International Space Environment Service
Coordinating space weather services since 1962

- Endorsed by national governments as space weather service providers
- Network Member of the ICSU World Data Service
- Formal exchange of letters with the WMO
- Provide local users with targeted services
- Coordinated world-wide operational effort

18 Regional Warning Centers
4 Associate Warning Centers
2 Collaborative Expert Center

www.spaceweather.org
Four elements needed to improve space weather capabilities:

1. User Needs: Understand the risks and the actions that need to be taken
2. Targeted Services: Develop useable capabilities from basic science knowledge
3. Observing Infrastructure: Shared approach for long-term continuity
4. Global Coordination: Consistent, accurate message
U.S. Perspective: Increase International Cooperation

Goal 6 of the U.S. National Space Weather Action Plan

Strengthen international coordination and cooperation on space weather products and services

- Sustain engagement with ISES
- Ensure global consistency during extreme events
- Sustain operational baseline observing capabilities
ISES in the Broader Context:
World Meteorological Organization

Formal collaboration established between ISES and WMO

Goals within the WMO Four-Year Plan:

• Promote sustained observations essential for space weather services
• Improve exchange of data and information
• Support coordination of services for aviation and other major application sectors
• Improve emergency warning and global preparedness

WMO Space Programme Elements:

- Space-based Observing System
- Access to Satellite Data and Products
- Awareness and Training
- Space Weather Coordination
Enable immediate access to key alerts and warnings from all Regional Warning Centers

- Provide rapid situational awareness during extreme events
- Ensures immediate knowledge of regional events
- Supports National Space Weather Action Plan goal to ensure global consistency during extreme events
ISES Actions – Forecast Verification

Explore standard probabilistic forecasts and verification

- Value of standardized verification methods acknowledged
- Extensive expertise is available at ISES Centers
- Actions are underway to compare approaches and make recommendations on verification techniques
Recent Accomplishments

- New Members: - Mexico Regional Warning Center (2015)
  - Indonesia Regional Warning Center (2016)
  - STFC Rutherford Appleton Laboratory – Collaborative Expert center (2017)

- Product inventory with metadata created – This will help with selection of key information for rapid availability during extreme events.

- Economic impact studies and user outreach activities conducted by numerous Members

- Ongoing progress on observations and product development
Space Weather User Workshops

Australia Bureau of Meteorology – ISES Regional Warning Center

• Meeting of stakeholders and customer survey
• Aviation Space Weather Services Workshop
  - Present prototype industry-specific products
  - Obtain feedback and industry requirements
Characterizing Extreme Events

Natural Resources Canada – ISES Regional Warning Center

100 years estimation. Geoelectric field

- 40 year of data
- 13 Canadian magnetometers

Maximum measured
Estimated extreme

Nikitina et al., Space Weather, 2016
Models, Products, and Services

China National Space Science Center – ISES Associate Warning Center

- Ionospheric Assimilation Models and Products
- Operational CME propagation forecast system
- Space Situation Environmental Awareness System
- Space Environment Teaching and Practice Software
- Space Environment Services for China Space Flight Missions
  - Tiangong II
  - Dark Matter Particle Explorer Satellite
  - The retrievable Shijian-10
  - Quantum Science Satellite
Summary

- International Space Environment Service - growing global network dedicated to operational space weather services
- Members are integrated with expanding international efforts
- Actions are under way to enhance global coordination
- Future directions:
  - Understanding social/economic impacts
  - Sharing user needs and post-event information
  - Rapid dissemination of event information
  - Common verification techniques and metrics
  - Sharing research/application developments