What is really happening to the Greenland icecap?

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The Greenland ice cap has been a focal point of recent climate change research because it is much more exposed to immediate global warming than the larger Antarctic ice sheet. Yet while the southern Greenland ice cap has been melting, it is still not clear how much this is contributing to rising sea levels, and much further research is needed. A framework for such research was defined at a recent workshop organised by the European Science Foundation (ESF).

"The main objectives were to establish current understanding, prioritise research needs, and develop proposals," said one of the ESF workshop's convenors, Professor Tavi Murray from the Glaciology Group at Swansea University in the UK. "I believe we did the first two very well and laid the ground for developing research proposals."

While recent observations indicate that the Greenland ice cap is melting fast, it is uncertain how much this is contributing to sea levels, as co-convenor Carl Bøggild, from UNIS in Svalbard explained. "A major challenge is to determine what fraction of melt water really runs off, because in many places the melt water will just drain into the cold snow and refreeze," said Bøggild.

One way to determine how much water is running off is to measure not just the area of the Greenland ice cap but also its thickness, but this is much more difficult. Alternatively, the run off process can be tracked both on the ground and by satellite, preferably integrating the two, as was discussed at the workshop. The need to establish a database of

ground based observations, including run off, as well as the ongoing calving of ice bergs from the ice cap and occasional events such as earthquakes beneath the ice was discussed.

Perhaps the greatest immediate challenge identified at the workshop though lies in reducing the high levels of uncertainty over the current and future behaviour of the Greenland ice cap, and reconciling the many conflicting observations and predictions. In the case of the meltwater, estimates of the annual total vary by a factor of five from 50 gigatons (GT) to around 250 GT, and this level of uncertainty makes future predictions almost meaningless. "Laser satellites can detect elevation changes within 10 cm accuracy - but do not consider compaction of the snow," said Murray. "Other satellites using radio waves have a problem with penetration of the signal into the snow. And, yet another method from satellites, measuring the 'weight' of the ice sheet covers too large areas - so you also detect weight changes outside the ice sheet." But at least these multiple sources of data have the potential of being combined to yield more accurate estimates.

Not surprisingly, given these uncertainties, it is unclear even what the immediate future holds for the Greenland ice cap. As Murray noted, recent high levels of thinning in the south and around the edges have taken climatologists by surprise, but there is no guarantee it will continue. "There is much uncertainty presently, because observations of thinning have come as a surprise," said Murray. "We can basically say that three scenarios are possible regarding the enhanced thinning which has been observed recently. One is that it will keep escalating. Secondly it may remain constant even though the climate gets warmer, and thirdly the enhanced rate of thinning may stop altogether, with future thinning being purely the result of melting."

It is not clear yet which of these scenarios will transpire, but Murray and Bøggild are convinced that the ESF workshop has prepared the ground

for substantial progress, by bringing together the relevant diverse skills in glaciology, climatology, geology, modelling and satellite imaging. The workshop, Sea-Level Rise From The Greenland Ice Sheet, was held in Mallorca, Spain in May 2008.

Source: European Science Foundation