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PP	Restricted to other programme participants (including the Commission Services)	
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ENSEMBLES

Milestone M4.4.3

IPSL
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Assessment of Intraseasonal Variability in existing hindcast ensemble integrations against which the new ENSEMBLES multi-model system can be judged

1. Introduction

The tropical intraseasonal variability (ISV) plays a significant role in determining the seasonal distribution of rainfall during summer monsoon. Due partly to the strong air-sea interactions associated with ISV, it is at present not properly simulated or predicted using atmospheric GCMs. Current problems in simulating and predicting the seasonal mean and interannual variations may be thus related in part to shortcomings of ISV simulations in GCMs. A series of diagnostics are developed to assess the intraseasonal variability associated with the Asian summer monsoon as simulated by ensemble simulations of coupled general circulation models (CGCMs).

This milestone M4.3.3 of the ENSEMBLE project is a summary of a study reported in the deliverable D5.11. The DEMETER hindcasts are used to develop the diagnostic strategy described in D5.11 because the corresponding ENSEMBLE hindcasts were not available at the time this study began. This milestone acts that a first set of diagnostics is ready to be used for further analyses of ENSEMBLE hindcasts in the framework of WP4.

2. Evaluation of the tropical intraseasonal variability and predictability

Each DEMETER hindcast is an integration of six months starting from 1 February, 1 May, 1 August and 1 November and comprises an ensemble of nine members. All seven models have been run for a common period of 1980-2001. The focus is on the spatial and seasonal variations associated with the summer monsoon intraseasonal oscillations (ISO) of outgoing longwave radiation (OLR), their large-scale organization, propagation characteristics, the air-sea coupling, their deterministic predictability and implications on seasonal predictability.

A multi-variate Local Mode Analysis (LMA, essentially a complex EOF analysis over a window of 90 days moving over the 180 days of hindcasts) has been utilized in order to evaluate the above characteristics of ISOs in the hindcasts against observations. Most models have problems in simulating large-scale organized perturbations of the convection. In addition, perturbation patterns are more variable from one intraseasonal event to another compared to observation. However, most models do exhibit some form of northeastward propagation of the perturbations over the Indian Ocean. Realistic periods of the modes (25-35 days) are produced in a few models, while most models produce shorter periods (20-25 days).

Models with poor seasonal cycle tends to have larger biases in the northeastward propagation and organization. One possible source of deficiency in organizing intraseasonal large-scale convective perturbation could be the air-sea interaction. The analysis of the nature of coupling in the hindcasts indeed shows that most models simulate too weak SST perturbations and

systematic phase quadrature between OLR and SST, indicative of a slab-ocean-like response of the temperature to surface flux perturbations. Simulation done with the same AGCM and different OGCMs tend to have similar biases of the simulated ISOs, indicative of the importance of atmospheric processes in defining the nature of the intraseasonal SST perturbation.

Because of their relatively coarse vertical resolution (and the absence of appropriate parameterization), the different OGCMs used are limited in their ability to represent some processes, such as warm layer formation, which are important for realistic simulation of the SST perturbation and feedback at intraseasonal time-scales. This may explain partly the too small SST amplitude and the relatively similar behavior for the different OGCMs.

Evaluation of the predictability at the ISO time scale (10-50 days) is also performed on the basis of pentad mean OLR maps. Results show a better predictability in the summer (1 May initial conditions) hindcasts compared to the winter hindcasts (1 November initial conditions). This is possibly due to the better predictions and consistency among all ensemble members of the strong seasonal cycle and the embedded ISOs in boreal summer compared to boreal winter.

The results of the analysis are detailed in Deliverable D5.11 and will be published as scientific articles in the near future.

3. Outcome and future work

The main conclusions of this study are as follows:

- The strong seasonality in the behaviour of ISV during boreal summer demands realistic simulations of seasonal cycle for realistic ISV simulations.
- The ISV of the SST in the simulations is largely driven by atmospheric fluxes indicating a rather passive role of the ocean component. The too systematic phase relationships between the convection and SST perturbations, and the relatively small SST perturbations, are indicative of the limited capabilities of the ocean models to simulate SST perturbations. This may be due to surface processes such as warm layer formation that is not simulated with current OGCM because of the poor vertical resolution. The relatively small perturbation of the SST may be also related to underestimated surface turbulent and radiative fluxes perturbations given by the atmospheric models. This limits the perturbation of the ocean mixed layer temperature and may also generate insufficient mixing between the mixed layer and the deeper ocean during strong surface wind phase. All these process will be studied in more detail in a near future.
- Deterministic predictability of the intraseasonal perturbation of the convection is better in boreal summer than in boreal winter. This is related to the marked seasonal variation that leads to a better consistency between the different members of the ensemble simulations. This enhanced predictability can possibly impact the seasonal predictability. Studies are in progress with an emphasis on the influence of large-scale organized ISO perturbations on the regional seasonal evolution of the precipitation at particular location.
- The different approaches that have been developed here will be used to assess the representation of the intraseassonal variability and its predictability in the ENSEMBLE hindcats simulations.

4. Acknowledgments

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