

BER Response to BERAC Virtual Laboratory Report

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U.S. DEPARTMENT OF
ENERGY

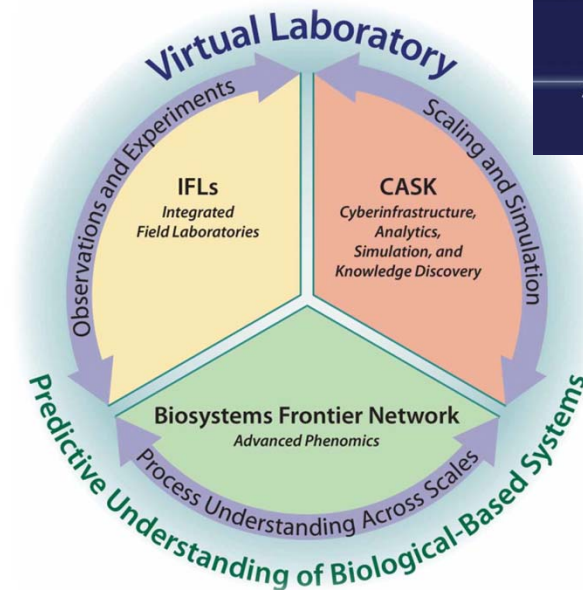
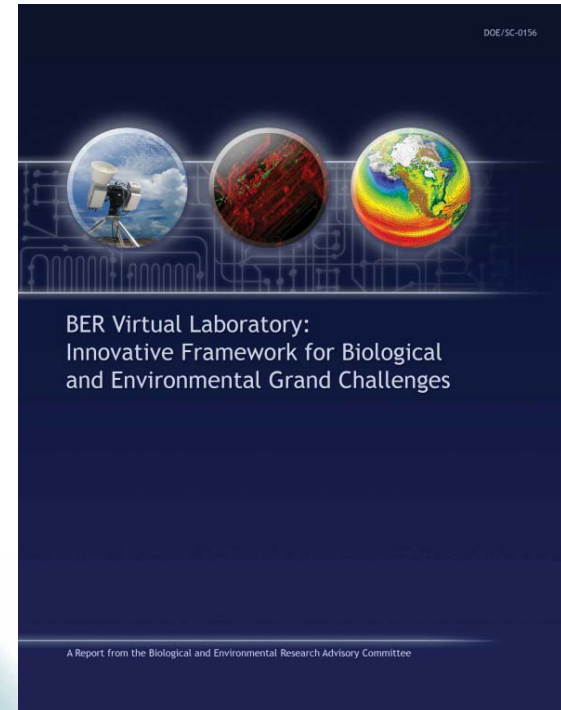
Office
of Science

Office of Biological
and Environmental Research

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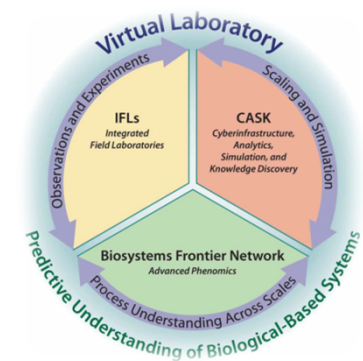
Three key elements:

- Integrated Field Laboratories
- Biosystems Frontier Network
- CASK – Cyberinfrastructure, Analytics, Simulation, and Knowledge Discovery



Integrated Field Laboratories – BERAC Report Summary

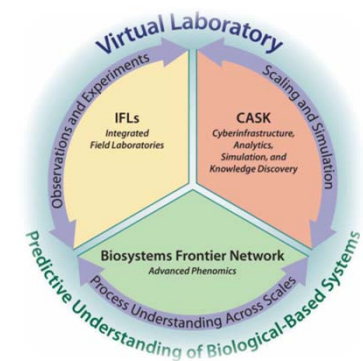
- Capitalize on existing investments - ARM, AmeriFlux, NGEE, Subsurface field sites, etc
- Will traverse ecosystems with focus on understanding and scaling fundamental biogeochemical, microbial and plant processes that drive energy, water, biogeochemical cycles
- Will measure elemental, energy and water transfer across mineral, biological and atmospheric interfaces, including all ecological and climate processes that play a role in geochemical cycling
- Associated with Instrument Incubator to ensure development and implementation of needed measurement technology



BERAC Checklist of recommendations for Virtual Laboratory

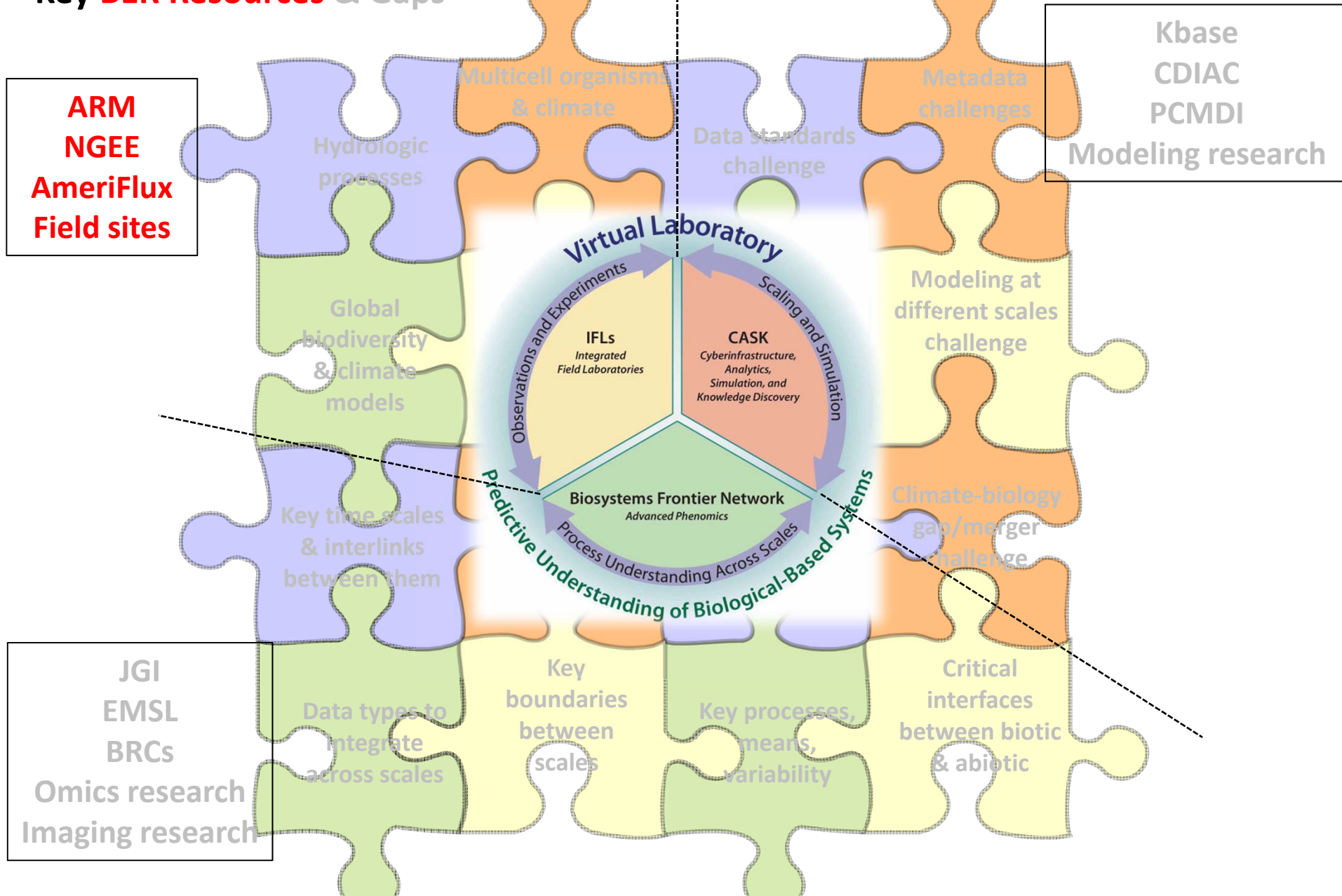
IFLs:

- Identify opportunities for leveraging and extending BER investments to develop vertically integrated laboratories
- Strategically identify geographically dispersed sites with the necessary subsurface, land surface and atmospheric components
- Develop instrument incubator programs



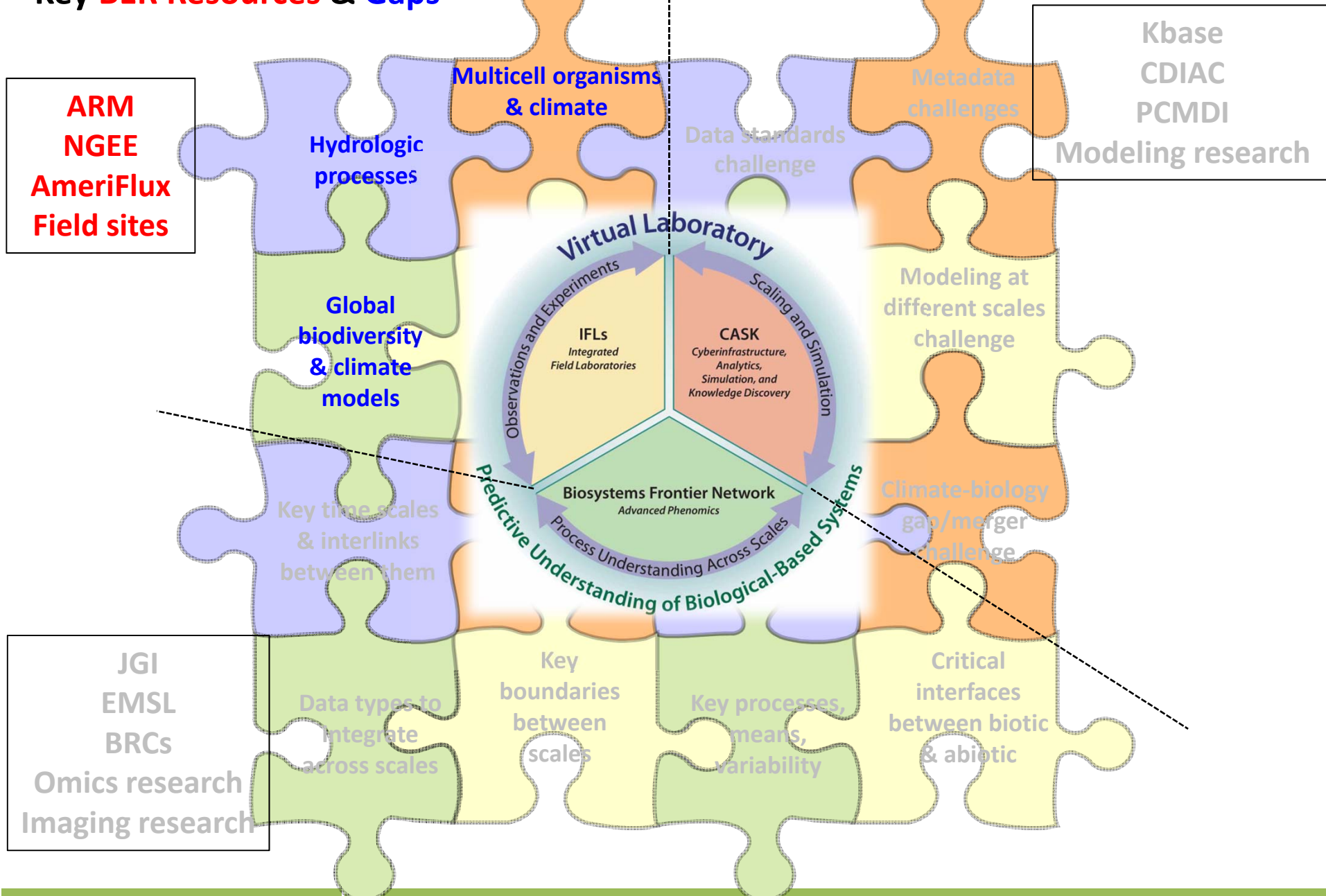
Implementing the BER Virtual Laboratory

- Key BER Resources & Gaps



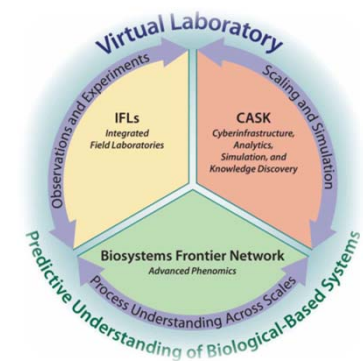
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Biosystems Frontier Network – BERAC Report Summary

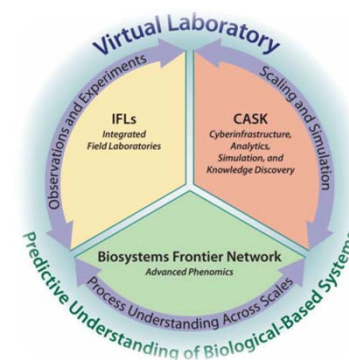
- Integrate & expand technologies for microbial & plant physiology and phenomics to gain a better understanding of organism and community phenotypic expressions with complex and highly dynamic natural environments.
- Includes:
 - In situ and nondestructive “omics”
 - Quantitative measurement capabilities that enable nondestructive analyses across expansive temporal (nanoseconds to years) and spatial (subnanometer to kilometer) scales in diverse environments.
 - Bioimaging innovations
 - Development of distributed research and instrumentation resources built on the core expertise of the JGI and EMSL



BERAC Checklist of recommendation for Virtual Laboratory

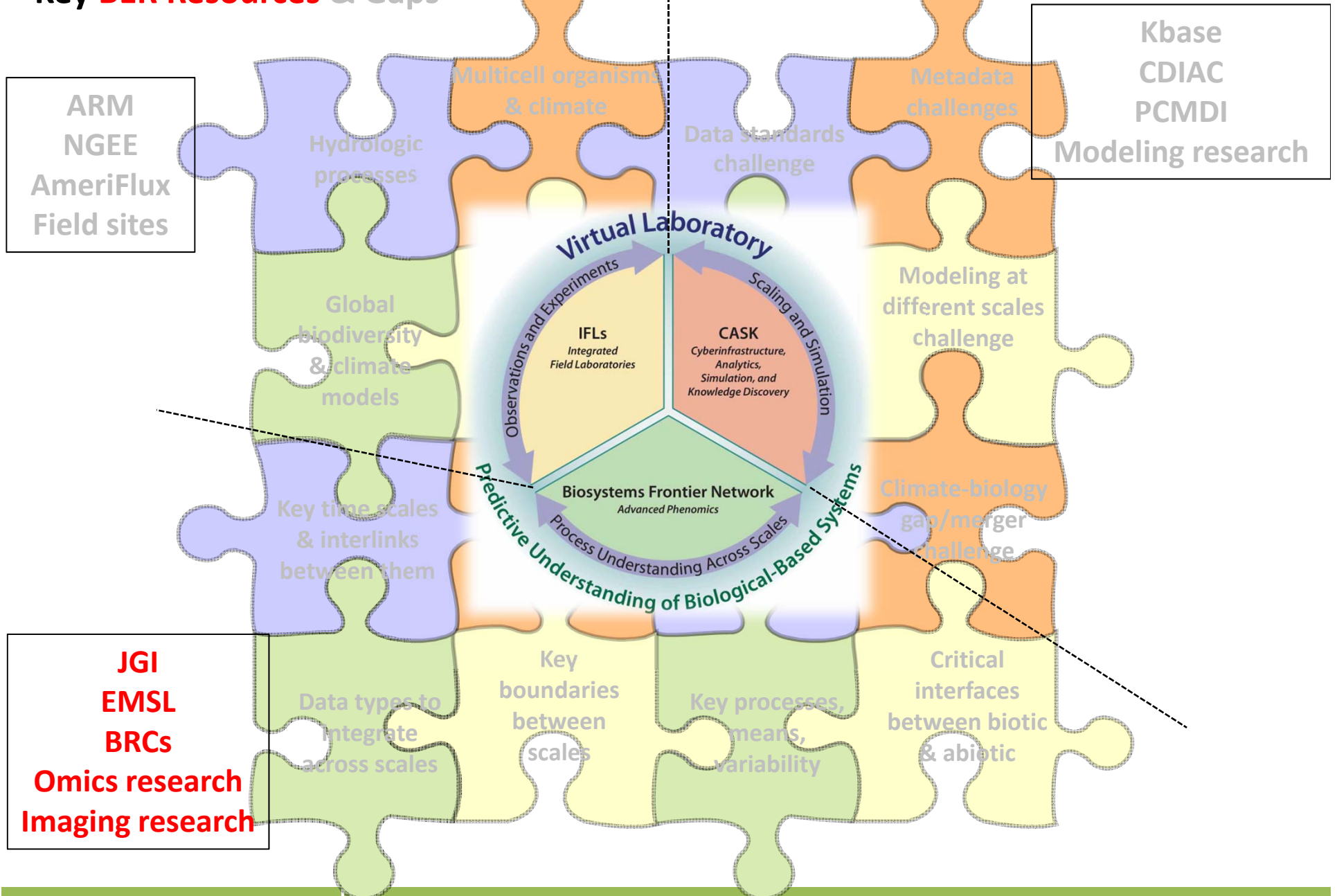
Biosystems Frontier Network:

- Develop comprehensive, real-time and nondestructive methods to quantify stress-specific proteomic and metabolomic signatures for microbial and plant communities in diverse and dynamic hydrological and biogeochemical environments
- Develop in situ, ultrafast, and nondestructive measurement and analysis techniques to improve the detection, identification and resolution of cellular molecules, metals and ions
- Develop advanced bioimaging platforms and tools featuring multimodal technologies with ultrafast temporal and subnanometer spatial resolution



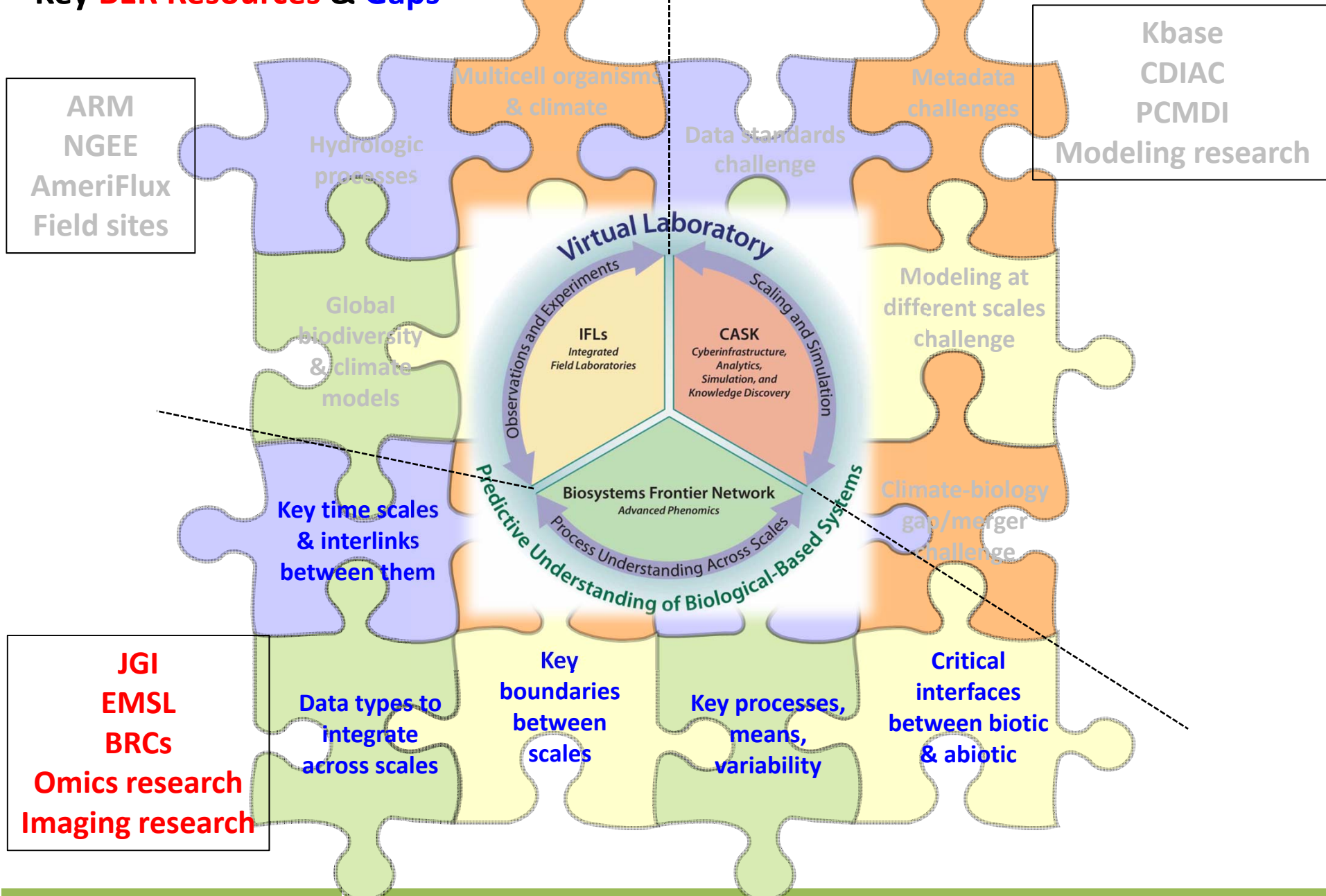
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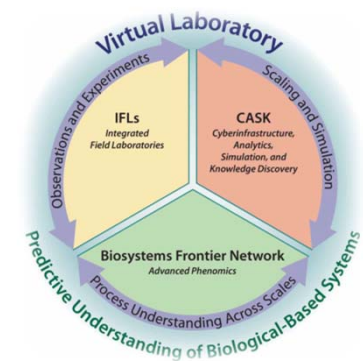
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CASK – Cyberinfrastructure, Analytics, Simulation, Knowledge Discovery – BERAC Report Summary

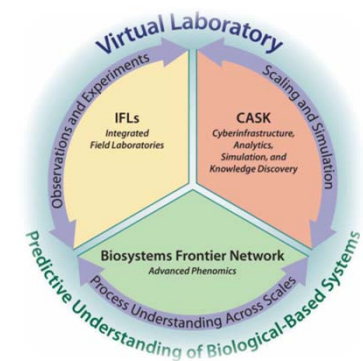
- Computational infrastructure needed to integrate disparate & multiscale measurements, theory and process understanding into predictive models, creating new knowledge to develop energy & environmental solutions.
- Built upon existing knowledge discovery infrastructure (Kbase, CDIAC).
- Will
 - develop strategies for linking heterogeneous databases
 - provide federation and exchange of information from IFLs and Biosystems Frontier Network
 - provide innovative capabilities in distributed data discovery, visualization, analysis, uncertainty quantification
 - develop advanced system component models.



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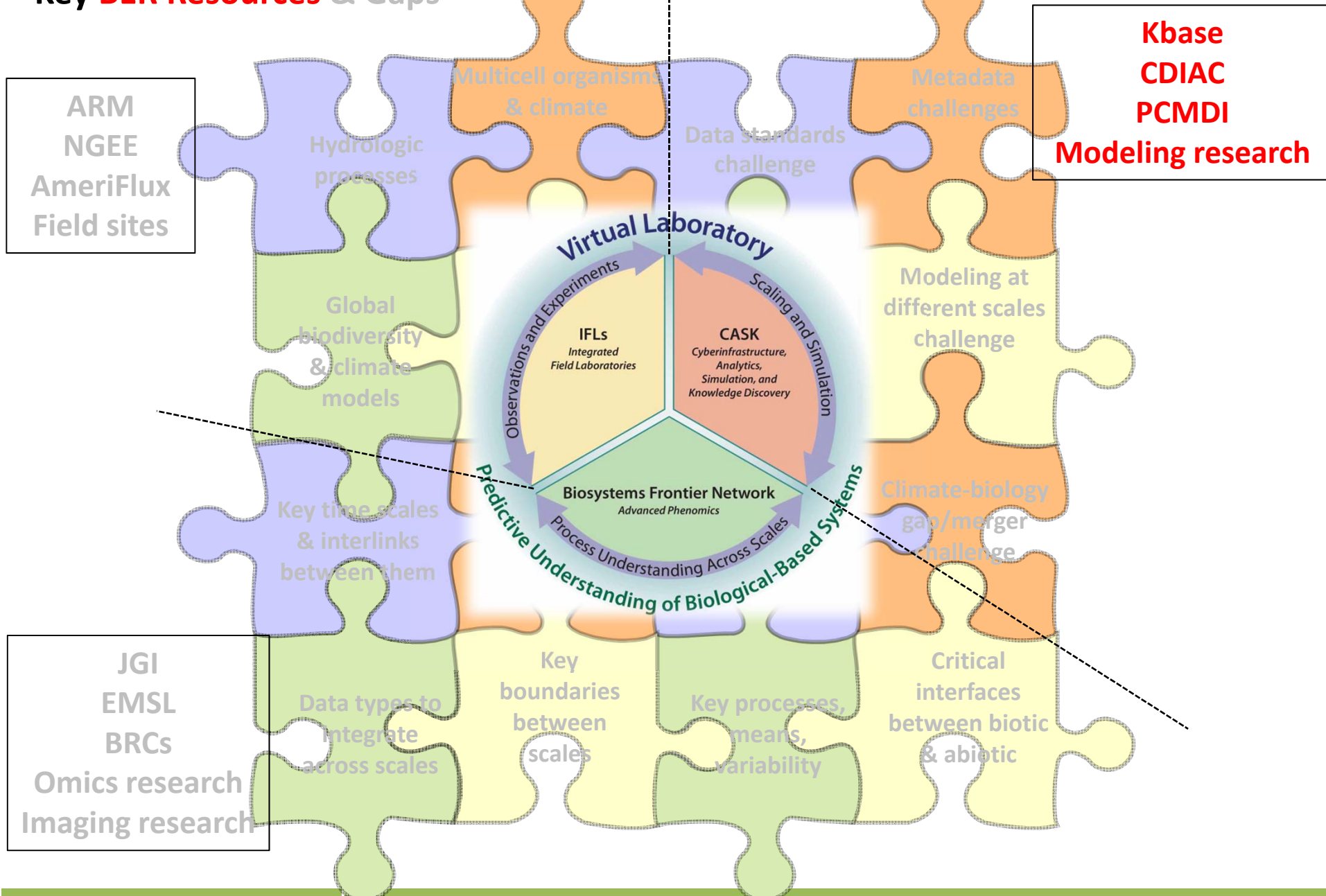
CASK:

- Link heterogeneous databases
- Develop multiscale simulation frameworks and data assimilation tools
- Develop advance system component models
- Extend and link knowledge discovery tools



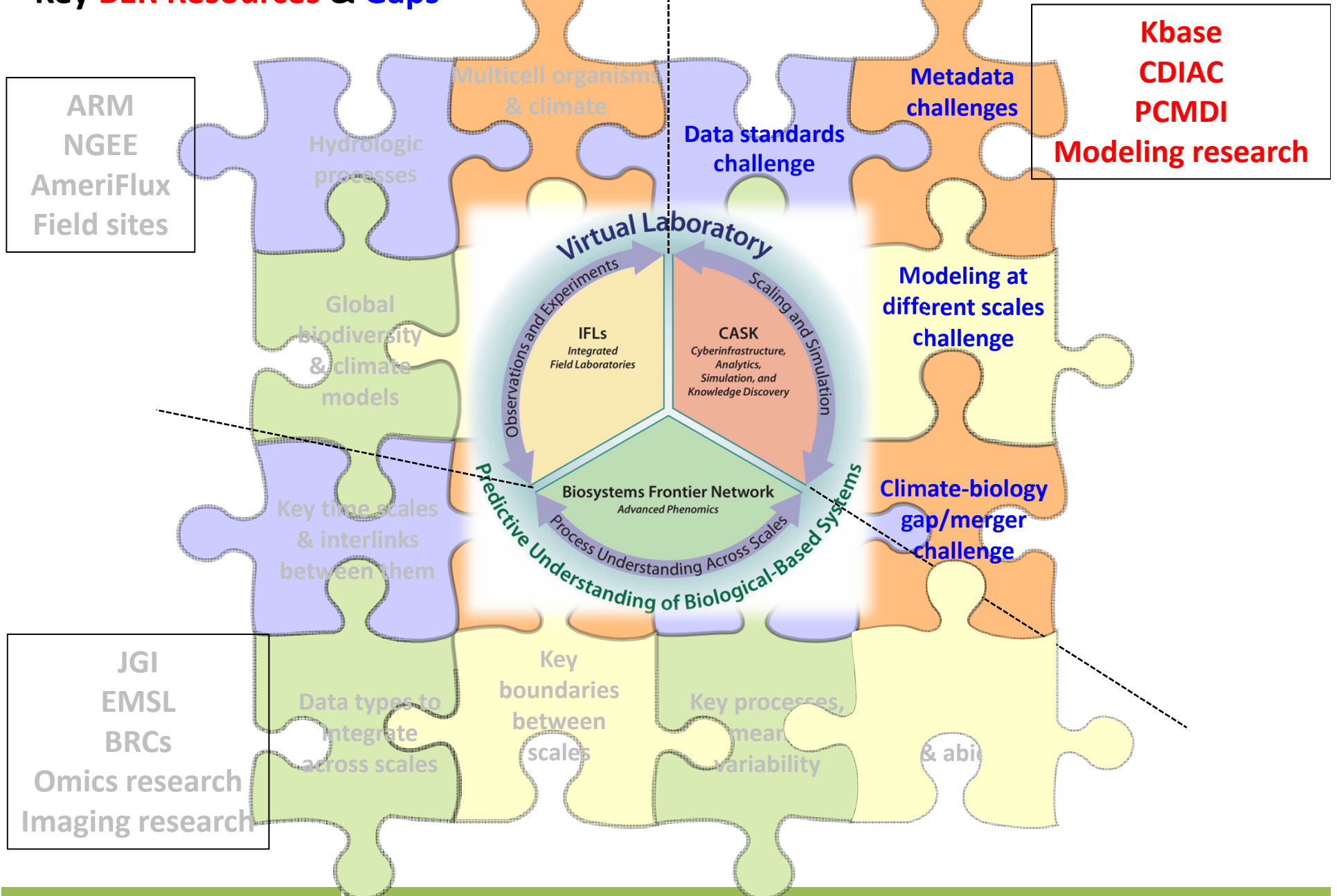
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Path Forward

- Internal (BER) seminar series on modeling – from molecular systems to global systems, helping to identify and understand logical breakpoints across all scales
- New BER staff – Jay Hnilo – exploring new opportunities for data integration and modeling
- Future NGEE workshop to explore next steps – Critical locations? Natural, managed and urban ecosystems?
- New strategies to pull diverse groups of scientists together – from data collectors to modelers, jamboree space, visualization capabilities, understanding NSF synthesis centers
- BERAC workshop on visualization / phenotyping?

BER Seminar Series on Modeling

- From plant genomics to computation to climate
- Biogeochemical models across temporal & spatial scales
- Microbial genome-scale modeling
- Modeling the Earth
- Macromolecular modeling
- Climate model construction
- Land modeling from watersheds to the globe
- Microbial community modeling
- Atmospheric modeling from clouds to the global scale
- Plant metabolic modeling
- Integrated assessment modeling

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