Comparisons of in situ observations of bulk near-surface meteorological variables, turbulent and radiative fluxes, and cloud properties with operational NWP models in the VOCALS region.

Diane Stanitski[1], C. W. Fairall[2], R. Weller[3], E.F. Bradley[4], Huai-min Zhang[5], W. Hankins[5], and A. Beljaars[6]

[1]NOAA Climate Program Office, Climate Observation Division, Silver Spring, MD; [2]NOAA ESRL/Physical Science Division, Boulder, CO; [3]Woods Hole Oceanographic Institution, Woods Hole, MA; [4]CSIRO Land and Water, Canberra, NSW Australia; [5]NOAA National Climatic Data Center , Asheville, NC; [6]ECMWF, Reading, Berks., England

1. Introduction.

Project SURFA is an initiative of the World Climate Research Programs (WCRP) Working Group on Numerical Experimentation (WGNE) and the Working Group on Surface Fluxes (WGSF). The ultimate objective of SURFA is to institutionalize the evaluation of near real-time NWP fluxes (and related fields) with high quality reference data. During the pilot study phase the feasibility and value of this activity will be reviewed before the decision is made to develop an operational program.

2. Motivation.

Coupled Ocean-Atmosphere climate models are subject to a variety of biases. Fig. 1 shows an example of tropical SST and wind biases due, in part, to inadequate model representations of air-sea interactions. SURFA hypothesis is that these interactions can be examined by comparing flux observations with operational NWP fluxes.

3. Implementation.

SURFA resideS at the NOAA National Climate Data Center (NCDC) as a component of the NOMADS system. Huai-Min Zhang will be the NCDC contact. Detlev Majewski (Deutscher Wetterdienst Research and Development) will be the WGNE coordinator.

4. In Situ Data.

Ocean fluxes will be derived from a collection buoy, VOS, and research vessel observations in coordination with *OCO* climate reference data project. The SAMOS and SEAFLUX projects will cooperate. An *in situ* data working group will be created. A subset of the OceanSITES global array provides high quality surface meteorological measurements for bulk formula flux estimation and sensors for precipitation, solar and infrared radiation. OceanSITES data can help diagnose random errors and biases in model, *in situ* and satellite-based flux fields.

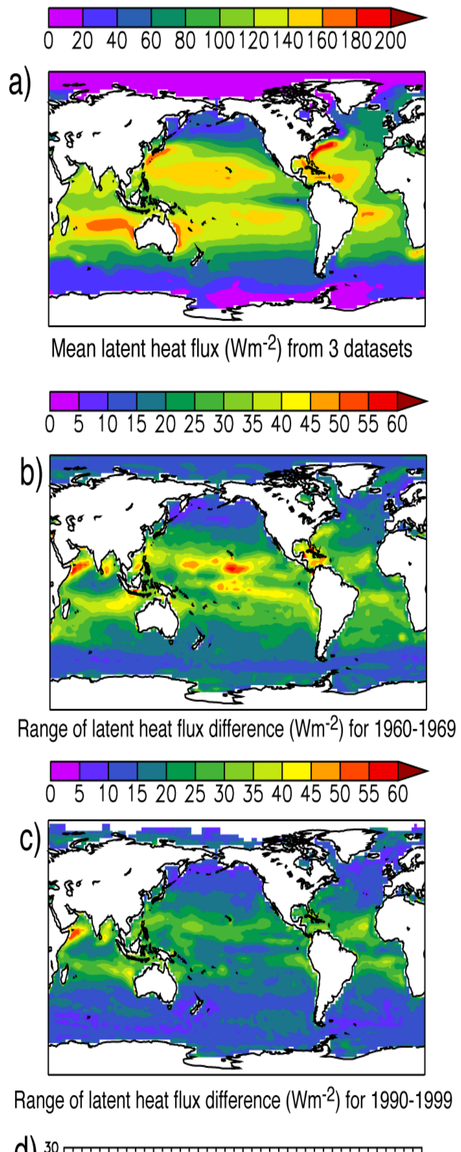

Fig. 1: Monthly mean fluxes from NCEP, ERA-40, and OAFlux. a) latent heat flux mean of three products, averaged over 1960 to 1999; b) range across products in monthly-mean estimates from 1960 to 1969; c) as b) for 1990 to 1999; d) time series of global average difference range (individual months and 12 month running mean).

5. Preliminary Evaluation from the Stratus Region.

We have performed a preliminary comparison of SURFA data with *in situ* observations from the stratocumulus region off Chile. The observations are from the NOAA PSD ship-based flux system and from the Woods Hole flux reference buoy at 20 S 95 W. PSD has made 7 cruises since 2001 (see Fig. 2) and these observations are used in a statistical comparison with SURFA data for the Oct-Nov period. SURFA data from the ECMWF and DWD models for 2008 are used. Examples of this comparison are 10-m winds (Fig. 3) and 10-m air temperature and water temperature (Fig. 4); cloud radiative properties (Figs. 5 and 6) and turbulent transfer coefficients (Fig. 7).

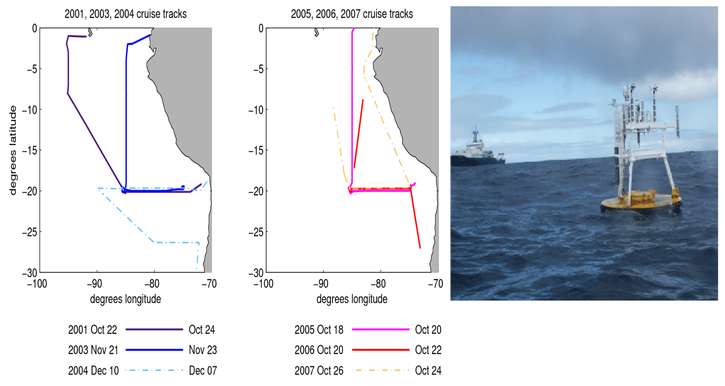

Fig. 2: NOAA R/V cruise tracks used for this study. The WHOI flux reference buoy at 20S 85W is shown.

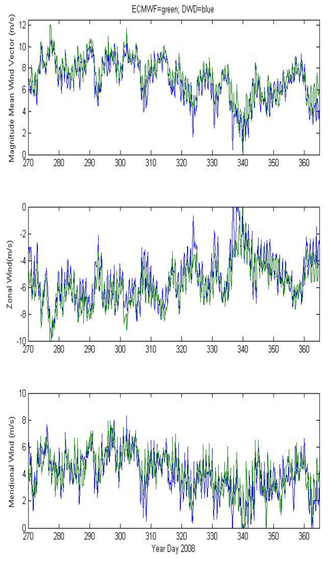

Fig. 3. Comparison of 10-m wind speeds for Oct 2008: Upper panel – speed; middle – zonal wind; lower – meridional wind. ECMWF – green; DWD – blue; Buoy – red dots.

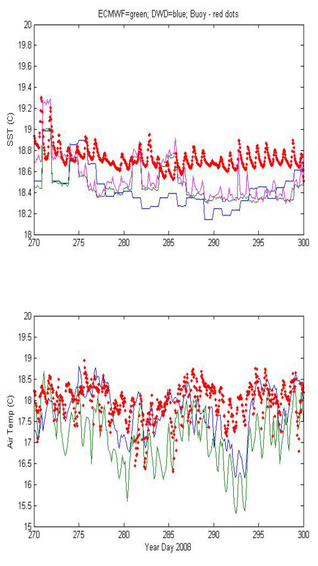

Fig. 4. Comparison of temperatures for Oct 2008: Upper panel – SST; lower – 10-m air temperature. ECMWF – green; ECMWF+warm layer – magenta; DWD – blue; Buoy – red dots.

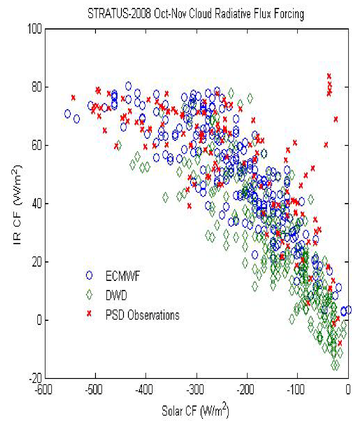

Fig. 5. Cloud radiative forcing phase diagram – IR cloud forcing vs Solar cloud forcing during daytime. CF defined as Mean radiative flux – Clear Sky flux; CF=0 in the absence of clouds.

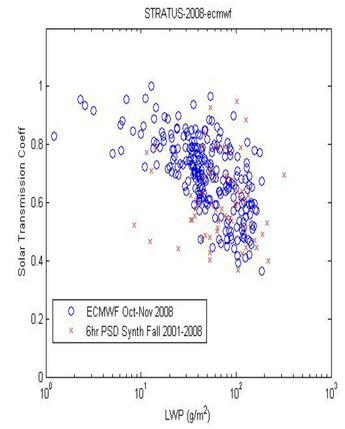

Fig. 6. Cloud solar radiative flux transmission coefficient as a function of column Liquid Water Path. Tr=Mean Flux/Clear sky flux; Tr=1 in the absence of clouds.

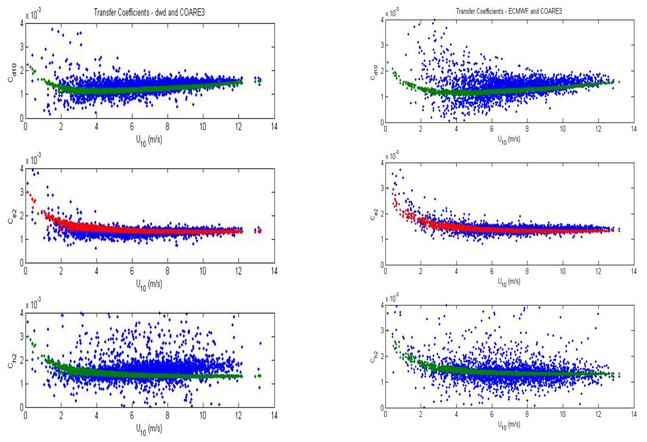

Fig. 7. Transfer coefficients for momentum (Cd), sensible heat (Ch), and latent heat (Ce). Blue dots = DWD (left) or ECMWF (right); Red or Green dots are the COARE3.0 algorithm on the using model data for input.

6. Summary & Future Work:

*SURFA will draw heavily on the Ocean Observing Network to advance the representation of surface fluxes in numerical models. This will have applications in operational oceanography, improvements of medium range forecasts, and parameterizations in climate models.

*This pilot evaluation of SURFA for one case is extremely encouraging.

*The SURFA working group will continue a more comprehensive evaluation and present recommendations to WGNE.

Contact Information: C. W. Fairall, NOAA ESRL, PSD3, 325 Broadway, Boulder, CO 80305 USA; chris.fairall@noaa.gov; Phone: 303-497-3253