IHOP_2002 CI Planning Process: The conception of an idea and the role of the USWRP

The IHOP_2002 field campaign came together as the result of the merging of several closely related, but independent efforts which were eventually tied together under the banner of the United States Weather Research Program (USWRP). These efforts include:

i) The interest of Tammy Weckwerth in this subject can be traced back to the CaPE experiment in 1991 where significant variations in boundary layer water vapor were observed in aircraft and sounding data and these variations were critical to onset of convection (Weckwerth et al. 1996, MWR, 769-784; Weckwerth 2000, MWR, 4017-4030). The representativeness of sounding measurements in the prediction of convection, even due to the presence of relatively benign boundary layer circulations, was raised by the Weckwerth (1996) study. The idea of an experiment linking water vapor and convective activity was conceived at the 1998 NCAR/NOAA Water Vapor Workshop (Weckwerth et al. 1999, BAMS, 2339-2357). Many scientists interested in CI attended this workshop and justified the need for improved moisture measurements to better understand CI processes.

ii) Around the same time, other CI scientists (primarily Conrad Ziegler, Erik Rasmussen and Jeanne Schneider) were planning TIMEx (Thunderstorm Initiation Mobile Experiment). Through discussions with Jim Wilson and Roger Wakimoto, the TIMEx PIs agreed that the campaign could not be successful without improved water vapor measurements. TIMEx was subsequently put on hold and many of the TIMEx investigators put their energy into the CI component of IHOP_2002. The argument for 3-

D high spatial resolution in the water vapor measurements also came out of the TIMEx ideas and those formulated at the Water Vapor Workshop.

iii) Another closely related, but independent effort was USWRP-funded work, led by Dave Parsons and Mike Hardesty, to examine the impact of improved water vapor measurements on the prediction of the initiation and evolution of convective systems. Parsons and Hardesty's resulting USWRP effort envisioned numerical Observing System Experiments (OSEs) based on data provided from a series of field experiments to examine the impact of improved water vapor measurements on QPFs for warm season rainfall. The first experiment in this series took place as part of the Atmospheric Radiation Measurements (ARM) program's Water Vapor Intensive Observation Period (WVIOP) from 10 to 30 September 1996. The concept for this experiment was to examine the impact of integrated water vapor measurements obtained by Global Positioning System (GPS) receivers on the prediction of convection. Measurements from 15 GPS sensors from NOAA, ARM and NCAR were assimilated using a 4-D VAR approach and the relative impacts of different observations were assessed in MM5 simulations (Guo et al. 2000, MWR, 619-643). These studies showed that wind profiler data had the maximum impact on the model's ability to recover the vertical structure of moisture and reproduce the rainfall pattern and amount due to the importance of dynamical features, especially areas of ascent and descent, in controlling the distribution of water vapor. The ground-based GPS data did have a positive impact on the rainfall prediction, but had relatively small influence on the recovery of moisture structure. The next step was to conduct an experiment with direct measurements of water vapor through water vapor lidars and then conduct numerical OSEs to examine the impact on

forecasting of convection. The USWRP concept of a water vapor experiment linked to convective rainfall was also influenced by Keith Browning of the University of Reading's Joint Centre for Mesoscale Meteorology during Parsons' sabbatical visit to that institution in 1998[1]. Upon returning from sabbatical, Parsons proposed IHOP_2002 and found a similar experiment being planned by Weckwerth and others. Both scientists resided with NCAR's Atmospheric Technology Division (ATD) and Dave Carlson, who at the time was the director of NCAR's ATD, encouraged collaboration between the TIMEx community, the USWRP QPF efforts led by Parsons and Hardesty, and the experimental concepts formulated at the Water Vapor Workshop. The result of Carlson's proposal was that the groups collaborated forming a major IHOP_2002 field effort with four different research components under the framework of the USWRP, which allowed interagency collaboration on the field effort.

As these groups came together, the CI investigators specifically noted the need for measurements of the horizontal variability of water vapor. Thus an airborne, sideways-pointing water vapor DIAL, in addition to the vertically-pointing ground-based and airborne systems, was deemed highly desirable for IHOP_2002. It was determined that it would be most useful to have these spatial measurements along with the 3-D wind field, as retrieved by ELDORA. Thus in early 1999 Weckwerth and Craig Walther met with Jacques Pelon (CNRS-France) to discuss the possibility of pointing Leandre II water vapor DIAL sideways onboard the NCAR Electra, which also housed ELDORA. Although a sideways-pointing water vapor DIAL had never been operated before, Pelon was confident that it was possible and recruited Cyrille Flamant who enthusiastically led

[1] Perhaps the success of IHOP_2002 and the initial discussions between Parsons and Browning helped formulate the concepts of the UK's CSIP experiment.

the planning and testing of such a configuration with LEANDRE II. In the meantime, the NCAR Electra was decommissioned so the ELDORA was transitioned to the NRL P-3. This was an extraordinary effort in itself but even more complicated with the addition of a sideways-pointing DIAL. NCAR/ATD and CNRS came through with flying colors and amazingly met the deadlines to have the first-ever simultaneous horizontal-pointing DIAL and Doppler radar measurements onboard the same platform. This was a key instrument combination for CI studies, although the horizontal range of < 4 km proved to be a limiting factor. A longer-range system is still desired by the research community.