VIIRS-CrIS Mapping

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Introduction

Mapping? Why?

Mapping sounder and imager is of high interest at least for

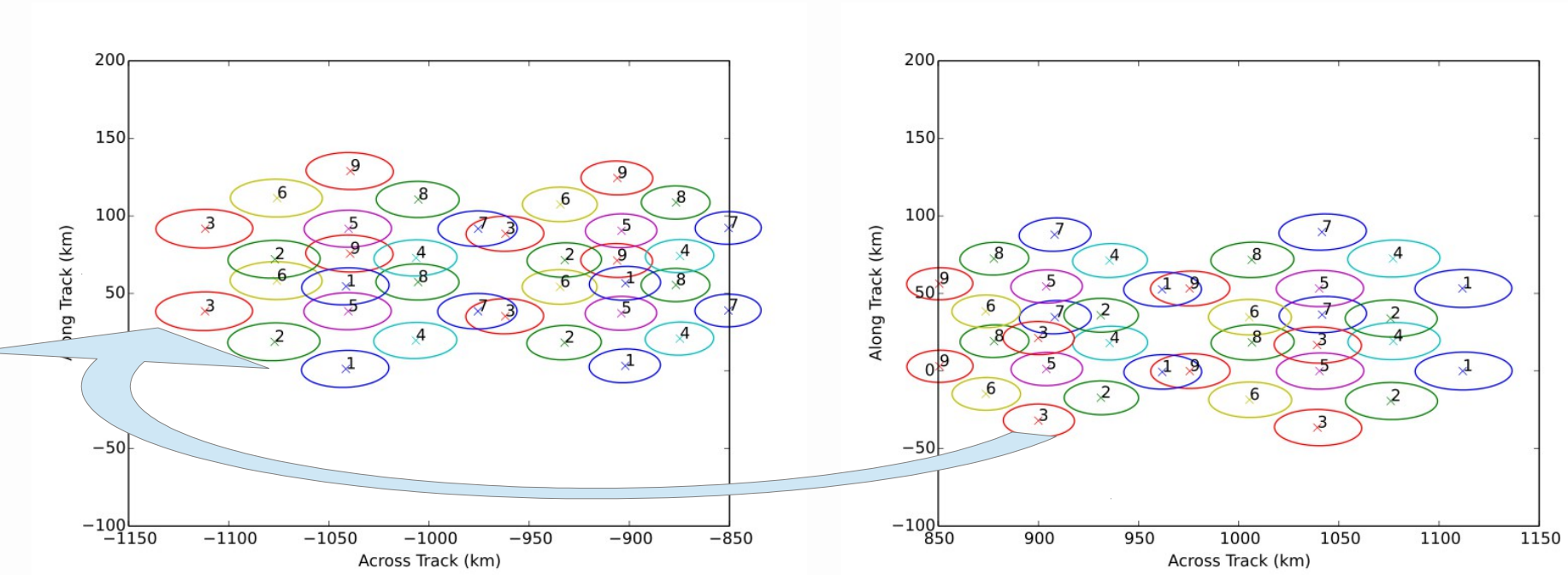
- Navigation and calibration control/validation
- Cloud characteristics in sounder FOV
- Surface parameters (T, Land/Sea)
- Atmospheric profile retrievals
- Variability inside FOV

What are the issues

- Sounder footprint (CrIS FOR rotates)
- Imager neighbours (VIIRS bow-tie)
- Computation time

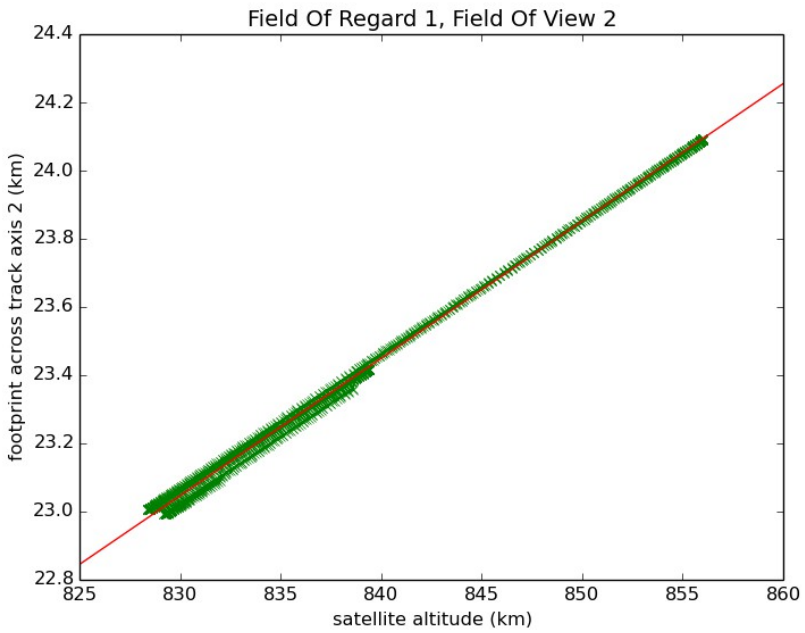
CrIS footprint

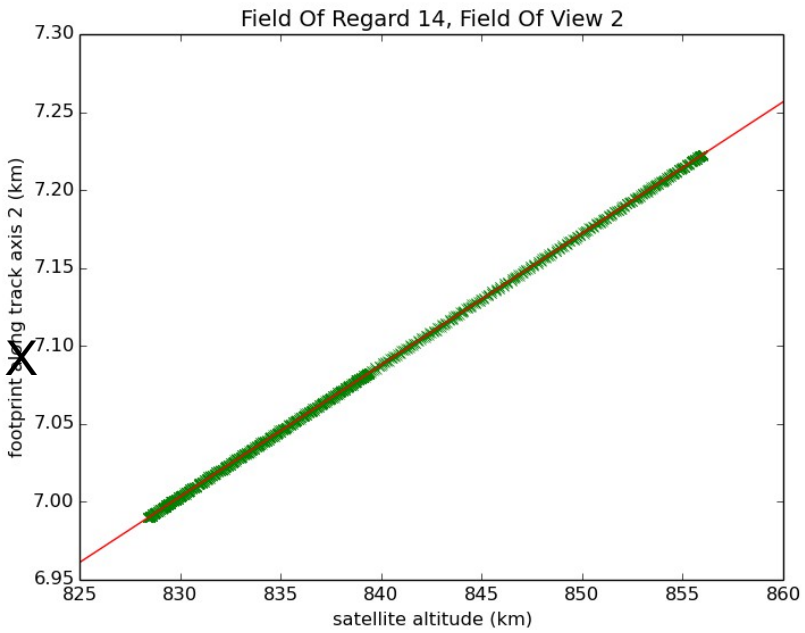
- Similar equations as for IASI, but 9 FOVs and field of regard rotates by 45°
- Validation against CrIS SDRs
- Nominal footprint contour (FOV 16.8mrad) calculated by AAPP
- Variation from 14x14 to 48x24 km



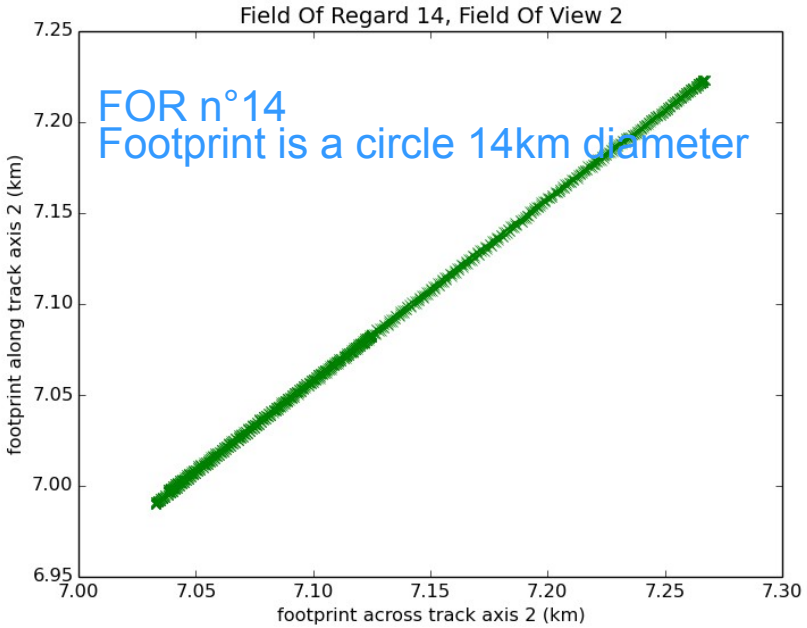
CrIS footprint

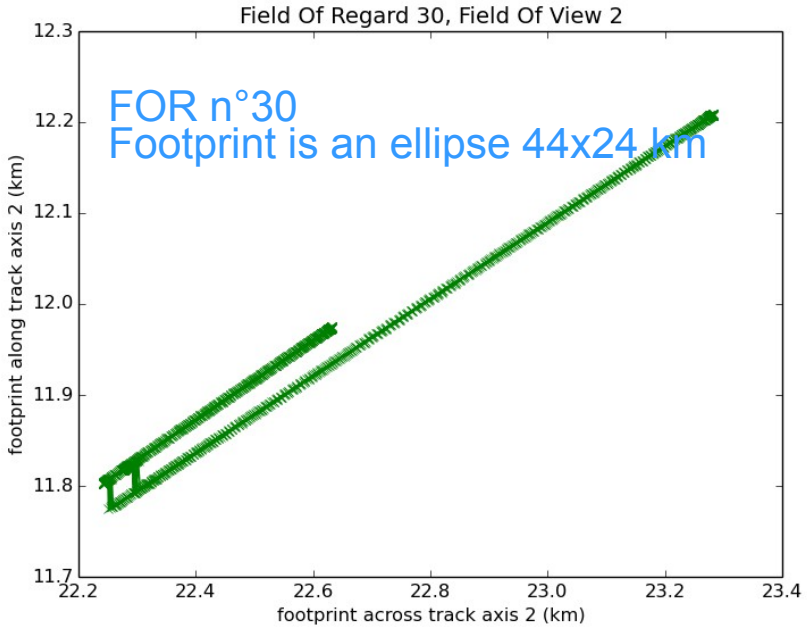
Footprint mainly varies with satellite altitude

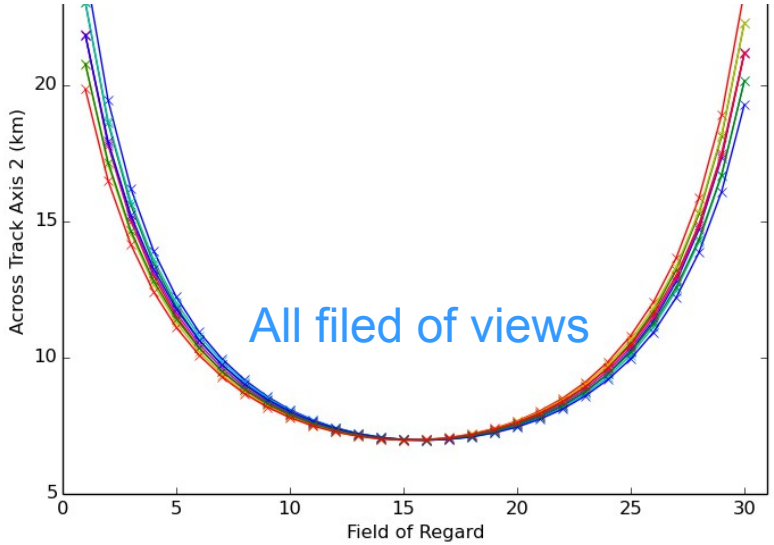




CrIS footprint







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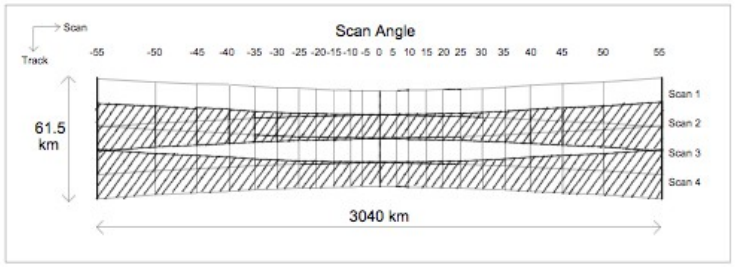
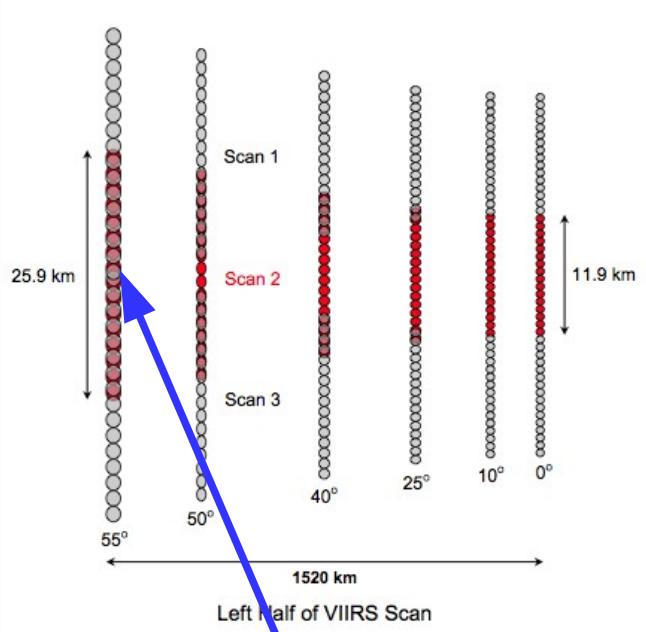
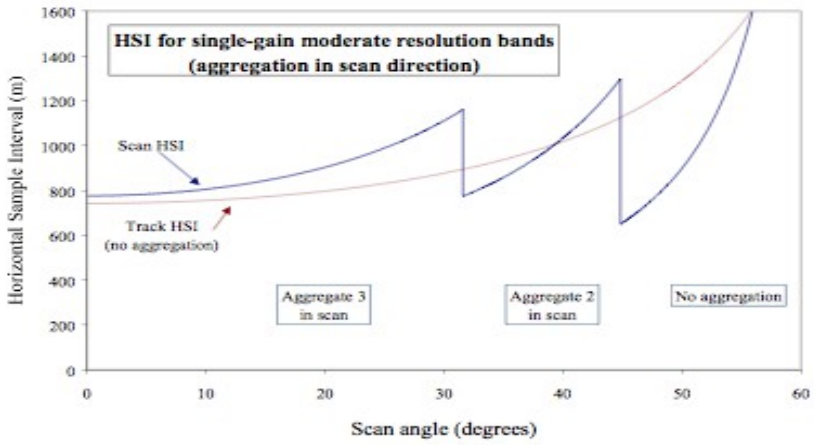
VIIRS scanning

VIIRS bow-tie





VIIRS spatial resolution
Agregation across scan



3 pixels of 3 different scan lines in the same geographical location

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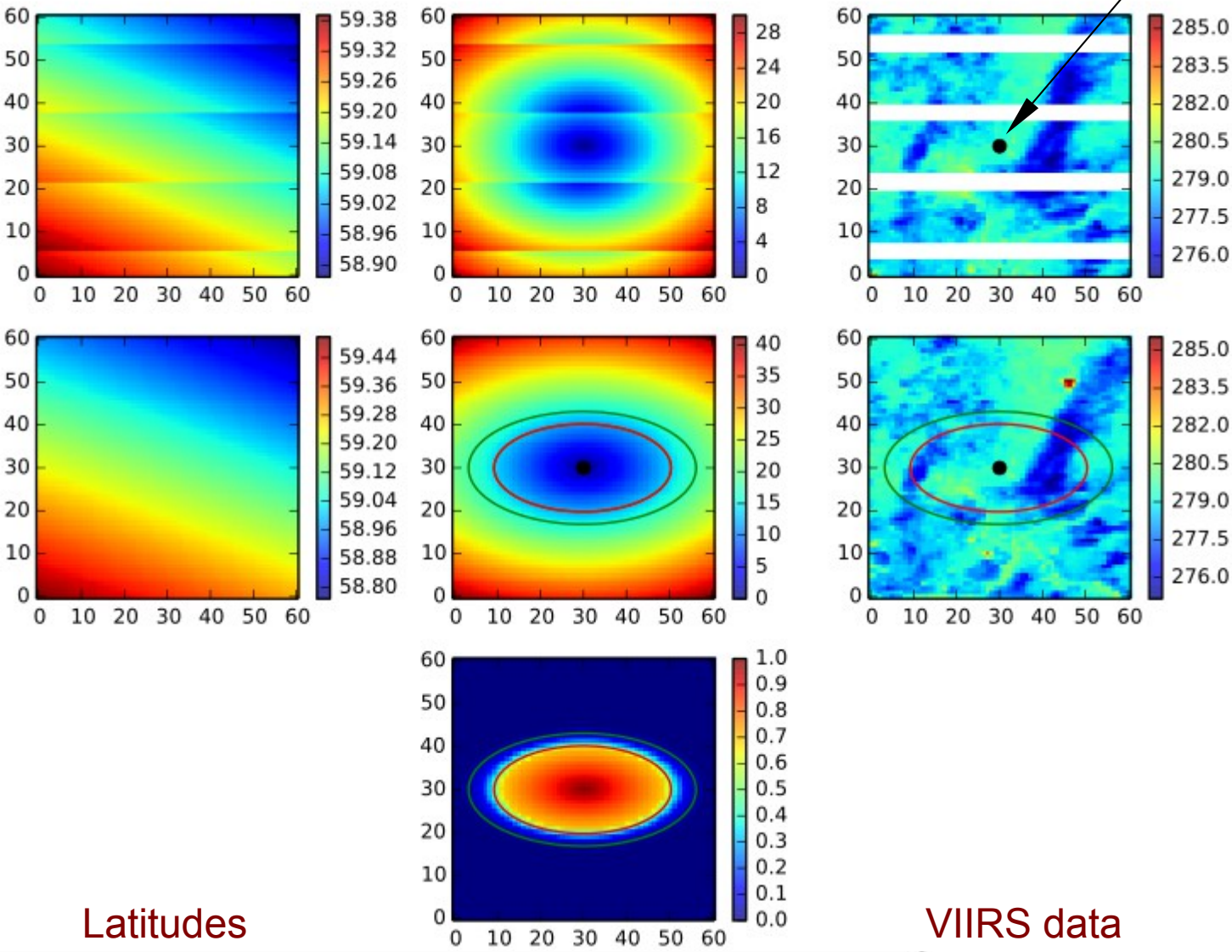
CrIS ellipse centred on VIIRS 2600

Raw

Adjacency

Weights



Latitudes

Distance

VIIRS data

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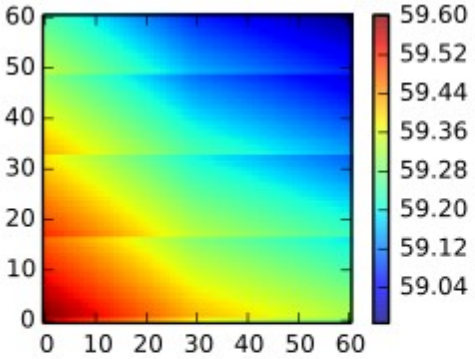
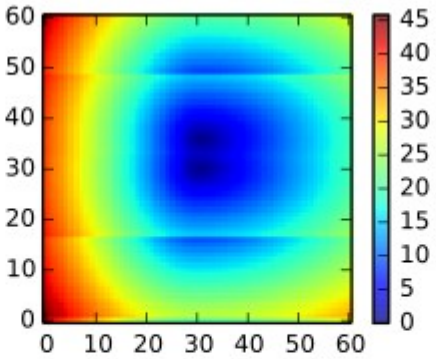
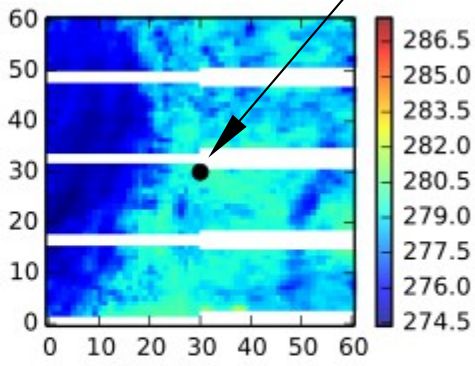
CrIS ellipse centred on VIIRS 2560

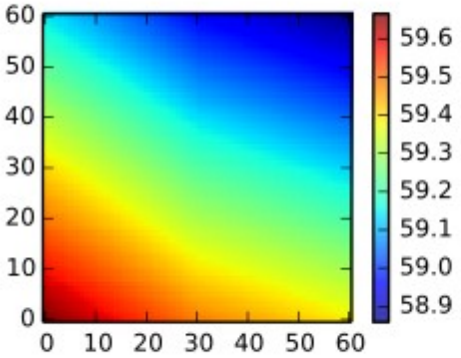
Raw

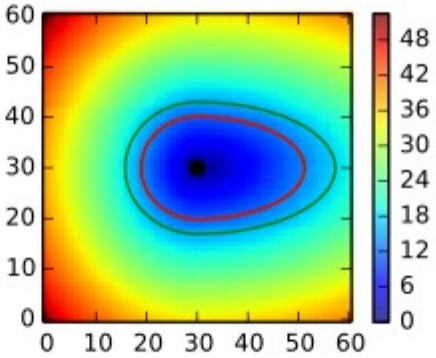


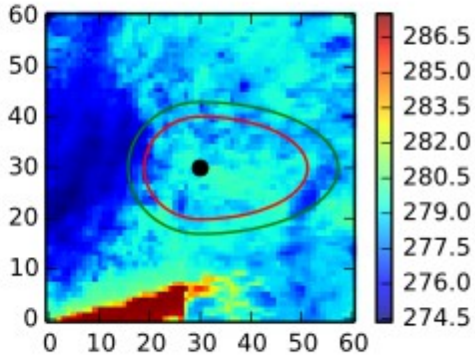




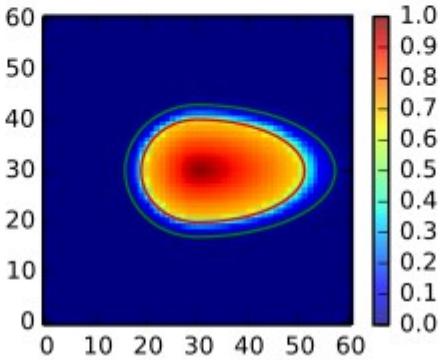
Adjacency







Weights



Latitudes

VIIRS data

Distance

CrIS Footprint data file

Pre-calculate CrIS footprints for

- all FORs
- all FOVs
- Fixed altitude

Store :

- axis values in kilometres
- regression coefficients with altitude from several full orbit tests

Conversion between km axis to line/pixel axis done with real data

Implementation of mapping in AAPP

Fortran 90

Inputs:

- CrIS AAPP level 1d (or level 1c)
- VIIRS HDF5 SDRs
  - geolocation NON terrain corrected
  - de-correction is implemented
- VIIRS MAIA4 cloud mask files
- CrIS footprint data file

Output:

- CrIS AAPP level 1d (or level 1c)

Footprint:

- axis sizes
  - Coefficients data file
  - Altitude from SDR
- contour
  - Pure ellipse
- shape
  - Nominal shape assumed, (3% 10% 50% 70%of peak response)

Implementation of mapping in AAPP

- Compute adjacency tables for VIIRS bands M or I
- Optimise use of trigonometric routines
- Earth is flat
- Constant latitude for conversion to km
- Tabulated cosine for latitude

Find FOV centre in VIIRS data

- Date and lat/long from CrIS
- First guess
  - Nominal pixel position in data file
  - Nearest VIIRS scan in time
- Iterations using vector products

Mapping structure

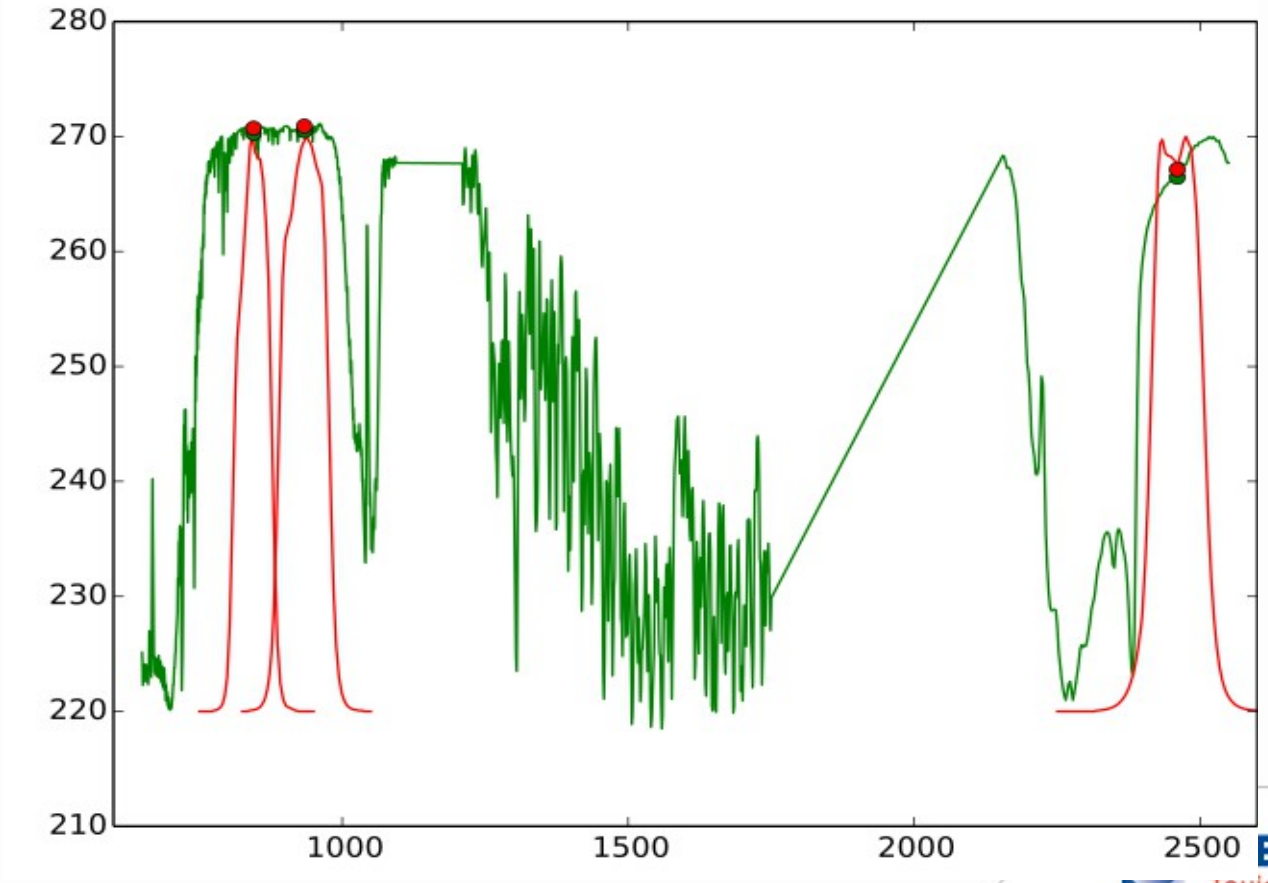
- Contains all necessary information for a given CrIS FOV in nominal VIIRS coordinates
  - Contour
  - Weights
  - Centre

Mapping

- Routines for FOV radiances convolution (VIIRS SDR and MAIA)
- Conversion of VIIRS radiance units to CrIS units

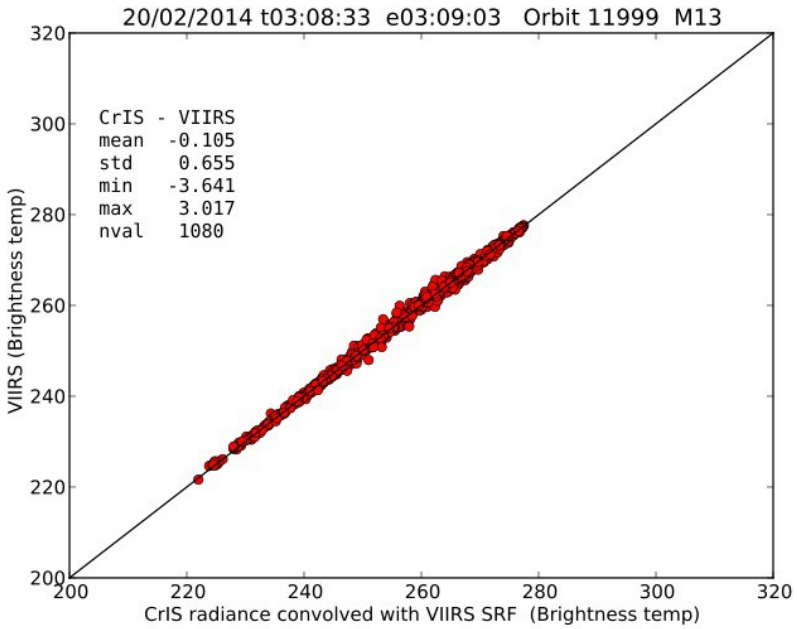
Validation

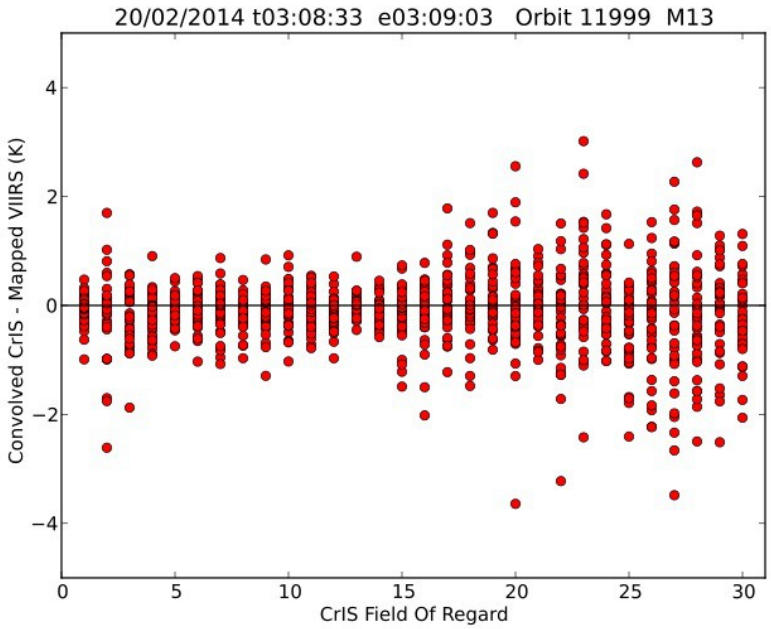
- Channels I5, M13, M15, M16 lies in the CrIS spectrum
- Compare CrIS spectrum convolved with VIIRS spectral response function to VIIRS radiances convolved with CrIS footprint
- Care of radiance conversions



Results example

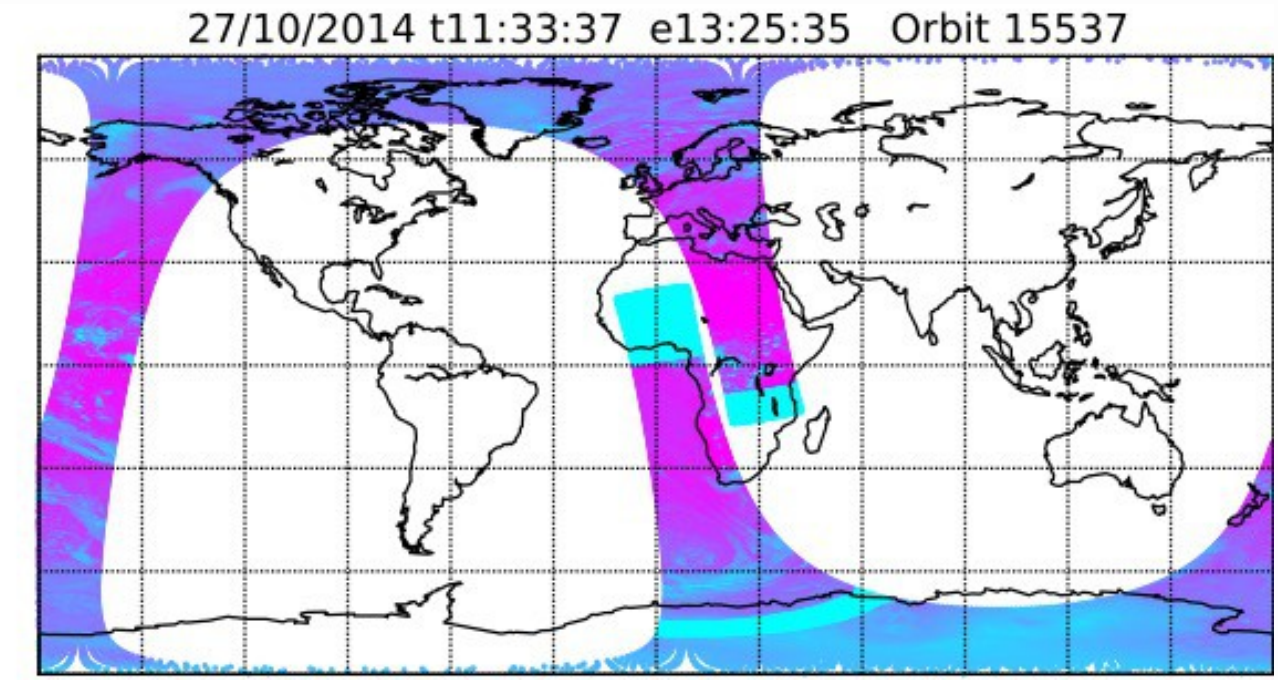
Channel M13, one CrIS granule, all FOVs





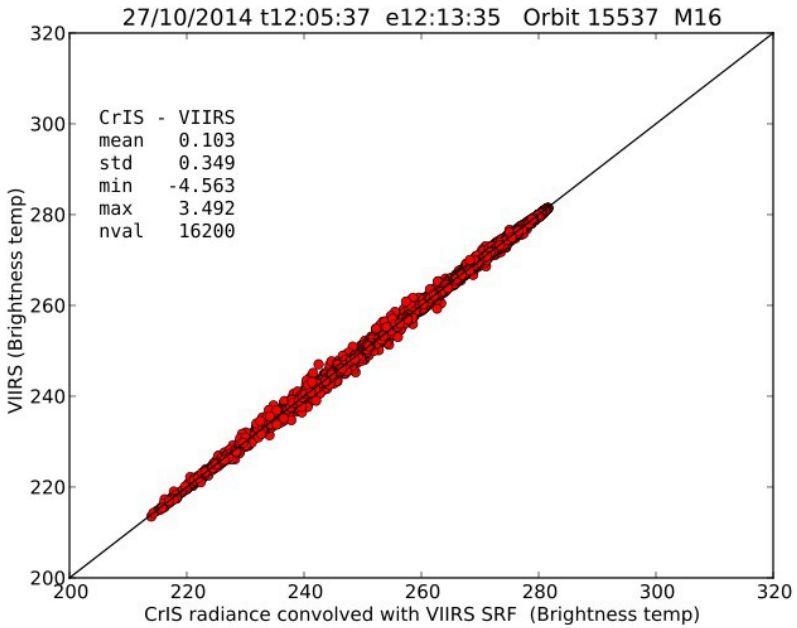
Full orbit pass

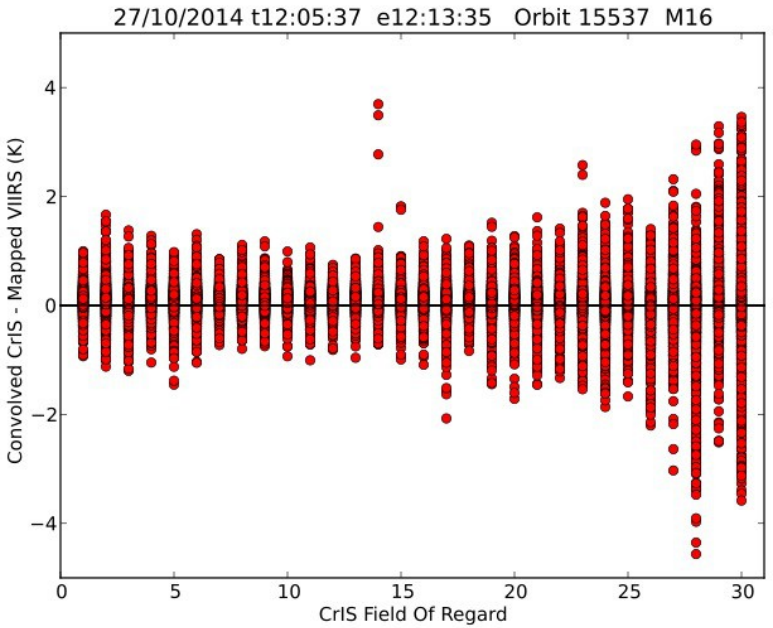
Full orbit pass 15537 (peate archive), VIIRS M16 BTs
Some missing VIIRS in ascending part, near South Pole + Start/Stop



Full orbit pass

Common result for 8 minutes of CrIS data, channel M16
Mean ~0.15K StDev ~0.40K

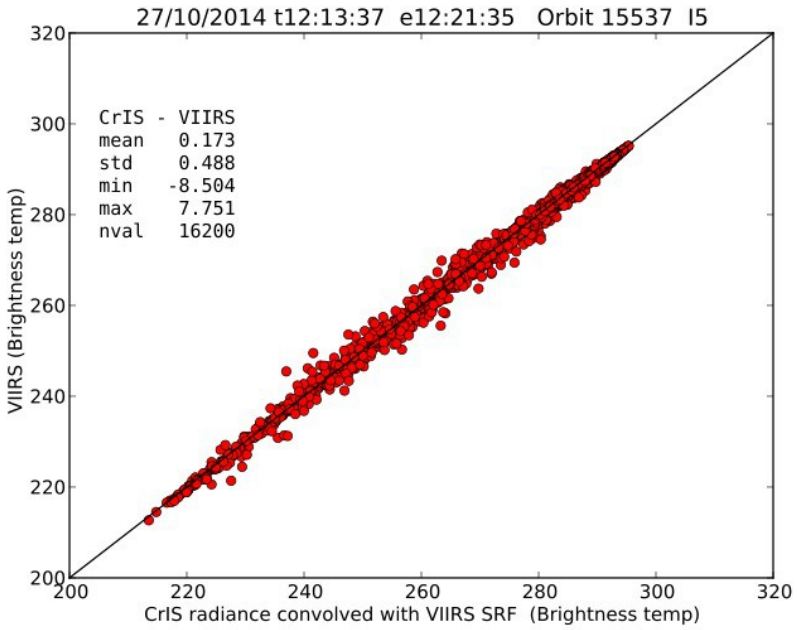


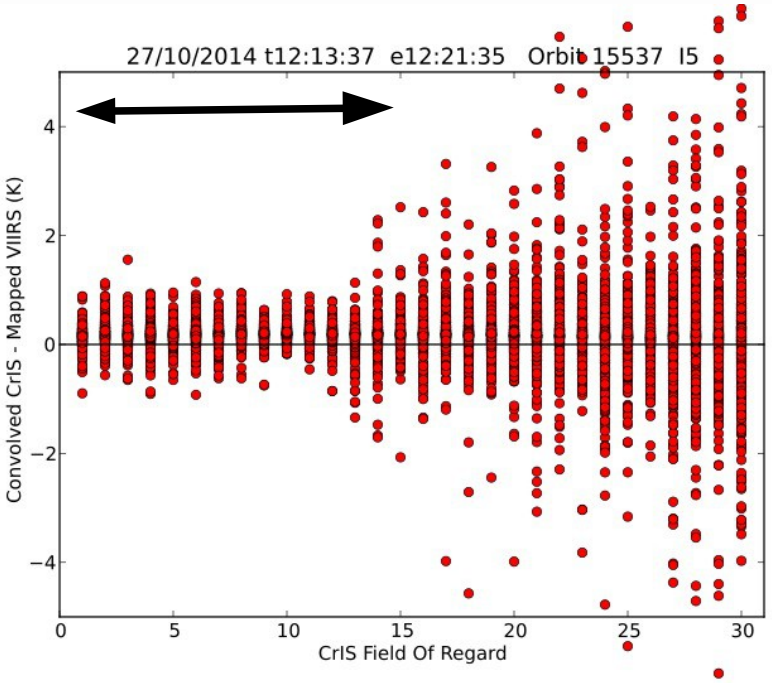


Full orbit pass

Worse case:

- Channel I5, StDev 0.50K up to 0.70K
- Tropical areas
- Always better for FORs 1-15





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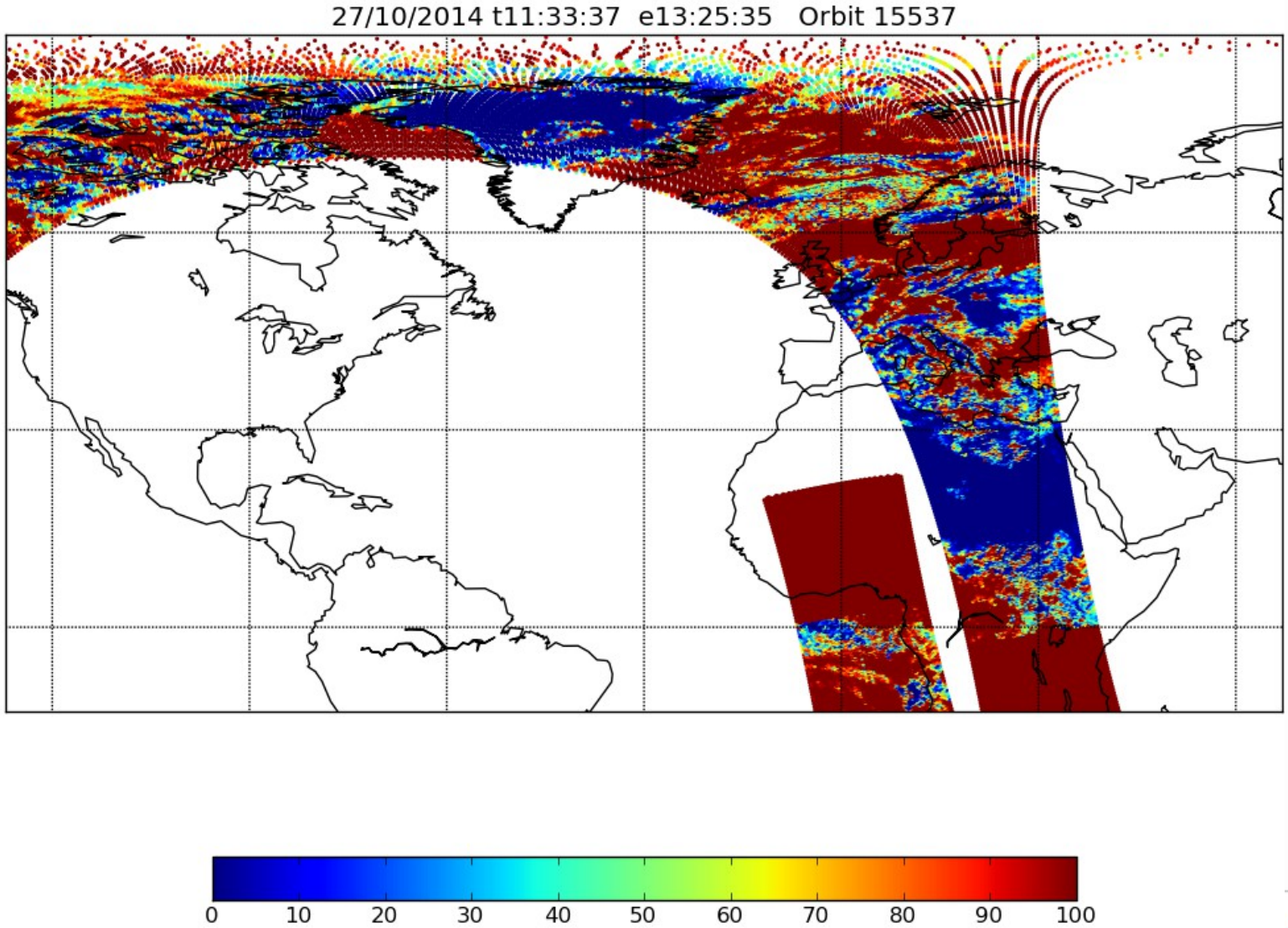
Full orbit pass statistics

Statistics for the 27/10/2014 11h33-13h25 full orbit

		11h41	11h49	11h57	12h05	12h13	12h21	12h29	12h37	12h45	12h53	13h01	13h09
I5	bias	0.220	0.145	0.136	0.134	0.173	0.194	0.176	0.159	0.133	0.146	0.150	0.180
I5	std	0.390	0.444	0.353	0.324	0.488	0.745	0.703	0.570	0.266	0.155	0.447	0.608
M13	bias	-0.144	-0.089	-0.107	-0.116	-0.085	-0.081	-0.094	-0.084	-0.007	-0.071	-0.077	-0.100
M13	std	0.308	0.361	0.316	0.308	0.501	0.695	0.655	0.550	0.274	0.963	0.435	0.488
M15	bias	0.252	0.219	0.248	0.231	0.226	0.236	0.226	0.238	0.251	0.279	0.234	0.226
M15	std	0.424	0.490	0.379	0.347	0.519	0.804	0.748	0.584	0.286	0.172	0.479	0.646
M16	bias	0.191	0.123	0.110	0.103	0.139	0.156	0.139	0.131	0.097	0.108	0.122	0.147
M16	std	0.425	0.496	0.385	0.349	0.507	0.801	0.742	0.617	0.286	0.172	0.479	0.625
		N.Afr	Eur	Artic	Alask	W.Cal	Paci	Paci	S.Pac	Anta	Anta	S.Atl	S.Afr

Example of cloud mask mapping



Conclusion

VIIRS-CrIS mapping is implemented in AAPP

- Adjacency algorithm in F90
- Doxygen documented

Interface F90 is simple

Runs fast, 30 sec for 15mn of VIIRS M data

Available with next AAPP release

Need to improve the results for CrIS FORs 15-30

- Verify CrIS navigation simulations
- Check radiances conversion (wavelength to wavenumber)
- Test VIIRS shift
- Test new weights

Discussion with University Wisconsin people should help

Present quality seems to be enough for cloud mapping (clear/cloudy)

Thank you for listening

Questions?

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http://www.meteo-spatiale.fr

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