The next generation of EUMETSAT hyperspectral geophysical products

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EUMETSAT

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Plan

The EUMETSAT HSIR PC & L2 products

Presentation of the IASI, IASI-NG and IRS principal components and geophysical products

Preparing the next generation

The last updates to the IASI PC & L2 products

The future of EUMETSAT HSIR L2

The plan of EUMETSAT for IASI and for the next generation of HSIR instruments

The EUMETSAT Hyperspectral Infrared PCs and L2 products

	Platform	Lifespan	Orbit	Sampling	Footprint
IASI	Metop	2007-2030	LEO	0.25 cm^{-1}	12 km
IASI-NG	Metop-SG	2025-2046	LEO	0.125 cm^{-1}	12 km
IRS	MTG-S	2025-2041	GEO	0.61 cm^{-1}	4 km

EUMETSAT HSIR products

	Description
L1C	Radiances
L1D	Principal Components
L2	Geophysical Variables

Data Compression, Dimensionality Reduction, Noise Filtering
PCC

Temperature, Humidity and Ozone
Profiles - ML + OEM

Clouds parameters
Mask, fraction, height - OEM

Surface parameters
T & ε - ML + OEM

CO, O_3, HNO_3
Profiles - OEM

CH_4
Total col. - ML

SO_2
Partial col. & height - LUT

SAFs and partners

Operational

Demonstrational

New
Polar 3D Winds
Optical Flow

CO_2, N_2O, Cloud phase
ML

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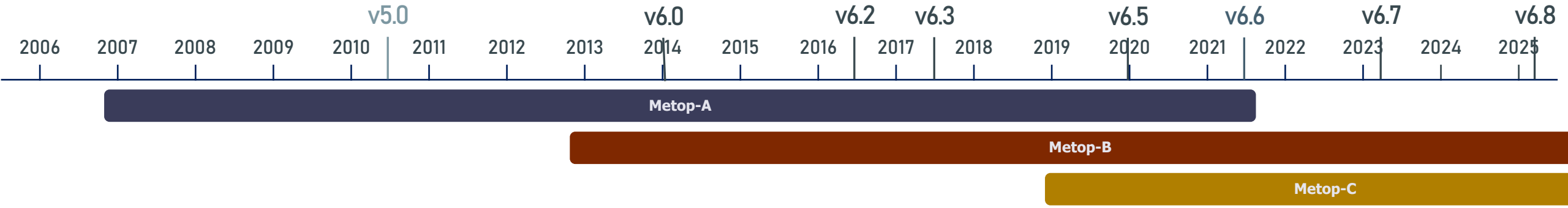
The last evolutions of the EUMETSAT IASI L1D/L2 products

- More than 15 years of content update and quality improvement based on collaborations, users feedback and internal developments.



- In recent years, the evolution of the products has also taken into account the prospect of the next generation of instruments.
- Three examples of recent updates to the IASI PC and L2 products:
  1. The evolution from Global to Hybrid Principal Components
  2. The quality update to the all-sky PWLR products
  3. The release of the new IASI L2 Polar 3D Winds product

1. The new Hybrid Principal Components (Hybrid PC)

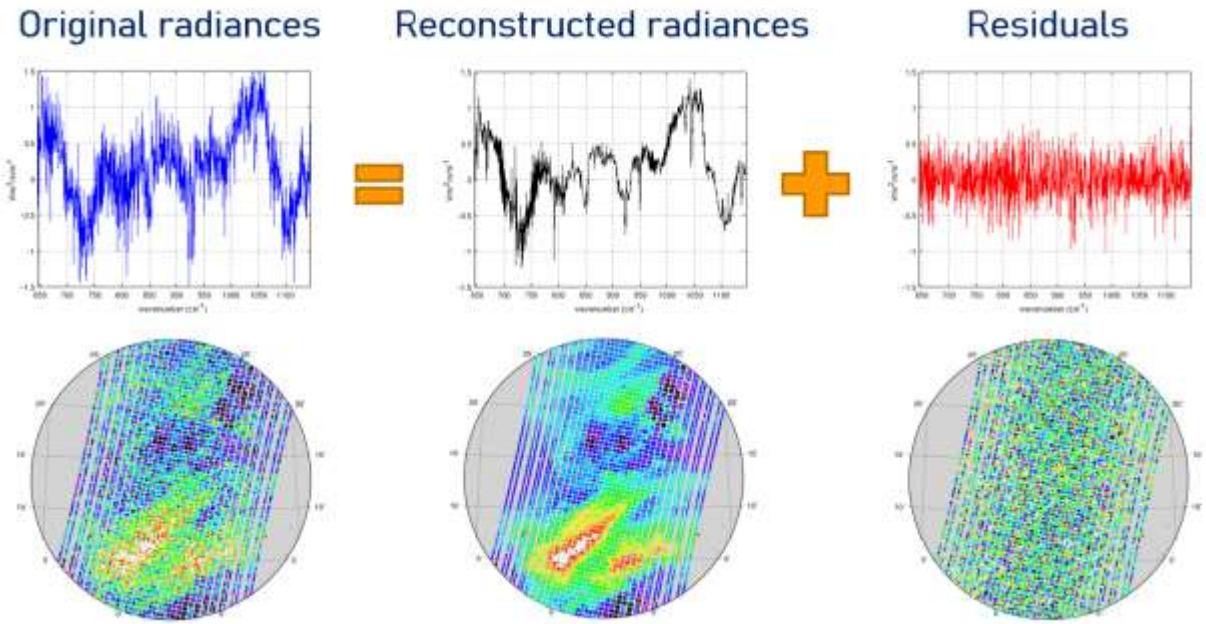
Since 2010: Global PC

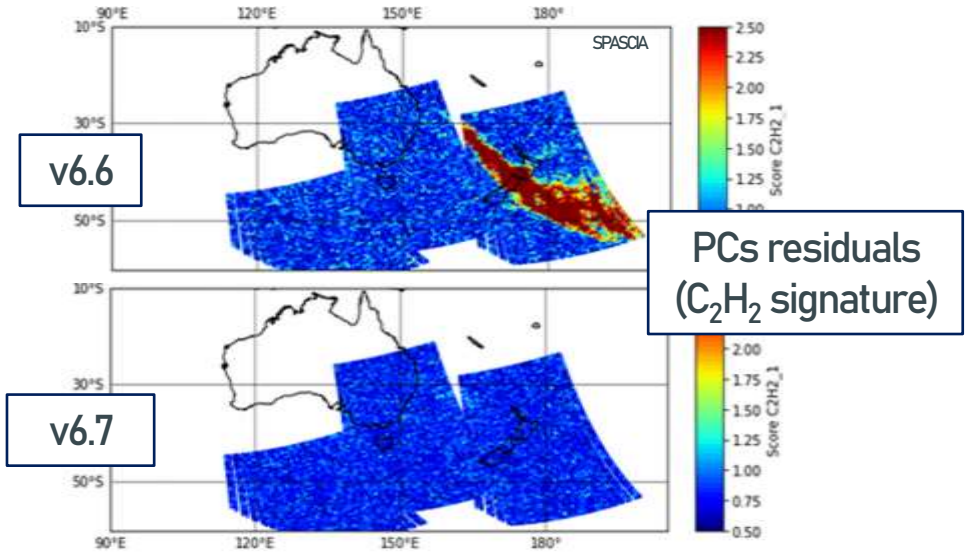
Built using a large number of spectra

→ Good compression rate

→ Efficient noise filtering

→ But limited capture of uncommon signals like rare species





March 2023 (IASI L2 v6.7): Hybrid PC

Addition of local PCs (granule) to the already available global PCs

→ Uncommon gases or unusual amounts of common gases are retained

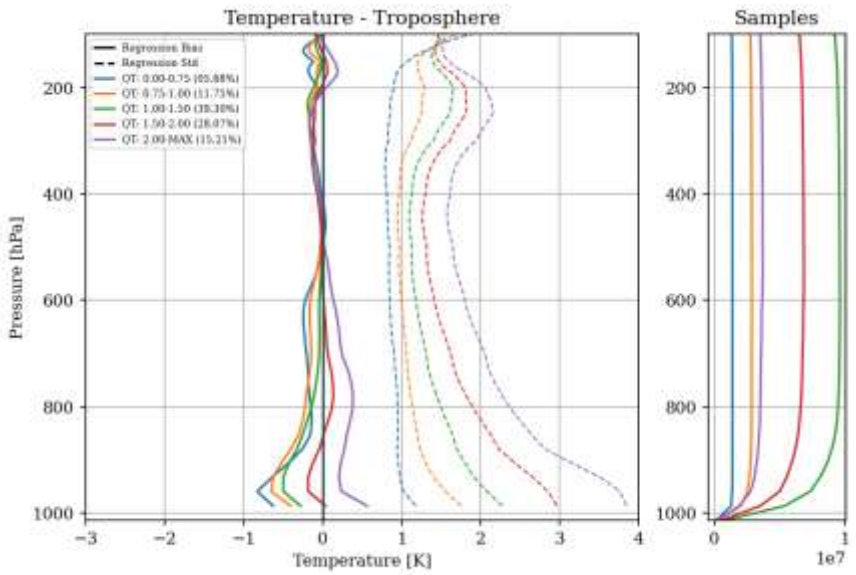
→ Atmospheric trends are captured

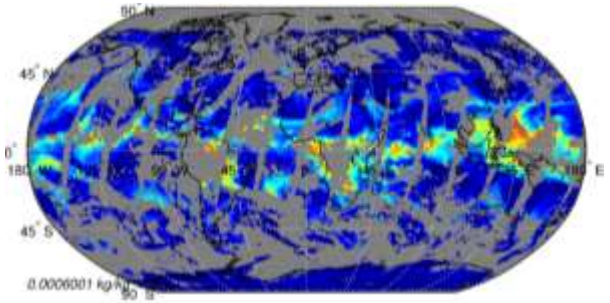
→ NRT IRS L1 as Hybrid PC only !

2. Quality update for the all-sky PWLR products

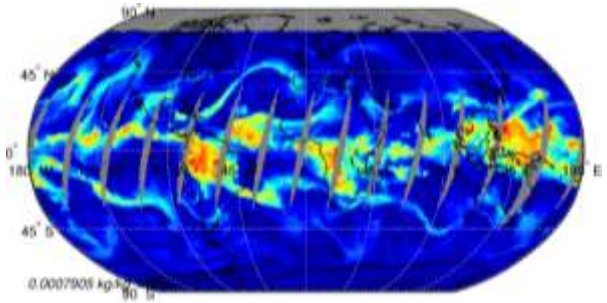
Since 2014: PWLR: Piece-Wise Linear Regression

- Microwave (AMSU/MHS) and Infrared (IASI) synergy
  → All-sky retrieval (~99.5%)
- Fast Machine Learning retrieval
  → EARS IASI L2 regional processing available
- Associated error estimation + validation & monitoring
  → Informed products use





1DV clear sky



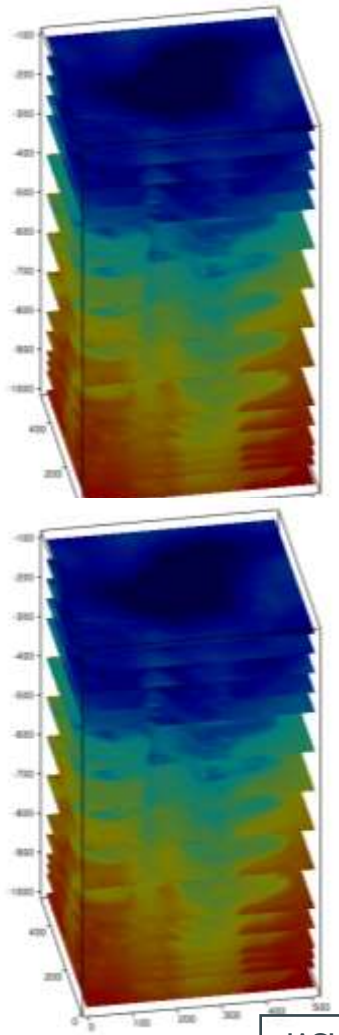
PWLR all sky

Q2/2025: PWLR quality update

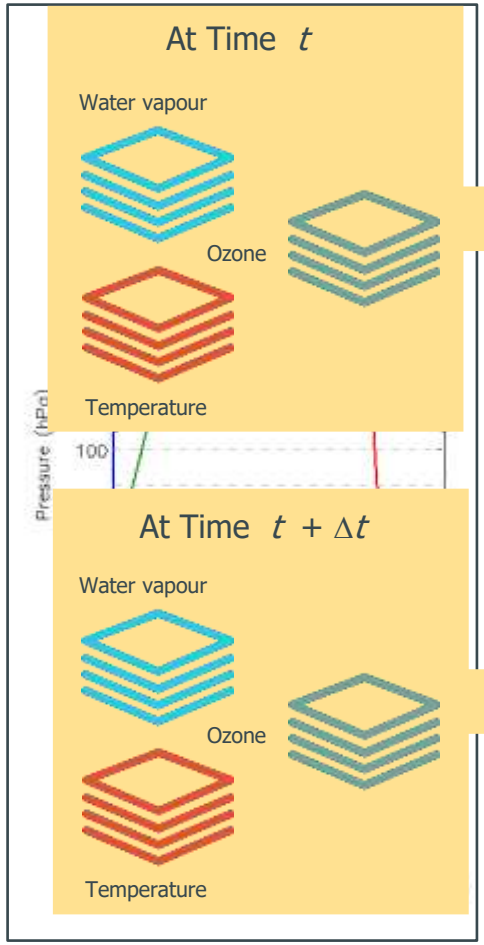
- Except for Cloud Products, the PWLR will perform at least as good as the OEM
  → PWLR can be used as single main algorithm
  → Will be used to provide high quality IRS L2 products despite the high data rate

3. IASI Polar 3D winds – Concept

Joint inversion of all vertical levels



All-sky IASI PWLR profiles

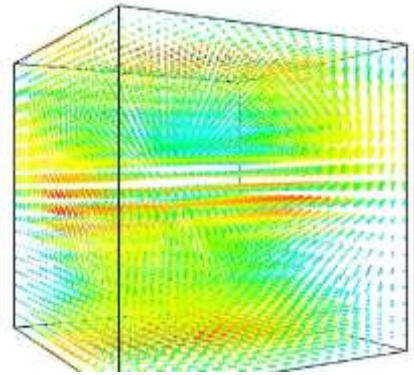


IASI temperature (K,), humidity (x10^5,) and ozone (x10^7) profiles on 01/01/2023 over the North pole at 00:54:34

Model Settings

3D Winds model based on Optical Flow technics

Basic Conservation Law
Minimization algorithm
Regularization

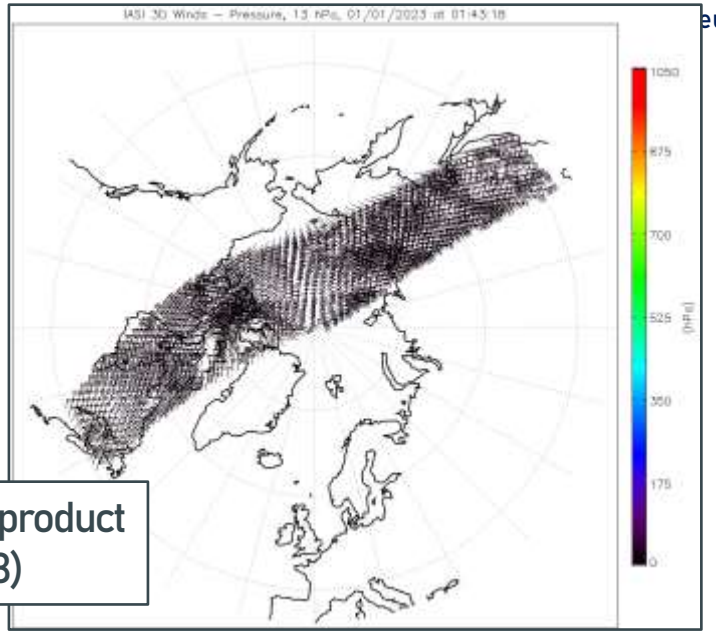


3D wind field

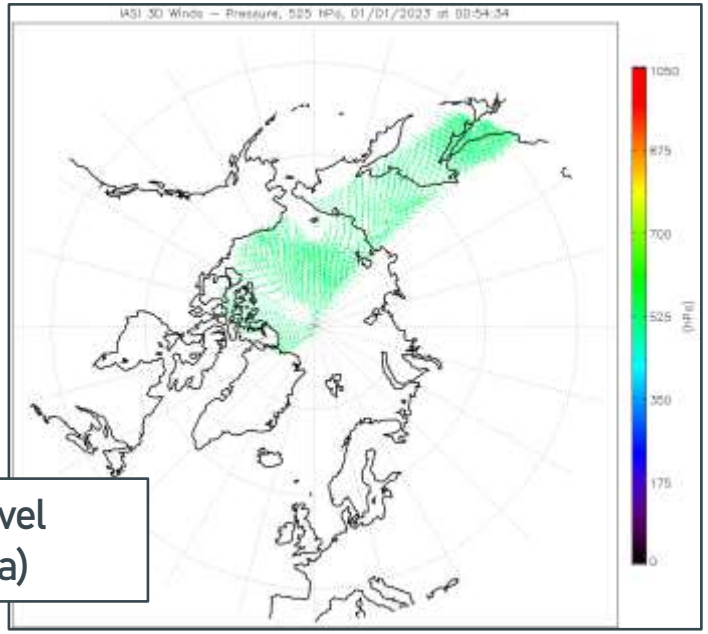
U,V,W fields derived from observations

3. IASI Polar 3D winds – Product description

- Product description:
  - Dual-satellite operations (Metop-B and Metop-C); 29 products per day and per area (NH and SH)
  - High-latitude regions (poleward of 45s)
  - Troposphere and low stratosphere; 25 layers (from 10 to 1000 hPa)
- Scientific validation against
  - Radiosondes
  - Aeolus
  - AVHRR AMVs
  - ECMWF model forecast
- Operational production started on 25 November 2024.
- Version 2 will implement improvements, plus IASI-NG and IRS readiness



All pressure levels for one product (01/01/2023 at 01:43:18)



All products for one level (01/01/2023 at 525 hPa)

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The future EUMETSAT HSIR L2 products

More than 15 years of evolutions on IASI L1D/L2
→ Since 2007, new algorisms, new products, new users, new needs…

New generation of instruments, IASI-NG and IRS
→ New geometry, new constraints, but more important: new possibilities!

New major version of the EUMETSAT HSIR L2 products
→ IASI L2 v7
→ IASI-NG L2 v2
→ IRS L2 v2

New format
Cleaner, clearer, more user friendly

PWLR as baseline
No double products anymore

New pressure grid
Fix grid → Sigma levels

New error estimate
Scalar Qi → Full profiles

PWLR with FCT prior
Additional product, only for some of the parameters

New/updated products
TWLC/TWIC, instability indices, CO_2/N_2O vertical information

L2 flags rework
Remove obsolete flags and add new required ones

Thank you!

Questions are welcome.