Data Product Linkages

General users of JWST data may initially be concerned with only the most calibrated, combined science data products for a given target. Yet many other products are important to developing a full understanding the science data. This article summarizes the relationships between the science vs. other products, and their representation in the MAST Portal.

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Relationships Among Data Products

Many different data products, often hundreds or even thousands, contribute to the construction of a small set of high-level, most-combined JWST science products. They are all connected within MAST to one or more primary ***Observations,*** which are displayed as single rows in the MAST Portal results table. Users should be aware how all of these data products are related to the final Science products. This article describes the nature of these relationships; the article Linkages in the Portal provides a visual representation of how they are represented in the Portal user interface.

Associations

The term ***association*** is used within the JWST data management system to describe formally the connections among data that are essential in order to produce the highest-level products. See JWST Data Associations for details. Here are informal descriptions of the types of relationships that are included in associations:

Prerequisite

The products in this relationship support the proper execution of the science observations on the spacecraft, or provide evidence that observations were executed as planned. They do not contribute to science data processing.

- Pre-image (if obtained as a part of the program)
- Confirmation image

Antecedent

The input products for a stage of the pipeline are related to output products by a parent-child relationship. That is, Level-1b products for a given program, observation, visit, detector, and exposure are *antecedents* for their corresponding Level-2a products; L-2a are antecedents for L-2b, and so on. (See the Science Data Products article for information about product levels.) In addition, the association definition files are themselves required to specify the output child products.

Composition

Level-2b products, or the output of Stage 2 processing, are the final, calibrated science products *per-exposure*. Further processing by the Stage-3 pipeline produces L-3 products per *source* or *target* by combining L-2b products in a way that depends on the instrument configuration. That is, L-3 products for a given source or target are *composed of* L-2b exposure-level products. Here are examples of types of exposures from a given instrument, filter/grating that are associated by composition to form L-3 products:

- All dither positions
- All detectors in a camera
- All mosaic tiles within or among observations in a single program
- All segments of a (lengthy) time-series observation
- All orientations (for coronagraphy)

See the section *Types of Associations* in the JWST Data Associations article for an exhaustive list. See the article Linkages in the Portal for a visual representation of associations as viewed from the Portal.

Multiplicity

Some L-3 spectroscopic products are processed after combination to produce multiple derived products, e.g., one extracted spectrum per target.

Contemporaneous Calibration

Some types of calibration observations are obtained as a part of an observation, and near in time to specific science exposures. Contemporaneous calibrations are specific to the instrument configuration and to the specific target, and are used in science calibration processing:

- Arc lamp and flat-field exposures
- Astrophysical background exposures
- Reference PSF exposures in the same program for coronagraphy

Aggregation

Some anciliary data products are associated with the Observation, but are not used in the science processing to create the highest-level science products. These include:

- Intermediate products generated during calibration processing
- Guide-star products obtained during guided observations

Linked Data Products

Other products are also related to the science observations, though less directly than associated products. They are represented in MAST as ***linked*** data, and include:

- Contemporaneous guide-star observations
- Micro-shutter Array (MSA) Plan source catalog (NIRSpec only)
- Previews and image cut-outs generated to aid in data visualization within the Portal
- Links to data from other missions (applies to High-Level Science Products, but not currently to standard JWST products)

Contributing Products

The following kinds of data products are neither associated nor linked within MAST, although they do contribute to constructing the highest-level products in an Observation. They can be accessed from the MAST Portal via special mechanisms.

Calibration Reference Files

Static calibration products are used during pipeline calibration processing to remove some element of the instrumental signature, or are used to specify how output products are to be created from input products. These products are updated periodically to reflect some improvement in the calibration, or to capture a temporal change in a calibration.

Engineering Data

Engineering data are incorporated as header metadata in science data processing. The engineering data related to a specific exposure or observation are available in the Engineering Database interface.

External Pre-Images

Pre-images of a field from an external source (e.g., an HST program) may be contributed by an observer as an astrometric reference for a multi-object spectroscopic observation.

Minimum Recommended Data Products

Of the many different data products produced by the calibration pipeline, a subset has been identified as essential for extracting the intended science from the data. These are identified in the MAST Portal as "minimum recommended products" (MRP). The data products included in this set depends upon the the highest level product that is produced. Generally, products in the MRP include the most calibrated science products (i.e., those for which the instrumental signature has been removed, plus the combined products), but *exclude* anciliary products.

> ⚠ **MRP Checkbox**
>
> The MRP checkbox in the **Download Manager** must be de-selected in order to see and select raw or intermediate-level data products, and ancillary products, for retrieval. **Note:** Some L-2b products may also be appropriate for science analysis, but will not be visible if MRP is checked and L-3 products exist.

For Further Reading...

- Associations (JDox)
- Pipeline definition of Associations
- MAST Portal Guide