Six-Month (May 1 2012 – Oct 31 2012) Report for

NOAA CDR Project (Award No. NA10NES4400004)

Creating UTH-Related FCDRs from IR and Microwave Sensors Cross Calibrated by In Situ Measurements from Commercial Aircraft

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1. Overview

As stated in the original proposal, the objective of this project is to "*bring together all the upper-tropospheric humidity (UTH)-relevant radiance data from multiple satellites and process them to establish a long-term, global radiance record from which a climate data record (CDR) of UTH can be retrieved and UTH research may be conducted*". Since IR-based UTH CDR (from HIRS) has already been developed and is now operational at NCDC (Shi and Bates 2011), emphasis of this project is placed on microwave sensors, especially SSM/T2, that have not been well archived and calibrated before.

During the last six months, our research has been focused on the following areas:

1. Completed the merge of ISCCP cloud data with the SSM/T2.

2. Further inter-calibrate the NGDC version SSM/T2 data using methods discussed in John et al (2012), including: 1) SNO, 2) natural targets, and 3) zonal averages.

3. Inter-compare water vapor channel radiances from AMSU-B and SSM/T2. This part is still ongoing.

2. Research Progress

2.1 Completed the merge of ISCCP cloud data with the SSM/T2.

SSM/T2 UTH radiances are influenced by thick high clouds with large ice particles (e.g., cirrus anvil spawning from deep convection). Figure 1 shows an example. The whole CDR will be much more useful if cloud information is appended so that future users can decide to include or reject certain measurements when calculating UTH. Also, appending collocated cloud information will help future research concerning the influence of deep convection on UTH (e.g., Luo et al. 2012). Since early this year, we have started to write up code to merge ISCCP pixel-level data (30km and 3 hourly) with SSM/T2. Now, the work was completed. When newer version of ISCCP data (10km and 3 hourly) become available early next year, we will re-do the job. But it should be fairly straightforward, given the software has already been developed.

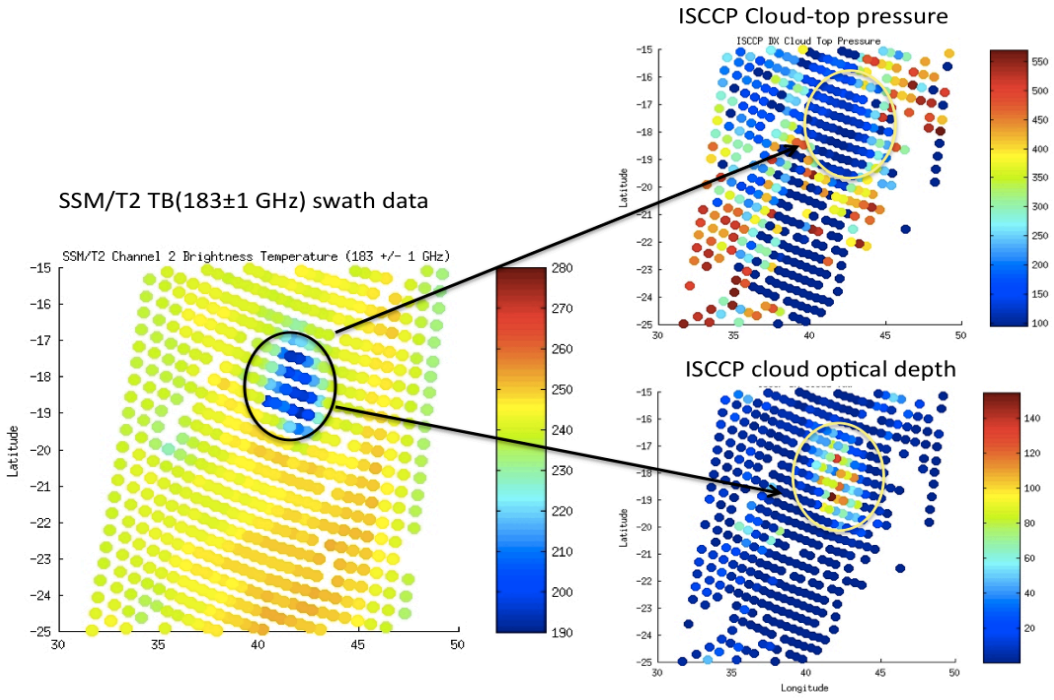

Figure 1. An example of contamination of SSM/T2 radiances by deep convection. As the yellow ovals on the right panels show, these clouds have cloud-top pressure < 200 hPa (upper right) and optical thickness > 50 (lower right). Such clouds can only be deep convection. They need to be labeled in order to generate a meaningful UTH CDR.

2.2 Further inter-calibrate the NGDC version SSM/T2 data

Ever since the beginning of the project, we've tried several calibration methods to inter-calibrate SSM/T2 data, including relative calibrations such as SNO and absolute calibration using collocated MOZAIC sounding data during takeoff and landing which were then fed into the Community Radiative Transfer Model (CTRM) to calculate the SSM/T2 brightness temperatures. Recently, we decided to follow a publication by John et al. (2012) and run three inter-calibration methods through the NGDC version SSM/T2 data simultaneously, with the purpose of seeking mutually consistent conclusions. These methods include: 1) SNO, 2) natural targets (such as Antarctica and tropical oceans), and 3) zonal averages.

While we are still trying to consolidate the results, a few robust conclusions already emerge. Taking the 183 ± 1 GHz radiances as an example, if we use F14 as the calibration base, F11 needs to be shifted downward by about 0.5K and F12 shifted upward by 1K. F14 and F15 seem to agree with each another fairly well until 2004, after which some weird disagreement is observed, which is still being investigated.

2.3 Inter-compare vapor channels from AMSU-B and SSM/T2 (ongoing)

In addition to SSM/T2, AMSU-B also provides UTH radiances. Our ongoing effort is to inter-calibrate AMSU-B against SSM/T2. This part has just started. We've

downloaded some AMSU-B data from CLASS website and made some straightforward comparisons. This task will continue and will be finished during the upcoming 6-month cycle.

3. Future plans

3.1 Research plans

As we are entering into the final 6 months of the project, we plan to wrap up the CDR. A few tasks that remain to be finished are:

1) Apply the same calibration procedures to ASMU-B water vapor channels
2) Finish inter-comparison/calibration between AMSU-B and SSM/T2
3) Merging ISCCP with AMSU-B water vapor channel radiances

3.2 Special request: 1-year no-cost extension

We request a no-cost extension of the project for one year (i.e., from May 2013-April 2014) to ensure a smooth closure and transition to NCDC. A few unexpected situations led to delays of the project. First, it took longer than expected to obtain raw SSM/T2 data and make out the data format (SSM/T2 data are poorly archived). At the beginning of the project, it took us some time to find and train a research associate who can work on the programming part of the project. Another important reason for the extension is to wait for the newer version of ISCCP (10km and 3-hourly) to become available so that the merged cloud-water vapor data will be up to date.

References:

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