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Preliminary
Cloud – Aerosol IIR Infrared Pathfinder Satellite Observations (Calipso)

Wide Field Camera Subsystem Design Document

Data Management Team
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1.0 Overall Processing Flow

The Wide Field Camera algorithm flowchart is shown in ***Figure 1***. ***Figure 2*** shows the grid format and the calculations performed on each. A 5-km packet of data will first be read in. If this is raw data then the data will be outputted as a Level-1 calibration product; if not then the input subsystem will average the 125-m data to 1-km footprints such that the data structures will contain a 5-km by 61-km swath of 1-km footprints and a 5-km by 5-km swath of 125-m footprints. The center row and column pixel will be retrieved and the proper pointing vectors and dark current offsets will be read for each swath (e.g. 1-km and 125-m). With the proper pointing vectors geolocation can be performed obtaining latitude, longitude, and the viewing geometry products. If this is nighttime data then the digital count data will be outputted as a Level-1 calibration product. If this is daytime data then the pseudo radiance will be calculated for both swaths. The pseudo reflectance, and 125-m and 1-km homogeneity will then be calculated. The IIR registration will then be performed on the 1-km data as well as the pseudo reflectance and homogeneity calculation on the IIR grid. The Level-1 output product will then be generated. ***Figure 3*** shows the functions used in the WFC processing and below is the description of the specific functions in the algorithm.

1.1 Input Data Packet

Initially a 5-km data packet will be read. If this data is the raw data then the data will be outputted as a Level-1 calibration product and a new packet will be read in. If this is not the raw data then this packet will contain the digital counts and the time. The data will have 28 1-km low-resolution pixels followed by 320 125-m high-resolution pixels then 28 1-km low-resolution pixels. The input subsystem will average the center pixels to 1-km pixels such that there will be the 61-km low resolution data followed by the 5-km high resolution data. The routine ***read_pack*** will read in this data.

The dark current offsets and the pointing vectors will also be read in at this point, if necessary. Anytime the center column or row changes or if this is the first time through the algorithm then this data needs to be read in. Prior to inputting the data an index will be calculated using the center row and column information. This index will be used to determine which dataset needs to be read in. This process is performed inside the routine ***read_off***.

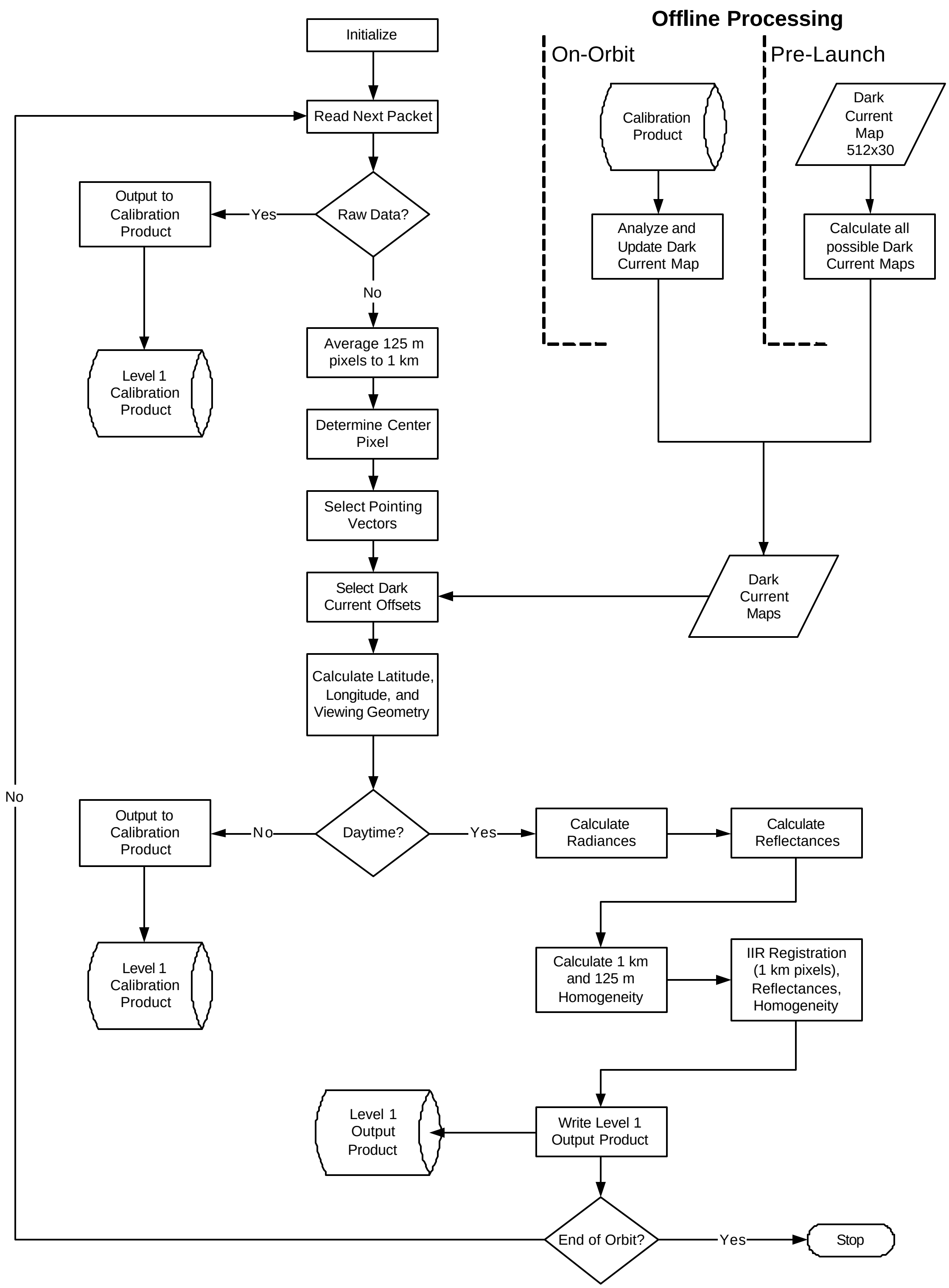

Figure 1 Wide Field Camera Algorithm

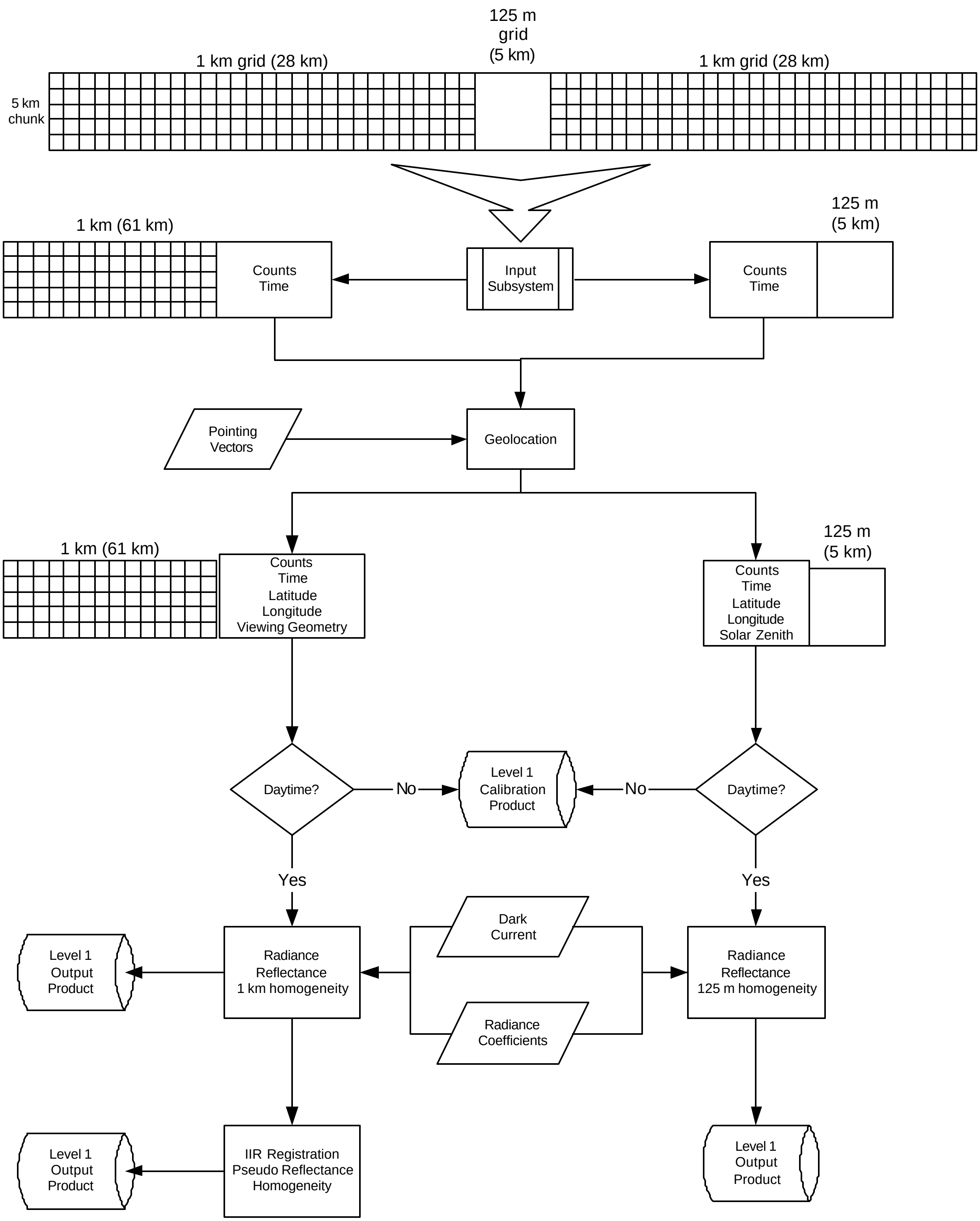

Figure 2 WFC Grid Format and Calculations

1.2 Geolocation

Input: Time, Pointing Vectors
Output: Latitude, Longitude, Viewing Geometry

Geolocation is the initial function to be executed in the Wide Field Camera algorithm after the data is read in. The latitude, longitude, and viewing geometry will be computed using the EOSDIS PGS toolkit routines. The CALIPSO time is converted to ASCII time, as the toolkit requires. The ECI frame vectors are obtained and then converted to ECR coordinates for use in the routine to get the zenith angles. The intersection of the ECR pointing vector will be calculated using the WGS84 ellipsoid. The routine ***WFC_geolocate*** performs the geolocation.

1.3 Radiances

Input: Digital Counts, Dark Current Map
Output: Radiances

The radiances will only be calculated for daytime data. If the packet contains nighttime data, then the digital counts will be stored in a Level-1 calibration product and the next data packet will be read in. If the packet contains daytime data then the radiances are calculated by subtracting the dark current from the digital counts. The radiances are calculated in the routine ***WFC_Radiance***.

1.4 Reflectances

Input: Radiance, Solar Zenith Angles
Output: Reflectances

The reflectances are calculated using the radiances and the solar zenith angles as defined in the ATBD. Reflectances are calculated on the high-resolution grid and the low-resolution grid using the ***WFC_Reflectance*** routine.

1.5 1-km and 125-m Homogeneity

Input: Radiances on 1-km grid and 125-m grid
Output: 1-km Homogeneity, 125-m Homogeneity

The 1-km and 125-m homogeneity will only be calculated for the daytime data and is defined as the standard deviation in radiance normalized by the mean as described in the WFC ATBD. The 125-m homogeneity is over the central 5-km high-resolution portion and the 1-km homogeneity is for the entire 61-km low-resolution swath. The homogeneity is calculated for each row. The routine ***WFC_Homogeneity*** performs this function.

1.6 Interpolation to IIR grid

Input: Radiances, Latitudes, Longitudes, Lidar Time
Output: IIR Latitudes, IIR Longitudes, Radiances on IIR grid
Reflectances on IIR grid, Homogeneity for IIR grid

The daytime WFC data will be registered to the IIR grid in the routine ***IIR_Registration***. First, the IIR grid will be calculated centering it on the Lidar footprint (routine ***createRefGrid***). Then the closest four WFC grid points are determined for each IIR grid point. WFC radiance data will be registered to the IIR grid by interpolation of the WFC 1-km grid using a four-point weighted mean (routine ***Interpolation***). Any IIR grid points outside the WFC grid will be set to a fill value. Reflectances will then be calculated using the interpolated IIR radiances (routine ***IIR_Reflectance***). The homogeneity will also be calculated for each row using these radiances (***IIR_Homogeneity***).

1.7 Output

At this point all the Level-1 output products will be written. If the data is nighttime data then the Level-1 calibration products will be written after the geolocation algorithm and there will be no writing to the Level-1 output product. The final WFC Level-1a data products will be on three grids: the IIR grid (1-km), the WFC native grid (1-km), and the WFC central 5-km swath native grid (125-m). Following the output of the data the next row is accessed and the steps are repeated until the end of file is reached. The data will be outputted in the routine ***Data_out***.

2.0 Offline Processing

The dark current maps are processed offline. Prior to launch Ball will supply a dark current map that will include all the exposed pixels (512 by 30). The 30 rows are the center rows of 512 rows of pixels. The center column and row in the data will always be between 253 and 259 so there are a total of 49 pixels that could be the center pixel. As a result, there will be 49 sets of dark current maps and pointing vectors for the 1-km swath and the 125-m swath. So, prior to launch, the dark current values will be based on measurements supplied by Ball. After launch, the calibration product will be analyzed to determine if the dark frame values need to be updated based on on-orbit measurements. Any updates will be incorporated into the dark current maps for the applicable center pixel. Note that since we cannot update the map for a given center pixel (e.g. one of the 49), the first time that a row or column shift is commanded to use a different pixel as the center pixel, the dark current map used will be based on the original Ball laboratory measurements. The dark current map for the new center pixel can only be updated after sufficient data has been collected. This could lead to a need to reprocess the data once a new dark current map is available. Each combination will be computed and stored in an HDF file that can be accessed by computing the proper index.

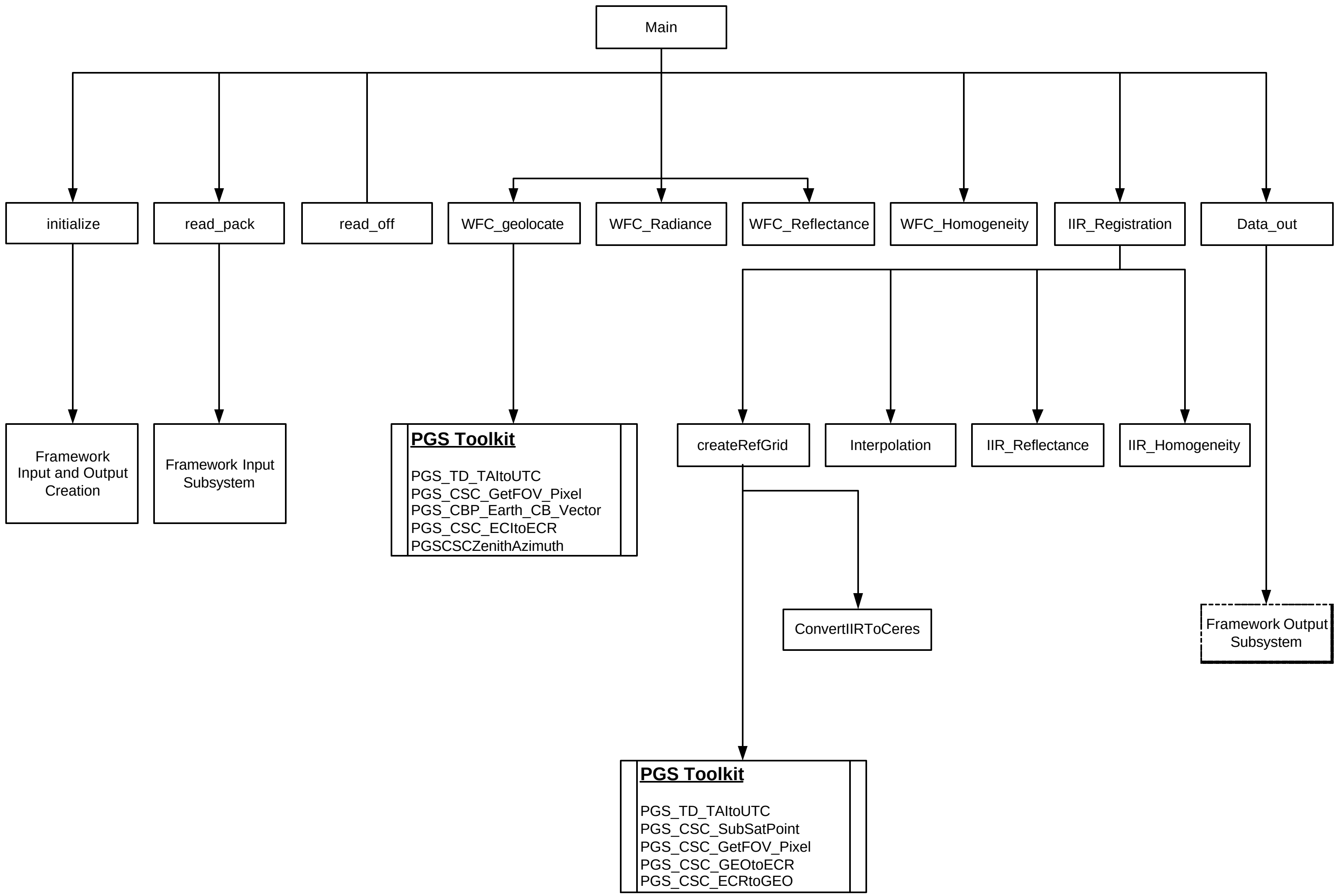

Figure 3 WFC Structure