Recent years have witnessed the arrival of more and more semantically annotated data and related ontologies in the Semantic Web. For example, the Linked Open Data initiative has been very successful in making ontologically annotated datasets available online, with a constantly evolving set of interconnected RDF graphs. While existing semantic tools and reasoning engines are getting better in dealing with time invariant ontological knowledge, supporting rapidly changing information has not until now attracted sufficient attention. However, with the deluge of dynamic data now being created — from sensor data streams, to geospatial information and imagery, financial transactions, news feeds, 3D models, engineering data, information for policy intelligence — the issues of evolving, maintaining, updating and managing data and knowledge on the Web over time are becoming critical.

The ontologies as the basis of the Semantic Web need to be updated: changes could be initiated because of a change in the world being modelled; or by a change in the users’ needs which would require a different conceptualization; or by the acquisition of knowledge previously unknown, unclassified or otherwise unavailable; or by the noticing of a design flaw in the original conceptualization. In all these cases, the representation of knowledge in the ontology should be modified so as to form a more accurate or adequate conceptualization of the domain.

At the data level, semantic data on the Web, especially linked data, suffers from the same issues. Conceptual structures at the basis of the representation of the data need to be maintained, access methods to the data need to take into account the evolution of the data, and links between different pieces of data need might require specific mechanisms where such pieces of data evolve over time.

In a nutshell, the general issue of Semantic Web dynamics includes difficulties from both practical and theoretical points of view, raising a variety of research questions and development challenges, such as how to support the ontology and data publishers in maintaining up-to-date, adequate representations; how to detect the need for evolution and changes; how to facilitate the integration of new, dynamic sources in existing datasets and ontologies; how to validate and evaluate the impact of the changes on semantic information; how to handle changes triggered from multiple sources and collaborative updates; and how to keep track of (possibly concurrent) versions of and ensure the delivery of up-to-date and valid knowledge.

In this special issue, we collect original, high quality articles that together answer some of these questions, focusing on the challenges raised by dynamic data and knowledge on the Semantic Web. In “Concept drift and how to identify it”, the authors consider the complex notion of concept drift on the Semantic Web, i.e., of the changes in the meaning of identified concepts over time. The authors use four concrete case studies in different, more or less open domains, and different formats. The practical result presented in this paper is a method to identify concept drift in Web ontologies.

“DSNotify – A Solution For Event Detection And Link Maintenance in Dynamic Datasets” tackles the complex problem of link maintenance in dynamic datasets. Indeed, the distributed and uncoordinated evolution of linked datasets can lead to broken or incorrect links. DSNotify provides a simple solution based on detecting and notifying data publishers of the changes happening in the dataset they link to. DSNotify is based on an event detection mechanism that represent changes in an EventSet vocabulary and taking a resource-centric perspective on data changes, therefore making it particularly suited to the tasks of maintaining links in Web data.

In “Using Provenance to Debug Changing Ontologies”, the authors consider scenarios in which ontologies are updated and evolved in a collaborative fashion, possibly leading to conflicts and inconsistencies. They propose a mechanism to reason with the provenance of ontology statements, based on the notion of pinpointing. In doing so, critical questions in debugging ontologies such as “When has an inconsistency been introduced and who has made this change?” or “Can I trust this inference?” can be answered.

Also considering the scenario of collaborative development and maintenance of ontologies, the article “A Holistic Approach to Collaborative Ontology Development Based on Change Management” presents an environment, both as tool-support and methodological guidelines, for realising, monitoring and managing ontology changes from multiple sources. This environment is based both on the formalisation of the ontology editing workflow, and on a specific representation of ontology changes. This conceptual framework forms the basis of the distributed change management environment, which also includes mechanisms for ontology synchronisation and change propagation.

While representing only a small sample of all the research realised on the issues related to Semantic Web dynamics, these four articles demonstrate how critical and broad the challenges in this area are: from the maintenance of the meaning of concepts on the Web, to the resolution of inconsistencies in collaboratively built ontologies; and from the management of events and links between linked datasets to the propagation of changes in distributed ontology editing workflows. We expect that more high quality articles on Semantic Web dynamics will appear in the future.