

HypIRI Mission

VSWIR Instrument

TIR Instrument

VSWIR Science Questions

TIR Science Questions

Combined Science Questions

TIR Overarching Science Questions

- TQ1. Volcanoes and Earthquakes
 - How can we help predict and mitigate earthquake and volcanic hazards through detection of transient thermal phenomena?
- TQ2. Wildfires
 - What is the impact of global biomass burning on the terrestrial biosphere and atmosphere, and how is this impact changing over time?
- TQ3. Water Use and Availability
 - How is consumptive use of global freshwater supplies responding to changes in climate and demand, and what are the implications for sustainable management of water resources?
- TQ4. Urbanization/Human Health
 - How does urbanization affect the local, regional and global environment? Can we characterize this effect to help mitigate its impact on human health and welfare?
- TQ5. Earth surface composition and change
 - What is the composition and thermal property of the exposed surface of the Earth? How do these factors change over time and affect land use and habitability?

Pros and Cons

Question	Description	Together	Separate
TQ1	...		
TQ2	...		
TQ3	How is consumptive use of global freshwater supplies responding to changes in climate and demand, and what are the implications for sustainable management of water resources?	Pros: <ul style="list-style-type: none"> •Coincident VNIR data for calculating ET •Coincident data for calculating cloud-mask during daytime Cons: <ul style="list-style-type: none"> •VNIR data do not cover full swath 	Pros: <ul style="list-style-type: none"> •VNIR data do not need to be coincident for ET calculation •Alternate VNIR source could be full swath (better for cloud detection) Cons: <ul style="list-style-type: none"> •Alternate VNIR source must be sufficiently close in time to TIR data
TQ4	...		
TQ5	...		

Leads and Co-Leads for Questions

- VQ1 – Pattern and Spatial Distribution of Ecosystems and their Components
- VQ2 – Ecosystem Function, Physiology and Seasonal Activity
- VQ3 – Biogeochemical Cycles
- VQ4 – Changes in and Responses to Disturbance
- VQ5 – Ecosystems and Human Well-being
- VQ6 – Earth Surface, Snow/Ice, and Shallow Water Benthic Composition
- TQ1 – Volcanoes and Earthquakes
- TQ2 – Wildfire temperature and emissions
- TQ3 – Water Use and Availability
- TQ4 – Urbanization and Human Health
- TQ5 – Surface composition and Change
- CQ1 – Coastal, ocean, and inland aquatic environments
- CQ2 – Wildfire, fuel, and recovery
- CQ3 – Volcanoes and hazards
- CQ4 – Ecosystem Function and Diversity
- CQ5 – Land surface composition and change
- CQ6 – Human Health and Urbanization

VSWIR Science Questions

VSWIR Overarching Science Questions

- VQ1. Pattern and Spatial Distribution of Ecosystems and their Components
 - What is the global spatial pattern of ecosystems and diversity distributions and how do ecosystems differ in their composition or biodiversity?
- VQ2. Ecosystem Function, Physiology and Seasonal Activity
 - What are the seasonal expressions and cycles for terrestrial and aquatic ecosystems, functional groups, and diagnostic species? How are these being altered by changes in climate, land use, and disturbance?
- VQ3. Biogeochemical Cycles
 - How are the biogeochemical cycles that sustain life on Earth being altered/disrupted by natural and human-induced environmental change? How do these changes affect the composition and health of ecosystems, and what are the feedbacks with other components of the Earth system?
- VQ4. Changes in and Responses to Disturbance
 - How are disturbance regimes changing, and how do these changes affect the ecosystem processes that support life on Earth?
- VQ5. Ecosystem and Human Health
 - How do changes in ecosystem composition and function affect human health, resource use, and resource management?
- VQ6. Earth Surface, Snow/Ice, and Shallow-Water Benthic Composition
 - What are the land surface soil/rock and shallow-water benthic compositions?

VQ1. Pattern and Spatial Distribution of Ecosystems and their Components

- How are ecosystems organized within different biomes associated with temperate, tropical, and boreal zones, and how are these changing?
- How do similar ecosystems differ in size, species composition, fractional cover and biodiversity across terrestrial and shallow aquatic biomes?
- What is the current spatial distribution of ecosystems, functional groups, or key species within major biomes including agriculture, and how are these being altered by climate variability, human uses, and other factors?
- What are the extent and impact of invasive species in terrestrial and shallow aquatic ecosystems?
- What are the spatial structure and species distribution in observable phytoplankton blooms?
- How do changes in coastal morphology and surface composition impact coastal ecosystem composition, diversity and function?

VQ2. Ecosystem Function, Physiology and Seasonal Activity

- How does the seasonal activity of ecosystems and functional types vary across biomes (terrestrial and shallow aquatic), geographic zones, or environmental gradients between the equator and the poles? How are seasonal patterns of ecosystem function being affected by climate change?
- How do seasonal changes affect productivity, carbon sequestration, and hydrological processes across ecosystems and agriculture?
- How do environmental stresses affect the physiological function of water and carbon exchanges at the seasonal time scale within ecosystems (including agriculture)?
- What is the environmental impact of aquatic plants and coral in inland and coastal water environments at the seasonal time scale?

VQ3. Biogeochemical Cycles

- How do changes in climate and atmospheric processes affect the physiology and biogeochemistry of ecosystems?
- What are the consequences of uses of land and coastal systems, such as urbanization and resource extraction, for the carbon cycle, nutrient fluxes and biodiversity?
- What are the consequences of increasing nitrogen deposition for carbon cycling and biodiversity in terrestrial and coastal ecosystems?
- How do changes in hydrology, pollutant inputs and sediment transport affect freshwater and coastal marine ecosystems?
- How do changing water balances affect carbon storage by terrestrial ecosystems?
- What are the key interactions between biogeochemical cycles and the composition and diversity of ecosystems?
- How do changes in biogeochemical processes feed back to climate and other components of the Earth system?

VQ4. Changes in and Responses to Disturbance

- How do patterns of abrupt (pulse) disturbance vary and change over time within and across ecosystems?
- How do climate changes affect disturbances such as fire and insect damage?
- What are the interactions between invasive species and other types of disturbance?
- How are human-caused and natural disturbances changing the biodiversity composition of ecosystems, e.g.: through changes in the distribution and abundance of organisms, communities, and ecosystems?
- How do climate change, pollution and disturbance augment the vulnerability of ecosystems to invasive species?
- - What are the effects of disturbances on productivity, water resources, and other ecosystem functions and services?
- How do changes in human uses of ecosystems affect their vulnerability to disturbance and extreme events?

VQ5. Ecosystem and Human Health

- How do changes in ecosystem composition and function affect the spread of infectious diseases and the organisms that transmit them?
- How will changes in pollution and biogeochemical cycling alter coastal and inland water quality?
- How are changes in ecosystem distribution and productivity linked to resource use, and resource management? Forestry management, fire effects, biofuels, agricultural management
- How will changes in climate and pollution affect the health and productivity of aquatic and agricultural resources?
- What are the economic and human health consequences associated with the spread of invasive species?
- How does the spatial pattern of policy, environmental management, and economic conditions correlate with the state and changes in ecosystem function and composition?
- What are the impacts of flooding and sea-level rise on ecosystems, human health, and security?

VQ6. Earth Surface, Snow/Ice, and Shallow Water Benthic Composition

- What is the distribution of the primary minerals and mineral groups on the exposed terrestrial surface?
- What is the bottom composition (sand, rock, mud, coral, algae, SAV, etc) of the shallow water regions of the Earth?
- What fundamentally new concepts for mineral and hydrocarbon research will arise from uniform and detailed global geochemistry of the exposed rock/soil surface?
- What changes in bottom substrate occur in shallow coastal and inland aquatic environments?
- What impact do desert dust and black carbon have on critical water resources through the acceleration of snow and glacier melt?
- What is the impact of climate change on the reflectivity of snow and ice in the Earth's polar regions?
- How can measurements of rock and soil composition be used to understand and mitigate hazards?

TIR Science Questions

TIR Overarching Science Questions

- TQ1. Volcanoes and Earthquakes
 - How can we help predict and mitigate earthquake and volcanic hazards through detection of transient thermal phenomena?
- TQ2. Wildfires
 - What is the impact of global biomass burning on the terrestrial biosphere and atmosphere, and how is this impact changing over time?
- TQ3. Water Use and Availability
 - How is consumptive use of global freshwater supplies responding to changes in climate and demand, and what are the implications for sustainable management of water resources?
- TQ4. Urbanization/Human Health
 - How does urbanization affect the local, regional and global environment? Can we characterize this effect to help mitigate its impact on human health and welfare?
- TQ5. Earth surface composition and change
 - What is the composition and thermal property of the exposed surface of the Earth? How do these factors change over time and affect land use and habitability?

TQ1. Volcanoes and Earthquakes

- Do volcanoes signal impending eruptions through changes in surface temperature or gas emission rates and are such changes unique to specific types of eruptions?
- What do changes in the rate of lava effusion tell us about the maximum lengths that lava flows can attain, and the likely duration of lava flow-forming eruptions?
- What are the characteristic dispersal patterns and residence times for volcanic ash clouds and how long do such clouds remain a threat to aviation?
- What do the transient thermal anomalies that may precede earthquakes tell us about changes in the geophysical properties of the crust?
- Can the energy released by the periodic recharge of magma chambers be used to predict future eruptions?

TQ2. Wildfires

- How are global fire regimes changing in response to, and driven by, changing climate, vegetation, and land use practices?
- Is regional and local scale fire frequency changing?
- What is the role of fire in global biogeochemical cycling, particularly trace gas emissions?
- Are there regional feedbacks between fire and climate change?

TQ3. Water Use and Availability

- How is climate variability (and ENSO) impacting the evaporative component of the global water cycle over natural and managed landscapes?
- What are relationships between spatial and temporal variation in evapotranspiration and land-use/land-cover and freshwater resource management?
- Can we improve early detection, mitigation, and impact assessment of droughts at local to regional scales anywhere on the globe?
- How does the partitioning of Precipitation into ET, surface runoff and ground-water recharge change during drought?
- What areas of Earth have water consumption by irrigated agriculture that is out of balance with sustainable water availability?
- Can we increase food production in water-scarce agricultural regions while improving or sustaining quality and quantity of water for ecosystem function and other human uses?

TQ4. Human Health and Urbanization

- How do changes in local and regional land cover and land use, in particular urbanization affect surface energy balance characteristics that impact human welfare?
- What are the dynamics, magnitude, and spatial form of the urban heat island effect (UHI), how does it change from city to city, what are its temporal, diurnal, and nocturnal characteristics, and what are the regional impacts of the UHI on biophysical, climatic, and environmental processes?
- How can the factors influencing heat stress on humans be better resolved and measured?
- How can the characteristics associated with environmentally related health effects, that affect vector-borne and animal-borne diseases, be better resolved and measured?
- How do horizontal and temporal scales of variation in heat flux and mixing relate to human health, human ecosystems, and urbanization?

TQ5. Earth Surface Composition and Change

- What is the spectrally observable mineralogy of the Earth's surface and how does this relate to geochemical and surficial processes?
- What is the nature and extent of man-made disturbance of the Earth's surface associated with exploitation of non-renewable resources (oil & gas, mining)? How do these vary over time?
- How do surface temperature anomalies (hot spots) relate to deeper thermal sources, such as buried lava tubes, underground coal fires and engineering structures? How do changes in the surface temperatures relate to changing nature of the deep seated hot source?
- What is the spatial distribution pattern of surface temperatures and emissivities of various land surfaces and how do these influence the Earth's heat budget?
- What are the water surface temperature distributions in coastal, ocean, and inland water bodies. How do they change, and how do they influence aquatic ecosystems?

Combined Science Questions

Combined Overarching Questions

- CQ1. Coastal Ocean, and Inland Aquatic Environments
 - What is the status of inland and coastal aquatic ecosystems in the context of local and regional thermal climate, land-use change, and other environmental factors?
- CQ2. Wildfire, Fuel and Recovery
 - How are fires and vegetation composition coupled?
- CQ3. Volcanoes and Related Signatures
 - Do volcanoes signal impending eruptions through changes in the temperature of the ground, rates of gas and aerosol emission, temperature and composition of crater lakes, or health and extent of vegetation cover?
- CQ4. Ecosystem Function and Diversity
 - How do species, functional type, and biodiversity composition within ecosystems influence the energy, water and biogeochemical cycles under varying climatic conditions?
- CQ5. Earth Surface Composition and Change
 - What is the composition of exposed terrestrial surface of the Earth and how does it respond to anthropogenic and non anthropogenic drivers?
- CQ6 Human Health and Urbanization
 - How do patterns of human environmental and infectious diseases respond to leading environmental changes, particularly to urban growth and change and the associated impacts of urbanization?

CQ1. Coastal Ocean, and Inland Water Environments

- What are the feedbacks between climate and habitat structure, biogeochemical cycling, biodiversity, and ecosystem productivity of shallow aquatic habitats?
- What are the ecological linkages of landscape-scale ocean-atmosphere interactions including the hydrologic cycle, aerosol production and transport, and cloud radiative forcing?
- How are small-scale processes in shallow benthic habitats related to changes in functional community types (coral reefs, submerged aquatic vegetation and floating aquatic vegetation), productivity, and biogeochemical cycling including material fluxes and water quality?
- How can these observations be used to guide the management and utilization of resources in the shallow aquatic environment?
- What are the seasonal expressions and cycles for terrestrial and shallow aquatic ecosystems, functional groups and diagnostic species?
- What is the susceptibility and likely response in the context of changes in climate, land use, and disturbance?

CQ2. Wildfire, Fuel and Recovery

- How does the timing, temperature and frequency of fires affect long-term ecosystem health?
- How does vegetation composition and fire temperature impact trace gas emissions?
- How do fires in coastal biomes affect terrestrial biogeochemical fluxes into estuarine and coastal waters and what is the subsequent biological response?
- What are the feedbacks between fire temperature and frequency and vegetation composition and recovery?
- How does vegetation composition influence wildfire severity?
- On a watershed scale, what is the relationship of vegetation cover, soil type, and slope to frequency of debris flows?
- How does invasive vegetation cope with fire in comparison to native species?

CQ3. Volcanoes and Surface Signatures

- What do comparisons of thermal flux and SO₂ emission rates tell us about the volcanic mass fluxes and the dynamics of magma ascent?
- Does pressurization of the shallow conduit produce periodic variations in SO₂ flux and lava dome surface temperature patterns that may act as precursors to explosive eruptions?
- Can measurements of the rate at which lava flows cool allow us to improve forecasts of lava flow hazards?
- Does the temperature and composition of volcanic crater lakes change prior to eruptions?
- Do changes in the health and extent of vegetation cover indicate changes in the release of heat and gas from crater regions?

CQ4. Ecosystem Function and Diversity

- How can we enhance phenological & stress characterization through synergy between reflective and emitted radiation with higher frequency temporal sampling?
- How is energy partitioned between latent and sensible heat fluxes as a function of different plant types and fractional cover and how does this impact hydrology?
- How is physiological function affecting water and carbon exchange expressed at the ecosystem scale, especially seasonal down-regulation due to environmental stress factors?
- What is the vegetation phenological response to seasonal and interannual changes in temperature and moisture due to climate change and how does this response vary at the community/species level?
- What are the feedbacks between changes in canopy composition, mortality and retrieved canopy temperatures resulting from disturbances (e.g., disease, moisture deficiency, insect attack, fire, land degradation, fragmentation) in natural and managed ecosystems?
- How do climate-induced temperature and moisture changes impact the distribution and spread of invasive and native species?

CQ5. Surface Composition and Change

- What is the composition of the exposed terrestrial surface of the Earth?
- How does the surface mineralogy and soil composition relate to the plant physiology and function on the terrestrial surface of the Earth?
- How is the composition of exposed terrestrial surface responding to anthropogenic and non anthropogenic drivers (desertification, weathering, disturbance e.g. logging, mining)?
- How do types and distributions of altered rocks define regional trends in hydrothermal fluid flow for magmatic arcs and tectonic basins, better define hydrothermal deposit models, and assist in the discovery of new economic deposits?
- How do regional trends of minerals and shale thermal maturity within basins better define depositional models and assist in the discovery of new hydrocarbon reserves?

CQ6. Human Health and Urbanization

- How do land surface characteristics such as vegetation state, soil moisture, temperature, and land cover composition affect heat and drought, and vector- and animal-borne diseases?
- What changes can be observed and measured in emissivity's of urban surfaces and how do emissivity's change for different cities around the world as they impact the urban heat island and associated land-atmosphere energy balance characteristics?
- How does the distribution of urban and peri-urban impervious surfaces affect regional energy balance fluxes, hydrologic processes, biogeochemical fluxes, and what is the response of ecosystems to these changes?
- What is the status and availability of freshwater resources including snow and ice and how is this related to climate variability, land-use, and population growth?