

# *The TIGGE Model Validation Portal: An Improvement in Data Interoperability*

Thomas Cram

Doug Schuster      Hannah Wilcox

Michael Burek      Eric Nienhouse

Steven Worley

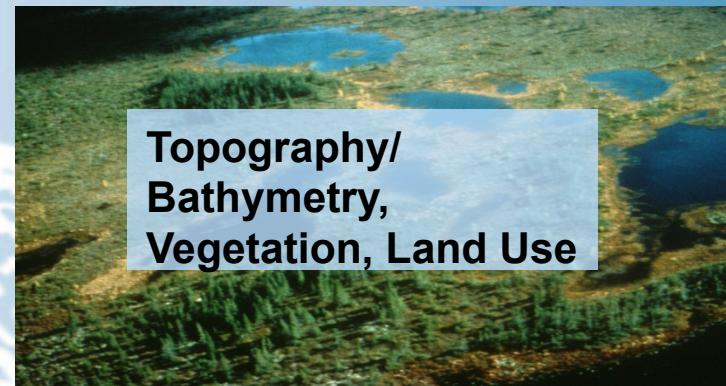
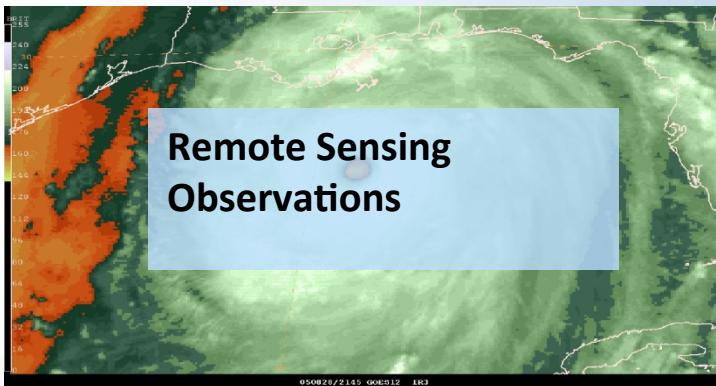
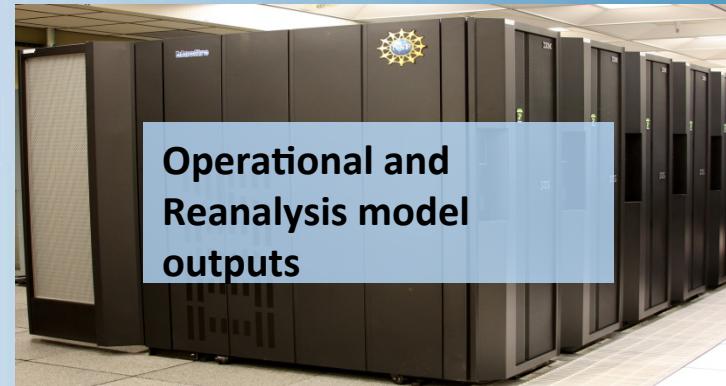
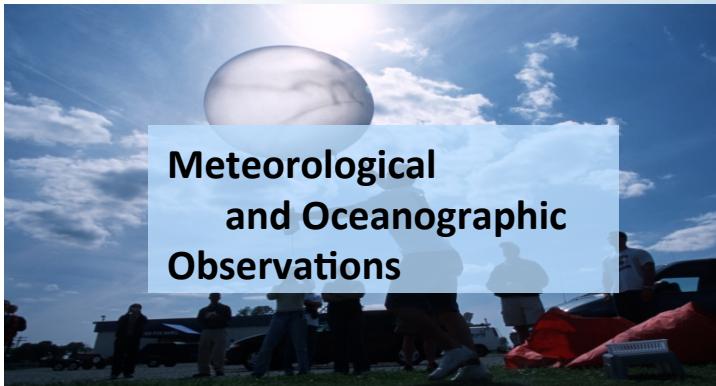
National Center for Atmospheric Research  
Boulder, CO  
*dss.ucar.edu*



SEA Software Engineering Conference, Boulder, CO 24 Feb 2012

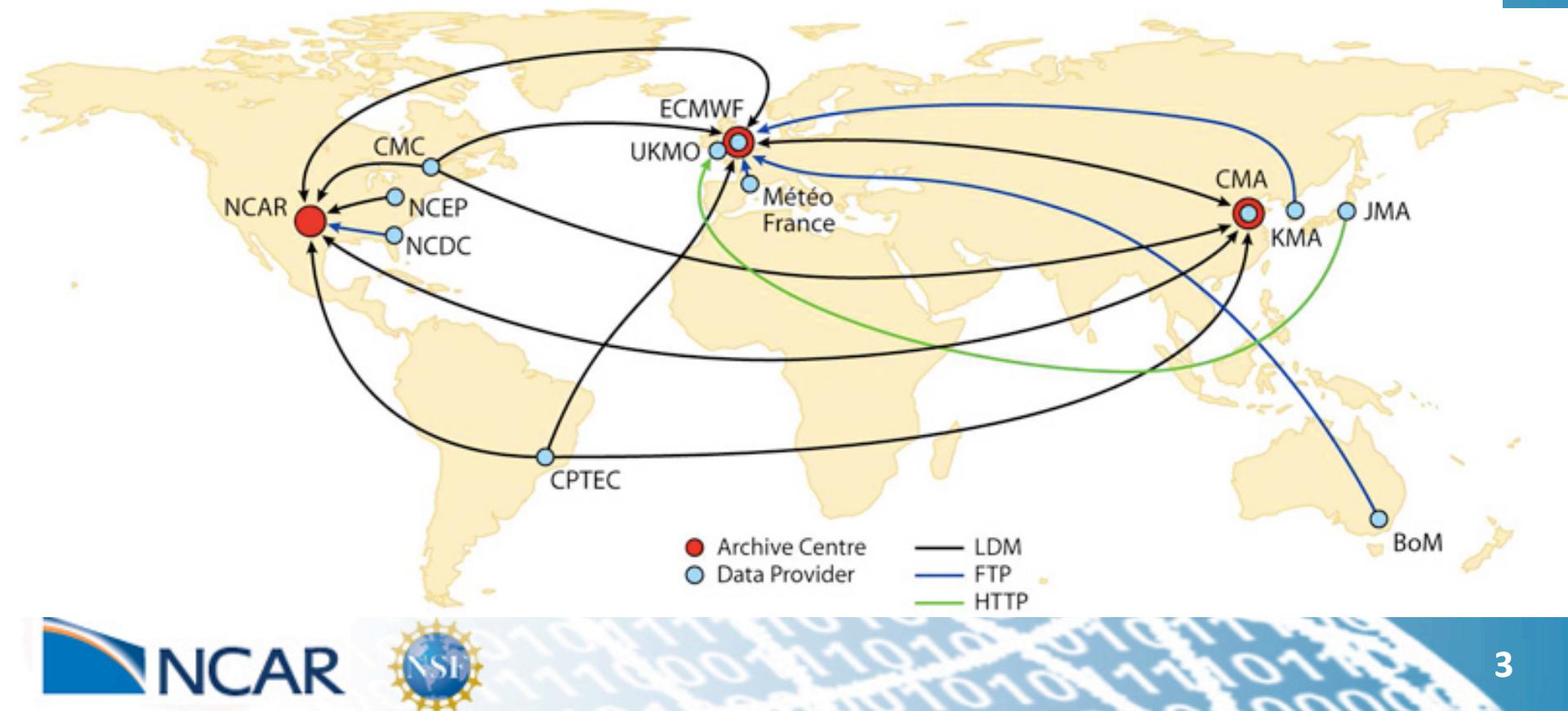
# NCAR Research Data Archive

- Total archive volume over 1.3 PB
- 8000+ unique users annually



# *THORPEX Interactive Grand Global Ensemble (TIGGE)*

**Mission:** Foster and accelerate 1-day to 2-week high-impact weather forecasts.



# NCAR TIGGE Data Portal

**THORPEX Interactive Grand Global Ensemble**  
**TIGGE Data Archive Portal**

National Center for Atmospheric Research  
Computational and Information Systems Laboratory

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## TIGGE Data Archive Portal

[Submit Data Request](#) [Check Data Request Status](#)

This data portal provides full discovery of all TIGGE data available online at NCAR. Data access options include an interface to browse and select staged forecast files for download and an interface to select parameters, grid resolution, and spatial subsets across multiple centers for download.

A number of [tools](#) for analysis and visualization of TIGGE data are available.

### Programme Mission

THORPEX: A Global Atmospheric Research Programme is an international research and development programme responding to the weather related challenges of the 21st century to accelerate improvements in the accuracy of 1-day to 2- week high impact weather forecasts for the benefit of society, the economy and the environment. THORPEX research topics include: global-to-regional influences on the evolution and predictability of weather systems; global observing system design and demonstration; targeting and assimilation of observations; societal, economic and environmental benefits of improved forecasts.

The programme establishes an organizational framework that addresses weather research and forecast problems whose solutions will be accelerated through international collaboration among academic institutions, operational forecast centres and users of forecast products.

THORPEX contributes to the development of a future global interactive multi-model ensemble forecast system, which would generate numerical probabilistic products, available to all WMO Members including developing countries. The purpose is to provide accurate, timely, specific and definite weather warnings in a form that can be readily used in decision support tools, to improve and demonstrate such tools in order to reduce the impact of natural hazards and to realize societal and economic benefits of improved weather forecasts.

THORPEX is a part of the WMO World Weather Research Programme (WWRP). Since 2005 programme name became THORPEX: a World Weather Research Programme, where THORPEX means THe Observing system Research and Predictability EXperiment

# NCAR TIGGE Data Portal

THORPEX Interactive Grand Global Ensemble

TIGGE Data Archive Portal

National Center for Atmospheric Research

Computational and Information Systems Laboratory

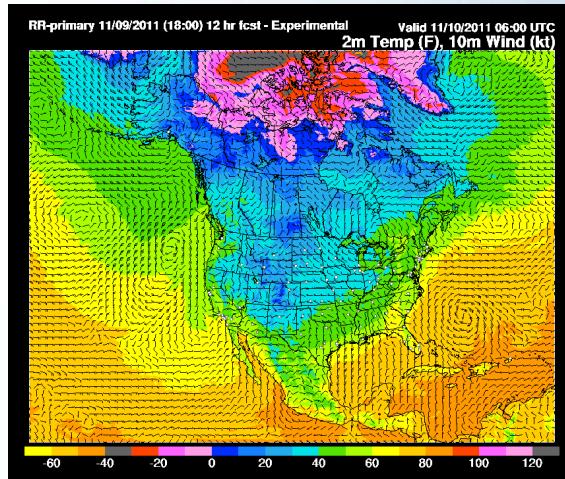


- ***tigge.ucar.edu***
- Most recent 3 months of ensemble forecast data
- Filter data request by NWP center, date range, regional & variable subsets
- Delayed mode request with e-mail notification

such tools in order to reduce the impact of natural hazards and to realize societal and economic benefits of improved weather forecasts.

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# *TIGGE Model Validation Portal at NCAR*



**Ensemble  
Forecast**



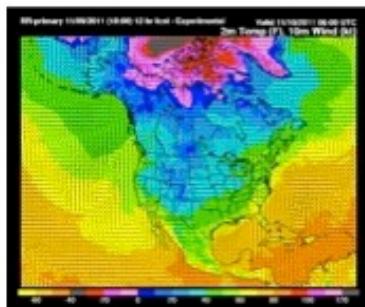
**Observations**

# *TIGGE Model Validation Portal at NCAR*

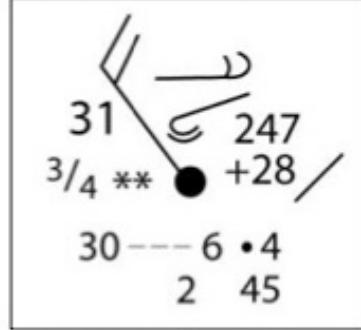


- Match observations with ensemble forecasts
- Streamline access to observational data to support model validation
- Add value to ensemble forecast research
- One-stop shop approach

# Data Access - Common Approach



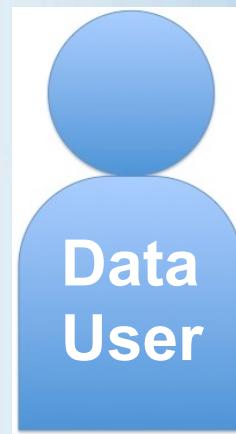
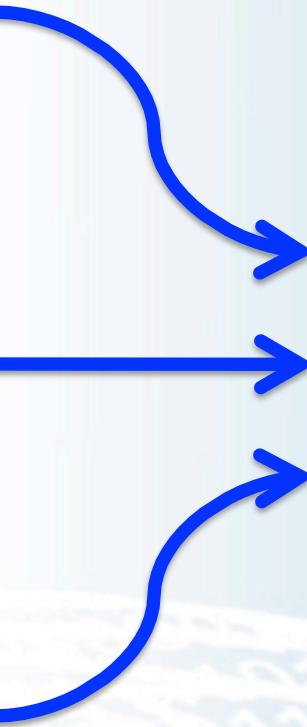
Model Forecast Data



Station Observations



Remote Sensing Data



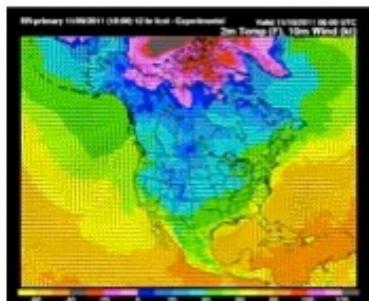
User-side  
resources

- Data Storage
- Format Conversion
- Re-gridding
- Subset Extraction
- Post Processing

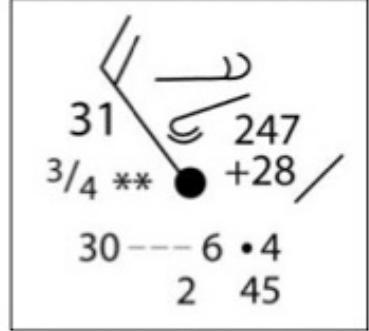


Forecast Validation

# TIGGE MVP Data Flow



Model Forecast Data



Station Observations



Remote Sensing Data

## NCAR RDA system processing

- Data Storage
- Format Conversion
- Re-gridding
- Subset Extraction



# How It Works

**THORPEX Interactive Grand Global Ensemble**  
**TIGGE Data Archive Portal**

National Center for Atmospheric Research  
Computational and Information Systems Laboratory

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**TIGGE Data Archive Portal**

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**Programme Mission**

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THORPEX contributes to the development of a future global interactive multi-model ensemble forecast system, which would generate numerical probabilistic products, available to all WMO Members including developing countries. The purpose is to provide accurate, timely, specific and definite weather warnings in a form that can be readily used in decision support tools, to improve and demonstrate such tools in order to reduce the impact of natural hazards and to realize societal and economic benefits of improved weather forecasts.

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# How It Works

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# *Parameter selection*

## Data Subset Selection

**TIGGE Portal for Sub-setting**

Select Centers									
Australia Bureau of Met.	China Met. Administration	Met. Service of Canada	ECMWF	United Kingdom Met. Office	USA NCEP	Met. France	Japan Met. Agency	Korea Met. Administration	Brazil CPTEC
<input type="checkbox"/> AMMC	<input type="checkbox"/> BABJ	<input type="checkbox"/> CWAO	<input checked="" type="checkbox"/> ECMF	<input type="checkbox"/> EGRR	<input type="checkbox"/> KWBC	<input type="checkbox"/> LFPW	<input type="checkbox"/> RJTD	<input type="checkbox"/> RKSL	<input type="checkbox"/> SBSJ
<input type="button" value="All"/> <input type="button" value="Clr"/>									
Select Forecast Initialization Hour(s)									
<input checked="" type="checkbox"/> 00z					<input checked="" type="checkbox"/> 12z				
Select Forecast Initialization Date Range									
Start Date					End Date				
Forecast (yyyy-mm-dd hh:mm:ss) <input type="text" value="2012-02-14 00:00:00"/>					Forecast (yyyy-mm-dd hh:mm:ss) <input type="text" value="2011-11-24 00:00:00"/>				
Select Variables									
Variable	Long name			Units	Level Type	Level Values <small>Highlight desired level(s)</small>			Forecast Hours <small>Highlight desired hour(s)</small>
<input type="checkbox"/> gh	geopotential_height			gpm	PL				
<input type="checkbox"/> q	specific_humidity			kg kg <sup>-1</sup>	PL				
<input checked="" type="checkbox"/> t	temperature			K	PL	700	<input type="button" value="0"/>	30	<input type="button" value="0"/>
						850	<input type="button" value="0"/>	36	<input type="button" value="0"/>
						925	<input type="button" value="0"/>	42	<input type="button" value="0"/>
						1000	<input type="button" value="0"/>	48	<input type="button" value="0"/>
						mb		hrs	
<input type="checkbox"/> u	u_velocity			m s <sup>-1</sup>	PL				
<input type="checkbox"/> v	v_velocity			m s <sup>-1</sup>	PL				
<input type="checkbox"/> pv	potential_vorticity			K m <sup>2</sup> kg <sup>-1</sup> s <sup>-1</sup>	PT				
<input type="checkbox"/> pv2pt	potential_temperature			K	PV				
<input type="checkbox"/> pv2u	u_on_2pu_surface			m s <sup>-1</sup>	PV				
<input type="checkbox"/> pv2v	v_on_2pu_surface			m s <sup>-1</sup>	PV				
<input type="checkbox"/> 10u	10_meter_u_velocity			m s <sup>-1</sup>	SL				
<input type="checkbox"/> 10v	10_meter_v_velocity			m s <sup>-1</sup>	SL				
<input type="checkbox"/> 2d	surface_air_dew_point_temperature			K	SL				
<input type="checkbox"/> 2t	surface_air_temperature			K	SL				
<input type="checkbox"/> cape	convective_available_potential_energy			J kg <sup>-1</sup>	SL				
<input type="checkbox"/> lsm	land_sea_mask			0 or 1	SL				
<input type="checkbox"/> mn2t6	surface_air_minimum_temperature			K	SL				

# Regrid & Spatial Subsetting

## Subset Request Refinement

### TIGGE Portal for Sub-setting

Enter  
Request  
Description  
(Optional):

Forecast data subset (2012-02-18 11:02:30)

**Regrid (Interpolate) to:**

Grid Longitude and Latitude Increment (Degrees):

- 1.0 (360 X 181)
- 1.25 (288 X 145)
- 1.5 (240 X 121)
- 2.0 (180 X 91)
- 2.5 (144 X 73)

**Select Spatial Region**

*Using degrees E for longitude (limits 0 to 360 E), degrees N for latitude (limits 90 to -90 N).*

North Boundary

West Boundary

East Boundary

South Boundary

**Output File Format:**

GRIB-2  NetCDF

Next

Back

Cancel

# Data request review

## Data Subset Selection

### Summary

To make changes, use your browser back button to return to previous page.

Enter Request Description (Optional):	Forecast data subset (2012-01-19 20:46:22)	
Center(s)	kwbc	
Forecast Times	2012-01-15 00:00:00    2012-01-15 06:00:00    2012-01-15 12:00:00    2012-01-15 18:00:00	
t	temperature (K)	
Level(s)	200    250    300    500    700    850    925    1000    PL	
Forecast hour(s)	0    6    12    18    24	
Regrid (Interpolate) to:		
Grid		
Longitude		
and		
Latitude	1.0 (360 X 181)	
Increment (Degrees)		
Output File Format		
NetCDF		
<input checked="" type="checkbox"/> Retrieve Matching Model Validation Data:		
Check the box above to retrieve NCEP PREPBUFR observations for model validation. This will be processed as a separate data request from the NCAR DSS data portal and will match the available parameters chosen in your TIGGE data request.		
To make changes, use your browser back button to return to previous page. OR,		
<a href="#">Back</a>	<a href="#">Submit Request</a>	<a href="#">Cancel</a>

# Data request review

## Data Subset Selection

### Summary

To make changes, use your browser back button to return to previous page.

Enter  
Request  
Description  
(Optional):

Forecast data subset (2012-01-19 20:46:22)

- Click on checkbox – get matching obs data
- E-mail notification when data are ready

hour(s) 0 6 12 18 24

Regrid (Interpolate) to:

Grid

Longitude

and  
Latitude 1.0 (360 X 181)

Increment

(Degrees)



### Retrieve Matching Model Validation Data:

Check the box above to retrieve NCEP PREPBUPR observations for model validation. This will be processed as a separate data request from the NCAR DSS data portal and will match the available parameters chosen in your TIGGE data request.

To make ch

Submit Request

# Download page



## SUBSET DATA REQUESTED FROM DS337.0

Go to [DS337.0 Home Page](#).

The Subset Data requested by Thomas Cram ([tcram@ucar.edu](mailto:tcram@ucar.edu)) from ds337.0 - 'NCEP ADP Global Upper Air and Surface (PREPBUFR and NetCDF formats) Weather Observations, May 1997 - Continuing' are listed below. The data files will remain available online for 5 days (until 2012-01-14 15:28:15). If you need additional time to complete the download, please notify [Thomas Cram](#). After you have completed the download, please also let me know by clicking this button

[I Have Finished Download, Please Purge the Request](#)

---

TIGGE forecast validation subset (2012-01-09 03:17:33)

[Show Selected Files/Get As a Tar File](#) [Perl Download Script](#) [Csh Download Script](#)

- Total **4 Files (3.25M)** are listed below
- Click a file name to download a single file
- Select one or multiple files to get a download script
- Select multiple data files to download as a single tar file
- Currently **0 File** selected [Clear Selection](#)

<input type="checkbox"/>	INDEX	File Name	Size	Data Format	Date Online
<input type="checkbox"/>	1	<a href="#">gdas.9499.2012010600.nc</a>	1.06M	PBNETCDF	01/09/2012
<input type="checkbox"/>	2	<a href="#">gdas.9499.2012010606.nc</a>	596.30K	PBNETCDF	01/09/2012
<input type="checkbox"/>	3	<a href="#">gdas.9499.2012010612.nc</a>	1.08M	PBNETCDF	01/09/2012
<input type="checkbox"/>	4	<a href="#">gdas.9499.2012010618.nc</a>	515.14K	PBNETCDF	01/09/2012

[Show Selected Files/Get As a Tar File](#) [Perl Download Script](#) [Csh Download Script](#)

# *Under the hood*

- DSRQST daemon receives data request
- MySQL db request record created
- Perl script parses request information

```
dates=2012-02-12 00:00 2012-02-12 12:00&lats=30.0 N  
50.0 N&lons=120.0 W 90.0 W &params=APCP TMP  
HGT&qualmark=2&tigge=true&fhours=0 6 12 18
```

# *Data Description*

## NCEP PREPBUFR Observations (1997 – present)

- Surface and upper air reports – used for NCEP GDAS

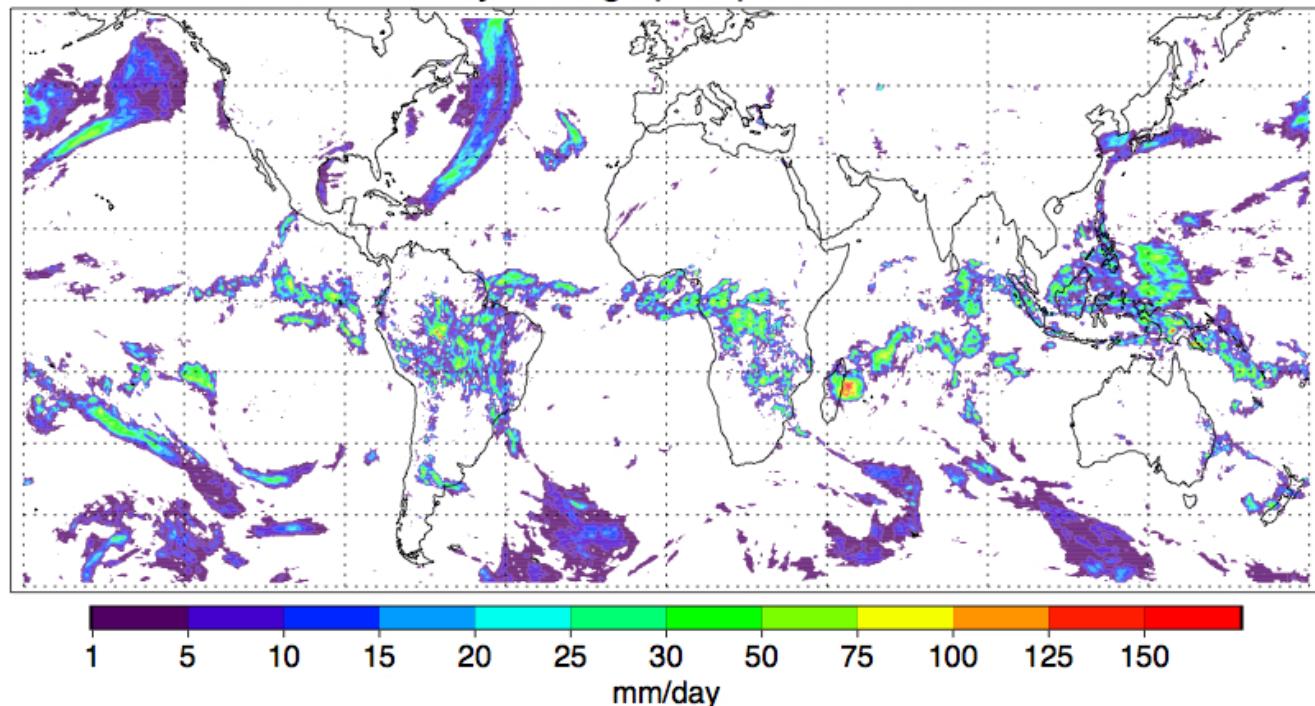
Geopotential	Rel. Humidity
Temperature	Specific Humidity
Wind vectors & speed	Dew Point
Mean SLP	Vapor Mixing Ratio

# *Data (cont.)*

## CMORPH Precipitation (coming soon)

- Precipitation derived from multiple satellites
- Dec. 2002 – present
- $0.25 \times 0.25$  grid
- 3-hourly

CMORPH daily average precipitation: 13 Feb 2012



# *Output Format – NetCDF*

## PREPBUFR obs

- Model Evaluation Tools software NetCDF format
  - [www.dtcenter.org/met/users](http://www.dtcenter.org/met/users)
- MET software ingests:
  - forecast
  - observations

TIGGE forecast validation subset (2012-01-09 03:17:33)

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<input type="checkbox"/>	2	<a href="#">gdas.9499.2012010606.nc</a>	596.30K	PBNETCDF	01/09/2012
<input type="checkbox"/>	3	<a href="#">gdas.9499.2012010612.nc</a>	1.08M	PBNETCDF	01/09/2012
<input type="checkbox"/>	4	<a href="#">gdas.9499.2012010618.nc</a>	515.14K	PBNETCDF	01/09/2012

Show Selected Files/Get As a Tar File   Perl Download Script   Csh Download Script 



# Access to full archives of data

[DS HOME](#) | [DATA ACCESS](#) | [DS DOCUMENTATION](#) | [DS SOFTWARE](#) | [INVENTORIES](#) | [STATION LIBRARIES](#)

 [ds330.0 HOME PAGE](#) [Help](#)

## Historical THORPEX Interactive Grand Global Ensemble (TIGGE) Data Archive

This datasets holds all THORPEX Interactive Grand Global Ensemble (TIGGE) forecast data archived on the NCAR MSS. The archive ranges from Oct 1,

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Forecasts (

Australia Bu

 [ds337.0 HOME PAGE](#) [Help](#)

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## NCEP ADP Global Upper Air and Surface (PREPBUFR and NetCDF formats) Weather Observations, May 1997 - Continuing

**PERIODS:**

NCEP ADP Global Upper Air and Surface (PREPBUFR and NetCDF formats) Weather Observations are composed of a global set of

**UPDATES:** surface and upper air

[DS HOME](#) | [DATA ACCESS](#) | [DS DOCUMENTATION](#) | [DS SOFTWARE](#) | [INVENTORIES](#) | [STATION LIBRARIES](#)

**USAGE:** surface, marine, upper air

 [ds502.0 HOME PAGE](#) [Help](#)

**VARIABLES:** derived winds

Information Series

and speed. Re-

CMORPH (CPC MORPHing technique) produces global precipitation analyses at very high spatial and temporal resolution. This technique

(GDAS), which uses precipitation estimates that have been derived from low orbiter satellite microwave observations exclusively, and whose features are

transported via spatial propagation information that is obtained entirely from geostationary satellite IR data.

Precipitation estimates are

derived from the passive microwaves aboard the DMSP 13, 14 and 15 (SSM-I), the NOAA-15, 16, 17 and 18 (AMSU-B), and AMSR-E and

TMI aboard NASA's Aqua and TRMM spacecraft, respectively.

These estimates are generated by algorithms of Ferraro (1997) for SSM-I,

Ferraro et al. (2000) for AMSU-B and Kummerow et al. (2001) for TMI.

Note that this technique is not a precipitation estimation algorithm

but a means by which estimates from existing microwave rainfall algorithms can be combined.

Therefore, this method is extremely flexible

such that any precipitation estimates from any microwave satellite source can be incorporated.

## NOAA CPC Morphing Technique (CMORPH) Global Precipitation Analyses

CMORPH (CPC MORPHing technique) produces global precipitation analyses at very high spatial and temporal resolution. This technique uses precipitation estimates that have been derived from low orbiter satellite microwave observations exclusively, and whose features are transported via spatial propagation information that is obtained entirely from geostationary satellite IR data. Precipitation estimates are derived from the passive microwaves aboard the DMSP 13, 14 and 15 (SSM-I), the NOAA-15, 16, 17 and 18 (AMSU-B), and AMSR-E and TMI aboard NASA's Aqua and TRMM spacecraft, respectively. These estimates are generated by algorithms of Ferraro (1997) for SSM-I, Ferraro et al. (2000) for AMSU-B and Kummerow et al. (2001) for TMI. Note that this technique is not a precipitation estimation algorithm but a means by which estimates from existing microwave rainfall algorithms can be combined. Therefore, this method is extremely flexible such that any precipitation estimates from any microwave satellite source can be incorporated.

**UPDATES:**

**PERIODS:** 2002-12-07 00:00 +0000 to 2012-01-07 21:00 +0000 (Entire dataset)

[Period details by subset](#)

**VARIABLES:**

**UPDATES:** Daily

**VARIABLES:** Precipitation Rate

-----

**LEVELS:** See the [detailed metadata](#) for level information

**TYPES:** Grid

**COVERAGE:** Longitude Range: Westernmost=180W Easternmost=180E

Latitude Range: Southernmost=-59.875S Northernmost=59.875N

[Detailed coverage information](#)

# *Access to full archives of data*

DS HOME | DATA ACCESS | DS DOCUMENTATION | DS SOFTWARE | INVENTORIES | STATION LIBRARIES

ds330.0 HOME PAGE Help

This dataset contains forecasts from the TIGGE archive. It includes forecasts from the Operational Forecast Center (OFC) in Australia, the Commonwealth of Australia (Cwao), and the European Centre for Medium-Range Weather Forecasts (ECMWF). The forecasts are available in PREPBUFR format.

**TIGGE forecasts (2006-present):**  
[dss.ucar.edu/datasets/ds330.0](https://dss.ucar.edu/datasets/ds330.0)

**PREPBUFR (1997-present):**  
[dss.ucar.edu/datasets/ds337.0](https://dss.ucar.edu/datasets/ds337.0)

**CMORPH (2002-present):**  
[dss.ucar.edu/datasets/ds502.0](https://dss.ucar.edu/datasets/ds502.0)

**PERIODS:** GRIB2 precipitation estimates from 2002-12-07 to 2012-01-07 (Entire dataset)  
but a means by which estimates from existing microwave rainfall algorithms can be combined. Therefore, this method is extremely flexible such that any precipitation estimates from any microwave satellite source can be incorporated.  
Period details by subset

**UPDATES:** Daily  
**VARIABLES:** Air Temperature, Sea Surface Temperature, Dew Point Temperature, Geopotential Height  
Period details by subset

**UPDATES:** Daily  
**VARIABLES:** Air Pressure, Sea Surface Temperature, Station Height, Surface Winds  
Period details by subset

**LEVELS:** See the detailed metadata for level information

**TYPES:** Grid

**COVERAGE:** Longitude Range: Westernmost=180W Easternmost=180E  
Latitude Range: Southernmost=-59.875S Northernmost=-59.875N  
Detailed coverage information

# Data file downloads

 **ds337.0 DATA FILE ONLINE FOR DOWNLOAD**

  PREPNR-NETCDF-2012 - PREPNR-NETCDF obs data for 2012

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<input type="checkbox"/> 	INDEX	File Name 	Description 	Size 	Data Format	Date Archived 
<input type="checkbox"/>	1	<a href="#">netcdf.gdas.2012010100.nc</a>	2012jan01 	58.9M	PBNETCDF	01/03/2012
<input type="checkbox"/>	2	<a href="#">netcdf.gdas.2012010106.nc</a>	2012jan01 	55.7M	PBNETCDF	01/04/2012
<input type="checkbox"/>	3	<a href="#">netcdf.gdas.2012010112.nc</a>	2012jan01 	61.2M	PBNETCDF	01/04/2012
<input type="checkbox"/>	4	<a href="#">netcdf.gdas.2012010118.nc</a>	2012jan01 	58.9M	PBNETCDF	01/04/2012
<input type="checkbox"/>	5	<a href="#">netcdf.gdas.2012010200.nc</a>	2012jan02 	60.7M	PBNETCDF	01/04/2012
<input type="checkbox"/>	6	<a href="#">netcdf.gdas.2012010206.nc</a>	2012jan02 	56.1M	PBNETCDF	01/05/2012
<input type="checkbox"/>	7	<a href="#">netcdf.gdas.2012010212.nc</a>	2012jan02 	60.9M	PBNETCDF	01/05/2012
<input type="checkbox"/>	8	<a href="#">netcdf.gdas.2012010218.nc</a>	2012jan02 	58.7M	PBNETCDF	01/05/2012
<input type="checkbox"/>	9	<a href="#">netcdf.gdas.2012010300.nc</a>	2012jan03 	55.9M	PBNETCDF	01/05/2012
<input type="checkbox"/>	10	<a href="#">netcdf.gdas.2012010306.nc</a>	2012jan03 	55.7M	PBNETCDF	01/06/2012

# Data subset interface

## ds337.0 NCEP ADP GLOBAL UPPER AIR AND SURFACE WEATHER OBSERVATIONS SUBSET REQUEST FORM

This form allows a user to request a temporal and spatial subset from the NCEP ADP Global Upper Air and Surface Weather Observations. Also included is the option to select data for one or more observing stations. Once the form is completed and submitted, the user is notified through email when the data is ready for download. All information boxes must be filled, except where noted as *optional*, and are seeded with default or min./max. limits. The output data is converted from PREPBUFR format to either ASCII or NetCDF. The NetCDF data format conversion is done using the Model Evaluation Tools (MET) software and can be easily interfaced with the model validation utilities included in the MET software.

Select Temporal Range

Start Date	End Date
<input type="text" value="1997-04-30"/> <input type="button" value="00:00"/> <input type="button"/>	<input type="text" value="2012-01-07"/> <input type="button" value="00:00"/> <input type="button"/>
<input type="button" value="Reset Range"/> <input type="button"/>	

Select Output Data Format

<input type="button" value="NetCDF"/>
---------------------------------------

Select Parameters

<input checked="" type="checkbox"/> Specific humidity (observed)	<input checked="" type="checkbox"/> Dewpoint temperature (derived)
<input checked="" type="checkbox"/> Temperature (observed)	<input checked="" type="checkbox"/> Wind speed (derived)
<input checked="" type="checkbox"/> Geopotential height (observed)	<input checked="" type="checkbox"/> Relative humidity (derived)
<input checked="" type="checkbox"/> East-West wind component (observed)	<input checked="" type="checkbox"/> Humidity mixing ratio (derived)
<input checked="" type="checkbox"/> North-South wind component (observed)	<input checked="" type="checkbox"/> Pressure reduced to mean sea level (derived)

or

# Data subset interface

## ds337.0 NCEP ADP GLOBAL UPPER AIR AND SURFACE WEATHER OBSERVATIONS SUBSET REQUEST FORM

This form allows a user to request a temporal and spatial subset from the NCEP ADP Global Upper Air and Surface Weather Observations. Also included in the section to select data for one or more observing stations. Once the form is completed and submitted.

The user is notified optional, and are NetCDF. The Net with the model va

1997-

Specific humidity

Temperature (ot)

Geopotential hei

East-West wind

North-South win

or

### Select Spatial Subset Preference

Select region via Google map

Enter latitude & longitude manually

Interactive Map Instructions:

- Use the 'Pan Map' option to drag and center the map on your area of interest
- Use the 'Draw Box' option to drag a box around your area of interest. You can also manually enter bounding latitudes and longitudes in the text boxes.

North\*: 90  East\*: 180

West\*: -180 South\*: -90

\*Latitudes and longitudes must be specified in whole degrees

POWERED BY 5000 mi 5000 km   Pan Map  Draw Box

# Summary

- Integrated access for ensemble forecasts and observations that can be used for validation
- Output compatible with MET software
- Service brings together diverse datasets (*burden taken off researcher*)
- Modular approach – Integrated & stand-alone access

**More info:**  
**[tigge.ucar.edu](http://tigge.ucar.edu)**  
**[tcramp@ucar.edu](mailto:tcramp@ucar.edu)**