Aerosol satellite product inter-comparisons (WG 3)

(introduction / seed questions)

Inter-comparison questions

- Review of existing inter-comparisons
- -> can we identify gaps?
  - What to compare / which focus
  - Which reference datasets
  - Which metrics
  - Which approach (experiments, statistics, sensitivities, information content, synthetic simulations, …)
- Can we define additional meaningful exercise(s)?
  - -> seek funding

Inter-comparison potential gaps

- aerosol properties: fine mode AOD, …
- geostationary (several SEVIRI algorithms; GEO - LEO)
- Climatologies of AOD (and aerosol properties)
- (regional) trends and anomalies (using same time windows, same background period)
- …?

Inter-comparison table (ocean and dust)

publication	variables	method(s)	sensors														period	regions	references
			VIIRS	SeaWIFS	AVHRR	TOMS	MODIS	MISR	POLDER	AATSR	MERIS	SYNAER	OMI	AIRS	IASI	CALIOP	SEVIRI			
Smirnov, et al. (2011), AMT, 4, 583-597, doi:10.5194/amt-4-583-2011	AOD	Lv2 statistics					x	x										2006-2010 (80 cruises)	Global oceans	MAN
Kinne, S. (2009), edited by A.Kokhanovsky and G. de Leeuw, Springer ISBN: 978-3-540-69396-3	AOD	L3 scoring	various algorithms for one sensor		x	x	x	x	x									Various multi-annual	Global ocean; regions	AERONET, SKYNET
Myhre, et al., (2005), ACP, 5, 1697-1719, doi:10.5194/acp-5-1697-2005	AOD	Monthly means		x	x	x	x	x				x						Various, 1997-2000 / 8M of 2000	Global oceans; regions	AERONET, campaigns
Sayer, et al., (2012), JGR, 117, D03206, doi:10.1029/2011JD016599	AOD	Lv3		x			x	x		x	x							Multi-year	Global ocean	AERONET
Kahn, et al. (2007)., JGR, 112, D18205, doi:10.1029/2006JD008175.	AOD, ANG, size distribution, refr indices	L2					x	x										2001-2005 case studies	Over-water case studies	AERONET
Carboni, et al. (2012), AMT, 5, 1973-2002, doi:10.5194/amt-5-1973-2012	Dust AOD	L3 statistics					various algorithms for one sensor										x	March 2006	Saharan Dust Plume	AERONET
Banks, et al. (2013), RSE, 136, 99-116, doi: 10.1016/j.rse.2013.05.003	Dust AOD	Lv2 statistics					x	x							x		x	June 2011	Sahara	AERONET + Fennek campaign (ground, air, lidar)

Inter-comparison table (land)

Publication	variables	method(s)	sensors														period	region(s)	reference(s)
			VIIRS	SeaWIFS	AVHRR	TOMS	MODIS	MISR	POLDER	AATSR	MERIS	SYNAER	OMI	AIRS	IASI	CALIOP	SEVIRI			
Kahn et al. (2011), JQSRT, 112:901–909. doi:10.1016/j.jqsrt.2009.11.003	AOD	L2 statistics					x	x										3 months 2006	Global	-
Liu, et al. (2014), JGR, 119, 3942–3962, doi:10.1002/2013JD020360.	AOD	L2 statistics	x				x											2012/13	global	AERONET, MAN
Kinne, et al. (2003), JGR, 108, 4634, doi:10.1029/2001JD001253	AOD	Monthly means			x	x	x												global	AERONET, AEROCOM
Kittaka et al. (2011), AMT, 4, 131–141, doi:10.5194/amt-4-131-2011	AOD	Collocated pairs, 5 deg					x									x		2006-2008	global	-
Sayer, et al. (2012), AMT, 5, 1761, doi:10.5194/amt-5-1761-2012	AOD	Lv3		x			x	x										Multi-year	global	AERONET
Redemann, et al. (2012), ACP 12, 3025-3043, doi:10.5194/acp-12-3025-2012, 2012	AOD	L2					x									x		4M 2007 & 2009	Global CALIOP tracks	-
Carlson and Lacis (2013), JGR, 118, 8640–8648, doi:10.1002/jgrd.50686	AOD	PCA analysis		x			x	x										2002-2010	Global ocean	-
Kahn,et al. (2009), TGARS 47, 4095-4111, doi: 10.1109/TGRS.2009.2023115	AOD, ANG	L2 statistics					x	x										2M of 2006	Global	-
Bréon,et al., (2011), RSE 115, 3102	AOD, ANG	L2 statistics					x		x		x					x	x	various,	global; sea/land	AERONET
de Leeuw, et al., RSE (2014) doi: 10.1016/j.rse.2013.04.023	AOD, ANG	Lv2 / L3 L3 scoring	various algorithms for one sensor															4M of 2008	global;,	AERONET
Holzer-Popp, et al., AMT, 6, 1919 - 1957, (2013) doi:10.5194/amt-6-1919-2013	AOD, ANG	L3 statistics algorithm experiment	various algorithms for one sensor															1M of 2008	Global; regions	AERONET
Kokhanovsky, et al. (2010), AMT, 3, 909-932, doi:10.5194/amt-3-909-2010	AOD, optical properties	Single cases	various algorithms for one sensor															Single cases	Single cases	Simulations

Inter-comparison potential gaps

- aerosol properties: fine mode AOD, AAOD, …
- geostationary (several SEVIRI algorithms; GEO - LEO)
- Climatologies of AOD (and aerosol properties)
- (regional) trends and anomalies (using same time windows, same background period)
- Spatial variability – Dragon campaigns / plume detection frequency/high AOD episodes, pdfs

Aerosol_cci comparisons

Lessons learned and plans

ACCI comparisons

- Improve: Workshops + algorithm experiments (1 month)
  - Optical models, cloud masks, (surface)
  - Post-processing (cloud contamination, bright surface)

Holzer-Popp, et al., AMT 2013

- Select: Round robin exercise (4 months)
  - Best versions for all algorithms

de Leeuw et al., RSE 2013, in press

- Validate: Full ECV products (entire 2008)

Kinne, et al., in preparation

- At all steps application of the same validation tools and statistics
  - Level 2 and level 3
  - Global + regional statistics
  - Scoring (spatial / temporal correlation)
  - Against AERONET / MAN + MODIS / MISR / CALIPSO

ACCI experiences

- Improvement achieved by
  - working groups, algorithm experiments, iterated validation
- Level / amount of analysis needed
  - 4 months (all seasons) global analysis sufficient (equals 12 months)
  - Lv3 (AEROCOM grid) results overall similar to lv2
- Limited coverage of reference data
  - Oceans, Southern hemisphere, near clouds
  - Aerosol properties for low AOD (all inversions)
- Filters matter
  - Common points - “fair” comparison
  - All points – deserves separate focus (coverage, difficult cases)
  - Land / ocean / coast / regions / seasons
    - needed for problem identification

ACCI plans (- 2017)

- Round robin comparison 4 IASI “dust AOD” algorithms
  - “Greater Sahara” region / 1 year
- Fine mode AOD, dust AOD from AATSR, …
- Use POLDER / GRASP as “quasi-reference”
  - 4 diagnostic sites (1200 x 1200 km^2) with few AERONET
  - land regimes (biomass burning, dust, pollution), oceans
- Suggested optional round robin exercises of pathfinder algorithms responding to user needs
  - AAOD (glint, mixing fractions, AAI)
  - Layer height (O2A, IASI spectra)
  - MERIS algorithms

GCOS requirements

variable	resolution			accuracy	Stability [/ decade]
	Horizontal [km]	Vertical [km]	Temporal		
Aerosol optical depth (column)	5-10	N / A	4 h	Max (0.03; 10%)	0.01
Single scattering albedo (column)	5-10	N / A	4 h	0.03	0.01
Aerosol layer height	5-10	N / A	4 h	1 km	0.5 km
Aerosol extinction coefficient (profile)	200-500	1k (~10km) 2k (~30km)	1 week	10%	20%