"1st International Satellite Snow Product Intercomparison Workshop ISSPI-1"
NOAA Center for Weather & Climate Prediction (NCWCP) - Conference Center, 21-23 July 2014

Prototyping of hemispherical snow cover extent products toward the Japanese global change observation mission GCOM-C

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JASMES
JAXA Satellite Monitoring for Environmental Study

GCOM
GLOBAL CHANGE OBSERVATION MISSION
JAXA

GRENE-Arctic

JAXA
宇宙航空研究開発機構
Japan Aerospace Exploration Agency

Outline

- Snow cover extent products in JAXA
- Technical specification of snow products
- Input satellite data and auxiliary data
- Description of retrieval algorithm
- Aggregation procedure in case of multiday product
- Examples of SCE analysis results
- Method for deriving product quality (validation)
- Specification of reference data for validation
- Validation results
- Strengths and weaknesses of product
- Summary

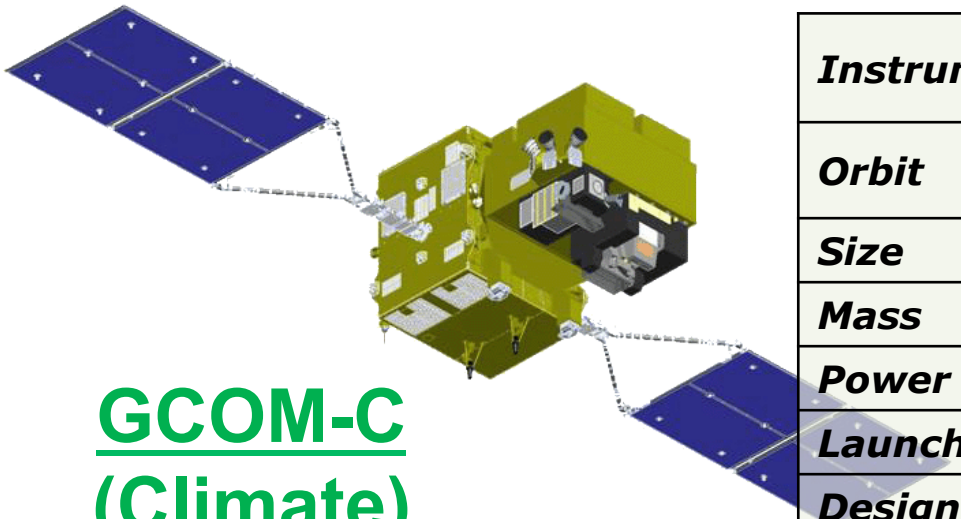
Snow Cover Extent Products in JAXA

- Snow products (incl. snow physical params.) derived from ADEOS-II/GLI were released in 2003.
- JAXA has released satellite products of geophysical variables (incl. SCE) derived from MODIS radiances since 2008. These products have been available at the web site “JAXA Satellite Monitoring for Environmental Studies (JASMES)”.
- Currently a new long-term SCE product is under preparation using AVHRR and MODIS data spanning from 1980’s to 2013 as a climatological baseline for the coming GCOM-C mission.

GCOM Mission: GCOM-W(ater) & GCOM-C(limate)

Instrument	Advanced Microwave Scanning Radiometer-2 (AMSR2)
Orbit	Sun Synchronous orbit Altitude : 699.6km (over the equator)
Size	5.1m (X) * 17.5m (Y) * 3.4m (Z)
Mass	1880kg
Power	Over 4050W
Launch	May 18 2012 (JFY2012)
Design Life	5-years
Status	Uner operation

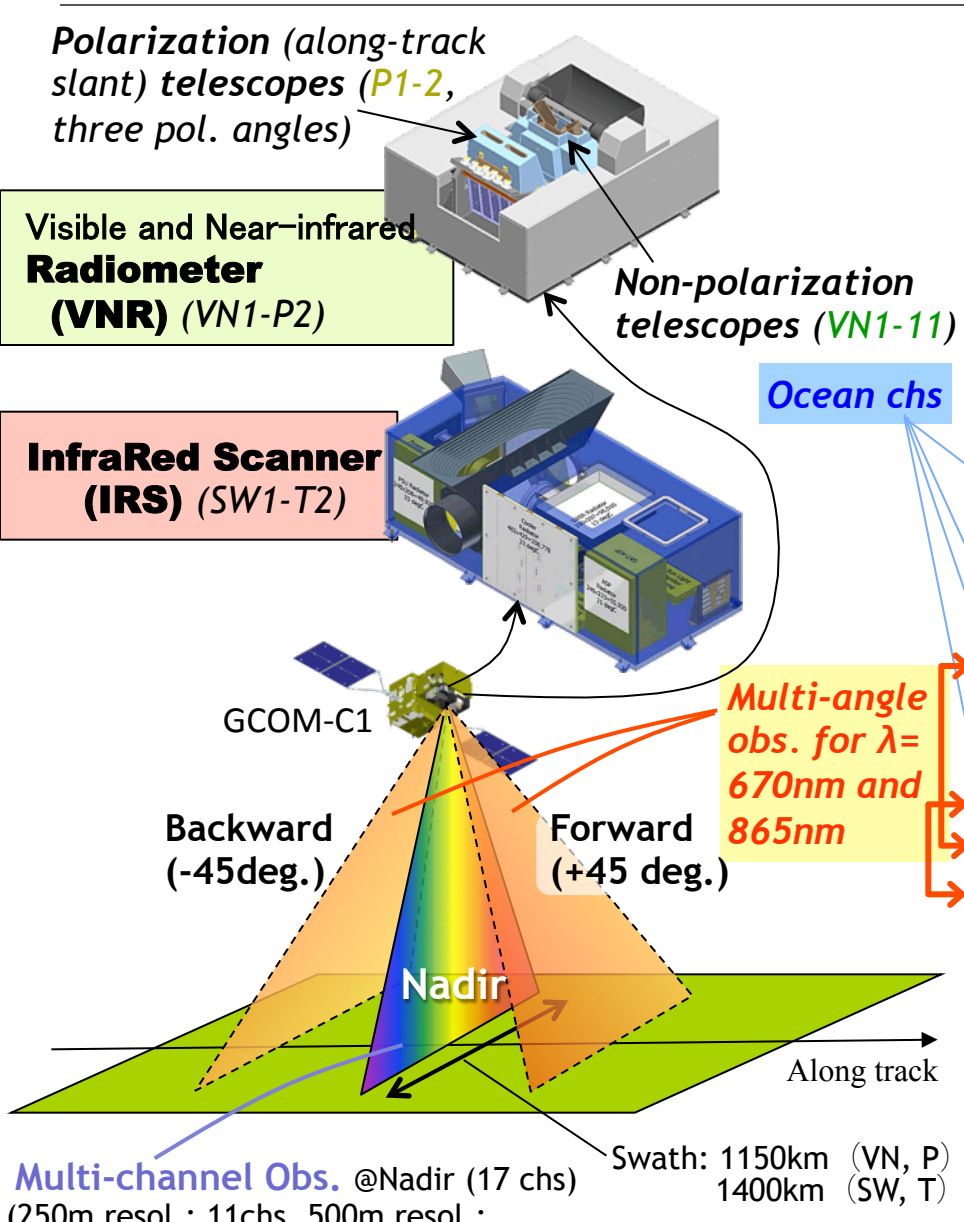
GCOM-W (Water)



GCOM-C (Climate)

Instrument	Second-generation Global Imager (SGLI)
Orbit	Sun Synchronous orbit Altitude : approx. 800km (over the equator)
Size	4.6m (X) * 16.3m (Y) * 2.8m (Z)
Mass	1950kg
Power	Over 4250W
Launch	JFY2016 (planned)
Design Life	5-years
Status	Under the development of PFM

SGLI instrument onboard GCOM-C



SGLI channels						
CH	λ	Δλ	L_{std}	L_{max}	SNR at Lstd	IFOV
	VN, P, SW: nm T: μm		VN, P: W/m²/sr/μm T: Kelvin		VN, P, SW: - T: NEΔT	m
VN1	380	10	60	210	250	250
VN2	412	10	75	250	400	250
VN3	443	10	64	400	300	250
VN4	490	10	53	120	400	250
VN5	530	20	41	350	250	250
VN6	565	20	33	90	400	250
VN7	673.5	10	23	62	400	250
VN8	673.5	20	25	210	250	250
VN9	763	12	40	350	400	250/1000
VN10	868.5	20	8	30	400	250
VN11	868.5	20	30	300	200	250
P1	673.5	20	25	250	250	1000
P2	868.5	20	30	300	250	1000
SW1	1050	20	57	248	500	1000
SW2	1380	20	8	103	150	1000
SW3	1630	200	3	50	57	250
SW4	2210	50	1.9	20	211	1000
T1	10.8	0.74	300	340	0.2	250/500
T2	12.0	0.74	300	340	0.2	250/500

SGLI can cover the globe every 2days

(option) 250m resol.

SGLI Cryosphere Products

Type	Product name	Product ID	Category	Target accuracy *1		
				Release	Standard	Goal
Extent	Snow and Ice Cover Extent	SICE	Standard	10%	7%	5%
	Okhotsk sea-ice distribution	OKID	Standard	10%	5%	3%
	Snow and ice classification	SIC	Research	-	-	10%
	Snow covered area in forest and mountain	SCAFM	Research	-	-	30%
Physical Parameters	Snow and ice surface temperature	SIST	Standard	5K	2K	1K
	Snow grain size of shallow layer	SNGSL	Standard	100%	50%	30%
	Snow grain size of subsurface layer	SNGSS	Research	-	-	50%
	Snow grain size of top layer	SNGST	Research	-	-	50%
	Snow and ice albedo	SIALB	Research	-	-	7%
	Snow impurity	SNIP	Research	-	-	50%
	Ice sheet surface roughness	ISRGH	Research	-	-	0.05
Bound-ary	Ice sheet boundary monitoring	ISBM	Research	-	-	less than 500m

*1. Target accuracy of SGLI products are defined for several mission phases. *Release accuracy* is a data release threshold after 1 year from the satellite launch whereas *standard* and *goal accuracies* are target accuracies for judging standard (ful) success and extra success, respectively after 5 years from the launch.

Snow Cover Extent Products in JAXA

- There are currently three SCE products.
  - Global SCE derived from MODIS spanning from 2000 to 2014 [5km, daily, half-month, monthly] [Algorithm: **MDS10C** , use 10 channels of MODIS]
  - Local (around Japan) SCE derived from MODIS spanning from 2003 to 2014 [500m, daily, weekly, half-month, monthly] [Algorithm: **MDS10C**]
  - Global (currently excl. the Antarctica) SCE derived from AVHRR and MODIS spanning from 1979 to 2013 [5km, daily, weekly, half-month, monthly] [Algorithm: **GHRM5C**, use only 5 CHs of AVHRR]

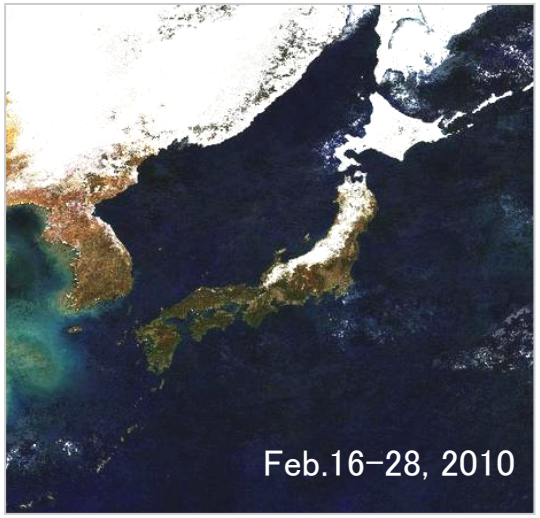
Technical Specification of Snow Product [GHRM5C]

- **Product Name** : Snow Cover Extent for climate (TBD)
- **Sensor and applied spectral channels** : **AVHRR + MODIS (5CHs same as AVHRR)**
- **Temporal Characteristics** :
  - Period (Start – End) : **1979-2013 (-2000:AVHRR, 2000-:MODIS)**
  - Temporal resolution (1 day, 1 week, ..) : **1 day, 1 week, half month…**
- **Spatial Characteristics**
  - Spatial resolution / Pixel size : **0.05°(approx. 5km) 7200x3601 pix**
  - Spatial Coverage : **global (but Antarctic SCE is not good)**
  - Map Projection / Datum : **Equirectangular (lat/lon) projection**
- ***If applicable: Cloud screening***
  - Algorithm : **Threshold tests & Temporal filtering**
- ***If applicable: Valid / non-valid areas***
  - Invalid/masked areas : Ocean and Antarctic areas are not valid
- **Product Format :** HDF4 and binary + ascii (for snow area)
- **Products accessible at** **Under preparation …**
- **Contact Person**
  - Name : Masahiro Hori (EORC/JAXA)
  - email : hori.masahiro@jaxa.jp

Technical specification of snow product [MDS10C]

- **Product Name** : Snow Cover Extent for MODIS (snwcfr)
- **Sensor and applied spectral channels** : **MODIS (10 channels)**
- **Temporal Characteristics** :
  - Period (Start – End) : **2000-2013**
  - Temporal resolution (1 day, 1 week, ..) : **1 day, 1 week, half month, monthly**
- **Spatial Characteristics**
  - Spatial resolution / Pixel size : **0.05°(approx. 5km) 7200x3601 pix**
  - Spatial Coverage : **global and local around Japan**
  - Map Projection / Datum : **Equirectangular (lat/lon) projection**
- ***If applicable: Cloud screening***
  - Algorithm : **Threshold tests & Temporal filtering**
- ***If applicable: Valid / non-valid areas***
  - Invalid/masked areas : Ocean not validated (should be masked)
- **Product Format :** HDF4 and binary + (for snow area)
- **Products accessible at** ***http://kuroshio.eorc.jaxa.jp/JASMES/index.html***
- **Contact Person**
  - Name : Masahiro Hori (EORC/JAXA)
  - email : hori.masahiro@jaxa.jp

Input Satellite Data (MODIS)



Analysis area of Japan data

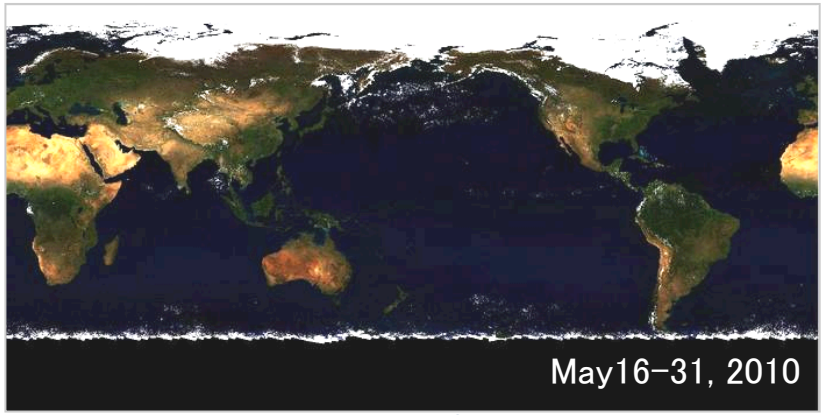
I. Local Data (Received at Japan)

Input

- Sat/Sens : TERRA/MODIS & AQUA/MODIS
- Receiving Sta. : Hatoyama (Japan)
- Resolution: 500m(VNIR-SWIR), 1km(TIR)
- Period : 2003 ～ the present

Output

- Grid resol. : 500m(snow), 1km(others)
- Interval: 1 day, 1 week, half-month, and monthly
- Products: Snow Cover Extent (incl. dry/wet snow classification)
- Format: HDF4 and/or binary + ascii (each prefecture's snow covered area)



Analysis area of global data

II. Global Data (ftp get from NASA/LAADS)

Input

- Sat/Sens: TERRA/MODIS & AQUA/MODIS
- Resolution: 5km (MOD02SSH, MYD02SSH)
- Period: 2000 ～ the present

Output

- Grid resol. : 0.05 deg. (about 5km)
- Interval: Daily, Half-month & monthly
- Products: Snow Cover Extent (incl. dry/wet snow classification)
- Format: HDF4 and/or binary + ascii (each country's snow covered area)

Input Satellite Data (AVHRR, Etc.)

III. Global Data (obtained from NOAA National Climatic Data Center)

Input

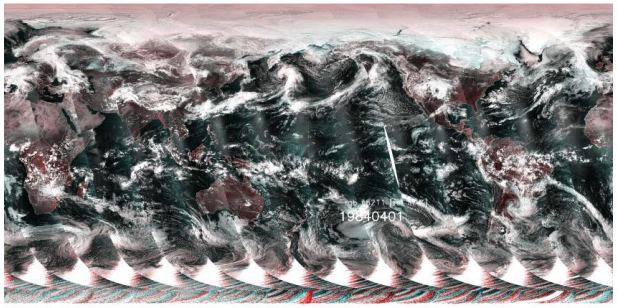
- **Sat/Sens:** Tiros-N and NOAA series (7, 9, 11, 14, 14, 16, 18) / AVHRR
- **Resolution:** approx. 4km (GAC data)
- **Period:** 1978 ～ 2008

Output of preprocessing

- **Grid resol. :** 0.05 deg. (about 5km i.e., JASMES 0.05 deg. grid)
- **Interval:** 1day
- **Products:** Radiance corrected for gain degradation after the launch to compensate calibration biases among different NOAA satellites

Output

- **Grid resol. :** 0.05 deg. (about 5km)
- **Interval:** 1day, 1week, Half-month (& Monthly)
- **Products:** Snow Cover Extent (incl. dry/wet snow classification)
- **Format:** HDF4 and/or binary + ascii (each country's snow covered area)



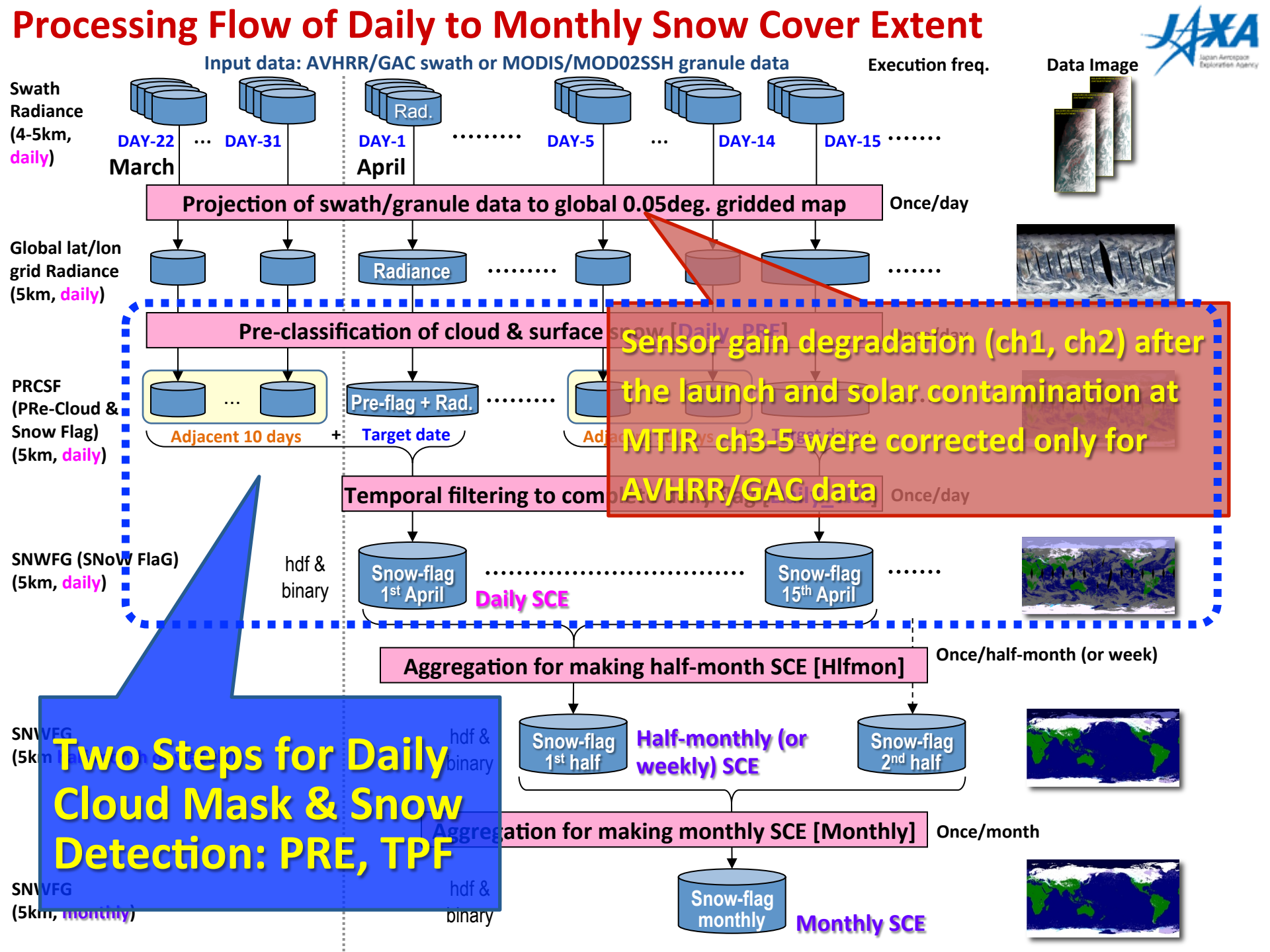
IV. Auxiliary Data

- **Elevetaion:** ETOPO02
- **Land/Water:** Land /Water flag generated with GMT

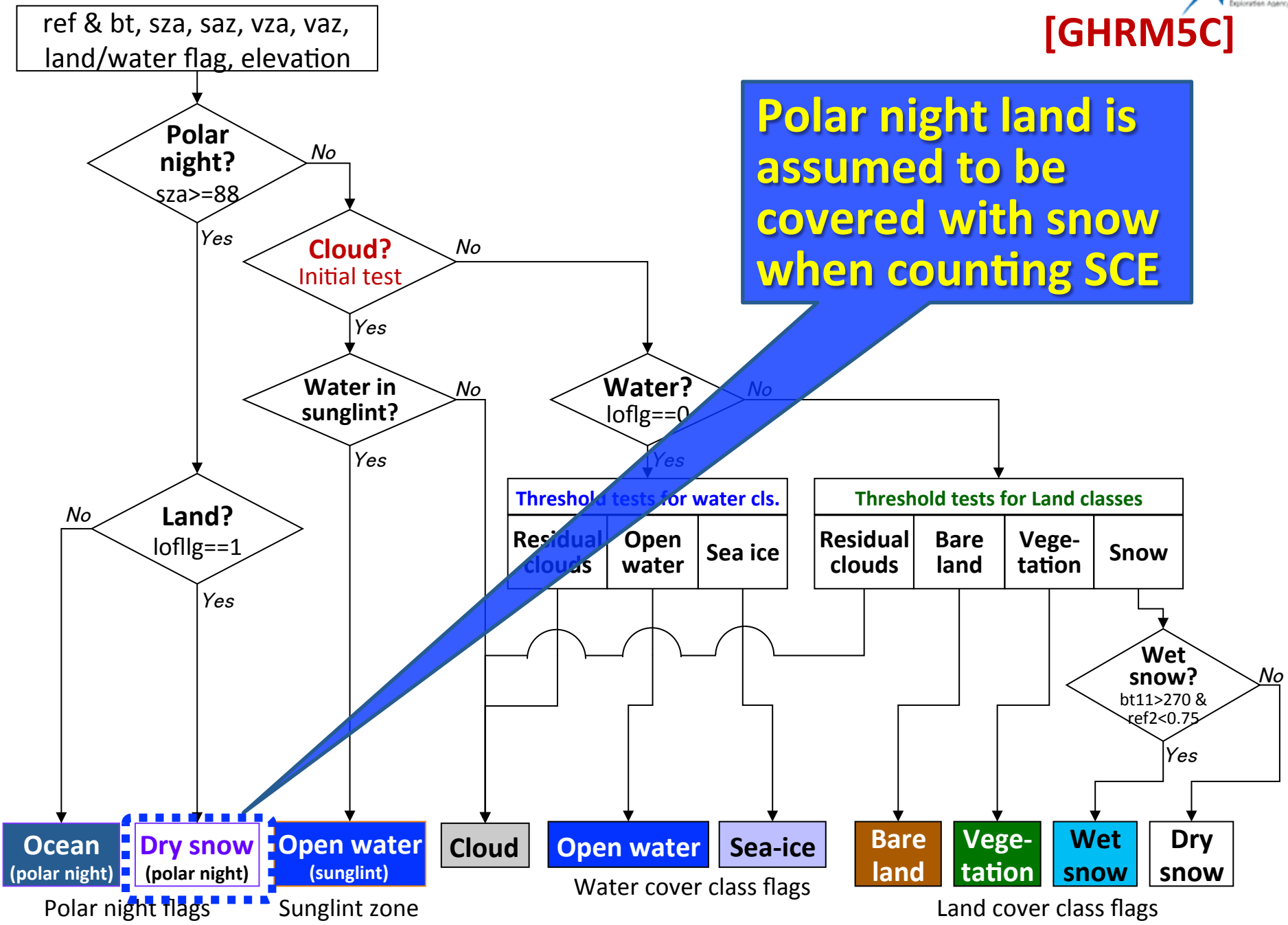
IV. Benchmark Data

Snow Cover Extent: NOAA/NCDC CDR weekly SCE chart (ver.4) obtained from NSIDC

Processing Flow of Daily to Monthly Snow Cover Extent



Flowchart for classifying daily land/ocean classes [Daily_PRE] [GHRM5C]



Threshold tests employed in the initial cloud detection [GHRM5C]

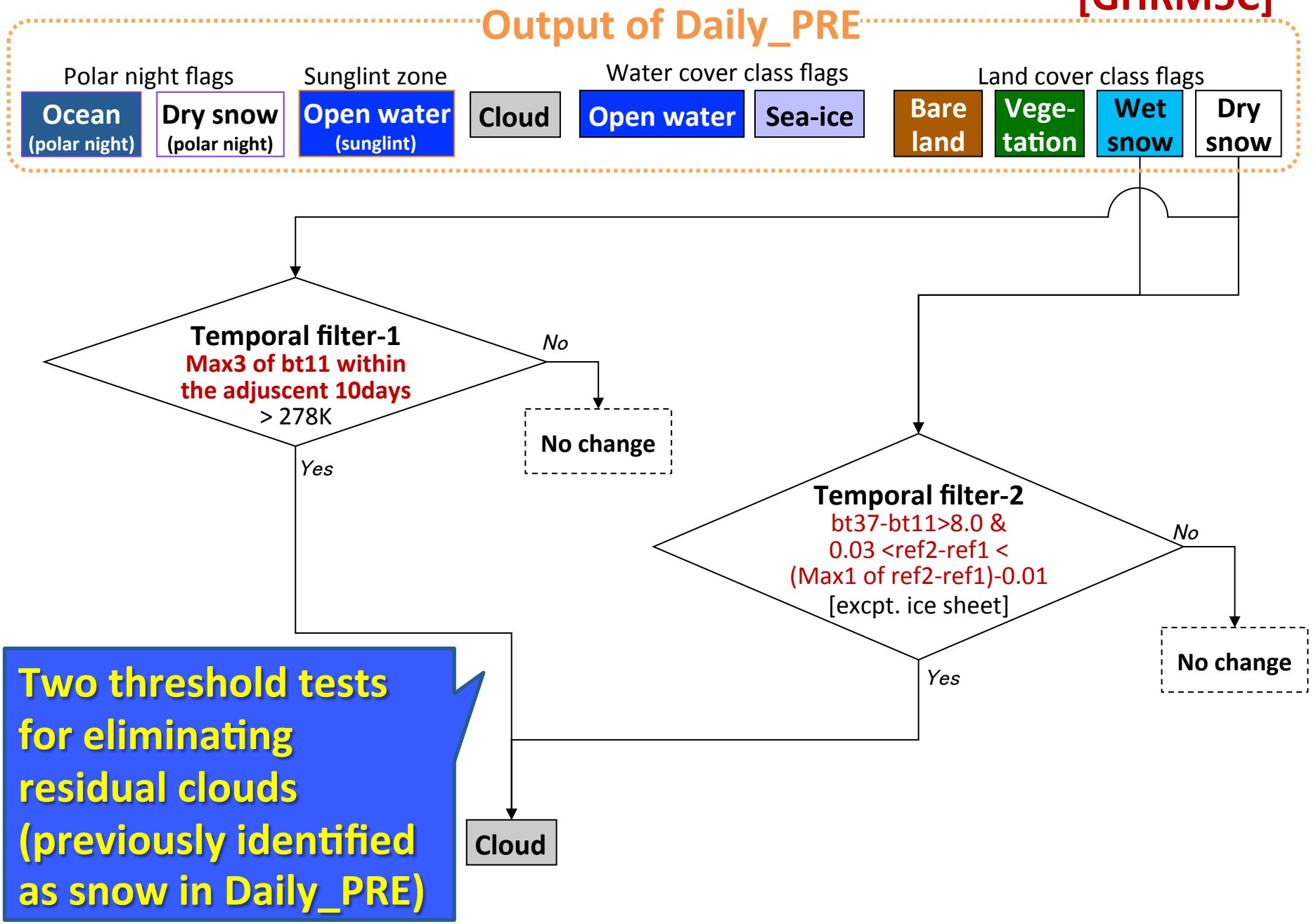
Tests / Targets	Ref01 (0.6um)	Ref02 (0.8um)	Ref03 (3.7um)	Ref01-Ref02	NDVI	NDSI	BT11	BT37-BT11	BT11-BT12
high & cold land							●	●	
(if hgt>300m & bt11<260K)			●	●		●			
low land							●	●	
				●			●	●	
	●			●			●	●	
(else)		●		●			●	●	●
		●					●	●	●
	●		●				●		
water							●	●	
					●		●		
		●					●		
								●	

Only 5 channels are used. Threshold values for individula tests are implemented by manual inspection of classification results.

Threshold tests employed in the land-class discrimination [GHRM5C]

Meaning of test or flag	Flag			SLZA	Ref01	Ref02	Ref03	Ref01-Ref02	Ref03 - Ref02	Ref03/Ref02	NDVI	NDSI	BT11	BT11-BT12
land -A *mode (low contribution tests)*	NA				●	●	●		●				●	
wet snow condition		NA				●							●	
residual clouds			85	●									●	●
vegetation			140					●						
wet snow on land			180								●			
dry snow condition		NA												
residual clouds (test #1)			87	●									●	●
			88	●						●			●	
residual clouds/ dry snow (TBD in tpf)			161							●			●	
vegetation			141					●						
residual clouds/ dry snow (TBD in tpf)			162								●			
land-B mode *(high contr. to snow detec.)*	NA				●						●	●	●	
residual clouds		89		(same as above test #1)										
wet snow condition		NA				●							●	
vegetation			142					●						
wet snow mixed with oth cls (remains)			**191**											
dry snow condition		NA												
residual clouds/ dry snow (TBD in tpf)			**164**							●			●	
vegetation			143					●						
dry snow mixed wt oth cls (remains)			171											
land-C mode *(high contr. to land)* (OR test)	NA				●								●	
non-desert		NA							●					
residual clouds			91	●						●				
residual clouds/ dry snow (TBD in tpf)			165							●			●	
vegetation (remaining pixels)			**144**											
bare land (remaining pixels)		**150**												
land-D mode *(supplemental tests)*	NA				●						●			
residual clouds		92		(same as above test #1)										
residual clouds / dry snow (TBD in tpf)		166								●			●	
vegetation		145						●						
wet snow on land		181				●							●	●
residual clouds / dry snow (TBD in tpf)		167												●
bare land (remaining pixels)		151												
land-E mode *(supplemental tests)*	NA				●									
residual clouds		94		(same as above test #1)										
residual clouds / dry snow (TBD in tpf)		168								●			●	
vegetation		146						●						

Flowchart for completing daily flag with temporal filter[Daily_TPF] [GHRM5C]



Confidence Levels and Aggregation Process in Half-month and Monthly Products

●Half-month : Three confidence levels

if Num of Clear day >= 3 & Num of Snow day >= 1
  & Ave of $BT_{11um,\ clear}$ <= 10 deg.C
else if Num of Clear day < 3 & Num of Snow day >= 1
  & Ave of $BT_{11um,\ clear}$ <= 10 deg.C
else
(Weekly processing also uses the sampe aggregation scheme)

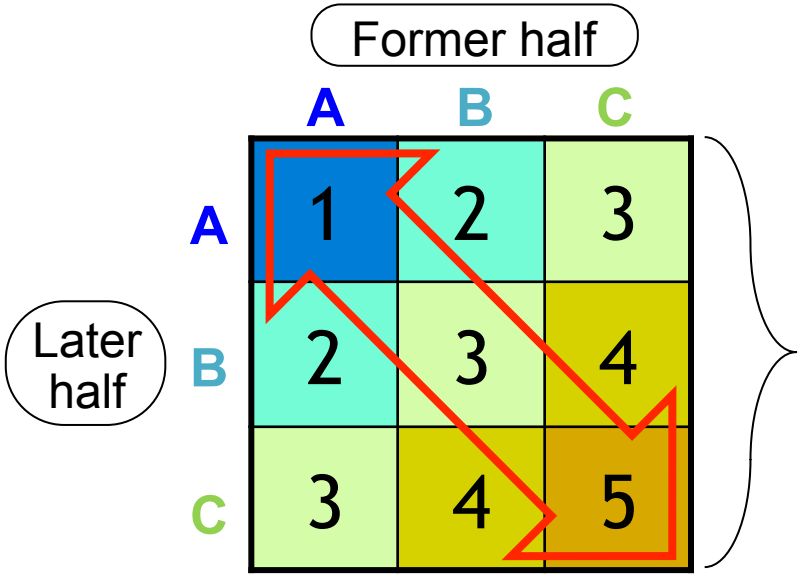
Conf. level (Half-month)

→ A. Snow (High Conf.)

→ B. Snow (Low Conf.)

→ C. Non-snow land

●Monthly : Five confidence levels



5-levels

Conf. level (Monthly)

→ 1. Snow (Very High Conf.)

→ 2. Snow (High Conf.)

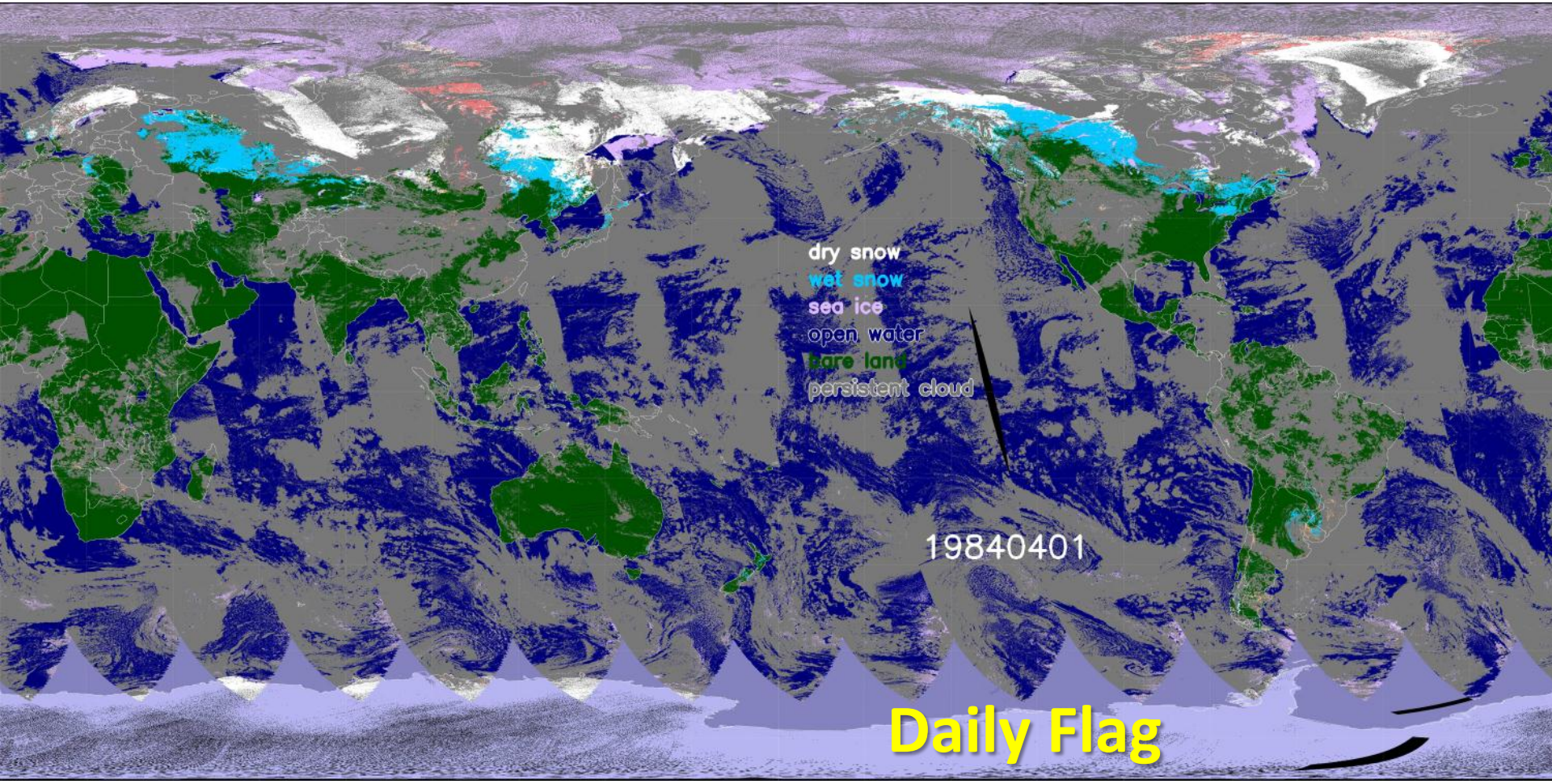
→ 3. Snow (Middle Conf.)

→ 4. Snow (Low Conf.)

→ 5. Non-snow land

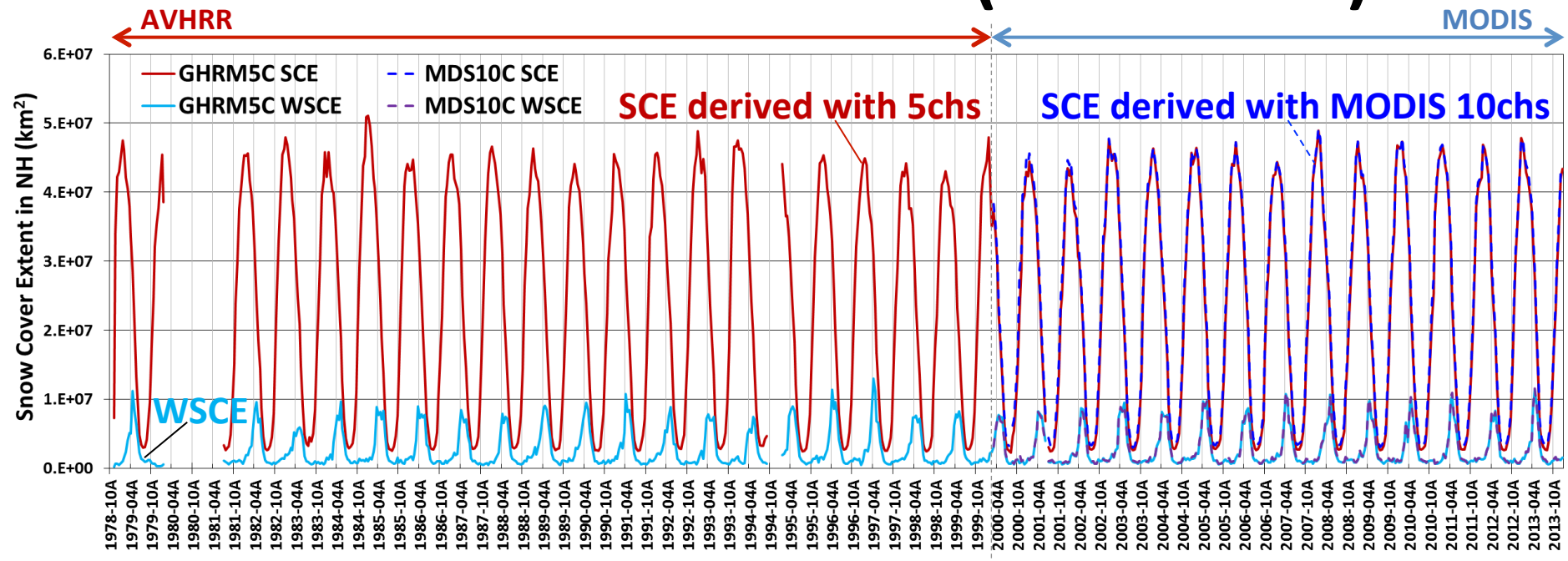
Analysis Results

Snow Cover Extent (1978-2013)

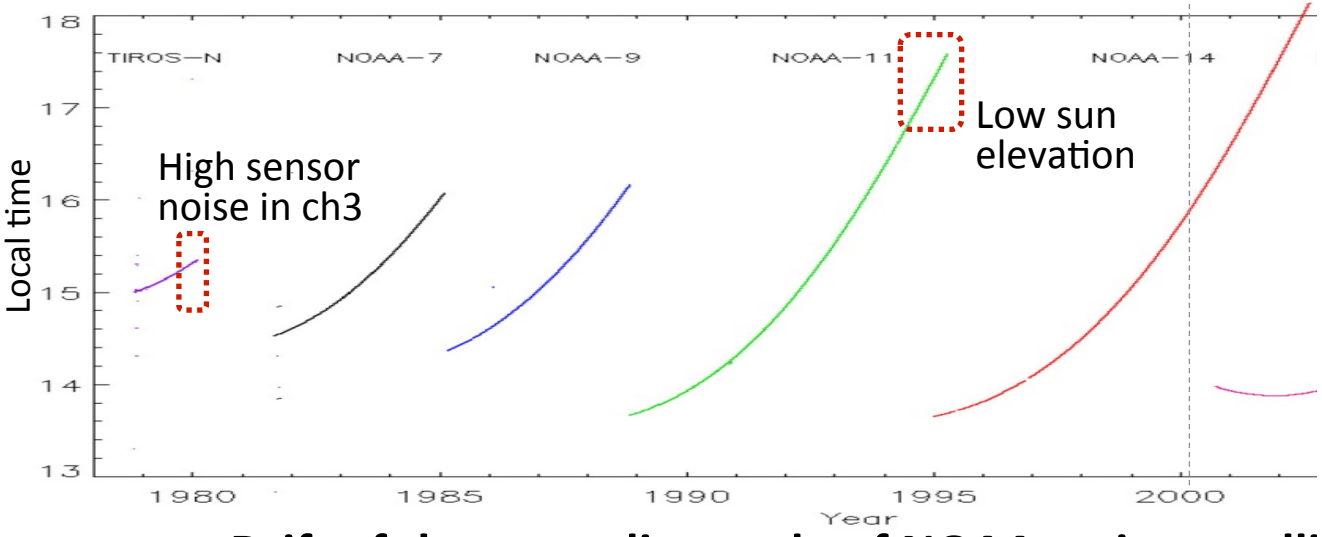


Analysis Results

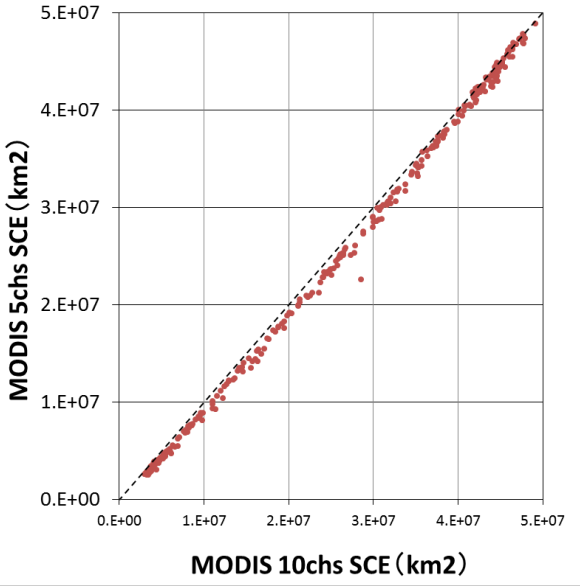
Snow Cover Extent (1978-2013)



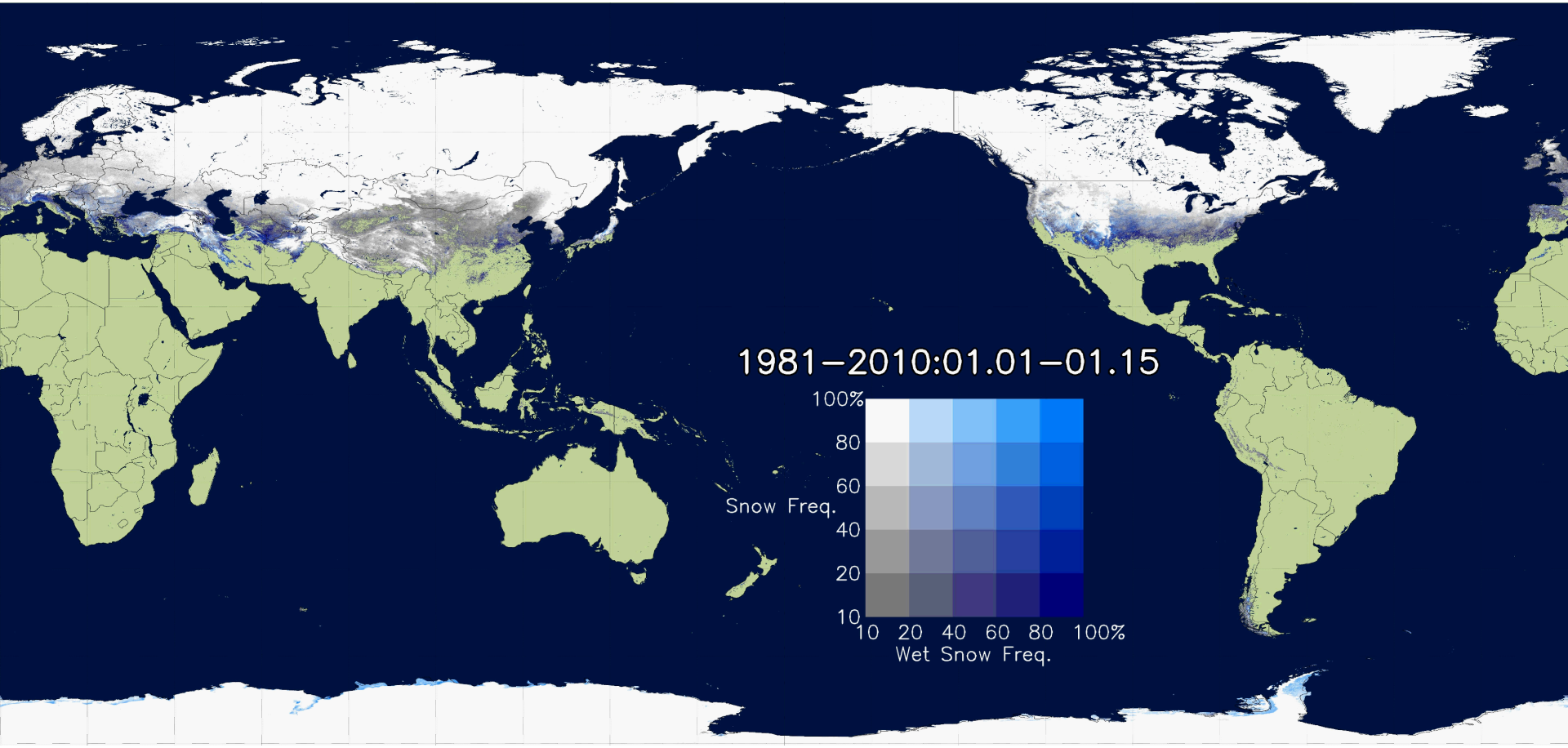
33-year trend of Northern Hemisphere Half-monthly SCE & WSCE (1978-2013)



Drift of the ascending node of NOAA series satelli

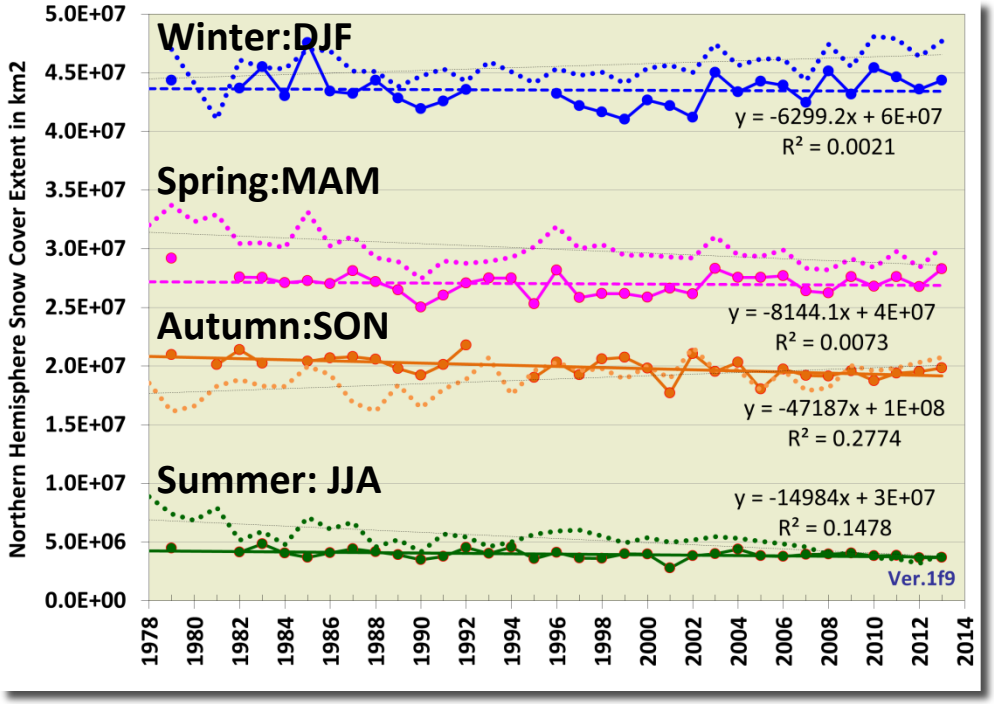


Preliminary Climatology of Snow Frequency Map derived from 30-year Half-monthly SCE Products

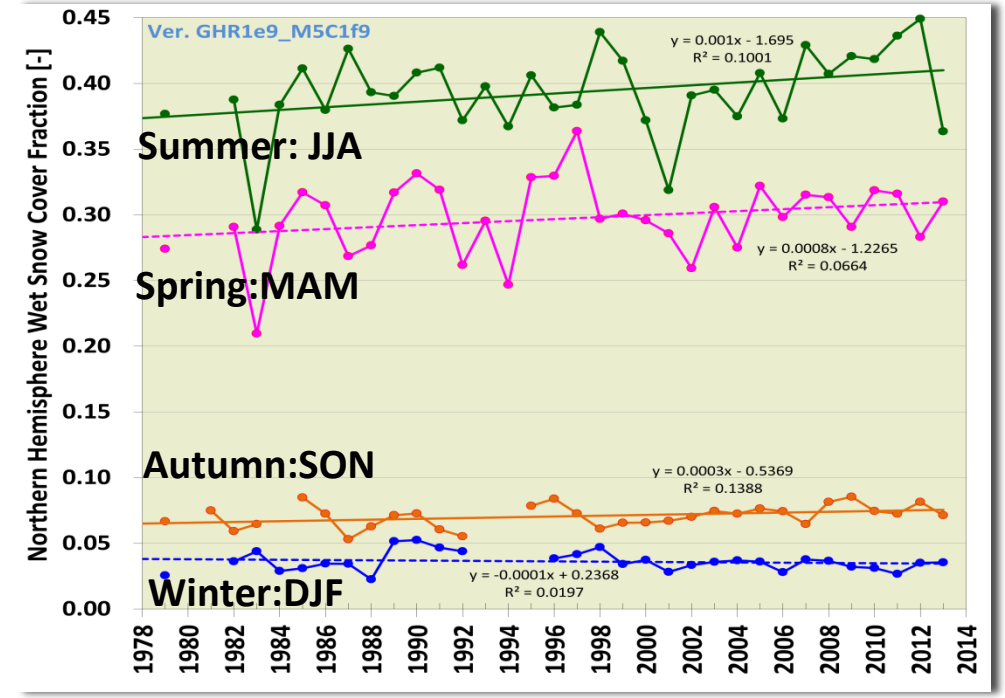


Frequency of Snow Cover Extent/Wet Snow Cover Extent
1981-2010 (30-year)

35-year trend (1979-2013) Northern Hemisphere

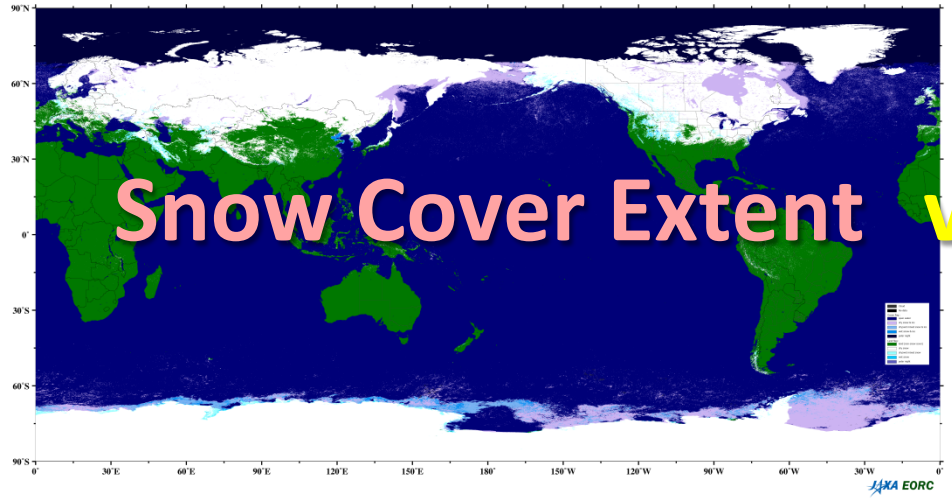


Snow Cover Extent

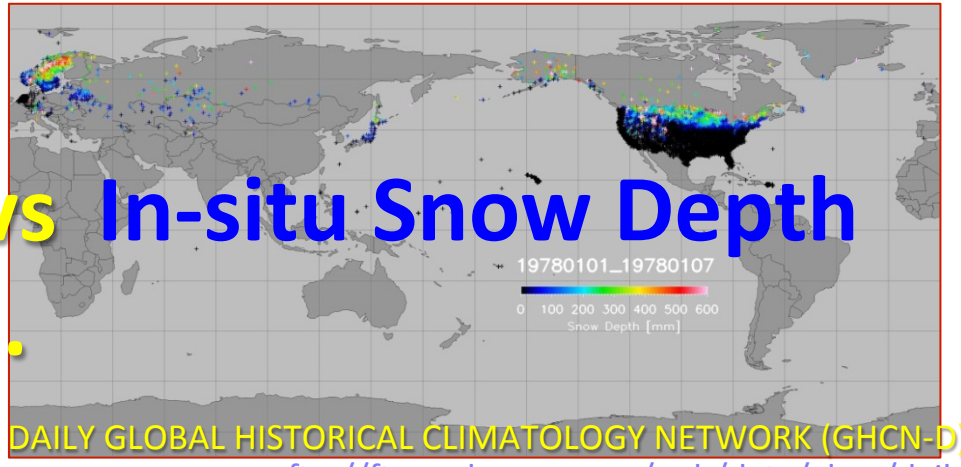


Wet Snow Cover Fraction

Validation Protocol for Snow Cover Products



vs

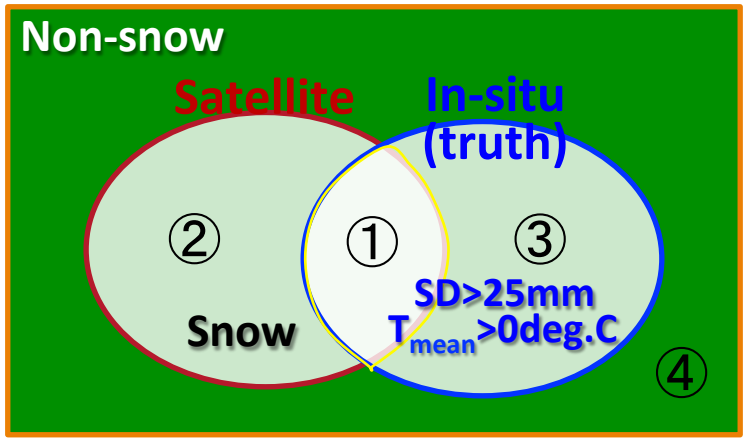


ftp://ftp.ncdc.noaa.gov/pub/data/ghcn/daily

Comparison with in-situ snow depth data (GHCND obtained from NCDC/NOAA)

Criteria for SCE val.: if snow depth (SD) > 25mm, NN pixel is "snow covered"

Criteria for Wet SCE val.: if $T_{mean} = (T_{max}+T_{min})/2 > 0$deg.C, NN pixel is "wet snow"



Definitioin of the accuracies shown in this ppt

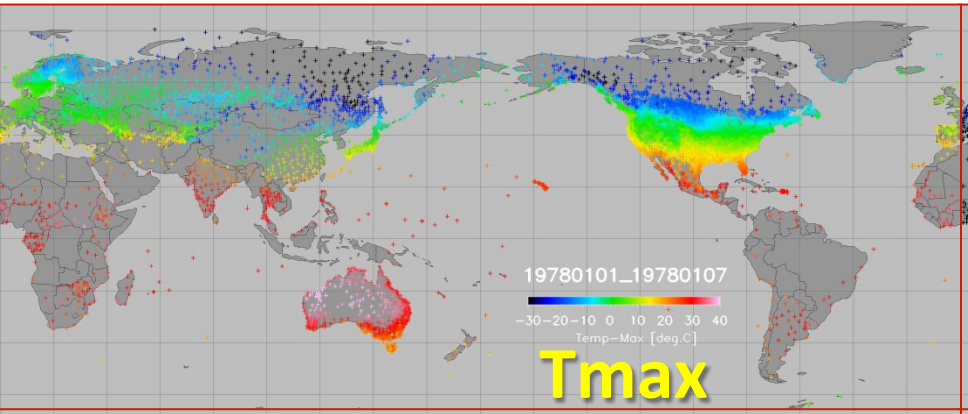
Users accuracy (UA) ＝①／(①+②)

(Commission error : Rate of correct answer)

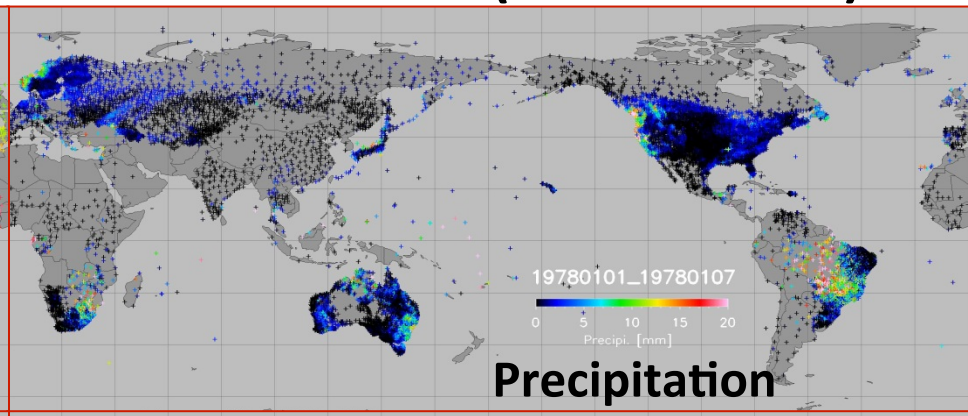
Producers accuracy (PA) ＝①／(①+③)

(Omission error : Rate of snow detection)

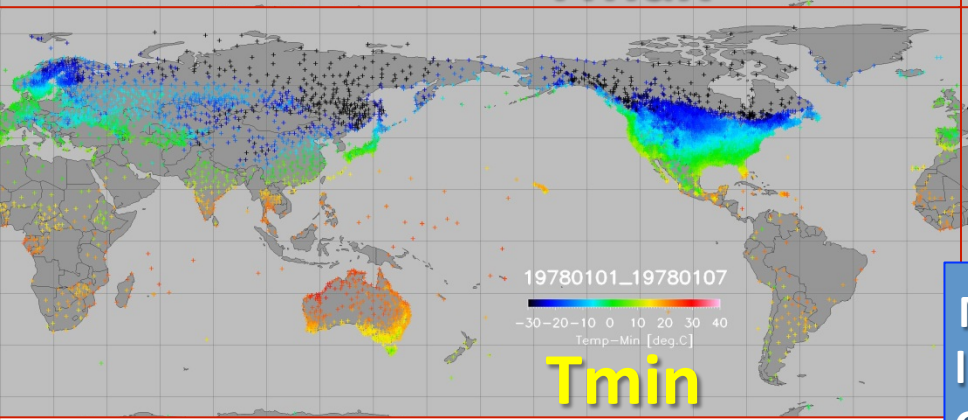
DAILY GLOBAL HISTORICAL CLIMATOLOGY NETWORK (GHCN-DAILY)



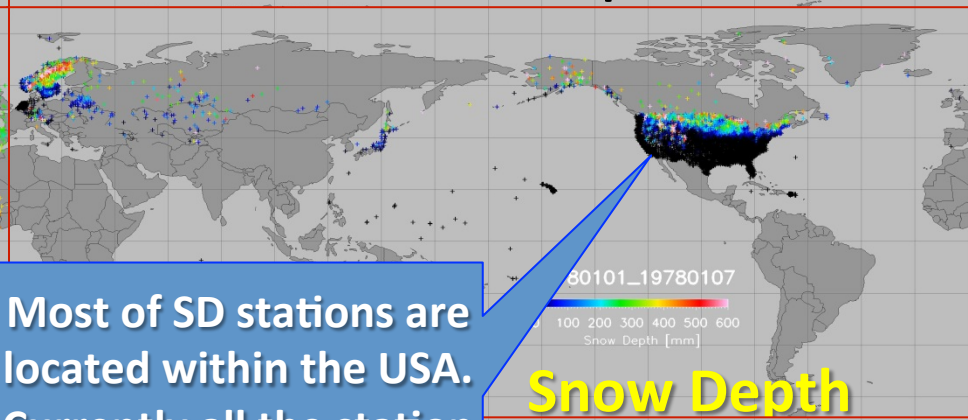
Tmax



Precipitation



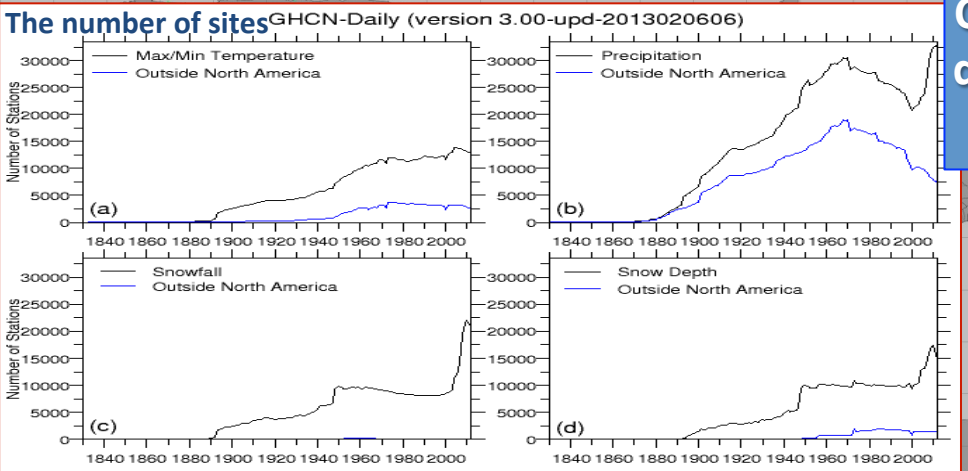
Tmin

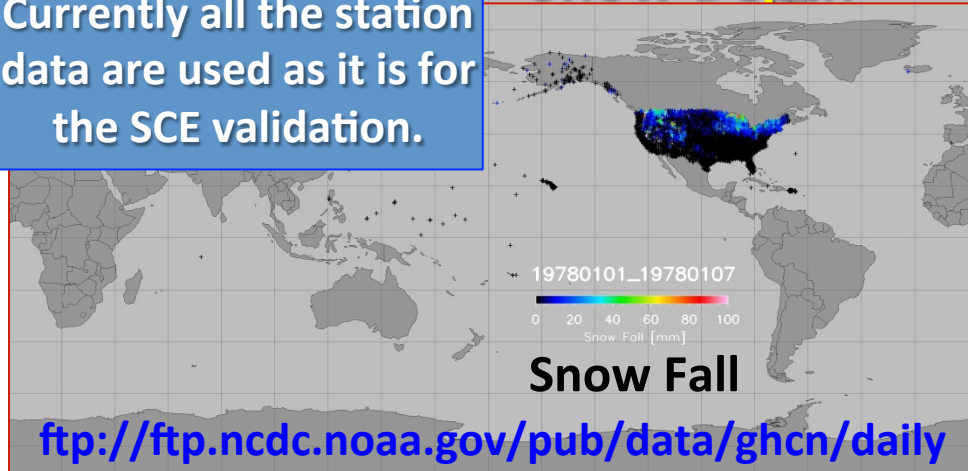


Snow Depth

Most of SD stations are located within the USA. Currently all the station data are used as it is for the SCE validation.

The number of sites

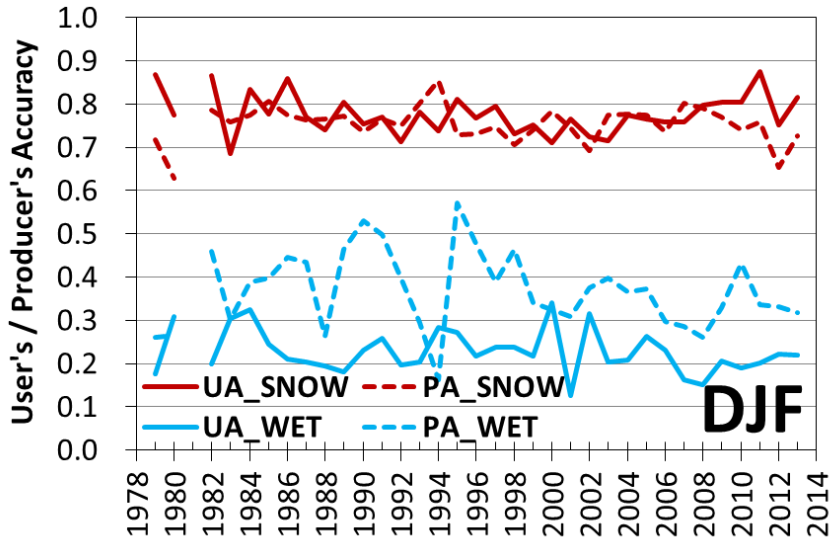


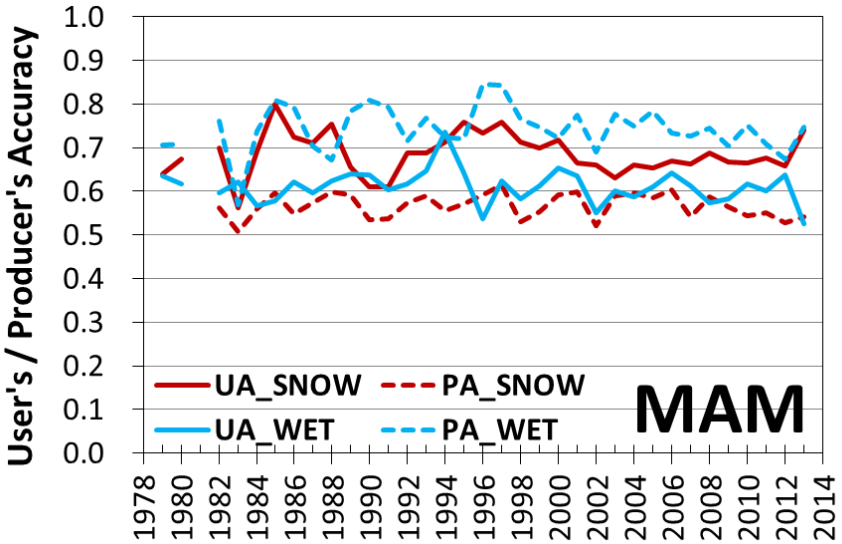


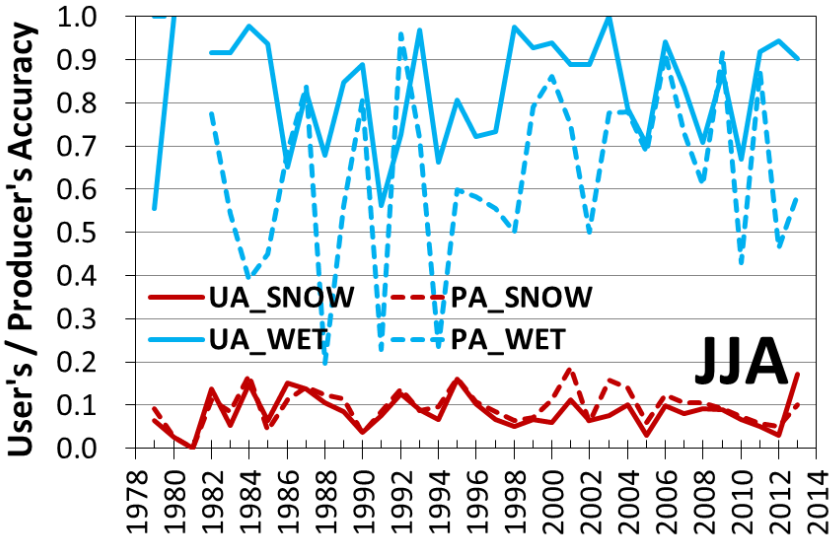
Snow Fall

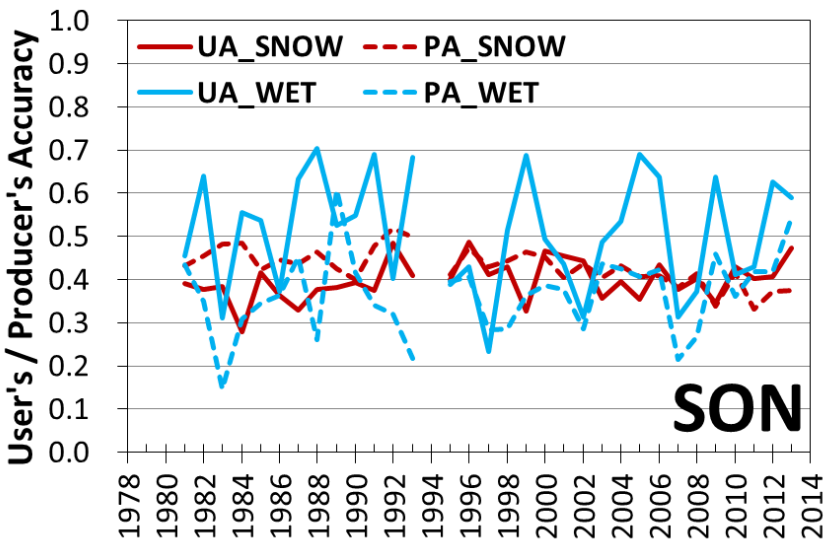
ftp://ftp.ncdc.noaa.gov/pub/data/ghcn/daily

User's and Producer's Accuracy of JASMES SCE and Wet SCE (WSCE)



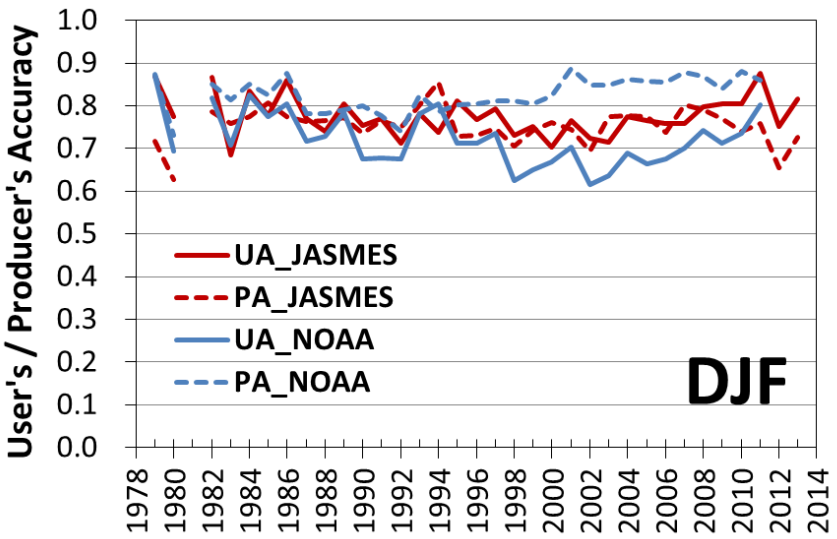


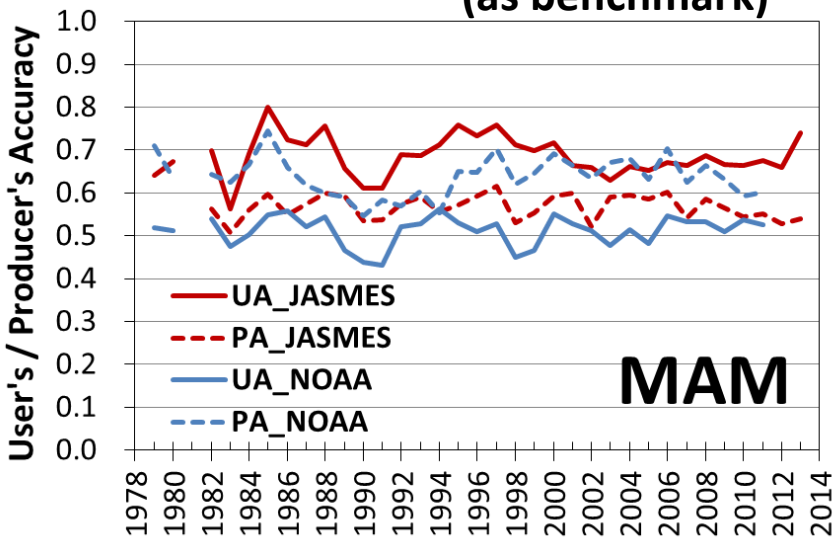


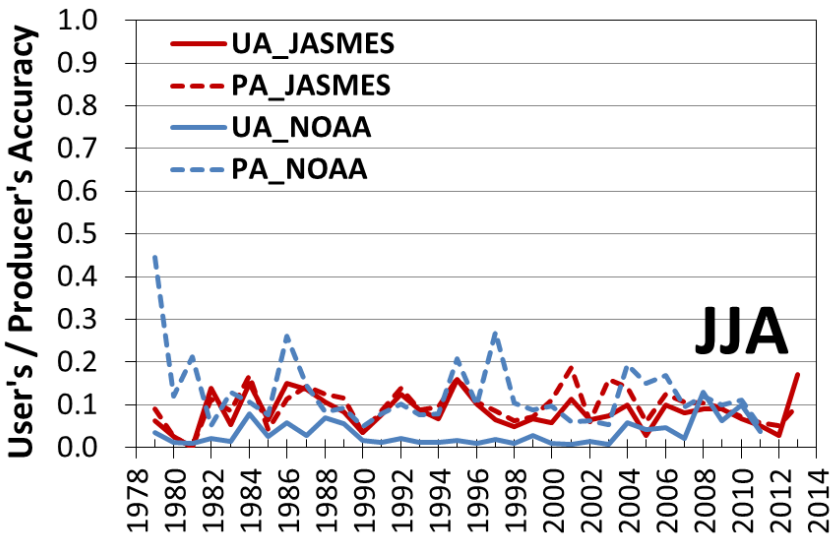


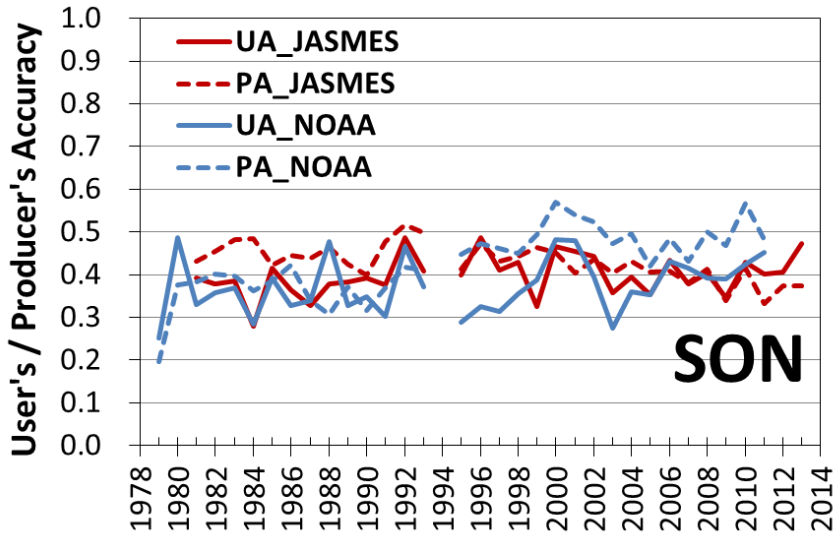
SCE's UA is nearly euqal to PA, and both accuracies are temporally stable. UA & PA of WSCE is high in melt seasons, but variable in JJA due to low snow pixel numbers.

User's and Producer's Accuracy of JASMES and NOAA SCE chart (as benchmark)









NOAA's PA > UA, indicating that NOAA SCE chart seems to overestimate snow cover extent due to the coarser pixel size (~190km).

Summary of UA & PA

JASMES SCE (Dry+Wet Snow) vs. GHCND (SD>25mm) [1978.11-2013.12]					JASMES WSCE (Wet Snow) vs. GHCND (T_{mean}>0deg.C) [1978.11-2013.12]			
	UA		PA		UA		PA	
Season	Ave	Std	Ave	Std	Ave	Std	Ave	Std
DJF	**0.777**	0.047	**0.753**	0.042	0.228	0.049	0.369	0.088
MAM	**0.685**	0.048	0.567	0.027	**0.611**	0.038	**0.743**	0.053
JJA	**0.084**	0.040	**0.097**	0.042	**0.832**	0.126	**0.656**	**0.214**
SON	0.396	0.048	0.429	0.041	0.508	0.128	0.369	0.093
Total (1978-2013)	**0.761**		**0.704**		0.380		0.590	

NOAA SCE vs. GHCND (SD>25mm) [1978.11-2011.12]				
	UA		PA	
Season	Ave	Std	Ave	Std
DJF	**0.723**	0.062	**0.827**	0.040
MAM	0.513	0.034	**0.638**	0.045
JJA	**0.033**	0.029	**0.126**	0.080
SON	0.373	0.064	0.430	0.079
Total (1978-2011)	**0.671**		**0.790**	

JASMES:

SCE: high in winter & spring, low in summer

WSCE: high in spring & summer, low in winter & fall

JASMES SCE: UA=PA

NOAA SCE: UA<PA

Strengths and Weaknesses

Strengths

- Higher spatial resolution (5km) compared with NOAA CDR SCE
- Long-term data record from 1979 to 2013 (w/o some months in 1980, 1981, 1994, 1995, 2001)
- Continuity of the algorithm (5CHs ver.) and reproductivity
- Discrimination between dry and wet conditions of snow cover

Weaknesses

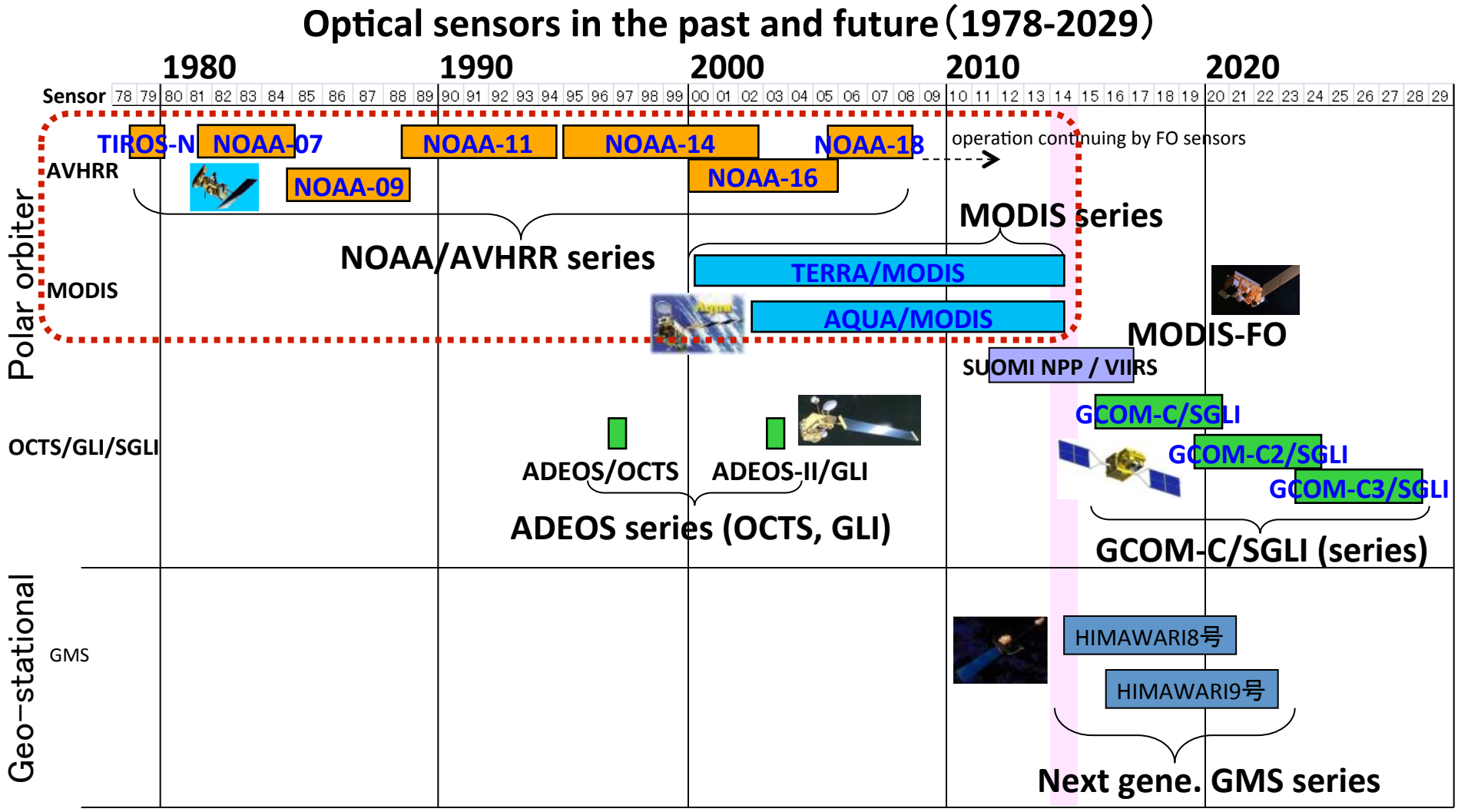
- Poorer performances in dense forest, cold desert, and high mountain areas (compared with 10CHs ver.)
- Data gaps as shown above (partly because of snow detection losses due to sensor noises, low solar elevation condition etc.)
- Processing of the reference data for SCE validation still needs to be improved (e.g., in terms of spacing of in-situ data station).

Summary

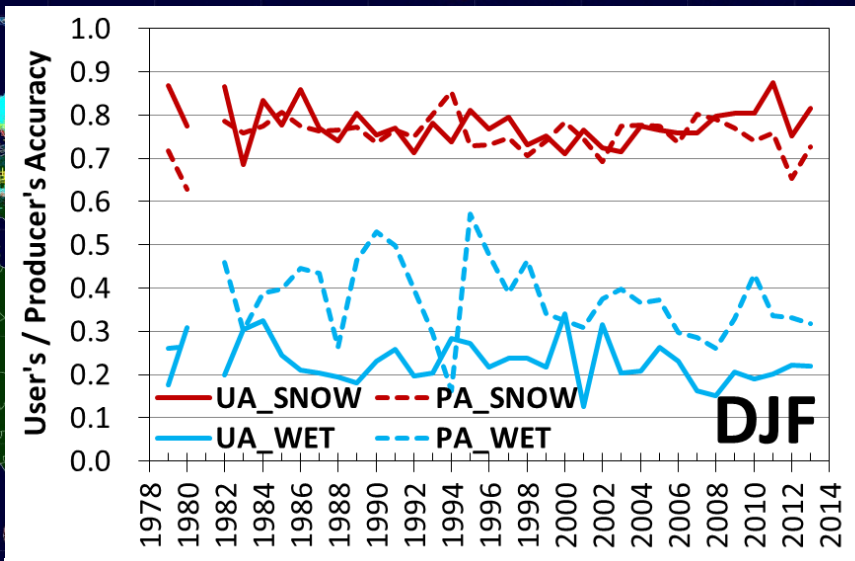
- Three snow cover extent products have been prepared for the GCOM-C mission (two MODIS 10 CHs ver. and a AVHRR 5CHs ver.)
- The algorithms employ conventional decision tree threshold tests including the discrimination between dry snow and wet snow.
- The 5CHs version is consistent with the MODIS 10CHs version within the bias of 5% (SCE_{5chs}<SCE_{10chs}).
- Comparisons with in-situ snow depth (GHCND) indicate that UA/PA of SCE are about 0.76/0.70, whereas those of wet SCE are about 0.38/0.59 (seasonaly high in melting seasons (spring & summer) and low in colder seasons (winter & autumn)).
- Commission error (1-UA) of JASMES/SCE is smaller than those of NOAA SCE chart, while omission error (1-PA) of JASMES is larger than NOAA SCE.
- Remaining works: further validation of SCEs using e.g. regridded GHCND data and other in-situ datasets etc.

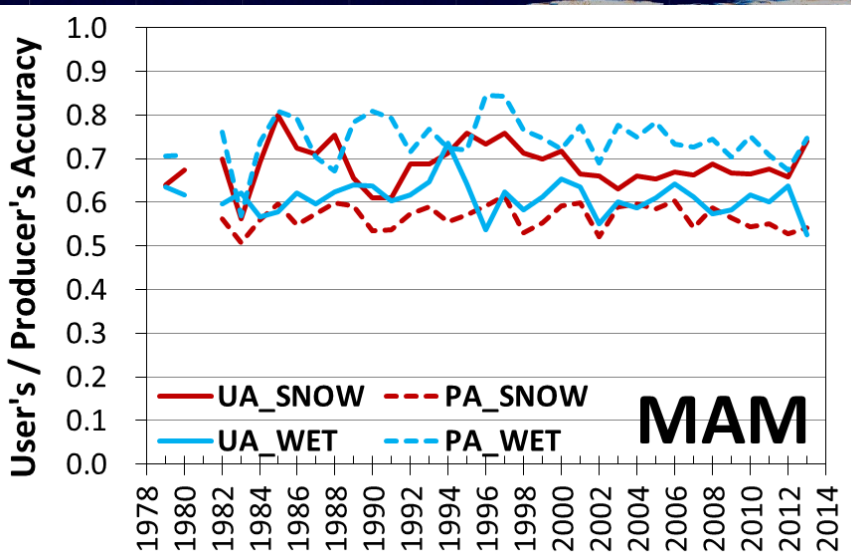
Supplemental slides

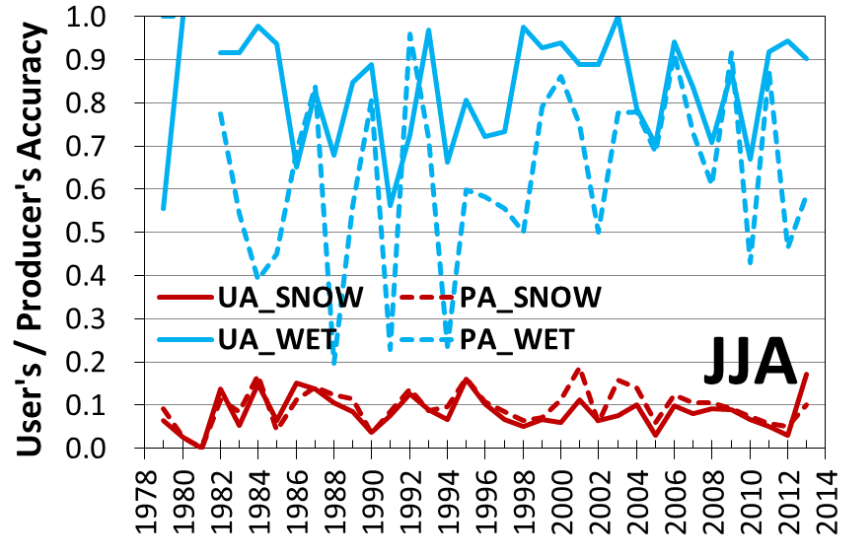
Optical sensors used to process SCEs

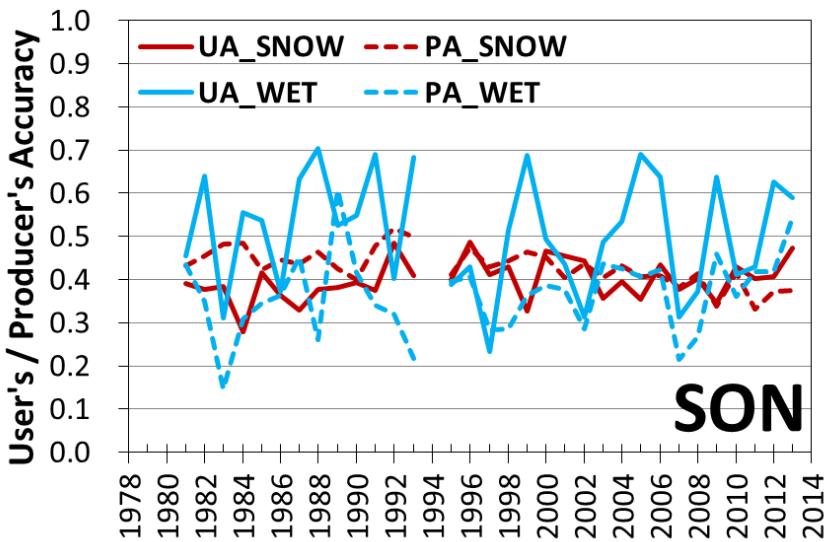


User's and Producer's Accuracy of JASMES SCE and Wet SCE (WSCE)









SCE's UA is nearly euqal to PA, and both accuracies are temporally stable. UA & PA of WSCE is high in melt seasons, but variable in JJA due to low snow pixel numbers.

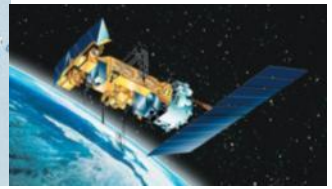
Spectral bands for cloud screening & snow detection

MODIS	AVHRR	GCOM-C/SGLI	JASMES MDS10C	JASMES GHRM5C	SGLI Cloud flag	Usages
CH01: 0.645 μm	CH1	VN8: 0.6735 μm P1: 0.6735 μm	○	○	○	“Cloud” and “Snow over land” detection in daytime mode, “Bare sea ice” & “Snow over sea ice” detection
		VN9: 0.763 μm			○	“Cloud height”
CH02: 0.858 μm	CH2	VN11: 0.8685 μm P2: 0.8685 μm	○	○	○	Retrieval of snow grain size and mass fraction of impurities, “Bare sea ice” & “Snow over sea ice” detection
CH18/19: 0.936 μm			○/○※			"Water vapor"
CH05: 1.240 μm		SW1: 1.050 μm	○		○	“Bare sea ice” & “Snow over sea ice” detection, Snow over desert area detection
CH26: 1.375 μm		SW2: 1.380 μm	○		○	“Cloud” detection in daytime mode
CH06: 1.640 μm	(CH3A)	SW3: 1.630 μm			○	“Cloud” detection in daytime mode
CH07: 2.130 μm		SW4: 2.210 μm	○		○	“Cloud” detection in daytime mode
CH20: 3.750 μm	CH3B			○		“Cloud” detection in daytime & nighttime mode
CH31: 11.030 μm	CH4	T1: 10.80 μm	○	○	○	“Cloud” and “Snow over land” detection in daytime & nighttime mode
CH32: 12.020 μm	CH5	T2: 12.00 μm	○	○	○	“Cloud” detection in nighttime mode
CH36: 13.913 μm			○※			CO2 absorption band for “Cloud height”

※not available for SGLI

MDS10C is designed for obtaining consistent SCE with the future SGLI products as far as possible, whereas GHRM5C concentrates on the continuity of snow detection accuracy for generating long-term climate

Correction of AVHRR gain degradation (ch1, ch2) after the launch



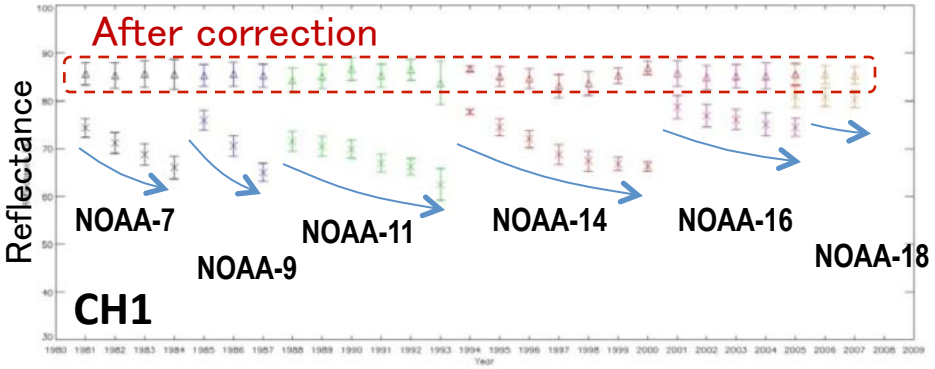
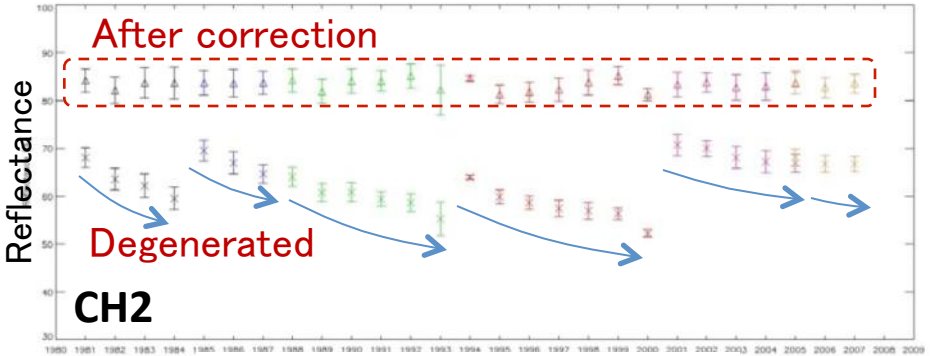
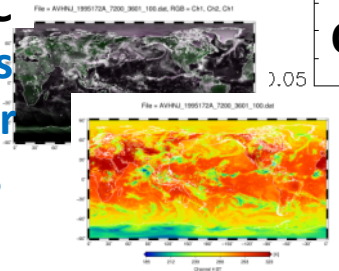


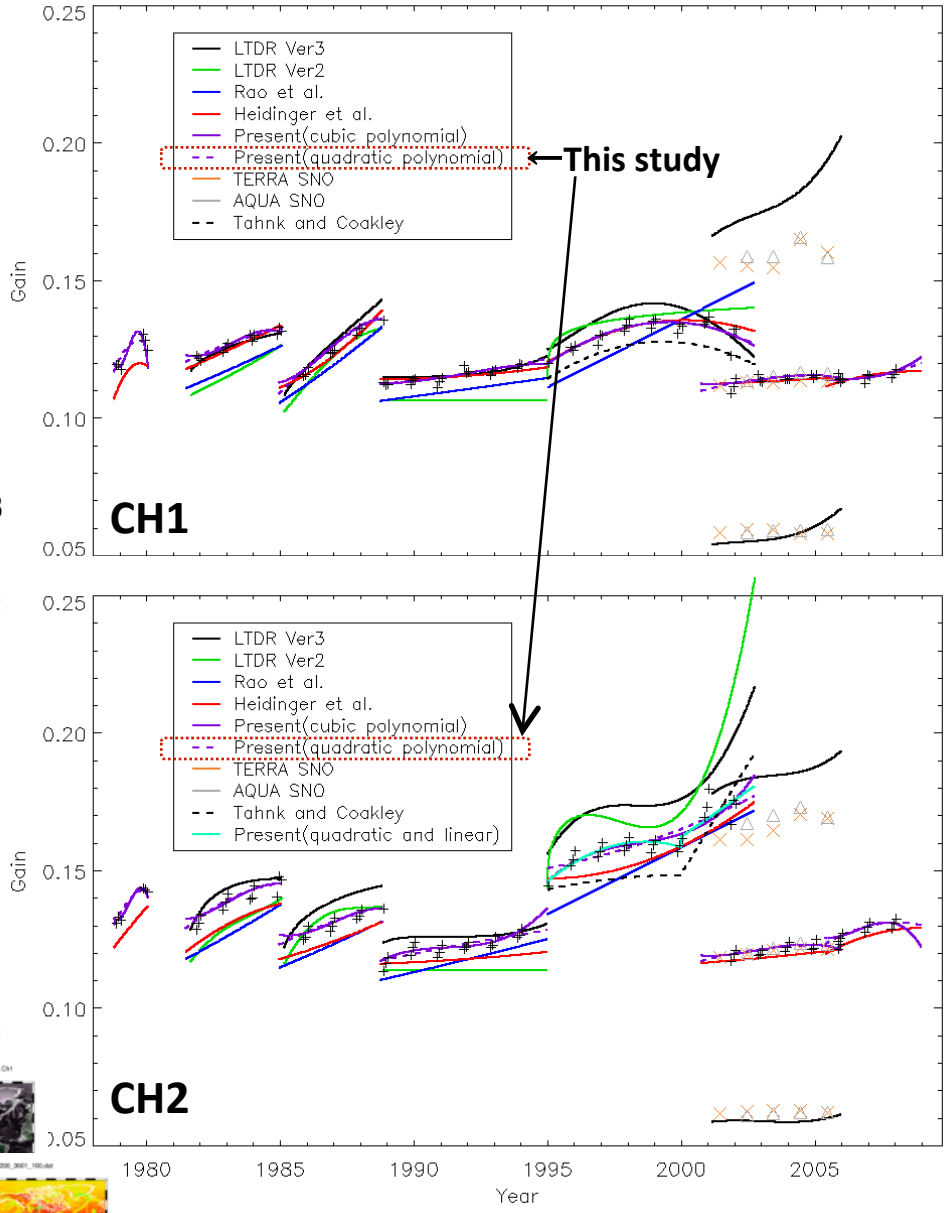
図 3　反射率の経年変動（Channel 1）



Reflectance over Dome-C

Sensor sensitivity degeneration was corrected using the reflectance over Dome-C. Also, TIR chs radiance was corrected for solar contamination





Variation of sensor gain

SGLI channels and Cryosphere Targets

CH	λ	Δλ	L_{std}	L_{max}	$SNR@L_{std}$	IFOV	Possible Targets (Product ID)
	VN, P, SW: nm, T: μm		VN,P: W/m²/sr/μm, T: Kelvin		VN,P,SW: -, T: NEΔT	m	
VN1	380	10	60	210	250	250	SNGSL, SNGSS, SIALB, SNIP
VN2	412	10	75	250	400	250	SNIP, SIALB
VN3	443	10	64	400	300	250	SICA,OKID,SIC,SCAFM, SNGSL, SNGSS, SIALB, SNIP, ISBM
VN4	490	10	53	120	400	250	*(Ocean channel)*
VN5	530	20	41	350	250	250	SICA,OKID,SIC,SCAFM, SNGSL, SNGSS, SIALB, SNIP, ISBM
VN6	565	20	33	90	400	250	*(Ocean channel)*
VN7	673.5	20	23	62	400	250	*(Ocean channel)*
VN8	673.5	20	25	210	250	250	SICA,OKID,SIC,SCAFM, SNGSL, SNGSS, SIALB, SNIP, ISBM
VN9	763	12	40	350	1200	250/1000	Cloud detection over snow
VN10	868.5	20	8	30	400	250	*(Ocean channel)*
VN11	868.5	20	30	300	200	250	SICA, OKID, SIC, SCAFM, SNGSL, SNGSS, SIALB, SNIP, ISRGH, ISBM
P1	673.5	20	25	250	250	1000	SIC, ISRGH
P2	868.5	20	30	300	250	1000	SIC, ISRGH
SW1	1050	20	57	248	500	1000	SICA, OKID, SIC, SCAFM, SNGSL, SNGSS, SIALB, SNIP, ISBM
SW2	1380	20	8	103	150	1000	Cloud detection over snow
SW3	1630	200	3	50	57	250	SICA OKID, SIC, SCAFM, SNGSL, SNGSS, SIALB, SNIP, ISRGH, ISBM
SW4	2210	50	1.9	20	211	1000	*(cloud microphysics) Possibly used for cloud detection over desert*
T1	10.8	0.74	300	340	0.2	250/500	SICA, OKID, SIC, SCAFM, SIST
T2	12.0	0.74	300	340	0.2	250/500	SICA, SIC, SIST

Summary of UA & PA

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low in summer

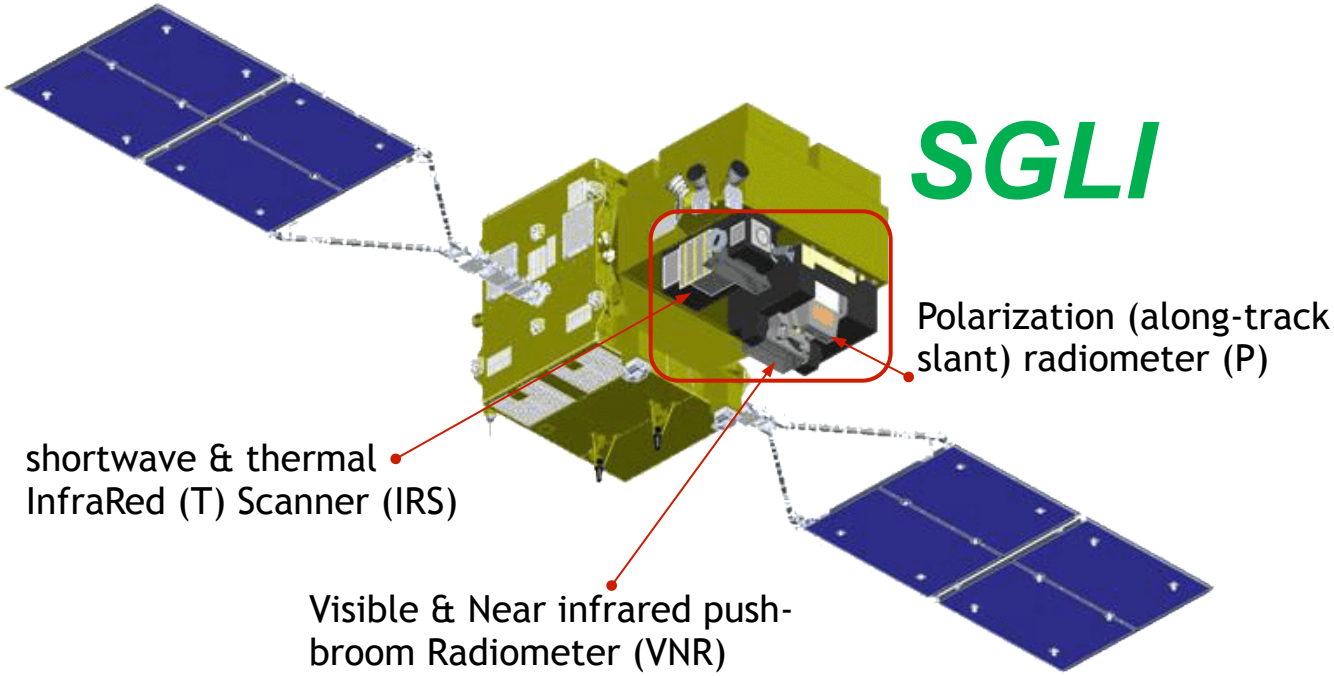
WSCE: high in spring & summer
low in winter & fall

JASMES SCE: UA=PA

NOAA SCE: UA<PA

GCOM-C

- ***Targets of GCOM-C are carbon cycle and radiation budget, and will carry the Second-generation Global Imager (SGLI).***
- ***SGLI will continue most of the GLI observations (sea surface temperature, ocean color, aerosols, cloud, vegetation, snow/ ice, and so on).***
- ***The new SGLI features (250m (VN) and 500m (T) channels and two polarization/ multi-direction channels (P)) will enable improvement of land and coastal monitoring and retrieval of land aerosols.***



Threshold tests employed in the water-class discrimination [GHRM5C]

Meaning of flag	sza	rfa	ref01	ref02	ref01-ref02	ref03/ref01	ref03/ref02	bt11	bt11-bt12
open water (within sunglint)		●							
dry snow on ice mixed with oth cls			●		●	●		●	
open water			●						
								●	
				●					
residual clouds	●							●	●
	●						●		
dry snow on ice (remaining pixels passing through the above tests									