Browse strategy for MAJIS

10/09/2019

C. Pilorget, Y. Langevin, F. Poulet

Rationale

- **Limited downlink capability (2-3.5 Gbit/day)**

Rationale

- **Limited downlink capability (2-3.5 Gbit/day)**
- Should we limit the number of observations? Not many opportunities…

Rationale

- **Limited downlink capability (2-3.5 Gbit/day)**
- Should we limit the number of observations? Not many opportunities…
- We plan to observe significantly more (e.g. 3x), and then select the ones that are interesting

Rationale

- **Limited downlink capability (2-3.5 Gbit/day)**
- Should we limit the number of observations? Not many opportunities…
- We plan to observe significantly more (e.g. 3x), and then select the ones that are interesting
  $\Rightarrow$ Need to make a **selection based on specific criteria**

Rationale

- **Limited downlink capability (2-3.5 Gbit/day)**

- Should we limit the number of observations? Not many opportunities…

- We plan to observe significantly more (e.g. 3x), and then select the ones that are interesting
  - ⇒ Need to make a **selection based on specific criteria**
    - ⇒ **Browse product: we generate low data volume products to be downloaded within a few days. If the observation is "relevant" the corresponding datacube is downloaded (later).**

Rationale

- **Limited downlink capability (2-3.5 Gbit/day)**

- Should we limit the number of observations? Not many opportunities…

- We plan to observe significantly more (e.g. 3x), and then select the ones that are interesting
  - ⇒ Need to make a **selection based on specific criteria**
    - ⇒ **Browse product: we generate low data volume products to be downloaded within a few days. If the observation is "relevant" the corresponding datacube is downloaded (later).**

- **Highly target dependent:**
  - Europa => only 2 flybys
  - Ganymede => multiple observations, in particular at high spatial resolution
  - Callisto => multiple observations
  - Jupiter => long-term monitoring

Browse products strategy

- For each observation and each channel, **a maximum of 1 browse product** is generated (nominally 1 per channel)

Browse products strategy

- For each observation and each channel, **a maximum of 1 browse product** is generated (nominally 1 per channel)

- What **flexibility** do we have to generate these browse products?

  - ❑ spatial undersampling (beyond nominal data binning)
  - ❑ up to 32 wavelengths /channel (out of 508)
  - ❑ compression

Browse products strategy

- For each observation and each channel, **a maximum of 1 browse product** is generated (nominally 1 per channel)

- What **flexibility** do we have to generate these browse products?

  - ❑ spatial undersampling (beyond nominal data binning)
  - ❑ up to 32 wavelengths /channel (out of 508)
  - ❑ compression

- **32 tables for the VIS-NIR and 32 tables for the IR** will store onboard the parameters for these browse products

Browse products strategy

- For each observation and each channel, **a maximum of 1 browse product** is generated (nominally 1 per channel)

- What **flexibility** do we have to generate these browse products?

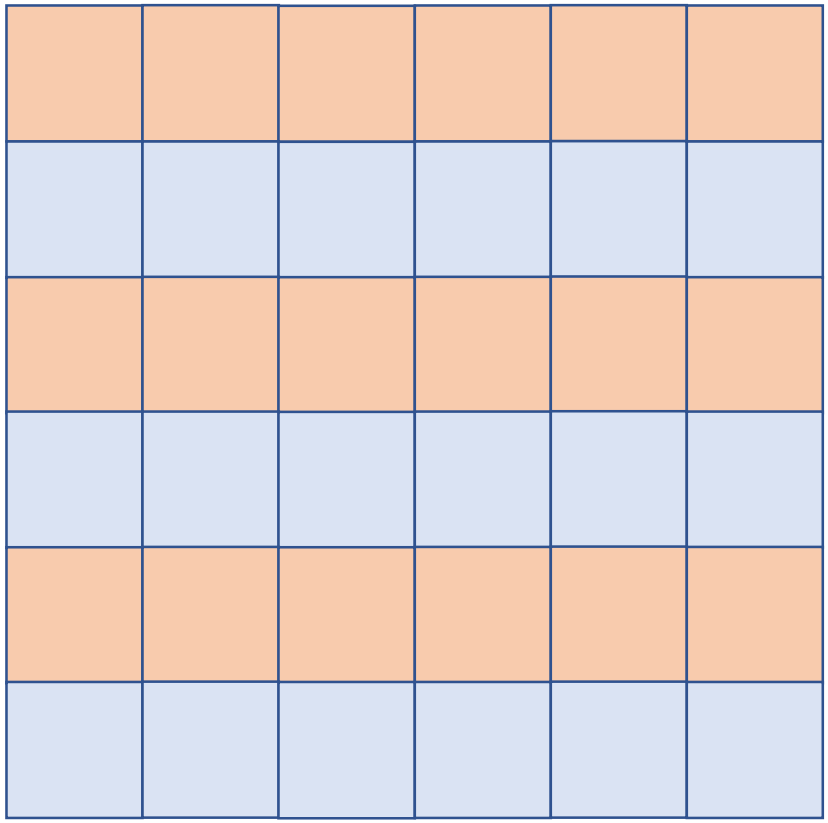
  - ❑ spatial undersampling (beyond nominal data binning)
  - ❑ up to 32 wavelengths /channel (out of 508)
  - ❑ compression

- **32 tables for the VIS-NIR and 32 tables for the IR** will store onboard the parameters for these browse products

- **Objective =>** 1 browse product should be typically **30x times smaller** than the nominal datacube.

Parameters

- **Spatial undersampling (selecting 1, 2 or 4 of 4 successive pixels, after nominal binning)**
  - Maintains data quality (spikes) at the level as the nominal data (vs binning)
  - Spatial scale of the heterogeneities



Pixels after 2x1 undersampling

Parameters

- **Spatial undersampling (selecting 1, 2 or 4 of 4 successive pixels, after nominal binning)**
  - Maintains data quality (spikes) at the level as the nominal data (vs binning)
  - Spatial scale of the heterogeneities

- **Spectral channels**
  - Any channels we want (**up to 32 out of 508**)

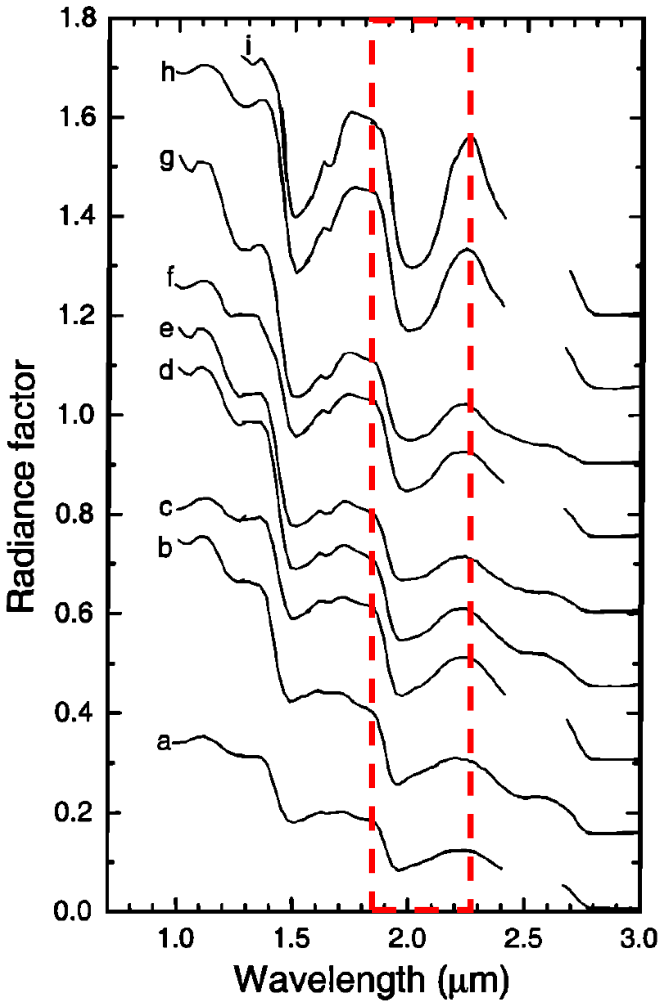
Parameters

- **Spatial undersampling (selecting 1, 2 or 4 of 4 successive pixels, after nominal binning)**
  - Maintains data quality (spikes) at the level as the nominal data (vs binning)
  - Spatial scale of the heterogeneities

- **Spectral channels**
  - Any channels we want (**up to 32 out of 508**)
  - Browse for datacube selection => need to identify which combination of spectral channels will be the most diagnostic (what information do we need to assess if an observation is relevant or not?)

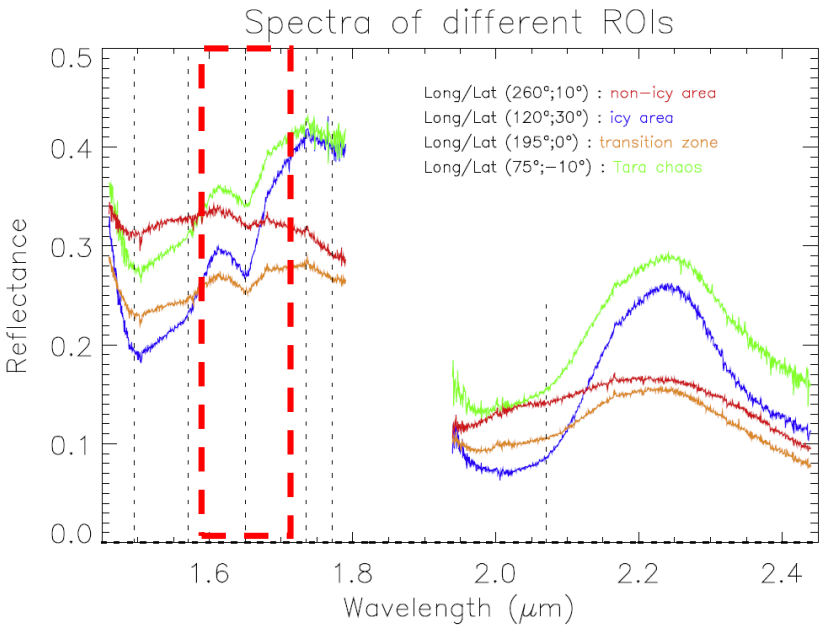
Examples

Salts / ice



NIMS spectra of Europe (McCord et al. 1999)

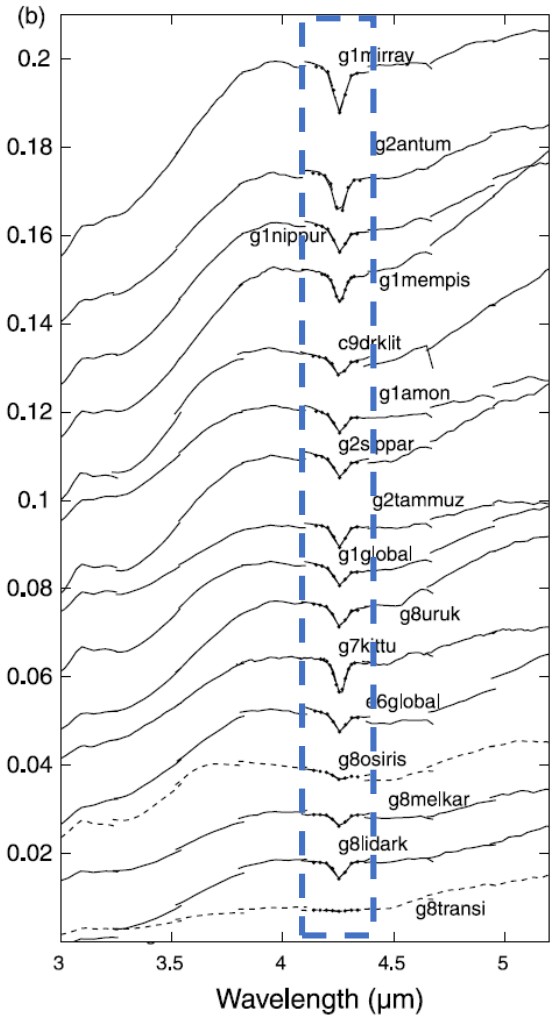
Cristalline / amorphous ice



VLT/SINFONI spectra of Europe (Ligier et al. 2016)

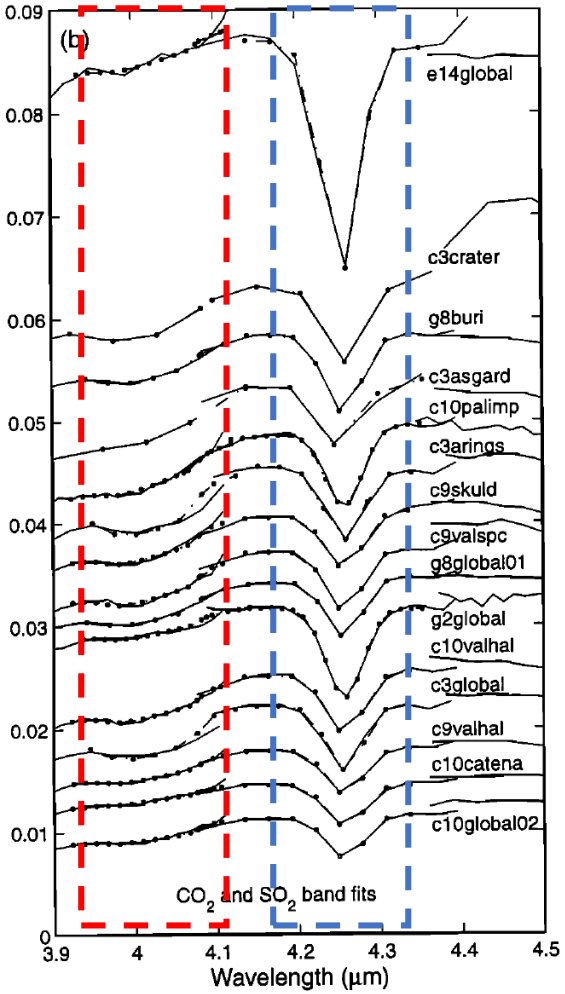
Examples

CO_2



NIMS spectra of Ganymede
(Hibbitts et al. 2003)

CO_2/SO_2

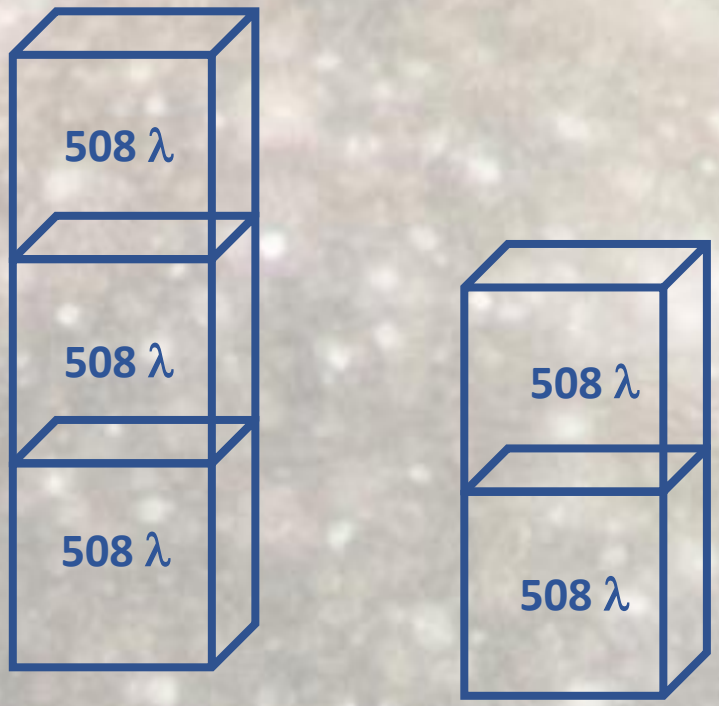


NIMS spectra of Callisto
(Hibbitts et al. 2000)

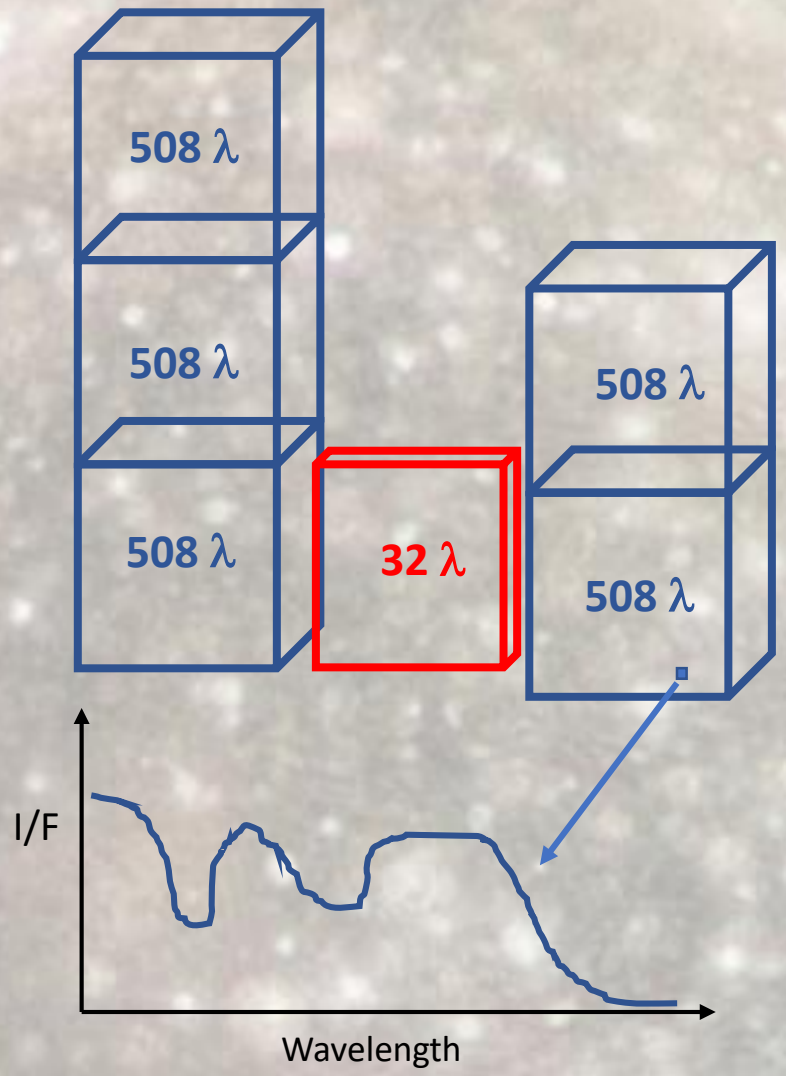
Parameters

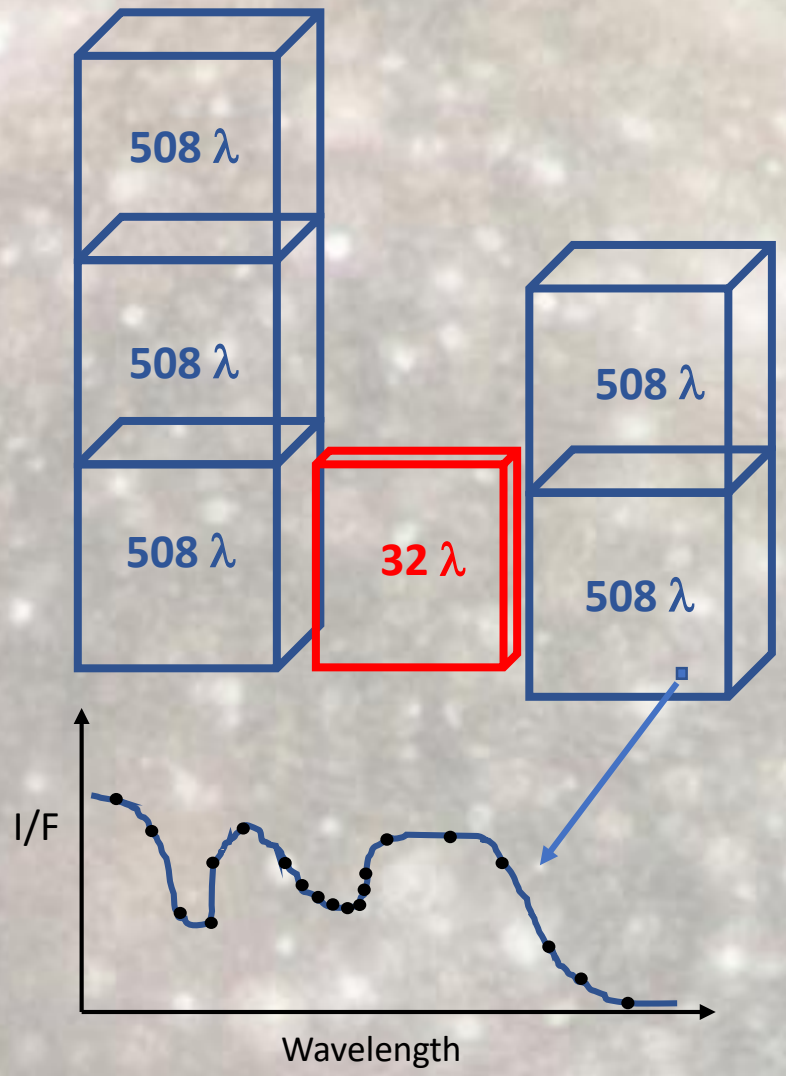
- **Spatial undersampling (selecting 1, 2 or 4 of 4 successive pixels, after nominal binning)**
  - Maintains data quality (spikes) at the level as the nominal data (vs binning)
  - Spatial scale of the heterogeneities

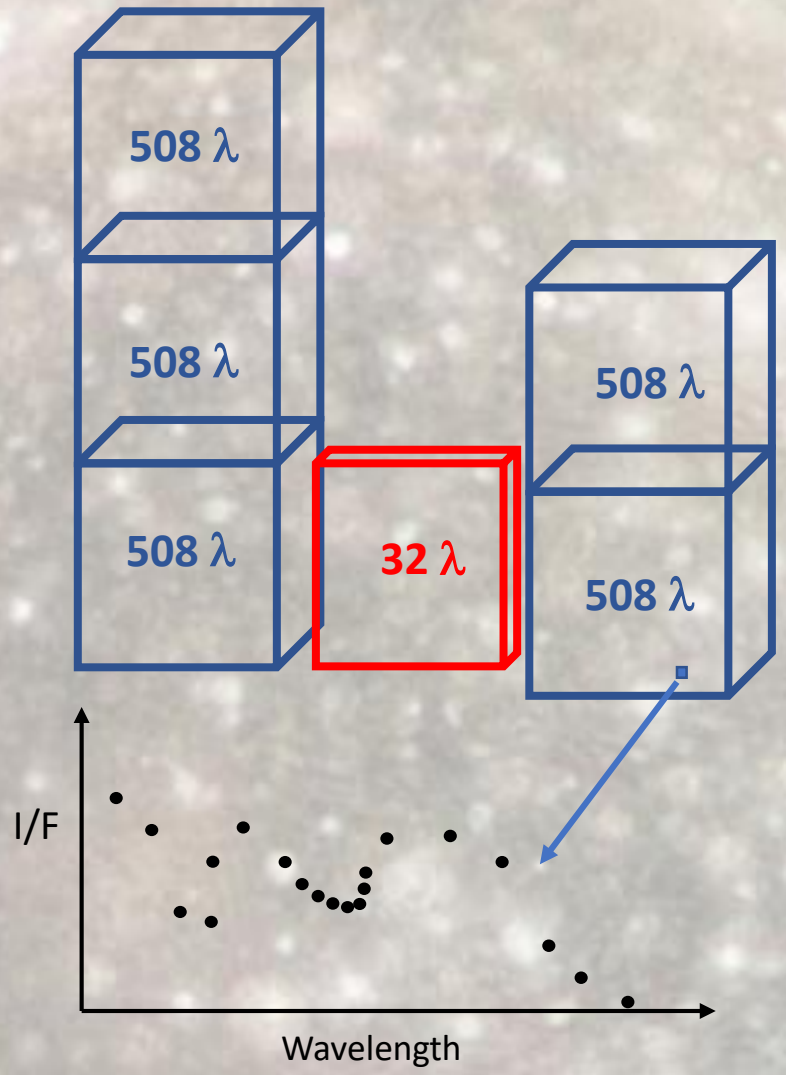
- **Spectral channels**
  - Any channels we want (**up to 32 out of 508**)
  - Browse for datacube selection => need to identify which combination of spectral channels will be the most diagnostic (what information do we need to assess if an observation is relevant or not?)
  - Browse as a science product => which channels would be the most interesting? Combination of the browse and the "nominal datacubes)

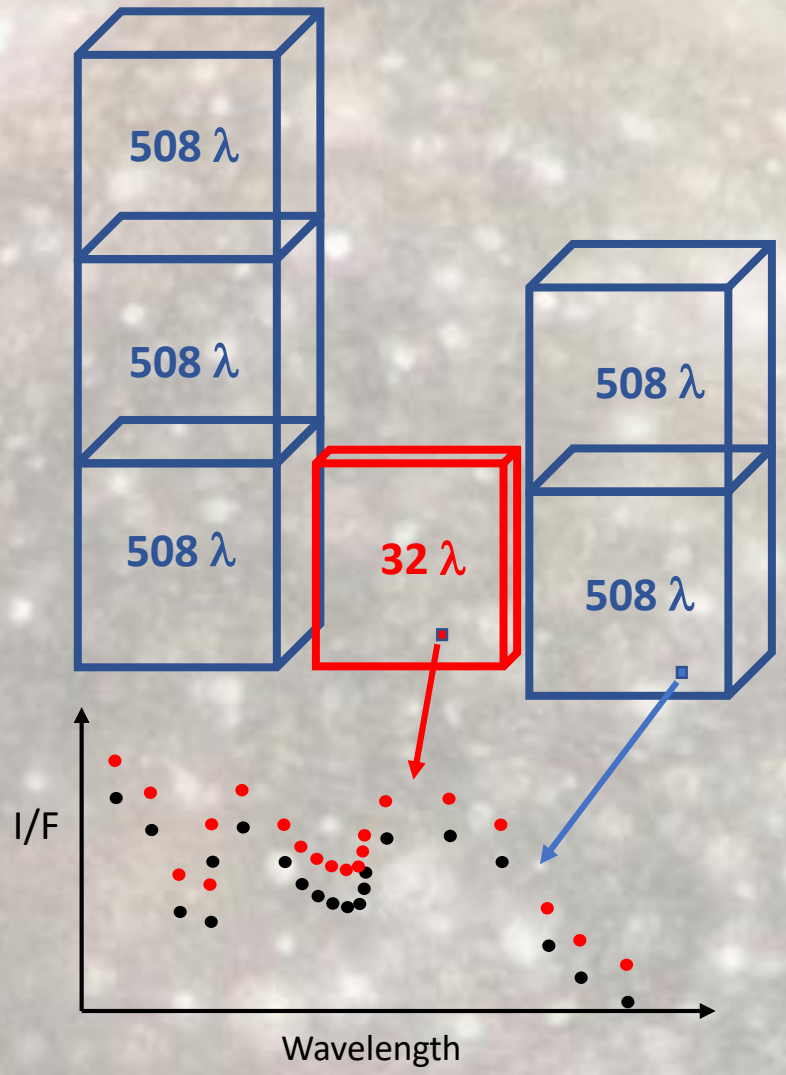

508 λ
508 λ
508 λ
508 λ
508 λ


508 λ
508 λ
508 λ
508 λ
508 λ
I/F
Wavelength


508 λ
508 λ
508 λ
32 λ
508 λ
508 λ
I/F
Wavelength


508 λ
508 λ
508 λ
32 λ
508 λ
508 λ
I/F
Wavelength


508 λ
508 λ
508 λ
32 λ
508 λ
508 λ
I/F
Wavelength


508 λ
508 λ
508 λ
32 λ
508 λ
508 λ
I/F
Wavelength

Parameters

- **Spatial undersampling (selecting 1, 2 or 4 of 4 successive pixels, after nominal binning)**
  - Maintains data quality (spikes) at the level as the nominal data (vs binning)
  - Spatial scale of the heterogeneities

- **Spectral channels**
  - Any channels we want (**up to 32 out of 508**)
  - Browse for datacube selection => need to identify which combination of spectral channels will be the most diagnostic (what information do we need to assess if an observation is relevant or not?)
  - Browse as a science product => which channels would be the most interesting? Combination of the browse and the "nominal datacubes)
  - Compression efficiency! Likely less correlation between spectral channels

Parameters

- **Spatial undersampling (selecting 1, 2 or 4 of 4 successive pixels, after nominal binning)**
  - Maintains data quality (spikes) at the level as the nominal data (vs binning)
  - Spatial scale of the heterogeneities

- **Spectral channels**
  - Any channels we want (**up to 32 out of 508**)
  - Browse for datacube selection => need to identify which combination of spectral channels will be the most diagnostic (what information do we need to assess if an observation is relevant or not?)
  - Browse as a science product => which channels would be the most interesting? Combination of the browse and the "nominal datacubes)
  - Compression efficiency! Likely less correlation between spectral channels

- **Compression**
  - **Selection of the data quality**
  - Data quality cannot be better than for the nominal datacubes

Parameters

⇒ **Browse products can be defined specifically for a target** (Callisto, Ganymede, Jupiter, Europa, others?) **or for several targets** (e.g. icy satellites)

Parameters

⇒ **Browse products can be defined specifically for a target** (Callisto, Ganymede, Jupiter, Europa, others?) **or for several targets** (e.g. icy satellites)

=> For each target or set of targets, we can have **several browse products corresponding to a specific science objective** (rationale for the observation)

Parameters

⇒ **Browse products can be defined specifically for a target** (Callisto, Ganymede, Jupiter, Europa, others?) **or for several targets** (e.g. icy satellites)

=> For each target or set of targets, we can have **several browse products corresponding to a specific science objective** (rationale for the observation)

=> 1 browse per compound? (e.g. CO_2 ice, amorphous/cristalline H_2O ice)

Parameters

⇒ **Browse products can be defined specifically for a target** (Callisto, Ganymede, Jupiter, Europa, others?) **or for several targets** (e.g. icy satellites)

=> For each target or set of targets, we can have **several browse products corresponding to a specific science objective** (rationale for the observation)

=> 1 browse per compound? (e.g. CO_2 ice, amorphous/cristalline H_2O ice)

Key lies generally in the **correlation** between the different compounds, and/or with specific locations (latitude, morphology, leading/trailing hemisphere, etc.)

Parameters

⇒ **Browse products can be defined specifically for a target** (Callisto, Ganymede, Jupiter, Europa, others?) **or for several targets** (e.g. icy satellites)

=> For each target or set of targets, we can have **several browse products corresponding to a specific science objective** (rationale for the observation)

=> 1 browse per compound? (e.g. CO_2 ice, amorphous/cristalline H_2O ice)

Key lies generally in the **correlation** between the different compounds, and/or with specific locations (latitude, morphology, leading/trailing hemisphere, etc.)

=> **1 browse => combination of different criteria** to assess the presence of different compounds and their correlation (except for specific studies where 1 compound might be sufficient.

In practice

- Some tables will be implemented prior to launch (definition in progress)
- Tables can be (of course!) upgraded during cruise and operations
- First observations will also help refining the tables
- Inputs are welcome!