



Atmospheric Observation Panel for Climate (AOPC):
Surface pressure group workshop
Norwich 20th –21st November, 2002
Workshop minutes

1. Present (further details in Annex 1)

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Tara Ansell
Manola Brunet-India
Svetlana Iagovkina
Victor Lagun
Maurizio Maugeri
Andreas Philipp
Val Swail
Pascal Yiou

Enric Aguilar
Lars Barring
Shyh Chen
Phil Jones
David Lister
Anders Moberg
Oscar Saladie
Scott Woodruff

Rob Allan
Theo Brandsma
Gil Compo
John Kington
Jürg Luterbacher
David Parker
Vicky Slonosky
David Wuertz

Minutes taken by: Tara Ansell

2. Workshop outline

2.1 Historical MSLP data: compilations and quality control

2.1.1 Introduction and welcome (Rob Allan)

The workshop was opened with a brief summary of the AOPC pressure working group, its core membership and aims. Its formation was initiated by Mike Manton and it is co-convened by Ed Harrison (PMEL, NOAA) and Rob Allan (Hadley Centre, Met Office). The workshop in Norwich was the first major meeting of the group.

The aims of AOPC surface pressure group are:

- 1) promote the analysis of global surface pressure (monthly and daily),
- 2) record and evaluate differences between data sets,
- 3) recommend actions to ensure data quality and consistency,
- 4) promote the recovery and access of pressure data,
- 5) promote the comparison of various types of instruments,
- 6) report annually to AOPC and the Oceanographic Observation Panel for Climate (OOPC).

David Parker (for Chris Folland (Hadley Centre, Met Office)) requested that the following could also be made an aim of the AOPC pressure group; namely that data sets should be ready in time for the 4th IPCC assessment and of sufficient quality for this need.

The core membership overseeing the AOPC pressure working group is: Rob Allan, Ed Harrison, Gil Compo, Phil Jones, Masao Kanamitsu, Doug Luther, Bob Seaman and Scott Woodruff



2.1.2 Short presentations

(copies of each power point presentation will be provided on the workshop web site)

GHCN project

David Wuertz (NCDC, NOAA)

A new version of the global historical climatological network (GHCN) data set for sea level pressure (GHCN version 2) has been prepared by the National Climate Data Centre (NCDC). It has been 10 years since version 1 was updated. An overview of the process was presented, outlining issues such as merging individual data sources, eliminating duplicates, checking for transitivity violations, resolving meta data issues, assigning correct country code, performing quality assurance checks, manually inspecting data via plotting, checking for reasonable data ranges and looking at statistical wild outliers. The data set is now available (*see section 5*). It contains 2668 stations, with a mean station length of <100 years.

The philosophy of using country codes and whether it was still relevant was discussed. David Parker suggested that country codes are useful as they provide important meta data information (particularly with colonial records). In GHCN version 2 country codes have been assigned strictly according to the current political boundaries.

Hadley Centre MSLP data base

Rob Allan (Hadley Centre, Met Office)

The Hadley Centre's MSLP terrestrial data base currently contains some 1196 individual pressure records. Examples of data sources that have been explored to date are: International Met services, the GHCN product, CLIMAT messages, Reseau Mondial, World Weather Records, Monthly climatic data for the world, Met Magazine, Met. Zeitschrift, individual researchers (Phil Jones, Jim Salinger, Kenneth Young, Hildebrandsson, Hahn, De Tillo, Dove, Angot, Walker and Lockyer), the UK Board of Trade, UK Royal Engineers, UK Army Medical Department, Royal Met. Society, French Met. Society, UK Met Office Archives, Missionary records, private diaries and the British East India Company.

The future plans include increases to the data bank, both in station length and the number of stations, developing the data bank, so it extends beyond the specific needs of HadSLP, a focus on long historical stations, such as Tahiti, and work on indices of climatic importance.

Comparison of ICOADS ship observations with US Historical Weather Maps 1899-1939

Gil Compo (CDC, CIRES)

A comparison of old historical pressure maps with the International Comprehensive Ocean and Atmosphere data set (ICOADS) was presented. ICOADS data between 1899 and 1912 does not contain the US historical weather map observations. Comparisons were also made with the German 'morning maps' and UK Met Office and NCAR Northern Hemisphere gridded MSLP fields. The work suggests that mutual consistency checks are very valuable.



Canadian historical MSLP data and future plans

Vicky Slonosky (McGill Uni)

Work on historical MSLP from 71 stations over Canada was reported. A '50 foot rule' was discovered where stations at less than 50 feet in altitude were described as recording sea level pressure until 1976, when the observations were then described as station pressure. This appeared to be a WMO directive and so may affect other countries' records around this period.

An EOF analysis of the station pressure was compared to that using HadSLP and revealed some interesting differences which may be a reflection of the gridding process or the way the EOF analysis was applied. Future plans will be to continue the analysis of the pressure patterns and work on daily data for the 18th and 19th century (particularly for Montreal and Quebec).

Dutch and colonial (Indonesian and Japanese) historical MSLP.

Theo Brandsma (KNMI)

3 times daily Dutch pressure data from the 18th and 19th century has been digitised. 24 hourly values are available for Amsterdam 1823-onwards and for Leiden (including 2 years of daily pressure in 1701). A large number of KNMI year books, containing mostly 3 times daily data, have also been digitised from 1900 onwards. Information on daily data for the 20th century can be found on the ECA & D web site (see below). The Dutch records make a large contribution to ICOADS and KNMI is also a partner in the CLIWOC project.

There is also a large amount of colonial pressure data in Dutch year books, including daily records in Surinam, Indonesia (digitised), Japan and Africa. Projects include pressure reconstruction with the Indonesian daily data and work on the SOI. A current project is using hourly data to reconstruct the Quasi-biennial Oscillation (QBO).

Historical MSLP data from Estonia and Poland

Lars Barring (Lund Uni)

Work on historical MSLP from Poland and Estonia was reported. A lot of digitisation has already been done for Tartu (1865-present), Tallinn (1835-present), Warsaw (1826-present), Krakow (1826-present) and Lund (1780-present, 1740-1779 remains to digitised). There are some QC issues remaining, however there is the potential for interesting regional applications.

Russian historic Antarctic surface pressure data management

Victor Lagun (AARI)

Efforts to create a long data set of pressure in Antarctica was presented. Many of the pressure time series are not continuous and also short in length, thus their use in climate change studies is limited. A number of long stations (minimum of 27 years) have however been analysed to examine pressure trends during the period 1971-2000. Phil Jones mentioned that this work is part of the READER project, lead by John Turner, at the British Antarctic Survey. This project involves re-examining the raw data.



Summary of EMULATE meeting

Phil Jones (CRU, UEA)

The recently started EC funded project, EMULATE, was described. The EMULATE partners are UEA, Met Office, Uni Wuerzburg, Uni Rovira, Uni Bern, Stockholm Uni, Uni Gothenberg and CEA. A daily gridded MSLP field from 1850 over the region (25-70N, 70W-50E) will be created. Analysis objectives will be to look at circulation patterns, relationships with precipitation and temperature changes over Europe, extremes and model integrations.

Val Swail asked whether data will be made available to people outside of Europe. It is anticipated that the data will eventually be made available. Data from the CLIWOC project will also be made available when this project concludes.

Air pressure data in Italy

Maurizio Maugeri (Milan Uni)

Historical Italian pressure data availability and future plans were described. There is good coverage of daily pressure between 1951-2000. Long historical records have already been produced as part of the EC funded ADVICE and IMPROVE projects, e.g. Milan (IMPROVE), Torino, Florence (ADVICE), Rome (ADVICE) and Palermo. There is also digitisation in progress for a number of stations. Six stations in particular have been highlighted as having the potential to provide very long daily pressure series. These are Torino (1788), Milan (1763), Lugano (1864), Padova (1725), Genova (1833) and Bologna (1813).

2.1.3 Open discussion led by Rob Allan.

The main topic of discussion was the proposal to set up an international MSLP data base. Discussion focused around a number of pertinent issues to service and develop this idea.

- FORMAT & TEMPORAL ISSUES

The group will consider adopting and modifying the Long Marine Format (LMF) for synoptic pressure observations. The aim is to simplify the maintaining of meta data information, accommodating multivariates, such as temperature and winds and to help facilitate international collaboration.

Scott Woodruff reported that a transition from long marine to International Maritime Meteorological Archive (IMMA) format, in ASCII, is underway which will achieve greater flexibility.

The data required for the data base were discussed. The importance of having all versions of the data was noted, including both the raw and finished product, which may include blending or averaging of a number of stations and correction to sea level pressure.

The group noted that it is important to have separate monthly and daily fields. There is also a need for very good documentation and, on regional scale, high resolution data that has been quality controlled.



- DIGITISATION

Optical Character Recognition (OCR), to aid digitisation, was discussed. The general view of the group is that it performs poorly with data from the pre 1900 era and it does not work well with digits. Voice recognition was mentioned, as a possible alternative.

The Climate Database Modernisation Project (CDMP), headed by Steve Doty, is aiming to digitise a lot of data. There is the potential that they will be able to digitise some pressure data from countries other than the US. This will be weighted towards areas and time periods where there is a real lack of data. The group was encouraged by David Wuertz to consider this option to get records digitised (*see section 5*).

- CAN YOU CONTRIBUTE DATA TO THE DATA BASE?

Attendees commented on their efforts in cataloguing and extending historical MSLP records. Manuela Brunet-India reported on Spanish records (*information on Spanish records is provided on the web page*). Phil Jones suggested that African data may be available from the Data Rescue (DARE) project (see below). A lot of African data has been put onto microfilm, however it has not yet been digitised.

There is a very good archive of European records from around the world in Italy. Maurizio Maugeri suggested that it may be cheaper to come to Italy and digitise the records there. Rob Allan drew the groups attention to the NOAA Library site (http://docs.lib.noaa.gov/rescue/data_rescue_home.html), which contains large amounts of scanned foreign records, available to view and download as pdf files. Some volume are missing, and a number of these have been located at the UK Met Office's library. The Hadley Centre are organising to have this data scanned and so a complete record can be created.

- OUTSTANDING DATA ISSUES

The group noted the need to raise awareness of a number of important records that are missing. It is hoped that discussion may help unearth these data. For example:

Labrador : Phil Jones reported that we have monthly observations, however meta data indicates that these came from 3 hourly observations, which should go back to 1780. These have not been found.

Azores: there is monthly data from 1820-1840, however we have been unable to locate the original daily measurements.

Hong Kong: unable to locate the historical daily data from the Hong Kong observatory.

Tahiti: Jim Salinger from NIWA in New Zealand is looking into old hard copies of the 'Messenger of Tahiti' newspaper, a source of old Tahitian pressure records, held in the Archdiocese of Papeete. This newspaper is also held in the British National Library in London, on microfilm.

Mauritius: Gil Compo would be interested to learn where the original Mauritius data might be held. These potentially go back to 1774.

London : There are a number of potential sources for London: Phil Jones mentioned Gordon Manley's records; Manley collated very long temperature records and there may also be pressure records available, David Parker mentioned the original Lamb maps, held by the Met Office, and the Thomas Barker journals, only one of which has been recovered.

Paris: Vicky Slonosky has done a lot of work on Paris pressure data and suggests that there is the potential to generate records from the 1650s (currently there is digitised daily data from 1870). The records from 1688-1720 have already been copied and/or hand-written. There is a gap around the 1730 and the record then starts again in 1747. All of this data requires checking, but essentially awaits digitisation.

Other potential sources mentioned: Lighthouse records, coal mine data, Hydro Quebec, Railroad companies, Military records around the Arctic, Jesuit records in Rome. Mannheim collated many observations across Western Europe, published in Latin. Additionally, John Kington has digitised daily pressure charts for Europe from 1781-1787 and these are available for those who are interested.

2.2 Historical MSLP: analyses and data extensions

2.2.1 Short presentations

(copies of each power point presentation will be provided on the workshop web site)

Historical MSLP data from Norway, Sweden and Finland

Anders Moberg (Stockholm Uni)

Recently digitised Nordic stations (19 stations), including those which were part of the Waves and Storms in the North Atlantic (WASA) project, were described. There are particularly long series at Upsalla, Stockholm and Lund. The data is limited if you wish to study long term trends, however the day-to-day variations between stations are very good and reliable.

Feasibility of reanalysis before the radiosonde era.

Gil Compo (CDC, CIRES)

The use of surface pressure observations to reconstruct the 4 times daily tropospheric circulation was reported, comparing optimal interpolation (OI), NCEP/NCAR CDAS with a fixed error and ensemble square root filter (EnSRF), using a varying error. The data field for 2001-2002 was processed to remove all modern observations and resampled to be equivalent to the 1895, 1905, 1915 and 1935 sampling. The impact of using other fields, including temperature and wind was also presented. Results indicated some degree of information for the mid troposphere (700 hPa) was gained and the EnSRF method did significantly better. In cases with very few observations, the improvement was greater when multivariate data were used.

Surface pressure observation: a view from Reanalysis

Shyh Chen (Scripps)

In reanalysis work, pressure is defined as a weak variable, as it is easily driven by other fields and hence is prone to modification by the initialisation process. It was suggested that surface pressure tendency may become important in the future and that more research is needed on the diurnal and semi diurnal oscillation. Specific recommendations to the Working Group were to make the data available, start archiving pressure tendency, keep a separate archive of instantaneous and monthly averages and keep documentation on new instruments.

Trends in HadSLP and MSLP data

Rob Allan (for Nathan Gillett, Victoria Uni, BC)

An analysis of pressure trends using NCEP reanalysis fields, HadSLP and Trenberth's data was presented. Large trends, with a significant decrease in the Southern Hemisphere and significant increases over Europe and the Atlantic, in all three data sets were observed.

ICOADS data

Scott Woodruff (CDC, NOAA)

An overview of ICOADS was presented. New data, not yet incorporated in the recent ICOADS blend, include the German Maury Collection (not digitised), the Russian R/V Marine data (not digitised) and the Japanese Kobe collection (being digitised). The inclusion of Japanese whaling ships, from 1946-1984, is also anticipated. These have very good coverage in the high southern latitudes. There are also plans to add in the 1878-1894 global US Marine Met. Journal data.

Pertinent issues such as gravity corrections and biases in the US Maury collection were discussed. Undetected biases and issues with the most recent data, owing to the inclusion of buoy measurements and declining ship observations, were also mentioned.

A new version of HadSLP using ICOADS data.

Tara Ansell (Hadley Centre, Met Office)

The Hadley Centre's plan for a new version of HadSLP was discussed. The aim is to take advantage of the ICOADS data and incorporate new terrestrial stations to produce a 5 x 5 degree gridded product from 1850-2000. Current gridding and interpolation methods will be revised. An additional aim is to provide uncertainty estimates. Longer term plans involve bringing the data to 24 hourly means and making it readily updated in near real time.

2.2.2 Open discussion led by Rob Allan

Discussion concentrated on gridded analyses, drawing from recommendations made at the January 2002 Boulder Workshop on Advances in the Use of Historical Marine Climate Data.

Recommendations from this meeting were presented by David Parker (see presentation file).

Discussion then moved on to various topics including reanalysis fields, copyright issues, homogenisation and error assessment.

- REANALYSIS FIELDS

Problems with the NCEP reanalysis were discussed, such as issues over southeast Asia in the pre 1967 period. Phil Jones also alerted the group to a problem with the pre 1967 data over Europe; all low pressure centres were excluded due to pressures <1000 hPa being wrongly interpreted. The ECMWF data is better over Europe, however access is a problem. Phil Jones proposed the group write a letter to ECMWF (see motion below), requesting the data be made freely available.

- COPYRIGHT ISSUES

Copyright issues are not a problem in both the US and Canada. In Europe, laws are specific to each European country. David Wuertz, who had been appointed administrator of the monthly data

base, was concerned that this would make administration difficult if different versions of both raw data and analysed product are available, depending on your access rights. This issue will remain open.

- HOMOGENISATION

Some groups are re-homogenising old records and in some cases these data now look different to the real time CLIMAT observations and a correction has to be applied. Phil Jones asked whether the data could be homogenised to the current observing standard, to avoid having to make these adjustments.

- ERRORS

Discussion focused on the assessment of grid box uncertainties and error covariance structures. With temperature there are a number of ways to assess the error; it is more difficult with the MSLP. There might be a consistent error with the marine data, for example gravity corrections, but with terrestrial observations potential errors are less obvious.

David Parker suggested that the random error is very small, however there may perhaps be systematic errors. Each station would have its own bias and if it high above sea level, this would be greater. Since 1850 we know that most records should have been corrected for gravity, but correction to mean sea level is more problematic.

Phil Jones initiated discussion on whether we want to ignore / reject the high altitude stations? David Parker spoke of the problems of determining MSLP over the Antarctic when HadSLP was created. Vicky Slonosky indicated that one of the most useful ways of dealing with this problem is to separate out the anomaly and the mean field.

It was suggested by Phil Jones, that it would be of interest to calculate the average pressure of the world, as this may help constrain the pressure fields over areas such as the Himalayas and Antarctica.

2.3 Close

Rob Allan closed the meeting by thanking all for attending and for their contributions. The minutes will be made available on the web shortly and he hoped that this was an initial step forward to forging greater international ties. The next opportunity for AOPC discussions will be in **Asheville** in June, 2003.

3. Executive summary and recommendations

3.1 International data base

The group will aim to set up an international monthly pressure data base. It was also deemed to be important to set up a separate data base of sub daily observations and, accordingly, the development of a international operational pressure data base was also initiated. David Wuertz and Gil Compo volunteered to be administrators of the monthly and operational data bases respectively, with input from the Hadley Centre.

A decorative wavy line at the bottom of the page, consisting of a single continuous curve that starts low on the left, rises to a peak in the middle, and then falls back to a low point on the right.

No final decision was made about the inclusion of other variables such as wind speed and direction in the data bases and it was agreed to keep this issue open for later discussions. However the group agreed, if resources permit, it is better to digitise a number of variables at one time, rather than just pressure.

The need to adopt a uniform data format was recognised. We will work towards using the International Maritime Meteorological Archive (IMMA) format, or a variant thereof, and adapt this to work with terrestrial pressure observations. This will simplify user access, allow us to store more than one variable and to maintain more detailed meta data. It is however best suited for the operational rather than the monthly data base. *Details of this format are now available as a separate pdf document.*

3.2 Outstanding data issues

The group notes the need to raise awareness of a number of important records that are missing. Rob Allan suggested to the group that they compare their own pressure holdings with the scanned images on the NOAA library site (http://docs.lib.noaa.gov/rescue/data_rescue_home.html). This site has near complete records of a number of foreign data holdings and publications. There are some gaps in these records, however, and it would be desirable to fill in some of these missing years.

Rob Allan and Tara Ansell will check for the Hong Kong daily records in the Met Office's library. *We have found some daily observations from 1853-1862, 1866-1886 since the meeting. We will keep searching!*

David Parker will investigate the Gordon Manley pressure records. *Since the meeting David has been able to find evidence that Gordon Manley did indeed collate pressure observations and there appears to be coverage for London from 1770.*

We have the potential to take the London and Paris records back to the 17th Century, possibly earlier. Work on these two cities was highlighted as being very important. Phil Jones in particular commented that despite their relatively close proximity, London and Paris are quite different series and hence provide a good measure of the North Atlantic Oscillation (NAO).

3.3 Reanalysis fields

The group agreed to Phil Jones' recommendation to write a formal letter, acting on behalf of AOPC, to ECMWF requesting that their reanalysis data be made freely available. *The co-convenors of the AOPC pressure working group will write the letter, to then be approved by the members of AOPC and forwarded on to ECMWF by the head of AOPC.*

3.4 Homogenisation of series

Phil Jones requested that series being homogenised should be done so according to the current operating standard (i.e. observing hours and/or averaging scheme), thereby preventing the need for further adjustments when blending in current observations.

3.5 Errors

One recommendation from the Boulder Workshop was to produce, in time for the 4th IPCC assessment, grid box uncertainties and error covariance structures in gridded MSLP products. This led to discussion on how to estimate errors with terrestrial observations. The group was asked to consider the following issues:

- can we look simply at the number of observations per day?
- are there any consistent errors, such as urbanisation effects with temperature?
- any gross potential bias?
- do we want to ignore / reject the very high altitude stations or how should we handle them?

This will be reviewed at follow-up meetings.

4. Additional Information:

4.1 List of frequently used acronyms

AARI: Arctic and Antarctic Research Institute

ADVICE: Annual to Decadal Variability in Climate in Europe

AOPC: Atmosphere Observing Panel for Climate

CDMP: Climate Database Modernisation Program

CEA: Commissariat À l'Energie Atomique

CIRES: Cooperative Institute for Research in Environmental Studies

CLIWOC: Climatological Database for the World's Oceans

CRU: Climate Research Unit (at UEA)

ECA & D: European Climate Assessment & Dataset

ECMWF: European Centre for Medium-Range Weather Forecasts

EMULATE: European and North Atlantic daily to MULTIdecadal climATE variability

GHCN: Global Historical Climatological Network

HadSLP: Hadley Centre, Sea Level Pressure gridded data set.

ICOADS: International Comprehensive Ocean and Atmosphere Data Set

IMPROVE: Improved Understanding of past climatic variability from early daily European instrumental sources

KNMI: Koninklijk Nederlands Meteorologisch Instituut

IMMA: International Maritime Meteorological Archive

MSLP: Mean Sea Level Pressure

NCAR: National Centre for Atmospheric Research

NCDC: National Climate Data Centre

NCEP: National Centers for Environmental Prediction

NOAA: National Oceanic and Atmospheric Administration

OOPC: Oceanographic Observation Panel for Climate

PMEL: Pacific Marine Environmental Laboratory

QC: Quality control

UEA: University of East Anglia

WASA: Waves and Storms in the North Atlantic

WWR: World Weather Records

4.2 Climate Database Modernisation Program (CDMP):

Steve Doty is the Program Manager for CDMP. His email address is Stephen.R.Doty@noaa.gov. He should be contacted by anyone who has a data set consisting of 1,000 or more documents that needs digitising. Steve can explain or send information on the CDMP and its proposal process. He has an annual brochure on the program with guidelines for submitting proposals.

The CDMP's budget (funded by the U.S. Congress) last year was very large, and NCDC manages contractors for digitising the data that involve over 1400 employees! They are quite busy, so it is very important for anyone interested to learn about the proposal process as soon as possible. Proposals involving data sets that nicely complement others that are already funded for digitising are very likely to be accepted. *Information on the CDMP project was provided by David Wuertz.*

4.3 How to retrieve the GCHN version 2 data?

- ftp <ftp.ncdc.noaa.gov>
- cd /pub/data/ghcn/v2
- prompt
- mget *slp*
- bye

4.4 Useful web sites and relevant projects:

AOPC:

<http://www.wmo.ch/web/gcos/aopc.htm>

NOAA Library:

http://docs.lib.noaa.gov/rescue/data_rescue_home.html

ECA & D:

<http://www.knmi.nl/samenw/eca/index.html>

CLIWOC:

<http://www.ucm.es/info/cliwoc/>

DARE:

<http://www.wmo.ch/web/wcp/wcdmp/>

READER:

<http://www.antarctica.ac.uk/met/READER/>

ADVICE:

<http://www.uea.ac.uk/~f094/advice.html>

IMPROVE:

<http://www.cru.uea.ac.uk/cru/projects/improve/>

ICOADS:

<http://www.cdc.noaa.gov/coads/>

WASA:

<http://w3g.gkss.de/G/Mitarbeiter/storch/wasa.html>

EMULATE:

<http://www.uea.ac.uk/mailman/listinfo/emulate>



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