



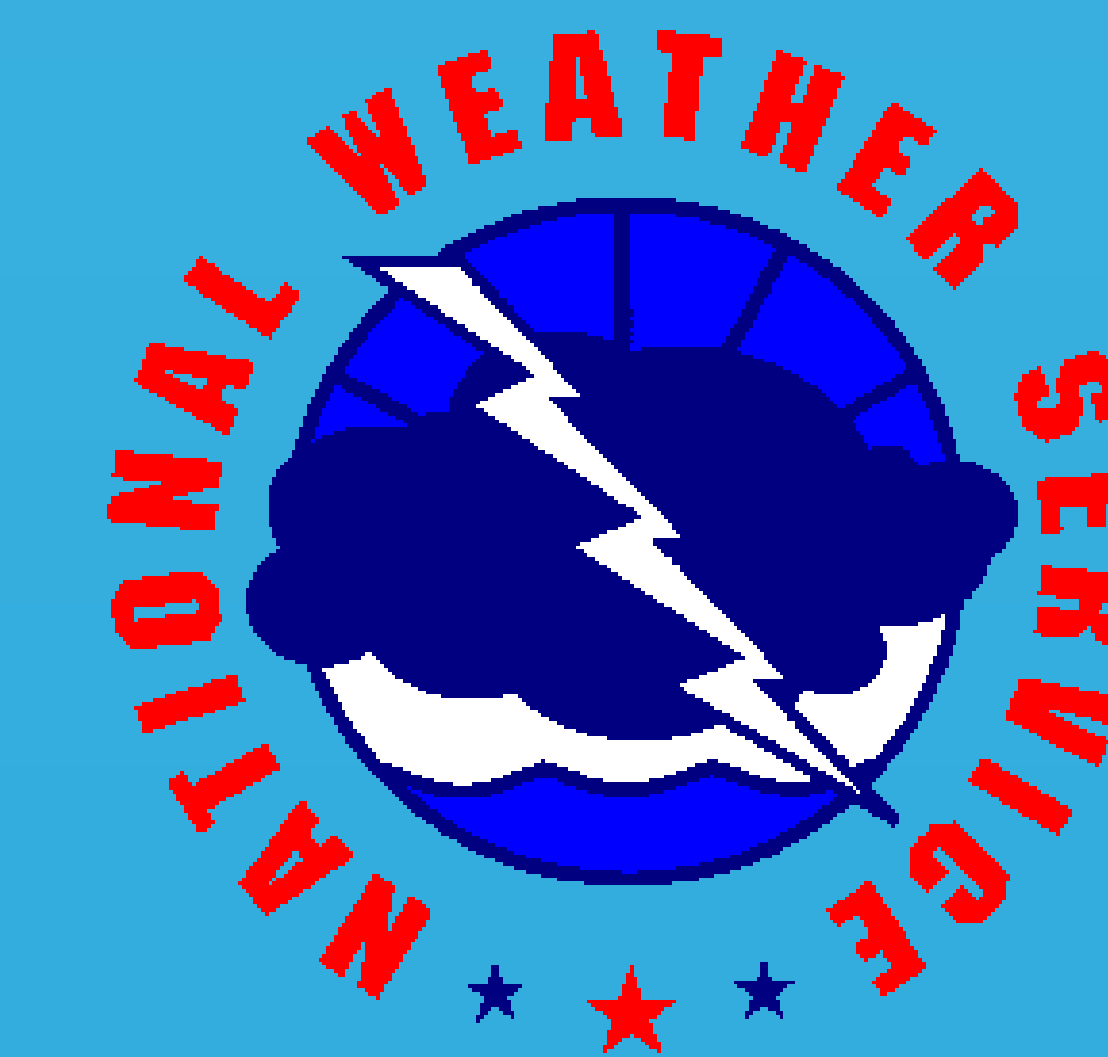
# The Mesoscale Implications for a Freezing Rain Event for the 2014



## Opening Day at Steamboat Ski Resort

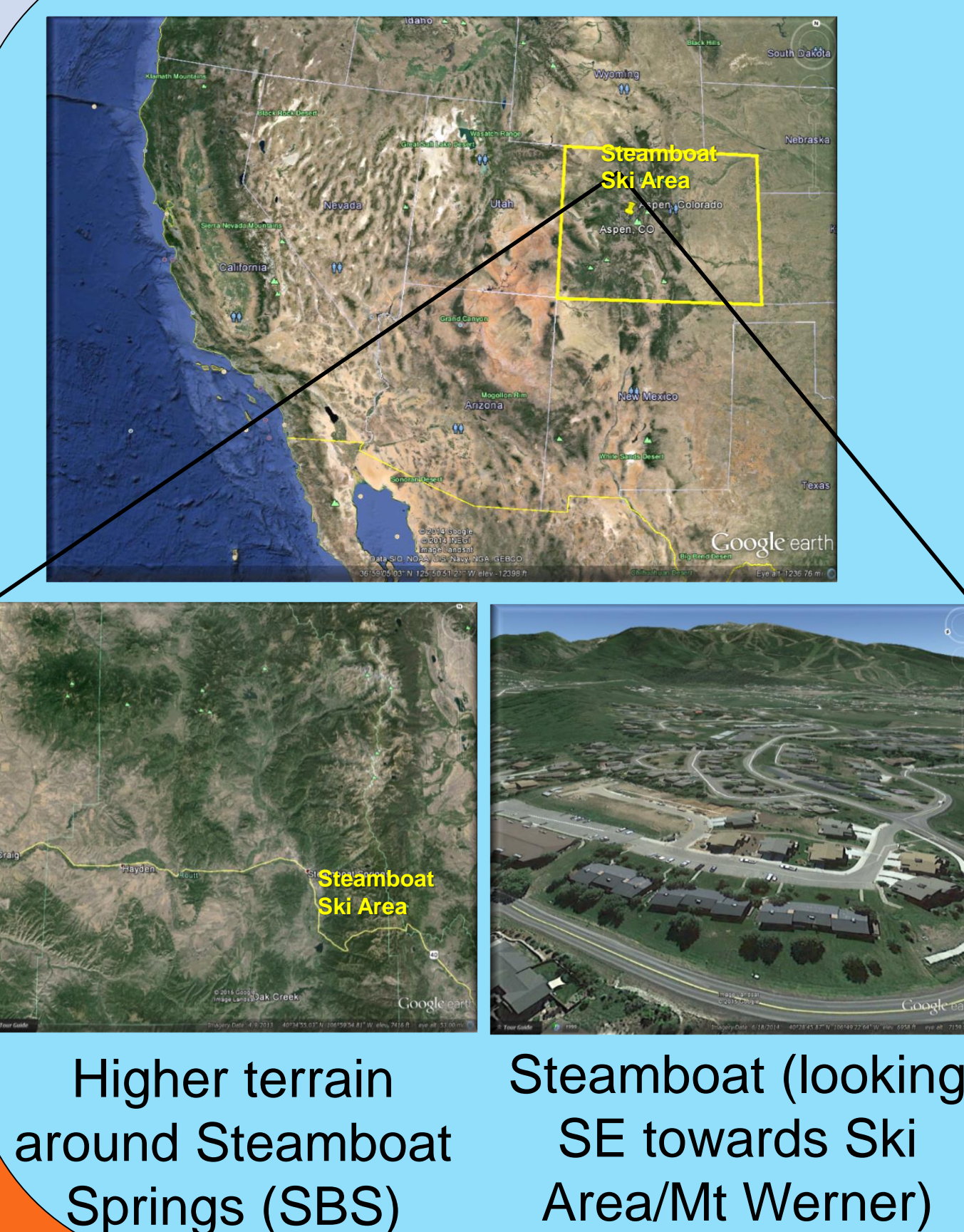
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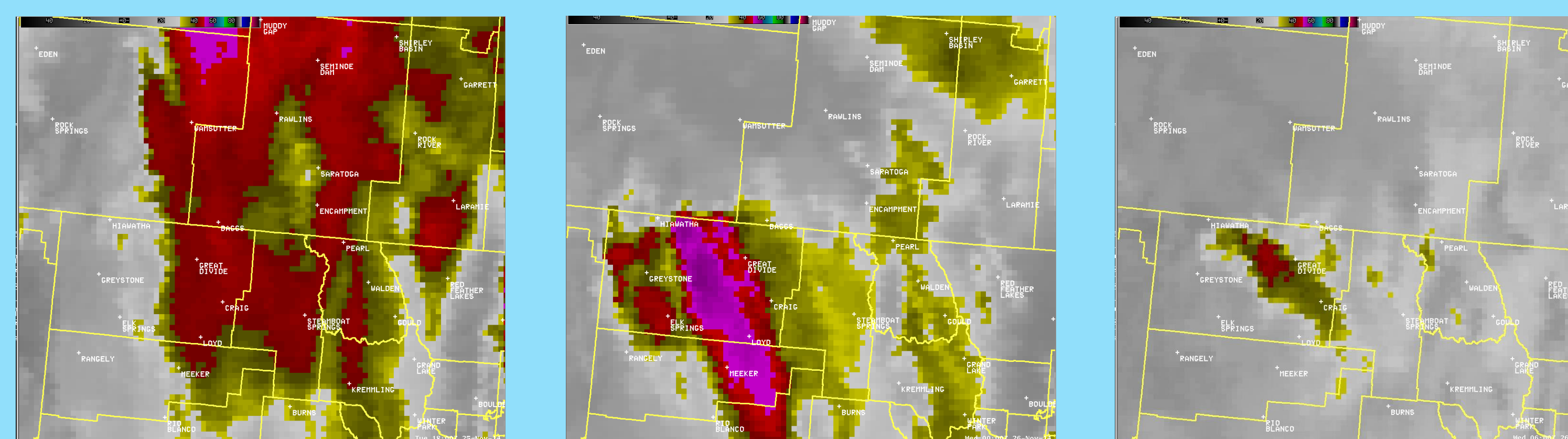


### Background

- Weather conditions seemed to be primed for an excellent opening day at Steamboat Ski Resort
  - Several feet of snow had fallen in and near Steamboat Ski area during the past week
  - Enthusiasm was dashed as heavy snow switched to freezing rain (not forecasted) and encrusted the powder with a layer of ice up to a centimeter thick on the mountain creating dangerous ski conditions
- This study will examine:
  - The storm evolution and factors responsible for orographic precipitation and freezing rain
  - Impact of a freezing rain event on a ski resort in the Rockies

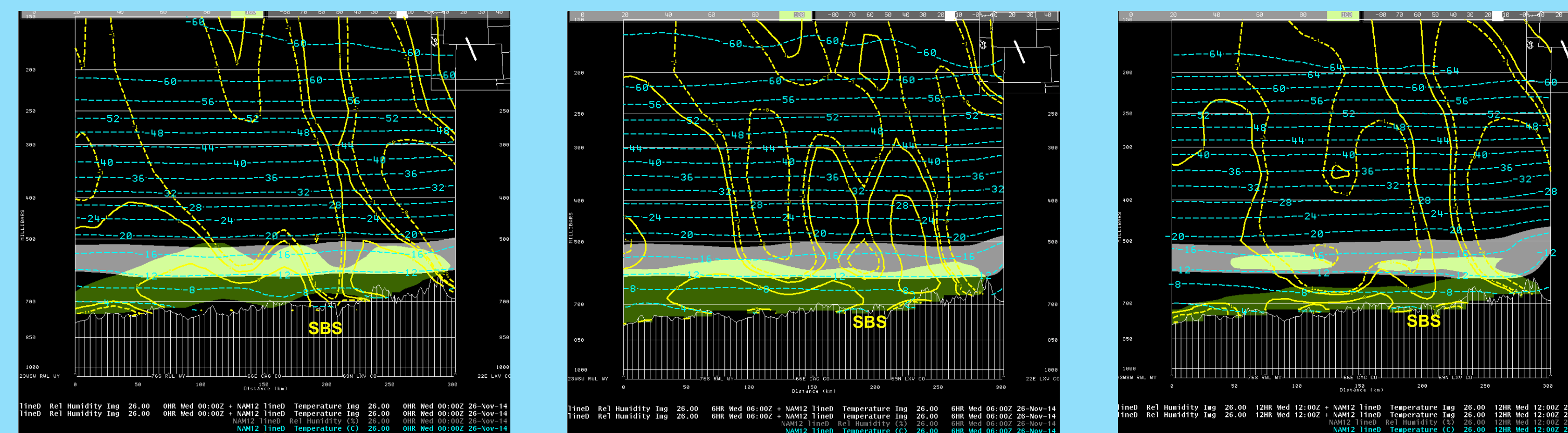


### IR Satellite Imagery



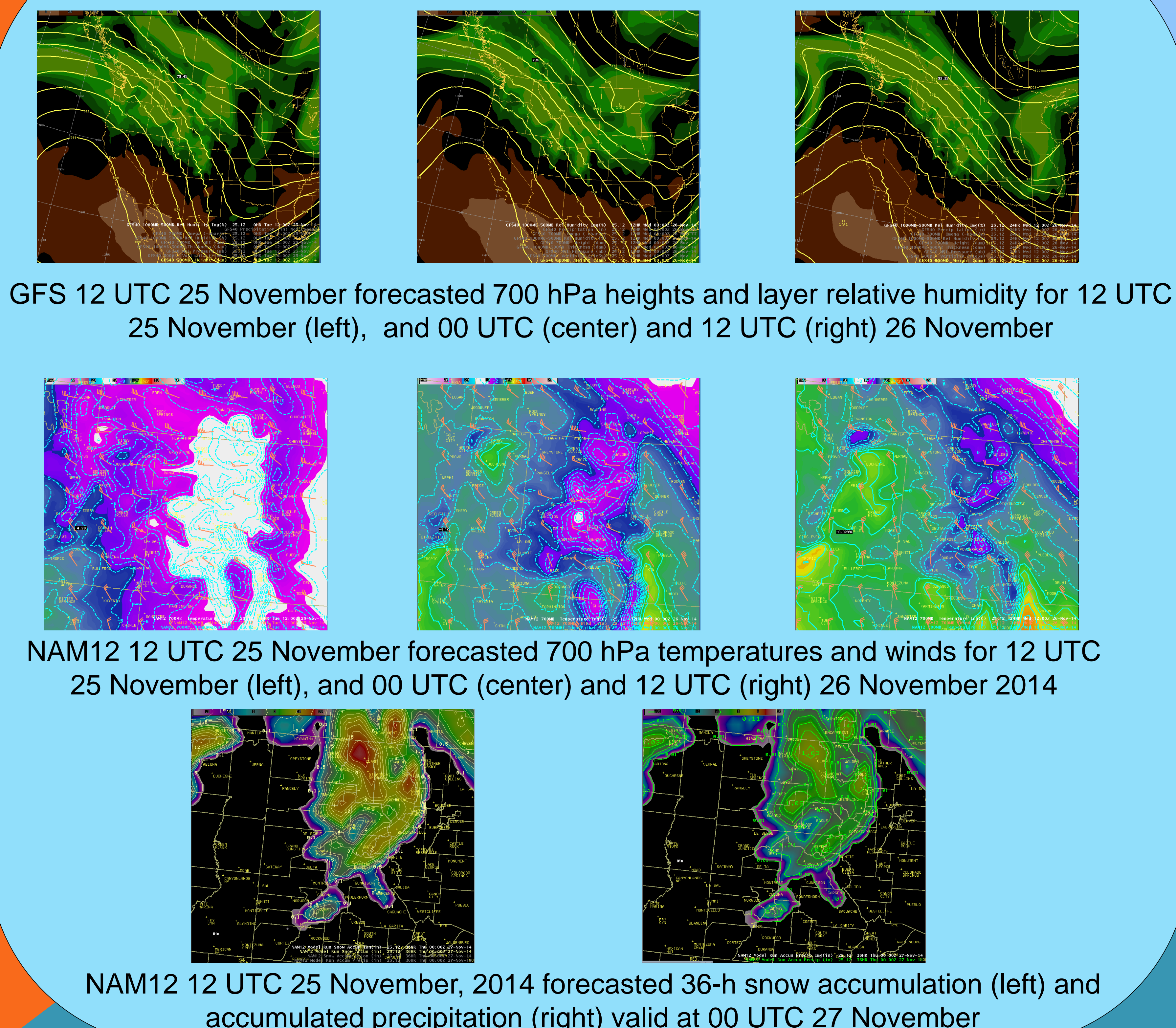
IR Satellite Imagery at 18 UTC (left) on 25 November 2014, 00 UTC (center) and 06 UTC (right) on 26 November 2014

### Model Cross-section

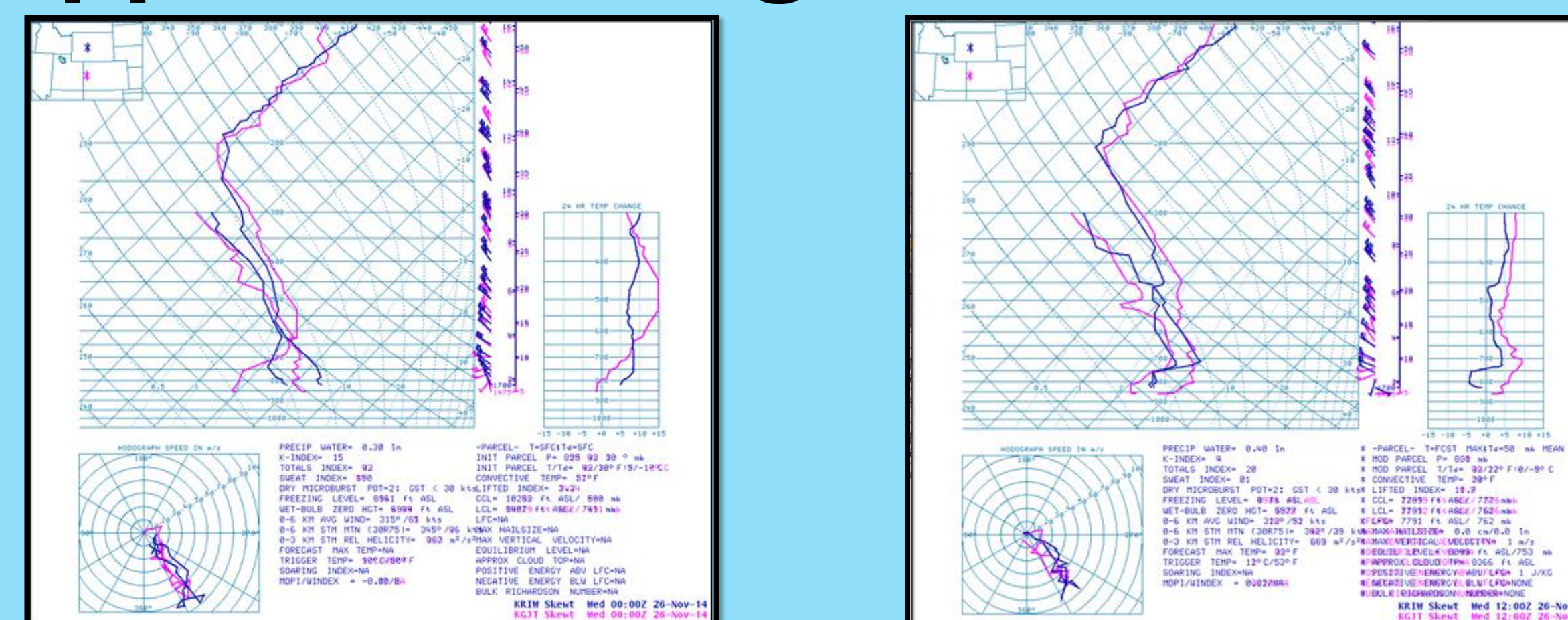


NAM12 00 UTC 26 November forecast Cross-section through Steamboat (location noted by "SBS"). Temps in blue, Omega in yellow and RH > 85% imaged 00 UTC (analysis) (left), 06 UTC (center) and 12 UTC (right)

### Storm Background

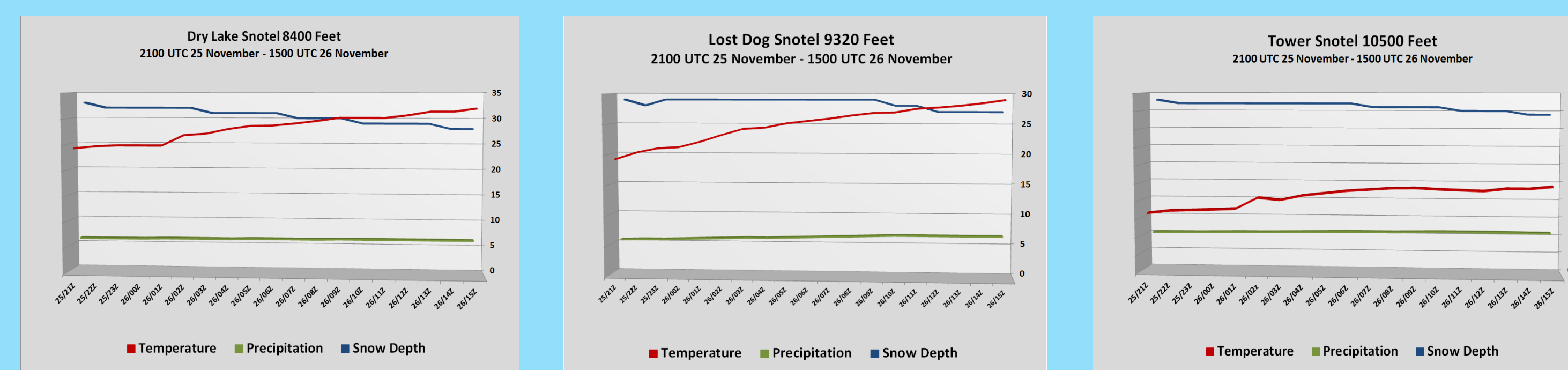


### Upper Sounding from GJT and RIW



Upper-air soundings from GJT (pink) and RIW (blue) from 00 UTC (left) and 12 UTC (right) on 26 November, 2014

### SNOTEL Time-series



Time series for Dry Lake SNOTEL (left), Lost Dog SNOTEL (center) and Tower SNOTEL (10500 feet) (right). Temperature (Red), Precipitation (Green) and Snow depth (Blue) from 2100 UTC 25 November to 1500 UTC 26 November

### Social Impact



A sample of the anticipation of heavy snow prior to opening day at Steamboat Ski Resort and public reaction after snow changed to freezing rain overnight as posted on their social media Facebook pages

### Discussion

- Storm Background**
  - Moist NW flow (favorable for Steamboat) forecasted to continue into 26<sup>th</sup>
  - Significant warming forecasted at 700 hPa: from -12°C at 12 UTC 25<sup>th</sup> to -5°C at 12 UTC 26<sup>th</sup> over SBS
  - Models forecasting impressive snowfall totals ~18 inches (45 cm) at SBS
- IR Satellite Imagery**
  - Mid/upper level "seeder" cloud dissipated overnight
- Model Cross Section**
  - 00 UTC NAM indicated a drying trend of the dendritic layer through the night but not as fast as satellite imagery suggested.
  - Additional upward forcing (Omega) persisted below the dendritic zone, which is presumed to contain mainly super-cooled liquid droplets
- Upper Air for Grand Junction and Riverton (upstream sites)**
  - Showed mainly sub-freezing temperatures with mid-level drying trend overnight and saturation shifting below 700 hPa (at Riverton)
- SNOTEL Time Series**
  - Temperatures increased but remained sub-freezing throughout the event
  - Snow depth trend flattened and then decreased
  - Precipitation continued to climb upward - indicating rain
- Storm synopsis**
  - Warmer mid-level flow shut down seeder-feeder mechanism over the area
    - Resulted in a shallow supercooled warm-precipitating orographic cloud which produced freezing rain over the mountain
- Social Media**
  - Anticipation of heavy snow accumulations at Steamboat Ski Resort
  - Public comments provide evidence of freezing rain and an ice layer on top of the snow surface that resulted in adverse ski conditions