The Tropopause Folding Product (ASII-TF) NWC SAF User's Workshop 2025

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What is a tropopause fold?

- A tropopause fold is a local folding of the tropopause over an intense cyclone. (AMS Glossary)
- Tropopause folds are formed by a steepening of the tropopause at a jet core.
- Tropopause folds occur in areas with large vertical shear and strong meridional thermal gradients. (Holton 2004) → prone to turbulence





What is a tropopause fold?

- Tropopause folds are the dominant and most efficient form of short-term Stratosphere-Troposphere Exchange (STE).
- Potential vorticity is a good tracer for stratospheric air and tropopause folding events.





ASII-TF needs satellite data and NWP fields as input.

From NWP:	- specific humidity (multi-level up to 50 hPa) - wind speed at 300 hPa - shear vorticity at 300 hPa
From satellite: SEVIRI	- WV 6.2 μm - IR 9.7 μm (Ozone channel) - IR 10.8 μm



30 scenes (January to December 2014) were used to retrieve the coefficients from the logistic regression method; each scenery comprises 715 000 pixel.

Reference field (truth): Gradient of the PV=2 height from NWP

- In version 2016, a subjectively analyzed tropopause fold was used.

The input parameters are transformed and/or combined before being used in the **logistic regression**.

- The tropopause height derived from model specific humidity and the gradient therefrom
- Gradient of the BTD 9.7 μm 10.8 μm
- Gradient field of VW 6.2 μm
- BT from WV 6.2 μm
- Black stripe detection from WV 6.2 μm
- Wind speed at 300 hPa
- Wind shear at 300 hPa





Tropopause folds : Output [0-100%]



Tropopause Folds : Validation

1. Validation with PIREPs:





Tropopause Folds : Validation

2. Validation with IASI level-2 data:

• Eyeball validation of the ASII-TF output with IASI derived tropopause height (from specific humidity profiles).



Figure 5: Comparison of the IASI derived tropopause folds (right) with the ASII-TF output (left). Date: 26 March 2018, 20:45 UTC. High probabilities for being located at a tropopause fold are depicted in red in the ASII-TF product; high gradients of the tropopause height are depicted in green in the IASI output.



Comparison between ASII-TF SEVIRI and ASII-TF FCI

SEVIRI

FCI



Eyeball verification shows a very similar output. However, this should be quantified.



The FSS compares the number of hits and misses for to different outputs on the same sub-domain depending on the chosen threshold.





The **FSS** helps us answering the 2 question:

- 1. Are the 2 ASII-TF outputs comparable in terms of location (size of the subdomain)
- 2. Are the 2 ASII-TF outputs comparable in terms of thresholds (10% 90%)

For the comparison of ASII-TF (SEVIRI) with ASII-TF (FCI):

	SEVIRI		FCI
Subdomain size:	50x50 pixel	$\leftrightarrow \rightarrow$	75x75 pixel
Variation of thresholds:	10% - 90%	$\leftrightarrow \rightarrow$	10% - 90%

We did not do a variation of the sub-domain size.



Comparison of SEVIRI with FCI output



Probability output [%]



■ 0-10 ■ 10-20 ■ 20-30 ■ 30-40 ■ 40-50 ■ 50-60 ■ 60-70 ■ 70-80 ■ 80-90 ■ 90-100

Comparison of SEVIRI with FCI output



The output of ASII-TF (SEVIRI) and ASII-TF (FCI) look very similar at first glance (for location and intensity).

However, small differences are noticeable when comparing them directly.





Conclusion

- There is a minor, still noticeable difference depending on the use of SEVIRI or FCI data.
- To obtain a similar output, the logistic regression should be repeated with FCI image data.

