# UPPER TROPOSPHERIC HUMIDITY AND CLOUD RADIATIVE FORCING: A TROPICAL PERSPECTIVE

This presentation participates in OSPP

Outstanding Student & PhD candidate Presentation contest

Devika Moovidathu Vasudevan[1], Ajil Kottayil[1], and Viju O John[2]

[1] Satellite Remote Sensing and Applications, Advanced Centre for Atmospheric Radar Research, Cochin University of Science and Technology, Kerala, India

[2] EUMETSAT, Eumetsat Allee 1, 64295 Darmstadt, Germany

EGU25 - 849

## 1. INTRODUCTION

Clouds are one of the significant factors influencing the Earth's Energy Budget (EEB). The cloud radiative forcing (CRF), which is the net radiation difference between all-sky and clear-sky conditions, quantifies the impact of clouds on the EEB. CRF consists of two opposing components: longwave cloud radiative forcing (LWCRF) and shortwave cloud radiative forcing (SWCRF). Upper tropospheric humidity (UTH) variability also impacts the amount of outgoing longwave radiation, affecting the EEB. The present study analyzes the influence of UTH on the longwave cloud radiative forcing in the tropics from 2000 to 2021.

## 2. DATA AND METHODOLOGY

- This study uses the satellite microwave (MWUTH) and infrared UTH (IRUTH) measurements from NOAA and MetOp-A (Buehler et al., 2008; Buehler et al., 2007; Devika et al., 2023).
- Observed TOA longwave (LW) fluxes monthly means data from the Edition 4.1 CERES SYN1deg Daily data (Wielicki et al., 1996; Doelling et al., 2013; Rutan et al., 2015).
- NVAP-M CLIMATE Total Precipitable Water (TPW) data with 1° × 1° grid resolution globally is used in this study (Doi:10.5067/NVAP-M/NVAP_CLIMATE_ Total-Precipitable-Water_L3.001).
- This study focuses on the tropical region. Initially, the annual climatology of UTH, TPW and LWCRF are analysed. The joint distribution of UTH and TPW was studied with the composite projection of LW. MWUTH, IRUTH and LW data for 2000-2010 are used to reconstruct LWCRF for 2011-2021 by linear regression method. Correlation maps were constructed between the original and reconstructed LWCRF.

| | Land | | Ocean | |
|---|---|---|---|---|
| | RMSE | Correlation | RMSE | Correlation |
| LWCRF and $LWCRF_{MWUTH}$ | 6.47 | 0.89 | 6.99 | 0.89 |
| LWCRF and $LWCRF_{IRUTH}$ | 7.36 | 0.86 | 7.88 | 0.86 |
| LWCRF and $LWCRF_{TPW}$ | 11 | 0.74 | 13.69 | 0.74 |

**Table 1. Statistics of reconstructed LWCRF over land and ocean regions.**

## 3. RESULTS

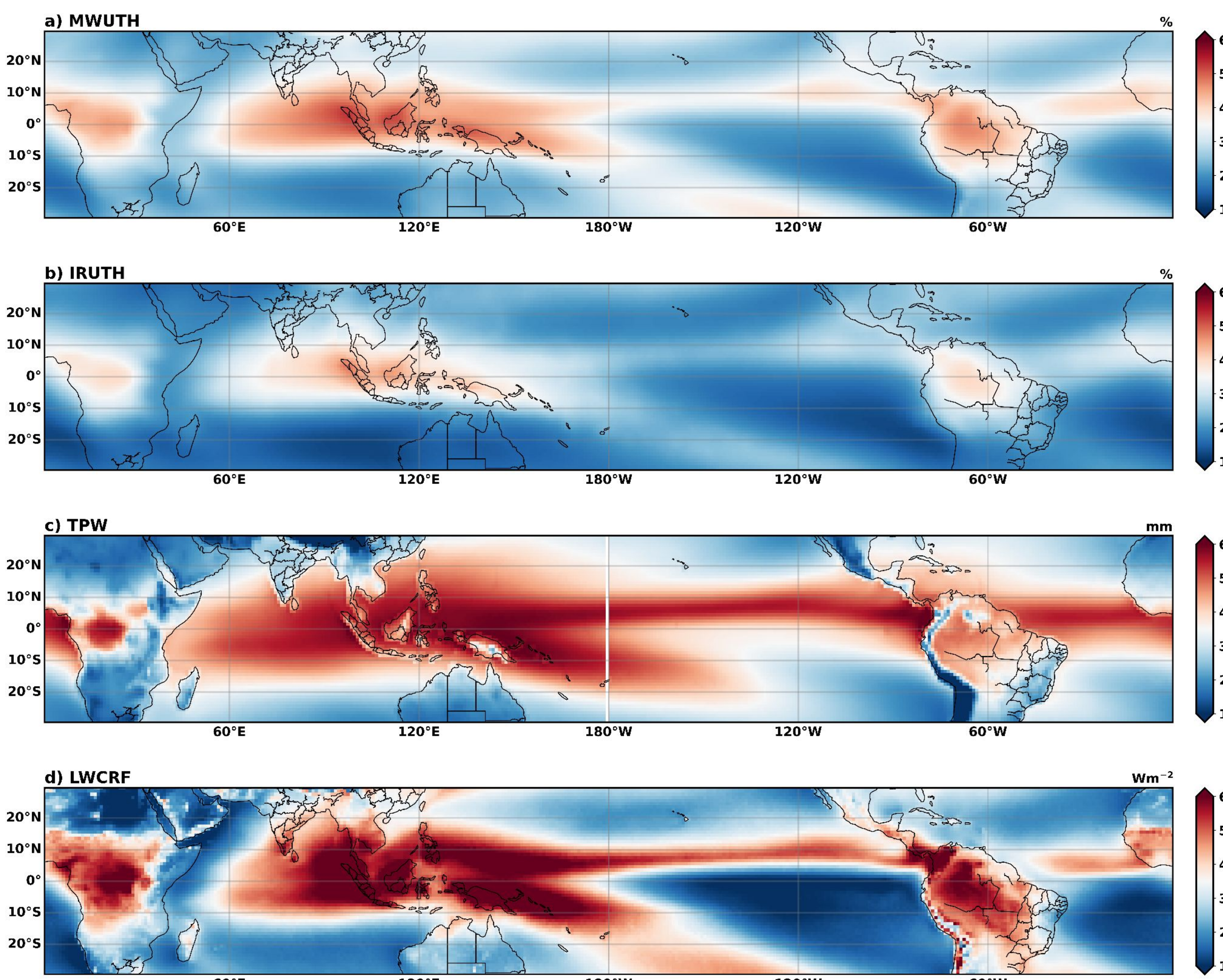


**Fig 1. Annual climatology of a) MWUTH, b) IRUTH, c) TPW, and d) LWCRF for the period 2000-2021.**

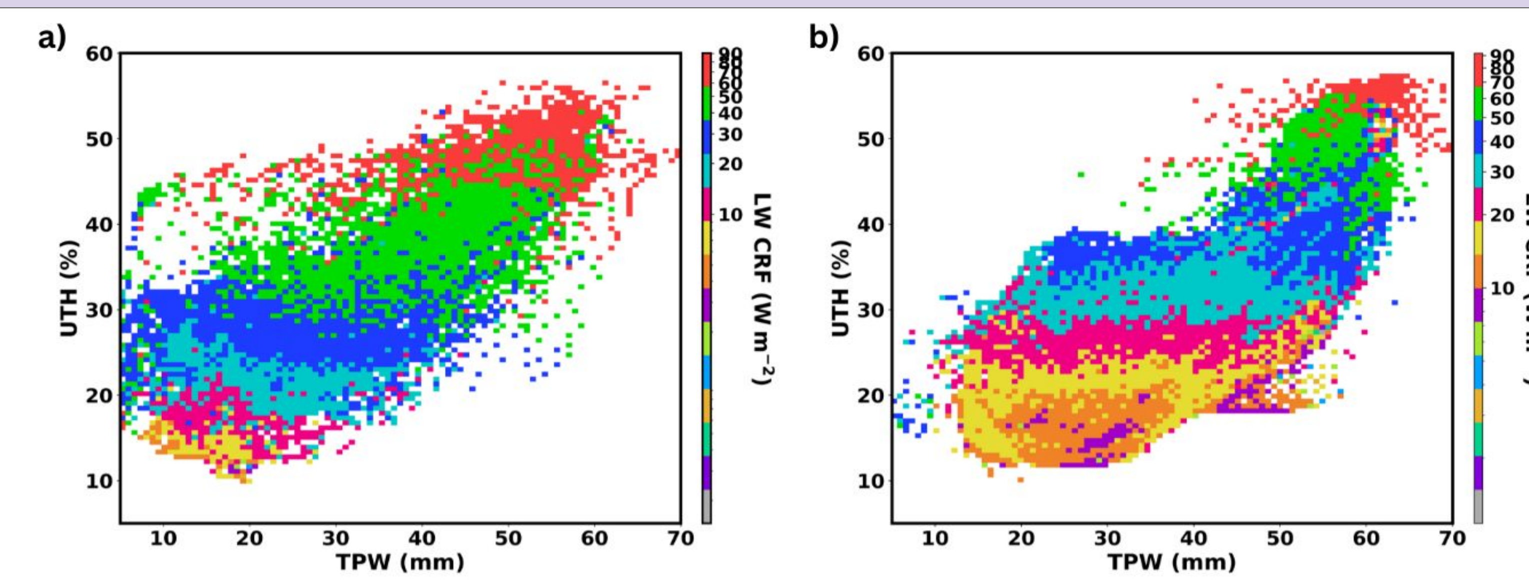


**Fig 2. Joint distributions of UTH, TPW, and LWCRF over a) land, and b) ocean.**

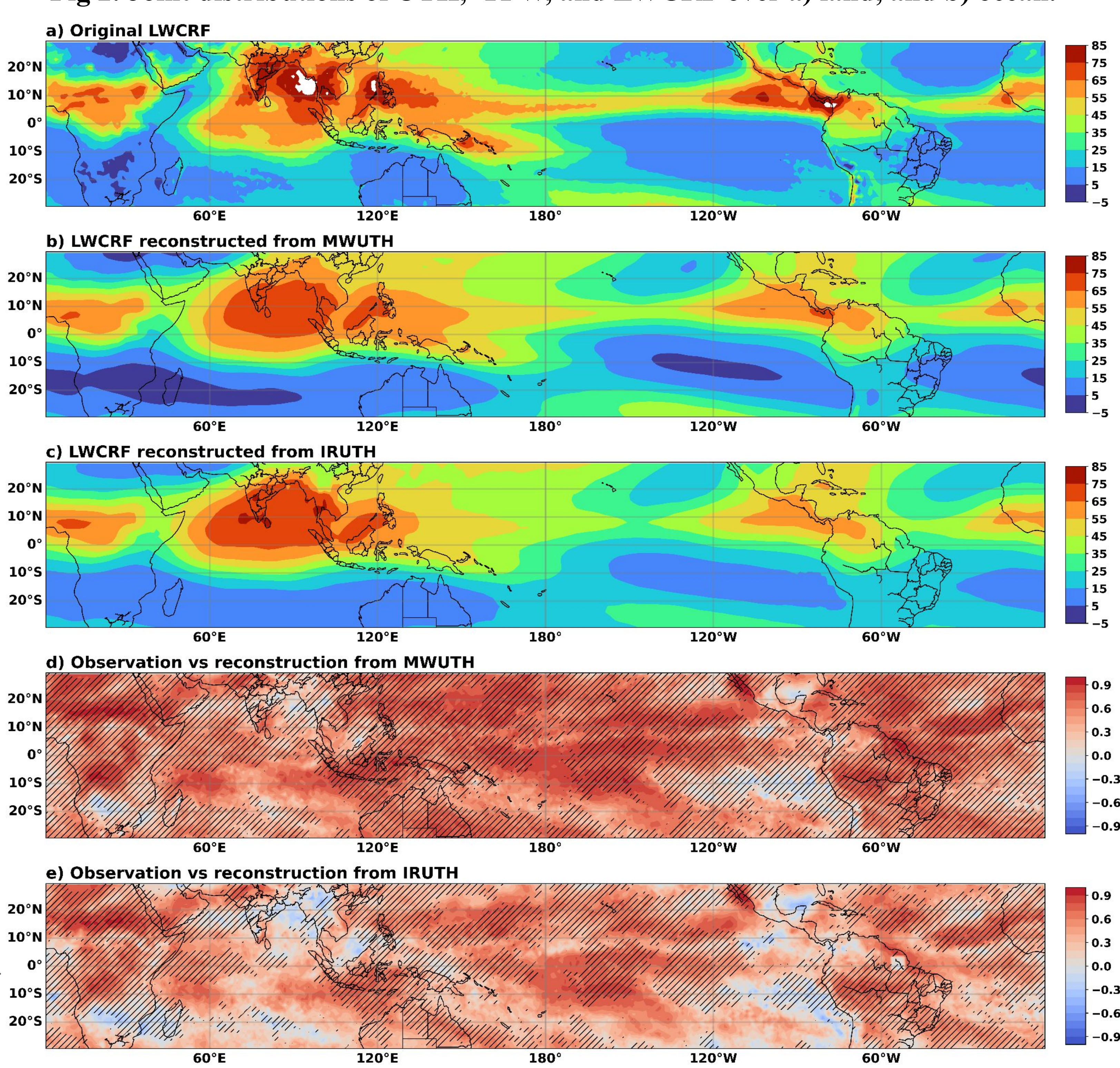


**Fig 3. Seasonal climatology of original LWCRF (a), LWCRF reconstructed from MWUTH (b) and from IRUTH (c), correlation between original and reconstructed LWCRF from MWUTH (d) and IRUTH (e) for the period 2011-2021.**

## 4. CONCLUSIONS

- The spatial patterns of annual climatology of MWUTH, IRUTH, TPW and LWCRF are similar with varying intensities.
- From the joint distribution of UTH and TPW, it is clear that UTH highly impacts LWCRF than TPW over land and ocean regions.
- LWCRF is reconstructed for the period 2011-2021 by linear regression method using the original LWCRF and UTH data for the years 2001-2010.
- The variability of LWCRF is better represented by MWUTH than IRUTH.

## 5. REFERENCES

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