MUSICAL: Leveraging MUSICA to innovate on the aerosol/chemistry science across US weather/climate models

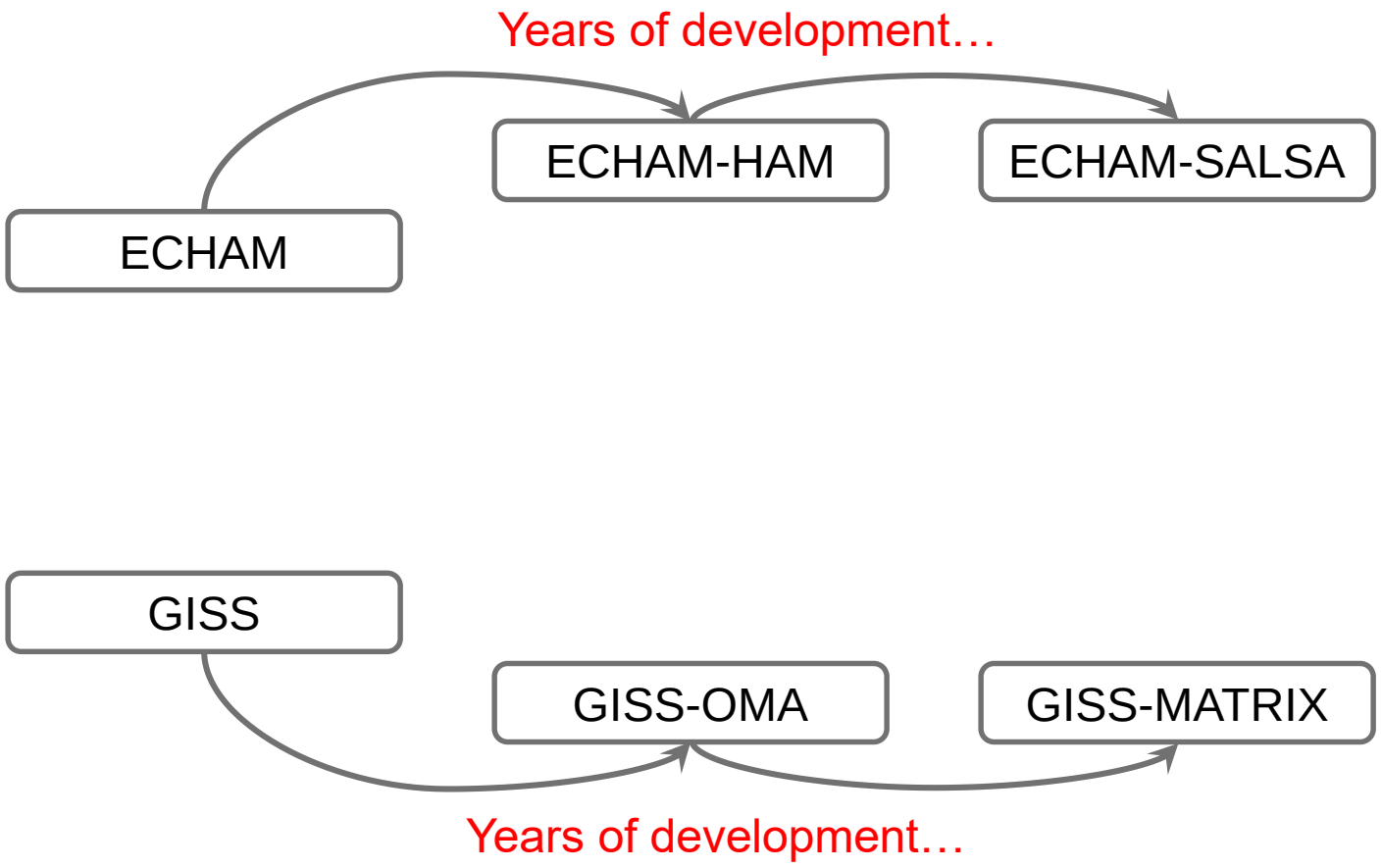
Abstract modeling interface for chemistry and aerosols

Susanne Bauer (NASA GISS), Andrew Conley (NCAR), Matt Dawson (NCAR), Louisa Emmons (NCAR), Jerome Fast (PNNL), Paul Ginoux (NOAA GFDL), Alma Hodzic (NCAR), Larry Horowitz (NOAA GFDL), Daniel J. Jacob (Harvard), Oriol Jorba (BSC), Xiaohong Liu (TAMU), Po-Lun Ma (PNNL), **Natalie Mahowald (Cornell)**, Nicole Reimer (UIllinois), Simone Tilmes (NCAR), Kostas Tsigaridis (Columbia University/NASA GISS), Hailong Wang (PNNL), Matt West (UIllinois), Rahul Zaveri (PNNL), Jean-Francois Lamarque (NCAR)

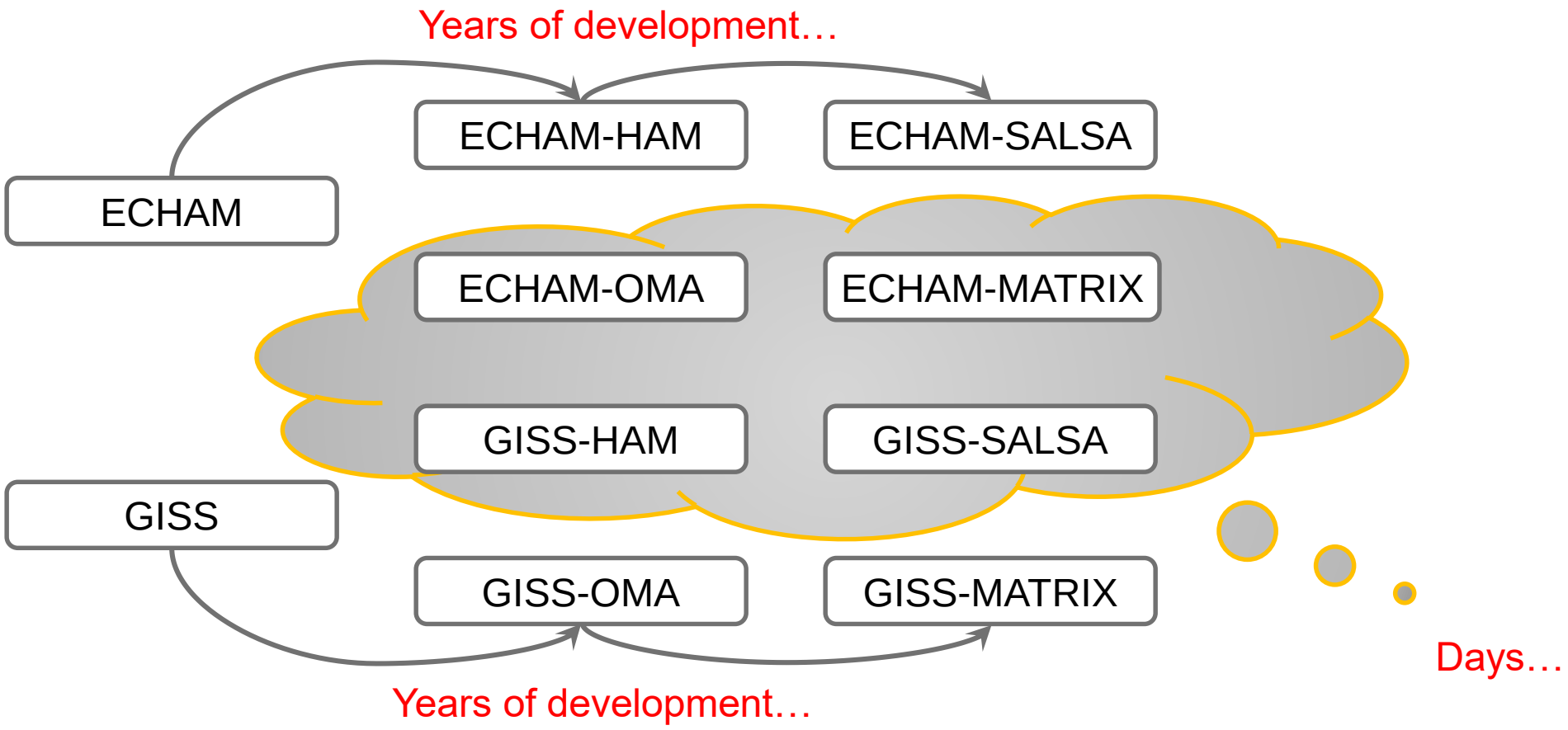
COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK

National Aeronautics and Space Administration
Goddard Institute for Space Studies
New York, N.Y.

Real life example



Imagine…


Years of development…
ECHAM
ECHAM-HAM
ECHAM-SALSA
ECHAM-OMA
ECHAM-MATRIX
GISS-HAM
GISS-SALSA
GISS
GISS-OMA
GISS-MATRIX
Days…
Years of development…

Goals/motivation for discussing a unified interface

- Pros
  - Can do more science: swap in and out different modules in different models.
  - Good for university/independent folks (can get funding from more sources).
  - Use ESMF framework, so build on other efforts.
  - New Earth System Prediction possible funding?
  - Opportunity right now: MUSICA trying to build WRF/CESM framework: can we make it broader?
  - Opportunity to get more funding?

- Cons
  - Some elements are so tied to physics: very hard.
  - Funding/agency priority issues.

(possible) Goals here

- Long term goal: build interface or set of interfaces that could be used by multiple modeling groups

- Short term: write a very short white paper describing why and send to program officers
  - ‘Workshops’ to identify needs.
  - Programmer funding to implement at different centers.
  - If everyone on this call decided to join: very convincing set of players for climate system/aerosol/chemistry group.

Associated challenges with the parameterization

- Difficult to add new species, update aerosol representation; or aerosol-cloud interactions.
- Lack of portability across platforms/host models.
- Lots of links to other components (radiation, clouds, chemistry) of the host model which makes it difficult to modify aerosol representation.
- Difficult to coordinate successive developments by multiple users.
- Changes in aerosol-related physics treatment make them hard to use. Would be easier if the changes can be flexibly switched on/off.
- Difficult to swap between model versions.
- One needs to be very familiar with the particular model to figure out the changes needed to make updates.
- When there are several aerosol schemes, the hooks to the host model are generally more generic.

Associated challenges with the host model interface

- It is all over the place in the host model.
- Lots of cross-dependencies with other components.
- Not a very clean programming interface.
- Not standardized.
- Interfacing with some components e.g. emissions is done by hand.