Exploring Pattern Recognition Techniques for ACSPO Clear-Sky Mask

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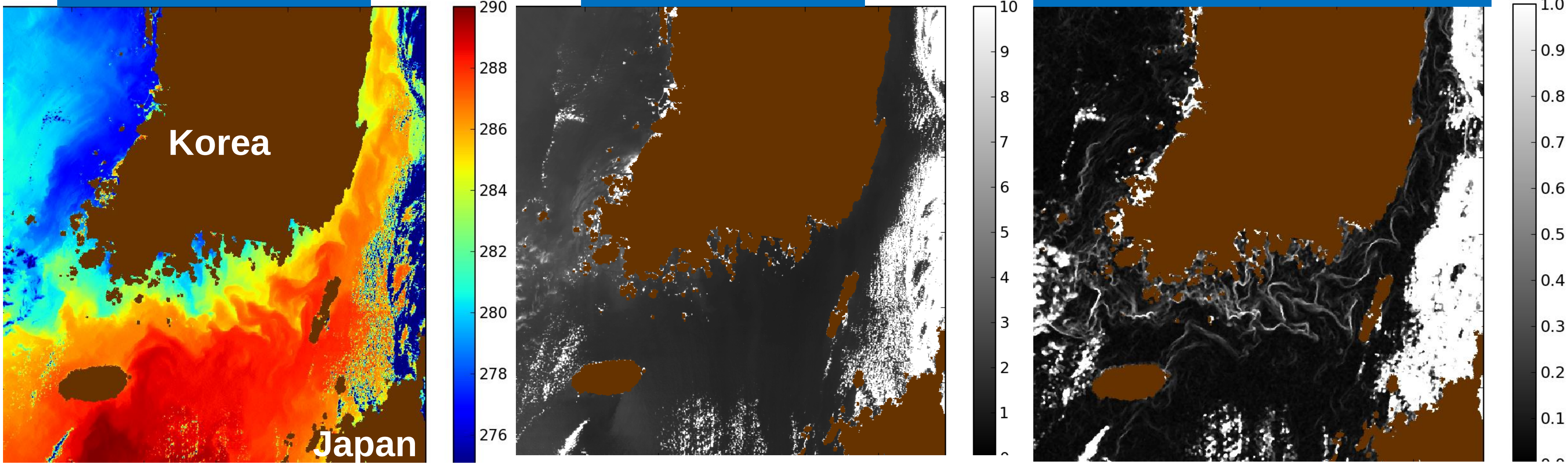
The Need in New Cloud Masking Approach

- **The current ACSM performance compares well with other world-class cloud masks.**
- **However, some cloud leakages and misdetections still take place due to incomplete discrimination between clouds and cold SST anomalies**
- **These deficiencies are best detected by visual inspection of SST – L4 images.**
- **We assume that using the pattern recognition/machine learning (ML) techniques could help improve the ACSM performance**
- **Here we present preliminary results of exploring the ML approach for cloud vs. SST discrimination.**

Object of Analysis and Assumptions

SST Regression | **Ch M7 Albedo** | **SST Gradient Magnitude**



- **Analyzed images: SST retrieved from destriped VIIRS BTs (see presentation by M. Bouali) in ALL ocean pixels, both clear-sky and cloudy**

- **General assumptions:**
  - **Ocean surface is warmer and more uniform than cloud**
  - **Smooth, regular patterns are more typical for ocean than for cloud**
  - **Chaotic, highly variable structures are more typical for cloud**

The Feature Variables

The following three variables are used for classification:

1. **T_S SST;**

2. ***P Median(M)×Range(cosθ);***

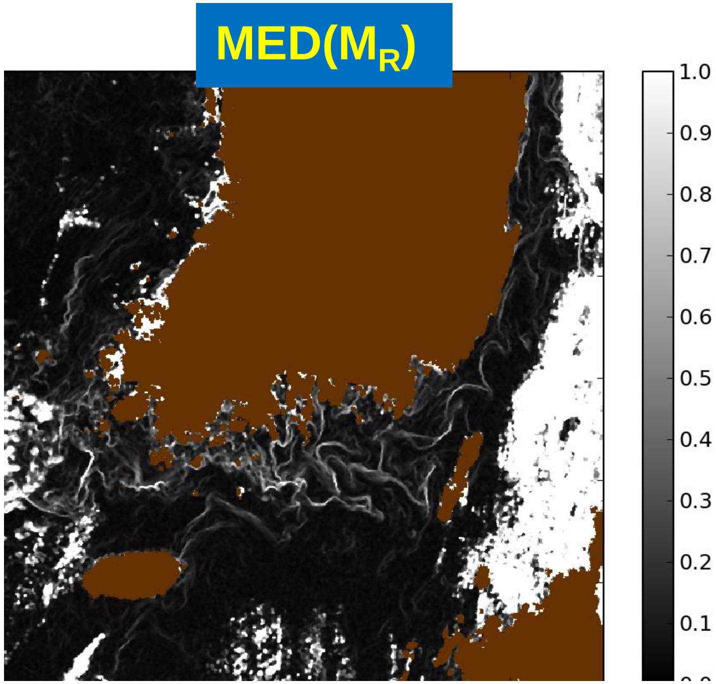
$M=[(\partial T_S/\partial x)^2+(\partial T_S/\partial y)^2]^{1/2}$	**Magnitude of SST gradient**
$\theta=\tan^{-1}[(\partial T_S/\partial x)/(\partial T_S/\partial y)]$	**Gradient angle**
$Range[\cos\theta]=Max[\cos\theta]-Min[\cos\theta]$	**Range of *cosθ***

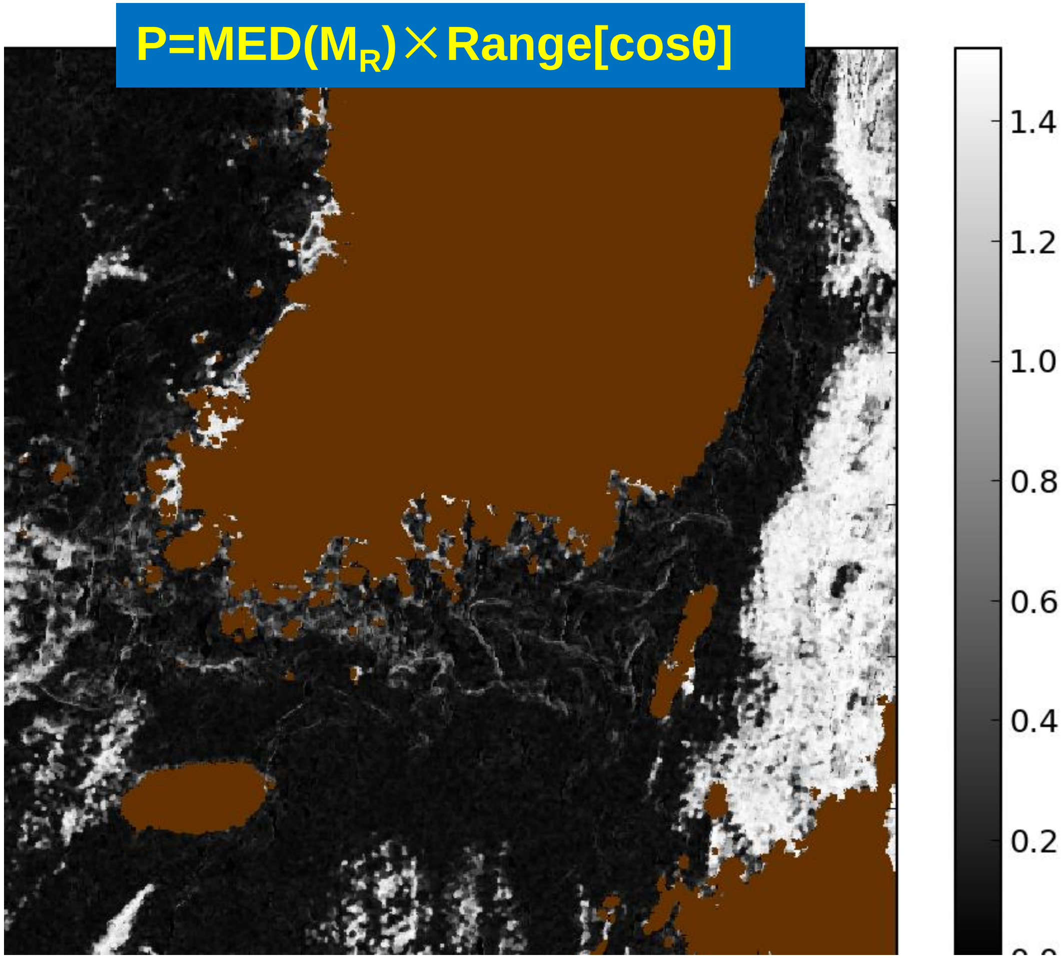
3. ***N*** **Range of Wiener High Frequency SST component**

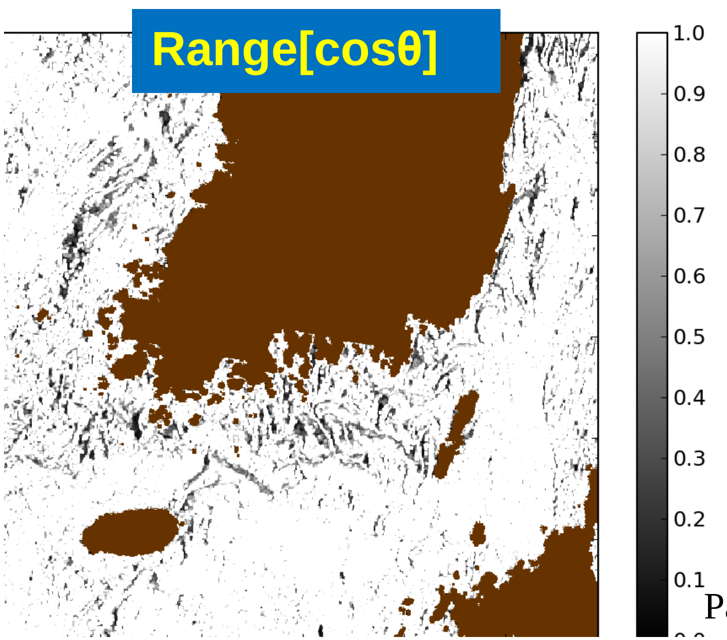
$N=\max(\lvert T_S-S(i,j)\rvert)-\min(\lvert T_S-S(i,j)\rvert)$,	
$S(i,j)=\mu(i,j)+\{[\sigma(i,j)^2-v^2]/\sigma(i,j)^2\}[T_S(i,j)-\mu(i,j)]$	**Wiener HF component**
$\mu(i,j)$ **and** $\sigma(i,j)$	**Local mean and SD of SST**
v^2	**Local noise power**

All variables except SST are calculated within 3×3 window

$P = MED(M_R) \times Range[\cos\theta]$



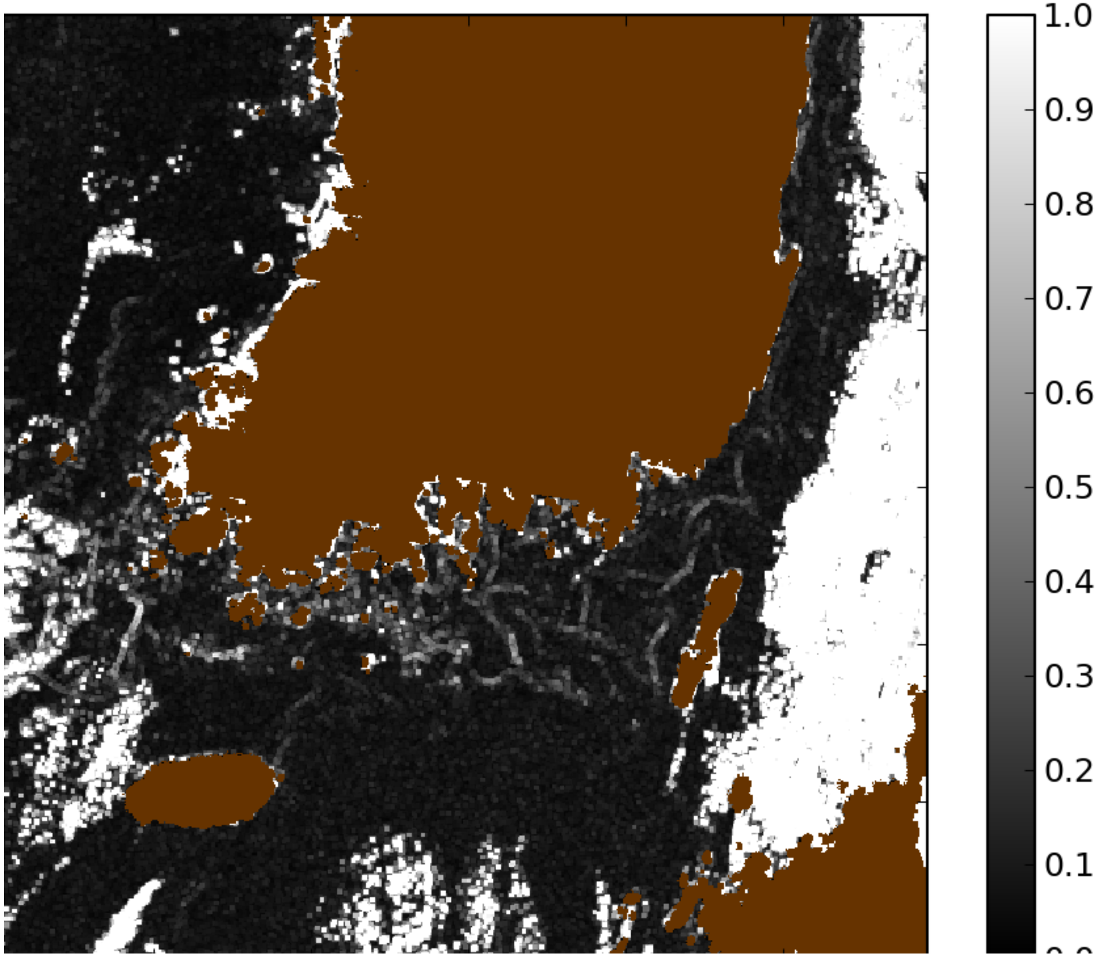




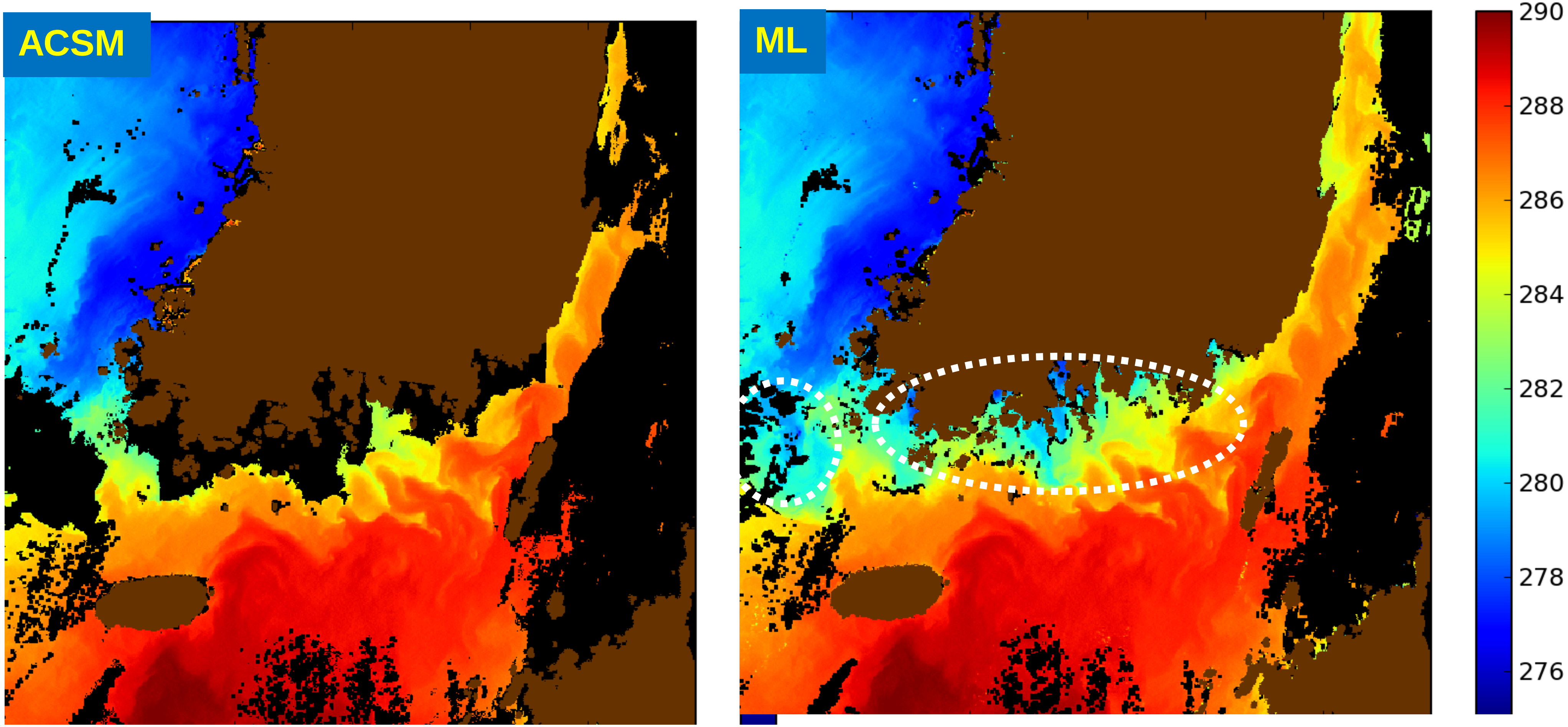
SST fronts are suppressed in P image, but cloud is well detected

Range of Wiener HF Component

Variation in HF SST component is smaller over ocean and larger over cloud

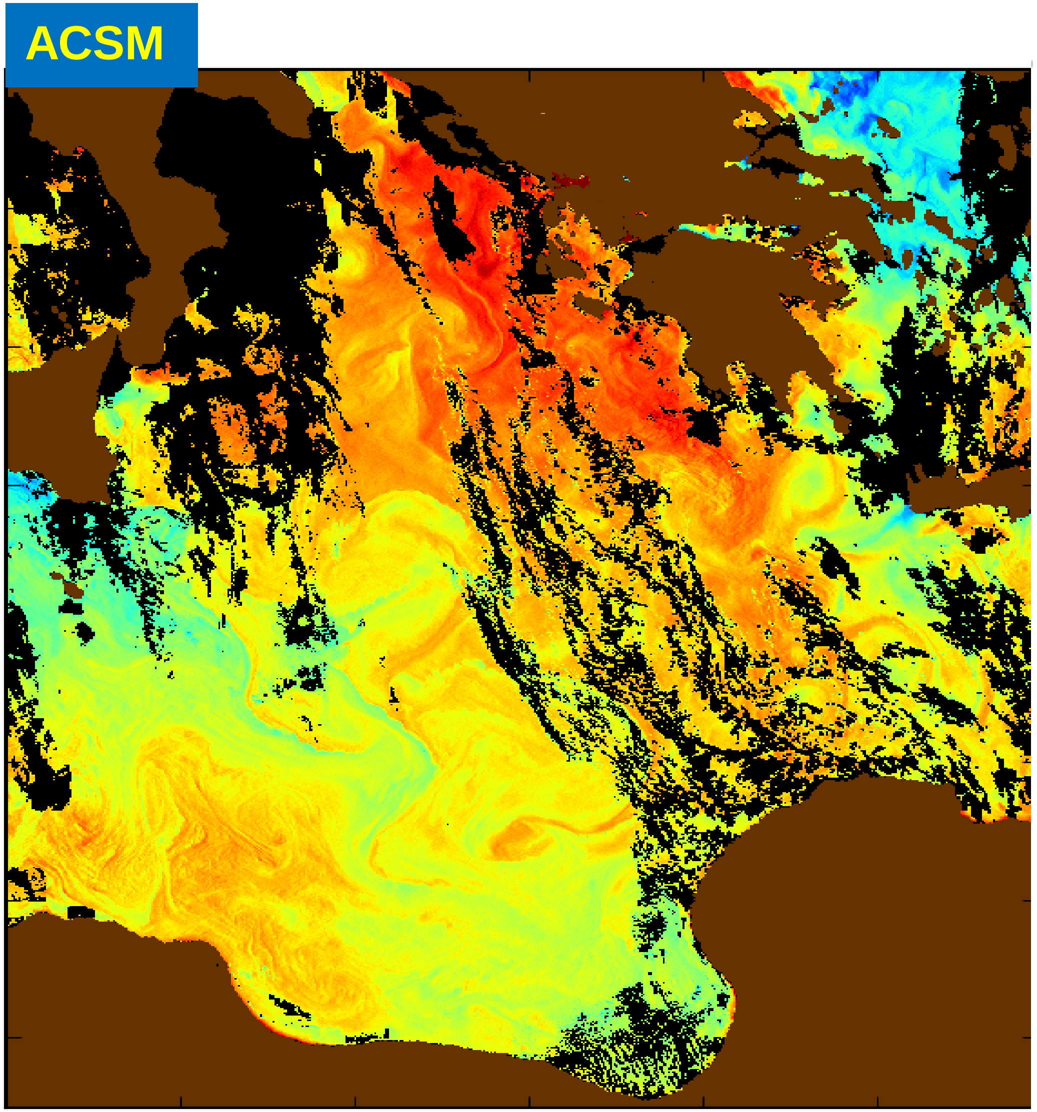


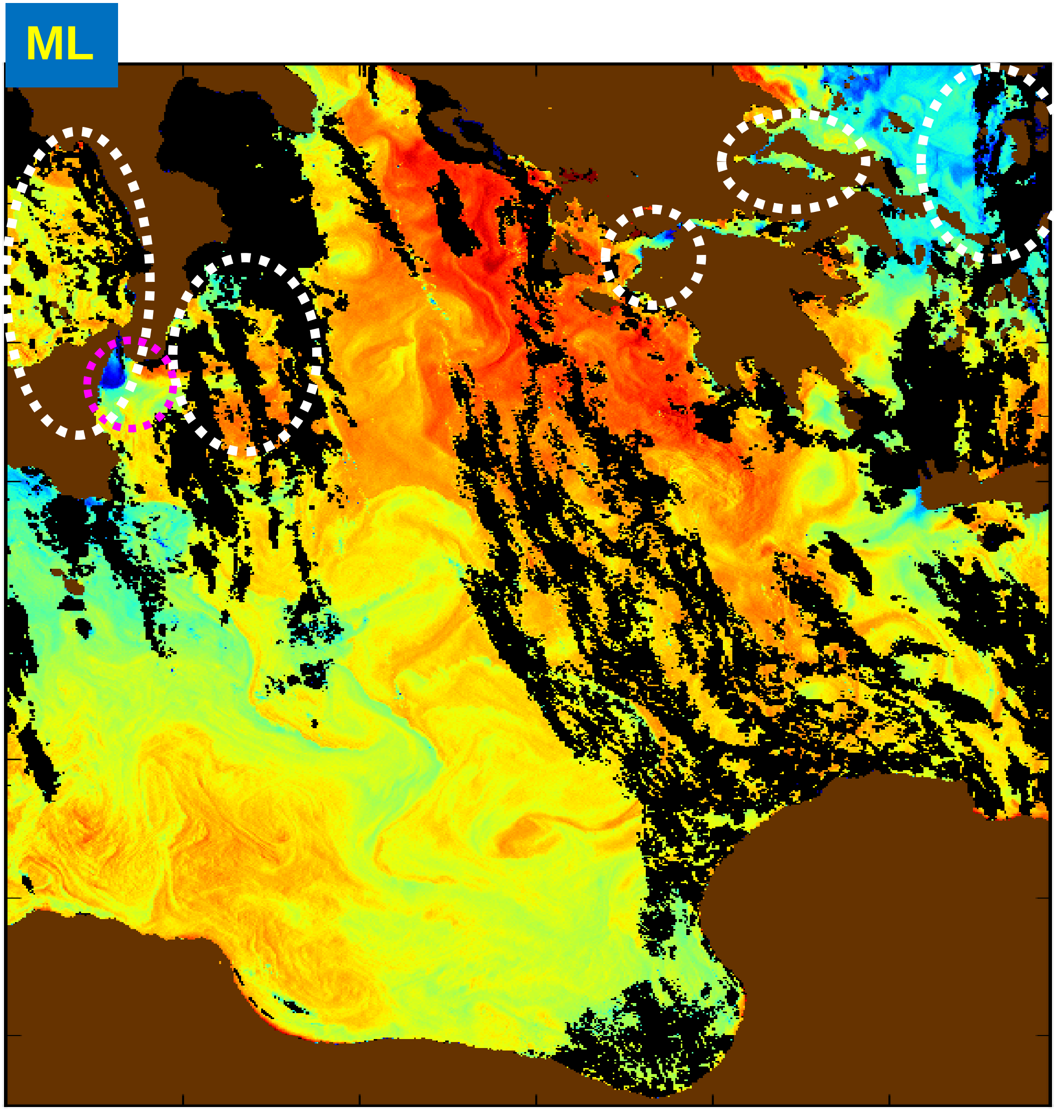
ACSM vs ML Cloud Filter(Korea strait)



- The “Logistic Regression” algorithm was used for classification
- The ML reveals some interesting areas hidden by the ACSM, particularly in coastal zones

ACSM vs ML (Mediterranean sea)





Preliminary Observations

- **Pattern-Recognition/Machine Learning approach has potential to augment the current ACSPO Clear-Sky Mask**

Future Work

- **Test the current ML approach on a representative data set of VIIRS SST (at least one full day of VIIRS data).**
- **Consider improvements to the ML algorithm, if necessary**
- **Explore using the ML algorithm as**
    - **a standalone clear-sky mask alternative to ACSM; or**
    - **an additional cloud filter within ACSM**