Jan17 comments

I spent some time this afternoon playing with the sap flow gear and looking at the trends over the past week. I still don't have a register of which instrument sits in which tree, but this will happen soon. I finally resolved the issues I was having with the new modem and the new SIM card (separate from the Telstra issues). The new Netcom modem at this end simply did not like the line filter I use that allows the ADSL broadband to travel down the phone line. It took a while to figure out that this was the issue, and I finally resolved the problem today by replacing the old filter with a new and different variety. Now it all works just fine and once again it is quite easy to talk to the trees from my home base.

I still have one sensor/tree at Kamarooka that refuses to talk to me, so I need to get up there again soon to work out what is going on. I attempted to do this yesterday, but the alternator in the falcon had different ideas and it was not to be. I have given you the sap flow trends for all five of the probes/trees for most of the past week. Remember, there are ten traces because each probe has an inner and outer sensor. We measure at two different depths in the xylem (sap wood). I can't remember the distance between the two, but I think it is about 50mm.

I am really only looking at patterns at present so I have not plotted the detail from individual sensors on particular days. I want to see what they are all doing first so we get a sense of how they are responding to the very hot days and how that differs from the milder days. You can see there is a marked difference in response to the variation in temperature. On the milder days the shape of the graph is almost symmetrical, whilst on the hotter days it is skewed toward higher values earlier in the day. On the hot days the trees reduce transpiration to deal with the intense conditions of bright light, dry atmosphere, and high temperature. As we have discussed previously these atmospheric conditions drive the leaves to pump more water than the rest of the organism can supply, so it has to reduce the water flow or risk collapsing (wilting) through water stress.

The other important point in this discussion is realising the trees have to process saline water in order to transpire. There is no fresh water left for them to access in the soil. They used all of that long ago. They now have to deal with the salty stuff that sits within the unsaturated soil and within the deeper capillary fringe above the saline groundwater. To extract the fresh water they need from the salty water have to overcome the osmotic pressure established by salt in the root zone. The latter is trying to pull water out of the roots. Equally, the trees do not want these inorganic salts getting across the root membrane into the plant cells. That would be sudden death. They have to leave almost all of it behind in the soil. One of the ways they achieve this is by producing their own internal organic salts (osmoprotectants). These reduce the osmotic potential across the root membrane. If there is more organic salt inside the trees then the pull from the salt outside is lessened. It is these organic salts that are the subject of the PhD study we have commenced in a partnership between NUFG, Swinburne University and the National Herbarium.

The separation of salt in the root membrane is interesting, perhaps fascinating and understanding of it is still a bit new. We now know that the roots contain a bunch of proteins that sit within the cell membranes of the roots called 'aquaporins'. These little guys allow water molecules to rapidly pass but prevent the passage of dissolved salts. We animals seem to have the same cells with the same function supporting our kidneys and a bunch of other organs. They were discovered by an American scientist, Dr. Peter Agre in the late 1990s. He received the Nobel Prize in Chemistry for his work in 2003. I found this

a really interesting story. Even after so many years of looking at these things we are still building our knowledge of some of the fundamentals.

I am not certain that we understand the rates of saline water extraction for transpiration in our trees but I sense it is limited. We cannot simply wind up the atmospheric/plant pump on hot days and expect the filtration process across the root membranes will keep pace. The fact that our eucalypts clearly have the capacity to regulate their water use is interesting because it says that they have evolved to cope with both aridity, and high salt stores. This....of course is another story.

Perhaps I should also say in closing that the plantations at Kamarooka are not at all stressed by the hot weather of January 2010. They are simply moderating their behaviour to accommodate the climatic circumstances.