

AOSC 658N: North American Hydroclimate: Seasonal-to-Interannual Variability

Background: Hydroclimate refers to the weekly (and longer term) averaged distributions of near-surface meteorological and hydrologic fields such as precipitation, surface (air) temperature, streamflow, surface radiative fluxes, sensible and latent heat fluxes, soil temperature, evaporation, soil moisture, surface and subsurface runoff, etc. Many of the fields are influential in shaping both the water and energy cycles; the listing order reflects the increasing uncertainty with which they are known.

Hydroclimate analysis is distinct from hydrologic analysis, which typically focuses on the sub-degree scale basins (e.g., USDA watersheds, Mesonets). The important and interesting connections with the neighboring and remote regions, via atmospheric circulation and moisture fluxes, are highlighted in hydroclimate analyses. The course will thus focus on the structure and mechanisms of regional-to-subcontinental scale hydroclimate variability over North America. Extreme events - droughts and pluvials/floods - in the 20th century record will be discussed. Western Water issues will be covered, but most likely, in the 2nd offering of the course.

Broad Outline:

- Global Water Cycling
- Data sets: Observations .vs. observationally constrained products
- Annual-mean structure and seasonal/intra-seasonal variability of hydroclimate fields
- Precipitation processes: Convective and Stratiform rainfall; resulting heating profiles
- Named circulation features: North American monsoon, Pacific & Bermuda Highs, Great Plains Low Level jet, Gulf of California Low Level jet, etc.
- Moisture transports; stationary & transient fluxes; storm tracks; back trajectories
- Atmospheric water balance: Moisture flux convergence .vs. Evaporation; Storage
- Surface water balance: Evaporation .vs. surface/subsurface runoff
- Surface energy balance: Net radiative influence of clouds; Bowen Ratio
- Interannual hydroclimate variability: Pacific (ENSO, PDO, NPO) and Atlantic (NAO, TAV) influences in the cold and warm seasons; Mechanisms
- Intraseasonal hydroclimate variability: Influence of the Madden-Julian Oscillation
- Drought and floods in the 20th century; Palmer Drought index; Causes/impact of the Dust bowl drought (1930s)
- Hydroclimate variability in Global Change: Signals in IPCC climate change simulations
- Western Water issues: Solid phase recharge and discharge
- Topics of students' interest

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CSS 3435, alfredo@atmos.umd.edu, 301 405 0160
- Time & Room: Conference Room (CSS 3425); 9:30-10:45pm (M,W)
- Please send Alfredo and me an email with your contact information; include "AOSC 658N" in the title line. Mention your current research interests, name of your advisor, degree sought, topics that you would like to see covered, and list the other courses you are taking this semester. Also let us know if you are auditing the course. Thanks.
- Format: Reading assignment & presentation 30%
Project 70%
- Individual projects: Assigned by mid September: Goal is to produce a small publication quality analysis/paper
 - *Introduction*: Problem statement, motivation, literature search and contextual discussion of why the proposed analysis strategy is novel and potentially insightful. (15%; no figures; order 5 pages; double spaced; 12 font; due **late September**; looking for a nice, brief synthesis of what is done and not done, and how your project will advance things
 - *Data set and analysis method descriptions* due in **mid October** (10%)
 - Mid-stream presentation (20 minutes) in **mid November** (15%; peer)
 - Full project report with summary and discussion sections due in **mid December**; oral presentations in the Finals week (25%)
- Project logistics
 - Fortran and Grads
 - Computer accounts
 - Data set access
 - Individual

Project Ideas:

- **Palmer Drought Severity Index:** Monitors meteorological drought conditions. Compute monthly PDSI from North American Regional and ERA-40 global reanalyses which are widely used in climate variability studies. PDSI availability will make these data sets more useful for hydroclimate studies. The computed index should be intercompared with NOAA's operationally generated index.
- **SST and Droughts in the 20th century:** Explore linkage between Pacific and Atlantic basin SST variability and regional-to-subcontinental scale droughts over the US. Both continental and oceanic centric analyses can be conducted to investigate antecedent drought conditions in the adjoining basins. If antecedent linkages exists, drought predictability can be investigated as well. Knowledge of EOFs will be helpful here.
- **Drought incidence/strength in IPCC Global warming simulations:** Compute drought frequency and amplitude in the current and future climate simulations.
- **Land-surface energy balance in regional hydroclimate variability:** Characterize the balance in observational, reanalysis, and climate simulation data sets; and their impact on surface air temperature.
- **Terrestrial Water Balance over the North American continent:** Uncertainties
- **Atmospheric Water Balance over the neighboring Oceans:** Residual diagnosis of evaporation and implications for salinity.
- **Hydroclimate footprints of climate teleconnection patterns on monthly time scales:** Contemporaneous links of ENSO, NAO, NPO, and PDV variability.
- **Western Water issues:** The Colorado River Basin: Terrestrial water balance and trends in 20th Century; IPCC report.