

CLIM 751: PREDICTABILITY AND PREDICTION OF WEATHER AND CLIMATE – CONCEPTS AND PHENOMENOLOGY

Fall 2026 – Syllabus
(updated 31 July 2026)

Instructor: James (Jim) Kinter (office: 284 Research Hall, e-mail: ikinter@gmu.edu)

Class Schedule: Tuesday 10:30 am – 1:10 pm (face-to-face: 281 Research Hall)

Textbooks, Recommended and Supplementary Reading Materials:

Required Reading: See list below. All reading materials will be posted on Canvas.

Course Description:

This course covers predictability and seamless prediction of weather and climate for timescales ranging from days to decades. Studies limitations to predictability due to chaos, and possible sources of predictability due to slowly varying surface boundary conditions produced by interactions among atmospheres, ocean and land system. Discusses predictability of droughts and floods, monsoons, ENSO, decadal variations and climate change.

Course Requirements:

1. *Presentation of Selected Papers from the Literature:* 70%
2. *Data analysis project:* 30%

Each week, selected students will be assigned to present papers from the scholarly literature. *All* students are expected to read *all* the required papers each week. All students are expected to conduct a data analysis exercise, using data sets provided for the course including long time series of re-forecasts and verifying observations. A separate assignment sheet describes the data analysis project.

Detailed Course Schedule (subject to minor adjustment)

Date	Week	Lecturer	Topic
25 Aug	1	Kinter	Logistics; Introduction; Prediction of Weather & Climate
1 Sep	2	Kinter / Reed	Data Analysis Project
8 Sep	3	Shukla	Weather Predictability & Dynamical Seasonal Prediction
15 Sep	4	DeSole	Predictability of Decadal Var. & Climate Change
22 Sep	5	Krishnamurthy	Predictability of the South Asian Monsoon
29 Sep	6	Koster	Land Surface Predictability
6 Oct	7	Straus	Intraseasonal Predictability
13 Oct	8	Kinter	Predicting Probabilities and Extreme Events - Ensembles
20 Oct	9	Kinter / Reed	Data Analysis Project
27 Oct	10	Straus	Seasonal Prediction: ENSO
3 Nov	NA	NA	NO CLASS (Election Day)
10 Nov	11	Buckley	Ocean Dynamics and North Atlantic SST
17 Nov	12	Stan	The Ocean's Role in Tropical Climate Prediction
24 Nov	13	Kinter	AI/ML in Weather and Climate Prediction
1 Dec	14	Students	Data Project Presentations

PAPERS The papers listed below (subject to revision) are readings for each week of the course. The references below are either *REQUIRED* (should be read by all students), *RECOMMENDED* (optional reading), or *PRESENTED* (to be presented by students; highlighted in yellow). In some weeks, there will be two papers presented by students. In other weeks, there will only be a single paper presented, whose impact will be assessed by a different student. A separate schedule of student presentations will be provided.

1 – INTRODUCTION (no student presentations this week)

- *REQUIRED*: Shukla, J., 1985: Predictability. Issues in atmospheric and oceanic modeling, Part II. Weather Dynamics. *Advances in Geophysics*, Vol. 28B. Ed: S. Manabe, Academic Press, 87-122.
- *REQUIRED*: Craig, G. C., Fink, A. H., Hoose, C., Janjić, T., Knippertz, P., Laurian, A., Lerch, S., Mayer, B., Miltenberger, A., Redl, R., Riemer, M., Tempest, K. I., & Wirth, V. (2021). Waves to Weather: Exploring the Limits of Predictability of Weather, *Bulletin of the American Meteorological Society*, 102(11), E2151-E2164. <https://journals.ametsoc.org/view/journals/bams/102/11/BAMS-D-20-0035.1.xml>
- *REQUIRED*: Shukla, J. and J. L. Kinter III, 2006: Predictability of seasonal climate variations: A pedagogical review. In *Predictability of Weather and Climate*, T. Palmer and R. Hagedorn, eds. (Cambridge University Press, Cambridge, UK, 702 pp.), 306-341.

2 – DATA ANALYSIS PROJECT (no student presentations this week)

- *REQUIRED*: Huang, B., C.-S. Shin, J. Shukla, L. Marx, M. A. Balmaseda, S. Halder, P. A. Dirmeyer, and J. L. Kinter III, 2017: Reforecasting the ENSO Events in the Past Fifty-Seven Years (1958-2014). *J. Climate*, doi: 10.1175/JCLI-D-16-0642.1

3 – WEATHER & DYNAMICAL SEASONAL PREDICTION

- *TO BE PRESENTED*: Lorenz, E. N. (1982) Atmospheric predictability experiments with a large numerical model, *Tellus*, 34:6, 505-513, DOI: 10.3402/tellusa.v34i6.10836
- *TO BE PRESENTED*: Hoskins, B., 2013: The potential for skill across the range of the seamless weather-climate prediction problem: a stimulus for our science. *Quart. J. Roy. Meteor. Soc.*, 139: 573–584.
- *REQUIRED*: Lorenz 1969: Three approaches to atmospheric predictability. *Bull. Amer. Meteor. Soc.*, 50, 345-351.
- *REQUIRED*: Lorenz, E. N. 1963: Deterministic Nonperiodic Flow. *J. Atmos. Sci.*, 20, 130-141.
- *REQUIRED*: Lorenz, E. N., 1975: Climate predictability: The physical basis of climate modeling. *GARP Publication Series*, 16, WMO, 132–136. AND Hoskins, B., 2012: Predictability Beyond the Deterministic Limit. *WMO Newsletter*, 61, World Meteor. Org. (<https://public.wmo.int/en/bulletin/predictability-beyond-deterministic-limit>).
- *REQUIRED*: Shukla, J., 1998: Predictability in the Midst of Chaos: A Scientific Basis for Climate Forecasting. *Science*, 282, 728-731.
- *REQUIRED*: Shukla, J., 1981: Dynamical predictability of monthly means. *J. Atmos. Sci.*, 38, 2547-2572.
- *RECOMMENDED*: Miyakoda, K. and J. Sirutis, 1985: Extended range forecasting, *Adv. Geophys.*, 28B, 55-85.

4 – DECADAL & CLIMATE CHANGE

- *TO BE PRESENTED*: IPCC AR6: chapter 4: Future Global Climate: Scenario-based Projections and Near-term Information (up to and including sec. 4.4). <https://www.ipcc.ch/report/ar6/wg1/>

- **TO BE PRESENTED:** Scaife and Smith, 2018: A signal-to-noise paradox in climate science. *npj* <https://www.nature.com/articles/s41612-018-0038-4>
- **REQUIRED:** DelSole, T., 2017: Decadal Prediction of Temperature: Achievements and Future Prospects. *Curr. Climate Change Rep.*, doi: 10.1007/s40641-017-0066-x.
- **REQUIRED:** Smith, D.M., R. Eade, A. A.Scaife, L.-P. Caron, G. Danabasoglu, T. M. DelSole, T. Delworth, F. J. Doblas-Reyes, N. J. Dunstone, L. Hermanson, V. Kharin, M. Kimoto, W. J. Merryfield, T. Mochizuki, W. A. Müller, H. Pohlmann, S. Yeager, Yang, X., 2019: Robust Skill of Decadal Predictions. *npj Nature Climate and Atmospheric Science*, 2, <https://www.nature.com/articles/s41612-019-0071-y>.
- **RECOMMENDED:** Latif, M., and N. S. Keenlyside, 2011: A perspective on decadal climate variability and predictability, *Deep Sea Res., Part II*, 58(17–18), 1880–1894, doi:10.1016/j.dsr2.2010.10.066.

5 – SOUTH ASIAN MONSOON

- **TO BE PRESENTED:** Charney, J. G., and J. Shukla, 1981: Predictability of monsoons. *Monsoon Dynamics*, J. Lighthill, and R. P. Pearce, Eds., Cambridge University Press, 99-109.
- **TO BE PRESENTED:** Shin, C.-S., B. Huang, and J. Shukla, 2025: Influences of the Indian Ocean SST on the Indian summer monsoon and its seasonal prediction in El-Nino Developing years. *J. Climate*, **38**, 6129-6152.
- **REQUIRED:** Krishnamurthy, V., 2017: Seasonal prediction of South Asian monsoon in CFSv2, *Climate Dyn.* doi:10.1007/s00382-017-3963-8
- **REQUIRED:** Krishnamurthy, V., 2017: Predictability of CFSv2 in the tropical Indo-Pacific region at daily and subseasonal time scales. *Clim. Dyn.*, doi:10.1007/s00382-017-3855-y

6 – LAND SURFACE

- **TO BE PRESENTED:** Dirmeyer, P. A., and S. Halder, and R. Bombardi, 2018: On the harvest of predictability from land states in a global forecast model. *J. Geophys. Res.: Atmos.*, **123**, 13,111-13,127, <https://doi.org/10.1029/2018JD029103>.
- **TO BE PRESENTED:** Koster, R. D., and Coauthors, 2011: The second phase of the Global Land-Atmosphere Coupling Experiment: Soil moisture contributions to subseasonal forecast skill. *J. Hydrometeor.*, **12**, 805-822, <https://doi.org/10.1175/2011JHM1365.1>.
- **REQUIRED:** Koster, R. D., and Coauthors, 2004: Regions of strong coupling between soil moisture and precipitation. *Science*, **305**, 1138-1140, <https://doi.org/10.1126/science.1100217>.
- **REQUIRED:** Santanello, J. A., and Coauthors, 2018: Land-atmosphere interactions: The LoCo perspective. *Bull. Amer. Meteor. Soc.*, **99**, 1253-1272, <https://doi.org/10.1175/BAMS-D-17-0001.1>.
- **REQUIRED:** Shukla, J. and Y. Mintz, 1982: Influence of Land-Surface Evapotranspiration on the Earth's Climate. *Science*, **215**, 1498-1501, DOI:[10.1126/science.215.4539.1498](https://doi.org/10.1126/science.215.4539.1498)
- **REQUIRED:** Rahmati, M., and Coauthors, 2024: Soil Moisture Memory: State-Of-The-Art and the Way Forward. *Reviews of Geophysics*, **62**, e2023RG000828, <https://doi.org/10.1029/2023RG000828>

7 – DATA ANALYSIS PROJECT

- **REQUIRED:** Huang, B., C.-S. Shin, J. Shukla, L. Marx, M. A. Balmaseda, S. Halder, P. A. Dirmeyer, and J. L. Kinter III, 2017: Reforecasting the ENSO Events in the Past Fifty-Seven Years (1958-2014). *J. Climate*, doi: 10.1175/JCLI-D-16-0642.1

8 – PROBABILITIES AND EXTREME EVENTS (ENSEMBLE PREDICTION)

- **TO BE PRESENTED:** Slingo, J. and T. N. Palmer, 2016: Uncertainty in weather and climate

prediction. *Phil. Trans. R. Soc. A* (2011) 369, 4751–4767.

- **TO BE PRESENTED:** Weisheimer, A., F. J. Doblas-Reyes, T. Jung, and T. N. Palmer, 2011: On the predictability of the extreme summer 2003 over Europe, *Geophys. Res. Lett.*, 38, L05704, doi:[10.1029/2010GL046455](https://doi.org/10.1029/2010GL046455).
- **REQUIRED:** Leutbecher, M. 2018: Ensemble size: How suboptimal is less than infinity? *Quart. J. Roy. Meteor. Soc.*, 145, 107–128. <https://doi.org/10.1002/qj.3387>
- **REQUIRED:** Hagedorn, R., F. J. Doblas-Reyes and T. N. Palmer, 2005: The rationale behind the success of multi-model ensembles in seasonal forecasting – I. Basic concept. *Tellus*, 57A, 219–233.
- **REQUIRED:** Krishnamurthy, V., Stan, C. Prediction of extreme events in precipitation and temperature over CONUS during boreal summer in the UFS coupled model. *Clim Dyn* 59, 109–125 (2022). <https://doi.org/10.1007/s00382-021-06120-0>
- **REQUIRED:** Fischer, E.M., Beyerle, U., Bloin-Wibe, L. *et al.* Storylines for unprecedented heatwaves based on ensemble boosting. *Nat Commun* 14, 4643 (2023). <https://doi.org/10.1038/s41467-023-40112-4>
- **REQUIRED:** Gershunov, A., 1998: ENSO influence on intraseasonal extreme rainfall and temperature frequencies in the contiguous United States: Implications for long-range predictability. *J. Climate*, 11, 3192–3203.
- **RECOMMENDED:** Vitart, F., Robertson, A.W., 2018: The sub-seasonal to seasonal prediction project and the prediction of extreme events. *npj Clim Atmos Sci* 1, 3. <https://doi.org/10.1038/s41612-018-0013-0>
- **RECOMMENDED:** Becker, E. F., H. van den Dool, and Q. Zhang, 2014: Predictability and Forecast Skill in NMME. *J. Climate*, 27, 5891–5906.
- **RECOMMENDED:** Pegion, K., and Coauthors, 2019: The Subseasonal Experiment (SubX): A Multimodel Subseasonal Prediction Experiment. *Bull. Amer. Meteor. Soc.*, 100, 2043–2060.
- **RECOMMENDED:** Kirtman, B. P., D. Min, J. M. Infanti, J. L. Kinter III, ^[SEP] D. A. Paolino, Q. Zhang, H. van den Dool, S. Saha, M. Pena Mendez, E. Becker, P. Peng, P. Tripp, J. Huang, D. G. DeWitt, M. Tippett, A. G. Barnston, S. Li, A. Rosati, S. D. Schubert, M. Rienecker, M. Suarez, Z. E. Li, L. Marshak, Y.-K. Lim, J. Tribbia, K. Pegion, W. J. Merryfield, B. Denis, E. F. Wood, 2014: The North American Multimodel Ensemble: Phase-1 Seasonal-to-Interannual Prediction; Phase-2 toward Developing Intraseasonal Prediction. *Bull. Amer. Meteor. Soc.*, 95, 585–601.
- **RECOMMENDED:** Pepler, A. S., L. B. Diaz, C. Prodhomme, F. J. Doblas-Reyes, A. Kumar, 2015: The ability of a multi-model seasonal forecasting ensemble to forecast the frequency of warm, cold and wet extremes. *Wea. Climate Extremes*, 9, 68–77.
- **RECOMMENDED:** Sillmann, J., Thorarindottir, T., Keenlyside, N., Schaller, N., Alexander, L.V., Hegerl, G., Seneviratne, S.I., Vautard, R., Zhang, X., Zwiers, F.W., 2017: Understanding, modeling and predicting weather and climate extremes: challenges and opportunities. *Weather Clim. Extremes*, 18, 65–74.
- **RECOMMENDED:** Feudale, L. and J. Shukla, 2011a: Influence of sea surface temperature on the European heat wave of 2003 summer. Part I: an observational study. *Climate Dyn.*, 36:1691–1703, DOI 10.1007/s00382-010-0788-0
- **RECOMMENDED:** Feudale, L. and J. Shukla, 2011b: Influence of sea surface temperature on the European heat wave of 2003 summer. Part II: a modeling study. *Climate Dyn.*, 36:1705–1715, DOI 10.1007/s00382-010-0789-z
- **RECOMMENDED:** Namias, J., 1978: Multiple causes of the North American abnormal winter of 1976–77. *Mon. Wea. Rev.*, 106 (1978), pp. 279–295.
- **RECOMMENDED:** Miyakoda, K., T. Gordon, R. Caverly, W. Stern, and J. Sirutis, 1983: Simulation of a blocking event in January 1977. *Mon. Wea. Rev.*, 111, 846–869.

9 – INTRASEASONAL

- **TO BE PRESENTED:** Kim, H. et al., 2018: Prediction of the Madden-Julian Oscillation: A Review. *J. Climate*, 31, 9425-9443.
- **TO BE PRESENTED:** Ferranti, L., L. Magnusson, F. Vitart and D. S. Richardson, 2018: How far in advance can we predict changes in large-scale flow leading to severe cold conditions over Europe? *Quart. J. Roy. Meteor. Soc.*, 144, 1788-1802. DOI:10.1002/qj.3341.
- **REQUIRED:** Simmons, A. J., J. M. Wallace, and G. W. Branstator, 1983: Barotropic Wave Propagation and Instability, and Atmospheric Teleconnection Patterns. *J. Atmos. Sci.*, **40**, 1363-1392.
- **REQUIRED:** Vitart, F., 2017: Madden-Julian Oscillation prediction and teleconnections in the S2S database. *Quart. J. Roy. Meteor. Soc.*, 143, 2210-2220. July 2017 A DOI:10.1002/qj.3079.
- **RECOMMENDED:** Straus et al, 2023: Intrinsic predictability limits arising from Indian Ocean Madden-Julian oscillation (MJO) heating: effects on tropical and extratropical teleconnections. *Wea. Clim. Dyn.*, 4, 1001–1018. <https://doi.org/10.5194/wcd-4-1001-2023>
- **RECOMMENDED:** Sardeshmukh, P. D., and B. J. Hoskins, 1988: The Generation of Global Rotational Flow by Steady Idealized Tropical Divergence. *J. Atmos. Sci.*, **45**, 1228-1251.
- **RECOMMENDED:** Judt, F., 2020: Atmospheric Predictability of the Tropics, Middle Latitudes, and Polar Regions Explored through Global Storm-Resolving Simulations. *J. Atmos. Sci.*, 77, 257-276.
- **RECOMMENDED:** Vitart, F., and F. Molteni, 2010: Simulation of the Madden-Julian Oscillation and its teleconnections in the ECMWF forecast system. *Quart. J. Roy. Meteor. Soc.*, 649B, 842–855.
- **RECOMMENDED:** Ferranti, L., S. Corti and M. Janousek, 2014: Flow-dependent verification of the ECMWF ensemble over the Euro-Atlantic sector. *Quart. J. Roy. Meteor. Soc.*, 688A, 916–924.

10 – SEASONAL PREDICTION: ENSO

- **TO BE PRESENTED:** Timmermann, A., An, S., Kug, J. et al. 2018: El Niño–Southern Oscillation complexity. *Nature* 559, 535–545. <https://doi.org/10.1038/s41586-018-0252-6>
- **TO BE PRESENTED:** L’Heureux, M.L, A.F.Z. Levine, M. Newman, C. Ganter, J.-J. Luo, M. K. Tippett, and T. N. Stockdale, 2020: ENSO Prediction. In *El Niño Southern Oscillation in a Changing Climate* (an AGU book to be published in August). (only a manuscript is available now)
- **REQUIRED:** Zhu, J., B. Huang, L. Marx, J. L. Kinter III, M. A. Balmaseda, R.-H. Zhang, and Z.-Z. Hu, 2012: Ensemble ENSO hindcasts initialized from multiple ocean analyses. *Geophys. Res. Lett.*, 39, L09602, DOI:10.1029/2012GL051503.
- **REQUIRED:** McPhaden, M. J., A. Timmermann, M. J. Widlansky, M. A. Balmaseda, and T. N. Stockdale, 2015: The curious case of the El Niño that never happened. *Bull. Amer. Meteor. Soc.*, 96, 1647-1665.

11 – OCEAN DYNAMICS AND NORTH ATLANTIC SST

- **TO BE PRESENTED:** Yeager et al (2018). Predicting near term changes in the earth system, BAMS, doi: 10.1175/BAMS-D-17-0098.1
- **TO BE PRESENTED:** Deser et al (2003): Understanding persistence of sea surface temperature anomalies in the midlatitudes. *J. Climate*, 16, 52-72. Doi:10.1175/1520-0442(2003)016<0057:UTPOSS>2.0.CO;2
- **REQUIRED:** Buckley, M.W. and J. Marshall (2016). Observations, inferences and mechanisms of the Atlantic Meridional Overturning Circulation: a review. *Reviews of Geophysics*, 54, 5–63.

doi: 10.1002/2015RG000493. ONLY required to read sections 2.4 and 6. The rest of the paper, particularly the introduction and section 2 may be useful background for students, particularly those not familiar with the oceanography of the Atlantic Ocean.

- **RECOMMENDED:** Buckley, M. W., T. DelSole, M. S. Lozier, and L. Li (2019), Predictability of North Atlantic Sea Surface Temperature and Upper Ocean Heat Content, *J. Climate*, 32, 3005–3023, doi: 10.1175/JCLI-D-18-0509.1.
- **RECOMMENDED:** Liu, Glenn and Kwon, Young-Oh and Frankignoul, Claude and Lu, Jian (2023), Understanding the Drivers of Atlantic Multidecadal Variability using a Stochastic Model Hierarchy, *J. Climate*, 36, 1043–1058, doi: 10.1175/JCLI-D-22-0309.1

12 – OCEAN’S ROLE

- **TO BE PRESENTED:** Chang, P., T. Yamagata, P. Schopf, S. K. Behera, J. Carton, W. S. Kessler, G. Meyers, T. Qu, F. Schott, S. Sheyte, and S.-P. Xie, 2006: Climate Fluctuations of Tropical Coupled Systems – The Role of Ocean Dynamics. *J. Climate*, 19, 5122–5174.

13 – AI / ML IN PREDICTION

- **TO BE PRESENTED:** Any of the following:
 - Bi, K., L. Xie, H. Zhang, X. Chen, X. Gu, and Q. Tian, 2023: Pangu-Weather: A 3D High-Resolution System for Fast and Accurate Global Weather Forecast. *arXiv preprint arXiv:2211.02556*.
 - Kurth, T., and Co-authors, 2023: FourCastNet: Accelerating global high-resolution weather forecasting using adaptive Fourier neural operators. *Proc. Platform for Advanced Scientific Computing Conf.*, Davos, Switzerland, ACM, 11 pp., <https://doi.org/10.1145/3592979.3593412>.
 - Lam, R., and Coauthors, 2023: Learning skillful medium-range global weather forecasting. *Science*, 382, 1416–1421, <https://doi.org/10.1126/science.adi2336>.
 - Lang, S., and Coauthors, 2024: AIFS–ECMWF's data-driven forecasting system. *arXiv*, 2406.01465, <https://doi.org/10.48550/arXiv.2406.01465>.
- **TO BE PRESENTED:** Any of the following:
 - Pasche, O.C., Wider, J., Zhang, Z., Zscheischler, J. and Engelke, S., 2025. Validating deep learning weather forecast models on recent High-Impact extreme events. *Artificial Intelligence for the Earth Systems*, 4, p.e240033. <https://journals.ametsoc.org/view/journals/aies/4/1/AIES-D-24-0033.1.xml>
 - Ullrich, P.A., and Co-Authors, 2025. Recommendations for comprehensive and independent evaluation of machine learning-based Earth system models. *Journal of Geophysical Research: Machine Learning and Computation*, 2(1), p.e2024JH000496.
 - Eyering, V., and Co-authors, 2024: Pushing the frontiers in climate modelling and analysis with machine learning. *Nat. Climate Change.*, 14, 916–928, <https://doi.org/10.1038/s41558-024-02095-y>
- **RECOMMENDED:** Barnes, E. A., and Coauthors, 2025: Combining climate models and observations to predict the time remaining until regional warming thresholds are reached. *Environ. Res. Lett.*, 20, <https://doi.org/10.1088/1748-9326/ad91ca>.
- **RECOMMENDED:** Chantry, M., H. Christensen, P. Dueben, and T. Palmer, 2021: Opportunities and challenges for machine learning in weather and climate modelling: hard, medium and soft AI. *Philos. Trans. Roy. Soc. London*, A379, 20200083, <https://doi.org/10.1098/rsta.2020.0083>.
- **RECOMMENDED:** de Burgh-Day, C. O., and T. Leeuwenburg, 2023: Machine learning for numerical weather and climate modelling: A review. *Geosci. Model Dev.*, 16, 6433–6477, <https://doi.org/10.5194/gmd-16-6433-2023>.

- *RECOMMENDED*: Duncan, W. J., and Coauthors, 2025: SamudrACE: Fast and Accurate Coupled Climate Modeling with 3D Ocean and Atmosphere Emulators. *arXiv*:2509.12490v1
- *RECOMMENDED*: Kent, C., Scaife, A.A., Dunstone, N.J. *et al.* Skillful global seasonal predictions from a machine learning weather model trained on reanalysis data. *npj Clim Atmos Sci* **8**, 314 (2025). <https://doi.org/10.1038/s41612-025-01198-3>
- *RECOMMENDED*: Shi, J., Shirali, A., Jin, B., Zhou, S., Hu, W., Rangaraj, R., Wang, S., Han, J., Wang, Z., Lall, U. and Wu, Y., 2025. Deep learning and foundation models for weather prediction: A survey. *arXiv*, arXiv:2501.06907.

Goals and Learning Outcomes:

The course will:

1. *Provide a background in the scientific problem of weather and climate predictability.* Students will gain an in-depth understanding of how and why weather and climate is or is not predictable. Students will have the opportunity to critically review the scholarly literature on the predictability of variations of the Earth system at time scales of days to decades. The emphasis on both the nature of scientific findings and the impact that individual papers have had on subsequent scholarship ensures that students will gain an appreciation for the practice of professional scientific inquiry.
2. *Provide knowledge and skills necessary to conduct original quantitative research in predictability.* By having access to a research-quality data set for analysis and manipulation, the students will develop the ability to work with high-volume geophysical data from a variety of sources.
3. *Reinforce oral and written communication skills.* Students will present papers from the literature, evaluate the impact these papers have had on the scientific body of knowledge, and critically examine the results reported in the literature. Students will write reports on the findings of their calculations with research-quality data sets, with the potential to submit truly new findings for peer-reviewed publication.

Academic Standards

Academic Standards exist to promote authentic scholarship, support the institution's goal of maintaining high standards of academic excellence, and encourage continued ethical behavior of faculty and students to cultivate an educational community which values integrity and produces graduates who carry this commitment forward into professional practice.

As members of the George Mason University community, we are committed to fostering an environment of trust, respect, and scholarly excellence. Our academic standards are the foundation of this commitment, guiding our behavior and interactions within this academic community. The practices for implementing these standards adapt to modern practices, disciplinary contexts, and technological advancements. Our standards are embodied in our courses, policies, and scholarship, and are upheld in the following principles:

- **Honesty:** Providing accurate information in all academic endeavors, including communications, assignments, and examinations.
- **Acknowledgement:** Giving proper credit for all contributions to one's work. This involves the use of accurate citations and references for any ideas, words, or materials created by others in the style appropriate to the discipline. It also includes acknowledging shared authorship in group projects, co-authored pieces, and project reports.
- **Uniqueness of Work:** Ensuring that all submitted work is the result of one's own effort and is original, including free from self-plagiarism. This principle extends to written assignments, code, presentations, exams, and all other forms of academic work.

Violations of these standards—including but not limited to plagiarism, fabrication, and cheating—are taken seriously and will be addressed in accordance with university policies. The process for reporting, investigating, and adjudicating violations is outlined in the university's procedures. Consequences of violations may include academic sanctions, disciplinary actions, and other measures necessary to uphold the integrity of our academic community.

The principles outlined in these academic standards reflect our collective commitment to upholding the highest standards of honesty, acknowledgement, and uniqueness of work. By adhering to these principles, we ensure the continued excellence and integrity of George Mason University's academic community.

Student responsibility: Students are responsible for understanding how these general expectations regarding academic standards apply to each course, assignment, or exam they participate in; students should ask their instructor for clarification on any aspect that is not clear to them.

Guidelines for the use of Artificial Intelligence (AI)

Generative AI tools (e.g. ChatGPT, Claude, Gemini, CoPilot) may be used in this course with the following guidelines. Students may use generative AI tools to prepare answers to questions on homework or to create text or code in course projects. Students must disclose when AI tools are used and how they contributed to the work. Students may be quizzed on material generated by AI tools in order to demonstrate mastery of concepts. Misuse may be treated as a violation of academic standards.

Accommodations for Students with Disabilities

Disability Services at George Mason University is committed to upholding the letter and spirit of the laws that ensure equal treatment of people with disabilities. Under the administration of University Life, Disability Services implements and coordinates reasonable accommodations and disability-related services that afford equal access to university programs and activities. Students can begin the registration process with Disability Services at any time during their enrollment at George Mason University. If you are seeking accommodations, please visit <https://ds.gmu.edu/> for detailed information about the Disability Services registration process. Disability Services is located in Student Union Building I (SUB I), Suite 2500. Email: ods@gmu.edu. Phone: (703) 993-2474.

Student responsibility: Students are responsible for registering with Disability Services and communicating about their approved accommodations with their instructor *in advance* of any relevant class meeting, assignment, or exam.

FERPA and Use of GMU Email Addresses for Course Communication

The [Family Educational Rights and Privacy Act \(FERPA\)](#) governs the disclosure of [education records for eligible students](#) and is an essential aspect of any course. **Students must use their GMU email account** to receive important University information, including communications related to this class. Instructors will not respond to messages sent from or send messages regarding course content to a non-GMU email address.

Student responsibility: Students are responsible for checking their GMU email regularly for course-related information, and/or ensuring that GMU email messages are forwarded to an account they do check.

Title IX and Non-Discrimination: Access and Compliance with George Mason's Non-discrimination Policies

George Mason University is committed to providing a safe and non-discriminatory learning, living, and working environment across all educational programs, services, and activities for all members of the University community. University educational programs, services, and activities will be free from discrimination on the basis of race, color, religion, ethnic national origin (including shared ancestry and/or ethnic characteristics), sex, disability, military status (including veteran status), sexual orientation, gender identity, gender expression, age, marital status, pregnancy status, genetic information, or any other characteristic protected by law.

Required Reporting

All non-confidential employees, including your faculty members, have a legal requirement to report all relevant details, obtained directly or indirectly, about any incident of discrimination or harassment, including Title IX Prohibited Conduct, to the Office of Access, Compliance, and Community (OACC), which includes the Title IX Coordinator.

Reportable Conduct by an employee, a student, or a third party includes:

- Discrimination and harassment under Title VI or Title VII, which can include unequal and unfavorable treatment in the educational/work environment or conduct (oral, written, graphic) that is physically threatening, harmful, or humiliating.
- Prohibited Conduct under Title IX, which can include sexual harassment, sexual assault, gender-based stalking, or dating/domestic violence.
Upon notification, OACC professionals will assess the report and determine if outreach is required. If outreach is required, the potentially harmed individual (the “Complainant”) will receive a communication, likely in the form of an email, with an offer to meet with a representative of the appropriate team.

Applicable Policies and Resources

- University Policy 1201: Non-Discrimination
 - Contact masoneo@gmu.edu with related questions.
- University Policy 1202: Sexual and Gender-Based Harassment and Other Interpersonal Violence
 - Contact titleix@gmu.edu with related questions.
- University Policy 1204: Prohibited Relationships with Students

General questions may be directed to OACC at oacc@gmu.edu, or by phone at 703-993-8730, or in person on the Fairfax campus in Aquia 373 or at Mason Square in Van Metre Hall Suite 222.

Student opportunity: If you prefer to speak to someone *confidentially*, please contact one of Mason’s confidential employees in Student Support and Advocacy (SSAC), Counseling and Psychological Services (CAPS), Student Health Services (SHS), and/or the Office of the University Ombudsperson.

Other Useful Campus Resources:

Mason has several support services for students. Please go to

<https://stearnscenter.gmu.edu/knowledge-center/knowning-mason-students/student-support-resources-on-campus/>

for a directory of services.

Other University Policies:

The University Catalog, <http://catalog.gmu.edu>, is the central resource for university policies affecting student, faculty, and staff conduct in university academic affairs. Other policies are available at <http://universitypolicy.gmu.edu/>. All members of the university community are responsible for knowing and following established policies.