AIRS/AMSU/HSB Version 4.0
Level 2 Product Levels and Layers

Edited by:
Edward T. Olsen

Contributions by:

Evan Fishbein, Sung-Yung Lee, Evan Manning

Jet Propulsion Laboratory, California Institute of Technology

March, 2005
Version 1.0

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, CA

Submit Questions to:
http://airs-inquiry.jpl.nasa.gov/feedback/feedback_form.cfm

Table of Contents

A Discussion of the AIRS Level 2 Products on Levels and Layers
and at the Top of Atmosphere and the Surface

Introduction

Please note in the discussion which follows, non-profiles are swath data fields dimensioned (**GeoXTrack**[30 elements], **GeoTrack**[45 elements]). Profiles are swath data fields dimensioned (**StdPressureLev**[28], **GeoXTrack**[30], **GeoTrack**[45]) in the case of standard product or (**XtraPressureLev**[100], **GeoXTrack**[30], **GeoTrack**[45]) in the case of support product.

Pressure Grids, Surface Pressure and Bottom Element of Profiles

The surface pressure, **PsurfStd**, is derived from the forecast sea level surface pressure and the topography provided by the digital elevation model (DEM):

$$\mathbf{PsurfStd} = \mathbf{P_F} \times \left[1 - \frac{\left(\mathbf{h} - \mathbf{h_F}\right)}{\mathbf{c_p T_s}} \mathbf{g} \right]^{7/2}$$

where $\mathbf{P_F}$ is the forecast sea level surface pressure; **h** is the altitude from the DEM; $\mathbf{h_F}$ is the forecast altitude; $\mathbf{T_s}$ is the forecast surface temperature; $\mathbf{c_p}$ is the gas constant; **g** is the gravitational constant. The forecast sea level surface pressure is interpolated to the AMSU FOV centriod, and the elevation is the average over the DEM within the AMSU FOV.

The fixed pressure grid for the AIRS Level 2 Standard Product, **pressStd**, contains 28 levels defined congruent with the World Meteorological Organization (WMO) standard pressure levels. Thus the highest pressure in the array is the first element. The 17 WMO standard pressures are a subset of this pressure array. The level spacing is closer together in the lower atmosphere.

The standard product profiles are filled, decrementing indices from the top of atmosphere (TOA), array element 28, to the near-surface array element at index **nSurfStd**. This bottom level is below the surface topography unless the pressure at the surface is within 5 mb of the pressure of the next **pressStd** level upward. In that case, **nSurfStd** is the index of that level and is above the surface. Entries in standard product profiles whose indices are less than this index must be ignored. They are customarily set to –9999.

Level 2 Product Levels and Layers

The fixed pressure grid for the AIRS Level 2 Support Product, **pressSupp**, contains 100 levels, and is the pressure grid used by the AIRS rapid transmittance algorithm (RTA) to calculate radiances. The order and finer grid were defined to facilitate diagnosis of the retrieval process and calculation of radiances from the retrieved physical products. Thus the highest pressure in the array is the last element. The level spacing is closer together in the lower atmosphere.

The support product profiles are filled, incrementing indices from the TOA, array element 1, to the near-surface array element at index **nSurfSup**. This bottom level is below the surface topography unless the pressure at the surface is within 5 mb of the pressure of the next **pressSupp** level upward. In that case, **nSurfSup** is the index of that level and is above the surface. Entries in support product profiles whose indices are greater than this index must be ignored. They are customarily set to diagnostic intermediary values during the retrieval process, and are not physically meaningful.

Temperature Profile

The standard product temperature profile, **TAIRStd**, and the support product temperature profile, **TAIRSup**, are both level quantities, i.e. they are the retrieved air temperature at the corresponding pressure level. Both temperature profiles vary linearly between levels, and **TAIRStd** is obtained from **TAIRSup** using linear interpolation with pressure. The surface air temperature, **TSurfAir**, is then obtained from the support product temperature profile, also using linear interpolation with pressure.

Let:

$$\mathbf{f} = \frac{\mathbf{PsurfStd} - \mathbf{pressSup}[\mathbf{nSurfSup}]}{\mathbf{pressSup}[\mathbf{nSurfSup} - 1] - \mathbf{pressSup}[\mathbf{nSurfSup}]}$$

The surface air temperature at **PsurfStd** is:

$$\mathbf{TSurfAir}_{\mathbf{PsurfStd}} = \mathbf{f} \times \mathbf{TAIRSup}[\mathbf{nSurfSup} - 1] + (1 - \mathbf{f}) \times \mathbf{TAIRSup}[\mathbf{nSurfSup}]$$

Moisture Profiles

The standard product moisture saturation profile, **H2OMMRSat**, is a level quantity and is the mass mixing ratio in gm/kg_dry_air on the **pressStd** level at which it is reported. It is derived from the retrieved standard product temperature (**TAIRStd**) at the corresponding pressure (**pressStd**) using software from the University of Oklahoma, Center for Analysis and Prediction of Storms. If the temperature is greater than 273.15 K it is calculated over water, otherwise the calculation is over ice. The code calculates saturation pressure and then converts it to saturation mixing ratio. The documentation in the code states it is a modified Teten's formula, but the expression is the Buck algorithm (Buck, A.L., new equations for computing vapor pressure and enhancement facor, J. Appl. Meteorol., **20**, 1527-1532, 1981).

The other moisture profiles in the standard and support products are layer quantities. Except at the top of the atmosphere, they are the mean for a layer whose bottom boundary is the pressure level at which they are reported and whose top boundary is the pressure level immediately above.

The standard product moisture profile, **H2OMMRStd**, is a layer quantity and is the mean mass mixing ratio in gm/kg_dry_air between **pressStd** levels. For **28 > J ≥ nSurfStd**, the value at level **J** is the mean mixing ratio between level **J** and **J+1**. For **J=28**, the value is the mean over the layer bounded by that pressure level (0.1 mb) and the TOA of the support product (0.005 mb). The mean mixing ratio in the layer bounded by the surface is equal to mixing ratio at **nSurfStd**.

The support product moisture profile, **H2OCDSup**, is the layer amount in molecules/cm^2 between **pressSupp** levels. For **2 < J < nSurfSup**, the value at level **J** is the amount between level **J** and level **J-1**. The value at **J=1** is the layer amount between that pressure level (0.0161 mb) and the TOA, 0.005 mb. The values of **H2OCDSup** below **nSurfSup** are zero and the value at **PsurfStd** must be interpolated or extrapolated in pressure to arrive at the amount from the surface up to level **nSurfSup -1**.

The value of **H2OCDSup** at the surface (at **PsurfStd**) is thus:

$$\mathbf{H2OCDSup_{PsurfStd} = f \times H2OCDSup\left[nSurfSup - 1\right] + \left(1 - f\right) \times H2OCDSup\left[nSurfSup\right]}$$

The retrieval algorithms use linear interpolation in pressure for the surface layer, which is equivalent to constant mass mixing ratio in this level.

Ozone Profiles

The standard product and support product ozone profiles are all layer quantities. Except at the top of the atmosphere, they are the mean for a layer whose bottom boundary is the pressure level at which they are reported and whose top boundary is the pressure level immediately above.

The standard product ozone profile, **O3VMRStd**, is the mean volume mixing ratio in molecules/molecules_dry_air between **pressStd** levels. For **28 > J ≥ nSurfStd**, the value at level **J** is the mean mixing ratio between level **J** and **J+1**. For **J=28**, the value is the mean over the layer bounded by that pressure level (0.1 mb) and the TOA of the support product (0.005 mb). The mean mixing ratio in the layer bounded by the surface is equal to mixing ratio at **nSurfStd**.

The support product ozone profile, **O3CDSup**, is the layer amount in molecules/cm^2 between **pressSupp** levels. For **2 < J < nSurfSup**, the value at level **J** is the amount between level **J** and level **J-1**. The value at **J=1** is the layer amount between that pressure level (0.0161 mb) and the TOA, 0.005 mb. The values of **O3CDSup** below **nSurfSup** are zero and the value at **PsurfStd** must be interpolated or extrapolated in pressure to arrive at the amount from the surface up to level **nSurfSup -1**.

The value of **O3CDSup** at the surface (at **PsurfStd**) is thus:

$$\mathbf{O3CDSup}_{\mathbf{PsurfStd}} = \mathbf{f} \times \mathbf{H2OCDSup}\left[\mathbf{nSurfSup} - \mathbf{1}\right] + \left(\mathbf{1} - \mathbf{f}\right) \times \mathbf{O3CDSup}\left[\mathbf{nSurfSup}\right]$$

The retrieval algorithms use linear interpolation in pressure for the surface layer, which is equivalent to constant volume mixing ratio in this level.