Extraction of 3D Wind Profiles from Hyperspectral IASI Level 2 Products

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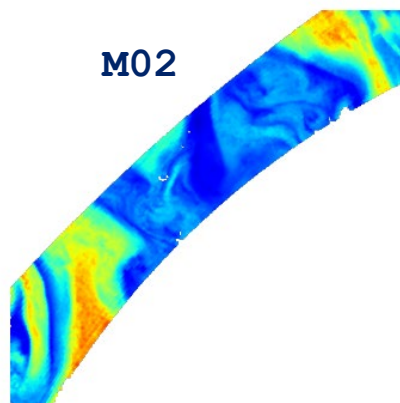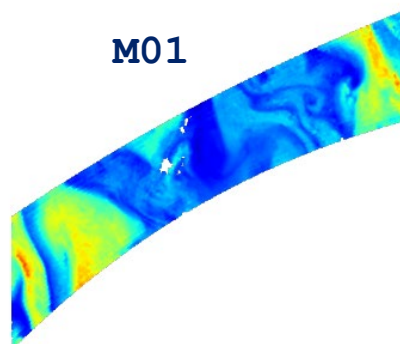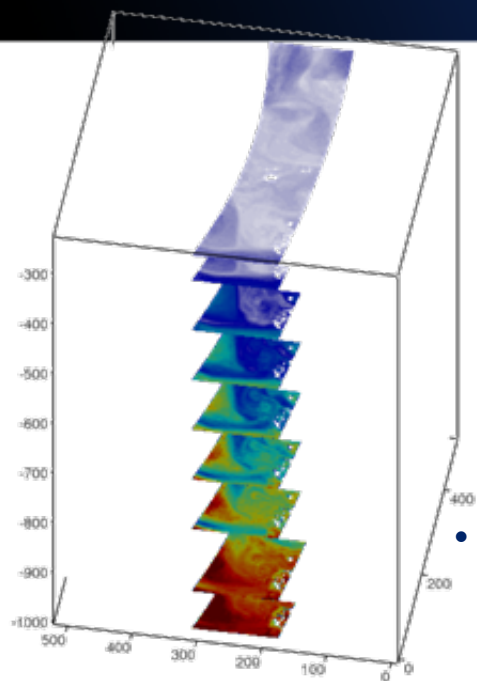
Patrick Héas – INRIA

Algorithm principles

- Rely on features tracking technique
  - Water vapour & ozone features
  - All-sky tracking
  - Only 2 overpasses needed

- Global model
  - Implementing an optical flow algorithm on a 3D scene
  - All vertical levels linked
  - Full profile u, v, ω retrieved for each pixel

- Independent from the NWP models

IASI 3D winds product

M01

M02

NH_20170321004609Z_M02_54062
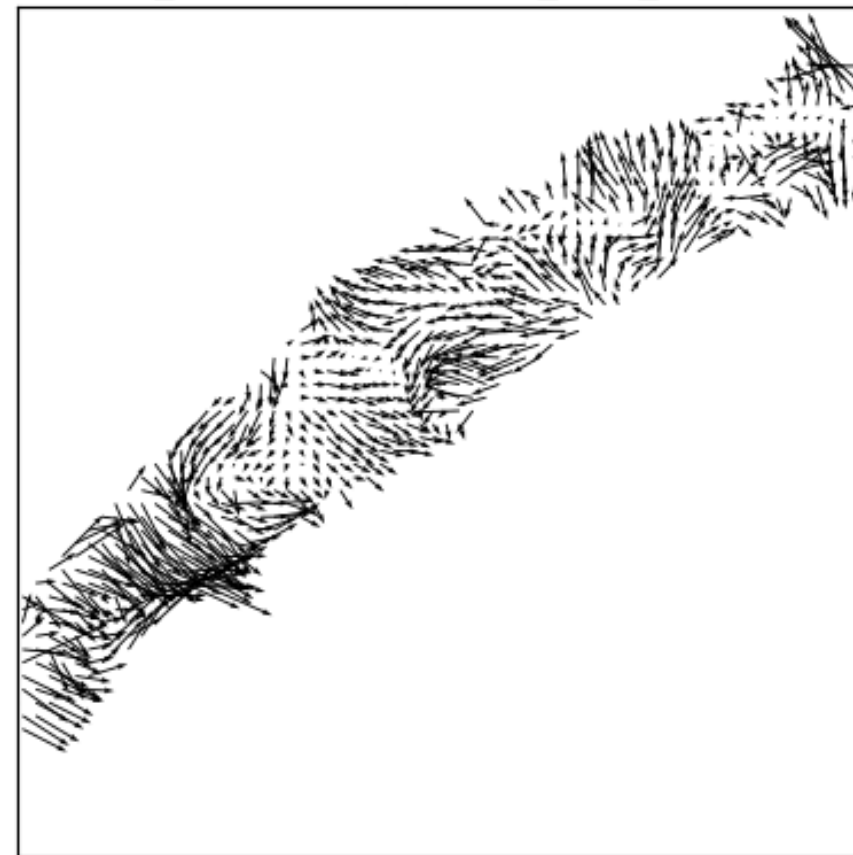
- Based on IASI Level 2 products:
  - All-sky water vapour, ozone and temperature profiles
- Dual satellite operations
  - 29 products per day
- High-latitude regions (polewards of 45°)
- Troposphere and low stratosphere
  - 19 pressure levels (10 to 1000 hPa)

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Analysis of the first demonstration period

Obs minus FG
Frequency characteristics
2017062500 - 2017063021

From Alexander Cres, DWD

|	Troposphere						Stratosphere					
	mean	*rms*	*std*	*min*	*max*	*NN*	*mean*	*rms*	*std*	*min*	*max*	*NN*
All	-0.74	9.17	9.14	-75.1	115.9	19591087	8.52	13.3	10.3	-27.8	151.4	8681184
Active	-0.85	5.03	4.95	-22.2	16.7	10040752	1.98	4.65	4.21	-14.8	16.6	3836571

- Some spurious vectors (no quality check)
- FG check keeps about 50% of the IASI AMV
  - Bias and stdev comparable to CMV
  - Higher bias at the level of the jets
- Number of profiles very large
  - Possible correlated observation erros

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Data screening

- Implementation of a spatial binning strategy
  - Screening independent from forecast winds
  - Over a sphere tessellation
    - Equal area: ~ 0.84 square degree (~100 km)
  - Remove the outliers
  - Reduce the number of winds by a factor ~25
  - Reduce the internal spatial correlation of the wind product

- Output variables:
  - Mean and standard deviation of the wind speed over the bin

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Intercomparison of collocated data

**Vector difference
IASI 3D winds vs Forecast
winds**
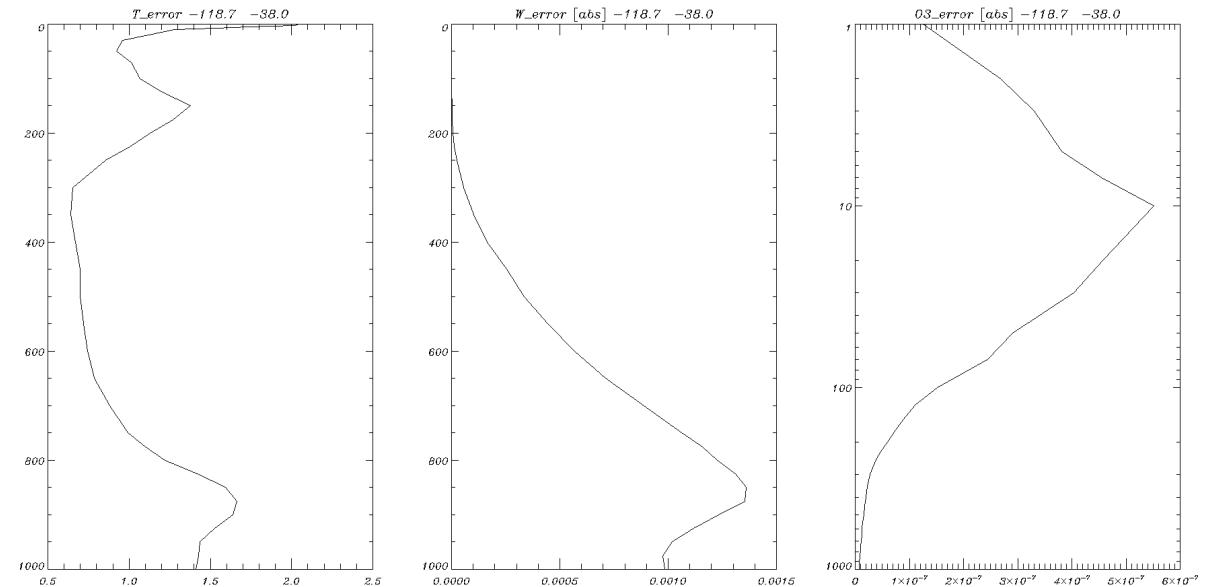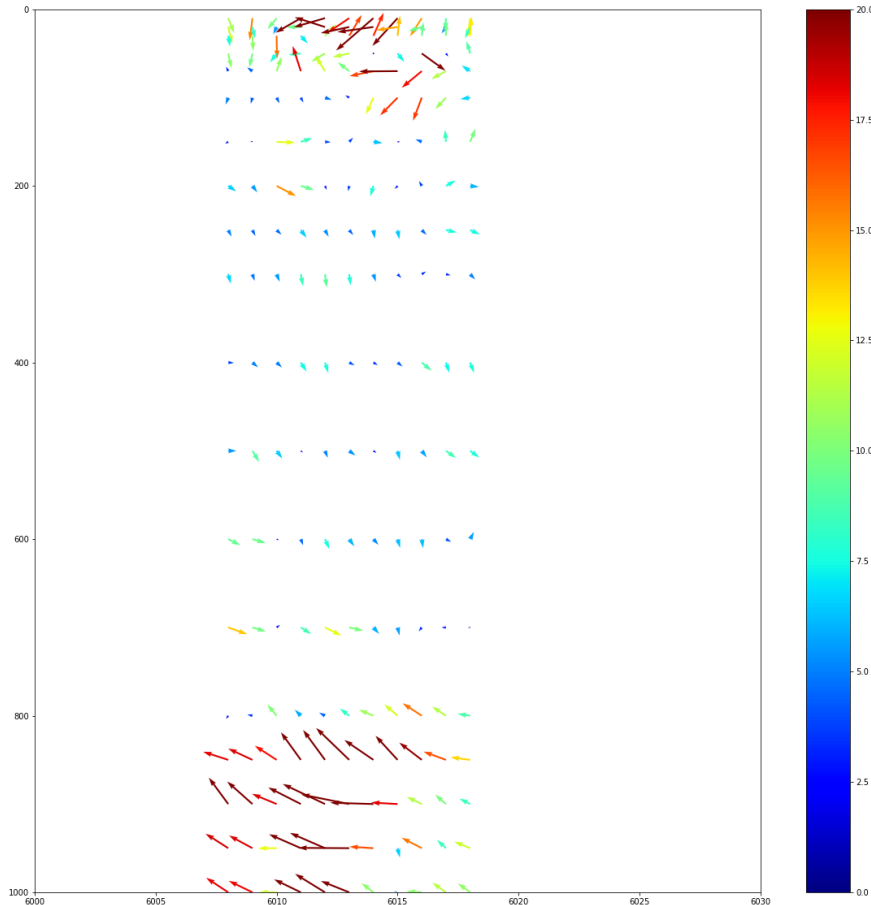
- Best quality between 200 – 800 hPa
- Consistent with estimated retrieval error profile for IASI level 2 product
- Still no level/pixel screening

Potential for NWP application

- O-B speed biases (solid line) and RMS (dashed line) profiles of IASI 3D winds against ECMWF forecast

  - *All the wind vectors*
  - *Filtered on the vector difference against forecast wind (vd < 10 m/s)*
  - *Shaded zone shows the ECMWF variability inside the binning area*

- **After cut-off at 10 m/s for O-B**

  - Bias is close to zero and RMS < 4 m/s
  - Speed STD within the box comparable to ECMWF model field variability
  - 40% of the wind vectors left
  - Statistics consistent on the vertical ranges, however a bit larger at low (P>850 hPa) and very high levels (P<150 hPa).

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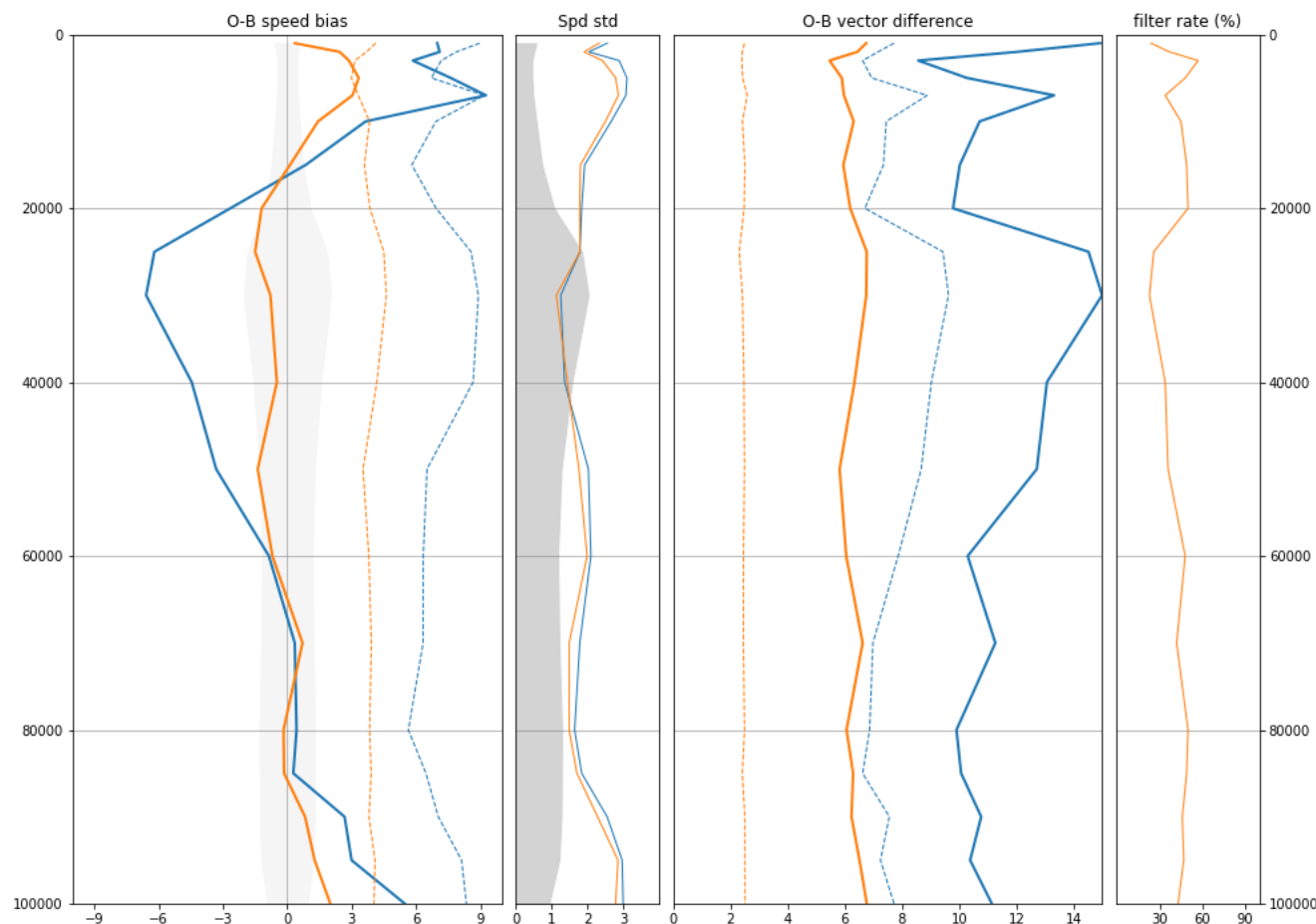
Towards a NRT demonstrational product

- Binned product
  - Resolution: ~100 km
  - BUFR format
    - For each layer:
      - Bottom and top pressure
      - u, v components (mean and standard deviation)
      - Number of grid pixels considered

- Implementation is ongoing
  - First implemented in the offline environment.
    - Off line production foreseen April 2021
  - Operational implementation on EPS GS
    - Target date: 2021 Quarter 3 (TBC)

Future developments

- Intercomparison against
  - Airborne data
  - Aeolus data (only close to poles)
  - GEO winds

- New version in the preparation to MTG IRS data
  - To handle missing pixels or levels (IRS cloudfree retrievals)
  - To estimate retrieval errors (or confidence)