Response to Reviewer #1.

We would like to thank the reviewer for his constructive comments.

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.

In order to address the reviewer's comment, we have carried out additional analyses in order to check the importance of the east-west equivalent signals.

1. The analysis of ITV spectrum (new figure 2) shows the strong westward signal in 5 models among 16 (CanESM2, CNRM-CM5, IPSL-CM5A-MR, MPI-ESM-LR, MRI-CGCM3). These models are excluded from further analysis. In other models the westward power is of the same order than in Reanalysis. 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. Below we present the results for INM-CM4 and two other models for comparison.
2. We recompose the U850 signal in the same frequency intervals as for MJO and ER but for the opposite sign of zonal wave numbers: -1…-3 for MJO (westward propagation) and +1..+8 for Rossby waves (eastward propagation) (Figures A1 andA2). 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). The correlation is rather small that allows suggesting that the signals are incoherent.

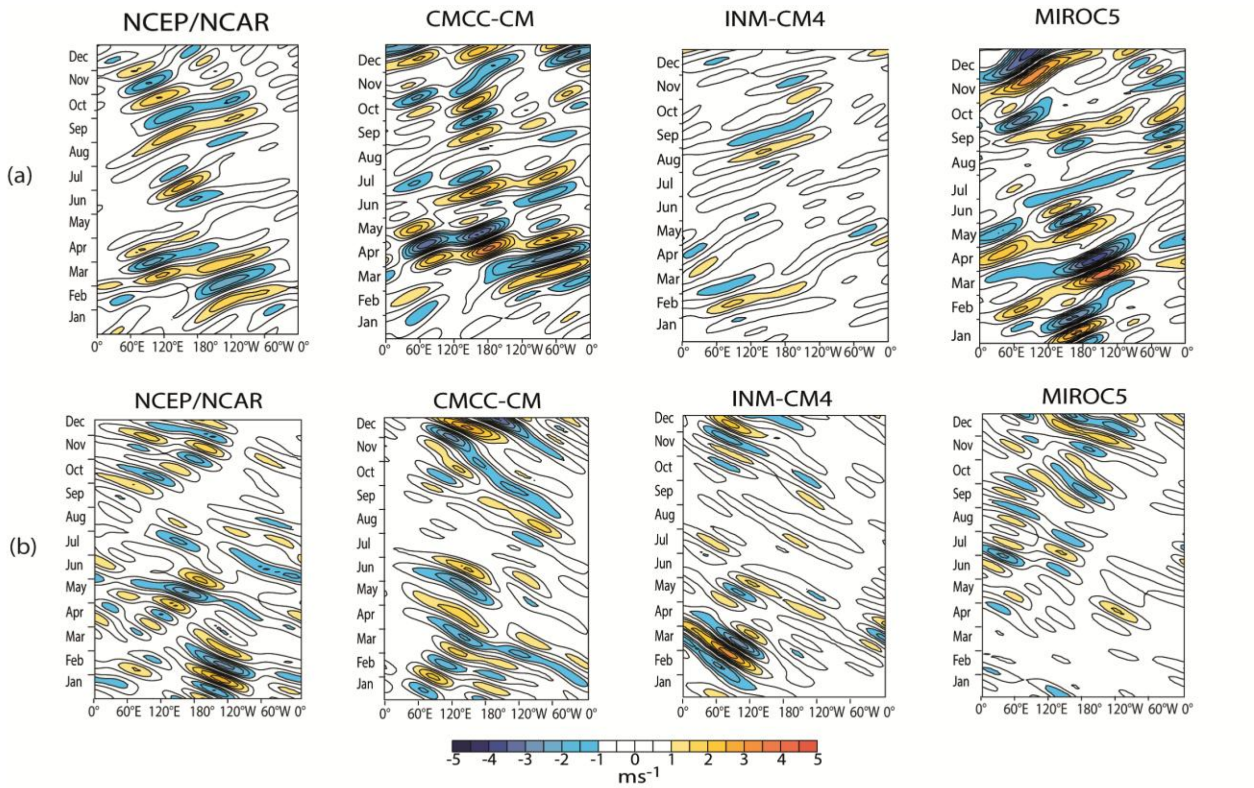

Figure A1: Time-longitude plots of equatorial averaged (5°N–5°S) daily-mean anomalies of MJO filtered U850 from NCEP/NCAR Reanalysis and 3 CMIP5 models (zonal wave numbers: +1...+3 (a), -3...-1 (b)). Contour interval is 0.5 m/s. Negative values ≤–1 m/s are blue shaded, positive values ≥1 m/s are orange shaded.

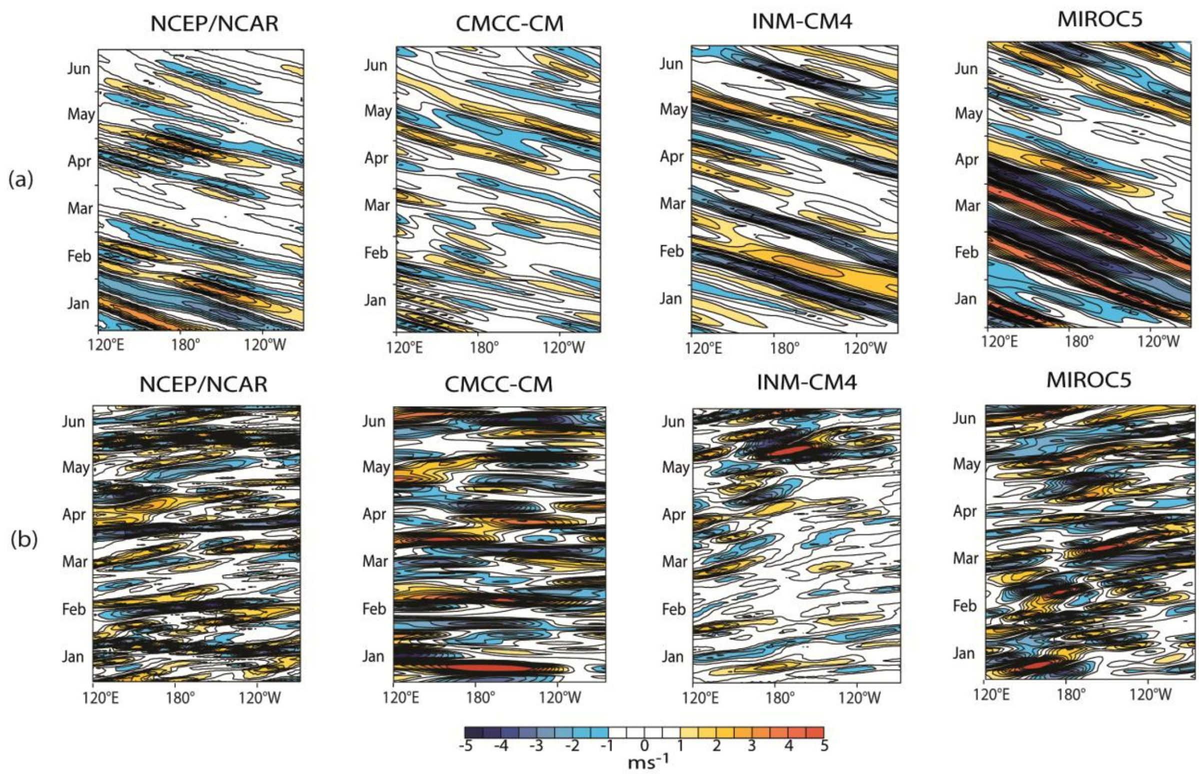

Figure A2: As in Figure A1, but for Rossby waves (zonal wave numbers: -8...-1 (a), +1...+8 (b)).

Table 1: Correlation between MJO and Rossby waves and the signals filtered in the same frequency intervals but opposite sign of zonal wave numbers in 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

3. We have analyzed the spatial distribution of variance of westward/eastward signal in the frequency interval of MJO (Figure A3). It may be seen that the maximum of variability for MJO are much higher than for its westward counterpart

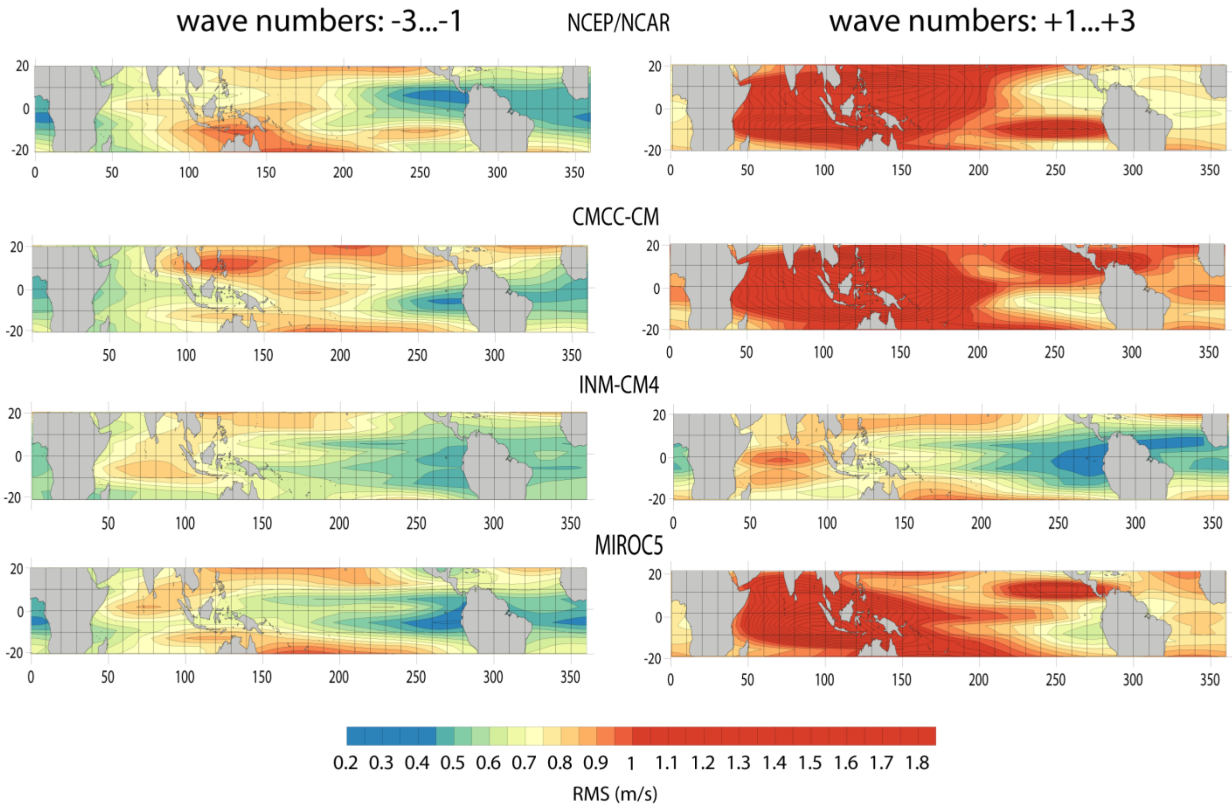

Figure A3: Variance (rms) of U850 filtered in MJO frequency interval (30-60 days) for zonal wave numbers -3...-1 (left column) and +1...+3 (right column).

4. The signal in the frequencies of MJO for zonal wave numbers from -3 up to +3 was recomposed (Figure A4). Figure A4 shows that eastward propagating signal dominates during almost the whole year. The stationary signal can be guessed but its characteristics are comparable to the Reanalysis.

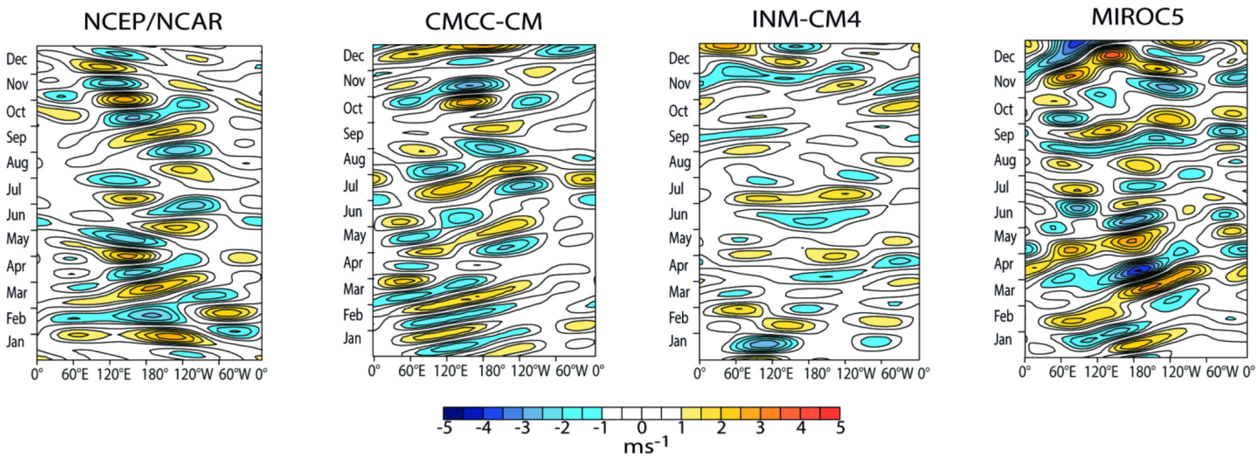

Figure A4: U850 filtered in MJO frequency intervals for zonal wave numbers -3...+3.
Contour interval is 0.5 m/s. Negative values ≤–1 m/s are blue shaded, positive values ≥1 m/s are orange shaded.

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

"Following Hayashi (1979), only the part of the eastward power that is incoherent with its equivalent westward power represents the true eastward propagating signal. Moreover the results of Jiang et al. (2015) emphasize the dominant stationary signals in many model simulations. To verify if the westward counterpart is present in the models, we recomposed the signal in the same frequency intervals that for MJO and Rossby waves but for the opposite sign of zonal wave numbers: -1…-3 for MJO and +1..+8 for Rossby waves. Insignificant correlation between westward and eastward signals confirms that westward and eastward parts are incoherent, validating *a posteriori* our decomposition approach of the model outputs."

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.

Following the reviewer's recommendation we have substantiated our analyses providing metrics of the models' skill in accounting for the ENSO and ITV characteristics. In details:
1) To evaluate quantitatively the simulation of SST distribution associated to the types of ENSO we calculated the spatial correlation between observations and model for SST projected onto the E and C indices (see new Table 2). The models with spatial correlation less than 50% were excluded from further analysis. We also provide the new Figure 1 that summarizes the comparison between observations and models in terms of the spatial structure of ENSO. .
2) For evaluating the ITV characteristics in the models, we now provide the root mean square error (RMSE) of total variance as a function of longitude (Figure 3.cdgh), the RMSE of MJO and Rossby wave seasonal variance in the western and central Pacific respectively (Figure 6). The phase speed values of MJO and ER in the models were compared to the ones of the NCEP/NCAR data (Figures 7 and 8) following the diagnostic of (Hung et al., 2013).

3) We introduced a measure of the predictive score of the ER and MJO with regards to El Niño types, which is used to select the periods over which the statistics is done, recognizing that the seasonal ENSO/ITV relationship has a decadal modulation. This follows the study by Gushchina and Dewitte (2017, submitted to Climate Dynamics). A supplementary material is provided in relation to that.

4) We have introduced the new tables 3 and 4 that summarize the evaluation of the models based on the different diagnostics done in the paper. We acknowledge that the evaluation has a certain degree of subjectivity owing to the difficulty in ranking the importance of the diagnostics between each other.

Significance level of 90% is lower than commonly used 95% in modern literatures.

The results are hardly impacted when we use the 95% significant level. We provide the figures A5 and A6 that illustrates the differences when using 95% instead of 90%.

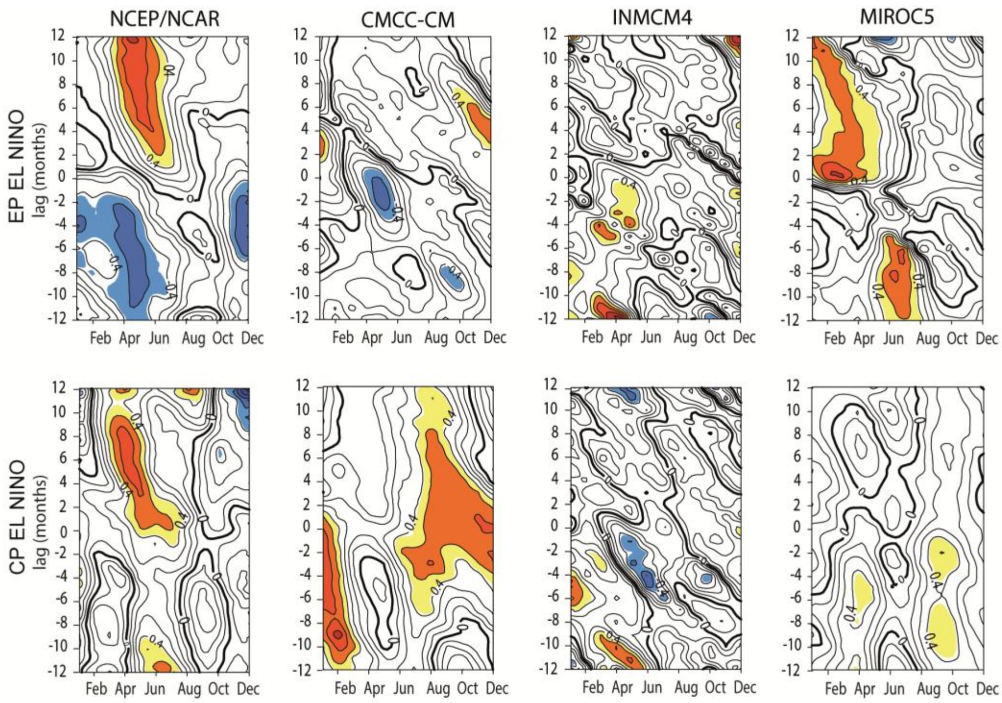

Figure A5: Monthly lagged correlation of E (a-d) and C (e-h) indices as a function of start month with respect to MJO activity index WPacMJOu850 for NCEP/NCAR Reanalysis and 3 CMIP5 models. Contour interval is 0.1. Negative correlation ≤–0.42 is blue shaded, positive correlation ≥0.42 is orange shaded (90% significance level) .

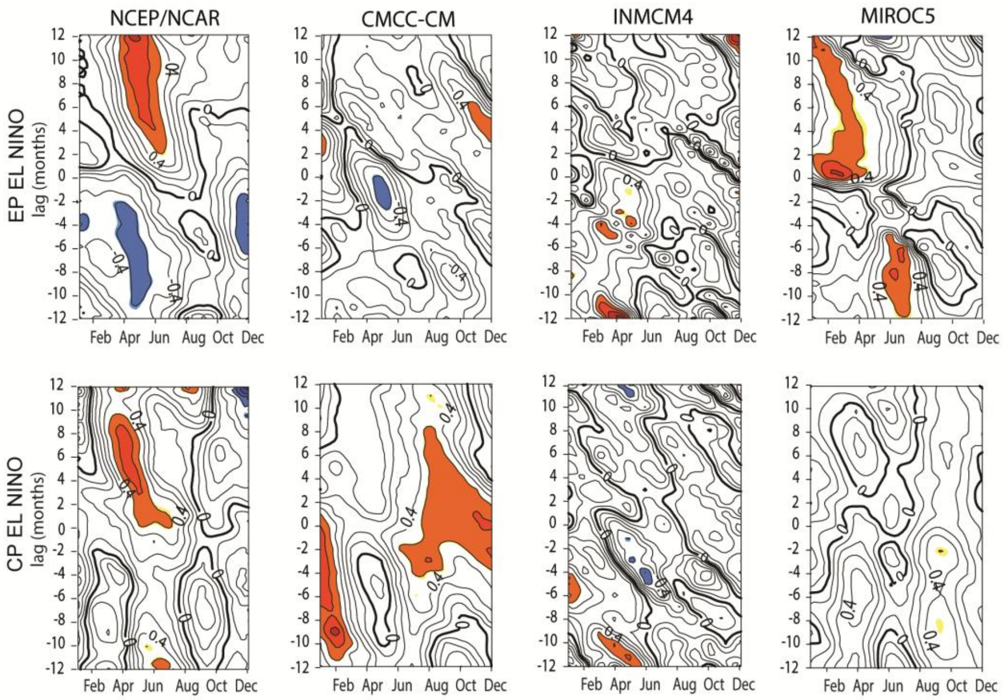

Figure A6: As in Figure A5, but negative correlation ≤–0.49 is blue shaded, positive correlation ≥0.49 is orange shaded (95% significance level).

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.

In the revised manuscript, we better justify the use of U850 field for deriving the ITV components:
“We use here the U850 field for deriving the various components of the ITV instead of Outgoing Longwave Radiation (OLR) or brightness temperature signals from satellite data noting that the regions in the frequency-wavenumber domains where the spectral energy peaks are similar for OLR and U850, which is also predicted by a simple dynamical model of ITV (Thual et al., 2014). Moreover the use of U850 eases the interpretation of the results since it is the westerly wind anomalies that serve a physical conduit from the ITV to the ENSO dynamics. This approach follows previous relevant studies (McPhaden et al. 2006; Hendon et al. 2007).”

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.

Hendon et al. (2007) was used as a reference in the original manuscript, and the other suggested references were added to the revised version.