We would like to thank the reviewer for his constructive comments. We have incorporated the appropriate changes into the revised manuscript and have made substantial revisions to improve the quality of the manuscript.

Referee's comment: There are some technical issues that need to be addressed. The band-pass filtering of zonal wavenumber k = 1 – 3 for the MJO and k = -1 – -8 for the Rossby wave are inappropriate for model simulations. According to Hayashi (1979), only the part of the eastward power that is incoherent with its equivalent westward power represents true eastward propagating signals. The coherence part represents stationary of standing signals. So using k = 1 – 3 to represent the MJO and k = -1 – -8 to represent the Rossby wave would exaggerate the propagating signals. In observations, the eastwest equivalent signals are weak, so this practice is ok. For model simulations, such east-west equivalent signals are strong, the potential coherence part is great and this practice is problematic. The regression results from Jiang et al (2015, Fig. 3) clearly show the dominant stationary signals in many model simulations. The band-pass filtering method used in this current study would mistakenly extract propagating signals from these simulations when there is none.

Authors' response: This study may be considered as an extension of previous investigation of ITV/ENSO relationship by (McPhaden et al., 2006, Hendon et al., 2007, Gushchina and Dewitte, 2011,2012) which based on the observation. We need to use the model's data to explore this kind of relationship in future climate. As a first step we need to evaluate the model's skill in simulation ENSO/ITV. In all aforementioned studies the method of (Wheeler and Kiladis, 1999) were used. To compare our results with those obtained from observation we preferred to use the same method of ITV filtering. Noteworthy this method was used for ITV analysis in the CMIP3 and CMIP5 models (Lin et al., 2006; Hung et al., 2013). However we agree with the reviewer that models tend to overestimate the coherent westward part of MJO. Therefore we have thoroughly examined the models chosen for further analysis (MIROC5, INMCM4, CMCC-CM) from this aspect.

1. Firstly we have analyzed the spectrum of ITV in the models and compare them to Reanalysis (Fig.1). It is obviously seen that in MIROC5 and CMCC-CM the westward power (blue square) is much lower than eastward power (red square) in the MJO intervals (period 30-60 days, zonal wave number 1-3 (eastward) and -1…-3 (westward)). Moreover in Reanalysis the westward power is rather intensive as compare to westward

power in the models. Exception is the INM-CM4 models where the westward power is equivalent to eastward one. To verify if the signals are coherent we made the further analysis.

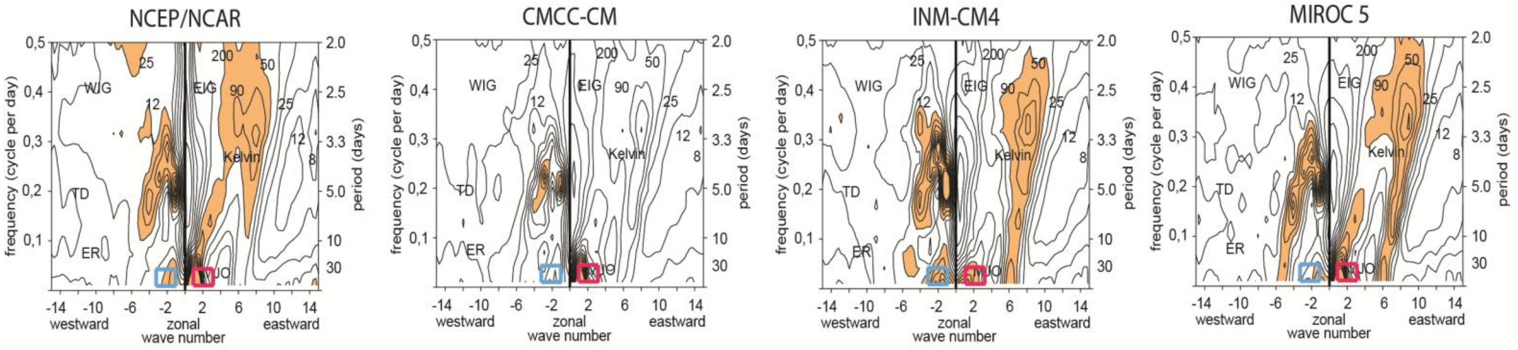

Figure 1: Space–time spectrum of the 15°N–15°S symmetric component of U850 divided by the background spectrum from NCEP/NCAR Reanalysis and 3 CMIP5 models.

2. For MJO (Rossby) waves we recompose the westward (eastward) signal in the same frequency intervals but for the opposite sign of zonal wave numbers: -1…-3 for MJO and +1..+8 for Rossby waves (Fig.2-3). It may be seen that the amplitude of westward analogue of MJO is significantly lower as compare to eastward propagating patterns (except for INM-CM4). For Rossby waves the amplitude of eastward and westward propagating signal is comparable but the timing, spatial localization and speed of propagating signal differ significantly. To confirm quantitatively this suggestion we calculated the correlation between eastward and westward propagating signals (Table 1).

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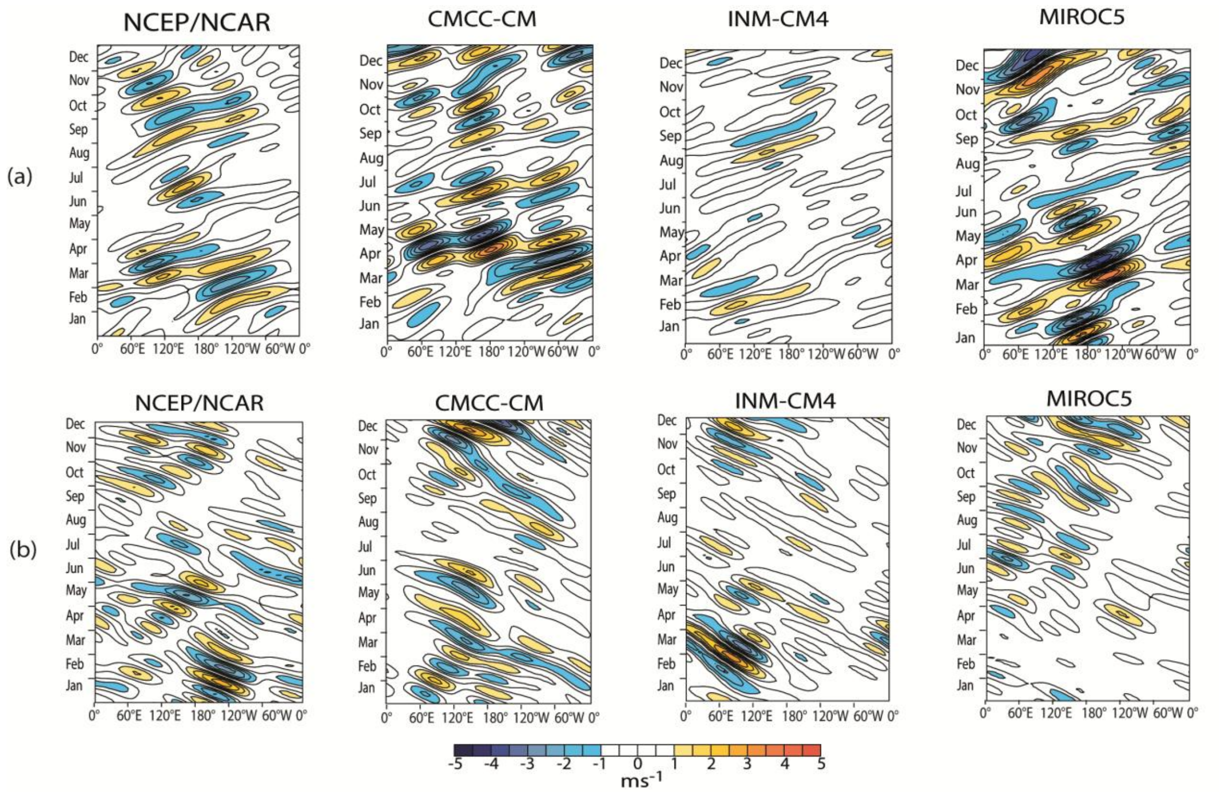

Figure 2: Time-longitude plots of equatorial averaged (5°N–5°S) daily-mean anomalies of MJO filtered U850 from NCEP/NCAR Reanalysis and 3 CMIP5 models (zonal wave numbers: +1...+3 (a), -3...-1 (b)). Contour interval is 0.5 m/s. Negative values ≤–1 m/s are blue shaded, positive values ≥1 m/s are orange shaded.

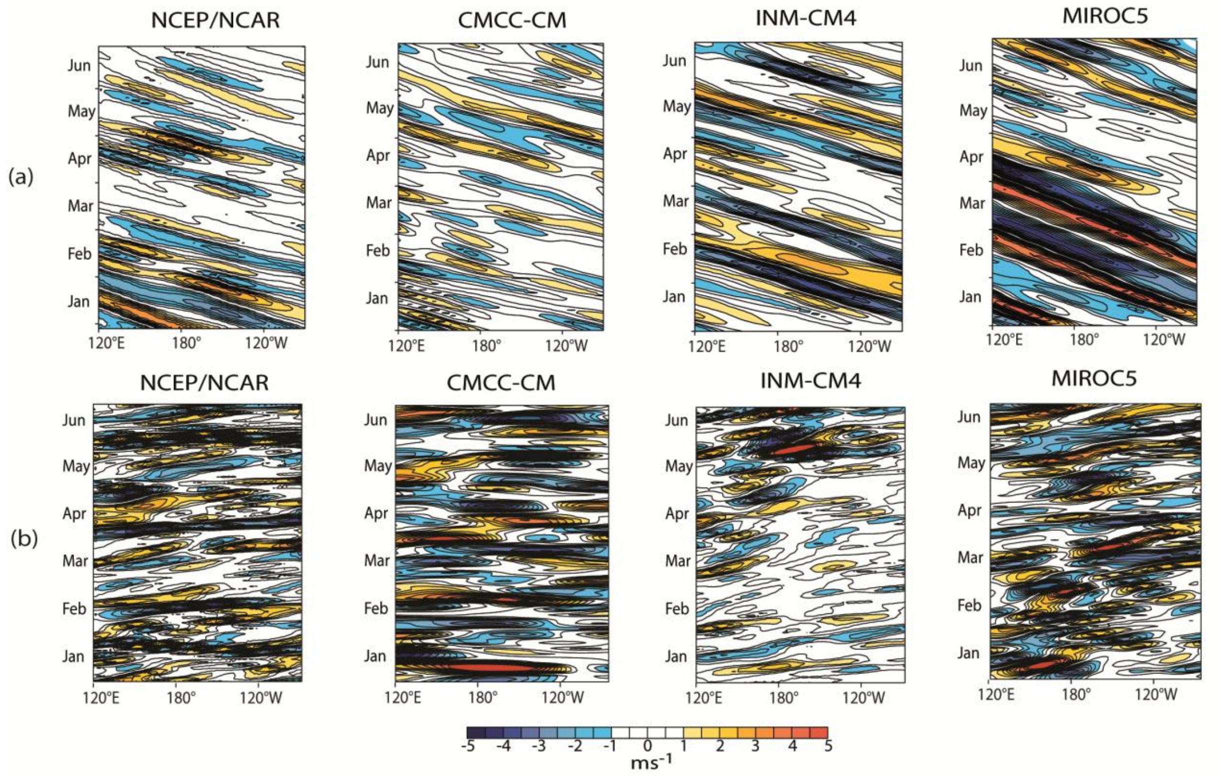

Figure 3: As in Figure 2, but for Rossby waves (zonal wave numbers: -8...-1 (a), +1...+8 (b)).

Table 1. Correlation between MJO and Rossby waves and the signals in the same frequency intervals but opposite sign of zonal wave numbers in 3 CMIP5 models.

	MJO (wave numbers: 1…3, -1…-3)	Rossby waves (wave numbers: +1…+8, -1…-8)
CMCC-CM	0.08	0.23
INM-CM4	0.12	0.3
MIROC5	0.15	0.17

The correlation is rather small that allows to suggest that the signals are incoherent.

3. We have also analyzed the spatial distribution of total variability of westward/eastward signal in the frequency interval of MJO (Fig.4). It may be seen that the maximum of variability for MJO are much higher than for its westward counterpart.

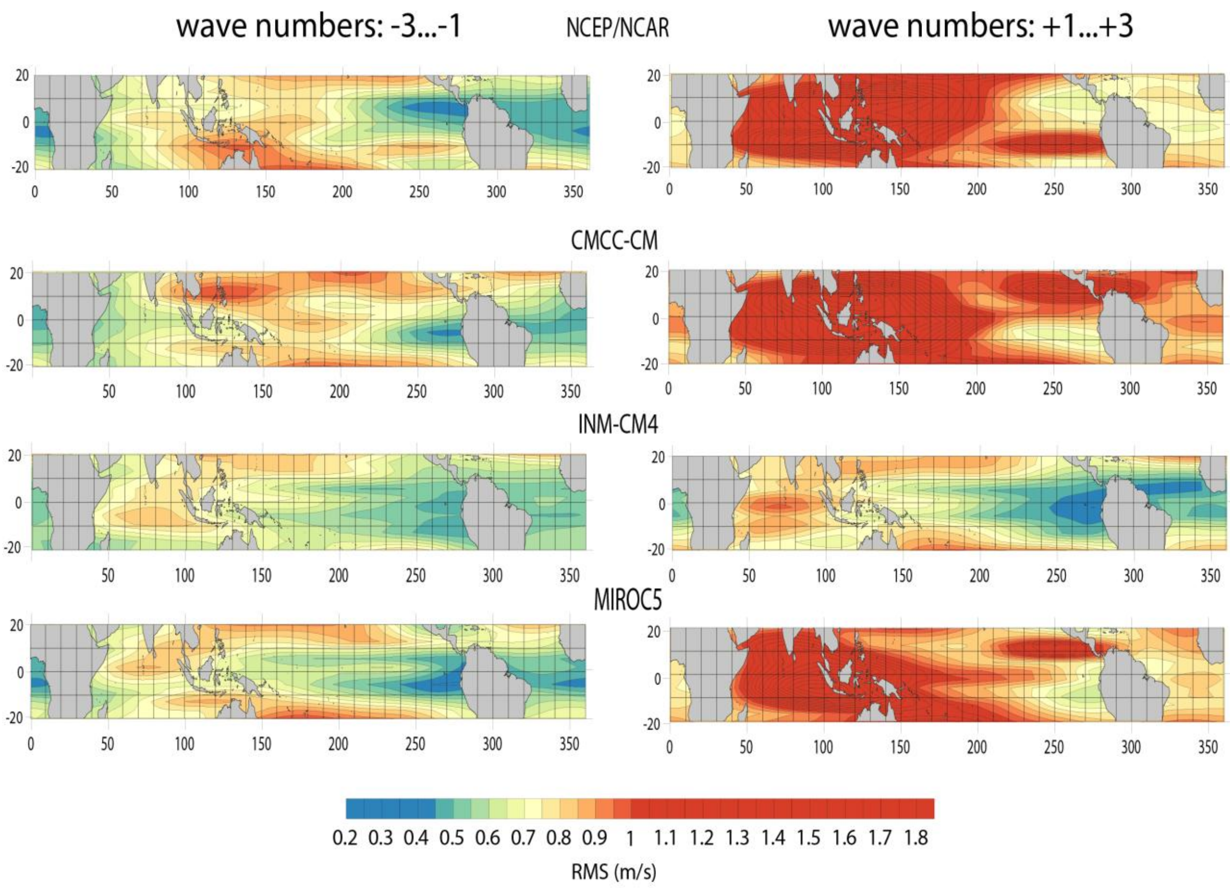

Figure 4: Variance (rms) of MJO from NCEP/NCAR Reanalysis and 3 CMIP5 models. Wave numbers: -3...-1 (left column) and +1...+3 (right column).

4. The full signal in the frequencies of MJO for zonal wave numbers from -3 up to 3 was recomposed (Fig.5). Fig. 5 shows that eastward propagating signal dominates during almost the whole year. The stationary signal presents but it is comparable to the one observed in the Reanalysis.

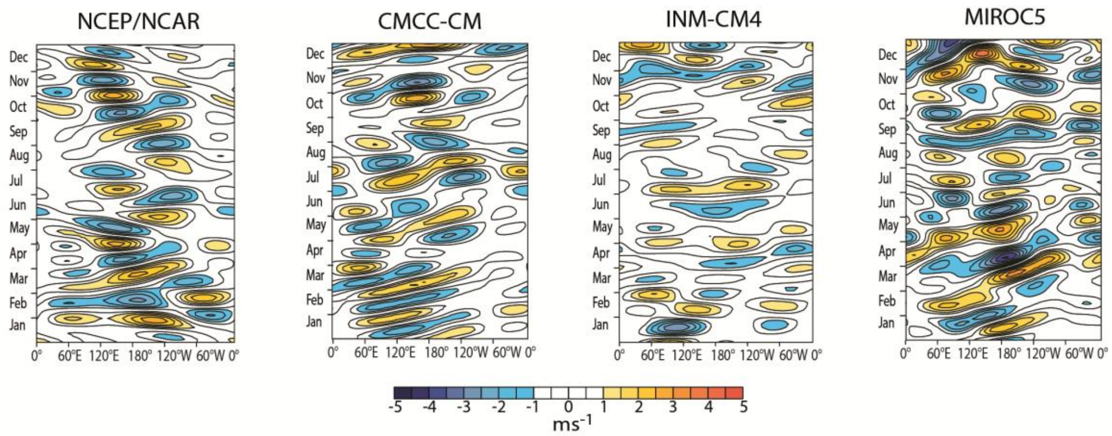

Figure 5: Time-longitude plots of equatorial averaged (5°N–5°S) daily-mean anomalies of MJO filtered U850 from NCEP/NCAR Reanalysis and 3 CMIP5 models (zonal wave numbers: -3...+3). Contour interval is 0.5 m/s. Negative values ≤–1 m/s are blue shaded, positive values ≥1 m/s are orange shaded.

The analysis of recomposed signals demonstrated that westward (eastward) analogue of MJO (Rossby) waves is rather weak in the MIROC5 and CMCC-CM models and to a lesser extent in INM-CM4 model. But we would like to emphasize that even if the model exaggerate the propagating signals it is not crucial for the simulation of ITV/ENSO relationship. The intensification of MJO and Rossby waves in the year prior to El Nino contributes to the forcing of intraseasonal oceanic Kelvin wave which deepens the thermocline along its propagation and results in El Nino condition several months later. Therefore the contribution of ITV to ENSO generation is not associated to the individual propagating patterns of MJO or Rossby waves but is dependent on the intensity of MJO or Rossby wave signal in the specific region (western Pacific for MJO and central Pacific for Rossby wave) where the Westerlies associated to MJO and Rossby waves generate or intensify the oceanic Kelvin wave.

The discussion of coherent signal in the models was added to the revised manuscript.

Referee's comment: Discussions of the results are mostly qualitative and subjective, heavily relying on visual impression. Suggest use quantitative measures to compare models and between models and observations.

Authors' response: In agreement with reviewer's recommendation we have added some quantitative measures. In other cases we precise in the text the criteria that were used to select the "skilful" models. In details:

To validate the simulation of ENSO diversity (separate CP and EP type) we applied the same approach as in other studies of ENSO simulation in CMIP3 and CMIP5 (Yu and Kim, 2010; Kim and Yu, 2012). The first two EOF of SST anomalies in the tropical Pacific capture the structure of SST anomalies associated to the two types of El Niño, with the EOF1 associated to EP event and EOF2 associated to CP event. Therefore to estimate the model's skill in simulation of two type of El Nino we analyzed the structure of EOF distribution in the models. Namely the EOF1 maximum located on the equator in the Eastern Pacific and EOF2 maximum located on the equator in the central Pacific and minimum located to the east. The models which represent the maximum in off equatorial regions or don't simulate the maximum of EOF2 were excluded from the analysis. We did not introduce the specific quantitative measure at this stage as even visual analysis allow confidently exclude the models incapable to simulate CP El Nino. However we have added to the revised version the discussion of the criteria applied to select the "good" models.

In analysis of simulation of ITV characteristics we have added the following quantitative measures: the RMSE of total intensity as a function of longitude, the RMSE of MJO and Rossby wave variability in the western and central Pacific respectively as a function of calendar month. To estimate the simulation of seasonal cycle we analyze the timing of ITV maximum for MJO and Rossby waves and interhemispheric migration for MJO. If the model do not reproduce the maximum in correct season (for example in southern summer for MJO) and do not reproduce the maximum in correct hemisphere (in the southern hemisphere in boreal winter and northern hemisphere in boreal summer for MJO) it was excluded from the further analysis.

The key feature of ITV/ENSO correlation pattern which provide correct simulation of ITV contribution to El Nino generation is the intensification of MJO (Rossby waves) in the western (central) Pacific in March-April (June-July) prior to El Nino. We selected the models which are capable to reproduce these features, however the models demonstrate some time and space shifts as compare to observation.

The appropriate specification of the used criteria was added to the revised version.

Referee's comment: Significance level of 90% is lower than commonly used 95% in modern literatures.

Authors' response: We are agree that the significance level 95% is commonly used, however taken into account we have relatively short time series (20 samples) we decide to use 90% threshold. If we shade the significant correlation at 95% level the correlation patterns appear rather small and it becomes difficult to analyze the figures. The difference between significance levels is small (42% for 90% significance level and 49% for 95% significance level). When we use the 95% level the interpretation of the results does not change significantly (Fig.6b)

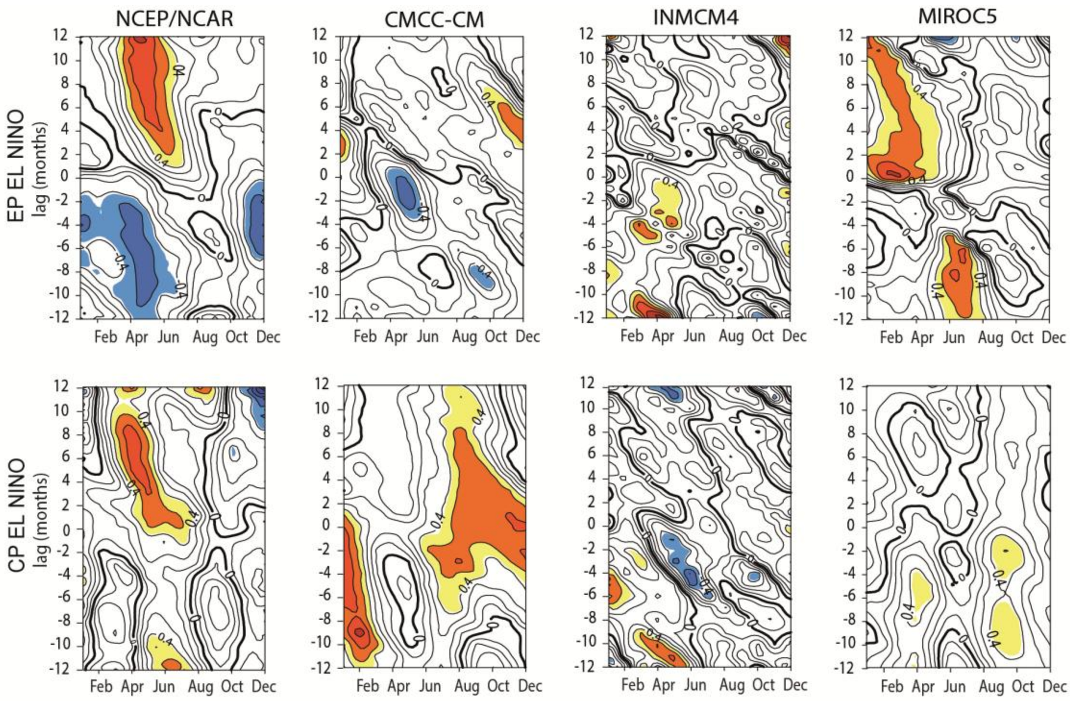

Figure 6a: Monthly lagged correlation of E (a-d) and C (e-h) indices as a function of start month with respect to MJO activity index WPacMJOu850 for NCEP/NCAR Reanalysis and 3 CMIP5 models. Contour interval is 0.1. Negative correlation ≤–0.42 is blue shaded, positive correlation ≥0.42 is orange shaded (90% significance level) .

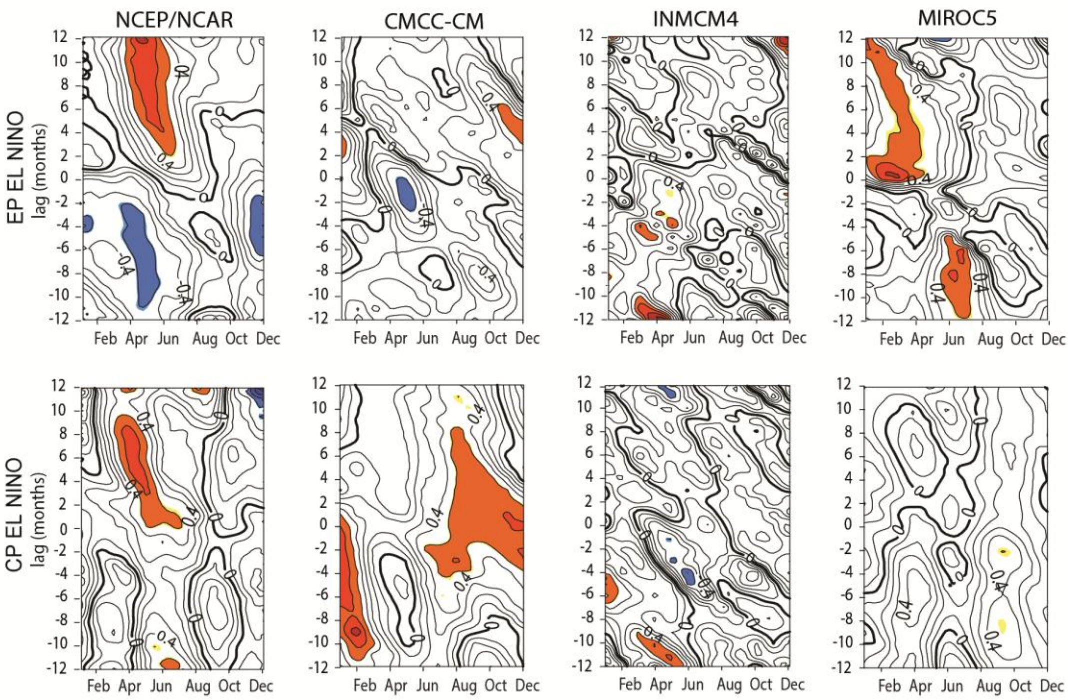

Figure 6b: As in Figure 6a, but negative correlation ≤–0.49 is blue shaded, positive correlation ≥0.49 is orange shaded (95% significance level).

Referee's comment: Using U850 to define the MJO and Rossby wave might be problematic. There are obviously other perturbations in the same frequency band of the Rossby wave (Fig. 3). Why not use precipitation as everyone else did? This would yield results that can be directly compared to others.

Authors' response: Using U850 in our study is attributed to the mechanism involved in ITV/ENSO relationship. The MJO is thought to be tightly related to the El Niño–Southern Oscillation (ENSO) through its relationship to episodes of westerlies that can trigger downwelling intraseasonal Kelvin waves, a precursor to El Niño onset (McPhaden et al., 2006; Hendon et al., 2007; Gushchina and Dewitte, 2011; Puy et al., 2015). Gushchina and Dewitte (2012) also suggested that an enhanced Rossby wave activity prior to El Nino is associated to the anomalous oceanic Kelvin wave activity during the development of El Niño events. While the anomalous westerlies related to the convective phase of MJO induce the oceanic Kelvin wave in the Western Pacific in March-April preceding El Niño peak, the intensification of convectively coupled equatorial Rossby waves in June-July in the central Pacific acts to compensate for the Kelvin wave dissipation along its way through the eastern Pacific. Namely, the anomalous westerly winds associated to the Rossby wave contribute to the deepening of thermocline in the central Pacific when the Kelvin wave induced to the west reaches the date line.
Therefore to identify the ITV/ENSO relationship we need to focus on the circulation patterns associated to MJO and Rossby waves as it is the westerly wind anomalies that are responsible for this interaction. Noteworthy in previous studies of ITV/ENSO relation (McPhaden et al., 2006; Hendon et al., 2007; Gushchina and Dewitte, 2011,2012) the wind characteristics (U850 or zonal wind stress) were used.

Reviewer: Some missing literature citations should be added: Hendon et al. (2007) for seasonally varying relationship between MJO activity and the ENSO cycle Kessler et al. (1995) for MJO inducing the oceanic Kelvin wave in the Western Pacific Zhang and Gottschalck (2002) for MJO as a precursor of El Nino.

Authors' response: (Hendon et al., 2007) was cited in the manuscript, and other references were added to the revised version.

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