

Growing the Space Weather Enterprise

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Global Opportunities

Roundtable Session

Space Weather National Workshop

Boulder, CO

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Agenda

- “Celestial Storm Warnings”
 - High Level Support Increasing
- Implications for the Future
- Global Collaboration
- Societal Impacts and Solutions

“Celestial Storm Warnings”

By JOHN P. HOLDREN and JOHN BEDDINGTON
International Herald Tribune; New York Times Web Site: March 10, 2011

- Emphasis on Effects versus Science
- US and UK data sharing and cooperation agreement
 - Wide ranging cooperation
 - Data sharing
- AAAS Meeting
 - Scientists, **planners**, and **emergency managers**
 - Risks to **international human** and **economic well being**
- Vulnerability and Risks
- Societal Solutions
 - Back up systems (e.g. GPS)
 - Satellite Shielding
 - Hardening Power Grids
 - Replace Aging Satellite Observation/warning systems

Blueprint for the future?

Implications for the Future

What should be on our agenda?

- Global Cooperation and Organization
- Government and Private Sector Collaboration
- Space Weather Science connected to Solution Providers
- Risk Management and Societal Solutions
- Government Emergency Management Connection
- Private Sector Industry Developed Equipment and Services

Some are here now and more will be possible in the future!

Global Collaboration

Global Threat – Global Impact: Oct 2003

18 of 34 NASA Earth and Space Science Missions impacted

Flare damages Mars Odyssey probe

Powerdown of Canadian robotic arm on ISS

Solar cell damage on ESA's Smart-1 satellite

Numerous anomalies on FedSat and other Australian satellites

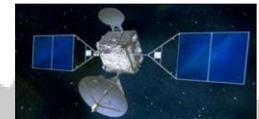
Loss of Japan's ADEOS II satellite



Numerous Polar flights rerouted



Failures of GPS based positioning

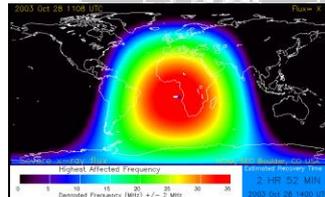


Japan's Data Relay Test Satellite went into safe mode, and took over a week to recover

NOTAM
Route restrictions due to geomagnetic storm impact on communications



Nuclear power plants reduced power due to geomagnetic storm



Widespread HF outage over African continent



SatComm and HF outages



Oilfield services company reported several cases of survey Instrument Interference around world



C.R. Luigs drill ship, loses GPS, resorts to backup systems



Transformer damage



SatComm and HF outages

Over 130 hours of HF communication blackout in Antarctic

Global Collaboration

Group on Earth Observations (GEO)

- Background

- World Summit on Sustainable Development and G-8 (2002)
- Earth Observation Summit I (2003)
- Multidisciplinary, comprehensive, integrated, coverage, availability of information

- Current

- Group on Earth Observations (GEO) (2005)
- Global Earth Observation System of Systems (GEOSS)
- Nine Benefit Areas (Disasters, Climate, Weather, Energy, Agriculture, Biodiversity, Health, Water, and Ecosystems)
- USGEO – U.S. Interagency effort led by White House
- U.S. hosted 2009 GEO plenary, China hosted 2010 Ministerial

- Successes

- GEO NETCAST
- Tsunami Warning System
- Increased global cooperation



GROUP ON
EARTH OBSERVATIONS

Global Collaboration

Group on Earth Observations (GEO)

- Organization (non-UN)
 - 86 Nations and 61 international(UN)/intergovernmental organizations
 - Ministerial level – Earth Observing Summits every 3 or 4 years
 - Headquartered in Geneva
 - Membership open to all countries
- Purpose
 - Achieve comprehensive, coordinated, and sustained Earth observations
 - Capacity building for developing countries
 - Full and open exchange of information
- Support -- voluntary contributions (developed nations)
- Ten Year Plan -- GEOSS
 - Systems and projects (ex. Global Climate Observing System GCOS, Carbon monitoring of forests)
 - Supports Nine Benefit Areas (Disasters, Climate, Weather, Energy, Agriculture, Biodiversity, Health, Water, and Ecosystems)

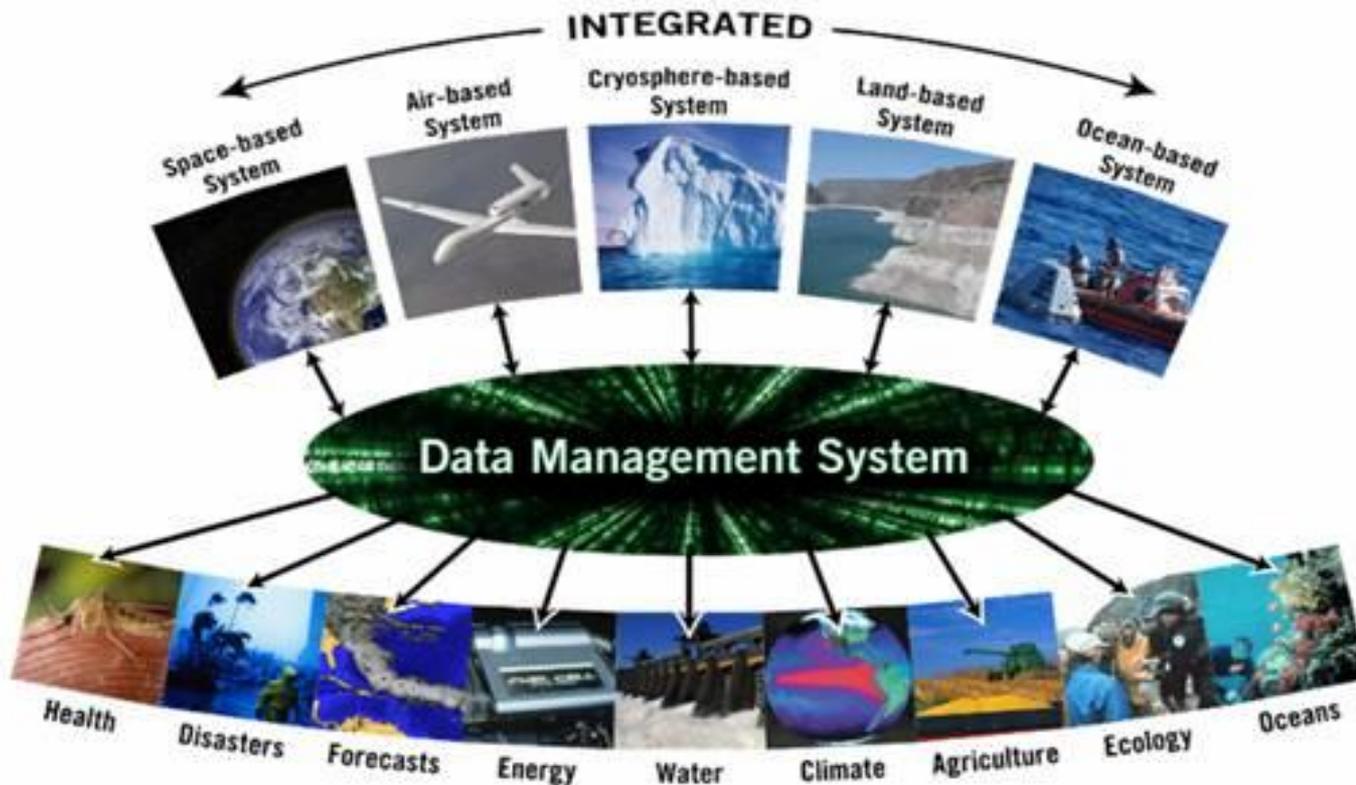


Global Collaboration

Group on Earth Observations (GEO)

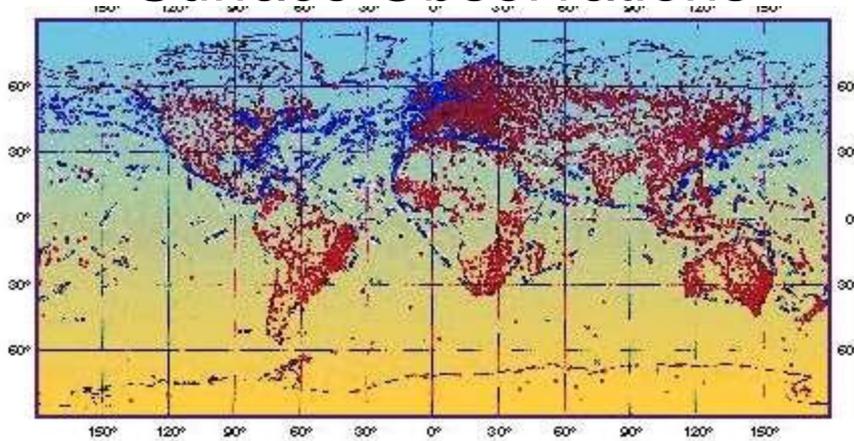
Observing Systems

Global Earth Observation System of Systems

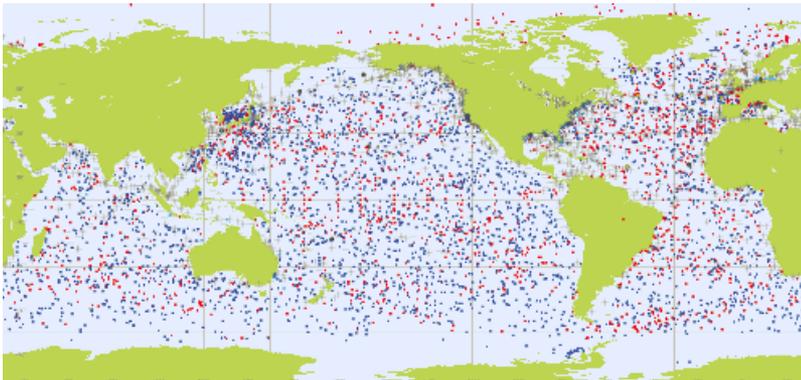


Global Collaboration

Surface Observations



Marine Observations



Global Observing System Components

Space Observations

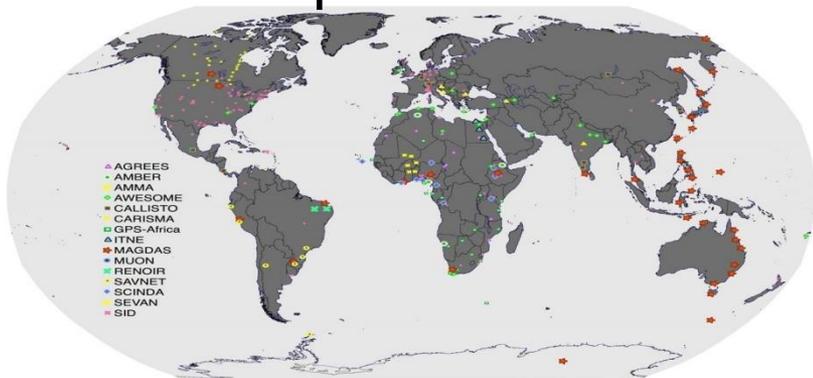


Courtesy of Murtagh and Onsager

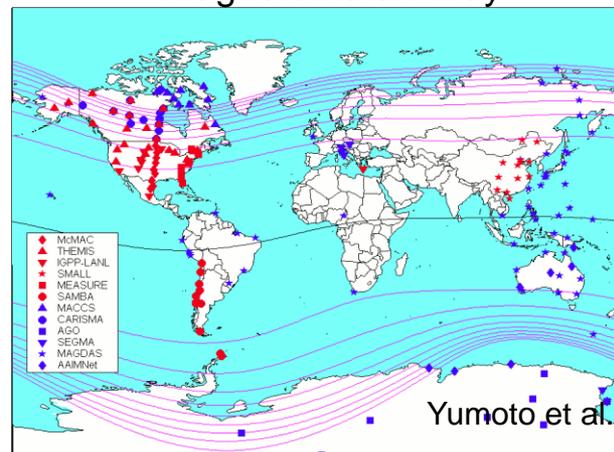
Global Collaboration

Space Environment Data Network Expansion

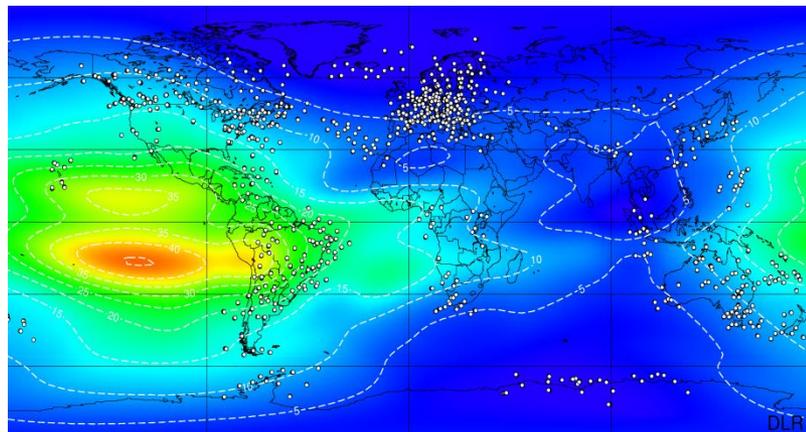
International Space Weather Initiative



Ultra-Large Terrestrial International Magnetometer Array

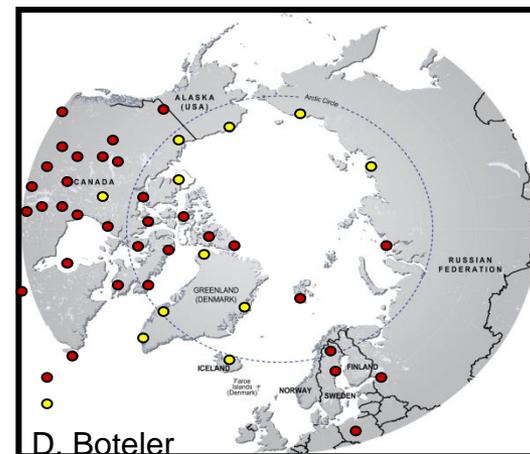


International GNSS Service



N. Jakowski, German Aerospace Center

Circum-Polar Riometer Network



Courtesy of Murtagh and Onsager

Global Collaboration

Real-Time Specification of Geomagnetic Activity

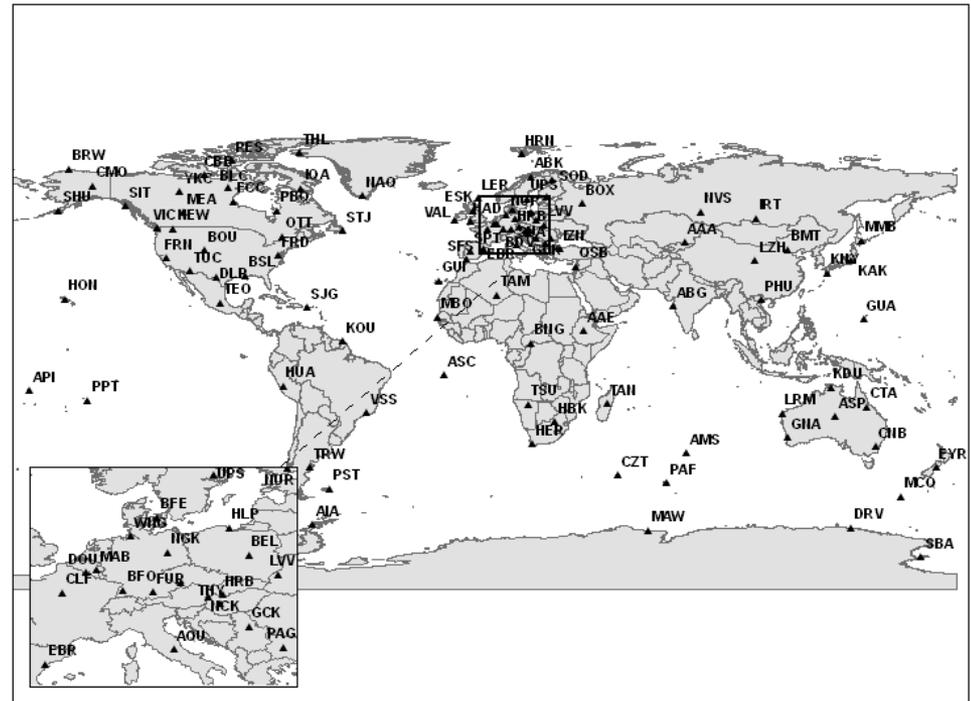
Near-term NOAA plans:

- Regional K index and/or dB/dt at North America sites
- dB/dt versus K climatology
- Real-time Planetary Kp
- 25 April Users Meeting to explore product needs

Long-term goals:

- Global GIC product suite
- Assimilate global data in prediction models

International Real-Time Magnetic Observatory Network (INTERMAGNET)



Courtesy of Murtagh and Onsager

Global Collaboration

The Recent Chain of Progress!

- Space Weather Brief to White House
- Op-Ed by Holdren and Beddington
- Electric Infrastructure Security Summit(EISS) at Westminster
 - Severe solar flares will cause **long term infrastructure failure**
 - US and UK data sharing and cooperation agreement
 - Next EISS Summit at Capitol Building in D.C. (Apr 2011)
- Space Weather in the UN
 - World Meteorological Organization (WMO)
 - International Civil Aviation Organization (ICAO)
 - Committee on the Peaceful Uses of Outer Space (COPUOS)
- Next: active GEO participation
 - Disasters
 - Energy

Societal Impacts and Solutions

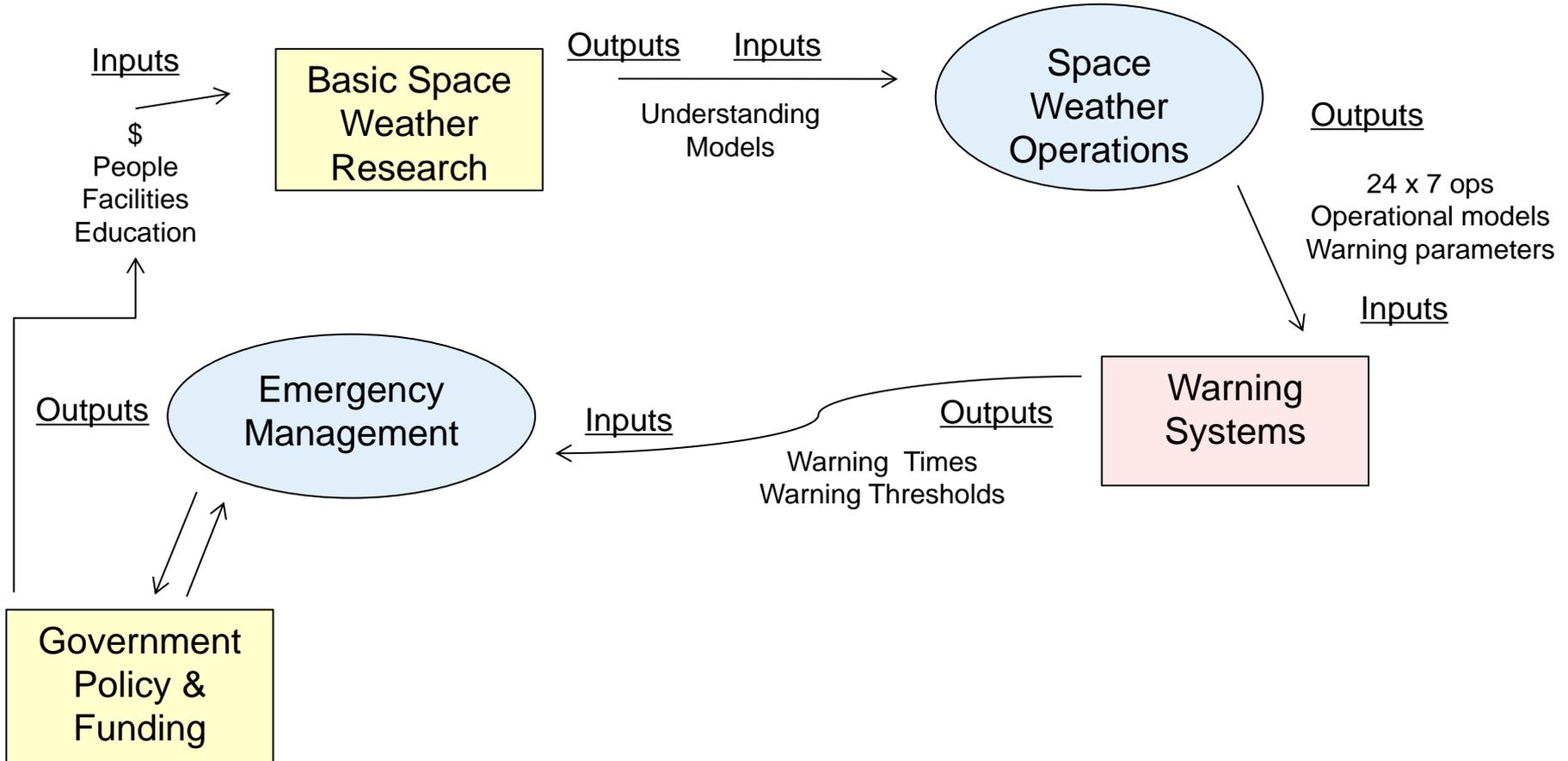
What people really care about!

- Long Term Infrastructure Failure
 - Blocking devices to harden grids
 - Replacement hardware at the ready
 - Reduced electrical loads during emergencies
- Loss of Critical Communications
 - Increase shielding for satellites and terminals
 - Back up systems - redundancy
 - Advanced Warning
- GPS Black Outs
 - Back-up systems
- Personal Exposure to Harmful Radiation
 - Airline route deviations
 - Increased shielding

The best road to increased support!

Summary

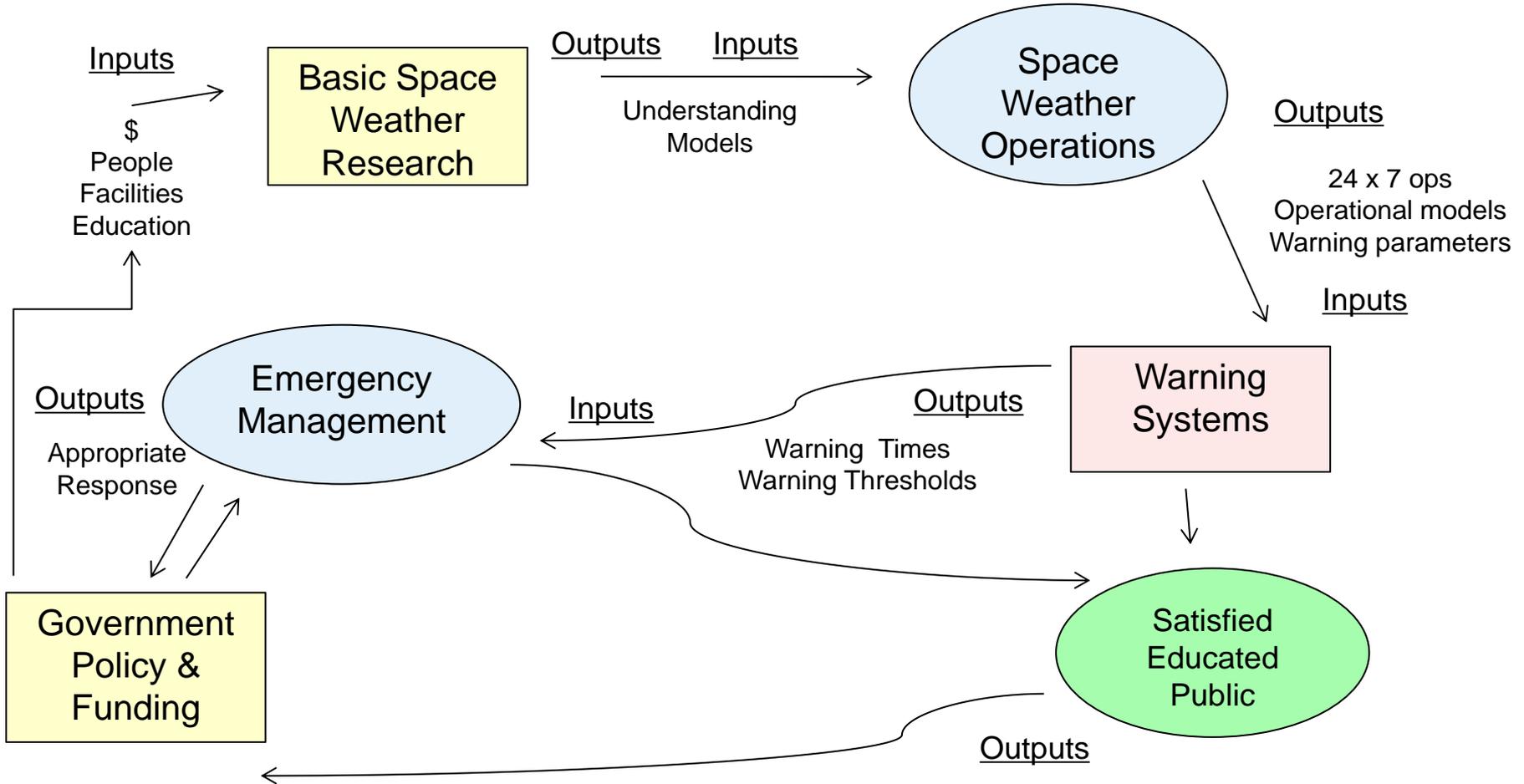
Building the bigger tent takes all parts working together



A Systems Engineering Approach

Summary

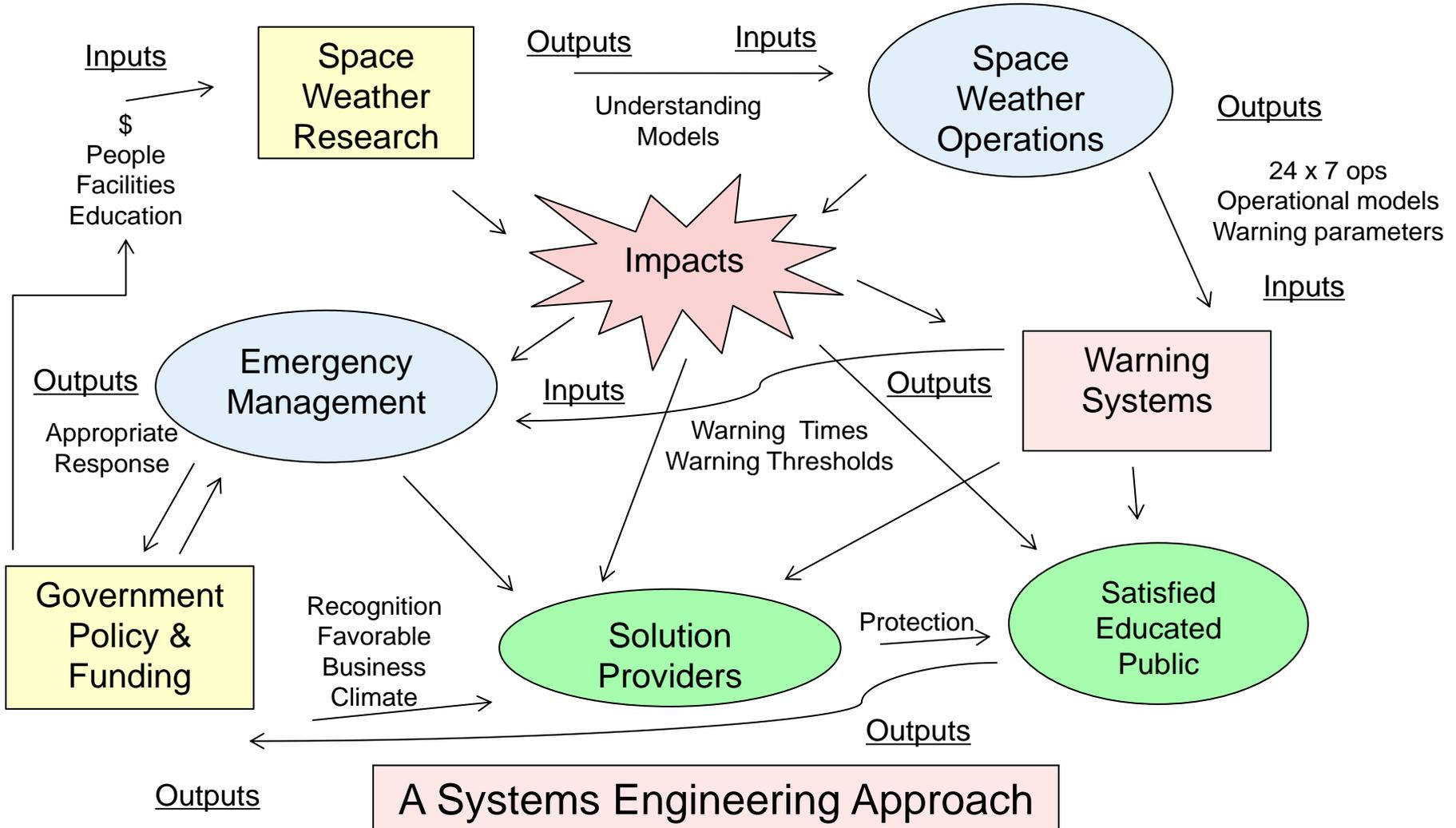
Building the bigger tent takes all parts working together



A Systems Engineering Approach

Summary

Building the bigger tent takes all parts working together!

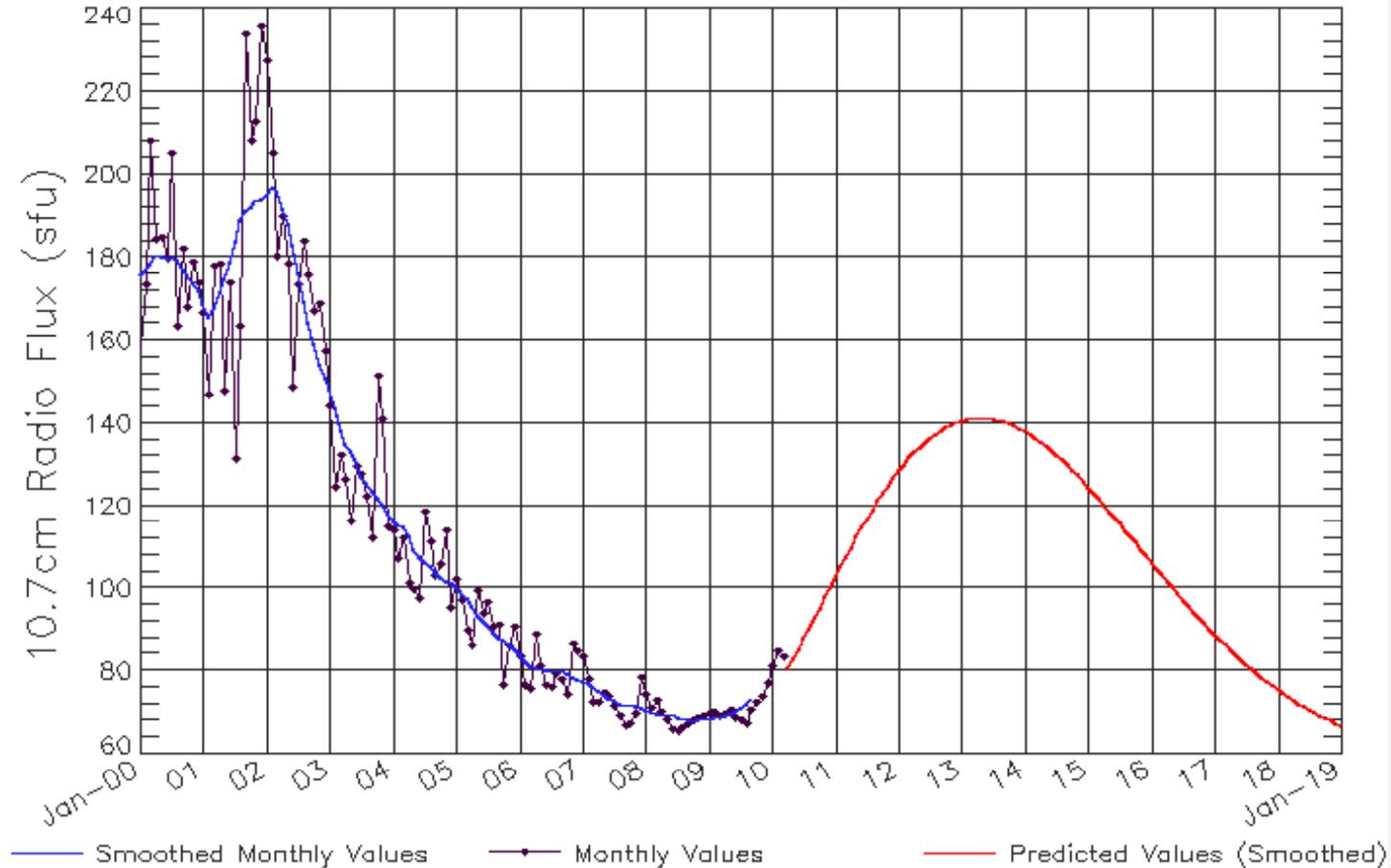


Growing the Space Weather Enterprise

BACKUP

The Solar Cycle

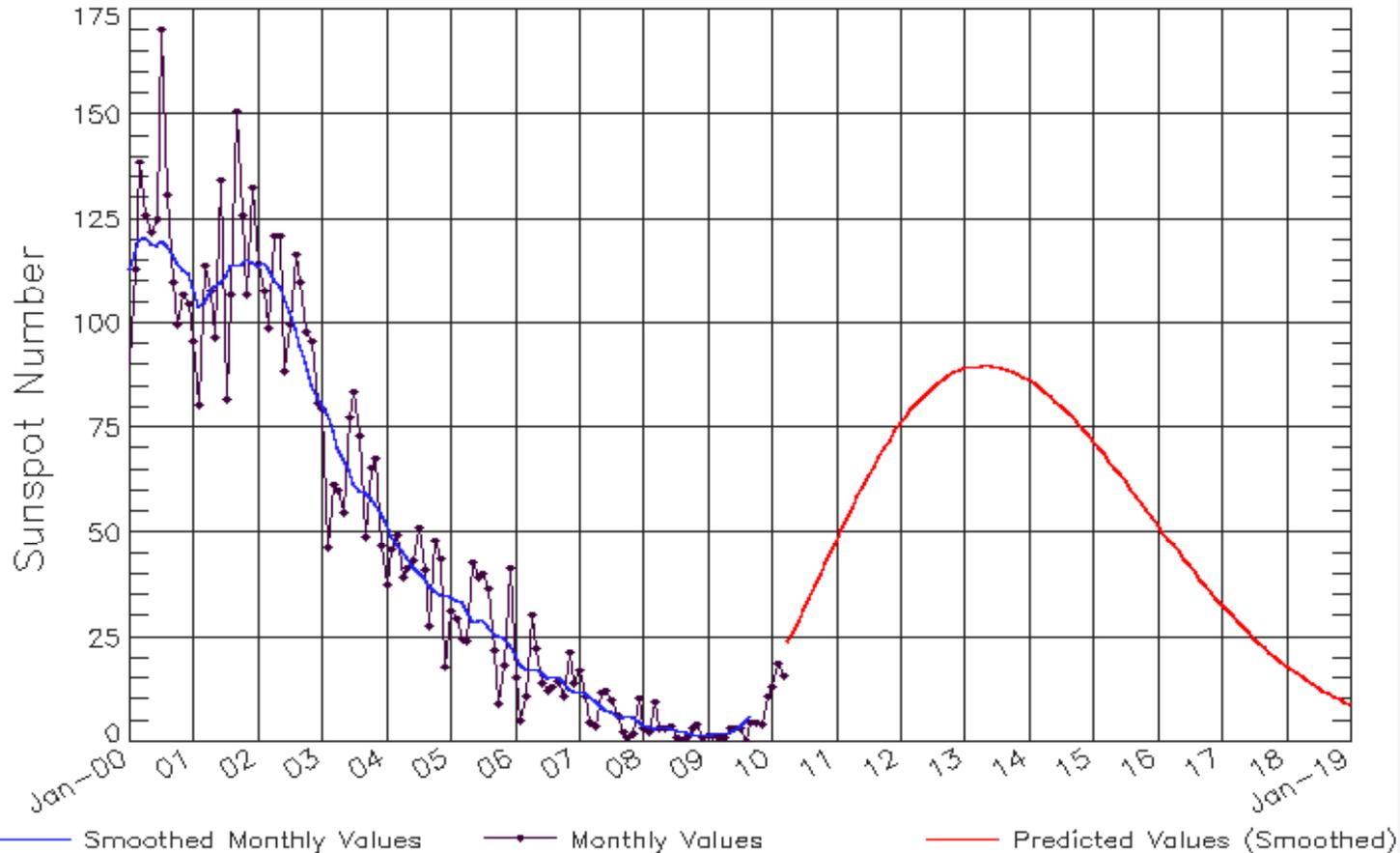
ISES Solar Cycle F10.7cm Radio Flux Progression
Observed data through Mar 2010



In 2010 the F10.7 cm flux is significantly increasing!

The Solar Cycle

ISES Solar Cycle Sunspot Number Progression
Observed data through Mar 2010



Updated 2010 Apr 6

NOAA/SWPC Boulder, CO USA

In 2010 the number of Sunspots are finally increasing!

International Activities – Operational Focus

Growing international interests in space weather:

- United Nations
 - World Meteorological Organization
 - International Civil Aviation Organization
- Cross Polar Working Group
- International Space Environment Service
- Space Situational Awareness in the EU
- International Space Weather Initiative

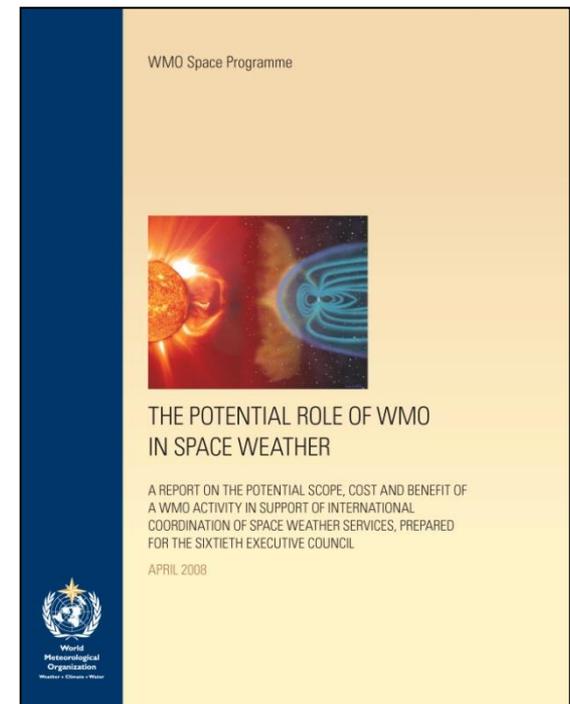


Space Weather in the United Nations



World Meteorological Organization (WMO)

- Several WMO Members including Australia, China, the Russian Federation and the United States have placed Space Weather under the responsibility of their National Meteorology Services
- Members lobbied WMO to engage space weather
- WMO – “UN system's authoritative voice on the state and behavior of the Earth's atmosphere”...*extends now to the space environment!*
- Executive Council fully endorsed the principle of WMO activities in support of international coordination in Space Weather.”



Space Weather in Emergency Management

Emergency responders becoming increasingly aware of potential impacts of space weather on electric power grid, and on systems critical in emergency response (communications, GPS).

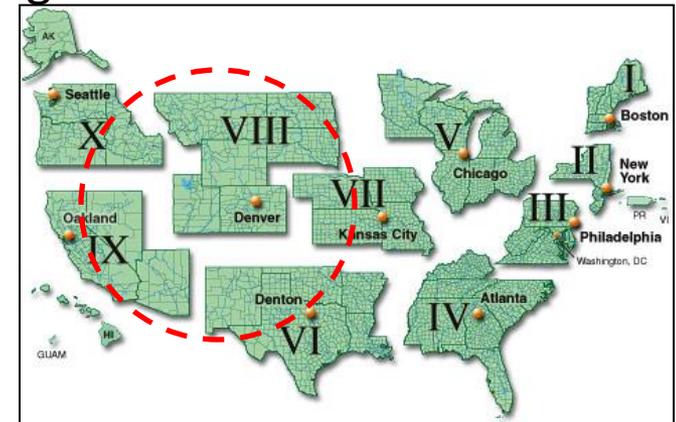
Prepare – SWPC staff providing education and training at FEMA Regional Interagency Steering Committees, DHS conferences & more.

Emergency preparedness exercises – regional and even international

Protect – DHS, DOE and others looking at ways to protect power grid from impacts of geomagnetic storms

Respond and Recover – Emergency responders receive space weather products for key situational awareness and for decision making on use of communications systems.

FEMA Region VIII designated as FEMA's "Center of space weather excellence"



How Do We Grow?

- Community Size
 - Partnerships
 - Industry Associations (AWCIA vs. Separate)
 - Common Policies and Goals
 - Career Life Cycle (education to occupation)
- Public Education/Visibility
 - Community Coherence (work together!)
 - Public Exposure
 - Press and Speaking Events
 - Community Involvement
- Revenue
 - Business Processes for growth
 - Products
 - Customers

The Future

The Ideal Public/Private Partnership

- Common Goals
 - Defined Roles
- Defined Products and Services
 - Public
 - Private
- Mutual Support
 - Commercial associations that advocate Budget Growth
 - PACs, Public Education
 - Government programs that incorporate private contributions
 - Judicious Use of FACA's, Advisory Committees
- Inclusion of R & D and Operations
- Variety of Partnerships Mechanisms
 - Public/Private
- Collaborative Policy Development Mechanisms
- Frequent Communication
 - Planning to execution
- **Mutual Trust**