GOES-R Ocean Dynamics Algorithm

NOAA Satellite Science Week
Kansas City, MO
April 30 – May 4, 2012

Eileen Maturi[1], Andy Harris[2], Igor Appel[3]

1. NOAA/NESDIS/STAR/SOCD
2. University of Maryland, CICS
3. NOAA Contractor, IMSG

The GOES-R ABI has been designed to address the needs of many users of geostationary data and products (*Schmit, et al, 2005*). It will offer more spectral bands (to enable new and improved products), higher spatial resolution (to better monitor small-scale features), and faster imaging (to improve temporal sampling and to scan additional regions) than the current GOES imager. The spatial resolution of the ABI data will be nominally 2 km for the infrared bands and 0.5 km for the 0.64-μm visible. Sixteen spectral bands will be available on the ABI. The channels that are expected to be tested for use in the Ocean Dynamics algorithm include bands 7, 13, 14 and 15.

The Ocean Dynamics algorithm determines vectors of ocean motion by comparing values of brightness temperatures for pairs of images. Because ocean motion vectors are slow in comparison with the atmosphere, significant improvements in the performance of the image navigation and registration, expected with GOES-R and improving the retrieval of ocean motion, is critically important. The stability of the frame-to-frame navigation, in particular, is a key factor for deriving accurate ocean motion vectors. The Ocean Dynamics algorithm works in a multi-stage process using a sequence of three images separated by 3 hours following the requirements formulated in specifications. Currently it is assumed that equal in size GOES-R images include the same set of navigated and co-registered pixels.

Ocean motion vector determination is the process of measuring the displacement of water pixels. It always involves assumptions of the radiometric characteristics of water, particularly those that relate to the brightness temperature in the 11 micron band. The ocean dynamic algorithm selects a target area in one image and then is compared with many areas of the same size in a search region of the previous and following images. The displacement of water is then defined by the location in the images where the sum-of-squared-differences between brightness temperatures (or SST) are the smallest. This approach makes the basic assumption that the local water movement can be treated as only a translation of quasi-solid plane (e.g., ignoring deformation and rotation in speed fields). This assumption is generally valid over short distances, at least for the features of ocean motion, characterized by a large scale comparatively to the resolution of observations.

The ocean motion vectors will have several dependencies that will affect the accuracy and precision of the product. As the product will be based upon sequential clear views of the ocean surface, consistent image navigation from scene to scene is essential to optimize the interpretation of such motion as being advective processes occurring on the ocean surfaces. Another dependency issue is that of the cloud-mask. While the input ocean scene will need to be devoid of clouds in order to avoid the tracking of such regions in sequential images, many dynamically active regions of the ocean (strong gradient regions, upwelling zones, eddies) could be erroneously flagged as clouds. The transient nature of such events is of particular importance to the oceanographic community; hence inclusion of such features in the Ocean Dynamics product is essential.