



Clouds and the Earth's Radiant Energy System (CERES) ERBE-like Instantaneous TOA Estimates (ES-8) Data Set Abstract



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Data Set Description:

The ERBE-like Instantaneous TOA Estimates (ES-8) product contains 24 hours of instantaneous Clouds and the Earth's Radiant Energy System (CERES) data for a single scanner instrument. The ES-8 contains filtered radiances recorded every 0.01-second for the total, shortwave (SW), and window (WN) channels and the unfiltered SW, longwave (LW), and WN radiances. The SW and LW radiances at spacecraft altitude are converted to Top-of-the-Atmosphere (TOA) fluxes with a scene identification algorithm and Angular Distribution Models (ADMs) which are "like" those used for the Earth Radiation Budget Experiment (ERBE). The TOA fluxes, scene identification, and angular geometry are included on the ES-8. These data are organized according to the CERES 3.3-second scan into 6.6-second scan cycles. As long as there is one valid scanner measurement within a scan cycle, the ES-8 record will be generated.

The ES-8 contains the following information:

1. Scan-level Data (Vdata Structures)
 - a. Time of Observation (Julian date and time)
 - b. Earth-Sun distance
 - c. Satellite position and velocity and Sun position
2. Measurement-level Data (Scientific Data Sets (SDSs))
 - a. Instrument Field-of-View (colatitude and longitude)
 - b. Radiometric data (total, shortwave, and window channels)
 - c. Satellite and Sun geometry (viewing zenith, solar zenith, and relative azimuth)
 - d. Unfiltered radiances (shortwave, longwave, and window)
 - e. TOA fluxes (shortwave and longwave)
 - f. ERBE scene identification
 - (1) clear ocean
 - (2) clear land
 - (3) clear snow
 - (4) clear desert
 - (5) clear coastal
 - (6) partly cloudy ocean
 - (7) partly cloudy land-desert
 - (8) partly cloudy coastal
 - (9) mostly cloudy ocean
 - (10) mostly cloudy land-desert
 - (11) mostly cloudy coastal
 - (12) overcast

Additional information about the format and content of the ES-8 can be found in the [CERES Data Products Catalog](#). Details concerning the science parameters and how they are calculated can be found in the [CERES Algorithm Theoretical Basis Document for Subsystem 2.0](#) and in the [ES-8 Collection Guide](#).



Summary of Changes:

The CERES Data Management Team and the Atmospheric Science Data Center (ASDC) at Langley use a Sampling Strategy, a Production Strategy, and a Configuration Code (CCode) to track versions of CERES archival data products. In general, minor reprocessing changes are tracked by increasing the Configuration Code while major reprocessing changes result in a new Production Strategy. The Sampling Strategy identifies the satellite and instrument which acquired the data in the product.

A summary of changes made to the ES-8 HDF-EOS product is shown in the following table.

Modification History for: [NPP](#) | [Aqua](#) | [Terra](#) | [TRMM](#)

Modification History of the CERES ES-8 NPP Archival Product

Sampling Strategy and Production Strategy	CCode	Available at ASDC	Impact on the ES-8 Product
NPP-FM5_Edition1 ⁽³⁾	100103	Dec 2013	<ul style="list-style-type: none"> • First application of time-varying gains to FM5 data. • Initiated by instrument PGE update using this CCode.
NPP-FM5_Edition1-CV ⁽³⁾	300303	Aug 2013	<ul style="list-style-type: none"> • No science impact. • Reprocessed entire FM5 data set due to spikes detected in initial Instrument data (BDS), which translated into fill values in downstream products. • Fixed by Instrument PGE update using this CCode.
NPP-FM5_Edition1-CV ⁽³⁾	300301	Sep 2012	<ul style="list-style-type: none"> • No science impact. • Migration of software to IBM P6 and x86 platforms.
NPP-FM5_Edition1-CV ⁽³⁾	300300	Sep 2012	<ul style="list-style-type: none"> • Initial delivery.
Availability: (1) Validation version only available to CERES analysts; (2) restricted to CERES Science Team; (3) public			

Modification History for: [NPP](#) | [Aqua](#) | [Terra](#) | [TRMM](#)

Modification History of the CERES ES-8 Aqua Archival Product

Sampling Strategy and Production Strategy	CCode	Available at ASDC	Impact on the ES-8 Product
Aqua-FM3_Edition4 ⁽³⁾ Aqua-FM4_Edition4 ⁽³⁾	400403	Nov 2013	<ul style="list-style-type: none"> • Uses new set of Spectral Correction Coefficients similar to Edition3's.
Aqua-FM3_Edition3 ⁽³⁾	300303	Aug 2013	<ul style="list-style-type: none"> • No science impact. • Reprocessed data from 201210 due to incorrect scan time initialization detected in initial C++ Instrument data stream (BDS). • Fixed by Instrument PGE update using this CCode.
Aqua-FM4_Edition3 ⁽³⁾	300301	Jan 2013	<ul style="list-style-type: none"> • Migration of software to IBM P6 and x86 platforms. • Uses new set of Spectral Correction Coefficients which incorporate SW, WN and TOT channel radiometric shifts to have monthly average all-sky FM1 radiances equal to FM4's at start first full month of science data (July 2002). • Monthly Spectral Correction Coefficients beyond July 2002 are based on Spectral Response Functions with different levels of SW and TOT channel RAPS induced changes. • Updated quadratic coefficients to account for FM4's SW Thermal leak, originally all instruments used PFM derived numbers.
Aqua-FM3_Edition3 ⁽³⁾	300301	Nov 2012	<ul style="list-style-type: none"> • No science impact. • Migration of software to IBM P6 and x86 platforms.
Aqua-FM3_Edition3 ⁽³⁾	300300	Nov 2011	<ul style="list-style-type: none"> • Uses new set of Spectral Correction Coefficients which incorporate SW and TOT channel radiometric shifts to have monthly average all-sky FM3 radiances equal to FM1's at start of the Aqua's first full month of science data (July 2002). • Monthly Spectral Correction Coefficients beyond July 2002 are based on Spectral Response Functions with different levels of SW and TOT channel RAPS induced changes. • Updated quadratic coefficients to account for FM3's SW Thermal leak, originally all instruments used PFM derived numbers.

Modification History of the CERES ES-8 Aqua Archival Product

Sampling Strategy and Production Strategy	CCode	Available at ASDC	Impact on the ES-8 Product
Aqua-FM3_Edition1-CV ⁽³⁾	300303	Aug 2013	<ul style="list-style-type: none"> No science impact. Extension of 300301 data set following upstream Instrument PGE update (see NPP-FM5_Edition1-CV entry above with this CCode).
Aqua-FM3_Edition1-CV ⁽³⁾	300301	Sep 2012	<ul style="list-style-type: none"> No science impact. Migration of software to IBM P6 and x86 platforms.
Aqua-FM3_Edition1-CV ⁽³⁾	300300	Nov 2011	<ul style="list-style-type: none"> No science impact. Migration of software to IBM P6 platform.
Aqua-FM3_Edition2 ⁽³⁾ Aqua-FM4_Edition2 ⁽³⁾ Aqua-FM3_Edition1-CV ⁽³⁾ Aqua-FM4_Edition1-CV ⁽³⁾	027032	Oct 2010	<ul style="list-style-type: none"> No science impact. Migration of software to IBM P4 platform.
Aqua-FM3_Edition1-CV ⁽³⁾ Aqua-FM4_Edition1-CV ⁽³⁾	026029	Apr 2006	<ul style="list-style-type: none"> No science impact. Reprocessed to use all available input.
Aqua-FM3_Edition1-CV ⁽³⁾ Aqua-FM4_Edition1-CV ⁽³⁾	026028	Apr 2006	<ul style="list-style-type: none"> Eliminated data affected by Solar Heating.
Aqua-FM3_Edition1 ⁽³⁾ Aqua-FM4_Edition1 ⁽³⁾	026026	Mar 2005	<ul style="list-style-type: none"> Instrument Subsystem code changes result in less radiances processed. The worst case is 1.5% less records for a day compared with 026025 processing.
Aqua-FM3_Edition2 ⁽³⁾ Aqua-FM4_Edition2 ⁽³⁾	026025	Jun 2004	<ul style="list-style-type: none"> (FM3) Corrected SW part of Total Channel spectral response. (FM4) Corrected SW part of Total Channel spectral response.
Aqua-FM3_Edition1 ⁽³⁾ Aqua-FM4_Edition1 ⁽³⁾	026025	May 2004	<ul style="list-style-type: none"> No science impact.
Aqua-FM3_Edition2 ⁽³⁾ Aqua-FM4_Edition2 ⁽³⁾	026024	Feb 2004	<ul style="list-style-type: none"> (FM3) Corrected SW part of Total Channel spectral response. (FM4) Corrected SW part of Total Channel spectral response.
Aqua-FM3_Edition1 ⁽³⁾ Aqua-FM4_Edition1 ⁽³⁾	026024	Feb 2004	<ul style="list-style-type: none"> No science impact.
Aqua-FM3_Edition1 ⁽³⁾ Aqua-FM4_Edition1 ⁽³⁾	025023	Aug 2003	<ul style="list-style-type: none"> No science impact.
Aqua-FM3_Edition1 ⁽³⁾ Aqua-FM4_Edition1 ⁽³⁾	025022	Jun 2003	<ul style="list-style-type: none"> Release of Aqua Edition1. Provided new day and night spectral correction coefficients for FM3 and FM4.
Availability: (1) Validation version only available to CERES analysts; (2) restricted to CERES Science Team; (3) public			

Modification History for: [NPP](#) | [Aqua](#) | [Terra](#) | [TRMM](#)

Modification History of the CERES ES-8 Terra Archival Product

Sampling Strategy and Production Strategy	CCode	Available at ASDC	Impact on the ES-8 Product
Terra-FM1_Edition4 ⁽³⁾ Terra-FM2_Edition4 ⁽³⁾	400403	Oct 2013	<ul style="list-style-type: none"> Uses new set of Spectral Correction Coefficients similar to Edition3's except for the TOT channel offset: instead of being in the spectral response function, it was put back into the gain.
Terra-FM1_Edition3 ⁽³⁾ Terra-FM2_Edition3 ⁽³⁾	300303	Aug 2013	<ul style="list-style-type: none"> No science impact. Reprocessed data from 201210 due to incorrect scan time initialization detected in initial C++ Instrument data stream (BDS). Fixed by Instrument PGE update using this CCode.
Terra-FM1_Edition3 ⁽³⁾ Terra-FM2_Edition3 ⁽³⁾	300301	Nov 2012	<ul style="list-style-type: none"> No science impact. Migration of software to IBM P6 and x86 platforms.
Terra-FM2_Edition3 ⁽³⁾	300300	Mar 2012	<ul style="list-style-type: none"> Uses new set of Spectral Corrections Coefficients which incorporate SW, WN and TOT radiometric shifts to have monthly average all-sky FM2 radiances equal to FM1's at start of mission (Mar 2000). The Spectral Corrections Coefficients are based on Spectral

Modification History of the CERES ES-8 Terra Archival Product

Sampling Strategy and Production Strategy	CCode	Available at ASDC	Impact on the ES-8 Product
			<p>Response Functions with different levels of SW and TOT channel degradation to account for RAPS mode operation.</p> <ul style="list-style-type: none"> Updated quadratic coefficients to account for FM2's SW Thermal leak, originally all instruments used PFM derived numbers.
Terra-FM1_Edition3 ⁽³⁾	300300	Nov 2011	<ul style="list-style-type: none"> The Spectral Corrections Coefficients are based on Spectral Response Functions with different levels of SW and TOT channel degradation to account for RAPS mode operation. Updated quadratic coefficients to account for FM1's SW Thermal leak, originally all instruments used PFM derived numbers.
Terra-FM1_Edition1-CV ⁽³⁾ Terra-FM2_Edition1-CV ⁽³⁾	300303	Aug 2013	<ul style="list-style-type: none"> No science impact. Extension of 300301 data set following upstream Instrument PGE update (see NPP-FM5_Edition1-CV entry above with this CCode).
Terra-FM1_Edition1-CV ⁽³⁾ Terra-FM2_Edition1-CV ⁽³⁾	300301	Sep 2012	<ul style="list-style-type: none"> No science impact. Migration of software to IBM P6 and x86 platforms.
Terra-FM1_Edition1-CV ⁽³⁾ Terra-FM2_Edition1-CV ⁽³⁾	300300	Nov 2011	<ul style="list-style-type: none"> No science impact. Migration of software to IBM P6 platform.
Terra-FM1_Edition2 ⁽³⁾ Terra-FM2_Edition2 ⁽³⁾ Terra-FM1_Edition1-CV ⁽³⁾ Terra-FM2_Edition1-CV ⁽³⁾	027032	Oct 2010	<ul style="list-style-type: none"> No science impact. Migration of software to IBM P4 platform.
Terra-FM1_Edition1-CV ⁽³⁾ Terra-FM2_Edition1-CV ⁽³⁾	026029	Apr 2006	<ul style="list-style-type: none"> No science impact. Reprocessed to use all available input.
Terra-FM1_Edition1-CV ⁽³⁾ Terra-FM2_Edition1-CV ⁽³⁾	026028	Apr 2006	<ul style="list-style-type: none"> Eliminated data affected by Solar Heating.
Terra-FM1_Edition2 ⁽³⁾ Terra-FM2_Edition2 ⁽³⁾	026026	Mar 2005	<ul style="list-style-type: none"> Instrument Subsystem code changes result in less radiances processed. The worst case is 1.5% less records for a day compared with 026025 processing. Linearly dropped FM2's SW channel spectral response by 0.25% from Dec03 level. Each month Jan04 to Nov04 has a 0.25%/11 drop from the preceeding month.
Terra-FM1_Edition1 ⁽³⁾	026026	Mar 2005	<ul style="list-style-type: none"> Instrument Subsystem code changes result in less radiances processed.
Terra-FM2_Edition1 ⁽³⁾			<ul style="list-style-type: none"> The worst case is 1.5% less records for a day compared with 026025 processing.
Terra-FM1_Edition1 ⁽³⁾ Terra-FM2_Edition1 ⁽³⁾ Terra-FM1_Edition2 ⁽³⁾ Terra-FM2_Edition2 ⁽³⁾	026025	May 2004	<ul style="list-style-type: none"> No science impact.
Terra-FM1_Edition1 ⁽³⁾ Terra-FM2_Edition1 ⁽³⁾	026024	Feb 2004	<ul style="list-style-type: none"> No science impact.
Terra-FM1_Edition2 ⁽³⁾ Terra-FM2_Edition2 ⁽³⁾	025023	Aug 2003	<ul style="list-style-type: none"> (FM2) Corrected SW Channel spectral response.
Terra-FM1_Edition1 ⁽³⁾ Terra-FM2_Edition1 ⁽³⁾	025023	Aug 2003	<ul style="list-style-type: none"> No science impact.
Terra-FM1_Edition2 ⁽³⁾ Terra-FM2_Edition2 ⁽³⁾	023019	Sep 2002	<ul style="list-style-type: none"> Corrections for ground to flight changes in the calibration coefficients. Corrections for on-orbit drifts in the calibration coefficients. Corrections for on-orbit drifts in the spectral response functions. (FM1) Corrected SW Channel spectral response. (FM1) Corrected SW part of Total Channel spectral response. (FM2) Corrected SW part of Total Channel spectral response.
Terra-FM1_Edition1 ⁽³⁾ Terra-FM2_Edition1 ⁽³⁾	023019	Sep 2002	<ul style="list-style-type: none"> No science impact.
Terra-FM1_Edition1 ⁽³⁾ Terra-FM2_Edition1 ⁽³⁾	021018	Sep 2001	<ul style="list-style-type: none"> Added a Three Channel Intercomparison Test to check for bit flips in the radiance data. Added ability to specify at runtime different strategies pertaining



Modification History of the CERES ES-8 Terra Archival Product

Sampling Strategy and Production Strategy	CCode	Available at ASDC	Impact on the ES-8 Product
			<ul style="list-style-type: none"> to the SW. offset, ADMs, and Spectral Correction Algorithm. Provided capability to run ERBE data through CERES ERBE-like Inversion to Instantaneous TOA Fluxes software. New Spectral Correction Coefficients were created for ERBS and NOAA9.
Terra-FM1_Edition1 ⁽³⁾ Terra-FM2_Edition1 ⁽³⁾	020016	Apr 2001	<ul style="list-style-type: none"> Applied HDF Compression.
Terra-FM1_Edition1 ⁽³⁾ Terra-FM2_Edition1 ⁽³⁾	019015	Nov 2000	<ul style="list-style-type: none"> Release of Terra Edition1. Slope/intercept Spectral Correction code updated to apply 2nd order polynomial fits for the window channel and for shortwave cloudy cases, and to perform interpolation of unfiltered radiances. Provided new day and night spectral correction coefficients for FM1 and FM2.
Availability: (1) Validation version only available to CERES analysts; (2) restricted to CERES Science Team; (3) public			

Modification History for: [NPP](#) | [Aqua](#) | [Terra](#) | TRMM

Modification History of the CERES ES-8 TRMM Archival Product

Sampling Strategy and Production Strategy	CCode	Available at ASDC	Impact on the ES-8 Product
TRMM-PFM_Edition2 ⁽³⁾	025023	Jun 2003	<ul style="list-style-type: none"> No science impact.
TRMM-PFM_Edition2 ⁽³⁾	023019	Sep 2002	<ul style="list-style-type: none"> No science impact.
TRMM-PFM_Edition2 ⁽³⁾ TRMM-PFM_Transient-Ops2 ⁽³⁾ TRMM-PFM_FailingSensor ⁽²⁾	021018	Sep 2001	<ul style="list-style-type: none"> Added a Three Channel Intercomparison Test to check for bit flips in the radiance data. Added ability to specify at runtime different strategies pertaining to the SW offset, ADMs, and Spectral Correction Algorithm. Provided capability to run ERBE data through CERES ERBE-like Inversion to Instantaneous TOA Fluxes software. New Spectral Correction Coefficients were created for ERBS and NOAA9.
TRMM-PFM_Edition1 ⁽²⁾	018014	Sep 2000	<ul style="list-style-type: none"> No science impact.
TRMM-PFM_Edition2 ⁽²⁾	017013	Apr 2000	<ul style="list-style-type: none"> Change Spectral Correction Algorithm to use slope intercept method. Change LW TOA flux upper limit from 400 W/m² to 450 W/m². Modified slope intercept method (2nd (+) order curve fit) used in the Spectral Correction Algorithm. New day & night Spectral Correction Coefficients for PFM, FM1, & FM2.
TRMM-PFM_Edition2 ⁽²⁾	016012	Mar 2000	<ul style="list-style-type: none"> No science impact.
TRMM-PFM_Edition2 ⁽²⁾	014011	Feb 2000	<ul style="list-style-type: none"> No science impact.
TRMM-PFM_Transient-Ops2 ⁽²⁾	011004	Dec 1999	<ul style="list-style-type: none"> Set regional averages for viewing zenith and relative azimuth angle values to default on EID-6 if any included measurement is not from crosstrack mode.
TRMM-PFM_Edition1 ⁽³⁾	009001	Oct 1998	<ul style="list-style-type: none"> New window channel spectral correction coefficients to correct radiances that were about 10 0gh. Both crosstrack and rotating azimuth measurements included in regional averages that are passed to Subsystem 3.0.
TRMM-PFM_Edition1 ⁽²⁾	008000	Aug 1998	<ul style="list-style-type: none"> No science impact.
TRMM-PFM_Edition1 ⁽²⁾	007000	Jun 1998	<ul style="list-style-type: none"> Release of Terra Edition1. 3rd word of scanner operations flag was modified to designate crosstrack, RAPS, alongtrack, and transitional data modes. Window channel units to "per micron". Revised spectral correction coefficients because of differences in shortwave throughput between ERBE and CERES. Used ERBE ADMs and thresholds.
Availability: (1) Validation version only available to CERES analysts; (2) restricted to CERES Science Team; (3) public			

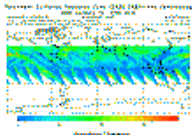


Examples of Data:

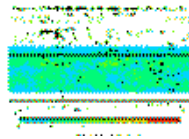
Nine quality control images (gif files) are generated and made available on the Web for each ES-8.

These images are for shortwave, window, and total filtered radiances; shortwave, window, and longwave unfiltered radiances; shortwave and longwave TOA fluxes; and the results of the ERBE scene identification algorithm. Examples for each of these images from the January 1, 1998 TRMM data set follow.

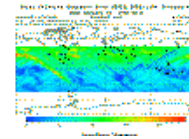
Filtered Radiances



Shortwave

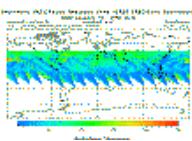


Window

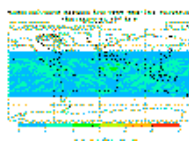


Total

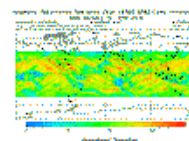
Unfiltered Radiances



Shortwave

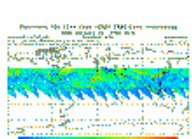


Window

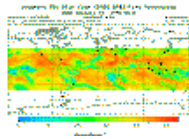


Longwave

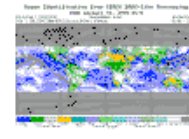
TOA Fluxes



Shortwave



Longwave



ERBE Scene ID

Additional images and ancillary data sets (such as Spectral Correction Coefficients and Angular Distribution Models) are available from the [CERES ERBE-like Data Validation - Public Page](#).

References:

1. Blackadar, Alfred, *A Computer Almanac, Weatherwise*, Vol. 37, 5, October 1984, p. 257-260.
2. Clouds and the Earth's Radiant Energy System (CERES) Data Management System [Data Products Catalog](#).
3. Clouds and the Earth's Radiant Energy System (CERES) [Algorithm Theoretical Basis Document](#), Instrument Geolocate and Calibrate Earth Radiances (Subsystem 1.0), Release 2.2, June 1997.
4. Clouds and the Earth's Radiant Energy System (CERES) [Algorithm Theoretical Basis Document](#), ERBE-like to Instantaneous Fluxes (Subsystem 2.0), Rel. 2.2, June 2, 1997.
5. Clouds and the Earth's Radiant Energy System (CERES) [Data Management System Software Requirements document](#), ERBE-like Inversion to Instantaneous TOA and Surface Fluxes, (Subsystem 2.0) Release 1, Version 1, November 1994.
6. Clouds and the Earth's Radiant Energy System (CERES) [Validation Plan](#), ERBE-like Inversion to Instantaneous TOA and Surface Fluxes, (Subsystem 2.0) Release 2.2, July 1997.
7. [HDF User's Guide](#), NASA Langley Atmospheric Science Data Center, Hierarchical Data Format Web Site, (from NCSA) Version 4.0, February 1996.
8. Jefferys, William H., ["Julian Day Numbers"](#).
9. Release B SCF ToolKit User's Guide for the ECS Project, June 1998.
10. [Software Bulletin "CERES Metadata Requirements for LaTIS"](#), Revision 1, January 7, 1998.
11. Smith, G. L., "Effects of time response on the point spread function of a scanning radiometer," *Appl. Opt.*, **30**, 7031-7037, 1994.

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Acknowledgement:

The requested form of acknowledgment for any publication in which these data are used is:

"These data were obtained from the NASA Langley Research Center Atmospheric Science Data Center."

The Langley Data Center requests a reprint of any published papers or reports or a brief description of other uses (e.g., posters, oral presentations, etc.) of data that we have distributed. This will help the Data Center determine the use of data distributed, which is helpful in optimizing product development. It also helps us to keep our product related references current.

Reference:

The CERES Team has gone to considerable trouble to remove major errors and to verify the quality and accuracy of these data. Please provide a reference to the following paper when you publish scientific results with the CERES data:

Wielicki, B. A., B. R. Barkstrom, E. F. Harrison, R. B. Lee III, G. L. Smith, and J. E. Cooper, "Clouds and the Earth's Radiant Energy System (CERES): An Earth Observing System Experiment," *Bull. Amer. Meteor. Soc.*, **77**, 853-868, 1996.

Document Information:

- Document Creation Date: July 1999
- Modification Dates: Aug 1999; Jan 2000; Feb 2000; Mar 2000 Apr 2000; Nov 2000 (Terra Edition1); Jun 2001; Oct 2001; Oct 2002; May 7, 2003; Sep 16, 2003; Jun 14, 2004; Nov 17, 2004; Mar 31, 2005; March 14, 2011; Sep 18, 2012; Feb 2013, Sep 2013
- Review Dates: Mar 2000; Mar 2000; Apr 2000; Jun 2001; Oct 2001; Oct 2002; May 2003; Sep 2003; Jun 2004; Dec 2004; Mar 2005; Mar 2011; Sep 2012; Feb 2013, Sep 2013
- Document ID:
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