

### **Comments to the Author**

This manuscript evaluates the representation of total column water vapour (TCWV) and total cloud cover (TCC) in seven AMIP6 models and ERA5 against ESA-CCI satellite products over the tropical region. The study applies multi-resolution analysis (MRA) to decompose the signals into multiple temporal bands and assesses model performance across a range of timescales. The topic is relevant, and the timescale-dependent evaluation framework is potentially useful for identifying where model deficiencies become apparent. The manuscript also reports several potentially interesting results, including better agreement at seasonal-to-annual scales than at daily and subseasonal scales in many cases. Overall, the study has merit. However, several methodological and interpretive issues need to be addressed before the manuscript can be considered for publication. I therefore recommend major revision.

### **Major comments**

1. The three datasets (AMIP6, ESA-CCI, and ERA5) have different native spatial resolutions, but the manuscript does not describe clearly how they were made spatially consistent for the comparison. This point is important because the results are presented as tropical land/ocean averages, which may be sensitive to regridding and area weighting. The authors should explicitly state how each dataset was regridded or upscaled.
2. The TCC comparison may be affected by a definition mismatch between the observational product and the model-derived diagnostic. In the manuscript, model TCC is diagnosed from vertical cloud profiles using a maximum-overlap-type assumption, whereas the Cloud\_cci quantity is retrieved from satellite observations and is not necessarily an equivalent quantity. The manuscript also notes that a full Cloud\_cci simulator-based comparison is not feasible with the available model output. Therefore, part of the reported discrepancy may reflect differences in variable definition and observation-to-model comparability, rather than model deficiency alone. This source of uncertainty should be discussed more explicitly.
3. The MRA framework is not described in enough detail for reproducibility. The manuscript does not sufficiently document key implementation details, including how the 4202-day series is reduced to 4096 points, which wavelet basis is used, and how boundary effects are treated. These choices can affect the decomposition, especially at low frequencies. The authors should provide the exact MRA settings and clarify how sensitive the main results are to these choices.
4. The manuscript extends the relationships identified during the ESA-CCI period to the pre-ESA period by using ERA5 as a surrogate reference under a stationarity assumption. However, the manuscript itself shows notable ERA5–ESA-CCI differences, especially over tropical land and in the Niño3.4 interannual analysis. The authors should clarify how these discrepancies affect the interpretation and robustness of the pre-ESA results.

### **Minor comments**

1. Abstract / Methods / Conclusions: The common observation period is not reported consistently throughout the manuscript. The Abstract states July 2003–December 2014, whereas the Methods and Conclusions refer to July 2003–September 2014. Please use one consistent period throughout the manuscript, figures, and tables.
2. Section 2.1.1 and Table 1(ii): The description of the Cloud\_cci dataset is inconsistent. The main text refers to AVHRR measurements from NOAA platforms, whereas Table 1(ii) lists ATSR-2, AATSR, and SLSTR instruments. Please reconcile these descriptions and specify clearly which

Cloud\_cci product and version were used in this study.

3. Lines 180 and 183: The expression “time serie” should be corrected to “time series.” Please check the manuscript carefully for similar grammatical issues.
4. Throughout the manuscript: The terms “AMIP6” and “CMIP6” are used inconsistently in several places. Please standardize the terminology and use the correct experiment name throughout the text, tables, and figure captions.
5. Line 285: “Figures 9” should be “Figure 9”.
6. Throughout the manuscript: Please standardize the citation style for figures, tables, and in-text references. For example, expressions such as “Fig4,” “Fig.5,” [Table 3], and “[Tab.5]” should follow one uniform format.
7. Section 2.1.3 and Table 2: The ERA5 horizontal resolution is reported inconsistently. Section 2.1.3 states  $0.25^\circ \times 0.25^\circ$ , whereas Table 2 lists  $0.5^\circ \times 0.5^\circ$ . Please reconcile this discrepancy and clarify the actual spatial grid used in the analysis.
8. Line 163: The reference to 'FIG. 1' in this caption is inconsistent with the actual content of Figure 1. They do not correspond to each other; I suggest that the author carefully check and verify this.