

## **Snow Processes slide narrative**

### **Why Snow?**

Snow is important for the energy balance at the global scale, it reflects the sun's energy.

The chemistry of the snow is important for the bacteria, plants and animals that live within snowpacks. Snowpacks are an important fresh water resource for drinking, hydro-power and agriculture. We can also use snow to reconstruct past climates. Snow can have a damaging effect, unstable snowpacks can cause avalanches, melting snow can cause flooding, shallow snowpacks or early or late snowmelt can cause droughts and a change in snowmelt timing can increase the chance and frequency of forest fires.

Ice mass balance changes.

Snow plays an important control on the Biogeochemical cycles of Carbon, Water and Nitrogen as it is an important store of water, which can insulate the ground from harsh temperatures enabling plants and animals below to survive over winter.

Economically snow is also important for leisure activities of skiing, hiking etc..

### **Why Remote sensing?**

The measurement of snow properties in the field can be unreliable. There are often logistical challenges in just getting to field sites. Even when meteorological stations have been established there are often problems with the data. Ground based point scale measurements are useful yet snow is highly variable across spatial and temporal scales, so point measurements can only ever provide small scale specific point information. Snow is easily picked up and re-distributed by wind. Satellites can provide frequent measurements of snowpacks globally at relatively high resolution.

### **Existing MODIS AMSR-E**

This image is from a satellite called MODIS which can see the visible light we can. You can make the beautiful pictures like this of the UK in January 2011. You can clearly see snow here, but you can also see clouds. They are both white and present an interesting problem. If we want to remotely sense snow cover from space how can we tell the difference between snow and clouds? ASK AUDIENCE

### **Existing MODIS AMSR-E - click**

Well, scientists have worked out that by using Infrared measurements at the same time you can tell the difference between clouds and snow from space.

This means that we now know every week where there is snow cover in the world with good accuracy.

However, it's not just where snow is that is important. It is useful to know how thick it is, how dense it is, and how it interacts with vegetation.

### **Measuring Snow Properties**

When we measure snow from space the signal received by the satellite is affected by the properties of the snow. For example at the top here we have an image from the Central Antarctica, here precipitation and snowfall is so low it is considered a desert. The image shows Megadunes, we could not measure these on the ground as they are just too large to see, on average they can be 20m high,

2-10km in width and up to 100km in length. Satellites can be used to distinguish these properties from space.

On the bottom right here we have a photograph of the crystals on snow surface. A very smooth snow surface will behave differently to a rough snow surface shown here.

On the left here we have a photograph of someone taking measurements of snow density. This provides information on how much water there is contained within the snow.

These properties of the snow all directly affect the signal received by the satellite. We have to understand how these change over time and over the landscape to understand what the satellite is measuring.

### **Future Challenges**

We know where snow is, but from space we can't see through it, so we can't tell how thick it is and therefore how much water is in it. But satellites can by using microwaves.

The earth emits microwaves, snow partially blocks these microwaves, so the more snow there is the fewer microwaves we see – but this varies with different types of snow.

The signal received by the satellite is also confused by the presence of vegetation and precipitation.

Scientists study snow properties and processes to try and solve these problems, there are still a lot of challenges remaining.