The NCEP 65+ Year Reanalysis Observation Database

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NCEP partnered with NCAR, with contributions from other NWP research centers, to produce the first long term (50 years, 1948-1998) global reanalysis product during the 1990's. The database setup and data assimilation component carried out at NCEP was ongoing through the years 1993-2000. The project was known as the NCEP/ NCAR Global Reanalysis (NNGR), or GR1. The observation preparation and preprocessing requirement for this project was significant. The bits and pieces of the data were stored in many different places and formats. The data rescue group of ~10 people at NCAR spent many man years cleaning up and time checking archived datasets and sending them to NCEP. Diagrams below, for example, show the major components of the PILOT/TEMP and the SYNOP datasets, 1948-1997.

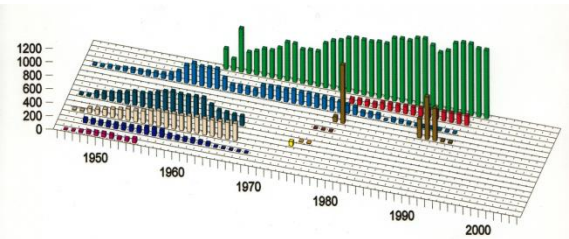


Figure 1. Raob/pibal inventory. From back to front, in megabytes; NMC, JMA, SPEC, FGGE/ECM, USAF, TD54, TWERLE, GATE, USCR, TD53, CARDS.

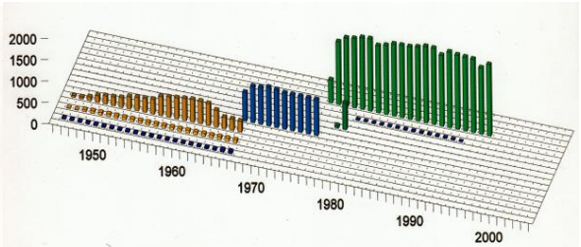
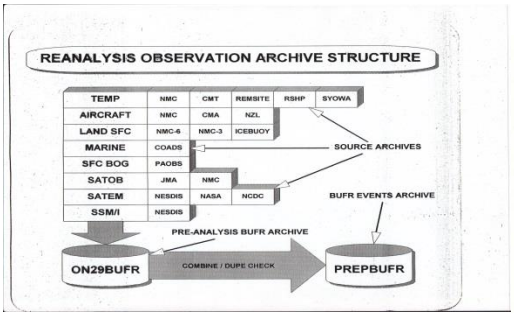


Figure 3. Land surface inventory. From back to front, in megabytes; NMC, ICEB, FGGE, USAF, TD13, TD14, USSR.

The components of each datatype were converted to WMO standard BUFR formats and assembled in a UNIX file system database structure. A consolidation system was developed to extract synoptic data from the database and assemble synoptic assimilation files for the reanalysis. The assembly system is diagramed below left, and the consolidated assimilation datasets shown graphically below right. A version of this system evolved over several years to perform this function in NCEP operations for ingest and preprocessing of all observations into the NCEP data assimilation and forecasting functions. The new BUFR database was implemented into operations in March 1997, as the 50 year R1 reanalysis was completing. The extension of R1 has been carried out at NCEP to the present day. The operational BUFR database has replaced the original prototype to supply observations to the R1 extension, otherwise known as CDAS.



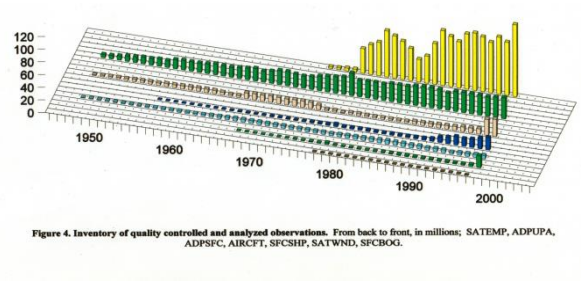
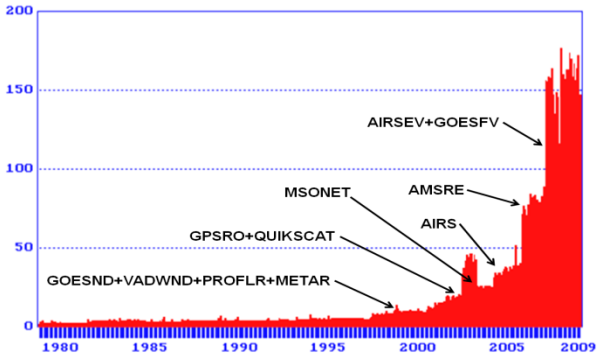
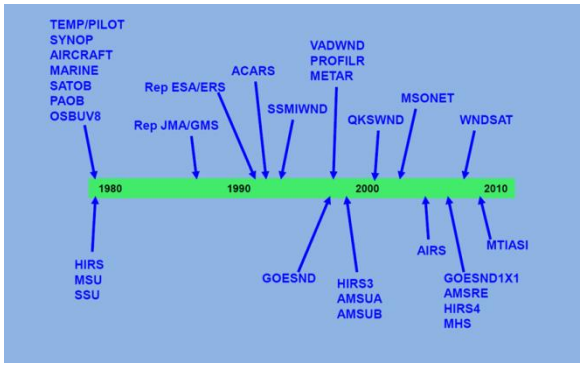


Figure 4. Inventory of quality controlled and analyzed observations. From back to front, in millions; SATEMP, ADPUPA, ADPSFC, AIRCFT, SFCSHP, SATWND, SFCBOG.

The NCEP Reanalysis Database is augmented with new observations from the BUFR database every day. Storing and using high resolution satellite data, staring around 1998 was challenging because of the sheer magnitude of the new datasets. The charts below illustrate the increase in and composition of NCEP data ingest from FGGE through 2009. Specific types of data added through the period are shown in the observation timeline below right. Thanks to an excellent tape archive system developed at NCEP over the past 20 years, the entire archive of GR1

reanalysis observation data has been saved intact, along with updates making corrections and additions over the years covered.





The GR1 database has been upgraded over time into modern NCEP/BUFR formats with improvements such as radiosonde drift and extended aircraft information, etc. New projects are starting at NCEP to reanalyze as far in the past as is useful for climate research. Several projects have analyzed surface obs back into the 19th century. NCEP plans to reanalyze back to at least 1948, in order to replace and update the GR1/CDAS with a third generation ensemble based reanalysis for advanced climate research and monitoring. The pilot for this will use the updated GR1 datasets, and with other historical dataset archives produced from other center's re-analyses, as they are available. NCEP is also focused on exchanging feedback information with other groups and products.

GR1 Observation Database Contributions to Other Reanalysis Projects

A number of reanalysis projects carried out around the world have directly benefitted from the work that went into creating the NCEP reanalysis observation archive for GR1. Additional reanalysis projects at NCEP, including GR2, NARR, and CFSR, all used the GR1 observation database. The ECMWF ERA40/ERAI/ERACLIM projects used significant amounts of the GR1 observations, 1957-1994. The JMA JRA25/JRA55 projects used NCEP and ERA40 datasets containing the GR1 datasets. MERRA1 and MERRA2 reanalysis projects at NASA/GMAO used the GR1/CDAS archive as the bulk of the conventional datasets. The ASR project at OSU downloaded the entire GR1 archive 1979-2014 as observations for reanalysis of the Arctic region. Below are references describing some of the prominent reanalysis projects which have used the GR1 datasets, and who provided constructive feedback.

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