

# Roadmap Goal Structure

*Agency Strategic Objective: Explore the Sun-Earth system to understand the Sun and its effects on the Earth, the solar system, and the space environmental conditions that will be experienced by human explorers, and demonstrate technologies that can improve future operational systems.*

	Phase 1: 2005-2015	Phase 2: 2015-2025	Phase 3: 2025-beyond
<p><i>Objective F:</i> Opening the Frontier to Space Environment Prediction</p>	<p><i>Expected Achievements:</i></p> <p>Measure magnetic reconnection at the Sun and Earth.</p> <p>Determine the dominant processes of particle acceleration.</p> <p>Set the critical scales over which cross-scale coupling occurs.</p>	<p><i>Expected Achievements:</i></p> <p>Model the magnetic processes that drive space weather.*</p> <p>Quantify particle acceleration for the key regions of Exploration.*</p>	<p><i>Expected Achievement:</i></p> <p>Predict solar magnetic fields and energy release.</p> <p>Predict high energy particle acceleration in the solar system.</p>
<p><i>Objective H:</i> Understanding the nature of our home in space</p>	<p>Understand how solar disturbances propagate to Earth.</p> <p>Determine quantitative drivers of the geospace environment</p> <p>Identify the impacts of solar variability on Earth's atmosphere</p>	<p>Identify precursors of important solar disturbances and predict the Earth's response</p> <p>Integrate solar variability effects into Earth climate models</p> <p>Determine the habitability of solar system bodies</p>	<p>Understand coupling of disparate astrophysical systems.</p> <p>Continuous forecasting of conditions in the inner heliosphere</p> <p>Predict climate change*</p> <p>Determine how habitability of planets evolves in time</p>
<p><i>Objective J:</i> Safeguarding our outbound journey</p>	<p>Describe how space plasmas and planetary atmospheres interact</p> <p>Determine extremes of the variable radiation and space environments at Earth, Moon, &amp; Mars</p> <p>Nowcast solar and space weather and forecast "All-Clear" periods for space explorers near Earth</p>	<p>Characterize the near-Sun source region of the space environment</p> <p>Reliably forecast space weather for the Earth-Moon system; make the first SW nowcasts at Mars</p> <p>Determine Mars atmospheric variability relevant to aerocapture entry, descent, landing, surface navigation and communications*</p>	<p>Situational awareness of space environment throughout the inner Solar System</p> <p>Reliably predict atmospheric and radiation environment at Mars to ensure safe surface operations*</p> <p>Analyze first direct samples of the interstellar medium.</p>
	Develop technologies, data, and knowledge systems to improve future operational systems		

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	Phase 1: 2005-2015	Phase 2: 2015-2025	Phase 3: 2025-beyond
<b>Objective F:</b> Opening the Frontier to Space Environment Prediction	<p><i>Expected Achievements:</i></p> <p><b>Determine and measure:</b></p> <ul style="list-style-type: none"> <li>a) the scale sizes and topology changes of magnetic reconnection at the Sun and Earth</li> <li>b) the location and dominant processes of particle acceleration at Earth-Sun system</li> <li>c) the critical scales over which cross- scale coupling occurs between systems</li> </ul>	<p><i>Expected Achievements:</i></p> <p><b>Quantify and model:</b></p> <ul style="list-style-type: none"> <li>a) the physical processes of magnetic field creation, merging, and dissipation that drive space weather.*.</li> <li>b) Particle acceleration in and propagation to the key regions that impact exploration.*</li> <li>c) the detailed mechanisms of cross-scale coupling from atmospheric to interplanetary scales.</li> </ul>	<p><i>Expected Achievement:</i></p> <p><b>Understand, at the predictive capability level:</b></p> <ul style="list-style-type: none"> <li>a) magnetic field generation, evolution, and energy release throughout the Solar System.</li> <li>b) the acceleration of highly energetic particles in the solar system.</li> <li>c) coupling of systems across all size scales in the solar system.</li> </ul>

# Roadmap Goals

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	<b>Phase 1: 2005 – 2015</b>	<b>Phase 2: 2015 - 2025</b>	<b>Phase 3: 2025-beyond</b>
<i>Roadmap Objective H:</i> Understanding the nature of our home in space	<p><i>Expected Achievements:</i></p> <ul style="list-style-type: none"> <li>a) Understand evolution of solar disturbances as they propagate towards the Earth (H1I1)</li> <li>b) Determine quantitative drivers of Earth's near-space environment (H2I1,2,3)</li> <li>c) Identify the role of solar inputs in determining the state of the Earth's atmosphere</li> <li>d) Describe the interaction of space plasmas and planetary atmospheres</li> </ul>	<p><i>Expected Achievements:</i></p> <ul style="list-style-type: none"> <li>a) Develop effective precursors of solar disturbances that impact Earth (H1I2)</li> <li>b) Predict the near-space response to solar disturbances (H2I1,2,3)</li> <li>c) Integrate effects of solar variability into Earth climate models</li> <li>d) Determine the habitability of solar system bodies</li> <li>e) Develop and assimilate technologies that support operational systems</li> </ul>	<p><i>Expected Achievements:</i></p> <ul style="list-style-type: none"> <li>a) Predict solar disturbances that impact Earth (H1I3)</li> <li>b) Continuous forecasting of near-space state (H2I1,2,3)</li> <li>c) Predict climate change</li> <li>d) Predict longterm evolution of habitability of planets</li> </ul>

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	<b>Phase 1: 2005-2015</b>	<b>Phase 2: 2015-2025</b>	<b>Phase 3: 2025-Beyond</b>
<i>Roadmap Objective J:</i> Safeguarding our outbound journey	<p><i>Expected Achievements:</i></p> <p>A) Determine variability and extremes of radiation and space environment</p> <p>B) Now-cast solar activity and space weather, and provide rudimentary forecasts of “All-Clear” periods for space explorers</p> <p>C) Characterize the radiation environment at the surface of Mars</p> <p>D) Provide knowledge to mitigate risk of lunar dust environment</p>	<p><i>Expected Achievements:</i></p> <p>A) Characterize and understand the near Sun source region of the space radiation environment to enable predictive modeling</p> <p>B) New observational techniques and technologies to quantitatively characterize and enable prediction</p> <p>C) Reliable, quantitative space weather forecasts for Earth-Moon system and rudimentary space weather nowcasts at Mars</p> <p>D) Determine Mars atmospheric variability relevant to aerocapture and EDL environment, surface navigation and communications*</p>	<p><i>Expected Achievements:</i></p> <p>A/B) Situational awareness of space environment throughout (Inner) Solar System</p> <p>C) Reliably predict atmospheric and radiation environment at Mars to ensure safe surface operations*</p> <p>D) Add something about outer boundary of heliosphere</p>