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EXTRATROPICAL TRANSITION AND THORPEX

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1. THORPEX

THORPEX: a Global Atmospheric Research Programme is an international research program to accelerate improvements in the accuracy of 1 to 14-day high-impact weather forecasts for the benefit of society and the economy. It builds upon ongoing advances within the research and operational-forecasting communities. It will make progress by enhancing international collaboration between these communities and with users of forecast products.

Core research objectives of THORPEX are:

- to contribute to the design and demonstration of interactive forecast systems that allow information to flow interactively between forecast users, numerical forecast models, data-assimilation systems and observations;
- to advance the knowledge of global-to-regional influences on the initiation, evolution, and predictability of high-impact weather;
- to collaborate with numerical forecast centres in the development of advanced data-assimilation and forecast model systems;
- to develop and apply new methods to enhance the utility of improved weather forecasts;
- to perform THORPEX Observing-System Tests (TOSTs) and THORPEX Regional field Campaigns (TreCs);
- to demonstrate the full potential of THORPEX research results for improving operational forecasts of high-impact weather on time-scales out to two weeks. This demonstration includes the THORPEX Global Prediction Campaign.

THORPEX is developed and implemented as a part of the WMO World Weather Research Programme (WWRP). Research objectives are developed under four Sub-programmes: Predictability and Dynamical Processes; Observing Systems; Data Assimilation and Observing Strategies; Societal and Economic Applications. More information can be found in the International Science Plan for THORPEX (Shapiro and Thorpe 2003).

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2. EXTRATROPICAL TRANSITION IN THORPEX

The extratropical transition (ET) of tropical cyclones can result in a high impact weather system with strong winds, heavy precipitation, and high seas. The societal impacts include severe flooding (e.g. Floyd in 1999, Atallah and Bosart 2003), landslides (e.g. Tropical Storm Janis in 1995), and bush fires (Foley and Hanstrum 1994). In addition, the modification of the extratropical tropopause by the outflow of a system undergoing ET can promote explosive extratropical cyclogenesis downstream of the ET event (Hoskins and Berrisford 1988).

Extratropical transition presents a particular challenge for numerical weather prediction on the 1-14 day timescale considered by THORPEX. Limited-area models that have adequate resolution to simulate the internal tropical cyclone features must rely on initial and boundary conditions from global models to represent the midlatitude circulation features into which the decaying tropical cyclone is moving. On the other hand, operational global models generally provide accurate guidance with respect to the midlatitude circulation patterns, but fail to capture the detailed tropical cyclone characteristics. Therefore, neither class of models adequately simulates interactions between a tropical cyclone and the midlatitude circulation. The occurrence of an ET event often compromises the forecast skill across an entire ocean basin. During August 1996 (Fig. 1) the forecast skill of the Navy Operational Global Atmospheric Prediction System (NOGAPS) over the western North Pacific was reduced dramatically when Typhoon Joy, Typhoon Kirk, and Typhoon Orson recurved and underwent ET.

Since ET is both a cause of high impact weather and a significant source of uncertainty in numerical weather forecasts, research into predictability issues associated with ET will both contribute to and benefit from the collaborative efforts within THORPEX. Through THORPEX more resources could be available to study predictability issues associated with ET. Research areas potentially leading to a measurable benefit to society would include the development of strategies for targeted observations, the investigation of the causes of the high

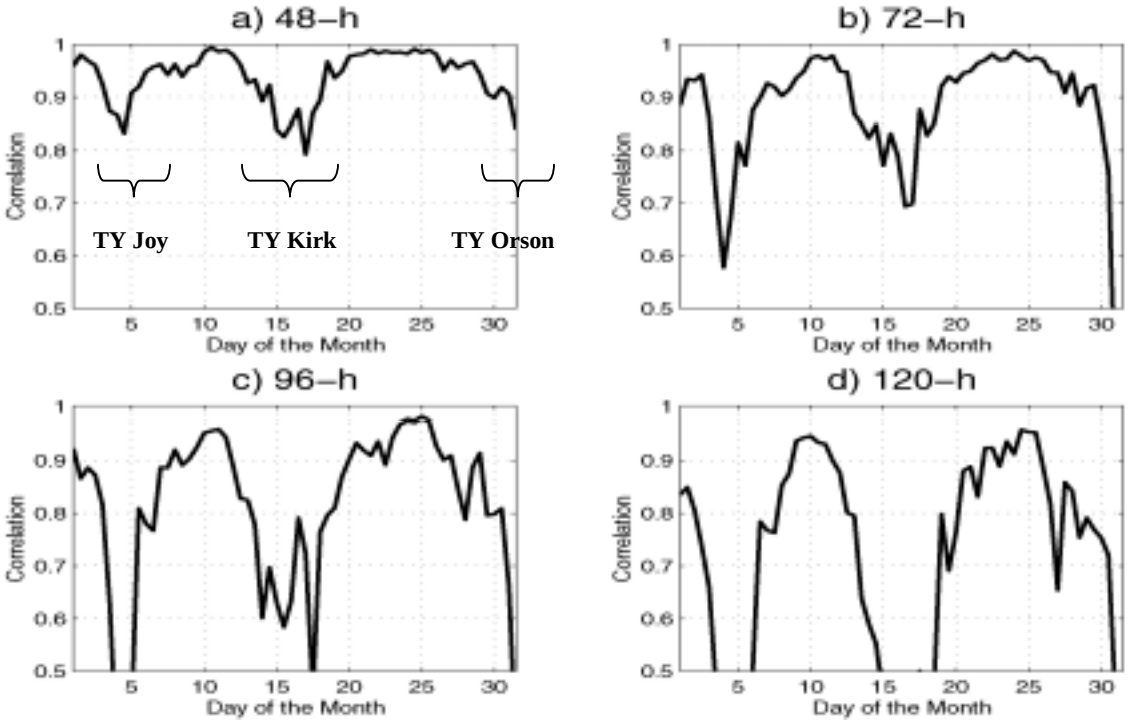

Figure 1: Anomaly correlations for Navy Operational Global Atmospheric Prediction System (NOGAPS) forecasts of 500-mb heights over the Northern Hemisphere during August 1996.Each panel represents a specific forecast interval as labeled in the figure. The extratropical transition events that occurred during the month are marked in panel (a). Taken from Jones et al. (2003).

uncertainty in numerical forecasts of ET, and the role of ET in the excitation of Rossby wave-trains leading to initiation of high impact weather well downstream of the ET event itself. Through THORPEX opportunities may arise to observe ET and its interaction with the midlatitude flow as part of Atlantic and Pacific TreCs. During the North Atlantic TReC in 2003 a collaboration was defined between THORPEX activities and the NOAA/Hurricane Research Division and Canadian field programs. During the NA-TreC Hurricane Kate and Tropical Storms Nicholas and Odette were identified as having a possible impact on the predictability over Europe. Targeted observations were made using the NOAA WP3s and G-IV in the case of Odette. Further ET observations may arise from targeted satellite observations based on model projections of analysis weaknesses.

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