Background and guidelines for contributors to the

Sea Ice Drift Forecast Experiment

(SIDFEx)

version 1 September 2017

Feedback to this document and to SIDFEx generally to sidfex<AT>polarprediction<DOT>net is more than welcome.

Background

The Sea Ice Drift Forecast Experiment (SIDFEx, 2017–2020) is a community effort to collect and analyse Arctic sea ice drift forecasts at lead times from days to a year, based on arbitrary methods, for a number of sea-ice buoys and, ultimately, research icebreaker *Polarstern*, on a regular basis.

SIDFEx is motivated in part by the need to determine an optimal deployment position of the research icebreaker *Polarstern* when she will start her year-long drift across the Arctic in autumn 2019 (Multidisciplinary drifting Observatory for the Study of Arctic Climate – MOSAiC; http://www.mosaicobservatory.org). Specifically, it is unclear whether forecast systems that account for initial conditions and provide forecasts of the evolving atmosphere, ice, and ocean system, can provide additional skill over drift forecasts made using historical sea ice velocity fields. The MOSAiC drift provides a template for assessing the capabilities to forecast sea-ice drift for a range of applications, ranging from logistics support for future field experiments to potential search and rescue operations. The examination of sea ice drift forecasts provides an integrated assessment of many aspects of the coupled atmosphere-ice-ocean system and will motivate in depth investigations into how key variables are measured, modeled, and forecast. In particular, we expect coordinated drift forecasts to draw attention to the interaction between sea ice physics and boundary layer physics in both atmosphere and ocean. We expect that a systematic assessment of real drift forecasting capabilities will improve our physical understanding of sea ice and enable us to identify and resolve model shortcomings and identify limits of predictability.

SIDFEx is largely the result of discussions held at various meetings, in particular in the context of the Year of Polar Prediction (YOPP; http://www.polarprediction.net/yopp-activities/), MOSAiC, the Sea Ice Prediction Network (SIPN; https://www.arcus.org/sipn), the Forum for Arctic Modeling and Observations Systhesis (FAMOS; http://famosarctic.com/index.html), and the International Arctic Buoy Program (IABP; http://iabp.apl.washington.edu).

Timeline

Forecasts are invited starting at the beginning of June 2017 simultaneous with both the start of the 2017 SIPN Sea Ice Outlook (SIO) season and the launch of the Year of Polar Prediction Core Phase (mid-2017 – mid-2019). Forecasts targeting selected Arctic sea-ice buoys (Phase 1) will be collected on a regular basis. Beginning summer of 2019, specific forecasts will be solicited to help optimise the MOSAiC drift start (Phase 2). Subsequent forecasts (autumn 2019-2020) through autumn 2020 will project the

Polarstern trajectory (Phase 3). Phase 1 trajectory forecasts will continue through the end of the project (2020) to allow for broader spatial assessment of forecast skill.

Forecast Targets

In *Phase 1* (June 2017 – mid-2019) ~5 selected sea-ice buoys of the International Arctic Buoy Program (IABP) are targeted. These buoys are listed on a dedicated page of the website of the International Arctic Buoy Program (IABP; http://iabp.apl.washington.edu/SIDFEX.html), including near-real-time information on their position. The list of buoys may change as they stop operating and/or new buoys are added. Information on the retrieval of buoy positions are provided in the *Appendix*. This phase serves as a baseline during which experience is gained, model and forecast method shortcomings are diagnosed, and forecast quality can be assessed.

Phase 2 (summer/autumn 2019) will add additional forecast targets with relevance for the planning of the upcoming *Polarstern* drift. These targets will be virtual points distributed in the broader region of the possible drift start and will be determined in collaboration with MOSAiC planners and announced through http://www.polarprediction.net/yopp-activities/sidfex .

Phase 3 (autumn 2019 – autumn 2020) will include the *Polarstern* drift trajectory as the primary target with ship locations providing initial positions for forecasts. It is anticipated that these forecasts will be of considerable value to support MOSAiC operations, e.g., for the planning of supply operations and the ordering of satellite imagery.

Note that Phase 1 trajectory forecasts will continue through the end of the project (2020) to allow for broader spatial assessment of forecast skill and method/model biases.

Forecast methods and lead times

SIDFEx is open to any forecast methods as long as forecast method and source are identified and forecasts follow formatting conventions (see below). Example methods include drift trajectories derived from historical drift records (satellite, buoys, models), free-drift using atmospheric wind forecasts, as well as trajectories predicted from complex prognostic models. Following SIPN Outlook tradition, "heuristic" forecasts are also invited if the basis of the prediction (e.g., variables considered) are provided.

Forecast modes and submission deadlines

Forecasts can be submitted at any time and with any delay between the time of initialisation (initial buoy position and, if applicable, physical model state) and the time of submission. However, to streamline subsequent analyses, we define two primary forecast modes:

(i) *Monthly Mode*: Monthly forecasts initialised at the reported buoy position on the last day of the month. Ideally, these forecasts shall be submitted with no more than 10 days delay, but also later submission ("hindcasts") are invited.

(ii) *NRT (Near-Real-Time) Mode*: Daily (or less frequent) forecasts submitted with as little delay as possible.

Forecast range and time resolution

The *Monthly Mode* is aligned with the Sea Ice Outlook (SIO) and allows for a wide range of participants. Modelling groups already participating in the SIO can contribute easily to SIDFEx by computing trajectories for Lagrangian tracers. *Monthly Mode* contributions are expected to have a range (i.e., forecast lead time) from a month to a year, with temporal forecast resolution from a day (ideally) to a week. By contrast, contributions following the *NRT Mode* target operational forecast centers capable of providing more frequent updates (and higher time resolution). Seamless forecasts, ranging from days to a year, are encouraged.

IDs and forecast output format

Each contributing group (or individual) will be assigned a **GroupID** (a short unique text string) in consultation with the SIDFEx team (contact *sidfex<AT>polarprediction<DOT>net*). Each group or individual can define and "register" one or more **MethodID**s that should be short (< ~20 characters, avoiding fancy ones) and more or less meaningful. For each MethodID a concise method description needs to be sent to *sidfex<AT>polarprediction<DOT>net*. **TargetID**s are identical with IABP BuoyIDs in case of those, and the TargetID for *Polarstern* is just that: Polarstern. Additional TargetIDs for Phase 2 (see above) will be communicated in due course.

Forecasts shall be provided in simple ASCII text files that follow the below described file naming convention and content format.

File naming convention:
<GroupID>_<MethodID>_<TargetID>_<InitYear>-<InitDayOfYear>_<EnsMemNum>.txt

Example:
GroupX_MethodY_300234060834110_2017-61.417_001.txt

File content (example for a 12-day buoy drift forecast):

--- example file begins below this line
GroupID: GroupX
MethodID: MethodY
TargetID: 300234060834110
InitYear: 2017
InitDayOfYear: 61.417
InitLat: 85.24160
InitLon: 26.39600
EnsMemNum: 001
end of header

Year	*DayOfYear*	*Lat*	*Lon*
2017	*62.000*	*85.22420*	*26.40660*
2017	*63.000*	*85.21800*	*26.00540*
2017	*64.000*	*85.30060*	*25.86140*
2017	*65.000*	*85.20860*	*26.14940*
2017	*66.000*	*85.05520*	*26.85060*
2017	*67.000*	*84.97160*	*27.07000*
2017	*68.000*	*84.87860*	*26.95040*
2017	*69.000*	*84.76520*	*27.44780*
2017	*70.000*	*84.68420*	*27.60120*
2017	*71.000*	*84.61000*	*27.05020*
2017	*72.000*	*84.56660*	*27.68280*

2017 73.000 84.55160 27.62280
--- example file ends above this line

In case of single ("deterministic") forecasts, the ensemble member (*EnsMemNum*) number shall be *001*. In case of ensemble ("probabilistic") forecasts, one file for each member shall be submitted. The table may or may not contain the initial time and location of the target.

Following the IABP convention, all *DayOfYear* values start from *1.000* at the beginning of January 1st of each year.

The data table must start after the row "*### end of header*" with the column names provided in the example. The table can be space or tab delimited.

Apart from numeric values, the *Lat* and *Lon* columns may contain only the string "*NaN*".

The file name elements must exactly match the corresponding elements provided in the file header.

The format will be checked automatically for any submission and must be followed carefully. Those familiar with the programming language *R* may use the function *sidfex.checkfileformat()* provided in a corresponding script on the SIDFEx website, to check their files ahead of submission.

After submission (and a successful format check), five lines of the form
SubmitYear: 2017
SubmitDayOfYear: 62.621
ProcessedYear: 2017
ProcessedDayOfYear: 62.643
end of auto header
will be added automatically as first lines to the file header to document the submission time.

Forecast submission

Forecasts can be submitted through the cloud service of the German Climate Computing Centre (DKRZ) at any time. Permissions and instructions for the submission (e.g., using the UNIX tool *curl*) can be obtained by contacting *sidfex<AT>polarprediction<DOT>net* .

Note that the time of upload is noted and added automatically to enable a later assessment from a real-time and timeliness perspective.

If a submission does not pass the automatic file format check, no processed file will appear under the link provided below. Instead, the contributor will be contacted by the SIDFEx lead team with instructions as soon as possible. If a processed file appears, the format check was successful. When contributing for the first time, it is advisable first to submit only one file to see whether it passes the format check.

Getting the forecast data

After submission, each forecast is automatically processed and made publicly available in real-time (<1h delay) at the Cloud Service of the German Climate Computing Centre from this link:
https://swiftbrowser.dkrz.de/public/dkrz_0262ea1f00e34439850f3f1d71817205/SIDFEx_processed/ .
The results are ordered by contributor GroupIDs.

Automatic plots of recent results are under development, as are simple tools to browse, search, download, plot, and analyse the results.

Contact

For any questions related to SIDFEx, please contact the SIDFEx lead team at *sidfex<AT>polarprediction<DOT>net* .

SIDFEx lead team: Helge Goessling, Axel Schweiger, Ed Blanchard-Wrigglesworth, Thomas Krumpen, Marcel Nicolaus, Robert Grumbine, Ignatius Rigor .

Appendix

Current IABP buoy positions can be obtained from this URL (e.g., with *wget*), where <TargetID> needs to be replaced by a valid IABP BuoyID (e.g., 300234060834110):
http://iabp.apl.washington.edu/WebData/<TargetID>.dat

The current *Polarstern* position can be optained from this URL (e.g., with *wget*):
https://dashboard.awi.de/nrt/rest/data?limit=1&sensor=polarstern:hydrins:latitude&sensor=polarstern:hydrins:longitude