Project Introduction: Personal Weather Predictor

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CSCI-B 649 Science Gateway Architectures

INDIANA UNIVERSITY BLOOMINGTON
SCHOOL OF INFORMATICS AND COMPUTING

Todays Outline

- Motivating weather prediction use case
- Linked Environment for Atmospheric Discovery
- Personal Weather Predictor
- Advance Track Project

Logistics

- Project Team Questions?
- Associate Instructors
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Numerical Weather Prediction (NWP)

- Forecasting technique to use computer models to simulate the evolution of the atmosphere.
- NWP forecasts can be improvised by tuning the computer model but largely by improving initial conditions.
- The models are initialized by analysis of observational data from current weather.

NWP Forecasts

- Atmosphere is a physical system governed by the laws of physics which are expressed as mathematical equations.
- Initial conditions are determined from observations at a given initial time.
- Future weather is forecasted calculating how the current state changes over time.

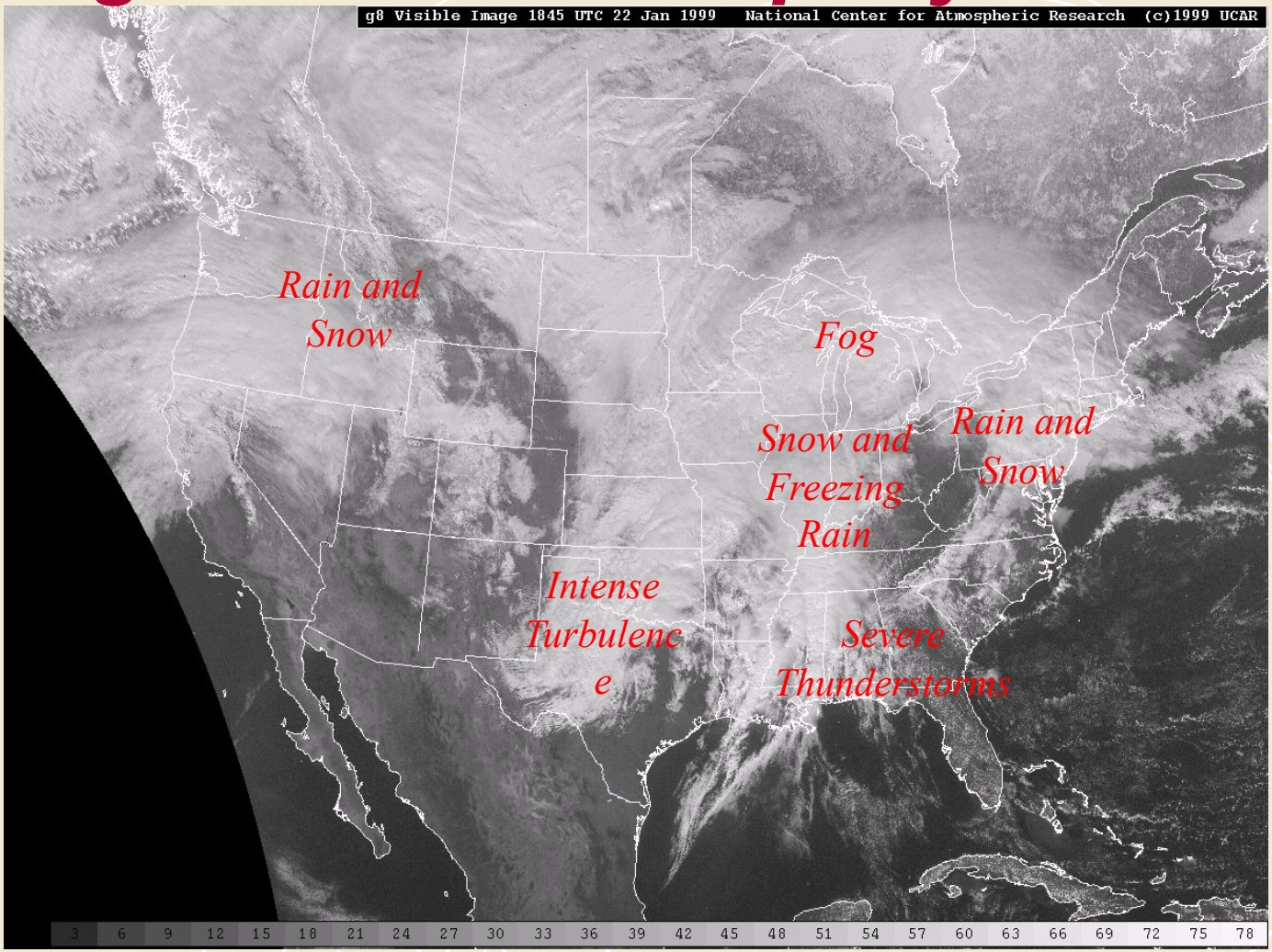
NWP Challenges

- The equations are very complicated (non-linear) and a powerful computer is required to do the calculations.
- The accuracy decreases as the range increases; there is an inherent limit of predictability.

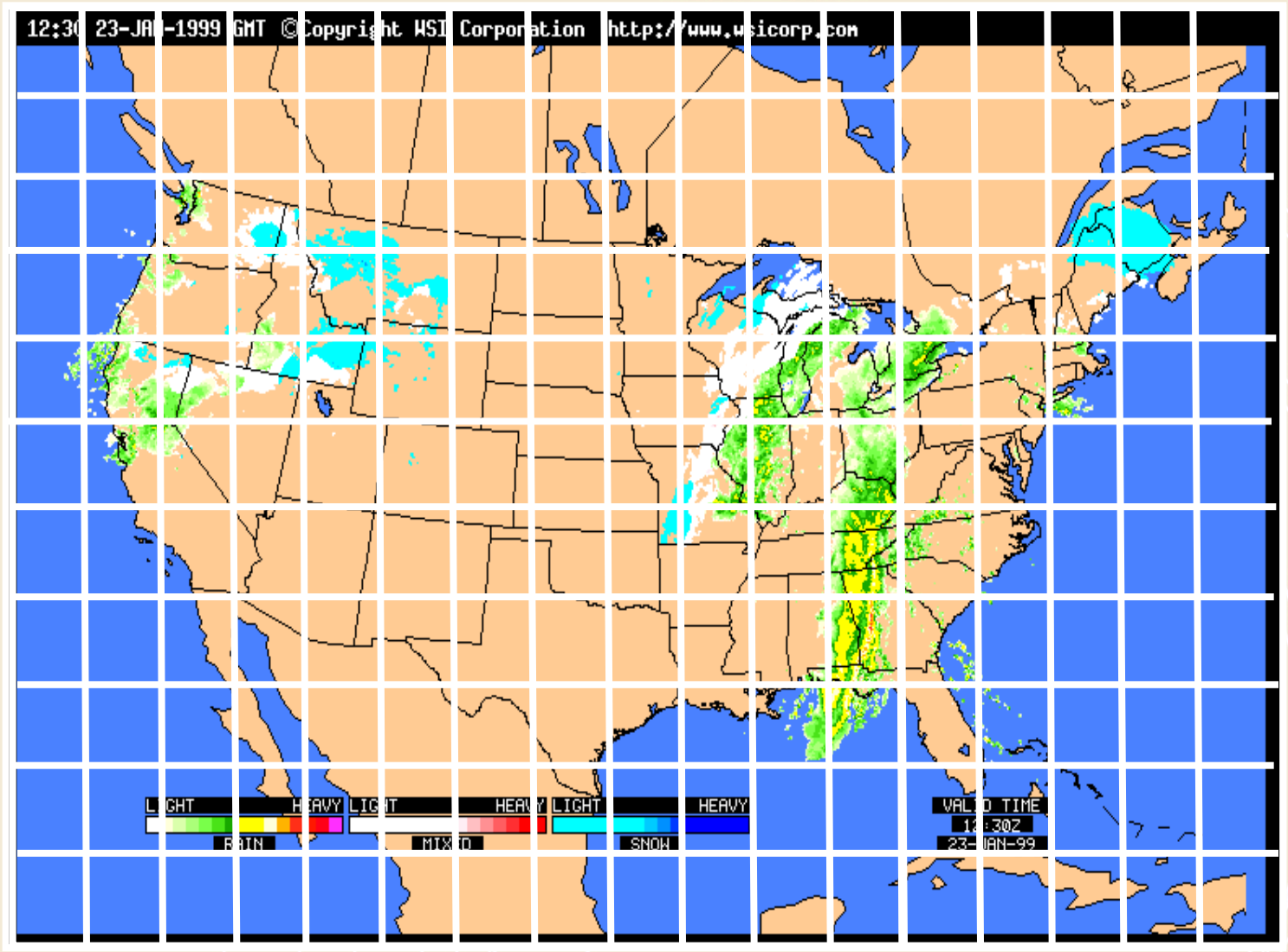
NWP techniques improve ..But ..

- Increased power of supercomputers, allowing much finer numerical resolution and fewer model approximations.
- Improved representation of small-scale physical processes (clouds, precipitation, turbulent transfers of heat, moisture, momentum, and radiation) within the models.
- More accurate methods of data assimilation, which result in improved initial conditions for the models.
- ..but the weather models are still static ..

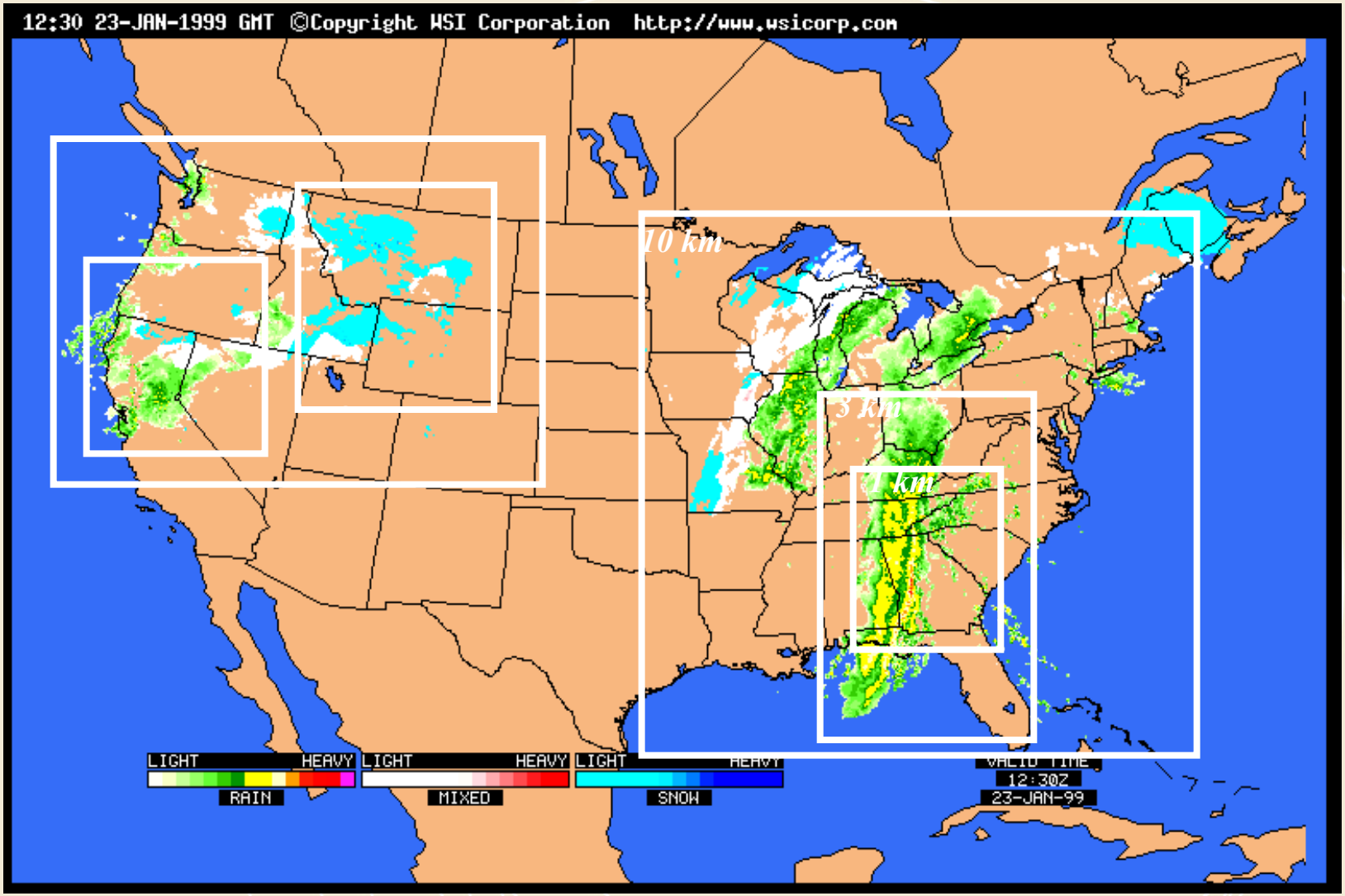
Weather is Local, High-Impact, Heterogeneous and Rapidly Evolving



Fixed, Coarse Model Grids

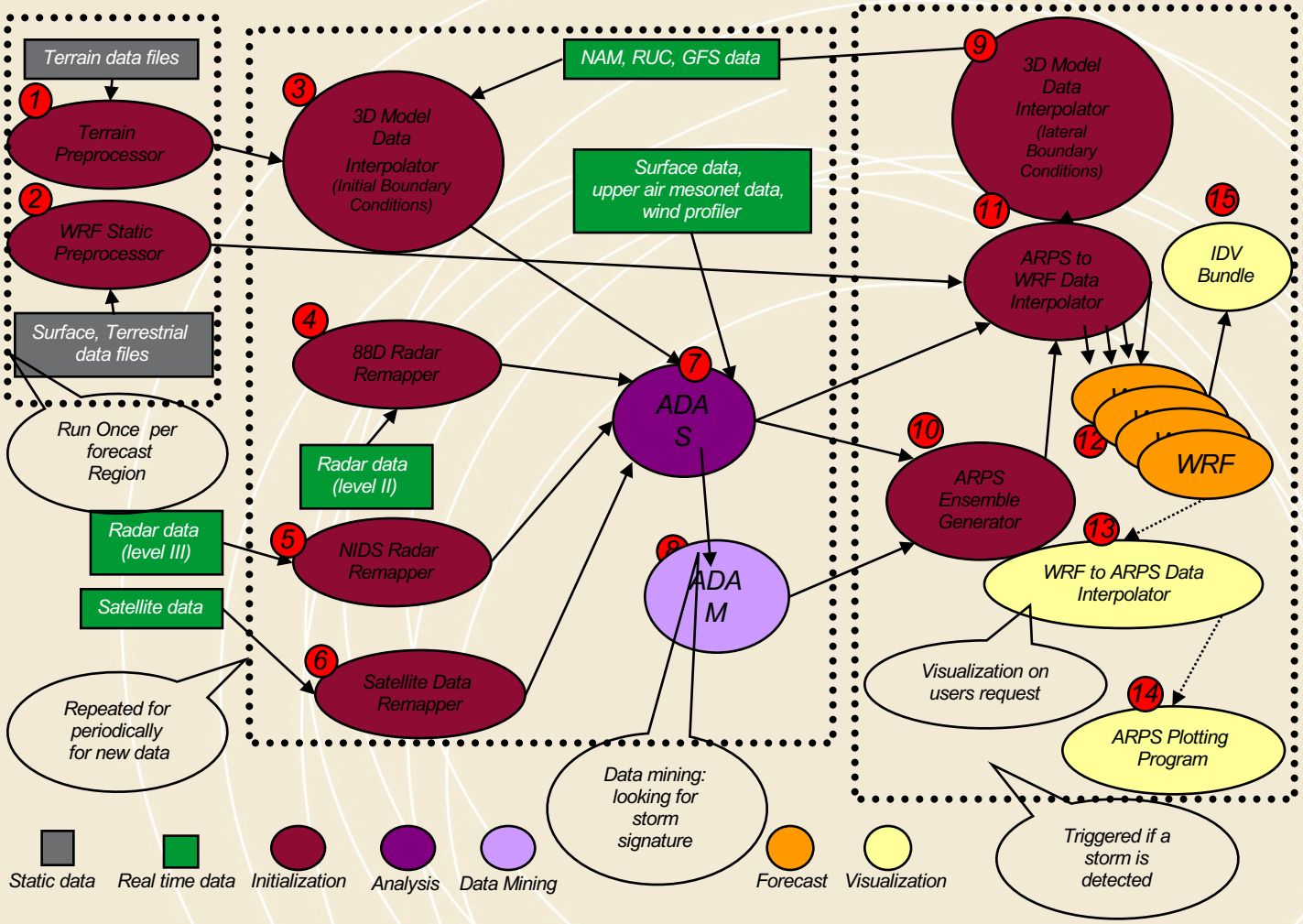


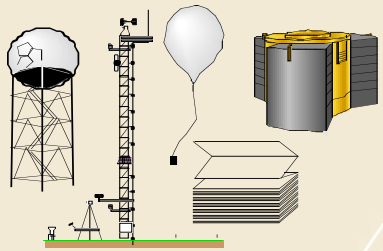
Nested Models



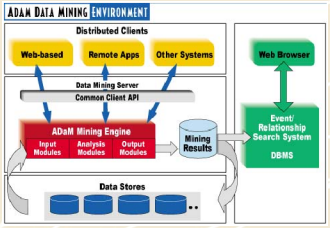
L I N K E D
ENVIRONMENTS
FOR ATMOSPHERIC
D I S C O V E R Y

Dynamic Workflows





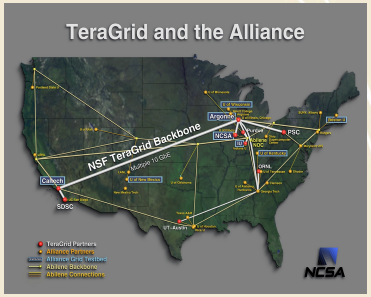
Streaming Observations



Data Mining

Storms Forming

Forecast Model

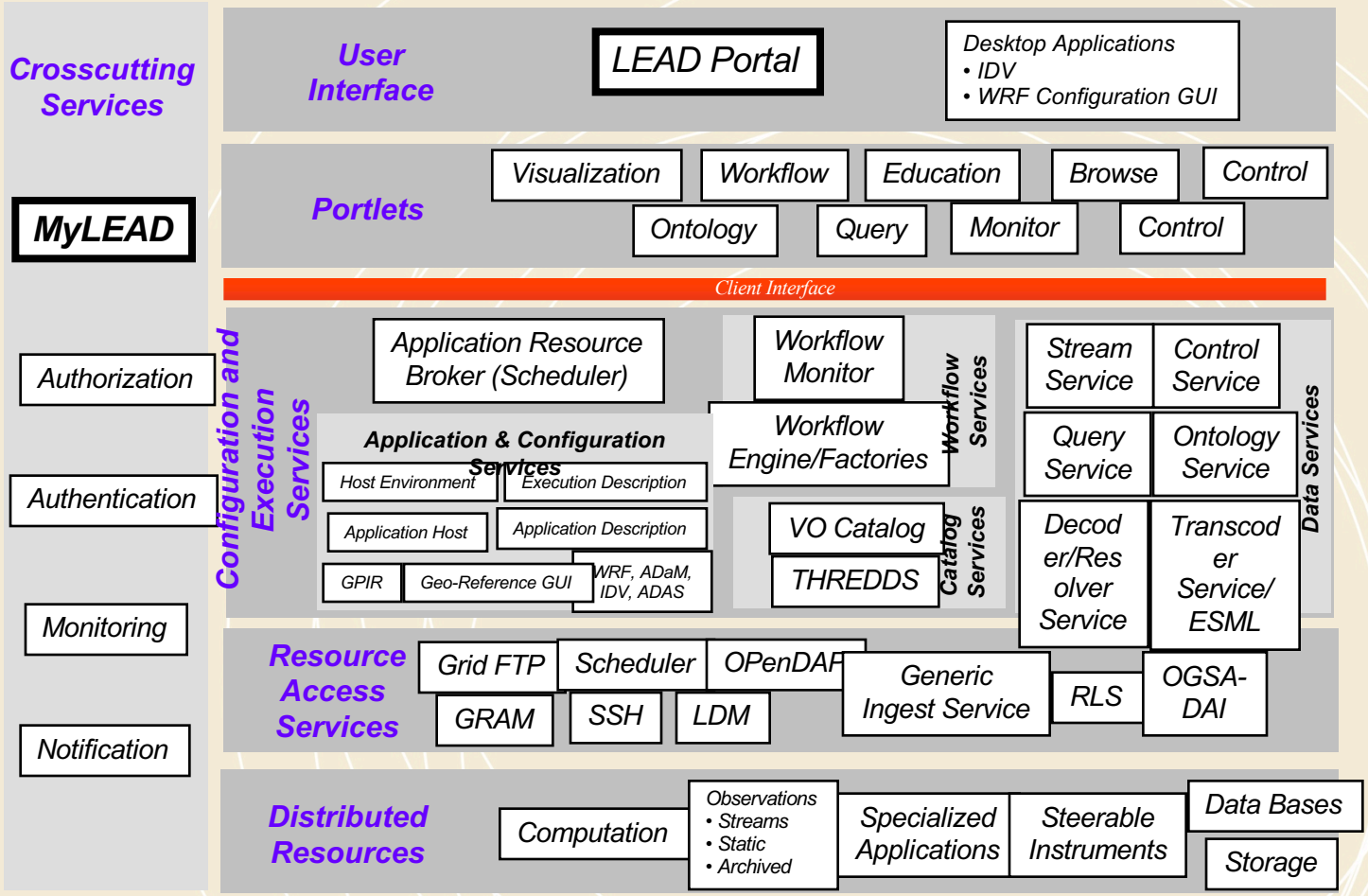


On-Demand Grid Computing

Fundamental Research Question

Can we better understand the atmosphere, educate more effectively about it, and forecast more accurately if we adapt our technologies and approaches to the weather as it occurs?

(micro)service architecture in 2003



If LEAD started in 2016

- Leverage the open source software resulting from Web-Scale Architectures.
- Focus on “Science” without necessarily getting distracted to “engineer” a scalable, fault tolerant and interoperable distributed system.

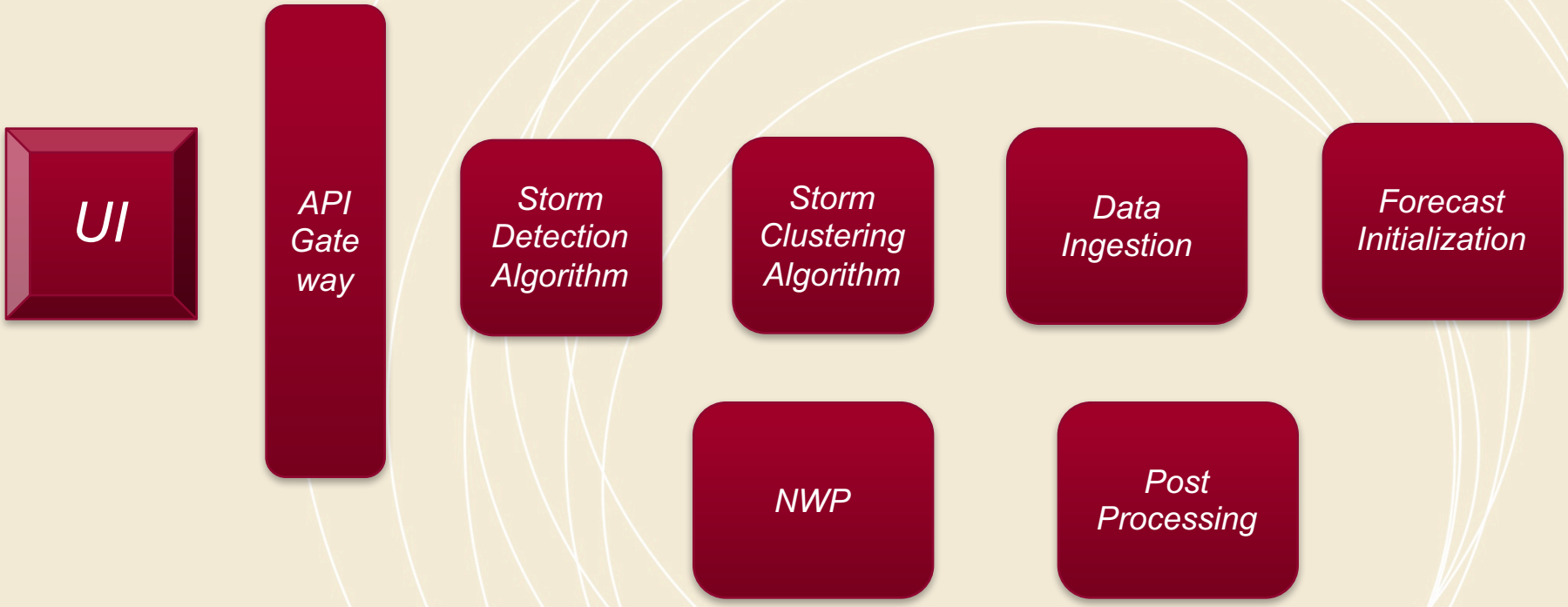
Project Use Case

- Develop a simplified personal weather predictor
  - Mock the implementation of services to avoid getting distracted.
  - Focus on the Science Gateway Architecture a special case of “Distributed System”.

Weather Predictor

- Two distinct and dependent aspects:
  - Diagnostic
    - Assimilate initiate state of the atmosphere.
  - Prognostic
    - Knowledge of the physical laws which determine the evolution of the atmosphere.
    - Requires running weather simulation models on supercomputers.
    - Focus of project milestone 4

Implement "mock" services



Project Milestone 1 Preparation

- Learn how to write API's in REST and Apache Thrift
- Decide on your Programming Languages.
- Decide on your Web Framework.
- Learn how to use build systems like Apache Maven.
- Test-Driven Development

Thank You!

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