



PHIDIAS

Prototype of HPC/Data Infrastructure for On-demand Services

PHIDIAS WP4 : Technical implementation


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The PHIDIAS project has received funding from the European Union's Connecting Europe Facility under grant agreement n° INEA/CEF/ICT/A2018/1810854.

State of the art : IASI-PCA

-  PCA processing of IASI level 1 data already tested (CNES, SPASCI, HYGEOS, LATMOS)


-  Existing approach and methodology

-  Promising results

On going work : implementation for Sentinel 5P :

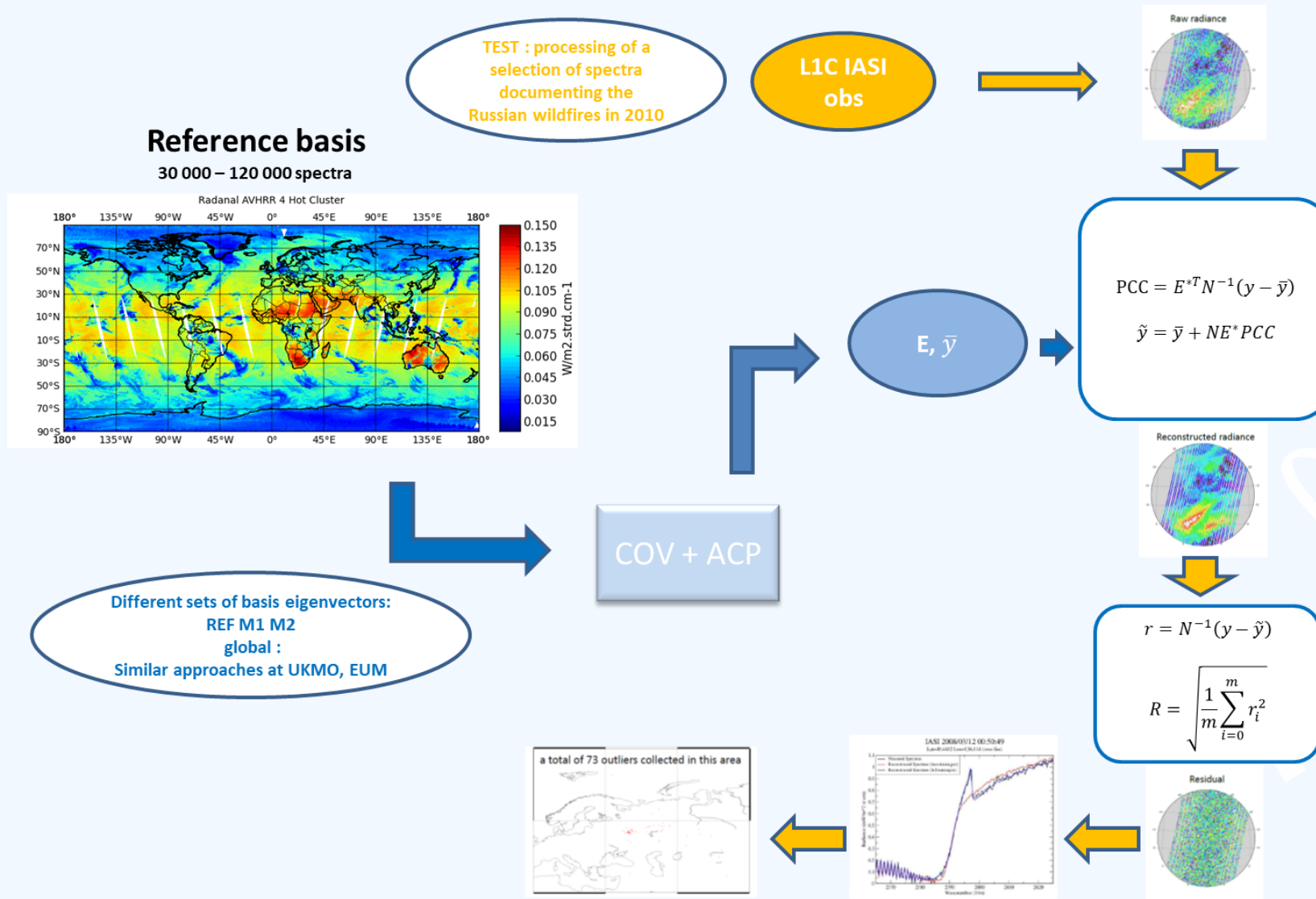
-  Generation of a reference basis

-  L1B reader for S5P data

-  PCA analysis

Challenges with S5P L1 data

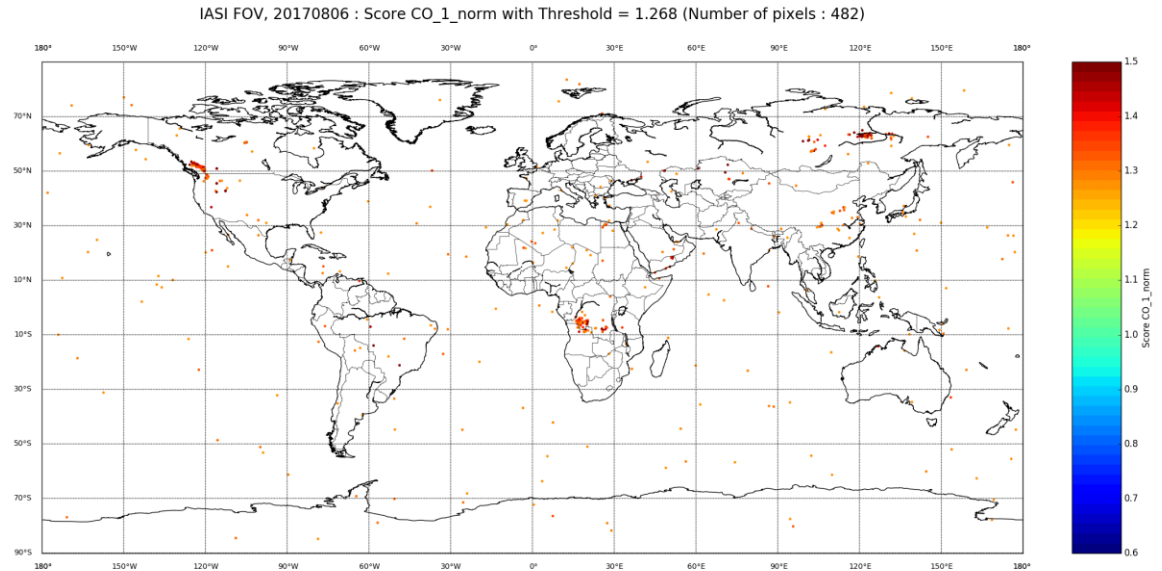




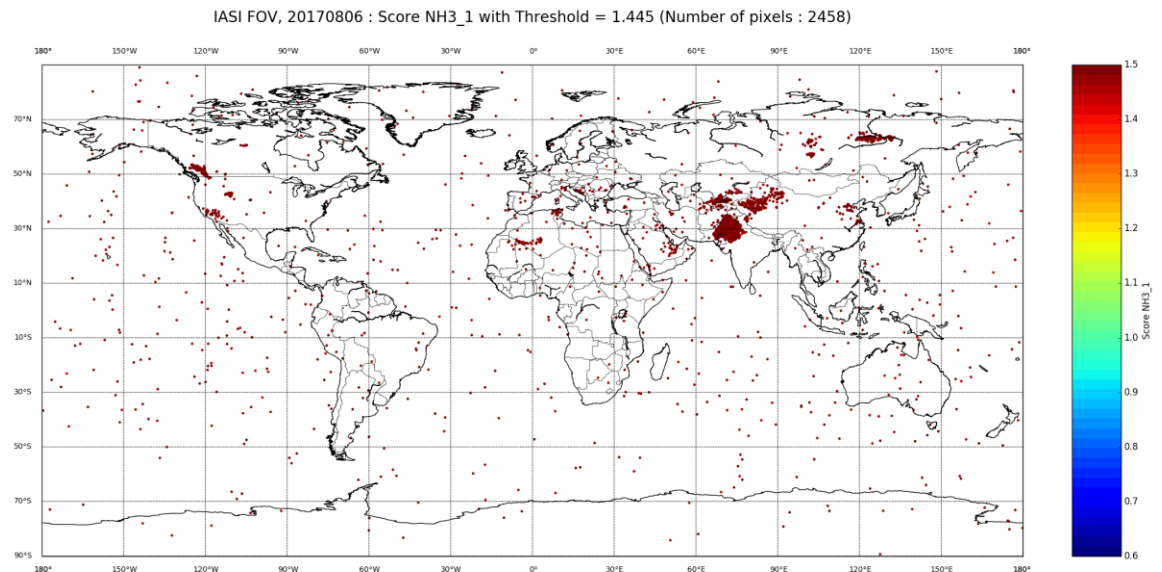
✿ This method has been successfully applied to IASI on Metop (SPASCIA, HYGEOs, LATMOS collaboration, CNES funding)

✿ More than 60 indicators (scores) of extreme atmospheric events (concerning more than 10 molecules: CO, NH₃, CH₄, SO₂, HCl,).

CO

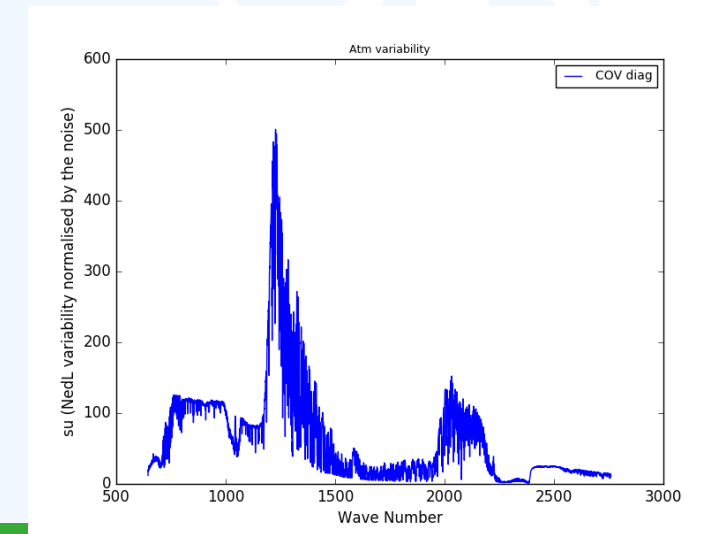
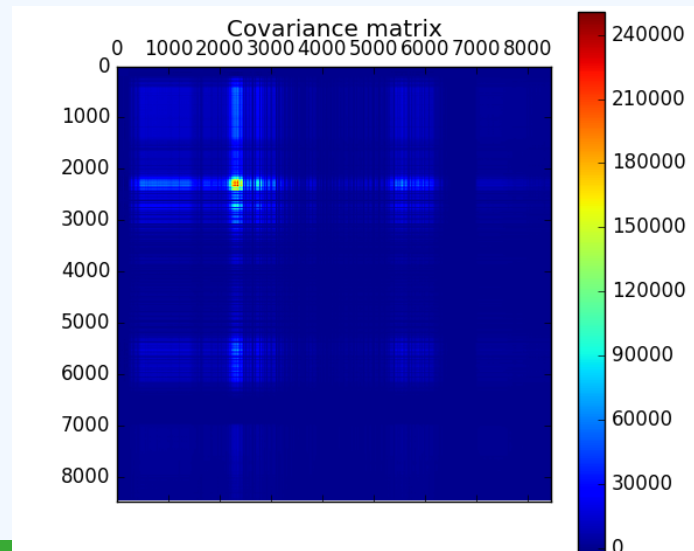


NH₃



Detection of fire events : exemple of IASI, 10/2017

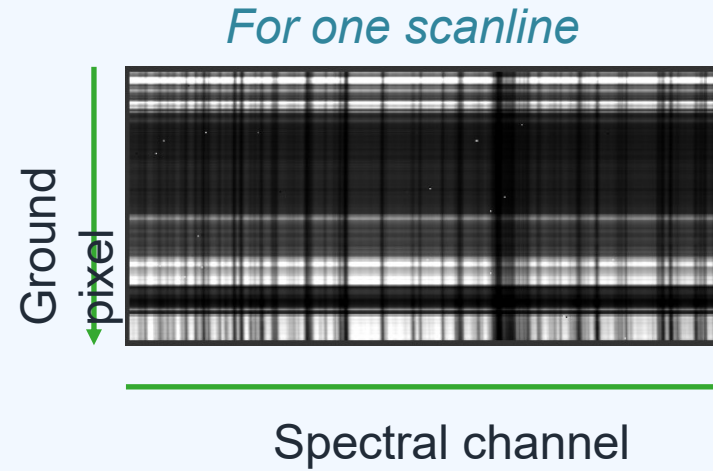
- ✿ Has to be done once. Can be seen as an ancillary data
- ✿ Composed of more than 75 000 spectra random – oriented selection
- ✿ Covering a long temporal period (typically one year): day 1, 6, 11, 16, 21 and 26 of each month are selected
- ✿ About 75 spectra per orbit: orientated random selection to extract a representative set of :
 - ✿ Scanline and ground pixel (IFOV) number
 - ✿ Solar and viewing zenith angles (SZA)
 - ✿ Latitude/longitude




Read L1B data measurements
(scanline x ground pixel x spectrum)
And
Associated flags

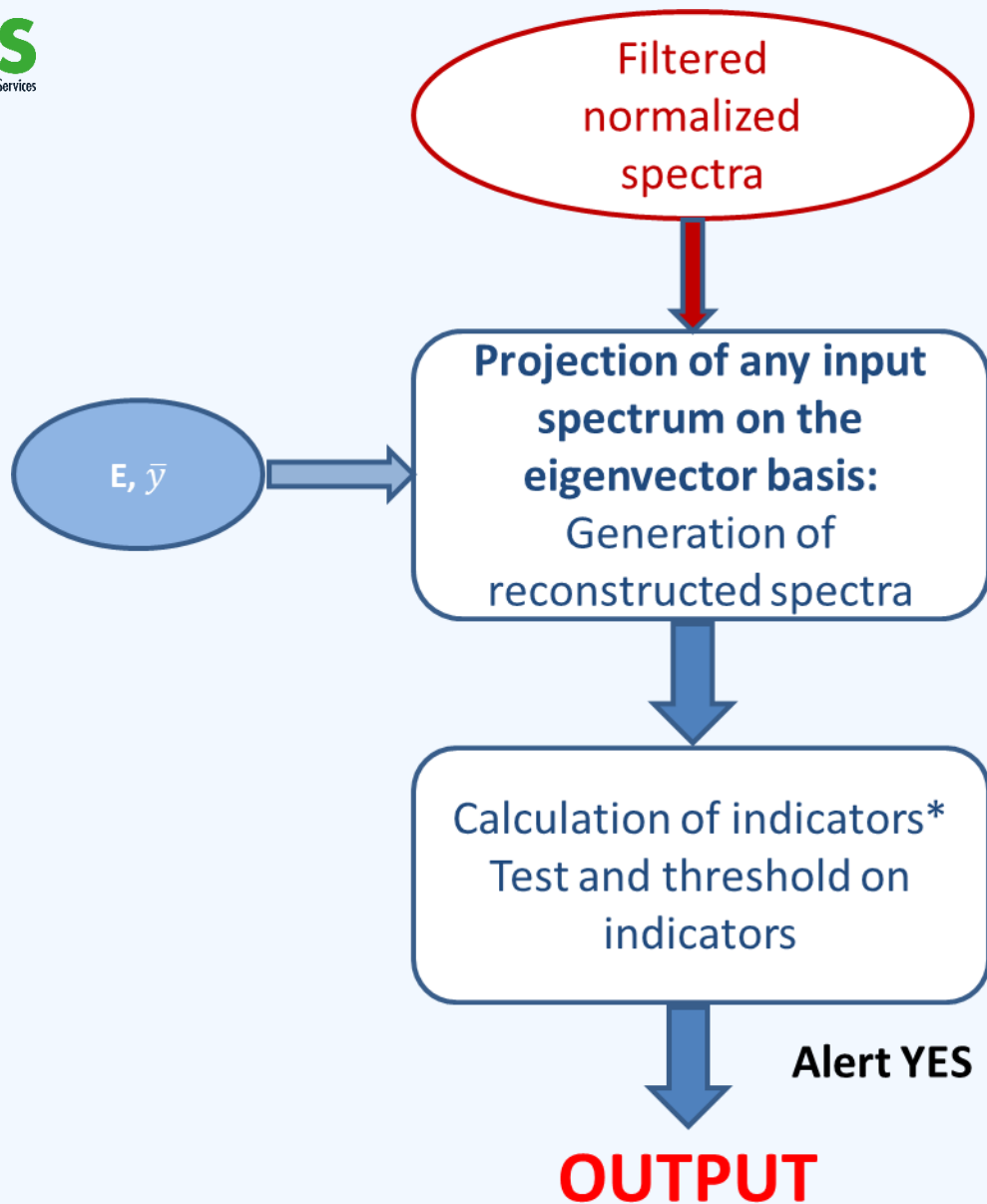
For one ground pixel into a scanline line (so for one spectrum):
Detect and correct anomalous measurements

Filter if necessary (use or not)
And normalization



 Challenging for S5P

Temporary output: filtered normalized spectra

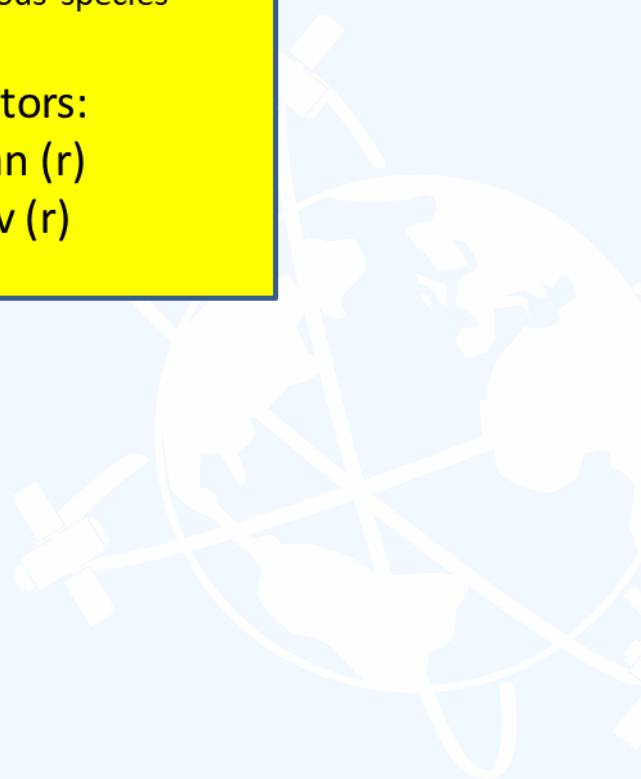


$r = \text{radiance residual}$
 $= \text{reconstructed} - \text{measured}$

r is calculated for different spectral range (whole spectral range or dedicated spectral windows for each molecule/gaseous species)

*Indicators:

- mean (r)
- stdv (r)



- ❖ Code written in **python** (core API)
- ❖ Processing at the scale of an orbit (divided into chunks – arrays of data)
- ❖ S5P versus IASI: much more input data (but only SWIR bands BD7 and BD8), and only daytime data will be used
- ❖ S5P L1 data versus IASI
 - ❖ Dealing with **noise** → the noise is radiance dependent hence scene dependent (different from IASI)
 - ❖ **Normalization** → the instrument covariance matrix is to be established (more complicated than for IASI)
 - ❖ **Spectral indicators** → to be defined (as for IASI) searching for the most appropriate spectral signatures of CH₄ (first priority) and CO (second priority, since strongly perturbed by CH₄ features). H₂O features are also to be considered because of their ubiquity and large variability. Other species will be searched for in the **discovery** or **extreme event** mode.
 - ❖ **Day/night** transition → since the recorded signal is the solar radiation reflected by the surface/atmosphere system, low sun scenes will be filtered out (threshold for high solar zenith angles, SZA)
- ❖ Does a huge amount of input data mean a huge amount of output data ?

- ❖ Main output: **logbook** of atmospheric events detected (netcdf file). How to be efficient and useful for users and researchers ?
 - ❖ Where is the L1B data: L1B filename (attribute), scanline, ground pixel
 - ❖ Ground pixel quality flag (from L1B)
 - ❖ Spatial geolocation: latitude/longitude
 - ❖ Which indicators will provide an alert (detection flag coded in 8 or 16 bytes depending on the number of indicators)
 - ❖ Values of the indicators (mean and standard deviation of the residual difference)
- ❖ Other outputs (to be investigated and validated by ICARE):
 - ❖ Maps
 - ❖ Post-processing for the whole day
 - ❖ Tools to link to L1B or L2 data corresponding to detected events ?
- ❖ Additional difficulties: bad pixels always present in 2D SWIR focal arrays
 - ❖ Need to establish the map of bad pixels in the spatial (ifov) and spectral (channel) plane using solar calibration views (onboard diffuser plate) acquired in the polar region for one orbit per day

Thank-you

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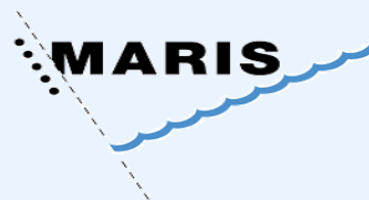
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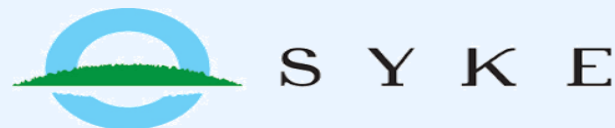
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