Data User Guide

Global Forecast System (GFS) CPEX

Introduction

The Global Forecast System (GFS) CPEX dataset includes model data simulated by the Global Forecast System (GFS) model for the Convective Process Experiment (CPEX) field campaign. The NASA Convective Processes Experiment (CPEX) aircraft field campaign took place in the North Atlantic-Gulf of Mexico-Caribbean Sea region from 25 May-25 June 2017. CPEX conducted a total of sixteen DC-8 missions from 27 May-24 June. The CPEX campaign collected data to help explain convective storm initiation, organization, growth, and dissipation in the North Atlantic-Gulf of Mexico-Caribbean Oceanic region during the early summer of 2017. These data are available from May 24, 2017 through July 20, 2017 and are available in netCDF-3 format.

Citation

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Keywords:

NASA, GHRC, CPEX, GFS, numerical weather prediction, atmospheric precipitation

Campaign

The NASA Convective Processes Experiment (CPEX) aircraft field campaign took place in the North Atlantic-Gulf of Mexico-Caribbean Sea region from 25 May-25 June 2017. CPEX conducted a total of sixteen DC-8 missions from 27 May-24 June. The 16 missions covered a wide range of weather conditions from clear and calm wind, isolated convective cloud systems, to Tropical Storm Cindy (2017). It is the first field campaign that collected airborne observations continually from pre-tropical disturbance in the Caribbean Sea, to tropical depression, and formation of Tropical Storm Cindy in the Gulf of Mexico prior to landfall. The three main science objectives of CPEX were: 1) Improve understanding of convective processes including cloud dynamics, downdrafts, cold pools and thermodynamics during initiation, growth, and dissipation. 2) Obtain a comprehensive set of simultaneous wind, temperature, and moisture profiles, using Doppler wind lidar (DAWN), microwave radiometer and sounder (HAMSR/MASC), and GPS dropsondes, conduct a quantitative evaluation of those profiles in the vicinity of scattered and organized deep convection measured by airborne precipitation radar (APR2), in all phases of convective life cycle. 3) Improve model representation of convective and boundary layer processes over the tropical oceans using a cloud-resolving, fully coupled atmosphere-ocean model, and assimilate the wind, temperature and humidity profiles into the model. More information is available from NASA's Jet Propulsion Laboratory's CPEX field campaign webpage.

Figure 1: CPEX field campaign logo
(Image source: CPEX)

Model Description

The Global Forecast System (GFS) is a National Centers for Environmental Prediction (NCEP) weather forecast model that generates data for dozens of atmospheric and land-soil variables, including temperatures, winds, precipitation, soil moisture, and atmospheric ozone concentration. The system couples four separate models (atmosphere, ocean model, land/soil model, and sea ice) that work together to accurately depict weather conditions. The GFS is the cornerstone of NCEP's suite of numerical guidance, providing global atmospheric and wave predictions at 13 km resolution. The GFS is used for initial and/or boundary conditions for other NCEP production suite forecast systems for regional, ocean and wave prediction. The Global Data Assimilation System (GDAS), which runs a 4D hybrid ensemble-variational data assimilation scheme, produces initial conditions for the GFS forecast. The GFS is run four times a day, producing forecasts up to 16 days in advance. The forecast component uses the Finite Volume Cubed (FV3) model with a resolution of ~13 km, with the atmosphere coupled to the NCEP Global Wave Model. In the vertical, the model is divided into 127 vertical layers. It produces hourly forecast output for the first 120 hours, then 3 hourly for days 5-16. More information about The GFS model can be found at the NCEI NOAA GFS Model webpage.

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Data Characteristics

The Global Forecast System (GFS) CPEX dataset contains GFS forecast data simulated for the CPEX campaign. Ingests occur every 12 hours. These data are available at a Level 4 processing level. The characteristics of this dataset are listed in Table 1 below.

Table 1: Data Characteristics

Characteristic	Description
Platform	Global Forecast System (GFS)
Spatial Coverage	N: 40.0 , S: 5.0, E: -45.0, W: 100.0 (United States)
Spatial Resolution	28 km
Temporal Coverage	May 24, 2017 - July 20, 2017
Temporal Resolution	12 hours
Parameter	Atmosphere and surface variables at different heights (temperature, relative humidity, cloud mixing ratio, geopotential height, wind components, and vertical velocity)
Version	1
Processing Level	4

File Naming Convention

The Global Forecast System (GFS) CPEX dataset files are separated by forecast date and times. The files are stored in netCDF-3 format and named using the following convention:

Data files: cpex_gfs_YYYYMMDD00_<###>.nc

Table 2: File naming convention variables

Variable	Description
YYYY	Four-digit year
MM	Two-digit month
DD	Two-digit day
###	GFS ingest hour (000 - 120)
.nc	netCDF-3 format

Data Format and Parameters

The Global Forecast System (GFS) CPEX dataset files are separated by forecast date and time. This dataset contains atmospheric and surface variables at varying pressure level heights from the GFS model. Please refer to Table 3 for additional data field information.

Table 3: GFS netCDF-3 data fields

Variable	Description	Unit
lat	Latitude	degrees
lon	Longitude	degrees
PMSL	Mean sea level pressure	mb
TPW	Total predictable water	mm
CLWMR1000	Cloud mixing ratio at 1000 mb	kg/kg
CLWMR950	Cloud mixing ratio at 950 mb	kg/kg
CLWMR925	Cloud mixing ratio at 925 mb	kg/kg
CLWMR900	Cloud mixing ratio at 900 mb	kg/kg
CLWMR850	Cloud mixing ratio at 850 mb	kg/kg
CLWMR800	Cloud mixing ratio at 800 mb	kg/kg
CLWMR700	Cloud mixing ratio at 700 mb	kg/kg
CLWMR600	Cloud mixing ratio at 600 mb	kg/kg
CLWMR500	Cloud mixing ratio at 500 mb	kg/kg
CLWMR400	Cloud mixing ratio at 400 mb	kg/kg
CLWMR300	Cloud mixing ratio at 300 mb	kg/kg
CLWMR250	Cloud mixing ratio at 250 mb	kg/kg
CLWMR200	Cloud mixing ratio at 200 mb	kg/kg
CLWMR150	Cloud mixing ratio at 150 mb	kg/kg
CLWMR100	Cloud mixing ratio at 100 mb	kg/kg
HGHT1000	Geopotential height at 1000 mb	gpm
HGHT950	Geopotential height at 950 mb	gpm
HGHT925	Geopotential height at 925 mb	gpm
HGHT900	Geopotential height at 900 mb	gpm
HGHT850	Geopotential height at 850 mb	gpm
HGHT800	Geopotential height at 800 mb	gpm
HGHT700	Geopotential height at 700 mb	gpm
HGHT600	Geopotential height at 600 mb	gpm
HGHT500	Geopotential height at 500 mb	gpm

HGHT400	Geopotential height at 400 mb	gpm
HGHT300	Geopotential height at 300 mb	gpm
HGHT250	Geopotential height at 250 mb	gpm
HGHT200	Geopotential height at 200 mb	gpm
HGHT150	Geopotential height at 150 mb	gpm
HGHT100	Geopotential height at 100 mb	gpm
RH1000	Relative humidity at 1000 mb	kg/kg
RH950	Relative humidity at 950 mb	kg/kg
RH925	Relative humidity at 925 mb	kg/kg
RH900	Relative humidity at 900 mb	kg/kg
RH850	Relative humidity at 850 mb	kg/kg
RH800	Relative humidity at 800 mb	kg/kg
RH700	Relative humidity at 700 mb	kg/kg
RH600	Relative humidity at 600 mb	kg/kg
RH500	Relative humidity at 500 mb	kg/kg
RH400	Relative humidity at 400 mb	kg/kg
RH300	Relative humidity at 300 mb	kg/kg
RH250	Relative humidity at 250 mb	kg/kg
RH200	Relative humidity at 200 mb	kg/kg
RH150	Relative humidity at 150 mb	kg/kg
RH100	Relative humidity at 100 mb	kg/kg
T1000	Temperature at 1000 mb	C°
T950	Temperature at 950 mb	C°
T925	Temperature at 925 mb	C°
T900	Temperature at 900 mb	C°
T850	Temperature at 850 mb	C°
T800	Temperature at 800 mb	C°
T700	Temperature at 700 mb	C°
T600	Temperature at 600 mb	C°
T500	Temperature at 500 mb	C°
T400	Temperature at 400 mb	C°
T300	Temperature at 300 mb	C°
T250	Temperature at 250 mb	C°
T200	Temperature at 200 mb	C°
T150	Temperature at 150 mb	C°
T100	Temperature at 100 mb	C°
U1000	x-wind component at 1000 mb	m/s
U950	x-wind component at 950 mb	m/s
U925	x-wind component at 925 mb	m/s
U900	x-wind component at 900 mb	m/s
U850	x-wind component at 850 mb	m/s
U800	x-wind component at 800 mb	m/s
U700	x-wind component at 700 mb	m/s

U600	x-wind component at 600 mb	m/s
U500	x-wind component at 500 mb	m/s
U400	x-wind component at 400 mb	m/s
U300	x-wind component at 300 mb	m/s
U250	x-wind component at 250 mb	m/s
U200	x-wind component at 200 mb	m/s
U150	x-wind component at 150 mb	m/s
U100	x-wind component at 100 mb	m/s
V1000	y-wind component at 1000 mb	m/s
V950	y-wind component at 950 mb	m/s
V925	y-wind component at 925 mb	m/s
V900	y-wind component at 900 mb	m/s
V850	y-wind component at 850 mb	m/s
V800	y-wind component at 800 mb	m/s
V700	y-wind component at 700 mb	m/s
V600	y-wind component at 600 mb	m/s
V500	y-wind component at 500 mb	m/s
V400	y-wind component at 400 mb	m/s
V300	y-wind component at 300 mb	m/s
V250	y-wind component at 250 mb	m/s
V200	y-wind component at 200 mb	m/s
V150	y-wind component at 150 mb	m/s
V100	y-wind component at 100 mb	m/s
VVEL1000	Vertical velocity (pressure) at 1000 mb	Pa/s
VVEL950	Vertical velocity (pressure) at 950 mb	Pa/s
VVEL925	Vertical velocity (pressure) at 925 mb	Pa/s
VVEL900	Vertical velocity (pressure) at 900 mb	Pa/s
VVEL850	Vertical velocity (pressure) at 850 mb	Pa/s
VVEL800	Vertical velocity (pressure) at 800 mb	Pa/s
VVEL700	Vertical velocity (pressure) at 700 mb	Pa/s
VVEL600	Vertical velocity (pressure) at 600 mb	Pa/s
VVEL500	Vertical velocity (pressure) at 500 mb	Pa/s
VVEL400	Vertical velocity (pressure) at 400 mb	Pa/s
VVEL300	Vertical velocity (pressure) at 300 mb	Pa/s
VVEL250	Vertical velocity (pressure) at 250 mb	Pa/s
VVEL200	Vertical velocity (pressure) at 200 mb	Pa/s
VVEL150	Vertical velocity (pressure) at 150 mb	Pa/s
VVEL100	Vertical velocity (pressure) at 100 mb	Pa/s

Algorithm

The atmospheric forecast model used in the GFS is a global spectral model (GSM) with spherical harmonic basis functions. The semi-Lagrangian advection calculations as well as treatment of physics are done on a linear, reduced Gaussian grid in the horizontal domain. To improve the accuracy of associated Legendre function computation at higher wavenumbers, an extended-range arithmetic is used. More information can be found at the NOAA Virtual Lab GFS document.

Software

This dataset is in netCDF-3 format and does not require any specific software to read. However, the data are easily readable and viewed in Panoply.

Known Issues or Missing Data

There are no known issues with these data or any known gaps in the dataset.

References

NCEI NOAA Global Forecast System (GFS)
https://www.ncei.noaa.gov/products/weather-climate-models/global-forecast

NOAA Virtual Lab Global Forecast System - Global Spectral Model (GSM). 2016.
https://vlab.noaa.gov/web/gfs/documentation

Related Data

All other datasets collected as part of the CPEX campaign are considered related and can be located by searching the term "CPEX" in the Earthdata Search.

Contact Information

To order these data or for further information, please contact:

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