P1.61 ESTIMATES OF TURBULENT FLUXES FROM HIGH RATE AIRCRAFT DATA DURING EPIC

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1. INTRODUCTION

The winds observed in the Eastern Pacific region appear to be very important in determining the characteristics of the convection observed in the Inter-Tropical Convergence Zone (ITCZ). Raymond et al (2003) showed that the intensification of convection was significantly correlated with the surface winds. A logical follow-up is that the winds are indicators of the turbulent surface fluxes of latent heat, and that are these fluxes the ones responsible for the intensification of convection.

We present here preliminary results obtained from high resolution data from 8 flights in the Eastern Pacific during EPIC2001. We analyze high rate temperature, humidity and wind data observed during the low level runs above the sea surface along the 95W meridian.

2. DATA AND METHODOLOGY

The East Pacific Investigation of Climate (EPIC) field project took place from 1 September to 15 October 2001, in the region centered in 10N and 95W, over the warm pool in the Eastern Tropical Pacific. Nineteen flights were conducted by the NSF C-130 operated by NCAR, divided into flights to characterize convection in the ITCZ and flights to determine boundary characteristics along 95W, across the sea surface temperature front. All flights included low level segments, nominally at 30m above sea level. Dropsondes were also deployed regularly during the flights, to determine the vertical structure of the lower atmosphere.

The high rate (25Hz) temperature (from the reverse flow thermometer), humidity (from the Lyman-alpha #1 sensor) and wind data obtained in the low level runs were analyzed to estimate the vertical turbulent fluxes of latent and sensible heat as well as momentum fluxes and turbulent kinetic energy.

An inspection of the low level flight segments indicated that the aircraft changed altitude during those segments, so that the data were sorted into an altitude bin, including all datapoints between 35 and 50m.

During the flights along 95W, the sea surface temperature varied significantly from about 30C at the northern end of the flight to about 18C at the southern end, as seen in Figure 1. A large variability in SST was observed at the southern end of the flight tracks. Therefore, the data were sorted according to sea surface temperature in the flights along 95W in order to estimate the turbulent fluxes.

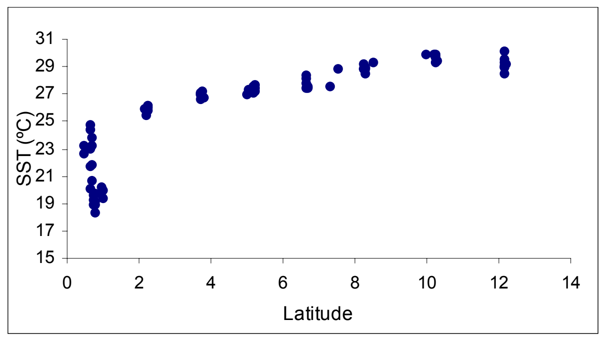

Figure 1. Sea surface temperature (SST) as a function of latitude for all 8 flights

The mean winds exhibited a less systematic behavior with latitude, as seen in Figure 2. Large variability is observed at all latitudes, with an indication of maximum winds on average between 5 and 8N. The estimated fluxes and turbulent kinetic energy were sorted by the mean wind in the segment.

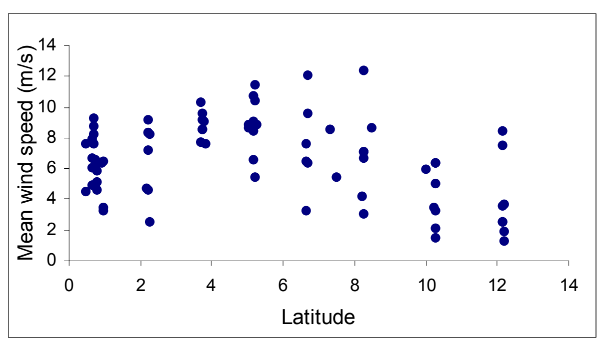

Figure 2. Mean wind speed below 50m as a function of latitude for all 8 flights

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3. RESULTS

Figures 3 and 4 present the estimated latent heat flux as a function of mean SST and mean wind for each of the segments in each of the 8 flights. At the northern end of the flight tracks the SST is largest but the mean wind speed is not, resulting in an "inverted V" pattern of the latent heat flux as a function of SST. There is a more uniform increase of the latent heat flux as a function of mean wind speed.

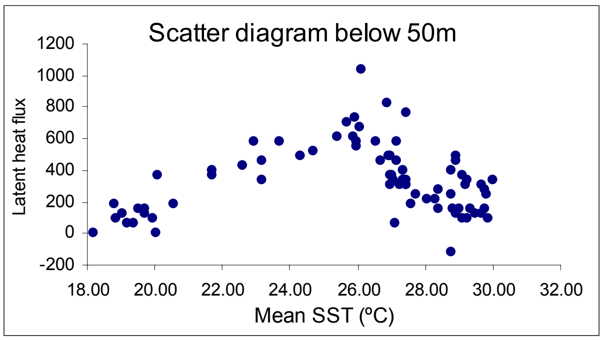

Figure 3. Latent heat flux (W/m^2) for all 8 flights as a function of mean sea surface temperature (SST)

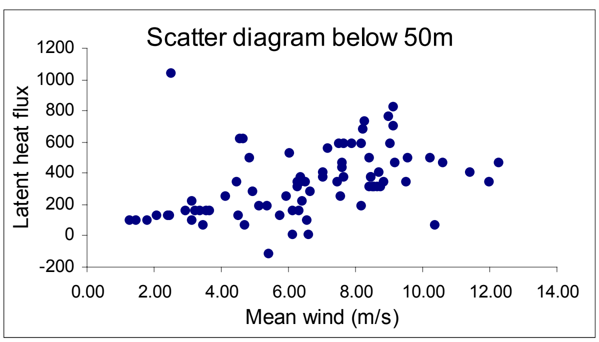

Figure 4. Latent heat flux (W/m^2) as a function of mean wind speed for all 8 flights

The TKE presents little sensitivity to the mean SST values (as seen in Figure 5), while it is shown to increase monotonically as a function of wind speed (Figure 6). It is interesting that there are a couple of instances in which the TKE is very large for fairly low mean wind speed in the segment. These values correspond to 2 segments during Research flight 14, and the datapoint corresponding to the lowest mean wind speed (2 m/s) also exhibits a large value in the latent heat flux, and will be further investigated.

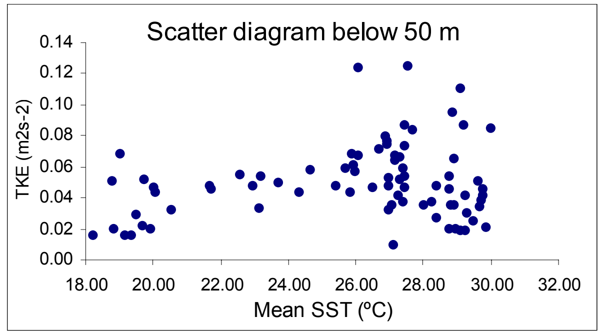

Figure 5. Turbulent kinetic energy (TKE, in J/kg) for all 8 flights as a function of sea surface temperature (SST)

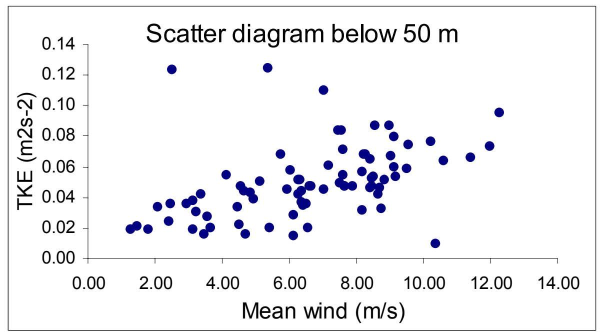

Figure 6. Turbulent kinetic energy (TKE, in J/kg) for all 8 flights as a function of mean wind speed

A preliminary comparison between the turbulent fluxes derived from the high rate in situ data and the bulk formulae from the dropsonde data indicated that the bulk estimate was adequate, but further analysis will be performed and more definite results will be presented at the conference

During the month of February 2004, there is a field project "Gulf of Tehuantepec Experiment" taking place, in which the C-130 is making low level runs very near the region where measurements were made during EPIC. The main difference is that these measurements are being obtained during the winter season, when very strong winds can be present in the region. These measurements will allow us to extend our findings to the higher wind regime. Results from GOTEx will also be presented at the conference.

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4. REFERENCES

Raymond, D. et al, 2003: Convective Forcing in the Intertropical Convergence Zone of the East Pacific. *J. Atmos. Sci.* **60**, 2064-2082.