



3DNEPH CHRONOLOGY

EDITED BY

CHARLES W. COOK

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JULY 1984

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)  This Forecaster Memo contains a compilation of the 3DNEPH chronology of significant events from 1 Jan 72 through 31 Jul 83. This information provides an in-depth insight into which years and geographical areas are most likely to contain good data. Users of the historical analysis data sets can determine potential deficiencies.							
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PREFACE

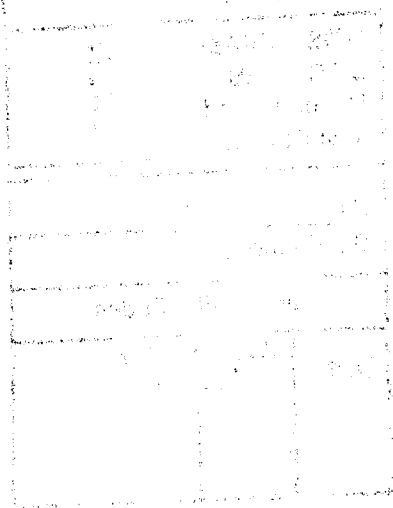
This Forecaster Memo contains the Three-Dimensional Cloud Analysis (3DNEPH) chronology of significant events from 1 January 1972 through 31 July 1983. The information provides an in-depth insight into which years and geographical areas are most likely to contain good data. Users of the historical analysis data sets can determine potential deficiencies.

The chronology describes the entire data set archived during the production life of the 3DNEPH model, which was replaced on 1 August 1983 with the Real Time Cloud Analysis (RTNEPH) model. Another publication will be written at a later date for RTNEPH chronology.

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CHRONOLOGY OF 3DNEPH SIGNIFICANT EVENTS SINCE 1972

- Jan 72: The Northern Hemisphere (NH) 3DNEPH began with 32 boxes--11-14, 18-23, 26-31, 34-39, 42-47, and 51-54. Archival of these data began 00Z, 1 January 1971 (see Atch 1). NH boxes 3, 4, and 5 were added operationally on 31 January, but were not archived.
- Feb 72: NH boxes 17,25, and 33 were added operationally on 28 February, but were not archived.
- Mar 72: Archival of 38 boxes was begun 12Z, 21 March.  
DMSF 5528 was launched 24 March.
- Apr 72: NH boxes 50,59-62 were added operationally on 19 April and archival began 12Z, 20 April.  
New geography fields, delineating land/water boundaries, were implemented.  
DMSF 5528 was used after April 1972.  
DMSF 4527 ended 27 April. Attitude control problems precluded computer processing.
- May 72: NH boxes 24, 32, 40, and 48 were added operationally on 15 May and archival began 18Z, 16 May.
- Nov 72: DMSF 6530 was launched 8 November.  
A 3DNEPH window capability was added, permitting off-line analysis over selected areas.
- Jan 73: All DMSF 5528 Southern Hemisphere (SH) ascending data were processed; only some DMSF 6530 SH data were processed.
- Feb 73: 3DNEPH was expanded to include SH (see Atch 2) on an operational basis, 12 February. The model ran 4 times daily beginning at 00Z plus every 6 hours (00Z PE6HRS).  
Full coverage was achieved on 14 February for all 60 NH boxes (4 corner boxes have no data). Complete NH archival began 09Z, 15 February.
- Mar 73: DMSF 3526 ended 3 March.
- Apr 73: The satellite data processors were removed from 3DNEPH runstream and placed in the preprocessor runstream.

- Jun 73: The 3DNEPH satellite 2NM infrared (IR) preprocessor was adjusted, resulting in fewer clouds being categorized as "thin." This adjustment improved the ability of the cloud forecast models to infer moisture from the cloud analyses.
- DMSP 6530 ended 21 June.
- Aug 73: Only SH ascending data from DMSP 5528 were processed.
- DMSP 7529 was launched 16 August.
- Sep 73: High resolution 2NM visual (HR) and "IR" were used from both DMSP 7529 and 5528.
- Oct 73: Quality of the NH 3DNEPH was marginal.
- Nov 73: Improved video processor software was implemented to improve detection of low stratus over water.
- Feb 74: DMSP 5528 ended 23 February.
- High frequency noise degraded the DMSP 7529 IR data.
- Mar 74: The quality of the 3DNEPH was degraded by noise in the DMSP 7529 data.
- A 1/2 mesh (100 NM) surface temperature analysis model replaced a whole mesh (200 NM) surface temperature data base for improved IR interpretation.
- DMSP 8531 was launched 16 March.
- Apr 74: In early April, the primary recorder on DMSP 8531 had a problem resulting in lost data at the beginning of playbacks.
- The operational run time for SH 3DNEPH was offset 3 hours (03Z PE6HRS) to maximize conventional data input.
- May 74: Beginning in late May DMSP 8531 IR data were not incorporated into 3DNEPH analysis because of a sensor malfunction.
- Archival of SH 3DNEPH for all 60 boxes began 03Z, 4 May.
- Jun 74: There was no DMSP data in the 3DNEPH 01/03Z-06/06Z because of a planned outage of data formatter.
- For the entire month of June, only IR data from DMSP 7529 were used in the 3DNEPH. DMSP 8531 had sensor/vehicle problems. HR data were occasionally available for operational use.
- Jul 74: No satellite data were included on 2, 3, 10, 19, and 27-31 July due to a planned outage of the data formatter.

Aug 74: Only DMSP 7529 provided data to the 3DNEPH. DMSP 9532 was launched 8 August and failed to produce any visual data.

Sep 74: DMSP 7529 attitude problems caused mislocation of data.

A new video data satellite processor; 1/64 (3 NM) vice 1/8 (25 NM) mesh grid, was implemented. Improvements included more accurate total cloud (particularly small scattered clouds), less occurrences of erroneous depictions of clouds over the bright land masses (deserts) and better analyses over high contrast coastal areas.

Oct 74: On 19 October, DMSP 8531 experienced a reoccurrence of the previous IR problem. Apparently an IR signal amplification malfunction caused the IR data signal to be overdriven in the northern portions of ascending and descending passes, resulting in data being completely white over this region. DMSP 8531 IR data were removed from 3DNEPH on 20 October. (9532-IR, 7529-HR/IR, and 8531-HR were used.)

The short range (3-6 hours) prog ("PROGER") capability in the 3DNEPH was eliminated 24 October. "PROGER" produced a first guess (initialization) for next synoptic 3DNEPH.

Jan 75: The 1/2 mesh surface temperature forecast model was added to the 3DNEPH program the last week in January. It incorporated a diurnal temperature forecast out to 6 hours so processing of IR would always have a temperature field within 90 minutes. This land temperature module minimized time-phased problems between IR and conventional surface temperature analysis. It also reduced overinterpretation of clouds and permitted the detection of more low clouds.

A finer 1/8 mesh geography field was incorporated into the 3DNEPH on 6 January. The field was derived from the Defense Mapping Agency Aerospace Center (DMAAC) and has a 5-10 mile resolution. This helped minimize erroneous interpretation of clouds, especially near lakes, small islands, etc.

Mar 75: Use of high resolution cloud prog (HRCP) forecasts as "first guess" for the desert areas of North Africa (3DNEPH boxes 23, 31, and 39) were discontinued on 10 March. This reduced the overanalysis of clouds induced by vertical motion forecast along the boundary of the grid. This problem had been most serious during spring months when upper lows stagnated over the Mediterranean area.

IR satellite data from DMSP 8531 improved in quality and were put back into the 3DNEPH about 28 March. These data, not used since October 1974, improved the 3DNEPH significantly.

Apr 75: A new bias curve was added to the 3DNEPH IR processor. Statistics for this curve were collected for each DMSP IR sensor using AFGWC surface temperature analysis data.

DMSP 8531 IR data were removed from 3DNEPH effective 29 April.

Snow data from Snow Analysis Program (SNOSEP) were incorporated into NH satellite data processing.

May 75: DMSP 10533 was launched 23 May 75. This spacecraft was launched to replace 7529 and 9532. The sunshade failed to completely deploy. All data near the right edge of scan were impaired. Approximately 145NM of IR data were unusable near the edge of scan and approximately 60NM of visual data were marginal. Incorporation of IR data into 3DNEPH from 10533 began 31 May.

Persistence replaced HRCP 3-hour forecast as 3DNEPH first guess on 28 May.

The 3DNEPH was badly overinterpreted; the Pacific was nearly overcast all the time. Middle and high cloud information was usable, but clouds were too low.

Jul 75: On 17 July, minor improvements were made to the 1/2 mesh surface temperature analysis module. Improvements included expanding the size of the surface station files and increasing the scan radii. These modifications helped improve differentiation between clouds and bright sand in desert regions.

DMSP 8531 IR data were reintroduced into the 3DNEPH on 18 July.

DMSP 7529 could record only 97 minutes, vice nominal 200 minutes, of HR/IR data.

Aug 75: DMSP 7529 lost one HR/IR recorder, resulting in a data void over Canada.

Eastern Europe cloud cover was seldom updated. The 09Z 3DNEPH was very good over Eurasia, but the quality steadily deteriorated through 00Z.

DMSP 8531 IR data were taken out of the 3DNEPH on 24 August.

Sep 75: 3DNEPH satellite data were slightly underinterpreted. This was done to compensate for a problem with the IR data that caused it to be overinterpreted along the left side of descending pass. This correction resulted in missing low clouds, and heights of other clouds being too low.

Two problems were identified with DMSP 8531 HR data. Coastlines are often outlined with clouds because of mislocation of data and a gray-shade problem with the digitizing of HR data caused anomalous cloud interpretation.

On 25 September, a new first guess temperature field was introduced into the 1/2 mesh surface temperature analysis. The 3-hour analysis used by the satellite processor benefited from a diurnal surface temperature forecast as a first guess plus available surface report temperatures to update the forecast. Many desert problems were corrected by this change.

Oct 75: The SH snow analysis module was implemented on 9 October. This module paralleled its NH equivalent and generated daily 1/8 mesh snow-depth and age analyses for specific SH boxes. The module used satellite brightness, surface observations, continuity, climatology, land, sea and ice geography, and manual updates.

The sunshade on 10533 deployed on its own.

Nov 75: The Satellite Global Data Base (SGDB) was implemented 4 November. The SGDB was literally a composite image of cloud cover around the world, continuously updated by visual and IR data from the DMSP spacecrafts and stored in digital format by the satellite processor.

No 3DNEPH between 04/12Z and 13/03Z November should be used.

All 3DNEPHs after 26 November were of good quality.

Dec 75: NH boxes 31 and 39 over Africa, 13 and 14 over India, and 22 over Pakistan had persistent overinterpretation of clouds.

No data from DMSP 8531 were received 31 October - 12 December due to playback problems. Limited playback capability became available 12 December for visual data.

Jan 76: Overinterpreted clouds in NH boxes 28, 29, 36, and 37 over the Arctic. SH 3DNEPH showed large scale systems, but seriously underinterpreted clouds, especially low stratus over water.

Feb 76: The capability to provide a 3DNEPH of specific cloud types from simultaneous IR and visual satellite data was developed. The program was designed to correlate 1/8 mesh satellite derived parameters with actual "ground truth" surface cloud reports.

NH box 36 had problems because of limited DMSP data and Greenland/Canada cloud cover was overinterpreted.

SH 3DNEPH was poor especially 1-5 February.

Beginning on 26 February, data from DMSP 8531 playbacks could only be accomplished while spacecraft was in daylight.

DMSP 11534 was unsuccessfully launched 19 February.

Mar 76: The IR normalization software was implemented on 4 March. New software used correlation statistics to fine tune the interpretation of IR satellite data. Interpretation is heavily dependent on the conventional surface temperatures and improved cloud/no cloud decisions and the ability to detect stratus.

3DNEPHs for 20-23 March were poor.

NH boxes 35, 36, 43, 44, and 45 received limited or no DMSP data.

Greenland usually appeared overcast with just the coast clear because of nonrepresentative surface temperature reports and the dependency of the IR processor on a good surface temperature field. These data should be disregarded.

All 3DNEPHs from 24-31 March were degraded because of IR calibration problems.

Apr 76: All 3DENPHs from 1-28 April were degraded because of IR calibration problems.

Several tuning adjustments were made on 28-29 April resulting in satisfactory 3DNEPHs thereafter.

3DNEPHs for 20, 21, and 29 April were of unusable quality.

May 76: A new background brightness data base was implemented at 21Z, 4 May. This new data base was used for analysis of DMSP visual data and differed considerably from the previous minimum brightness technique. The new technique (1) reduced the size (factor of 15) of the data base; (2) interfaced with the snow analysis; (3) was unaffected by persistent cloudiness, sunglint, and terminator darkness (twilight); and (4) was flexible for future state-of-the-art advances. The new data base assumed albedo was a very conservative parameter in snow free areas. A representative brightness value for each 25NM gridpoint on the earth was allowed to oscillate slowly in response to seasonal and satellite sensor changes.

The NH cutoff times for DMSP data increased to 6 hours vice 4 hours, 15Z, 12 May. Using data collected in blinds, improved European, Asian, and Pacific cloud analyses resulted.

The satellite cloud typing logic was expanded to include cumulonimbus (CB) effective 12Z, 13 May. Previously CB identification was based on visual data only. The new bispectral, visual and IR, cloud typing technique demonstrated capability to detect more CBs than previous method. This capability resulted in the generation of multi-layered (or many "filled" layers) clouds in the data base. Previously, 3DNEPH was only able to identify the cirrus shields of CB clouds and missed associated multi-layered cloud systems.

DMSP 8531 data were lost on 14 May. This very productive noon-ascending satellite survived 11,211 revs and 26 months on orbit. The data loss degraded analyses. The snow analysis program also lost its input for the "no snow" determination and was discontinued. DMSP 7529 was only vehicle providing HR data to SGDB.

- Jun 76: Two major events resulted in improved satellite data coverage. Beginning 15 June, NOAA-4 data were processed by 3DNEPH and on 17 June, a second recorder on DMSP 7529 became operational, permitting receipt of data over polar latitudes. Only SH HR data were excluded from processing since it was actually nighttime data in both quarter orbits. NOAA-4 provided more current data, filled in many previously data void or data sparse areas (particularly in northern latitudes, including Canada), and eliminated the traditional data gap which generated many discontinuities. The snow analysis program once again became operationally feasible.
- NOAA-4 HR/IR data were routinely used to update NH boxes 42, 43, 50, 51 and 52; however, ascending data often incorrectly removed stratus from the area.
- An IR without paired HR data problem, identified in April and May 76, was corrected so descending IR data no longer caused extensive areas of overcast. However, the large, somewhat uniform stratus area off the SW coast of the U.S. was missed throughout the period.
- Jul 76: The NOAA-4 data became increasingly noisy due to transmission line problems. Noise introduced vast speckled or grainy areas which 3DENPH interpreted as scattered cloud. When IR tuning factors were set to minimize the effect of noise, it precluded analysis of stratus or low clouds. The NOAA-4 IR data were removed from the SH at 21Z, 7 July, but not from NH because of the availability of coincident visual data which was not as noisy.
- The usage of the second recorder on DMSP 7529 was reduced 25%, resulting in reduced coverage. Analyses over desert areas were excellent.
- Aug 76: NOAA-5 was launched. A new IR data processor, with stratified IR tuning factors, was implemented 24 August. The new IR processor partially corrected the thin cirrus and low stratus class problems. General characteristics of the new processor were (1) increased sensitivity to scattered cloud conditions; (2) more accurate determination of cloud tops; (3) improved ability to detect stratus; (4) more accurate analyses in the tropics (old processor tended to be too cloudy); (5) improved cloud amount determination in the vicinity of cloud edges; and (6) correction of gridpoint dropouts due to the failure of the processor to define statistical nodes. The new IR was tuned for the first time and was now representative of the real world. (Until this time, low stratus/cumulus were missing and all clouds detected had negative altitude errors.) Accurate analysis of Eastern Pacific stratus using nighttime data also resulted.

The NOAA-4 noise problem, which occurred in July, diminished and cloud analyses improved. There were still problems with NH boxes 31 and 39 over the desert. The low stratus over water was generally underinterpreted.

Sep 76: DMSP 12535, the first in the series of Block 5D vehicles, was launched on 11 September.

NOAA-5 data became primary, vice NOAA-4, on 17 September. There was not noticeable difference between these data. Both continued to suffer from occasional "noise" and NOAA-5 data were processed into the NH only.

Severe satellite data problems occurred on 13 September (grayshade scale was inverted) and on 21-23 September (NOAA-5 data were incorrectly located), which resulted in unusable 3DNEPHs for these dates.

Oct 76: Effective 5 October, a new routine was implemented for inserting the Navy ice edge limits into the snow data base. The previous method involved manual encoding of teletype messages which yielded a coarse outline of the ice limits. The new technique involved direct digitization of the US Navy ice analysis maps, which provided very accurate ice location data and directly benefited 3DNEPH and SNODEP.

The Greenland overcast problem returned when operational criteria necessitated the lowering of decision thresholds to allow more clouds to be analyzed over snow.

SH 3DNEPH was very good over water, but less reliable over land. Low clouds were often missed over land and clouds outlined ice fields frequently because of poor surface temperature fields.

The high plateaus around the Himalayas were consistently overinterpreted because of poor surface temperature fields.

Northern latitudes were underinterpreted for low and middle clouds 1-7 October. On 7 October, the NOAA-5 video data were trimmed and a correction to an indexing problem in the IR processor substantially corrected this problem. From 12/12Z until 13/15Z, the 3DNEPH was badly underinterpreted because of a system implementation error. NOAA-5 data were lost from 12/21Z until 13/06Z. On 19 Oct, another indexing error was corrected and the satellite data were returned. After 21 October, DMSP 7529 video data were no longer processed into the 3DNEPH. This, plus the correction made on the 19th, made the NH 3DNEPH very representative. The elimination of all DMSP 7529 IR data from the 3DNEPH on 27 October also eliminated many problems caused by bad data readouts.

Nov 76: The 3DNEPH was generally of high quality.

The high plateaus around the Himalayas were generally overinterpreted for 03Z through 09Z. Cloud interpretation over Hudson Bay, Greenland, and high latitudes was unreliable because of problems in the ice field.

Dec 76: A new 1/2 mesh initialization temperature field procedure for the NH was implemented at 15Z, 21 December. This new temperature field was obtained by using stratified standard atmospheric lapse rates to adjust the terrain following temperature field of the 5LAYER model to the surface. It produced a marked improvement in the infrared satellite cloud analysis over high latitudes, deserts, and other data sparse areas. The Greenland/Himalaya class problem was significantly reduced.

NOAA-5 data became increasingly dark during the month and grayshade adjustments were made to brighten the data and improve the cloud detail.

3DENPH quality was good.

Jan 77: The quality of the NH 3DNEPH was degraded by a persistent DMSP 10533 data interpretation problem over snow fields and resulted in large areas of overcast low cloud over the snow fields in Asia. The interpretation of NOAA-5 data was generally more realistic for these areas. Problem was corrected on 5 February.

The 3DNEPH start time was changed on 17 January to approximately 1+30 vice 1+55 after the synoptic data time for operational considerations. The 3DNEPH, running at its new time, contained the same amount of surface data but the central time of the satellite data was shifted back approximately 25 minutes.

Clouds were overinterpreted over the Sahara because of diurnal time phasing in the new temperature field. On 19 January, NOAA-5 IR data was cooled by 3 degrees Celsius to make it look more like DMSP. At the same time, the 3DENPH was also tuned to compensate for the change.

Feb 77: The NOAA-5 grayscale was found to be restricted at the cold end of the scale to a temperature no lower than 226 degrees Kelvin because of a hardware error. Despite the error, the 3DNEPH was not adversely affected. The problem existed since NOAA data had been processed at AFGWC.

On 3 February, AFGWC expanded the IR bias capability to incorporate bias curves for each satellite. Separate tuning factors, but not separate curves, existed previously for each satellite. Concurrently, the DMSP 10533 curve was adjusted to apply more warming at the cold end of the curve to alleviate excessive cloudiness over snow areas of the northern latitudes.

On 14 February, a software change was implemented to apply manually altered "bogus" data to the synoptic 3DNEPH. Thereafter, manual corrections were available to all automated users and archive customers. Satellite data over most Northern Hemisphere land masses are bogused using three bogus techniques; addition or subtraction of a specific cloud type and amount to an area, zeroing out all clouds, and replacement of cloud amounts and types in specific areas. Only the last type of bogus data are translated to the synoptic 3DNEPH.

An error in the temperature forecast program in production since 1974, was corrected on 17 February. The temperature forecast was made between temperature analysis times and satellite observation times. The phase lag error was particularly severe in areas experiencing high amplitude diurnal temperature variations such as in desert areas. The error caused a shift in the diurnal temperature forecast of up to 6 hours for analysis times centering around 00Z.

A DMSF 10533 data problem was discovered on 19 February and all 10533 data were deleted except NH daytime IR from the 3DNEPH. A banding effect or alternate light/dark areas parallel to the subtrack, extended across the entire pass and produced grayshade anomalies. The 3DNEPH occasionally placed clouds over the bright areas of these bands, especially over water.

The problem was traced to spacecraft recorders and data were subsequently restricted to eliminate the banding. Meanwhile, 3DNEPH operated almost entirely from NOAA-5 data.

Mar 77: The quality of the 3DNEPH was excellent. A diurnal temperature correction was added 13 March. The correction improved the interpretation of clouds in data sparse land areas using initial temperature, cloud cover, latitude, albedo, water vapor and time (season, time of day, etc.).

The background brightness values for DMSF 10533 were corrected using NOAA-5. This correction greatly alleviated the overinterpretation problems over deserts and improved detection of low stratus over southern China.

Apr 77: 3DNEPH quality was excellent.

A major milestone in the history of 3DNEPH was reached with the operational processing of DMSF Block 5D data. The constant resolution and sensor gain characteristics resulted in data which were truly superior for automated processing. The local noon orbital configuration also contributed a great deal. The only known problem with the data from DMSF 12535 was the occurrence of data drop-outs due to proton bombardment of a critical sensor element. This resulted in artificial cloudy and clear bands which stretched completely across the data with respect to subtrack.

These drop-outs were confined primarily to the geographical areas of the Poles and the South Atlantic. DMSP 12535 IR data were turned on in the NH effective 15Z, 19 April and HR data were turned on in the NH for background brightness updating effective 15Z, 22 April.

NOAA-5 data were removed from the automated processing mode to eliminate redundant data between NOAA-5 and DMSP 12535. NOAA-5 data had been suffering from noise which degraded the 3DNEPH to a limited extent.

Only ascending NH IR data from DMSP 12535 were processed because visual data had shown continued degradation in the form of mislocation and grayshade banding. 3DNEPH was not impacted.

Beginning this month, Video Normalization correlations for clear gridpoints were made with respect to visual grayshades. A grayshade correction curve was dynamically produced and applied within 3DNEPH with respect to "sunlint cone angles."

May 77: The quality of the 3DNEPH data base was excellent.

The problem with DMSP 12535 data drop-outs continued in the South Atlantic and over South America. This resulted in occasional thin anomalous cloud lines and clear lines; however, the data were generally representative of the actual meteorological condition.

Analyses over high latitudes of NH (boxes 28, 29, 36, and 37) were greatly improved with the addition of DMSP 12535 data on 19 April. When severe attitude problems developed, DMSP 12535 HR/IR data were removed, effective 23Z, 25 May.

All NOAA-5 IR/HR data were put into the 3DNEPH, effective 15Z, 26 May. The 3DNEPH data bases for 00Z-15Z, 26 May were very limited in data and the SH for this period should not be used. The quality of the 3DNEPHs was good; however, analyses over the northern portions of NH boxes 28, 29, 36 and 37 were poor and should not be used.

Jun 77: 3DNEPH analyses were good, but somewhat degraded due to limited and noisy satellite data. DMSP 12535 data were returned to operational processing by 3DNEPH effective 18Z, 21 June; discontinued for a 24-hour period (23 June) due to a data formatter problem; and were intermittent 25-27 June due to continuing problems. NOAA-5 data replaced the 12535 data, but were of poor quality. Noise became severe at times resulting in poor cloud interpretation

DMSP 13536 was launched on 5 Jun.

The snow reports file was converted from inches to centimeters on 7 Jun. SNODEP display remained in inches.

Quality control was increased for the SH in late June.

Jul 77:

The quality of the SH 3DNEPH over the South Atlantic and South America was somewhat degraded by problems with the Block 5D spacecraft. High energy protons striking the spacecraft sensors in the region of the "South Atlantic Anomaly" caused wide areas of drop-outs. When 3DNEPH processed data in this region, it used persistence to replace data drop outs. The final product often had a striped appearance where persistence was markedly different from the new interpretation. Proton hits and data drop-outs also occurred at the Poles with intermittent occurrences elsewhere. In addition to data drop-outs, DMSP 12535 was also subject to an OLS reset caused by proton hits. DMSP 12535 turned itself off when proton hits occurred and all further data were lost until it was turned on at the next readout. This problem occurred frequently in the Pacific blind and resulted in the loss of several quarter orbits of data.

Effective 14Z, 14 July, DMSP 13536 IR data were processed into the 3DNEPH NH replacing 10533. Effective 14Z, 19 July, 13536 IR data were processed into the SH. DMSP 13536 HR data could not be processed.

As part of a new project to upgrade the SH data base, a surface temperature forecast option was activated on 1 July. The infrared satellite imagery processor used temperatures as a baseline for comparing infrared temperatures to determine if clouds were present. The purpose of the temperature forecast was to offset some of the time phase lag between satellite crossing times and surface observations times. The forecast had been in use for over two years with good success. The forecast program used inputs of latitude, times of day, albedo, initial temperature, atmospheric moisture, and cloud cover/height to produce a 3-hour radiative temperature forecast.

On 26 July, software was provided to copy persistence, by 3DNEPH box, into areas of the synoptic 3DNEPH identified as bad.

Aug 77:

The quality of the 3DNEPH remained unchanged. The same problems were present concerning high energy protons. Data from DMSP 12535 became more degraded because of noise, especially on multiple readouts for the Pacific.

Sep 77:

The quality of the 3DNEPH was poor, 6-21 September, because of software changes to map DMSP data into the SGDB. The new software was much faster and mapped all Block 5D data to give overlap at the equator.

Several minor problems impacted 3DNEPH. During the period 6-12 September, no descending DMSP data were mapped into the SGDB; ascending data were mapped only 60% of width. Ascending and descending data were mapped only 70% of width, 12-20 September.

All data were mapped after 20 September, but interpretations were degraded somewhat until 28 September.

A change on 14 September to the SNODEP spreading routine allowed more gradual changes in snow depths but this change and 3DNEPH snow flag problems degraded video interpretation.

Oct 77: The quality of 3DNEPH was excellent. A change to the video analysis over snow fields caused a partial disabling of video input to 3DNEPH from 6-31 October; NH was not degraded and effect upon SH was minimal.

Nov 77: The quality of the 3DNEPH was generally good. Video processing was turned off at 14Z, 4 November because of severe degradation of DMSP 12535 data. The problem was corrected and processing was reinstated at 19Z, 8 November.

On 8 November, a new linear interpolation scheme between present, past, and future temperature fields was implemented. This change greatly improved IR analysis over desert regions.

Dec 77: The quality of the 3DNEPH was generally good, but deteriorated gradually during late December because of a slight overinterpretation of clouds.

A major software error made the 06-15Z NH 3DNEPHs on 6 December unusable.

Hardware problems degraded the 3DNEPH data bases on 21 and 22 December.

Jan 78: 3DNEPH quality was fair during the month with a marked improvement at the end of the month after resolution of a DMSP satellite temperature channel command error on 24 January. Overinterpretation of the Indian subcontinent was a consistent problem until the command error was corrected.

On 1 January, the DMSP 12535 spacecraft clock did not change years correctly, and as a consequence, several quarter orbits were mapped into the wrong hemisphere; SH 3DNEPHs for 03Z and 09Z, 1 January should not be used.

An IR pass was mapped into the video data base and subsequent 3DNEPH processing resulted in severe overinterpretation. NH 3DNEPH boxes 14, 15, and 22 should not be used for 03Z and 06Z, 15 January.

Feb 78: The quality of the NH 3DNEPH was better than January. Overall quality of the SH was degraded by apparent increases in data loss due to proton events and increased incidents of OLS resets.

All ocean areas in SH from 3-7 February were seriously overinterpreted by the insertion of an incorrect adjustment factor.

NH boxes 53, 54, and 55 for 12Z, 9 February were degraded by an OLS reset to DMSF 13536.

Beginning 15 February, a change was made to the 3DNEPH temperature fields. Valid surface reports were assigned to the appropriate eighth-mesh point and spread to the surrounding four points to re-establish existing temperature gradients which were lost by using only smoothed half-mesh temperature fields.

Beginning 21 February, SH 3DNEPH began using the forecast field from the previous nephanalysis for satellite interpretation since it provided a sufficiently accurate and more appropriate field.

Mar 78: The quality of the 3DNEPHs were good. The SH continued to experience interpretation problems due to frequent OLS resets.

The 06Z, 1 March NH 3DNEPH had no surface reports in the analysis. Only satellite data and persisted analysis were used, but the analysis was satisfactory.

The northeastern corner of Africa, NH box 15, was severely overinterpreted on the 06Z, 7 and 9 March. The problem was caused by the incorrect storage of a reference field used to determine the surface temperature field.

Due to a software problem at the Fleet Numerical Weather Facility, the sea surface temperature field could not be updated from 12Z, 7 March until 00Z, 15 March. Interpretation over most sea areas remained good.

Video data were mapped into the IR SGDB on 22 March. This problem caused 06Z NH boxes 12, 13, 20, 31, 28, and 29 to be unusable.

Apr 78: The quality of the 3DNEPHs deteriorated slightly during the month because of overinterpretation.

A computer file management problem prevented about 10% of the boguses from entering the synoptic nephanalysis. The problem was corrected 28 April.

Video data mapped into IR portion of the SGDB degraded NH boxes (14, 15, 23, and 31) 03Z, 11 April to 03Z, 12 April.

Implementation of bad software on 26 April forced all surface reports to be treated as clear. This error resulted in the 18Z and 21Z 3DNEPHs were almost entirely clear and therefore unusable.

May 78: DMSF 14537 was launched 1 May.

The quality of the 3DNEPH improved during the month. Inclusion of DMSF 14537 data was accomplished smoothly with little interpretation error. Since 14537 did not experience OLS resets in

the SH, the interpretation over the South America improved dramatically.

A hardware error on 18 May permitted 14537 and 12535 video data to be mapped into the SGDB inverted (light areas appeared dark and vice versa). Action was taken to prevent this data from contaminating the NH data base; however, SH boxes 15, 23, and 31 for 15Z and 21Z were heavily overinterpreted and unusable.

Modest overinterpretation of land points in the SH was discovered late in the month involving mismanagement of temperature files. The fix was implemented in June.

A three hour synoptic SH 3DNEPH was implemented for a two-week test.

Jun 78: The quality of the 3DNEPHs decreased slightly, resulting in an overinterpretation of NH oceans and slight underinterpretation over land masses.

Readout conflicts between DMSP 13536 and 14537 from 1 June to 5 June caused further satellite data loss (1-2 passes/day).

DMSP 14537 data were misgridded into the SGDB from 3 to 5 June because of inaccurate ephemeris. The primary effect on the 3DNEPH data base was misinterpretation near shorelines due to anomalous comparisons of surface and IR temperature values. Once detected, the problem was corrected.

An aperiodic fluctuation of the onboard sensor assembly reference temperature was suspected to have caused some misinterpretation problems in descending DMSP 14537 data. The data were watched closely and removed from the data base when the fluctuations became too gross; resolution of the DMSP glare obstructor problem solved these errors.

Jul 78: The quality of the NH 3DNEPH improved while the SH remained the same. A commercial power outage on 7 July caused severe degradation of the SGDB. Neph analyses for 09Z/12Z NH and 09Z/15Z SH were of poor quality and should not be used.

Aug 78: Operational production of three hourly SH 3DNEPHs began 1 Aug.

Quality of the 3DNEPHs were good. Two NH 3DNEPHs (03Z, 3 August and 21Z, 8 August) were deficient in surface reports due to systems problems. The 09Z, 10 August NH contained no surface data for the same reason. These three NEPHs were satisfactory.

Sep 78: The quality of the 3DNEPHs was good. Two NH 3DNEPHs (03Z, 6 September and 00Z, 18 September) were deficient in surface reports due to systems problems. The interpretation of both was considered usable.

The 03Z and 06Z NH 3DNEPHs for 3 September contained no synoptic bogus due to a series of systems problems. The quality was not significantly degraded.

A series of diagnostic runstreams were made available to display total cloud, infrared satellite cloud amount, surface report cloud amount, and total cloud minus infrared cloud amount.

The problem associated with the use of the 1000mb temperature initialization field in data sparse areas of the SH was eliminated by substituting the gradient level five-layer (5LAYER) temperature field. This was accomplished for the NH in December 76.

The gradient level temperature field was reduced to the surface by using a series of standard lapse rates stratified by latitude and season.

Oct 78: The quality of the 3DNEPHs improved since a slight optimistic bias was reduced in both hemispheres.

System hardware problems degraded 09Z, 8 October SH boxes 28, 29, 35, 36, 37, 43, and 44; 12Z, 8 October SH boxes 36, 43, and 44; and NH boxes 10, 18, 19, and 27. Data within these boxes were unusable.

SH 3DNEPHs around Antarctica were improved by extending possible ice points into 3DNEPH boxes 27, 30, and 38. Failure to recognize the existence of pack ice in these boxes previously resulted in incorrect analyses by the IR processor.

Nov 78: The quality of the 3DNEPHs was good.

Dec 78: The quality of the 3DNEPHs was degraded by the occurrence of computer hardware problems which reduced the amount of satellite data available. All 3DNEPHs were satisfactory.

IR cloud analyses around Antarctica were improved by new lapse rates south of 75 degrees south. These lapse rates, stratified by season, were used to reduce the gradient level 5LAYER forecast temperature field to a terrain-height temperature field. NH lapse rates had previously been used for this region.

An error in the routine which updated the background brightness field was corrected. Incorrect packing of IR cloud amounts prohibited any changes in background values. This correction should result in improved video cloud analyses in areas of large seasonal variation in background brightness. This problem was particularly evident in northern Africa (box 31), which was often overinterpreted.

Jan 79: The quality of the 3DNEPHs was good.

Feb 79: The quality of the 3DNEPHs was good.  
SH surface temperature fields required for accurate satellite data interpretation, and previously built after the 1+40 surface batch, were scheduled after the 2+15 surface batch, resulting in an improved IR interpretation.

Mar 79: The quality of the 3DNEPHs was good.  
The SH18Z, 6 March 3DNEPH was degraded because of a failure to process current satellite data into the analysis.

Apr 79: The quality of the 3DNEPHs was good.

May 79: The quality of the 3DNEPHs was good.

Jun 79: Quality of the 3DNEPHs was good.

DMSP 15539 was launched 6 June.

The 3DNEPH bogus routine was altered to bogus stratus into layers 4 and 5 regardless of terrain. Prior to this change, stratus was added to higher layers over terrain heights greater than 535 meters. Bogusing stratus into varying layers resulted in discontinuous layers of cloud over areas of rapidly changing terrain heights.

A problem was discovered in the satellite processor and the correction resulted in a significant decrease in "speckling," an increase in the amount of low cloud analyzed, and some improvement in the vertical distribution of 3DNEPH clouds. Speckling is the single point non-meteorological occurrence of clear or broken clouds in otherwise overcast areas.

Jul 79: Quality of the 3DNEPHs was good.

DMSP 15539 data replaced DMSP 12535 data input to the 3DNEPH on 2 July 79.

15539 OLS resets caused degradation in the 24/12Z and the 31/00Z, 03Z, 06Z and 09Z SH 3DNEPHs.

Aug 79: Quality of the 3DNEPHs remained good.

The 18Z, 1 August 3DNEPHs were degraded due to a loss of synoptic data.

The 18Z 3DNEPHs for 2 August were degraded by DMSP 15539 OLS resets. A software change to OLS operation significantly reduced further reset problems.

3DNEPH software was modified to add tuneable correction factors stratified by satellite, gray-shade and location to the temperature calculation. DMSP 15539 has a T-channel spectral window of approximately 10.8-12.5U rather than the 8-13U interval used on earlier flights. 3DNEPH calculation of IR temperatures is highly sensitive to the variability of atmospheric water vapor because of the reduced absorption by ozone in this narrower interval. As a result, tuning the infrared analysis for relatively dry mid-latitude and the moist tropics was extremely difficult.

- Sep 79: Quality of 3DNEPHs remained good. DMSP 12535 ended 16 September.
- Oct 79: Quality of 3DNEPHs remained good.
- Nov 79: Quality of 3DNEPHs remained good.
- Dec 79: The quality of 3DNEPHs deteriorated due to the failure of DMSP 14537 on 2 December. The 09Z, 2 December 3DNEPH was the last cycle containing DMSP 14537 data, and the last to contain only DMSP data.

Processing of TIROS-N imagery began with the 06Z 3 December cycle. Corrections for TIROS-N pessimism over water and optimism over land were made for each hemisphere.

The quality of the 3DNEPH was normal by 12 December.

- Jan 80: The quality of the 3DNEPHs deteriorated with the loss of IR data from DMSP 15539 due to restricted spacecraft operations when battery cell failures reduced available data to daylight only.

Processing of IR satellite data from DMSP 13536, which is now in a mid-morning ascending orbit, started with the 21Z, 2 January 3DNEPH. Video data from DMSP 13536 began to be processed with the 21Z, 7 January 3DNEPH.

TIROS-N was declared non-operational by NOAA on 20 January, however AFGWC continued to receive data from this vehicle on a non-timely basis.

The overall quality of the 3DNEPH in both hemispheres was degraded due to the fluctuation in NOAA satellite data sources.

The 18Z and 21Z 3DNEPHs for 14 January contained no conventional surface data.

- Feb 80: The fluctuation in satellite data sources continued to degrade the 3DNEPHs in both hemispheres. TIROS-N returned to operational status on 5 February, however readout conflicts with NOAA-6 prevented timely data receipt. Processing of Northern Hemisphere (N.H.) NOAA-6 IR data began at 06Z, 26 February.

On 17 February, DMSP 13536, which had been providing visual and IR data, failed, and, until 26 February, TIROS-N was the sole source of input data for the 3DNEPHs.

Corrections for pessimism over Northern Hemisphere (N.H.) land, optimism over South Hemisphere (S.H.) land and significant optimism over water in both hemispheres were made throughout the month.

Mar 80: The quality of the 3DNEPHs was good, even with the absence of video data. Northern Hemisphere corrections were made for pessimism over water and optimism over land.

Apr 80: The quality of the 3DNEPHs remained good with one exception. Rapid seasonal changes in the Middle East and Indian Ocean areas caused an interpretation problem along coastal boundaries. Early morning 3DNEPHs, using NOAA-6 data, would erroneously place a string of clouds along coastlines, which had to then be manually removed from the data base. This problem continued through the month.

TIROS-N video was input to the N.H. 3DNEPH on 15 April, 18Z. This was the first video data used in the 3DNEPH since 17 February.

NOAA-6 IR and TIROS-N video were input to the S.H. 3DNEPH on 28 April, 18Z.

DMSP 15539 daylight IR was processed into the S.H. 3DNEPH on 28 April, 18Z.

To optimize data processing in the S.H., the following satellite data processing scheme began on 21 April:

- a. No TIROS-N data processed south of 45°S.
- b. Alternate NOAA-6 quarter orbits not processed south of 45°S. Every other quarter-orbit was processed completely.

On 1 April, an iteration scheme was added to the 3DNEPH which adjusted the cloud amount in each of the 15 layers. The scheme ensured the sum of all layers would be within 5% of the total cloud amount at each grid point.

Corrections continued to be made for a pessimistic bias over N.H. land.

May 80: The quality of the 3DNEPHs improved during the month. The coastal over-interpretation problem was solved at 21Z, 22 May. Software was modified to add tunable correction factors stratified by satellite, grayshade, and latitude, to the satellite sensed temperature. This correction was primarily for NOAA-6 over-interpretation in the tropics, and is similar to the Aug 79 correction for DMSP 15539.

On 15Z, 13 May, video data from DMSP 15539 were processed into the 3DNEPHs and video data from TIROS-N turned off. Northern Hemisphere TIROS-N video data were turned on again at 06Z, 16 May.

Jun 80: The quality of the 3DNEPHs was good, with no discernable biases during the month.

An electronic malfunction in the Data Formatters (D.F.) used to process satellite data, resulted in degraded Northern and Southern Hemisphere 3DNEPHs from 12Z, 24 June to 09Z, 25 June. These 3DNEPHs should not be used.

Jul 80: After NOAA-6 and TIROS-N data were corrected for an overall pessimistic bias, 3DNEPH interpretations during the month were stable in both hemispheres.

Aug 80: This was a month of turmoil for the 3DNEPH.

The loss of DMSP 15539 on 9 August resulted in the degradation of all Northern and Southern Hemisphere 3DNEPHs due to a lack of visual data. NOAA-6 visual data were unsuitable as a replacement due to the presence of the terminator in the data. TIROS-N data were specially enhanced to provide a suitable display within AFGWC, rendering the data unacceptable in this form for 3DNEPH processing. During 12-15 August, the enhanced visual TIROS-N data were processed into the N.H. and S.H. 3DNEPHs, resulting in definite over interpretation.

TIROS-N and NOAA-6 IR data are now the only satellite data inputs to the 3DNEPH.

Sep 80: This month saw less turmoil but little improvement in 3DNEPH quality.

Southern Hemisphere processing limits for NOAA-6 were removed at 00Z, 22 September. Previously, every other quarter orbit was not processed south of 45°S.

An intermittent problem with one Data Formatter led to a number of unuseable quarter orbits being processed into some N.H. and S.H. 3DNEPHs between 23-28 September. The bad data affected the following 3DNEPHs;

- a. S.H. 15-18Z 23 September, 03-18Z 26 September, 15-21Z 27 September.
- b. N.H. 06-18Z 26 September.

Oct 80: This was the first full month without surface data from the Iran/Iraq region. Impact to the 3DNEPH was minimal, however, due to the overall clear weather in the region.

The 3DNEPH over the Horn of Africa and Persian Gulf continued to be underinterpreted, especially low clouds along the coastal areas.

Clouds derived from NOAA-6 data over water areas of the Northern Hemisphere in general were overinterpreted.

A bad Data Formatter on 2 October again caused several quarter orbits of satellite data to be unuseable. The bad data affected the 6 N.H. and 3 S.H. 3DNEPHs from 15Z, 2 October to 09Z, 3 October.

Nov 80: As a result of sensor failure aboard TIROS-N, all visual and IR data from this spacecraft were lost on 2 November. This left only NOAA-6 IR imagery as a source of satellite data for the 3DNEPH.

The coastal interpretation problem surfaced again on 4 November over India and the Horn of Africa. This was corrected on 25 November when it was discovered that the Mid East coastal points were set at too low a gray shade value.

New background brightness values were implemented on 24 November to help correct the persistent overinterpretation problem from August 80.

On 12 November, the N.H. and S.H. 3DNEPHs were impacted by bad satellite data again due to Data Formater malfunction.

Dec 80: There were no major interpretation problems during the month; however, a small adjustment was made over N.H. Night Land on 15 December to reduce underinterpretation.

On 4 December, the 3DNEPH cutoff time for satellite data was increased to accept data up to 8 hours old.

On 8 December, an outage of the Det 7, AFGWC Automated Weather Network computer resulted in the loss of several hours of surface data. This impacted the 8 December 06Z and 09Z, 3DNEPHs.

Jan 81: Overall quality of the 3DNEPH was good. However, between 19-21 January several large bias adjustments were made to both the N.H. and S.H. Nephs. Corrections were made for underinterpretation of low clouds over both N.H. day land and day water. In the S.H., adjustments were made for overinterpretation of the land areas and underinterpretation of the daytime water areas.

Feb 81: Overall, the 3DNEPH showed a slight tendency toward optimism during the month. There were, however, several problems that significantly degraded several analyses.

Low surface report counts, due to hardware problems at AFGWC, on 2 February, and a switching problem from Europe on 8 February affected the 2/15Z, 8/21Z, and 9/00Z N.H. 3DNEPHs.

Hardware problems at Wallops Island caused the loss of several quarter-orbits of NOAA satellite data on 3 and 8 February. The lost data impacted the 3/15Z, 3/18Z, and 8/15Z N.H. and S.H. 3DNEPHs.

Significant degradation of the 25/00Z, 03Z, 06Z, 09Z, and 12Z N.H. and S.H. 3DNEPHs was traced to a hardware problem at AFGWC. A Data Formatter was incorrectly shipping NOAA-6 visual data into the IR data base causing severe interpretation problems. These 3DNEPHs should not be used.

New Background Brightness Grayshade (BBGS) values were implemented on 26 February to account for snow covered land and SEA ICE. The new BBGS's enabled the Neph to respond to different temperature thresholds over snow and ice, giving a better representation of low cloud at northern latitudes.

Mar 81: The 3DNEPH was degraded by several substantial data outages during March. These were caused by a variety of problems at NOAA, AFGWC, and with the NOAA-6 satellite. The following Neph's were impacted: N.H. 2/03Z, 17/15Z, 20/03Z, 27/03Z, and 30/15Z; S.H. 13/15Z, 17/06Z, and 31/12Z.

The 21/03Z N.H. Neph was not run and the 06Z S.H. Neph was run with extremely low surface data counts due to an AFGWC computer outage.

During the month, the Neph's were basically optimistic despite small positive temperature bias corrections for IR interpretation on 2, 3, 10, and 17 March. In addition, another positive bias correction was made on 31 March after implementation of new IR temperature curves.

On 26 March, new NOAA-6 IR temperature correction curves (vice the DMSP F-4 curves which were being used for NOAA-6) were implemented into the 3DNEPH. Prior to this implementation, it was extremely difficult to tune the Neph to differentiate between cloudy and non-cloudy areas over both the extreme northern and middle latitudes. The Neph's that followed showed substantial improvement.

Apr 81: 3DNEPH interpretation was generally good during April although weekly bias corrections were made to minimize an optimistic bias over N.H. land areas and pessimistic bias over water areas.

On 14 April, for the first time, additional bias corrections were made for the tropical areas. This allowed the N.H. land and water areas to be tuned separately from the tropical areas which had been extremely pessimistic. By the end of April, tremendous improvement was noted in the interpretation over Africa and South America due to this change.

Beginning on 21 April, DMSP F-3 center expand AGE data was used as an aid to bogusing the 3DNEPH.

During April, 4 N.H. 3DNEPHs and 1 S.H. 3DNEPH were lost during the period 28/18Z to 29/03Z due to a computer outage at AFGWC. In addition, 3 complete satellite passes were not processed due to the system outage.

On 5 April, 2 satellite passes were completely lost, due to NOAA hardware problems, which impacted the 5/18Z N.H and S.H. 3DNEPHs.

May 81: 3DNEPH quality was good.

Weekly bias corrections to the 3DNEPH continued to minimize the pessimistic trend over N.H. water areas and the optimistic bias in the tropical regions.

Jun 81: Generally the 3DNEPH did a good job of interpretation early in the month. However, there continued to be a problem with overinterpretation of Northern Hemisphere day water. Also, during the last two weeks of June, analyses over the SE United States were extremely pessimistic.

On 2 June, both the Northern and Southern Hemisphere 3DNEPHs for 00Z were cancelled due to a power outage to AFGWC hardware.

On 18 June, a new bogus routine was implemented into the operational quality control of the 3DNEPH. The new software, known as "AGE BOGUS", allows the incorporation of cloud intelligence into the 3DNEPH by bogusing directly from the expanded AGE high resolution film data. The "AGE BOGUS" software was initially developed to allow data from DMSP satellite F-3 to be included in the 3DNEPH through bogusing. By 24 June, the AGE BOGUS technique was also being used on data from NOAA 6. This new software allowed more accurate quality control of the 3DNEPH.

Jul 81: 3DNEPH quality was good during the month even though there were some problems in interpretation. Communications problems between AFGWC and Carswell AFB on 3 July degraded the 3/15Z, 3/18Z, and 3/21Z 3DNEPHs due to sparse surface reports.

Cloud interpretation was slightly optimistic in the tropics and oceans of the Northern Hemisphere.

Conversely, land areas exhibited a very pessimistic bias due to a problem with the background brightness values. Incorrect Background Brightness Grayshades had inadvertently been added to the operational files. This problem was corrected on 13 Jul by reloading the old fields from tape archive.

NOAA-7 thermal (IR) satellite imagery was integrated into the 3DNEPH beginning 21 July. The addition of this data improved satellite coverage and timeliness which produced a higher quality

3DNEPH. However, limitations on AFGWC data processing equipment forced the deletion of some NOAA-7 IR data, i.e. quarter-orbits 3 and 4 south of 45°S. This action reduced data processing time with minimal impact to 3DNEPH data quality.

Aug 81: The 3DNEPH suffered during August due to several unrelated hardware problems. Overall cloud interpretation was slightly optimistic over both land and ocean areas. The loss of AFGWC computer resources due to a base-wide power outage on 9 Aug delayed the receipt of numerous surface observations. As a consequence, the 03Z Northern and Southern Hemisphere 3DNEPHs were not completed.

Onboard hardware problems with NOAA-6 began on 15 August and continued through the end of the month. The problem involved the scanner motor and the associated power supply and created noise and dropouts in the data. This problem only slightly degraded 3DNEPH quality until 30 August. However, between 30/12Z August and 31/23Z August, only 45 percent of all NOAA-6 data was processed resulting in degraded 3DNEPH's throughout this period.

Sep 81: Onboard hardware problems with NOAA-6 continued from August. No NOAA-6 data were processed directly into the 3DNEPH between 1 and 8 September, but an effort was made to incorporate some NOAA-6 data, when possible, into the 3DNEPH using the AGE Bogus software. 3DNEPHs during this period contained predominantly NOAA-7 IR data and conventional meteorological reports. On 8 September, the NOAA-6 problem was fixed, and data quality returned to normal. After the NOAA-6 vehicle problems early in the month were corrected, overall 3DNEPH interpretation was very good. No significant errors in interpretation were detected.

Hardware problems with a Data Formatter at AFGWC on 17 and 18 September caused degraded satellite data to be placed in the Satellite Global Data Base. As a result, overinterpretation in the 3DNEPH was apparent in thin bands running parallel to satellite swaths. This overinterpretation affected all Northern and Southern Hemisphere 3DNEPHs during the period 17/00Z September 81 to 18/21Z September 81. The problem was corrected at 19/00Z September 81 with no subsequent failures.

Oct 81: Throughout the month, cloud interpretation in the 3DNEPH was consistently optimistic over land areas and slightly pessimistic over ocean regions.

Hardware problems at AFGWC degraded several 3DNEPHs during October. Limited surface reports from these hardware outages affected the following 3DNEPHs: 19/03Z and 19/06Z Southern Hemisphere; 28/12Z and 28/18Z Northern Hemisphere; and 30/06Z Northern Hemisphere (no surface data available).

Two compensating errors in the 3DNEPH snow interpretation software were discovered during the month. As a result, snow fields were consistently misinterpreted. Software was modified to correct this condition with no apparent impact on 3DNEPH quality.

Nov 81:

Cloud interpretation in the 3DNEPH was consistently optimistic throughout the Northern Hemisphere. Numerous attempts to correct this optimism were mostly unsuccessful. Specifically, areas in the SNOW/ICE fields of the polar and sub-polar regions were underinterpreting cloud cover and degrading the 3DNEPH.

A possible solution to this underinterpretation problem in the polar regions was discovered late in the month. The temperature/gray shade curve for cloud interpretation was identified as a potential problem in the 3DNEPH optimism. The proposed solution was to modify the temperature difference (surface temperature fields minus satellite IR fields) to achieve the desired cloud interpretation. Initial testing showed no significant improvement, but testing continued through the end of the month.

Dec 81:

Changes to the temperature/gray shade curve for cloud interpretation in November improved 3DNEPH interpretation in December. Generally, the cloud underinterpretation problem, identified in November, was less noticeable in December. The 3DNEPH remained slightly optimistic throughout the month.

Three separate problems with computer hardware at AFGWC resulted in a variety of degraded and uncompleted 3DNEPH cycles.

Hardware outages on 10 December 81 resulted in total loss of the 15Z and 18Z 3DNEPH cycles (both Northern and Southern Hemispheres). Additionally, the 21Z 3DNEPH cycle was severely degraded with only small amounts of satellite data processed.

Disk hardware problems on the computer used to process satellite data degraded the 23/18Z December 3DNEPH cycle (running with limited satellite data) and finally caused the total loss of the 21Z cycle.

Other computer hardware outages on 30 December resulted in minimal surface data processed for the 18Z Northern Hemisphere 3DNEPH. The impact of the problem, however, was lessened due to the processing of extensive satellite data into this cycle.

Jan 82:

Considerable 3DNEPH degradation during January resulted from a variety of AFGWC computer system failures and Automated Weather Network (AWN) problems. The new World Meteorological Organization (WMO) synoptic code caused some problems initially, but by mid-month, data receipt had returned to normal. The optimistic bias evident during December continued into early January. Tuning factors were introduced that increased cloudiness in the Northern

Hemisphere high latitudes. This change improved the overall 3DNEPH by month's end.

A base-wide power fluctuation on 1 January caused a temporary loss of AFGWC's primary and back-up computer systems. This outage resulted in an incomplete 12Z 3DNEPH (north and south) cycle.

3DNEPHs during the period 02/03Z to 02/12Z were degraded due to low surface report counts. These problems were a result of a bad software decoder implementation at Carswell AFB TX, for the WMO synoptic code change.

Problems with the AWN from 6 January 21Z to 7 January 18Z degraded those data bases. As a result, approximately 10% of surface data for each 3DNEPH cycle was lost. Each 3DNEPH during this period was degraded accordingly.

Nine 3DNEPHs between 21Z 13 January and 00Z 15 January were without the benefit of full surface data coverage. The degraded surface counts resulted from an AFGWC system hardware problem. A broken steam pipe in the air handler unit serving AFGWC's computer System 5/6 caused a significant computer outage on 21 January 1982. The 12Z 3DNEPH cycle was not completed and the 15Z and 18Z cycles did not contain satellite data. Considerable care should be taken when using these data bases.

A combination of problems with Carswell AFB TX, computers and AFGWC computers resulted in degraded 3DNEPHs between 00Z 25 January and 15Z 26 January. Initially, Carswell's computers caused a loss of surface data processing at AFGWC, then AFGWC's computers failed to process all required surface data.

Feb 82: Northern Hemisphere land regions tended to be under-interpreting cloudiness in 3DNEPHs during February. Similarly, the Southern Hemisphere was under-interpreting over water. Tuning biases were introduced to respond to this misinterpretation. Improvement was apparent by late February.

Three separate incidents during February caused some degradation to 3DNEPH quality.

An Automated Weather Network (AWN) communications outage on 9 February prevented 4000 surface reports from being processed into the 12Z N.H. 3DNEPH. Data receipt returned to normal for the 15Z cycle.

A hardware outage on AFGWC Systems 1/4 on 12 February resulted in low surface reports for the 03Z 3DNEPH. Considerable degradation is expected in that data base.

On-board hardware problems with the NOAA-6 weather satellite on 24 and 25 February caused a significant loss of quality to the 24/12Z through 25/18Z 3DNEPHs (both Northern and Southern). A similar satellite failure occurred in September 1981 before NOAA engineers fixed the problem. Outages of this nature are expected to increase with the continuing poor health of the NOAA-6 vehicle.

Mar 82: Three separate incidents during March caused severe degradation to 3DNEPH quality.

Low surface reports resulted in several degraded 3DNEPHs throughout the month. System 1/4 hardware and software problems caused each surface data outage. The degraded 3DNEPHs were: 01/18Z - 02/00Z; 20/12Z - 20/15Z; 28/00Z; 29/21Z - 30/06Z.

Hardware problems at the Navy's Fleet Numerical Oceanography Center (FNOC) resulted in very old sea surface temperatures (SST) during two separate periods in the month. Caution should be used when applying the 3DNEPH interpretation over water during these periods. The SST's were not updated from 03-05 March and 13-19 March.

Continuing on-board power supply problems with NOAA-6 have continued to degrade the 3DNEPH. NOAA-6 data were not available from 6-8, 13-16, and 20-29 March.

Several modifications to the 3DNEPH software were completed in March. These modifications include a surface spreader change, 500 mb standard height correction, and corrections to the interpretation bias over snow.

The 3DNEPH surface spreader was modified from a three-point weighted spreader to a two-point constant spreader on 1 March. The new spreader decreases the influence (spatially and temporally) of surface data on 3DNEPH interpretation. Regions with sparse surface data will more noticeably reflect this change.

An error was detected with the standard level at 500 mb in the 3DNEPH. Previously, the 550 mb level was incorrectly used to represent the 500 mb standard height. The change was implemented on 1 March.

On 29 March, an error was detected in the IR temperature difference required to interpret cloud over snow/ice. The value was incorrectly set at 8 degrees K. It was changed to 3 degrees K. This action increased the amount of cloud interpreted over snow/ice.

Prior to 29 March, the 3DNEPH was primarily optimistic. The changes in the snow/ice temperature delta reduced this optimism. By the end of the month, some pessimism was evident.

Apr 82:

The 3DNEPH was mostly pessimistic during the month. Tuning factors were introduced, but the 3DNEPH remained pessimistic at month's end. Two problems occurred during April which severely degraded the quality of the 3DNEPH. In addition, two quality control modifications of satellite data were accomplished.

During April, the reliability of the NOAA-6 on-board scanner improved considerably. However, NOAA-6 was not available on 8, 14, 15, 16, and 17 April. Several 3DNEPHs were severely degraded when bad NOAA-6 data entered the data base undetected. These degraded 3DNEPHs were: 14/00Z-14/06Z; 16/21Z-17/00Z.

Low surface reports resulted in several degraded 3DNEPHs throughout the month. Hardware problems on System 1/4 caused the vast majority of these low surface counts. The degraded 3DNEPHs were: 05/21Z; 06/12Z-06/15Z; 13/00Z; 13/15Z-13/21Z; 14/03Z; 16/03Z; 18/03Z; 19/00Z; 19/09Z; 24/12Z; 25/12Z and 26/09Z.

Beginning 20 April, F-3 data were used to improve the quality of the 3DNEPH. These data were not computer processed directly into the 3DNEPH. However, the 3DNEPH was manually quality controlled with the F-3 data. This was done only when NOAA-6 was not available.

Effective 23 April, NOAA-7 quality control was reduced by 50 percent to alleviate AFGWC/WSP workload saturation. All NOAA-7 data were still computer processed directly into the 3DNEPH.

The 3DNEPH spreader was modified from a two-point spreader to a three-point spreader on 19 April for supplemental SPRINTs run without timely satellite data. The two-point spreader will still be used for SPRINTs run with timely satellite data. The effects of the surface data will, as a result, be more evident in the 3DNEPH.

May 82:

The 3DNEPH remained pessimistic during May. Efforts to decrease cloudiness was successful late in the month when some optimism became evident. The poor health of NOAA-6 during May highlights the problems encountered.

The reliability of the NOAA-6 on-board scanner became very poor during May. Data were only available on the following dates: 1-4, 17, 20, 23, and 29 May. DMSP F-3 data were used to improve the quality of the 3DNEPH when NOAA-6 data were not available.

The quality control of NOAA-7 was increased on 5 May back to the level it was prior to last month. AFGWC/WSP was able to meet this increased workload since NOAA-6 was not available for most of the month.

Low surface reports resulted in four degraded 3DNEPHs in May. Two were due to hardware problems, one was due to an AWN outage, and one was due to a Carswell outage. Degraded 3DNEPHs were: 01/21Z, 10/15Z, 14/03Z, and 30/21Z.

Sea surface temperatures were not updated from 10-15 and 24-26 May. Satellite interpretation over water during these periods should be used with caution, although no major interpretation problems were detected in these regions.

A lightning strike on the Wallops Island antenna resulted in the loss of some NOAA-7 data on 31 May. No satellite data from this readout site were processed into the following 3DNEPHs: 31/09Z through 31/21Z.

The cutoff time for allowing satellite data to process was increased during May. Due to the poor health of NOAA-6, NOAA-7 has been the only reliable source of satellite data to the 3DNEPH. To allow all the NOAA-7 data from the multiple readouts to process, a six hour cutoff time was used. Previously, a five hour cutoff was used, but this prevented some satellite data from processing.

Jun 82:

The reliability of the NOAA-6 on-board scanner remained poor in June. Data from the satellite were only available on the following dates: 2-4, 16, 17, and 19-23 June. F-3 data were used to quality control the 3DNEPH when NOAA-6 data were not available.

Low surface reports resulted in 13 degraded 3DNEPHs in June. Nine were due to hardware problems, two were due to a scheduled system outage, one was due to an AWN outage, and one was due to a power outage. The degraded 3DNEPHs were: 01/03Z, 01/18Z, 03/21Z, 04/15Z, 06/12Z, 10/18Z, 10/21Z, 11/00Z, 11/12Z, 14/00Z, 14/06Z, 24/15Z, and 26/21Z.

Two 3DNEPHs were not run at all due to hardware problems. These 3DNEPHs were the 17/03Z and the 17/06Z.

The lightning strike on the Wallops Island antenna resulted in the loss of additional NOAA-7 data for the first two days of June. All 3DNEPHs from 01/00Z to 02/03Z were consequently degraded.

Bad NOAA-6 data were processed into one Northern 3DNEPH and five Southern 3DNEPHs. The degraded Northern 3DNEPH was the 04/21Z. The degraded Southern 3DNEPHs were: 04/21Z, 05/00Z, 05/03Z, 05/06Z, and 05/09Z.

The 3DNEPH was basically optimistic during June. Efforts to increase cloudiness had mixed results. While the Northern Hemisphere had a good interpretation, the Southern Hemisphere still remained optimistic at the end of the month.

Jul 82: The 3DNEPH remained slightly optimistic in July. This optimism was small enough that no major adjustments in the interpretation were made.

The reliability of the NOAA-6 on-board scanner remained poor in July. Data from the satellite were only available on the following dates: 1, 14-19, and 22-24 July. F-3 data continued to be used to quality control the 3DNEPH when NOAA-6 data were not available.

Low surface counts resulted in 19 degraded 3DNEPHs in July. The vast majority of these were due to hardware problems. The degraded 3DNEPHs were: 04/18Z, 05/12Z, 06/03Z, 06/18Z, 10/15Z, 10/18Z, 12/12Z, 12/15Z, 13/00Z, 14/15Z, 14/18Z, 18/00Z, 19/06Z, 21/21Z, 24/18Z, 25/21Z, 30/12Z, 31/09Z, and 31/12Z.

Two 3DNEPHs (13/06Z and 16/15Z) were degraded due to bad satellite data being processed.

Aug 82: The reliability of the NOAA-6 on-board scanner remained poor in August. Data from the satellite were only available on the following dates: 8, 13-19, and 21 August. F-3 data continued to be used to quality control the 3DNEPH when NOAA-6 data were not available.

Low surface counts resulted in only six degraded 3DNEPHs in August. The degraded 3DNEPHs were: 03/00Z, 03/03Z, 10/21Z, 14/18Z, 30/21Z, and 31/03Z. The problems which caused the low surface counts were varied with no trend evident.

The 3DNEPH interpretation over water was pessimistic most of the month. Turning factors were applied on the 18th which corrected the problem outside of the equatorial region ( $+30^{\circ}$ ). Further tuning factors were applied on the 26th to correct pessimism in the equatorial region which was causing a distinct line of clouds primarily at  $30^{\circ}\text{N}$ .

Sep 82: The 3DNEPH interpretation over water was optimistic most of the month. The problem was complicated by several periods when the sea surface temperatures were not updated. By the end of the month, new tuning factors had corrected this optimism.

The reliability of the NOAA-6 on-board scanner improved in September. Data from the satellite were available on the following dates: 1, 6-10, 12, 13, and 15-27 September. F-3 data were used to quality control the 3DNEPH when NOAA-6 data were not available through 20 September. The use of this data was discontinued on 21 September.

Low surface counts resulted in only two degraded 3DNEPHs in September: 29/18Z and 29/21Z.

Bad satellite data were processed into six specific 3DNEPHs. They were the SH 06/03Z, NH 08/00Z, NH 13/21Z, NH 14/00Z, NH 14/03Z, and NH 14/06Z.

The Northern Hemisphere sea surface temperatures grew substantially old during several periods of the month. Sea surface temperatures were older than 40 hours on the following dates: 15th, 18th-19th, and 23rd-27th.

Oct 82: 3DNEPH interpretation over land areas above 50°N was optimistic. The main problem was that warm stratus over cold land was not being identified as cloud. On 15 October, tuning factors were adjusted for IR interpretation over snow-covered areas to correct this problem. No usable NOAA-6 data were received in October. The only satellite data processed into the 3DNEPH were from NOAA-7.

Five quarter orbits of NOAA-7 were not processed into the 3DNEPH on 6 October. Degraded 3DNEPHs were: 06/00Z - 06/09Z.

Sea surface temperatures on 4 October were greater than 40 hours old. This will degrade the cloud interpretation over the water for that day.

Twenty-one 3DNEPHs were degraded due to low surface data counts. Nine were due to hardware problems within AFGWC, five were due to problems with the lines between AFGWC and Carswell, and seven were due to a lower than expected number of reporting stations. The degraded 3DNEPHs were: 05/18Z, 06/12Z, 12/15Z, 14/09Z, 15/12Z, 15/15Z, 16/09Z-16/15Z, 17/00Z, 17/18Z, 17/21Z, 19/18Z-20/00Z, 20/06Z, 21/15Z, 22/21Z, 23/00Z, 26/21Z, and 27/21Z.

Nov 82: 3DNEPH interpretation over mid-to-high latitude land areas remained optimistic. Tuning factors were again adjusted on 15 November (as they were on 15 October) to add more cloud over snow-covered areas. The result was a somewhat better interpretation.

The reliability of the NOAA-6 on-board scanner improved considerably in mid-November. Data from the satellite were available on the 14th as well as 17-30 November.

Bad satellite data were processed into the 3DNEPH on 25 November which degraded the 25/03Z-25/12Z NEPHs.

Sea surface temperatures were greater than 38 hours old for these 3DNEPHs: 05/00Z-07/00Z, 11/03Z-11/18Z, 22/15Z-23/00Z, and 29/03Z-29/09Z. Consequently, the interpretation over water for these data bases may be slightly degraded.

Twelve 3DNEPHs were degraded due to low surface counts. Four were due to lines at either Clark or Hickam being down. The remainder were due to hardware problems within AFGWC. The degraded 3DNEPHs were: 03/12Z-03/18Z, 04/03Z, 13/12Z, 18/15Z, 19/12Z, 20/09Z, 24/06Z, 24/21Z, 26/12Z, and 27/15Z.

Dec 82:

The reliability of the NOAA-6 on-board scanner was outstanding in December. Data from the satellite were available the entire month.

Five 3DNEPHs were degraded due to low surface counts. They were: 04/21Z, 11/12Z, 19/00Z, 19/03Z, and 24/03Z.

Sea surface temperatures were greater than 38 hours old for these 3DNEPHs: 01/03Z-12Z, 02/18Z-21Z, 04/00Z-06/18Z, 07/15Z, 10/06Z, 11/15Z-12/12Z, 14/06Z-15/06Z, 16/15Z-19/15Z, 20/06Z-21Z, 22/03Z-18Z, 23/03Z-25/18Z, 27/06Z-29/12Z, 30/15Z-31/12Z. The interpretation over water for these data bases may be slightly degraded.

The surface spreader was changed from a two-point constant spreader to a three-point constant spreader on 16 December. The original decision to have a two-point spreader was arbitrary. The original options were two-point and three-point; both were considered satisfactory, but the two-point version was chosen. A detailed quality control of the 3DNEPH, however, indicated that a three-point spreader would provide a better analysis. This was especially evident in the interpretation of stratus in data sparse regions.

The IR grey shade-to-temperature conversion table was modified to represent DMSP temperature ranges and resolution on 29 December 1982. The NOAA data are now processed to fit the DMSP table. This was done in preparation for the processing of F-6 data. Visual comparisons of the cloud interpretation of the NOAA data revealed no significant degradation.

Jan 83:

F-6 data was processed into the 3DNEPH immediately after the satellite was declared operational on 7 January. This was done by using the old F-4 IR-BIAS correction curves to determine the cloud analysis. Some tuning was required, but the overall analysis was good. New IR-BIAS correction curves are being developed for F-6 to further improve the analysis.

Effective 8 January, F-6 data replaced NOAA-6 in the 3DNEPH. NOAA-6 data are still being used to quality control the 3DNEPH, but only F-6 and NOAA-7 are processed. Of these two, F-6 is now being quality controlled vice NOAA-7.

Two 3DNEPHs were degraded due to low surface counts. They were 21/12Z and 25/15Z.

Sea surface temperatures were greater than 38 hours old for these 3DNEPHs: 01/00Z-02/21Z, 04/15Z-07/18Z, 14/03Z-15/03Z, 25/03Z-26/03Z, 27/03Z-28/03Z, and 29/03Z-30/03Z. The interpretation over water for these data bases may be slightly degraded.

An area of bad satellite data in the southern hemisphere was not being overwritten by newer data. The problem existed in boxes 10 and 18 from 1 January to 18 January. The problem was analyzed and fixed. The data in these boxes for the times listed should not be used.

Feb 83

The new IR-BIAS correction curve for F-6 was developed and subsequently implemented on 10 February at 15Z. This resulted in an overall improvement in the analysis during the last half of the month.

F-6 and NOAA-7 continue to be processed into the 3DNEPH. In addition, 187 quarter orbits of NOAA-6 data were used to quality control it.

Thirteen 3DNEPHs were degraded due to low surface counts. They were: 01/12Z, 02/15Z, 3/18Z, 4/00Z, 10/12Z, 11/12Z, 11/18Z, 14/00Z, 17/12Z, 17/15Z, 23/03Z, and 25/12Z.

Sea surface temperatures were greater than 38 hours old for these 3DNEPHs: 01/15Z-03/00Z, 19/03Z-19/06Z, 24/15 -25/06Z, and 26/03Z-28/21Z. The interpretation over water for these data bases may be slightly degraded.

The 23/12Z 3DNEPH was not run. A fire in a backup system put the production cycle too far behind to catchup. As a result we were forced to skip this data base to get current databases on schedule.

Mar 83:

The overall quality of the cloud analysis remains good. Towards the end of the month some slight overinterpretations were detected and tuning factors were applied to correct them.

Fifteen 3DNEPHs were degraded due to low surface counts. They were: 04/12Z, 16/06Z, 17/12Z-17/21Z, 18/12Z, 18/15Z, 24/12Z, 26/03Z-15/21Z, 21/18Z, 21/21Z, 27/03Z and 27/06Z.

A total of 217 quarter orbits of NOAA-6 data were used to quality control the 3DNEPH.

Apr 83:

The quality of the 3DNEPH cloud analysis was good in April. No tuning factors were required during the month.

Six 3DNEPHs were degraded due to low surface counts. They were: 01/15Z, 14/18Z, 15/00Z, 21/15Z, 23/21Z, and 27/12Z.

Sea surface temperatures were greater than 38 hours old for the following 3DNEPHs: 01/03Z-01/18Z, 12/15Z-19/00Z, 21/18Z-22/09Z, and 26/09Z-27/12Z. Note: There were not temperature updates for seven days from the 12/03Z through 18/21Z.

A total of 109 quarter orbits of NOAA-6 data were used to quality control the 3DNEPH up through 16 April. Imagery from the vehicle was turned off on 17 April. Data receipt from NOAA-8 began 26

April and 35 quarter orbits were quality controlled in the same manner as NOAA-6.

May 83: The quality of the 3DNEPH cloud analysis remained good in May. Tuning factors during the first week corrected some over interpretation in the tropics and some underinterpretation in the NH water.

Eight 3DNEPHs were degraded due to low surface counts. They were: 01/12Z, 01/15Z, 01/21Z, 02/18Z, 08/03Z, 13/12Z, 24/18Z, and 28/03Z.

Sea surface temperatures were greater than 38 hours old for the 02/06Z-02/18Z 3DNEPHs.

A total of 185 quarter orbits of NOAA-8 data were used to quality control the 3DNEPH in May. F-6 and NOAA-7 data continues to be processed into the 3DNEPH.

Three additional 3DNEPHs were degraded. The 07/12Z and 07/15Z 3DNEPHs contained no new satellite data due to a personnel error. The 28/21Z 3DNEPH contained some bad boguses.

Jun 83 The quality of the 3DNEPH remained good in June. Some under interpretation in the NH water developed and tuning factors were applied to correct it.

Ten 3DNEPHs were degraded due to low surface counts. They were: 01/15Z, 01/18Z, 01/21Z, 02/00Z, 02/03Z, 05/12Z, 06/18Z, 16/03Z, 18/03Z and 23/03Z.

Sea surface temperatures were greater than 38 hours old for the following 3DNEPHs: 01/15Z-02/15Z, 05/06Z-10/03Z, and 13/18Z-13/21Z.

A total of 172 quarter orbits of NOAA-8 data were used to quality control the 3DNEPH in June. F-6 and NOAA-7 continued to be processed into the 3DNEPH.

Jul 83 The quality of the 3DNEPH remained good in July. No tuning factors were required.

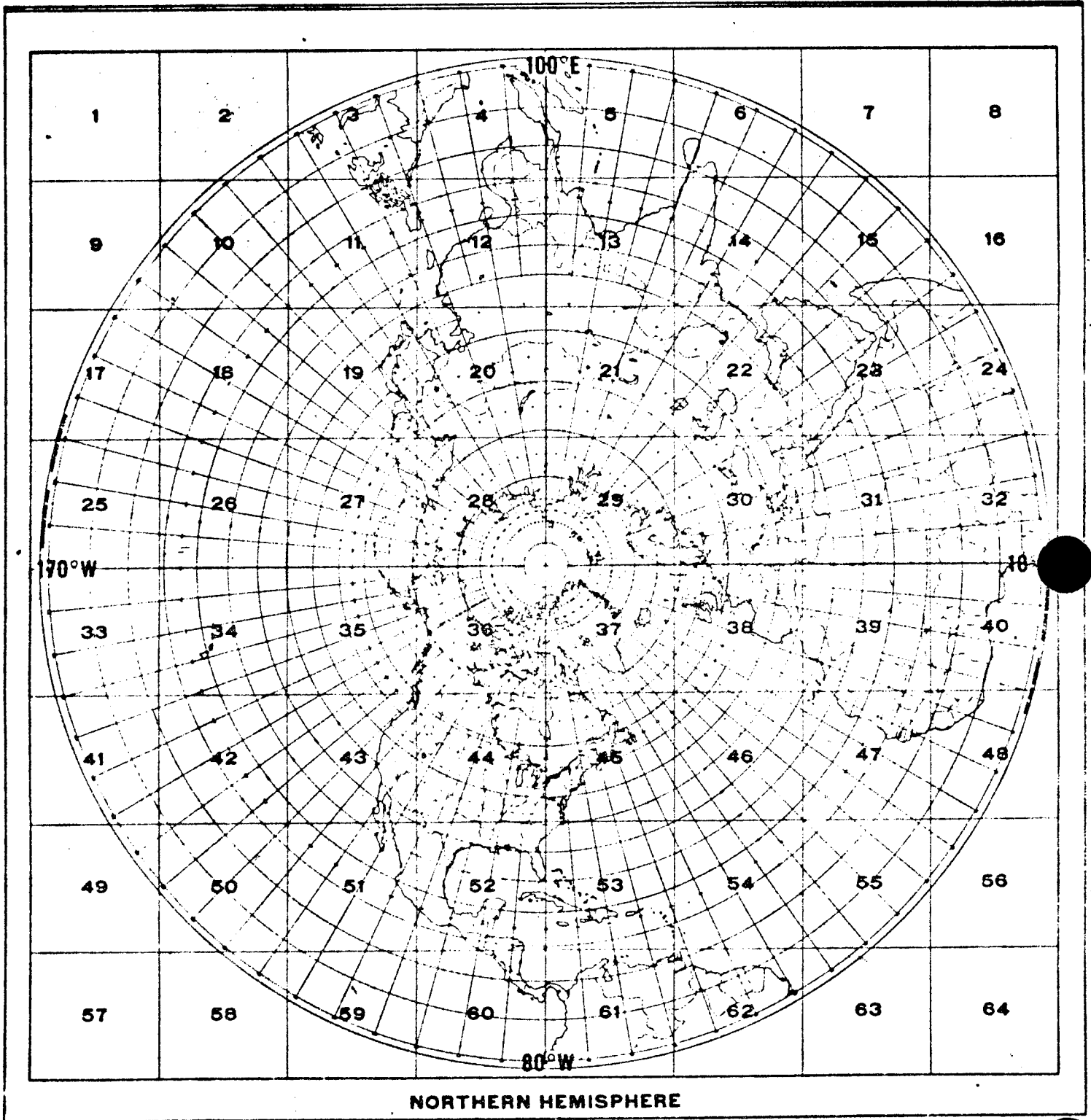
Nine 3DNEPHs were degraded due to low surface counts. They were: 02/00Z, 02/03Z, 06/21Z, 12/18Z, 12/21Z, 14/00Z, 15/09Z, 17/18Z and 30/15Z.

Sea surface temperatures were greater than 38 hours for the following 3DNEPHs: 10/03Z-11/00Z, 21/15Z-22/12Z, and 28/06Z-28/21Z.

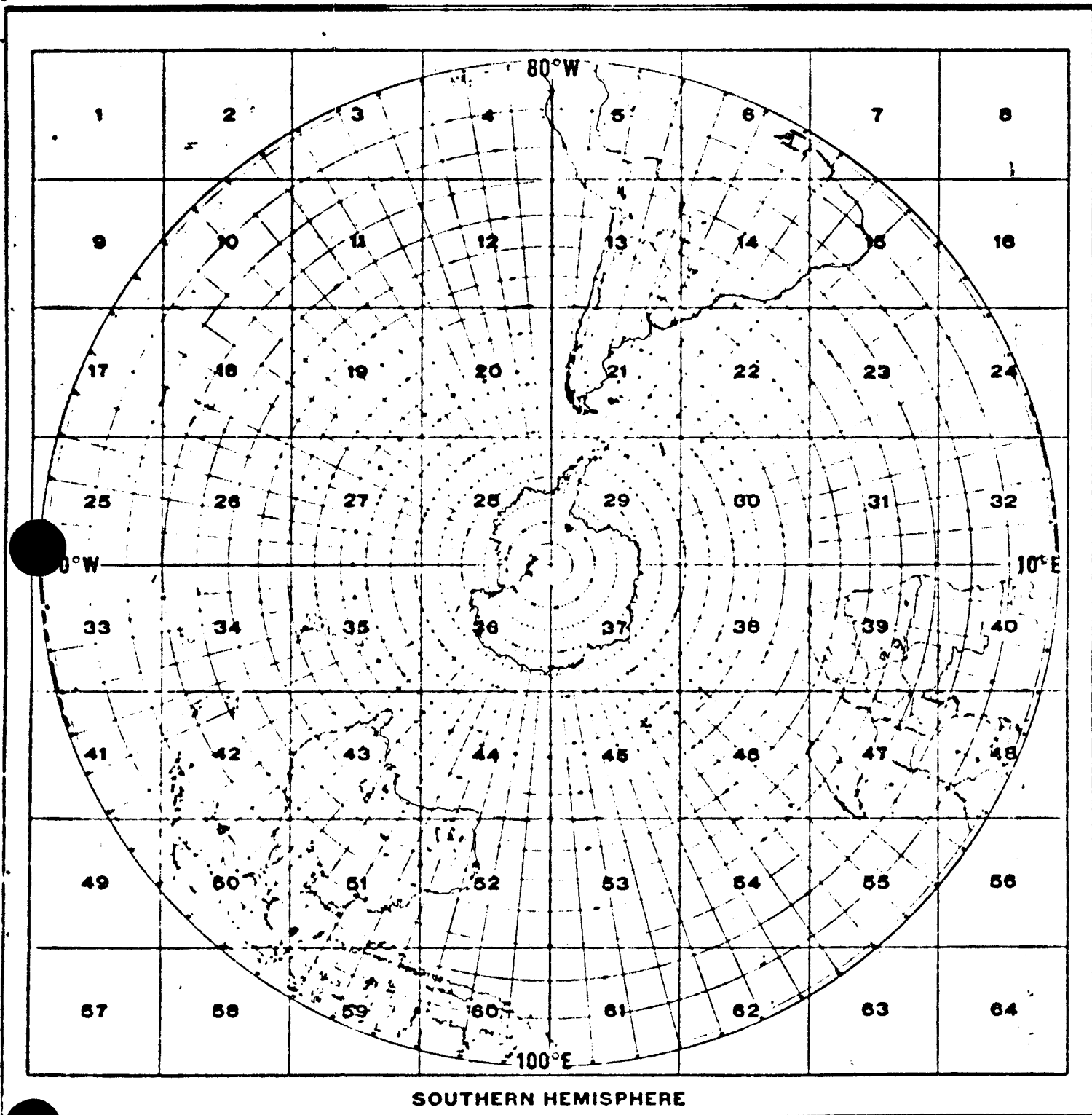
A total of 188 quarter orbits of NOAA-8 data were used to quality control the 3DNEPH in July.

An operator error led to an incorrect Julian hour being input for the land temperature time. This resulted in gross misinterpretation over the land areas. The 14/15Z-15/00Z 3DNEPHs were severely degraded. The 15/03Z and 15/06Z data bases were partially degraded since the bad data was still being overwritten by new data.

# 3DNEPH BOXES



# 3DNEPH BOXES



SOUTHERN HEMISPHERE

## LIMITATIONS OF 3DNEPH MODEL

Recognized long term analysis limitations of the 3DNEPH often referred to as "class problems," are described below. Where appropriate, a date is given to indicate when a major model change was implemented.

### 1. Software related limitations.

- a. Excessive cloudiness over desert or high albedo areas due to the misinterpretation of bright backgrounds as clouds by the satellite video data processor. The basis of this problem was a basic philosophical characteristic of the total cloud algorithm. A new video data processor was implemented in September 74 to eliminate the misinterpretation problem.
- b. Excessive cloudiness over desert areas due to inaccurate surface temperature analyses used by the satellite infrared (IR) data processor. The problem was greatest over data sparse and large diurnal temperature range areas with a phase lag between satellite flyover and temperature data receipt. Implementation of the eighth mesh temperature forecast model in January 1975 improved interpretation of IR data. The problem was further minimized in June 1976 with the final tuning of an IR height threshold which is a function of the background brightness. However, this tuning procedure limits the detection of low clouds over high albedo areas.
- c. Excessive cloudiness over high terrain areas, particularly the Tibetan Plateau, due to no synoptic stations to report relatively cold temperatures. The problem was minimized with the implementation of the items discussed in paragraph (b) and a new temperature initialization scheme in December 1976.
- d. Erroneous analyses over snow and ice areas by the video data processor. Overinterpretation of clouds occurred in areas of new snow and where the ice analysis contained too little ice and underinterpretation or no interpretation of clouds resulted when snow melted rapidly or the ice analysis contained too much ice. These errors were caused by the background brightness data base and associated updating logic was implemented in May 1976 to eliminate snow problems to the accuracy extent of the snow analysis model (SNODEP). A new improved ice analysis method was implemented in October 1976.
- e. Underinterpretation of clouds by the visual data processor in areas of persistent cloudiness was a severe problem. This error was induced by design limitations in the background brightness data base which included a 6 day lag in the updating procedure. Implementation of a new background brightness data base in May 1976 eliminated the problem.

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f. Inability to detect thin cirrus clouds by the visual or infrared processors because of an inherent limitation of the raw satellite data. When sufficient opacity renders thin cirrus detectable by the infrared processor, the height attached to the cloud top is in error (too low) to a degree which depends on the opacity of the cirrus. In extreme cases thin cirrus may be analyzed as stratus. Detection depends on the tuning of infrared data and availability of coincident visual data.

g. Underinterpretation or total omission of low stratus clouds by the infrared processor, particularly where inversions exist. This problem occurs primarily over polar regions and in areas where visual data are not available. Interpretation quality depends on the tuning of infrared data. Infrared data processor modifications in September 1975 and a new processor in August 1976 minimized, but did not eliminate problems. In October 1982, the temperature difference (surface minus IR) threshold for snow-covered points was reduced to 1 to improve stratus interpretation over snow-covered areas.

h. Detection of cumulus clouds due to the relatively coarse resolution of satellite imagery compared to the size of cumulus cloud elements. Implementation in September 1974, May 1976, and August 1976 have exploited all available cumulus intelligence data at the 3NM resolution and new constant resolution satellite sensors have added to the cumulus detection capabilities.

i. Detection and identification of cumulonimbus (CB) by satellite visual data processor. CB identification is critical to initiate vertical stacking of clouds throughout layers by the data integration processor. If CB is not identified, cirrostratus is usually placed in the upper layer(s) and all low/middle clouds are omitted. A new cloud typing module was implemented in May 1976 to provide an improved CB analysis.

j. Lack of horizontal continuity within cloud layers. Model makes no horizontal consistency checks as it does in the vertical.

2. Satellite data related limitations.

a. Mislocated satellite data resulting in ambiguous cloud lines along coastlines, particularly high contrast coastlines. This problem occurs almost exclusively with visual data, but has been observed with infrared data. The overinterpretation of clouds persists even after the satellite mapping errors are corrected due to the basic design of the background brightness field. Although mislocated data still occur, the new background brightness data base implemented in May 1976 does not perpetuate this condition. Also, the implementation of the Satellite Global Data Base (SGDB) in October 1975 eliminated the need for many transformation algorithms which contributed to the overall inaccuracy of the mapping process.

b. Noise in the raw satellite data occasionally occurs and in severe cases results in overcast or clear areas with peculiar shapes. Generally, the satellite processors can produce a reliable analysis despite the presence of noise. The frequency and extent are functions of METSAT "health".

c. The DMSP data are unnormalized resulting in anomalous analyses with respect to the source of the data, the readout site, nighttime versus daytime, left side of pass versus right side, and equator versus pole. Overall, these anomalies can be categorized as distinct and identifiable biases and their treatment accounts for most of the complexity in the satellite processors. Nevertheless, many cloud analyses are probably compromised because of attempts to achieve an optimum analysis in a certain area or portion of a pass at the expense of another area. Implementations in January 1975, September 1975, March 1976, August 1976, and December 1976 have minimized problems. Manifestations of this lack of normalization are:

- (1) Nighttime infrared analyses are generally worse than daytime infrared analyses (independent of visual data).
- (2) Tropical areas tend to be excessively cloudy.
- (3) The terminator side of infrared passes tend to be excessively cloudy during the fall and winter.
- (4) Small cloud elements on the sunlit side of visual passes which are normally detectable, are not always analyzed.
- (5) The terminator side of visual data tends to be underinterpreted due to decreased illumination on morning satellites.

3. Conventional data related limitations. Some limitations of conventional data are described below. Manifestations of these limitations in 3DNEPH analyses are not known precisely; however, the user must be aware of possible error sources.

- a. Inaccurate total cloud estimates, especially when clouds are low and parallax error is the greatest. Cloud amounts are usually overestimated.
- b. Inaccurate nighttime observations with a tendency to underestimate cloud amounts, particularly high clouds.
- c. Variations in the reporting procedures and quality of observing between countries.
- d. Inaccuracy of cloud heights when estimated by observers and pilots or measured by instrumentation.
- e. Incorrectly prepared reports and transmission garbling.

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## ACRONYMS

AFGWC	Air Force Global Weather Central
AGE BOGUS	High Resolution Cloud Bogus
BBGS	Background Brightness Grayshade
CB	Cumulonimbus clouds
DMSP	Defense Meteorological Satellite Program
GLOB	Glare Obstructor on DMSP Vehicle
HR	High Resolution (2 NM) visual data
HRCF	AFGWC High Resolution Cloud Prog Model (25 NM horizontal resolution)
IR	High Resolution (2 NM) Infrared Data
LTAN	Local Time Ascending Node (satellite equatorial crossing time)
LTDN	Local Time Descending None (satellite equatorial crossing time).
NOAA	National Oceanic and Atmospheric Administration
OLS	DMSP Operational Linescan System (Primary sensor)
SGDB	AFGWC Satellite Global Data Base
SNODEP	AFGWC Snow Depth Analysis Model
VHR	Very High Resolution (0.3 NM) visual data
5LAYER	AFGWC Medium Resolution Cloud Prog Model with five layers in vertical (100 NM horizontal resolution)

Atch 4

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