Update on Hierarchical Inter-Calibration Algorithms for GSICS

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Slide: 1 GSICS Research Working Group web meeting, 25 November 2008



- Drafted Hierarchical ATBD
 - for EUMETSAT's prototype SEVIRI-IASI inter-calibration (ICESI)
- As Word document

Contents

- Referring to IDL subroutines used in ICESI
- Started documentation of ICESI (as Annex)
- Developed Prototype of Hierarchical ATBD in Table Format
- As HTML webpage
 - Latter may be suitable for publication on GSICS Wiki
 - Negotiations with GDWG on Wiki technology
- Discussion points



Principles of Hierarchical ATBD (Reminder)





The Hierarchical Tree in Practice





	Inter-Cal	Instruments				
	Instrum ent Type	Inter-Calibration Type	Orbital Class	Band	Instrument pairs	
		Inter-satellite/	GEO- LEO		SEVIRI-IASI GOES-AIRS MVIRI-HIRS	
	Infrared Sensor	IIIIEI-SEIISOI	LEO- LEO	IR	AIRS-IASI	
		Intra-satellite/ Inter-sensor	LEO- LEO	IR	HIRS-IASI AVHRR-IASI AVHRR- HIRS	
		Inter-satellite/	GEO- GEO	IR	Met9-Met8 SEVIRI GOESE-W	
Slide: 5		Intra-sensor	LEO- LEO	IR	NOAA17- NOAA16 HIRS	

The World of GSICS

- Different Implementations
- Based on common principles
- Common documentation
- Ensures maximum consistency



ATBD for EUMETSAT's prototype SEVIRI-IASI inter-calibration

- Drafted Hierarchical ATBD
 - for EUMETSAT's prototype
 SEVIRI-IASI inter-calibration (ICESI)
- As Word document
 - Referring to IDL subroutines used
 - Started documentation of ICESI (as Annex to ATBD)
- Allows full details to be described
 - Including figures, equations, etc.
- But:
 - Duplication for different ATBDs
 - Difficult to compare directly
 - May be hard to maintain

SEVIRI-IAS	SI ATBD v0.3.doc - Microsoft Word	
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	3.1. Find Collocations	
	The first step is to obtain the data from both instruments, select the relevant	
	comparable portions and identify the conocated pixels.	
	3.1.a. Select Orbit	
	3.1.a.i. We first perform a rough cut to reduce the data volume and only include	
	3.1 a ii General Ontions	
	3.1.a.ii.v0.1. Data is selected on a per-orbit or per-image basis. To do this, we need	
	to know how often to do inter-calibration – which is based on the observed	
	rate of change and must be defined iteratively with the results of the inter-	
	calibration process.	
	3.1 a iii v0.1 We define the GEO Region of Inter-sententier (Rol) as within 60° (latitude or	
	longitude) of the GEO Sub-Satellite Point (SSP). The GEO and LEO data	
	is then subsetted to only include observations within this RoI within each	
	inter-calibration period.	
	3.1.a.iv. SEVIRI-IASI specific 2.1.a.iv.0.1 Era SEVIRI + CEO Bell is further and and a include only data	
	5.1.a.t.v.v.1. For SEVIAL, the GEO Koi is further reduced to include only data within ±30° latton of the SSP A single Maton organizes is selected with a	
	night-time equator crossing closest to the GEO SSP. The IASI data within	
	this overpass is then geographically subsetted to only include data within	
	this smaller GEO RoI by applying time filtering.	
	3.1.a.iv.v0.2. As v0.1, except that a fixed GEO time frame is taken every day at the	
	nominal LEO local equator crossing time (21:30) and the <u>KOI</u> is extended to $\pm 35\%$ in the North South direction. This is implemented as a standing	
	order from EUMESAT's Unified Meteopological Archive and Retrieval	
	Facility (U-MARF). The native format datasets are then converted to	
	NetCDF format, as described in Annex A.	
	2 1 h Collecte Birch	
	5.1.0. Collocate Pixels 3.1 h i This component of the first stan defines which nivels can be used in the divert	
	comparison. To do this, we need to define the Field of View (FoV) for all	
	pixels, and the environment around them. Then we need to identify those	
	pixels for both instruments within these areas that meet collocation criteria for	
	time, space and geometry.	
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Original Concept			otion	oles	ions	GEO-LEO			LEO- LEO by SNO		LEO- LEO Same Sat.		GEO- GEO	
Chiginian Concept	Step #	Process id	cess descrip	Basic Princip	General Opti	EO-LEO ecific	ES-AIRS ecific	VIRI-IASI ecific	-LEO SNO	RS-IASI	LEO Same	RS-IASI	EO-GEO	ES-SEVIRI
 Documentation linked to table Basically, a table of hyperlinks to 			2 2	i) E	ii) 0	iii) GF Sp	iv) GO sp	iv) SE\ spi	iii) Leo-	iv) All	III) LEO-I	iv) HI	III) GE	iv) GOE
the ATBD	1	1a 1b	Select Orbit Collocate Pixels											
Incorporates Version Control		2a 2b	Calculate Radiances Spectral Matching	v0.1	v0.1	v0.1	v0.1							
 Cells show version numbers of algorithms and hyperlink to their documentation. Colour coding indicates the status of 	2	2c 2d	Spatial Matching Temporal Matching	v0.1 v0.1										
 documentation review and approval Old versions of each algorithm to be maintained 	3	3a 3b 3c	Uniformity Test Outlier Rejection Auxiliary	v0 1										
 Must be obvious from the version number and colour coding that they are not the current version. 		4a 4b	Datasets Regression Define reference	v0.1 v0.1	v0.1 v0.1	v0.1 v0.1								
Tag GSICS datasets & products with	4	4c 4d	radiances Calculate biases Test non-	v0.1 v0.1	v0.1 v0.1	v0.1								
 indicating version number of all algorithms. Ensures reproducibility of the results. 		4e	Inearity Recalculate calibration coefficients	v0.1	v0.1									
	5	4t 5a	Report Results Operational Corrections	v0.1	v0.1									

Hierarchical Algorithm summarised in Table Form in Word

#	id	Process descriptio n	i) Basic Principles	ii) General Options	iii) Class Specific for IR Inter- Sensor Inter-satellite GEO- LEO	iv) Instrument Specific for SEVIRI-IASI
1 .	1 a	Select Orbit	A first rough-cut to: •Reduce data volume •Include only relevant portions (channels, area, time, viewing geometry)	V0.1: •Select data on per-orbit or per-image basis •Need to know how often to do inter-calibration – based on observed rate of change Defined iteratively with 2c & 2d	V0.1: •Define GEO Region of Interest: within 60° of GEO SSP •Subset GEO data to Rol •Select LEO data within GEO Rol for each inter-cal period •Subset LEO data to GEO Rol	V0.1: •GEO Rol = $\pm 30^{\circ}$ lat/lon of SSP •Take 1 Metop overpass with night-time equator crossing closest to GEO SSP •Subset IASI data to GEO Rol •Select SEVIRI image closest in time to LEO Equator crossing V0.2, as v0.1, except: •Select fixed GEO frame at nominal LEO local equator crossing time (21:30) •Extend Rol to $\pm 35^{\circ}$
	1 b	Collocate Pixels	Defining which pixels to compare: •Define FoV for all pixels •and environment around pixels •Identify pixels for both instruments within these areas meeting collocation criteria for time, space and geometry	v0.1: •Search for all pixels within FoV and environment v0.3: •Grid observations using 2D- histogram in lat/lon space	V0.1: •Geometric alignment: Select GEO/LEO pixels where secant of zenith angle is within 0.01 •Temporal alignment: Select GEO/LEO pixels with time differences <300s	v0.1 •IASI FoV=12km at nadir •SEVIRI FoV=3km at SSP •Time difference <900s •Select 5x5 SEVIRI pixels closest to centre of IASI FoV v0.3, as v0.1, except: •Select SEVIRI and IASI pixels in same bin of 2D histrogram with 0.125° lat/lon grid
Slide	1 c : 10	Pre- select Channels	•Select only broadly comparable channels from both instruments (to reduce data volume)	V0.1: •Selection based on pre- determined criteria for each instrument pair	V0.1: •Select IR channels (3-15µm)	V0.1: •Select IR channels of SEVIRI •Select a clannels fr ASA

Hierarchical Algorithm in Table Form in HTML

GSICS ATBD Table - Mozilla Firefox File Edit View History Bookmarks GMarks Tools Help G • Google C http://tim.hewison.org/gsics/ £7 • ABP R Home EUMETSAT - Access to Data - GSICS M... 🖂 GSICS ATBD Table x **Documentation Index for Hierarchical GSICS Algorithms** Step Proc Process Description a) Specific Class: iv) Specific Instruments: i) Basic Principles ii) General Options SEVIRI-IASI IR Inter-Satellite/Inter-Sensor GEO-LEO 🔽 l1a Select Orbit A first rough-cut to: E :01 $\Box v01$ $\equiv v0.1$ Define GEO Region of Interest: GEO RoI = ±30° lat/lon of SSP Select data on per-orbit or Reduce data volume. per-image basis within 60° of GEO SSP Take 1 Metop overpass with Include only relevant Need to know how often to do Subset GEO data to RoI night-time equator crossing closest portions (channels, area, inter-calibration – based on Select LEO data within GEO RoI to GEO SSP time, viewing geometry) observed rate of change Subset IASI data to GEO RoI for each inter-cal period Subset LEO data to GEO RoI. Select SEVIRI image closest in (Defined iteratively with 2c & 2d.) time to LEO Equator crossing $\pm v0.2$ Collocate Pixels 1b Define which pixels to compare: $\pm v0.1$ \square v0.1 $\pm v0.1$ · Geometric alignment: Select \square v0.3 v0.3 - IR1b4eeGLSIv0.3 Define FoV of all pixels GEO/LEO pixels where secant of Grid observations using as v0.1, except: and environment around zenith angle is within 0.01 2D-histogram in lat/lon space Select SEVIRI and IASI pixels in pixels Temporal alignment: Select Identify pixels for both same bin of 2D histrogram with GEO/LEO pixels with time 0.125° lat/lon grid instruments within these differences <300s areas meeting collocation criteria for time, space and

Discussion Points

- Are the classes above defined in the right order?
 - e.g. Would the instrument type be better 'below' orbital class?
- Do we need Spectral Band independent of Instrument Type?
- Should ATBD include details of, or references to, particular implementations?
- How applicable is it to other instrument types are under consideration?
- Do the basic principles (i) and general implementation options (ii) apply in general?
- Do the class-specific details (iii) apply for other instrument pairs in the same class?
- Are Word documents, or HTML tables preferable? (Or combination?)



Hierarchical Approach for Generic ATBD

Hierarchy of GSICS inter-calibration algorithm: from basic theoretical principles to specific recommendations for each instrument pair.

At each step in the data flow:

- Identify each process in this step For each process:
 - i. Describe the basic principles of each process in this generic data flow.
 - ii. Provide different options for how these may be implemented in general.
 - iii. Identify specific recommended procedures for GEO-LEO inter-calibrations.
 - iv. Provide specific details for each instrument pair (e.g. GOES-AIRS).
- Details such as threshold values are defined in part iii).
- May be further refined by the GSICS partners investigating specific instrument pairs in part iv).
- Version numbers issued for each process



The Hierarchical Levels of each Process

- Steps and Processes within each step defined in general terms
 - to ensure a generic approach.
- Details such as threshold values are defined in part iii) of each process.
 - May be further refined by GSICS partners for specific instrument pairs in part iv)
 - Give each process a version number,
 - and version-control documentation accordingly
- Hierarchical approach ensures maximum consistency between the intercalibration of different satellites
 - by first defining the basic principles for each process,
 - whilst allowing details to vary for specific instrument pairs where necessary.



Key Features of Hierarchical ATBD

- Hierarchical
 - Can build all inter-calibration on common principles
 - And minimise differences between instrument pairs
 - For maximum consistency
- Modular
 - Different GSICS partners can work on different instrument pairs
- Provides traceability
 - Include version number for each process, option, dataset
 - Integration with review cycle
- Simplifies documentation
 - Based on common principle,
 - with specific details for each instrument pair





Questions and Answers