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DISCRIMNATION OF CLOUDS AND SURFACES IN SATELLITE IMAGES

This paper provides a summary of the cloud detection and cloud analysis algorithm foreseen for the MSG satellite .

DISCRIMNATION OF CLOUDS AND SURFACES IN SATELLITE IMAGES

1 INTRODUCTION

At CGMS-XXVII the Cloud Processing for Meteosat Second Generation (MSG) was discussed in WG III. Some updates have been included since then. Most important, the algorithm has now been tested on a subset of MODIS channel data, which are similar to the MSG channels. This document provides an overview of the main features of the Scenes and Cloud Analysis algorithm and should stimulate relevant discussions within WG II on scenes analyses. As the scenes analyses are a fundamental task at all satellite processing centres it is felt that exchange of information is of mutual benefit.

2 SCENES AND CLOUD ANALYSIS

The Scenes and Cloud Analysis algorithm is split in two parts, the cloud detection/cloud mask generation (Scenes Analysis (SCE)) and the derivation of detailed cloud parameters (Cloud Analysis (CLA)). Both parts are summarised in the following subsections.

2.1 SCENES ANALYSIS

The Scenes Analysis algorithm has been designed to support the derivation of products from MSG/SEVIRI. It derives a cloud mask on pixel basis for every repeat cycle (15 min.) and generates quality information of the cloud/no cloud decision. The algorithm is based on threshold techniques and can use up to 29 tests in parallel (some tests are used as a backup).

The following types of threshold tests are used.

- reflectance tests using the solar channels (4 tests)
- reflectance ratio tests (3 tests)
- temperature tests using the IR window channels (4 tests)
- temperature difference tests (using all combinations of the 10.8 µm and 12.0µm channels with all other IR/WV channels) (11 tests)
- standard deviation tests on a moving 3 x 3 pixel target (7 tests)
- snow and ice test (the normalised snow index)

The threshold tests are applied according to a pre-defined starting set of tests. The appropriate tests will be selected according to the situation at the pixel location, e.g. time of the day (day/night/twilight), location (land/sea/coast), special situation (sunglint, high elevation, cold surfaces).

The algorithm uses “dynamic” thresholds, e.g. generated from forecast data. The thresholds are generated as follows:

- for the solar channels static thresholds are used based on climatological values depending on surface type; this will be replaced by a reflectance map generated from MSG solar channels on a weekly basis and corrected for bi-directional effects
- for the infrared channels dynamic thresholds are used derived from forecast data and the results of the previous image, with an additional adjustment for land/sea/coast/high

elevation/day/night/twilight/cold regions
- for standard deviation tests static thresholds are used depending on location (land/sea/coast/sunglint)

2.2 CLOUD ANALYSIS

The Cloud Analysis derives detailed cloud information on pixel basis for every repeat cycle (15 min.). It is also based on threshold techniques, for which the selection of the tests is depending on the location, time of the day, synoptic situation.

The following cloud information is derived:
- Cloud phase - using channels 0.6, 1.6, 3.8, 8.7, 10.8 and 12.0 µm
- Cloud top height (pressure and temperature) with rationing methods using channels 6.2, 7.3, 10.8 and 13.4 µm
- semi-transparency flag and effective cloud amount, derived with the height information
- Cloud type information using the derived parameters above, the standard deviation of channel 10.8 µm for cumulus/stratus type identification and a combination of channels 3.9 µm and 10.8 µm for fog/low stratus identification.

The generation of cloud optical properties into the Cloud Analysis algorithm will be implemented in the near future.

3 APPLICATION OF THE SCE AND CLA ALGORITHMS

The SCE and CLA algorithms have been tested with different sets of satellite data, i.e. Meteosat-5 (INDOEX), Meteosat-6, Meteosat-7, GOES-8 imager, GOES-8 sounder, and AVHRR. The detailed results of these test runs can be found in CGMS-XXVII-EUM-WP-33 and in EUMETSAT Technical Memorandum TM04. Results of the test runs with MODIS data will be published in the near future.

4 CONCLUSION

The Scenes and Cloud Analysis algorithm performs an accurate cloud detection and cloud analysis for data from different satellites, even in areas complicated scenes like thin Cirrus situations, cold snow/ice surface situations, and low-level warm Stratus and Fog situations. The algorithm is well prepared to run within the Meteorological Products Extraction Facility (MPEF) of the MSG satellite.