Stefano Casadio (20-02-1965) **Remote Sensing Specialist**
Laurea degree **Physics** (1991-1993), PhD **Geophysics and Remote Sensing** (2000-2003)

Working experience

Phys. Dep. Univ. Rome (1993-1997); Cap Gemini (1997-1998); **SERCO** (1998-now)

Research Topics

- **Earth's surface** (satellite): fire detection, gas flaring monitoring, LST
- **Urban Boundary Layer** (ground based lidar, sodar, radiometer): water vapour, aerosols, turbulence, convection
- **Troposphere** (ground based lidar, satellite): water vapour, aerosols, ozone, clouds, NO2
- **Stratosphere** (airborne lidar, satellite): total ozone, ozone profiles, aerosols, PSC
- **Mesosphere** (satellite): Sodium layer
- **Ionosphere/Magnetosphere** (satellite): South Atlantic Anomaly
- **Instrumental Quality Check** (satellite): geo-location/co-location, calibration, algorithms

Other topics

- Fusion engineering (data analysis); didactics of Physics (lessons at Phys. Dept., ESA Summer Schools)

Publications/Conferences

Peer reviewed papers:	**32** (**9** first author) +**1** submitted (first author), h-index = 13, h10-index = 15
Short papers:	**41** (**14** first author)
Conference presentations:	**88** (oral + poster)
Conference organisation:	**7** (chair/secretary of session)
Laurea/Phd tutoring:	**6**

Scientific Collaborations

DLR (**Ger**); MPI-Mainz (**Ger**); INPE (**Bra**); Univ. Sapienza (**Ita**); Univ. Tor Vergata (**Ita**); ENEA (**Ita**); IFA/CNR (**Ita**); INGV (**Ita**); KF Univ. Graz (**Aut**); SRON (**Ned**); CNRS/IPSL (**Fra**); Harvard Univ. (**USA**); MMS (**USA**)

Additional Info

Scientific Reviewer for **RSE** and **IJRS** journals (ass. editor of Annals of Geophysics, 2013-2014)
Computer skills: Windows, Unix , Linux (very basic!), C (basic), FORTRAN (intermediate), **IDL** (advanced)

Support for instruments and Cal/Val contracts

“No one trusts a model except the man who wrote it;
Everyone trusts an observation except the man who made it.”

Harlow Shapley (1885-1972)

ESA Atmospheric **Validation** projects (feedbacks to Calibration projects)

Name/Prime	Sat. Instrument	Obs. Geometry	Val. Instrument
TASTE-F BIRA	GOMOS, MIPAS, SCIAMACHY	NADIR, LIMB	Ground based (lidar, MWR, sonde, FTIR, …)
MMValRO Univ. Graz	GOMOS, MIPAS	LIMB	Satellite (GPS)
SCILOV Univ. Bremen	SCIAMACHY	NADIR, LIMB	Satellite (many)
PANDONIA LuftBlick	OMI, GOME-2, S5p, S4	NADIR	Ground based (Pandora)

ESA Atmospheric **Calibration** projects (feedbacks to Validation projects)

Name/Prime	Instruments	Method	Instr. Type
ICAL BIRA	Brewer, Dobson, Pandora	Inter-comparison, inter-calibration	Ground based
ATLAS PMOD/WRC	Spectrometers (e.g. Brewer, Pandora)	Tuneable laser analysis (straylight)	Ground based
ISTINA GRASP	Algorithm (aerosols)	Numerical Modelling	N/A
ALTS TSVG	ATSR (1.6 µm, geoloc.)	Statistical analyses, new tools	Satellite

The Oath of IDEAS Contractor

•**I will** initiate and **monitor contracts** related to the implementation of the Long Term Calibration / Validation plan for the period 2012-2015.This includes the preparation of statements of work for contract renewal where applicable and the generation of new statements of work, the monitoring of on-going and future activities by participation to the progress meetings and ensuring proper execution of the contract.

•**I will interface** with the ENVISAT Atmospheric Chemistry **Validation Team** (ACVT) and the MERIS and AATSR **Validation Team** (MAVT). I will **closely follow** the activities of the ACVT and MAVT, including the organization of the ACVT and MAVT meetings and workshops.

•**I will ensure the quality** and adequacy of the in-situ data generated by Long Term Calibration / Validation activities to the needs of the ESA instrument-related Quality Working Groups (QWG).

•**I will establish requirements** for the extension of the Long Term Calibration / Validation plan related to campaigns, ground-based, ship-borne and airborne measurements, data assimilation and satellite inter-comparison taking into account the current SPPA activities.

•**I will monitor activities** related to the inter-calibration of validation facilities.

•**I will** cover the above activities for the following current ESA satellite missions and instruments: MERIS/Envisat, AATSR/Envisat, SCIAMACHY/Envisat, GOMOS/Envisat, MIPAS/Envisat

•**I will** cover the above activities for following the future ESA satellite missions and instruments: ADM-Aeolus, EarthCARE, OCLI/Sentinel 3, SLSTR/Sentinel 3, Sentinel 5 Precursor

Keywords: to "**MONITOR**", to "**FOLLOW**", to "**INTERFACE**" …
In practice, let the others do the "real" job and check if it is done correctly.

From my experience (but I might be wrong), it is not possible to effectively make it, unless you play an active role in the activity. In other words:

YOU MUST ***DEMONSTRATE*** THAT YOU ARE YOURSELF **ABLE TO DO THE JOB**

Maybe not the "complete" job, but at least a significant part of it, that is you understand all main problems and solutions, and the outcomes of ESA projects are REALLY UNDER YOUR FULL CONTROL.

It's fundamental to gain **CREDIBILITY**.

Of great importance is the “ability” to establish active colla arch instit

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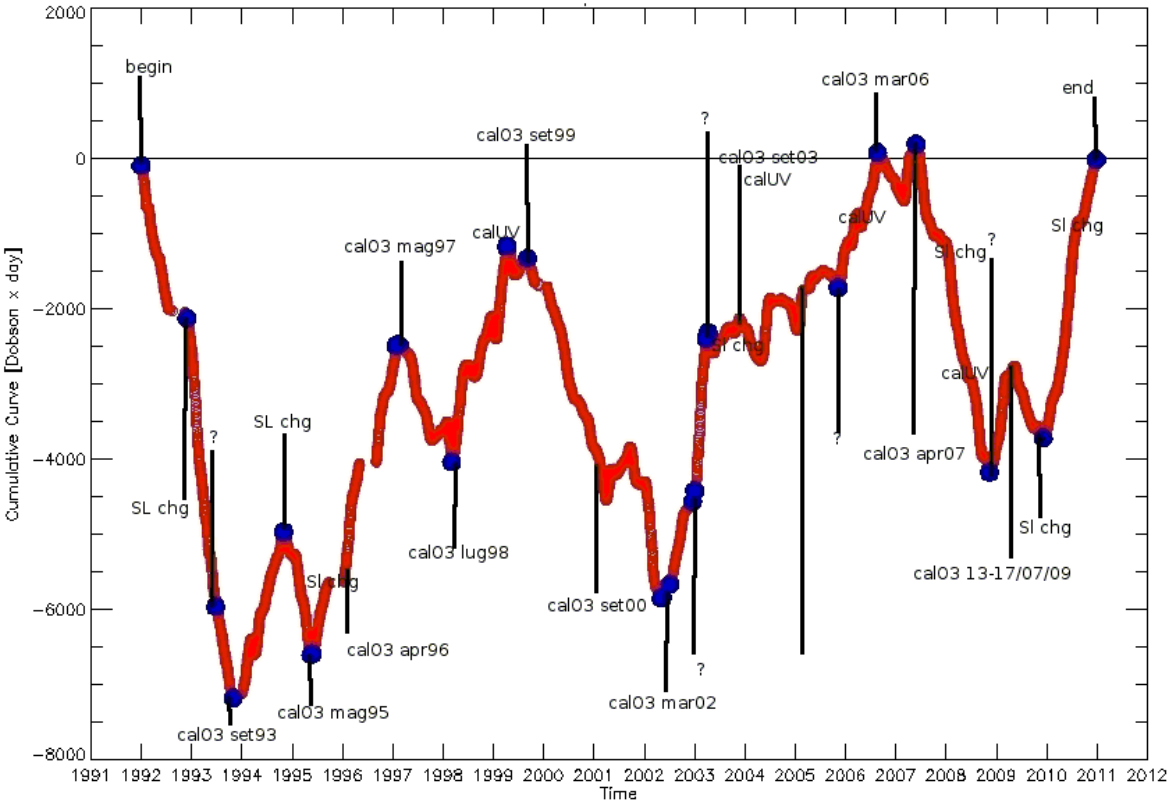
It is at a signi ities is es bility outsi ESA

EUBREWNET (COST-action)

On 2013 I was asked to give a presentation on ESA future plans (Manchester).

The audience was a bit inattentive.



After showing that I knew what they were talking about, people started listening with due attention.

R&D activities not included in the "oath"

Activity	When	IDEAS+ People	Outcomes/Perspectives
MIPAS new species validation	2012-2014	S. Casadio (T3)	Scientific Paper
ATSR (S3) water vapour (funded ESA project)	2013-2016	S. Casadio (T3) A. Burini	Scientific Papers, collaboration with CNR
GOMOS HRTP validation method (ENEA funded by ESA through IDEAS+)	2012-2016	R. Iannone (T2) S. Casadio (T3)	Scientific Paper, collaboration with ENEA (2016)
MERIS/SCIAMACHY Level 1 inter comparison	2014-2016	A. Burini (T3) S. Casadio (T2)	Ongoing
MIPAS (SCIAMACHY) main species validation	2015-2016	G. Brizzi (T2) A. Burini (T3) S. Casadio (T3)	Started, collaboration with CNR (TBC)
S5p and **S4** Validation Super-site (post-doc and Sapienza funded by ESA through IDEAS+)	2015-2016	S. Casadio (T3) A. Burini (T3)	Started, collaboration with Univ. Sapienza, post-doc (A.M. Iannarelli)

In my opinion, **Task 2** people should be deeply involved in the scientific use of the data they are going to check, they should do **R&D** with the data they are handling (**goldmine!**).
The detailed knowledge of the "physical content" of the products, both Level 1 and Level 2, is mandatory to provide ESA with a high level service. Counting files and checking product sizes, although mandatory, is certainly not enough.
A **significant** portion of the working time should be devoted to R&D.

1) Fast data fetching
2) Powerful machines (speed, space)
3) Efficient in house coding (scripting, analysis)
4) Powerful tools for the automation of (at least some) checks

Atmospheric composition

These Task3 activities are inter-connected

[R-17] Validation expertise with Atmospheric Chemistry background:
The contractor shall set up a PANDORA instrument and operate the system at the Physics department of the university of Rome, La Sapienza.
Ground based atmospheric instrumentation set up and operated at La Sapienza shall be used in synergy with the PANDORA instrument.
The work shall include the set up of an Urban boundary layer validation site, including procedures and protocols for satellite validation activities (e.g. OMI, ACE).
Further Urban pollution monitoring and atmospheric boundary layer studies shall be performed.

[R-20] OMI validation support:
The contractor shall implement a dedicated support for validation activities for the Third Party Mission OMI. The work shall comprise a data analysis part, as well as the set up of a ground based instrumentation (PANDONIA) for validation purposes. The contractor shall procure two Pandora instruments for the field calibration.

[R-21] Aerosol remote sensing - Sensitivity studies ISTINA:
The contractor shall implement a new WP dedicated to Investigation of Sensitivity Tendencies and Inverse Numerical Algorithm Advances in aerosol remote sensing. The contractor shall prepare a manuscript on the subject.

But also connected to this one (at least R-17 and R-20)

[R-29] Radiometric characterisation of array spectroradiometers and development of correction functions for stray light and linearity in support of ground-based mini spectrometers:

The contractor shall implement a project with the objective at improving the accuracy of array spectroradiometers that are widely used for satellite validation of various atmospheric products. Three main WP shall be focused at:

- Commissioning of tuneable laser system.
- Radiometric characterisation of array spectroradiometers using tuneable laser sources.
- Development of correction methodologies for stray light and linearity.

Instruments available at Univ. Sapienza, Rome (part 1)

INSTRUMENT	DESCRIPTION	WAVELENGTHS	MEASURED PARAMETERS	AVAILABLE PARAMETERS	SPATIAL RESOLUTION	RESOLUTION TIME	MEASURES DAYTIME / NIGHT	IN OPERATION SINCE..
PREDE	Sun-sky radiometer.	315, 400, 500, 675, 870, 8940, 1020 [nm]	Direct and diffuse solar irradiance.	Optical thickness, single scattering albedo, phase function, asimmetry factor, refractive index for each wavelength. Volume distribution and Angstrom coefficient. Columnar content of precipitable water.	Measurements columnar.	5 mins (may vary depending on the need).	Measurements daytime.	Autumn 2009.
BREWER	Solar Spectrophotometer.	UV: 306, 310, 313, 316, 320 [nm] VIS: 431, 437, 442, 448, 453 [nm]	Intensity of direct and diffuse solar radiation.	Total ozone, nitrogen dioxide, sulfur, the aerosol optical depth. Vertical profiles of ozone and UV irradiance spectra.	Measurements columnar.	Programmable measures according to the needs.	Measurements daytime.	1992
MFRSR	Il Multi-Filter Rotating Shadow-band Radiometer.	415, 500, 615, 671, 868, 937 [nm]	Global and diffuse solar radiation, total solar irradiance.	Measurement of aerosol optical depth, water vapor and ozone.	Measurements columnar.	The full sequence of steps is completed in 10 seconds and is programmed to perform 4 measurements per minute.	Measurements daytime.	1995

Instruments available at Univ. Sapienza, Rome (part 2)

Elastic LIDAR (LIght Detection And Ranging).	Instrument of active remote sensing of the distribution of aerosols in the atmosphere.	1064,532 [nm]	The backscattered radiation by molecules, aerosols, clouds.	Backscatter coefficient and extinction of aerosol backscatter ratio, depolarization ratio.	7.5 m	10 s	Measures day and night.	1995
SODAR 400 (SOund Detection And Ranging).	Doppler sodar in monostatic configuration, consisting of two emitter / receiver and a receiver, all three directed towards the zenith.	Acoustic waves. 4843.75 Hz	Thermal turbulence.	Wind speed vertical height of the mixed layer, frequency and wavelength of the atmospheric waves, etc..	1.42 m, fino a 110 m.	1 s	Measures day and night.	1995
LIDAR Raman (LIght Detection And Ranging).	Instrument of active remote sensing of the distribution of water vapor in the atmosphere.	Emitted: 355 nm Collected: 407.386 nm	Raman backscattered radiation by water vapor and nitrogen.	Water content .	7.5 m	10 s	Measures day and night.	1990
Sonic anemometer.	Instrument of active remote sensing of wind speed .	Acoustic waves.	Doppler shift of the speed of sound in the atmosphere.	Wind speed, temperature, turbulent variables.	In situ	20 Hz	Measures day and night.	To install.

All those instruments will operate in synergy with two Pandoras: the first will be located at the University Sapienza, on the roof of the Physics Department building, very close to the PREDE instrument, in the city centre. The second will be installed at ESRIN on the roof of Building 2 (above Room E), 200m higher than the first one and in an almost clean environment.

We would like to establish a link with the Medicine Faculty of University Sapienza (they have some instruments operating and could be interested in the monitoring of pollutants), with the ARPA (in charge of the monitoring of air quality with in situ instruments), CNR (atmospheric instruments close to ESRIN).

Spare slides

CALIBRATION

The Committee on Earth Observation Satellites (CEOS)'s Working Group on Calibration and Validation (WGCV), and ISO 9000, defines **Calibration** as

the process of quantitatively defining the system responses to **known, controlled signal inputs**

Correspondingly a calibrated product is the output from the complete calibrated data generation chain. **Indirect**, or **vicarious**, calibration simulates the signal at the satellite sensor input based on independently measured geophysical parameters and then compares it to the actual signal measured by the sensor. The outcome of the comparison can be used to calibrate the sensor output.

VALIDATION

The WGCV and ISO 9000's definition of **Validation** is

the process of assessing, by independent means, the quality of the data products as derived from the system outputs

Geophysical validation ensures that the quality of geophysical products derived from the system is properly assessed by independent means and via **quantification of the uncertainties at any stage of the product processing chain**.

A validated product is thus the output from the **complete validated data generation chain**.

For satellite instruments these definitions cannot be applied rigorously.

Calibration (Level 1):

•How do we get a "known controlled signal input" in space?

- Impossible, even for instruments equipped with calibration bodies (ATSR)

•How do we check the "complete data generation chain"?

- We should fill the instrument with other instruments (stable? calibrated?)

In practice, only "vicarious calibration" is possible. However, it relies on the "calibration of the calibrators" and on assumptions/modelling on other factors (e.g. atmosphere, surface reflectivity)

Validation (Level 1 and Level 2):

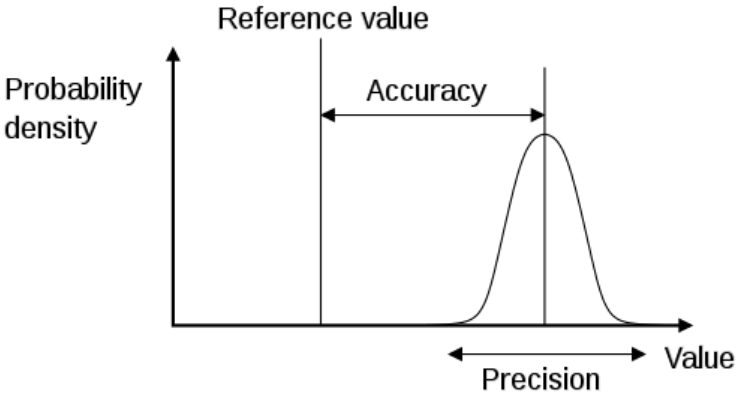
•What do we consider "independent means" ?

- For atmospheric Level 2 products we rely on data from remote sensing and in situ instruments (calibrated? validated? accuracy&precision?)
- For Level 1 (spectra, integrated radiances) the situation is more complex.

The **Accuracy** of a measurement system is the degree of closeness of measurements of a quantity to that quantity's actual (**true**) value.

The **Precision** of a measurement system is the degree to which repeated measurements under **unchanged conditions** show the same results.

A measurement system can be accurate but not precise, precise but not accurate, neither, or both. For example, if an experiment contains a systematic error, then increasing the sample size generally increases precision but does not improve accuracy. The result would be a consistent yet inaccurate string of results from the flawed experiment. Eliminating the systematic error improves accuracy but does not change precision.



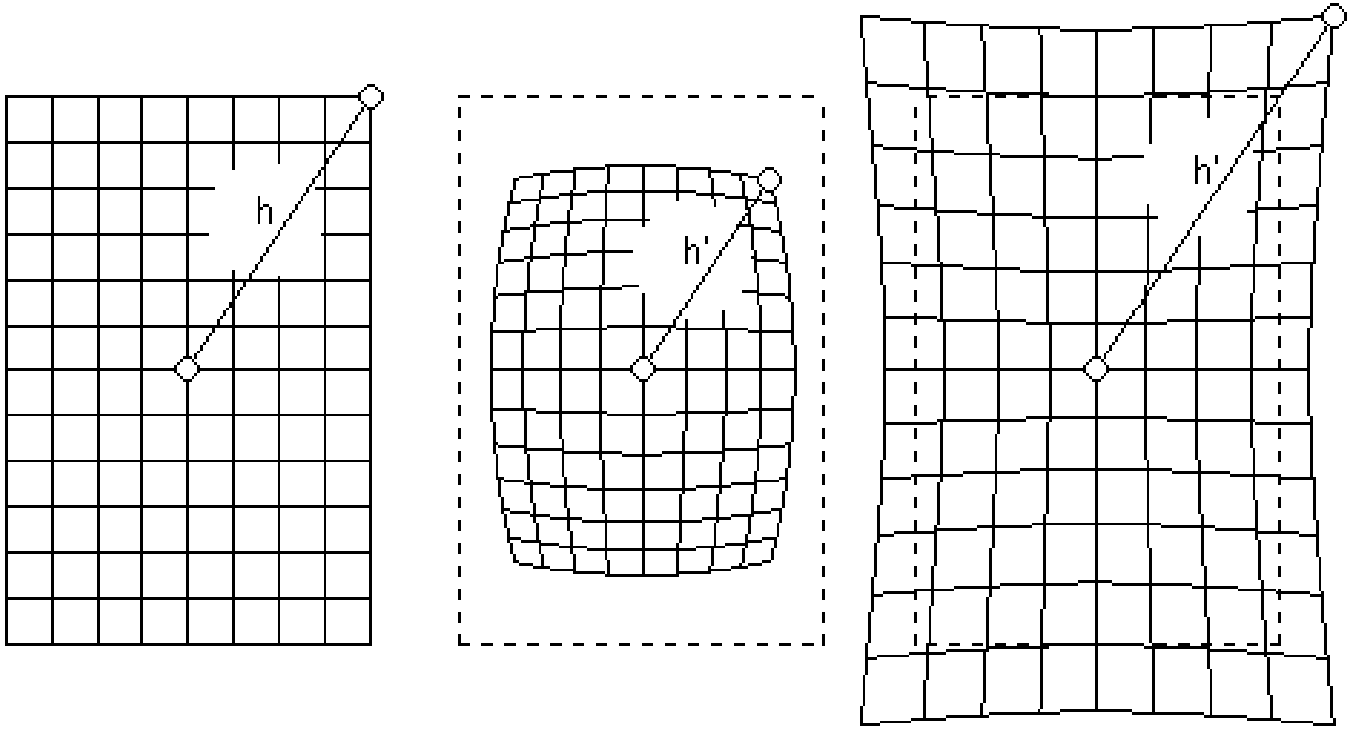
Trueness is the closeness of the mean of a set of measurement results to the actual (**true**) value and precision is the closeness of agreement among a set of results

Low accuracy, poor precision, good trueness

Low accuracy, good precision, poor trueness

Rigorously, we should compare satellite data to the "**truth**" in order to estimate ACCURACY, PRECISION, and TRUENESS.

Unfortunately, there is no "**truth**" to compare with!
All we can do is to compare what the satellite instrument sees with its "glasses" with what other instruments see with their own "glasses"!.



Truth (unknown) Validation Reference Satellite Instrument

The publication of a scientific paper is an excellent measure of your degree of understanding of a problem (of general interest). It should be strongly encouraged/supported by IDEAS+ management.

The production of a TN is definitively NOT ensuring that you really got the point, nor that you used the most appropriate methodology. In this respect, a sort of review/criticism mechanism could be implemented within IDEAS+, involving people with common skills (“no conflict of interest”). This should imply the possibility to strongly criticise ourselves, without blaming each other, with the aim of giving a better “service to the customer”.