

# Idaho Power Company's Cloud Seeding Program

November 10, 2016

Mel Kunkel



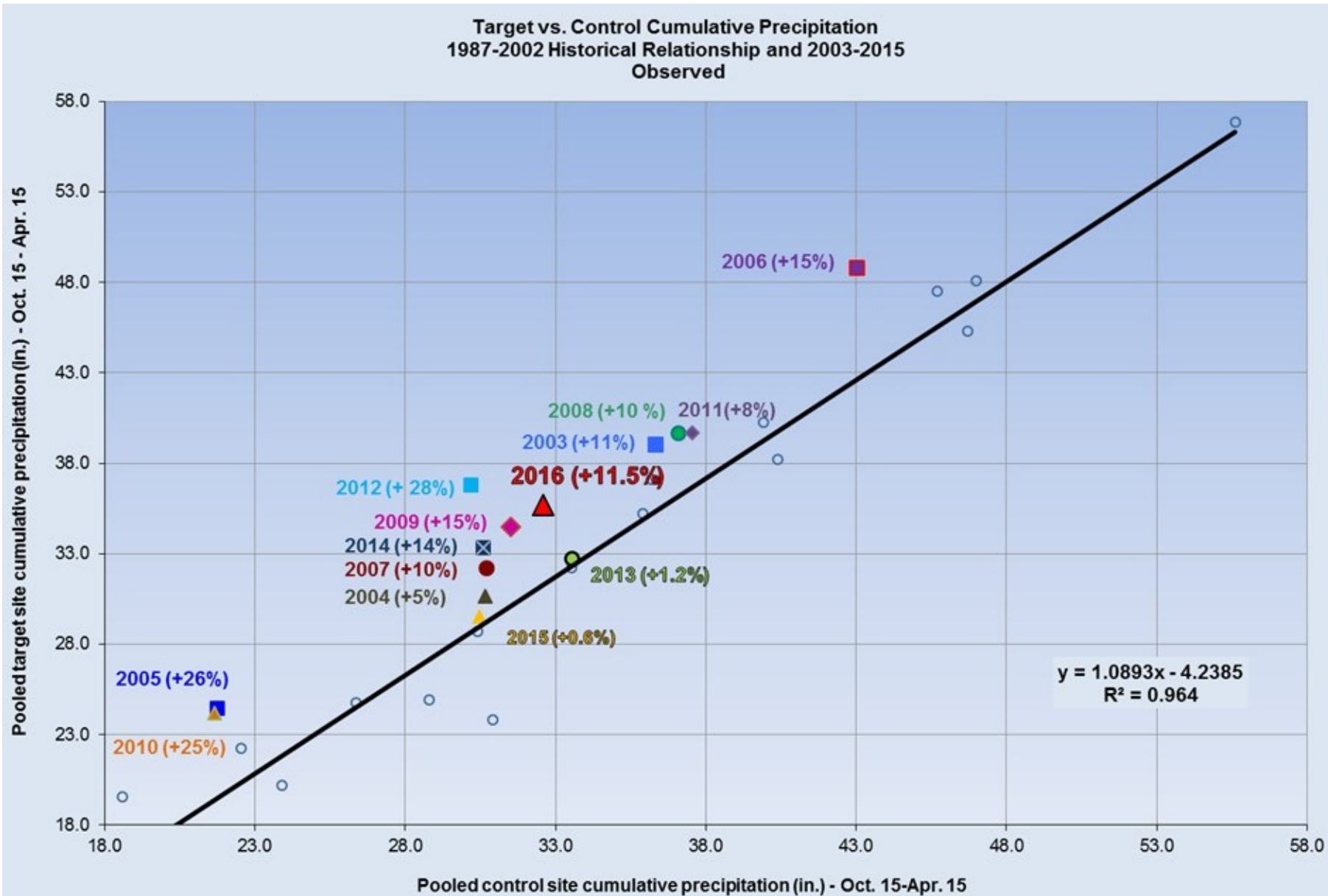


# Overview

- 2015-16 Cloud season results
  - Payette Target-Control
  - Basin-wide Target-Control results
  - WRF modeling results
  - WRF model example
- 2016-17 Project overview
- SNOWIE



# Target – Control



## Target Control Analysis

% Change by Basin

<b>Payette River Basin</b>	<b>11.5%</b>
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<b>Boise River Basin</b>	<b>9.4%</b>
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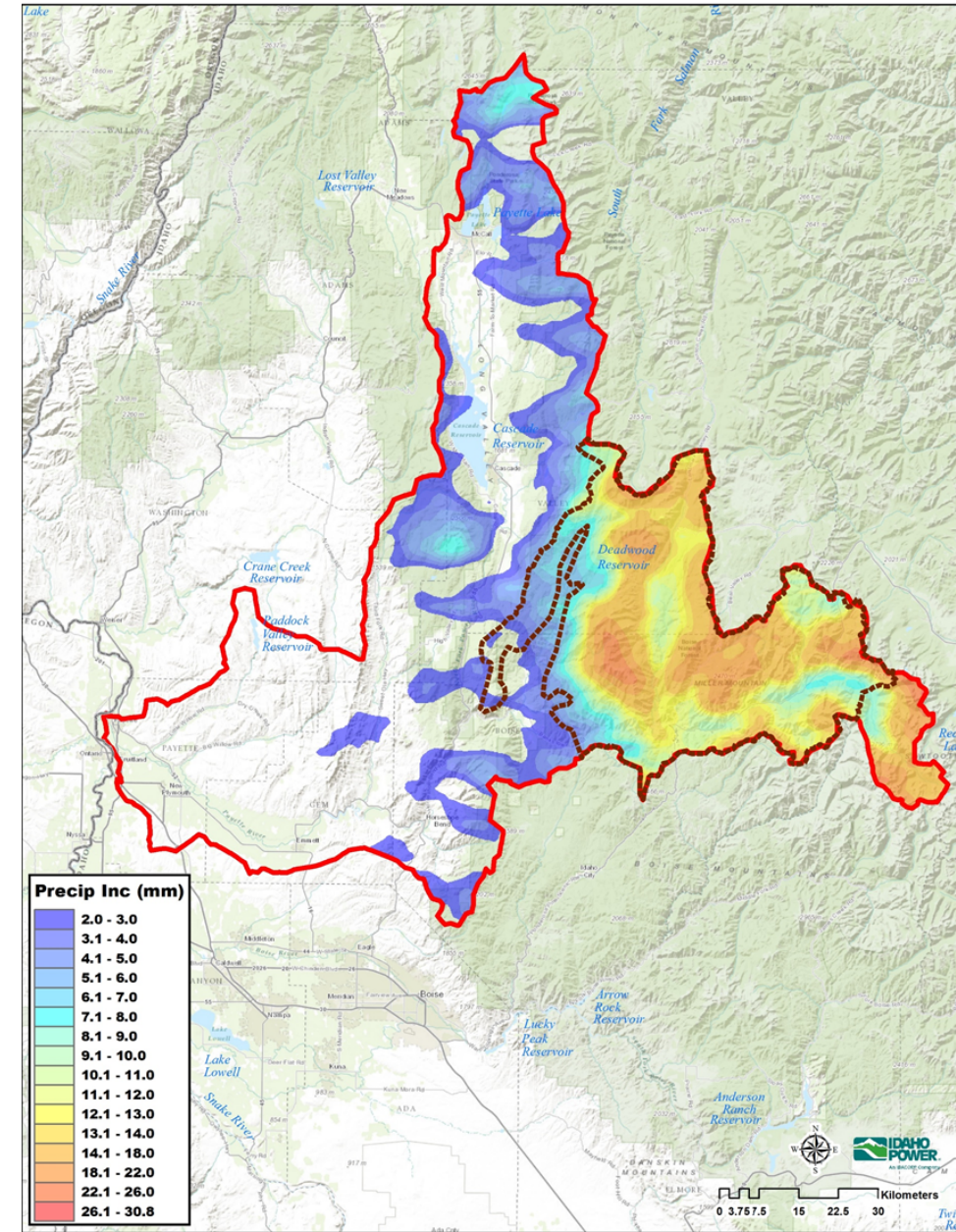
<b>Wood River Basin</b>	<b>5.4%</b>
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<b>Northern Upper Snake Basin</b>	<b>4.3%</b>
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<b>Eastern Upper Snake Basin</b>	<b>5.4%</b>
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# WRF/WRF Cloud Seeding Module

- Weather Research and Forecasting model
  - High resolution 5.4km & 1.8 km
  - Calibrated for the Snake River Basin
  - Provides spatial estimates of natural precipitation and temperature
- Cloud Seeding Module
  - Uses WRF
  - Provides cloud seeding guidance for operations
  - Provides estimates cloud seeding precipitation enhancements
- Both work with WRF-Hydro
  - Provides flow enhancement estimates

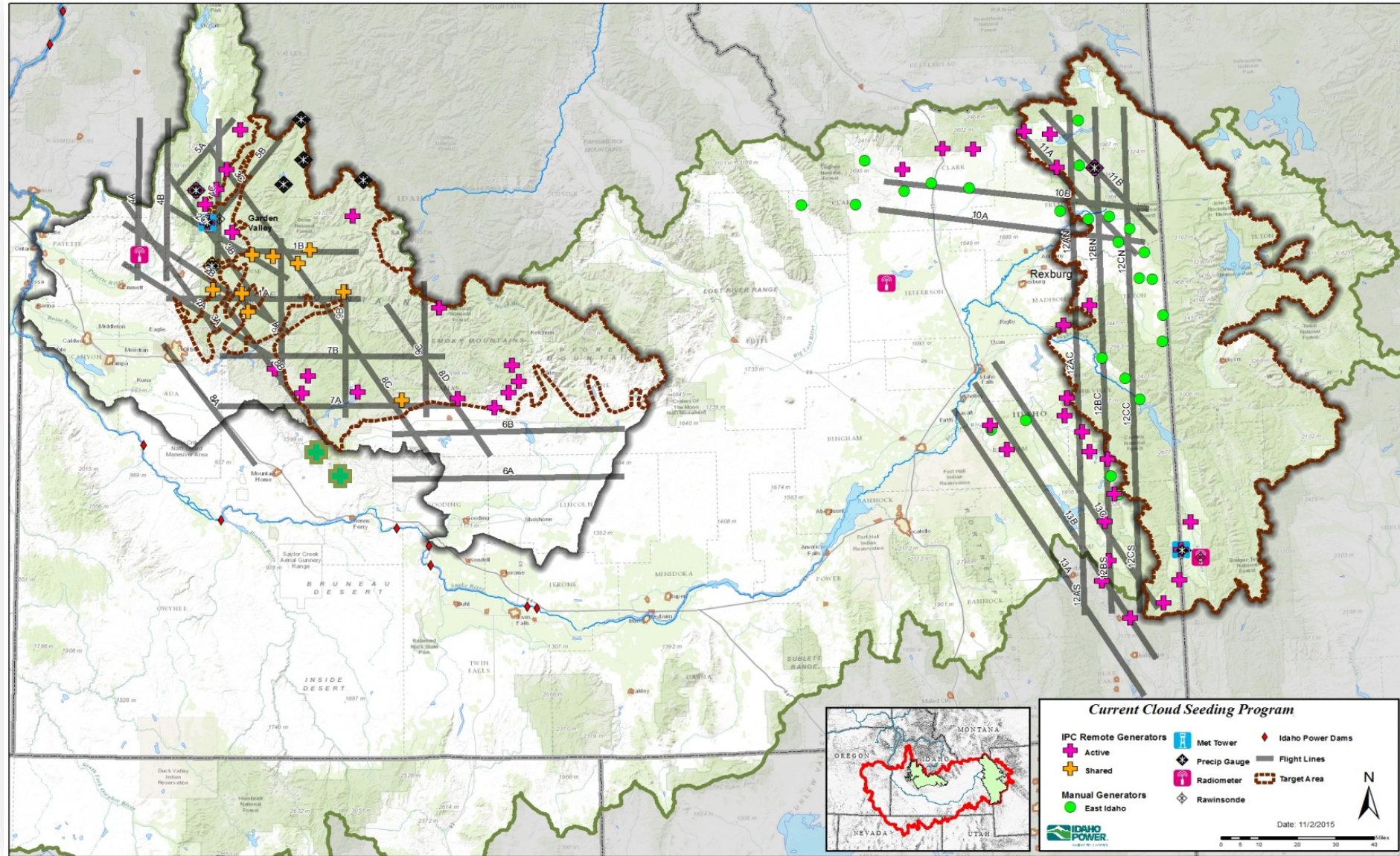




# IPC 2016-17 Cloud Seeding Program

## Payette, Boise, Wood & Upper Snake

- **Payette**
  - 17 Remote Gen's
  - Aircraft
  - Radiometer
  - Weather Balloon
  - Weather Tower
  - 8 hi-res precip gauges
- **Boise and Wood**
  - 13 Remote Gen's
    - 2 New 2016-17
  - Aircraft
  - Radiometer
  - Weather Balloon
  - Weather Tower
  - 3 hi-res precip gauges
- **Upper Snake**
  - 25 Remote Gen's
  - 25 Manual Gen's
  - Aircraft
  - 2 Radiometers
  - 2 Weather Balloons
  - Weather Tower
  - 2 hi-res precip gauge





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# SNOWIE

## Seeded and Natural Orographic Winter time clouds—the Idaho Experiment

- A National Science Foundation funded research project focused in the unique and very complex terrain of the Payette River Basin. Jan-Mar 2017
- A comprehensive observational and modeling research program involving multiple research institutions and Idaho Power.
- To understand the natural dynamical and microphysical processes by which precipitation forms and evolves within orographic winter storms.
- To determine the physical processes by which cloud seeding with silver iodide (AgI), either from ground generators or aircraft, impacts the amount and spatial distribution of snow falling across a river basin.



# SNOWIE

## Core Scientific Objectives

- Natural Cloud Structure: Evaluate the role of mesoscale and microscale dynamics and of the underlying terrain in the formation, growth, and fallout of natural ice crystals in winter storms through observations
- Investigate how the natural snow growth process is altered as a result of airborne and ground based AgI seeding through both observations and model simulations
- Evaluate the effectiveness of aircraft ground seeding on snowfall amount and distribution
- Incorporate key results on the dynamical and microphysical processes into WRF and other national level weather models to improve US weather forecasting capabilities.



# Project Investigators

- National Center for Atmospheric Research, Research Applications Laboratory
- University of Wyoming, Department of Atmospheric Sciences
- University of Colorado at Boulder, Department of Atmospheric and Oceanic Sciences
- University of Illinois at Urbana-Champaign, Department of Atmospheric Sciences
- Boise State University, Department of Geosciences
- Desert Research Institute, Division of Atmospheric Sciences



# Project Equipment

## **Cloud Seeding Equipment**

Seeding aircraft (King Air C200)

17 remotely operated cloud seeding generators

## **Meteorological Equipment**

University of Wyoming King Air research aircraft

- 95 GHz Wyoming cloud radar

- Cloud lidar

2 Doppler on Wheels (DOW) X-Band dual-polarization radars

6 microwave radiometers

6 Vertical-pointing microwave radars

14 High resolution precipitation gauges

1 High resolution downward looking radar for snow water equivalent

25 Meteorological stations

3 Radiosondes (Weather Balloons)

25 Assorted pieces of meteorological equipment

Mobile research instrument van to provide inflow atmospheric measurements

## **Other Resources and Facilities**

WRF model (5.4 km & 1.8 km) and NCAR FINECAST model (3.0 km)

Boise State University, Trace Chemistry Laboratory

Yellowstone supercomputer center





Thank You