



The **GLOBE** Program



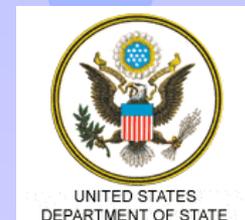
SME Advies

Satellite validation using highschool student data

KNMI-Globe Aerosol Project

www.knmi.nl/globe

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Hoeven,
J de Vroom, D Brooks, S Stockman, and PF Levelt



Contents

- GLOBE international
- KNMI team & goals
- The method
- Results
- Validation
- Outlook

The GLOBE Program



Students collaborate with scientists



Hands-on science



<http://www.globe.gov>



Atmosphere/Climate
Hydrology
Soil
Land Cover/Biology
Phenology

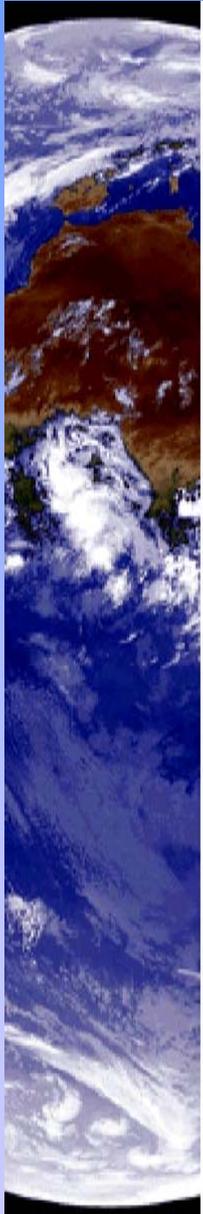


Over 14 million environmental measurements reported



International Program in 109 countries





GLOBE The Netherlands

Secondary schools

“Basisvorming” (12-15 year olds)

- Module Weather & climate
- Module Water
- Module Nature Calender

“Tweede Fase” (final years, 15-18 year olds)

- Module Aerosols
- Module Soil

Every module has *knowledge institute* partner



SME Advies

Rijk Nederlands Meteorologisch Instituut



KNMI team & goals

New project scientist: Tim Vlemmix

New leader: Ellen Brinksma



Until Nov 1, 2005: Joris de Vroom & Folkert Boersma

Strong collaboration with D. Brooks, S. Stockman

Goals:

1. Outreach – get satellite research (OMI) and atmospheric research knowledge to schools
Generate publicity for OMI (press coverage of GLOBE events)
2. Science validation of OMI aerosols (previously – MODIS)
School measurements provide potential for dense network that cannot be reached with professional instruments
 - (~30-40 locations compared to ~ 3-4?)

Goals for 2006-2008



Large increase of nr participating schools
(now active <10, next years ~ 30 to 40)

“Aerosols” module will be part of new curriculum (2007-2008)
Note: Module was tested, very enthusiastic reactions.

KNMI trains teachers to train students & use module

SME coordinates GLOBE the Netherlands & organizes efforts

Rework module to include OMI (was MODIS)

Quality control of school measurements

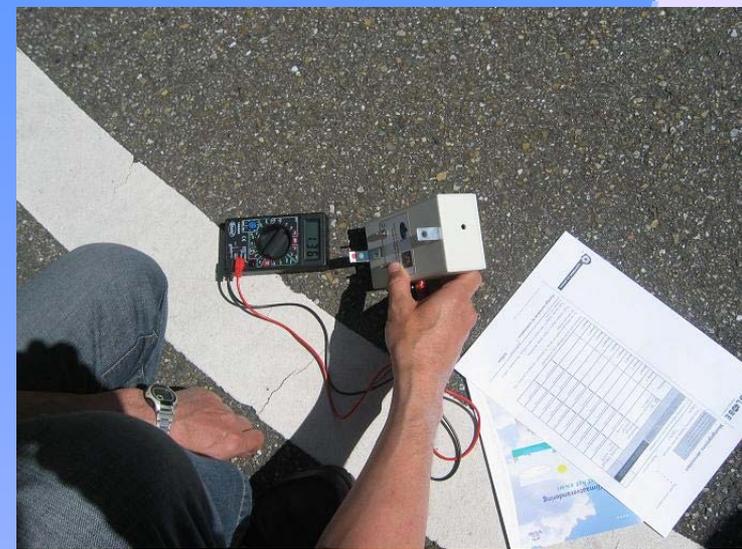
Use for OMI validation





Tools

Instruments by Dave Brooks (US Globe)
calibrated at KNMI



Quality control & feedback to schools by KNMI

Websites in NL and US (includes data entries)

Protocols written by GLOBE US, translated by SME

Educational module "Aerosols and UV" (in Dutch, SME-KNMI)

Funding situation GLOBE work by Brooks uncertain!



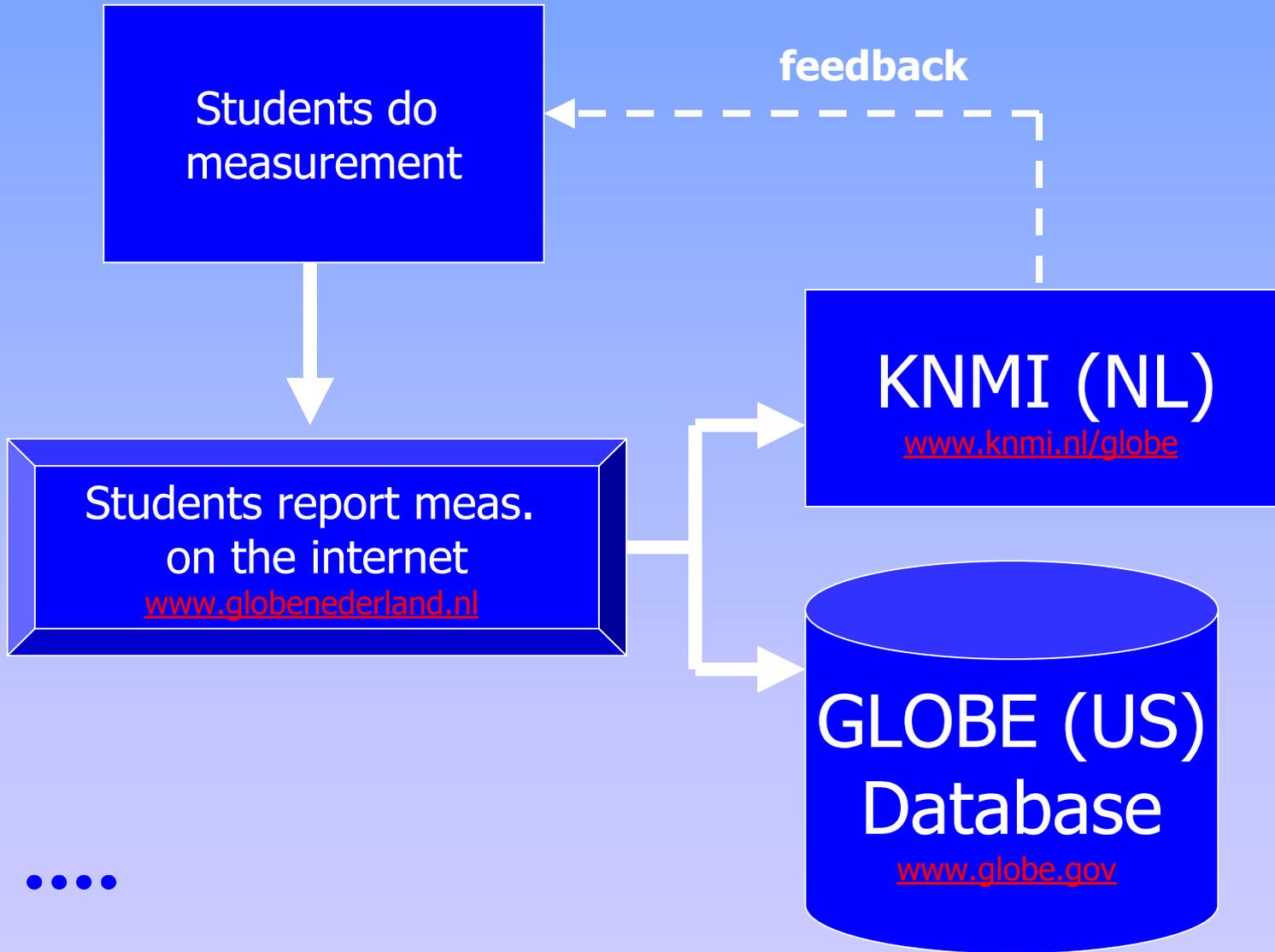


The GLOBE measurement

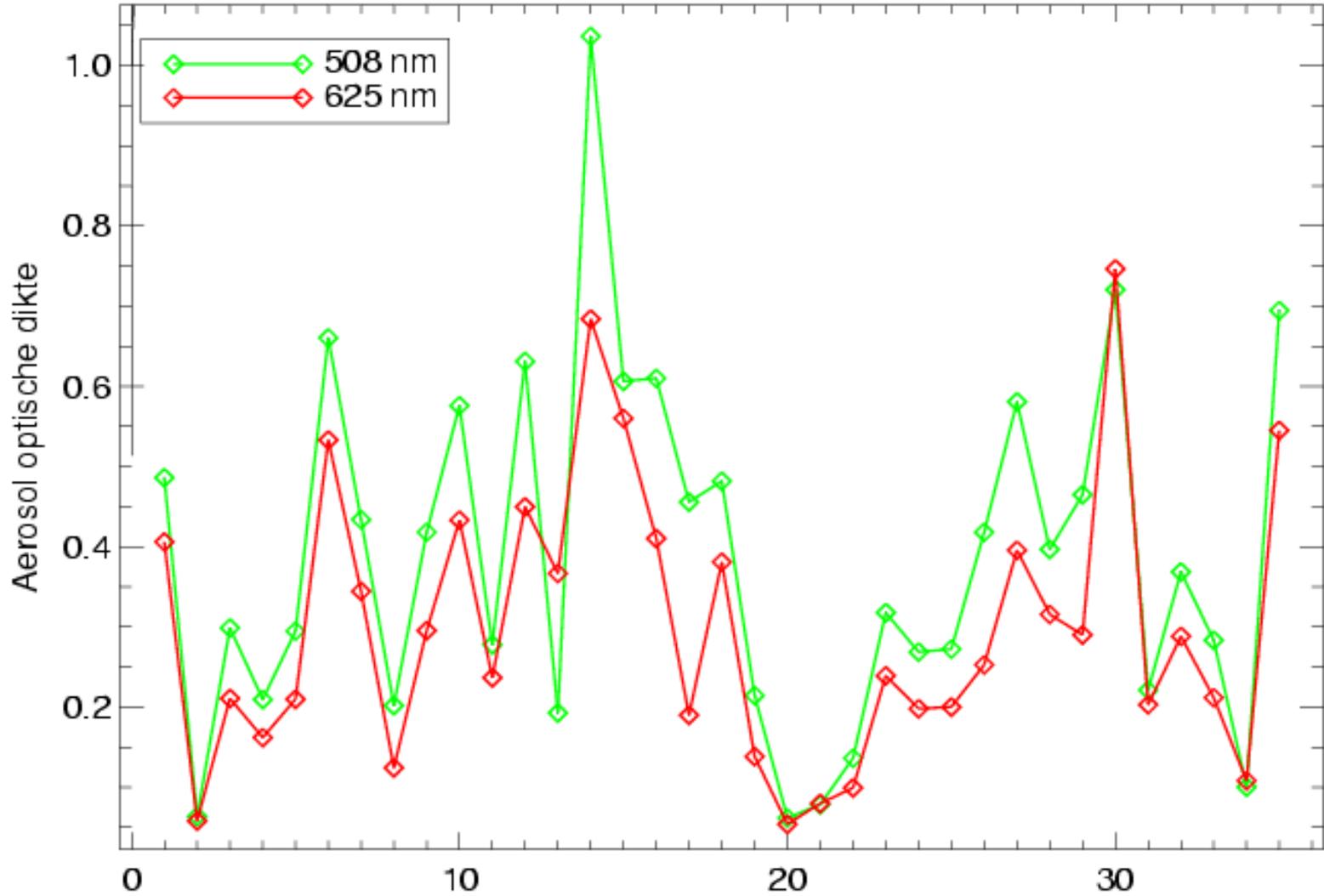


- Handheld Sun photometer
- 2 students together
- Measured quantity: light attenuated by aerosols
- 508 and 625 nm
- Results are reported on the internet → AOT calculation





Aerosol metingen Zwin college (Oostburg)

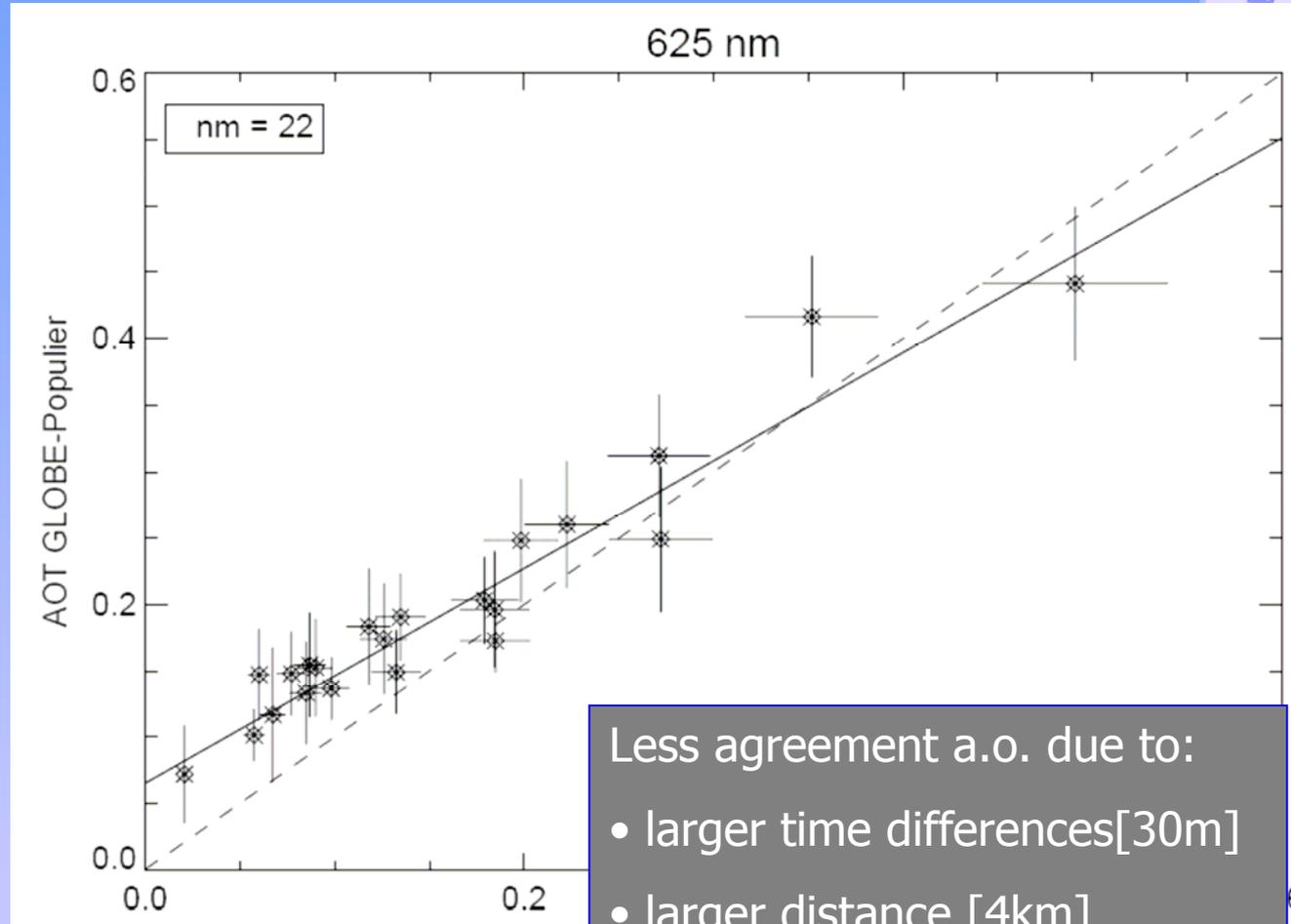


Comparison with AERONET (CIMEL) The Hague



Kon

- Measurements by students
- March 2002-September 2003
- $n = 22$
- AERONET interpolated to GLOBE wavelengths
- Larger dynamical range



Less agreement a.o. due to:

- larger time differences [30m]
- larger distance [4km]
- students vs. professionals
- calibration issues

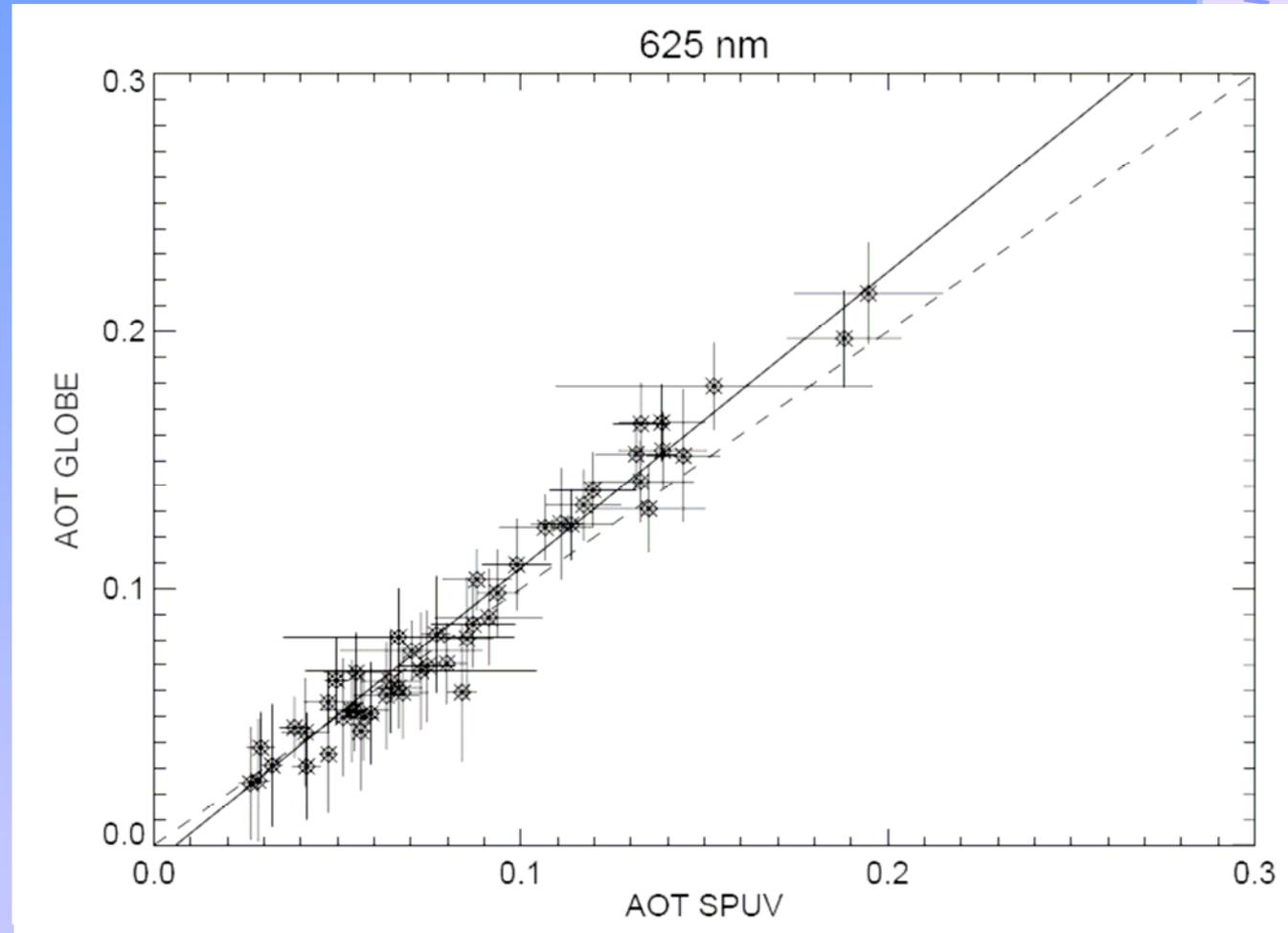
Location	n	R^2	Bias	RMS	Regression
KNMI 508 nm	49	0.992	-0.005	0.009	$y = -0.02 + 1.10x (\pm 0.06)$
KNMI 625 nm	49	0.980	+0.004	0.012	$y = -0.01 + 1.15x (\pm 0.08)$
De Populier 508 nm	22	0.956	+0.035	0.029	$y = 0.05 + 0.93x (\pm 0.06)$
De Populier 625 nm	22	0.927	+0.039	0.033	$y = 0.07 + 0.81x (\pm 0.10)$

Comparison with SPUV at De Bilt



Ko

- Measurements by professionals
- March 2002-September 2003
- $n = 49$
- SPUV interpolated to GLOBE wavelengths
- Modest dynamical range!

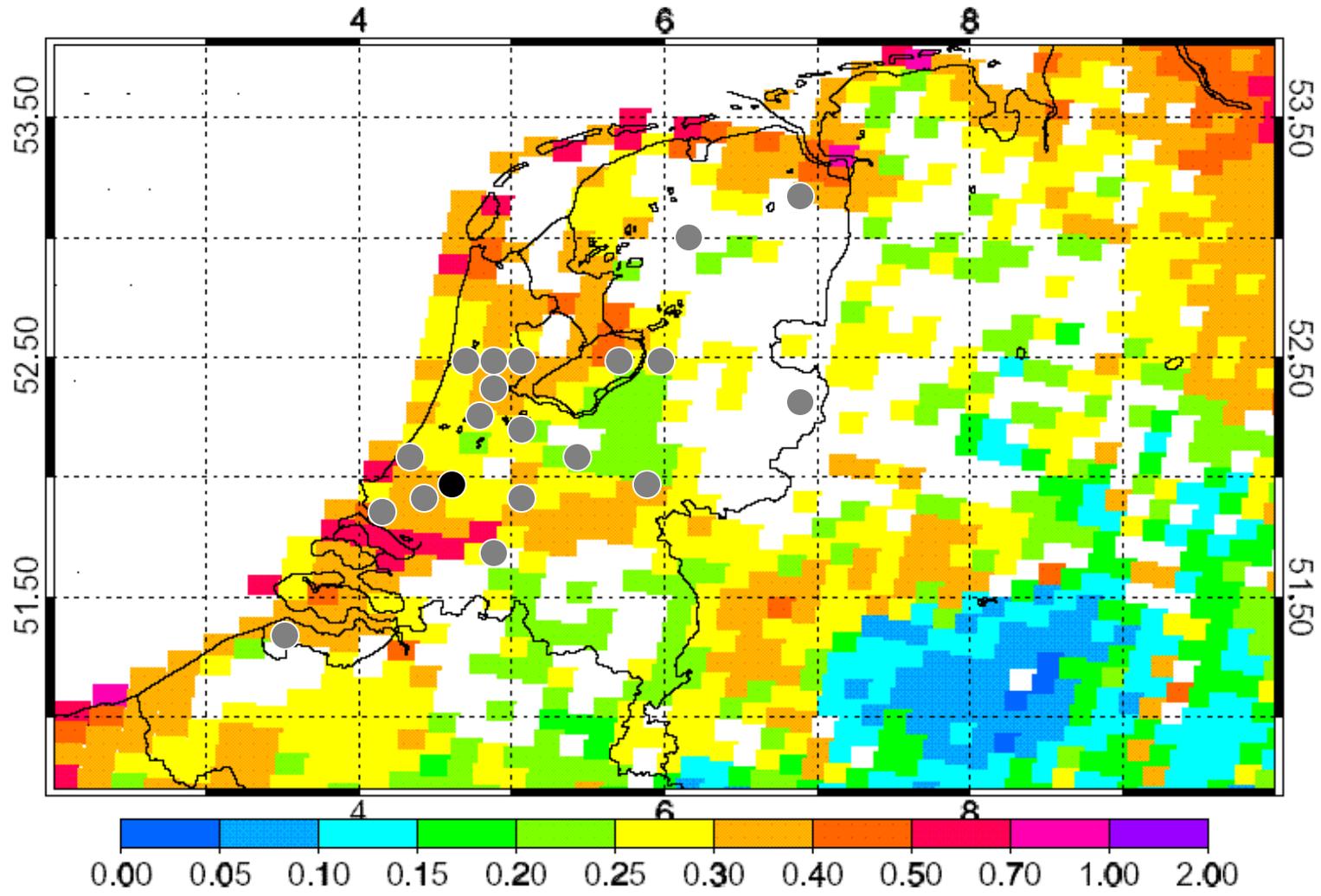


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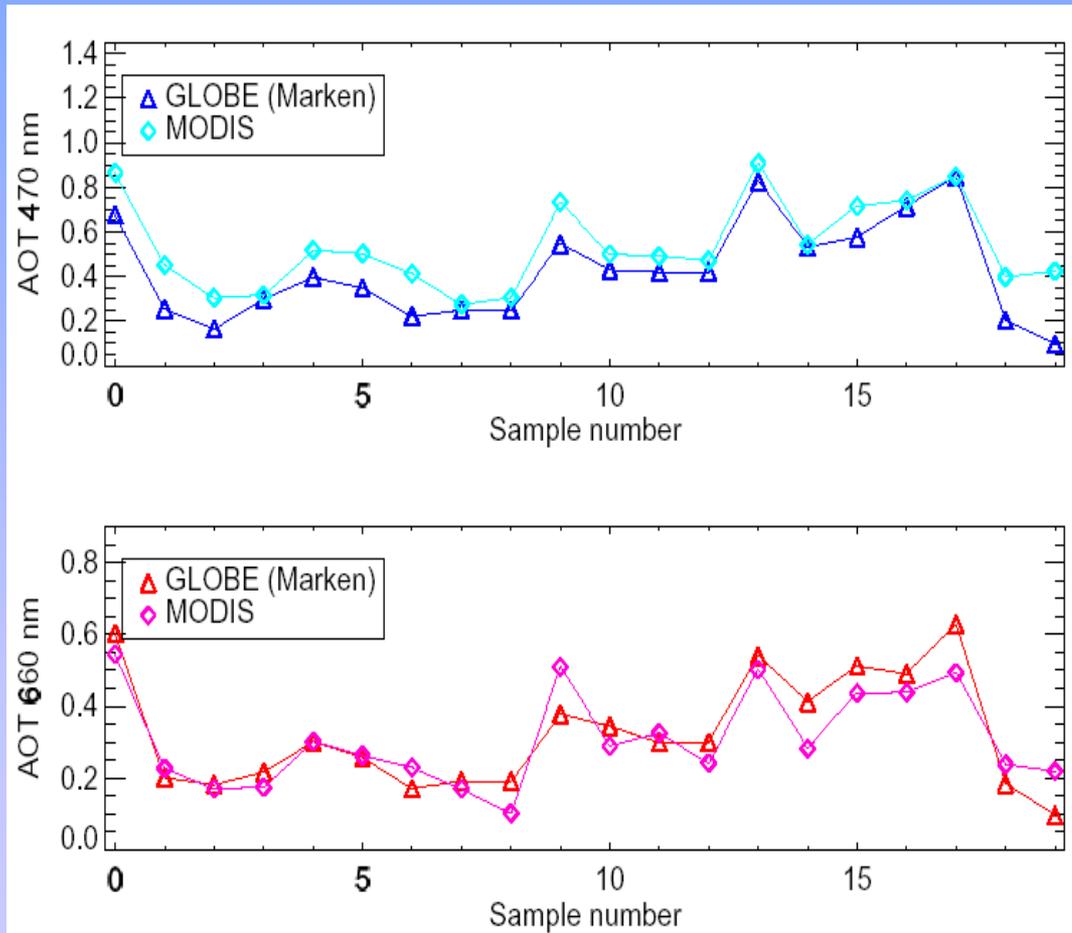


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Case 1: MODIS Validation



MODIS vs. GLOBE in Marken

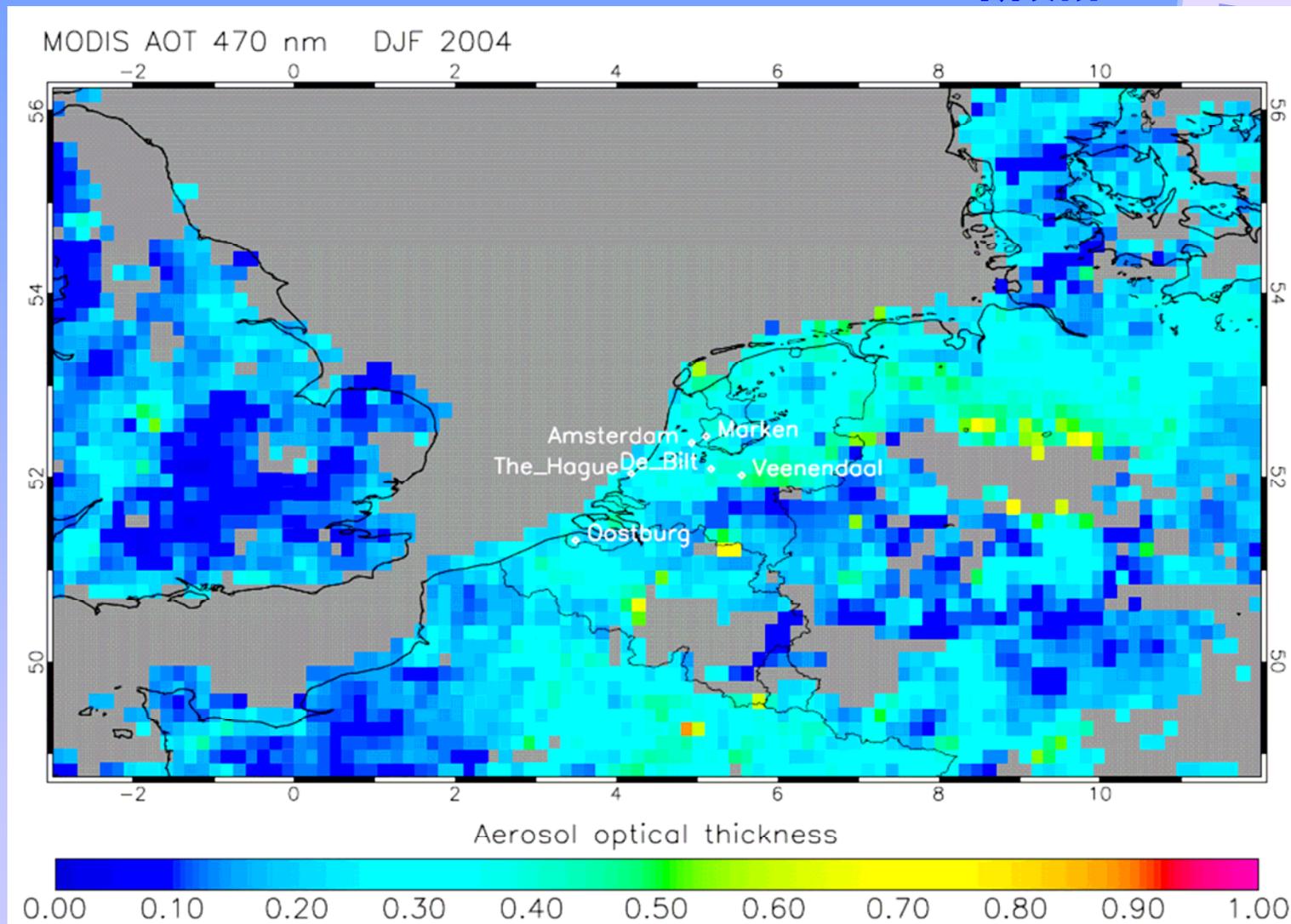


Previous work suggests student observations may be used to validate satellite observations

Demonstration case:

MODIS cloud-free AOT retrievals over land

5 schools with student measurements



MODIS validation with student observations in the Netherlands



470 nm

$$r^2 = 0.66$$

This work:

$$y = 0.10 + 0.78x$$

Remer et al.(2005):

$$y = 0.09 + 0.83x$$

660 nm

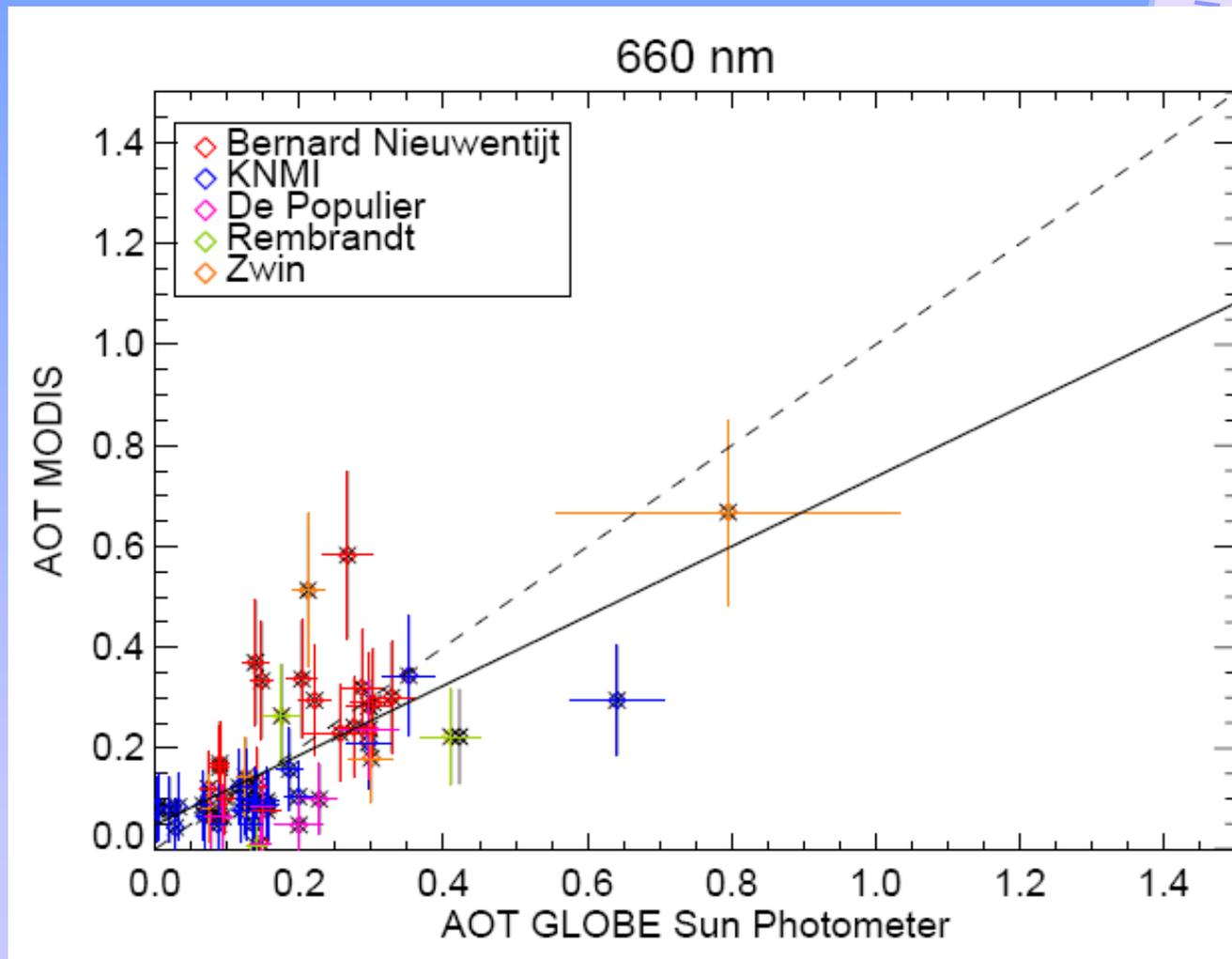
$$r^2 = 0.50$$

This work:

$$y = 0.05 + 0.69x$$

Remer et al.(2005):

$$y = 0.05 + 0.70x$$



Absolute mean Delta t = 65 minutes
n = 61

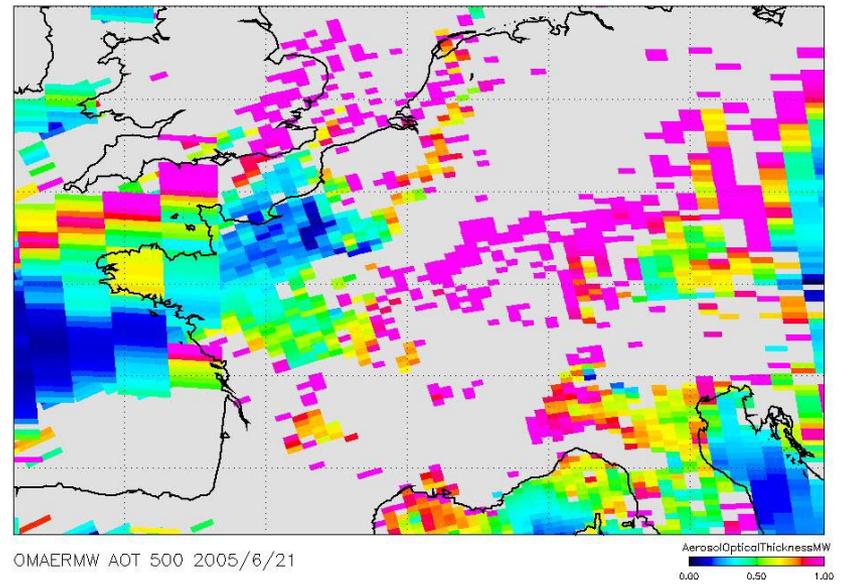
Conclusions on MODIS validation

- Students can do it!
- GLOBE provides a tight network of aerosol measurements
- Qualitative MODIS validation shows promising results
- Known feature in MODIS AOT identified by GLOBE students
- GLOBE Aerosols show science to students in a practical way

Results shown are from paper by Boersma & De Vroom, JGR, 2006 (accepted)

Planned for 2006- 2008: OMI validation

- Overpass files provided to participating schools
- Students & KNMI compare OMI aerosol and GLOBE measurements
- KNMI team uses results in validation (details depend on school record density)





Outlook

- MODIS paper in press (Boersma & De Vroom, JGR)
- Much larger effort (2 years fulltime) just started
- Increase of number of schools
- Regular checks on data quality, feedback

Contribute to validation of OMI aerosols:

- Intra-pixel variability
- Quantitative Omi validation

UV measurements? (Funding to be sought for

- collaboration with D. Brooks)