Measurement of alpine precipitation using an X-band polarimetric radar

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Importance of precipitation in mountainous regions

Mountains = water towers of many regions all over the world

Critical for water resources and for natural hazards

Precipitation = only water input!

Ice “mining” at Chimborazo (Ecuador)

http://www.visit-switzerland.ch/travel_grand-dixence-dam.html
Difficulties in measuring precipitation in mountains

- Strong spatial and temporal variability (rugged topography).
- Snowfall is significant if not major part of precipitation.
- Harsh environment (cold, wind, remote,...).

→ Large uncertainties in measurements.
→ Snow water equivalent ?
→ Limited representativity of point measurements.

How accurately can we quantify precipitation in mountainous regions?
What is the dynamics of precipitating systems in these regions?
Potential of weather radar

Radar remote sensing
→ high spatial and temporal resolution
→ extended coverage

Limitations in mountainous regions:
- ground echoes / beam shielding
- overshooting at medium distance
- variability of snowflake shape and density

Quantitative estimation of rain/snowfall using weather radar is still an open question!
Field campaign in Davos, CH

- Hydrometeor identification (using X-band polarimetric radar obs.)
- Investigate snowfall estimation.
- Characterize the (small-scale) variability of alpine precipitation.

Sep. 2009 - Jul. 2010, in collaboration with SLF

Unique combination of sensors!
MXPol = EPFL's mobile X-band Doppler polarimetric radar (manuf. ProSensing).

Specs:

- **X-band** (9.41 GHz).
- 25-kW Magnetron (pseudo-coherent).
- Simultaneous transmission of H and V pol.
- 3dB-beamwidth = 1.45° (1.8 m antenna).
- Range resolution up to 15 m.
- Remotely controlled and operated.
- Autonomous (diesel generator).
- Mobile (on a trailer)!
Radar deployment

Radar site at 2150 m of altitude (ski resort)

Line power supply
Wifi link down to Davos
Positioning

Need accurate positioning of the radar data

Sun tracking

Ground echoes

DEM reconstructed from radar data

DEM from Swisstopo
Versuchsfeld site

2540 m of altitude – opposite side of valley / the radar
Instrumented by SLF (started in the 1940s):

Disdrometers:
-2DVD
-Parsivel

Gauges

Snow pillow

Weather station

Daily manual snow height and density
Ex. 1: March 26 2010

Strong snowfall event (~40 cm of fresh snow)
Ex. 2: May 26 2010

Rain/snow event (~10 mm of rain)
Conclusions - Perspectives

Davos field campaign:

- Collect a representative data set about alpine precip. (70 events, 300 h).
- Snowfall quantification using X-band polarimetric radar.
- Small-scale dynamics of alpine precipitation.

Potential contribution to HyMeX:

- Monitoring of intense Mediterranean rainfall:
  - mobile radar;
  - disdrometers (Parsivel, see poster HPF 35).
- Investigate spatial and temporal variability of Mediterranean precip.
- Link between variability and microphysical processes.
Thank you for your attention!
Real-time display on the web

http://lte.epfl.ch/anim_radar.shtml

Webcam

Zdr

Doppler V

Zh