Contrail observations over Southern and Eastern Asia in NOAA/AVHRR data and comparisons to contrail simulations in a GCM

Source **International Journal of Remote Sensing** archive
Volume 28 , Issue 9 (April 2007) table of contents
CLOUDMAP: New satellite cloud products for cirrus and contrails for NWP and climate analysis
Pages 2049-2069
Year of Publication: 2007
ISSN:0143-1161

Authors

R. Meyer	SunTechnics GmbH, D-20537 Hamburg, Germany
R. Buell	DLR - Oberpfaffenhofen, Institut für Physik der Atmosphäre, D-82234 Wessling, Germany
C. Leiter	Science and Computing AG, München, Germany
H. Mannstein	DLR - Oberpfaffenhofen, Institut für Physik der Atmosphäre, D-82234 Wessling, Germany
S. Pechtl	DLR - Oberpfaffenhofen, Institut für Physik der Atmosphäre, D-82234 Wessling, Germany,now at Institute for Environmental Physics, University of Heidelberg, D-69120 Heidelberg, Germany
T. Oki	Institute of Industrial Science, University of Tokyo, Tokyo 153-8505, Japan
P. Wendling	SunTechnics GmbH, D-20537 Hamburg, Germany

Publisher Taylor & Francis, Inc. Bristol, PA, USA

DOI Bookmark: 10.1080/01431160600641707

ABSTRACT

For the first time the contrail cover for a region covering Thailand and surrounding regions as well as for the region of Japan and its surroundings are determined by remote sensing observations. Locally received NOAA/AVHRR satellite data are analysed by a fully automated contrail detection algorithm. For both regions approx. 400 NOAA-14 satellite scenes from four months of the year 1998 were analysed. Both regions show sufficient air traffic to produce an observable amount of contrails. Thus we are able to measure for the first time contrail frequencies in the tropics and compare it to a nearby mid latitudinal region. The annual average of the daily mean contrail cloud coverage is 0.13% for the Thailand region and about 0.25% for the Japan region. For both regions the contrail cover is largest during spring. The daily cycle shows surprisingly high contrail coverage during night in spite of lower air traffic densities during night time. The satellite observed contrail cover is compared with simulations of contrails by use of the general circulation model ECHAM4 related to air traffic emissions of 1992. While the derived patterns of the regional contrail distributions agree well, the contrail coverage derived from satellite data is larger than the simulated coverage. This discrepancy appears to be mainly due to an increase in air traffic in the time period between the model study and the observations.

REFERENCES

Note: OCR errors may be found in this Reference List extracted from the full text article. ACM has opted to expose the complete List rather than only correct and linked references.

1 Asnani, G. C. (1993) Tropical meteorology, Noble Printers, Pune, India

2 Bakan, S., Betancor, M., Gayler, V. and Grassl, H. (1994) Contrail frequency over Europe from NOAA-satellite images.. Annales Geophysicae, 12, pp. 962-968.

3 Chen, J.-P., Lin, W.-H. and Lin, R.-F. (2001) Estimation of contrail frequency and radiative effects over Taiwan area, Terrestrial.. Atmospheric and Oceanic Sciences, 12, pp. 155-178.

4 Gierens, K., Sausen, R. and Schumann, U. (1998) A diagnostic study of the global coverage by contrails, Part II: Future air traffic scenarios.. Theoretical and Applied Climatology, 63, pp. 1-9.

5 IATA (1994)

6 IPCC (1999) Aviation and the global atmosphere.. Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge

7 Jensen, E. J., Toon, O. B., Kinne, S., Sachse, G. W., Anderson, B. E., Chan, K. R., Twohmy, C. H., Gandrud, B., Heymsfield, A. and Mikae-Lye, R. C. (1998) Environmental conditions required for contrail formation and persistence.. Journal of Geophysical Research, 103, pp. 3929-3936.

8 Kästner, M., Meyer, R. C. C. and Wendling, P. (1999) Influence of weather conditions on the distribution of persistent contrails.. Meteorological Applications, 6, pp. 261-271.

9 Liou, K. N., Ou, C. C. and Koenig, G. (1990) An investigation of the climatic effect of contrail cirrus.. Air Traffic and the Environment: Background, Tendencies, and Potential Global Atmospheric Effects, pp. 154-169. Springer-Verlag, Berlin

10 Mannstein, H., Meyer, R. and Wendling, P. (1999) Operational detection of contrails from NOAA-AVHRR-data.. International Journal of Remote Sensing, 20, pp. 1641-1660.

11 Marquart, S. and Mayer, B. (2002) Towards a reliable GCM estimation of contrail radiative forcing.. Geophysical Research Letters, 29, pp. 1-4.

12 Meyer, R., Mannstein, H., Meerkötter, R., Schumann, U. and Wendling, P. (2002) Regional radiative forcing by line-shaped contrails derived from satellite data.. Journal of Geophysical Research, 107, pp. 1-16.

13 Minnis, P., Schumann, U., Doelling, D. R., Gierens, K. M. and Fahey, D. W. (1999) Global distribution of contrail radiative forcing.. Geophysical Research Letters, 26, pp. 1853-1856.

14 Ponater, M., Brinkop, S., Sausen, R. and Schumann, U. (1996) Simulating the global atmospheric response to aircraft water vapour emissions and contrails: A first approach using a GCM.. Annales Geophysicae, 14, pp. 941-960.

15 Ponater, M., Marquart, S. and Sausen, R. (2002) Contrails in a comprehensive climate model: Parameterisation and radiative forcing.. Journal of Geophysical Research, 107, p. D13, ACL 2-1-10.

16 Roeckner, E. K., Arpe, L., Begtsson, M., Christoph, M., Claussen, M., Dümenil, L., Esch, M., Giorgetta, M., Schlese, U. and Schulzweida, U. (1996) The atmospheric general circulation model ECHAM-4: Model description and simulation present day climate..

17 Sausen, R., Gierens, K., Ponater, M. and Schumann, U. (1998) A diagnostic study of the

global distribution of contrails. Part I: Present day climate.. Theoretical and Applied Climatology, 61, pp. 127-141.

18 Schmitt, A. and Brunner, B. (1997) Emissions from aviation and their development over time..pp. 37-52.

19 Schumann, U. (1996) On conditions for contrail formation from aircraft exhausts.. Meteorologische Zeitschrift, 5, pp. 4-23.

20 Schumann, U. (2002) Contrail cirrus.. Cirrus, pp. 231-255. Oxford University Press, Oxford

21 Strauss, B., Meerkötter, R., Wissinger, B., Wendling, P. and Hess, M. (1997) On the regional climatic impact of contrails: Microphysical and radiative properties of contrails and natural cirrus clouds.. Annales Geophysicae, 15, pp. 1457-1467.

22 Sun, D. Z. and Lindzen, R. S. (1996) Distribution of tropical tropospheric water vapor.. Bulletin of the American Meteorological Society, 50, pp. 1643-1660.

23 Udelhofen, P. M. and Hartman, D. (1995) Influence of tropical cloud systems on the relative humidity in the upper troposphere.. Journal of Geophysical Research, 100, pp. 7423-7440.

CITED BY

J. -P. Muller , J. Fischer, The EU-CLOUDMAP project: Cirrus and contrail cloud-top maps from satellites for weather forecasting climate change analysis, International Journal of Remote Sensing, v.28 n.9, p.1915-1919, April 2007

INDEX TERMS

Primary Classification:

I. Computing Methodologies

- **I.4** IMAGE PROCESSING AND COMPUTER VISION
  - **I.4.8** Scene Analysis

Additional Classification:

I. Computing Methodologies

- **I.4** IMAGE PROCESSING AND COMPUTER VISION
  - **I.4.6** Segmentation
    - **Subjects:** Region growing, partitioning
  - **I.4.9** Applications
- **I.5** PATTERN RECOGNITION
  - **I.5.2** Design Methodology
    - **Subjects:** Pattern analysis; Feature evaluation and selection

J. Computer Applications

- **J.2** PHYSICAL SCIENCES AND ENGINEERING
  - **Subjects:** Earth and atmospheric sciences

General Terms:

Algorithms, Design, Measurement

Collaborative Colleagues:

R. Meyer: colleagues

R. Buell: colleagues

C. Leiter: colleagues

H. Mannstein: colleagues

S. Pechtl: colleagues

T. Oki: colleagues

P. Wendling: colleagues