Imagine the Future

John D. Cunningham

From TIROS and DMSP to the Future

...Tomorrow is here today

Direct Readout Conference of the Americas
Building A More Capable System --
The Historical Context

First Image from TIROS-1

EOS-Aqua MODIS Image-250 m

Saharan Dust off the Canary Islands
18 February 2004
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Defense Meteorological Satellite Program
Imagine the Future

Nimbus 1 launched on Aug 28, 1964, 2 notable firsts
-- first three-axis stabilized metsat
-- first sun synchronous satellite
The Challenges
Transitioning Research to Operations

- Transition from research to operations remains an item of great interest and concern to the National Academy.
- Identified and agreed to as a policy element in the new National Space Policy.
Growing data volume and rate could stress processing and archive

1960 - 2010

**DMSP**
(Defense Meteorological Satellite Program)

Sensor data rate: 1.5 Mbps
Data latency: 100-150 min.

1.7 GigaBytes per day (DMSP)
6.3 GigaBytes per day (POES)

2000 - 2010

**NPP**
(NPOESS Preparatory Project)

15 Mbps sensor data rate
Data latency: 100-180 min.
Data availability: 98%
Ground revisit time: 12 hrs.

2.6 TeraBytes per day (EOS)
2.4 TeraBytes per day (NPP)

2010 – 2020+

**NPOESS**
(National Polar-orbiting Operational Environmental Satellite System)

20 Mbps sensor data rate
Data latency: 28 min.
Data availability: 99.98%
Autonomy capability: 60 days
Selective encryption/deniability
Ground revisit time: 4-6 hrs.

8.1 TeraBytes per day

Growing data volume and rate could stress processing and archive.
Imagine ... 
What if ... ???
Can we make the future what we want??

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I envision four distinct possibilities in the NPOESS era

• Training

• Cooperation in regional data networks

• Cooperation in instrument development to meet new needs

• Cooperation at the mission level
We get to write the history of the future

• We get to decide if we will follow the ideas of the past or try new things

• What says that we can’t take new and old Ideas and find new solutions to old problems?
Training
Training

• You have heard several groups from the United States discuss the superb tools they are developing to train meteorologists in the use of existing and future satellite capabilities
• You also heard that the biggest weakness is our ability to provide these tools in the languages of your countries
• Why don’t we discuss cooperative agreements where we supply the technical products and you have your scientists, engineers and meteorologists provide the translation
  • Your meteorological services could provide equivalent imagery that depicts your region
  • Our training groups would then integrate the results into a finished product
Regional Data Sharing
Regional data sharing

... what am I thinking about?

- Historically, satellites stored high resolution data because they didn’t have the RF links to send the data down
- Realtime data was normally limited in quality and quantity
- Data transfer was limited because of limited ground communication links
- So ...
  - Lets look at it with a new set of eyes
Consider the NPOESS concept, but use the ideas a different way

- **What makes NPOESS unique and capable?**
  - SafetyNet™
  - Full instrument data set send down over X-band realtime link
  - Multiple instruments on the same platform
    - Even potential for high resolution multispectral imaging in the 2130 orbit with Landsat Data Continuity Mission

- **What are NPOESS’ weaknesses?**
  - SafetyNet™ is a playback-only system whose data may not be of interest or even relevant (because it was recorded somewhere else)
  - Readtime links don’t cover continent-sized areas in a single pass
  - Weather comes from somewhere else, perhaps out of the realtime field of view
NPOESS’ Greatest Facilitators

• SafetyNet™ makes NPOESS possible
  • The worldwide fiber net makes SafetyNet possible

• A standard software package for users opens tremendous potential
  • NPOESS data processing software is being designed to operate on a family of computers, driven by
    – User timelines
    – User needs
Let’s Looks At One Possibility
Consecutive NPOESS Orbits

Pass-to-pass overlap
5 – 6 stations can cover all of the Americas south of the US
Tied together by fiber networks
Result:

• Continental data coverage available locally in near real time

• Adjacent ocean areas available from NOAA after NPOESS playback
Is This Possible?
NPOESS approach allows user to buy commercial, local equipment to meet their specific needs, based on their performance requirements.
Absolutely!!
The critical facilitator exists NOW!!

So, is it possible?
Preplanned Product Improvement
Preplanned Product Improvement on NPOESS

IPO P$^3$I

Announcement of Opportunity

Your Ideas and Needs

Payload on NPOESS

Tropospheric winds
Neutral winds
All weather day/night imagery
Coastal sea surface winds
Ocean wave characteristics
Surf conditions
Oil spill location
Littoral current
CH4 column
CO column
CO2 column
Optical background
Sea and lake ice
Coastal ocean color
Bioluminescence potential
Coastal sea surface temperature
Sea surface height coastal
Bathymetry
Vertical hydrometeor profile
Salinity
Capability

- NPOESS designed with built in margin for P3I
  - Set at 25% most heavily loaded s/c (1330) payload capability
    - 365 kg
    - 326 w
- No constraints on mission
  - Meeting NPOESS requirements is a “bonus”
- Data release conditions can be negotiated
Mission Cooperation
Mission Cooperation

• The first NPOESS will carry
  • Moderate resolution imagery (400 – 800 m visible and IR)
  • Microwave imagery for
    – Soil moisture
    – Sea ice edge and motion
  • Perhaps a higher resolution, multispectral Landsat imager
    – 10 – 30 m resolution

• Eumetsat’s Metop will carry
  • IASI infrared sounder
  • US’ Advanced Microwave Sounding Unit (AMSU)
  • Scatterometer

• What we don’t have
  • Imaging radar
  • Altimeter
What could be done?

- As new national missions come on line, consider NASA’s “train” concept
  - Closely spaced satellites that see the same environmental phenomena
  - Maintain separate schedules, ground stations, data processing
  - Sharing data between users

A little movie follows that shows fused data – land use, weather, elevation, ocean color

... Imagine what we could do if we planned it ...
Fused data sets give value greater than the sum of their parts..

Graphic courtesy of NASA
Summary

The Data Will Be Out There … It’s Up To Us To Make It Happen
Imagine...