

# Numerical Simulations of Snowpack Augmentation for Drought Mitigation Studies in the Colorado Rocky Mountains

## Financial Assistance Agreement No. 03-FC-81-0925

### Summary for the Colorado WDMP Midterm Project Review Meeting Hosted by Colorado State University, Depart. of Atmospheric Science CSU ACRC – Riehl Conference Room February 19, 2004 @ 10:30 AM MST

**Purpose for meeting:** The Financial Assistance Agreement between the U.S. Bureau of Reclamation (Reclamation) and the Colorado Water Conservation Board (CWCB) required that a midterm project review meeting be held approximately three to six months after the initiation of the project. Communication with Dave Matthews, the Reclamation GCAOR for this project, indicated that they would like to hold this meeting early during the project while the field cloud seeding operations were still in progress. At this meeting the Project Research Team updated Reclamation on the project and the preliminary results (if any) of each work item. Future plans for each work item, especially for the 2<sup>nd</sup> quarter of the project, were also presented. This review provided face-to-face interaction between Colorado WDMP project participants and opportunity to ensure the project is on target. The discussions included a review of problems that may have impacted the ability to complete the work items on the schedule proposed, and what was done to overcome such problems. **The meeting agenda closely followed the project's First Quarter Progress Report (dated January 31, 2004)**, but allowed for interaction between Reclamation and the Project Research Team during the presentations.

### Meeting Summary

#### Attendees round-the-table introductions (name, organization, role in project)

Name	Organization	Phone	E-mail
Joe Busto	CWCB	(303) 866-4807	<a href="mailto:Joe.Busto@dwr.state.co.us">Joe.Busto@dwr.state.co.us</a>
Curt Hartzell	Consultant	(320) 222-8780	<a href="mailto:curtjoan@en-tel.net">curtjoan@en-tel.net</a>
Ross Williams	Consultant	(719) 473-7333	<a href="mailto:rawscoe@adelphia.net">rawscoe@adelphia.net</a>
Steve Schmitzer	Denver Water	(303) 628-6525	<a href="mailto:Steve.Schmitzer@denverwater.org">Steve.Schmitzer@denverwater.org</a>
Greg Bryant	Denver Water		<a href="mailto:Greg.Bryant@denverwater.org">Greg.Bryant@denverwater.org</a>
Larry Hjermstad	Western Weather C.	(970) 247-8813	<a href="mailto:westernweather@sprynet.com">westernweather@sprynet.com</a>
William Cotton	Colorado State U.	(970) 491-8593	<a href="mailto:cotton@atmos.colostate.edu">cotton@atmos.colostate.edu</a>
Brenda	Colorado State U.	(970) 491-	<a href="mailto:brenda@atmos.colostate.edu">brenda@atmos.colostate.edu</a>

Thompson		8593	
Ray McAnelly	Colorado State U.	(970) 491-8341	<a href="mailto:raymc@atmos.colostate.edu">raymc@atmos.colostate.edu</a>
Gustavo Carrió	Colorado State U.	(970) 491-8508	<a href="mailto:carrio@atmos.colostate.edu">carrio@atmos.colostate.edu</a>
Paul Mielke	Colorado State U.	(970) 484-3374	<a href="mailto:rrmielke@aol.com">rrmielke@aol.com</a>
Dave Matthews	USBR	(303) 445-2470	<a href="mailto:dmatthews@do.usbr.gov">dmatthews@do.usbr.gov</a>
Jon Medina	USBR		<a href="mailto:jmedina@do.usbr.gov">jmedina@do.usbr.gov</a>
Steve Hunter	USBR		<a href="mailto:smhunter@do.usbr.gov">smhunter@do.usbr.gov</a>

### **Reclamation review of WDMP and objectives for meeting – Dave Matthews**

Dave gave the Power Point presentation on weather modification that he gave earlier to Reclamation’s Science & Technology Group. The presentation included drought-year snow water equivalent table/graph, winter-season drought seeding potential (Colorado is fairly good), the need for transport and diffusion studies, and the National Academy of Science, Board of Atmospheric Sciences’ report. Dave stated that the main purpose for the review meeting was to look at the project’s technology and where it was going.

### **Overview of Project Status**

#### **Comments by Joe Busto – Colorado WDMP Project Manager**

**Problem: late start of CWCB – CSU contract**

(Reference First Quarter Technical Progress Report.)

#### **Comments by Curt Hartzell – Project Assistant Manager, Coordinator and Overseer of project activities**

#### **Denver Water’s and the Central Rockies Cloud Seeding Programs – Steve Schmitzer – Status of Denver Water’s operational programs**

Steve stated that Denver Water needs to know **what** information they will be getting out of this research project and **when** they will get this information. The group discussed these important questions. This research project will not provide a definitive evaluation of the Denver Water operational program’s seeding effects. RAMS is simulating cloud seeding and, therefore, will provide indications for seeding effects and the types of favorable meteorological conditions. The research project’s final report is not due until December 2004, but preliminary findings from project studies will be made available as early as possible.

#### **Larry Hjernstad – Status of cloud seeding activities**

October 2003 was dry, so the 2003-2004 water year got off to a slow start. Starting around 1 November 2003 (the start of cloud seeding operations) and continuing through 10 February 2004 (the end of the main cloud seeding period), precipitation in the Denver Water project's target area was thought to be close to normal. During this period, WWC used a heavier seed rate (about 50%) than had been used the previous winter.

**To do item:** Larry stated that he had a few (4-6) digital pictures of seeding generator sites that he would make available for inclusions in project reports.

### **Research Project Performance and Status by Task**

#### **Comments by Bill Cotton – PI for CSU research activities**

**Task 1 – *Set up RAMS over the Denver Water Department operational cloud seeding areas and over the locations of the ground-based generators.***

#### **CSU Deliverable 1 – Ray McAnelly**

(Reference First Quarter Technical Progress Report.)

#### **RAMS grid incorporated into GIS and GIS Updates – Ross Williams**

(Reference First Quarter Technical Progress Report.)

#### **Renaming of Generator Sites – Joe Busto (or Greg Bryant)**

(Reference First Quarter Technical Progress Report.)

**To do item:** Greg Bryant said that he would email the EXCEL spreadsheet containing the final list of generator sites to the project team and Reclamation.

#### **Using the Generator Site Excel spreadsheet for seeding reports - Larry Hjermstad**

Starting in January 2004, the WWC seeding reports are being put into the new format.

**To do item:** Larry will put the seeding reports for November and December 2003 into the new format so that all of the WWC's 2003-2004 operational seeding reports will be in the new Excel spreadsheet format.

**Task 2 – *Implement algorithms simulating cloud seeding generators as sources of IFN at specified ground-based sites.***

#### **CSU Deliverable 2 – Gustavo Carrio**

#### **Preliminary 3D RAMS test case from February 4-5, 2003 - Ray McAnelly**

(Reference First Quarter Technical Progress Report.) Initial runs were made with RAMS that contained a temperature problem.

**To do item:** Ray and Gustavo will complete the test case before doing the model seeding runs for this season.

**Task 3 - *Perform simulations of Lagrangian transport of seeding materials on selected days covering a range of wind and stability regimes.***

**CSU Deliverable 3.1 – Ray McAnelly**  
(Reference First Quarter Technical Progress Report.)

**Identification of all precipitation observation sites - Ray McAnelly and Larry Hjernstad** (Reference First Quarter Technical Progress Report.)

**CSU Deliverable 3.2 - Ray McAnelly (with input from Larry Hjernstad)**  
The selection of various meteorological regimes are needed for transport and diffusion case studies to determine if seeding nuclei are getting into the clouds.

**CSU Deliverable 3.3 – Ray McAnelly**

**Langranian Analyses – Ray McAnelly**  
(Reference First Quarter Technical Progress Report.)

**Task 4 – *Perform forecasts for seeded and non-seeded days.***

**CSU Deliverable 4.1 - Ray McAnelly**  
(Reference First Quarter Technical Progress Report.) The new computer cluster was up and running as of 18 February 2004.

**CSU Deliverable 4.2 - Ray McAnelly**  
(Reference First Quarter Technical Progress Report.) Reruns need to do 32 hours/day (8-hr startup and 24-hr day)

**CSU Deliverable 4.3 - Ray McAnelly**  
(Reference First Quarter Technical Progress Report.)

**CSU Deliverable 4.4 – Ray McAnelly**  
(Reference First Quarter Technical Progress Report.)

**Real-time model runs – Ray McAnelly and Larry Hjernstad**  
(Reference First Quarter Technical Progress Report.)

**WWC’s Use of RAMS Model Output to Refine Forecasts – Larry Hjernstad**  
(Reference First Quarter Technical Progress Report.)

**Problems identified in RAMS Real-time Forecast Model - Ray McAnelly and Bill Cotton** (Reference First Quarter Technical Progress Report.)

**Task 5 – *Perform evaluations of model predictions of precipitation using MRBP.***

**CSU Deliverable 5.1 – Gustavo Carrio and Paul Mielke**  
(Reference First Quarter Technical Progress Report.)

**CSU Deliverable 5.2 – Gustavo Carrio and Paul Mielke**

**Task 6 – *Research study supervision and reports.***

**Deliverable 6.1 – Curt Hartzell (1<sup>st</sup> progress report, completed January 31, 2004)**

Dave Matthews and Jon Medina from Reclamation said that the format and content of the first progress report were good.

**Midterm meeting with Reclamation – Everyone (completed February 19, 2004)**

**Deliverables 6.2 – Curt Hartzell (2<sup>nd</sup> progress report, due April 30, 2004)**

The next project conference call was planned for the second week in April 2004. (This call is currently scheduled for Wednesday, 14 April starting at 9:30 AM Mountain Time.)

**Deliverables 6.3 – Curt Hartzell (3<sup>rd</sup> progress report, due July 31, 2004)**

**Evaluation by Seeding Contractor – Larry Hjermstad**

**Deliverables 6.4 – Curt Hartzell (draft Final Report, due October 31, 2004)**

**Meeting with Reclamation to present overall progress and findings from research study, and to review the draft Final Report – Curt Hartzell (early November 2004?)**

**Deliverables 6.5 – Curt Hartzell (Final Report, due December 31, 2004)**

**Closing Discussions - Everyone**