



On-Board Science Data Processing

Tom Flatley

GSFC Science Data Processing Branch / Code 587



Hybrid Science Data Processing

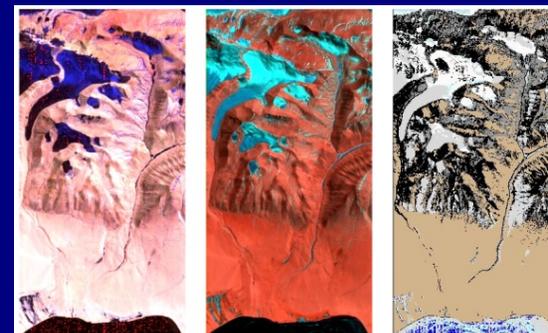
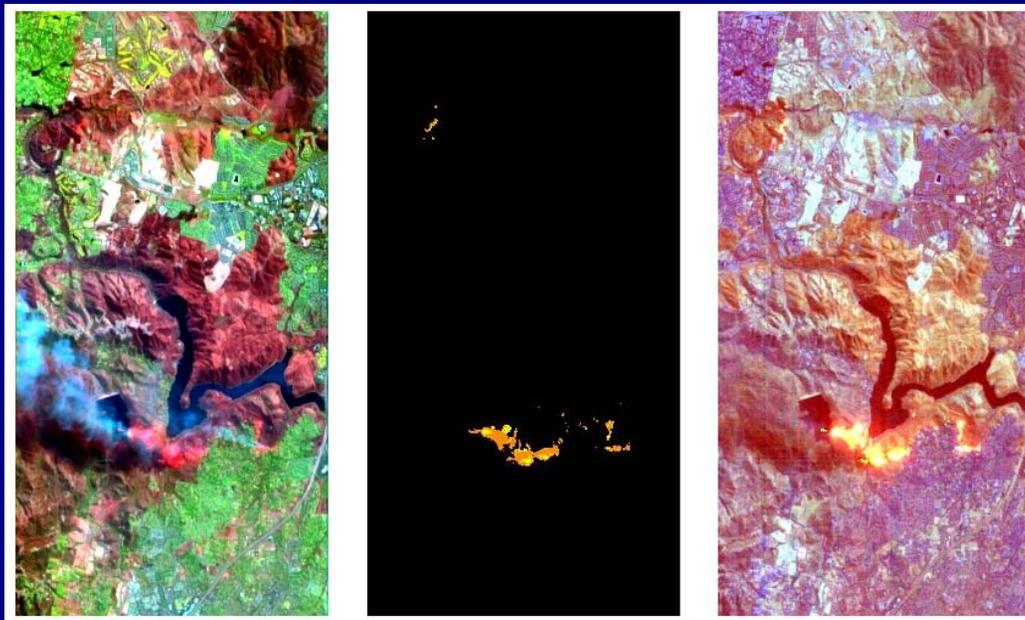
- Combined CPU / FPGA / DSP platforms
- Implement complex / compute intensive algorithms
 - GOES
 - EOS/MODIS
 - EO-1 Hyperion
- Ground-based IR&D
- Experimental SpaceCube flight platform





Hyper-Spectral Application

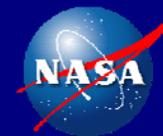
Advanced “on-board” product generation
(Steve Ungar & Betsy Middleton)



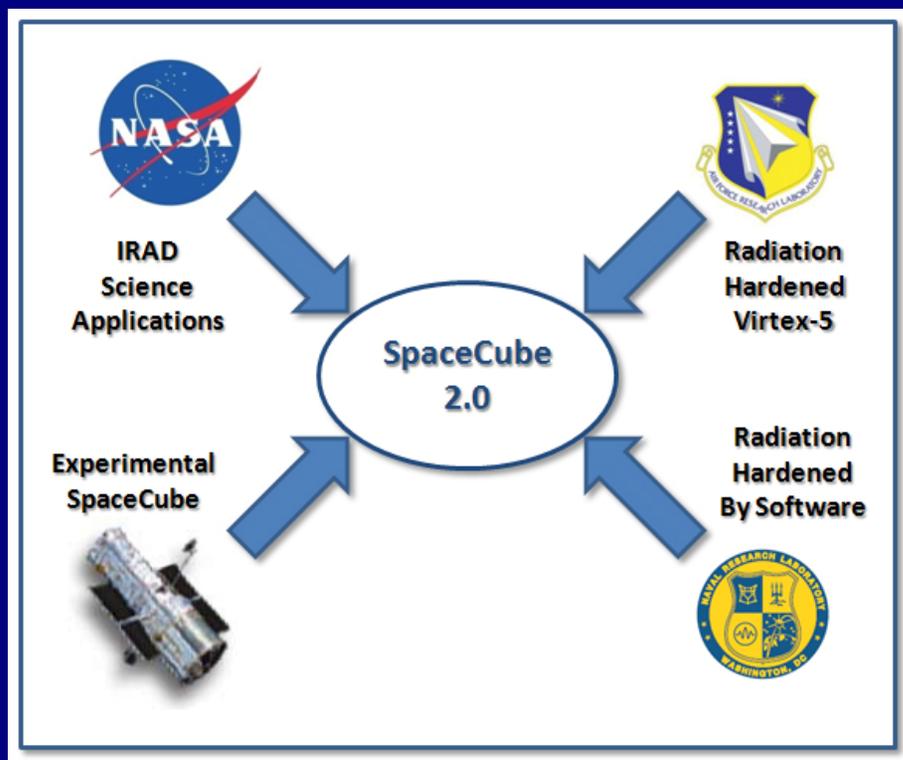
Real-time Products

- Level 0
- Level 0.5
- Level 1
- Level 2
- Level 3

On-Board Hyper-Spectral Data Processing IRAD --- Left: California Wildfire Scene, Center: On-Board Wildfire Detection and Temperature Characterization, Right: On-Board Product Generation for Direct Downlink to Emergency Services Personnel



Hybrid Science Data Processing



- HST SpaceCube V1.0
- HST lessons learned
- Hyper-Spectral applications
- MISSE7 RHBS experiment
 - USC RHBS inputs
 - AFRL Virtex-5 (\$10M+)
- Decadal Science support

Target date: early 2012



Potential Applications

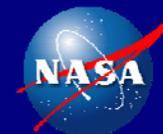
An “order of magnitude” increase in processing power and the ability to “reconfigure on the fly” enables ...

- Implement algorithms that detect and react to events such as forest fires, eruptions, severe storms, releases of pollutants, and industrial accidents
- Produce data products on-board for applications such as direct downlink, quick look, and “first responder” real-time awareness
- Perform “adaptive” data compression
- Perform autonomous operations, cloud screening, and scheduling for special data takes



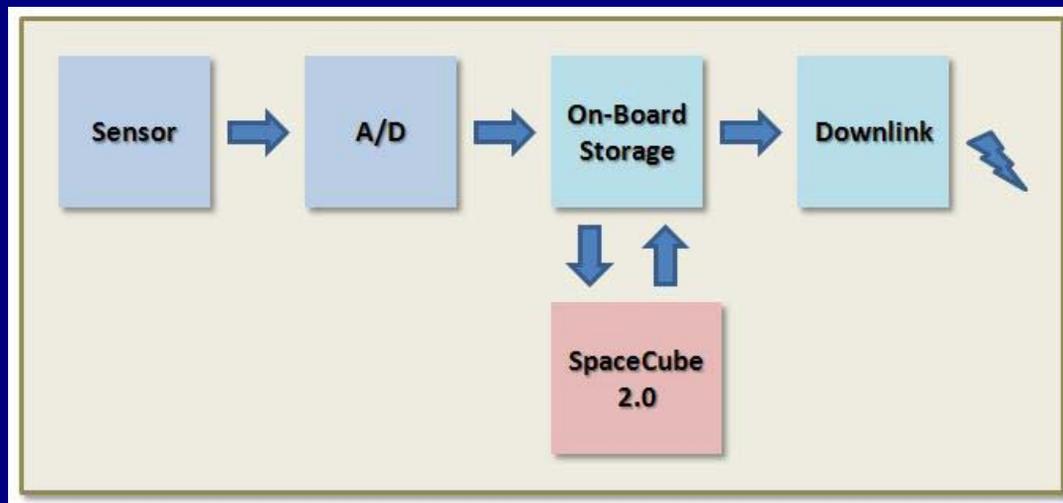
Potential Applications (cont.)

- Implement “sensor web” multi-sensor and/or multi-platform collaboration
- Implement on-board “lossless” data reduction by migrating typical ground-based processing functions on-board, reducing on-board storage and downlink requirements. *ex) 6:1 data volume reduction achieved on SAR application*
- Perform on-board calibration, smoothing, integration
- Generate “per scene” atmospheric corrections on-board using the full spectrum, and specific wavelengths at atmospheric absorption features

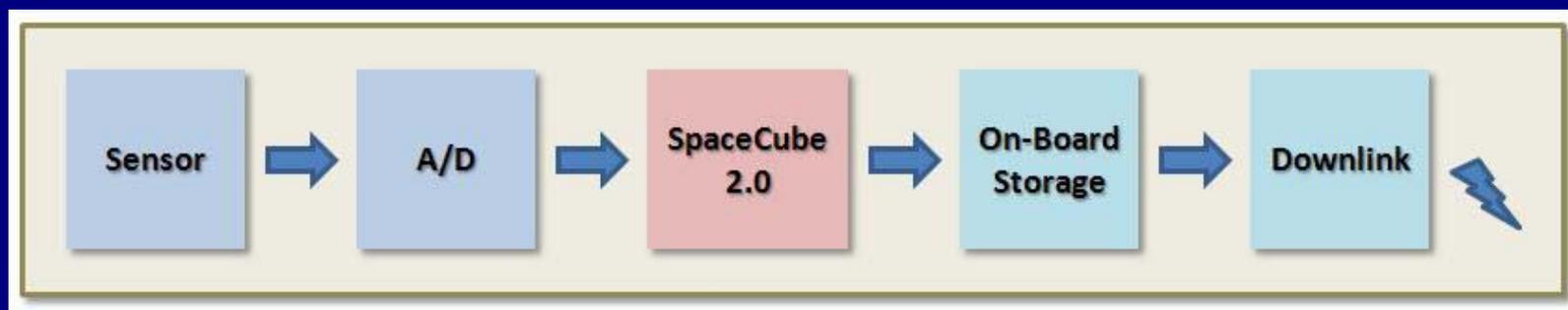


Instrument Processor Modes

Off-line



In-line





Capabilities & Costs

	<u>MIPS</u>	<u>Cost</u>
MIL-STD-1750A	3	-
RAD6000	35	\$250K
RAD750	<500	\$200K
SpaceCube 2.0	4400+	\$60K



Enabling Technology?

What could you do with this kind of on-board computing power?

- **to save cost?**
- **to enable new functionality?**