BOUNDARY LAYER RADIOMETRY IN MOUNTAIN ENVIRONMENTS

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TOPICS:

- Radiometer information
- History of Projects: Gunnison and Mancos
- Liquid retrievals
- Future research
Countries all over the world use radiometers for both research and operations, currently there are more than 100 radiometers in use in Asia.
- Passive Microwave Thermodynamic profiler
- Generates a sounding much like a radiosonde sounding once each minute.
- Profiles of Temperature, water vapor, liquid water and relative humidity from the ground to 10km AGL
- 58 information levels 0-10km
- Zenith and Angle Scan modes build vertical profiles.
- Portable, Rugged, easy to install, operate and maintain.
\[ T_{sky} = \left( \frac{V_{sky}}{\text{gain}_{sky}} \right)^{\frac{1}{\alpha}} - T_{rcv\_sky} \]

- \( T_{sky} \) = Brightness temperature
- \( V_{sky} \) = Integrated receiver output from sky observation
- \( \text{gain}_{sky} \) = Gain during sky observation
- \( \alpha \) = Non-linearity correction exponent
- \( T_{rcv\_sky} \) = Receiver temperature during sky observation

22-30 and 51-54GHz detect water vapor
51-59GHz detect temperature

Off Zenith Hyperspectral Measurement
GUNNISON AND MANCOS COLORADO WINTER SEEDING OPERATIONS
2013-2014 WINTER SEASON GUNNISON COLORADO DEPLOYMENT

TRACK LIQUID WATER MOVEMENT AND TEMPERATURE FLUCTUATION DURING ALL-WEATHER CONDITIONS.
This campaign concluded that we can detect temperature, vapor and liquid in real time in multiple directions. This prompted the addition of two more elevation scan angles in following projects.
0.10 [g/m³]  

0.12 [g/m³]  

0.16 [g/m³]  

Azimuth: 260°  

Zenith  

80°
Cloud Base Height [km]

Integrated Liquid Water [mm]

Mountain top Height

Zenith Scan Mode
The Jackson Reservoir Radiometer site
MARCH-APRIL 2014
MANCOS COLORADO DEPLOYMENT

ADDED A LIVE DATA FEED AND MORE OBSERVATION ANGLES THAN THE PREVIOUS CAMPAIGN
Liquid water ‘plume’ detected to the west of radiometer site, exists for ~1 hour.
Three dimensional ‘mapping’ of liquid water as moves across the FOV, this information can help us determine location, temperature and movement of liquid water.
Supercooled Liquid Water Observations: April 2

- **South (180)**
- **SSW (195)**
- **WSW (225)**

6 hours
RAOB calculates precip type using 850mb lower limit, this is not applicable for this sounding.
K- AND V-BAND LIQUID WATER SIGNATURES

Tuesday, September 23, 2014, Boulder Colorado
During clear dry conditions the atmosphere is nearly transparent to the K-band channels, when water and water vapor are present the brightness temperatures increase dramatically from their ‘base’ temperature which can be as cold as cosmic background radiation (~3 Kelvin).

This plot shows brightness temperatures from the same time period as the previous slide, these are from the Zenith scan angle.
The V-band is sensitive to atmospheric oxygen. The bottom 7 frequencies in the V-band, 51-54 gHz, also sense the presence of liquid water. The top 7 frequencies 54-59gHz, detect brightness temperatures that correlate to physical temperature.

The neural networks use information from all frequencies and an in-situ surface sensor to create a thermodynamic profile while the IRT sensor detects clouds, the combination gives Cloud Base Height.
MOUNTAIN ENVIRONMENTS AND MOBILE APPLICATIONS

Site-specific configuration
Mobile platforms
Basin Site Configuration
Conceptual Model of Mountain Valley “Mesoclimate” mapping strategy
Mobile Platform: Chase the snowstorm through the Basins
QUESTIONS/COMMENTS?