

## WGNE positional paper with regard to CAS/WCRP reforms

The Working Group on Numerical Experimentation (WGNE) was founded over 30 years ago with the purpose of “fostering the development of atmospheric circulation models for use in weather prediction and climate studies on all time scales, and diagnosing and resolving shortcomings”. Since its creation, WGNE has been a pioneer of seamless working and promoted cross-cutting projects. Examples include the Atmosphere Model Intercomparison Project (AMIP) and transpose-AMIP protocols which permit the intercomparison of models primarily developed for NWP or climate projection in a common experimental framework. The main work of WGNE can be summarised as:

- Identification of systematic errors common to many models (e.g. by organising and leading model intercomparison projects).
- Sharing diagnostic tools and techniques to get to the root of the error.
- Sharing knowledge around sensitivity of errors to model formulation (parametrizations, dynamical core, etc.).
- Work with other groups (e.g. the GEWEX groups Global Atmosphere System Studies (GASS) & Global Land-Atmosphere System Studies (GLASS)) to increase the knowledge targeting the development of solutions.

WGNE is unique within the WMO structure in being a working group which reports to both the World Climate Research Programme Joint Steering Committee (WCRP-JSC) and to the Commission for Atmospheric Sciences (CAS) which also oversees the World Weather Research Programme (WWRP) & Global Atmosphere Watch (GAW). Both of WGNE’s ‘parent’ groups are undergoing reform. CAS is likely to be replaced with a Research Board and Science Advisory Panel. In this context, the 70<sup>th</sup> session of the WMO Executive Council recommended a seamless-oriented research structure and a unified, integrated Earth system modelling approach. The recent sponsors’ review of WCRP proposed a reorganisation of the working groups and projects within the programme. A common theme in both reforms is the desire for a strong working group covering model development.

In both the most recent CAS meeting (informed by the Science Summit) and the WCRP sponsors’ review, the importance of seamless modelling has been stressed. Coupled atmosphere-ocean-ice models, which were previously only used for longer timescale simulations, are now being used for operational NWP. Earth system components such as interactive aerosols and chemistry are being used for climate change projections, air quality forecasting and subseasonal to seasonal predictions alike. Furthermore, convective permitting models of the order of 1km grid spacing, typically used for regional NWP are increasingly being used to downscale climate projections for specific regions. Thus many of the traditional differences between models used for climate and weather forecasting no longer exist and it makes sense for the model development community more generally to share best practice and work together on common systematic errors. In a recent survey of NWP and climate centres on their most concerning systematic errors, the top four highest ranking issues (convective precipitation, surface flux errors, surface temperature errors, and cloud microphysics) were common, irrespective of whether the model was being used for NWP, seasonal forecasting or climate change projections. Many of the top ranking issues are exacerbated or even created by system component feedbacks. Dealing with systematic errors arising from coupling Earth system components will require an integrated view of the Earth system.

WGNE’s purpose and seamless methodologies makes it an obvious choice to evolve into the model development focal point desired by CAS and the WCRP sponsors’ review. WGNE has so far mainly focussed on atmospheric (and land surface) model development as this was originally the model component which was common across timescales. Consistent with this, membership of the group is currently largely comprised of developers of the atmospheric component of models from NWP and

climate modelling centres. However, at many centres and institutions the transition towards a more integrated Earth system view is already happening. For WGNE to take more a holistic view of models today, there should be an increased land-hydrology, ocean, cryosphere and atmospheric composition presence. Scientific development of the components in Earth system models has often occurred with little cross-fertilization of methodologies. For example, it may foster accelerated development of atmospheric boundary layer processes, ocean mixed layer processes and surface flux modelling to have increased interaction between researchers in ocean, land and atmosphere modelling. Work on numerical methods and basic geophysical fluid dynamics will clearly benefit from increased interaction between ocean and atmosphere modellers.

Like all WMO working groups, WGNE is composed of volunteers who have demanding jobs at their own institutions and we would need to ensure that acting as this modelling focal point does not increase the workload of members or the co-chairs beyond what is currently asked of them. One possible way this could be achieved is by having a single reporting to the Research Board, rather having to deal with similar, but subtly different requests from WCRP and WWRP (e.g. as input to/progress with their implementation plans). In order to maintain efficiency, we also think that the overall size of the group should not exceed substantially its current set of members and ex-officios, hence we propose that the broader expertise in Earth system components is obtained over time as members rotate off and are replaced. However, WGNE could be immediately strengthened by adding 1-2 new members with corresponding expertise. We also see a continued role for the process modelling and parametrization development groups of GASS and GLASS who WGNE would continue to work closely with, and we could imagine similar groups being formed, for example on ocean/sea-ice dynamics and parametrization.