Pattern Recognition Enhancements to ACSPO Clear-Sky Mask.

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ACSPPO Clear-Sky Mask (ACMS) employs comparisons of retrieved SST with L4 analyses, reflectance threshold tests and spatial uniformity tests.

ACSM performs well on a global scale but tends to overscreen some highly dynamic areas (e.g., with strong currents, cold upwellings, eddies) as well as the coastal zones.

These deficiencies cannot be completely eliminated by simple thresholds adjustment within ACSM without triggering massive cloud leakages.

Visual analysis of SST field easily discriminates cloud leakages from cold SST anomalies.
Typical clear sky ocean regions misclassified by the ACSM:

- contiguous,
- with well-defined boundaries,
- typically located in the vicinity of ocean thermal fronts.

Existing image processing techniques:

- Segmentation;
- Morphological Procedures: erosion and dilation;
- Thermal Front Detection.
- Human eye does not perceive absolute pixel values (i.e., SST values)

- It relies instead on local contrasts and ratios, which more directly correlate with gradients in an image.

- Difference between ocean and cloud patterns should be more pronounced in the SST gradient magnitude domain.
Gradient magnitude and angle

SST

Gradient magnitude

Gradient angle
Algorithm

Step 1: Identify Search Domain
Step 2: Determine SST gradient ridges
Step 3: Determine spatially connected cold SST regions
Step 4: Discard SST segments found in Step 3 that do not border the ridges found in Step 2
Step 5: Statistical Test
Steps

Search Space  SST Gradient Ridges  Segments bordering Ridges
Considered 2 sets of VIIRS data:

- 48 hand picked and cropped regions with typical clear sky misclassification
- 144 granules representing 1 day global observations

Results were visually inspected and analyzed; Success rate is promising but more work is needed.
Gulf Stream, 05/10/13 (day)

Data courtesy of: USDOC/NOAA/NESDIS

Satellite: NPP
Sensor: VIIRS
Date: 2013/05/10 JD 130
Start time: 21:10:00 UTC
End time: 21:19:59 UTC
Projection type: SWATH
Latitude bounds: 36 N -> 42 N
Longitude bounds: 70 W -> 63 W
Gulf Stream, 05/10/13 (day)

Data courtesy of: USDOC/NOAA/NESDIS

Satellite: NPP
Sensor: VIIRS
Date: 2013/05/10 JD 130
Start time: 21:10:00 UTC
End time: 21:19:59 UTC
Projection type: SWATH
Latitude bounds: 36 N --> 42 N
Longitude bounds: 70 W --> 63 W

SST REGRESSION (K)

- 300
- 298
- 296
- 294
- 292
- 290
- 288
- 286
- 284
- 282
Gulf Stream, 02/16/13

Data courtesy of: USDOD/NOAA/NESDIS
Satellite: NPP
Sensor: VIIRS
Date: 2013/02/16 JD 047
Start time: 21:30:00 UTC
End time: 21:39:59 UTC
Projection type: SWATH
Latitude bounds: 40 N -> 46 N
Longitude bounds: 55 W -> 52 W
Gulf Stream, 02/16/13

Data courtesy of: USDOC/NOAA/NESDIS

Satellite: NPP
Sensor: VIIRS
Date: 2013/02/16 JD 047
Start time: 21:30:00 UTC
End time: 21:39:59 UTC
Projection type: SWATH
Latitude bounds: 40 N -> 46 N
Longitude bounds: 59 W -> 52 W
Gulf Stream, 02/17/13

Data courtesy of: USDOC/NOAA/NESDIS

Satellite: NPP
Sensor: VIIRS
Date: 2013/02/17 JD 048
Start time: 09:40:01 UTC
End time: 09:49:59 UTC
Projection type: SWATH
Latitude bounds: 40 N -> 45 N
Longitude bounds: 51 W -> 43 W

SST REGRESSION (°C)
Great Lakes, 02/17/13

Data courtesy of:
USDOC/NOAA/NESDIS

Satellite:
NPP
Sensor:
VIIRS
Date:
2013/05/10 JD 130
Start time:
11:30:00 UTC
End time:
11:40:00 UTC
Projection type:
SWATH
Latitude bounds:
41 N -> 47 N
Longitude bounds:
84 W -> 76 W
Pamlico Sound, 02/16/13 (night)

Data courtesy of
USDOC/NOAA/NESDIS

Satellite: NPP
Sensor: VIIRS
Date: 2013/02/16 JD 047
Start time: 11:50:00 UTC
End time: 12:00:00 UTC
Projection type: SWATH
Latitude bounds: 32 N -> 38 N
Longitude bounds: 75 W -> 72 W
A supplemental algorithm to the current ACSPO Clear-Sky Mask based on pattern recognition is being explored.

Our preliminary analyses suggest that some of the limitations inherent to the current ACSM may be alleviated and SST coverage improved.

The improvements are mostly noticeable in the areas interesting to ACSPO users, including dynamic areas of the ocean and coastal zones.

Future work will include tuning the algorithm, with emphasis on resolving the remaining cloud leakages.