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Combining Sub-seasonal and Seasonal Precipitation Forecasts over Indonesia

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1. Introduction

The onset of Maritime Continent monsoon during September to December is strongly influenced by El Niño-Southern Oscillation (ENSO). Timely information on ENSO status has been known to be helpful for the Indonesian agriculture, as it enables the local farmers to plan their rice planting (Naylor *et al.* 2001). Using Tropical Pacific July sea surface temperature (SST) as a predictor, Moron *et al.* (2009) were able to construct onset date forecasts that exhibited some skill over parts of Indonesia.

Precipitation over the Maritime Continent is also strongly influenced by the Madden-Julian Oscillation (MJO), leading to the hypothesis that SST-based forecasts of monsoon onset dates could be improved using MJO information. The goal of this work is to develop and test a statistical forecast model of monsoon onset date over Indonesia, incorporating both ENSO and MJO information.

2. Data

Two precipitation data sets are used to derive the onset dates: gridded pentad CMAP on 2.5×2.5 from 1979-2009 (Xie and Arkin 1996), and daily rainfall gauge data from 99 stations over Indonesia, compiled from the NCDC and CPC GSOD datasets, and the dataset of Hamada and Sribimawati (1998). The local onset is defined when the accumulated precipitation reaches 20 cm, counted from July 30. Figure 1 shows the mean onset dates thus calculated, which compare well with previous estimates (Moron *et al*. 2009).

Predictor variables are constructed from OLR pentad data obtained from NOAA-NCEP-CPC (Liebmann and Smith, 1996), and NOAA ERSST data (Smith *et al.* 1998), both 1979–2009.

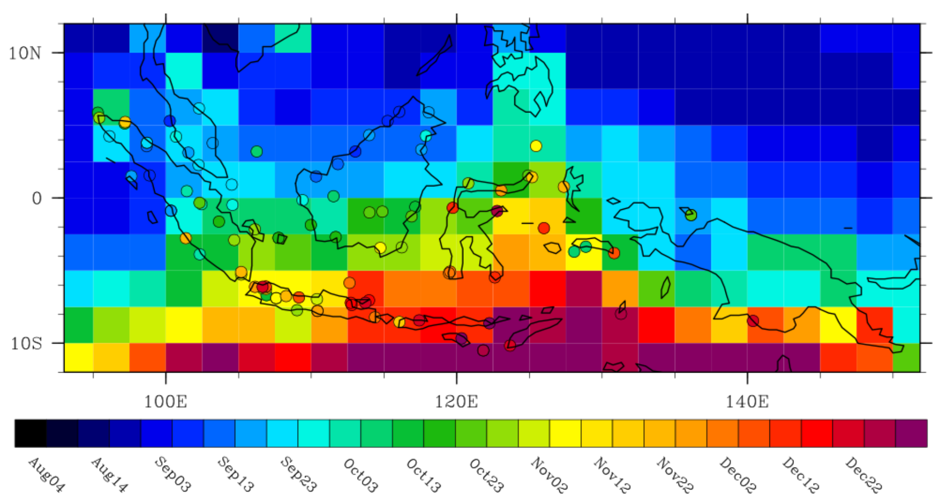

Fig. 1 Onset dates averaged over all years 1979-2009, derived from gridded CMAP and station data.

3. Methodology

Empirical forecast models for local onset date are built using multivariate (pattern) regression based on cross-validated Canonical Correlation Analysis (CCA), using IRI's CPT Toolkit (http://iri.columbia.edu/climate/tools).

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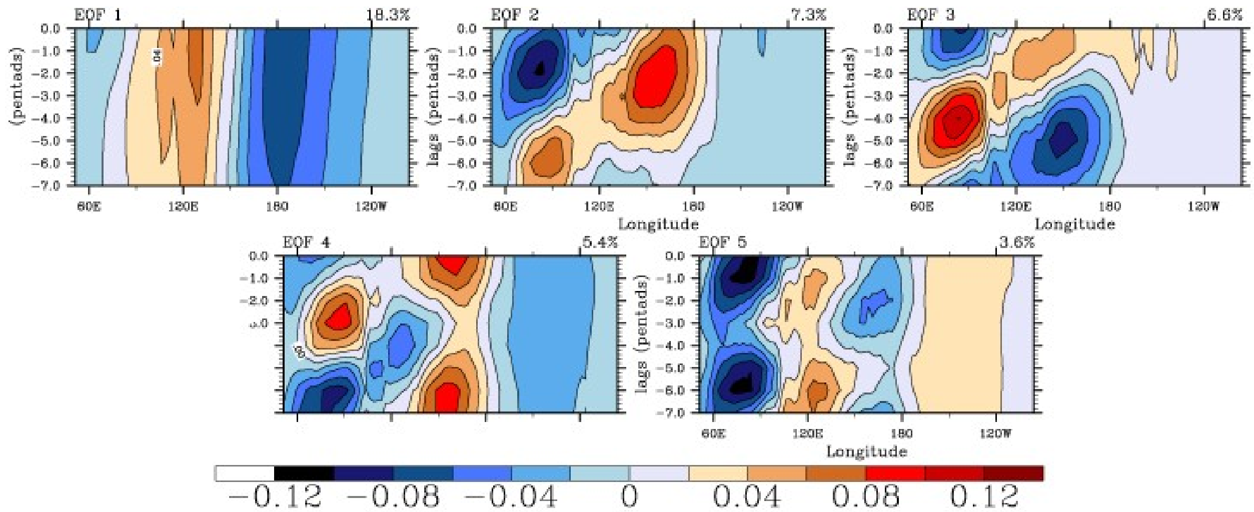

Fig. 2 Leading 5 extended EOFs of latitude-averaged OLR [10ºS-10ºN]. Percentage of variance explained is given above each panel.

In the case of OLR, extended EOFs are applied to the OLR data, so as to include the 8 pentads before the forecast start date. Start dates are taken at each pentad, beginning Jul 15–19, and ending Dec 13–17. The CCA uses PCs of 5 extended EOFs (EEOFs) of latitude-averaged OLR [10ºS-10ºN] vs. PCs of onset date (4 EOF modes), for the Aug–Dec season, with the seasonal cycle subtracted from the OLR data.

4. Results

The leading five EEOFs of latitude-averaged OLR are shown in Fig. 2 as a function of time lag. The leading mode varies slowly in time, and its timeseries is dominated by interannual periods (not shown). EEOFs 2-4 are dominated by sub-seasonal periods and eastward propagation.

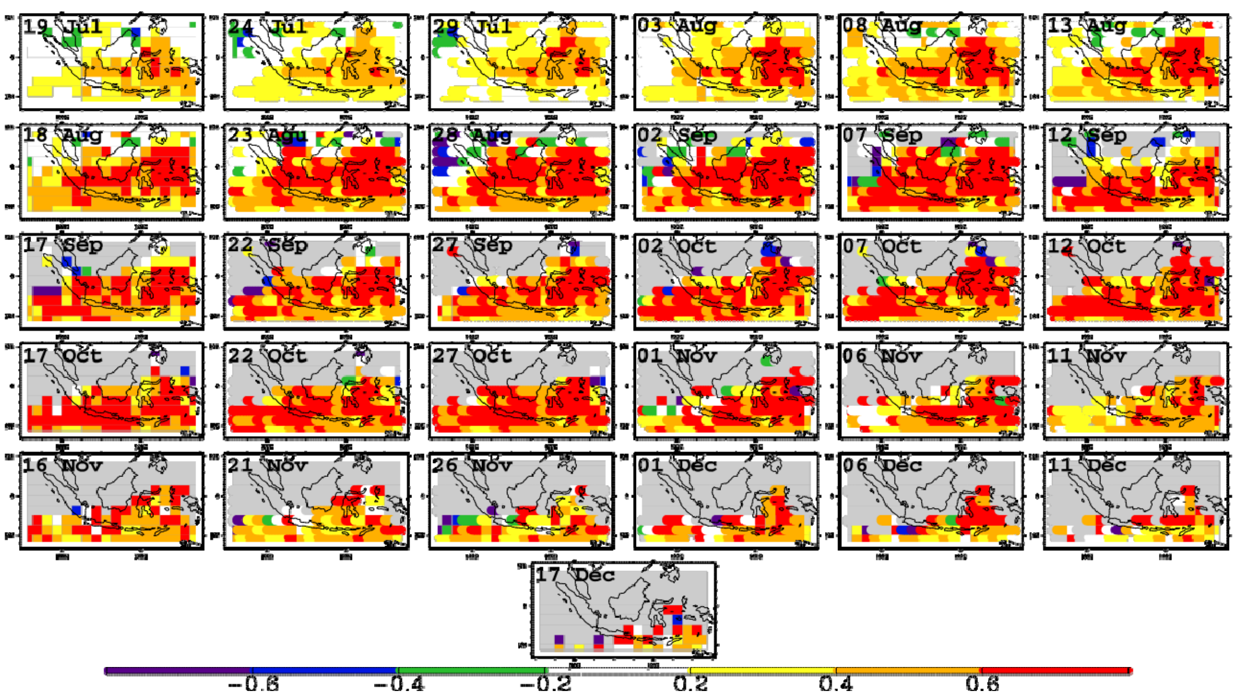

Fig. 3 Anomaly correlation skill of cross-validated hindcasts of local onset date, based on OLR conditions at consecutive pentads. The start dates are given in each panel.

Hindcasts of gridded onset date were made at different lead times, and their cross-validated anomaly correlation skill plotted in Fig. 3. Each panel shows the skill for a particular pentad start date. Skill levels rise as the climatological onset date approaches, which propagates seasonally from north to south (Fig. 1). Grey regions in Fig. 3 denote locations where the climatological onset date has already passed. We have repeated the hindcasts using only EEOFs 2-4, thus filtering out the ENSO-related predictive information in EEOF 1. The resulting skill levels are generally much lower, except over eastern Java during Nov–Dec (*i.e.* close to onset date there, not shown).

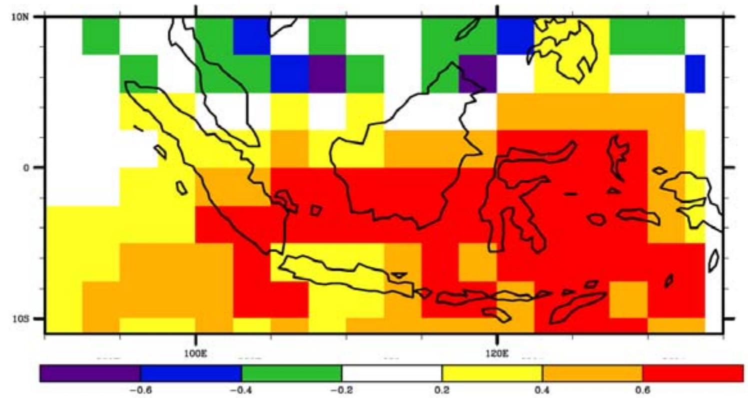

Fig. 4 Anomaly correlation skill of cross-validated hindcasts, based on July SST.

The OLR-based hindcasts in Fig. 3 can be compared with July SST-based hindcasts, shown in Fig. 4. Skill levels based on SST and OLR are comparable, but the latter are markedly higher locally as the onset approaches.

4. Concluding remarks

The work reported here suggests that subseasonal OLR observations have the potential to augment the skill of onset date forecasts over Indonesia at shorter lead times, compared to that obtained from July SST. The regions of skill at shorter lead times are found to migrate southward with the monsoon. Most of the increased skill is found to be associated with updating of the interannual predictive signal, rather than to intra-seasonal modes of variability.

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