Climate monitoring and prediction at sub-seasonal to seasonal time scales

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The implementation of the Tropical Atmosphere Ocean array in the tropical Pacific Ocean in the eighties was a major achievement for both improved climate monitoring and prediction activities. Since then surface and subsurface tropical Pacific Ocean conditions started to be better recorded, helping to increase our knowledge about the El Niño-Southern Oscillation phenomenon – a major climate system driver – and its global impacts. In the mid-nineties the first experimental climate predictions started to be produced with dynamical climate models. Since then several operational centers and research institutions developed different climate model versions and nowadays climate predictions for the forthcoming seasons are produced every month using multi-model ensemble systems.

Since the late nineties when the World Meteorological Organization encouraged the establishment of Regional Climate Outlook Forums both the operational and research climate communities acquired important experience in terms of oceanic and atmospheric climate monitoring (at global and regional scales) and seasonal climate prediction. These predictions are of probabilistic nature in recognition of the uncertainties involved in their formulation process. The current scientific knowledge allows the use of modern techniques for issuing seasonal climate predictions using multi-model ensemble systems, sometimes aggregating both dynamical and empirical (statistical) predictions. The use of a set of several models rather than a single model allows sampling uncertainty due to different model formulations. By running each model with a distinct set of initial conditions it is also possible to sample uncertainties in the used initial conditions. Retrospective seasonal predictions (i.e. predictions made after the events were observed) are produced for each prediction system for a number of years – generally for the last two to three decades – for accessing the ability of these systems to reproduce the observed seasonal climate (i.e. the skill of these prediction systems). When a new multi-model ensemble prediction is produced for a future season these retrospective predictions are then used to calibrate the new prediction taking into account the retrospective performance of the multi-model ensemble system when compared to the observed climate. Mathematical models are currently available for this calibration purpose generating numerically probabilistic seasonal predictions.

Despite the important advances in both climate monitoring and prediction activities in recent years there is still scope for improvements, particularly in the Latin American region. In this talk a few research areas in need of priority will be discussed. The communication of probabilistic predictions to decision makers and the general public is an area that deserves particular attention. Research on how decision makers and the general public interpret probabilistic predictions is still much in need. Understanding how these actors interpret probabilistic predictions is likely to help devising new ways of presenting these predictions. Monitoring and prediction of sub-seasonal climate events such as onset and demise dates of rainy seasons in monsoon regions, wet and dry spells duration, and the number of wet and dry days within a given season, which are of great relevance for a number of application sector (e.g. water resources and agriculture), are in early development stages. There is therefore scope for advancing the research for creating new monitoring and prediction tools for generating sub-seasonal climate information. In addition to monitoring and prediction, verification of sub-seasonal predictions is another area that deserves new research and developments to adequately assess and communicate the skill level of the emerging sub-seasonal prediction products.

The traditional three category format that seasonal climate predictions are presented also deserves revisiting. For a number of end-users this format may be of little or null utility. Applied research on integrating seasonal climate predictions in user applications is therefore much needed. Hydrological and agricultural models generally require high frequency (daily) climate information for the forthcoming months in order to estimate the expected river flow or crop in the next season. Research on how best to produce such high frequency climate information, based on the available seasonal prediction information, to feed application models should therefore be prioritized. Finally, improvements are needed in the way climate monitoring and prediction research are transferred to operations for practical use. There is generally a long time gap between the research conclusion and the implementation of new operational products incorporating the acquired research knowledge. Mechanisms encouraging and facilitating faster operational implementation of recently developed research should be identified in order to put more effectively in practice the most recently generated scientific knowledge.