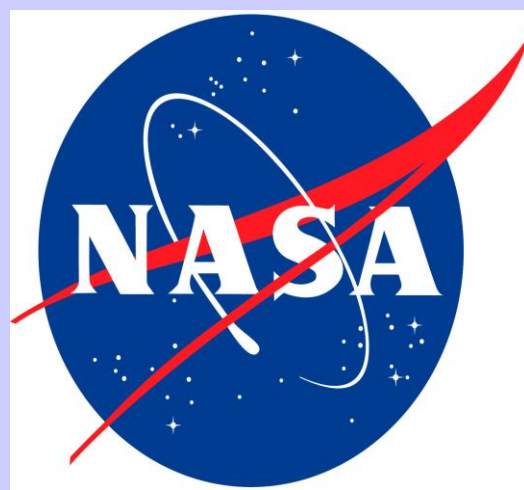




Cloud and TOA Radiative Characteristics during the 97/98 El Nino from the new CERES flux-by-cloud-type dataset

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Motivation

First, to use the new CERES flux-by-cloud type data to describe the radiative and cloud characteristics during the 97/98 El Nino; Second, to show NCAR CAM4 and CAM5 model simulation compared with the observations as a model test. Some of this presentation is from *Sun et al., 2012*. Third, introduce the new flux-by-cloud-type dataset by NASA Langley CERES group.

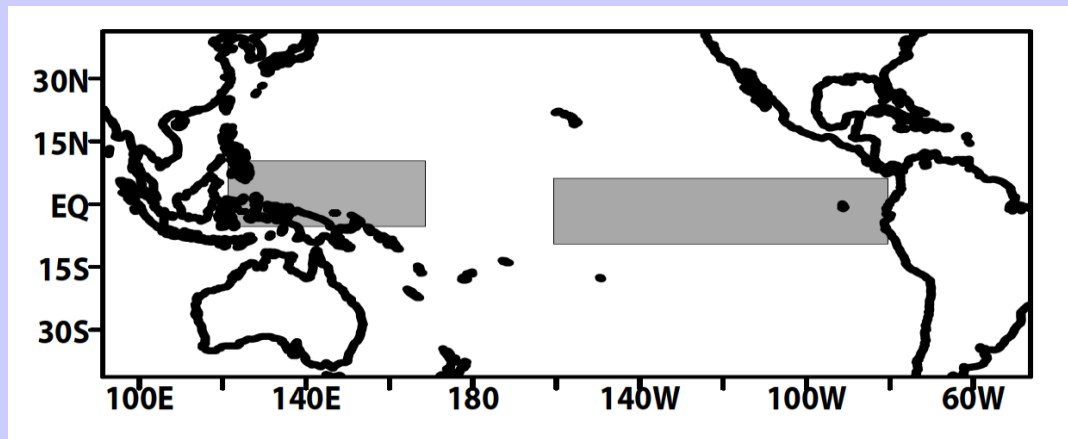


Figure 1 Study Area

TWP (Tropical Western Pacific:120E-170E; 5S-10N)
EST (Equatorial Eastern Pacific:160W-80W; 8S-8N)

Introduction

The 97/98 El Nino is a very strong event which collapsed quickly toward the beginning of 1998 Summer in term of Nino3 (**Figure 2**). This strong event was used to test climate models (Cess et al 2001; Lu et al 2004). Here, we try to use CERES data to document and understand TOA radiative and cloud characteristics. And then we will compare the results with NCAR CAM models to show model's simulation capability.

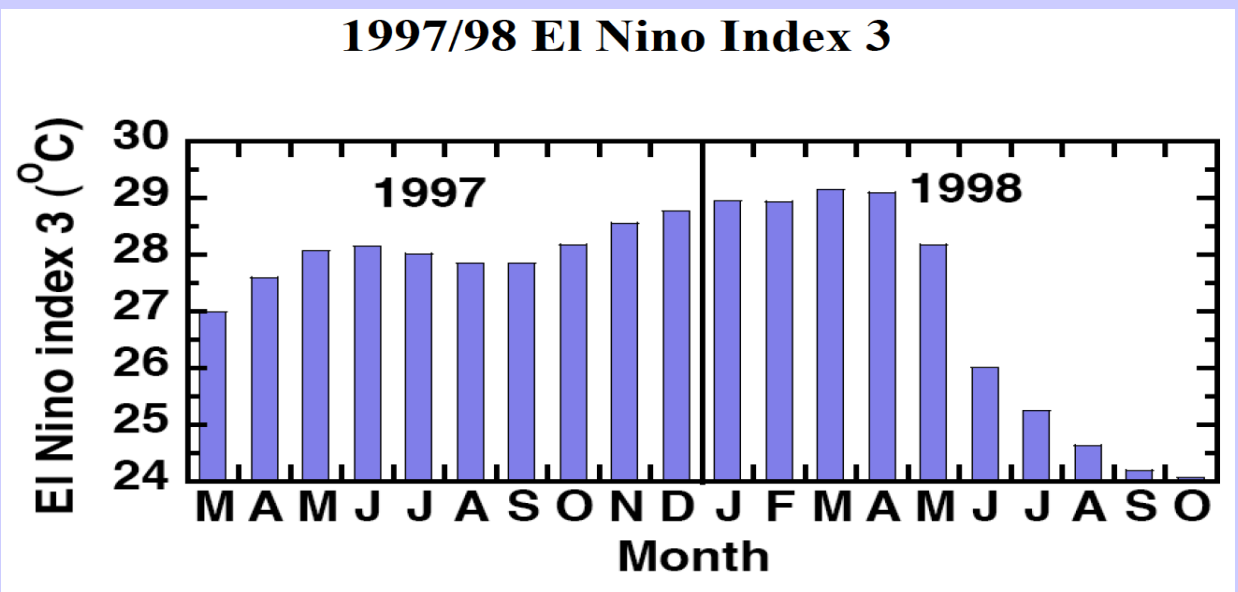
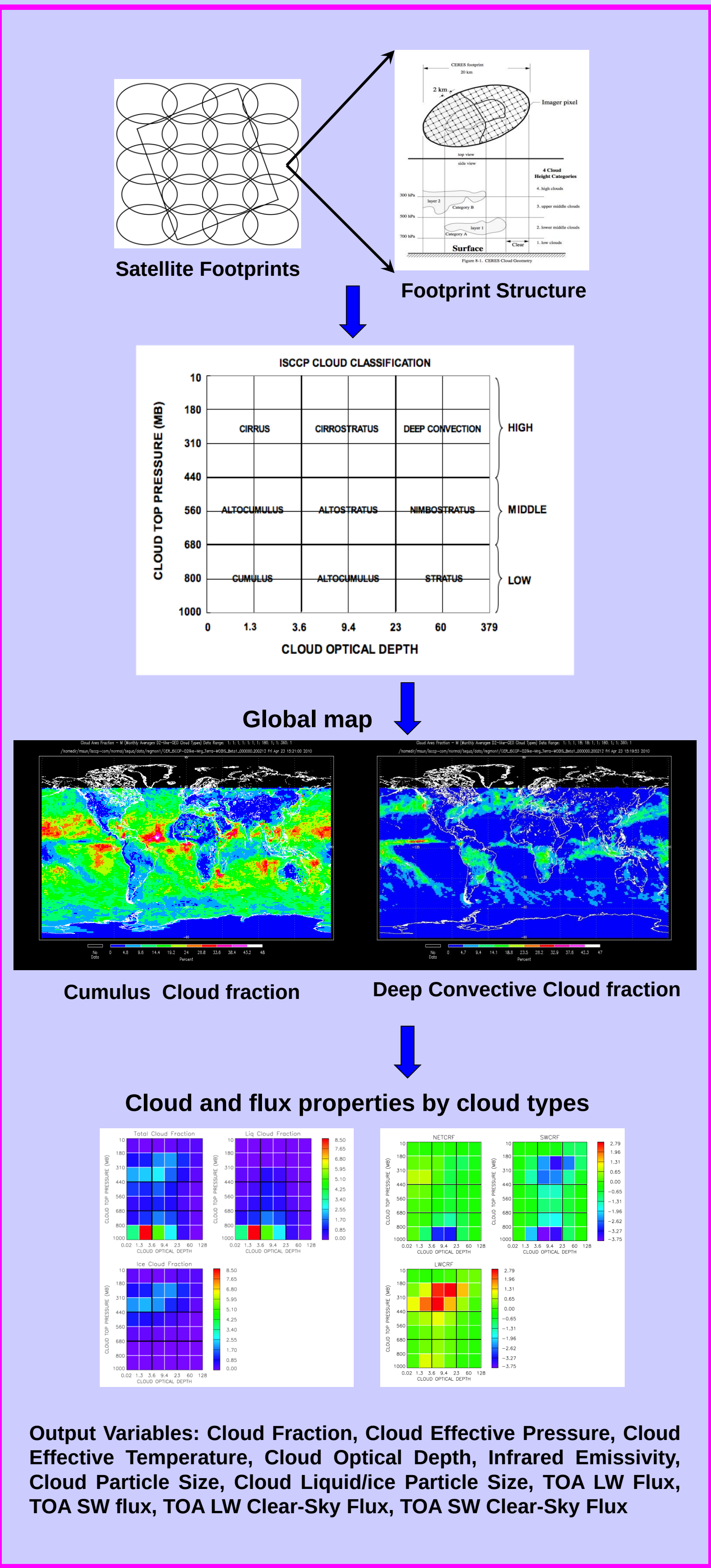


Figure2. SST (5N-5S,90W-150W).

Data

Flux-by-cloud-type data product is produced by the CERES TISA working group. It produces both instantaneous and monthly mean radiative fluxes associated with the retrieved cloud properties that conform to the ISCCP D1 like Pressure-Optical depth format to suit the needs of climate community. The data resolution is 1x1 degree. Following diagrams show more details about the data.

Flux-by-cloud-type Algorithm Flowchart



Model and the Simulation

NCAR CAM4.0, which is the atmospheric component of the fully coupled Community Climate System Model 4.0 [Collins et al. , 2006; Neale et al. , 2010], is used for this study. Since our focus is on the atmospheric radiation and cloud parameterization, CAM4 with the prescribed SSTs rather than the fully coupled model is chosen. The model is configured to have 64x128 (latitude x longitude) grid resolution and 26 vertical levels. The boundary is forced with the monthly mean observed sea-surface temperatures (SSTs) [Hurrell et al. , 2008]. The model is run for a year beginning in September 1, 1997 and only the first eight months of 1998 are analyzed. Cloud fraction is computed from the ISCCP simulator, which uses CAM4 outputs to generate clouds that simulate those retrieved by satellites [Klein and Jakob, 1999; Webb et al. , 2001]

Analysis: Model vs. Observation

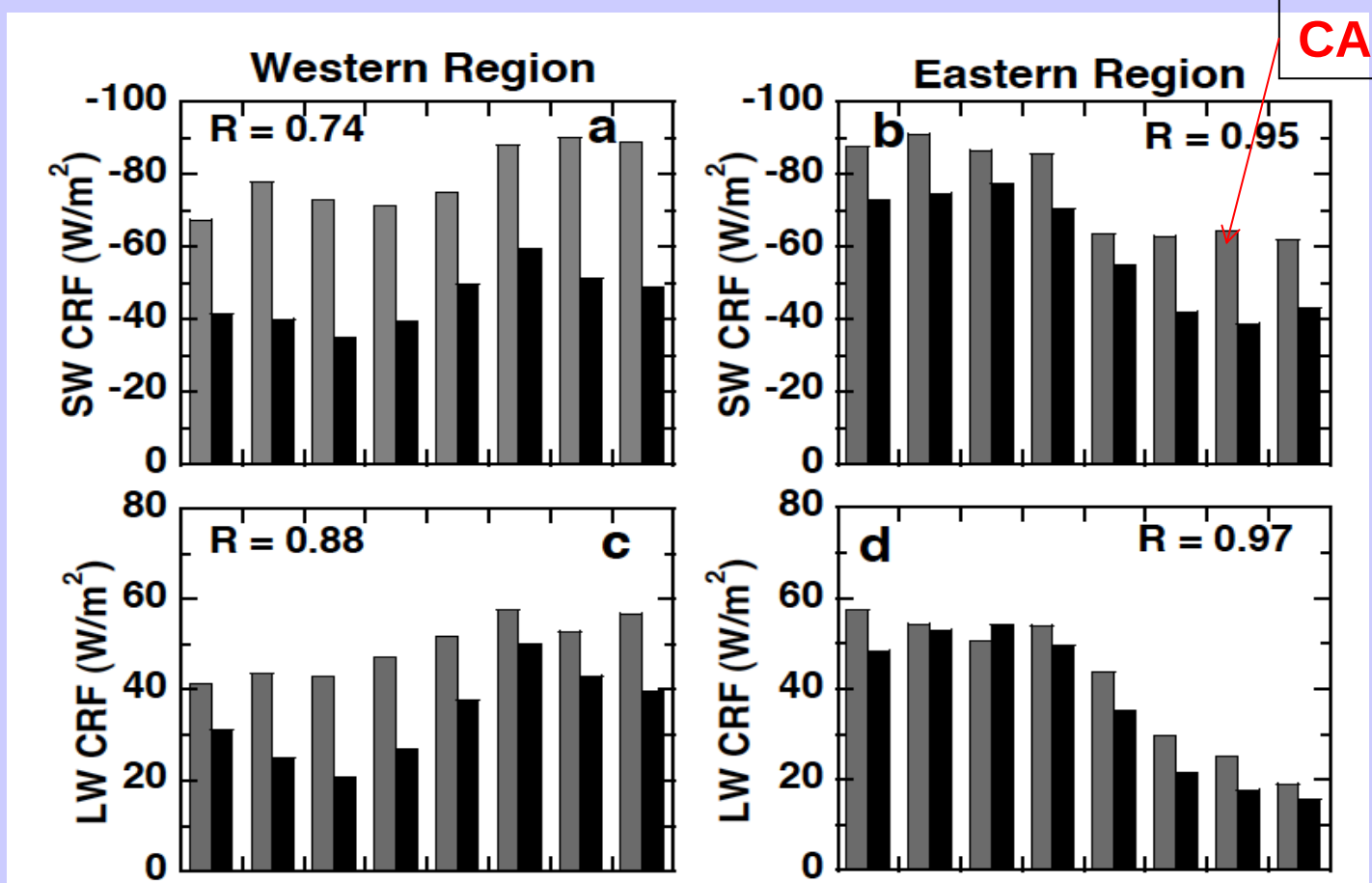


Figure 3

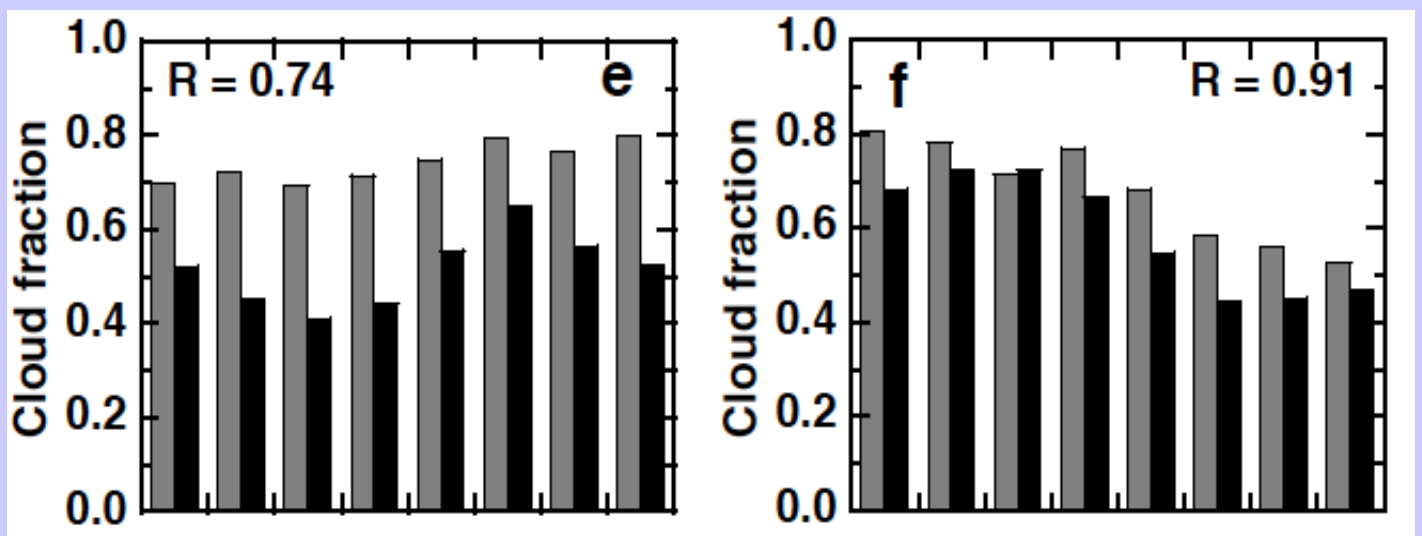


Figure 4

Figure 3 and 4 show that CAM4 captures the main cloud and radiation features of the El Niño event. In terms of magnitude, CAM4 overestimates all radiative and cloud properties. The eastern region compares better with the observations than does the western region. Over both regions, the change in the

References:

Cess, R. D., M. H. Zhang, P.-H. Wang, and B. A. Wielicki (2001), *Cloud structure anomalies over the tropical Pacific during the 1997/98 El Niño* (2001), *Geophys. Res. Lett.*, **28**, 4547-4550.
Lu, R., B. Dong, R. D. Cess, and G. L. Potter (2004), *The 1997/98 El Niño: A test for climate models*, *Geophys. Res. Lett.*, **31**, doi:10.1029/2004GL019956.
Sun, M., R. D. Cess and D. Doelling (2012), *Interpretation of cloud structure anomalies over the tropical Pacific during the 1997/98 El Niño*, *Journal of Geophysical Res.*, **117**, doi:10.1029/2011JD015861

Analysis (Continued)

simulated LW CRF is better correlated with observations than the change in SW CRF. Figure 5 and Figure 6 show the cloud fractions binned by ISCCP D1-like pressure and cloud optical depth values for both observations on the TRMM satellite and CAM4 model results. CAM4 captures cloud changes with the El Nino characteristic such as deep convection increases over the TWP and low cloud increases over the EST region. However, CAM4 has sub-cloud types misplaced compared with CERES data. For both TWP and EST regions, clouds anywhere tend to be optically thicker than the observation. Also, one of the obvious deficiency is the large high thin cirrus cloud generated by CAM4. Given Figure 4 that shows pretty good CAM4 simulation for the total cloud fraction, Figure 5 and Figure 6 reveal more details about the model deficiency simulating cloud amount for different cloud types.

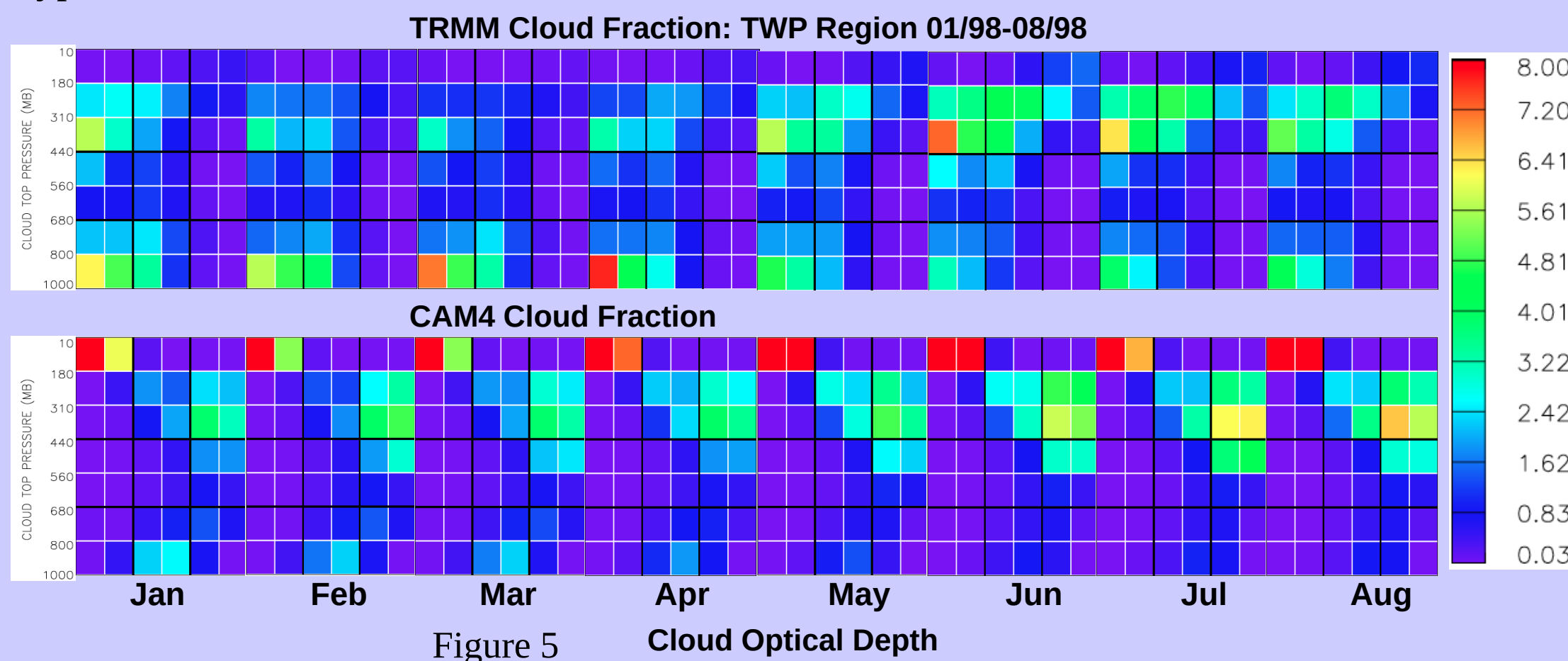


Figure 5

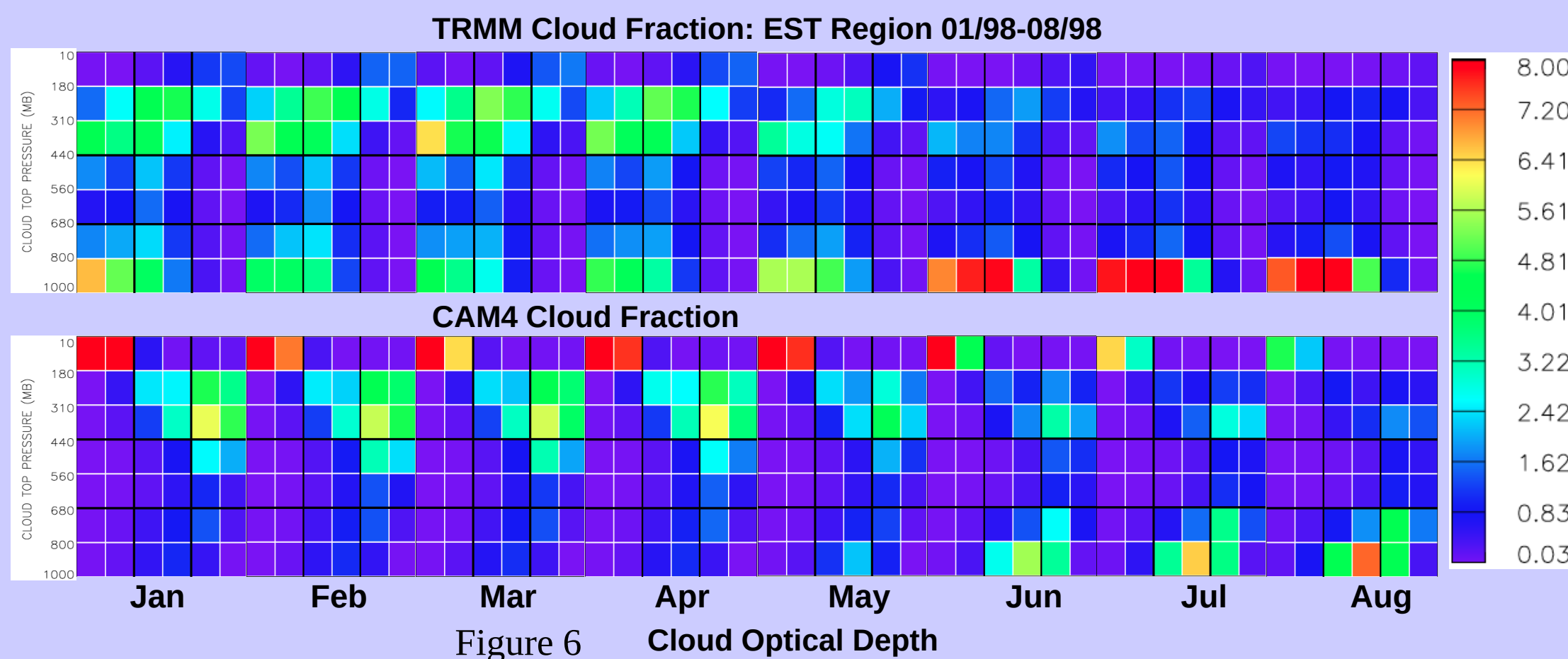


Figure 6

Summary

The strong 97/98 El Nino is characterized by drastic radiative and cloud property change over both Eastern and Western Pacific captured by CERES cloud data. CAM4 captures these changes reasonably well for total cloud fraction but produces deficient cloud fraction for different types. The El Nino can be used as a good test case for model diagnostic study. The flux-by-cloud-type data product helps to further improve these diagnostics.

Acknowledgments The work is supported by the NASA CERES project.