Questions on cold weather waxing and high floro waxes

WIth the cold weather and cold snow that we are just experiencing I've been asked, especially by some of our skate skier contingent, on what to wax for minus 16; minus 20 or lower temperatures with new or newly renovated snow so as to get better glide.

First review my article on ski base preparation and structuring. For cold snow with relatively sharp snow crystals you need almost a mirror smooth polished running surface to maximize capture of the little bit of available microscopic water molecules under the skiis that you glide on. The Swix Ski wizard and J.P. Squires article on waxing that can be found elsewhere in the Nickel Plate website are also good resources to review for proper waxing technique and specific waxes that can be used at different temperatures. In this case, the wax wizard reccomends CH 4 as a glide wax and VR 30 as the kick wax for minus 20 C temperatures with 40 to 60% relative humidity on new or fairly new snow. The swix CH 4 is a hydro carbon wax recommended from -10 to -32 C. Toko makes a highly flourinated dibloc blue glide wax that is recommended for -12 to -20 C. The toko grip wax would be either their green (very thin layers and try to shorten the kick zone) or their turquoise. Toko also makes a interesting product call the x-cold powder which is a hardwax added on top of existing hard glide wax to harden them and is good for temperatures below -15 C. Briko makes a B3G green glide wax for -10 to -30 C temperatures and their classic green hard grip wax can be used from - 10 to -30 C if you adjust the length and number of layers. Then there is Start, Solda, Star, Rode, Rex, Kuu and Fast Wax to name a few other brands. Each have recommended glide and grip waxes formulated for specific conditions and you won't be too far wrong if you go by what's recommended on their labels.
The key is smooth application and thin layers. For glide wax, it is crucial that you hot wax the wax so it penetrates the skii pores. A review of snow structure, and how snow changes is in order as is a bit closer examination of the three crucial factors that determines which wax to chose. If you are Innuit, you would have many words for the different types of snow and how it changes over time with different temperature conditions. The Swix wax wizard only have 3 categories of snow but we know that there are many more. When you see the classic snow flake you see something with lots of sharp points. The hardness and how sharp the crystalline structure of the snow crystal determines how much the snow crystals penetrates into the wax. The sharp snow crystals maintains it's structure better with colder temperatures and is harder. Over time the snow crystals break down and amalgamates and loses some of its' sharp points. Renovation with snow grooming equipment serves to both compact the snow and to smooth out some of the sharp points. Pressing tracks on the snow further compacts and smooths out the snow crystals (which is why you often get better grip out of the track then in the track). Grooming also serves to homogenize the snow so that it is more consistent in both structure and temperature. When you get really old snow, rototilling with the renovator breaks up some of the crystals so you renew some of the sharp points and somewhat rejuvenate the old snow so it acts a bit like a newer snow.
The first crucial factor that determines the wax to use is the snow structure (is it sharp hard crystals or smoothed rounded crystals or glazed ice etc.) The sharper and harder the snow crystals, the harder the glide and grip wax need to be sothat the snow crystals do not penetrate too far into the wax. A quick aside on wax and what it happening to it on your skiis. Wax penetrates into your ski base in the order of a generally less than the thickness of the human hair. The better the base, the bigger the microscopic pores in the base and the better the penetration of wax into the base. As you ski the wax comes out of the pores of the ski base and interacts with the snow crystals and, if you have a good ski base, then you have a bigger reservoir of wax to ooze out of your ski base and you can ski further without wearing out your wax That's why when you hotwax your glide wax you want to progressively add succesive fairly thin layers of wax, as each time you heat the wax, it drives it a little deeper into the pores of your ski base (up to the limits of how deep and interconnected you ski base pores are). If you have too much wax on your skiis, then unless you have perfectly matched the hardness and composition of your wax to the snow crystal, then you will get either too much or too little penetration of the snow crystal into your wax. Glide waxes should be slightly harder than the snow crystals so that it presses down on the snow and creates moisture and then interacts with the snow to lubricate the skiis. That's why you plastic

scrape most of the glide wax off after hot waxing it onto the skiis as it's almost impossible to get just the right wax to match the snow. Grip waxes should be slightly softer than the snow crystals so that when you press down on the snow with the grip wax the snow crystals penetrates into the wax and you grip, then releases when pressure is off so you can glide. It's a fairly fine line.
The second crucial factor is the snow temperature. Yup you heard me right, snow temperature not air temperature. It's the temperature right on the surface of the snow that you are interested in, as that is what is affecting the snow. The air temperature only gives you an indication of the trend that the snow temperature will be in the next few hours. When you measure the snow temperature, make sure that you measure it within a half centimeter or less of the snow surface. Snow is an excellent insulator and the snow temperature can be much warmer (or colder depending on what conditions have been) just a few centimeters down from the surface. Colder usually means harder crystals, meaning harder waxes. An exception is ice which requires harder glide wax but soft klister wax for grip.
The third factor which is somewhat less crucial is the relative humidity right near the surface of the snow. This determines how much free moisture is available. The more humid, the more moisture available and generally the slippyer the conditions, so softer waxes. However high humidity plus wet snow equals sucktion between water molecules in the snow and the ski surface, hence the need to get rid of the excess free water, ie structuring. This is the time when the high floro waxes come into it's own as highly fluorinated waxes tends to make moisture bead up repelled from the ski base. In low temperature low humidity situations, highly floro waxes is a waste of money. As usual there is an exception, and that is if the snow is highly aggessive and abrasive and you are skiing a longer distance, then adding some high floro waxes will increase the durability of the glide wax.
So the ultimate question: what wax to use? The Norwegian and Swedes and Italian teams usually have 9 to 12 wax technicians plus a meterologist when they are testing for important events. They've already had teams out at Callahan Olympic Park, site of the 2010 Games for the last 2 seasons. The conditions there are unique and challenging. You can get dry powder snow then a coastal storm can come in and you get coastal slop, then a cold spell can hit and you get frozen mush - all within a few days! What the wax techs are looking for is what the snow and conditions are in different parts of the race course. They look at snow crystal structure, differences in the high point of the course vs. the low point, differences in the sun vs. the shade. How this changes with changing temperature (snow and air) and humidity and of course what waxes work in specific conditons. Often new waxes are developed specifically for a venue and games. Already there is the Callahan hairys waxless skiis that have been developed and used during last seasons Canadian Championship. Rumor is that Fisher is developing a new skiis designed just for Callahan valley. They have glide wax technicians, specifically charged with testing for glide. In glide testing they have a number of matched pairs of skiis, that is skiis that are as alike as possible with the bases then identically treated (base prepared, structured and glide wax identically, at least 10 coats of the same glide wax initially). Then they mark a 60 to 100 meter length of slightly downhill uniform track where they set up electronic timing lights. They run each of the marked pairs of skiis at least 4 to 12 times through the marked coarse, timing them until the times are pretty consistent for each of the pairs of skiis. During each run you have the same skier doing the skiing using the same technique and protocol for each run. Then you take the at least 4 (more if you have time) of the runs that are consistent and get an average time for each run then zero that time to the fastest pair of skiis. So your fastest skiis would be 1.00 then the slower skiis would be some small percentage above that so that when you multiple it out they all come out with the same time. Now you are ready for glide wax testing. Apply different glide waxes (at least 2 layers of the new glide wax is better than just the one layer) to the different pairs of skiis that you want to test (obviously if the more test pairs of matched skiis that you have the faster the wax testing will be). Do the ski off as before when you were zeroing the test skiis. When you get at least 4 consistent results you then can multiple the times out with the zeroed factor then you can compare which glide wax makes the skiis go faster. Often the results are within hundreds of a second. You continue testing different glide waxes (different brands within the range for the specific condition) until you run out of different waxes, time or conditions change) always keeping one pair of skiis as a standard with the same glide wax so you can compare. Typically you use as the standard the fastest tested glide wax from the first round of testing, making sure you clean and rewax with at least one layer of that wax with each round of wax testing. Meanwhile you have another team of wax

technicians with their own set of matched test skiis testing for structure (if you enough techs, otherwise the glide testers will have to do the structure test). Often you also then test for additives to the glide wax, such as to apply floro or not etc.

The grip wax testers have it slightly easier. Grip wax testers are typically ex racers of the same level as the competitors. They have to be able to ski the specific portion of the race course using the same technique and at approximately the same pace as the competitor. A wax technician marks the test pair of skiis so that they can be identified. Without the skier knowing (blind test) the waxer then apply the grip wax(es), a different one on one of the skiis then on the other. The wax tester then goes out and ski parts of the course (usually the trickest part for grip) and report back to the waxer and rate each of the skiis from 1 to 5 as to grip and relative glide (with 5 being dynamite grip, bombprooof for grip and 5 for glide as being really free and good glide). The waxer then cleans off the skii with the poorer grip and glide and puts on a different grip wax combo and the skier does the test again and again and again until they run out of grip wax combo ideas, waxes, or time or the condition change. When they come up with grip waxes which are 5's (or as close to as possible) in both grip and glide, then the skier has to test for durability (if there is a question of durability). Often, if the glide and grip test teams get it together in time, they do the durability test with both the recommended grip and glide waxes so they can test both at once, otherwise they do it separately. Now keep in mind that the snow conditions can change drastically over different parts of the course. In Canmore the lower stadium and trails can be abrasive man-made snow while the higher trails can be all natural snow, if you've skiied in Salmon Arm, you know that upper elevation can use aharder wax while the lower elevation need a softer wax. Plus waxes react differently at different speeds, so coming down a long hill at 50 km/hr one wax might be faster than going up a hill at a crawl. Or a wax may be fast but is not durable enough, so you either cover it with something a bit more durable or use a additive to make it more durable. All this need to be taken into account by the wax team when they decide on the race wax of the day. You also have to take into account the specific technique of the athlete and the skiis that they have. Typically they will recommend a glide wax for all the athletes, then they recommend a number of grip wax combos - one may have better grip but less glide while another may have slightly less grip but better glide - the athlete then decides which works better for their particular style and skiis and test it before the race then adjusts if necessary.

I've done extensive wax testing on many different snow conditions with test matched pairs of skiis with timing lights so that results are accurate and reproducible. I've come up with a number observations. One, stick with one brand of wax, learn where it works and where it don't seem to work so well. If it does not work so well in certain conditions, look for another brand that might work better in those conditions. Generallly, unless you work with the national team or other wise have access to many numbers of exotic brands of wax, stick to one or two brands that is readily available. Swix seems to work better in more humid conditions than Toko. My theory is that Swix is mainly formulated and tested in Norway, right near the coast while Toko is formulated and tested in Switzerland which is inland continental in climate. For most of us, training time is the time to test for grip and glide wax. We usually only have a few different brands of wax to test and we usually do not have dedicated matched test skiis to test glide waxes, so a subjective test is best. For glide testing I recommend that you base treat both of your pair of skate skiis the same then put different glide waxes on each of your skiis. Go out and ski on them, switching skiis on your feet now and then and determine which of the glide wax feels like it's gliding better. That's what I did. For minus 18C new snow freshly renovated at about 65% humidity I found that the Briko B3Green seemed slightly freer glide then the Toko x-cold powder. I'm going to try out the Toko dibloc thermo blue (-12 to -20 recommendation) and the Swix CH 4 glide waxes today. Grip wax testing can be done like the pros. Whatever you do keep notes so you can start to build up your own databank of experience as to what waxes work best in different conditions.

For further info take a look at Cross Country Canada website under tips and the level 4 waxing ski preparation paper. Soon you will be the waxing guru that others look for advise!