

EARSel LISSIG Workshop  
07 – 09 February 2017  
Berne, Switzerland

# *Processing Line For Monitoring Glacier Outlines & Snow Area Extent By Means Of Sentinel-2 Data*

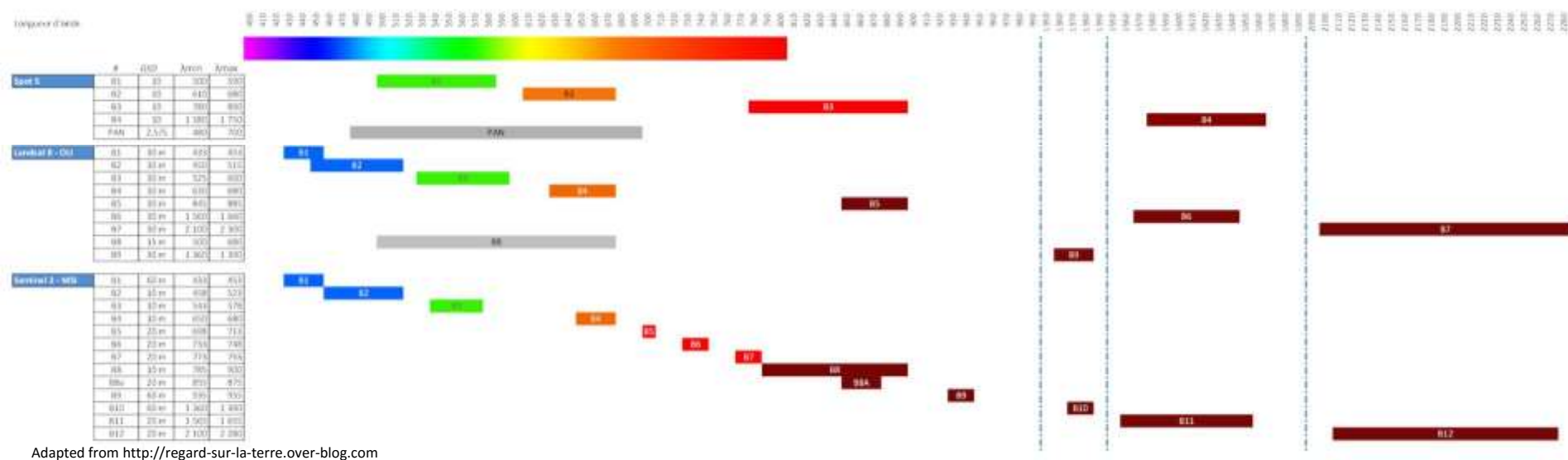
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Helmut Rott, Thomas Nagler



# Some facts about Sentinel-2



*Improvements compared to other high resolution optical satellite data:*



## Spectral bands

13 bands (VNIR, SWIR)

LT5: 7 bands (VNIR, SWIR, TIR)

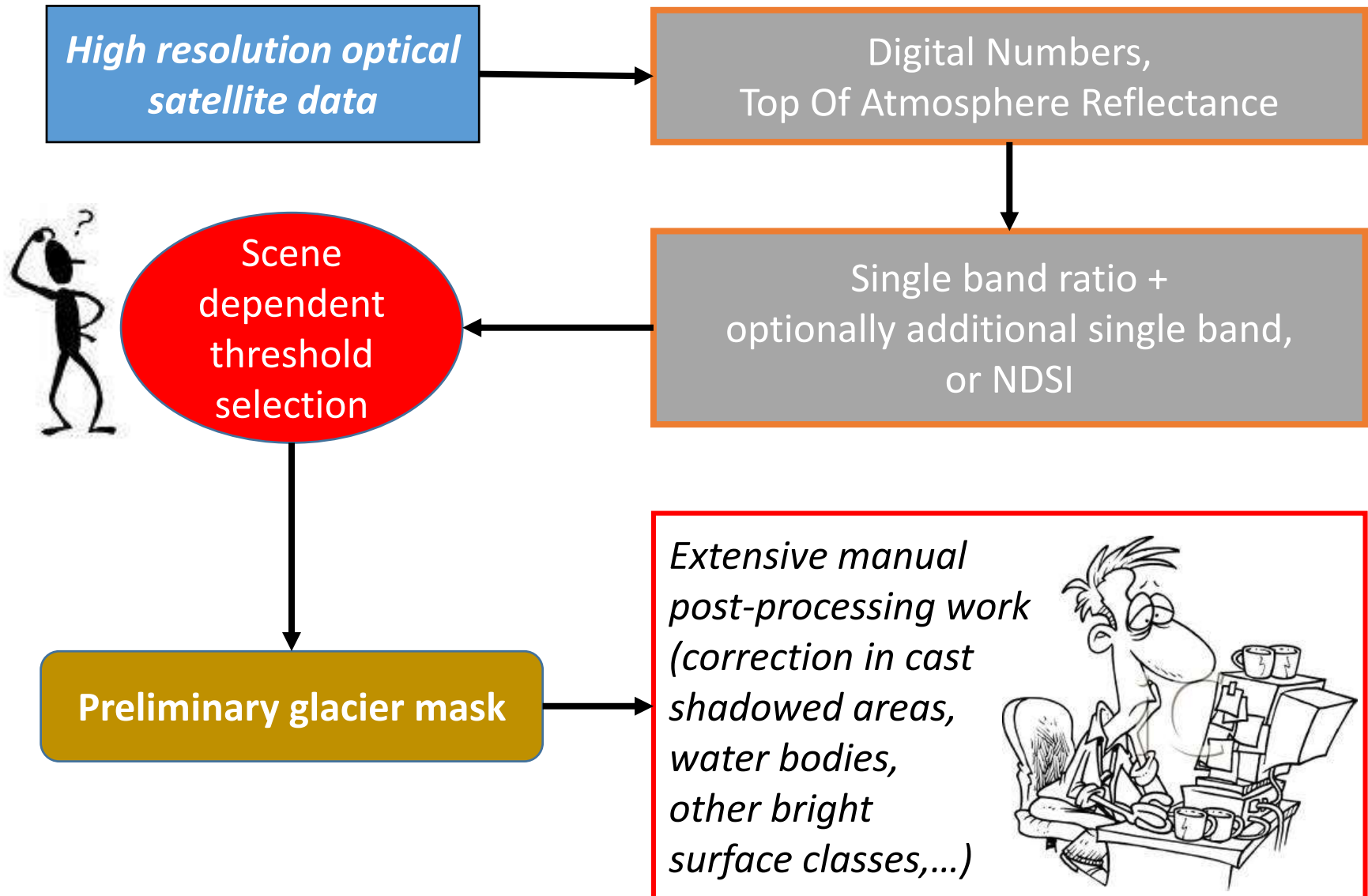
LE7: 8 bands (VNIR, SWIR, TIR, PAN)

LC8: 9 (VNIR, SWIR, TIR, PAN)

5 bands (VNIR, SWIR, PAN)

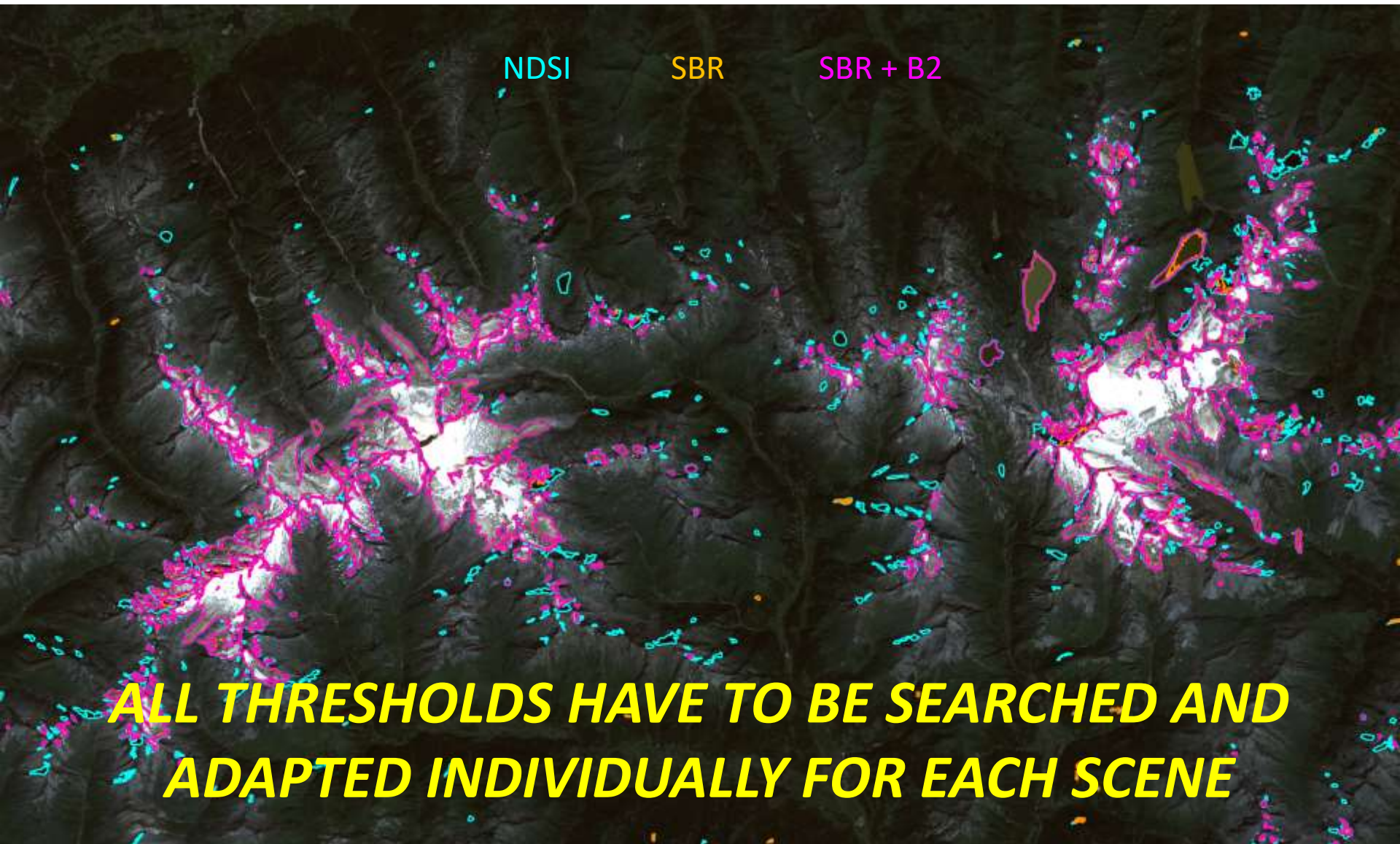
Sentinel-2 provides a great new data basis for regular monitoring of glacier areas and glacier surface zones

# Commonly used methods for mapping glacier areas in the past years



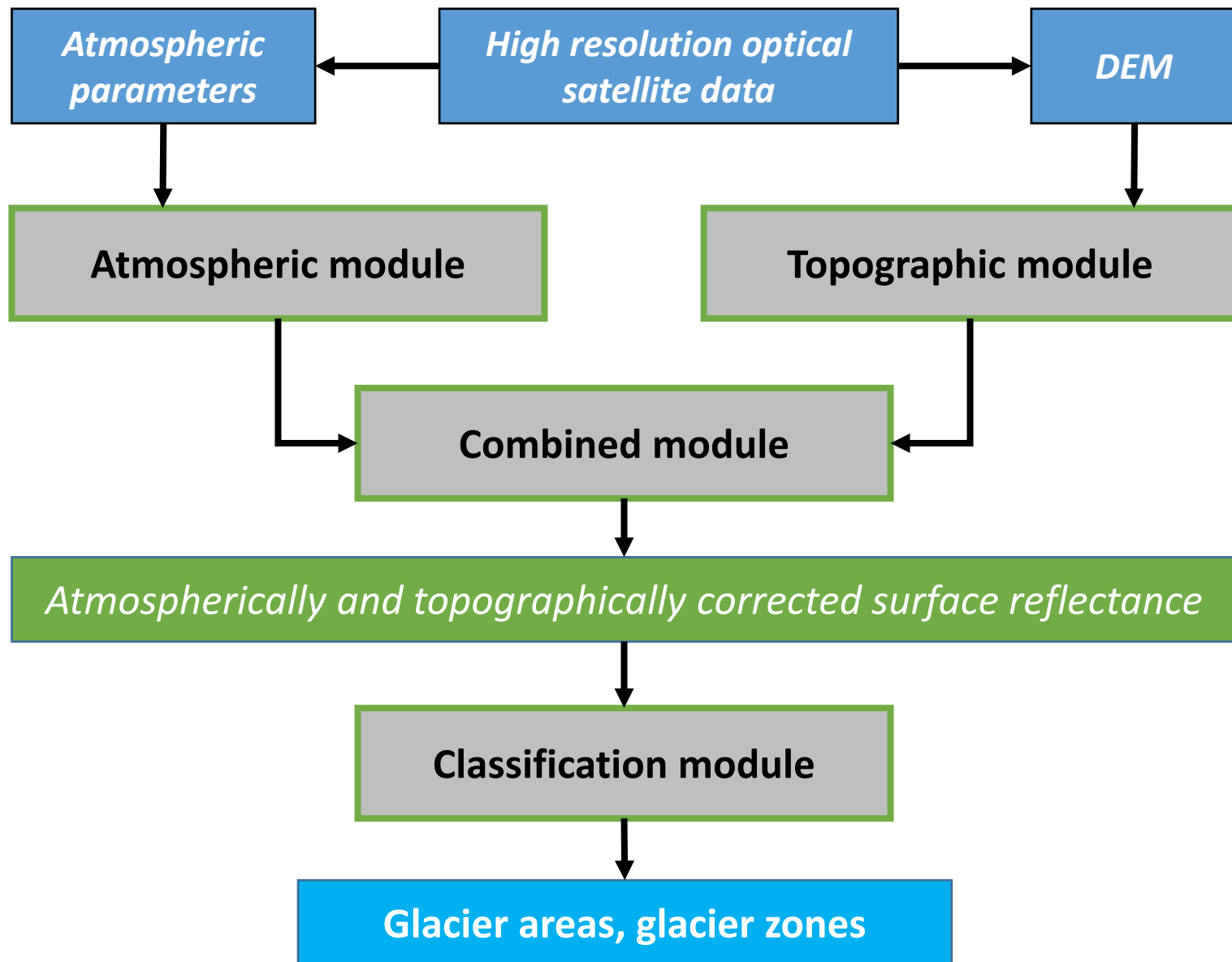


# Some preliminary glacier areas resulting from the standard methods



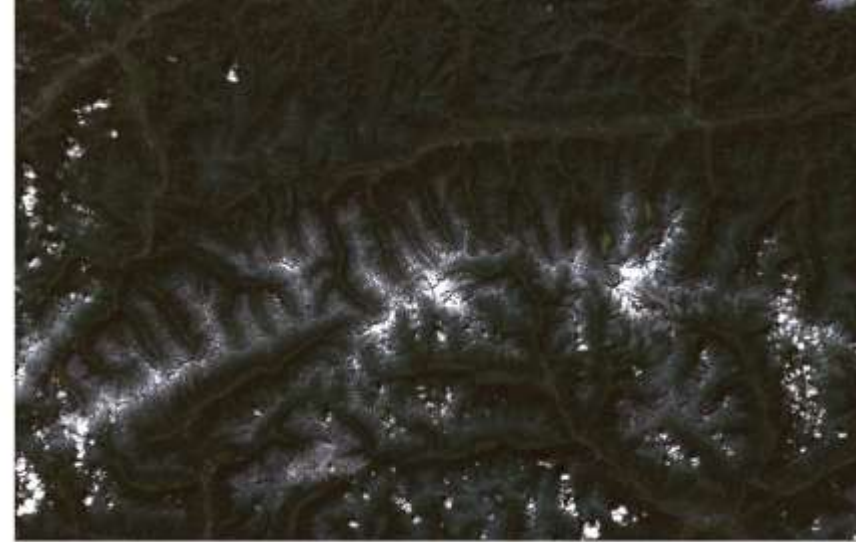
- Find and test a method for mapping glacier zones from Sentinel-2 data, independently of the atmospheric and topographic conditions at the acquisition time
- Reduce manual workload during and after the preliminary glacier map generation as far as possible
- Update the Austrian Glacier Inventory (2015/16) (will be made available to the public via the GLIMS data base)

# Advanced preparation of glacier area and glacier zone maps



- Two Sentinel-2 scenes over the region Hohe Tauern (AT/IT) (R022, T32TQT)
- EU Digital elevation model (30 m), topographic parameters from a national DEM (10 m) showed partly significant shifts compared to S2 data → ESA is working on improving the geolocation
- Atmospheric data from Copernicus Atmospheric Monitoring Service (CAMS), provided by ECMWF

2015-08-13



2016-08-27



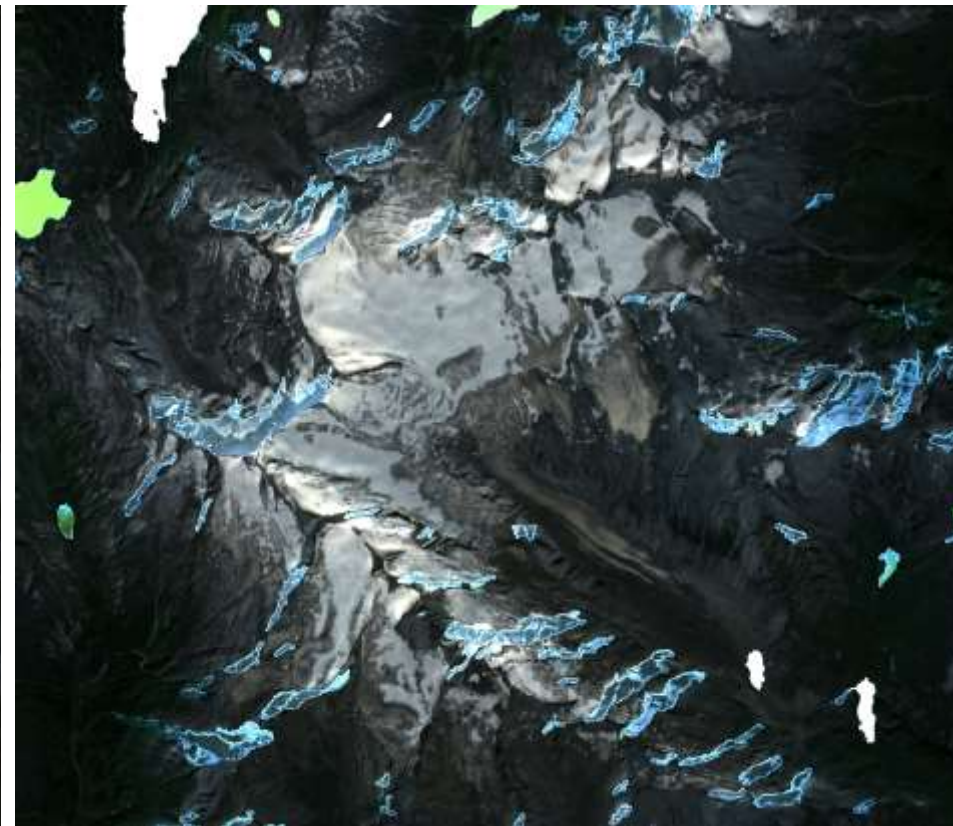


# Atmospheric and topographic correction



## SMAC & Ekstrand correction

## Advanced physical atmospheric and topographic correction (based on 6S altitude dependent LUTs)





- Automated classification module applied on surface reflectance maps:
  - Combine multiple band ratios to discriminate snow and ice from other surface classes
  - Filtering processes
  - Automated masking of water bodies
  - Minimum altitude of glacier area from digital elevation model
- STILL MISSING: Cloud screening method
- Manual mapping of debris cover glacier parts from surface reflectance maps

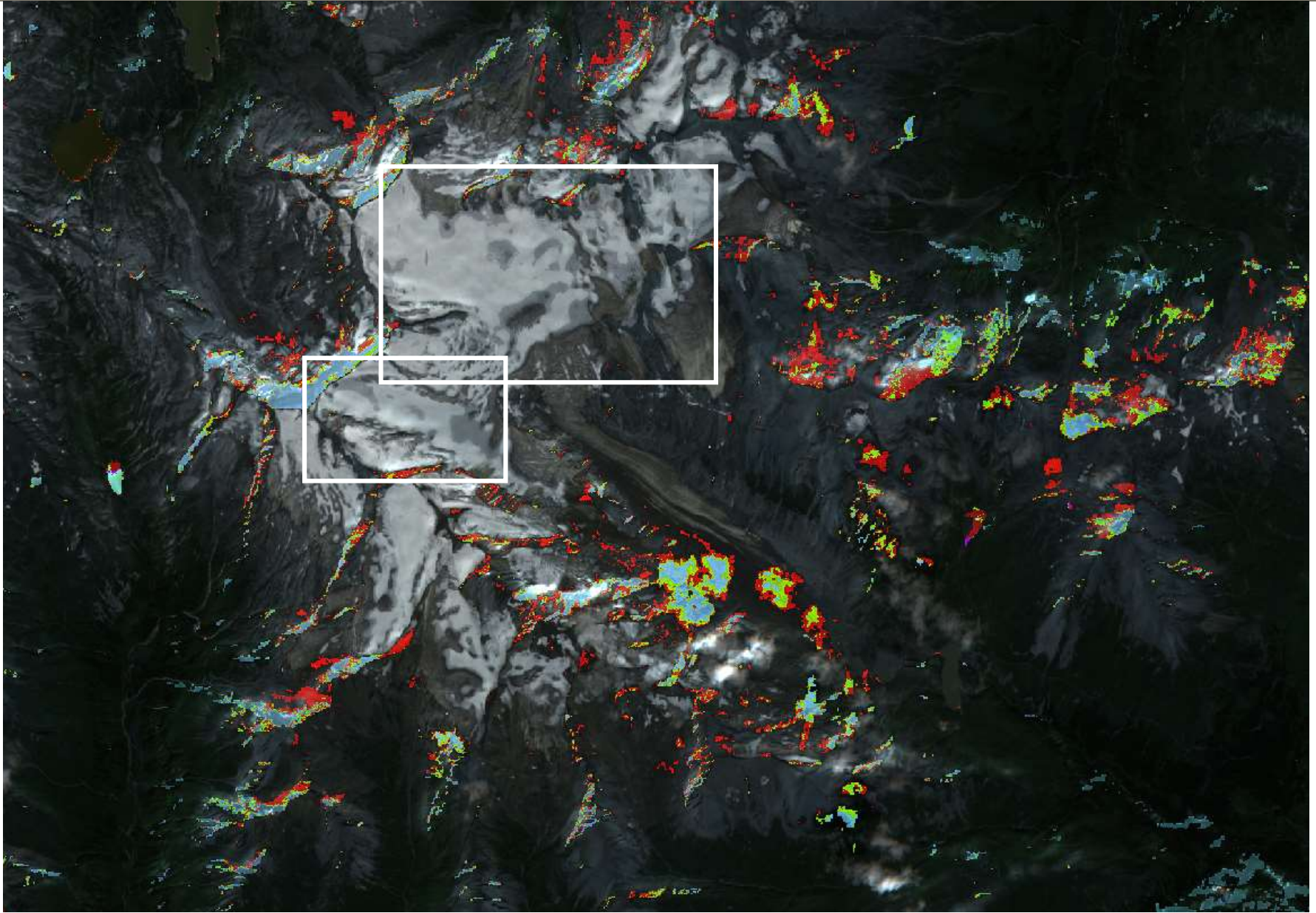
# Glacier outlines from Sentinel-2 (update of Austrian Glacier Inventory)

enveo

→ identify glacier surface zones  
from surface reflectance maps

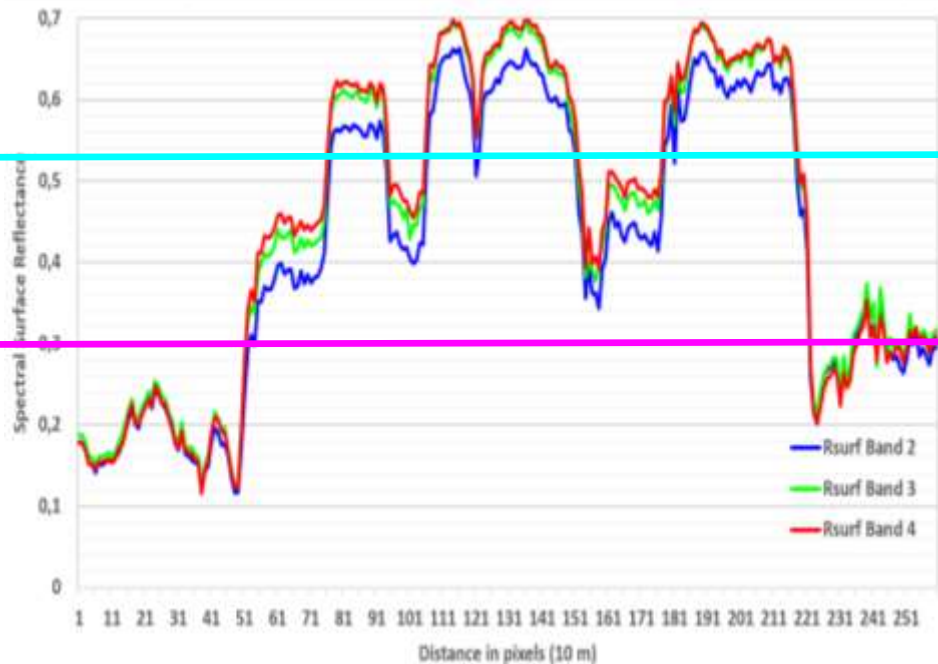
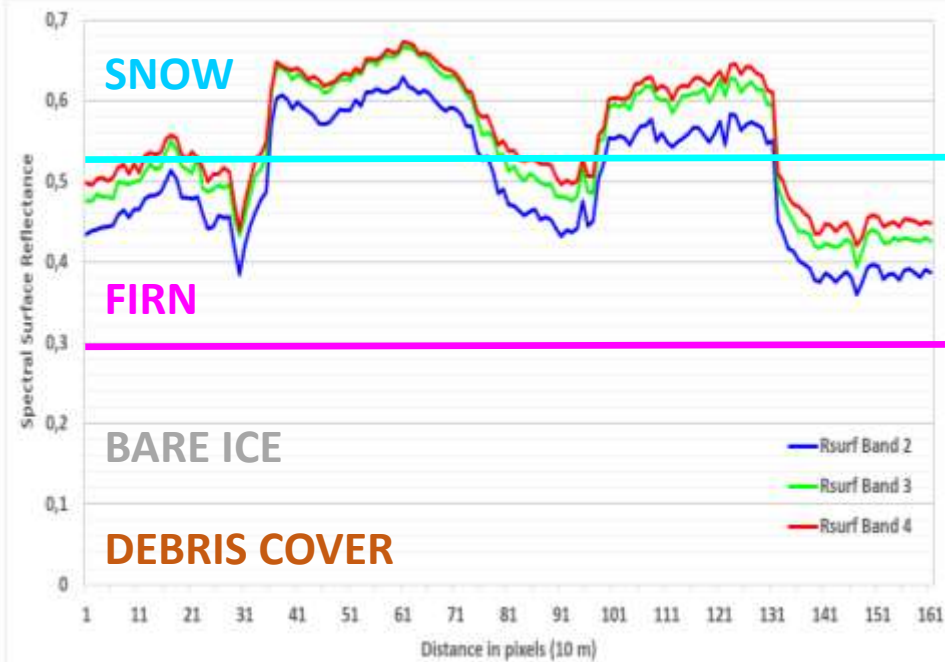
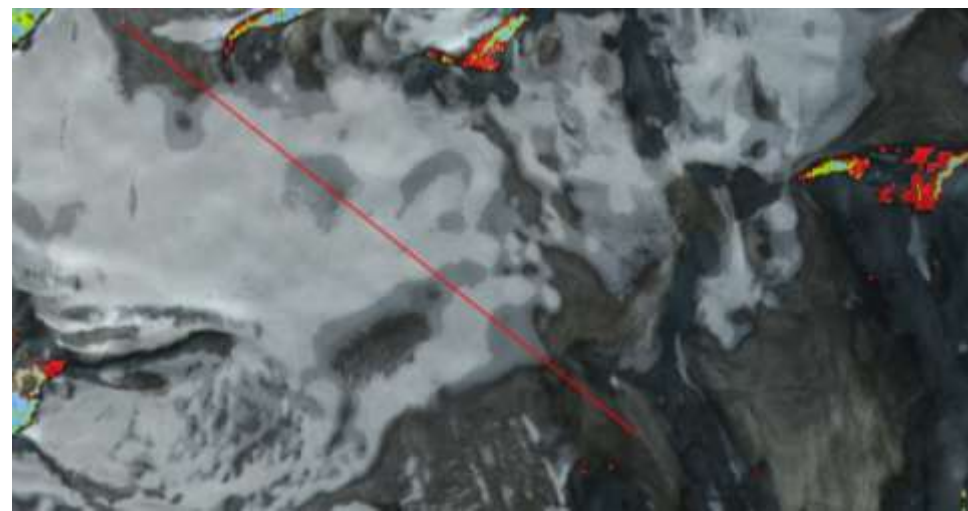
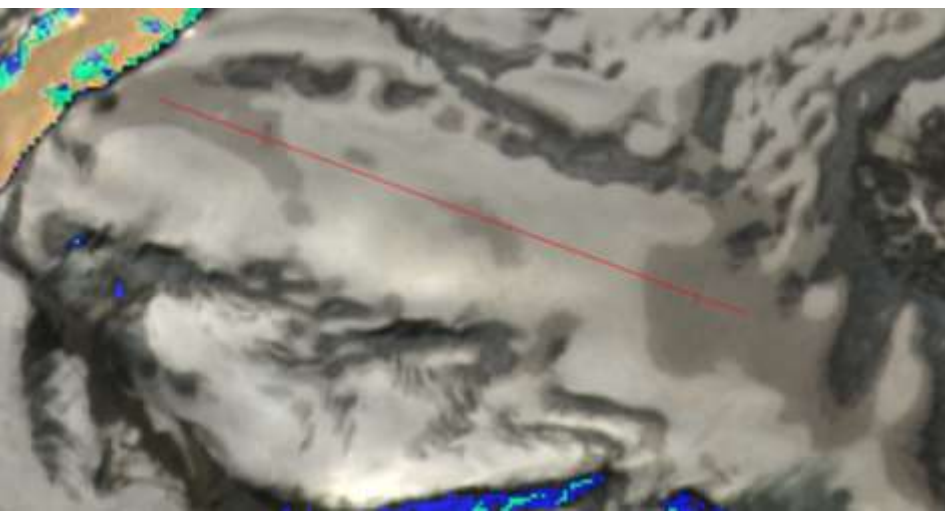


# Glacier zones from spectral surface reflectances

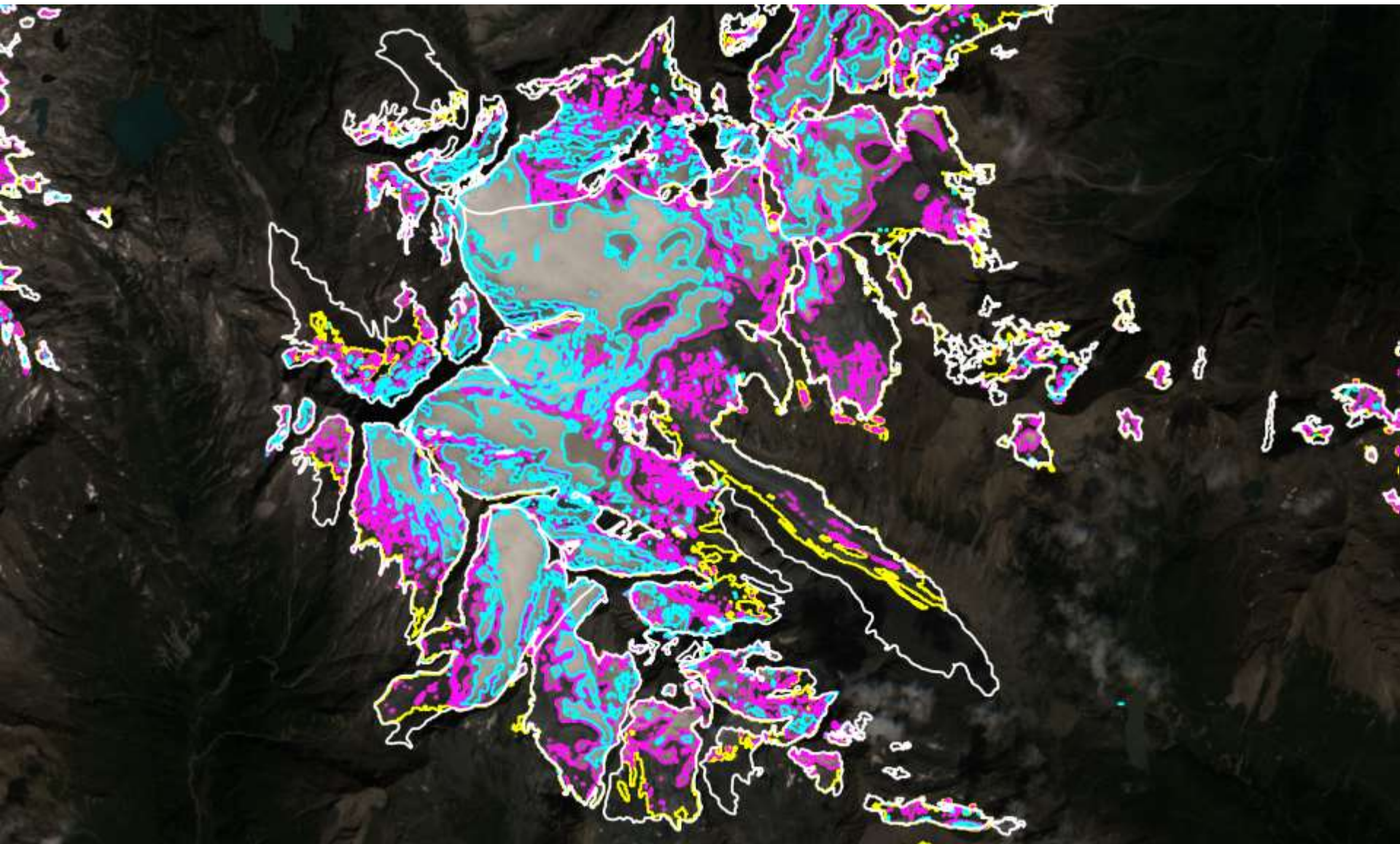




# Glacier zones from spectral surface reflectances



# Example of advanced glacier zones (Glocknergruppe, 13 August 2015)





# Comparison of snow areas from different sensors & times



**WORK JUST STARTED IN ESA GLACIER CCI OPTION 3  
UNDER THE LEAD OF ENVEO**

SPOT-5, 01/09/2009

S2A, 13/08/2015

LC8, 09/08/2015



- Advanced fully automated pre-processing of Sentinel-2 data implemented  
→ atmospheric and topographic correction method to generate spectral surface reflectance in complex terrain
- Advanced automated classification of glacier areas and glacier surface zones based on spectral surface reflectances  
→ ***ESA Glacier CCI Option 3 on late summer snow line and glacier zones***
- Minimum effort for manual post-corrections (large snow patches, debris covered areas, pre-glacial lakes)
- Sentinel-2 data of August 2015/16 analysed to update the Austrian Glacier Inventory (data will be provided to the public via the GLIMS data base soon)