Community Standards for Model Integration, Scaling, and Data Compatibility

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ENVISIONING NEXTGEN MODELING OF THE EARTH SYSTEM

▸ A grand challenge for our time is to grow scientific modeling infrastructure to understand the interactions between human and biophysical components of the earth system

▸ Meetings in 2015-2018 organized by scientific networks representing modelers of societal, ecological and geophysical systems

  ▸ AIMES (Analysis, Integration and Modelling of the Earth System, Future Earth) https://aimesproject.org

  ▸ CoMSES Net (Network for Computational Modeling in the Social & Ecological Sciences) http://www.comses.net

  ▸ CSDMS (*Community Surface Dynamics Modeling System*) http://csdms.colorado.edu
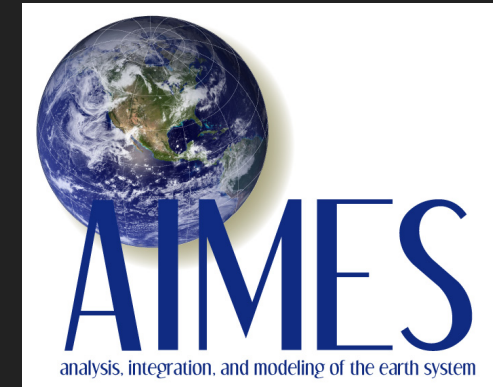
IASS - March 2017

ENVISIONING NEXTGEN MODELING OF THE EARTH SYSTEM

▸ How can we integrate modeling of human and biophysical systems and their processes?

▸ How can we enable flexible modeling across scales?

▸ How can we incorporate diverse conceptual approaches to modeling human-earth system dynamics?

▸ How can we develop scientific resilience for questions we cannot yet anticipate and unknown future challenges?

▸ How can we democratize advanced modeling technology to make it widely accessible to a global community?
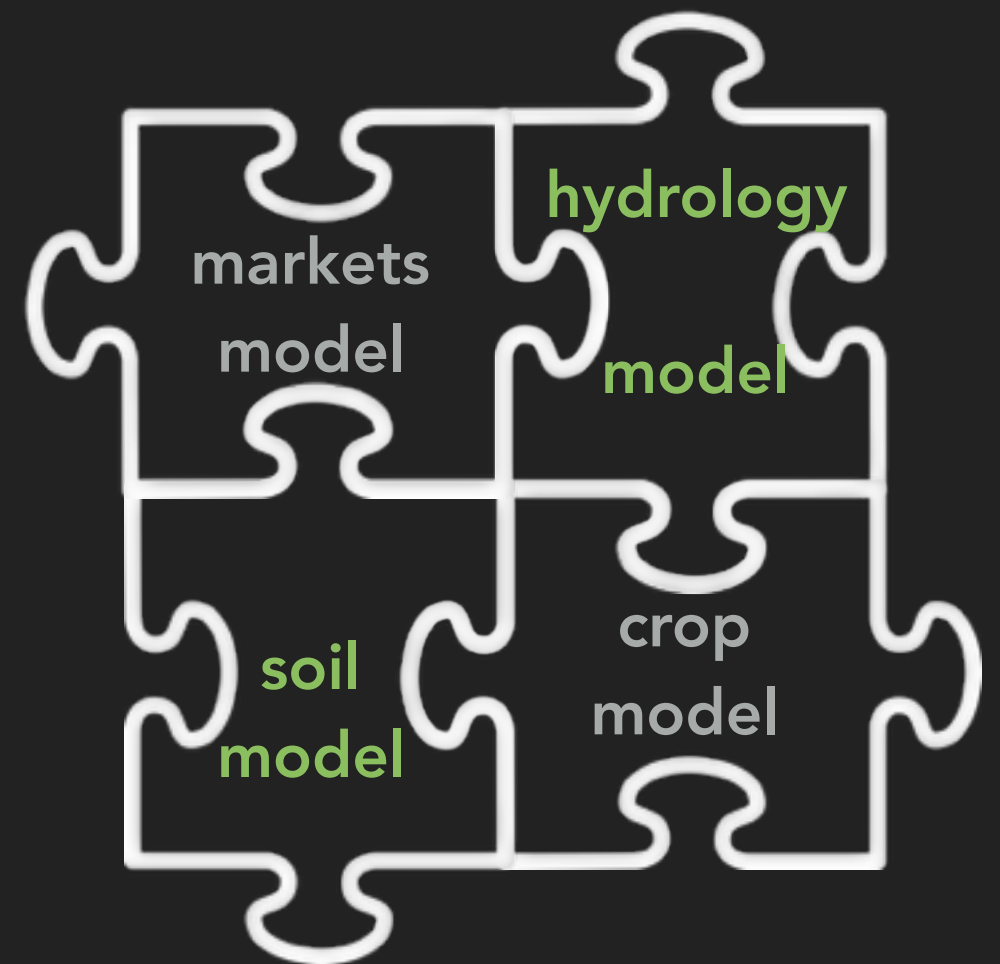
ENVISIONING NEXTGEN MODELING OF THE EARTH SYSTEM

▸ How can we establish, maintain, and manage a international scientific agenda for integrative modeling of human and Earth systems?

▸ How can we build new capacity in data science and modeling at scales from local to planetary?

▸ How can we build from current technologies, yet surpass limitations of legacy systems and explore new directions?

AN OPEN, EVOLVING MODELING ECOSYSTEM

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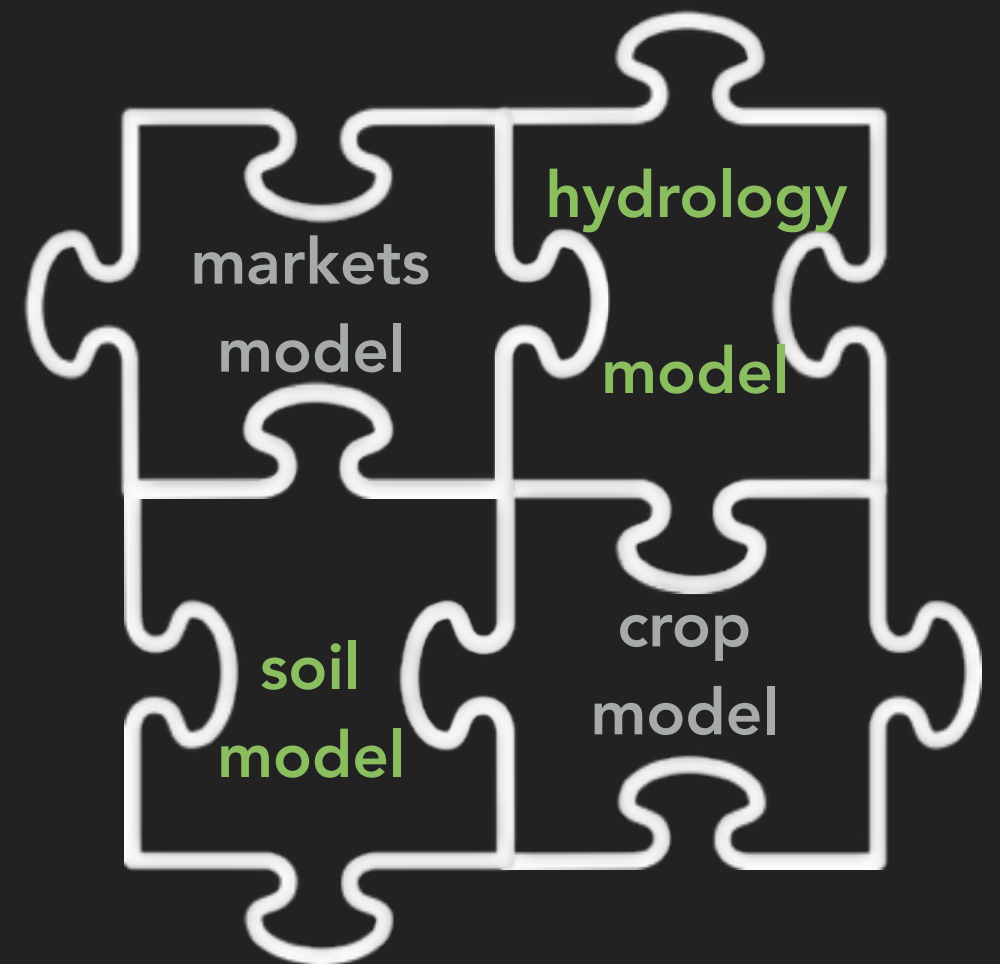# AN OPEN, EVOLVING MODELING ECOSYSTEM

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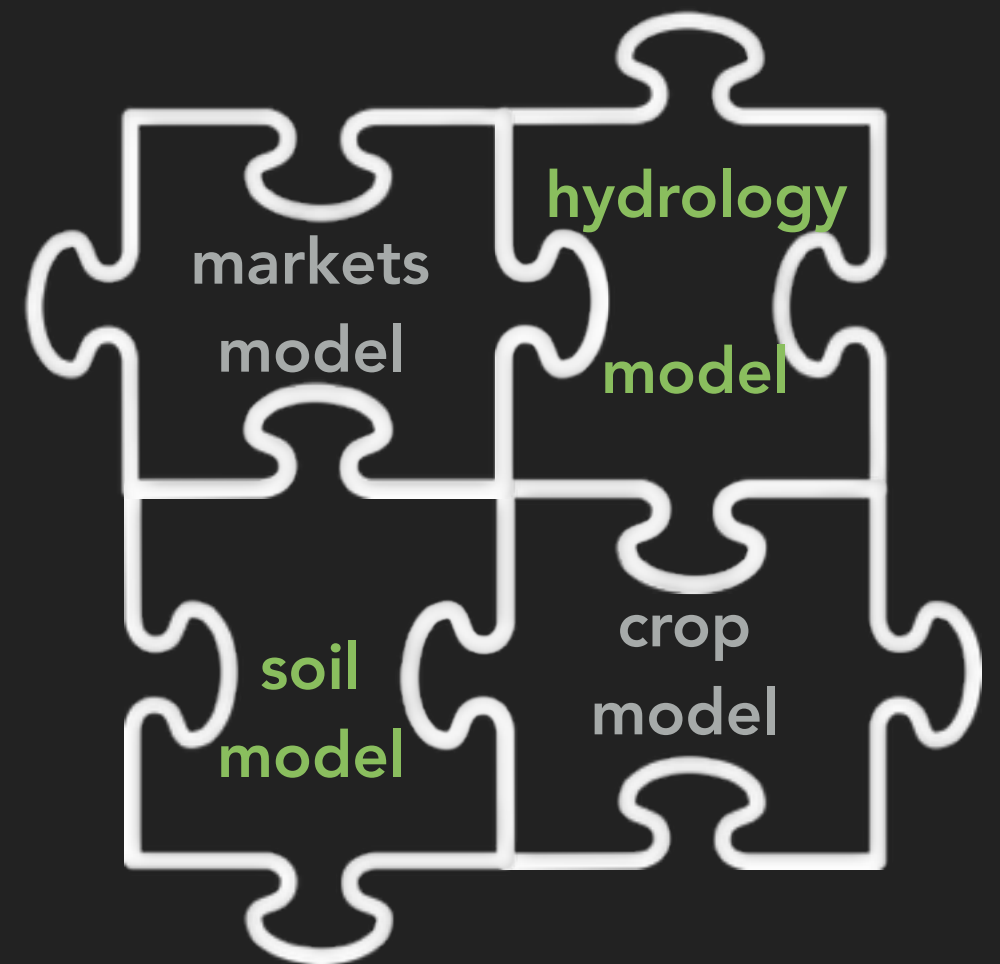▸ Enable representation human systems and biophysical systems at multiple scales, and to address diverse questions

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▸ Flexibility, scalability, and ability to rapidly incorporate new concepts and technologies

markets model

hydrology model

livestock model

crop model
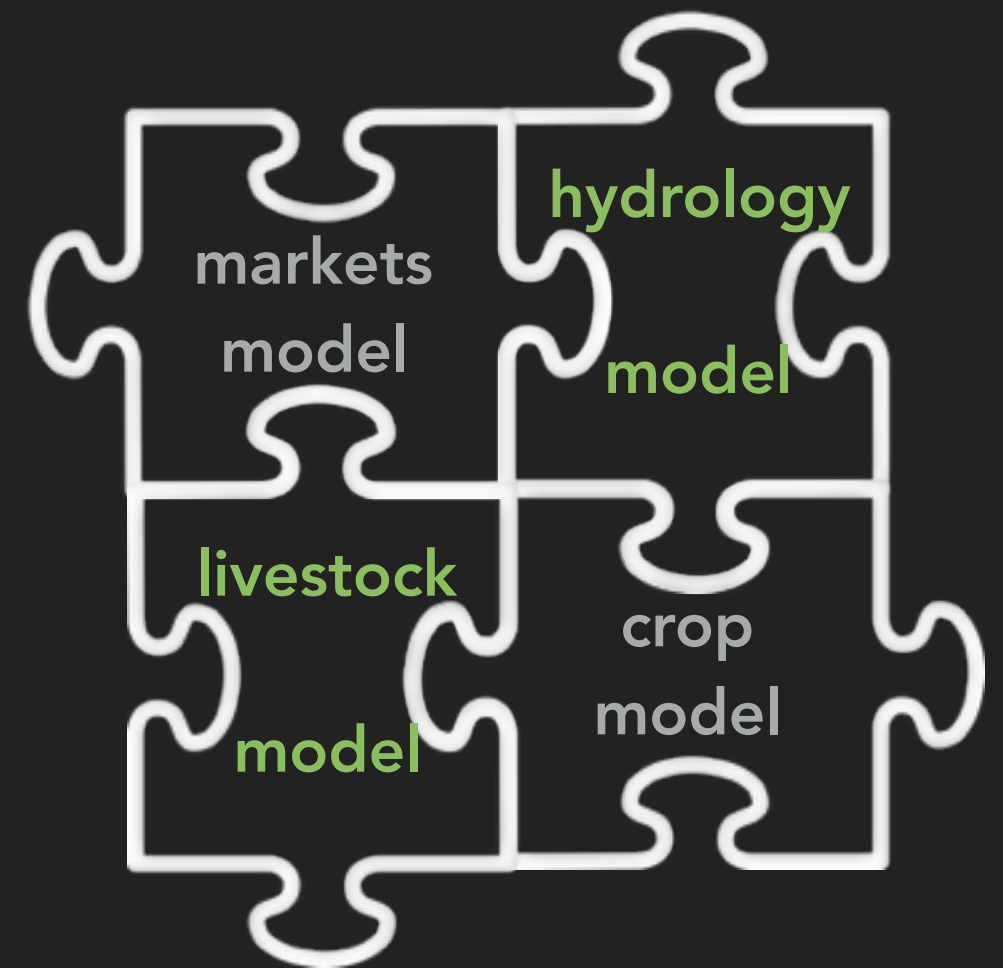
TECHNOLOGIES FOR STANDARDS–BASED MODELING

▸ Model interoperability not a new idea and widely seen as desirable for future modeling and simulation

▸ …but has been difficult to operationalize

▸ Recent maturation and convergence of technologies to advance this goal

▸ Platform independent, reusable, interoperable modeling

   ▸ Encapsulation for platform independence

▸ Standard API wrapper with shared ontology for multi-model integration

▸ Web services wrapper to run in cloud

▸ Reproducible workflow supervisor for complex model integration

▸ Enable existing models conform to integration standards with minimal changes

COMMUNITY STANDARDS FOR INTEGRATIVE MODELING

▸ Technology is helpful but not sufficient

▸ Evolving modeling ecosystem needs scientific institutions to:

   ▸ develop software standards for modeling best practices that can apply broadly across multiple global scientific communities

   ▸ disseminate information about standards to diverse stakeholder communities

   ▸ administer standards, including evaluation and certification of software

   ▸ provide education, training, assistance, and incentives to modeling scientists

▸ Requires coordinated, international effort from social and natural science communities

▸ A social challenge as much or more than technological

OPEN MODELING FOUNDATION

▸ Meeting in June 2018 to discuss action items of workshops in preceding two years

▸ Attended by representatives from scientific networks representing thousands of modeling scientists across social, ecological, environmental, geophysical sciences (AIMES, CoMSES, CSDMS, iEMSS, ISEM, OpenMI, EPA, others). Joined by more organizations in 2019

▸ Proposed a federated meta-organization to develop, disseminate, and administer community standards for: *access*, *documentation*, *reuse*, *interoperability* for modeling science

▸ Long term goal to support a self-organized, evolving modeling ecosystem

OPEN MODELING FOUNDATION – EXAMPLE STANDARDS

▸ Drafting preliminary community standards for best practice in model development and deployment for review and comment

▸ Examples

  ▸ Accessibility: publish code in discoverable, open-access, persistent, FAIR-aligned data repositories

  ▸ Documentation: document code so that model can be understood and reproduced

  ▸ Reusability: through encapsulation or similar technologies for platform independent reuse and replicability

  ▸ Interoperability: through standard APIs and ontology wrappers for multi-model interoperability

OPEN MODELING FOUNDATION – EXAMPLE ORGANIZATION

▸ Self-governing meta-organization: network of networks

▸ Working groups (standards, education/outreach, cyberinfrastructure, etc.)

▸ Develop and administer/recognize standards

  ▸ Code review and certification with digital badges

  ▸ Provide incentives for adopting standards

▸ Support via training and cyberinfrastructure

OPEN MODELING FOUNDATION – WHERE WE ARE NOW

▸ Initial strategic planning workshop May 2019 (Potsdam, Germany)

▸ Preliminary organizational charter drafted

▸ Web framework and domain set up (only limited content): http://openmodelingfoundation.org

▸ Funding proposals to US National Science Foundation and A.P. Sloan Foundation - for planning workshops, other meetings, supporting cyberinfrastructure (Sloan funds awarded)

▸ Agreement to participate in planning OMF among 14 scientific organizations ≈ 12k modeling scientists

▸ Open Code badge deployed to 2 journals. Working on more

▸ Open letter to generate support for OMF nearly ready to circulate

OPEN MODELING FOUNDATION – WHAT WE WANT TO AVOID
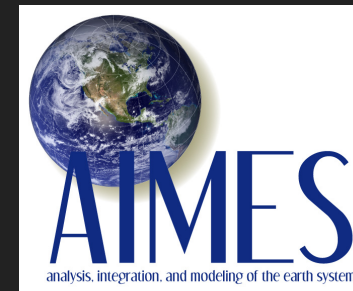

https://xkcd.com/927/
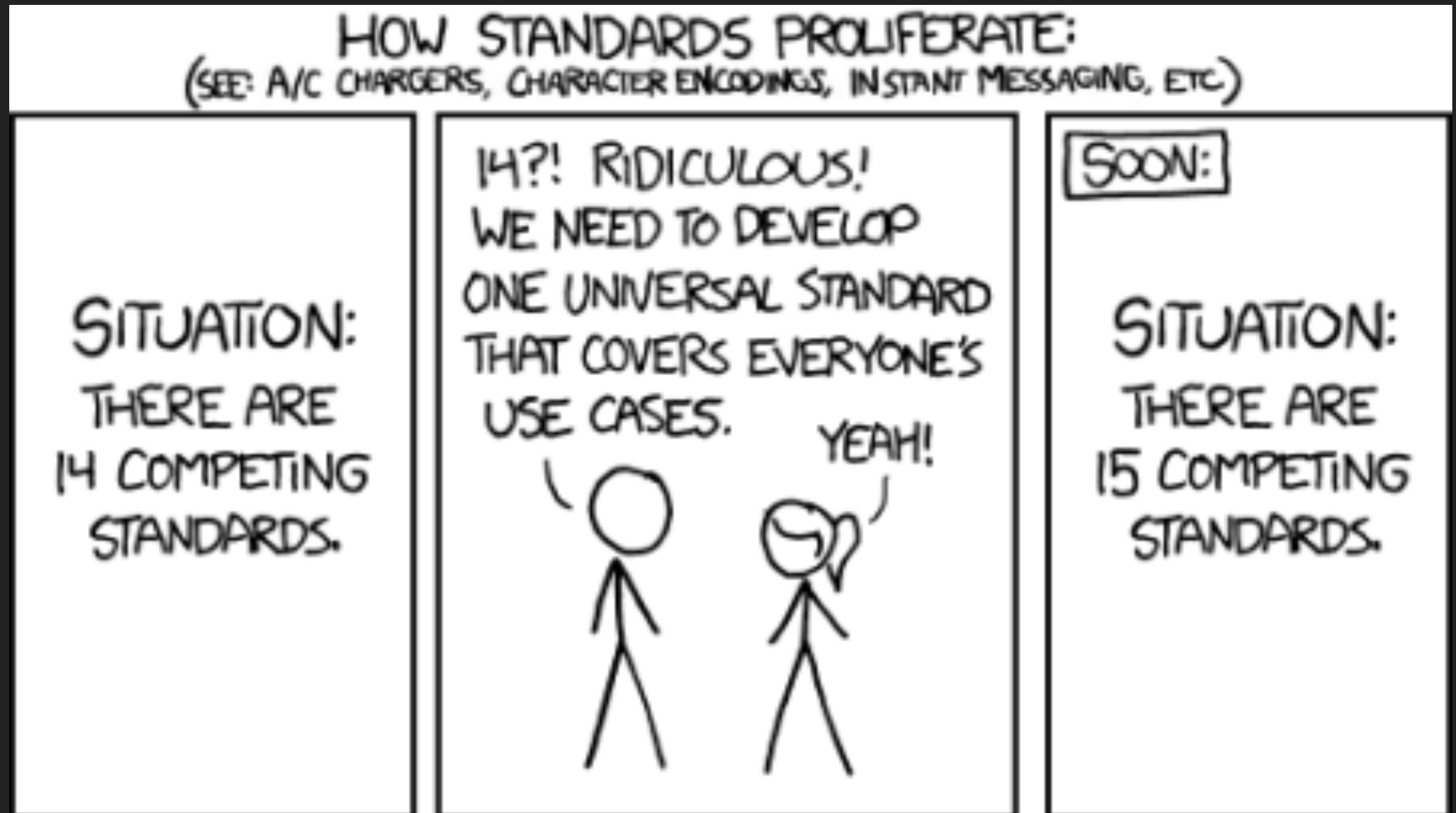
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