



PROJECT

Data Analysis of the dynamic ionosphere cubesat experiment

DATE

30 JULY 2012

SITE

ASTRA, LLC

STUDENT

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Summary

- ✱ Overview of DICE mission
- ✱ Discussion of the satellites and instrumentation
- ✱ Early satellite ops challenges
- ✱ Data availability
- ✱ Temperature, current, and voltage plots
- ✱ Langmuir probe data and the IRI model
- ✱ Conclusion

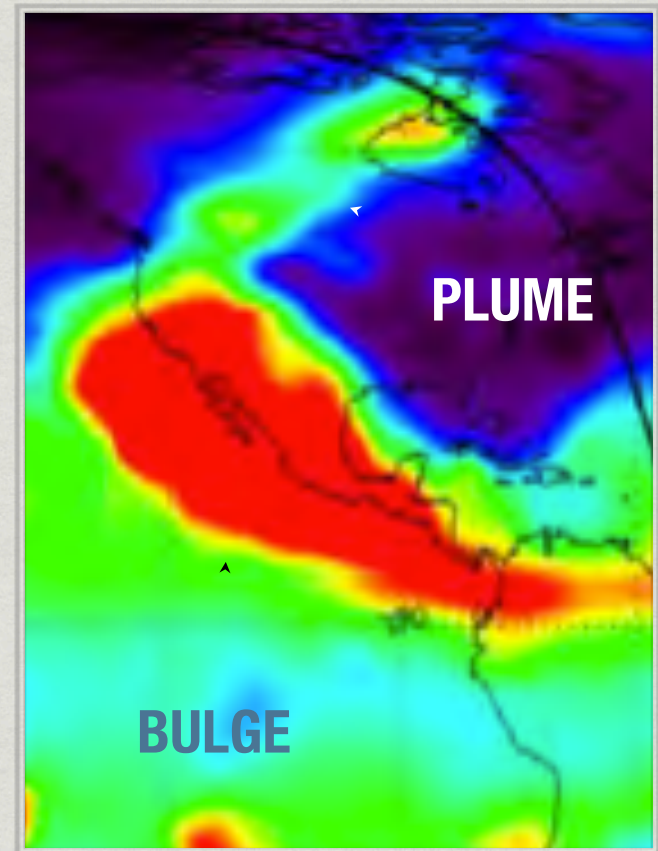
An Overview of DICE

- ✱ Two twin, 1.5U CubeSats (10 X 10 X 15 cm)
- ✱ Launched in NASA rocket from Vandenberg Air Force Base in October 2011
- ✱ Sent into orbit via NASA P-POD
- ✱ Lifetimes of ~3 years



Science Objectives

- * Investigate the physical processes responsible for formation of the geomagnetic Storm Enhanced Density (SED) Bulge
- * Investigate the physical processes responsible for the formation of the SED Plume at the base of the SED Bulge – and transport of high density SED plume across the polar region
- * Investigate the relationship between the penetration electric fields and the formation and evolution of SED



SATELLITES AND INSTRUMENTATION

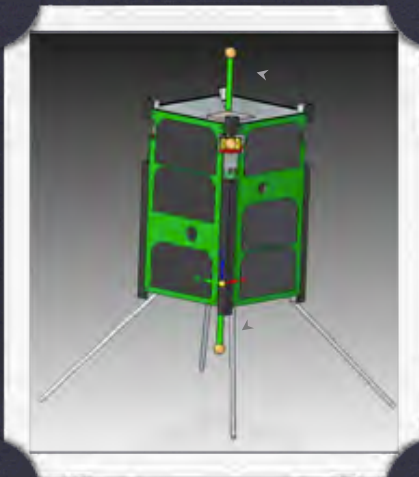


THE SATELLITES

The Mission

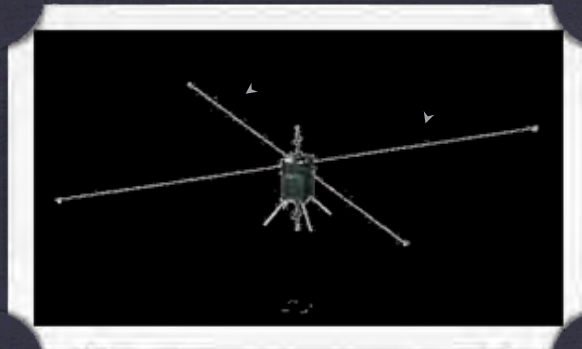
- ✱ Two spinning CubeSats
- ✱ Elliptical orbit (410 - 820 km altitude)
- ✱ Pearls-on-a-string orbit configuration
- ✱ Instruments
 - ✱ 2 Langmuir probes
 - ✱ 4 five meter electric field booms
 - ✱ 1 magnetometer to determine field-aligned currents

INSTRUMENTS



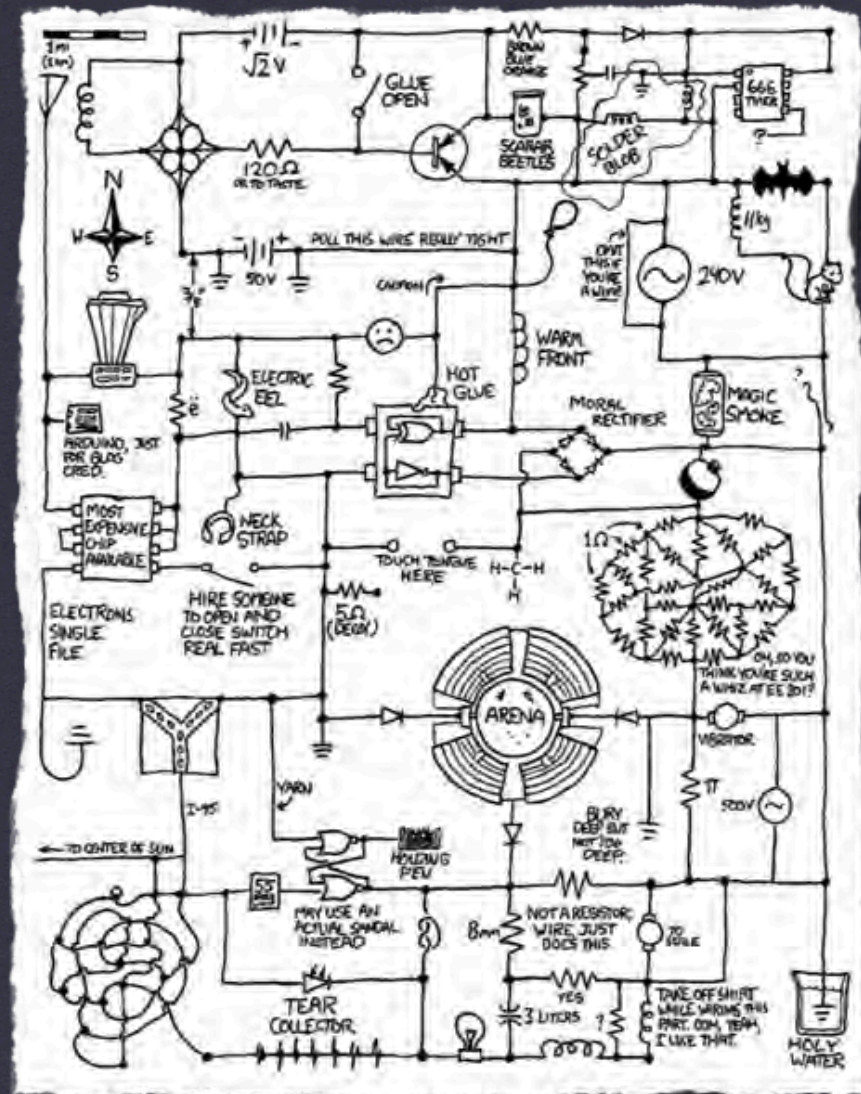
LANGMUIR
PROBE

ELECTRIC FIELD
BOOMS

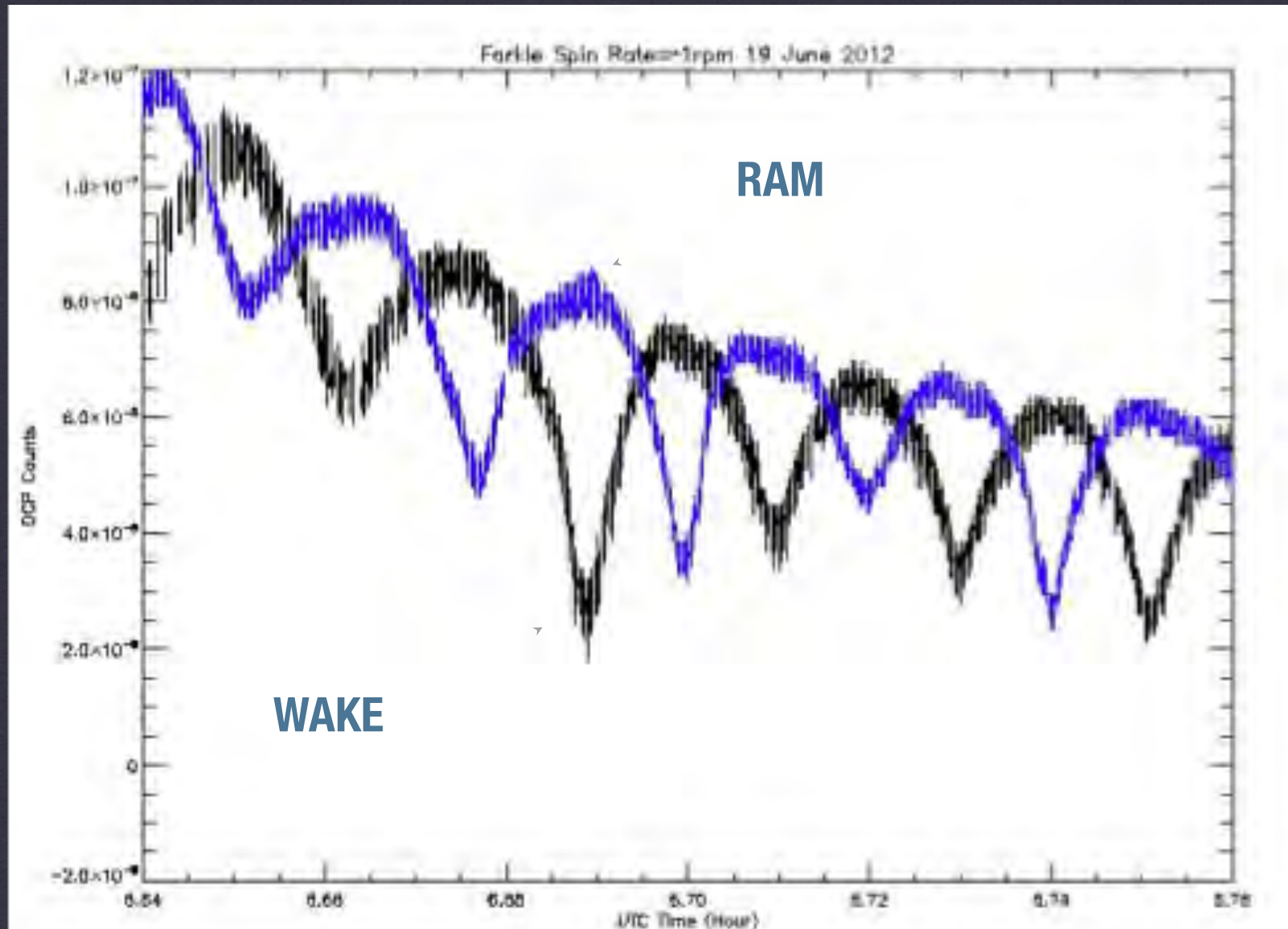


Major Satellite Components	
A	DC Probe
B	E-Field Sensor Payload
C	GPS Receiver
D	Science / ADCS Board
E	C&DH Processor Board
F	C&DH Motherboard
G	Power Board w/ Batteries
H	Radio Electronics and Board
I	Turnstile Antennas
J	DC Probe

Science Board Schematic

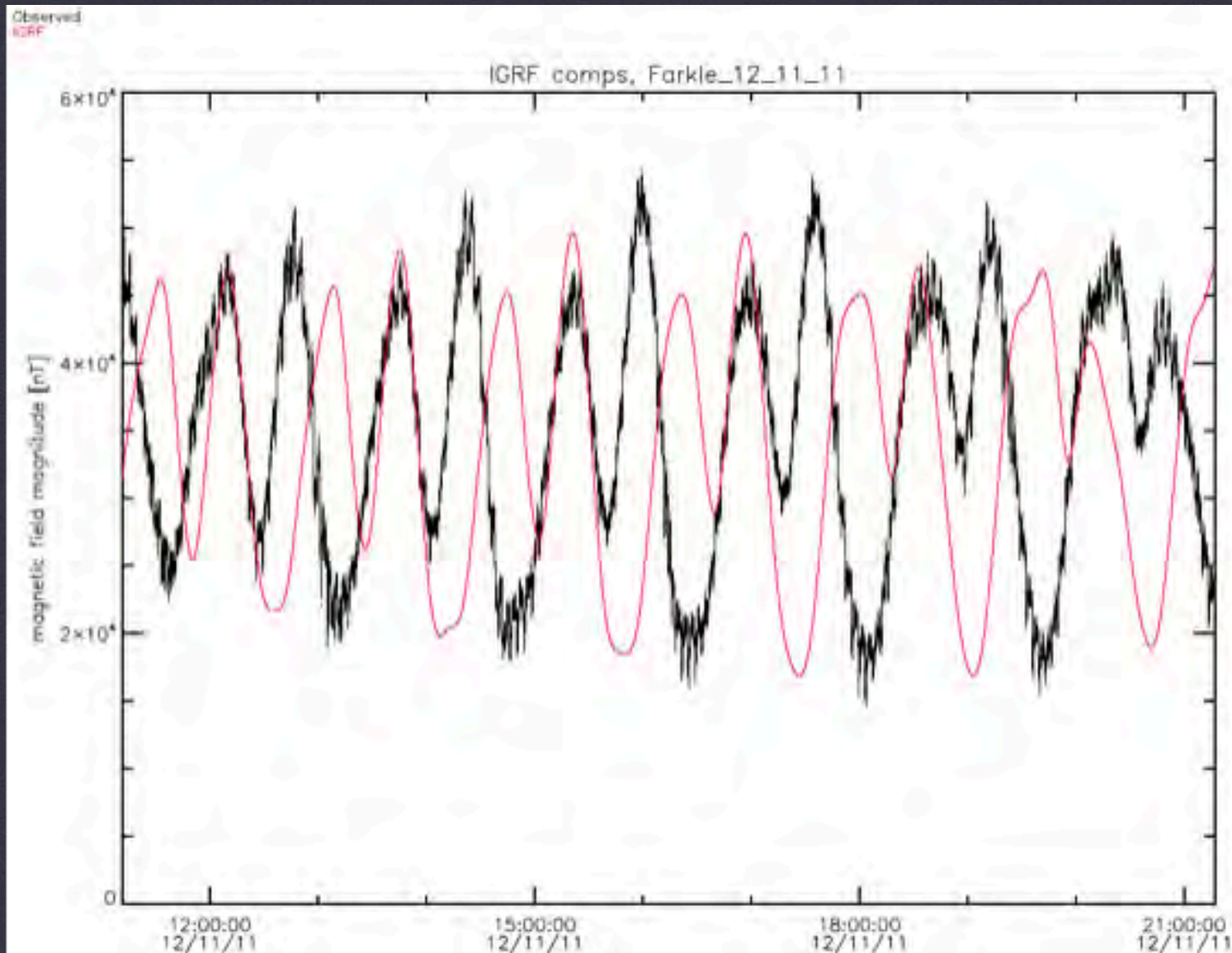


EARLY SATELLITE OPS CHALLENGES



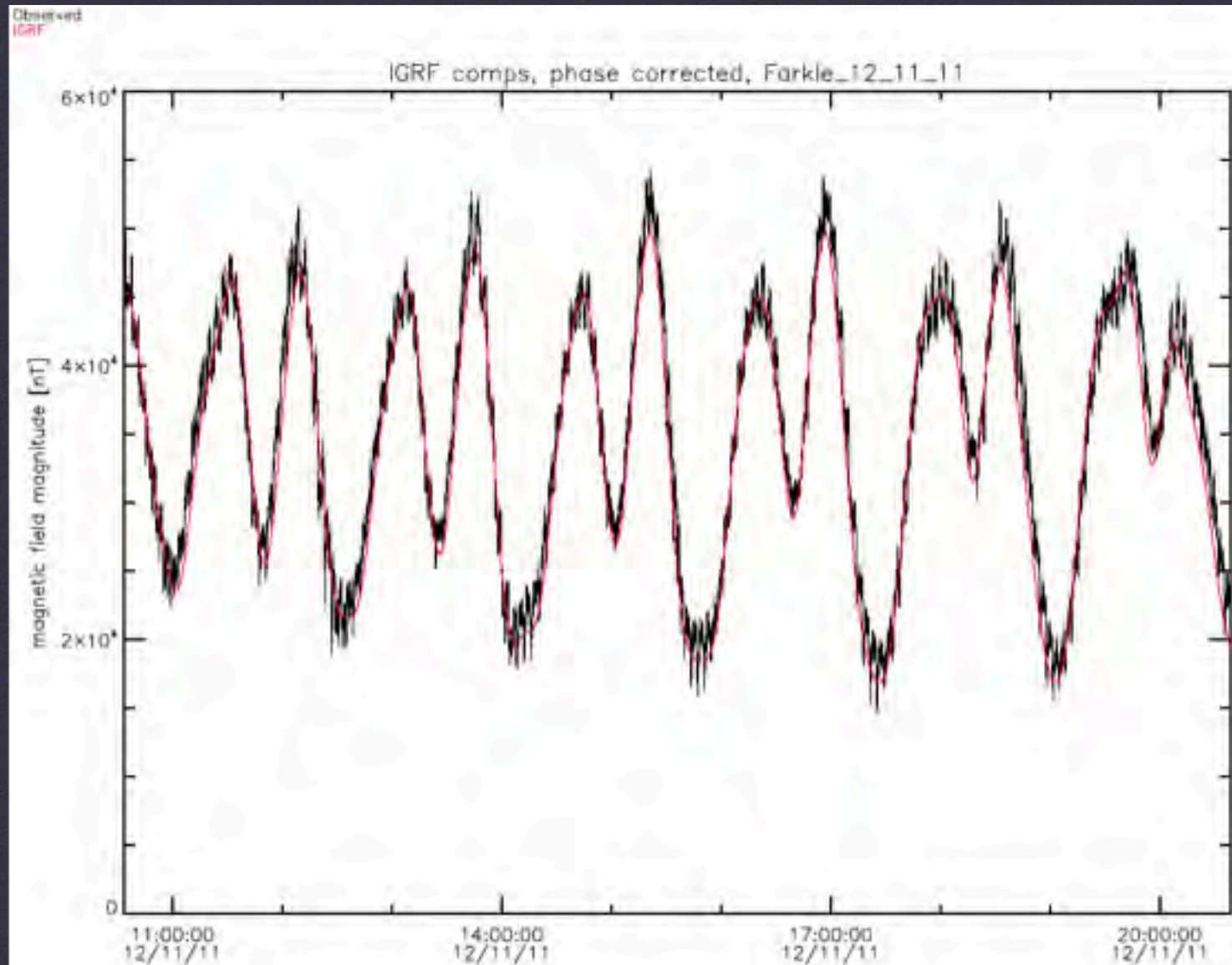
RAM AND WAKE EFFECT

FARKLE 19 JUNE 2012



CLOCK OFFSET

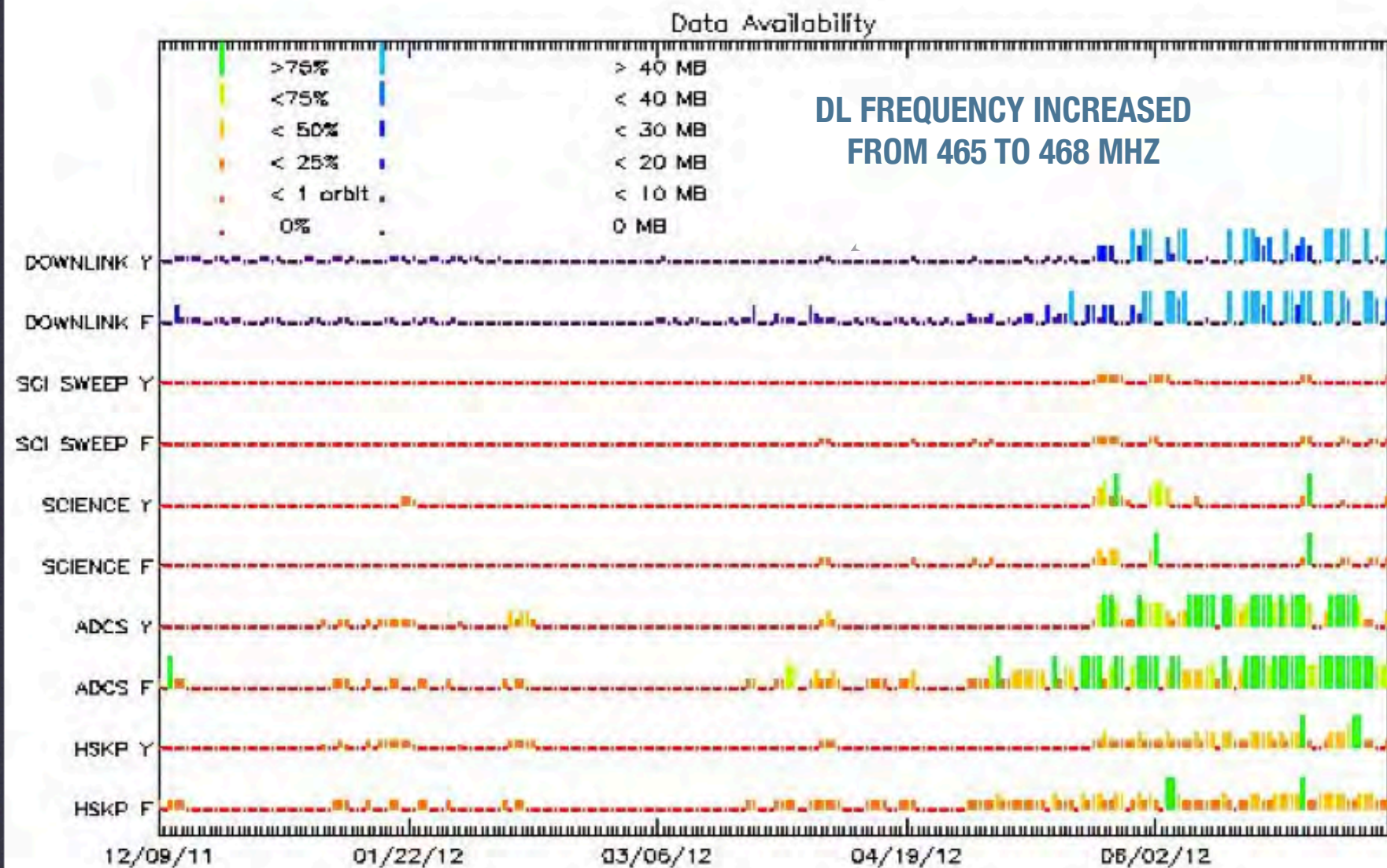
COURTESY OF MARCIN PILINSKI



CLOCK CORRECTION

COURTESY OF MARCIN PILINSKI

DATA AVAILABILITY



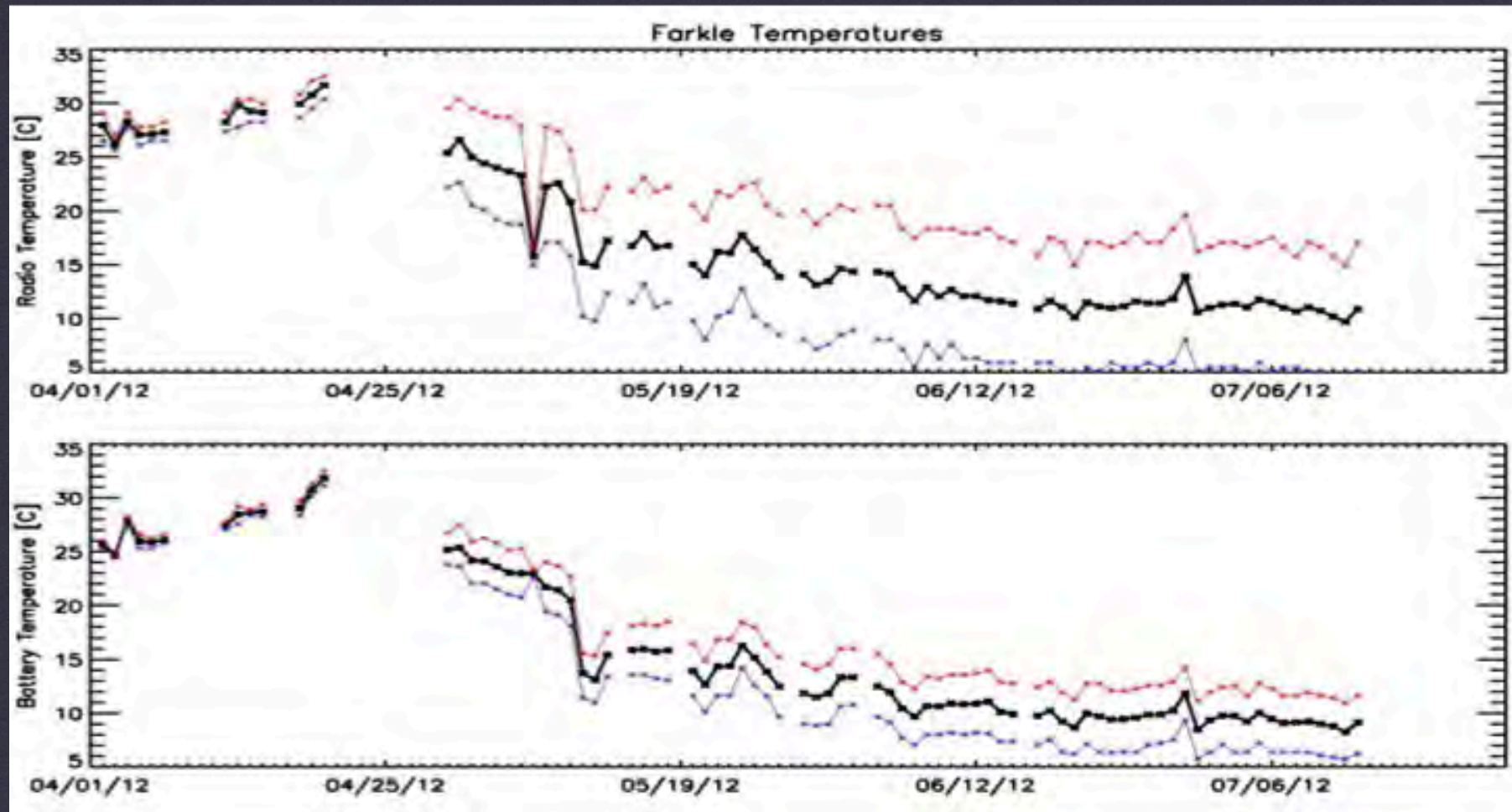
DATA AVAILABILITY PLOT

TIME RANGE: 9 DECEMBER 2011 - 23 JULY 2012

WHY IT'S IMPORTANT

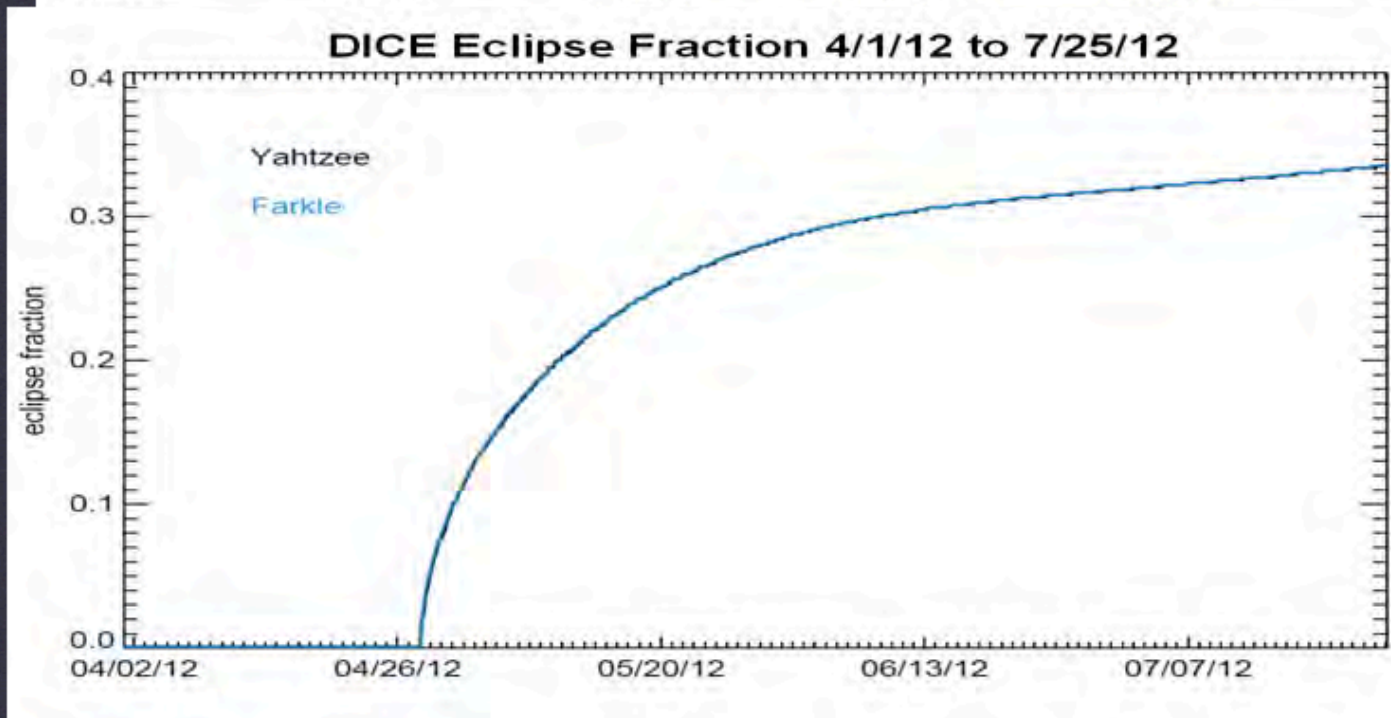
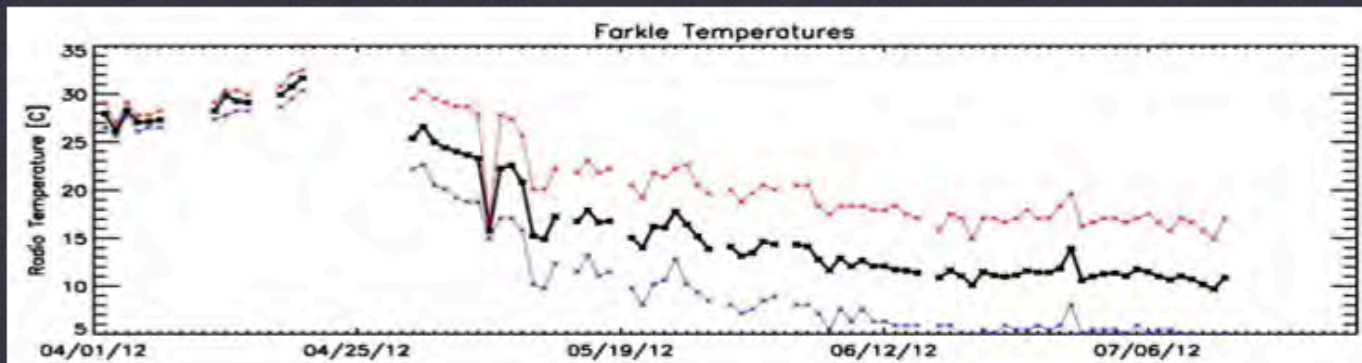
- ✱ Allows us to visualize the amount of data that is collected for the satellites
- ✱ Allows us to see how efficiently the downlinks from the satellites are
- ✱ Helps us determine when/if either of the satellites stops responding

TEMPERATURE, CURRENT, AND VOLTAGE

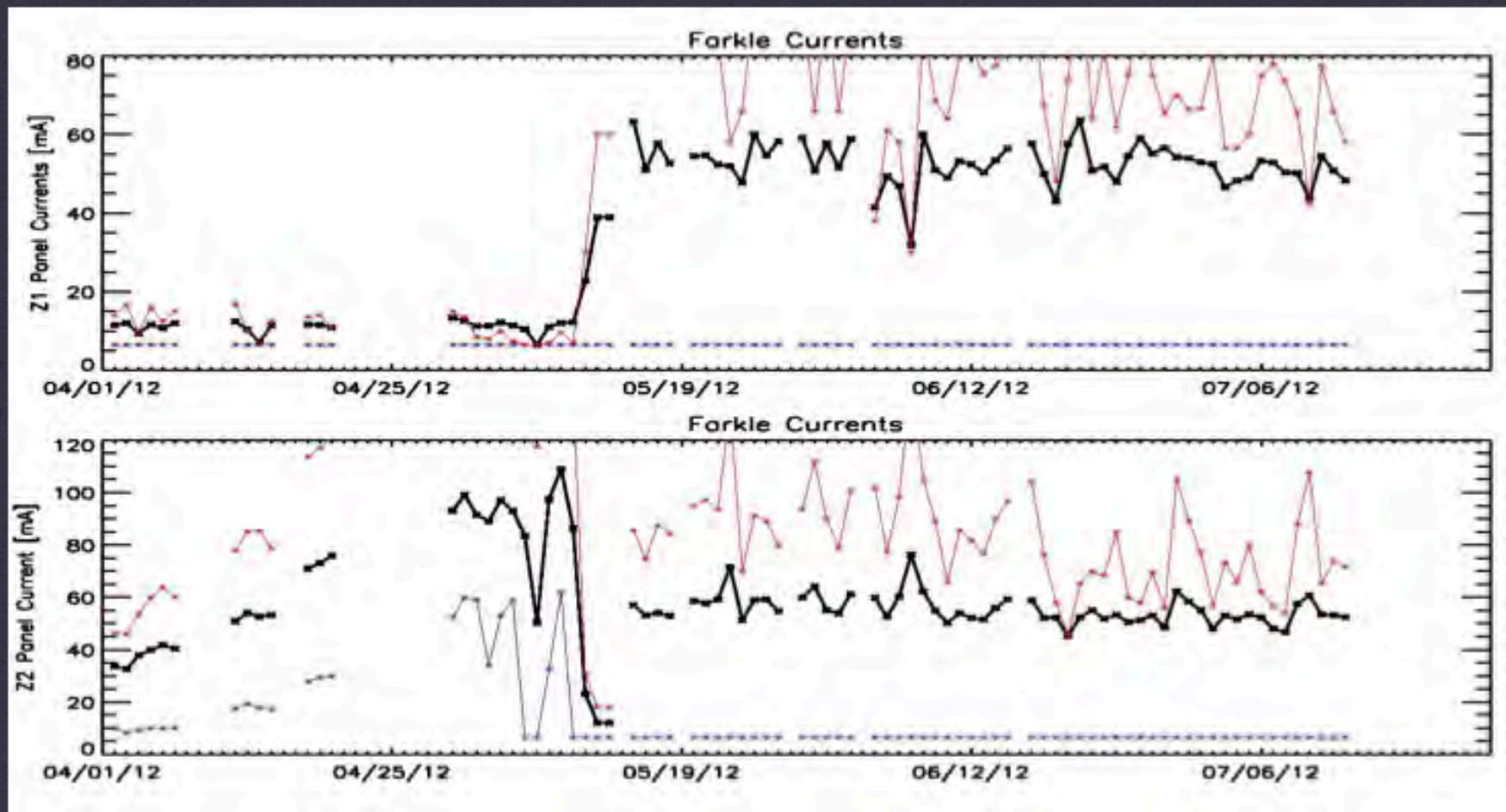


TEMPERATURE PLOT

FARKLE: 1 APRIL 2012 - 23 JULY 2012

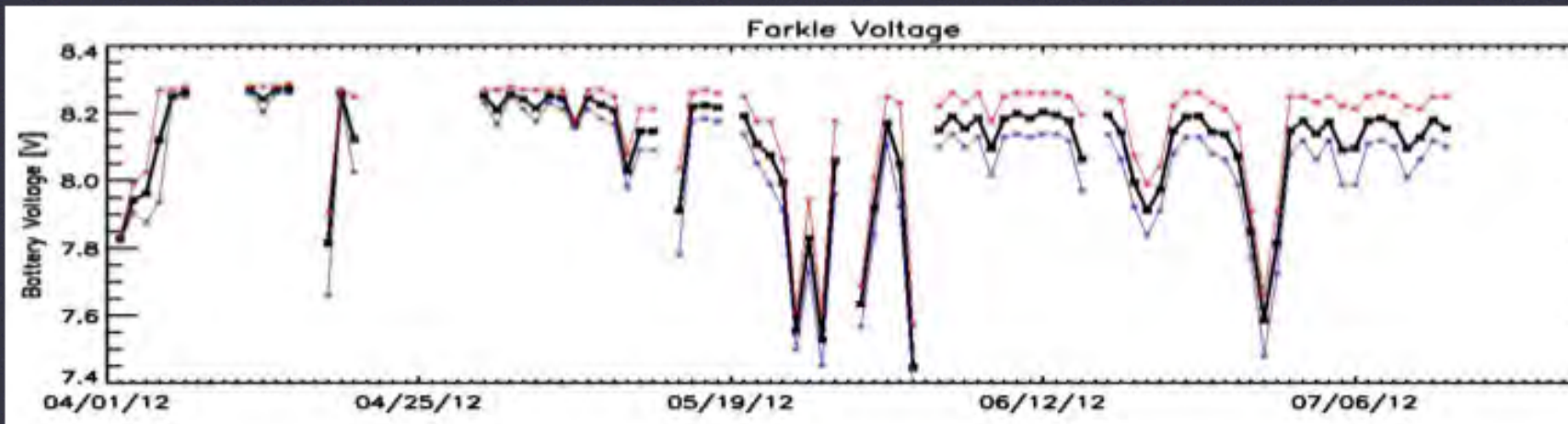


TEMPERATURE VALIDATION



CURRENT PLOT

FARKLE: 1 APRIL 2012 - 23 JULY 2012



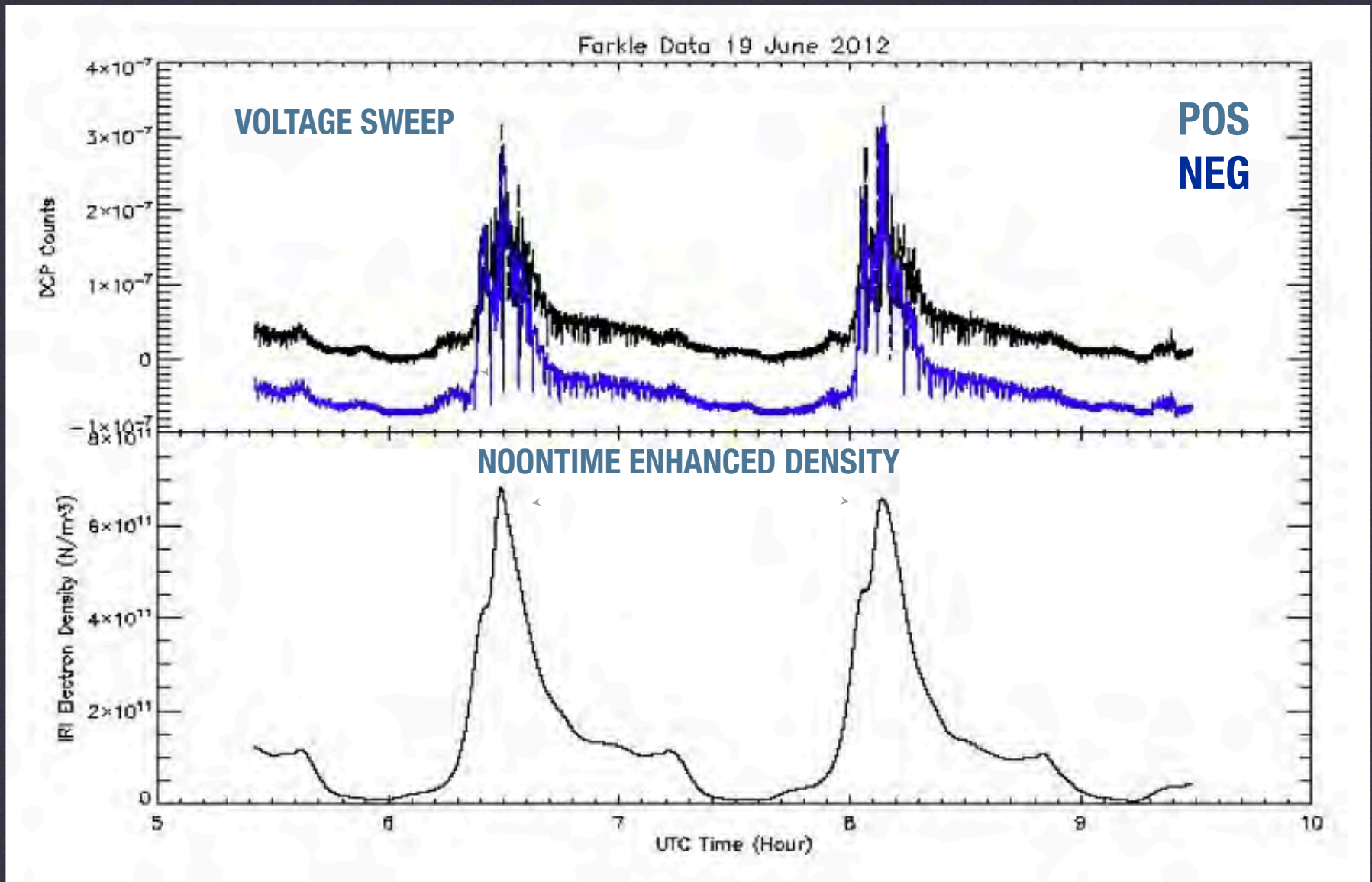
VOLTAGE PLOT

FARKLE: 1 APRIL 2012 - 23 JULY 2012

LANGMUIR PROBE DATA AND THE IRI MODEL

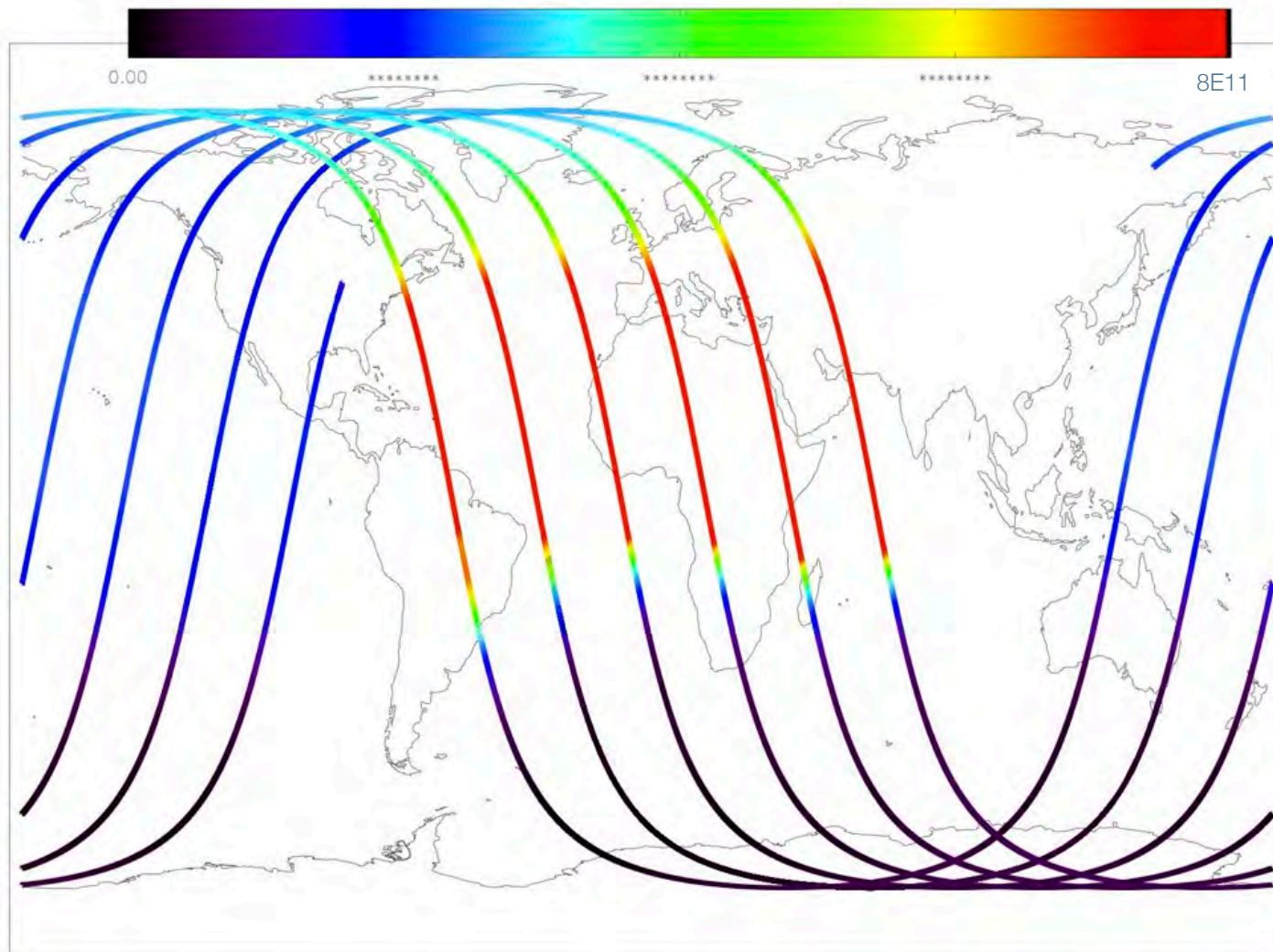
About the IRI Model

- ✱ IRI = International Reference Ionosphere
- ✱ A model of electron density, electron and ion temperature, and ion composition
- ✱ Altitude range is between 50 and 2000 km



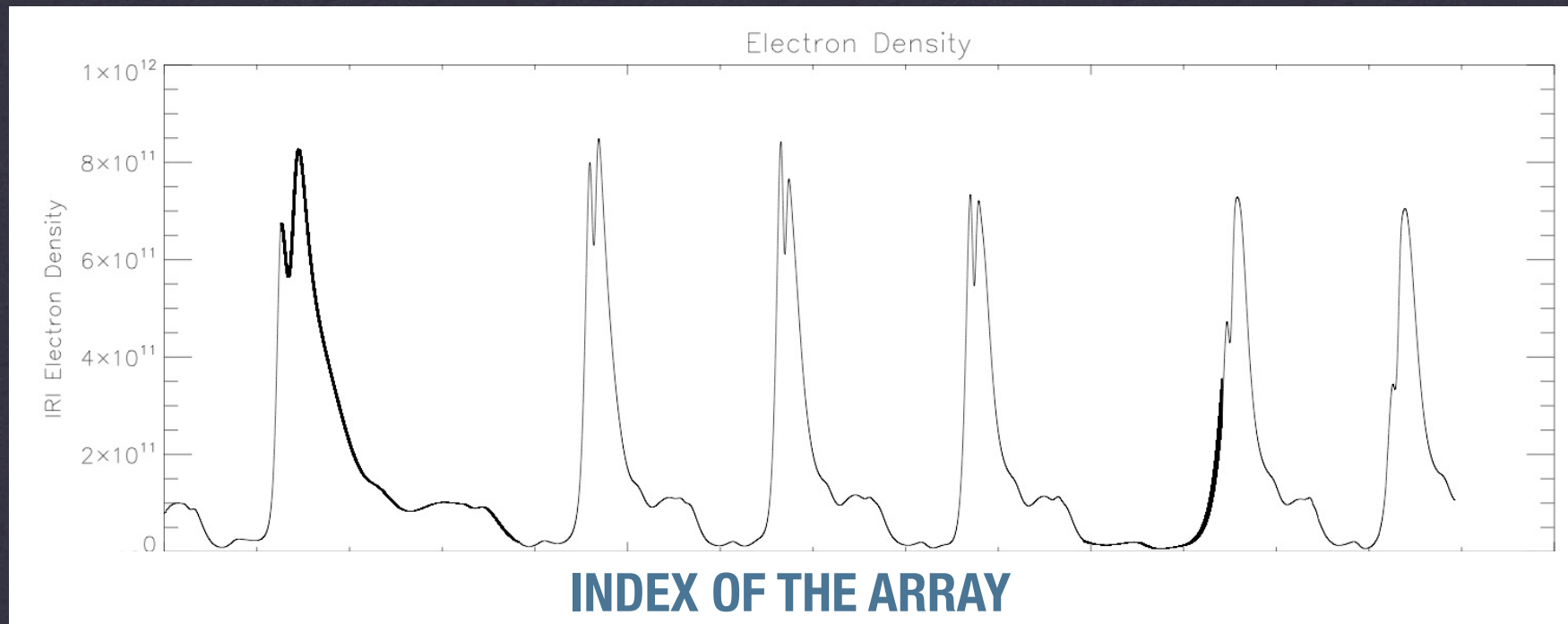
LANGMUIR PROBE DATA AND IRI MODEL PLOT

FARKLE: 19 JUNE 2012



SATELLITE PASSES AND THE IRI MODEL

YAHTZEE: 1 JUNE 2012



IRI Model

1 June 2012

Conclusions

- ✱ Both satellites are successfully corresponding with their ground station
- ✱ Both Yahtzee and Farkle are collecting quality data when compared to the IRI Model
- ✱ After the download frequency change that occurred in April, there was an increase in the amount of data each satellite was downlinking

acknowledgements

I WOULD LIKE TO THANK ASTRA FOR ALLOWING ME TO WORK WITH THEM
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