STATUS OF NASA LANGLEY TRIANA ALGORITHMS

NISTAR CORRECTION FACTORS

EPIC SIMULATIONS FOR CLOUD STUDIES

CLOUD PHASE/SHAPE DETERMINATIONS

MULTISATELLITE, MULTIVIEW DATASETS

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Triana Science Team Meeting

October 16-17, 2000

NISTAR CORRECTIONS FOR EACH OBSERVATION

OBJECTIVES

- **COMPUTE GLOBAL ALBEDO**
  - **ACCOUNT FOR ANISOTROPY (BRDF)**
  - **ACCOUNT FOR MISSING LIGHT**
- **COMPUTE GLOBAL LONGWAVE FLUX (OLR)**
  - **ACCOUNT FOR LIMB-DARKENING**
  - **ACCOUNT FOR DARK SIDE OF EARTH (OLR CORRECTION FACTOR)**

- **TO COMPUTE ERBE ALBEDO AT TRIANA TIME FROM THE TWO CLOSEST ERBE OBSERVATIONS**

$$\alpha_{erbe}(\mu_T) = w_1 \sum_{i=1}^{4} \alpha_{erbe}(\mu_1)\, \delta_i(\mu_T)/\delta_i(\mu_1) \; + \; w_2 \sum_{i=1}^{4} \alpha_{erbe}(\mu_2)\, \delta_i(\mu_T)/\delta_i(\mu_2)$$

$$w_1 = (t_2 - t_T) / (t_2 - t_1),\ w_2 = (t_T - t_1) / (t_2 - t_1)$$

δ_i = ERBE SW directional model 1=clear, 2=partly cloudy, 3=mostly cloudy, 4=overcast

- **TRIANA REGIONAL ALBEDO (2.5°lat x 2.5°lon) REGION**

$$\alpha_{triana}(\mu_T) = \alpha_{erbe}(\mu_T)$$

- **TRIANA REGIONAL REFLECTANCE (2.5°lat x 2.5°lon) REGION**

$$\mathbf{REF}_{triana}(\mu_T, \mathbf{vz}_T, \mathbf{ra}_T, \mathbf{scene}_T) = \alpha_{erbe}(\mu_T)\, \chi(\mu_T, \mathbf{vz}_T, \mathbf{ra}_T, \mathbf{scene}_T)$$

- **TRIANA GLOBAL ALBEDO AND REFLECTANCE**

$$\alpha_{triana}(\mathbf{gmt}) = \sum_{earth}^{vz<90} \alpha_{triana}(\mu_i)\, \mu_i \cos(\mathbf{lat}_i) \Big/ \sum_{earth}^{vz<90} \mu_i \cos(\mathbf{lat}_i)$$

$$\mathbf{REF}_{triana}(\mathbf{gmt}) = \sum_{earth}^{vz<90} \mathbf{REF}_{triana}(\mu_T, \mathbf{vz}_T, \mathbf{ra}_T, \mathbf{scene}_T)\, \mu_i \cos(\mathbf{lat}_i) \Big/ \sum_{earth}^{vz<90} \mu_i \cos(\mathbf{lat}_i)$$

$\mu_i \cos(\mathbf{lat}_i)$ accounts for solar insolation and area weighting

- **TRIANA GLOBAL BIDIRECTIONAL FACTOR**

$$\chi_{triana}(\mathbf{gmt}) = \mathbf{REF}_{triana}(\mathbf{gmt}) / \alpha_{triana}(\mathbf{gmt})$$

- **TRIANA GLOBAL MISSING LIGHT ALBEDO CORRECTION FACTOR**

$$\alpha_{FACTOR}(\mathbf{gmt}) = \left[\sum_{earth} \alpha_{erbe}(\mu_i)\, \mu_i \cos(\mathbf{lat}_i) \Big/ \sum_{earth} \mu_i \cos(\mathbf{lat}_i) \right] \Big/ \left[\alpha_{triana}(\mathbf{gmt}) \right]$$

• TRIANA GLOBAL OLR AND LONGWAVE RADIANCE

$$\mathbf{OLR}_{\text{triana}}(\mathbf{gmt}) = \sum_{earth}^{vz<90} \mathbf{OLR}_{\text{triana}}(\mathbf{t}_T)\cos(\mathbf{lat}_i) \Big/ \sum_{earth}^{vz<90} \cos(\mathbf{lat}_i)$$

$$\mathbf{RAD}_{\text{triana}}(\mathbf{gmt}) = \sum_{earth}^{vz<90} \mathbf{RAD}_{\text{triana}}(\mathbf{t}_T, \mathbf{vz}_T, \mathbf{lat}_T, \mathbf{season}_T, \mathbf{scene}_T)\cos(\mathbf{lat}_i) \Big/ \sum_{earth}^{vz<90} \cos(\mathbf{lat}_i)$$

$\cos(\mathbf{lat}_i)$ accounts for area weighting

• TRIANA GLOBAL LIMB DARKENING FACTOR

$$\gamma_{\text{triana}}(\mathbf{gmt}) = \mathbf{RAD}_{\text{triana}}(\mathbf{gmt}) \,/\, \mathbf{OLR}_{\text{triana}}(\mathbf{gmt})$$

• TRIANA GLOBAL NIGHT OLR CORRECTION FACTOR

$$\mathbf{OLR}_{\text{FACTOR}}(\mathbf{gmt}) = \left[\sum_{earth} \mathbf{OLR}_{\text{erbe}}(\mathbf{t}_T)\cos(\mathbf{lat}_i) \Big/ \sum_{earth} \cos(\mathbf{lat}_i)\right] \Big/ \left[\mathbf{OLR}_{\text{triana}}(\mathbf{gmt})\right]$$

- **TO COMPUTE ERBE OLR AT TRIANA TIME FROM THE TWO CLOSEST ERBE OBSERVATIONS**

  LINEAR INTERPOLATION FOR OCEAN, SNOW AND COAST

  ERBE HALF SINE FIT FOR LAND AND DESERT

- **TRIANA REGIONAL (2.5°lat x 2.5°lon) OLR**

  $\mathbf{OLR}_{triana}(t_T) = \mathbf{OLR}_{erbe}(t_T)$

- **TRIANA REGIONAL (2.5°lat x 2.5°lon) LONGWAVE RADIANCE**

  $\mathbf{RAD}_{triana}(t_T, vz_T, lat_T, season_T, scene_T) = \mathbf{OLR}_{erbe}(t_T)\,\gamma(t_T, vz_T, lat_T, season_T, scene_T)$

  $\gamma = \pi\,\mathbf{RAD} / \mathbf{OLR}$, where $\gamma = 1$ for Lambertian surface

- **TO COMPUTE VARIABILITY (*100%)**

Albedo:

$$V_{albedo} = 100\% * Std \{ (\alpha_{erbe} - \alpha_{triana}) / \alpha_{erbe} \}$$

OLR:

$$V_{olr} = 100\% * Std \{ (OLR_{erbe} - OLR_{triana}) / OLR_{erbe} \}$$

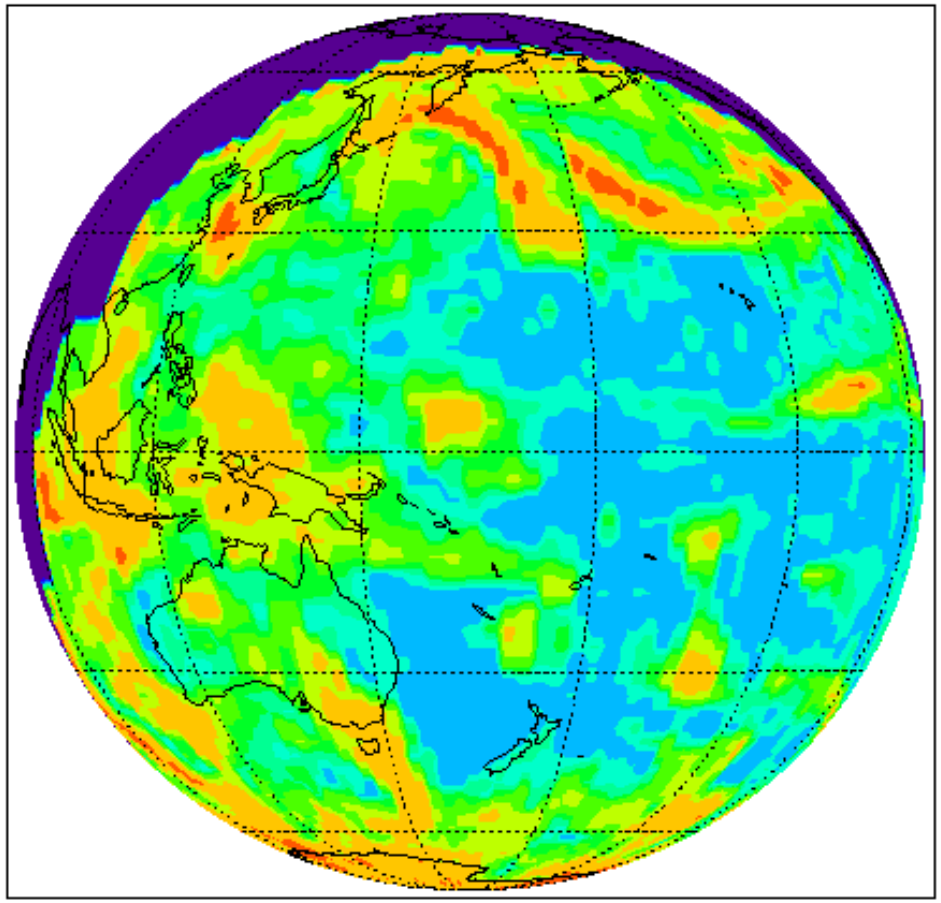
Bidirectional Factor:

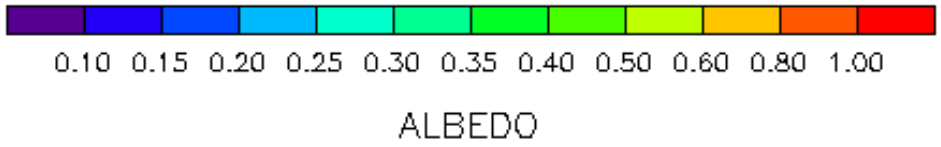
$$V_{bdrf} = 100\% * \{ Std (\chi_{triana}) / \overline{\chi}_{triana} \}$$

Limb Darkening Factor:

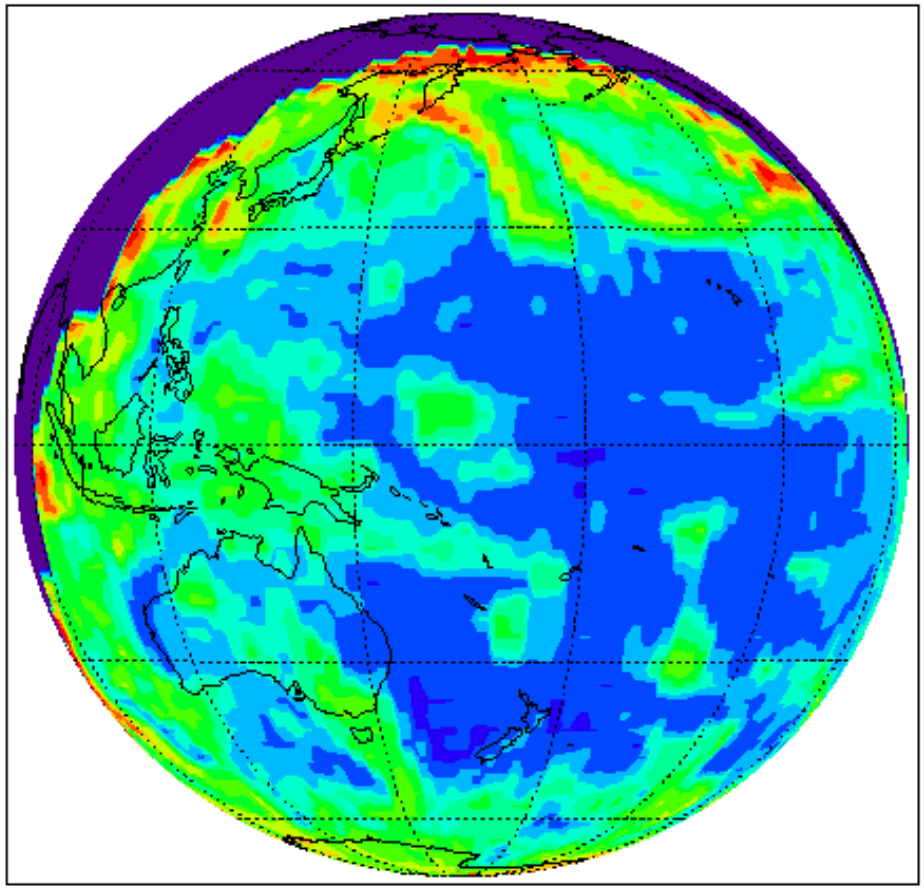
$$V_{bdrf} = 100\% * \{ Std (\gamma_{triana}) / \overline{\gamma}_{triana} \}$$

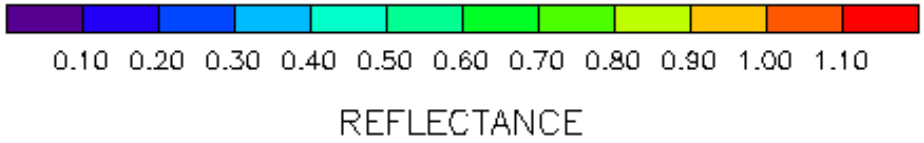
TRIANA VIEWED ALBEDO AT (−20.54,163.95) FOR JAN. 15,1986



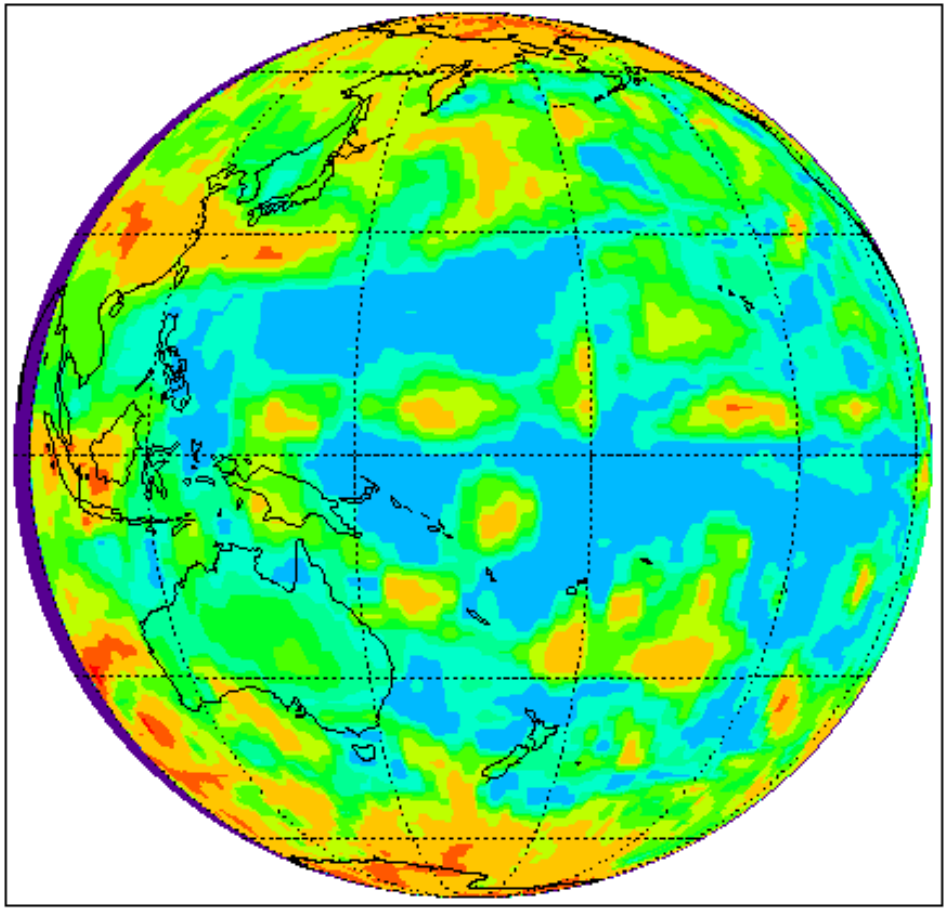


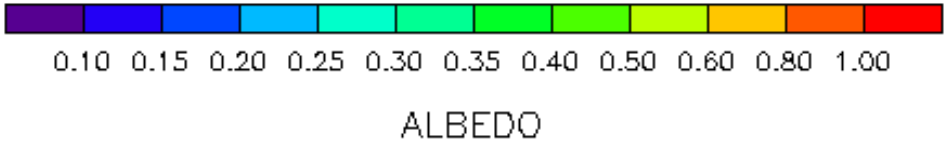
TRIANA VIEWED REFLECTANCE AT (−20.54,163.95) FOR JAN. 15,1986



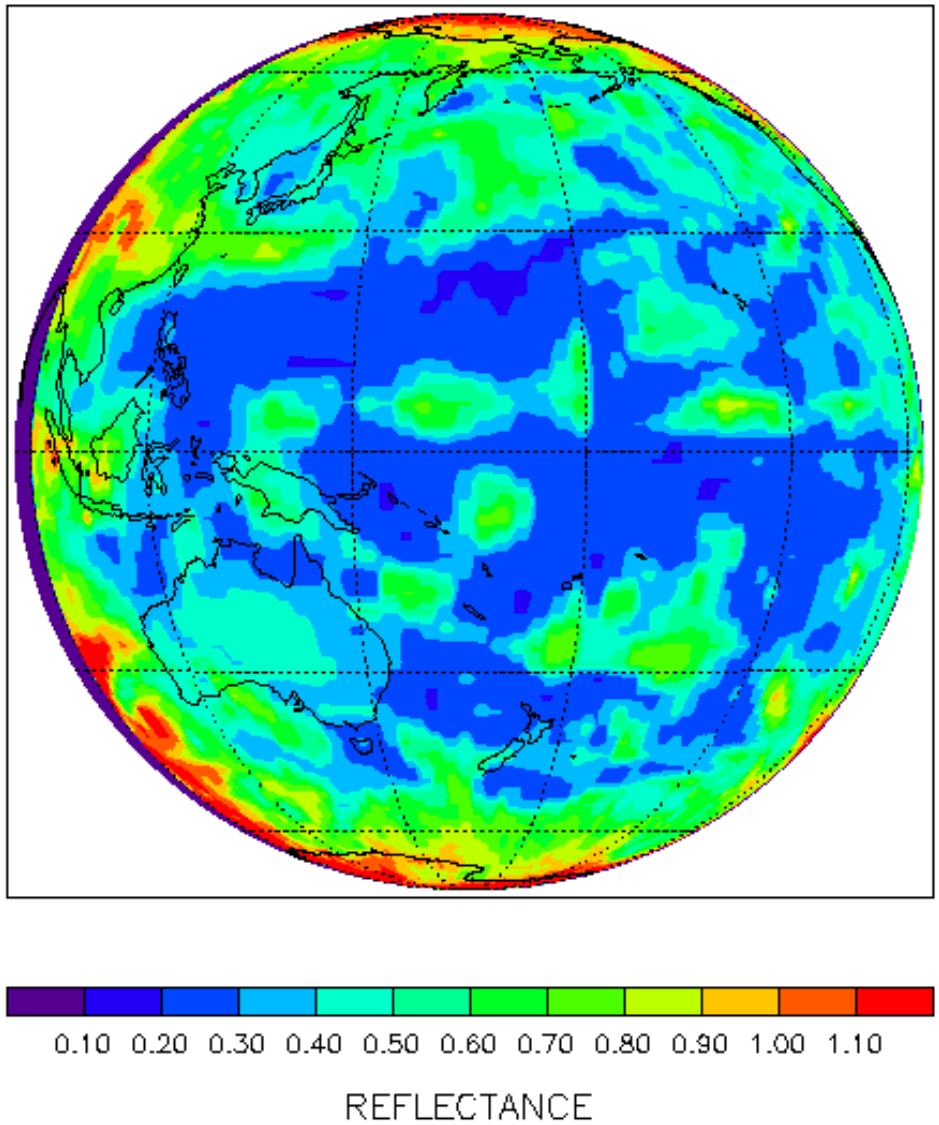


TRIANA VIEWED ALBEDO AT (−0.16,165) FOR March. 21,1986

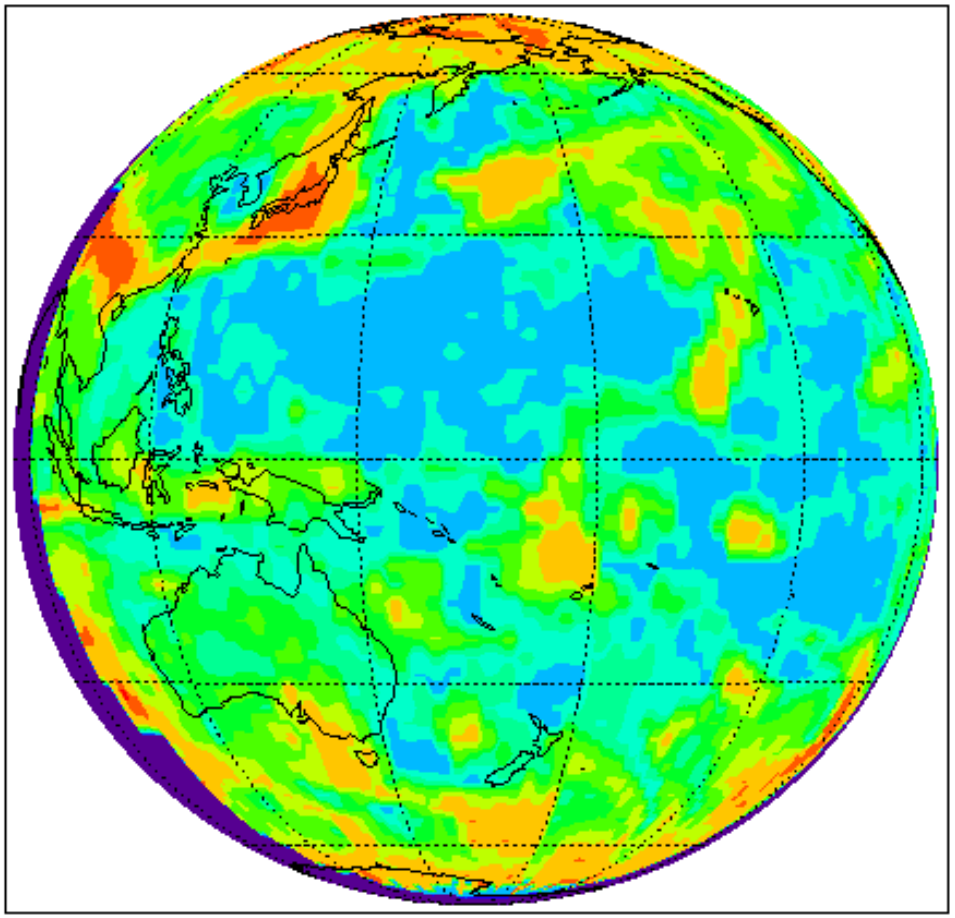


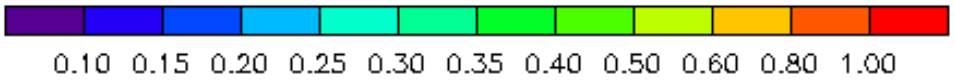


TRIANA VIEWED REFLECTANCE AT (−0.16,165) FOR March. 21,1986



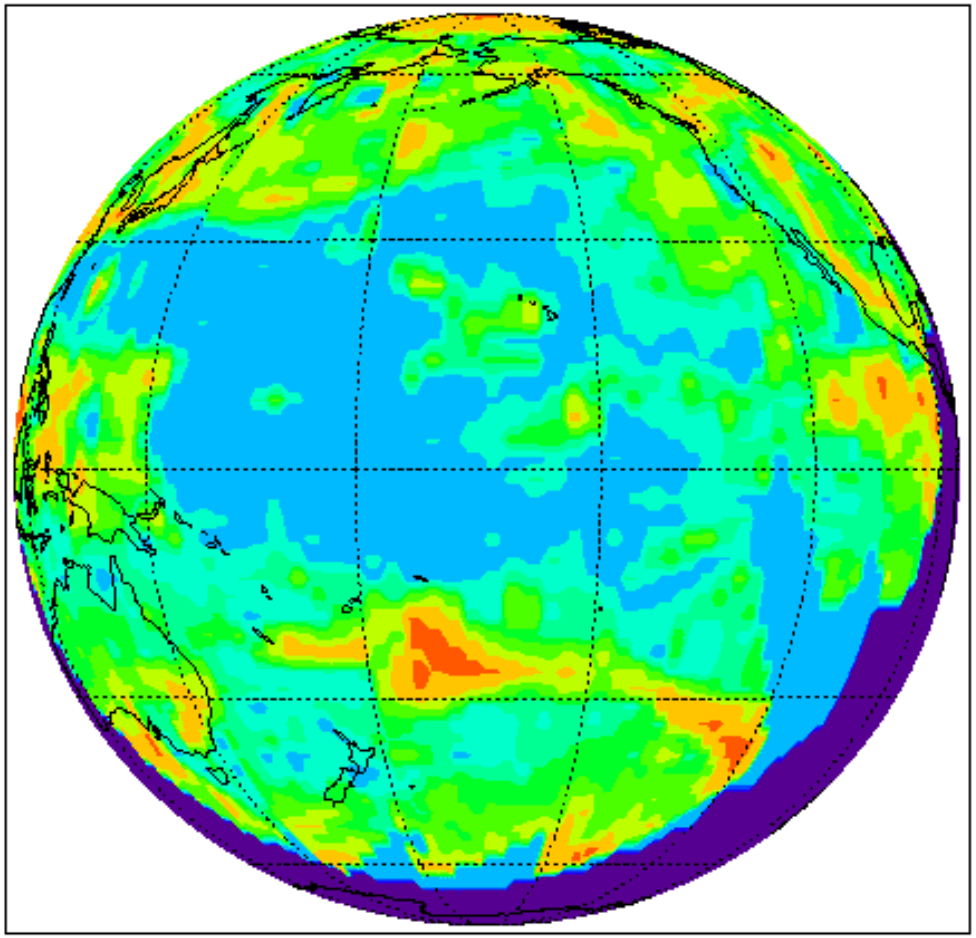
TRIANA VIEWED ALBEDO AT (9.08,164.81) FOR April. 15,1986

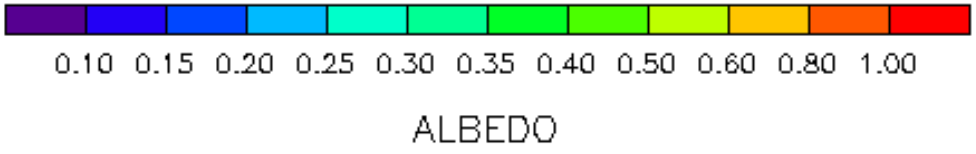




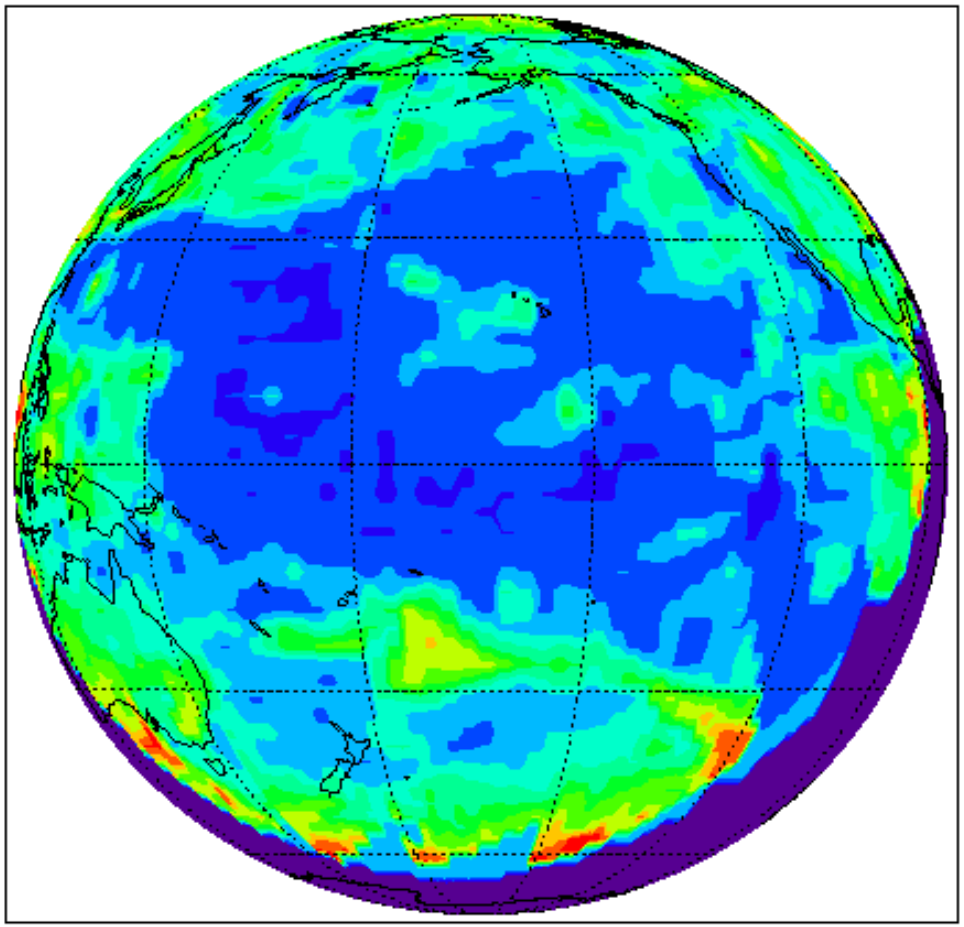
ALBEDO

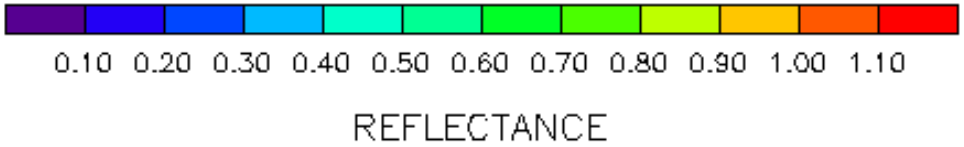
TRIANA VIEWED ALBEDO AT (20.91,196.08) FOR July 15,1986



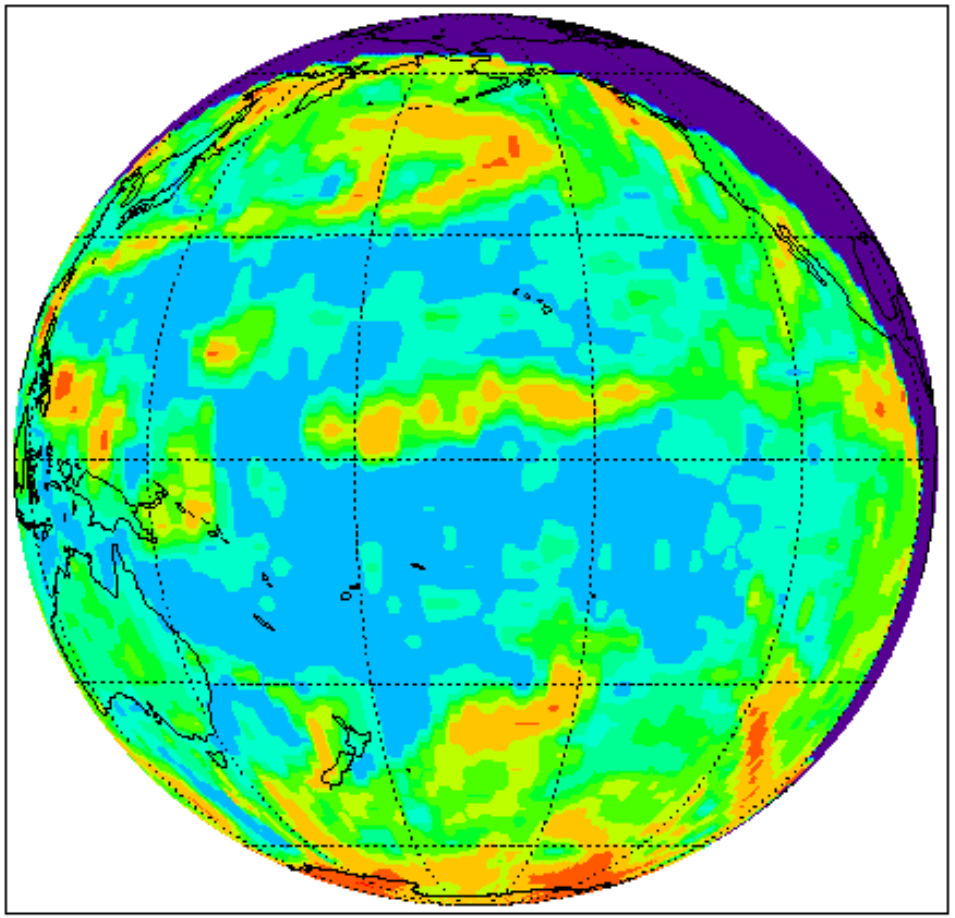


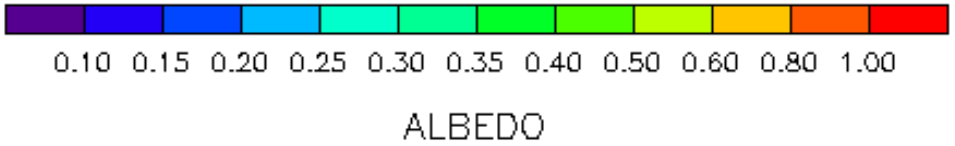
TRIANA VIEWED REFLECTANCE AT (20.91,196.08) FOR July 15,1986



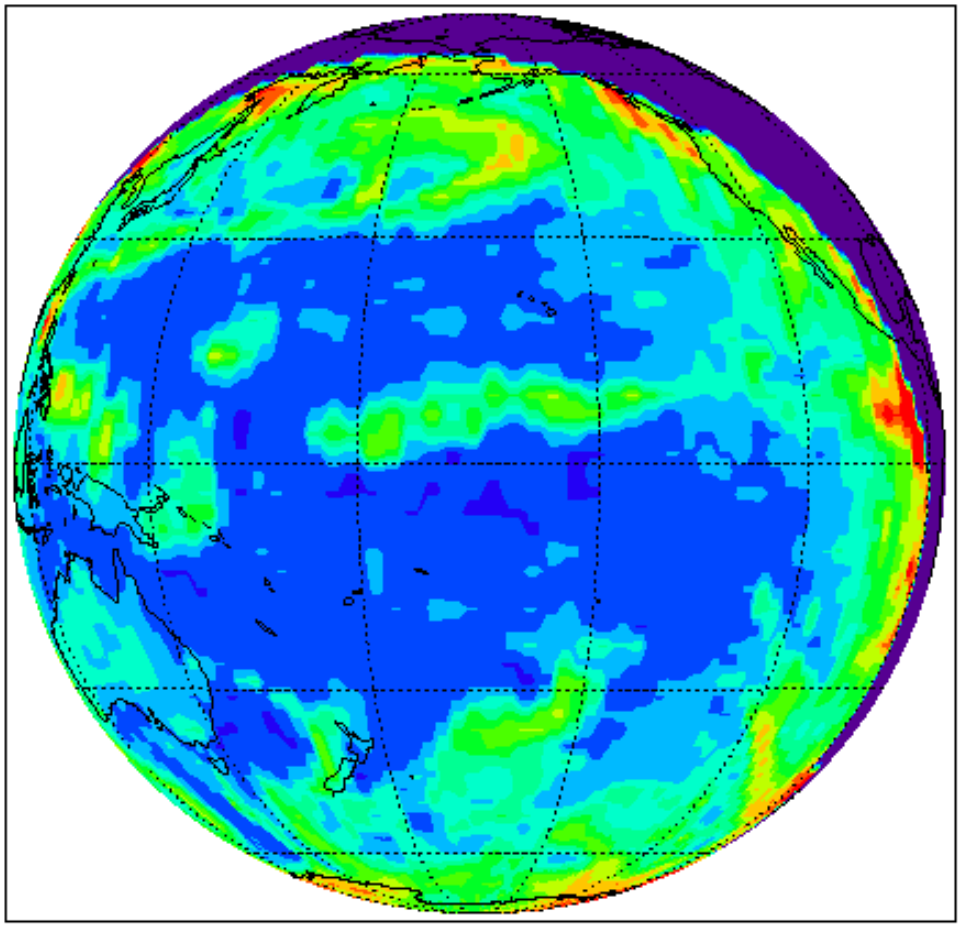


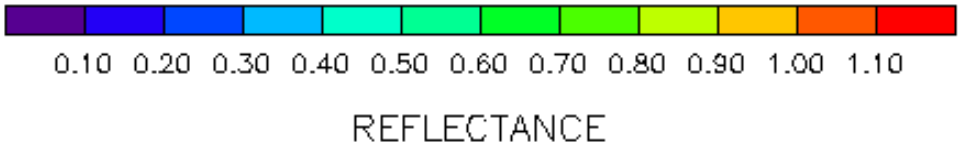
TRIANA VIEWED ALBEDO AT (−7.86,195.15) FOR Oct. 15,1986



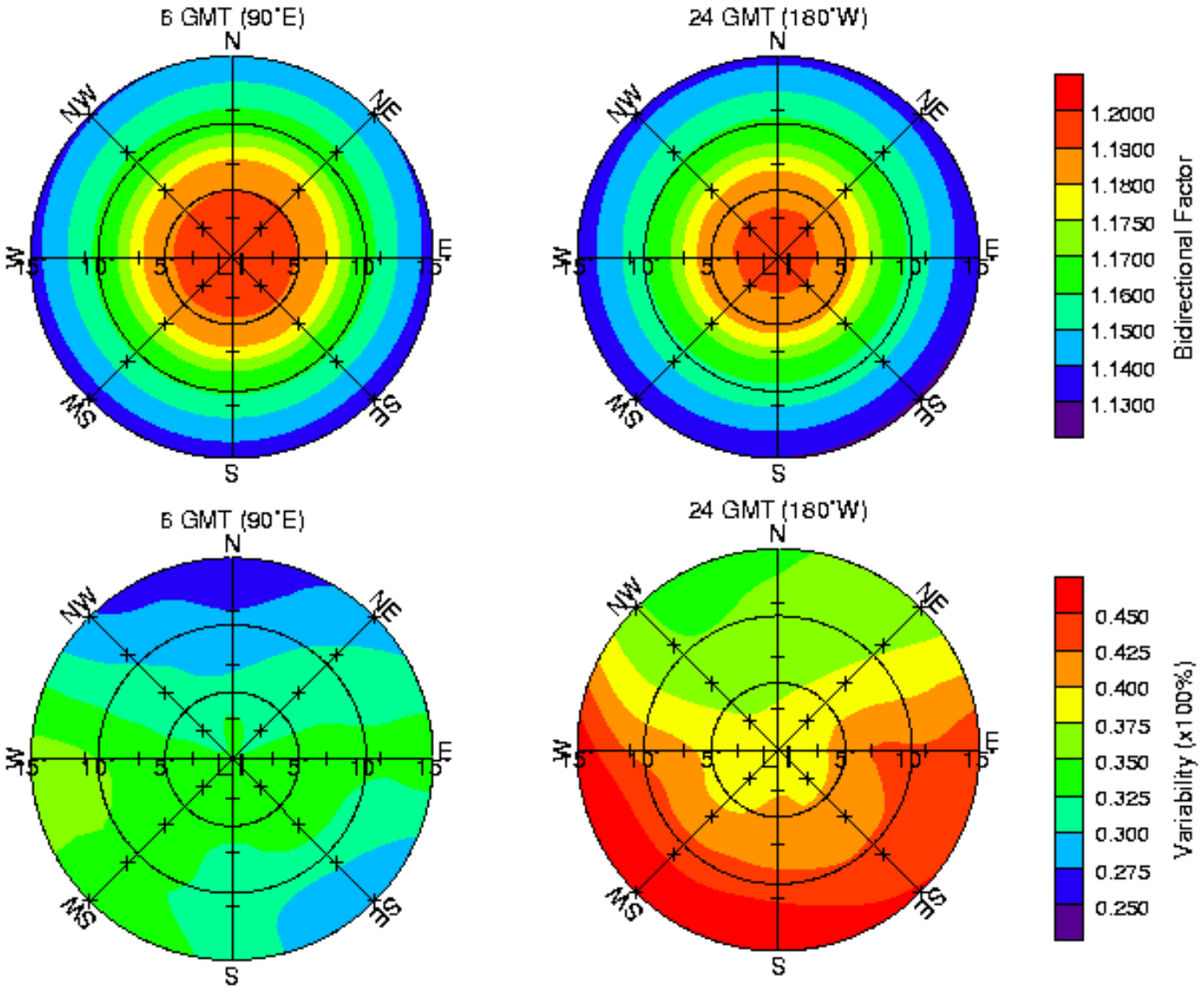


TRIANA VIEWED REFLECTANCE AT (−7.86,195.15) FOR Oct. 15,1986

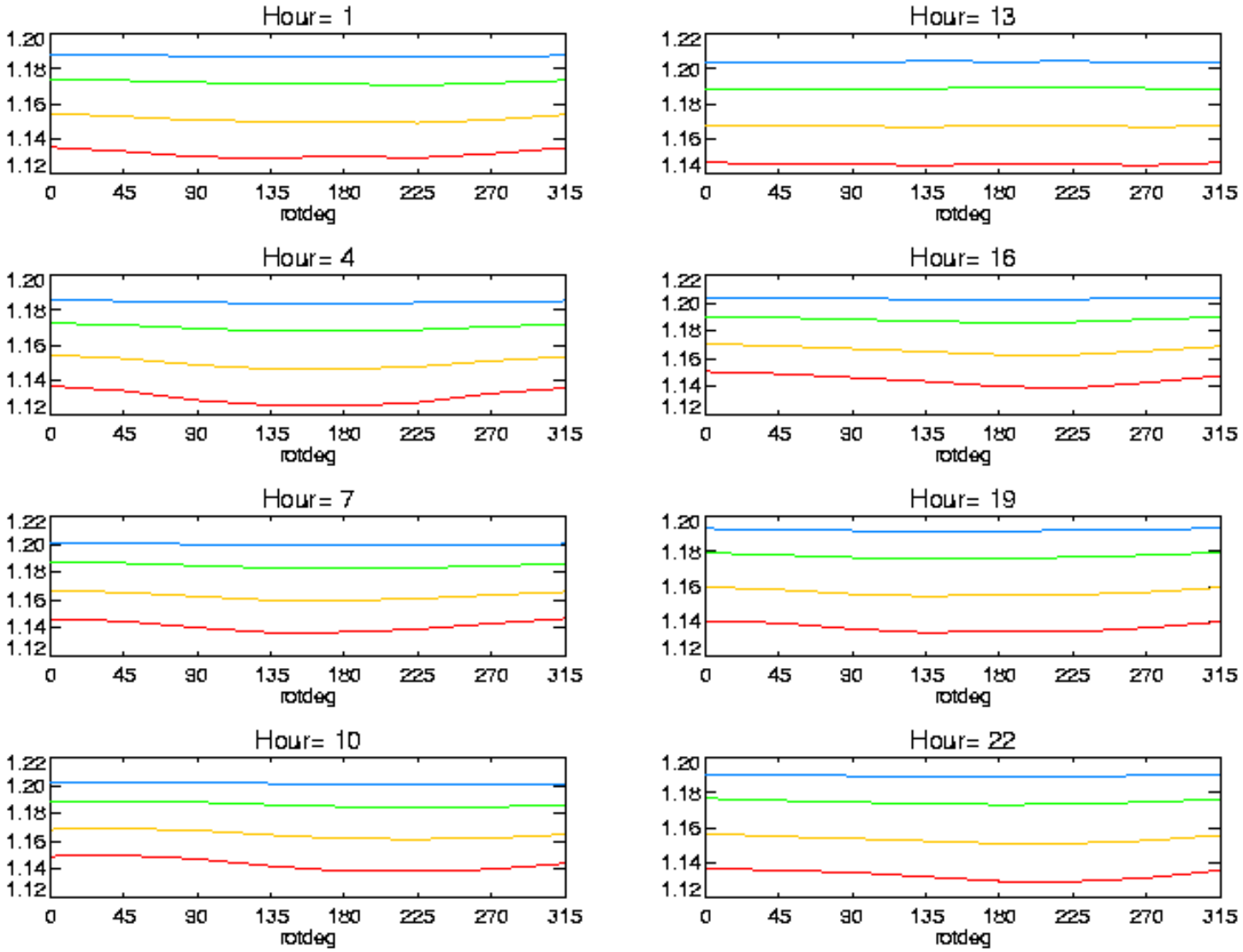




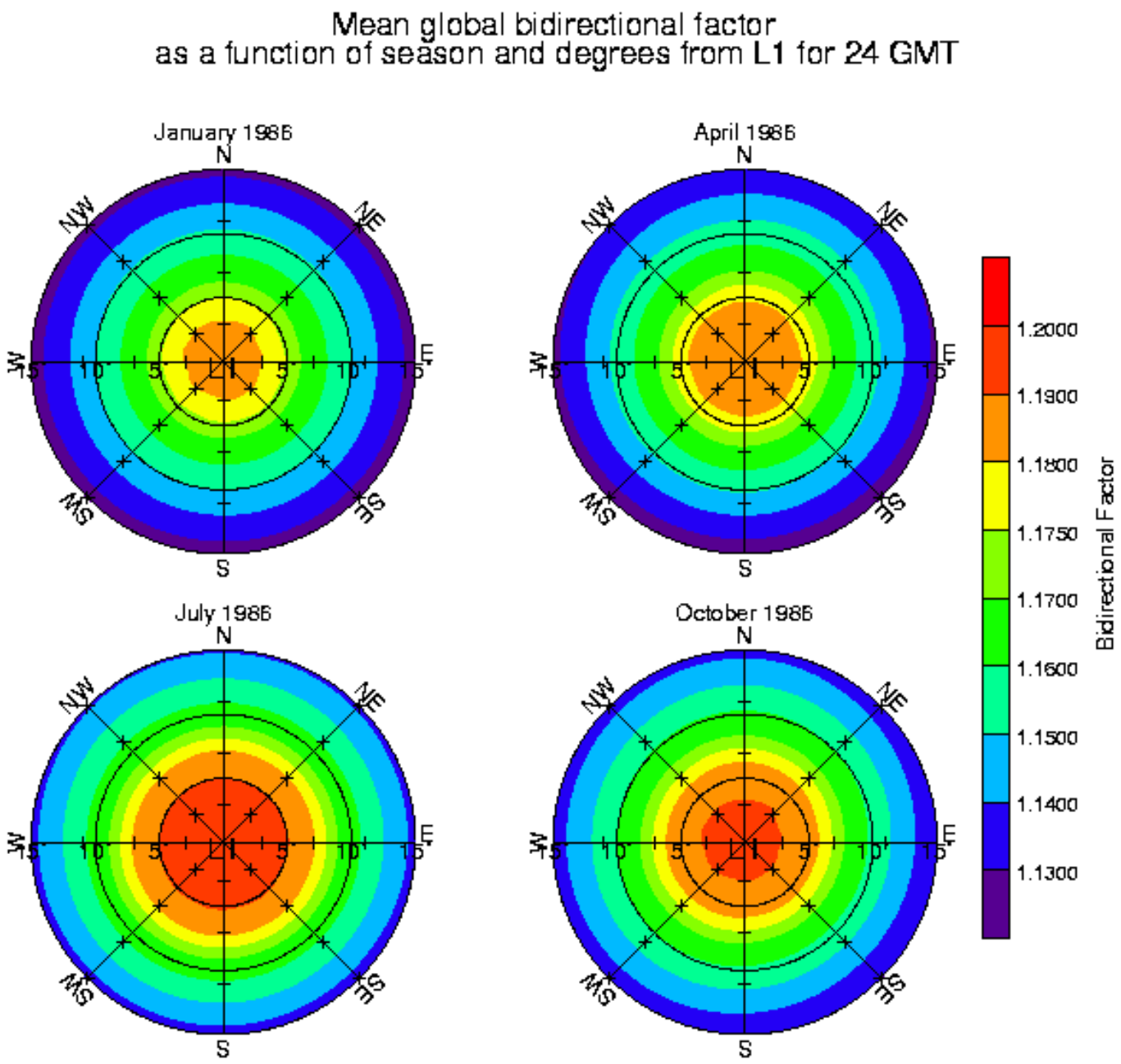
Mean and standard deviation of global bidirectional factor
as a function of GMT and degrees from L1 for March 1986



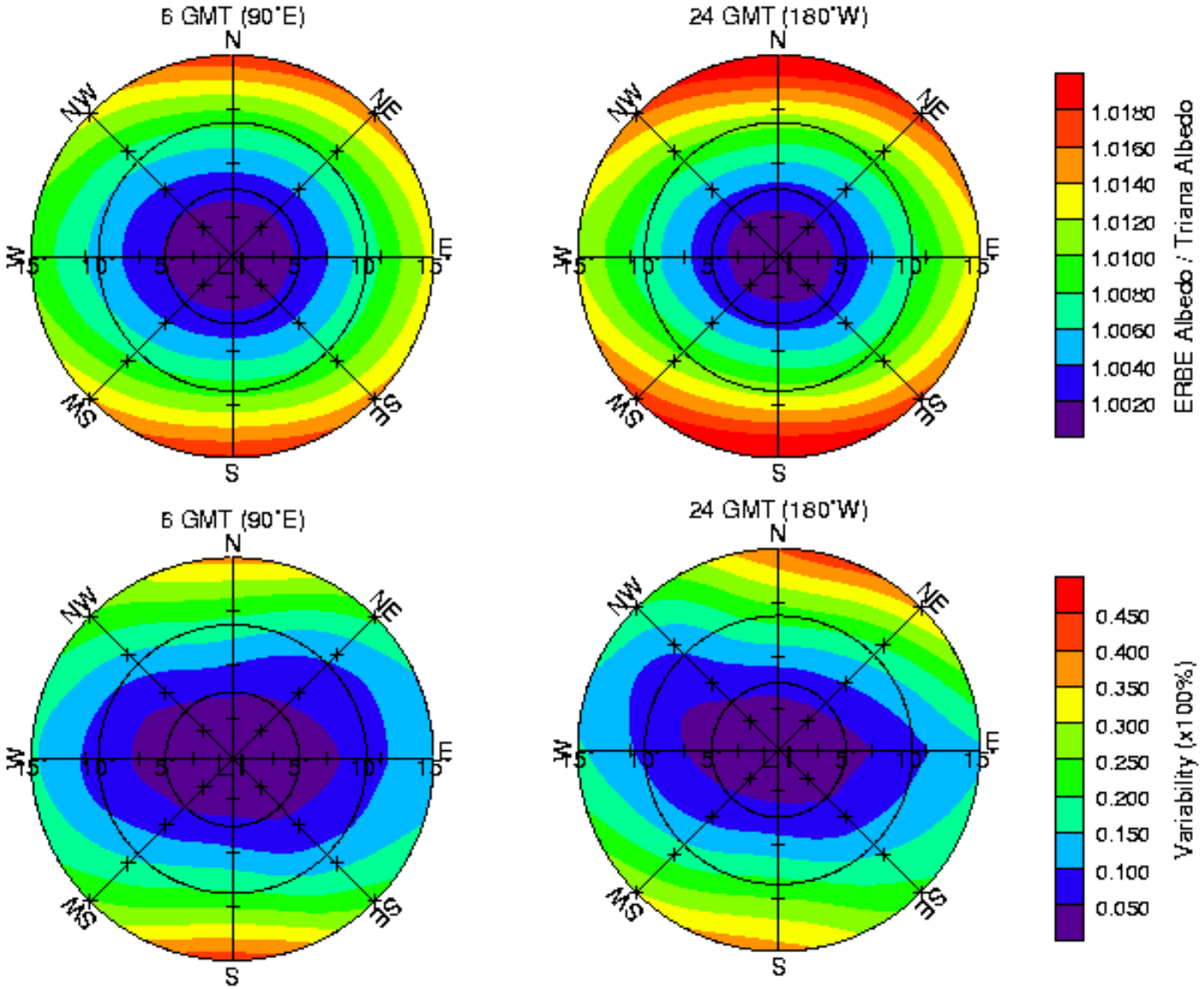
Diurnal variation of mean global bidirectional factor as function of GMT for March 1986



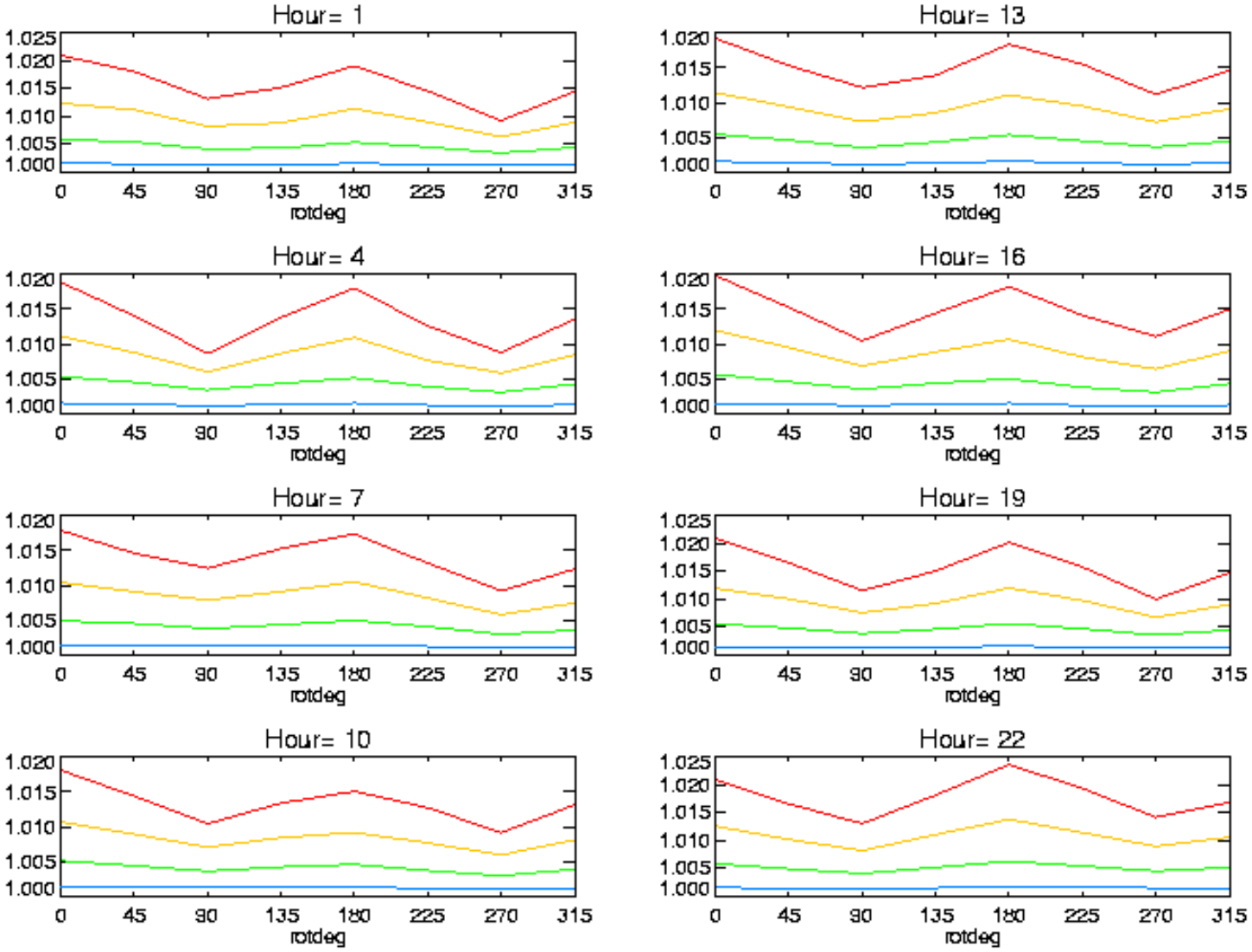
Red line =15.0, Yellow line =11.0, Green line =7.0 and Blue line =3.0


Mean global bidirectional factor
as a function of season and degrees from L1 for 24 GMT
January 1986
April 1986
July 1986
October 1986
N
NE
E
SE
S
SW
W
NW
15
10
5
1
5
10
15
1.2000
1.1900
1.1800
1.1750
1.1700
1.1600
1.1500
1.1400
1.1300
Bidirectional Factor

Mean and standard deviation of global missing light albedo correction factor
as a function of GMT and degrees from L1 for March 1986

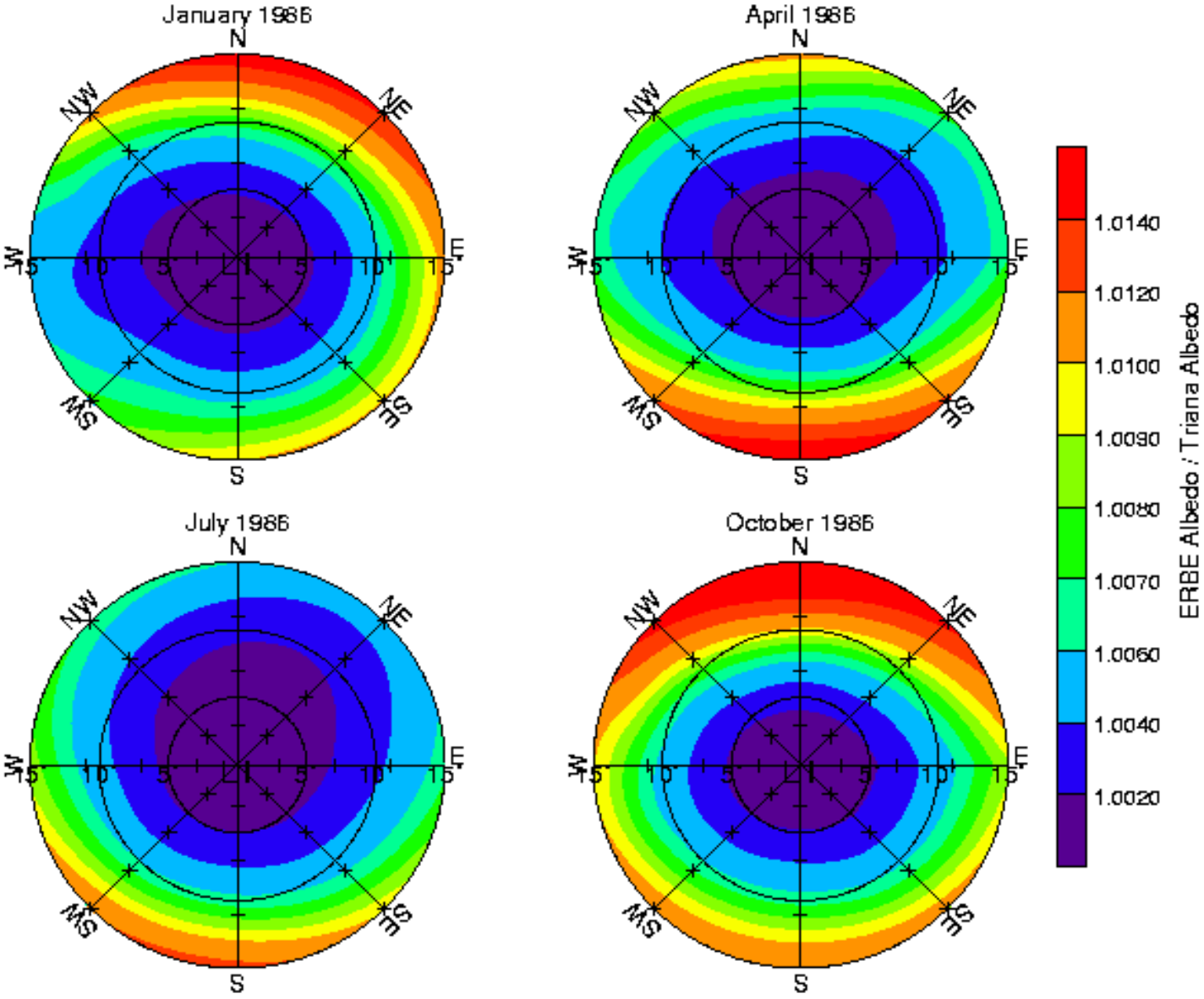


Diurnal variation of mean global missing light albedo correction factor as function of GMT for March 1986

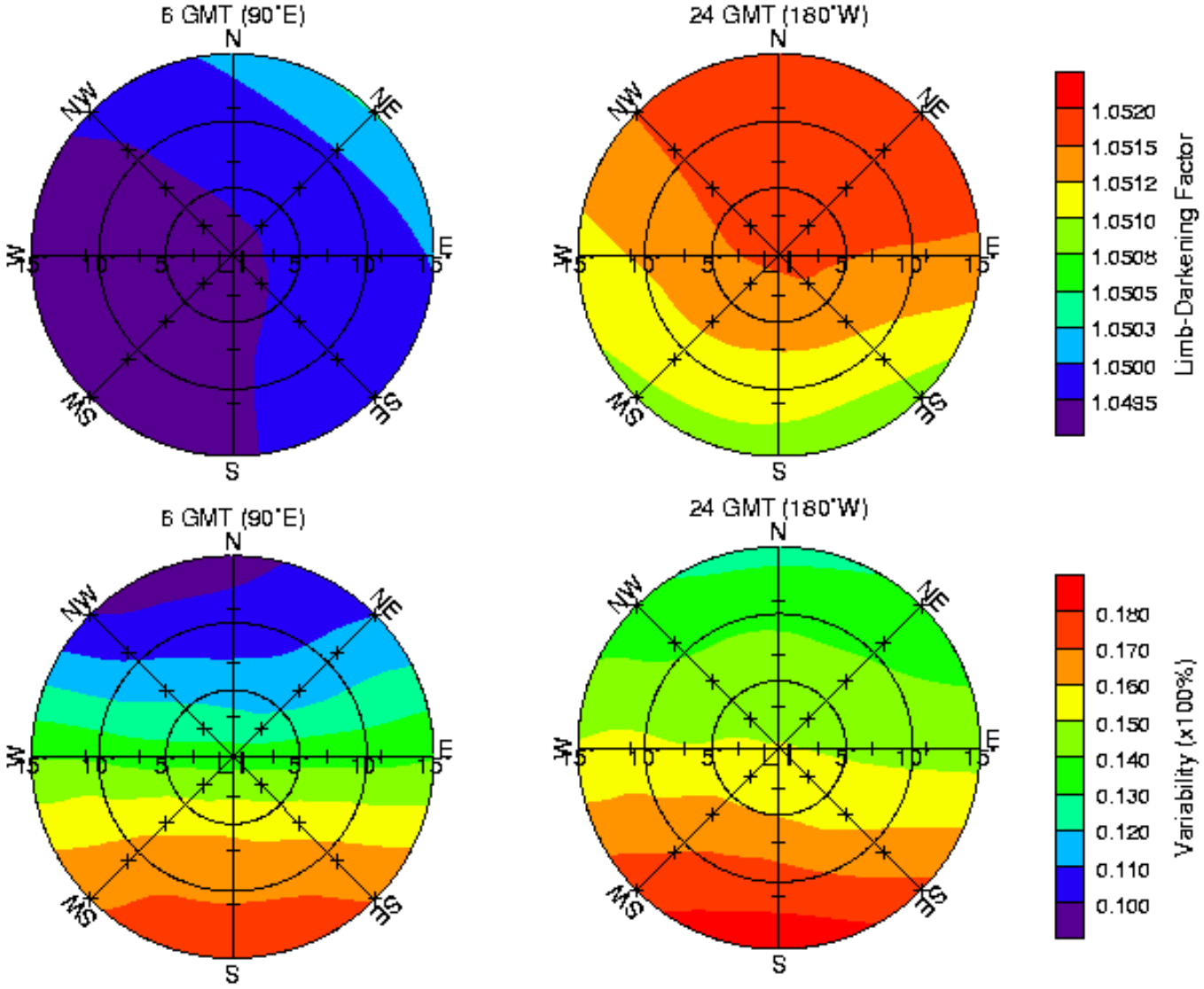


Red line =15.0, Yellow line =11.0, Green line =7.0 and Blue line =3.0

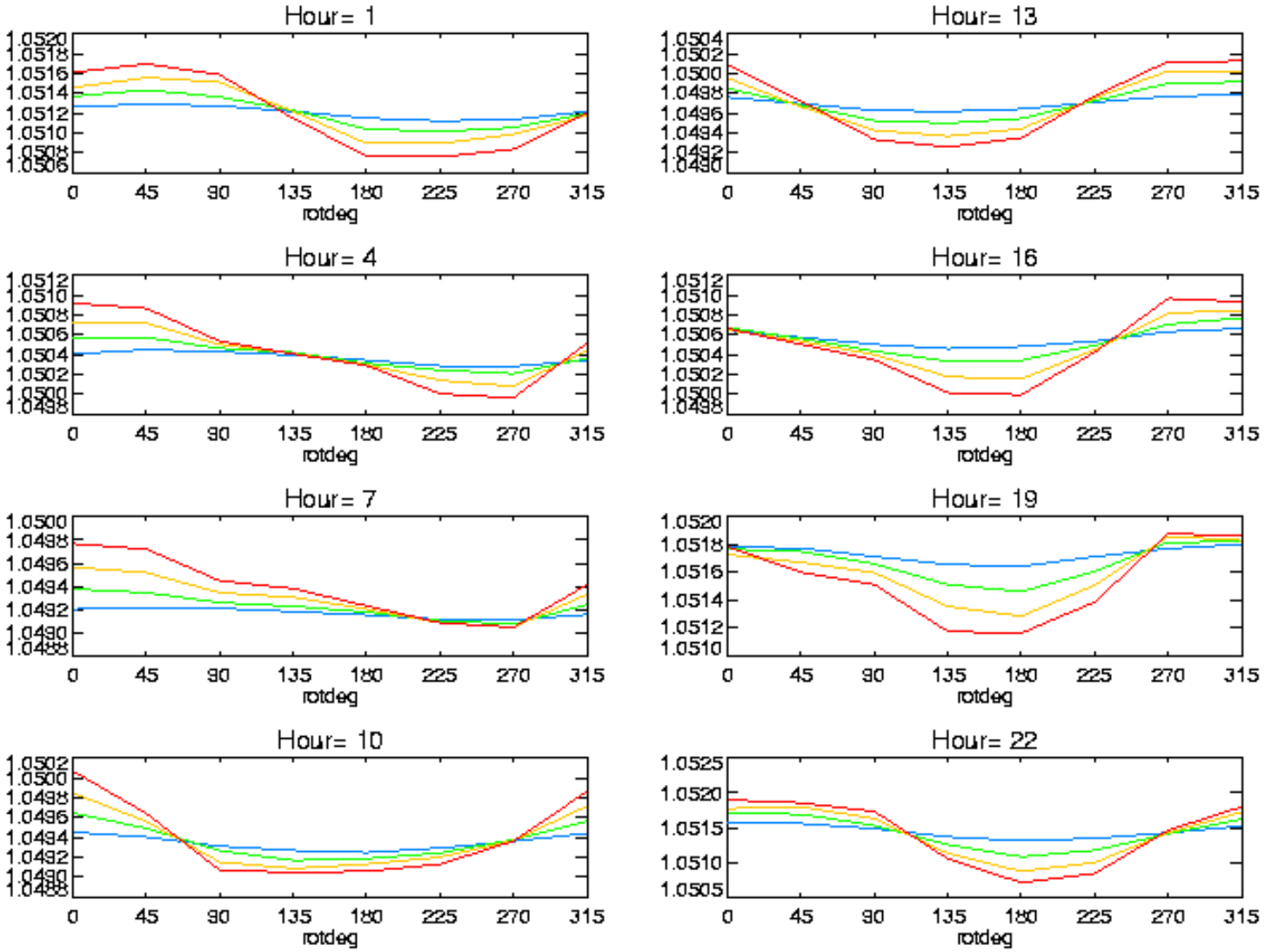
Mean global missing light albedo correction factor
as a function of season and degrees from L1 for 24 GMT



Mean and standard deviation of global Limb-Darkening factor
as a function of GMT and degrees from L1 for March 1986

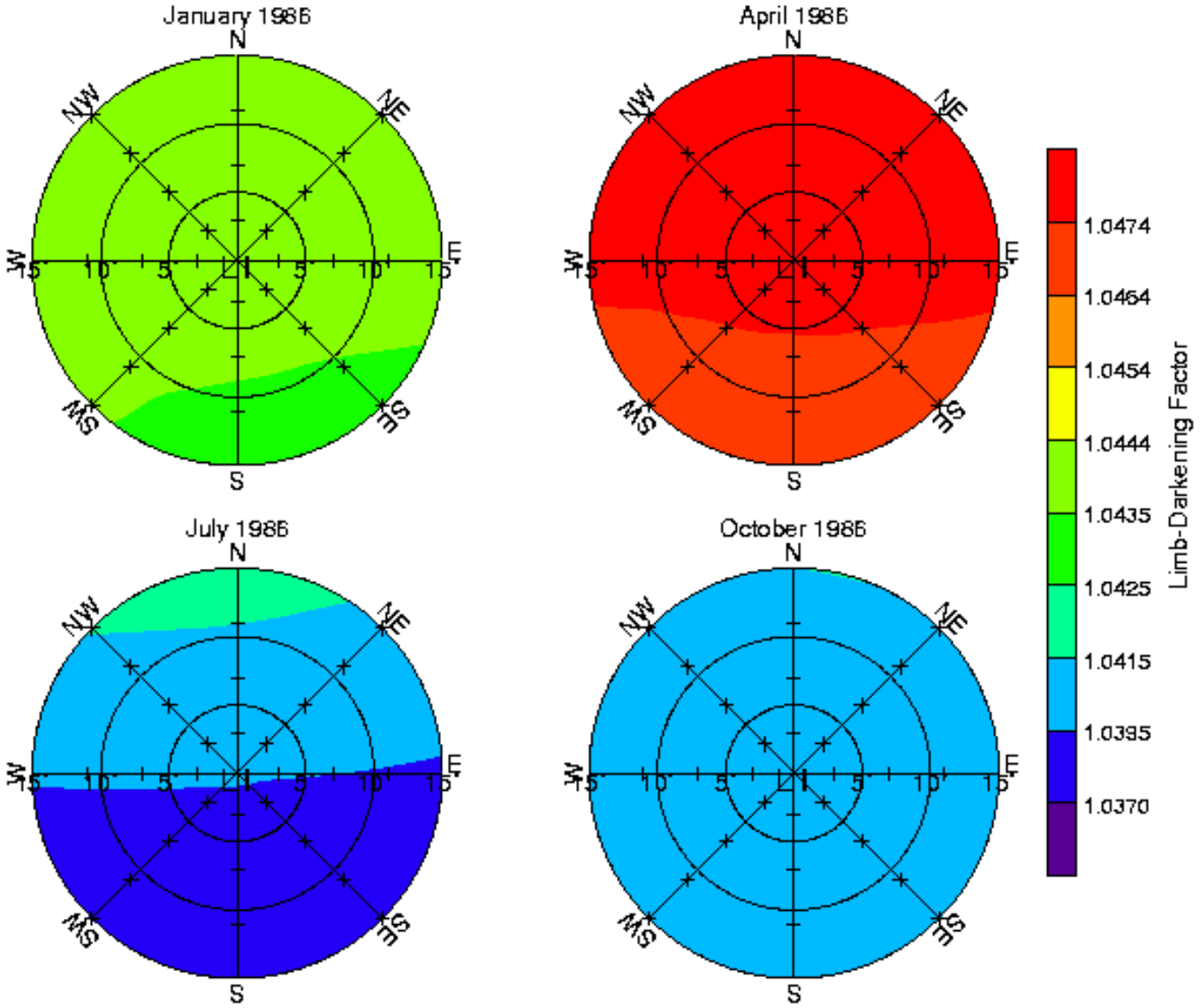


Diurnal variation of mean global Limb-Darkening as function of GMT for March 1986

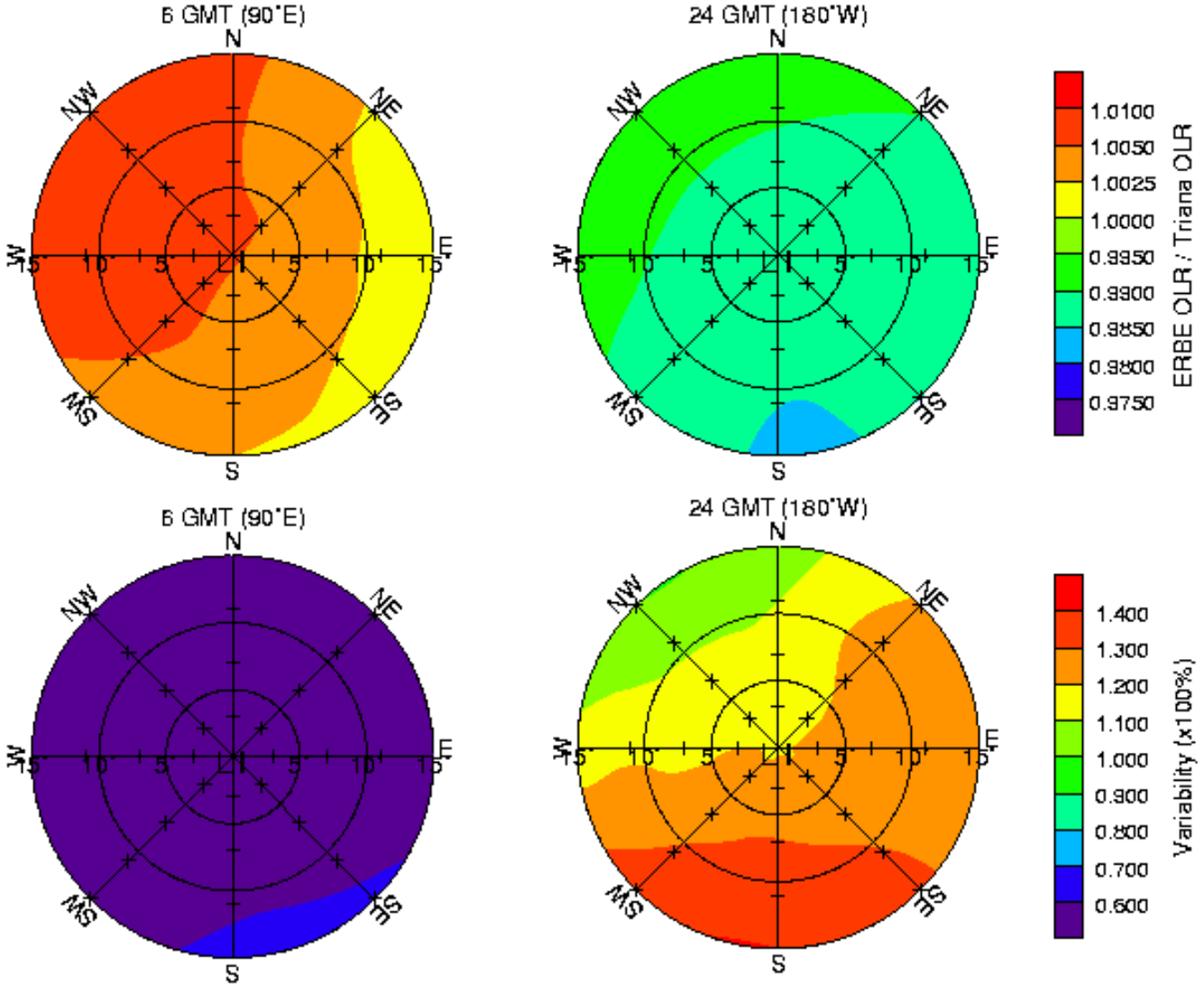


Red line =15.0, Yellow line =11.0, Green line =7.0 and Blue line =3.0

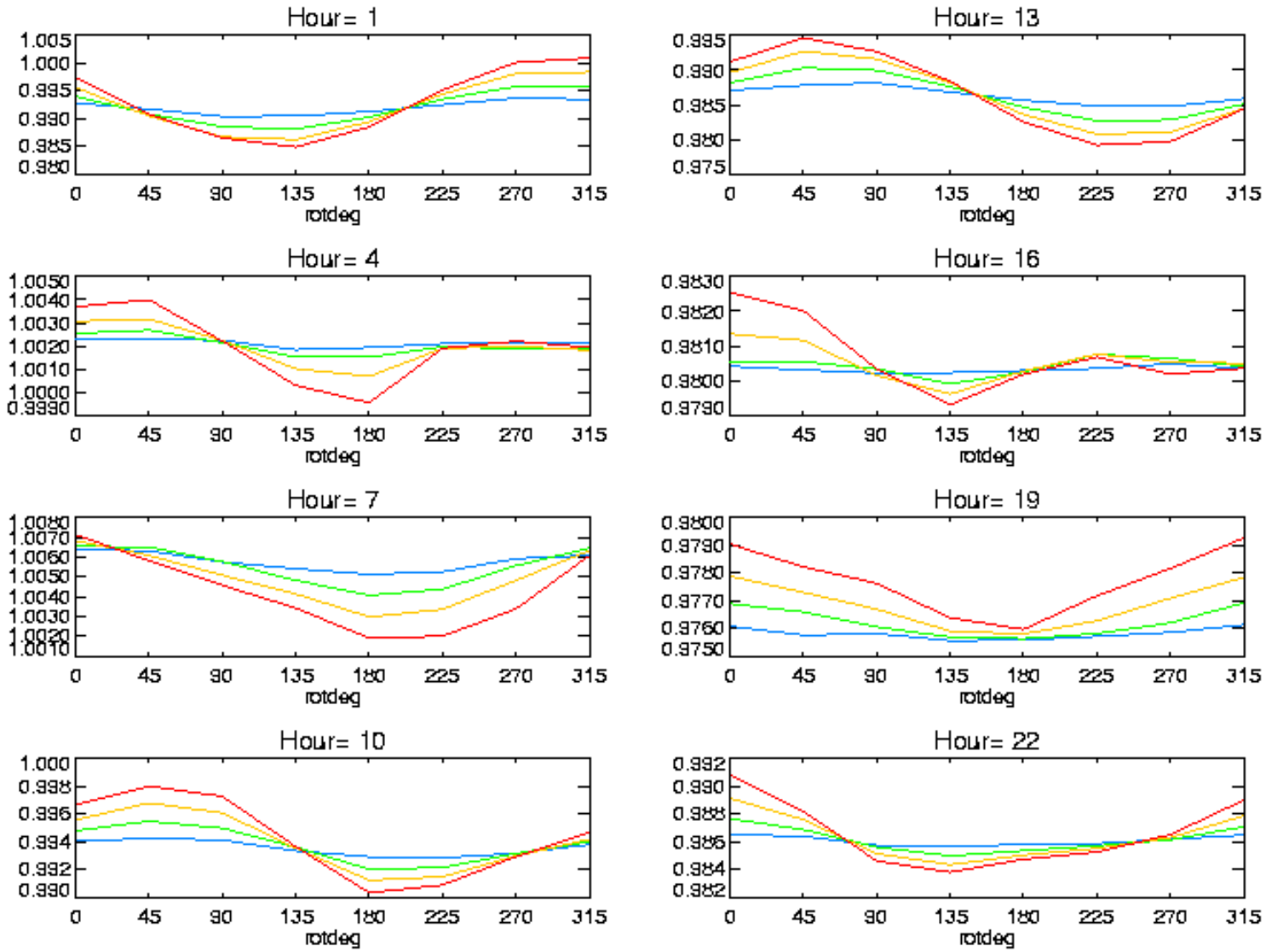
Mean global Limb-Darkening factor
as a function of season and degrees from L1 for 24 GMT



Mean and standard deviation of global OLR correction factor
as a function of GMT and degrees from L1 for March 1986

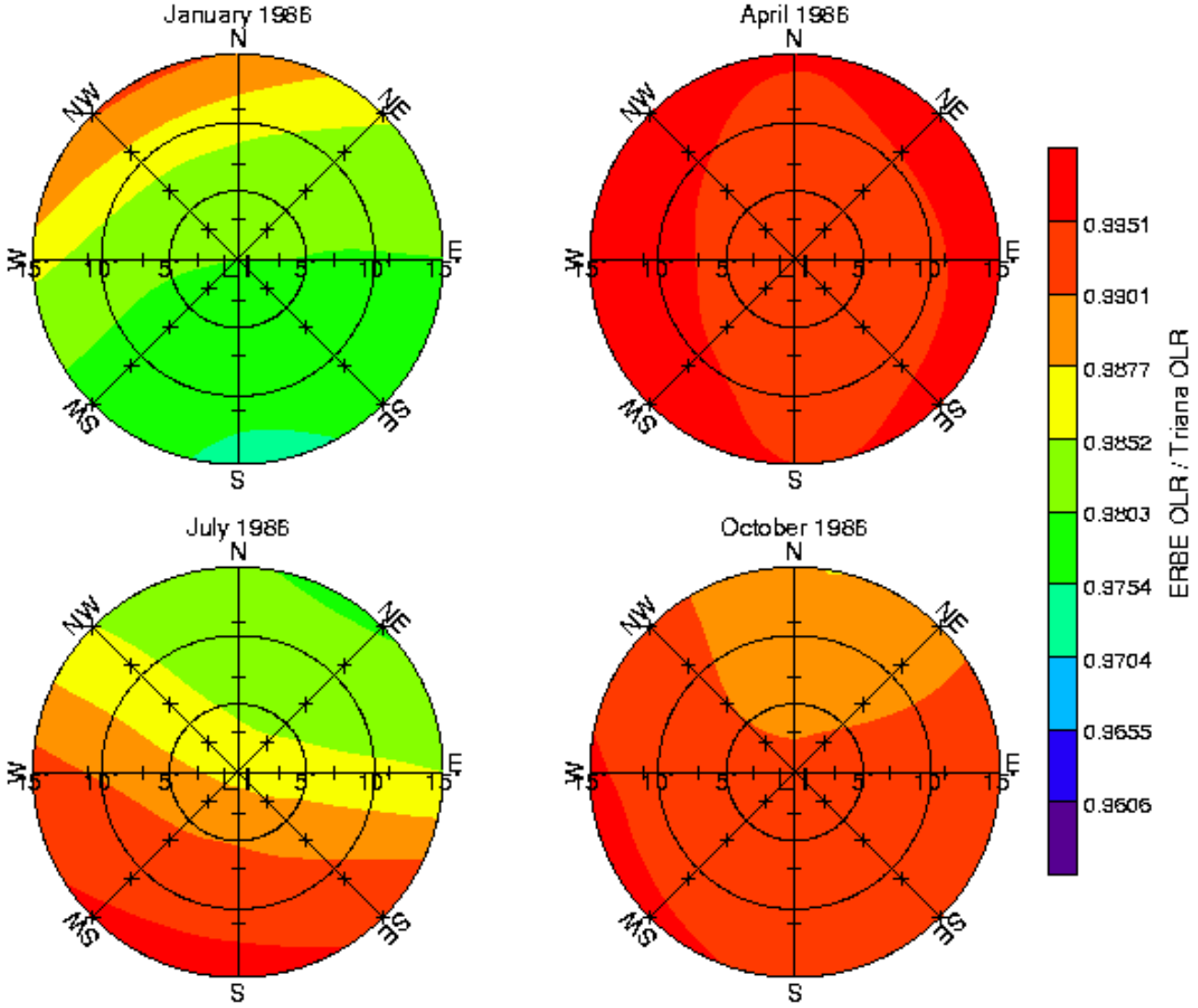


Diurnal variation of mean global OLR correction factor as function of GMT for March 1986

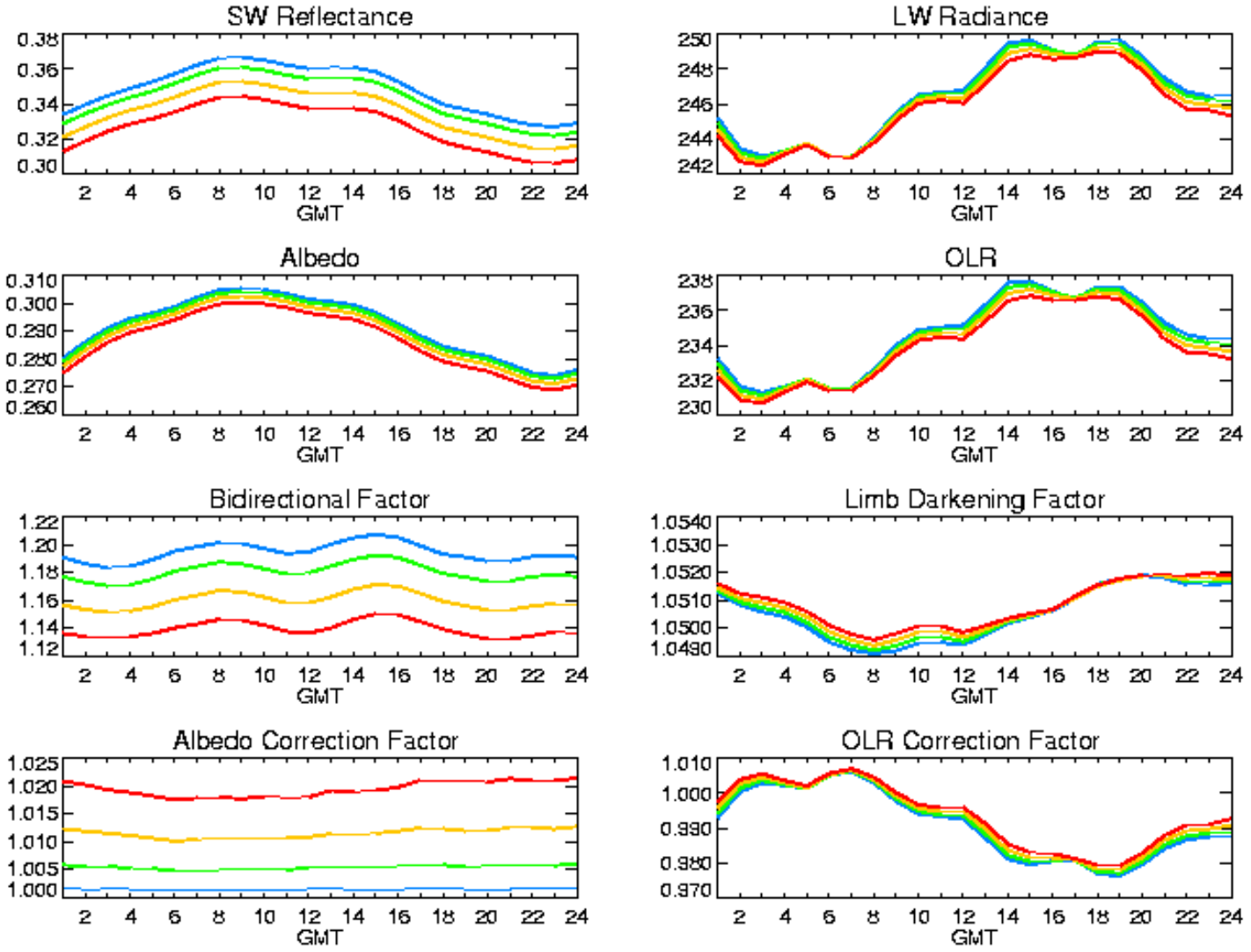


Red line =15.0, Yellow line =11.0, Green line =7.0 and Blue line =3.0

Mean global OLR correction factor
as a function of season and degrees from L1 for 24 GMT



Diurnal variation of mean global Triana parameters as function of degrees North of L1 for March 1986



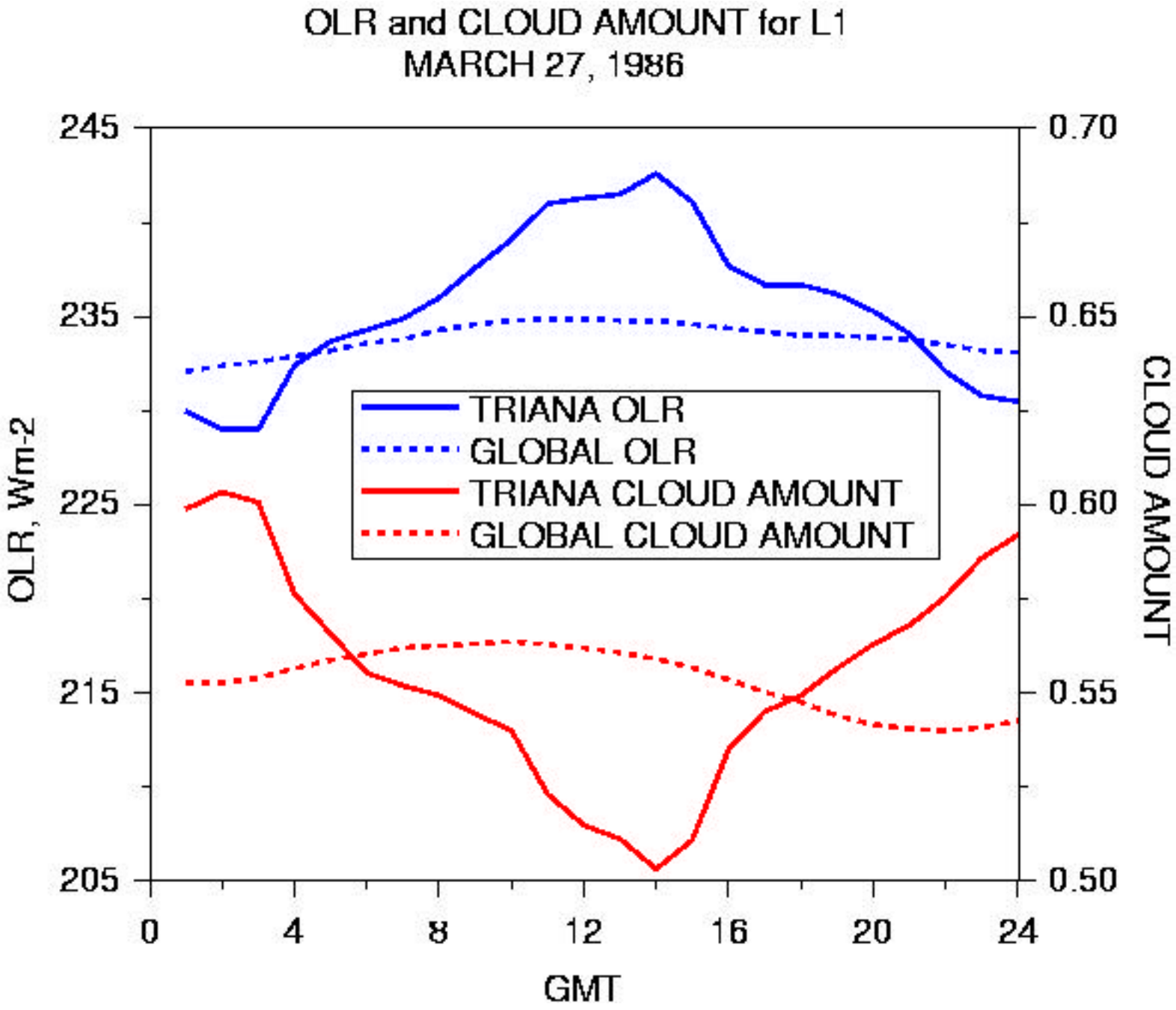
Red line =15.0, Yellow line =11.0, Green line =7.0 and Blue line =3.0

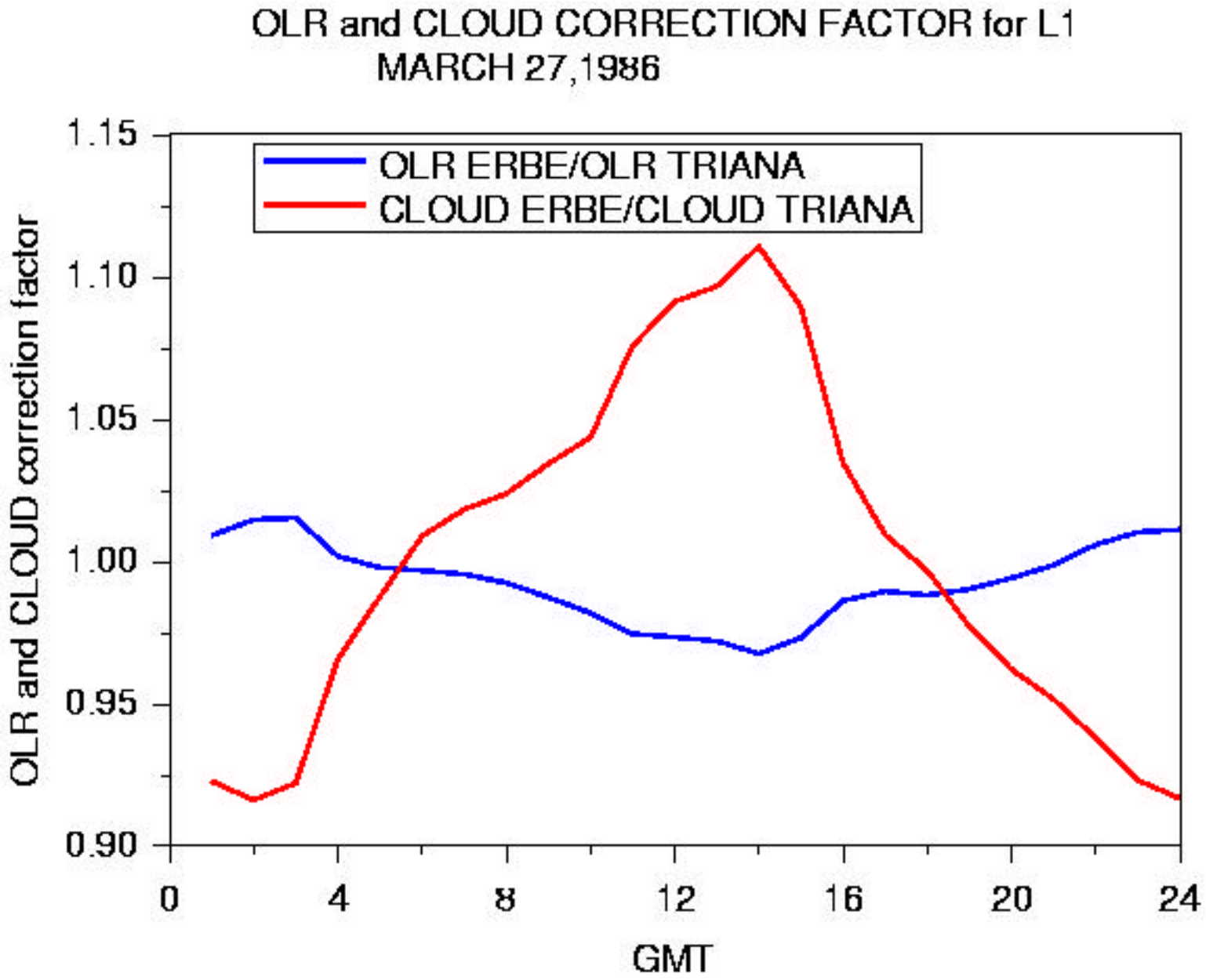
SUMMARY

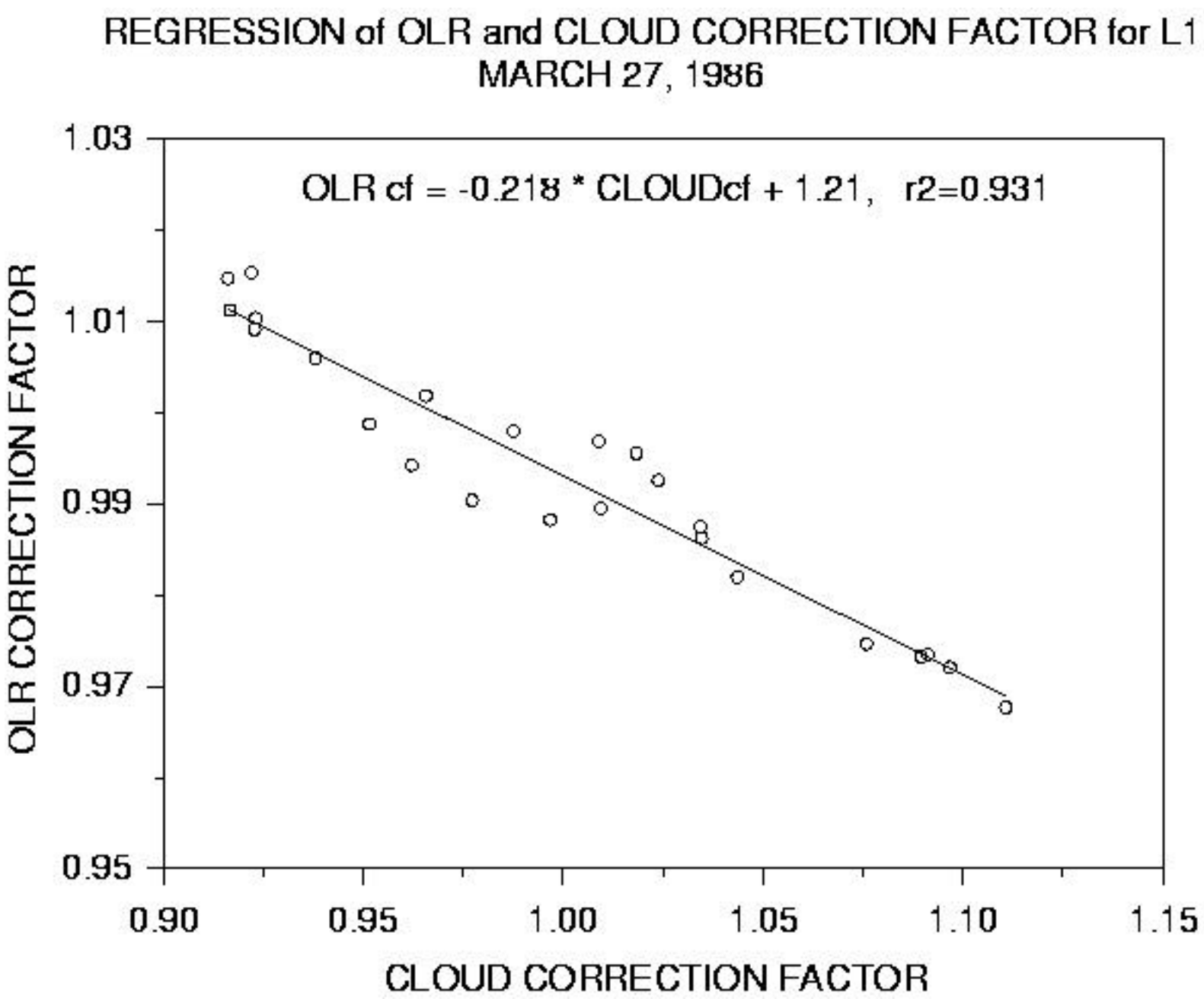
- **INITIAL CORRECTION FACTORS COMPUTED**
  - **BRF: 1.125 - 1.201 1-σ ERROR: 0.25 - 0.45%**
  - **ACF: 1.000 - 1.021 1-σ ERROR: 0.00 - 0.40%**
  - **LDC: 1.037 - 1.052 1-σ ERROR: 0.10 - 0.18%**
  - **OCF: 0.990- 1.005 1-σ ERROR: 0.58 - 1.40%**

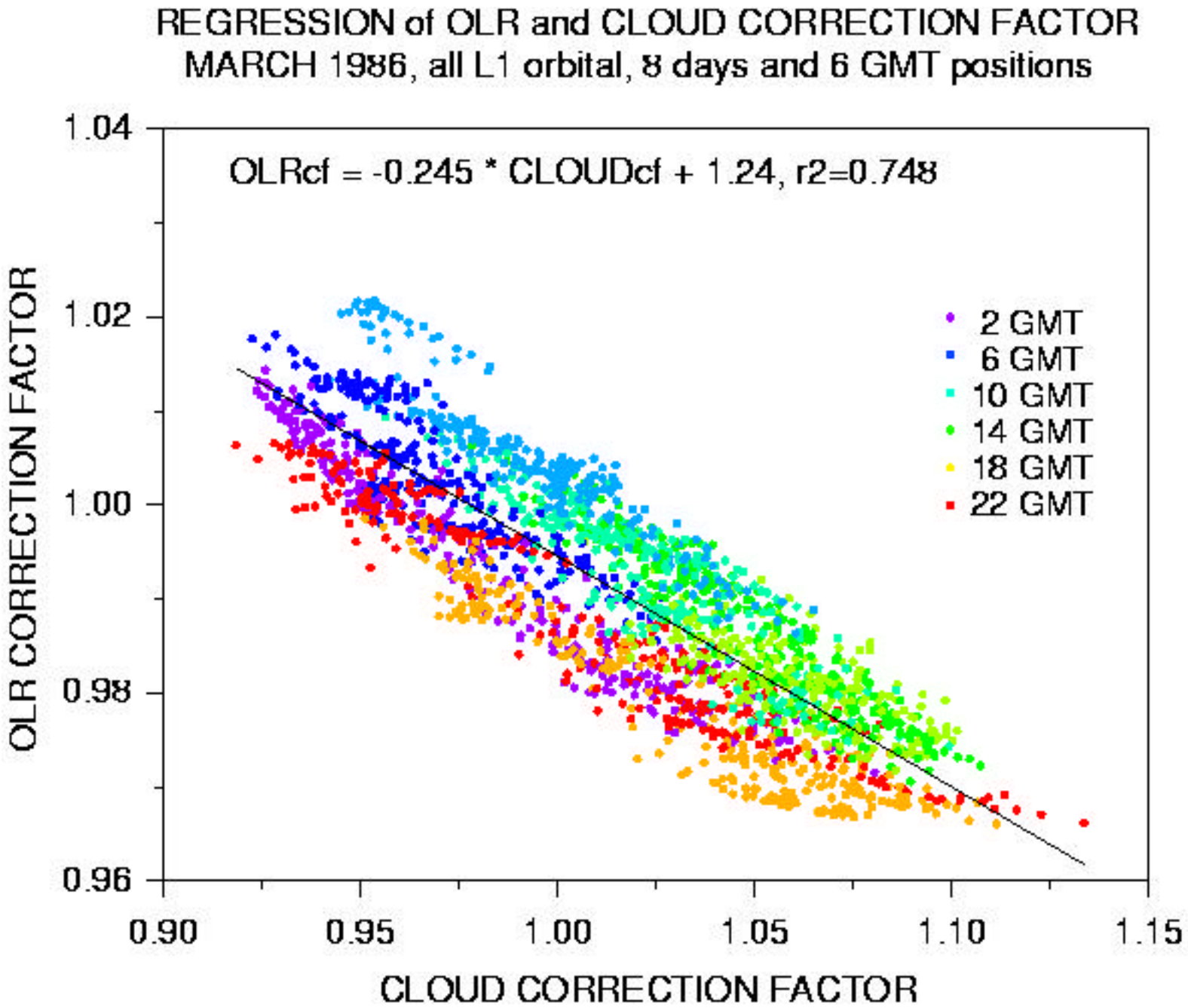
  EXTREMES TYPICALLY FOUND WHEN MAX DEG ABOVE ECLIPTIC PLANE, E-W OFFSET MAX BETTER

- **4 MONTHS ONLY SO FAR, TO ANALYZE FOR FINAL ALGORITHM**
  - **AT LEAST 4 YRS OF *ERBE* & 3 MOS *CERES* DATA**
  - **AT LEAST 4 YRS *ISCCP* D2 DATA**
- **STUDY IMPACT OF EPIC CLOUD INFO, NO-SHADOW OLR**
- **CONSIDER USE OF NEW CERES MODELS**


OLR and CLOUD AMOUNT for L1
MARCH 27, 1986
245
235
225
215
205
OLR, Wm-2
0.70
0.65
0.60
0.55
0.50
CLOUD AMOUNT
TRIANA OLR
GLOBAL OLR
TRIANA CLOUD AMOUNT
GLOBAL CLOUD AMOUNT
0
4
8
12
16
20
24
GMT


OLR and CLOUD CORRECTION FACTOR for L1
MARCH 27,1986
OLR ERBE/OLR TRIANA
CLOUD ERBE/CLOUD TRIANA
OLR and CLOUD correction factor
1.15
1.10
1.05
1.00
0.95
0.90
0
4
8
12
16
20
24
GMT

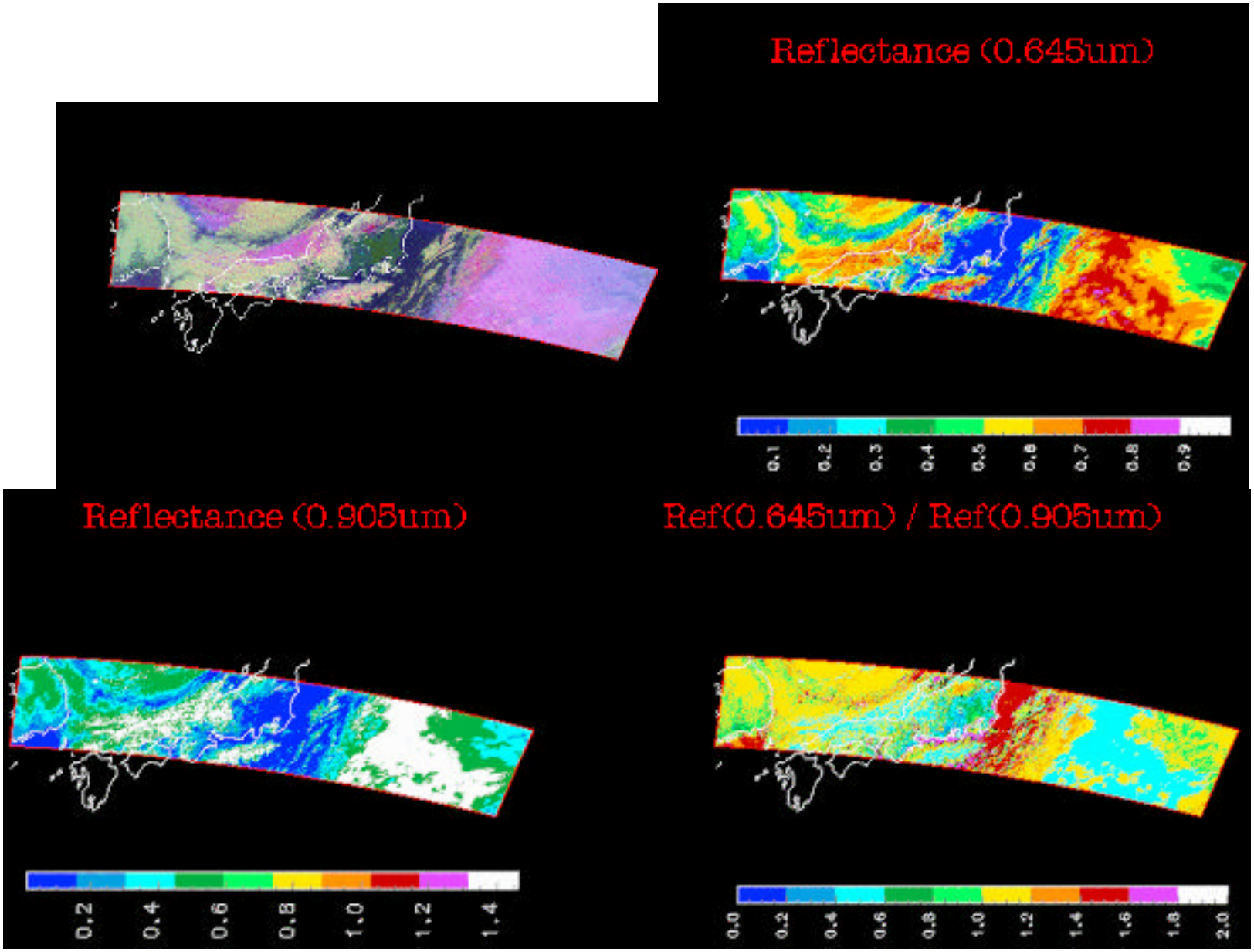
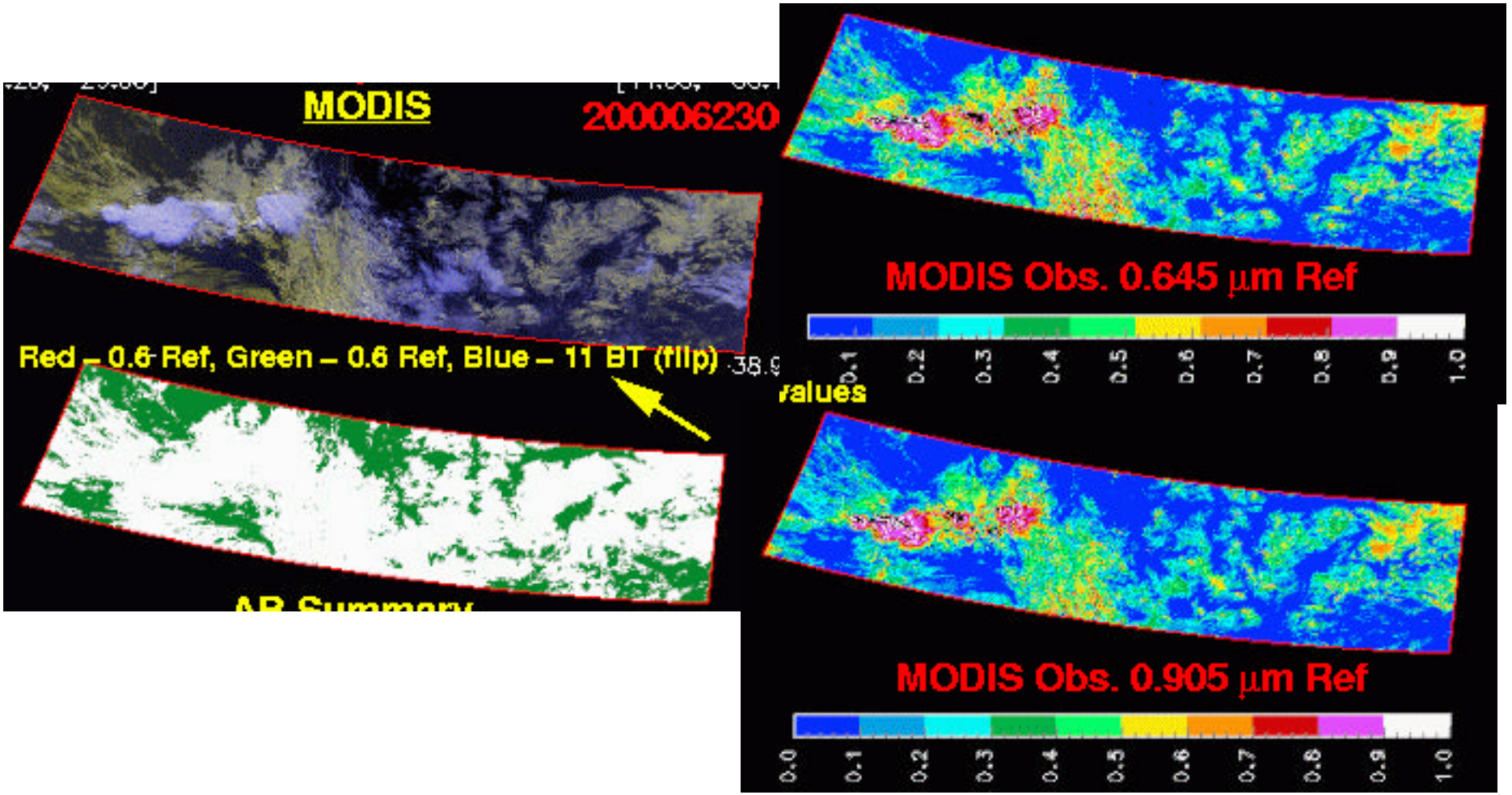

REGRESSION of OLR and CLOUD CORRECTION FACTOR for L1
MARCH 27, 1986
OLR cf = -0.218 * CLOUDcf + 1.21, r2=0.931
OLR CORRECTION FACTOR
1.03
1.01
0.99
0.97
0.95
0.90
0.95
1.00
1.05
1.10
1.15
CLOUD CORRECTION FACTOR


REGRESSION of OLR and CLOUD CORRECTION FACTOR
MARCH 1986, all L1 orbital, 8 days and 6 GMT positions
OLRcf = -0.245 * CLOUDcf + 1.24, r2=0.748
2 GMT
6 GMT
10 GMT
14 GMT
18 GMT
22 GMT
OLR CORRECTION FACTOR
1.04
1.02
1.00
0.98
0.96
0.90
0.95
1.00
1.05
1.10
1.15
CLOUD CORRECTION FACTOR

CLOUD ALGORITHM STATUS

- **MODIS DATA STARTING TO ARRIVE**
- **CHECKING INTO SEAWIFS AVAILABILITY**
- **ANALYST HIRED (NOT IN YET)**

MODIS DATA OVER JAPAN, MARCH 29, 2000



MODIS DATA OVER OCEAN, JUNE 23 , 2000