D. Impacts, Tipping Points and Systems Responses and Resilience

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Challenge 1: Integrated, exploratory, large ensemble tipping points experiments

Current EESM Capabilities
- Balance between fidelity of representation and uncertainty
- Many consistent scenarios across the continuum of ESM to impact models

Gaps
- Connections between ESMs, regional models, and multi-sectoral impact models
- UQ across the continuum of models
- ML/AI for ensemble emulation
- Validation of rare events

Goals
- Mechanistic understanding of tipping points and indicators at a decision relevant timescales

Challenge 2: Exploratory modeling of socioeconomic shocks and feedbacks

Current EESM Capabilities
- Regional economic models: GCAM, PCHES
- Subregional impact models: GO, STATEMOD
- Agent based models: ICOM, IM3, COMPASS

Gaps
- Representations of institutions
- Evolving infrastructure
- Distributional impacts

Goals
- Better understand high consequence feedbacks and vulnerabilities across system sectors and scales

Challenge 3: Methods to visualize, share, and ensure reproducibility for large ensemble experiments

Current EESM Capabilities
- ESGF, MSD LIVE
- Diverse toolkits across science focus areas
- Projects with stakeholder engagement/coproduction Urban IFLs, climate resilience centers, HyperFACETS

Gaps
- Compression
- Server side analysis
- Metrics, benchmarking for decision relevant insights (scenario discovery)
- Effective visualization for diverse audiences

Goals
- Maximize the translational value of the large ensemble experiments and basic science insights/innovations