Subject: revision to PLWCC code
Al Cooper
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Background

The code for processing the King probe was recently revised to incorporate three Nu-Re relationships for the GV and to update the leading coefficient to zero the results when out of cloud. That new code is in use in CONTRAST (Feb 2014).

Present Processing Code

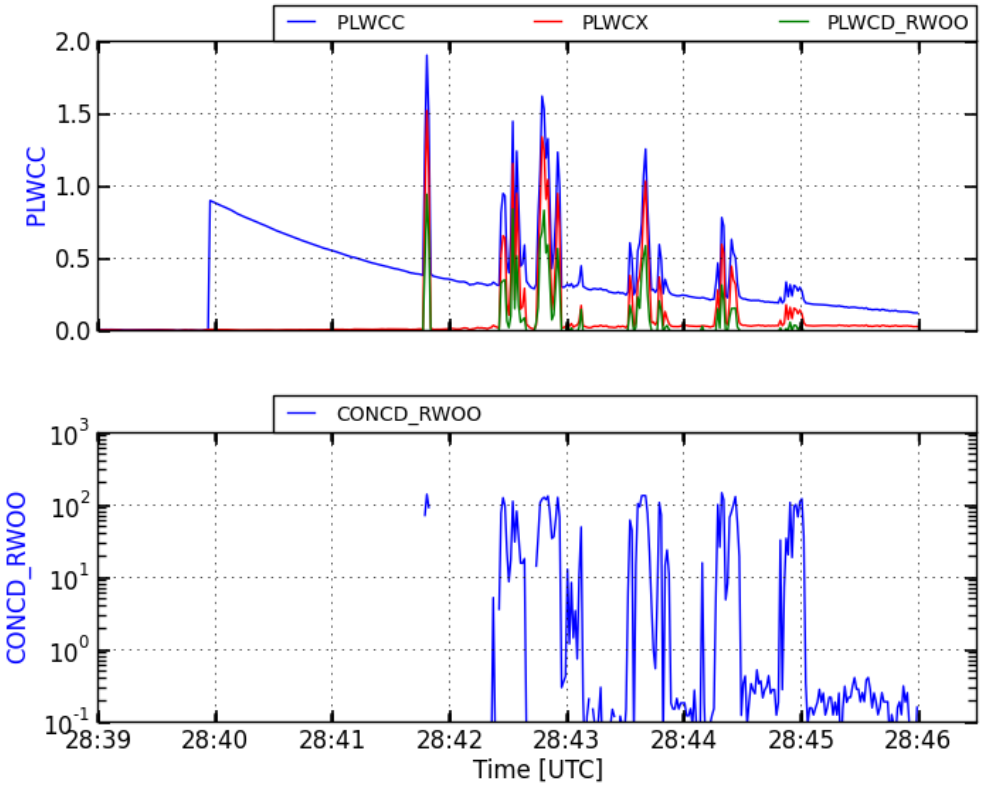
See the draft tech note on processing algorithms dated 7 Feb 2014, available at this URL, and the previous note on PLWCC at this URL.

Reasons For Proposing Changes

In CONTRAST there are often spikes in the output that arise from transitions among these three regions. The reason is that on transition there may be discontinuity in Nu(Re) that arises from updating of the coefficients, which is different in the three branches (based on Re and TASX). It is better to make these transitions continuous by translating coefficients so that they match when the boundaries are crossed.

Analysis

The plot that follows shows the problem and the solution. The blue trace in the top panel is the King-probe processing as it exists now in CONTRAST. Just before 28:40, there is an abrupt spike to 0.9 g m^{-3}, associated with a drop in airspeed through 150 m/s. This spike is not real, and it then decays over the next 10 min or so, but it affects the measurement of LWC in a serious way. For example, the first real spike in LWC is measured to be about 0.4 g m^{-3} too large, at nearly 2 g m^{-3}. If the zero is adjusted just before 29:40 as described below, the sawtooth feature is eliminated (PLWCX in this plot, red trace) and the measurements appear to be corrected appropriately for the offset.



[[see the next page for the algorithm]]

Recommendations

Modify the algorithm as follows. (Changes from the previous version are highlighted in red.)

```
# at initialization only:
TASL = 0.
ReL = 0.
# -------
# each record:
# see algorithm note. It appears that three different relations
# are required to represent performance on the GV, so the following
# branches account for those three regions:
if CONCD < 1. and TASX > 50.:
    ANu = PLWC / (3.141592*L*cond*(Ts-ATX))
    if TASX < 150.:
        if TASL >= 150.:    # avoid jumps
            ANuc0 = ANub0 * Re**(ANub1-ANuc1)
        ANuc0 += (ANu / (Re**ANuc1) - ANuc0) / tauNu
    elif Re[i] < 7244.:
        if TASL < 150.:
            ANua0 = ANuc0 * Re**(ANuc1-ANua1)
        elif ReL >= 7244:
            ANua0 = ANub0 * Re**(ANub1-ANua1)
        ANua0 += (ANu / (Re**ANua1) - ANua0) / tauNu
    else:
        if TASL < 150.:
            ANub0 = ANuc0 * Re**(ANuc1-ANub1)
        elif ReL < 7244.:
            ANub0 = ANua0 * Re**(ANua1-ANub1)
        ANub0 += (ANu / (Re**ANub1) - ANub0) / tauNu
if TASX < 150.:
    ANu = ANuc0 * Re**ANuc1
elif Re < 7244.:
    ANu = ANua0 * Re**ANua1
else:
    ANu = ANub0 * Re**ANub1
Pdry = 3.1415926*L*cond*(Ts-ATX) * ANu # power required out of cloud
TASL = TASX
ReL = Re
PLWCC = Ckg2g * (PLWC - Pdry) / (L * d * TASX * ((ALHV0+ALHV1*Tb) + Cw * (Tb - ATX)
```

—- END —-