VIIRS Gridding and Granulation Algorithms for NPOESS

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Introduction

Abstract:
The VIIRS Gridding/Granulation algorithms are used to produce a host of gridded intermediate products (IP) and to map these products on the VIIRS swath for direct ingest in the Environmental Data Records (EDR). These mapping algorithms have a long heritage and are based on the MODIS Gridding/Granulation algorithms. In this presentation we discuss some of the gridded products produced by VIIRS gridding granulation their use in VIIRS EDRs and also some of the testing of the Gridding/Granulation algorithms by NGST.

Background:
The NPOESS system produces only one deliverable gridded product, the Quarterly Surface Type IP (QST IP). All other gridded IPs are used in the generation of either the QST IP or various EDR after granulation to the VIIRS swath. The VIIRS Gridding/Granulation algorithms which create the needed Gridded IP or granulate them to the swath follow the MODIS heritage. The algorithms are built on a key weight calculator module which computes the area of the intersection between swath pixels and grid cells.

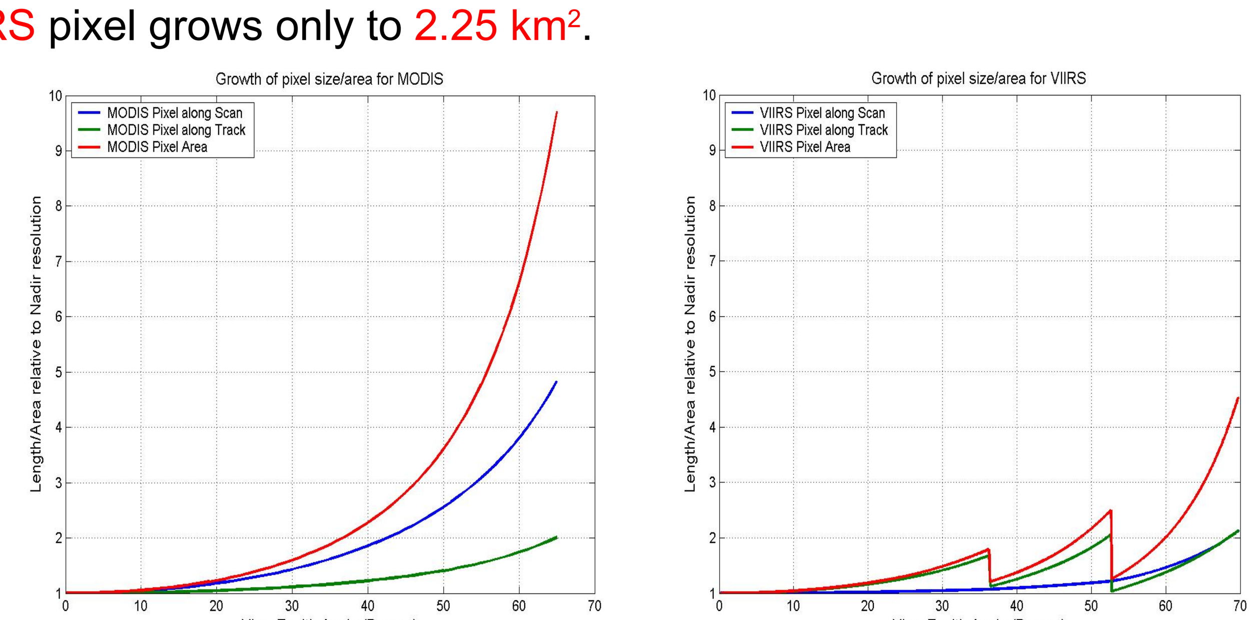
The grid used for the VIIRS gridded products is the Sinusoidal projection at (nominally) 1 km resolution. The exact resolution is 0.926 km. The gridded IPs produced by the VIIRS gridded algorithm are the following:

- Gridded Monthly Vegetation Index
- Gridded Monthly Surface Reflectance
- Gridded Monthly Brightness Temperature
- Gridded Quarterly Surface Type
- Gridded Annual Max/Min NDVI
- Gridded Daily Surface Reflectance collection
- Gridded Land Surface Albedo
- Gridded Land BRDF Archetypal
- Gridded Snow/Ice Cover

The Monthly products are input to the surface type algorithm which produces the QST IP and the annual Max/Min IP. The granulated version of QST IP and annual Max/Min NDVI are then input to the surface type EDR. The surface reflectance collection is input to the albedo algorithm which produces the land albedo and BRDF archetypal IPs. These are then input to the albedo EDR. The Snow/Ice cover IP is used as a backup at night for input to the VIIRS cloud mask algorithm.

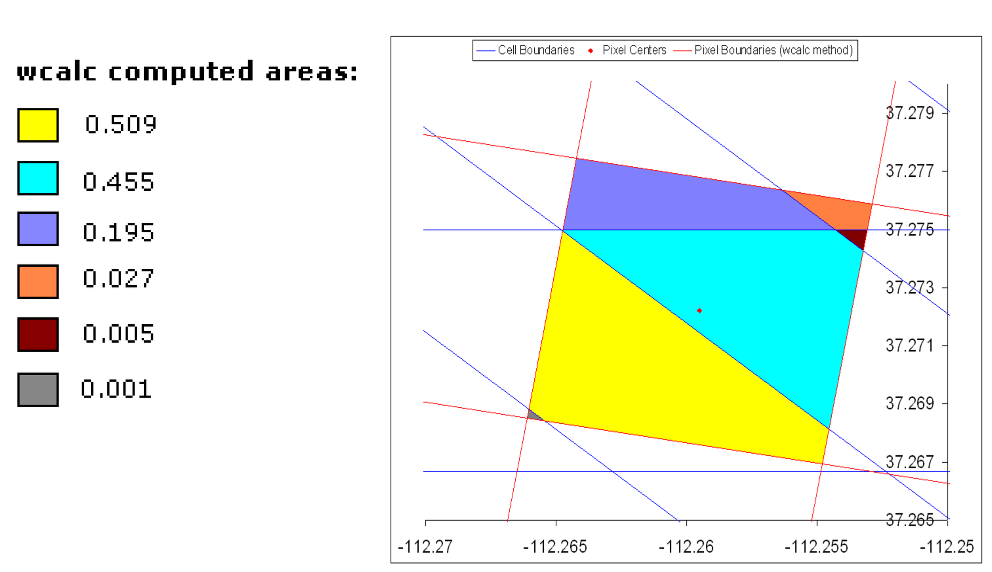
Area Weighting and Compositing Algorithms

Thanks to the aggregation scheme used for VIIRS, the pixel growth at the edge of scan is greatly reduced compared to MODIS. For example at the edge of scan a 1 km^2 MODIS pixel grows to 9.7 km^2 whereas a moderate resolution (0.75 km^2) VIIRS pixel grows only to 2.25 km^2.



Benefits of pixel aggregation: pixel growth for MODIS (left) and VIIRS (right) relative to the pixel size at nadir.

The smaller pixel size for VIIRS has beneficial implications for the gridding/granulation algorithm. Since the sinusoidal grid is based on grid cells of 0.926 km by 0.926 km (area of 0.857 km^2) then 10 grid cells are sufficient to cover the largest pixel at the edge of scan. This is demonstrated on the truncation error plots to the right.



Example of Weight Calculation for a VIIRS pixel.

Regarding monthly gridded products, such as the monthly vegetation index, surface reflectance or brightness temperatures, a compositing procedure was used to derive a single value per month for each of these products. The compositing procedure is basically the MODIS compositing algorithm which is based on a combination of maximum value and constrained views compositing.

The so called CV-MVC procedure selects values based on the maximum value of NDVI within a constrained set of view angles to limit BRDF effects. The maximum value is used a post cloud screening method since clouds typically depress the NDVI. A couple of values of NDVI, surface reflectance and brightness temperature are kept and compared to new (daily) values. At the end of the month the "best" value is retained and stored in the monthly product.

Gridding/Granulation Testing

Testing of the main module in the VIIRS Gridding/Granulation algorithm, namely the weight calculator, was done for various VIIRS and MODIS granules located at challenging locations, such the poles and dateline. The testing consisted in evaluating the pixel area by summing the weights determined by the algorithm; indeed if the weights were correctly computed their sum must yield the underlying pixel area. The number of weights used for VIIRS was set to 10 which as shown below is enough to capture the VIIRS pixel size at the edge of scan.

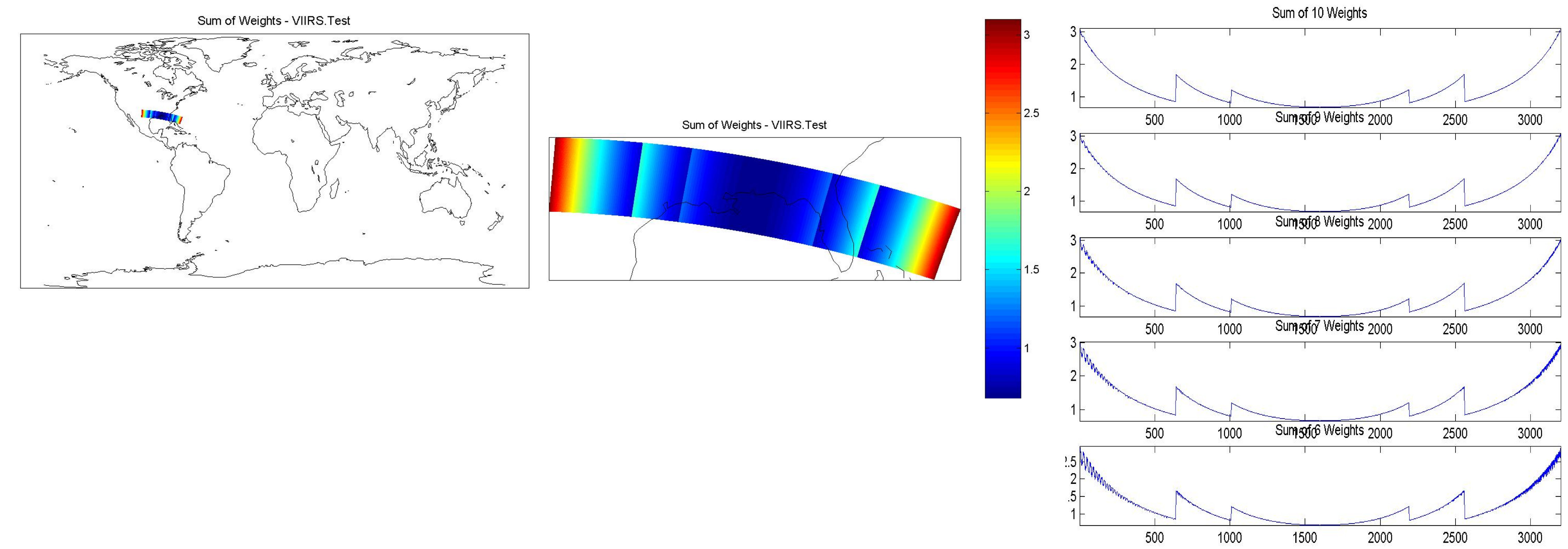
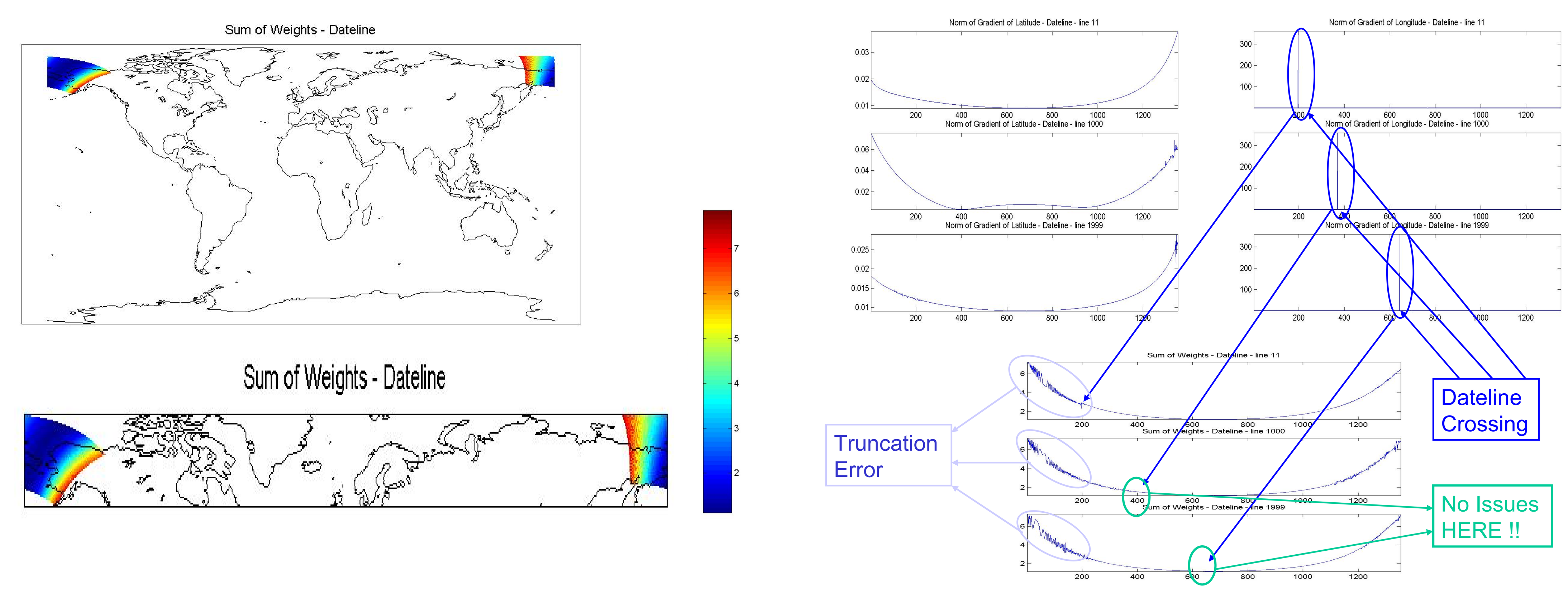
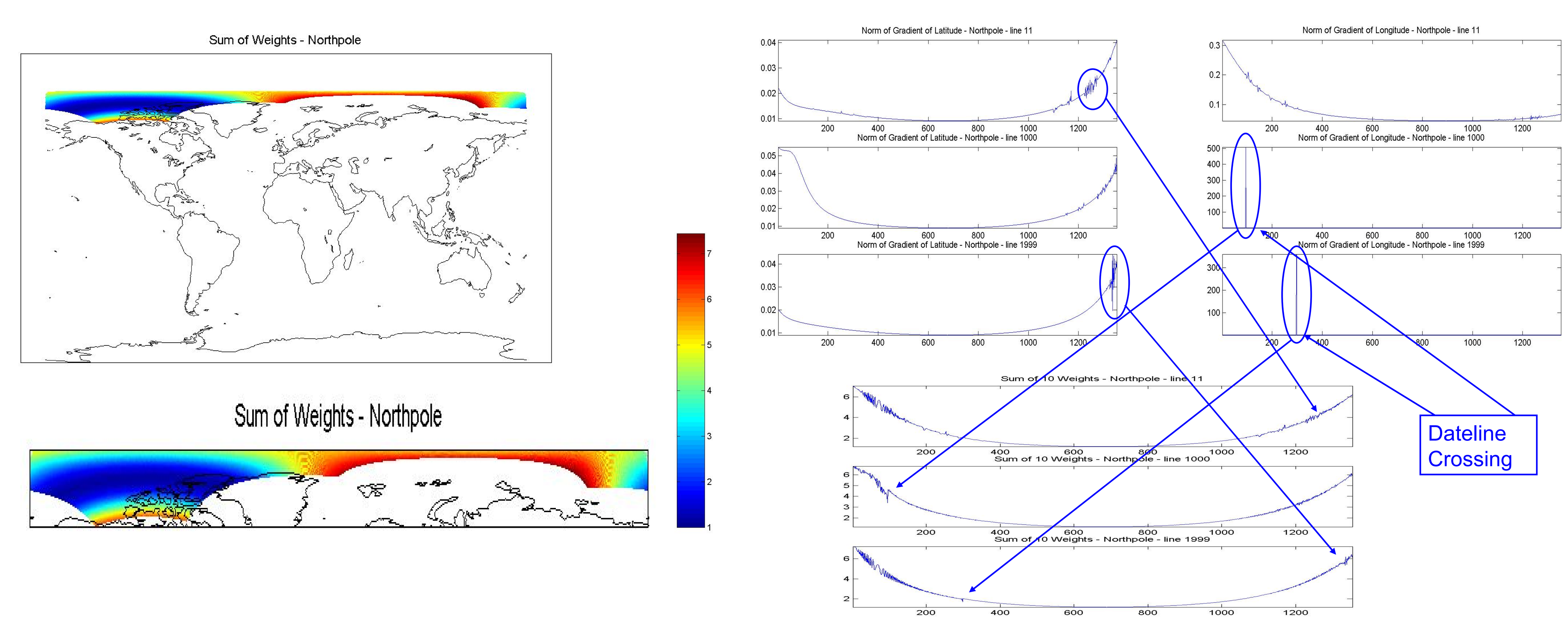


Illustration of the truncation error for a VIIRS granule

Using MODIS granules for testing was useful as well since the effects of topography was included in the data and granules over the poles and the dateline could be tested. Due to the much larger MODIS pixel size at the edge of scan, truncation errors do appear at the edge of scan. Indeed only 10 weights are kept for a maximum area of 8.57 km^2 which is less than the MODIS pixel size of 9.7 km^2. Depending on the alignment of the scan with respect to the sinusoidal an oscillating pattern of truncation errors can clearly be observed.



Dateline Granule: Test of dateline handling for a MODIS granule



North Pole Granule: Test of pole singularity handling for a MODIS granule

Conclusions

The tests and evaluation of the VIIRS Gridding/Granulation algorithms show that the algorithm behaves as expected. Its accuracy for VIIRS granules appears to be satisfactory in particular in resolving the pixel growth at edge of scan.