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**ATMOSPHERIC MODELLING ACTIVITIES IN SUPPORT OF WCRP**

**(Submitted by the Chairman of the JSC/CAS Working Group  
on Numerical Experimentation)**

The following text briefly review the main activities of WGNE in support of WCRP objectives, emphasizing items arising at its twenty third session which was kindly hosted by the Chinese Meteorological Agency at the Shanghai Meteorological Bureau, 22 - 26 October 2007. On this occasion it was a joint session with the GMPP.

Emphasis has been given to activities where international coordination is paramount and facilitated by the working group's existence, or where new scientific initiatives are involved. *(Please note that this is not in the proposed project format as the working groups activities do not fit naturally into this.)*

**1. Role of WGNE in support of WCRP and CAS**

WGNE, as a joint working group of the JSC and CAS, has the basic responsibility of fostering the development of atmospheric models for use in weather prediction and climate studies on all space and timescales. In the WCRP, WGNE is at the core of the global modelling effort and co-ordination between WGNE, WGCM and WGSIP is maintained primarily through ex officio meeting attendances. WGNE also works in close conjunction with the WCRP Global Energy and Water Cycle Experiment (GEWEX) particularly in the development of atmospheric model parametrizations, with WGNE sessions held jointly with the GMPP except in 2006. The WGNE Chair is a member of WMP, with WGNE represented on WOAP also.

WGNE also has specific THORPEX sessions at its meetings. The close relationship that exists between WGNE and operational (NWP) centres underpins many of the activities of WGNE, and it is the work of these centres that provides much of the impetus for the development and refinement of the physics and dynamics of atmospheric models.

The Chair of WGNE is a member of the Organizing Committee for the World Modelling Summit and, following discussion of the aims and aspirations of the summit during the WGNE meeting, has provided this input to the planning process.

**2. Studies and comparisons of atmospheric model simulations**

Model inter-comparison exercises are a key element in meeting a basic WGNE objective of identifying errors in atmospheric models, appreciating their causes and reducing or eliminating these errors.

PCMDI and CMIP

WGNE congratulated PCMDI for continuing to maintain and enhance a valuable infrastructure for processing model outputs at PCMDI and establishing efficient data

formats etc for such exchanges of model simulations. The recent outstanding achievements in the context of the IPCC/AR4 are of particular note. PCMDI has offered to receive high resolution NWP AMIP-type runs to complement their ongoing CMIP activities.

#### International Workshop on Model systematic errors

PCMDI was the local host for a pan-WCRP/CAS workshop on Model systematic errors in February 2007. This was organized by PCMDI and WGNE with input from WGCM and GMPP, and the programme was structured by timescales to emphasis the 'seamlessness' of many model errors. The meeting was very successful and attended by over 180 people. A report on the meeting is included as the Annex 1 to this document. More information on this meeting is available at the following link:

<http://www-pcmdi.llnl.gov/wgne2007/presentations>

#### "Transpose" AMIP

The goal of the WGNE-Transpose AMIP is to obtain the benefits for climate model development and evaluation that have been invaluable for weather prediction model development, by applying climate models to weather forecasting. The method allows direct comparison of parametrized variables such as clouds and precipitation with synoptic observations, satellite and field programmes. In general, development of a complete analysis system is not needed with initial conditions obtained from NWP

(re-)analyses. The method allows direct comparison of parametrized variables such as clouds and precipitation with observations including field programmes (such as ARM), early in the forecast while the model state is still near that of the real atmosphere. This WGNE initiative was prototyped jointly by PCMDI and NCAR and known as CAPT. The intention is to encourage climate modelling groups to implement this forecast strategy into their development process. Following the formal proposal for Transpose AMIP to climate modelling groups, approximately 8 groups are taking part with results beginning to flow. Additional participants are welcome.

#### Aqua-Planet Experiments (APE)

WGNE recognizes the value of applying atmospheric models to simplified surface conditions for examining the behaviour of physical parametrizations and the interactions of parametrizations with the dynamical cores. In particular, "aqua-planet" experiments with a basic sea surface temperature distribution offer a useful vehicle in this regard. The details of the experiment and schedule are available at <http://www.met.reading.ac.uk/~mike/APE>.

The experiment is designed to provide a benchmark of current model behaviour and to stimulate research to understand differences arising from: (1) different subgrid-scale parametrization suites, (2) different dynamical cores, and (3) different methods of coupling model dynamics and parametrizations. Using the APE database, analysis of the APE experiments is continuing for another year. Following the workshop held in April 2005, a second workshop is planned to discuss the more complete analyses in November 2007 at the Chiba Institute for Science, Japan. Thirteen groups have submitted results and comparative analysis is underway

The basic experiments are deliberately done at "climate model" resolutions but a few groups are examining convergence with resolution and the results and interpretation of resolution studies will be an important outcome of this work. The November workshop will discuss future directions for APE, but any further formal intercomparison will be considered a new project.

#### Regional Climate Modelling

A second RCM workshop is planned for March 2008 in Trieste at ICTP, sponsored by

WCRP and ICTP. This will run for two weeks with the first week for presentations etc and the second being a training week targeted at developing nation scientists.

WGNE also supported the suggestion for a WCRP Working Group on Regional Downscaling Techniques to strengthen its activities in the area of regional climate prediction.

WGNE also discussed results from SGMIP-2 (Stretched Grid Model Inter-comparison Project-2), and the planned 3<sup>rd</sup> phase to extend this activity to climate change scenarios. It will continue to monitor the developments in this area in its future sessions and would like to see more comparisons of the stretched versus the traditional limited domain approaches.

### **3. Climate Model Metrics**

WGNE has been involved in developing standard climate model diagnostics and metrics for some years. The goal of such metrics is to objectively measure model quality or skill and suitable metrics depend on the intended applications. The application for climate models includes the prediction of future climates for which no verification data will be available within the lifetime of the model. WGNE discussed the issue of climate model metrics at some length with many questions and issues resulting. A sub group with a member from each of PCMDI, WGCM, WGNE, GMPP and the JWGV (Joint Working Group on Verification) will define the climate model metrics and standard verification data sets with the intention of asking WCRP to encourage usage of these metrics for climate models. These metrics were extensively discussed at the February 2007 model systematic errors workshop and the choice of good metrics for climate models is still under discussion.

### **4. Physical parametrizations in models**

WGNE's close working relationship with GMPP (the GEWEX modelling and prediction panel), provides the focus for the development, refinement and evaluation of atmospheric model parametrizations, notably those of cloud and radiation, land surface processes and soil moisture, and the atmospheric boundary layer. WGNE reiterated the value of the interaction with GMPP for parametrization work, particularly with GCSS. A joint WGNE/GCSS model intercomparison study of a Pacific cross section (GPCI) to evaluate physical parametrizations along the atmospheric cross section following the trade winds is in progress, with excellent support from both NWP and climate modeling groups. The need for an expert group on parametrization to advise both WCRP and WWRP (and their Working Groups) was discussed, and the Chairs of WGNE and GMPP have drafted a proposal for consideration by the GEWEX SSG this February and the JSCs of the WCRP and WWRP when they next meet. (See Annex 2)

### **5. Numerical weather prediction**

#### Reanalysis projects and data assimilation

Production of ERA-Interim started in summer 2006, following a comprehensive set of preparatory experiments. The first ten years, from 1989 to 1998, have now been completed, and production is expected to reach present time during the second half of 2008. The clear superiority of ERA-Interim products over ERA-40 has been confirmed and many of the shortcomings of ERA-40 (e.g. the incorrect hydrological cycle and the too strong stratospheric Brewer-Dobson circulation) appear to be resolved.

Following the successful completion of the Japanese 25-year Reanalysis Project (JRA-25, 1979-2004), plans were described for a new JRA-50 to start in 2009.

Plans for the next NCEP 30 year reanalysis were also aired, and this will be the first to use a coupled ocean model.

WGNE reiterated its strong support for the reanalysis work, the desirability of maintaining a core of experts without excessive duplication of effort and ensuring efficient phasing of these efforts.

#### Earth System assimilation

The new developments in the assimilation of parameters pertinent to the Earth System but not routinely analysed by current data assimilation systems are being monitored by WGNE. These include analyses of greenhouse gases, aerosols and reactive gases. Earth system science such as the GEMS (Global and regional Earth-system Monitoring using Satellite and in-situ data) project will increasingly demand cross-project liaison within WCRP and CAS. The GEMS FP6 Integrated Project has the objective of developing an operational capability for global analysis of greenhouse and reactive gases and aerosols through assimilation of satellite data and for global forecasting of reactive gases and aerosols and is led by ECMWF. GEMS has the further objective of providing retrospective analyses (or reanalyses) for the period 2003-2007, when observational capability is at its best and In doing so, draws on data, scientific and technical developments and validation provided by partners in the project. Surface-flux inversions and regional-air quality (RAQ) forecasting are also components of the project.

#### Model developments

WGNE noted the substantial improvements in the resolution of global and deep convection permitting forecast models in progress or planned in the next few years. There exists a dichotomy of opinion regarding the use and interpretation of grid-lengths of several kms for forecasting. These resolutions are becoming affordable for GCM use in the coming years, and the prospect of climate simulations with grids of order one kilometre is an issue of international activity and debate, and WGNE will continue to monitor and advise on such developments.

Recent results showing the need for model resolutions of 100 kms or better to properly define the statistics of extra-tropical storm tracks were noted. This contrasts with typical climate model resolutions substantially poorer than this, a matter of serious concern to the group.

WGNE noted that plans for unified (coupled) forecast systems that will provide forecasts from days out to seasons, typically by progressively degrading the resolution with forecast range, will provide new opportunities for ensemble techniques, including initial perturbations, stochastic parametrizations and metrics, and bring even closer collaboration between the NWP and climate communities.

WGNE contributed to the TFSP meeting in Barcelona, June, 2007 including a report on the Systematic Errors workshop.

#### Performance of the main global operational forecasting models

WGNE routinely reviews the skill of daily forecasts from a number of the main operational centres in terms of verification scores for various fields at different lead times. For most centres, a distinct increase in skill continues.

#### Model Verification

With global models attaining much higher resolutions, and mesoscale models being routinely run at operational centres, consideration is being given to additional skill scores to the conventional ones that are more appropriate for such resolutions. Furthermore there is an increasing requirement to provide measures of model performance for predicting weather elements and severe weather events. The joint

WGNE/WWRP working group on verification (JWGC) is considering this important subject.

There are a number of WGNE projects involved with the validation of forecasts. New developments were discussed including the development of methods to verify high resolution spatial forecasts; verification methods for rare events; incorporation of scaling methods into verification processes; approaches to account for observational uncertainty in verification measures and analyses; development of methods that are customer dependent and appropriate for studies of forecast value; and verification of probability distribution functions.

#### Inter-comparison of typhoon track forecasts

The inter-comparison of forecasts of typhoon tracks has been an ongoing project that has been conducted by the Japan Meteorological Agency on behalf of WGNE for a number of years. This now includes all ocean basins, and data from operational forecasts is now available from eight Centres. The overall gradually improving performance of these models in predicting cyclone tracks over the past few years has been maintained. Statistics are now gathered to assess the skill in intensity forecasts and forecasts of cyclone genesis. Many results related to typhoon track forecast including a multi-model ensemble are presented on the web site ([http://nwp-verif.kishou.go.jp/wgne\\_tc/index.html](http://nwp-verif.kishou.go.jp/wgne_tc/index.html) (user id and password are required)).

#### Verification and inter-comparison of precipitation forecasts

This WGNE initiative is being conducted at the DWD, NCEP, BMRC, CMA, JMA, CMC, the Met Office and Meteo-France. Quantitative global precipitation forecasts from the above are being verified against surface stations in these relatively data rich areas (some Centres also include their limited area model forecasts in the verification). It was noted that there is clear evidence from several Centres that the skill of precipitation forecasts in mid-latitudes was increasing.

#### Model-derived estimates of ocean-atmosphere fluxes (SURFA)

SURFA will evaluate and inter-compare global surface flux products (over ocean and land) from the operational products of a number of the main NWP centres and this will provide a good opportunity for estimating and determining the quality of model surface fluxes, of considerable relevance to atmospheric and coupled modelling communities and oceanographers. Progress on SURFA was reported at WGNE-23 and an agreed set of operational NWP fields etc is now being routinely archived at the National Climate Data Centre, initially from one centre (ECMWF), but this will soon be extended to other global NWP centres.

#### The WGNE 'Blue book'

A key WGNE publication for many years has been the WGNE "blue cover" numerical experimentation report series which continues to be popular with the modelling community. and is prepared on behalf of WGNE by Recherche en Prevision Numerique (RPN), Montreal since its inception, and the latest annual summary of research activities in atmospheric and oceanic modelling (No. 37) has been released. This publication is facilitated by use of e-mail contact and the website at RPN, ([www.cmc.ec.gc.ca/rpn/wgne](http://www.cmc.ec.gc.ca/rpn/wgne))

## **6. THORPEX**

At the 23rd WGNE meeting there was a session which reviewed the status and plans of THORPEX and the wide-ranging opportunities for collaboration and synergy with WCRP and other bodies. The plans for T-PARC were of particular note, and this 'campaign'

promises to make a major contribution to our understanding of meteorology in the Pacific basin.

The use of ensemble methods now forms a cornerstone of forecasting on all timescales, and WGNE noted that the rapidly progressing TIGGE project will help accelerate the effective use of ensemble forecasting information.

## **7. A Year of Tropical Convection**

WGNE discussed the proposal for 'A Year of Tropical Convection' (YOTC) which is aiming to assemble a dataset that will enable focussed research on many aspects of tropical convection, which in turn should lead to significant/important advances in our NWP abilities on all timescales currently labelled under 'seamless' prediction. The discussions strongly supported the idea but felt that it was less clear how the aims of the YOTC would be achieved.

As this YOTC dataset will be a judicious combination of many existing datasets in a variety of forms and repositories, questions were asked as to whether this is an opportunity to harness the powers of the new WMO Information System (WIS), and what was the YOTC relationship to other planned 'global' activities such as IPY and a possible Monsoon' focus. A workshop was held just after the WGNE meeting with support from WMO and US-CLIVAR to consider these questions and to progress the implementation. Recognizing that convection is central to many problems in modelling research on almost all space and time scales, YOTC should help coordinate efforts across the entire WCRP community.

## **ANNEX 1: Workshop on Systematic Errors in Climate and NWP Models**

San Francisco, February 12-16, 2007

### **Introduction and summary**

This was the Third JSC/CAS-sponsored WGNE workshop on model systematic errors, the previous ones being in Toronto in 1988 and Melbourne in 2000. On this occasion PCMDI provided substantial logistic and financial help for this well-attended meeting (~170 people). The workshop was structured to study model errors across multiple timescales, from NWP to climate integrations. Errors in both atmospheric and coupled ocean-atmosphere models were high on the agenda. The workshop was structured with a limited number of presentations, a large number of posters with plenty of time to view and discuss them, a number of breakout groups to discuss various issues, and a plenary session to review and discuss the meeting as a whole and to identify and address the salient themes emerging from the workshop.

Systematic errors in climate and weather prediction models are evident on a wide range of space and time scales. The root causes of these errors are often difficult to address, because the many complex processes and phenomena of the climate system interact, both in the real world and in model simulations. A key motivation for this workshop was to bring together a variety of diagnostic approaches, with the expectation that awareness and understanding of the causes of systematic errors would be increased, and lead to a more coherent strategy for future advances.

There were several main issues which emerged from the presentations and the discussions of the breakout groups:

**The importance of metrics.** In the NWP community, standard metrics that gauge the skill of forecasts have been routine for years. There is now increased interest in developing performance metrics for climate models. Establishment of a set of standard metrics could encourage all modelling groups to provide at least a minimal standardized summary of model strengths and weaknesses, which would facilitate monitoring and documenting of changes in model performance. A hierarchy of metrics could be designed to help assess the simulation of a variety of processes and phenomena on a range of time and space scales. Although work on optimizing the utility of metrics is in its early stages, it is widely believed that the metrics of most value will almost certainly be application dependent. Community-based efforts are underway to explore and establish a set of standard metrics relevant for climate models. The IPCC-AR4 archive typically includes results from more than thirty models and it is evident (both a priori and on looking at the model output) that not all models are created equal! The climate modelling community have traditionally been reluctant to

“rank” model performance, but maybe the workshop has encouraged them to be more open about where they stand. Metrics may also be able to guide the interpretation of the model results - some models may be given more weight when making predictions of future climate change. This is a difficult and sometimes controversial area yet it is essential to perform weighting. The issue of appropriate metrics (typically based on simulation of past and present climate) is an area of ongoing work. Metrics that assess phenomena are important for intercomparison but weighting climate predictions really needs to be based on a more systematic assessment of model physics/dynamics.

**The importance of short range forecasts from NWP analyses.** Increasingly, our confidence in climate simulations (decades and longer) is dependent on how well they perform on much shorter time scales. What is wrong in a 100 year climate run is often going perceptibly wrong after 5 days of integration, because many errors are in the treatment of fast processes (boundary layer, convection, radiation, clouds). Short integrations from realistic initial conditions allow both detailed comparison with the latest observational data and diagnosis of the processes and tendencies in the model. This is a much simpler and cheaper experimental framework than that of a fully coupled ocean-atmosphere general circulation model (OAGCM) run for decades to centuries. A number of climate modelling groups are beginning to use such techniques (as championed by WGNE for several years with the Transpose AMIP project)

Experience thusfar with several climate models in this mode has shown that the growth of systematic errors can be so prominent that residual problems of ‘spin-up’ due to incompatibilities between analysis and forecast model are not critical for many of these studies when using the highest quality NWP analyses. Undoubtedly there is a limit to this especially when looking at surface or near-surface issues and there are opportunities for research in this area. The ability to simulate the observed climate record over long periods still remains a crucial model test.

**The difficulties of accurate simulation of the diurnal cycle.** It clearly stretches the capability of current models to realistically capture the coupled and local physical processes that constitute the diurnal cycle. It is generally poorly simulated in GCMs, but models with very high horizontal resolution (e.g., less than 4km) do a little better, and cloud resolving models (CRMs) also do well with sufficient resolution. Poor simulation of the diurnal cycle impacts weather forecasts, but it is also important for climate via the Earth’s radiation balance or the terrestrial carbon budget. It remains unclear what impact this deficiency might have on climate change projections. Climate models have yet to be run at convection-resolving resolutions, however, careful experimentation at high enough resolutions to capture cloud systems (gridlengths~10kms) may benefit parameterization development in ways that could lead to better simulation of the diurnal cycle at typical climate resolutions. It was noted that the impact of explicitly resolving deep convection (gridlengths~1km) in a climate simulation remains to be seen and is a clear challenge in the coming decade.

Results showing that the diurnal cycle had a strong impact on the momentum

budget in the equatorial ocean suggest that the diurnal cycle of forcing might be important in ocean data assimilation systems. Much improved complete physics packages are needed to better handle these highly coupled situations involving a range of time and space scales.

**The value of running suitably initialized coupled models in forecast mode over seasonal timescales.** This is analogous to atmosphere-only runs from NWP, but allows examination of somewhat slower processes, particularly those associated with ENSO and the seasonal cycle in the tropics. Relatively short coupled runs are also natural tools for comparing modelled and observed cloud/SST interactions. An analysis of ENSO in the AR4 models shows that ENSO amplitude has a big scatter - many models are overly strong, quite a few models are overly weak, very few models look anything like reality. The experience of seasonal forecasters is that simple initialization with wind and SST data was capable of giving very good ENSO forecasts, and that by selecting a relatively limited set of initial dates a model's ability to handle a range of EL Nino / La Nina / neutral conditions could be assessed. WGSIP will try to provide some "recommended" procedures and dates through the auspices of CLIVAR.

An outstanding challenge in modelling the MJO and monsoons was that active-break transitions are not forecast, and typically not represented in GCMs. The broader implications of this is that this limits medium-range and seasonal predictability, as well as ENSO forecasting, and that the simulation of extreme events is compromised. To date, many of the root causes behind errors in simulating the monsoon have not been identified.

**The need for much higher resolution.** The highest resolution simulations in AR4 are around T85, but the sentiment of the workshop suggested that the argument supporting much higher resolutions is now overwhelming, with several presentations demonstrating positive impacts of much higher resolution both from a dynamical and physical viewpoint. Recent experiments with high-resolution (60-90km) coupled models show that, in the tropics, the full potential of high resolution emerges if coupled models are used. Moreover, it seems crucial that high-resolution is used in both the ocean and the atmosphere.

### **Further workshop conclusions**

There are a number of persistent model errors for which there is limited understanding of the underlying processes, and for which there are no clear solutions. Model errors affecting intermediate time-scales (e.g., monsoons and the Madden Julian Oscillation) are often subtle, and the processes responsible for them need not be local. On longer time-scales, the El Niño Southern Oscillation (ENSO) is a dominant mode of climate variability, and there continue to be simulation errors in its structure, frequency and amplitude. Other coupled atmosphere-ocean modes of variability that require improvement include the Pacific Decadal Oscillation and the Atlantic Multi-decadal Oscillation. Increasing the use of climate models for seasonal time-scale experimentation is a practical recommendation from this workshop to tackle some modelling deficiencies associated with these modes of variability.

Although there is a growing appreciation of how the climate may change, century-long simulations are still very uncertain. How the global cloud fields respond to small changes in the Earth's energy budget is a key issue, with systematic errors over the sub-tropical oceans, for example, being responsible for substantial uncertainty.

The development of Earth System Models brings new challenges not least via their need for greatly increased resources, both computational and human. It was suggested that this posed a genuine threat to the necessary studies required for minimizing existing major systematic errors evident in less complex models, and without which, reliable/stable ESM simulations will pose a major challenge for some time.

The extent to which systematic errors limit the veracity of climate model projections is a key issue. Some systematic errors are clearly sensitive to horizontal resolution, while other errors seem not to be, and are presumed to be attributable to deficiencies in the parameterized formulations of unresolved processes. Nevertheless, recent experimentation suggests that current climate model resolutions are significantly too coarse to properly resolve important atmospheric and oceanic phenomena. The exploration of systematic errors should be conducted at much higher resolution than is typical for current global climate models and hopefully high enough to be operating in a numerically convergent regime for the realistic representation of the most important climate phenomena.

Progress will also be aided by emerging observational technologies for crucial physical processes in the climate system (e.g., clouds, aerosols, precipitation, surface energy exchanges), which will help to constrain the formulation of these processes in climate models. New types of data now becoming available such as from the CloudSat/Calipso satellite, will be a great resource for looking at model errors in simulating cloud and rain.

Increased computing resources will undoubtedly accelerate progress in reducing systematic errors in climate models. In this workshop, there were striking examples of how increased atmosphere and ocean horizontal resolution (substantially higher than typical for climate) can improve the simulation of some key climate processes. However, the meeting consensus was that, while continuing enhancements in computing resources were needed, having the right scientific manpower to work with interfacing the increasingly abundant observational data with the models was just as important. Since progress is at best incremental, there was concern expressed that model development was unattractive to young scientists and that it was difficult to attract and keep young talent in a publication-driven environment.

## **Annex 2: The future of parametrization research and development in WCRP and WWRP**

(A discussion paper for the WCRP and CAS communities)

### **The background**

Many of the processes that are important to weather and climate act on scales smaller than the grid-sizes of contemporary models used in Numerical Weather Prediction (NWP), seasonal prediction and climate simulation. Examples of such processes are turbulence and convection in both the atmosphere and the ocean, cloud processes, and processes related to the energy, water and biogeochemical exchanges at the land and ocean surfaces. As these processes affect the evolution of the Earth System on all time-scales they need to be represented in models, this is usually achieved by means of parametrization. It is generally accepted that the key deficiencies, and hence uncertainties, in our current climate projections are directly related to our ability to represent these parametrized processes. Modern parametrizations are comprised of conceptual models of the processes they are aiming to represent. Importantly this extends their usefulness well beyond the application in a model, as the conceptualization of a process requires a deep understanding of the important mechanisms and feedbacks. It can be argued that in many areas the need for improved parametrizations has driven research progress such as in the design and implementation of both field experiments and research satellites.

The last decades have seen great advances in both computing and model design, leading to the application of models with smaller and smaller grid-sizes, in particular in the NWP area. Limited-area NWP models are now routinely used at grid-sizes well below ten kilometres. These grid-sizes begin to approach scales where certain processes that have traditionally been parametrized can be resolved by the model. Perhaps the prime example for such a process is that of atmospheric deep convection. This development has led to the erroneous impression that parametrizations, in particular those of deep convection, do not require much further development as they will become obsolete in the foreseeable future.

While it is likely that a small number of research activities will employ models of high enough resolution to be able to abandon the parametrization of deep convection, it is highly unlikely that even the most advanced prediction centres will be using models of such resolution for several decades to come. This is true in particular for efforts in medium-range weather and seasonal prediction and climate simulation, where the requirements of ensemble methods will prohibit the use of such high-resolution models. Even where these can be used, the parametrization of processes other than deep convection will remain of crucial importance for the foreseeable future.

## The problem

In contrast to the great advances in computing and general model development, the scientific field of parametrization development has not advanced similarly and is arguably in decline especially for moist processes such as clouds and convection. There are a number of likely reasons for this. Parametrization research requires a team effort where all aspects of development are covered in a holistic manner. It needs to be embedded in a global or limited area modelling effort to ensure that the work is relevant and practicable in the context of the overall model development. This makes it difficult to establish sustainable efforts away from large modelling centres, and, with only a few notable exceptions, many centres have reduced their relative effort in parametrization in recent years. It is likely that a significant contribution to this decline also comes from a lack of visibility and promotion of the field through relevant international organizations. In WCRP, parametrization development activities are carried out on a relatively small scale and are mostly concentrated in the GEWEX Modeling and Prediction Panel (GMPP), a small organizational unit of one of several WCRP projects. Since its restructuring CAS currently has no specific parametrization expertise, although it has recently expressed interest in the need for this. It is important to note that many of the GMPP activities have been strongly supported by the Working Group on Numerical Experimentation (WGNE) whose membership represents the main institutions where parametrization development is carried out and implemented in all the main NWP and global models.

Given the current and future importance of parametrization to ALL applications used in both programmes it is remarkable how little visibility (and support) is given to parametrization development.

## A proposal

Given the arguments outlined above it is timely to rethink the organization of parametrization development in the various WMO activities. The aims of the changes proposed below are:

- to prevent the demise of parametrization as a scientific discipline
- to promote throughout all WMO research programmes the need for additional investment in parametrization development
- to facilitate the necessary dialogue between parametrization developers and model users in all areas of model application
- to facilitate scientific activities, such as coordinated research programmes, workshops and scientific conferences on parametrization
- to embrace parametrization development as an important contribution to enhance our predictive capabilities on all space and time-scales
- to build a critical mass within the WMO structures to make significant progress in critical areas of parametrization development over the next 10 years

To achieve the aims above it is proposed to form one central parametrization expert subgroup within WMO, which will engage with all other programmes and will be the focal point for parametrization development within WMO. As WGNE represents both WCRP and CAS, it is proposed that the expert group resides within WGNE. As this will add substantially to WGNE's portfolio, it is proposed to appoint a WGNE co-chair with specific responsibility for the parametrization activities. (Note that having co-chairs has been encouraged in recent years to share the voluntary workload). The membership of the expert group will be drawn initially from existing groups within WCRP and CAS. At a minimum the group would invite the current chairs of the GEWEX projects GCSS, GLASS and GABLS, who currently form GMPP. It is proposed to investigate and encourage the inclusion of parametrization efforts beyond the atmosphere and land surface, such as the ocean and the cryosphere, to enable cross-fertilization of concepts.

While WGNE represents the NWP community well, its membership currently does not cover the entire spectrum of activities with which the new expert group needs to engage, such as seasonal prediction and Earth System Modelling. It is envisaged that the new WGNE-co-chair would attend the relevant meetings of groups like the WGCM and WGSIP while their respective chairs interact with the new and wider parametrization community by attending future WGNE meetings.

It is important to note that this proposal has minimal cost implications, since the core of the proposed expert subgroup would be constituted from the existing GMPP membership who already meet annually with WGNE. The new arrangement will also enable contributions by the CAS to parametrization-relevant activities.

## **A timeline**

January 2008 - send proposal to GEWEX SSG, CAS and WCRP JSC

February 2008 - discussion (and approval?) at GEWEX SSG

March 2008 - discussion (and approval?) at WCRP JSC

April/May 2008 - discussion (and approval?) at CAS/AREP

April/May 2008 - appoint new co-chair

Summer 2008 - Modify the terms of reference for WGNE to accommodate the changes to its portfolio if necessary. Develop plans for activities, expectations and needs of the expert subgroup

October 2008 - WGNE meeting in Canada to include discussion of the above.  
(Drafted by Christian Jakob (Chair GMPP) and Martin Miller (Chair WGNE)  
Jan 2008)