

Water isotope tracers in CESM

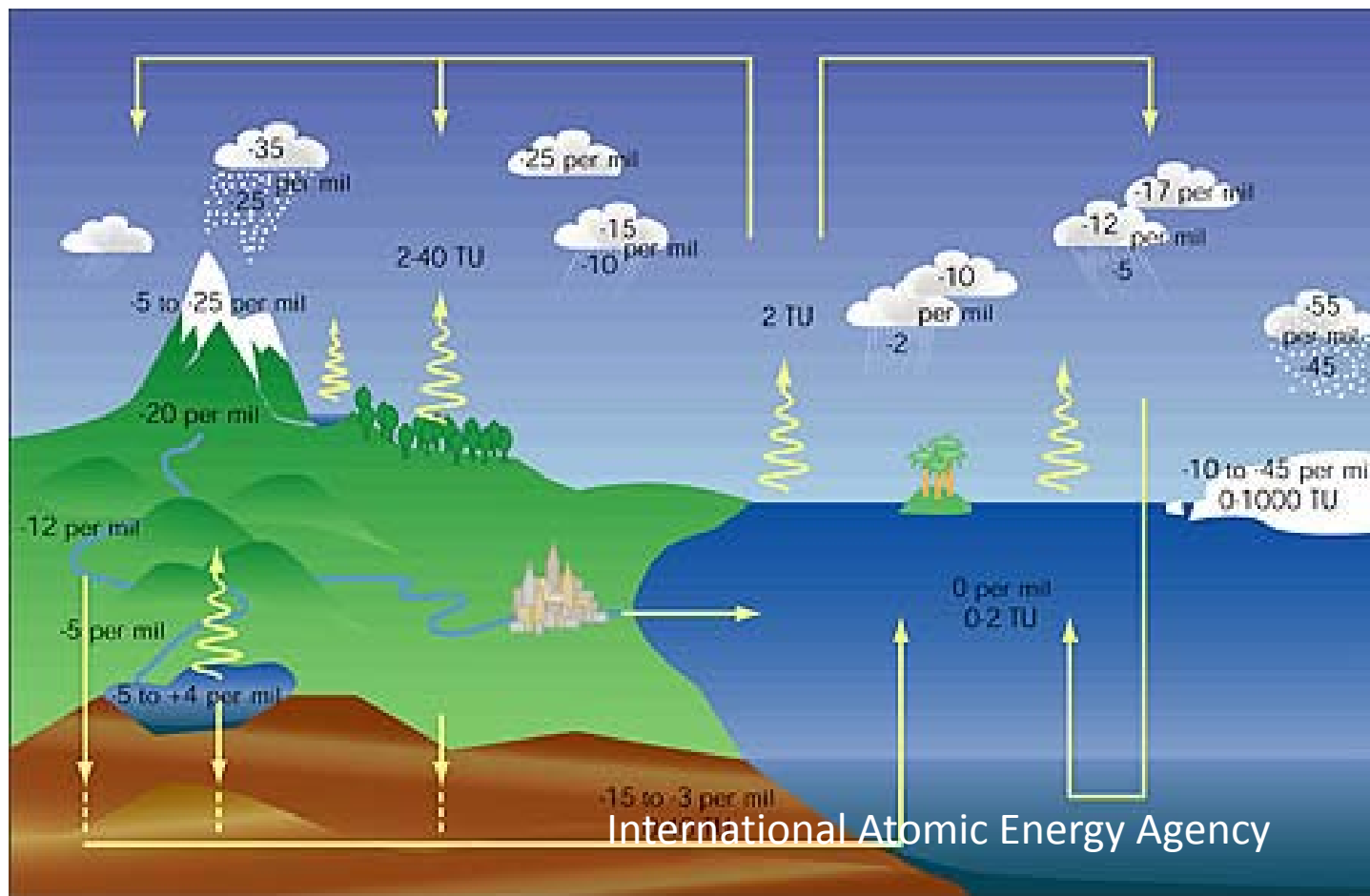
David Noone, Jesse Nusbaumer, Tony Wong (U. Colorado)

Chuck Bardeen (NCAR)

Also Bill Riley and Jinyung Tang (LNBL)

Hydrologic cycle with isotopic exchange

Isotopic information used to help correctly balance the water budget
(observed and modeled)



“Delta values” $\delta^{18}\text{O} = (R/R_{\text{standard}} - 1) \times 1000$ $R = \text{moles of H}_2^{18}\text{O} / \text{moles of H}_2^{16}\text{O}$

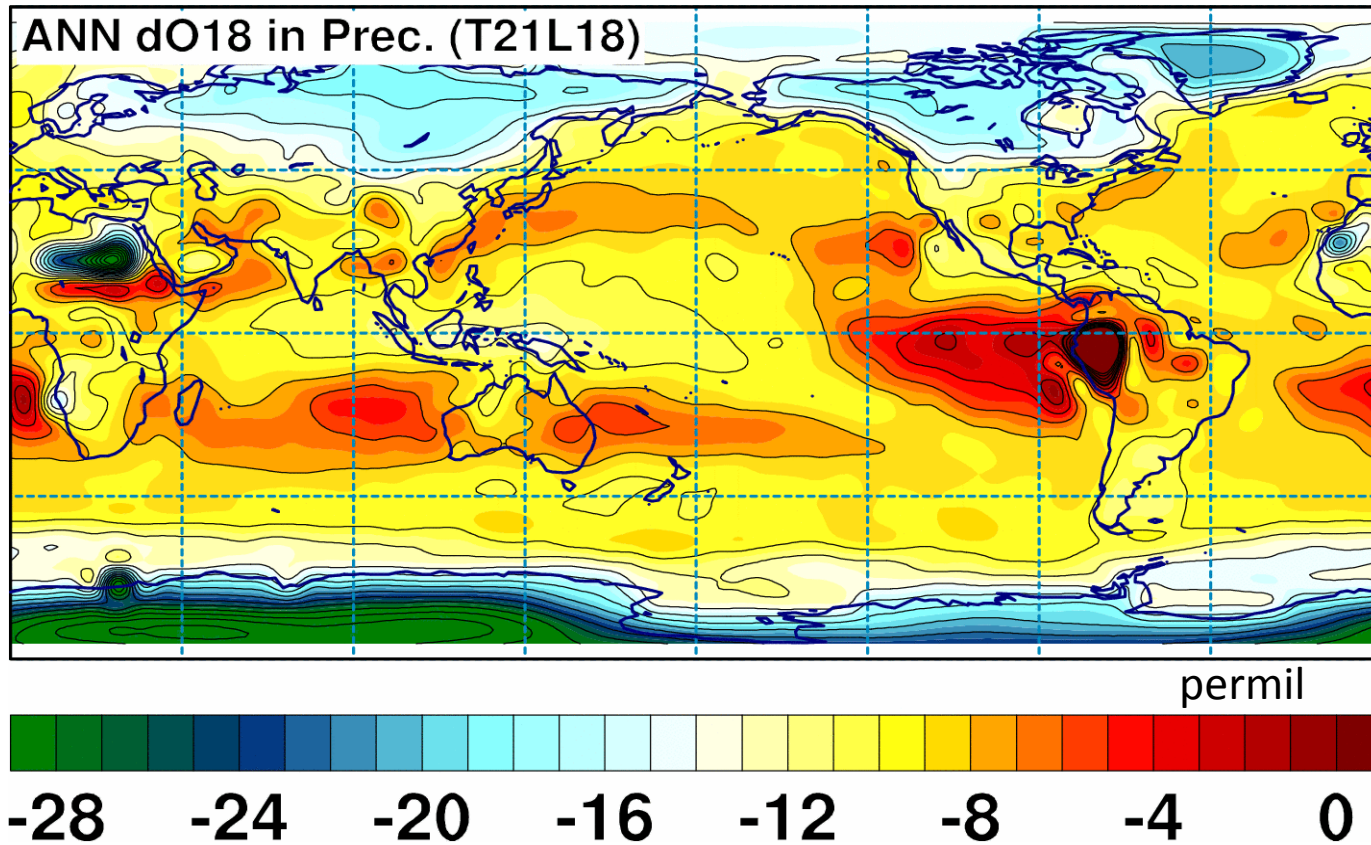
Community modeling efforts

- Stable Water isotope INtercomparison Group (SWING) was a “MIP” under GEWEX and IAEA.
- Swing 1 (2002) 4 isotope enabled AGCMs
- SWING 2 (2008) 13 models

- iPILPS (land model intercomparison) ~ 4 land surface models

- Within CESM family, isotope tracer codes have been in CCM3 (twice!), CAM2, CAM2.3, CAM3.0.
- Growing interest from paleo community, and other groups for supported code in standard release.
- Requires generic aqueous phase tracers as an infrastructure consideration.

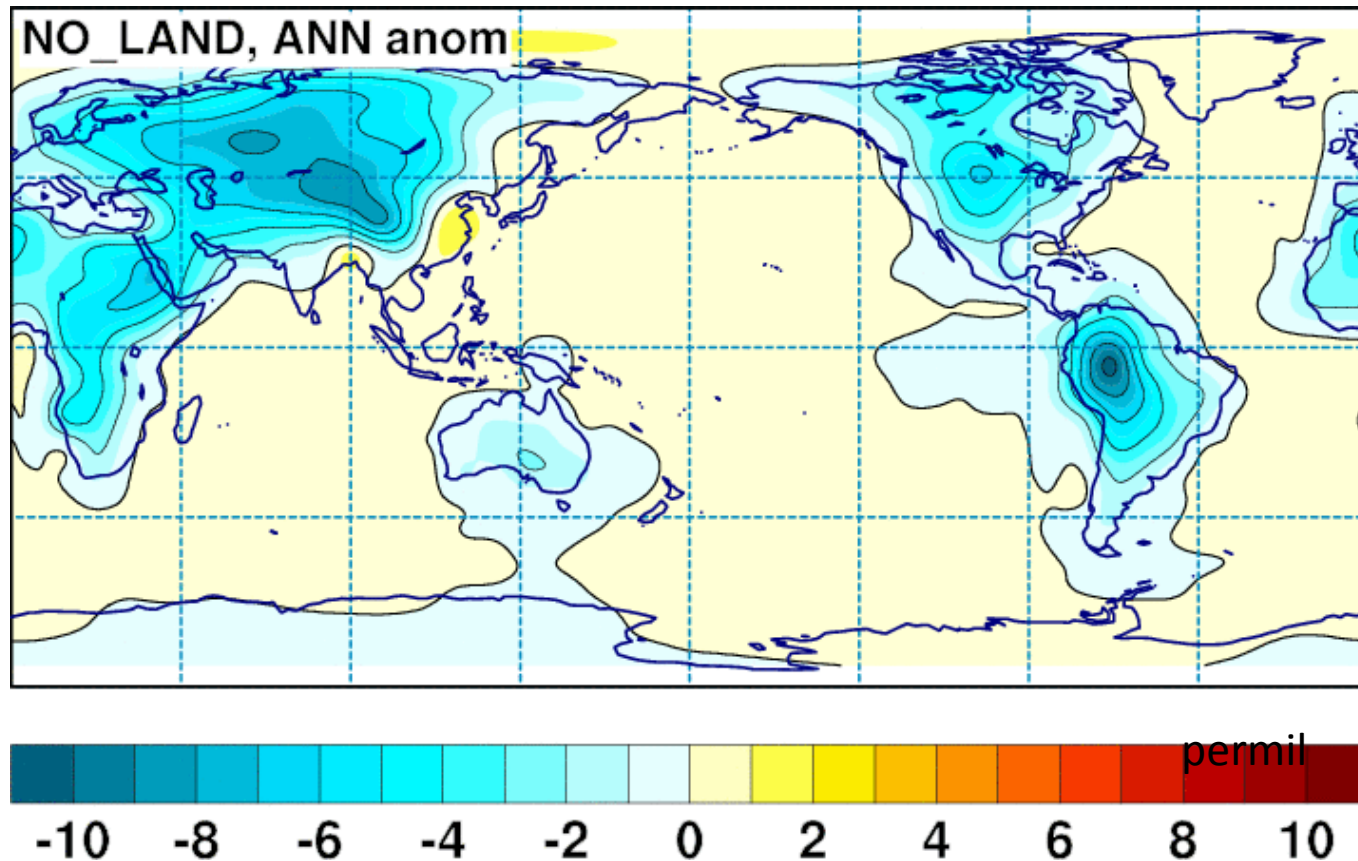
Water isotopes CCM3/LSM1



Test simulation (3 years) captures large scale distribution

- Depleted high latitude, continental interiors, region of convection
- Enrichment in high evaporation regions

Tracking fate of water and its isotopes



Land water source tagged (plot shows difference when all ET is suppressed)

- Identify role of recycling on local isotopic signal (measurement precision is 0.02 permil)
- Local water tends to enrich further precipitation by measurable amounts
- Good models strength of terrestrial impact on atmospheric hydrology.

Science interests in water (isotope) tracers

- Approximately 5 groups using ISOCAM3 for ***paleoclimate*** applications. Better comparison with ice core, tree ring cellulose, speleothem and corals
- Climatology from ISOCAM3 used as initial guess in ***satellite retrieval*** of HDO from NASA Tropical Emission Spectrometer
- Other contemporary studies applications on atmospheric ***contemporary hydrology*** in climate (water origins) (including correcting errors in convective and boundary layer parameterizations)
- Atmosphere-Biosphere ***coupling and feedbacks*** at regional scales, e.g., for regional scale water resource assessments
- Others...

CAM5
(evolution from
ISOCAM3.0,
ISOCCM3)

Jesse Nusbaumer (CU)
Chuck Bardeen (NCAR)
With David Noone

CLM
(evolution from
ISOLSM, ISOCLM3,
and CLM-BTR)

Tony Wong (CU)
Jinyung Tang (LNBL)
With David Noone and Bill Riley

Timeline

Phased approach

- CAM5 stand alone
- CLM4-BTR stand alone
- Anticipate combining code with preliminary runs for CESM workshop

- Implementation generic to allow multiple water “tagged” tracers
(generalized to allow aqueous phase chemistry/tracers)
- Specific implementation now for ^{18}O and 2H , with trivial addition of ^{17}O and ^3H