Confidential Comments and Feedback for PI

Project Name: **IHOP 2002**
Principal Investigators: **Weckwerth et al.**
Facilities Requested: **NRL P-3, ELDORA, King Air, S-Pol, ISS, ISFF, GLASS, Dropsondes**

IHOP is a large multi-agency/multi-university/NCAR project involving most of the lower atmospheric observing facility pool (LAOF) equipment including the NRL P-3 with ELDORA, S-POL, 400 dropsondes, 9 ISFF, the ISS-MAPR, 2 MGLASS with 420 sondes/balloons and the Wyoming King Air. Additional requests not in the facility pool include the WCR, BINET, and a dropsonde aircraft. The RAF will also be responsible for installing other instrumentation on the P-3 including Leandre II. The project may also include a large number of other facilities including the NASA DC-8 and Proteus, the DLR Falcon, DOW and SMART-R radars, the UAH MIPS, NOAA ETL radiometers, ground based lidars, and operational facilities such as the Oklahoma mesonet, the WSR-88D radars, and special 3 hourly rawinsondes from the NWS. The location of the experiment includes the ARM/CART site, and the WPN and ABLE networks.

The project has four overlapping components. The quantitative precipitation forecasting component is aimed at determining the increase in forecasting skill that can be achieved by better observation of the water vapor field; the convective initiation component is aimed at better understanding the processes that trigger convection, and determination of the key measurements required to improve prediction of convective initiation; the Atmospheric Boundary layer component seeks to improve understanding of the relationship between atmospheric boundary layer processes, water vapor distributions and QPF; the instrumentation component seeks to evaluate the usefulness of new techniques to characterize the water vapor field and determine the optimum instrumentation suite required for operational characterization of the water vapor field. These data will be assimilated into models with the goal of improving forecasts.

Suggestions and Comments from the Panel:

Convective Initiation Component
The project design favors the convective initiation component at the expense of other components. Significant new information will be obtained regarding convective initiation.

Quantitative Precipitation Forecasting Component
The deployment of the instrumentation array and the aircraft sampling strategies, as laid out in the design documents, are less than optimal for success of the QPF component:

1) The data systems are concentrated to study convective initiation. This conflicts directly with the need for measurements over a broad domain for QPF. The advective time scales need to be considered in the experiment design, particularly in regard to the placement of the dropsondes and vapor sensors, since the impact of vapor measurements to QPF is central to the experiment. A strong southerly low level jet and a strong southwesterly upper level jet stream often accompany strong convective storms forming along the dry line. When these jets are present, the air passing through and around convective storms may be located well outside the intense observing network of IHOP in the hours prior to convective initiation. Assimilation of data into forecast models normally occurs in a time window 0-6 hours prior to the zero hour of the forecast run. Convection triggers one or more hours into the forecast. For data assimilation to improve a forecast of QPF, the data should be obtained well upstream of the location where convection initiates.

2) The temporal and spatial scales over which the QPF validation will be conducted were not specified. Storms often develop in lines that are hundreds of kilometers long. A line of storms

can last many hours and cross several states. Is the QPF validation to be localized to only those storms developing within the intensive operation area? Will the validation be limited to the period when the storms are over specific river basins, or over the lifetime of the convective systems? How does one determine the impact of specific measurements of water vapor on QPF in the context of these diverse scales?

3) QPF requires precipitation measurements for validation. Little attention was paid to this issue.

4) For QPF, the vapor, and all other measurements to be used in data assimilation, should be made upwind of and at an earlier time than the anticipated convection. This may be logistically difficult, and possibly involve nocturnal observations (with attendant logistical concerns).

5) With the possible exception of ARPS, data assimilation systems are currently not capable of assimilating most data from the remote sensing systems. Other than a table listing modeling participants, there was no description of specific modeling efforts to address this issue or to allow quantitative assessment of the impact of specific measurements on QPF. The creation of level 3 datasets seems essential to these and other modeling efforts.

6) Prior to the experiment, adjoint modeling studies, or even back trajectories, for key cases with synoptic conditions similar to those expected during IHOP could help the PIs identify upstream regions of the atmosphere and/or key variables that influence convection in the project area. These studies could provide key guidance for developing sampling strategies.

Atmospheric Boundary Layer Component:

This component is an integral part of the convective initiation and QPF components. The comments above apply to this component.

Instrumentation Component:

Determining the accuracy of vapor measurements and performance limitations of both new and conventional instrumentation for measuring water vapor is a critical aspect of IHOP.

A protocol should be established before the experiment specifying the methods for intercomparing measurement techniques. This is a difficult but essential part of this experiment and needs to be considered carefully by the PIs. What will be used as the accurate water vapor baseline against which the instruments will be compared? Quiescent conditions (i.e. weak gradients) may provide better conditions for intercomparison.

Experimental design

The complex aircraft patterns will require an experienced aircraft coordinator and an operations center with the capability of tracking all aircraft and overlaying meteorological data on flight tracks in real time. Communicating to multiple aircraft will place considerable stress on radio communications and air crews, particularly in rapidly evolving situations involving dangerous weather.