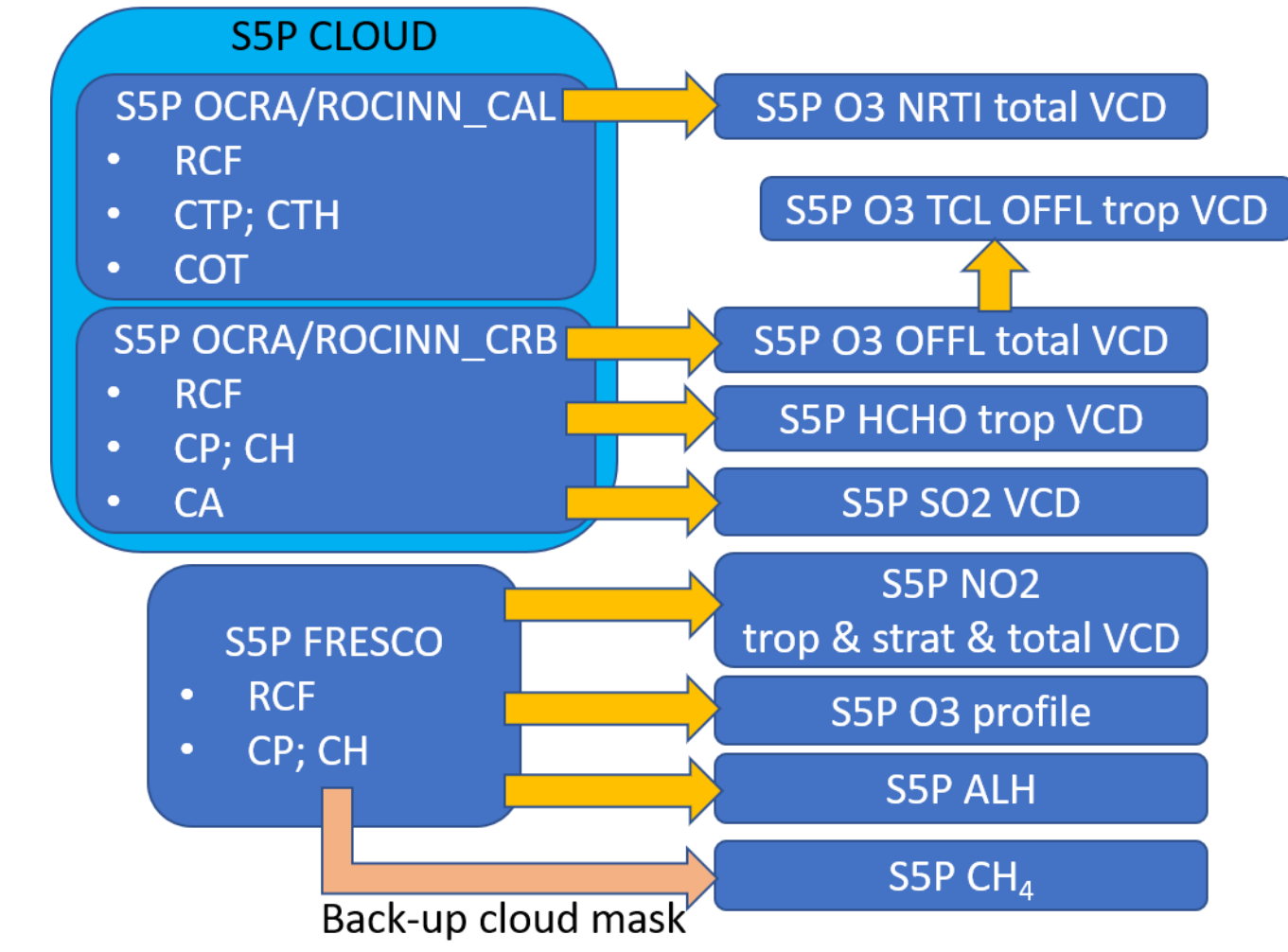


# Sentinel-5p TROPOMI cloud products and their evolution: quality assessment using ground-based Cloudnet data

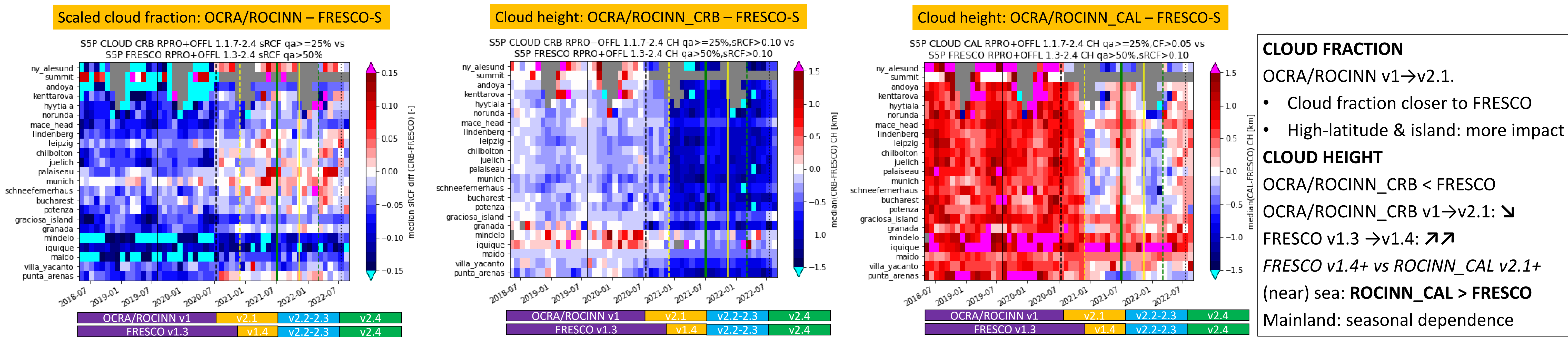
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## Role of cloud products in retrieval of atmospheric species by S5P/TROPOMI

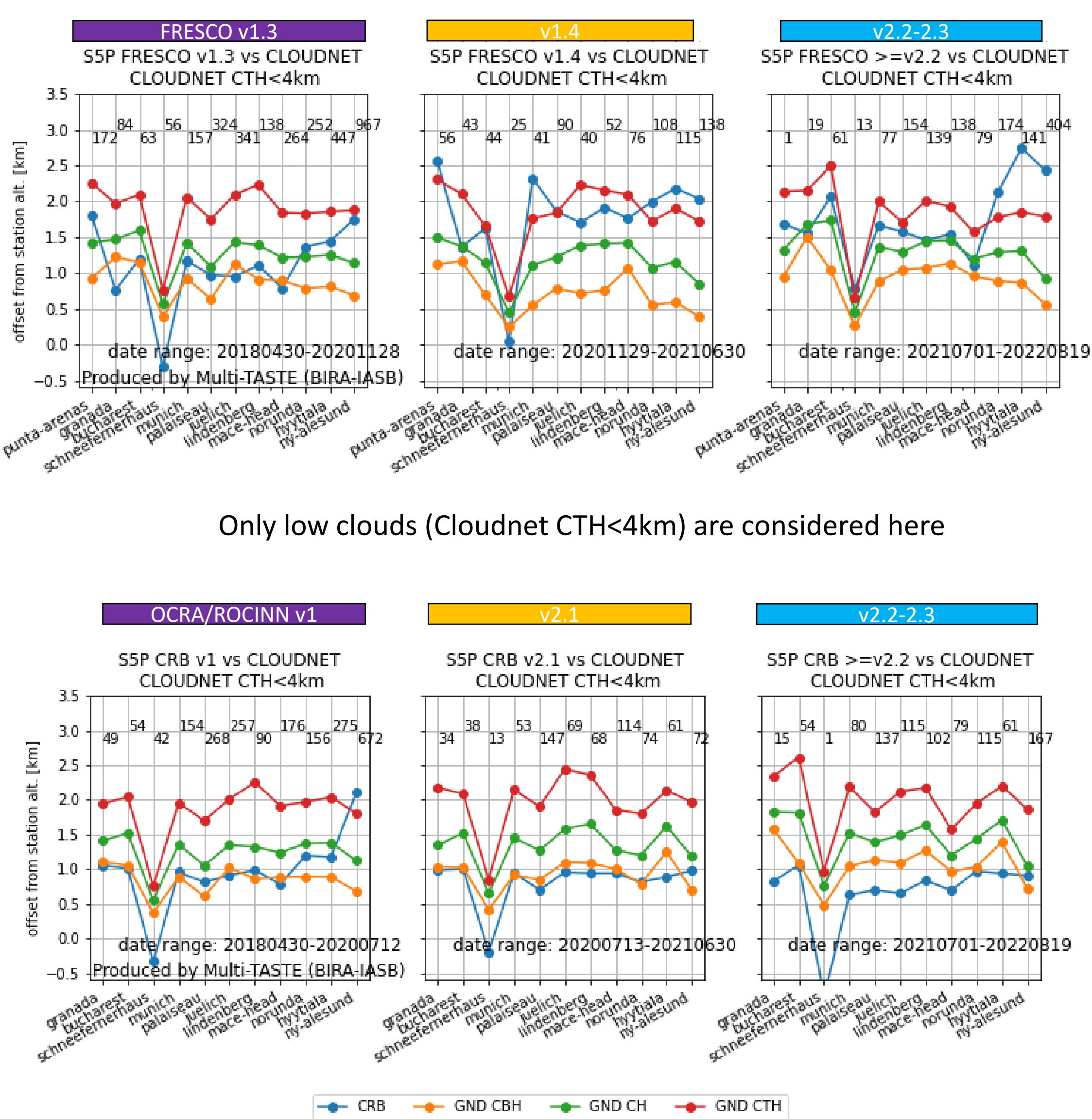
- Space-based retrieval of atmospheric composition is strongly affected by clouds.
- Cloud information, typically from the same sounder, is used to filter and/or correct the data (radiative transfer modelling, air mass factors)
- Within ATM-MPC validation service, the quality of 3 cloud products is assessed.
- Version upgrades can have an important impact on the cloud products, and therefore on the atmospheric species products for which they are input.



## Intercomparing the cloud products



## Cloud height: comparison with Cloudnet



**FRESKO-S vs Cloudnet**  
 v1.3→v1.4: FRESKO CH increases, closer to Cloudnet CTH

**Impact on L2\_NO2:**  
 bias of trop VCD and total VCD decreases

**ROCINN\_CRB vs Cloudnet**  
 v1→v2.1:  
 ROCINN\_CRB drops below cloud base height  
 v2.1→v2.2/2.3:  
 ROCINN\_CRB drops further below

**Impact on L2\_HCHO:** not conclusive  
 BUT: low precision, limited number of stations

## Impact version change on trace gas retrieval

**S5P L2\_NO<sub>2</sub> trop VCD vs MAX-DOAS**

Date (JFMAMJ)	2019	2020	2021	2022
Version	v1.2/1.3	v1.3	v1.4	v2.3
Collocation count	565	845	719	677
Median bias [%]	-32	-34	-29	-22
Dispersion (0.5 IQ68) [Pmolec/cm <sup>2</sup> ]	3.5	2.4	2.5	2.3

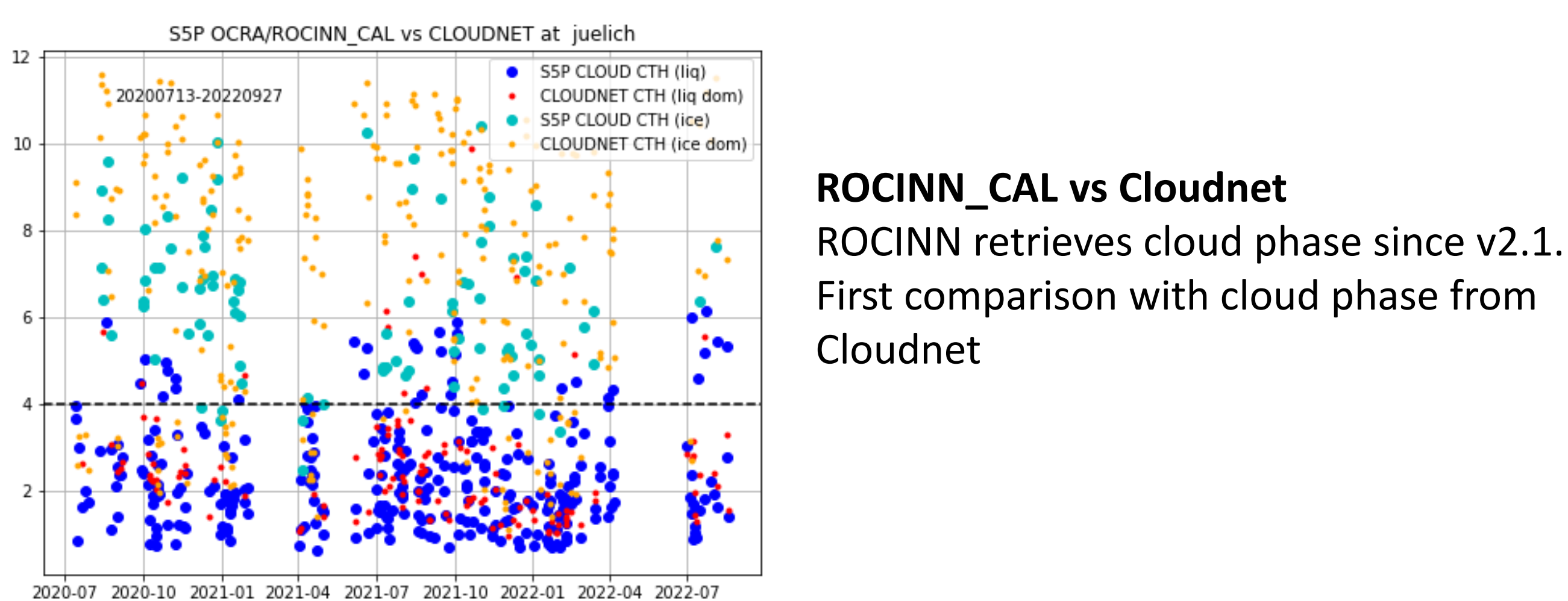
**S5P L2\_NO<sub>2</sub> tot VCD vs direct Sun DOAS (PGN)**

Date (JFMAMJ)	2019	2020	2021	2022
Version	v1.2/1.3	v1.3	v1.4	v2.3
Collocation count	315	378	434	456
Median [%]	-15	-19	-10	-5
Dispersion (0.5 IQ68) [Pmolec/cm <sup>2</sup> ]	2.3	2.7	2.8	2.5

**S5P L2\_HCHO trop VCD vs MAX-DOAS**

Date (JFMAMJ)	2019	2020	2021	2022
Version	v1.1	v1.1	v2.1	v2.2/2.3
Collocation count	242	389	275	335
Median [%]	-23	-48	-54	-49
Dispersion (0.5 IQ68) [Pmolec/cm <sup>2</sup> ]	7.2	8.4	8.1	8.0

## Cloud phase: comparison with Cloudnet



**ROCINN\_CAL vs Cloudnet**  
 ROCINN retrieves cloud phase since v2.1.  
 First comparison with cloud phase from Cloudnet

## Conclusions and prospects

- Processor version changes can have important impact on cloud parameters
- Changes in FRESKO-S are reflected in validation results of S5P L2\_NO<sub>2</sub>
- Changes in ROCINN\_CRB are not discernible in validation results of S5P L2\_HCHO
- Analyze the new processor version 2.4 with its reprocessing
- Use recently available data from PGN HCHO for better estimation of bias and dispersion
- Continue the analysis on cloud phase retrieval

See also contributions of I. De Smedt, C. Vigouroux, G. Pinardi, R. Lutz

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