Feasibility of Hierarchical Inter-Calibration Algorithms for GSICS

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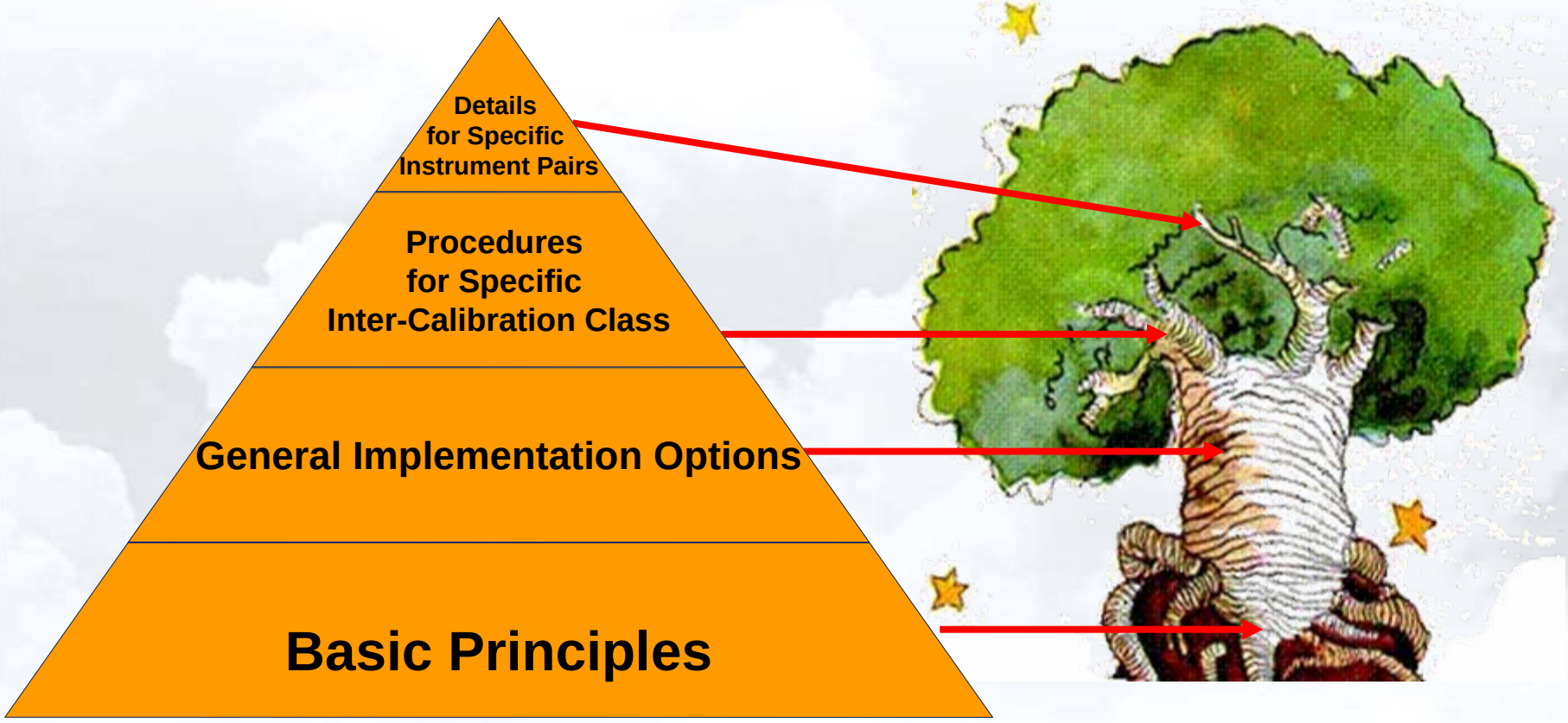
Contents

- Review of Hierarchical ATBD
- Hierarchy of inter-calibration classes
- Example: EUMETSAT's prototype SEVIRI-IASI inter-calibration
- Discussion points
- Your experience

Principles of Hierarchical ATBD (Reminder)



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Hierarchical Approach for Generic ATBD

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

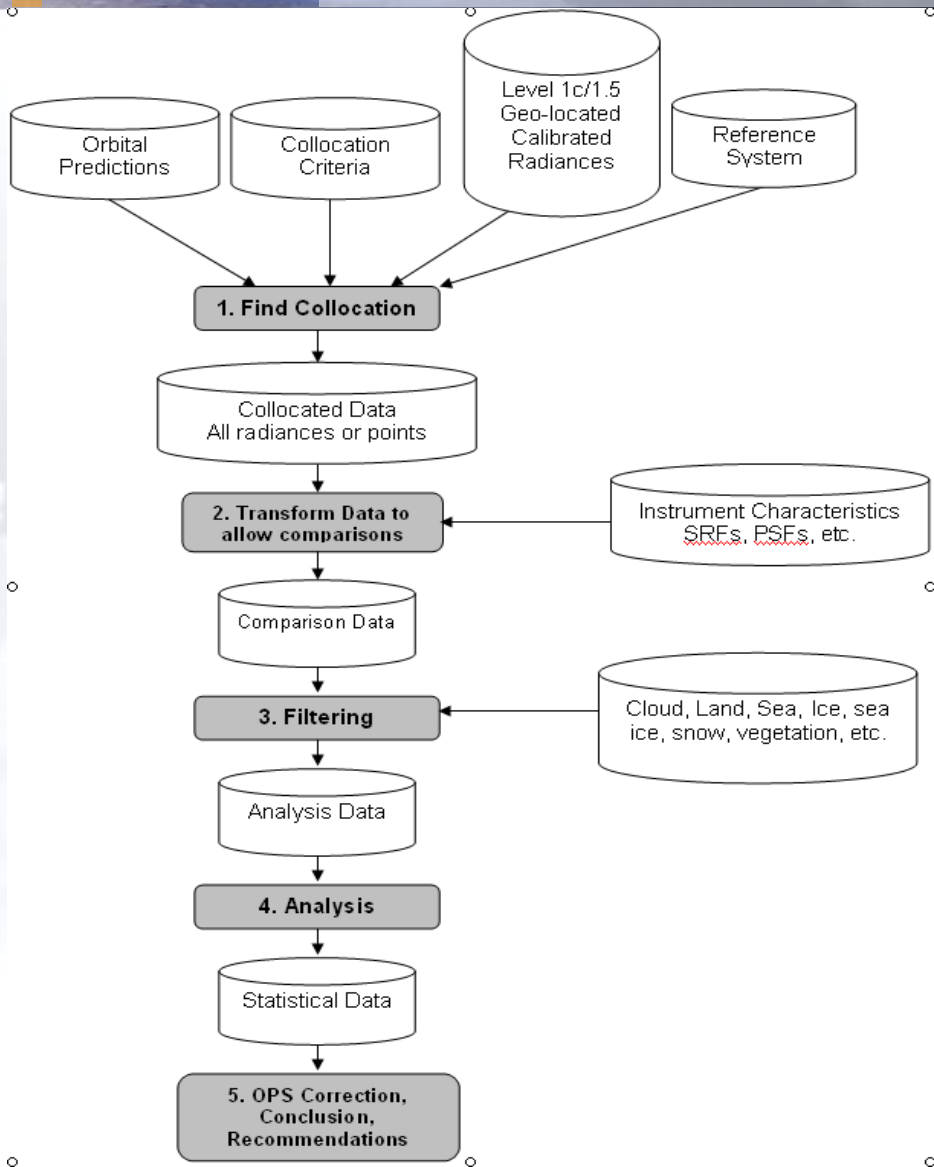
At each step in the data flow:

- 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).

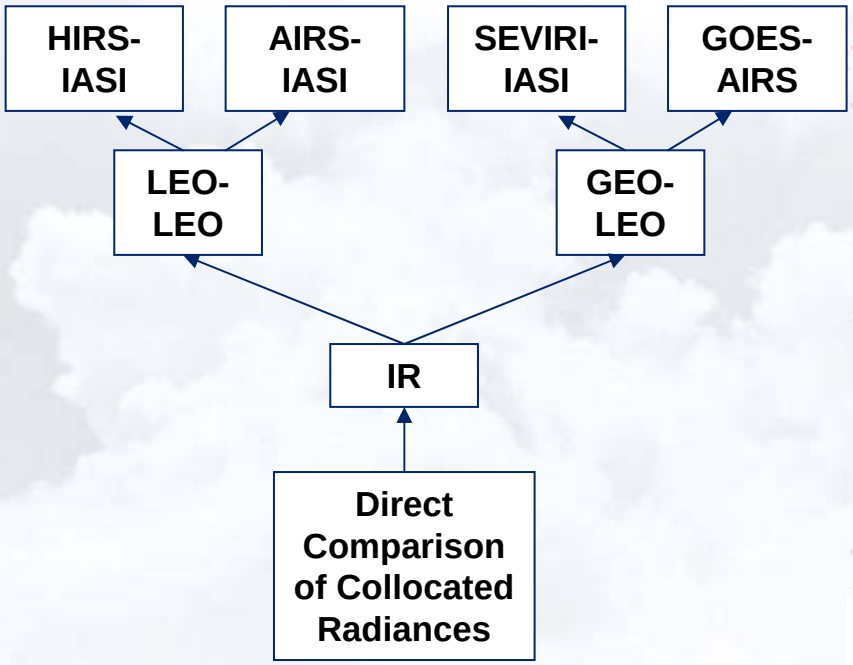
Version numbers issued for each process



Key Features of Hierarchical ATBD (review)

- 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

The Hierarchical Tree in Practice



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Class System

- Defines the hierarchy
- Subject to revision
- Does this work?

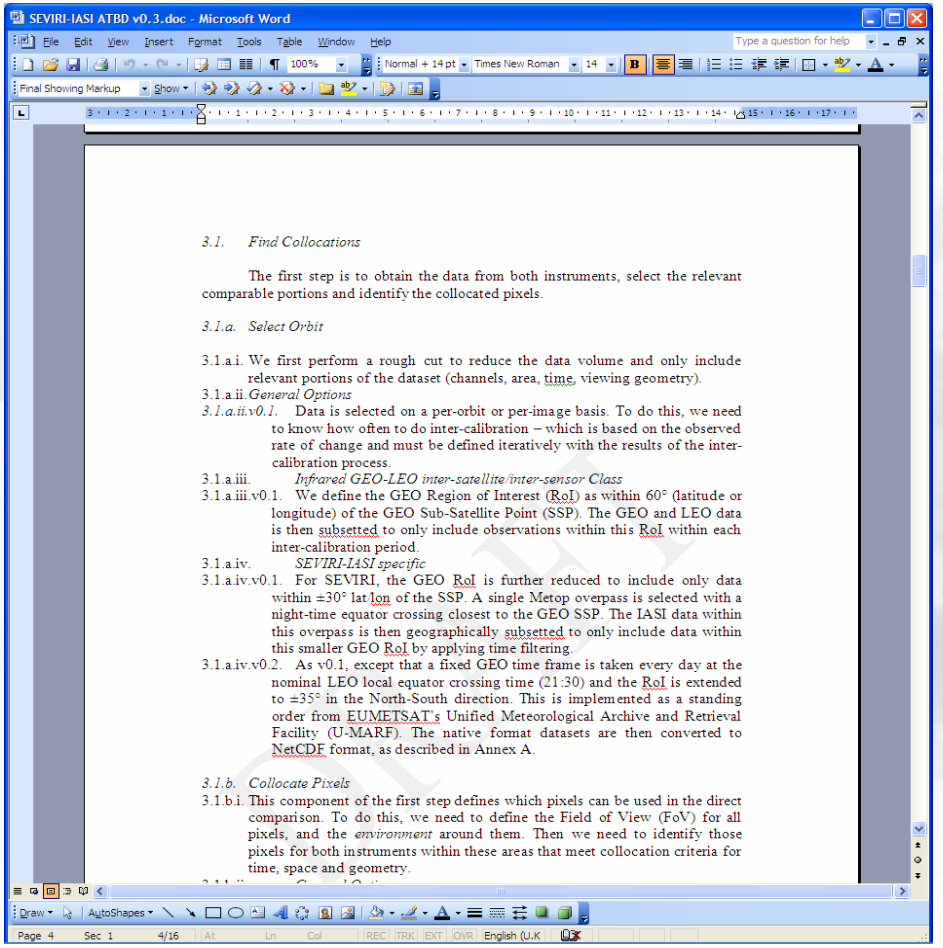
Inter-Calibration Class				Instruments
Instrument Type	Inter-Calibration Type	Orbital Class	Band	Instrument pairs
Infrared Sensor	Inter-satellite/ Inter-sensor	GEO-LEO	IR	SEVIRI-IASI GOES-AIRS MVIRI-HIRS
		LEO-LEO	IR	AIRS-IASI
	Intra-satellite/ Inter-sensor	LEO-LEO	IR	HIRS-IASI AVHRR-IASI AVHRR-HIRS
	Inter-satellite/ Intra-sensor	GEO-GEO	IR	Met9-Met8 SEVIRI GOESE-W
		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.
- Could be implemented on Twiki
- But:
  - Duplication for different ATBDs
  - Difficult to compare directly
  - May be hard to maintain



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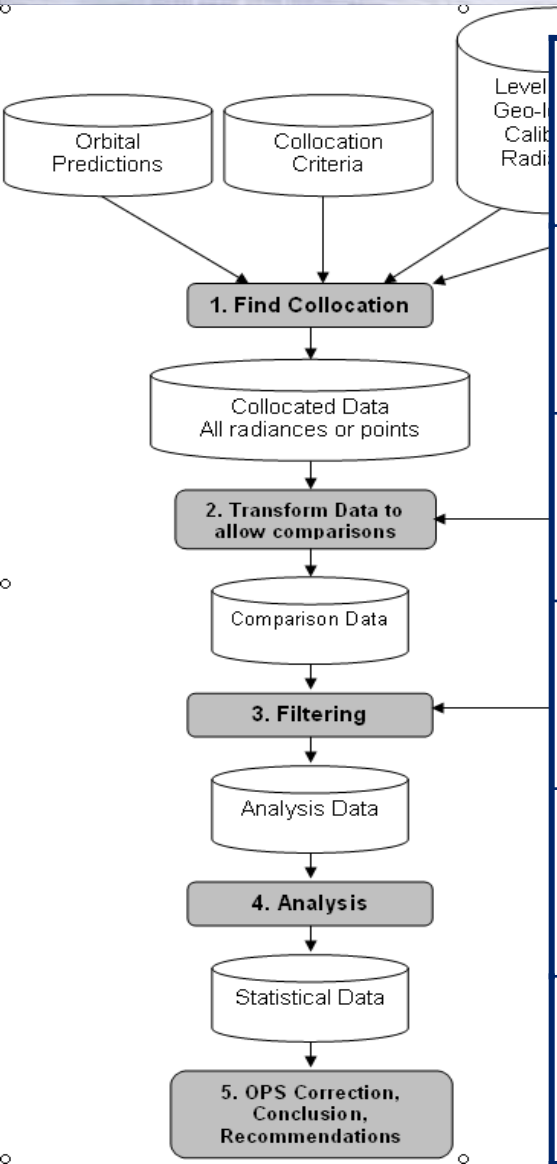
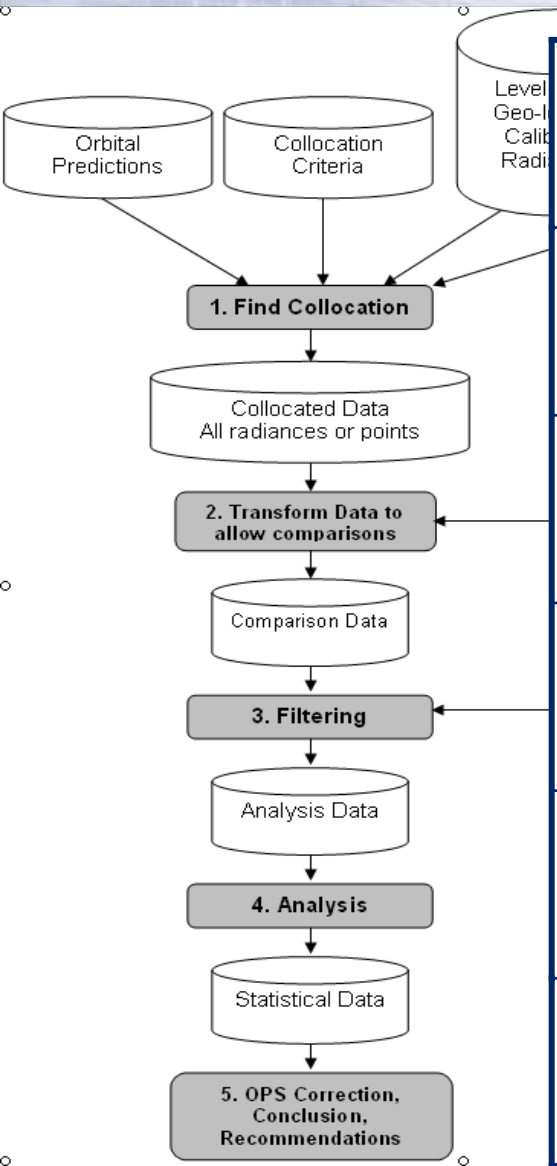
Hierarchical Algorithm in Table Form



	Basic Principles	General Options	Class Specific	Instrument Specific
Step 1		v1.0	v1.0	v1.0 V1.1
Step 2		v1.0	v1.0	v1.0
Step 3		v1.0	v1.0	v1.0
Step 4		v1.0	v1.0	v1.0 V1.1
Step 5		v1.0	v1.0	v1.0 V1.1

Hierarchical Algorithm Summary in Table Form



	Basic Principles	General Options	Class Specific	Instrument Specific
Step 1		v1.0	v1.0	v1.0 V1.1
Step 2		v1.0	v1.0	v1.0
Step 3		v1.0	v1.0	v1.0
Step 4		v1.0	v1.0	v1.0 V1.1
Step 5		v1.0	v1.0	v1.0 V1.1

Original Concept

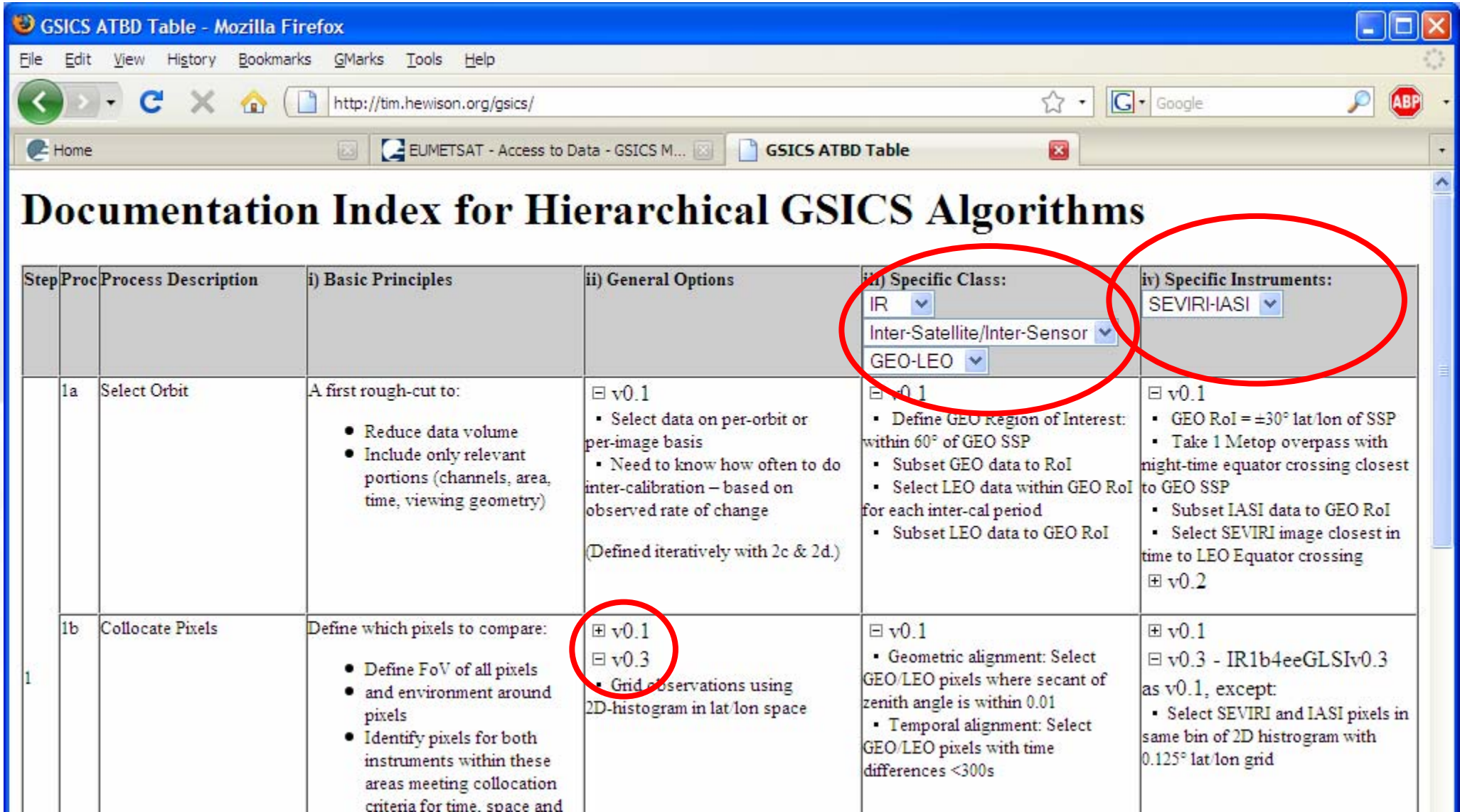
- Documentation linked to table
  - Basically, a table of hyperlinks to paragraphs describing each component of the ATBD
- Incorporates Version Control
  - Cells show version numbers of algorithms
  - and hyperlink to their documentation.
  - Colour coding indicates the status of documentation review and approval
  - Old versions of each algorithm to be maintained
  - Must be obvious from the version number and colour coding that they are not the current version.
- Tag GSICS datasets & products with pedigree
  - indicating version number of all algorithms.
  - Ensures reproducibility of the results.

Step #	Process id	Process description	i) Basic Principles	ii) General Options	GEO-LEO iii) GEO-LEO Specific	GEO-LEO iv) GOES-AIRS specific	GEO-LEO iv) SEVIRI-IASI specific	LEO-LEO by SNO iii) LEO-LEO SNO	LEO-LEO by SNO iv) AIRS-IASI	LEO-LEO Same Sat. iii) LEO-LEO Same	LEO-LEO Same Sat. iv) HIRS-IASI	GEO-GEO iii) GEO-GEO	GEO-GEO iv) GOES-SEVIRI
1	1a 1b	Select Orbit Collocate Pixels											
2	2a	Calculate Radiances											
	2b	Spectral Matching	v0.1	v0.1	v0.1	v0.1							
	2c	Spatial Matching	v0.1										
	2d	Temporal Matching	v0.1										
3	3a	Uniformity Test											
	3b	Outlier Rejection											
	3c	Auxiliary Datasets	v0.1										
4	4a	Regression	v0.1	v0.1	v0.1								
	4b	Define reference radiances	v0.1	v0.1	v0.1								
	4c	Calculate biases	v0.1	v0.1	v0.1								
	4d	Test non-linearity	v0.1	v0.1									
	4e	Recalculate calibration coefficients	v0.1	v0.1									
	4f	Report Results	v0.1	v0.1									
5	5a	Operational Corrections											

Hierarchical Algorithm Summarised in Table Form in Word

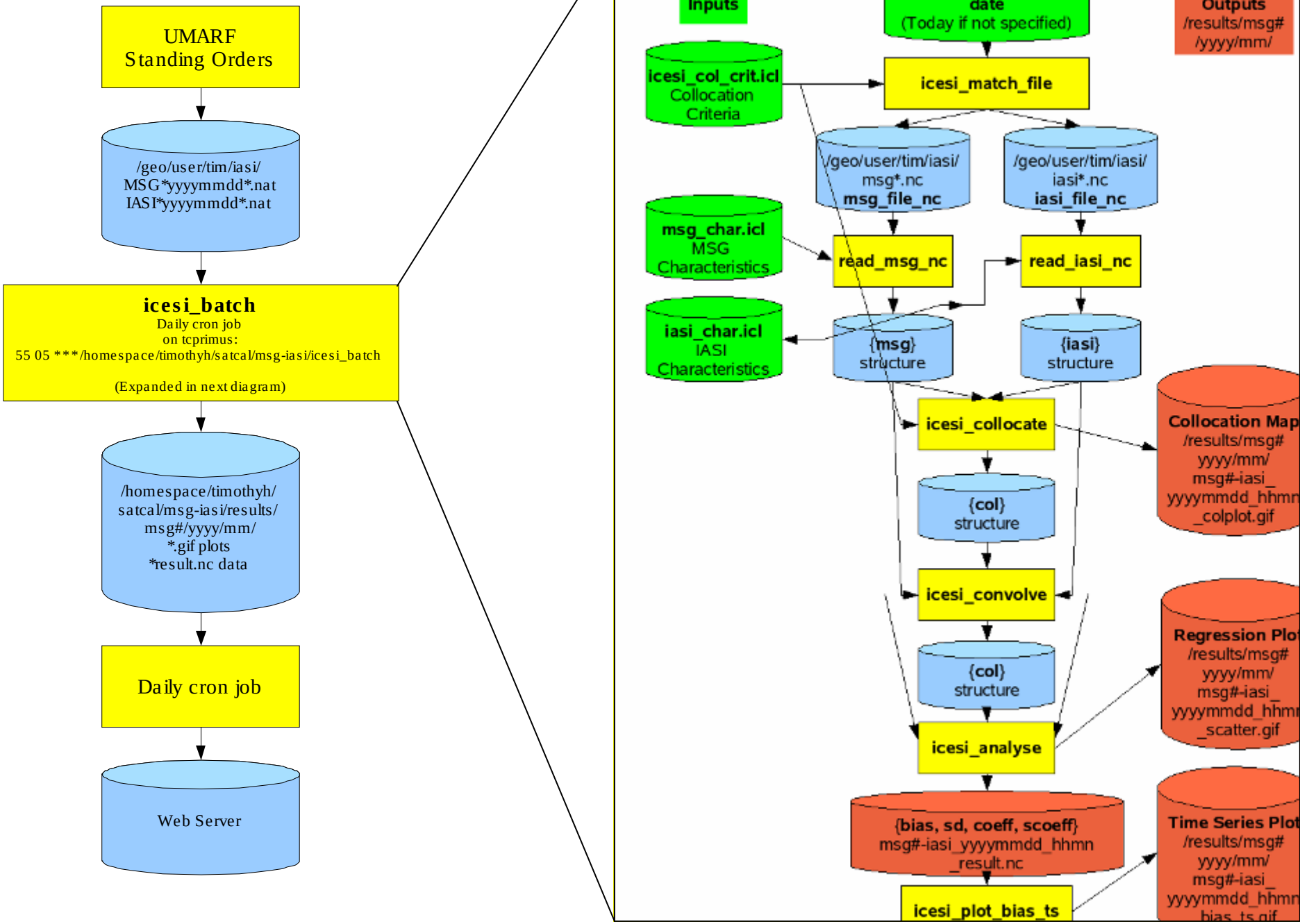
#	id	Process description	i) Basic Principles	ii) General Options	iii) Class Specific for IR Inter-Sensor Inter-satellite GEO-LEO	iv) Instrument Specific for SEVIRI-IASI
1	1 a	Select Orbit	A first rough-cut to: •Reduce data volume •Include only relevant portions (channels, area, time, viewing geometry)	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 RoI •Select LEO data within GEO RoI for each inter-cal period •Subset LEO data to GEO RoI	V0.1: •GEO RoI = ±30° lat/lon of SSP •Take 1 Metop overpass with night-time equator crossing closest to GEO SSP •Subset IASI data to GEO RoI •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 RoI to ±35°
	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
	1 c	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 all channels for IASI

Hierarchical Algorithm Summarised in Table Form in HTML



Documentation Index for Hierarchical GSICS Algorithms

Step	Proc	Process Description	i) Basic Principles	ii) General Options	iii) Specific Class: IR / Inter-Satellite/Inter-Sensor / GEO-LEO	iv) Specific Instruments: SEVIRI-IASI
1	1a	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 RoI ▪ Select LEO data within GEO RoI for each inter-cal period ▪ Subset LEO data to GEO RoI	⊟ v0.1 ▪ GEO RoI = ±30° lat/lon of SSP ▪ Take 1 Metop overpass with night-time equator crossing closest to GEO SSP ▪ Subset IASI data to GEO RoI ▪ Select SEVIRI image closest in time to LEO Equator crossing ⊞ v0.2
	1b	Collocate Pixels	Define which pixels to compare: • Define FoV of all pixels • and environment around pixels • Identify pixels for both instruments within these areas meeting collocation criteria for time, space and	⊞ v0.1 ⊟ 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 ⊟ v0.3 - IR1b4eeGLSIv0.3 as v0.1, except: ▪ Select SEVIRI and IASI pixels in same bin of 2D histrogram with 0.125° lat/lon grid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Standing Orders
/geo/user/tim/iasi/
MSG*yyyymmdd*.nat
IASI*yyyymmdd*.nat
icesi_batch
Daily cron job
on tcprimus:
55 05 ***/homespace/timothyh/satcal/msg-iasi/icesi_batch
(Expanded in next diagram)
/homespace/timothyh/
satcal/msg-iasi/results/
msg#/yyyy/mm/
*.gif plots
*result.nc data
Daily cron job
Web Server
Inputs
date
(Today if not specified)
Outputs
/results/msg#
/yyyy/mm/
icesi_col_crit.icl
Collocation
Criteria
icesi_match_file
/geo/user/tim/iasi/
msg*.nc
msg_file_nc
/geo/user/tim/iasi/
iasi*.nc
iasi_file_nc
msg_char.icl
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structure
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Collocation Map
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structure
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structure
Regression Plot
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{bias, sd, coeff, scoeff}
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_result.nc
Time Series Plot
/results/msg#
yyyy/mm/
msg#-iasi_
yyyymmdd_hhmn
icesi_plot_bias_ts

Discussion Points – Your Experience/Opinion

- GRWG:
  - Can the Hierarchical ATBD be applied to *your* inter-calibrations?
    - **Do we need to add extra processes or revise any?**
  - 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?**
  - How applicable is it to other instrument types are under consideration?
    - **Do (i) basic principles, (ii) general implementation options apply in general?**
    - **Do (iii) class-specific details apply for other instrument pairs in class?**
  - Are Word documents, or HTML tables preferable? (Or combination?)

- GDWG:
  - Should ATBD include details of, or references to, particular implementations (code)?
  - How can the chosen ATBD documentation be implemented on web?

Thank you

Questions and Answers