

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

Summary of 3<sup>rd</sup> Project Meeting (conference call)  
Hosted by the CWCB  
January 14, 2004

## List of attendees:

<b>Name</b>	<b>Agency</b>	<b>phone</b>	<b>email</b>
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Dave Matthews	USBR	303-445-2470	<a href="mailto:dmatthews@do.usbr.gov">dmatthews@do.usbr.gov</a>

## Project members unavailable to participate in conference call

Paul Mielke, CSU; Steve Schmitzer, Denver Water; Ross Williams, Consultant

## Project Agreement Payments

Check for 1<sup>st</sup> CSU invoice was received. Brenda stated that the check was made out incorrectly and asked Joe to make a change for future payments, which he said he would do. Brenda was told that CSU could submit invoice #2, which they subsequently did on January 16, 2004. Curt approved this invoice via email on January 19, 2004. Joe asked Curt to submit his 1<sup>st</sup> invoice, which he subsequently did on January 19, 2004.

## Clarification and Action Items by Task

**Reference summary document for the December 16, 2003 conference call – the red text in this referenced document relates to discussions during the January 14<sup>th</sup> conference call.**

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

**Renaming of Generator sites** - Ross Williams, Greg Bryant (Denver Water GIS Coordinator) and Joe Busto worked with Larry Hjermstad to rename generator sites from initials of the operators to a numbering system. This will be official for Denver Water (DW) and their numbers scheme should be built into the studies GIS and graphics.

**New Action Item:** The DW and CSU websites should link to the official list of generator sites.

**Action item 1.1** – Larry was to review the generator site IDs and status on the new DW Excel spreadsheet. Larry subsequently finalized the generator site list with DW to standardize the site ID usage. The spreadsheet was emailed to members of the team on January 18, 2004.

There was discussion about adding columns to the spreadsheet for WWC seeding reports. Larry suggested using one spreadsheet per storm to reduce confusion. These “storm report” spreadsheets would be combined into a summary spreadsheet at the end of the operational program.

**New Action Item:** Joe should coordinate with Larry and Greg Bryant (DW) to finalize the spreadsheet columns for reporting seeding operations by storm and winter season.

**Identification of all precipitation observation sites** - Ray and Larry will collaborate on the development of the list of precipitation observation sites within and around the research project area needed for evaluation studies.

**Action item 1.2** – Ray stated that he was still working on preparing a list of precipitation observation sites that he has. Larry should provide Ray with a list of the observation sites he uses in evaluations of seeding effectiveness.

**New Action Item:** When Ray completes the list of precipitation observation sites, he should post the list on CSU’s project website and notify the project team via email that the list was posted.

**Action item 1.3** - Larry stated that he was still waiting for a reply from Knox Williams at the Colorado Avalanche Information Center (CAIC) on Ski Area Data that could possibly be used in our study. On January 19, 2004 Larry sent the following to Ray with Cc to some team members (note: all team members should be Cc’d in such emails):

“We are making some progress on the Ski Area Data we want to include in the Study. Knox got back to me this morning and we decided on the following Ski areas as having the best quality and most reliable observations:

- Vail
- Beaver Creek
- Breckenridge
- A-Basin
- Winter Park
- Monarch
- Aspen Mountain
- Snowmass
- Steamboat

The CAIC did not have the GPS locations of any of these data sites. I spent part of this afternoon contacting each of them and I think all of them are interested in providing the GPS information to be included in the study. I will start getting this information tomorrow and hope to have all of it by week’s end.”

**New Action Item:** Larry should get GPS locations for the above list of Ski Area precipitation observation sites and email to Ray with Cc to all team members.

**Action item 1.4** – The project studies will require data from SNOTEL, Snowcourse, NWS climate and cooperative sites, and State CoCoRaHS sites. We need to make sure we don't have too much data on the map. Ray said that he would make a separate map for each type of data, plus a comprehensive observation site map – Larry suggested using symbols for the different types of data.

**New Action Item:** Ray needs to complete these maps, which he said he would do before the end of January 2004. These maps should be available from the CSU project website.

**RAMS grid incorporated into GIS** – The DW and the research project will use the target-area polygon developed by Ross.

**Action item 1.5** - In an email from Ross to Curt/Joe dated January 10, 2004, Ross stated that he still has the following needs:

*“1) The correct locations in latitude / longitude of the cloud seeding generators being used only in this study, and as updated through coordination between Larry and Greg Bryant of the Denver Water Board. There appears to be some miscommunication between groups, as my generator sites do not match those I believe are being used solely for this study.*

It was noted in the conference call that the new Excel spreadsheet would be the official list.

*2) The correct locations in latitude / longitude of the SNOTEL and snow course sites being used in this study. Joe had asked me to do some looking for these sites, but a busy school and work schedule has kept me from this. I ask that this information come from the person in this study who is responsible for collecting the SNOTEL and snow course data. That person should have a comprehensive list of these sites.*

Ray said that he can provide this information, and it's probably also available at DW (Greg Bryant). After the conference call, in an email dated January 20, 2004, Greg provided an Excel file listing the data points for SNOTEL and Snowcourse sites in Colorado.

*3) If they are being utilized in the study, the correct locations in latitude / longitude of any NWS cooperative stations (like Leadville, Hartsel, Dillon, etc) being used for extra data collection. I have EarthInfo NCDC station data if only the names of the stations can be provided - I can find the rest.*

If necessary, Ray will select and provide to Ross.

*4) Ray, at CSU, sent me the corner coordinates of the final RAMS grid being used for final results in this study. I have tried to convert these coordinates into a replica of the RAMS grid, but the results are less than satisfactory. I need to talk one-on-one with Ray to let him know just what it is I need in order for the GIS replica to look right. There appears to be some miscommunication between us as to just what it is that I need.*

Ray needs to talk with Ross.

**New Action Item:** Ray will contact Ross and discuss the concerns stated by Ross in his email.

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

Gustavo and Ray were going to do a test run of RAMS, viz. the 3-d case from February 4, 2003, but they were uncertain about what generator locations should be used. Larry will communicate with Ray and provide needed clarifications.

**Action item 2.1** – At the time of the conference call, this was still to be completed. Ray said that they had used 9 sites for an initial 1-hr period test run of RAMS. Larry subsequently sent Ray an email dated January 18, 2004 that responded to the questions in Ray's original email dated December 16, 2003.

**New Action Item:** Ray and Gustavo need to complete this test run of RAMS.

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

**Action item 3.1** – The CSU project website that will archive all data and model runs for the project is under development. Any meteorological or created information for the weather or for seeding will be archived there. After the conference call, Brenda emailed the CSU Website link to the team, viz. <http://rams.atmos.colostate.edu/clseeding/>. The CSU team noted that this website would continue to be a work in progress.

**New Action Item:** Larry will put together a list of all observation sites he uses and give to Ray.

**New Action Item:** Ray will continue to work on the development of the CSU project website.

**Action item 3.2** – Quality-controlled NRCS SNOTEL and Snowcourse data need to be collected and archived.

**New Action Item:** Ray will implement procedure to download selected quality-controlled SNOTEL and Snowcourse data from the NRCS website and add to the CSU project website.

**Langranian Analyses** – This task involves selecting meteorological regimes that impact the transport and dispersion of seeding material, and identifying case study days that represent those regimes. The analyses will be for selected days and selected generator sites for various observed wind and stability regimes during operational cloud seeding periods.

**Action item 3.3** – There was some discussion on a couple a couple of possible storms to use in this analysis, but the actual selection of different meteorological regimes has not started as yet.

**New Action Item:** Larry and Ray should start identifying the meteorological regimes and picking out case study days for possible use in the study.

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

**Real time runs** – Larry asked Ray if CSU could keep old model output information available on the CSU project website until the new run data are posted. In a subsequent email dated January 19, 2004, Ray responded to this request with the following:

“Starting tonight, the forecast products from the previous night's run will still be on the website through the current run, until the current run reaches each successive 2h forecast period, produces the new products, and overwrites the older products.

I'm trying to get a message like: "Current forecast complete through 34h", to be updated as each set of 2h products are completed. Not sure that will be working tonight, so a look at the "Initialized" date/time label above the maps is the sure way to tell the new vs. old products.”

**Action item 4.1** - January 10 – around February 10, 2004 will be daily high-speed 00Z forecast runs on a real-time basis. It was agreed that a full month will still be a good test. Larry talked about the importance of model output on cloud bases and the lower portion of the clouds in WWC’s decision making. Dr. Cotton added that it’s useful to use the model’s vertical cross-sections.

**New Action Item:** Larry needs to make good daily notes during this period (Jan 10. – Feb. 10) of how he is using the RAMS data in WWC’s cloud seeding decision making.

**Action item 4.2** – Larry/WWC should provide a list containing all generator operation information to-date (dates, times, rates by site) to the CWCB, CSU and Curt/project coordinator. It is understood that these monthly lists could include some estimates due to generator operators not submitting their operations logs to WWC in a timely manner.

This action item is for Deliverable 4.3 in the CSU-CWCB contract. Due to the late signing of this contract, the target completion date for this deliverable was slipped one month to February 29, 2004.

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

**Action item 5.1** - Developing a comprehensive list of precipitation observation sites was talked about in Task 1. Once this list is completed, we should start working on this task.

**New Action Item:** During February and March, Gustavo, Ray, Paul, Larry and others should collaborate on the selection of precipitation observation sites - narrow the comprehensive list down to specific sites for use in this study. Deliverable 5.1 (due March 31<sup>st</sup>) for this task includes the updating of the MRBP analysis code with documentation for users, and the selection of about 30 days (a month) from the 2003-04 operational winter season to be used in this study.

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

**Quarterly Progress Reports** - The first quarterly technical progress report is due to Reclamation during early February 2004.

**Action item 6.1** - The CSU-CWCB contract requires a draft of this technical progress report to be prepared and submitted to Curt and Joe for review by January 31, 2004.

**New Action Item:** Curt should draft an outline for the technical progress report and email it to the project team no later than Friday, January 23, 2004.

**Action item 6.2** – Larry should draft text on how WWC has used the RAMS daily forecast runs in their operational cloud seeding decision making, and email to project team by January 23, 2004. Larry subsequently drafted “The Use of CSU/RAMS Model Outputs for Cloud Seeding Operations” and emailed the draft to team members on January 21, 2004.

**New Action Item:** Curt and CSU team members need to review Larry’s draft before the end of January 2004.

**Action item 6.3** – Ross should draft a summary on the GIS development, and email to project team. Due to a family emergency, Ross did not participate in the conference call. In order to complete this task, he needs to review this summary and talk to Ray about the needs he listed in his January 10, 2004 email.

**New Action Item:** Ross should draft text on the GSI development and email to project team by January 31, 2004.

**New Action Item:** After receiving the progress report outline, the CSU team should draft their portion of the report and email it to Curt and Joe by January 31<sup>st</sup>.

**New Action Item:** Curt and Joe will finalize the report, and then Joe will print the report at the CWCB and send it to the USBR. This should be completed before the mid-project meeting.

**Denver Water’s and the Central Rockies Cloud Seeding Program** - Vail ends on the January 10<sup>th</sup> middle park – Blue River, Williams fork ends 10<sup>th</sup> of February, south park area end the March 31<sup>st</sup>. Larry stated that depending upon the number of hours of seedable conditions between the conference call and February 10<sup>th</sup>, there could be some hours budgeted for the northern area remaining in the base fixed-price WWC contract with the DW program.

**Mid-project meeting at CSU** - The mid-project meeting is scheduled to be held at the CSU Atmospheric Sciences facility (Riehl Conference Room in new building) on Thursday, February 19, 2004, starting around 10:30 AM. Dave Matthews said that Jon Medina, Steve Hunter and himself from the USBR would likely attend.

**New Action Item:** Brenda suggested box lunches and will email out a menu for those who will attend the meeting to order from.

**New Action Item:** Brenda said that Power Point presentations could be accommodated, and if presenters sent their PP presentation to her early, she would have them loaded on Dr. Cotton’s laptop PC prior to the meeting. It was suggested that pictures (e.g. jpeg) of selected seeding generator, SNOTEL, and other precipitation observation sites would be beneficial. If anyone has or can get such pictures, perhaps they can email them to Ray who can add them to a presentation.