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Toward a Seamless Process for the Prediction of Weather and Climate: On the Advancement of Sub-seasonal to Seasonal Prediction

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Toward A Seamless Process for the Prediction of Weather and Climate

- A collaborative effort between the WMO Programs WWRP-THORPEX and WCRP on the advancement of sub-seasonal to seasonal prediction;
- A white paper was prepared by a joint WWRP-THORPEX/WCRP team comprised of: Gilbert Brunet, Melvyn Shapiro, Brian Hoskins, Mitch Moncrieff, Randal Dole, George Kiladis, Ben Kirtman, Andrew Lorenc, Rebecca Morss, Saroja Polavarapu, David Rogers, John Schaake and Jagadish Shukla.

Proposed Joint Research Objectives between WCRP and WWRP

- Seamless weather/climate prediction with Multi Model Ensemble Prediction Systems (MMEPSs)
- The multi-scale organisation of tropical convection and its two-way interaction with the global circulation
- Data assimilation for coupled models as a prediction and validation tool for weather and climate research
- Utilization of sub-seasonal predictions for social and economic benefits

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Seamless weather/climate prediction with Ensemble Prediction Systems(EPSs)

- Terms of reference for collaboration between TIGGE and CHFP must be establish for experimentation and data sharing for sub-seasonal to seasonal historical forecasts (weeks to season) including the required infrastructure.
- Development and use of ensemble based modeling methods in order to improve probabilistic estimates of the likelihood of high-impact events.
- The requirements for both ensemble prediction methods and greatly increased spatial resolution imply substantial future requirements for computational power and for data storage and delivery capacity.

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The multi-scale organisation of tropical convection and its two-way interaction with the global circulation

- Capability acceleration of the High-Performance Computing (HPC) centers for high-resolution regional and global numerical weather, climate and environmental science activities;
- Maintaining existing and implementing planned satellite missions that measure tropical cloud and precipitation systems in order to provide a long-term capability for process studies, data assimilation and prediction in collaboration with GCOS;
- Collaborative effort through YOTC and TPARC.

Lagged probability composites of the NAO index with respect to each MJO phase.

- Lag n means that the NAO lags the MJO of the specific phase by n pentads, while Lag –n represents that the NAO leads the MJO by n pentads.
- Positive values are for upper tercile, while negative, while negative for low tercile
- Values shown are only for those pass a 0.05 significance level according to a Monte Carlo test.
- From Lin et al. 2008, JCL

• A significant change of upper zonal wind in the tropical Atlantic is caused by a modulated transient westerly momentum flux convergence associated with the NAO.

Phase	1	2	3	4	5	6	7	8
Lag −5		−35	−40			+49	+49	
Lag −4						+52	+46	
Lag −3		−40					+46	
Lag −2						+50		
Lag −1								
Lag 0				+45				
Lag 1			+47	+45				
Lag 2		+47	+50	+42		−41	−41	−42
Lag 3		+48				−41	−48	
Lag 4						−39	−48	
Lag 5								

The enhanced precipitation reaches the tropical central Pacific with reduced precipitation over the Indian Ocean

Maximum convection between Ocean Indian and Maritime continent

• Increase of the NAO after the MJO-related convection anomaly reaches the tropical Indian Ocean and western Pacific region.

• The development of the NAO is associated with a Rossby wave train in the upstream Pacific and North American region.

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Data assimilation for coupled models as a prediction and validation tool for weather and climate research

- In addition to the resources needed for the continued development of operational forecasting systems, specific resources are needed for the development of the seamless coupled aspects of data assimilation which are not immediately linked to Numerical Weather Prediction (NWP);
- The next generation re-analysis is progressing towards fully coupled Earth-system assimilations. To achieve, they need an ongoing **interdisciplinary weather-climate research programme** into the coupled model assimilation issues.

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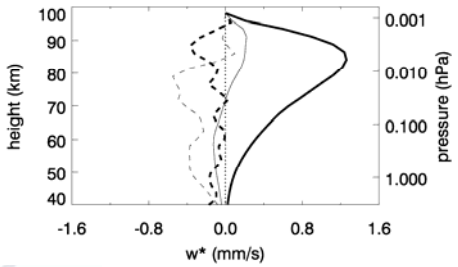
Tuning Non-Orographic Gravity Wave Drag



- Residual vertical velocity (w*) induced by the resolved waves (dashed) and non-orographic gravity wave drag (GWD) parameterization (solid) in the steady, "downward control" limit.
- An ensemble of forecasts that capture (thick curves) or miss (thin curves) the 2002 stratospheric sudden warming in the southern hemisphere.
- The GWD parameterization is responsible for the mesospheric cooling (upwelling) around 80 km in the forecast "hits" (thick solid).
- From Ren et al. 2008.

Utilization of Sub-Seasonal and Seasonal Predictions for Social and Economic Development

- A need for closer ties between weather and climate research:
  - Understanding how information at the weather/climate interface, including uncertainty, connects with decision-making
- There is also a great need for much easier access to forecast data by the user community. These need to be available in special user-oriented products. How to achieve this service?
- The post-processing techniques that are needed by many users may require an archive of past forecasts (e.g. for water cycle applications). Some user applications require an archive of re-forecasts from fixed models for periods as long as 20 years or more.

Simplified set of public health- related decisions and supporting