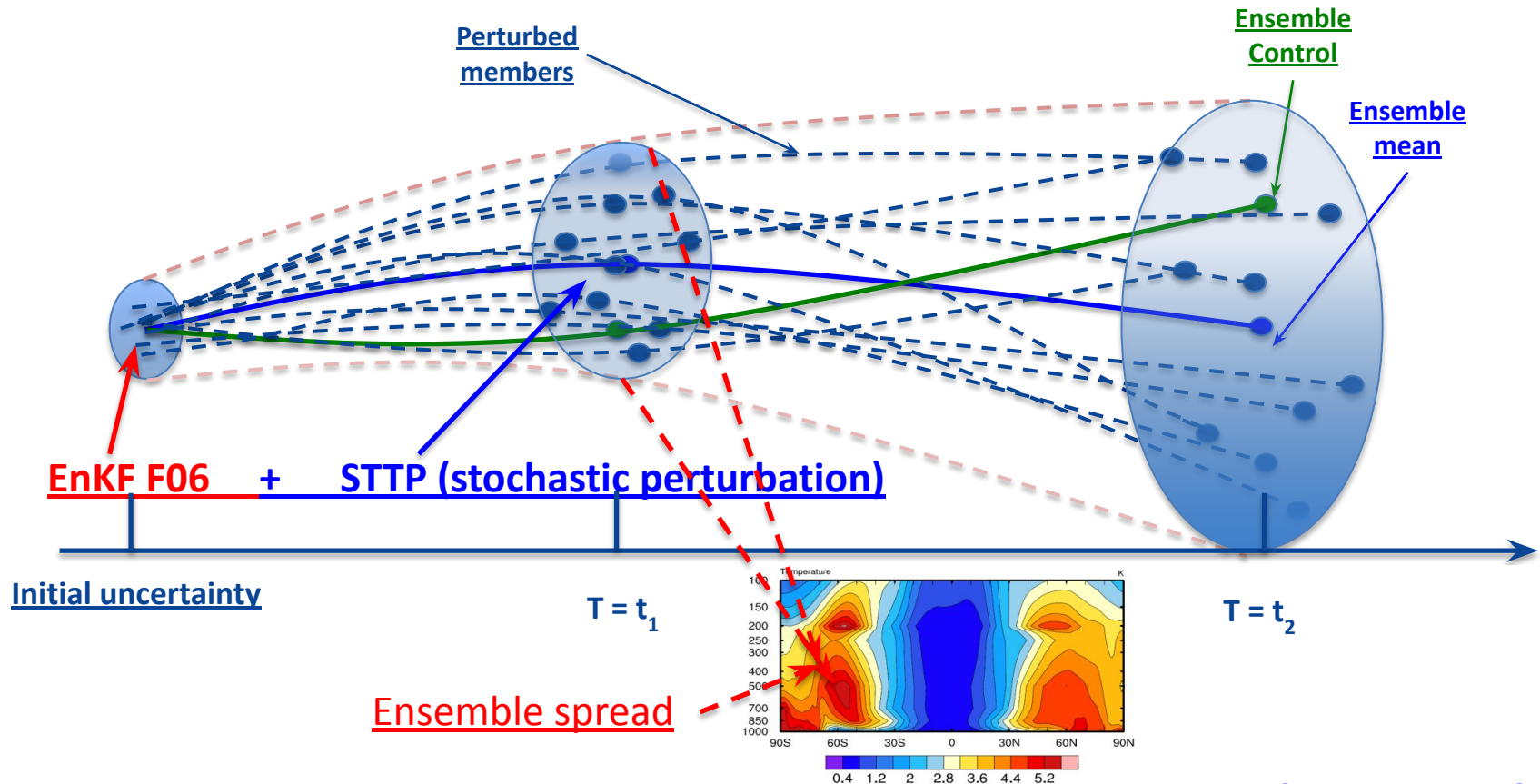
Reference: - [first global ensemble review paper](#)

Buizza, R., P. L. Houtekamer, Z. Toth, G. Pellerin, M. Wei, Y. Zhu, 2005:

"A Comparison of the ECMWF, MSC, and NCEP Global Ensemble Prediction Systems" *Monthly Weather Review*, Vol. 133, 1076-1097

**In Operations: ECMWF-1992; NCEP-1992; MSC-1998**

# Schematic diagram of ensemble forecast



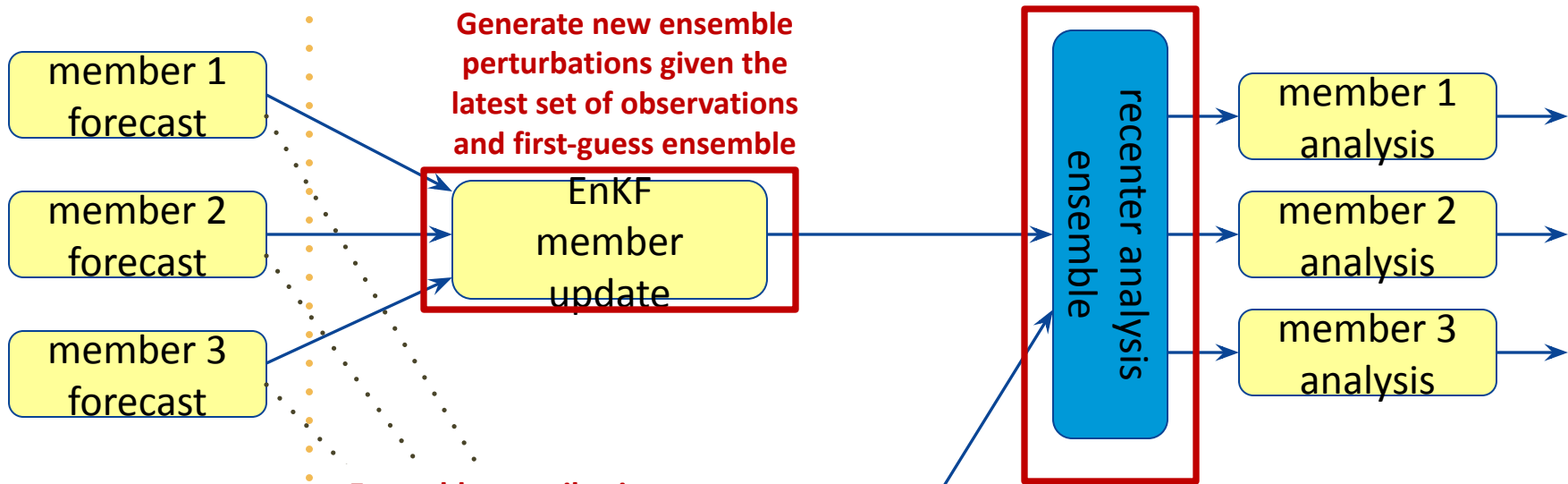


## 2). Operational GEFS

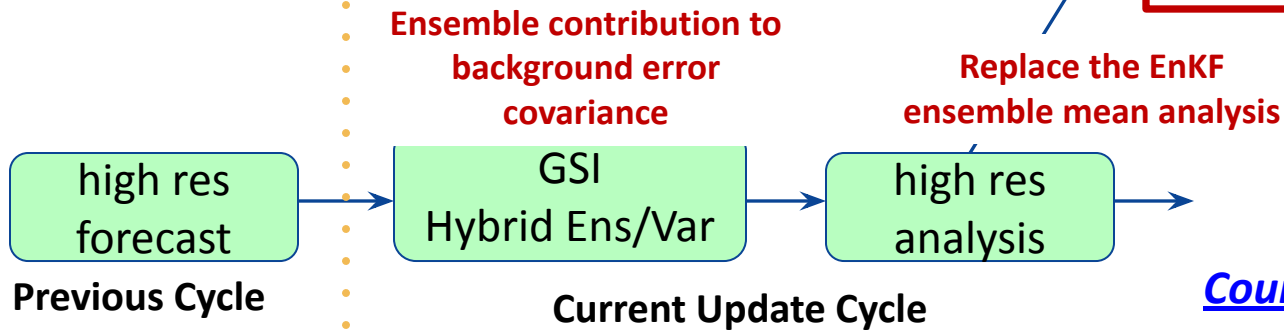


# NCEP Dual-Res Coupled Hybrid DA System

C384L127



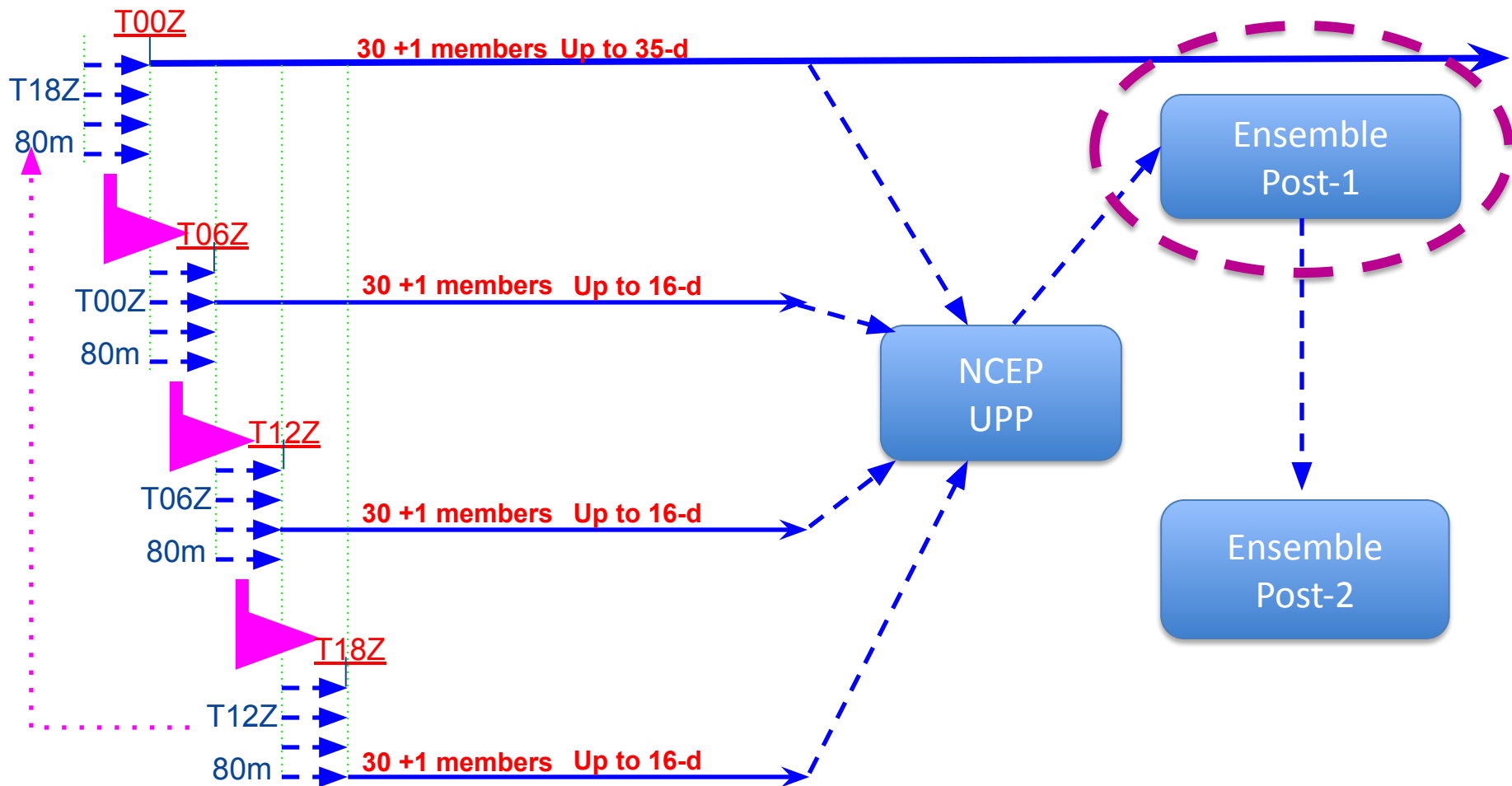
C768L27



*Courtesy of Daryl Kleist*



# EnKF and GEFS at 6 hours cycling



# Evolution of NCEP GEFS configuration (versions)

Version	Implementation	Initial uncertainty	TS relocation	Model uncertainty	Resolution	Forecast length	Ensemble members	Daily frequency
V1.0	1992.12	BV	None	None	T62L18	12	2	00UTC
V2.0	1994.3				T62L18	10(00UTC) 4(12UTC)	16	00,12UTC
V3.0	2000.6				T126L28(0-2.5) T62L28(2.5-15)			
V4.0	2001.1				T116L3(0-3.5) T62L28(3.5-16)			
V5.0	2004.3				T126L28(0-7.5) T62L28(7.5-16)			
V6.0	2005.8				14			
V7.0	2006.5					T126L28		
V8.0	2007.3					20		
V9.0	2010.2				T190L28			
V10.0	2012.2				T254L42 (0-8) T190L42 (8-16)			
V11.0	2015.12	EnKF (f06)	TSR	STTP	TL574L64 (0-8) TL382L64 (8-16)	35 (00UTC) 16 (others)		
V12.0	2020.9				N/A		SPPT/SKEB	C384L64

Ensemble Evolution!!!

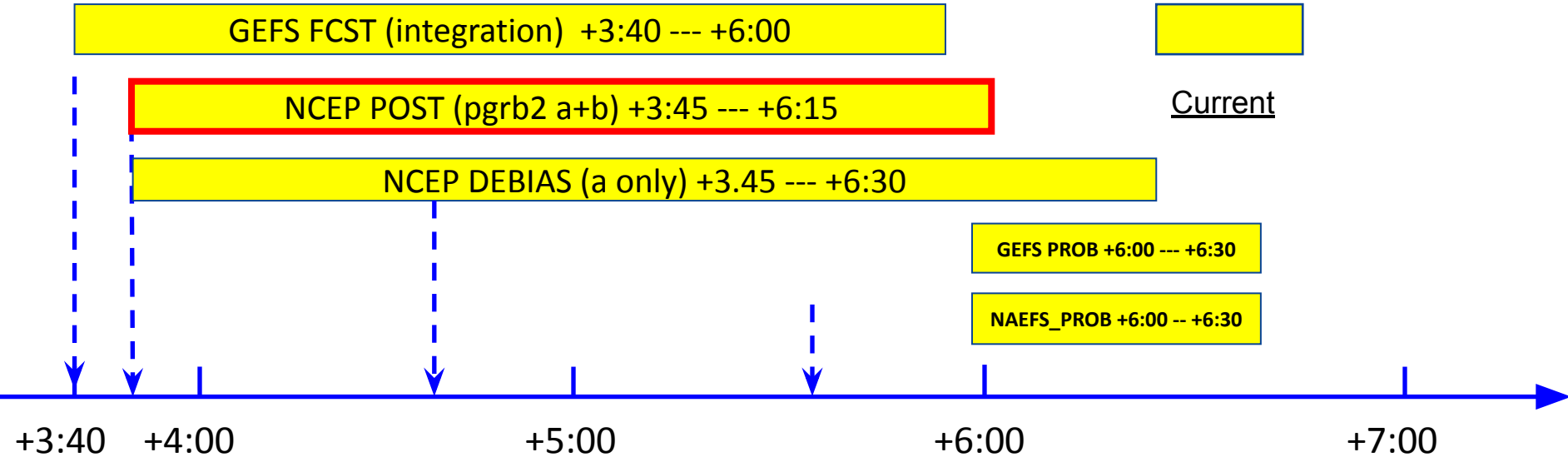
# Useful References

- [Toth, Z. and E. Kalnay, 1993: \*Ensemble Forecasting at NMC: The Generation of Perturbations\*. Bull. Amer. Meteor. Soc., 74, 2317–2330](#)
- [Toth, Z., and E. Kalnay, 1997: \*Ensemble forecasting at NCEP and the breeding method\*. Mon. Wea. Rev., 127, 3297-3318.](#)
- [Zhu, Y., Z. Toth, R. Wobus, D. Richardson, and K. Mylne 2002: \*On the Economic Value of Ensemble Based Weather Forecasts\*, Bull. Amer. Meteor. Soc., Vol. 83, 73-83](#)
- [Toth, Z., Y. Zhu and T. Marchok, 2001: \*The Use of Ensembles to Identify Forecasts with Small and Large Uncertainty\*, Wea. Forecasting, Vol. 16, 436-477](#)
- [Wei, M., Z. Toth, R. Wobus, and Y. Zhu, 2008: \*Initial Perturbations Based on the Ensemble Transform \(ET\) Technique in the NCEP Global Operational Forecast System\* Tellus 59A, 62-79](#)
- [Zhou, X. Y. Zhu, D. Hou, and D. Kleist 2016: \*Comparison of the Ensemble Transform and the Ensemble Kalman Filter in the NCEP Global Ensemble Forecast System\*. Wea. Forecasting, Vol. 31, 2058-2074](#)
- [Zhou, X. Y. Zhu, D. Hou, Y. Luo, J. Peng and D. Wobus, 2017: \*The NCEP Global Ensemble Forecast System with the EnKF Initialization\*. Wea. Forecasting, Vol. 32, 1989-2004](#)
- [Zhou, X. and co-authors, 2022: \*The Development of the NCEP Global Ensemble Forecast System Version 12\*. Wea. Forecasting, Vol. 37, 1069-1084](#)



# 3). GEFS data process

# GEFS 6-hr window data flow chart (timeline)



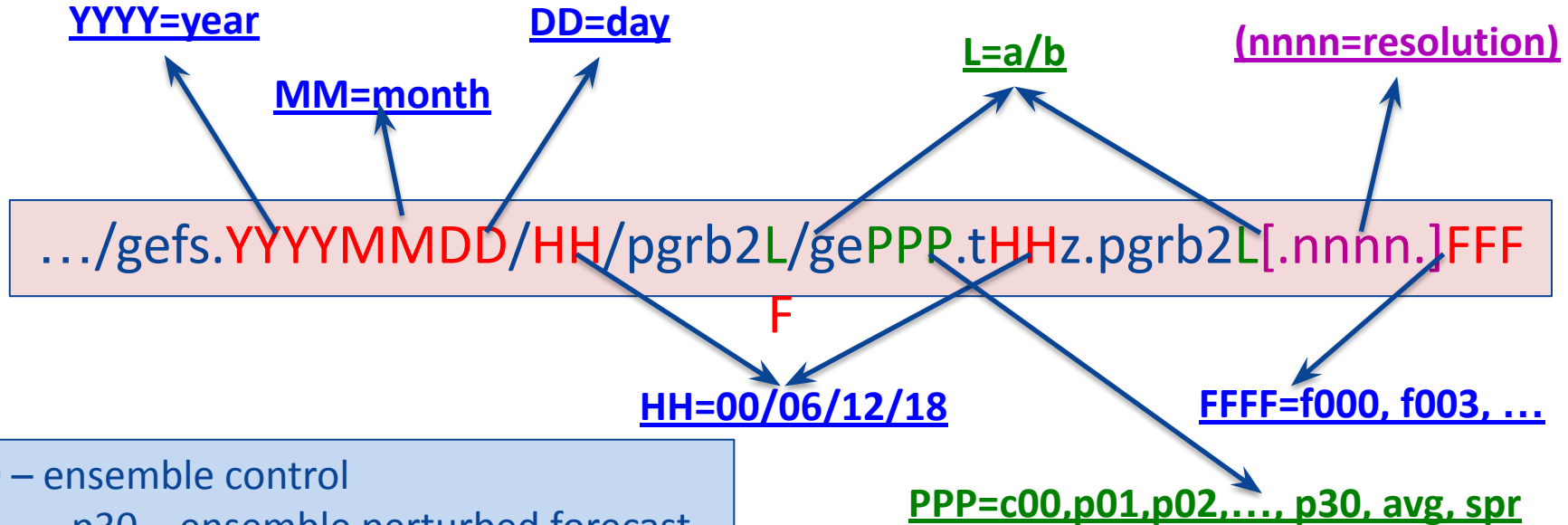
+3:40 (hours)  
GEFS starting integration

## NCEP POST products:

- pgrb2a (71/85) + pgrb2b (505) variables
  - At 0.5d or 1.0d resolution
- Pgrb2sp25 (selected 34 variables at 25km resolution)
- Every 3h/6h (out to 240 hours), then 6h out to 16/35 days



# How to pick up right data for you?



c00 – ensemble control  
p01,...,p30 – ensemble perturbed forecast  
avg – ensemble mean  
spr – ensemble spread

pgrb2a - includes most commonly used variables/levels  
pgrb2b - extended set of variables/levels not included in pgrb2a (much larger files)





# Data Change Notices

- **All changes are announced ahead of time via Service Change Notice (SCN)**
  - Web link at <https://www.weather.gov/notification/>
  - Email list subscription available
  - All data changes listed in detail within the SCN
  - At least 45 days notice prior to any change or deletion to existing data
  - At least 30 days of real-time “parallel” data with the changes to allow users to prepare
  - Prior to 2017, data changes were announced via Technical Implementation Notice (TIN), which contained much the same information
- **Information collection on data service**
  - Many open channels to collect information
  - Ensemble users workshop (every other year)
- **NWS HQ (OSTI) – issue changes officially**
- **NCO email: [ncep.list.pmb-dataflow@noaa.gov](mailto:ncep.list.pmb-dataflow@noaa.gov)**
  - NCEP Central Operations (NCO) maintains model data for public access
  - Technical support for missing data, delay, et al.
- **EMC contact – Yuejian Zhu and Bing Fu, email: [Yuejian.Zhu@noaa.gov](mailto:Yuejian.Zhu@noaa.gov) and [Bing.Fu@noaa.gov](mailto:Bing.Fu@noaa.gov)**
  - Environmental Modeling Center for ensemble system development
  - Scientific support and development of ensemble products



# Service Change Notice 20-75 (SCN)

NOUS41 KWBC 201455, PNSWSH

Service Change Notice 20-75

National Weather Service Headquarters Silver Spring MD

1055 AM EDT Thu Aug 20 2020

To: Subscribers:

- Family of Services
- NOAA Weather Wire Service
- Emergency Managers Weather Information Network
- NOAAPort

Other NWS Partners, Users and Employees

From: Brian Gross, Acting Director

National Centers for Environmental Prediction

Subject: Announcement of Upgrade to the Global Ensemble Forecast System (GEFS), Coupled with the Global Wave Ensemble System (GWES) and the NEMS GFS Aerosol Component (NGAC): Effective September 23, 2020, and Request for Comments Effective on or about Wednesday, September 23, 2020, beginning with the 1200 Coordinated Universal Time (UTC) run, the NCEP Global Ensemble Forecast System (GEFS) will be updated from Version 11.3 to Version 12.0. The GEFSv12 upgrade includes implementation of Finite Volume Cubed Sphere (FV3) dynamical core and integration of wave (GWESv3.0.9) and aerosol (NGACv2.5.1) components via coupling following the Unified Forecast System (UFS) framework.

Specifics are below, and additional science and technical information can

be obtained from the Public Information Statement 20-07 released on March 4, 2020:

[https://www.weather.gov/media/notification/pdf2/scn20-07gefs\\_nbm\\_qpf.pdf](https://www.weather.gov/media/notification/pdf2/scn20-07gefs_nbm_qpf.pdf)



# Useful documentations

## NCEP Products Inventory:

GEFS - <http://www.nco.ncep.noaa.gov/pmb/products/gens/>

- 22 products (categories) has been listed
- Definitions of file names (GRIB2 definition)
- Availability for public access (ftp and http)

## Full description of "a" variables:

GEFS - <http://www.nco.ncep.noaa.gov/pmb/products/gens/gec00.t12z.pgrb2af06.shtml>

- grib2 format, resolution, initial/valid time
- definition for each output variables
- instantaneous, accumulation, period average, unit and et al.

## Full description of "b" variables:

GEFS - <http://www.nco.ncep.noaa.gov/pmb/products/gens/gec00.t12z.pgrb2bf06.shtml>

- grib2 format
- include all available variables except "a" file



# NCEP GEFS exchange Variables (pgrb2a)

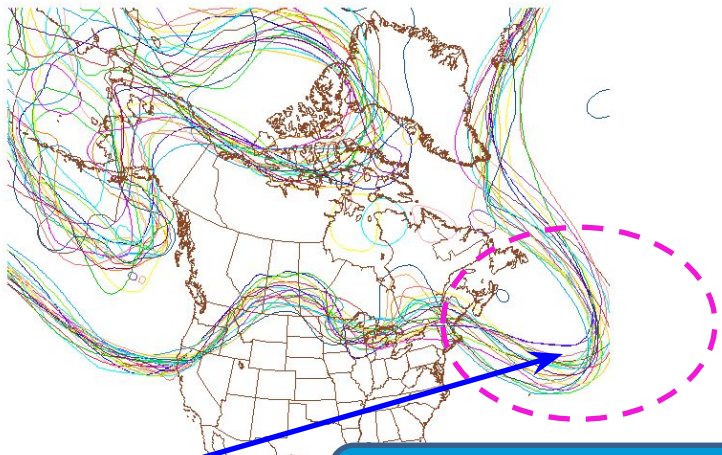
Variables	Levels and Categories	Total 86
GHT	Surface, 10, 50, 100, 200, 250, 300, 500, 700, 850, 925, 1000 hPa	12
TMP	2m, 2mMax, 2mMin, 10, 50, 100, 200, 250, 500, 700, 850, 925, 1000 hPa	13
RH	2m, 10, 50, 100, 200, 250, 500, 700, 850, 925, 1000 hPa	11
UGRD	10m, 10, 50, 100, 200, 250, 300, 400, 500, 700, 850, 925, 1000 hPa	13
VGRD	10m, 10, 50, 100, 200, 250, 300, 400, 500, 700, 850, 925, 1000 hPa	13
PRES	Surface, PRMSL	2
PRCP	APCP, CRAIN, CSNOW, CFRZR, CICEP	5
FLUX (surface)	LHTFL, SHTFL, DSWRF, DLWRF, USWRF, ULWRF	6
FLUX (top)	ULWRF (OLR)	1
PWAT	Total precipitable water at atmospheric column	1
TCDC	Total cloud cover at atmospheric column	1
CAPE	Convective available potential energy, Convective Inhibition	2
SOIL/SNOW	SOILW(0-10cm) , TMP(0-10cm down), WEASD(water equiv. of accum. Snow depth), SNOD(surface)	4
Other	850 hPa vertical velocity, Ice thickness (ICETK)	2
Notes	Last implementation for 0.5d data exchange – August 17 2018	



# 4). GEFS applications

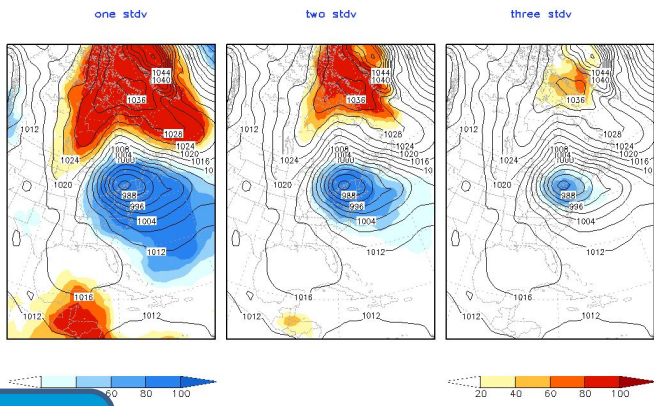


- Legend
- GEFS P01
- GEFS P02
- GEFS P03
- GEFS P04
- GEFS P05
- GEFS P06
- GEFS P07
- GEFS P08
- GEFS P09
- GEFS P10
- GEFS P11
- GEFS P12
- GEFS P13
- GEFS P14
- GEFS P15
- GEFS P16
- GEFS P17
- GEFS P18
- GEFS P19



**Uncertainties & disagreements**

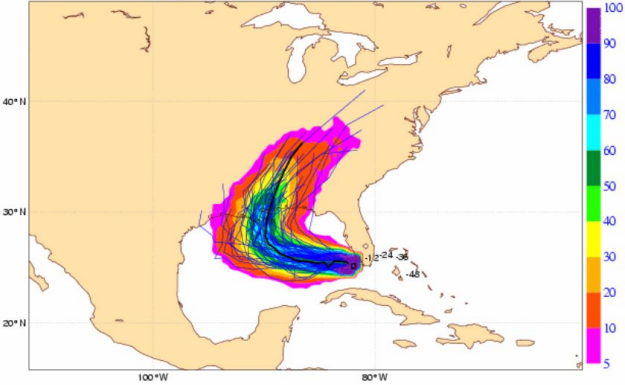
Ensemble forecast is widely used in daily weather forecast



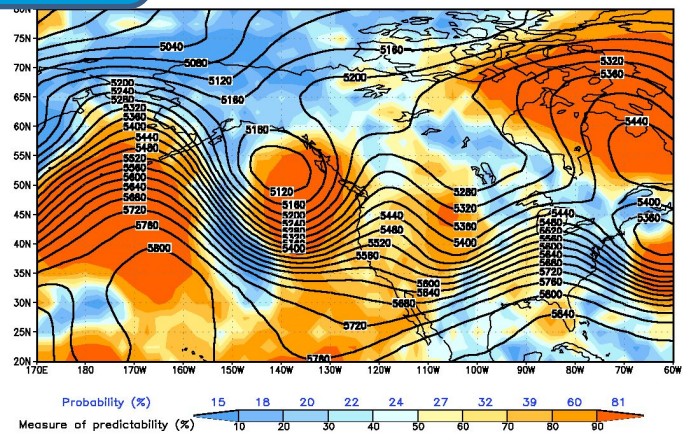
YUEJIAN ZHU, GCM/EMC/NCEP/NOAA

Relative measure of predictability (colors)  
 Contour-mean forecast (contours) of 500 hPa height  
 Time: 2012121500 valid: 2012122000 fcst: 120 hours

20050826 12 UTC  
 Probability that KATRINA will pass within 120km radius during the next 120 hours  
 tracks: black-OPER, green-CTRL, blue-EPS numbers: observed positions at t±.h



CONTOURS



YUEJIAN ZHU, GCM/EMC/NCEP/NOAA

# Characteristics of Ensemble Forecast

## 1. Ensemble Mean

*Each perturbed member is equal*

$$\bar{f}_i = \frac{1}{n} \sum_{j=1}^n f_{i,j}$$

## 2. RMS error of ensemble mean

$$RMS = \sqrt{\frac{1}{m} \sum_{i=1}^m (\bar{f}_i - a_i)^2}$$

## 3. Ensemble spread

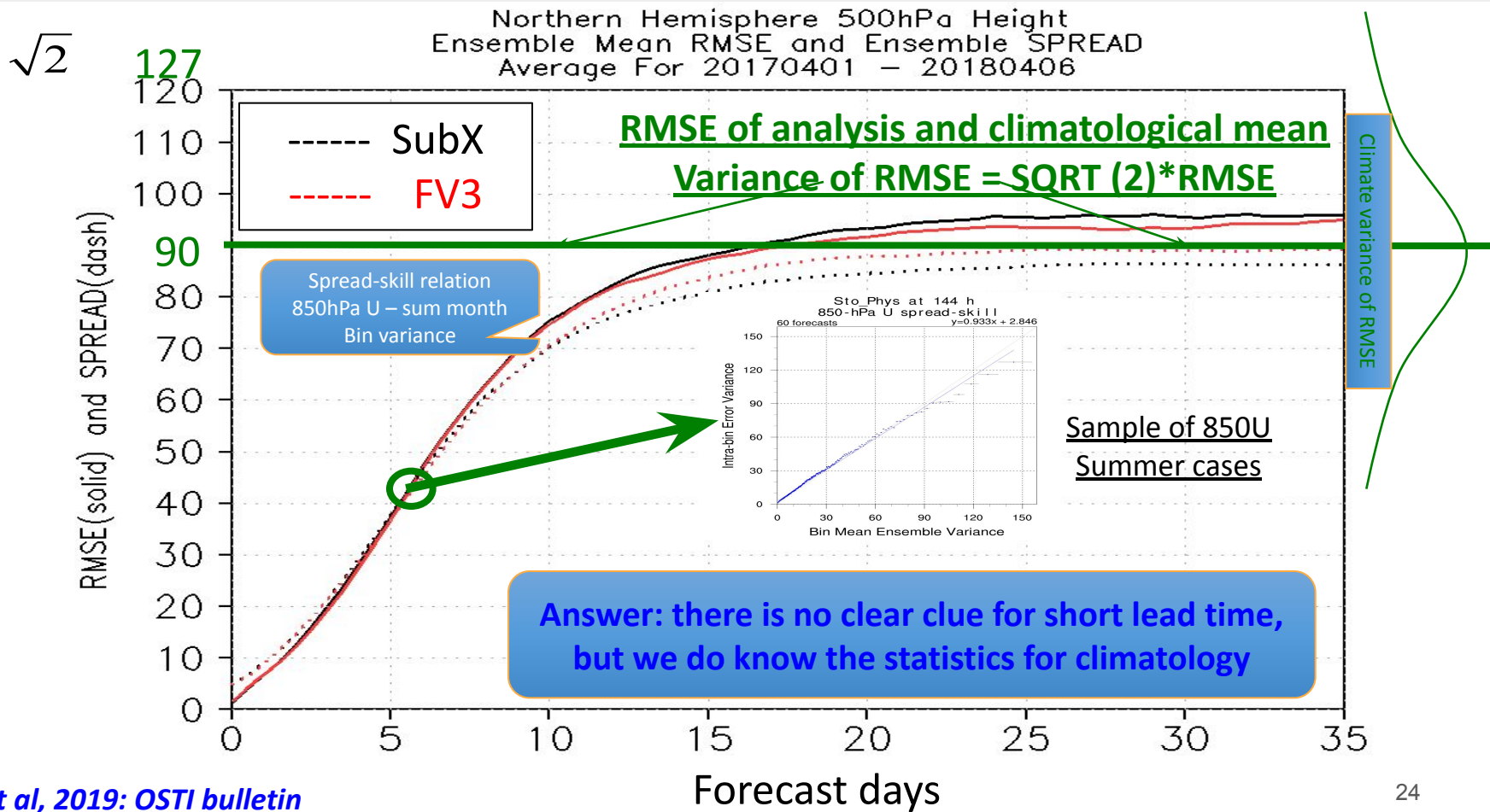
$$SPRD = \sqrt{\frac{1}{m} \sum_{i=1}^m \frac{1}{n-1} \sum_{j=1}^n (\bar{f}_i - f_{i,j})^2}$$

*Forecast uncertainty*

Where  $n$  is the total ensemble members (size) and  $m$  is the sample size to take average for RMS errors and ensemble spread

**SPRD** is similar to **standard deviation**, has the same unit as **RMS** error which measures ensemble's uncertainty.

# RMSE and Ensemble Spread of NH 500hPa height





# A few things are easy to be confused (?)

## Deterministic forecasts

High resolution – GFS (13km resolution) – “gegfs”

Low resolution – GEFS control (unperturbed) (25km resolution) – “gec00”

## Analysis

“ani” file contains all variables from our analysis system (and/or hybrid DA)

- Some variables (diagnostic) may not be in this file (e.g. precipitation)

“f000” is saving file after one-step model integration

- Most of the variables could be good as analysis reference

GFS analysis (early cycle)

- Analysis from earlier (cycle) run without hybrid DA
- Quality of analysis is not as good as final analysis
- Most model initial conditions are from this analysis

FNL analysis (GDAS)

- Final run (cycle) with hybrid DA (but, very late)
- Provide high quality background for next early run (cycle) analysis

## Ensemble forecasts and distributions

- There are 30 perturbed forecasts (“gep###”) for each runs, and 1 control forecast
- Ensemble mean (“geavg”) and spread (“gespr”) are generated using only perturbed members
- **All individual perturbed forecast is equal (weight) – no “best member” at all**



# A few variables to be discussed

## Precipitation

Period accumulation/average

- Total precipitation; Convective precipitation; Large scale precipitation
- Precipitation rate (PRATE) is convertible to/from total accumulated precipitation

Types

- Liquid; Frozen; Snow; Ice pellet
- Still use a “dominate type” of last integration step (will update this soon)

## Surface temperature (2-meter)

- Diagnostic variables
- Maximum/minimum (generated through each integration step)

## Surface winds (10-meter)

- Diagnostic variables
- Wind gust? – >duration for 20 seconds, but we can not offer this. Instead we use the maximum wind in the vertical (PBL), then interpolate to the 10 meter for (6) hourly output
- 



# 5). GEFS data access



# GEFS data in the GCP Marketplace

Google Cloud NOAA

Marketplace

Marketplace > "GEFS"

1 result

**NOAA Global Ensemble Forecast System (GEFS)**  
NOAA

The Global Ensemble Forecast System (GEFS) has been operational at NCEP since December 1992, with the initial version using the NCEP Global Spectral Model (GSM) at T62L18 resolution (about 200km in horizontal and 18 vertical sigma levels) and the initial condition perturbations (2 pairs perturbed and 1 control members) were generated by breeding vector (BV) method (Toth and Kalnay 1993; Toth and Kalnay 1997; Toth et ...

Filter Type to filter

Category

- Science & research (1)
- Climate (1)

Type

- Datasets (1)

Price

- Free (1)

<https://console.cloud.google.com/marketplace/product/noaa-public/gfs-ensemble-forecast-system>

**NOAA Global Ensemble Forecast System (GEFS)**  
NOAA

NOAA Global Ensemble Forecast System (GEFS) data

[VIEW DATASET](#)

OVERVIEW

### Overview

The Global Ensemble Forecast System (GEFS) has been operational at NCEP since December 1992, with the initial version using the NCEP Global Spectral Model (GSM) at T62L18 resolution (about 200km in horizontal and 18 vertical sigma levels) and the initial condition perturbations (2 pairs perturbed and 1 control members) were generated by breeding vector (BV) method (Toth and Kalnay 1993; Toth and Kalnay 1997; Toth et al. 1997; Toth et al. 2001; Zhu et al. 2002; Buizza et al. 2005; Zhu 2005). The GEFS ran once per day, out to 12 days in the early 90s. During the early 2000s, the 1st generation of GEFS reforecast (1979 - 2006) was produced off-line from using NCEP GFS/GEFS 1998 model version by NOAA PSL (Hamill et al. 2006) to demonstrate the improved ensemble reliability through bias correction and calibration.

Over the years, the GEFS has been upgraded. In early 2010, the GEFS was upgraded with enhanced representation of model uncertainty using the Stochastic Total Tendency Perturbation (STTP) algorithm (Hou et al., 2008). The stochastic tendency perturbations were updated every 6 hours. Meanwhile, the 2nd generation of NOAA GEFS reforecasts were produced off-line for 29 years (1985 - 2013) by NOAA PSL (Hamill et al. 2013, NOAA/PSL reforecast website) using GEFS v10 configurations and GFS reanalysis. Through another major upgrade in December 2015, the GEFS initial perturbations were chosen from the operational hybrid Global Data Assimilation System (GDAS) 80-member Ensemble Kalman Filter (ENKF; Whitaker et al., 2008) 6-h forecasts along with tropical storm relocation and centralization of the initial perturbations (Zhou et al. 2016; 2017). More information on GEFS can be found at [a link](#).

GEFS data can be found in the GEFS bucket:

- <gs://gcp-public-data-gfs-ensemble-forecast-system>

### Additional details

Type: [Datasets](#)

Category: [Science & research](#), [Climate](#)

Dataset source: [GEFS](#)

Cloud service: GCS

Expected update frequency: Real-time



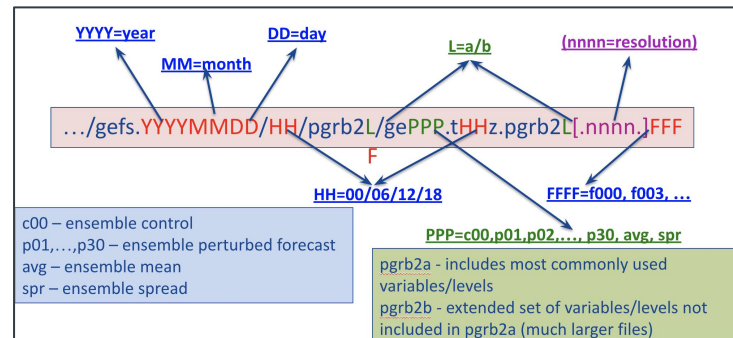
# Access GEFs data using a browser

1. The Google Cloud Storage bucket that stores the data is **gfs-ensemble-forecast-system**
2. Using a web browser, access the root of the bucket with the following URI\*  
<https://console.cloud.google.com/storage/browser/gfs-ensemble-forecast-system>
3. You can examine multiple levels of the bucket by appending the path to the URI above.

For example, to access the path **gfs.20230815/06/atmos/bufr**, use the URI

<https://console.cloud.google.com/storage/browser/gfs-ensemble-forecast-system/gfs.20230815/06/atmos/bufr>

\*You will be asked to sign in if you are not currently signed in



Google Cloud | Select a project | Search (/) for resources, docs, products, and more

Bucket details

gfs-ensemble-forecast-system

OBJECTS | CONFIGURATION | PERMISSIONS | PROTECTION | LIFECYCLE | OBSERVABILITY | INVENTORY REPORTS

Buckets > gfs-ensemble-forecast-system

UPLOAD FILES | UPLOAD FOLDER | CREATE FOLDER | TRANSFER DATA | MANAGE HOLDS | DOWNLOAD | DELETE

Filter by name prefix only | Filter | Filter objects and folders | Show deleted data

<input type="checkbox"/>	Name	Size	Type	Created	Storage class	Last modified	Public access	Version history	Encryption	Retention expiration date	Holds
<input type="checkbox"/>	gfs.20210101/	-	Folder	-	-	-	-	-	-	-	-
<input type="checkbox"/>	gfs.20210102/	-	Folder	-	-	-	-	-	-	-	-
<input type="checkbox"/>	gfs.20210103/	-	Folder	-	-	-	-	-	-	-	-
<input type="checkbox"/>	gfs.20210104/	-	Folder	-	-	-	-	-	-	-	-
<input type="checkbox"/>	gfs.20210105/	-	Folder	-	-	-	-	-	-	-	-
<input type="checkbox"/>	gfs.20210106/	-	Folder	-	-	-	-	-	-	-	-
<input type="checkbox"/>	gfs.20210107/	-	Folder	-	-	-	-	-	-	-	-
<input type="checkbox"/>	gfs.20210108/	-	Folder	-	-	-	-	-	-	-	-
<input type="checkbox"/>	gfs.20210109/	-	Folder	-	-	-	-	-	-	-	-
<input type="checkbox"/>	gfs.20210110/	-	Folder	-	-	-	-	-	-	-	-
<input type="checkbox"/>	gfs.20210111/	-	Folder	-	-	-	-	-	-	-	-
<input type="checkbox"/>	gfs.20210112/	-	Folder	-	-	-	-	-	-	-	-
<input type="checkbox"/>	gfs.20210113/	-	Folder	-	-	-	-	-	-	-	-
<input type="checkbox"/>	gfs.20210114/	-	Folder	-	-	-	-	-	-	-	-
<input type="checkbox"/>	gfs.20210115/	-	Folder	-	-	-	-	-	-	-	-
<input type="checkbox"/>	gfs.20210116/	-	Folder	-	-	-	-	-	-	-	-
<input type="checkbox"/>	gfs.20210117/	-	Folder	-	-	-	-	-	-	-	-

Google Cloud | Select a project | Search (/) for resources, docs, products, and more

Bucket details

gfs-ensemble-forecast-system

OBJECTS | CONFIGURATION | PERMISSIONS | PROTECTION | LIFECYCLE | OBSERVABILITY | INVENTORY REPORTS

Buckets > gfs-ensemble-forecast-system > gfs.20230815 > 06 > atmos > bufr

UPLOAD FILES | UPLOAD FOLDER | CREATE FOLDER | TRANSFER DATA | MANAGE HOLDS | DOWNLOAD | DELETE

Filter by name prefix only | Filter | Filter objects and folders | Show deleted data

<input type="checkbox"/>	Name	Size	Type	Created	Storage class	Last modified	Public
<input type="checkbox"/>	avg/	-	Folder	-	-	-	-
<input type="checkbox"/>	c00/	-	Folder	-	-	-	-
<input type="checkbox"/>	geavg.t06z.bufsnd.tar.gz	74.4 MB	binary/octet-stream	Aug 15, 2023, 4:07:34 AM	Standard	Aug 15, 2023, 4:07:34 AM	Value
<input type="checkbox"/>	gec00.t06z.bufsnd.tar.gz	76.4 MB	binary/octet-stream	Aug 15, 2023, 3:52:20 AM	Standard	Aug 15, 2023, 3:52:20 AM	Value
<input type="checkbox"/>	gep01.t06z.bufsnd.tar.gz	76.6 MB	binary/octet-stream	Aug 15, 2023, 4:05:08 AM	Standard	Aug 15, 2023, 4:05:08 AM	Value
<input type="checkbox"/>	gep02.t06z.bufsnd.tar.gz	76.7 MB	binary/octet-stream	Aug 15, 2023, 4:05:08 AM	Standard	Aug 15, 2023, 4:05:08 AM	Value
<input type="checkbox"/>	gep03.t06z.bufsnd.tar.gz	76.5 MB	binary/octet-stream	Aug 15, 2023, 4:05:09 AM	Standard	Aug 15, 2023, 4:05:09 AM	Value
<input type="checkbox"/>	gep04.t06z.bufsnd.tar.gz	76.7 MB	binary/octet-stream	Aug 15, 2023, 4:05:07 AM	Standard	Aug 15, 2023, 4:05:07 AM	Value
<input type="checkbox"/>	gep05.t06z.bufsnd.tar.gz	76.5 MB	binary/octet-stream	Aug 15, 2023, 4:05:07 AM	Standard	Aug 15, 2023, 4:05:07 AM	Value
<input type="checkbox"/>	gep06.t06z.bufsnd.tar.gz	76.7 MB	binary/octet-stream	Aug 15, 2023, 4:05:07 AM	Standard	Aug 15, 2023, 4:05:07 AM	Value

<https://console.cloud.google.com/storage/browser/gfs-ensemble-forecast-system>

# Access GEFs data using the command line

**gsutil** is a Python application that lets you access Cloud Storage buckets and contents from the command line.

To list objects from the root of the bucket:

```
$ gsutil ls gs://gfs-ensemble-forecast-system

gs://gfs-ensemble-forecast-system/gefs.20210101/
gs://gfs-ensemble-forecast-system/gefs.20210102/
gs://gfs-ensemble-forecast-system/gefs.20210103/
gs://gfs-ensemble-forecast-system/gefs.20210104/
gs://gfs-ensemble-forecast-system/gefs.20210105/
gs://gfs-ensemble-forecast-system/gefs.20210106/
gs://gfs-ensemble-forecast-system/gefs.20210107/
gs://gfs-ensemble-forecast-system/gefs.20210108/
...
```

Using **gcloud storage** has a similar effect:

```
$ gcloud storage ls gs://gfs-ensemble-forecast-system
```



# Access GEFS data using the command line

To copy an entire prefix (directory tree) and its contents to the current directory\*

```
$ gsutil -m cp gs://gfs-ensemble-forecast-system/gefs.20230812 .
```

\*The -m flag enables multiprocessing to parallelize object downloads. Note that data for a single date (i.e. a gefs.YYYYMMDD folder) is more than 100 GB in size.

Again, using gcloud storage has a similar effect (without the -m flag):

```
$ gcloud storage cp gs://gfs-ensemble-forecast-system/gefs.20230812 .
```

(For more info, see <https://cloud.google.com/sdk/gcloud/reference/storage>)





Google Cloud | Select a project | Search (/) for resources, docs, products, and more

Bucket details

gfs-ensemble-forecast-system

OBJECTS | CONFIGURATION | PERMISSIONS | PROTECTION | LIFECYCLE | OBSERVABILITY | INVENTORY REPORTS

Buckets > gfs-ensemble-forecast-system > gefs.20230801 > 00 > atmos > pgrb2ap5

UPLOAD FILES | UPLOAD FOLDER | CREATE FOLDER | TRANSFER DATA | MANAGE HOLDS | DOWNLOAD | DELETE

Filter by name prefix only | Filter | Filter objects and folders | Show deleted data

Name	Size	Type	Created	Storage class	Last modified	Public a
<a href="#">geavg.t00z.pgrb2a.0p50.f000</a>	13.5 MB	binary/octet-stream	Jul 31, 2023, 8:48:09 PM	Standard	Jul 31, 2023, 8:48:09 PM	Value h
<a href="#">geavg.t00z.pgrb2a.0p50.f000.idx</a>	3.5 KB	binary/octet-stream	Jul 31, 2023, 8:48:12 PM	Standard	Jul 31, 2023, 8:48:12 PM	Value h
<a href="#">geavg.t00z.pgrb2a.0p50.f003</a>	14.4 MB	binary/octet-stream	Jul 31, 2023, 8:49:28 PM	S		
<a href="#">geavg.t00z.pgrb2a.0p50.f003.idx</a>	5 KB	binary/octet-stream	Jul 31, 2023, 8:48:08 PM	S		
<a href="#">geavg.t00z.pgrb2a.0p50.f006</a>	13.8 MB	binary/octet-stream	Jul 31, 2023, 8:50:29 PM	S		
<a href="#">geavg.t00z.pgrb2a.0p50.f006.idx</a>	5 KB	binary/octet-stream	Jul 31, 2023, 8:50:22 PM	S		
<a href="#">geavg.t00z.pgrb2a.0p50.f009</a>	13.4 MB	binary/octet-stream	Jul 31, 2023, 8:51:29 PM	S		
<a href="#">geavg.t00z.pgrb2a.0p50.f009.idx</a>	5 KB	binary/octet-stream	Jul 31, 2023, 8:51:33 PM	S		
<a href="#">geavg.t00z.pgrb2a.0p50.f012</a>	12.9 MB	binary/octet-stream	Jul 31, 2023, 8:52:35 PM	S		
<a href="#">geavg.t00z.pgrb2a.0p50.f012.idx</a>	5.1 KB	binary/octet-stream	Jul 31, 2023, 8:52:39 PM	S		
<a href="#">geavg.t00z.pgrb2a.0p50.f015</a>	12.7 MB	binary/octet-stream	Jul 31, 2023, 8:54:53 PM	S		

Google Cloud | Select a project | Search (/) for resources, docs, products, ...

Object details

Buckets > gfs-ensemble-forecast-system > gefs.20230801 > 00 > atmos > pgrb2ap5 > geavg.t00z.pgrb2a.0p50.f009

LIVE OBJECT | VERSION HISTORY

DOWNLOAD | EDIT METADATA | EDIT ACCESS | DELETE

Overview

Type	binary/octet-stream
Size	13.4 MB
Created	Jul 31, 2023, 8:51:29 PM
Last modified	Jul 31, 2023, 8:51:29 PM
Storage class	Standard
Custom time	-
Public URL	<a href="https://storage.googleapis.com/gfs-ensemble-forecast-system/gefs.20230801/00/atmos/pgrb2ap5/geavg.t00z.pgrb2a.0p50.f009">https://storage.googleapis.com/gfs-ensemble-forecast-system/gefs.20230801/00/atmos/pgrb2ap5/geavg.t00z.pgrb2a.0p50.f009</a>
Authenticated URL	<a href="https://storage.mtls.cloud.google.com/gfs-ensemble-forecast-system/gefs.20230801/00/atmos/pgrb2ap5/geavg.t00z.pgrb2a.0p50.f009">https://storage.mtls.cloud.google.com/gfs-ensemble-forecast-system/gefs.20230801/00/atmos/pgrb2ap5/geavg.t00z.pgrb2a.0p50.f009</a>
gsutil URI	gs://gfs-ensemble-forecast-system/gefs.20230801/00/atmos/pgrb2ap5/geavg.t00z.pgrb2a.0p50.f009

<https://console.cloud.google.com/storage/browser/gfs-ensemble-forecast-system>

# Needs More Information?

- 9th NOAA Ensemble Users Workshop - [link](#)
  - Dates - August 22-24 2023
  - Location - [NCWCP](#) at College Park MD 20740
  - Format - hybrid

**Thanks for attention!**

**Questions?**



# Questions and Discussion

- Please be brief in your questions / comments
- Use the chat or raise your hand for questions
- Identify who the question is directed to where possible
  - As questions are answered, we will go to the next in the chat queue and call on you to unmute yourself and ask your question.
  - We appreciate there may be questions that cannot be answered immediately and even those that we won't have an opportunity to get to: please be patient as we build our understanding and summary responses.



# Resources

We invite you to stay engaged with NOAA!

- [NWS Office of Organizational Excellence](#)
  - Email: [cindy.elsenheimer@noaa.gov](mailto:cindy.elsenheimer@noaa.gov)
- [NOAA Open Data Dissemination](#)
  - Email: [NODD@NOAA.GOV](mailto:NODD@NOAA.GOV)

