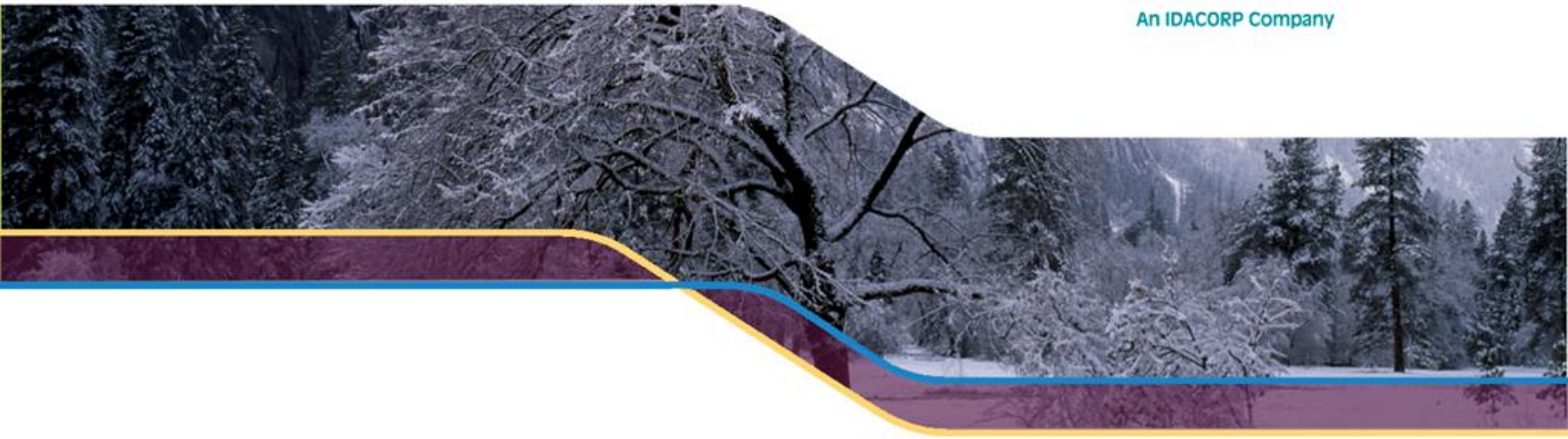


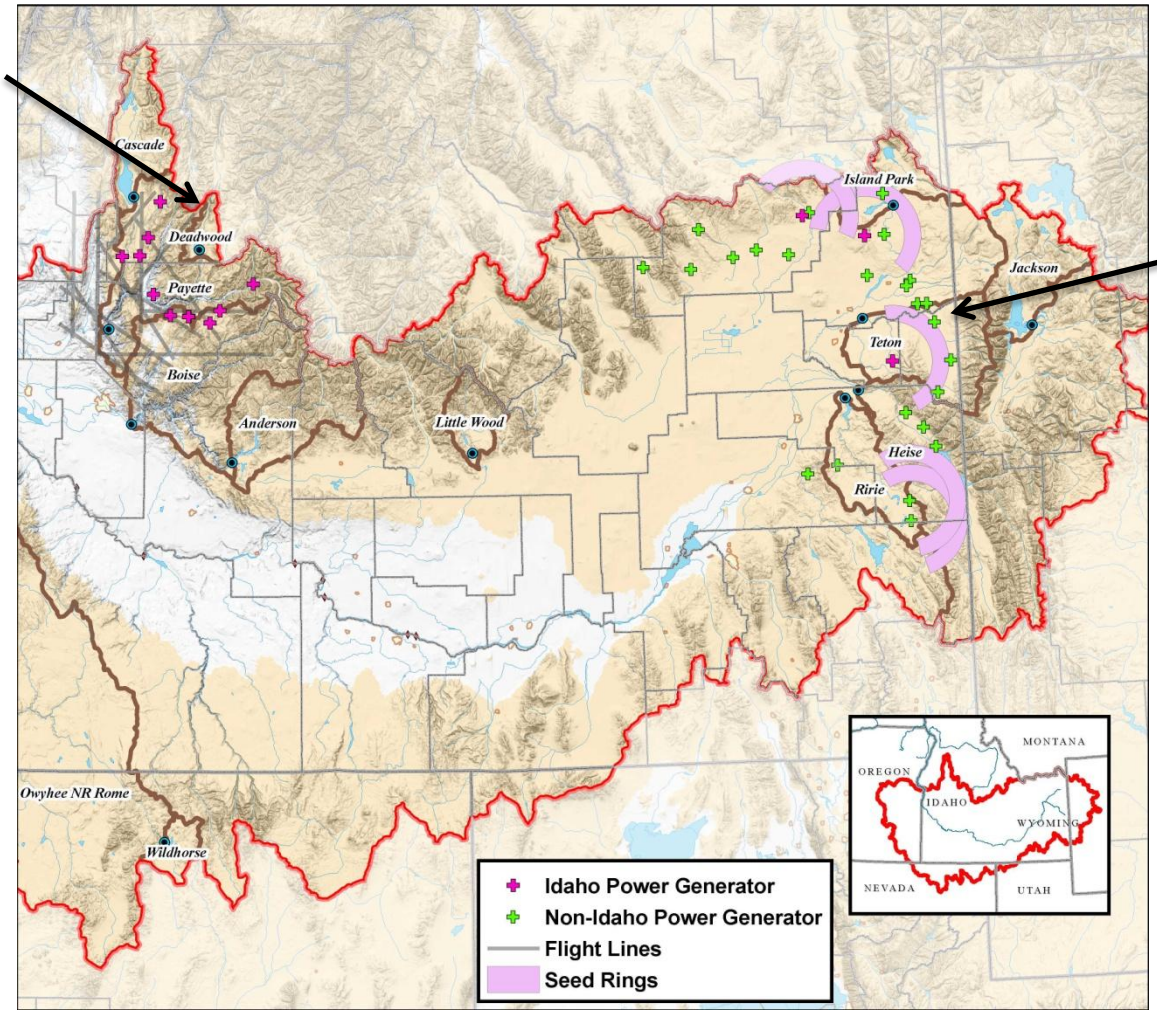
Idaho Power Company's 2009 Cloud Seeding Program Summary

Shaun Parkinson, Ph.D, P.E.

Engineering Leader

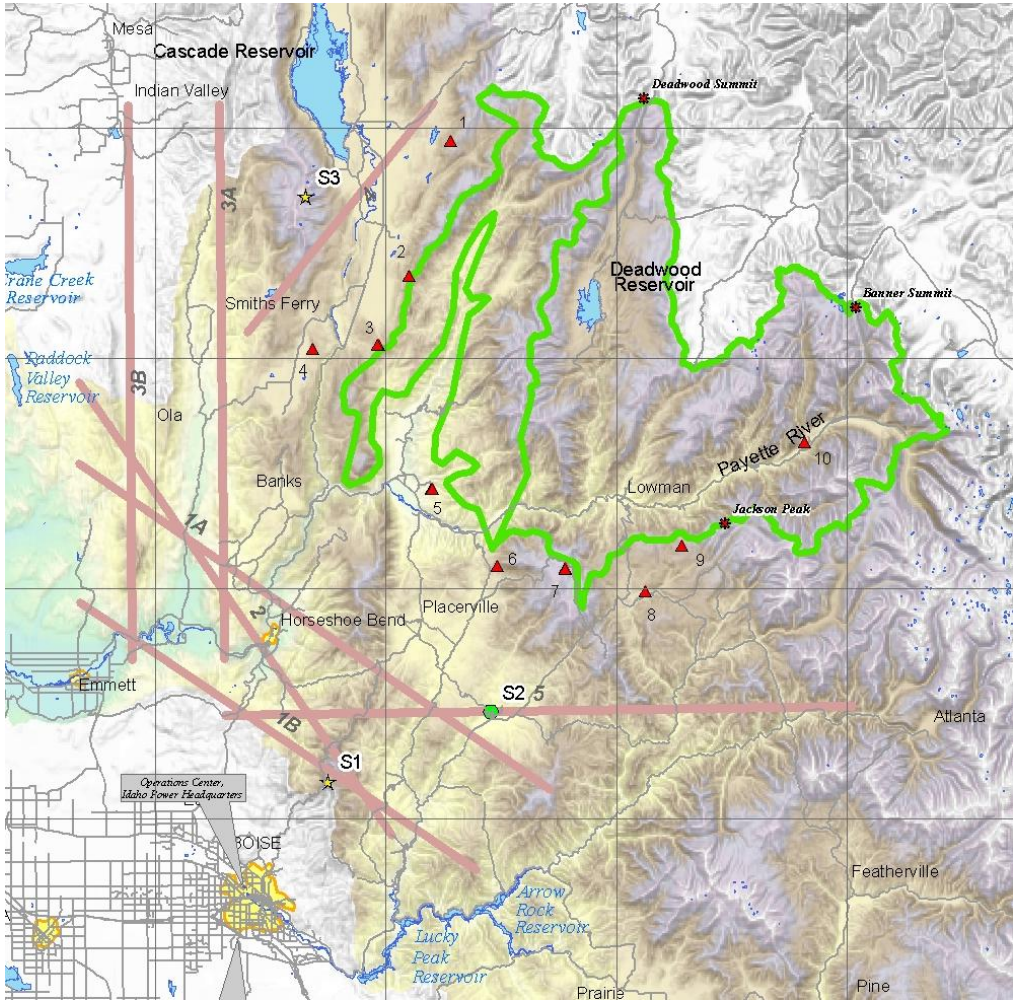
Idaho Power's Cloud Seeding Projects

Payette



Upper Snake
in cooperation with
E. Idaho - HCRC&D

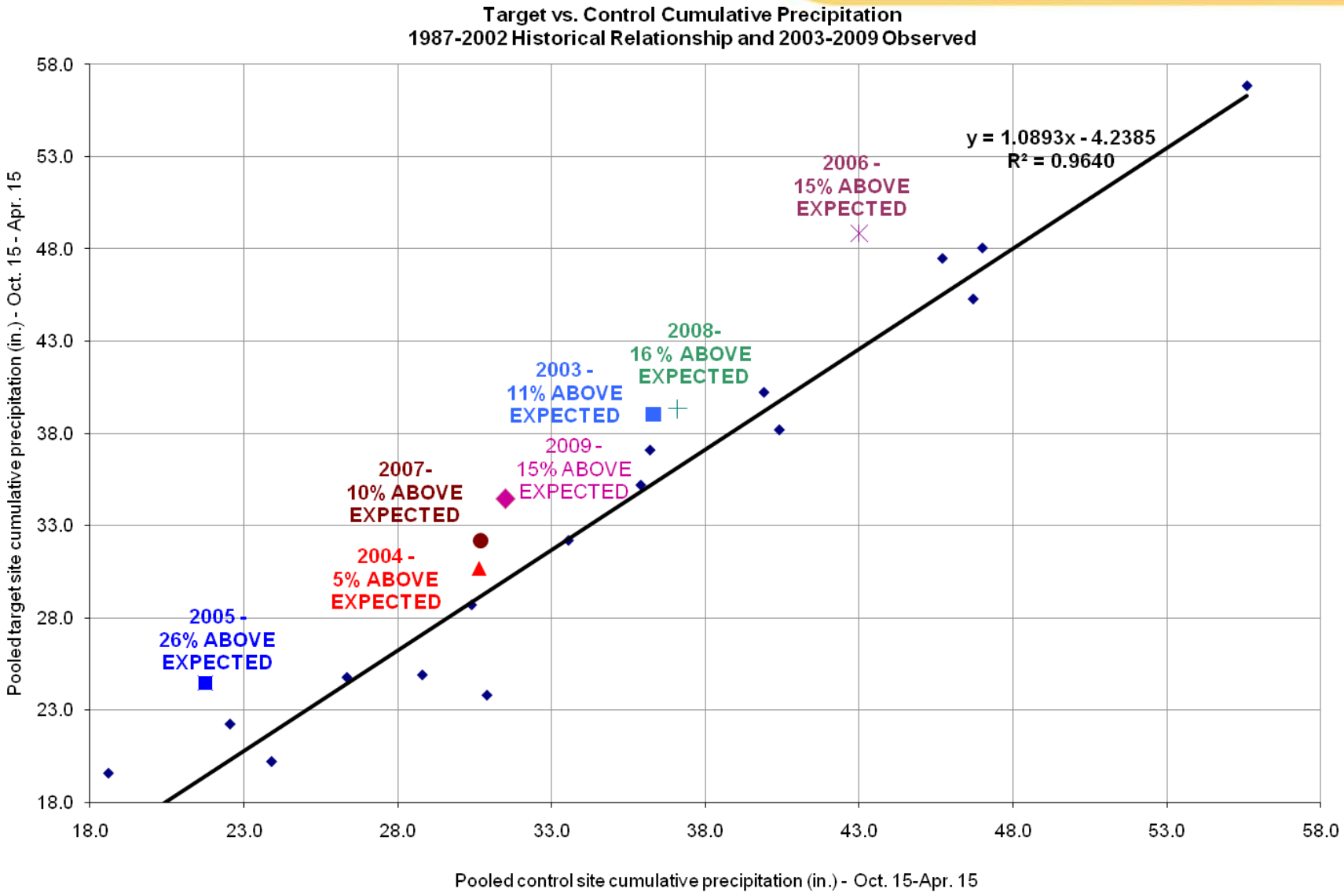
Payette Project
Airborne and Ground-based Seeding



- Seeding intended to enhance snowpack at the higher elevations above 4500’
- Target area ~ 938 sq. miles
- ~ 497 mi^2 above the 6000’ level

- 10 remote ground generators
  - private property
  - Working on SUP’s
- Aircraft –Beach King Air C90
- Combined approach provides more opportunities for addressing storms.

Payette Target Control



Payette
Operations Summary

Water Year	WY % Normal*	% TC** Benefit	Silver Iodide (grams)			Hours		Status
			Total	Air	Ground	Air	Ground	
2003	93%	16	33558	23270	10288	15.4	515	start-up (Feb-April)
2004	74%	5	21485	2803	18682	11.9	930	assessment
2005	65%	7***	27301	11122	16179	50.5	810	assessment
2006	136%	15	113173	97710	15463	48.5	768	operational
2007	56%	10	106082	76980	29102	51.3	1351	operational
2008	105%	16	61147	38740	22407	29.4	1123	operational
2009	107%****	15	50274	26110	24164	17.1	1208	operational

* Unregulated Payette Flow calculated at Horseshoe Bend

** TC = Target Control

*** DRI Trace chemistry average benefit

**** Estimated July 2009 runoff

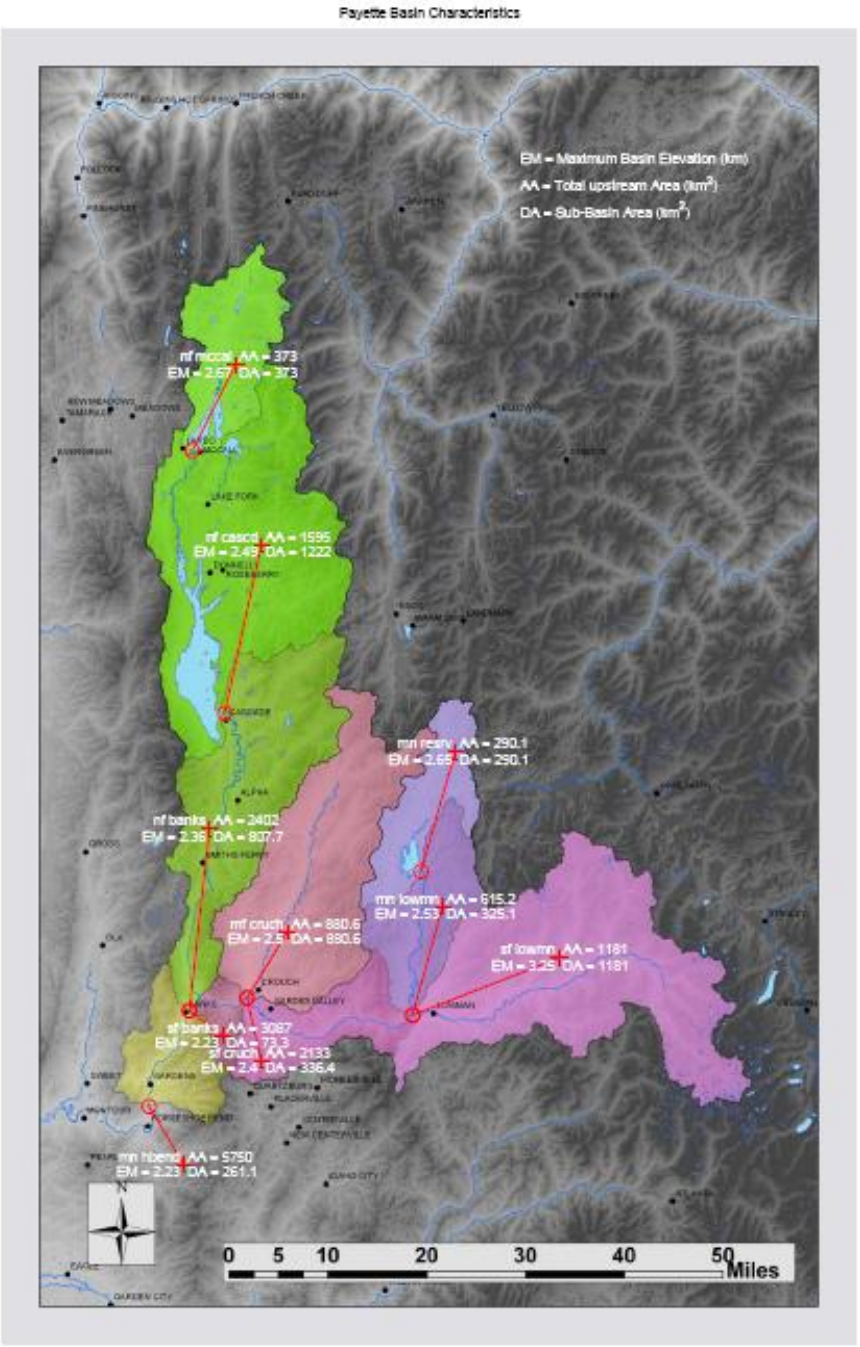
Payette Benefit Estimate

Benefits estimate using:

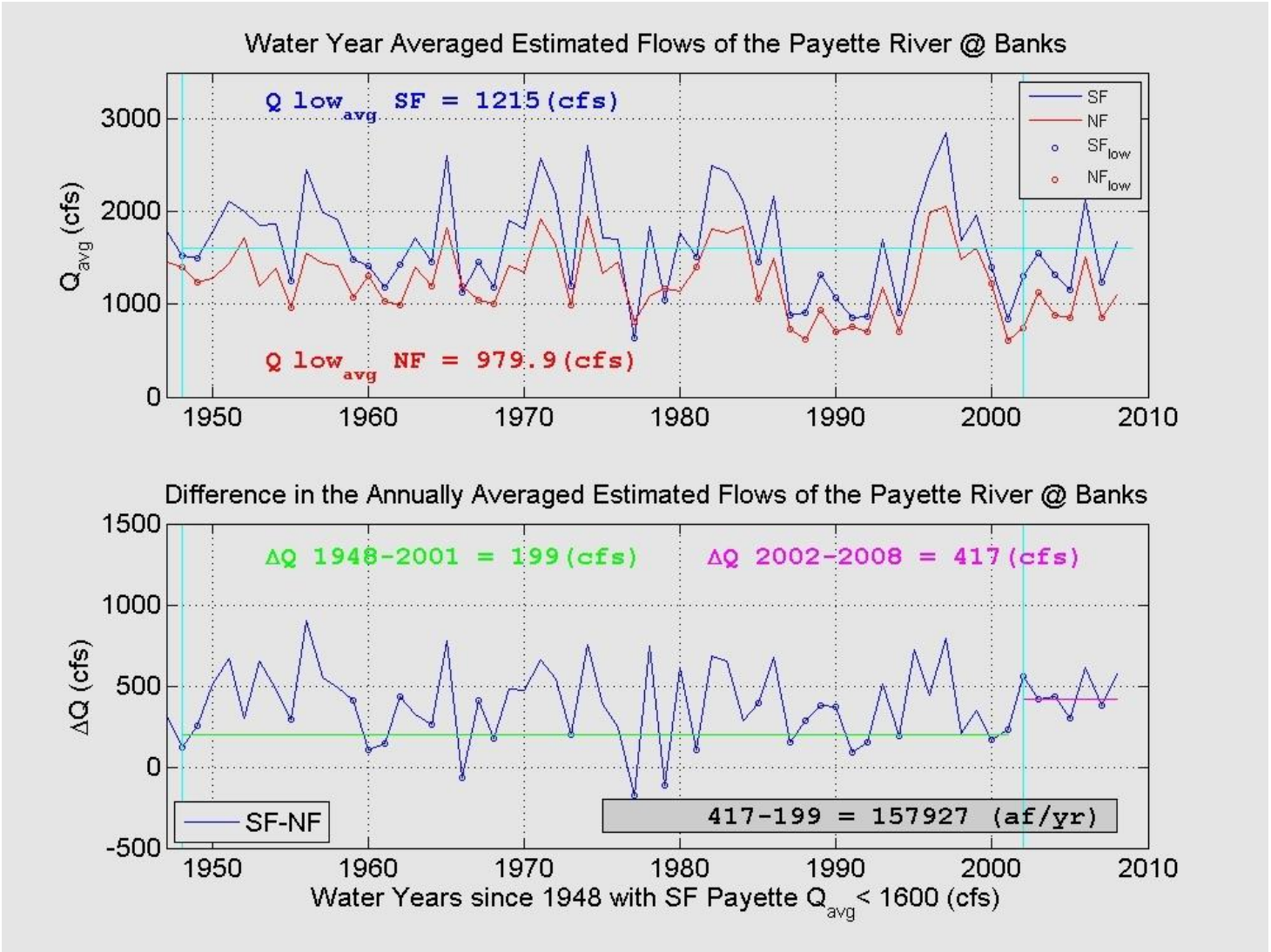
- USBR regression equation for Payette at Horseshoe Bend
  - Using current 2008 conditions (near normal)
- Precipitation increase of 10% from cloud seeding
- Results in approximately 120 KAF of additional Apr – Jul runoff

Estimated cost of additional water ≈ $6.5 / acre-foot

Payette Streamflow Analysis

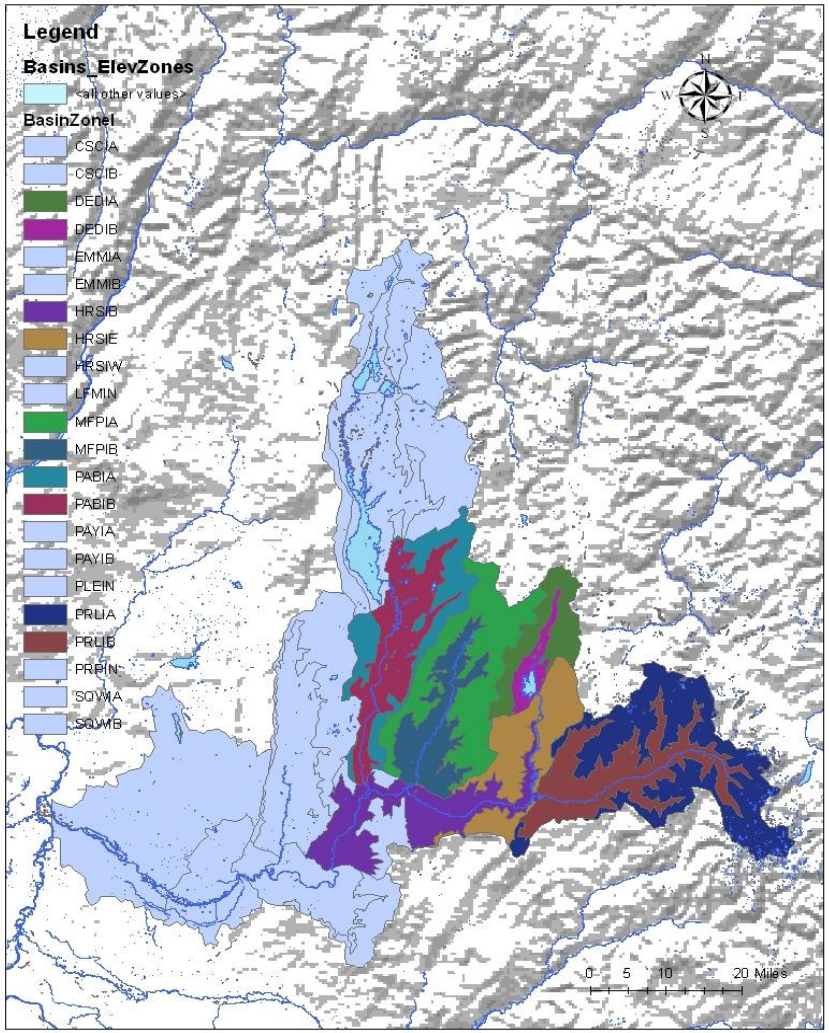


Payette Streamflow Analysis



Streamflow Modeling

NWS River Forecast Model



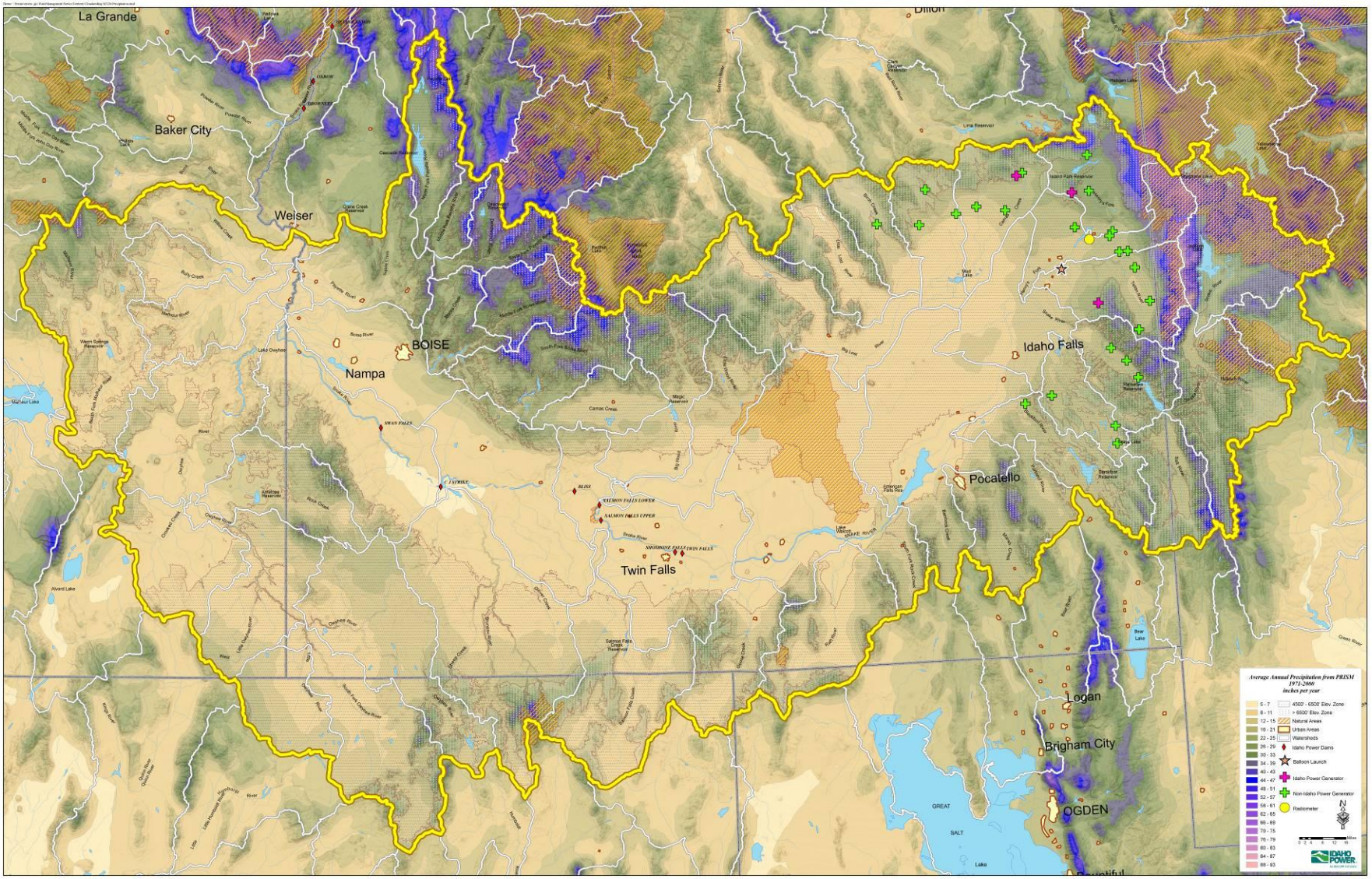
- Additional runoff estimated using IPC's NWS river forecast model.
- Model uses mean aerial temperature and precipitation (MAT & MAP) by elevation bands
- Two scenarios…with and without cloud seeding
- Without seeding – adjusted MAP down by amounts indicated by target-control analysis (observed data includes seeding)
- With seeding – used MAP based on observed data
- Streamflow increase ranges from 6% to 16% increase (Draft)

Upper Snake
Cloud Seeding Program

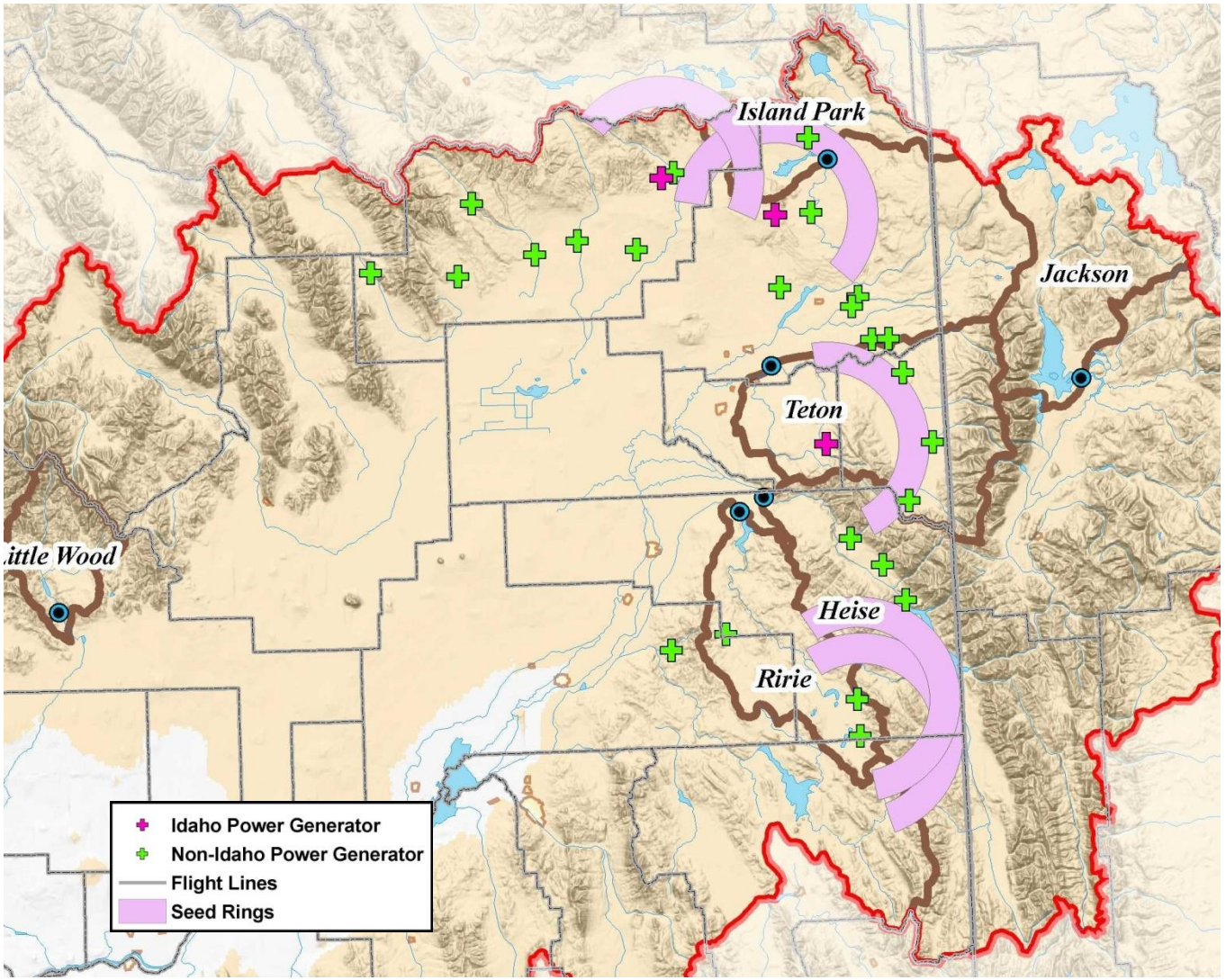
Water Year 2009:

- Placed 3 remote generators to augment the manual network run by the HCRC&D
  - IPC Operated and Maintained these units
- Provided Meteorology Support for the overall USB project.
- Data:
  - Radiometer in Ashton, Id (Temp, Rel Humidity, Liquid Water)
  - Rawinsonde in Wilford, ID (Wind)

E. Idaho CS Program



Upper Snake Operations Area

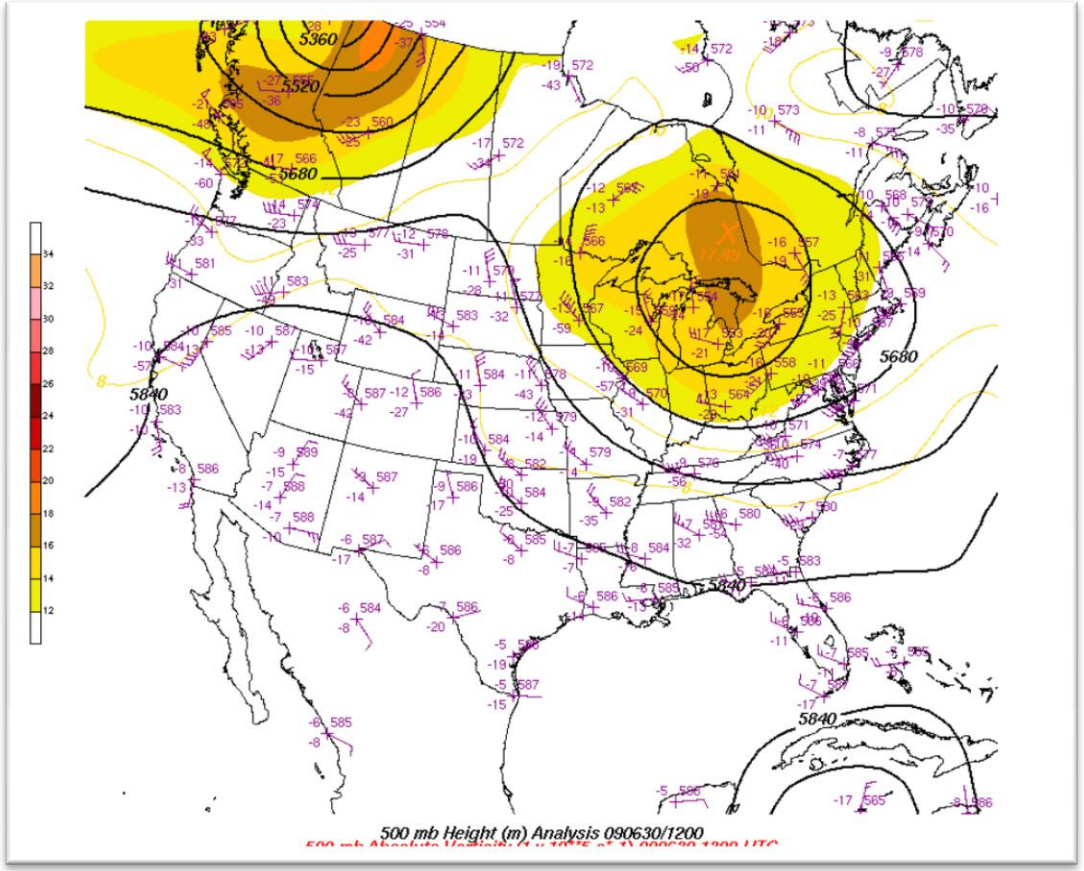


Upper Snake Operations Summary

IPC Upper Snake 3 Remote Generators Ground Generator Usage for 2008-2009			
Month	**Total Hours**	**Total Silver Iodide (grams)**	**Weather Balloons (Sondes)**
2008-12	82.5	1,649	0
2009-01	56.9	1,138	10
2009-02	42.3	846	12
2009-03	137.2	2,743	15
2009-04	51.1	1,021	5
Totals	**369.9**	**7,398**	**42**

Meteorology Support

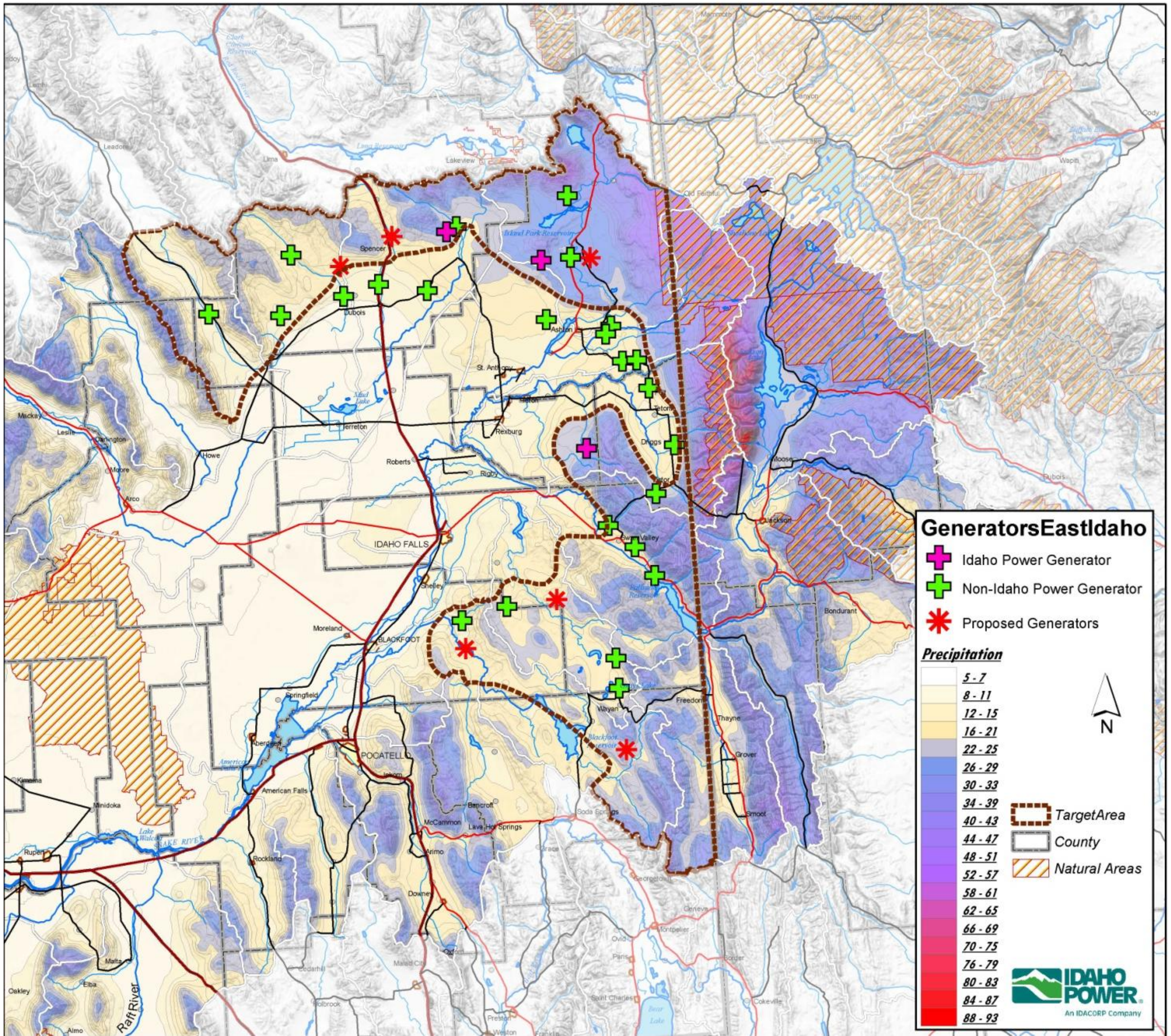
- 24/7 project support by 3 experienced cloud seeding meteorologists
- IPC generators are operated remotely from Boise
- Use public data and IPC Radiometer, Rawinsondes and Weather Stations.
- The meteorologist use this weather data to determine which generators to turn on and off to seed most effectively.



‘09-’10 Objectives

- Redesign remote generators summer 2009
  - Less Maintenance
  - Safety
  - Faster and easier to deploy and recover
  - More cost effective
  - New generators will replace current units in the Payette
- Add 7 to the Upper Snake for a total of 10 remotes
  - IPC and RC&D have identified the locations.
- Continued meteorology support
  - Rawinsonde

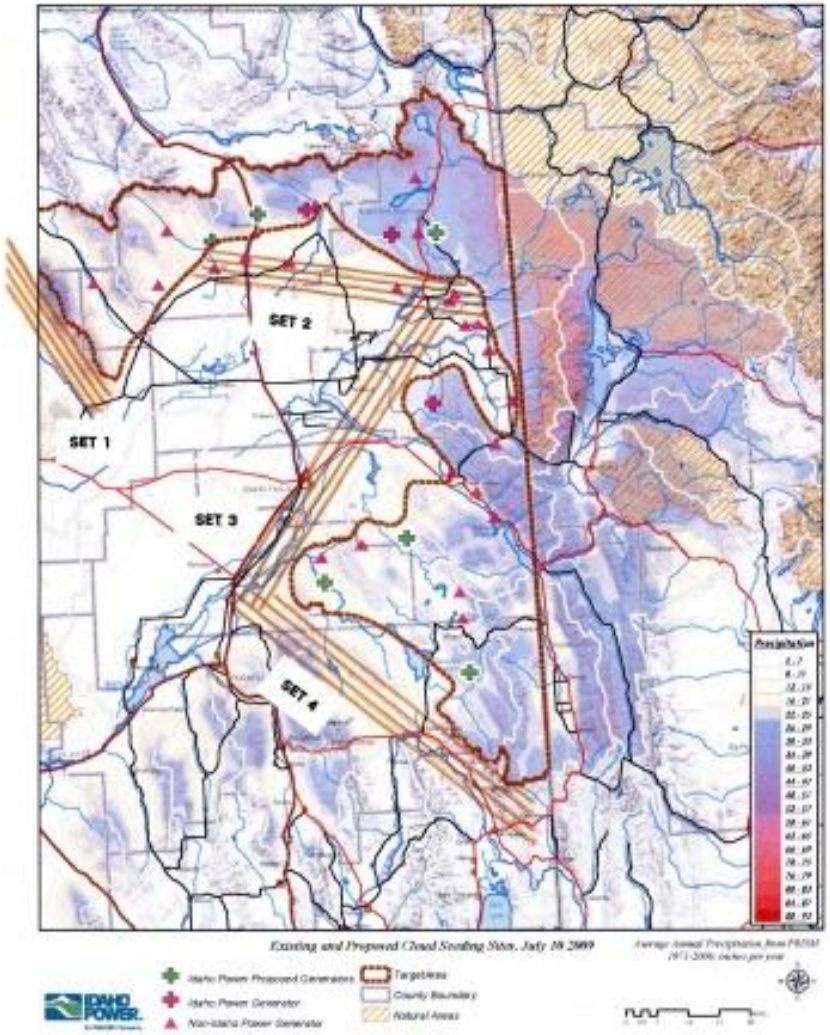
Upper Snake Planned
'09-'10 Operations



2010 Efforts – E Idaho

- Fabricate 10 additional remote generators in 2010 to use during ’10-’11 season.
- Locations to be identified – focus on continued enhancement of existing program before moving into new areas
- Develop sampling plan to establish current silver levels in watershed (water, soils, plants, aquatic organisms).
  - Currently planning for this in Payette
- Develop target – control analysis for E Idaho
- Assess benefits of additional radiometer

E Idaho Aircraft



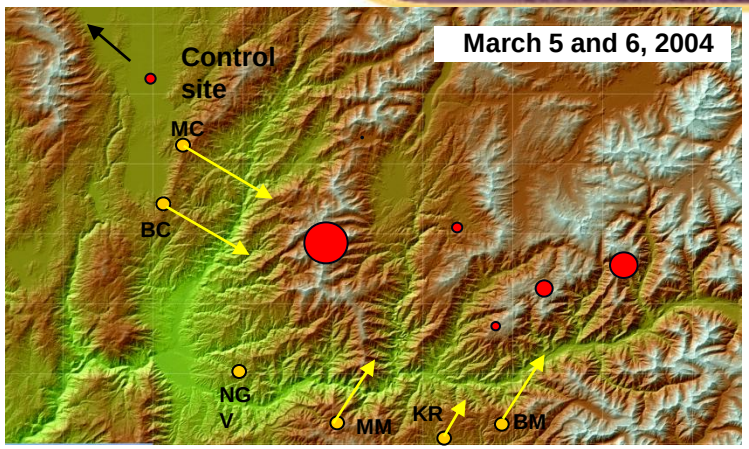
- Explore aircraft – first cut of flight lines from WMI
  - Cost would be similar to Payette
- Needs additional review and discussion…

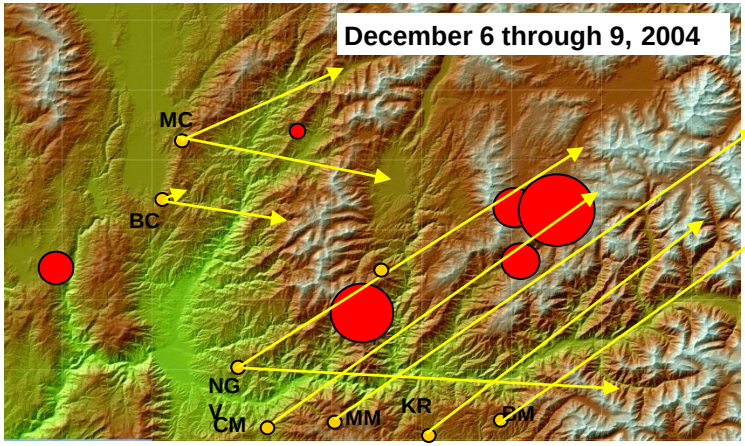
E Idaho Assessment

- Develop plan for assessment
- Initial discussions with DRI
- Since Payette assessment…
  - Australia's Snowy Hydro
  - Wyoming
- Draw from these and other research efforts that show cloud seeding works
- IPC's intent will be to focus assessment on project targeting, project efficiency, and measuring effect

Targeting from Chemistry Data

- Targeting of the seeding operations was assessed by integrating the silver found in the snow over a given storm period to estimate the total amount of silver deposited during the storm.





Ground-generator Site

= silver deposited 100 x 10^{-12} g

= silver 100 g released

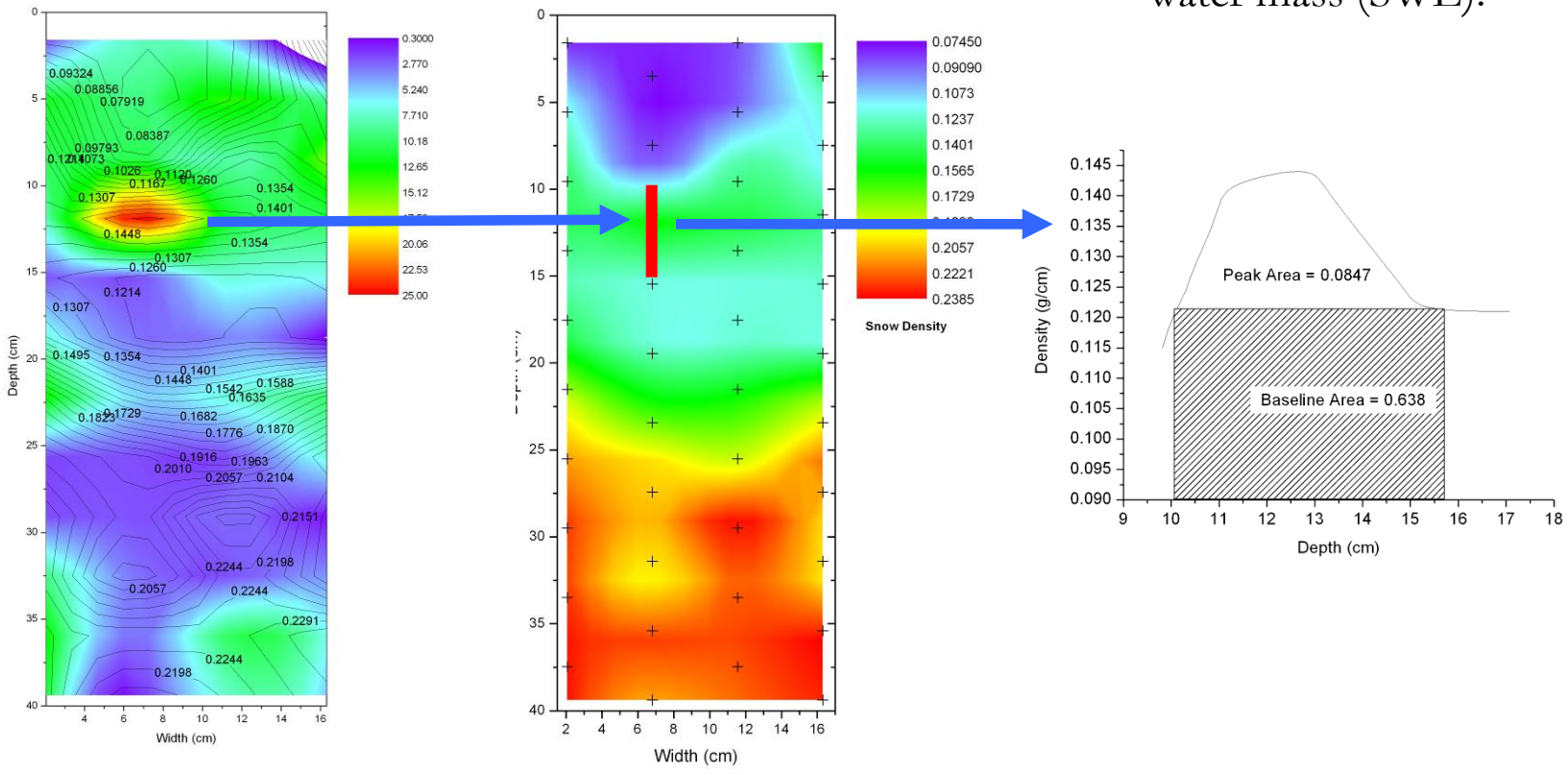
Example Targeting Maps for the March 2004 and December 2004 storm periods

Trace Chemistry Interpretation

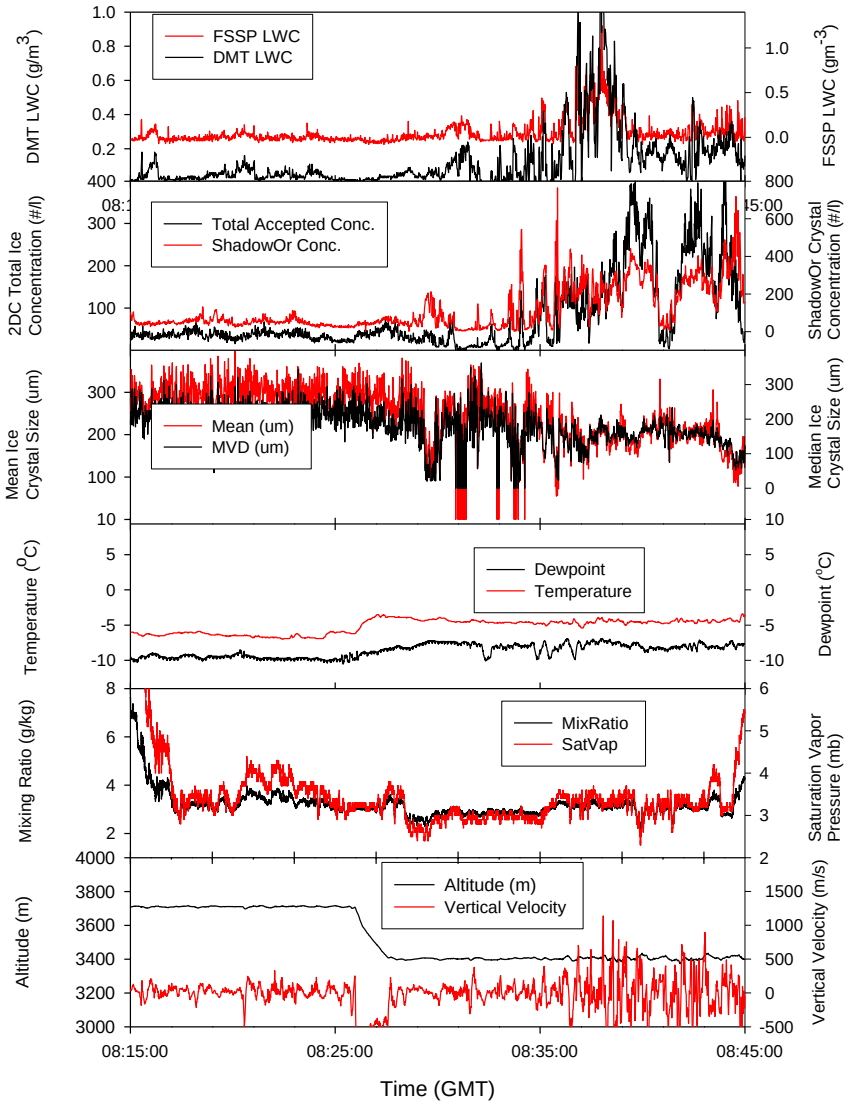
Trace Chemistry

Snow Pack Density

13% increase in integrated water mass (SWE).



2004 Cloud Physics



Airborne seeding starts at left edge of frame. Note that the total ice mass increases dramatically about 20 minutes after the onset of seeding while at the same time, the mean ice crystal size decreases.

Indicative of conversion of supercooled liquid water into new ice crystals that can then grow into snowflakes.

Silver Toxicity

- The WMA has issued a statement on toxicity of silver originating from cloud seeding…
  http://weathermodification.org/AGI_toxicity.pdf
- In summary,

  "The published scientific literature clearly shows ***no environmentally harmful effects*** *arising from cloud seeding with silver iodide aerosols have been observed; nor would they be expected to occur. Based on this work, the WMA finds that silver iodide is environmentally safe as it is currently being dispensed during cloud seeding programs."*

Questions?