This official approved conference statement from the Third International Conference on Reanalysis is intended for use in a variety of fora, and especially to help garner support for ongoing reanalysis efforts of all sorts, from basic data issues to modelling and data assimilation. For instance, it may be used to promote reanalysis and its application at the Third World Climate Conference (WCC-3) in late 2009. It will be reported to the Joint Scientific Committee of the World Climate Research Programme and the Steering Committee of the Global Climate Observing System, and may be used as the basis for a conference summary (such as in Eos Transactions, published by the American Geophysical Union).

Third WCRP International Conference on Reanalysis
Conference Statement

Atmospheric reanalyses have greatly improved our ability to analyse the past climate variability. Further improvements to reanalyses, including expansion to encompass key trace constituents and the ocean, land and sea-ice domains, hold promise for extending their use in climate change studies, research and applications.

The Third International Conference on Reanalysis held in Tokyo from 28 January to 1 February 2008 is the third in a series of international meetings to showcase results of progress in reanalysis products and research and to discuss future goals and developments.

Reanalysis of atmospheric observations using a constant state-of-the-art assimilation model has helped enormously in making the historical record more homogeneous and useful for many studies. Indeed in the twenty years since reanalysis was first proposed, there have been great advances in our ability to generate high-quality temporally-homogeneous estimates of the past climate. The World Climate Research Programme (WCRP) and the Global Climate Observing System (GCOS) have provided continuing leadership in promoting the underpinning research and observational needs for reanalysis. With the ongoing development of analysis and reanalysis in the ocean, land and sea ice domains, there is huge potential for further progress and improved knowledge of the past climate record.

The climate record is made up of analysis of observations taken for many other purposes, such as weather forecasting in the atmosphere, or core oceanographic research. It is now recognised that global climate can only be understood by ensuring that there are climate-quality observations taken in the atmosphere, ocean and land surface including the cryosphere. A consequence of past practices is that the climate record often displays biases that mask long-term variations. Many climate data sets are inhomogeneous: the record length is either too short to provide decadal-scale information or the record is inconsistent owing to operational changes and absence of adequate meta-data. Hence major efforts have been required to homogenize the observed data for them to be useful for climate purposes.

GCOS has specified the GCOS Climate Monitoring Principles (GCMP) that should be followed by all agencies wishing to contribute to the climate record. The GCOS Implementation Plan (2004) recognises the importance of both *in situ* and satellite data in providing global coverage of the atmosphere, ocean and land. It is encouraging to note that the Committee on Earth Observation Satellites (CEOS) has prepared its Response to the GCOS Implementation Plan, which describes its proposed actions to ensure that future climate-related satellite missions yield climate-quality data. Global analyses are an essential tool to enable the optimal use of global Earth observations in a number of the domains covered by the Group on Earth Observations (GEO); indeed reanalyses for climate along with the improvement of corresponding observation data sets are identified as a specific GEO Work Plan task. Further, the GCOS Plan describes the required actions to improve the future climate data and it includes strong support for reanalysis of the past record using state-of-the-art analysis systems. However, progress in implementing the Plan has not been as great as hoped.

Global reanalysis of the climate system requires substantial infrastructure and intellectual resources to establish and enhance the basic database of observations, to carry out the computations, to analyse the output to ensure the quality of the products, and to archive and distribute the products, but it can often draw on much of the infrastructure and other resources established for global numerical weather prediction. Climate and weather prediction research and applications have benefited enormously from the products of atmospheric and ocean reanalysis, and so the support of the sponsors of reanalysis has been well rewarded.

The products of global reanalysis have provided the basis for advances in many areas, including providing the essential foundation for an accurate assessment of current climate ("climate nowcasts"), diagnostic studies of features, such as weather systems, monsoons, El Niño-Southern Oscillation, and other natural climate variations, seasonal prediction, and climate predictability. Moreover, the basic assimilation and prediction systems are improved as deficiencies are identified and corrected by applying them both in reanalysis and routine weather and climate prediction. Global reanalysis is also the foundation for regional reanalysis projects and downscaling where detailed climatologies can be prepared to support studies of local climate and climate impacts. There has been some progress in the use of reanalysis to investigate the difficult problem of the detection and attribution of long-term climate trends and variability. Reanalysis in the ocean and atmosphere has helped identify and correct deficiencies in the observational record, including the recovery of additional observations.

Trace constituents of the atmosphere influence the thermodynamics and dynamics of climate through both short-lived constituents, such as aerosols (tiny particulates) and ozone, and longer lived gases, such as carbon dioxide and methane. As assimilation techniques for observations related to these constituents are refined and extended, it is expected that reanalysis will eventually provide the means to develop consistent climatologies for the chemical components of the atmosphere, including the carbon cycle, and thus help to address key uncertainties in the radiative forcing of climate, as identified for example in the recent Fourth Assessment Report of the IPCC.

While the origins of reanalysis have been in atmospheric climate and weather, there have been significant studies of reanalysis (or synthesis) of ocean data. Because of the limited size of the historical ocean data sets, it has been necessary to develop novel techniques for increased homogeneity of ocean reanalysis. Other promising developments are occurring in sea ice, Arctic, and land surface reanalysis. There has also been initial development of coupled atmosphere-ocean data assimilation, which is laying the foundation for future coupled reanalysis studies that may lead to more consistent representations of the energy and water cycles. A challenge is to improve estimates of uncertainty in the reanalysis products.

Global atmospheric reanalysis results in high-quality and consistent estimates of the short-term or synoptic-scale variations of the atmosphere, but variability on longer time scales (especially decadal) is not so well captured by current reanalyses. The primary causes of this deficiency are the quality and homogeneity of the fundamental data sets that make up the climate record and the quality of the data assimilation systems used to produce reanalyses. However, research into bias corrections and advanced reanalysis techniques is showing promise, and further reanalysis efforts are needed.

Improvements in reanalysis depend upon continuing support for the underpinning strategic research, the development of comprehensive Earth system models required to expand the scope of reanalysis, and for the infrastructure for data handling and processing. The magnitude of the resources required for global reanalysis is such that only a small number of centres of expertise are expected to be able to support the whole process. Moreover, there needs to be continued close cooperation among these centres, as well as the broader community involved in aspects of global reanalysis, to ensure that the global benefits are maximized and that each new reanalysis learns from the knowledge gained from all the previous efforts. In particular, future global reanalyses should be coordinated and, if possible, staggered to ensure that the basic observational data record is improved before each reanalysis, and so that there is time to analyse and hence learn from the output of the past efforts. Reanalysis centres and sponsors should continue to be responsive to user needs.

Reanalysis has proved to be as valuable for monitoring climate, climate research and applications as was believed when it was proposed twenty years ago. However, as the scope of global reanalysis grows, the research effort needed to optimise the benefits is so large that international cooperation will be essential. Further challenges remain and we urge sponsors to continue their support for further reanalysis efforts in all domains spanning the instrumental record, and for the climate system as a whole.

More on the WCRP Conference: http://jra.kishou.go.jp/3rac_en.html