

Summary of 21-22 June 2007 Meeting of the NOAA HMT Advisory Panel Sacramento, CA

Executive Summary

Seventeen members of NOAA's HMT Advisory Panel (three by phone) and five guests met for two days in Sacramento to discuss the current state of the HMT project, the long-range prospects of HMT (HMT-East and the HMT-West legacy), and perhaps most importantly, to consider plans for the coming field season (November, 2007 – March, 2008).

The first day included a lively and engaging discussion about the purpose and objectives of HMT and a detailed look at what has been accomplished since HMT formally began in 2005. Building on the first day, the second day focused on planning for the coming season. The group also outlined two new white papers that consider HMT's QPE efforts and planning for the HMT-West legacy.

Primary conclusions and recommendations from the meeting include:

- #1 HMT-West is still in an exploratory phase: we are still learning how to do research to operations and have not generated a data set sufficient to inform long-term decisions.
Recommendation: Continue HMT-West operations at a sustained level for several years beyond FY09; i.e. at levels comparable to FY08-FY09.
- #2 Planning for the FY08 field season is on track. A number of refinements were discussed and will be acted upon.
Recommendations: Phase-3 of the HMT mesonet will focus on Placer County "group B" sites (per CN-RFC's plan) but other sites will be surveyed. Consideration should be given towards placing one of the gap-filling radars (NSSL) in the lee of the Sierras.
- #3 A proposal to reconfigure the HMT advisory structure with a smaller nationally focused advisory panel and newly formed regional implementation teams met with general agreement. However, more detail indicating the scope of their respective responsibilities, how they interact, etc., is needed before a final plan can be considered.
Recommendation: Proper consideration will be given to the plan when the aforementioned issues have been articulated and reviewed in an HMT Charter.
- #4 A better job needs to be done to communicate the objectives of HMT: They are to improve QPE, QPF and hydrologic monitoring and forecasts, and to develop decision support tools that integrate new science (knowledge) with new models and observational data streams. Whereas the immediate beneficiary of HMT are NOAA's frontline operational units (i.e. WFOs, RFCs and national centers), careful consideration and attention should be given to external stakeholders such as local, state and other federal entities.
Recommendation: Carefully identify and articulate HMT's objectives and customers in the Charter.
- #5 *Recommendation:* Future Advisory Panel meetings will be held in April to better respond to the PPBES process, increase prep-time for future field seasons and improve attendance.

Attendees:

Mike Anderson*	CADWR	Elissa Lynn*	CADWR
Mike Bodner	NCEP/HPC	John McGinley (phone)	ESRL/GSD
Mike Ekern	CNRFC	Elizabeth Morse	STO WFO
Gary Estes*	SAFCA	Josh Nowlis*	NMFS/SFSC
Rob Hartmann	CNRFC	Dave Reynolds	MTR WFO
Art Henkel	CNRFC	Woody Roberts (phone)	ESRL/GSD
Dave Jorgensen	NSSL	Tim Schneider	ESRL/PSD
John Juskie	STO WFO	Paul Schultz	ESRL/GSD
Dave Kingsmill	ESRL/PSD	Mike Smith	OHD/HL
Dave Kitzmiller (phone)	OHD/HL	Stuart Townsley*	USACE
Dan Kozlowski	CNRFC	Kevin Werner	WR HR

* Guests

† Copies of the presentations from the meeting are available at: ftp://ftp.etl.noaa.gov/user/hmt/HMT_June_21-22/

Morning session, Thursday 21 June

State of HMT (Tim Schneider)

After some introductory remarks by Rob Hartmann, Tim Schneider opened the meeting with a presentation on the state of the HMT (Schneider_HMTAPmtg_Jun07.ppt.pdf). One of the first elements of his presentation was a set of questions relevant to the status of HMT, such as science goals for the project and progress on QPE, QPF and hydrologic modeling. These questions spurred considerable discussion among meeting participants. The first basic issue that was discussed involved defining the key objectives for HMT. While nothing definitive was agreed upon, there appeared to be general consensus that improvements in QPF, QPE, hydrologic modeling and physical process understanding are the key issues to address. There was some concern about how improvements in QPF and QPE will translate to improvements in hydrologic forecasts.

Some discussion was then directed at how we attack these problems. In particular, there was uncertainty about whether we had truly “over-sampled” from an observational standpoint. There was a suggestion that an Observing System Simulation Experiment (OSSE) approach should be considered to help determine the optimal observing system. Another suggestion was to carefully consider the critical gaps in our knowledge on these issues and then strategically deploy observing system resources in a manner that addresses these gaps.

The discussion then transitioned to how we might define success for the western HMT. NOAA Corporate performance measures for Flash Floods and QPF were offered as a possible structure that could be used to measure success. However, these specific performance measures may not provide the fine granularity to allow an adequate assessment. Tim Schneider outlined the “Demonstration” performance measure concept that has been advocated by the NOAA Science, Technology and Infusion (ST&I) matrix program. These demonstration measures could be tailored to the specific issues relevant to HMT-West. Another construct suggested for defining HMT-West success was the development of a Decision Support Tool that would allow

operational forecasters and key end-users to integrate the various pieces of hydrometeorological information. It was emphasized that such a tool needs to be extensible to other parts of the West, not just the American River Basin and operation of the Folsom Reservoir. Another issue raised in this context was that a decision support tool needs to address more than just QPF and QPE; operational decisions for water management have a complicated set of cost-benefit trade-offs with societal impacts.

Another related area of discussion revolved around the question of how long it will take to achieve the objectives of HMT-West. Tim Schneider showed a HMT timeline that indicated HMT-West activity peaking in 2008-2009, then decreasing about 50% for the next several years as part of the legacy transition. While the HMT-West legacy is occurring, activities associated with HMT-East will be ramping up. There was serious concern about the realism of achieving HMT-West success with just two more intensive winter seasons of activity. Serious concerns were also expressed about moving to HMT-East before successfully completing HMT-West; in such a scenario, the credibility of the HMT project could be called into question. There was a question about why we need to stop activity in certain regions (like HMT-West), when there will be a need for continued improvements in capability. There was also an observation that we still seem to be in an exploratory phase of HMT-West rather than the desired demonstration phase. The need for a strong follow-up effort following HMT field operations to complete research and, equally importantly, implement research into NWS operations was expressed.

Tim Schneider then proceeded to discuss the need for a change in the HMT management structure. At present, the HMT Advisory Panel has a composition that has a primarily western perspective. In order for HMT to grow, the Advisory Panel needs to have a broader national perspective. However, it is critical to retain expertise at the regional level, both inside and outside of NOAA. To address this need, Tim proposed the development of Regional Implementation Teams composed of key NOAA organizational elements in a particular region as well as important partners from other government agencies (federal, state, regional, local) and Universities of the region. This proposal was viewed in a generally favorable manner. However, there were several comments and suggestions. For example, it was suggested that the Regional Implementation Team (RIT) should have representation from a broad region of the West, not just the Sacramento area. It was also suggested that there will likely need to be several RIT's, not just those for West, East and next as depicted in Tim's presentation. Another comment was that the chairs of the RIT's should be members of the Advisory Panel. Other comments about the Advisory Panel were that it should be interdisciplinary and be composed of multiple agencies (i.e., not just NOAA). There was some concern that the distinction in roles of the Advisory Panel and the RIT's needs to be better defined.

Overview of HMT-West and PSD Activities (Dave Kingsmill)

After a break, Dave Kingsmill presented an overview of HMT-West, with a focus on activities from the 2005-2006 and 2006-2007 cool seasons (Kingsmill_PSD_HMTAPmtg_Jun07.ppt.pdf). He described the time series of precipitation and streamflow in the North Fork American River Basin for the two seasons, the different Intensive Operating Periods (IOP's) that were executed and the details of the observing system deployment strategy for the two seasons and how they differed from one another. In a nutshell, HMT-West'06 featured more IOPs, which were

generally shorter in duration, whereas HMT-West'07 had fewer IOPs that were somewhat longer in duration.

Data from the biggest storm sampled during each of the seasons was presented (IOP4 for HMT-West 2006 and IOP5 for HMT-West 2007). Dave then outlined some HMT activities undertaken by ESRL/PSD over the past year. These include field deployment of observing systems, precipitation gauge inter-comparisons, gap-filling QPE analysis from the ESRL X-band polarimetric radar (XPOL), analysis of data from the PARSIVEL optical disdrometer and an analysis of integrated water vapor flux and its connection to heavy rainfall along the coast during landfalling atmospheric river events. Issues and questions raised included:

1. Concern was raised about the need for integrating the various datasets into a single precipitation analysis. GSD commented this could be done through data assimilation.
2. Ability to access data in real time through ALPS or AWIPS
3. Concern about the scan strategies for NWS radars: PSD and NSSL would like to use VCP12 to be consistent with their scan strategies. The Sacramento WFO needs to take steps to ensure that VCP12 is the default scan strategy employed by KDAX and KBBX during HMT-West IOPs.
4. A suggestion to have NWS staff participate in mid August PSD field deployments was made.

Afternoon session, Thursday 21 June

NSSL Activities (Dave Jorgensen)

Dave Jorgensen started the afternoon by providing an overview of HMT activities at NSSL (Jorgensen_NSSL_HMTAPmtg_Jun07.ppt.pdf). The focus of the presentation was on their efforts in radar QPE and on application of a hydrologic model (CSU TREX) for QPE validation. In their detailed examination of HMT-West 2006 IOP7, it was clear that the operational radar (KDAX) QPE was lower than that from gauges in the basin. QPE from the NSSL SMART-R gap-filling radar matched the gauges reasonably well in terms of total accumulation at the end of the event. However, individual peaks in precipitation rate during the event did not match up very well. Input of radar QPE (both KDAX and SMART-R) to the hydrologic model produced a wide range of streamflow results. However, it was concluded that the KDAX QPE does not produce nearly enough streamflow compared to observations. The presentation motivated several comments. There was concern about NSSL's use of a simple interpolation scheme for gauge data in their calculation of basin average precipitation; such an approach does not account for the complex terrain intrinsic to the area. Concern was also expressed about the approaches and assumption employed in the hydrologic modeling and about the application of QPE validation with such a technique. A suggestion to use the operational RFC QPE analysis in any comparison of QPE tools was made. Finally, several individuals expressed the importance of integrating all QPE information (gauges, operational radar, gap-filling radar, satellite) into a single analysis tool such as the NSSL Q2 or OHD MPE or EMPE.

GSD Activities (Paul Schultz)

Next, Paul Schultz presented an overview of HMT activities at ESRL/GSD during the past year (Schultz_GSD_HMTAPmtg_Jun07.ppt.pdf). His presentation focused on their development of

ensemble modeling techniques, validation of QPF using techniques and code borrowed from the National Precipitation Verification Unit (NPVU) and the deployment of ALPS workstations to the Monterey, Sacramento and Reno field offices for display of special HMT-West datasets and high-resolution model output. Paul mentioned that the impacts of the microphysical differences in the various ensemble members were starting to become apparent. For example, it is becoming clear that accurately simulating shallow, warm-rain processes will be critical for better QPF. Paul also alluded to the fact that GSD is creating a user-adjustable time window NPVU web interface for comparison of various model forecasts; several meeting participants expressed great interest in such a tool. A suggestion was made to display verification statistics spatially on a gridded basis. At present, GSD is verifying their QPF against the Stage IV precipitation analysis. There was uncertainty expressed by Paul and several meeting participants about the composition of the Stage IV analyses; some thought it was a combined gauge and radar (WSR-88D) analysis while others thought it was a gauge-only analysis modified by the Mountain Mapper tool. The importance of improved QPE for model validation was emphasized by Paul and several other meeting participants. In his comments about the ALPS workstations, Paul outlined their designed capabilities but freely admitted that they need to get much faster. Several meeting participants noted that the load time for high-resolution model output was usually so prohibitive that most forecasters did not attempt to look at these products. The problem appears to be a bandwidth issue in the field offices; various solutions are being considered for activities during the upcoming field season. GSD efforts in QPF have been focused on the 0-24 h time frame; there was curiosity among meeting participants about QPF activities focused on longer time scales. Paul mentioned that the Hamill/Whitaker re-forecast approach to probabilistic QPF might be a better pathway to follow for forecast times longer than 24 h. The Hamill/Whitaker approach is being used by the NWS/OHD/CNRFRC ensemble work. It was suggested the developers for the GSD and OHD ensembles should work together.

OHD Activities and DMIP-2 (Mike Smith)

Mike Smith then provided an overview of HMT-oriented activities at OHD (Smith_OHD_HMTAPmtg_Jun07.ppt.pdf). The focus of his presentation was on the Distributed Hydrologic Model Intercomparison Project (DMIP). One of the objectives of DMIP is to evaluate the differences between lumped and distributed models and under what scenarios distributed models can provide superior guidance compared to lump models. The first phase of DMIP was focus on basins in Oklahoma while the current second phase of the project (DMIP-2) also has a focus on basins in the west, one of which is the North Fork American River Basin that is central to HMT-West. Mike mentioned that errors in input data may mask the benefit of higher resolution hydrologic models. Therefore, there was a desire to make use of the enhanced HMT-West datasets in DMIP-2, particularly those datasets that can provide information about precipitation amount and type. DMIP-2 participants (fifteen for the western basins) will first perform hydrologic simulations using basic data inputs that are routinely available. Then, they will perform another series of simulations using an enhanced input dataset that makes use of HMT-West observations. Finally, Mike provided a sobering reminder of the difficulty and time consuming nature of research to operations transitions; it took three years after the conclusion of DMIP-1 to develop a revised hydrologic model based on the research performed during the project. When asked, Mike said the DMIP-2 project could be extended into FY09 should HMT-West be extended.

HMT-West Mesonet Augmentation (Art Henkel)

Next, Art Henkel discussed a draft plan for phase III of the HMT-West Mesonet Augmentation (Henkel_CNRFHMTAPmtg_Jun07.ppt.pdf). He emphasized that the current mesonet is doing a good job in sampling across and over the Sierra. The phase III plan is intended to fill a few gaps in precipitation gauge coverage and perhaps employ some new approaches to precipitation gauge data collection. Proposed new ETI gauge sites include locations used previously during the Sierra project, used currently by Placer County on the windward Sierra for snow surveys and used currently as SNOTEL sites in the lee of the Sierra. The logistical issues of siting instrumentation at these locations is unknown, but is suspected to be difficult, particularly from a site-use permission standpoint. Deploying instrumentation at the SNOTEL sites might be the most realistic given that other instrumentation already exists at those locations. Art also proposed a novel approach to rain gauge data collection that would target the warmest and wettest storms. The idea would be to deploy an array of 10-20 simple tipping bucket gauges at various locations throughout the North Fork American River Basin in advance of a warm, wet precipitation event and then extract the gauges after the event so that they are not buried by snow during subsequent cold events. This approach would certainly yield a very unique dataset. However, the logistical difficulty of executing such a plan would be prohibitive. A large number of people would be required on short notice to deploy and extract the gauges. Safety issues for staff executing these deployments would also be a serious concern.

WFO-Sacramento Perspective (John Juskie)

John Juskie then offered some brief thoughts about HMT-West from the perspective of the Sacramento WFO (Juskie_STOWFO_HMTAPmtg_Jun07.ppt.pdf). He re-iterated concerns about the relative slowness of the ALPS workstations and how this impacted use of the workstations by operational forecasters. John also mentioned that it would be desirable to have the high-resolution model output in a form that would allow it to be ingested into the Graphical Forecast Editor (GFE). He emphasized the importance of maintaining the profiler network and encouraged HMT-West researchers to keep WFO staff in the loop regarding new research advances. Other points that were raised during the ensuing discussion included:

1. Suggestion for doing a PQQF for 0.01” as this equates to the Probability of Precipitation the WFO forecasts operationally
2. A suggestion was made to run the GSD NWP at the WFO to cut down on communications problems
3. A suggestion was made to develop an atmospheric river climatology

Western Region Perspective (Kevin Werner)

Kevin Werner concluded the afternoon by providing some thoughts about HMT-West from the perspective of Western Region HQ (Werner_WRHQ_HMTAPmtg_Jun07.ppt.pdf). The most striking comment from his presentation was that NOAA still lacks a unifying and robust precipitation estimation process. Various candidate QPE tools exist such as Mountain Mapper (MM), Q2, MPE and EMPE. However, these tools are somewhat insular in nature; i.e., they have not been employed or tested much, if at all, outside of their originating organizations (WR RFCs for MM, NSSL for Q2 and OHD for MPE and EMPE). Other comments from his presentation included the importance of continuing with the “whole-mountain” concept, the benefit that could result if OHD occasionally participated in the daily coordination call during the project and the question of whether the NSSL hydrologic model should be part of DMIP-2.

Morning session, Friday 22 June

HPC Perspective (Mike Bodner)

The morning session started off with a few comments from Mike Bodner of HPC regarding their role in HMT-West. Mike showed several web-based products from HPC, such as confidence interval forecasts and NWP standardized anomaly analyses that may be of value to HMT applications.

Discussion (Tim Schneider)

Tim Schneider provided a brief recap of some key points from the previous day:

1. Can we afford to stay longer than 3 years in California?
2. Need to go from exploratory to demonstration of capabilities
3. Need for an integrated precipitation analysis
4. Need to better couple meteorology and hydrology in HMT-West

2007-08 Deployment Plans (Dave Kingsmill)

Dave Kingsmill then provided an overview of initial plans for observing system deployments for the upcoming field season, HMT-West 2008 (last 3 slides of Kingsmill_PSD_HMTAPmtg_Jun07.ppt.pdf). The proposed network is very similar to HMT-West 2007 with a few exceptions. The biggest difference is that the ESRL XPOL radar will be deployed at Blue Canyon, which will allow gap-filling radar QPE coverage over 95% of the NFARB. Plans for deployment of a gap-filling radar by NSSL are less clear. It is possible that they could deploy their own mobile X-band polarimetric radar that is currently under development. Alternatively, they could deploy one of the C-band SMART-R radars, especially if the X-band system has not been fully tested by early fall. The deployment location for the NSSL radar was discussed. There was not much excitement about deploying their radar at the Foresthill site used for the past two seasons. However, there was considerable interest in the possibility of deploying the NSSL radar in the lee of the Sierra, perhaps Truckee or somewhere in the Tahoe basin. There was also interest in placing a profiler at the crest. Dave explained some of the logistical constraints of that type of deployment (i.e., snow piling on top of the profiler antenna).

Some changes to the precipitation gauge network will be executed. A new “hot-plate” gauge will be available and the desire is to deploy this instrument at Norden (NDN). Due to extreme under-catch at the Duncan Peak (DCP) site, the desire is to redeploy the ETI gauge to the Huysink (HYS) snow pillow site operated by the USBR. Finally, to the extent possible, efforts will be undertaken to deploy new precipitation gauges associated with phase III of the HMT-West Mesonet Augmentation (as mentioned earlier, deployment at the SNOTEL sites listed in the plan may be the most realistic option). Changes to the snow depth and soil moisture sensors in the network will also occur. Snow depth sensors will be added at Big Bend (BBD), Onion Creek (OCR), Truckee (TRK) and probably also at Greek Store (GKS) and Hell Hole (HLH). Soil moisture sensors will be added at HYS, OCR, and Sugar Pine (SGP) and probably at GKS and HLH. Finally, Jessica Lundquist will be deploying an array of 80-100 micro temperature sensors throughout the NFARB. These sensors will be deployed along transects that parallel I-

80 and the Foresthill Divide road as well as a few transects at various elevations that extend from the river up to a transverse ridge crest.

Other points raised in the discussion included:

1. Balloon strategy – Supplemental soundings should be used to target atmospheric river events rather than other types of events.
2. Oakland supplementals – NWS will provide a status update on the ability to do supplemental soundings from Oakland in the 2007-08 season
3. Mesonet Phase 3 – There was a general consensus to go with the Placer County “group B” sites from Henkel’s presentation but to continue investigating the “group A” sites. There is a need to survey all the sites before making a final decision.
4. There were differing opinions on the importance of telemetering gage and radar data in real time; some thought it will be essential while others think it would simply be “nice to have” for the 2007-08 deployment.
5. GSD reported their 2007-08 plans include:
 - a. Keeping their NWP suite from last season stable
 - b. Increase visitations to CNRFC and WFOs
 - c. Providing a concise summary of modeling activities to other HMT participants

Break-Out groups

After a short break, Tim Schneider made some introductory remarks about the rationale for the break-out sessions. They will help finalize the QPF white paper and begin the process of outlining the QPE, Hydrology and HMT-West Legacy white papers. Meeting participants then went to separate rooms to engage in discussions about the different breakout topics. These discussions continued into the early afternoon. Due to the lack of a critical mass, the Hydrology break-out was not executed. However, Mike Smith agreed to outline the white paper for hydrology and submit for feedback.

Afternoon session, Friday 22 June

Meeting participants re-assembled in plenary to hear summaries of the break-out sessions and engage in relevant discussion.

HMT Legacy (Dave Reynolds)

Dave Reynolds summarized the discussions from the HMT-West legacy break-out session. A focus of these discussions was on concepts of transitioning research to operations and on the development of decision support tools. Transferability to other western basins was expressed as a key concern as we move forward. One of the biggest issues for the HMT-West domain is the lee-side spillover problem; addressing this issue would be a good legacy for HMT-West. Rain - snow level was identified as a critical observation for HMT-West. Break-out participants emphasized the need for improved verification of the profiler-based snow level measurement. Specifically, it was suggested that verification of surface hydrometeor type at different levels was needed. Direct visual validation by driving up and down I-80 was suggested as one way to accomplish this type of validation and the group felt a single transect of the barrier (e.g. I-80) would be sufficient. Another suggestion was to employ optical disdrometers at different elevations of the windward Sierra slope to infer precipitation type at the surface. Similar

concerns were expressed for verification of GPS IWV. Concern was also expressed at the difficulty for integrating with NWS operations through the NWS processes including OSIP.

QPE (Dave Jorgensen)

Dave Jorgensen then summarized the discussions from the QPE break-out session. He discussed the draft outline for the QPE white paper that was formed by the break-out participants. This outline contained sections that would explain the current status of several observational QPE approaches (i.e., gauges/MM, radar, satellite) and where progress was needed to make improvements. Other sections focused on tools needed to integrate the various observational QPE approaches; candidates were the NSSL Q2 and OHD MPE and EMPE packages. Integration of QPF into the QPE problem was also suggested, as it represents another unique piece of information that could be part of a QPE ensemble. Confusion existed within the break-out group and the larger group about stage IV: is it the RFC MM analysis or something different? A link between QPE and a GSD data assimilation project led by John McGinley was suggested. A need for WFO level software to correct radar biases (e.g. from KPIX) with gage data in real time was expressed.

QPF (Paul Schultz)

Paul Schultz then summarized the discussions from the QPF break-out session. Given that extensive work had already been accomplished with the QPF white paper, there was not a lot to discuss. The biggest unresolved issue appears to be better defining realistic performance measures for QPF.

Wrap up (Tim Schneider)

Tim Schneider closed the meeting by mentioning the need to develop a charter for HMT that includes objective and science goals. He also mentioned that the desire to convene the Advisory Panel meeting earlier next year, perhaps in April. It was suggested that plans should be made in fall 2007 to accomplish this.