# Diurnal calibration of INSAT-3D Sounder/Imager using AIRS/IASI

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# INSAT-3D

## 6 Channel IMAGER

| Spectral Bands | (µm) | Resolution |
|---|---|---|
| Visible | : 0.55 - 0.75 | 1 km |
| Short Wave Infra Red | : 1.55 - 1.70 | 1 km |
| Mid Wave Infra Red | : 3.70 - 3.95 | 4 km |
| Water Vapour | : 6.50 - 7.10 | 8 km |
| Thermal Infra Red – 1 | : 10.30 - 11.30 | 4 km |
| Thermal Infra Red – 2 | : 11.30 - 12.50 | 4 km |

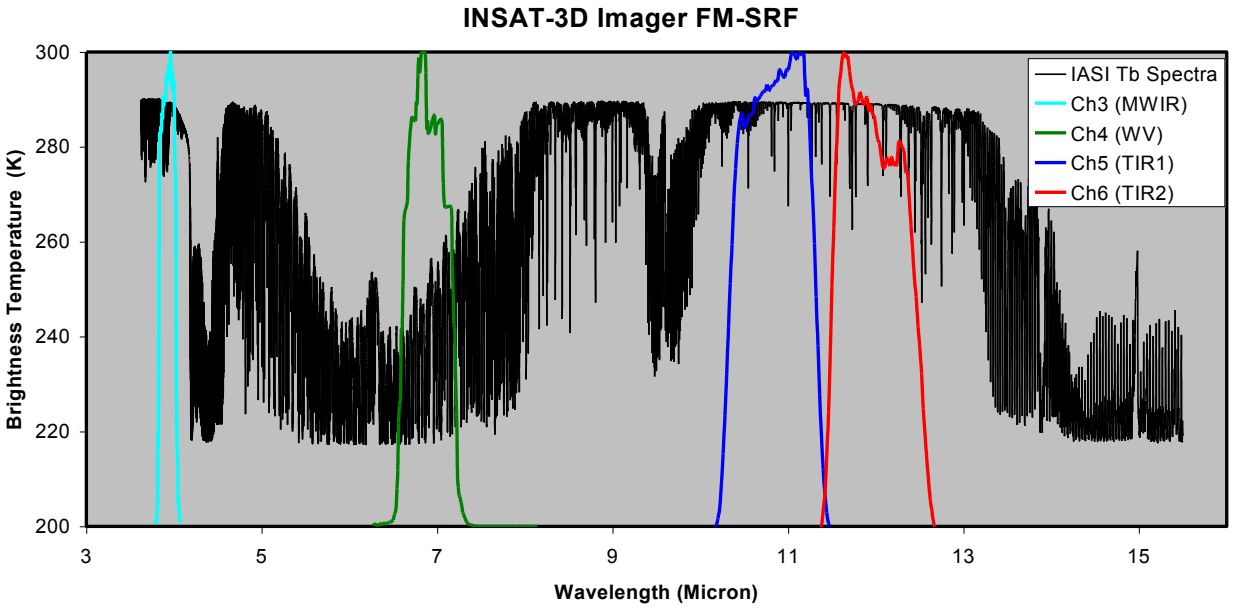
## 19 Channel SOUNDER

- **Spectral Bands (µm)**

| | | |
|---|---|---|
| Short Wave Infra Red | : | Six bands |
| Mid Wave Infra Red | : | Five Bands |
| Long Wave Infra Red | : | Seven Bands |
| Visible | : | One Band |

- **Resolution : 10 km**

Launch Date: 26 Aug 2013 Location: 83E



# Satellite Sensors and Data Used

## Indian Geostationary Satellites

www.mosdac.gov.in

## Hyperspectral IR Sounders

IASI (Metop-A/B) 8461 IR-Channels (Morning/Evening Observations)

Data available through EUMETCAST

AIRS (Aqua) 2378 IR-Channel (Noon/mid-night Observations)

Data available through http://mirador.gsfc.nasa.gov/

Period: July 2014

# Reference Instruments

**AIRS**: Atmospheric InfraRed Sounder

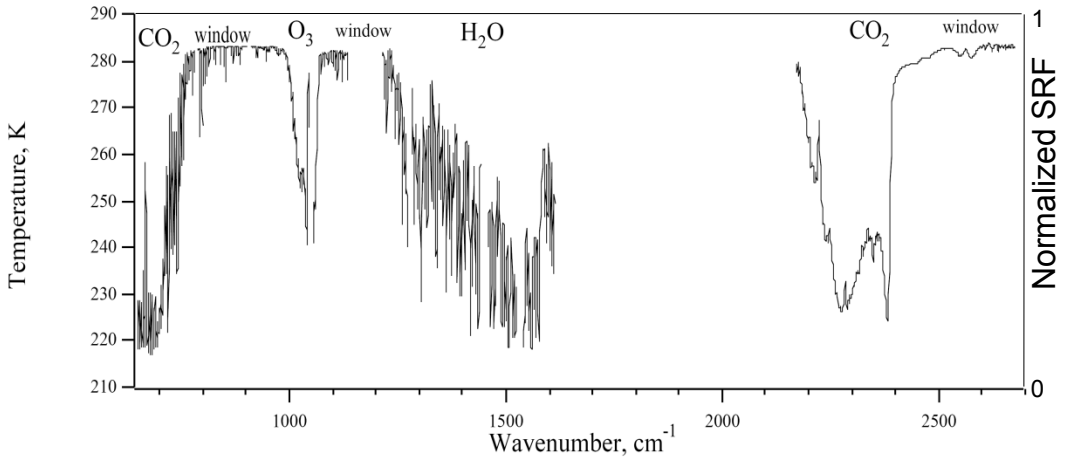
Polar Orbiting Aqua (2002)

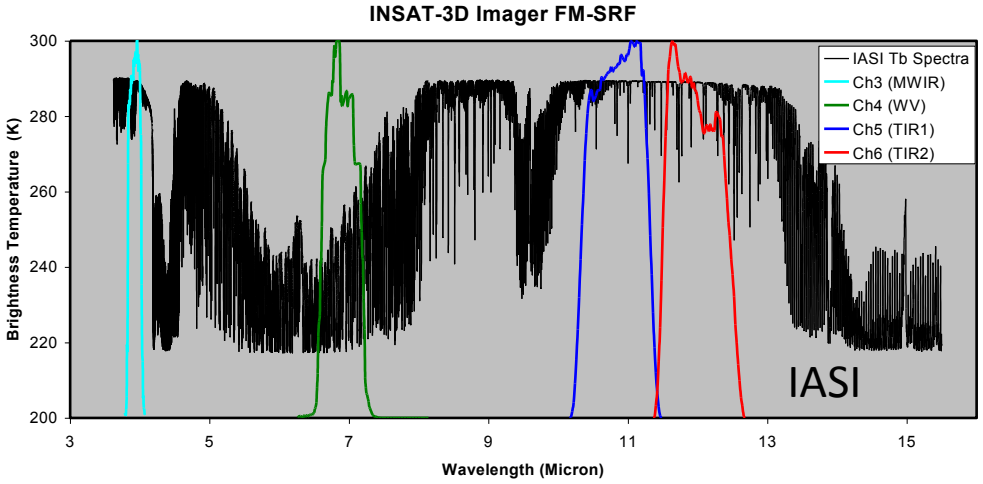
Channels: 2378 (650 $cm^{-1}$ to 2675 $cm^{-1}$)
(3.74 µm - 15.4 µm)

Spectral resolution: $\nu/\Delta\nu \approx 1200$

Spatial Resolution: 13.5 Km at Nadir

ECT: 01:30 AM/PM




**IASI**: Infrared Atmospheric Sounding Interferometer

Polar Orbiting Metop (2007)

Channels: 8461 (645 $cm^{-1}$ to 2760 $cm^{-1}$)
(3.62 µm - 15.5 µm)

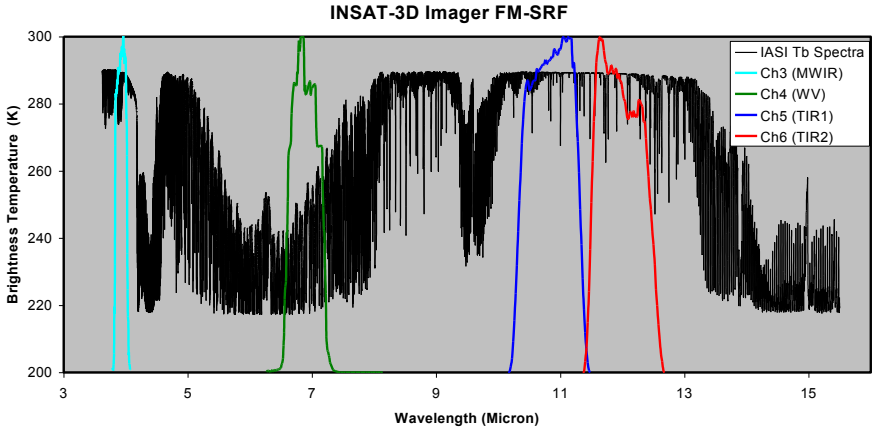
Spectral resolution: 0.35 $cm^{-1}$ at SWIR
0.50 $cm^{-1}$ at LWIR
(resampled at 0.25 $cm^{-1}$)

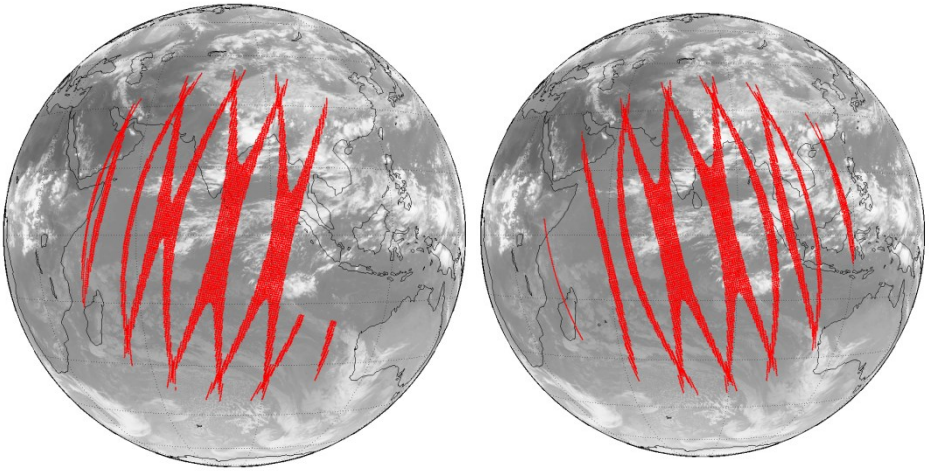
Spatial Resolution: ~12 km at Nadir

ECT: 0930 AM/PM Metop-A

# Global Space-based Inter-Calibration System (GSICS)

## Monitored instrument: INSAT-3D Imager / Reference instrument: IASI



There are channel gaps in AIRS/IASI. These gaps are filled with simplest option that is linear interpolation.

**Data Source: IASI L1C (Eumetcast)**

**Temporal Collocation: < 15 Minutes**

**Spatial Collocation: within IASI pixel (12 km)**

**Zenith angle collocation:** $\left|\frac{\cos(geo_zen)}{\cos(leo_zen)} - 1\right| < \max_zen$

maxzen = 0.02

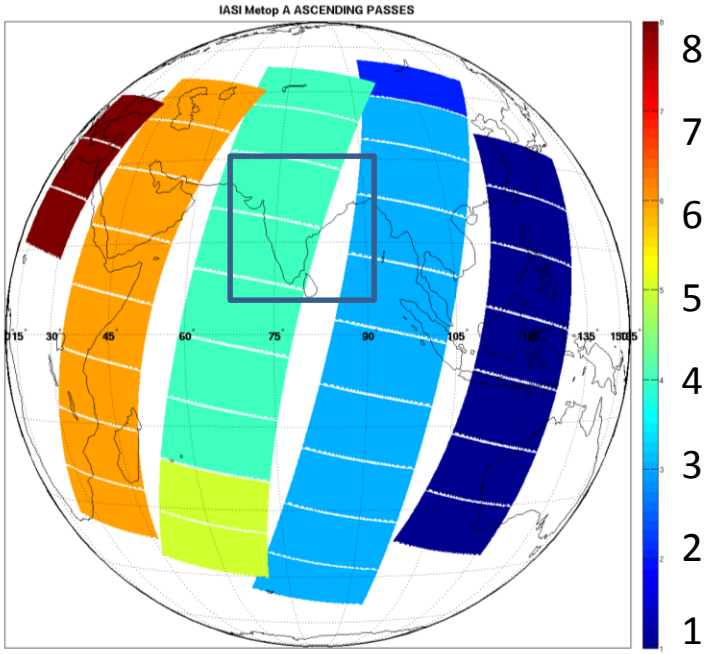
**Spatial homogeneity test:**

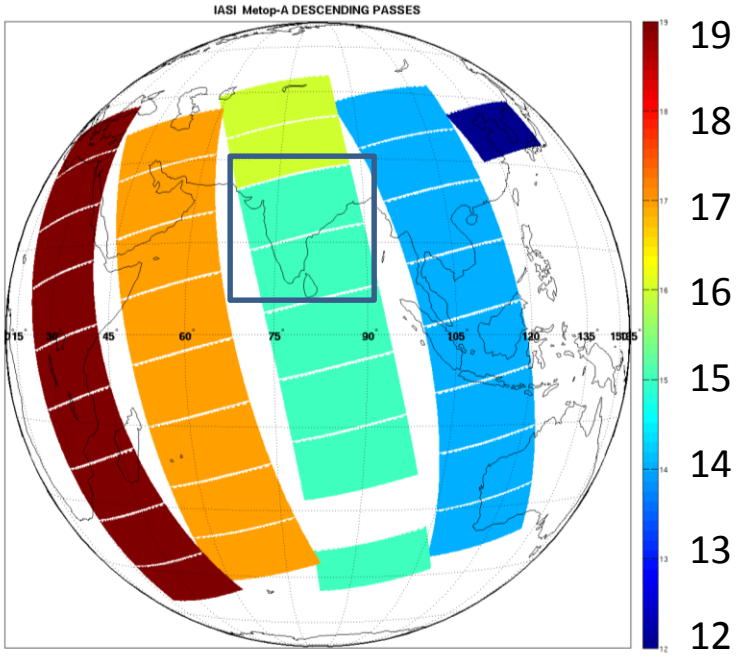
Std. Dev. of INSAT-3D (7x7 pixel) and IASI (5x5) radiances within environment surrounding the target pixel

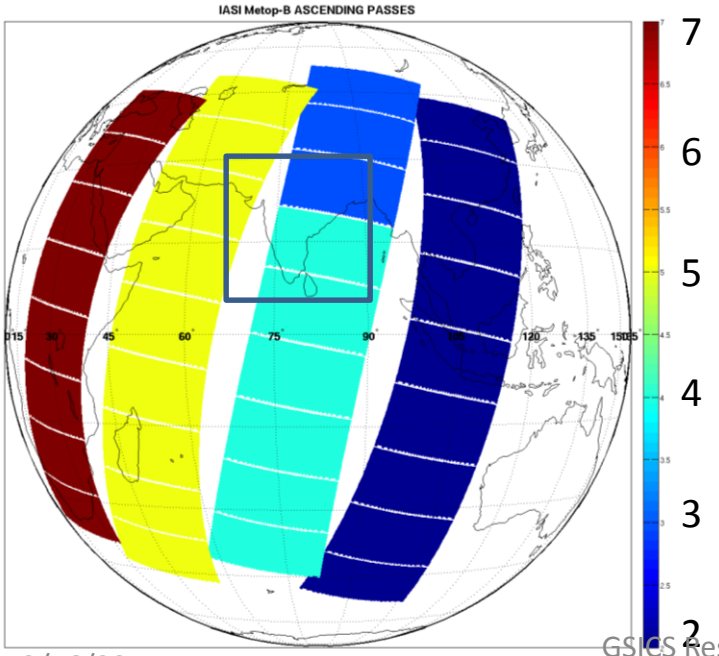
- Convolved radiance of broadband sensor using '*n*' number of hyperspectral sounders channels may be computed using:

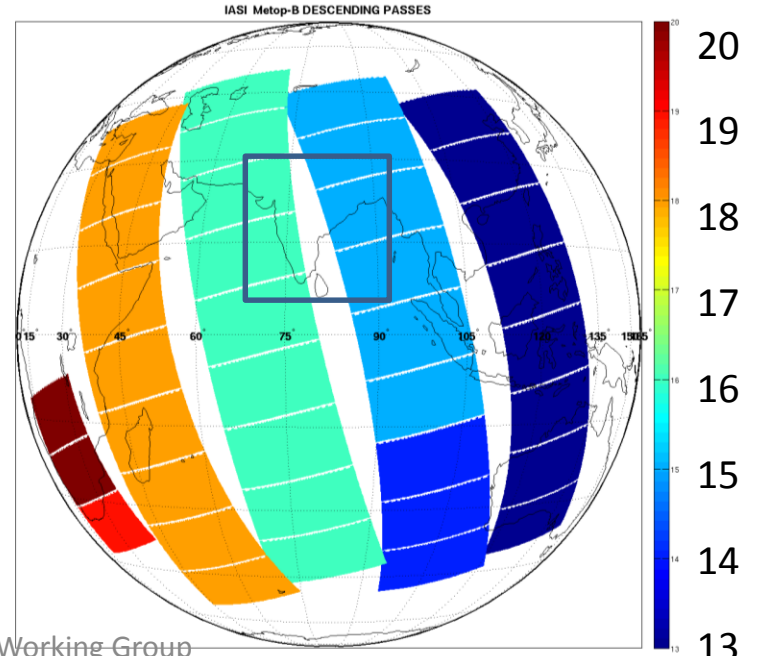
$$R_{conv} = [\sum_{i=1}^{n} R_{IASI}^{i} S_{INSAT}^{i} \Delta v] / [\sum_{i=1}^{n} S_{INSAT}^{i} \Delta v]$$

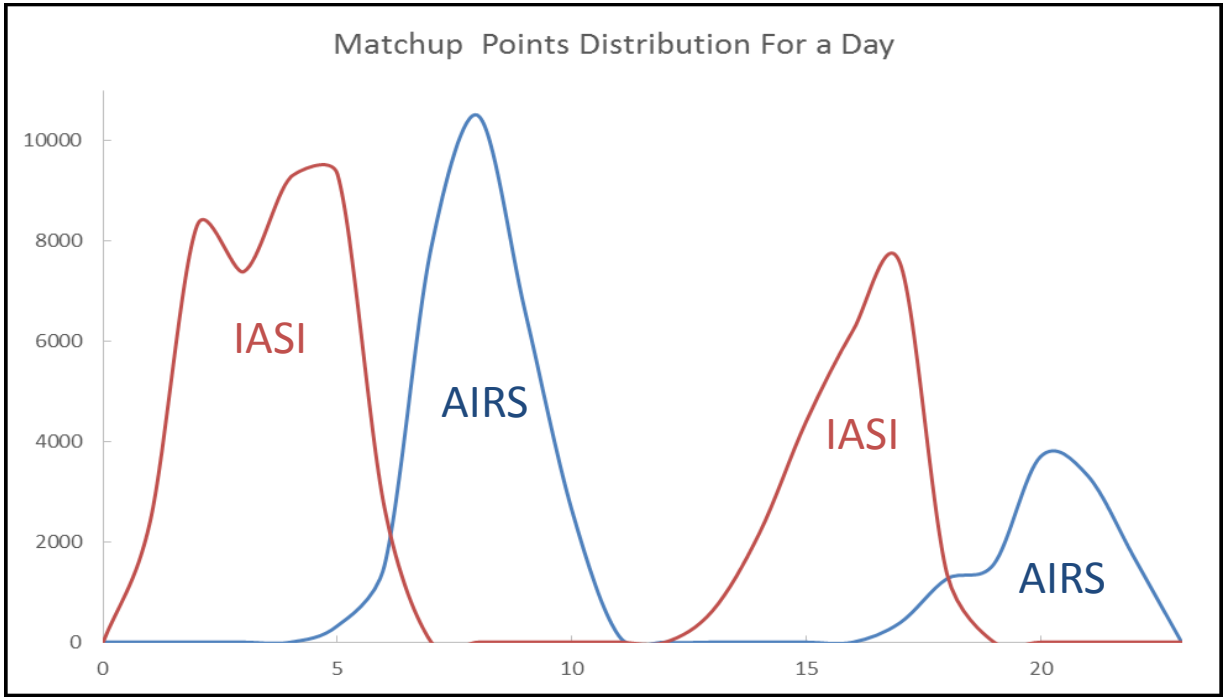
- $R_{conv}$ is convolved broadband radiance, $R_{IASI}$ is radiance of hyper-spectral sounder, superscript '*i*' is hyper-spectral channel index, $S_{INSAT}$ is the sensor response function of INSAT-3D channels at the central wavenumber of hyper-spectral channel '*i*', and *'n'* is the total number of hyper-spectral channels in broadband sensor's SRF range.

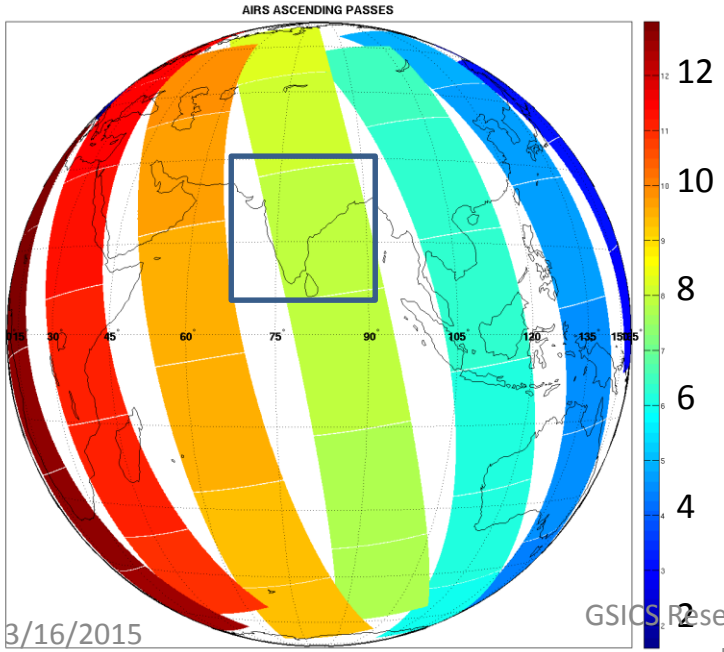

IASI Metop A ASCENDING PASSES
8
7
6
5
4
3
2
1

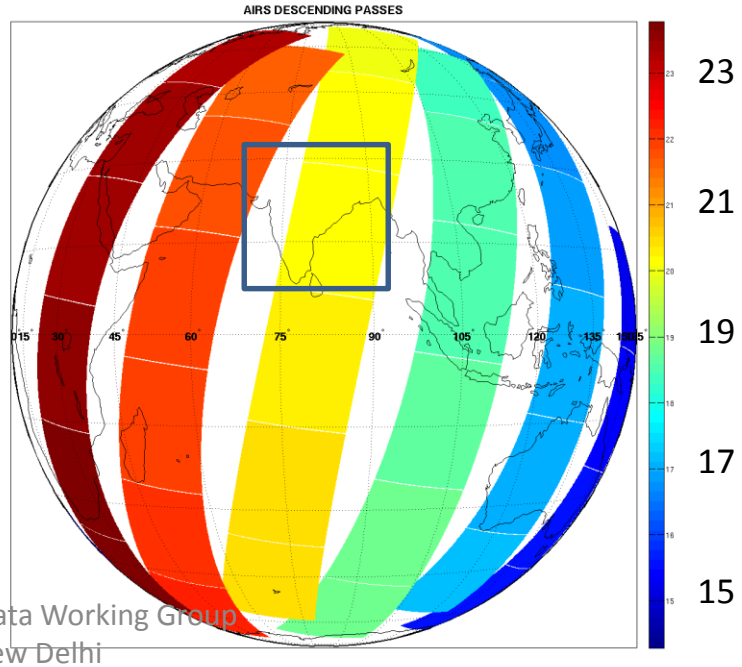

IASI Metop-A DESCENDING PASSES
19
18
17
16
15
14
13
12


IASI Metop-B ASCENDING PASSES
7
6
5
4
3
2

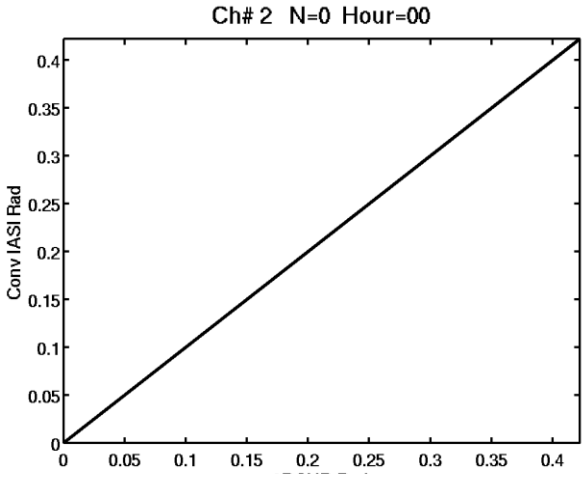

IASI Metop-B DESCENDING PASSES
20
19
18
17
16
15
14
13

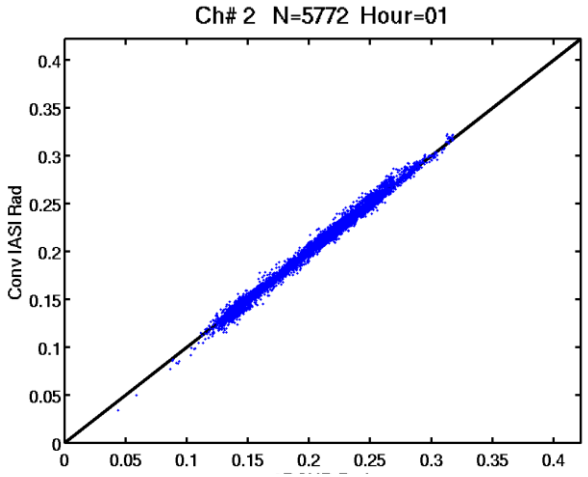

Matchup Points Distribution For a Day
10000
8000
6000
4000
2000
0
0
5
10
15
20
IASI
AIRS
IASI
AIRS

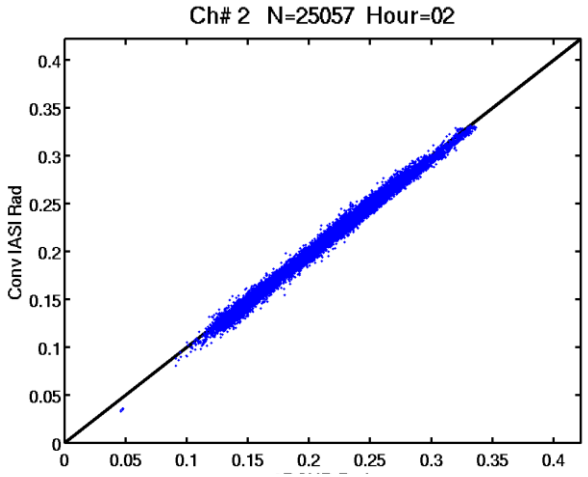

AIRS ASCENDING PASSES
12
10
8
6
4
2

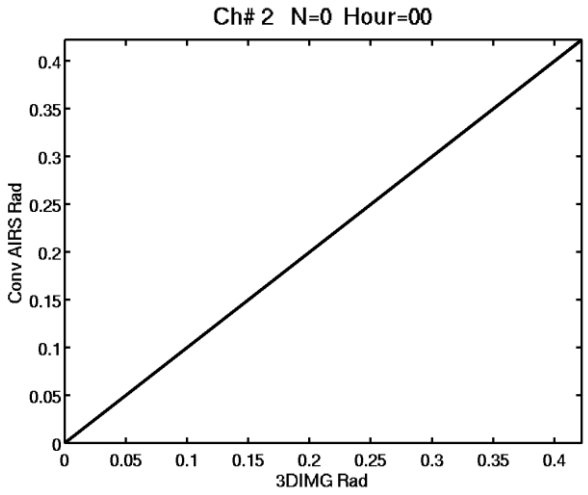

AIRS DESCENDING PASSES
23
21
19
17
15

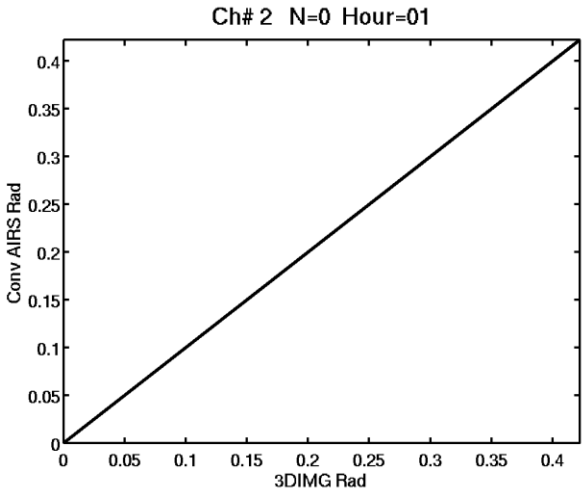
# Intercalibration of INSAT-3D WV Channel with IASI (top) and AIRS (bottom)

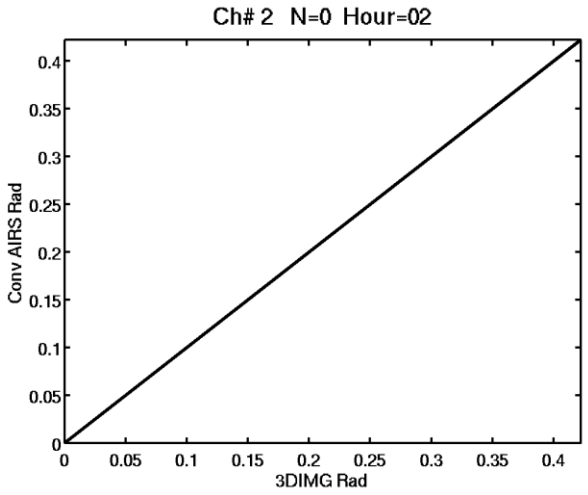


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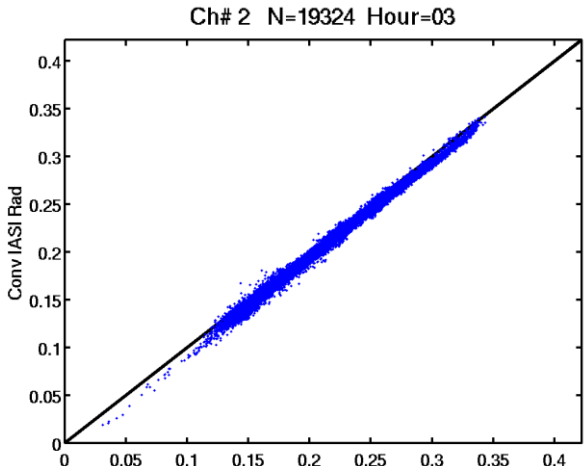


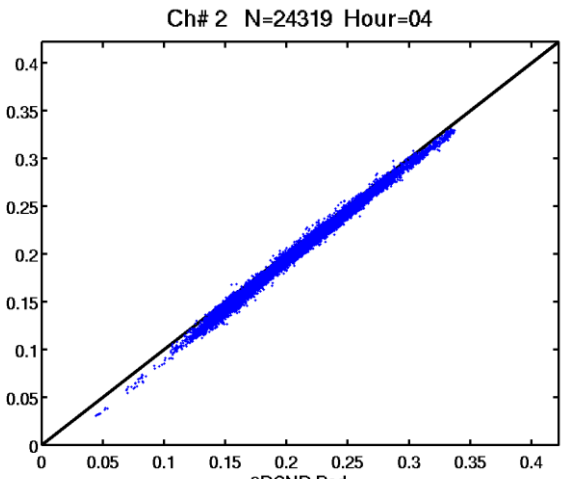


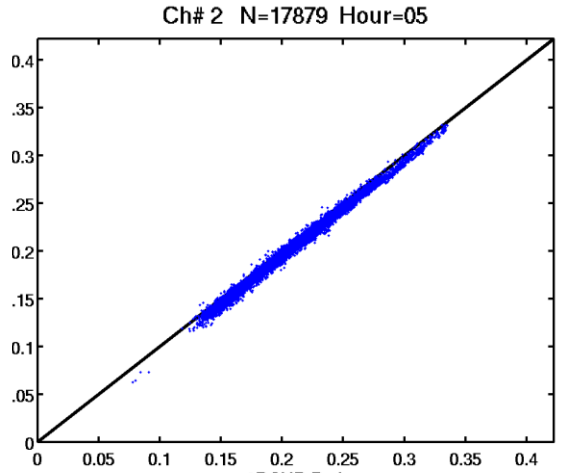


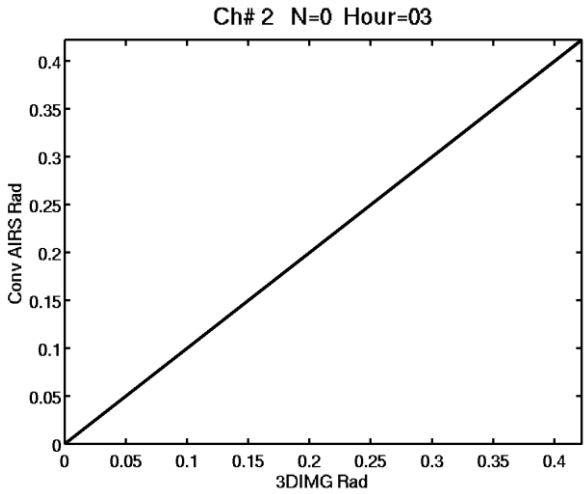


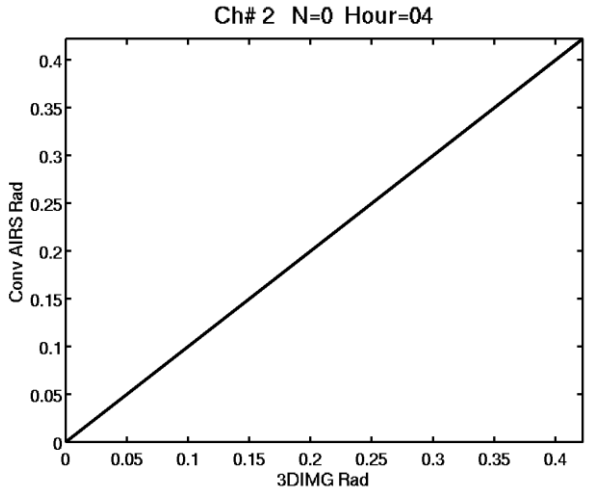


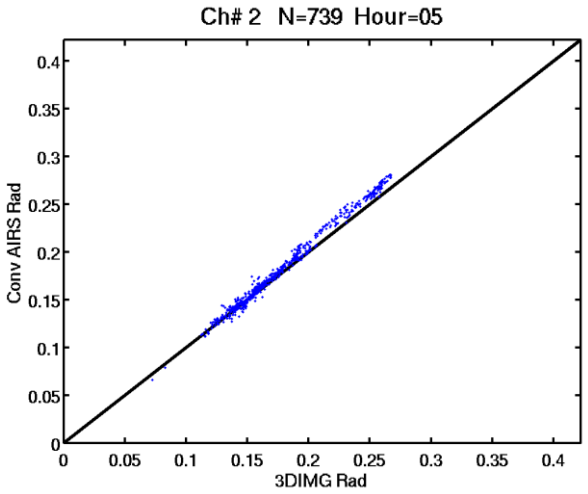

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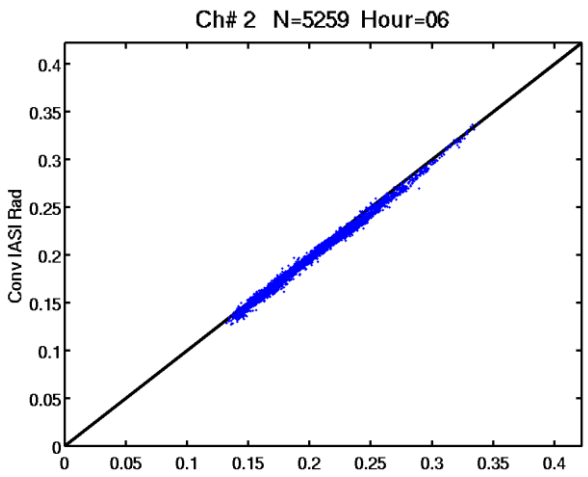


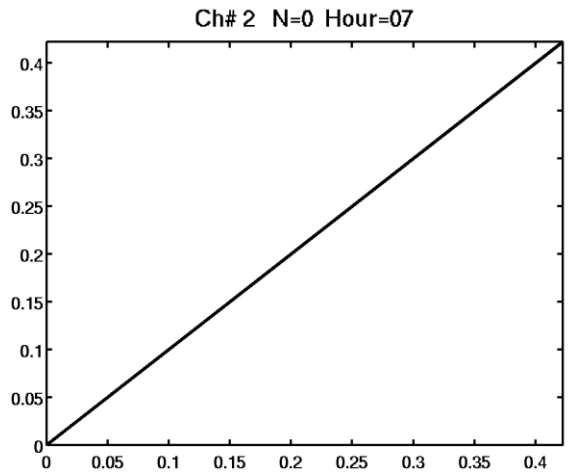


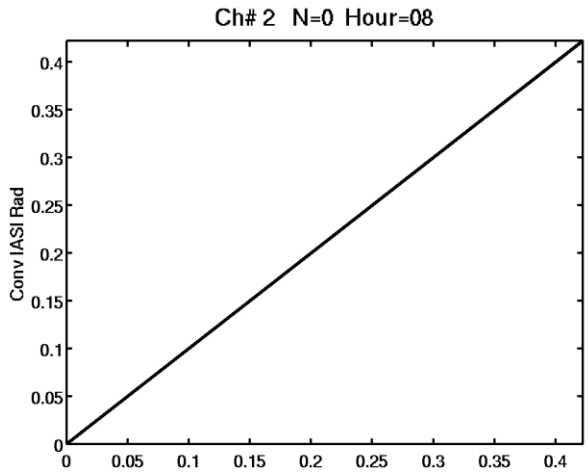


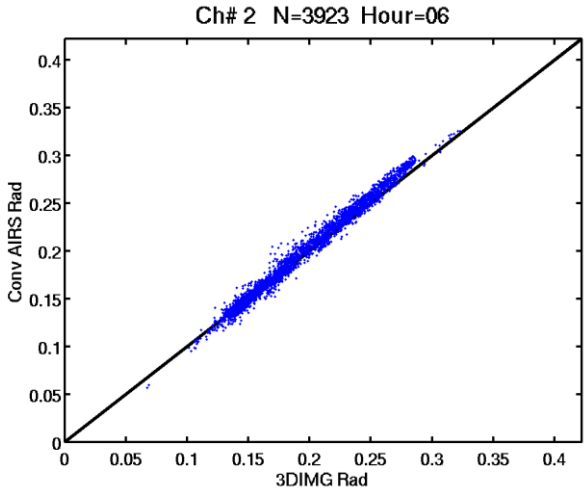


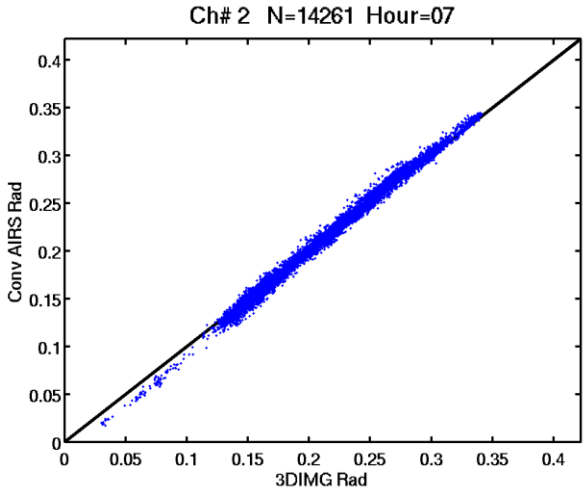


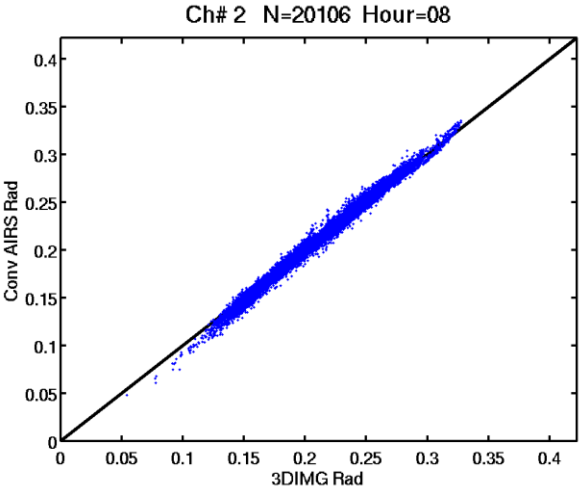

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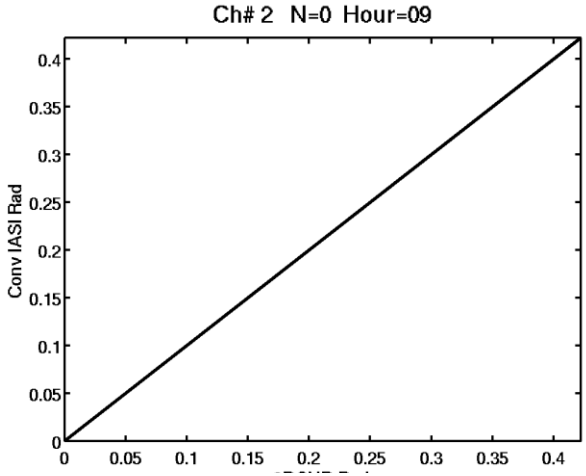


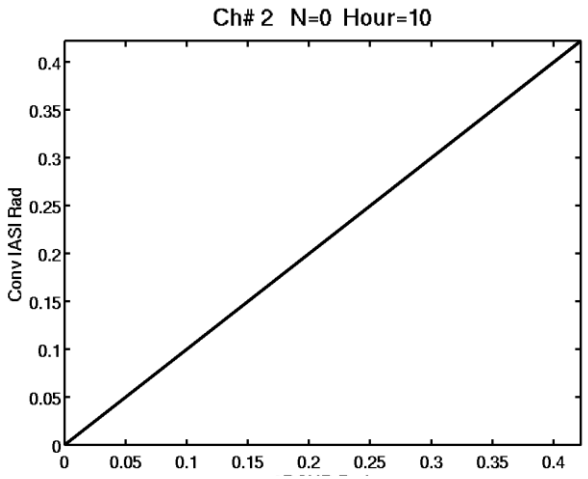


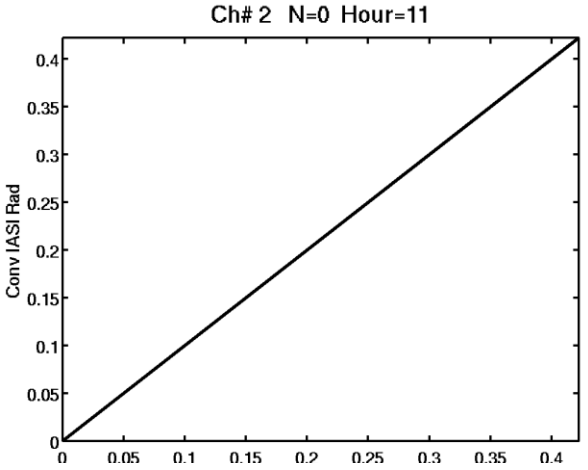


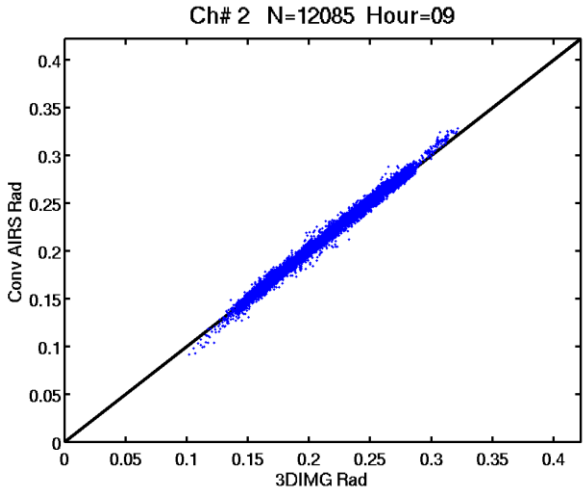


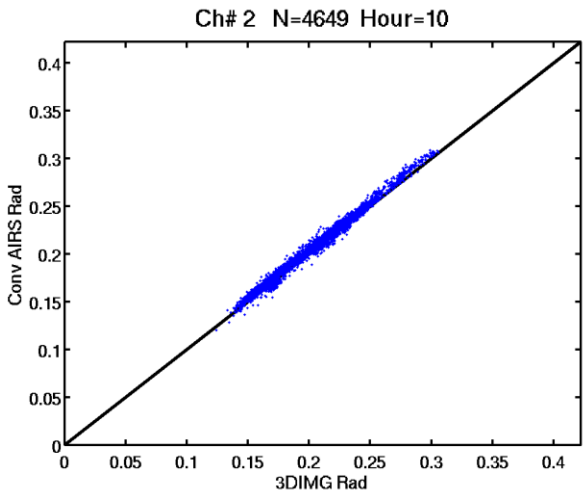


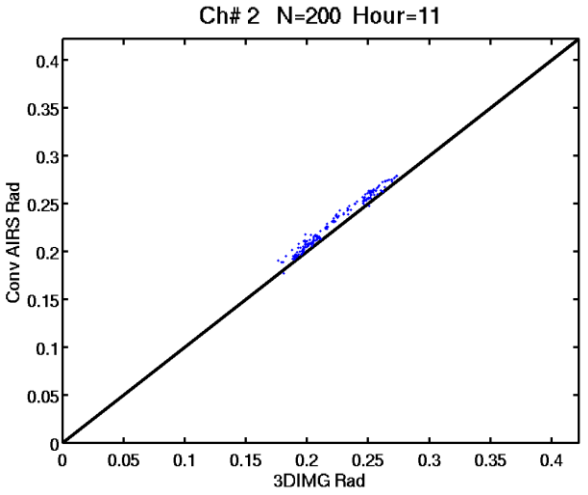

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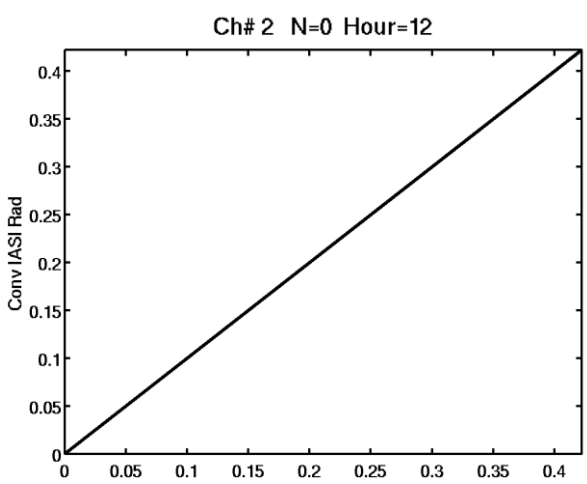
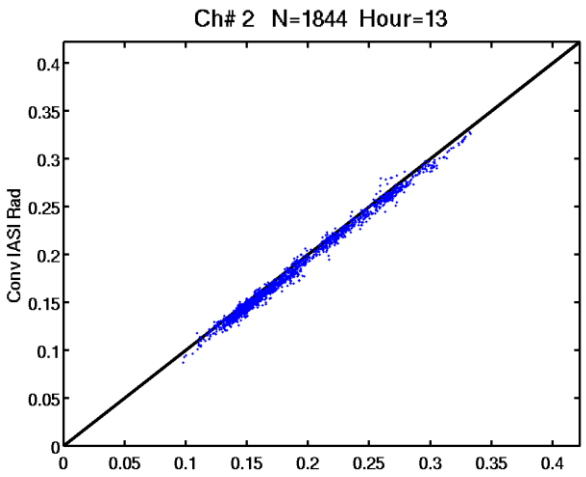
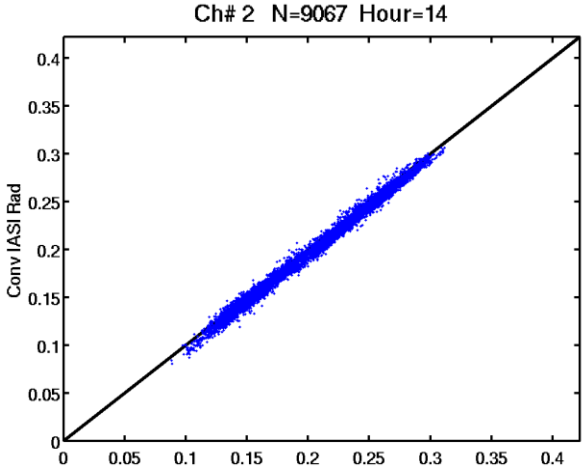
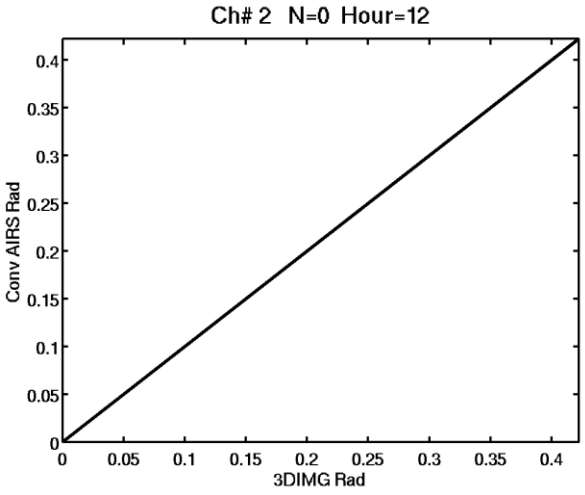
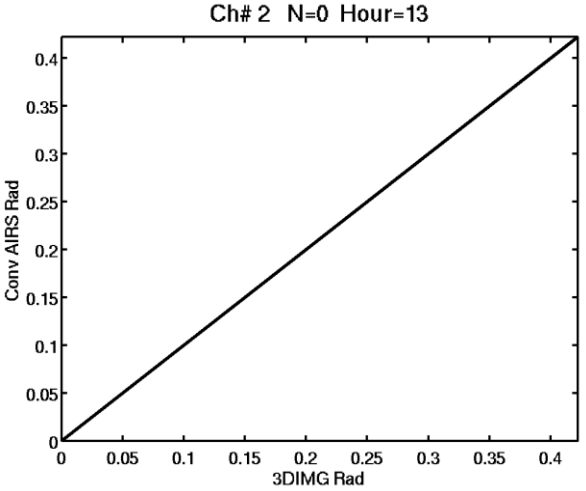
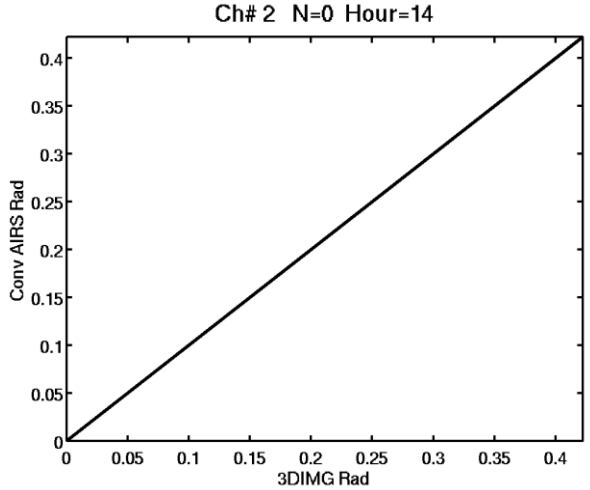


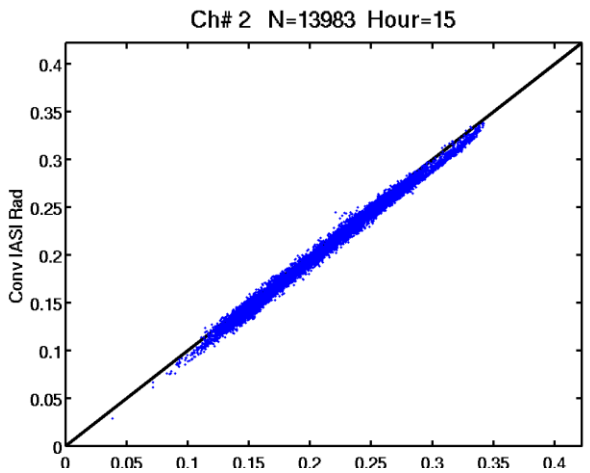



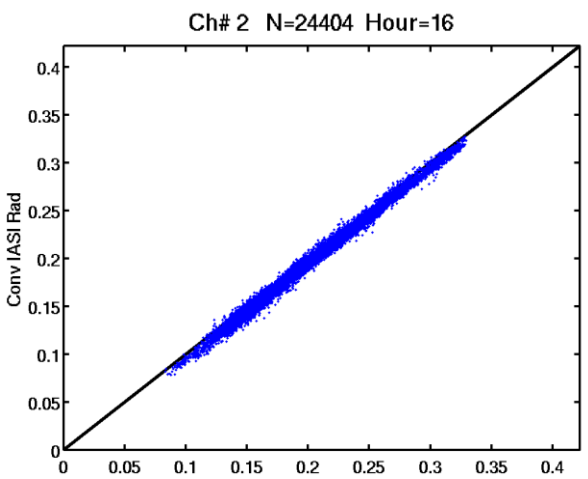



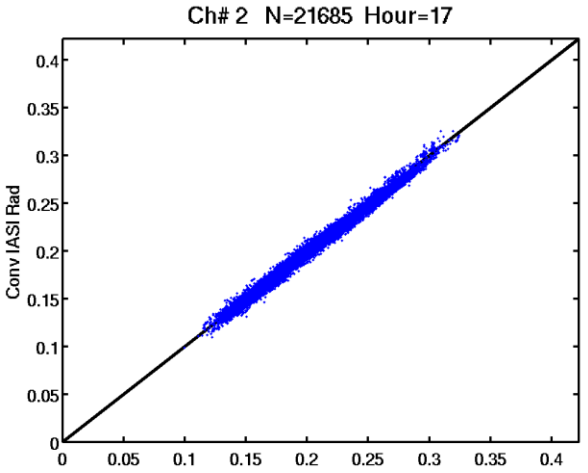



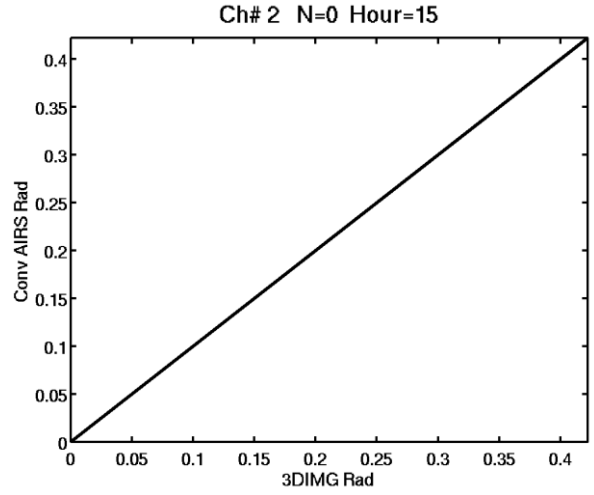



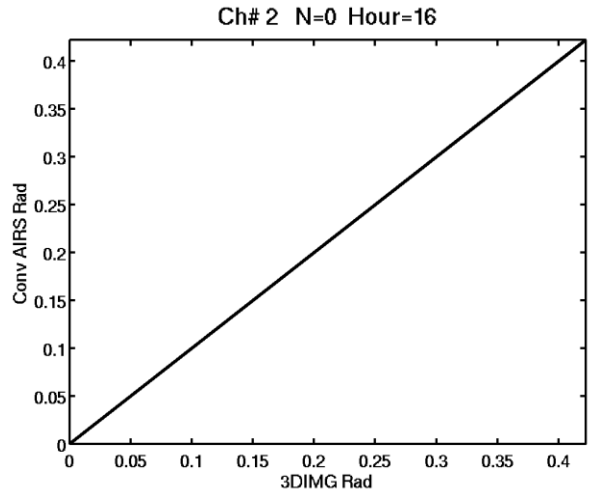
# Intercalibration of INSAT-3D WV Channel with IASI (top) and AIRS (bottom)

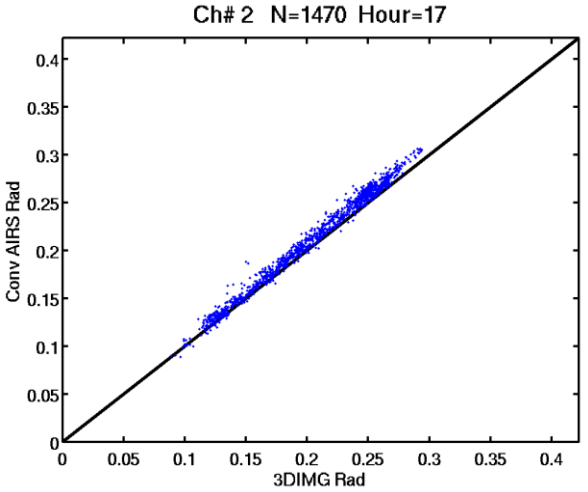


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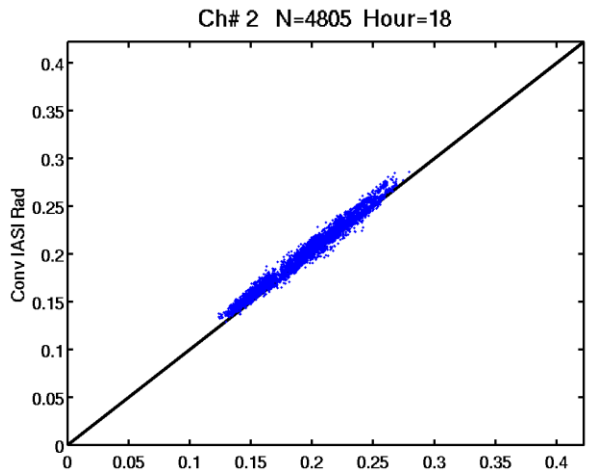


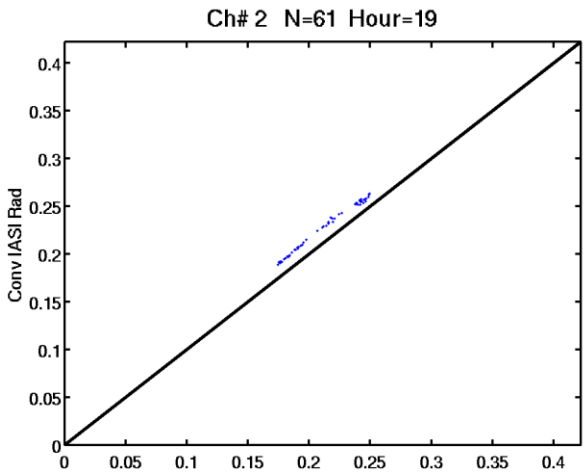


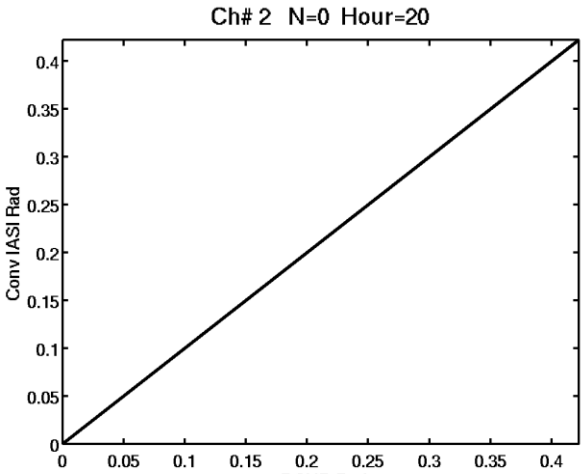


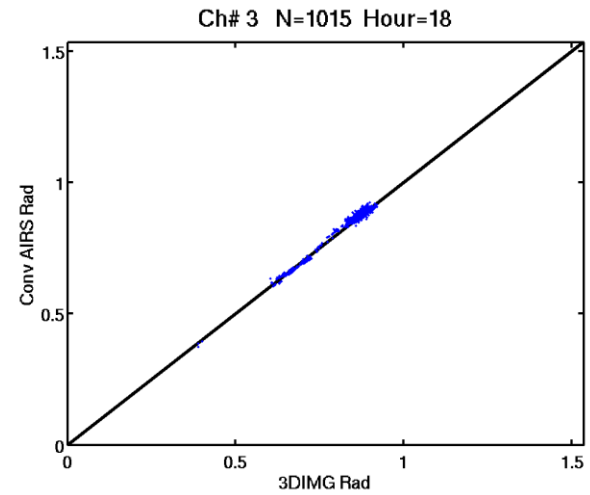


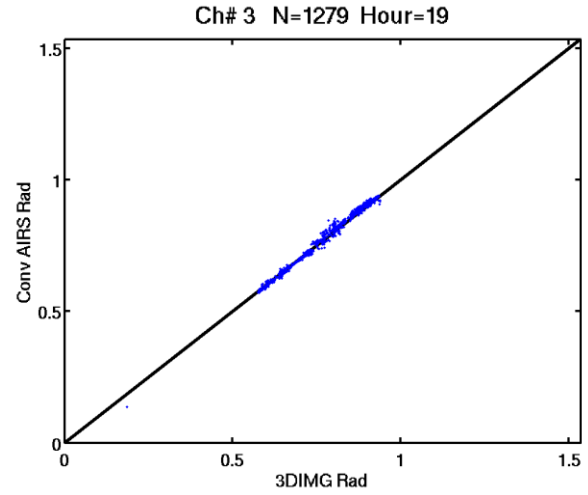


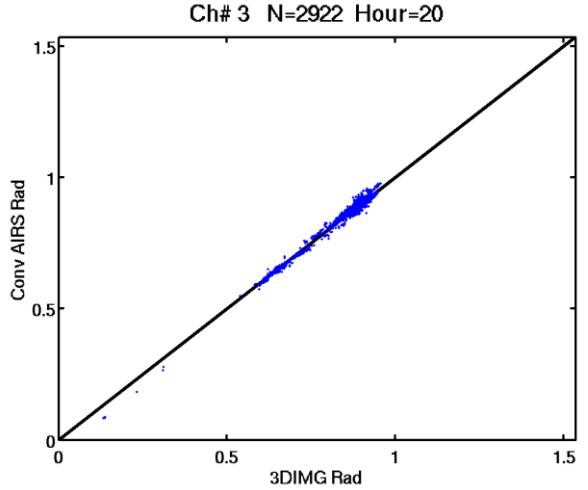

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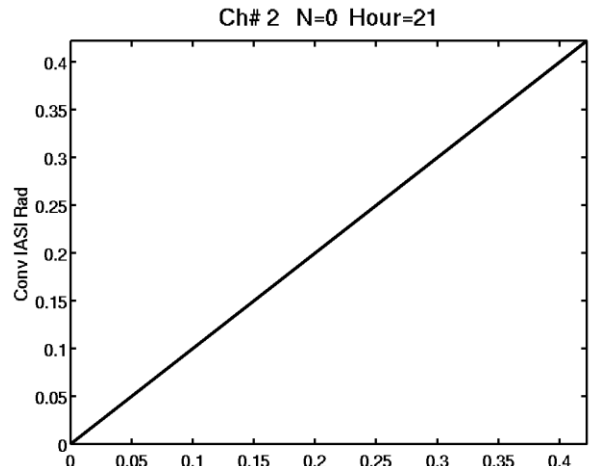


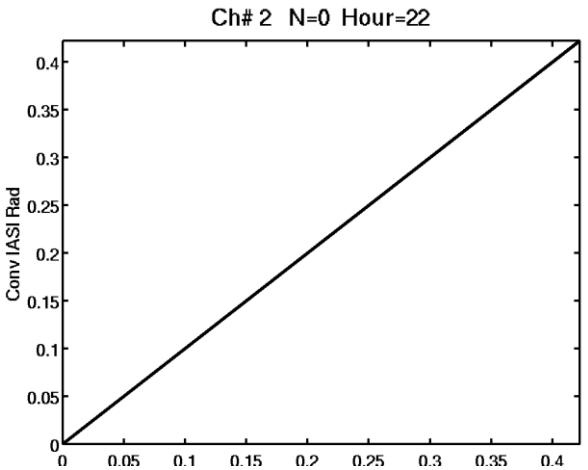


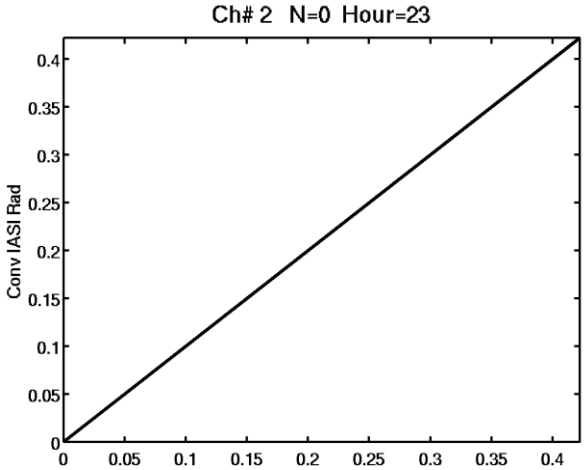


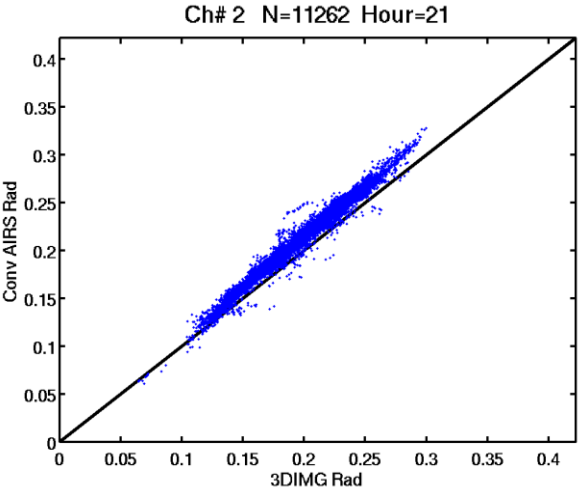


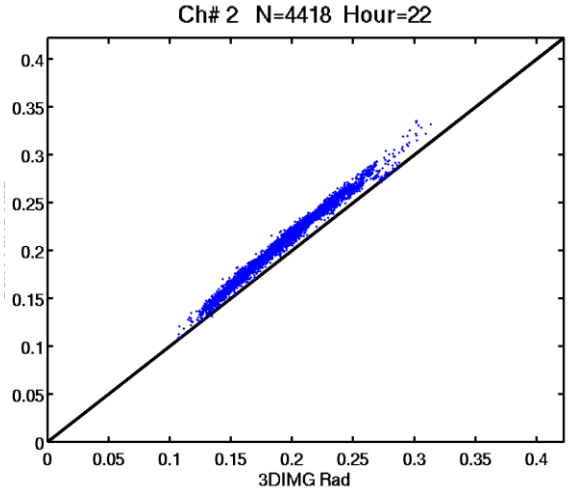


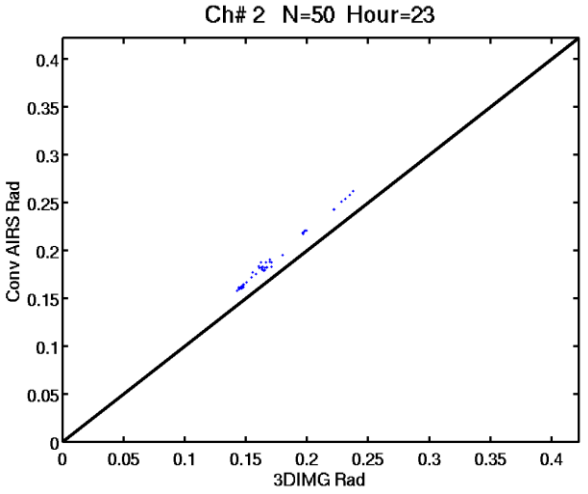

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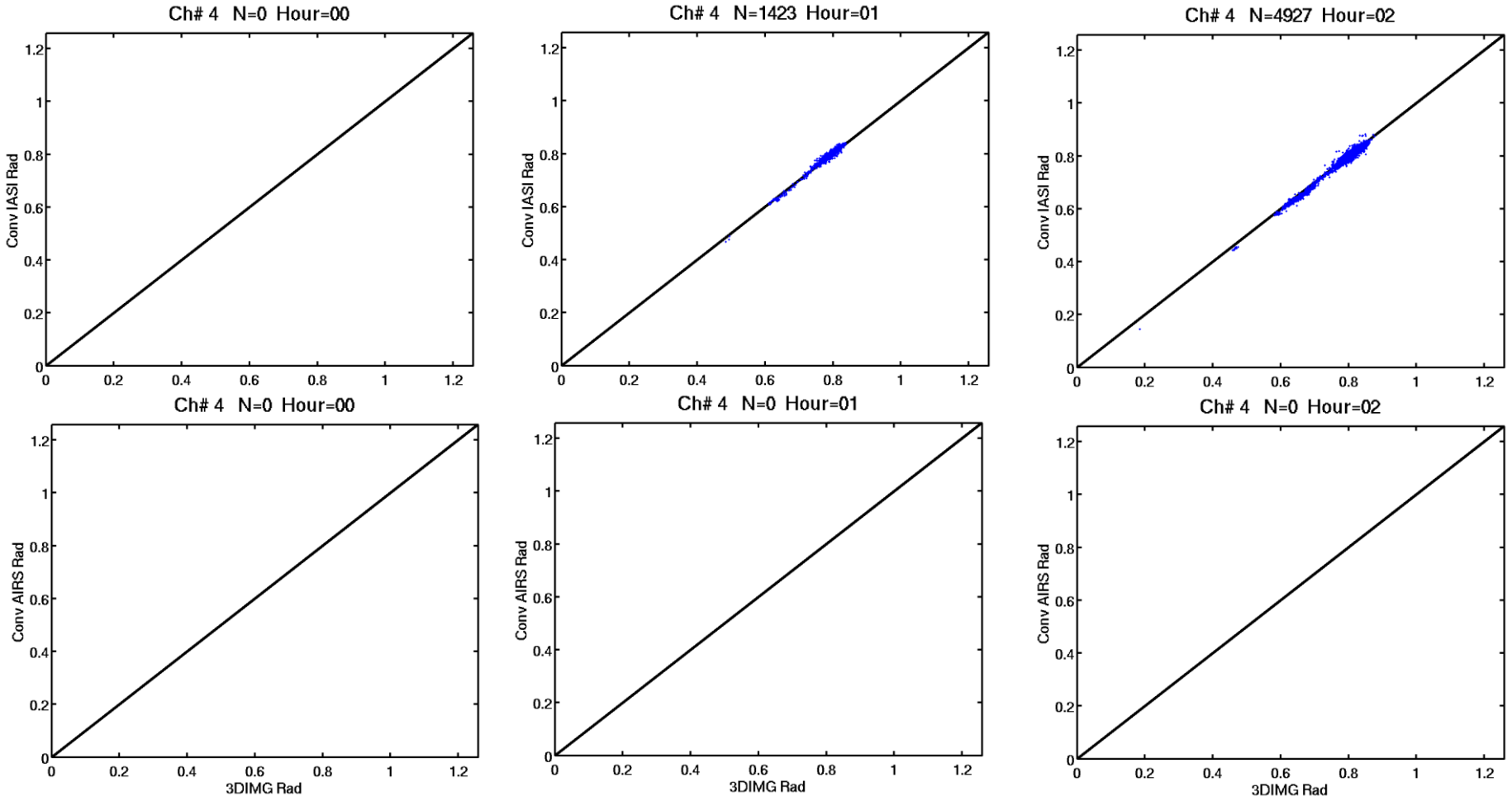
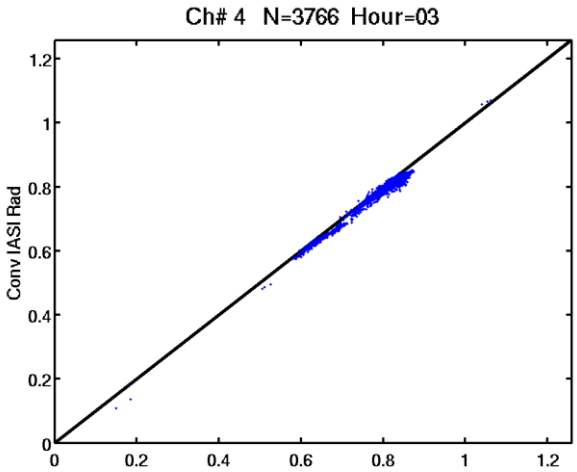
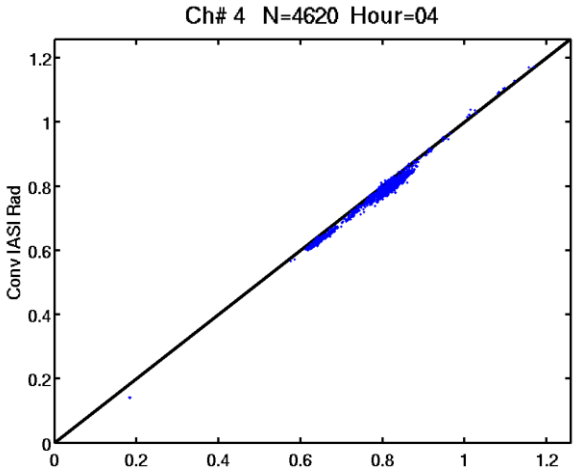
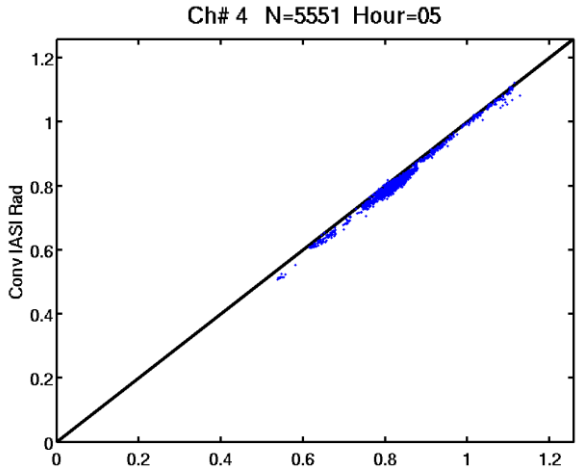
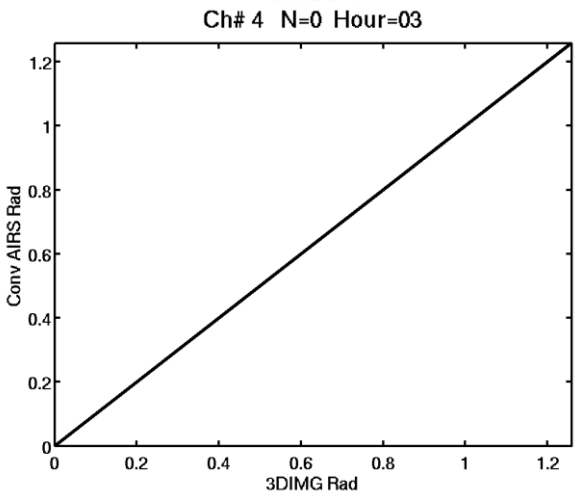


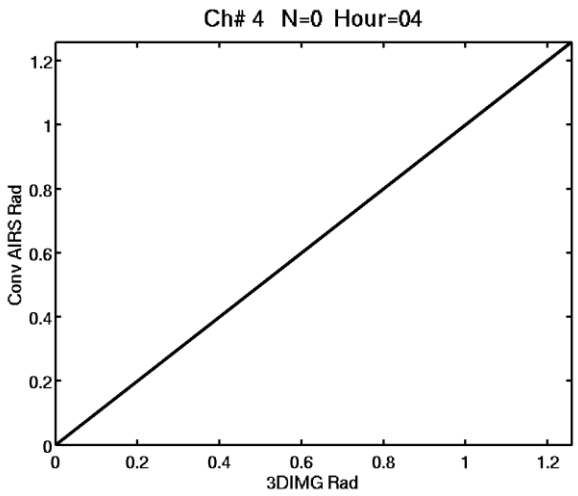
# Intercalibration of INSAT-3D TIR-2 Channel with IASI (top) and AIRS (bottom)

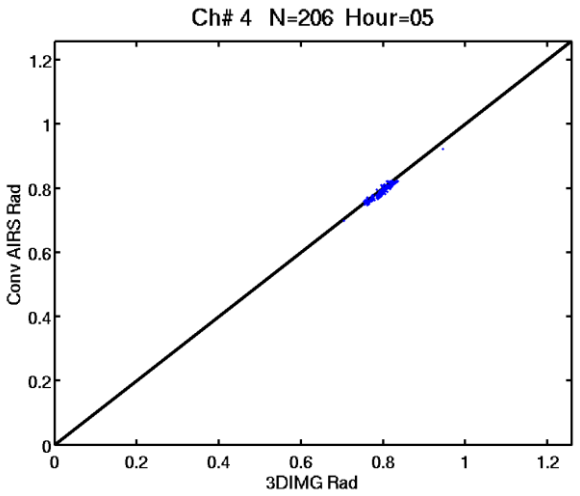


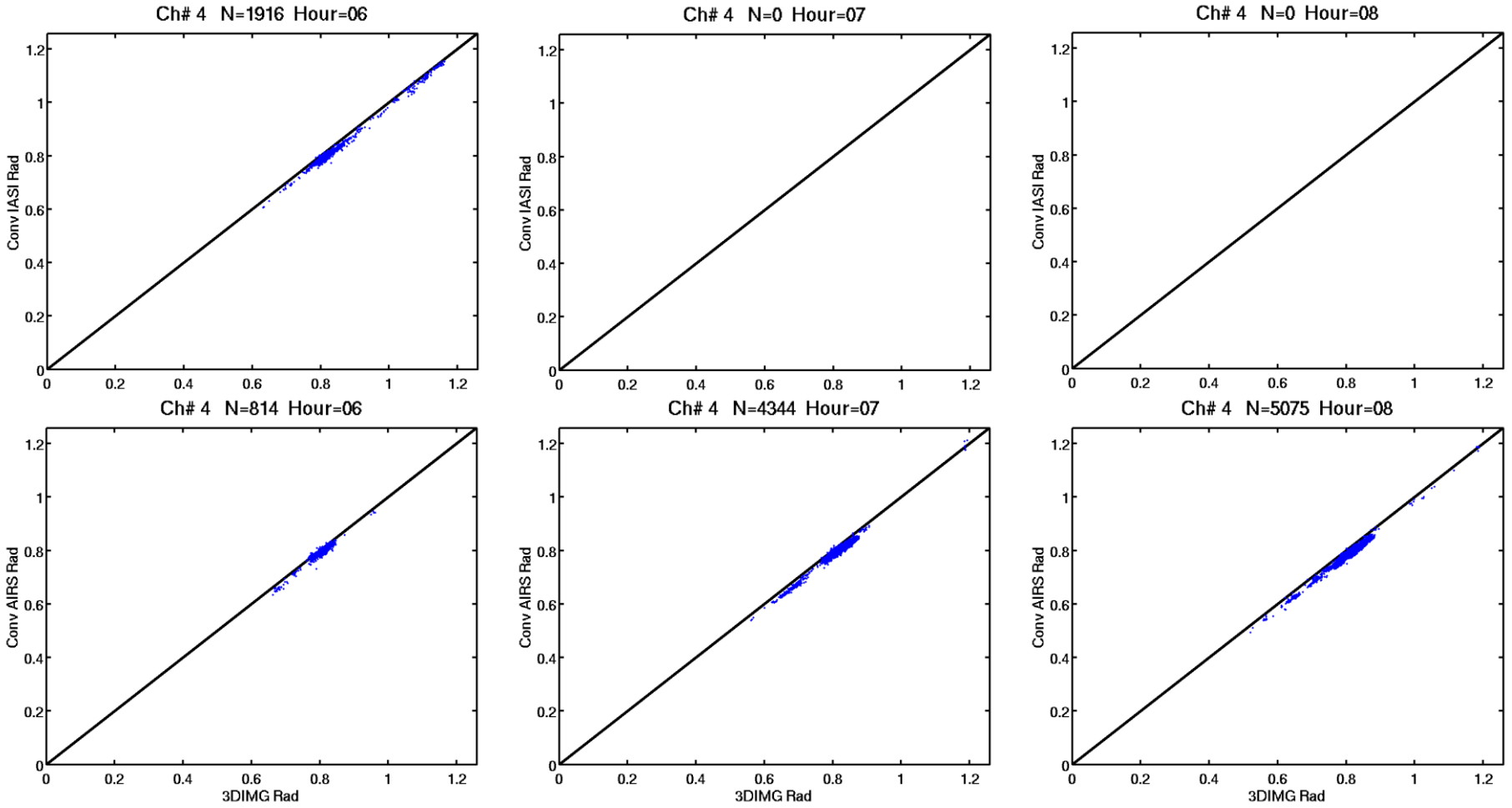



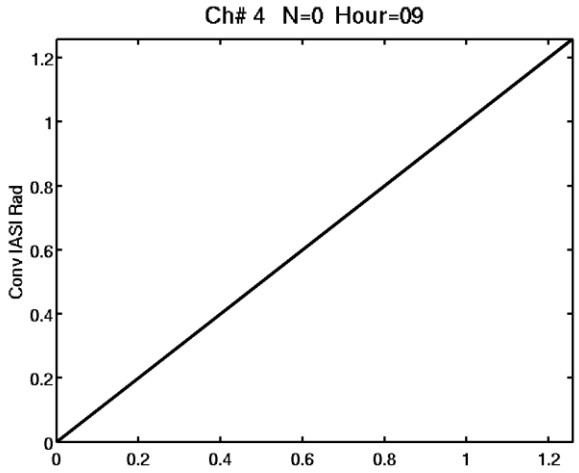



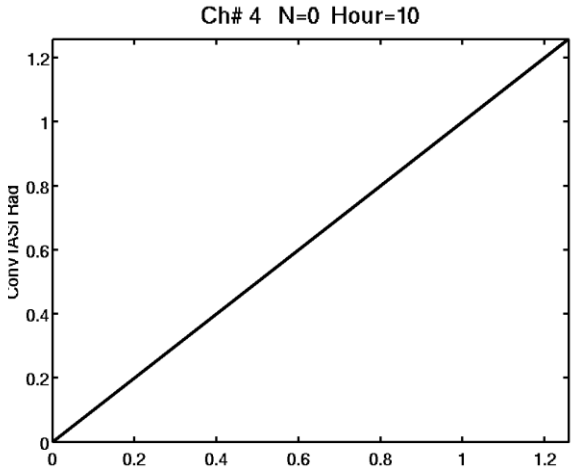



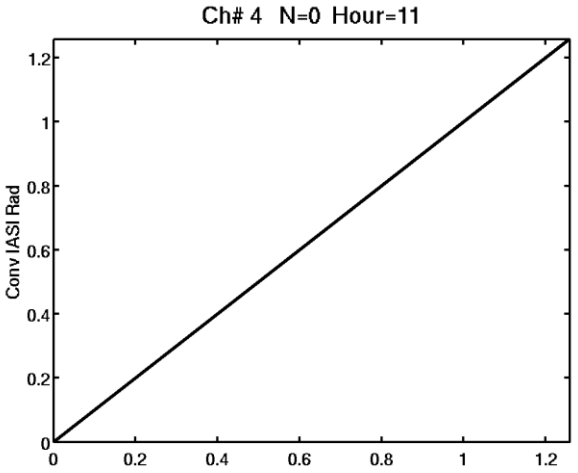
# Intercalibration of INSAT-3D TIR-2 Channel with IASI (top) and AIRS (bottom)

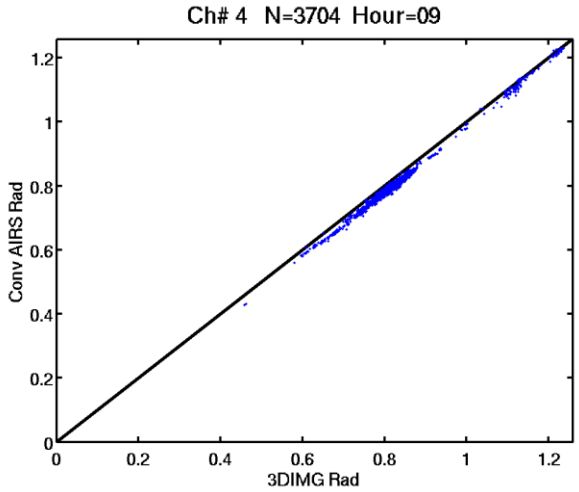


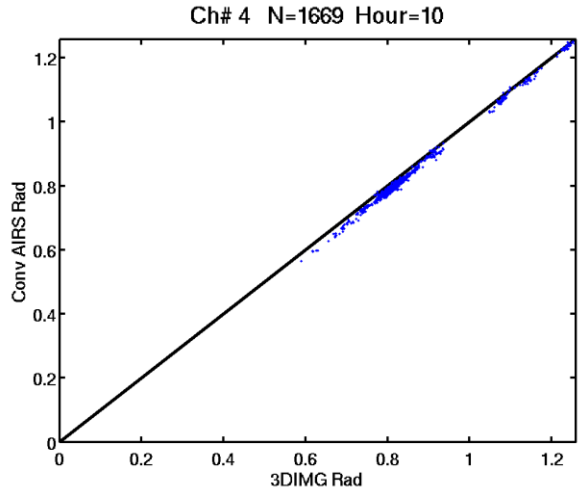
# Intercalibration of INSAT-3D TIR-2 Channel with IASI (top) and AIRS (bottom)

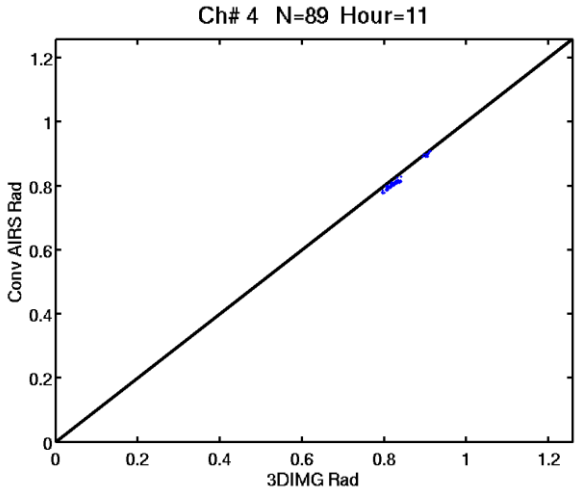


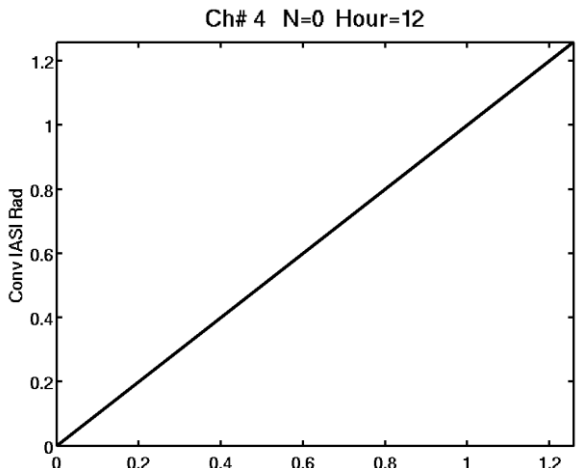



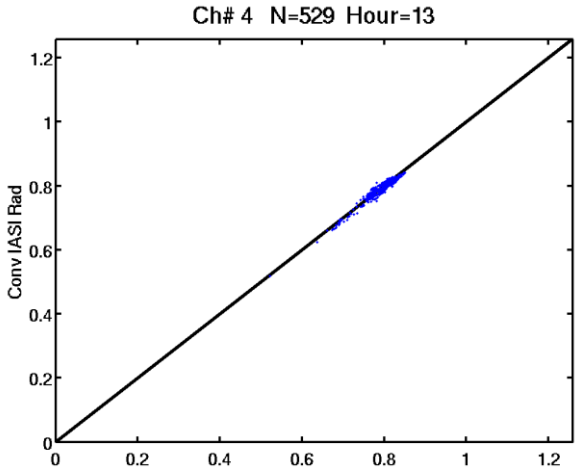



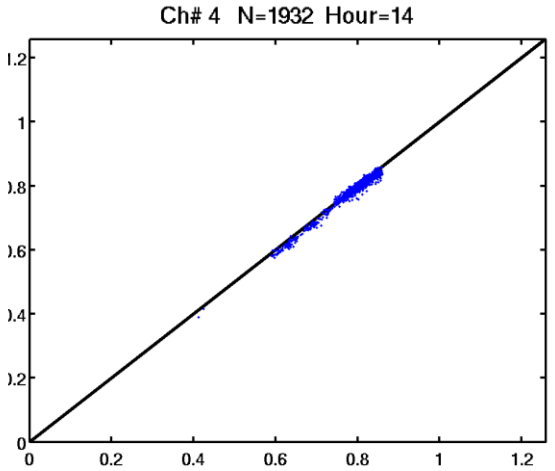



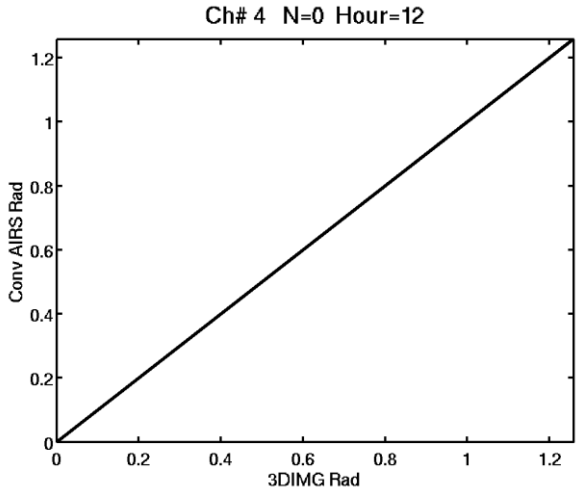



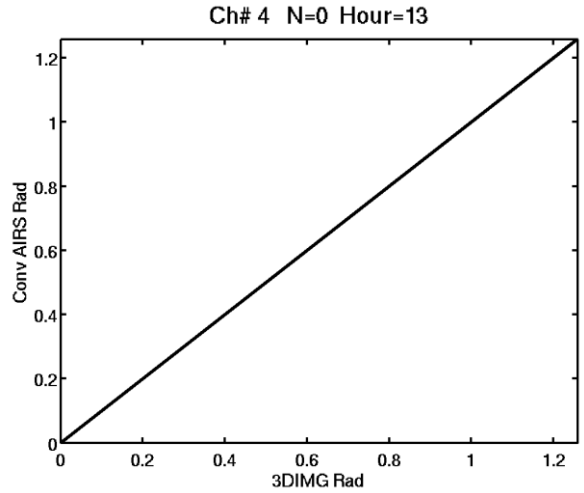
# Intercalibration of INSAT-3D TIR-2 Channel with IASI (top) and AIRS (bottom)

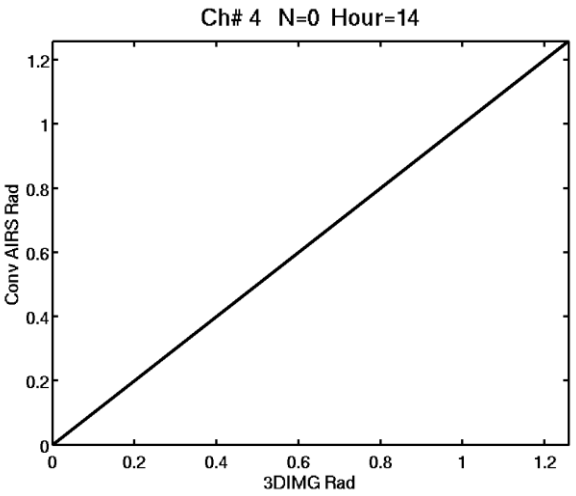


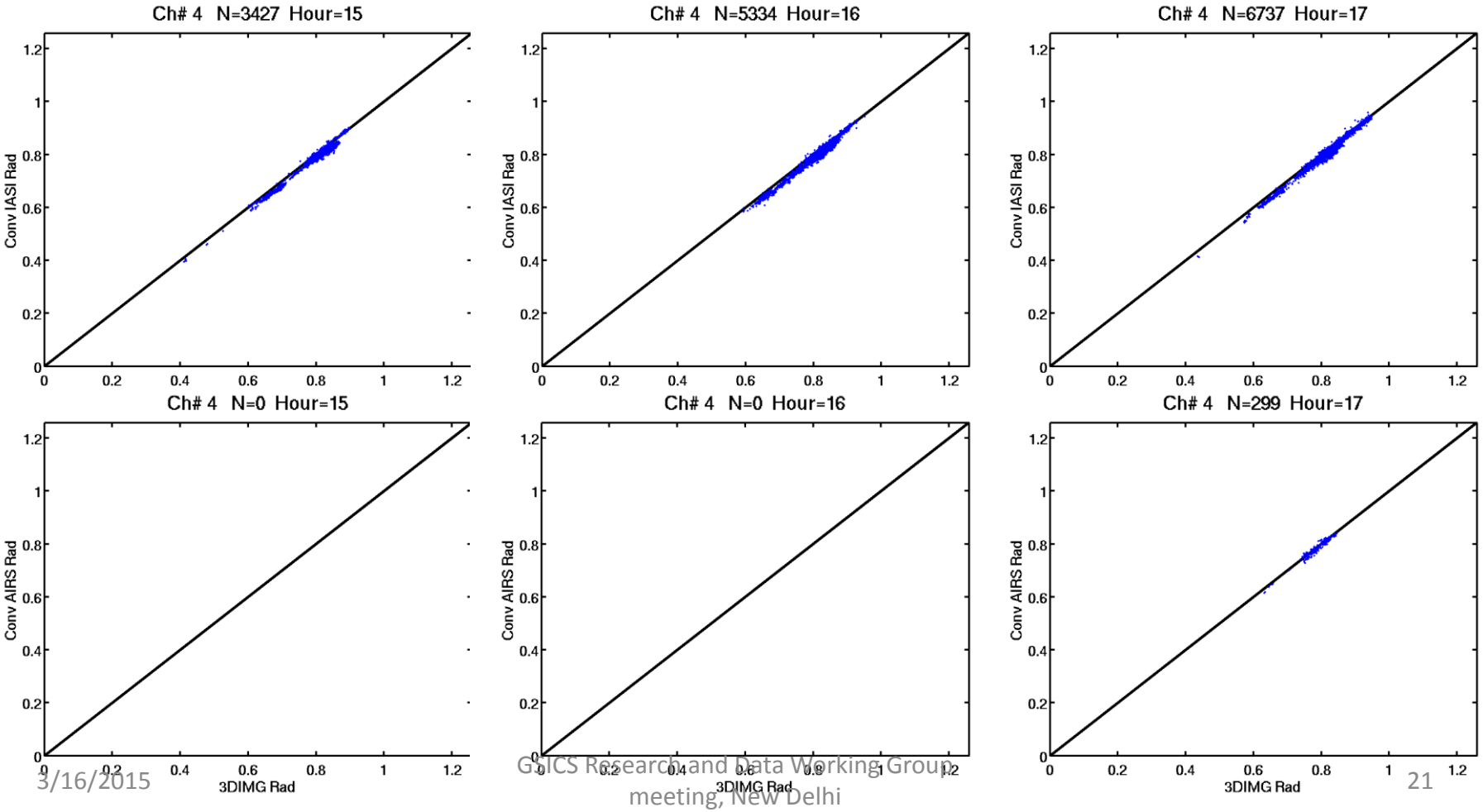



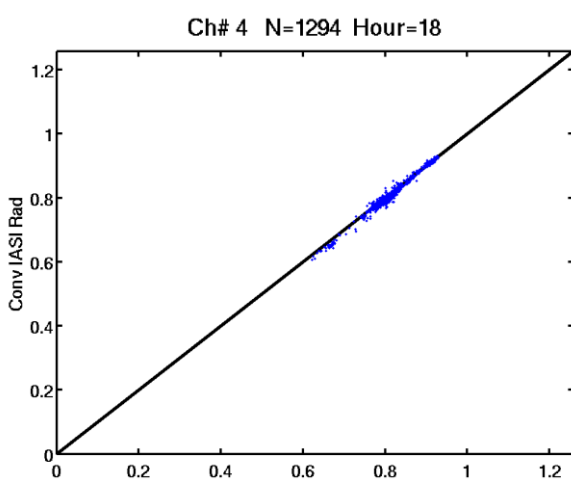



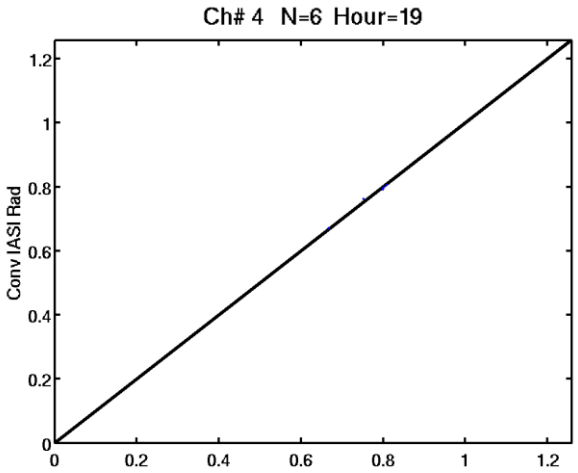



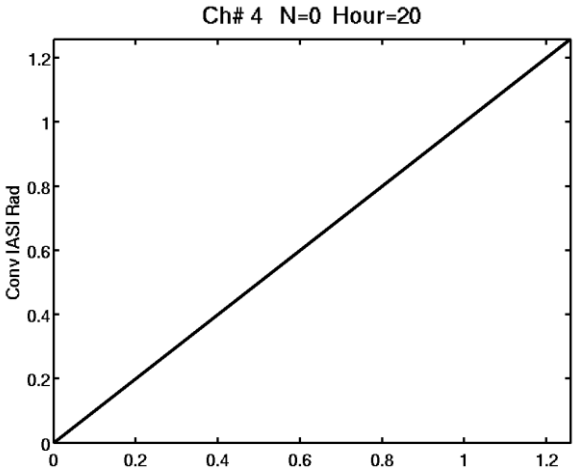
# Intercalibration of INSAT-3D TIR-2 Channel with IASI (top) and AIRS (bottom)

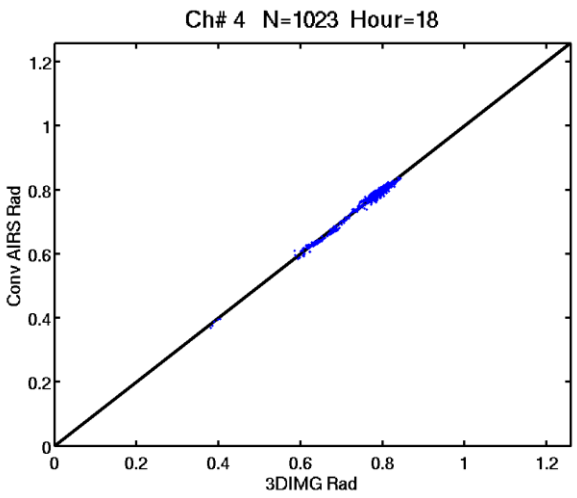


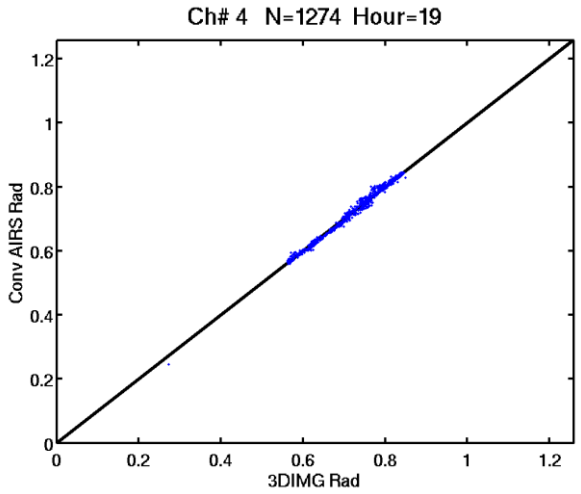
# Intercalibration of INSAT-3D TIR-2 Channel with IASI (top) and AIRS (bottom)

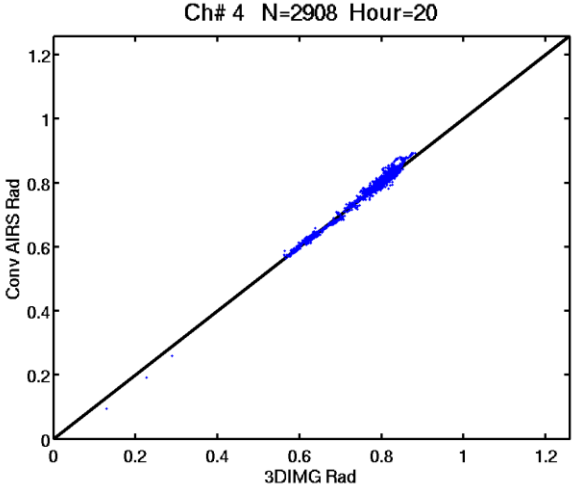


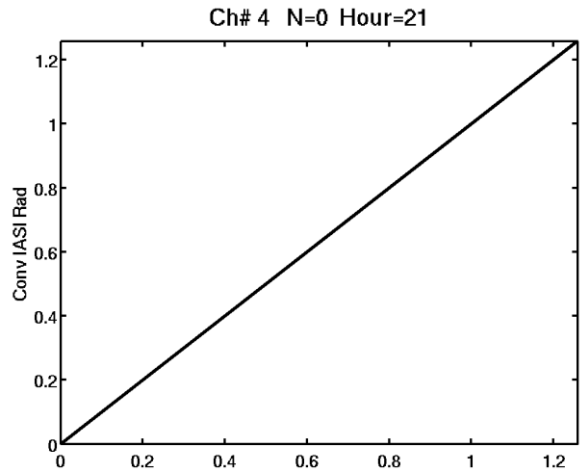



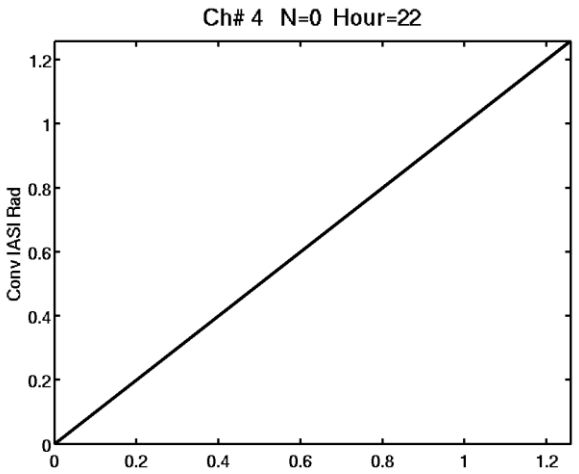



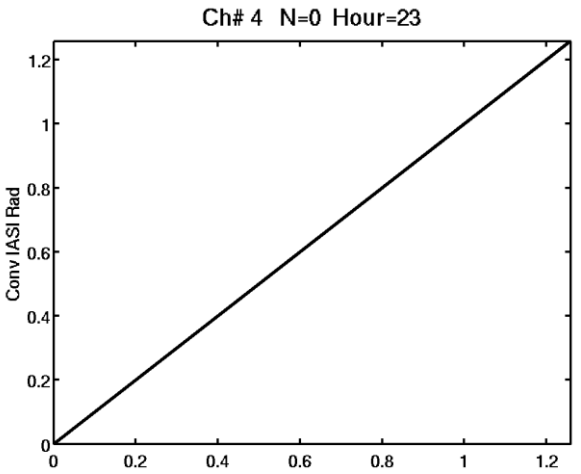



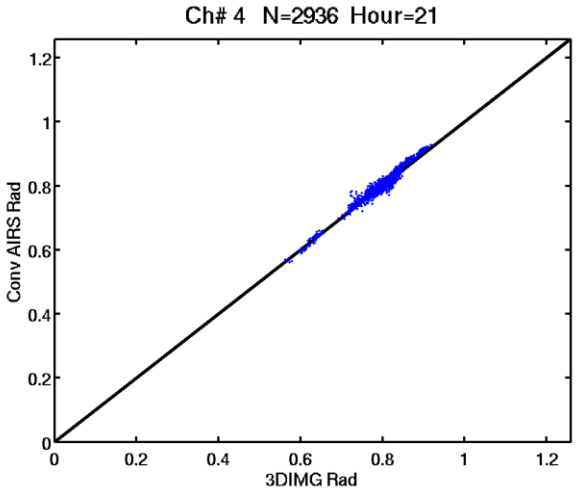



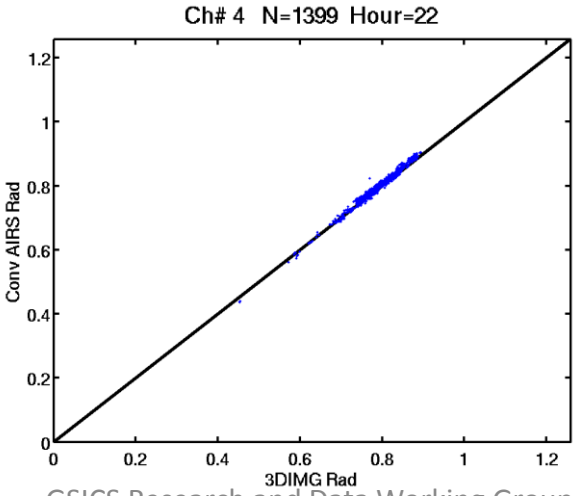
# Intercalibration of INSAT-3D TIR-2 Channel with IASI (top) and AIRS (bottom)

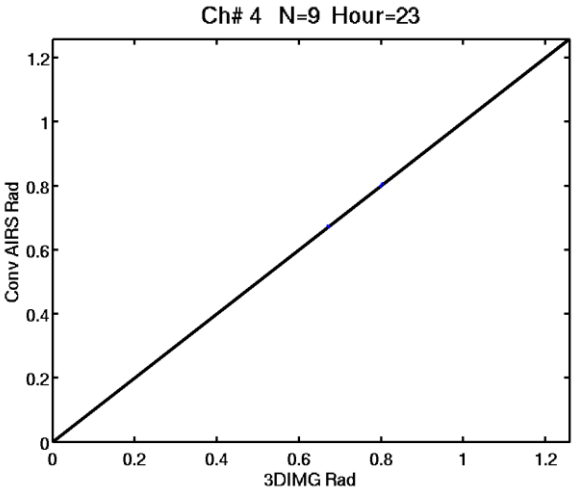


# Summary

- Preliminary study to assess diurnal calibration of INSAT-3D Imager and Sounder using AIRS and IASI observations.
- Imager with full disk coverage has advantage for wider time coverage, whereas Sounder being limited to Indian landmass  covers only few hours each day. AIRS does not cover entire spectral bands of INSAT-3D Sounder, but covers entire Imager bands.
- Imager channels intercalibration with IASI and AIRS show largely consistent behavior throughout the day/night except for few hours during satellite local midnight, indicating calibrations biases during these times.
- There are common hours when AIRS and IASI have coverage coinciding with Imager, albeit over different region, and can be used to define delta-correction.
- Detailed study is being carried out to asses the diurnal behavior of the calibration, especially to assess the mid-night calibration biases.

# Thanks

# Suggestions and feedbacks are welcome