

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

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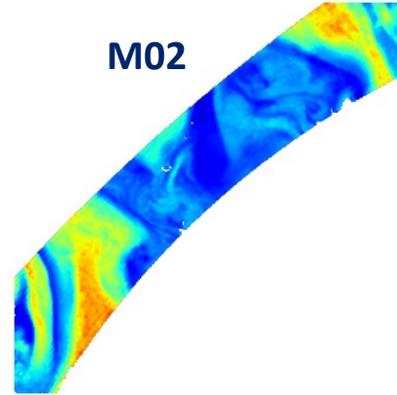
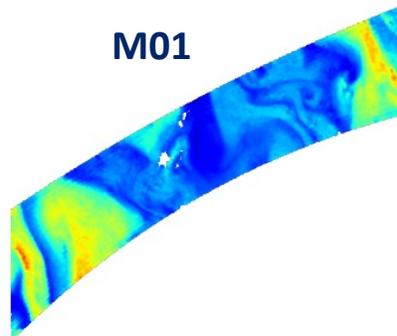
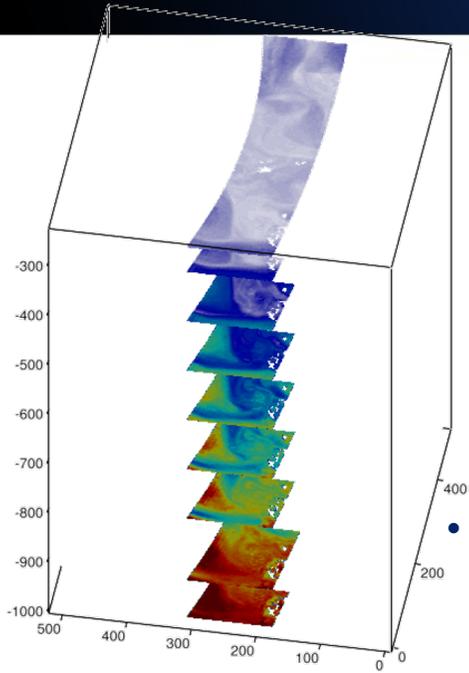
Patrick Héas – INRIA



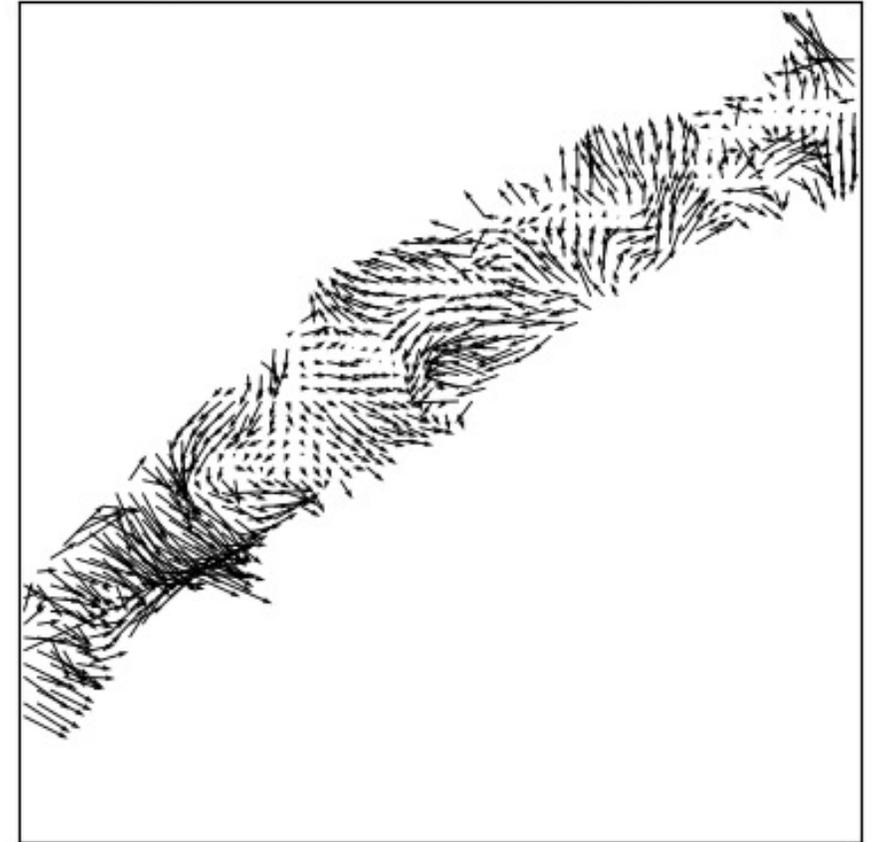
Algorithm principles

- Rely on features tracking technique
 - Water vapour & ozone features
 - All-sky tracking
 - Only 2 overpasses needed
- Global model
 - Implementing an 3D optical flow algorithm
 - Multi-scale, multi-resolution
 - All vertical levels linked
 - Full profile u , v , ω retrieved for each pixel
- Independent from the NWP models
- Computing efficient for NRT processing

IASI 3D winds product



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)

Analysis of the first demonstration period

Obs minus FG
Frequency characteristics
2017062500 - 2017063021

From Alexander Cres, DWD

	Troposphere						Stratosphere					
	<i>mean</i>	<i>rms</i>	<i>std</i>	<i>min</i>	<i>max</i>	<i>NN</i>	<i>mean</i>	<i>rms</i>	<i>std</i>	<i>min</i>	<i>max</i>	<i>NN</i>
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

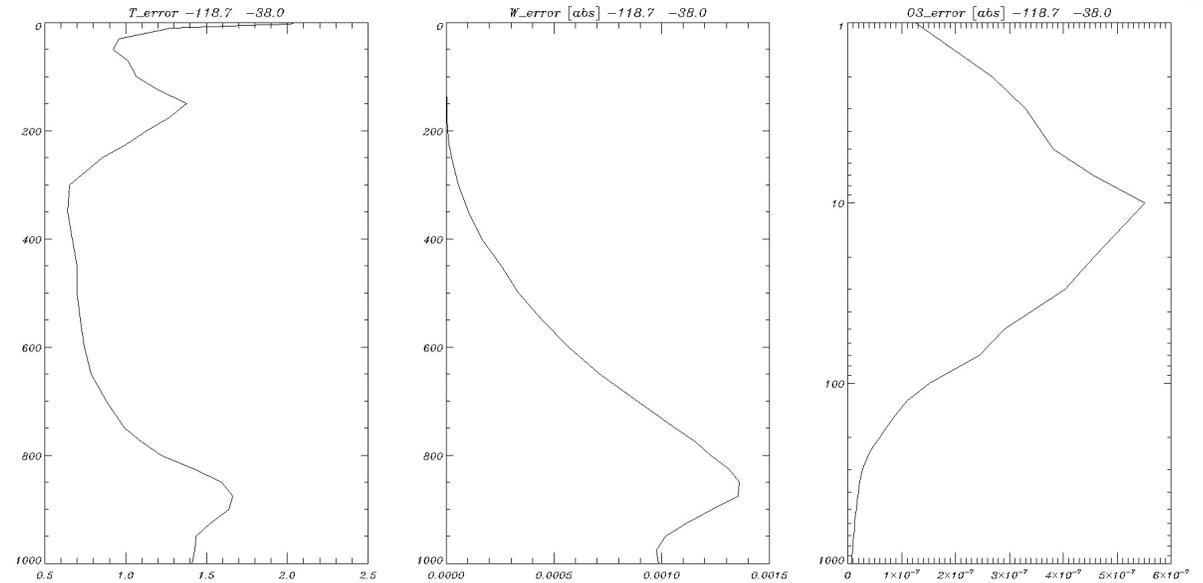
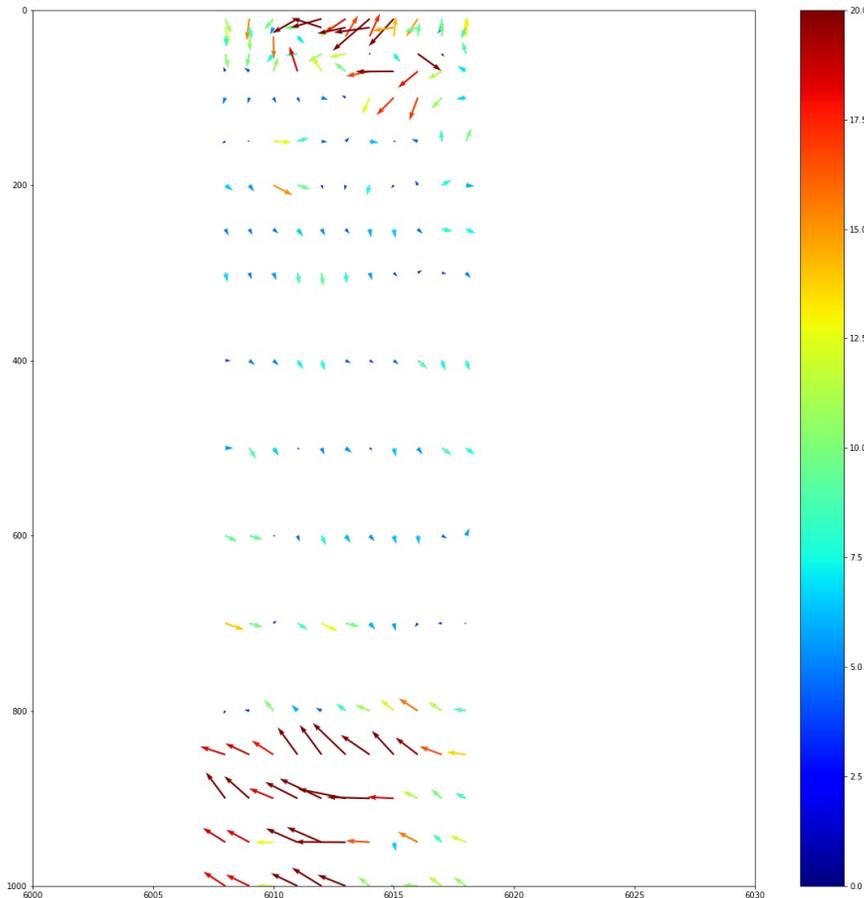
- Some spurious vectors (no quality check)
- FG check keeps about 50% of the IASI AMV
 - Bias and stdev comparable to CMV
 - Higher bias at the level of the jets
- Number of profiles very large
 - Possible correlated observation errors

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 vector over the bin
 - u-, v-components

Intercomparison of collocated data

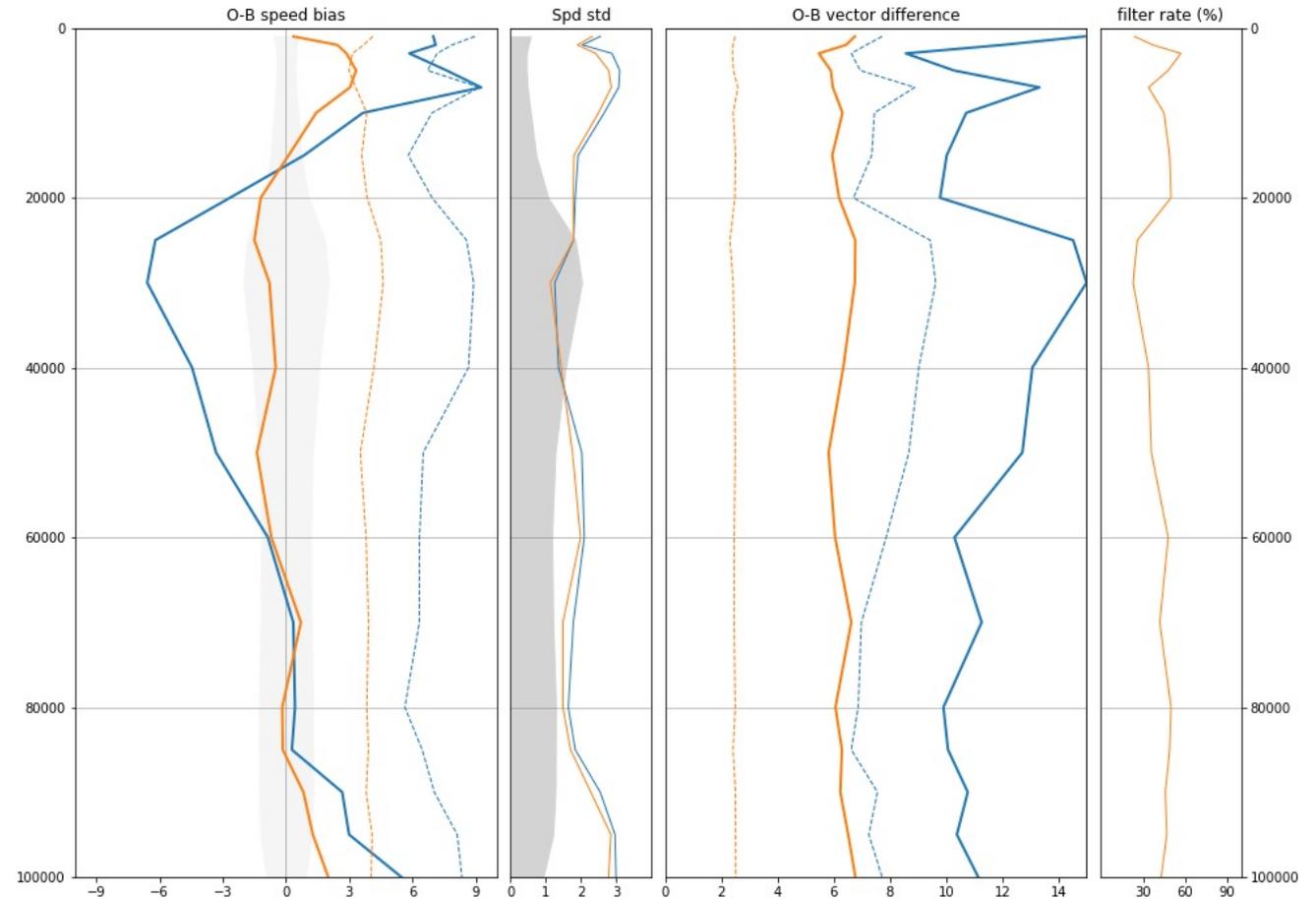
Vector difference
IASI 3D winds vs Forecast winds



- 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).



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

- New direct output variables
 - Divergence, vorticity
 - Wind shear
- 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)