HIAPER Atmospheric Radiation Package (*HARP*)

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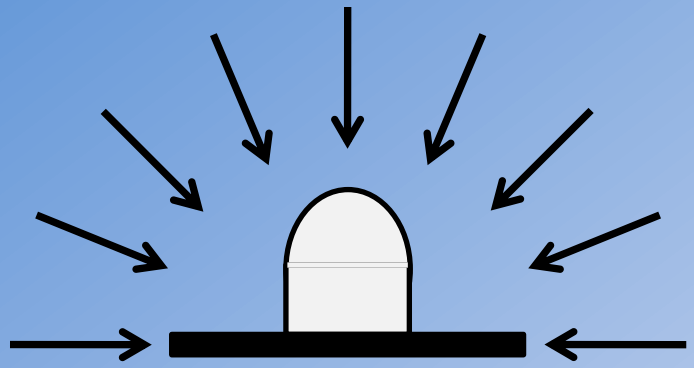
Actinic flux



Frosted Dome

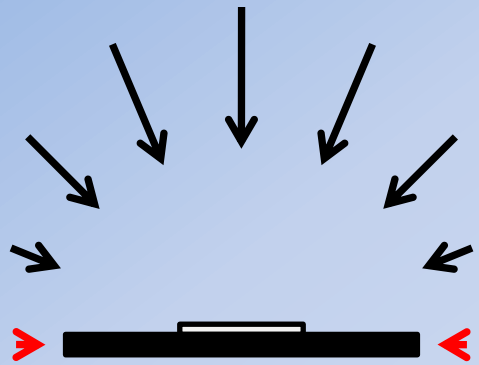
Measures Energy Flux through a sphere

Equally responsive to photons from all directions

Total Actinic Flux (sum of downwelling and upwelling) also known as spherical radiance

Molecules (and people) are 3-D and can absorb photons from any direction

Irradiance



Flat Plate or **Integrating Sphere**

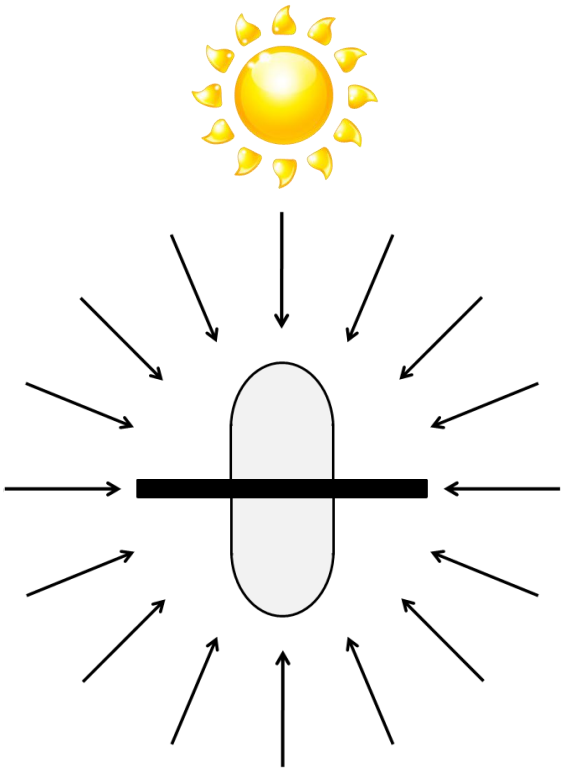
Measures Energy Flux through a plane

Cosine response (i.e., insensitive to photons from 90 deg)

Many uses in radiative transfer including **Net Irradiance** (difference between downwelling and upwelling)

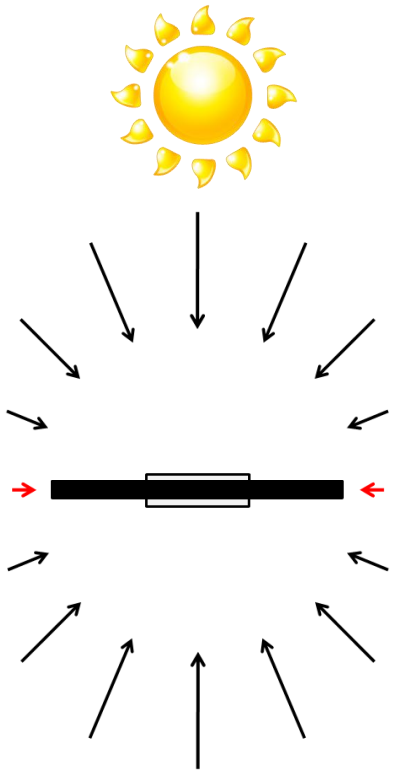
Energy passing through a layer is sensitive to direction

To stabilize, or not to stabilize?



Actinic Flux

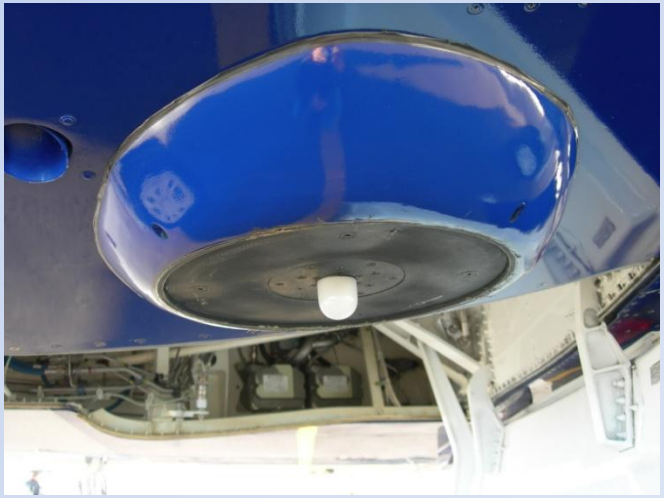
- **NO Stabilization Required**
- Optics insensitive to orientation



Irradiance

- **Stabilization Required**
- Optics strongly sensitive to orientation

HARP Actinic Flux

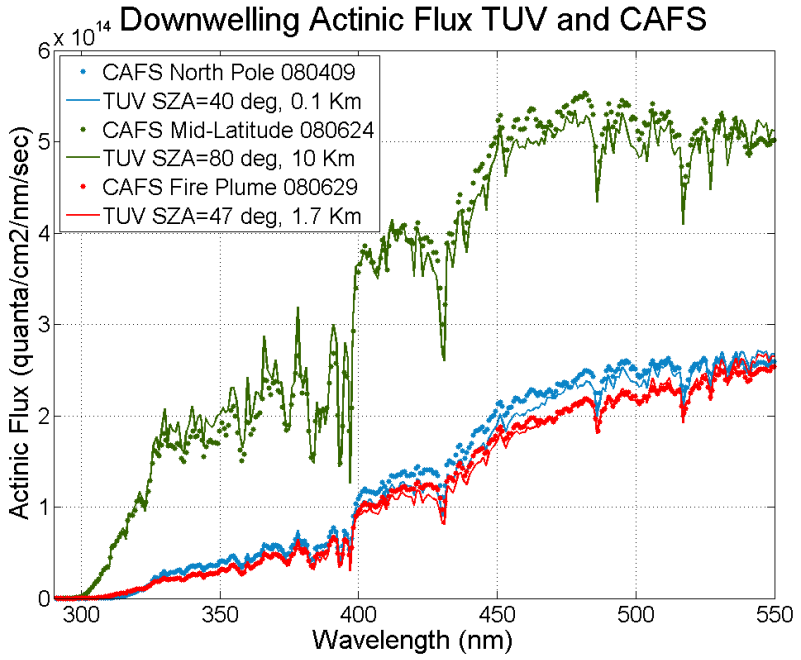


HARP Irradiance

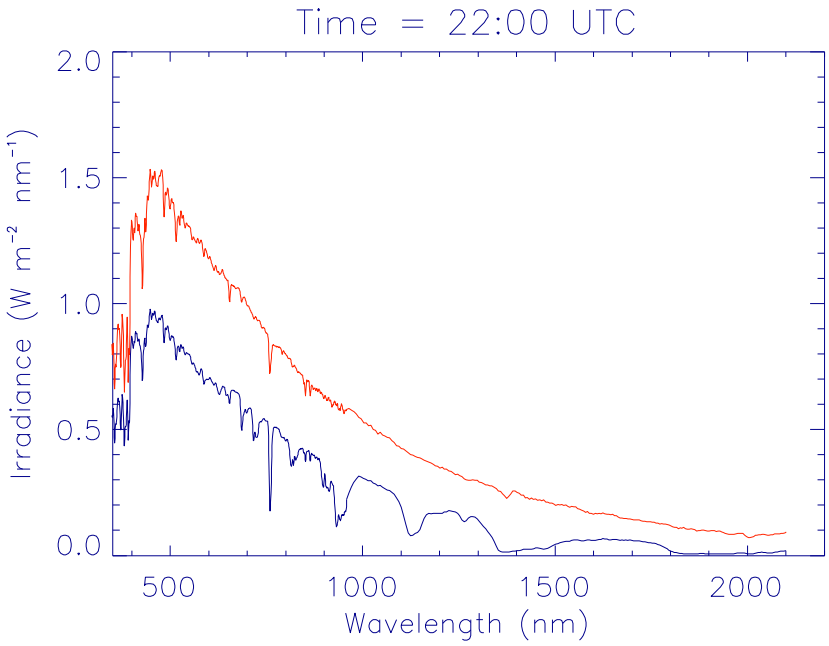
Spectral Specifications

Measurement	Optical Design	Spectral Description	Wavelengths (nm)	Pixels	Sampling (nm)	FWHM (nm)
Actinic Flux	Concentric Domes	UV-VIS	280-680	512	0.8	1.7 @ 297 nm, 2.4 @ 400 nm
Irradiance Si	Integrating Sphere	VIS-NIR	260-1090	1024	0.8	3
Irradiance InGaAs	Integrating Sphere	NIR	903-2217	256	5	16

Actinic Flux



Irradiance



Calculated photolysis frequencies from actinic flux

j [O3->O2+O(1D)]

j [NO2->NO+O(3P)]

j [H2O2->2OH]

j [HNO2->OH+NO]

j [HNO3->OH+NO2]

j [CH2O->H+HCO]

j [CH2O->H2+CO]

j [CH3CHO->CH3+HCO]

j [CH3CHO->CH4+CO]

j [C2H5CHO->C2H5+HCO]

j [CHOCHO->products]

j [CHOCHO->HCO+HCO]

j [CH3COCHO->products]

j [CH3COCH3->CH3CO+CH3]

j [CH3OOH->CH3O+OH]

j [CH3ONO2->CH3O+NO2]

j [PAN->products]

j [CH3COCH2CH3->Products]

j [CH3CH2CH2CHO->C3H7+HCO]

j [CH3CH2CH2CHO->C2H4+CH2CHOH]

j [HO2NO2-->HO2+NO2]

j [HO2NO2-->OH+NO3]

j [CH3CH2ONO2->Products]

j [Br2->Br+Br]

j [BrO->Br+O]

j [Br2O->products]

j [BrNO3->Br+NO3]

j [BrNO3->BrO+NO2]

j [BrCl->Br+Cl]

j [HOBr->HO+Br]

j [BrONO2->Br+NO3]

j [BrONO2->BrO+NO2]

j [Cl2+hv->Cl+Cl]

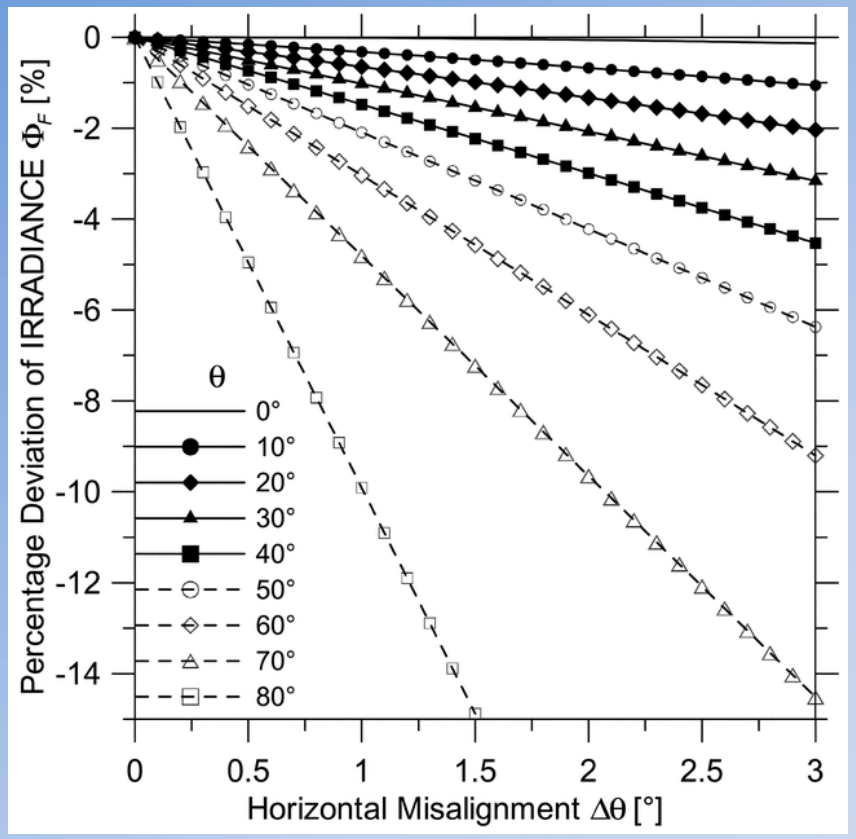
j [ClO->Cl+O]

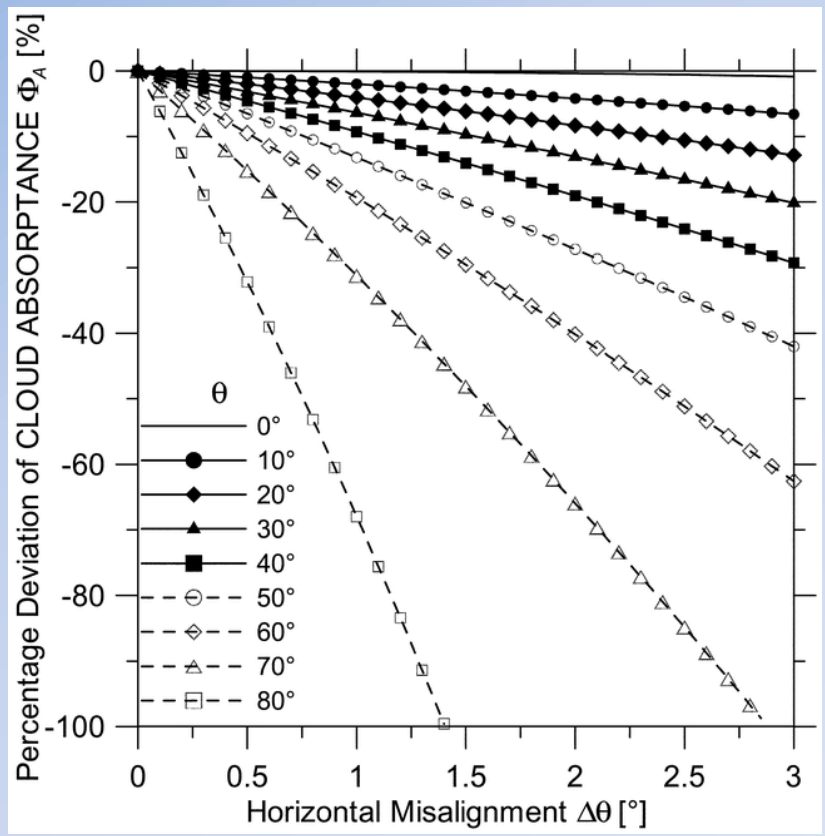
j [ClONO2->Cl+NO3]

j [ClONO2->ClO+NO2]

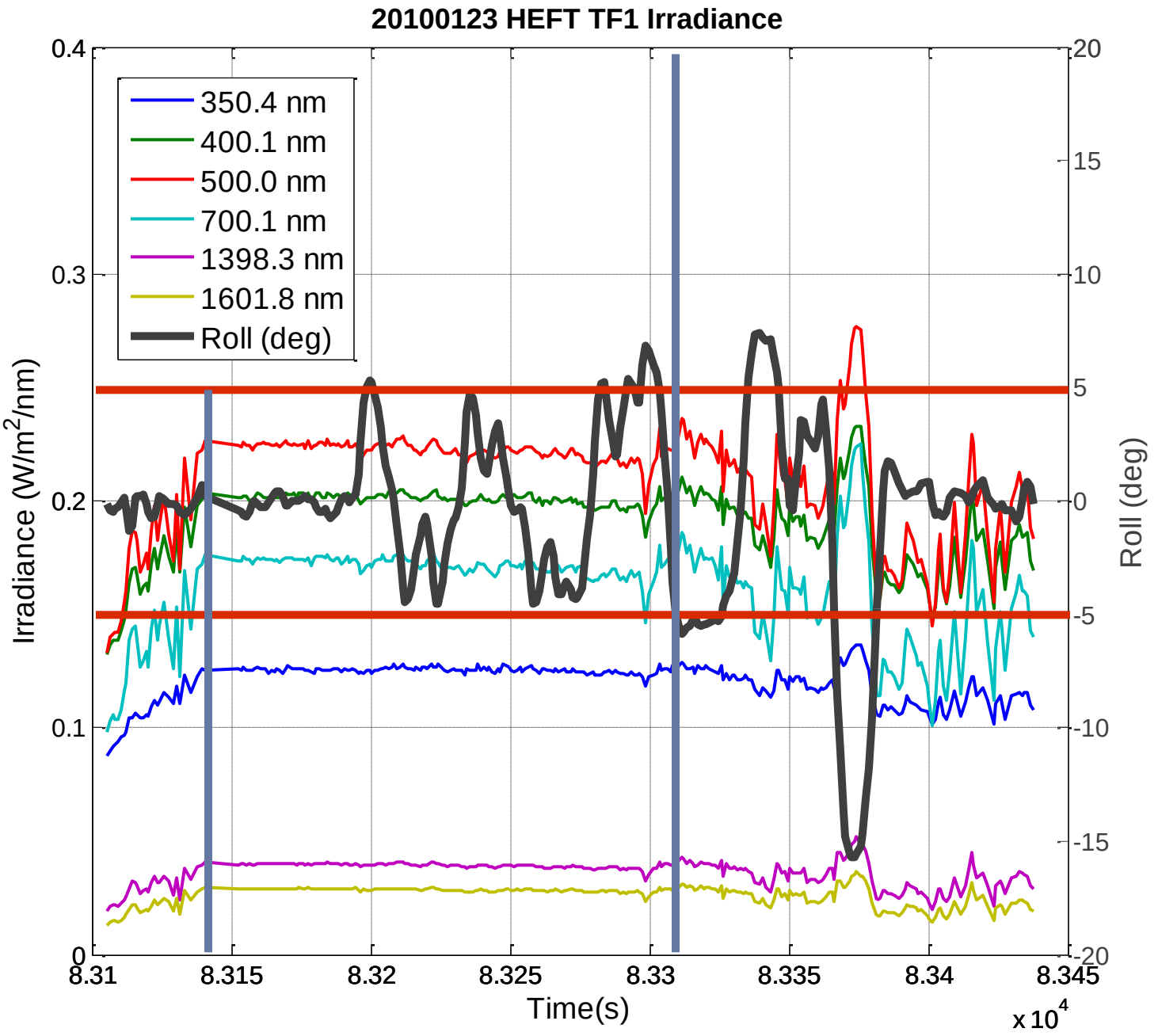
Additional photolysis frequencies under construction (including Iodine compounds)

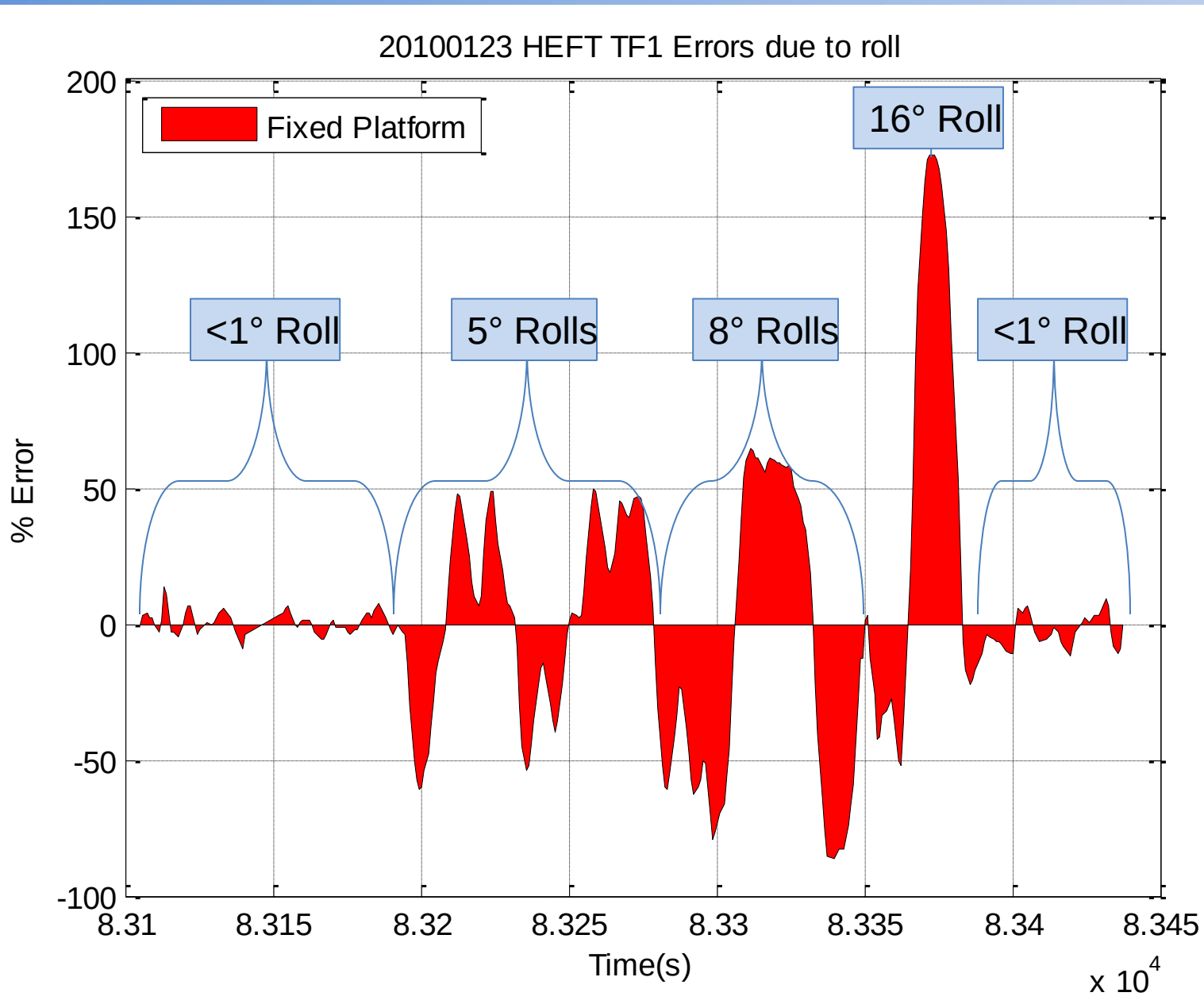
Irradiance errors due to deviation from the horizontal

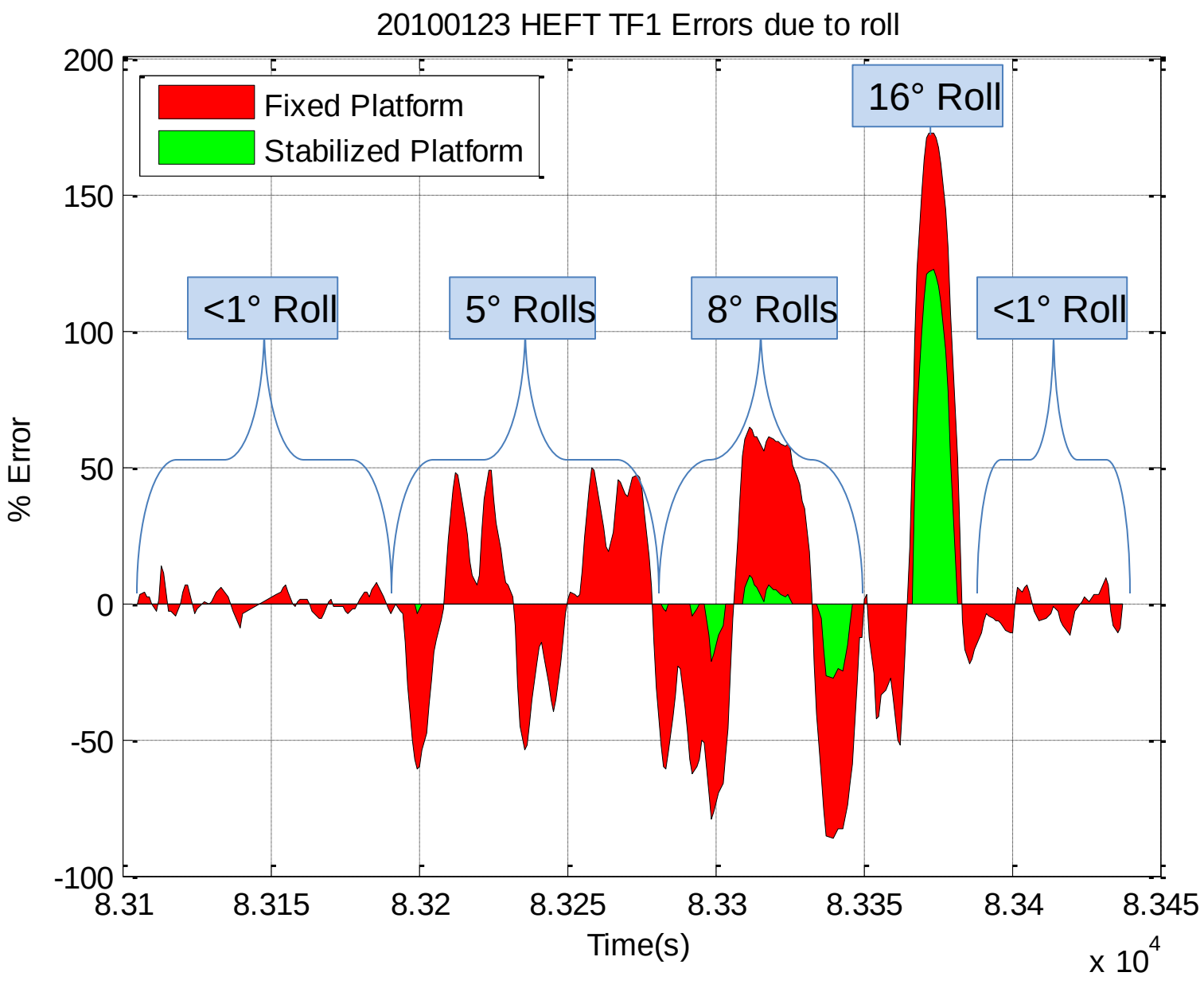


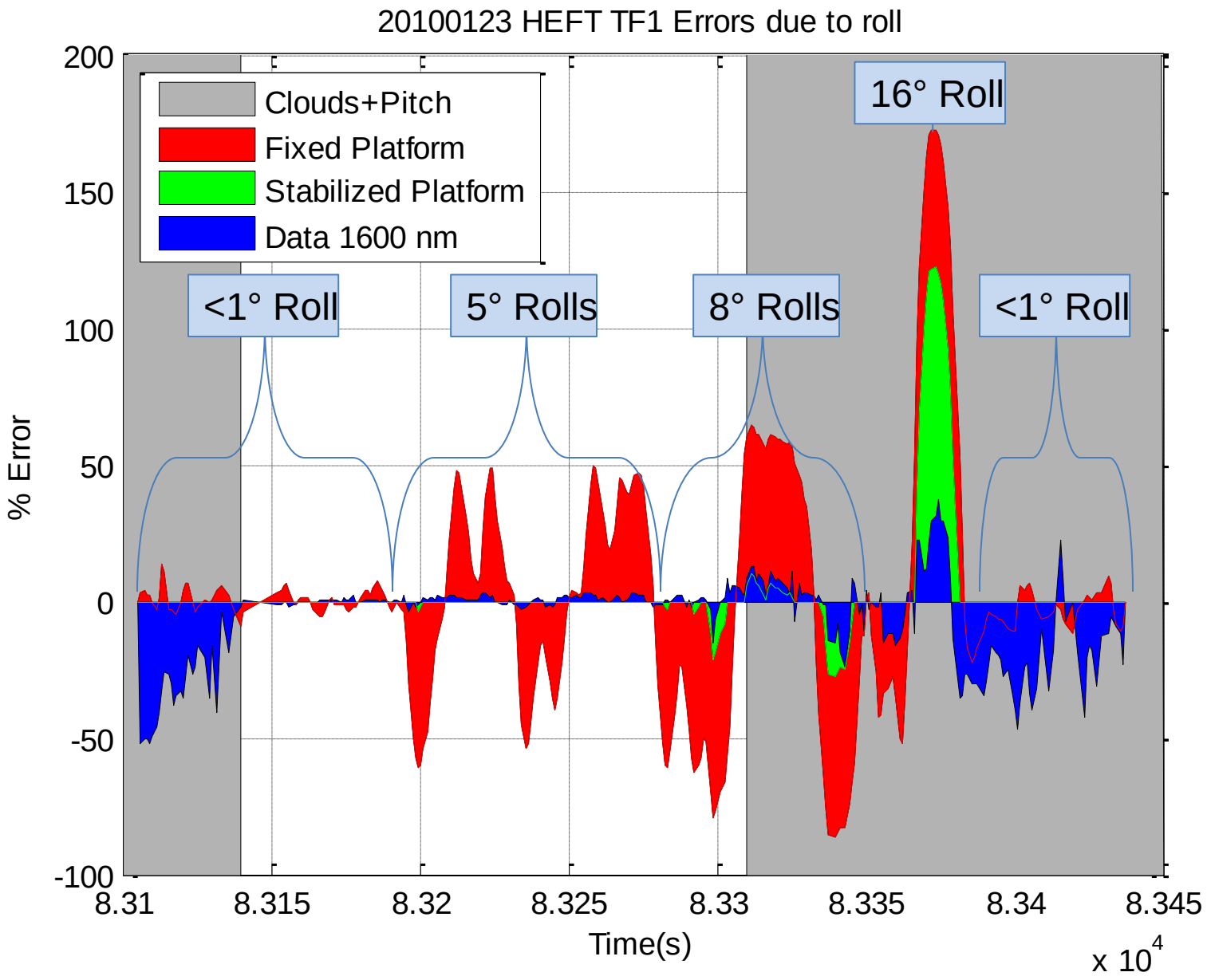


Wendisch et al., 2001


20100123 HEFT TF1 Irradiance
350.4 nm
400.1 nm
500.0 nm
700.1 nm
1398.3 nm
1601.8 nm
Roll (deg)
Irradiance (W/m2/nm)
Roll (deg)
Time(s)
x 10^4
0.4
0.3
0.2
0.1
0
20
15
10
5
0
-5
-10
-15
-20
8.31
8.315
8.32
8.325
8.33
8.335
8.34
8.345


20100123 HEFT TF1 Errors due to roll
Fixed Platform
<1° Roll
5° Rolls
8° Rolls
16° Roll
<1° Roll
% Error
200
150
100
50
0
-50
-100
8.31
8.315
8.32
8.325
8.33
8.335
8.34
8.345
Time(s)
x 10^4


20100123 HEFT TF1 Errors due to roll
Fixed Platform
Stabilized Platform
<1° Roll
5° Rolls
8° Rolls
16° Roll
<1° Roll
% Error
Time(s)
x 10^4
200
150
100
50
0
-50
-100
8.31
8.315
8.32
8.325
8.33
8.335
8.34
8.345


20100123 HEFT TF1 Errors due to roll
Clouds+Pitch
Fixed Platform
Stabilized Platform
Data 1600 nm
<1° Roll
5° Rolls
8° Rolls
16° Roll
<1° Roll
% Error
200
150
100
50
0
-50
-100
8.31
8.315
8.32
8.325
8.33
8.335
8.34
8.345
Time(s)
x 10^4

Goals

- Measure spectrally resolved actinic flux density and calculated photolysis frequencies
- Addition of halogen photolysis calculations
- Measure spectrally resolved stabilized irradiance (~ +/- 5 degrees attitude) for calculated products (CU: Schmidt, Kindel,…)
- Radiative transfer modeling of irradiance effects (e.g. albedo, cloud properties) on actinic flux and photolysis frequencies