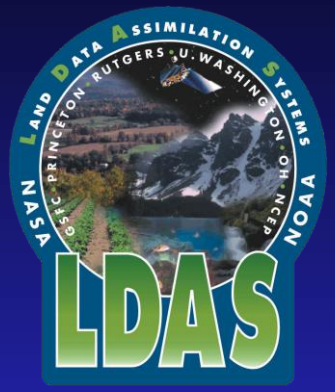

Real-time and Retrospective Forcing in the North American Land Data Assimilation System (N-LDAS) Project

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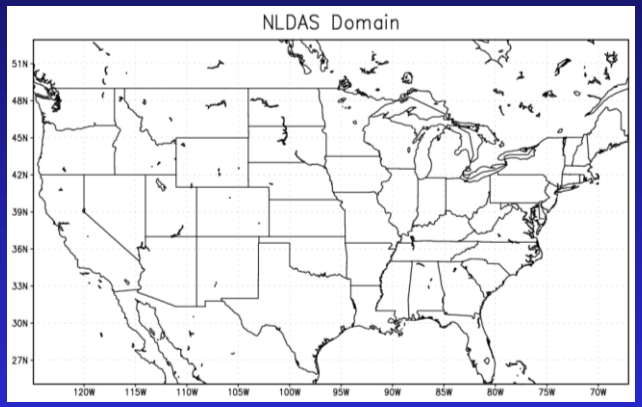
Background

- NLDAS project seeks to provide accurate, near-real-time and retrospective land surface states over North America
- Quality of land surface model (LSM) output is closely tied to the quality of the meteorological forcing data used to drive the model
- Model and observation-based data used to create high-quality forcing data used by Mosaic, NOAH, VIC, Sacramento and CLM LSMs
  - Retrospective (1996-2000, NASA)
  - Real-time (1999-Present, NOAA)

Forcing Data Specifics

- Hourly files
- 1/8th Degree (~15 km) over central North America



- GRIB format, ~2 megabytes per file
- C-shell scripts, Fortran programs used to automatically generate and archive forcing
- Quality controlled, adjusted for terrain height
- 15 Model and observation-based fields

Forcing File Contents

- Nine primary fields used by LDAS LSMs

Model Based	Observation Based
2 Meter temperature	Downward shortwave radiation
2 Meter specific humidity	Doppler/gauge/model based precipitation
Surface Pressure	
U wind component	
V wind component	
Downward longwave radiation	
Convective Precipitation	

- Six secondary fields available for additional modeling and validation efforts

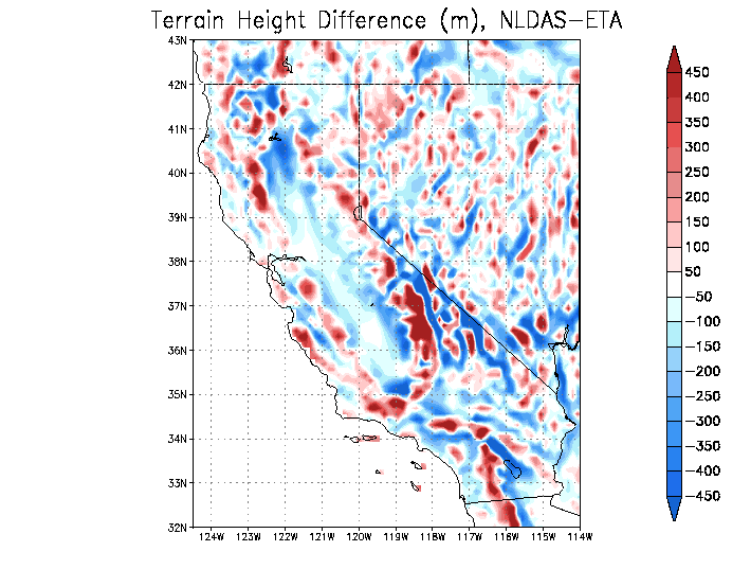
Model Based	Observation Based
Downward shortwave radiation	Skin temperature
Total precipitation	PAR
Convective available potential energy (CAPE)	Doppler radar total precip

Forcing File Creation — EDAS/ETA

- Observations not always available, so EDAS/ETA data used as base
  - EDAS, 3 hourly, AWIPS212 (40km)
  - ETA, 3 and 6 hourly, AWIPS 212 (40km)
- Spatially interpolated to 1/8th degree
- Temporally interpolated to hourly data
- Quality controlled using ALMA ranges

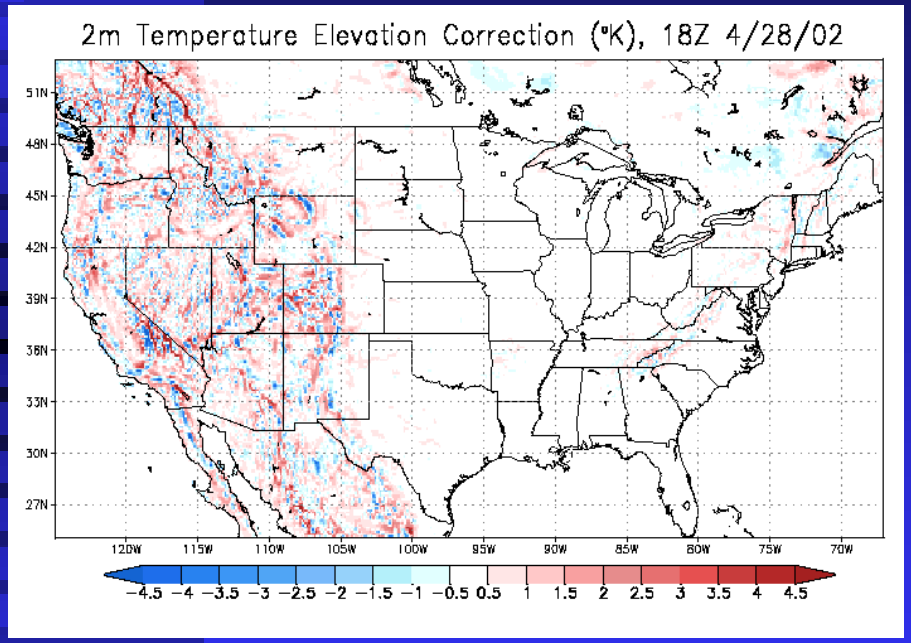
Terrain Height Adjustment

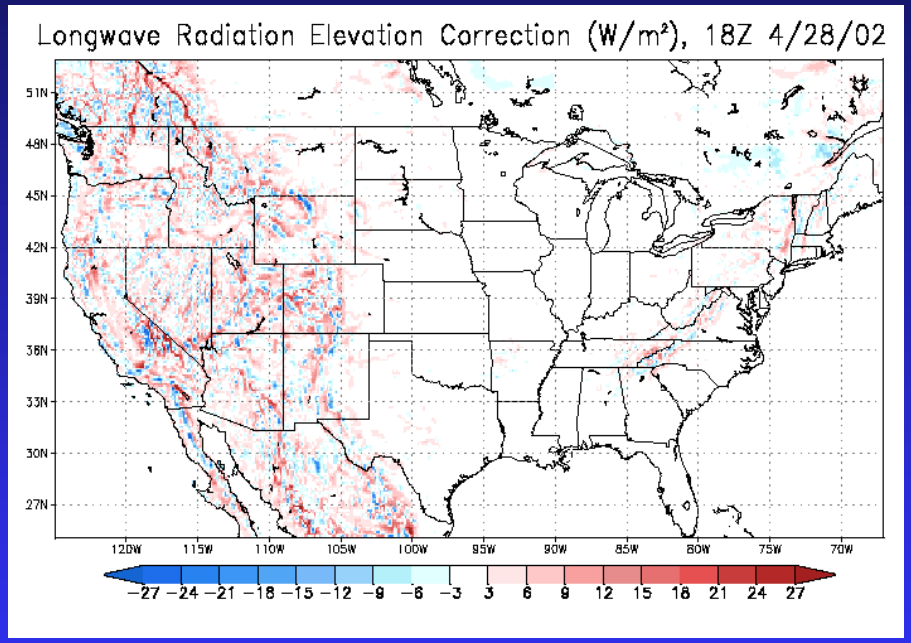
- ETA temperature, pressure, humidity and longwave radiation adjusted for differences in ETA versus LDAS terrain height



- Temperature and pressure corrected using standard lapse rate
- Specific humidity and longwave radiation corrected by holding relative humidity constant

Terrain Height Adjustment





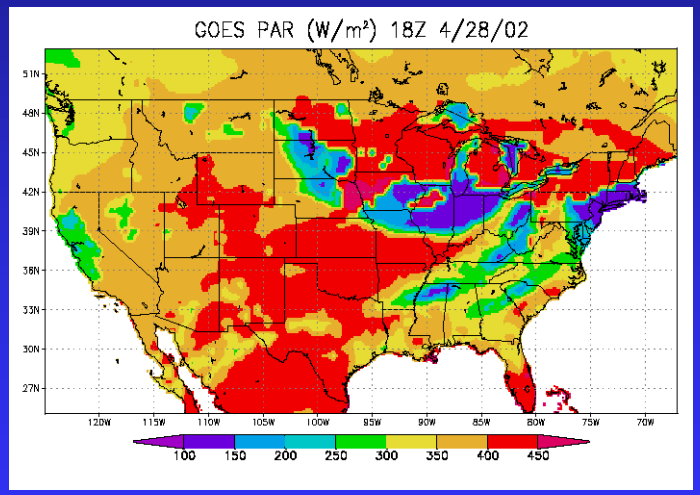
- Corrections of up to 6K, 120mb, 40W/m^2, 2 g/kg

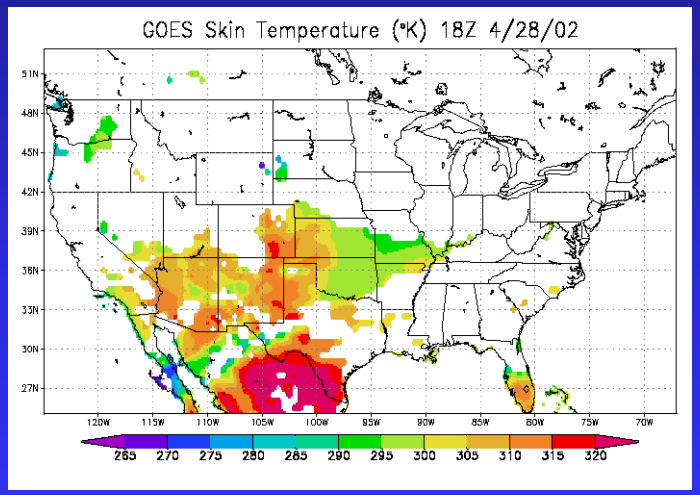
Observations

- Model-based data subject to model error, so observations used when possible
- Radiation
  - GOES-UMD downward shortwave
  - GOES-UMD PAR
  - GOES-UMD skin temperature
- Precipitation
  - Stage II hourly Doppler radar/RFC gauge data
  - CPC daily gauge data
  - CPC reprocessed daily gauge data

Observed Radiation

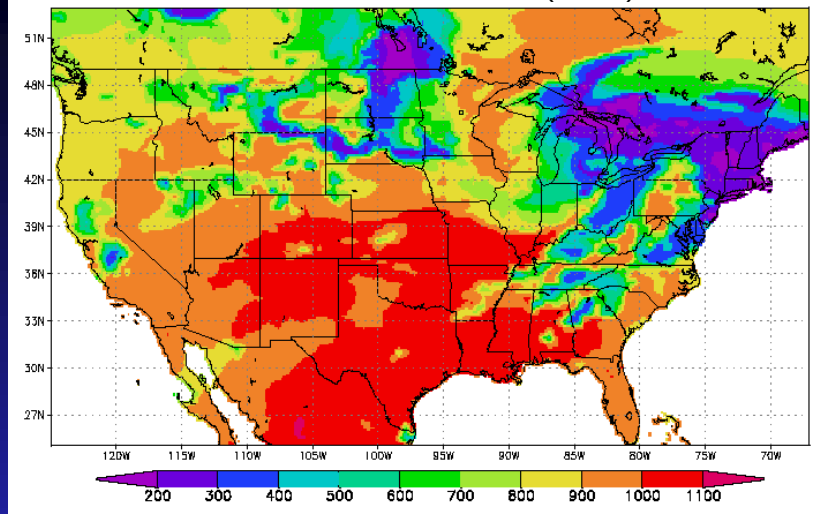
- GOES data processed at UMD to create ½ degree, hourly, instantaneous surface downward shortwave radiation, PAR and skin temperature fields
  - Interpolated to 1/8th degree



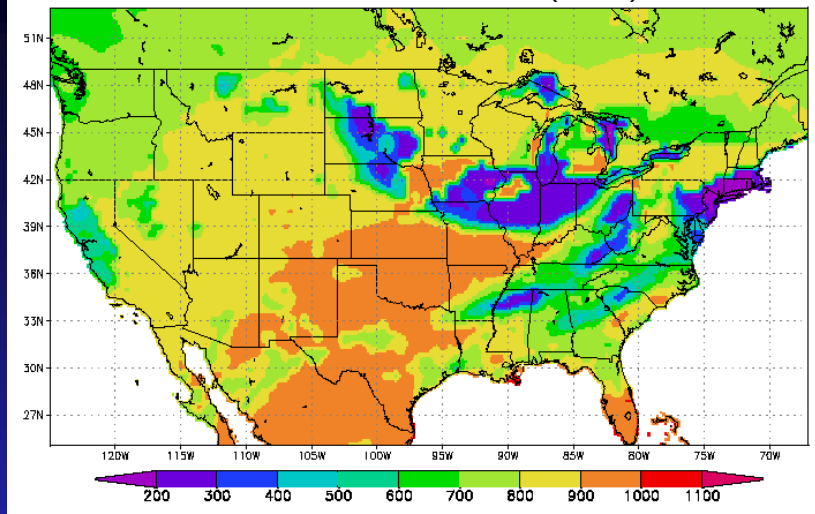


- GOES shortwave radiation is zenith angle corrected, used in place of ETA data when possible

EDAS Downward Shortwave Radiation (W/m^2) 18Z 4/28/02

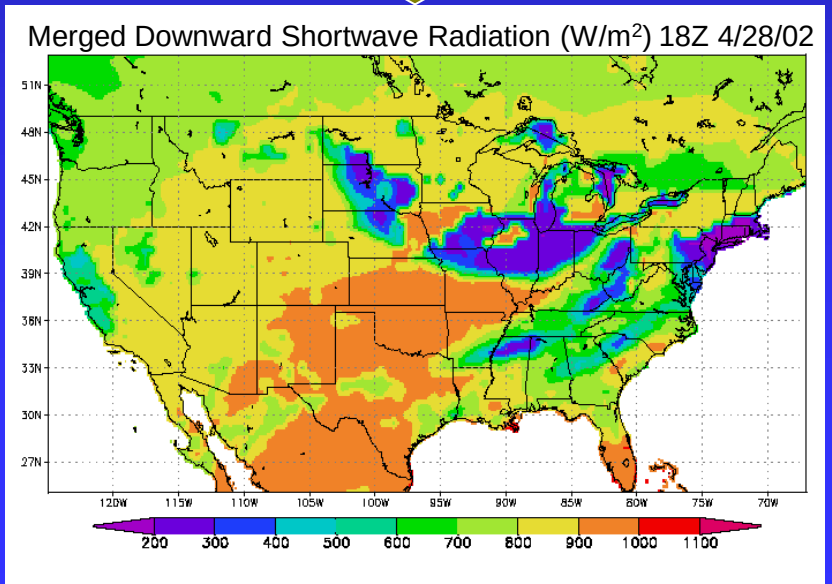


GOES Downward Shortwave Radiation (W/m^2) 18Z 4/28/02



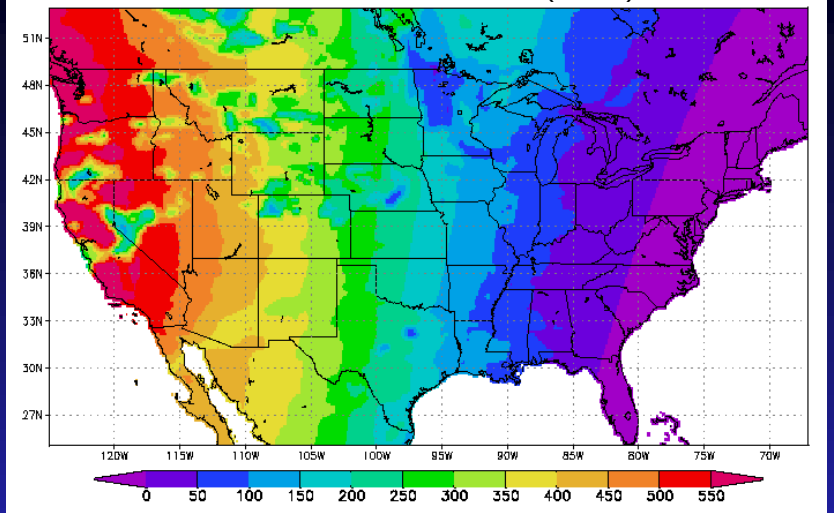
Combine

Merged Downward Shortwave Radiation (W/m^2) 18Z 4/28/02

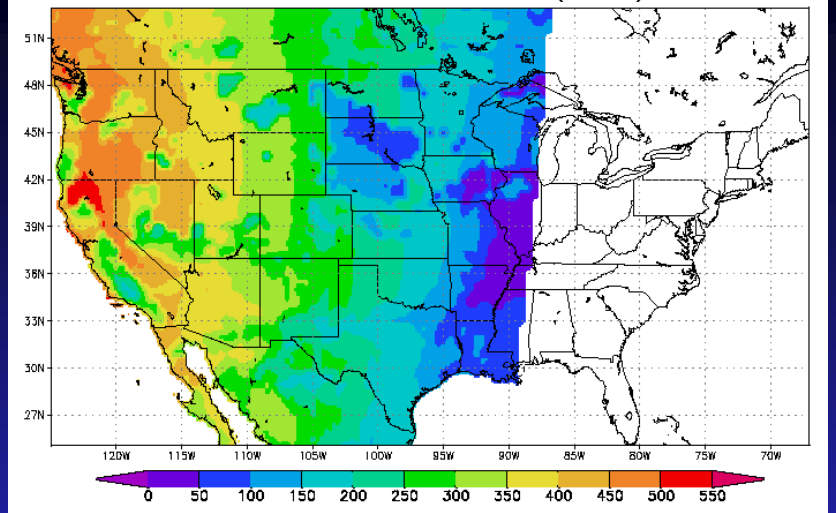


- **GOES defined over entire domain, so EDAS not used in merged product**

EDAS Downward Shortwave Radiation (W/m^2) 00Z 4/29/02

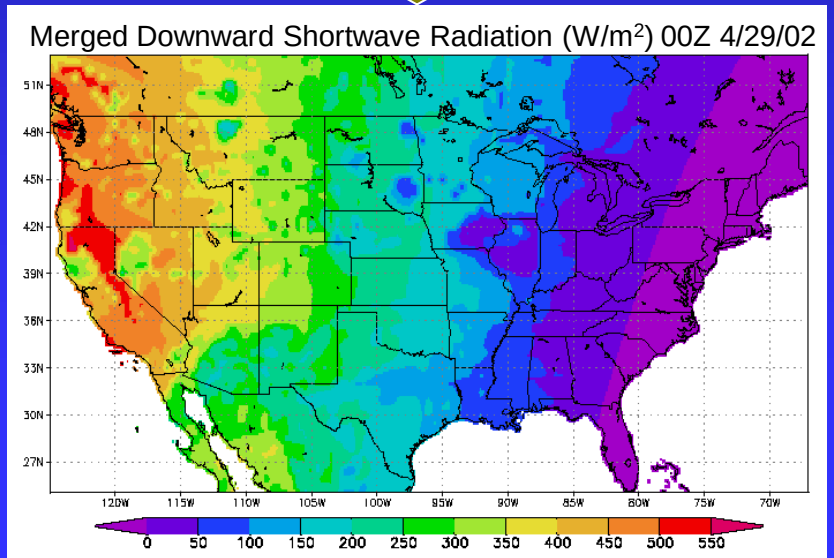


GOES Downward Shortwave Radiation (W/m^2) 00Z 4/29/02



Combine

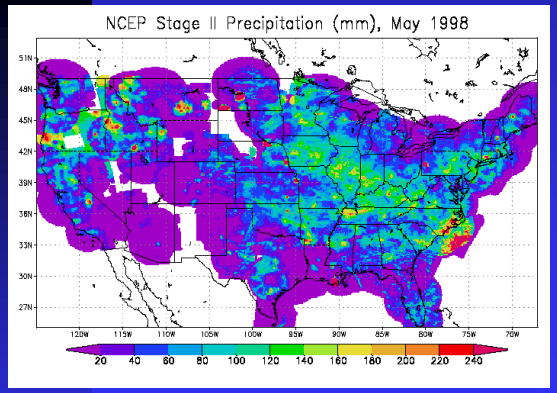
Merged Downward Shortwave Radiation (W/m^2) 00Z 4/29/02

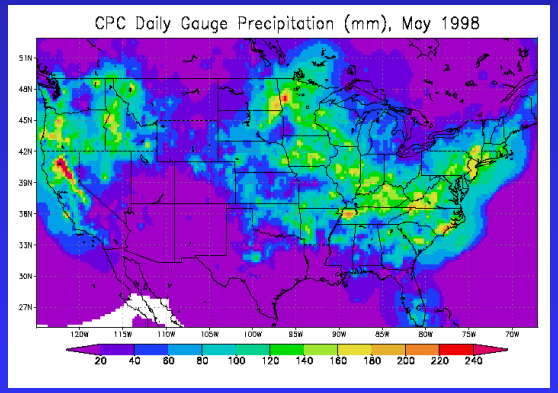


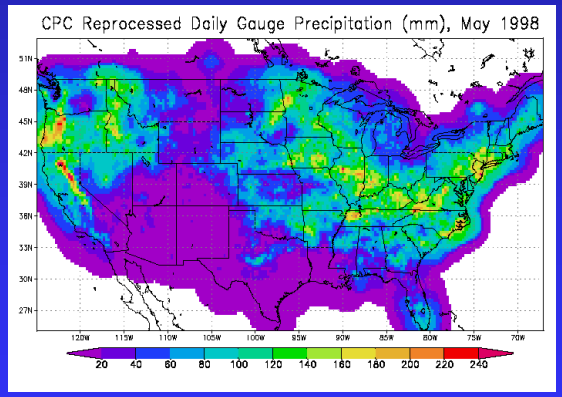
- **GOES undefined at low sun angles over eastern seaboard, so EDAS used in merged product as filler over this region**

Observed Precipitation

Data	Advantages	Disadvantages
NCEP Stage II Doppler radar / RFC gauge	Hourly, 4km	Errors in radar magnitude Holes in coverage
CPC daily rain gauge data	Accurate	Coarse temporal resolution Sparse coverage over Canada, Mexico 0.25 Degree Resolution
CPC Reprocessed daily rain gauge data	Most accurate (additional stations and qc checks)	Coarse temporal resolution Light coverage over Canada, Mexico 0.25 Degree Resolution Only through 1998







- Make use of ETA, Stage II and CPC data to form best available product—a temporally disaggregated hourly CPC value

Temporal Disaggregation Process

Example: 15Z 4/25/97

CPC, Stage II and ETA data ingested

↓

Data interpolated to 1/8th degree

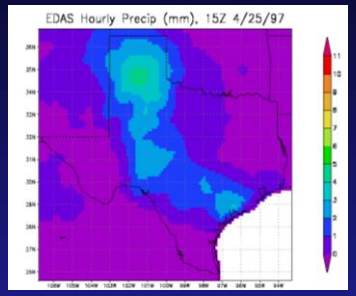
↓

Nearest neighbor technique used to fill in Stage II gaps to a radius of 2 degrees

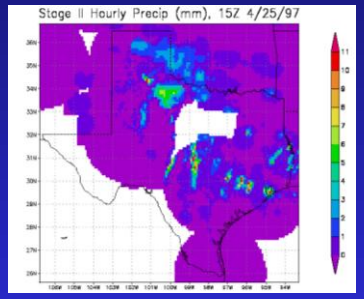
↓

ETA data used to fill in remaining Stage II gaps

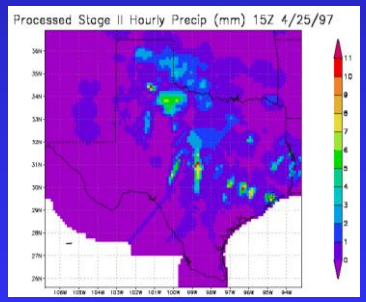
Interpolate EDAS data



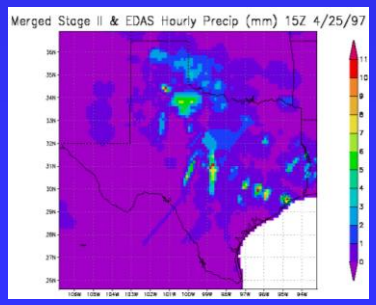
Interpolate Stage II data



Fill Stage II gaps with nearest neighbor Stage II data



Fill in remaining Stage II gaps with EDAS data



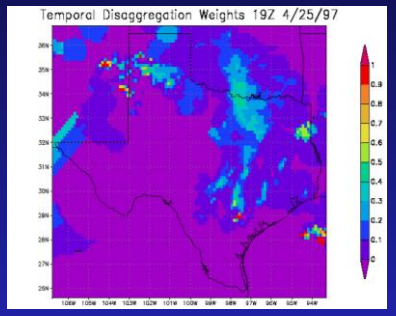
Temporal Disaggregation Process

Example: 19Z 4/25/97

Hourly Stage II values divided by daily Stage II sum to create hourly temporal disaggregation weights

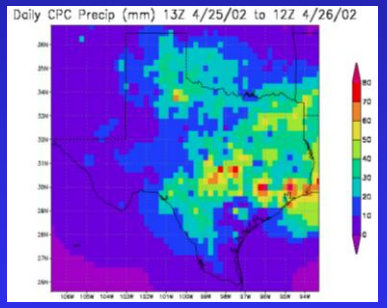
Hourly weights applied to daily CPC data to arrive at hourly CPC values

Derive hourly temporal disaggregation weights



X

Multiply by daily CPC total



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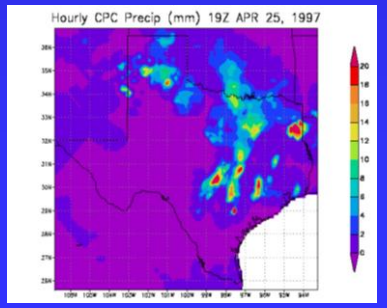
Arrive at hourly CPC precipitation value

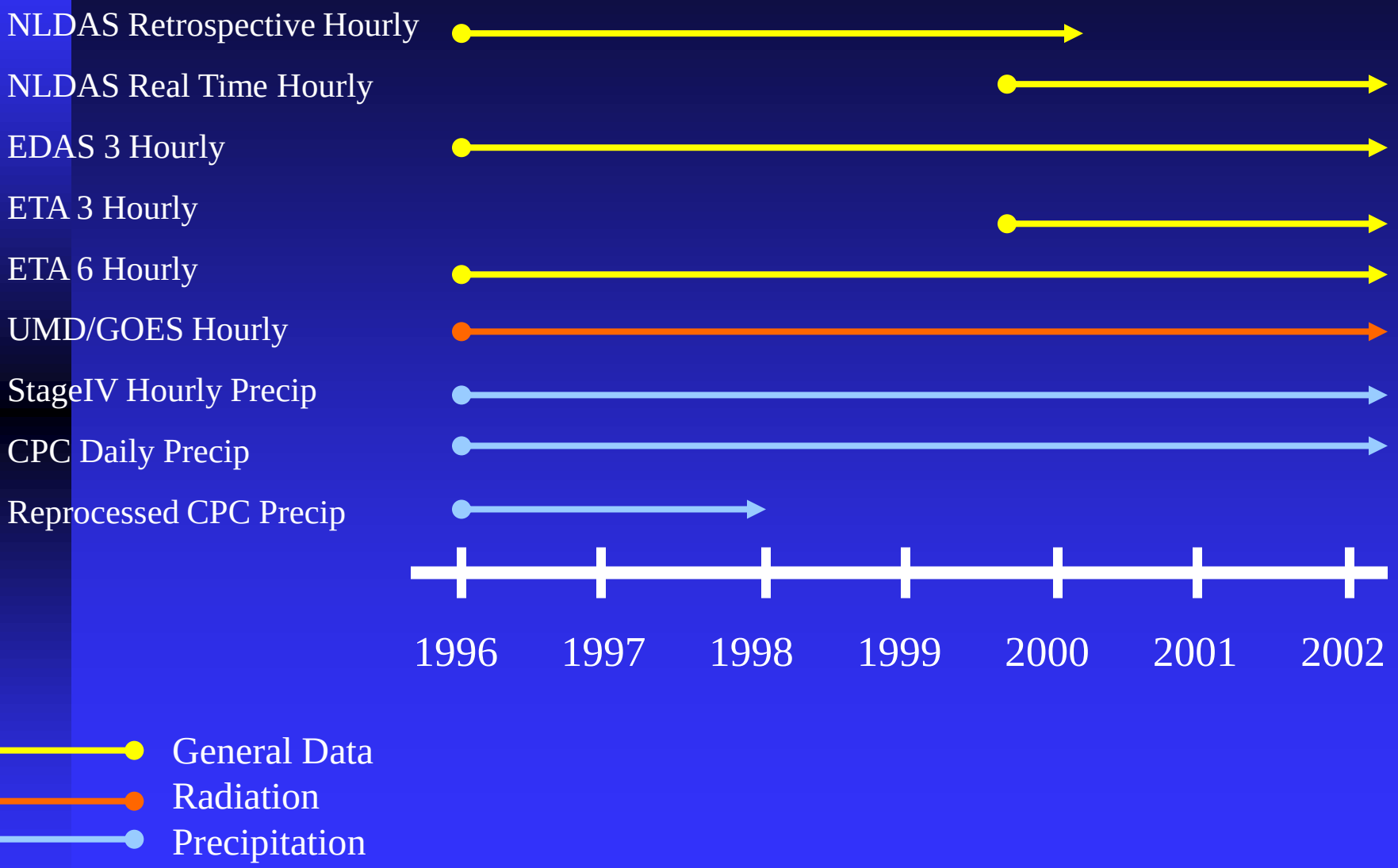


Key Points:

*Stage II data used only to derive temporal disaggregation weights

*Sum of hourly CPC data values equals original daily CPC gauge total

Forcing Data Archive



Conclusions

- Model and observation based data merged to create robust, accurate 1/8th degree hourly forcing data set
  - EDAS/ETA data serves as base
  - GOES, Stage II and CPC data used to augment data set
- Common set of forcing integral to LDAS LSM intercomparisons
- Six years archived, with production occurring daily
- Validation effort proceeding (presentation by Lifeng Luo)
- Visit ldas.gsfc.nasa.gov for further details on project