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Swiss Confederation

Federal Department of Home Affairs FDHA
Federal Office of Meteorology and Climatology **MeteoSwiss**

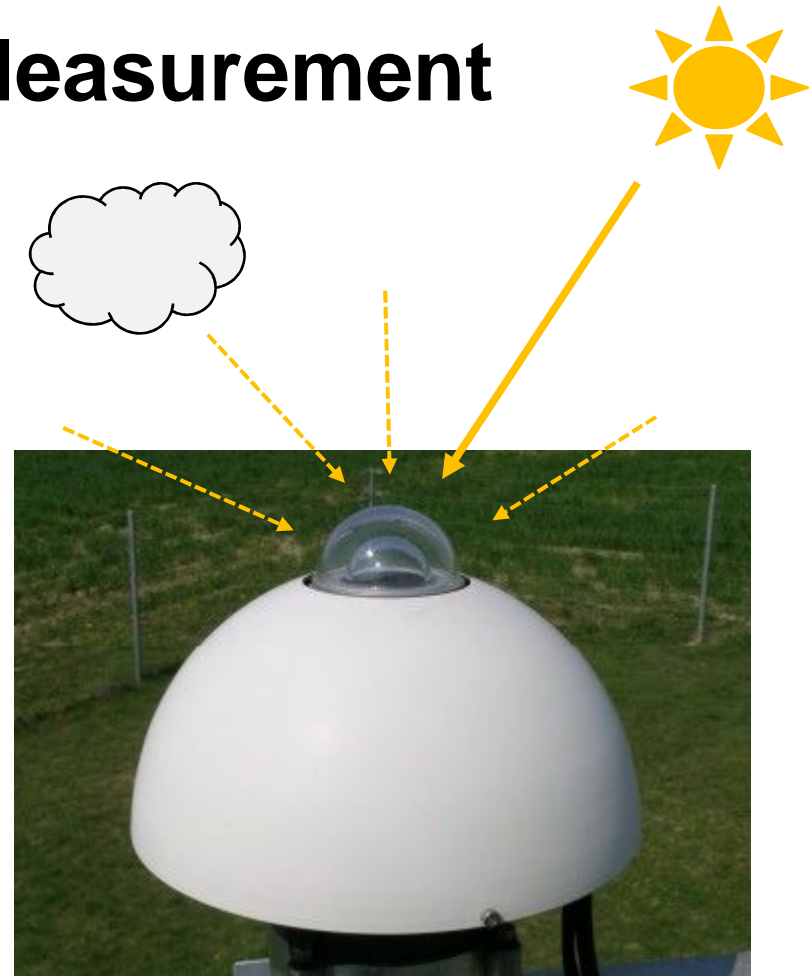
Verification of Global Radiation With Hourly Measurements Over Switzerland

Pirmin Kaufmann and Francis Schubiger
COSMO GM - WG5 Parallel Session



Global Radiation: Measurement

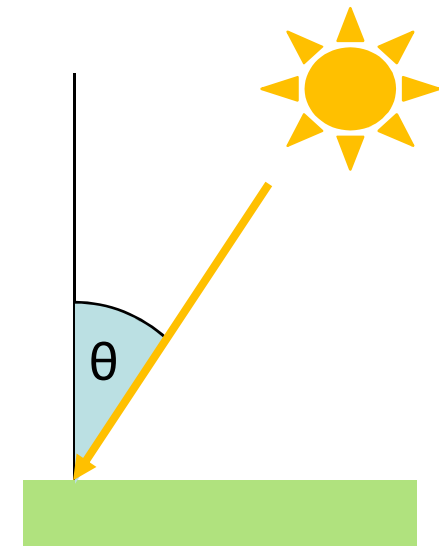
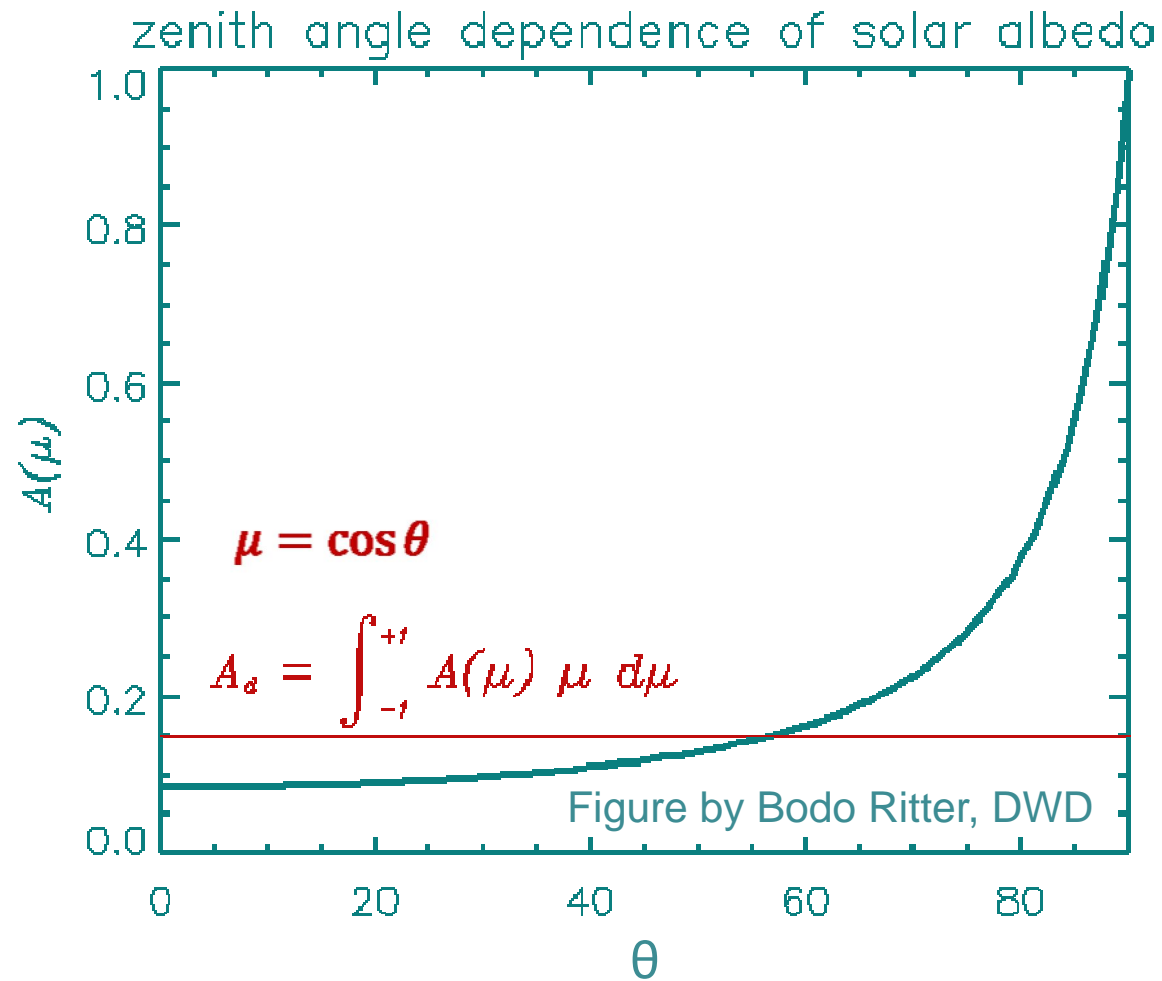
- Shortwave incoming radiation, measured by Pyranometer
- Consists of 2 components
 1. Direct radiation
 2. Diffuse radiation
- Instrument is always positioned horizontally (not parallel to surface)





Global Radiation from the Model

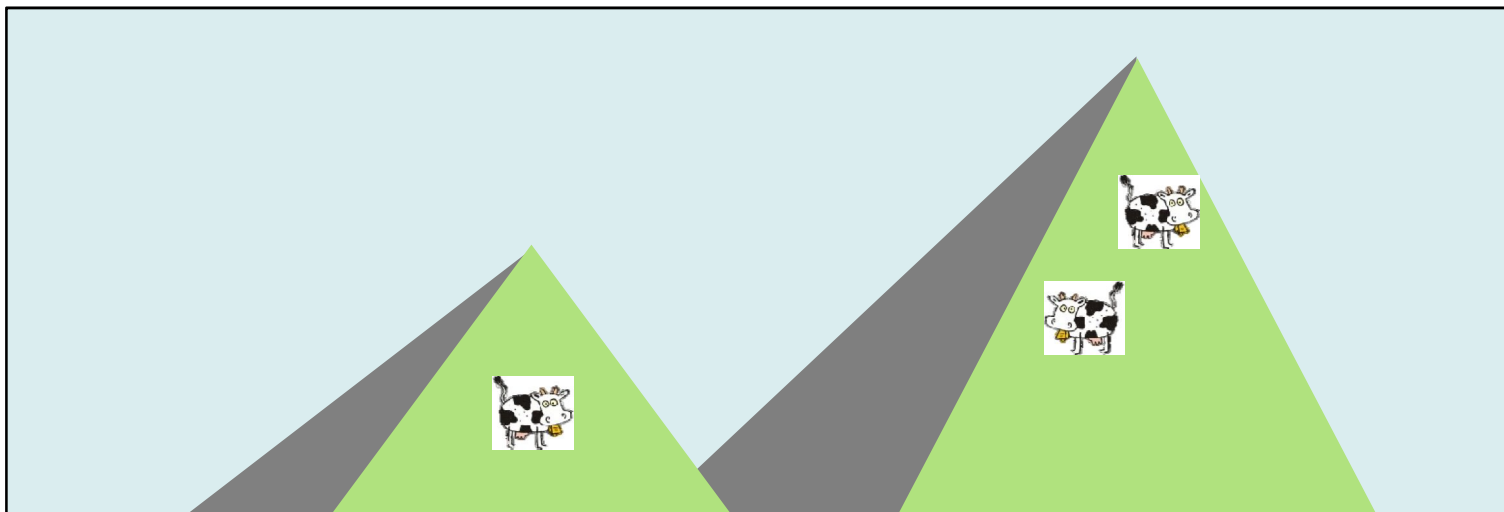
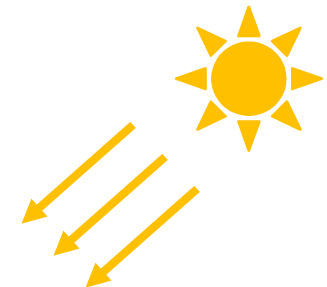
- **Old** approximation (e.g. "[Beschreibung des COSMO-DE-EPS und seiner Ausgabe in die Datenbanken des DWD](#)", 2012)
 - $GLOB = ASOB_S / (1 - ALB_RAD)$
 - Caveats:
 - ALB_RAD is the albedo for the diffuse radiation only
 - ALB_RAD is an instantaneous value, ASOB_S an accumulated value → inconsistency
- **New** output available since about 2 years (but not yet documented): Sum of output parameters
 - $GLOB = ASWDIR_S + ASWDIFD_S$





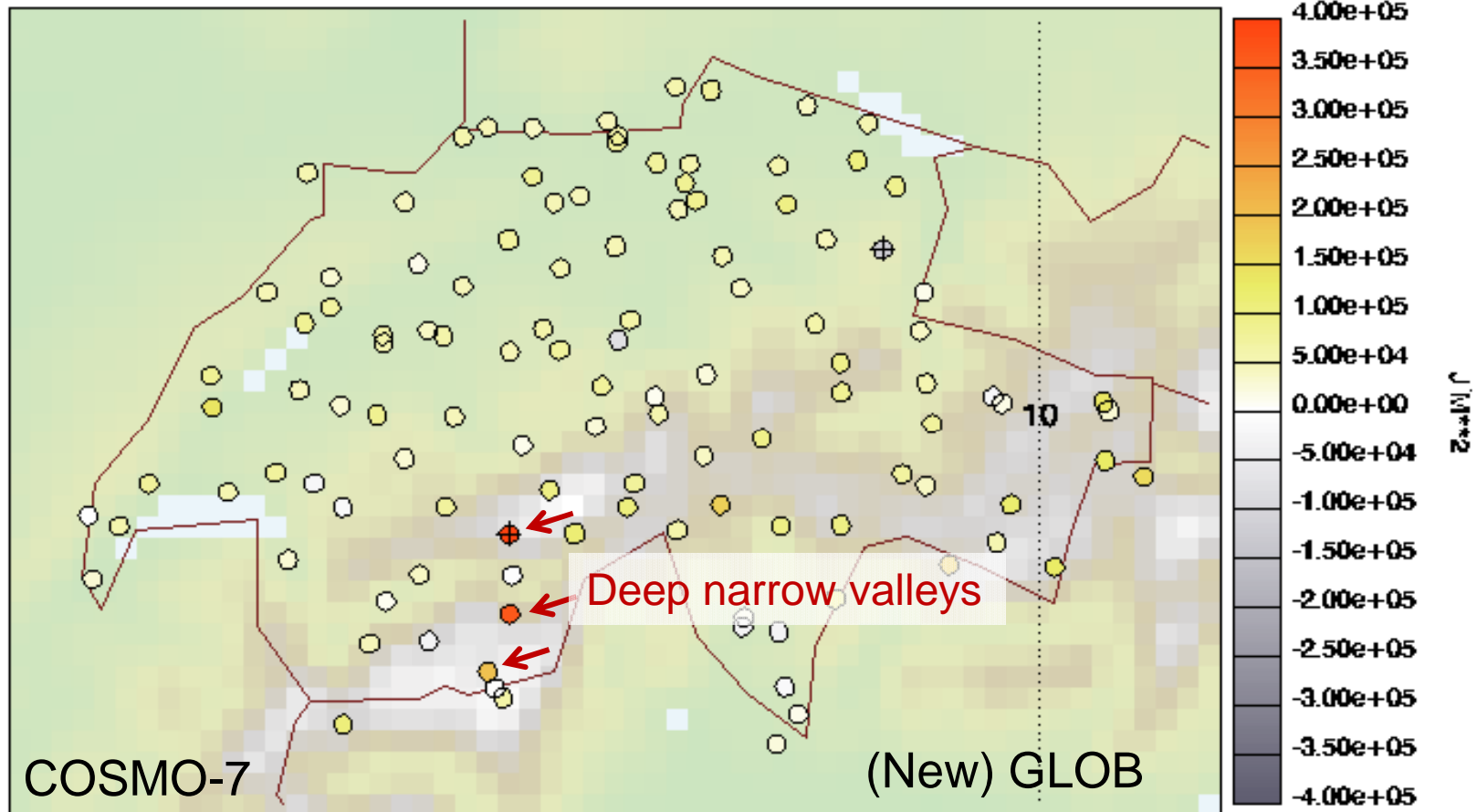
Radiation and Topographical Correction

- COSMO-7 runs without topographical correction of radiation (lradtopo=.false.)
- COSMO-2 runs with topographical correction of radiation turned on (lradtopo=.true.)
 - Include exposition and inclination of terrain
 - Include shading effect of topography
 - Include visibility of sky



Verification: Bias Spring 2013 (MAM)

GLOB: ME



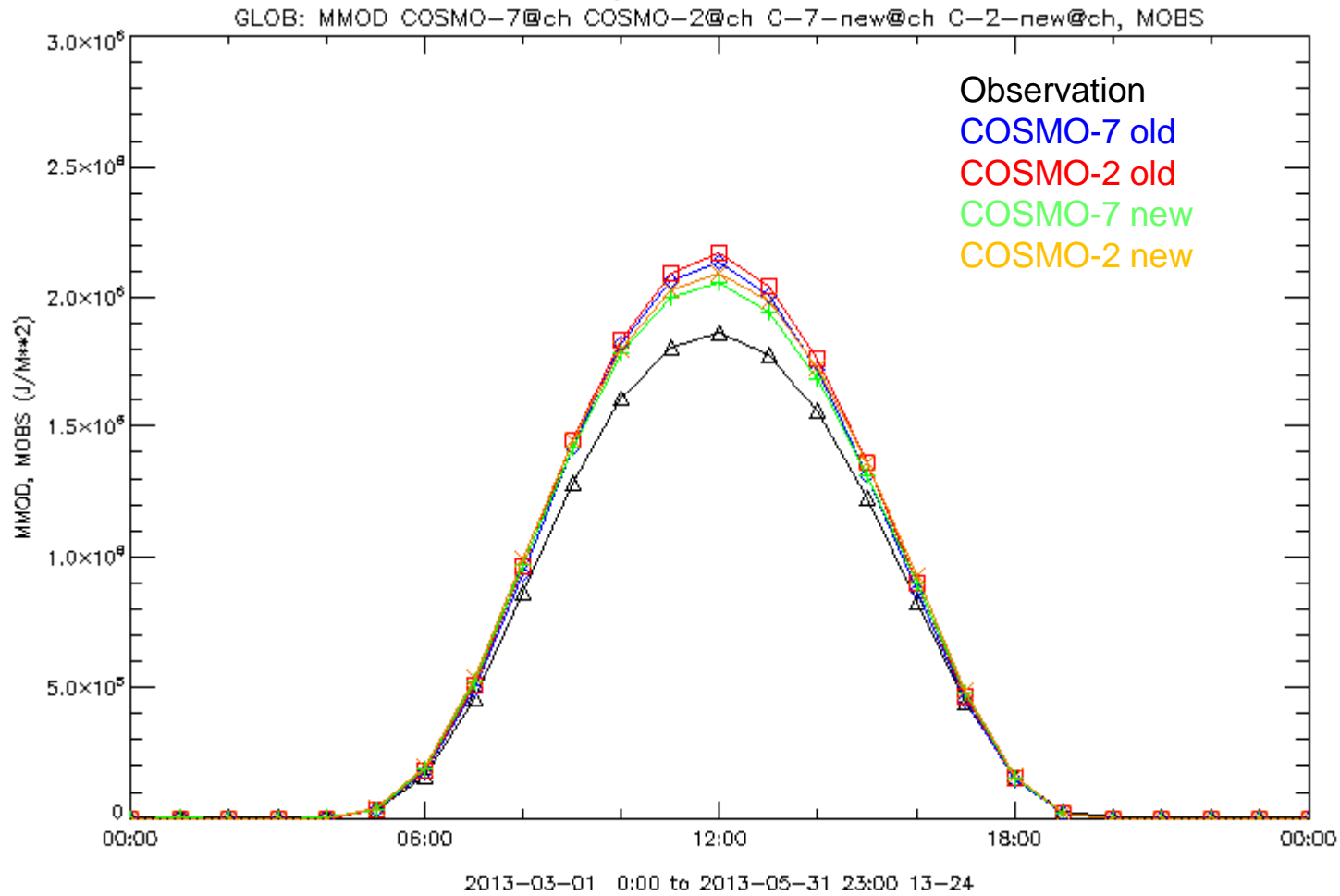
C-7-new@ch 2013-03-01 0:00 to 2013-05-31 23:00 13-24

+Min: -1.173e+05 J/M**2 at station 06680 +Max: 5.147e+05 J/M**2 at station 06725



Spring 2013 (MAM)

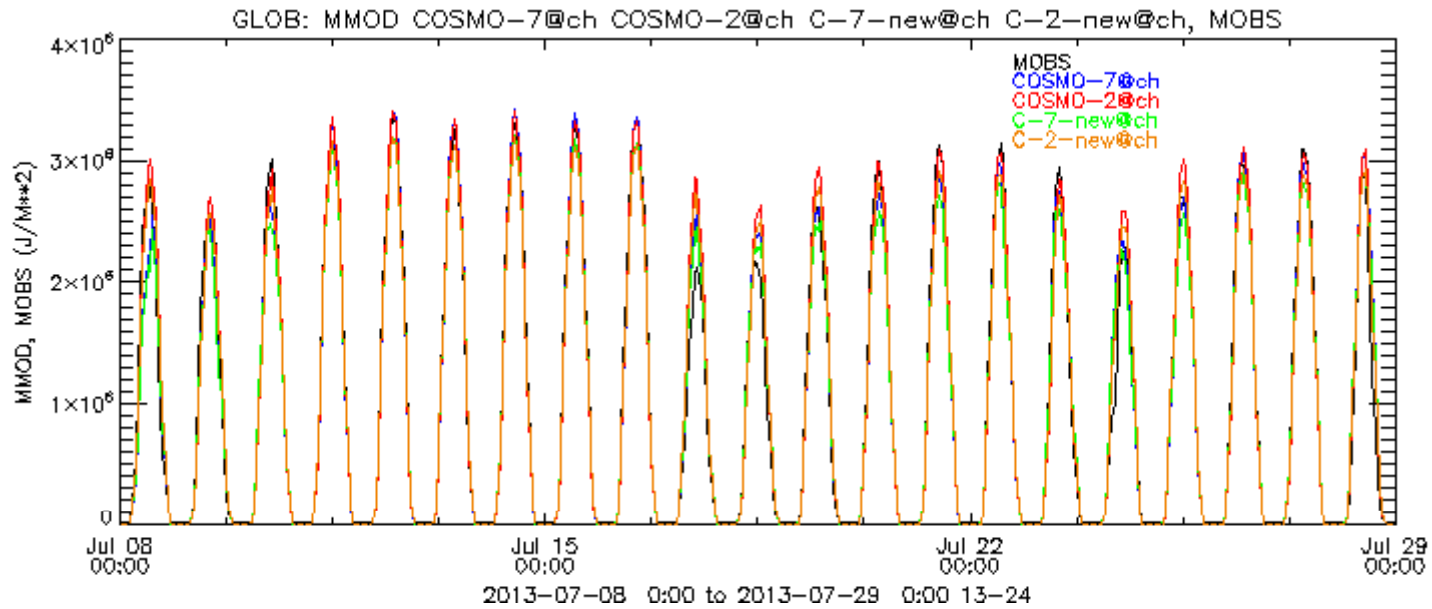
Mean diurnal cycle GLOB



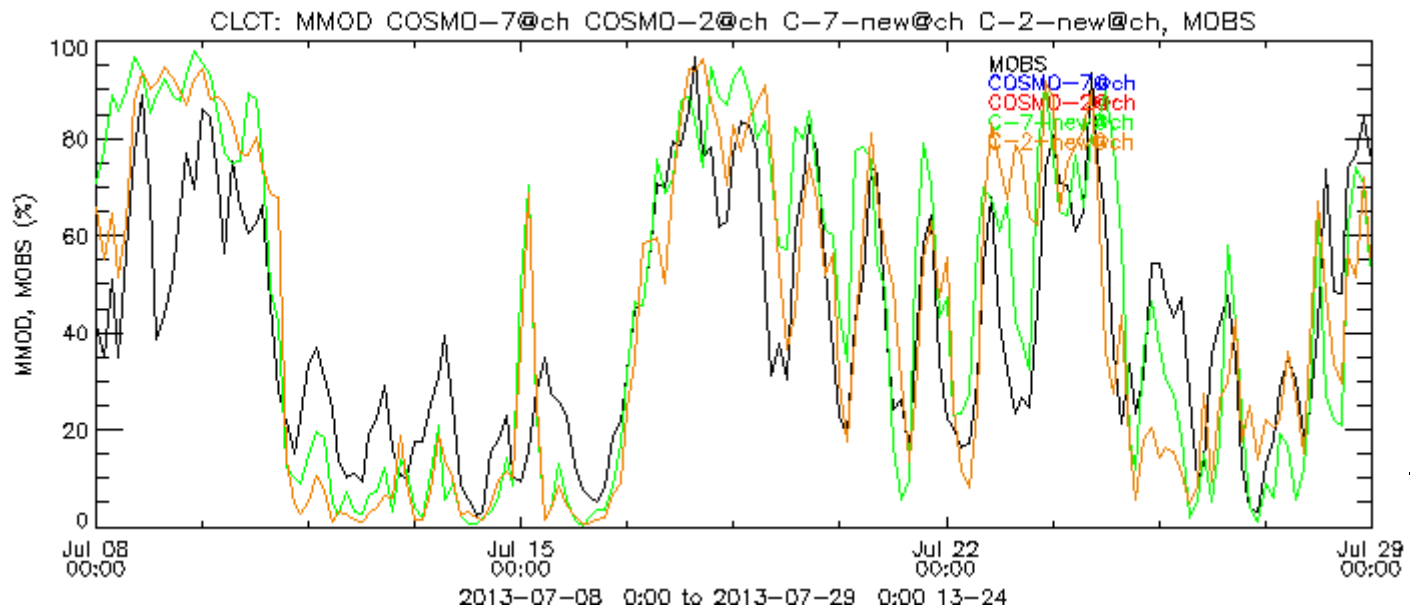


Clear days: 21 days in July 2013

GLOB



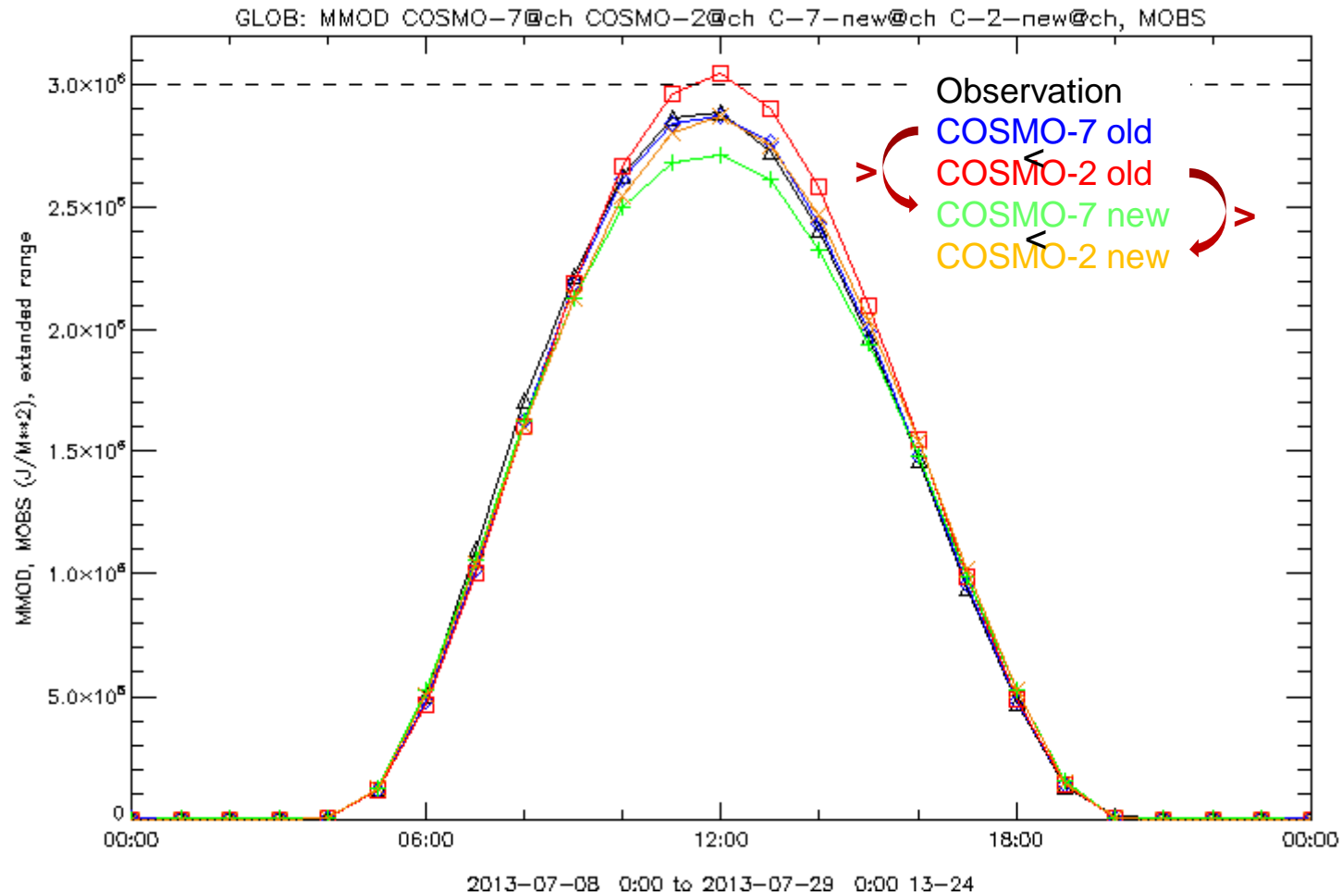
CLCT





21 days in July 2013

Mean diurnal cycle of GLOB

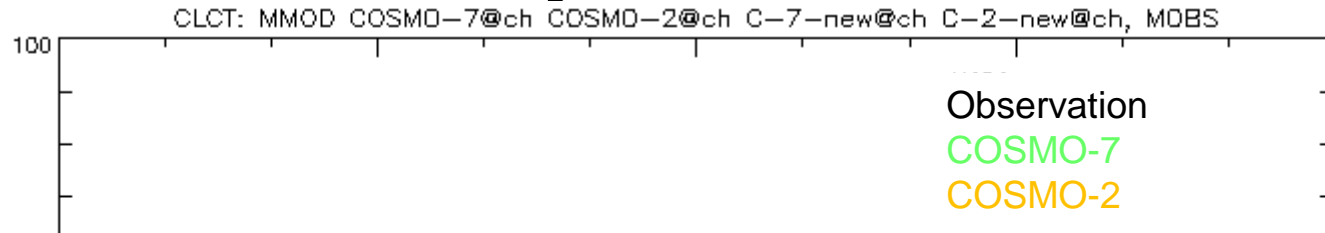


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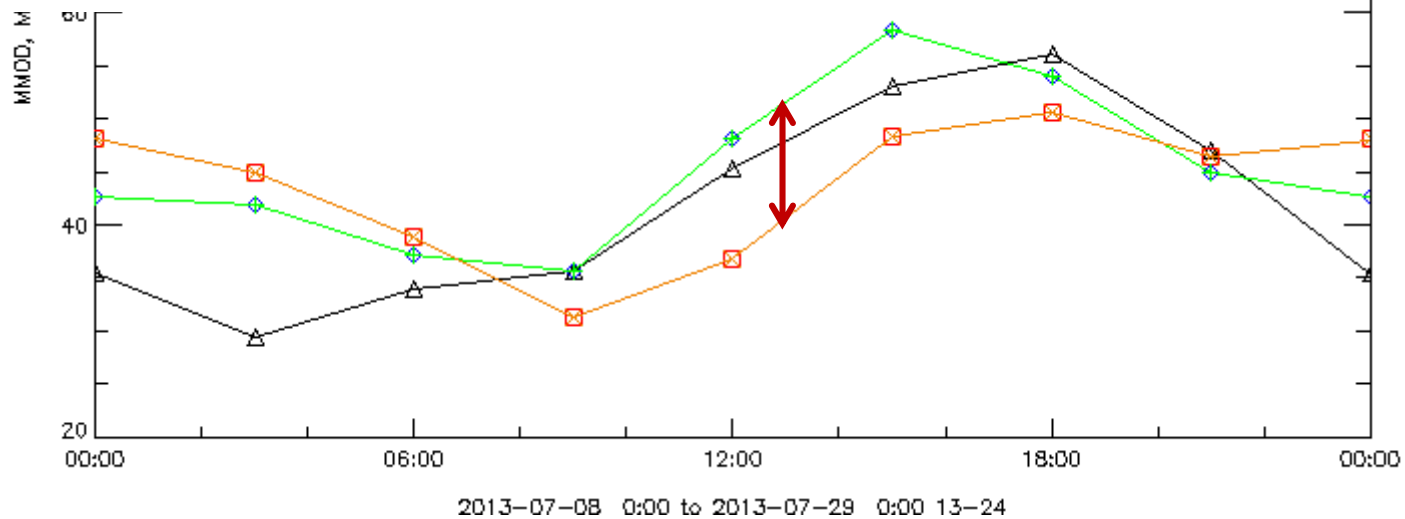


21 days in July 2013

Mean diurnal cycle of CLCT



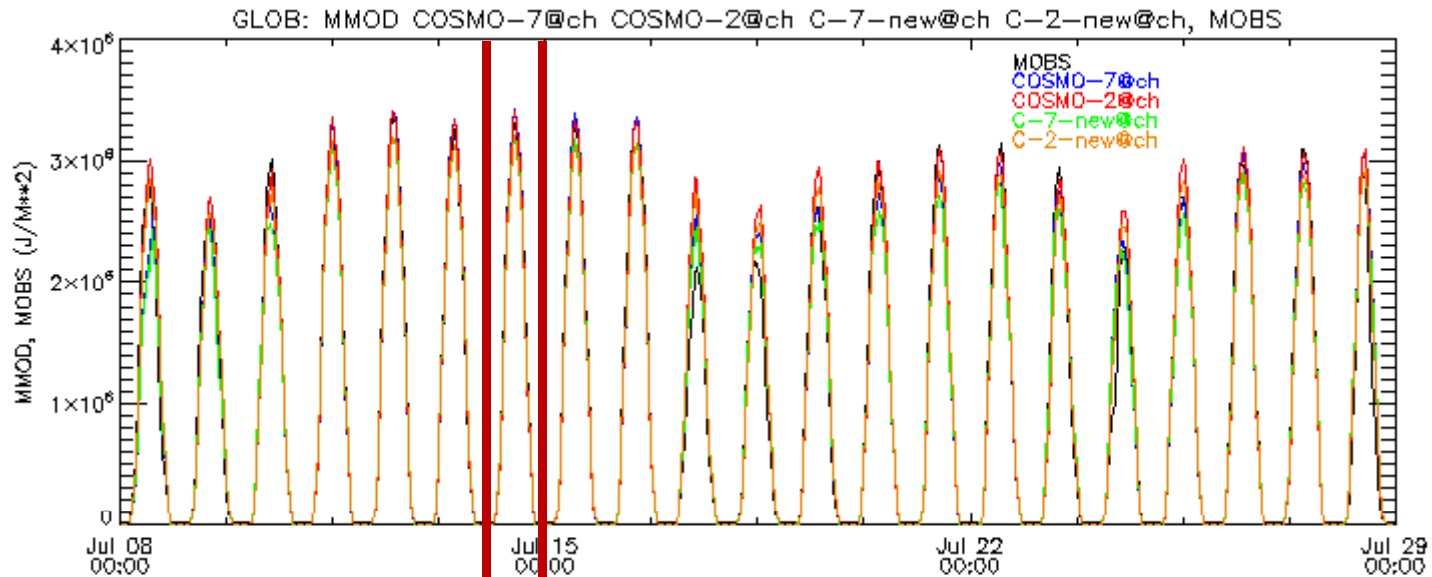
Difference in radiation between COSMO-7 and COSMO-2 is due to different cloudiness



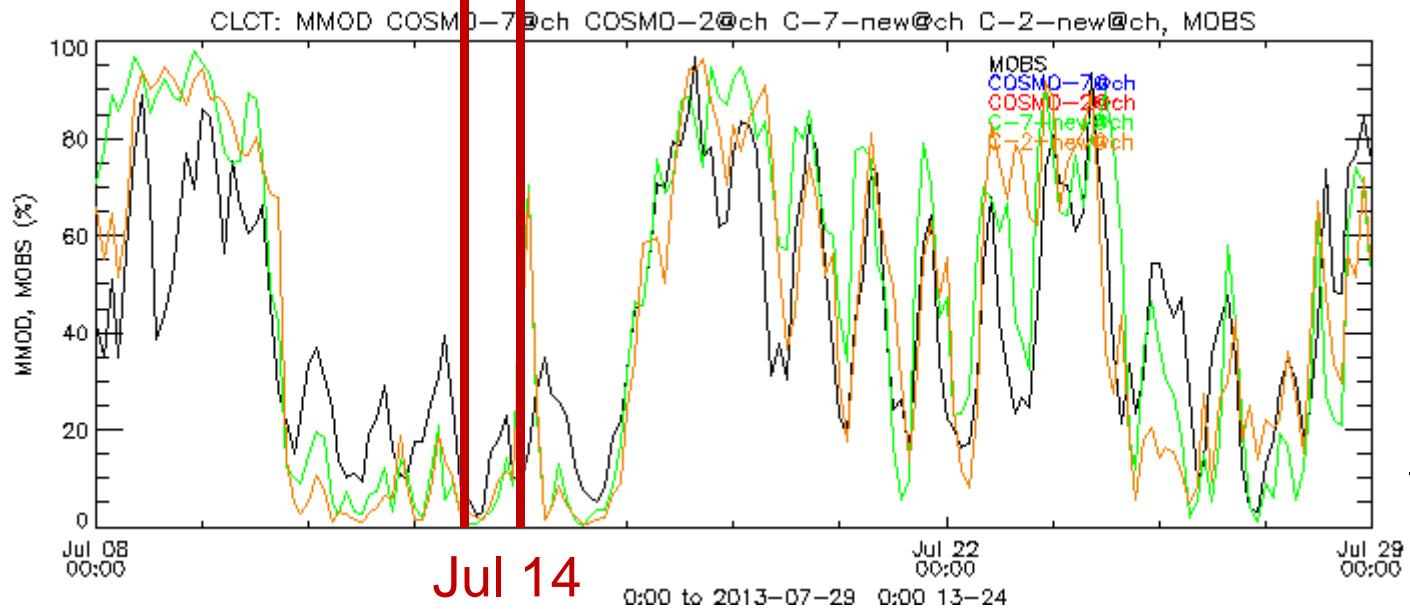


Clear days: 21 days in July 2013

GLOB



CLCT

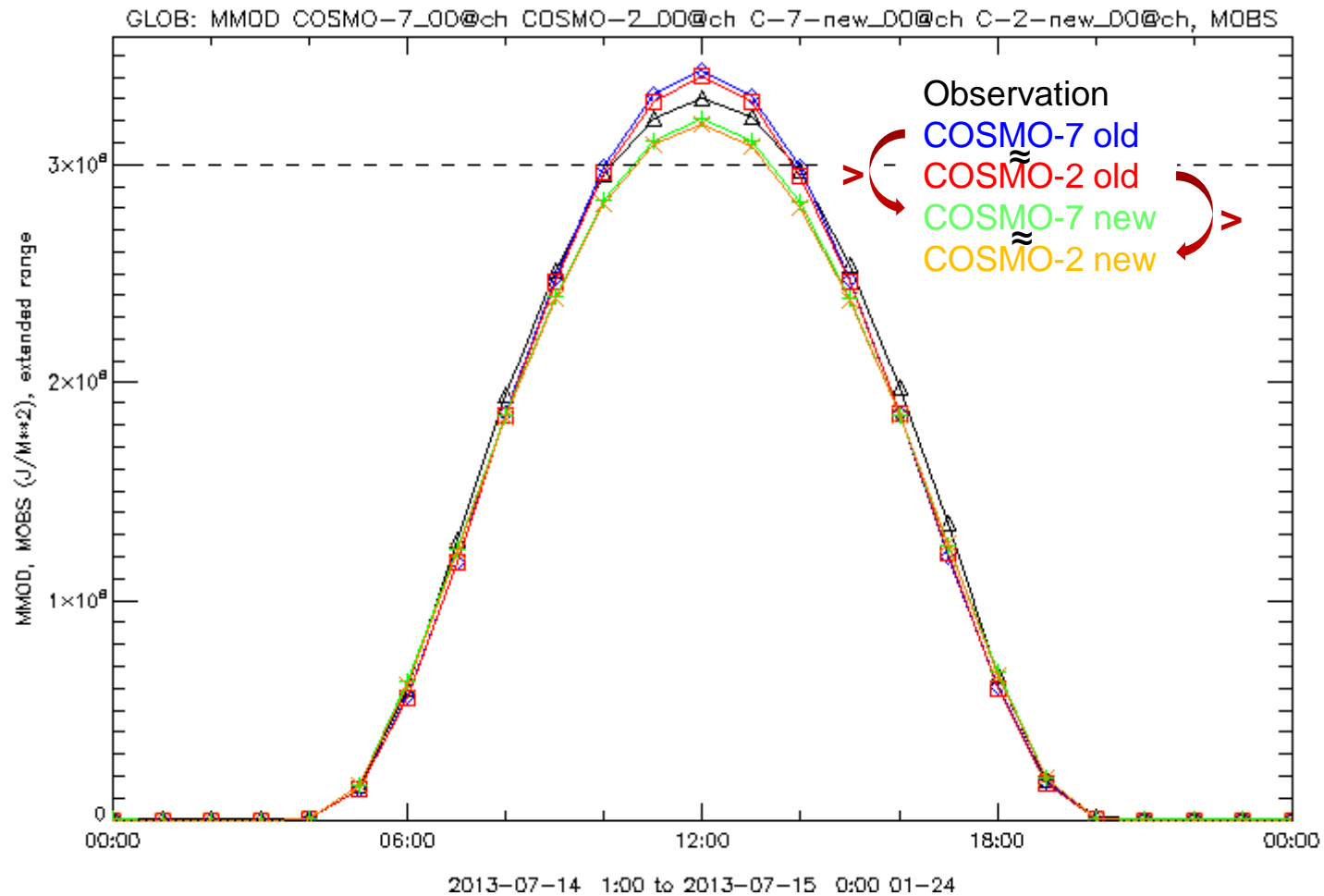


Jul 14

0:00 to 2013-07-29 0:00 13-24



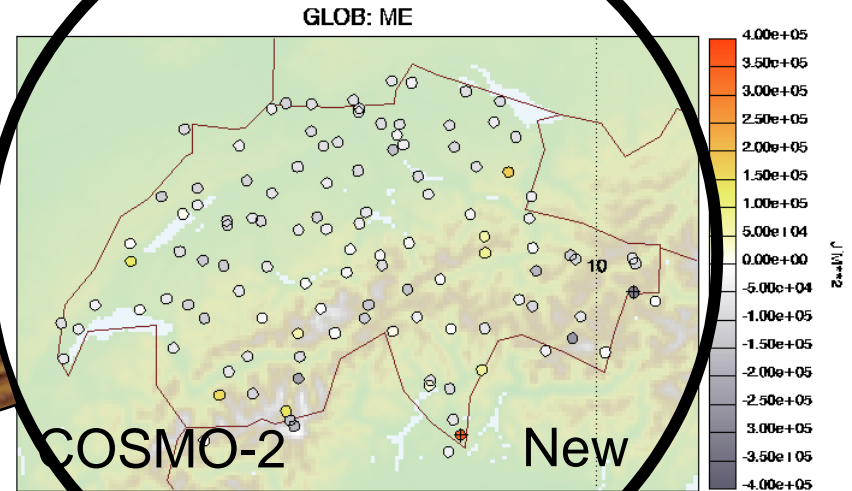
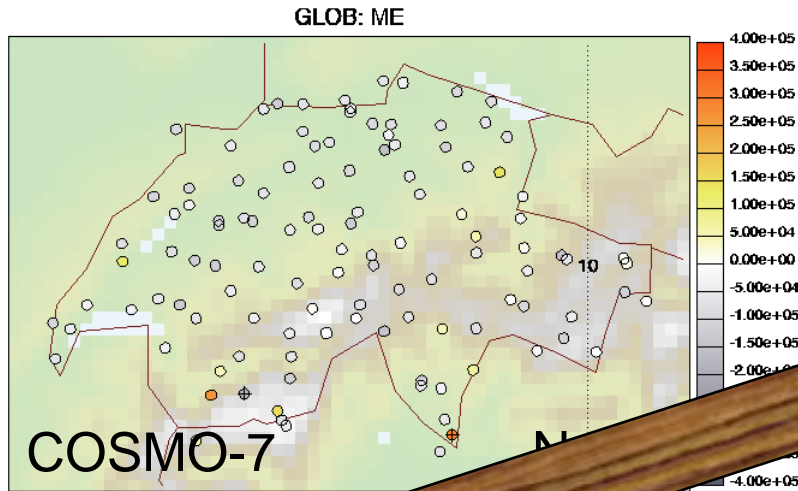
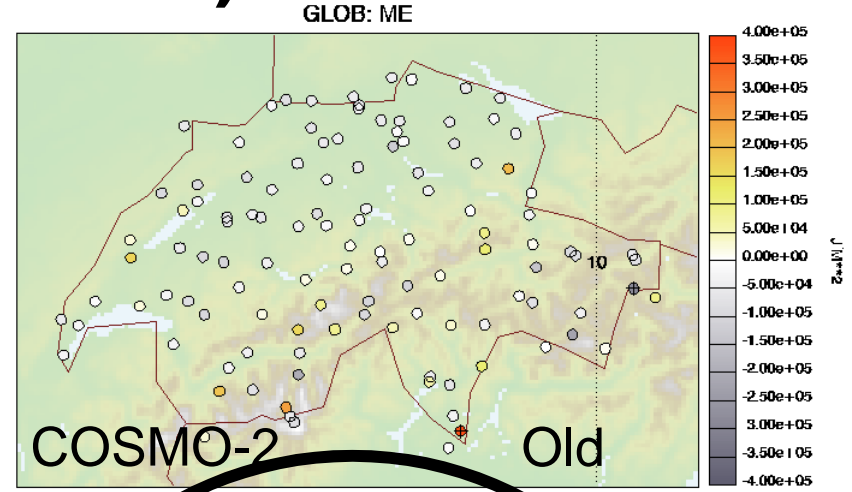
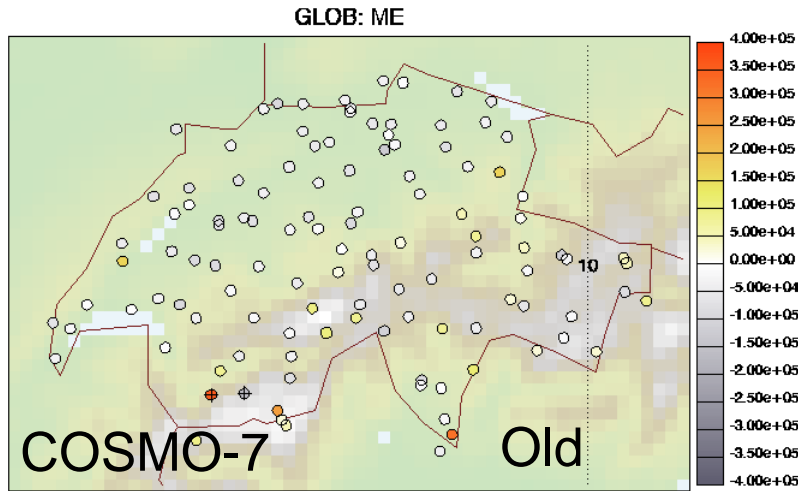
Single day: 14 July 2013, all Stations Global Radiation (GLOB)





Bias 14 July 2013

Global Radiation (GLOB)



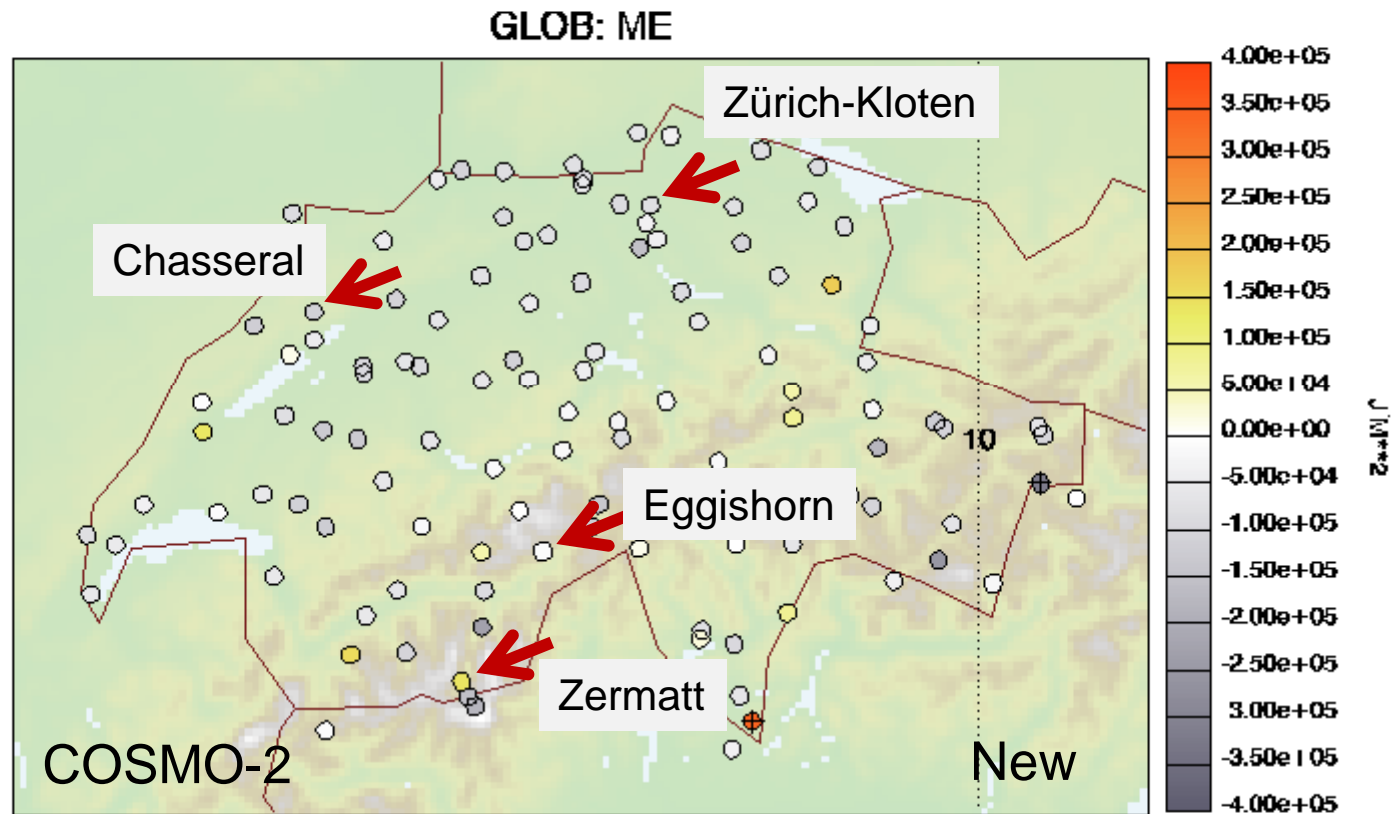
C-7-new_00@ch 2013-07-14 1:00 to 2013-07-15 0:00 01-24
+Min: -1.925e+05 J/M**2 at station 06777 +Max: 3.487e+05 J/M**2 at station 06777

C-2-new_00@ch 2013-07-14 1:00 to 2013-07-15 0:00 01-24
+Min: -3.181e+05 J/M**2 at station 06778 +Max: 3.487e+05 J/M**2 at station 06777



Bias 14 July 2013

Global Radiation (GLOB)



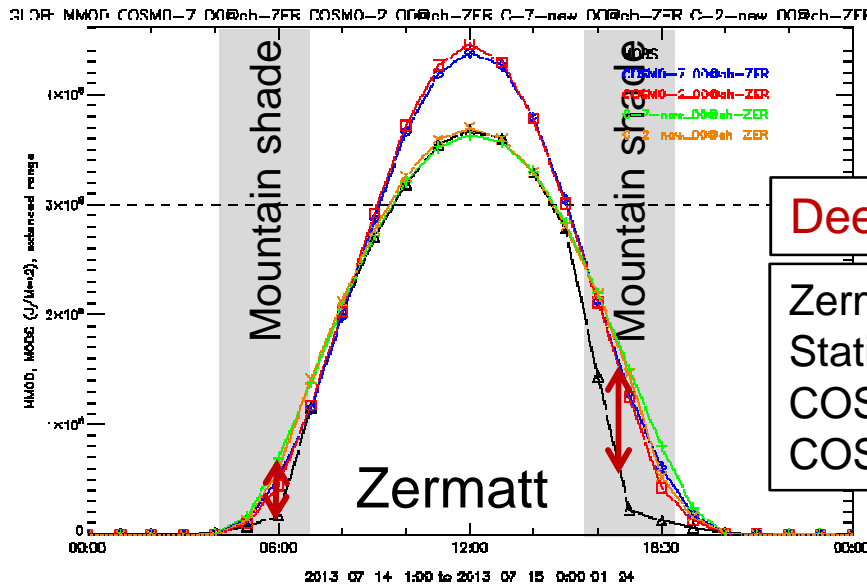
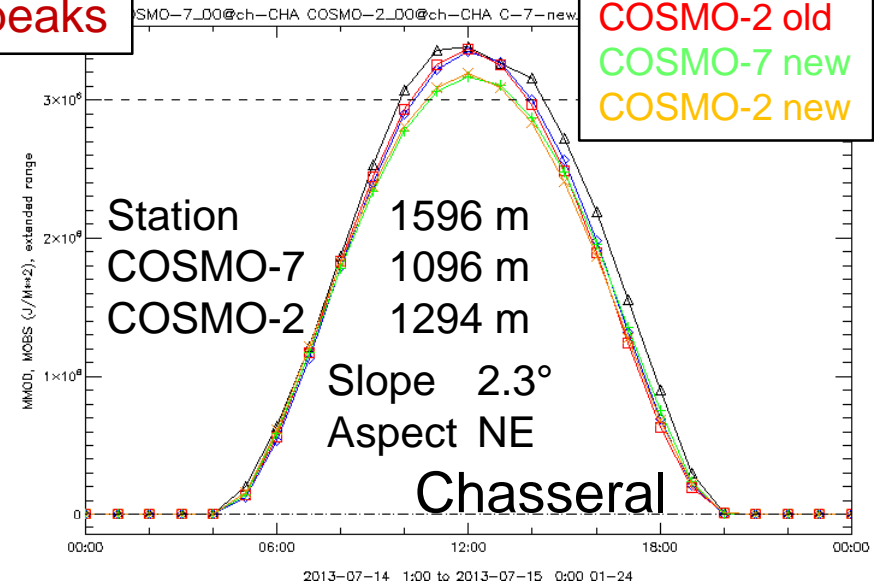
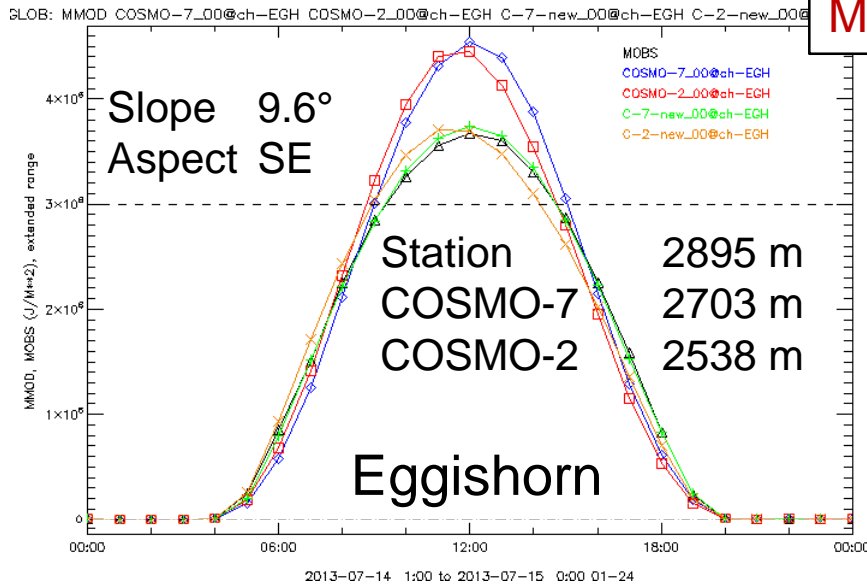
C-2-new_00@ch 2013-07-14 1:00 to 2013-07-15 0:00 01-24
+Min: -3.181e+05 J/M**2 at station 06778 +Max: 3.487e+05 J/M**2 at station 06777



14 July 2013

Mountain peaks

Observation
 COSMO-7 old
 COSMO-2 old
 COSMO-7 new
 COSMO-2 new



Deep narrow valley

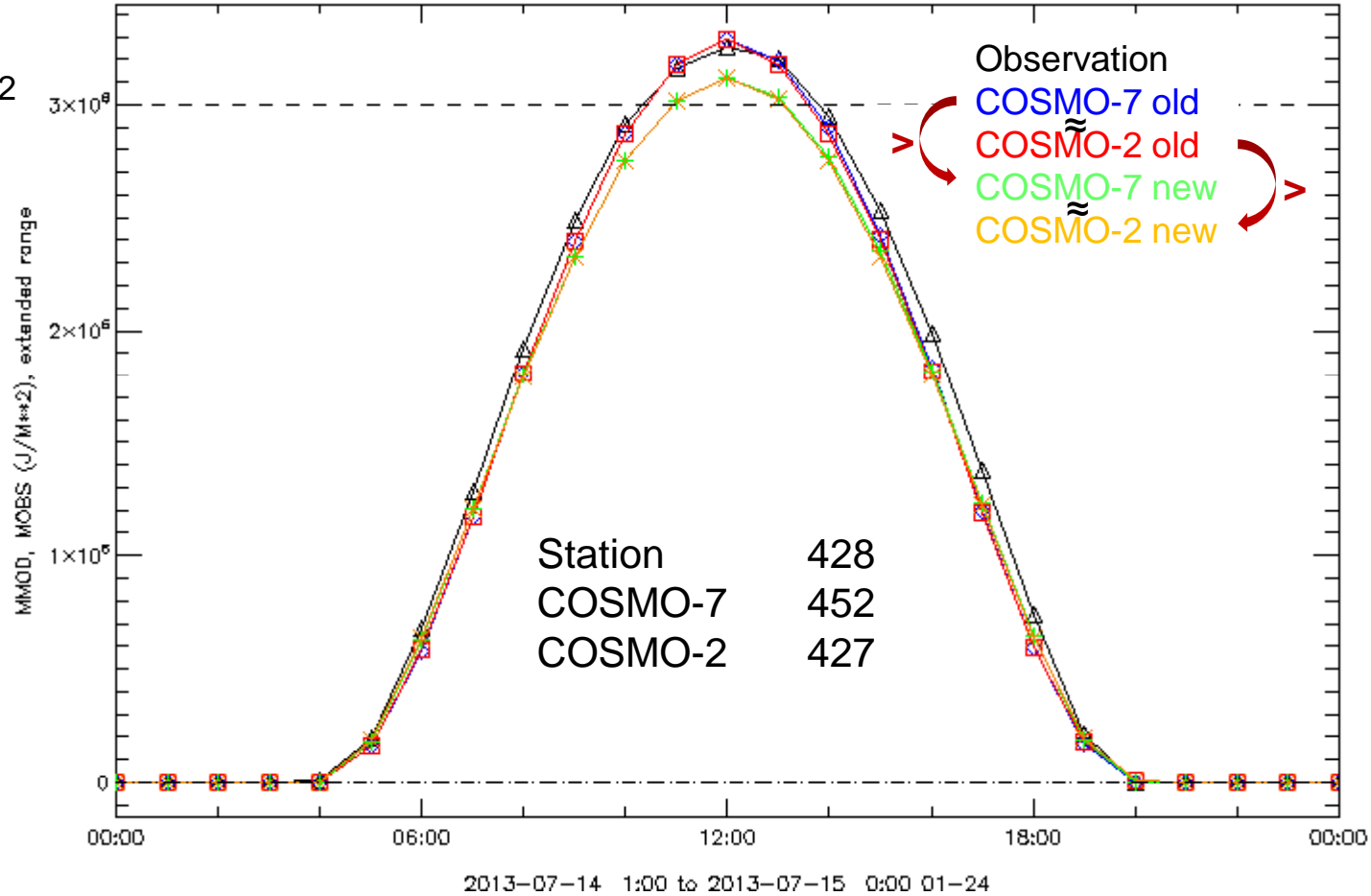
Slope 1.3°
Aspect SE



14 July 2013 Zürich-Kloten Representative for Swiss Plateau

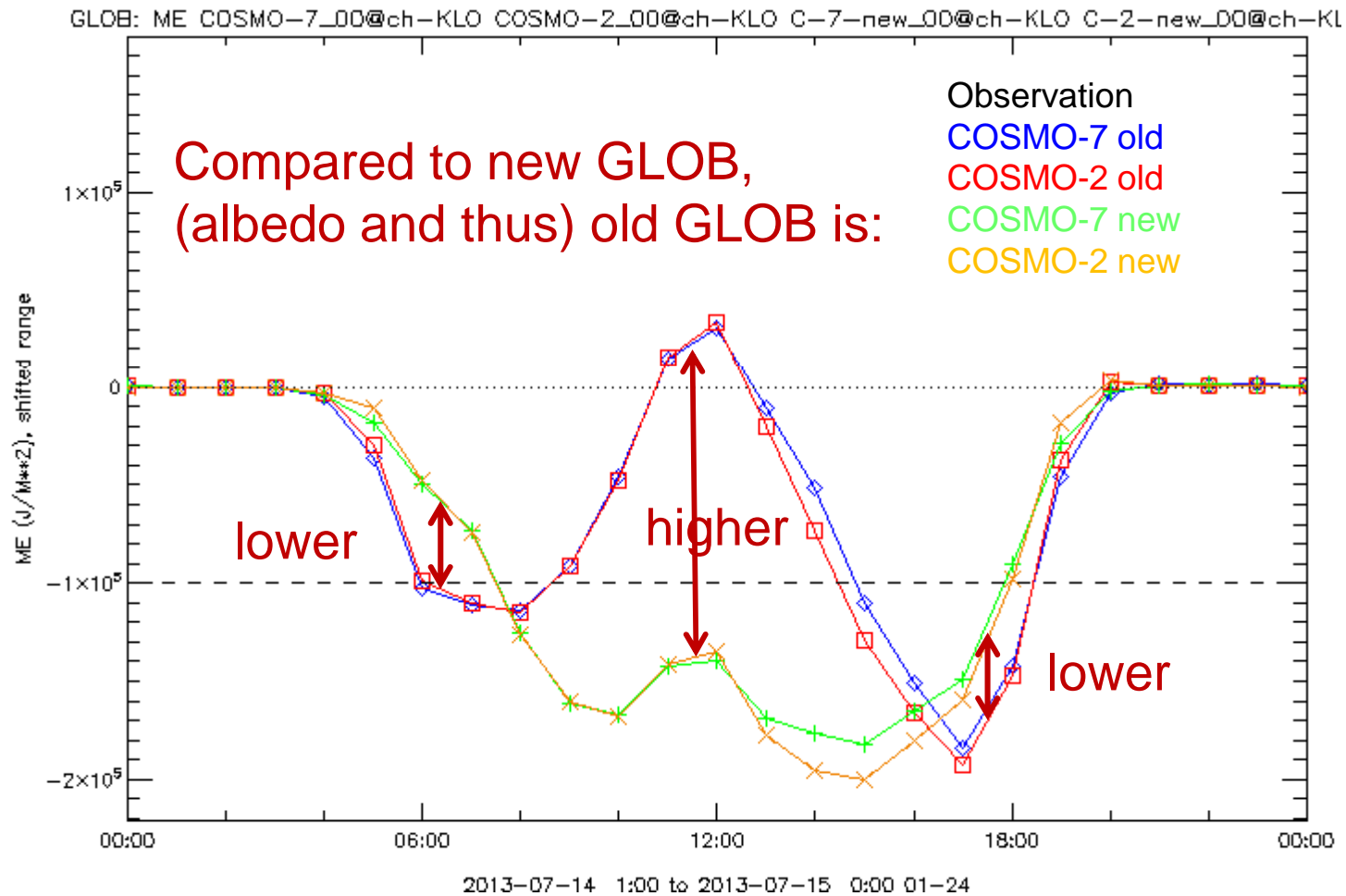
GLOB: MMOD COSMO-7_D0@ch-KLO COSMO-2_00@ch-KLO C-7-new_D0@ch-KLO C-2-new_D0@ch-KLO

833 W m⁻²





14 July 2013 Zürich-Kloten Bias GLOB





Summary

- Global radiation in COSMO-7 and COSMO-2 is almost equal (if cloudiness is equal) -> topographical effect is small
- Old approximation using diffuse albedo (ALB_RAD) leads to systematically higher values during clear days of at least 5-10% or even greater at some locations
- New direct summing of radiation components should be used for consistency with what the model uses internally
- The global radiation is generally slightly underestimated compared to measurements during fair weather conditions especially at lower elevations