DRAFT CURRICULUM

Day 1, Tuesday, January 12

0800 – 0900 Lab – Introductions, safety, logistics, course overview

0900 – 1030 Lab – Introduction to snow depth tools and SWE (Federal samplers)
- Manual probes - Elder
  - Assembly, care, dos and don'ts
- Magnaprobes – Marshall and Sturm
  - Assembly, care, dos and don'ts
- Federal sampler - Starr
  - Assembly, care, dos and don'ts
- Details in ***Snow Depth Lab*** below

1030 – 1200 Field - Snow depth trials – near lab
- Three stations:
  - Manual probes - Elder
  - Magnaprobe – Marshall and Sturm
  - Federal sampler - Starr
    - Probing and sampling - digging out probes to see what tip is doing
    - Short transect practice
    - Problems and solutions
    - Ground cover and condition – frozen, organic layer, vegetation
    - Stratigraphic and basal ice lens and crusts
    - Over- and under-measurement
- Details in ***Snow Depth Trials*** below

1200 – 1300 Lunch in dorm

1300 – 1600 Field – Probe-A-Thon - Working in small groups
- Instructions - Elder
- Data sheets
  - Depth probes - Elder
  - Magna probe - Sturm
  - Federal sampler - Starr
- Details in ***Probe-A-Thon*** below

1600 – 1730 Lab – Dump Magnaprobe data – Marshall and Sturm
- Enter manual probe and Federal sampler data into Excel
- Compare data and discussion
- Details in ***Probe-A-Thon Lab*** below

1800 – 1930 Dorm – Dinner

1930 – 2030 Lab – Introduction to snowpit tools and snow stratigraphy - Elder

Day 2, Wednesday, January 13

0800 – 1100 Field at Fraser
- Four groups – students rotate every 45 min

Exploratory snowpits – Marshall and Starr
- Practice using tools without recording any data
- Details in ***Exploratory Pits*** below

Snow stratigraphy and photography – Elder and Sturm
- Grain ID and quantification, and recording with digital cameras
- Details in ***Stratigraphy and Photos*** below

1100 – 1130 Lunch – in the dorm – drive to next field location

1230 – 1730 Field at Bethoud Pass
- Show students operational SnoTel site
- Full data pits - snowpit data collection and recording
- All data, all parameters, and photos

Details in ***Full Data Pits*** below

1800 – 1900 Dorm – dinner

1900 – 2100 Lab – Snowpit data reduction and analyses
Details in ***Snowpit Data Reduction and Analyses Lab*** below

Day 3, Thursday, January 9

0800 – 1200 Lab lectures

0800 – 0900 – Shallow snowpack measurements – special problems - Sturm

0900 – 1000 – Deep snowpack measurements – special problems – Elder

1000 – 1100 – Crusts, ice lenses, saturated snow, and other insidious problems – Elder

1100 – 1200 – Measurements in extremely remote situations, problems or oportunities? – Hill

1200 – 1300 Dorm – Lunch

1230 – 1630 Lab lectures

1230 – 1430 – Designing a snow survey and field program - Marshall
- Bias, error and uncertainty -
- Sample size related to measurement parameter
- Anisotropy
- Correlation length
- Ancillary data

1430 – 1530 – Logistics and planning for field surveys - Elder
- Teams and training
- Division of labor
- Group size
- Coordination with other measurements – aircraft, satellite
- Tracking in situ changes during field campaign
- Data handling and records

1530 – 1600 – Safety in the field – winter operations - Starr
- Accidents and trauma
- Communications
- Avalanches and other hazards

1600 – 1630 - Course wrap up and evaluation
- Outstanding questions
- Questionnaire – fill out written, anonymous course survey
- Comments

1700 – 1900 Dorm – Dinner

1900 – 2100 – High Arctic Traverses – Staying alive and getting useful data - Sturm

Day 4, Friday, January 10

0700 – 0800 Breakfast

0800 – 0900 Clean dorm – check out

Snow Depth Lab

Mechanics:

Instructors:

- introduce manual depth probes, Magnaprobes, and Federal samplers in lab
- explain advantages and disadvantages of all tools
- explain basic methodology and advanced techniques

Students:

- assemble depth probes sets, Magnaprobes, and Federal samplers in lab

Outcome:

Students will:

- be comfortable cleaning, assembling, disassembling, and maintaining tools
- understand basic measurement techniques

Methods:

Lecture – brief , history, demos, data sheets

Hands on tools

Snow Depth Trials

Mechanics:

Instructors:

- assist students in field

Students:

- assemble depth probes sets, Magnaprobes, and Federal samplers in field
- learn how to use these tools in the field
- examine ground conditions at measurement points and assess affect on measurements

Outcome:

Students will:

- be comfortable assembling tools in field
- gain experience collecting high-quality measurements
- know how to fix measurement problems
- understand external factors that affect measurements

Methods:

Three groups of six

Limited tool sets (Magnaprobe and Federal sampler) so need to have common tool sites

Manual probes
Magnaprobe
Federal sampler

Probing and sampling - digging out probes to see what tip is doing
Short transects – repeat measurements, record and compare differences
Problems and solutions

Ground cover and condition – frozen, organic layer
Stratigraphic and basal ice lens and crusts
Over- and under-measurement

Probe-A-Thon – Field Portion

Mechanics:

Instructors:

- assist students in field

Students collect:

- high-resolution depth data using manual depth probes and Magnaprobe
- moderate resolution SWE data with Federal sampler

Outcome:

Students will:

- be comfortable using manual depth probes, measuring depths to 1 cm accuracy with 1 m horizontal resolution
- gain experience setting up and using Magnaprobe
- know how to initialize and end Magnaprobe data acquisition
- know how to collect SWE transect data using a Federal sampler

Methods:

Students working in small groups
100 m transects
Measure to distal point and return to origin
Exchange tool with other group and repeat transect with other tool
Repeat with third tool

Manual probe resolution – 1 m
Magnaprobe resolution – single step ~1/2 m
Federal sampler resolution – 5 m

NASA iSWGR Snow School – Field Section
Probe-A-Thon - Lab Portion

Mechanics:

Instructors:

- assist students in lab

Students:

- download manual field data to spreadsheets or preferred data analysis package
- graphical data visualization of measured transect values
- conduct basic statistical analyses on each parameter (mean, variance, etc.) including manual depth, Magnaprobe depth, Federal sampler depth, density and SWE

Outcome:

Students will:

- learn how to download and process Magnaprobe digital data
- understand the differences in data uploading, reduction, analyses between methods
- understand the differences in accuracies and uncertainties between methods
- be able to graphically represent transect data and perform basic statistics
- be able to combine high-resolution depth data with low-resolution density data to produce SWE linear SWE transect
- understand the strengths and weaknesses of different tools and methods

Methods:

Use laptops
Spreadsheets
Stats/math software – Matlab, R, SAS?
Present transect results to group using digital projector

Exploratory Pits

Mechanics:

Instructors:

- demonstrate pit techniques and tool use through snow pit

Students:

- excavate and prepare snowpit for sampling
- practice using thermometers, density samplers, pocket microscopes, and cameras

Outcome:

Students will:

- be introduced to and use snowpit analysis tools
- understand sources of error in measurements and how to minimize error
- understand how to manage pit measurements to decrease time and increase accuracy

Methods:

Work in pairs with complete set of tools

Instructors will divide students in to three groups (six each) and work with them in big pit

Stratigraphy and Photos

Mechanics:

Instructors:

- demonstrate tools – loupes, pocket microscopes, crystal cards
- demonstrate techniques for delineating stratigraphy
    - brush, knife, hand hardness
    - identifying grain type, quantifying grain size
- demonstrate grain photography techniques
    - collecting, photographing, and using effective metadata techniques

Students:

- examine stratigraphy, identify dominant metamorphic regime
- postulate weather and snowpack history that lead to observed grains
- estimate grain size using pocket microscope with reticule, loupe with crystal card
- record grains with digital camera and record metadata

Outcome:

Students will:

- gain experience in delineating relevant stratigraphic changes in the snowpack
- gain experience in defining grain type
    - students should be able to determine major processes (equilibrium, kinetic)
- understand how to photograph snow crystals for data records and record metadata

Methods:

Instructors will divide students in to groups (six each) and work with them in pits

Full Data Pits – Field Portion

Mechanics:

- Instructors:
  - assist students in field
- Students:
  - excavate and prepare snowpit for sampling
  - measure and record
    - temperature profile
    - density profile
    - hand hardness profile
    - stratigraphy profile: grain type and size
    - photo record of layers identified in stratigraphic analyses (with metadata)

Outcome:

- Students will:
  - know how to collect and record full data pit information

Methods:

- Work in pairs with complete set of tools
- Instructors will divide students in to pairs
- Each pair will complete their own full data pit

Snowpit Data Reduction and Analyses – Lab Portion

Mechanics:

Instructors:

- will demonstrate and assist students as needed

Students:

- calculate snowpit profile statistics
  - mean layer density
  - mean grain size
- plot
  - temperature profile
  - density profile
  - hand hardness profile
  - stratigraphy profile: grain type and size
- archive grain photos
  - edit photos
  - name appropriately

Outcome:

Students will:

- know how to reduce and analyze full data pit information

Methods:

Work in groups on laptops

Results will be shown to group with digital projector

Designing a Snow Survey

Mechanics:
- Instructors:
  - lecture including theory and examples
- Students:
  - observe

Outcome:
- Students will:
  - know how to apply field techniques they learned in course with sampling practice and theory to design a field survey

Methods:
- Powerpoint presentations
- Discussions
- Case studies
- Student designed surveys to answer specific scientific questions provided by instructors