

Some Historical Notes on Noctilucent Cloud Studies

John Olivero

Embry-Riddle Aeronautical
University

ABSTRACT

A brief history of noctilucent cloud studies both from an “objective” point of view, along with a personal history of my exposure to some of these themes.

I came, I saw, and I am still confused!

Some Basic History

1880s – First recorded observations

Cloud height estimated as 82.9 km [Jesse, 1889] *Why are cloud heights so constant?*

- Ground-based (passive) observers (N. Europe, Russia, Canada)
- [Witt, 1962]

1960s – sounding rocket observations (Sweden, Canada)

particle capture attempts

photometry

Evolution of rocket campaigns

Basic History (cont,)

1960s (continued)

OGO-6 makes first “global” measurements

The first of many satellites.....

1970s – Gadsden’s contributions (observations, spectroscopy, polarimetry, and modeling

1980s – LIDAR studies begin to characterize the
MLT: temperature, dynamics, meteoric metals,
NLC in high time & space resolution.

Basic History (Cont,)

1980s (cont,)

- Microphysical models [Turco, et al 1982]
- Full dynamical/microphysical models
- **First trends estimate** [Nature paper – Thomas et al 1989]
CH₄ → H₂O leading to observable NLC

2000s – SBUV satellite series detects trend and a solar cycle effect

POLAR MESOSPHERIC CLOUD OBSERVATIONS FROM SATELLITE INSTRUMENTS

Instrument (Satellite)	Dates (PMC data)	Observing method	Key references
OGO-6	June 1969–Dec.1970	Limb scattering (visible)	Donahue et al. (1972)
SBUV (Nimbus-7), SBUV/2 (NOAA-9, 11, 14, 16, 17)	Nov. 1978–present	Nadir backscatter (visible)	Thomas et al. (1991) and DeLand et al. (2003)
UVS (SME)	Oct. 1981–Dec.1986	Limb scattering (UV)	Thomas (1984) and Thomas and Olivero (1989)
METEOSAT	1983–present	Limb scattering (visible)	Gadsden (2000)

SAGE II (ERBS)	Oct. 1984–Nov.2000	Solar occultation (UV, visible, near-IR)	Burton and Thomason (2000) and Shettle et al. (2002b)
WINDII (UARS)	Sep. 1991–July1996	Limb scattering (visible)	Evans et al. (1995) and Shettle et al. (2002a)
HALOE (UARS)	Sep.1991–present	Solar occultation (IR)	Hervig et al. (2001) and Hervig and Siskind (2005)
POAM (SPOT	Oct. 1993–Nov.1996; 1998-2005	Solar occultation (UV, visible, near-IR)	Debrestian et al. (1997a, b) and Shettle et al. (2002a)
MAHRSI (Shuttle)	Nov.1994 & Aug1997	Limb scattering (UV)	Stevens et al. (2001)
CRISTA (Shuttle)	Nov.1994 & Aug1997	Thermal emission (IR)	Stevens et al. (2003)

SPIRIT III (MSX)	May 1996–Feb 1997	Thermal emission (IR)	O’Neil et al. (2001)
UVISI (MSX)	May 1996–Dec.1999	Limb scattering (UV)	Carbary et al. (1999, 2004)
UVS (SNOE)	Feb.1998–Dec.2003	Limb scattering (UV)	Merkel et al. (2003) and Bailey et al. (2005)
OSIRIS (Odin)	Nov. 2001–present	Limb scattering g (UV, visible)	Petalina et al. (2005a)
SCIAMACHY (Envisat)	Apr 2002–present	Limb scattering (UV, vis, IR)	von Savigny et al. (2004)
OMI (AURA)	2004-present	Nadir scatter (UV, vis.)	Deland et al (2010)
CIPS (AIM)	2007-present	Nadir backscatter (UV, vis)	Rusch et al (2009)
SOFIE (AIM)	007-present	Solar occultation (IR)	Gordley et al (2009) and Russell et al (2009)

A Personal History

1966 - Heard Fiocco's talk on NLC at NASA Conference

1970 - Dissertation on MLT at Michigan

1972 – OGO-6 shows widespread phenomena

used data to estimate particle radii < 100 nm

1980s – Thomas contacts me for two theses on NLC + informs me of plans for SME satellite studies helps me take a sabbatical at LASP

We publish first “global” climatology of NLC from SME observations

We dare to call observations PMC

I

POAM II & III – SH PMCs (with Shettle, Rusch, Randall, et al)

“Three Satellite Study” (with Thomas, Shettle, and Evans) SME + SAGE II +UARS-WINDII

SBUV – Thomas tries to interest me, but I suggest it is like “hunting Arctic hares in a snowstorm”

Eventually I give in – this is the only long term global data set collaboration with Thomas Shettle, Evans and DeLand)

POAM II & III – SH PMCs (with Shettle, Rusch, Randall, et al)

“Three Satellite Study” (with Thomas, Shettle, and Evans) SME + SAGE II +UARS-WINDII

SBUV observations – Thomas tries to interest me, but my comment was “it was like hunting Arctic Hares in a Snowstorm

Eventually I do give in- there are no other long-term NLC/PMC data sets available (collaborate with Thomas, DeLand, Shettle, and Evans.

Where are we now?

- SOFIE-AIM is giving us the most detailed look into NLC structure in the vertical
- CIPS-AIM is helping us “visualize” NLC horizontal structure
- LIMA model is achieving impressive results
- Particle size workshops made real progress, but also reminded us how difficult it is to do this well
- PMC trends are still unsettled science