AIM/CIPS Observations of PMC Variability

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Thanks to the AIM Team

1. CIPS Data Set
2. Large time/spatial scale variations
3. Intra-seasonal variations
How can AIM/CIPS contribute to trend analyses?

Help to elucidate the physical basis of PMC variability, so concepts can be applied to long-term data sets / models.
CIPS Data Status

VERSION 4.20, REV 05, IS THE CURRENT VERSION

http://aim.hamptonu.edu/sds/index.html
http://lasp.colorado.edu/aim/
Each camera image is binned on-chip to 170x340 pixels
Resolution is 25 km²
Publicly Available Data

Level 2
Orbit-by-orbit png files and netcdf files

Cloud parameters: albedo, radius, iwc

Files: geolocation, cloud parameters, phase function, (ozone)
Publicly Available Data

**Level 3a**
Daily png files and netcdf files

Albedo (Radius and IWC in the future)

Combined Asc & Dsc

**Level 3b**
Season-long movies (mp4)

Albedo (Radius and IWC in the future)
Publicly Available Data

Level 3c
Season-long, 1-deg latitude-binned summary files: IDL Save & ASCII
Orbit-by-orbit cloud parameters
Other possible binning (i.e., local time)

Level 3d
Season-long, common volume summary files: IDL Save & ASCII
Orbit-by-orbit cloud parameters

Level 3e
Season-long, station-specific summary files: IDL Save & ASCII
Orbit-by-orbit cloud parameters
ASC Frequency, 85° Lat

Days From Solstice
v04.20, Rev05, 2G

Frequency (%)
Frequency is anti-correlated with temperature and ~correlated with water vapor *except for SH 2009-2010.*
Omitting beginning of SH0910 season brings it into line with the others.

High frequencies in early SH0910 caused by early winter-to-summer stratospheric wind shift (Karlsson et al., 2011).
Variability **During** the Seasons

PMC frequency variations are (often) anti-correlated with local temperature variations throughout the season.
Winter hemisphere variations also drive the PMCs, but with varying time lag (related to PMC altitude?)
NH PMC Variability vs. SH (Winter)
Stratopause Temperature Variability

CIPS LAT 80°
NH07

CIPS LAT 80°
NH08

CIPS LAT 80°
NH09

CIPS LAT 80°
NH10

CIPS LAT 80°
NH11

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CAWSES PMC Trends Mtg, May 2012
SH PMC Variability vs. NH (Winter)
Stratopause Temperature Variability

CIPS LAT -80°
MLS LAT 70°

SH07

CIPS LAT -80°
MLS LAT 70°

SH08

CIPS LAT -80°
MLS LAT 70°

SH09

CIPS LAT -80°
MLS LAT 70°

SH10

CIPS LAT -80°
MLS LAT 70°

SH11
Spatial Variability On Different Time Scales

ALL_JAN

ALL_JULY

Albedo (10^{-6}sr^{-1})

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CAWSES PMC Trends Mtg, May 2012
Figure CIPS-global-2. Average PMC albedo over all January measurements in the SH (upper left), as well as the average albedo during January of each SH season that CIPS has observed (as labeled).
Temperature cannot explain high albedo in 2010 relative to 2008 & 2009, but can explain low albedo in 2011 and 2012.
But H2O itself is consistent with bright 2010

January, SH
H2O (ppmv)
MLS 0D (Hervig) ice water content

SH January

Ice water content, μg/m²

2008

2009

2010

2011

2012
Hervig 0D equilibrium model can give reasonable overall values:
When/where can it be applied?
CIPS Local Time Differences

- NH Asc
- NH Dsc
- SH Asc
- SH Dsc

Local Time (hrs)

| Latitude |

50  60  70  80  90
- Interannual variability in SH is substantial
- Asc > Dsc in some seasons
- Similar plot for NH does not show this behavior
Do bright clouds vary differently than faint clouds?

- Anti-correlation between bright and faint clouds in mid-season
- So zonal average frequencies of bright and dim clouds must show opposite relationships with *bulk* temperature.
SNOE, SOFIE, & OSIRIS: Anti-correlation, NH & SH

SNOE, NH 2000, 75-80°N
- Brightest 20%
- Faintest 20%
- R: -0.7

SOFIE, NH 2007
- Brightest 20%
- Faintest 20%
- R: -0.7

OSIRIS, NH08
- Brightest Faintest
- R: -0.7

SNOE, SH 2000-2001, 75-80°S
- Brightest 20%
- Faintest 20%
- R: -0.8

SOFIE, SH 2008-2009
- Brightest 20%
- Faintest 20%
- R: -0.7

OSIRIS, SH0708
- Brightest Faintest
- R: -0.8
Summary

● The AIM/CIPS high spatial resolution and extensive spatial coverage provide a wealth of information on PMCs that has yet to be mined.

● Overall CIPS variations can often be explained simply by large-scale T and H2O, but quantitative explanations & detailed mechanisms are needed.

● Modeling PMC trends will require appropriate treatment of intra- and inter-hemispheric teleconnections. Gravity Waves!

● Trend analyses should be performed on specific parts of the season, and should consider bright/dim clouds separately.

● Local time effects can change from year to year – Must understand this.

We invite you to use the data!

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http://lasp.colorado.edu/aim/