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Report On Second Twelve Months Research on NASA Grant

Entitled

MODELING ENERGY AND MASS FLUXES FROM PRAIRIE CANOPIES

Principal Investigator

John M. Norman
Department of Soil Science
1525 Observatory Dr.
University of Wisconsin
Madison, WI 53706

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OBJECTIVES

The main emphasis of this research project is on partitioning of mass and energy fluxes between vegetation and soil at the FIFE site, preparation of data from the FIFE Information System for an international thermal data set comparison, and studying the relation between surface temperatures observed from satellites and insitu measurements of surface temperature.

A FIFE THERMAL DATA SET FOR ALGORITHM COMPARISON

The complete data from FIFE for two days (August 15, 1987 and Aug. 4, 1989) was provided to the International Geosphere-Biosphere Program (IGBP) Working Group on Data and Information Systems for an international study on comparison of surface temperature retrieval algorithms. The total data set consists of two 6250 BPI magnetic tapes (one for each day of data) and three high density diskettes with documentation. This data was sent to M. Stoll of ENSPS, Strasbourg, France on December 11, 1991. In January 1992 we received notification that the data was received and no difficulties were encountered with reading the tapes and diskettes. In March, 1992 the FIFE data set was distributed along with data sets from NESDIS, CSIRO in Australia and HAPEX from France.

COMPARISON OF INSITU AND SATELLITE OBSERVATIONS OF SURFACE TEMPERATURE

Surface temperature estimates from the NOAA-9 and NOAA-10 satellites have been made for the entire FIFE site and compared with infrared thermometer (IRT) measurements averaged over the automated meteorological stations (AMS). The results indicate good agreement between surface temperature estimates from atmospherically corrected AVHRR channel 4 for surface temperatures below 25 C (Fig. 1). Above surface temperatures of 25 C the AVHRR surface temperature estimates are 2 to 5 C higher than the infrared thermometer averages over the AMS sites (Fig. 1). These high temperatures occur during afternoon hours with a dry soil surface that can become elevated to temperatures of 50 C or more.

Infrared thermometers can be prone to errors. In an effort to evaluate possible errors in the AMS infrared thermometers, we compared IRT measurements with predictions of canopy temperature from the Cupid model (Norman et al., 1992). Predictions of infrared canopy temperatures from cupid have been compared with directional measurements made using a Barnes Modular Multiband Radiometer and generally found to agree within about 1 C. Input data for the Cupid model is derived primarily from observations at the AMS. Figure 2 contains the diurnal course of solar radiation, air temperature at a two-meter height, soil surface temperature, vegetation (canopy) temperature and nadir infrared temperature. Clearly the differences in the various temperatures can be considerable. Figure 3 shows the

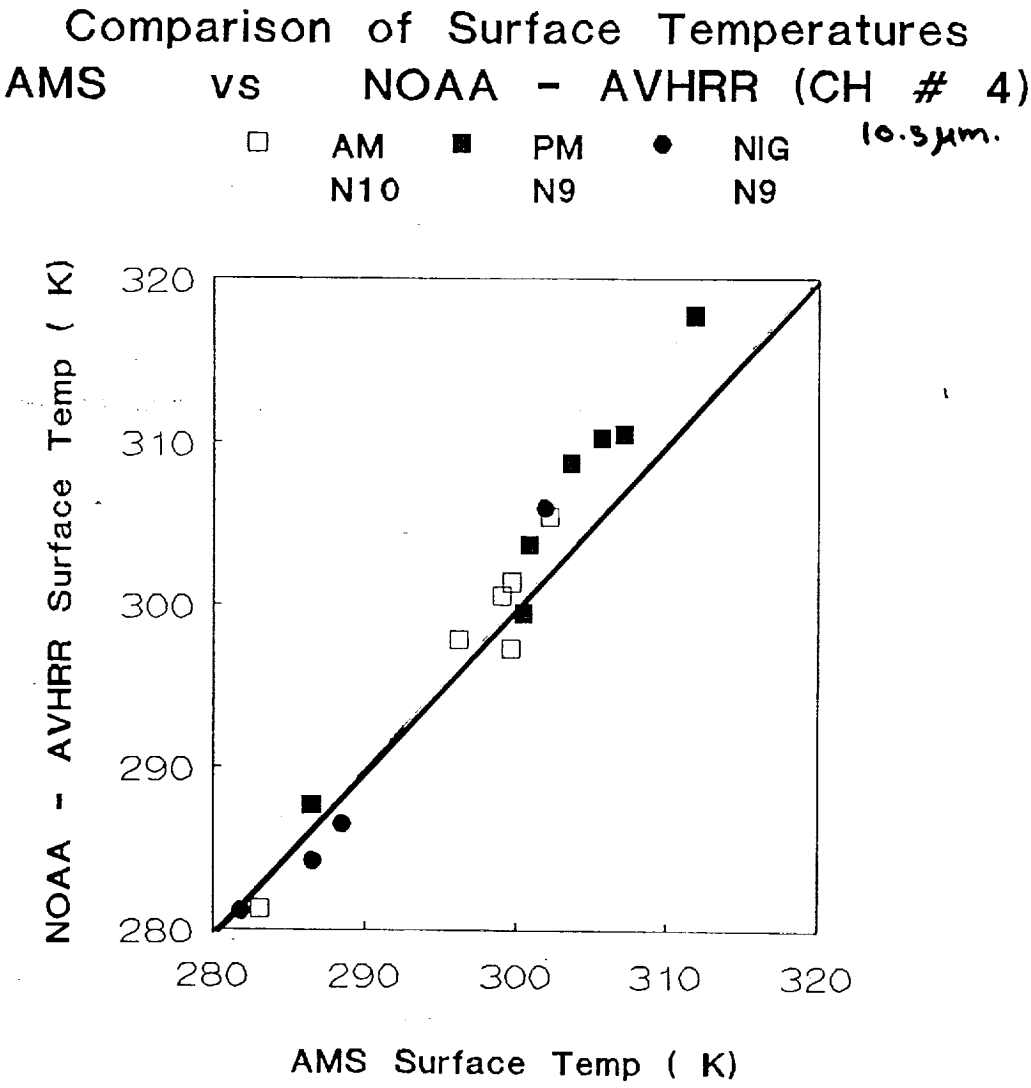

Fig. 1. Comparison of surface temperature estimates for the entire FIFE site from atmospherically corrected AVHRR observations and an average of the infrared thermometer measurements from the automated meteorological stations.

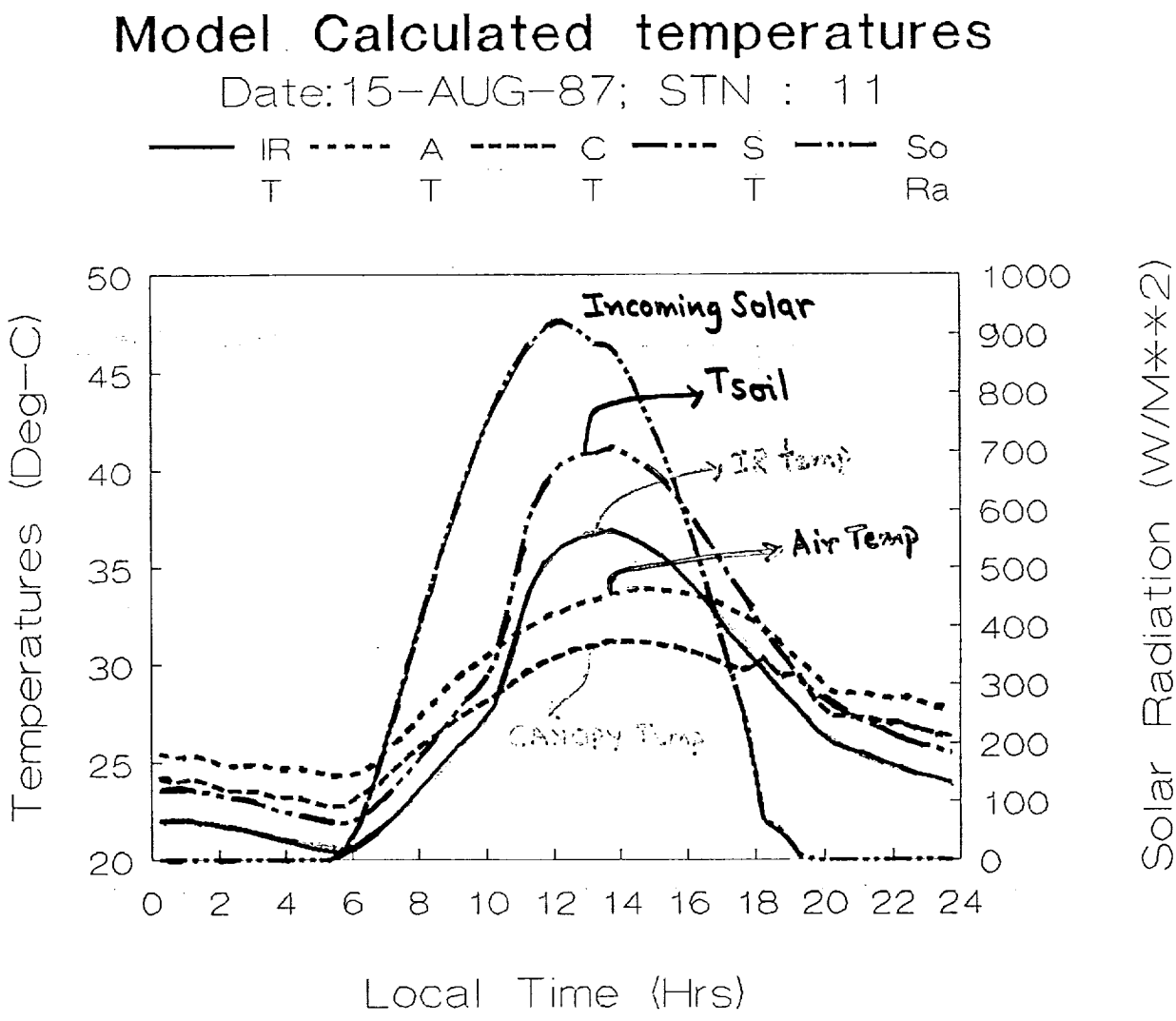

Fig. 2. Predictions of various temperatures from the Cupid model along with measurements of the incoming solar radiation.

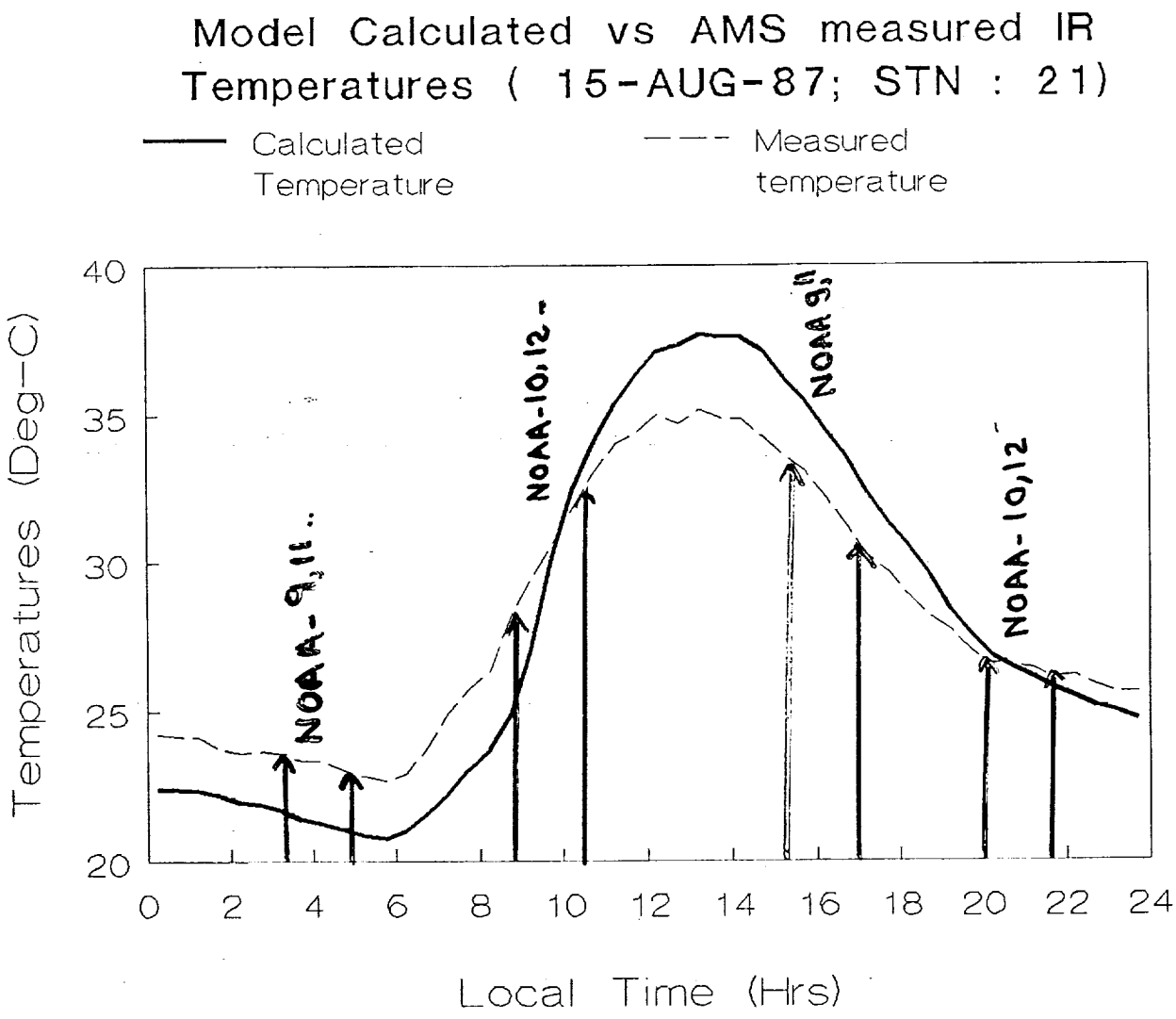

Fig. 3. Comparison of predicted infrared temperature from Cupid with IRT measurements for nadir view. NOAA AVHRR satellite overpasses are indicated .

diurnal course of predicted nadir infrared temperature and measured nadir infrared temperature. The two temperatures agree within about 2 to 3 C with predictions indicating lower night-time and higher day-time temperatures. Considering typical spatial variability associated with surface temperature measurements, this agreement is encouraging and suggests that the IRT measurements may be reasonable.

References

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PRESENTATIONS UNDER THIS GRANT:

Norman, J.M. and L.K. Balick. 1992. Directional temperature and emissivity of vegetation: Model and measurements. Symposium on Methods and Challenges in Estimating Surface Temperature from Spacecraft, Aaircraft and Ground-Based Platforms. 29th Plenary Meeting of the Committee on Space Research (COSPAR), 28 Aug. - 5 Sept., 1992, Washington, D.C.

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