Fame-CM Cloud-mask and Collocation with MWR Data

In the framework of **ESA Cloud-CCI** a Bayesian cloud-mask algorithm for the Synergy of MERIS and AATSR has been implemented:

Bayesian cloud detection for MERIS, AATSR, and their combination

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Data sources:

- Synergy-product from MERIS and AATSR (AATSR swath=500km)
- 15 Channels from MERIS, 7 Channels from AATSR
- 1km x 1km resolution (nadir)
- 2007-2009

- Non-Bayesian synergy cloud-mask (Gómez-Chova et al., 2008)
  (set as truth)
  (only mask, no probabilities)

Gómez-Chova, L., Camps-Valls, G., Munoz-Marı, J., Calpe, J., and Moreno, J.: Cloud screening methodology for MERIS/AATSR Synergy products, in: Proc. 2nd MERIS/AATSR User Workshop, ESRIN, Frascati, 22–26, 2008.

Theoretical Background:

Bayesian Approach:

$$P\left(C_{yes}|\boldsymbol{F}\right)=\frac{P\left(C_{yes}\right)\,P\left(\boldsymbol{F}|C_{yes}\right)}{P\left(\boldsymbol{F}\right)}$$

Probability for having a cloud under The condition of a feature F, (**F** =vector of any dimension e.g. Measurement spectrum) = (Probability for a cloud) * (Probability of occurrence for the feature **F** under the condition of having a cloud) / (Probability for having feature **F**)

Features

Gómez-Chova et al., 2008

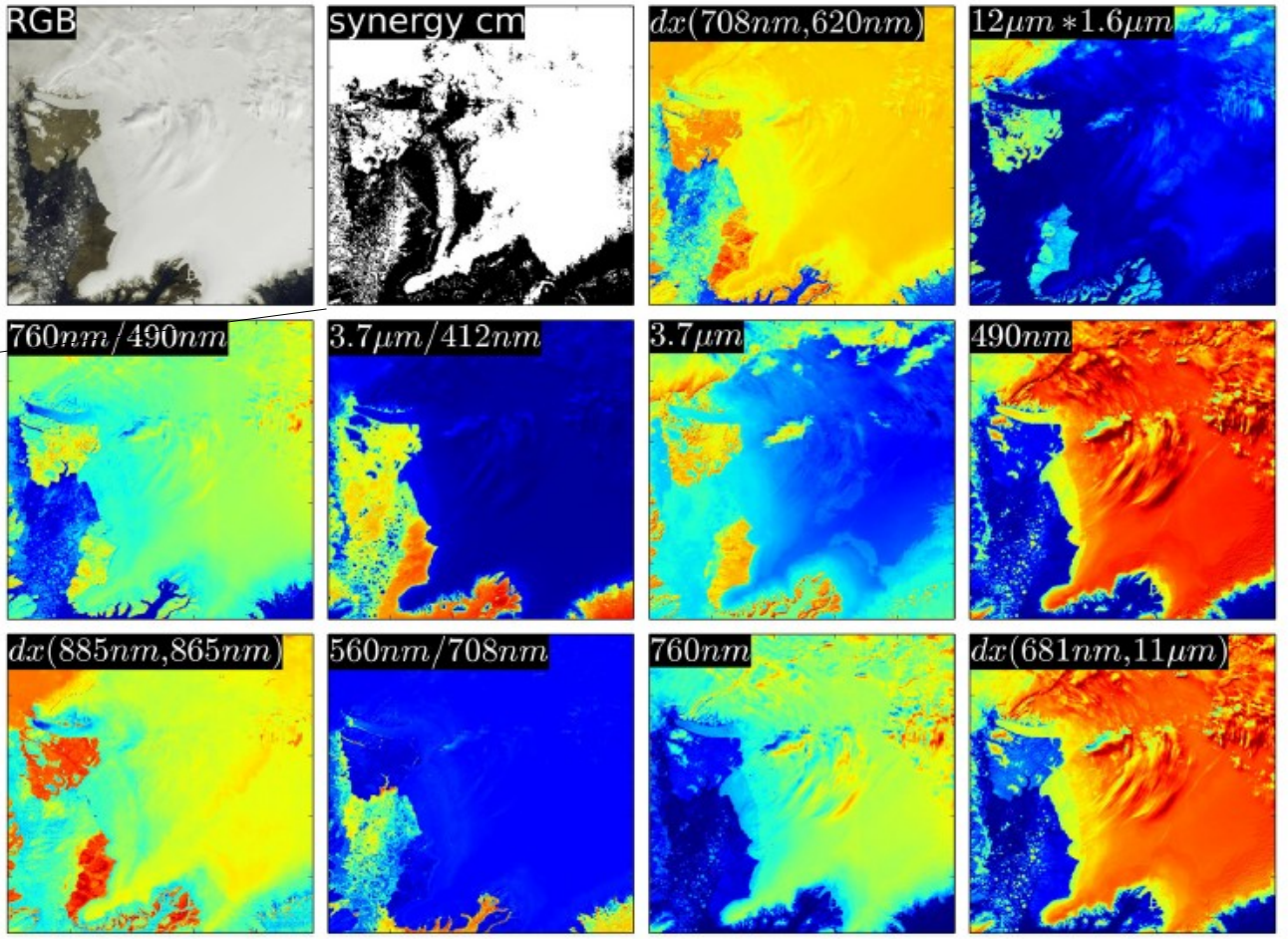


Figure 1. Several views of a scene over Greenland from 17 July 2007 with the image centered at 59°31′12″ W and 79°0′0″ N. Single panels include a pseudo RGB view, results of the non-Bayesian Synergy cloud mask (with white indicating clouds; see Sect. 6), as well as single channels and simple functions operating on two channels. The function dx denotes the index function and is defined as $\mathrm{d}x(a,b) = (a-b)/(a+b)$. Units are not shown and the color scales are stretched to maximize the visible contrast.

1. Finding the appropriate features:

Try (all) combinations of features and determine the combination with the highest skill scores:

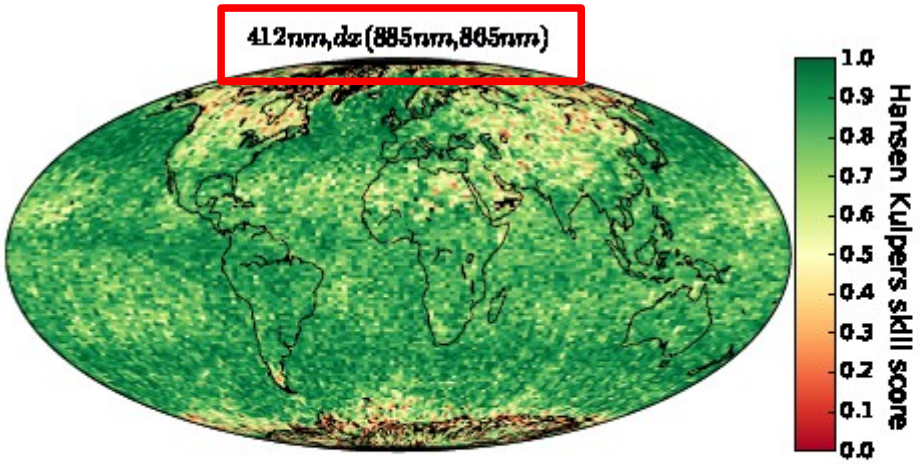


Figure 5. Global distribution of skill scores for a classical Bayesian cloud mask using only two strongly independent features. Data are shown for the year 2008 and the joint probabilities of the mask were estimated with data from the year 2007. The global skill score is 0.78 and the used features are shown in the title of the figure.

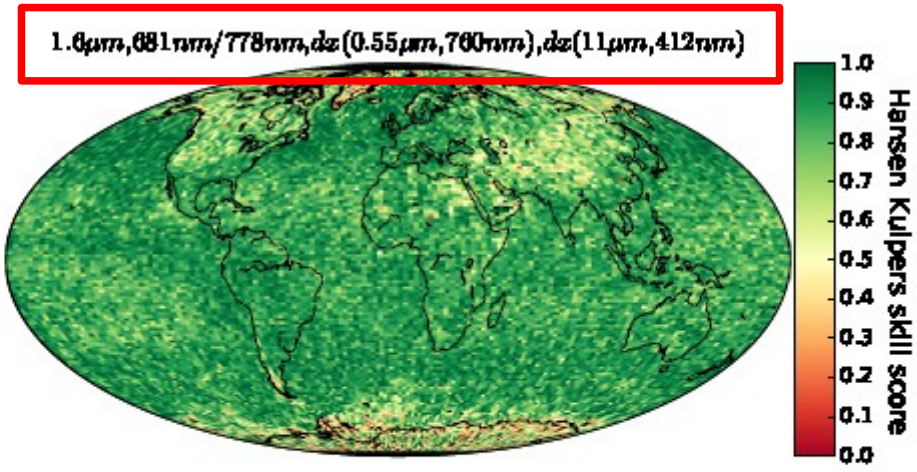
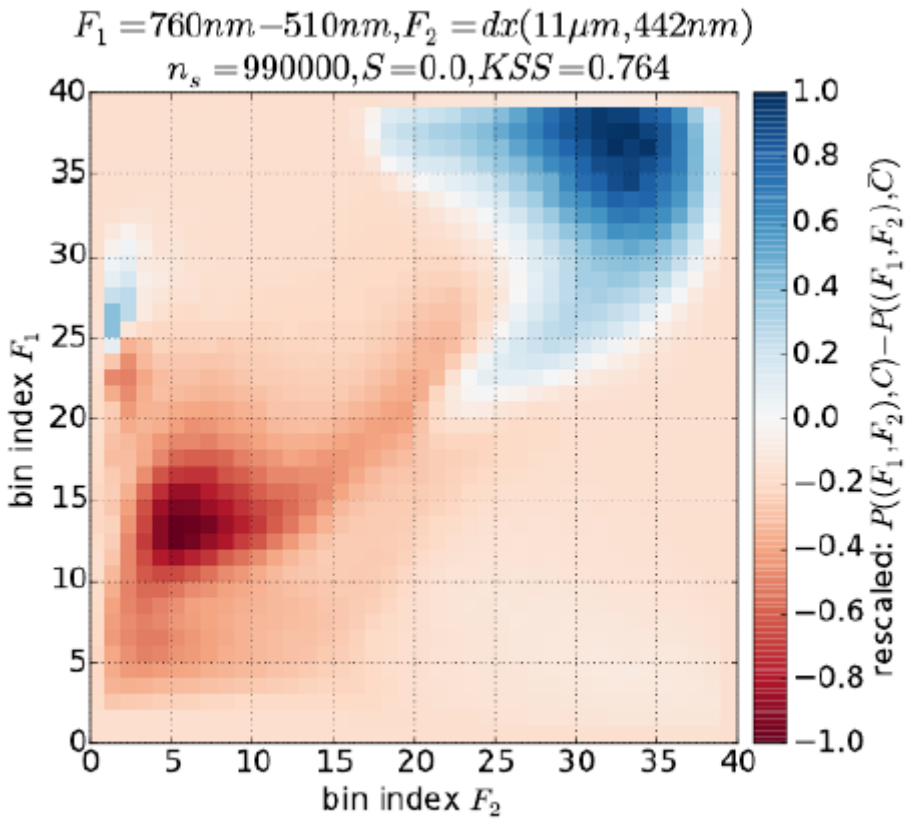


Figure 6. Similar to Fig. 5 but for a different classical Bayesian cloud mask based on four strongly independent features. The global skill score is 0.83.

2. Compute probabilities and store in n-dimensional histograms

Example: 2D histogram for Features F1 and F2



P((F1,F2),cloud) -
P((F1,F2),nocloud)

Gaussian smoothing is performed
(sophisticated optimization of smoothing-parameter and number of bins was done beforehand)

3. Output:

- Probabilities for clouds (0-100%) on pixel basis

- 2007-2009 for all MERIS-AATSR synergy orbits (nc-files)
  - only for daytime orbits
  - there are missing orbits

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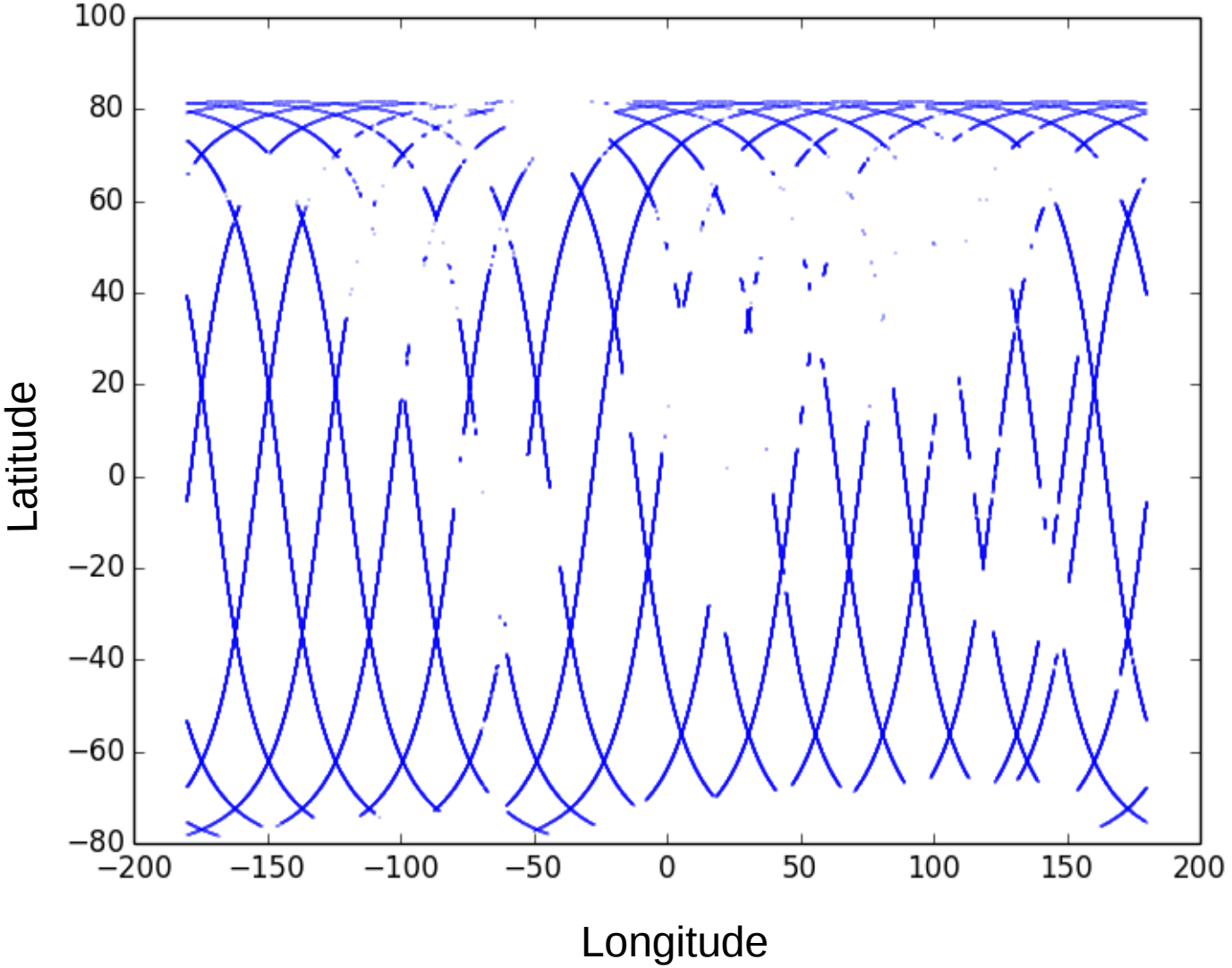
Advantages of the algorithm:

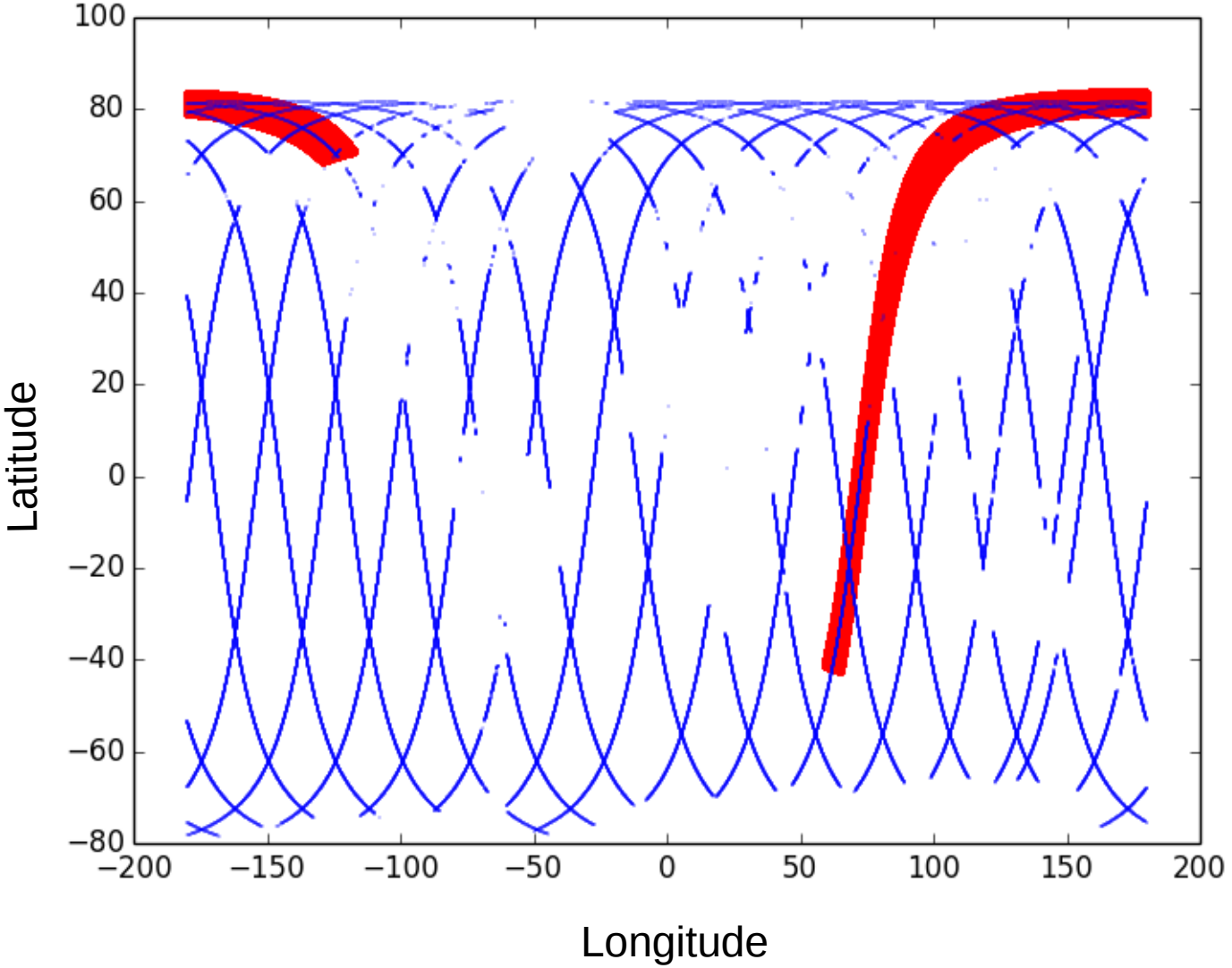
- **Fast**
- Independent (from other data sources)
- Flexible:
  - New features, new preclassified data can be included
  - An only-MERIS and only-AATSR procedure is possible (a subsets of channels can be used)
  - Adaptation to future data-sets (e.g. OLCI) is straightforward

Collocation:

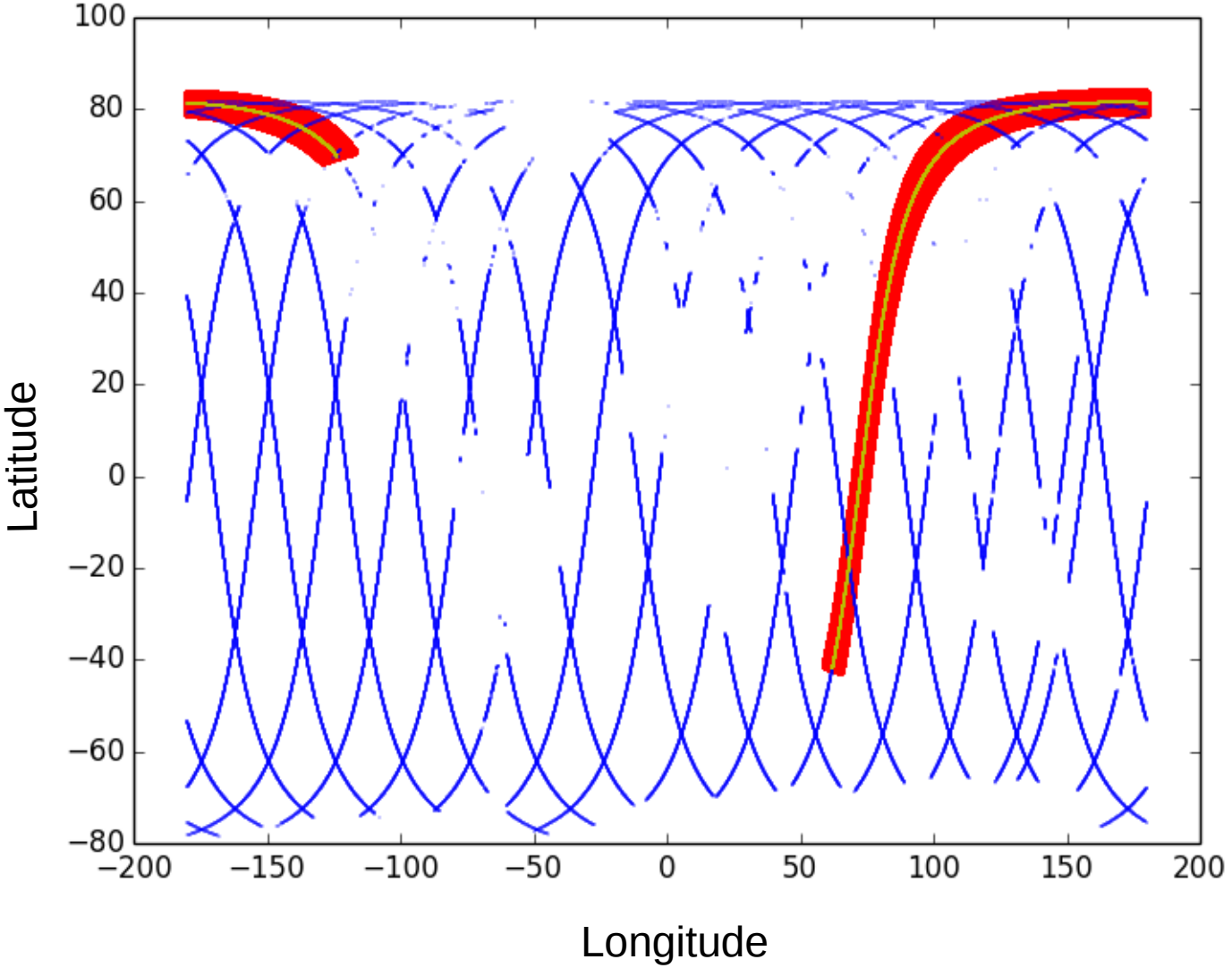
MWR-data (orbits for one day in one file):



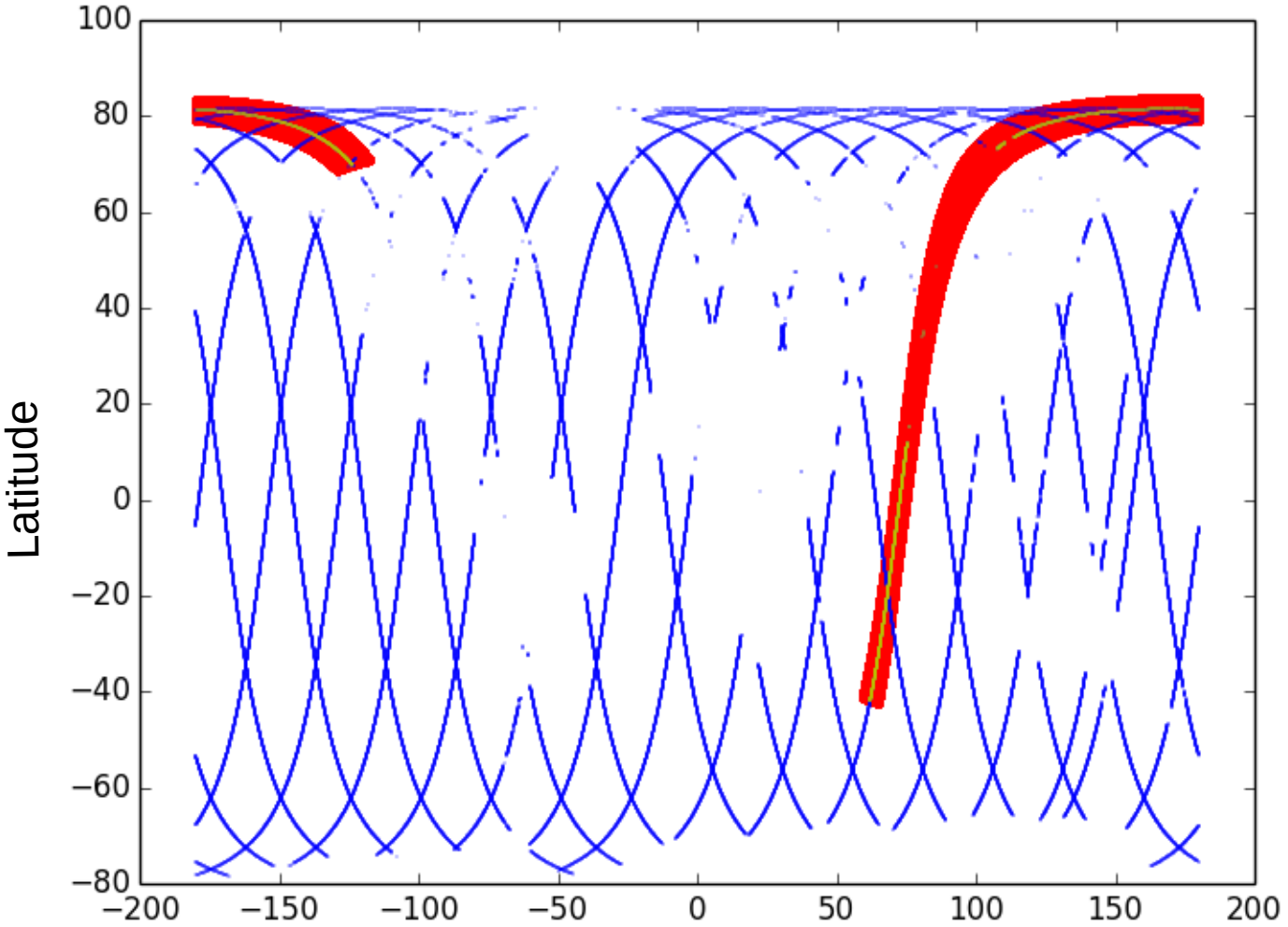
Synergy (MERIS+AASTR) swath



Middle Pixel of synergy swath:



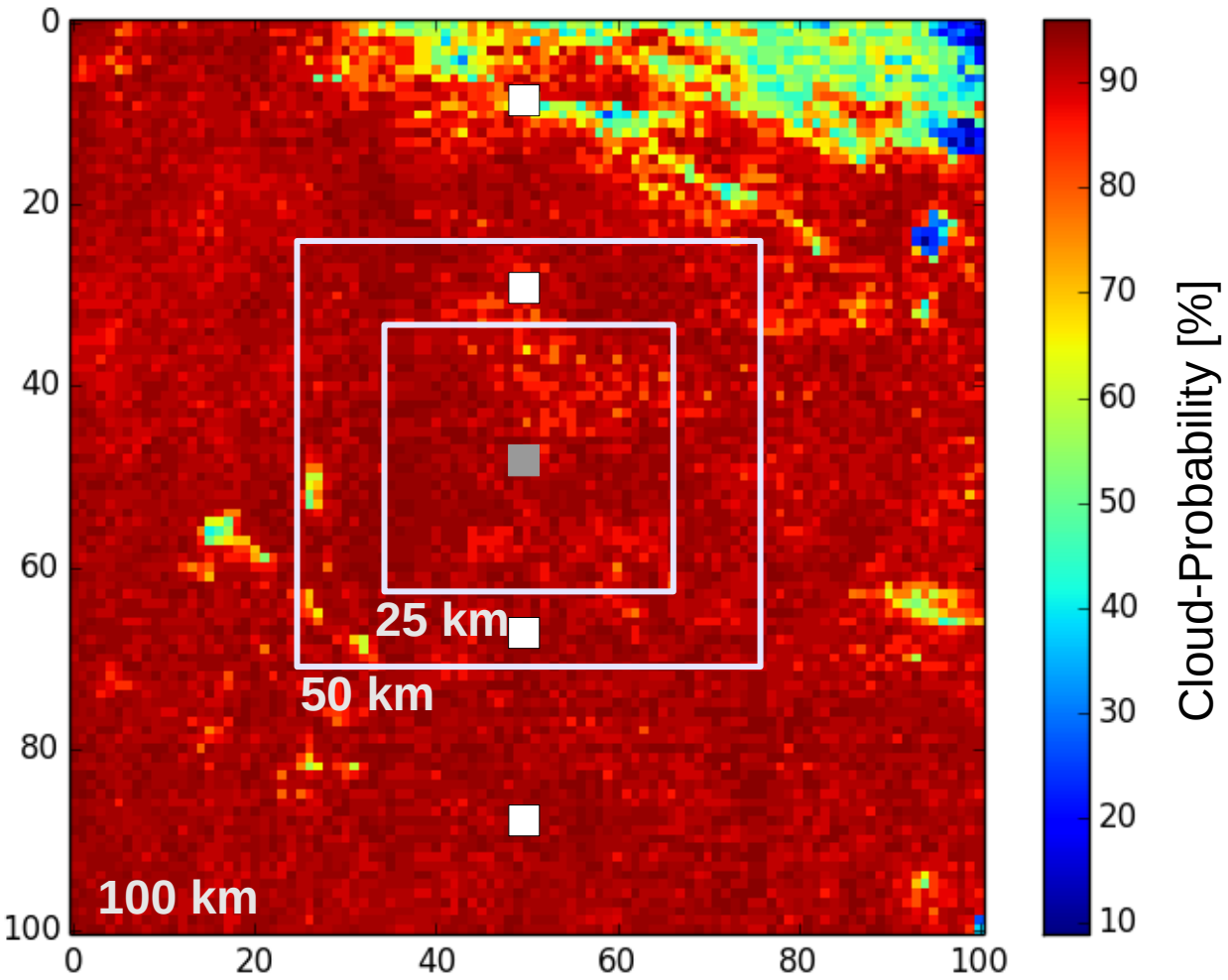
Middle Pixel of synergy swath:
without land pixel



Collocation with nearest neighbour method

Compressing the information about cloud probabilities

Counting the number of pixel in a 25, 50, 100 and 200 km diameter area for different cloud probabilities bins



Output:

(0)	LON	float =	Array[50491]
(1)	LAT	float =	Array[50491]
(2)	FRAC	float =	Array[13]
(3)	CM_50	float =	Array[13,50491]
(4)	CM_25	float =	Array[13,50491]
(5)	CM_200	float =	Array[13,50491]
(6)	CM_100	float =	Array[13,50491]

Contains the number of pixel that have a cloud probability below a threshold (bins = 0,1,2,5,10,20,30,40,50,60,70,80,90) relative to the number of pixel in the area.

Thank you for your attention!

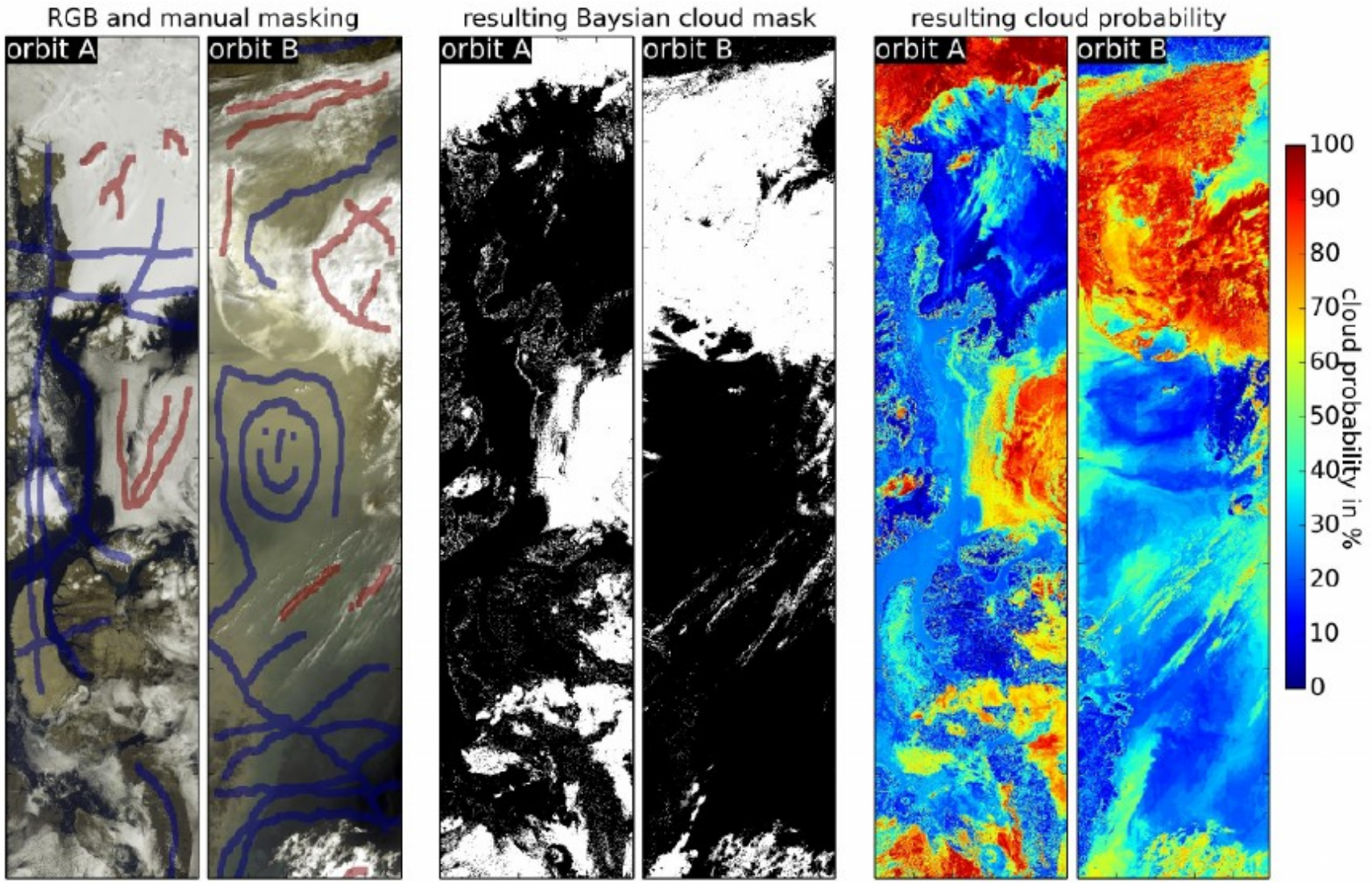


Figure 12 Manual classification of the scenes shown in Figure 1 and 2. Shown are the cloudy and non-cloudy classification together with an RGB view for two scenes (two leftmost panels, blue=non-cloudy, red=cloudy), the resulting cloud mask (two middle panels), and the cloud probability (rightmost two panels).