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EUMETSAT Satellite Application Facility on
Support to Operational Hydrology and Water Management




**Product Validation Report (PVR)
for product SE-D-FCI (H43)
Snow detection (snow mask) by VIS/NIR of MTG FCI**

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DOCUMENT CHANGE RECORD

Issue / Revision	Date	Description
0.1	19/03/2025	First draft
0.2	21/03/2025	First revision
0.3	25/03/2025	Second revision
1.0	28/04/2025	Final version delivered to Eumetsat
1.1	09/05/2025	<p>Final Version with update for RID's of MTG ORR part2:</p> <p>RID 23: pag 6 in Chp1, resolution was corrected in 2km and 3 km at Nadir</p> <p>RID 24: a case study analysis was added in Chp3 "Overall Evaluation of the results", with "good" and "bad" performance of the product</p> <p>RID 25: in Tables 4,5,6 labels were added</p> <p>Overall: the Product Requirements from PRD were added in pag. 9</p>



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1 Introduction

H SAF SE-D-FCI (H43) snow extent is a Day-1 product which has been developed partly before the satellite launch and then improved based on actual satellite data after the launch.

The H43 snow extent product has a resolution of ~2 km at nadir and contains three variants, which cover all land areas in the FCI detection disk. The variants are flatland snow extent, mountain snow extent and merged snow extent. The flatland snow extent targets especially flatland and forest areas, mountain snow extent mountain regions, and merged variant combines both using a predefined mountain mask. All three variants cover the full MTG/FCI disk.

The H SAF MTG/FCI flatland snow extent algorithm is a thresholding method based on the different properties of the snow covered and snow free surfaces and clouds. Snow recognition for mountainous regions through multi-spectral threshold technique has been implemented on VIS and IR satellite imagery from MTG/FCI. Binary Cloud, Land and Snow Cover Maps have been produced. The cloud mask is retrieved from NOWCASTING Cloud product (CM: Cloud Mask and CT: Cloud Type are used). Detailed information about the algorithms used for H43 can be found in ATBD-43. The validation for the H SAF's H43 snow cover extent (SCE) product (cf. Figure 1) is performed for the period 1 December 2024 – 28 February 2025. The reference dataset used in the validation is obtained from the MODIS MOD10A1 NDSI snow cover C6.1 data (Riggs *et al.*, 2019). The results for H43 are also compared with the ones obtained for SE-D-SEVIRI (H34), the preceding version of Snow Cover Extent product generated from MSG-SEVIRI, which has a resolution of ~3 km at nadir.

H43 (MTG) Snow detection by VIS/IR radiometry 20250226

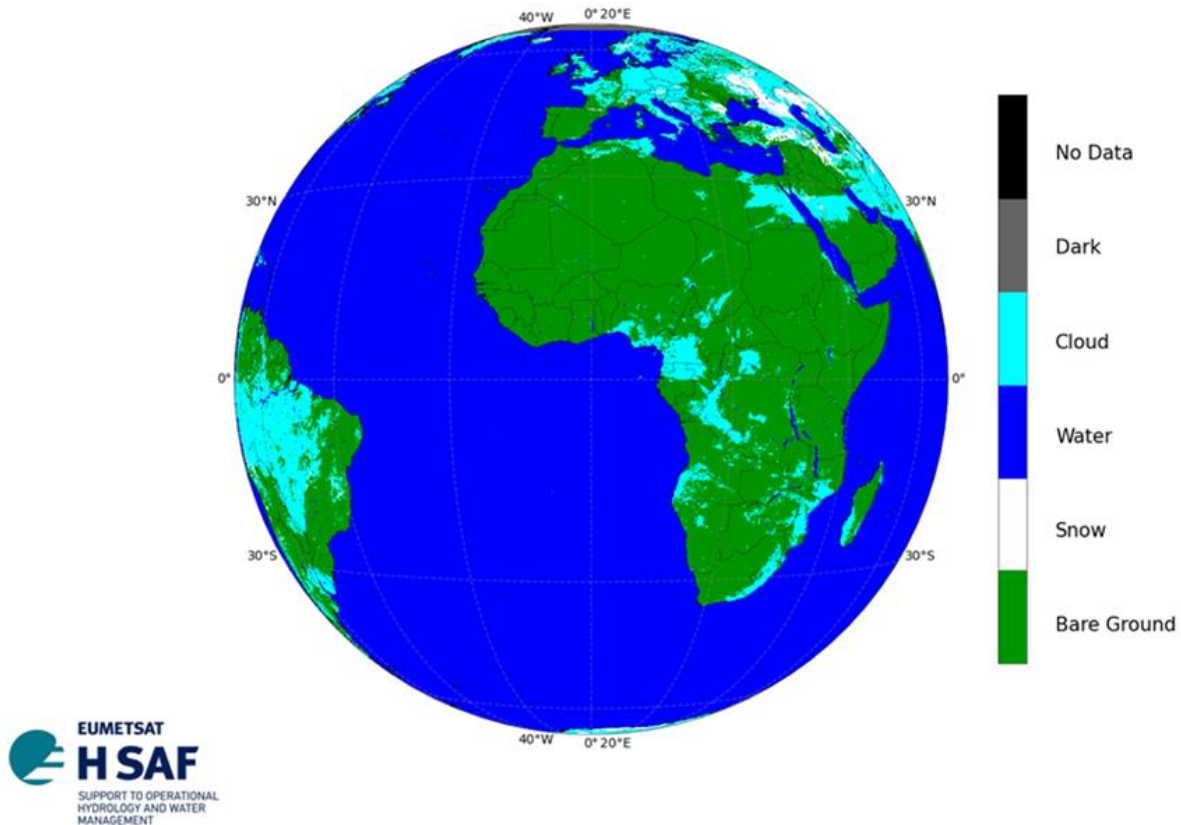



Figure 1. H43 product for 26 Feb 2025.

1.1 Spatial Domain for the Validation

The H43 SCE product is validated in four regions: the European Alps, Georgia-Caucasus, Turkey, and South Russia-North Kazakhstan (cf. Figure 2). These areas represent diverse topographic and climatic conditions, ensuring a comprehensive evaluation (Note: The classification of flat and mountainous terrain is based on the H43 mountain mask, while the percentage of water area is determined using the H43 water mask.):

- European Alps:** It covers $\sim 445,470 \text{ km}^2$ between $48^\circ 30' \text{ N}$ and $43^\circ 39' \text{ N}$, and $5^\circ 6' \text{ E}$ to $16^\circ 17' \text{ E}$. It has a temperate alpine climate with frequent winter snowfall. The terrain is 37% mountainous, 51% flat, and 12% water. Maximum elevation is 4,572 m, with an average of 1,607 m. Snow cover is influenced by complex topography (Gobiet *et al.*, 2014), making it a key test area.

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- Turkey:** It covers ~811,774 km² between 42° 12' N and 35° 55' N, and 30° 49' E to 44° 56' E. It has a continental and mountainous climate, with harsh winters in highlands and semi-arid conditions at lower elevations (Turkes, 2020). Terrain distribution is 61% mountainous, 25% flat, and 14% water. Elevation ranges from 1,553 m (average) to 4,711 m (maximum). Snowpack variability and cloud cover complicate validation efforts.
- Georgia-Caucasus:** It spans ~382,225 km² between 44° 47' N and 40° 50' N, and 38° 59' E to 50° 0' E. It has a humid continental to alpine climate, with cold, snowy winters (Loveluck *et al.*, 2024). The region is 38% mountainous, 37% flat, and 25% water. Elevation ranges from 1,637 m (average) to 5,450 m (maximum). Steep terrain and mixed land cover create challenges for snow retrieval.
- South Russia-North Kazakhstan:** It is the largest region, ~822,594 km², extends from 55° 40' N to 47° 25' N, and 50° 24' E to 64° 41' E. It has a cold continental climate with long winters and widespread snow cover (Gudko *et al.*, 2021; Salnikov *et al.*, 2023). The terrain is 98.5% flat, 0.5% mountainous, and 1% water. Elevation is relatively uniform, with a maximum of 1,422 m and an average of 499 m. Its homogeneous landscape makes it ideal for assessing large-scale snow detection.

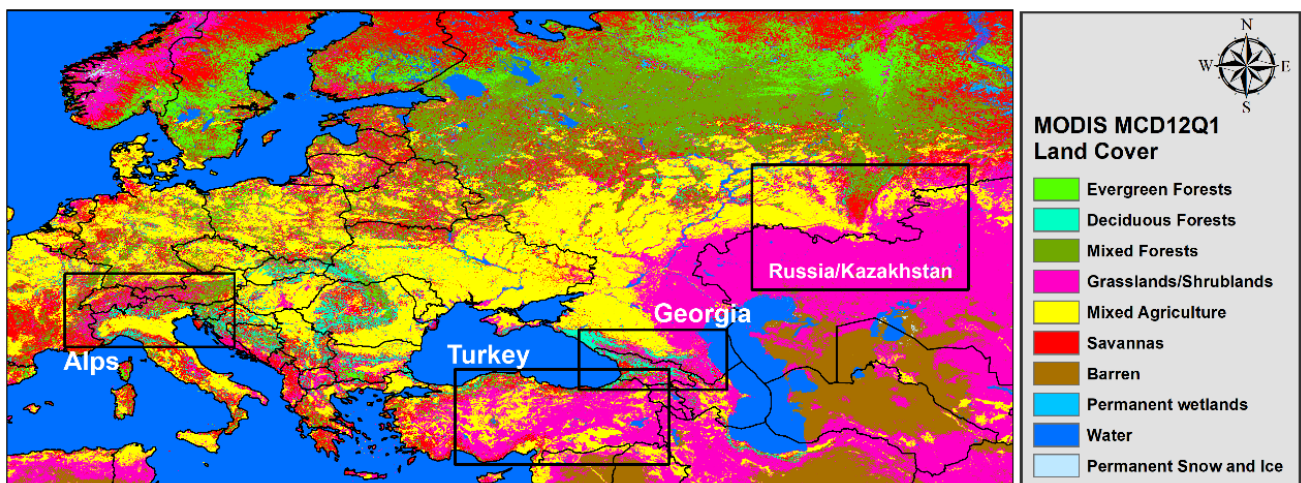


Figure 2. Selected areas for the validation over MODIS MCD12Q1 merged land cover class map.

1.2 Statistical Metrics

The accuracy and reliability of the H43 and H34 SCE products are evaluated using MODIS-derived reference snow cover maps. A binary error matrix (i.e., contingency table, cf. Table 1) is

used to compare satellite-based snow data with reference dataset. Key performance metrics include:

- Probability of Detection (POD): Measures the percentage of actual snow pixels correctly identified. Higher values indicate better detection ($POD = A / (A + C)$).
- False Alarm Ratio (FAR): Shows the proportion of falsely detected snow pixels. Lower values mean fewer errors ($FAR = B / (A + B)$).
- Overall Accuracy (ACC): Represents the total percentage of correctly classified pixels, reflecting overall reliability ($ACC = (A + D) / (A + B + C + D)$).

Table 1. The binary error matrix.

		<i>Ground Truth (MODIS MOD10A1 NDSI)</i>	
		Snow	No Snow
<i>Satellite Product (H34/H43)</i>	Snow	HITS (A)	FALSE ALARMS (B)
	No Snow	MISSES (C)	CORRECT NEGATIVES (D)


The product requirements of the new MTG product H43 are the same as for the operative MSG H34 and are displayed in Tables 2 and 3 **Errore. L'origine riferimento non è stata trovata.** (ref. PRD).

Table 2. Product requirements for product SE-D-FCI in Mountainous areas.

Score	Threshold	Target	Optimal
POD	0.60	0.70	0.99
FAR	0.30	0.20	0.05

Table 3. Product requirements for product SE-D-FCI in Flat/Forest areas.

Score	Threshold	Target	Optimal
POD	0.80	0.85	0.99
FAR	0.20	0.15	0.05

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1.3 MODIS-Derived Reference Snow Dataset

The H43 SCE product is validated using reference snow cover maps from the MODIS MOD10A1 NDSI Collection 6.1 dataset (Riggs *et al.*, 2019). MOD10A1, a daily global snow cover product from NASA’s Terra satellite, has been widely validated against in-situ and satellite data, with reported accuracy between 77% and 100% (Gascoin *et al.*, 2015; Klein *et al.*, 2003; Parajka and Blöschl, 2006; Tekeli *et al.*, 2005). While cloud cover and snowpack properties introduce some uncertainties (Brubaker *et al.*, 2005; Crawford, 2015), its 500-meter resolution makes it a reliable dataset for snow detection over large geographical areas. The necessary MOD10A1 dataset between 1 December 2024 and 28 February 2025 is downloaded from the dedicated web-based platform of NASA (<https://appeears.earthdatacloud.nasa.gov/>).

To validate H43, MODIS data is re-gridded and aggregated to match H43’s resolution (~2 km at nadir) (cf. Figure 3):

- Pixels with NDSI ≥ 0.4 are classified as snow, otherwise non-snow (Kuter *et al.*, 2018).
- Snow classifications are aggregated over each H43 pixel footprint.
- The most frequent class (snow, non-snow, cloud, water, unclassified, or no data) is assigned to the H43 pixel.
- If the frequency of snow and other labels are equal, the pixel is labeled snow to avoid underestimation.

This pixel-wise validation ensures accurate reference data for evaluating H43. The same process is applied to H34 (~3 km at nadir), allowing a direct comparison between H43 and H34. This comparison helps assess improvements in snow detection within the H SAF project.

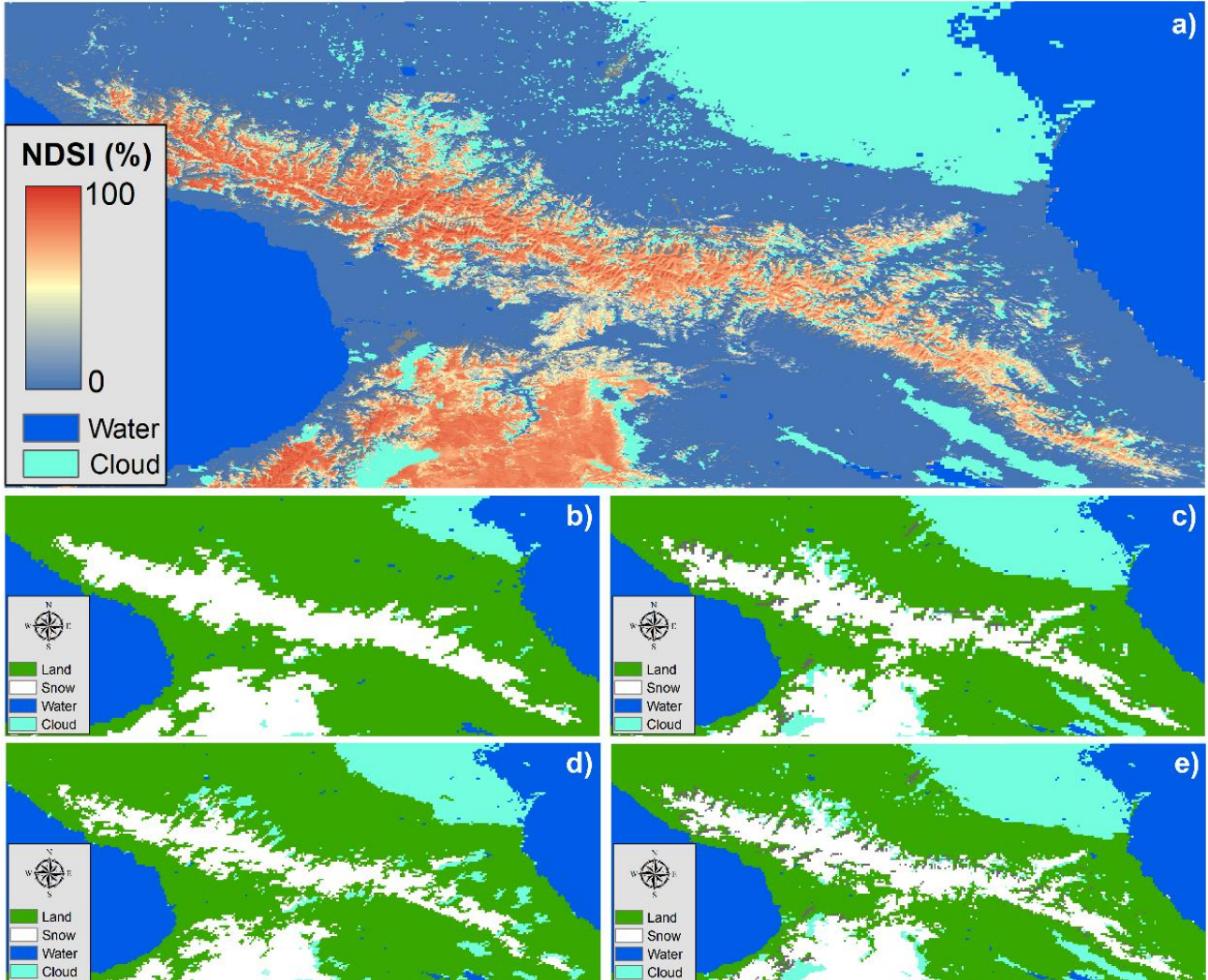



Figure 3. Georgia on 9 January 2025: a) MODIS MOD10A1 NDSI, b) H34 SCE, c) MODIS-derived reference H34 SCE, d) H43 SCE, e) MODIS-derived reference H43 SCE.

While populating the corresponding error matrices, cloud, no data, and water pixels are excluded from the analysis. The obtained accuracy metrics over the four geographic validation regions are also evaluated with respect to land cover classes, which are obtained from the MODIS MCD12Q1 land cover class dataset developed within the frame of International Biosphere-Geosphere Program (Friedl *et al.*, 2010; Sulla-Menashe and Friedl, 2022). There are 17 land cover classes in the original MCD12Q1 product, and they are merged to 10 classes for simplicity, as shown in Figure 2.

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2 Results

This section presents the validation results of the H34 and H43 SCE products across four distinct geographic regions: the European Alps, Turkey, Georgia-Caucasus, and Russia-Kazakhstan. The analysis focuses on key accuracy metrics, including POD, FAR, and ACC, to assess the performance of both products in various environmental conditions. The evaluation is conducted at two levels: regional-scale validation and land cover-based performance assessment.

At the regional scale, the daily accuracy metrics for each product are examined over the study period, providing insights into their overall detection capabilities and sensitivity to seasonal variations and cloud cover contamination. Additionally, a land cover-based analysis is performed using the MODIS MCD12Q1 land cover dataset, where similar classes are merged to enhance interpretability. This approach allows for a detailed examination of how different land cover types influence snow classification accuracy.

2.1 Regional-Scale Results


2.1.1 European Alps

The minimum, maximum and mean values of the statistical metrics over the European Alps is provided in Table 4, while all metrics are given in Figure 4, together with the cloud cover percentage.

Table 4. Summary of statistical metrics over European Alps for H34 and H43.

Metric	H34			H43		
	Min	Max	Mean	Min	Max	Mean
POD	0.2965	0.9556	0.7824	0.2272	0.9834	0.8466
FAR	0.0029	0.2006	0.0743	0.0064	0.2419	0.0695
ACC	0.7848	0.9758	0.9209	0.7728	0.9800	0.9343

The results indicate that H43 consistently outperforms H34 in terms of higher POD and ACC while maintaining a slightly lower FAR on most days. The lowest POD values were observed in early December, likely due to cloud cover interference. ACC values remain high for both products, with H43 showing better agreement with the reference dataset (i.e., MOD10A1 NDSI). Monthly variations reveal that in December, H34 and H43 had similar POD values around 0.77, but in January, H43 significantly improved to 0.92, while H34 remained steady. By February, H43 reached its highest POD levels at 0.95, indicating improved snow retrieval. The FAR values were lower in December, suggesting fewer false detections early in the season, but slightly increased in January and February due to mid-winter snow variations and late-winter melting effects. Accuracy levels remained high throughout, with H43 showing superior performance, reaching a maximum ACC of 0.97 in February. Cloud contamination has had a significant impact on both products, reducing POD and ACC values

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on high-cloud days. However, H43 appeared more resilient. The highest cloud cover was recorded in early December and mid-February, causing occasional drops in accuracy.

Overall, H43 demonstrated improved snow detection over H34, particularly in terms of POD and ACC. H34 exhibited more variability and a slightly higher FAR. Seasonal variations affected performance, with POD increasing over time, particularly in H43. While cloud cover remained a challenge, its impact was less pronounced in H43, indicating that the updated algorithm is more robust in handling cloud clearing. These findings highlight the enhanced capabilities of H43 for snow cover detection in complex mountainous regions like the European Alps.

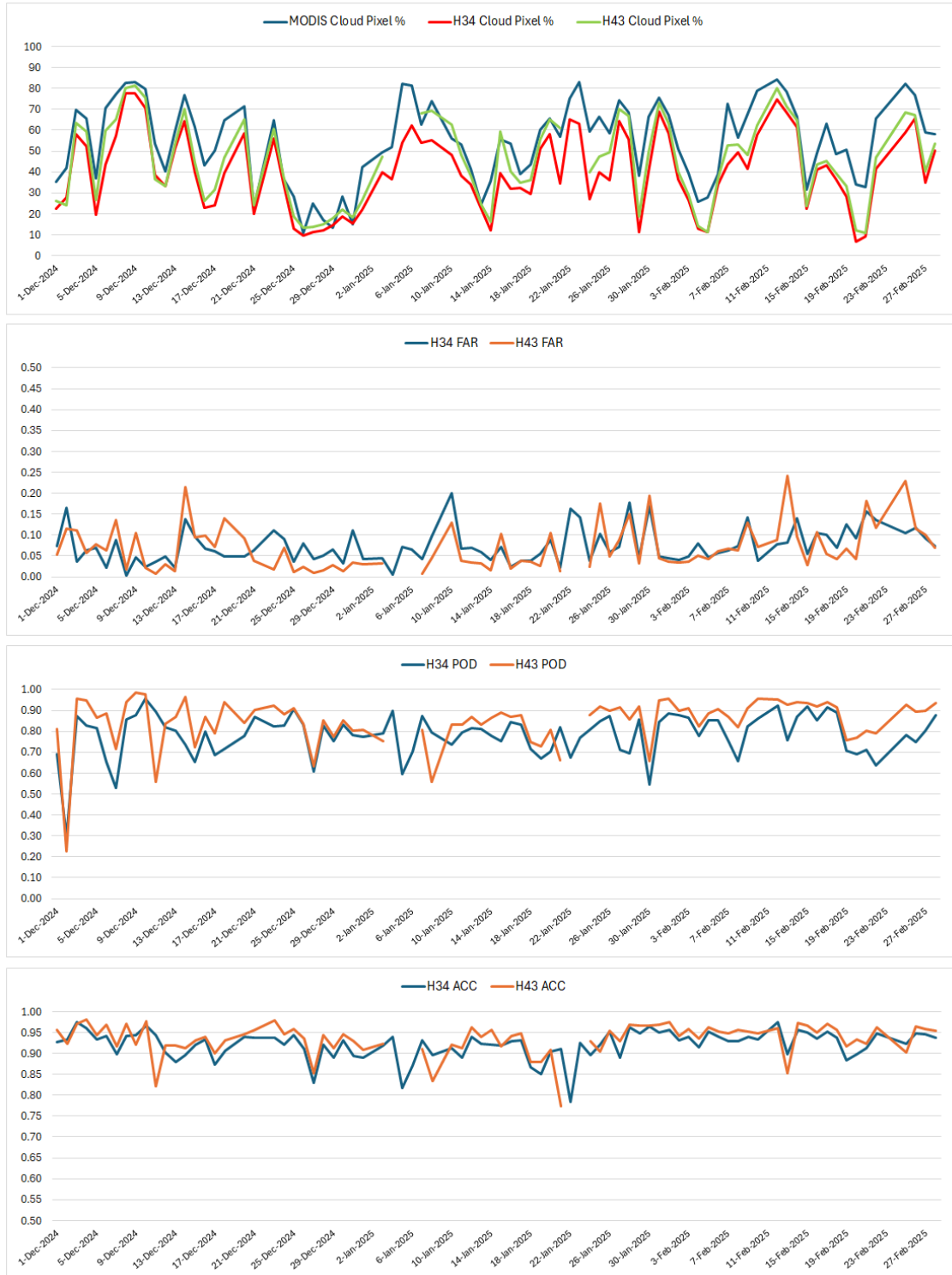


Figure 4. From top to bottom: Cloud cover percentage, FAR, POD, and ACC metrics for European Alps between 1 December 2024 and 28 February 2025.

2.1.2 Turkey

Throughout the study period, the POD of H34 ranged from 0.615 to 0.976, whereas H43 varied between 0.80 and 1.00 (cf. Table 5). The average POD for H34 was 0.88, while H43 showed a significant improvement with an average of 0.94, indicating a more reliable detection of snow-covered areas. When examining false positives, H34's FAR ranged from 0.0009 to 0.1701, while H43 had values between 0.007 and 0.237. The mean FAR values were 0.060 for H34 and 0.070 for H43, suggesting that H43's refinement in snow detection does not lead to a significant increase in false alarms. In terms of overall classification accuracy, H43 exhibited consistently better agreement with reference data, reaching accuracy values between 0.857 and 0.996, compared to 0.892 to 0.987 for H34 (cf. Figure 5). The mean ACC was 0.96 for H43 and 0.95 for H34, confirming H43's ability to provide a slightly more precise representation of snow cover in the region.

Table 5. Summary of statistical metrics over Turkey for H34 and H43.

Metric	H34			H43		
	Min	Max	Mean	Min	Max	Mean
POD	0.6148	0.9755	0.8792	0.7988	1.0000	0.9429
FAR	0.0009	0.1701	0.0571	0.0066	0.2373	0.0729
ACC	0.8920	0.9878	0.9534	0.8573	0.9958	0.9601

A closer look at monthly trends reveals that detection performance improved progressively from December to February. In December, the average POD was 0.858 for H34 and 0.931 for H43, with both products increasing their detection capabilities in February to 0.896 for H34 and 0.959 for H43. False alarm rates remained relatively stable but exhibited slight variations in January, likely due to transitional snow conditions. The highest accuracy levels were observed in February, where the classification of snow-covered and non-snow-covered areas became more stable. Cloud cover played a critical role in shaping accuracy trends. Periods of extensive cloud coverage, particularly in early December and mid-February, caused noticeable fluctuations in detection accuracy. H43 demonstrated better resilience to cloud interference, maintaining a more stable performance than H34. In summary, the Turkey region validation confirms H43's superiority over H34 in snow detection, with higher detection efficiency, improved accuracy, and minimal compromise in false detections. Seasonal influences affected both products, yet H43 adapted more effectively, particularly in handling cloud-contaminated scenes.

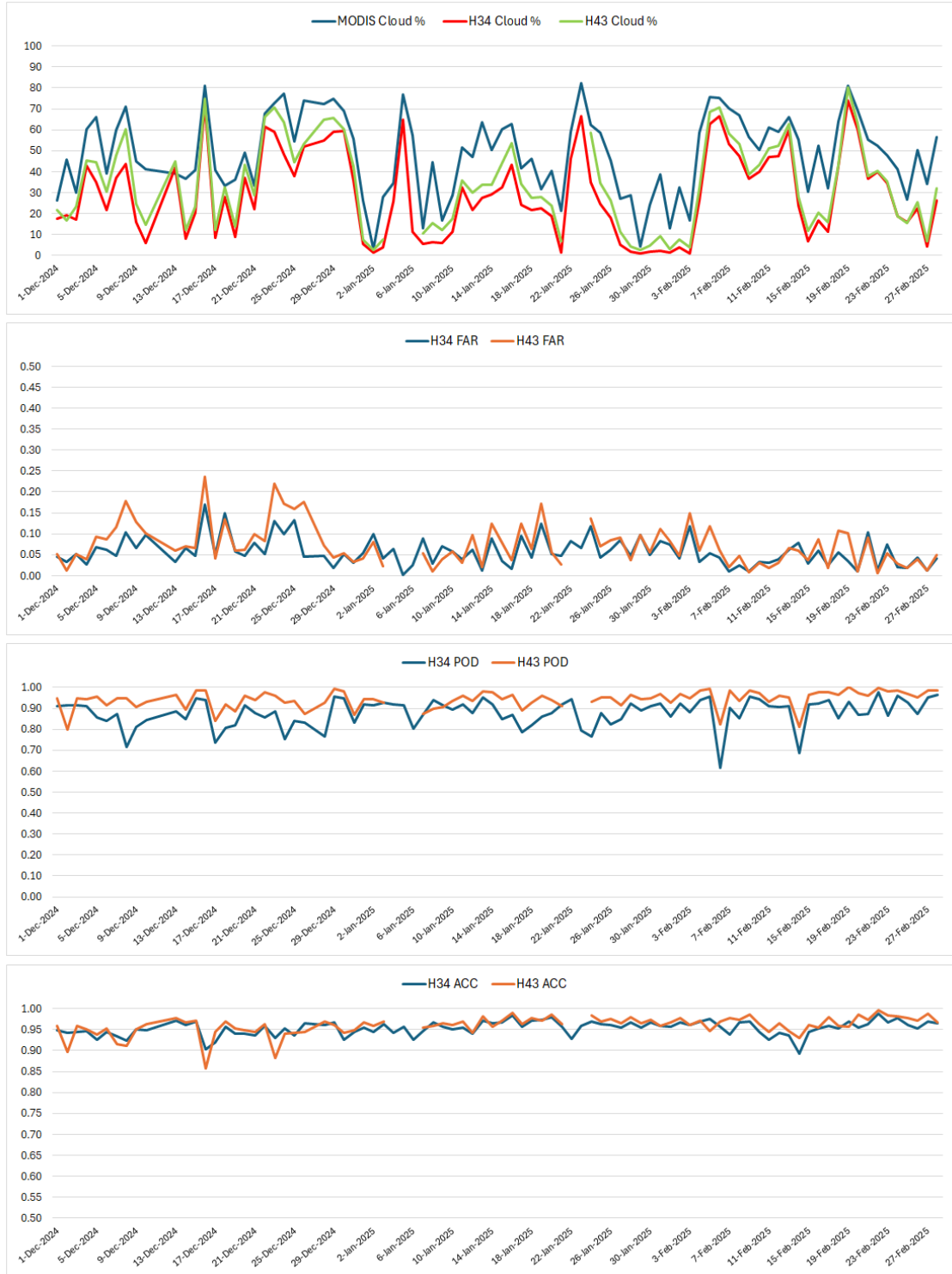


Figure 5. From top to bottom: Cloud cover percentage, FAR, POD, and ACC metrics for Turkey between 1 December 2024 and 28 February 2025.

2.1.3 Georgia-Caucasus

In general, H43 outperformed H34 in detecting snow cover over the Georgia-Caucasus, with higher POD and ACC values and slightly higher FAR. The seasonal variations affected performance, but both products showed improved detection in later months. Cloud cover remained a challenge, but H43 handled it more effectively.

H43 generally outperforms H34 in terms of higher POD and ACC while maintaining comparable FAR values. Over the entire period, H34 recorded a POD ranging from 0.674 to 0.939, while H43 had a POD between 0.712 and 0.955 (cf. Table 6). The mean POD for H34 was 0.854, whereas H43 achieved a higher average of 0.858, confirming its improved detection performance. Regarding FAR, both products performed similarly, with H34 ranging from 0.028 to 1.000 and H43 between 0.011 and 0.372 (cf. Figure 6). The mean FAR values were 0.102 for H34 and 0.128 for H43, showing that H43 slightly increased false detections.

Table 6. Summary of statistical metrics over Georgia-Caucasus for H34 and H43.

Metric	H34			H43		
	Min	Max	Mean	Min	Max	Mean
POD	0.6745	1.0000	0.8484	0.7563	1.0000	0.9179
FAR	0.0096	0.3163	0.1014	0.0035	0.3723	0.0977
ACC	0.7869	0.9859	0.9105	0.7981	0.9915	0.9289

The overall accuracy of H43 remained consistently higher than H34, with an ACC range of 0.817 to 0.991 compared to H34's 0.902 to 0.985. The mean ACC for H43 was 0.932 whereas H34 had an average of 0.91, reinforcing H43's greater agreement with the reference dataset. Analyzing monthly trends, both products showed increasing POD values from December to February, with H43 improving more notably. In December, the mean POD values were 0.854 for H34 and 0.923 for H43, while by February, these values had increased to 0.858 for H34 and 0.937 for H43. FAR values remained relatively stable across the months but tended to be higher in January, likely due to variations in snow conditions. ACC values followed a similar trend, peaking in February when snow cover detection was more consistent. Cloud contamination had a significant impact on both products, with the highest cloud cover recorded in early December and late February, causing fluctuations in POD and ACC. Despite this, H43 demonstrated greater resilience to cloud interference

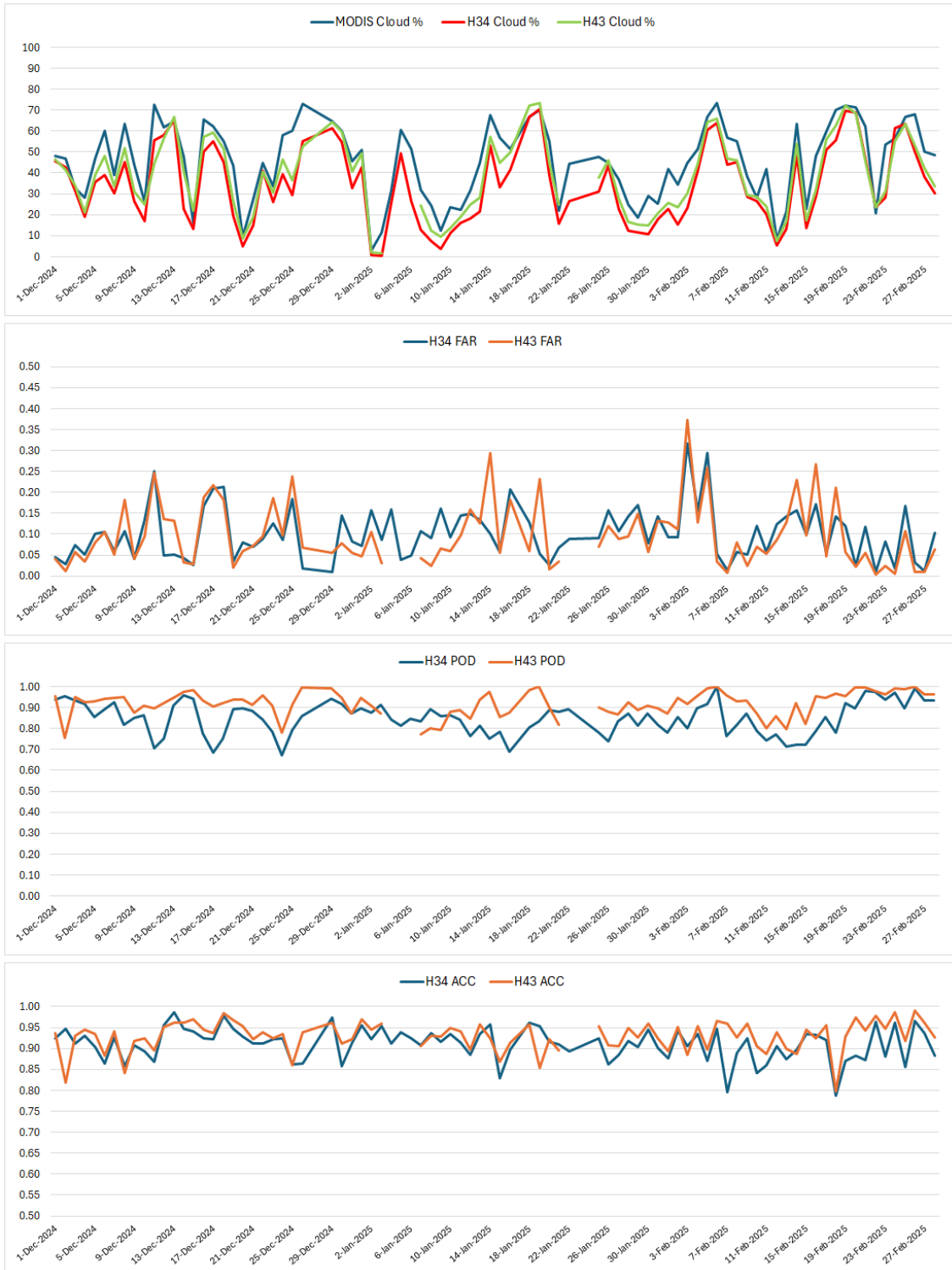


Figure 6. From top to bottom: Cloud cover percentage, FAR, POD, and ACC metrics for Georgia-Caucasus between 1 December 2024 and 28 February 2025.

2.1.4 Russia-Kazakhstan

Given the predominantly flat landscape and extensive seasonal snow cover, both products exhibited high detection accuracy, with POD values frequently approaching 1.0. The results highlight H43's enhanced detection stability, especially under varying cloud conditions, while maintaining minimal false positives. Over the entire period, H34 and H43 achieved almost similar POD values ranging from 0.814 to 1.000 (cf. Table 7). The average POD was 0.988 for both H34 and H43, confirming similar performance in detecting snow cover across open landscapes. FAR values remained low for both products, with H34 ranging between 0.00 and 0.16 and H43 between 0.00 and 0.15 (cf. Figure 7).

Table 7. Summary of statistical metrics over Russia-Kazakhstan for H34 and H43.

Metric	H34			H43		
	Min	Max	Mean	Min	Max	Mean
POD	0.8138	1.0000	0.9880	0.8135	1.0000	0.9884
FAR	0.0000	0.1601	0.0208	0.0000	0.1514	0.0066
ACC	0.8116	1.0000	0.9717	0.8641	1.0000	0.9859

The mean FAR values were 0.021 for H34 and 0.007 for H43, suggesting H43's lower rate of false snow detections. When considering overall accuracy, H34 exhibited ACC values between 0.81 and 1.00, while H43 ranged from 0.86 to 1.00. The mean ACC was 0.97 for H34 and 0.99 for H43, confirming that both products performed exceptionally well in this region.

A breakdown of monthly trends shows that both products achieved their highest accuracy levels in January and February, with POD values exceeding 0.99 on most days. In December, H34 had a mean POD of 0.978, while H43 recorded 0.994. By February, H34 reached 0.994, and H43 remained stable at 0.981, reinforcing the strong reliability of both datasets in this region. FAR values were minimal throughout, with only slight fluctuations in December, potentially due to transitional snow conditions. ACC values remained consistently high, with minor variations largely influenced by cloud cover. One of the most significant challenges in this region was persistent cloud cover, with cloud percentages exceeding 90% on many days. Even under high cloud contamination, H43 managed to sustain high accuracy values between 0.86 and 1.00 during the validation period. H34, while also performing well, showed slightly more variability in terms of accuracy.

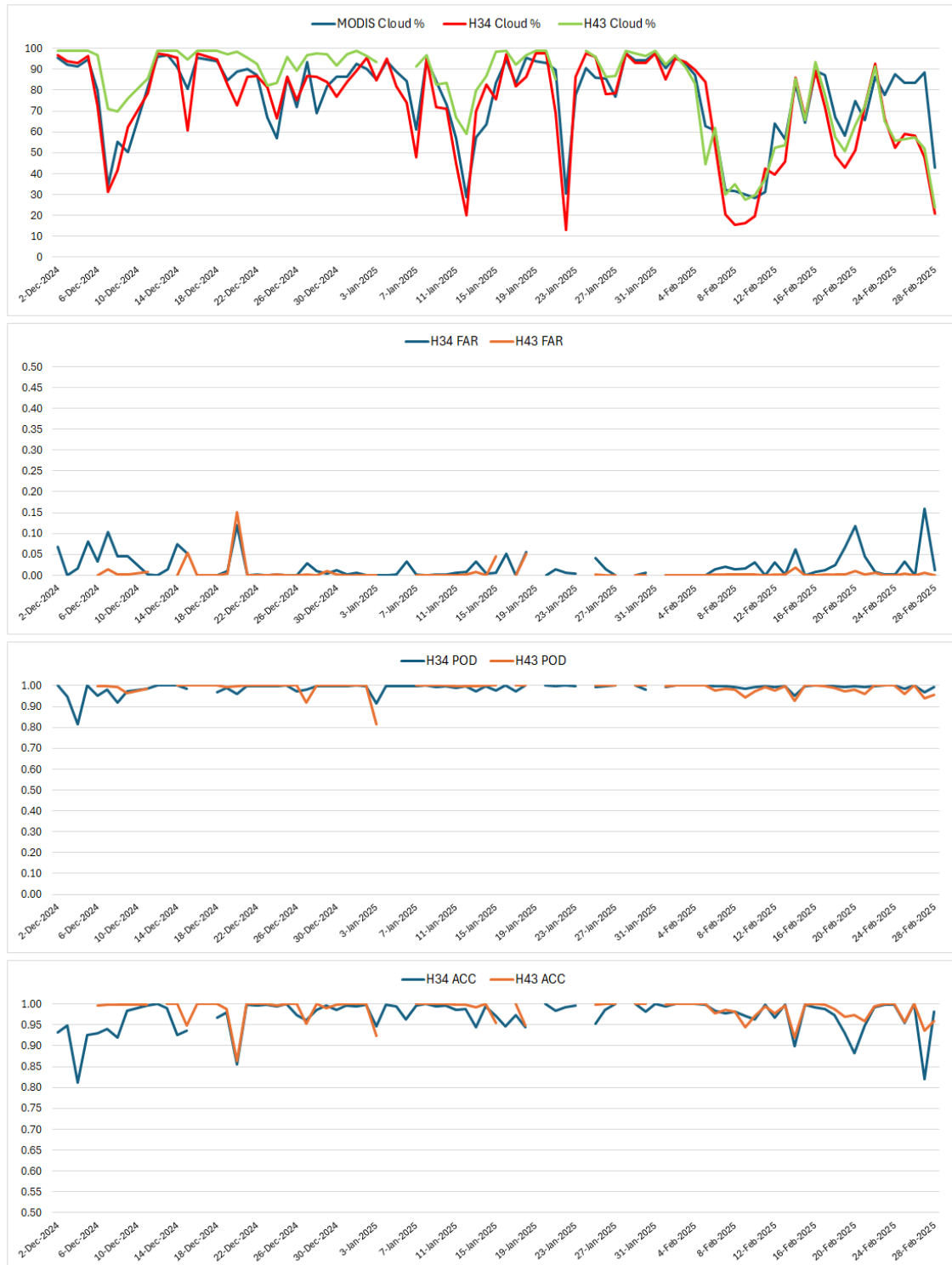


Figure 7. From top to bottom: Cloud cover percentage, FAR, POD, and ACC metrics for Russia-Kazakhstan between 1 December 2024 and 28 February 2025.

In overall, the Russia-Kazakhstan validation confirms H43’s superior detection stability and lower false alarm rate compared to H34, despite both products performing at near-optimal levels.

The region’s relatively uniform topography and consistent seasonal snow cover contributed to high detection rates, with minimal seasonal fluctuations. These findings reinforce H43’s reliability for large-scale snow monitoring in open landscapes.

2.2 Further Study: Land Cover-Based Performance Assessment

The land cover type percentages over each validation area are given in Figure 8. Across all regions, H43 consistently demonstrated improved snow detection performance compared to H34, exhibiting higher POD and ACC values while maintaining comparable or slightly lower FAR values. The impact of land cover heterogeneity was evident, particularly in regions with forest-dominated and mixed-vegetation landscapes, where snow classification is inherently more complex. The land cover-based assessment results are shown in Figure 9.

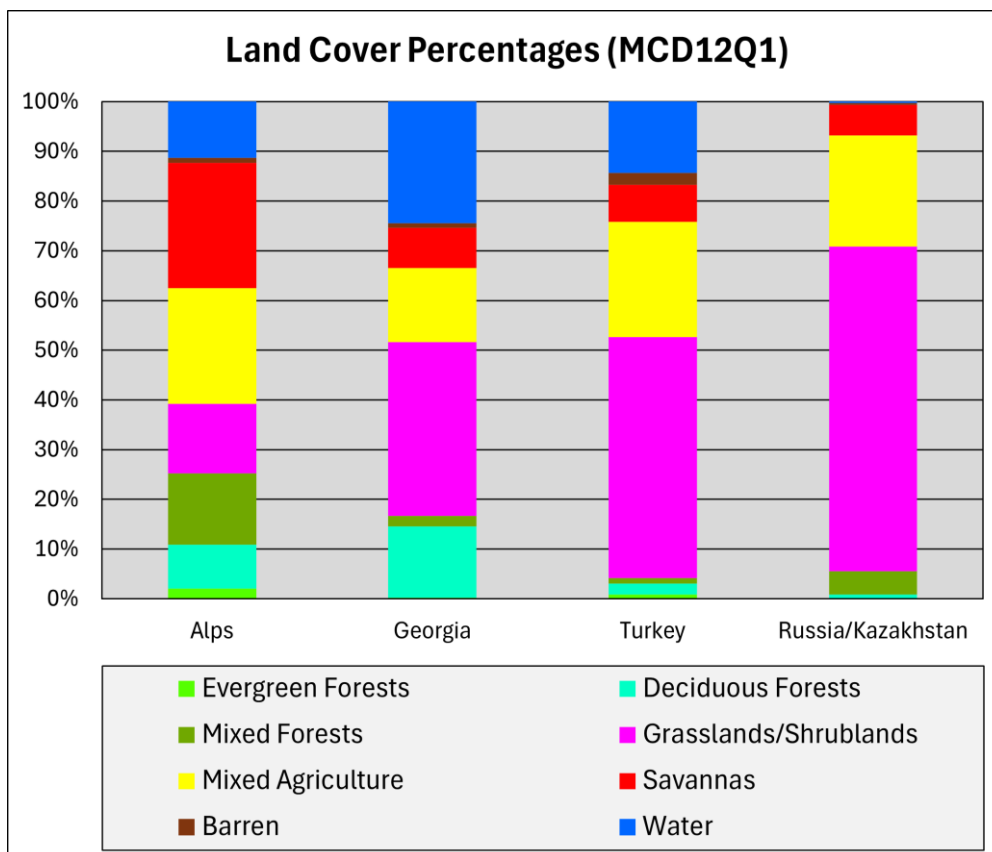



Figure 8. The percentage of each land cover class over each validation area with respect to MODIS MCD12Q1 product.

In the Alps, land cover types such as Evergreen and Mixed Forests showed lower POD values for both H34 and H43 due to frequent tree canopy-induced snow misclassification. In contrast, open

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areas like grasslands and shrublands exhibited higher POD values, indicating better snow retrieval in areas with minimal vegetation obstruction. H43 generally reduced false alarms in forested regions, improving accuracy compared to H34.

The Turkey region displayed a similar trend, where grasslands, barren areas, and agricultural lands showed the highest detection performance, while forested areas had relatively lower POD values. Snow misclassification was more frequent in agricultural areas, possibly due to mixed pixel effects caused by seasonal land use changes. H43 achieved higher ACC values across all land cover types, reinforcing its enhanced performance in complex terrains.

In the Georgia-Caucasus region, forests, croplands, and mixed vegetation areas exhibited higher FAR values, reflecting the challenges of snow detection in diverse landscapes. However, H43 showed improved detection in these classes, reducing false positives and increasing POD compared to H34. Grasslands and barren areas once again yielded the most reliable snow detection performance, highlighting the influence of vegetation density on classification accuracy.

The Russia-Kazakhstan region, characterized by vast open landscapes and minimal topographic variation, provided the highest POD and ACC values among all study regions. Both products performed well, but H43 demonstrated superior accuracy, particularly in barren lands and croplands. Snow retrieval was most stable in grasslands and open fields, while minor classification errors were observed in shrublands and mixed agricultural areas due to spectral similarities between snow and underlying vegetation.

Overall, the results confirm that H43 outperforms H34 in diverse land cover conditions, particularly in forested and mixed-vegetation areas, where it reduces false alarms and enhances detection consistency. Open landscapes such as grasslands and barren lands consistently yielded the highest accuracy across all regions. These findings emphasize the need for continued advancements in snow detection algorithms, especially in complex land cover environments, where vegetation influences retrieval accuracy.

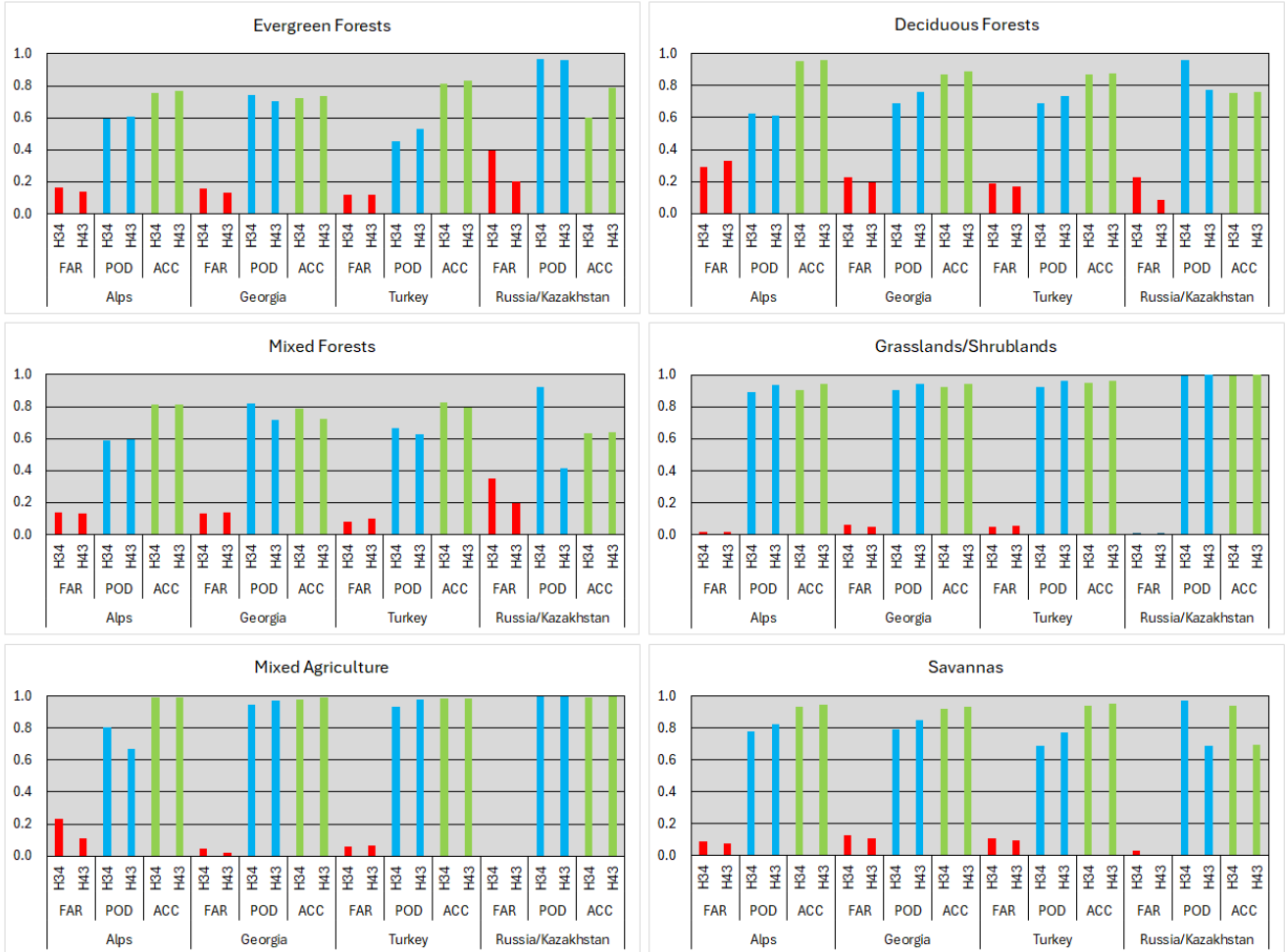


Figure 9. FAR, POD, and ACC metrics with respect to each land cover class over the validation areas.

3 Overall Evaluation of the Results

The validation of the H43 SCE product was carried out across four regions with different topographic and climatic characteristics: the European Alps, Turkey, Georgia-Caucasus, and Russia-Kazakhstan. The evaluation used MODIS-derived snow cover maps. Accuracy metrics, including Probability of Detection (POD), False Alarm Ratio (FAR), and Overall Accuracy (ACC), were computed on a daily basis and analysed with respect to land cover types using the MODIS MCD12Q1 product.

As observed in Figure 10, the H43 product demonstrates strong capability in mapping snow cover across heterogeneous mountain landscapes, including areas with fragmented topography and mixed land cover. It effectively captures the dendritic snow distribution patterns along valley networks and the snow extent gradients on the fringes of slopes, where detection is often complicated by elevation changes, terrain shadowing, and variable vegetation cover.

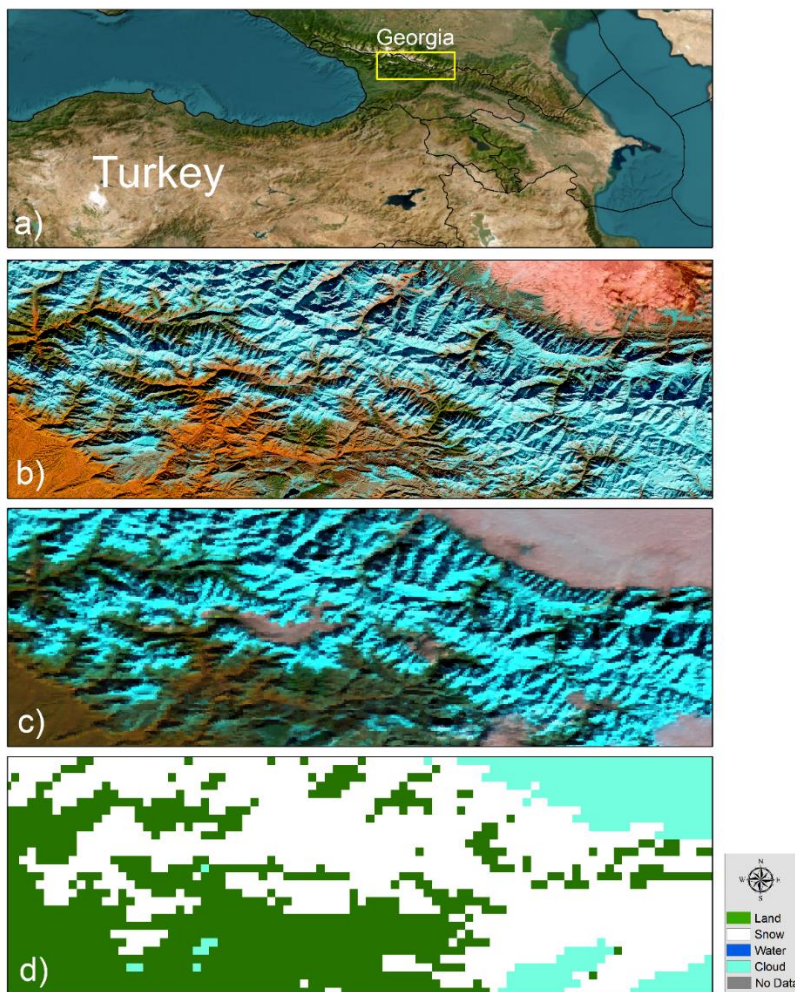



Figure 10. Close up view of a mountainous area over Georgia on 2 Dec 2024: a) Area of interest; b) Sentinel-2 false color RGB image at 20 m; c) MODIS false color image at 500 m; d) H43 product.

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While the H43 product generally provides accurate snow detection across diverse landscapes, its performance may occasionally be limited over flat regions due to conservative cloud screening. For instance, in the Russia-Kazakhstan region on 7 January 2025 (cf. Figure 11), a significant portion of snow-covered areas appeared to be mislabelled as cloud, leading to localized underestimation of snow extent. Such cases highlight the sensitivity of cloud detection thresholds in low-relief areas with uniform surface conditions. Nevertheless, these occurrences are relatively infrequent and do not detract from the overall strength of H43 in delivering consistent and reliable snow cover information across a wide range of geographic settings.

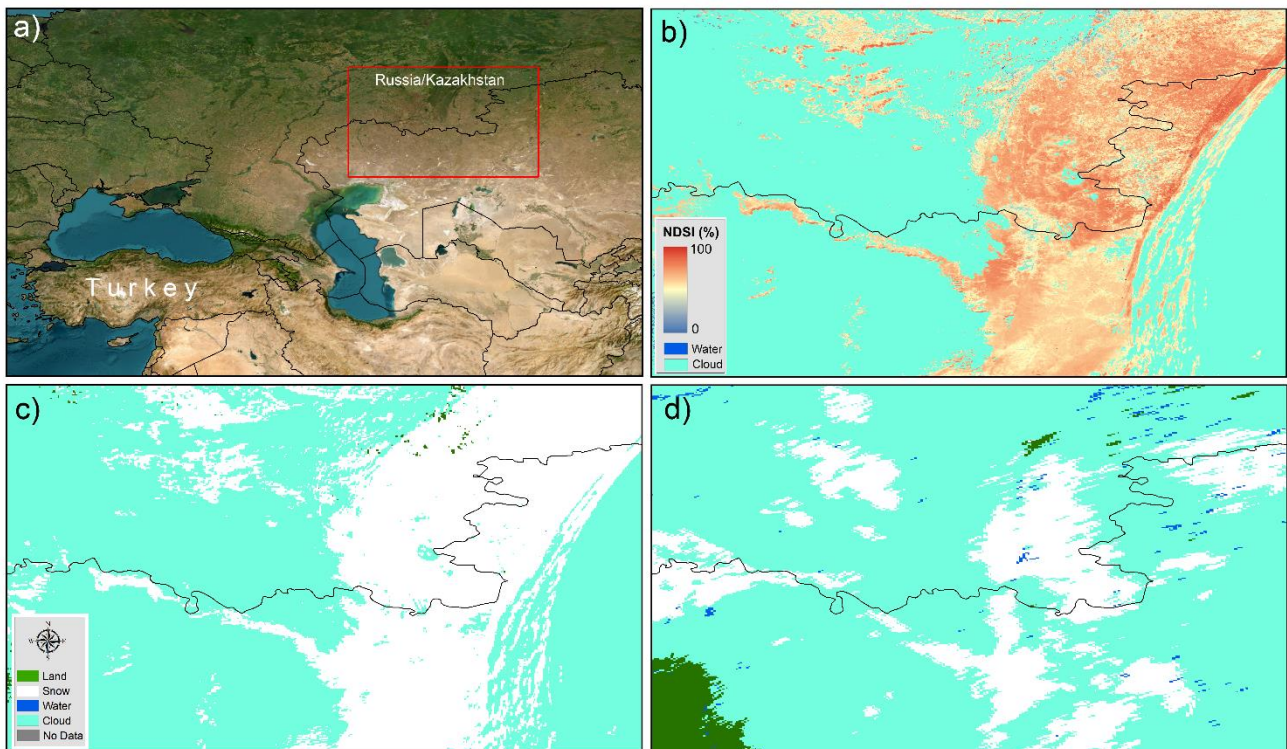



Figure 11. Russia/Kazakhstan on 7 January 2025: a) Area of interest; b) MODIS MOD10A1 NDSI image; c) MODIS-derived reference snow map; d) H43 image.

The results show that H43 performs better than its predecessor, H34, in terms of both detection capability and overall reliability. H43 consistently achieved higher POD and ACC values, especially in open and less complex land cover classes such as grasslands, shrublands, and bare lands. It also maintained a low false alarm rate across most conditions, with notable improvements in forested areas and mixed vegetation types, where snow detection is often difficult due to canopy cover and mixed pixels.

The land cover-based analysis confirmed that snow detection performance is strongly affected by surface type. H43 showed better consistency across a wide range of land cover classes,

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including those that previously caused high uncertainty. In regions with complex terrain or frequent cloud cover, such as the Alps and Georgia-Caucasus, H43 remained more stable than H34 and was less impacted by atmospheric conditions.

Overall, while it is important to note that this validation represents an initial assessment based on a three-month period covering December 2024 through February 2025, it shows that the H43 product represents a clear improvement in snow detection accuracy and spatial consistency. Its enhanced performance across different landscapes and surface types supports its use in regional to continental-scale snow monitoring applications.

Further validation efforts over extended periods, including accumulation and melt phases in early autumn and late spring, will be conducted in the next OR's and will assess the seasonal robustness of the H43 product, help quantifying interannual consistency and identifying any potential limitations under different climatic and surface conditions.

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