Geolocation Error for NOAA POES Microwave Satellite Data
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Abstract
In this study, we investigated and corrected the geolocation errors of the observations from AMSU-A, -B and Microwave Humidity Sounder (MHS) onboard NOAA-15 to 19. The difference between ascending and descending observations along the coastlines was used to quantify the geolocation error in terms of the satellite attitude (Euler) angles, i.e., pitch, roll, and yaw. Then, the calculated attitudes were used to correct level-1b geolocation data including geographical coordinates and scan/local zenith angles. The results show that NOAA-15 AMSU-A2 sensor is mounted about half a pixel (1.2 degrees) negative along track. Other satellite-sensor pairs also had some geolocation errors. A few example of the calculated attitude angles and also the difference maps before and after correction are shown in the results.

NOAA Level 1b Geolocation Problems

The left figure shows the difference between new geolocation data and level-1b geolocation. During 2001-2002 many scanlines are not geolocated but are filled with zero for both latitude and longitude. In the beginning of 2004 the software failed to calculate Greenwhich hour angle and the longitude is about one degree wrong. The middle plot shows the level-1b geolocation for 01/01/2004 and the right figure shows the new geolocation data. It is obvious that the level-1b data are shifted from the coastlines.

Geolocation Algorithm
- No geolocation error => ΔTb, ascending – descending, is very small
- Geolocation error => ΔTb is very large along the coast lines because the land TB is much higher than ocean TB
  - negative alongtrack offset => northern coastlines will have a cold edge, and southern coastlines will have a warm edge.
  - negative crosstrack offset => western coastlines will have a cold edge and the eastern coastlines will have a warm edge.

The algorithm starts with zero for all the three attitude angles (pitch, roll, and yaw), then makes the difference map and calculate number of pixels along the coastlines where ΔTb is higher than threshold. If correction is required, then pitch, roll, and yaw are tuned. After all local zenith angle, latitude, and longitude are calculated and stored in the new geolocation dataset.

Results
Attitude errors for different NOAA AMSU-A Channels. Some sensors like NOAA-15 AMSU-A2 has a sensor pointing error more than one degree. The values are denoised using wavelet and vertical lines show the standard deviation of the percentiles.

Sample difference maps before and after corrections. The cold and warm edges along the coastlines show the geolocation error. Top: before correction, bottom: after correcting satellite attitude and sensor pointing errors.

Summary
A) NOAA AMSU/MHS geolocation is subject to inaccuracy that can be up to 70 km in some cases.
B) The geolocation is affected by the sensor mounting and satellite attitudes offset which require correction
C) L1b geolocation accuracy has been improved in recent years, yet needs monitoring and evaluation
D) The geolocation inaccuracy can seriously influence sensor/satellite pointing angles which are very important for RT calculations
E) The quality of AMSU/MHS products is highly affected by the geolocation accuracy. The effect of any inaccuracy is especially important along the coast lines
F) A method was developed to correct the geolocation errors. All AMSU-A/B/MHS data will be corrected soon in the AMSU CDR project.