Utilization of AAPP within ATPP-1

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I. Introduction

The Cooperative Institute for Meteorological Satellite Studies (CIMSS) has initiated the software design phase for the Advanced TOVS Processing Package (ATPP). In late 1996, visits were made to Meteo France, the United Kingdom Meteorological Office and the European Center for Medium Range Weather Forecasting to discuss collaboration on NOAA-KLM retrieval software development. Preliminary versions of the ATOVS and AVHRR Processing Package (AAPP) (Klaes, 1995) were obtained and an early assessment of the code revealed consistent processing strategies and code structure, and a significant amount of documentation.

It has been decided to base the ATPP on the existing AAPP algorithms for signal decommutation, calibration and navigation. By doing so, we will be making inter-changeability of data and algorithms much easier within the TOVS working group. We will add procedures for the use of AVHRR data to the AAPP, and the ATPP will benefit from faster and more universal inter-instrument collocation.

II. ITPP Program Structure

The International TOVS Processing Package (ITPP) is the result of research involving about 20 scientists, most of whom are members of the International TOVS Working Group. Although the package has benefited from cooperation amongst the working group, the code has been continuously evolving to meet the needs of the working group over the last two decades. Significant improvements were made in the fifth version of the ITPP to improve coding formats and documentation (Smith et al., 1995), but a coherent code structure remains lacking within ITPP-5, because a proper software design phase has been long overdue.

Examination of the ITPP-5 data flow diagram (figure 1.) reveals problems which have arisen due to the evolutionary nature of the package. There are three separate paths by which raw data enters; i) the traditional means for ingesting TIP data utilizing programs preinw, ingtow and tovprw; ii) the incorporation of model and surface data; and iii) the newly added means of inserting HIRS and AVHRR data for collocation and cloud clearing. Since the AVHRR use was a separate development within the McIDAS (Suomi et al., 1983), it utilizes a data structure for HIRS which is distinct from that traditionally incorporated within TIP data. This is unfortunate, but resources have not been available to eliminate the redundancy. A second redundancy can be seen in the two separate data files, labeled tovsorb.dat and tovssnd.dat, before the retrieval step. Both of these files contain the same calibrated, navigated and partially pre-processed HIRS and MSU data. One is in a format for easy input to the retrieval program while the other is in a format for efficient use by plotting and diagnostic support programs.

A further limitation of the ITPP algorithm has been an inefficient processing of AVHRR information. Due to separate application of spatial coherence (Coakley and Bretherton, 1982) and NSTAR (Smith, 1968) methodology, the algorithm actually reads the data two complete times instead of the necessary one time. It does not buffer lines since it must be capable of

processing an entire pass. Thus, it reads AVHRR data repeatedly for HIRS FOVs on the same HIRS line. It also does count-radiance-temperature conversions on all of the data rather than waiting to perform such calculations only on the result.

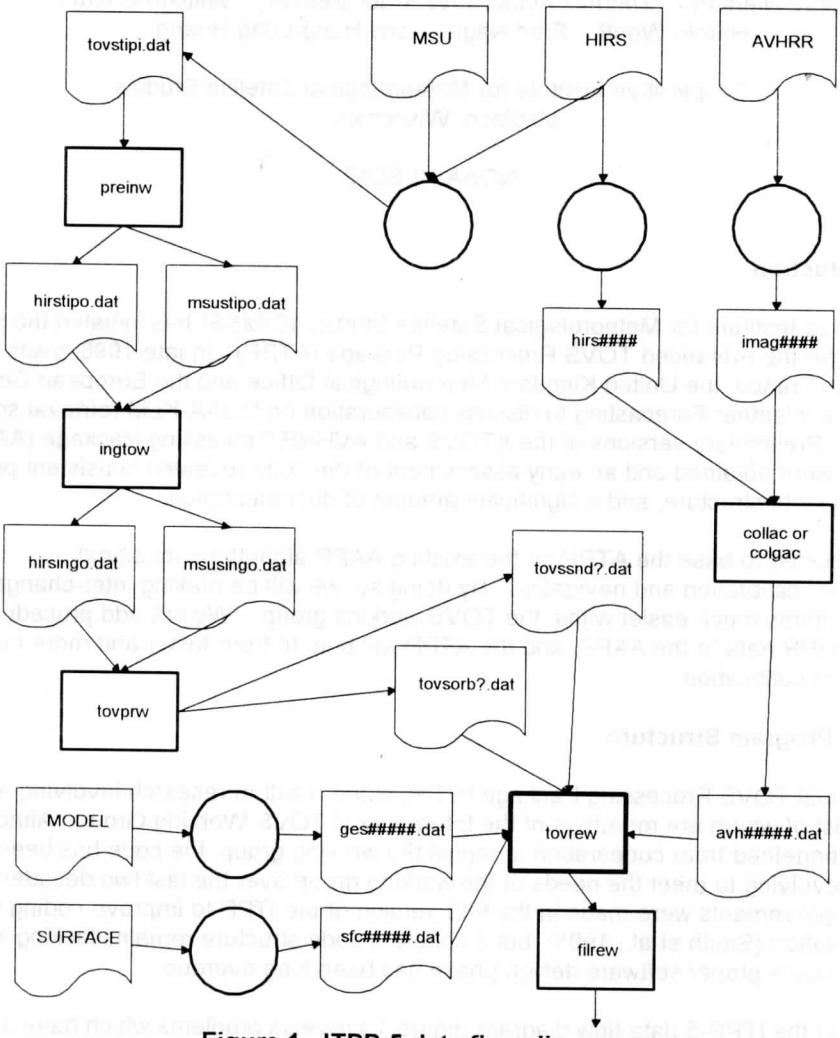

Figure 1. ITPP-5 data flow diagram

III. ATPP Software Development

CIMSS considers the advent of NOAA-K and AMSU as an opportunity to undertake a software design phase for the retrieval export package (ATPP). Clearly, the TOVS working group will wish to utilize the ATOVS and AVHRR processing package (AAPP) which is being overseen by EUMETSAT. By using AAPP calibration and navigation, CIMSS reinforces the commonality of methodology within the community. We plan to develop the ATPP in such a way as to conform to all AAPP input formats and most AAPP output formats. Thus, it may be possible in the near future to easily use one of any number of retrieval schemes from many centers. Intercomparisons between results will be much easier and the best ideas from all packages can be utilized to produce better retrieval algorithms worldwide.

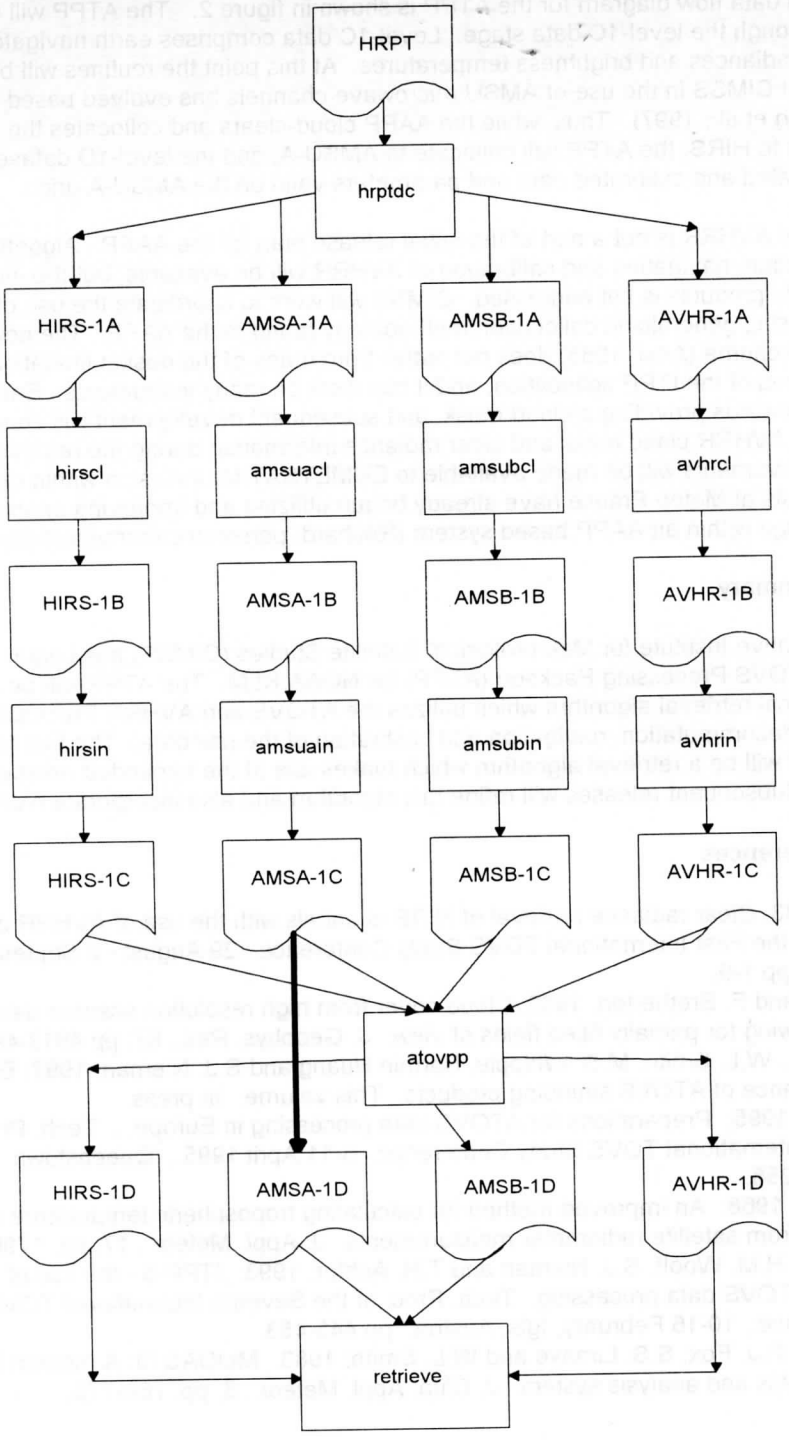

Figure 2. Proposed data flow diagram for ATPP-1. The bold line signifies that AMSU-A data will be processed at full resolution.

A proposed data flow diagram for the ATPP is shown in figure 2. The ATPP will rely on AAPP routines through the level-1C data stage. Level-1C data comprises earth navigated and calibrated radiances and brightness temperatures. At this point the routines will begin to differ. Research at CIMSS in the use of AMSU microwave channels has evolved based on the AMSU-A FOV (Huang et al., 1997). Thus, while the AAPP cloud-clears and collocates the other instruments to HIRS, the ATPP will collocate to AMSU-A, and the level-1D datasets will contain earth navigated and calibrated data and parameters valid on the AMSU-A grid.

Utilization of AVHRR is not a part of the initial release plan for the AAPP. Algorithms for the decommutation, navigation and calibration of AVHRR will be available, but the incorporation of that data into products is not addressed. CIMSS will work to coordinate the use of AVHRR into the ATPP using generalized collocation methodology found in the AAPP. The new Aoki based collocation scheme (Aoki, 1985) does not suffer from many of the design limitations that interfere with the speed of the ITPP collocation, and it can work on many instruments. Early releases will be geared towards providing a cloud mask, and subsequent development will concentrate on utilizing the AVHRR cloud mask and clear radiance information during the retrieval process. These improvements will be made available to EUMETSAT for inclusion within the AAPP, and in fact, scientists at Meteo-France have already begun utilizing and improving upon an ITPP based AVHRR usage within an AAPP based system (Rochard, personal communication).

IV. Summary

The Cooperative Institute for Meteorological Satellite Studies (CIMSS) has begun work on the Advanced TOVS Processing Package (ATPP) for NOAA-KLM. The ATPP will be an AMSU-A based physical retrieval algorithm which utilizes the ATOVS and AVHRR Processing Package (AAPP) for decommutation, navigation and calibration of the raw data. The first formal release of the ATPP will be a retrieval algorithm which makes use of the expanded microwave capability of AMSU. Subsequent releases will refine this algorithm and also incorporate AVHRR data.

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