



1 Moving Sea Ice Prediction Forward Via Community Intercomparison

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39 FIRST SEA ICE OUTLOOK CONTRIBUTORS' WORKSHOP: SUSTAINING AND  
40 IMPROVING SEASONAL SEA ICE PREDICTION VIA COMMUNITY  
41 INTERCOMPARISON

42 What: Participants met to discuss how to sustain and improve seasonal sea ice prediction via the  
43 annual Sea Ice Outlook (SIO), an international activity organized each year by the multi-agency-  
44 sponsored Sea Ice Prediction Network—Phase 2(SIPN2).

45 WHEN: 21-22 JANUARY 2021

46 WHERE: VIRTUAL, ORGANIZED BY THE SIPN2 PROJECT TEAM AND THE ARCTIC RESEARCH  
47 CONSORTIUM OF THE UNITED STATES (ARCUS).

48

49 The Sea Ice Prediction Network—Phase 2 (SIPN2) is a multi-agency international effort to  
50 compare seasonal sea ice prediction methods and results at pan-Arctic, pan-Antarctic, and  
51 regional spatial scales using a multi-disciplinary approach that includes modeling, data analysis,  
52 and scientific networks. SIPN2 builds on lessons learned during the first phase of the Sea Ice  
53 Prediction Network (2014-2017), and since then has expanded in scope with activities that have  
54 included community seminars, workshops, and extensive research on the topic of seasonal sea  
55 ice prediction.

56

57 A central SIPN2 activity and product is a Sea Ice Outlook (SIO) developed and released for each  
58 summer month (June to August). The SIO is a vehicle for interested individuals and research  
59 groups to submit a seasonal prediction of sea ice conditions; these are then collected and  
60 categorized based on the prediction method employed: (i) dynamical modeling, (ii) statistical  
61 modeling (including machine learning), and (iii) heuristic methods. Predictions of pan-Arctic

62 September mean sea ice extent (SIE) are requested on three dates: May 1, June 1, and July 1.  
63 (SIE is defined as the summed area of all model grid cells with a sea ice concentration of at least  
64 15%. September represents the end of the ice melt season when SIE is at its seasonal minimum.)  
65 SIO predictions are typically validated using SIE derived from the satellite passive microwave  
66 brightness temperature record that extends from late 1978 to the present. While Arctic SIE has  
67 trended downward over the period of satellite observations in all months (and most strongly in  
68 September), extent at both the pan-Arctic and regional scales is highly variable from year to  
69 year.

70

71 Work under SIPN is relevant to understanding both the trends and variability of sea ice  
72 parameters. Regional-scale variability is of particular interest to a variety of stakeholders,  
73 including indigenous communities, fisheries, shipping, and national security interests. More  
74 recently, the scope of SIPN has expanded to include Southern Ocean seasonal sea ice prediction,  
75 where SIE is characterized by pronounced regional anomalies, strong inter-annual variability,  
76 and a slight positive trend at the pan-Antarctic scale. The SIO has also expanded to include the  
77 prediction of other variables such as the timing of ice retreat and advance. Several studies have  
78 analyzed SIO predictions, comparing them with observations and with predictions based on  
79 simple schemes such as persistence or linear trends (Stroeve et al. 2014; Hamilton & Stroeve  
80 2016).

81

82 On 21-22 January, 2021, the first-ever SIO Contributors Forum was held as an online workshop,  
83 hosted by the Arctic Research Consortium of the United States (ARCUS). There were 70  
84 participants from ten countries, including SIO contributors and the SIPN2 leadership team.

85 Sessions were held in the morning (Pacific time) on both days, and in the evening on the first day  
86 (Pacific time) to facilitate participation with colleagues in both European and east Asian time  
87 zones. The meeting included a mix of pre-recorded presentations, plenary and lightning talks,  
88 and breakout group discussions. The agenda and list of participants may be found here:  
89 <https://www.arcus.org/sipn/meetings/2021/contributors-workshop>. Online presentations were not  
90 publicly posted, since this forum focused on the free exchange of ideas and information,  
91 including work in progress and “messy results” that require further study.

92

93 Participants shared and discussed successes and challenges in Arctic and Antarctic sea ice  
94 prediction, identified future activities to improve seasonal prediction, and recommended future  
95 collaboration and networking activities.

96

97 Plenary presentations covered a broad range of topics relevant to the SIO, including an  
98 intercomparison between SIE observational products (which use different methods to convert  
99 satellite data into ice concentration), a review of the role of sea ice initial conditions (the starting  
100 point of forecasts that may include SIE but also sea ice thickness, sea surface temperature, and  
101 other variables), potential lessons to be learned on predictability from the hurricane prediction  
102 community, a perspective from the private stakeholder sector, and a meta-analysis of the more  
103 than 1,000 predictions contributed to the SIO to date. Lightning talks provided brief updates  
104 from each SIO contributor, structured around the following questions: What method are you  
105 using? What is working well? What is not working? Are your forecasts improving? What is  
106 needed in the future to improve forecasting?

107

108 Breakout group discussion topics were guided by a summary of an SIO contributor survey that  
109 was circulated prior to the meeting. These topics included skill metrics, model validation, model  
110 intercomparison, user needs, predictability, initialization, and data assimilation.

111

112 The SIO for the 2021 Arctic sea-ice melt season is now underway, and has already implemented  
113 some of the recommendations from the meeting (see sidebar). In particular, contributors are  
114 asked to submit SIE anomaly predictions, relative to their computed long-term linear trends.  
115 Additionally, a September 1 prediction will be solicited. Moving forward, annual SIPN  
116 contributors' workshops are envisioned, subject to funding.

117

118 Sidebar:

119 Several key recommendations emerged from the workshop:

- 120 • Extend the number of annual pan-Arctic September mean SIE prediction dates from the  
121 current three (June 1, July 1, August 1) to five (adding May 1 and September 1).
- 122 • Explore adding new metrics, including SIE anomalies and measures of ice advance  
123 timing. Specifics may benefit from a survey of contributors and users.
- 124 • Update a previous 2016 initialization experiment with a consistent ice thickness  
125 initialization, while perturbing initial states and analyzing the impact of “initialization  
126 shocks” in more detail.
- 127 • Publish a synthesis study of dynamical and statistical model forecasts approaches and  
128 skill.
- 129 • Create an SIO database to facilitate meta-analysis of predictions.

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