DNMI

klima

THE TELE/SYNOP CLIMATOLOGICAL DATABASE SYSTEM

Petter Øgland

DNMI - REPORT

NORWEGIAN METEOROLOGICAL INSTITUTE

BOX 43 BLINDERN   N-0313 OSLO

PHONE: +47 22 96 30 00

TITLE

THE TELE/SYNOP CLIMATOLOGICAL DATABASE SYSTEM

AUTHOR

Petter Øgland

PROJECT CONTRACTOR

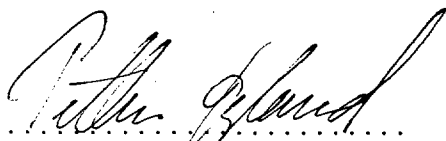DNMI - Climatology Division

SUMMARY

The TELE/SYNOP climatology database system was established as a central part of the KLIBAS database system February 1994. The purpose of the system is to collect and temporarily store synop observations for production of DNMI products such as VSUKE, STATUT, H_STAT and partial update of the DNMI internet web site.

The report gives a present view of the database system by investigating how the number of weather stations and data quality, as stored in datatables TELE and SYNOP, have changed during the last five years. The influence of automatic interpolation of weather observations is commented upon.

The complete system of computer programs constituing the TELE/SYNOP system is documented by focusing on execution, errors and general development of the system.

Further plans and a historical review of the development of the system is given by a summary of the KLIBAS system documentation and KLIMA research reports.

SIGNATURE

Petter Øgland

Bjørn Aune

Research Scientist   Head of Climatology Division

1. INTRODUCTION

The TELE/SYNOP system was established in May 1994 by the first implementation of the SYNO_INN computer program for reading syno-files into Oracle datatables. The purpose of this report is to give status and history of development for the system on January 26 1997.

Statistics for system performance, system quality and history of development are given in order to suggest directions for future development. The SYNOP/TELE system consists of 4 datatables and 18 computer programs that are being executed with a frequency of every ten minutes (SYNO_INN) to about once a month or less (SYNUT).

Every day 400-500 observations are inserted into Oracle datatables TELE. A warning is generated if less observations are recorded. Apart from reading the syno-files, TELE is also supplied with AWS observations fro auto-files that have to be adjusted to the synop format. Raw data from SYNOP and suggested interpolations and corrections, as performed in TELE, are further delivered to the KLIMA system.

Every day observations are quality checked automatically and manually in TELE. Weather statistics are then produced in daily cycles (STATUT), weekly cycles (VSUKE) and monthly cycles (DNMI web-page, H_STAT). At present Barabara Toporowska and Stein Kristiansen are conducting the quality control and production of climatology statistics. Åse Moen Vidal and Petter Øgland have contributed computer programs to the system.
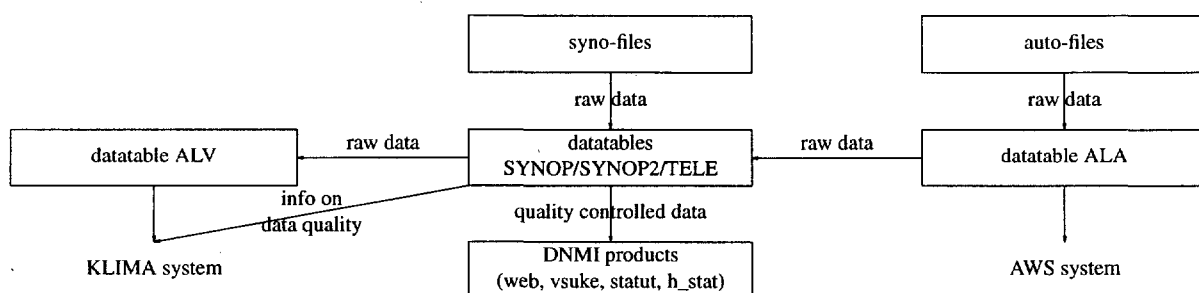
The statistics below show how many rows, how many stations and how many days of observations presently stored in each of the datatables.

Datatable	# rows	# stations	# months	# days
SYNOP	461500	204	15	15
SYNOP2	90000	162	3	1
TELE	150167	222	26	0
TELE_PARA	170	170	-	-

In the table TELE a total of 4647 observed values where either interpolated or corrected in order to achieve satisfiable data quality.

The SYNOP/TELE computer system consists presently of 18 computer programs working together. The system has spent about 223 hours executing programs on Typhoon so far this month, where the total number of executions was 12265 with 37 executions returning in error.

At the moment there are recorded 3 items on the problem list for further needed improvement of the system.

2. DATATABLES AND DATA QUALITY

The database for the TELE/SYNOP system consists of four datatables. The datatable SYNOP is used for storing raw data as read from the syno-files. The table SYNOP2 contains the same observations as in SYNOP, but for a shorter interval of time (91 days) and is therefore more efficient in data search for applications only needing recent raw data. The table TELE is used for quality control and is the basis for diverse climatological applications and weather statistics. The table TELE_PARA keeps administrative track of weather stations used by the other three tables.
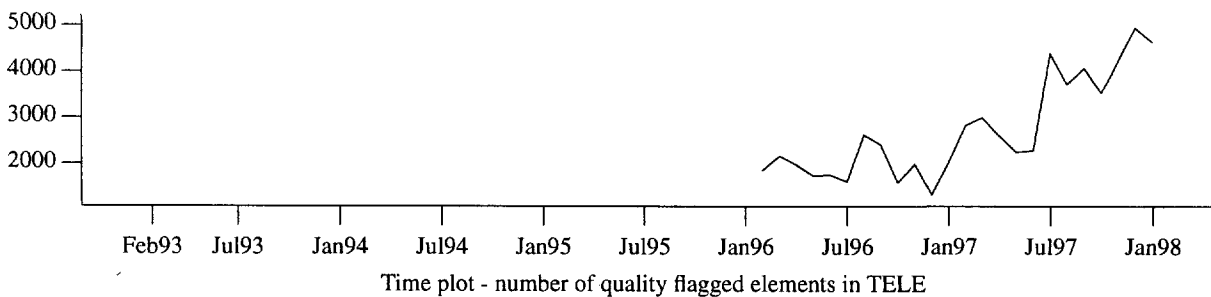
2.1 Datatable TELE

The graph below shows the development for the number of rows in TELE since the TELE routine was established in July 1995. The reason for the big dip in February 1996 was a system breakdown with consequences. The dip is also reflected in dips on the graphical display for SYNOP and SYNOP2 in chapters below.

Time plot - number of rows in datatable TELE
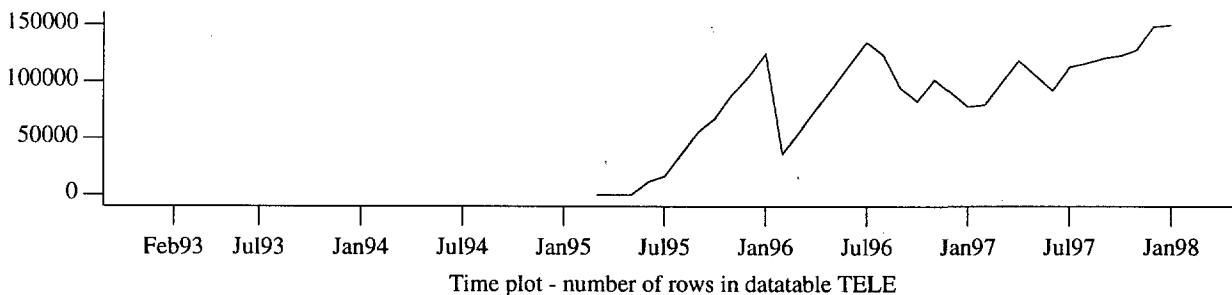
At present datatable TELE contains observations from 222 stations. Most of these are read from datatable SYNOP, although some are inserted from ALV and ALA.

Soon after the TELE routine was established, quality flags were added to the table. Quality flags were particulariy useful for controlling dataflow between MI and VNN. Systematic analysis of data quality by investigating monthly distributions of quality flags commenced in February 1996.

By July a test system for automatic interpolation of missing observations was introduced. A system for automatic correction of some cases of obviously erroneous observations was added to the system a few months after. As a consequence of these applications, the number of corrections made to the datarows in TELE increased notably. The curve is expected to increase further as more interpolation and correction programs are developed.

Time plot - number of quality flagged elements in TELE

2.2 Datatable TELE_PARA

The administrative datatable TELE_PARA was added to the system only when one had enough experience with a similar ALV_PARA for the KLIMA system. Statistics from the table have been collected since January 1998. In order to give an impression of how the size of the weather station network has been changing during the last five years, the number of stations in datatable SYNOP2 are plotted instead. For an explenation of the fall of the curve in Jan 1997, see curve for SYNOP2 below.

Time plot - number of stations defined in SYNOP2 / TELE_PARA
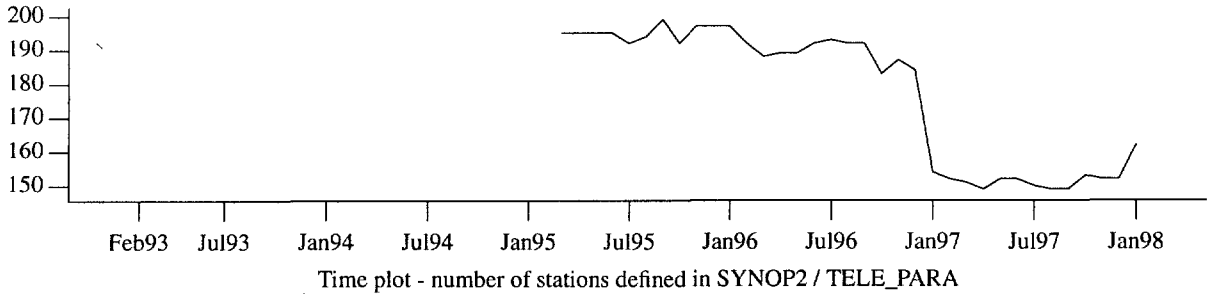
2.3 Datatable SYNOP

The datatable SYNOP was the first table in the TELE/SYNOP system to be created. In order to make sure that the SYNO_INN loading system is under control, statistics for SYNOP have been collected since Mars 1995. In the beginning observations were accumulating in SYNOP. In October 1995 there was a data crash resulting in all observations being deleted from SYNOP. When the system was restored, a program was designed to make sure that only about three months of data were stored in the table at any time. In January 1997, due to raw data were being used as reference data in the KLIMA system, SYNOP was moved to a wider table space, and the automated three month restriction was eliminated.

Time plot - number of rows in datatable SYNOP
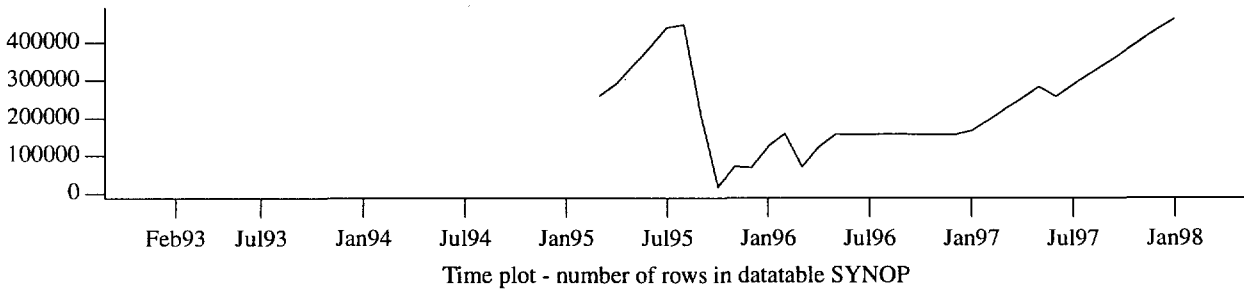
2.4 Datatable SYNOP2

The table SYNOP2 was introduced in June 1995. Like in the case of the SYNOP table, the program that inserted observations into SYNOP2 also deleted observations so the table would only contain about three months of observations. Due to lack of space, this limit was set to thirty days in the period January 1996 to August 1997. The limit then changed to 91 days.

Time plot - number of rows in datatable SYNOP2
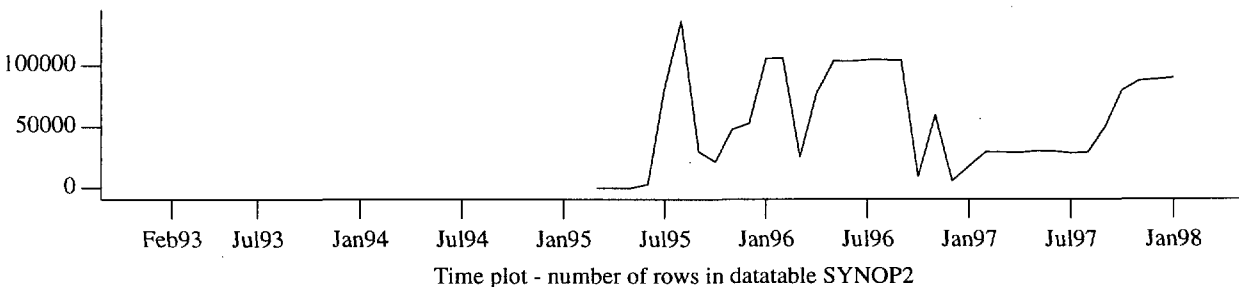
3. COMPUTER PROGRAMS.

The graphs below are intended to show how the recorded number of executions and errors have changed since work on the system commenced. How the number of programs in the system has grown and a list of programs presently used are also provided. Performance statistics have been logged in most cases since April 1995. Statistics earlier to this have been estimated.

3.1 Program execution

The quality or the necessity of a particular program may be reflected in how many times it is used on a monthly or annual basis. In the case of the TELE/SYNOP system there was a rapid increase of the number of executions for the system in February 1997. This was mainly due to the SYNO_INN program being rescheduled to execute every ten minutes.

Time plot - system performance measured by number of executions pr month
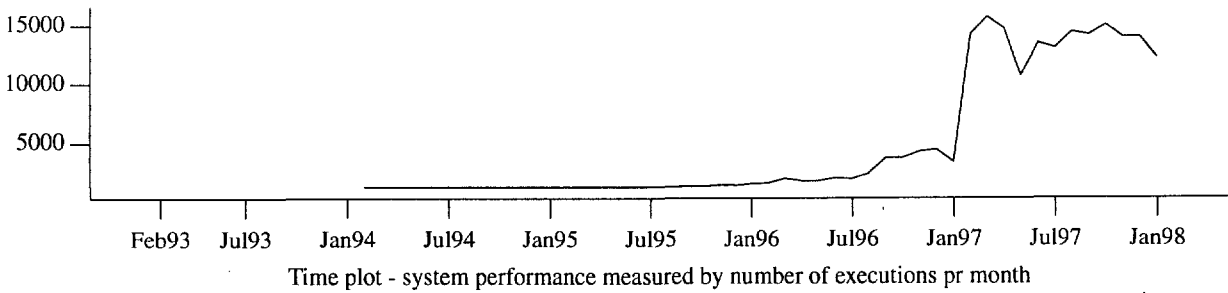
3.2 Program errors

One would expect the total number of errors to increase as the system increases. The peeks in the curve below are mostly due to periods of program maintenance. Errors between May and July 1997 were mostly due to maintenance of the SYNO_INN and the VNN systems.

Time plot - number of severe errors pr month
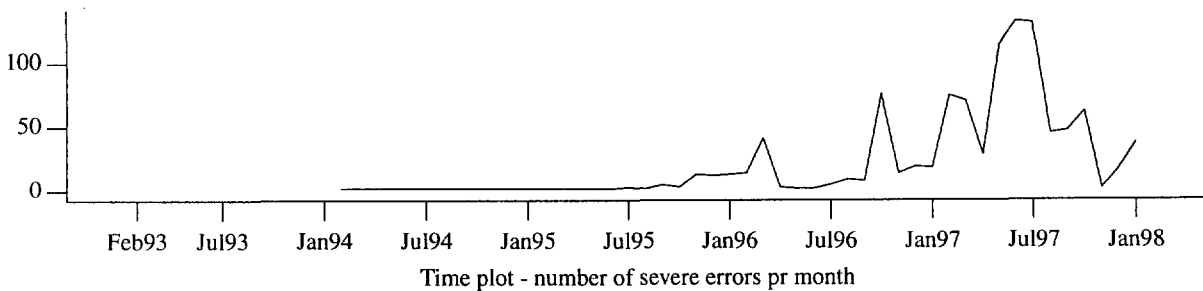
3.3 Number of programs within the system

The building of the TELE/SYNOP system started in Februar 1994 with the introduction of the first version of the SYNO_INN program. Most programs have been documented by appearance in the DNMI-KLIBAS report series. In chapter four there is a description of the system development according to existing system documentation.

Time plot - number of programs
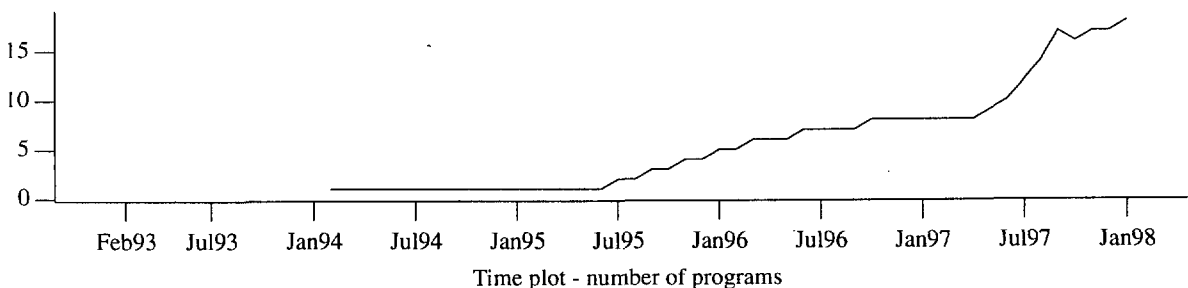
3.4 List of programs

Below is a description of each of the 18 programs sorted by number of warnings recorded for each of the programs during the last twelve months, and should to a certain extent reflect the order maintenance is likely to be served.

3.4.1 The program /klima/people/kapo/synop/synop.csh

The purpose of the program SYNOP is to monitor all programs and facilities associated with the TELE datatable (the SYNOP/TELE routine), predict how these characteristics may develop in the near future and generate warnings or trigger rescue programs whenever predictions indicate problems ahead.

3.4.2 The program /klima/people/kapo/synop/syno_kontr/syno_kontr.csh

The purpose of SYNO_KONTR is to manage the interpolation and correction programs in the TELE/SYNOP system. Due to problems in the TELE routine, ideas concerning error statistics for quality surveilance and assurance of the TELE routine should be implemented. The programme SYNO_KONTR should contain surveilance routines that make sure that programmes UT1 and S-T-F function as planned.

3.4.3 The program /klima/people/kapo/synop/syno_kontr/interpol2/interpol2.csh

The purpose of INTERPOL2 is to fill in blanks among the observation series in TELE with estimated values. A double exponential correlation method is used. The method is not perfect, and one should therefore try whether other interpolation techniques, such as B-splines, radial basis function or model data estimation can reduce the present random errors. Statistics should be provided in order to get more insights into present method.

3.4.4 The program /klima/people/kapo/synop/faxut/faxut.csh

The purpose of the programme FAXUT is to present temperature and precipitation data read from the STATUT file in a fax presentation format.

3.4.5 The program /klima/people/kapo/synop/vsuke2/vsuke.csh

The program VSUKE generates weekly weather statistics. Lately the program has been unable to produce a sequence of prints from list. Reprogramming is badly needed.

3.4.6 The program /klima/people/kapo/synop/syno_inn/syno_inn.csh

The purpose of the program SYNO_INN is to load data from syno-files into datatables SYNOP, SYNOP2 and TELE.

3.4.7 The program /klima/people/kapo/synop/vnn/vnn.csh

The purpose of the program VNN is to guide the programs that are being used for exchanging weather data and quality information between KLIMA and VNN in a systematic manner.

3.4.8 The program /klima/people/kapo/synop/vnn/tr_tele/tr_tele.csh

The program TR_TELE is used for reading data from weather station 90450 into datatable TELE. The program is a part of the VNN routine.

3.4.9 The program /klima/people/kapo/synop/syno_kontr/interpol1/interpol1.csh

The program INTERPOL1 is used for filling in for missing data in datatable TELE by searching table SYNOP2. For automatic weather stations, data from table ALA should be converted into synop format and filled in.

3.4.10 The program /klima/people/kapo/synop/syno_kontr/control2/control2.csh

The purpose of the program CONTROL2 is to make a guess whether an observation is correct or not

based on an areal quality control test. The results are forwarded to INTERPOL3 that decides whether an update will be executed or not.

3.4.11 The program /klima/people/kapo/synop/statut/statut.csh
The program STATUT generates weather statistics for the last 30 days for all stations defined in TELE/TELE_PARA. The program should be extended in order to make it handle error diagnostics and generate input for daily quality control.

3.4.12 The program /klima/people/kapo/synop/vnn/mangelliste/mangelliste.csh
The purpose of the program MANGELLISTE is to generate a list of missing observations to VNN. The program is also used for detecting values that are to be automatically interpolated within the SYNO_KONTR system.

3.4.13 The program /klima/people/kapo/synop/syno_ut/synut/synut.csh
The program SYNUT is used to generate lists of observations stored in the SYNOP datatable. The program is mostly used for getting information in order to make manual estimates for quality control and interpolation.

3.4.14 The program /klima/people/kapo/synop/syno_kontr/interpol3/interpol3.csh
The purpose of the program INTERPOL3 is to update datatable TELE when evidence from programs CONTROL1 and CONTROL2 seem to indicate that a correction may be safely done

3.4.15 The program /klima/people/kapo/synop/syno_kontr/syno_test/syno_test.csh
The purpose of the program SYNO_TEST is to make different kind of consistency tests in order to be sure that the program SYNO_INN is working as planned and that observations are being properly stored in datatables SYNOP, SYNOP2 and TELE.

3.4.16 The program /klima/people/kapo/synop/syno_kontr/mkk/mkk.csh
The purpose of the program MKK is to make a short summary from the SYNO_KONTR programs. The results are mailed to kapo on a daily basis.

3.4.17 The program /klima/people/kapo/synop/syno_kontr/control1/control1.csh
The program CONTROL1 conducts certain simple quality control tests such as checking internal consistency between TT, TN and TM and a consistency check for precipitation RR.

3.4.18 The program /klima/people/kapo/synop/vnn/rettelser/rettelser.csh
The program RETTELSER is used within the VNN routine in order to insert corrected observations into datatable TELE.

4. MAINTENANCE AND DEVELOPMENT

In order to plan work, a list of problems have been updated on a monthly basis since September 1995. Below is a description of how problems concerning the TELE/SYNOP system have been added and removed from the list.

Time plot - number problems on the project list
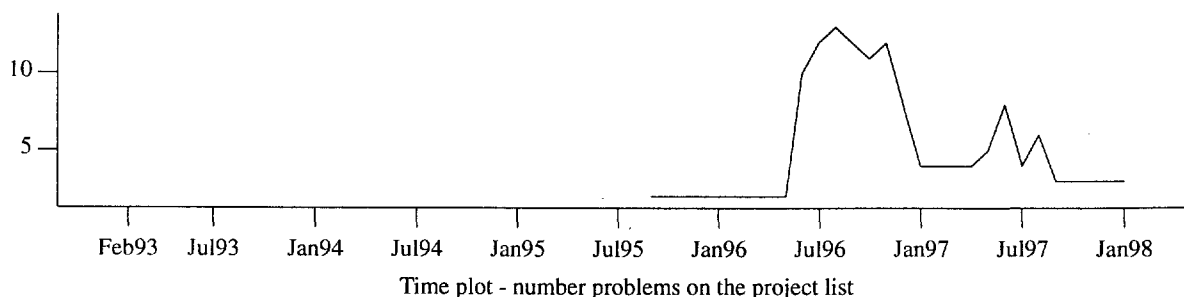
The following 3 items are noted on the January 1998 problem list.

Program	Registered
s-t-f v2.0	June 1996
utl v2.0	June 1996
vsuke v2.1	August 1997

Most solutions to major problems are documented in the DNMI-KLIBAS report series, and so far 26 reports have been written concerning the TELE/SYNOP system. Below is a synopsis of the system documentation sorted by order of publication.

February 22nd, 1994
DNMI-Report no. 05/94 KLIBAS "Innlasting av synoptiske data til arbeidslager."
A system SYNO_INN v.1.0 (FIFOfeed + FIFOread) was implemented in order to read syno-files on SGI computer Tornado into Oracle datatable SYNOP every hour at 00:00, 01:00, ..., 23:00 UTC.

June 27th, 1994
DNMI-Report no. 18/94 KLIBAS "Eksperimentering med enkel kvalitetskontroll og interpolasjon av værstasjonsdata med varierende tidsoppløsning."
A complete quality control system was made for synop observations. Experience with this system was later used in development of later quality control systems.

December 20th, 1994
DNMI-Report no. 40/94 KLIBAS "Innlasting av synoptiske data til arbeidslager. Revidert utgave."
Bugs were removed from the SYNO_INN system. Minor changes were made.

Mars 18th, 1995
DNMI-Report no. 12/95 KLIBAS "Automatisk datakontroll for SYNOP og AUTO: ADK v.2.0."
The automated quality control system for automatic weather stations ADK was reprogrammed in order to be applied also for non-automatic synop stations.

May 29th, 1995
DNMI-Report no. 17/95 KLIBAS "MDK: Manuell datakontroll av SYNOP-data."
The program MDK was a manual quality control based on priciple of the ADK system. The program was only used for a short time.

July 4th, 1995
DNMI-Report no. 18/95 KLIBAS "Innlasting av synoptiske data til arbeidslager. Versjon 2.0."
The program SYNO_INN was revised. Shell programming was used to a greater extent than what had been the case earlier on.

July 13rd, 1995
DNMI-Report no. 19/95 KLIBAS "Hurtigkontroll av SYNOP-data 1987-1995."
In order to make sure that any new quality control methods for observations in datatable TELE were not to be any less sufficient than older methods, a survey of older methods was undertaken.

July 14th, 1995
DNMI-Report no. 20/95 KLIBAS "Programmer S-T-F og UT1 for hurtigkontroll av SYNOP-data."
For manual quality control of observations in table TELE, programs S-T-F and UT1 were constructed.

August 31st, 1995
DNMI-Report no. 21/95 KLIBAS "Backup av ubearbeidede SYNOP."
A backup system was established using tapes.

September 14th, 1995
DNMI-Report no. 22/95 KLIBAS "Programmer auto2tele, gts2syn og tromso i synoprutinen."
A report was written to document recent developments of the TELE/SYNOP system, including VNN program TROMSO and the SYNO_INN programs AUTO2TELE and GTS2SYN.

January 18th, 1996
DNMI-Report no. 02/96 KLIBAS "Beskrivelse av synop-rutine."
In order to facilitate further development of the TELE/SYNOP system, a description of the system, as it was performing at the beginning of 1996, was established.

Mars 26th, 1996
DNMI-Report no. 09/96 KLIBAS "Beskrivelse av synop-rutine. Versjon 1.1."
The total description of the TELE/SYNOP system was revised as the program STATUT was introduced and general changes had been made to the system.

October 29th, 1996
DNMI-Report no. 15/96 KLIBAS "Eksperimentell overføring av data fra syno-filer til Oracle-database. Versjon 3.0."
The program SYNO_INN was totally restructured and programmed from scratch.

January 6th, 1997
DNMI-Report no. 01/97 KLIBAS "Punching og rettelser mot TELE utført av VNN for synop-rutinen."
A script VNN.CSH was made in order to centralise execution of the VNN programs TR_TELE, RETTERLSER and MANGELLISTE.

January 19th, 1997
DNMI-Report no. 04/97 KLIBAS "Overføring av data fra syno-filer til tabeller SYNOP og TELE. Versjon 3.1."
The program SYNO_INN was extensively reprogrammed.

Mars 7th, 1997
DNMI-Report no. 47/97 KLIBAS "DAGLIGSTATISTIKK. Programmet statut v.1.1."

Bugs were removed from the program STATUT. The program was extensively reprogrammed.

Mars 22nd, 1997
DNMI-Report no. 48/97 KLIBAS "Ukesoversikter fra TELE med programmet VSUKE v.2.0."
The revision of VSUKE made it possible to generate sequences of statistical output.

May 26th, 1997
DNMI-Report no. 52/97 KLIBAS "Punching og rettelser mot TELE utført av VNN for synop-rutinen. Versjon 2.0."
Programs TR_TELE, RETTELSER and MANGELLISTE, operated for transaction of corrected data with VNN, were put into a system VNN (vnn.csh). The program VNN was designed to run the programs and make resulting performance and error statistics.

June 7th, 1997
DNMI-Report no. 55/97 KLIBAS "Dataoverføring SYNO_INN v.3.2 fra syno-filer til tabeller SYNOP og TELE med utvidet sikkerhet."
The SYNO_INN program was extended with routines to reduce the need for manual surveil of the program.

June 18th, 1997
DNMI-Report no. 57/97 KLIBAS "DAGLIGSTATISTIKK - Programmet statut v.1.2."
A number of bugs were corrected in STATUT. A program FAXUT was also made, generateing a FAX for weather station V44560 SOLA from STATUT.

August 2nd, 1997
DNMI-Report no. 60/97 KLIBAS "Døgnlig driftskontroll for SYNOP: syno_kontr v.2.0."
A system SYNO_KONTR was added to the TELE/SYNOP system. The purpose of SYNO_KONTR was to start quality control and interpolation programs on a daily basis and generate statistics from the execution of these programs.

August 28th, 1997
DNMI-Report no. 61/97 KLIBAS "Automatic interpolation of SYNOP weather observations: Interpol1 and Interpol2."
Two programs were added to the TELE/SYNOP system in order to automate interpolation of missing observations. The program INTERPOL1 checked if any of the missing values in TELE were reported in SYNOP2, and made the proper transaction. The program INTERPOL2 made interpolation by a statistical estimation procedure.

September 9th, 1997
DNMI-Report no. 62/97 KLIBAS "Automatic correction of SYNOP weather observations: Control1, Control2 and Interpol3."
Two programs for detecting errors CONTROL1 and CONTROL2, with the addition of a program INTERPOL3 for recognising the cause of error and make updates into the TELE datatable, were added to the TELE/SYNOP system.

October 20th, 1997
DNMI-Report no. 23/97 KLIMA "Evaluation of a meteorological radial interpolation method by statistical experiments."
A statistical experiment was conducted in order to evaluate the first method implemented for estimation in the programme INTERPOL2.

November 16th, 1997
DNMI-Report no. 25/97 KLIMA "Evaluation of a double exponential correlation weighted interpolation method by statistical experiments."
As a consequence of the results genereated from the first evaluation of the estimates in INTERPOL2, the program was modified and a new statistical test was carried out. The new method proved better than the old one.

January 14th, 1998
DNMI-Report no. 03/98 KLIBAS "SYNO_INN v.3.3: Revised for inserting international synops into TELE."
The purpose of the revised version 3.3 of the computer program SYNO_INN was to make it possible to insert chosen foreign synop observations into the TELE datatable. At he moment of its release, five test stations were being used.

REFERENCES

Arbeidsnotat 30 KLIMA "Fremtidig database for klimadata" (1984)

Rapport 32/91 KLIMA "Database/maskin prosjektet i Klimaavdelingen 1990-1991. Informasjonsmod-ell, flagging og kontroller. Status pr 30.06.91"

Rapport 53/92 KLIMA "Databaseprosjektet i Klimaavdelingen. Status pr 23.12.1992"

Rapport 03/94 KLIBAS "Databaseprosjektet i Klimaavdelingen. Status pr 31.12.1993"

Rapport 24/94 KLIBAS "Databaseprosjektet i Klimaavdelingen. Status pr første halvår 1994"

Rapport 06/95 KLIBAS "Databaseprosjektet i Klimaavdelingen. Status pr årsskifte 1994/95"

Rapport 22/95 KLIMA "KLIBAS - The DNMI Climatological Database System"

Rapport 01/96 KLIBAS "Databasegruppen 1995"

Rapport 13/96 KLIBAS "KLIBAS - status 30.06.1996"

Rapport 18/96 KLIBAS "Kvalitetssikring av driftsrutiner for automatstasjoner i databasesystemet KLIBAS"

Rapport 03/97 KLIBAS "Referater fra møter i databasegruppen 1996"

Rapport 45/97 KLIBAS "Logging av driftsparametre for kvalitetssikring av driftsrutiner"

Rapport 46/97 KLIBAS "Kvalitetstrend QUAL_TREND i månedlig driftsrapportering"

Rapport 49/97 KLIBAS "Eksperiment med automatisk feilbehandling i KLIBAS"

Rapport 50/97 KLIBAS "Beregning og presentasjon av datakvalitet i månedlig driftsrapport"

Rapport 53/97 KLIBAS "Beregning og presentasjon av maskinvarekvalitet i månedlig driftsrapport"

Rapport 60/97 KLIBAS "Døgnlig driftskontroll for SYNOP: syno_kontr v.2.0"