Group 3 Avalanche Forecasting

For Tiffany, with love

Observation and avalanche data NOAA should gather from existing sources

- SNOTEL
- CAIC avalanche observations (back to May 2010, avalanche.state.co.us)
- CoCoRaHS
- PRISM climatology data
- USGS National Elevation Dataset
- Avalanches.org
- NOHRSC snow observations and analyses
- NSIDC Snow Data Assimilation (SNODAS) data products
- Temperature, wind, precip obs from MADIS, METAR, Mesonet, WeatherBug, Weather Underground
- Snowpack attributes from JPSS

Avalanche- related predictor information to be saved from global ensemble reforecasts

- Temperature at multiple levels
- Precipitation amount
- Frozen precipitation amounts
- Relative humidity/dewpoint/mixing ratio (original model output)
- Insolation
- Wind
- Thickness

How data will be saved and made conveniently available to all partners

- Host raw forecast data on all cloud services in standard format (NetCDF?)
- Final forecast stored as probabilities on a grid
- NWS and private partners use forecasts as guidance to issue warnings

Post-processing methodologies to attempt
Reference for indicating improvement

Methodologies

- Pre-existing physical avalanche models, with parameters tuned to match dataset
  - operating on downscaled model data
- statistical learning methods: logistic regression, random forests, gradient boosted regression
- consensus methods that combine multiple approaches

Reference

- Avalanche climatology
- Existing avalanche forecasts

Deliverables

- Probability of avalanche of any kind
- Conditional probability of extreme avalanche
- Probability of avalanche conditioned on slope angle and elevation
- Forecast for individual mountain ranges, rather than individual mountains

How NOAA will work with partners: respective roles and responsibilities

- NOAA coordinates hosting of data with Big Data companies, model generation procedures, and coding standards
- NOAA will establish CRADA and R2O plans
- Commercial partners handle dissemination
- NOAA coordinates with MeteoSwiss, Met Office, WMO for international forecasting responsibilities
- Academic partners help with algorithm development and evaluation

How avalanche forecast products will be evaluated

- “Truth” data sources
  - CAIC avalanche observations
  - Avalanches.org
- Metrics
  - **Tiffany’s time on ski slopes increases**
  - Reliability diagrams
  - ROC curves (PoD vs. PoFD)
  - Decline of deaths and injuries by x%
  - Decline in blockages of key passes due to mitigation
  - Economic losses
- Testbed
  - Test in Hydromet Testbed
  - Test in Andes prior to NH winter
- Publication
  - Computed daily and posted on public website

Plan for a durable infrastructure allowing further improvement in coming years

- Flexible, extensible, modular framework
- GitHub code repository
- Open source project paradigm
- Alliance of multiple research and commercial groups for development
  - Yearly meeting at Trump Ski Resort
  - Reality series on the making of the product
- Recruitment of additional rich users
- MOP-UP subsidiary branch
- Documentation
- Integration Testing suite

Desired Tremendous Outcomes